

**UNIVERSITY OF KWAZULU-NATAL**

**FACTORS AFFECTING ADOPTION OF MOBILE HEALTH AMONG  
HEALTHCARE WORKERS IN NIGERIA.**

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degree of  
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College of Law and Management Studies**


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## DECLARATION

I, Omotanwa Moji Adegbola, declare that

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- ii. This thesis has not been submitted for any degree or examination at any other university.
- iii. This thesis does not contain other persons' data, pictures, graph or other information, unless specifically acknowledged as being sourced from other persons.
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## ACRONYMS

E-health:	Electronic Health
EMR:	Electronic Medical Record
GDP:	Gross Domestic Product
ICT:	Information and Communication systems
LUTH:	Lagos University Teaching Hospital
M-health:	Mobile health
MOH:	Medical Officer for Health
NCC:	Nigerian Communication Commission
NITEL:	Nigerian Telecommunication Limited
NPC:	National population commission
TOE:	Technology Organization Environment Framework
UNICEF:	United Nations children's emergency funds
UTAUT:	Unified Theory of Acceptance and Use of Technology
WHO:	World Health Organization

## **ABSTRACT**

Mobile technology has been shown to play a significant role in the healthcare sector, especially in developing countries, because of their capacity in addressing some of the sector's difficulties. One of the numerous benefits of m-health is that it is an affordable solution that increases access to health services. Despite the recognised benefits associated with m-health technology, there are concerns about the reasons why its adoption is relatively low in emerging economies. Therefore, this study was undertaken to examine the factors influencing the adoption of m-health from the perspective of healthcare workers and hospital management in Nigeria. The research explored the information and communication technologies available in Nigerian hospitals, and afterwards, the knowledge of healthcare workers on m-health technology and its uses was examined. Next, the individual, technological, organizational and environmental determinants of m-health technology were investigated.

The study adopted a positivist standpoint in conducting the research. A survey design was employed for the study, using both quantitative and qualitative research methods. The population of the study consisted of healthcare workers in Nigeria and the sample was drawn from six healthcare facilities in Lagos State, using stratified random sampling and purposive sampling. Quantitative data were collected through questionnaires from 201 healthcare workers, while qualitative data were collected through interviews with three hospital managers. The Statistical Package for Social Sciences (SPSS) software was used to analyse quantitative data, while the qualitative data were analysed with Nvivo software.

The Unified Theory of the Acceptance and Use of Technology (UTAUT), and the Technology, Organization, and Environment (TOE) Framework underpin this study.

The findings revealed the existence of ICT in all the hospitals surveyed and the common ICT tools used were the internet and mobile phones. Also, the findings showed a relatively good knowledge of m-health among healthcare

workers. Lastly, self-efficacy, experience, effort expectancy, government support and external support were found to be factors that influence m-health adoption in Nigeria.

The primary recommendation is that, in order to enhance effective service delivery, standard ICT policies that support the integration of mobile device use for the provision of healthcare throughout the country be established.

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# CHAPTER 1: INTRODUCTION

## 1.1 Introduction

A good healthcare system is characterised by its ability to deliver quality and affordable services to its citizens whenever and wherever it is needed. These services include health promotion, prevention, treatment, diagnosis and rehabilitation (WHO, 2021). The availability and accessibility of these services often lead to better health outcomes of the people which in turn positively impact on the economic growth of a nation. A balance between the available resources and the healthcare needs and demands of the population is key to achieving equitable service delivery (World Health Organisation, 2003). One of the goals of many countries is to attain Universal Health Coverage (UHC) in order to meet Sustainable Development Goal 3 (SDG3). This can be achieved through the strengthening of the healthcare system as well as integrating appropriate information technology for providing services (United Nations, 2016). Given the positive impact of information and communication technology in several sectors, research has shown that their use particularly mobile telecommunication devices can address the challenges faced in various sector due to its ubiquity (Beebeejaun & Chittoo, 2017; Hoque & Sorwar, 2017; Özer et al., 2013).

In addition to the capability of mobile devices, its accessibility, affordable cost and high adoption rate can make it an effective tool in addressing healthcare challenges especially in developing countries (Aker & Mbiti, 2010; Shahriar Akter, Ambra, & Ray, 2010; Kahn, Yang, & Kahn, 2010; Rashid & Elder, 2009).

Mobile Health, according to WHO (2011), is the medical and public health practises supported by mobile technologies, including mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices, are referred to as -health

## **1.2 Background**

Despite the enormous benefits that come with the usage of m-health technology, many developing countries, such as Nigeria, have yet to fully exploit it (Folaranmi, 2014; Pankomera & van Greunen, 2018a). This difficulty may be due to the healthcare ecosystem's complexity, which extends beyond the technology itself (Jacob et al., 2020b). Research has shown the importance of considering factors not only from the standpoint of system users, but also from the broader perspective of the organization where the system is to be implemented when introducing a new technology (Shozi *et al.*, 2012). Hence, there is a need to examine the various factors that influence the adoption of m-health in Nigerian hospitals. Therefore, this study aims to examine the factors that influence m-health adoption in the Nigeria's healthcare system, using both the Unified Theory of Adoption and Usage of Technology (UTAUT) and the Technology-Organization-Environment theories. Although many studies on m-health adoption in Nigeria have been conducted, most of them focus on mobile applications, maternal health, sexual health, and chronic disease management, while others only consider a few factors that influence adoption (David et al., 2020; Ezeanolue et al., 2017; Kasali et al., 2020; Nelissen et al., 2018; Okunade et al., 2020; Otu et al., 2021). Also, various factors that influence m-health adoption in Nigeria has not been studied. In this vein, this study examines four contexts using the UTAUT theory and T-O-E frameworks in order to gain insight into m-health adoption in the Nigerian healthcare system. This study is important because, in comparison to existing theories, there is a need for a comprehensive framework that provides greater theoretical knowledge in m-health adoption decision (Awa et al., 2017; Nathan, 2020)

## **1.3 Problem Statement**

The wellness of individuals in a society determines how well the economy of a nation will perform. A necessary condition for this is healthcare system that provides high quality support that is not only accessible but is also affordable to all (WHO, 2018). Unfortunately, like many developing countries the Nigerian healthcare system is

confronted with issues such as an uneven distribution of healthcare workers, lack of proper infrastructure, insufficient funding, a shortage of healthcare personnel in rural areas and poor health-related strategies ( Kenny *et al.*, 2017; Erinosh, 2005). Based on the aforementioned problems, many choose to travel overseas to seek proper care. The country's healthcare system was placed 187th out of 195 in the global healthcare system rating by the World Health Organization in 2017. Given that the country is the most populated Africa nation with about 209 million people (Federal Republic of Nigeria, 2021), 60% of its citizens do not have access to a healthcare facility, especially those in the rural parts of the country (National Population Commission/ICF, 2018). However, with the country's increasing mobile phone penetration and over 200 million active phone users (ncc.gov.ng, 2020), this could be used to delivery healthcare services. This provides a far-reaching service which is not limited by geographical location. Despite the fact that m-health is not a new concept, its acceptance in Nigeria is still low. A review of the literature shows that most applications of m-health have not gone beyond the pilot stage (Babatunde *et al.*, 2021). Kreps & Neuhauser (2010), argue that understanding the healthcare context in which information and communication technology is deployed is important because decisions in this sector are influenced by a combination of individual, organisational and societal factors. Supporting this assertion, Jacob *et al.*, (2020) state that in order to fully understand the adoption of m-health, it is important that the focus should go beyond the technology itself to the different concerns of clinician in relation to the work environment.

Therefore, for m-health to be adopted by the Nigerian healthcare sector, there is a need to examine various factors that would contribute to its adoption. This contention forms the basis of this study. The study seeks to identify factors from individual, technological, organisational and environmental perspectives that would influence the acceptance of this technology amongst healthcare service providers. Also, the knowledge of healthcare workers about the use of mobile phones for healthcare delivery will be examined, as well as their current use. Although the use of m-health among healthcare providers is not new, a number of barriers have impeded its widespread adoption, including problems with integration of software with current medical practices, the dependability of the

content, and a lack of knowledge about how mobile communications technologies can be used to improve productivity in the sector (Byambasuren, Beller, & Glasziou, 2019). Zakerabasali et al., (2021) and Sahli (2022), assert that the market readiness for m-health is determined by a doctor's desire to accept and use the technology. Given this, it is important to understand the elements that determine adoption decision among healthcare professionals, as these factors could also have an effect on patient intentions. In other words, the more proficient the experts are as a result of the knowledge provided and the evidence-based outcomes observed, the easier it is for mobile technology to be used as a medium to provide services to patients

#### **1.4 Research Aim**

This study aims to investigate the factors influencing the adoption of m-health technology among healthcare workers in Nigerian hospitals.

#### **1.5 Research Objectives**

The specific objectives of this study are as follows:

1. To determine the existence of the current information and communication technology resources available to healthcare workers for service delivery in Nigerian hospitals.
2. To ascertain the knowledge of healthcare workers about m-health services and their current use.
3. To investigate the individual, technological, organisational and environmental factors influencing m-health adoption and use in delivering healthcare services in Nigerian hospitals.

#### **1.6 Research Question**

The main research question guiding this research is: What are the factors influencing the adoption intention of m-health solutions by healthcare workers in Nigerian Hospitals?

The research question is further broken into the following parts in order to adequately answer the main research questions:

1. Which information and communication technology tools are currently available for service delivery among healthcare workers in the Nigerian hospitals?
2. How knowledgeable are healthcare workers about m-health and the current use of the technology in providing healthcare services?
3. What are the individual, technological, organisational and environmental factors influencing the adoption of m-health technology by healthcare providers in delivering services in Nigerian hospital?

### **1.7 Methodology**

The philosophical standpoint adopted for this research is positivism. A survey strategy was used for the data gathering process. Data was collected using both a quantitative and a qualitative instrument. Quantitative data was collected using a questionnaire administered to healthcare workers who included doctors, nurses, laboratory scientists and pharmacists from six healthcare facilities in two administrative divisions in Lagos State, Nigeria. Furthermore, qualitative data was collected from hospital managers, who included the Chairman of the Medical Advisory Committee (CMAC), a human resource manager and a medical officer for health of a health centre, using semi-structured interviews. The quantitative data were analysed using the Statistical Package for the Social Sciences (SPSS) while the Nvivo software was used to analyse the qualitative data. The detail of the methodology used in this research is presented in Chapter Five.

### **1.8 Significance of the Study**

Firstly, this inquiry can be understood from a practical standpoint. As previously stated, Nigeria's healthcare sector suffers from a number of constraints. This study could lead to the deployment of information technology tools in addressing the sector's problems. For the healthcare sector to successfully adopt technology, it is necessary to examine the factors that influence this adoption. The majority of research on the acceptance of mobile health in Nigeria tends to assess the factors that influence m-health technology adoption mostly from a

technical perspective, but this study aims to identify what individual, technological, organisational and environmental factors influence adoption of m-health in the country.

The study outcome may aid Nigerian health-care decision-makers in fully comprehending the critical aspects that contribute to the technology's adoption before committing to its complete implementation. This would also aid the country's healthcare space in providing access to services that suit the needs of the country's rising population.

Looking at the study from a theoretical perspective, the study integrates two well-known adoption models in information systems, which are the UTAUT and T-O-E frameworks, with other determinants used in previous studies to examine the factors that are determining the adoption of m-health in Nigeria. The reason for this is that one theory of adoption cannot adequately address all the factors involved in m-health adoption. Hence the need for the extension (Jacob et al., 2020a).

As stated by Duarte & Pinho (2019), the impediments to m-health adoption are dependent not only on the technological issue but also on the healthcare system and on individuals. Willingness to accept m-health technology as well as the organisational capacity to support it have been shown to have a great influence on adoption (Min *et al.*, 2020). In other words, it is necessary to use a comprehensive approach to examining the factors that influence the adoption of m-health.

## **1.9 Study Outline**

This study is organised into eight chapters as outlined below:

Chapter One introduces the study.

Chapter Two discusses the context where the research was undertaken.

Chapter Three presents the literature review by discussing the previous research related to the study at hand.

Chapter Four discusses the theory used for this research

Chapter Five covers the methodology used in conducting the study.

In chapter six, the data analysis and findings are reported.

The discussion of the research findings provided in Chapter six is presented in Chapter seven.

Chapter Eight presents the conclusion and recommendations of the study.

### **1.10 Chapter Summary**

This chapter has introduced the study. It started by providing a brief introduction to the state of the healthcare sector in developing countries and the need for m-health technology to proffer affordable solutions to some of the problems. The chapter further discussed the challenges of the low adoption of m-health in the Nigerian healthcare sector and the need to investigate the factors that are influence its adoption. The aim and objectives of the research were presented, and the significance of conducting this study was described. Lastly, the theories on which the research is built were highlighted.

The next chapter discusses the healthcare system and presents an overview of the penetration of information and communications technology in Nigeria.

## **CHAPTER 2: CONTEXT OF THE STUDY**

### **2.1 Introduction**

This chapter discusses the context in which the research was conducted. The chapter begins by providing a brief profile of the country. Then the healthcare system in the country is described, starting with the history of modern healthcare practice in the country, which is followed by a description of the different divisions of the healthcare structure and the problems affecting the sector. The chapter proceeds to identify the information and communication technology present in the country and the various ICT initiatives found in the healthcare sector.

### **2.2 Country Profile**

Nigeria is located in the Western region of Africa and has a population of about 209 million (Federal Republic of Nigeria, 2021) making it the most populous African nation. The population consists of about 250 ethnic groups. It gained its independence in October 1960 after being a British protectorate since 1901, and adopted the English language as its official language. It is made up of 36 states, with Abuja as its federal capital territory and Lagos State as the economic hub of the country. The country is grouped into six geopolitical zones with 774 local governments and has a land mass of 923,768 km<sup>2</sup>. In addition to English, the three common spoken languages are Hausa, Yoruba and Igbo. The administrative arm of Nigeria is divided into three tiers, which are the local, state and federal governments ([nig.gov.ng](http://nig.gov.ng)). The country's economy is chiefly dependent on oil and gas export revenue, which contributes about 44.6 per cent to the gross domestic product, while agriculture, mining, banking and light industry contribute the remaining 55.4 per cent (Central Bank of Nigeria, 2020). Despite Nigeria's wealth in agricultural produce and oil, over 70 per cent of its population are poor and about 40 per cent lives on less than 137,430 naira (\$381.75) each year.

### **2.2.1 Healthcare in Nigeria**

The first modern medical facility in Nigeria was established in 1885 in Abeokuta, Ogun State by the Roman Catholic Church and was named the Sacred Heart Hospital (Scott-Emuakpor, 2010). The first government hospital was established in Calabar in 1889 marked the start of Nigeria's publicly owned hospital system (Ogaji & Brisibe, 2015).

The Nigerian healthcare system consists of both alternative and orthodox healthcare practices. Alternative healthcare practises such as herbalism, naturopathy, and aromatherapy to manage diseases exist in parallel to orthodox private and public medical healthcare services (Fleisher & Paina, 2009; Touyz, 2012). According to the Federal Ministry of Health (2019), there are a total of 29,366 public healthcare facilities in the country, while the number of privately owned hospitals is 10,655. The public healthcare facilities are divided into three groups, based on their management. These are the primary, secondary and tertiary healthcare providers (Market Study Report, 2015).

The primary healthcare division is said to be the first point of call in the country for potential patients. It is made up of health centres and health posts which are administered by the local government of each state. Some of the healthcare functions performed at the primary level include the treatment of diseases such as malaria, which is prevalent in many West African countries, creating awareness for the public through health education, and maternal and child-related cases (Ademiluyi & Aluko-Arowolo, 2009; Eguagie & Okosun, 2010).

The general hospitals belong to the second tier of the public healthcare system in Nigeria and they are managed by the state governments. A secondary healthcare centre can provide complex medical services such as surgery that primary facilities are not equipped to provide.

The tertiary health division consists of teaching hospitals, federal medical centres and specialist hospitals managed by the federal government. They are equipped to handle complicated medical procedures because of the high number of skilled medical personnel found at this level. They are also concerned with policy-making for all tiers of the healthcare sector, as well as with conducting medical research, the outcomes of which are reported to the government so that it may come up with viable solutions to the problems facing the healthcare sector in the country (Ademiluyi & Aluko-Arowolo, 2009; Sehinde, 2018).

The private healthcare sector is growing rapidly due to the inadequacies of the public healthcare domain in the country and the private sector is reported to account for more than 50 per cent of healthcare service delivery to Nigerians. Private hospital practices include maternity homes, physicians' practices, hospitals and clinics (Fleisher & Paina, 2009). They are supervised by the State Ministry of Health in the state in which they operate.

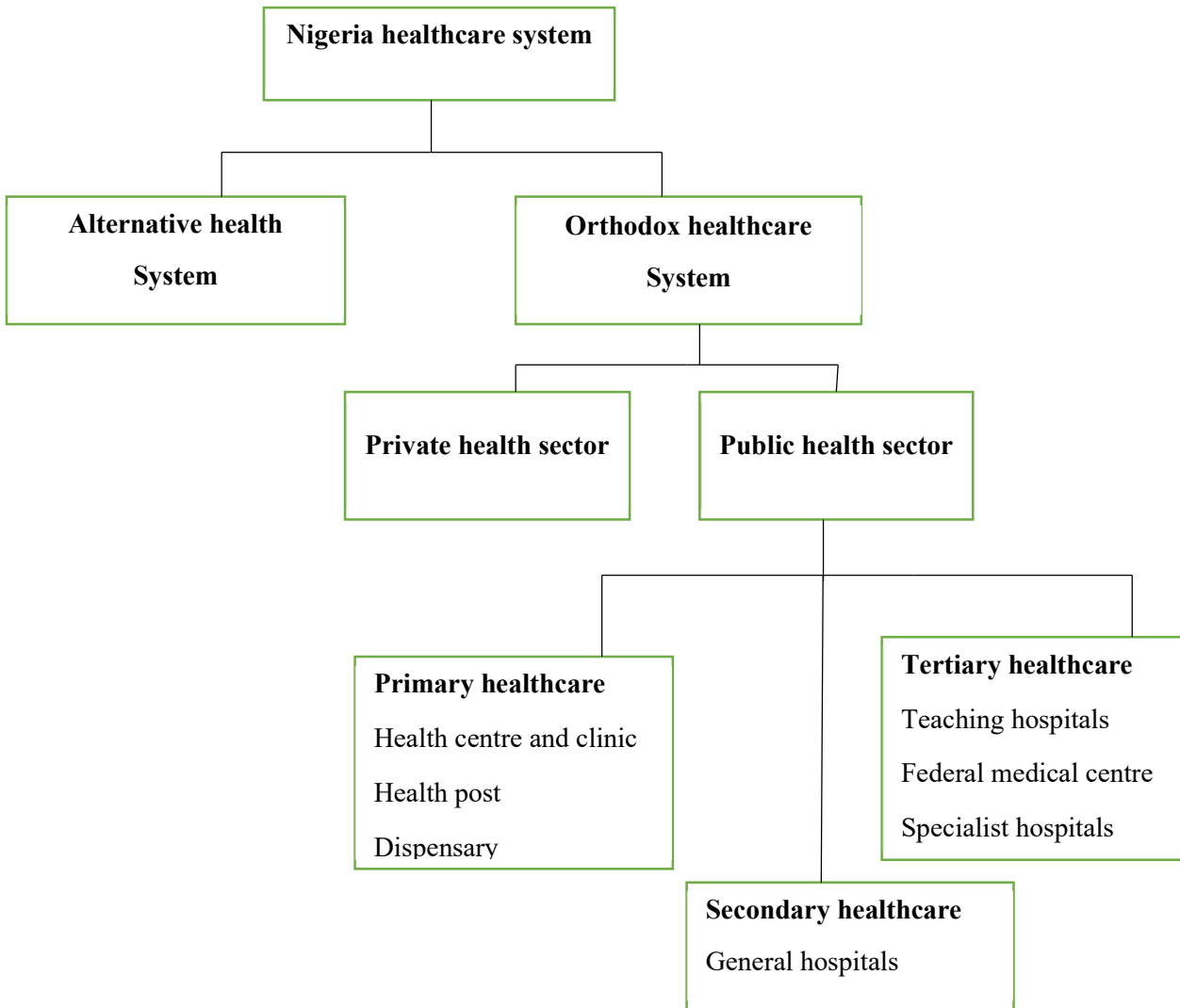


Figure 2:1 Structure of the Nigerian Healthcare System.

### 2.2.2 Problems with Nigerian Healthcare

The World Health Organisation (2003) defines a healthcare system as a combination of institutions, people and resources aimed at improving people’s health outcomes of by providing good health services, responding to their expectations and receiving fair financial contributions. For the healthcare system of any country to be effective the importance of leadership and the availability of resources cannot be overemphasised. Unfortunately, the Nigerian healthcare sector is faced with challenges which stem from leadership issues, lack of resources, financial issues

and infrastructural problems (Amedari & Ejidike, 2021; Anthonia Obi-Ani et al., 2021). These problems are elaborated upon below.

**Leadership and governance challenge:** The three tiers of government in Nigeria often operate independently of one another, and this has resulted in a lack of a unified healthcare agenda at the national level (Ogaji & Brisibe, 2015). Although some policies are promulgated at the federal level, the attempts to implement these policies at the local level remains very poor. This is because the local government in charge of healthcare centres often suffer from a poor allocation of resources, mismanagement and corruption, which results in people bypassing them, causing a wide gap in the system, which in turn prevents the country from realising the national goal for healthcare development (Ogaji & Brisibe, 2015; Uzochukwu *et al.*, 2020). Also, the constant change of political leaders contributes to the problems mentioned above because it makes the new government abandon the work of the previous administration. This is an issue that constantly affects the healthcare sector, because there is minimal legislative backing of the few policies that are already in existence (Omoleke & Taleat, 2017)

**Inadequate human and material resources:** There is one doctor for every 4250 citizens in Nigeria as against the 1:600 recommended by the WHO (Omosho et al., 2019). This problem is one of the major causes of medical error among medical personnel, as doctors are often overworked and experience burn-out (Omoleke & Taleat, 2017). Despite the limited number of healthcare workers in the country, urban areas tend to have the highest number of skilled healthcare workers, and this has been the major cause of the uneven distribution of healthcare resources in the country. Many rural communities are often left with healthcare personnel of lesser skills to manage the primary healthcare centres (Ogaji & Brisibe, 2015).

**Inadequate funding:** The success of a country's healthcare system is dependent on the method adopted to finance its healthcare sector (Adebisi *et al.*, 2020). In Nigeria, the primary means by which healthcare is financed is through taxes, out-of-pocket payment, donor funding and social insurance scheme. In terms of budget allocation,

Nigeria devotes less than the recommended 15 per cent of the national budget to healthcare services as proposed in the 2001 Abuja declaration by WHO (Amos *et al.*, 2021) causing hospitals to perform sub-optimally (Omoleke & Taleat, 2017). Considering the poorly allocated funds to government-owned healthcare facilities, the provision of quality basic healthcare in these hospitals is challenging. This problem has made it necessary for anyone who seeks medical help to pay out of their pocket for the service. Out-of-pocket payment contributes about 70 per cent to healthcare financing in Nigeria, a nation that has a large number of poor people who live below one dollar a day. This makes it difficult for many Nigerians to gain access to healthcare service (Adebisi *et al.*, 2020; Ogaji & Brisibe, 2015). For Nigeria to achieve equitable healthcare coverage, the need to reduce out-of-pocket spending for healthcare has to be prioritised. One of the strategies to achieve health coverage for all, as advocated by the World Health Organization, is to ensure financial independence and accessibility to the health needs of the country, and this can be achieved only by an increase in expenditure by the government (Adebisi *et al.*, 2020).

**Poor infrastructural development:** One of the resultant effects of inadequate funding is the dire situation of the healthcare infrastructure across the country. Much of the infrastructure is plagued by the poor management of buildings, out-of-date equipment, an erratic power supply, a shortage of drugs, a lack of medical supplies, a lack of water, a bad road network to the hospital, a lack of bed space and a lack of functional medical equipment (Omoleke & Taleat 2017; Obansa & Orimisan, 2013). On the one hand, these problems have led to the frustration of medical personnel who attempt to carry out their duties, as well as patient dissatisfaction with the healthcare services provided in public healthcare facilities. On the other hand, some patient turn to private facilities for their health needs, while others turn to unqualified healthcare workers (Obansa & Orimisan, 2013).

**Poor remuneration of healthcare workers:** In addition to the heavy workload and limited resource availability, many healthcare workers are underpaid and, worse still, their salaries are not always paid by the government. These problems have led to having less motivated healthcare workers who have to embark on frequent industrial

action to make their grievances known to the government (Omoleke & Taleat, 2017; Oloribe *et al.*, 2017). Also, emigration is on the rise in the country, as many healthcare workers find their way out to other countries with better resources and prospects for their careers (Adeniran *et al.*, 2021).

In response to the problems mentioned above, seeking better care outside the country is very popular among the elite sector of the population (Makinde, Brown, & Olaleye, 2014). Delivering healthcare service through face-to-face consultation cannot cater for the large Nigerian population and as such the ever-growing adoption of information and telecommunication technology in Nigeria could serve as a method of addressing the health needs of the country (Babatunde *et al.*, 2021).

### **2.3 Sustainable Development Goal (SDG)**

The Sustainable Development Goals (SDGs), established by the United Nations in 2015 and adopted by 193 nations as part of the 2030 agenda, is a universal framework designed to eradicate poverty and enhance the quality of life for both present and future generations (Johnston, 2016). This vision began as the Millennium Development Goals (MDGs), which were launched in 2000 and declared by the United Nations with the focus of poverty eradication, access to primary education, gender equality, improving child and maternal health, combating diseases, environmental sustainability, and fostering global collaborations for development before 2015. With health as the primary concern as it formed three out of the eight agendas, the MDGs were a precursor to the SDGs implemented in 2016 (WHO, 2013). Although the MDG saw significant progress, particularly with regards to children enrolling in elementary schools, the number of people living in poverty declining, and improvements in maternal and child health because of the design of frameworks that encourage collaboration between decision-makers and international agencies, however, the MDG's limited progress, particularly in African countries, as well as lack of a clear outline of the resources required for implementations emerged as some of its major shortcomings (Bhattacharya & Ali, 2014; Fehling, Nelson, & Venkatapuram, 2013). This might

be ascribed to the fact that socioeconomic determinants of health from various nations were not taken into proper consideration because global measures are insufficient to address difficulties from different countries.

According to the World Health Organization (2013), setting priorities for yet-to-be-achieved goals necessitates consistency without any question, which led to the creation of Sustainable Development Goals (SDGs). The 17 goals, 169 targets and 232 indicators make up the SDG framework which place a strong emphasis on a sustainable future supported by social, economic, environmental stability as well as the recently included governance (Allen et al., 2018; Cling et al., 2020). The goals are listed in the table below:

**Table 2. 1: Sustainable Development Goals**

Goal 1	No Poverty	Goal 10	Reduced inequalities
Goal 2	Zero hunger	Goal 11	Sustainable Cities and Communities
Goal 3	Good Health and Wellbeing	Goal 12	Responsible Consumption and Production
Goal 4	Quality Education	Goal 13	Climate Action
Goal 5	Gender Equality	Goal 14	Life below Water
Goal 6	Clean water and Sanitation	Goal 15	Life on Land
Goal 7	Affordable and clean energy	Goal 16	Peace and Justice
Goal 8	Decent Work and Economic growth	Goal 17	Partnership for the goals
Goal 9	Industry Innovation and Infrastructure		

Given the focus of this research on health, SDG3 would be discussed. It emphasizes on health and wellbeing for all, which is a fundamental human right with the goal of ensuring everyone has access to safe medicine and health services, lowering the rate of maternal and infant mortality, promoting reproductive health, and reducing the number of deaths from both communicable and non-communicable diseases, among other health matters (Fischer & Carow, 2019). Although SDG achievement is a function of the performance of each country's targets and indicators, the prosperity of a nation depends on the wellness of its people; hence, it comes as no surprise that

SDG3 has the second highest number of targets with 13 indicators (Estoque, 2020). Guégan et al., (2018) further highlighted the existence of interconnections between people's health and other targets based on the fact that factors like education, nutrition, climate change, and environmental conditions impact people's wellbeing (United Nations, 2017). In order to achieve sustainable development goal 3, it is important that healthcare system performance is improved.

Failings in the healthcare sector affects combating diseases and reaching larger populations. In addressing this matter, strengthening the sector is one of the major ways of achieving universal healthcare coverage (Seidman, 2017). An effective health system is built on professionals who are capable of providing services and implementing programmes in a systematic way because this is the means by which quality health services and agendas are achieved (Beracochea & Pied, 2020), hence, introducing programmes that improve health outcomes and enable healthcare workers to deliver better services are some of the steps that improves the system (Olaniyi et al., 2022) . Therefore, it is crucial that health personnel are equipped with the tools and developmental techniques that will improve their ability to deliver high-quality services that meet patients' demands. Also, the means of implementation was thought to be very important in accomplishing this target because this involves the availability of resources in pursuing the vision. The use of new technologies, training of medical personnel as well as resource allocation were found to be vital in addressing the need of various healthcare systems (Bloom, Khoury, & Subbaraman, 2018). Although the use of technology in the healthcare sector has grown considerably recently, there are still some gaps in the integration of health service delivery in the two sectors that need to be filled, particularly in terms of raising enough awareness among health professionals, decision-makers, and ICT stakeholders particularly in African countries (Olu et al., 2019). In addition, drawbacks such as organisational barriers, inadequate or lack of support from the government, infrastructural deficits, among others, affect the effectiveness of digital health use (Asi & Williams, 2018).

### **2.3.1 Healthcare Reform Policy in Nigeria**

The Federal Ministry of Health developed the health sector reform initiative in the country with the primary objective of developing strategic plans for efficient and effective healthcare delivery (Angie & Asoka, 2011). This program was designed to enable partnerships between the government, the healthcare sector and private and international partners that would revamp the healthcare sector. Considering the fact that the major issue facing the healthcare sector in the country is accessibility to care, the National e-health ICT framework 2015-2020 was launched in March 2016 at the 58<sup>th</sup> National Council of Health with the aim of adopting ICT, which aligns with the current investment in technology of the country, in order to achieve universal health coverage (FMH, 2016). The framework developed has three components, which are vision, the action plan, and monitoring and evaluation. The vision focusses on the use of ICT to achieve health coverage in the country by 2020. The action plan involves the various elements needed to achieve the vision, while monitoring and evaluation involves taking steps to track the progress and ascertain if the program is yielding result. Despite the development of these strategic plans, the healthcare sector remains the same due to the lack of implementation of the plans. Adeleke (2017), states that reforming the sector requires more than just the creation of new policies. Instead, implementation would go a long way towards producing the needed change. Frost et al., (2018), distinguished between high-level policy, which includes establishing guidelines for the use of technology in healthcare, and implementation-oriented procedure, which entails the various steps necessary to carry out actionable plans as well as performance evaluation of technology usage in healthcare. Together, these two methods help a nation attain its national health objectives. Data fragmentation also serve as an obstacle in the healthcare system in the country, this is because health information systems data is dispersed across various institutions with little to no communication between them (Meribole et al., 2018). Given the lack of interagency cooperation, lack of financial incentive, lack of technical expertise in operating the system, unclear duties, and poor leadership in managing the system, this issue has rendered the HIS of the nation ineffective. Although health-related policies should be

implemented locally to ensure that the governments centrally established decisions are carried out effectively, it is crucial that the roles of the various governmental tiers and levels of healthcare are clearly defined. The implementation strategy would be greatly aided by the provision of the required funds, technology, and assistance. Its implementation will be facilitated by the standardization of adoption guidelines and performance indicators based on results that assesses if the objectives of such a policy are being met (Abubakar et al., 2022).

## **2.4 Information and Communication Technology in Nigeria**

### **2.4.1 Ministry of Information and Communication Technology**

Information and communication technology (ICT) refers to any “communication device, system, or application such as a computer, mobile phone, television, radio, or satellite system; which allows users to access, store, manipulate, and transmit data or information effectively” (Khan, 2019, pp 229). ICT serves as a tool that helps businesses, organisations and individual have access to and store information conveniently. In Nigeria, ICT policy formulation is the responsibility of the Ministry of Communication and Digital Economy, which was established in 2011 under the leadership of Dr Isa Ali Ibrahim Pantami. Some of the functions of the Ministry as regards ICT innovation in Nigeria include:

1. Formulation and monitoring of the National ICT Policy's implementation
2. Facilitating and implementing good ICT development partnerships among government and private parastatals.
3. Providing support for ICT capacity-building programs in order to encourage and promote the usage of ICT.
4. Maintaining contact with international ICT organizations in order to nurture and promote national ICT growth and stay up with current advancements.

5. Managing the deployment and implementation of IT infrastructure (hardware and software) to facilitate ministries, departments, and agencies' e-government initiatives (MDAs).
6. Establishing a national site to enable access to government services through a single point of contact.

#### **2.4.2 Nigerian Telecommunications Industry**

In 1886, the Nigerian telecommunication service started with a cable link established between Lagos and the colonial administration in London; and telephone services were provided to government offices in Lagos in 1893 and later extended to Ilorin and Jebba (NCC, 2012). The Ministry of Communication was responsible for the operations of telecommunication facilities till 1985, when it was deregulated due to the underdevelopment of the industry. The Nigerian Telecommunications Limited (NITEL) was formed afterwards to manage the country's telecommunication. Also the Nigerian communications commission was established in 1992. Its major responsibility was for telecommunication policy-making. It is still in existence to date (ncc.gov.ng). The first mobile communication made its way into Nigeria in 1993, with NITEL providing the mobile telecommunication service (Nkordeh, Bob-manuel, & Olowononi, 2017). The Global System for Mobile communication (GSM) was introduced in 2001 and experienced exponential growth from 2,271,050 subscribers in 2002 to 184,699,409 in 2019 (Nigerian Communication Commission, 2020). This growth can be said to be a result of telecom liberalisation in Nigeria, which enabled the introduction of many GSM network providing companies in the country, which in turn accelerated the growth of ICT ( Ndukwe, 2005). The popular GSM network providers in Nigeria include Airtel, MTN, Globacom and 9mobile, and with the high demand for quality service, this has made these network providers highly competitive. They work in partnership with other sectors of the economy that use telecommunication networks for service provision. This sector is regarded as the fastest growing sector in Africa. Yet, despite this growth this sector has been unable to meet the demands of the people.

### **2.4.3 ICT in Nigerian healthcare**

Information and communication technology has been instrumental in advancing various sectors of the economy, thereby making it highly competitive in the global market. ICT has also been a useful tool that has helped the healthcare sector to facilitate service delivery to its population. With the amount of information generated in the healthcare sector, ICT is found to be an essential tool capable of managing such volume and thereby ensuring the optimal performance of medical doctors (Gagnon et al., 2012).

The ICT indicators in some Nigerian teaching hospitals show that the common technology tools found in Nigerian hospitals include personal computers, mobile phones and internet facilities. The mobile phones were shown to be the most frequently used of these technologies to facilitate communication between different wards, physicians and consultation (Onoja et al., 2021). Afolayan & Oyekunle (2014), identifies the technologies used in healthcare and the purpose of the use, finding that mobile phones, the internet and computers are the most commonly used technology by doctors in the Ilorin metropolis, which supports the claim of Ogunbodede and Idowu (2003) of the existence of ICT technology in Nigerian hospitals. Udousoro (2014), on the other hand, reports that telephones, computers and networks, multimedia projectors and the internet are the most popular technologies used in Nigerian healthcare sector.

### **E-health Initiatives in Nigeria**

The first use of digital technology in health dates back to the late 1990s, when collaborative research was carried out between the Finnish and Nigerian research teams of the University of Kuopio and Obafemi Awolowo University to develop a hospital information system on a standalone computer which was used for the administrative purposes of Obafemi Awolowo University teaching hospital (Idowu *et al.*, 2008). Software called MINPHIS (Made In Nigeria Primary Healthcare and Hospital Information System) was developed, which serves the purpose of keeping patient records electronically as well as generating medical reports for health management

(Gambo & Soriyan, 2017). Despite the completion of the MINPHIS software over 20 years ago, the software has been adopted in only five teaching hospitals and medical centres in Nigeria. This low level of adoption is due to the high price of the purchasing and implementation of the software (Adedeji *et al.*, 2018).

Afterwards, the first proposed nationwide e-health initiative in Nigeria started in 1994, with the publication of a document for e-health development that was prepared by the Department of Planning, Research and Statistics of the Federal Ministry of Health in 1996 (Adebola, 2013). This was done to improve the healthcare sector in Nigeria, which has been burdened with several problems. The initiative lacked political backing and thus did not go beyond the planning stage. However, after a group of computer scientists and information technology experts developed an ICT policy based on the outcome of a national workshop held on the national information and communication infrastructure, in 2002 the government included e-health as a component of e-government (Vladzimirsky *et al.*, 2016). Some projects initiated at the early stage of e-health adoption include (Adebola, 2013):

1. Video conferencing and a digitized electrocardiography machine to provide teleconsultation in cardiology in Abuja communities. This was a pilot project designed by National e-Government Services Limited in 2006.
2. In 2007 the federal government telemedicine project, which was piloted through the National Space Research and Development Agency (NASRDA). It was aimed at introducing the telemedicine idea to Nigeria and promoting its use to achieve the Millennium Development Goals.
3. The India Pan African e-Health Network Project, which provide trans-border teleconsultation and workforce training was inaugurated at the teaching hospitals of the Universities of Ibadan, Lagos Teaching Hospitals

4. The Intel telemedicine/e-health project for paediatrics in critical care unit and those in need of surgery at Federal Medical Centre, Bida, west-central part of the country and the National Hospital at the Federal capital territory of the country.
5. The FCT e-Health pilot. This is a web-based portal designed to manage medical information of patient and to link different levels of health systems by integrating data from several medical centers.
6. Mobile-based healthcare pilot project. These were of two types. The first m-health project was designed for the National Primary Health Care Development Agency (NPHCDA) and was used in the Midwives Service Scheme (MSS) at the health centres, while the second type called the mCBS (Mobile Community Based Surveillance) initiative was targeted at helping traditional birth attendants to report vital maternal and child-related events in real time, using mobile phones.
7. The District Health Information System (DHIS). This started as the result of a research outcome of health informatics by Professor Jørn Braa at the University of Oslo (Ajose, 2016). The first version of the system was piloted in South Africa in 2002, from where it moved to other African countries. In Nigeria, DHIS was adopted as the National Standard for Information Technology in 2012, after it was first piloted in Zamfara, Northern Nigeria in 2003. A health information systems platform designed to capture, store, analyse and report healthcare data, its major purpose is to strengthen the national health information systems of the country. It works by capturing data at the local government level and reports are displayed at all levels of administration (Shuaib *et al.*, 2020). Although the DHIS is reported to be deployed across Nigeria, fewer than 60 per cent of the healthcare facilities consistently use the system to report data (Ajose, 2016)
8. UNICEF Rapid SMS. In a campaign to eradicate malaria in Nigeria, UNICEF partnered with the National Malaria Control Programme and Roll Back Malaria Programme in using Rapid SMS messages to track the supply of malaria nets in Nigeria (Adebola, 2013). This programme was launched in 2010 in Kano, a

northern state in Nigeria. It works by sending an SMS to notify the arrival and distribution of mosquito nets from the warehouse to the individual who receives it (UNICEF, 2010).

9. Lastly, in 2009 the Lagos State Ministry of Health, in partnership with the Ministry of Science and Technology, piloted a web-based health management information system in some state-owned hospitals to facilitate effective healthcare service delivery. This system works by registering patients on a central database which is accessible to all departments of the hospital.

Despite the efforts of the Federal government of Nigeria to use information technology to strengthen the healthcare system, many of these schemes yielded little to no results. Hence, many of them are no longer in existence due to their abandonment, while others are under-utilised. The failure of these project is a result of a lack of collaboration among the stakeholders, an inadequate ICT infrastructure, the lack of the funds needed to finance the project, the lack of a national framework for e-health implementation, low internet connectivity and an erratic power supply (Adebola, 2013).

## **2.5 M-Health in Nigeria**

Given the high rate of maternal and infant mortality in Nigeria, which is one of the major leading cause of death among women and children below five years old (United Nations, 2014), the government of Nigeria responded to the situation by launching an initiative called Saving One Million Lives (SOML). This project was introduced in 2013 under President Goodluck Ebele Jonathan's administration, and one of its core aspects was to use ICT to address this issue; as a result, the ICT4SOML (Information and Communication Technology for Saving One Million Lives) program was founded. Some of the initiatives under ICT4SOML are discussed below:

1. Mobile mid-wives. This is an interactive voice response service which delivers evidence-based healthcare information to targeted pregnant women and new parents, based on subscription. The application, which is modelled on Ghana's Mobile Midwife application, provides services in the three dominant languages

in Nigeria. This helps midwives to make clinical decisions for better healthcare service delivery as well as educating patients in self-care.

2. M4change. This mobile application based in the northern part of Nigeria was developed in 2012 by the Pathfinder Group, in collaboration with the Ministry of Health and Dimagi for Community Healthcare Extension Workers (CHEW), to support them in making clinical decisions, data collection, and sending reminders for antenatal purposes. It also provides counselling to pregnant women with the use of audio clips to promote healthy behaviour during pregnancy.
3. Clinipak360. This is a mobile device programme aimed at helping healthcare workers in the Federal Capital Territory of Nigeria to capture and analyse data in order to reduce the maternal mortality rate (Qualcomm, 2018). This programme was an outcome of a partnership between Qualcomm Wireless Reach and other stakeholders such as Etisalat Nigeria, InStrat Global Health Solutions, National Primary Health Care Development Agency (NPHCDA), Vecna Cares Charitable Trust, and State Primary Health Management Boards. Midwives are handed a tablet pre-loaded with software that helps them to capture pregnant women's data at the point of care. The purposes of this technology are to reduce the mortality rate among pregnant women, and the better coordination of healthcare resources.
4. Mobile baby polio immunisation. An emergency response centre was launched in 2011 by Etisalat Telecommunication Company in partnership with ESRI and GIS to promote polio vaccination in the northern part of the country, where polio is still endemic. The integration of GIS in the mobile technology helps the agent at the call centre to generate a map that allows the communication to be traced to the location from which it originates in real time, thereby making it possible to allocate resources to avoid an outbreak of polio in that part of the country.
5. M-nutrition. This is a dietary application that gives users daily reminder of various food-related benefits to people of all ages. For example, parents can subscribe to 'best natural nutrition for babies'

6. Africa Indoor Residual Spraying (AIRS). This is a mobile phone-based application initiative aimed at malaria prevention by providing information on environmental compliance to prevent mosquito bites.
7. Mobile Authentication Service (MAS). This is a mobile-based anti-counterfeiting authentication system designed to combat the sale and use of counterfeit medicine. One of the major challenges in healthcare systems around the world, especially in the developing world, is the circulation of counterfeit medicine (Buckley & Gostin, 2013). According to Spink *et al.*, (2016), Nigeria has one of the highest incidences of counterfeit medication in circulation in sub-Saharan Africa. In a bid to combat the menace, the National Agency for Food and Drug Administration and Control (NAFDAC) implemented the use of MAS to ensure the authenticity of medicine at the point of sale (Oyetunde *et al.*, 2019). MAS is an SMS-based authentication service that uses a one-time personal identification number (PIN). The consumer sends the PIN to a short code provided on the pack of the medicine for free and a response is immediately received in the form of an SMS to confirm the genuineness of the product.

