**ADDIS ABABA UNIVERSITY**

**SCHOOL OF GRADUATE STUDIES**

**SCHOOL OF INFORMATION SCIENCE AND SCHOOL OF PUBLIC HEALTH**

# MOBILE HEALTH APPLICATION IN ETHIOPIA: EXISTING INITIATIVES AND PRACTICES

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HEALTH INFORMATICS PROGRAM

FACULTY OF INFORMATICS, ADDIS ABABA UNIVERSITY

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EXAMINER

# DEDICATION

This thesis is dedicated to my beloved and adored family!!

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# LIST OF ACRONYMS

| | |
|---|---|
| ANC | Antenatal Care |
| ARC | AIDS Resource Center |
| BMGF | Bill & Melinda Gates Foundation |
| BPR | Business Process Reengineering |
| BRHP | Butajira Rural Health Program |
| CCP | Center for Communication Program |
| CDC | Center for Disease Control |
| CHAI | Clinton Health Access Initiatives |
| CPOE | Computerized Physician Order Entry |
| CSA | Central Statistical Agency |
| DBS | Dried- Blood-Spot |
| E-Health | Electronic Health |
| EHNR | Ethiopian Health and Nutritional Research |
| EHRs | Electronic Health Records |
| EID | Early Infant Diagnosis |
| FMoH | Federal Ministry of Health |
| GDP | Gross Domestic Product |
| GPRS | General Packet Radio service |
| GPs | General Practitioners |
| HAPCO | HIV/AIDS Prevention and Control Office |
| HC | Health Center |
| HEP | Health Extension Program |
| HEWs | Health Extension Workers |

| | |
|---|---|
| HIS | Health Information System |
| HMIS | Health Management Information System |
| HP | Health post |
| ICT | Information Communication Technology |
| IEC | Information, Education and Communication |
| IVR | Interactive Video Response |
| JHU | Johns Hopkins University |
| JHU/CCP | Johns Hopkins University/Center for Communication Programs |
| JSIRTII | JSI Research &Training Institute Inc |
| L10K | Last Ten Kilometer |
| M&E | Monitoring and Evaluation |
| MAMA | Mobile Alliance for Maternal Action |
| MDGs | Millennium Development Goals |
| mHealth | Mobile Health |
| MIS | Management Information System |
| MNCH | Maternal and Newborn Child Health |
| MNH | Maternal and Neonatal Health |
| MTCT | Maternal to Child Transmission |
| MU | Mekelle University |
| MVP | Millennium Villages Project |
| NARC | National AIDS Resource Center |
| ODK | OpenDataKit |
| PCs | Personal Computers |
| PDAs | Personal Digital Assistants |

| | |
|---|---|
| PEPFAR | President's Emergency Plan for AIDS Relief |
| PHC | Primary Healthcare |
| PHCU | Primary Healthcare Unit |
| PLHIV | People Living with HIV |
| PNC | Prenatal Care |
| RHBs | Regional Health Bureaus |
| SMS | Short Message Service |
| SNNP | Southern Nations National People Representative |
| STDs | Sexually Transmitted Diseases |
| TAT | Turnaround Time |
| UNDP | United Nation Development Program |
| UNICEF | United Nation Children's Fund |
| WHO | World Health Organization |
| WorHOs | Woreda Health Offices |

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# ABSTRACT

**Background:** The use of ICT, such as computers, mobile phones, satellite communications, patient monitors, etc., to support health services and information exchange are becoming common place. The mHealth field has emerged as a sub-segment of eHealth. As such, it is observed that mobile technology has the potential to improve the quality, safety, and efficiency of health care services and to impact almost every aspect of the health sector. The realization the potential of mobile devices to improve healthcare system resulted in many initiatives in mobile health in Ethiopia. Those initiatives have showed huge opportunities in the healthcare industry so far; however, whether they are sustainable and scalable remains to be seen.

**Objective:** The main objective of this study is to explore the existing mHealth projects in Ethiopia with regard to their challenges, lessons learned and success factors.

**Method:** The exploratory study design was conducted using qualitative research approach. The purposive sampling research method was adopted to select participants of the study. The data were then collected using in-depth interview, questionnaire and document review.

**Results:** The researcher identified eight mHealth projects (seven are ongoing and one has ended). It is learnt that these projects are facing many challenges. Amongst them are poor network coverage, limited technological literacy of health workers, and sustainable financial support. Developing user-friendly system, pilot assessment and having M&E framework are some lessons taken from some of mHealth projects.

**Conclusion:** Generally, we may conclude that mHealth projects have a significant impact in healthcare services delivery if government commitment, collaboration, capacity building of health workers, financial support, infrastructure and M&E are in place.

# CHAPTER ONE

# INTRODUCTION

## 1.1. Background

The Federal Ministry of Health (FMoH) in Ethiopia is responsible for overseeing the overall operation of the country's healthcare system. It is accountable for preparing, publishing and distributing the national standards for health posts, health centers and district hospitals in the country. However, literature indicates that there are many challenges hindering the efficient operation. (ref)

For instance, Nada (2007) states that Ethiopia is a poor country with weak health care systems and infrastructure. Government health outlets may be relatively few and widely dispersed; and private-sector sources often favor wealthier urban areas. The government is the main healthcare service provider but the coverage and distribution of the healthcare facilities among regions are uneven. Poor health coverage is of particular concern in rural Ethiopia, where access to any type of modern health institution is limited at best. Health systems and roads are underdeveloped, and transportation problems are severe, especially during the rainy season.

The report by FMoH (2011) indicated that Primary Health Care (PHC) in Ethiopia is provided by facilities including health centers and health posts. In 2010/11, there were 2,660 health centers and 15,095 health posts throughout the country. About 85% of the healthcare provision is provided by public healthcare facilities, while the remaining 15% is provided by the private healthcare sector. There were a total of 184 hospitals in the country in 2010/11, where 56 belongs to the private sector, while 122 are State owned and 6 are supported by non-governmental organizations.

The World Health Organization (WHO, 2004) further states that the health status in Ethiopia is poor; this is mainly due to the circulation of communicable diseases caused by poor sanitation and nutritional deficiencies. On top of that, there is a shortage of trained medical personnel in the healthcare system.

According to Murray & Frenk (2000), there is a broad consensus that a strong Health Information System (HIS) is an integral part of the health. Effective health communication is essential because it equips the public with the tools and knowledge to respond appropriately to health crises. Over the last decade, the need to develop and organize new ways of providing efficient healthcare services has been accompanied by major advances in Information and Communications Technology (ICT). This has resulted in a dramatic increase in the use of ICT applications in health care. ICT in Healthcare is the use of information technology to improve the process of healthcare delivery and is concerned primarily in streamlining administration and putting information into the hands of point-of-care professionals.

ICT has the potential to improve the quality, safety, and efficiency of health care services and impact almost every aspect of the health sector (Bypass & Ambruoso, 2008). In public health, information management and communication processes are crucial, and are facilitated or limited by the availability of information. In addition, beyond the formal health sector, the ability of impoverished communities to access services that responds to their priorities can be significantly influenced by broader information and communication processes.

Bypass & Ambruoso further claim that ICT can help patients become more involved in their own care, which is especially important in managing chronic conditions like diabetes, asthma, or heart disease. Primary healthcare costs can be cut, where remote access can be facilitated via innovation in telemedicine, cutting down the need for those in remote areas to forgo a day's work and wages in trying to get to a doctor for minor ailments. Additionally, it can help streamline processes and reduce administrative overheads, as it has in other industries, while leading to the creation of new, high-tech markets and jobs.

According to the United Nations Development Program (UNDP 2006), increased use of ICTs enhances healthcare service delivery by:

- Delivering economies of scale to improve access to basic services
- Optimizing service delivery
- Providing incentives for development and transfer of new technologies and products
- Increasing efficiency through enhanced connectivity and exchange of knowledge

- Enabling regions to focus on delivering services where they have a comparative advantage
- Providing access to digital development for continuous improvement.

The Presidential National Commission (PNC) on Information Society and Development (2006) states that ICT applications are suitable for addressing the digital divide between rural and urban populations, including rich and poor, young and old, males and females, and unequal distribution of health professionals, particularly in specialist healthcare.

The mobile health (mHealth) field has emerged as a sub-segment of eHealth, the use of ICT, such as computers, mobile phones, satellite communications, patient monitors, etc., to support health services and information exchange. MHealth ranges from simple mobile phone-based applications for the transfer of health information on basic handsets via SMS to highly sophisticated diagnostic applications that rely on advanced equipment and robust back-end data systems. The 2011 mHealth in Ethiopia report identified five priority areas where mHealth could best help to strengthen the Health Extension Program (HEP). These five areas are: referrals, data exchange, supply chain management, training and education, and consultation. M-Health has great potential to improve health services delivery in the developing world. M-Health harnesses the increasing presence of cell phones among diverse populations and uses phones to deliver increased healthcare services to those receiving incomplete care.

This study mainly focuses on mobile health. In Ethiopia, access to mobile phones is expanding widely to rural and inaccessible areas making them a preferred way of communication. Since communication is the key to improving services, mobile phones can have great potential. This has resulted to have many initiatives working in mobile health to support the healthcare services; but very few programs that have reached scale. Consequently, the study explored mHealth initiatives and their challenges, lessons learnt and success factors in Ethiopia.

## 1.2. Statement of the Problem

Mobile phones are penetrating in developing countries fast. Barry, et al., (2005) states that, mobile phones can help patients and healthcare workers overcome institutional barriers by reducing the time spent on travelling to consult medical specialists, thereby effectively expanding the pool of available health personnel with relevant expertise. The ability of mobile phones to transform health services delivery, by improving supply chain management, and increasing reliability of communication between health care providers at different levels of care. It is also reported that although mobile phone penetration in Ethiopia still remains low (10%), over 90% of Health Extension Workers (HEWs) presently have access to a mobile phone, and a lot of them are reported to use their phones and personal airtime to conduct work tasks (Vital Wave Consulting, 2011).

Consequently, there has been a recent surge in the deployment of mHealth initiatives in developing world, particularly in Ethiopia. And those initiatives have showed huge opportunities in the healthcare industry so far; however, whether they are sustainable and scalable remains to be seen. Indeed, most of the mHealth projects which have been launched during the last decade are still pilots, or simply do not exist anymore. What are the main bottlenecks mHealth projects faces when they engage into a scaling-up process? What are the key success factors leading to a successful scaling-up dynamic?

