Chapter 14
Improving Access to Health Services in Sub-Saharan Africa Using Mobile and Wireless Technologies

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14.1 Introduction

In sub-Saharan Africa, communicable sicknesses are still the leading cause of death, causing about 70% of deaths (IPIN 2012). WHO (2016) reports that sub-Saharan Africa accounts for about 90% of the world's yearly 300–500 malaria cases. The most affected are children and pregnant women. Furthermore, with just about 12% of the world's population, sub-Saharan Africa accounts for 49% of maternal mortality and about 50% of infant mortality under age 5 years (Soucat 2014). Additionally, a sub-Saharan African population is the most affected with HIV and AIDS epidemic in the world. For example, in 2013, 71% (about 24.7 million) of the people living with HIV globally were from sub-Saharan Africa, with 1.5 million new HIV infections and 1.1 million AIDS-related deaths every year (UNAIDS 2014). On the other hand, viral hemorrhagic fevers (VHF) are steadily gaining ground in sub-Saharan Africa, with frequent occurrence of epidemics such as yellow fever, the Ebola virus, Marburg virus, Rift Valley fever, or Congo-Crimean hemorrhagic fever virus (IPIN 2012). The recent Ebola epidemic in the West African countries of Liberia, Guinea, and Sierra Leone is the gravest in history. It is reported that, out of 13,500 Ebola cases, about 4900 resulted in deaths (WHO 2016). Despite the massive disease prevalence, there are extremely few medical facilities and professionals to handle the disease burden. In many sub-Saharan African countries, there are very few hospital beds, doctors, nurses, midwives, and other health professionals as compared to their counterparts in developed countries. For instance, in 2009, on average, there were 62 hospital beds per 10,000 people in Europe, while sub-Saharan Africa had only 9 hospital beds per 10,000 people (WHO 2012; Vishwanath et al. 2012). The significantly low doctor to patient ratio has also been

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reported in sub-Saharan Africa. For instance, the number of doctors per 10,000 patients in sub-Saharan Africa was 2.3 in 2010, while in Europe and the Americas, it was 33.3 and 22.5, respectively (WHO 2012; Vishwanath et al. 2012). The huge disease burden coupled with the weak health systems incapable of handling the disease burden has significantly affected the rate of economic growth and development. Sub-Saharan African countries and many economies in the Indian Ocean countries will be unable to develop unless there are massive investments from governments into their healthcare sectors (WHO 2016; IPIN 2012). The United Nations 2008 report on the steps so far made in achieving the Millennium Development Goals (MDGs) shows that there are still recurrent dreadful situations in the health sectors of many sub-Saharan African countries.

There have been numerous calls for measures that can improve health systems and curtail deaths caused by easily preventable diseases in sub-Saharan Africa. Various approaches have so far piloted. One of the approaches that have registered some success is the use of mobile technology to provide the much-needed health services, which is popularly known as mobile Health (mHealth). WHO (2011) defines mHealth as "the practice of medical and public health supported by mobile technologies, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices" (p. 6). Kahn et al. (2010) define mHealth as "the use of portable electronic devices for mobile voice or data communication over a cellular or other wireless network of base stations to provide health information" (p. 255). For a case like in sub-Saharan Africa which has extremely weak health systems, high mortality rates, and very high prevalence of tropical diseases, the use of mobile technologies for providing the much-needed medical services has been recognized as a more cheaper and easier way to reach higher-quality health services at lower costs, thus lowering the mortality rates (Crul 2014). Some scholars have discussed the viability and the potential benefits of using mobile and wireless technologies. For instance, personal digital assistant (PDA) and mobile phone have been used for health-related research as creating awareness and adherence support and providing public-based social and health services (WHO 2011; Ogunmefun et al. 2010; Seebregts et al. 2009; Skinner et al. 2007; Tomlinson et al. 2009). All these researchers reveal that the use of mobile technology in providing health services has a great potential in providing critical health-related information even to the most distant settlements, and this can as well serve as an access point of national health surveillance systems. However, there is very little mHealth-based empirical evidence on the efficacy, sustainability strategy, and best practice, as the use of mobile technologies in providing health services remains dominant only in Europe, in the Americas, and in the Asian Tigers. Many of the mHealth projects implemented in sub-Saharan Africa are still at pilot or informal stages (Soucat 2014; Unite for Sight 2015).

