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# THE USE OF mHEALTH TO IMPROVE QUALITY AND REDUCE COST OF HEALTHCARE IN RURAL KENYA

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## Abstract

Background: The use of wireless technologies such as mobile phones in healthcare is referred to as mHealth. The young field has the potential to improve the well-being of the world's population. Although the use of mobile phones and other communication devices in providing education on preventive healthcare is the major application of mHealth, other applications do occur. These include the use of mHealth to track management of chronic diseases, epidemic outbreak, treatment support, and in disease surveillance.

Aim and Objectives: This literature search was carried out with an aim of exploring how mHealth is being used in the improvement of healthcare as well as in reduction of costs in Rural Kenya. Kenya has one of the most advanced environments for mobile technology in the developing world but is faced by challenges in healthcare accessibility, affordability, functionality, and quality.
Methods: An integrative review of literature as method was used to analyze and critique existing literature in line with the topic of this study. Diffusion of innovations is applied as a background theory to generate themes using qualitative research practices

Results: Adoption challenges of mHealth remain high in rural Kenya due to poor distribution of resources across the country. The infrastructure for mHealth is improving due to good mobile technology network coverage but poor regulation and privacy laws, poverty and literacy levels can hinder its realization and adequate implementation. The study has explored the remedies to these challenges and the associated benefits.
Conclusion: Since the adoption challenges can be remedied, it is feasible to implement mHealth in rural Kenya to solve the identified health challenges.
*Key words: mHealth, rural Kenya, Developing World, Quality of care, Cost of care.*

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# 1 Introduction

**Defining mHealth**: mHealth (mobile health) is a constituent of eHealth (electronic health). To date, researchers have not developed a standard definition of mHealth. However, the definition provided by the Global Observatory for eHealth (GOe) is commonly used (World Health Organization 2012). In this regard, mHealth is defined as the use of mobile devices, such as personal digital assistants (PDAs), patient monitoring devices, mobile phones, and other forms of wireless devices to support public and medical health practices.

**Examples of mHealth applications**: At the regional level, social networking models have been used in the past to electronically link many people through the use of tools such as mobile text messaging. Although the initial application of social networking models was in disaster mitigation, their uses have found applications in health promotion. For example, specific messages can be carefully crafted and disseminated to the members of the public through text messaging to encourage them to adopt healthy behaviors (Kyriacou, Pattichis & Pattichis 2009). In some rural areas, the networks are the only effective medium for use in the public information campaigns. For example, a million text messages are sent by South Africa's Project Masiluleke to encourage members of the public to get tested for HIV/AIDS (Kahn, Yang & Kahn 2010).

Web surfing has also been an important application of mHealth largely because the Internet has made medical information widely available (Hardey 1999). The once-specialized medical information can now be accessed via web surfing, allowing health consumers to gain a better understanding of various medical conditions (Umberson 1987). Also, diagnosis is facilitated and health provider-patient interactions are improved. Similarly, the Internet is a source of information for health providers about important advances in medical practice, rare diseases, and guidelines on best practice in the medical field. Health consumers can use mobile devices to access the Internet and obtain information about health commodities and other relevant information. Information on medicine and devices quality, suppliers, and cost can be obtained. Therefore, it can be said that this mHealth approach has the potential of preventing monopoly in the supply chain and in the delivery system for the benefit of the health services consumer. The pitfall of this mHealth approach is that the

improved access to information can facilitate the spread and consumption of inaccurate information if information quality controls are not applied (Labrique, Vasudevan, Fabricant & Mehl 2013). Lack of proper training may make it hard for some patients or health care providers to fully understand or even accurately interpret the available information.

**Research problem**: Kenya and other developing nations suffer from a host of health problems that are either absent or less common in the developed world. Countries in the developing world suffer from the problem of controlling tuberculosis, malaria, and HIV/AIDS. In addition to a high rate of such epidemic diseases, Kenya experiences other nonepidemic but communicable diseases, such as pneumonia and diarrhea(Müller & Krawinkel 2005). Being near the equator, Kenya carries another disease burden referred by the World Health Organization and the United Nations as the "neglected tropical diseases". Examples of these diseases are rabies, leprosy, dengue and Chagas. Kenya can use mHealth applications to stop or reduce the spread of these diseases by promoting behavior that reduce contagion, raising awareness about epidemics, expanding treatment outreach, and helping patients to comply with various medical regimes (Daar, Thorsteinsdóttir, Martin, Smith, Nast, & Singer, 2002).

Kenya experiences an additional challenge posed by non-communicable diseases. Diabetes incidence in Kenya is rising gradually, and cardiovascular disease and cancer are major killers(IDF 2010). Just like in the case of communicable diseases, mHealth application can be used to extend the reach of the Kenyan health system and act as important help for patients being treated for non-communicable diseases such as diabetes, which require lifelong management and support (Daar et al. 2002).

**Studies that have addressed the problem**: Cocosila and Archer (2010) avowed that the launch of iPhones made mHealth a growing trend among populations across the world. It has been noted that around 33% of the world population own a smartphones. A rise in smartphone ownership continues to increase the number of people using the internet to look for information about different elements of healthcare, such as effective medicines for a certain disease or the use of a certain mobile device. Regardless of whether the

smartphone users are looking for health-related news or for personal interests, they encouraging factor is that they are online and can be reached through online platforms Raftery (2001).

Another group studies discovered that the use of mobile devices has also increased among physicians (Applebaum 2012; Ventola (2014). Through such studies, it is apparent that smartphones and other mobile devices have become readily available resource for physicians. They use the devices as a point-of-care and continued education (Chismar & Wiley-Patton 2003; Schoen et al. 2003).

Through different studies, researchers have explored how mHealth can improve healthcare by providing benefits for health care providers and patients (West, 2012). Free et al. (2013) explained that mobile technologies can increase medication adherence by patients since messages and information can be sent to them through well designed mobile applications.
Although studies have explored different aspects of mHealth, deficiencies in the research base on this topic can be identified. Previous studies on this area have over-concentrated on aspects of mHealth in the developed world. This means that only a limited number of studies have focused on the developing world. Furthermore, the few studies that focused on mHealth issues in the developing world have barely studied the potential of mHealth in achieving specific goals, such as reducing the cost of healthcare and improving the quality of healthcare (Istepanian, Jovanov & Zhang 2004; Garritty & El Emam 2006).

## 2 Theoretical perspective

How and why people adopt or embrace innovations has facilitated much research. Computing adoption by individuals has been described by researchers through the lenses of different adoption theories. The concerns-based adoption model (CBAM) is a common theory used to describe how individuals develop in the process of learning about a certain innovation as well as the stages of the adoption. According to Loucks-Horsley (1996), this theory recognizes that adoption of a new innovation is a very personal developmental process.

The process of innovation adoption in CBAM can be assessed and guided by three components of the diagnostic dimensions. The first component is the innovation configurations, which is a map that provides a good picture of the characteristics of a high-quality implementation. It serves as an example in guiding and focusing staff efforts.

The second component is the stages of concern, a process that involves open-ended statements, an interview, and a questionnaire. Through this, leaders of the innovation process are able to identify the attitudes and beliefs of staff members towards a new innovation or program. The knowledge gathered by the leaders is then used to address concerns presented by each individual.

The last component entails the levels of use, which is an interview used to ascertain how well the innovation or program is being used by the targeted parties, both collectively and individually. The levels of use have been found to range between nonuse level to advanced use level. In addition to gaining new skills, people involved in a change process must shift their attitudes and beliefs. As the competence and comfort level of individuals with an innovation increases, they overcome their personal concerns and concentrate on the desired outcomes. The challenge of implementing this theory in innovations developed in the healthcare is that the theory was developed with education institutions in mind (Straub 2009).

Technology acceptance model (TAM) is another theoretical model used to explain acceptance and use of an innovation or technology. This theoretical model predicts the acceptability of an innovation and the modifications that can make it more acceptable to the users. According to Davis, Bagozzi and Warshaw (1989), the acceptability of the innovation or information system is influenced by its usefulness and ease of use as perceived by the users. Perceived usefulness is the degree to which an innovation can improve the user's performance. On the other hand, the ease of use is the degree to which the adoption of the innovation will be effortless. In addition to the attitude of an individual toward a certain innovation, the possible impact on the individual's performance influences his/her adoption of the innovation in question (Venkatesh & Davis 2000). Therefore, it is important to note that the behavioral intention of a user is determined by his/her attitude towards

the adoption of an innovation (Legris, Ingham & Collerette 2003). Application of TAM in healthcare is limited by the fact that it was initially developed to predict the acceptability of information systems in other sectors.

Developed by E.M Rogers in the year 1962, the diffusion of innovations theory (DOI) is one of the oldest and most popular theories used in the study of how a product or an idea spreads through a certain social system or population (Kaminski 2011). Although it was initially used in communication, its use in studies involving the acceptance of information technologies and the spread of these technologies between and within communities is gaining momentum (Sanson-Fisher 2004). Therefore, this theory was used as the theoretical framework in an effort to understand the various aspects of the adoption and spread of mHealth in the developing world, with a special focus on rural Kenya. Its strengths over other innovation adoption theories such as CBAM and TAM are identified in subsequent sections.

