KWAME NKRUMAH UNIVERSITYOF SCIENCE AND TECHNOLOGY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

DEPARTMENT OF POPULATION, FAMILY AND REPRODUCTIVE HEALTH

FACTORS ASSOCIATED WITH THE USE OF A MOBILE PHONE-BASED HEALTH INFORMATION SYSTEM AMONG CAREGIVERS OF CHILDREN UNDER-FIVE IN RURAL GHANA

BY

TIMOTHY KWABENA ADJEI

PG3466918

SEPTEMBER, 2019

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY (KNUST)

FACTORS ASSOCIATED WITH THE USE OF A MOBILE PHONE-BASED HEALTH INFORMATION SYSTEM AMONG CAREGIVERS OF CHILDREN UNDER-FIVE IN RURAL GHANA

BY

TIMOTHY KWABENA ADJEI

(INDEX NUMBER: PG3466918)

A THESIS SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH, KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PUBLIC HEALTH (POPULATION, FAMILY AND REPRODUCTIVE HEALTH

SEPTEMBER, 2019

DECLARATION

I, Timothy Kwabena Adjei 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 Public Health (Population, Family and Reproductive Health) 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: _____

Timothy Kwabena Adjei

(Candidate)

Signed: _____ Date: _____

Prof. Ellis Owusu-Dabo

(Supervisor)

Signed: _____ Date: _____

Prof. Easmon Otupiri

(Head of Department)

DEDICATION

I dedicate this work to my loving wife, Delali H. Adjei, and my children, Jehnissi and Yehoda and Jerohi. I love you. God bless you!

ACKNOWLEDGEMENT

My utmost gratitude goes to the Most High God, whose I am and who I serve.

I also owe my heartfelt appreciation to my supervisor, Prof. Ellis Owusu-Dabo, for his help, assistance and mentorship.

My appreciation also goes to all the team members of the MOBCHILD project: Dr. Mrs. Sylverken, Dr Twumasi Ankrah, Dr Michael Owusu, Dr Aliyu Mohommed, Mrs Princess R. Acheampong and Mr. Emmanuel Aquah Gyan for your support. It is great working with you all.

I would like to specially appreciate Mrs. Patricia Amoah Yirenkyi (Project Manager of MOBCHILD study) and Mrs. Princess Acheampong for your encouragement throughout this study. My utmost gratitude also goes to IDRC, the funders of the MOBCHILD project for funding my studies.

I would also like to appreciate all my lecturers in the School of Public Health: Prof Ellis OwusuDabo, Prof. Easmon Otupiri, Prof. A. K. Edusei, Dr. Nakua, Dr Amuasi, Dr Yeetey, Mr. Paul Okyere, Mr. Oppong Nkrumah, Dr Addai Donkor and all others for the knowledge they imparted to me.

Special thanks also go to Rev Dr Evans Ansu Yeboah for your timely assistance.

My final and heartfelt gratitude goes to my life partner, Mrs Delali Adjei.

ABSTRACT

Introduction

Although childhood mortality and morbidity continues to be one of the leading challenges in LMICs, the burden can significantly be prevented with simple and affordable interventions. The phenomenon of using mobile phone technology in healthcare (mHealth) has attracted a global attention because of increase access and use of mobile phones in both urban and rural areas. MHealth interventions therefore provide a promising vehicle to improving the health outcomes in developing countries where access to health continues to be a significant obstacle. Notwithstanding the potential benefits of mHealth, its adoption and use among the end users in developing countries, such as Ghana, have not been thoroughly explored.

Objective

This study assessed the factors that influence the use of a mobile phone-based health information system among caregivers of children under five years in the Asante Akim North District.

Methodology

A community-based cross-sectional study nested in the MOBCHILD project was conducted in Asante Akim North District, a rural area in Ghana. In all 354 caregivers of children under-five years were interviewed using a structured questionnaire. Regression analysis was done to examine the strength of the relationship between the independent and dependent constructs (variables) within the Unified Theory of Acceptance and Use of Technology (UTAUT) model.

Results

Most caregivers were females (86.44%). Mobile phones ownership was very high (86%). Male gender, age and socio-economic status were associated with phone ownership ($p<0.05$). A significant 92.66% (324) of the all the respondents expressed intention to use to mHealth service in the future although a third (28.53%) reported actual use.

The results also indicated that the relationship between Performance Expectancy (PE) and Behavioural Intention (BI) (β-0.278, 95% CI-0.207-0.349 p<0.001), Effort Expectancy (EE) and BI (β-0.242, 95% CI-0.159-0.326, p<0.001), Social Influence (SI) and BI (β-0.081, 95% CI-0.044-0.120, p<0.001), Facilitating Condition (FC) and User behaviour (UB) (β-0.609, 95% CI0.502-0.715, p<0.001), were significant. Behavioural Intention (BI) had a strong positive impact on User Behaviour (UB) (β-0.426, 95% CI-0.255-0.597, p<0.001). Mobile phone experience and socio-economic status significantly moderated the effect of performance expectancy, effort expectancy, social influence, facilitating condition on behavioural intention and usage of mHealth service.

Conclusion

The perceived usefulness (PE) of mHealth system, ease associated with its use (EE), social influences (SI) and existing facilitating condition (FC) are strong determinants of users' attitude and actual use (UB) of mHealth services. In order to increase uptake of mHealth, barriers such as electricity and network challenges must also be considered.

TABLE OF CONTENTS

LIST OF TABLES

TABLES **PAGE**

LIST OF FIGURES

FIGURES **PAGE**

LIST OF ABBREVIATIONS AND ACRONYMS

BI – Behavioural Intention

EA – Electoral Area

EE – Effort Expectancy

FC – Facilitating Conditions

HIS – Health Information System

IVR – Interactive Voice Response

LMICs – Low and Middle Income Countries

MHIS – Mobile phone-based Health Information System

PE – Performance Expectancy

RLC – Resource Limited Countries

SES – Socio-economic Status

SI – Social Influence

SMS – Short Messaging Service

UB – User Behaviour

UTAUT – Unified Theory of Acceptance and Use of Technology

WHO – World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND INFORMATION

Globally, it is estimated that about 85% of the total of 6.2 million children less than 15 years who died in 2018, were under the age of 5. This means about 15, 000 under-five deaths occur per day. It is projected that children in sub-Saharan Africa are 15 times more likely to die before their fifth birthday than those in developed countries (WHO, 2019).

In Ghana, the under-5 mortality is currently 60 deaths per 1,000 live births and one (1) in every 17 dies before his or her fifth birthdate. Infections such as acute respiratory infections (ARIs), malaria, malnutrition and diarrhoea diseases are the main causes of under-5 morbidity and mortality. Most of these acute infections commonly are associated with fever (Ghana Statistical Service, 2014b). According to Quansah et al (2016), maternal education, family wealth (income), rural-urban disparities and high dependency are some of the identifiable factors that influence child mortality, health-seeking behaviours and hygiene practices among caregivers.

Unfortunately, most of these childhood deaths occur in rural areas where there are limited health resources and facilities (Quansah et al, 2016). Rural setting, poverty and lack of education among caregivers have been found to be associated with high risk of under-five mortality (Ghana Statistical Service, 2014b). Such caregivers probably lack the capacity to be able to identify early symptoms of disease before even proceeding to seek timely intervention.

In the midst of this burden, it is estimated by the Word Health Organization (2019) that over 50% of childhood mortality could be prevented with affordable and simple interventions.

In recent times, the use of mobile phone technological application and systems in health related matters; commonly known as mHealth (Akter and Ray, 2018) has been found to improve health outcomes. The use of mobile phone-based health information systems (MHIS) has also been shown to improve healthcare delivery (World Bank, 2016).

As a result of fast unprecedented advancement in technology, mobile devices have not just become affordable, but its usage globally and especially in resource-limited countries (RLC) has rapidly increased. MHealth interventions therefore provide a promising vehicle to reach greater section of the population who could otherwise not access affordable health care (Patricia N. Mechael, 2009).

Though it has been established that mHealth has the potential of improving health outcomes in diverse ways in Africa, factors that influence its adoption among users has become necessary. This study focuses on using the Unified Theory of Acceptance and Use of Technology (UTAUT) model to assess the factors that influences the use of a mobile phone-based health information system among caregivers of children under-five.

1.2 PROBLEM STATEMENT

Although there is an increase in the usage of mobile phone-base health information systems, its uptake is low. While using mHealth holds a huge potential in addressing healthcare challenges in resource limited countries, there is the need to have evidence-based research to validate the demand for scaling, and sustaining such interventions (Ndayizigamiye, 2018).

User related factors such as awareness, acceptability, affordability, and availability which are recognizable factors that can greatly influence uptake (Akter and Ray, 2018) have also not been given the necessary weight of attention. Very little is done in the area of user experiences, though it greatly affects uptake (Georgsson and Staggers, 2016).

A study found that there were about 22 eHealth projects in Ghana, using tablets, smart phones and simple phones. These projects are at various limited levels of implementation due to several problems. While the opportunity to utilize this mHealth to improve access to health in remote areas exists, applying this technology must consider local needs and barriers so as to guarantee acceptance, usability, scaling up and sustainability of mHealth interventions (Vest, Issel and Lee, 2014).

In order to improve acceptability, utilization and sustainability of mHealth systems, stakeholders and designers of mHealth systems must consider user related factors and behaviours (Wambugu and Villella, 2016).

Although studies reveal that the use of mobile health (mHealth) systems have improved the management of diseases, not much has been done in assessing the utilization of these interventions from the user perspective (Georgsson and Staggers, 2016), giving rise to a literature gap. Georgsson and Staggers (2016) recommended that future studies be employed with a larger sample size that is representative of mHealth users.

In Ghana, access and use of Information Communication Technology (ICT) is rapidly increasing. Although a minority (3.6%) of the population of Asante Akim North use internet for business, shopping and social networking purposes, mobile phones have become the most commonly used telecommunication tool within the area with about 42.1% phone ownership rate (Ghana Statistical Service, 2014a). Even though this window of opportunity exists to apply it in healthcare, it is unclear how caregivers will readily adopt it. Factors influencing mHealth use in such resource limited settings have not been comprehensively explored.

The continuous use of technology in health makes it imperative to assess the factors that influence the use of mHealth systems among users in the context of verifiable models and theories. Very little has also been done in applying widely acceptable models (such as the Unified Theory of Acceptance and Use of Technology-UTAUT) to predict the adoption and use of such technologies especially in low and middle income settings (Jewer, 2018).

1.3 RESEARCH QUESTION

What are the key factors that influence caregivers' use of a mobile phone-based health information system in rural Ghana?

1.4 RESEARCH OBJECTIVES

1.4.1 Main Objective

To assess the factors that influences the use of a mobile phone-based Health Information System (MHIS) among caregivers of children under-five in Asante Akim North District.

1.4.2 Specific Objectives

1. To assess the use of a mobile phone-based health information system (IVR) among caregivers in Asante Akim North District.
2. To assess the strength of the determinants for caregivers to use a mobile-phone-based health information system Asante Akim North District.
3. To identify barriers in using a mobile-phone-based health information system among caregivers of children under five in Asante Akim North District.

1.5 SIGNIFICANCE OF STUDY

Health outcomes of individuals can be greatly improved by developing a strong health information system which, in turn, will lead to robust healthcare delivery systems especially in developing countries (Kumar and Millar, 2017).

The use of health information systems has been classified as one of the six building blocks for strong national health systems (WHO, 2007). The utilization of mobile phone technology among people in Low and Middle Income Countries (LMICs) is markedly increasing. The outcome of this study will provide a basis to accelerate uptake of mHealth in the health systems so as to improve access, make patients well-informed and also provide real time data for resource allocation and decision making. Health care delivery will as well be enhanced (World Bank, 2016).

The outcome of this study will also contribute to literature in this potential and rapidly growing field. The findings of this study, in addition to others, will therefore form a basis for policy makers, stakeholders, governments and health ministries to have basis for making key decisions in improving healthcare delivery in similar populations in developing countries.

It will also help designers of mHealth applications and systems to incorporate important userrelated factors in their work for product acceptability and effective use.

1.6 CONCEPTUAL FRAMEWORK-RESEARCH MODEL

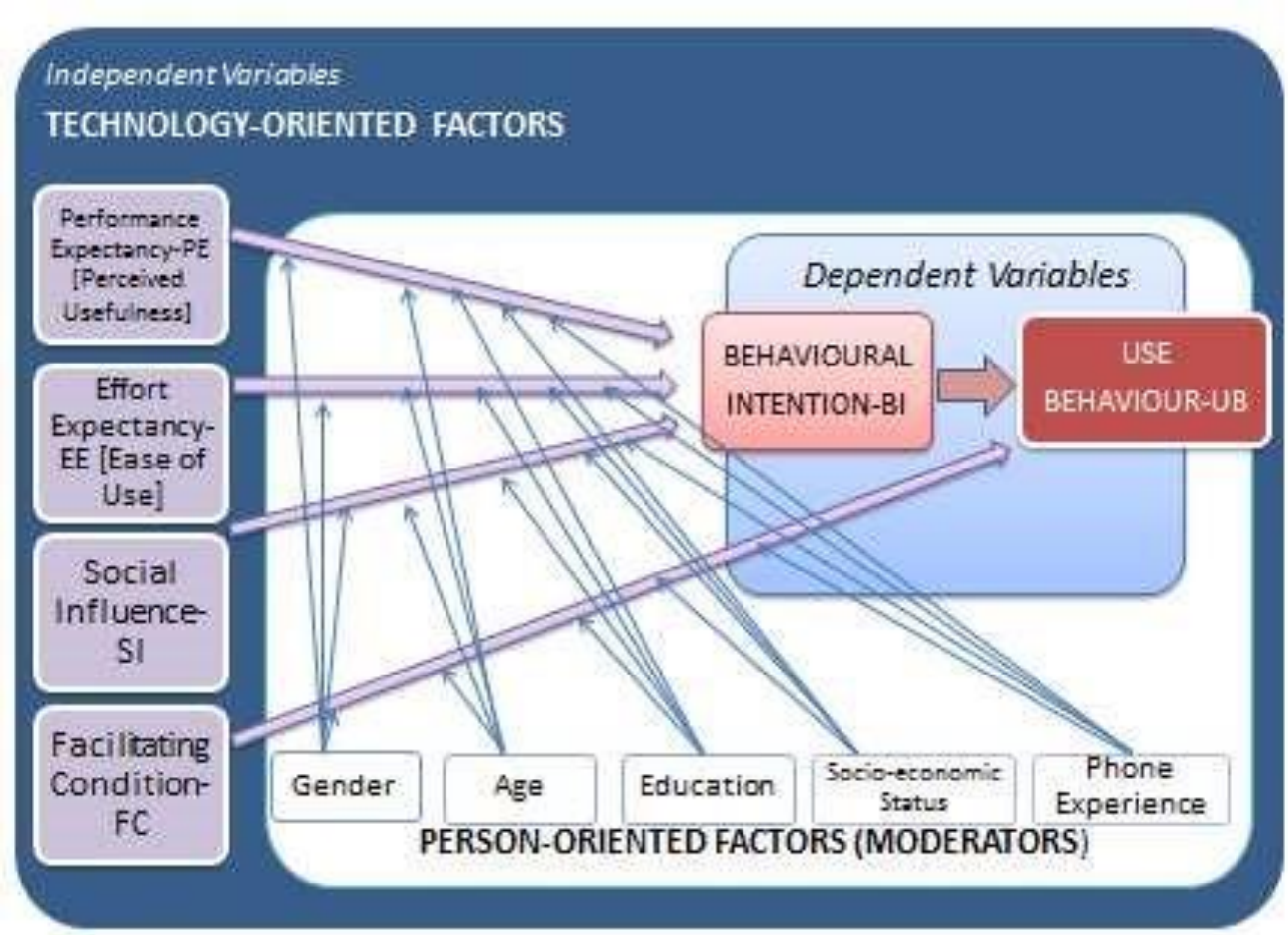


Figure 1.0 Research Model (modified UTAUT model- Adapted from Venkatesh et al (2003).

