Spring 5-10-2017

MOBILE MESSAGE DESIGN: A MIX-METHODS STUDY OF A MATERNAL HEALTH PROJECT IN NORTHERN GHANA

Erica Bass

ACCEPTANCE

This dissertation, Mobile Message Design: A Mix-Methods Study of a Maternal Health Project in Northern Ghana, by Erica Bass-Flimmons was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Philosophy, in the College of Education and Human Development, Georgia State University. The Dissertation Advisory Committee and the student's Department Chairperson, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty.

_____
Steve Harmon, PhD
Committee Co-Chair

_____
Wanjira Kinuthia,PhD
Committee Co-Chair

_____
Elizabeth Armstrong-Mensah, PhD
Committee Member

_____
Joyce King PhD
Committee Member

_____
Date

_____
Brendan Calandra, PhD
Chairperson, Department of
Learning Technologies

_____
Paul Alberto, PhD
Dean, College of Education and
Human Development

AUTHOR'S STATEMENT

By presenting this dissertation as a partial fulfillment of the requirements for the advanced degree from Georgia State University, I agree that the library of Georgia State University shall make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to quote, to copy from, or to publish this dissertation may be granted by the professor under whose direction it was written, by the College of Education and Human Development's Director of Graduate Studies, or by me. Such quoting, copying, or publishing must be solely for scholarly purposes and will not involve potential financial gain. It is understood that any copying from or publication of this dissertation which involves potential financial gain will not be allowed without my written permission.

_____

Erica Bass-Flimmons

NOTICE TO BORROWERS

All dissertations deposited in the Georgia State University library must be used in accordance with the stipulations prescribed by the author in the preceding statement. The author of this dissertation is:

Erica Bass-Flimmons
Learning Technologies
College of Education and Human Development
Georgia State University

The director of this dissertation is:

Steve Harmon and Wanjira Kinuthia
Department of Learning Technologies
College of Education and Human Development
Georgia State University
Atlanta, GA 30303

MOBILE MESSAGE DESIGN: A MIX-METHODS STUDY OF A MATERNAL HEALTH PROJECT IN NORTHERN GHANA

by

ERICA BASS-FLIMMONS

Under the Direction of Steve Harmon and Wanjira Kinuthia

ABSTRACT

Mobile health (mHealth) message design strategies for low and middle-income countries (LMICs) have quickly gained acceptance in the field of health education. mHealth initiatives focusing on maternal health are frequently implemented with the aim of providing access to information while improving maternal health practices. Within Ghana, access to relevant health information and hospital care within rural settings remain scarce for the majority of citizens (WHO, 2011). However, with the rapid rate of mobile phone adoption, delivering learning opportunities in conjunction with mobile devices may be promising for many individuals in Ghana. The purpose of this study was to examine message design inputs influencing expecting mothers' maternal health activity. McGuire's communication-persuasion theoretical framework informed the mix-methods study. I used participatory rapid appraisal techniques while carrying out the study with research team members. I employed surveys to collect quantitative data. To gather qualitative data I engaged in open-ended survey questions, interviews (one-on-one and

focus groups), a journal and team reflections. The findings revealed that participants from two communities in Northern Ghana in rural settings had several inputs in the message design which may influence expecting mothers. These include; information source, design and delivery, power dynamics and personal circumstances, and perceived gains. The findings highlight that for many mHealth projects in LMIC's, there is an urgent need to reexamining the culture attributes of the users' local environment. These findings also address critical aspects of a real world problem with intent to support rural community development in Northern Ghana with goals to alleviate the lack of academic knowledge by providing an insider's perspectives regarding community insights.

INDEX WORDS: mHealth, Mobile Devices, International, Women's Studies

MOBILE MESSAGE DESIGN: A MIX METHODS STUDY OF A MATERNAL HEALTH PROJECT IN NORTHERN GHANA

by

ERICA BASS-FLIMMONS

Dissertation

Presented in Partial Fulfillment of Requirements for the

Degree of

Doctor of Philosophy

in

Instructional Technology

in

Learning Technologies Division

in

the College of Education and Human Development

Georgia State University

Atlanta, GA
2016

ACKNOWLEDGMENTS

The completion of this dissertation is due to the Lord Almighty. By far this has been one of my most challenging experiences however with your support, I conquered the journey. I wish to offer my most heartfelt thanks to the following individuals. To my committee chairs, Wanjira Kinuthia and Steve Harmon. Thank you for the advice, support, and willingness that allowed me to pursue research on this interdisciplinary topic for which I am truly passionate. Thank you both for all of the small chats and various meetings over the years. To my committee member, Elizabeth Armstrong-Mensah, you welcomed me with open arms and made numerous efforts with navigating my trips to Ghana while also pushing me to understand the contextual features of the Northern Region. To my committee member Joyce King. Thank you for the encouraging words of wisdom. To my Ghana family, thank you to the local NGO, hospital, communities, study participants and everyone who supported me while visiting the country. I can honestly say that without your support, this dissertation would not exist. To my husband, Randall Flimmons. I have always been able to turn to you when I needed a listening ear, a dissenting opinion, or someone to support me. You are my best friend and a rock of stability in my life. To my Mom and Dad. Since the beginning, you have encouraged my academic interest from day one, even when my curiosity led to taking lonely trips to West Africa. Thank you to my sister who answered all of my phone calls and gave me the motivation and drive to continue to push myself. To my brother, thank you for not making me feel bad for the many life events of my nieces and nephew that I missed because of this experience. To all my friends who helped me with this dissertation, there are too many of you to list here but do know that I thank you and will honor the help you gave me by repeating the kindness to others who will pursue their PhDs. Thank you. I apologize to anyone that I may have forgotten. Thank you as well.

Table of Contents

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

In low and middle-income countries (LMICs), various sectors such as education and health, are exploring learning opportunities that involve mobile technologies (Brown, 2003; Greenspun & Coughlin, 2013; Kukulska-Hulme & Traxler, 2005; Mechael, 2010; Ofosu, 2009; Sarasohn-Kahn, 2013; Traxler, 2006). Over the past four years, the continent of Africa has had the highest growth rate of mobile subscriptions and mobile-broadband penetration has increased from 2% in 2010 to 40% in 2014 (Sanou, 2014). The use of mobile devices in the fields of education and health has gradually drawn the attention of African countries to tackle social and economic issues (Brown, 2003; Kyomuhendo, 2003; Nations, 2008). For instance, health inequities such as inadequate health services and limited healthcare resources are hampering social and economic developments (Cockcroft et al., 2009). Mobile devices play a crucial role in establishing an educational and economic change (Akerv& Mbiti, 2010; Mechael, 2009). To illustrate, many large-scale mobile health projects have been created to improve teaching and learning experiences in many cultures within Africa while putting efforts towards contextualizing them in a local community (Cockcroft et al., 2009; Kraut, 2013). However, according to UNESCO (2011), a mobile learning developmental program for health information for patients continues to be a challenge for individuals and the nation as a whole (Kraut, 2013; Sarasohn-Kahn, 2010). These challenges occur due to a lack of strategies that take into account the local context (Cockcroft et al., 2009; Kraut, 2013). For example, within the rural communities of LMICs, most individuals do not have access to relevant information to stay healthy or can obtain health care services (Cockcroft et al., 2009; Nyonator, et al., 2005). For individuals living in remote areas, the practice of accessing relevant health information seems to be uncommon, yet it is considered a vital component of human life (Cockcroft et al., 2009; Sarasohn-Kahn, 2010). Glassmen, Helgeson

and Kattlove (2012) found that the use of mobile phones to deliver healthcare services such as receiving health messages on the phone has the potential to improve the quality of healthcare in underserved areas (Martínez-Pérez et al., 2013; WHO, 2012. Hence, the investigation of a mobile maternal health project in rural Ghana becomes useful. In this chapter, I propose a research project that focuses on how inputs influence mobile message design for expecting mothers' maternal health in rural settings of Northern Ghana.

Problem Statement

Often in a clinical setting pregnant women within rural communities of LMICs do not have access to relevant maternal health information. For example, in a clinical setting, information is frequently given directly from midwives and nurses, while mothers are visiting the hospital for ANC appointments in the form of face-to-face transmission. However, during these visits, there could be power imbalances and a social hierarchy between provider-patients that may deter the patient from seeking explanation regarding the information (Martínez-Pérez et al., 2013; Tones & Green, 2004; Yakong et al., 2010).

Many of these expectant mothers have no formal education, thus limiting their access to and interpretation of information given by healthcare professionals that could benefit mothers (Yakong et al., 2010). According to Kickbusch (2001), developmental efforts of health literacy must focus on components of access to information, knowledge, and negotiating skills to address significant challenges faced by disenfranchised and marginalized populations (Kickbusch, 2001). Don Nutbeam (2001) notes that health literacy is understanding one's ability to judge, shift and use information provided in the context of one's life. Experts suggest that due to the lack of unsettled power struggles large-scale efforts of health literacy along with health education around the world have failed (Keating, 2001). These power struggles exist while focusing on topics of

women, sexuality and reproduction (Kickbusch, 2001). The method of distributing health information to expectant mothers during their ANC appointments relies mainly on expectant mothers appearing at the clinic for their monthly exams; however, this method of distributing health information is not even adequate for those living in urban areas where the cost of the monthly visit is not onerous, and expectant mothers are more likely to recognize the benefits of monthly visits (Kraut, 2013).

In the case of rural areas, expectant mothers may face a three or four -hour walk for a monthly visit. Thus, the walk undermines the appreciation of the visit (Addai, 2000; Ansong-Tornui et al., 2007; Aryee, 2014; Nyonator et al., 2005; Yakong et al., 2010). Such long walks are particularly arduous for expectant mothers especially in the final months of their pregnancy when the health information is most valuable, particularly those about warning signs. The cost of sending health workers to villages to provide maternal health information is both costly in terms of transportation and unsustainable, in that healthcare workers are needed in the clinic where there are already long waits for expectant mothers to receive their antenatal check-ups (Addai, 2000; Ansong-Tornui et al., 2007; Aryee, 2014; Nyonator et al., 2005; Yakong et al., 2010). Therefore, distributing maternal health information via cell phone technology increases the frequency of the mobile messages and reduces the burden on the expectant mother in that she does not have to travel long distances to receive maternal health information (Aryee, 2014; Motech, 2012; Nations, 2008).

Ghana has made significant progress in achieving the Millennium Development Goal (MDG)-4, target of reducing both infant and under-five mortality rates by two-thirds by 2015 (Nakamura et al, 2011). However, MDG-5 -improving maternal health by reducing the mortality

rate by three-quarters is off-track, and maternal health indicators have remained resistant to improvement (Nakamura et al, 2011. For example, the presence of skilled birth attendants at birth has hardly increased in the past 20 years, and the maternal mortality ratio remains over 500 deaths per 100,000 live births (Addai, 2000; Nakamura et al., 2011; Nyonator et al., 2005;). According to the 2010 MDG Ghana report, maternal mortality ratio is one of the greatest concerns for the country. The MDGs package focused on eight goals while establishing measurable and time-bound targets. However, shortfalls occurred from commitments of official development assistance by Western countries. Consequently, beginning in September 2015, the sustainable development goals (SDGs) were established out of a growing urgency of sustainable development for the entire world (Sachs, 2012). Over the next 15 years, goals are set to end poverty, protect the planet, and ensure prosperity for all (United Nations, 2015). Goal three focuses on providing healthy lives and promoting well being for all and at all ages. Regarding maternal mortality, WHO states that the maternal mortality ratio in LMICs continues to be 14 times higher than in developed regions. Interestingly, women in LMICs are receiving ANC. Only half of women in LMICs obtain the recommended amount of health care they need (United Nations, 2015). As a result WHO's target goal by 2030 is to reduce the global maternal mortality ratio to less than 70 per 100,000 live births (United Nations, 2015).

The Northern region of Ghana is of most concern with the recorded highest consistent rate of maternal mortality rate between the beginning of 2011 and the end of 2012 (Kankam, 2013). According to World Health Organization (2012), the regions' maternal deaths were 2,700 with a total of 250 women dying during childbirth (Kankam, 2013). When it comes to accessing health care services for expectant mothers, one of the most important ways of reducing maternal

mortality is by providing antenatal care (ANC) from health professionals (doctors, nurses, mid-wives or community health officers). Data from the 2008 Ghana Data Health Service indicate that 15 percent of all pregnancies develop complications and 36 become emergencies (Ghana Statistical Service, 2016). Early assistance with pregnancy can help the pregnancy process to be managed to avoid maternal and child mortality. The 2010 Ghana Health Sector Review indicates that the number of pregnant women who received at least one ANC visit nationwide dropped by five percentage points, from 95.0 % in 2008 to 90.6 % in 2010 (Ghana Statistical Service, 2016). To assist in combating these statistics, various initiatives have been created such as; a nationwide free universal delivery policy (Ansong-Tornui et al., 2007; Witter et al, 2009). This initiative has been implemented to improve access to delivery care in health facilities, thereby improving access to skilled attendants at birth and reducing maternal mortality (Ansong-Tornui et al., Department of State, 2011; Witter et al, 2009). Even though services such as a nationwide free universal delivery policy and midwifery mobile technology projects have been provided to remove financial barriers for pregnant women to obtain free delivery care, the majority of Ghanaians in the Northern Region live in rural areas and have limited access to delivery facilities (Ansong-Tornui et al., 2007; Department of State, 2011; Witter et al, 2009). Obtaining medical services can become quite difficult when you have barriers such as poor road conditions, long distances to travel to get to a health center, and a lack of transportation (Lori et al., 2012). Two consistently identified factors include a lack of knowledge about when to access healthcare services and difficulties with transportation.

Background and Context

The Republic of Ghana is a sovereign nation situated in West Africa, ten degrees north of the Equator and spans an area of 92, 085 miles (Ghana Statistical Service, 2014). The nation has

three neighbors: Burkina Faso, Côte d'Ivoire, and Togo (Ghana Statistical Service, 2014). Among the world's top 10 quickest growing economies for LMICs, Ghana is one of the fastest growing economies on the continent (Sun et al., 2012).

As far as demography, the population is about 25.2 million. Out of the economically active population, 95.3% (10.2 million) are employed, with 2.3 % unemployed. Of the employed, 81 % (8.4 million) are self-employed/private employees, with the remaining 19 % being government employees. In Ghana, according to Ghana Statistical Service (2014), the general literacy rate, a person's ability to read and write a basic statement on his or her everyday life, is 65.8 %. Supplementary depictions about the novel foundation and society standards are examined in Chapters 2 and 3.

Kumbugu District

The context of this study includes examining mobile messages as it applies to pregnant women in Northern Ghana included the individuals within the population of the Kumbungu district with the Dagombus ethnic group. The Kumbungu District, cut out of the then Tolon/Kumbungu District in 2011, was introduced on the 28th of June 2012 with Kumbungu as its capital (Ghana Statistical Service, 2012). It offers limits toward the north with Mamprugu/Moagduri locale, Tolon and North Gonja Districts toward the west, Sagnerigu area toward the south and Savelugu/Nanton Municipal toward the east (Ghana Statistical Service, 2010). The district has an aggregate area mass of 617 miles being one of the smallest and newest districts in the Northern region (Ghana Statistical Service, 2010). According to 2010 Population of Housing Census, the district is home to 39,341 individuals. However, all of the individuals within this district live in rural areas (Ghana Statistical Service, 2010). Concerning family life, 84.4 % of females are married; within the ages 25-29 57.7 % of males are married (Ghana Statistical Service, 2010). When

it comes to literacy, the levels of the general population of Kumbungu from individuals who are 11 years and above consist of 26 % being literate and 74 % being illiterate; the percentage of literate males is 32.9 %, and the percentage of literate females is 19.3 % (Ghana Statistical Service, 2010). Of the population aged three years and above (10,491) in the District, 63.8 % have never attended school, 9.6 % are currently attending, and 6.6 % have attended in the past (Ghana Statistical Service, 2010).

Dagomba Ethic Group

Within Kumbungu, 95 % of the district's population consists of the Dagombas (Ghana Statistical Service, 2010). Therefore, the context of this study will be exploring the Dagomba people of the Kumbungu District in Northern Ghana. The Dagomba people are an indigenous population (Addai & Pokimica, 2010;F. Alhassan, personal communication, April 13, 2014; Ghana Statistical Service, 2010). The Dagomba ethnic group comes from the Kingdom of Dagbon in Northern Ghana (Donyong et al., 2012; Ghana Statistical Service, 2010).). The founder of Dagbon is Na Gbewa. Na Gbewa is remembered as the founder of the Mamprusi and the Dagomba kingdoms (Donyong et al., 2012; Ghana Statistical Service, 2010). The Dagombas are among the great West African medieval empires. Starting in the 12th century, they ultimately ruled the lands of the entire northern Volta basin, which today comprises all of Northern Ghana and Burkina Faso (Addai & Pokimica, 2010; F. Alhassan, personal communication, April 13, 2014). However, during their second expansion in the north, the Mossi invasion reached eastern Masina and Lake Débo these empires in the present day are Mali (Ghana Statistical Service, 2010; Pellow, 2011). The second period of the Dagomba victory concluded with the restoration of Imperial Songhai power towards the close of the 15th century (Addai & Pokimica, 2010; Pel-

low, 2011). Nevertheless, the Dagombas are traditionally regarded as “senior” to the Ouagadougou, Yatenga, and Fada N'Gourma groups all located in Burkina Faso (Addai & Pokimica, 2010; Pellow, 2011). The main settlement of the Dagombas is in the city of Tamale, which serves as the Northern Region Capital.

Language

Dagombas speak the Dagbani language where there are over one million speakers of the language (Pellow, 2011; F. Alhassan, personal communication, April 13, 2014).

Religious Beliefs

Regarding religion, the population is made up of Dagomba Tradition (Ancestral Worship), Islam, and Christianity. The latest survey conducted in 2010 census estimated that 96.0 % of the population reported being Muslims, Christians constitute 2.8 %, and traditionalists make up 1.2 % (Aseweh Abor, Abekah-Nkrumah, Sakyi, Adjasi, & Abor, 2011) (J. K. Ganle et al., 2015; GSS & Macro, 2009). Concerning religion and maternal health in the Northern region, increasing the proportion of women who receive skilled maternal health care services is one of the most important policy actions needed to reduce maternal mortality (Aseweh Abor et al., 2011; J. K. Ganle et al., 2015). Unfortunately, Muslim women are among a sub-population that has low rate of skilled maternal health service usage. Experts note that this situation may be related to religious beliefs and practices of Muslim women. Therefore according to the Ganle (2015), there are several barriers to utilization of services. For example, findings suggest that Muslim women in the North value safer childbirth since it enhances their bargaining power in their families, ensures the perpetuity of their lineages which brings them honor, and guarantees their position, especially in polygamous marriages. Women often prefer having professional assistance while be-

ing pregnant due to the fear of maternal mortality in the process (J. K. Ganle, 2015). Hence, services must be organized and delivered that considers their beliefs. Because their religious obligations include maintaining bodily sanctity by avoiding body exposure or being in contact with male caregivers, the majority of women have a preference with a female attendant at birth or either an attendance by a healthcare provider who shares the same religious faith (Gyimah, Takyi, & Addai, 2006; Takyi, 2003) (J. K. Ganle, 2015). In return, mothers believe that those health care attendants who shared similar views have a better appreciation of the religious practices of Muslim women (J. Ganle, Parker, Fitpatrick, & Otupiri, 2014; Gyimah et al., 2006; Takyi, 2003).

Dagomba Family Practices

With regards to family, marriage is an important aspect of the Dagomba communal life. Overall, many women do not meet their husbands until they are married (F. Alhassan, personal communication, April 13, 2014; E. Jakalia, personal communication, April1, 2015). Thus, divorce is very rare in the Dagomba culture, and it is a duty of parents on both sides of the family to keep a marriage going (F. Alhassan, personal communication, April 13, 2014; E. Jakalia, personal communication, April1, 2015). For the Dagombas, family and the mother's clan are critical; however, a woman's husband makes most of the decisions for the household (Donyong et a., 2012; F. Alhassan, personal communication, April 13, 2014; E. Jakalia, personal communication, April1, 2015). The Dagombas live in a household that is composed of co-wives, mother-in-law, and children (Donyong et a., 2012; F. Alhassan, personal communication, April 13, 2014; E. Jakalia, personal communication, April1, 2015). The family lives in different dwelling that are set up around a yard (Donyong et a., 2012; F. Alhassan, personal communication, April 13, 2014; E. Jakalia, personal communication, April1, 2015).

Dagomba Maternal Health Practices

Within the context of Ghana, TBAs have been the most valuable source for women during childbirth. Their role includes multiple areas across several cultures. However, the majority of their focus consists of deliveries in a rural area of LMICs (J.K. Ganle, 2015). TBAs are in most communities around the world, yet their function varies considerably. In this study, the role of a trained TBA is often an older woman who has no formal education however she has been trained by the local midwives and nurses at the hospital (J.K. Ganle et al., 2014). For families who do not have sufficient funds to arrange for transportation to a health facility, TBAs are a cheaper option. Typically TBAs are respected members of the community who may lead cultural rituals and often provide assistance to women during childbirth. A trained TBA's goal is to decrease maternal and child mortality and morbidity through child care practices and deliveries.

Traditionally older women who are mother-in-laws, are given some authority when they continue to preserve tradition by being the repository of knowledge on fertility for younger women (J.K. Ganle et al., 2014). Hence, in making a decision to attend a modern health service husbands and leaders in the community approval or permission must be sought from women elders along with husbands (J.K. Ganle, 2015).

Gender equality remains distant in rural settings of Northern Ghana. Women are disadvantaged concerning decision-making at the community and household level (J.K. Ganle et al., 2014). When compared to the Southern part of the country, rural women in the Northern region face significant structural disadvantages than those in the South. For instance, in rural northern Ghana, women are consumed with agriculture activities while serving as the labor force to produce cash crops such as rice and vegetables (J.K. Ganle, 2015). However, they are unpaid and

are assigned a low social status (J.K. Ganle, 2015). The hierarchical arrangement within this society places men at the upper level and women at a low level. Therefore when it comes to making decisions about reproductive health women have little or no autonomy (J.K. Ganle et al., 2014). In the household, it is the husband's sole responsibility to make decisions about using the household spending income for his wife to attend a local clinic, buy accessories, and provide funds for the health of his children.

Dagomba Technology Practices

Indigenous Forms of Communication

Dagombas are one of the ethnic groups with a refined oral custom woven around drums and other musical instruments. In this manner, the majority of its history has been passed down via oral tradition with drummers as expert griots (Addai & Pokimica, 2010;Donyong et al., 2012; F. Alhassan, personal communication, April 13, 2014; E. Jakalia, personal communication, April1, 2015; Ushe, 2015). Before the arrival of the British in the 19th-century, citizens in Ghana possessed their own way of communicating. Their communication was primarily through theater, music, storytelling and dance. These "wireless" methods of correspondence allowed for messages to be passed on from individual to individual and from village to village and generation to generation without any technological infrastructure (Ayensu, 2003; Ushe, 2015). Traditionally, long-distance communication was transferred by way of drumming. Drumming in Ghana was developed in forested areas and used for ceremonial and religious functions. Historically, Dagomba people along with other ethics used the hourglass-shaped talking drums (Ayensu, 2003; Ushe, 2015). The talking drum allowed for specific messages to be sent from one village to the next, which was faster than being carried by a person riding a horse. By using tones, the drummer communicates through phrases and pauses which can travel upwards four to five miles

(Ayensu, 2003; Ushe, 2015). For instance, to notify the village of a chief's death, wireless communication of "Talking Drums" signals villages through the sound; "A big tree has fallen, A big tree has fallen" to indicate the death of the chief (Ushe, 2015). Drums are very powerful instruments to measure the level of Ghana's technological progress. They serve as the medium through which the culture can reach the limitations of indigenous communication. As such, in the Ghanaian culture drums were equivalent to the mobile phones since they pass on information over long distances to numerous individuals. Hence, this inclination gives Ghanaians preference to conquer a late start in innovative progression. For example, Ghanaians do not have to have special education on how technology works. Hence, their indigenous communication systems, such as drums, served as a signaling device which enables them to understand the underlying concept of how wireless technology works (Ayensu, 2003).

Modern forms of Communication

Despite that fact that Ghana faces challenges with access to safe drinking water, effective hospital care, the majority of citizens that live in rural settings own a mobile phone thus leaving room for mobile experiences that have the potential to educate individuals in their daily lives (Anger, 2010; Commission, 2013; Throup, Jackson & Bain, 2014). Benigeri and Pluye (2003) express that in health, Internet and mobile phones are considered major changes in the dissemination of healthcare services and medical information, with the ability of transferring knowledge and information from health professionals to the general public, and vice versa. Therefore, many projects that focused on providing access to health information for low-level learners with an easy accessible technology tool have focused on the relatively new phenomenon of mobile health (mHealth) for mobile phones. mHealth for mobile phones have the potential to provide the unforeseen benefits of open access to information and communication. According to WHO (2011),

the term mHealth is defined by the Global Observatory for eHealth as "medical and public health practices supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices" (p. 6). Mobile health applications range from communication between health care provider and patient, delivery of services, patient education, data collection at point of care, disease outbreak monitoring and reporting, training of health workers in remote settings, medication and treatment adherence support, and appointment reminders (Istepanian et al., 2006; Kay et al. 2011; Torrado-Carvajal et al., 2012). In healthcare, the potential of employing a mobile phone and its features reveals a series of original activities that support mobile health. For instance, health information in the form of text messaging and a pre-recorded voice messaging aid the transferring of information such as reminders to take medication, attend maternal and antenatal appointments, and receive first-aid information (Istepanian et al., 2006; Kay et al. 2011; Torrado-Carvajal et al., 2012). According to Mechael, Batavia, Kaonga, Searle, Kwan, et al. (2010), the use of mobile phones to perform activities related to health is changing many lives across the world in general and, specifically, many communities in LMICs.

In terms of access to mobile phones with the Kumbuga District, individuals contribute to mobile cellular penetration. Unsurprisingly in the Northern Region, 62.3 % of males and 37.7 of females 12 years and older own mobile phones (Ghana Statistical Service, 2014). Within the populace of Kumbuga, 26.9 % of males compared to females at 7.1 % own mobile phones. Overall 16.9 % of individuals 12 years or more have mobile phones in Kumbuga (Ghana Statistical Service, 2014). However, only 19 family units representing 0.5 % of the aggregate households in the district have desktop/laptop computers (Ghana Statistical Service, 2014).

Background of Project

In 2013, a local NGO implemented the Mobile Maternal Health Project (MMHP) in four districts and six health facilities in Northern Ghana. Before the project, services for accessing maternal health information were constrained t conveying information to expecting mothers during their month-to-month ANC visits. Hence, the primary goal of the program was to provide access to maternal health information through text and voice messages while seeking to provide pregnant mothers with valuable information to contemplate attending ANC appointments and being assisted by a professional birth attendant during childbirth. Further description of the family practices is discussed in Chapter Three.

Statement of Purpose

Although providing maternal health information to mothers is the primary focus of the MMHP, equally important is the development of a knowledge base about how best to provide the service to this population, along with the addressing all of the critical elements needed for successful outcomes. Accordingly, the purpose of this study is to explore how inputs (information source, design and delivery, power dynamics and personal circumstances, and perceived gains) influence mobile message design for expecting mother's maternal health in rural settings of Northern Ghana.

Theoretical Framework

Communication-Persuasion Model

The communication-persuasion model considers how various forms of public communication change attitudes and behaviors (Elder et al. 2009). Studies have examined McGuire's communication-persuasion model toward guiding public education and public health communication specifically in using mass media (Elder, et al. 2004; Nutbeam, 2000; McGuire, 1981; McGuire

1968). McGuire is responsible for developing both the information-persuasion model and the communication-persuasion model. Hence, several names exist for the model, including "information-processing theory", "information processing for behavior change theory", communication/persuasion matrix", and communication behavior change model.

The foundation of the communication-persuasion model includes communication inputs and outputs (Figure 1). The inputs included various components in which one can construct the communication to change outputs. They consist of the successive information processing behavioral steps that the communication must evoke in the target person for the persuasive impact to occur (McGuire, et at. 2001; McGuire, 1984; McGuire 1969). Characterized by an input-output matrix, the model can be manipulated and measured to achieve a change in an individual's behavior (Corcoran, 2013).Figure 1 displays the communication-persuasion model.

Input Communication Factors

	INPUT	*Factors in this 'input' section include:*
1	Source	Demographics, credibility, attractiveness etc.
2	Message	Appeal, organization, style etc.
3	Channel	Type of media used, i.e. television
4	Receiver	Demographics, social/psychological factors
5	Destination	Immediacy/delay, prevention/cessation

Output Persuasion Techniques

	OUTPUT	Description of what happens at each step:
1	Tuning in	Exposure to the message
2	Attending	Paying attention to the message
3	Liking	Liking and being interested in the message
4	Comprehending	Understanding the message
5	Generating	Related cognitions
6	Acquiring	Gaining the appropriate skills to act on the message
7	Agreeing	Agreeing the message is correct
8	Storing	Saving the message to memory
9	Retrieval	Retrieval of the message from memory when needed
10	Decision	Acting on the message
11	Acting	Performing the action
12	Post-action	Integration of the action into behaviour
13	Converting	Advising others to behave likewise

Figure 1.9 Information persuasion matrix, adapted from McGuire (2001)

Figure 1 McGuire's Communication-Persuasion Model

The input aspects within the model contain five separate stages of communication: source, message, channel, receiver, and destination. These factors correspond directly to Lasswell's (1948) description of communication as to who says what, through which channel, to whom, and with what effect (Lasswell, p.12 1948). These factors or input variables are known to influence communication effectiveness and thus are considered essential in any planning efforts. The input variables provide options for designers to select and manipulate. Individual input variables are the main steps in achieving the output variables. Hence, at the fundamental level viable choices in planning and carrying out communication efforts include selecting reliable sources, selecting message strategies, determining optimal channels for delivery of the communication, considering characteristics of the target audience, and including the desired outcome of the communication (McGuire, 2001, Corcoran, 2013). The output factors within the model contain thirteen separate stages of events.

According to McGuire (2001), the output factor events must take place in order to enable the message to have an effect and change happen. As a result, variations in the input steps have an impact on the persuasion process by affecting the 13-step sequence of events which links exposure to communication to long-term change in behavior (McGuire, 2001). McGuire assumes that a person cannot, for example, complete step 7 (agreeing with the message is correct) without first completing step 2 (attending to the communication). McGuire thus proposes that all of these stages must be completed to reach the final stages. The above steps would then fit the process in the following way: the message recipient first has to be presented with the message. If exposed, he or she would have to pay attention to that message. The recipient then has to become interested in the message while also comprehending it, the overall position it advocates, and the arguments provided to support this position. The recipient must agree and consequently change his

or her attitude. And, if this change is to persist over a period of time, the message recipient must retain the information or store in memory and be able to retrieve his or her changed attitude. Because the ultimate goal of persuasive communication is to lead the recipient to behave in a certain way, the last stage, as a consequence of the described process, would be behavior change while also influencing others with similar attitudes to change their behavior (McGuire, 2001).

McGuire's theory, with its stair-step sequence of responses, is complete and descriptive, and indeed, very useful in the creation and evaluation of persuasive communications. To evaluate an existing information campaign, one should analyze how the input factors effect on the above output steps (McGuire, 2001). The planning stages in this model can be followed to obtain an outcome deemed as an advantage (Corcoran, 2011). For instance, Bull et al. (2002) conducted a study using the communication-persuasion matrix and discovered that some features of printed health education materials can lead to behavior change in overweight adults. These include attractiveness, encouragement, levels of information and application to oneself. Associated with the findings were the early steps in the communication-persuasion matrix. The studies suggest that the first stages of the model might enable progression through the stages when designing health promotion materials. Another advantage noted in the literature by Alclay and Bell (2000) is that the model can help practitioners to identify and examine different channels and strategies that can influence the campaign outcomes. They noted that evaluation is built into the model and has to be included in the communication strategy. Emphasis on each step, message, and stage should be examined for impact, appropriateness, and effectiveness.

Kreuter and McClure (2004) employed the model as a framework for considering the ways in which culture may influence health communication effectiveness. The study analyzed three information segments of the model (source, message, and channel factors) and inspected

how each influences communication and persuasion, and how each might be affected by culture. The study concludes that expanding the acknowledgment of culture as a vital element in public health and health communication can add to the advancement of new and more compelling effective strategies to eliminate health disparities. Be that as it may, the evidence base supporting such a focus is currently underdeveloped; accordingly, there is a requirement for research on the role of culture in health communication.

However, the model has been criticized for several reasons. McGuire (2001) himself considers that the framework might limit fixation on a solitary variable at once as they all cooperate with each other. McGuire likewise considers that the matrix assumes rational behavior, and the process of response to a message may not be a linear process. The relationship to a personal computer is apparent in the title of the model itself. Likewise with the criticisms highlighted in the cognitive models, individuals do not necessarily act in a rational or logical manner and do not process data rationally. Finally, Huhman (2004) recommends that as the audience processes a message, a percentage of these audiences are lost at each step. For this model to be effective, high exposure and high awareness levels is key. The model lends itself along these lines to all the more prominent, high-level communication than smaller communication efforts.

Although trying to identify and understand the maternal health needs for mobile messages of expectant mothers are complex, most of these requirements have more to do with lack of relevant information in attempting to understand pregnant women of the MMHP and identifying possible approaches for mobile maternal health to address their needs. For the purpose of this study, I have chosen to look at them mainly from a communication perspective. I intend to adopt McGuire's (2001) communication-persuasion model. The communication component is significant while dealing with expectant mothers who live in a collective environment of rural settings

in Northern Ghana. Information, Education, and Communication (IEC) are vital when designing mobile messages intended to reach a particular audience in this case, expectant mothers of Northern Ghana. IEC embodies the process of learning that empowers people to make decisions, modify behaviors and change social conditions (Nutbeam, 2000). Health information can be communicated through many channels to increase awareness and assess the knowledge of different populations about various issues and behaviors. Acceptable communication between users and providers of any service is essential; but it is significant while providing maternal health services, given the sensitive nature of some of the challenges that are addressed (WHO, 2012; UNESCO, 2015). Thus, IEC strategies should be carefully and appropriately designed and selected. Although good "one-on-one" communication is essential for the transmitting of information and building trust with a patient, communication with other individuals and groups within communities are also vital. It is through communication networks that service providers can obtain information about users' needs, priorities and concerns.

My interest in the communication-persuasion model focuses on the inputs of the model. However while conducting the study I allowed for the mothers to discuss their influences that were directly related to their context and culture dynamics. Hence, lead to a new strategy as a new action emerged which included an iterative process. While permitting the mothers to have social interaction the participants describe culture as it relates to their context and how it may influence the message design. By allowing for an integration of culture in the design of the framework, I re-examined the research data. This examination includes focusing on the three components (source, message, and channel) of the model and allowing for the role of culture and components (power dynamics, personal circumstance and perceived gains) identified by the participants to serve as inputs.

The study used the framework as a guide to analyze the five inputs of the model and while inspecting how they influence mobile message design. However Figure 2 presents the modified communication-persuasion framework as it relates to this study.

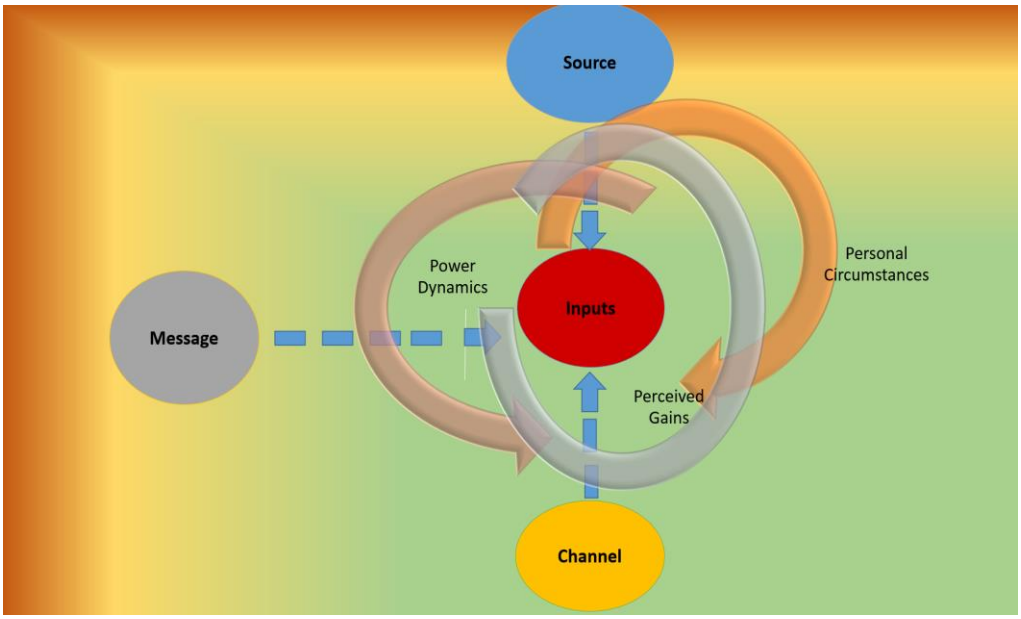


Figure 2 Communication-Persuasion Modified Version

This focus provides a chance to consider how elements identified by the mothers influence the mobile message design for expecting mothers' maternal health.

This study proposes to assess closely the mobile messages inputs while carefully examining the audience and their reactions to the messages. This study hopes to encourage instructional designers to consider the target audience thoroughly when designing mobile messages for maternal health initiatives in rural settings across the nation.

Research Guiding Question and sub questions

What inputs of the mobile message design influence expecting mothers' maternal health in a rural setting of Northern Ghana?

1. How does source of information influence the mobile message design for expecting mothers' maternal health?
2. How does information design and delivery of mobile messages influence expecting mothers' maternal health?
3. How do power dynamics and personal circumstances influence the mobile message design for expecting mothers' maternal health?
4. How do perceived gains influence the mobile message design for expecting mothers maternal health?

Significance of the Study

mHealth is considered to have excellent potential for reinforcing health services and promoting positive wellbeing results, particularly in low-resources nations. However, there continues to be a lack of evidence to support this notion. Within LMICs, several studies have been conducted on mHealth applications while failing to carry out evaluations. Therefore, this study is significant because it addresses a critical aspect of an important real world problem more effectively. Supporting rural community development in Northern Ghana helps to alleviate the lack of academic knowledge regarding insider perspectives regarding the evaluation of community programs (Pratt, 1993).

The study is vital for multiple reasons: (1) understanding the design elements that impact expectant mothers regarding the mobile messaging content for promoting: maternal care activity, antenatal care visits, and new birth delivery assistance, and thereby assess their cultural needs; (2) providing valuable insight for future decision makers in designing mHealth projects and initiatives for LMICs; (3) bridging the healthcare delivery services gap between patients and community by extending the dialogue among local NGO's, hospitals, and communities concerning the

impact of mobile messaging on maternal health and opportunity attainment for expectant mothers in rural areas; (4) suggestions for mobile maternal health projects and initiatives in rural areas of Ghana; (5) contributing to the current body of literature on mobile health in LMICs specifically focused on mobile message design and maternal health.

Operational Definitions

Antenatal Care (ANC): The care received from healthcare professionals during pregnancy. Pregnant mothers will be offered a series of appointments with a midwife, or sometimes with a doctor who specializes in pregnancy and birth (WHO, 2015).