## 1.1 Diffusion of innovations theory

According to the diffusion of innovations theory, innovation should be understood as a technology, process or idea perceived by individuals in a social system or a particular area as unfamiliar or new. On the other hand, diffusion refers to the flow of information about the innovation from one individual to another within the social system. The diffusion of innovation theory identified four major factors that can influence the success of an innovation in information technology. The four factors are the communication channels, innovation's attributes, adopters' characteristics, and the social system. Communication channels, in this context, refer to the medium used to convey information about the innovation to the potential users to give them an opportunity to perceive its usefulness. Interpersonal communication and mass media are the main communication channels (Berwick 2003).

When looking at the innovation's attributes, five qualities, as perceived by the users, were identified by Rodgers. These are compatibility, relative advantage, trialability, observability, and complexity. Compatibility is about the degree to which the innovation in question is perceived by the potential adopters as being compatible with their needs, past experiences, and existing values. Relative advantage is a measure of the level to which the new innovation is better than the previous idea or behavior. The complexity of an innovation is the degree to which it is difficult to comprehend and use (Denis, Hébert, Langley, Lozeau & Trottier 2002). As another attribute of an innovation, trialability of an innovation is the degree to which it can be tested and modified. Lastly, observability is used to refer to the degree to which an innovation's benefits are visible to the targeted audience or users.

The theory by Rodgers is important as it divides potential adopters of an innovation into five categories according to the attitudes toward the specific innovation. The first category of adopters is made up innovators, which is made up individuals who want to be pioneers in the adoption of a specific innovation. These are always ready to take risk, explaining why no or little effort is needed to appeal to this category of adopters. They have the understanding and the ability to apply technical and complex knowledge needed in such a stage of innovation's adoption. The second category is the early adopters who act as the opinion leaders and embrace opportunities for change (Fleuren, Wiefferink & Paulussen 2004).

Early majority is the third group of innovation adopters identified by Rodgers. Although individuals in this group are rarely leaders, they are known to adopt new ideas before the average members of a social system. The fourth category, the late majority, is made up of individuals who are cynical of change and are ready to adopt a technology once it has been proved beneficial through adoption by most people. Laggards are in the last category and known to be very conservative individuals, largely because they are bound by tradition (Greer 1977).

Despite the suitability of the diffusion of innovation theory to this study and other similar studies, it is associated with some limitations. To begin with, Lyytinen & Damsgaard (2001) noted that a great deal of the evidence presented in the theory, such as the adopter groups, was not developed with public health in mind. Therefore, it may not bring out a

clear explanation of the issues surrounding adoption of health innovations or new health behaviors. Furthermore, the theory does not consider the social support or a person's resources in the adoption of an innovation or a new behavior.

The increased use of the diffusion of innovation theory to study adoption of information technologies in healthcare in specific regions encouraged the author to use it in the current study. For example, Helitzer, Heath, Maltrud, Sullivan and Alverson (2003) used this theory to predict and assess the adoption of a telehealth initiative in New Mexico's rural areas. Chew, Grant and Tote (2004) used the same theory to understand the use of Internet healthcare services among family physicians. In another qualitative study, Rodgers' theory was used to study a computerized nursing care plan's adoption (Lee 2004).

Previous research has suggested that the most effective method of communicating advantages of or the need for a new information technology in healthcare is face-to-face exchange. This study applied the diffusion of innovation theory to assess the effectiveness of this and other methods in rural Kenya. Through this strategy, the involved parties can tailor their information to the target audience. The same theory was used to understand the process through which the mHealth adoption decision can be made. In the first step, information about adoption of mHealth is acquired by researchers and health authorities (Helitzer et al. 2003). What follows is the persuasion of the users, both patients and physicians, about the benefits of this innovation. The potential users are then engaged in activities that allow them to make a choice on whether to accept the change or reject it. If the change is accepted, the innovation is integrated into the user's daily activity or used when a need arises. The diffusion of innovations theory was used to study the Kenya social context as far as response to the idea of mHealth adoption is concerned. The idea was to study whether this social system is characterized by a creative and innovative culture since such a culture can quickly and easily respond to a new innovation (Lee 2004).

## 1.2 Underlying logic behind the study

The diffusion of innovation theory allowed the researcher to make some predictions even before carrying out the study. It was expected that mHealth would show a high relative advantage when compared to tradition methods of delivering healthcare. For example, the

use of mHealth by patients to manage cancer, diabetes, and other choric diseases reduces the number of times the patient is required to visit the hospital (Kaminski 2011). Since the study area was rural Kenya, the complexity of mHealth was expected to be relatively high. Most people living in such areas have a low level of education and may find it difficult to understand and use mHealth applications. At the same time, physicians in this country may have obtained their training before the use of technology increased, increasing the chances that they may also find it difficult to use these applications. On compatibility of mHealth with residents and healthcare providers in rural Kenya, it was expected that the presence of many health challenges would make this element show a high degree. The fact that a good number of people in the study area own smartphones means that mHealth has a high trialability.

## 2 Aim of the study

The study was carried out with an aim of exploring how mHealth is being used in the improvement of healthcare as well as in reduction of costs in Rural Kenya

The study was carried out to answer two research questions as follows:

1. How can mobile applications be utilized to reduce the cost of healthcare in rural Kenya?
2. How can mobile applications be utilized to improve quality of healthcare services in rural Kenya?

## 3 Methodology

This research is a qualitative study. Integrative literature review was used to identify representative literature on mHealth. The literature was analyzed and critiqued in line with the study topic and innovation of diffusion theory to generate themes based on the findings.

The nature of this study necessitated the use of a qualitative research design to collect data and answer the research questions. This was based on collection of secondary data from previous studies and execution of an integrative review of the studies obtained.

An integrative review method was used in order to conduct the study and achieve the specified aim. There are specific reasons why this method was selected from many possible methods. It was expected that this method would give room for generation of a better understanding of the issue in question. As explained by Whittermore & Knafl (2005), an integrative literature review is an effective framework for use as a research methodology as it allows the researcher to summarize, synthesize the results of previous studies and conclusions based on the resulting themes. Furthermore, the methodology permits execution of a rigorous search of literature. The integrative process can be said to be rigorous enough to generate the expected outcome as it relies on a 5-stage review process. These steps are purpose identification, data collection from identified articles, evaluation of the collected data, data analysis, data interpretation and results presentation. In line with these stages, the topic of interest was initially identified before literature was searched to come up different primary articles. A researcher using this method is able to widen the research and incorporate varied studies with diverse designs, including both quantitative and qualitative studies. At the same time, it has the advantage of giving room for use of both experimental and non-experimental data. Therefore, this review aims to generate a more comprehensive understanding of the potential of mHealth applications in Rural Kenya

## 4.1 Eligibility criteria

For the purpose of this study, specific limiters were identified and used at the beginning of every search with an aim of obtaining the most relevant studies as far as the current review is concerned. In this regard, the inclusion criteria for this study included, studies published in English language, primary research articles, and studies authored between 2005 and 2017. Studies outside these boundaries were excluded from the current review. Additionally, the researcher undertook a manual search by locating studies from reference lists of some of the identified articles, and searching for them in the databases of Scopus, Google Scholar, and Web of Science. This was a good way to obtain additional research that was not found during the electronic search for the topic targeted by this thesis. Inclusion of studies between 2005 and 2017 was preferred for diverse reasons. A span of 12 years was regarded long enough to give the author a range of research studies. Additionally, very old articles were avoided since the aspect of the use of mHealth applications was

made part of this study, thereby requiring the researcher to be keen to ensure the obtained studies would provide recommendations based on current evidence.

## 4.2 Information sources and search strategy

Research was the potential of mHealth applications in health systems. For the purpose of this integrative review, five electronic data bases including Cinahl, Pubmed, Medline and Cochrane were searched for articles which addressed the potential of mHealth applications in health systems, especially in the developing world. During the search process, there was no restriction on the study design and type of research methodology used since the primary focus of the study was the potential of mHealth applications in health systems.

Ten search terms were employed to identify sources related to the reviews' main concept based on the study questions, which were (1) what are the benefits of mHealth applications adoption? (2) what is the potential of mHealth applications in solving the problem of high cost and poor quality of healthcare in rural Kenya? (3) what are the adoption challenges in the implementation of mHealth applications and how can they be solved? The search terms were "mobile health", "mHealth", "electronic health", "eHealth", "cost of care", "quality of care", "developing nations" "underdeveloped nations" and "developing world". The search process involved the use of various combinations utilizing "or" and "and" in order to come up with the most suitable articles for use in addressing the targeted issue. For example, between each search term and keywords associated with it, the researcher used "or" as the combining word. However, "and" was used as the combining word between different search terms and their chosen keywords. Moreover, the researcher used the truncation symbol (*) with some keywords with the aim of widening the research and retrieve any reference that contained the word that began with the truncation symbol.

The PRISMA flow diagram shown below is a summary of the process of article selection and the reasons why some were eliminated.