## **2.6 Leading m-health use in Nigeria**

Immunization has been found to be a major way to reduce the childhood mortality rate among children under 5 years of age (Siddiqui et al., 2022). The healthcare system seeks to improve disease management using technology as a means of sensitization as well as a reminder of the importance of child immunization. One of the major problems with vaccination is poor compliance with the scheduled appointment (Eze, Agu, Agu, & Acharya, 2021). The M-health tools, especially the use of SMS, have been found to be of great benefit in reminding caregivers of their children's appointments for immunization against preventable diseases (Babarinde & Atulomah, 2022) High phone ownership and affordability, as well as high network coverage, have been identified as common factors that encourage the use of m-health in appointment reminders (Ibraheem et al., 2021)

M-health has been found to be used by primary healthcare workers for the purpose of addressing the maternal care challenge, especially in developing countries (Osanyin et al., 2022). One of the popular m-health initiatives used is hello mama, which is a tailored SMS message for maternal care disease (Idris, Abdulkarim, & Arkwright, 2022). Also, the Commcare application, an open-source mobile decision support system platform, is used by community healthcare workers to provide guidance on maternity health as well as collect relevant data (McNabb et al., 2015). This mHealth technology not only provides CHEW with easy-to-understand content, but it also serves as an alternative method for manual data collection in the country's maternal care, which is uploaded to a secured database and accessed by authorized personnel.

In terms of disease outbreaks, the clinipak was used during the recent Ebola outbreak to help front-line workers collect information on the disease. It is also called a 'clinic in a box' because it is an application on smart devices such as phones and tablets aimed at generating data to contain the spread of the disease (Chaka, Ishiwu, & Okpoko, 2020). Likewise, mHealth has been found to be useful in the training of healthcare workers in Nigeria. The use of applications such as Instra was used in training healthcare workers during the heat of the

COVID pandemic. The application was deployed in Ogun state primary healthcare centres to give up-to-date information on symptoms as well as measures for taking specimens for examination ( (Otu, et al., 2021).

## **2.7 Challenge of ICT in the Nigerian Health Sector**

Information and communication technology use is affected by several challenges, which are discussed below.

**Lack of government support.** Government support of implementation in terms of the provision of enabling policies and funding is pivotal to the success of ICT usage in healthcare. Unfortunately, the lack of such support has hindered the use of innovative technology for service delivery in hospitals. According to the Nigerian Minister of Communication Technology (2019), there is a lack of national governance structure to facilitate the use of health ICTs at the moment, and this has caused inconsistency in the standards that guide the use of ICTs and the protection of the privacy of individuals (Adesoji *et al.*, 2021). One of the key cause of this problem is the refusal of administrations that take over from those who made previous laws to follow up on them. As recommended by the Ministry of Communication Technology (2019), there is a need for a unified ICT policy which aligns with the national goals of the country. Also, the procurement and implementation of ICT infrastructure are capital intensive. In most developing countries, such as Nigeria, there is very little investment in health ICT due to inadequate support from the government. The government's budgetary allocation for the healthcare sector is 6.7 per cent of the total budget, and as a result of the poor funding ICT availability is constrained in the healthcare sector (Ajala et al., 2015). Innovation availability in healthcare is largely dependent on the provision of adequate funding by the government.

**Lack of ICT infrastructure.** The effective healthcare service delivery using information technology requires adequate and functioning ICT infrastructure (Makawa, 2014). Such infrastructure includes hardware, software packages, internet connectivity and a stable electricity supply. The lack of these has been shown to impede

technological innovation in the Nigerian healthcare sector (Olayemi, 2018). To maximise the productivity of ICT in the sector, the availability of adequate infrastructure is of utmost importance.

**Erratic power supply:** The use of ICT depends on the availability and stability of a supply of electricity, because these tools can function optimally only when the power supply is uninterrupted (Idowu, Cornford, & Bastin, 2008.). The poor state of the nation's electricity supply accounts for losses in many businesses, which in turn affect economic development. With the increasing population of Nigeria, the current amount of electricity generated is insufficient to provide a steady power supply to the population (Ayamolowo, Buraimoh, Salau, & Dada, 2019). The erratic state of the supply of electricity in the country has caused damage to some ICT infrastructure as well as frequent downtime (Olayemi, 2018).

**Shortage of staff.** The lack of sufficient medical personnel in the country is one of the issues affecting the use of ICT in the country. Nigeria healthcare workers are burdened with heavy workloads which leave them with no time to use technology for their work as a result of their burn-out. They view the use of technology as an additional burden, an attitude which makes them unwilling to use it (Babalola, Anayo, & Itoya, 2021).

**Telecommunication infrastructure deficit.** The efficiency of ICT is dependent on the strength of the telecommunication infrastructure available. Although the International Telecommunication Union (2012) rated the telecommunication sector of Nigeria as the second largest in Africa, the high cost and frequent downtime of network connectivity has been a source of concern to ICT use in healthcare (Nigerian National Broadband Plan, 2020). The rural part of the country is challenged by its inadequate telecommunication infrastructure, making connectivity difficult in this area. There is an over concentration of communication equipment in the industrialised part of the country. Given the lack of proper funding in healthcare, health workers who have to use telecommunication services for their work or research-related purpose have found themselves spending money from their own pockets, which is not sustainable. Also, the frequent network downtime has shown to be a major

discouragement in the sector, which is already overburdened by work. Therefore, for ICT to become commonplace in the Nigerian healthcare sector, it is important that there should be network stability and affordability (Ajala *et al.*, 2015; Olayemi, 2018).

## **2.8 Chapter Summary**

The study context was described in this chapter. It has identified various problems affecting the healthcare sector of the country such as leadership problems, a lack of resources, infrastructural problems and financial issues. The country showed to have an existing ICT infrastructure, but this is not properly reflected in the healthcare domain, especially in government-owned hospitals. The e-health initiative was found to produce little to no health outcome, and as a result some of these initiatives are no longer in existence.

The availability of ICT in Nigerian healthcare settings, healthcare workers' awareness of mobile health, and factors influencing its adoption are discussed in the next chapter.

## CHAPTER 3: LITERATURE REVIEW

### 3.1 Introduction

This chapter presents a review of the literature relevant to the stated study objectives of this study. This is a vital aspect of any study because it provides the basis for the study at hand. Hart (1998, pp. 48) defines a literature review as “the selection of available documents from published and unpublished sources, which contain information, ideas, data and evidence written from a particular standpoint to fulfil certain aims or express certain views on the nature of the research or topic and ways in which it will be investigated and the effective evaluation of these documents in relation to the research being processed. As suggested by the definition above, it is the evaluation of the knowledge that is currently available in the material that is connected to the study at hand in order to know what has been done and to find gaps that provide a rationale for performing a new study (Blaxter *et al.*, 2007; Galvin, 2015). The reasons for conducting literature review, as stated by Wilson (2014), are as follows:

- It helps to broaden the knowledge of a researcher in the existing research area.
- It helps in contributing to knowledge by preventing a researcher from doing what has already been done.
- It identifies areas for further research, as defined by previous researchers.
- It identifies the methods and approaches used by previous researchers.
- It helps in organizing a researcher’s thoughts.

In conducting a literature review, it is important that boundaries are in place to maintain the research intention. This is often done by studying existing works that addresses the research questions/objectives as well as parameters such as the key words found in the research (Wilson, 2014).

The chapter begins by considering the several words used to characterize healthcare information technology, such as electronic health (E-health), telemedicine, telehealth and m-health. The chapter also discusses the drivers of

m-health, their application areas and the various m-health initiatives in Nigeria. Previous literature relating to the research objectives and questions is also discussed in this section of the report. Lastly, the solutions that could lead to the sustainability of m-health are addressed in this chapter.

### **3.2 e-Health**

The term ‘e-health’ refers to the use of the internet and other related ICT technologies to support the provision of health services and information (Eysenbach, 2001). It is an umbrella term used to capture the use of ICT for clinical, preventive, educational, research and administrative purpose in the health sector both on local site and remotely (Kwamka, 2001). The goal of e-health is to improve the effectiveness, efficiency and care quality of healthcare service delivery (Alkhatlan *et al.*, 2016). Some of the services that resort under the term include health data analytics, electronic health records, self-management tools, telemedicine, telehealth, and health information systems (Barbabella *et al.*, 2016).

Electronic medical record is an “information system that is used to manage the storage, distribution and processing of information needed for the healthcare service delivery of a patient” (Lærum & Faxvaag, 2004; PAHO, 2010). One major benefit of EMR is to ensure the continued care of patients by different healthcare practitioners and in different places. This system, which includes information such as a patient’s medical history, helps a healthcare provider to make an informed decision that improves patient safety and effectively manages potential risk in addressing a patient’s case.

Telemedicine is the method of providing clinical services to a patient over a long distance using telecommunication and information technology (Diego *et al.*, 2006). This has the potential of providing access to clinical services to patients by overcoming the barrier of distance, which in turn improves patient outcomes. Telemedicine dates back to the nineteenth century, but the modern telemedicine practice started in 1960 with the use of television for consultation between a general practitioner and a consultant (WHO, 2010). Telemedicine

aims at providing clinical support over a geographical distance to an underserved population at a reduced cost using ICT in order improve health outcomes (Zobair & Sanzogni, 2020). In other words, it helps in reducing patient travel time, increases a clinician's productivity, and improves patient outcomes.

Telehealth uses telecommunication and digital devices to provide medical-related services (Lee & Harada, 2012). Unlike telemedicine, which involves the use of telecommunication technologies for providing only clinical services, telehealth covers a broad range of healthcare services such as healthcare education, transmitting health records such as vital signs, and remote provider-to-provider communication using telecommunication technologies (Diego et al., 2006)

Health data analytics are ICT tools that are used by medical practitioners to analyse patient data so as to make informed judgement (Barbabella *et al.*, 2016). Computerised decision support system are the common tools used for this purpose. This is described as a computer programme designed for clinician to make diagnostic decisions.

### **3.3 M-Health**

M-Health is the use of mobile devices to serve as healthcare service delivery tools because of their affordability and accessibility. It is the subset of e-health that focusses more on supporting medical and public health practices through mobile phones, personal digital assistances, patient monitoring devices and other wireless technologies (Istepanian & Lacal, 2003). M-Health is an interactive service whose major purpose is to provide any user, at any time, with ubiquitous and universal access to medical guidance via a mobile platform ( Akter & Ray, 2010). The researcher's definition is based on the argument that previous definitions focused only on patient use of m-health, it is a tool that serves all types of users, whether healthcare providers or patients. Ivatury *et al.* (2009) also state that m-health is different from telemedicine because m-health is not location-specific as it can be accessed from anywhere and at any time, unlike telemedicine, which takes place in a fixed place where a patient would have to be connected to a provider. The use of mobile devices has shown to be an attractive service tool in healthcare.

This is so because it is highly affordable, easier to use, accessible and can be personalised to suit the user's purpose ( Akter & Ray, 2010). Also, the economic, political and social shortcomings of the developing nations have positioned m-health platforms as adequate solutions to the problem of addressing their healthcare needs.

m-Health services can take the form of a short message (SMS), a voice call, video and data-based communication, sensors, applications and wearable devices. Clinicians may use voice calls, text messages and applications to support and provide healthcare services to patients (Adum & Ejiofor, 2020). Text messages are often used for appointment reminders and provide the information necessary for patient care. The application is sometime used in prescribing medication because of the ability to quickly cross-reference information about a patient's history of medication (Salami, 2015). Images captured through cameras are often exchanged between health workers for patient care. On the patient's part, there are various mobile applications that help with lifestyle management.

Some of the drivers of m-health technology include:

- A high penetration of mobile devices and connectivity. The fast spread of mobile phones provides the opportunity for the healthcare sector to leverage the use of this technology to address the health needs of people all over the globe (Mechael, 2009). Based on its affordability and portability, a mobile phone is more accessible to a larger population than any other type of information technology (Davey & Davey, 2013).
- Capabilities of mobile technology. The functional capability of mobile phones has made them an essential tool to use in the delivery of healthcare, particularly in developing economies (Mechael, 2009). The functions of mobile devices, which range from simple communication using either voice or text messages to more complex ones such as mobile applications and wearable devices, have provided everyone from all backgrounds irrespective of their educational qualifications the ability to use them. Text messages, phone calls, and even pre-recorded messages have been used to communicate information such as health

awareness, appointment booking, and reminders, among other things, while using mobile devices to provide medical services. (Davey & Davey, 2013).

- Understanding the healthcare need. Developing countries are faced with many healthcare problems, which include limited human resources, lack of infrastructure and so on. With the capability of and increased access to mobile phones, some of these challenges can be addressed, especially when the healthcare need is understood (Norris, Stockdale, & Sharma, 2009). People in developing countries suffer from both transmittable and non-transmittable diseases as well as issues relating to infant and maternal health (Qiang *et al.*, 2012). Diseases such as HIV/AIDS, malaria and tuberculosis are prevalent in Africa, and mobile devices have served as tools in providing awareness on how to limit the spread of these diseases as well as for the provision of healthcare support. Secondly, with the increase in cardiovascular disease, diabetes, cancer and respiratory disease, m-health tools have been able to provide long-term remote support to patients with these conditions. Also, maternal and child health problems have been addressed by m-health technology by providing vital life-saving information to pregnant and nursing mothers in developing countries.

### **3.4 Applications of m-Health**

#### **3.4.1 Education and awareness**

Health education as described by WHO (2012) is any combination of learning experiences designed to help individuals and communities improve their health, by increasing their knowledge or influencing their attitudes. Its purpose is to equip individuals with information on making decisions as well as on changing behaviours that are harmful to their health (Al-Hashem, 2016). According to a WHO report, infectious diseases are one of the primary risk factors in developing nations, and they can be prevented if appropriate knowledge is provided in the form of education that promotes awareness. (Latif *et al.*, 2017). Given the wide spread and cost-effectiveness of

mobile phones in both developed and developing nations, they could be an effective tool in providing health education and awareness to users in a wider population. The SMS is said to be the most common m-health service used in healthcare campaigns and awareness such as epidemic outbreaks, disease management, vaccination, medical testing and so on. The SMSs are sent directly to the users' phones (Vital Wave Consulting, 2009). Projects such as the South African 'Masiluleke' and Uganda Text-to-Change have used 'Please call me' and SMSs to provide information on the treatment and prevention of HIV to a larger audience (Karin *et al.*, 2013.). The outcomes of these projects show that SMSs are effective in reaching otherwise hard-to-reach audiences who are mostly in the rural areas of a country, and providing confidentiality in reporting the health status of the recipient. Mobile phones can also be the media for disseminating alerts or, as interactive tools, for disseminating quizzes on health matters, or as means of providing vital information to users.

### **3.4.2 Remote data collection**

Field surveys are important ways of gathering data in public health programmes, because healthcare providers and policymakers need accurate data to know how effective various policies are and whether or not it is necessary to formulate better ones. Field surveys are usually collected using paper and pen, especially in developing countries, and this approach is prone to error due to the volume of data to be stored in a central database, which might lead to the replication of data entries, which would affect the outcome of an analysis (Tomlinson *et al.*, 2009.). Mobile phones have been used for this purpose, and they are said to be a better alternative to pen and paper (Duane *et al.*, 2017). Mobile phones have been used for data collection, for ensuring adherence to a regimen of medication, and for the monitoring of diabetes self-management and physical activity.

### **3.4.3 Remote monitoring**

The mobile phone has shown to be a great tool in taking the care of patients beyond the doctor's office and monitoring them from a distance, thereby reducing the cost of care in developed countries and treating patients

in developing countries where access to healthcare facilities is limited (West, 2012). This is usually beneficial in managing patients with chronic diseases so that they can avoid hospitalisation, which incurs a costs for both the patient and the healthcare facility. A good example of this initiative is in the management of tuberculosis in Thailand, where patients are given mobile phones so that healthcare workers can call them daily to remind them to take their medication (Kunawararak et al., 2011).

#### **3.4.4 Communication and training of health workers**

The training of health workers is imperative in the healthcare sector because this helps to provide them with up-to-date information on developments in medicine such as healthcare problems and interventions (Latif *et al.*, 2017). Using a mobile phone for this purpose has made possible projects such as health line in Pakistan, where a healthcare provider with a low literacy level can call the helpline and be given valuable information. Commcare is used in Tanzania to provide information to healthcare providers through videos on mobile phones. Communication between health workers helps in facilitating patient care. One of the major benefits provided by m-health initiatives is allowing health providers to efficiently refer patients from one health facility to another (Duplaga, 2019). This helps to prepare a new set of health providers as well as to equip existing ones to be able to meet the health needs of the community

#### **3.4.5 Disease and epidemic outbreaks**

Among the efficient techniques to control an outbreak of disease is by using a surveillance system that detects a disease early enough to break the transmission chain before the disease spreads in the community (Mohanty et al., 2019). The use of mobile technology has shown to be a better alternative for tracking an epidemic in developing countries where the surveillance systems may be weak. The tracking of diseases has been done through the use of m-health by informing healthcare workers about the symptoms to watch out for to curb the spread of diseases. Uganda RapidSMS is an example of such an innovation used to report malaria cases, to track

epidemic records and to report on stocks of medicines. In India immunisation services against diseases such as Japanese B encephalitis, tetanus, measles and polio have been tracked in real time using the Acute Encephalitis Syndrome Surveillance Information System (AESSIMS), using mobile phones and web-based solutions (Karin *et al.*, 2013).

### **3.4.6 Treatment and diagnostic support**

This provides step-by-step guidance to healthcare workers on how to manage an ailment. The phone has a built-in application that becomes a point of care support for healthcare workers to avoid medical error. The data generated from diagnosis helps in deciding the treatment type as well as the medication for patient care. Some of the uses of mobile phones for this purpose are drug dose calculators, drug reminder alarms, pulse counters and drip rate calculators, which are connected through a sensor when installed on phones (Karin *et al.*, 2013).

### **3.5 Benefits of m-Health**

Some benefits of mobile health as found in literature include the following:

Access to up-to-date medical information. Access to current information has shown to be one of the numerous benefits derived from the use of m-health technology. The ability of healthcare providers to access information on the go on mobile devices helps them to stay aligned with medical guidelines. They have a ready point of reference without the need to carry reference books around (Ventola, 2014)

Increased efficiency. This has helped in improving workflow patterns among health workers. The ability to retrieve patient information without going through a paper record has helped reduce the wastage of time on finding patients' records (Schoen *et al.*, 2017). Also, it has shown to be productive among pharmacists as they can easily retrieve medication information (Hillblom *et al.*, 2014). This has helped reduce the processing time for prescriptions, as well as prescription error. M-Health has also been found very useful in the promotion of preventive healthcare through disseminating awareness programmes.

Increased access to healthcare services. Universal access to healthcare services is key to achieving Sustainable Development Goal 3. For this to be achieved it is pertinent to incorporate technologies that can facilitate service delivery in the healthcare sector (Babatunde *et al.*, 2021) . In a resource-constrained environment, m-health devices can facilitate the provision of medical services to people beyond the traditional way of going to healthcare facilities. Also, it helps in promoting self-management and maintaining a healthy lifestyle.

### **3.6 Availability of ICT in the Healthcare Sector**

Technology use in health care stems from the need to address the problems of medical errors, the high cost of health care, inaccessibility and reducing paperwork. The technology used in healthcare is called health information systems; which is defined as a collection of computerized systems developed to assist healthcare personnel in performing both medical and administrative tasks in hospitals (AL-Hadban, Yusof, & Hashim, 2016). Dineshkumar *et al.*, (2019) state that the use of the internet and the web-based platforms common in the healthcare setting has given rise to the e-platforms in healthcare known as electronic health or e-health.

Currently, the mobile phone is one of the most frequently used communication technology tools in healthcare settings. This is because it allows for simple, fast and effective communication through voice calls, the short message service, teleconferencing, image sharing and medical calculation (Udousoro, 2014). Apart from the telephone, the use of computers is found to be common in the healthcare sector.

The healthcare setting deals with a high volume of data and the computer helps with the management of this data effectively. The Internet provides interconnected platforms that facilitate information search, the sharing of information and online discussion forums. The advantages of using ICT tools for healthcare service delivery include helping healthcare providers make better treatment decisions, providing a safer and quality healthcare service, helping policymakers to make better decisions through their awareness of risk patterns, and making government more responsible in providing for the nation's health needs (Chetley *et al.*, 2006). According to

(Jamison, 2006), any health need must be built on four principles, which are information monitoring and analysis, health services administration, human capital and financing, and the utilization of diverse ICT resources in healthcare.

Farahat *et al.* (2018), conducted a mixed method research project to identify the available ICT resources among physicians in primary healthcare facilities in Egypt. The research showed that a good number of physicians had access to ICT tools and were trained on how they are used. They stated that the availability of technological resources was key to their acceptance, as the willingness of workers in the health sector to implement ICT is based largely on their having access to the equipment.

Ceo *et al.* (2018) used a descriptive approach to identify common ICT tool in the Nigeria healthcare sector. They found that computers were said to be the most common ICT technology used, although many of these computers were non-functional. They also gathered that their subjects believed that the use of ICT would improve the poor state of healthcare delivery in the country. Some barriers to the full deployment of technology were identified to be the erratic power supply, the absence of access to personal computers, and unavailability of equipment maintenance.

The work of Rabiou *et al.* (2019), identifying ICT utilisation in the northern part of Nigeria, surveyed 10 primary health centres with the purpose of understanding the available tools and their use among 80 healthcare personnel and 40 patients. They report that only 3 out of the 10 facilities surveyed use computers for patient record keeping, while the others document the information manually. However, the findings of the research showed that all staff had mobile phones which they used for personal communication. Rabiou *et al.* 2019, also report that no health service is rendered using ICT, as there are no ICT facilities in the state.

Ojo *et al.* (2021) also report that the availability of ICT tools to nurses in Nigeria is very low, stating that mobile phones are the common ICT found in the healthcare facilities studied. They find that the relatively poor availability of ICT tools calls for prioritisation to ensure that the full benefit of modern technology is achieved.

Corroborating the work of previous researchers, Onoja *et al.* (2021) conducted an extensive research project on the availability of ICT in Nigeria. They adopted a facility-based survey quantitative approach to gather data from 872 healthcare facilities in 33 states, including the Federal Capital Territory. They report that the basic mobile phone owned by members of staff for their personal use is the most commonly available ICT in the Nigerian healthcare sector. Furthermore, they report that although computers are found among the existing ICT's, these were to be found only in privately owned hospitals, where they are used for patient registration. As a result of the inadequacy of the available ICT tools, the overall usage for supply chain management, staff training, mobile transactions and electronic media records was found to be below 10 per cent.

Although the use of information and communication technology has gained ground in the healthcare setting, especially in developed countries, where it leads to the provision of better healthcare services, the use of ICT is relatively rare in developing country such as Nigeria. This can be traced to the unavailability of ICT resources in the healthcare sector of the country. As stated by Adekunle (2016), the effectiveness of ICT tools in any organisation is dependent on the availability and distribution of the tools.

### **3.7 Knowledge of m-Health**

Knowledge about innovation is important to the adoption of such innovation. Users tend to avoid an innovation that they do not know about. Hasanain *et al.* (2015) state in their research on the knowledge of healthcare workers on the adoption of EMR in Saudi Arabia that the innovation was not adopted due to a lack of knowledge of the technology by its users. Also, Ngcobo (2019) reports that a lack of knowledge of the use of information technology for healthcare purposes impedes health information systems adoption among Botswana healthcare

workers. A further report shows that most Botswanan healthcare facilities do not have m-health services. The research finds that there is a need for policies that support this initiative as well as network support to ensure the smooth adoption of this technology

Investigating knowledge of m-health services among health workers in Nigeria shows that some healthcare workers know about the use of mobile phones for healthcare purpose but are not familiar with the name 'm-health' (Owolabi *et al.*, 2018). Health call centres, mobile telemedicine, and appointment reminders were reported as the most prevalent uses of m-health among healthcare personnel. Although mobile phones for healthcare delivery is known, however, the knowledge of its use is limited among health provider.

Adebara *et al* (2017) find that health workers are knowledgeable about the use of mobile phones for healthcare service delivery, and that this is common among professional consultants and more senior people. Also, mobile phones are freely used for making appointments, consultations, confirming prescriptions and booking bed space, as well as sending reminders about hospital appointments.

### **3.8 Mhealth Effectiveness and its Adoption Factors in Healthcare sector.**

Examining the usefulness and effectiveness of the Hayat app, a mobile health application for maternal and child care in Afghanistan and Pakistan, Zaidi et al (2020) conducted a qualitative study among community healthcare professionals and female health workers, who are the primary users of the technology. The study found that the app was very useful as it has been fully deployed in Pakistan. Participants from both countries highlighted the fact that its usefulness could be seen through the volume of information with accuracy being generated, service improvement, time management, communication and compliance of caregivers, a simplified work routine, and increased performance. Although the applications were found to be useful and fit with the job routine, some of the issues associated with the system were revealed. These issues were found to be network unavailability, especially when they needed to visit the rural community to work. Although it was stated that the application has offline capabilities, not being able to sync collected data in real time becomes burdensome to the health workers. Also, more training was seen as necessary to help bridge the digital literacy gap.

Through a qualitative analysis of the perspectives of Brazilian health workers on the usage of GGeohealth, Schoen et al., (2017), reported that m-health application has replaced paper work and organised data so that field workers no longer need to carry piles of paperwork. Although the idea was positively received, downsides such software glitches, defective devices, and unfavourable attitudes from the user community were noted.

According to a qualitative research study by Han et al (2019), the adoption of mHealth by doctors in Sri Lanka was motivated by a desire to enhance patient-physician communication and efficiency, particularly in times of emergency. This reduces travel time, especially for patients who live in rural locations. But the issue of patient illiteracy particularly in dealing with the complexity of mobile devices as well as miscommunication in scenarios when patients do not grasp what the doctors say were both seen as obstacles.

The usage of mobile health reminder systems for HIV/TB patients in Mozambique from the perspective of healthcare professionals revealed that the intervention was crucial as it has decreased the number of patients missing appointments and medicine refills (Nhavoto, Grönlund, & Klein, 2017). The results also show that the problem of privacy is difficult since any member of the patient's family who is unaware of the patient's health situation could pick up the phone and read text messages.

A study was carried out by Keel et al (2022), on the adoption of physio-track, a mobile health app used by physiotherapists in Switzerland, among healthcare professionals and patients using the ethnography method to determine use and non-use of the technology. Following a video recording of the users using the app, interviews with them regarding their experiences were conducted. The study approach also made use of the application's documentation, which helped to provide comprehensive details on the technology being studied. The research revealed that the app includes exercise videos, assessment questionnaires, learning resources, and platforms for contact between a health professional and patient. During the COVID-19 pandemic, there was a dearth of in-patient consultation; the medical professional claimed that m-health was quite helpful in that situation. However, it was found that a few things were limiting its utilisation. These limitations were divided into healthcare system level, the institutional level, and the individual level. In the first level, which is the Swiss healthcare system, policies and rules pertaining to the legal system, data privacy, and access to in-person consultation are discussed. The inability to get paid for online services like emailing PDF documents through postal services and providing outpatients with virtual consultations using their own funds was cited as a barrier, as was the length of time required to use the services. Additionally, people prefer in-person consultations, so using applications wasn't really necessary. The institutional component determined that in order for them to use the gadgets, they must be easily accessible and readily available. The application design should make it easy to find the necessary information whenever it is needed. The inability of the m-health device to interface directly with other devices, such as the printer, was considered a hurdle because, in most cases, the document must first be stored on the

desktop before it can be transferred to the printer directly. Finally, at the individual level, the lack of training offered and the level of technological proficiency were both seen as obstacles to the adoption of mHealth.

Though many of these studies have demonstrated the value and significance of m-health, many healthcare workers are still reluctant to adopt it. This might be because certain factors are needed for healthcare professionals to completely adopt it, yet they are missing.

Zakerabasali et al (2021), explored the reasons why healthcare organisations were reluctant to implement mobile health. User resistance is a serious concern in technology adoption studies. The introduction of an innovation to an existing system tends to disrupt the way activities are performed, and this often meets a form of resistance from users (El-Wajeih, Galal-Edeen, & Mokhtar, 2014). Resistance, according to Zaltman & Duncan (1977), is any behavior that helps sustain the status quo in the face of demand to change it. Three categories of impediments were identified from the study: individual, technical, and health-system. The results of the literature review revealed that challenges relating to technological elements are caused by variables such as a lack of existing technology, regulation and effectiveness of applications, privacy concerns, interoperability, slow networks, and user-friendliness. Individual obstacles included a lack of support from doctors, resistance to change, technological complexity, and uncertainty about the positives of mHealth. The five main impediments related to the healthcare system are legal impediments, problems with reimbursement, economic and financial impediments, and a lack of health system rules and standards.

The financial strain and psychological impacts of the cost of mHealth use among community health nurses in Ghana were taken into consideration by Abane et al (2021). The researchers used a mixed-method approach to determine how the two characteristics will affect nurses in Ghana who are providing health services using mHealth technology. According to the study's findings, nurses who used their funds to purchase credits for their

devices to administer healthcare encountered financial strain. As a result, there was a clear disadvantage to employing mHealth technology.

David et al (2020), studied the contextual barriers of using the Almanach mHealth application, deployed in the northern region of Nigeria. The problems found were divided into primary, secondary, and tertiary categories. The main difficulties are a lack of mobile health devices and longer consulting times. Secondary issues include a staffing deficit and a lack of resources to use the technology. It was reported that the device remained challenging to use even after training due to a lack of technical expertise by health workers. Unfortunately in the context of developing countries, much attention has been given to the lack of human resources, ignoring the need for capacity building through skills acquisition (Koivu et al., 2016). It was discovered that because of a fear of using technology, they avoided caring for young children under the age of five, for whom the technology was designed. Users of the device also stated that they have to travel twice a week to an area where the internet is operational in order to upload data that has already been preloaded into the system due to a shortage of internet infrastructure. The health centre allegedly does not provide funding for the use of technology, so those who utilise it must pay for their own travel expenses to areas with internet access. Additionally, it was said that the technology had drawbacks, such as the requirement for manually entering some sensitive data, which discouraged users from using it. Finally, numerous interventions are ongoing at the same time, so they are advised to use them all rather than concentrate on a single one.

Gagnon *et al* (2016), reviewed the factors influencing m-health adoption and stated that technological factors, individual characteristics and environmental factors play important part in mobile health technology utilization for healthcare delivery. The technological factors included in the study were Perceived usefulness, compatibility, ease of use, confidentiality and system trust. Individual factors included knowledge, the attitude of users, self-efficacy, and experience. Organisational factors were divided into the internal and external environment. The

internal environment included the availability of training, IT staff support and resource availability, while the external environment included policies influencing the use of technology for healthcare. All of the factors were said to play important roles in the successful adoption of m-health by healthcare workers.

Tariq and Akter (2011) categorise the factors influencing m-health adoption among community health workers in developing countries as individual, task, context and technological characteristics. The researchers state that the characteristics of users in term of how well they are able to execute a required task using the technology is crucial to adoption intention. Also, the presence of facilitating conditions in the environment of the technology contributes to adoption intention. Lastly, the ability of the technology to work effectively based on its own features has a substantial impact on user intention.

Kaium *et al.* (2019) conducted a review on understanding the factors that contribute to the adoption of m-health solutions both in advanced and developing economies, with most of the adoption studies being focussed on developing countries. This research shows that organisational, individual and contextual factors are key in m-health adoption.

Prince *et al.* (2019) used the T-O-E and DOI frameworks to assess the determinants of m-health adoption in a Kenyan hospital from both the patient and organizational perspectives. They show that government support, the hospital's access to financial resources, the acquisition strategy, compatibility with the hospital's systems, medical insurance company support and ICT infrastructure capacity are important factors influencing m-health adoption in the country. The researchers state that m-health adoption requires an integrated approach, as there are many factors that determine its adoption. They also state that the support of the government, especially at the organisational level, goes a long way towards determining how well m-health technology will be accepted in the country.

Jacob *et al.* (2020) undertook a systematic assessment of the factors affecting the adoption of m-health tools among clinicians between 2008 and 2018. The factors they found in the literature include leadership engagement, output quality, ease of use, technical support, data privacy, self-efficacy, attitude, organisational inner setting, training, workload, and workflow fit. They find that mobile health acceptance is influenced by a combination of factors which is beyond the technology itself. They group these factors into the individual, the technological and the organisational.

Studying the factors affecting community case management m-health decision support system adoption and sustainability in Malawi, Chirambo *et al.* (2019) conducted qualitative research among 19 health care officers from the Ministry of Health and non-governmental organizations (NGOs) implementing m-Health. The factors found to be of utmost importance to the adoption of m-health include acceptance for use by health surveillance and management support, as this was identified to be key to the continued use of m-health. According to the study's findings, financial support from the government in the form of resource provision, such as phones, airtime, and internet subscriptions, to all health assistance in remote areas of the country was critical to the successful use and acceptance of technology. Since government funds weren't enough and sustainable in financing, the project partnership with other stakeholders was identified as a propeller for the acceptance of m-health technology in health surveillance assistance. When evaluating the effectiveness of the m-health program, barriers such as a poor network, a lack of adequate electricity, and device maintenance were discovered to be major drawbacks to the technology. The instability of a network is a source of concern for mobile device users, as the functionality of many m-health projects is directly affected by service quality (Idowu, Cornford & Bastin, 2008). Lastly, an adequate sustainability blueprint for the success of the innovation was identified as another major issue with acceptance. The researchers therefore grouped all the drivers of m-health adoption into the following categories: environmental support, funding stability, partnerships, organizational capacity, program evaluation, and strategic planning as emergent themes impacting the adoption of m-health.

Using a descriptive-analytical approach, Nezamdoust et al. (2022) studied the factors influencing nurses' acceptance of mobile health applications at Tabriz University of Medical Sciences, Iran. Trialability, observability, compatibility, relative benefit, perceived usefulness, and perceived ease of use were discovered to be significant and positively influence nurses' adoption of m-health applications using factors from TAM and DOI theories.

By combining constructs from TAM 2 and TAM 3, Ebrahimi et al. (2018) investigated factors impacting the acceptance of mobile-based healthcare services among 150 physicians in five teaching hospitals in Iran. The study indicated that characteristics like perceived usefulness, simplicity of use, perceived enjoyment, image, subjective norm, and objective usability greatly affect physicians' attitudes about the adoption of m-health. The findings also indicated that mobile devices' technical design, portability, and accessibility substantially influence healthcare providers' adoption behavior.

Blumenthal et al. (2018), conducted a study in Canada to examine the viewpoint of physiotherapists on the adoption of mobile health for their profession. Using an online tool called Typeform, 76 respondents were asked survey questions based on the TAM theory and clinical factors. The study's findings revealed that among the experts, perceived usefulness was the factor most strongly associated with m-health adoption, accounting for around 31 percent variance of the model. Another important consideration for adoption was claimed to be one's readiness to employ wearable technology. The study, however, did not find that a moderating factor, like age, had any effect on behavioral intention.

Nezamdoost et al. 2022, worked on the determinant of mobile health application acceptance by nurses in Tabriz University of Medical Sciences using a descriptive-analytical method. Using integrated factors from TAM and DOI theories, factors such as trialability, observability, compatibility, relative advantage, perceived usefulness

and perceived ease were found to be significant and positively influence the adoption of m-health applications by nurses.

In a quantitative cross-sectional study, Teferi et al. (2021), revealed that past experience, simplicity of use, accessibility to technical support, perceived utility, internet access, a positive outlook, technical proficiency, and training all positively impacted the adoption of smartphone medical applications among 417 physicians in 5 referral hospitals in North Ethiopia. The study also revealed the significance of proper knowledge and the availability of a good network as a crucial step to establishing the use of m-health applications

Hu (2022), conducted a quantitative study to consider factors influencing doctors' willingness to recommend mobile health services to patients in China. The study found that doctors with a positive attitude often recommend m-health services to patients since it is a psychological state of readiness. The service providers were encouraged to provide adequate training and awareness to doctors, which translates to influencing their decisions. Also, the perceived usefulness of m-health was also found to be a strong determinant of m-health recommendation to patients by doctors. The study stated that when the evident benefit of m-health is seen, adoption as well as recommendation would be easier for healthcare providers.

Munyua *et al.* (2015) reveal that there are no clear guidelines from the government on how m-health solution can be integrated into the healthcare system. The Ministry of Health oversees many policies, and it has shown that there is no clear guidance on how to facilitate the financing of m-health solutions. The availability of ICT infrastructure has an impact on the adoption of m-health, and studies have shown that many hospitals do not have access to this equipment. The high cost of acquiring the equipment has a negative effect on the adoption of health technology.

Summarizing the research on the factors affecting m-health, it can be argued that the advantages, ease of use, compatibility, resources accessible, and assistance in terms of training related to mobile device use for health

have a significant impact on its acceptance. However, Grossi et al. (2021), argued that for the application of technology in healthcare settings, contextual factors including funds accessibility and management style are essential. According to the study, the distribution of resources across the hospital's many departments in relation to the infrastructure that is available has a significant impact on the uptake of health technology. The adoption of technology in healthcare is also aided by management approaches that take user attitudes regarding technology into account. In other words, management should not only focus on the final result but also work to motivate users at different levels to use the technology.

**Table 3.2: Summary of Factors Influencing M-health Adoption among Health workers**

Authors	Technology Type	Country	Research Methodology	Factors
Tariq and Akter, (2011)	m-health	Developing countries	Review	Individual self-efficacy, task fit, facilitating conditions and performance expectancy
Munyua et al., 2015	m-health	Kenya	Quantitative	Funding Standardized government policies Availability of ICT infrastructure
Gagnon et al., 2016	m-health		Review	Perceived usefulness, compatibility, Ease of Use, confidentiality and system trust, knowledge, attitude, self-efficacy, experience, training, IT support, resource availability and policies
Nhavoto et al., 2017	m-health	Mozambique	Qualitative	Data Privacy
Schoen et al (2017)	M-health (Geohealth)	Brazil	Qualitative	Software problems Defective devices, unfavourable attitudes
Blumenthal et al. (2018)	M-health	Canada	Quantitative	Perceived Usefulness Ease of use User readiness
Ebrahimi at al., 2018	m-health	Iran	Quantitative	Perceived usefulness, ease of use, perceived enjoyment, image, subjective norm, and usability
Chirambo et al. (2019)	M-health (Case management)	Malawi	Qualitative	Network and electricity issue, lack of support for device management, Funding issues, unstandardized policies, organizational factors

Prince et al., 2019	M-health	Kenya	Quantitative	Government support, access to financial resources, acquisition strategy, compatibility, availability of medical insurance and ICT infrastructure capacity
Han et al., 2019	m-health	Sri Lanka	qualitative	Patient illiteracy
Kaium et al., 2019	m-health	Developing countries	Review	Organizational, individual and contextual factors
Jacob <i>et al.</i> , 2020	M-health		Review	leadership engagement, output quality, ease of use, technical support, data privacy, self-efficacy, attitude, organizational setting, training, workload, and workflow fit
David et al., 2020	M-health (Almanach)	Nigeria	Qualitative	Lack of Funds, techno-phobia, Inadequate training and information overload
Zaidi et al., 2021	M-health (Hayat app)	Pakistan and Afghanistan	Qualitative	Network Availability Training
Abane et al., 2021	M-health	Ghana	Mixed-method approach	Lack of funds
Teferi et al., 2021	M-health	Ethiopia	Quantitative	Past experience, simplicity of use, accessibility to technical support, perceived utility, internet access, a positive outlook, technical proficiency, adequate knowledge, network availability and training
Zakerabasali et al., 2021	m-health		Review	Uncertainty about app effectiveness, interoperability networks issue, privacy concerns, resistance to change, technological complexity, legal impediments, funding, lack of health system rules and standards regulation.
Hu, 2005	M-health	China	Quantitative	Adequate training and awareness to doctors Evident of usefulness Attitude
Keel et al., 2022	M-health Physio-track	Switzerland	Ethnography	Government policies and rules Funds, training, technicality of app
Nezamdoust et al., 2022	m-health	Iran	Quantitative	Technology factors

### **3.9 Sustainability of m-Health**

M-health solutions go beyond the mobile technology itself. Rather, it is an interconnected network that consists of different stakeholders who are vital to the ability of the technology to improve health outcomes. The intersection of the health, technological and financial sectors, which are influenced by policies, regulations and strategies put in place by governments, is a key indicator that determines the potential outcome of the mobile health technology (Qiang *et al.*, 2012). Through its policies the government can decide on what m-health solutions are to be implemented at either state or national level. This will enable the government to focus on an initiative that is of the utmost priority in the healthcare sector, thus giving adequate support in terms of funding and infrastructural development to enhance the success of such an initiative. Also, regulating the mobile service provider for m-health in the country would promote a scaling-up of m-health technology. Mobile service regulation in terms of the price of the service and of data would enhance the use of m-health technology (Qiang *et al.*, 2012).

#### **3.9.1 Partnership between the private and public sectors**

Strategic collaboration between the government and private sectors in building a sustainable business model is crucial to the full implementation of m-health (Diop & Crul, 2014). For sustainability, various stakeholders, government and private organisations need to contribute their strengths, resources, market access and networks to build a better m-health solution which is scalable (Latif *et al.*, 2017). The benefit of a partnership is to be able to share the financial burden of investment as well as the risk involved, in order to achieve a sustainable system.

#### **3.9.2 System integration and interoperability**

For m-health to be scaled up, all m-health initiatives must be made to interoperate with each other. Most m-health solutions are designed by non-governmental organisations which address a specific problem, and this eventually

leads to data fragmentation as much of the data generated by these organisations does not integrate (Nsor-Anabiah, Udunwa, & Malathi, 2019; Pankomera & van Greunen, 2018b). To build sustainable m-health solutions, policymakers must ensure that policies guide the development of an interoperable platform that allows for various m-health solutions to be able to communicate with one another (Latif *et al.*, 2017).

### **3.9.3 Data privacy and security**

The trust of the users of m-health solutions is a necessary factor when it comes to m-health sustainability, because health-related data are highly sensitive and should be treated as such to gain the confidence of users. For m-health to be scaled up in developing countries, measures that help to maintain the privacy of patient data should be put in place (Pankomera & van Greunen, 2018b). When the system is trusted, users will be willing to give their information, because they will be sure that their information is accessible only to authorised users (Nsor-Anabiah *et al.*, 2019)

### **3.10 Chapter Summary**

This chapter commenced with the concept of electronic health and went on to discuss the literature relating to m-health technology drivers and their application areas. A review of the m-health solutions found in Nigeria was presented, and the chapter also discussed literature relating to the current ICT tools found in the country's healthcare space, the knowledge of m-health, adoption factors of m-health, the barriers to m-health adoption and the sustainability of m-health. The literature suggested that individual, technological, organisational and environmental factors play a major role in m-health adoption. It was therefore no surprise that most of the successful adoptions of the technology are to be found in developed countries and only a few are to be seen in emerging economies. To this end, it is evident that there is a need to investigate the m-health adoption factors in Nigeria using an integrative approach, considering that most of the m-health services in Nigeria do not go beyond the pilot phase. To the best of the researcher's knowledge, based on a search of the literature, no existing study

has considered all four factors in scrutinising m-health in Nigeria. The study also considers the adoption of m-health from perspectives of both healthcare workers and hospital managers.

The next chapter discusses the theoretical foundation that underpin this study.

## **CHAPTER 4: THEORETICAL FRAMEWORK**

### **4.1 Introduction**

Theory is “an interrelated set of constructs (or variables) formed into propositions, or hypotheses, that specify the relationship among variables (typically in terms of magnitude or direction)” (Creswell, 2014, pp 86). The use of theory in research is important because it provides the lens for understanding the phenomena under investigation. This chapter presents some prominent theoretical background relating to the adoption of information technology. It further discusses how the conceptual framework used was developed by integrating and refining the UTAUT theory and the TOE framework.

### **4.2 Existing Theoretical Models for m-health Adoption**

One of the major markers of the success of technology is its acceptance by users. If a system is not accepted then there is a high possibility that the technology will fail. The need to understand why users accept or reject technology is of the utmost importance to researchers; hence the need for acceptance theories (Williams et al., 2012; Momani et al., 2017). Some of the theories that have been popularly used to mobile health acceptance include acceptance of technology include, the Technology Acceptance Model, the Theory of Planned Behavior, the Unified Theory of Acceptance and Use of Technology (UTAUT), Theory of Reasoned Action, DOI, TOE. These theories are explained below.