Community: A group of people with diverse characteristics who are linked by social ties, share common perspectives, and engage in joint action in geographical locations or settings (MacQueen et al., 2001)

Dagombus: Ethnic group of people in the Northern Region Ghana (Donyong et al., 2012)

Ghana Health Services (GHS) The Ghana Health Service (GHS) is a Public Service body established under Act 525 of 1996 as required by the 1992 constitution. It is an autonomous Executive Agency responsible for implementation of national policies under the control of the Minister for Health through its governing Council - the Ghana Health Service Council. The GHS continue to receive public funds and thus remain within the public sector (Ghana Health Service, 2000).

Expectant Mother: The state in which a women carries a fertilized egg inside her body. The period from conception to birth usually last 40 weeks, beginning for the first day of woman's last menstrual period, and is divided into three trimesters, each lasting three months (WHO, 2015).

Information and communications technology - or technologies (ICT) An umbrella term that includes any communication device or application, encompassing radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as videoconferencing and distance learning. ICTs are often spoken of in a particular context, such as ICTs in education, health care, or libraries (World Bank, 2015).

Islam: The religious faith of Muslims based on the ethical framework established instructed by the Koran. The essential guideline of which is total submission to an exceptional and personal God, Allah. The religion that is worshiped amongst more than half of the Dagomba ethnic group in Northern Ghana (Clarke, 1982).

Kumbunga: District located in Northern Ghana (Ghana Statistical Service, 2005).

Local Medical Center: An establishment department where outpatients are given medical treatment or advice, located within a local community (Oxford, 2015).

Low and Middle Income Country (LMIC): Those with a Gross National Income per capita, calculated using the World Bank Atlas method, of $1,045 or less in 2014; middle-income economies are those with a GNI per capita of more than $1,045 but less than $12,736 (World Bank, 2016).

Millennium Development Goals (MDG): Eight international development goals that were established following the Millennium Summit of the United Nations in 2000, following the adoption of the United Nations Millennium Declaration (World Bank, 2015).

Maternal Health: Health of women during pregnancy, childbirth and the postpartum period. While motherhood is often a positive and fulfilling experience, for too many women it is associated with suffering, ill health and even death. (WHO, 2015)

Maternal Mortality: The death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes (CDC, 2011).

mLearning: learning by means of wireless technological devices that can be pocketed and utilized wherever the learner's device is able to receive unbroken transmission signals (Attewell & Savill-Smith, 2005).

mHealth: The use of mobile and wireless technologies to support the achievement of health objectives (WHO, 2013).

Mobile Device: A portable cellular phone that is registered on the MTN Ghana, Vodafone or Airtel network.

Mobile Message: An audio-recorded voice message received on a cellular phone (WHO, 2011).

Mobile Message Design: The creation of voice messages being used on a cellular phone (WHO, 2011).

Non-Governmental Organization: (NGO): A non-governmental organization (NGO) is an organization that is neither a part of a government nor a conventional for-profit business. Usually set up by ordinary citizens, NGOs may be funded by governments, foundations, businesses, or private persons (World Bank, 2016).

Rural: Rural locations are composed of individual population of 5,000 or less; thus, the classification of this area has been rural since 1960 by the country (World Bank, 2016).

Traditional Religion: The traditional beliefs and practices of the Dagomba people include the religion of the Dagomba tradition. The Dagomba traditional religion practices ancestral worship. (Kankam, 2013; Donyong et al, 2012).

Conclusion

Overall, providing expectant mothers with the opportunity to access health information can serve to improve their health. In LMICs mobile penetration and usage have increased, though, governments, NGOs, businesses, and individuals have not explored specific roles of how mobile message design may influence maternal health. Also, these explorations may benefit individuals living in remote rural communities that have limited access to health facilities.

2 REVIEW OF THE LITERATURE

According to Rocco and Plakhotnik, a literature review is intended to "determine if a topic is researchable, to report the results of closely related studies, and to establish the importance of the current study to previous studies (2009, p. 125)." By attending to these three duties of a literature review, I will provide further reasoning for the research study. The purpose of this study is to explore how inputs influence mobile message design for expecting mother's maternal health in rural setting of Northern Ghana. The literature is divided into three areas: (a) Message Design, including instructional message design, mobile message design, and the value of understanding culture in message design; (b) Public health message design including health message design, valuing culture in health message design, mHealth, mHealth funding and collaborations, mHealth messages for LMICs, and mHealth maternal messages for LMICs; (c) Ethics, including research ethics in the global context, ethics of initiatives potential impacts, ethics of mHealth and mHealth power relations. These areas of the literature provide a background to my current study because they inform readers about specific parts of the dissertation topic. Relevant research on the particular context and research interest of this study, rural areas of Ghana and mobile maternal health messages design are not available.

Message Design

Introduction

In the instructional design field, current message design (within the past ten years) research has had a narrow focus due to studies traditionally investigating the intersection of learning and communication theories with an objectivist approach to instructional message design and delivery (Bishop, 2014). Further, cognitive psychology's dependence on "an objectivist origination of learning" implies that it develops the same as behaviorist thoughts (Jonassen 1990, p. 32).

Berry (1990) states that a philosophical movement toward constructivism and the making of learner and context- focused environments was causing some to contend that traditional instructional design and instructional message design introductions were contradictory to this new instructive educational approach–stirring significant confrontation in the field. As indicated by constructivists, for example, Cooper (1993), Jonassen (1990; 1991), Kember and Murphy (1990), conclude that information does not exist autonomously of learners at the same time. Rather, building knowledge happens through connections between learners' earlier understandings and new, authentic experiences with the world. Jonassen (1990) argued that the field should, rather, be looking for approaches to support learners' dynamic knowledge development. In spite of Grabowski's (2004) and others' endeavors to clarify the role message design, the design may at present play inside of a more learner-focused worldview (Cunningham, and Duffy 1991; Winn, 1993). Hence, utilization of the term instructional message design seems to have dropped out of support following the mid-90s. Further, as Molenda and Boling (2007) noted, instructional message design research has been genuinely meager since Dwyer's visual literacy studies in the mid-90s, with standards based on principles of prior empirical work (Lohr & Ku, 2003); (Morrison, Ross, Kalman, and Kemp, 2011). The literature gives the idea that, while the instructional design has philosophically moved far from "the configuration of pre-specified instructional routines," studies progress toward "the design of an environment to encourage learning" (Januszewski and Molenda, 2008, p. 2). Nevertheless, few considerations were given for what Fleming (1993) saw as the "linking science" between learning theory and instructional practice (Dewey, 1900). In its place, research has concentrated progressively on exceedingly compelled examination investigations of multimedia learning and its consequences for cognitive processes (Mayer, 2003, 2005, 2008, 2009, 2011; and others). Consequently, Reeves (1991, 1994) has advised those inquiring

about the effect concerning instructional software to enhance their understanding "a little bit at a time," by first building theory-based models (p.5). The creation of these models should protect the innovation's dimensional multifaceted nature, and after that gathering and breaking down pertinent information utilizing techniques that illuminate instructional decision making, from the "empirical swap" of media comparison studies (Reeves, 1991). Thus, for the purpose of this study, it was important to approach the study from a unique perspective that includes instructional message design, mobile message design, and the value of understanding culture in message design.

Message Design

Message design is an active process of manipulating information that can achieve behavior changes in learners (Fleming, 1993). Within both Instructional Design and Public Health disciplines, message design has a promising way to deal with creating a plan to develop appropriate messages for various populations throughout the world via print, face-to-face, or technology-enhanced devices. In return, messages can be designed for a particular context, culture, and media device. Hence, when face-to-face or computer-based instruction are not options such as giving instruction to individuals who live in rural settings of LMICs, messages presented on mobile devices could be an option for mobile learners in LMICs.

According to the guidelines noted by the United Nations Educational Scientific and Cultural Organization (UNESCO) policy 2013 for mobile learning, message designs for mobile devices of large-scale projects have frequently been casually implemented due to inadequate contextual understandings. For instance, most contents within the messages for LMICs populations

lack local language options and ethnic specific material (UNESCO, 2013). However, since messages have the ability to be designed to target a defined population for specific goals, efforts to understand how to deliver them can include various approaches.

Message design is interdisciplinary and has served as an essential element in more than fifty disciplines, including communications, public health, instructional design, etc. The theoretical message design model illustrates that the various areas of knowledge such as behavioral and cognitive, communication, art and aesthetic, information, language and business and media production technology all contribute to the foundation of message design (Fleming, 1993). Brief communication that is transferred in an oral, written, or verbal manner through an agency from one person or group to another defines a message. This definition implies that individuals receive the message, and the objective is to design a message that includes the goals that the creator of the message wishes to attain (Fleming, 1993).

Instructional Message Design

Instructional message designs controls and organizes signs and images conveyed to individuals with the final objective of adjusting the cognitive, affective or psychomotor behavior of one or more persons (Lohr, 2001). Concerning instructional design, instructional outcomes are partitioned into three domains cognitive dealing with thinking, affective with feelings and psychomotor dealing with movement (Fleming, 1993). Be that as it may, in the affective domain self-developments, attitudes, and motivation are the three most consistent ideas connected with that area (Fleming, 1993). Furthermore, Fleming (1993) notes that attitude and self-idea influence learning in the cognitive and psychomotor domains, and motivation attitude-change is one

of the results most consistently represented as part of the affective domain. Therefore, one successful approach that emerges from the literature is to provide persuasive messages within instructional message design (Petty & Wegener, 1998).

The use of persuasive messages can be seen as a type of fundamental communication in which a source introduces a message through a channel to a receiver (Fleming & Levi, 1993). The perception of the source's credibility contribute to the probability that a receiver will accept the conclusions made, found of a given lesson (Fleming & Levi, 1993). Source credibility is not a constant property of a source; rather. Credibility is an attribute that is given upon the source by the receiver. One method utilized is to expand the perceived similarity of the source by establishing belief congruence between the source and receiver as part of the message. Additionally, no one media has been shown to have more dominate persuasive effectiveness than any other media type. For example, McGuire (1985) reported that audio-visual media interchanges are about as powerful as audio-only presentations at changing attitudes; however, neither is as effective as face-to-face communication. Within educational media, the instructional process is only as effective as the design of the message that it intends to communicate (Bishop, 2014). Hence, the instructional message design investigates how different media and delivery systems could be used more effectively to assist with instructional communications within context-specific instructional environments, and learner needs (Bishop, 2014). Consequently, the task of constructing the design of the message is at the sender’s discretion. Fleming and Levie (1993) and Lipton (2007) state that while designing messages, it is critical for senders and designers to keep the intended receivers in mind while defining the purpose and objective of the message.

Mobile Message Design

Mobile learning enables the distribution of instructional content to a learner when the need, relevance, and significance of the lesson are most desired (Wang & Shen, 2012). Wang and Shen (2012) state that, instructional designers who plan to integrate mobile learning into their design practices will require guidelines for successfully design materials. mLearning guidelines ought to rely on best practices and bits of knowledge informed by research (Vavoula, Lefrere, O'Malley, Sharples and Taylor 2004). They distinguish nine rules; however, just two of these are for designers: choosing innovation and ease of use. First, the technology should support the learning one is designing. Second, designers must consider the practical limits of the technology, e.g., screen size, and any confinements users might experience with the innovation, e.g., visual barriers.

Low and O'Connell (2006) stressed that m-learning design should be an outcome of e-learning plan. At last, Wang and Shen (2012) recognize four standards of configuration. Low and O'Connell (2006) point out two of these – "Design for eLearning, Adapt for m-learning" and "Design Short and Condensed Materials for Smart Phones". Literature in mobile learning has done far less to formalize the technological guidelines, yet it is possible to recognize two categories of learner-centered design: m-learning should be learner-driven and represent the variety of environments that the learner might himself or herself. Wang and Shen (2012) likewise communicate a similar claim that mLearning should be learner-driven. Noting that designers should design material for various devices, Wang takes note that creators ought to plan mLearning for 1) intuitiveness and 2) knowledge construction and sharing.

These guidelines underline the requirement for guaranteeing opportunities for interactivity of learners and those learners can develop and impart learning activities to others. These both

situate the learner at the focal point of learning activities and strengthen the requirement for a learner-centric guideline (O'Connell, 2006). One additional point underscored in Wang's research is that the learner's environment is a function of location. Location, however, alludes to a small-scale level, a particular setting where the learner is present, additionally a large-scale level, which alludes to the place or locale where the learner finds one Wang and Shen (2012) Recognizing this distinction prompts the further acknowledgment that learner's social and culture environment will have an impact on m-learning and should incorporate any design guidelines.

Due to the lack of empirical studies regarding message design for mobile learning, instructional designers should be open to applying various multimedia or persuasive principles while designing mobile messages (Wang & Shen 2012; Goh & Chen 2012). The worldwide popularity of providing information on a mobile device has motivated some educators to explore the use of mobile messages in educational settings, while using persuasive principles within the message design (s (Goh & Chen 2012; Ferebee, 2010; Naismith, 2007; Revelle, Reardon, Betancourt and Kotler, 2007; Van Essema, 2002). Such studies noted previously used persuasive principles that could be used to effect behavior change. B. J. Fogg defined the term persuasive technology to describe “any interactive computing system intended to change individuals' attitudes or behaviors"(Fogg, 2002). Central to the idea of persuasive technology is the idea of persuasion, which Fogg clarified as "an attempt to shape, fortify, or change behaviors, feelings, or thoughts about an issue, object, or activity" (Fogg, 2009). Constructed in many forms, technology using persuasive principles include for online applications portable hand-held devices and standalone programs (Fogg et. al, 2002). Fogg notes that the potential application areas for persuasive technology incorporate governmental issues, religion, gaming, self-change, empathetic skills, advertising, wellbeing, security, and environmental conservation (Fogg, 2002, King and Tester, 1999).

According to Fogg, there are seven Principles of Persuasion Fogg (2003): 1)reduction, 2)tailoring, 3)tunneling, 4)suggestion, 5)self-monitoring, 6) surveillance, and 7) conditioning. Reduction aims at compressing complex behavior to simple tasks.

Tailoring is a persuasive principle that recommends providing information that is custom-made to the individual needs, intrigues, and identity, using setting and different elements that apply to the person (Fogg, 2002). Fogg (2003) states that "tunneling explains the principle to guide the individual through a process or an experience in the interactive system" (p.2). The suggestion is the point at which recommended behavior to a user just in the most advantageous minute (Fogg, 2002). Self-monitoring helps people groups to accomplish predetermined results or objectives by eliminating the medium of tracking performance or status (Fogg, 2002). Surveillance depicts the phenomenon that the observation of a specific behavior automatically improves the probability of accomplishing the desired outcome (Fogg, 2003). Fogg notes that conditioning is "the reinforcement and shaping of complicated behavior in a positively and to change existing behavior into habits" (p.2).

In 2013, Mothana (2013) at Jadara University in Jordan conducted an SMS-based study based on Fogg's principles. Jadara University students employed SMS messages for the study. For example, the principle of simplification focuses on reducing a complex task to a simpler task by removing steps in the process. Hence, precise text terminology was used to communicate important notices like assignment due dates to students. The study found that it was easier for students to read, comprehend, and respond when using text terminology. Also, the principle of tailoring or personalization looks at using relevant, personalized information as part of the intervention. The study included sending tailored messages to students. The customized messages re-

minded them about the particular times and room for instructional exercises, lectures and workshop sessions. The idea of persuasion through personalization generates the perception that information has been tailored to suit them.

Other studies that use SMS messaging in higher education include Anderson and Blackwood (2004), who used messages to provide support, motivation and continuity; Naismith et al. (2004), Brown (2005), and Motlik (2008) who used messages to provide alerts and reminders, and Taxler (2005), who used messages to deliver learning content and revision tips. Learners likewise invited SMS messages that were seen as timely, fitting and customized (Stone & Briggs, 2002; Markett et al., 2006). However Garner (2002) proposed that "SMS can be used to interact with people and influence their actions and understandings of situations;" he also suggested that text messaging may promote involvement in a community of learners, thus supporting the development of independent learners and reducing feelings of isolation through promoting community (p.). Market (2005) discovered that mobile messages could be used to create and enhance the in-class discussion. Meanwhile, Harley (2005) supports the utilization of text messaging as an approach to guide the transition into college life for first-year students, and he likewise noticed that they can be utilized to improve individual personal face-to-face correspondence. In regards to multimedia principles, Wang and Shen (2012) concluded that designers should create condensed materials that provide brief points to summarize a course. Further, content should be developed that eliminates redundant information by chunking and packing it into a message. Since often the mobile device does not have enough space for long texts without scrolling, the instruction presented to the learner should blend into the design (When and Shen, 2012). In a study with Higher Education students, Lu (2008) discovered that designers should take learners' needs and styles

into account if the goal is to maximize the utility of learning material. Also, small bits of regularly delivered information within a message for SMS are manageable for students in Higher Education settings (Lauricella, & Kay, 2013; Lu, 2008). Rosell-Aquilar and Qian (2015) also noted that little learning bits would manage best due to small screen size, and the number of resources of the learning situations is maximized being devices are often used on the move. Thus far, design principles that could apply to message design for mobile learning have yet to be tried on mobile devices (Wang & Shen 2012). According to Wang and Shen (2014, 2011), mobile learning definitions have moved towards an emphasis on the mobility of the learner instead of the mobility of the technology. The new focus places importance on the perspective of the mobile learner that involves studying how to improve design-learning content tailored to the specifics of learner mobility (Wang & Shen, 2012, Elias, 2011). Leading experts suggest that designers should think not only about the environmental factors, as well as the learners' inclinations and diverse design components to address the issues of particular learners in various circumstances, such as learners who are illiterate or located in rural settings (Glassman et al., 2012). The integration of message design for mobile learning will require novel ways of engaging the design process. It may require using persuasive or multimedia principles for mobile messages (Wang & Shen, 2012; Elias,2011). Therefore, more design specifications will enable a comprehensive integration of message design for mobile learning. However, these design specifications need to be organized in models, frameworks, or a set of standardized guidelines for mobile message designs (Young, 2008).

The Value of Understanding Culture in Message Design

Many definitions of culture exist. One of the most applied is that by Tylors (1884) "culture is that complex whole which includes knowledge, beliefs, arts, morals, law, customs, and

any other capabilities and habits acquired by a human as a number of society” Using this definition of culture may apply broadly and is not synonymous with race or ethnicity. Racial and ethnic groups may culturally define populations, but that is not always the case. Many cultural groups cut across racial and ethnic boundaries, for example, members of the military, academics and Muslims. Hofstede (20011) defines culture as "the collective programming of the mind that recognizes the individuals from one group or category of people from another" (p. 6). However, Scheel and Branch (1993) define culture as being interdisciplinary with "patterns of behavior and thinking by which members of groups recognize and connect with each other." These patterns are formed by a group's qualities, standards, customs, convictions, and ancient rarities. Culture is the manifestation of a group's adjustment to its surroundings, which incorporates other cultural groups and in that capacity, is constantly evolving. Culture is translated extensively there to encompass the patterns formed by ethnicity, religion, socio-economic status, geography, profession, philosophy, sex, and way of life. People are individuals from more than one society, and they epitomize a subset as opposed to the totality of cultures identifiable attributes (p. 7). This meaning of culture in Instructional Design helps designers to consider the numerous features of culture while building learning environments. Instructional Design tries to provide a path to learning, and in this way, a thorough comprehension of culture is required. According to Scheel & Branch, (1993), the cultural demographics of learners can be considered a design specification. Learners' backgrounds influence how they learn, how they respond to what they have learned, and how they progress in learning (Young, 2008). Thus, the cultural demographics of learners are considered an asset to the design process (Rogers et al. 2007). The subject matter content of instruction is contingent upon learner characteristics, such as ability level, skill level

and schema (Wang & Reeves 2007). Designers should acknowledge learners as cultural resources in the design of subject matter (Young, 2008). Learners can lend diversity of perspectives to the development of subject matter content, culturally pluralistic instruction, methods and materials of instruction, and instructional practices (Scheel & Branch, 1993). Instructional content should be goal oriented and should meet the academic and cultural needs of learners (Young 2008; Gunawardena & LaPointe, 2008; Schell & Branch, 1993.). Designers could also provide ongoing formative assessments and opportunities for feedback to determine learners' concerns (Scheel & Branch, 1993). If all of the design specifications focus on a target audience, then cultural demographics are more specialized than generic (Gunawardena & LaPointe, 2008). Research in ID has revealed a broad spectrum of considerations for designers, such as cultural informants, communication, learning environments and cultural sensitivity (Reeves, 2007). Cultural informants are members of the target audience who can assist and inform design decisions (Reeves, 2007). The cultural informant acts as a buffer to inadvertently stereotyping or presenting biased perspectives (Scheel & Branch, 1993), and they ensure the accurate portrayal of traditions, language and other interests of the community (Fleer, 1989). Usually, the cultural informant is a member of the community. With the assistance of the cultural informant, designers can foster a social environment where communication and understanding occur between the design team and target audience (Young, 2008). Ultimately, designers need to consider the multiple interpretations and perspectives that can influence the design process (Scheel & Branch, 1993). The design of learning environments is also important. Designers have to consider learner preferences, values, cognitive approaches, identity, language, traditions, and social, economic and political implications in the design of learning environments (McLoughlin, 1999). This means that

designing with culture in mind can be a multi-tiered process that must include a variety of factors. In essence, more attention to details may be required. Finally, culturally sensitive design and designers legitimize, acknowledge and understand other cultures (Powell, 1997). The design focuses on the perspectives of the target audience and uses this perspective as a conduit in which to create. Culturally sensitive designers validate ethnically diverse people through the accurate portrayal of groups; demonstrate dispositions that respect the target audience; and acquire knowledge related to the target audience's political, social and economic histories (Powell, 1997). The designer must engender culturally sensitive qualities to engage culture-based design. The development of a culturally sensitive design indicates the successful integration of technology, culture and design (Branch, 1997; Chen et al., 1999; McLoughlin, 1999). These examples move more towards specialized designs. According to Young (2008), message design should be scrutinized based on cultural criteria as well as aesthetic criteria. However, before any attempt can be made to incorporate culturally pluralistic perspectives into instructional message design, it is important to understand culture is a patterned way of thinking, feeling and reacting to the environment (Young, 2008). Culture is transmitted mainly by symbols and actions; and that regardless of the subject, there is a personal commitment required to identify alternative perspectives based on different cultural orientations (Branch, Goodwin & Gualtieri, 1993). Successful message designs require a personal commitment to facilitate maximum learner achievement (Young, 2008). Regardless of the significance of cultural characteristics, few empirical studies have analyzed their effects on the post-adoption perceptions of the individual user. Likewise, most studies equate a country, religious group, school etc. with the culture, an assumption that can be misleading. Technological research on cultural issues in various countries frequently operationalizes

culture at the country level (Cho, 2011; Hoftstead, 2010; Kreuter, 2004). For instance, in technology information systems studies, Kralisch, Eisend, and Berendt (2005) contend that users' cultural backgrounds influence their website navigation patterns, assumed that the cultural profiles of individual users matched the dominant cultural profile of the country they lived in. However, using the country as a surrogate for the individual is liable to be deceiving, because within-country heterogeneity is sometimes greater than between-country heterogeneity (Cho, 2011; Hoftstead, 2010; Kreuter 2004).

As McCoy, Galletta , and King (2005) observe, one cannot assume that the cultural characteristics of the entire country under investigation are the same as the cultural features of the people in the country. Cultural differences exist both within and across political boundaries. As Van Biljon, and Kotzé, (2008) and McCoy et al. (2005) have all argued, two individuals may have different cultural characteristics even though they live in the same country. There is, then, a growing consensus that culture is important as an individual-level variable (Van Biljon, & Kotzé, 2008). Moreover, although definitions of national culture may adequately explain macro-level behavior, they lack precision in explaining behavior at the individual level because the cultural characteristics individuals derive from within their national culture may be influenced and modified by their membership in ethnic, religious, and social groups that have their particular cultures (Van Biljon, & Kotzé, 2008). Individuals who do not belong to the same professional organization, and group cultures will probably have a different cultural profile even though they all belong to the same country (Van Biljon, & Kotzé, 2008). Thus, a national culture affects, but does not ultimately determine, the cultural characteristics of individuals. Conceptualization of culture at the individual level reflects the multilayered cultural values accumulated in the self (Punchoojit & Chintakovid, 2012). These cultural values which are different from personal features

pertain only to individual-level traits hence, technologies like the mobile phones, designed for individual users who have different needs and expectations for mobile messages, are voluntarily used, by the individual preferences of the user's (Ling & Campbell, 2011). One may infer that use of the mobile messages is more influenced by individual cultural characteristics than by national or organizational traits (Ling & Campbell, 2011). Thus, ascertaining the relevance of the instructional message is especially paramount because learners might otherwise reject the instructional materials as not applicable. In spite of the need to create instructional materials that adjust to learners' cultural considerations, accomplishing this task remains as a significant challenge (Ling & Campbell, 2011).

Consequently, instructional designers must be aware of how different cultures will respond to the layout, sound and symbols of a message (McAnany, 2009). Hence, it is vital to think about the choices and also to obtain perceptions of the intended interest group who will be receiving the message. Overall, the message received should have significant relevance to one's cultural context and experiences (McAnany, 2009). Pincas (2001) addressed several issues that international educators must consider as they plan global messages through education courses. One important issue is how to contextualize their courses in such a way as to reduce misunderstanding. Furstenberg, Levet, English, and Maillet (2001), urged online teachers to try to make culturally hidden semantic networks explicit by structuring course discussions around enabling students to situate themselves in relation to others, so that they may become aware of how the content and manner of what they say is relevant to their immediate situation and a given context. Pincas (2001) noted that in most cases where students are working in an international context, they need to find a balance between adapting to different social and cultural interactions in English while maintaining a secure sense of self as a member of their national culture. Culture can

affect the way we accept and use messages. Bentley, Tinney, and Chia (2004) note that communication and group behaviors vary among different cultures. These behaviors, in turn, affect how the learner uses various learning systems online. Bentley, Tinney, and Chia (2004) designed a research study that focused on high and low context cultures. High-context cultures were described as individuals having strong people bonds, and low-context cultures have weak people bonds. Within the study, individuals with high-context cultures used implicit message and individuals with low-context cultures used explicit messages. In another study, Woodrow (2004) suggested that learning may be construed differently by various cultures. He expressed that cultural values and beliefs not only provide the basis of interactions, as well as influence how one sees learning. Learners from some cultures view learning as something that is extremely restricted and not open to interpretation, though others from another culture look at learning as being wide and open to address. Selinger (2004) proposes that approaches should be altered to consider learners from various culture backgrounds. Bentley, Tinney and Chia (2004) suggested that a student's cultural background, values, and beliefs influence the student's perception of learning. Turing to Africa, Brown (2005) considers why rural regions, for example Africa, are a fit for mLearning. A developing percentage of the populace has mobile phones this are the key to access for mLearning in Africa, and it is this that justifies the development of mLearning in rural and remote areas (Brown, 2008). There are two take away points from the writing above. The first is that message designer for mobile cell phones ought to know about the kind of innovation that learners will utilize; this is a point that mirrors the former guideline recognized by Wang and Shen (2011) on planning to the most reduced common denominator. Second, designers should not accept that the mLearners have the time and resources to engage in content. One of the greatest, challenges is recognizing pertinent cultural characteristics of individual learners (McAnany,

2009). Two approaches that can be used to help with identifying relevant and significant cultural attributes for messages are the development and diffusion of targeting and tailoring messages.

Public Health Message Design

Introduction

Within the public health field, health messages are seen as a way to educate, persuade, and inspire and motivate an audience for behavior change (Cho, 2011). Through messages, an audience can be reached, and messages can be built, modified, and might impact people along with social groups, organizations, and institutions (Royne & Levy, 2015). Through social influence, messages are equipped to change policies. Also, the quality of the messages is of important significance to health communication interventions and campaigns (Cho, 2011). Since there are numerous guidelines for message design within public health, it is important to focus on the areas that would provide the best holistic overview of this unique topic. These sections include health message design, valuing culture in health messages, mHealth, mHealth funding and collaborations, mHealth messages for LMICs, and mHealth maternal messages for LMICs.

Health Message Design

Levi and Fleming (1978, 1993) provided around two hundred "principles" for instructional message design. They concluded that the main focus is on the receiver. These principles are related to the receiver's attention, perception, memory, concept learning, and attitude change. On the other hand, health message design is interdisciplinary, and it includes main aspects from planned communication, advertising, and propaganda (Fleming & Levi,1978). Health message design falls under the umbrella of persuasive design and consists of studies on carefully planned information activities when the goals are related to some kind of change in behavior of the receivers (Cho, 2011; Fleming & Levi, 1978). In persuasion design, the main objective is to convince the interpreter or receiver the message to adopt a particular attitude, to become convinced

of something, to change his or her behavior and resemble someone else, or to behave in a particular way (Cho, 2011; Fleming & Levi, 1978). In both health and instructional message design, the focus is on the receiver while focusing on the ultimate goal of attitude change (Cho, 2011; Fleming & Levi, 1978).

Despite the source and expected scope of a message, before a health message can start to accomplish the goal of invoking behavioral change, message designers should first choose how to reach effectively the intended interest group and motivate them to listen to their messages (Cho, 2011). In short, designers attempt to make health messages significant to the audience. Furthermore, trying to reach an audience with a health message is similar to entering an information contest (Thompson, 2014). Presentation of health information often is troublesome for some people to comprehend because of how it is presented (Royne & Levy, 2015). According to America's National Assessment of Adult Literacy (2006), approximately 9 out of 10 adults have difficulty with fully understanding health information available in medical facilities, retail outlets, media, and community settings. Hence, there is a critical need for health communication to be effective. Also, health decisions are powered by an individual's' health knowledge (Royne & Levy, 2015). Moreover, description of several strategies that are commonly used to address designing public health problems are divided into a Theory-Based Message Design section and an Audience-Centered Message Design (Royne & Levy, 2015;Cho, 2011).

Theory-based health message design reduces the probability of error and increases the likelihood of success of health communication efforts (Cho, 2011). Theory based message design is based on psychosocial theories of behavior change (Cho, 2011). Explicating the path from a theory of behavior change to health communication messages is necessary and significant.

Within theory-based message design, several studies have investigated health messages that utilized the prospect theory. Prospect Theory explains how message framing will influence an individual's decision-making (Kahneman & Tversky, 1979). It states that gain-framed messages will be more likely to influence behavior than loss-framed messages when the risks of acting are perceived to be small and when outcomes are certain (Michael Evangeli, 2013). For example, loss-framed messages present negative results or outcomes of neglecting to adhere to certain activities (Gallagher & Updegraff, 2012). Hence, someone could present a choice of taking medication on time. One way of loss-framing a message is to say, "If you don't take your medication on time, you are likely to have health complications." The gain-framed message would be "If you take your medication on time, you are likely to avoid health complications." In the example, the choice facing the decision maker or receiver is to take their medication on time. In this context, the supported behavior is improving medication intake. The adverse outcome (health complications) of not performing the behavior (not taking the medication) is a loss-frame message (Gallagher & Updegraff, 2012). The gain frame messages present a positive outcome, avoiding health complications by performing the behavior (taking medications) (Gallagher & Updegraff, 2012). Presentation of the outcome is an important aspect of message framing (Gallagher & Updegraff, 2012).

Another strategy within theory-based message design is the designing of narrative- based messages (Miller-Day & Hecht, 2013). Narrative based designed messages use stories to collaborate and exchange information to pass on knowledge and influence behaviors (Miller-Day & Hecht, 2013). Narratives additionally may provide opportunities for individual readers to connect with broader social groups and population represented by story characters (Niederdeppe et al.,

2008). Experts who investigate the impact of narratives mostly agree that stories heighten readers' message recall and comprehension and facilitate attitude and behavior changes (Niederdeppe et al., 2008). The literature additionally states that, compared with other types of evidence, stories are easier to understand and recall because they more closely resemble authentic life experience.

Makalea, (2015) explored the utilization of a locally developed storytelling prompt as an option for HIV and AIDS with an alternative medium for awareness and prevention messages among rural university students in Limpopo Province, South Africa. In what was known as the "storytelling in the holding up room project," the researchers utilized animal characters and adult health experts to provide information about HIV/AIDS as patients sat in holding rooms at selected clinics. After listening to the stories, the respondents were asked to explain what they had understood from the narration. An analysis of the respondents' narrative accounts showed that they recalled the main ideas of the stories, the messages communicated, as well as the expected actions. Researchers argued that storytelling offers culturally appropriate communicative means for low-literate audiences at rural clinics (Cho, 2011). Beyond this, they deemed storytelling to be "accessible, transparent and contextualized to local rural communities in South Africa which are affected by poverty and where a significant number of its inhabitants are infected with HIV" (Wijbenga et al. 2010, p. 385). Yet, the evidence for narrative message design concentrates on student samples, and the impact results have been minor (Niederdeppe et al., 2008). Clarity on how to construct compelling narratives, along with which story characteristics are most critical, lack in current research (Niederdeppe et al., 2008).

Audience-Centered Message Design includes pragmatic goals to examine ways to reduce disparities in health practices and outcomes among a diverse segment of the population (Cho,

2011). The theoretical goal is to advance the conceptual basis of audience diversity and systematic frameworks for addressing this diversity in health communication (Hecht & Choi 2012).Two approaches to audience-centered message design is the design of targeting and tailoring of health messages. These two strategies can be used to improve the cultural fit of health messages (Cho, 2011). Often contrasted, these approaches represent different points on the same, dual continual of message customization and audience segmentation. Message targeting includes creating messages for individuals who have shared characteristics from a subgroup of a population such as expectant mothers in rural Ghana in the Northern. This method assumes that individuals have corresponding attributes and inspirations. Also, the impact of the message will include all persons in the subgroup (Alden et al., 2014). For instance, in healthcare, a subset may include individuals who have the same disease condition. In regards to both targeting and tailoring messages, studies have mostly been conducted on pamphlets, newsletters, or magazines (Cho, 2011; Lustria et al., 2013).

Valuing Culture in Health Messages

Having access to the Internet and a mobile device has changed the dissemination of healthcare information (Lustria et al., 2013). Suggestions for future studies show that research should give a better depiction of their customizing criteria and strategies utilized for message design, modes of delivery and components of the intervention (Lustria et al., 2013). To address culture in health message design, it is necessary to consider how culture influences health behavior (Cho, 2011). The public health literature is rich with qualitative and quantitative data documenting associations between culturally defined groups and health-related attitudes, behaviors and beliefs. But the extant literature leaves many unanswered questions. For example, how, exactly, does culture influence health outcomes? Why do associations between culture and health outcomes vary across studies? Why do associations between culture and specific health outcomes

vary among participants with studies from the same cultural groups? How should health messages incorporate culture to effectively induce health behavior change?

Within the public health communication discipline, while attempting to accomplish an understanding, culture provides valuable information that enables individuals within groups to improve their comprehension (Alden et. al., 2014). The relevant culture information within messages is critical to the success of health education (Alden et. al., 2014). Valuing cultural considerations in health care is significant because it may relate to differing patterns of health behaviors that may influence health outcomes. Culture often influences values, attitudes, and beliefs that influence health behaviors (Davis & Resnicow, 2001). For example, a pregnant woman will select her baby's food, birthing practices, and her baby's feeding according to her cultural background (Skolnik, 2011). Culture is also an important determinant of people's opinion of illness and disease. For instance, Western societies such as the United States see disease as a result of a natural scientific phenomena and advocate for medical treatments that combat the disease (Skolnik, 2011). Other societies may believe that illness is a result of supernatural phenomena and promote prayer or other spiritual interventions (Skolnik, 2011). However, little data exist regarding patterns of health behaviors and outcomes by cultural affiliation (Cho, 2012). Thus, research comparing racial and ethnic groups indicates that health behaviors and results may vary by culture. Consequently, public health surveillance research routinely tracks, recognizes, and describes patterns of illness and risk factors in populaces, and along these lines highlights the necessities of some groups over others (Kreuter & McClure, 2004). Rather, the populace characteristics that are regularly accessible in the data are limited (e.g., age, race, sex, geographic limits) and give only a rough proxy for culture and other shared characteristics, views, experiences, and

living conditions of a group. For instance, populace groups characterized only by broad racial/ethnic classes have been shown to incorporate numerous particular subgroups (Kreuter & McClure, 2004). To supplement this data, program organizers recommend conducting a more in-depth examination of demographically defined groups that can incorporate a thoughtful consideration of the role of culture (Kreuter & McClure, 2004). Accordingly, research shows a two-stage approach: first recognizing population subgroups encountering the excess burden of ill health, and next, trying to distinguish and better comprehends what is shared by individuals from the group and may impact health. The two-stage approach recommends a practical way to address culture in health communication and health promotion programs (Kreuter & McClure, 2004).

Hence, health communication messages are more persuasive when framed to be congruent with the receiver's cultural characteristics (Alden et al., 2014). While framing health messages, presentations of the outcome may directly or indirectly associate with health-related decisions (Gallagher & Updegraff, 2012). For example, while framing a message that presents dietary options to promote the prevention of certain diseases, the message designer must understand the cultural group’s traditional dietary practices and the setting, along with the values of the collectivist culture. Likewise, a source delivering public health communication has two essential dimensions: expertise and trustworthiness (Cho & Kregur, 2010). The literature demonstrates that expert sources are more influential than those lacking expertise, and despite the fact that findings are to some degree less reliable and associations not as stable, the relationship between trustworthiness and influence is positive (Kang & Sundar, 2016; Kreuter & McClure, 2004). Effects of source expertise and trustworthiness are often determined by the context. For instance, they might differ given attributes of the message, the receiver, the channel through which persuasion happens, as well as combinations of these factors (Kang & Sundar, 2016; Kreuter & McClure,

2004). Sources that are respected or judged to be socially appealing are likewise more persuasive than others, especially when the communication channel is video or sound, or when the message is not attractive (Cho & Kregur, 2010). At the point when an individual perceives a source to be like him or herself, evaluations of the source are more ideal. These similarities might be demographic or attitudinal in nature and might be real or perceived (Kreuter & McClure, 2004).

mHealth

mHealth is expanding rapidly. More frequently, it is being used to improve delivery of health services in both resource limited and unlimited settings. In LMICs, mHealth diminishes expenses and expands network coverage by giving an extensive variety of opportunities for applications utilizing global health and other telecommunication technologies. These opportunities can extend to the usage of mHealth advances in public health (Aranda-Jan, 2014). The utilization of mHealth services can be used to enhance the affordability of interventions for health promotion and expand health education and disease prevention (Aranda-Jan, 2014).

Mitchell et al. (2013) propose that compactness and consistently reachable status, as well as information transmission are the characteristics of mobile phones that have made them achieve a larger populace than PCs. Hence, the extensive use of SMS (short message service), is the least-expensive mobile phone function which offers a solution that could quickly overcome shortcomings in communication, perhaps leading to improved delivery of health services and better health outcomes. Two options for mobile messages include short message service (SMS) or voice messaging; both offer particular focal points and hindrances. SMS is accessible on an estimated 98% of mobile phones, does not require technical mastery to utilize, and is versatile to numerous mHealth purposes (Labrique et al., 2013). At the user convenience, SMS messages can be delivered to phones without power or those that have flat batteries. Additionally, telecom costs for SMS are less costly than expenses for voice messages. Given these points of interest, it

is not surprising that SMS is the most common delivery strategy for mobile development services (Labrique et al., 2013).