As stated by the Vital Wave Consulting, PATH et al. (2012) most mHealth initiatives in Ethiopia are pilot, short term or have covered a limited geography; they have no common platform; the services are disconnected and do not leverage a central database. And as such sharing experiences have not been common between initiatives (except some of them), this expected to duplication of efforts. And also they are not familiar with many stakeholders even they are not well-known with each other.

In order to create platform and recommend possible consideration towards success and sustainability each of the project may need to be assessed in terms of objectives, platforms, team, application, etc. Therefore, this research explored each mHealth initiatives and their challenges, lessons learnt and come up with the possible success factors.

The following research questions are the bases for the study:

1. What are the current initiatives regarding mobile health?
2. What are the challenges associated with the initiatives?
3. What lessons can one learn from the existing initiatives?
4. What conditions are needed to scale up and sustain existing mobile health initiatives?

## 1.3. Significance of the Study

In view of addressing the research questions listed above and with the general objective of exploring existing mobile health initiatives and success factors, many stakeholders may be beneficiary as major contributions of the research work. Mobile health organization, mobile health system developers would benefit from this thesis because, it helps to share their experiences with one another. And they can also use the results for their sustainability and success. Overall, the government, researchers in the area, health professionals and the community at large are expected to benefit from the results of this research.

## 1.4. Objective of the Study

### 1.4.1. General Objective

The main objective of this study is "to explore mobile health initiatives and success factors in healthcare systems".

### 1.4.2. Specific Objectives

- To identify and describe the current initiatives regarding mobile health;
- To examine the challenges associated with mobile health initiatives;
- To identify lessons learnt from the existing initiatives; and
- To explore factors that are considered for scalability and sustainability of mobile health initiatives.

## 1.5. Scope of the Study

The study made an attempt to include all mHealth projects in Ethiopian health care system. The researcher made attempts to identify them through personal contacts at the FMOH and through the networks of people who are involved in mHealth initiatives. Therefore, this study is scoped so as to include all mHealth initiatives undertaken in Ethiopia and explore their challenges, lessons learnt and success factors.

## 1.6. Organization of the Thesis

This thesis is organized into 5 chapters. Chapter 1 presents an introduction consisting of background, statement of the problem, significance of the study, research questions, objective, scope, and organization of the study. Chapter 2 provides a review of literature related to healthcare systems, Ethiopian healthcare challenges and the potential solution particularly mHealth, and related works done in the area. Chapter 3 deals with the research methodology that was used to collect the desired data so as to attain the objective of the study. It discusses, study design, data collection instruments, data collection procedures and method of data analysis used in carrying out the research. Chapter 4 presents the findings based on: objective, technology platform, technology application, current status, team composition and area & beneficiaries of the each identified mHealth projects are presented first, challenges, lessons learnt and scalability and sustainability issues of mHealth projects. Chapter 5 is dedicated to concluding remarks as well as recommendation for future work.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1. INTRODUCTION

The healthcare system involves a wide range of actors and activities, linked together in a complex web of relationships between each other and with the technologies they use in order to produce the complex product/service we call healthcare.

Sauerborn and Lippeveld (2000) stated that, there is a need by the health sector of developing countries to use the limited resource effectively in order to provide an efficient and equitable health service to the communities. This then requires sound management that is based on information, which is crucial at each level of the health service management. Availability of reliable, relevant, comprehensive and timely health information is widely recognized and recounted as an essential foundation for any public health interventions. As health systems around the world are being re-structured, the demand for sound information and the skills to manage and use information are increasing considerably. The health information systems are expected to provide health workers and health managers with a systematic tool for decision making.

However, challenges facing healthcare organizations vary widely around the globe. In the developed world there is sophisticated healthcare infrastructure in place, but it's not ubiquitous, and there is an increasing focuses on rational consumption of both primary and specialty services. A growing population of aging citizens strains existing facilities and resources.

In the developing world, a lack of facilities, equipment, and trained personnel mean that many people do not have convenient access to care providers or medical facilities. This is especially true for those in remote rural areas. Ibekwe and Perpetus (2010) discussed that, on the part of the end users, there is also the problem of availability, accessibility, affordability and sustainability of services. Availability of healthcare facilities is an important problem as there is gross deficiency in the distribution of health facilities. Where the health facility is available, accessibility becomes the problem. This contributes to significant delays in accessing health care. In most countries, roads are inaccessible and transportation system is chaotic. Thus, when a person takes a decision to seek medical attention, it may take days to reach health care facility.

Sometimes, pictures have been painted where patients are brought to the hospital on wheel barrows, bicycles, on donkeys or physically carried on stretchers. When eventually, the person arrives hospital, affordability of the available services becomes the issue.

Recognizing that the majority of the populace lives below poverty line, especially in rural areas, it becomes easy to appreciate why most of our people can not avail themselves of the available healthcare facilities. In these nations, healthcare providers and governments are focused on creating a healthcare infrastructure that will be expand access and improve the quality of care available to citizens. Another major problem within the healthcare system in the developing countries is the weak referral systems from a lower to a higher health facility in the hierarchy. This leads to delays in commencing medical treatment and often leads to preventable deaths.

Generally, the healthcare problems in developing countries result from a combination of factors. There is therefore an urgent need for a concerted effort on the part of individuals, communities, governments and partners interested in the provision of qualitative healthcare in developing nations, towards putting in place workable structures at the healthcare facilities to alleviate these problems.

## 2.2. Health Information System in Ethiopia

According to the report (HSDP IV, 2010), the recently implemented Business Process Reengineering (BPR) of the health sector has introduced a three-tier health care delivery system: level one is a Woreda/District health system comprised of a primary hospital (to cover 60,000-100,000 people), Health Centers (1/15,000-25,000 population) and their satellite Health Posts (1/3,000-5,000 population) connected to each other by a referral system. The primary hospital, Health Centre (HC) and Health Post (HP) form a Primary Health Care Unit (PHCU). Level two is a General Hospital covering a population of 1-1.5 million people; and level three is a Specialized Hospital covering a population of 3.5-5 million people. The devolution of power to regional governments has resulted in largely shifting the decision making for public service delivery from the centre to being under the authority of the regions and down to the district level. Offices at different levels from the FMoH to Regional Health Bureaus (RHBs) and Woreda Health Offices share in decision making processes, powers, duties and responsibilities. The Ministry and the RHBs focus more on policy matters and technical support while Woreda Health Offices manage and coordinate the operation of the district health system under their jurisdiction.

The report on National Health Information System Road Map (2012) describes that, HIS in Ethiopia is run under different authorities. While the routine Health Management Information System (HMIS) is managed primarily by the FMOH, population based information comes predominantly from Central Statistical Authority (CSA).

The FMOH receives service, diseases and administrative reports from RHBs, from agencies, and federal hospitals. Different process owners and hospitals under FMOH and RHBs are expected to submit activity reports regarding achievement of targets stated on the annual core plan of the Ministry. In addition to the report on core plan, RHBs and hospitals are expected to deliver quarterly activity reports. Likewise, the RHBs receive quarterly reports from Woreda and Regional hospitals while Woreda Health Offices (WorHOs) receive service, disease and administrative reports from primary hospital, HC and HP. Routine data collection and aggregation process at all levels of the health system produce summary statistics that can be used during performance monitoring meetings and planning.

## 2.3. Health Care in Ethiopia

Despite major strides to improve the health of the population in the last one and half decades, Ethiopia's population still face a high rate of morbidity and mortality and the health status remains relatively poor. The major health problems of the country are largely preventable communicable diseases and nutritional disorders.

FMOH of Ethiopia has committed to reaching Millennium Development Goals (MDGs) 4, 5 and 6 and has designated maternal and newborn child health (MNCH) and HIV/AIDS as its highest priorities in the Health Sector. For that reason, in this section some of the major problems in Ethiopia and the potential solution (ICT, particularly mobile phones) of those problems were discussed.

The mortality risk for pregnancies is conventionally divided into direct causes (those that occur only during pregnancy and the immediate post-delivery period) and indirect causes (those derived from conditions that precede, between are aggravated by pregnancy, such as anemia, diabetes, malaria, tuberculosis, cardiac disease, hepatitis, and, increasingly, AIDS). Direct causes are attributed to approximately 75% to 80% of maternal mortality. Such causes include (in order) hemorrhage, sepsis, hypertensive disorders of pregnancy, complications of unsafe abortion, and obstructed and/or prolonged labor.

Some ways to reduce maternal deaths include reducing pregnancies, reducing high-risk pregnancies, and improving access to and quality of obstetric care. The adequacy of obstetric care is based on several items, including: the treatment of sepsis, shock, anemia, hypertensive disorders; providing uterotonic (induction, prevention and treatment of post partum hemorrhage); manual procedures, including vacuum extraction; monitoring of labor; provision of safe abortion services; blood transfusions; and others such as anesthesia, surgery. Misoprostol has been suggested for active management of postpartum hemorrhage because of its strong uterotonic effects, ease of administration, low costs, and room temperature storage. However, according to Menken and Rahman (2006), the emphasis on reducing maternal morbidity and mortality has been on "decreasing the total number of pregnancies per woman" as well as targeted interventions to ensure early detection of risk factors during pregnancy. The risk differentiation for the maternal delivery process is distinguished by number of pregnancies for each woman.

According to Darmstadt et al. (2005), each year, approximately four million babies out of 130 million born die in neonatal period of the first 28 days (4 weeks) of life, and 70% of these deaths could be prevented if proven interventions were implemented effectively with high coverage where they are needed most. More than 90% of child deaths are due to pneumonia, diarrhea, malaria, neonatal problems, malnutrition and HIV/AIDS, and often a combination of these conditions. Lawn et al. (2005) also further stated that, the proportion of child deaths that occurs in the newborn (or neonatal) period is increasing, and the MDGs for child survival – to reduce the under-five mortality rate by two thirds between 1990 and 2015 – cannot be met without substantial reductions in neonatal mortality.

Ethiopia is one of the hardest hit sub-Saharan African countries by the HIV pandemic. According to statistics from the FMoH, the overall prevalence of HIV in the population is 4.4%. The highest prevalence rate is found in the 15-49 age groups and particularly in urban settings, where the prevalence is as high as 12.6%, as opposed to rural settings where prevalence is approximately 2.6% and rising. These rates indicate that approximately 1.5 million people are infected and living with HIV in Ethiopia in a population of 69 million. 54.5% of all people living with HIV are women and 96,000 are children under the age of fifteen.