The four key constructs of Unified Theory of Acceptance and Use of Technology (UTAUT) model constituting the independent variables are as follows:

1. Performance Expectancy (PE) - The degree to which a person believes that the use of the system will result in performance gains. It is also known as the perceived usefulness of system.
2. Effort Expectancy (EE) - The degree of ease associated with using the system. It is also defined as perceived ease of use of the system.

3. Social Influence (SI) – The degree to which peers influence an individual in using the system. In order words the extent to which an individual believes that other people who are important to him or her believes that he or she should use the system.
4. Facilitating Condition (FC) - The degree to which the individual believes that an organizational and technical infrastructure required for support of the system exist (Venkatesh et al, 2003).

These independent variables are hereby also classified as technology-oriented factors.

The two other constructs of the UTAUT model constituting the dependent variables are:

1. Behavioural Intention (BI) - Is defined as an individual's subjective possibility that he or she will exhibit the specific desired behaviour. In other words it is the individuals' attitude towards demonstrating a particular behaviour.
2. Use Behaviour (UB) – This is defined as the actual use behaviour of a particular technology or system (Venkatesh et al, 2003). The specific system identified here is the Interactive Voice Response (IVR) service.

This model (UTAUT) originally incorporates four moderating variables: age, gender, experience and voluntariness. Modifications of the moderators have been done for this research work to now constitute age, gender, education, socio-economic status and mobile phone experience (Venkatesh et al, 2003). These moderators are also classified as person-oriented factors.

1.7 ASSUMPTIONS

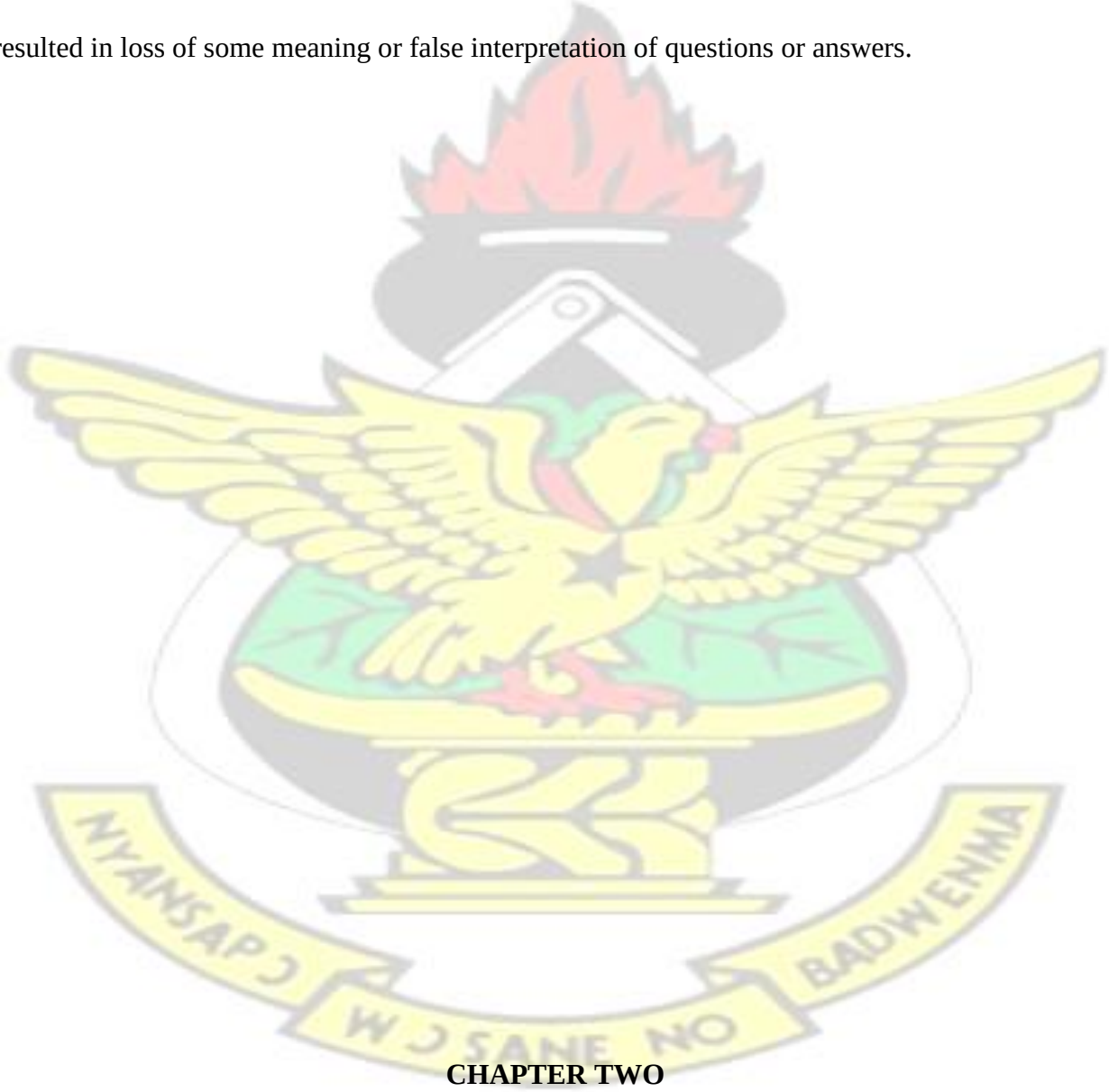
A number of assumptions were made in conducting this research.

a. That all respondents live within the Asante Akim North District.
b. That the information provided by respondents is true.

c. That all caregivers have access to mobile phone for use for which cause they have been recruited into the MOBCHILD project.

The study appreciates that the self-reported use of the mHealth system by caregivers might not accurately reflect the actual mHealth use.

It is also possible that the translation of research instrument into the local language may have resulted in loss of some meaning or false interpretation of questions or answers.



CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

The term mHealth as cited by Folaranmi (2014) was created by Professor Robert Istepanian, who generally defined it as the use of emerging mobile communications and network technologies for healthcare. MHealth has since attracted various definitions. The Global Observatory for eHealth (GOe) for instance describes mHealth or mobile health as using mobile devices to support medical and public health practice. These devices include mobile phones, personal digital assistants (PDAs), patient monitoring devices and supplementary wireless devices (Burns, 2011). In its 71st World Health Assembly, WHO, on the other hand, defined it as the use of appropriate digital technologies for public health (Assembly, 2018). The uptake of this phenomenon in health care delivery has attracted global attention because of the rapid access to mobile phones (Eze, Gleasure and Heavin, 2016).

Application of mobile phone technology in health (mHealth) can be in various forms: voice, Short Messaging System (SMS), video, imaging, Global Positioning System (GPS), web browsing and broadcasting (Mechael and Searle, 2010).

The International Telecommunication Union indicated that in 2015, mobile phone subscriptions were more than 7 billion globally, out of which 70% were in low- or middle- income countries (Measuring the Information Society Report, 2015). It is not surprising that some people in most of these countries are more likely to have access to mobile phones than to clean water or electricity (Annex, 2016).

MHealth has continuously been touted by the World Health Organization in numerous of its resolutions adopted by the World Health Assembly as one of the vital approaches through which achieving universal health coverage and improving quality of care, especially in rural populations can be accelerated. Such framework makes the health system more responsive to the needs of

people and puts the patients and their caregivers at the centre in the provision of health care (Assembly, 2018). Although mHealth holds the potential of transforming the health system, it is not devoid of challenges.

In Africa, Ghana has been recognized as one of the nations with amazingly high mobile phone subscription. A 2018 report on the Ghanaian Mobile Sector indicated that there were about 34.57 million subscribers and a penetration rate of 119%, with nearly one third (10.1 million) of the entire population being active internet users. The high user rate of mobile phones has been attributed to increased network coverage and availability of affordable mobile phones from China (Zaney, 2018).

In Ghana, a national eHealth strategy was adopted in 2009 with the ultimate goal of harnessing the potential of ICT to improve the health profile of the citizenry, especially those living in rural areas. In order to increase access and bridge the equity gap in health, one of the key actions identified in the strategies was the use of mobile telephony in the health service, also regarded as mHealth (Kunbuor *et al.*, 2009).

A total of about 22 e-health related projects, largely donor funded, have been piloted over the decade following the launch of this strategy in 2010. These include Mobile Technology for Community Health (MOTECH) project, with an objective of using mobile phones to improve the health outcomes in rural Ghana, in the area of antenatal and neonatal care. Others include Onetouch Medicareline (ML), Mahiri Mobile, VODAPHONE Healthline Project, all of which involved using mobile phones to improve health outcomes (Vest, Issel and Lee, 2014).

Irrespective of the potential mHealth holds for the health sector, its adoption, uptake and sustainability requires addressing key challenges especially among users and other key

stakeholders (Mechael and Searle, 2010). In fact, mHealth is said to be a vital instrument in eliminating the various obstacles of access: socio-cultural, geographical, economical and organizational (Ali *et al.*, 2017).

2.2 THEORETCAL FRAMEWORK AND DEFINITIONS (UTAUT MODEL)

Researchers over the decades have been concerned with developing models and theories for the adoption and use of technology. Various models have been proposed and used to assess the acceptance and use of technology. Amongst them are Technology Acceptance Model (TAM) which employs two keys constructs- perceived usefulness and perceived ease of use- (Davis and Bagozzi, 1989). Davis et al (1989) also proposed the Theory of Reasoned Action as well as Theory of Planned Behaviour.

Finally the Diffusion of innovation (DoI) theory by Rogers (2003) on the other hand advocates that population embraces a novel technology based on a number of factors: the apparent benefit of the new technology in relation to the current, the chance for people to perceive the outcome of the innovation, and to mention a few.

All these models proffered several factors and explanations for technology acceptance and usage. After a comprehensive assessment and review of the various models, Venkatesh et al (2003) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT) which incorporates the essential elements of about eight theories: Theory of Reasoned Action (TRA), TAM and TAM2, Theory of Planned Behaviour (TPB) and Decomposed TPB (DTPB), combined TAM and TPB, DoI, Motivational model (MM), Social Cognitive Theory (SCT) and Model of PC utilization. There are four key constructs of UTAUT model: Performance Expectancy (perceived usefulness), Effort Expectancy (perceived ease of use), Social Influence and Facilitating Conditions.

The UTAUT model also includes four moderators: age, gender experience, and voluntariness.

These moderators further improve the predictive power of the model (Venkatesh et al, 2003). Williams et al (2015) also acknowledged that the UTAUT model provides opportunities for researchers to make modifications that are cultural and context-related to target populations and various fields of endeavour.

The UTUAT model has been found to have the highest predictive power (70%) of user acceptance and behavioural intention (Venkatesh et al, 2003) and consequently on actual technology use behaviour (50%) (Venkatesh et al, 2012) compared with all the other theories. William et al (2015) following their comprehensive review of over 170 UTAUT related studies since 2004, identified its extensive use in business, management, information and technology fields especially in the developed countries. They hence recommend further use of UTAUT model in diverse areas such as medicine and education so as to augment the level of understanding of the theory, subject it to further scrutiny and enquiry as well as elucidate possible strengths and weakness of the model (Williams, Rana and Dwivedi, 2015). In addition to the high explanatory and predictive power, the UTAUT model is preferred above all the others because its extensive use by researchers to determine users' acceptance and use of new technology in comparison to other models (Dwivedi *et al.*, 2019).

Research continues to provide a means through which theoretical models formulated to understand and predict adoption and use of technology are modified or validated (Nanyombi and Habinka, 2017).

2.3 USE OF MOBILE PHONE-BASED HEALTH INFORMATION SYSTEM

As user rates of mobile phone especially in developing countries increases, it is expected that technologies that are mobile phone related will also attract significant patronage. Household mobile phone ownership in Ghana has markedly increased across the nation, both in the urban

(97%) and rural (88%) areas and it is associated with appreciable high user rates among men (88%) and women (82%), with minimal disparities in the urban and rural centers (Ghana Statistical Service, 2019).

Although the use of mHealth systems is yet to be integrated into Ghana's health system at the caregivers level, a number of projects on various stages of implementation have been undertaken over the past decades (Vest, Issel and Lee, 2014a). A number of factors therefore need to be considered to ascertain level of use of mHealth systems. Caregivers' readiness to adopt and use a mobile phone-based health information system significantly depends on their needs (Georgsson and Staggers, 2016).