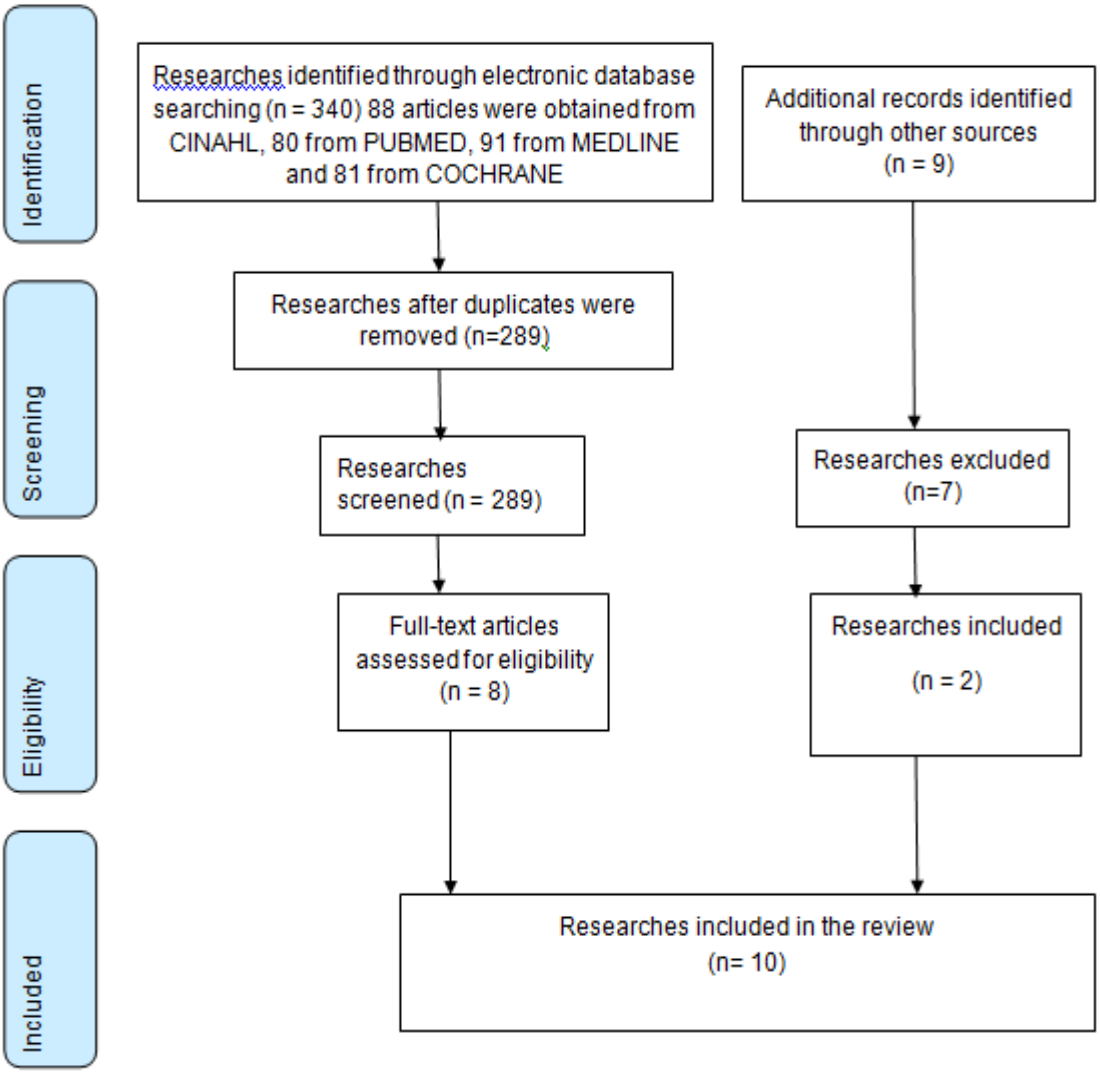


Figure 1: Prisma flow diagram

## 3.1 Literature review

### 3.1.1 Emerging mHealth paths for growth

According to Cohn and Xiong (2012), around 2 billion people globally owned mobile phones by the end of 2011. Since then, the figure has increased by more than another 2 billion individuals thus making the mobile technology to be used in improving service delivery in many economic and social settings. For instance, this technology offers tremendous opportunities for the health care to address its challenges. Enhancing the accessibility of the health care, making it cheaper, faster, and better has been a major problem that the health care sectors had to address over the years. The mobile Heath will have a greater impact in delivering health services as the increasing competition levels will decrease the cost and enhance functionality. Additionally, the mobility associated with the mobile technology implies that users can access and receive highly valuable information (Cohn, & Xiong 2012).

As noted by Dobkin and Dorsch (2011), mHealth has taken the world by storm, accelerating and enabling major global trends in the health care sector. It has contributed to both private and public participation in the provision of health care. This technology has improved the access and quality of healthcare offered to these two sectors. At the same time, mHealth has ensured greater innovations and also created cost-effective opportunities that have benefited the private sector (Davis, DiClemente, Prietula 2016). With time, the rapid advancement in mobile technology will lead to the introduction of new personal toolkits that will aid the management of chronic illnesses as well as various acute conditions. Dobkin and Dorsch (2011) analyzes how medical care is flourishing under the new mHealth technology. It's argued that the mass data availability and connectivity in most developed countries is making the service thrive incredibly.

### 3.1.2 Uses and Benefits of mHealth

As explained by Davis et al. (2016), the range of advantages and uses associated with mobile technology in the health sector are incredible. Duties of health care professional (HCPs) have

been enhanced to a great extent by the mobile devices thus improving many clinical practice areas. The rapid development of the mHealth technology has been due to the increased use of mobile devices in most health care centers thereby prompting the introduction of medical software applications (apps). Technologically, there has been a rapid revolution in the use of the mobile technology in the healthcare. Most importantly, the varying numbers of apps currently available assist HCPs in managing information and time, accessing and maintaining health records, communicating and making proper consultations, gathering of information, effective monitoring and management in addition to enhancing professional decision making (Dobkin, & Dorsch, 2011).

According to Handel (2011), mobile devices offer an important platform for delivering health-related information, especially when it comes to infections with a high level of stigma, such as HIV/AIDS and other sexually transmitted diseases. In third world countries like Kenya, many non-profit organizations have ventured into the health sector with the objective of improving health service delivery. In Uganda, for example, organizations such as the Text to Change together with telecommunications operators have jointly introduced SMS (short messages) quizzes to enlighten people on matters concerning HIV/AIDS and other issues concerning various aspects of healthy living (Chang et al. 2011).

The increased global cases of STIs such as gonorrhea have triggered the development of new apps. For instance, SEXINFO is an SMS service dealing with information associated with sexual health. Internet Sexuality Information Services (ISIS) partnered with the San Francisco Department of public health in developing SEXINFO, which significantly addressed the rising gonorrhea cases among black Americans in San Francisco (Chib et al. 2012). Some organizations use SMS to educate people on various trends and topics in health as it the case with the programs targeting the low-income groups in Bangladesh. SMS campaigns aimed at increasing health awareness. Most importantly, Estrin and Sim (2011) reveal that the urgency to address and cope with national tragedies triggered the development of this service.

### 3.1.3 Health Centers

Evidently, the main objective when using mobile applications in health centers is to offer services such as health advice through strategies such as phone calls using their trained personnel. Mobile technology has been embraced globally over the years thus encouraging interested parties from both low and middle-income countries to set up health call centers with the idea of facilitating patients and public access to health information. Creation of such centers has resolved many challenges experienced previously. Juzang et al. (2011) explains that a couple of health system challenges including deficiencies in health professionals, reliance on unqualified providers, transportation expenses, as well as poor sources of information have been eased. Examples of the developing countries having operational health call centers include Bangladesh, India, Mexico and Pakistan. Although these centers have been recently set up in these nations, countries such as Canada, United States of America, and the United Kingdom have enjoyed the associated benefits associated for many years (Estrin, & Sim 2011).

Another example of a program highlighting the technological advancement in the health sector is the Line Verte Toll-Free Hotline introduced in the Democratic Republic of Congo. It aims at supporting family planning initiatives by availing private information and consequently directing patients to readily available clinics to purchase contraceptives in addition to other necessities. On the other hand, MedicalHome service is an initiative common among the Mexicans. Similarly, it allows people to seek answers to all health-related concerns. Despite the enormous advantages associated with these health call centers in the distinct nations, they have obvious shortcomings. Most of the centers available in the developing countries aim at making a profit. Also, the imposition of charges on patients is a huge concern. Accessibility problems in poor network coverage areas, applications' limitation to women with mobile gadgets, and limited sources of information due to the lack of connectivity to other sources represent the additional problems commonly associated with the health centers (Handel 2011).

### 3.1.4 Emergency toll-free telephone services

Emergency toll-free telephone services refer to the free telephone hotlines that explicitly connect people at times of health emergencies. These services facilitate quick access to health professionals who offer directional guidance in response to a medical emergency. One challenge associated with these services is the tendency of slow response hence shifting preference to other local private services in case of emergencies.

### 3.1.5 Mobile telemedicine

According to Ly (2011), communication or consultation among health specialists on matters involving patients that use mobile devices for services such as voice, text, data, imaging, or video recording is famously described as mobile telemedicine. Additionally, mobile telemedicine has been widely deployed in the management of chronic diseases for patients grounded at home. A common problem in most developing countries is the scarcity of human resources in the health sector thereby making it difficult for people to access specialized care. The introduction of mobile technology has immensely boosted the remediation of this challenge as these gadgets connect patients and community health workers based both in upcountry and urban areas. The benefit associated with this connection is that it improves the quality of service delivery. Precisely, for mobile telemedicine, health care providers share health-related data through mobile devices after thorough consultations. Mobile screen size, image quality, and network issues in data transmission include some of the challenges facing mobile telemedicine systems (Ly 2011).