Although utilized less frequently as a part of mHealth projects, voice messages offer several advantages for mHealth. Voice messages have accessibility to illiterate populaces, the capacity to contain more data per message than SMS, and provide the ability to be recorded in any dialect (not all dialects/characters are supported by SMS (Labrique et al., 2013). Additionally, recorded voice messages permit data to be passed on by a clinical "character" as utilized as a part of Bangladesh by the Mobile Alliance for Maternal Action (MAMA), to assemble compatibility and trust over time (Alva, 2013). Numerous studies in India have reported mobile phone communication as a satisfactory and acceptable device in disease management, for example, Type-2 diabetes, tuberculosis, epilepsy and HIV for both patients and medicinal services suppliers (Gautham et al., 2014; Ramachandran et al., 2013; Elangovan and Arulchelvan, 2013; Bigelow et al., 2013; Shetty et al., 2011; Bali and Singh, 2007). In light of research exploration in India, Priyaa et al. (2013) and Prasad & Anand (2012) give the idea that instant messages are the most favored method of correspondence. Instant messages, as opposed to handouts, are favored for education information identified with oral health, prevention of transferable and non-communicable illnesses, for example, HIV/AIDS, and tuberculosis (Sharma et al., 2011; Deglise et al., 2012; Schneider et al., 2012). Even though, SMS functions on a lower bandwidth than voice and is personally convenient because of the asynchronous characters, there have been several mHealth projects that have explored this service within the continent of Africa.

Andreattam (2011) conducted a patient follow-up, and drug adherence project in rural Ghana that concentrated on enhancing healthcare for patient and treatment follow-up. The study

assessed the utilization of mobile phones by expert and traditional birth attendants (TBAs) in rural settings for reporting birth outcomes. The attendants were prepared to send SMS instant messages from cell phones by utilizing a basic numeric protocol to communicate information. Members sent a text to a pre-customized number to report information for all births they attended over a 90-day period. In Uganda and South Africa, in areas limited in staff and infrastructure, the utilization of mobile phone advances by community health workers (CHW) gave positive results on HIV-infected patient care (Déglise, Suggs, & Odermatt , 2012;Källander et al,. 2013) Frequent delivery of instant text messages has positively influenced patient consideration and logistics, supporting facility and community health workers and patients (Déglise, Suggs, & Odermatt, 2012;Källander et al,. 2013). Likewise, mHealth is used for staff evaluation and performance monitoring and compliance with treatment rules (Déglise, Suggs, & Odermatt , 2012;Källander et al, 2013). Studies included three Random Control Trials (RCTs) and one cost-examination. In Kenya and Uganda, the utilization of SMS reminders enhanced patient care and had a beneficial outcome in case management (Déglise, Suggs, & Odermatt , 2012;Källander et al,. 2013). Different uses have been in drug supply and stock administration. In Kenya and Tanzania, SMS messaging has additionally been utilized to enhance drug supply chain and management. Text messaging has been employed to give ongoing upgrades on medication stocks in health facilities, decreasing out-of-stocks and supporting stock medication administration (Déglise, Suggs, & Odermatt , 2012;Källander et al,. 2013). Regarding the rising of transmittable and non-transferable illnesses, challenges have overstretched health systems (Källander et al. 2013).). Some mHealth projects have focused on disease surveillance and monitoring to reduce disease burden. Studies include two pilot projects for malaria reporting (Déglise, Suggs, & Odermatt, 2012;Källander et al,. 2013) and case detection (Déglise, Suggs, & Odermatt , 2012;Källander et al,. 2013). Zambia

and Uganda, both pilots, researched the feasibility of using SMS reporting for active case detection, disease surveillance and case identification for malaria (Déglise, Suggs, & Odermatt , 2012;Källander et al,. 2013). Within health education, L'Engle et al. (2012) assessed the procurement of automated family planning information to the overall population through cellular phones. While the study infers that it is achievable to utilize cell phones for health education purposes, results indicated vast underreporting, a danger of inclination (e.g. utilization of contraceptives prior of the implementation of the project) and the need to evaluate impacts of utilizing random control trials (RCTs).

mHealth projects are exceedingly dependent upon the attributes of the technology available. Often identified as the primary drivers for use were mobile phones ease, usability, and broad accessibility. (Déglise, Suggs, & Odermatt , 2012;Källander et al,. 2013). An expansion in access to mobile phones has propelled researchers and project managers towards looking for innovative ways in which healthcare services can be given, especially in areas that present infrastructure and desktop computer based technology shape or form reach. Within the literature, advantages of mHealth projects were depicted at each level inside of the healthcare system, from governments to staff, and patients. For instance, governments may benefit from the expanded support of patient management (Déglise, Suggs, & Odermatt, 2012;Källander et al,. 2013) along with an increase in direct correspondence with stakeholders in rural areas (Déglise, Suggs, & Odermatt , 2012;Källander et al,. 2013). Staff might get support from expert systems or can organize endeavors in areas where they are most needed such as rural areas uncovered by particular projects or interventions. At last, patients are at an advantage by having increased attention and receive more support from health providers, as discussed in previous sections. SMS alone has been demonstrated to help bridge the communication gap in the health sector between health

workers and patients, administrative levels, and between the ministries of health and facilities in the peripheral areas (Déglise, Suggs, & Odermatt , 2012;Källander et al,. 2013). The primary reason for a profoundly positive view of mHealth projects by health workers, staff, and patients were high acceptance and commonality of use of mobile phones (Déglise, Suggs, & Odermatt , 2012;Källander et al,. 2013). These positive perceptions are understandable given the massive achievement with mobile phone subscriptions in recent years in Africa. Henceforth, the acceptance of the technology itself may have an effect on the overall acceptance of the project. Other advantages of mHealth are identified with the mobile technology itself. When compared to different technologies (e.g., PDAs or laptops), mHealth projects benefited from the way that cell phones turned out to be less subject to burglary and breakage (Déglise, Suggs, & Odermatt , 2012;Källander et al,. 2013). Also, projects have proved to be effective when adjusted to the local context and dialect (Déglise, Suggs, & Odermatt, 2012;Källander et al,. 2013). Moreover, project success includes when the government has an existing mHealth or eHealth project and has an interest to set-up a system to integrate mHealth projects (Déglise, Suggs, & Odermatt , 2012;Källander et al,. 2013) and when the project has been created and executed by public-private associations (Déglise, Suggs, & Odermatt , 2012;Källander et al,. 2013).

mHealth Funding and Collaborations

mHealth contributes to the rise of new actors that have rarely been involved in the field of public health such as mobile phone operators in charge of mobile phone networks and connectivity along with technical private operators in charge of development platforms and mobile applications and interfaces as well as data storage companies (Tamrat & Kachnowski, 2012). These firms act in their best commercial interests and marketing developments, without necessarily feeling obliged to endorse the objectives of equality and access to health for all (Lemaire, 2013). Also, mobile health can reshape health financing; on the one hand, because it contributes to the

emergence of new funders such as private foundations born from Information and Communication Technology (ICT) companies such as Vodafone Foundation or Bill and Melinda Gates Foundation.

On the other hand, because some health projects′ funders (governments, foundations, insurance companies, NGOs, etc.) may reallocate funds previously devoted to building care infrastructure towards innovative technologies such as those involving mobile phones, to the detriment of more "traditional" healthcare services (Ali, 2016). For instance, the U.S. government launched in May 2011 a $10 million partnership called "Mobile Alliance for Maternal Action" (MAMA), devoted exclusively to providing health information to future or young mothers using mobile phones(Lemaire, 2013). USAID and the Johnson & Johnson pharmaceutical company support the 3-year partnership. Three pilot countries were targeted to implement mHealth activities: India, Bangladesh, and South Africa. This public–private partnership is an example of how mHealth projects tend to mix general and commercial interests, especially in LMICs (Lemaire, 2013). Maternal health overall represents near to one out of five funded mHealth projects in LMICs (Al Dahdah, et al. 2015;Lemaire, 2013).

Subsequently, the development of mHealth projects raises the issue of equity in partnerships when implementation of projects occurs in LMICs; however, developed countries control technology implementation, developments, monitoring, and evaluation (Ali, 2016). For instance, within the MOTECH project for mobile maternal health in Ghana, project stakeholders are numerous: the Bill and Melinda Gates Foundation, the U.S. Agency for International Development (USAID), the Johnson & Johnson laboratory, the Grameen Foundation and the Norwegian government funding the project. Some of the responsibilities of these actors included the Public Health Department of Columbia University responsible for research studies; Department of

Computer Sciences of the University of Southern Maine in Portland are responsible for the scientific coordination of the project; and the U.S. companies Dimagi and Thoughtworks. In addition, Reach Village is responsible for developing the platform and for its local use, and finally, the Ministry of Health of Ghana collaborates with the project and contributes to its implementation country-wide (Al Dahdah, et al. 2015). The American technical operators and funders are largely dominant within this "African" project, and facilitation occurs by the ability to develop remotely, manage and maintain these technological tools (Al Dahdah, et al. 2015).). This new wave of mobile technology applied to health thus raises complex issues regarding the economic organization, governance, distribution of power and control (Al Dahdah, et al. 2015).

mHealth for maternal care raises international issues because of its financing, technical implementation, infrastructure and areas of implementation supported by different actors across the world (Lemaire, 2013). The transnational mechanisms underlying these various applications occur through studies involving various cultural areas, different socio-economic contexts, different situations regarding maternal care and public/private healthcare sectors articulations (Al Dahdah, et al. 2015. mHealth is giving way to a new approach to public health by rearranging roles and allow new actors to implement a socio-technical system (Lemaire, 2013). Nevertheless, research continues to lack regarding the reorganization and redistribution of powers between private and public actors involved in mHealth projects (Al Dahdah, et al. 2015). Also, these mobile devices call attention to important issues regarding data safety, confidentiality and "security" in the context of gathering and investigation of health information that is globalized (Al Dahdah, et al. 2015). They additionally highlight the dynamics of how foreign ethical financial practices adjust to local economic and political context, traditions and customs, health organization and experts (Lemaire, 2013. Issues of confidentiality and security of health data collected via mobile,

the technical conditions of storage and dissemination, and the evaluation of these specific health programs also remain to be explored (Ali et al., 2016). Researchers state that studies should include observation of mobile phone users, that is, what people do with these objects and technical devices (Ali et al., 2016). Al Dahdah, Du Lou, and Medel (2015) among others, formalized the impact of the mobile phone on society by investigating patient care and health in LMICs; nonetheless, further exploration is needed on the analysis of the individualized approach to mHealth and the mobility of health practices associated with these projects in LMICS (Al Dahdah, Du Loû, & Méadel, 2015). Accordingly, mHealth programs exploring maternal health via mobile phones are specifically relevant to examine, thanks to these areas of analysis: they grow rapidly due to the emergency of the situation around maternal health, they provide the basis for questioning how gender roles connect within the roles of the actors and beneficiaries of health programs, and they possibly can reshape these roles by the use of new technologies (Clark, 2015), Steenson and Donner (2009) illustrate that mobile-phone usage practices of device-sharing make it difficult for the dissemination of sensitive medical information for women groups who are reliant on male partners for access to information. Clark (2015) notes that mHealth for maternal care creates tensions within a society when the establishment of a communication-information infrastructure layers over an existing socio-culture foundation whether in a medical institution or a local village community. Additional future research should examine potential shifts in power relationships caused by the introduction and adoption of mobile technologies in healthcare systems, and the extent and the limitations of their impact, as measured by improvements in community health (Ali et al., 2016). Research gaps also exist in examining the cost-adequacy of interventions, so a key essential requirement for policymakers is to oversee investment choices in

technological support and human resources (Krishna, Boren, and Balas, 2009). As a result, studies should include cost-effectiveness of mHealth projects to manage funds from funding partners (Ali et al., 2016).). Concerning sustainability, Clark (2015) states that mHealth and the local health care system should work in conjunction with other technological platforms. Ordinary, mHealth implementations are primarily standalone interventions that rarely integrate the local healthcare system (Clark, 2015). Therefore, mHealth research should emphasize sustainability and argue that the incorporation of the healthcare system leads to integrated parts of national government health plans, and potentially expanded to programs led by private entrepreneurs and corporations (Al Dahdah, et al. 2015).

mHealth messages for LMICs

The last decade has seen an extraordinary development of the improvement of information communication technologies (ICT) infrastructure worldwide (The International Telecommunication Union, 2009). The pattern displays a reasonable movement from landline toward cell telephones, whose subscription rates are three times more prominent than landlines (The International Telecommunication Union, 2009). Overall in LMICs mobile-cellular penetration will reach 90% by end 2014, compared with 121% in developed countries (The International Telecommunication Union, 2014). The extension has been most noteworthy in Africa where mobile broadband growth has continued to show double-digit growth rates of over 40% twice as high as the global average (The International Telecommunication Union, 2014). By end 2014, mobile-broadband penetration in Africa will have reached almost 20%, up from less than 2% four years earlier (The International Telecommunication Union, 2014). LMICs not only have the majority of world cellular telephone subscribers, but also will likewise represent 80% of the new ones (GSM Association, 2008). Today, the World Health Organization (2011) perceives that technologies should be utilized to their fullest degree wherever possible to provide advanced information

to create efficient and transparent communication channels that will permit interactive sharing and learning among different groups of stakeholders in society. With the quick development of mobile health applications consolidated with current and anticipated economic and public health challenges, reviews of existing applications and confirmation of SMS-supported projects in LMICs are needed.

Regarding emerging developments, mHealth devices may combine app and sensor capabilities into a general purpose-computing environment (Tipp, 2014). The most direct way to achieve this is to augment a general -purpose computing device with sensors that feed information to the device. For example, the iGBStar solution from Sanofi Aventis is a blood glucose-monitoring device for diabetes patients that connect directly into Apple phones (Prabhu, 2013). Additionally, when deployed successfully, devices and sensors give patients the ability to record and transmit their biometric data into a user interface providing an actionable and informative picture of their health that may be shared with physicians, caregivers, family members, or their social networks (Steinhubl, Muse, and Topol 2015). Many medical practitioners and other healthcare workers are also beginning to use apps as part of their professional practice (Buijink et al., 2013). Despite the prevalence and apparent popularity of medical and health apps, very little critical sociocultural analysis has been undertaken to investigate the ways in which app developers present their wares and to site apps within the broader landscape of digital health technologies (Prabhu, 2013). Studies of health and medical apps have predominantly appeared in the medical and public health literature and have taken an instrumental approach, directed at such issues as their effectiveness for behavior change, towards the medical accuracy of the content or legal and regulation issues. Yet from a sociological perspective, digital devices such as health

and medical apps have significant implications for the ways in which the human body is understood, visualized and treated by medical practitioners and patients alike, for the doctor–patient relationship and the practice of medicine (Lupton & Jutel, 2015).

In recent times, however, diagnosis as process and the authority of the medical profession to affect diagnoses have been confronted by changes in the practice of medicine and the doctor–patient relationship. The patient's role in interpreting symptoms has entered a phase of liberalization. A vast array of medical information is now available on websites and platforms, including patient support platforms and social media sites in which patient can exchange their experiences of diagnosis and medical treatment (Kivits, 2013, Lupton, 2014a and Murthy, 2013). Given the panoply of online sources of information about illness and disease, the contemporary patient has much greater access to opportunities to self-diagnose. While the patient has always contributed to diagnosis by instigating the medical consultation, presenting symptoms for consideration, and even negotiating the diagnosis offered by the doctor (Balint, 1964), today, a patient, with the help of technology, might seek out the doctor not for the purposes of deciding the diagnosis, but rather for endorsing a diagnosis she or he brings to the consultation (Kivits, 2013). Contemporary diagnostic technologies include a growing array of self-diagnosis devices designed for the use of patient's. There has been a trend towards self-diagnosis on the part of patients armed with the information they have been able to access online and the growing number of digital self-diagnosis instruments and direct-to-consumer kits that are now available on the internet (Goyder et al., 2010 and Hynes, 2013). There also remains the issue of how healthcare practitioners may respond to patients who have attempted self-diagnosis using apps like these. For consumer and patient support groups, the ideal of the empowered patient is a means by which a challenge occurs with medical experts. For governments, this ideal is viewed as key to reducing healthcare costs

in an age of austerity (De Vogli, 2011 and Mort et al., 2013). Researchers contributing to the medical literature demonstrate ambivalence, with some supporting the concepts of patient engagement and participatory medicine, but others articulating unease about the extent to which patients should 'take control' over their healthcare (Lupton, 2013 and Prainsack, 2014). With respect specifically to diagnosis, the medical profession has been reluctant to surrender its professional authority to the patient. A review of the medical literature on self-diagnosis highlighted that medical researchers have argued for its utility in cases where early disease recognition is paramount for individual or public health protection, or where medical resources are scarce (Jutel, 2010). Patients may struggle to know how to deal with the information they access from self-diagnosis apps. Users, evaluating the claims to authority and legitimacy of the content of each app and its developer, are in a position that many may find difficult. Many stakeholders now compete for patients' attention in the world of digital health information, (Lupton, 2014 and Rozenkranz et al., 2013). It is not always clear where vested interests lie for digital formats of medical information either beneficiaries or members of the medical profession (Lupton & Jutel, 2015)Self-diagnosis apps are also part of a growing market aimed at promoting the digitally engaged patient (Lupton & Jutel ,2015). At present, there is no way of fully identifying the role that pharmaceutical companies or medical device developers may have played in contributing to the content of apps. Such companies are increasingly developing and distributing apps as part of their marketing efforts, raising issues of conflict of interest (Buijink et al., 2013 and Ebeling, 2011). One significant difference between diagnosis apps and previous diagnostic technologies is the potential they hold for contravening the privacy of users. Thus, the value of big digital datasets for health and medical-related purposes is being recognized (Lupton, 2014 and Neff,

2013). In this context of the increasing collection, storage of digital data, data security is a pressing concern for users of health and medical apps (McCarthy, 2013). For those apps designed for online use, in many cases users cannot be sure of how their data will be archived or on-sold to third parties due to limited details.

Cell phones offer short message service (SMS), otherwise called content informing. SMS is a communication protocol institutionalized in the Global System for Mobile communications permitting messages of 160 characters maximum to be interchanged from a mobile phone or a PC to one or numerous cell phones at the same time (Lupton & Jutel ,2015). SMS can convey information in near-real time to numerous individuals as recipients of institutionalized, bulk messages or even customized or custom-made messages. SMS is accessible on every mobile phone, including modest low-end handsets, through the Global System for Mobile correspondences system.

An expanding number of SMS mobile health initiatives that emphasize various sorts of message design strategies such as one-way, two-way, are executed and tested in LMICs (Waugaman, 2014). For example, SMS served as one-way communication tools where preventions focused on health-supported messages to vast quantities of subscribers who had no chance to respond to messages or seek specific advice. Projects that included one-way communication SMS that are either institutionalized or targeted, tend to focus on large populations and provide information about healthy behaviors and testing services. Such activities regularly require the ownership of a cellular phone. For instance, SMS promoted health care services for an HIV/AIDS Hereo program in India. The program urged parents sign up their children to receive vaccinations during Polio Vaccination Days. In Nepal, hand washing was encouraged, while in India infor-

mation regarding tuberculosis was promoted. In the Central African Republic of Congo, messages were sent to parents to encourage vaccination, bed net use, and hand washing. In one component of Text Me! Flash Me! SMSs promoted educational and promotional public health messages.

SMS projects that included two-way communication combined opportunities to send and receive text for health tips obtain information about clinic locations or contact a live person (Gurman, et al., 2012). SMS supports other media channels, allowing people to ask questions when they needed more information. Individuals can remain anonymous, which is particularly important for stigmatizing issues such as HIV/AIDS and tuberculosis. Kenyan subscribers in the Mobile for Good project received messages that ask questions on HIV/AIDS and breast cancer-related issues (Mobile for Good, 2011). Some projects supported existing public access services to deliver the intervention. In Uganda, the Application Laboratory project employed operators to convey information through an SMS-searchable database of health tips on sexually transmitted diseases and family planning. The project also contained information on local clinics and a timetable operation for services. In Tanzania, doctors sent SMS to a retail bed net outlet, while the retailer provided the doctor with a voucher code. Women redeemed their vouchers for a bed net with transferred codes from doctors.

SMS projects that included games consisted of learning about healthcare in the form of a game app (Gurman, et al., 2012). The Freedom HIV/AIDS project in India and HIV/AIDS Star Program project in Africa both used mobile platforms that were deployable through games to enhance participation while promoting disease prevention behaviors (Gurman, et al., 2012).). In India for over 15 months, ten million game sessions were played. In Africa over one year, 6 million

game sessions were played (Gurman, et al., 2012).). After implementing HIV/AIDS content, the project explored other topics such as malaria, women's health issues, and tuberculosis.

SMS projects that included a reward system consisted of receiving a reward for an accomplished task. Individuals receiving an award encouraged participation. In Uganda, the Text to Change project consists of an SMS multiple-choice quiz three times a week to raise recognition of HIV/AIDS (Veldhuizen, 2009). If users submitted correct answers to the quiz, they were offered the possibility to win free phone airtime. eQuest in Kenya also used the rewards system, which targeted youth to text correct answers for HIV/AIDS issues to win free airtime, T-shirts, mobile phones, computers, or DVD players (Gurman, et al., 2012).. By reviewing these projects, one may note that it is of high importance that one considers the entire communication process. Also, it is important to develop cultural and gender-sensitive messages and approaches provided in the languages of the target population (Gurman, et al., 2012). Additionally, high-quality SMS-based intervention studies continue to lack the literature from LMICs, as reported in recent literature reviews (Noordam, 2011; Mukund 2010). Regarding the last mentioned, findings include cases of coordinated efforts between universities in developed and LMICs, research foundations, non-profit organizations, the private sector, public and private hospital facilities and public sector. Regardless of the positive conclusions of the studies introduced, the project design continues to lack within mHealth projects. In this sense, administrators, organizers, and designers specifically have a vital role to play to guarantee the success of the project.

mHealth maternal messages for LMICs

The rapid increase of mobile health projects focusing on maternal health is due to the widespread access of women to cellular phones. The gap of access to the innovation between males and females are far less for mobile access in LMICs (Källander et al., 2013). Literature

regarding gender access to technologies has demonstrated that access to ICT is (or has been for quite a while in LMICs), in general, is harder to obtain for women (Källander et al., 2013). The dominant male position in the development of ICT advancement might likewise clarify why women have a hard time finding their place in those same technologies (Paul et al., 2015). Mobile phones, however, hold a unique spot in the realm of ICT: women are 21% less likely than men to own a phone (Paul et al., 2015). Although gender differences do exist, yet mobile phones are a more "equal innovation" than the PC or Internet access (Källander et al., 2013). Due to the low cost and easy functionality, several mHealth initiatives have focused on maternal health in LMICs (Paul et al., 2015)

mHealth supports the exchange of information on health promotion, often through an asynchronous modality that generates short-message service (SMS) to expecting mothers (Liamputtong et al.,2013). Thailand's ''Better Border and Healthcare Program'' disseminated information via SMS regarding antenatal care visits and the expanded program on immunization (EPI) for women along the Thai-Myanmar border. After this intervention, Kawekungwal et al. (2012) reported that the odds of on time antenatal visits and EPI increased by 1.91 and 2.13, respectively, for mothers enrolled in the program. Similarly, the ''Wired Mothers'' project in Zanzibar, Tanzania, used mobile phones to link pregnant women with health units, send reminders on antenatal care appointment, and facilitate access to skilled attendants for obstetric care (World Health Organization, 2014). Preliminary data indicates 42% of the pregnant women with mobile phones called their midwives, and the group's opted for skilled delivery attendance and antenatal care visits increased. Also, a randomized controlled trial in an urban hospital in Thailand researched the emotional health of women who received SMS-based guidance throughout the course of their pregnancy (Liamputtong et al., 2013). The findings of the study revealed that

pregnant women receiving messages during the prenatal period were significantly less anxious and felt more confident about health workers at the time of delivery; yet, there were no significant differences in the pregnancy outcomes of the two groups. Lastly, an overview report identified the Beba Dolazi program in Serbia, which sends weekly health education messages via SMS to pregnant women based on the progression of their pregnancy (Cormick et al., 2012). Nonetheless, the current study could not retrieve information about the health outcomes of women enrolled in this particular program. Recognizing the sociocultural context while engaging local partners in developing culturally appropriate and language-friendly messages is another common theme for the integration and sustainability of mHealth applications (Cho, 2011; Gallagher & Updegraff; Gurman et al., 2012) Thus, the mobile-midwives project in Aceh Besar demonstrated that technologies that permitted the use of the local Indonesian Bahasa were more accessible and efficient compared to other digital media that solely used English. Similarly, the ‘‘Wired Mothers’’ study in Zanzibar, Tanzania, showed that SMS services intended for pregnant women adapted the content to the local context for the adoption of the behavioral change practices.

Interventions also often employed a strategy that anchored mHealth programs at the community level and utilized personnel with the most existing outreach capacity to pregnant women. Invariably, emergency response and point-of-care support programs incorporated frontline workers, volunteer assistants, and paid health workers embedded in their communities’ health ecosystem (Tamrat, & Kachnowski, 2012). For example, the RESCUER program in Uganda demonstrated that empowering community-based health workers with mobile communication provided the opportunity to strengthen linkages between community members and health facilities (Tamrat, & Kachnowski, 2012). Also, the ‘‘Lady Health Worker’’ initiative in Pakistan worked with ubiquitous and socially accepted health workers who had easy access to mothers and could

bridge disenfranchised populations with the formal health system (Tamrat, & Kachnowski, 2012). Accordingly, programs should build upon the local context and resources, while still introducing an innovative tool for healthcare delivery. Research examining the outcomes of voice versus SMS messaging is, however, limited in the mHealth literature, though in a small number of studies, the examination of user preference occurs. For instance, in Ghana, the Mobile Technology for Community Health (MOTECH) initiative aims to provide pregnant women with maternal health education and reminders to access necessary medical services. Mothers selected to receive voice or SMS messages, 99% of enrollees selected voice (MOTECH, 2012). Yet, in Argentina surveys found that users were open to receiving SMS and voice messages during pregnancy, with 96% of individuals opting to receive SMS messages, and 87% opting to receive voice (Tamrat, & Kachnowski, 2012). Up to this point, there is an absence of research that has been directed to find the distinction in acceptability, comprehension, or behavior change between users receiving messages from voice, compared with SMS formats (Crawford, 2014). Hence, further research analyzing the interpretation of health information transmitted through cell telephones into healthy behaviors is needed to comprehend the potential effect of mHealth interventions on their planned clinical outcomes. Understanding the impacts of message modality is critical when choosing SMS or voice message services in mHealth programs. In spite of the fact that SMS is a typical and successful method, voice messages might be an attractive choice in light of education levels and cellular telephone access.

Ethics

In this section I examine ethics that guide research in the global context, and in particular as it relates to conducting research in mHealth in LMICs.

Research Ethics in the Global Context

According to Bhutta (2002), ethical principles as they relate to international research, focus on micro-level relations such as rights of the individual research participants and strengthening interpersonal relationships between researchers and study communities includes details to consent procedures, and ascertaining their effectiveness in socio-economic, cultural settings (Agre & Rapkin, 2003; Lindegger et al., 2006; S. Molyneux & Geissler, 2008). However, significant ethical concerns consisting of whole populations, the functioning of research institutions, the process of collaborations and ethics of inequitable international relations still need attention (Bhutta, 2002; Costello & Zumla, 2000; Jentsch & Pilley, 2003).Therefore, the emphasis includes recognizing that in the overall health field, research conducted on global disparities of wealth and health and within this context involves vulnerable people, but does not immediately apply for their benefit (C. Molyneux, Peshu, & Marsh, 2004). In an LMIC setting, researchers who collect data in 'the field" face significant challenges in mediating between the priorities of and concerns of the research institution and the community setting. During the process, there is no simple way to observe and adhere to external formal ethical guidelines neutrally; such interactions have positive and negative interactions with community members and researchers. Also, social relationships between actors and participants continually are tested by context-specific concerns and interest. These concerns are difficult to foresee and may extend beyond the duration of the study. Experts suggest that while formal ethical guidelines play a role in regulating research and practice, social relations from day-to-day and engagements between people are fundamental to the research process (Gikonyo, Bejon, Marsh, & Molyneux, 2008).Therefore, Gikonyo argues for greater attention needed on the social relations in the field of health as we face global and economic inequality in many deprived countries. According to Gikonyo (2008), such focus may contribute to a more equitable and democratic medical science.

For a start, Theobald and Nhlema-Simwaka (2008) note that while research ethics committee members are reviewing social science protocols, there is a need to explore the document in practical ways by building support and mentors with the committee. According to Molyneux (2004), in doing research on AIDS and orphanhood, researchers can cause harm if they do not address the high expectations raised in the study populations. Therefore while studying vulnerable populations, considerations should address long-term and short-term consequences. Another difficult task includes linking the research question to the community's development (Theobald & Nhlema-Simwaka, 2008). Such as process involves consultation with the community on all levels of development of the study. Therefore, ethics in international health research should include strengthening local capacity by developing partnerships.

Additionally, a challenging process includes obtaining informed consent. While researching in a rural setting, many prospective participants in LMICs have limited formal education. Consequently, they may have difficulty comprehending the process of voluntary consenting to participate in a study (Mandava, Pace, Campbel, Emanuel, & Grady (2012). Riessman (2005) states that while conducting her research on ‘female infertility’ in a rural dwelling of India, it was challenging to obtain informed consent due to participants assuming the form represented a government document. Although written consent was provided individuals struggled to make sense of the process (Mandava et al., 2012). In Nepal Regmi, Aryal, Kurmi, Pant, Teijlingen, & Wasti (2016) discovered that it might be difficult to receive confidentiality during the interview process due to the constant interference of family members (Mandava et al., 2012).

As research becomes interdisciplinary and collaborative across international boundaries, it is a common practice to advocate for documents and protocols to be translated into the local (vernacular) languages and validated (Regmi et al., 2016). Regmi (2016) states that during the

translation phase, the original meaning may be verifiable if an independent translator executes a back translation from the local language into English. Therefore, it is not easy to carry out research among indigenous population ethnic groups. As they're traditional culture or languages may be barriers. There is limited literature among the consent process of indigenous peoples and reflects that these groups have little or no representation, rights or interpretation to the research process or the use of the resulting data (Sharma, Khatri & Harper, 2016). Hence, researchers should organize, design and conduct studies while taking into consideration the account of cultural differences and share their results (Regmi et al., 2016).

Ethics of Initiatives Potential Impacts

Within the public health field, some research in LMICs aims to develop new studies where results and interventions are provided primarily in high-income countries (Hughes, 2012)). There is an agreement among public health researchers that the research in LMICs should benefit host communities. However, there is no consensus about what type of benefit is required, or what group to assist (Bhutta, 2002; Hughes, 2012). Although healthcare resources and research, in general, are needed in LMICs that are particular to their important needs, the ethical requirement should stem from the researcher's interaction with the community (Hughes, 2012; London, 2005). According to Hughes (2012), there are three aspects to consider that raise obligations to benefit host communities when interacting with participants.

Though the research might not help the host country, there is no responsibility for research sponsors to make sure their study benefits the particular community. Researchers may notify participants that the results of the research may benefit people in other LMICs (Hughes, 2012). For example, researchers may reasonably ask individuals of South Africa to enroll to receive information regarding a low-cost malaria treatment, though the low prevalence of malaria,

which occurs in South Africa, implies that the treatments would be used primarily in other countries (Hughes, 2012, 2014; London, 2005).

Since research sponsors do not have obligations to host individuals, they may host communities as a whole (Hughes, 2012, 2014; London, 2005). While investigating in a community, researchers place burdens on the host community as a whole by using community's public resources. Hence, if researchers place burdens on communities with limited means, then they should provide fair compensation. These burdens include the use of roads, public safety, water, and public spaces. Researchers have the potential of committing the wrong of free-riding as they conduct their study without making a fair contribution to the community (London, 2005).

Carrying out a study may also place indirect burdens on a community's resources, for instance, taking up space in a clinic or diverting medical personnel from working with patients who need urgent care. Also, by presenting risks to the health of participants, the study may present indirect burdens of the public health system. For instance, long after a study has concluded, it may impose a risk of a condition. According to Hughes (2012), if the individuals or community as a whole does not benefit from the research, then the host community should be notified of a net burden. A net burden consists of describing all of the community's direct and indirect resources, including individuals that the research study may use during the study. In other words, it is an agreeable document upon by the local community and all stakeholders within the community. In all fairness, if the international research sponsor profits from conducting the research study, those gains ought to cover more than just the burdens they impose, but also they must share some of the benefits.

Ethics of mHealth

Although mHealth provides an enticing solution to the shortage of healthcare practitioners, ethical guidelines have yet to be established. Though WHO alludes to practical guidance by acknowledging the need to respect the principles of equality and differences in regards to language, education culture, physical and mental ability and geographic location, it does not address specific ethical questions (Miller, 2003). In particularly, there is the issue of vulnerability of people in LMICs. Currently, USA, United Kingdom, India, and Austria develop most guidelines for technology in healthcare (Miller, 2003). Nevertheless, the guidelines lack an address of specific issues to mHealth in LMICs, although the subject continues among conversations (Grimwood, 1990). According to Miller (2003), further investigation on reliability, follow-up plans and training should be considered to ensure ethical requirements.

According to Tamrat & Kachnowski (2012), while implementing mHealth initiatives, there is the obligation to make sure that the technology is correctly calibrated and that it will not fail and or compromise the patient. Therefore, power supply and telephone communication links in areas of rural setting make for failure issues that need special consideration when producing guidelines for LMICs (Grimwood, 1990; Tamrat & Kachnowski, 2012). Also, there is an expectation that the practitioner offering a mHealth option is competent in the field and is available for additional follow-up consultation if required. Furthermore, for devices being used to diagnose patients under the umbrella of mHealth, health practitioners should undergo additional training be accredited to practice. Currently, there are no prerequisites in most existing services (Tamrat & Kachnowski, 2012). Consequently, practitioners have learned skills through trial and error. Grimwood (1990) recommends that users should undergo some training in the use of ICTs that

they will be using. One approach may be to include basic training for mHealth devices into public health or undergraduate medical programs. In return, providing exposure to younger learners would enable young healthcare practitioners to utilize the devices during their community service requirements.

mHealth Power Relations

In most rural settings of LMICs women are limited by their gender. Women's roles include living as homemakers, child-bearers, wives and some include farming (J. K. Ganle, 2015). In many cultures, women spend their youth under the authority of their father and their adulthood under the control of their husband (Murphy & Priebe, 2011). Overall, gender roles consist of women being responsible for the household and children while men are responsible for making decisions. In northern Ghana, men dominate all spheres of social relationships, by controlling the interactions and actions of members of their families (Takyi, 2003). The male plays the role as head of the family in the social structure and is regarded in some cases by his wife as a master who makes final decisions.

Thus the term gender relations, refers to varying roles and relations between women and men which are influenced by socio-cultural, political, economic, religious, and environmental factors (Takyi, 2003). Globally, studies have shown that mHealth initiatives can foster women's empowerment (Corker, 2010). Conversely, there are concerns that mobile-based programs may exacerbate women's gender inequalities. In a systematic literature review which examines the empirical evidence of changes in men and women's interactions as a result of mHealth interventions, studies were mostly found using SMS-based mHealth interventions conducted in sub-Saharan Africa on topics included maternal health, HIV/AIDS, and noncommunicable diseases. For example, Balasubramanian Thamizoli, Umar and Kanwar (2010) studied gender

hierarchies related to women's husbands receiving phones provided by a program if they did not possess a phone. In this setting, men were unfavorable to women's ownership of phones since they traditionally control the household resources. The results concluded that conflicts arose between couples by having to negotiate the use of the project phones for women's intervention purpose versus communication purposes for men. Misraghosh et al. (2011) examined spousal abuse by some women whose participation in the intervention challenged expectations of appropriate activities for women. Males demanded control and lacked spousal assistance resulting in abandoning the mobile program.

Likewise, evidence pointed out that mHealth initiatives may have enforced prior relational practices, including women's dependence on men for financial support, approval and technical support (Odigie et al., 2012).For instance in Nigeria, Odigie et al. (2012). SMS cancer-treatment reminders and hotline intervention enabled women to be less reliable on their husband's permission and financial support for care-seeking. The spouses often assumed the role of arranging follow-up visits and speaking with the physician. Women attributed these results to the men's role as the decision maker of the household. As well Balasubramanian et al. (2010) stated that while addressing mobile phone literacy for an intervention, nearly half (42%) of selected women affirmed that they had to seek help from their spouse for textual and literacy assistance. Also, an initiative in the Congo focused on providing a family planning voice hotline for women of reproductive ages, yet over 80% of the callers were men. Although the intervention successfully reached men, the study stated that results were entrenching rather than transforming gender-based inequities (Corker, 2010).

Overall, experts suggest that mobile phone programs can influence gender relations in meaningfully positive ways by providing new modes of couple's health communication. For

instance, mhealth initiatives may enable male participation in women's health (Murphy & Priebe, 2011). mHealth initiatives also may increase women's decision-making, social status, and access to health resources. One issue that may be addressed is intrafamilial power dynamics. Currently, studies are exploring decision making of women's reproductive health (J. K. Ganle et al., 2015). As it relates to women in Ghana, evidence suggests that within the household, family and community settings, women often have limited autonomy and control over these decisions. For instance, J.K Ganle et al., (2015) explored how intra-familial decision-making power may affect women's ability to access and use maternal health services. Findings suggest that mothers have the least amount of power while making decisions regarding access to and use of maternal healthcare services. Therefore, the values and opinions of husbands, mothers-in-law, TBAs and other family and community members strongly influence women's decisions. Therefore, considerations for mobile programs may involve the entire household of a mother (J. K. Ganle et al., 2015). However, programmatic experiences may inadvertently reinforce the digital divide and perpetuate existing gender-based power imbalances which may lead to domestic disputes or lack of spousal approval**.**

Conclusion

In conclusion, a major condition of the design for mHealth messages is on its adaptability to the local context or tailored to the population's needs. Projects have increased the risk of failure when they have not considered or adapted to the specific context (Tamrat & Kachnowski, 2012). Additionally, these projects are small-scale, and success of comparable large-scale projects is not guaranteed. Luckily, because of the attributes of the technology, the evaluated low replication costs, and the high versatility to local cultural settings (Cho, 2012), there is potential for these projects to scale up, especially if focusing on remote and resource-limited regions

(Tamrat & Kachnowski, 2012). Opportunities to increase implementation and grow uses of mHealth in Africa are tremendous, yet according to the literature, steps should be taken mindfully. Tomlinson et al. (2012) recently published a review that focuses on the lack of evidence regarding mHealth effective. Researchers argue that mHealth is liable to work if there is a subsequent follow-up of the project, intended for a particular context and if significant consideration has been given to the message delivery, wording and content of the message. While implementing mHealth projects, addressing ethical principles includes considering the mobile device, community, and users. Critical evaluation and regulation of mHealth initiatives before widespread use are necessary to ensure that technology meets users' need (Benatar & Singer, 2000). Likely, early in the process, designers and developers of mHealth should engage with patients and stakeholders throughout the development.

3 METHODOLOGY

This chapter describes the research design and methodology while applying McGuire's communication–persuasion theory as a framework, while also using the triangulation mixed methods study design. The purpose behind this mixed methods study was to investigate how the inputs (information source, design and delivery, power dynamics and personal circumstances, and perceived gains) influence mobile message design for expecting mothers' maternal health. This study sought to explore pregnant women who have participated in a mobile maternal health project (MMHP) in rural settings in the Northern part of the country.

Research Questions

The main question guided the study:

Main Research Question:

1. What inputs of the mobile message design influence expecting mothers' maternal health in northern rural Ghana?

Sub Research Questions:

The following sub questions guided the study:

1. How does source of information influence the mobile message design for expecting mothers' maternal health?
2. How does information design and delivery of mobile messages influence expecting mothers' maternal health?
3. How do power dynamics and personal circumstances influence the mobile message design for expecting mothers' maternal health?
4. How do perceived gains influence the mobile message design for expecting mothers maternal health?