The Theory of Planned Behavior (TPB) was developed by Ajzen in 1991. It was an extension of the Theory of Reasoned Action, which was a reaction to the limitations of TRA (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). The individual intention to perform a given behaviour is regarded as the most prominent aspect of TPB (Ajzen, 1991), which is based on motivational factors which influence behaviour. TPB predicts that user intention is influenced by attitude, subjective norms, and perceived behavioural control. The applicability of perceived

behavioral control and intention has provoked a lot of controversy. Firstly, it was argued that issues associated to complex goals are dependent on a series of behaviors which was not considered in the model (Finkbeiner, 2017). The model's predictive validity is further questioned due to the variability of intention shown by the model's measurements (Sniehotta et al., 2014). In addition, the author claims that the model primarily focuses on rational reasoning without considering other cognitive and affective factors. The Technology Acceptance Model (TAM) was developed by Davis (1989). It is based on the principles of the Theory of Reasoned Action (TRA) developed by Fishbein and Ajzen in 1975. The TAM model identified perceived usefulness and perceived ease of use as the two important constructs that determine a user's acceptance of a system. Perceived usefulness means the "degree to which an individual believes that using a system would enhance his or her job performance" (Davis, 1989, pp 320) while perceived ease of use, on the other hand, relates to a person's belief that system utilization will require no physical or mental effort (Davis, 1989). Perceived usefulness and perceived ease of use are said to have a positive influence on an individual's attitude, which in turn influences the individual's behavioural intention. TAM has been used in the adoption studies of m-health. Researchers such as Faqih et al. (2015) used the model to study adoption in Jordan by extending it with cost, trust, privacy, and social influence. The findings of the research confirmed the applicability of the theory in various contexts. However, external constructs were included in the model in order to increase its explanatory power. In a similar manner, El-Wajeih (2014) used the original TAM model to explain the adoption factors of m-health in Yemen and Egypt. Only 59.7 percent of the variance in behavioural intention is explained by the model. Although, TAM is said to be a robust and parsimonious model for explaining a user's intention regarding system adoption Olushola & Abiola, (2017), however, it has raised some argument in the research community. The use of self-report data, which is regarded abstract and imprecise, is a major critique of TAM and as a result, the finding cannot be generalized. Also, it is argued that it is extremely simple model that focuses on individual beliefs, perceptions, and usage intentions hence reducing its explanatory power. (Shachak et al., 2019). It is assumed to be ineffectual in a structured environment governed by rules and

regulations because it is unable to properly describe the reasons for acceptance (Ajibade, 2019). TAM is also faulted because the two main construct only focuses on the technology characteristic thereby leaving out the important factors that contributes to the adoption process (Sträub, 2009).

Diffusion is described as the “process by which an innovation is communicated through certain channels over time among members of the social public” (Rogers, 1983, pp 4). DOI helps to explain how new ideas are spread through culture (Munyua *et al.*, 2015). According to Rogers (1983), four elements make up DOI theory. These are innovation, the communication channel, time, and social systems. An innovation is adopted based on a different unit of analysis; hence the process should not be oversimplified by assuming that the process is the same for every individual adopter (Rogers 1983). In other words, as long as it is new to an individual then it is an innovation. Furthermore, Rogers (1983) stated that the newness of an innovation should not be limited only to knowledge about the innovation. Rather it should be considered in terms of persuasion, knowledge and the decision to adopt. Also, five characteristics of innovation, according to Rogers (1983), account for 49 to 87 percent of the variation in innovation adoption rates and they are relative advantage, complexity, compatibility, trialability and observability. The theory has been used extensively by researchers due to the broader perspectives involved in technology adoption from how individual users arrive at their decision, to deployment of the innovation, and how they decide to utilize it after adoption (Barrette, 2015). . However, despite the popularity of this theory some limitation has been identified in it. One of the key drawbacks of DOI is that it solely considers innovation qualities, leaving out other elements such as the adopter and the context (cultural and social) in which the adoption takes place (Oldenburg & Glanz, 2008). Furthermore, Botha & Atkins (2005) claim that the model contains some biases that make it impractical to assume that all members of a target group should accept innovation without re-invention or rejection. Individuals are also considered to be held responsible for their lack of adoption rather than the system to which they belong. Lyytinen and Damsgaard (2001), also argued that the

theory's explanatory power is low, and as a result, it does not provide sufficient prerequisites for innovation adoption.

Researchers such as Brohi and Hakro (2018) and Ramdani *et al.* (2020) investigated mobile health adoption in Pakistan and China using the TOE framework. According to Ramdani *et al.* (2020), the model explains behavioural intention among Chinese healthcare workers with approximately 81 percent variation. Furthermore, Ngongo *et al.* 2019 studied m-health adoption using the TOE framework. The finding stated that the framework is robust and easily adaptable in many research settings due to its flexibility and ability to contextualise variables peculiar to the area of study.

Using the UTAUT models, Min *et al.* (2020) examined the factors impacting the adoption of m-health apps among primary health care workers in Malaysia. Although factors from the model were said to influence adoption, UTAUT has the limitation of not being an exhaustive model, which has prompted researchers such as Fuad and Hsu (2018) to extend it in order to include the contextual factors influencing health information technology adoption in developing countries. A multi-level UTAUT framework was developed, which confirms the argument of Moghavvemi, Salleh & Abessi (2013) that the model needed improvement to capture the effect of different dimensions and external variables that influence adoption in a different context.

For the purpose of this study, the TOE framework and UTAUT theory were adopted. The details of these theories are explained below, as well as the justification for their application.

#### **4.2.1 Unified Theory of Acceptance and Use of Technology**

The UTAUT theory was developed by Venkatesh *et al.* in 2003, and the theory was built by integrating constructs from eight existing technology acceptance theories, which were the Theory of Reasoned Action by Fishbein and Ajzen (1975), the Technology Acceptance Model by Davis (1989), the Motivational Model by Davis *et al.* (1992), the combined TAM/TPB (Taylor and Todd 1995a), the Theory of Planned Behavior by Ajzen (1991), the Model

of PC Utilization (Thompson *et al.*, 1991), the Innovation Diffusion Theory by Rogers (1995), and the Social Cognitive Theory by Bandura (1986) (Hennington & Janz, 2007; Williams *et al.*, 2012). The theory identifies four factors that influence the adoption of technology. These factors are performance expectancy, effort expectancy, social influence, and facilitating conditions. It also identifies gender, age, experience, and voluntariness as key behaviour moderators. Performance expectancy has to do with the possible benefit a new system will bring to the user, as compared to the technology in use. According to Venkatesh *et al.* (2003), performance expectancy is the strong construct that determines behavioural intention. Effort expectancy is said to be the extent of ease at which a system can be used (Venkatesh *et al.*, 2003). The construct has to do with TAM's ease of use, and it's said to be particularly important in both voluntary and mandatory situations. Social influence has to do with whether or not important others believe an individual should use the system (Venkatesh *et al.*, 2003). Facilitating conditions describes the idea that the necessary technical and administrative support is in place to aid in system use (Venkatesh *et al.*, 2003). This construct was found to be consistent with compatibility in DOI theory, perceived behavioural control in TPB, and facilitating conditions in MPCU. However, the construct is found to be insignificant when used with performance expectancy and effort expectancy. In this situation it is instead a direct antecedent to usage.

UTAUT theory is said to be one of the most highly influential models in information system research for predicting technology acceptance (Sun *et al.*, 2013; Bawak, 2017). UTAUT has been used in various study contexts to explain the adoption factors involved in the acceptance of new technology, because it is an integrated model which has a broad capacity to explain the behavioral intention to adopt technology, with a better explanatory power (of about 70 per cent) than other models of the acceptance of technology. According to Venkatesh *et al.* (2003), one of the reasons for developing this theory was to have a unified theory that could be used by researchers to predict adoption without requiring any contribution from other theories (Owolabi, 2016).

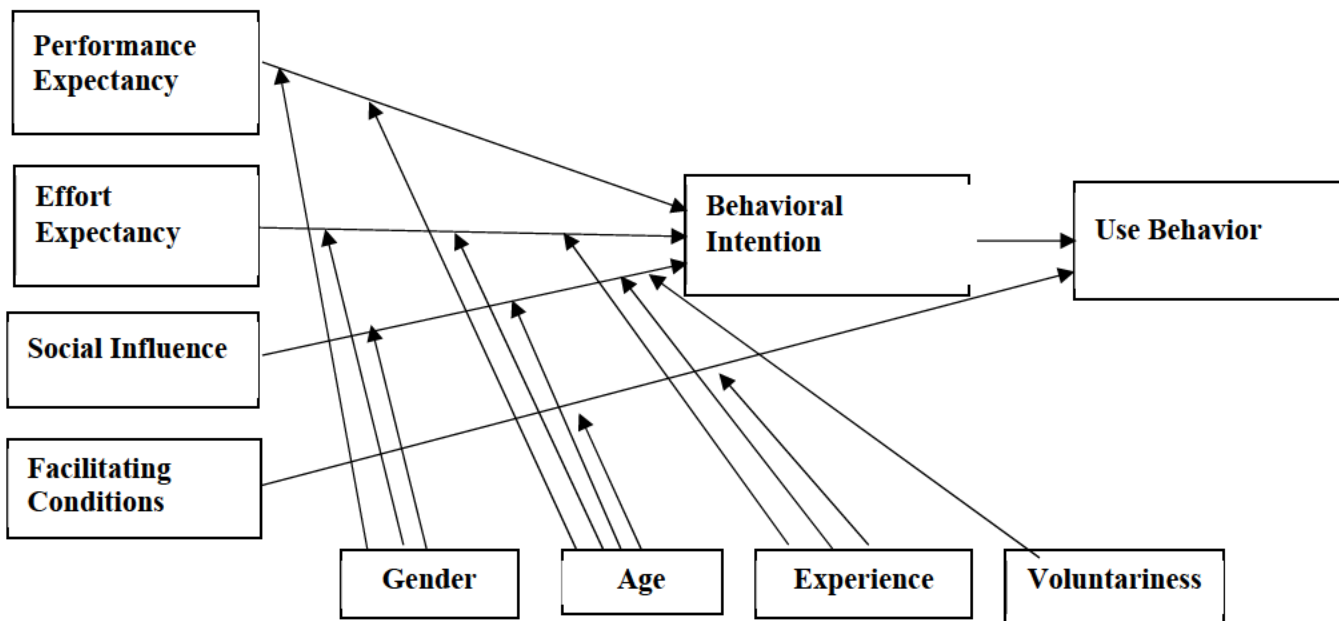


Figure 4:1: Unified Theory of Acceptance and Use of Technology.

Source: Viswanath Venkatesh, Michael G. Morris, Gordon B. Davis and Fred D. Davis, (2003). MIS Quarterly, Vol. 27, No. 3, pp. 425-478

#### 4.2.2 T-O-E Framework

Tornatzky and Fleischer established the Technology-Organization-Environment framework (TOE) in 1990 and outlines three determinant that influence organization's adoption of technology they are technology, organisation and the environment (Williams *et al.*, 2012). The technological context as described by Tornatzky and Fleischer (1990), consist of an organisation current technology as well as other available technologies in the market. The attributes of an innovation have been found in several research projects to influence individual and organisational adoption of technology (Gangwar, Date & Raoot, 2014). As found in innovation diffusion theory by Rogers (1983), these attributes are compatibility, relative advantage, complexity, trialability and observability. The internal characteristic that influences an institution's adoption of technology is referred to as organizational factors. These include culture, the availability of resources, size, the quality of the workforce, and management support (Awa *et al*, 2017; Dwivedi *et al*, 2012). The culture of an organisation consists of its values, norms and

sense of identity, which influence the adoption of technology. Also, the support received from management has been shown to greatly influence the adoption of innovation. When individuals in an organisation perceive the availability of support, then the acceptance of innovations becomes easy (Ramdani, Duan & Berrou, 2020). Furthermore, Tornatzky and Fleischer (1990) state that resource availability and the size of the organisation play a major role in the adoption of technology. They explain that larger organisations have a stronger tendency to accept innovations because of the availability of resources and their ability to survive the risk linked with the early stage of adoption. Lastly, the environmental factor has to do with how external organisations such as the government, competitors and suppliers and shareholders affect innovation acceptance (Chiu, Chen & Chen, 2017; Xu, Ou & Fan, 2017). The availability of favourable policies, business competition, external support and legal frameworks can determine adoption. Considering the generic nature of TOE in providing a holistic basis for the study of the adoption of technology in its three contexts, it has been widely used in explaining the acceptance of an innovation (Ramdani *et al.*, 2020). Despite the strength of the framework, it has been majorly criticised for its lack of concise constructs, which vary depending on the context (Bryan & Zuva, 2021).

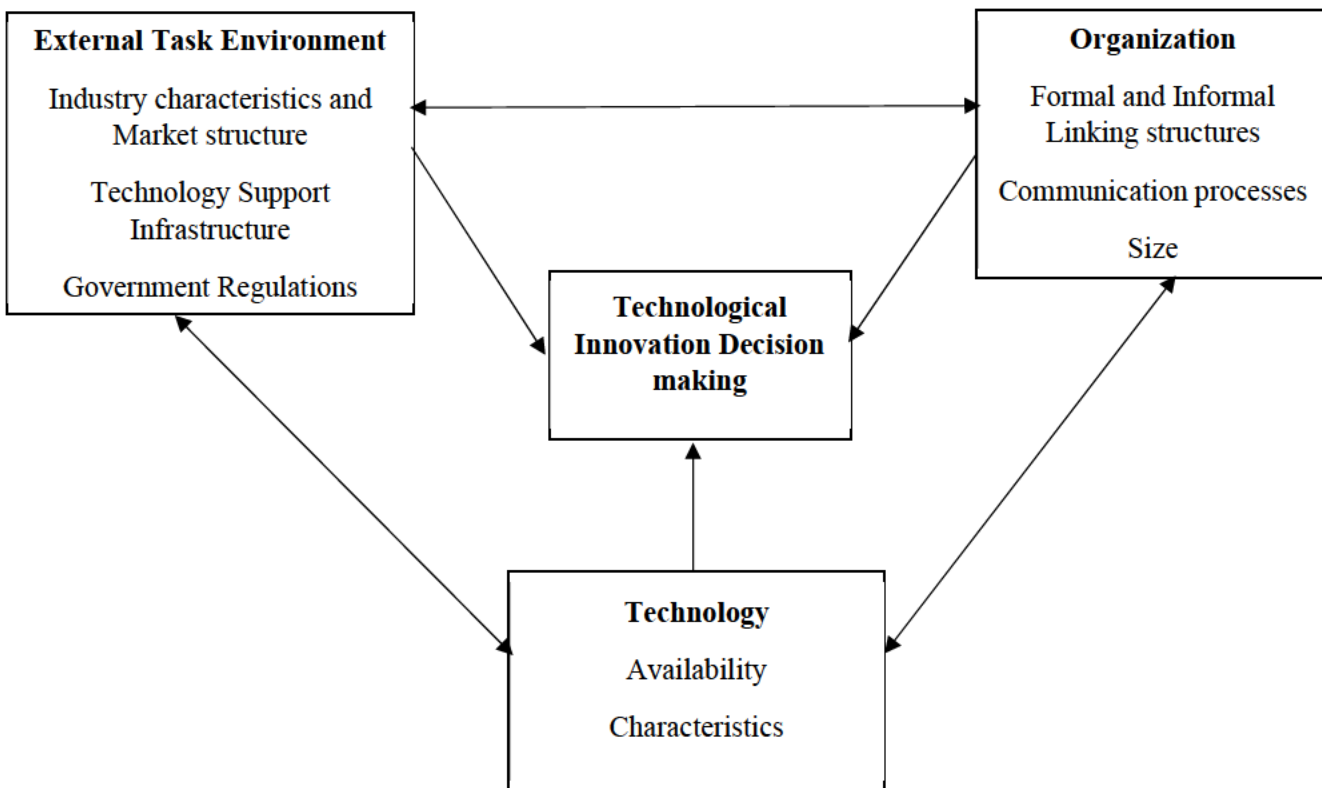


Figure 4:2: Technology-Organization-Environment Framework.

Source: Yogesh, K. Dwivedi, Michael R. Wade and Scott L. Schneberger. Integrated Series in Information Systems 2012, vol. 28, PP. 236

### 4.3 Research Framework

The UTAUT and TOE frameworks were used as the theoretical foundation for this study. The justification for integrating the theories was to provide detailed insight into m-health adoption in Nigeria. Although the UTAUT is considered a comprehensive theory, some limitations have been identified in it. One of the shortcomings of the theory is associated with the fact that behavioural intention is shown to be a reflection of an individual schema of belief, without representing the external variables that affect performance (Venkatesh *et al.*, 2003). This means that external factors that influence adoption are not considered. Also, individual factors were not considered in the UTAUT theory as a direct determinant of adoption, and these have shown to affect the acceptance of technology (Moghavvemi, Salleh, & Abessi, 2013). Given the robustness of the TOE framework, which describes

how technology, organization, and environmental factors affect or obstruct information system adoption (Ramdani, Kawalek, & Lorenzo, 2009), it was deemed appropriate for use in this research. TOE was therefore integrated with variables from UTAUT, and other technology acceptance factors identified in previous pertinent research were included in the study. This framework was then categorised into individual, technological, organisational and environmental factors. The individual factors are experience, attitude and self-efficacy. The technological factors are performance expectancy, effort expectancy, compatibility and privacy. The organisational factors are training and technical support as well as management support, while the environmental factors are government policies and external support. Individual characteristics relate to individual capability, skills, attitude, personality, risk perception, as well as competence, such as those required for the execution of a project (Anders Bakkli & Malene Tennfjord, 2019; Zabadi, 2016). Technological context pertains to the characteristics of the innovation at hand and the potential implication of integrating it into an existing organization (Mouakket & Aboelmaged, 2021). According to Lian et al. (2014) , an organization's acceptance of innovation will be greatly influenced by its financial resources, leadership commitment, and anticipated advantages associated with technology . Environmental factor addresses the external elements such as government policies, collaboration from other organization needed for the organization readiness in acceptance of technology (Tornebohm, 2019).

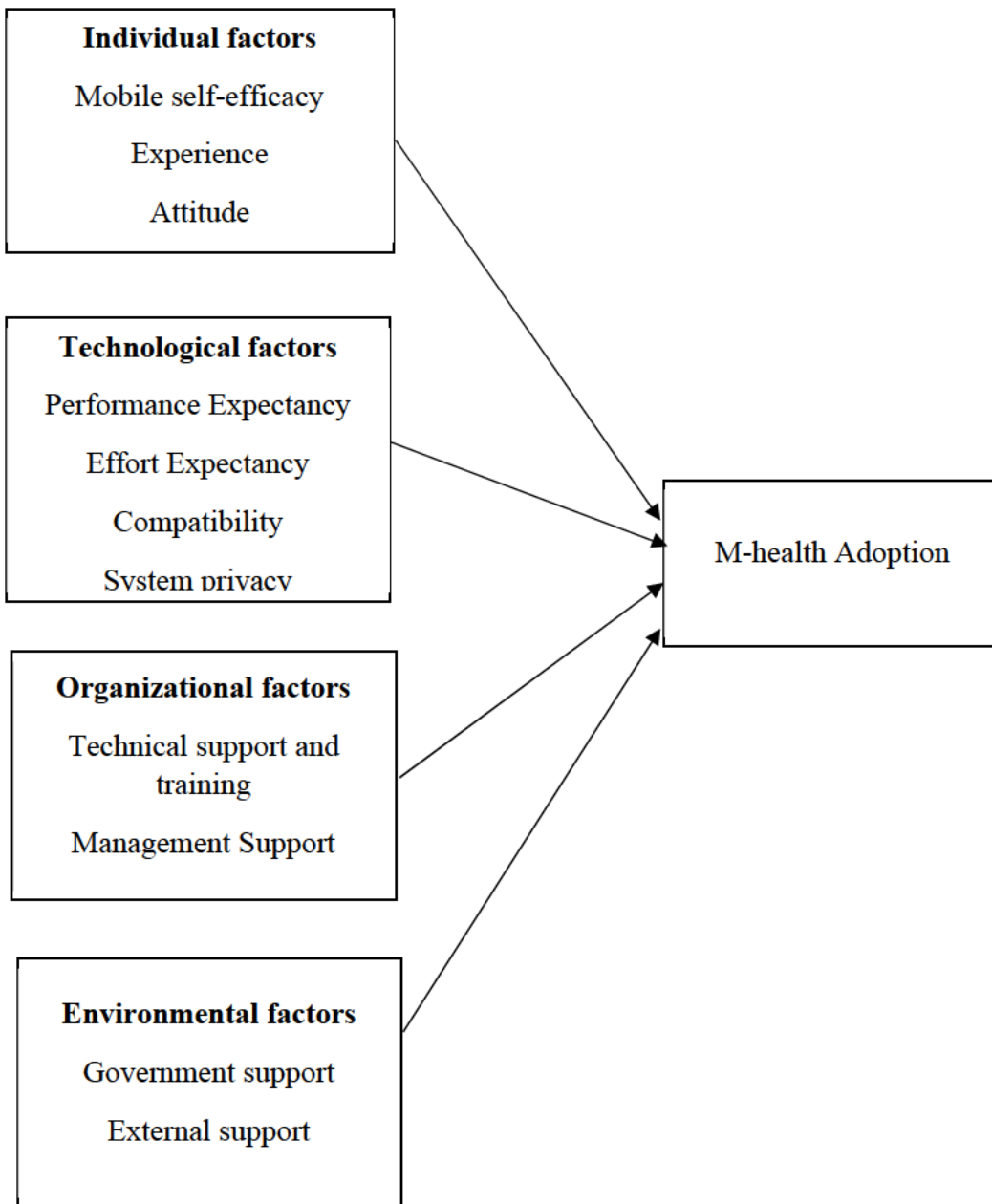


Figure 4:3: Conceptual framework.

#### 4.4 Individual Factors

Individual factors are said to be among the key determinants of technology adoption. These factors are said to explain the perception of the user in accepting or refusing a technology, because they represent the cognitive interpretation individuals give to innovation and themselves (Talukder, 2012). Some of the characteristics that explain this factor as found in several studies include attitude, computer self-efficacy and prior experience of the use of technology.

#### **4.4.1 Attitude**

Attitude plays an important role in behavioural intention to adopt a technology (Ajzen, 1991). The term attitude describes user's perception towards engaging in a specific behavior (Ajzen, Fishbein, Lohmann, & Albarracin, 2018). TAM theorises that the intention to adopt is influenced by individual attitudes which are based on the user's perception of the use of technology. In TPB, one important factor that determines technology acceptance is the user's attitude. The theory states that the more favourable the attitude of a user to technology, the more positive the behavioural intention. Hussein et al. (2017), studied the influence of consumer attitude on the intention to adopt m-health. The study showed that a positive attitude toward m-health solutions plays an important role in its adoption. Aggelidis and Chatzoglou (2009) studied the acceptance of technology in hospitals using the technology acceptance model in individual, technological and implementation contexts. The work noted that attitude is a key factor that determines whether or not a user is willing to adopt an innovation. In investigating physicians' intention to adopt telemedicine, Chau and Hu (2002) reported that adoption was predicted by the attitudes of the physicians.

From the extensive study of adoption literature, it can be argued that the attitude of users is an important factor to investigate when studying the adoption of technology. Hence the formulation of hypothesis 1:

The attitude of healthcare workers influences their intention to adopt m-health technology.

#### **4.4.2 Self-efficacy**

Self-efficacy theory has its foundation in Social Cognitive Theory and is said to influence an expected outcome (Compeau & Higgins, 1995). Self-efficacy, according to Bandura (1986), is the belief in one's ability to plan and act out the steps necessary to achieve a specific level of performance. Self-efficacy is not limited to the skill an individual possesses; rather, it includes what can be done with the skill. Behavioural intention is influenced by the perceived self-efficacy of an individual in the process of decision making. Compeau and Higgins (1995) state

that computer self-efficacy is best described as an individual skill to use a computer to accomplish a task. Similarly, Sezgin *et al.* (2018) explain mobile device self-efficacy as the personal ability users possess to complete a given task on the device. Self-efficacy is an important individual factor as the use of an innovation is dependent on skill and how users can use that skill when having to adapt to an innovation. The decision as to whether a system is useful or not is informed by user's level of expertise (Tariq & Akter, 2011; J. H. Wu, Wang & Lin, 2005, 2007). Researchers such as Holden and Rada (2011), Jaradat and Faqih (2014) and Venkatesh and Davis (1996) argue that the greater the users' self-efficacy the more positive their perception of the usefulness of information systems, which in turn positively influences their willingness to adopt new technology. Therefore, this study proposes hypothesis 2:

Healthcare workers self-efficacy influences the intention to adopt m-health technology.

#### **4.4.3 Experience**

As defined by Zabadi (2016, pp 31), experience "is the awareness and ability needed to carry out technology-related duties." The experience could be prior or previous experience gained from the use of technology or system property or usage context. Frambach and Schillewaert (2002) explain that prior experience in the use of technology influences the adoption of new technology by an individual. Evaluating users perception about a previous technology helps in knowing their willingness or refusal toward a new system (Dillon & Morris, 1996; Tariq & Akter, 2011). A person who has used technology before tends to adopt new technology. Taylor and Todd (1995) argue that experience gained from the previous use of technology influences behavioural intention. To validate the influence of experience on adoption, Rahayu and Day (2015) studied the determinants of IT adoption among small and medium enterprises in Indonesia. They report that experience has a positive influence on the adoption of technology. Prior experience of the user in innovative technology can be said to influence the adoption

of a new technology. Hence, for this study hypothesis 3 posits a relationship between experience and the adoption of m-health technology:

Healthcare workers' experience influences the intention to adopt m-health technology

#### **4.5 Technological factors**

The term technological factor refers to the characteristics of m-health technology that influence its adoption. The factors considered in this study include performance expectancy, effort expectancy, compatibility and system privacy.

##### **4.5.1 Performance expectancy**

This is the perception of users that using a system would improve their job productivity (Venkatesh, 2003). Performance expectancy relates to the usefulness of a system in accomplishing a task, increased productivity and other benefits found in using the technology. Previous research has investigated the influence of performance expectancy on behavioural intent and found that it is one of the major factors that contribute to technology adoption because of its positive influence on behavioural intention (Mohammad Zahedul Alam, Hu, Kaium, Hoque, & Alam, 2020; Cimperman, Makovec Brenčič, & Trkman, 2016; Fuad & Hsu, 2018; Lim et al., 2020; Rastogi, Verma, & Sushil, 2018). Regarding innovation acceptance in the healthcare sector, the ability to meet the job requirement and increase productivity is a major factor to be considered among healthcare providers (Owolabi, 2016). Thus, this research proposes hypothesis 4:

Performance expectancy influences the intention to adopt m-health technology

##### **4.5.2 Effort expectancy**

Effort expectancy describes the absence of difficulty in operating a product. Several studies have found that effort expectancy is an important determinant in the adoption of technology as they argue that acceptance should be

measured based on how easily a system can be used (Alam *et al.*, 2020; Brohi & Hakro, 2018; Cimperman *et al.*, 2016; Fuad & Hsu, 2018; Lim *et al.*, 2020; Phan & Daim, 2013; Rastogi *et al.*, 2018; I. L. Wu *et al.*, 2011). This study formalises the influence of effort expectancy on m-health technology adoption as:

Hypothesis 5: Effort expectancy influences the intention to adopt m-health technology.

### **4.5.3 Compatibility**

As defined by Rogers (1995, pp 14) compatibility refers to “the degree to which an innovation is perceived as being consistent with the existing values, experience and need of potential adopters.” Brohi and Hakro (2018) state that when a technology is compatible with the existing technology of an organisation and user perception then the chances of adopting that technology will be high. This is in agreement with the study by Wu *et al.* (2007), which explains the correlation between compatibility and adoption intention. The outcome of their research shows that compatibility has a strong influence on the adoption of technology. Using the T-O-E framework to analyse the determinant of enterprise resource planning technology adoption, Xu, Ou and Fan (2017) report a positive significance between compatibility and the adoption of ERP technology. Prince *et al.* (2019) studied the factors contributing to the adoption of m-health technology in Kenya. According to their research, compatibility is one of the most important variables in determining whether or not m-health technology is adopted. Therefore,

Hypothesis 6: Compatibility influences the intention to adopt m-health technology.

### **4.5.4 System privacy**

System privacy is the degree to which a platform is safe and secure from divulging customer information (Parasuraman *et al.*, 2005). Several researchers have shown how system privacy influences the perception of a user in the adoption of technology (Gagnon *et al.*, 2016; Nisha *et al.*, 2016; Jacob *et al.*, 2020). Ramdani *et al.*

(2020), stated that a mobile health system should be a platform that is secured not only from cyber attacks but also be a platform where users' personal data are well safe. Therefore,

Hypothesis 7: System privacy influences the intention to adopt m-health technology

#### **4.6 Organisational Factors**

Ajzen (1991) argues that some of the factors that determine behavioural intention can be linked to the presence or absence of the resources needed by an individual to perform a task, The study goes further to explain that the more available the resources, the less resistance to the use of technology. As stated by Venkatesh et al (2003), an individual's belief concerning the existence of facilitating conditions influence use behaviour. The amount and type of support provided to employees by an organisation to use a technology refers to facilitating conditions (Talukder, 2008). Training and management support are found to be very important in influencing an individual in an organisation to use an innovation (Venkatesh *et al.*, 2003). Gagnon *et al.* (2016) reviewed various factors that influences the adoption of m-health technologies by health professionals. Among the organisational factors reviewed, management support was found to have a significant influence on potential users' intention to adopt.

##### **4.6.1 Management support**

Management support is explained in terms of the encouragement provided by the management to facilitate adoption. The literature review found that the management of an organisation must deliberately sell the idea of an innovation and also provide an appropriate atmosphere when transiting into a new technology (Li *et al.*, 2005; Najaftorkaman *et al.*, 2013). The absence of support from management during the change process would give rise to uncertainty, which would affect the willingness to accept the change. Hence,

Hypothesis 8: Management support influences the intention to adopt m-health technology.

#### **4.6.2 Technical support and training**

Technical support is an important factor in m-health adoption as well as the provision of adequate training to use the system. Before deploying innovation in an organization, it is necessary to assess the organization's technological strength in terms of the technical infrastructure in place to enable the use of technology. (Faber, 2014; J. H. Wu *et al.*, 2005, 2007). Research findings such as Cresswell *et al.*, 2013 and Jacob *et al.*, 2020 have shown that the provision of adequate training and technical support often influences individuals' adoption of innovation. Igarria *et al.* (1997), showed that this factor improves users' understanding, which leads to the development of favourable attitudes and a greater use of the technology.

The importance this organizational element cannot be overemphasized because this will increase users' confidence that the infrastructure that would support their work is available. This leads to

Hypothesis 9a: Technical support influences the intention to adopt m-health technology

Hypothesis 9b: The availability of staff training influences the intention to adopt m-health technology

#### **4.7 Environmental Factors**

Environmental context refers to the context in which an organisation conducts its business, competes, gets support and collaboration from providers, and works within the regulation of its business environment (Mujahed, Ahmed & Samikon, 2020). According to Baker (2012), the environmental context consists of the industry structure, the availability of external support and the regulatory environment. The environmental context is the set of opportunities and constraints that affect an innovation (Oliveira & Martins, 2011). Competitive pressure, as stated by Ramdani *et al.*, (2009) is a feature of an industry's structure that might influence the adoption of new technologies. They refer to the pressure from competitors in the same industry that is felt by a firm (Awa *et al.*, 2017). The existence of supportive infrastructure also influences the adoption of innovation. Support from the IT industry such as the availability of expertise and technological services has a strong impact on the adoption of

new technology (Dwivedi et al., 2012; Rahayu & Day, 2015). A study conducted by Premkumar (1999) showed that the presence of external support from other firms has a major influence on an organisation in adopting an innovation. Lau and Kwok (2007) studied the various environmental factors influencing the adoption of e-commerce in Hong Kong and report that the existence of appropriate telecommunication infrastructure plays an important role in the adoption of an innovation. The better the telecommunication infrastructure of a country, the higher the possibility of the adoption of new technology.

#### **4.7.1 Government support**

Regulatory support from the government has also been found to positively influence an organisation in the adoption process (Baker, 2012). A regulation that works in support of an organisation would make the organisation willingly consider new technology for adoption, but when regulations are too stringent, this affects adoption negatively. This yields

Hypothesis 10: Regulatory policies influence the intention to adopt m-health technology

#### **4.7.2 External technical support**

The availability of technical support from a third party has the likelihood of influencing technology acceptance. Adoption intentions are often influenced by network stability and relatively cheap services that are affordable to user (Nwagwu & Areo, 2020). This can be provided by the telecommunication industry with the support of government in regulating cost associated with the use of mobile services in health industry.

Hypothesis 11: External technological support influences the intention to adopt m-health technology.

**Table 4.1: Summary of the constructs used in the framework**

Factors	Construct	Source
Individual factors	Mobile self-efficacy	Social Cognitive Theory (Compeau & Higgins, 1995)
	Experience	(Taylor & Todd, 1995)
	Attitude	Technology Acceptance Model (Davis, 1989) Theory of Planned Behaviour (Ajzen, 1991)
Technological factors	Performance expectancy	UTAUT (Venkatesh <i>et al.</i> , 2003)
	Effort expectancy	UTAUT (Venkatesh <i>et al.</i> , 2003)
	Compatibility	DOI (Rogers, 1995)
	System privacy	(Parasuraman <i>et al.</i> , 2005)
Organisational factors	Training and technical support	UTAUT (Venkatesh <i>et al.</i> , 2003) TOE (Tornatzky & Fleischer, 1990)
	Management support	UTAUT (Venkatesh <i>et al.</i> , 2003) TOE (Tornatzky & Fleischer 1990)
Environmental factor	Government Support	TOE (Tornatzky & Fleischer 1990)
	External Support	TOE (Tornatzky & Fleischer 1990)

#### 4.8 Chapter Summary

The chapter has discussed various innovation adoption theories and the literature relating to previous research into the adoption of technology. UTAUT was chosen for this research because of its strength relative to other theories of adoption, and it was extended by the inclusion of factors from the T-O-E framework, because it is sufficiently flexible to make such inclusion possible and because of its ability to give a broader perspective on

how an innovation is adopted. The chapter went further by categorizing m-health adoption into four contexts, which are the individual, the technological, the organizational and the environmental. A total of eleven factors were identified and explained in detail.

The next chapter discusses the research methodology for this study.

## **CHAPTER 5: RESEARCH METHODOLOGY**

### **5.1 Introduction**

The method of gathering, evaluating and interpreting data for the purpose of finding answers to questions is known as research (Kumar, 2011). For research to be conducted successfully, it has to be done systematically. This systematic approach to seeking answers to research problems is known as a research methodology (Wilson, 2014). This chapter discusses the approaches used for this study, the method of data collection, and the sample selection. The chapter firstly explains research philosophy, approach, strategy and design of the research, and the techniques of data collection and analysis.

### **5.2 Research Paradigm**

Patton (1990), described a research paradigm as a world view and a way of breaking down the complexity of the real world. It is a way of looking at the social world and is composed of philosophical assumptions that guide thinking and action (Guba & Lincoln, 1994). Understanding the research paradigm in a study is very important because it provides the trajectory that helps put research in perspective. It is necessary to understand how to go about finding answers to the research questions relative to the phenomena under study. Essentially, a research paradigm describes knowledge development and the nature of that knowledge (Saunders, Lewis, & Thornhill, 2007)(Saunders et al., 2007). The choice of method used in conducting research depends on the paradigm guiding the research activity. Guba and Lincoln (1994) identify three factors that help define the research paradigm, which are ontology, epistemology and methodological assumption.

#### **5.2.1 Ontology**

This refers to belief about the nature of reality and asks about human perception of the social world (Wilson, 2014). In other words ontology studies what exists in the social world and the assumption of reality. It is used to discuss questions to build theories and understand the world better. Guba and Lincoln (1994) state that ontological

assumptions respond to the question: what exactly is reality's nature? Objectivism and subjectivism are the two broad views that determine the nature of a person's ontology. According to Neuman (2007), researchers with an objective view believe reality exists independently, while those with a subjective view believe that the outcome of reality is dependent on social processes. The difference between the two positions is based on how a researcher believes knowledge is created.

## **5.2.2 Epistemology**

The term epistemology relates to the nature of knowledge and the process of acquiring and validating it (Burrell & Morgan, 1979). Saunders *et al.* (2007), put it simply as what makes up an acceptable knowledge in a field of study. Epistemology is focussed on knowledge gathering and the development of new theories that are better than existing ones (Grix, 2002). Positivism and interpretivism are the two major positions held in epistemology.

### **5.2.2.1 Positivism**

The word positivism was first used by French philosopher Auguste Comte for his philosophical position that knowledge can be acquired through experience, which can be advanced through experiment and observation (Cohen *et al.*, 2013). Positivism takes an objective position independent of those involved in the study when conducting research (Wilson, 2014). Research that is based on this approach is usually devoid of a researcher's influence on the participants in the research, which makes it truly objective (Wilson, 2014). This approach uses a combination of deductive logic and empirical observation to ascertain causal laws that can be applied to large population to make predictions (Neuman, 2003). The law of cause and effect is used to govern research that adopts this approach, and it results in quantifiable data.

### **5.2.2.2 Interpretivism**

This research approach agrees that natural science can be used to study the physical world but is not suitable for studying the social world, which contains several characteristics that define it (Guba & Lincoln, 1994).

Understanding that the behaviour of an individual participant in the social world is not generalizable to a population is the main factor an interpretivist researcher considers when conducting research (Wilson, 2014, Guba & Lincoln, 1994). To put it simply, interpretivism seeks to understand human behaviour and the social world (Bryman, 2012). This paradigm is frequently used in qualitative research because its methods are inductive and it has high validity, as opposed to the generalising that takes place in the positivist approach.

The epistemological stance taken for this research is positivist. This stance was taken for the purpose of precision, because of its emphasis on observable fact. Also, the objective position of this approach makes the data collected truly reliable as it cannot be influenced by the researcher (Wilson, 2014). Although this research reflects the adoption of a positivist approach, it combines a quantitative and qualitative processes to produce a better understanding of the phenomenon under study.

### **5.3 Research Approach**

A researcher usually adopts either a deductive approach or an inductive approach, depending on the problem under study (Saunders *et al.*, 2007).

The deductive approach, as described by Lancaster (2005, pp 22), involves the use of a “set of techniques for applying theories in the real world in order to test and assess their validity.” It is an approach that involves the development and testing of a hypothesis or theory through empirical observation. This approach is commonly adopted in the natural sciences, where developed theories are subjected to rigorous testing in order to test their validity (Saunders *et al.*, 2007). Deductive reasoning is sometimes called the top-down approach because it moves from a theoretically expected pattern to observation that tests if the pattern actually exists (Barbbie, 2010). Deductive reasoning is characterised as operationalization, reductionism and generalisation. Operationalization ensures that concepts are measured quantitatively. This is then followed by the reduction of the concept into measurable smaller elements, and finally generalisation, with the use of the sample set (Saunders *et al.*, 2007).

On the other hand, the inductive approach aims at theory development in order to explain empirical observation of the real world (Lancaster, 2005). This can be likened to using a bottom-up approach whereby a researcher moves from specific observations to generalised theory (Lodico, Spaulding, & Voegtle, 2006). This empirical observation can be based on personal experiences or observed patterns from which hypotheses can be formulated and explored, which will finally result in the development of theories or the drawing of general conclusions. According to Lancaster (2005), the inductive approach is quite flexible in terms of sample size and because any sort of data or information can be used to develop theory.

The choice of the school of thought used in a research project is dependent on the available knowledge in the study area. Since inductive reasoning aims at theory development, this approach is suitable for a study where there is no available theory to guide the study and where the study is not concerned about making generalisations. However, in a case where there are existing theories and generalised conclusions are to be made, then a deductive approach is more suitable. This study employs the deductive approach to investigate the m-health adoption factors among healthcare workers because of the existence of prior knowledge in the field.

#### **5.4 Research Design**

A research design is the method adopted by a researcher to investigate a phenomenon and provide answers to questions about it (Kumar, 2011). It is a “blueprint for the collection, measurement and analysis of data created to answer research questions” (Sekaran & Bougie, 2016, pp 108). A research design could be explorative, descriptive or explanatory. Exploratory designs are used when the knowledge about a subject is limited and new ideas need to be generated (Gray, 2013). According to Babbie (2004), it is done to satisfy the researcher's curiosity to have a better understanding of the subject. Descriptive study is conducted when an existing phenomenon needs to be described. It aims at providing what is endemic to the issue under study through the description of situations and events (Gray, 2013). It usually involves using statistics to interpret the data. This type of research can be

conducted through a sample survey and is frequently longitudinal in nature. Lastly, explanatory research finds how and why a relationship exist between two aspects of a phenomenon (Kumar, 2011). It explores causal relationships and is performed through laboratory and field experiments. This research design aims to develop a theory that would be used to explain the subject under study, which in turn leads to generalisation.

A descriptive research design was applied in this research project. The study began by conducting an extensive literature review on the state of the healthcare system in Nigeria, followed by the identification of the current technology used for healthcare service delivery, which was then narrowed down to the use of mobile technology for healthcare purpose. A framework was developed from the work of previous authors, based on technology adoption theories found in the literature. Research questions and objectives were developed afterwards. Questionnaires and an interview protocol were developed from the research questions and objectives. To validate the research instruments, a pilot study was conducted and based on its outcome modifications were made to the research framework.

## **5.5 Research Method**

Research approach as defined by Creswell is the plan and procedure used in conducting research, It includes the method used in collecting, analysing interpreting data (Cresswell, 2014). The choice of a research approach should depend on the problem under study. There are three approaches that are used in studying a phenomenon. These are the qualitative, quantitative and mixed-method approaches. Quantitative approach may be adopted for the purpose of exploring and developing an understanding of an individual or group, or a social or a human problem (Cresswell, 2014). It is concerned with how people construct their experiences and their worlds, and the meanings they give to them (Merriam, 2002). Qualitative research is subjective in nature because it measures narrative data (Wilson, 2014). The data used in a qualitative approach can be gathered through interviews, observations and documents. Mixed approach uses both quantitative and qualitative processes in a research study.

This is done to have a complete understanding of the phenomenon been studied rather than what happens when using only the quantitative or qualitative approach, which have their limitations (Cresswell, 2014).

To this end, this research used both quantitative and qualitative methods to provide answers to the research questions. A survey questionnaire was designed to collect data from healthcare workers who represent the larger population of healthcare worker on the various tiers of healthcare in Nigeria. A questionnaire was seen as an appropriate instrument to gather the perceptions of healthcare workers on the possible factors that influence m-health adoption, because they are the primary users of the technology and getting their perspective on the possibility of its adoption is very important to its success in the country. Also, the opinions of managers, who are the decision-makers of the organisation was gathered through interview, on the issues related to the use of m-health technology in their organisation. Using this method made it possible to answer the research questions effectively.

## **5.6 Research Time Dimension**

In conducting a research project, time is considered as an essential factor, because it helps to determine the duration of the data collection activity (Brink *et al.*, 2018). Based on the time required for data gathering, a study can be cross-sectional or a longitudinal. Cross-sectional study is a type of study that is carried out at a particular point in time. As opposed to a cross-sectional study, a longitudinal study is often conducted over an extended period. For the purpose of this study, the cross-sectional research time dimension was employed. describes it as a study in which observations about a target population or phenomenon are collected at once within a limited timeframe. The data collection exercise is non-recurrent and involves a single set of participants, making it manageable and less time-consuming (Brink, Hilla *et al.*, 2018). This study is descriptive in nature and, as stated by Barbie (2010), a cross-sectional study is suitable for the study at hand.