### 3.1.6 Health surveys and surveillance

In reference to mHealth, health surveys are defined as collection and reporting of health data using mobile data. On the other hand, surveillance is a mHealth initiative describing the input and transmission of data that will help surveillance programs in tracking diseases using the much advanced mobile devices. Both initiatives are common in low and middle-income countries compared to the high-income ones. Ly (2011) describes the incredible technological revolution that has taken place in the use of mobile technology in the health sector. Health information systems have become sophisticated thus improving surveillance and real-

time monitoring. Also, the changes have eradicated the necessity of paper health surveys in monitoring health outcomes in addition to monitoring the use of health services.

Mobile technology has taken the world by a storm thanks to the immense benefits associated with it. This technology has grown rapidly in recent years leading to the discovery of more sophisticated software and applications. Namakula et al. (2012) argues that the health sector is among the sectors that have inarguably benefited from this technology. More importantly, it is now possible to support data collection solutions such as monitoring diseases and conducting health surveys. Application of mobile technology in disease surveillance is advantageous compared to the ancient techniques used for the same purpose. The former improves the levels of accuracy in addition to saving time and cost. Additionally, it guarantees data quality. Progressive research has revealed that various mobile functions have different error rates during collection of data. Among them, voice is known to have the least error rate. Electronic forms are next in line, followed by SMS. However, further study needs to be conducted to establish the most efficient mobile data collection method in addition to establishing the range of health benefits associated with these functions (Aranda, Mohutsiwa, & Loukanova 2014).

### 3.1.7 Patient Monitoring

As far as mHealth is concerned, the tendency of managing, monitoring, and treating an individual's illness such as diabetes and cardiac diseases from far defines the activities comprising patient monitoring. Mobile devices are connected to remote sensors fixed in homesteads which allow the transmission of sensitive data to specialists offering health services. This connection highly benefits individuals seeking check-ups as they don't have to visit health centers to access desired services. The sensor technology utilized in mobile patient monitoring is expensive, making it less common in developing countries. Another challenge is the fact that only a limited number of patients have the chance of accessing different services associated with this technology. This is because not all individuals have the gadgets which connect to diagnostic sensors. Significant enough about mobile patient monitoring is the fact that it allows the consistent monitoring of patient's recovery progress using mobile devices or computers.

According to Mechaelet al. (2010), the tremendous changes realized in the medical care field are a form of response to the overwhelming challenges facing the health sector. Also, the need to benefit from new opportunities has triggered the onset of these numerous changes. Most countries have embraced the use of mobile technology globally. This technology is commonly used by government agencies to acquire population health data. The cost effective nature of mHealth explains its broad applications in identifying and controlling medical conditions in addition to creating a basis for health policy formulation. The significance of mHealth is diverse since not only does patients benefit, but the health specialists as well. The latter category enjoys the easy accessibility of health programs (Namakula, Shemsanga, Durbach, & Kanter 2012).

Health professionals are beneficiaries of the mobile technology it enables them to access patients' data, which is aids in the diagnosis and treatment of the established infections. Mbuagbaw et al. (2011) elaborates the use of mHealth and depicts this information as a link to acquiring valuable knowledge on various health aspects. Also, the cellphone technology facilitates individual self-evaluation and subsequent transmission of health-related information to concerned medical personnel. Inarguably, the physically impaired people together with those in remote areas are the major beneficiaries of the mHealth services.

According to Nilsen et al. (2012), health care sector has progressively benefited from the changes witnessed with the mobile technology. The different number of medical apps being developed shows the health care's bright future ahead. These medical apps allow patients to play a major role when medical decisions concerning their lives are being made. In the current era, medical apps empower people to gain extra knowledge as well as take more responsibility in making medical decisions. Traditionally, individuals did not have much knowledge on their health status unlike nowadays where the revolutionized technology allows people to access their health data. These apps favor patients more than the attendants, thereby signaling how they will change the future of healthcare in years to come (Marcelo, Adejumo, & Luna 2011).

### 3.1.8 Role of Mobile Health in Combating Adult Obesity

According to Mitchell et al. (2011), the diversity of the innovations made in mobile healthcare industry in the past few years has increased its application in addressing various life health issues. It has immensely contributed to the management of adult obesity thus promoting a healthy lifestyle. Behavioral factors that cause obesity may be modified through the use of mobile applications. Research depicts the effectiveness of the mobile technology in managing weight, body mass index, in addition to lifestyle behaviors.

Utilization of mobile technology in combating obesity is advantageous as it foresees a reduction in costs in addition to other benefits. Despite obesity being a huge challenge in the modern world, a series of comprehensive approaches may be taken to address it. mHealth plays a crucial role in the fight against obesity. It creates a platform that allows care providers to deliver psychological, educational, and medical support to patients struggling with obesity. These patients benefit from the engagement and the motivation they get from the service providers. Additionally, these measures lead to cost reduction (Cornelius et al. 2012).

### 3.1.9 Mobile phone attachments for blood tests

In the past couple of years, frequent hospital visits for blood tests have always been the order of the day in most countries. However, this trend is fading as time progresses thanks to the introduction of the mobile smartphones that contain attachments for blood tests. Interestingly, patients do not have to visit specialists for checkups as it is possible to undertake many medical tests through these apps. Simple smartphone attachments are used in running these tests. (Juzang et al. 2011) emphasizes on the significance of these apps in saving life. Some tests, including blood tests, are fatal in nature thus risking life. The smartphone attachments are cost-saving, which has led to their increased preference. Additionally, they are used in testing fatal diseases. HIV-reading smartphone dongle is one good example of a mobile accessory used in performing blood tests. It saves both time and cost thus increasing its popularity. Such developments have contributed to the increased demand for medical apps globally (Colorafi 2016).

### 3.1.10 Challenges of mHealth offerings

Although the many advantages associated with mobile health applications have increased the demand for mHealth, this innovation has its own set of challenges. According to Akter and Ray (2010), confidentiality of data remains a major concern in the application of mobile applications in the provision of healthcare. Different regulations require individuals or organizations implementing mHealth in their health systems to guarantee the patients that their data will be safeguarded. Since this is not always easy, security of personal data is an obvious concern for the health care industries in different nations, especially the developing ones. Additional issues become evident when mobile apps are developed or executed poorly. If the mobile apps fail or are of poor quality, it is likely that the users will become frustrated and lose interest in the health applications. To overcome this challenge, Colorafi (2016) explained that mobile health demands appropriate regulation, specific rules, and well-developed policies to ensure that there is the correct handling of Protected Health Information data (PHI). What is more, only a small percentage of health facilities in different regions of the world have policies governing the use of mobile devices.

One cannot ignore the challenge posed by market volatility when it comes to the design and use of mobile health applications for different purposes. There is a rapid evolution of mobile devices and market conditions. Furthermore, the high speed of change is also experienced in consumer habits. Therefore, demand for mobile health applications and the services they offer can be inconsistent. Since the healthcare payers have no control over the specified issues, the best remedy is embracing the use of current technology and refreshing the apps as often as possible.

Mobile devices offer diverse opportunities for different players in the health sector to interact with the consumers. However, research shows that these opportunities are rarely exploited by the healthcare payers. When generating innovative ideas, there is a great need to ensure that there is lots of participation of all the necessary parties. At the same time, the involved culture must be made to appreciate some ideas may not succeed. Therefore, innovation remains a complicated phenomenon in healthcare since organizations are required to pursue something more than the ‘me too’ strategy. For this reason, the remedy to the issue

of innovation should entail proper identification of user needs. Integrating mHealth with the existing IT systems is another challenge. This is because the healthcare organizations are required to make sure the targeted mobile apps and associated technologies are properly integrated with the available health IT systems and developed standards. This creates a need for application of the latest mHealth technologies. Moreover, the health organization in question must address all the integration loopholes.

Since there are various challenges in the successful implementation of mobile applications in the provision of healthcare, healthcare payers must have several things in mind. To begin with, the parties involved in the development and implementation of the mobile app should categorically decide the role that the specific app will play in reaching health consumers. It is also prudent to select an app that will allow the implementers to engage direct member response. More importantly, the controls and budget needed in the management of mobile solutions must be determined. The objectives of the mobile app should be discovered and clarified routinely. When doing so, one should consider the changing member feedback, app usage, consumer mobile device trends, and business goals. Member experience must be emphasized through app design with the aim of increasing user adoption in addition to driving competitive advantage. Aranda-Jan et al. (2014) avowed that it is important for healthcare payers to look for mobile app development vendors with the ability to adapt to changes in regulations and support the seamless transition of a mobile app from one healthcare generation to another.

Stakeholders in health sectors, together with patients, have high expectations in mHealth. A major concern in some countries is the fear that the resistance demonstrated towards change will profoundly deter the development of innovative mHealth. Despite the ubiquity of mobile technology in the provision of medical care, some individuals need to change their behaviors, which are based on self-interests. Despite the several improvements such as patient-centered care as well as better focus on prevention measures that will arise due to mHealth, provision of healthcare will be disrupted. This remains a problematic issue for innovators. The diversity of interests makes the whole technological evolution a bit complex. As Bruce, et al. (2014) reveals, it's ironic that majority of the patients demand better services in the health care yet they still long to have total control of their health.