14.2 Purpose of the Study

This chapter seeks to establish the extent to which the use of mobile and wireless technologies in the prevention, surveillance, management, and compliance of disease epidemic in sub-Saharan Africa addresses the rampant challenges associated with access to health services. This chapter also outlines and discusses bottlenecks hampering the successful implementation of mHealth in sub-Saharan Africa. Recommendations to these bottlenecks are also identified. The lessons outlined in this chapter may be valuable in informing governments in sub-Saharan Africa and other developing countries on the opportunity provided by the explosive spread of mobile and wireless technology as a tool for providing the much-needed health services.

14.2.1 Research Questions

Three major research questions were asked in this chapter:

1. To what extent do mobile and wireless technologies address significant challenges in the areas of disease prevention, surveillance, management, and compliance in sub-Saharan Africa?
2. What are the major challenges affecting the deployment of mobile and wireless technologies in the health sector in sub-Saharan Africa?
3. How can these bottlenecks be addressed?

14.3 The Methodology

A systematic review method was used to answer the three research questions identified in section “Research Questions”.

14.3.1 The Need for Systematic Review

A systematic review was the primary method used in this chapter. In the last 30 years or so, some scholars have criticized narrative literature reviews style, observing that it is biased and inadequate regarding the thoroughness of research performed (Hemingway and Brereton 2009). This has led to the emergence and widespread use of systematic review method of research. Systematic review is a laborious method used to plot out secondary data and lets the evidence to emerge out automatically (DFID 2013). Its strength is in using empirical evidence to establish what works and how it worked (Zanker and Mallett 2013). Systematic review has been widely used

for many years in different fields such as medical research and natural sciences. It is commonly used by international agencies such as the Australian Agency for International Development (AusAID), the UK's Department for International Development (DFID), and many others, and these agencies have funded a number of systematic reviews with the sole aim of finding what works and how it worked in generating development outcomes (Zanker and Mallett 2013). Please see the appendix for the reviewed literature in this chapter.

14.3.2 Systematic Review Method

In 1984, Cooper (1984) proposed a five-stage systematic review process, and it was followed by this chapter.

- Problem formulation – Apparent problem and research questions to be addressed by the review (Khan et al. 2003). This chapter formulated three major questions (see section "Research Questions") that needed to be answered or investigated using systematic review.
- Data collection – This normally takes the form of identification of relevant works. Guided by the three research questions stated in section "Research Questions", an extensive and unbiased literature search was conducted particularly on the extent to which mobile and wireless technologies have offered the much-needed services in the areas of disease prevention, surveillance, management, and compliance in sub-Saharan Africa and also the challenges and remedies of deploying mobile technology in health. A review was conducted on reports, journals, conference proceedings, books, and websites. Google Scholar was majorly used in this review. About 83 citations were selected for the review. Their potential relevance in the areas of prevention, surveillance, management, and compliance of different diseases was examined, and about 16 citations were removed because they were irrelevant. The remaining 67 citations gave relevant information on the three research questions.
- Data evaluation – Assessing the studies for inclusion in the review. This chapter used a simple data extraction table which was used to organize the information extracted from each review (e.g., authors, publication year, abstract, study design, and particularly the outcomes of these studies).
- Analysis and interpretation – Narrative synthesis was the primary form of analysis used in this chapter. It relies primarily on the use of homogenous words and text to summarize and explain the findings of the synthesis. From each of the studies, a homogenous trend was derived particularly on prevention, surveillance, management, and compliance of diseases in sub-Saharan Africa using mHealth.
- Public presentation – The findings of the review were presented in the next section. These findings majorly answer or address the three research questions stated in section "Research Questions".

14.4 Findings

As already discussed in the introduction, health challenges present perhaps the most substantial hurdle to sustainable global development in many sub-Saharan African countries. In the next section, this chapter discusses the potential of using mHealth to improve health services in sub-Saharan Africa.