There are complex array of factors that help explain and contribute further to the proliferation of the pandemic. HIV in Ethiopia is predominantly spread through unprotected heterosexual

intercourse, which accounts for approximately 88% of all HIV infections. Mother, or parent, to child transmission (MTCT) accounts for 8-10%, and 2-5% of HIV infections can be attributed to blood and blood-contaminated products (including un-sterilized needles). Behavioral factors such as, multiple sexual partnering, socio cultural attitudes about sex, alcohol & substance abuse (especially the use of Chat), and the lack of awareness about HIV and high levels of untreated Sexually Transmitted Diseases (STDs), all help drive the epidemic. HIV can be both a cause and a symptom of poverty. Given the high rates of unemployment and poverty at the household level, increasing numbers of women turn to selling sex for survival. Ethiopia has also been affected by significant social disruptions such as wars (troop movements), further fueling the epidemic.

Recently, the applications of ICT to health care delivery have raised hopes. ICT particularly mobile phones have a great impact in reducing the above discussed major problems burden in Ethiopia.

ICT application in healthcare is described broadly as eHealth, which includes telemedicine, electronic medical records, and health information systems with decision support, mHealth and eLearning tools. Pagliari (2005) states that, the term 'eHealth' is sometimes used to describe activities in health or medical informatics, telemedicine, mHealth, tele-monitoring, tele-care and citizen health information, and has proliferated in international health policy, management and research. As said by Viziteu (2008), eHealth integrates actions and technologies across practices of biomedicine, medical engineering, bioinformatics and biotechnology. It provides, alongside genetics, antibiotics and vaccines, an exciting tool for providing innovative medical care in the 21st century. According to Marker, et al. (2002), eHealth has shown potential in facilitating a better health care delivery system, leading to better health and universal health coverage.

## 2.4. Common eHealth Applications

Adesina et al. (2012) stated that, there are three applications prevalent in various global, regional and national policies and programmes –telemedicine, EHR and mHealth – provide an insight into e-Health.

A. **Telemedicine**

Telemedicine is a subset of e-Health that uses communication networks to deliver health care and medical education between different locations (Sood et al. 2007). It is a redistributive

technology that can help to overcome shortages and lopsided geographical distributions of health professionals and other resources. It is sometimes used synonymously with telehealth and tele-monitoring (where telhealth is used by parahealth professionals) (Grigsby, 2002). According to an early definition (Bashshur 1995), it is an integrated system of health-care delivery that employs telecommunication and computer technology as a substitute for face-to-face contact between provider and client. This stresses technology during a clinical encounter between a patient and a health-care professional to improve access and quality as well as reduce costs for patients and health-care systems.

B. **Electronic health records (HERs)**

A simple set of EHR ranges are:

- Within a health-care provider organization, such as a General Practitioners (GPs) practice or hospital, or across several organizations, such as several GPs practices and hospitals
- Complete or partial clinical information
- Detailed or summarized clinical information on each patient
- Virtual EHRs that draw data from other information when it is needed, or EHR databases that hold patient information and are fixed
- Authorized users such as just doctors or doctors and other clinical professions

Common features are reliance on clinical information systems, health informatics, interoperability, standards, information and enterprise architecture, functionalities and citizen or patient indices.

Few EHR systems are comprehensive or complete. Many are in the course of development and implementation, with not all the clinical information systems in place, resulting in a continuing, long-term development programme. Where EHRs are substantial, they have extensive benefits that stem from the sharing of current, accurate and relevant clinical information between doctors and other health-care professionals. They empower health-care professionals, save time and benefit patients.

C. **M-Health**

In recent report the Vital Wave Consulting (2012) describes that, in many developing countries, much of the population, especially in rural areas, does not have access to health care due to resource constraints, system inefficiencies and a lack of awareness about services offered. The inadequate presence of health facilities and providers in many communities has been compounded by a lack of access to modern communication technologies. Yet a number of developments have changed this situation. Increased efforts by governments to strengthen health systems are bringing access to care closer to people in need. And the expansion of mobile communications is providing a way to accelerate this system by strengthening and bridging gaps between healthcare access and rural populations that still exist. At the confluence of these trends lies mHealth.

Cipresso, et al. (2012) also defines mHealth as, a term used for the practice of medicine and public health, supported by mobile devices. The term is most commonly used in reference to using mobile communication devices, such as mobile phones, tablet computers and PDAs, for health services and information, but also to affect emotional states. The Germanakos, et al. (2005) report states that, mHealth applications include the use of mobile devices in collecting community and clinical health data, delivery of healthcare information to practitioners, researchers, and patients, real-time monitoring of patient vital signs, and direct provision of care (via mobile telemedicine).

According to WHO (2008), the motivation behind the development of the mHealth field arises from two factors. The first factor concerns the numerous constraints felt by healthcare systems of developing nations. These constraints include high population growth, a high burden of disease prevalence, low health care workforce, large numbers of rural inhabitants, and limited financial resources to support healthcare infrastructure and health information systems. The second factor is the recent rapid rise in mobile phone penetration in developing countries to large segments of the healthcare workforce, as well as the population of a country as a whole.

According to the Global Observatory for eHealth at the WHO, a multitude of mHealth solutions have emerged over the years in countries such as Ethiopia, Kenya, Nigeria and South Africa, which are leading the way in using mobile health services. Getachew Sahlu of WHO identified the convergence of the following factors as the driving force behind the current rapid mHealth

growth in developing countries: (1) a record growth of mobile phone users, (2) rapid expansion of mobile networks, (3) the decline in mobile phone costs, and (4) the innovation in mobile technology. MHealth initiatives have also been effective in reaching underserved populations, particularly those in rural areas, changing health behaviors and outcomes, and addressing a wide variety of healthcare challenges, including:

- The shortage of skilled healthcare workers in certain developing country settings
- Treatment adherence and compliance
- Lack of timely and actionable disease surveillance
- Poor drug inventory and supply chain management
- Use of counterfeit drugs
- Slow rates of information flow and reporting delays.

In accordance with Simon Davies (2008), with greater access to mobile phones to all segments of a country, including rural areas, the potential of lowering information and transaction costs in order to deliver healthcare improves. Pagliari (2005) also further stated that, the important role of mobile phones, smart phones, handheld computers and wireless networks for accessing e-Health applications is well recognized. Rapid technological advances in mobile phone hardware and software as well as wireless and mobile network functions and capability have made m-Health an essential component of e-Health services in developing countries. An example of the potential of m-Health is the impact of emerging hardware and software built on increasingly advanced smart phones.

The invention of mobile phones has significantly chanted communication. Many large scale studies have documented the potential application of mobile phones for different health interventions. In a recent study by (Zurovac, 2011), text massage reminders were found to be effective in Kenya in improving had significantly improved ART adherence and viral suppression compared with individuals in the control group. A study form Uganda (Kunutsor, 2010) documented short text massage reminders for People Living with HIV (PLHIV) increased clinic attendance after missed attendance after missed appointments.

Yen M. et al. (2009) stated that, studies have documented the application of mobile text massages as a tool for public Health surveillance. For example in Darfur (Deribe K., 2011), mobile phones were found to be effective means of communication for public health surveillance and the provision of health information on pre-specified illnesses where access to the paper and pen-based reporting system was blocked due to the prevalent political instability. In China during the Sichuan province earthquake (Yang C. et al. 2009) mobile phones were used as an infectious disease surveillance tool which revived the surveillance system within a week. In Kenya (Shah A., 2007) mobile phones were used for surveillance of avian flu. Mobile phones were used in Uganda (Sasaki D. & Gebru B., 2008) to collect health information and send it to a centralized server. This approach was found to be more cost-effective than the traditional paper based reporting.

## 2.5. The Role of Mobile Phones in Healthcare

ICT, particularly mobile phone is revolutionizing our life, our ways to interact with each other, and day-to-day life and work. Its use is wide now and plays an important role in the delivery of better and efficient healthcare services. It is part of healthcare structure in any organizations to support the processes and consequently to deliver better outcome to organization and particularly to the patient. The report of Public Relations (2011) states that, ICT provide opportunities for individuals, medical professionals and healthcare providers to: obtain information; communicate with professionals; deliver first-line support especially where distance is a critical factor and promote preventive medicine programmes. Its role is one of providing support to the human resources generation function by facilitating initial training and continuing education processes in some form: improving access, increasing effectiveness, lowering costs, etc.

According to Vital Wave Consulting (2012), the use of ICT could help African countries overcome the remaining challenges to achieve MDGs 4, 5 and 6, and improve their health systems. Rather than depriving other areas of the health system of resources, investment in ICT serves to amplify the impact of those resources by improving accuracy, extending services to underserved areas, and cutting waste and redundancy.

Mobile phones can be used to reduce under-five child mortality (MDG 4) by improving supply chain management to increase access and streamline the deployment of antibiotics, oral rehydration, vaccinations and mosquito nets. Also, mobile, Short Message Service (SMS),

Interactive Voice Response (IVR) and video technologies can make it possible to administer short-term and mid-term training regimens for HEWs. These same technologies can be used to identify and resolve health issues, including epidemics, more proactively. Databases, as part of modular and national HIS allow cross-analysis of patient information (e.g., child weight loss) to drive evidence-based decision-making at the individual, group, community and national levels.

Vital Wave Consulting (2009) also states that, mobile phones can be used to improve maternal health (MDG 5) by making it possible to increase pre-natal consultation with professional healthcare workers and deliveries attended by skilled birth attendants. SMS can be used to send out advice about contraception and family planning - as is the case with Text to Change in Uganda. Mobile-based training and monitoring (MoTeCH in Ghana and RAFT in Senegal) will prove more valuable as GSM and CDMA networks and subscription penetrate rural areas, and even more so when mobile broadband services become a part of the national communication service offering. At that point, HEWs will have access to nurses and doctors via mobile phones, text message or video chat when problems arise. In Uganda, for instance, the Ugandan Health Information Network experienced a 25% cost savings in the first 6 months as a result of the ability to use mobile phones to inform patients where to access skilled healthcare workers.

Mobile phones can also be used to combat HIV/AIDS, malaria and other diseases (MDG 6) by making educational materials about prevention more readily available, faster and more frequent. This is happening with HIV Confidant in South Africa. SMS being used to manage supply chains, train workers and track epidemic outbreaks (e.g., FrontlineSMS: Medic30 and Ushahidi31 in Malawi and Kenya, respectively).