Research Design

The study included gathering and examining both quantitative and qualitative information. Therefore, a blended technique approach was needed to address the research questions. Within this study the quantitative and qualitative (QUAN + QUAL) approach simultaneously occurred in all phases of this study, such as detailing of the research question, elaborating of the research design, data collecting and data analyzing procedures, and discussion of the findings.

The principle aim of this approach is "to obtain differently but complementary data on the same topic" and is used when seeking to develop qualitative results and quantitative data (Morse, 1991, p. 122). The approach was best for my study being that I wanted to compare or relate the inputs of the mobile message design being influenced by the mothers. Figure 3 shows the triangulation study design process for the study.

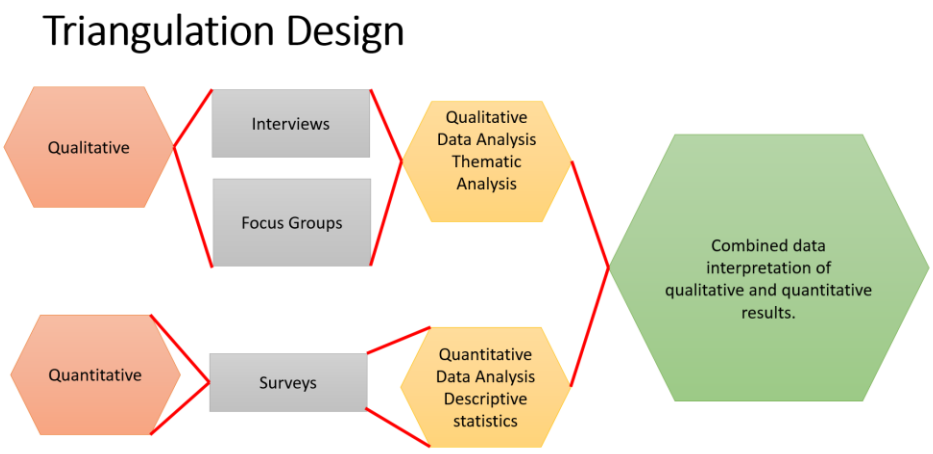


Figure 3: Modified Triangulation Design

Research Setting

Due to the discretion of the location, the name of the NGO must be kept confidential. The mobile maternal health project (MMHP) responded to proving access to maternal health information via mobile messages in hopes of reducing maternal mortality (Aryee, 2014).

The local organization that houses the project is a recorded Non-Governmental Organization, listed with the Ghana Registrar General's Department. The organization is also officially registered with and recognized by the Ghana Social Welfare Department as an NGO, which renders selfless social service to humanity and humanity. The NGO is supervised by a five-member board of directors and managed by a team of dedicated staff led by an Executive Director. The mission of the organization is to be the first point of call for innovations in Information Communication Technologies for Development (ICT4D), equipping the vulnerable with skills and mobilizing and empowering citizens to interface state for transparent and accountable governance at local and national levels.

The Maternal Health Project Overview

In 2013, a public funding organization subsidized the MMHP. The project provided maternal health information through both SMS and voice messages. The messages were adapted from the Mobile Alliance Maternal Action (MAMA) organization. For mothers who could not read SMS, the audio messages were translated into the local dialect of Dagbani. Within the health clinic, midwives used phones to register expectant mothers to receive messages. The messages are correlated with the number of weeks a mother is expecting. A mother may receive messages once a professional midwife confirms her as being pregnant up until she is forty-two weeks. Hence, each week a mother received information on the stage of her pregnancy, and recommendations to keep her and her baby healthy. The information included in the messages also

counteracts traditional beliefs that often hinder women from accessing medical help, even in fatal circumstances.

The project was intended to create easy access and valuable maternal health information for expectant mothers with the ultimate goal of contributing to reducing maternal and infant mortality. Therefore, one of the primary goals of the project is to provide pregnant mothers with relevant information to encourage them to attend ANC appointments.

The target population goal was to register 3,000 expectant mothers by the end of 2014. By the end of 2013, a total of 1,875 signed up for the program. In July 2014, 4,393 expectant mothers participated in receiving the messages. The project worked in partnership with the Ghana Health Service (GHS) to implement the plan in selected health clinics in Tamale, Savelugu, Kunbumbu, and Yendi districts in the Northern region of Ghana. I selected to examine this project due to my understanding of how the design of mobile messages influences the mothers' maternal health.

Research Site

The study was focused on the Kumbungu District of Northern Ghana. Due to the confidentially of the location, pseudonyms are used for the clinic (Prince Medical Clinic) and local communities (Disdane and Tylon). The MMHP was organized by the local NGO at the Prince Medical Clinic. The local medical clinic is a public clinic serving forty-five communities that are recognized by The Ghana Health Services. The clinic provides services to insured and uninsured patients. The research setting took place within Disdane and Tylon communities. The number of registrants included in this study was 323. The selection was based off of communities who had the highest number of expectant mothers receiving maternal health messages during the duration of the project (February 2013 to February 2015). The study was carried out by a research team

of ten members including myself over a period of four weeks. The methods in the study included one-on-one interviews, focus groups, surveys, journaling and reflections. Figure 4 displays the overview of the study design.

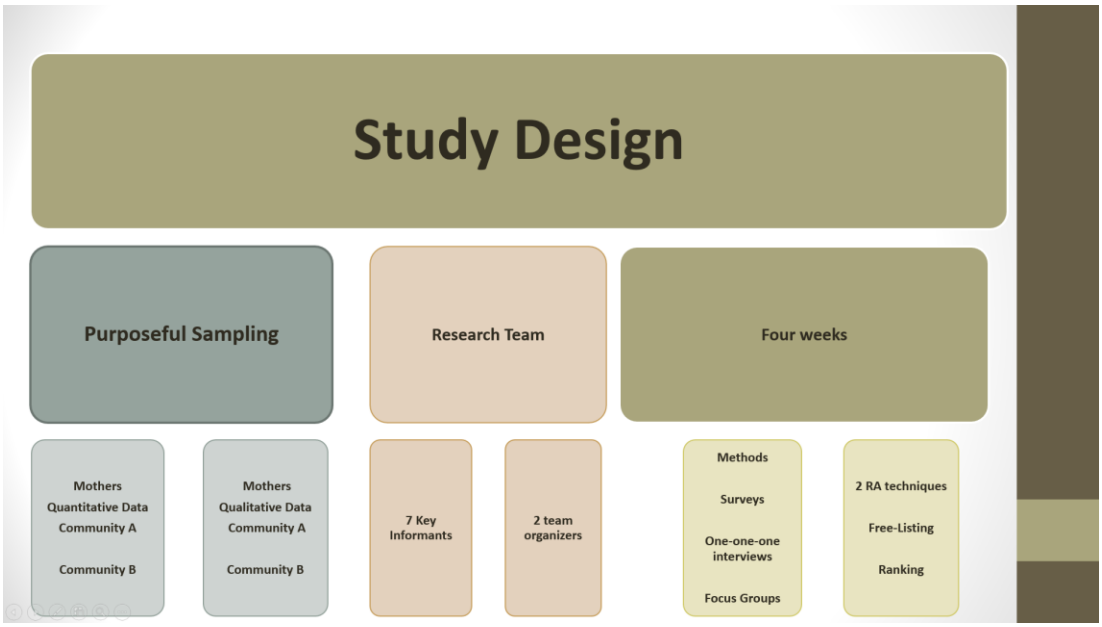


Figure 4: Study Design

Target Population

The population for this study included mothers who took an interest in the MMHP within two communities in Northern Ghana. These mothers attended the Prince Medical Clinic that was located in a rural setting. Purposeful sampling was used to select participants. For this study, the sampling frame was derived from a comprehensive list of mothers who participated in the Mobile Maternal Health Project (MMHP) organized by the local clinic in the Kumbunga District between 2013-2015. Figure 5 displays the inclusion criteria for participants.

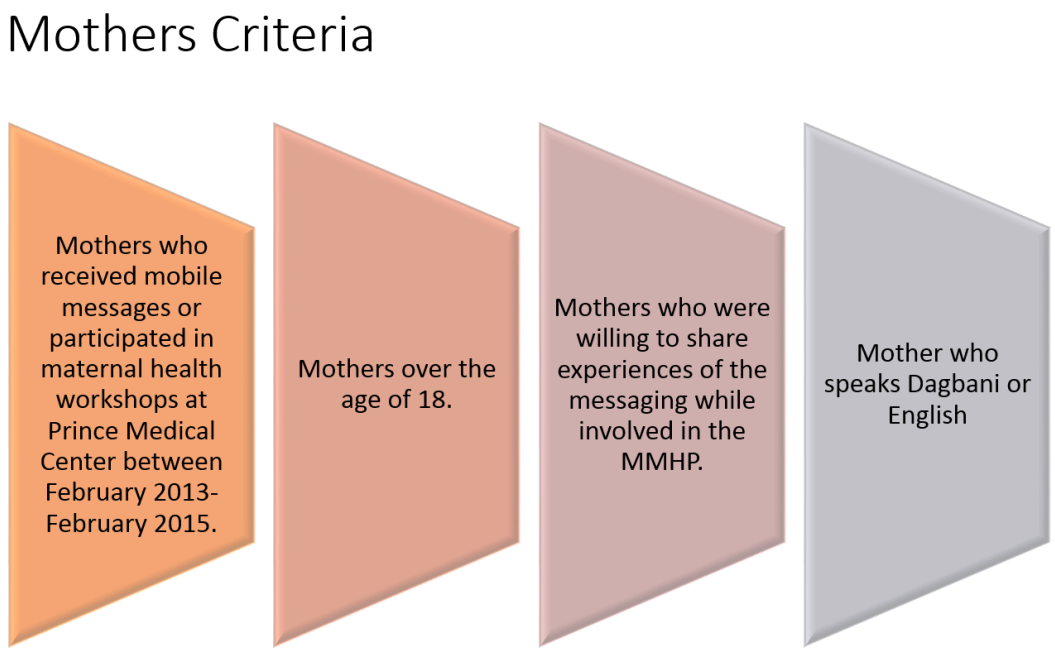


Figure 5: Mothers Criteria

Mothers meeting the criteria voluntarily participated in the study. This study reflects 66 of the mothers receiving messages and attended maternal health workshops, and 257 who did not receive messages but only attended maternal health workshops. All participants for this study were individuals aged 18 years and above. Although in Ghana, English is the official language, "Dagbani" is one of the main local dialects in the Northern Region. All individuals who fit the above criteria and spoke either language were welcomed to participate in the study. There were no restrictions on levels of education for people to participate. Henceforth, taken into account included the readability of the consent form.

Qualitative Methods

While employing the mix methods triangulation design, I used a variety of qualitative rapid appraisal (RA) methods along with journaling and reflections to assist with developing a rich description of the experiences of expectant mothers in rural Ghana. When incorporating RA

methods, features of these methods include lower cost and rapid measures. Based on the context of this study situated in a West African country within a rural community setting, I used two RA methods and two RA techniques. Figure 6 displays the RA methods and techniques.

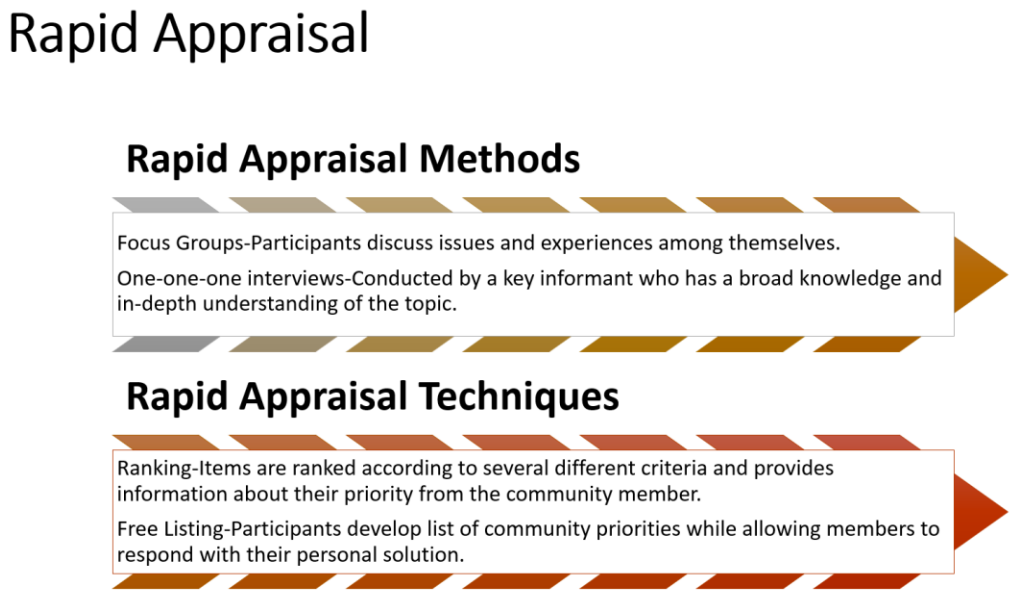


Figure 6: Rapid Appraisal

These methods were selected based on the contextual features of the community along with my previous experience with similar communities in the country. The RA methods included focus groups and one-on-one interviews while using two techniques :(1) ranking and (2) free-listing.

In terms of the journaling and reflection, each day of the study beginning with the first day of my arrival in Ghana included a self-audio journal of the events along with my thoughts regarding the research process and understanding of the cultural elements surrounding the community. I maintained a field journal and conducted debrief sessions.

Quantitative Methods

In terms of quantitative data, I employed a survey instrument to gain quantitative insights from the mothers who participated in the MMHP.

Survey Instrument

The first data collection instrument was the survey (see Appendix D). The survey instrument was used to gain information through quantitative and qualitative means from a paper-based survey. The instrument included a total of 28 questions a demographic section that consisted of six questions, twelve questions were open-ended, two questions were closed-ended, two questions were scale questions, and six were multiple choice. The closed questions items included a mixture of dichotomous questions requiring yes or no responses. The multiple-choice questions had predefined responses for the respondents. The scale item questions are scored ranging from "strongly agree" to "strongly disagree" on a Likert scale. These forms of questions provided very clear and precise responses that were quantifiable.

Permission was granted to utilize this instrument and received in January 2015 while conducting the pilot study regarding perceptions of mobile maternal health in Northern Ghana. An updated request was sent to Dr. Aryee in January 2016 and approved. The instrument was a revised version of a previous dissertation study titled "The Role of Mobile Phones in Health Education for Rural Communities in Ghana: An Exploratory Study in Digital Technologies" by Dr. Aryee. According to Dr. Aryee, the survey questions validation occurred through a pilot testing in 2012 with similar characteristics of participants and communities before data collection (Aryee, 2012).

of 292 mothers for the quantitative methods and thirty-one mothers for the qualitative methods from two communities.

Pre-Field Arrangements

Pilot Study

In 2015, I received IRB approval from Georgia State University, and I conducted a pilot study within a rural setting of one community (Janvlic) in Northern Ghana. The study focused on the perceptions of the community receiving maternal health information via mobile phone within two communities that Prince Medical Clinic serves. As part of this pilot study, I conducted surveys, one-on-one interviews, and focus groups. Implementation of the survey instrument occurred with thirty-two mothers, eight of whom received mobile messages. The interview protocol occurred with three mothers who took part in the MMHP. Lastly, the focus groups consisted of two focus groups, one group of all males and one group of all females. All of the individuals in the focus groups were married; however, they were not married to one another. The initial survey and interviews allowed me to gain additional experience conducting interviews and surveys and become more familiar with the logistical considerations of data collection and management.

As a result of the pilot study, the survey and interview protocols were refined, and this led to an improvement in data collection procedures and subsequent analyses for this study. For example, the initial study informed the current study about questions that should be open ended in a private, one-on-one interview setting versus closed ended questions. During the pilot study, I found that the participants enjoyed having the opportunity to share information during open-ended questions, which allowed the participants to become more comfortable and willing to offer explanations in an interview format. This open-ended approach allowed participants to report

their personal stories and give their understanding as they developed, which allowed me more insight into the connection-making of participants that is not exhibited in a closed-ended form of questions.

Protocols

Interview Protocol

I developed a protocol of questions/probes for semi-structured interviews (see Appendix F). The questions were constructed in cooperation with the Prince Medical Clinic. There were a total of six questions: four were open-ended, three questions allowed participants to rank items, and two were free list questions. Construction of the questions focused on three elements; 1) attitudes 2); beliefs; and 3) behaviors of mothers along with their influences of the mobile message design.

Focus Group Protocol

I developed a protocol of question/probes for semi-structured focus group (See Appendix G). Questions were constructed in cooperation with the Prince Medical Clinic. There were a total of three questions within the focus group. The focus of these questions was around their attitudes, beliefs, and behavior regarding the message design elements. Development of the inquiry concentrated on the prior components within the one-on-one interview.

Journaling and Reflection Protocol

My journaling questions included; (a) describing the events that happened throughout the day, (b) describing any challenges throughout the day, (c) describing any cultural norms that challenged my thinking, (d) describing my feelings towards participants or team members. The reflection process with the team members included notes from the following responses; (a) our plan for the day, (b) any challenges from the previous day, (c) how to face current challenges in

the present community while collecting data, and (d) description of personal thoughts and feelings about the participants or research process**.**

Informed Consent

I designed the original consent form in conjunction with the local NGO and hospital staff before submitting to Georgia State University's IRB board. Once the form was approved, the research team members prepared for translation to participants then reviewed the form.

Research Team Members

Research team members' roles consist of: four issuing surveys, two issuing surveys and served as translators for focus groups, one serving as a translators for interviews and focus groups, and two organizing the study. I participated in all interviews and focus groups. Out of the ten total research team members, six of them were also key cultural insiders to the community. From my previous experience with the pilot study, while conducting interviews with mothers, I found that they might be sensitive to responding to information that focuses on their cultural practices and maternal health. Hence, I advocated for women researchers to be a part of the research team to allow for the expecting mothers to have a safe space during the one-on-one and focus group sessions where women can exchange their thoughts and make comments about their maternal health activities. Figure 7 shows the research team member positions.

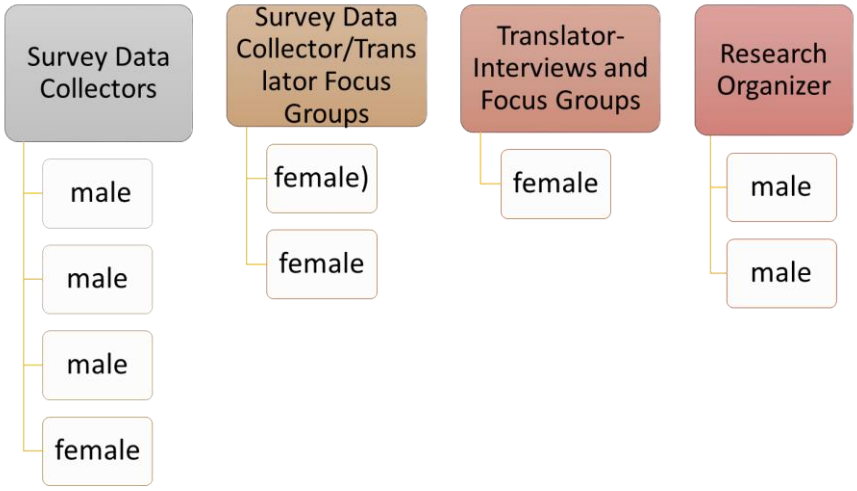


Figure 7: Research Team

All team members (see Appendix E) participated in a three-day face-to-face data collection training that I designed and conducted. The local NGO, local clinic, and Georgia State University IRB board all approved the training. The goal of the training was to have a common understanding of the consent and confidentiality process and research plan for both communities. Figure 8 shows the overview of the study pre-field study arrangements:

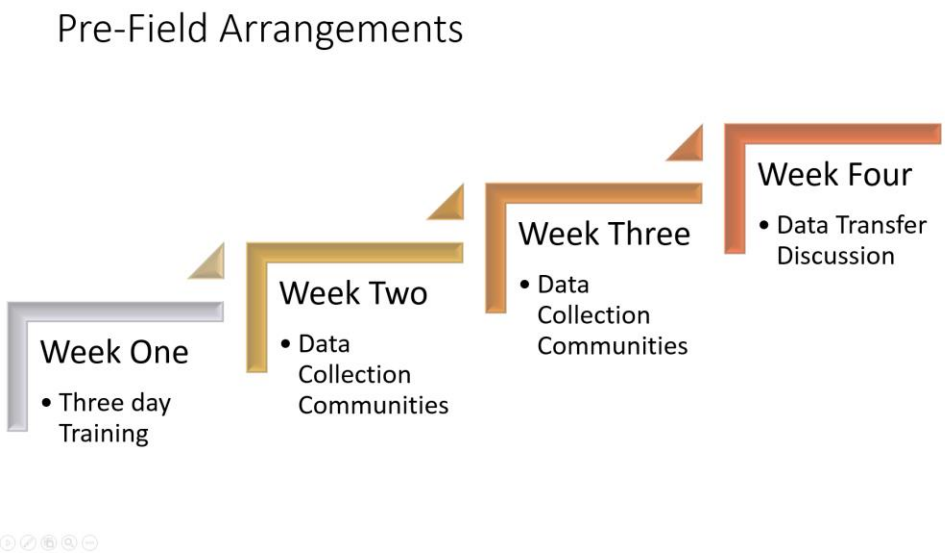


Figure 8: Pre-Field Arrangement

Before proceeding to data collection activities, a chief's call (see Appendix C) and radio announcement occurred to recruit individuals throughout the local community. The chief's call consists of research team members participating in a ceremony to ask for permission from the chief to conduct the study in the local community. Once the chief has approved the call he sends a drummer around the community to deliver an announcement telling the mother's about the event. Members of the community are urged to put aside everything and honor the particular activity. This specific study was only open to those who fit the criteria.

On each day of data collection, each mother who heard the announcement attended one of two predetermined locations for the study. The radio announcement entailed visiting the radio station in the local community. A team representative met with the radio director and coordinated the announcement details for both communities. Next, we decided to use the mother's ANC journals distributed by the clinic to verify participants' involved in the MMHP. Lastly we reviewed the following protocols.

Procedures for Data Collection

Data Collection included collecting information with the tools descrived above. Participants elected to take part in the survey method to be selected for the one-on-one interview method. However, individuals within the focus group method had the option to participate in the survey along with the focus group or to soley participate in the focus groups.

Tylon Community Data Collection

Data collection with the Tylon community required two days to complete. The playing of drums occurred once we arrived at the chief's palace to signal our presence to community mem-

bers along with our location. On day one, a team of six individuals from the research team including myself conducted the study. The members included two assistants who were organizing the mothers, two cultural insiders initiating the surveys, and one cultural insider served as my translator while issuing surveys and interviews. On day two, an additional cultural insider issued surveys with a total of seven team members. Figure 9 shows the data collection methods and number of participants within the community.

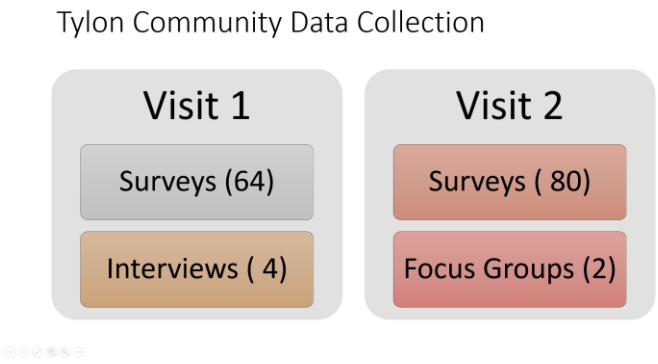


Figure 9: Data Collection in the Tylon Community

Regarding organization, registration included verifying participants' eligibility, consenting, and ticketing. All mothers were verified by reviewing their ANC journals. Once they were in compliance, they participated in the consent process. The consent process included mothers lining up by the research organizers to be translated the consent form. Next, they were asked if they would like to take part in the study and if agreed, signatures by way of thumbprints were collected. Following, the participants were given a ticket number along with a paper-based form. Mothers who decided to consent participated in issuing their thumbprint. For organization purposes, we issued tickets along with a blank survey form. Written on the consent form along with

their blank survey form was the ticket number. We issued a blank form regardless if mothers participated in an interview, focus group, or survey. Once the registration process concluded, mothers waited to be interviewed or surveyed by team members. On the final day of data collection mothers were allowed to turn in their paper-based document along with their ticket to receive a snack (biscuits and drinks) along with selecting diapers, baby soap, or a baby bottle.

All participants within this community spoke the local language; therefore, all procedures and instruments of data collection were translated to participants. In terms of the surveys, answers were recorded in English on the paper forms. Each data collection approach took place in a private setting and mothers only responded to questions that applied to them. Hence, for those mothers who did not receive mobile messages but only attended maternal health workshops, the data collection team decided not put a specific number cap on those individuals who wanted to take part in the study, due to the agreed- upon requirements in the chief's call. Ultimately, all individuals could participate in the surveys.

However, in terms of the one-on-one interviews we did receive a few false accounts regarding mothers receiving mobile messages. These false accounts were subsequently verified through probing and reviewing notes from the ANC journals.

Overall, our expectations for participation were met, and we exceeded our goal of 100 mothers from each community. For example on day one we had an overage of 10 committed mothers, and on day two we have an overage of 30 mothers. The paper-based surveys were imported in a Kobo Tool-box system by two team members during the last week of data collection and took approximately two days each for this community. KoBo Toolbox is a free open-source tool for mobile data collection, available to all. It allows you to collect data in the field using mobile devices such as mobile phones or tablets, as well as with paper or computers. Transcripts

were emailed to Prince Medical Clinic requesting for feedback, but no feedback was offered other than the suggestion to use the initials during the analysis and write up of the study. Each interview was audio recorded, and a Microsoft Excel file was created to track the demographics of each transcription, which included notes on the Microsoft Word file and Nvivo 10.

The logistics of this study included a substantial amount of collaborative communication. Hence, the time length within the communities was limited to this study, and the team decided to employ data management daily. Therefore, decisions had to be made such as mothers' organization, translation duties, and break times for the team. Although we had a few setbacks with implementation of the system during the first week of data collection, we successfully implemented the process during the second week of data collection.

Disdane Community Data Collection

Data collection in the Disdane community data collection was conducted over two days. Due to the changes in communication, there was no chief's announcement; only the radio announcement was made on the first day of data collection. Two team members' recruited participants within the community form notable locations where mothers spent time such as the water pump or discussion areas within the village. On the first day, a team of seven individuals counting myself from the research team conducted the study. The individuals consisted of: two members assisting the mother's, three cultural insiders issuing surveys, and one cultural insider served as my translator while conducting interviews. On the second day we had an extra two members making the entire team consisting of ten individuals. Figure 10 displays the data collection methods and number of participants.

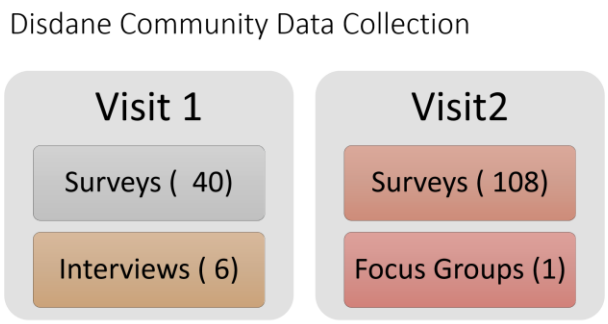


Figure 10: Data collection in the Disdane Community

On the 2nd day of data collection, the chief's call and the radio announcement made it to the mother's. The study took place at the youth development center and the youth ICT center. The mothers within this community came prepared with their ANC journals along with their babies and young children.

Regarding organization, we used the same process as the Tylon community in regards to registration and verification and implantation of surveys, interviews, and focus groups. However, owing to the radio announcement, we had 12 mothers from other communities participate in the survey session; yet, their data was not included within this study. The focus group was held on day two since this was the last day of interaction. The central questions and follow-up questions were based on what was discussed previously from prior interviews; nonetheless, I sought to confirm some of the prior reasoning along with verifying the cultural customs that were discussed.

Once again, it was a challenge to conduct one-on-one interviews on day two due to the overwhelming number of mothers who decided to participate in the study, as we had underestimated the number of mothers who decided to take part in the study. On day two we were unable to distribute surveys to 50 mothers due to the limited amount of resources. We nonetheless distributed snacks to the mothers as an appreciation of their time.

Lastly, my field journal included fifteen recorded entries ranging from fifteen minutes to two hours. Additionally, before and after each field day, the research team debriefed and participated in reflexive thoughts and personal feelings regarding the study. A total of eight debrief sessions with research team members lasted for fifteen minutes maximum. Additionally, each team member participated in a personal closing reflection lasting for ten minutes. Finalizing the data that included converting the paper-based surveys, the transcribing process, the audio recording and filling process mirrors the process conducted in the Tylon community.

Protection of Human Subjects

For this study, the rights of the participants in the study were considered at all times. Initial IRB approval for this research was granted in 2015, renewed in April 2016, and amended in May 2016 (Appendices D). The local NGO involved provided letters of approval that are on file with the IRB protocol. All research participants were fully informed of the research purpose through both verbal communications, and informed consent was obtained from selected participants by thumb prints. Participants were made aware that they are not obliged to respond to the every question, and could leave the study at any time. My family member, who assisted wih organizing the study, had a current Collaborative Institutional Training Initiative (CITI) training on file; yet, they were only responsible for organizing the crowd, the collection of tickets and handing out snacks. All information that was collected for the study was kept confidential.

Concerning the surveys, they were only identifiable by ticket numbers, and no names were associated. During the focus group interviews, participants were adamant about using their real names; nevertheless, it was settled by the Prince Medical Clinic research team that initials of the mothers be used to keep confidentiality as promised in the consent forms.

Data Analysis Procedures

In this particular study, qualitative analysis consisted of an examination of mothers answers to open-ended interview questions, open-ended survey questions, journal and reflection entries. The quantitative analysis comprised of analyzing the mother's responses to the demographic, Likert scales, multiple choice, and closed ended questions. The intent of the triangulation design was to collect both quantitative and qualitative data at the same time and to integrate the two forms of data to have a better understanding of the research questions. Quantitative and qualitative data are equally prioritized. Figure 11 shows the simultaneous data analysis procedure for this mixed-methods study.

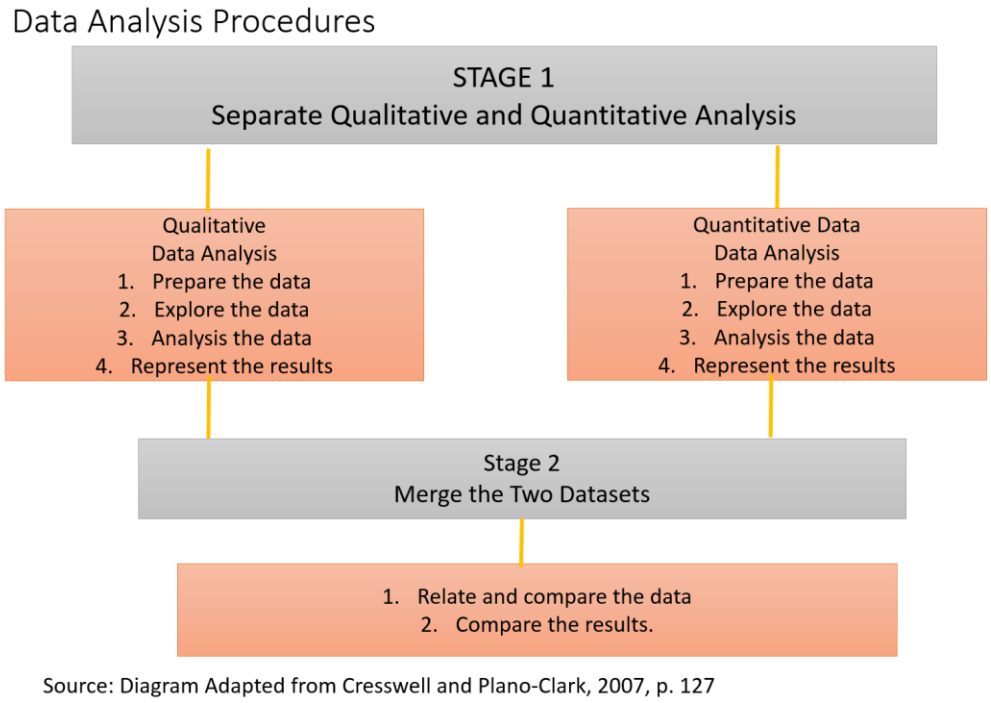


Figure 11: Data Analysis Procedures

The study required similar steps for both forms of data analysis: organizing data, reviewing and exploring data, coding and building themes, determining statistical test, reporting

and interpreting the data. The focal inquiry of this study identifies with mixing the information while exploring the members' influences regarding the mobile message design.

This triangulated mixed methods study analyzed data in two stages. In stage 1, I separated initial data analysis for each of the qualitative and quantitative databases which included coding, theme development, and identifying the interrelationship of analysis of qualitative data and quantitative data. In Stage 2, I merged the two sets of data and used triangulation design to allow for a complete picture of the study. Data interpretation involved explaining the patterns and trends revealed during the data analysis process.

Qualtative Data Analysis

Understanding the views of mothers influences was paramount to the goals of the study.The multiple perspectives from the participants were imperative in understanding the stated problem. Thus, the mothers' open-ended interview questions and open-ended survey questions provided a better understanding of the context of their community for the researcher to understand what underlies their behavior and actions. In so doing, the qualitative portion of this study was designed to investigate and describe how these inputs of the mobile message design influence expecting mothers in Northern Ghana. In so doing, qualitative data analysis of this study involved the following steps below. Figure 12 displays the qualitative data analysis steps.

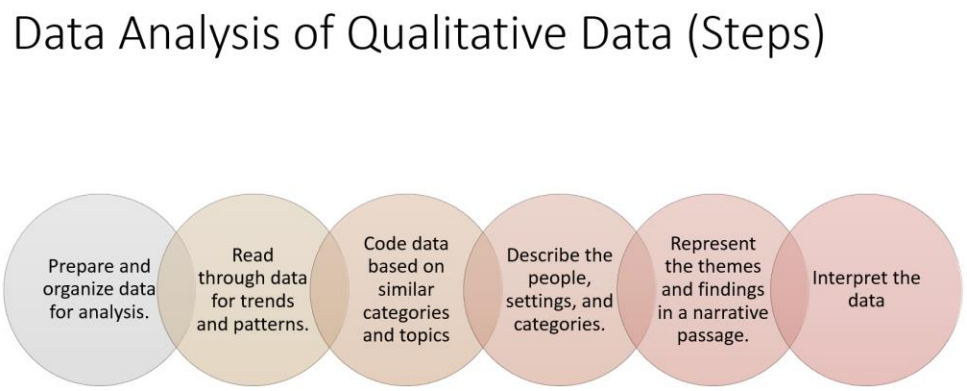


Figure 12: Qualtiative Data Analysis

Step 1: Prepare and organize data for analysis.

I used a mobile phone and portable recorder to record interviews. Within an Excel file, demographic information for each interview included the length, day, community, and ticket number. A Microsoft Word file housed the transcribed interviews. One team member along with one data entry assistant from the local NGO entered the paper-based files into the electronic the Kobo system. Microsoft excel held all responses in a spreadsheet. Once all of the data was entered by the assistants, I reviewed all responses from the paper-based surveys and adjusted any general responses entered by the assistants to word from word answers given by the mothers.

Step 2: Read through data for trends and patterns.

I read all transcripts of the ten one-on-one interviews and three focus groups to develop pre-codes. While developing pre-codes, I determined and developed themes for the qualitative data, and identified unusual patterns to find unexpected or puzzling issues that stood out. The 292 responses to the open-ended questions within the survey were pre-coded by a team of two

graduate level professionals. The coding assistants used a color highlighting system based on the set of pre-codes that I developed; still, they were free to add additional categories. Each response had a color assigned to it along with a coding chart created by each coder (see example in Appendix H). Final patterns were re-read by the researcher and pre-coded trends and patterns were identified.

Step 3: Code data based on similar categories and topics.

I used Nivivo 10 to house all interviews and qualitative survey data. Two rounds of coding including line-by-line coding and focused coding were employed within Nvivo10. Common patters were grouped together by applying codes, and themes were identified based on codes across individual responses and themes appearing across responses. Next, codes were grouped into broader themes directly related to the words of the participants and will be reported in Chapter 4.

Step 4: Describe the people, settings, and categories.

Once coding concluded, I spent time describing the parameters of the study, the mothers who agreed to participate in the study, themes that emerged from qualitative data, and categories that surfaced in the data analysis. Then, I created a demographic profile for each participant (Appendix I).

Step 5: Represent the themes and findings in a narrative passage.

Next, I classified all data related to the thematic pattern and related sub-themes. Within Nvivo10, several queries were ran to construct summaries that would result in narrative passages(Appendix J). The narrative analysis of the data collected painted a portrait of the inputs of the mobile message design that influence expecting mothers. The narrative included direct citations from participants and a comparison of results from the study.

Step 6: Interpret the data

Finally, I derived thematic categories that emerged from the qualitative data, which were consistent with the literature review to describe the topic under study. By examining parallel findings, it helped to explain the meaning of the information gathered to increase knowledge about the factors that influence the attitudes, beliefs, and behaviors of the mobile message design of pregnant mothers in Northern Ghana. Thick descriptions were utilized in the data analysis to assure the readers' understanding of the transferability of results.

Quantitative Data Analysis

Quantitative investigation of this study included two steps. Figure 13 displays the qualitative data analysis steps.

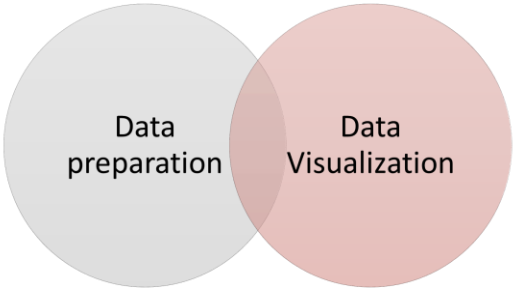


Figure 13: Quantitative Data Analysis

Step 1. Data Preparation

I prepared the data by which information was logged, checked for precision, and entered into the computer utilizing SPSS, which is intended to analyze, and display the frequencies, means, and modes.

Within the Kobo system, I created a link that was sent to the one research assistant and one data entry assistant to convert all paper-based surveys into electronic excel format.

Step 2. Data Visualization

I utilized line charts to speak to quantitative information while permitting readers to better comprehend the quantitative results of the study in a summarized form.

Sample Size Justification

The target sample size for the surveys included 300 expecting mothers with the ultimate goal of achieving 150 samples from both communities total. By way of purposeful sampling, the study obtained 292 completed surveys with a response rate of 97.5% thus affording a 95% confidence interval with a sampling error of 5%.

The Triangulation Procedure

To examine the inputs that influence the mobile message design for expecting mothers maternal health in rural Northern Ghana, it was necessary to conduct interviews, focus groups, surveys, journal entries and reflections. These methods provided sources for the triangulation of the data that allowed me to get valid findings and results about the topic under study. The triangulation of these five sources allowed me to ensure that the data collected from each source was relevant to the same questions. I examined whether the influences reflected the self-reported behaviors. I additionally examined whether the influences were predictive of the current demographics. I then compared the results of quantitative discriptives and qualitative narratives to verify whether they yield similar results.