14.4.1 Mobile Technology in Sub-Saharan Africa

Brinkel et al. (2014) observe that the application of mHealth services can transform global health systems. This assertion is supported by a powerful combination of four facts: (a) rapid technological growth, (b) the continued fall in the price of the mobile technology products, (c) widespread ICT infrastructure, and (d) wide spread use of mobile phones worldwide (Piette et al. 2012). The widespread adoption and use of mobile and wireless technologies are evident in many sub-Saharan African countries. Mobile penetrations in Africa, Asia-Pacific, and Latin America were expected to increase to 82%, 98%, and 119%, respectively, in 2014 (Vishwanath et al. 2012). In Uganda, for example, there are over 19 million mobile phone users, 2300 base stations, and 100% network coverage (UCC 2015). Mobile phones are and will remain the primary medium of telecommunication in sub-Saharan Africa and can be an alternative channel for health service provision (Lallana 2007). Therefore, the viability of mobile technologies supporting the much-needed health sector systems in sub-Saharan Africa is bigger than ever before. Some sub-Saharan African countries are already using mobile and wireless technologies in the health sector like monitoring measles outbreaks in Zambia, auxiliary diagnosis and treatment in Mozambique, and sending awareness messages in Benin, Malawi, and Uganda (Aker and Mbiti 2010). In Kenya, Malawi, and South Africa, mobile phones are being used to send several reminders a day to HIV-positive patients (Aker and Mbiti 2010).

14.4.2 mHealth in Sub-Saharan Africa

The pace at which mobile and wireless technologies have spread universally is matchless in the history of technology. In recent years, a significant influx into the healthcare industry by both private, nongovernmental organizations (NGOs), and government agencies particularly to offer mHealth services has been registered. Recent predictions suggest that the global mHealth market will grow to 24 billion US dollars by 2018, up from 4.5 billion US dollars in 2012 (Vishwanath et al. 2012). One of the biggest benefits that mobile and wireless technologies offer is the bridging of geographically spaced regions, where the infrastructure connecting the

regions is extremely poor (Crown Agents 2014). With the introduction of mobile technologies, remote areas can now easily access professional medical services which were previously inaccessible to them or only accessible following a challenging, lengthy, and time-consuming journey. The potential benefits that these mobile technologies have created in tackling health challenges in sub-Saharan Africa have been enormous, the reason why medical bodies, NGOs, governments, and other players in the health sector have greatly embraced it (Crown Agents 2014). The mHealth projects are already being implemented enormously all over the world, but the projects are majorly gaining ground throughout sub-Saharan Africa, where demonstrations have been done in prevention, surveillance, management, and compliance of disease epidemics such as HIV/AIDS, malaria, Ebola, and much more. In the next section, this chapter discusses how the use of mobile and wireless technologies has tremendously aided the prevention, surveillance, management, and compliance of different diseases in sub-Saharan Africa.

14.4.3 Prevention

There is overwhelming evidence that prevention and control of noncommunicable diseases (NCDs) has proven to be one of the major barriers for the health sector in many sub-Saharan countries and even some middle-income countries (WHO 2013; Gaziano et al. 2007; Abegunde et al. 2007). Therefore, a number of carefully planned health awareness approaches together with multi-sectoral policies aimed at advocating for healthy lifestyles are much needed to decrease the burden of these NCDs (Gaziano et al. 2007; WHO 2013). One of the strategies that have been adopted by a number of sub-Saharan African countries is disease prevention through public health promotions. Health promotion and awareness campaign programs focus on keeping people healthy and encourage individuals in the communities to live healthy lifestyles. These strategies further focus on behavioral change so as to reduce the risk of contracting diseases and other morbidities. Some of these strategies include communication, education, and policy change. Both Wakefield et al. (2010) and Naugle and Hornik (2014) do acknowledge that while health awareness programs disseminated through television and radio can promote healthy living, there are quite a number of limitations to these traditional media. Some of these limitations include:

- Challenges in capturing audiences' attention in a multimedia environment.
- The one-way communication from the radio/TV to the listener.
- Mass broadcast, therefore it is difficult to target a particular audience.