## 2.6. M-Health Applications in Ethiopia

Despite of the coverage and energy constraints, HEWs are already using their mobile phones to facilitate their work. They use mobile devices to communicate with supervisors, health centers, kebele heads and other HEWs and to discuss emergency situations and protocols. In cases of emergency (delivery), they are contacted on their mobile phones, and when vaccines are running in short supply, they sometimes call health centers for replenishment. Yet mobile communication protocols and procedures are ad-hoc and the effectiveness of mobile phones is not being fully realized.

Mobile phones appear particularly well-suited to HIV/AIDS work in education, prevention, treatment, care, and support applications, and can potentially be used to overcome some of the traditional barriers to accessing essential information and services, such as geographic isolation, gender, and social stigma (Iluyemi 2009; Kahn et al. 2010; McKee et al. 2004; Mechael 2009). In addition to the more obvious role communication has to play in education and prevention initiatives, communication interventions remain essential throughout the entire continuum of outreach, testing, treatment, care, and support (Bharath Kumar et al. 2009). Particularly in the Ethiopian context, communication is essential to combat widespread stigma and misinformation, to facilitate the frequent reliance on non-professional medical personnel for treatment and support, and to provide Information, Education and Communication (IEC) outreach critically needed for preventing infection, encouraging testing, and facilitating access to. The use of mobile phones holds significant promise and potential for two interrelated critical aspects of HIV/AIDS intervention: (1) facilitating outreach, prevention, and awareness programs; and (2) improving access to treatment, care, and support services. While treatment efforts are still critically dependent on acutely lacking health infrastructure, human capacity, and material resources such as ARV drugs, the use of mobile phones can be approached as a way to stretch limited resources and improve effectiveness and efficiency of treatment and care.

Realizing the potential of mobile devices to improve healthcare system resulted in many initiatives are running in mobile health.

### 2.6.1. M-Health Initiatives

In recent years, the expansion of mHealth technologies, including health text messaging, mobile phone applications, remote monitoring and portable sensors, have changed the way healthcare is being delivered in globally.

A recent study by the GSMA looking at global mHealth services reviewed almost 700 initiatives, ranging from wellness and prevention to those targeting various elements of health systems. Fifty per cent of the mHealth services reviewed have been launched across Africa. The study found that despite the proliferation of mHealth services in emerging markets, most remain limited in scale.

There are many mHealth initiatives in Africa, some of are:

- D-Tree International offers **Tanzanian** (among other) health professionals easy-to-use mobile phones enabling them to screen, examine, counsel and treatment of patients, as well as offer safe and affordable meningitis vaccine through their CommCare project.
- In **Tanzania**, a team of trained but non-physician health professional, equipped with cervical screening and treatment tools, use Smartphone to screen for cancer.
- In **Uganda**, a pilot project launched in October of 2010 in which community health workers use eMOCHA to provide HIV awareness and prevention information with rural residents.
- MAMA (Mobile Alliance for Maternal Action) works with low-income and at-risk **South African** mothers and families to provide vital health information through SMS text messaging and simple voice messages.
- **Botswana**: Kgonafalo allows for remote diagnosis of health ailments. A pilot project served 6 areas but is ready to expand to 25. Handsets have been replaced with Android tablets.
- **Senegal**: RapidSMS saves costs by using SMS aggregation to send text messages to multiple recipients for a single cost. RapidSMS is used in many other African countries as well.
- Cell-Life (**South Africa)**: This is a multiplatform system for the therapeutic and logistics management of HIV/AIDS population which was started by 2 universities in SA in 2003. It is a mobile health solution that was built on mobile devices (Cellphones & PDAs) with 3G/GPRS/SMS networks. It is set to enable community health volunteers to assist their fellows HIV + management. And also enables organisational planning for drug supply and emergency situations
- **Rwanda** uses TRACnet to collect, store, retrieve, and disseminate critical program, drug, and patient information related to AIDS patients through mobile phones.
- The Wired Mothers pilot project aimed to examine the beneficial impact of use of mobile phones for health care on maternal and neonatal morbidity in **Zanzibar**.

- The WelTel trial in **Kenya** involved sending weekly messages to patients asking whether they were well or whether they were experiencing problems with their treatment.
- Mobile Midwife project in northeast **Ghana** aims to improve antenatal and neonatal care among the rural poor and to empower women to take control over their own health.

## 3.1. Related Works

The study by Galliher et al. at the American Academy of Family National Research Network found significantly lower errors of omission and missing data items when comparing the use of handheld computers in Data collection versus traditional paper and pen methods. Their results showed 3 versus 35% errors of omission in handheld computer compared to paper-and-pen, and 0.04 versus 3.5% missing data items for handheld computer compared to paper-and-pen. Heiberg et al. found both methods to perform similarly, but 82.9% preferred using a PDA. Tegang et al. in a study in Western Kenya found reduced time preparing data for analysis, from six weeks to seven days. Buck, Rochon, and Turley, Escandon et al., Safaei et al. anecdotally reported faster data collection with PDAs and mobile phones in addition to positive feedback from interviewers. A preliminary study and randomized control trial collecting tuberculosis bacteriology data on Peru for partners in health found a decrease in errors of 57.1%, in addition to work hours reduced by 70%. These results are relatively high in comparison to other studies, and may be linked to the nature of laboratory data.

The research entitled "Scaling up Mobile Health: Elements Necessary for the Successful Scale up of mHealth in Developing Countries" conducted by Jeannine Lemaire (2011). The case study research aimed at to identify elements necessary for successfully scaling up, with the aim of highlighting best practices and specific programmatic, operational, policy and global strategy recommendations that can promote scale up of mHealth.

Lemaire was selected several mHealth programs that have been piloted and are currently in the scale up phase, and have proven enough success that they should be considered as models for other initiatives to follow. They are: CHILDCOUNT+ **(**Kenya, Tanzania, and Ghana), mPEDIGREE (Nigeria, Ghana, and Kenya), mTRAC (Uganda), PESINET (Mali), PROJECT MWANA (Zambia, Malawi), SMS FOR HEALTH (Uganda), SMS FOR LIFE (Tanzania, Kenya, and Ghana), TELE SALUD (Guatemala) and TXT ALERT (South Africa).

Lemaire recommended that, For implementers, the elements necessary for the successful scale up of mHealth involve building sustainability and scale into the project from the beginning, ensuring the solution is locally appropriate, securing buy-in from key stakeholders, creating strategic partnerships, ensuring alignment with local and national health priorities and integrating into local healthcare structures.

For governments to create an enabling environment for scale up, mHealth must be mainstreamed into existing healthcare structures, agencies, and national health authorities' policy and priorities frameworks.

Finally, Lemaire concluded that the landscape of mHealth is inundated with pilot projects that often are not sustainable beyond the pilot phase and fail to scale up. For this landscape to change to support long-term, sustainable implementations of mHealth, the support of a variety of actors is required including governments, donors, project designers and implementers, institutional players and the private sector.

Atanu Garai (2012) identified seven factors that will affect the success of mHealth projects based on strategic lessons on the report entitled "Seven factors for designing successful mHealth projects". Those factors are:

i. mHealth is not mass media
ii. Deliver multiple services through mHealth
iii. Evolve business models for curative and preventive health
iv. Consider mobile data collection as the means to an end
v. Partial automation deters mHealth adoption in health system
vi. mHealth is integrative
vii. mHealth is multidisciplinary

Nilmini & Steve (2005) have developed a Framework for Delivering M-health Excellence to answer a question how to achieve excellence in m-health? Figure 1 provides an integrative model for all key factors that they have identified through their research that are necessary in order to achieve m-health excellence.

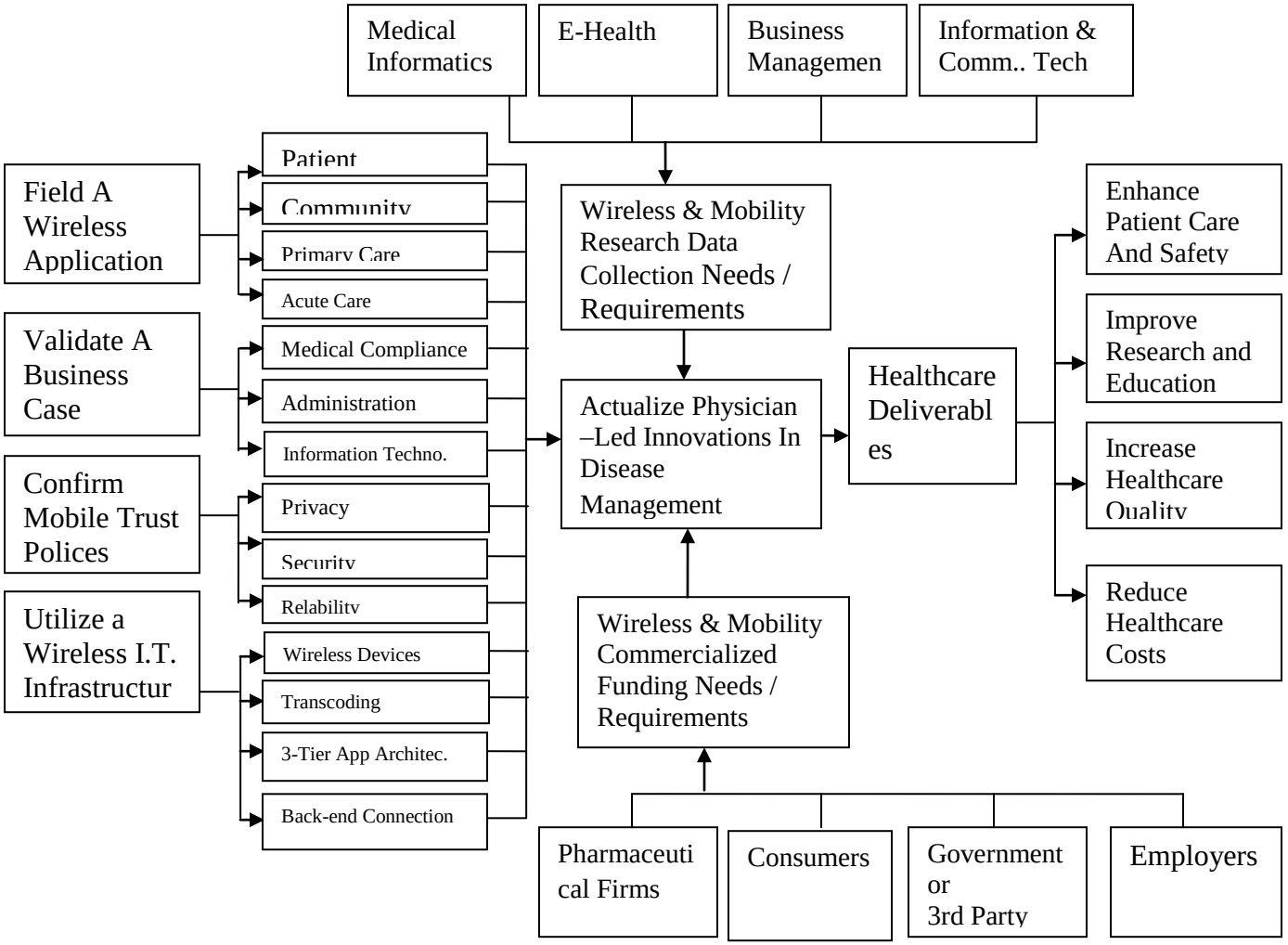


Figure 1 *A Mobile e-Health Project Delivery Model*

Nilmini & Steve concluded that the most critical key success factor is the web of healthcare players. Any m-health project must consider the impact and role on each of these players, the interactions of such an initiative both within one group of the web of players as well as between groups of players. It is critical to the ultimate success of these projects and the ability to realize the healthcare deliverables that they are indeed physician led. Figure 2 depicts the web of players that must be considered for healthcare in general and m-health in particular.