Researcher's Role, Power, and Bias

Researcher's Role

Prior to studying the MMHP I had the opportunity to study indigenous technologies at the University of Durban South Africa. My experiences with the local culture and community members in that context lead me to pursue studies with individuals of rural communities. The inspiration for this study, thus, comes from my background as an instructional designer with a focus on

global health education, and my experience with volunteering with the local NGO and conducting my pilot study regarding mobile health programs that serve rural communities in Northern Ghana. Ghana was selected for this study upon discovery of the MMHP while conducting content analysis on mobile learning projects on YouTube. This particular projected was promoted by local NGO's on YouTube, and I subsequently approached the organization.

Four months prior to my first visit to Ghana, I expanded my knowledge in global health by taking a graduate level global health course at Georgia State University. Thus, following the course, I became interested in conducting this study as a way of obtaining more insight into some of the health-related challenges faced by most rural communities and to share the results with agencies willing to partner with such communities.

I would like to ensure that I am not perpetuating Western bias in an instructional context. Therefore, it was imperative to obtain a deep understanding of individuals in this rural setting as it relates to mobile maternal health content. Being aware of one's influence is significant to carrying out ethical research in natural settings. My desire as an instructional designer is to learn more about how to design relevant information from the learner's perspective on the use of mobile devices in LMICs.

I am aware that as an American citizen, and student researcher who has visited the NGO several times, I have insider knowledge of the overall setting, which has provided me with the insight into the contextual aspects of the study. For instance, while engaging with communities, I am aware of the community's protocol of greeting the chief first before engaging with participants. Carrying out interviews in a profoundly culturally sensitive community can be quite challenging, yet as a researcher in the field, I served as an insider to many of my participants. By being African American, members of the community perceived that I was an individual from either

the capital city of Ghana or from a neighboring town. My research team members expressed that since I resembled participants, then they will be most authentic in their responses after I gained their trust. Being perceived as an insider allowed me to gain a deeper insight and closer understanding of the issues that mothers may have been challenging while receiving the messages. According to the research team members, the mothers rarely have a chance to discuss maternal health information delivery or practices associated with their beliefs. Therefore, I felt that the mothers became comfortable and were open with me throughout the study. Thus, because I am a middle-class woman of African descent, I remained committed to ensuring that individuals in Ghana have the right to know how technological advances will change their lives.

Researcher's Power

In attempts of recognizing my power, I acknowledge the following:

Relationships

- **Trust**-I developed trust with the NGO, local clinic, and research team by having individual relationships with all of the key members involved in my research project. For three years, I build rapport with these individuals by meeting their family, attending ceremonial events, and communicating with them on a monthly basis. I developed trusting relationships by not having a hidden agenda to design my study.
- **Previous Visits-** I visited the NGO and local clinic three times and conducted one pilot study which assisted me with building relationships with the individuals who were responsible for approving my study and serving on my research team. I used previous visits to strengthen my understanding of the stakeholders, the research team and participants.

- **Team make-up-** The first year I was given a team of three people (NGO program officer, NGO program coordinator, and clinic project coordinator) to conduct an observational study. However, once the initial team and program directors observed my methods, I was offered the opportunity to design my team while advocating for female participation on the team. I used my relationships to make up my research team.

Student Status

- **Doctoral Student**-I reached out to the organization by using my doctoral student status and made it clear that I wanted to conduct research with the NGO and local clinic. The directors took it upon themselves to investigate the University and accepted the offer due to the status that the University held. After my first visit, I discovered that Ghana holds education to a very high standard, and therefore they value individuals pursuing doctoral degrees. Therefore I used my position as a student to conduct a study within the boundaries of University's IRB board and my dissertation committee's approval.
- **Free Cost-** The NGO and local clinic were made aware that since I was a student, I would be doing the research free of charge. GSU and Emory provided funding to support my research, which allowed me to be independent of the NGO and local clinic. I used funding from the University to support my team, participants, and local clinic.

Areas of Study

- **Instructional Design and Technology-** While reaching out to the local NGO, I highlighted my Master's Degree field of study (Instructional Design and Technology) and my previous experience with conducting research studies in international environments along with my interest in public health. Upon our initial meeting, I

made it clear that I would be open to working on any projects where I could utilize my skills. Hence I used my status and expertise as an instructional designer to make a connection with the NGO while offering collaboration on future projects.

- **Public Health-**During my first interaction with the local clinic, I emphasized my desire to study public health. After volunteering with the clinic and interacting with several midwives, nurses, and program coordinators, they suggested that I continue my studies and take more courses in the area. Throughout my matriculation through the doctoral program, they continued to inquire and encourage me while challenging my study design. In return, at one particular clinic I built up relationships, and they allowed me to explore maternal health as it related to their context. Therefore, I used my status to select the local clinic, team members, study design, and communities.

African-American

- **African Descent-** I was the first African American that the NGO and local clinic interacted with to conduct research with the NGO and local clinic. Therefore, I used my status to identify with the experts along with my team members who have a passion for community development in rural settings.
- **African Descent**-I was the first African American who conducted research and visited both communities. Participants perceived that I was from Ghana due to my resemblance; therefore they believed that I had an influence on the healthcare developmental programs within their communities. I used my African descent to identify with mothers to receive authentic responses.

Being a Women

- The NGO's mission is to provide education to women and youth. Therefore, the staff members believed that I might serve as a role model to other female officers at the NGO and local clinic. I was the first African American woman that offered to conduct research in both communities. I used my gender status to recruit my female team members and to identify with my participants.

Respecting the culture

- Before visiting Ghana, I investigated and learned as much as I could about the country and the Northern Region. I spoke with my committee member who is Ghanaian along with several other individuals from the country. I also conducted research on the cultural norms before visiting the country. During my visit, I was invited to participate in several traditional ceremonies while also having the opportunity to stay in a compound. Hence, I developed an openness spirit to learning about the customs and traditions of the individuals in the setting. I humbled myself to understand their norms and followed their practices. I used my understanding to relate to my team members and participants.

Researcher's Bias

My position as an instructional designer with a concentration on public health has influenced my role as a researcher. In the following list of prior assumptions, I have certain beliefs and assumptions about mobile maternal health messages:

- Expecting mothers are seeking to use the mobile phone as a tool to extract maternal health information.
- Expecting mothers depend on family and community members to make final decisions regarding maternal health care.

- Expecting mothers communicate and share information with mothers who do not receive the messages.
- Mobile messages can influence community decisions regarding health.

Going into data collection, I also had several assumptions about working with community member's participants:

- Building trust between the researcher and community members is essential.

The researcher must rely strongly on self-reflections from participants. Individuals will be honest in their responses; yet, it is possible that they may misrepresent their experiences, so it is critical to have multiple sources of data.

Limitations

Sampling Procedures

Only participants who received mobile messages were invited to take part in the one-on-one interviews and focus groups. As a result, individuals interviewed had similar beliefs regarding the messages. Therefore, during the interview stage, the sampling technique excluded participants who did not receive messages.

Study Duration

The study period was three weeks. There were a low number of mothers who took part in the study that received mobile maternal health messages. Hence if the duration of the time had been longer, such as six weeks, then we may have had a higher number of responses.

Research team language barriers

Due to team members' availability, we recruited additional members to serve on the research team. We had to exclude individuals who spoke other languages outside of the research team.

Gender of Participants

The study consisted of all female members who were mothers. Therefore, omitted from the study were husbands. As a result, there were no views from male participants.

Number of Participants

There were a low number of mothers recruited who received mobile messages. Hence, the majority of mothers who participated in the survey method consisted of individuals who did not receive messages but attended maternal health workshops.

Gender of Research Team Members

The study included a mix gendered research team (females and males). However, the surveys were distributed and translated by a majority of male research team members. Thus, mothers may have been reluctant to provide accurate information regarding their maternal health status.

Multiple Translators

The study included a total of three translators who interviewed the mothers for the one-on-one sessions along with the focus groups. Consequently, since we did not have one primary translator, the individuals may have imposed their thoughts, perceptions and understandings of the study on the participants without fully building a rapport with the mothers.

Mothers' verification

Mothers needed to have possession of their ANC journals to take part in the study. Therefore, we may have missed out on mothers who participated in the project due to us excluding mothers who did not have their journals during the time of the study.

Registration for the MMHP

Mothers confirmed that some of the healthcare professionals signed them up unknowingly to receive the mobile messages. As a result, mothers may have been signed up for a language or layout (voice vs. text) that they could not understand. Hence, this study had a limited amount of mothers that participated in the project full-term do to the miscommunication of project objectives, goals, and intent of the mobile messages

Conclusion

This research was designed to move beyond recommendations for mobile message design of users and towards understanding inputs that influence mobile message design for mothers in Northern settings of rural Ghana. By using quantitative and qualitative methods along with RA techniques, this research does provide sufficient data and an appropriate analytical strategy to offer trustworthy answers to the guiding question of the study. Findings of the study are presented in the next chapter.

4 DATA ANALYSIS

This study is guided by the central question *what inputs of the mobile message design influences expecting mothers' maternal health in rural Northern Ghana.* I used the triangulation mixed methods design along with RA techniques on both qualitative and quantitative data. In

this chapter I present results of the data analyzed from surveys, interviews, focus groups, team reflections and journal reflections. Presented are my findings from both quantitative and qualitative methods. First, I present descriptive statistics of participants' characteristics. Next, I organize the qualitative data findings by themes while summarizing results.

To identify participants in my qualitative interviews, I use one initial and number for each participant per their request such as C01. Within the qualitative open-ended survey responses, I provide a code that consists of the initial P for participant along with their aligned ticket number used in the study e.g.P34. A detailed discussion of the data analysis, findings, results, and interpretation of the qualitative and quantitative data of this study are also included in the chapter.

Quantitative Findings

The use of descriptive statistics helped to summarize the study's collection of data in a transparent way. The primary goal of using descriptive statistics in this study was to describe quantitative data through the use of numbers by graphically representing this information in a comprehensible manner. Table 1 below presents descriptive statistics for respondents' Demography in both frequencies and percentages.

Participants	Frequency	Percentage
Community Participation		
Disdane	148	51%
Tylon	144	49%
Total Number	*292*	
Messages Received		
Received Messages	227	78%
Did not receive messages	65	22%
Total Number	*292*	

Ages		
30-35	86	35%
19-24	67	27%
25-29	66	27%
Above 36	28	11%
Total Number	*247*	
Number of Children		
1-2	102	41%
3-4	98	39%
Over 5 children	49	20%
Total Number	*249*	
Level of Education		
No formal education	161	56%
Informal education (farming and trading)	93	33%
Primary level of education	24	8%
Secondary level of education	9	3%
Total Number	*287*	
Marital Status		
Married	274	94%
Engaged	15	5%
Never Married	3	1%
Total Number	*292*	
Distance to the clinic		
8 to 12 miles	94	68%
1 to 7 miles	22	16%
13 to 17 miles	13	9%
Over 18 miles	10	7%
Total Number	*139*	
Number of ANC appointments attended		
Over 4 ANC	64	58%
2-3 appointments	32	29%
0-1 appointments	14	13%
Total Number	*110*	
Preferred Format		
Voice Calls	122	42%
Face-to-face	90	31%
Radio	72	24%
Video	8	5%
Total Number	*292*	

Table 1 Quantitative Findings

The total subject pool of mothers was fairly equally distributed between both communities with 51% (n=148) from Disdane and 49% (n=144) from Tylon. Regarding receiving the mobile messages in the study, a high number of 78% (n=227) did not receive messages, compared to 22% (n=65) who received messages. As for mothers' self-reported age, 35% (n=86) were between 30 and 35, 27% (n=66) between 19 and 24, 27% (n=67) between 25 and 29, and 11% (n=28) were above the age of 36. The average age of respondents was 28 years old. At the time of participation, 41% (n=102) of the mothers reported having one to two children, 39% (n=98) reported having three to four children, and 20% (n=49) reported having over five children. This analysis consisted of multiple modes and reported the values of one and three. Therefore, mothers having one child or three children within the data set had an equal number of reports.

Subjects' education fell into five groups; no formal education 56% (n=163), information education (farming and trading) 33% (n=96), primary education 8% (n=24), and secondary education 3% (n=9). Marital status of respondents included married 94% (n=274), engaged 5% (n=15), never married 1% (n=3). Mothers completing surveys for the study distance to the local clinic ranged from 8 to 12 miles 68% (n=94), 1 to 7 miles 16% (n=22), 13 to 17 miles 9% (n=13), and over 18 miles 7% (n=10). While considering maternal health actions, respondents self-reported ANC visits to the clinic while involved in the MMHP. Mothers attending over four appointments including 58% (n=64), two to three visits included 29% (n=32), and zero to one included 13% (n=14). Regarding maternal health communication format, respondents stated that they preferred voice calls 42% (n=122), face-to-face communication 31% (n=90), radio 24% (n=72), and video 3% (n=8).

Qualitative Findings

Analysis of the recorded interviews and open-ended responses revealed four themes. The themes are: 1) Information source 2) Design and delivery 3) Power dynamics and Personal circumstances (4) Perceived Gains. Descriptions of topics are recorded in the following chapter.

Theme I: Information Source

Information source refers to anything, person, or group of individuals that informed the mothers about maternal health. These sources are persons who they value and trust in regards to the information. The data from this theme draws from the interviews, open-ended surveys, and focus groups and includes remarks that explore the roles that individuals play within the context of the mother's life while being pregnant and receiving mobile messages. While focusing on my guiding research question, I requested participants to share with me their responses from where and whom they receive maternal health information, as well as why they value as a trusted source to provide this information. Subthemes that emerged from interviews and surveys related to information source included: (a) healthcare professionals, (b) husbands, (c) trained and untrained traditional birth attendants.

Healthcare Professionals

Healthcare professionals are individuals who the mothers' perceive as valuable sources they are trusted to provide maternal health information. These members are midwives, nurses, and doctors. Throughout the study the mother's stated remarks regarding their confidence in the abilities of these individuals to guide them throughout their pregnancy. During the course of the data analysis, 134 mothers from the open-ended surveys responses, 12 mothers who participated in the one-on-one interviews, and 1 team member stated that healthcare professionals were a trusted source for maternal health content.

The mothers viewed the healthcare members as significant sources due to the credentials and training of the professionals. Concerning the study, mothers had high regards for the healthcare professionals and felt confident about their recommendations they received while navigating their pregnancy. Also, the mothers implemented the advice from the professionals and concluded that they were favorable for their conditions. Within the survey, mothers stated reasons why they valued the health care professionals as a source for maternal health information. Forty-one mothers within the open-ended survey responses stated:

Survey Responses
P4 When she practiced health information given by health professionals it makes the baby healthy and strong.
P12 Health professionals encourage her.
P77 Nurse because she is well trained and has a good qualification.
P98 Nurse, because she has to take and advice from a trained person.
P134 Because the health center was a partner, I knew it was trustworthy.

Some of the mothers assumed that the messages were being designed and delivered by the healthcare professionals. This misconception was assumed because their midwife signed them up for the project. Consequently, mothers felt excited about receiving first-hand information about their pregnancy from a source that they deemed as being trained and qualified. My previous observations during my pilot study concluded that there was a shortage of midwives at the local clinic, which created limited time for mothers to interact with healthcare professionals during ANC appointments. Twelve individuals interviewed stated that the health professionals

signed them up and that they trusted that the health professional would not give them damaging information. Participants noted in interviews and focus groups:

Interview Responses

A13

I was asked at the health center to give out her number…so I gave it out…but I felt that if it is the health center that is taking her number then it is for a good reason.

A04

I was told by the health providers…. so if it comes from them and they are telling you to sign up then it is good.... we know that it is not bad information they told me I can receive information about health information and if I want to then. Sign up for it.

Focus Group Response: B01

I trusted the messages…because the health providers told me to register and they know what is best.

The mothers demonstrated strong beliefs that the healthcare professionals were trying to assist them with their pregnancies. There was one instance where the health professional opted for a mother to share the message with her significant other. This action prompted the husband to consider his options while purchasing food for the pregnant mother.

Focus Group Response: B01

When we came to the health center they told us that they should take this information and give it to our husband's….they told us to get eggs…so I brought that information to my husband and he went to get some eggs.

One woman, in a focus group discussion, decided to confront her husband about items she needed to change her diet for her pregnancy while believing that she must do what was instructed by the clinic.

Focus Group Response: B01

With diet I use to just eat anything the husband bought…but this time around I felt I was pushed to talk to my husband and tell them that these are some of items that we should eat but the husband doesn't know why the hospital are asking for him to buy it…but he buys it….

During the interview sessions, four mothers revealed that they had positive feelings towards the healthcare professionals within the clinic. In the interviews, the individuals who received messages discussed how their actions were due to them believing the information was from the valid source of healthcare professionals. These activities included attending ANC, hospital delivers, and diet and nutrition. Participants and one team member stated:

Focus Group Responses: C01

C01
The clinic told us that….when we have pregnancy we should first come to the hospital to check so that they check them…so that we can check them more instead of them going to the locals (untrained TBAs) for helps those can easily damage them.

Me
"So who is telling you to go there is it…?

C01
The hospital. When we go to the maternal health workshops and some of the calls that we receive… this is the knowledge that they we will receive so at this point only two of us have receive a message like that….but some of us changed our past from what they are saying.

Reflections

Team member Reflection
I think that some of the mothers were changing because of the messages because they realize what they were giving out to them was the right thing so they decided to follow-up with what they were advised by the Doctors or what the nurses were given them so I think the turnout for the messages was very good.

Researcher Reflection
Also different traditional practices have been used in the past but for some reason they have learned that the clinic can be trusted.

Overall, it appears that mothers considered majority of healthcare professionals to be trustworthy while having pregnant mothers' best interest taken into consideration. The mothers perceived that the professionals communicated information that confirmed or complemented the messages. Consequently, most of the participants had positive comments and beliefs regarding the professionals. By inquiring about the actions that the mothers took while understanding who

influences those decisions, healthcare professionals set the tone for making the patient feel respected and comfortable while being pregnant.

Husband

Husbands were viewed as a source if they provided the mothers access to receive the message information. From the mothers' viewpoint, husbands were sources who provided them with information and clarified information that was communicated by healthcare professionals. Although husbands were not qualified as health professionals, the mothers viewed them as someone who could assist with their understanding of information. Also, husbands could allow them access to listen to the maternal health information within the messages.

Crucial to the study is the fact that for some mothers to receive the messages they had to receive secondary information relayed through their husbands due to him having physical possession of the phone. From the inquiry, there were no direct questions within the interviews or focus groups that focused on husbands. Consequently the individuals emerged during discussion sessions with the mothers. Nevertheless, the surveys inquired about husband support along with how the mother receives messages. Data analysis included two mothers from the surveys, six mothers from the interviews, one mother from the focus group, and two research team members made statements regarding the influence of the husband. Some of the husbands understood that they were to transmit the messages to the mothers. Mothers stated:

Interviews Responses

A12
I received the messages myself once…but the other ones my husband came and told me.

A04
I went to the hospital with my husband…so they registered my husband's number….on the system…and so for the first two times my husband left the phone with me… but then after that he took his phone back then went to the city so whenever he goes to town for business or visit he goes with his phone….so when he gets the calls they ring him and

then later he then found out that they were calling me and I would tell him what they said.

Focus Group Responses:
CO5
So I used my husband's phone….he had a phone.

Me
So did he allow her listen to the messages?

C05
Yes. Actually they we were lying together when the call came.

Me
So he listens to the messages to?

C05
Yes, we (husband and wife) listen to the messages together.

For the mothers who received messages, they believed that their husbands would relay the messages. Yet, within the study the husbands were often confused about the message and what information needed to be relayed to the mother. Husbands initially thought the messages might be stored and listened to at a later date or the mother could return the healthcare professionals' calls. Some spouses had a limited understanding regarding the messages unless the wife discussed the process of the project. As a result, if the husband did not have a solid knowledge of the MMHP, he may have caused the mother to miss out on information in the messages. Mothers stated:

Interview Responses
A04
Each time he got a message.. a call…he would receive it and then cut it….he couldn't understand who was calling….he would tell me "your people called".

A03
My husband…he had received a call once and said that he was in the farm when the call came through and he took the phone…and he receive the call and he came back early …the midwives called him but he didn't understand what they were trying to tell him….then he told me.. so then I tried to explain to my husband what was going

on…they are calling me giving me some information in the form of messages. Then I explained some of the messages to him.

The mothers believed that if the messages would educate their husbands about the importance of relaying the information, then he would have been more supportive of the mothers' participation in the project. There was one instance during the survey that a mother noted:

Survey Response
P226
Husband was able to explain to me.

In terms of behavior change, it was revealed that if husbands were aware of the information within the messages, then they might have a stake in the mother's pregnancy and also the birth of the child. Within the survey, mothers stated:

Interview Response
A12
My husband told me about the nutrition, bring the child to ANC after delivery.

Survey Response
P270
I gave birth in the hospital, I went to the hospital at night to give birth, and me husband always takes me to the ANC.

Focus Group
C01
We need the men the male support…because sometimes the messages tell you that your husband can help.

During reflection time, the research team made several comments regarding the spouse's influence of the messages. They believed that since the husband is a trusted source, then he should be more supportive of the mothers receiving the information. Some mothers received

messages; that reflected on negative attitudes of husbands towards communicating the messages or being involved in the project. Team comments included:

> **Reflections**
> Team Reflection
> What I found really surprising was that we interviewed during the focus group discussion...we interviewed and she said...my husband stop actually giving me the phone and letting me listen to the messages.
>
> Team Reflection
> Yes, I think they have a problem with their husbands.. you know like a caring husband you mean like ah…a husband who communicate …the husbands that we have in the communities don't attend to their wives very well because if you come to the urban areas…you will see most of the husbands some of them like to attend the clinic with their wives they will go to the clinic with them to know what is going on with them and know how to care and attend to them….but most women in the community there husband doesn't have time to go with them to the clinic and listen to the advice that is given to the pregnant women because sometimes it is not like you forget but you might forget like "oh they said you should do this " and if your husband is with you at that moment or when you do the wrong thing in the house I think he will be in the mood to tell you this is what they said you should do. So I think the husband have to take part…or have to help them or go with them to the clinic and also help them so that they can share the knowledge between the wife and the husband….no one is perfect and they always say that two heads are better than one so if your husband is able to remind the mother " oh you said that you should do this and do that" I think it will help out.

From the analysis, the husbands were supportive of participants who receive the messages. The mothers had positive remarks regarding the assistance they received such as the husbands relaying the messages. Conversely, overall with the mothers who did not receive messages, they commented on their spouse's absence, which resulted in being less supportive. Yet, the mothers concluded that if the husbands had a better understanding of their responsibilities as it relates to relaying the messages then, they would have supported the mothers throughout the project. Further discussion of husband's support discussed in the Power Dynamics and Personal Circumstances theme.

Traditional Birth Attendants (Trained and Untrained)

While analyzing data, participants reflected on trained and untrained traditional birth attendants (TBAs). From the mother's perspective, trained birth attendants included community midwives who underwent specialized training conducted by an experienced team of midwives, doctors, and nurses from the local clinic. Untrained TBA's include elders or members within the community who had experience with delivering the mothers babies. They are viewed as traditionalists who do not include westernized medicine into their practices; though, they were not integrated into the formal healthcare system. Many trained and untrained TBAs were also the herbalists and known as traditional healers in the community. Within the data analysis 14 mothers from the surveys, seven mothers from the interviews, four mothers from the focus groups, one team member reflection and eight team researcher reflections provided statements regarding the TBAs role. Interviews questions included ranking TBAs while focus groups consist of an extensive understanding regarding their role in the mother's life. Within the survey there were no specific questions centered on TBA's; yet, the term emerged in birthing responses from the mothers. Remarks from the individuals affirmed that mothers valued the role of the TBAs as a means to an end for their deliveries. Nevertheless, the mothers viewed TBAs as the deliverer of babies; they did not place expectations on their knowledge regarding the information within the messages. Furthermore, mothers in interviews stated:

Interview Responses

Me
Yes, if you have a baby will just go to a TBA untrained in your community…

A08
We have the older women who look after the house they go there because they know how to birth…I guess they would be an untrained TBA

Me
Oh, the older ones the elders.

A08

Yes, we go to all ANC appointments then we come back home for delivery……..so we trust these ladies…

Me
Will they ask the untrained TBAs or elderly in the community about information received from the messages?

A08
We wouldn't ask…I don't know what to ask....these women are there to help us to deliver safely so they might not know the answers and they don't know about all of these things during pregnancies.

Me
So you don't think that they know

Translator (own words)
They don't know…..

B02
So when you are in labor you don't really have a say…the people around you decided everything for you…. then all decide not to take you to the hospital or use the TBA or house help.. then you give birth….

The mothers' beliefs include them feeling like they don't have a choice but to deliver their babies with the TBAs. Still, they don't have faith in them in terms of providing them with maternal health information. Within one interview a mother stated that she believed what the health professionals told her; nevertheless, she did not follow the recommendations. Her remark includes:

Interview Response
B02
See the nurses tell them that they should come to the hospital to deliver because it is safer but she has failed to listen.

By the mothers participating in ANC appointments, their behaviors reflected their priority of beliefs of the healthcare professionals being their main source of information. Mothers stated:

Interview Responses
A13
There are a total of 8 ANC appointments that I visited.

A14
So I went to all the ANC..I was told to go unless it was irrelevant..

A08
The most that is important is ANC…all are important…but ANC first.

Concerning birthing, the mothers' maternal health behavior does not correlate with whom they trust as a source of information. Several mothers delivered their babies at home. Even though, they valued the health care professional as the primary source of information. Within the analysis, five mothers within the interviews, several mothers from three focus groups and one team member's reflection comment with who or where they delivered their babies. Team members and mothers noted:

Reflection Response
Team Reflection
They actually go to women who just deliver in the village…so this lady stays in her section.

Interview Responses
A08
Me
So there is no trained TBA….

A08
Right, there is not one near…so we go to an untrained one….

Me
So where do they deliver their babies….so they have to deliver at home?

A08
Yes, so usually with an untrained TBA at home …we don't have access to a trained one.

A04
So we have a TBA in the village…. I will go to the TBA for delivery…..I always goes to the clinic for her ANC….I gave birth at home but the reason was that when I went into labor I went to the clinic and they said that the position of the baby was not so good they have to take a scan.. when they took the scan at the clinic they couldn't clear her to go. They felt that they had to operate and they had to give her a drug to sedate her to make the baby reposition before I was able to give birth and so they referred me to the urban hospital so I went to the urban hospital and when they took the scan they realized that they didn't have to operate they had to give her a drug and then they asked me to come in within a week to come back to administer the drug because within that week I could go into to labor so when I went back home it just took two days and then here comes the baby. And so I delivered the baby at home.

Reflection Response
Team Reflection
This is the thing that is happening here…. they go for ANC but is most of them don't go to the clinic for their delivery……unless it is really serious that is when they go.

Nonetheless, there was one mother who participated in a one-on-one interview who had strong feelings about her delivery decision.

Interview Responses
A01
I decided not to have her baby with the TBA

Me
What was her reasoning?

A01
Because the TBA was a family member….my aunt

Me
Oh, ok...why didn't she want her aunt to deliver her baby?

A01
My aunt was trained by Prince Medical Clinic therefore, I wanted to go to the place that trained her aunt. I wanted the perfect qualified professional.

Reflection Response:
Researcher Reflection

She decided to have her baby at the clinic because her aunt was trained by the clinic and her aunt is a TBA that was trained by the source (the hospital) so she wanted her delivery to come from the source that trained her aunt.

There were also two mothers from the interviews and eight mothers within the focus group who experienced giving birth to the community and at the local clinic. These mothers felt that the local clinic was the best option. Mothers stated:

Interview Responses
A14
So what she is saying is that she prepared to have a baby there at the clinic…because when you have the baby there…they check the health of the baby to see if the baby is fit…also they are able to clean up all the blood and everything and you don't worry the placenta and everything getting germs…but when you have the baby at home sometimes they don't really clean up after you and so you end up having further complications and so she would really prefer to have a baby at the clinic.

Focus Group Responses
C01
(All focus group members)
Translator #2
With a TBA most of us wouldn't give birth with them again they will go to the hospital and some of them say that when you go to the locals (untrained TBAs they give you the herbs and some of them don't like it because of the messages that they get (they are not supposed to take it) and also they said that sometimes the women is in labor…they just deliver at home because they don't have the time to get to the hospital.

Focus Group C01
Me
Oh so how many delivered at home vs the clinic?

Focus Group C01

3 with TBA at home and 5 at hospital.

Focus Group D01
There is a difference with giving birth at the clinic vs. giving birth at her house and I prefer to giving birth at the hospital versus at my house because when I was giving birth at the hospital the nurses were there to help her and they were feeding me….I wanted the birthing to be smooth and I had to be careful not to tear myself so they were helping her with her legs when I was trying to push so that the baby will come out with good form and they were bringing my legs together when it was not time to push…so I enjoy the way the hospital handles me.

> Focus Group D01
> I preferred giving birth in the hospital because they give us some medications that will prevent you from infections and any disease that will infect you doing your delivery but in the house no one will be able to do that… so I prefer to give birth in the hospital vs the house.

Co-Wives

The mother's remarks display that some of the TBAs are a valuable source when they decided to have home deliveries. However, mothers who delivered their babies in both the clinic and the community felt they would consider avoiding the untrained TBAs due to their positive experiences with delivering their babies in the clinic.

Polygamy exists among the communities in this study; therefore, co-wives are wives who share the same husband. Co-wives are individuals who the mothers perceive as a support system. Within the study, the mother's noted that a co-wife to sign up for the messages mainly refers them. Also, the co-wives serve as a reference while navigating any challenging thoughts or inquiry regarding the messages. Within the focus group, I inquired to find out if mothers talked to other co-wives regarding maternal health. While interviewing participants, the individuals discussed the diffusion of information throughout the household. Statements included comments that co-wives exchange dialog with each other and tell stories about their daily lives. Co-wives converse during regular family dinners; other mothers talk while participating in household chores together such as fetching water or during special events like community festivals. Specifically, at dinner, mothers share their most cherished moments they had throughout the day with other family members. Individuals explained that while participating in family time with other co-wives, information would is relayed. If the mothers are receiving messages, they will share their experiences with the family. During the focus group a mother stated:

Focus Group Response: C02

You know in the Northern culture we eat together so it is everyone maybe the man will have three or four wives and we may eat together ….so when we finish eating we will tell what is happening and what is going on and how the day went and all of that so sometimes they bring those stories ….the ones about the messages into the conversations.

Though concerning maternal health, mothers consistently observe the pregnancies of others such as co-wives while assessing if their practices deemed as being beneficial. If the pregnancy and the mother have successful outcomes, then the mother is confident that the same methods will work for her and she will adopt the routine. While receiving the messages, the mothers recognized that co-wives who received messages were not falling sick, experiencing miscarriages, having infant mortality, or becoming victims of maternal mortality. Therefore, the participants concluded that messages must assist with their pregnancy. Also, they observed that mothers who were sick received some treatment from the untrained TBAs. During an interview session, a participant commented that she associated good health with listening to the information within the messages. Also, the information created trust once she observed another co-wife receiving information trust was. Eventually, they would follow the practices of the information. Mothers from the focus group stated:

Focus Group Response:C01

Because of good health…because we saw that some of the things were not working and so when the co-wives told them those message... it helped us so that is why we believed in the messages. So we trusted them because they realized that some of the things that they did in the olden days they are no longer working because now they are taking a lot of things so when the messages told them all of this information they believed them and their co-wives made it clear to them that time has changed.

Me
So it was working because we had seen other people maybe other co-wives get sick or they had problems with their pregnancy……or??

> Focus Group C01
> All mothers say YES (VERY STRONG AGREE)
> Yeah…so when some co-wives came from the untrained TBAs…. we believed the experiences that they had and they told them the problems that they had with the local herbs that they were given were not healthy for their baby...they lost their babies.
>
> Focus Group C01
> So now we believe that all the herbs the TBAs tell you to take don't work because….if your pregnancy is like 2 months you can easily cause a miscarriage…and other co-wives that we know miscarried and that was proof of those things don't work for you .

Although the untrained TBAs provided assistance to their mothers and great-grandmothers, the mothers were receptive to change and understood that times are changing and new methods are needed for her and her unborn baby to survive. Consequently when co-wives received messages, mothers viewed how their body responded to the information and task and responded accordingly.

Information Source Summary

Regarding the information source the majority of participants describe their main sources as being healthcare professionals, husbands, TBAs, and co-wives. Each one of these individuals plays an essential role in the mother's life. The mothers admire the healthcare professionals' qualifications while having positive attitudes and beliefs that they would provide finest assistance throughout their pregnancies. The husband's value develops as he provides the means for the messages along with the communication to the mother. TBAs' appreciation is reflected as they retain the traditional roles within the community. Subsequently, co-wives assist with supporting mother's process of a successful pregnancy. Overall the mothers value each distinct source to assist her with maternal care.

Theme II: Design and Delivery

At the core of the research question is the focus of mobile message design and delivery of maternal health information. This theme includes the way the information is presented for individuals to have an understanding of it rather than only an artistic expression. The characteristics that mothers described were items that resonated with them from their perspectives. To obtain detailed responses, individuals who specifically received messages were targeted to discuss certain aspects of the messages. Yet, those who did not receive messages reported on features that they preferred. I asked participants questions about the mode of delivery, layout, and content regarding the mobile messages. Henceforth, results showed influences from the subthemes of 1) dissemination, 2) tailoring, 3) explanations and 4) relevance.

Dissemination

Within this study, dissemination refers to the distribution of information to mothers. In the MMHP mothers had the choice to select to receive voice or text messages. As stated in the demographics section above, the majority of the mothers within the survey elected to receive information via mobile phones along with all participants included in the interviews (10 mothers) and focus groups (21 mothers). Nonetheless, I decided to inquire about other modes of communication such as radio, face-to-face workshops and video that may have been useful for the mothers. Hence during the interview, ranking questions focusing on challenges to the mobile device, I allowed the mothers to explore the challenges to the mobile phone while also providing solutions. Following, during the focus group we continued to expand our thoughts on options by opening the dialogue with the group of mothers. Mothers noted that typically, they were given the solution to a problem, and we were challenging them with expressing their thoughts regarding possible solutions to the issue at hand. Thereupon, my team and I created the opportunity for

mothers to express their ideas about using the mobile device as a primary tool for communication while also allowing for mothers who did not receive the information to provide their suggestions. These suggestions included radio and face-to-face workshops.

Overall, the mothers seemed to be in agreement with receiving information via voice format. Participants expressed several reasons for their preference of the format, such as the convenience, accessibility, and non-readable selection. Nonetheless, husband must be willing to purchase a phone for the mother or invest in a phone for himself while being responsible for communicating the information to the mother. The mobile phone allowed the participants to receive the information at their convenience, and they may have felt that they did not have time for face-to-face interaction because it may interfere with their chores and duties within the household. Thus, they preferred to have the information presented via voice messages. From the analysis, 142 mothers from the surveys, two mothers from the interviews, and one reflection noted that mothers had positive reviews towards receiving the message through voice calls of the mobile device from the surveys comments consist of:

Interview Responses
A05
Translator #1
All of the messages I liked (laughing) because they were all giving me sooo much information……I liked receiving the information.

Me
You didn't mind that it was through the mobile phone?
Interview Responses
A05

No I didn't.

A13
I prefer the calls….over the videos and the text….with a video I don't not own a television so I would not be able to see it…so a call.

Survey Responses

P5
I can easily get the information from the mobile phone because I have no time and can also show it to some of her friends.

P65
I can easily be reached.

P79
I prefer voice, I cannot read.

P18
I have no time for in person advice.

P112
I she can easily get the information from the husband.

P118
I will always have my phone with me.

P210
I can have a phone in which I can receive voice messages.

P223
Voice messages are common these days.

Team Reflection
They prefer voice calls.

Similarly, mothers seemed to be in agreement with receiving information from the voice message format. Mothers expressed several reasons as to why they preferred the voice format on the mobile phone. The mothers' positive attitudes reflected within the discussion, and they might have viewed that access to information is readily available on their mobile phones vs. any other form of communication. Similarly, regarding the mothers who did not receive the messages, their overall attitudes were positive while discussing the possibility of receiving messages. Mothers within eight survey responses stated.

Survey Responses
P67
If I received it would be understandable and also easy to cope with.

P104
I received text calls, voice will be more understandable to me since I cannot read.

P27
Voice calls would give us the opportunity for mothers to call and ask questions.

By reviewing the analysis from participants who did and did not receive the messages, a common thread revealed within both discussions. Both groups of mothers wanted interaction with healthcare professions by using a device that was readily accessible. During the duration of their pregnancies, the mothers believed that having frequent interaction with the professionals would allow them to have a considerable amount of reliable information before making decisions such as a clinic delivery. Data from mothers in 5 interviews, 20 surveys, and a team reflection stated:

Interview Responses
A10
My problem was that we couldn't talk back to them.

A05
You can't speak to the person and so you can just listen to get information from it.

A03
My first challenge... was that I couldn't reply.

Survey Responses
P27
Would like to have the opportunity for mothers to call and ask questions.

P30
Would like to have two-way communication.

P101

Survey Responses
P101
Would like to have help and encouragement through the pregnancy.

P134
Would like to have the opportunity for mothers to call and ask questions.

Team Reflection
What they didn't know was that you could not talk back to them because if you talk they cannot hear what you are saying.

On the contrary, while collecting data in the field, I met several mothers who failed to participate in the entire duration of the project due to the medium being a mobile phone. Some of the challenges consisted of phone breakage, lost phones, and network issues. As seen in my demographic data, this study included more participants who did not receive the messages versus those who received the messages. I question if there were other means of communication that the participants preferred? Mothers within a focus group stated:

Focus Group Responses
D03
We prefer both…the phone and the radio…but the phone is an important one because it is a cell phone to you.. but when we call them about health messages we have a chance to receive important information that could save our lives…. but with the radio sometimes you might miss it and you wouldn't have a chance to receive but with the phone call.

D03
But with the radio there are issues….if we hear the message on the radio we can be passing by and hearing it …but with a cell phone.. so when they call you..you will know to listen to it because you have time….so right now we are here… so if the radio message came through then we would be missing it but with the phone you can call your friend or text you friend and tell them what the messages said.

The mothers make good points as it relates to radio; while they may be accessible, there might be issues with trying to produce the radio message during a time of day that is feasible. On the other hand, within the open-ended questions from mothers who did not receive the messages within the surveys 72 mothers expressed the following:

Survey Responses

P01
I have no phone but I have radio.

P23
I prefer radio, for everyone to have access to the information and can benefit from it.

P51
I prefer radio, it's easier to understand and it's everywhere.

P72
I prefer radio, so that everyone would know the effort of Prince medical clinic and to have access to information.

P195
I prefer radio because people can also listen with us including our husbands.

P278
I prefer radio; you can collect other people's radio and make good use of it without any cost.

Likewise, there was another format for communication that emerged from the open-ended surveys. This format included the face-to-face method. Comments from mothers reflected that typically face-to-face workshops are celebrated as a time to collaborate and interact with others. Mothers have the opportunity to connect with other pregnant women while discussing the progress of their pregnancies, complications they are having, while also receiving advice from other mothers. I experienced several accounts during my focus group session where participants felt free to express themselves while they were among other mothers who were dealing with similar issues. Topics ranged from experiencing the loss of a child to the loss of a friend during their pregnancy. Individuals were comfortable with speaking without reservation about how they felt along with their beliefs. Even though they were receiving messages, they continued to need the

comfort of the group setting to discuss sensitive information. Within one focus group and 27 survey responses, mothers explained:

Focus Group Responses

C02
They are saying that calling on the phone is good….but sometimes…they don't carry their phones everywhere so if they leave their phones at home then they can miss the messages …so they will prefer that even though the radio is good….they would like for us to bring it to them ….bring it in person.