Therefore, to solve some of these challenges identified, social media technologies have been introduced and used in a number of sub-Saharan African countries (Yepes et al. 2016). These social media technologies such as text messages (SMS), WhatsApp, Facebook, Twitter, and Instagram are increasingly being used in health awareness campaigns, providing target-specific messages that encourage specific

behavioral changes like increased fruit and vegetable consumption (Silva et al. 2015), smoking cessation (ITU 2013), and adoption of healthy living and lifestyles (Beratarrechea et al. 2015). For example, since 2006, a number of mobile phone games were implemented in Botswana, Kenya, Malawi, Mozambique, Tanzania, and Uganda with over 6 million handsets in total. These games were designed to help educate participants on HIV/AIDS prevention, healthy living for those infected with HIV, and how to fight stigma and discrimination surrounding the disease. In some countries like Uganda, considerable impact of the project on behavioral changes particularly among the youth was registered (Crown Agents 2014). The Mobile Midwife project currently running in Ghana aims to improve antenatal and neonatal care among the rural poor. It sends text and voicemail messages to women during their pregnancies, particularly messages on postpartum depression or postpartum anxiety and messages on essential vaccinations and management of critical childhood diseases. In the first 2 years after the program was launched in 2010, more than 20,000 users had enrolled (Cheers 2013). "Learning about Living" is a collaborative pilot program in Nigeria and provides a forum for young Nigerians to be educated on health-related issues such as sex, AIDS, personal development, relationships, and healthy living skills. With "My Question" option, the youth can get to know about healthy living by sending a text message, calling a toll-free line, or sending an e-mail. When the project was launched in 2007, it was piloted in three places in Nigeria. The project saw an early success in that the service received close to 2500 health-related questions in the first 5 days and about 10,000 questions within the first month after its launch (Vital Wave Consulting 2009). The use of SMS or email-based interventions to change behavior has also been piloted in several other sub-Saharan African countries such as Democratic Republic of the Congo, Ghana, Kenya, Nigeria, South Africa, Uganda, and Tanzania, and generally, some encouraging results have been registered (Gurman et al. 2012; Corker 2010).

14.4.4 Surveillance

One of the challenges that health systems in sub-Saharan African countries still face, and will continue to face if not checked, is the inadequate capacity to carry out effective disease surveillance and infectious disease outbreak investigation (USAID/Ghana 2013). Brinkel et al. (2014) agree and observe that health surveillance as well as disease monitoring in the region is still weak. It is characterized by very high costs. These high costs range from logistical, financial to infrastructural provisions. However, the use of mobile technologies has reduced the costs of disease surveillance and monitoring to a greater extent and has provided a more effective means to perform surveillance in some sub-Saharan African countries. Kahn et al. (2010) concur and state that mHealth has the capacity to deliver lifesaving information even to the most distant, remote, and resource-poor areas in developing countries. It is important to note that early access to disease reports by health professionals can lead to a fast and timely identification and control of disease outbreaks (Kahn et al. 2010).

For example, the malaria surveillance study in Botswana applies an immediate case-based notice per confirmed positive malaria case and offers supplementary weekly information. This enables rapid response toward the spread of malaria in a particular area (Chihanga et al. 2012). Similarly, community-based longitudinal demographic surveillance sites (DSS) exist in 12 sub-Saharan African nations, and the system collects NCD data on births and mortality by verbal autopsy. The DSS has provided important information on changes in the major causes of mortality (Steyn et al. 2005; Tollman et al. 2008). For example, data from one DSS cohort in South Africa discovered that four of the top five most common causes of death in adults are noncommunicable conditions (Steyn et al. 2005). In Uganda, an AED SATELLITE program used for disease surveillance and used wireless-enabled PDAs for health data collection and reporting produced a 24% cost saving on surveillance compared to the traditional paper approach. Eighty-seven percent of the health professionals engaged in the program acknowledged that the system allowed them to make faster and more accurate diagnoses and response to an outbreak (Berhane 2008). In Mozambique, PDAs and other GPS devices were also deployed for malaria monitoring project. The mobile technology system was meant to enable health professionals implementing malaria programs to make quick and accurate decisions. The health professionals use the PDA and GPS devices to gather data and transmit it via the GPRS network to a central database used to produce health information, which helps the Mozambican government to effectively allocate resources (Vital Wave Consulting 2009). The Ministry of Health in Malawi in partnership with John Snow Inc., a public health consulting firm, has created cStock that used an SMS-based system that enables health workers to monitor and track the number of drugs at local clinics, reducing the chances of drug deficiencies (Cheers 2013).