## 5.7 Research Strategy

Research strategy as described by Bryman (2008), is the position of a researcher in relation to carrying out a study. The goal of research strategy is to guide a researcher on the effective method that can be applied in finding answers to research questions and achieving the research purposes. The research questions and objectives, the existing knowledge, time constraints, resource availability, and the philosophy guiding the study all influence the method of research chosen, since no strategy is superior to another (Saunders *et al.*, 2007). The various types of research strategy as identified by Saunders *et al.* (2007) are experiment, survey, case study, action research, grounded theory, ethnography and archival research. Survey research is a popular approach used in data gathering that involves a large number of respondents (Lancaster, 2005). It usually involves adopting the deductive approach used in descriptive and exploratory research (Saunders *et al.*, 2007). This method employs highly structured questionnaires for data collection. These projects answer questions of ‘who’, ‘what’, ‘where’ and ‘how’. This research strategy allows a researcher to collect quantitative data which can be analysed using descriptive and analytical inferential statistics. Although questionnaires are commonly used in survey research strategy, structured observation and structured interviews are also used for data collection (Saunders *et al.*, 2007). Furthermore, to ensure that this strategy is properly used, the researcher must ensure that the sample is properly representative, the questionnaire must be properly designed and tested, and finally the response rate must be adequate.

This study employed the mixed method approach to collect data from healthcare professionals due to their large population and also to perform statistical analysis on the data. As previously stated by Saunders *et al.* (2007), although data can be collected through questionnaires, interviews are also applicable, stating that the decision to use a specific research strategy should be informed by existing knowledge on the subject under investigation, time constraints, resource availability, research objectives, and the research philosophy, because no strategy is superior to another. To achieve the objective of the research, the need to consider all factors that adequately

influence m-health adoption is important, which means that data must be gathered on a wide spectrum of topics. Also, from a positivist philosophical standpoint, the deductive approach is typically used to test existing theories. Furthermore, in a situation where generalisation and large sample size are important, the survey research strategy is best suited for such a study. The present study follows the standard description of what a survey study involves.

### 5.8 Population of the Study

A population is the group of people or the element a researcher wants to generalize a finding to (Daniel, 2004). These are the actors or cases that can provide answers to research questions. The target population for this study consisted of healthcare workers and the management of selected Nigerian hospitals. The healthcare workers of the selected healthcare organisations are doctors, nurses, pharmacists, laboratory scientists, administrators and dieticians. The decision to include the managers of the hospital was taken because they are the decision-makers in these organisations and they have a better insight in providing answers to the questions asked. The study included participant from teaching hospital, private hospitals and healthcare centre. The total number of the target population was 1520.

**Table 5.1: Data Source on Sample Size**

Study Site	Healthcare workers	Data Source
Lagoon Hospital	100	Human Resource Department, Lagoon Hospital Ikeja Lagos
Reddington Hospital	90	General Manager, Reddington Hospital, Victoria Island Lagos
Isalu Hospital	60	Head of Human Resources, Isalu Hospital, Ogba Ikeja Lagos
St. Nicholas Hospital	150	Administrative head, St. Nicholas Hospital, 57 Campbell Street, Lagos Island.
LUTH	1100	Head of Ethics, Lagos university teaching hospital.
Iwaya Health Centre	20	Medical Officer, Yaba Local government Development Area
Total	1520	

## 5.9 Sampling

A sample can be defined as the selection of a relatively small group of cases drawn from a large population for an investigation, to predict a situation or an outcome regarding a larger population (Kumar, 2011). Getting data from an entire population is usually unrealistic. To effectively conduct such a study, a small representative group that shares certain relevant characteristic with the total population can be drawn. This is called a sample. The process by which a sample is drawn from a large population is called sampling. There are two forms of sampling and they are probability sampling and non-probability sampling. Probability sampling involves random selection from a large population, where everyone has an equal opportunity to be selected (Babbie, 2007) while non-probability sampling does not involve giving an equal opportunity to everyone. The key to probability sampling is random selection, as this captures the representativeness of the population of the study, based on their having an equal chance of selection. Types of probability sampling include simple random sampling, systematic sampling, stratified random sampling and cluster random sampling. Purposive sampling, snowball sampling, convenience sampling and quota sampling are some types of non-probability method. Some of types of probability sampling are discussed below. Simple random sampling is the type of random sampling where each member of the population has an equal chance of been selected. Stratified sampling allows a population to be grouped into strata based on predefined attributes, and afterwards a sample can be drawn from each stratum using simple random sampling (Kumar, 2011; Sekaran & Bougie, 2016). This type of sampling is used when there is a criterion guiding selection. Purposive sampling is based on the researcher's judgment of who can provide the best information needed to achieve the research objective (Kumar, 2011). According to Brink *et al.* (2018), the major benefit of this sampling technique is that it allows for sample selection based on the knowledge of the phenomena under study

A stratified sampling technique was used for this study, because the healthcare system under study is divided into different tiers based on its management. Nigerian teaching hospitals belong to the third tier of the healthcare

system, private hospitals could belong to all three tiers of healthcare based on the function they perform, and primary healthcare belongs to the lowest tier of the healthcare system. Also, interviews were conducted with managers of the organisations. The purposive, non-probability approach was adopted for this purpose. This was because of the need to gain insight into the factors that influence the adoption of m-health in hospitals and these answers could be provided only by those who manage the affairs of the organisation. These hospitals were chosen to ensure that various levels of the hospital system in Nigeria were represented. Afterwards, healthcare workers were randomly chosen to ensure that the perception of the use of technology were not restricted to the clinicians alone. The final data included six healthcare organisations, which were seen as representing the whole population of Nigerian healthcare workers.

### 5.10 Sample Size

This is the number of cases from which the information required for research project is obtained. The Krejcie and Morgan (1970) formula was used to calculate the sample size for study. The total population was 1520, consisting of 1,100 healthcare workers in Lagos University Teaching Hospital (LUTH), 60 healthcare workers in Isalu Hospital, 150 at Nicholas, 90 at Reddington, 20 at the healthcare centre, and 100 at Lagoon Hospital. Using the Krejcie and Morgan (1970) sample size formula, a sample of 255 respondent was drawn.

$$n = \frac{x^2 NP(1 - P)}{e^2(N - 1) + x(1 - p)}$$

Where

$X^2$  = Chi-square degree of freedom

P= Proportion of population

N= Population size

n= Sample size

e= Margin of error

The questionnaire was administered to each hospital, based on the calculation of the individual sample size for each healthcare facility using

$$SI = \frac{PI}{TP} \times 255$$

Where

SI = Individual sample size

PI= Individual population size

TP= Total population

The table below shows the sample frame for the distribution of the questionnaire

**Table 5:2: Research Sample**

Study Site	Population	Sample Size
Lagoon Hospital	100	17
Reddington Hospital	90	15
Isalu Hospital	60	10
St. Nicholas Hospital	150	25
LUTH	1100	184
Iwaya Health Centre	20	5
Total	1520	255

## **5.11 Data Collection Method**

Data collection is the process by which a researcher goes about providing answers to research question. There are several tools that are used for data gathering exercises such as questionnaires, observations, individual interviews and focus group interviews. A detailed explanation of the instrument used for this research is given below.

### **5.11.1 Questionnaire**

A questionnaire is a pre-developed set of questions to which the respondent answers, usually in a pre-determined manner (Sekaran & Bougie, 2016). They are usually a less expensive way of collecting a large amount of data. They are often used in gathering data in surveys. The questionnaires can be administered in three different ways: the face-to-face method (personally distributed), the online method and the mailed method.

### **5.11.2 Questionnaire development**

The questionnaire designed for this study was divided into six sections. The first section consisted of general information which was designed to collect basic information about the respondents and the hospitals they work in. The questions in section A included the demographic information of the respondent, such as age, gender, the type of hospital the respondent worked at, a description of the respondent's job and the staff strength of the organization. This section also included questions about the current use of ICT's such of mobile phones, laptops, desktops, internet and medical applications, and the respondent was asked to specify other types of technology used which were not included in the options given. Options were provided to respondents to rank the frequency of use of the ICT tools on a scale of 1 to 5, where 1 represented never and 5 represented very often. Next, the question of what the technology was used for was asked. Respondents were also asked about their knowledge of the use of mobile devices for healthcare service delivery by ticking boxes headed either yes or no. The question next to this was based on what the mobile devices were used for. The purpose of this section was to gather the demographic information of respondents as well as to learn the various ICT tools used for work, and what they are used for.

Section B assessed the individual factors that influence the adoption of m-health among healthcare workers in Nigeria through a Likert scale which represented their extent of agreement (where 1 = strongly disagree and 5= strongly agree).

Section C assessed the technological factors that influence the adoption of m-health among healthcare workers in Nigeria through a Likert scale which represented their level of agreement (where 1 = strongly disagree, to 5= strongly agree).

Section D assessed the organisational factors that influence the adoption of m-health among healthcare workers in Nigeria through the Likert scale which represented their level of agreement (where 1 = strongly disagree, to 5= strongly agree).

Section E assessed the environmental factors that influence m-health acceptance among healthcare workers in Nigeria through a Likert scale which represented their degree of agreement (where 1 = strongly disagree, to 5= strongly agree).

The possibility of m-health technology adoption was investigated in section F, using a Likert scale of 1 to 5 (where 1 = strongly disagree, to 5= strongly agree). Lastly, 'barriers to adoption' was the topic in section G, and respondents were asked to rate them on a scale of 1 to 5. The section listed various factors that influence the adoption of m-health technology, ranging from individual factors to environmental factors. The intention of the respondent to adopt this technology was also assessed in this section, and lastly what potential barrier could hinder the adoption of m-health.

The questions were based on the theories tested in this research so that answers to the research questions could be provided. Some of the questions in the survey instrument were adapted from a past study on m-health adoption, while the rest were formulated by the researcher.

## 5.12 Interview Protocol

An interview is a method of data collection a researcher uses to gather information from a participant for research purposes. An interview is a guided, purposeful conversation between two or more people (Sekaran & Bougie, 2016). Interviews can be categorised as structured, semi-structured or unstructured. A structured interview is an interview where a pre-planned sequence of questions is prepared by a researcher before entering an interview. An unstructured interview is an interview where an interviewer does not have a planned sequence of the question to ask when in the interview. A semi-structured interview is an interview where an interviewer prepares some open-ended questions on the topic under investigation but also allows discussion of other issues related to the topic. This type of interview gives an interviewer the opportunity to give prompts to the interviewee where a question is not understood or too brief a response was given (Mathers *et al.*, 2002). Also, an interview could be conducted face-to-face, online, or telephonically.

Both questionnaires and interviews were used for data collection in this study. The questionnaires were administered using both the personal method and the electronic method. The electronic method was chosen because one of the organisations specifically requested that a copy of the questionnaire should be sent to them, which they later forwarded to the email addresses of their staff for them to print and fill out the questionnaire. Some of the questionnaires that were administered using the personal method were handed over to a representative in the administrative department of the hospital and later distributed to the healthcare workers of the hospital. A date was fixed for the questionnaires to be collected. Although the researcher had made provision to use the online survey method, this was not welcomed by the hospitals. Also, for hospitals to whom access was granted to the researcher, the questionnaires were personally administered to the healthcare workers. On the day the questionnaires were administered, the researcher approached the study site and the purpose of the visit was explained. The researcher remained on site until the questionnaires had been completed to ensure that questions that needed clarity were addressed if need be. It took about 15 to 20 minute to complete the questionnaire and

afterwards it was handed back to the researcher. Of the 255 questionnaires distributed only 220 were returned, with only 201 of them usable, which makes the response rate 79 per cent.

A semi-structured interview with managers of the hospitals was also used for this study to obtain information relating to the technology available, the policies in place, and the infrastructural capacity in existence. The interviews were conducted both face-to-face and by telephone, depending on the interviewees' preference. The interviews were recorded using a mobile phone. They were recorded so that the interviewer could always go back to them if the need arose, and it also helped to concentrate the mind and to stop the interviewees from repeating themselves, as happens in the note-taking process. Prior to the commencement of the interviews, the interviewees consent was obtained. Only 3 managers on the 6 health sites consented to be interviewed. These were at Isalu Hospital, Lagos University Teaching Hospital (LUTH) and the Primary Health Centre of the Yaba local council development area. Each interview lasted for about 30 minutes

### **5.13 Pilot Testing**

Pilot testing as defined by Abu Hassan *et al.* (2006) is a small study to test research protocols, data collection instruments, sample recruitment strategies, and other research techniques in preparation for a larger study. In other words, a pilot study is a process of pre-testing a research instrument with a smaller sample before using the instrument for the actual study. The reason for this is to identify the shortcomings of the instrument and improving on them to ensure the quality of the main study. The questionnaire used for this study was pre-tested with 30 respondents who were healthcare workers. The questionnaire was then improved, based on comments from the respondents and the researcher's analysis.

### **5.14 Validity**

Sekaran & Bougie (2016:150) defined validity as "the test of how well an instrument that is developed measures the particular concept it is intended to measure." It helps with knowing whether the concept specified in the

research are measured accurately. According to Kumar (2011) face or content validity, construct validity and concurrent or predictive validity are the common type of validity technique used in research. Face or content validity assesses the extent to which a measuring instrument is measuring what it intends to measure, based on the logical link between the research questions and the objectives of the research. Construct validity addresses how well the results derived from the measurements fit the theories around which they were designed (Sekaran & Bougie, 2016). Concurrent validity is based on how well an instrument compares with a second assessment concurrently done, while predictive validity can be assessed based on its ability to predict the outcome of the research (Sekaran & Bougie, 2016; Kothari, 2010).

The survey instrument used in the context of this research was subjected to tests of content and face validity. In terms of content validity, the researcher conducted an extensive study of the literature on previous studies to understand how the construct that relates to the research framework, as well as the research objectives, were defined, and the context in which they were used. This was done to ensure that the content of the research instrument correctly reflected the research questions and the objectives of the research. After the content analysis had been done, the researcher further approached four healthcare workers to test the face validity of the research instrument. The questionnaire was given to them, and they were asked to carefully examine it and give their opinion on it. This was to ensure that the issue of ambiguity was addressed before going to the field, and also so that they could make contributions where necessary. Concerns regarding the ambiguity of questions identified by the healthcare workers were addressed, and so the research instrument was modified to ensure clarity.

### **5.15 Reliability**

A measuring instrument that produces consistent result when used to collect the same type of information under the same or similar condition is regarded as reliable (Kumar, 2011). The coefficient of reliability varies from 0 to 1 (Lodico et al, 2006). The characteristics of reliability commonly evaluated include stability, internal consistency

and equivalence reliability (Brink et al, 2018). According to Sekaran and Bougie (2016), the stability of an instrument can be measured using either the test/re-test or parallel-form reliability. Test/re-test method uses an instrument more than once under the same conditions with the same set of respondents while parallel-form reliability involves having a high correlation between two set of measures of same construct. Lodico et al (2006), stated that internal consistency refers to the uniformity within a measuring instrument. It addresses how well the questions on survey instrument measures a common variable (Brink et al, 2018). Split-half reliability and Cronbach's alpha coefficient can be used to determine the internal consistency of an instrument. Split-half reliability shows the reliability between the two halves of an instrument while Cronbach's alpha co-efficient are often used in very structured quantitative survey instrument. Equivalence reliability is the type of reliability whereby a parallel form of the same test is given to participants. The scores on the forms are then compared to determine the correlation between them.

In this study, Cronbach's alpha was used to test for the internal consistency of the scale used in the questionnaire. The relationship between items are shown by their correlation in Cronbach's alpha coefficient (Sekaran & Bougie, 2016). Cronbach's Alpha coefficient ranges from 0 to 1. The closer the coefficient is to 1, the higher the internal consistency. Reliability less than 0.6 is generally said to be poor, a figure around 0.7 is well accepted, and anything above 0.8 is referred to as good (Sekaran & Bougie, 2016).

The data collection process took five weeks. Afterwards the questionnaires were sorted by separating the useable ones from those that were unusable. Data coding from the questionnaire was done with the SPSS software, and Nvivo was used to identify the separate themes in the qualitative data.

## **5.16 Data Analysis**

The analysis began with the cleaning of the data. This was to ensure that responses that were not usable were separated from those that were. This was followed by a data coding exercise. Data coding is done to categorise

data according to their type before typing them in. After the data had been entered, missing and invalid responses that were out of the range coded by the researcher were taken care of before the analysis of the data began. A total of 201 responses were found to be usable and were entered into the (SPSS) software. Statistical analysis is very important in quantitative research in order to make sense of the data gathered. According to Brink *et al.*, (2018) it enables researchers to reduce, summarise, manipulate, interpret and communicate the results of quantitative data. Therefore, descriptive and inferential statistics were performed on the data. Descriptive techniques are used in describing and presenting data using measures such as the mean, median, mode, variance, and standard deviation, which are often presented with the use of graphs, charts and tables (Cohen, 2007). Inferential statistics was used to check relationship among variables from sampled data. Multiple regression was used in this research. P-values were generated for predictor variables, which were used to test hypotheses.

The Nvivo software was used to analyse qualitative data derived from the interviews. According to QSR international (2021), the software helps to import, sort and analyse data from various sources, thereby examining the relationship between data which are combined by linking, shaping, searching and modelling. Given the software qualities, which include robust text capabilities and multimedia functionalities necessary for organising data in qualitative research, it produces more rigour and precision in analysis (Zamawe, 2015). It also aid in completing activities such as data management and organization, understanding of theoretical and conceptual concerns raised during study, data modelling and reporting and enhances further investigation into generated data (Hamed Hilal & Said Alabri, 2013). It works well with a variety of research design, including phenomenology, mixed methods, discourse analysis, and others (Sanusi, 2019). Additionally, it has been demonstrated to be quite helpful for time management, convenient location, and theme classification (Dollah, Abduh, & Rosmaladewi, 2017) and as a result Nvivo was considered appropriate for this study given the outlined benefits and suitability with the research design.

### **5.17 Ethics**

According to Gray (2004), research ethics is related to the appropriateness of the conduct of a researcher concerning a research subject or those directly affected by the research. Ethical considerations involving research participants, as stated by Akaranga and Makau (2016), include: advocacy and safety, anonymity, confidentiality and privacy, beneficence, deception, non-maleficence and voluntary and informed consent. The researcher adhered strictly to all instructions provided by the University of KwaZulu-Natal social science and humanities ethics committee. Before beginning the data collection process, an application for ethical approval was submitted, and the institution provided a gatekeeper clearance. The researcher next went to the administrative department head of the hospital to ask for permission to conduct a survey.

The researcher subsequently requested the involvement of hospital administrators and other staff members in their offices, to which they had been granted access. The researcher explained the purpose of the study and the value of consent to the participants. A consent form and a questionnaire were given to those who agreed to participate in the study. Even though research participants' confidentiality was assured, some of them did not include their names for fear of losing their anonymity. The head of administration signed the consent form, noting that it covers the entire staff, in the case of hospitals where the research instrument was requested to be delivered to a representative to distribute among the healthcare personnel.

### **5.18 Chapter Summary**

This chapter has discussed the methodology adopted for this research. The study was conducted from a positivist standpoint. Data collection exercise was done using mixed method. A validated questionnaire was used to collect data from 255 healthcare workers, but only 220 were returned. Out of the 220 returned only 201 were found usable. Also, managers of three hospitals were interviewed so that they could give their perspective on the factors influencing m-health adoption in their organizations. Participants were selected through stratified random

sampling, while purposive non-random sampling was employed in the selection of the interviewees. Quantitative data were analyzed with descriptive and inferential statistic. The researcher ensured that ethical standards were strictly adhered to in the process of data collection. The findings of the data analysis are presented in the chapter six.

## **CHAPTER 6: DATA ANALYSIS AND FINDINGS**

### **6.1 Introduction**

This chapter focusses on the analysis of the data and the presentation of the findings. The main purpose of this is to answer the research questions put forward by the researcher. There are two parts in this. The first part analysed the data collected by using the questionnaire using descriptive statistics such as frequency count and percentages. In addition, regression analysis and the analysis of variance (ANOVA) were used to test the hypotheses. The second part of the section presents the qualitative data, which are coded and analysed in line with the research questions.

### **6.2 Reliability Analysis**

A measuring instrument is said to be reliable if it produces a consistent results when used to collect the same type of information under the same conditions over time (Kumar, 2011). Cronbach's alpha was used to test the internal consistency of the scale used in the questionnaire answered by the respondents in the study. Reliability of below 0.6 is considered weak. Anything in the range of 0.7 is well accepted and anything above 0.8 is referred to as good (Sekaran & Bougie, 2016). As shown in Table 1.1, the internal consistency for each section was close to or over 0.7, which indicates that the instrument used was reliable.

**Table 6:1: Reliability of Questionnaire**

Questions per Section	N	Number of items	Cronbach's Alpha Value
Current ICT tools used to perform your duties	201	5	0.707
Use of technology for work-related purposes	201	7	0.784
Current use of mobile devices (m-health) for work	194	6	0.792
Individual factors influencing m-health adoption	196	8	0.717
Technological factors influencing m-health adoption	199	7	0.726
Organisational factors influencing m-health adoption	201	4	0.901
Environmental factors influencing m-health adoption	200	5	0.857
Potential adoption of m-health	201	3	0.850
Potential barriers to the adoption of m-health	201	5	0.716
Overall	188	56	0.816

### 6.3 Demographic Description

In relation to the adoption of innovations, Venkatesh et al. (2003) emphasised the significance of demographic data on technology users, such as their age and gender. Likewise, the survey sample as depicted in Table 6.2 shows that the majority of the respondents were females (107; 53.2%) while the 94 males made up 46.8% of the total number of the respondents. The findings further show that most of the healthcare workers were young adults whose ages ranged between 26 and 35 years (45.3%). Furthermore, majority of the participant were doctors as indicated by research data (64; 31.8%), closely followed by other professionals (55; 27.4%), who included medical laboratory scientists, radiologists, physiotherapists and dieticians.

**Table 6:2: Demographic Description of the Respondents**

S/N	Variable	Category	Frequency	Percentage
1	Gender of the respondents	Male	94	46.8
		Female	107	53.2
		Missing	0.0	0.0
		Total	201	100
2	Age	Between 20 and 25	42	20.9
		Between 26 and 35	91	45.3
		Between 36 and 45	47	23.4
		Above 45	21	10.4
		Total	201	100
3	Healthcare type	Primary healthcare centre	6	3
		Private hospital	59	29.4
		Federal medical centre	4	2
		General hospital	2	1
		Teaching hospital	130	64.7
		Total	201	100
4	Job description	Administrator	18	9.0
		Nurse	47	23.4
		Pharmacist	17	8.5
		Doctor	64	31.8
		Others	55	27.4
		Total	201	100
5	Staff strength	Below 20	9	4.5
		Between 20 and 40	5	2.5
		Above 40	181	90.0
		Missing	6	3.0
		Total	201	100

#### **6.4 Research objective 1: To Investigate Information and communication tools available for service delivery among healthcare workers in Nigerian hospitals**

In order to determine how this experience affects the acceptance of m-health in the healthcare sector, this research aim helps to assess the availability of ICT tools and how they are utilised at work. Dillon and Morris (1996) stated that prior experience from previous technology use has a great influence on the adoption of new technology. Consequently, it was deemed crucial to look at how existing technology might be used to examine the effects on mobile health. Table 6.3 shows that 64.7% of healthcare providers use the internet often and very often, making it the most used ICT tool in the healthcare sector of Nigeria. Mobile phones are the second most used tool with 62.2%, as depicted in the table, while desktop computers showed to be the least used with 42.8%.

**Table 6.3: Current ICT Tools for Healthcare Service Delivery**

S/N	Technology Type	Never	Rarely	Sometimes	Often	Very often	Often + very often
1	Mobile phone	26 (12.9%)	13 (6.5%)	37 (18.4%)	38 (18.9%)	87 (43.3%)	62.2%
2	Laptops	27 (13.4%)	25 (12.4%)	39 (19.4%)	46 (22.9%)	64 (31.8%)	54.7%
3	Desktop computer	36 (17.9%)	48 (23.9%)	31 (15.4%)	20 (10.0%)	66 (32.8%)	42.8%
4	Internet	16 (8.0%)	26 (12.9%)	29 (14.4%)	39 (19.4%)	91 (45.3%)	64.7%
5	Medical applications	32 (15.9%)	25 (12.4%)	32 (15.9%)	50 (24.9%)	59 (29.4%)	54.3%

Additionally, the study used descriptive statistics to assess the area of ICT usage. Table 6.4 below shows that mobile phones were chiefly used for healthcare worker communication (67.2 %), which use was followed by

creating health awareness (41.3%) and the tracking of diseases and epidemic outbreaks (38.8%). Also, the table shows that mobile phones rank higher than other technology in the workplace. Laptops were also found to be used more than any other technology, and it was reported that they are often used for training purpose. They were also said to be used for other work purposes which were not identified by the respondents, but some respondents said that most of the jobs done are still paper-based. Technology such as the land-line phone was found to be used quite often for intra-departmental communication in the private healthcare sector.

**Table 6:4: Purpose of ICT for Health Service Delivery**

S/N	Work Related Use	Mobile Phone	Landline Telephone	Desktop	Laptop	Tablet	Others	Total
1	Remote Data Collection	72 (35.8%)	2 (1.0%)	46 (22.9%)	37 (18.4%)	6 (3.0%)	38 (18.9%)	201 (100%)
2	Disease and Epidemic Outbreak Tracking	78 (38.8%)	8 (4.0%)	36 (17.9%)	28 (13.9%)	6 (3.0%)	45 (22.4%)	201 (100%)
3	Diagnostic Support	62 (30.8%)	7 (3.5%)	51 (25.4%)	36 (17.9%)	3 (1.5%)	40 (20.9%)	201 (100%)
4	Remote Patient Treatment and Monitoring	80 (39.8%)	12 (6.0%)	30 (14.9%)	18 (9.0%)	6 (3.0%)	55 (27.4%)	201 (100%)
5	Health Workers Awareness/training	83 (41.3%)	5 (2.5%)	27 (13.4%)	53 (26.4%)	2 (1.0%)	31 (15.4%)	201 (100%)
6	Communication with Other Healthcare Professionals	135 (67.2%)	25 (12.4%)	15 (7.5%)	13 (6.5%)	1 (0.5%)	12 (6.0%)	201 (100%)

S/N	Work Related Use	Mobile Phone	Landline Telephone	Desktop	Laptop	Tablet	Others	Total
7	Health Workers' Training	53 (26.4%)	9 (4.5%)	26 (12.9%)	76 (37.8%)	0	37 (18.4%)	201 (100%)

**6.5 Research object 2: To assess healthcare workers' knowledge of mobile device use for service delivery and the purpose of use.**

Though the scalability and adoption of m-health is still challenged globally (Oyungerel et al. 2020), healthcare workers were tested on their knowledge of mobile device use for delivering health services. Figure 3 reveals that the majority of the respondents (164; 81.59%) are knowledgeable about the use of mobile phones for healthcare service delivery, while 36 (17.91%) of the respondents were not aware of their use.

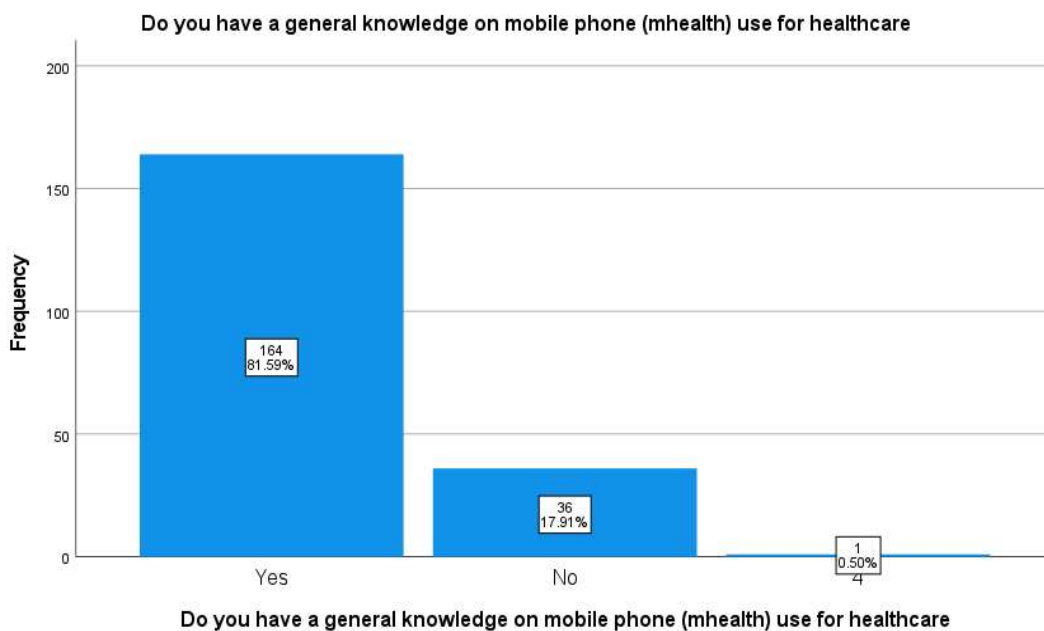


Figure 6:1 Knowledge of Mobile Phone Use for Healthcare Purposes

Furthermore, the current use of m-health was also examined. Table 6.5 below depicts the various uses of m-health among healthcare workers. The results show that mobile phones are mostly used in communicating with other healthcare workers, with 78.1% of the respondents indicating that they do so frequently. The data shows that mobile devices are used quite often for health awareness and education purposes, with 61.2% of the respondents indicating that they do this frequently, 50% of the respondents saying that they use them for patient monitoring, and 45.3% saying they use them for booking appointments. On the other hand, only 27.8% and 25.8% of the respondents indicated that they use m-health for medication refill purposes and mobile telemedicine. This implies that although the healthcare providers are not quite familiar with the term m-health, they are aware of the use of a mobile device platform for service delivery.

**Table 6:5: Current Use of a Mobile Phone for Service Delivery in Your Organisation**

S/N	Work-related Purpose	Never	Rarely	Sometimes	Often	Very Often
1	Appointment Booking	50 (24.9%)	15 (7.5%)	45 (22.4%)	43 (21.4%)	48 (23.9%)
2	Mobile-telemedicine (Teleconsultation)	58 (28.9%)	45 (22.4%)	46 (22.9%)	22 (10.9%)	30 (14.9%)
3	Sending SMS for Drug Refill	75 (37.3%)	30 (14.9%)	36 (17.9%)	35 (17.4%)	21 (10.4%)
4	Communicating with Other Health workers	2 (1.0%)	8 (4.0%)	34 (16.9%)	74 (36.8%)	83 (41.3%)
5	Patient Monitoring	19 (9.5%)	32 (15.9%)	47 (23.4%)	53 (26.4%)	47 (23.4%)
6	Health Education and Health Awareness	13 (6.5%)	21 (10.4%)	43 (21.4%)	78 (38.8%)	45 (22.4%)

## 6.6 Research Objective 3: Factors influencing m-health Adoption

The main objective of this research is to determine the various factors that influence healthcare workers' adoption of m-health technology in the Nigerian healthcare system. Four distinct contexts were used to group the factors, which include individual, technological, organizational, and environmental concerns. Bally & Cesurogu (2020) claim that the interaction between a number of stakeholders is crucial to the acceptance of m-health in a complicated health system. As a result, each category of the research findings is covered below.

### 6.6.1 Individual factors influencing m-health adoption

This depicts variables relevant individual healthcare worker sample for this study. Table 6:6 below shows the individual factors that influence adoption. The results obtained from the table indicate that more than 80% of the respondents agree or strongly agree that individual factors influence m-health adoption. From the analysis of the result obtained, self-efficacy ranks high among m-health technology determinant in the individual context, which makes it the factor that can most usefully be taken into consideration in promoting the adoption of m-health technology.

**Table 6:6: Individual Factors Influencing m-Health Adoption**

S/N	Individual factors	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
1	I can confidently use a mobile phone for health purposes	2 (1.0%)	3 (1.5%)	18 (9.0%)	98 (48.8%)	80 (39.8%)
2	I am confident in my ability to use mobile technology for health-related purposes	0	1 (0.5%)	19 (9.5%)	89 (44.3%)	91 (45.3%)
3	If I have someone to show me how, I am sure I can use m-health solutions	2 (1.0%)	11 (5.5%)	6 (3.0%)	87 (43.3%)	92 (45.8%)

S/N	Individual factors	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
4	I will use m-health if I have a lot of time on my hands to complete my job	3 (1.5%)	17 (8.5%)	14 (7.0%)	98 (48.8%)	67 (33.3%)
5	With my experience with computer technology, I can confidently use mobile based technology	3 (1.5%)	3 (1.5%)	13 (6.5%)	100 (49.8%)	82 (40.8%)
6	I believe m-health is a useful tool for providing services	3 (1.5%)	3 (1.5%)	28 (13.9%)	100 (49.8%)	67 (33.3%)
7	I prefer m-health to other technology	4 (2.0%)	14 (7.0%)	97 (48.3%)	59 (29.4%)	27 (13.4%)
8	M-health reduces patient waiting time	2 (1.0%)	10 (5.0%)	42 (20.9%)	97 (48.3%)	50 (24.9%)

## 6.6.2 Technological factors influencing m-health adoption

Features relating to m-health technology and their functionality were assessed here. Table 6.7 below indicates that over 60% of the respondents either strongly agree or agree that technological factors influence the adoption of m-health in their organisations. The findings also show that m-health increases patient access to healthcare. This ranks high among the technological factors, while the least favoured factor is that m-health is always available to use provided there is no network downtime.

**Table 6:7: Technological Factors Influencing m-Health Adoption in the Organisation**

S/N	Technological factors	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
1	m-Health use increases my professional performance	3 (1.5%)	4 (2.0%)	32 (15.9%)	97 (48.3%)	65 (32.3%)
2	m-Health increases patient access to healthcare services	4 (2.0%)	7 (3.5%)	19 (9.5%)	104 (51.7%)	67 (33.3%)

S/N	Technological factors	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
3	m-Health helps to complete patient care more quickly	5 (2.5%)	8 (4.0%)	42 (20.9%)	104 (51.7%)	42 (20.9%)
4	m-Health solutions are easy to use	2 (1.0%)	0	46 (22.9%)	114 (56.7%)	39 (19.4%)
5	Healthcare workers finds it easy to use m-health in interacting with patients	0	5 (2.5%)	72 (35.3%)	87 (43.8%)	38 (18.9%)
6	m-health is compatible with the nature of my work	2 (1.0%)	12 (6.0%)	30 (14.9%)	109 (54.2%)	48 (23.9%)
7	m-health ensures the privacy of information	5 (2.5%)	17 (8.5%)	75 (37.3%)	73 (36.3%)	31 (15.4%)

### 6.6.3 Organisational factors influencing m-health adoption

Here, the internal organisational factors of management and technical support for the adoption of m-health were examined. Table 6.8 demonstrate that only about 40% of the respondents either strongly agree or agree with the organisational factor that affect m-health adoption in their workplace. However, the hospital provides adequate technical support for m-health technology ranked high among the organisational factors while the factor least agreed on was management is willing to invest funds in the use of m-health technology.

**Table 6:8: Organisational factors influencing m-health adoption**

S/N	Organisational factors	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
1	The hospital provides adequate training on the use of m-health technology	25 (12.4%)	49 (24.4%)	54 (26.9%)	59 (29.4%)	14 (7.0%)
2	The hospital provides adequate technical support for m-health technology	32 (15.9%)	46 (22.9%)	42 (20.9%)	62 (30.8%)	19 (9.5%)
3	The management provides resources to use m-health solution	34 (16.9%)	46 (22.9%)	45 (22.4%)	58 (28.9%)	18 (9.0%)

S/N	Organisational factors	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
4	Management is willing to invest funds in the use of m-health technology	27 (13.4%)	40 (19.9%)	83 (41.3%)	41 (20.4%)	10 (5.0%)

#### 6.6.4 Environmental factors influencing m-health adoption

Finally, how government support and telecommunication issues impact m-health adoption were investigated. Table 6.9 below reveals the environmental factors influencing m-health technology adoption in the organisation. The table above shows that barely 50% of the respondents strongly agree or agree with the statement concerning the environmental influence m-health technology adoption in their organisation. The order of influence showed that the ‘telecommunication network is good enough to support m-health technology’ ranked high while ‘there is strict compliance to m-health is the least among organizational factors.

**Table 6:9: Environmental Factors influencing m-health technology adoption**

S/N	Environmental factors	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
1	Government policy supports the use of mobile phones for healthcare service delivery	20 (10.0%)	29 (14.4%)	89 (44.3%)	48 (23.9%)	15 (7.5%)
2	There is sound healthcare legislation and regulation guiding the use of m-health	27 (13.4%)	24 (11.9%)	106 (52.7%)	35 (17.4%)	9 (4.5%)
3	There is strict compliance to m-health use	28 (13.9%)	36 (17.9%)	87 (43.3%)	36 (17.9%)	14 (7.0%)
4	Cost of telecommunication Network is affordable to support this innovation	21 (10.4%)	41 (20.4%)	51 (25.4%)	69 (34.3%)	18 (9.0%)
5	The telecommunication network is good enough to support m-health technology	14 (7.0%)	25 (12.4%)	53 (26.4%)	80 (39.8%)	29 (14.4%)

## 6.7 Potential Adoption of m-Health Technology

Table 6.11 below indicates that more than 80% of the participants strongly agreed or agreed to the statements on the potentials to adopt m-health technology in their organisation. The order of ranking to which the strongly agree/agree is as follows: ‘I intend to learn about m-health services’ ranks high while ‘I have strong intention to use m-health services’ ranks low among adoption potentials.

**Table 6:10: Potential adoption of m-health technology**

S/N	Adoption Intention	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
1	I have a strong intention to use m-health services	0	7 (3.5%)	21 (10.4%)	113 (56.2%)	60 (29.9%)
2	I intend to use m-health services	0	6 (3.0%)	22 (10.9%)	113 (56.2%)	60 (29.9%)
3	I intend to learn about m-health services	1 (0.5%)	5 (2.5%)	9 (4.5%)	111 (55.2%)	75 (37.3%)

## 6.8 Possible Barriers to m-Health Adoption in Nigeria

Table 6.10 below shows the various barriers to m-health adoption in some selected organisation in Nigeria. More than 70% of the respondents strongly agreed/agreed to the statements connected to the barriers to m-health adoption in their organisations. In order to show the ranking in which each act as barriers; 78.1% of respondent agreed that unreliable network connection affects m-health adoption which makes it the highest barrier to m-health adoption while 40.3% agreed that privacy and security concern inhibit the adoption of m-health

**Table 6:11: Barriers to m-health adoption in Nigeria**

S/N	Barriers to m-health	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
1	Lack of skill to develop m-health application affect m-health technology adoption	5 (2.5%)	26 (12.9%)	38 (18.9%)	100 (49.8%)	32 (15.9%)
2	Unreliable network connection is a barrier to m-health adoption	2 (1.0%)	17 (8.5%)	25 (12.4%)	13 (53.7%)	49 (24.4%)
3	High cost of internet bundle is a barrier to m-health adoption	7 (3.5%)	13 (6.5%)	33 (16.4%)	99 (49.3%)	49 (24.4%)
4	Privacy and security concern inhibit the adoption of m-health technology	8 (4.0%)	33 (16.4%)	71 (35.3%)	69 (34.3%)	20 (10.0%)
5	Lack of interest to use technology from health professionals impedes m-health adoption	22 (10.9%)	16 (8.0%)	52 (25.9%)	81 (40.3%)	30 (14.9%)

## 6.9 Regression Analysis

Regression analysis was used in this study to determine the impact of independent variables on adoption intention. Before proceeding with regression analysis, the test for normality was carried out to ensure that normality assumption was not violated. A normality test is important in research whose goal is to make inference (Tabachnick & Fidell, 2007). Normality is said to be the degree to which data corresponds to normal distribution (Hair, 2010). One of the methods to test for normality is the use of the histogram residual plot whereby the shape of data distribution of a continuous variable correspondence to normal distribution. As depicted in figure 6.2 below the normality assumption is addressed as the histogram follows a normal curve.

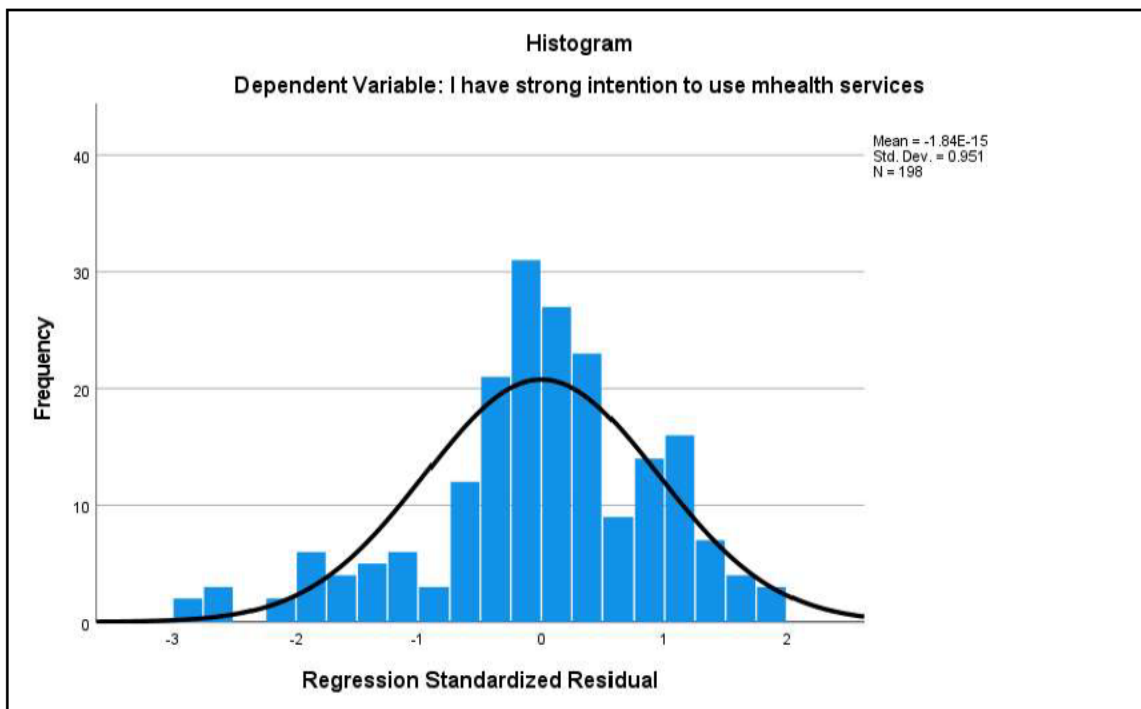


Figure 6:2: Normal distribution curve

**Table 6:12: Model Summary**

Model Summary <sup>b</sup>					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.417 <sup>a</sup>	.174	.125	.684	1.942
Dependent Variable: intention to adopt m-health services					

Based on the result shown in table 6.12, the correlation coefficient value obtained was 0.417 which indicate the existence of a relationship between the independent variables (Mobile self-efficacy, experience, attitude, performance expectancy, effort expectancy, compatibility, system reliability, technical support and training, management support, government regulation and external support) and dependent variable (m-health adoption).

Also, the coefficient of determination (adjusted R square) of 0.125 was obtained. The obtained value for Durbin-Watson is 1.942 indicating the absence of first order serial correlation.

