

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF HEALTH SCIENCE

SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF HEALTH PROMOTION, EDUCATION AND DISABILITY



**ASSESSING THE USEFULNESS AND CHALLENGES OF A MOBILE HEALTH
INTERVENTION AMONG CAREGIVERS OF CHILDREN UNDER-5YEARS IN
RURAL COMMUNITIES IN THE ASANTE AKIM NORTH DISTRICT.**

BY

EMMANUEL ACQUAH-GYAN

PG5134418

NOVEMBER, 2019

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY (KNUST)



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**A THESIS SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH, KWAME
NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI IN PARTIAL
FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF
SCIENCE DEGREE IN PUBLIC HEALTH (MSC. HEALTH EDUCATION AND
PROMOTION)**

NOVEMBER, 2019

DECLARATION

I, Emmanuel Acquah-Gyan hereby declare that this dissertation being presented to the School of Public Health, KNUST in partial fulfillment of the requirements for the award of the degree of Master of Science, Public Health (MSc. Health Education and Promotion) is my original work and have never presented it either in part or as a whole and will never present it to any other University for any other degree.

Signed: _____ Date: _____

Emmanuel Acquah-Gyan

(Candidate)

Signed: _____ Date: _____

Professor Ellis Owusu-Dabo

(Supervisor)

Signed: _____ Date: _____

Professor Anthony Kwaku Edusei

(Head of Department)

DEDICATION

I dedicate this work to my God and father; Opanyin Elias Asirifi Asante Dadiako, Princess Selina Asante Nyarkoa and my mother; Madam Mary Animah, for their immense love, tremendous support and encouragement throughout my study period. I also dedicate this work to my siblings: Maame Akosua, Stephen, Zephaniah, Benjamin, Isaac and Sabina for their support towards my studies.



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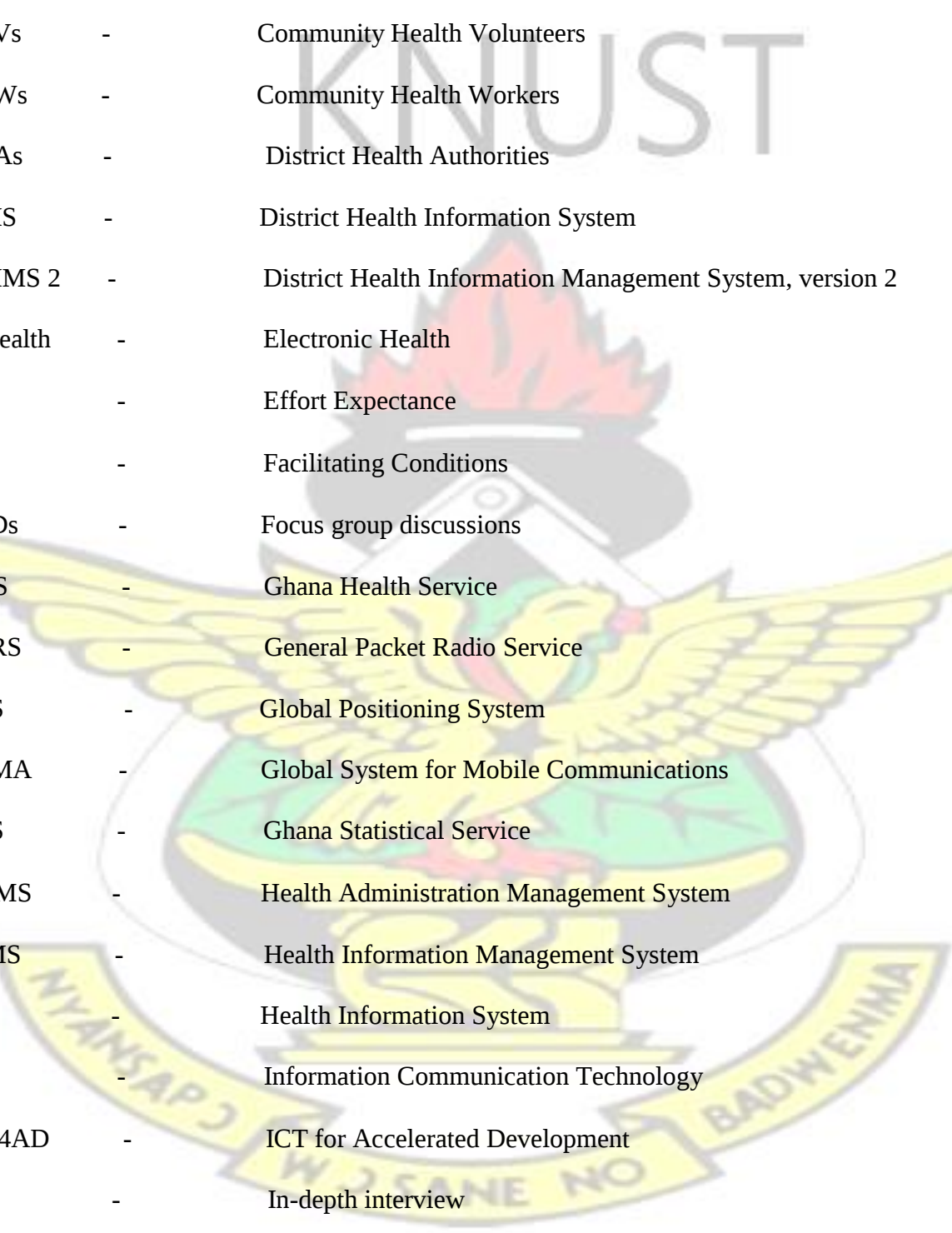
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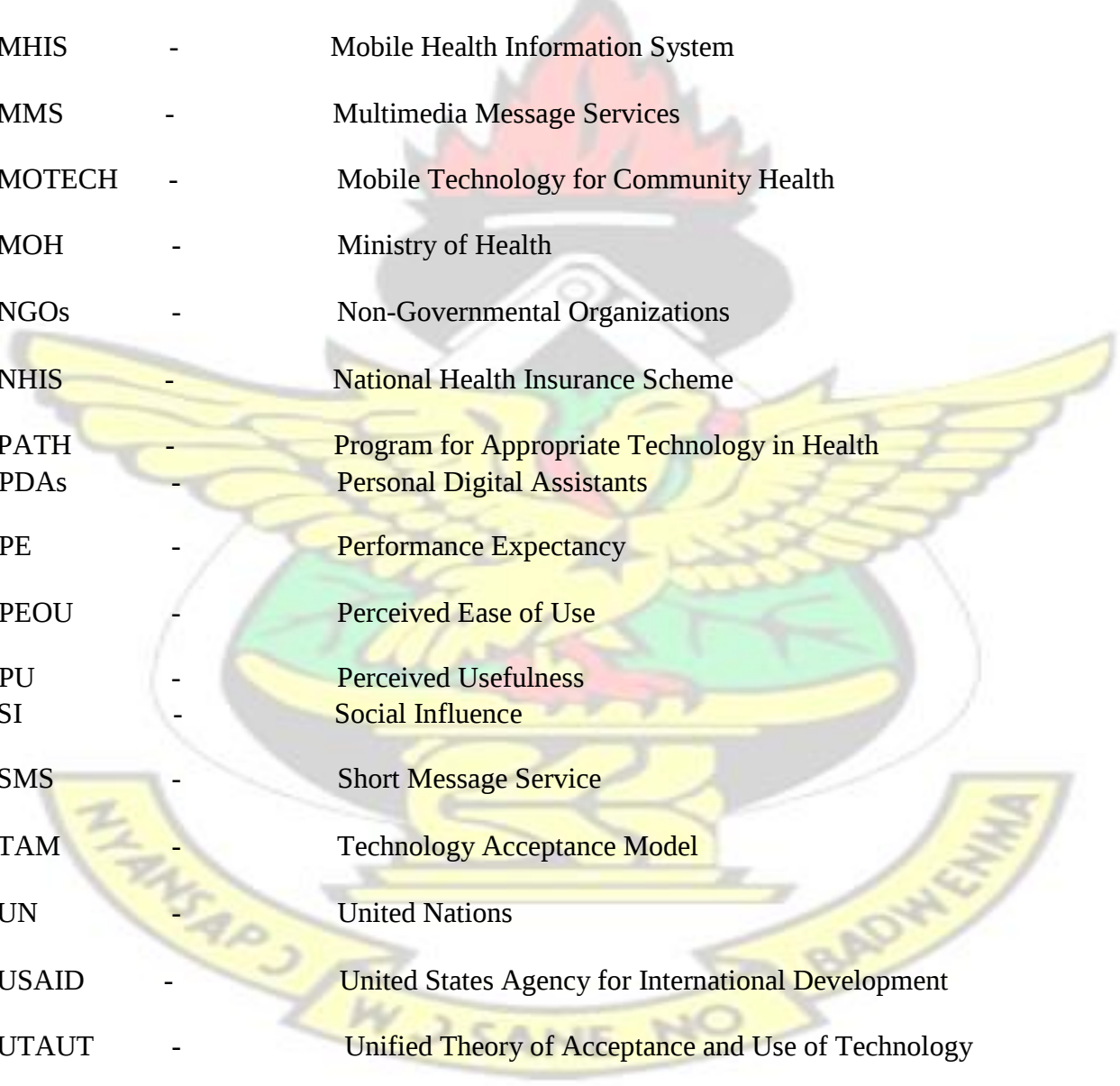
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Last but not the least, I thank all caregivers enrolled on the MOBCHILD study, especially those who participated in this study for their co-operation and support.

LIST OF ABBREVIATIONS/ACRONYMS



BI	-	Behavioural Intention
CHVs	-	Community Health Volunteers
CHWs	-	Community Health Workers
DHAs	-	District Health Authorities
DHIS	-	District Health Information System
DHIMS 2	-	District Health Information Management System, version 2
E-Health	-	Electronic Health
EE	-	Effort Expectance
FC	-	Facilitating Conditions
FGDs	-	Focus group discussions
GHS	-	Ghana Health Service
GPRS	-	General Packet Radio Service
GPS	-	Global Positioning System
GSMA	-	Global System for Mobile Communications
GSS	-	Ghana Statistical Service
HAMS	-	Health Administration Management System
HIMS	-	Health Information Management System
HIS	-	Health Information System
ICT	-	Information Communication Technology
ICT4AD	-	ICT for Accelerated Development
IDI	-	In-depth interview
IMCI	-	Integrated Management of Childhood Illnesses



IVR	-	Interactive Voice Response
KCCR	-	Kumasi Center for Collaborative Research
KNUST	-	Kwame Nkrumah University of Science and Technology
LMICs	-	Low and Middle Income Countries
M-Health	-	Mobile Health
MDG	-	Millennium Development Goal
MHIS	-	Mobile Health Information System
MMS	-	Multimedia Message Services
MOTECH	-	Mobile Technology for Community Health
MOH	-	Ministry of Health
NGOs	-	Non-Governmental Organizations
NHIS	-	National Health Insurance Scheme
PATH	-	Program for Appropriate Technology in Health
PDAs	-	Personal Digital Assistants
PE	-	Performance Expectancy
PEOU	-	Perceived Ease of Use
PU	-	Perceived Usefulness
SI	-	Social Influence
SMS	-	Short Message Service
TAM	-	Technology Acceptance Model
UN	-	United Nations
USAID	-	United States Agency for International Development
UTAUT	-	Unified Theory of Acceptance and Use of Technology
WHO	-	World Health Organization

TABLE OF CONTENT

DECLARATION	ii
DEDICATION	iii
ACKNOWLEDGEMENT	iv
LIST OF ABBREVIATIONS/ACRONYMS	v
TABLE OF CONTENT	vii
LIST OF TABLES	x
LIST OF FIGURES	x
ABSTRACT	x
CHAPTER ONE	1
INTRODUCTION	1
1.0 Background of the study	1
1.1 Problem statement.....	4
1.2 Rationale of the study	5
1.3 Conceptual Framework of the study	6
1.4 Research questions.....	8
1.5.1 General Objective:	8
1.5.2 Specific Objectives:	8
CHAPTER TWO	10
LITERATURE REVIEW	10
2.0 Introduction.....	10
2.1 Theoretical foundations of the study.....	11
2.1.1 Technology Acceptance Model (TAM).....	11
2.1.2 Unified Theory of Acceptance and Use of Technology (UTAUT)	12

2.2 Overview of Electronic-Health (eHealth) and Mobile-Health (mHealth)	13
2.2.1 Overview of Electronic health (eHealth)	14
2.2.2 Overview of M-Health (mHealth).....	15
2.2.3 Electronic Health and Mobile Health in Developing Countries	18
2.2.4 Electronic Health and Mobile Health in Ghana	19
2.3 Usefulness/Benefits of mHealth interventions.....	21
2. 4 Acceptance of, and attitude towards mHealth interventions.....	22
2.5 Challenges/Barriers to mHealth interventions	23
2.6 Strategies for mHealth improvement, sustenance and upscale	26
CHAPTER THREE.....	30
METHODOLOGY	30
3.0 Introduction.....	30
3.1 Profile of study area	30
3.2 Study Design and Approach	32
3.3 The 'MOBCHILD' study	33
3.3.1 The "Mobchild" MHIS functionality	33
3.4 Study Population.....	35
3.5 Inclusion and Exclusion Criteria.....	35
3.6 Sampling technique and Sample size.....	36
3.7 Data collection procedure	36
3.8 Data analysis procedure	38
3.9 Validity and Reliability.....	38
3.10 Ethical Considerations	39
CHAPTER FOUR.....	40
RESULTS/FINDINGS.....	40
4.0 Introduction.....	40

4.1 Socio-demographic Characteristics of Participants	41
4.2 Usefulness/Benefits of mHealth (IVR) intervention to its users.....	43
4.3 Feasibility, Acceptance of, and attitude towards mHealth (IVR systems)	48
4.4 Challenges/Barriers with mHealth (IVR) intervention use among its users	54
4.5 Strategies for mHealth (IVR) system improvement, sustenance, and scale-up	61
CHAPTER FIVE	66
DISCUSSION OF KEY FINDINGS	66
5.0 Introduction	66
5.1 Socio-demographic characteristics of Participants:	66
5.2 Usefulness/Benefits of mHealth (IVR) intervention.....	67
5.3 Feasibility, Acceptance of, and attitude towards mHealth (IVR) systems	71
5.4 Challenges/Barriers with mHealth (IVR) intervention	73
5.5 Strategies for mHealth (IVR) intervention improvement, sustenance, and scale-up.....	77
5.6 Limitations of the study	80
CHAPTER SIX	81
CONCLUSIONS AND RECOMMENDATIONS	81
6.0 Introduction	81
6.1 Conclusions	82
6.1.1 Usefulness/Benefits of mHealth (IVR) system	82
6.1.2 Feasibility, Acceptance of, and attitude towards mHealth (IVR systems)	82
6.1.3 Challenges/Barriers with mHealth (IVR) intervention	83
6.1.4 Strategies for mHealth (IVR system) improvement, sustenance, and scale-up	83
6.2 Recommendations to key stakeholders	84
REFERENCES	89
APPENDICES	99
APPENDIX B	101

LIST OF TABLES

TABLE 4.1 SOCIO-DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS	42
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LIST OF FIGURES

FIGURE 1.1 FACTORS INFLUENCING THE ACCEPTANCE AND USE, SUSTAINABILITY, UPSCALE AND INTEGRATION OF MHEALTH SYSTEMS.	7
FIGURE 3.1 MAP OF ASANTE AKIM NORTH DISTRICT	32

ABSTRACT

The rapid growth in the use of mobile devices has influenced the creation of mobile Health (mhealth) interventions to contribute to healthcare development and childhood survival in underserved communities. MHealth interventions have been found to help widen healthcare coverage, and also improve on the quality of healthcare. Despite these numerous prospects of mHealth interventions in promoting health, its scale-up and sustenance, have been challenging. Many of such interventions are not able to advance beyond the pilot stage of implementation and often cover a small-targeted scope. The full benefits of mHealth therefore, have not been fully realized and utilized.

The main objective of this study was to qualitatively explore the usefulness and challenges of a mHealth (IVR/toll-free call) system among caregivers of children under-5years in rural communities in the Asante Akim North District of Ghana.

The study adopted an exploratory design and a qualitative approach. A simple random sampling technique was used to select 27 participants for the study. 11 In-depth interviews and 2 Focus group discussions (8 participants in a group) were conducted among participants using an interview guide and a focus group discussion guide respectively. Thematic content analysis strategy was adopted for the analysis of data in this study.

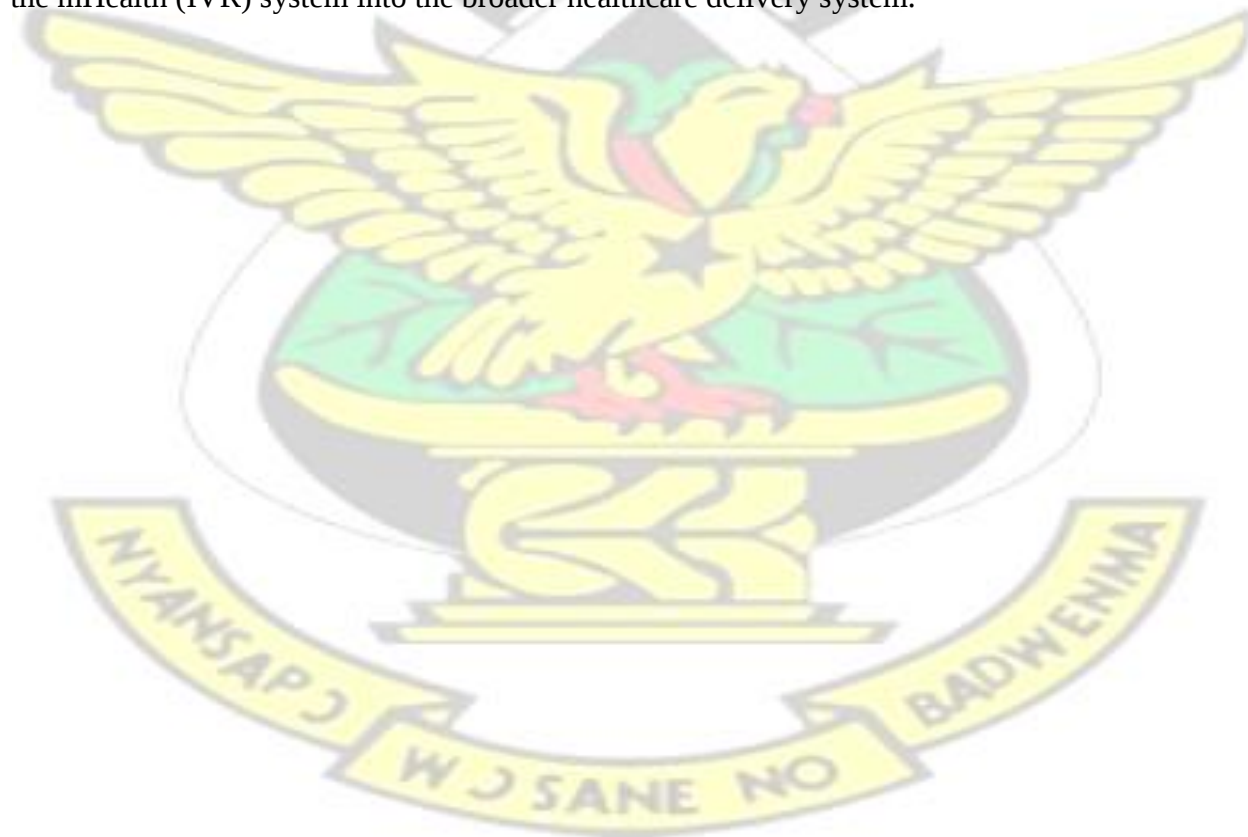
The study discovered that the mHealth (IVR) system was useful in improving access to healthcare, improving communication between caregivers and health professionals, served as a decision and emotional support system to caregivers, and improved the knowledge of caregivers on selfmanagement of childhood diseases.

The mHealth (IVR) system was found to be feasible and highly acceptable, and the attitude of caregivers towards the system was also found to be positive.

Poor network quality and unstable electricity power supply, missed calls, dropped/cut calls, and toll-free number busy, and problems with the pressing of keys to feed information into a mHealth (IVR) system served as challenges towards the acceptance and use of the mHealth system.

Among others, improved infrastructure, partnerships with community institutions and community stakeholders, and assignment of healthcare professionals to mHealth care delivery in health facilities were recommended strategies by caregivers to contribute to mHealth system sustenance, scale-up, and integration.