Some medical experts have voiced their concern with the mobile technology despite its mass contribution in reducing doctor's medical burden in service delivery. mHealth has participated in the provision of better patient care in addition to helping doctors in reducing their administrative roles. However, it has deprived them the absolute patient control they once enjoyed. Essentially, it's the patient's viewpoint which will be considered. This claim is supported by the interest shown by payers towards mHealth in addition to the economic pressure that advocates for a patient-centered healthcare (Bruce et al. 2014)

Most challenges associated with the implementation of mobile technology in the provision of health care are as a result of limited resources, which constrain both the improvement and expansion of technological infrastructure. Lack of active internet connection that enhances collection and reporting of health data to relevant health authorities in addition to facilitating sharing of crucial information to other electronic platforms is one huge problem experienced in the developing nations. Low-income earners enjoy services of the mobile technologies due to its affordability when compared to other electronic health (eHealth) applications.

### 3.1.11 Barriers to mHealth Implementation

According to Evans et al. (2012), implementation of mHealth is never easy as people may assume. Certain barriers deter its implementation in various countries. Most importantly, it is crucial to understand and establish long-term solutions to these obstacles. These solutions will immensely aid in resource allocation thus ensuring public health programs are functional. The developed and emerging markets have differing perceptions on mobile healthcare. Its implementation is affected by a number of factors including inadequate support from physicians, poor existing technology, doubts on the regulation and efficacy of applications, many health system priorities that in competition, poor evaluation in addition to lack of legal guidelines on enhancing privacy (Davis, DiClemente, & Prietula, 2016).

Researchers suggest that the failure of the medical care providers to support the development of the mHealth industry has been a significant barrier to the implementation of this

technology in both the emerging and the developed markets. The strides made in this industry have resulted from the tireless contribution of mobile network operators, app developers, and manufacturers of the mobile phones. Research has established the primary factors that prevent doctors from offering their support. Lack of an established business model for the mobile healthcare technology creates doubts among many health personnel. Other healthcare specialists cite the existence of a conservative culture in addition to increased patient control as additional obstacles to the implementation of mHealth (Kahn, Yang, & Kahn 2010).

Availability of poor existing technology slows the adoption of this technology. Few private, as well as public health facilities, have wireless internet connection globally. Over the years, concerns have been raised on the regulation of mobile applications. Many health care centres have discouraged the use of these apps as a result of reduced patients visits and the failure to facilitate proper use of these apps. Lack of industry regulations to control the market is a huge drawback in the implementation of mobile health solutions. Mobile app developers have made significant advances in solving this obstacle. However, both regulators and developers are faced with an additional burden which involves establishing solutions that balance public interests with innovations (Kahn, Yang, & Kahn 2010).

Health systems experience many work-related challenges including financial constraints. mHealth's lack of clear business model to act as a basis for its evaluation makes all funds to be directed to other health programs. All these barriers may be addressed through public awareness campaigns, better guidelines for use, improved research and development in addition to introducing measurable performance indicators. Security issues need to be addressed by the policy makers as well. Essentially, managing the barriers that slow the implementation of mHealth will require collective efforts of health researchers, technology experts, and application developers from all over the globe (Mahmud, Rodriguez, & Nesbit 2010).

### 3.1.12 Emerging Markets

It's highly likely that there will be an increased use of the mobile health applications in the emerging markets compared to the usage in the already developed nations. Similarly, Mbuagbaw et al. (2011) notes that mHealth services are more offered by health specialists in the emerging market compared to their counterparts in the developed countries. Additionally, the emerging market has more payers settling various costs associated with mHealth. The incredible ubiquity of the technology in developing nations is down to the demand for a change in the existing health service delivery.

Most importantly, it has been revealed that the success of mHealth lies on the solutions that will be taken to counter the challenges facing its implementation and adoption in most low income as well as middle-income countries. Basically, the success of mobile healthcare is not influenced by technology. As explained by Coomes et al. (2012), the current payers hugely impact the global adoption of the technology. As a result, it is crucial to foresee the delivery of attractive services and products to payers because most patients are never willing to spend much thus leaving payers with little income. There is need to address all problems connected to the payers. Emerging markets have become an area where mobile healthcare solutions are being utilized most thanks to the high expectation that people in these market have towards mHealth (Mbuagbaw, Thabane, Ongolo-Zogo, & Lang 2011).

On the other hand, the technology's prevalence and usage are not encouraging in the developed countries. Countries such as India and Singapore are good examples of markets where mHealth utilization has been on upward trend since its initiation. In the U.S, which is a developed nation, the government is more concerned with addressing other health issues such as securing electronic medical records. Another notable difference between these two healthcare markets is that patients in the emerging markets are more informed in addition to having higher expectations in mobile healthcare compared to their counterparts in developed nation (Mbuagbaw et al., 2011).

Basically, there is much optimism about mHealth among population characterizing the emerging market. People are expecting much from mobile applications in the future. These

include a reduced cost of overall health care, making access to healthcare more convenient in addition to improving its quality. Over the years, research has proven that the demand for mHealth is still high among the emerging market population who currently use the technology. It's worth stating that the emerging market will contribute immensely to the future success of the mobile technology (Colorafi 2016). Not only patients have expressed their interest in the whole mobile healthcare idea in this market, but also the payers and doctors. Many healthcare surveys are being conducted, and as noted, payers have over time pledged to offer financial supports in these initiatives. Such level of dedication and generosity is not common among payers in the wealthier nations. Essentially, it's noted that payers in the emerging market cover costs for most mHealth services in comparison to their counterparts in the developed markets. The necessity of improved healthcare in the low-income countries is overwhelming. This explains the mass adoption of mobile applications in the health sector (Cohn, &Xiong 2012).

According to (Lemay et al. 2012), mHealth has contributed to the renovation of the doctor's workplaces in emerging markets. Also, the close association between physicians and payers will hugely convince patients to use mHealth. There is great diversity in the scope of mobile healthcare in the low-income market. Supporting public health initiatives including addressing disease outbreak in the poor neighborhoods is one perfect illustration portraying the effectiveness of mobile technology. To support his argument, (Lemay et al. (2012) describes how this technology was once deployed in Brazil in response to the dengue fever outbreak. The data gathering program used provided leading information on the epidemic within a very short span. This emerged as a record-breaking achievement as other previously deployed methods took ages to give any substantial information during past outbreak control.

Analysts have voiced their expectations about mHealth as well. They highly believe that health professionals in developing countries will be the frontrunners in enjoying the benefits of the mobile technology. Additionally, analysts expect this service to help these workers before addressing consumer problems. Mechael et al. (2010) notes the rapid increase in mHealth projects in various developing nations. Brazil, for instance, initiated a digital project that links ambulances thus facilitating the transmission of cardiograms to a telemedicine unit. This ensures quick diagnosis, therefore, offering guidance in treating the emergency

cases. Other countries that have embraced the mobile technology in healthcare are Mexico and Turkey. In the latter, there is Acibadem Mobile that offers mHealth nutrition service while in the former; there is the Medical Home that requires people to subscribe after which they access medical advice. Additionally, some countries such as South Africa are developing mobile healthcare programs to enhance HIV/AIDS screening. All these initiatives are encouraging signs of the incredible strides being made by mHealth (Mechael et al. 2010).

The variance depicted in the demand of mobile healthcare in the emerging markets and the developed markets is caused by broad range of factors that are evident. Individuals in the emerging markets are driven by the need for health services and the fact that they have fewer options at their disposal. In the developed nations, people have the luxury problem that immensely slows the utilization of mobile healthcare. Most doubt whether the mHealth fully guarantees top quality services or rather if they are assured special treatment. This has been a big challenge unlike in the emerging markets where the whole situation is different. A primary concern in the delivery of healthcare is the disparity in the distribution of medical personnel in the developing countries. Most prefer operating in the urban areas. Additionally, the number of doctors in these countries is small (Nilsen et al. 2012).

Healthcare in emerging markets is also not cost friendly therefore prompting many to adopt mHealth. The ubiquity of mobile technology makes it viable in situations where a large population is targeted. Ly (2011) argues that the hope for enhanced mHealth development in these markets is down to the fact that there is no healthcare infrastructure there hence necessitating the adoption of another strategy to address health issues. Nevertheless, there exist obstacles that deter the required change in the healthcare. Hospital systems in China are for instance said to be fragmented therefore creating difficulty in implementation of reforms. Barriers to change are more severe in the developed markets than in the emerging ones. In the former, there exists large and conservative medical infrastructure that is resistance to change while in the latter, there are many innovators that spearhead change (Nilsen et al. 2012).

Basically, Ly (2011) tries to show that mHealth adoption is at times triggered by need. In a nutshell, many factors are favoring the mass use of mobile healthcare in the developing

nations. Most importantly, these markets are doing relatively well on economic grounds, have required technological infrastructure as well as a population that is highly anticipating for improved healthcare hence making them suitable to engage in mHealth.