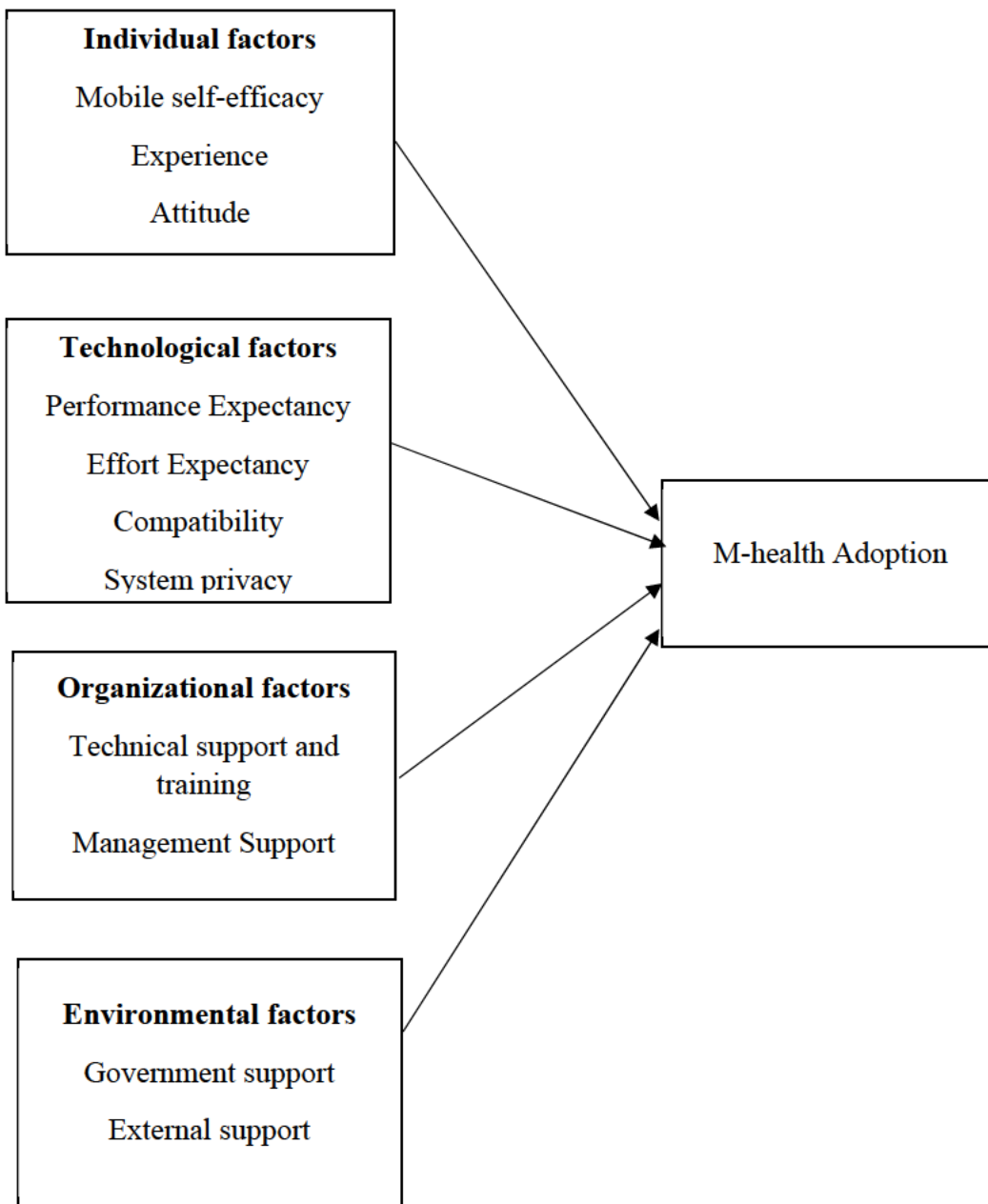


Figure 6.3: Conceptual Framework

**Table 6:13: ANOVA<sup>a</sup>**

ANOVA <sup>a</sup>						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.394	11	1.672	3.575	.000 <sup>b</sup>
	Residual	87.465	187	.468		
	Total	105.859	198			
Dependent Variable: Intention to adopt m-health services						

According to Cohen *et al.* (2007), it is important to establish the existence of a statistical relationship between the independent and dependent variables before proceeding with analysis. As presented in table 6.13, the results show that there is a statistical significance between the independent variables and dependents variables at  $p < 0.05$  ( $F(11, 187) = 3.575, p = 0.000$ ). This means that the independent variables are suitable to explain m-health adoption among healthcare workers.

### 6.10 Multicollinearity

According to Hair *et al.* (2014), multicollinearity refers to the existence of a strong correlation among independent variables. When there is a really strong correlation between independent variable variables (that is, when a correlation is above 0.9 between independent variables) then multicollinearity issues occur. This affects the predictive power of each independent variable, which makes interpretation difficult (Hair *et al.*, 2014). Multicollinearity can be tested either by using a correlation matrix or by using the tolerance and variance inflation factor method. For this study, tolerance and VIF were used to test for multicollinearity. As stated by Hair *et al.* (2014), the tolerance should be greater than 0.10 and the VIF cut-off should be 10. As shown in table 6.14, the tolerance value of each variable is greater than 0.1 and less than 10. This indicates the absence of multicollinearity between the independent variables.

**Table 6:14: Coefficients<sup>a</sup>**

Coefficients <sup>a</sup>								
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.411	.478		5.047	.000		
	Mobile self-efficacy	.217	.082	.199	2.655	.009	.783	1.277
	Experience	-.173	.073	-.184	-2.379	.018	.737	1.356
	Attitude	.119	.073	.131	1.624	.106	.679	1.472
	Performance expectancy	.016	.064	.018	.242	.809	.826	1.211
	Effort expectancy	.128	.061	.155	2.089	.038	.802	1.247
	Compatibility	.078	.065	.091	1.206	.229	.781	1.280
	System reliability	-.044	.056	-.057	-.789	.431	.839	1.192
	Training and technical support	.007	.078	.010	.086	.932	.321	3.120
	Management support	-.145	.083	-.212	-1.738	.084	.296	3.380
	Government regulation	.119	.059	.169	2.007	.046	.622	1.608
External support	.107	.054	.150	1.993	.048	.784	1.276	

a. Dependent variable: intention to adopt m-health services

### 6.11 Hypothesis Support

This section shows the result of hypothesis testing using regression analysis. Based on the results obtained from Table 6.14 above, some factors were found to be non-significant, hence not supporting the hypothesised relationship for m-health adoption in the Nigerian healthcare context. The following conclusions can be drawn regarding the hypotheses:

The table indicates that 5 items are significant, with their p-values lower than 0.05. The significant variables include mobile self-efficacy ( $\beta=0.217$ ;  $p=0.009$ ), experience ( $\beta=-0.173$ ;  $p=0.018$ ), effort expectancy ( $\beta=0.128$ ;  $p=0.038$ ), government support ( $\beta=0.119$ ;  $p=0.046$ ) and external support ( $\beta=0.107$ ;  $p=0.048$ ).

The unstandardized coefficient ( $\beta = 0.217$ ;  $p = 0.009$ ) depicts a statistical relationship between m-health adoption and mobile self-efficacy (H1). This implies the existence of a positive and significant relationship between mobile self-efficacy and the intention to adopt m-health. It can therefore be deduced that as self-efficacy increases, adoption of m-health increases as well. Hence H1 was accepted.

The second hypothesis (H2), which tests the relationship between experience and m-health adoption, shows an unstandardized coefficient ( $\beta=-0.173$ ;  $p=0.018$ ) implying a significant and negative relationship between the variables. This means that the negative experience from previous technology would affect adoption intention, hence the second hypothesis was accepted.

Furthermore, the unstandardized coefficient ( $\beta=0.128$ ;  $p=0.038$ ) indicates that effort expectancy has a significant positive relationship with m-health adoption intention. This means that easier to operate m-health technology positively influences healthcare workers' acceptance. Hence, the hypothesis H3 was accepted.

With regard to environmental factors, both government support and external support shared significantly positive relationships with the intention to adopt m-health as indicated by ( $\beta= 0.119$ ;  $p= 0.046$ ) and ( $\beta= 0.107$ ;  $p= 0.048$ ). This means that the availability of active policies surrounding the use of technology in healthcare influences healthcare workers' willingness to accept m-health; also, support from technology providers impacts m-health adoption. Therefore, H10 and H11 were accepted.

Therefore, the significance was found in the individual factors, technological factors, and environmental factors, while the organisational factor was found to be non-significant. From the 11 hypotheses, only H1, H2, H5, H10, and H11 were supported, while the remaining were rejected.

**Table 6:15: Summary of Hypotheses**

Determinant factor	Result
H1: Mobile self-efficacy	Supported
H2: Experience	Supported
H3: Attitude	Not Supported
H4: Performance expectancy	Not Supported
H5: Effort expectancy	Supported
H6: Compatibility	Not Supported
H7: Reliability	Not Supported
H8: Training and technical support	Not Supported
H9: Management support	Not Supported
H10: Government policy support	Supported
H11: External telecommunication support	Supported

## 6.12 Qualitative Analysis

This section presents findings that were obtained from the analysis of data collected from the interviews conducted with the managers of three healthcare organisations. The healthcare organisations were Lagos University Teaching Hospital (LUTH), Isalu Hospital and the local council development area health centre. The main techniques for this analysis were to group expressions into categories called codes. Afterwards, the codes

were compiled into themes and cross-referenced to ensure that the data provided by the interviewees were related to the research questions. The themes were as follows: information and communication technology tools used in healthcare service delivery and their uses; knowledge of healthcare workers about m-health technology; the individual, technological, organisational and environmental determinants of m-health technology adoption; and potential barriers to m-health adoption.

At LUTH the interview was held with a member of the management board who doubles as a consultant as well as a Professor at the College of Medicine. The interviewee was particularly relevant because he is not only a decision-maker, but he is also part of the advisory committee to the board of directors. Also, being a physician and a scholar, he is directly affected by the decisions made by the management.

At Isalu Hospital, the interviewee was the director/head of the administrative department of the hospital. Based on his position, all that involves the proper functioning of the hospital is under his care. He was directly involved with the introduction of ICT to the hospital and this makes him well informed about the technology the hospital has deployed, the challenges encountered, and the significance of ICT to the output of the hospital.

The medical officer for health of one of the local council development areas in Lagos mainland was interviewed. The name of the local council development area is omitted for the sake of confidentiality.

**Table 6.16: Emergent themes from Qualitative Data**

Data Excerpt	Code	Theme	Sub-theme
We have laptops for data collection, mobile phones for communication in 24hrs centers. We have electronic medical record used to store information of patients. Doctoora installed an App used to communicate with the mothers if they don't come for antenatal. There is also the Jaika software that is used in such a way to communicate with the patients informing them of their antenatal date visit	We have laptops for data collection  mobile phones for communication in 24hrs centers  We have electronic medical  Doctoora installed an App used to communicate with the mothers	Technology Availability	Laptop Electronic medical record Mobile phones Smart phones
We have an Apps used to communicate with the mothers if they don't come for antenatal. We also have one Jaika used in such a way to communicate with the patients informing them of their antenatal date visit (MOH)	We have an Apps used to communicate with the mothers if they don't come for antenatal.	Awareness and use of m-health	Medication refill Appointment booking Remote consultation Communication
Majority of the staff are well experienced in the used of mobile device technology, the old staff can be described as experts and quite vast in the used of tools for patient management. The attitude, experience, and knowledge of the staff on the use of m-health is very positive (Isalu).	Staff are well experienced in the used of mobile device technology.	Individual factor	Attitude Experience Skill Confidence
We have fiber cables laid round the hospital for steady network. Our hospital has a 24hr electricity supply, and the telecommunication service provider has improved tremendously. We made sure that we have a secured technology. The current technology in the organization supports the proposed m-health system. Government regulations and competition in the telecommunication industry has made the cost to be minimal and it is readily available and affordable (LUTH)	We have fiber cables laid round the hospital for steady network  24hr electricity supply, and the telecommunication service provider has improved tremendously  The cost to be minimal and it is readily available and affordable	Technology factor	Affordability Network availability Electricity Compatibility Ease of use Performance

Data Excerpt	Code	Theme	Sub-theme
<p>The organization provide credit on the phone for the staff to use, we make sure they have their phone recharged every month and encourage client to have all primary healthcare centres to have their number (MOH)</p> <p>We have the enabling laws and environment to implement m-health and the government regulations and competition in the industry has made the cost to be minimal (LUTH)</p>	<p>Organization provide credit on the phone for the staff to use, we make sure they have their phone recharged every month</p> <p>Enabling laws and environment to implement m-health</p>	<p>Organizational factor</p> <p>Environmental factor</p>	<p>Training</p> <p>Resource availability (airtime, internet)</p> <p>IT support</p> <p>National assembly law</p> <p>Government regulation</p>
<p>Those against the adoption were the nurses, it was a war, and they did not see the need for it. Sometimes bad network can make call without success. Right now, whomever has access to the file can see the history of the patient which makes confidentiality a problem. Security is a challenge right now; funding has also been a problem. The internet cost is a bit high and only affordable by those who can buy it. One major barrier is from the government side, different taxes and policies that discourage the internet service provider, and on the part of Telecommunication Company their service sometime becomes poor and expensive</p>	<p>Those against the adoption were the nurses, it was a war, and they did not see the need for it.</p> <p>Confidentiality is a problem</p> <p>Major barrier is from the government side, different taxes and policies that discourage the internet service provider</p>	<p>Barrier</p>	<p>Resistance to change</p> <p>Job interference</p> <p>Shortage of staff</p> <p>Unstable government policy</p> <p>Security concern</p> <p>Network instability</p>

### **6.13 Research objective 1: The Available and Extent of Use of Information and Communication Tools in the Organisation**

The existence of ICT tools in the healthcare sector has shown to be beneficial in the improvement and efficiency of service delivery. This section discusses the current technological tools used for service delivery in the selected hospitals to determine if there is currently an existing innovation and also their perception about the use of innovations in technology in healthcare.



the hospital is working on having a central server by building a health information system which will include medical record and the billing systems that will enable various units of the hospital to retrieve patient-related information in all departments. It was also found that mobile phones were commonly used in the teaching hospital and health centre for communication purposes, appointment booking and reminders, as well as remote consultation. In addition, the respondent from the primary healthcare centre stated that mobile phones were used particularly in the 24 hours centre to provide services to patients around the clock. Mobile applications were also installed on their phones in the health centre to ensure monitoring and communication with pregnant women. In addition, according to the respondent from LUTH, training was provided to the staff of the hospital online via Zoom, and fibre optics are being laid to facilitate the data management system.

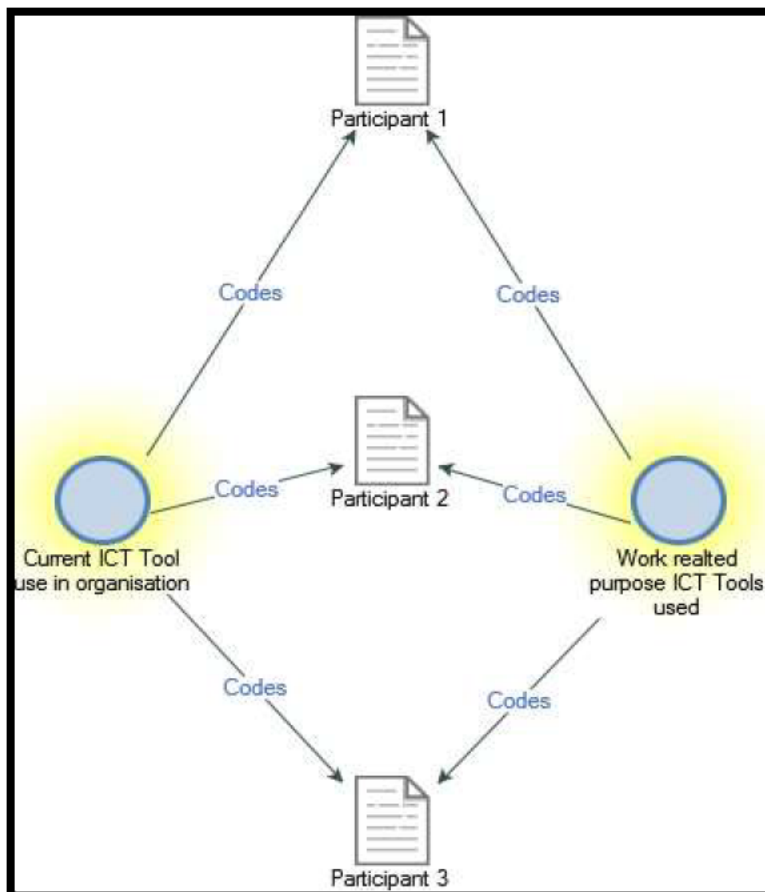


Figure 6:4: Types of technology used for service delivery in Nigeria's healthcare sector.

## 6.14 Research Objective 2: Knowledge of Healthcare Workers about m-Health Technology

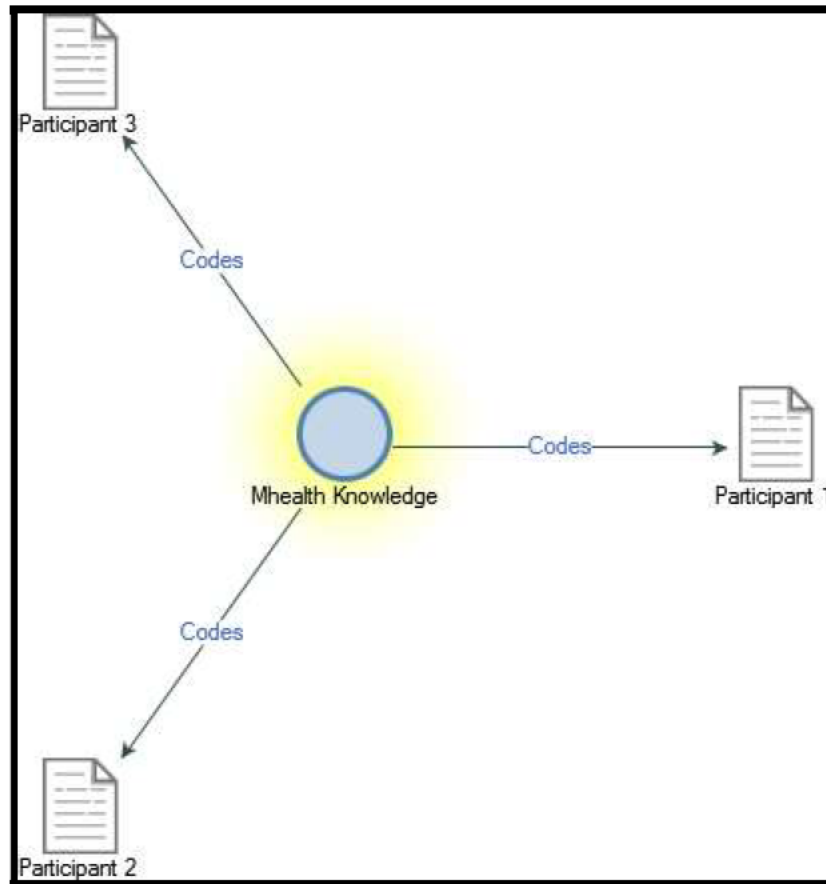


Figure 6:5: Knowledge of healthcare workers about m-health solutions

Assessing the knowledge of the hospital management of the use of mobile devices for healthcare service delivery, the findings showed there is a relatively high knowledge of m-health among the respondents. Some of the uses of m-health based on the statements made in the interview include telemedicine, medication refills and mobile applications. According to the participant from LUTH, their technology includes a tracking device worn during fitness exercises that monitors the heart rate. In addition, m-health was used to provide patients with remote medical consultation from the comfort of their homes without their having to travel to the hospital to see a doctor. The findings further showed that medication refills can be requested by patients over mobile phones and the medication is sent to them through dispatch riders. Lastly, healthcare workers in the primary health centre make



### **6.15.1 Individual factors**

The interviews showed that healthcare workers possess a positive attitude towards the use of m-health services. The participants said that mobile phones are user-friendly, and that they were common devices among many people. Healthcare workers are well experienced in using mobile devices for patient management. This was attributed to the adequate training provided by the organisations in the use of the technology. Hence, the ability to use the m-health system is linked to the training of healthcare workers, which has resulted in helping them increase their confidence and experience in using m-health services. This section of the research therefore suggests that the skills acquired through training and the experience acquired through the use of m-health helps to improve the confidence of healthcare workers in using the technology.

### **6.15.2 Technological factors**

This section was broadly categorised into factors related to the network, the cost, electricity, compatibility, telecommunication and performance. The participants stated that the affordability of telecommunication services has been a major contributing factor to m-health usage. This affordability was linked to the regulations enforced by the government in the telecommunication sector, which allow several network providers to operate in a highly regulated environment which in turn has improved service availability from providers due to the competition that exists between them. The teaching hospital has fibre optics cable laid around the premises to provide a steady network. In addition, the participants identified a steady supply of electricity as a factor that contributed to the use m-health, stating that the hospital has a 24-hour steady supply that can be used to charge devices when needed. That said, another factor that was found to be influential was the integration of mobile technology in the hospitals operations. m-Health technology was found to be compatible with the nature of the tasks performed in the hospital by the healthcare workers, and could interoperate with the existing technology in the hospital. In terms of the technicalities of the mobile devices, all of the participants stated that m-health is very easy to use and its cost of

maintenance was relatively cheap. Lastly, when asked about how the use of m-health had impacted on their work, they said that there had been an improvement in terms of job performance with the use of the innovation.

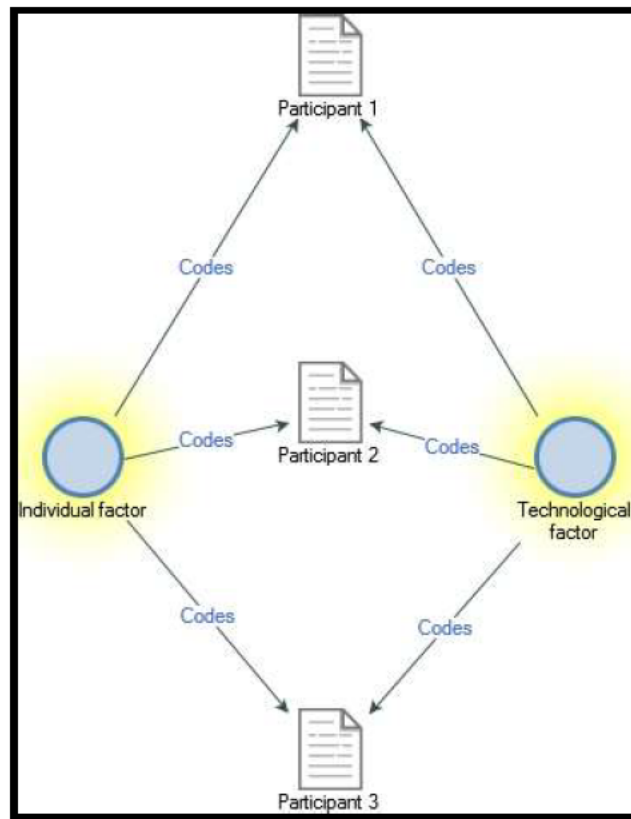


Figure 6:7: Individual and technological factors determine the adoption of m-health technology

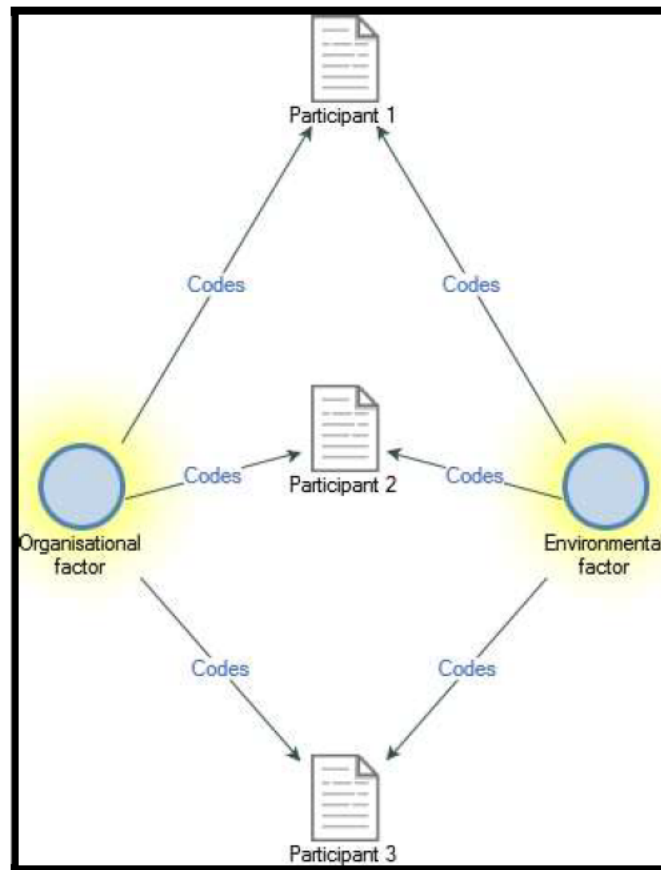


Figure 6:8: Organisational and environmental factors that determine the adoption of m-health technology

### 6.15.3 Organisational factors

According to the interviewees, the organisational factors found to contribute to m-health adoption included training, the provision of devices, internet and airtime, and technical support. The participants stated that training was provided to healthcare workers in order for them to be able to use m-health technology to provide services. The participant from Isalu Hospital stated that healthcare workers were trained and retrained for a long period of time in the use of m-health, and afterwards they were mandated to use the technology. The participant from the teaching hospital said that training was essential, particularly during the pandemic, to ensure that measures to protect the hospitals were communicated to the staff daily. In addition to the provision of training by the organisation, mobile phones, funds, data and airtime were provided to the healthcare workers as a way of

encouraging them to provide services to patients over the phone. Also, the devices provided were user-friendly, thereby requiring less effort on the part of the users. Lastly, the interviewees said that ICT support was readily provided by the organisation when needed.

#### **6.15.4 Environmental factors**

The participants had divergent opinions about the environmental influences on m-health adoption. Those from the government-owned healthcare facilities, in other words the teaching hospital and the primary health centre, identified the existence of government regulation and national assembly law that supports the use of innovation in healthcare. However, despite the claim that existing policies support the use of technology in healthcare, only the respondent from the primary health facility stated expressively that there are government regulations in place. The respondent from the tertiary facility stated that there is no government policy guiding the use of ICT in health facilities, and that the only law in support of this derives from the national assembly. This is because any innovation to be adopted for healthcare service delivery in government hospitals has to go through the lawyers to check if it aligns with the law of the hospital. The participant from the private hospital said that these policies apply only to government-owned facilities and not to private hospitals. Finally, regarding the availability of telecommunication support, the interviewees stated that the government regulations and competition in the telecommunication industry have made the cost minimal.

#### **6.15.5 Potential Barriers to m-Health Adoption**

Figure 6:10 represents the words that were frequently referenced concerning the barriers to m-health adoption.

The words are service, cost, staff, internet, provider, security, policies and government



Figure 6:9: Word cloud of potential barriers to m-health adoption.

With regard to the barriers to the adoption of m-health, the findings revealed several factors that impede m-health solutions. These include resistance to change on the part of the healthcare workers, lack of in-house ICT support, security issues, a bad network, cost of the network and the constant change of policies. The participant from Isalu Hospital stated that when m-health was first proposed to healthcare workers, the nurses were strongly against the idea. The participant from the private hospital stated that:

*“Those against the adoption were the nurses, it was a war, and they did not see the need for it.”*

In addition to the subjects’ resistance to change, the other barriers related to the use of telecommunication services were found to be common among all respondents. The participants stated that network instability causes a major disincentive to healthcare workers to use the technology because sometimes the network may be disrupted during sessions with a patient, which would eventually lead to a loss of time and money with no positive outcome. Also, the cost of telecommunication services was mentioned by two of the participants as a barrier to m-health use. According to them, the instability of government regulation in terms of taxes often affects the service providers, thereby leading to an increase in the price of the services provided. Furthermore, the shortage of staff was

highlighted as an impediment to m-health adoption because there is not enough manpower to add the use of m-health services to the existing pressure of work. In addition, mobile devices are often switched off as they can cause a distraction during working hours. Also, security and confidentiality were considered by some participants to be a barrier to m-health adoption. Lastly, the participant from the primary health centre stated that the unavailability of in-house ICT support personnel causes delay when a technical issue arises from using the device.

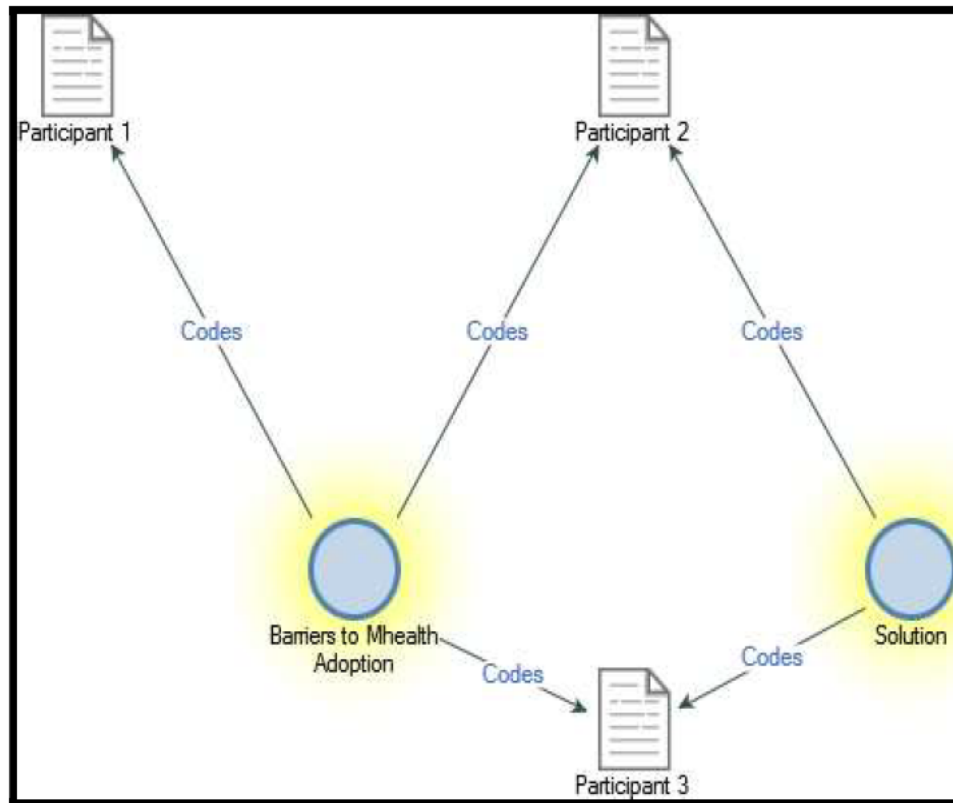


Figure 6:10: Potential barriers to m-health Adoption

## 6.16 Chapter Summary

This chapter has presented the findings from the data analysis. The chapter began by investigating the reliability of the survey instrument. The investigation showed that the internal consistency was sufficient to allow the use of the data for further analysis. The analysis proceeded with the extraction of descriptive statistics for the survey data. This showed that the majority of the respondents were female, with their ages ranging from 26 and 35 years.

It was also found that the internet and mobile phones were the ICT tools most frequently used by healthcare workers in Nigeria. It was ascertained in the interviews that software and hardware such as EMR and fibre optics are to be found in some hospitals. The chapter also showed that there is relatively high degree of knowledge of m-health among healthcare workers. It was also found that mobile phones were commonly used for communicating with other healthcare workers, creating awareness, monitoring patients, collecting data, training, and booking appointments. Also, the majority of the healthcare workers were willing to adopt m-health technology. The study indicates that the barriers to the adoption of m-health are the unreliable network, the high cost of data, privacy-related concerns, and psychological resistance among the healthcare workers. A further impediment to m-health adoption as shown by findings from the interviews was the shortage of staff, the lack of in-house ICT support, and the constant change of policies. Self-efficacy, experience, effort expectancy, government policy and external networks were factors that were found to influence the adoption of m-health services among healthcare workers in Nigeria.

The outcomes of the study are discussed in the next chapter.

## **CHAPTER 7: DISCUSSION OF RESULTS**

### **7.1 Introduction**

This chapter presents a discussion of the findings as reported in the previous chapter (Chapter 6). Research findings are discussed with respect to previous research in order to ensure research continuity and also to provide possible explanation (Kothari, 2004). Therefore, the discussion is centred on the research objectives outlined in chapter one and they are:

- To identify the availability of the technology used for service delivery in Nigerian healthcare sector.
- To assess the knowledge of healthcare workers about m-health solutions and their current use.
- To investigate the individual, technological, organizational and environmental factors influencing m-health adoption and use in delivering healthcare services in Nigeria hospitals.

### **7.2 Research Object 1: To Investigate Information and communication tools available for service delivery among healthcare workers in Nigerian hospitals**

Information and communication technology tools has shown to be beneficial in the improvement and efficiency of service delivery in the healthcare sector. Therefore, this study sought to find out the ICT tools currently used by healthcare providers to provide services in the Nigerian healthcare system. It is found that the ICT tools currently used by the healthcare organisations include desktop computers, phones, the internet, electronic medical records, medical applications and laptops. Based on the quantitative finding of this study, the internet was found to be the ICT tool most frequently used by healthcare workers with 45.3 per cent of the respondents indicating that this technology is very often used by them. Mobile phones are the technology most frequently used by the respondents for healthcare service delivery, while medical applications are the technology least used by the healthcare workers, at 29.4 per cent. The high rate of adoption of the internet and mobile devices is due to the fact that the telecommunication industry is the main driving force behind the federal government's goal for the

digital economy. The adoption of m-health technology is predicated on the important premise that there is widespread access to mobile devices and the internet. Also, the high usage rate of the internet can be attributed to the fact that most healthcare professionals rely on the internet to get up-to-date information in their field because of the rapid rate at which information may be found, compared to paper-based libraries (Adeleke, 2015). The work of previous researchers such as and Idowu *et al.* (2003) supports the findings of this research. They concur that the internet is the most commonly used ICT tool in the healthcare sector. With reference to the reasons why mobile phones were indicated as the second most commonly used ICT tool for work purposes, Adeleke (2015) reports that most healthcare providers have their own personal mobile phones which can be used to access the internet, so their mobile phones are often used to access medical information. On the other hand, desktop computers and medical applications were the ICT tools least used. This is because most of the medical applications are used by midwives, especially in the health centres, to remind pregnant women of their antenatal appointments and to follow up on them in case an appointment is missed. This finding can be associated with the fact that the m-health initiative is mostly found in healthcare centres to specifically address the safety of the mother and child as part of the goal of the federal government to reduce the infant and maternal mortality rates. Addressing the low rate of desktop computer usage in the healthcare sector, Adedeji *et al.* (2018) indicate that although computers may be found in the health centres, most of them are non-functional.

The qualitative findings of this research project show that there are other ICT systems that are peculiar to the different organisations involved in this research. For instance, Isalu Hospital has software programmes called e-Clerk and Meditorix which are used specifically for administrative purposes, while the fibre optics backbone was peculiar to LUTH. Mobile phones and internet connectivity were prevalent in government hospitals. Due to the installation of fibre optics across the organization, Luth offers high-speed internet access.

### **7.2.1 Work-related purpose of the ICT tools used**

Regarding the use of ICT tools in healthcare organisations, this research finds that mobile phones are the technology most commonly used by healthcare workers for communication purposes with a percentage of 67.2. The rate of remote data collection is 35.8 per cent, while 41.3 per cent of health workers use their use mobile phones for education and awareness purpose. Mobile phone use among healthcare workers for patient monitoring shows a percentage of 38.9, diagnostic support with mobile phone indicates 30.8 per cent use, and lastly, epidemic tracking shows that 38.8 per cent use mobile phones for this purpose. However, the training of healthcare workers was done mostly on laptops and computers. This indicates a percentage of use of 37.8. Further findings derived from the interviews were that computers are used for the management of patient records and laptops are also used for data gathering purposes. According to the LUTH interviewee, the health information system of the organisation is yet to be fully implemented. Hence, data collection is done using both the manual and the automated method. Also, further training of healthcare workers was done over the internet via Zoom during the Covid-19 pandemic, to keep the health workers informed about the virus. Going by the result of the analysis, it can be deduced that mobile phones serve as the major ICT tool used for service provision by healthcare experts in the country. Other media which were not specified were also used for service delivery in the healthcare sector. The findings of this work are backed up by the research outcomes of several researchers. Idowu (2015) finds that mobile phones are the most utilised ICT tools among healthcare workers, and they serve the purpose of communicating with other healthcare providers within and outside the healthcare environment.

### **7.3 Research Objective 2: Knowledge of mobile devices for healthcare service delivery**

The result derived from the data analysis shows that the knowledge of the use of mobile phones for healthcare service delivery among healthcare workers in Nigeria is relatively high. The percentage of healthcare professionals who know about mobile phone use for health service delivery is 81.59, while only 17.91 per cent

of the sample of the population of the study did not know about the use of a mobile phone for healthcare service delivery. Adebara *et al.* (2017) report in their study that health workers are knowledgeable about the use of the mobile phone for healthcare service delivery, and that this is very common among professional consultants. Supporting Adebara *et al.*'s (2017) finding, Owolabi *et al.*'s (2018) report on the knowledge of healthcare workers about m-health services in Nigeria states that they are quite knowledgeable about the use of mobile phone for healthcare service delivery, although they are not familiar with the term m-health. Madaki *et al.* (2017) studied family medicine specialists experience with providing patient care using mobile phones. Their study showed that 98 per cent out of the 107 respondents surveyed use a mobile phone to provide healthcare-related services to patients. This indicates that the physicians are well informed about the usage of the mobile phone in hospitals. The findings of this study may be said to be aligned with those reported by previous researchers, that the knowledge of mobile phone use in Nigeria among healthcare workers is relatively high.

### **7.3.1 Current use of m-health in Nigeria**

According to the outcome of this study, m-health is used in the Nigerian healthcare sector. Of the 201 respondents, only 24.9 per cent had never used m-health for appointment booking while 75.1 per cent of the total population had used it. 51.3 per cent of the respondents claimed they did not use mobile phones for consultations, while 25.8 used them often for this purpose. 27.8 per cent had used them to send medication refill reminders. 78.1 per cent had used them for communicating with other healthcare workers. 49.8 per cent often used them for patient monitoring while 23.4 per cent used them sometimes. 62.1 per cent used them to create awareness as well to educate people about health and lifestyle habits. This shows that mobile health services are used in Nigerian hospitals mostly for communication, appointment booking and providing health awareness to patients. The findings of this study showed that although the use of m-health was identified, its use is very limited. Underutilizing m-health could be traced to a lack of adequate awareness of the potential and related benefits the

technology offers in addressing health services. This correspond with the work of past researchers on the use of m-health in developing countries. Madaki *et al.* (2017) report that mobile phones are mostly used for appointment booking in Nigeria among family medicine practitioners, with 88 per cent use among them. Mobile phones were also reported to be used for handling prescription-related problems among health provider and to provide awareness on health and lifestyle. Adebara *et al.* (2017) report that in the semi-urban area of Nigeria doctors used mobile phones mostly for appointment booking and reminders, consultations, confirming prescriptions and communication with other healthcare providers. Owolabi *et al.* (2018) report the use of mobile phones for healthcare call centres, mobile telemedicine and appointment reminders among doctors and nurses in the secondary healthcare facility of the country. In the context of the current global pandemic, it is reported by Otu *et al.* (2021) that the mobile phone is an essential ICT tool in the healthcare sector for the purpose of service delivery. The work of Karin *et al.* (2013) shows that the healthcare uses of the mobile device include one-way text messages and reminders of appointments, data gathering, and education and awareness of lifestyle changes. That supports the findings of this research, which finds that these are the common uses of m-health services in the Nigerian healthcare system. In their qualitative study on the use of m-health among healthcare providers and users in Ghana, Peprah *et al.* (2020) report that healthcare workers use mobile devices for communicating with other healthcare providers when they need information related to their profession. The same researchers also report that the use of mobile phones among healthcare providers has provided them with the opportunity to provide medical consultations beyond the walls of the hospital. The findings of this research are in line with the research outcomes of previous researchers, that mobile phones are used for remote consultation, communication among healthcare worker and appointment booking, as well as education and awareness purposes.

Also, further findings from the interviews suggest that mobile phones are also used for medication refill purposes. Findings from the interviews also show that the primary healthcare centres are more knowledgeable about the m-

health initiative, from the basic application such as the voice call to the more advanced applications. Although, there is a significant awareness and use of mobile devices for service provision among healthcare workers in the country, their use is limited. The need to create more awareness through training among healthcare workers at all levels is imperative for the benefits of m-health to be fully realised across all levels of healthcare in the country. Also, in response to the use of m-health in the country, the findings from interviews conducted with the MOH attest to the fact that majority of m-health initiative in the country are directed toward reducing mortality incidence in maternal and child care. The finding suggested that apart from voice call, there are applications which are used to track pregnant women in order for them to be present for their appointment and also follow up on them. In addition, the results of an interview with the MOH in response to the usage of m-health in the nation attest to the fact that the majority of m-health initiatives in the nation are focused on lowering the incidence of mortality in maternal and childcare. The studies found that in addition to voice calls, there are applications from both government and private organisations like doctoraa and jaika that track pregnant women so they can show up for visits and follow up on them. This can be considered an effort on the part of the government to fulfil the maternal health-related sustainable development target.

#### **7.4 Objective 3: Identifying Individual, Technological, Organisational and Environmental factors that determine the adoption of m-health technology.**

It is important to understand the ways in which different aspects impact how health professionals perceive m-health in order to identify its adoption factors. Several researchers propose different factors that affect m-health acceptance in the literature. However, only five factors were statistically confirmed to affect m-health uptake in the Nigerian healthcare sector. The results showed that self-efficacy and experience in the individual factor, effort expectancy from technological factors, government support, and telecommunication support from environmental

factors influence adoption. No factor in the organisational context was significant. Results from both the quantitative and qualitative studies are discussed in this section.

#### **7.4.1 Individual factors**

##### **7.4.1.1 Self-efficacy**

Self-efficacy shows to be a significant factor that influences the intention to adopt m-health services. This is in line with the findings of Compeau and Higgins (1995) and Carter and Schaupp (2008), both of whom argue the importance of self-efficacy to the acceptance of technology. The importance of self-efficacy in reducing technology anxiety was highlighted by Aggelidis and Chatzoglou (2009). The same researchers report that self-efficacy significantly influences the use of health information systems among healthcare workers in Greek hospitals. The research outcomes of Alam *et al.* (2020) on the determinants of mobile health app acceptance in Bangladesh include the conclusion that self-efficacy is important to m-health acceptance. This study confirms a significant influence of self-efficacy on the adoption of m-health services among healthcare workers. ICT competence has shown to be a major factor in technology adoption. This result can be understood to suggest that healthcare staff that are confident and skilled will be able to utilize m-health technologies with ease. One of the major ways in which self-efficacy can be improved is by providing adequate training in the use of various m-health tools, as this will improve the confidence of healthcare workers when using the technology.

##### **7.4.1.2 Experience**

Previous researchers argue that experience gained from a previous technology use influences the intention of a user to adopt new technology (Frambach & Schillewaert, 2002; Taylor & Todd, 1995). This suggests that the more experienced users are with existing technology, the more comfortable they are with subsequent innovations. The finding shows that experience has a significant influence on the adoption of m-health technology. It is supported by the work of researchers such as Dillon and Morris (1996) and Tariq and Akter (2011), who state

that the prior experience of users plays a crucial role in innovation acceptance. Also, Rahayu and Day (2015) report that experience is a determinant of technology adoption among users in Indonesia.

Additional findings obtained from the interviews on the influence of individual factors on m-health adoption shows that healthcare workers are well skilled in the use of mobile phones as well as mobile applications for personal purposes, and this has made it easier for them to transfer such personal knowledge to the use of mobile devices for service delivery in their field. Also, healthcare workers were trained when these applications were installed on the phones, and this has translated into acquiring the experience needed to use the m-health apps.

#### **7.4.1.3 Attitude**

The work of previous researchers demonstrated the key role users attitude play in technology adoption. Surprisingly, the findings of this research indicate that attitude is non-significant in the adoption intention of m-health service. The finding is contrary to the findings of several researchers who indicated the existence of a strong and significant relationship between attitude and adoption intention (Aggelidis & Chatzoglou, 2009; Hussein et al., 2017). However, the result of this study is in line with the observation of Nabila (2017), and Massoro and Adewale (2019), who found no relation between attitude and the intention to adopt. The original UTAUT theory, proposed by Venkatesh et al. (2003), excluded the impact of attitude on behavioral intention, which was discovered to be one of the model's flaws. The importance of attitude on adoption intention was investigated in this study, as proposed by previous adoption theories such as TAM, and the findings showed that attitude is not a direct determinant of m-health technology adoption among healthcare workers, confirming the effect of attitude on behavioral intention in the UTAUT model. Additionally, the findings from the interview revealed that mobile devices are often turned off to avoid distraction as a result of the excessive workload on healthcare workers due to a shortage of staff. Therefore, adequate awareness of the benefits associated with the use of m-health should be communicated to health workers to influence their attitude to its use.