With the household being the primary producer of health, the health-seeking behaviour of caregivers becomes an essential determinant to the health of their dependents. The health needs of children under-5 in Ashanti Region cannot be over emphasized. A recent survey revealed high regional mortality rates (79 per 1,000 live births) despite gradual declining national rates (56 per 1,000 live births) (Ghana Statistical Service, 2019). Studies have also established that mHealth interventions targeted at rural women have the potential of reducing barriers to access of child healthcare services in rural settings, thereby eliminating the equity gap (Laar *et al.*, 2018). May et al (2017) also found that although no previous exposure in using Interactive Voice Response (IVR) health information was reported among the study subjects, caregivers demonstrated the readiness in using mHealth to meeting their health needs. This gives credence to the fact that caregivers in the Ghanaian environment are willing and ready to use mobile phone-based IVR to receive health information for child healthcare (May *et al.*, 2016).

Notwithstanding the users health needs, and assess to mobile phones, other factors such as socio-demographic characteristics, gender disparities and user's interactions with the system also influence mHealth user behaviour. For instance the male gender, younger age and higher educational level were associated with increased use and satisfaction of mHealth systems (Georgsson and Staggers, 2016).

Khatun et al (2017) however found that, men are more likely to own mobile phones, compared to women, regardless of high intention to use mHealth services among both genders irrespective of age, educational level and socio-economic status. Strategies to increase utilization and achieve equity in usage should therefore target women (Khatun *et al.*, 2017). Yu et al (2008) found out that about 34% of caregivers who were predominantly females (95%) expressed intention to use a newly introduced health IT system.

2.4 DETERMINANTS OF MHIS USE

2.4.1 Technology-Oriented Factors

The UTAUT model explains that Performance Expectancy, Effort Expectancy and Social Influence have direct positive influence on Behavioural Intention to use technology. User Behavioural Intention and Facilitating Conditions then directly influence user behaviour (Venkatesh et al, 2003). A number of research works undertaken have elucidated various degrees to which these dependent variables are influenced by their predictors (Williams, Rana and Dwivedi, 2015).

Performance Expectancy

Performance expectancy (PE) is simply defined by Venkatesh et al (2003) as the extent to which the individual believe that the use of the system will result in performance gains. This can also be

described as the perceived usefulness of the system or technology. PE has been identified to be the strongest determinant of consumers' behavioural intention to adopt or use technology with a predictive power of 0.81(Venkatesh et al, 2003). William et al (2015) also in a systematic review concluded that PE is the strongest determinant of users' behavioural intention to use technology. A study conducted by Hoque and Sorwar (2017) also supported the fact that PE has a significant influence on behavioural intention to use mHealth systems. Alshehri et al (2013) also established that performance expectancy has a positive influence on user intention to use eHealth services among citizens in Bangladesh.

Effort Expectancy

The degree of ease associated with the usage of the system is known as Effort Expectancy (EE). It is also known as perceived ease of use. EE has also been found to be one of the significant predictors of behavioural intention to use technology with a predictive power of 0.59 (Venkatesh et al, 2003). Perceived usefulness and ease of use have been found to have significant influence on intention to use such systems (Yu, Li and Gagnon, 2009).

Several studies also demonstrated that effort expectancy is a strong determinant of users intention to use technology (Hoque and Sorwar, 2017; Dwivedi *et al*., 2019). Alshehri et al (2013) also identified EE as a factor that positively impacts users' behavioural intention with no moderating effect by age and gender to this relationship.

Social Influence

Social Influence (SI) is defined as the extent to which an individual believes that other people who are important to him or her believes that he or she should use the new system. SI has also been found to be a strong determinant of users' behavioural intention to use technologies with a

predictive power of 0.75 (Venkatesh et al, 2003). Hoque and Sorwar (2017) also supported social influence as a significant predictor of users' behavioural intention to use mHealth services. Alshehri et al (2013) however found insignificant impact of social influence on users' behavioural intention to adopt or use technology.

Facilitating Condition

Facilitating condition (FC) is hereby defined as the extent to which a person believes that there is the presence of an organizational and technical infrastructure assistance to use of the technology or system. Facilitating conditions includes the appropriate resources and knowledge needed to use the system as well as a specific person or group for technical assistance in case a user encounters a problem in using the system. FC however has a direct positive influence on actual user behaviour (UB) with a predictive power of 0.67 (Venkatesh *et al*, 2003). Facilitating condition was again observed to be one of the significant predictors that positively impacts users' adoption of mHealth in developing countries (Alam *et al*, 2018).

Behavioural Intention

Behavioural Intention (BI) is an individual subjective possibility that he or she will exhibit the specific desired behaviour (Venkatesh *et al*, 2003). Fishbein and Ajzen (1975) also defined Behavioural Intention is indicative of the strength of an individuals' intention to accomplish a precise behaviour. Behavioural intention has been identified to have a strong positive impact on user behaviour with a predictive power of 0.82 (Venkatesh *et al*, 2003). Numerous studies have evinced that BI is a valid predictor of user behaviour. A systemic review of over 150 studies that used the UTAUT model indicated that PE and BI were best predictors of Behavioural Intention and Use Behaviour respectively (Williams, Rana and Dwivedi, 2015).

Use Behaviour

This is defined as the actual use behaviour of the system by an individual. It is also directly influenced by facilitating conditions and users' behavioural intention to use technology (Venkatesh *et al*, 2003). Alam et al (2018) also established that behavioural intention is positively associated to actual use of mHealth services. This inference was also corroborated by Mohammed et al (2017). It must be stated that the study reported on self–reported use by caregivers and not an actual measurement of use of the system.

2.4.2 Effect of Person-Oriented Factors (Moderators)

Person-oriented factors such as age, gender, experience and voluntariness of use have been posited to mediate the impact of PE, EE, SI, and FC on behavioural intention and actual usage of technology (Venkatesh et al., 2003). An adjustment in the moderators or controlling factors that takes into consideration culture, research context and diversity of user groups have been recommended for future studies (Williams, Rana and Dwivedi, 2015). Moderating factors such as socio-economic status, income and education have also been introduced and used in some studies. Khatun et al (2017) indicated that males, education, and people with highest socioeconomic status are more likely to have intention to use mHealth service in the future.

A study conducted in one of the LMICs, indicated that gender has a moderating effect on mHealth adoption. Gender specifically moderated the effect of performance expectancy, effort expectancy and facilitating conditions to behavioural intention significantly (Alam *et al.*, 2019).

Alshehri et al (2013) on the other hand did not find any significant moderating effect of age and gender on the behavioural intention to use such technological services, although IT experience significantly moderated the effect of behavioural intention to use eHealth services.

2.5 BARRIERS OF MHIS USE

The promising potential of mHealth is certainly not without diverse gaps and barriers. Several studies have identified numerous hindrances that need to be curtailed to realize the full benefits of mHealth especially in poorly resourced settings. Identification of important barriers encountered by users of mHealth is very crucial. Effective integration of mHealth into health systems must consider such barriers so as to warrant the involvement of the appropriate stakeholders within the community, government and telecommunication industry (Feroz *et al.*, 2017). Jewer et al (2018) identified infrastructural (such as lack of or limited network availability and electricity challenges) and technical barriers (lack of familiarity with the system and difficulties in operating a phone) among caregivers in Ghana who demonstrated willingness to use a mobile-phone based interactive voice response system for seeking healthcare. Alshehri et al (2013) also identified infrastructural challenges as very important barriers among users of eHealth. They also identified network availability and reliability as very important barrier among the citizenry. In as much as network coverage is important, the reliability of the network signals perceived by the users is equally important to build trust among the end users of technological services (Alshehri *et al*., 2013). Other user related barriers associated with mHealth usage as elucidated by Jewer et al (2018) include social factors such as complexity of health problem and cost. The degree of gender-based factors in my opinion may also pose as a social barrier especially in developing countries where male involvement in household decision making on health seeking behaviour cannot be exaggerated.

CHAPTER THREE

METHODOLOGY

3.1 STUDY TYPE AND DESIGN

A community-based cross-sectional study was conducted to assess factors influencing the use of mHealth, using quantitative approaches.

3.2 STUDY SITE

This study was nested in the MOBCHILD project; an interventional study which seeks to access the impact of a mobile phone-based health information system in improving childhood survival. The MOBCHILD project seeks to introduce a mobile phone-based Health Information System (HIS) intervention in the form of symptom-based algorithm Interactive Voice Response (IVR) system and voice messaging to caregivers of children under five years to ascertain its impact on childhood survival. Caregivers recruited into the MOBCHILD project have been given a toll-free number to engage the IVR system whenever their children are unwell, irrespective of the network they use. The symptom-based IVR system was developed based on WHO's Integrated Management of Childhood Illness (IMCI) guideline. Upon assessing the system via a phone call, caregivers can also request to speak to a doctor about the health of their child. The outcome of this study therefore will be imputed into the on-going MOBCHILD project.

This study was conducted in the Asante Akim North District in the Ashanti Region of Ghana. The district is dominated by Akans, and presently has a population of about 81,419, who are mainly farmers. It is demarcated into four (4) sub-districts, and has about sixty four (64) communities, twenty-two (22) Community-Based Health Planning and Services (CHPS) and one district hospital. The lower health facilities (CHPS) serve as the primary health care providers within most of these communities, and referrals are made where necessary. The 23 EAs within the Asante Akim District largely have about 100% network coverage.

3.3 BACKGROUND OF STUDY AREA

Asante Akim North District is one of the recently created districts (2012) in Ghana. The district capital is Agogo. Although the district is in the Ashanti Region, it shared borders with other districts in the same region and those of Eastern Region.

3.3.1 Size and Population

The district spans six hundred square kilometers area of land. As at 2018, the district had a projected population of about 81,419 from the 2010 census as illustrated in Table 3.1 below. In all, there are one hundred and five (115) communities within the district.

3.3.2 Health

The health system of the area is well structured under the Health Directorate. The district has been divided into sub-district. The first and largest sub-district is Agogo. The second is Amantenama which is closely followed by Ananekrom. This categorization is in terms of the size of the population. Juansa is the last among the sub-districts. The population distribution of the district is shown in Table 3.1 below. The district has been profiled into electoral areas (EAs). The health system functions along these EAs with equivalent health facilities in the form of Community Based Health Planning Service zones. The profile of the health facilities within the area is shown in Table 3.2.

Table 3.1 Distribution of population distributions in within the district, 2019

Name of Sub-District	**Estimated Population**	**Percentage**
Agogo	45594	56.0

Juansa	10178	12.5
Ananekrom	12376	15.2
Amantenaman	13271	15.8

Source: DHA Asante Akim North, Annual Performance Review Report, 2018

Table 3.2 Health Facilities per sub-district

Name of Sub-district	**Number of electoral areas**	**Demarcated CHPS zones**	**Functional CHPS zones**	**Number of health facilities**
Agogo	11	11	11	1
Juansa	5	5	5	2
Amantenaman	4	4	4	1
Ananekrom	2	2	2	1
DISTRICT TOTAL	22	22	22	5

Source: DHA Asante Akim North, Annual Performance Review Report, 2018

3.3.3 Ethnic Groups, Traditional, Religions and Group Associations

The district has a wide spectrum of ethnic groups within the area. The commonest ethnic group is the Akan. This makes Twi, the main language spoken within the area. Other smaller tribes within the area include Ewes, Moshies, Kussasis, Gas, Mamprushies, Sissalas, Dagombas and Fantis. Most of the communities have local traditional leaders in the form of Chiefs and Queen mothers.

These leaders have instituted traditional councils within the principal towns to streamline and coordinate their leadership.

The inhabitants of this area are mostly Christians. A significant percentage of these are Presbyterians. The Muslims constitute the second commonest religion. A number of people are pagans though. A number of associations either affiliated to a particular work or vocation such as traders, hairdressers and to mention a few exist within the district.

3.3.4 Vegetation and Rainfall

Rainforest and savannah are the main types of vegetation in the area. A number of factors have contributed in reducing the woodland in the area. Rampant bush fires has accounted for this to some degree. Also, the activities of some people groups have deteriorated the forest. Illegal felling of trees, production of charcoal has significantly contributed to this outcome.

Rainfall season is experienced biannually in the district. The first period occurs from third to the sixth month of the year. The second season follows from latter part of the eighth month up to the eleventh month of the year. The area also experience the harmattan season usually from the last month of the year through to the second months of the year

3.3.5 Electricity and Water Supply

The district is privileged to have electricity supply within the principal towns. Some of these principal towns include Juansa, Agogo, Hwidiem as among others. Some of the minor communities also have access to electricity.

The major towns within the district also have pipe borne water for use. Numerous bore holes have also been made within the various towns and villages to improve water supply to the inhabitants.

A significant proportion of these projects were executed by World Vision, Ghana. There are some areas where wells have been dug for water supply. Unfortunately there are some less privileged areas within the district that do not have access to safe water and therefore resort to water from water bodies such as rivers.

3.3.6 Transportation, Communication and Banking Services

Public transport system which primary consists of taxis and buses are the common means by which people move within the district. However a sizeable number of people also utilize motorbikes as a means of transport. The road connecting Konongo to the district capital, Agogo, is completely tarred. Whiles most of the roads networks linking the major towns are tarred, a significant proportion of the ones between the smaller communities in the area are not. This makes access to such place places quiet daunting during times of rainfall.

Network signals of the major telecommunications organisations are available in most of the major towns and surrounding areas for individual usage and commercial purposes. The towns and communities are embedded with numerous information centers where vital news is relays to the residents. People use these communication points for funeral announcement as well.

In the area of banking, the GCB Bank is one of the main banks in the district capital. Other rural banks also exist in the district.

3.3.7 Economic Characteristics

Most of the residents in the district are farmers. This is the main economic activities of the populace. Most of these farmers engage in farming primarily for their livelihood and not on large scale. They cultivate crops such as maize, plantain, tomatoes and to mention a few. The period spanning from the third through to the ninth month is regarded as the suitable time for farming.

Those who farm commercially are few. Maize and plantain, as well as cocoa constitute the common crops for large scale farming.

People living in areas around the Afram Plains engage in fishing as an economic activity. Other activities within the district include trading, the production of charcoal and sand winning.

3.3.8 Top Ten Causes of OPD Attendance and Deaths

The top ten cases treated on Out Patient Department (OPD) basis at the health facilities within the Asante Akim North District over the past three years are hereby represented in Table 3.3. Upper respiratory tract infection has been the leading OPD case over these past years. Malaria has continuously been ranked as the second of OPD attendance over this same period of time.

The top ten causes of mortality within the district are also shown in Table 3.4.