The mHealth system implemented in the MOBCHILD project was found to be feasible and acceptable to contribute to healthcare delivery in this study. Therefore, investment in this system by Government and other funding agencies is required to sustain and scale-up, and also, integrate the mHealth (IVR) system into the broader healthcare delivery system.



CHAPTER ONE

INTRODUCTION

1.0 Background of the study

Morbidity and mortality of children under-5years continues to be high and a challenging issue in many Sub-Saharan African countries including Ghana (UN, 2015b). According to a United Nation's publication in 2016, about six million of under-5years mortality occurred worldwide, with the chunk occurring in Sub-Saharan Africa (UN, 2016). This is attributed to preventable diseases such as acute respiratory infections, diarrhea, cholera and malaria (Liu *et al.*, 2016; UN, 2015a).

Universal access to health care for patients and caregivers is very challenging in Sub-Saharan Africa including Ghana. This is due to the numerous challenges confronting the healthcare delivery systems (UN, 2015a). Health staff shortages, long travel distances to health facilities, high cost of health care and absence of needed services among others, are known barriers to accessing health care in Sub-Saharan Africa among patients and caregivers (Mahmud *et al.*, 2010; UN, 2015a). This results in limited universal access to healthcare and a weaker surveillance system making it impossible to respond quickly to childhood diseases. These numerous challenges confronting the current healthcare delivery system also made it impossible for countries in Sub-Saharan Africa to achieve the millennium targets (MDG 4) to reduce child mortality (UN, 2015a). In order to contribute to achieving the sustainable development goal's target to reduce childhood mortalities by 2030, innovative interventions are required to support universal access to healthcare services, proper surveillance, and timely diagnosis and treatment of diseases of children under-5years (Kadobera *et al.*, 2012; Krumkamp *et al.*, 2013; UN, 2016).

The rapid growth in the use of mobile devices offers opportunities for the creation of mobile Health

(mHealth) interventions and technologies to contribute to universal healthcare coverage and healthcare development (WHO, 2011a; Mehl & Labrique, 2014; Lee *et al.*, 2016). WHO (2011a) defines mHealth as the use of mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless communication technologies to support medical and public health practices. These include the use of short message services (SMS), smartphone apps, combining SMSs and calls, and Interactive Voice Response technologies to promote health and wellbeing (WHO, 2011a). MHealth interventions have been found to be useful in the areas of treatment compliance, health promotion and disease prevention, health awareness-raising and health monitoring (The Earth Institute, 2010; WHO, 2011a; Aranda-Jan *et al.*, 2014). It is also useful in disease surveillance, health communication, and data collection, point of care and decision support, and emergency medical response (The Earth Institute, 2010; WHO, 2011a; Aranda-Jan *et al.*, 2014).

According to WHO (2011a) and Cvrkel (2018), mHealth interventions helps to prevent the challenge of health care provider shortages. It also helps to timely and accurately determine the state of health of vulnerable populations and therefore inform prompt evidenced-based decisions and planning. Using mHealth also for the surveillance of childhood diseases for children living in rural communities has proven to be feasible and applicable (Franke *et al.*, 2018; Ginsburg *et al.*, 2016). Therefore, mHealth has offered an opportunity to widen the scope of health care coverage, improve on the quality of care for children under-5years, and also contribute to evidence-based health decisions and planning. M-Health again helps to improve on the knowledge and selfmanagement skills of patients and caregivers through the use of voice and text messages, and interactive voice response systems (IVR) (Anshari & Almunawar, 2014). It also offers

opportunities for patients and caregivers to become active partners in healthcare delivery and hence contribute towards the healthy development of their children under-5years.

Despite the proven potentials of mHealth interventions to help improve on health care delivery, health care accessibility and health equity among communities, its sustainability, up-scale and integration into broader health care systems have been a major challenge. Most mHealth interventions are not able to progress beyond the pilot stage of implementation and often cover a small-targeted scope (Aranda-Jan *et al.*, 2014; Abaza & Marschallek, 2017). Unstable mobile networks (Brinkel *et al.*, 2017a & b), low ownership of mobile phones in some hard-to-reach communities (Mohamed *et al.*, 2018), and high cost of mHealth development and implementation (The Earth Institute, 2010; WHO, 2011a) have been some barriers which have impeded the smooth implementation of some mHealth projects. Lack of adequate information and knowledge on the use of mHealth interventions among end-users have also been a major barrier in the roll-up of mHealth interventions (WHO, 2011a; Brinkel *et al.*, 2017a & b)).

To realize the full potentials of mhealth interventions, it requires that all the various factors which affect their development and implementation, sustainability and upscale are determined. This will inform strategies that can help to ensure their sustainability and integration into broader health care systems. To ensure improved sustainability of mHealth interventions, the assessment of the usefulness of the system, acceptability of, and attitude towards the mHealth systems among endusers is necessary. Assessment of the various barriers associated with the development, implementation and the use of the mHealth system is also very important to help devise strategies that would help to scale-up, sustain and integrate mHealth into regional and national healthcare systems (Mohamed *et al.*, 2018). This study, nested within a bigger study titled; "Reducing child mortality: the role of mobile electronic health information system (MOBCHILD)" is therefore

designed to qualitatively explore the usefulness and challenges of a mHealth (IVR/toll free call) system implemented in the MOBCHILD project in the Asante Akim North District of Ghana among its end-users (caregivers of children under-5years).

1.1 Problem statement

Close to six million under-5years death were reported globally, with the majority of the cases occurring in Low and Middle-Income Countries (LMICs) in 2015 (United Nations, 2016). Even though improved provision and universal access to health care services have proven to be effective in the timely diagnosis and treatment of diseases of children under-5years (Kadobera *et al.*, 2012; Krumkamp *et al.*, 2013), its provision and access still remains a challenge in many areas of SubSaharan Africa (Bhutta & Black, 2013; UN, 2016). The health care delivery system in low and middle-income countries (LMICs) is affected by a lot of challenges. Lack of adequate and qualified health staff, lack of access to health care due to lack of needed services, high cost of care and long travel distances to reach health facilities prevent people, especially those in rural areas from enjoying their health right (Mahmud *et al.*, 2010; UN, 2015a). Due to this, preventable diseases such as acute respiratory infections, diarrhea, cholera and malaria continue to cause the mortality of infants in Sub-Saharan Africa including Ghana (UN, 2015b; Liu *et al.*, 2016).

M-Health has proven to have great potentials to help minimize health problems and improve healthcare delivery in LMICs (Tomlinson *et al.*, 2009). It has proven to have the feasibility to help improve health and health equity among deprived populations (Akter, 2010; Mahmud *et al.*, 2010; Aranda-Jan *et al.*, 2014). However, despite the numerous prospects of mhealth interventions, several challenges such as unstable mobile networks, low ownership of mobile phones (Brinkel *et al.*, 2017a & b; Mohamed *et al.*, 2018) and high cost of mhealth development and implementation (The Earth Institute, 2010; WHO, 2011a) affect the smooth implementation of mhealth

interventions. Lack of adequate information and knowledge on the use of mhealth interventions among its users has also been a major barrier in the implementation of mhealth interventions (WHO, 2011a; Brinkel *et al.*, 2017a &b). Such challenges have affected most mhealth interventions and have therefore affected their implementation, scale-up, sustainability and integration into broader healthcare systems after their pilot stage (Aranda-Jan *et al.*, 2014). Despite all these, context-based evidence regarding these challenges that interfere in the effective large scale deployment, sustenance, and integration of mHealth interventions remains unclear and hence unsolved.

The usefulness of mHealth to help provide healthcare to underserved and vulnerable populations (Akter, 2010) makes it a responsibility that efforts are directed towards the scale-up and integration of such interventions into broader healthcare systems. This will help in the realization of the full potential benefit of mHealth interventions to all individuals within a particular community and country. However, due to the limitation in the scale-up and integration of mHealth interventions Tomlinson *et al.*, 2013; Aranda-Jan *et al.*, 2014), the full potential benefits of mHealth on the health of individuals and communities have not been realized fully.

1.2 Rationale of the study

Mhealth has the potential to revolutionize healthcare and health delivery in Ghana. The Government of Ghana recognizing the rapid increase in mobile subscriptions and a rise in Internet mobile-broadband subscriptions saw the need for ICT and eHealth development to complement health services delivery in the country. This led to the development of national policies and strategies on ICT and eHealth (Government of Ghana, 2003; MOH, Ghana 2010; Gyasse & Takyi, 2014). The rise in subscriptions also created opportunities for the implementation of different eHealth projects in the country. However, many of these eHealth projects were implemented

without the evaluation of indicators for their successful implementation and sustainability (Afarikumah, 2014).

M-Health is a subset of eHealth and hence requires the assessment of indicators that ensures their effective implementation, sustainability, and integration. This study is designed to assess the various factors, which promote or restrict the successful implementation of mHealth interventions. It is to qualitatively ascertain the local factors; Economic, environmental and socio-cultural factors that affect the deployment of mHealth at the community and district levels. It is also designed to help determine the technical aspect of mhealth interventions, and the behavioral factors of endusers of mHealth which also affect the implementation of mHealth interventions. Findings will serve as lessons learned, and therefore help to devise strategies and policies to substantially improve mHealth programs and make them sustainable. It will also help to effectively deploy, scale-up, sustain and integrate mHealth interventions into District, regional and national healthcare systems. The findings from this study will again add to the body of scientific knowledge on mHealth when published in a peer-review journal.

1.3 Conceptual Framework of the study

After theoretical reviews, a conceptual framework was adapted from the Technology Acceptance Model, and the Unified Theory of Acceptance and Use of Technology to guide this study. Below is the framework adapted to support and guide this study.

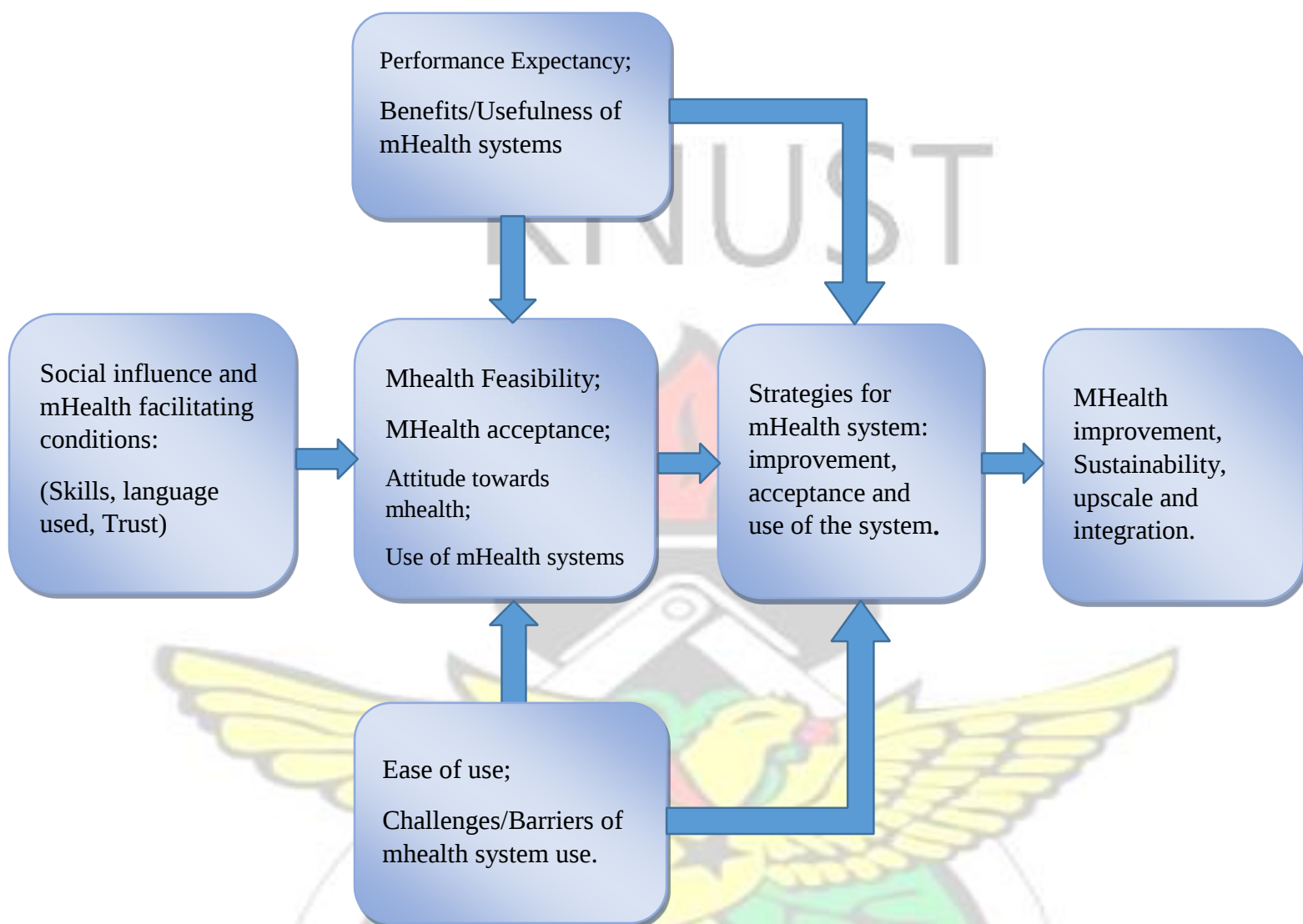


Figure 1.1 Factors influencing the acceptance and use, sustainability, upscale and integration of mHealth systems.

The conceptual framework, as shown above, shows the factors which may influence mHealth implementation, upscale and sustainability, and integration into broader healthcare systems. The framework shows how socio-cultural and facilitating factors of mhealth systems, barriers with the use of mHealth systems, and the benefits of mHealth systems may influence mHealth acceptance, Attitude towards mhealth and Use of mHealth systems. It also shows how the benefits and challenges, attitude towards, and acceptance and use of mhealth systems may also influence the

development of strategies aimed at mHealth system improvement, acceptance, and use of the system. Once the mHealth systems have been improved, accepted and adopted by users, their Sustainability, upscale and integration becomes feasible and practicable. This conceptual framework is however designed to correspond with the objectives of this study.

1.4 Research questions

1. What is the usefulness of mHealth interventions to caregivers of under-5years in the Asante Akim North District?
2. What is the attitude towards, and acceptability of mHealth interventions among caregivers of under-5years in the Asante Akim North District?
3. What are the challenges with the use of mHealth interventions among caregivers of under-5years in the Asante Akim North District?
4. What are the strategies for improving, sustaining and up-scaling mHealth interventions among caregivers in the Asante Akim North District?

1.5 Research objectives

1.5.1 General Objective:

The main objective of this study is to qualitatively explore the usefulness and challenges of a mHealth (IVR/toll-free call) system among caregivers of children under-5years in rural communities in the Asante Akim North District of Ghana.

1.5.2 Specific Objectives:

To determine the usefulness of a mHealth intervention to caregivers of children under-5years.

To determine the feasibility, attitude towards, and acceptability of a mHealth intervention among caregivers of children under-5years.

To identify the challenges with the use of mHealth interventions among caregivers of children under-5years.

To identify strategies for mHealth improvement, sustenance and upscale among caregivers of children under-5years.



CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Reviewing existing knowledge about a study builds on the idea that knowledge accumulates and that, we can learn from and also build on it (Neuman, 2014). Therefore, reviewing literature is very essential in research. It deals with the careful and critical collection of already existing knowledge about the phenomenon under study and hence, guide and support scientific discussions and arguments.

This chapter, therefore, explored already existing literature/knowledge concerning mHealth interventions and their application in medical and public health practices in Ghana, and around the globe. It examined specifically key concepts on mHealth, its usefulness, and challenges in use, and other factors that contribute to its acceptance and use. Literature on mHealth end-user recommended strategies for improving and sustaining mHealth interventions was also done. To achieve the objectives of this study, a review of the literature was done based on the following main themes:

1. Theoretical foundations of this study
2. Overview of Electronic health (eHealth) and Mobile Health (mHealth).
3. Usefulness/Benefits of mHealth interventions
4. Acceptance of, and attitude towards mHealth interventions
5. Challenges/Barriers of mHealth interventions
6. Strategies for mHealth improvement, sustenance and upscale.

2.1 Theoretical foundations of the study.

2.1.1 Technology Acceptance Model (TAM)

The technology acceptance model (TAM) proposed by Davis in 1989 is one of the most used models for predicting how a technology will fare among its end-users (Davis, 1989). Its ability to predict technology acceptance and use has been validated by many authors in different studies. This, therefore, makes it one of the most validated model tool for predicting technology adoption and use among end-users (Chuttur, 2009).

TAM was originally developed to predict the acceptance and use of computer technologies e.g. MIS among potential users (Davis, 1989). It was developed using the Theory of Reasoned Action (TRA), developed by Ajzen and Fishbein in 1980 as its foundation block (Davis *et al.*, 1989). Just as proposed in the TRA, according to TAM, an individual's adoption and use of a technology/system is influenced by the individual's intention to use the system. The individual's intention to also adopt and use a technology is, however, influenced by the positive or negative attitude towards the technology, and the influence of subjective norms (Davis, 1989). In dealing with the cognitive and affective determinants of technology acceptance and use, Davis, (1989) postulated that an individual's perception of ease of use (PEOU) of a technology, and perception of usefulness/Benefits (PU) of the technology influences the decision to use or not use the technology. PEOU is the perception of a user on the degree of efforts required to perform or use a technology/system as against its benefits, whiles PU is a user's perception of the amount of benefits to be derived by the adoption and use of a technology (Davis, 1989). According to TAM, PEOU and PU among users serves as a predictor of attitude of end-users towards a technology hence influencing intention to use (BI), and on actual use of a technology.

The TAM has been criticized for not having the full capacity to explain in detail what makes PU strong in studies, and for failing to recognize other external factors that may also influence the acceptance and use of a technology among users (Heart & Kalderon, 2013). This, therefore, called for the need for another theory/model to achieve the aim of this study. The Unified Theory of Acceptance and Use of Technology was therefore chosen to complement the TAM for this study.

2.1.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

Unified Theory of Acceptance and Use of technology is a theory developed by Venkatesh *et al.*, (2003) to unify alternative views and perspectives of innovation and technology acceptance and use among users. This theory was developed through the review and integration of eight major theories and models, namely: the Technology Acceptance Model (TAM), the Motivational Model, the Theory of Planned Behaviour (TPB), the Theory of Reasoned Action (TRA), a combined TPB/TAM, the Model of PC Utilization, Innovation Diffusion Theory (IDT), and Social Cognitive Theory (SCT) (Venkatesh *et al.*, 2003). It was designed to harmonize the different perspectives or factors that help to predict user acceptance, adoption and associated behaviors towards the use or non-use of a technology.

According to the UTAUT, performance expectancy (PE) of a technology, effort expectancy (EE) required for the use of a technology, social influences on using a technology, and facilitating conditions of a technology which makes it use conducive and interesting are the four main constructs which serves as the predictors of behavioural intention and adoption of a behaviour (acceptance, use and non-use of a technology). Performance Expectancy (PE) is defined as "the extent to which a person considers using a technology will help him/her perform well at their job", Effort Expectancy (EE) is also "the ease of using a tool in relation to the job to be performed", while Social Influence (SI) is "the extent to which a person considers that persons who matter to

him/her expect them to use the tool" (Venkatesh *et al.*, 2003). Facilitating Conditions (FC) are also explained as "the degree to which an individual trusts that technical, organizational and other conditions exist to support their use of the technology" while Behavioural Intention (BI) is "an individual's intent to use a specific technology tool for a specific job function" (Venkatesh *et al.*, 2003).

According to the theory, the four constructs are also moderated by other factors such as gender, age, experience and voluntariness of use. Through the assessment of these variables, a user's intention to use a technology, and actual use of the technology can be determined to predict acceptance and attitude towards the technology among its users (Venkatesh *et al.*, 2003). The identification of the key technology acceptance influencing factors will internally influence the development of strategies to ensure system improvement and sustenance.

2.2 Overview of Electronic-Health (eHealth) and Mobile-Health (mHealth)

The application of Information Communication Technology (ICT) to improve human activities in healthcare delivery has long been regarded as an innovative and effective tool (Oh *et al.*, 2005). Its evidence can be traced back to the 1890s in America where a punch-card data processing system was developed and used for the US census (Shortliffe & Bloist, 2006). Many Health information systems (HIS) were also developed, mostly by academic medical centers for billing and patient management in the early years of technology introduction in healthcare (Atherton, 2011; Saranummi, 2013). Subsequently, the use of Information Communication Technology has gradually become the backbone of many health systems in many countries as it is applied in the areas of medical and public health practices, healthcare administration, and medical education and research (Aanensen *et al.*, 2009; Dentzer, 2010).