## **7.4.2 Technological factors**

### **7.4.2.1 Performance expectancy**

Performance expectancy is found to be a major determinant of behavioral intention in several studies of the adoption of technology. Some have shown the importance of performance expectancy in the adoption of health information systems among various user groups, because if technology is perceived to improve job performance then such technology will be accepted. Contrarily, this study shows that performance expectancy is not statistically significant in relation to the intention to adopt m-health among healthcare workers in Nigeria. This study does not align with prior findings, such as those of Alam et al. (2018), who found a positive relationship between performance expectancy and adoption intention in m-health apps. Similarly, Rastogi et al. (2018), discovered a significant relationship between performance expectancy and cloud computing adoption.

However, this finding is corroborated by the work of Yildirim (2018), who finds that performance expectancy is non-significant to the adoption intention of m-health applications. Furthermore, Ramdani, Duan and Berrou, (2020) show that perceived usefulness is insignificant to m-health adoption in China. This result could be explained as a result of a lack of adequate awareness of the importance of m-health to improving the healthcare sector in the country. This view is shared by Mensah (2019), stating that when users are uninformed of the benefits associated with their job performance, performance expectancy seems to have no effect on their intention.

### **7.4.2.2 Effort expectancy**

If a technology is perceived as easy to use, this usually results in a high rate of adoption. This research project shows that effort expectancy significantly influences m-health adoption intention among healthcare workers. The findings of this research correspond with those of Seethamraju *et al.* (2018), who report that effort expectancy positively influences the adoption of mobile-based technology for the treatment of TB patient among healthcare workers in India. Supporting the report, the work of Ifinedo (2012), that examines healthcare workers' intentions toward the adoption of information systems establishes the relationship between effort expectancy and technology

adoption in Canada. Similarly, the significance of effort expectancy on m-health services was also found among patients. For instance, the work of Nisha et al. (2016), on factors influencing m-health service adoption among the Bangladesh population found that effort expectancy positively influences adoption intention. The result of this study is similar to that of Hoque & Sorwar, (2017), which found effort expectancy as a predicting factor of m-health adoption among the elderly in Bangladesh.

Furthermore, studies in other contexts, such as e-learning, were found to support the findings of this study. Yang et al. (2019) studied factors influencing the acceptance of cloud-based classroom learning and flipped instruction; the study findings showed a positive and significant influence of effort expectancy on technology adoption.

Therefore, it is unsurprising that effort expectancy was also found to be a contributing factor to m-health technology adoption among healthcare workers in Nigerian hospitals. The complexity of the system, it can be argued, has a significant impact on using technology. In light of the foregoing discourse, it is clear that an individual's perspective toward technology adoption is influenced by an effective system design with user-friendly features. Users who believe the technology requires little to no effort to utilize are more likely to accept it.

#### **7.4.2.3 Compatibility**

The influence of compatibility on m-health technology adoption among healthcare workers in Nigeria was tested based on the existing technology in the organisation and the nature of their jobs. Compatibility can be related to the value, experience or needs of a potential adopter, according to Rogers (1995). Although the outcomes of previous research such as that of Aziz & Wahid (2020), have shown that compatibility is an influential factor in behavioral intention, however, the study finding indicate that this factor is not statistically significant to the intention to adopt solutions. This finding is supported by the work of Ramdani *et al.* (2020) and Yildirim (2018) who find that compatibility does not influence m-health technology adoption. A possible explanation for this

could be that mobile devices can be more easily integrated into an organisation's practises than other technological innovations

#### **7.4.2.4 System privacy**

System privacy has been considered as a key determinant of technology adoption. This is because when users perceive that an innovation poses a threat to their personal data, then the adoption potential becomes relatively low (Karin *et al.*, 2013). However, contrary to the findings of researchers such as Al Dahdah *et al.* (2015) and Ramdani *et al.* (2020), system privacy was found in this exercise to be not statistically significant in relation to the intention to adopt m-health among healthcare workers in Nigeria. This finding is in line with that of Zayyad and Toycan (2018) and Fox *et al.* (2020), that system privacy and security concerns do not influence health-workers' intentions to adopt e-health and m-health. This may be due to the fact that there are dedicated mobile devices used for service delivery and they are kept safely at work after use. Therefore, it can be said that a minimal threat is posed by the use of m-health solutions.

### **7.4.3 Organisational factors.**

#### **7.4.3.1 Management support**

Management must be convinced of the necessity of an innovation before it can be adopted by giving the necessary resources. Managers are growing aware of the relevance of the competitive advantage that may be gained via the use of information technology tools (García-Moreno *et al.*, 2016). As a result, managerial support is critical to the transformation that is taking place. Previous research findings, such as those of Najaftorkaman *et al.* (2013), have shown that management assistance during a change process helps to remove uncertainty, which influences the user's decision to adopt. Clohessy & Acton, (2019), identified top management support to be crucial in block chain adoption in their study of organizational drivers of block chain adoption. Klitsie & Etter (2018), observed a positive and significant association between employee performance and top management support when a new system was implemented, which is aligned with their findings of past researchers.

However, contrary to Ramdani et al. (2020) and Talukder et al. (2008), findings on the influence of management support on the intention to adopt, the findings of this study suggest that management support has no impact on the adoption of m-health technology among Nigerian healthcare workers. This result backs up Al-Mamary & Shamsuddin (2015) and Adam Wong (2018) conclusions. The possible explanation for this could be linked to management's failure to provide the resources required for using m-health technology, leaving a negative perception on users and inhibiting technology acceptance.

#### **7.4.3.2 Training and technical support**

Technical support and training has been proven to be critical in maximizing investment and increasing user acceptance of technology. This is due to the fact that it aids in the acceptance of a new system (Too, Bomett, & Kiprop, 2021). According to Wickramasinghe & Goldberg (2005) and Jewer (2018), technical support is a major prerequisite for technology adoption in the healthcare sector since it assures consumers that they will receive assistance in the event of a problem. However, the finding of this research show that training and technical support are non-significant to m-health adoption among health providers. This could be attributed to the fact that healthcare workers are willing to use their mobile phones for healthcare service delivery because of its simplicity. Also, giving that the adoption of m-health is still relatively low, little to no attention is given to the necessary support from management. The findings contradicts the work of Faber (2014), which finds a significant relationship between technical support and e-health adoption in Netherlands. Similarly, the finding of Eneizan, Mostafa, & Alabboodi (2018), showed a positive and significant correlation between technical support and the adoption of electronic management human resource. Despite the conflicting outcome, this finding is consistent with the work of Al-Mamary and Shamsuddin (2015) and Alaiad (2019), who find that neither training nor technical support provided by an organisation influences a user to adopt an innovation.

Qualitative results showed that the organisation encourages the use of m-health by training healthcare workers and providing them with resources for the job, including internet connection, rechargable monthly cards, and

mobile devices for service delivery. Other tools that require little to no technical support to use were also provided, and their use was made compulsory to healthcare workers.

#### **7.4.4 Environmental factors**

##### **7.4.4.1 Government policy**

Several studies have found that government support influences the uptake of various types of innovation. The government is said to be able to help by providing policies, funding, and technological infrastructure in order to stimulate technological acceptance (Ocloo et al., 2020). For example Haryanto et al. (2020), discovered that due to the influence of government backing, e-signature use in Indonesia has substantially improved. Similarly, according to Setiyani & Yeny Rostiani (2021) study, government support for in terms of the initiatives put together has a major impact on e-commerce adoption. This factor was found to be statistically significant to the adoption of m-health among healthcare workers in Nigeria. This result is in line with the findings of Williams, Rana and Dwivedi (2012) and Mohamed & Haderi (2014), that shows that government support has a strong influence on the technology adoption behaviour among users. According to Dwivedi, Wade and Schneberger (2012), government policies have the potential to serve as either a barrier or a facilitator to technology adoption. When there is lack of enabling policies guiding the use of technology, then the adoption of innovation would be impeded. However, it can be suggested from this study findings that there is in existence enabling policy that supports the use of m-health services among healthcare workers in Nigeria.

The interviewees had divergent opinions on the effect of government support in terms of their policies. The representatives of public healthcare organisations (the teaching hospital and the health centre) believed that there are existing policies that are in support of the use of m-health technology for service delivery, while the representative of the private healthcare sector believed that government policies are favourable to government-established hospitals only. This divergence of opinion can be attributed to the lack of standardised policies regarding the use of ICT in the healthcare sector. According to the representative of the Lagos University

Teaching Hospital Chairman's Medical Advisory Committee, the national assembly act pertaining to the use of ICT in healthcare is the policy followed to use m-health in the hospital but he stated that there is no universal policy. In order for m-health to be fully adopted in the country, there is a need for unified policies that also support private organisations in using m-health technology. As stated by Daly (2003), putting the right policy in place for the use of ICT in healthcare would enhance the effectiveness of technological tools in the hands of those who are positioned to deliver health services to the people. Furthermore, the need for collaboration between the public and private sectors in developing a sustainable business model is crucial for the sustenance of m-health (Diop & Crul, 2014).

#### **7.4.4.2 External support**

External support for information technology is said to have an impact on an organization's decision to adopt technology. The importance of external support on the adoption of enterprise resource planning among Nigerian SME managers was discovered by Awa et al. (2016). The research finding on the influence of external telecommunication support on m-health adoption shows that telecommunication costs and availability significantly influence the intention to adopt m-health technology. This can be said to be the result of having a highly competitive telecommunication industry in the country, where each telecommunication company roll out plans that are relatively affordable, to remain competitive in the market. Also, many mobile phone users in the country use more than one service provider in case of network failure in one. This result is in line with the findings of Alaiad (2019) and Lau and Kwok (2007), that the affordability and availability of telecommunication services influence users' adoption of an innovation, because the better the telecommunication infrastructure of a country the higher the possibility of the adoption of technology. Also, reiterating the importance of external support, Dwivedi *et al.* (2012) state that the availability of information technology as well as of a provider of technological services has a strong impact on technology adoption.

Furthermore, findings from the perspective of the decision-makers identified the existence in the organisation of ICT infrastructure such as fibre optics, which has made it easy for healthcare workers to access the internet for their work. Telecommunication services were said to have improved tremendously over the years due to governmental regulation and competition among the providers in the telecoms industry. As such, there is no problem with network availability or cost. Improvement in terms of productivity, especially in the primary healthcare centre, was identified as an outcome of using mobile phones for service delivery.

#### **7.4.5 Potential Barriers to m-Health Adoption**

This section discusses findings of what impedes m-health technology adoption in Nigeria as identified from interview with managers of healthcare facilities used for study

#### **7.4.6 Network Constraint**

Although the telecommunication sector of the country is regarded as the best information and communication sector in the country, the data derived from the interviewees reveal that Nigerian network services can sometimes become very poor and sometimes become inoperative during use for healthcare purpose (MOH & HOA interview, 2020). The research shows that network unreliability is a barrier to the adoption of m-health technology in Nigeria. This finding agrees with that of Idowu et al. (2008), that the state of technology use in the Nigerian healthcare system is directly affected by the instability of the telecommunication network. Khan *et al.* (2015) report that network problems are a major challenge faced by rural doctors in Bangladesh when communicating with physicians, because this problem affects the quality of the call when using the call centre in Bangladesh. Supporting the outcomes of previous research, Peprah *et al.* (2020) also identify network failure as a critical challenge in the use of m-health services in Ghana among healthcare providers. Echoing the network instability in Nigeria, Fox *et al.* (2020), who conducted research into the perceptions of m-health among healthcare workers in primary healthcare centres, identify this as one of the major barriers to the adoption. The research corroborates

the work of previous researchers, that an unreliable network is the major impediment to the adoption of m-health in the Nigerian healthcare sector.

#### **7.4.7 Lack of a unified policy guiding the use of m-health**

Findings from the interviews highlighted government policy as a major hindrance to m-health adoption. Findings from the interviewees show a fragmentation in the policy obtainable for m-health use. In the case of Isalu hospital, it was claimed there were no policies guiding mobile device use in healthcare, and that everything done was based on the discretion of the management to meet the job demand. Contrarily, CMAC claimed the existence of National Act law was a guide for them in terms of m-health use. However, the health centre attests to the fact that there is government policy laid down on how to use m-health. This fragmentation can be said to be as a result of the three arms of government working independently of one another, and this leads to a lack of a unified healthcare agenda at the national level. (Ogaji & Brisibe, 2015). The result agrees with the finding of Kenny *et al.* (2017), that there are unstable and unclear policies guiding the use of health information technology in Nigeria. With issues regarding government policies revolving around m-health adoption, this would serve as a major drawback for healthcare workers because of the lack of unified and holistic law backing them on technology use. There must be an effective strategy that supports the integration of ICT in the healthcare domain, for m-health to be successful (Idowu *et al.*, 2008.; Qiang *et al.*, 2012)

#### **7.4.8 Scarcity of human resources**

One of the interviewees who contributed to this research said “There is a shortage of staff, which makes the device to be occasionally switched-off.” This problem leads to work overload on the part of healthcare workers, who therefore neglect to use m-health in performing their duties. It would be productive to encourage healthcare workers to use the m-health initiative by giving them incentives based on their performance. This might lead to an increased use rate (Roumani, Nwankpa & Roumani, 2015).

## **7.5 Proposed Model for m-health adoption by healthcare workers in Nigeria**

Based on the study's findings, the model presented below has been proposed for m-health adoption among healthcare practitioners. First, the model recognised the need to address the policy gap by adopting a strategic implementation approach to ensure standardised policy for m-health. Additionally, it was discovered that self-efficacy was a major factor in encouraging adoption. As a result, the model recommends giving enough training with regard to skill acquisition. Cost and network restrictions were also noted as crucial aspects of m-health adoption and were taken into account in the model. Basic telecommunication services, which don't only rely on the usage of the network, are one of the main approaches to overcome network concerns. Additionally, government partnerships with the telecom industry to subsidise costs would be a positive step, particularly for m-health use.

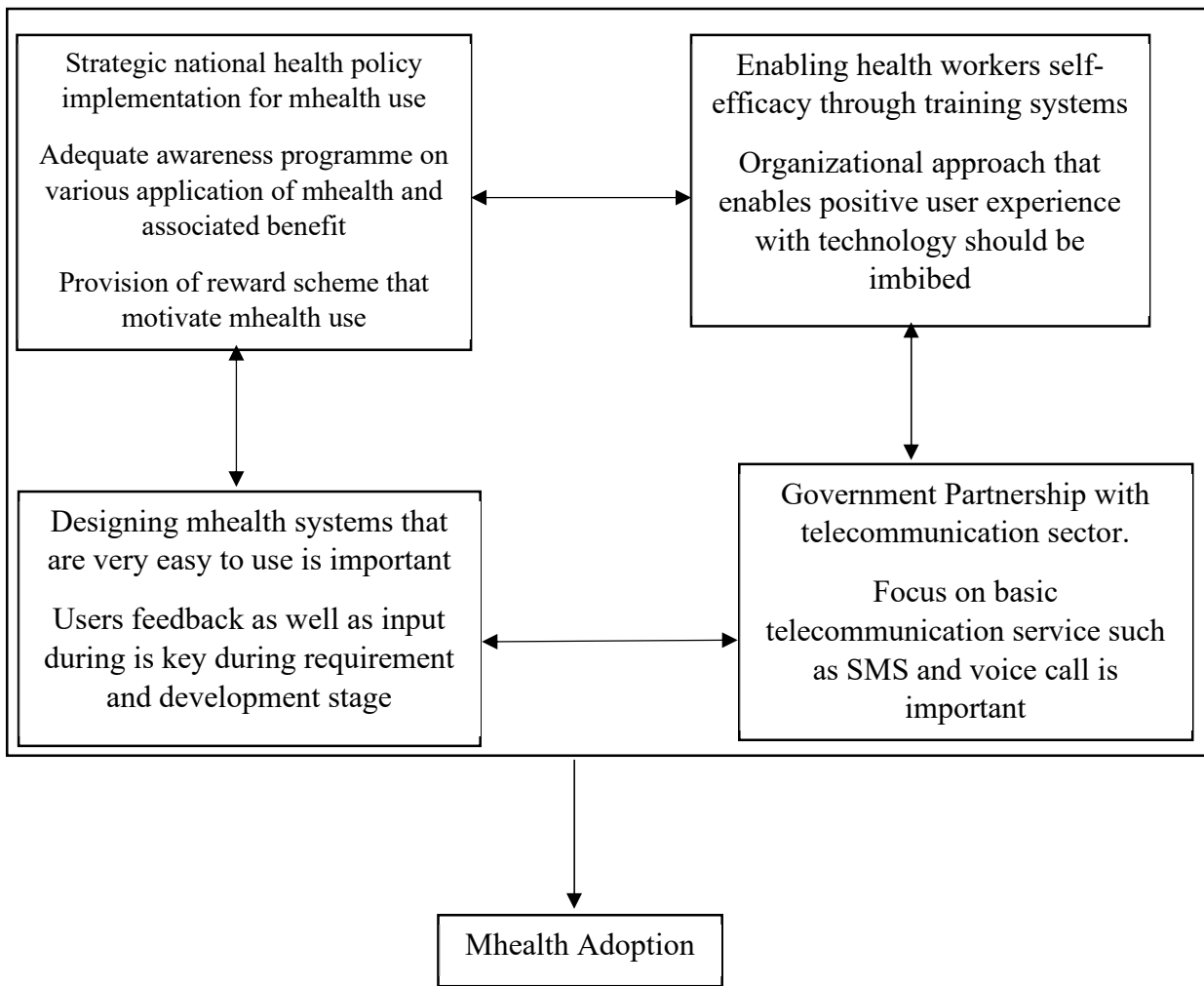


Figure 7:1: Proposed model for M-health Adoption.

## 7.6 Chapter Summary

This chapter has discussed the findings of the research. The discussion was guided by the research questions and objectives presented at the beginning of the research. The Chapter started by discussing the state of the available ICT tools used in the healthcare sector in Nigeria. It was found that ICT tools are available in the healthcare sector. These tools are desktop computers, mobile phones, the internet, electronic medical records, medical applications and laptops. The internet and mobile phones were most commonly used by the healthcare workers. Also, some ICT tools such as e-Clerk and Meditorix were found to be peculiar to one organisation, where they are used for administrative purpose. M-health knowledge was found to be high among healthcare workers in Nigeria. The technology is used most frequently for appointment booking (and reminders) and communication,

data collection and creating health awareness in the public. Although mobile phones are used in providing healthcare services, the findings indicate that their use is limited to only certain services. Training should be provided to the healthcare workers so that they are aware of the various services that can be provided on mobile phones. Questions relating to the intention to adopt m-health revealed that there is a high percentage of healthcare workers who are willing to use m-health to provide healthcare-related services. With regard to the factors influencing m-health adoption, the research finds that self-efficacy, experience, effort expectancy, government support and external support were found are key. None of the organisational factors was found to influence m-health adoption among healthcare providers in Nigeria. It is therefore pertinent that priority should be given to the significant factors that influence adoption if this innovation is to be successful. This could be achieved by the provision of adequate training to healthcare workers to ensure that they are confident enough to use m-health services. Also, it is important that the technology is free of all complexity that may arise during its use. Given the situation of the healthcare sector in the country, which is already overburdened, a complex technology would wear a user out, and this would ultimately lead to its abandonment. Lastly, barriers to adoption were found to be the unreliable network, a lack of unified policy, and shortage of human capacity. The study's conclusion and recommendations are discussed in the next chapter.

## CHAPTER 8: CONCLUSION AND RECOMMENDATIONS

### 8.1 Introduction

This chapter summarises this study by presenting its findings, drawing conclusions and making recommendations for further research. The research performed here aimed to examine the determining factors that influence m-health adoption among healthcare workers in Nigeria. Understanding these factors was thought necessary because this will help improve the adoption of m-health in Nigeria and may eventually lead to its sustainability in the Nigerian healthcare sector. The following research questions were addressed in this study:

1. Which current ICT tools are available to healthcare workers for service delivery in the healthcare sector?
2. How knowledgeable are healthcare workers about m-health solutions?
3. What are the individual, technological, organisational and environmental factors that determine the adoption of m-health technology?

The theoretical foundation for the study was the Unified Technology Acceptance and Use of Technology, Technology- Organization- Environment framework, and other factors that were considered important to m-health adoption in Nigeria. A mixed methods approach was adopted to study the phenomena under research. A stratified random sampling and a purposive sampling technique were used in selecting research participants for the study. A sample of 201 participants was drawn and validated questionnaires were administered to healthcare workers through the face-to-face method and the electronic method, while three organisation managers were interviewed to get their perspectives on the research questions asked. The Statistical Package for the Social Sciences (SPSS) was used to analyse survey data, while the Nvivo software was used for qualitative data analysis.

## 8.2 Research Summary

The report started with an introductory chapter that identifies what the healthcare system consists of and the differences that exist between health organisations in developed and developing countries. Given the shortcomings in the healthcare sector of the developing countries, the chapter went further to discuss how mobile phones can be used to address these challenges. Next, the author identified the need to study the factors affecting m-health adoption in Nigeria. In the literature review conducted it was found that the technology adoption model that explains m-health should entail a broader view by integrating all aspects that enhance adoption (Shozi *et al.*, 2012). Hence the rationale for this study. To address this gap, a conceptual framework based on the UTAUT and T-O-E frameworks was used to identify the determinants of adoption from the healthcare workers' perspective.

The second chapter started with a brief introduction of Nigeria, which is the context of the study, and it went on to explain the origins of the healthcare system, the divisions in the Nigerian healthcare system, the various functions performed on each level, and the challenges faced by the healthcare sector in the country. The challenges faced pertain to leadership and governance, inadequate human and material resources, inadequate funding, poor infrastructural development and poor remuneration of healthcare workers. The chapter then discussed ICT in Nigeria by describing the role of the Ministry in charge of ICT and mobile telecommunications and the various e-health and m-health initiatives in the country were identified. The initiatives include teleconsultation, the midwives' service scheme, and the District Health Information System, UNICEF Rapid SMS, and health management information systems. The policy guiding the use of ICT in healthcare was discussed, as well as the barriers to such use.

The third chapter provided a review of the literature. In this chapter the concept of electronic health was defined and some of its components were identified. These include EMR, telemedicine, telehealth and m-health. M-health was discussed extensively by identifying its drivers and the related benefits. Also, applications of m-health such

as education and awareness, remote data collection, remote monitoring, communication and the training of health workers, disease and epidemic outbreak tracking and treatment, and diagnostic support were discussed in detail. The study identified the various m-health initiatives in Nigeria. However, it was established that most of these initiatives are not yet fully adopted, while some others are no longer in existence. Also, the existence of available ICT tools in the healthcare sector was established. It was found from the literature that computers, mobile phones and the internet were the most commonly used ICT tools in the healthcare sector. Furthermore, the knowledge of healthcare professionals about the use of m-health technology was examined in the chapter. A brief discussion of various factors that influence the adoption of m-health followed. Finally, impediments to m-health adoption were sought for in the literature, and how to sustain m-health was discussed.

Chapter Four discussed the theoretical framework applied in the study. The chapter started by discussing information systems adoption theories such as the Technology Adoption Theory (TAM), the Innovation Diffusion (DOI) Theory of planned Behavior (TPB), the Unified Theory of Acceptance and Use Technology (UTAUT) and the Technology-Organization-Environmental (T-O-E) framework. The theories were discussed because of the factors considered in this study. The theories upon which the research was based were the UTAUT and T-O-E frameworks. Also, eleven adoption determinants of m-health were extracted from the literature review. These were later categorised into individual, technological, organisational and environmental factors, which made up the theoretical framework applied in this study. Each factor was then discussed and hypotheses were formulated.

The methodology applied in this research was presented in Chapter Five. This chapter discussed various research philosophies, designs and methods that are applied in conducting research. The positivist stance was taken in this study, and a descriptive approach was applied to studying the phenomena under scrutiny. An extensive literature review on the use of health technology for service delivery was conducted, which was then narrowed down to the use of mobile technology for healthcare purposes, after which the research questions were formed. Both

quantitative and qualitative data were gathered to generate a better understanding of the topic being studied. The chapter went on to discuss the sampling techniques, the study population and the sample size. Healthcare workers and the decision-makers of the hospitals made up the study population. Stratified random sampling and purposive sampling were used in selecting the participants in the study. Lastly, a questionnaire was developed and subjected to scrutiny to ensure the validity of the research instrument, and comments made by experts in the field were addressed

Chapter Six presented the data and their analysis. The chapter contained the analysis of both the quantitative and qualitative research data. The reliability of the measurement instrument was tested using Cronbach's Alpha to ensure internal consistency. It was found that the instrument was reliable. Next, each section of the questionnaire was analysed, using descriptive statistics. Hypotheses was tested with multiple regression analysis. The second part of the analysis discussed the qualitative data obtained from the research. The data were coded, analysed in line with the research questions, and conclusions were drawn.

Chapter Seven provided a discussion of the results obtained in Chapter Six. The results obtained were discussed in comparison with those of previous research projects by several authors. The findings were presented in terms of the research objectives, namely to identify the types of technology used for service delivery in Nigeria's Healthcare sector, to assess the knowledge of healthcare workers about m-health solutions, the individual, technological, organisational and environmental determinant of m-health technology, and to identify potential barriers to m-health adoption. These are discussed below.

### **8.3 Summary of Findings**

This section summarizes the findings for each of the research objectives.

### **8.3.1 Objective 1: To determine the existence of the current information and communication technology resources available to healthcare workers for service delivery in Nigeria hospitals.**

The findings of this research suggest that the current ICT tools available in the healthcare sector in Nigeria are desktop computers, mobile phones, the internet, electronic medical records, medical applications and laptops. The availability of these tools means that ICT tools are being used to provide healthcare services. Although all these tools are said to be in existence, the most commonly used tools are the internet and mobile phones, as indicated by healthcare workers. This suggests that many ICT resources are unavailable in most healthcare sectors of the country. These findings suggest that the popularity of the internet and mobile devices is a result of healthcare workers having personal mobile phones which can be used to access the internet. Hence, their mobile phones are often used to access medical information. Other tools are peculiar to different sites accessed in the study. These include fibre optics, Meditorix and e-Clerk. The fibre optics were found in the tertiary healthcare organisation and are said to be used to ensure internet connectivity at all times. On the other hand, the Meditorix and e-Clerk software were found in Isalu Hospital, where they are basically used for administrative purposes.

### **8.3.2 Objective 2: To ascertain the knowledge of healthcare workers about m-health services and their current use.**

Knowledge of m-health technology among healthcare workers was found to be relatively good. However, the actual use of m-health services was very limited. It was established that m-health services most often provided in Nigerian hospital are appointment bookings, communication among healthcare workers, and creating healthcare awareness. Thus, it can be deduced that there is a need to create more awareness among healthcare workers of other application areas of m-health to encourage an increased use of the technology.

### **8.3.3 Objective 3: To investigate the individual, technological, organizational and environmental factors influencing m-health adoption and use in delivering healthcare services in Nigeria hospitals.**

The findings regarding the factors influencing healthcare workers' adoption of m-health showed that five variables have a significant influence. Two of these factors were found in the individual category, one was found among the technological factors, while the remaining two factors were the environmental factors. The factors are self-efficacy, experience, effort expectancy, government support and external support. It can therefore be suggested that individual, technological and environmental factors should be given priority when developing m-health technology. The analysis showed that none of the organisational factors were statistically significant in relation to the intention to adopt m-health. This can be attributed to the lack of adequate funding of the healthcare sector in the country, which affects the support that needs to be provided to users of m-health. As a result, some of the m-health services offered on the mobile platform are sometimes paid for by healthcare workers without their receiving any incentive in return.

Lastly, unreliable network connectivity, a lack of unified policies and a shortage of human resources were found to impede the usage of m-health services in Nigeria. The findings derived from the interviews suggest that there is a need for unified policies that promote the usage of m-health services, as this is a major barrier to the use of the technology. Also, regulating the telecommunication sector for healthcare services purpose was said to be a necessary step to take if the use of m-health services is to achieve its full potential in the Nigerian health sector.

### **8.4 Research Contribution**

The current study makes some significant contributions by attempting to fill certain gaps in understanding the adoption determinants of mobile health in Nigeria.

First, the study indicates that m-health's innovation attributes by themselves are insufficient to explain its acceptance in the healthcare sector. Although this can contribute to adoption to some extent, given the fact that

innovation adoption within an organisation can be complex due to the interplay of several elements, this may pose a challenge in deciding which factor to focus on. As a result, based on the current findings from this study, there are pointers that could be used by managers in deciding on relevant determinants peculiar to mobile health adoption within the Nigerian healthcare sector. The importance of training healthcare workers on m-health functionalities is important because this will help facilitate skill capacity building in boosting users' confidence, which translates to the self-efficacy needed by users. Particular attention should be given to ensuring that m-health innovations are easy to use. It is advised that healthcare providers' involvement and feedback during development should be considered, as this would help analyse and address issues that are peculiar to m-health complexity and use. Adequate support from the government in terms of enabling policies regarding mobile health technology use and other ICT bodies goes a long way towards influencing technology adoption.

The research took a holistic approach to understanding m-health adoption among healthcare professionals in the Nigerian healthcare system. This research took the individual, technology, organization, and environmental context into account to understand the innovation adoption factor. The study relies on both UTAUT theory and the TOE framework to provide an explanation for the phenomenon being studied. This has aided in the theoretical development of the information system adoption stems. Effort expectancy, which is a variable in the UTAUT theory, was found to be a significant factor in m-health adoption. Several other studies, such as Seethamraju et al. (2018) on m-health, have found ease in using technology as an enabling factor to innovation adoption, hence explaining the role of UTAUT in technology adoption studies. Also, environmental factors like government support and external support from the TOE framework were found to be influential in m-health adoption among health users, explaining how crucial they are in adoption studies. The TOE has been used in understanding adoption in various organisational contexts and, as a result, the finding of this study aligns with the validity of this framework in explaining m-health in a healthcare setting. Bringing a different perspective to the research, the

individual context factors of self-efficacy and experience were found to be important in the adoption study of m-health for healthcare workers. Several studies have stated that the use of technology is dependent on the perception of users based on their self-efficacy (Jaradat & Faqih, 2014). Lastly, adding the individual context to the existing theories brings a richer explanatory power to adoption theories.

## **8.5 Recommendations**

Various pre-existing research projects attest to the fact that training boosts the confidence of technology users. Currently, there is limited knowledge in the health sector of several uses of m-health and the benefits they provide. It is therefore recommended that adequate awareness should be developed through the provision to healthcare workers of seminars and training on m-health technology in healthcare, particularly on the various aspect of the use of m-health so as to realise its full potential. Moreover, it is crucial that the instruction offered be simple to comprehend in situations where an authorised healthcare worker is required to instruct others in various areas.

Additionally, this study demonstrates that m-health interventions that are easy to use and straightforward in terms of design have a good impact on adoption. Therefore, it is recommended that ICT stakeholders make sure that users of this technology are involved in the intervention's development stage and that they provide feedback in order to ensure that the technology meets the nation's health needs and has features that are simple for medical professionals to use.

Furthermore, the study's findings showed how disjointedly policies are currently being implemented. Assuring that mobile health technology is in line with the objective of national healthcare is one of the key strategies to overcome this difficulty. It is recommended that policy implementation be managed through the decentralization of policy management to local and state levels with clear roles and accountability measures in order to have a policy that is implementable. By doing this, state regulators who set standards of operational access to healthcare facilities within their jurisdiction could easily monitor the implementation progress with respect to m-health use.

Also, focusing on low-cost technology is a step forward in addressing the financial constraints in the country. Additionally, the interoperability of m-health and other digital platforms is highly recommended as this would avoid repetition of actions for the same goal, which would translate to cost-reduction. Lastly, partnership between various parastatals such as ICT and telecommunication sectors with the government sector is recommended as this would aid government efforts.

## **8.6 Research Limitations and Further Study**

The following limitations were found in the study. Firstly, the sample size for the qualitative analysis was relatively small. This was because of the difficulty encountered in getting the consent of some hospital managers due to the extra work pressure they are experiencing as a result of the Covid-19 situation globally. A further study that includes a larger sample size is suggested as this would shed light on other factors.

Secondly, the study was conducted in only one state in Nigeria, and the research findings cannot be generalised to the country as a whole due to the insecurity issues elsewhere. Further research should be extended to the other states, and the outcomes of the research in each state should be compared. In addition, the constructs used in this research can be applied to study m-health adoption in other developing countries in order to ascertain if general principles can be developed. Also, it may be productive to use the conceptual framework presented here to study other types of information technology, such as electronic health records and clinical informatics. This framework could also be used to study the adoption of other mobile-based service platforms as well as other forms of technology in other organizational settings.

Thirdly, no patients were included in the research. Further study could include a cohort of patients, and a comparison of the perceptions of healthcare providers and receivers could be made. This would help in identifying the factors that are peculiar to patients that need to be addressed in influencing adoption

Lastly, no general hospitals were included in the research. This was because the researcher was not given approval to conduct the study in a general hospital because of the need to reduce the possibility of exposure to Covid-19 infection. Further research should incorporate hospitals managed at the state level.

## REFERENCES

- Abane, A. M., Mariwah, S., Owusu, S. A., Kasim, A., Robson, E., & Hampshire, K. (2021). Mobile phone use and the welfare of community health nurses in Ghana: An analysis of unintended costs. *World Development Perspectives*, 23(October 2020), 100317. <https://doi.org/10.1016/j.wdp.2021.100317>
- Abu Hassan, Z., Schattner, P., Mazza, D., Keluarga, K., & Lumpur, K. (2006). Research Notes DOING A PILOT STUDY: WHY IS IT ESSENTIAL? *Malaysian Family Physician*, 1(3), 170–173.
- Abubakar, I., Dalglish, S. L., Angell, B., Sanuade, O., Abimbola, S., Adamu, A. L., ... Zanna, F. H. (2022). The Lancet Nigeria Commission: investing in health and the future of the nation. *The Lancet*, 399(10330), 1155–1200. [https://doi.org/10.1016/S0140-6736\(21\)02488-0](https://doi.org/10.1016/S0140-6736(21)02488-0)
- Adam Wong, P. N. and M. F. L. H. (2018). Factors that affect the acceptance of new technologies in the workplace : a cross case analysis between two universities Dimitra Skoumpopoulou Adam Wong , Peggy Ng and Man Fung Lo. *International Journal of Education and Development Using Information and Communication Technology*, 14(3), 209–222.
- Adebara, O., Adebara, I., Olaide, R., Emmanuel, G., & Olanrewaju, O. (2017). Knowledge, Attitude and Willingness to Use m-health Technology among Doctors at a Semi Urban Tertiary Hospital in Nigeria. *Journal of Advances in Medicine and Medical Research*, 22(8), 1–10. <https://doi.org/10.9734/jammr/2017/33232>
- Adebayo, A. K., Bankole, F. A., & Adebayo, J. A. (2021). (2021). The impact and challenges of information and communication technology on health care delivery in nigeria 1, (1), 13–14.
- Adebisi, Y. A., Umah, J. O., Olaoye, O. C., Alaran, A. J., Sina-Odunsi, A. B., & III, D. E. L.-P. (2020). Assessment of Health Budgetary Allocation and Expenditure Toward Achieving Universal Health Coverage in Nigeria. *International Journal of Health and Life Sciences*, 6(2). <https://doi.org/10.5812/ijhls.102552>
- Adebola, O. (2013). Implementing eHealth: The Nigerian Experience. *11th Annual Commonwealth Telecommunications Organization (CTO) Forum, Abuja, Nigeria, October 7-11*. Retrieved from <http://www.cto.int/media/events/pst-ev/2013/CTO Forum/Implementing eHealth The Nigerian Experience.pdf.%22>

- Adedeji, P, Irinoye, O., Ikono, R., & Komolafe, A. (2018). Factors influencing the use of electronic health records among nurses in a teaching hospital in Nigeria. *Journal of Health Informatics in Developing Countries*, 12(2), unpaginated. Retrieved from <http://jhidc.org/index.php/jhidc/article/view/174/227>
- Adedeji, Peter, Irinoye, O., Ikono, R., & Komolafe, A. (2018). Journal of health informatics in developing countries. *Journal of Health Informatics in Developing Countries*, 12(2), 1–20.
- Adekunle, Y. (2016). *EVOLVING USAGE AND ACCESS TO ICTs IN THE NIGERIAN HEALTH CARE SECTOR : CHALLENGES AND PROSPECTS*. WestminsterResearch, University of Westminster, UK. Retrieved from [www.westminster.ac.uk/westminsterresearch](http://www.westminster.ac.uk/westminsterresearch)
- ADELEKE, I. T. (2015). Computer and Internet Use among Tertiary Healthcare Providers and Trainees in a Nigerian Public Hospital. *American Journal of Health Research*, 3(1), 1. <https://doi.org/10.11648/j.ajhr.s.2015030101.11>
- Adeleke, Y. S. (2017). Breaking the Jinx : A Neo-Synthesis Approach to Successful Implementation of Nigeria ' s National Health ICT Strategic Framework 2015-2020. *Advances in Computer Science and Information Technology (ACSIT)*, 4(3), 133–137.
- Ademiluyi, I. A., & Aluko-Arowolo, S. O. (2009). Infrastructural distribution of healthcare services in Nigeria: An overview. *Journal of Geography and Regional Planning*, 2(5), 104–110. Retrieved from <http://www.academicjournals.org/JGRP>
- Adeniran, A., Oluwole, E. O., & Ojo, O. Y. (2021). Job Satisfaction and Intention of Primary Healthcare Workers to Leave: A Cross-Sectional Study in a Local Government Area in Lagos, Nigeria. *Global Journal of Health Science*, 13(4), 138. <https://doi.org/10.5539/gjhs.v13n4p138>
- Adum, A. N., & Ejiofor, M. C. (2020). Awareness and Utilization of Mobile Health Applications among Teaching and Non Teaching Staff of Nnamdi Azikiwe University Awka, Anambra State, 5(2).
- Afolayan, & Oyekunle. (2014). Availability , Accessibility and Frequency of Use of Ict Tools By Health Professionals in Ilorin Metropolis. *Covenant Journal of Informatics and Communication Technology (CJICT)*, 2(1), 1–27.
- Aggelidis, V. P., & Chatzoglou, P. D. (2009). Using a modified technology acceptance model in hospitals. *International Journal of Medical Informatics*, 78(2), 115–126.

<https://doi.org/10.1016/j.ijmedinf.2008.06.006>

- Ajala, F. A., Adetunji, A. B., & Akande, N. O. (2015). TELEMEDICINE ACCEPTABILITY IN SOUTH WESTERN NIGERIA : ITS PROSPECTS AND. *International Journal of Advanced Computer Technology*, 4(9), 1970–1976.
- Ajibade, P. (2019). Technology acceptance model limitations and criticisms: Exploring the practical applications and use in technology-related studies, mixed-method, and qualitative researches. *Library Philosophy and Practice*, 2019.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, (50), 179–211. <https://doi.org/10.4135/9781446249215.n22>
- Ajzen, I., Fishbein, M., Lohmann, S., & Albarracin, D. (2018). The Influence of Attitudes on Behavior. *Contemporary Sociology*, 197–255.
- Akaranga, S. I., & Makau, B. K. (2016). Ethical consideration and their applications to a Research[1]. *Journal of Educational Policy and Entrepreneurial Research*, 3, 1–9.
- Aker, J., & Mbiti, I. (2010). Mobile Phones and Economic Development in Africa. *Journal of Economic Perspectives*, 24(3), 207–232. <https://doi.org/10.1257/jep.24.3.207>
- Akter, S., & Ray, P. (2010). m-health - an Ultimate Platform to Serve the Unserved. *Yearbook of Medical Informatics*, 94–100. <https://doi.org/10.1055/s-0038-1638697>
- Akter, Shahriar, Ambra, D. J., & Ray, P. (2010). Service quality of Health platforms: development and validation of a hierarchical model using PLS. *Electronic Markets*, 20(3), 209–227. <https://doi.org/10.1007/s12525-010-0043-x>
- AL-Hadban, W. K. M., Yusof, S. A. M., & Hashim, K. F. (2016). The Barriers and Facilitators to the Adoption of New Technologies in Public Healthcare Sector: A Qualitative Investigation. *International Journal of Business and Management*, 12(1), 159. <https://doi.org/10.5539/ijbm.v12n1p159>
- Al-Hashem, A. (2016). Health education in Saudi Arabia: Historical overview. *Sultan Qaboos University Medical Journal*, 16(3), e286–e292. <https://doi.org/10.18295/squmj.2016.16.03.004>
- Al-Mamary, Y. H., & Shamsuddin, A. (2015). The Impact of Top Management Support, Training, and

- Perceived Usefulness on Technology Acceptance. *Mediterranean Journal of Social Sciences*, (December), 10–17. <https://doi.org/10.5901/mjss.2015.v6n6s4p11>
- Al Dahdah, M., Desgrées Du LoÛ, A., & Méadel, C. (2015). Mobile health and maternal care: A winning combination for healthcare in the developing world? *Health Policy and Technology*, 4(3), 225–231. <https://doi.org/10.1016/j.hlpt.2015.04.002>
- Alaiad, A. (2019). The Determinants of M-Health Adoption in Developing Countries : An Empirical Investigation, 820–840.
- Alam, Mohammad Zahedul, Hu, W., Kaium, M. A., Hoque, M. R., & Alam, M. M. D. (2020). Understanding the determinants of m-health apps adoption in Bangladesh: A SEM-Neural network approach. *Technology in Society*, 61(April), 101255. <https://doi.org/10.1016/j.techsoc.2020.101255>
- Alam, Mohammed Zahedul, Hu, W., & Barua, Z. (2018). Using the UTAUT Model to Determine Factors Affecting Acceptance and Use of Mobile Health (m-health) Services in Bangladesh, 17(2), 137–172.
- Alkhatlan, H., Almutairi, B., & El-Shazly, M. (2016). Knowledge, Attitude and Practice of Primary Health Care Providers Regarding E-health: A Validation Study. *Greener Journal of Medical Sciences*, 6(1), 018–024. <https://doi.org/10.15580/gjms.2016.1.021716040>
- Allen, C., Metternicht, G., & Wiedmann, T. (2018). Initial progress in implementing the Sustainable Development Goals (SDGs): a review of evidence from countries. *Sustainability Science*, 13(5), 1453–1467. <https://doi.org/10.1007/s11625-018-0572-3>
- Alugbuo, J. C., & Eze, E. (2021). A Correlational and descriptive study on the economic effect of telecommunication industry in Nigeria. *Vol. V, No. V*, (May), 423–431.
- Amedari, M. I., & Ejidike, I. C. (2021). Improving access, quality and efficiency in health care delivery in Nigeria: a perspective. *PAMJ - One Health*, 5(May). <https://doi.org/10.11604/pamj-oh.2021.5.3.28204>
- Amos, O. A., Adebisi, Y. A., Bamisaiye, A., Olayemi, A. H., Ilesanmi, E. B., Micheal, A. I., ... Lucero-Prisno, D. E. (2021). COVID-19 and progress towards achieving universal health coverage in Africa: A case of Nigeria. *International Journal of Health Planning and Management*, 36(5), 1417–1422. <https://doi.org/10.1002/hpm.3263>
- Anders Bakkli & Malene Tennfjord. (2019). *The effect of human factors on safety related to barrier*

*management*. University of Tromsø Institute.

Angie Roques and Dr Tarry Asoka. (2011). Health Reform Foundation in Nigeria(Herform) Annual Review 2011, 44(0), 1–94. Retrieved from [www.hlsp.org](http://www.hlsp.org)

Animasahun, V. J. (n.d.). Contemporary issues and challenges of health sector in Nigeria Enjeux contemporains et défis du secteur de la santé au Nigeria, 5(4), 210–216.