Table 3.3 Top Ten Causes of OPD Attendance

	2016		**2017**		**2018**	
	Disease	**Cases**	**Disease**	**Cases**	**Disease**	**Cases**

1	Upper Respiratory Tract Infections	12,660	Upper Respiratory Tract Infections	8,952	Upper Respiratory Tract Infections	11404
2	Malaria	9,012	Uncomplicated Malaria Tested Positive	8,407	Malaria	10782
3	Eye Infection	5,244	Anaemia	3,281	Diarrhoea Diseases	4240
4	Acute Urinary Tract	4,371	Diarrhoea Diseases	2,924	Intestinal Worms	2096
5	Gynecological conditions	3,599	Rheumatism & Other Joint Pains	2,920	Typhoid Fever	600
6	Rheumatism & Other Joint Pains	3,538	Hypertension	2,529	Pneumonia	585
7	Diarrhea Diseases	3,392	Intestinal Worms	1,584	HIV/AIDS Related conditions	235
8	Anaemia	3,293	Diabetes Mellitus	1,390	Septiceamia	60
9	Intestinal Worms	2,444	Pneumonia	778	Viral Hepatitis	49

10	Skin Diseases	2,389	Typhoid Fever	449	Chicken Pox	45

Source: DHA Asante Akim North, Annual Performance Review Report, 2018 Table 3.4 Top 10 Institutional Deaths

No	**2016**		**2017**		**2018**	
	Disease	**Cases**	**Disease**	**Cases**	**Disease**	**Cases**
1	Pneumonia	42	Cardiac Diseases	76	Septicaemia	65
2	HIV/AIDS/AIDS related conditions	29	Liver Cirrhosis	50	Sev. Pneumonia	45
3	Prematurity	26	HIV/AIDS	25	Hypertension	33
4	Cardiac Disease	25	Sev. Pneumonia	24	Prematurity	32
5	Liver Cirrhosis/Hepatoma	20	Severe Malaria	19	Tuberculosis	25
6	Tuberculosis	12	Hepatitis	16	HIV/AIDS/AIDS-related Conditions	24

7	Viral Hepatitis	11	Prematurity	15	Liver Cirrhosis/Hepatoma	22
8	Severe Anaemia	10	Tuberculosis	15	Diabetes Mellitus	17
9	Hypertension	10	C V A	14	Anaemia	12
10	C V A	10	Severe Anaemia	12	Sev. Malaria	9

Source: DHA Asante Akim North, Annual Performance Review Report, 2018

3.4 STUDY POPULATION

All caregivers of children aged 0-59 months within the Asante Akim North District who have been recruited into the MOBCHILD project constituted the study population.

3.4.1 Inclusion Criteria

1. Only caregivers (legal parents or guardians) of children aged 0-59 months within the Asante Akim North district, who are already recruited into the MOBCHILD project, were included in the study.
2. Caregivers were either male or female.

3.4.2 Exclusion Criteria

1. Caregivers of children under five years within the Asante Akim North District who have not been recruited into the main MOBCHILD project were excluded.
2. All caregivers outside the Asante Akim North District were also excluded from the study.

3.5 SAMPLE SIZE AND TECHNIQUE

Asante Akim North has 22 Electoral Areas (EAs) according to the 2010 Population and Housing Census. All the EAs have been selected for the MOBCHILD project as stated in the table below. A total of 1026 caregivers from 1,698 households and 670 structures have been recruited into the MOBCHILD project. The sampling frame therefore constituted all the caregivers (1026) recruited into the MOBCHILD project.

In order to obtain a representative sample from the population, 8 EAs out of the 22 were selected by simple random sampling. All the caregivers in these randomly selected EAs who have already been recruited into the MOBCHILD project were selected as study participants. This eliminated any form of bias since each of the EAs considerably averagely had about 40-50 caregivers.

In all 357 caregivers, constituting 34.8% of the sampling frame, were recruited into the study and interviewed using a well-structured questionnaire. A sample size of 320, with 10% non-response, adding to 352 was initially selected based on the average number of caregivers in each EA. This number was also arrived based on statistical recommendation for such research works that adopt multivariate analytical approach. For instance, Roscoe as cited by Hoque and Sowar (2017) acclaim that in multivariate research such as multivariate regression analysis, the sample size must be at least 10 times the number of items in the study, in this case the various constructs in the UTAUT model. This study also employed regression analysis with a total of 20 items, both dependent and independent inclusive.

3.6 DATA COLLECTION AND PROCEDURE

A structured questionnaire was designed and four research assistants were trained .The questionnaire had seven (7) sections for easy comprehension. The first section contained

sociodemographic profile of participants which included variables such as age, gender, highest educational level and occupation. The second and third sections contained information on mobile phone ownership and phone/computer experience and knowledge. Assessment of socioeconomic statutes of participants was done in section four. The fifth section contained questions that assessed the use of the mobile phone-based health information system. Section six of the questionnaire contained barriers to the use of the mobile phone-based health information system for which caregivers ranked each according to the scale of importance to them using a likert scale: not a barrier (0), low important barrier (1), slightly important barrier (2), moderately important barrier (3), very important barrier (4), or extremely important barrier (5). Some of the variables included limited network, spousal consent and system challenges. The seventh section contained the UTAUT model which assessed the degree to which performance expectancy, effort expectancy, social influence, facilitating conditions affect behavioural intention and user behaviour using a likert scale ranging from (1) strongly disagree to (5) strongly agree for each variable.

A pretesting of the questionnaire was done, after which it was reviewed appropriately. The questionnaire was translated into the local language by research assistants who administered them to consented caregivers. Administering the questionnaire to each participant took averagely eight minutes.

3.7 MEASUREMENTS

3.7.1 Moderators

A number of independent variables were categorized to help with the analysis. Age was categorized into ranges of 10, beginning from less than 20years, 21-30 years, 31-40 years, 41-50 year and 51 years and above. Gender was defined as either male or female. Highest educational level was categorized as no education, primary, JHS/Middle school, secondary and tertiary education

accordingly. With regard to the socio-economic status (SES), the principal component factor analysis (PCA) was used to estimate the asset score of the respondents by using a wealth score centered on household assets. The ownership of about 24 household items (electricity, wall clock, radio, pressing iron, television, mobile phone, gas/electric cooker, refrigerator, freezer, electric generator, washing machine, computer, digital camera, car, motor cycle, table, bed, wrist watch, bicycle, livestock, poultry, cabinet/cupboard, wardrobe and microwave) were used to generate the asset score. Weighted scores were subsequently divided into 5 quintiles. The lowest quintile represents the poorest households, whiles the highest quintile denotes the wealthiest households. Phone ownership was assessed from self-reporting of caregivers and re-categorized as yes or no. Mobile phone experience was assessed with 5 variables: using phone for calls, SMS and internet purposes, duration of use of mobile phone and caregivers' self-report knowledge of mobile phones. To generate phone experience, the values for each variable were added to get a composite score. The score was re-categorized so that respondents who obtained below the median were classified as inexperienced phone users whereas those who obtained above or equal to the median were classified as experienced mobile phone users.

3.7.2 UTAUT Model

A likert scale consisting of six constructs (PE, EE, SI, FC, BI and UB) and 20 items was used to assess the degree of agreement or disagreement (1-Strongly disagree, 2-Disagree, 3-Neutral, 4Agree, 5-Strongly Agree) in relation to the use of the mHealth Interactive Voice Response (IVR) system. The mean score of the items in each construct (variable) was generated and used in the analysis to determine the predictors of mHealth use.

3.8 DATA ANALYSIS

The data was exported from Excel to STATA. Out of 357 responses received 354 were used for analysis after cleaning the data. Analysis of the data was subsequently done with STATA 14 software. A descriptive analysis of the socio-demographic profile was done. The cronbach's alpha was calculated to assess the internal consistency of the various constructs in the UTAUT model. Linear regression analysis was done to assess the relationship between the independent (PE, EE, SI and FC) and dependent variables (BI and UB) in the UTAUT model. Each of the pathways of the constructs in the UTAUT model between the independent and dependent variables was tested for significance.

The moderators (age, education, gender, socio-economic status, phone experience, ethnicity and religion) were introduced as confounders between these pathways. The moderators that resulted in significant change in the beta (β) coefficient of the association (more than 10%) were hereby considered as significant moderators for those pathways.

3.9 ETHICAL CONSIDERATIONS

In line with good clinical practice, ethical approval for this study was given by the Committee on Human Research, Publication and Ethics, Kwame Nkrumah University of Science and Technology (CHRPE-KNUST) with reference number CHRPE/AP/497/19. Approval was also given by the authorities of the Health Directorate of Asante Akim North for the conduction of this study. Study participants who consented to the study were made to sign consent forms before questionnaires were administered. Caregivers were not forced to participate in the study thereby respecting their autonomy. All recruited participants were assured of optimum confidentiality with respect to their identity and the data provided.

3.10 STUDY VARIABLES

The various variables measured in the study are shown in Table 3.5.

Table 3.5 Variable Table

VARIABLE	DEFINITION OF VARIABLE	TYPE OF VARIABLE	OBJECTIVE ASSESSED
Age	As in completed years	Continuous	1,2
Gender	Sex of respondent as in either male or female	Binary	1,2
Education	Highest level of formal education	Nominal	1,2
Marital Status	As in single, married, divorced or widowed	Nominal	1
Religion	Religious association	Nominal	1,
Employment Status	The occupation of the respondent	Nominal	1
Ethnicity	Ethnic group that one belongs	Nominal	1
Social Economic Status (Asset Score)	Socio-economic status of respondents	Ordinal	1,2
Mobile Phone Ownership	As in person owning the mobile phone	Categorical	1

Phone Share	Shares mobile phone with other family members/neighbours.	Binary	1
Mobile Phone Experience/Technological capabilities	As in using mobile phone for calls, SMS and internet purposes	Binary	1
Duration of Mobile phone use	Duration of mobile phone usage (in years)	Ordinal	1
Phone Knowledge	Self-assessment of knowledge on mobile	Ordinal	1
Phone Experience	Classified as experience or inexperience phone user	Binary	1,2
Computer Knowledge	Self-assessment of knowledge on computers	Ordinal	1
Ever use of IVR service	Use and Non-use of Mobchild IVR system	Binary	1

Reason for Use	Reason for using IVR service	Nominal	1
Frequency of use	Number of times of usage of IVR service	Continuous	1
Person use	Specific person who used the system	Nominal	1
Reason for Non-use	Reason for non-use of IVR service	Nominal	1,3
Intention to use	Intention to use Mobchild IVR service	Binary	1,2
Barriers of mHealth use	Identified barriers in Mobchild use	Categorical	3
Electricity challenges	Extent to which respondent grades electricity challenges as a barrier	Ordinal	3
Challenges with phone access	Extent to which respondent grades access to phone as a barrier	Ordinal	3
Limited network	Extent to which respondent grades limited network as a barrier	Ordinal	3

Call drops	Extent to which respondent grades call drops as a barrier	Ordinal	3
Lack of familiarity with the technology or system	Extent to which respondent grades challenges with the system as a barrier	Ordinal	3
Challenges in operating a phone	Extent to which respondent grades operating a phone as a barrier	Ordinal	3
Complex health problem	Extent to which respondent grades complex health problem as a barrier	Ordinal	3
Limited local Language	Extent to which respondent grades local language as a barrier	Ordinal	3
Spousal (partner's) Consent	Extent to which respondent grades spousal support as a barrier	Ordinal	3
Performance Expectancy (PE) Score	Degree of perceived usefulness of the MOBCHILD mHealth system.	Ordinal	2
Effort Expectancy (EE) Score	Degree of perceived ease of use of the MOBCHILD mHealth system.	Ordinal	2
Social Influence (SI)	Extent to which others influence the use	Ordinal	2
	of the MOBCHILD IVR system.		
Facilitating Conditions (FC) Score	Degree to which the individual believes that a structural support needed for the system exists.	Ordinal	2
Behavioural Intention (BI) Score	Degree of behavioural intention to use MOBCHILD mHealth system.	Ordinal	2
User Behaviour (UB) Score	Degree of actual use behaviour of the MOBCHILD mHealth system.	Ordinal	2

Source: Author's construct, 2019 **CHAPTER FOUR**

RESULTS

4.1 SOCIO-DEMOGRAPHIC CHARACTERISTICS

The socio-demographic profile of all respondents interviewed in this study is presented in Table 4.1 as shown below.

A total of 354 caregivers with mean age of 30.17 years (SD=6.92) were interviewed; out of which 86.44% (306) were females. The study also revealed that 1 out of every 5 caregivers (21.75%) had no formal education. A quarter of the respondents had primary education (24.58%), 33.9% (120) had JHS or middle school education, 16.10% (57) with vocational or secondary school education and 3.67% (13) had tertiary education. In all 235 (66.38%) caregivers were married, 35 (9.89%) were single and 83 (23.45%) divorced or separated. Christianity (73.16%) was found to be the commonest religion among the respondents, followed by Islam (25.14%). The distribution on their employment status indicated that a significant 44.07% (156) were farmers and 27.4% (97) were traders. While 16.95% (60) were not involved in any form of employment, 5.37% (19) were hairdressers/seamstresses, 3.39% (12) were apprentices/students and 2.82% (10) were civil servants. Akans (70.06%) form the most of the ethnic group among the caregivers. The Mole-Dagbanis constituted 22.03% (78) of the respondents while other minor ethnic groups such as Kusaasi, Grushie, Gonja, Ewe, as among others accounted for 7.91% of the caregivers. The socio-economic status of caregivers as measured by an asset score of their household wealth had the poorest being 20.06% and wealthiest 19.21% among the respondents.

Table 4.