Recognizing the significant roles of clients as partners in healthcare delivery, recent trends in technology application in healthcare delivery by professionals have adopted mobile health (mHealth) technologies to manage the health of their clients/Patients (Dobkin & Dorsch, 2011; Saranummi, 2013). Electronic Health (eHealth) and Mobile Health (mHealth) have therefore become two distinct tools, yet two connected concepts, which have gained roots in medical and public health practices. They have become innovative concepts and tools in healthcare and offer opportunities to manage the challenges of healthcare delivery in this modern day of rapid rise in Communicable and Non-communicable diseases, and an increase in costs of healthcare in Low and Middle-Income countries (LMICs) (Arak & Wójcik, 2017).

2.2.1 Overview of Electronic health (eHealth)

Electronic health (eHealth) has become a known concept in the world. This has therefore created different meanings and understandings of the concept among different authors. These differences in meanings and understandings have led to the absence of a unifying definition of the concept (Vroom, 2017). Even though many authors have defined the concept differently, a common theme, which is, the use of ICT to promote healthcare delivery services runs through all the definitions. According to Eysenbach, (2001a), electronic-Health is the application of information and communications technologies (ICTs) in the delivery of functions across the health sector. Ahern, Kreslake, and Phalen (2006) also defined the concept as "The use of emerging interactive technologies (e.g., Internet, CD-ROMs, personal digital assistants, interactive television and voice response systems, computer kiosks, and mobile computing) to enable health improvement and healthcare services." Al-Shorbaji and Geissbuhler (2012) also defined eHealth as "The cost-effective and secure use of information and communication technologies in support of health and health-related fields." E-Health thus includes the use of digital applications, electronic health

record systems, and telemedicine in healthcare. It also includes using smartphone apps, remote monitoring devices and biosensors, computer algorithms, and analytical tools to inform decision making in healthcare. Thus, eHealth involves the use of digital technology to maximize the collection, management, and distribution of data and information across the health sector (OECD, 2015). Generally, eHealth can be classified into four concepts, namely; telemedicine, health information systems (HIS), mobile health (mHealth) and distance medical learning (Mendoza *et al.*, 2013). This wide application area of eHealth however, makes it possible for it to be implemented across all levels of healthcare systems (Peterson *et al.*, 2016).

E-Health has the benefits of improving the quality of healthcare, ensuring effective planning and allocation of health resources, and also, ensuring cost efficiency in healthcare delivery. It also contributes to evidence-based healthcare delivery and policymaking, and also, real-time monitoring of health states within populations (Arak & Wójcik, 2017).

2.2.2 Overview of M-Health (mHealth)

Mobile health (mHealth) is a sub-concept of eHealth that involves the use of mobile communication devices to complement medical and public health practices. It involves the application of devices such as mobile phones, mobile health applications, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices to promote health and wellbeing (WHO, 2011a; Whittaker *et al.*, 2012; Peterson *et al.*, 2016). M-Health involves the capitalization on the utilities of a mobile phone such as voice and short messaging services, general packet radio service (GPRS), 3G and 4G systems, global positioning system (GPS), etc. in health information and medical and public health practices (WHO, 2011a). It also includes the functionalities of lifestyle and well-being mobile applications and health promotion medical devices (Peterson *et al.*, 2016).

Globally, different mHealth initiatives and interventions have been adopted in different countries across different and wide areas of health systems. According to the WHO's report on country profiles on eHealth in 2011, several countries across the globe were reported to have adopted mHealth initiatives such as toll-free emergency call systems, health call centers, mobile diseases surveillance, etc. to complement medical and public health practices (WHO, 2011b; 2016). For example, mHealth initiatives such as toll-free emergency call systems, health call centers and mobile diseases surveillance have already been established in countries such as Cuba, Finland, Estonia, Ethiopia, Gambia and Ghana while many other initiatives at the local and national levels are also in their pilot stages (WHO, 2011b; 2016). M-Health initiatives are categorized into mobile telemedicine, mobile health surveys, mobile disease surveillance, awareness-raising, and Health promotion strategies, healthcare telephone helplines, decision support systems, and toll-free emergency response systems (WHO, 2011a).

According to WHO (2011a), mHealth interventions can be classified into improving communication between individuals and health service providers, through the use of healthcare telephone helplines, emergency toll-free telephone services, appointment reminders, and awareness-raising over health issues; improving consultation among healthcare professionals, through the effort of mobile telemedicine; enhancing inter-sectorial communication during emergencies; and health monitoring and surveillance, through the use of mobile health surveys, mobile disease surveillance, and patient health monitoring. Other classification areas also includes improving access to information for healthcare professionals at point of care through mobile patient records, information and decision support systems, and mobile data collection (WHO, 2011a).

Also, a systematic literature review by Abaza & Marrchollek (2017), classified mHealth initiatives implemented into the application areas of health monitoring and surveillance, health promotion and awareness-raising, communication and data reporting, data collection, telemedicine, emergency medical care, point of care support, and decision support systems. A review by Fiordelli *et al.*, (2013) also categorized mHealth initiatives reviewed into health promotion and selfmanagement, communication, remote monitoring, data collection, treatment adherence improvement, and medical training/education. Aranda-Jan *et al.*, (2014) in their review on "what works, what does not work and why of implementation of mHealth in Africa" classified mHealth into "patient follow-up and medication adherence, staff training, support and motivation, staff evaluation, monitoring and guidelines compliance, drug supply chain and stock management, patient education and awareness-raising, disease surveillance and intervention monitoring, and data collection and reporting strategy.

According to Abaza & Marrchollek (2017) in their literature review, the commonly used mHealth technologies include the use of SMS messages, smartphone applications, a combination of SMS and calls, IVR/phone calls, and mobile website/emails. Other technologies such as videoconferencing, combining SMS with MMS, sending video or voice messages, and combining SMS with mobile applications had also been applied to promote health even though it had not been commonly used (Abaza & Marrchollek (2017). Kallander *et al.*, (2013) and Fiordelli *et al.*, (2013) also highlighted that the most used mHealth technology includes voice and text messages (SMS), and data access. This was also evident in Otieno *et al.*, (2014), Stanton *et al.*, (2015) and Perosky *et al.*, (2015). Even though voice messaging or voice calls are relatively preferred by users of mHealth initiatives (Chang *et al.*, 2011; Crawford *et al.*, 2014), it is also the relatively less used mHealth technology (Vroom, 2017). M-Health has commonly been applied in maternal and

childcare, treatment adherence, management of medical logistics, training of health staff, and for data collection (Lau *et al.*, 2014; Madon *et al.*, 2014; Otieno *et al.*, 2014).

2.2.3 Electronic Health and Mobile Health in Developing Countries.

In a systematic literature review by Fiordelli *et al.*, (2013), it was discovered that the interest in mHealth was growing in Africa, Australia, North America, and also in South America. This was evident due to the upsurge increase in the percentage of studies conducted within these regions from 2008 to 2012 reviewed in the literature search. Many Developing countries are making tremendous strides in applying eHealth and mHealth in their healthcare delivery systems (WHO, 2011a; WHO, 2011b; Vroom, 2017). In WHO's (2016) publication of country profiles on eHealth, it was evident that many developing countries such as Ghana, Kenya, Ethiopia, Bangladesh, etc. have made effort to implement different kinds of eHealth and mHealth initiatives. Many developing countries have developed national eHealth policies or strategies making it possible for the piloting and implementation of eHealth and mHealth interventions (WHO, 2016). The adoption of toll-free emergency helplines, health call centers, electronic health records and the use of eLearning in health sciences by many developing countries (WHO, 2016) is also an indication that the concepts "eHealth" and "mHealth" have become an acceptable concepts among developing nations.

Many mHealth interventional studies have been implemented across many African countries to provide lessons to guide upscale and integration into bigger health systems. For example, in Tomlinson *et al.*, (2009), the authors sorted to determine the feasibility, extent, and ease of implementation of training community health workers on collecting data using mobile phones in South Africa. A similar intervention was also implemented by Madon *et al.*, (2014) in Tanzania to test the feasibility of village health workers (VHW) collecting data using mobile phones. Perosky

et al., (2015) also assessed the feasibility of implementing SMS data reporting by midwives in a low resource setting in Liberia. Similarly, Stanton *et al.*, (2015) tested an SMS tool for reporting cases of lymphoedema and hydrocele by community-based health workers in Ghana and Malawi. Several other studies by Zurovac *et al.* (2011), Vélez *et al.*, (2013), Otieno *et al.*, (2014), Crawford *et al.*, (2014), etc. have been carried out across many African countries. A review by Lee *et al.*, (2017), also discovered a total of 487 mHealth programs/projects implemented across Sub-Saharan African countries between 2006 and 2016.

2.2.4 Electronic Health and Mobile Health in Ghana.

Ghana as a country has the structural foundations which make it possible for eHealth and mHealth initiatives to be carried out. It has the ICT infrastructure and the supporting policies which create rooms for the development and implementation of eHealth and Mhealth initiatives (Achampong, 2012; Vroom, 2017). Through innovative programs such as ICT for Accelerated Development (ICT4AD) (Government of Ghana, 2003; MOH, Ghana 2005), and governmental and private partnerships in ICT development in Ghana, the country has become a regional leader in ICT in Africa (Achampong, 2012). The development of a national eHealth strategy (Ministry of Health, Ghana, 2010) have also created opportunities for the pilot and implementation of eHealth interventions, particularly, telemedicine and mHealth (Grameen Foundation, 2015; GSMA, 2014) in Ghana.

In a systematic literature search by Afarikumah in (2014) to determine the state of electronic health in Ghana and its future prospects, the search yielded twenty-two (22) different interventions implemented across the country and the different domains of eHealth (Telemedicine, mHealth, Health information systems, and eLearning). In the review, the Sene PDA project, Mobile

Technology for Community Health (MOTECHE) in Ghana project, Millennium Villages and Mobile Telemedicine project, Onetouch Medicareline (ML) project and the Ghana Consultation Network project were among eHealth Initiatives in the Country. Other projects such as the MIMcom.NET project, eHealth Initiative project, Vodaphone Healthline project, USAID-Deliver project, etc. were also discovered in the literature search (Afarikumah, 2014). Other systems such as Health Administration Management System (HAMS), District Health Information System (DHIS), Health Information Management System (HIMS) and Hospital Administration Management Systems were also discovered to be used by healthcare systems in the country (Afarikumah, 2014). Currently, The Ghana Health Service relies on the District Health Information management system, version 2 (DHIMS 2) for its data capture, aggregation and generation of management reports (Achampong, 2012).

Tremendous effort has also been made by researchers and institutions in the country towards different mHealth initiatives implemented across the country. Vroom (2017) assessed the feasibility of CHVs using mobile phones for data reporting for the lymphatic Filariasis control program. In Ginsburg *et al.*, (2015), researchers from PATH- USA, University of Washington and the Kintampo Health Research Center designed and piloted a mHealth application for diagnosing and treating childhood Pneumonia and Other Childhood Illnesses in Ghana. Another study by Franke *et al.*, (2018) developed and piloted a mobile phone-based integrated clinical algorithm which helps to identify symptoms of childhood diseases in Ghana. Andreatta *et al.*, (2011) also evaluated the reporting of postpartum hemorrhage data through the use of mobile phones by professional and traditional midwives in rural parts of Ghana. Many of such interventions have ended, while many are still in their implementation stages across the country.

2.3 Usefulness/Benefits of mHealth interventions

The usefulness/benefits of mHealth interventions are unprecedented. M-Health interventions serve as very useful tools through which many health system challenges can be managed. In this modern day of high social, financial, and structural costs to seeking healthcare for vulnerable populations, mHealth interventions lowers the burdens of healthcare access to underserved populations (Akter, 2010). It helps to accurately and timely capture the state of health of vulnerable populations, and therefore, inform the creation of concrete interventions to ensure positive health outcomes, and improved quality of care (Cvrkel, 2018).

The benefit of mHealth to help deliver healthcare services to vulnerable and underserved populations (Akter, 2010) makes it an efficient tool to manage the health equity gaps in LMICs. M-Health interventions such as IVR/ phone call systems, audio, visual and text messages systems have been used to improve on the self-management skills of clients/patients, and also, helped them to become active partners in caring for their health states (Anshari & Almunawar, 2014). One of the commonly known benefits of mHealth is its use for timely collection and reporting of data. In the studies of Tomlinson *et al.*, (2009), Madon *et al.*, (2014), Jandee *et al.*, (2015), the benefit of mHealth in the timely collection and reporting of data was discovered. A review by Abaza & Marschollek, (2017) discovered that, the following benefits of mHealth; improving access to healthcare for patients/clients by minimizing distance and time limitations, improving appointment attendance by clients, improving medication and treatment adherence, and increasing patients/clients knowledge on certain health conditions in order to promote and sustain good health practices, had been reported in studies by Mahmud *et al.*, (2010), Ngabo *et al.*, (2012), Lemay *et al.*, (2012), Chang *et al.*, (2011), Leventhal (2014) and Neupane *et al.*, (2014).

Other studies by Odigie *et al.*, (2012) and Schooley *et al.*, (2015) showed the usefulness of mHealth in improving communications between patients and physicians/health workers. This benefit of mHealth to improve on communication between clients and health professionals was also discovered by Chang *et al.*, (2011), and by Madon *et al.*, (2014). M-Health is also known to serve as a decision support system for hard to reach clients/patients and in the case of healthcare provider shortages (Kuntagod *et al.*, 2015). It is also known as a tool for learning about diseases and therapies, and for raising awareness about disease conditions to increase the knowledge of clients/patients (Lau *et al.*, 2014; Otieno *et al.*, 2014). In a systematic review by Feroz *et al.*, (2017) on "The role of mHealth applications for improving antenatal and postnatal care in low and middle income countries", mHealth was discovered to be useful in educating clients, improving communication between clients and health professionals, collecting and reporting data, keeping health records electronically, and for keeping track of vital registries/ events. Other studies by Franke *et al.*, (2018), Brinkel *et al.*, (2017a & b), Laar *et al.*, (2019) etc., and other reviews by Sondaal *et al.*, (2016), Hall *et al.*, (2014) and Aranda-Jan *et al.*, (2014) have all reported other several benefits of mHealth ranging from reducing the cost of healthcare through a reduction in financial and time cost incurred through transportation for patients/clients, serving as a disease surveillance and an intervention monitoring system, increasing patients uptake of screening tests and counselling, and for improving referral systems.

2. 4 Acceptance of, and attitude towards mHealth interventions

Determining the acceptance of, and attitude towards a mHealth intervention is very necessary to help understand how the intervention will be embraced and used by end-users for delivering and seeking the needed healthcare services (Chib, 2013). This may help to determine and predict the success of a mHealth intervention implemented, and hence inform strategies to improve and

sustain the intervention. As far as mHealth is concerned, very few mHealth interventional studies did assess the acceptance and attitude of potential end-users of the technology before embarking on the implementation of the intervention (Afarikumah, 2014; Vroom, 2017).

Generally, mHealth acceptance among its users has been positive across studies that did assess them. In a study by Laar *et al.*, (2019) to "assess a mHealth technology for maternal and child health services in a rural part of Upper West Region, Ghana", a high acceptability of, and a positive attitude was discovered among users towards the intervention. In other studies by Brinkel *et al.*, (2017a & b) aimed at assessing users' attitudes, willingness to use, and user experiences of using an IVR system for seeking healthcare, a positive attitude and a high acceptance of the technology was discovered by the researchers. Diesel *et al.*, (2018) in their study to assess the perceptions and attitudes of local stakeholders towards mobile phone use by village health volunteers for child health surveillance in the Democratic Republic of Congo, discovered a high acceptance of, and a positive attitude towards the system. Other studies by Yé *et al.*, (2018) and Kessel *et al.*, (2016) have all discovered a high acceptance and a positive attitude of end-users towards mHealth interventions. In a systematic review by Aranda-Jan *et al.*, (2014), the authors attributed the success, high acceptance, and the positive attitudes towards mhealth interventions among endusers to the perceived benefits of such interventions among users.

2.5 Challenges/Barriers to mHealth interventions

Several common challenges have been known to influence the smooth implementation of mHealth interventions in many studies. The challenge of poor network quality have been identified in many studies as a major barrier to the successful implementation of mHealth interventions. This barrier was evident in studies by Perosky *et al.*, (2015), Madon *et al.*, (2014) and Rajput *et al.*, (2012). In

other studies by Stanton *et al.*, (2015), Brinkel *et al.*, (2017a & b), Shiferaw *et al.*, (2018) and Laar *et al.*, (2019), this challenge was again, discovered.

Limited electricity supply for the charging of phones has also been discovered as a barrier to the implementation of mHealth interventions. In the studies of Chang *et al.*, (2011), Brinkel *et al.*, (2017a & b), Shiferaw *et al.*, (2018) and Laar *et al.*, (2019), reliable supply of electricity for charging phones was a challenge. Due to that, participants used other means such as charging their phones with car batteries or relied on phone charging shops. This however affected the progress and success of mHealth interventions implemented.

The challenges of limited ownership of phones or mobile phone sharing, phone theft and phones of participants becoming damaged during the implementation of mHealth initiatives have been discovered by researchers to negatively influence the implementation of mHealth interventions. In the studies of Chang *et al.*, (2011), Lau *et al.*, (2014), and Laar *et al.*, (2019), this barrier was discovered. Due to these challenges, mhealth interventions such as text and audio SMS, and phone calls meant for actual participants gets lost without participants getting the chance to view, listen or receive them (Lau *et al.*, 2014). In the study by Laar *et al.*, (2019), it was discovered that some women who did not have phones and needed that of their husbands to access the mHealth intervention were not allowed by their husbands. The cost of acquiring a mobile phone to benefit from mHealth was also raised in this study.

No or limited literacy level of participant's in mHealth interventional studies have also been discovered as another barrier to mhealth implementation (Perosky *et al.*, 2015; Crowford *et al.*, 2014). The ability of participants to read and write plays an important role in the implementation of many mHealth interventions that involve text messaging. It is due to this limited ability to receive and interpret, and report health issues with texts, why participants with low literacy in

Crawford *et al.*, (2014) preferred voice messages to SMS for receiving and sending health messages. Limited knowledge on how to use mHealth interventions, and on medical danger signs have also been identified as barriers to mHealth implementation by (Madon *et al.*, 2014) and Tuhebwe *et al.*, (2015) respectively. This was also highlighted by Brinkel *et al.*, (2017a & b) where participants reported limited familiarity with the mHealth system implemented.

Low level of literacy and limited knowledge on mHealth use and disease danger signs further creates the problem of data entry errors and wrong diagnosing of disease systems using mHealth. The problem of data entry errors have been discovered in studies by Vélez *et al.*, (2013), Stanton *et al.*, (2015) and Perosky *et al.*, (2015) where some participants had challenges with the pressing of correct buttons, reading keypads of phones, and also, selecting numbers using functional keys. Another study by Franke *et al.*, (2018) also discovered misdiagnosing and reporting of convulsions or unconsciousness through a mHealth system by participants due to limited knowledge on the symptoms of these conditions. This, therefore, led to some errors in data sent and collected with the mHealth intervention.

In the systematic review by Aranda-Jan *et al.*, (2014), among others, poor network quality, phone theft, high illiteracy and individual preferences for mHealth interventions, male control over phones owned by households, limited knowledge and skills for mHealth use, and limited staff availability to respond to calls and text messages are known barriers which have affected the implementation of mHealth interventions in many studies. In the policy white paper by The Earth Institute in (2010) on the barriers and gaps affecting mHealth interventions in LMICs, several other challenges such as limited infrastructure, high implementation cost, limited mHealth policies, etc. were also highlighted.

2.6 Strategies for mHealth improvement, sustenance and upscale.

The benefit of mHealth to help serve unserved/underserved populations due to challenges confronted by health systems in LMICs (Akter, 2010), makes it a responsibility that innovative and evidenced-based strategies are adopted to ethically pursue, scale-up and sustain, and integrate mHealth interventions into broader healthcare systems (Cvrkel, 2018). The high scalability potential of mHealth (Tomlinson *et al.*, 2009 & 2013), and the sense of responsibility among mHealth designers and managers, mHealth implementers, and among mHealth policy formulators have led to the recommendation of different strategies towards mHealth improvement and scaleup, and towards mHealth sustainability and integration.