C02
They prefer the group communication so that they can bring us their issues because sometimes the phone communication has issues…and they can't call back.

Survey Responses

P80
I prefer voice and verbal meetings, so that we can have interactions with them and have an understanding of what they are telling us to do.

P270
Group sessions will help me ask all questions.

For the mothers who received the messages, the mobile voice dissemination method was highly selected over text messages. There were only four individuals who received text messages, and they did not understand those messages due to not being able to read English. Previously stated, voice message dissemination included challenges such as registration, technical, and connection issues. Participants concluded that solutions to these problems with mobile phones included examining another means of communication such as radio or face to face along with the option of combining different modes. Statements from nine mothers who participated in interviews and a focus group who received messages included:

Interview Responses

A12
Within her community…where she lives. They have good reception ….

A05
I actually missed some of the messages because of no service….so the calls were coming through….but I would not receive them.

A08
So in terms of the messages…..the problem was with the network. Sometimes I couldn't receive calls unless I was out…away. I had to go out in order to get a signal.

A03
So in this village you really have to position your phone in the right direction….in order to get calls….if you don't position your phone carefully then you might not be able to receive service.

A10
For the reception needed for the phone, I had to go waayyy for out from the town…most of the reception is inside town (in the nearest city).

Focus group C01
Network with the mobile device was a challenge for all of us.

This section investigated participants' responses to the dissemination method. It appears that though some of the mothers had several challenges while receiving information through the mobile phone, they are still open to this type of communication in addition to other forms of media to support the dissemination method.

Targeting and Tailoring

From the mothers' perspective, targeting refers to information created for a particular group of individuals. Additionally, tailoring consists of individualized characteristics that reflect content for an individual. Mothers commented on several features that focused on the content and layout of the information. These features were described throughout the interviews while ranking the message information topic. Additionally, reviews of experiences continued

with focus group members. Participants were transparent, as during the discussions they described specific situations that related to their personal journeys with examples from their process. For instance, mothers could recall information about their reminders, examinations, and voice translators. In general, their remarks focused on the presentation of the specific information.

My previous pilot study determined that the messages were designed to be dispersed based on the number of weeks of gestational time a mother is during her pregnancy. For example, a mother who is eight weeks pregnant would receive different messages from a mother who is 20 weeks pregnant. Also, the messages were correlated with the ANC appointments and would prompt individuals regarding reminders about their next scheduled visit to the local clinic.

Lastly, throughout the pregnancy, the messages promoted examinations of the women's bodies to notice any changes with how they felt or how to look for warning signs of any complication. These observations included noticing discomfort with their pregnancy, the site of blood, or feeling weak. As a result, mothers commented on how they attended the clinic for scans for regarding complications while also being prompted to change their diet options in order decrease an iron inefficiency. While receiving the information the mothers were excited to learn that the messages took their personal traits about their pregnancy into consideration, which made them feel valued. Mothers within the focus group and interviews noted:

Focus Group Responses
C02
The messages targeted the months…so when I went to the hospital …they started giving me information …from that stage of my pregnancy from that moment ..so it was relevant to me because it was from that point on.

Interview Responses
A03
I listened to the information and I was surprised. I was surprised the messages told me that if I was feeling something strange then I should go to the hospital and go for a scan at her ANC appointment. One time I went to the hospital to have a scan due to a complication that I might have been feeling based on what she heard in the messages...and the messages were correct.

A05
It was the supplements….yes, I really liked that one because each time I took the supplements I woke up later feeling really funny… and after that morning that I took them the rest of her pregnancy was fine…

A14
So they are given supplements and they are also given anti-malaria tablets…I she took the supplements over the malaria tablets because the supplements help to avoid feeling weak…so next would be supplements and then malaria…

I wanted to learn if there was a difference in male or female translators and their thoughts regarding gender selection and communication. Statements concluded that mothers felt comfortable with receiving information from either a male or female. Their primary concern consisted of the person speaking to them in a calm tone, which allowed them not to be anxious with their next steps of pregnancy. The participants considered the male translator as a person who was assisting them with receiving maternal health information. Still, concerning a man physically attending to them during their ANC visits, they were uncomfortable with them being responsible for touching them. Comments came from six interviews, two focus groups, and one team reflection. Statements included:

Interview Responses
A05
I liked the person who was speaking because they calmed me down….because they are speaking softly ……I would feel really bothered if I didn't get to listen to her messages for the week.

A04

It doesn't really matter if there is a male or female who is calling…once there is a nice conversation….then it is good.

A12
So my husband was called by….a man….but I received calls from a women…and what the male said was fine with her husband.

Focus Group Responses

C02
Because the lady did the calls calmly... so when the lady called she was happy because she calms her down.

C02
Received from a male…sometimes she would laugh because it was a male being soft.

C02
I received a male and he was friendly. So when they call (the male) they will say this is the male Dr. that they registered with at the hospital so it is ok for them to call although they are males…because they are male Doctors.

C02
I had a male translator; I didn't have a problem with a male saying it because she felt it is something that will help them. Sometimes you can be comfortable with the man of the phone….but once you get to the hospital itself when he is trying to touch you in a place that you not comfortable with then can be uncomfortable so we are definitely more comfortable with a women at the hospital.

Team Reflection

Actually they don't mind if male or female…..

This section concludes responses from participants regarding tailoring and targeting information for mobile messages. Participants' reflections highlight that mothers find it comforting when information correlates to their specific pregnancy journey. The fitting information allows them to feel at ease throughout their process.

Explanations of Messages

In this study, explanations refer to the how the information was presented to provide an understanding to the mothers. The mothers received weekly messages that covered several ma-

ternal health topics such as diet and nutrition and malaria prevention. Though, some of the individuals had prior knowledge regarding the information by being pregnant beforehand or having prior interactions with co-wives and friends who received messages. Most of the mothers were receiving this volume of information for the first time. They commented on how the information made them feel along with the presentation of the instructions. The data analysis emulated interview responses from ranking message information, these conversations extended in the focus groups. Thus mothers who received information were eager to address activities they implemented as a result of receiving the messages. They also explained previous actions they performed before receiving the messages; yet, the messages addressed these topics.

A key feature spoken about positively was how the instructions provided reasoning and broke down particular task or areas to be aware of throughout their pregnancy. For instance, when describing stomach pains the information explains how to relax and state that if there is the sight of blood, contact the doctor immediately. These statements reflect that information within the messages informs the mothers of several new activities that may have been unknown before receiving the messages. Thus, during the time that they received the information, they were trying to grasp an understanding of the information. The mothers commented on how the messages positively communicated to them. They spoke about how the information explained certain tasks. For instance, within 5 interviews and 1 focus group discussion mothers stated:

Interview Responses

A05

With me it was being clean…and cleanliness….I received information about the environment…they told them about the environment and how to keep the environment clean so that they don't get malaria….don't leave standing water or leave water out…all of those things. To prevent malaria. And that is what I remember about the calls that I received.

A04

The mosquitoes come in seasons….and during that season they are supposed to be sleeping under a bed net…so once I got pregnant I realized that I should be sleeping under the bed net and then I started using it and the messages confirmed that I should be..

Focus Group Responses
D03
So what I am saying is that the messages called me… to tell me to eat lots of vegetables and also when I am expecting for delivery…I am suppose to wash clothes and dry them in the sun before you pack everything and that's what I received from the messages.

D03
When I was pregnant they called me several times to tell me what to do during my pregnancy and after the pregnancy and at first they were telling her to practice exclusive breastfeeding for 6 months and when the baby gets to 6 months I am suppose to do supplements with the baby

Some participants were aware or had an understanding of the information within the messages. Initially while interviewing, the mothers agreed that the content of the information was understandable and relatable. Nonetheless, as I continued to probe, they stated their previous knowledge about some of the information. Only mothers who had previous experience with being pregnant claimed to be knowledgeable of such tasks such as malaria prevention and breastfeeding. With my bias in mind, I took a neutral stance while asking these details and listening to the responses. In return, I challenged my thoughts and conclusions about the awareness that the mothers stated. The comments make it clear that some of the mothers already knew how to breastfeed or attend ANC appointments. Thereupon, they found some of the explanations to be redundant. Two mothers and one research team member stated

Interview Responses
A04
About the breastfeeding …for a first timer that is having a child you wouldn't know so much about breastfeeding…so the messages are listened to much because it is your first time…but if it is your 2nd or 3rd time then you would have common experiences…so you would have some idea about breastfeeding…so for her…..this is her 2nd time….

A03
Yes, I went to all ANCs…I went every time ...

Reflections
Researcher Reflection
So most of them go for ANC at the clinic

Team Member Reflection
Yes, yes…they go for ANC at the clinic this is not new. They know to go for ANC at the clinic but sometimes they might not know when to go but they do know that they must go.

This section concluded statements from participants' views on explanations within the mobile messages. The mothers enjoyed how the explanations were displayed and how they instructed them to do new task. However, there continues to be a need for understanding the individual's characteristics in order to better design instructions that are relevant to learners.

Relevance

From the mother's views, relevance includes how the information within the messages related to the mother's maternal health needs. As noted earlier, the messages were originally in English; nevertheless, the local translator engaged with the voice messages and translated the information into the local language. These mothers are in a unique environment of a rural setting. Hence, according to the mothers, translation of the messages is the first step in providing them with relevant information. Next, there is a consideration of the context while communicating information. Therefore, I decided to explore the concerns of the context, which could provide an understanding of the relevance related to their needs. Mothers referenced how the information such as diet and nutrition was not relevant to their current circumstances. In the analysis, there were no questions that specifically focused on the relevance of information. However, throughout the interviews, participants were asked to rank maternal health topics while providing explanations of

their selection. Meanwhile, in the focus group discussions, participants stated challenging issues within the messages.

The mothers thought that some of the information received was not relevant to their context. Highly discussed among 94 participants were the diet and nutrition topic. The messages focused on several dietary options that the mother may consider to purchase or prepare which would improve their pregnancy. These selections may be healthier regarding receiving a balanced diet; still, the items were not readily available to mothers in this particular rural setting in Northern Ghana. Although the individuals listened to the messages, they found it challenging to have access to the items. For instance, in a focus group, one-on-one interview, and team reflection, statements included:

Focus Group Reponses C01
All of those things they did but we are complaining about managing to get the food to get those items and also the men the male support…because sometimes the messages tell you that your husband can help you with an egg and he can put the egg in your mouth and he can feed you but it doesn't happen like that around here…

C01
We are complaining about the messaging telling us to buy all those things to eat all of those things and they have to buy all of those things ….the information is telling them to get all of those things they. That is alright… but where you get money to buy all of those things to eat during pregnancy.

Interview Reponses
A08
So…the nutrition…once in awhile you can afford a nice meal…the common dishes might not be the best for the diet…but once in awhile they would have a nice dish and I enjoyed it. The food I was given to the baby was somewhere within the locality within here and other foods they were supposed to picking up from nearest city. Then I needed to travel to go and get it.

Team Reflection Responses

Team Member: In a group. They were complaining that the messages telling them to buy food. But they might not have this food in their community...and that's something I'm interested in because I think that the content should be specific to what they have available. I'm an advocate for providing them with information based on what they have because if they don't have access to it and you're telling them to go buy it.. doesn't work..then they cannot participate in the change.

Team Member: I think that is another area that we should take a look at for a project like this. We have to look at the message...then we need to target it. Like, what they have access to and what they can afford. I think there are other kinds that could be helpful. So maybe this is the lesson that we should think about.

The messages seemed disconnected to the food items in the mother's local communities. As much as they agreed the messages suggest several dietary options, they found it difficult to access some of the selections. The food items described in the messages included eggs, meat, and fruit. These items were typically found in the nearest city, which was 20 miles away. The participants stated that they would like for the messages to include various options that were similar within their community.

This section includes statements from the participant's arguments on the relevance of the information concerning the mobile messages. Although the mothers did not have any concerns with the content itself, they did comment on how they could not relate to the dietary and birthing options explained in the messages. Therefore, a greater understanding of the context is further analyzed in Power Dynamics and Personal Circumstances section.

Information Design and Delivery Summary

Concerning information design and delivery, the majority of participants noted that they preferred mobile phone via voice message dissemination as a desirable form of communicating maternal health. Then again, mothers who did not have access to mobile devices stated that they were interested in other outreach methods such as radio or face-to-face discussions within their

communities. Likewise, mothers who received messages found the precise targeting to be beneficial. They affirmed several positive comments regarding how the information paralleled their individual process, which resulted in gaining their attention and allowed them to the feel supported throughout their pregnancy. Similarly, the mothers reported the explanations within the messages as favorable for their situation regarding the layout of the information. Conversely, references within discussions referred to information being irrelevant that did not take the context into consideration.

Theme III: Power Dynamics and Personal Circumstances

Though the central research question revolves around mobile message design for maternal health information for expectant mothers, the context of the Northern Ghana must not be overlooked. This section reports some of the contextual features that come into play while mothers are opting to receive health information from their mobile phone. Participants were not purposely asked questions related to the power dynamics of their community or personal circumstances; however, replies to other questions and or discussions allowed this theme to emerge from their responses. The value of the interviews and open-ended surveys lies in the wealth of information gleaned from the mothers who have and have not tried to incorporate the information within the messages into their personal lifestyles. For, these context features include family life, transportation, and income.

Family Life

Family life pertains to the structure of the mother's family concerning her lifestyle. Throughout the study, mothers reflected on their role within their family. Mothers expressed that they have a central position while being attached to several other members. Thus, while receiv-

ing the messages, they are connected to the husband due to him possibly receiving the information, or other co-wives who may have previously received the information, or other friends who are involved in the project. Thus while interviewing participants, I noted that power dynamics and personal circumstances might allow or hinder the mother to receive and abide by the information. Some comments were stated during the survey, focus group discussion, and group reflections while requesting participants to share improvements for the project. Data analysis results noted that family members, husbands, and other friends may hold a stake in the mother's life, which could lead to decisions that challenge their thoughts regarding maternal health.

Within the Northern Ghana culture, the traditional role of the husband is to provide and oversee the household. The men ultimately make all decisions for the mothers. For example, mothers must seek approval to receive mobile messages from their spouse. Also, the husband is responsible for sharing or purchasing a phone. The spouse may decide when the mother has a baby. Accordingly the participants and team members' discussions consisted of having husbands be more involved in maternal health. Since this culture consists of husbands having the role of being the provider and overseer, comments suggest that mothers would appreciate their involvement with maternal health while better understanding how to support them. Besides, the mothers wanted to learn how to motivate their husbands to be involved in their pregnancies. Mothers' focus groups, surveys and research team members stated:

Focus Group Responses

C02

The men just want to be there after birth but once you get pregnant then they deliberately get one day or two and so you can no longer tell them to buy anything for you and can't ask them to buy food things for you so…...So when they are pregnant the husband doesn't want to be bothered with them cause they can't do anything…oh because there production slows down…because the work around the house slows down…

Survey Responses
P129
Messages should teach husbands to support.

P57
Messages and projects should involve our husbands.

P36
Messages should involve our husbands so that they can give us their full support.

Team Reflection Responses
Translator #2
I learned a lot the women spoke a lot and giving an examples about how their husbands not really helping and all of those things...we are hoping that it gets better.

Team Reflection
We need to consider a situation where we...draft surveys for men as well...in as much as we are dealing directly with women men engagement is very necessary we need to get their views...we need to understand why they dodge their responsibilities. And we need to encourage them to send their wives to the hospital so we can speak to the women but if the husband doesn't make the discussion for her then she cannot do anything...and in a typical Ghanaian or Northern home...the husband makes the decisions so if we target the husbands...then they will be able to speak to their wives and then they will be able to respond to all of these issues...ANC...the diet and all of those things during pregnancy. All of those things are necessary as well. It might not be surveys but it can be a focus group discussion...just get the views from their perceptions on all of those things!!!

This section concludes that family life plays a significant role in the mother's decisions about maternal health. Husbands are at the forefront of these decisions .Overall, mothers expressed their concerns regarding having men become aware of maternal health. Statements included that mothers would like husbands to become a support system while taking into consideration their perspectives.

Transportation

In this study, transportation consists of the action of transporting mothers. The participants employed several modes of transportation including bus, motorcycle, and bicycle or walking. Comments included that mothers used these forms of transportation to attend the local

clinic for medical check-ups along with going to the nearest city to acquire goods. Distance in this context is reported in kilometers and miles and is the length the mothers had to travel to receive assistance from Prince Medical Clinic. The demographic data stated that mothers who took part in this study were between 16 to 19 km (10 to 12 miles) of the local clinic and 33 to 40 km (20 to 25 miles) of the closest town. Regarding the individuals involved in the MMHP, these two distinct communities were known to have a high number of mothers who participated in the MMHP, while also receiving mobile messages. Hence, as stated in the demographic section, there were specific inquiries regarding the distance within the survey. However, during the interviews and focus groups, remarks regarding transportation emerged as mothers discussed ANC and hospital visits. Within the data analysis, mothers commented on transportation challenges, along with how they overcame these challenges. There were several comments regarding transportation within the interviews, focus groups, and surveys mothers stated:

ANC visits
Interview-A04
I go to the clinic by bus… have a bus within this community that shuttles me to the clinic. Well the bus is from here to the nearest city….so when they see you need a ride they will drop you off.

Focus Groups-B01
Even the ANC attendance. We even had to go by ourselves…sometimes we had to walk.

ANC and Purchasing Items
Focus Group
C02
We had a challenge with the transportation…because some of the things that they told them on phone was that you have to go to the hospital for ANC, and so because of the transportation we couldn't get there...we couldn't even get some food to transport herself there so how...how do you see to yourself so that you may be healthy …..so we are saying of the phone messages that if you get these things than you will be healthy.

Focus Group
D03

Motorbike……..ok now with the transportation it depends on the family you are from…if your husband has a motorbike and you are lucky he can send you to that place, and if someone is going by bicycle or motorbike anything it can help you to go, but with the walking to the hospital there is no problem with that but when they get there coming back is a problem…because they will be standing on the roadside before they get to the clinic itself and when they are about to come home there won't be vehicles or cars to help them get back unless the one who sends you there come back for you.

Hospital Delivery
Interviews
A14
Transportation…when it is time for birth and may happen in the night. There is no way to the clinic ..no one going in or going out of the community..and mostly it starts at home…and when it starts at home ... labor there is a big rush…

A14
Yes, I had my babies at at home…since you are already in pain just stay at home and suffer pain at home…and not go to the clinic….and once you come home…there are no cars….no transportation.

A14 Interview
(looking at the last child) this particular child came early in the morning and just when I woke up I told my husband…I am in pain and I think I am in labor…so my husband quickly arranged for them to get to the clinic….but the previous ones happen during the night and by the time her water would break and if she tried to get transportation then she would probably have delivered …so I didn't even bother to go to the hospital.

Focus Groups
B01
The husband didn't help with the other ones…but this one he help out a lot he even took and carried me on a bike to be taken to the clinic

Survey
P193
I had babies at home because she was unable to get to the hospital

The following statements display that participants faced various challenges in regards to transportation. Some mothers resorted to walking to and from the local clinic while being pregnant, which took up to one hour and a half each direction if she did not catch a ride. However, if the husband or family had the income to address transport issues, then they could arrange for the

mother to attend the clinic while also having funds to go to the nearest market for baby supplies. This section concludes that transportation options for the mothers were limited unless they come from a family that has the means to support those attending ANC and hospital deliveries. Despite receiving the messages, mothers stated that there would be higher numbers of individuals delivering their babies with TBAs in local communities since they don't have access to attend the local health clinic.

Income and the Local Economy

Although the income sub-theme does not directly relate to the research question, the theme emerged from the data analysis that remained significant to the overall context and power and personal circumstances central theme. Income refers to the compensation within the household. The demographic data included that some mothers who took part in the study were involved in formal employment and mothers were mostly self-employed in farming or trading.

Hence, Ghana has a free delivery policy for mothers who are pregnant. Therefore, mothers who took part in this study received complementary services associated with maternal care. The data analysis reflected the mother's thoughts on cost. During the survey responses, mothers commented on the income topic while responding to questions focusing on the preferred format. Next, during interviews and focus groups, income was discussed while reflecting on challenges of the messages. Mothers noted that they could not afford a phone, transportation to the clinic, and food items. Individuals who discussed mobile phone issues believed that even though information was free, there was a cost involved which included purchasing a phone. Comments regarding the transportation to the clinic challenges consist of having funds to access local transport. Lastly, statements involving items to purchase for the baby relate to the husband being

unsupportive with the pregnancy process. Yet, members did make recommendations that might assist with them being able to receive information from the surveys and focus group

Phone
Survey Responses
P221
I prefer radio messages no money to pay before getting information

P223
I prefer face to face sessions because they offer free cost

Clinic
Interview Response A08
Yes,… the only option that I have is to go to the clinic and I don't go all of the time sometimes I don't have the funds to go…

Reflected in the statements above, participants recognize the significance of revenue. Mothers commented that if a mother were able to participate in receiving messages from a mobile phone, then the mother is considered "lucky" or coming from a family that provides funds to support the mother. Nonetheless, some of the mothers within this study took matters into their hands and thought about other individuals within their families that could support them during their pregnancy. Although the ultimate goal of the messages was to provide mothers with maternal health information, the messages may have reminded mothers about their personal situations that include not having the means to provide for themselves.

Power Dynamics and Personal Circumstances Summary

Although the focus of the research question did not include viewing power dynamics and personal circumstances, the mothers spotlighted their experiences which resulted in discussions regarding their families, transportation, and income. The participants valued their family and re-

spected their role as a wife to their husband. Conversely, they were steadily negotiating their decisions and opinions regarding maternal health to their spouses, co-wives, mothers in law, and other friends who are in a position of power within the mothers' lives. While receiving the messages, the mothers discussed that they needed support with challenges that were unique to their lifestyles while being pregnant. These challenges included not having transportation to the hospital along with limited funds to purchase supplies for their unborn child. Therefore, by receiving the messages, they noted that to put the information into practical usage the material should relate to their particular context.

Theme IV Perceived Gains

While focusing on the research questions and reviewing emerging data from participants, several debates between the mothers considered the value of the mobile message design for pregnant women in rural Northern Ghana. Thus, perceived gains within this study refers to the benefits or assets that mothers valued as a result of participating in the MMHP. This section of the chapter examines the beneficial elements that were discussed by the mothers while being involved in the MMHP. Participants were asked on several occasions about the beneficial characteristics while taking part in the project. Although some of these gains are not described directly by the mothers, they developed from the data analysis of the interviews, surveys, and focus groups. Therefore, the sub themes include the following: 1) knowledge, 2) empowerment, and 3) access to information.

Knowledge

Within this study, knowledge refers to new information that mothers acquired through an experience or by being educated through the tool of the mobile phone by way of mobile messages. The participants consistently referred to the term “knowledge” while describing the new

information. Hence, during the surveys, interviews, and focus groups, participants responded to questions that considered what they learned from the messages, while also exploring why they decided to perform the requested task. During the interviews, many mothers felt proud that they expanded their intellectual growth while partaking in a project that would provide self-improvement through learning more about maternal health. The mothers perceived that they gained knowledge about their pregnancy, which was empowering to them.

Although the mothers were receiving information from the healthcare professionals, they viewed their gains as ultimately having the choice to make decisions regarding her health. Some of the participants felt that they were at the mercy of traditional practices. Yet, by being exposed to the messages, they had the opportunity to investigate traditional information while also learning about current practices within maternal health. Nonetheless, providing mothers with the information was the first step to counteracting harmful traditional beliefs. Once the knowledge was received, the mothers would then make a decision about how to carry out their actions or maternal health activities. One mother within an open-ended survey noted:

Survey Responses
P4
She learned from the healthcare professionals that you can go to the hospital for ANC and not for delivery if it is your choice.

The mothers felt that they learned several new practices for instance, sexual intercourse and clinic deliveries. The mothers find joy in learning if the information is truthful, while also benefiting from the information. Mothers within in interviews, surveys and focus groups responded:

Diet and Nutrition
Interview A12
When I realized that I didn't have all of the information on all those things…I liked all of them because I had no previous information. I also mentioned that ..for 6 months the child shouldn't drink water…that is what she learned…

Focus Group B01
I learned about her diet…diet and nutrition and about what to eat …and how to improve my health…I also learned about how to take care of myself and her husband...and I also learned that I will have to visit the health center.

Focus Group C02
P2 AS
Translator
So it was the food …some of the things we didn't know that they were supposed to be eating.

Breastfeeding
Interview A03
Yes, breastfeeding I didn't know about breastfeeding exclusively. So the older children didn't get it.

Focus Group D01
For the breastfeeding it was my first time for the breastfeeding exclusively for 6 months.

Focus Group D01
With the exclusive breastfeeding it was my first time because she was educated on the way to do it.

Sexual Intercourse
Focus Group B01
With the first calls…they we are talking about how to manage with our husbands while being pregnant and having sex…some of us are scared to continue to have sex while being pregnant and some stay away from the men while they are pregnant and the calls encouraged me not to stay away from my husband.

Hospital Delivery
Focus Group C02
I didn't know that you were not to give birth in at home with untrained TBA…She gave birth at the hospital.

Also, if the mother was satisfied with the results of the new activity, then the behavior is reapplied over and over again and shared with others. Mothers from surveys stated:

Survey Responses

P20
Because when I practiced the information on the phone I become healthy.

P101
I found the truth through what they were saying.

P109
Because I tried and it worked for me.

P115
It helps me when I practiced.

P126
I trusted the information, it was very helpful, I looked at other people who benefited and I observed what they did and this is how I decided what to do.

P128
See the changes so I trusted.

P276
I trusted because the first four babies I didn't get some right information and I didn't know what to eat but this one I receive the right information and her pregnancy was good.

In summary the mothers viewed being informed about options allows them to make choices about and for themselves as a prerequisite of gaining knowledge. The information within the messages allowed them to consider different options in relation to maternal health. Before implementing the new practices, they reviewed where the information came from, observed others who previously participated in the practices, and then conducted a self-test and self-assessment before fully converting their behavior change.

Empowerment

Within this study, empowerment refers to how the mothers learned to get information so that they could understand information that was of interest to them, speaking up for themselves

while making their decisions, and finding out who would support them throughout their pregnancy. In rural settings of Northern Ghana typically, expectant mothers follow instructions based on what other mothers tell them, healthcare professionals, or traditional family practices. Therefore, by receiving the mobile messages on their phones, the mothers had the opportunity to be exposed to information that may or may not influence their decisions about maternal health. Moreover, if the mother decided to adhere to such practices, she made decisions based on her understandings for her life. Inquiries within the study did not specifically focus on knowledge or empowerment. However, throughout the surveys and focus groups, mothers commented on the reasoning for selecting mobile forms of communication. Meanwhile, in the focus group discussions, a mother stated how she overcame her challenges to being involved in the project.

While interviewing mothers they reflected on the discussions that the messages provided a chance for the mothers to problem solve while coming to terms with their understandings and decisions regarding maternal health. During the surveys, interviews, and focus groups, the mothers made comments regarding how the messages put them in a position to seek and find out information for themselves, while also establishing support for themselves within their environment. For instance, one mother discussed how she sought out others to gain an understanding. Her statement included:

Survey Response
P179
Ican seek the views of older women to be sure the contents of the messages are right.

It is interesting to review that the mother continues to gain an understanding by seeking out the views of older women who have experience being pregnant. The mother respects the elders and consults with them because this information is new and she is not sure if she can depend

on it. The mother views the messages as information discussed with other women and that she now has gained to apply to herself.

Once the mothers had positive attitudes about adopting the information from the messages, they began to voice their concerns about how the information applied to their current circumstances that revolved around their pregnancies. Since they believed that the healthcare professionals reflect a support system for them, they wanted to speak openly and freely to the source that they valued and trusted. Within the open-ended surveys mothers stated:

Survey Responses
P73
Because I can ask questions and empower herself freely.

P80
We can have interactions with them and to believe what they say.

Survey Responses
P174
To express myself freely.

P267
Having a discussion with nurses makes it easier to get attention.

The mothers realized that if they had support from a belief system that matches their preliminary decisions, then they will be able to gain more information from this source that ultimately leads to making decisions about their life. One particular mother in a focus group decided that she was going to speak up and make decisions for herself. The mother stated:

Focus Group Response
C02
Because my husband would not buy her a phone, I decided to ask her brother to buy me a phone I wanted to receive calls...she even went to the hospital...she wanted to support herself.

The mothers noted that to make maternal health decisions, they needed to have prior information or knowledge about the topic, or otherwise, their voices were powerless regarding maternal health within their families. However unintentionally, by providing mothers with tools e.g. mobile messages and experiences e.g. a research study may have allowed them to take greater control over their lives.

Access to Information

Access to information refers to the ability for the mothers to gain insight of maternal health information from being involved in the MMHP. The participants received maternal health information from various sources, such as their family members and TBAs. Yet, from the mothers' perspectives, their most valued and trusted source where the healthcare professionals. Frequently these professionals had limited amounts of time to speak with the mothers due to the overwhelming amount of appointments. They commented on the difficulty they had with inquiring about their pregnancy due to simply, in the words from one participant, "not knowing what to ask." Ultimately, the health care professionals provided them with ANC booklets which included general maternal health information with a particular focus on their ANC appointment details written in English. As stated before, most mothers within this setting do not read, write, nor speak English. Henceforth, the majority of the mothers relied on recommendations from other co-wives and close family friends who may have received information from a healthcare professional.

During the MMHP, once mothers started receiving messages, there were few reports of individuals who decided to discontinue their participation in the project. The local clinic noted the positive response to mothers' participation and decided to host workshops at the clinic as a supplement to the messages. These workshops concentrated on the information given within the

messages and hosted by midwives. The intent was to provide mothers who did not have the opportunity to receive messages the ability to receive the information in a face-to-face workshop at the local clinic. In the study, direct questions did not focus on the access to information. Yet, while inquiring about participants' reasoning for signing up, comments included access to information. The mothers perceived that easy access to information would provide them with "good health for their baby." Hence, by having access to information at all times through their mobile phones and having the workshops during convenient times at the clinic, they would be informed and would assist with their pregnancies. When asked why they signed up to receive mobile messages in the survey mothers stated:

Survey Responses
P134
Helps us to prepare well for delivery and we get to know our gestation periods.

P31
I wanted good health for my baby and me.

P29
Because it alert you all time to know the duration of the pregnancy.

P30
To get information that would ensure safe delivery

The mothers felt that they were gaining information about their pregnancy, which overall would contribute to their health. Some of the mothers believed that the only way to communicate information to them was through the mobile phone or face-to-face workshop sessions because midwives often don't have time to explain details like the messages do. One mother within an interview stated:

Interview Response
A12 …when you go to ANC it is important…but when you go there they will just check on you but not explain. Being aware of what is going on with your baby is a strong belief that the mothers had.

The individuals note that if they missed a message, it would put them in a state of uncertainty during their pregnancy. Therefore they became somewhat dependent on the messages. The mothers believed that overall the messages gave them more information while holding them responsible and also holding the health professionals accountable. By having access to the information, they were more likely to show up for ANC while expecting to be thoroughly checked out by the healthcare professionals during their appointments.

Overall, the mothers enjoyed learning how to do a new task such as breastfeeding or changing their diet. However, due to the limited amount of healthcare workers they are not always able to provide such detail about these different activities. Thereupon, the messages could be serving as a gap for mothers who want to describe explanations regarding their pregnancies.

Perceived Gains Summary

The participants viewed benefits as options that allowed them to make decisions regarding their pregnancy. In some cases of the mothers, the messages granted them access to information that overall constructed an opinion regarding their maternal health. The mothers considered the information as knowledge that would ultimately improve their pregnancy. Therefore, they were open to advocating for themselves, while also having the chance to make decisions about their life. Consequently by having access to the information they felt empowered about being exposed to new tasks such as; breastfeeding, diet nutrition, and ANC check-ups that revolved around their current situation.

Conclusion

This chapter presented a review of the findings of this study, including quantitative demographics. Also, four qualitative themes emerge from the data and were presented and discussed. Mobile message design involves considering characteristics of the users or learners who are on the receiving end. Participants were able to articulate their perspective and described their understandings and challenges to the mobile messages. In the next chapter, I will examine the study findings and provide an analysis.

5 DISCUSSION

Introduction

This study explored how the inputs influence of the mobile message design for expecting mother's maternal health in a rural setting of Northern Ghana. In Chapter 4, an analysis of interviews, survey data, and reflections were presented by reviewing quantitative demographics from 292 respondents while showing both frequencies and percentages. Following by, qualitative data from 31 mothers and ten team members that focused on one-on-one interviews, focus groups, open-ended survey questions and journal reflections. The study sought to answer the following primary question: What inputs of the mobile messages design influence expectant mothers maternal health in rural settings of Northern Ghana?

To elicit answers to the primary question, the study was guided by the following sub questions:

1. How does source of information influence the mobile message design for expecting mothers' maternal health?
2. How does information design and delivery of mobile messages influence expecting mothers' maternal health?
3. How do power dynamics and personal circumstances influence the mobile message design for expecting mothers' maternal health?
4. How do perceived gains influence the mobile message design for expecting mothers maternal health?

In this chapter, I will examine my findings in the context of reviewed literature. I will discuss areas for future research.

Field Description

Chapter Two discussed ethics as it relates to LMICs settings, individuals, mobile devices and local communities. According to Bhutta (2002) for the community and researcher to both benefit from the study, the research questions and community's development should be connected. Also, there should be consultation with the community on all levels of development of the research. In compliance with the statement, I had three years to focus this study. There were several major actors involved such as the NGO, local clinic, community leaders, and research team members. Several meetings took place to make sure that everyone had a clear understanding of the research process. Over the duration of two years the NGO sought additional funding to continue providing the messages. During this research study, the NGO received funds to continue providing the service to the communities for five additional years.

According to S. Moluneux and Geissler (2008) in an LMIC setting, researchers may face several challenges in mediating between priorities of the research institution and community setting. Similarly, in the research setting for this study, I negotiated between the adherences to community participants versus the formal research guidelines. For instance, while interviewing participants, most of the mothers wanted to expose their real names in connection with the research study; however, according to the institutional guidelines, researchers are not allowed to disclose participants' identity in fear of possibly harming the individuals. Nevertheless, mothers' expressed that they wanted their stories to be shared with individuals around the world to receive proper credit for what they stated. Thus, the mothers' attitudes and openness towards the research study may have shifted as a result of feeling that their voices were silent due to the formal guidelines. Bhutta (2002) notes, the process of interaction with participants can be complicated and have positive or negative reactions towards community members and researchers.

As the participants noted, the registration process of the project was unclear for some of the mothers. Miller (2003) suggests that while implementing mHealth initiatives, there is an obligation to make certain the expert performs additional follow-ups in the field along with providing basic training for the users and implementers. In this study, mothers who signed up but did not receive the messages may or may not have benefited from individuals conducting a trouble-shooting evaluation. Additionally, mothers commented on participating in training along with their husbands to feel competent with the messaging service.

Hughes (2012) suggests that while investigating in a community researchers place direct and indirect burdens on a community. Unintentionally, this study put direct and indirect burdens on the local clinic, study setting, and participants. For instance, commitments to serve on the research team diverted members from their responsibilities at the NGO or local clinic. Due to their workloads and limited staff, members were forced to return to their jobs after collecting data in the field. Hence, members were consistently balancing roles as a result of the study. Also, in one community the study took place at the youth center, the facility used the air-conditioner to allow participants to be comfortable. Consequently, the study used a public facility along with community resources. Furthermore, participants had daily responsibilities for their households. Some of the mothers were self-employed while others engaged in household chores. The research study diverted the mothers from their daily responsibilities. Fortunately, I avoided the term described by Hughes (2014) stated as “free riding”, by using received funds to conduct the research study. Thus all team members received compensation. Participants received gifts for their time, and the community, local clinic, and NGO received contributions for resources used throughout the research.

Information Source

Regarding information source the literature review in chapter 2 reveals that in instructional message design, persuasive techniques use critical communication in which a source introduces a message through a channel to a receiver (Fleming & Levi, 1993). Therefore, the perception of the source's credibility contributes to the likelihood of the receiver acceptance of information. Credibility is an attribute given to the source by the receiver (Fleming & Levi, 1993). In this study, the information in the messages may have influenced perceptions. Granting the mothers' had previous views regarding who they valued as a source, the messages had the ability to persuade the individuals' thoughts or attitudes towards their source of maternal health. For instance, the messages indirectly referred mothers to contacting health professionals' for assistance during their pregnancy. Particularly, if mothers were feeling weak, the information would advise them to attend the local health clinic. Consequently, asking the mothers to visit the health clinic implies that the knowledge or practices used by healthcare professions possess value. Nevertheless, the messages may inform the mothers to avoid specific dietary practices carried out by herbalists or TBAs accordingly, the mother would avoid these recommendations. Consequently, the mothers may observe that the healthcare professional gave them helpful information and the TBAs gave them unhelpful information. Notwithstanding, the mothers may have perceived that TBA's herbalist practices were harmful yet, the messages reinforce the ideas that healthcare professional's information is acceptable.

My findings were consistent with Fleming and Levi (1993) being that whomever the mothers valued as a source, they were most likely to accept the information. As stated before, some of the mothers' believed that the information came directly from the healthcare professionals, yet others were aware that the messages were from NGO. However mothers' who were

aware of the collaboration stated that they trusted the information because the professionals approved of the project. Therefore, the healthcare professionals were credible sources from the mothers' perspectives. In the case of mothers in this study, conversations with the mothers validated why the participants considered healthcare professionals, husbands, and TBAs as a source for maternal health.

Regarding the healthcare professionals, when mothers visited the local clinic, they were continuously reminded of the status that the healthcare professionals possess. The professionals had limited interaction with the mothers due to the number of individuals requesting their assistance. Thus, when the participants were in the healthcare professionals' presence, they would have her undivided attention while also agreeing to comply with recommendations. Hence, the healthcare professionals had a significant amount of influence. I noted several cases of the mother explaining that the professionals would encourage them to confront their husbands about signing up to receive the messages along with complying with the information. Study results showed that some participants believed that to have a safe pregnancy that they should yield to all the guidelines given by the healthcare professionals, even if it meant approaching their husbands for assistance. Ideally, according to Gallagher and Updefraff (2012) when presenting health messages, if the information represents an outcome directly or indirectly associated with a health-related decision individuals are more likely to consider the information.

Accordingly, Clark (2015) states that mHealth focused on maternal health programs provided a basis for questioning how gender roles connect with participants of the project along with the health program. Additionally, Clark (2015) notes that gender roles may reshape the societal roles within the setting by the use of mobile technologies. In the study, I found that partici-

pants who received the messages had several conversations with their husbands regarding transferring information. First, to receive the information the husband had to be present at the local clinic to register the phone. Following, he needed to relay the information to his wife; this information only came three times a week. The mothers noted that they tried their best to explain the process to their husbands. In some cases, their spouses escorted them to their ANC appointments while also participating in maternal health workshops at the local clinic. Though, the majority of the mothers shared phones with husbands in this study. Hence the typical role of a male within this culture was challenged due to the husband having to relay maternal health information, being responsible for providing assistance to transport his wife to the clinic, and also yielding to the health professionals' recommendations. Several mothers who did not receive the messages stated that their husbands did not adhere to the recommendations from the messages concerning transferring the information. Fleming (1993) argues that the goal of a message is to provide brief communication transferred through an agency from one person or group of individuals. The sender selects the messages from an information source. Afterward the sender sends the message through a communication channel (Fleming 1993, Shannon & Weaver, 1963, Carlile 2004). The receiver collects the message by decoding it and might take action based on the meaning of the receiver (Fleming 1993, Shannon & Weaver, 1963, Carlile 2004). Findings displayed husbands as receivers of the messages; they did not decode the information nor did they take action on the messages since there was no meaningful connection to the message.