1: Socio-demographic characteristics

Variable	Frequency (N=354)	Percentage (%)
Age (years)		
≤ 20	27	7.63
21-30	178	50.28
31-40	121	34.18
41-50	23	6.50
> 50	5	1.41
Mean (SD)	30.17 (±6.92)	
Gender		
Male	48	13.56
Female	306	86.44
Highest Educational level		
No education	77	21.75
Primary	87	24.58
Middle/JHS	120	33.90
Secondary/Vocational	57	16.10
Tertiary	13	3.67
Marital status		
Married/living together	235	66.38
Single	35	9.89
Divorced/ separated	83	23.45
Widowed	1	0.28
Religion		
Christianity	259	73.16
Muslims	89	25.14
Traditional	3	0.85
Pagan	3	0.85
Employment status		
Unemployed	60	16.95
Farmer	156	44.07
Hairdresser/ seamstress	19	5.37
Apprentice/ student	12	3.39
Trader	97	27.40
Civil servant	10	2.82
Ethnicity		
Akan	248	70.06
Mole Dagbani	78	22.03
Others	28	7.91
Community		
Agogo Gyidim	87	24.58
Agogo Obuasi	47	13.28
Agogo old police station	25	7.06
Bebuso	34	9.60
Domeabra	72	20.34
Zongo	56	15.82
Pataban/Aniwoso	33	9.32
Wealth quintiles (SES)		
1st quintile	71	20.06

2nd quintile	71	20.06
3rd quintile	83	23.45
4th quintile	61	17.23
5th quintile	68	19.21

Source: Field Data, 2019

The communities from which the caregivers who were interviewed included Agogo Gyidim, Agogo Obuasi, Agogo Old Police Station, Bebuso, Domeabra, Zongo and Pataban/Aniwoso, all of which are in the Asante Akim North District.

4.2 USE OF MOBILE PHONE-BASED HEALTH INFORMATION SYSTEM

The distribution of phone ownership among all the respondents is illustrated in Figure 4.1 below. Out of the total of 354 caregivers, 86% (304) indicated phone ownership, 4% (16) had access to their partners (spouses) phones, 5% (19) accessed their relative phone, 4% (13) had access to the mobile phones from their friends/neighbours (4%) and 1% (2) utilized phones from phone shops.

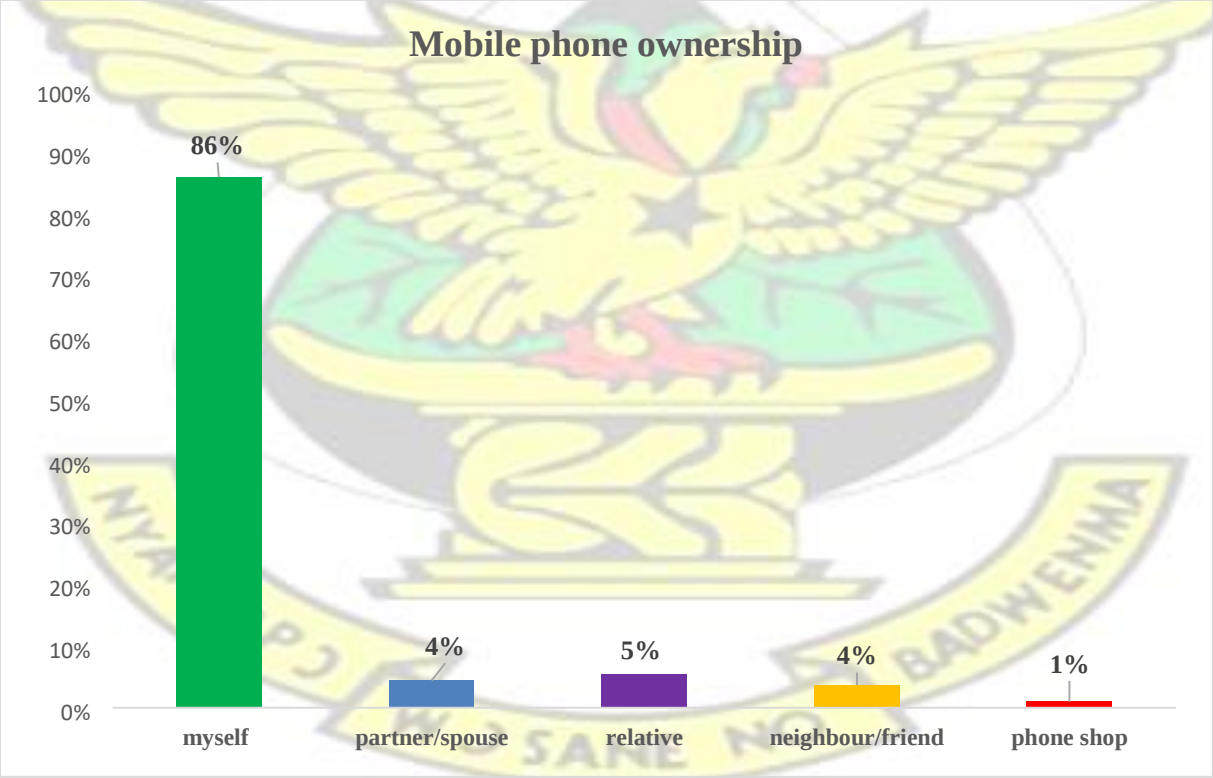


Figure 4.1: Mobile phone ownership among caregivers

Table 4.

Source: Field data, 2019

2 Analysis of mobile phone ownership among caregivers (N=304)

Variables	**Number of respondents**	**% of respondents with mobile phone**	**p- value**
Age (years)			0.001
≤ 20	16	59.26	
21-30	155	87.08	
31-40	105	86.78	
41-50	23	100.0	
> 50	5	100.0	
Educational level			0.080
No education	67	87.01	
Primary	71	81.61	
Middle/JHS	99	82.50	
Secondary/Vocational	54	94.74	
Tertiary	13	100.0	
Wealth quintiles (SES)			0.001
1st quintile	43	60.56	
2nd quintile	63	88.73	
3rd quintile	78	93.98	
4th quintile	56	91.80	
5th quintile	64	94.12	
Phone Experience			0.30
Experience	171	84.24	
Inexperience	133	88.08	
Gender			0.003
Male	48	100.0	
Female	256	83.66`	

Source: Field data, 2019

The distribution of mobile phone ownership along the demographic profile of respondents is represented in Table 4.2 above.

Increasing age of respondents was associated with increased likelihood of owning a mobile phone; 59.26% for those less than 20 years and 100% for those above 40years ($p<0.001$).

Education however did not have significant association with phone ownership. A significant 87% (67) of respondents with no education owned mobile phones, whereas 81.6% (71) and 82.5% (99) of those with primary and middle school (JHS) also respectively owned phones. Phone ownership among caregivers from the poorest households was 60.56% (43), whiles those from the wealthiest households had 94.14% (64) phone ownership. There is an association between household wealth and phone ownership ($p<0.001$). There was no significant association between phone ownership among experienced (84.24%) and inexperienced (88.03%) phone users ($p>0.05$).

Caregivers who are males (100%) were more likely to own mobile phones than their female (83.66%) counterparts ($p<0.05$).

3: Knowledge and Experience about Mobile Phone/computers

Variable	**Frequency**	**Percentage (%)**
Do you use mobile phone for calls Yes		
	325	91.81
No	29	8.19

Table 4.

Do you use mobile phone for SMS Yes		
	267	75.42
No	87	24.58
Do you use mobile phone for internet		
Yes	43	12.15
No	311	87.85
Duration of mobile phone usage (years)		
< 1	105	29.66
1-4	76	21.47
> 4	173	48.87
Knowledge about mobile phone Very		
poor	21	5.93
Poor	55	15.54
Moderate	89	25.14
Good	150	42.37
Very good	39	11.02
Knowledge about computers Very		
poor	123	34.75
Poor	95	26.84
Moderate	45	12.71
Good	61	17.23
Very good	30	8.47
Mobile Phone Experience Experienced		
Users	203	57.34
Inexperienced Users	151	42.66

Source: Field data, 2019

Table 4.3 provides an overview of the level of knowledge about mobile phones/computers and mobile phone experience among respondents.

With regard to technological capabilities in mobile phone usage, 91.8% (325) of the respondents use mobile phones for receiving and/or placing calls, 75.42% (267) use Short Messaging Service (SMS) and a significant 87.85% (311) do not use internet services on their mobile phones.

Almost half of the caregivers (48.87%) have used mobile phones for more than 4years, while the others have either used it for less than 1 year (29.66%) or between 1-4 years (21.47%). Out of the

354 respondents, a little over 50% rated themselves as either “good” (42.37%) or “very good” (11.02%) regarding knowledge about mobile phones. A quarter (25.14%) of the caregivers admitted “moderate” knowledge about mobile phones whiles the rest ranked themselves as having poor (15.54%) and very poor (5.93%) knowledge about mobile phones.

In relation to knowledge about computers, a cumulative of about 61.5% (218) of the respondents rated themselves as either poor (26.84%) or very poor (34.75%) , whiles a quarter classified themselves as having good (17.23%) or very good (8.47%) knowledge.

Overall, 57.34% (203) of the caregivers were experienced mobile phone users while 42.66% (151) were found to be inexperienced.

Table 4.4: Distribution of use of the IVR service by caregivers

Variable	Frequency	Percentage (%)
Ever used IVR service	N-354	
Yes	101	28.53
No	253	71.47
Intension to use in the future	N=354	
Yes	328	92.66
No	1	0.28
Not sure	25	7.06
Reasons for use	N=101	
Seeking care for my child health	91	59.48
It's time saving	6	3.92
Enhanced access to health care and information	9	5.88
Cost reduction	9	5.88
Opportunity to talk to doctor	38	24.84
Frequency of Use of IVR service	N=101	
1	53	52.48
2	39	38.61
3	7	6.93
4	2	1.98

Source: Field data, 2019

The distribution of use of the Interactive Voice Response service by caregivers is represented in Table 4.4 above.

The study revealed that 28.53% (101) of the caregivers ever used the IVR service while 71.47% (253) reported non-use of the service. Among the users of the IVR system, more than half (52.48%) have used it on single occasion while 38.61% indicated using it on two occasions. Fewer caregivers reported use on three (6.93%) and four (1.98%) occasions. Users of the IVR service adduced several reasons for the use of the system. Most caregivers used it for the purposes of seeking care

for their children (59.48%). About a quarter (24.84%) of the respondents stated the opportunity to talk to a doctor as a reason for the use of the system. Other reasons for the use of the system included cost reduction (5.88%), enhanced access to healthcare and information (5.88%) and time saving (3.92%). A significant 92.66% (324) of the all the respondents interviewed however expressed intention to use the IVR service in the future.

Table 4.5: Analysis on caregivers' usage of the IVR system

Variables	**Usage of IVR se**		**p- value**
	Yes n (%)	**No n (%)**	
Age (years)			0.64
≤ 20	6 (5.9)	21 (8.3)	
21-30	57 (56.4)	121 (47.8)	
31-40	32 (31.7)	89 (35.2)	
41-50	5 (5.0)	18 (7.1)	
> 50	1(1.0)	4 (1.6)	
Educational level			0.001
No education	5 (5.0)	72(28.5)	
Primary	25 (24.8)	62 (24.5)	
Middle/JHS	44 (43.6)	76 (30.0)	
Secondary/Vocational	22 (21.8)	35 (13.8)	
Tertiary	5 (5.0)	8 (3.2)	
Wealth quintiles			0.001
1st quintile	7 (6.9)	64 (25.3)	
2nd quintile	24 (23.8)	47 (18.6)	
3rd quintile	33 (32.7)	50 (19.8)	
4th quintile	27 (26.7)	34 (13.4)	
5th quintile	10 (9.9)	58 (22.9)	
Phone Experience			0.98
Experience	58 (57.4)	145 (57.3)	
Inexperience	43 (42.6)	108 (42.7)	

Gender			0.35
Male	11(10.9)	37(14.6)	
Female	90(89.1)	216(85.4)	

Source: Field data, 2019

An analysis of caregivers' usage of the IVR system is represented in Table 4.5 above.

More than half (56.4%) of users of the IVR service were in the 21-30 years age group. Three out of ten (31.7%) users were also in the 31-40 years age group. However there was no significant association with the various age groups and usage of the IVR service ($p>0.05$). The usage or non-usage of the system was associated with the level of education of the respondent ($p<0.001$). It was noted that a quarter of the users (24.8%) and non-users (24.5%) were of primary education while 43.6% who used the system were of secondary education.

The study also revealed that the wealth quintiles of households of caregivers was associated with the use of the system ($p<0.001$) such that whiles a quarter (25.3%) of non-users were of the poorest household, a cumulative of 93.1% of the users belonged to higher quintiles (2^{nd}, 3^{rd}, 4^{th} and 5^{th}). In all, about 6 out of every 10 caregivers who reported usage (57.4%) or non-use (57.3%) of the IVR system were experienced in mobile phone use. Mobile phone experience therefore had no significant association with use or non-use of the IVR system ($p>0.05$). With respect to gender, we found similar proportions of caregivers who indicated use (89.1%) or nonuse (85.4%) of the system being females. There was no association between gender and usage of the IVR service ($p>0.05$).

4.3 DETERMINANTS OF MHIS USE

4.3.1 Technology-oriented Factors

The constructs in the UTAUT model were used to assess the determinants of actual use of the mobile phone-based HIS. The stability and consistency of each construct was calculated

(cronbach's alpha) to determine the reliability of the measurement as indicated in Table 4.6 below. The cronbach's alphas calculated were within acceptable range of 0.56-0.91.

Table 4.6 Results of Cronbach Alpha Reliability

Variable/Construct	Number of Items	Cronbach's Alpha (α)
Performance expectancy	4	0.9132
Effort expectancy	4	0.8869
Social influence	3	0.5620
Facilitating condition	3	0.5860
Behavioural intention	3	0.5765
Use behaviour	3	0.8734

Source: Field Data, 2019

The relationship between the independent and dependent variables in the model was tested using regression analysis for significance and the beta coefficients for each pathway determined as shown in Table 4.7.

Table 4.7: Results of relationships between independent and dependent variables in the model

Path (Relationship)	Beta Coefficient (β)	Standard Error	95%Confidence Interval	P-Value	Comments
PE→BI	0.278	0.036	0.207-0.349	0.001	Supported
EE→BI	0.242	0.042	0.159-0.326	0.001	Supported
SI→BI	0.081	0.019	0.044-0.120	0.001	Supported
FC→UB	0.609	0.054	0.502-0.715	0.001	Supported
BI→UB	0.426	0.087	0.255-0.597	0.001	Supported

Source: Field Data, 2019

The results indicated that the relationship between PE and BI (β-0.278, 95% CI-0.207-0.349 $p<0.001$), EE and BI (β-0.242, 95% CI-0.159-0.326, $p<0.001$), SI and BI (β-0.081, 95% CI-

0.044-0.120, p<0.001), FC and UB (β-0.609, 95% CI-0.502-0.715, p<0.001), BI and UB (β-0.426, 95% CI-0.255-0.597, p<0.001) were significant.