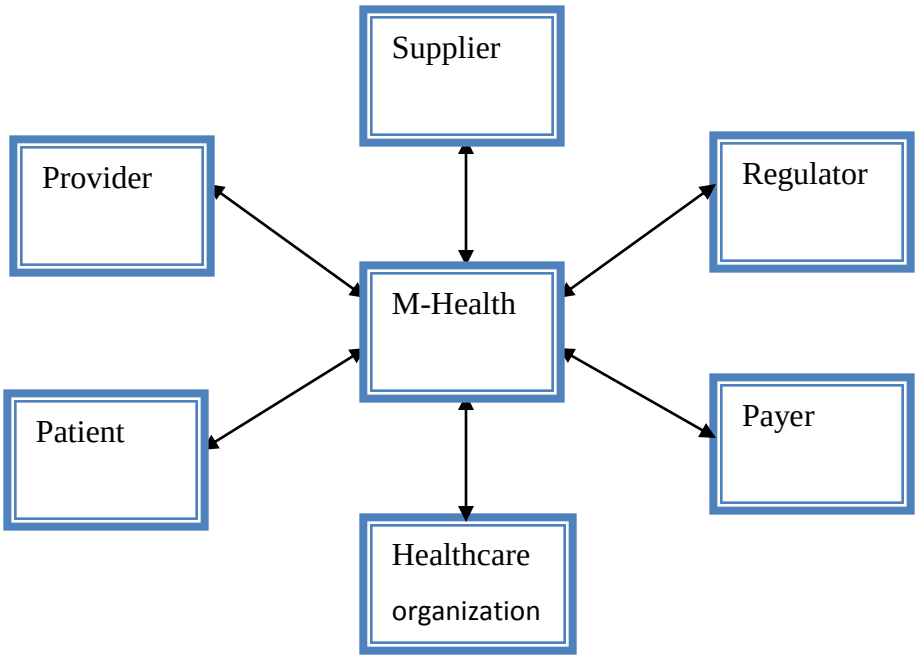


Figure 2 *Web of healthcare players – adapted from (Wickramasinghe et al., 2004)*

The recent report by Vital Wave Consulting (2011) on mHealth in Ethiopia- Strategies for a New Framework suggested that there are several main components in an mHealth framework that will move Ethiopia toward scalable, sustainable mHealth interventions that make an impact on health outcomes. Such as: a multi-phase approach, a structure that matches HEW needs with appropriate interventions and a digital ecosystem framework to ensure mHealth integration into the Ethiopian health system. And they identified that collaboration with local institutions and government and specific program to the targeted population (HEW) are important things to ensure both long-term sustainability and scalability of mHealth projects.

# CHAPTER THREE

# METHODS

In this section, the methods used to address the research questions related to exploring mHealth existing initiatives and practices in healthcare systems were discussed.

## 3.1. Study Period and Area

The study was conducted from November 2012 to June 2013 in Ethiopia and focused on mHealth initiatives. Ethiopia is a Federal Democratic Republic having 11 regions with nine national regional states and two city administration and further divided in to 805 districts. Ethiopia is the second largest county among sub-Saharan Africa. There are number of mHealth initiatives in different regions of Ethiopia. Therefore, the study area for this study is scoped in Ethiopia.

## 3.2. Research Design

The exploratory study design that employed qualitative research approach was conducted in mobile health initiatives that are carried out in Ethiopia.

## 3.3. Source and Sample Population

The source population includes all individuals and organizations that are involved in mobile health initiatives in Ethiopian healthcare system. The sample populations are derived from all mobile health initiatives which are currently pursued. The study participants (focal person) were selected using purposive sampling technique.

## 3.4. Data Collection Instruments

The data were collected using in-depth interviews, questionnaire and document review as discussed in the subsequence section.

### i. Questionnaire

The closed-ended questionnaire was used in this study to explore the profile of the mHealth projects (Annex 1). The multiple choices for the questions are derived based on other African

mHealth projects. The questionnaire was employed on seven mHealth projects (ongoing projects). The research questionnaire was adopted with little modification from J. Cullen, C. Cullen and E. Hamilton.

### ii. In-depth Interview

The interview guides were prepared prior to going to the respondents' answer to find out the challenges, lessons learned and scalability and sustainability issues of their projects. There were also large informal talks to get clarity of issues that were not clear to the researcher. Face-to-face interview were conducted on 7 mobile health projects. From each projects two focal persons were interviewed. In total 14 Interviews were conducted; 12 face to face and 2 over the phone. Most of the interview questions were unstructured and open-ended. The interview questions used for this study are included in Annex 2.

### iii. Document Review

The document review data collection method was employed to get the data for ended mHealth project, since there was no focal person to contact. The data were found in the Internet using Google search engine.

## 3.5. Data Collection Procedures

Face-to-face interviews were conducted in the participant's work area by making an appointment. The interview was conducted with focal person of each mHealth projects during March to April 2013. The researcher asked a series of unstructured, open-ended questions. Detailed notes of the participant's responses were taken by the researcher during the interviews. The questions on the interview were intended to elicit the participant's thoughts on their mHealth projects of challenges, lessons learnt and success factors.

## 3.6. Data Analysis

Interpretation of the data first involved classifying the responses into themes. These themes, generated from the data itself, were determined after data collection had occurred in order to enable the researcher to establish preliminary patterns. After the themes were formed and the

information was placed appropriately, the data were sorted accordingly. The data were analyzed by using content analysis of individual responses to produce qualitative data.

The findings were presented thematically based on identified mHealth projects in Ethiopia; objective, technology platform, application software, current status, and team composition of each projects. The challenges and lessons learnt are also discussed, and the scalable and sustainable factors for mHealth projects are suggested in the recommendation section.

# CHAPTER FOUR

# RESULTS AND DISCUSSION

In this chapter, the results and discussions are presented in a manner that will address the research questions established at the beginning. To render a meaningful flow, the order of presentation followed in the preceding chapters has been maintained. Accordingly, the results and discussions on the identified mHealth projects in Ethiopia based on their objective, platform, technology application, current status, team composition and area & beneficiaries are presented first. In the second, third and fourth section; challenges, lessons learnt and scalability and sustainability issues of mHealth projects are presented respectively.

## 4.1. M-Health Initiatives in Ethiopia

The following table summarizes the profiles of the mHealth projects identified for this study.

| No | Project Name | Established Date | Partners | Funders | Geographic Coverage |
|---|---|---|---|---|---|
| **1** | Wegen AIDS Talkline | September 2004 | ARC, JHU/CCP, HAPCO | PEPFAR | Addis Ababa (accessible to all regions) |
| **2** | Fitun Warmline | May 2008 | ARC, JHU/CCP, HAPCO | PEPFAR | Addis Ababa (accessible to all regions) |
| **3** | SMS for Lab Result | 2009 | CHAI, HP and EHNR | CHAI, HP and EHNR | SNNPR, Addis Ababa, Oromia, Tigray, Harar, and Amhara |
| **4** | Mobile Phones for MNCH | September 2011 | CHAI, AAU, and RHBs | CHAI, and RHBs | Tigray and Oromia |
| **5** | SNNPR Mobile Phone-Based Data Exchange | 2010 | World Bank & AAU | World Bank | SNNPR |
| **6** | EpiSurveyor | July 2010 | JSIRTII, L10K, RHBs, UNICEF and USAID | BMGF, UNICEF and USAID | Amhara, Tigray, Oromia and SNNPR |
| **7** | Tigray MNCH Mobile Health | June 2011 | MU, Maastricht University, Universidad de Alcala & RHB | AECID (Spanish) Technical Cooperation | Tigray |
| **8** | RapidSMS | October, 2008 | UNICEF, Dimagi, & MVP | UNICEF | SNNPR |

Table 1: mHealth initiatives in Ethiopia

### 4.1.1. Objective of the mHealth Projects

As presented in table 1 eight mHealth projects are identified. Those projects are presented below based on their objective.

#### I. Wegen AIDS Talkline

The objective of the Wegen AIDS Talkline project is to empower Ethiopians to know their HIV status and help those HIV negative maintain their status; and support PLWHIV and their families adopt a healthy life style. This project serves the community with up-to-date information, counseling and referral service on HIV/AIDS, STI and TB. The Talkline provides anonymous, confidential and nonjudgmental service allowing callers to speak about sensitive and private issues without embarrassment.

#### II. Fitun Warmline

Fitun's main objective is to provide rapid, evidence-based responses to questions from health care professionals about HIV/AIDS and related health topics. This project provides an information service in order to contribute to the quality of comprehensive HIV/AIDS prevention, care and support services in Ethiopia.

#### III. SMS for Lab Result

The introduction of dried-blood-spot (DBS) collection as a testing procedure has allowed a vast decentralization in the collection of samples for early infant diagnosis (EID) testing, since DBS samples are more stable than liquid blood and can be transported in batches. The problem is that many infants' caretakers are not receiving test results in a timely fashion. The main objective of this project is reduce long turnaround time (TAT) of laboratory results for referred DBS samples, to care for HIV-exposed and HIV-infected infants using SMS-driven printer.

#### IV. Mobile phones for MNCH

This project is one of the interventions that is being piloted through CHAI Ethiopia's MNH program. The aim of this project is to increase access to and uptake of skilled delivery in primary health care units in Ethiopia via improved tracking and referral.