The relevance of inter-sectorial collaborations in mHealth implementation has been highlighted by many mHealth researchers, institutions, and policymaking bodies. Private-public partnerships have been known to be an effective strategy if mHealth sustainability and scale-up is to be achieved (The Earth Institute, 2010; Mahmud *et al.*, 2010; Aranda-Jan *et al.*, 2014; Lee *et al.*, 2017). Increased investment towards network quality and coverage to support mHealth scale-up (The Earth Institute, 2010; Rothstein *et al.*, 2016; Vroom, 2017; Lee *et al.*, 2017) is best achieved through collaborations between/among Governments, the private sector (Telecommunication companies & Mobile device manufacturers), Donors, NGOs and researchers. These partnerships ensure the availability of the needed infrastructure such as quality network, reliable electric power supply with alternative power supply systems (solar panels and micro.wind turbines), and quality and affordable mobile devices to support and realize the potentials of mHealth scale-up. It also ensures cost-effective financing of mHealth through the absorption of cost of implementation among partners. This again, ensures a sustained and secure source of funding for mHealth

interventions (The Earth Institute, 2010; Mahmud *et al.*, 2010; WHO, 2011a; Aranda-Jan *et al.*, 2014; Lee *et al.*, 2017).

End-users of mHealth interventions play a crucial role in the sustenance, scale-up, and integration of mHealth interventions. End-users trust and confidence in a mHealth intervention greatly influence its success, upscale and potential for integration. Due to this, researchers and mHealth implementers have identified and recommended the need for community engagement to ensure an improved trust, motivation and cultural-appropriateness of mHealth interventions (The Earth Institute, 2010; Hartzler & Wetter, 2014). Through the engagement of communities, the level of literacy, language requirement and potential significant others of mHealth users can be determined. This, in turn, informs the need for training, local language adoption in mHealth, and the involvement of family and friends, opinion and community leaders, and celebrities to promote mHealth adoption and use by individuals and communities.

A review by Hartzler & Wetter, (2014) discovered in literature, strategies such as the adoption of theories to alter the thinking of participants, the use of families and friends, community elders, and other significant others (advocates from schools, churches, and opinion leaders) to sell mHealth initiatives to families and communities. The review again discovered the need for families and key significant others in communities in the training of mHealth end-users to improve on their knowledge and skill on using mHealth interventions, and the need for using local languages in the delivery of mHealth interventions.

In Brinkel *et al.*, (2017a), the authors discussed and recommended training of participants on mHealth interventions to improve on their knowledge and skill on its use, and the adoption of tollfree mHealth systems to avoid cost incurred by users. Integration of mHealth system (IVR) into

communities by significant others in communities (CHW, CHV, opinion leaders, etc.), and the adoption of multiple local languages with the option to choose was highlighted in this study.

Human interaction in the implementation of IVR interventions was also highlighted in this study. Again, another study by Brinkel *et al.*, (2017b) recommended the need for the adoption of local languages, training of users, and integration of mHealth interventions into community living. In this study, Participants recommended that community health workers, community health volunteers, and community and opinion leaders who are trusted by communities should spearhead the introduction of mHealth interventions into the community. This study again reported the relevance of using local communication channels (churches, hospitals and welfare clinics, local radio stations, information centers, and information Van) to introduce mHealth interventions to participants in communities. In Yé *et al.*, (2018), series of trainings were organized for participants involved in their study and this reflected in the success of the mHealth intervention implemented.

The use of incentives to sustain and motivate the interest in the adoption and use of a mHealth intervention is very relevant for the success and scale-up of mHealth interventions. In the studies of Lester *et al.*, (2010), Wakadha *et al.*, (2013) and Bradley *et al.*, (2012), incentives such as airtime, mobile phones, etc. were given to participants in return for their use of a mHealth system. Toll-free mHealth systems and human involvement in IVR systems have been advocated by Brinkel *et al.*, (2017a) to serve as an incentive for adoption, and sustained motivation towards the use of mHealth systems.

Ensuring privacy and trust in mHealth implementation plays a significant role in the success of mHealth initiatives (Tomlinson *et al.*, 2009; WHO, 2011a; Nehl *et al.*, 2013; Tran & Houston, 2014). They improve on the trust and confidence that users have in a mHealth intervention if the medical condition it addresses has a stigma attached to it by society. However, ensuring privacy is

also difficult due to phone and Sim card sharing, and frequent Sim Card ownership change (de Tolly *et al.*, 2012). Therefore, configuring mHealth messages or protecting messages with passwords to prevent information leakages ensures that this privacy and trustworthiness of a mHealth system is achieved (Tomlinson *et al.*, 2009; Nehl *et al.*, 2013; Tran & Houston, 2014).

Human resource availability and development for mHealth implementation and scale-up are relevant. The availability of a trained workforce to support the implementation of mHealth ensures mHealth success and improved potential of sustainability and scale-up (The Earth Institute, 2010; WHO, 2011a; Hartzler & Wetter, 2014). This strategy was also highlighted by Nsanzimana *et al.*, (2012) that staff and user training on mHealth is crucial for mhealth success and sustainability. The availability of a trained workforce ensures that there are adequate staff to attend to IVR/phone call systems, and respond to SMS interventions (Aranda-Jan *et al.*, 2014).

To ensure mHealth sustainability, upscale and integration, high government commitment towards eHealth and mHealth policies and strategies, and mhealth financing is required (The Earth Institute, 2010; Asiimwe *et al.*, 2011; WHO, 2011a). This high governmental commitment contribute to secure funding sources (Ngabo *et al.*, 2012), availability of trained mhealth staff within the health sector, and a strengthened health system (The Earth Institute, 2010; WHO, 2011a; Aranda-Jan *et al.*, 2014) to support mhealth sustainability, scale-up, and integration.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

The methodology of a study in the development of understanding of the entire research processes. It is the development of understanding of the social-organizational context, the philosophical assumptions and the ethical considerations of the study, the design and approach of the study, the methods for collecting and analyzing data, instrument for collecting data for the study, and how validity and reliability of the study will be ensured. It also includes the ethical considerations that were observed during the undertaking of the study (Neuman, 2014).

3.1 Profile of study area

This study was carried out in the Asante Akim North District of Ghana in the Ashanti region. Asante Akim North District was carved out of Asante Akim North Municipal and inaugurated on 28th June 2012. It was created by Legislative Instrument 2057 and has Agogo as its district capital. The District is located in the eastern part of the Ashanti Region and lies between latitudes '60 30' and '70 30' North and longitudes '00 15' and '10 20' West. It shares boundaries with the Sekyere Kumawu District in the north, Kwahu East in the east, Asante Akim South District in the south and the Sekyere East District in the west. It covers a land area of 1,126 square kilometers constituting 4.6 percent of the Region's land area (GSS, 2014). The political and administrative governance of the District is vested in the Asante Akim North District Directorate. It is made up of the District Chief Executive who is the head, Presiding Member, Assembly members, Members of Parliament and heads of departments of the Assembly. The District Chief Executive is nominated by the President and he/she is accepted by not less than two-thirds of the General Assembly through voting (GSS, 2014).

The population of Asante Akim North District as of 2010 was 68,186 representing 1.4 percent of the Region's total population. About 53.5 percent of dwellings for the population are rural while 46.5 percent is urban. The total household population in the District is 68,423. Children (42.2%) account for the largest proportion of household members accounting. The Akan culture is the most common in the District. Twi is also the most widely used language of communication in the district. Of the population, 12 years and above, 42.1 percent have mobile phones, and 79.2 percent of the population aged 11 years and over, are literate with 20.8 percent being illiterate(GSS, 2014).

About 69% of the population aged 15 years and older is economically active while 30.8% are economically inactive. Of the population who are economically active, 95.4% are employed while 4.6% are unemployed. Students (47.5%) account for a greater portion of the economically inactive population in the district. 60% of the employed population are engaged as agricultural, forestry and fishery workers while 16.8 percent are service and sales workers (GSS, 2014).

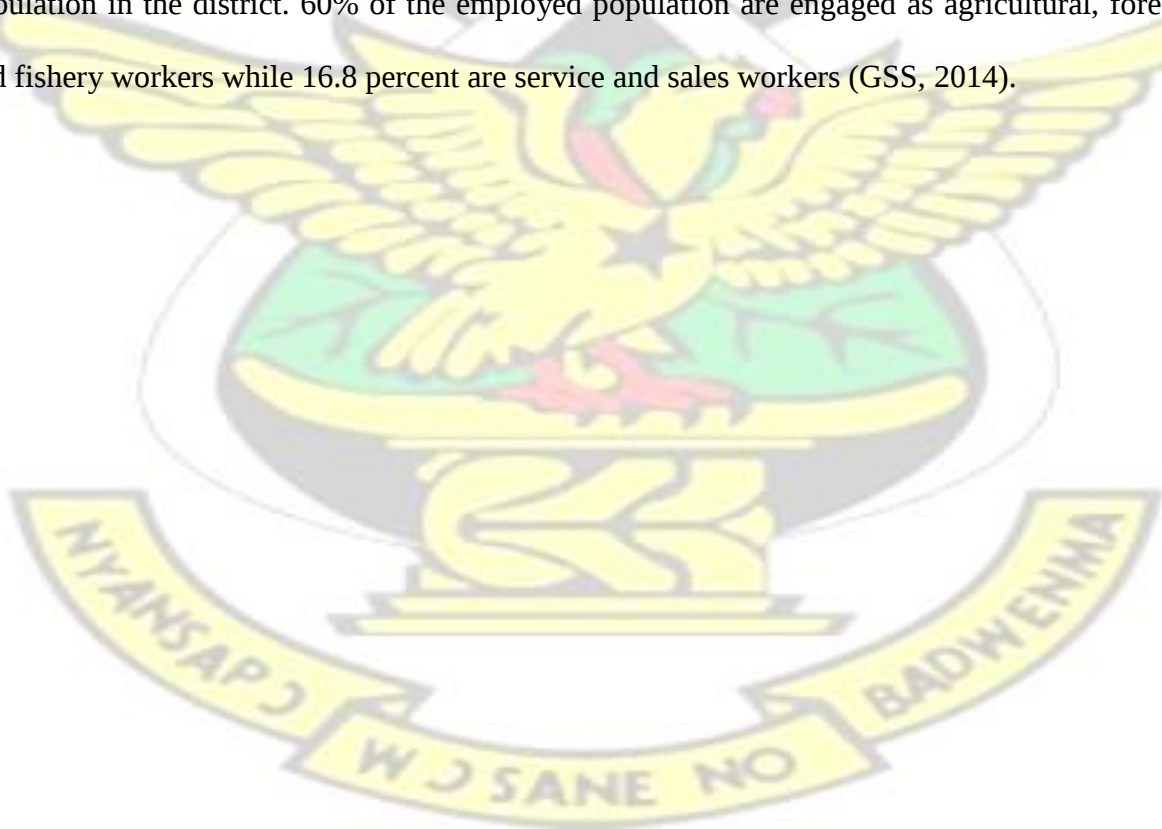
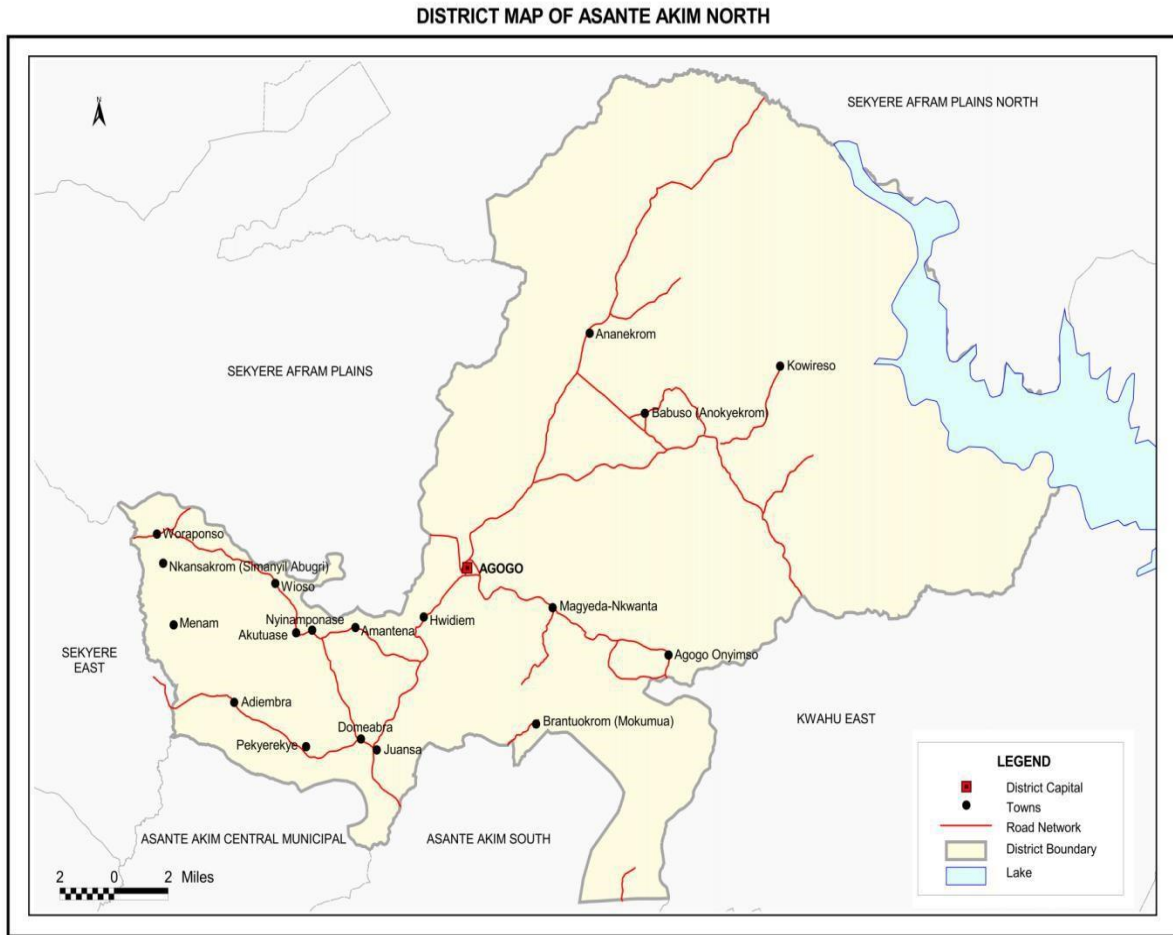


Figure 3.1 Map of Asante Akim North District



Source: GSS, 2014

3.2 Study Design and Approach

This study was a qualitative study nested within the "Mobchild" interventional Study. This nested qualitative study sorted to explore how useful the "Mobchild" System is among its end-users, and the challenges that confronted them whilst they used the system. According to (Brown, 2006), an exploratory qualitative research design is used to determine the nature of a phenomenon of which little knowledge exists so that a better understanding of the phenomenon can be achieved. It also helps to derive context-based in-depth understanding and insight into certain concepts under study.

3.3 The 'MOBCHILD' study

The "Mobchild" study; *"Reducing child mortality: the role of mobile electronic health information system (MHIS)"* is a quasi-experimental study implemented in the Asante Akim North District- Intervention site and Asante Akim South District- Control site. Both the control and the intervention sites are located within the Ashanti Region of Ghana. Both sites are situated in the part of the Region where access to health facilities and healthcare is challenging. The main goal of the MOBCHILD study is to improve the survival of children under five years of age through the development of a mobile phone-based health information algorithm system (MHIS) for collecting data directly from both caregivers of children under-five and health facilities, and also build the capacities of caregivers to be able to discover life-threatening diseases of their children through a weekly theory-based health education voice messages. It also aims to assess the overall impact of the intervention on childhood disease outcomes and device mitigation strategies for national uptake (Owusu-Dabo *et al.*, 2017).

The study employs a mixed-method approach to assess the overall impact of the algorithm based mobile health information system (MHIS) on child health outcomes by comparing the childhood health outcomes from the control and the intervention sites, and with 6 months repeated followups. It also seeks to assess the effectiveness of the MHIS in providing useful and quality data to the District Health Authorities (DHAs) for health services planning and management (OwusuDabo *et al.*, 2017).

3.3.1 The "Mobchild" MHIS functionality.

The 'Mobchild' mhealth intervention is a multi-dimensional intervention which utilizes the packages of voice reminders to caregivers on vaccination schedules and follow-ups after seeking healthcare, a weekly theory-based health education voice messages to participating caregivers, and

a toll-free (IVR) call system where caregivers can call and have the opportunity to speak and report illness of their child(ren) to a pediatrician for early guidance. The MHIS intervention is only enrolled in the intervention site (Asante Akim North District) while the control site (Asante Akim South District) has no intervention.

The MOBCHILD mobile phone-based health information system (MHIS) is a toll-free automated interactive voice response (IVR) technology that allows caregivers to dial into a computer system over a telephone line and access a service running on the computer when their child(ren) are sick. The caller then interacts with the system through voice prompts output by the system and respond to the voice prompt using the telephone keypad. Users are provided with health advice after answering several sequential questions through the IVR system depending on the severity of the symptom or combinations of symptoms reported. After the first advice by the system, it is linked directly to a pediatrician. The user again has the opportunity to also describe disease symptoms of the sick child(ren) to the pediatrician to obtain advice on whether to seek professional care or whether it is fine to treat their child(ren) at home.

The IVR system is designed based on a clinical algorithm (Integrated Management of Childhood Illnesses (IMCI) (WHO, 2014). The system is, therefore, able to classify disease symptoms as severe (A), mild (B) or moderate (C). Disease symptoms such as inability to breastfeed or drink, unconscious or convulsions and other combinations of severe symptoms is classified as danger signs by the system and hence advise the caregiver to take the child(ren) to the nearest health facility within the next 24 hours. Similarly, symptoms that fall into category 'B' are advised to provide some level of care and immediately take a child to the nearest health facility. The symptoms that may fall into category 'C' are also advised to provide home treatment and take a child to the nearest health facility if symptoms persist.

The system keeps records of all the disease symptoms of all the sick children based on the calls, and children who are advised to be taken to the hospital. The district health authorities have access to the data generated from the system and therefore expected to be used for monitoring disease surveillance in the district. The health providers are also able to follow-up on caregivers who are advised to report to a health facility but failed to access the health facility to assess their condition. The system also can send automatic reminders to patients who are due for review. Weekly Theorybased health education voice messages about childhood diseases are also sent to all caregivers. Voice messages on caring for children under-5years is also sent to the caregivers. This is to help build the capacities of the caregivers in identifying childhood danger signs and properly caring for their children under-5years. The MOBCHILD system is designed such that users have the opportunity to choose a language (Twi or English) which they are conversant with for interacting with the system.

However, for the sake of this study, the researcher was only interested in the IVR/Phone call aspect of the whole intervention implemented in the MOBCHILD project.

3.4 Study Population

The population of this study consisted of all caregivers of children under five in the Asante Akim North District of Ghana recruited on the MOBCHILD project. Participants for this study will, however, be selected from the population of caregivers, subscribed to the parent MOBCHILD study, and have utilized the mHealth intervention (IVR/Toll-free call) of the MOBCHILD project.

3.5 Inclusion and Exclusion Criteria.

Participants of the MOBCHILD study who had used the 'Mobchild' mHealth system for at least once, and gave voluntary consent constituted participants for this nested study. Also, participants

in the Mobchild study who had never used the mHealth system, and those who had ever used the system, but did not consent to be part of the study were excluded.

3.6 Sampling technique and Sample size

Sampling technique refers to the strategy adopted in selecting participants from the study population to form the sample from which data is collected from for a study.

In this study, a simple random sampling technique was used to select 27 participants among the caregivers who had used the Mobchild mHealth system for at least once. All participants who had used the MOBCHILD mHealth system for at least once were assigned numbers based on when they used the system. Once the numbers were assigned, the researcher randomly picked the assigned numbers in the form of a raffle for this study. The researcher continued with the selection of participants until a saturation point (Attride-Stirling, 2001) was reached in the data collection. The researcher adopted this sampling technique to allow all the prospective participants an equal chance of being selected to be part of this study.

3.7 Data collection procedure

Telephone numbers of the randomly selected Caregivers who had used the toll-free call system (IVR) of the Mobchild mHealth intervention were retrieved. A follow-up call was made to such caregivers and sorted for their permission to meet them in their respective communities. After their permission was sorted, the researcher met them in their respective communities and briefed them on this study nested in the bigger Mobchild project, which they had already consented to. Thus, using the languages of which the target participants are conversant with (Akan & English), the researcher first introduced himself to the target participants by name, the degree and program he is pursuing and the research he is undertaking. The researcher explained the aim and objectives of the study to the target participants, and any cost associated with the study. The researcher assured

them of confidentiality and anonymity and therefore sought for their voluntary consent. The help of Witnesses was also sorted to help inform illiterate target participants about the integrity adhered to by the researcher when explaining the contents of the participant information leaflets to them. All the randomly selected participants who did not want to be part of this nested study despite being part of the Parent 'Mobchild' study were replaced through the same sampling procedure with those who were not previously selected until the needed sample size was met.