4.3.2 Effect of Person-oriented factors (Moderators)

The effect of the moderating factors for each of the pathways between the independent and dependent variables in the UTAUT model is shown in Table 4.8

Age and gender had no moderating effect on the relationship between PE, EE, SI and behavioural intention and usage. Education was found to have a significant moderating effect between EE and BI. The relationship between PE and BI, EE and BI, and FC and UB were significantly moderated by phone experience and wealth quintiles (SES). The study also revealed that ethnicity and religion significantly moderated the association between facilitating condition and user behaviour.

Table 4.8: The effect of moderators on the association between the independent and dependent variables

Moderator	**Pathway (Relationship)**	**Comments/Decision**
Age	PE→BI EE→BI SI→BI FC→UB	Not significant Not significant Not significant Not significant

Education	PE→BI EE→BI SI→BI FC→UB	Not significant **Significant** Not significant Not significant
Phone Experience	PE→BI EE→BI SI→BI FC→UB	**Significant** **Significant** Not Significant **Significant**
Wealth quintile(SES)	PE→BI EE→BI SI→BI FC→UB	**Significant** **Significant** Not significant **Significant**
Gender	PE→BI EE→BI SI→BI FC→UB	Not significant Not significant Not significant Not significant
Ethnicity	PE→BI EE→BI SI→BI FC→UB	Not significant Not significant Not significant **Significant**
Religion	PE→BI EE→BI SI→BI FC→UB	Not significant Not significant Not significant **Significant**

Source: Field Data, 2019

4.4 BARRIERS OF MHIS USE

The reasons for non-use of the IVR service are illustrated in Figure 4.2 above.

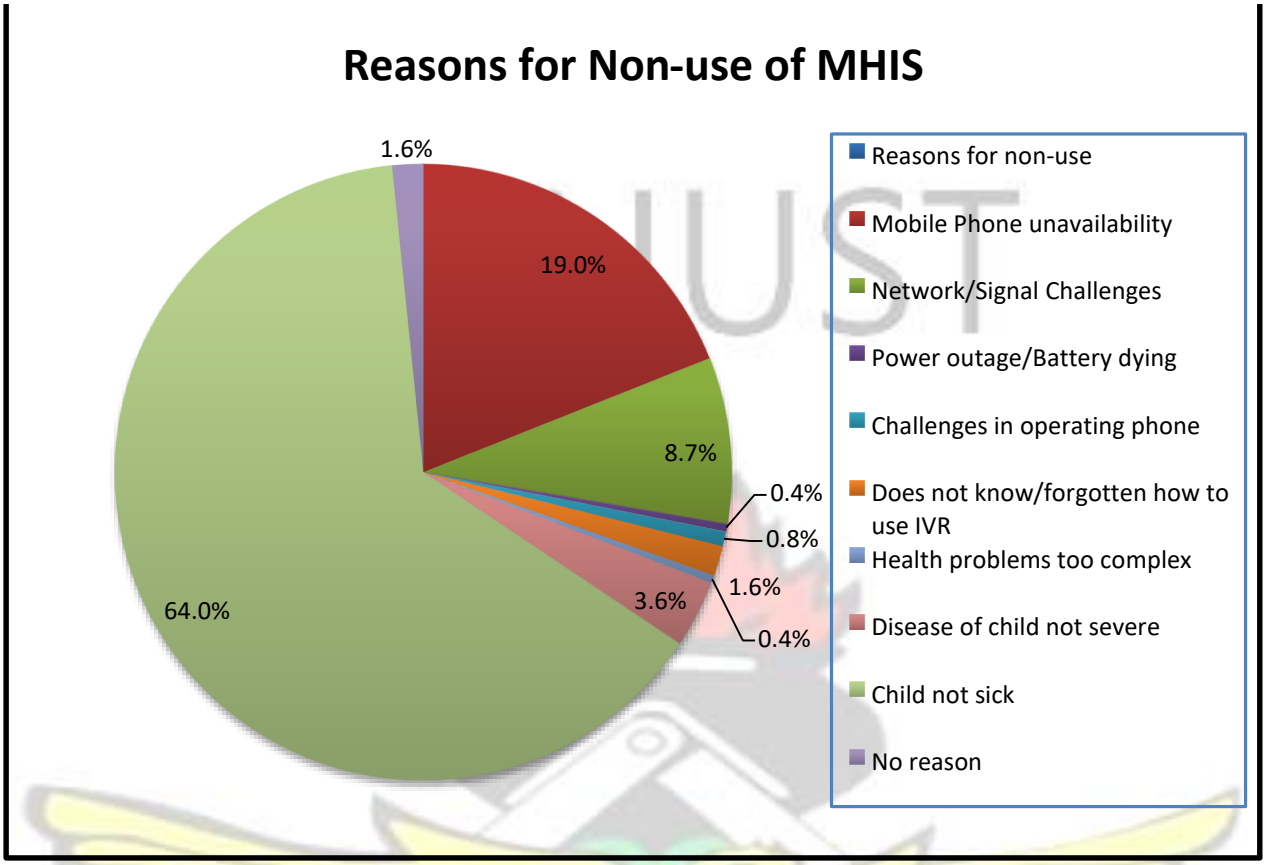


Figure 4.2 Reason for non-use of the IVR service.

Source: Field data, 2019

Almost two thirds (64.0%) of the caregivers who were non-users claim their children were not sick to warrant the use of the system. Mobile phone unavailability (19.0%), network/signal challenges (8.7%), non-severity of child disease (3.6%) and difficulties in operating the system (1.6%) accounted for some of the reasons for non-use of the system.

The study also found that 3 out of every 10 respondents (29.94%) indicated that there were times they wanted to use the IVR system but they could not. This was principally due to network/signal challenges (64.8%) or mobile phone unavailability (19.6%).

Table 4.9: Perceived Barriers by Caregivers in using the MOBHILD IVR service

Rank	Barrier	Obs	Mean	Std. Dev	Min	Max	NB

1	Electricity challenges	111	3.33	1.73	1	5	235	
2	Challenges with phone access	108	2.99	1.76	1	5	245	
3	Limited network	149	2.95	1.71	1	5	202	
4	Call drops	145	2.83	1.71	1	5	203	
5	Lack of familiarity with the or system	184	2.73	1.10	1	5	162	technology
6	Challenges in operating a phone	163	2.68	1.15	1	5	184	
7	Complex health problem	165	1.95	0.78	1	4	178	
8	Limited local Language	143	1.83	0.87	1	4	200	
9	Spousal (partner's) Consent	121	1.21	0.57	1	4	218	

Obs= Observation, Std. Dev= Standard deviation, Min= Minimum value, Max= Maximum value, NB= Participants who indicated Not a Barrier

Source: Field data, 2019

The magnitude of the barriers perceived by caregivers in the use of the mHealth service is represented in Table 4.9 above.

Although 67.9% of the respondent indicated electricity challenges as not a barrier, 32.1% of the respondents ranked it as moderately important barrier (Mean=3.33, SD±1.73). Similar findings were also reported for challenges with mobile phone access among 30.5% respondents as moderately important barrier (Mean=2.99, ±1.76).

Limited network (42.5% respondents) and call drops (41.3% respondents) were graded third and fourth moderately important barriers with mean scores of 2.95 (SD ±1.71) and 2.83 (SD±1.71) respectively. Subsequently 53.1% respondents also considered lack of familiarity with the mHealth system as a moderately important barrier (Mean=2.73, ±1.10). Other barriers included challenges in operating a phone (53.2% respondents, Mean=2.68, ±1.15) and complex health problem (48.1% respondents, Mean=1.95, ±0.78). Spousal (partners) consent was ranked by 35.7% of the respondents as low important barrier (Mean=1.21, ±0.57) whiles 64.3%

respondents did not consider it as a barrier at all.

CHAPTER FIVE

DISCUSSION

5.1 INTRODUCTION

Undoubtedly mHealth holds a huge potential in improving the health outcomes in developing countries where access to health continues to be a significant obstacle. Focusing on users is one of the important strategies to increase uptake of mHealth (Akter and Ray, 2018). This study therefore sought to assess the factors influencing caregivers' use of a mobile phone-based health information

system using the UTAUT model. The results of this study are discussed in this chapter in line with the objectives.

5.2 SOCIO-DEMOGRAPHIC CHARACTERISTICS

The study identified most of the caregivers to be females (86.44%). This perhaps was not surprising because generally, women are seen as the primary caregivers of most children underfive years of age. It was enlightening to know that most respondents had received a degree of formal education which is usually uncharacteristic of rural communities in LMICs. Although most of the respondents were Akans, the representation by other ethnic groups (30%) relatively expands the angle for analysis of the socio-demographic profile of the area. This will certainly be imperative for planning.

5.3 USE OF MOBILE PHONE-BASED HEALTH INFORMATION SYSTEM

The study revealed high phone ownership (86%) among caregivers in the area. This finding is consistent with a nationwide survey recently conducted in the country (Ghana Statistical Service, 2019). This finding indicates that mobile phone ownership in the study area has significantly increased from 42% as previously reported in nationwide survey over the past decade (Ghana Statistical Service, 2014a). Access to mobile phone remains an essential factor in the adoption and utilization of mHealth services. It was established that increase in age, male gender and socio-economic status as indicated by asset scores were associated with mobile phone ownership ($p<0.05$). This outcome is in agreement with a study done by Khatun et al (2017) establishing similar associations.

The study identified that although males were likely to own mobile phones, usage of mHealth services had no gender-based associations. Caregivers' level of education and socio-economic status however influenced their use of mHealth service. The study also found that caregivers' use

of the mHealth services had no associations with age or phone experience. Even though other studies had found that age and phone or IT experience contribute to the use of the mHealth services (Georgsson and Staggers, 2016), a number of reasons can explain our findings. The ease of mobile phone operability, the type of mHealth application being employed and the required task to be performed by the user in using the mHealth service can all influence utilization rates. The IVR application employed in the MOBCHILD mHealth service required the ability of caregivers to make a call. Most caregivers (91.8%) primarily reported using mobile phones for making or receiving calls, affirming their competence to use the system.

The findings also suggest that, although only a third had reported ever using the service mainly for the purpose of seeking health care services for the sick children, most of the caregivers expressed intentions to use mHealth service in the future (92.66%). These findings were not surprising though. This is because collection of data for this study took place a little over a month after caregivers had been recruited into the MOBCHILD project affording them little time after the introduction of the mHealth intervention. Caregivers who had not used the system affirmed this in our findings (64% of non-users), indicating that their children had not fallen sick for them to use the system. The readiness of a caregiver to use the mHealth system is dependent on a child being unwell. Majority of users (91%) have had less than three occasions to use the system.

5.4 DETERMINANT OF MHIS USE

5.4.1 Technology-oriented Factors

The study assessed the applicability of the UTAUT model in determining the factors that influence caregivers' use of mHealth in Asante Akim North District, a rural community in Ghana.

The study established that performance expectancy (β-0.278, $p<0.001$), effort expectancy (β-

0.242, p<0.001) and social influence (β-0.081, p<0.001) significantly influenced caregivers' intention to use mHealth service. It is therefore important to note that the usefulness of the mHeath service in addressing the needs of the user as well as the ease associated with the use of the system will significantly contribute to users' behavioural intention and actual use of such services. To achieve user satisfaction, mHealth systems designers must consider the needs of the target population and such systems must also be user friendly to ensure acceptability (Georgsson and Staggers, 2016). MHealth systems must therefore be easy to use requiring less education especially in rural settings to ensure acceptability and usability.

Facilitating conditions (β-0.609, p<0.001) and users' behavioural intention (β-0.426, p<0.001) were also found to positively impact on actual use behaviour among caregivers in rural Ghana. In other words, having the requisite knowledge and resources, users' perceptions of existing organization or system that facilitate their use of mHealth services as well as behavioural intention are strong predictors of actual use behaviour. The outcome of this study agrees with the conventional findings of the UTAUT model as proposed by Venkatesh et al (2003). Numerous studies that applied the UTAUT model to ascertain the key factors influencing the acceptance and use of mHealth also yielded similar outcomes (Williams, Rana and Dwivedi, 2015; Hoque and Sorwar, 2017; Dwivedi *et al.*, 2019). Even though Alshehri et al (2013) discovered similar findings that PE and EE had a positive impact on behavioural intention, SI however did not significantly influence behavioural intention among citizens in Bangladesh. Due to variations in social and health systems across different populations, such outcomes may be anticipated.

5.4.2 Effect of Person-oriented factors (Moderators)

Our findings revealed that gender and age had no moderating effect on the relationship between performance expectancy, effort expectancy, social influence, and facilitating conditions on

behavioural intention and usage of mHealth service. The implication of this findings indicate that age and gender differentials do not significantly affect the relationship between PE, EE, SI, FC on behavioural intention and usage of mHealth services. Consistent with Alshehri et al (2013), gender and age were also found to be insignificant in terms of controlling behavioural intention. Alam et al (2019) however identified that gender significantly moderated the effect of PE, EE and FC on users' behavioural intention to adopt mHealth in Bangladesh.

This study however discovered that socio-economic status and phone experience significantly moderated the effect of performance expectancy and effort expectancy on behavioural intention to use mHealth. The association between performance expectancy and effort expectancy on behavioural intention to use mHealth service was stronger among users of high socio-economic status and phone experience than those of low socio-economic status and inexperience in mobile phones. The connection between facilitating condition and user behaviour was also significantly controlled by socio-economic status and phone experience. This outcome was consistent with Alshehri et al (2013) who also found that experience significantly moderated the effect of FC on behavioural intention.

The study revealed that education only significantly moderated the effect of effort expectancy on behavioural intention to use mHealth. This means the relationship between effort expectancy and behavioural intention to use mHealth is significant and stronger for highly educated users than less educated ones.

Although not initially part of factors itemized for moderation, the study identified that ethnicity and religion significantly moderated the effect of facilitating condition on actual mHealth user behaviour. This means ones association with religion or particular ethnic descent can significantly impact the relationship between FC on user behaviour of mHealth services. It is worth recognizing

that such socio-cultural factors can significantly mediate the effects of key determinants of mHealth adoption and use. Religious and ethnic consideration may therefore play major roles in facilitating mHealth uptake especially in settings similar to the study area. This may not be the case in other jurisdictions, or user populations because of cultural diversities.