### 3.1.13 Emerging Solutions

Research reveals that the emerging market provides great opportunities for innovation. GlowCaps, an American mHealth tool warns patients as well as their service providers on the occurrence that the former fails to take medication. Also, Text4Baby is another mobile healthcare program that feeds expectant mothers with relevant information (Parker, Dmitrieva,Frolov, Gazmararian, 2012). This program has experienced massive development over the years leading to the introduction of VidaNet service in Mexico victims and MobileforGood Health Tips in Kenya that operate under similar principles. The Mexican program serves people living with HIV/AIDS. The development of technology firms, service providers, telecoms operators as well as payers will be hugely enhanced by the adoption of mHealth in the developing nations (Mahmud, Rodriguez, & Nesbit, 2010).

Barriers to change in the healthcare system are a real threat in the emerging market. Disruptions may be used to counter this challenge. The field of mHealth has tremendous potential for growth, but the primary concern among many people is the fact that only a few existing mobile technology programs have a proven business model. Lemay (2012) argues that it's important to establish a reliable revenue chain in every business model. Most importantly, it's worth noting that there is general assurance of new sources of income from the new technology. Despite the increase in the number of mobile health apps, some individuals still never believe in its authenticity. Nevertheless, progressive research has established cost as the major factor scaring many patients from utilizing this service. Additionally, research still proves price sensitivity of patients as the cause of the reduced use of mHealth other than the perceived expensive nature of the products. Convincing payers or providers advocating for reduction in cost to pay for mHealth requires a lot of effort (Thirumurthy, & Lester, 2012).

Coomes et al. (2012) argues that payers are the stakeholders of the whole initiative hence solutions that directly favor them need to be taken before attempting to persuade them to

pay for the mobile healthcare. Lack of imagination is another challenge that deters the development of progress of mobile technology in both the emerging as well as the developed markets. Creating mHealth solutions should be a joint initiative and not a responsibility of the care providers as it's commonly perceived. A solution based approach to change has been found to be more effective compared to one that relies on technology as it enhances continuous innovation. Other than blending with existing healthcare systems, mHealth needs to include many healthcare providers in its mission to deliver efficient healthcare (Chatzipavlou, Christoforidou, & Vlachopoulou 2016).

### 3.1.14 The future of health care

Thirumurthy and Lester (2012) argue that a more cooperative doctor-patient relationship will be witnessed in the future thanks to the advancement taking place in the healthcare sector. If patients experience prolonged body symptoms, it is expected that they will have an opportunity to reach the nearest physician for inquiry and consequently agree on the checkup day. If the condition appears to be serious, the physician will easily connect patients to the nearest specialists. A tool that will immensely shape the future of the health care is the Isabel Symptom Checker. This tool is special in that it lets people access services used by the medical community only. Through the tool, patients research and establish the origin of their symptoms. After establishing the causes of the symptoms, one shares the app's analysis results with the physician. Isabel Symptom Checker hastens patient's consultation treatment process as they eradicate the trial and error approach during medical diagnoses in addition to providing a clear insight on the relevant tests that would lead to a more accurate diagnosis (Mitchell, Bull, Kiwanuka, & Ybarra, 2011).

Isabel Symptom Checker (ISC) differs immensely from other mobile tools. A more important medical diagnosis is realized with this tool thus making it overshadow the previously available symptom checkers. Most importantly, this system embraces the new searching technologies in the current electronic gadgets where it creates a pattern of symptoms in a particular language and consequently generates a computation of all apparent diseases from the disease database. As a famously trusted infection diagnosis tool, ISC fulfill a global purpose of availing broad global medical knowledge at people's fingertips. Its reliability is supported by the fact that it's based on a system embraced by both nurses and doctors globally thus it

would not be wrong to claim that it will change the doctor-patient relationship. Saving both patient's and doctor's time and relieving one from prolonged pain and suffering include some of the positives associated with this app (Marcelo, Adejumo, & Luna 2011).

ECG apps represent another category of medical apps that have tremendously enhanced disease control in the world population. M arcelo et al. (2011) confirmed this by asserting that ECG has played an integral role in shaping the medical practice field. These apps are commonly used in iPhones where they avail crucial data that provides guidance in making life-saving moves. Kardia is one example of an ECG app that assists patients in monitoring the health progress of their hearts thus simplifying the doctor's job while still updating them with correct information regarding the heart health. Additionally, it gives easy access to heart data.

According to Ly (2011), guaranteed patient safety is another positive impact that will be realized by medical app users in the future. In the current health care centers, patients receive many papers containing doctor's prescriptions but dispose them off with time, forgetting the documented instructions from the physician. Medical apps present an excellent platform to eradicate this kind of challenge in the future as it serves as a central unit storing relevant patient information that hastens the recovery process. These apps will lower individual effort levels needed as they manage most of the tasks related to patient safety and recovery. Reminding patients on medication intake, monitoring side effects of the drug, and updating the physicians through texts or emails are some of the contributions of these apps in the patient recovery process. As a result, medical apps will immensely increase patient safety in the future (Handel, 2011).

Through the medical apps, scheduling of appointments between patients and health providers will be enhanced. Additionally, those seeking health services will be notified of any time changes in their appointments as well as get guidance on the significance of adhering to the treatment plan. Medical apps will benefit people living in rural areas, war-prone regions, and poor regions in the developing countries as they will manage to seek medical attention regardless of their geographical location. Research reveals high credibility and reliability of

the information is recorded in these apps as it is believed some patients fear to share certain information face-to-face with health professionals (Cornelius et al. 2012).

In reference to minimizing costs, the new medical apps will enable patients to make savings. The significance of these apps is down to the expensive nature of the frequent hospital visits. Evidently, these changes are already being experienced in some countries by now. It is possible to make a health issue consultation from a specialist and even book an appointment using a smartphone. Dr. Now is an excellent example of an app that connects patients to health experts. This app allows video consultation through the smartphone. Additionally, the app contains features that assist both users and patients in calculating its cost effectiveness. Chatzipavlou et al. (2016) outlines MeMD as another app that offers virtual medical consultation services whenever needed. In the recent years, many people have embraced this technological advancement due to the associated benefits.

### 3.1.15 Building an Effective mHealth Ecosystem

Mechael et al. (2010) suggests that mHealth ecosystem has extensively increased access as well as remote connectivity in the health industry. It describes how care providers relate to patients and consumers, with payers, employers, and public health providers. The clinical and business applications of mHealth aim at fostering a connected healthcare ecosystem by ensuring there is efficient mobile communication and transactions. Effective mHealth ecosystem facilitates better patient care, supports clinical decision making, and promotes improved resource allocation. Mobile healthcare ecosystem needs to be convenient, cost effective as well as connected to ensure better delivery of services. Most importantly, this ecosystem focuses on promoting innovation in care delivery (mHealth Alliance 2013).

# 4 Results

A thorough review of the studies was done with the aim of extracting the findings for synthesis in the review. Therefore, data from each of the study was necessary in the development of table below. The data includes the author name, year of publication, study design/methodology, study setting, variables/phenomenon, summary of findings, and the value of the article to the current study. From the table, it is clear that most of the studies were based on literature review due to scarcity in primary studies in this area of study.

| Serial No. | Author & year | Design/methodology | Setting | Variables/phenomenon | Findings | Value in the study |
|---|---|---|---|---|---|---|
| 1 | Hoque et al., (2014) | Interview data was coded and qualitatively analyzed for themes | Bangladesh's private and public sector | • Current status of E-health<br>• mHealth initiatives<br>• Challenges of mHealth implementation | • Poor ICT infrastructure, financial problems, lack of policies, resistance of change among the challenges of E-health implementation in Bangladesh<br>• E-health adoption challenges can be overcome through specific initiatives | • Provides a clear situation of challenges of mHealth adoption in the developing world, including Kenya.<br>• Suggest initiatives through which developing nations can overcome the challenge of mHealth adoption |
| 2 | Juma et al., (2012) | Qualitative examination of scientific research and telephone interviews | Kenyan health sector | • Awareness of mHealth<br>• Adoption of mHealth<br>• Legislative and regulatory backbone | • mHealth policies needed in Kenya for successful adoption of e-health<br>• major policies and strategies are already in place in Kenya, such as Kenya ICT policy of 2006 | • Reveals challenges to mHealth adoption expected in rural Kenya such as poor mHealth infrastructure and poor ICT capacity |