The researcher then made arrangements for the focused group discussions to be done in Agogo Presbyterian Hospital, a local teaching hospital having conference rooms conducive for discussions for the caregivers who gave verbal consent to want to participate in the focus group discussion. On the day for the focused group discussions, all participants were made to sign or thumb print a voluntary consent form before the group discussions. The witnesses were also made to sign on the consent forms of the people they witnessed consenting to partake in this study. For convenience reasons, In-depth interviews were done for caregivers having very young children, and caregivers who complained of having busy schedules and therefore wouldn't be able to move to the venue for the focus group discussion.

11 in-depth interviews and two semi-structured focus group discussions (FGDs) were conducted among a total of 16 caregivers (8 caregivers in a group) who had used the Mobchild Toll-free call (IVR) system to seek for health information to care for their sick children under-5years. The number of in-depth interviews and FGDs were established by the saturation of responses obtained from respondents (Attride-Stirling, 2001). This was determined when no new additional information was being obtained from the last two in-depth interviews, and also, from the last FGD.

The in-depth interviews and the FGDs were done using a semi-structured interview and focused group discussion guides respectively, and recorded using an audiotape recorder. The interview and focused group discussions guide were designed in line with the objectives of the study. The Technology Acceptance Model and the Unified Theory of Acceptance and Use of Technology (UTAUT) were applied as the basic theoretical framework that guided the design of the tools. The interviews and the discussions were done in Twi and transcribed into English. The interviews and the discussions were however limited to a maximum of 60 minutes per interview and a discussion.

3.8 Data analysis procedure

This study adopted the thematic content analysis strategy for analyzing its data (Neuendorf, 2019). The recorded data were first transcribed verbatim and coded by two independently trained research assistants. Emerging themes were derived from the transcribed data, evaluated and coded. The researcher also carefully listened to the recorded interviews and discussions to ensure that what the research assistants had transcribed were the same as what was in the recordings. To reduce biases, the transcribed data and coding's done by the research assistants were discussed. An agreement was also reached before the codes were categorized. Before a derived category was also accepted to be further analyzed, it was accepted by at least 7 of the participants as a true reflection of what transpired in the interviews, and the focus group discussions.

3.9 Validity and Reliability

Validity and reliability are very important indicators in determining the quality of research. They are very important because they are the ideas that helps to determine the truthfulness and the credibility of a research finding (Neuman 2014).

Validity is the extent of the truth to which a study measures what it is supposed to measure (Neuman, 2014). It refers to how truthful the study findings fit the actual reality for which it is intended to find. Thus, it determines how the research instruments allows the researcher to collect and analyze data which truthfully meet its research objectives. To ensure validity in this study, the researcher ensured that the appropriate sampling method was used to recruit participants to collect accurate data. Also, the interview and focus group discussion guides, and the transcribed interviewed data and the field notes, which were necessary in making appropriate enquiries to meeting the objectives of the research were subjected to the approval of the Committee of Human Research, Publication and Ethics of the Kwame Nkrumah University of Science and Technology and the research supervisor for content validity respectively.

Reliability also refers to the extent to which a study conducted can yield a consistent result (Saunders, Lewis, & Thornhill, 2009; Neuman, 2014). It is the ability of the data collection techniques or analysis of a study to reproduce similar results when it is undertaken in very similar conditions or settings using similar methodology. Therefore, to check for reliability in this study, the researcher conducted a pre-test among 6 users of the MOBCHILD mHealth intervention in the Asante Akim North District who were not sampled for this study. The pretest helped to clean minor errors within the data collection instrument before the conduction of the main study. Neuman (2014) and (Abawi, 2013) supports this idea that conducting a pilot study before the conduction of the actual study helps to ensure the reliability of the study.

3.10 Ethical Considerations

The researcher obtained ethical approval for this study from the Committee of Human Research, Publication, and Ethics of the Kwame Nkrumah University of Science and Technology before commencing the study (Ref: CHRPE/AP/562/19). Even though participants have already provided

written consent to participate in the parent 'MOBCHILD' study, Informed consent was again obtained from every participant. The researcher briefed participants about the study, its purpose, and relevance, and therefore sorted for their voluntary consent to participate in this study. Only participants who willingly, and voluntarily decided to be part of this study were allowed in this study.

The researcher also ensured the anonymity and confidentiality of participants by not disclosing identities and information obtained from participants to any third party without the consent of the participants. All records of participants were cleared from the memory of the audio recorder and transferred unto a password-protected laptop to safeguard the data of participants after every interview and a focused group discussion. All names, titles, contacts and other identifiers were not used in the analysis, interpretation, and publication of the study results.



CHAPTER FOUR

RESULTS/FINDINGS

4.0 Introduction

This chapter presents the findings of the thematic analysis of data collected from 27 participants in this study. This chapter is arranged according to the following themes which are a reflection of the

study's objectives. It starts with the socio-demographic characteristics of participants, through to the last objective of the study.

I. Socio-demographic characteristics of participants ii. Usefulness/Benefits of mHealth (IVR) intervention to its users. iii. Feasibility, acceptance of, and attitude towards mHealth (IVR) systems. iv. Challenges/Barriers with mHealth (IVR) system use.

V. Strategies for mHealth (IVR) system improvement, sustenance, and scale-up.

4.1 Socio-demographic Characteristics of Participants

The socio-demographic characteristics of participants of this study represented; sex, age, marital and occupational status, level of education, Ethnic group, religion and communities of participants.

A total of 27 participants were included in the research. This comprised of 27(100%) females with no male. 10(37.0%) of the participants were within the age ranges, (15-25) and (26-35) age range. 5(18.5%) and 2(7.4%) were within (36-45), and above 45 years respectively. 3(11.1%) have attained Primary as their highest level of education. 17(63.0%) and 7(25.9) have attained JHS/JSS and SHS respectively. More than half of the participants, 14(51.9%), were married while 3(11.1%) are single. 1(3.7%) and 9(33.3%) are divorced and cohabiting respectively. Majority 26(96.3%) of the participants are Christians while only 1(3.7) are Muslims. Participants were in varied occupations; Trading 16(59.2%), farming 5(18.5%) and sowing 1(3.7). 4(14.8) were unemployed while only 1(3.7%) was a student. 24 (88.9%) of them belonged to the Akan ethnic group and 3(11.1%) were Kusaasi's. Concerning the number of children under-5 years, most of the women 25(92.6) have only one child with 2(7.2%) women having 2 children. Participants were from 6

different communities in the district. Table 4.1 displays the socio-demographic characteristics of the 27 participants who were involved in this study.

Table 4.1 Socio-demographic Characteristics of Participants

Characteristics	Number	Percent	Mean $\pm$ SD	Range
Gender:				
Male				
Females	27	100		
Age:			29.63 $\pm$ 8.99	26-35
15-25	10	37.0	37.0	
26-35	10	18.5		
36-45	5	7.4		
>45	2			
Marital status:				
Single	3	11.1		
Married	14	51.9	3.7	
Divorced	1	33.3		
Cohabiting	9			
Level of Education:				
Primary	3	11.1	63.0	
JHS/JSS	17	25.9		
SHS/SSS	7			
Occupational status:			14.8	3.7
Unemployed	4	59.2		
Students	1	18.5		
Trader	16	3.7		
Farmer	5			
Seamstress	1			
Religion:				
Christian				
Muslim	26	96.3		
	1	3.7		
Ethnic group:				
Akan	24	88.9		
Kusaasi	3	11.1		

Community:

<i>Agogo</i>	16	59.3
<i>Hwidiem</i>	4	14.8 7.4
<i>Juansa</i>	2	11.1
<i>Domeabra</i>	3	3.7
<i>Wioso</i>	1	3.7
<i>Akutuase</i>	1	

Children under-5 years

<i>1</i>	25	92.6
<i>2</i>	2	7.4

Source: Field data, 2019.

4.2 Usefulness/Benefits of mHealth (IVR) intervention to its users.

This section obtained the benefits/usefulness of the mHealth (IVR/phone call) system implemented in the MOBCHILD project among caregivers of children under five years who have used the system for seeking healthcare for their wards. The responses obtained from participants indicated that the intervention was beneficial to them. Almost all participants except one, who experienced a challenge with the system, talked about the fact that the system had been helpful/beneficial to them. The benefits derived from the system according to participants have been grouped under the following themes below:

Increased access to healthcare/improved health

The benefit of the IVR system to help caregivers to seek healthcare for their children was reported by participants. The majority reported that the system helped them in providing care for their children when they were sick without traveling to any health facility. The system also helped

during times that access to a health facility would have been difficult for them. This, therefore, helped them to manage the health conditions of their children and prevented it from worsening.

"It was helpful to me. This is because it was in the night and my child was having a fever and diarrhea. So when I called, He told me that if I have ORS or paracetamol syrup, I should give the child some to drink. So I gave her the paracetamol syrup and the fever went down, and in the morning, I took her to the hospital". (Female caregiver, FGD).

"For me, when I called, the Doctor asked me to give him ORS and wait until the morning to take him to the hospital if the situation persists. So I gave him the ORS and by the morning, he was OK." (Female caregiver, FGD).

"For benefits, I got some from the system. This is because when I called the system and did exactly as the Doctor asked me to do for the child, he became better and ever since the condition hasn't occurred again". (Female caregiver, FGD).

"I have gained a lot of benefits because my child is okay and alive now due to the direction (first aid), he (The Doctor) gave me". (Female caregiver, IDI)

"After I was instructed to buy paracetamol for the child and when the condition is the same the next morning I should take the child to the hospital, by the next morning, the child was okay and I did not take the child to the hospital". (Female caregiver, IDI)

Communicating with a health professional/Doctor

Almost all participants except one reported that the IVR/Toll-free call system helped them to communicate with a medical Doctor on phone from their homes to seek care for their sick children. In the comfort of their homes, and sometimes in the night, the system created opportunities for caregivers to call a health professional to seek care for their children.

"My child was always scratching the back of her ears. It became soars and I called the system and spoke with the Doctor". (Female caregiver, FGD)

"For me, my child was not sick. She was only not taking the breast milk when I breastfeed her. So I called Doctor through the system and he asked me to take him to the hospital. ... So when we went home, after about four days, he started demanding for the breast milk. So I called again and spoke with Doctor and told him everything". (Female caregiver, FGD)

"Through the system, I had the opportunity to speak with a doctor" (Female caregiver, IDI).

"When I called, through the system, I was directed to speak to a Doctor and it was easy. I explained the child's condition to the Doctor and the Doctor asked me some questions concerning the child's illness" (Female caregiver, IDI)

"I wasn't having airtime but when I called, it went through and I was able to communicate with the Doctor. He asked me questions about what was wrong with my child and then asked me to go to the hospital tomorrow" (Female caregiver, IDI).

Helped caregivers in making decisions concerning their sick children

Almost all participants reported that the intervention supported them in making decisions regarding what to do for their children when they were sick. They reported that the intervention supported them in making decisions regarding whether the health condition of their child is serious or not, and whether taking the child to the hospital is necessary or not. They also reported that the intervention helped them in providing first aid to help care for their sick children.

"The system helped me because I first thought my child's sickness was nothing severe....when I talked with the Doctor, he explained everything to me and asked me to take the child to the nearest hospital or else bacterial can enter her body" (Female caregiver, FGD)

"When my child scratched the back of her ears and it became soars, I took it to be nothing serious and it will go on its own after some time. So when I called.... and I was asked to take her to the hospital, that was when I realized it was serious and then took her to the hospital".
(Female caregiver, FGD)

"...So at the first health facility, they told us they can't take care of the child there and that we should send the child to Agogo Hospital. So, that was what made me realize that the child could have died at any time if we had decided to stay home and not called the Doctor". (Female caregiver, IDI).

"I didn't know what to do when I noticed my child was sick. But when I called the system, I was instructed on what to do and after practicing what I was told, my child became well". (Female caregiver, IDI)

"I didn't know what to do concerning my child's sickness but when I called, the Doctor gave me directions which helped the child". (Female caregiver, IDI)

"...the system educated me that the condition is severe, and so, I should take the child to hospital". (Female caregiver, IDI)

Improved knowledge and awareness-raising/Educating caregivers on selfmanagement of childhood diseases

Participants reported that, through the system, they were given education on the diseases of their children and this helped them to learn new and more about practices that can help to protect the health of their children when they are sick. They reported that their awareness about the seriousness of certain health conditions of their children was raised. Through the system, they again learned about what needed to be done for their children to be healthy when they are sick.

"This is my firstborn. So when he felt sick in the night, I didn't know what to do. However, when I called the system, The Doctor after talking with me asked me to give him first aid (ORS) if I had some and take him to the hospital in the morning for proper care. I did that and my child felt better" (Female caregiver, FGD).

"If I had not called I wouldn't have known what to do for the child to be ok". (Female caregiver, FGD)

"I became surprised when I first called them (The IVR system). This is because the system made me realize the child's sickness was serious. when the child's body was warm, they told me to first wash the child with cold water and rush him to the hospital" (Female caregiver, IDI).

"I learned that when the colour of the eye change or when the body is warm, I can give the child paracetamol syrup and if the child is running, I can also give the child more water or coconut water to drink" (Female caregiver, IDI).

"It has helped me. Like I was saying, when my child was vomiting, it was the system that taught me what to do. If not it, I wouldn't have known what to do". (Female caregiver, IDI)

"If you are told to do something that you do not know which involves the life of your child, I think is very useful. The system is very useful because it educated me on how to take care of my child" (Female caregiver, IDI).

Provided emotional support to caregivers

Some participants reported that the opportunity provided by the system that enabled them to communicate with a health professional helped in relieving them of fear and anxiety when their children were sick. They reported that the empathetic nature of the Doctor, and the education given by the Doctor through the mHealth system, made them feel better, relaxed and supported when their children were sick.

"Please as for me, it was helpful to me. Because when my child was refusing to drink breast milk, I was scared and I was always thinking about it..... So when I called Doctor and he spoke with me, he told me not to be scared but take him to the hospital and I became ok". (Female caregiver, FGD)

"The system has been helpful to me. This is because this is my firstborn and I had also not seen anything like that as a mother. So when it happened like that in the night, I was frightened and very scared. However, when I called and got the chance to talk to the Doctor, He told me not to be scared but give him ORS to drink. So I felt ok and gave him the ORS" (Female caregiver, FGD).

4.3 Feasibility, Acceptance of, and attitude towards mHealth (IVR systems)

Assessing the feasibility, acceptance of, and attitude towards a mHealth intervention can help influence and predict whether a system will be adopted and used by its end-users. This study, therefore, assessed the feasibility and acceptance of a mHealth system (the IVR system), and the

attitude of caregivers who have used the system in seeking care for their children under-5years. Regarding the use of the system, almost all participants used the IVR system themselves without the help of anyone. The majority of participants had used the system just once with only a few using it for more than once. For example, in the FGDs, when participants were asked whether they used the system themselves or needed the help of someone, almost all reported that they used it themselves.

"I used it myself. Nobody helped me" (15 Female caregivers, FGD).

Also, during the in-depth interviews, when participants were asked whether they used the system themselves, or needed the help of someone, all the 11 participants responded "Yes" to the question. Only one participant in the FGDs reported that she needed the help of her son because the system was communicating with her in English which she didn't understand.

"...when I called, the person was speaking English. One of my children was standing near to me so I called him and asked him to talk to him". (Female caregiver, FGD) **Ease of use of the system:**

Also, almost all participants reported that using the IVR system was easy despite certain minor challenges. The use of a local language (Twi) and clear interaction voices used in the design of the IVR system seemed to have facilitated the ease of use of the system. Only one participant reported that the system wasn't easy to be used. When participants were asked how easy the system was, the following were quoted;

"...when you dial the number and it goes through, the machine will answer and ask you whether you want English or Twi. So is up to you to choose that you like Twi. So once you select

twi, it will start asking you questions about the disease of your child in twi" (Female caregiver, FGD)

"As with the system, it is not difficult to use. It is what you press that tells the system what to say" (all 8 female caregivers, FGD)

"When I called, the system was telling me what to do. For example, ...the system will tell me that if your child is vomiting, press maybe 1 and so on which was very easy to me" (Female caregiver, IDI).

"When you call, the system will ask you, say, if you want Twi press 1, or if your child is showing this symptom, press 2 and all that. So it was very easy when I was using" (Female caregiver, IDI)

"When I called, the system answered immediately. With the machine, everything was clear to me and there were no challenges" (Female caregiver, IDI).

The participant who reported that the system was not easy to be used supported her claim with the statement below;

"I was told to press 1 or 2 when I called the system. However, pressing those numbers sometimes disconnected the line and it was not easy for me to get it instantly. My only problem is the pressing of the numbers" (Female caregiver, IDI).

Acceptance and attitude towards the system:

Acceptance of the mHealth system was high and attitude towards the system was also positive among participants. Participants accepted the system to be a very useful tool and expressed their willingness to seek healthcare for their children whenever they are sick through the system. When

participants were asked whether they will be willing to report the illness of their children, recommend the system to their relatives and friends, and all caregivers, and also advocate for the availability of the system to every caregiver in Ghana, almost all participants responded "yes".

"Yes. We will be glad to recommend the system to others because if someone is dying, you can't let them die. However, we have been asked not to give the number to anyone who is not part of this project." (Female caregivers, FGD).

"But the thing is for children below 5yrs? So if you have a brother or a sister and they also have a child like that then you can give the number to them". (Female caregiver, FGD)

"I have two relatives; thus my mother and my sister, they have kids like mine and I want to help them register so that you can help them as well" (Female caregiver, IDI).

Adherence to the system's advice:

Participants expressed a high feasibility and acceptance, and a positive attitude towards the mHealth system through a high Adherence to the advice given by the mHealth system. Majority of the Participants who were advised to take their children to the hospital/health facility adhered to the system's advice. Others who were also advised to first provide certain home care to stabilize the health conditions of their children before seeking proper care from a health facility, also abided by the instructions given by the system. Almost all participants could remember the advice given by the system.

"...for mine, when I called and I was asked to take Him to the hospital, I did so. (Female caregiver, FGD).

"For me, when I called, the Doctor asked me to give him ORS and wait till the morning to take him to the hospital if the situation persists. So I gave him the ORS and by the morning, he was OK". (Female caregiver, FGD).

"... so when I called, the Doctor asked me to take him to the hospital. I took him to the hospital and they gave her an injection and all the rashes went away." (Female caregiver, FGD).

"The system told me to wash the child down with cold water and when I did that it helped" (Female caregiver, IDI).

Only about three participants refused to take their children to the hospital or seek proper treatment for their sick children when advised by the system. They attributed it to lack of money, and a valid health insurance to seek proper care.

"...I was told that I have to get NHIS before I can take the child to the health facility and because I did not have NHIS, I was not able to take the child to the hospital" (Female caregiver, IDI).

"For me, they did tell me to take my child to the hospital but I didn't go " (Female caregiver, IDI).

"The nurse... and asked me, "Where is our insurance card?" I told her our insurance has expired....So I also told her I did not bring any money thinking I would not have to pay because of the card (The Project's ID card). Then I told her (The nurse) I would have to go and come back later tomorrow if I find any money" (Female caregiver, FGD).

Social influence:

Significant others may play a role in the acceptance of a system, and the attitude of end-users towards a mHealth system. This study assessed the acceptance of, and attitudes towards the mHealth system among significant others from participants to tell how they would influence the use or non-use of the system. The social influence on the use and attitude of the Mhealth system was positive. Almost all participants reported that the system is perceived to be useful, and attitude towards the system among their significant others is also positive. The system seemed to have received approval from significant others as a useful tool for seeking healthcare. Participants expressed it through the following quotes;

"for me, I can tell they are happy with this intervention. This is because, on the first day that I called the system and I was asked to take the child to the hospital, my sister who was close to me started expressing her desire, and even wished that she had also been registered. All the others around me who saw the card were happy" (Female caregiver, FGD).

"As for me, I had even forgotten about the card. It was even my husband who reminded me of the number to call and speak with the Doctor. So he is happy and sees the system to be beneficial" (Female caregiver, FGD).