5.5 BARRIERS OF MHIS USE

The study found that a third of the caregivers admitted challenges with electricity was a barrier and ranked it as moderately important. This gives rise to problems in charging their mobile phones for usage where necessary. Similar findings were made by Jewer et al (2018) in their study at the southern part of Ghana within urban, peri-urban and rural communities. Electricity coverage continues to be a challenge in LMICs and progress in this area will significantly alleviate the challenge of rural dwellers in particular. It must be stated that about 70% of the respondent did not consider electricity challenge as a barrier to their usage of mHealth service.

Challenges with phone access were also identified from similar fraction of the respondents as a moderately important barrier (Mean-2.99, SD±1.76).This finding was not so surprising especially where almost 9 out of every 10 household own a phone in Ghana (Indicator and Surveys, 2019). Even though our findings on phone ownership was consistent with national survey, caregivers also admitted sharing phones (31.6%) with other members of their households, friends and neighbours, a characteristic of households in rural communities. This could therefore pose as a limitation to their access to mobile phone, thereby accounting for this finding. Nonetheless, this barrier must not be underestimated by stakeholders in appraising the areas of concerns for mHealth uptake.

The study also revealed that significant fraction of caregivers (41.3-42.5%) considered infrastructural challenges such as limited networks and call drops as moderately important barriers.

Attempts to increase adoption of mHealth services must critically consider the establishment of a reliable network among service providers (Alshehri et al., 2013). Although there is the general impression of adequate network coverage within the study area, these findings are suggestive of the likelihood of certain areas having limited network coverage.

Spousal (partner's) consent received the lowest rank of importance among caregivers perceived barriers (Mean=1.21, ±0.57) in using mHealth service. Among rural communities in developing countries such as Ghana, decision making on health seeking behaviour for members of the household is very important. It is necessary to indicate that even though a greater fraction of the caregivers were females, about third of them considered it as a barrier. This may not be the situation in other population. Attempts to curtail the barriers of mHealth must however be sensitive to address this growing concern from the end users.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

This study confirms the high phone ownership in rural Ghana. The study also established that although educational level influences phone ownership, high socio-economic status is associated with phone ownership and consequent use of mHealth systems. The study also revealed that while men are more likely to own a mobile phone, there is no gender association in the use of mHealth services. Caregivers primarily use the mHealth system for purposes of meeting the health needs of their children. It was established that caregivers have high intentions to use mHealth services although a relatively low proportion reported ever using the system.

The study concludes that the Unified Theory of Acceptance and Use of Technology model is applicable in mHealth systems in the rural communities of developing countries.

Performance expectancy, effort expectancy and social influence were found to have a direct strong and positive influence on users' behavioural intention to use mobile phone-based health information system. Facilitating conditions and behavioural intention were identified as significant predictors of actual mHealth use behaviour among caregivers.

These findings are consistent with the outcomes of previous studies that applied the UTAUT model in determining the factors that influence the adoption and use of mHealth. The factors that positively influence caregivers' use of mHealth service includes: perceived usefulness of the mHealth system, the ease associated with its use, social influence and existing facilitating conditions.

Phone experience and wealth quintiles (SES) were found to be the principal significant factors in moderating the relationship between the explanatory (PE, EE, SI, FC) and outcome variables (BI and UB). Age and gender were insignificant moderators of the relationship between the explanatory and dependent variables. The study however identified a significant moderating effect by religion and ethnicity between facilitating conditions and user behaviour of mHealth systems.

The important barriers to mHealth use among caregivers in rural areas are related to infrastructural challenges (electricity and limited network) and phone access.

The outcome of this study adds to the body of research and literature that will inform stakeholders in the design and development of mHealth services for uptake especially developing countries.

6.2 RECOMMENDATIONS

Caregivers' intention to use mHealth service is overwhelmingly high. This provides a window for local health authorities to consider how they can harness the potential of mHealth systems to

improve health outcomes of children in rural Ghana where there is limited access to healthcare services.

Stakeholders involved in designing mHealth applications and systems must consider these user characteristics obtained from these findings in developing such systems in order to ensure user acceptability and utilization.

Not much research has been done in the area of mHealth within the region of sub-Saharan. Further studies should therefore be done in this area to test the strength of the UTAUT model at resource limited settings. Such studies should consider the context and socio-cultural factors such as religion and ethnicity status of the user population. Further studies can also be done to actually measure the health impact of mHealth systems.

Stakeholders in the Ministry of Health, telecommunication industry, academic and research institutions, Government organizations, private sector companies, policy makers and bilateral funding agencies must deliberately support, fund and invest in mHealth research and application to ensure uptake and sustainable integration.

REFERENCES

Akter, S. and Ray, P. (2018) 'mHealth - an Ultimate Platform to Serve the Unserved', *Yearbook of Medical Informatics*, 19(01), pp. 94–100. doi: 10.1055/s-0038-1638697.

Alam, M. Z., Hu, W., Barua, Z., (2018) 'Using the UTAUT Model to Determine Factors Affecting Acceptance and Use of Mobile Health (mHealth) Services in Bangladesh' *Journal of Studies in Social Sciences*, ISSN 2201-4624 Volume 17, Number 2, 2018, pp. 137172

Alam, M. Z. *et al.* (2019) 'Factors influencing the adoption of mHealth services in a developing country: A patient-centric study', *International Journal of Information Management*, 50(October 2018), pp. 128–143. doi: 10.1016/j.ijinfomgt.2019.04.016.

Ali, M. *et al.* (2017) 'A mixed methods systematic review of success factors of mhealth and telehealth for maternal health in Sub-Saharan Africa', (1), pp. 7–10. doi: 10.21037/mhealth.2017.05.04.

Alshehri, M., Drew, S. and AlGhamdi, R. (2013) 'Analysis of Citizens Acceptance for Egovernment Services: Applying the UTAUT Model', pp. 69–76. Available at: http://arxiv.org/abs/1304.3157.

Annex, R. (2016) 'WORLD HEALTH ORGANIZATION 139 TH SESSION', (May).

Assembly, S. W. H. (2018) ‘Use of appropriate digital technologies for public health’, 28(March). doi: 10.2337/dc11-0366.4.

Burns, C. (2011) ‘WHO International Standards/Reference Reagents’, *Glob. Obs. eHealth Ser*, 3, p. 99. doi: 10.4258/hir.2012.18.3.231.

Davis, F. D., R. P. Bagozzi, et al. (1989). "User acceptance of computer technology: a comparison of two theoretical models." Management science 35(8): pp. 982-1003.

Dwivedi, Y. K. *et al.* (2019) ‘Re-examining the Unified Theory of Acceptance and Use of Technology (UTAUT): Towards a Revised Theoretical Model’. Information Systems Frontiers, pp. 719–734. doi: 10.1007/s10796-017-9774-y.

Eze, E., Gleasure, R. and Heavin, C. (2016) ‘Reviewing mHealth in developing countries : A stakeholder perspective’, *Procedia - Procedia Computer Science*. Elsevier Masson SAS, 100, pp. 1024–1032. doi: 10.1016/j.procs.2016.09.276.

Feroz, A. *et al.* (2017) ‘Feasibility of mHealth intervention to improve uptake of antenatal and postnatal care services in peri-urban areas of Karachi: a qualitative exploratory study’, *Journal of Hospital Management and Health Policy*, 1(November), pp. 5–5. doi: 10.21037/jhmhp.2017.10.02.

Fishbein, M. and M. J. Manfredo (1992). "A theory of behavior change." Influencing human behavior: 29-5

Georgsson, M. and Staggers, N. (2016) ‘Quantifying usability: An evaluation of a diabetes mHealth system on effectiveness, efficiency, and satisfaction metrics with associated user characteristics’, *Journal of the American Medical Informatics Association*, 23(1), pp. 5–11. doi: 10.1093/jamia/ocv099.

Ghana Statistical Service (2019), ‘Snapshots of key findings’ of Ghana Multiple Indicator Cluster Survey 2017/18, Accra. GSS, Accra

Ghana Statistical Service (2014a), 2010 Population and Housing Census: Distict Analytical Report, Asante Akim North District. GSS, Accra

Ghana Statistical Service, G. H. S. and I. I. (2014b) 'Ghana Health and Demographic Survey 2013'. doi: 10.15171/ijhpm.2016.42.

Hoque, R. and Sorwar, G. (2017) 'International Journal of Medical Informatics Understanding factors influencing the adoption of mHealth by the elderly : An extension of the UTAUT model', *International Journal of Medical Informatics*. Elsevier Ireland Ltd, 101(September 2015), pp. 75–84. doi: 10.1016/j.ijmedinf.2017.02.002.

Indicator, M. and Surveys, C. (2019) 'Snapshots of key findings'.

Jewer, J. (2018) 'International Journal of Medical Informatics Patients ' intention to use online postings of ED wait times : A modi fi ed UTAUT model', 112(January), pp. 34–39. doi: 10.1016/j.ijmedinf.2018.01.008.

Khatun, F. *et al.* (2017) 'Gender differentials in readiness and use of mHealth services in a rural area of Bangladesh', *BMC Health Services Research*. BMC Health Services Research, 17(1), pp. 1–11. doi: 10.1186/s12913-017-2523-6.

Kumar, M. and Millar, L. (2017) 'Stages of Health Information System Improvement Strengthening the Health Information System for Improved Performance', (December).

Measuring the Information Society Report 2015 (2015).

Kunbuor, B. *et al.* (2009) 'National E-Health', pp. 1–80.

Laar, A. S. *et al.* (2018) 'Assessment of mobile health technology for maternal and child health services in rural Upper West Region of Ghana', *Public Health*. Elsevier Ltd, 168, pp. 1–8. doi: 10.1016/j.puhe.2018.11.014.

May, J. *et al.* (2016) ‘An investigation of users ’ attitudes , requirements and willingness to use mobile phone-based interactive voice response systems for seeking healthcare in Ghana : a qualitative study’, 4(0). doi: 10.1016/j.puhe.2016.11.017.

Mechael, P. and Searle, S. (2010) ‘Barriers and Gaps Affecting mHealth in Low and Middle Income Countries : Policy White Paper’, *mHealth Alliance*, 54(March), pp. 1–79. Available at: http://www.globalproblems-globalsolutions-files.org/pdfs/mHealth_Barriers_White_Paper.pdf.

Nanyombi, A. and Habinka, A. (no date) ‘Factors Influencing the Adoption of Mobile Health in Uganda Health Facilities : A Case Study of Mobile Tracking System in Kayunga’, pp. 131–145.

Ndayizigamiye, P. (2018) ‘A Systematic review of mHealth interventions for public healthcare in East Africa TREO Talk Paper’, p. 2018.

Patricia N. Mechael (2009) ‘The Case for mHealth in Developing Countries’, *Innovations: Technology, Governance, Globalization.*, 4, pp. 103–118. doi: 10.1162/itgg.2009.4.1.103.

Quansah, E. *et al.* (2016) ‘Social factors influencing child health in Ghana’, *PLoS ONE*, 11(1), pp. 1–20. doi: 10.1371/journal.pone.0145401.

Rogers, E. M. (2003). "Elements of diffusion." Diffusion of innovations**5**: pp. 1-38.

Vest, J., Issel, L. M. and Lee, S. (2014a) ‘Experience of Using Information Systems in Public Health Practice: Findings from a Qualitative Study’, *Online Journal of Public Health Informatics*, 5(3), pp. 1–9. doi: 10.5210/ojphi.v5i3.4847.

Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D. (2003), “User acceptance of information technology: Toward a unified view”, *MIS Quarterly*, Vol. 27, No. 3, pp. 425-478.

Venkatesh, V., Thong, J. Y., and Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. MIS quarterly, pp. 157-178.

Vest, J., Issel, L. M. and Lee, S. (2014b) 'Experience of Using Information Systems in Public Health Practice: Findings from a Qualitative Study', *Online Journal of Public Health Informatics*, 5(3), pp. 1–9. doi: 10.5210/ojphi.v5i3.4847.

Wambugu, S. and Villella, C. (2016) 'mHealth for Health Information Systems in Low- and Middle-Income Countries: Challenges and Opportunities in Data Quality, Privacy, and Security', *mHealth for Health Information Systems*.

WHO. (2007). Everybody's business: Strengthening health systems to improve health outcomes.

WHO (2019). Fact Sheet on Children: Reducing Mortality. WHO. Assessed online via https://www.who.int/news-room/fact-sheets/detail/children-reducing-mortality

WHO's framework for action. Geneva, Switzerland: World Health Organization. Retrieved from http://www.who.int/healthsystems/strategy/everybodys_business.pdf

Williams, M. D., Rana, N. P. and Dwivedi, Y. K. (2015) 'The Unified Theory of Acceptance and Use of Technology (UTAUT): A Literature Review'.