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|---|---|---|---|---|---|---|
| | | | | | | • Provides global mHealth research trends |
| 3 | Mugo & Nzuki (2014) | Qualitative data extraction using 5 point thematic analysis | Developing countries | • Determinants of mHealth adoption<br>• How to overcome low adoption<br>• Determinants of e-Health in developing countries | • There exist various determinants of mHealth adoption such as level of internet penetration and ICT infrastructure in a nation.<br>• User engagement, development of necessary infrastructure, and improved data security can solve adoption challenges | • Highlights the factors expected to influence the success of mHealth implementation in rural Kenya<br>• Suggests how developing nations such as Kenya can overcome the adoption challenges |
| 4 | Boore et al., (2017) | Qualitative literature review: Systematic literature search of major databases | Kenyan health sector | • Forms of e-health<br>• Important e-health theories<br>• Strategic issues in e-health implementation | • M-health is an important aspect of e-health in Kenya<br>• Technology acceptance model, technology organization and environment framework theory, | • Acts as a source of different forms of e-health that work hand-in-hand with mHealth in Kenya<br>• Presents important theories and issues to think about when |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | and Actor network theory are important in explaining implementation and sustainability of mHealth and other forms of e-health.<br>• There are issues to think about in e-health adoption such as legislation, standards, and ICT policies. | implementing mHealth in rural Kenya. |
| 5 | Ouma & Herselman (2008) | Qualitativ study was applied by use of multiple case studies chosen through random sampling | Rural hospitals, Nyanza, Kenya | • Available e-health technologies and ICT infrastructure<br>• Awareness of benefits of using e-health<br>• Barriers to ICT use | • Rural hospitals in Kenya are making effort to apply technology in healthcare<br>• No adequate ICT infrastructure for easy implementation of e-health<br>• Barriers to e-health implementations can be overcome through various strategies | • Studies the actual area of interest, rural Kenya.<br>• Highlights factors that may motivate one to think of implementing mHealth in rural Kenya.<br>• Presents barriers to e-health adoption in the study area, such |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | as lack of computers, high cost of computers, and poor computer skills. |
| 6 | Sharma & Mishra (2015) | Qualitative research using thematic analysis | General public | • Evolution of different technology adoption theories and models<br>• Factors to consider when selecting a certain model | • Technology adoption theories and models have evolved over the years and include diffusion of innovation theory of reasoned action, technical adoption model among others<br>• These theories and models can be of importance to individuals interested in applying these models in mHealth adoption research | Highlights the specific constructs in a diffusion of innovations theory to show its relevance e when explaining mHealth adoption in rural Kenya. These aspects include Knowledge development, persuasion, decision making, implementation, and confirmation |
| 7 | Wamai (2009) | Qualitative Literature review | Kenyan health systems | • Distribution and organization of health system facilities | • Inappropriate distribution of health systems in Kenya | Makes clear the challenges to be solved the implementation of mHealth in rural Kenya. These include poor |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | through systematic identification of publications in major databases | | • Healthcare utilization<br>• Healthcare financing | • Healthcare financing is in need of more reforms to reduce the cost of healthcare<br>• Poor distribution of health finance, especially in rural areas | health financing, poor health utilization, and poor distribution of health facilities |
| 8 | Kokonya et al., (2007) | Quantitative questionnaires. Stratified and systematic sampling were used. Descriptive statistics were generated using SPSS | Kenya, Uganda, and Zimbabwe | • Distribution of psychiatrists in Kenya compared to Uganda and Zimbabwe<br>• Availability of psychiatrists in Kenya verses Uganda and Zimbabwe | Kenya experiences poor psychiatrist: population ratio | Shows a need to use mHealth to reduce the burden of the shortage of mental health workers in rural Kenya |
| 9 | Kay et al. (2011) | Qualitative Literature | Developing world | • Definition of mHealth<br>• Types of mHealth | • mHealth involves the use of mobile devices to transform health care | • Provides the reasons why the implementation of mHealth in |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Review: systematic literature search in Embase and Medline | | • Benefits of mHealth | • Cost reduction, quality improvement and mortality rate reduction are some benefits of mHealth | rural Kenya will do more good than harm |
| 10 | Qiang et al., (2011) | Literature review | Developing world | • Health needs in developing world<br>• Potential of mHealth | • Developing nations in need of better health care in terms of quality and efficiency<br>• mHealth has the potential to positively transform the access, quality and cost of healthcare. | • Reveals the reasons why mHealth is needed in rural Kenya. |

# 5 Discussion

Although there are different methods of qualitative data analysis, the qualitative data collected in this study was analyzed using thematic analysis as the preferred method. This was chosen because it entails a number of steps, which makes it a rigorous method.
The themes emerging from the analysis of the data in the articles included the healthcare challenges to be solved using the mHealth applications, factors favoring the adoption of mHealth in the developing world and the associated benefits, the challenges of this adoption, and the possible remedies.

## 5.1 Healthcare Challenges

The health care sector in rural Kenya has numerous problems, which have harmed and compromised the delivery of services. As far as the accessibility challenge is concerned, Juma et al. (2012) argued that most rural areas in Kenya are characterized by poor infrastructural development. Rural societies in the country are served with poor roads, which negatively impact on the health care sector. It is very difficult to access the health facilities in the rural areas as most of them are situated far away from the households. The situation worsens in case of rains as most of the roads are rendered impassable. More so, there are very few health facilities in the rural regions despite the ever growing population. mHealth would come in handy to help solve the accessibility challenge in rural Kenya. The service will address the challenge of having to travel for long distances in search for the health care. The patients will access the health care services at the comfort of their homes. In addition to being easy to access, this will create a great deal of convenience.

Secondly, devolution of the health care sector has now become a major threat to this sector especially in the rural areas. The commissioning of the 2010 Constitution of Kenya brought about key changes to the health sector. The health sector in Kenya is now under the county governments, doing more harm to the health sector because total paralysis of health care services has been witnessed in some areas due to aspects such as frequent strikes by the health workers. The challenge is that, during such strikes, most of the people in the rural areas cannot afford the services of the private health care providers. A number of the county

governments are not able to fund the sector in different matters, such as the purchase of drugs and remuneration of health care providers. Misappropriation of the healthcare funds at the county level has also affected the operations of the health care sector in the county levels. 'Ghost' workers are also in the county health care sector payrolls. The incorporation of mHealth in the sector would address the challenge because patients will have access to the services provided by health care providers without necessarily having to visit the hospitals.

Terrorism has been a major challenge for health systems in the developing world. For example, on 22nd November 2014, there was a terrorist attack in Mandera in which 24 teachers were shot dead after being tortured by the terrorists (Kenya National Commission on Human Rights 2015). The aftermath of this incident was that a number of civil servants' unions ordered their members who were not indigenous to the northern Kenya region to leave the region until their security was guaranteed. The fear created by such attacks has discouraged healthcare professionals from seeking employment in the terror-prone areas while others decline orders when deployed in the same areas. However, Hoque et al. (2014) made it clear that the impacts associated with such moves can be reduced through the use of mHealth because the patients can get access to some healthcare service through their mobile phones. Patients can also have the opportunity of monitor their health progress without having to meet the health care providers physically.

Furthermore, lack of enough personnel in the health sectors across the developing world is a major challenge for involved governments (Wamai, 2009). According to the Kenya Medical Practioners, Pharmacists and Dentists Union (KMPPDU), the doctor-to-patient ratio in northern Kenya is 1.0 to 100,000. According to the Kenyan government, the ratio stands at 1.0 to 20,000 (Wamai, 2009). The World Health Organization (WHO) recommends that the doctor-to-patient ratio should be one doctor for every 1,000 patients (WHO 2013). The human resource crisis in rural Kenya has been brought about by a number of factors. These include; poor motivation, brain drain, corruption, inability to hire, and misuse of resources. Therefore, there is a great need to solve the human resources challenge in rural Kenya using different strategies, one being the implementation of mHealth as it has the potential to allow few heath care providers to attend to many patients simultaneously.

## 5.2 Factors favoring adoption of mHealth and associated benefits

In the Kenya case, there is an almost universal penetration of smartphones. This gives rural Kenya a strong foundation for the implementation of mHealth projects because a majority of Kenyans are conversant with the use of these devices other than for the purpose of receiving and making calls. In fact, as at April 2017, the penetration of smartphones had steadily grown to more than 60 percent of the country's population compared to the last five years (Kokonya et al., 2007). The report attributed the great growth in the use of smartphones to the drop in the price of the gadgets. More so, Kenya leads Africa in internet penetration as the IT sector in Kenya has greatly grown to record an almost 70 percent internet penetration. As a matter of fact, 7 out of 10 Kenyans constantly use the Internet.

The existing use of mobile applications in a country is a great boost to the adoption and diffusion of mHealth applications in the country (Sharma et al. 2015). The mobile applications already in use in Kenya include M-pesa, MyDawa and M-tiba among others. For example, M-pesa has greatly transformed various sectors in Kenya, including the health sector. Patients are able to pay their medical bills through the mobile money service. On the other hand, M-tiba is a mobile application that enables people to save funds for healthcare. This application is designed in a way that users can send, save and receive funds meant for healthcare services. MyDawa enables Kenyans to make purchases of quality medicine at the convenience of their phones. One takes an image of the prescription and sends it through the app.

Sharma et al. (2015) indicated that the number of smartphones in a country is a major factor that influences the adoption and penetration of mHealth. It is encouraging to note that the number of mobile service providers in Kenya is on the rise. Among the major mobile service providers in Kenya are Safaricom, Airtel, Telkom and Equitel. Of these, Safaricom enjoys the largest market share. Its wide mobile network coverage is a major boost to its continued market domination. The presence of various mobile service providers in Kenya will greatly help in adoption of mHealth in the rural areas because majority of these regions have network coverage by the various providers.

Sharma et al. (2015) was of the idea that the literacy level in a country affects the adoption of technology. Therefore, the increased literacy levels in Kenya will boost the implementation of mHealth. The Kenyan government is currently offering free primary and secondary education. This has reduced the illiteracy levels all the over the country because education is easily accessible even in the rural areas.