## V. SNNPR Mobile Phone-Based Data Exchange System

The "SNNPR mobile phone-based data exchange system", is a research project, aimed at rigorously testing the impact of using mobile phones on the health outcomes of rural mothers and children in rural areas. And the key question they are investigating is: Does the use of a mobile phone-based tool for patient registration, appointment reminders, and inventory management in the hands of community health workers result in improved maternal and child health outcomes in a rural Ethiopian setting? The case study looks at testing the efficacy of using mobile phones in health care in Ethiopia.

The researchers randomly selected three Ethiopian districts (Ezha, Abshege and Sodo) and applied the tool in three ways:

- **Treatment 1**: All Health Extension Workers (HEW) received mobile phones equipped to perform the three use cases (improving antenatal care/delivery, vaccination coverage, and emergency referrals).
- **Treatment 2**: All HEWs and two Volunteer Community Health Workers (VCHW) within each district received mobile phones; HEW phones are software-equipped for the three use cases, while VCHWs received dumb phones intended to make missed calls only.
- **Control**: No mobile phones distributed.

## VI. EpiSurveyor

The objective of this project is to improve maternal, newborn, and child health to enhance its Management Information System (MIS) by adapting EpiSurveyor, a web-based mHealth platform developed by DataDyne.

## VII. Tigray MNCH Mobile Health

This project is part of a PhD research program, aimed at researching ways in which mobile technologies can help to improve maternal and child health care in rural areas of Ethiopia.

### VIII. RapidSMS

Ethiopia experienced crippling droughts. Faced with the possibility of famine, UNICEF (United Nation Children's Fund) Ethiopia launched a massive food distribution program to supply the high-protein food Plumpy'nut to under-nourished children at more than 1,800 feeding centers in the country. Given the size of the operation, one of the key challenges was monitoring distribution which required innovative methods. To deal with this, the country office piloted RapidSMS. The objective of the RapidSMS food distribution program was to enable the collection of data on stock balance, new admissions, location of distribution centers, and the quantity of Plumpy'nut received and consumed in pilot districts using RapidSMS.

Table 2 presents a summary of the objective of each mHealth initiatives.

| No | Project Name | Objective |
|---|---|---|
| **1** | Fitun Warmline | Provide rapid, evidence-based responses to questions from health care professionals about HIV/AIDS and related health topics. |
| **2** | Wegen AIDS Talkline | Empower Ethiopians to know their HIV status and help those HIV negative maintain their status; and support PLWHIV and their families adopt a healthy life style. |
| **3** | Mobile Phones for MNCH | Increase access to and uptake of skilled delivery in primary health care units in Ethiopia via improved tracking and referral. |
| **4** | SNNPR Mobile Phones-Based Data Exchange | Rigorously test the impact of using mobile phones on the health outcomes of rural mothers and children in rural areas. |
| **5** | SMS Printers for Lab Results | Reduce long turnaround time (TAT) of laboratory results for referred DBS samples, to care for HIV-exposed and HIV-infected infants using SMS-driven printer. |
| **6** | RapidSMS | Enable the collection of data on stock balance, new admissions, location of distribution centers, and the quantity of Plumpy'nut received and consumed in pilot districts using RapidSMS. |
| **7** | EpiSurveyor | Improve maternal, newborn, and child health to enhance its Management Information System (MIS). |
| **8** | Tigray MNCH Mobile Health | Researching ways in which mobile technologies can help to improve maternal and child health care in rural areas of Ethiopia. |

Table 2: Objective of mHealth initiatives

### 4.1.2. Technology Platform

Mobile health projects use different technology platforms. Many (six) mHealth projects in Ethiopia are using SMS- and Web-based platform. Two projects are used a toll-free hotline (call) platform technology. Those technology platforms which are used in each mHealth projects are described below.

- **Mobile Phones for MNCH** the software is named as ENAT messenger developed by AAU, is an SMS- and Web-based system that sends reminders to HEWs twice: one month before delivery and one week before delivery based on the data recorded on the system to visit the pregnant women and give her information on the importance of delivering at health center. The system allowed the HEWs sends a confirmation message to the system after visiting the mother. When an emergency occurs (labor or pregnancy related conditions): the HEWs sends a message to the system and the system sends an SMS to the mobile at the health center (midwife) which allows the midwife at the health centers to make necessary preparations. And also the system can generate quarter reports and send to central system.
- The **SMS Printers for Lab Result** project is an SMS-driven printer that connects referral laboratories to community clinics via GSM mobile networks and a simple database application. After sending the sample that is collected by DBS to the reference laboratory, the test results are stored in the central database and then the server automatically sends the test results to the SMS printers.
- **EpiSurveyor** is a web-based mHealth platform developed by DataDyne. It allows users to develop questionnaires on its web-site which are then installed to a cell phone that can access the internet. The cell phone is used to collect data, offline, using the installed questionnaire; capturing information from remote areas where there is no mobile network. Whenever a mobile network is detected, the data collector is able to transmit the data from the phone to a remote EpiSurveyor server. The EpiSurveyor platform includes a data analysis tool that allows end users to analyze the data uploaded on the server.
- **Tigray MNCH Mobile Health** research project use the OpenDataKit (ODK) tool. This is a free mobile phone- and web based data collection system on pregnant women using General Packet Radio Service (GPRS). The health extension workers have a Smartphone

with installed electronic forms (Registration, ANC, PNC, etc). The data will be sent to a central server, whose algorithm will analyze them and send an alert to the data collector regarding any complications. There is also a feedback mechanism on next week delivery and performances which the Health Extension Workers can use refer to.

- The **RapidSMS** food distribution project is an SMS- and Web-based system that compiles mobile text message data into a real-time correlated report, in selected districts. The RapidSMS system allows for mass-scale monitoring, data collection and information sharing from monitors using mobile telephones in the field. The system can also be used to send out SMS messages to multiple users in the field. Monitors were provided with a dial-in number and six pre-designated codes which they would enter into their phones followed by their monitoring data. Having sent the text data to UNICEF, the data were then automatically correlated by the RapidSMS computer programme into a real time report.
- The **SNNPR Mobile Phone-Based Data Exchange**: A team of researchers from The World Bank and Addis Ababa University developed a mobile tool. It is an SMS- and Web-based system that enables rural community health workers to improve antenatal care and delivery services, improve vaccination coverage, and facilitate emergency referrals.
- **Wegen** is a toll free Talkline both from land line and mobile phones and people from all parts of the country can reach it by dialing 952. The Talkline has 24 dedicated telephone lines which enable to serve 24 callers at a time.
- The **Fitun Warmline** project is a toll-free telephone information service devoted to answering questions from health care professionals about HIV/AIDS care and treatment. Health care professionals with HIV/AIDS care and treatment questions can contact Fitun Warmline by dialing 932 free of charge from any mobile phone or landline.

The technology platforms are summarized in Table 3.

| No | Project Name | Platform |
|---|---|---|
| **1** | Fitun Warmline | Call-based |
| **2** | Wegen AIDS Talkline | Call-based |
| **3** | Mobile Phones for MNCH | SMS- and Web-based |
| **4** | SNNPR Mobile Phones-Based Data Exchange | SMS- and Web-based |
| **5** | SMS Printers for Lab Results | SMS-based |
| **6** | RapidSMS | SMS- and Web-based |
| **7** | EpiSurveyor | Web-based |
| **8** | Tigray MNCH Mobile Health | Mobile phone- and Web-based |

Table 3: Technology platforms

### 4.1.3. Technology Application

The two call-based mHealth projects (Wegen AIDS Talkline and Fitun Warmline) do not use any application. But they used Mysql databases for recording the incoming call and referring to related topics to provide the relevant and updated information for the users. Delphi application is used by SMS Printers for Lab Results project. This application is used to record the lab results and send to the SMS printers. The Enat Messenger software for the project of Mobile Phones for MNCH is developed using Java (spring) application. The software that used by SNNPR Mobile Phones-Based Data Exchange project is also developed by using Java. The Tigray MNCH Mobile Health and EpiSurveyor projects are used Android application for data collection. RapidSMS is a Free Software SMS Applications framework written in Python with Django.

### 4.1.4. Current Status of the Projects

Although almost all mHealth projects are active in operation, some of them projects will end before long. For example, the two research projects such as: Tigray MNCH Mobile Health and SNNPR Mobile Phones-based Data Exchange System will end this year. And the Fitun Warmline project also will end in the coming month. Table 5 gives a summary.

| No | Projects | Status of Projects | |
|---|---|---|---|
| | | Active Projects | Completed Project |
| **1** | Wegen AIDS Talkline | ✔ | |
| **2** | Fitun Warmline | ✔ | |
| **3** | Mobile Phones for MNCH | ✔ | |
| **4** | SMS Printers for Lab Result | ✔ | |
| **5** | SNNPR Mobile Phones-Based Data Exchange | ✔ | |
| **6** | EpiSurveyor | ✔ | |
| **7** | RapidSMS | | ✔ |
| **8** | Tigray MNCH Mobile Health | ✔ | |

Table 5: Current status of mHealth projects

### 4.1.5. Team Composition

Team composition is required for a good performance of mHealth projects. As we can see from the first table different non-governmental, governmental and educational organization are involved in the projects. Addis Ababa University, DataDyne, Dimagi and others are supports the projects by developing software and platforms. Other non-governmental and governmental organizations are involved for financial support. Although regional health bureaus are working with those mHealth projects, they got involved after the implementation of the projects.

### 4.1.6. Area and Beneficiaries of mHealth Projects

Regarding the working area and beneficiaries of each mHealth initiatives are introduce in table 6.

| No | Project Name | Project Area | Targeted Beneficiaries |
|---|---|---|---|
| 1 | Wegen AIDS Talkline | HIV/AIDS, STI and TB | Open to general population |
| 2 | Fitun Warmline | HIV/AIDS | Health workers |
| 3 | Mobile Phones for MNCH | MNCH | Maternal and Children |
| 4 | SMS Printers for Lab Result | HIV/AIDS | Children |
| 5 | SNNPR Mobile Phones-Based Data Exchange System | MNCH | Maternal and Children |
| 6 | EpiSurveyor | MNCH | Maternal and Children |
| 7 | RapidSMS | Nutrition | Children |
| 8 | Tigray MNCH Mobile Health | MNCH | Maternal and Children |

Table 6: Area of mHealth Projects and targeted beneficiaries

## 4.2. Challenges

Even though all mHealth initiatives have different problems based on their projects, the following challenges are summarized for the projects per the responses provided.