Anthonia Obi-Ani, N., Ezeaku, D. O., Ikem, O., Isiani, M. C., Obi-Ani, P., & Janefrances Chisolum, O. (2021). Covid-19 pandemic and The Nigerian primary healthcare system: The leadership question. *Cogent Arts and Humanities*, 8(1). <https://doi.org/10.1080/23311983.2020.1859075>

Asi, Y. M., & Williams, C. (2018). The role of digital health in making progress toward Sustainable Development Goal (SDG) 3 in conflict-affected populations. *International Journal of Medical Informatics*, 114, 114–120. <https://doi.org/10.1016/j.ijmedinf.2017.11.003>

Awa, H. O., Ukoha, O., & Emecheta, B. C. (2016). Using T-O-E theoretical framework to study the adoption of ERP solution. *Cogent Business and Management*, 3(1). <https://doi.org/10.1080/23311975.2016.1196571>

Awa, H. O., Ukoha, O., & Igwe, S. R. (2017). Revisiting technology-organization-environment (T-O-E) theory for enriched applicability. *Bottom Line*, 30(1), 2–22. <https://doi.org/10.1108/BL-12-2016-0044>

Ayamolowo, O. J., Buraimoh, E., Salau, A. O., & Dada, J. O. (2019). Nigeria Electricity Power Supply System: The Past, Present and the Future. *IEEE PES/IAS PowerAfrica Conference: Power Economics and Energy Innovation in Africa, PowerAfrica 2019*, (February 2020), 64–69. <https://doi.org/10.1109/PowerAfrica.2019.8928767>

Aziz, A. S. A., & Wahid, N. A. (2020). Do New Technology Characteristics Influence Intention to Adopt for Manufacturing Companies in Malaysia?, (141), 30–35. <https://doi.org/10.2991/aebmr.k.200514.008>

Azodo, C. C., & Omuemu, V. O. (2017). Perception of spirituality, spiritual care, and barriers to the provision of spiritual care among undergraduate nurses in the University of Lagos, Nigeria. *Journal of Clinical Sciences*, 14(1), 119–125. <https://doi.org/10.4103/jcls.jcls>

Babalola, D., Anayo, M., & Itoya, D. A. (2021). Telehealth during COVID-19: why Sub-Saharan Africa is yet to log-in to virtual healthcare? *AIMS Medical Science*, 8(1), 46–55. <https://doi.org/10.3934/medsci.2021006>

- Babarinde, O. J., & Atulomah, N. O. (2022). Effects of Educational Intervention and Telephone-Reminders on Appointment-Keeping for Immunization among Mothers with Under-5 Children in Oyo State, Nigeria. *European Journal of Health Sciences*, 7(2), 47–58. <https://doi.org/10.47672/ejhs.1063>
- Babatunde, A. O., Abdulkareem, A. A., Akinwande, F. O., Adebayo, A. O., Omenogor, E. T., Adebisif, Y. A., & Ilesanmi, E. B. (2021). Leveraging mobile health technology towards Achieving Universal Health Coverage in Nigeria. *Public Health in Practice*, 2(April), 100120. <https://doi.org/10.1016/j.puhip.2021.100120>
- Baker, J. (2012). The technology–organization–environment framework. *Information Systems Theory*, 231-245. <https://doi.org/10.1007/978-1-4419-6108-2>
- Bandura, A. (1986). Bandura 1986\_Self efficacy Theory. *J Soc Clin Psychol*.
- Barbabella, F., Melchiorre, M. G., Papa, R., & Lamura, G. (2016). How can eHealth improve care for people with multimorbidity in Europe? Health Systems and Policy Analysis. *On Behalf of the ICARE4EU Consortium*, 31. Retrieved from [https://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0007/337588/PB\\_25.pdf](https://www.euro.who.int/__data/assets/pdf_file/0007/337588/PB_25.pdf)
- Barbbie, E. (2010). *The Practise of Social Research* (Twelfth Ed). Wadsworth.
- Barrette, C. M. (2015). Usefulness of technology adoption research in introducing an online workbook. *System*, 49, 133–144. <https://doi.org/10.1016/j.system.2015.01.005>
- Beebeejaun, M. R., & Chittoo, H. (2017). An Assessment of e-Health Readiness in the Public Health Sector of Mauritius. *International Journal of Sciences: Basic and Applied Research (IJSBAR)*, 35(August), 193–210.
- Bhattacharya, D., & Ali, M. A. (2014). The SDGs – What Are The “Means of Implementation”?, (September 2014). Retrieved from <http://www.futureun.org/media/archive1/briefings/FUNDS-Briefing21-SDGsMoI.pdf>
- Bloom, D. E., Khoury, A., & Subbaraman, R. (2018). The promise and peril of universal health care. *Science*, 361(6404). <https://doi.org/10.1126/science.aat9644>
- Blumenthal, J., Wilkinson, A., & Chignell, M. (2018). Physiotherapists’ and physiotherapy students’ perspectives on the use of mobile or wearable technology in their practice. *Physiotherapy Canada*, 70(3), 251–261. <https://doi.org/10.3138/ptc.2016-100.e>

- Brink, Hilla, Van der Walt, Christa, Van Rensburg, G. H. (2018). Fundamentals of research methodology for healthcare professionals. *Designing Qualitative Research*, 36–50.
- Brohi, P., & Hakro, D. N. (2018). Adoption of Healthcare Services on Mobile Platform : A Study of Sindh Province, 2(June), 1–6.
- Bryman, A. (2012). *Social research methods* (Fourth Edi).
- Buckley, G. J., & Gostin, L. O. (2013). Countering the problem of falsified and substandard drugs. *Countering the Problem of Falsified and Substandard Drugs*, (February), 1–351. <https://doi.org/10.17226/18272>
- Byambasuren, O., Beller, E., & Glasziou, P. (2019). Current knowledge and adoption of mobile health apps among australian general practitioners: Survey study. *JMIR M-health and UHealth*, 7(6). <https://doi.org/10.2196/13199>
- Carter, L., & Christian Schaupp, L. (2008). Efficacy and acceptance in E-file adoption. *14th Americas Conference on Information Systems, AMCIS 2008, 1*, 226–236.
- CBN. (2020). *Currency Operations Department Annau Report*.
- Ceo, O., In, A., Yi, E., Pa, A., Dambo, I., It, A., & Ma, I. (2018). Assessment of ICT Usage in Healthcare Service Systems : A Case Study of the Federal Medical Centre ( FMC ) Yenagoa in Bayelsa State , Nigeria, 6(1), 58–65.
- Chaka, M., Ishiwu, G. A., & Okpoko, C. (2020). Perception of Mobile Health Maternal Healthcare Services among Pregnant Women in Nigeria. *Global Journal of Health Science*, 12(8), 196–205. <https://doi.org/10.5539/gjhs.v12n8p196>
- Chau, P. Y. K., & Hu, P. J. (2002). Investigating healthcare professionals ’ decisions to accept telemedicine technology : an empirical test of competing theories, 39, 297–311.
- Chetley, A., Trude, B., Ramirez, R., Shields, T., Drury, P., Kumekawa, J., ... Nyamai-Kisia, C. (2006). Improving health, connecting people: the role of ICTs in the health sector of developing countries A framework paper. *Infodev*, (7), 1–65. Retrieved from <http://www.infobridge.org/asp/documents/3254.pdf>
- Chirambo, G. B., Muula, A. S., & Thompson, M. (2019). Factors affecting sustainability of m-health decision support tools and m-health technologies in Malawi. *Informatics in Medicine Unlocked*, 17(August),

100261. <https://doi.org/10.1016/j.imu.2019.100261>

- Chiu, C.-Y., Chen, S., & Chen, C.-L. (2017). An Integrated Perspective of TOE Framework and Innovation Diffusion in Broadband Mobile Applications Adoption by Enterprises. *International Journal of Management Economics and Social Sciences*, 6(1), 14–39. Retrieved from <http://www.ijmess.com>
- Cimperman, M., Makovec Brenčič, M., & Trkman, P. (2016). Analyzing older users' home telehealth services acceptance behavior-applying an Extended UTAUT model. *International Journal of Medical Informatics*, 90, 22–31. <https://doi.org/10.1016/j.ijmedinf.2016.03.002>
- Cling, J. P., Eghbal-Teherani, S., Orzoni, M., & Plateau, C. (2020). The interlinkages between the SDG indicators and the differentiation between EU countries: It is (mainly) the economy! *Statistical Journal of the IAOS*, 36(2), 455–470. <https://doi.org/10.3233/SJI-190507>
- Clohessy, T., & Acton, T. (2019). Investigating the influence of organizational factors on blockchain adoption: An innovation theory perspective. *Industrial Management and Data Systems*, 119(7), 1457–1491. <https://doi.org/10.1108/IMDS-08-2018-0365>
- Compeau, D., & Higgins, C. (1995). Development of a Measure and Initial Test. *Management Information Systems Research Center, University of Minnesota*, 19(2), 189–211.
- Cresswell, K. M., Bates, D. W., & Sheikh, A. (2013). Ten key considerations for the successful implementation and adoption of large-scale health information technology. *Journal of the American Medical Informatics Association*, 20(E1), 9–13. <https://doi.org/10.1136/amiajnl-2013-001684>
- Daly, J. A. (2003). World Summit on the Information Society and the Role of ICT in Achieving the Millennium Development Goals. *The Development Gateway*.
- Davey, S., & Davey, A. (2013). m-HEALTH- CAN IT IMPROVE INDIAN PUBLIC HEALTH SYSTEM. *National Journal of Community Medicine*, 4(3), 545–549. Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=93709147&site=ehost-live>
- David, N., Kah, M., Tyndall, J., & Longe, O. (2020a). Contextual contradictions to the scaling -up of mobile health in armed-conflict settings of north-eastern Nigeria: A case study of Almanach. *Proceedings of the 13th IADIS International Conference Information Systems 2020, IS 2020*, (May), 99–106. [https://doi.org/10.33965/is2020\\_2020061012](https://doi.org/10.33965/is2020_2020061012)

- David, N., Kah, M., Tyndall, J., & Longe, O. (2020b). Outcomes of M-health implementation on health workers' transformation in child health care service delivery: A case of ALMANACH. *Proceedings of the 24th Pacific Asia Conference on Information Systems: Information Systems (IS) for the Future, PACIS 2020*, (June).
- Davis, F. D. (2013). Information Technology Introduction, *13*(3), 319–340.
- Diego, S., Media, B., Di-, H. I., Corporation, M., Bird, K., Distinguished, A., ... Officer, C. I. (2006). ATA Meeting Summary, *12*(4), 496–504.
- Dillon, A., & Morris, M. G. (1996). User Acceptance of Information Technology. *Information Today*, *31*(August), 3–32. <https://doi.org/10.1006/imms.1993.1022>
- Dineshkumar, B., Krishnakumar, K., Nair, S. K., & Paul, D. (2019). An Overview of Information and Communication Technology Tools Application in Healthcare System. *Journal of Advanced Research in Medical Science & Technology*, *6*(1&2), 15–17. <https://doi.org/10.24321/2394.6539.201903>
- Diop, J., & Crul, S. (2014). The m-health opportunity in Sub-Sahara Africa; The path towards practical application. *Diop, J., & Crul, S.* Retrieved from <https://www.google.com/search?client=firefox-b-d&q=Diop%2C+J.%2C+%26+Crul%2C+S.+%282014%29.+The+m-health+opportunity+in+Sub-Sahara+Africa%3A+The+path+towards+practical+application.+Breda%3A+Deloitte>.
- Dollah, S., Abduh, A., & Rosmaladewi, M. (2017). Benefits and Drawbacks of NVivo QSR Application, (November). <https://doi.org/10.2991/icest-17.2017.21>
- Duarte, P., & Pinho, J. C. (2019). A mixed methods UTAUT2-based approach to assess mobile health adoption. *Journal of Business Research*, *102*(February), 140–150. <https://doi.org/10.1016/j.jbusres.2019.05.022>
- Duplaga, M. (2019). m-health – areas of application and the effectiveness of interventions, (January 2018). <https://doi.org/10.4467/20842627OZ.18.018.10431>
- Dwivedi, Y. K., Rana, N. P., Jeyaraj, A., Clement, M., & Williams, M. D. (2019). Re-examining the Unified Theory of Acceptance and Use of Technology ( UTAUT ): Towards a Revised Theoretical Model, 719–734. <https://doi.org/10.1007/s10796-017-9774-y>
- Dwivedi, Y. K., Wade, M. R., & Schneberger, S. L. (2012). Informations Systems Theory: Vol.2. *Springer*, *28*(November), 461. <https://doi.org/10.1007/978-1-4419-6108-2>

- Ebrahimi, S., Mehdipour, Y., Karimi, A., Khammarnia, M., & Alipour, J. (2018). Determinants of Physicians' Technology Acceptance for Mobile Health Services in Healthcare Settings. *Journal of Health and Biomedical Informatics*, 3(2), 92–99.
- Eguagie, I., & Okosun, V. (2010). THE ROLE OF PRIMARY HEALTH CARE IN NIGERIA . HEALTH CARE DELIVERY SYSTEMS : PROBLEMS AND PROSPECTS, 21(1), 71–76.
- El-Wajeeh, M., Galal-Edeen, G. H., & Mokhtar, H. (2014). Technology Acceptance Model for Mobile Health Systems. *IOSR Journal of Mobile Computing & Application*, 1(1), 21–33.
- Eneizan, B., Mostafa, A. A. N., & Alabboodi, A. S. (2018). Effect of Technical Support and Trust on the Adoption of Electronic Human Resource Management: Evidence from Developing Countries. *International Journal of Applied Research*, 4(7), 31–40.
- Engr, B., Ndukwe, E. C. A., & Commission, N. C. (2005). TELECOM LIBERALISATION IN.
- Erinoshio OA. (2005). Sociology for Medical, Nursing and allied Professions in Nigeria, Bulwark Consult, Abuja and Ijebu-Ode. *Hospital Management. Net*.
- Estoque, R. C. (2020). Erratum: A review of the sustainability concept and the state of SDG monitoring using remote sensing [Remote sens., 12 (2020) (1770)] DOI:10.3390/rs12111770. *Remote Sensing*, 12(16). <https://doi.org/10.3390/RS12162512>
- Eze, P., Agu, S. A., Agu, U. J., & Acharya, Y. (2021). Acceptability of mobile-phone reminders for routine childhood vaccination appointments in Nigeria – a systematic review and meta-analysis. *BMC Health Services Research*, 21(1), 1–15. <https://doi.org/10.1186/s12913-021-07296-1>
- Ezeanolue, E. E., Gbadamosi, S. O., Olawepo, J. O., Iwelunmor, J., Sarpong, D., Eze, C., ... Onoka, C. (2017). An m-health Framework to Improve Birth Outcomes in Benue State, Nigeria: A Study Protocol. *JMIR Research Protocols*, 6(5), e100. <https://doi.org/10.2196/resprot.7743>
- Faber, S. R. (2014). Factors influencing eHealth adoption by Dutch hospitals: An empirical study. <https://doi.org/10.1209/0295-5075/106/55001>
- Farahat, T. M., Hegazy, N. N., & Mowafy, M. (2018). Information and communication technologies in primary healthcare facilities in Egypt. *Primary Health Care Research and Development*, 19(1), 88–95. <https://doi.org/10.1017/S1463423617000470>

- Federal Republic of Nigeria. (2021). *National Policy on Population for Sustainable Development*.
- Fehling, M., Nelson, B. D., & Venkatapuram, S. (2013). Limitations of the Millennium Development Goals: A literature review. *Global Public Health*, 8(10), 1109–1122. <https://doi.org/10.1080/17441692.2013.845676>
- Fischer, F., & Carow, F. (2019). Impact of Public Health and Sustainability of Global Health Action for Achieving.
- Fleisher, L. K., & Paina, L. (2009). Nigeria Health System Assessment 2008, (May 2015). <https://doi.org/10.13140/RG.2.1.2367.6328>
- FMH. (2016). *National health policy*. <https://doi.org/10.1007/BF02760405>
- Folaranmi, T. (2014). M-health in Africa: Challenges and opportunities. *Perspectives in Public Health*, 134(1), 14–15. <https://doi.org/10.1177/1757913913514703>
- Fox, G., O'Connor, Y., Eze, E., Ndibuagu, E. O., & Heavin, C. (2020). End users' initial perceptions of m-health in nigeria: An investigation of primary healthcare workers' attitudes to the IMPACT app. *International Journal of E-Health and Medical Communications*, 11(4), 50–64. <https://doi.org/10.4018/IJEHMC.2020100104>
- Frambach, R. T., & Schillewaert, N. (2002). Organizational innovation adoption: A multi-level framework of determinants and opportunities for future research. *Journal of Business Research*, 55(2), 163–176. [https://doi.org/10.1016/S0148-2963\(00\)00152-1](https://doi.org/10.1016/S0148-2963(00)00152-1)
- Frost, M. J., Tran, J. B., Khatun, F., Friberg, I. K., & Rodríguez, D. C. (2018). What does it take to be an effective national steward of digital health integration for health systems strengthening in low- and middle-income countries? *Global Health Science and Practice*, 6, S18–S28. <https://doi.org/10.9745/GHSP-D-18-00270>
- Fuad, A., & Hsu, C. Y. (2018). UTAUT for HSS: Initial framework to study health IT adoption in the developing countries. *F1000Research*, 7, 1–6. <https://doi.org/10.12688/f1000research.13798.1>
- Gagnon, M., Ngangue, P., Payne-gagnon, J., & Desmartis, M. (n.d.). Title page m - Health Adoption by Healthcare Professionals : A Systematic Review, 1–38.
- Gagnon, M., Ngangue, P., Payne-gagnon, J., & Desmartis, M. (2016). m-Health adoption by healthcare

- professionals : a systematic review, 212–220. <https://doi.org/10.1093/jamia/ocv052>
- Gagnon, M. P., Desmartis, M., Labrecque, M., Car, J., Pagliari, C., Pluye, P., ... Légaré, F. (2012). Systematic review of factors influencing the adoption of information and communication technologies by healthcare professionals. *Journal of Medical Systems*, 36(1), 241–277. <https://doi.org/10.1007/s10916-010-9473-4>
- Gamatié, A. (2015). Computing in research and development in Africa: Benefits, trends, challenges and solutions. *Computing in Research and Development in Africa: Benefits, Trends, Challenges and Solutions*, 1–285. <https://doi.org/10.1007/978-3-319-08239-4>
- Gambo, I. P., & Soriyan, A. H. (2017). ICT Implementation in the Nigerian Healthcare System, (April).
- Gangwar, H., Date, H., & Raoot, A. D. (2014). Review on IT adoption: Insights from recent technologies. *Journal of Enterprise Information Management*, 27(4), 488–502. <https://doi.org/10.1108/JEIM-08-2012-0047>
- García-Moreno, M. B., García-Moreno, S., Nájera-Sánchez, J. J., & De Pables-Heredero, C. (2016). An explanatory model of the organisational factors that explain the adoption of e-business. *Journal of Industrial Engineering and Management*, 9(2), 547–581. <https://doi.org/10.3926/jiem.1917>
- Grix, J. (2002). Introducing Students to the Generic Terminology of Social Research. *Politics*, 22(3), 175–186. <https://doi.org/10.1111/1467-9256.00173>
- Grossi, A., Hoxhaj, I., Gabutti, I., Specchia, M. L., Cicchetti, A., Boccia, S., & de Waure, C. (2021). Hospital contextual factors affecting the implementation of health technologies: a systematic review. *BMC Health Services Research*, 21(1), 1–13. <https://doi.org/10.1186/s12913-021-06423-2>
- Guégan, J. F., Suzán, G., Kati-Coulibaly, S., Bonpamgue, D. N., & Moatti, J. P. (2018). Sustainable development goal #3, “health and well-being”, and the need for more integrative thinking. *Veterinaria Mexico*, 5(2). <https://doi.org/10.21753/vmoa.5.2.443>
- Hamed Hilal, A., & Said Alabri, S. (2013). Using NVivo for data analysis in qualitative research. *International Interdisciplinary Journal of Education*, 2(2), 181–186.
- Han, K. J., Subramanian, R., & Cameron, G. T. (2019). Listen before you leap: Sri Lankan health professionals’ perspectives on m-health. *Health Informatics Journal*, 25(3), 858–866. <https://doi.org/10.1177/1460458217725903>

- Haryanto, B., Gandhi, A., & Giri Sucahyo, Y. (2020). The Determinant Factors in Utilizing Electronic Signature Using the TAM and TOE Framework. *2020 5th International Conference on Informatics and Computing, ICIC 2020*. <https://doi.org/10.1109/ICIC50835.2020.9288623>
- Hasanain, R. A., Vallmuur, K., & Clark, and M. (2015). Electronic Medical Record Systems in Saudi Arabia: Knowledge and Preferences of Healthcare Professionals. *Journal of Health Informatics in Developing Countries*, 9(1), 23–31. Retrieved from <http://www.jhfdc.org/index.php/jhfdc/article/view/135>
- Helath, T., Experience, S., Idowu, B., Ogunbodede, E., & Idowu, B. (2003). *Journal of Information Technology Impact*, 3(2), 69–76.
- Hennington, A., & Janz, B. D. (2007). Information Systems and Healthcare XVI : Physician Adoption of Electronic Medical Records : Applying the UTAUT Model in a Healthcare Context RECORDS : APPLYING THE UTAUT MODEL IN A, 19(March). <https://doi.org/10.17705/1CAIS.01905>
- Hillblom, D., Schueth, A., Robertson, S. M., Topor, L., & Low, G. (2014). Pharmacy Claims Processing Pharmacies began to make the technology leap from paper claims to real-time claims adjudication with the National The Impact of Information Technology on Managed Care Pharmacy: Today and Tomorrow. *Www.Amcp.Org JMCP Journal of Managed Care & Specialty Pharmacy*, 20(11).
- Holden, H., & Rada, R. (2011). Understanding the influence of perceived usability and technology self-efficacy on teachers' technology acceptance. *Journal of Research on Technology in Education*, 43(4), 343–367. <https://doi.org/10.1080/15391523.2011.10782576>
- Hoque, R., & Sorwar, G. (2017). International Journal of Medical Informatics Understanding factors influencing the adoption of m-health by the elderly : An extension of the UTAUT model. *International Journal of Medical Informatics*, 101(September 2015), 75–84. <https://doi.org/10.1016/j.ijmedinf.2017.02.002>
- Hu, X. (2005). Factors affecting doctor ' s recommendation for mobile health services. <https://doi.org/10.1177/20552076221125976>
- Hussein, Z., Oon, S. W., & Fikry, A. (2017). Consumer Attitude: Does It Influencing the Intention to Use m-health? *Procedia Computer Science*, 105(December 2016), 340–344. <https://doi.org/10.1016/j.procs.2017.01.231>

- Ibraheem, R., Akintola, M., Abdulkadir, M., Ameen, H., Bolarinwa, O., & Adeboye, M. (2021). Effects of call reminders, short message services (SMS) reminders, and sms immunization facts on childhood routine vaccination timing and completion in Ilorin, Nigeria. *African Health Sciences*, 21(2), 951–959. <https://doi.org/10.4314/ahs.v21i2.57>
- Idowu, P. A. (n.d.). Information and Communication Technology : A Tool for Health Care Delivery in Nigeria, 59–79. <https://doi.org/10.1007/978-3-319-08239-4>
- Idowu, P., Cornford, D., & Bastin, L. (2008). Health informatics deployment in Nigeria Abstract. *Journal of Health Informatics in Developing Countries*, 2(1). Retrieved from [www.jhdc.org](http://www.jhdc.org)
- Idris, U., Abdulkarim, L., & Arkwright, B. (2022). Systematic Overview of Remote Patient Monitoring in Nigeria (West Africa). *Telehealth and Medicine Today*, 7(3), 1–6. <https://doi.org/10.30953/tmt.v7.359>
- Ifinedo, P. (2012). Technology acceptance by health professionals in Canada: An analysis with a modified UTAUT model. *Proceedings of the Annual Hawaii International Conference on System Sciences*, (November), 2937–2946. <https://doi.org/10.1109/HICSS.2012.556>
- Igbaria, M., Zinatelli, N., Cragg, P., & Cavaye, A. L. M. (1997). Personal computing acceptance factors in small firms: A structural equation model. *MIS Quarterly: Management Information Systems*, 21(3), 279–301. <https://doi.org/10.2307/249498>
- Istepanian, R. S. H., & Lacal, J. C. (2003). Emerging Mobile Communication Technologies for Health : Some Imperative notes on m-health, 1414–1416.
- Ivatury, G., Moore, J., & Bloch, A. (2009). A Doctor in Your Pocket Health Hotlines in Developing Countries.
- J, S., DC, M., & MR, R. (2016). Addressing the Risk of Product Fraud: A Case Study of the Nigerian Combating Counterfeiting and Sub-Standard Medicines Initiatives. *Journal of Forensic Science & Criminology*, 4(2), 1–13. <https://doi.org/10.15744/2348-9804.4.201>
- Jacob, C., Sanchez-vazquez, A., & Ivory, C. (2020). Social , Organizational , and Technological Factors Impacting Clinicians ’ Adoption of Mobile Health Tools : Systematic Literature Review Corresponding Author :, 8, 1–30. <https://doi.org/10.2196/15935>
- Jacob, C., Sanchez-Vazquez, A., & Ivory, C. (2020a). Social, organizational, and technological factors impacting clinicians’ adoption of mobile health tools: Systematic literature review. *JMIR M-health and*

*UHealth*, 8(2), 1–30. <https://doi.org/10.2196/15935>

- Jacob, C., Sanchez-Vazquez, A., & Ivory, C. (2020b). Understanding clinicians' adoption of mobile health tools: A qualitative review of the most used frameworks. *JMIR M-health and UHealth*, 8(7), 1–20. <https://doi.org/10.2196/18072>
- Jamison. (2006). Investing in health. In *Disease control priorities in developing countries*. (Vol. 383, pp. 3-34.). [https://doi.org/10.1016/S0140-6736\(14\)60475-X](https://doi.org/10.1016/S0140-6736(14)60475-X)
- Jaradat, M.-I. R. M., & Faqih, K. M. S. (2014). Investigating the Moderating Effects of Gender and Self-Efficacy in the Context of Mobile Payment Adoption: A Developing Country Perspective. *International Journal of Business and Management*, 9(11), 147–169. <https://doi.org/10.5539/ijbm.v9n11p147>
- Jewer, J. (2018). Patients' intention to use online postings of ED wait times: A modified UTAUT model. *International Journal of Medical Informatics*, 112(January), 34–39. <https://doi.org/10.1016/j.ijmedinf.2018.01.008>
- Johnston, R. B. (2016). Arsenic and the 2030 Agenda for sustainable development. *Arsenic Research and Global Sustainability - Proceedings of the 6th International Congress on Arsenic in the Environment, AS 2016*, 12–14. <https://doi.org/10.1201/b20466-7>
- Journal, I. M., & Sehinde, K. (2018). *African Research Review*, 12(49), 164–173.
- Kahn, J., Yang, J., & Kahn, J. (2010). 'Mobile' Health Needs And Opportunities In Developing Countries. *Health Affairs*, 2(2), 252–258. <https://doi.org/10.1377/hlthaff>
- Kaium, A., Bao, Y., Zahedul, M., & Hasan, N. (2019). Research in Business & Social Science Understanding the insight of factors affecting m-health adoption : A systematic review, 8(6), 181–200.
- Karin, K., Tibenderana, J. K., Chb, M. B., & Akpogheneta, O. J. (n.d.). Mobile Health ( m-health ) Approaches and Lessons for Increased Performance and Retention of Community Health Workers in Low- and Middle-Income Countries : A Review Corresponding Author :, 15. <https://doi.org/10.2196/jmir.2130>
- Kasali, F., Adekola, O., Akinyemi, I., Ebo, I., & Balogun, J. (2020). A Model for Ranking the Usability Attributes of Mobile Health Applications in Nigeria ( MCDM Approach ), 8(2).
- Keel, S., Schmid, A., Keller, F., & Schoeb, V. (2022). Investigating the use of digital health tools in

physiotherapy: facilitators and barriers. *Physiotherapy Theory and Practice*, 00(00), 1–20.  
<https://doi.org/10.1080/09593985.2022.2042439>

- Kenny, G., Connor, Y. O., Eze, E., & Connor, Y. O. (2017). Trends, Findings, and Opportunities: An Archival Review of Health Information Systems Research in Nigeria. *Journal of the Midwest Association for Information Systems*, 2017(2), 73–92.
- Khan, F. N. (2019). ICT and E-Government as the Sources of Economic Growth in Information Age: Empirical Evidence from South Asian Economies. *South Asian Studies*, 34(1), 227.
- Khan, N. U. Z., Rasheed, S., Sharmin, T., Ahmed, T., Mahmood, S. S., Khatun, F., ... Bhuiya, A. (2015). Experience of using mHealth to link village doctors with physicians: lessons from Chakaria, Bangladesh. *BMC Medical Informatics and Decision Making*, 15(1), 1–9. <https://doi.org/10.1186/s12911-015-0188-9>
- Klitsie, L., & Etter, M. (2018). on employees ' perceptions of performance and creativity, (june).
- Kreps, G. L., & Neuhauser, L. (2010). New directions in eHealth communication: Opportunities and challenges. *Patient Education and Counseling*, 78(3), 329–336. <https://doi.org/10.1016/j.pec.2010.01.013>
- Kumar, R. (2011). *Research Methodology: a step-by-step guide for beginners. Paper Knowledge . Toward a Media History of Documents* (3rd Editio, Vol. 3). SAGE.
- Kunawararak, P., Pongpanich, S., Chantawong, S., Pokaew, P., Traisathit, P., Srithanaviboonchai, K., & Plipat, T. (2011). Tuberculosis treatment with mobile-phone medication reminders in northern Thailand. *Southeast Asian Journal of Tropical Medicine and Public Health*, 42(6), 1444–1451.
- Lancaster, G. (2005). *Research Methods in Management: a concise introduction in management and business consultancy*. (First Edit). Elsevier Butterworth-Heinemann.
- Latif, S., Rana, R., Qadir, J., Ali, A., Imran, M. A., & Shahzad, M. (2017). Mobile Health in the Developing World : Review of Literature and Lessons from A Case Study, 3536(c), 1–16.  
<https://doi.org/10.1109/ACCESS.2017.2710800>
- Lau, A. S. M., & Kwok, V. W. S. (2007). How e-government strategies influence e-commerce adoption by SMEs. *Electronic Government*, 4(1), 20–42. <https://doi.org/10.1504/EG.2007.012177>
- Lee, A. C. W., & Harada, N. (2012). Telehealth as a Means of Health Care Delivery for Physical Therapist

- Practice. *Physical Therapy*, 92(3), 463–468. <https://doi.org/10.2522/ptj.20110100>
- Lee Ventola, C. (2014). Mobile devices and apps for health care professionals: Uses and benefits. *P and T*, 39(5), 356–364.
- Li, Y. C., Chang, I. C., Hung, W. F., & Fu, H. K. (2005). The critical factors affecting hospital adoption of mobile nursing technologies in Taiwan. *Proceedings of the Annual Hawaii International Conference on System Sciences*, 00(C), 157. <https://doi.org/10.1109/hicss.2005.586>
- Lian, J. W., Yen, D. C., & Wang, Y. T. (2014). An exploratory study to understand the critical factors affecting the decision to adopt cloud computing in Taiwan hospital. *International Journal of Information Management*, 34(1), 28–36. <https://doi.org/10.1016/j.ijinfomgt.2013.09.004>
- Lim, H. M., Dunn, A. G., Muhammad Firdaus Ooi, S., Teo, C. H., Abdullah, A., Woo, W. J., & Ng, C. J. (2020). mHealth adoption among primary care physicians in Malaysia and its associated factors: a cross-sectional study. *Family Practice*, 1–8. <https://doi.org/10.1093/fampra/cmaa103>
- Lodico, M. G., Spaulding, D. T., & Voegtler, K. H. (2006). *Methods in Educational Research: From Theory to Practice*. Retrieved from <http://books.google.com/books?id=G9D81mh9xCAC&pgis=1>
- Madaki, J., Gyang, M., Salihu, D., Malomo, S., & Dankyau, M. (2017). Family Medicine Trainers ' Experience with Cell Phone Use in Primary Care in Nigeria. *Internet Journ Med Informatics*, 8(1), 1–13. <https://doi.org/10.5580/IJMI.52039>
- Makawa, A. J. (2014). Assessment of ICT Infrastructure in Healthcare Provision in Referral Hospitals : A case study of Muhimbili National Hospital Assessment of ICT Infrastructure in Healthcare Provision in Refferal Hospitals. Pre. *Coventry University*, (January 2014), 1–51. Retrieved from <https://www.researchgate.net/publication/272984621%0AASSESSMENT>
- Makinde, O. A., Brown, B., & Olaleye, O. (2014). Medical tourism and the code of medical ethics on advertisement in Nigeria. *Pan African Medical Journal*, 19, 1–5. <https://doi.org/10.11604/pamj.2014.19.103.5217>
- Massoro, Z. Z., & Adewale, N. T. (2019). Influence of attitude, subjective norms and personal innovativeness on intention to use open access journals: A case of Agricultural Research Institutes. *Library Philosophy and Practice*, 2019(March).

- McNabb, M., Chukwu, E., Ojo, O., Shekhar, N., Gill, C. J., Salami, H., & Jega, F. (2015). Assessment of the quality of antenatal care services provided by health workers using a mobile phone decision support application in northern Nigeria: A pre/post-intervention study. *PLoS ONE*, *10*(5), 1–11. <https://doi.org/10.1371/journal.pone.0123940>
- Michael, P. N. (2009). The Case for mHealth in Developing Countries. *Innovations: Technology, Governance, Globalization*, *4*(1), 103–118. <https://doi.org/10.1162/itgg.2009.4.1.103>
- Mensah, I. K. (2019). Factors Influencing the Intention of University Students to Adopt and Use E-Government Services: An Empirical Evidence in China. *SAGE Open*, *9*(2). <https://doi.org/10.1177/2158244019855823>
- Meribole, E. C., Makinde, O. A., Oyemakinde, A., Oyediran, K. A., Atobatele, A., Fadeyibi, F. A., ... Orobato, N. (2018). The Nigerian health information system policy review of 2014 : the need, content, expectations and progress. *Health Information and Libraries Journal*, *35*(4), 285–297. <https://doi.org/10.1111/hir.12240>
- Micheuz, P. (2016). Stakeholders and Information Technology in Education, *493*, 26–36. <https://doi.org/10.1007/978-3-319-54687-2>
- Moghavvemi, S., Salleh, N. A. M., & Abessi, M. (2013). Determinants of IT-Related Innovation Acceptance and Use Behavior: Theoretical Integration of Unified Theory of Acceptance and Use of Technology and Entrepreneurial Potential Model. *Social Technologies*, *3*(2), 243–260. <https://doi.org/10.13165/st-13-3-2-01>
- Mohamed, S., & Haderi, A. (2014). The Influences of Government Support in Accepting the Information Technology in Public Organization Culture, *5*(5), 118–124.
- Mohanty, B., Chughtai, A., & Rabhi, F. (2019). Use of Mobile Apps for epidemic surveillance and response – availability and gaps. *Global Biosecurity*, *1*(2), 37. <https://doi.org/10.31646/gbio.39>
- Momani, A. M., Jamous, M., & Hilles, S. M. S. (2017). Technology Acceptance Theories : Review and Classification, (September), 0–14. <https://doi.org/10.4018/IJCBPL.2017040101>
- Mouakket, S., & Aboelmaged, M. (2021). Drivers and outcomes of green information technology adoption in service organizations: an evidence from emerging economy context. *Journal of Science and Technology Policy Management*, (May 2022). <https://doi.org/10.1108/JSTPM-09-2020-0137>

- Mujahed, H. M. H., Ahmed, E. M., & Samikon, S. A. (2020). Mobile Banking Adoption in Organization: Review of Empirical Literature. *International Journal of Innovative Science and Research Technology*, 5(9), 405–410. <https://doi.org/10.38124/ijisrt20sep288>
- Munyua, S., Rotich, G., & Kimwele, M. (2015). Factors Affecting The Adoption Of Mhealth In Maternal Health Care In Nakuru Provincial General Hospital. *International Journal of Scientific & Technology Research*, 4(11), 318–331.
- Nabila, M. (2017). The influence of Attitude, Subjective norm and Perceived behavioral control on Intention: the application of Theory Planned Behavior in choosing Double Degree Program, 11(1), 92–105.
- Najaftorkaman, M., Ghapanchi, A. H., Talaei-Khoei, A., & Ray, P. (2013). Full-Text Citation Analysis : A New Method to Enhance. *Journal of the American Society for Information Science and Technology*, 64(July), 1852–1863. <https://doi.org/10.1002/asi>
- Nathan, N. (2020). A Conceptual Framework for Organizational Adoption of M-Health in Nigeria .: A Conceptual Framework for Organizational Adoption of M-Health in Nigeria . A Conceptual Framework for Organizational Adoption of M-Health in Nigeria ., (January).
- National Population Commission/ICF. (2018). Nigeria Demographic and Health Survey 2018. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF; 2019 - Google Search. Retrieved from <https://www.google.com/search?q=National+Population+Commission+%28NPC%29+%5BNigeria%5D%2C+ICF.+Nigeria+Demographic+and+Health+Survey+2018.+Abuja%2C+Nigeria%2C+and+Rockville%2C+Maryland%2C+USA%3A+NPC+and+ICF%3B+2019&source=hp&ei=mDmjYc77Da-GjLsPwMewIA&ifls>
- NCC. (2012). *NATIONAL INFORMATION COMMUNICATION TECHNOLOGY ( ICT ) POLICY*.
- Nelissen, H. E., Cremers, A. L., Okwor, T. J., Kool, S., Van Leth, F., Brewster, L., ... Van 'T Hoog, A. H. (2018). Pharmacy-based hypertension care employing mHealth in Lagos, Nigeria - A mixed methods feasibility study 11 Medical and Health Sciences 1117 Public Health and Health Services. *BMC Health Services Research*, 18(1), 1–14. <https://doi.org/10.1186/s12913-018-3740-3>
- Neuman, W. L. (2007). *Basics of Social Research. Qualitative and Quantitative Approaches* (Second Edi). Pearson Education, Inc.

- Nezamdoust, S., Abdekhoda, M., & Rahmani, A. (2022). Determinant factors in adopting mobile health application in healthcare by nurses. *BMC Medical Informatics and Decision Making*, 22(1), 1–10. <https://doi.org/10.1186/s12911-022-01784-y>
- Nhavoto, J. A., Grönlund, Å., & Klein, G. O. (2017). Mobile health treatment support intervention for HIV and tuberculosis in Mozambique: Perspectives of patients and healthcare workers. *PLoS ONE*, 12(4), 1–13. <https://doi.org/10.1371/journal.pone.0176051>
- Nigeria, M., & Nigeria, M. (2019). National Health ICT Strategic Framework 2015 -2020. *Nigeria National Health ICT Strategy*, 53(9), 1689–1699.
- Nisha, N., Iqbal, M., Rifat, A., & Idrish, S. (2016). Exploring the role of service quality and knowledge for mobile health services. *International Journal of E-Business Research*, 12(2), 45–64. <https://doi.org/10.4018/IJEER.2016040104>
- Nkordeh, N., Bob-manuel, I., & Olowononi, F. (2017). The Nigerian Telecommunication Industry : Analysis of the First Fifteen Years of the Growths and Challenges in the GSM Market ( 2001 – 2016 ), I. NNBP 2020-2025. (2020). Nigerian National Broadband Plan 2020 - 2025, 1–100.
- Norris, A. C., Stockdale, R. S., & Sharma, S. (2009). Health Informatics Journal ©, 15(3), 244–253. <https://doi.org/10.1177/1460458209337445>
- Nsor-Anabiah, I. S., Udunwa, U., & Malathi, S. (2019). Review of the prospects and challenges of mHealth implementation in developing countries. *International Journal of Applied Engineering Research*, 14(12), 2897–2903.
- Nwagwu, W. E., & Areo, H. A. (2020). Use of mobile technologies for care of internal medicine clients in Nigeria’s premier teaching hospital. *Global Knowledge, Memory and Communication*, 69(8–9), 613–633. <https://doi.org/10.1108/GKMC-12-2019-0154>
- Obansa, S. A. J., & Orimisan, A. (2013). Health care financing in Nigeria: Prospects and challenges. *Mediterranean Journal of Social Sciences*, 4(1), 221–236. <https://doi.org/10.5901/mjss.2013.v4n1p221>
- Ocloo, C. E., Xuhua, H., Akaba, S., Shi, J., & Worwui-Brown, D. K. (2020). The Determinant Factors of Business to Business (B2B) E-Commerce Adoption in Small- and Medium-Sized Manufacturing Enterprises. *Journal of Global Information Technology Management*, 23(3), 191–216.

<https://doi.org/10.1080/1097198X.2020.1792229>

- Ogaji, D., & Brisibi, SFB. (2015). The Nigerian Health Care System: Evolution, contradictions, and proposal for future debates. *Port Harcourt Medical Journal*, 9(August), 79–88.
- Ojo, I. O., Oluwatumininu, O. R., Ani, O. B., & Adedeji, P. O. (2021). Factors Influencing Adoption and Use of Information and Communication Technologies Among Nurses in Selected Hospitals in Nigeria, *15*(1), 1–15.
- Okunade, K. S., Salako, O., Adejimi, A. A., Akinsola, O. J., Fatiregun, O., Adenekan, M. A., ... Berek, J. S. (2020). Impact of mobile technologies on cervical cancer screening practices in Lagos, Nigeria (mHealth-Cervix): Protocol for a randomised controlled trial. *F1000Research*, 9, 1–9.  
<https://doi.org/10.12688/f1000research.22991.1>
- Olaniyi, P. O., Oluwatobi, F. T., Olaniyan, M. E., Olajide, O. A., Sunday, B. A., Aborode, A. T., ... Chinonso, U. uzoma A. (2022). Healthcare systems strengthening in Africa: The call for action to achieve SDG 3. *International Journal of Health Planning and Management*, 37(1), 14–20.  
<https://doi.org/10.1002/hpm.3338>
- Olayemi, O. M. (2018). *Journal of Health Information and Librarianship*.
- Oliveira, T., & Martins, M. (2011). Literature review of Information Technology Adoption Models at Firm Level. *Electronic Journal of Information ...*, 14(1), 110–121. Retrieved from  
<http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=15666379&AN=65267826&h=+3mBLgsH44TuP+Md6aBOWR03issM0HLuIC10e2bYsd573ACXyFRydASKNeJIVclRbeOPZqZtJv6cXzNTjE4tdA==&crl=c>
- Olu, O., Muneene, D., Bataringaya, J. E., Nahimana, M. R., Ba, H., Turgeon, Y., ... Dovlo, D. (2019). How Can Digital Health Technologies Contribute to Sustainable Attainment of Universal Health Coverage in Africa? A Perspective. *Frontiers in Public Health*, 7(November), 1–7.  
<https://doi.org/10.3389/fpubh.2019.00341>
- Olushola, T., & Abiola, J. O. (2017). The Efficacy of Technology Acceptance Model : A Review of Applicable Theoretical Models in Information Technology Researches, *4*(11), 70–83.
- Omotosho, A., Ayegba, P., Emuoyibofarhe, J., & Meinel, C. (2019). Current state of ICT in healthcare delivery

in developing countries. *International Journal of Online and Biomedical Engineering*, 15(8), 91–107.  
<https://doi.org/10.3991/ijoe.v15i08.10294>

Onoja, A. J., Sanni, F. O., Awelewa, O., Akogu, S. P., & Onoja, S. I. (2021). Poor Availability of Information Communication and Technology in Sub-Saharan Africa Health Sector : A Case Study of Nigerian Health Facilities, 15(1), 1–9.

Opportunity, T., Technology, M., & World, D. (n.d.). mHealth for Development.

Osanyin, G. E., Bankethomas, A., Oluwole, E. O., Odeseye, A. K., & Afolabi, B. B. (2022). Effects of a mHealth voice messaging intervention on antenatal care utilisation at primary care level in Lagos, Nigeria: a cluster randomised trial. *Journal of Public Health in Africa*, 13(May), 1–11.