Nevertheless, the husbands' behavior may represent how gender relations exist within the community. Findings from experts displayed the potential of mHealth interventions to aggravate existing household dynamics (Corker, 2010). Balasubramanian et at.(2010) examined gender hierarchies related to a women's mHealth intervention, disputes arose between couples due to

women having to negotiate the use of the mobile device for the project versus communication purposes for men. There were instances in this study when mothers stated that if their husbands were going to work or out of the community, they would take the phone and assume the mother would listen to the messages at a later date. Also, if the mothers did not properly inform the husbands to transfer the information, they would cut the message short by hanging up the phone if a call came in. In addition, mothers noted that there were several miscommunications with their husbands, they recommended that we include husbands in the message implementation process so that they both have an understanding of the requirements. Hence the mothers' recommendations are identical with current literature, suggesting greater male participation in mHealth initiatives. This may influence meaningful and positive interactions with men and women by providing new modes for couple's health communication and cooperation (Corker, 2010 and J.K. Ganle, 2015).

Davis and Resnicow (2001) proposes that valuing cultural considerations in health care are significant because they may relate to differing patterns of health behaviors that may influence health outcomes. Before receiving information from the messages and healthcare professionals, mothers sought maternal health assistance from TBAs. The mothers perceived that TBAs were responsible for delivering babies and providing them with local herbs that may assist them with their pregnancy. Mothers noted that the messages promoted having the option to deliver at home or in the community, yet they heavily encouraged mothers to proceed to the clinic for birthing. Although the messages gave participants the option of home birthing, they neglected traditional practices. Titaley, Hunter, Dibley, and Heywood (2010) examined women's preference for TBAs in Indonesia and concluded that mothers' value TBAs patience, wisdom, and access within the community. The messages may have included services that were beneficial to

mothers provided by the local TBA. For instance, I observed that participants struggled with expenses associated with transport to the clinic for ANC appointments. Thus, the messages could have encouraged mothers to seek a trained TBA located in the local community for ANC visits. Also, untrained TBAs could have been promoted to provide information regarding labor techniques while mothers are in labor. Additionally, the NGO may consider including information that ensures the target population's religious beliefs are respected. A majority of the women in this study were Muslim. Similar to the Ganle (2015) study on the use of healthcare professionals in Northern Ghana, Muslim women prefer female attendants in the community at birth due to the religious obligations of maintaining bodily sanctity, respect of their beliefs, and understanding of their moral values. Jokhio, Winter, and Cheng (2005) and Walraven &Weeks (1999) note that previous initiatives for maternal health have tried to involve TBAs in Pakistan and demonstrated that engaging TBAs had a favorable impact on perinatal mortality. However, discontinuing training for TBAs may bring harm (Walraven & Weeks, 1999). Therefore, adjustments to mHealth messages focused on maternal health should be conducted, taking into account the traditional values in the community. Mothers' reflections included that they would prefer to have their babies at the clinic with the trusted source, however several factors are at play regarding delivering at the hospital.

Often mothers felt that they did not have a choice to deliver their babies in the community versus the clinic while giving birth because they were in pain. Consequently, persons such as husbands, co-wives, friends, and mother-in-laws in the home made the decision. I concluded that those surrounded by the mothers must have similar beliefs. Mothers may have benefited from specialized message designs discussed by Young (2008) who argues that message design

should be examined based on cultural criteria as well as aesthetic criteria. Before attempts to incorporate culturally pluralistic perspectives into message design, the designer must first understand the culture's patterned way of thinking, feeling and reacting to the environment. In the example above, if the mothers feel that they have no choice in their delivery, then the designer must understand the mothers' thoughts and beliefs as it relates to their choices for birthing.

While reviewing the mothers' remarks I noticed that when the participants were in control of their actions they planned their attendance to ANC appointments, and they performed the actions that they valued as important. Though, in an environment where they did not have control, those around by them planned their actions. Accordingly, I noted that individuals surrounded by the participants must have similar perceptions regarding birthing practices since the decision is at the mercy of others. These findings are also in consonance with other previous studies in Ghana and Mali focused on the intra-familial power on maternal health (J.K. Ganle et al., (2015) and White et al, (2015)). J.K. Ganle et al., (2015) showed that husbands, mother-in-law's, grandmothers and compound heads were some of the decision makers.

My findings mainly illustrated the fact there was a power play in between the husband, mother-in-law, co-wives and anyone in the house during the time of a mother's delivery. Ganle (2015) reported that women in communities where Islam was dominant, religion limited their ability to participate in the decision-making process. Additional women with limited education appeared less likely to take part in making decisions regarding access to healthcare professionals. Research has shown that mHealth initiatives enhanced by mobile phone technologies, can foster women's empowerment (Corker, 2010). Nevertheless, these differences and power dynamics suggest that natural complexity of relationships within families and decision-making highlight

the need for close attention to context when examining mHealth initiatives that focus on maternal health.

Design and Delivery

From the field of instructional technology Wang and Shen (2012) propose that design principles that may apply to messages for mobile learning have yet to examine these possibilities on mobile devices. Experts note that the emphasis is placed on the mobility of the learner instead of the technology, therefore, specifies involve considering various circumstances such as illiteracy or rural settings that relate to the particular learners (Glassman et.al., 2012). In this study, the mothers shared with me several unique characteristics that relate to their lifestyles and traditional hierarchical structure that may impact design principles.

During focus group session, the participants explained to me that their daily duties include household chores such as washing clothes by hand, fetching water, cleaning, and preparing meals. Some of the mothers stated that they also assist with farming land. Hence, having the information disseminated through the mobile phone was convenient for their way of living. Their findings are similar to Mitchell's et al. (2013) statements, who proposed that consistently reachable status and information transmission are the characteristics of mobile phones that have allowed them to achieve high populace. Additionally, Lustra et al. (2013) note that having access to a mobile device shifts the dissemination of healthcare information. Though the mothers agree with the diffusion method of the mobile device, they also commented on the voice message selection that they employed as their options. Within the demographic data 42% of participants preferred voice messages. In contrast to the majority of mHealth studies that use SMS, the mothers preferred voice messages, similar to the MoTech project organized in Ghana where mothers had options of receiving voice or SMS messages, in which their study results included 90% of

participants opting to receive voice messages. Similarly, as Labriue et al. (2013) states, voice messages offer accessibility to illiterate populaces and provide the ability to be voice recorded in any dialect. The findings revealed that participants sign up for voice messages and preferred messages translated in their local language. Therefore as stated in the UNESCO policy for mobile learning (2013), local language options for LMIC populations when designing mobile messages are necessary.

While examining design principles that relate to mobile messages one may consider the persuasive principle of tailoring that suggests providing information that is custom-made to the learner's needs, identity, setting, and various elements unique to the person (Fogg, 2002). Gunawardena and LaPointe (2008) note that if all design specifications focus on a target audience, then cultural demographics are specialized rather than generic. Likewise, in this study the messages were designed to include mothers' specific gestation periods, which were easily relatable to the participants.

On the contrary, the messages included revised information deemed relevant to the mother's cultural characteristics. I found that while mothers communicated with their husbands, co-wives, or friends, they needed to justify their reasoning for incorporating and practicing the emerging information. Overall the messages challenge mothers to decipher which information to follow. I discovered that while being pregnant, mothers are offered advice from several actors that hold significant positions in their lives such as their mother-in-law, husband, co-wives, etc. Thus the message design should include how to navigate this process. Reeves (2007) states that research in instructional design has considerations for designers such as cultural informants. The informant acts as a buffer while ensuring the portrayal of traditions, language and other interests of the community (Scheel & Branch, 1993). While the messages included some features such as

language options and content relevancy identified in the design, disconnections occurred between the mother's customs and traditions. Therefore, I believe that the mother, along with her personal community, needed a clear understanding while adhering to the information. As Scheel and Branch (1993) stated, multiple interpretations and perspectives can influence the design process. My thoughts include that characteristics should be in agreement with the viewpoint of the community and the receiver, then grouped by specific attributes of the individuals. For example a mother who is pregnant for the first time will receive different messages from those pregnant for the second or third time. Similar to Powell's (1997) remarks, designing with culture in mind may be multi-tiered while including a variety of factors, therefore, more attention to details may be required.

Kreuter and McClure (2004) state that program organizers must include an in-depth examination of demographically defined groups. My research team provided me with an understanding that overall in urban settings of Ghana such as the capital cities of the North and South regions, mother's possess mobile devices. However, in rural northern contexts distant from urban environments, hierarchical household structures may pose challenges to mothers receiving the information through the mobile device. Hence, the study results revealed that the messages along with the project required further depth into the culture, while noticing that various culture groups may exist in one country. Additionally, the two-stage practical approach that recommends a way to address culture in health communication described by Kreuter and McClure (2004), including 1) recognizing subgroups 2) comprehending shared characteristics that impact health, may benefit an understanding for designers and implementers of mHealth projects.

Ultimately, in the Chapter 2 discussion concerning mHealth messages for LMICs, one could infer that one-way messages are useful when information is targeted for large populations

while providing information about healthy behaviors and testing services (Waugaman, 2014). While two-way messages are beneficial for stigmatized issues such as HIV's and STDs support or assistance (Waugaman, 2014). In contrast to the assumption, study results showed that mothers preferred two-way communication. While speaking to mothers who did and did not receive messages, they expressed that the messages did not allow for them to have conversations with health professionals on their phone. The mothers who were technologically savvy entertained the idea of an online chat group that may enable them to interact with one another. On the contrary, the participants could not communicate with one another via online, they were able to participate in face-to-face sessions organized by the local clinic. As noted from my pilot study and communication from my team, the conception of the workshops occurred after providing mobile messages to mothers. The NGO realized that all mothers, regardless of receiving messages or not, demanded access to the information. However, the majority of mothers in the study including those who received messages stated that they would like to have these workshops within their communities. Similar to McGuire's (1985) thoughts, no one media type has shown to have more dominant persuasive effectiveness than any other along with neither are as effective as face-to-face communication.

Overall there have been positive perceptions regarding the mobile phone subscriptions in Ghana (GSS & Macro, 2009). By providing mothers with messages, they have collaborated to help bridge the communication gap between health providers and patients (Deglise, Suggs, & Odermatt, 2012; Kallander et al, 2012). Likewise in the study, if mothers did not receive their messages, they felt disconnected or out of reach from healthcare professionals. They were eager and willing to learn from the professionals how to care for themselves and their babies while adopting the use of the mobile phone to receive the information.

Power Dynamics and Personal Circumstances

According to Kallander et al. (2013) the rapid development of maternal health mHealth projects is due to women having access to mobile phones. Paul et al. (2015) stated that women are 21% less likely than men to own a phone. In this study due to the culture roles, mothers rarely possess a personal phone. Instead, they depend on their husband's phone for the messages or for him to transfer the messages to her. Moreover, Steenson and Donner (2009) state that mobile phone practices of device-sharing make it difficult for the dissemination for women groups.

Clark (2015) notes that mHealth for maternal care creates tensions within a society when the communication–information infrastructure layers over an existing socio-cultural foundation. Hence several tensions described by the mothers including roles of themselves, husbands and healthcare professionals exist in the study. The mothers and team members explained that throughout all pregnancies that happen in the community, mothers are observant of other mothers' practices. Once a mother begins to have complications with her pregnancy that results in losing a baby or her life, others examine her decisions to learn how they may avoid these outcomes. Once this project started, mothers were resistant to receiving the messages; however, as mothers signed up, others saw the benefits that they were receiving regarding their pregnancy and deliveries. Therefore, the information provided in the messages placed the healthcare professionals in a position of power since they successfully demonstrated that the knowledge they possess ultimately save lives. In return, other mothers received the knowledge and used it to navigate the importance of pregnancy to individuals who may not have considered the components of maternal health. These individuals included their husband, co-wives, friends, and TBAs.

The mothers stated that the information overall empowered them to voice their opinion as it relates to decisions they had to make for their pregnancy. There was one instance that a mother

reported tension between her and her spouse. Once the mother started to receive the information, power shifted in the relationship due to her demanding items described in the messages. Therefore, the husband discontinued her participation in the project because he did not have funds to support the mothers as requested in the messages. My research team noted that instead of asking the mothers to purchase items organizers or designers should observe what they have access to in the communities. Subsequently, the team members noted that these mothers are always on the receiving end, and that during our interactions with the participants the conversations allowed them to advocate for their necessities in regards to maternal health.

In Chapter 2 I discussed the concept of equity in partnerships while implementing mHealth projects. As described developed countries often control the technology implementation, developments, monitoring, and evaluation (Ali, 2016). Yet local actors collaborate to the project and contribute to its implementation (Al Dahda, et al..2015). Therefore mHealth raises complex issues regarding distribution power and control (Al Dahda, et al.,2015). Similarly, with this project, mothers have complex problems that need examining through redistribution of powers between private and public actors. However, in this study, the researchers opted to design a grassroots system for the mobile message to include the considerations of the mothers, along with the local clinic deciding to revise their current outreach program to include a more relatable approach for the mothers by providing demonstration videos during their weekly workshops. According to Lemaire (2013) mHealth is leaning towards new approaches in public health by rearranging roles and allowing new actors to implement a socio-technical system

Perceived Gains

Constructivists Cooper (1993), Jonassen (1990; 1991), Kember and Murphy (1990) conclude that knowledge happens through connections between learners' prior understandings and

new, authentic experiences with the world. In contrast, information does not exist autonomously of learners. Identically, findings showed the mothers perceived gains included new knowledge as it relates to maternal health information. Participants noted that while receiving the information they connected these new tasks to their reality or experiences throughout their pregnancy. By putting these tasks into practice while connecting their personal experiences, they concluded that knowledge occurred.

Fleming (1993) suggests that message design is an active process of manipulating information that can achieve behavior change in learners. While interviewing participants, I noticed that once mothers decided to adhere to the information within the messages, they commented on their behavior changes regarding maternal health. These changes included diet alterations, breastfeeding implementations, sexual intercourse engagements, and hospital delivery participations. If the mother successfully implemented the new task, it is likely that she trusted and believed the information which may have resulted in her continuing changing her practices. Also, as mothers gained and practiced this new knowledge, they possessed ownership over their pregnancy. For example, if information that they received encouraged them to receive iron supplements or a scan during their ANC visits, the mothers were more likely to hold the healthcare professionals accountable for these actions described in the messages. Also, the messages may have promoted self-diagnosis throughout their pregnancy. Their actions were in agreement with Kisvit's (2013) statement that notes with the assistance of mobile technology, a patient feels liberated to endorse a diagnosis that he or she brings to the consultation.

Implications

The major contribution this study makes to existing knowledge on mobile message design is its unique consideration of the mhealth practices use in rural settings of Northern Ghana

for expecting mothers. The themes provide insight into mothers' influences regarding the mobile message design by observing their attitudes, beliefs, and behaviors. The results are useful for several groups-instructional designers, mHealth, local NGOs and local hospital clinics. What follows are implication relevant to this study based on the findings and analysis.

Instructional Designers

An instructional designer's' task is to help deliver effective, efficient, and appealing instruction (Reigeeluth & Frick, 1999 pg. 196). Implications of this study for this group of people involved understanding the connections of effective, efficient, and appealing and being able to implement those characteristics in mobile message design. This may require instructional designers to expand their own learning. In consultations with local individuals within the community or community volunteers from the local clinic, they could provide better solutions to bridge the gap between the objectives of the message and the mother's needs.

Employed throughout various countries are several mHealth projects that focus on messaging for maternal health. However, there continues to be a lack of conversation about the features and characteristics that designers do not address. I recommend reexamining the cultural attributes of the users' local environment for individuals designing for mobile devices, particularly for distance instruction, designers or others who may tailor content in the distance vicinity. This examination process may include the designer visiting the local site to conduct analysis on the users or involving a cultural insider within the community that has a similar background of the user to implement an analysis before designing messages. When designing instruction that contradicts local customs, designers must be as intimate as possible with understanding the user's context while integrating the belief system of traditions. Also, I recommend that designs include several language options while putting emphasis on the local dialect or language spoken by the

users. One might even consider issuing responsive voice survey to potential users to learn more about the mother tongue or local dialect.

I also recommend designing an orientation to all mobile maternal health projects. The orientation may include the organization or individuals involved in employing the messages along with the users of the messages. The orientation may introduce a brief statement regarding the project and overview along with a face-to-face community orientation session. I recommend conducting follow-up procedures with all members receiving the information along with a troubleshooting plan that involves reaching out to members who have trouble with receiving the messages.

mHealth

One other group for which this study holds implications is that of mHealth providers. This study contributes to educators' understanding in identifying various forms of learning. Some studies on mobile learning and mHealth have included the use of mobile phones (Traxler, 2007). However few studies exist on research that broadens access to timely health information and healthcare services through mobile voice messages, by the inclusion of mobile messages being sent to individuals in rural communities with limited healthcare facilities, or cultural domination in terms of access to healthcare services.

As a contribution to mHealth, this study adds to how mobile messages have the potential to transcend the designer and subscriber of the messages. Also, this study contributes to how mobile messages serve as a health educational tool for individuals from diverse cultural backgrounds, were seeking medical attention are influenced primarily by cultural beliefs and practices (Helman, 2007; Vaughn, Farrah, & Baker 2009). Additionally, the study explores some of

the challenges of using mobile messages for maternal health information as a way of contributing to data for future research.

Lastly, gender participation in development is a vital sector that this study contributes to in decision-making when it comes to maternal health. In Ghana the government is constantly reminding men and women to be involved in decision-making processes, especially in rural communities. Obtaining information through voice messages on the phone related to maternal health would in one way or another reduce the traditional beliefs and practices where women would need the consent of the husband or head of household of the family before seeking medical help. Also, the recommendations from this study are to have men provide input to the development of future mHealth projects offered in rural settings.

Future Research

Expand Research Setting-The findings from this study are limited to participants disseminating mobile messages for individuals in rural settings of Northern Ghana. Because of my interest in mobile message design and the lack of studies that focus specifically on design qualities for mobile devices, it would be valuable to replicate the study using a similar context within an LMIC or urban setting. Further research could draw a larger sample from both rural and urban communities to compare results. Additionally, since studies frequently omit cultural practices from conversations such as the family planning topic, a researcher could stay in the community for a longer period to familiarize his/herself with the participants to establish trust by learning about the culture.

Expand research topics

Mothers from this study requested additional maternal health information following their pregnancy. Hence, I suggest considering a continuation of maternal health messages that focuses

on infant or child health messages such as birth to five. Studies may also be conducted to understand the influences of messages that are grouped by the number of births. For instance, mothers who are experiencing pregnancy for the first time receiving different messages compared to those experiencing pregnancy for the second time.

Perspectives from Male Participants

Furthermore, in future studies mothers and husbands both with and without mobile phones could be included in the population, this would provide an understanding of the reasoning for participating in the program, as well as obtaining diverse views about maternal health. My recommendations for development projects on mHealth include the use of informational images to mothers to show or explain the importance of maternal health to both mothers and husbands to provide an understanding to both parties involved.

Social Enterprise

The findings from this study add to the literature on ways of addressing health inequities in remote communities through conducting capacity-building projects. The study also assists development agencies and hospital clinics on the means of promoting adult maternal health education and means of addressing issues related to maternal health project accountability. Future research may include studies that foster interaction among local developmental agencies and residents in the quest for citizen empowerment regarding strategies to use in planning and implementing mHealth through voice messages, for example, collaboration through partnerships with community organizations, health professionals, and academics. Research projects may focus on an increase in qualitative and quantitative research methods, as well as mixed methods and approaches. Most importantly, these collaborative arrangements can do much to enhance the prospects for effective mHealth project for rural communities. Upon graduation of a partnership, the

plan has the potential to serve as a model for similar university-community partnerships at a time when rural communities need assistance. Faculty members and students within the US can make valuable contributions to various projects. Furthermore, the knowledge created through this applied research will help inform doctoral students, researchers, and policymakers about the opportunities associated with mHealth projects in remote regions.

Closing Remarks

Hence, I would conclude by saying this study has been tremendous in diverse ways in terms of beliefs about maternal health, source of maternal health information, and design and delivery characteristics of maternal health messages. As a result, this study was indeed worth investigating. Every day individuals shape their beliefs about health and actions by the interaction of information, communication, and technology. These processes make up a context for people to understand and use health information, significantly influencing their health choices and behaviors. With the developing complexity of health information and health care settings, most individuals require additional supportive relationships, information, and skills to meet their health needs.

Henceforth, instructional design along with public health disciplines has the ability to use strategies to improve health care quality, health equity, and health outcomes. For instance, through the application of user-centered design, access to health information and services challenged by users with limited literacy skills may be increased. Yet, disparities in access to health information and technology can result in lower rates of preventive services and less knowledge of disease management. Also, in this study, technology is viewed as a tool to access maternal health information, therefore other forms of communication such as community outreach, and

interpersonal communication are essential to ensuring that information is understandable to make good health decisions.

This research was conducted in a location and with communities that are rural and remote, and where cultural beliefs still play a major role in the promotion of maternal health. I found this study to be an opportunity in several ways: It offered to me, as an outsider/insider, various opportunities to understand not only cultural diversity, but the ability to delve into issues pertaining to rural Ghana, specifically health issues confronting individuals living in both remote and overly culturally-sensitive countries. This provides an avenue for policy-makers to employ findings from the research to develop strategies and working policies to assist individuals in rural and remote areas, not only in Ghana, but also in other sub-Saharan African countries.

REFERENCES

Addai, I., & Pokimica, J. (2010). Ethnicity and economic well-being: The case of Ghana. *Social indicators research, 99*(3), 487-510.

Addai, Isaac. (2000). Determinants of use of maternal–child health services in rural Ghana. *Journal of Biosocial science, 32*(01), 1-15.

Agre, P., & Rapkin, B. (2003). Improving informed consent: a comparison of four consent tools. *IRB: Ethics & Human Research*.

Ali, E. E., Chew, L., & Yap, K. Y. L. (2016). Evolution and current status of mhealth research: a systematic review. *BMJ Innovations*, bmjinnov-2015.

Aker, J. C., & Mbiti, I. M. (2010). Mobile phones and economic development in Africa. *The Journal of Economic Perspectives*, *24*(3), 207-232.

Alcalay, R., & Bell, R. (2000). Promoting nutrition and physical activity through social marketing: Current practices and recommendations. In *Promoting nutrition and* University of California. Center for Advanced Studies in Nutrition and Social Marketing.

Al Dahdah, M., Du Loû, A. D., & Méadel, C. (2015). Mobile health and maternal care: A winning combination for healthcare in the developing world?. *Health Policy and Technology*, *4*(3), 225-231.

Alva, S. (2013, November). M&E of mama's mhealth program to improve quality of maternal health care. In *141st APHA Annual Meeting (November 2-November 6, 2013)*. APHA.

Ambient Insight | International Mobile Learning Research. (2014). *Ambient Insight | International Mobile Learning Research*. Retrieved February 21, 2014, from http://www.ambientinsight.com/Reports/MobileLearning.aspx#section5

Ansong-Tornui, Janet, Armar-Klemesu, Margaret, Arhinful, Daniel, Penfold, Suzanne, & Hussein, Julia. (2007). Hospital based maternity care in Ghana-findings of a confidential enquiry into maternal deaths. *Ghana medical journal, 41*(3).

Aranda-Jan, C. B., Mohutsiwa-Dibe, N., & Loukanova, S. (2014). Systematic review on what works, what does not work and why of implementation of mobile health (mHealth) projects in Africa. *BMC public health*, *14*(1), 1.

Aryee, K. L. (2014). The Role of Mobile Phones in Health Education for Rural Communities in Ghana: An Exploratory Study in Digital Technologies.

Aseweh Abor, P., Abekah-Nkrumah, G., Sakyi, K., Adjasi, C. K., & Abor, J. (2011). The socio-economic determinants of maternal health care utilization in Ghana. *International Jour nal of Social Economics*, *38*(7), 628-648.

Ayensu, E. A. (2003). *Communication and culture in Ghana: Technology's influence and pro gress in a new digital age* (Doctoral dissertation, Georgetown University).

Balasubramanian, K., Thamizoli, P., Umar, A., & Kanwar, A. (2010). Using mobile phones to promote lifelong learning among rural women in Southern India. *Distance Education*, *31*(2), 193-209.

Beebe, J. (1995). Basic concepts and techniques or rapid appraisal. Human Organization, 54(1), 42-51.

Bamberger, M., Rugh, J., & Mabry, L. (2006). RealWorld Evaluation. Working under Budget. *Time*, *Data*.

Benatar, S. R., & Singer, P. A. (2000). A new look at international research ethics. *British Medi cal Journal*, *321*(7264), 824.

Benigeri, M., & Pluye, P. (2003). Shortcomings of health information on the Internet. *Health Promotion International*, *18*(4), 381–386

Berry, F. S., & Berry, W. D. (1990). State lottery adoptions as policy innovations: An event history analysis. *The American Political Science Review*, 395-415.

Bhutta, Z. A. (2002). Ethics in international health research: a perspective from the developing world. *Bulletin of the World Health Organization*, *80*(2), 114-120.

Bishop, M. J. (2014). Reconceptualizing instructional message design: Toward the development of a new guiding framework. In *Design in educational technolo gy* (pp. 143-159). Springer International Publishing.

Blay-Palmer, A. (2005). Growing innovation policy: the case of organic agriculture in Ontario, Canada. *Environment and Planning C: Government and Policy*, *23*(4), 557-581.

Bogdan, R., & Biklen, S. (2007). Qualitative research for education: An introduction to theory and practice.

Brown, K. K., Donkoh, S. A., & Alhassan, H. (2012). Perceptions of Development in the Northern region of Ghana.

Brown, Tom. (2003). *The role of m-learning in the future of e-learning in Africa.* Paper presented at *the 21st ICDE World Conference*. Retrieved from http://www. tml. tkk. fi/Opinnot.

Brown, T. H. (2008). M-learning in Africa: Doing the unthinkable and reaching the unreachable. In *International handbook of information technology in primary and secondary education* (pp. 861-871). Springer US.

Carlsson, B., Jacobsson, S., Holmén, M., & Rickne, A. (2002). Innovation systems: analytical and methodological issues. *Research policy*, *31*(2), 233-245.

Chambers, R. (2002). Relaxed and participatory appraisal. Retrieved October 12, 2003, from http://www.ids.ac.uk/ids/particip/research/pra/pranotes02.pdf

Cho, H. (2011). *Health communication message design: Theory and practice*. Sage.

CIA, C. (2011). *CIA World Factbook*. Tech. rep. Retrieved 2012-05-27.

Clarke, P. B. (1982). West Africa and Islam: A Study of Religious Development from the 8th to the 20th Century.

Cockcroft, Sophie, Sandhu, Neelam, & Norris, Anthony. (2009). How does national culture affect citizens' rights of access to personal health information and I nformed consent? *Health informatics journal*, *15*(3), 229-243.

Corcoran, N. (Ed.). (2013). *Communicating health: strategies for health promotion*. Sage.

Corker, J. (2010). Ligne Verte" toll-free hotline: using cell phones to increase access to family planning information in the Democratic Republic of Congo. *Cases in Public Health Com munication & Marketing, 4*, 23-37.

Costello, A., & Zumla, A. (2000). Moving to research partnerships in developing countries. *Brit ish Medical Journal, 321*(7264), 827.

Crotty, M. (1998). *The foundations of social research: Meaning and perspective in the research process*. Sage.

Commission. (2013). Reports and Documents. *Broadband Commission*. Retrieved February 21, 2014, from http://www.broadbandcommission.org/work/documents.aspx

Cooper, P. A. (1993). Paradigm shifts in designed instruction: From behaviorism to cognitivism to constructivism. *EDUCATIONAL TECHNOLOGY-SADDLE BROOK NJ-, 33*, 12-12.

Cormick, G., Kim, N. A., Rodgers, A., Gibbons, L., Buekens, P. M., Belizán, J. M., & Althabe, F. (2012). Interest of pregnant women in the use of SMS (short message service) text messages for the improvement of perinatal and postnatal care. *Reprod Health*, *9*(9).

Creswell, J. W., & Clark, V. L. P. (2007). Designing and conducting mixed methods re search.

Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. *Handbook of mixed methods in social and be havioral research*, 209-240.

Cunningham, D., & Duffy, T. (1996). Constructivism: Implications for the design and d elivery of instruction. *Handbook of research for educational communications and technology*, 170-198.

Curlette, W. L. (2006). A Framework for Research Studies: Mixed Methods through Combining Bayesian Statistics and Qualitative Research in Individual Psychol ogy. *Journal of Individual Psychology*, *62*(3).

Déglise, C., Suggs, L. S., & Odermatt, P. (2012). SMS for disease control in developing countries: a systematic review of mobile health applications.*Journal of Telemedicine and Telecare*, *18*(5), 273-281.

Department of State. (2011, May 3). Harnessing Mobile Phone Technology To Improve Maternal and Child Health "Mobile Alliance for Maternal Action" Partnership Estab lished. *U.S. Department of State*. Retrieved December 4, 2013, from http://www.state.gov/r/pa/prs/ps/2011/05/162469.htm

De Vaus, D. (2013). *Surveys in social research*. Routledge.

Dewey, J. (1900). Psychology and social practice. *Science*, 321-333.

Dyer, Kirsti A. "Ethical challenges of medicine and health on the Internet: a review." *Journal of Medical Internet Research* 3.2 (2001): e23.

Elder, R. W., Shults, R. A., Sleet, D. A., Nichols, J. L., Thompson, R. S., Rajab, W., & Task Force on Community Preventive Services. (2004). Effectiveness of mass media campaigns for reducing drinking and driving and alcohol-involved crashes: a systematic review. *American Journal of preventive medicine*, *27*(1), 57-65.

Fleming, M. L. (1993). *Instructional message design: Principles from the behavioral and cognitive sciences*. Educational Technology.

Ferebee, S. S. (2010). Successful persuasive technology for behavior reduction: mapping to fogg's gray behavior grid. In *Persuasive Technology*(pp. 70-81). Springer Berlin Heidelberg.

Fleming, M. L., & Levie, W. H. (1978). *Instructional message design: Principles from the behavioral sciences*. Educational Technology.

Fogg, B. J. (2002). Persuasive technology: using computers to change what we think and do. *Ubiquity*, *2002*(December), 5.

Fogg, B. J. (2009, April). A behavior model for persuasive design. In*Proceedings of the 4th international Conference on Persuasive Technology*(p. 40). ACM.

Furstenberg, G., Levet, S., English, K., & Maillet, K. (2001). Giving a virtual voice to the silent language of culture: The CULTURA project. *Language learning & tech nology*, *5*(1), 55-102.

Gallagher, K. M., & Updegraff, J. A. (2012). Health message framing effects on attitudes, intentions, and behavior: a meta-analytic review. *Annals of behavioral medi cine*, *43*(1), 101-116.

Ganle, J. K. (2015). Why Muslim women in Northern Ghana do not use skilled maternal healthcare services at health facilities: a qualitative study.*BMC international health and human rights*, *15*(1), 1.

Ganle, J. K., Parker, M., Fitpatrick, R., & Otupiri, E. (2014). Free maternity care and equity of access to maternal health services in Ghana: a descriptive study. *Int J Equity Health*, *13*, 89.

Ganle, J. K., Obeng, B., Segbefia, A. Y., Mwinyuri, V., Yeboah, J. Y., & Baatiema, L. (2015). How intra-familial decision-making affects women's access to, and use of maternal healthcare services in Ghana: a qualitative study. *BMC Pregnancy & Childbirth, 15*(1), 1.

Ghana. Statistical Service. (2005). *2000 Population & Housing Census of Ghana: GA-MY* (Vol. 2). Ghana Statistical Service.

Ghana Statistical Service. Census Report (2014). Retrieved March 10, 2016, from http://www.statsghana.gov.gh/

Ghana Statistical Service. Social and Demographic Statistics (2014). Retrieved March 11, 2016, from http://www.statsghana.gov.gh/

Ghana Statistical Service. Kumbunga District Census Report (2010). Retrieved March 11, 2016, from http://www.statsghana.gov.gh/

Gikonyo, C., Bejon, P., Marsh, V., & Molyneux, S. (2008). Taking social relationships seriously: lessons learned from the informed consent practices of a vaccine trial on the Kenyan Coast. *Social science & medicine, 67*(5), 708-720.

Glassman, P., Helgeson, M., & Kattlove, J. (2012). Using telehealth technologies to improve oral health for vulnerable and underserved populations. *Journal of the California Dental Association, 40*(7), 579-585.

Goh, T. T., Seet, B. C., & Chen, N. S. (2012). The impact of persuasive SMS on stu dents' self- regulated learning. *British Journal of Educational Technolo gy*, *43*(4), 624-640.

Green, J., & Thorogood, N. (2013). *Qualitative methods for health research*. Sage.

Greenspun, H., & Coughlin, S. (2013). Physician adoption of health Information technology: Implications for medical practice leaders and busi ness partners. *Washington, DC: Deloitte Soultions.*

Grimwood, K. (1990). Telemedicine in developing countries. *N Engl J Med*, *323*, 1657-1663.

Grabowski, B. L. (2004). Generative learning contributions to the design of instruction and learning. *Handbook of research on educational communications and tech nology*, *2*.

Grimwood, K. (1990). Telemedicine in developing countries. *N Engl J Med*,*323*, 1657-63.

Gurman, T. A., Rubin, S. E., & Roess, A. A. (2012). Effectiveness of mHealth behavior change communication interventions in developing countries: a systematic review of the literature. *Journal of health communication*,*17*(sup1), 82-104.

GSS, G., & Macro, I. (2009). Ghana demographic and health survey 2008. *Accra, Ghana: Ghana Statistical Service, Ghana Health Service, and ICF Macro*.

Gyimah, S. O., Takyi, B. K., & Addai, I. (2006). Challenges to the reproductive-health needs of African women: on religion and maternal health utilization in Ghana. *Social science & medicine*, *62*(12), 2930-2944.

Hecht, M. L., & Choi, H. (2012). The communication theory of identity as a framework for health message design. *Health Communication Message Design: Theory and Practice. Los Angeles, CA: Sage*, 137-152.

Hofstede, G. (2010). Geert hofstede. *National cultural dimensions*.

Hughes, R. C. (2012). Individual risk and community benefit in international research. *Journal of medical ethics*, *38*(10), 626-629.

Hughes, R. C. (2014). Justifying community benefit requirements in international research. *Bio ethics*, *28*(8), 397-404.

Isaacs, S. (2012). *Turning on mobile learning in Africa and the Middle East: Illustrative initiatives and policy implications*. UNESCO Working Paper Series on Mobile Learning, United Nations Educational, Scientific and Cultural Organ ization: de Fontenot, viewed 12 November 2012, from http://unesdoc. unesco. org/images/0021/002163/216359e. pdf.

Istepanian, R., Laxminarayan, S., & Pattichis, C. S. (2006). *M-health*. Springer Science Business Media, Incorporated.

Januszewski, A., & Molenda, M. (Eds.). (2013). *Educational technology: A definition with commentary*. Routledge.

Jentsch, B., & Pilley, C. (2003). Research relationships between the South and the North: Cin derella and the ugly sisters? *Social science & medicine, 57*(10), 1957-1967.

Johnson, B., & Turner, L. A. (2003). Data collection strategies in mixed methods re search. *Handbook of mixed methods in social and behavioral research*, 297-319.

Jokhio, A. H., Winter, H. R., & Cheng, K. K. (2005). An intervention involving traditional birth attendants and perinatal and maternal mortality in Pakistan.*New England Journal of Med icine*, *352*(20), 2091-2099.

Jonassen, D. H. (1990). Thinking Technology: Toward a Constructivist View of In structional Design. *Educational technology*, *30*(9), 32-34.

Kahneman, D., & Tversky, A. (2013). Prospect Theory: An Analysis of Decision under Risk, Econometrica, XLVII (1979), 263-291.

Kankam, B. (2013, September 27). Maternal mortality still on the rise in Ghana. Cit ifmonline.com. Retrieved December 4, 2013, from http://www.citifmonline.com/?id=1.1546696

Källander, K., Tibenderana, J. K., Akpogheneta, O. J., Strachan, D. L., Hill, Z., ten Asbroek, A. H., ... & Meek, S. R. (2013). Mobile health (mHealth) approaches and lessons for increased performance and retention of community health workers in low-and middle-income countries: a review.*Journal of medical Internet re search*, *15*(1), e17.

Kay, M., Santos, J., & Takane, M. (2011). mHealth: New horizons for health through mobile technologies. *World Health Organization*, 66-71.

Kang, H., & Sundar, S. S. (2016). When Self Is the Source: Effects of Media Cus tomization on Message Processing. *Media Psychology*.

Kember, D., & Murphy, D. (1990). Alternative New Directions for Instructional De sign. *Educational Technology*, *30*(8), 42-47.

Kotzé, P. User-centred Design in a Developing Country and International Context.

Kralisch, A., Eisend, M., & Berendt, B. (2005, July). Impact of culture on website navigation behavior. In *Proc. HCI-International*.

Kreuter, M. W., & McClure, S. M. (2004). The role of culture in health communication. *Annu. Rev. Public Health*, *25*, 439-455.

Kukulska-Hulme, A., & Traxler, J. (2005). Mobile teaching and learning.*Mobile learning-a handbook for educators and trainers*, 25-44.

Kraut, R. (2013). UNESCO Policy Guidelines for Mobile Learning. *France: UNESCO*.

Kyomuhendo, Grace Bantebya. (2003). Low use of rural maternity services in Uganda: impact of women's status, traditional beliefs and limited resources. *Reproductive health matters*, *11*(21), 16-26.

Labrique, A. B., Vasudevan, L., Kochi, E., Fabricant, R., & Mehl, G. (2013). mHealth innovations as health system strengthening tools: 12 common applications and a visual framework. *Global Health: Science and Practice*,*1*(2), 160-171.

Lasswell, H. D. (1948). The structure and function of communication in society. *The communication of ideas*, *37*, 215-228.

Lemaire, J. (2013). Developing mHealth Partnerships for Scale. *Advanced Development for Africa, Geneva*.

Liamputtong, P., Haritavorn, N., & Kiatying-Angsulee, N. (2013). AIDS support groups and women living with HIV/AIDS in Central Thailand. In*Stigma, Discrimination and Living with HIV/AIDS* (pp. 377-397). Springer Netherlands.

.

Lindegger, G., Milford, C., Slack, C., Quayle, M., Xaba, X., & Vardas, E. (2006). Beyond the checklist: assessing understanding for HIV vaccine trial participation in South Africa. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, *43*(5), 560-566.

Ling, R., & Campbell, S. W. (Eds.). (2011). *Mobile communication: Bringing us together and tearing us apart* (Vol. 1). Transaction Publishers.

Lodico, M. G., Spaulding, D. T., & Voegtle, K. H. (2010). *Methods in educational research: From theory to practice* (Vol. 28). John Wiley & Sons.

Lohr, L. L., & Ku, H. Y. (2003). Development of a Web-Based Template for Active Learn ing. *Quarterly Review of Distance Education*, *4*(3), 213-26.

London, A. J. (2005). Justice and the human development approach to international re-search. *Hastings Center Report*, *35*(1), 24-37.

Lori, Jody R, Rominski, Sarah D, Gyakobo, Mawuli, Muriu, Eunice W, Kweku, Nakua E, & Agyei-Baffour, Peter. (2012). Perceived barriers and motivating factors influenc ing student midwives' acceptance of rural postings in Ghana. *Human resources for health*, *10*(1), 17.

Low, L., & O'Connell, M. (2006, September). Learner-centric design of digital mobile learning. In *Proceedings of the OLT Conference* (pp. 71-82).