14.4.5 Management

In sub-Saharan Africa, the health management systems that address health service challenges are constrained both in terms of resources and capacity (Vital Wave Consulting 2009). It has been reported that weak health information management systems (HIMS) posed a critical challenge to reaching the health-related Millennium Development Goals in sub-Saharan Africa. Sub-Saharan Africa continues to grapple with a huge problem of poor health data collection, analysis, and management (WHO 2013; Kumar 2007). Health data storage, management, and analysis require robust information management systems (Sheikh 2014). There is an urgent need to find ways to strengthen HIMS in this part of the world. In other words, a well-functioning HIMS should produce accurate, dependable, and timely data on health status, health determinants, and health system performance and be capable of analyzing this information to guide health activities and decision-making processes across all other health system building blocks (Vital Wave Consulting 2009). There are some concerted efforts being undertaken in some sub-Saharan countries to strengthen existing HIMS. Some sub-Saharan countries have registered benefits

from their well-functioning HIMS. Studies conducted in some African countries that have a well-functioning HIMS found out that the average patient visits to a health facility in these countries were 22% shorter compared to other countries, with the time spent consulting or attending to the patient reduced by 58% and patients spending 38% less time waiting in the clinic (Rotich et al. 2003). Similar studies also show improvements in the accuracy of clinical information, prescriptions, and lab tests, easy program monitoring, improved management of chronic diseases, and timely and helpful reminders and alerts about lab results and medications (Douglas et al. 2003; Anokwa et al. 2012). An example of where the use of HIMS scored success was in Tanzania. When the Tanzanian government introduced the integrated management of childhood illness (IMCI), it did not show any signs of successes. This is because there was inadequate supervision, inadequate training of health works, and a slow implementation process that had significantly weakened its likely impact. However, there were efforts to address some of these problems by the project's research team. In an attempt to address these problems, the team created a program called e-IMCI which ran on a PDA device. The program provides a step-by-step guide on how to enter, retrieve, and disseminate vital information. Although long-term studies on the effects of e-IMCI are required, preliminary results from the pilot implementation were significantly encouraging (Dimagi 2015).

14.4.6 Compliance

One area that sub-Saharan Africa has been praised for is compliance to treatment. A 2015 report published by Unite for Sight (2015), an international health agency, stated that claims that compliance challenges are overwhelming in developing countries are not grounded in evidence. In fact, according to the report, adherence rates in sub-Saharan African countries are either equal or higher than adherence rates in developed countries. For example, HIV patients in Africa achieve close to 90% adherence rates significantly exceeding those achieved in a developed country like the USA or Canada (Unite for Sight 2015). This is remarkable, given the enormous obstacles in the health sectors in these poor regions of the world. However, there is evidence that shows an overall high proportion of patients defaulting tuberculosis (TB) treatment in sub-Saharan Africa. Four out of the five studies reported the percentage of default above 20% (Castelnuovo 2010). Poor compliance and patients defaulting on anti-TB treatment can lead to a significant increase in multidrug-resistant mycobacteria in the continent (Castelnuovo 2010). On the other hand, a study showed that on average, 17.6% of hospital admissions in 2008 resulted in readmissions within 30 days of discharge, 11.5% within 15 days, and 6.2% within 7 days due to noncompliance. Whereas variation in readmission rates varies by hospitals and geographic regions, reducing hospital readmissions could lower healthcare costs (Roney 2012). Research on effective ways to overcome noncompliance is underway, and the use of mobile technology to improve compliance tops the list. When using mobile technologies in treatment compliance, it is described as the