- **Network coverage problems:** Health extension workers and health development armies work in very remote areas. Some of these areas have network coverage problems thus making it difficult for the health extension workers to send/receive messages/data using their mobile phones smoothly all the time.
- **Internet connection:** The absence of internet connection is a problem for consistent and timely data transmission.
- **Limited computer knowledge and skill:** The health center staff had little or no computer skill and knowledge, therefore making it difficult for them to use the system more effectively right away.
- **Electric power interruption:** The interruption in some of the places posed affected the functioning of the system.

- **Monthly mobile credit recharge:** Difficult to limit the money provide the HEWs only for using the data transfer and finding a way to recharge the credits on the HEW's phones.
- **Ethical concerns:** Keeping patients records on mobile phone (information of patients on memory) could be a concern.
- **Misuse of mobile apparatus:** There were also incidents where some of the HEWs have lost or damaged their phones and use for personal use.

## 4.3. Lessons Learnt

- The good practices and problematic lessons that are taken from mHealth projects are summarized below.
- Through the mobile scorecard (for tracking patients, risk factors and appointments) the health workers can see a direct benefit to them in organizing their work, rather than simply as a data collection tool for the health bureau/ministry for collecting general statistics.
- Local language use is important to increase their understanding of medical terms and easy communication with clients.
- Flexible system that can be used for a variety of reporting applications, like RapidSMS.
- Use of GPRS (General Packet Radio service) network is reduce the cost of data transfer.
- Got regular feedback from the health workers in the development of the data collection forms, so this has helped them feel they have been directly involved and have a say.
- Consistent mobile phone network capability is important to ensure:

  - Consistent and timely data transmission

  - Timely feedback to data collectors

- Not possible (yet) to build graphs or tables, so each data element must be captured with one question and can result in cumbersome, long questionnaires.
- Estimated time savings in data entry partially offset by time spent on: Preparations, additional training and inventorying electronic records/records management.

- The increased encounters between HEWs and pregnant women (and their families) allowed for greater opportunity to discuss the need for institutional delivery or how to address barriers for institutional delivery such as transportation and others.
- The system platforms should be user-friendly.

## 4.4. Scalability and Sustainability Issues

Based on the results and discussion with the respondents, the following factors are needed for the scalability and sustainability of m-Health projects.

- **Government commitment**

If mHealth project ideas are developed in tandem with a support body from the Ministry of Health there will be a greater likelihood that the project will address already identified needs. The government involvement is essential to support valuable interventions in a sustainable way. Government should focus on initiatives that align with health systems strengthening and have potential for integration within existing systems.

- **Collaboration**

There is significant duplication of efforts among mHealth projects; collaboration between the projects is considered necessary to avoid this duplication of effort and agree on standards that allow interventions to be bundled and integrated. Moreover collaboration creates environments that open communication and sharing of successes and failures.

- **Capacity building of health workers**

The health workers as well as health extension workers and midwives should be well trained on the use of mobile technology and the potential role of mobile technology in healthcare delivery. (Engagement of the health workers in development project is reduced literacy, language barriers and other challenges). In addition, initiatives are being developed without the end-user at the table. Taking more of a human-centered approach to developing mHealth initiatives will be crucial for sustained demand, and can be achieved by finding a balance of working with Ministries of Health in addition to local communities.

- **Financial support**

Financial support from government and private donors is greatly needed for the prolonged mHealth projects, especially to cover telecommunication cost. The cooperation of telecommunication (Ethio telecom) with the mHealth projects is also necessary.

- **Infrastructure**

Increased coverage in rural areas, including faster networks, is critical to realizing the potential of mHealth. Consideration of investment into alternative power sources, such as solar panels and micro-wind turbines, will help overcome the barrier of having charged mobile phones that are reliable in a healthcare setting.

- **Monitoring and Evaluation**

Like no others the EpiSurveyor project has a Monitoring and Evaluation framework to monitor and document learning from its community solutions. M&E is an important tool for pilot projects after implementation, so that the projects can be effective by identifying their weakness and strength. Guidance on how to conduct rigorous evaluation and research on mHealth projects in a consolidated and accessible manner is also needed.

## 4.5. Strength and limitation of the study

The strength of this study is that it includes all mHealth initiatives which are exist in Ethiopia.

This study is limited to get in touch with focal person of mHealth initiatives with the limitation to include health extension workers since they are the main player of the projects.

# CHAPTER FIVE

# CONCLUSION AND RECOMMENDATION

## 5.1. Conclusion

The aim of this research is to explore initiatives regarding mHealth and success factors in healthcare systems. In particular, the study explored the current mHealth initiatives, challenges which are associated with those initiatives, the lessons learnt and the factors that are considered for the scalability and sustainability mHealth projects.

The results indicated that there are seven ongoing and one completed mHealth projects in Ethiopia. Many projects use SMS- and Web-based platforms where as two projects used toll-free call-based platform.

Those mobile health pilot projects have potentially supported the improvement of healthcare services or saved hundreds of Ethiopian lives (especially mothers and children, since many of them work in this area) over the past years. However, there are lots of challenges which are considered to be major obstacles for their achievement. Infrastructure especially fast network coverage, low technological literacy of HEWs and the knowledge regarding the use of the mobile health technology and continuous financial support are takes place the priority.

Project pilot assessment, having M&E framework or success criteria and develop user-friendly system are some of the points could be considered as lessons from some of the mHealth projects.

Generally, we may conclude that mHealth projects have a significant impact in healthcare services delivery if government commitment, collaboration, capacity building of health workers, financial support, infrastructure and M&E are in place.

## 5.2. Recommendations

The following recommendations are made based on the findings:

- For the researcher, to develop a common platform for mobile health initiatives based on their commonness.
- It's better if the researcher could improve this thesis by including health extension workers and community need.
- For mobile health implementers, to involve building scale and sustainability into the projects from the beginning.
- Government need to develop a strategic eHealth framework in which mHealth is an integral component in order to provide mHealth implementers in the NGO and private for profit sectors more guidance.
- Integrating the mHealth programs or systems within the existing healthcare structure. When the developed system is compatible within the existing system, it would be easy to implement.
- For sustainable implementations of mHealth, the support of a variety of actors is required including governments, donors, project designers and implementers, institutional players and the private sector.

# REFERENCES


1. Adesina I., 2007. Mobile/Wireless eHealth for Health System.Workers Development in Africa: Opportunities for eMobility ETP. Mobile Communications and Technology Platform Staying Ahead: Shaping the Futeru of Mobile and Wireless Communications. Rome, Italy.
2. Adesina Iluyemi, Tom Jone and Sylvia Anie, 2012. E-Health in the Commonwealth Making National E-Health Policies and Strategies Work.
3. Atanu Garai, 2012. Seven factors for designing successful mHealth projects.
4. Barry, Bower J., Norrie & Reid, 2005. Designing and implementing E-health applications in the UK's National Health Service. Journal of Health Communications, 733-750.
5. Bashshur R., 1995. 'On the Definition and Evaluation of Telemedicine', Telemedicine Journal, 1(1): 19–30.
6. Bharath Kumar, Uttara Antje, Becker Benton, Chery Lettenmaier, Jessica Fehringer, Jane T. and Bertrand, 2009. Communication and the Antiretroviral Treatment Rollout: Beyond the Medical Model. AIDS Education and Prevention 21, no. 5: 447-459.
7. Buck, Rochon and Turley, 2005. Taking It to the Streets: Recording Medical Outreach Date on Personal Digital Assistants.
8. Bypass, P. & Ambruoso L., 2008. Correspondence: Cellular Telephone Networks in Developing Countries. Aberdeen: University of Aberdeen. Available at: http://www.thelancet.com Accessed on 17/3/2013.
9. Chaudhry B., et al., 2006. "Systematic Review: Impact of Health Information Technology on Quality, Efficiency and Costs of Medical Care", Annals of Internal Medicine, Vol. 144, pp. E-12-E-22.
10. Cipresso P., Serino S., Villani D., Repetto C., Selitti L., Albani G., Mauro A., Gaggioli A., Riva G., 2012. "Is your phone so smart to affect your states? An exploratory study based on psycho physiological measures". Neurocomputing 84: 23–30.
11. Darmstadt G., Bhutta Z., Cousens S., Adam T., Walker N., Bernis L., 2005. Lancet Neonatal Survival Steering Team. Evidence-based, cost-effective interventions: how many newborn babies can we save? Lancet. 2005; 365(9463):977-88.

12. Deribe K., 2011. Mobile Phones Used for Public Health Surveillance in Darfur. Forced Migration Review issue. Available at http://www.fmreview.org/technology/ Accessed on 22/3/2013.
13. Escandon, Searng H., Goldberg R., Duran R., and Arce, 2008. "The Use of PDAs to Collect Baseline Survey Data: Lessons Learned From A Pilot Project in Bolivia."
14. FMoH, 2011. Health and Health Related Indicators, Ethiopia.
15. Galliher, Stewart, Pathak, Werner, Dickinson and Hickner, 2008. "Data Collection Outcomes Comparing Paper Forms with PDA Forms in an Office-Based Patient Survey." Annals of Family Medicine.
16. Germanakos P., Mourlas C., & Samaras G., 2005. "A Mobile Agent Approach for Ubiquitous and Personalized eHealth Information Systems", Proceedings of the Workshop on 'Personalization for e-Health' of the 10th International Conference on User Modeling'
17. Grigsby, 2002. Telehealth: An Assessment of Growth and Distribution. Journal of Rural Health.
18. GSMA, 2010. Women & Mobile: A Global Opportunity. A Study on the Mobile Phone Gender Gap in Low and Middle-Income Countries. London: GSM Association.
19. Health Sector Development Programme, IV 2010/11 – 2014/15, 2010. FINAL DRAFT [version 19 March].
20. Heiberg T., Kvien T., Dale O., Mowinckel P., Aanerud G., Songe-Moller, et al., 2007."Daily Health Status Registration (Patient Diary) in Patients with Rheumatoid Arthritis: A Comparison between Personal Digital Assistant and Paper-Pencil Format." Arthritis Rheum.
21. Ibekwe and Perpetus Chudi, 2010. Healthcare Problems in Developing Countries.
22. Iluyemi Adesina, 2009. Community-Based Health Workers in Developing Countries and the Role of M-Health. In Telehealth in the Developing World, International Development Research Centre; London: Royal Society of Medicine Press.
23. Importance of ICT in Healthcare, 2011. Written by Public Relations
24. Kahn, James G., Joshua S. Yang, and James S. Kahn. 2010. "Mobile" Health Needs and Opportunities in Developing Countries. Health Affairs 29, no. 2: 252-258.