"As for me too, my husband is also happy with the system. In the night when my child wasn't feeling well, it was even him who picked the card and dialed the number on his phone before giving me the phone to speak with the Doctor" (Female caregiver, FGD).

No cost involved in using the system:

Participants of the study reported that they did not spend any money on using the system since it's a toll-free system. They reported that, apart from the cost incurred at the health facilities or the first

aid prescriptions by the system, they did not incur any direct cost concerning using the mHealth (IVR) system. This became evident through the following quotes;

"There was no cost involved. It was the drugs that I was instructed to buy which was about 8 cedis" (Female caregiver, FGD).

"I wasn't having airtime but when I called, it went through and I was able to communicate with the Doctor". (Female caregiver, IDI).

"There was nothing like that. They didn't even deduct anything from my airtime. The only losses we made was the money the woman spent on the medicines at the hospital" (Female caregiver, IDI).

"There was no cost involved when I called the system. However, when I took the child to the hospital, I made some payments because the child did not have NHIS" (Female caregiver, IDI).

4.4 Challenges/Barriers with mHealth (IVR) intervention use among its users.

Identifying challenges/barriers which interfere with the use and adoption of mHealth is relevant in predicting the success of the intervention. It helps to determine what is preventing people from using the system or what is restricting the smooth use of the system and hence influence evidencebased strategies to curb the barriers. In this study, the perceived and actual challenges/barriers reported by participants regarding the mHealth system include;

Poor infrastructure:

Participants reported that a lack of stable and quality cellular network system, and a reliable electricity supply sometimes served as a hindrance to their use of the system. They reported that sometimes due to no/low network, calling the system when their children are sick becomes

problematic. They also reported that frequent power outtakes sometimes makes the batteries of their phones run low and shuts down. When this happens, they are not able to call the system to seek the appropriate care for their children when they are sick. For example, in one FGD, when participants were asked whether they do sometimes experience power outtakes, and no or low networks, and whether any other thing affects their use of the system, all participants responded "yes". They all made it clear that the challenge of poor network quality and power outtakes interferes, and would interfere in their use of the system.

"When your phone is also off, you can't call. It is when you call and he doesn't answer that you can say that when I called the doctor didn't tell me anything. However, when your phone is off, you can't even call". (Female caregiver, FGD)

"The only thing is, when it rains heavily, we have network problems..." (Female caregiver, IDI)

"The network can be bad sometimes but it does not take long so that may not be a big challenge. But with light (Electricity) issues, it can be a problem because if the lights are off and your phone goes off it will be a challenge if you want to use the system". (Female caregiver, IDI).

"Please as for this place we don't have light....." (Female caregiver, IDI).

"The network is bad here so it was very difficult for me to call" (Female caregiver, IDI).

"We know the network sometimes goes off and so it normal" (Female caregiver, IDI).

Missed calls, dropped calls and busy mobile phone numbers:

To enjoy the full benefits of IVR systems, the need to communicate with a health professional through the system to seek guidance on how to provide care is relevant. Therefore, in the situation when a user is not able to communicate with a health professional through the system due to unanswered calls, busy phone lines or due to dropped calls, then the full benefit of the system is curtailed. Some Participants, however, expressed these challenges.

"When I called at first there was no answer. So I became worried. However, there was a call back within a few minutes". (Female caregiver, IDI)

"I even tried it last three days. The call went through but nobody responded till the call ended". (Female caregiver, IDI)

"If you call and He (The Health professional) doesn't answer, you can't talk to him". (Female caregiver, IDI)

"When we called, we were on the line but didn't hear anything and then the call dropped. Meanwhile, my sister's child was also seriously sick.... I even thought that she dialed the wrong number and so I took the number and dialed it myself and I encountered the same problem" (Female caregiver, IDI).

"At times the child may be severely sick. So when we call and the line is busy,....it will be a great challenge". (Female caregiver, IDI).

Limited knowledge and Difficulty pressing keys:

Using IVR systems requires knowledge and understanding of how the system works, and the pressing of keys to feed information into the system. However, some participants reported having challenges with understanding the system, and with the pressing of keys to feed information into the system. This resulted in the repetition of instructions by the system and dropped calls.

"I did not understand the system from the beginning. I didn't even know what to do if to press 1 or 2" (Female caregiver, IDI).

"I was told to press 1 or 2 when I called the system. Pressing those numbers sometimes disconnected the line and it was not easy for me to get it instantly. My only problem is the pressing of the numbers". (Female caregiver, IDI).

"It (The system) was very easy but when I press say 3, the system repeats by saying the same thing over again". (Female caregiver, IDI).

Unmet expectation and Limited information on other diseases:

The inability of the system to cater for other disease conditions was reported by some participants. For a system that creates access opportunity to healthcare, its ability to capture many disease conditions is seen as its strength. Therefore, when this was not seen with the IVR system implemented, some participants expressed their worry about it. Some also reported that their expectation about the system was not met even though they consider the system to be very useful/beneficial.

"There was no information on the eye condition of my child so I couldn't press any key on the situation" (Female caregiver, IDI).

"To me, I was expecting that when I call, they will tell me to use this drug or that drug but it was not so". (Female caregiver, IDI)

Delays by the system during emergencies:

Participants expressed the challenge of having to go through the long procedures of the IVR system by pressing numerous keys before getting the opportunity to speak to a health professional. They expressed this may be a challenge/barrier during times of emergencies.

"...my only problem is when the child's condition is very serious and you have to go through all those procedures before the doctors speak to you" (almost all Female caregivers, FGDs; One Female caregiver, IDI).

Other observed challenges:

From the observation made by the researcher on the field, the following challenges observed may also interfere in the improvement, use, and scale-up of the mHealth system.

Misplaced Identity cards.

The researcher observed that the ID cards containing the toll-free number, which were given to all eligible caregivers, had been misplaced by some caregivers. This means that it would be difficult for such caregivers to remember and use the system again when their children are sick. This became evident when the researcher asked some of the caregivers with misplaced ID cards to remember the toll-free number without the card and some of them could not remember it.

Limited understanding of the whole intervention among some participant:

From the In-depth interviews and focus group discussions, certain questions and statements made by some participants indicated that there was a limitation of understanding concerning the whole intervention (The MOBCHILD project). Some questions and statements made by some participants made it clear that some participants lacked adequate education on the whole mHealth intervention. For example, some participants asked questions like *"Please is your Project also like that of KCCR?"* (Female caregiver, FGD), *"When you come to the hospital and when the doctor is assessing the child, do you have to also show the small card to the Doctor?"* (Female caregiver, FGD).

Some also made statements about their thought that, when they were asked by the system to take their children to the hospital, because of the project's Identification card, they thought it was going to be free.

"When we got there (The health facility), I brought out the small card (the project's ID). Then the nurse also asked me..."Where is our insurance card?" I told her our insurance has expired. Then she asked that.... So I told her I thought because of this paper, I would not have to pay... So I also told her I did not bring any money..." (Female caregiver, FGD).

"The mother said they bought medicines just like how the normal processes go. She said she showed the child's card thinking that they will be given free medicines but they were told the card will start working later but now they have to use their money to buy the medicines". (Female caregiver, IDI).

"I was thinking that when I call, you will take responsibility for everything but I was told that I have to get NHIS before I can take the child to the health facility" (Female caregiver, IDI).

Implementation of Other projects within the study site.

The presence of other Project running in the study site was also observed as a challenge/barrier which had an influence on some participant's perception and attitude towards the mHealth intervention which was assessed in this study. Some participants had the perception of the incentives given in some projects (e.g. the malaria research) that is being implemented by KCCR within the study site and projected it towards the mHealth intervention (The MOBCHILD project). Therefore, when they realized that there are no such incentives in the mHealth intervention (The MOBCHILD project), their attitude and motivation to continue using the system became influenced.

"...for that of KCCR, when the child is sick in the night and you call, they will bring a car to your house and pick him to the hospital" (Female caregiver, FGD).

"like KCCR, when you are part of them and your child is sick, you won't pay anything. It is them who even pay for your health insurance for you. For my firstborn whom I registered him with KCCR, they paid for his insurance premium and paid that of my other six children". (Female caregiver, FGD).

"My child is part of the malaria group... So, right now even if my child falls sick and I send him to the hospital, he wouldn't follow the normal process...Regarding the medicines, I don't pay for them. Rather, those who do the malaria program pay the bills and even give us our in and out lorry fare. So I have not yet started using yours". (Female caregiver, IDI).

4.5 Strategies for mHealth (IVR) system improvement, sustenance, and scale-up.

Improving, sustaining and scaling-up mHealth interventions require evidenced base and evidenceinformed strategies. The strategies helps to ensure that efficient and effective mHealth interventions are improved, sustained and scaled-up to serve continuous benefits to its users. This study, therefore, assessed for recommended strategies from participants to resolve reported barriers/challenges affecting the use, and the implementation of the mHealth (IVR) system implemented in the MOBCHILD project. From participants, the strategies bellow were recommended;

Financial support:

Participants recommended that, to ensure an effective sustenance and scale-up of the mHealth system, then users of the system should be supported financially. They reported that caregivers should be supported financially with regards to the cost incurred by a caregiver when they are referred to a health facility by the system, and also, help with the payment of insurance premiums of registered children on the intervention. They reported that this will help to avoid the defaults in the adherence to the advice by the mHealth system. This was made clear through the following quotes below;

"Then we will need help. This is because not all of us have money. If the child is sick, you can't also sit and watch the child die. So if you can talk to the Doctors that any parent who comes to the hospital with this card and does not have money should be taken care of and those who have money should also pay,..." (Female caregiver, FGD).

"...However, if the project can help pay maybe halve of the hospital bills when they are expensive, it will help. This will prevent people from not taking their children to the hospital when they call the system and they are asked to do so" (Female caregiver, FGD).

"What I will say is that you have to take part of the cost that comes. For example, if one goes to the hospital and the person is supposed to pay 300 Cedis, you can pay like 100 Cedis for the person" (Female caregiver, IDI).

"I was thinking that when I call you will take responsibility for everything. However, I was told that I have to get NHIS before I can take the child to the health facility. And because I did not have NHIS, I was not able to take the child to the hospital. So if you can help in that aspect it will really help" (Female caregiver, IDI).

Development of Partnerships with community institutions:

The relevance of the involvement of opinion leaders (Assemblymen/women), community health workers, churches, hospitals (welfare clinics) and other community members in the introduction of mHealth systems into a community was highlighted by participants. Participants reported that the involvement of these institutions will help to create much awareness, and also help individuals to develop trust and confidence in the mHealth system. They reported this will influence the acceptance and use of the system by community members. The quotes below support this claim;

"If someone doesn't want to use it, you can call a person who has used it before so the person explains to him or her" (Female caregiver, IDI).

"Assembly members/opinion leaders should be involved when introducing the system to the whole community" (Female caregiver, FGD).

"Churches can also be involved so that they can talk about it to their members. When we come for weighing, they can also talk about the system so that everyone will be aware of the system" (Female caregiver, FGD).

"For example, if the assemblyman and some leaders in the community are involved to introduce the system to the community, even if someone doesn't come for the meeting, the assemblyman and other leaders can later help to inform everyone in the community" (Female caregiver, FGD).

Improved mHealth infrastructure:

Ensuring Stable electricity power supply, and a quality cellular network to support the scale-up of mHealth systems was reported by participants. The challenge of poor network quality and electricity power supply was a major barrier to participants in their use of the mHealth system. Participants reported that, when their phones shut down due to electricity power outtakes, they wouldn't be able to use the system. They also added that, without a mobile cellular network, they can't use the mHealth system. Therefore, participants recommended the advocacy for stable electricity supply and also, the development of mHealth systems which makes it possible to use or call the mHealth (IVR) system, with or without mobile cellular network if the system is to be scaled-up in a whole community. Participants expressed this through the following quotes;

"The light out should be minimized and even if the light goes off, it should not take days before it comes back" (Female caregiver, IDI).

"You can help us get light over here since we don't have some so that I can get access to you anytime I want to contact you" (Female caregiver, IDI).

"There should be a system where we can call always without any network barrier" (Female caregiver, IDI).

Assigning health professionals, and Designating places within health facilities to attend to users of mHealth systems:

Participants reported that having specific designated health professionals to attend to users of mHealth interventions will help to sustain and scale-up mHealth (IVR) interventions. They also expressed that having specific designated places within health facilities for only the users of mHealth systems will be necessary to sustain mHealth interventions. Knowing the personnel and specific places within facilities where children can be taken to exactly during situations that users can't use the IVR system to seek care for their children was raised as relevant. This will help to reduce or prevent the situations of missed calls. This also will help users of mHealth (IVR) systems to know where exactly to take their children during emergencies. These were reported by participants through the following quotes below;

"If we can get to know the doctors and where exactly we are expected to bring our children when we come to the hospital, it will be helpful. This is because, it may be that your child is sick and your phone is also off or there is no network. When it happens like that you can't call the system. However, if you know where and who exactly is supposed to attend to your child, you can take the child there straight" (Female caregiver, FGD. 7 other caregivers nodded to this response)

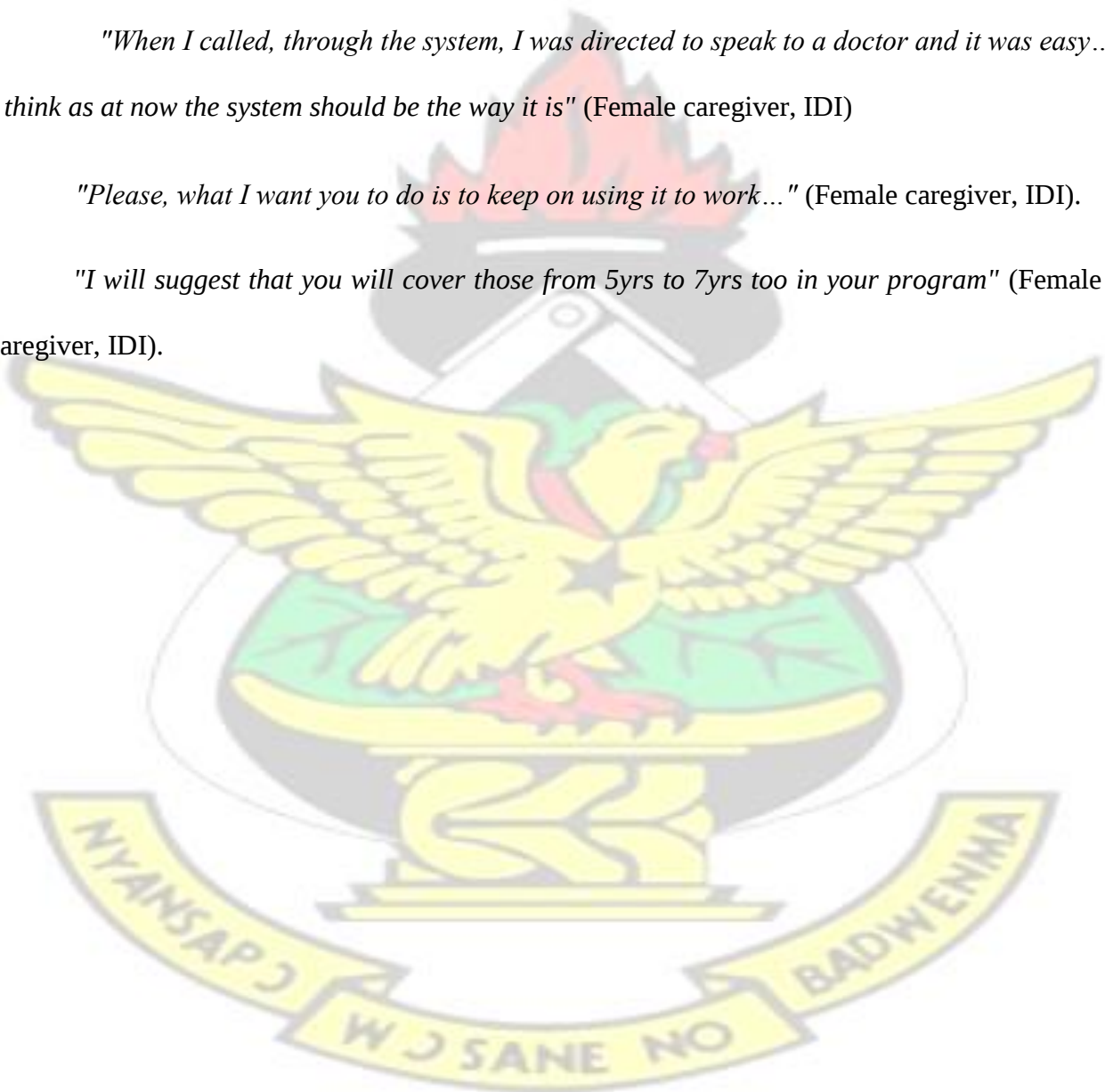
"We should know where the Doctors who take care of children from this project are just like that of KCCR. So when you come, you will know that this is the place you are going, and this is the person you have to give your card to. If you can also do it like that, it will be helpful" (Female caregiver, FGD)

Despite all the above-recommended strategies, some participants also expressed their satisfaction with the current design of the mHealth (IVR) system, designed and implemented in the MOBCHILD project and hence recommended that the system be maintained. However, some reported that the beneficiaries of such interventions should be expanded to cover children who may be up to 7years. This was expressed through the quotes below;

"When I called, through the system, I was directed to speak to a doctor and it was easy... I think as at now the system should be the way it is" (Female caregiver, IDI)

"Please, what I want you to do is to keep on using it to work..." (Female caregiver, IDI).

"I will suggest that you will cover those from 5yrs to 7yrs too in your program" (Female caregiver, IDI).



CHAPTER FIVE

DISCUSSION OF KEY FINDINGS

5.0 Introduction

This chapter presents the discussion of the results obtained from the study and the findings of other published works on the usefulness and challenges of mHealth interventions/systems among caregivers of children under-5years. This has been arranged per generated themes from the study. The discussions of the study are rooted and guided by the adopted; Technology Acceptance Model (TAM), and the Unified Theory of Acceptance and Use of a Technology (UTAUT).

5.1 Socio-demographic characteristics of Participants:

The background information on the demographic characteristics of respondents was very relevant to the study. Some of the characteristics of respondents were analyzed to provide insights into the research issues.

A total of 27 participants were included in this research and all were discovered to be females. They were from six different communities; Agogo, Hwidiem, Juansa, Domeabra, Wioso and Akutuase, and from the Akan 24(88.9%), and Kusaasi 3(11.1%) ethnic background. The majority, 26(96.3%) were Christians while only 1(3.7%) was a Muslim. The majority, 21(77.7%) were employed in varied occupations; trading (59.2%), farming (18.5%) and sowing (3.7%), 4(14.8%) were unemployed, and 1(3.7%) was also a student. 10(37.0%) of the participants were aged within (15yrs – 25yrs) and within (26yrs – 35yrs) age ranges, constituting the majority. Only 5(18.5%) and 2 (7.4%) were within 36yrs – 45yrs and above 45years respectively. The majority of the participants, 14(51.9%), were married while 9(33.3%) were cohabiting. 3 (11.1%) were single and only 1(3.7%) had divorced the partner.

This discovery of all females in this study reflects the notion people hold about caring for children. According to WHO *et al.*, (2018), in many Sub-Saharan African countries, women are regarded as the primary caregivers for nurturing children. Samman *et al.*, (2016) also support this finding that too much of the responsibility for childcare is left to women, especially those who are poor and vulnerable. This, therefore, may have accounted for the discovery of all females in this study as the primary caregivers of children under-5years without any male participant. The age ranges of which the majority of caregivers fall within also indicate the young nature of caregivers who were involved in the study. Also, the discovery of the majority of participants from the Akan ethnic background, and also being Christians is an indication of the dominance of the District by the Akan ethnic culture, and the Christian community. This discovery replicates the findings in the population and housing census of the District conducted by the Ghana Statistical Service in 2010 (GSS, 2014) which discovered a dominance of the District by the Akan culture and the Christian religion.

Also, the majority of participants 17(63.0%) had attained JHS/JSS education with only 7(25.9) attaining SHS/SSS level of education. This indicates a low level of education among participants and this may have influenced the literacy of participants in this study. This finding converges with results obtained by Brinkel *et al.*, (2017a & B) which also discovered a similar educational pattern among participants in their study within the same Asante Akim North District.

5.2 Usefulness/Benefits of mHealth (IVR) intervention.

How useful/beneficial a system or an intervention is perceived, is relevant to predict the adoption and use among its end users (Davis, 1989). It also influences the attitude towards a system among users, and therefore contributes to system use, sustenance, and scale-up among individuals and communities (Davis, 1989). This gives an indication that, if a system is perceived to be beneficial

or useful among users, then attitude towards the system will be positive and hence motivate the adoption and use of such a system (Davis, 1989).