Based on experiences from different parts of the developing world, it is expected that the adoption of mHealth in rural Kenya will impact positively on the health care sector. Positive impacts were stated by Hoque et al. (2014) whose study was based on the impacts of the adoption in Bangladesh. Similarly, mHealth will offer a solution to the provision of better access to healthcare for patients in rural Kenya. Patients will be able to access health care at the comfort of their homes. As stated by Hoque et al. (2014) well implemented applications can lead to pervasive healthcare. It will be possible for any person to access some health services at anytime and anywhere without being limited by time, location or any other contextual constraint. The improvements in the access and quality of healthcare after mHealth implementation will yield an improvement in the general health of the target population (Juma et al. 2012). Some of mHealth applications will be designed in a way that they will offer constant reminders to patients on how and when to take their medication.

Ouma & Herselman (2008) asserted that adoption of mHealth in a country can have notable benefits for the healthcare providers. It is therefore expected that service providers in rural Kenya will have an easy time when monitoring the progress of the patients under their care. It should be noted that some of the applications will be used as a source of the medical history of the patients. By reducing medication errors, this will improve the patient care and quality of life (Hoque et al. 2014). In addition to creating a room for easy interaction between patients and the healthcare providers, these applications will alert the health care provider about any possible cases of allergic reactions if some drugs are administered.

## 5.3 Adoption Challenges in mHealth

Different researchers have explained that the adoption of mHealth in the developing world does not happen without some challenges (Mugo & Nzuki 2014; Ouma & Herselman 2008). Therefore, the stakeholders expected to play a part in the implementation of mHealth in

rural Kenya must consider these drawbacks. Firstly, health policies, ICT policies and related regulations are poorly developed in Kenya. Kenya lacks ICT policy integration in matters relating to health and e-Health. The health care field is a sensitive department and the lives of people are always at risk. The 2005-2010 Kenya National Health Sector Strategic Plan (NHSSP 11) did not address any issue in regard to e-Health but it only casually addressed ICT in general (Boore et al. 2017). There is also the lack of synchrony among the Kenyan ICT policies and e-Health. The Ministry of Health and Ministry of ICT has not set up any guidelines that govern individuals' information in regard to e-Health services, placing the electronic health information of patients at risk. Legislation and standards on mHealth are crucial in all developing countries for successful mHealth adoption Hoque et al. (2014). Regrettably, satisfactory standards for software transmission, architecture, infrastructure, medical informatics, medical imaging, interoperability and bioinformatics are yet to be developed in Kenya.

According to Hoque et al. (2014), mHealth adoption in the developing world is faced with the challenge of resistance of change. The resistance may come from both the health care providers and the patients targeted by the implementation. The health care providers may be resistant to shift to mHealth because of the fear that their jobs will be at stake. On the other hand, the residents of rural Kenya may be reluctant to shift to mHealth because they may want to cling to the old manual system of seeking health care services. The targeted recipients of mHealth are also not fully conversant with the internet use despite the high internet penetration in Kenya.

According to Sharma & Mishra (2015), the challenge brought about by poor ICT infrastructure in developing nations should not be ignored when implementing mHealth. In Kenya, The ministry of Health has minimal infrastructure in place. At the same time, there is lack of awareness among the staff in the ministry. What is more, ICT staff in health sector lacks the necessary skills in health informatics. Though there is a high internet penetration in Kenya, the bandwidth is a major challenge.

Adoption of mHealth in Kenya is negatively affected by the poor funding of the health sector, especially for the health systems based in the rural areas. Development of mHealth

infrastructure may be costly and demands additional funding in the health sector. A study by the world Health Organization (WHO) indicated that inadequate funding is a major challenge to adoption of mHealth services in a number of developing countries (WHO 2013). The ministry of Health in Kenya largely depends on funding from the World Bank, International Monetary Fund (IMF), foreign investors and the developed nations for it to finance key projects in the health sector.

## 5.4 Remedies to adoption challenges

As described by Hoque et al. (2014), the government of Kenya needs to come up with stringent measures that will ensure the security and integrity of data. This recommendation is based on the fact that Kenya experiences data security and privacy concerns. The strict measures should include a number of legislations as well as how to implement the developed legislations. Privacy and security concerns are major issues in all mHealth services and therefore the need of having specific privacy policies and regulations in place to guarantee the patients of the safety of the information they provide (Wamai 2009).

Secondly, there is need to train the health care providers and patients on the use and benefits of mHealth. This will address the issue of resistance from both sides. The health care providers should be trained on proper use of mHealth applications to make it easier for them to familiarize with these applications and break their fears. The training should address all the concerns from both parties.

Information and communication technology (ICT) infrastructure is a very vital element in the effective implementation of mHealth in the developing world (Hoque et al. 2014). Therefore, the Ministry of ICT in Kenya should improve the ICT infrastructure all over the country, including the rural areas, if the implementation of mHealth is to be successful. The ICT sector should also address the challenge of internet connectivity, especially in rural Kenya. There is also a need for them to partner with NGOs and private companies to improve ICT infrastructure for mHealth applications. The mobile service providers should also implore 4G network coverage in all areas.

The health sector funding impacts the adoption of mHealth (Boore et al. 2017). The government of Kenya should channel more funds to the ministry of Health to improve the sector to a level deemed appropriate to accommodate changes brought about by the mHealth implementation. Addressing corruption in the various governmental sectors will help curb the embezzlement of public funds. The funds can be in turn directed to the health sector. Strict measures should be taken on those involved in corruption. The health sector in Kenya has been faced by a number of mega corruption scandals (Wamai 2009).

## 5.5 Evaluation

It is important to evaluate the study in terms of its aim and objectives and make recommendations based on the results obtained. The purpose of this study was to explore the feasibility of implementing mHealth applications in rural Kenya to solve the challenge of poor quality of healthcare and high cost of healthcare. It is encouraging to note that this has been explored to a significant level through an analysis of the actual health challenges in the developing world, the benefits of adopting mHealth in such regions, the barriers to successful adoption of mHealth, and appropriate remedies to the identified barriers.

This study and similar studies in the future are expected to be of great importance to different stakeholders. Insights obtained from this study will guide health providers in the design of more and better mHealth initiatives. With a clear understanding of the challenges experienced by adopters of mHealth strategies or measures can be developed to overcome the identified challenges, whether client-based or physician-based. The rigor of the study was increased through a discussion of the various models available for use when looking at adoption of technologies. The diffusion of innovations theory was found to be the most appropriate in this study since it has several advantages over other theories.

The use of an integrative review of literature in this study was deemed appropriate since it has the potential to provide a thorough exploration of the issue under study. However, its use limited the study in a number of ways since this is a type of secondary data. For example, it was not possible to study the actual feelings and attitudes of individuals in the target area since only arguments made by previous researchers were considered. At the same

time, the researcher has not criteria to determine whether the steps described in the studies were followed effectively. To overcome this limitation in the future, researchers should consider collection of primary data from actual participants. Another limitation of the study is the fact that obtaining primary research articles on the adoption of mHealth in Kenya was a challenge. This forced the researcher to rely on articles developed through review of available literature.

Based on previous experiences and studies, the study has indicated that introduction of mHealth applications in rural Kenya has a great potential as it can be used for diverse purposes. Some of the possible uses of these applications include management of adult obesity, measuring blood pressure, patient monitoring, and carrying out health surveys and surveillance.

The study has revealed that there exists a problem to be solved in rural Kenya using the proposed mHealth implementation. Some aspects of this problem include accessibility, inadequate management of healthcare facilities, lack of infrastructure, affordability, lack of essential equipment, poor management of healthcare facilities, terrorism, and human resources challenges. It has also been stated that implementation of mHealth applications is expected to be feasible due to the high number of individuals using smartphones and the great growth in internet use in rural Kenya. Barriers to adoption of mHealth in Kenya have also been cited and include poor ICT policies and infrastructure, resistance of change by patients and service providers, and financial constraints among others.

The study had some limitations, the major one being the use of secondary data since the political situation in Kenya could not allow the collection of reliable primary data. It is not possible to determine whether the methods specified in the articles were followed effectively. The lack of first hand experiences from the target population reduced the reliability of the study. What is more, individuals in rural Kenya would have been reluctant to provide the sought information for the fear of lack of secure storage of the collected data.

## 5.6 Recommendations

Implementing mHealth in rural Kenya is feasible since the stated barriers can be overcome. It is highly recommended that the Government of Kenya will come up with appropriate measures to guarantee the security and integrity of patient data. Regulative and privacy laws are not clearly stipulated and data breach remain a high possibility. The government of Kenya Information Communication Technology (ICT) policy fails to any regulative laws. This is a major reason why the patients may resist the expected change.

Prioritizing channeling of funds to important governmental ministries will give urgency to healthcare access as fundamental human right which in turn enable actors to mobilize resources to mHealth as a tool for combating disease and easing access to healthcare.

Investment in training the health care providers and consumers on the uses and benefits of mHealth to reduce the level of resistance to change. With no doubt, an increase the funds channeled to maternal health can make access to healthcare available to women who form the backbone of family health yet are very vulnerable especially in the rural areas of Kenya. Local actors should be given incentives to encourage innovations such as mobile applications that solves local health problems.

In the future, researchers interested in focusing in a similar study should come up with an elaborate benchmark between the area of study and regions in the same economic class. The use of primary data would allow these researchers to come up with a more reliable study.

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