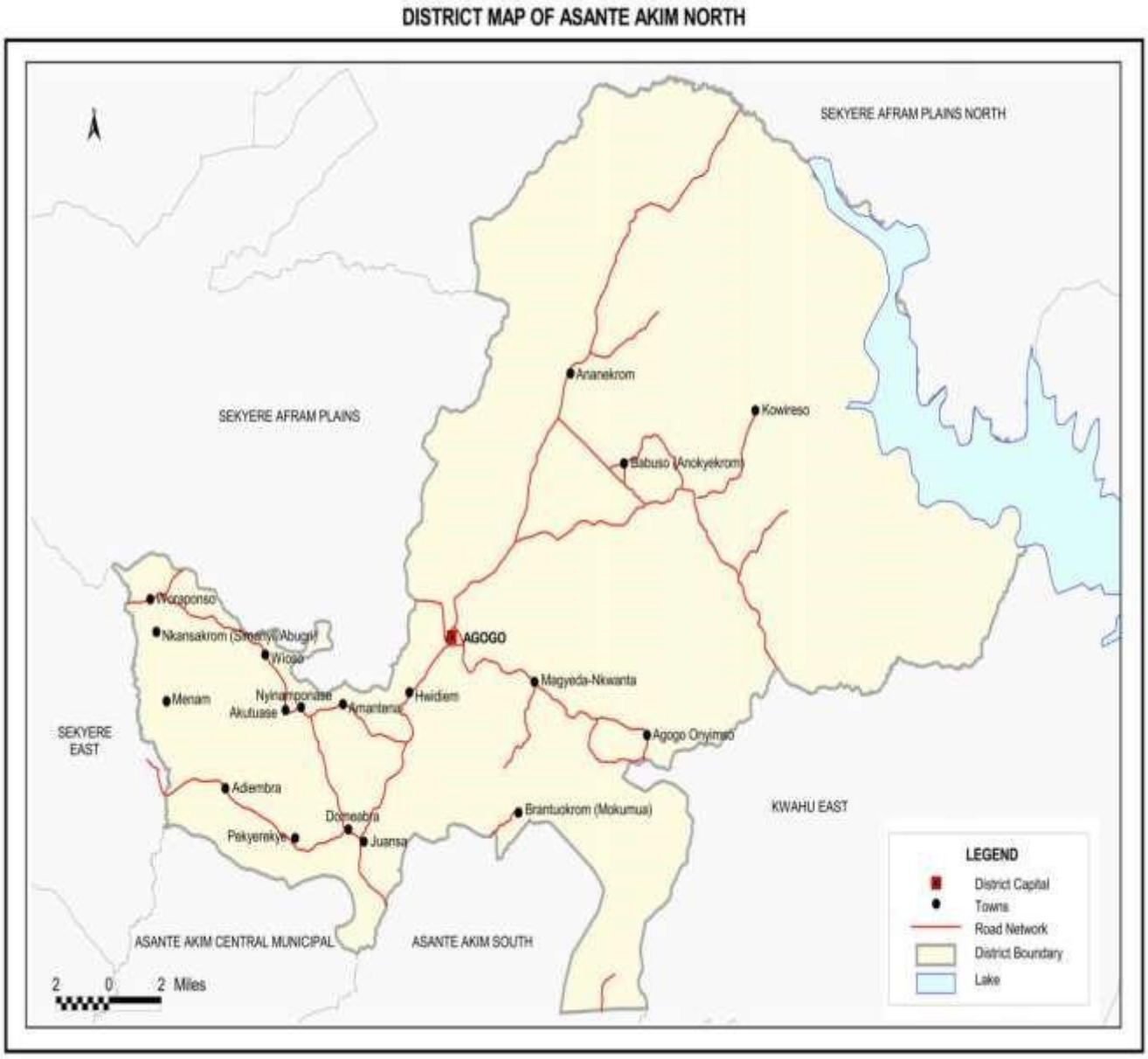
World Bank (2016). World Development Report: Digital Dividends. Washington, DC: World Bank. doi:10.1596/978-1-4648-0671-1.

Yu, P., Li, H. and Gagnon, M. P. (2009) 'Health IT acceptance factors in long-term care facilities: A cross-sectional survey', *International Journal of Medical Informatics*, 78(4), pp. 219–229. doi: 10.1016/j.ijmedinf.2008.07.006.

Zaney G. D., (2018). Jumia Annual Mobile Report. GOG, Accra. Retrieved online via: http://ghana.gov.gh/index.php/media-center/news/4470-jumia-annual-mobile-report-2018launched-in-accra assessed on 15th August, 2019 at 13:30hrs

APPENDICES

A: District Map of Asante Akim North



Source: Ghana Statistical Service, GIS

B: Data Collection Tool

QUESTIONNAIRE

Factors associated with the use of a mobile phone-based health information system among caregivers of children under-five in rural Ghana

DATE : [__][__]/[__][__]/[__][__][__][__] EA NUMBER: [__][__][__]

Community ……..... ID of Caregiver: [__][__][__]

SECTION 1: SOCIO-DEMOGRAPHIC INFORMATION OF CAREGIVER			
No	QUESTIONS	CATEGORIES	SKIP
1.1	Age (completed years)	[_____]	
1.2	Gender	[__] MALE----------1 [__] FEMALE ----------2	
1.3	Highest Educational level	[__] No Education ----------1 [__] Primary ----------2 [__] Middle/JHS ----------3 [__] Secondary (SHS)/Vocational -------4 [__] Tertiary (Polytechnic/University)---5	
1.4	Marital Status	[__] Married/Living Together ---1 [__] Single (Never been married or living together) ---- ----------2 [__] Divorced/Separated----------3 [__] Widowed ----------4	
1.5	Religion	[__] Christian----------1 [__] Muslim----------2 [__] Traditional-- ----------3 [__] Other Religion---- ----------4 Specify_____	
1.6	Employment Status	[__] Unemployed ----------1 [__] Farmer ----------2 [__] Hairdresser/Seamstress ----------3 [__] Apprentice/Student ----------4 [__] Trader ----------5	
1.7	Ethnic Group	[__] Akan ----------1 [__] Ga/Dangme ----------2 [__] Ewe ----------3 [__] Mole-Dagbani ---------4 [__] Other ----------9 (Specify)_____	

SECTION 2: MOBILE PHONE ACCESS/OWNERSHIP

2.1	Who owns the mobile phone?	[__] Myself ----------1 [__] Partner/Spouse--------2 [__] Relative ----------3 [__] Neighbour/Friend ----4 [__] Phone shop ----------5	
2.2	Do you share mobile phone with other family members/neighbours	[__] Yes ----------1 [__] No ----------2	
SECTION 3 : KNOWLEDGE AND EXPERIENCE ABOUT MOBILE PHONES			
3.1	What do you use the mobile phone for?		
	a. Calls	[__] Yes ----------1 [__] No ----------2	
	b. Messaging (SMS)	[__] Yes ----------1 [__] No ----------2	
	a. Internet	[__] Yes ----------1 [__] No ----------2	
3.2	For how many years have you been using mobile phone?	[__] Less than 1 year -----1 [__] 1-4 years ----------2 [__] More than 4 years ----3 [__] Don't use ----------9	
3.3	How would you describe your general knowledge about phones?	[__] Very Poor -----1 [__] Poor ----------2 [__] Moderate -------3 [__] Good ---- -------4 [__] Very Good -----5	
3.4	How would you describe your general knowledge about computer?	[__] Very Poor -----1 [__] Poor ----------2 [__] Moderate -------3 [__] Good ---- -------4 [__] Very Good -----5	
SECTION 4 : ASSET SCORE (SOCIO-ECONOMIC STATUS)			
4.1	Does your household have	(Tick as many as apply) [__] Electricity ----------01 [__] Wall clock ----------02 [__] Radio ----------03 [__] Pressing Iron ----------04 [__] Television ----------05	

		[__] Mobile Phone----------06 [__] Gas/Electric Cooker--------07 [__] Refrigerator----------08 [__] Freezer ---- ----------09 [__] Electric Generator ---------10 [__] Washing Machine----------11 [__] Computer----------12 [__] Digital Camera ----------13 [__] Car----------14 [__] Motorcycle ----------15 [__] Table ----------16 [__] Bed----------17 [__] Wrist watch ----------18 [__] Bicycle ----------19 [__] Livestock ----------20 [__] Poultry ----------21 [__] Cabinet/Cupboard --------22 [__] Wardrobe ----------23 [__] Microwave ----------24	
SECTION 5: LEVEL OF USE OF MHIS			
5.1	Have you ever used (call) the Mobchild IVR mhealth service?	[__] Yes ----------1 [__] No ----------2	If No skip to 6.1
5.2.	If 'Yes' why did you use it?	**(Tick as many as apply)** [__] Seeking care for my child(ren) health---------1 [__] It's time saving ----------2 [__] Enhanced access to health care and information----------3 [__] Cost reduction (transport etc) ----------4 [__] Opportunity to talk to doctor----------5 [__] Other ----------9 (Specify)_____	
5.3	Who specifically used (call) the Mobchild IVR mhealth service?	[__] Myself ----------1 [__] Partner/Spouse--------2 [__] Relative ----------3 [__] Neighbour/Friend ----4	
5.4	How many times did you use the Mobchild IVR mhealth service over this period?	[__][__]	
5.5	Which of the following did you comply with after using the Mobchild IVR mhealth service?	[__] Home Care and observe----------1 [__] Send Child to health facility immediately------2	

		[__] Supportive Care and report to health facility---3 [__] Did not comply---------- 4	
SECTION 6: BARRIERS OF MHIS USE			
6.1	If 'No' to 5.1 above, why didn't you use it?	[__] Mobile phone unavailability ----------1 [__] Network/Signal challenges----------2 [__] Power outages/battery dying ----------3 [__] Challenges in operating phone/or system ----4 [__] Does not know/forgotten how to use the IVR system----------5 [__] Health problems too complex----------6 [__] Disease of child not severe--------7 [__] Child not sick----------8 [__] No reason----------9 [__] Other (specify)----------10 _____	
6.2	Were there times you wanted to use the Mobchild IVR mhealth service but you could not?	[__] Yes ----------1 [__] No ----------2	If No, Skip to 6.4
6.3	If yes to 6.2, what was the reason for your inability to use it?	[__] Mobile phone unavailability -----1 [__] Network/Signal challenges--------2 [__] I was not satisfied the last time I used it ----------3 [__] Does not know/forgotten how to use the IVR system ----------4 [__] Other (specify)----------9 _____	
6.4	Do you have intention to use the Mobchild IVR mhealth service in the future?	[__] Yes ----------1 [__] No ----------2 [__] Not Sure -------3	
6.5	If your child falls ill (Eg. experiences fever) today, what will you do?	[__] I will use the Mobchild service-----1 [__] Send to health facility ----------2 [__] Use herbal treatment ----------3 [__] Home care ----------4	
6.6	In your opinion, do the following apply as barriers for you in using the MOBHILD IVR service? Please indicate all that apply: **0-Not a barrier 1-Low important Barrier 2-Slightly Important Barrier** **3- Moderately Important Barrier 4-Very important Barrier 5-Extremely important Barrier**		

No	Barriers	Not a Barrier	Low Important Barrier	Slightly Important Barrier	Moderately Important Barrier	Very Important Barrier	Extremely Important Barrier
a.	Challenges with phone access	0	1	2	3	4	5
b.	Limited Network	0	1	2	3	4	5
c.	Call drops	0	1	2	3	4	5
d.	Electricity challenges	0	1	2	3	4	5
e.	Challenges in operating a phone	0	1	2	3	4	5
f.	Lack of familiarity with the technology or system	0	1	2	3	4	5
g	Spousal (partner's) Consent	0	1	2	3	4	5
h.	Limited local Language	0	1	2	3	4	5
i.	Complex health problem	0	1		3	4	5

SECTION 7: UTAUT MODEL QUESTIONS

Using a rating scale of 1 to 5, please circle the number that best indicate your level of disagreement/agreement with the following statement regards the MOBChild mHealth system (IVR and messaging).

No	Statements	Rating Scale				
PERFORMANCE EXPECTANCY (PE)		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
PE1	The Mobchild IVR service is useful to me and the health of my child(ren).	1	2	3	4	5
PE2	Using Mobchild IVR service helps me to accomplish things more quickly	1	2	3	4	5
PE3	Using Mobchild IVR service saves time.	1	2	3	4	5
PE4	Using Mobchild IVR service increases the quality of health services.	1	2	3	4	5
EFFORT EXPECTANCY (EE)						
EE1	Learning to use Mobchild IVR service is easy for me.	1	2	3	4	5
EE2	My interaction with Mobchild IVR system is clear and understandable.	1	2	3	4	5
EE3	I find Mobchild IVR service easy to use.	1	2	3	4	5
EE4	It is easy for me to practically use the Mobchild IVR service.	1	2	3	4	5
SOCIAL INFLUENCE (SI)						
SI1	People who are important to me think that I should use Mobchild IVR service.	1	2	3	4	5

SI2	People who influence my behavior think I should use Mobchild IVR service.	1	2	3	4	5
SI3	The local health authorities encourage residents here to use Mobchild IVR service.	1	2	3	4	5

FACILITATING CONDITIONS (FC)						
FC1	I have the resources necessary to use Mobchild IVR services.	1	2	3	4	5
FC2	I have the knowledge necessary to use Mobchild IVR services.	1	2	3	4	5
FC3	There is specific person or group for assistance with any technical problem I may encounter.	1	2	3	4	5
BEHAVIOURAL INTENTION (BI)						
BI1	I intend to use Mobchild IVR service in the future.	1	2	3	4	5
BI2	I will always try to use Mobchild IVR service in the future.	1	2	3	4	5
BI3	I plan to use Mobchild IVR service frequently.	1	2	3	4	5
USER BEHAVIOUR (UB)						
UB1	Mobchild IVR service is an enjoyable experience.	1	2	3	4	5
UB2	I use Mobchild IVR service presently.	1	2	3	4	5
UB3	I use the Mobchild IVR service on regular basis.	1	2	3	4	5

C: Ethical Approval

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF MEDICAL SCIENCES / KOMFO ANOKYE TEACHING HOSPITAL
COMMITTEE ON HUMAN RESEARCH, PUBLICATION AND ETHICS

Our Ref: CHRPE/AP/497/19 — 15th August, 2019.

Dr. Timothy Kwabena Adjei
School of Public Health
KNUST-KUMASI.

Dear Sir,

LETTER OF APPROVAL

Protocol Title: ***"Understanding the Factors Associated with the Use of a Mobile Phone-Based Health Information System Among Caregivers of Children Under-Five in Rural Ghana."***

Proposed Site: ***Asante Akyem North District.***

Sponsor: ***Principal Investigator.***

Your submission to the Committee on Human Research, Publications and Ethics on the above-named protocol refers.

The Committee reviewed the following documents:

- A notification letter of 6th August, 2019 from the Asante Akim North District Health Directorate (study site) indicating approval for the conduct of the study at the District.
- A Completed CHRPE Application Form.
- Participant Information Leaflet and Consent Form.
- Research Protocol.
- Questionnaire

The Committee has considered the ethical merit of your submission and approved the protocol. The approval is for a fixed period of one year, beginning 15th August, 2019 to 14th August, 2020 renewable thereafter. The Committee may however, suspend or withdraw ethical approval at any time if your study is found to contravene the approved protocol.

Data gathered for the study should be used for the approved purposes only. Permission should be sought from the Committee if any amendment to the protocol or use, other than submitted, is made of your research data.

The Committee should be notified of the actual start date of the project and would expect a report on your study, annually or at the close of the project, whichever one comes first. It should also be informed of any publication arising from the study.

Thank you, Sir, for your application.

Yours faithfully,

Osomfo Prof. Sir J. W. Acheampong MD, FWACP
Chairman

Room 7 Block J, School of Medical Sciences, KNUST, University Post Office, Kumasi, Ghana
Phone: +233 3220 63248 Mobile: +233 20 5453785 Email: chrpe.knust.kath@gmail.com / chrpe@knust.edu.gh