Otu, A., Okuzu, O., Ebenso, B., Effa, E., Nihalani, N., Olayinka, A., & Yaya, S. (2021). Introduction of Mobile Health Tools to Support COVID-19 Training and Surveillance in Ogun State Nigeria. *Frontiers in Sustainable Cities*, 3(March), 1–9. <https://doi.org/10.3389/frsc.2021.638278>

Otu, A., Ukpeh, I., Okuzu, O., & Yaya, S. (2021). Leveraging mobile health applications to improve sexual and reproductive health services in Nigeria: implications for practice and policy. *Reproductive Health*, 18(1), 1–5. <https://doi.org/10.1186/s12978-021-01069-z>

Owolabi, K. A. (2016). Applying UTAUT in Clinical Informatics Research.

Oyetunde, O. O., Ogidan, O., Akinyemi, M. I., Ogunbameru, A. A., & Asaolu, O. F. (2019). Mobile authentication service in Nigeria: An assessment of community pharmacists' acceptance and providers' views of successes and challenges of deployment. *Pharmacy Practice*, 17(2), 1–9.  
<https://doi.org/10.18549/PharmPract.2019.2.1449>

Özer, A., Argan, M. T., & Argan, M. (2013). The Effect of Mobile Service Quality Dimensions on Customer Satisfaction. *Procedia - Social and Behavioral Sciences*, 99, 428–438.  
<https://doi.org/10.1016/j.sbspro.2013.10.511>

Pankomera, R., & van Greunen, D. (2018a). A model for implementing sustainable mHealth applications in a resource-constrained setting: A case of Malawi. *Electronic Journal of Information Systems in Developing Countries*, 84(2), 1–12. <https://doi.org/10.1002/isd2.12019>

Pankomera, R., & van Greunen, D. (2018b). A model for implementing sustainable mHealth applications in a

- resource-constrained setting: A case of Malawi. *Electronic Journal of Information Systems in Developing Countries*, 84(2), 1–12. <https://doi.org/10.1002/isd2.12019>
- Parasuraman, A., Zeithaml, V. A., & Malhotra, A. (2005). ES-QUAL: A multiple-item scale for assessing electronic service quality. *Journal of Service Research*, 7(3), 213–233.
- Patton, M. Q. (1990). *Qualitative evaluation and research methods*. (2nd ed.). SAGE Publications, inc.
- Peprah, P., Abalo, E. M., Agyemang-Duah, W., Budu, H. I., Appiah-Brempong, E., Morgan, A. K., & Akwasi, A. G. (2020). Lessening barriers to healthcare in rural Ghana: Providers and users' perspectives on the role of mHealth technology. A qualitative exploration. *BMC Medical Informatics and Decision Making*, 20(1), 1–12. <https://doi.org/10.1186/s12911-020-1040-4>
- Phan, K., & Daim, T. (2013). Exploring technology acceptance for mobile services. <https://doi.org/10.3926/jiem.2011.v4n2.p339-360>
- Premkumar, G. (1996). Adoption of new information technologies in small businesses. *Proceedings - Annual Meeting of the Decision Sciences Institute*, 2, 859–861.
- Prince, B., Id, N., Ochola, P., Ndegwa, J., & Katuse, P. (2019). The technological , organizational and environmental determinants of adoption of mobile health applications ( m-health ) by hospitals in Kenya, 1–25.
- Qiang, C. Z., Yamamichi, M., Hausman, V., Miller, R., & Altman, D. (2012). Mobile Applications for the Health Sector, (April).
- Qualcomm. (2018). Nigeria's National Primary Health Care Development Agency and Evidence for Action Collaborate to Improve Maternal and Child Health Today.
- Rabiu, A. M., Mukhtar, M. I., Abbas, F. M., & Yusuf, A. (2019). ICT utilization and its barriers in jigawa state primary health care centers. *Information Technologist (The)*, 16(2), 141–156.
- Rahayu, R., & Day, J. (2015). Determinant Factors of E-commerce Adoption by SMEs in Developing Country: Evidence from Indonesia. *Procedia - Social and Behavioral Sciences*, 195, 142–150. <https://doi.org/10.1016/j.sbspro.2015.06.423>
- Ramdani, B., Duan, B., & Berrou, I. (2020). Exploring the Determinants of Mobile Health Adoption by

- Hospitals in China : Empirical Study Corresponding Author : Objective :, 8. <https://doi.org/10.2196/14795>
- Ramdani, B., Kawalek, P., & Lorenzo, O. (2009). Predicting SMEs' adoption of enterprise systems. *Journal of Enterprise Information Management*, 22, 10–24. <https://doi.org/10.1108/17410390910922796>
- Rashid, A. T., & Elder, L. (2009). Mobile Phones and Development: An Analysis of IDRC-Supported Projects. *The Electronic Journal of Information Systems in Developing Countries*, 36(1), 1–16. <https://doi.org/10.1002/j.1681-4835.2009.tb00249.x>
- Rastogi, G., Verma, H., & Sushil, R. (2018). Determining factors influencing cloud services adoption in India. *Serbian Journal of Management*, 13(2), 335–352. <https://doi.org/10.5937/sjm13-13207>
- Report, M. S. (2015). Nigerian Health Sector, (March).
- Rogers, E. M. (1995). *Diffusion of innovations*. Macmillian Publishing Co. <https://doi.org/citeulike-article-id:126680>
- Roumani, Y., Nwankpa, J. K., & Roumani, Y. F. (2015). The impact of incentives on the intention to try a new technology. *Technology Analysis and Strategic Management*, 27(2), 126–141. <https://doi.org/10.1080/09537325.2014.952625>
- Sahli, E. (2022). *Master Thesis Technology Acceptance of Mobile Health Apps among French Pediatricians Student*. Retrieved from <https://www.researchgate.net/>
- Salami, O. O. (2015). *PRIVACY PROTECTION FOR MOBILE HEALTH (MHEALTH) IN NIGERIA: A CONSIDERATION OF THE EU REGIME FOR DATA PROTECTION AS A CONCEPTUAL MODEL FOR REFORMING NIGERIA'S PRIVACY LEGISLATION*. Ekp. Dalhousie University. Retrieved from <https://dalspace.library.dal.ca/>
- Sanusi, I. (2019). Strengths and Weaknesses of Using NVivo Software in Analyzing Qualitative Data. Retrieved from <https://repository.ar-raniry.ac.id/id/eprint/15044/>
- Saunders, M., Lewis, P., & Thornhill, A. (2007). *Research Methods for Business Students* (Fourth Ed). Pearson Education Limited.
- Schoen, J., Mallett, J. W., Grossman-Kahn, R., Brentani, A., Kaselitz, E., & Heisler, M. (2017). Perspectives and experiences of community health workers in Brazilian primary care centers using m-health tools in

- home visits with community members. *Human Resources for Health*, 15(1), 1–10.  
<https://doi.org/10.1186/s12960-017-0245-9>
- Scott-Emuakpor, A. (2010). The evolution of health care systems in Nigeria: Which way forward in the twenty-first century. *Nigerian Medical Journal*, 51(2)(53).
- Seethamraju, R., Diatha, K. S., & Garg, S. (2018). Intention to Use a Mobile-Based Information Technology Solution for Tuberculosis Treatment Monitoring – Applying a UTAUT Model. *Information Systems Frontiers*, 20(1), 163–181. <https://doi.org/10.1007/s10796-017-9801-z>
- Seidman, G. (2017). Does SDG 3 have an adequate theory of change for improving health systems performance? *Journal of Global Health*, 7(1), 1–7. <https://doi.org/10.7189/jogh.07.010302>
- Sekaran, U., & Bougie, R. (2016). *Research Methods for Business: A skill-building approach* (Seventh Ed). John Wiley & Sons.
- Setiyani, L., & Yeny Rostiani. (2021). Analysis of E-Commerce Adoption by SMEs Using the Technology - Organization - Environment (TOE) Model: A Case Study in Karawang, Indonesia. *International Journal of Science, Technology & Management*, 2(4), 1113–1132. <https://doi.org/10.46729/ijstm.v2i4.246>
- Sezgin, E., Yildirim, S., Yildirim, S. Ö., & Sumuer, E. (2018). Current and emerging mhealth technologies: Adoption, implementation, and use. *Current and Emerging MHealth Technologies: Adoption, Implementation, and Use*, (February), 1–311. <https://doi.org/10.1007/978-3-319-73135-3>
- Shachak, A., Kuziemy, C., & Petersen, C. (2019). Beyond TAM and UTAUT: Future directions for HIT implementation research. *Journal of Biomedical Informatics*, 100(October), 103315.  
<https://doi.org/10.1016/j.jbi.2019.103315>
- Shozi, N. A., Pottas, D., Mostert-Phillips, N., Box, P. O., Mandela, N., & Elizabeth, P. (2012). A Socio-technical Perspective on the Use of Mobile Phones for Remote Data Collection in Home Community Based Care in Developing Countries, 135–145.
- Shuaib, F., Garba, A. B., Meribole, E., Obasi, S., Sule, A., Nnadi, C., ... Vertefeuille, J. (2020). Implementing the routine immunisation data module and dashboard of DHIS2 in Nigeria, 2014-2019. *BMJ Global Health*, 5(7), 2014–2019. <https://doi.org/10.1136/bmjgh-2019-002203>
- Siddiqui, F. A., Padhani, Z. A., Salam, R. A., Aliani, R., Lassi, Z. S., Das, J. K., & Bhutta, Z. A. (2022).

- Interventions to Improve Immunization Coverage Among Children and Adolescents: A Meta-analysis. *Pediatrics*, 149(May). <https://doi.org/10.1542/peds.2021-053852D>
- Sträub, E. T. (2009). Understanding Technology Adoption : Theory and Future Directions for Informal Learning Author ( s ): Evan T . Straub Published by : American Educational Research Association Stable URL : <http://www.jstor.com/stable/40469051> REFERENCES Linked references ar. *Review of Educational Research*, 79(2), 625–649.
- Talukder, M. (2012). Factors affecting the adoption of technological innovation by individual employees: An Australian study. *Procedia - Social and Behavioral Sciences*, 40, 52–57. <https://doi.org/10.1016/j.sbspro.2012.03.160>
- Talukder, M., Harris, H., & Mapunda, G. (2008). Adoption of innovations by individuals within organizations: An Australian study. *Asia Pacific Management Review*, 13(2), 463–480. <https://doi.org/10.6126/APMR.2008.13.2.02>
- Tariq, A. ., & Akter, S. . (2011). An assessment of m-health in developing countries using task technology fit model. *17th Americas Conference on Information Systems 2011, AMCIS 2011*, 2, 1059–1070. Retrieved from <http://www.scopus.com/inward/record.url?eid=2-s2.0-84870173859&partnerID=40&md5=c883eb323ba6335bc8f857c27ed71b99>
- Taylor, S., & Todd, P. (1995). Assessing IT usage: The role of prior experience. *MIS Quarterly: Management Information Systems*, 19(4), 561–568. <https://doi.org/10.2307/249633>
- Technologynigeria, H. I. (2016). the Case of District Health, (February), 1–38.
- Teferi, G. H., Tilahun, B. C., Guadie, H. A., & Amare, A. T. (2021). Smartphone medical app use and associated factors among physicians at referral hospitals in Amhara region, North Ethiopia, in 2019: Cross-sectional study. *JMIR MHealth and UHealth*, 9(3), 1–12. <https://doi.org/10.2196/19310>
- Tomlinson, M., Solomon, W., Singh, Y., Doherty, T., Chopra, M., Ijumba, P., ... Jackson, D. (n.d.). BMC Medical Informatics and Decision Making The use of mobile phones as a data collection tool : A report from a household survey in South Africa, 8, 1–8. <https://doi.org/10.1186/1472-6947-9-51>
- Too, C., Bomett, E., & Kiprop, C. (2021). Critical Success Factors for Adoption of Cloud Computing in Public Universities in Kenya. *European Journal of Education Studies*, 8(10), 160–174.

<https://doi.org/10.46827/ejes.v8i10.3939>

- Tornebohm, J. (2019). *DEGREE PROJECT IN THE FIELD OF TECHNOLOGY Organisational adoption of innovation A qualitative study on role-based access control*. KTH ROYAL INSTITUTE OF TECHNOLOGY.
- Touyz, L. Z. G. (2012). Alternative and orthodox medicine and the “ODD” principle. *Current Oncology*, *19*(2), 64–65. <https://doi.org/10.3747/co.19.845>
- Udousoro, N. W. (2014). Use and Gratification of ICTs by Health Care Personnel in Nigerian South- South Tertiary Hospitals, *3*(November), 226–235.
- United Nations. (2016). The Sustainable Development Goals Report. *Report*. <https://doi.org/10.1177/000331979004100307>
- Uzochukwu, B. S. C., Okeke, C., Brien, N. O., Ruiz, F., Sombie, I., & Hollingworth, S. (2020). Health technology assessment and priority setting for universal health coverage : a qualitative study of stakeholders ’ capacity , needs , policy areas of demand and perspectives in Nigeria, *2*, 1–11.
- Venkatesh, V., & Davis, F. D. (1996). A Model of the Antecedents of Perceived Ease of Use: Development and Test. *Decision Science*, *27*(3), 451–481. <https://doi.org/10.1111/j.1540-5915.1996.tb01822.x>
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View, *27*(3), 425–478.
- WHO. (2013). Health in the Post-2015 Development Agenda: An analysis of the UN-led thematic consultations, High-Level Panel report and sustainable development debate in the context of health July. *WHO Press*, (July 2013), 2–71.
- WHO. (2021). *Monitoring Health for the SDGs: Sustainable Development Goals* (Vol. 7).
- Wickramasinghe, N., & Goldberg, S. (2005). A framework for delivering m-health excellence. *Proceedings of the 18th Bled ...*, (December), 1–21. <https://doi.org/10.4018/978-1-59140-658-7.ch002>
- Williams, M. D., Rana, N., & Dwivedi, Y. K. (2012). *Information Systems Theory* (Vol. 29). <https://doi.org/10.1007/978-1-4419-9707-4>
- World Health Organisation. (2003). Health Systems : principled integrated care. *World Health Organisation*,

- Wu, I. L., Li, J. Y., & Fu, C. Y. (2011). The adoption of mobile healthcare by hospital's professionals: An integrative perspective. *Decision Support Systems, 51*(3), 587–596.  
<https://doi.org/10.1016/j.dss.2011.03.003>
- Wu, J. H., Wang, S. C., & Lin, L. M. (2005). What drives mobile health care? An empirical evaluation of technology acceptance. *Proceedings of the 38th Annual Hawaii International Conference on System Sciences, 00*(C), 150a-150a. <https://doi.org/10.1109/HICSS.2005.689>
- Wu, J. H., Wang, S. C., & Lin, L. M. (2007). Mobile computing acceptance factors in the healthcare industry: A structural equation model. *International Journal of Medical Informatics, 76*(1), 66–77.  
<https://doi.org/10.1016/j.ijmedinf.2006.06.006>
- Xu, W., Ou, P., & Fan, W. (2017). Antecedents of ERP assimilation and its impact on ERP value: A TOE-based model and empirical test. *Information Systems Frontiers, 19*(1), 13–30.  
<https://doi.org/10.1007/s10796-015-9583-0>
- Yildirim, S. (2018). Understanding the perception towards using mHealth applications in practice : physicians ' perspective, (July 2020). <https://doi.org/10.1177/0266666916684180>
- Zabadi, A. M. (2016). Adoption of Information Systems (IS): The Factors that Influencing IS Usage and Its Effect on Employee in Jordan Telecom Sector (JTS): A Conceptual Integrated Model. *International Journal of Business and Management, 11*(3), 25. <https://doi.org/10.5539/ijbm.v11n3p25>
- Zaidi, S., Kazi, A. M., Riaz, A., Ali, A., Najmi, R., Jabeen, R., ... Sayani, S. (2020). Operability, usefulness, and task-technology fit of an mhealth app for delivering primary health care services by community health workers in underserved areas of Pakistan and Afghanistan: Qualitative study. *Journal of Medical Internet Research, 22*(9), 1–13. <https://doi.org/10.2196/18414>
- Zakerabasali, S., Ayyoubzadeh, S. M., Baniyasi, T., Yazdani, A., & Abhari, S. (2021). Mobile health technology and healthcare providers: Systemic barriers to adoption. *Healthcare Informatics Research, 27*(4), 267–278. <https://doi.org/10.4258/HIR.2021.27.4.267>
- Zaltman, G., & Duncan, R. (1977). Strategies For Planned Change. *John Wiley, Toronto*.
- Zamawe, F. C. (2015). The implication of using NVivo software in qualitative data analysis: Evidence-based

reflections. *Malawi Medical Journal*, 27(1), 13–15. <https://doi.org/10.4314/mmj.v27i1.4>

Zayyad, M. A., & Toycan, M. (2018). Factors affecting sustainable adoption of e-health technology in developing countries: an exploratory survey of Nigerian hospitals from the perspective of healthcare professionals. *PeerJ*, 6, e4436. <https://doi.org/10.7717/peerj.4436>

Zobair, K. M., & Sanzogni, L. (2020). Telemedicine Healthcare Service Adoption Barriers in Rural Bangladesh, 24, 1–24.

## APPENDIX

### Appendix A: Interview Transcript and Themes.

Interviewee	Themes	
	Available Technologies for Health Service delivery	m-health Knowledge and Use
Lagos University Teaching Hospital	<i>We have recent hard and software for the hospital operations in capturing data. The management is making an effort to harmonize all the various unit, to be able to connect to one central server. We have computers in the Health Information Management department where we store our record. We develop a means of communicating to our clients (patients), phones were giving to all the dept. and the numbers were made available on the internet for remote consultation</i>	<i>I know a lot about m-health solution and I used to wear one to check my heart rate</i>
Isalu Hospital	<i>We have the electronic medical record (EMR), Meditorix, E-clark, and HR Software. All the departmental unit have laptops, desktops and a robust IT dept. that have all we need to get the work done</i>	<i>I know our doctors use the machine (tool) to consult with patients. We use telemedicine in consulting patient at their home and drugs dispatch to them through dispatch riders.</i>
Medical Officer for Health	<i>We have laptops for data collection, mobile phones for communication in 24hrs centres. We have electronic medical record used to store information of patients. Doctoor installed an App used to communicate with the mothers if they don't come for antenatal. There is also the Jaika software that is used in such a way to communicate with the patients informing them of their antenatal date visit</i>	<i>We have an Apps used to communicate with the mothers if they don't come for antenatal. We also have one Jaika used in such a way to communicate with the patients informing them of their antenatal date visit</i>

## Individual, Technological, Organizational and Environmental factors influencing m-health Adoption

Themes	Interviewees
<b>Individual Factors</b>	<p><i>Most of them are used to the technology already, and most of them knows that the technology are user friendly. (LUTH)</i></p> <p><i>Majority of the staff are well experienced in the used of mobile device technology, the old staff can be described as experts and quite vast in the used of tools for patient management. The attitude, experience, and knowledge of the staff on the use of m-health is very positive. (ISALU)</i></p> <p><i>The staff are all skilled in the use of m-health technology. They have positive attitude in the use of it, experience and well trained healthcare personnel. (MOH)</i></p>
<b>Technological Factors</b>	<p><i>We have fibre cables laid round the hospital for steady network. Our hospital has a 24hr electricity supply, and the telecommunication service provider has improved tremendously. We made sure that we have a secured technology. The current technology in the organisation support the proposed mHealth system. Government regulations and competition in the telecommunication industry has made the cost to be minimal and it is readily available and affordable. (LUTH)</i></p> <p><i>The technology is compatible with the job, mobile device used is compatible with Healthcare tools used in this organisation. The compatibility factor is what encourages the use of the technology and it is very easy to use. The telecommunication company have being supportive by making their network available. (ISALU)</i></p>

Themes	Interviewees
	<p><i>The technology is not difficult to use and it is compatible with the existing ICT tools. The mobile phone is reliable for our healthcare service delivery and it has improve our service performance due to their influence on the job. (MOH)</i></p>
<p><b>Organizational Factors</b></p>	<p><i>The hospital organise training for staff and we are investing more on that too. Due to Covid-19 pandemic we deploy Zoom to train health workers on a daily basis, putting up measure to protect the system and to encourage staff by providing them with the devices and network/internet services that aid their works. The organisation employ enough ICT support for the staff and our organisation is ready to adopt m-Health fully for healthcare service delivery. (LUTH)</i></p> <p><i>We had to train and retrain staff for long time and the management made the use of ICT tools compulsory. The management made sure the tools provided were user friendly, very easy to use, we tried to discover which one will work with our system and then went further to train the staff. There is technical support wherever necessary, the organisation provide resources for the staff and the management team by providing fund and the devices needed to execute the task to encouraged the staff to adopt the use. (ISALU)</i></p> <p><i>The organisation provide credit on the phone for the staff to use, we make sure they have their phone recharged every month and encourage client to have all primary healthcare centres to have their number. (MOH)</i></p>

Themes	Interviewees
<b>Environmental Factors</b>	<p><i>We have the enabling laws and environment to implement mHealth and the government regulations and competition in the industry has made the cost to be minimal. (LUTH)</i></p> <p><i>This only affects the government own hospital establishment and Government has not being supportive in private healthcare organizations. (ISALU)</i></p> <p><i>I don't think privacy and confidentiality is an issue, the government has been supportive with their policies. (MOH)</i></p>

## Potential Barrier to m-health Adoption

Themes	Interviewees
Barrier to m-health adoption	<p><i>The level of security threat to use of m-health services is high. If the internet service become expensive it tend to discourage the adoption of m-health. The environmental factors and government policies in terms of monopoly and pricing can discourage the potential adoption of m-health technology. (LUTH)</i></p> <p><i>Those against the adoption were the nurses, it was a war, and they did not see the need for it. Sometimes bad network can make call without success. Right now, whomever has access to the file can see the history of the patient which makes confidentiality a problem. Security is a challenge right now, funding has also been a problem. The internet cost is a bit high and only affordable by those who can buy it. One major barrier is from the government side, different taxes and policies that discourage the internet service provider, and on the part of Telecommunication Company there service sometime becomes poor and expensive. (ISALU)</i></p> <p><i>There is shortage of staff which makes the phone to be occasionally switch-off due to shortage of staff. The network or service provider that are sometimes not reliable, there is fluctuation in network services or when their network goes bad. And finally, no technical support in-house, it is outsourced which cause delay whenever we have technical issues. (MOH)</i></p>

## Appendix B: QUESTIONNAIRE FOR HEALTHCARE PROFESSIONALS

### MOBILE HEALTH ADOPTION IN THE NIGERIAN HEALTHCARE SYSTEM

M-health is defined as the use of a mobile phone, personal digital device or wireless body sensors for the purpose of health care service delivery.

#### SECTION A: DEMOGRAPHIC INFORMATION

1. Please tick the box that represent your gender

Male  Female

2. Please tick the range that represent your age

Below 20	
Between 20 and 25	
Between 25 and 35	
Between 35 and 45	
Above 45	

3. Please tick the health Divisions you work with

Primary Healthcare center	
Private Hospital	
Federal Medical center	
General Hospital	
Teaching Hospital	

4. Please tick your current job description

Administrator	
Nurse	
Pharmacist	
Doctor	
Others: please specify	

5. Please indicate the number of staff in your hospital by ticking the range

Below 20	
Between 20 and 40	
Above 40	

6. Please indicate the current ICT tools used to perform your duties by ticking the extent to which you use them.

	Technology Type	Never	Rarely	Sometimes	Often	Very often
6.1	Mobile phones					
6.2	Laptop					
6.3	Desktop computer					
6.4	Internet					
6.5	Medical applications					
6.6	Others: Please specify_____					

7. Please indicate the current use of technology for work related purpose.

		ICT Tools					
	Work related use	Mobile Phones	Landline Telephone	Desktop	Laptop	Tablet	others
7.1	Remote Data collection						
7.2	Disease and Epidemic outbreak tracking						
7.3	Diagnostic Support						
7.4	Remote patient treatment and monitoring						
7.5	Health worker awareness/ training						
7.6	Communication with other healthcare professionals						
7.7	Health workers Training						
7.8	Others						

8. Do you have a general knowledge on mobile phone(mhealth) use for healthcare

Yes

No

9. Current Use of Mobile devices (m-health) for work related purpose

		Never	Rarely	Sometimes	Often	Very often
9.1	Appointment Booking					
9.2	Mobile-Telemedicine (Tele-consultation)					
9.3	Sending SMS for Drug refill					
9.4	Communicating with other health worker					
9.5	Patient Monitoring					
9.6	Health education and health Awareness					
9.7	Others: .....					

**SECTION B: INDIVIDUAL FACTORS INFLUENCING M-HEALTH ADOPTION**

10. Please rate the following statements with the extent to which you agree or disagree with the statements

		Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
10.1	I can confidently use mobile phone for healthcare purpose					
10.2	I am confident in my ability to use mobile technology for health related purpose					
10.3	If I have someone to show me how, I am sure I can use m-health solutions					
10.4	I would use m-health if I have a lot of time on my hand to complete my Job					

		Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
10.5	With my experience with computer technology, I can confidently use mobile based technology					
10.6	I believe m-health is a useful for providing service					
10.7	I prefer m-health to other technology					
10.8	M-health reduces patient waiting time					

### SECTION C: TECHNOLOGY FACTORS ON M-HEALTH ADOPTION

11. Please rate the following statements with the extent to which you agree or disagree with the statements

		Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
11.1	Mobile health use increases my professional performance.					
11.2	M-health increases patient access to healthcare services					
11.3	M-health helps to complete patient care more quickly					
11.4	M-health solutions are easy to use					
11.5	Healthcare worker finds it easy to use m-health in interacting with patient					
11.6	M-health is compatible with the nature of my work					
11.7	M-health ensures privacy of information					

## SECTION D: ORGANIZATIONAL FACTORS ON M-HEALTH ADOPTION

12. Please rate the following statements with the extent to which you agree or disagree with the statements

		Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
12.1	The hospital provides adequate training on the use of m-health technology					
12.2	The hospital provide adequate technical support for m-health technology					
12.3	The management provides resources to use m-health solution					
12.4	Management are willing to invest funds in the use of m-health the technology					

## SECTION E: ENVIRONMENTAL FACTORS ON M-HEALTH ADOPTION

13. Please rate the following statements with the extent to which you agree or disagree

		Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
13.1	Government policy supports the use of mobile phones for healthcare service delivery					
13.2	There is sound healthcare legislation and regulation guiding the use of m-health					
13.3	There is strict compliance to m-health use.					
14.4	Cost of telecommunication Network is affordable to support this innovation					
13.5	The telecommunication network is good enough to support m-health technology					

**SECTION F: POTENTIAL ADOPTION OF M-HEALTH TECHNOLOGY**

14. Please rate the following statements with the extent to which you agree or disagree.

		Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
14.1	I have strong intention to use m-health services					
14.2	I intend to use m-health services					
14.3	I intend to learn about m-health services					

**SECTION G: POTENTIAL BARRIER TO M-HEALTH TECHNOLOGY**

15. Please rate the following statements with the extent to which you agree or disagree.

S/N	Factors	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
15.1	Lack of skill to develop m-health application affects m-health technology adoption					
15.2	Unreliable network connection is a barrier to m-health adoption					
15.3	High cost of internet bundle is a barrier to m-health adoption					
15.4	Privacy and Security concern inhibit the adoption of m-health technology					
15.5	Lack of interest to use technology from health professionals is an impediment to m-health adoption					

**THANK YOU FOR PARTICIPATING**

## **APPENDIX C: INTERVIEW QUESTIONS FOR HOSPITAL MANAGEMENT**

### **SECTION A: INFORMATION ON CURRENT ICT USE IN ORGANIZATION**

1. What are the current ICT tools used in this organization and what are they used for?
2. How often are these technology used?
3. What are the health information technology used in this organization?

### **SECTION B: M-HEALTH KNOWLEDGE**

4. How well do you know about m-health technology?
5. Are there any m-health initiative currently in the healthcare sector? If yes, please state.

### **SECTION C: M-HEALTH ADOPTION FACTORS**

6. Are healthcare workers skilled and experienced with the use of mobile devices for service delivery?
7. What is the attitude of healthcare workers to the use of m-health solutions?
8. Regarding m-health technology are they easy to use?
9. In what way do you think m-health will improve healthcare sector?
10. Are there concerns about availability and security of m-health technology in service delivery?
11. Can the current technology in your organization support the implementation of m-health?

12. How does management support, technical support and training influences m-health adoption?
13. How does Ministry of health regulation influence m-health adoption?
14. What role of government policy play as regards m-health adoption?
15. What is the influence of telecommunication service provider in m-health adoption?
16. What can be done to promote m-health adoption by worker in healthcare sector?
17. How can m-health help to achieve the national health goal?
18. What other factor can make m-health adoption successful?
19. Are you willing to adopt m-health technology?

#### **SECTION D: BARRIERS TO M-HEALTH ADOPTION**

20. What are the factors that inhibit m-health adoption?
21. From your perspective, how can these issues identified above be resolved?

## APPENDIX D: CONSENT FORM

UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE  
(HSSREC)

APPLICATION FOR ETHICS APPROVAL  
For research with human participants

### Information Sheet and Consent to Participate in Research

Date: 11<sup>th</sup> March 2020

Dear Respondent,

My name is Omotanwa Moji Adegbola, with student number 217080699 from the Department of Information Systems and Technology, School of Management, IT and Governance, University of Kwazulu-Natal, Durban, South Africa.

You are being invited to consider participating in a study that involves research on the Development of an Evaluation Model for m-health in Developing Country: A Case Study of Nigeria. The aim and purpose of this research is to explore various factors that influences the use of m-health technology in healthcare sector Nigeria from both organizational and individual perspective. The study is expected to include 274 participants in total from all the selected study site in Lagos Nigeria and its extension. Lagoon Hospital will have 4 participants, St Nicholas

Hospital will include 14 participants, Medicare Hospital will include 23 participant, Reddington Hospital will have 13 participants, Lagos University teaching Hospital will include 213 participant and Isalu hospital will involve 7 participants. This study will involve the use of Questionnaire and Semi structured interview. The duration of your participation if you choose to participate and remain in the study is expected to be 25 minutes.

There are no risk of any kind involved in this study. It is worthy of note that there is no monetary gain in participating in this project. I hope that the study will contribute to the body of knowledge on adoption of m-health technology. Also it will help to identify factors that would make m-health technology adoption in Nigeria healthcare sector a success.

In the event of any problems or concerns/questions you may me on (Tel: +2348027638182, email: [217080699@ukzn.ac.za](mailto:217080699@ukzn.ac.za)) or my supervisor Professor Manoj Maharaj on

([Maharajms@ukzn.ac.za](mailto:Maharajms@ukzn.ac.za)) or the UKZN Humanities & Social Sciences Research Ethics Committee, contact details as follows:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001

Durban 4000 KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: [HSSREC@ukzn.ac.za](mailto:HSSREC@ukzn.ac.za)

Your anonymity will be maintained by the researcher and the School of Management, I.T. & Governance and your responses will not be used for any purposes outside of this study.

All data, both electronic and hard copy, will be securely stored during the study and archived for 5 years. After this time, all data will be destroyed.

If you have any questions or concerns about participating in the study, please contact me or my research supervisor at the numbers listed above.

Sincerely

Investigator's Name: Omotanwa Moji Adegbola

Signature:  \_\_\_\_\_ Date: 11<sup>th</sup> March 2020

## CONSENT TO PARTICIPATE

I ..... (Participant's full name) have been informed about the study entitled the Development of an Evaluation Model for m-health in Developing Country: A Case Study of Nigeria by Omotanwa Moji Adegbola.

I understand the purpose and procedures of the study.

I have been given an opportunity to ask questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

I have been informed that there is no risk involved in this research as well as no monetary gain.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at (Tel: +2348027638182, email: 217080699@ukzn.ac.za).

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

## HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001

Durban

4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557 - Fax: 27 31 2604609

Email: [HSSREC@ukzn.ac.za](mailto:HSSREC@ukzn.ac.za)



## Appendix E: GATEKEEPER PERMISSION

Monday, 01 July 2019.

To Whom It May Concern:

### Permission to Gather Data for PhD Research

I, Adegbola Omotanwa Moji (Student number: 217080699), a Ph.D. student in the School of Management, IT and Governance, at the University of KwaZulu-Natal, Durban South Africa; hereby seek your permission to gather data in your organization for the purpose of my research as part of the requirement for PhD qualification. This would enable me link theoretical knowledge to challenges faced by organization in real life setting. Data would be gathered through the use of questionnaire and interview.

The research work is titled: “Development of an Evaluation Model for m-health in Developing Country: A Case Study of Nigeria”; under the supervision of Prof. Manoj Maharaj.

Your permission to access your organization for the purpose of this research would be highly appreciated.

Also, be assured that all information gathered from this organization would be treated with utmost confidentiality.

Thank you for your assistance.

Yours Sincerely,

A black rectangular box redacting the signature of Adegbola Omotanwa M.

Adegbola Omotanwa M.

School of Management, IT and Governance,  
University of Kwazulu-Natal, Durban, South  
Africa.



LAGOS STATE GOVERNMENT



LAGOS STATE  
PRIMARY HEALTH CARE BOARD

LS/PHCB/MS/1128/VOL.VII/083


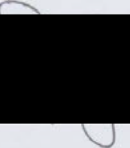
24<sup>th</sup> November 2020

Adegbola Omotanwa Moji  
Plot 3A Block 6 Owonifari Avenue  
Channels television road Opic  
Ogun State

**APPROVAL TO CONDUCT A STUDY TITLED "DEVELOPMENT OF AN EVALUATION MODEL FOR m-HEALTH ADOPTION IN DEVELOPING COUNTRY: A CASE STUDY OF NIGERIA".**

This is to acknowledge the receipt of your letter requesting for approval to conduct above named study in some of our Primary Healthcare centres in the state and to convey our Permanent Secretary's approval.

2. You have been given approval to access all the PHCs in Yaba LCDA.
3. We expect you to keep the confidentiality of all the study participants.
4. We would also like to emphasize that you share with us the result of your findings before public dissemination.
5. Thank you.

  
Dr. A. E Erinosh.   
Director Medical Services & Disease Control  
For: Permanent Secretary



**COLLEGE OF MEDICINE, UNIVERSITY OF LAGOS**  
**HEALTH RESEARCH ETHICS COMMITTEE**

CMUL HREC Registration Number: HREC/15/04/2015

Office Address: 2nd Floor, Biomedical Engineering Block,  
 College of Medicine, University of Lagos  
 P.M.B. 12003, Lagos, Nigeria

Telephone: 0802 864 2453 E-mail: hrec@cmul.edu.ng Website: cmul.unilag.edu.ng



**Chairman:**

Prof. Sunday A. Omilabu  
 B.Sc. (Hons.) (ife), M.Sc. (Ibadan),  
 Ph.D. (Ibadan)

**Vice-Chairman:**

Dr. Kolawole S. Oyedeji  
 B.Sc. (Uniport), M.Sc. (ife),  
 MHRG (South Africa), Ph.D. (Iagms),  
 AIMS (Ifg), CPHPE (Ibadan)

30<sup>th</sup> November, 2019

Re: Development of an Evaluation Model for m-Health in Developing Countries: A case study of Nigeria

CMULHREC Number: CMUL/HREC/10/19/586

Name of Principal Investigators: Adagbola, Omotaiwa Muji

Date of receipt of valid application: 30<sup>th</sup> October, 2019

Date of meeting when final determination of research was made: 20<sup>th</sup> November, 2019

**APPROVAL LETTER**

The above named proposal has been adequately reviewed; the protocol and safety guidelines satisfy the conditions of CMULHREC policies regarding experiments involving human and/or animal participants.

Therefore, the study under its reviewed state is hereby approved by the Health Research Ethics committee of College of Medicine of the University of Lagos.

PROF. S.A. OMILABU  
 Name of CMULHREC Chairman

  
 Signature & Date

Dr. K. S. Oyedeji  
 Name of CMULHREC Member

  
 Signature & Date

This approval is given with the investigator's responsibility declaration as attached and that:

- i) You will submit in CMULHREC prescribed forms, annual progress report during the course of this study, if it is more than one year and final report as the case may be if less than one year and after completion of the study.
- ii) The CMULHREC reserves the right to monitor and review this approval; even after the commencement of your study and inform you of any further changes or amendments that may be required for your compliance.

This approval dates from 30 /11/2019 to 29/11/2020. If there is delay in starting the research, please inform the HREC so that the dates of approval can be adjusted accordingly.

349B, Odusami Street,  
Off Wempeco Road, Ogba, Lagos, Nigeria.  
Tel: 08169618571, 08062287502, 08033089592  
info@isaluhospitals.com, www.isaluhospitals.com



**ISALU  
HOSPITALS  
LIMITED** RC: 502112  
[SPECIALIST HEALTHCARE PROVIDER]

Monday, July 22, 2019

**The Dean,**  
School of Management, IT and Governance,  
University of KwaZulu-Natal,  
Durban,  
South Africa,

**Attention: Professor Manoj Maharaj ,**

Dear Sir/Madam,

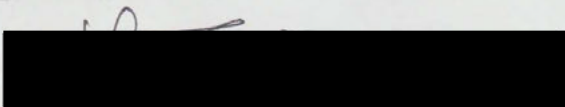
**Ref:Permission to Gather Data for PhD Research (Adegbola,  
Omotanwa M.)**

The above named student of your institution under your supervision has been given permission to use our facility as a case study for data gathering for her PhD programme.

We appreciate she keeps to the Organisational norms and value while here and expect her to be up and doing at all times, well behave and not abuse the privilege.

The Management appreciates the opportunity given us to impact her life.

Thank You.

  
**Labode-Macsam, Anthony**

Head, Human Resources & Admin  
+2348172001519 OR +2348104457798  
labode.macsam@isaluHospitals.com

**Internal Medicine**  
• Dermatology  
• Diabetes Mellitus  
• Cardiology  
• Gastro-Enterology  
• Neurology  
• Psychiatry  
• Nephrology

**General Surgery**  
• General Surgery  
• Orthopaedics  
• Urology

**Health Screening**  
• Well Man Scheme  
• Well Woman Scheme

**Obstetrics & Gynaecology**  
• Antenatal Clinic  
• Family Planning Clinic  
• Fertility Clinic  
• Routine Gynaecology Clinic

**Admissions**  
• Standard Private Suites  
• Standard Executives Suites

**Diagnostic Imaging**  
• X-Ray Services  
• Ultrasound Scans  
• ECG  
  
• Physiotherapy

**Operating Theatre**  
• Operating Rooms  
• Delivery Suites  
• Recovery Room  
• Incubators

**Paediatrics**  
• Out-Patient Clinic  
• Child Welfare  
• Immunization

**Ophthalmology**  
• Eye Clinic

97/101 Obafemi Awolowo Way,  
Lagoon Hospitals Ikeja,  
Lagos, Nigeria.  
Date: 22nd, October.2019

Ms. Adegbola Omotanwa Moji,  
School of Management, IT and Governance,  
University of KwaZulu-Natal,  
Durban South Africa.

LETTER OF AUTHORIZATION TO CONDUCT RESEARCH IN OUR ORGANIZATION

This letter serves as an authorization for Ms Omotanwa Moji Adegbola, to conduct the research titled "Development of an Evaluation model for m-health in Developing Country: A Case Study of Nigeria".

Distribution of questionnaire and all interviews will be duly supervised by the human resource unit of the organization.

May there be any concerns or need for additional information, feel free to contact the hospital.

Thank you.

Yours faithfully,

Mr Afolabi kolawole.L

Human Resource Manager.



APAPA:  
8, Marine Road, Apapa,  
Lagos, Nigeria  
09034136452, 01-5283812-15

IKEJA:  
97/101, Obafemi Awolowo  
Way, Ikeja, Lagos, Nigeria.  
07014311342, 01-628321-24

IKEJA:  
91, Adeniyi Jones Avenue,  
Ikeja, Lagos, Nigeria.  
09037508740, 01-6313810

VICTORIA ISLAND:  
13A, Idejo Street, VI,  
Lagos, Nigeria.  
07026892368, 01-6283827

VICTORIA ISLAND:  
Lagoon Specialist Suites (LSS)  
13B, Idejo Street, VI,  
Lagos, Nigeria.  
07026892368, 01-6313813

IKOYI:  
17B, Bourdillon Road, Ikoyi,  
Lagos Island, Lagos, Nigeria  
08082094409



# St. Nicholas Hospital

**Lagos Island**  
57, Campbell Street,  
Lagos Island, Lagos.

**Victoria Island**  
7B, Etim Inyang Crescent,  
Victoria Island, Lagos.

**Lekki Free Trade Zone**  
Lekki, Ibeju Lekki,  
Lagos.

**Maryland**  
18, Faramobi Ajike Crescent,  
Off Ikorodu Rd., Anthony, Lagos.

July 16, 2019

Adegbola Omotanwa  
Lonex Garden Estate  
Opic Area, along Channels Television  
Isheri  
Ogun State

Dear Mr Omotanwa

**RE: ETHICAL CLEARANCE**

Your application for ethical consent and approval refers.


We write to inform you that the Research & Ethics Committee of St. Nicholas Hospital have accepted your request to undertake a study on **"DEVELOPMENT OF AN EVALUATION MODEL FOR M-HEALTH IN DEVELOPING COUNTRY: A CASE STUDY OF NIGERIA"**


The hospital approval is subject to the following conditions in writing:

- That the information gathered shall be used strictly for research purpose only and will be kept confidential
- That a copy of the information gathered from the research exercise will be made available to us at St. Nicholas Hospital.

For any further enquiry, feel free to contact the office of the Medical Director, Mrs. Gloria Morgan via email address [mdsec@saintnicholashospital.com](mailto:mdsec@saintnicholashospital.com) or telephone numbers above, she will accord you the necessary assistance.

Thank you.

  
**DR. RALIAT USMAN**  
REGISTRAR  
Secretary

  
**DR. EBUN BAMGBOYE** FWACP, FRCP, FNAN  
CLINICAL DIRECTOR  
Chairman

+234 1 271 8691-3; +234 802 290 8484; +234 803 525 1295 | [info@saintnicholashospital.com](mailto:info@saintnicholashospital.com) | [www.saintnicholashospital.com](http://www.saintnicholashospital.com)

**BOARD OF DIRECTORS:** Mr. Dan Agbor (Chairman) | Dr. Dapo Majekodunmi MRCOG (MD/CEO) | Dr. Egun Bamgboye MB, BS, FWACP, FRCP (Clinical / Executive Director)  
**Non-Executive Directors:** Dr. (Mrs) Nonyelum Barrow, MSc, MBBS | Mrs. Umola Majekodunmi | Mr. Kofo Majekodunmi

PARTICIPANT CONSENT

I, ANDY CUNLIFFE....., hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I understand that I may withdraw from the project at any time, should I so desire.

Participant Signature: ..... [Redacted]

Date: ..... 16/01/20 .....

REDDINGTON HOSPITAL  
Victoria Island, Lagos  
[Redacted]  
A. CUNLIFFE  
General Manager &  
Business Development Director

15 September 2022

**Omotanwa Moji Adegbola (217080699)**  
**School Of Man Info Tech &Gov**  
**Westville Campus**

Dear OM Adegbola,

**Protocol reference number:** HSSREC/00001241/2020

**Original title:** Development of an Evaluation Model for m-health in Developing Country: A Case Study of Nigeria

**Previous amended title:** Mobile Health Adoption in the Nigerian Healthcare System

**New revised title:** Factors affecting adoption of mobile health among healthcare workers in Nigeria

### **Approval Notification – Amendment Application**

This letter serves to notify you that your application and request for an amendment received on 15 August 2022 has now been approved as follows:

- Change in title

**Any alterations to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form; Title of the Project, Location of the Study must be reviewed and approved through an amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.**

**PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.**

**All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.**

Best wishes for the successful completion of your research protocol.

Yours faithfully








.....  
**Professor Dipane Hlalele (Chair)**

/ms

---

**Humanities & Social Sciences Research Ethics Committee**  
**UKZN Research Ethics Office Westville Campus, Govan Mbeki Building**  
Postal Address: Private Bag X54001, Durban 4000  
Tel: +27 31 260 8350 / 4557 / 3587

Website: <http://research.ukzn.ac.za/Research-Ethics/>

Founding Campuses:  Edgewood  Howard College  Medical School  Pietermaritzburg  Westville