Lupton, D., & Jutel, A. (2015). 'It's like having a physician in your pocket!'A critical analysis of self-diagnosis smartphone apps. *Social Science & Medicine, 133*, 128-135.

Marshall, C., & Rossman, G. B. (2014). *Designing qualitative research*. Sage public cations.

Martínez-Pérez, B., de la Torre-Díez, I., & López-Coronado, M. (2013). Mobile health applications for the most prevalent conditions by the World Health Organization: review and analysis. *Journal of medical Internet research, 15*(6), e120.

Maruyama, G. M., & Deno, S. L. (1992). *Research in educational settings*(Vol. 29). Sage.

McAnany, D. (2009). Monkeys on the screen?: Multicultural issues in instructional message design. *Canadian Journal of Learning and Technology/La revue cana dienne de l'apprentissage et de la technologie*,*35*(1).

McCoy, S., Galletta, D. F., & King, W. R. (2005). Integrating national culture into IS research: The need for current individual level measures.*Communications of the Association for Information Systems*, *15*(1), 12.

McGuire, W. J. (1981). Theoretical foundations of campaigns.

McGuire, W. J. (1969). The nature of attitudes and attitude change. *The handbook of social psychology*, *3*(2), 136-314.

McGuire, W. J. (2001). Input and output variables currently promising for constructing persuasive communications. *Public communication campaigns*,*3*, 22-48.

McGuire, W. J. (1984). Public communication as a strategy for inducing health- promoting behavioral change. *Preventive medicine*, *13*(3), 299-319.

MacQueen, K. M., McLellan, E., Metzger, D. S., Kegeles, S., Strauss, R. P., Scotti, R., ... & Trotter, R. T. (2001). What is community? An evidence-based definition for participatory public health. *American journal of public health*,*91*(12), 1929-1938.

McLoughlin, C. (1999). The implications of the research literature on learning styles for the design of instructional material. *Australasian Journal of Educational Technology*, *15*(3), 222-241.

Merriam, S. B. (1998). *Qualitative Research and Case Study Applications in Education. Revised and Expanded from*. Jossey-Bass Publishers, 350 Sansome St, San Francisco, CA 94104.

Mayer, R. E. (2003). The promise of multimedia learning: using the same instructional design methods across different media. *Learning and instruction*, *13*(2), 125-139.

Miller, E. A. (2003). The technical and interpersonal aspects of telemedicine: effects ondoctor–patient communication. *Journal of telemedicine and telecare*, *9*(1), 1-7.

Minkler, M., & Wallerstein, N. (Eds.). (2011). *Community-based participatory re search for health: From process to outcomes*. John Wiley & Sons.

Molyneux, S., & Geissler, P. W. (2008). Ethics and the ethnography of medical research in Africa. *Social Science & Medicine*, *67*(5), 685-695.

Molyneux, C., Peshu, N., & Marsh, K. (2004). Understanding of informed consent in a low-in come setting: three case studies from the Kenyan Coast. *Social science & medicine*, *59*(12), 2547-2559.

Molyneux, S., & Geissler, P. W. (2008). Ethics and the ethnography of medical research in Af rica. *Social science & medicine*, *67*(5), 685-695.

MOTECH Lessons Learned. (2012, September 1). *MOTECH Lessons Learned*. Retrieved December 4, 2013, from http://www.grameenfoundation.org/sites/grameenfoundation.org/files/MOTECH-Lessons-Learned-Sept-2012.pdf

Morrison, R. Kalman and Kemp (2011). Designing Effective Instruction.

Motlik, S. (2008). Mobile learning in developing nations. *The International Review of Research in Open and Distributed Learning*, *9*(2).

Munro, P., van der Horst, G., Willans, S., Kemeny, P., Christiansen, A., & Schiavone, N. (2016). Social enterprise development and renewable energy dissemination in Africa: The experience of the community charging station model in Sierra Leone. *Progress in Development Studies*, *16*(1), 24-38.

Murphy, L. L., & Priebe, A. E. (2011). "My co-wife can borrow my mobile phone!" Gendered Geographies of Cell Phone Usage and Significance for Rural Kenyans. *Gender, Technology and Development*, *15*(1), 1-23.

Murray, S. A. (1999). Experiences with "rapid appraisal" in primary care: involving the public in assessing health needs, orientating staff, and educating medical students. *Bmj*, *318*(7181), 440-444.

Nations. (2008). Wireless Technology for Social Change: Trends in NGO mobile use. United Nations Foundation. Retrieved February 21, 2014, from http://www.unfoundation.org/news-and-media/publications-and- speeches/wireless-technology-for-social-change.html

Nakamura, H., Ikeda, N., Stickley, A., Mori, R., & Shibuya, K. (2011). Achieving MDG 4 in s ub-Saharan Africa: what has contributed to the accelerated child mortality decline in Ghana?. *PloS one*, *6*(3), e17774.

Naismith, L. (2007). Using text messaging to support administrative communication in higher education. *Active Learning in Higher Education*,*8*(2), 155-171.

Niederdeppe, Jeff. "Conceptual, empirical, and practical issues in developing valid measures of public communication campaign exposure."*Communication Methods and Measures* 8, no. 2 (2014): 138-161.

Nyonator, Frank K, Awoonor-Williams, J Koku, Phillips, James F, Jones, Tanya C, & Miller, Robert A. (2005). The Ghana community-based health planning and services ini tiative for scaling up service delivery innovation. *Health policy and planning*, *20*(1), 25-34.

Nutbeam, D. (2000). Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health promo tion international*, *15*(3), 259-267.

Odigie, V. I., Yusufu, L. M. D., Dawotola, D. A., Ejagwulu, F., Abur, P., Mai, A., ... & Odigie, E. C. (2012). The mobile phone as a tool in improving cancer care in Nigeria. *Psycho-Oncology*, *21*(3), 332-335.

Ofosu, A. (2009). Mobile devices: The essential medical equipment for the future. Retrieved from http://www.ghanahealthservice.org/includes/upload/publications/Mobile%20Devices.pdf

Ong, B. N., Humphris, G., Annett, H., & Rifkin, S. (1991). Rapid appraisal in an urban setting, an example from the developed world. *Social science & medicine*, *32*(8), 909-915.

Palmer, C. A. (1999). Rapid appraisal of needs in reproductive health care in southern Sudan: qualitative study. *BMJ*, *319*(7212), 743-748.

Paul, A., Thompson, K. M., & Heinström, J. (2015, November). After access: an inquiry into ICT use factors for Indian women. In *Proceedings of the 78th ASIS&T*

Annual Meeting: Information Science with Impact: Research in and for the Community (p. 35). American Society for Information Science.

Pettersson, R. (2002). *Information design: An introduction* (Vol. 3). John Benjamins Publishing.

Petty, R. E., & Wegener, D. T. (1998). Matching versus mismatching attitude functions: Implica tions for scrutiny of persuasive messages. *Personality and Social Psychology Bulletin, 24*(3), 227-240

Pincas, A. (2001). Culture, cognition and communication in global education.*Distance Education*, *22*(1), 30-51.

Pellow, D. (2011). Internal transmigrants: A Dagomba diaspora. *American Eth nologist*, *38*(1), 132-147.

Prabhu, A. (2013). mHealth: The Emerging Sub-segment of eHealth. *The journal of contemporary dental practice*, *14*(3).

Prakash, S., Kaur, M., Singh, B., Singh, A., Goyal, P., Surana, A., ... & Chaturvedi, R. (2015). A rapid appraisal of factors influencing utilization of primary eye health services among the residents in a rural community.

Punchoojit, L., & Chintakovid, T. (2012). An Overview of Research on the Ac commodation of Culture into Web Design. In *The International Conference in Business and Management and Information Sciences. Retrieved March*(Vol. 5, p. 2012).

Reeves, T. C. (1991). Ten commandments for the evaluation of interactive multimedia in higher education. *Journal of Computing in Higher education*,*2*(2), 84-113.

Reeves, T. (1994). Evaluating what really matters in computer-based education . *Com puter education : New perspectives*, 219-246.

Reigeluth, C. M., & Frick, T. W. (1999). Formative research: A methodology for creating and improving design theories. In *In CM Reigeluth (Ed.), Instructional-design theories*.

Rice, N., & Smith, P. C. (2001). Ethics and geographical equity in health care.*Journal of Medi cal Ethics*, *27*(4), 256-261.

Roberts, L. W., Battaglia, J., & Epstein, R. S. (1999). Frontier ethics: Mental health care needs and ethical dilemmas in rural communities. *Psychiatric Services*.

Rocco, T. S., & Plakhotnik, M. S. (2009). Literature reviews, conceptual frameworks, a nd theoretical frameworks: Terms, functions, and distinctions.*Human Resource Development Review*

Rosell-Aguilar, F., & Qian, K. (2015). Design and user evaluation of a mobile application to teach Chinese characters. *JALT CALL Journal*, *11*(1).

Salant, P., Dillman, I., & Don, A. (1994). *How to conduct your own survey*(No. 300.723 S3.).

Sanou, B. (2014). ICT facts and figures. *International Telecommunications Union*.

Sarasohn-Kahn, J. (2013). A role for patients: the argument for self-care.*American journal of preventive medicine*, *44*(1), S16-S18.

Savery, J. R., & Duffy, T. M. (1995). Problem based learning: An instructional model and its constructivist framework. *Educational technology*, *35*(5), 31-38.

Scheel, N. P., & Branch, R. C. (1993). The role of conversation and culture in the sys tematic design of instruction. *EDUCATIONAL TECHNOLOGY-SADDLE BROOK NJ-*, *33*, 7-7.

Stewart, C. M., Shields, S. F., & Sen, N. (2001). Diversity in on-line discussions: A study of cultural and gender differences in listservs. *Culture, technology, communica tion: Towards an intercultural global village*, 161-186.

Sun, Yongqiang, Wang, Nan, Guo, Xitong, & Peng, Zeyu. (2013). UNDERSTANDING THE ACCEPTANCE OF MOBILE HEALTH SERVICES: A COMPARISON AND INTEGRATION OF ALTERNATIVE MODELS. *Journal of Electronic Commerce Research, 14*(2).

Scale, C. (2004). Coding and analysing data. *Researching society and culture*, 305.

Stake, R. E. (1995). *The art of case study research*. Sage.

Takyi, B. K. (2003). Religion and women's health in Ghana: Insights into HIV/AIDS preventive and protective behavior. *Social science & medicine, 56*(6), 1221-1234

Tamrat, T., & Kachnowski, S. (2012). Special delivery: an analysis of mHealth in matern al and newborn health programs and their outcomes around the world. *Maternal and child health journal, 16*(5), 1092-1101.

Tashakkori, A., & Teddlie, C. (1998). *Mixed methodology: Combining qualitative and quantitative approaches* (Vol. 46). Sage.

Theobald, S., & Nhlema-Simwaka, B. (2008). The research, policy and practice interface: Re flections on using applied social research to promote equity in health in Malawi. *Social science & medicine, 67*(5), 760-770.

Thomas, K. (2003). *Religion and the decline of magic: studies in popular beliefs in six teenth and seventeenth-century England*. Penguin UK.

Throup, D. W., Jackson, C., Bain, K., & Ort, R. (2014). Developing Commercial Agriculture in Ghana. *The World Bank's Experience*, 145.

Titaley, C. R., Hunter, C. L., Dibley, M. J., & Heywood, P. (2010). Why do some women still prefer traditional birth attendants and home delivery?: a qualitative study on delivery care services in West Java Province, Indonesia. *BMC pregnancy and childbirth*, *10*(1), 1.

Tripp, N., Hainey, K., Liu, A., Poulton, A., Peek, M., Kim, J., & Nanan, R. (2014). An emerging model of maternity care: Smartphone, midwife, doctor?.*Women and Birth*, *27*(1), 64-67.

Tones, K., & Green, J. (2004). *Health promotion: planning and strategies*. Sage.

Torrado-Carvajal, A., Rodriguez-Sanchez, M. C., Rodriguez-Moreno, A., Borromeo, S., Garro-Gomez, C., Hernandez-Tamames, J. A., & Luaces, M. (2012, August). Changing communications within hospital and home health care. In *Engineering in Medicine and Biology Society (EMBC), 2012 Annual International Conference of the IEEE* (pp. 6074-6077). IEEE.

United Nations SDGs .Sustainable Development Knowledge Platform. (2015). Retrieved Octo ber 14, 2016, from https://sustainabledevelopment.un.org/sdgs

Ushe, U. M. (2015). The Talking Drum: An Inquiry into the Reach of a Traditional Mode of Communication. *International Journal*, *3*(1), 110-117.

Van Biljon, J., & Kotzé, P. (2008). Cultural Factors in a Mobile Phone Adoption and Usage Model. *J. UCS*, *14*(16), 2650-2679.

Vaughn, L. M., Jacquez, F., & Bakar, R. C. (2009). Cultural health attributions, beliefs, and prac tices: Effects on healthcare and medical education. *The Open Medical Education Jour nal*, *2*(1).

Vavoula, G. N., Lefrere, P., O'Malley, C., Sharples, M., & Taylor, J. (2004). Producing guidelines for learning, teaching and tutoring in a mobile environment. In *Wireless and Mobile Technologies in Education, 2004. Proceedings. The 2nd IEEE International Workshop on* (pp. 173-176). IEEE.

Wang, M., & Shen, R. (2012). Message design for mobile learning: Learning theories, human cognition and design principles. *British Journal of Educational Tech nology*, *43*(4), 561-575.

Walraven, G., & Weeks, A. (1999). Editorial: the role of (traditional) birth attendants with midwifery skills in the reduction of maternal mortality.*Tropical medicine & international health*, *4*(8), 527-529.

White, D., Dynes, M., Rubardt, M., Sissoko, K., & Stephenson, R. (2013). The influence of in trafamilial power on maternal health care in Mali: perspectives of women, men and moth ers-in-law. *International perspectives on sexual and reproductive health*, 58-68.

WHO | Mobilizing communities to improve maternal health ... (2011). Retrieved from http://www.who.int/bulletin/volumes/92/1/13-122721/en/

Witter, S., Adjei, S., Armar-Klemesu, M., & Graham, W. (2009). Providing free maternal health care: ten lessons from an evaluation of the national delivery exemption policy in Ghana. *Global Health Action*, *2*.

World Health Organization. (2014). Reducing maternal and child mortality in Zanzibar: Wired Mothers.

Yin, R. (2003). K.(2003). Case study research: Design and methods. *Sage Publications, Inc*, *5*, 11.

Yin, R. K. (2009). Case study research: Design and methods, 4th. *Thousand Oaks*.

Yin, R. K. (2013). *Case study research: Design and methods*. Sage publications.

Yakong, V. N., Rush, K. L., Bassett- Smith, J., Bottorff, J. L., & Robinson, C. (2010). Women's experiences of seeking reproductive health care in rural Ghana: chal lenges for maternal health service utilization. *Journal of advanced nurs ing*, *66*(11), 2431-2441.

Young, P. A. (2008). Integrating culture in the design of ICTs. *British Journal of Educa tional Technology*, *39*(1), 6-17.

Winn, W. (1993). A conceptual basis for educational applications of virtual reali ty. *Technical Publication R-93-9, Human Interface Technology Laboratory of the Washington Technology Center, Seattle: University of Washington*.

Witter, S., Arhinful, D. K., Kusi, A., & Zakariah-Akoto, S. (2007). The experience of Ghana in implementing a user fee exemption policy to provide free delivery care. *Reproductive health matters*, *15*(30), 61-71.

APPENDICES

Appendix A. Site Approval Letter

Dear Sir/Madam,

Reference: Research Study, Mobile Message Design: A Multiple Case Study of a Maternal Health Project in Northern Ghana

Dear Mrs. Erica Bass-Flimmons

Based on the Research Study Proposal received from you and the comments from Savana Signatures staff on the study proposal, I am happy to mention that your research study proposal has been approved by [redacted] r implementation in the communities that are selected by Kings Medical center regarding the mobile maternal health project organized by [redacted] within the Northern Region of Ghana.

You may issue surveys, organize small focus groups, conduct one-on-one semi-structured interviews, collect document, hospital, and mobile messaging records with 300 total participants during, before or after the community sessions in order to complete your study. Please remember that the Executive Director has the final right of approval or denial of the research proposal at the site. In addition, note that community members within may elect not to participate in the study and attendance is only voluntary.

This approval is valid for 12 months from the date on this approval letter. Should there be any changes in the agenda or design a request for these changes must be submitted in writing to the Executive Director of the organization. Changes should not be initiated until written approval is received. Further, should there be a need to extend the time requested for the project; the researcher must submit a written request for approval at least two weeks prior to the anniversary date of the most recent approval.

[redacted]

[redacted]

Appendix B. Informed Consent

Georgia State University

Department of Learning Technologies

Informed Consent

Title: Mobile Message Design: A Multiple Case Study of a Mobile Maternal Health Project

Principal Investigator: Steve Harmon, Wanjira Kinuthia
Co-Investigator: Elizabeth Armstrong-Mensah
Student-PI Erica Bass:

I. Purpose:

You are invited to be in a research study. The purpose of the study is to seek the views of mobile messaging for maternal health. You are invited to take part in this study because you live in a rural community. You are invited to take part in this study because have been in the mobile maternal health initiative. A total of 350 members will be called up for this study.

If you are interested in taking part in the study, you will be asked to voluntarily participate in a survey. If you decide to participate in the survey, you may also be asked to take part in a one-one-one interview, document review, group interview, and data records review based on certain criteria below. If you decide to join the study, you will take part in the following for each procedure:

Survey Participation:

- Once for 15 minutes
- Criteria: Members of the community involving expecting non-expecting mothers, expecting mothers, nursing mothers, health care helpers, and husbands.

One-on-One semi-structured interviews Participation:

- Once for 25 minutes to 35 minutes
- Criteria: 24 expecting mothers will be selected that took part in the survey to participate in a one-on-one interview

Focus Group Participation:

- Once for 25 minutes
- Criteria: 5 to 7 persons will be selected that took part in the survey to Participate in an all-male group, all-female group, or all key informant group.

II. Procedures:

If you choose to take part in the study, you will be asked to respond to survey questions. Then, you may be asked to be in a one-on-one semi-structured interview session, next, you may be asked to take part in a document review and one-on-one semi-structured interview session. Lastly, you may be asked be asked to take part in a group interview and a records review. Below are the details for each procedure:

To take part in the survey: You will answer 20 survey questions. The questions will try to find out your outlook on the use of mobile messaging for maternal health. The survey will take about 15 minutes. The survey will take place in the same classroom as the maternal health workshops and community sessions.

To take part in one-on-one semi structured interviews: You will meet one time for 20 minutes to talk. You will be asked to answer questions. The questions will try to find out how you view the guidance from the mobile messages. They questions will also try to find out your outlook on the health activities talked about in the messaging. The one-on-one semi-structured interviews will take place that is best for you. After the interview, you may ask to have your answers repeated. The session will be recorded. Audio records will be made into a paper record. You will receive a copy of the paper record and may make changes.

To take part in the document review. You will be asked questions about your saved mobile messages that you receive and your 1st survey during the sign-up of the project. The questions will try to find out how you view the guidance from the mobile messages. They questions will also try to find out your outlook on the health activities talked about in the messaging. The document review will take place that is best for you. After the review, you may ask to have your answers repeated. The session will be recorded. Audio records will be made into a paper record. You will receive a copy of the paper record and may make changes.

To take part in the focus groups: You will be in either an all-male, all female group, or all key informant group to answer group questions. Each group will meet one time for 25 minutes. The questions will try to find out the group's outlook on the use of mobile maternal health messages and will also try to find out the group's concerns about mobile maternal health. The focus group will take place in the same classroom as the maternal health workshop. The sessions will be recorded. Audio records will be made into a paper record.

You will receive a copy of your individual record that will include your personal responses and may make changes.

To take part in the records review: You will be asked to answer questions. You will be asked to allow the research team to review your mobile messaging records (number of messages you received length, and date). The team will try to find out how often you viewed the messages and how many message you received while in the project. The records will be recorded into a paper record. You will receive a copy of the paper record and may make changes.

III. Risks:

In this study, you will not have any more risks than you would in a normal day of life.

IV. Benefits:

If you agree to take part in this study it may or may not help you personally. We hope to gain many views from people in your community. Overall, we hope to gain many views about maternal health from persons in rural communities.

V. Voluntary Participation and Withdrawal:

To take part in this research is voluntary. You do not have to be in this study. If you decide to take part in this study and change your mind, you have the right to drop out at any time. You may not answer some questions or not take part at any time. Whatever you decide, you will not lose any benefits to which you are otherwise entitled.

VI. Confidentiality:

We will keep your records private to the extent allowed by law. Dr. Susan Ogletree, Dr. Steve Harmon, Dr. Wanjira Kinuthia, Dr. Armstrong-Mensah, and Erica Bass will have access to the information you provide. Information may also be shared with those who make sure the study is done correctly (GSU Institutional Review Board, the Office for Human Research Protection (OHRP). We will use the fake names rather than your name on study records. Since focus groups will be used we are asking that you do not reveal what was discussed in the group, however, we do not have complete control of the confidentiality of the data. The information you provide will be stored. Your data in the form of a survey answers audio recordings, and paper records of audio records, will be kept under lock and key at the researcher's home. Your name and other facts that might point to you will not appear when we present this study or publish its results. The findings will be summarized and reported in group form. You will not be identified personally.

VII. Contact Persons:

Contact **Dr. Wanjira Kinuthia o**r Erica Bass at 404-40-3188 at ebass3@student.gsu.edu if you have questions, concerns, or complaints about this study. You can also call if you think you have been harmed by the study. Call Susan Vogtner in the Georgia State University Office of Research Integrity at 404-413-3513 or svogtner1@gsu.edu if you want to talk to someone who does not take part of the study team. You can talk about questions, concerns, offer input, obtain information, or suggestions about the study. You can also call Susan Vogtner if you have questions or concerns about your rights in this study.

VIII. Copy of Consent Form to Subject:

We will give you a copy of this consent form to keep.

If you are willing to volunteer for the survey participation please sign below.

_____ _____

Participant Date

_____ _____

Principal Investigator or Researcher Obtaining Consent Date

Being that you signed up for the survey participation, you have the option to willingly volunteer for the one-on-one semi-structured interview participation while being audio recorded. Please sign below

_____ _____

Participant Date

_____ _____

Principal Investigator or Researcher Obtaining Consent Date

Being that you signed up for the survey participation, you have the option to willingly volunteer for the document review participation. Please sign below

_____ _____

Participant Date

_____ _____

Principal Investigator or Researcher Obtaining Consent Date

Being that you signed up for the survey participation, you have the option to willingly volunteer for the group interview participation while being audio recorded. Please sign below

_____ _____

Participant Date

_____ _____

Principal Investigator or Researcher Obtaining Consent Date

Being that you signed up for the survey participation, you have the option to willingly volunteer for the records review participation while being recorded. Please sign below

_____ _____

Participant Date

_____ _____

Principal Investigator or Researcher Obtaining Consent Date

Appendix C. Chief's Call Translation

"Attention! Attention! Attention! This message is from the chief. That you should be informed that all pregnant women that attended the King's Medical Center and gave birth at the facility or home and also provided their names and numbers to the center should please make it a point to be at the youth center tomorrow morning. You will meet with some visitors from the King's Village for an important discussion. Thank You!"

Appendix D. Confidentiality Agreement Cultural Insider

CONFIDENTIALITY AGREEMENT

Title of Research Project: Mobile Message Design: A Multiple Case Study of A Maternal Health Project in Northern Ghana

Local Principal Investigator: Erica Bass

By being a cultural insider of this research study I understand that I may have access to confidential information about study sites and participants. By signing this statement, I am indicating my understanding of my responsibilities to maintain confidentiality and agree to the following:

- I understand that names and any other identifying information about study sites and participants are completely confidential.
- I agree not to divulge, publish, or otherwise make known to unauthorized persons or to the public any information obtained in the course of this research project that could identify the persons who participated in the study.
- I understand that all information about study sites or participants obtained or accessed by me in the course of my work is confidential. I agree not to divulge or otherwise make known to unauthorized persons any of this information, unless specifically authorized to do so by approved protocol or by the local principal investigator acting in response to applicable law or court order, or public health or clinical need.
- I understand that I am not to read information about study sites or participants, or any other confidential documents, nor ask questions of study participants for my own personal information but only to the extent and for the purpose of performing my assigned duties on this research project.
- I agree to notify the local principal investigator immediately should I become aware of an actual breach of confidentiality or a situation which could potentially result in a breach, whether this be on my part or on the part of another person.
- I, _____ (Name of translator) certify that I will translate the information into Dagbani for mothers and community members and make sure they understand all aspects of what this research study entails. I certify that I will translate the information to English that is provided to me by the mother with regards to consent is true.

_____ _____ _____

Signature Date Printed name

_____ _____ _____

Signature of local principal investigator Date Printed name

Appendix E. Research Team Member's Profile

Gender	Role on Research Team	Region of Birth	Formal Education and areas of Study	Nature of current job	Reason for participating on project	Additional Projects
Male	Survey Data Collector	Northern Region	Construction Technician	Medical Records Assistant/Program Assistant: Water/Sanitation Community Development and Public Health Community Coordinator	I decided to join this research team so that I could expand my knowledge in research and to reach out to the communities to touch their lives through the project.	Ghana Access and Affordability Program-hypertensive and diabetic patients.
Male	Survey Data Collector	Upper East Region	BS-Economics and Mathematics Certificate: Evaluating Social Programs Certificate: Results Based Monitoring and Evaluation	Head of programs and monitoring and evaluation. Designs and implement performance management system.	I was interested in the project to assess the impact of one of the health projects that implemented in Kumbungu. This provided an opportunity for me as the M&E manager, to know first-hand, how women fell about the maternal health project, what worked well and what did not. It provided a platform to collect significant change stories and lessons.	
Male	Survey Data Collector	Northern Region	BS Public Health and Allied Sciences	Medical records officer	My interest in public health activities and interventions was what encouraged me to take part of in the project. It was seen	

					as a great opportunity for me as I see myself in the near future planning interventions for rural and deprived areas in northern Ghana and beyond.	
Female	Survey Data Collector/Translator Focus Group	Northern Region	BS-Management and Administrative Studies Currently: Masters in Policy Development and Implementation	Fundraising, designing and implementing projects that target young people, girls, maternal mortality, community development, gender, SGBV, SRHR activism	I realized that there are lots of young people who are deprived of basic needs. I was inspired to create the change I wish to see by engaging young people to realize their self worth so they can be empowered to make informed decisions regarding their growth and livelihood.	Technology for Girls in Action
Female	Survey Data Collector/Translator Focus Group	Upper West Region	BS-Community Nutrition	Healthcare and Community Development	This project would allow more time and effective participation of target group which means the project stands the better chance of achieving more accurate and greater results.	
Female	Translator-Interviews and Focus Groups	Upper West Region	High School Certificate-Broadcast Journalism	Event Management		
Male	Research Organizer	USA	BS-Communication MS Business Administration	Logistics Management	This project allowed for me to develop my logistic skills with community development at	

					an international capacity.	
Male	Research Organizer	Northern Region	High School Certificate	Currier	This project allowed for me to learn more about carrying out research projects with communities in rural settings.	

Appendix F. Survey Instrument

Title: Mobile Message Design: A Multiple Case Study of a Maternal Health Project in Northern Ghana

Ticket Number_____

1. Expectant Mother received mobile maternal health messages?
yes
no

2. Take pictures of Ticket attached to mother ANC books and ANC appointment
LOOK ON THE BACK SHEET

Please respond to all questions as best as you can. Duration: 15 minutes.

A. Demographic information

1. Age (Years):

2. Gender:
   ☐☐Female
   ☐☐Male

3. Walking or Driving to Kings Medical Center:

4. Marital status (Please check)
   ☐☐Married
   ☐☐Separated
   ☐☐Divorced
   ☐☐Never married
   ☐ Other (please specify) _____

5. How many children do you have?

6. Highest level of education (Please check)
   ☐☐☐Secondary education
   ☐☐☐Primary education
   ☐☐☐Informal education
   ☐☐☐No formal schooling
   ☐☐☐Other (specify) _____

7. Did you attend maternal health workshops at Kings Medical

8. How many maternal health workshops did you attend at Kings Medical?

9. Did your husband attend knowledge sharing sessions at Kings Medical?
☐☐☐ Yes
☐☐☐ No

10. Did receive voice calls or text during your pregnancy about maternal health?
☐☐☐ Voice messages
☐☐☐ Text messages
☐☐☐ Neither

11. If you gave out your number at Kings Medical but did not receive calls during your pregnancy what were some of the challenges?

(1-4) Attitudes of Mobile Maternal Health Information

Please respond to all questions best as you can. Please mark (X) the answer that best describes your views about the following statements

SD=Strongly Disagree, D= Disagree, N=Neutral/No opinion, A=Agree, SA=Strongly Agree

	SD	D	N	A	SA
1. The Mobile Maternal Health Messages are easy to understand.					
2. The maternal health workshops were easy to understand 3. The Mobile messages promoted maternal health education among mothers in the community					

1. Why did you decide to sign up to receive mobile messages?

2. Why did you decide to attend maternal health workshops?

3. Which topics did you like best from the maternal health workshops?

4. Which topics did you like best from the mobile maternal health messages?

5. How many ANC appointments did you attend while receiving the mobile maternal health messages?

6. How many babies have you had at the health clinic (included month and year)?

7. How many babies have you had in your home?(include month and year)?

8. What type of maternal health activities did you follow within the messages?

9. Why do you trust the information presented in the mobile maternal messages?

10. Who did you receive maternal health information from while you were pregnant and why?

11. What would you like to see incorporated in the mobile messages?

12. What would you like to see incorporated in the maternal health workshops?

14. Please Circle. Which format do you prefer messages to come in?:

voice
text
voice messages
radio

15. Why did you select this format?

Appendix G. Rapid Appraisal Techniques

Free Listing: (Attitudes and Beliefs)
Free listing is used for participants to develop lists of resources and community priorities.

- Free list activity A
    - Discuss how you receive maternal health care information within your community? Please Explain
- Free list activity B
    - Discuss the topics that you like within the mobile maternal messages? Please Explain
- Free list activity C

Discuss the topics that you did not like within the mobile maternal messages? Please explain

Ranking: (Attitudes and Beliefs)
Ranking allow for participants to rank the selection of topics.
Methods: (Interviews and Focus Groups)

- Ranking technique A-Ask the mother or community member to put the topics in order that they would like from best to least regarding the mobile maternal health messages. Note decisions and ask why they selected these options.
    - Index Cards will include
        - Supplements
        - Malaria
        - Diet and Nutrition
        - Breastfeeding
        - ANC appointments and Delivery
        -
- Ranking technique-B-Ask the mother or community member to tell the challenges they had with the messages in order for biggest challenge to largest challenge. Note decisions and ask why they selected these options.
    - Index Cards will include
        - Source
        - Message information (
        - Mobile Device
        - Receiver (
        - Destination
- Ranking technique-D-Ask the mother or community member to put priorities for expecting mothers in order from best to least in terms of checkup appointments and delivery. (Note decisions and ask why they selected these options.
    -
        - Traditional Birth Attendant (in village)
        - Midwife at clinic
        - None until labor

Appendix H. One-on-One Semi-Interview

One-on-one
Semi-Structured Interview 2016
Protocol

Last 5 digits of mobile phone number_______

1. Can you discuss some maternal health activities that you perform that you learned from the messages?

2. Free list activity B Draw or tell the topics that you like within the mobile maternal messages? Please Explain

3. Free list activity C
   Draw or tell the topics that you did not like within the mobile maternal messages? Please Explain

4. Ranking technique –A-Ask the mother to put the topics in order that they would like from best to least regarding the mobile maternal health messages. Note decisions and ask why they selected these options.
   - Supplements
   - Malaria
   - Diet and Nutrition
   - Breastfeeding
   - ANC appointments and Delivery

5. Ranking technique-B-Ask the mother to put the challenges they had with the messages in order for biggest challenge to largest challenge. Note decisions and ask why they selected these options.
   - Source
   - Message information
   - Mobile Device
   - Receiver
   - Destination

6. Ranking technique-D Ask the mother to put priorities for expectant mothers in order from best to least in terms of checkup appointments and delivery. Note decisions and ask why they selected these options.
   - Traditional Birth Attendant
   - Midwife at clinic
   - None until labor

Appendix I. Focus Group

Focus Group Protocol 2016

1. Can you all share with me some of the challenges that expecting mothers are likely to face when using the mobile messages to receive maternal health information?

2. Can you all share with me why mothers may trust some practices in the messages that may go against traditional beliefs?

3. Can you all share with me about any maternal health activities that you all took part in while receiving the messages?

Appendix J. Pre-Coding Example

Row: N
Health Professionals (Midwife, nurse, Dr_/ Clinics= Yellow
Communication= Blue
Receive information= Red
Being Educated= Green
Values Health= Gray
Husband= Pink

Row: 0
Diet= Gray
Breastfeeding= Yellow
ANC= Pink
Malaria= Green
Voice or Text= Blue
Safe Delivery= Purple
Sanitation= Red
Personal Hygiene= Turquoise
Family Planning= Underline
Exercise=Orange
Safe baby= Dark Green
A new Answer= Italic

Row=P
Free information = Blue
Diet= Gray
Breastfeeding= Yellow
To learn= Green
Safe Delivery= Purple
Seeking the views of other= Red
Staying alert =Purple

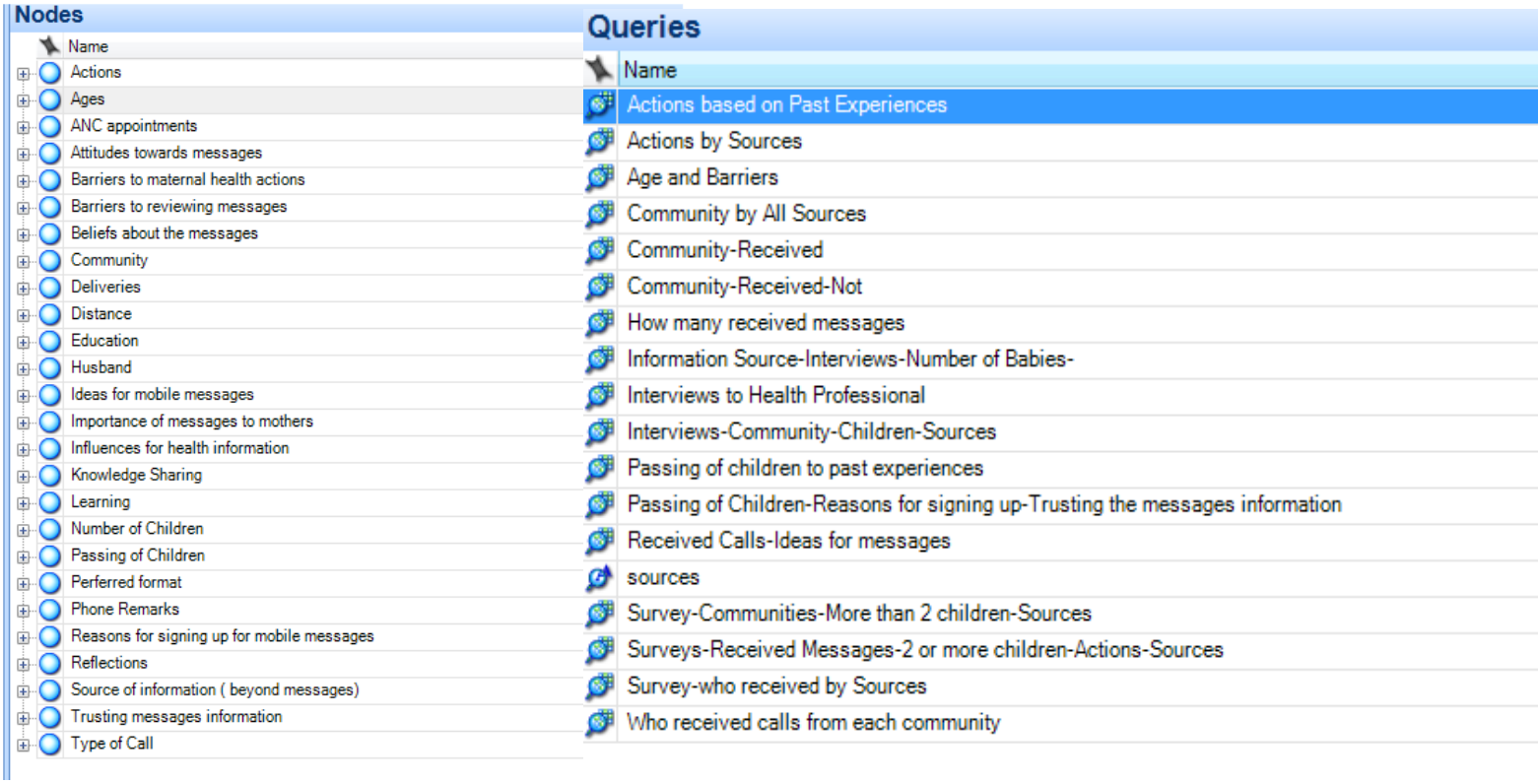
Appendix K. Demographic Profile

Interviews

Interviews	Ticket Number	expectant_mother_received_mobile_maternal_health_messages	Age	marital_status	how_many_children_do_you_have	_if_had baby in _village_please_note_how_many
Folder A Interview 10	1326017	Yes	30	Married	2	1
Folder A Interview 12	1326039	Yes	37	Married	4	3
Folder A Interview 13	1326045	Yes	30	Married	2	2
Folder A Interview 14	1326049	Yes	22	Married	1	0
Folder A Interview05-Headings	1325944	Yes	25	Married	1	1
Folder A Interview08	1326010	Yes	34	Married	5	
Folder A-Interview03	1325938	Yes	29	Married	2	0
Folder A-Interview04-Headings	1325942	Yes	23	Married	2	1
Folder B Interview 01	1326055	No	27	Married	2	1
Folder C Group Interview 02	1111112	Yes	Range 22-34	All Married		
Folder C Interview 01	1111101	Yes	26	Married	3	2
Folder D Interview 01-FG	1111001	Yes	Range 28-35	All Married		

Appendix L: Nvivo10 Codes Sample

Codes Sample **Query Sample**



Appendix M: Lessons Learned

Recruit Native Translators

There were several challenges to find individuals who spoke the local language. Due to the expansion of the city development and the need for employing qualified members who had experience or college degrees, these members were unfamiliar with the widely spoken local language in the community. In an attempt to minimize the barrier, research members included those who are natives of the study setting.

Advocate for Female Team Members

Participants felt comfortable with speaking about maternal health activities with women team members. Hence, there is a need to have female translators along with team members.

Train Research Team

In this study, all team members participated in a three-day face-to-face data collection training. The local NGO, local clinic, and Georgia State University IRB board all approved the training. The goal of training the research team is to have a common understanding of the consent, time-commitment, confidentiality, process, and research plan for each community.

Deliver a Chief's Call

This study used a chief's call to recruit participants. There is a fee associated with a chief's call however the chief's request has authority within the community. Thus, having a call may include background noise of drums throughout the duration of data collection. Hence we needed a private location to carry out interviews.

Create a Ticketing Process

This study used tickets to identify the participation of participants. Tickets were distributed to mothers and numbers were noted on their consent forms along with their surveys. The ticketing process allowed for organization of the study and helped eliminate double entries of mother's participation.

Provide explanation of research goals

One team member was hesitant to provide accurate responses due to the pressure of having hopes that the results would set the bar for future resources. In private, in explanation was given to him that stated that there was no particular description of sufficient or insufficient data.