Findings from this study discovered a beneficial or a useful mHealth (IVR) system among caregivers of children under-5years. From the study, it was discovered that the mHealth (IVR/tollfree call) system implemented in the MOBCHILD study had been useful to caregivers of children under-5years involved in the study. It was discovered that the mhealth system helped to increase access to healthcare for caregivers of children under-5years, and also, promoted communication between caregivers and healthcare professionals. The system was also discovered to have supported caregivers in making healthcare decisions concerning their sick children. Again, the mHealth system serving as a tool to have improved knowledge and awareness of caregivers on self-management of childhood diseases, and the system providing emotional support to caregivers when their children were sick was also discovered.

The potential of the mHealth (IVR) system to improve access to healthcare for caregivers of children under-5years, and also increase communication between caregivers and health professionals discovered in this study, makes this system an innovative and efficient tool which can contribute to improving the health of children under-five years. In a health system confronted with many challenges to the delivery of equitable and quality healthcare (Mahmud *et al.*, 2010; UN, 2015a), this system offer unprecedented opportunities to provide universal healthcare, and also, helps to improve the health of populations who are unserved or poorly served (Akter, 2010; WHO, 2011a; Lee *et al.*, 2016). The possibility of this mHealth system to enable caregivers to communicate with health professionals to access healthcare for their sick children without necessary moving to a health facility before accessing healthcare may help in reducing healthcare access burdens such as time and transport costs among caregivers (Akter, 2010). This will also

help them to become active partners in providing healthcare to their children under-5years (Anshari & Almunawar, 2014). In a review by Abaza & Marschollek, (2017) on mHealth, similar findings just as what is stated above was discovered. The findings of the mHealth system to improve access to healthcare and improve communication between caregivers and health professionals discovered in this study, also replicate findings discovered by Odigie *et al.*, (2012), Schooley *et al.*, (2015) and Madon *et al.*, (2014).

Again, the discovery of the mHealth system to have served as a decision support and an emotional support system to caregivers may make this system a very useful tool in the prevention of emergency disease situations among children under-5years. The system helped caregivers in determining the severity of disease symptoms of their children, and the needed action to be taken to protect the health of their children. Among early and inexperienced caregivers who may be scared and anxious, and also not know what to do when their children are sick, this system may help to offer support to such caregivers to decide on what to do, and relief them from fear and anxiety.

The mHealth system implemented recommended to caregivers, home care treatments for managing minor childhood diseases, and also, recommended the need and urgency for a caregiver to seek proper healthcare for their sick children. In such a study which discovered a high adherence to system advice among caregivers, it's an indication that, the mHealth system has the potential to help caregivers act promptly to the disease symptoms of their children and also seek for proper healthcare at the right time without needing to wait for a disease condition of their children to become very severe or worsened. In a situation whereby a health facility is hard to reach due to either geographical distance or due to the fact that a disease condition occurred in the night when access to transport to a health facility is difficult to find, this system offer the opportunity to support

caregivers in such situations by recommending healthcare practices to be done to safeguard the health of their children. The system, therefore, has the potential to help improve the health of children under-5years even during the situations when there are healthcare provider shortages and hence requires investment in. Kuntagod *et al.*, (2015) and WHO, 2011a have reported that mHealth has the potentials, and supports caregivers in decision making regarding providing care to their sick children. Also, the discovery of the mHealth system providing emotional support to caregivers replicate finding by Brinkel *et al.*, (2017b) where a mHealth (IVR) system implemented was discovered to have provided emotional support to caregivers in their study.

Improving knowledge and awareness of caregivers on self-management of childhood diseases is very useful and very relevant to safeguard and improve the health of children under-5years. For caregivers to be able to act promptly to the sicknesses of their children, then knowledge to determine diseases symptoms, and on what to do, is very relevant. The mHealth system assessed in this study offered caregivers this opportunity to learn about childhood disease symptoms and certain self-management practices. This potential of the mHealth system may contribute to helping clients become active partners in caring for their sick children (Anshari & Almunawar, 2014), and also, help prevent emergency disease conditions among children under-5years due to delays in identifying severity of disease symptoms of children under-5years among caregivers (Chang *et al.*, 2011 & Leventhal, 2014). In studies by Mahmud *et al.*, (2010), Ngabo *et al.*, (2012) and Chang *et al.*, (2011), mHealth systems were found to have improved the knowledge and awareness of caregivers on childhood diseases conditions and management practices just as discovered in this study. Lau *et al.*, (2014) and Otieno *et al.*, (2014) also raised this claim that, mHealth functions as a learning tool for learning and raising awareness about disease conditions and therapies for managing diseases among caregivers and patients.

5.3 Feasibility, Acceptance of, and attitude towards mHealth (IVR) systems.

The feasibility and acceptance of mHealth system as a tool for assessing healthcare among users is important to contribute to the use and sustenance of a mHealth system. It influences users' attitudes towards a mHealth system and also, influences their intention and actual use of the system (Davis, 1989).

This study discovered that the mHealth (IVR) system implemented in the MOBCHILD project is considered a feasible tool for assessing healthcare for children under-5years among caregivers. The system was also highly accepted among caregivers, and attitude towards the system was also positive. These were demonstrated through satisfaction with care received through the mHealth system, high willingness to continue using the mHealth system to access healthcare, and a high adherence to the system's advice. Also, a high willingness to recommend and advocate for the adoption and use of the mHealth system to all caregivers of children under-5years in Ghana among participants contributed to the above findings. The high acceptance and positive attitudes towards the mHealth system discovered in this study converge with discoveries made by Brinkel *et al.*, (2017a & b), Diesel *et al.*, (2018) and Laar *et al.*, (2019).

The consideration of the mHealth system as a feasible tool, the positive attitude towards the system, and the high acceptance of the system may be attributed to the ease of use of the system as discovered in the study. Facilitating conditions such as the use of local language (Twi), and clear interaction voice used for the design of the IVR system (Venkatesh *et al.*, 2003) which caregivers reported to have contributed to the ease of use of the mHealth system, may have also contributed to the high feasibility and acceptance of the system, and a positive attitude among caregivers. From the study results, almost all caregivers had used the system themselves without needing the help of others due to the easy to use nature of the system. The toll-free nature of the mHealth system,

and the fact that caregivers could communicate with a health professional (Doctor) through the IVR system, may have also influenced the perception and acceptance of the system as a feasible tool for assessing healthcare among caregivers. In studies by Brinkel *et al.*, (2017a & b), the lack of human interaction in an IVR system was discovered as a barrier to the acceptance of the IVR system among caregivers who had used their system. Also, the establishment of a toll-free number for an IVR system was raised in Brinkel *et al.*, (2017b) as a recommendation among participants to contribute to the acceptance and use of their system. Therefore, the high acceptance of the system reported in this study may be attributed to the fact that the mHealth system implemented in the MOBCHILD project had addressed the above issues discovered and raised by Brinkel *et al.*, (2017a & b).

Also, the positive attitude towards the mHealth system among caregivers may have been influenced by the fact that the system is considered easy to be used. According to Davis, (1989), the easy to use nature of a technology have the potential to influence the attitude of a user towards the technology, therefore, the researcher making this claim. The positive social influence discovered in this study may have also influenced the positive attitude of caregivers towards the mHealth system. The perception of the approval and acceptance of the mHealth system to be useful by significant others among caregivers in this study may have contributed to the high acceptance and the positive attitudes towards the system, and the high willingness to use and recommend the system to others among participants. Venkatesh *et al.*, (2003) supports this claim that, the degree to which a person considers that their significant others approve and expect them to use a tool or a technology, influences the behavioral intention of the individual to use the tool or the technology. Again, in a systematic review by Aranda-Jan *et al.*, (2014), it was discovered that, mHealth systems are considered feasible and acceptable, and attitudes expressed towards it are positive due to the

perceived benefits of the systems among its end-users. In this study, the mHealth system assessed was reported to be useful and beneficial among participants. This may have also contributed to the high acceptance and the positive attitudes of the caregivers expressed towards the mHealth (IVR) system.

5.4 Challenges/Barriers with mHealth (IVR) intervention.

Different challenges were discovered as barriers which affected, and can restrict the acceptance and use of the mHealth (IVR) system implemented in the MOBCHILD project among caregivers. The study discovered that, barriers such as poor infrastructure, missed and dropped/cut calls, and busy toll-free lines, limited familiarity and difficulty pressing keys to input feedback into the IVR system, unmet expectation and Limited information on other diseases, and delays by the system during emergencies influenced caregivers' acceptance and use of the system. Other challenges which the researcher observed; misplaced ID's, limited understanding of the whole intervention, and the presence of other Project running in the study site, may have influenced the acceptance and use of the mHealth system among caregivers.

To use mHealth system requires the existence of supporting infrastructure such as quality mobile cellular networks and stable electric power supply. However, in rural and peri-urban communities, these facilitating infrastructure are poorly developed and less invested in (Brinkel *et al.*, (2017b). This creates the problems of no/low networks and a lack of stable electricity supply to charge mobile phones. Therefore, regarding the acceptance and use of a mHealth system which also requires these infrastructure, caregivers become restricted and sometimes demotivated to adopt and use such systems. The discovery of these barriers in this study supports the discoveries made by Brinkel *et al.*, (2017a & b), Shiferaw *et al.*, (2018) and Laar *et al.*, (2019). These barriers may be a major challenge to the sustenance and scale-up of mHealth among individuals and

communities. This is to the fact that, in case a caregiver's child is sick and needs to utilize the IVR system, if the individual's phone is off, or if there is no network, it becomes difficult for the caregiver to call. This will also influence sustained interest to continue using the system and therefore making it difficult to sustain and rolled-up.

The challenges of missed and dropped/cut calls, and toll-free number busy raised in the study also affected the acceptance and use of the system. The inability of the health professional (Doctor) to respond to the calls of caregivers to interact with them through the mHealth system became a demotivation to caregivers. The opportunity for human interaction through the system which was incorporated to motivate the acceptance and use of the system (Brinkel *et al.*, 2017a & b) rather turned to have affected some people's acceptance of the system. This problem may be attributed to the fact the health professionals to respond to calls through the IVR system are few and therefore, whenever the health professional becomes busy with other health issues, and at other inconvenient times, the calls of caregivers would have to be missed. This will also affect the realization of the full benefits of the IVR system to caregivers.

Although a call back is made to all caregivers whose calls are missed by health professionals, this challenge will make the system less useful during emergencies. This claim is backed by the discovery made by Aranda-Jan *et al.*, (2014) and Nsanzimana *et al.*, (2012) that, limited availability of health staff to respond to calls and text messages, serves as barriers to mHealth system adoption and use. The problem of cut/dropped calls may be attributed to the poor network quality which was discovered in this study. It may also be attributed to a breakdown in the mHealth (IVR) system therefore not making it possible for calls to go through the system. When a caregiver calls the IVR system and wants to communicate with a health professional at a time when the

health professional is already communicating with another caregiver through the system, the caregiver then experiences a "Number busy" system.

Knowledge and understanding of how an IVR system functions, and the ability to feed information through the pressing of Keys into the system is the backbone of using IVR systems. Therefore, the discovery of this as a barrier to the use of the mHealth system (IVR) in this study makes it worrying. Familiarity with how an IVR system functions, and inputting information into the system influences the use of the system. The feedback given by an IVR system to a user depends on the information fed into the system. Therefore, when the wrong information is fed into the system due to the pressing of wrong keys, wrong recommendations will also be given back by the system. This problem may have also led to the cut/dropped calls and the repetition of instructions by the system which some participants reported in this study. In the studies of Madon *et al.*, (2014) and Brinkel *et al.*, (2017a & b), similar findings on limited knowledge and familiarity with the use of mHealth systems was discovered.

Stanton *et al.*, (2015) and Perosky *et al.*, (2015) also discovered in their study that, some participants had challenges with the pressing of correct buttons, reading keypads of phones, and also, selecting numbers using functional keys. In a study that discovered the majority (63%) of it participants attaining a JHS level of education, the issue of literacy cannot be overlooked when the issue of limited knowledge and difficulty pressing keys is being discussed. Studies by Perosky *et al.*, (2015) and Crowford *et al.*, (2014) also discovered that, no or limited literacy among participants served as a barrier to the use of mHealth systems.

Unmet expectations and Limited information on other diseases, and delays by the system during emergencies influenced caregivers' acceptance and use of the mHealth system in this study. The

IVR system is not designed to capture all childhood diseases. Therefore, when caregivers call the IVR system and the diseases of their children are not listed in the system, their acceptance of the system becomes influenced. Also, the unmet expectation of some participants that the mHealth (IVR) system would recommend a specific brand of drugs to them through the system, affected some caregivers' perception and acceptance of the system. In the study of Brinkel *et al.*, (2017b), this finding was also discovered. In their study, almost half of their participants reported the limitation of their IVR system to address symptoms of other diseases and wished for expansion. The issue of the designing of the system to recommend drugs to caregivers was also raised in their study.

Using IVR systems requires careful interaction with the system by following the voice prompts of the system and pressing keys to input information into the system. This careful process that caregivers would have to complete before receiving health advice from the system was raised as a barrier that could influence the use of the IVR system. During emergency disease situations, there may not be that adequate time for a caregiver to carefully follow all the processes of the system before receiving an advice from the system. Therefore, a system that creates rooms for emergency disease situations is relevant to ensure the use and continues use of the system during emergencies.

Lastly, the observed barriers such as the misplacement of IDs, limited understanding of the whole intervention, and the presence of other interventions/projects may influence the adoption and use, sustenance and scale-up of the System. When caregivers misplace the ID's of their children which contains the toll-free number, then calling the system at another time when their children are taken ill, will be difficult, if not impossible. When this happens, the actual purpose for which the mHealth system was created, will be compromised. Having an understanding of how an intervention functions is relevant for the adoption and use of a system. Therefore, when people have limitations

in understanding an intervention, the confusion affects their acceptance and use of the system. In this study, the researcher observed that some participants lacked this understanding, and therefore associated the mHealth intervention with other projects. Upon realization of the difference between this mHealth intervention and other projects, their perception and acceptance of the system were affected. This challenge may be because the participants were not adequately trained and therefore, lacked this understandings. The presence of other projects, and the incentives given in such projects affect people's attitude towards other interventions/projects without such incentives.

The continuous comparisons of the mHealth intervention to that of other projects implemented in the project site e.g. malaria research, and the frequent request by participants to include incentives given in other project, is an indication of how these can affect the attitude of users towards the use of the mHealth system implemented in the MOBCHILD project. Due to this, during a scale-up of the intervention over a long period, interest in the use of the mHealth system for accessing healthcare among participants may die out, and hence, affect the sustainability of the intervention. It there becomes necessary that an incentive package is included in the implementation of such interventions in sites where other projects/interventions are also being implemented.

5.5 Strategies for mHealth (IVR) intervention improvement, sustenance, and scale-up.

To sustain and scale-up mHealth systems in communities, participants recommended the strategy of providing financial assistance to caregivers, building partnerships with community institutions and other significant community stakeholders, improving mHealth infrastructure, and assigning health professionals and venues specifically to mHealth care.

Providing financial support to caregivers in catering for their incurred hospital bills, or their insurance premiums was greatly recommended among participants as a strategy, if mHealth

systems are to be sustained and scaled-up. The financial support may help caregivers to continuously use the mHealth system and also adhere to the advice of the system without any financial constraint. The financial support may serve as an incentive to the use and adherence to the mHealth's system advice. In the studies of Wakadha *et al.*, (2013) and Bradley *et al.*, (2012), incentives in the forms of airtime, mobile phones, etc. were given to users of their mhealth system in return of their use of the system. However, this recommendation by caregivers may have been influenced by the fact that such incentives are given to other individuals on different projects implemented within the District.

Also, the relevance of collaborations/partnerships in the implementation, sustenance, and scale-up of mHealth interventions discovered in this study have also been reported by The Earth Institute, (2010), Hartzler & Wetter, (2014) and Brinkel *et al.*, (2017a & b). In the review by Hartzler & Wetter, (2014), the use of families and friends, community elders, and other significant others (advocates from schools, churches, and opinion leaders) were discovered in literature to be useful in selling mHealth interventions to individuals and communities. The review again, discovered in literature, the need for families and key significant others in communities in the training of mHealth end-users.

Brinkel *et al.*, (2017a & b) also discovered the relevance of the involvement of community and opinion leaders, CHWs, CHVs, and other individuals who are trusted by a community, in the integration of a mHealth system into a community, and also, in the training of end-users. This recommendation by caregivers may be for the reason of the need to develop trust and confidence in a system before adoption and use. Nehl *et al.*, (2013) and Tran & Houston, (2014) support this claim that, the involvement of community significant others in the implementation of mHealth improves trust, motivation, and confidence of end-users in the system.

Increased investment in infrastructure is very necessary to support the implementation, sustenance and scale-up of mHealth interventions. This ensures a stable electric power supply for charging mobile devices, a quality mobile cellular network, and affordable mobile devices to support the implementation, use, and scale-up of mHealth interventions. It may also prevent the situations whereby a user of a mHealth system wants to use the system but due to no/low network quality, and because he/she's mobile device is off, access to the system wasn't made possible. This may also prevent the situations of dropped or cut calls due to poor network qualities. This discovery replicates findings made by Rothstein *et al.*, (2016), Vroom, (2017) and Lee *et al.*, (2017). However, the complex nature of investment in mHealth infrastructure which calls for private-government partnerships (Aranda-Jan *et al.*, 2014 and Lee *et al.*, 2017), have not been effectively pursued and hence, not equitably achieved (The Earth Institute, 2010 and Mahmud *et al.*, 2010).

To achieve this requires that, governments, telecom companies, research institutions, NGOs and Donors collaborate and invest in mHealth policies, strategies and infrastructure development. This can, however, be achieved effectively if all partners involved are committed towards the development of mHealth infrastructure and policies, and to improve equitable access to healthcare for vulnerable and underserved populations (The Earth Institute, 2010; Asiiimwe *et al.*, 2011; WHO, 2011a). This partnership for investment in mHealth infrastructure may also contribute to adequate funding of mHealth interventions (Ngabo *et al.*, 2012), reduced cost of implementing mHealth, and a strengthened health system to support mHealth implementation, sustenance and scale-up (WHO, 2011a; Aranda-Jan *et al.*, 2014).

Assigning health professionals to mHealth systems, and designating places within health facilities to attend to users of mHealth systems have been discovered in this study to have the potential to

contribute to mHealth sustenance and scale-up. Participants reported that having specific health professionals to attend to individuals who may seek care through mHealth systems, and having specific places designated for caregivers who seek care through mHealth systems would contribute to mHealth sustenance and scale-up. However, the question left unanswered is that, how can a health system confronted with many challenges such as health staff shortages and limited infrastructure (Mahmud *et al.*, 2010; UN, 2015a), assign health professionals specifically to only mHealth care, and also, designate specific venues for mHealth care?

To answer this question requires investment in the recruitment and training of more health staff and the development of more health infrastructure. This will ensure the availability of adequate health staff to support mHealth implementation and sustenance. Discoveries made by Aranda-Jan *et al.*, (2014) and WHO, (2011a) supports this claim that, availability of trained health workforce ensures that there are adequate staff to attend to IVR/phone call systems, and respond to SMS interventions. Having assigned health professionals, and designated venues purposely for mHealth care, would also help to manage the situations of emergency disease conditions of children under 5 years. Nonetheless, this can only be achieved through immense commitment from the government to invest in the redesign of the current health system, and also, strengthen it to accommodate mHealth systems (The Earth Institute, 2010; WHO, 2011a).

5.6 Limitations of the study

The assessment in this study is geographically and contextually limited to the MOBCHILD project implemented in the Asante Akim North District. Findings from this study do not reflect the true picture of all mHealth initiatives in the District, and Ghana. Thus, findings from this assessment cannot be generalized to all mHealth initiatives in the District and Ghana, due to the methodological design (qualitative) of this study.

The assessment is also done with only caregivers who have used the MOBCHILD mHealth (IVR) system. However, assessment among caregivers who had never used the system as at the time of data collection could have shown a clear picture of why they never used the mHealth system. Also, this could have helped to determine the true picture of acceptance and attitude towards the mHealth intervention implemented.



CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

This chapter presents the conclusions and recommendations of the study as per the results obtained, and the discussions of the results of each objective. The study assessed the usefulness and

challenges/barriers of using a mHealth (Toll-free IVR call) system among caregivers of children under-5years who are on the MOBCHILD project implemented in the Asante Akim North District. The study was nested in the MOBCHILD project to qualitatively help understand the various factors that may influence the sustainability, scale-up, and integration of the mHealth system implemented in the parent MOBCHILD study, and other similar mHealth systems into broader healthcare systems. This will, however, serve as lessons, and therefore influence strategies and recommendations to ensure improvement, sustenance, and upscale and integration of the MOBCHILD project and other mHealth interventions across Ghana and many other countries. Below are the conclusions made as per the objectives of the study.

6.1 Conclusions

6.1.1 Usefulness/Benefits of mHealth (IVR) system.

The mHealth (IVR) system that is implemented in the MOBCHILD study was found to be beneficial/useful to participants in this study. It was discovered that the system helped to improve access to healthcare for caregivers of children under-5years, by enabling them to communicate with a health professional through the IVR system. The system served as a decision and emotional support system to caregivers and therefore, helped them in deciding what needed to be done when their children were sick.

Again, it was discovered that the mHealth (IVR) system provided caregivers with education/awareness of childhood disease. This also helped to improve the knowledge of caregivers on the self-management of childhood diseases.

6.1.2 Feasibility, Acceptance of, and attitude towards mHealth (IVR systems).

The mHealth (IVR) system was found to be feasible and highly acceptable. The attitude of caregivers towards the system was also positive. The feasibility of the system was discovered

through the ease of use of the system reported by caregivers. The high adherence of caregivers to the system's recommendations, and their willingness to continue using, recommend and advocate for this system to be used by relatives, friends, and all caregivers in the country, demonstrates a positive attitude towards the system. The positive social influence by significant others, and the toll-free nature of the system discovered in the study, also had their part to play in the high acceptance and a positive attitude towards the system.

6.1.3 Challenges/Barriers with mHealth (IVR) intervention

A weak infrastructural support system such as Poor network quality and electricity power supply, negatively affected the use of mHealth (IVR) systems. Other challenges such as the inability of health professionals to answer calls (Missed calls), inability of the system to make calls, (dropped/cut calls), and the situation whereby a caregiver calls and the toll-free number is busy also affects the acceptance and use of mHealth systems.

Again, limited knowledge/familiarity with the use of mHealth systems created problems with the pressing of keys to feed information into a mHealth (IVR) system. Delays in using the mHealth (IVR) systems to seek for healthcare did not make the system conducive to caregivers of children under-5years during emergencies.

Other challenges such as misplaced Project IDs, Limited understanding of mHealth interventions and the implementation of other interventions may also influence continues use, and implementation of mhealth interventions.

6.1.4 Strategies for mHealth (IVR system) improvement, sustenance, and scale-up

The provision of financial assistance to support the cost of healthcare, and for insurance premiums of caregivers of children under-5years may positively influence the adoption and use of mHealth

(IVR) systems. Improved infrastructure may influence the use of mHealth systems among caregivers, and also influence the smooth implementation, sustenance, and scale-up of mHealth interventions. Collaborations with community institutions, key community stakeholders, and other significant others during the implementation of mHealth interventions are necessary to help promote awareness, trust and confidence, and a sustained motivation in the system. Designating health professionals and places in health facilities to respond specifically to caregivers who seek care through mHealth (IVR) systems may positively influence sustained motivation to use mHealth systems among caregivers of children under five years.

6.2 Recommendations to key stakeholders

Considering the results obtained in this study, the following recommendations are made to help sustain, scale-up and integrate the MOBCHILD mHealth system, and any other mHealth interventions across Ghana, Africa and the global world in communities, and into broader healthcare systems.

Government of Ghana:

The government of Ghana through its policy formulators should intensify policies that make it mandatory for telecom companies to expand and ensure quality mobile cellular networks in Periurban and rural communities. This will help to resolve the challenge of poor networks encountered by mHealth users and implementers, and hence, promote effective implementation and use of mHealth (IVR) systems. When this is achieved, sustaining, scaling-up and integrating mHealth systems will become more feasible.

Again, Government through the designated ministry for energy should improve investment and policies geared towards the provision of stable electric power supply in all communities. This will

also ensure a stable power supply to enable mHealth users to always have their mobile devices switched-on and hence promote their continuous use of mHealth systems.

Also, the Government through the Ministry of finance should allocate funds towards the development and implementation of mHealth interventions in the Country. For example, percentages of taxes from telecom companies, taxes from the use of airtimes, and NHIS premiums should be calculated and aggregated into a consolidated mHealth development fund and invested into the implementation of mHealth interventions to yield health benefits to underserved and vulnerable populations.

Lastly, the government should partner with university institutions e.g. KNUST, UG, and other research institutions like KCCR, to train individuals in mHealth, and also, research into effective and efficient ways of implementing and sustaining mHealth, and scaling-up and integrating mHealth into the healthcare delivery system in Ghana.

Ministry of Health/Ghana Health Service/Health Directorates:

Ministry of Health through Ghana Health Service and the various health directorates should recruit and train adequate health workers on the use of ICT in healthcare delivery. When this happens, the required health workforce needed to support the implementation, sustenance, and integration of mHealth interventions into the broader healthcare system will be made available. When an adequate health workforce is recruited and trained, health workers would be made available and therefore can be assigned specifically to respond to calls and attend to individuals who may seek healthcare through their mobile devices. This will, however, help to prevent the challenge of health professionals not responding to calls from caregivers through mHealth (IVR) systems and therefore promote continuous use of mHealth systems.

Again, Ghana Health Service through the various health directorates should redesign and strengthen the current healthcare delivery system in the country. Redesigning the current healthcare system to incorporate a complete electronic record system will make the integration of mhealth systems very feasible and achievable. Investment towards strengthening the healthcare system will also ensure a well-motivated health workforce to support the implementation, scaleup, and sustenance of mHealth interventions.

M-Health project implementers/Project managers:

M-Health project implementers/Managers should collaborate with community institutions, community leaders, and some other trusted community members during the introduction of mHealth interventions in communities. This helps to ensure a sustained trust and confidence in the mHealth system. This also ensures the acceptance and sustained motivation to adopt and use the system. This, therefore, will help to sustain and expand mhealth interventions to cover all other individuals in a community.

M-Health Project managers/implementers should also develop partnerships with telecom companies to seek for their support towards a sustained or quality mobile-cellular networks. They should also support by subsidizing the cost for the acquisition of toll-free numbers to reduce the cost of implementing mHealth interventions. When the cost of implementing mHealth is reduced through the subsidization of the cost of obtaining toll-free numbers to be used by caregivers, sustaining and up-scaling mHealth interventions will become more feasible to mHealth project managers/implementers.

Again, regular monitoring and evaluation of mHealth systems by project managers and project coordinators is very necessary. This regular monitoring of the system will help to detect whenever

there is a breakdown of the mHealth (IVR) system. This will, however, help to prevent the situation of dropped calls among users of the mHealth system. Evaluation of the system will also help to determine aspects of the system which may require modifications and improvements. This will also ensure a functional and supportive system during system implementation and scale-up.

Also, the provision of adequate training to research assistants, community health volunteers and users of mHealth systems is very relevant to sustain and scale-up mHealth interventions. Adequate training of research assistants and community health volunteers equip them with the necessary understandings of a mHealth intervention, and how the system functions. When this happens, research assistants and community volunteers will be able to adequately explain to users, the details of a mHealth system. This will also position them well to respond and address the questions of users regarding a mHealth system. Through the adequate training of research assistants and community health volunteers, users of mHealth systems should also be adequately trained. This will improve the ease of use of mHealth systems among users and prevent the challenges associated with the pressing of keys, and adequate understanding of mHealth interventions and systems. Therefore, mHealth project implementers/managers should ensure the availability of the necessary logistics needed to effectively carry out the training of research assistants, community health volunteers and users of mHealth systems.

Also, regular visits to users in their various communities by research assistance/ community health volunteers and field supervisors to promote a sustained interest and motivation to use a mHealth system is very relevant to sustain and scale-up mHealth interventions. This continues visits to users of mHealth systems by research assistants/community volunteers and field supervisors will help in sustaining a continuous motivation, and a positive attitude and behavior towards mHealth interventions. This will also help research assistants/community health volunteers to clarify and

answer questions of mHealth users regarding mHealth systems. Therefore, mHealth project implementers/managers should well motivate research assistants and community health volunteers to carry out this regular task of visits to users if mHealth interventions are to be sustained and scaled-up. For example, in a District like the Asante Akim North having different kinds of projects running in it, and with different direct incentives, sustained motivation and interest in mHealth interventions may diminish with time among users. However, through the regular visits by research assistants and community health volunteers, sustained interest in, and motivation to continue using mHealth interventions will be well maintained.

Again, acquisition of health facilities-specific toll-free numbers are very relevant to sustain, scaleup and integrate mHealth systems. The acquisition of one general toll-free number to be used by a large number of users, instead of health facilities-specific toll-free numbers may create the problem of diverse calling of a mHealth (IVR) system by different users at a particular same time and hence causing the experience of busy toll-free systems. Also, one specific toll-free number creates one central point of reception for IVR system calls and therefore creates the challenge of missed calls when health professionals assigned are not able to respond to the calls. However, acquiring health facilities-specific toll-free numbers makes it the responsibility of health professionals who will be on duties either within the day or during the night to respond to all calls that may reach the facility through mHealth (IVR) systems and hence prevent missed calls which are experienced by users.

This will also help health facilities to prepare in advance before a patient reaches the facility during emergencies.

Lastly, the use of multiple local languages in the design of mHealth systems is also relevant to sustain and scale-up mHealth systems. In this study, it was discovered that the use of local language

(Twi) influenced the ease of use of the system among participants. However, to scale-up and integrate mHealth systems, the multilingual nature of citizens in the country should be noted and reflected in the design of mHealth systems. Therefore, mHealth project implementers/managers should ensure that multiple local languages are adopted and used in the design of mHealth systems.

Donors/Funders:

Donors who are interested in funding projects geared towards the development and improvement of health of unserved, underserved and vulnerable populations should invest in mHealth interventions due to its potential to provide health benefits to the above-mentioned populations.

Further research

Regarding the persistent recommendation of the provision of financial assistance to mHealth users discovered in this study, further research should be conducted to assess the influence of financial incentives on the adoption and use of mHealth interventions since not much evidence exists regarding this phenomenon.

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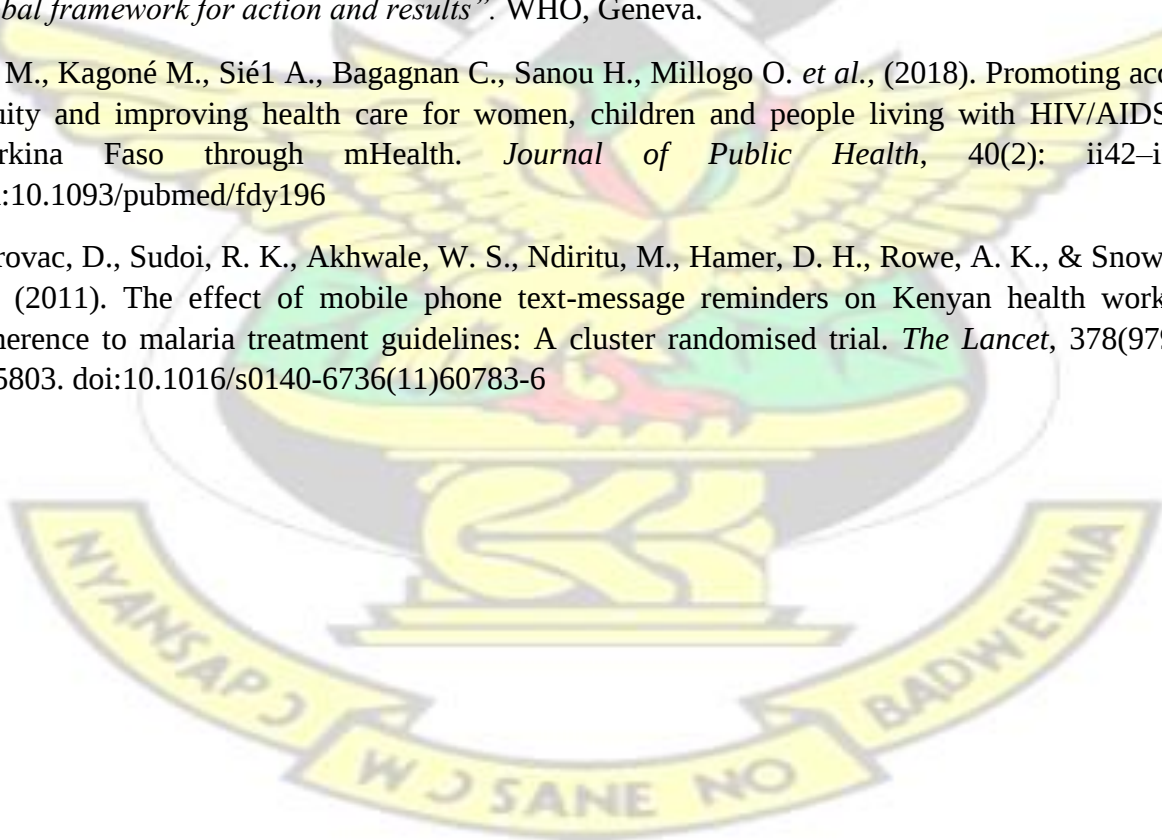
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APPENDICES

APPENDIX A PARTICIPANT INFORMATION LEAFLET

Please carefully read through the participant information leaflet.

Title of Research: Assessing the usefulness and challenges of an mhealth intervention in rural communities in the Asante Akim North District of Ghana

Name(s) and affiliation(s) of researcher(s): My name is Emmanuel Acquah-Gyan, a student pursuing Master of Science in Public Health from KNUST. As part of the requirement for my graduation, I am supposed to work on a research project. I will be very glad if you will be willing to help me complete this task by consenting to participate in this study.

Background (Please explain simply and briefly what the study is about): Not long ago, you were introduced to an mHealth system that you can call to report the illness of your child under five for guidance, by the Mobchild project. This study is designed to assess how useful the mHealth system is to you in helping care for your child(ren) under 5 years, and the challenges you encounter when using the system. It is also designed to determine whether the mHealth system implemented by the MOBCHILD project is acceptable within your local socio-cultural context, and how we can sustain and improve on the intervention.

Purpose(s) of research: The purpose of this research is to find out the factors that promote or constitute barriers to the implementation, scale-up, sustainability and integration of mHealth interventions into broader healthcare systems.

Procedure of the research, what shall be required of each participant and approximate total number of participants that would be involved in the research: We will interview participants individually, and in groups of 8 to have different focused discussions. In every discussion and indepth interview, participants will be asked questions concerning the mhealth intervention introduced by the MOBCHILD project. Participant will be expected to give their candid response in order to help answer the research questions. The discussions and interviews will be recorded so that the researcher can later transcribe in order not to miss any important response. In total, I expect to recruit 35 participants into this study throughout the District.

Risk(s): There is no known risk other than the risk involved in travelling to the site for the focused group discussions.

Benefit(s): You will benefit directly from health education on childhood health strategies. After every focused group discussions, the researcher will educate you on childhood health promotion and education strategies to help build your capacities in caring for your children under 5 years.

Confidentiality: The researcher will ensure your anonymity and confidentiality by not disclosing your identities and information obtained from you to any third party without your consent. Thus, all names, titles, contacts and other identifiers will not be used in the analysis, interpretation and publication of the study results. Therefore, Data collected from you cannot be linked to you in anyway.

Voluntariness: For you to take part in this study, it should be out of your own free will. You are not under obligation to. Research is entirely voluntary. If you choose not to participate, this will not affect you in any way.

Withdrawal from the research: You may choose to withdraw from this research at any time without having to explain yourself. You may also choose not to answer any question you find uncomfortable or private.

Consequence of Withdrawal: There will be no consequence to you if you choose to withdraw from the study. However, the information that may have been obtained from you without identifiers, and already used in analysis before you chose to withdraw cannot be removed anymore. I do promise to make good faith effort to comply with your wishes as much as practicable.

Costs/Compensation: For your time/inconvenience/transport to the Center for the focused group discussions, you will be compensated with GH¢30.00 as a token of appreciation for your participation.

Contacts: If you have any question concerning this study, please do not hesitate to contact Professor Ellis Owusu-Dabo (my supervisor) on 0201964425.

Further, if you have any concern about the conduct of this study, your welfare or your rights as a research participant, you may contact:

The Office of the Chairman

Committee on Human Research and Publication Ethics

Kumasi

Tel: 03220 63248 or 020 5453785

KNUST



APPENDIX B

CONSENT FORM

Researcher's Details

Name: Emmanuel Acquah-Gyan

Position: Student, Master of Science in Public Health, Department of Health Education, Promotion, and Disability, School of Public Health, Kwame Nkrumah University of Science and Technology.

Student Reference Number: 20607131

Contact Address: P. O. Box KS 458, Kasoa-Nyanyano

Email address: 0501345460s@gmail.com

Phone: 0548289033 or 0501364323

Statement of person obtaining informed consent:

I have fully explained this research to _____ and have given sufficient information about the study, including that on procedures, risks and benefits, to enable the prospective participant make an informed decision to or not to participate.

DATE: _____ NAME: _____

Statement of person giving consent:

I have read the information on this study/research or have had it translated into a language I understand. I have also talked it over with the interviewer to my satisfaction.

Respondent Confirmation Form

Please tick a box

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask question.

Yes [] No []

2. I understand my participation is voluntary and that I am free to withdraw at any time without giving reason.

Yes [] No []

3. I agree to take part in the above study

Yes [] No []

4. I agree to the answering of the questions in focused group discussion guide.

Yes [] No []

5. I agree to the use of anonymity quotes in publication

Yes [] No []

6. I agree that my data gathered in this study may be shared in a specialist data center and may be used for future research

Yes [] No []

Name of Researcher.....

Date.....

Signature.....

Name of Respondent.....

Date.....

Signature/Thump print.....

Statement of person witnessing consent Process for Non-Literate Participants:

I _____ (Name of Witness) certify that information given to

(Name of Participant),
in the local language, is a true reflection of what I have read from the study Participant
Information Leaflet, attached.

WITNESS' SIGNATURE (maintain if participant is non-literate): _____

APPENDIX C

IN-DEPTH INTERVIEW AND FOCUS GROUP DISCUSSION GUIDE FOR CAREGIVERS

Demographic characteristics	Sex: Age: Occupation: Level of Education: Marital status: Number of children under 5: Religion: Ethnic group:
Introduction:	Good morning! My name is Emmanuel Acquah-Gyan a student from the SPH-KNUST. The MOBCHILD project introduced to you a system that gave you the opportunity to report disease symptoms of your child(ren) under five years through mobile phones. I am here to have a little discussion about that system. This conversation is very confidential and will not be linked to you in any way as I will not ask for your names but use a code to identify you. I would like to record the discussion using a tape recorder so that I do not miss out on any important information. This recorded information is for research purposes only and will not be given out to anyone. After I have written out the conversation, it will be erased completely from the memory of the tape recorder. The

KNUST



Objectives Feasibility, attitude and acceptability	discussion will last for about 30 minutes. The information gathered will help the Ghana Health Service and other stakeholders to decide on implementing this system of reporting childhood illnesses nationally. If you agree, I would put on the tape recorder and then you say I agree so that we start. 1. Did you ever use the system? 2. Did you use it yourself? If no, who helped you? 3. How many times did you use the system? 4. How much did you spend when using the system? 5. Was it easy to use? 6. If yes, how? If no, what made it difficult? 7. How can the system be made easy to use? 8. Were you instructed to do something by the system? 9. Did you do as instructed by the system? 10. If yes, what happened when you did it? 11. Were you educated on any issue through the system? 12. What were you educate you? (Probe) 13. What did you learn from it? 14. Were you satisfied with the care you received through the system? 15. Will you like to report symptoms of your child through the mHealth system? 16. Would you recommend that your friends and relations also use this system to report illnesses of their children? 17. Do you recommend that everyone with a child in Ghana gets access to this system? 18. If this system is made available for every mother in Ghana, would you advocate its use to others? 19. How does your significant others perceive this system? 20. Was the system helpful to you? (Probe) 21. How helpful?
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Benefits

KNUST



Barriers	22. What prevented you or others from using the system? (<i>probe further on each challenge mentioned</i>)
Strategies	23. What can be done to prevent these challenges you have mentioned? 24. What can be done to improve, expand and sustain the intervention? (probe) Are there any other issues you would want us to discuss? Thank you!