sending reminder messages, by voice or SMS, to patients with the aim of achieving treatment compliance, disease eradication, and overcoming challenges such as drug resistance. In many cases, SMS has been deployed to support patients with conditions such as diabetes, HIV/AIDS, and TB (WHO 2013). This explains why sub-Saharan African population compliance rate is very high even more than in the USA or Canada. Mobile and wireless technologies offer hospitals a mean to lower medication noncompliance, which has been proven to be one of the biggest factors in high hospital readmissions. Mobile technology can help patients to stick to medication orders given by a health professional. It can inform patients on the usefulness of medical adherence, especially prescription adherence (Roney 2012). There are a number of cases where the use of mobile technology in medical compliance has improved adherence. For example, before a mobile device known as "SIMpill," which monitors and reminds the patient to take medication as prescribed in real time, was introduced to help improve patient compliance in South Africa, there was a 22–60% patient adherence rate. However, with the introduction of SIMpill in a pilot project, it showed that patient compliance could jump to over 90% (Vital Wave Consulting 2009). SMS reminders sent to patients have improved appointment adherence in Malawi (Mahmud et al. 2010) and follow-up in Nigeria (Odigie et al. 2012) and in Cameroons (Davey et al. 2012). SMS sent for treatment compliance with or without the use of smart pill boxes has been reported in Uganda (Siedner et al. 2012).

However, despite all the opportunities provided by mHealth solutions, there are challenges encountered during mHealth implementation. In the next section, this chapter discusses the challenges that mHealth initiatives in sub-Saharan Africa are facing.

14.5 Challenges of mHealth in Sub-Saharan Africa

Although a lot has been written on the potential benefits of mHealth in sub-Saharan Africa, its uptake has been limited compared to other parts of the world (Mars 2013). The uptake of mHealth in sub-Saharan Africa has been faced with a number of challenges, and among these challenges is a shortage of ICT trained doctors and nurses who can effectively use the mHealth system. The unfortunate reality again is that most mHealth systems involve a lot of steps, adding extra steps into the routine clinical workflow. This normally becomes a huge burden to the already overworked doctors and nurses (Mars 2013). Studies have shown the existence of technical challenges stemming from the lack of competencies in mobile-based applications usage on the part of the health professionals (Pascoe et al. 2012). Besides the challenge of ICT illiterate medical practitioners, a large population of people in many sub-Saharan African countries are illiterate and are digitally backward. Web-based solutions for patient-centric healthcare are currently largely irrelevant because, in poor communities, people are mostly ICT illiterate and just a few of the over 2000 African languages are available on the Web (Mars 2013).

Besides digital backwardness, other reported challenges affecting the implementation of mobile phone-based health services in sub-Saharan Africa are technical, financial, and infrastructural challenges, data security, as well as challenges concerning the accuracy of mHealth medical diagnosis tools (Brinkel et al. 2014). As far as infrastructural challenges are concerned, Internet penetration in Africa is half that of Asia and the Pacific and the lowest of any developing world region. In rural areas where mHealth services are much needed by the poorest of the poor, it is least likely to be provided because of inadequate infrastructure and high connectivity costs (Mars 2013). In fact, a study carried out by Kaplan in 2006 argued that mobile technology may not be an effective tool for healthcare interventions for two primary reasons: lack of access to these mobile technologies by many people and limited evaluations of effectiveness. However, this was way back in 2006 when mobile and wireless technology penetration in sub-Saharan Africa had not yet gained the momentum as it has now. A more advanced mobile health initiatives require a high level of ICT literate population and medical practitioners and significant infrastructural establishments such as state-of-the-art telecommunication infrastructure, like the 3G and 4G networks (WHO 2011). Crul (2014) observes that modern telecommunication infrastructure is being deployed across the world, driven in particular by strong consumer demand for technology-based services and also the enactment of good ICT policies to stimulate growth in ICT infrastructure and network connectively.

Although a lot of research and pilots projects have already been implemented, mHealth's practical application is still largely undeveloped. Projects are often not sustainable enough to go beyond the pilot phase. Scaling up implementation is often limited because a global, consistent framework including indicators and evaluation methods is still lacking (Crul 2014). Whereas a general acceptance of mHealth at the community level in many sub-Saharan countries was reported to be good (Brinkel et al. 2014), a number of cases were reported where physicians and nurses resist mHealth technologies. Many physicians and nurses were slow in adopting the new technologies, along with the "fee-for-service" mind-set. If the health authorities do not check this, it could act as a dampener for the rapid adoption of mHealth. For example, for some reasons, nurses refused to use the mobile-based solution to record stock used for patients in a large private hospital (Whittaker et al. 2011). In another case, health professionals who were given mobile phones to report on patients who were on treatment for drug-resistant tuberculosis completed less than a third of reports (Chaiyachati et al. 2013). Government policy can be an important first step toward mass physician acceptance (Vishwanath et al. 2012). Vishwanath et al. (2012) observe that in order for health professionals to accept to use mobile technology services, government action and commitment coupled with efforts from other stakeholders are crucial. Government policy will act as a foundation for pushing for health professionals to use mHealth solutions, and once they attain comfort levels, it will be easier to integrate other mobile technologies into healthcare delivery.