25. Lawn, J., Cousens S. & Zupan, J., 2005. Neonatal Survival 1: 4 million neonatal deaths: When? Where? Why? Available at: http://www.thelancet.com. Accessed on 24/2/2013.
26. Lemaire J., 2011. Scaling Up Mobile Health: Elements Necessary for the Successful Scale Up of Mhealth in Developing Countries. Advanced Development for Africa. Geneva, Switzerland.
27. Marker P, Mcnamara K, Wallace L., 2002. The Significance of Information and Communication Technologies for Reducing Poverty. London, UK: DFID.
28. McKee, Neill, Jane T. Bertrand, and Antje Becker-Benton., 2004. Strategic Communication in the HIV/AIDS Epidemic. New Delhi: Sage Publications.
29. Mechael Patricia, 2009. The Case for MHealth in Developing Countries. MIT Innovations Journal (Winter): 103-118.
30. Menken J. and Rahman M., 2006. Reproductive Health (Chapter 3), section on Maternal Health. International Public Health: Diseases, Programs, Systems and Policies (2nd ed.). Jones and Bartlett, Sudbury, MA).
31. mHealth in Ethiopia 2011: Strategies for a New Framework. Vital Wave Consulting, Bill & Melinda Gates Foundation.
32. Murray C, Frenk J (2000). A framework for Assessing the Performance of Health Systems. Bulletin of the World Health Organization, 79(6):717–732.
33. Nada Chaya, 2007. Poor Access to Health Services: Ways Ethiopia is Overcoming It; volume 2, issue 2.
34. National Health Information System Road Map, 2012: (2012/13 - 2019/20 G.C.).
35. Nilmini Wickramasinghe and Steve Goldberg, 2005: A Framework for Delivering M-health Excellence.
36. Oladosu, Emuoyinbofarhe, et al., 2009. "Framework for a Context-Aware Mobile E-Health Service Discovery Infrastructure for Rural/Suburban Healthcare." Journal of Theoretical and Applied Information Technology (JATIT).
37. Pagliari, Claudia, David Sloan, Peter Gregor, Frank Sullivan, Don Detmer, James P Kahan, Wija Oortwijn, Steve MacGillivray, 2005. "What is eHealth? A Scoping Exercise to Map the Field."
38. Robson C. 1996. Real World Research: A Resource for Social Scientists and Practitioner-Researchers, Blackwell.

39. Safaie A., Mousavi, LaPorte, Goya, and Zahraie, 2006. "Introduction a Model for Communicable Diseases Surveillance: Cell Phone Surveillance (CPS)."
40. Sasaki D. and Gebru B., 2008. Disease surveillance with mobile phones in Uganda. Available from http://mobileactive.org/berhane-gebru-disease-surveillance-mobile-phones-uganda Accessed on 2/4/20113.
41. Sauerborn R., and Lippeveled T., 2000. Design and Implementation of Health Information Systems. Geneva, Switzerland.
42. Scott J. Rundall, et al., 2005, "Kaiser Permanente's Experience of Implementing an Electronic Medical Record: A Qualitative Study".
43. Shah A, 2007. The Future Is Now: Mobile Technology and Public Health. The Yale Journal of Public Health. Available at http://www/cdc/gov/news/2007/03/mobiletechmian.html Accessed on 27/3/20113.
44. Shekelle P. and Goldzweig, 2009. "Costs and Benefits of Health Information Technology: An Updated Systematic Review", the Health Foundation, London.
45. Simon Davies, 2008. Global Mobile Phone Subscribers to Reach 4.5 Billion by 2012, available on http://www.cellular-news.com/story/29824.php Accessed on 17/3/2013.
46. Sood S., Mbarika V., Jugoo S. Dookhy R., Doarn C., Prakash N., et al., 2007. 'What Is Telemedicine? A collection of 104 peer-reviewed perspectives and theoretical underpinnings', Telemedicine and e-Health, 13(5): 573–590.
47. United Nations Development Program (UNDP), 2006. Workshop on E-Governance for Enhanced Service Delivery in the Context of a Capacity Development Framework. Available at: http://www.undpsaci.co.za/documents/aide_memoire_revised_rev_4.pdf Accessed on 5/2/20113.
48. Vital wave Consulting, 2011. Mhealth in Ethiopia. Strategies for a New Framework.
49. Vital Wave Consulting, 2012. eTransform Africa: Sector Assessment and Opportunities for ICT.
50. Vital Wave Consulting, PATH and the Earth Institute, Colombia University, 2012. Ethiopia mHealth Roadmap: Architecture and Design Workshop Report.
51. Vital Wave Consulting. 2009. Mhealth for Development: The Opportunity of Mobile Technology for Healthcare in the Developing World. Washington, D.C. and Berkshire, UK: UN Foundation-Vodafone Foundation Partnership.

52. Viziteu L., 2008. ‘Horizons and perspectives eHealth’, Annals of University of Craiova – Economic Sciences Series, 36(3): 1581–1591.
53. WHO, 2004. Ethiopia: A Country Status Report on Health and Poverty.
54. Yang C., Yang J., Luo X., Gong P., 2009. Use of Mobile Phones in an Emergency Reporting System for Infectious Disease Surveillance after the Sichuan Earthquake in China. Bulletin of the WHO, Aug; 87(8):619-23.
55. Yen M., Wu T., Chiu A., Wong W., Wong P., Chan T. and et al., 2009. Taipei’s Use of a Multi-Channel Mass Risk Communication Program to Rapidly Reverse an Epidemic of Highly Communicable Disease.
56. Zurovac, Dejan, Raymond K., Sudoi, Willis S., Akhwale, Moses Ndiritu, Davidson H. Hamer, Alexander K. Rowe, and Robert W., 2011. The Effect of Mobile Phone Text Message Reminders on Kenyan Health Workers’ Adherence to Malaria Treatment Guidelines: A Cluster Randomized Trial. The Lancet 378, no. 9793: 795-803.

# APPENDICES

**Annex 1**

**Cover Letter**

Dear Respondent

Thank you for taking the time to complete this survey. I am a student at Addis Ababa University in Health Informatics. I am conducting this survey as part of a research, which is part of my Masters degree. The title of my research is "Mobile Use in Healthcare Systems in Ethiopia: Existing Initiatives and success Factors". The aim of this research is to explore the existing mobile heath initiatives of the current status, progresses, challenges and finally to come up with the success factors in Ethiopian healthcare systems.

This research will help for Federal Ministry of Health to be able to know ongoing mHealth projects and to support and work together with those initiatives for a better healthcare system. Mobile health system developers would be benefited from this thesis because; it helps to share their experiences with one another. And they can also use the results for their sustainability and success. Overall, the government, researchers in the area, health professionals and the community at large are expected to benefit from the results of this research.

Your help and cooperation in this research is much appreciated. Taking into consideration for achieving the above stated objectives and contributions, your involvement is really important and needed. This interview will take you approximately 60 minutes to complete this survey. As a participant of this survey, please note the following: You may seek clarification on any of the questions asked in the survey should you wish to. You may withdraw from the survey at any time should you wish to. Your responses will be kept absolutely confidential. The results collected from the survey will be used for the purposes of the research only. A letter of authorization to conduct this survey has been issued to me and I will be happy to show this to you should you wish to peruse it.

Once again, thank you for your kind cooperation.

Yours sincerely, Student's Name: Cell Phone:

**Research Questionnaire**

**Background Information**

Name of Person completing the survey: _____

Organization Name: _____

Role in Organization: _____

**Profile of the Initiative**

1. Name of project: _____
2. Geographical coverage:

   Single city/town ☐ Regional ☐

   Region: _____

   City/town: _____
3. Status of project:

   Ongoing ☐ Ended ☐

   Date start: _____

   Date ended: _____Reason: _____

   Planned end date: _____
4. Funding

   National programme ☐ (specify): _____

   Regional programme ☐ (specify): _____

   Mixed public/private ☐ (specify): _____

   Private ☐ (specify): _____

   Other ☐ (specify): _____
5. Partnership

   National government ☐ (specify): _____

   Regional/local government ☐ (specify): _____

Private ☐ (specify): _____

Civil society ☐ (specify): _____

Other ☐ (specify): _____

6. Which one of the following platforms does your project employ?

SMS ☐

Call ☐

Web browser ☐

Other ☐ (specify): _____

7. What applications (ICT tools) are used in this initiative?

Java ☐

Android ☐

Other ☐ (specify): _____

8. Were any problems experienced in using these applications? Which are the difficulties encountered to use those applications?

Lack of indigenous knowledge ☐

Customization problem ☐

Storage problem ☐

Other ☐ (specific): _____

9. Who are the project beneficiaries?

Mothers ☐

Children ☐

HIV/AIDS patients ☐

Other ☐ (specify): _____

**Annex 2**

**Consent form**

**Addis Ababa University**

**Information science department**

**Health Informatics Program**

I the undersigned have been informed that this interview is part of the study that explore existing mobile health initiatives and their progress status, challenges and success factors in Ethiopia health care system. I have been told that the study will help mobile health projects to be successful and sustainable. And also have been told about the time it took to complete the data collection i.e. approximately 40 minutes.

Therefore, I am consented to participate in the study by signing this form.

The Study participant's Signature _____

Date_____

**In depth Interview Guide Questions**

1. What were the needs and problems it wanted to address?
2. Are you collaborating with other initiatives in the work you are doing now? In what ways?
3. What healthcare organization that is, or will be involved in sharing or supporting within this initiative? Is the government involved in these initiatives?
4. What problems have been experienced and how were they addressed?
5. What would you say are the lessons learned and the good practices that can be derived from this initiative?
6. Have any formal or informal evaluations been performed? If so what are the main findings?
7. Are there any success criteria that have been used to determine if this initiative is working well and should be continued?
8. What conditions are needed to scale up the mobile health projects?

# Declaration

I, the undersigned, declare that this thesis is my original work in partial fulfillment of the requirement for the Degree of Masters of Science in Health Informatics and has not been presented for a degree in this or any other university. All source of material used for this thesis and all people and institutions who gave support for this work have been duly acknowledged.

Name: Serkalem Jemberu

Signature: _____

Place: **Health Informatics Program, Faculty of Informatics, Addis Ababa University**

Date of submission: **3rd June 2013**

This thesis has been submitted for examination with our approval as the university advisors.

**Name of the advisors Signature**

**Dr. Demeke Assefa** _____

**Dr. Rahel Bekele** _____