Many sub-Saharan countries do not have enough legislation to foster mHealth. Regulators across the world must carefully address issues that can restrain the

growth of mobile health. Regulations should adequately address issues such as certification of devices as well as applications and standardization of procedure and systems (Vishwanath et al. 2012). Malaysia, for example, took bold steps way back in 1996, declaring various telehealth-related laws and implementing a "Multi-Media Super Corridor" initiative and introducing a Lifetime Health Plan with a "lifelong Personal Health Record (PHR)" (Scott and Mars 2014).

14.6 Conclusion

Despite bearing about 71% of the global distribution of communicable diseases (infectious diseases), sub-Saharan Africa still grapples with the weakest healthcare system, shortage of well-educated healthcare professionals, inadequate infrastructures, and laws for national and international funding toward the health sector. A very large section of the population in sub-Saharan Africa has very limited or no access to healthcare clinics and basic healthcare services. There is evidence that solutions have been developed for this life-threatening problem and save the lives of millions. Limited progress has been made to this date. Since this is a complex problem, the world has been unable to realize real success. However, many scholars and health practitioners believe that the use of mobile and wireless technology is an appropriate response to such dire circumstances. They believe that mHealth can strengthen and improve the current healthcare system, and it has the potential to deliver healthcare to patients in the most remote areas. Despite the numerous challenges associated with mHealth implementation and adoption, there is an overwhelming evidence that mHealth has improved health services in the form of prevention, surveillance, management, and compliance in sub-Saharan Africa. An integrated approach and close cooperation among different stakeholders are critical to move toward scaled and sustainable solutions.

Appendix

Group	References
Introduction	IPIN (2012), WHO (2016), Soucat (2014), WHO (2012), Vishwanath et al. (2012), WHO (2011), Kahn et al. (2010), Crul (2014), Ogunmefun et al. (2010), Seebregts et al. (2009), Skinner et al. (2007), Tomlinson et al. (2009), Unite for Sight (2015)
Methodology	Hemingway and Brereton (2009), DFID (2013), Kowalczyk and Truluck (2013), Zanker and Mallett (2013), Kahn et al. (2010)
mHealth in SSA	Vishwanath et al. (2012), Crown Agents (2014)
Mobile Tech in SSA	Brinkel et al. (2014), Piette et al. (2012), Vishwanath et al. (2012), UCC (2015), Lallana (2007), Aker and Mbiti (2010)

Group	References
Prevention	WHO (2013), Unite for Sight (2015), Gaziano et al. (2007), Crown Agents (2014), Soucat (2014), Vital Wave Consulting (2009), Cheers (2013), Abegunde et al. (2007), Wakefield et al. (2010), Odigie et al. (2012), Silva et al. (2015), Gurman et al. (2012), Corker (2010)
Surveillance	Berhane (2008), Chihanga et al. (2012), Steyn et al. (2005), Vital Wave Consulting (2009), Cheers (2013), ITU (2013), USAID/Ghana (2013), Brinkel et al. (2014), Kahn et al. (2010), Tollman et al. (2008)
Management	Douglas et al. (2003), Dimagi (2015), Rotich et al. (2003), Vital Wave Consulting (2009), WHO (2013), Kumar (2007), Sheikh (2014), Anokwa et al. (2012)
Compliance	Vital Wave Consulting (2009), Mahmud et al. (2010), Odigie et al. (2012), Siedner et al. (2012), Skinner et al. (2007), Unite for Sight (2015), Roney (2012), WHO (2013), Davey et al. (2012)
Challenges of mHealth in SSA	Mars (2013), Pascoe et al. (2012), Brinkel et al. (2014), WHO (2011), Crul (2014), Vishwanath et al. (2012), Whittaker et al. (2011), Chaiyachati et al. (2013), Sheikh (2014)

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