Is mHealth Viable to Ethiopia?—An Empirical Study

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Abstract—The expansion of Internet and the availability of mobile devices in affordable price to all type of people in the world expand the opportunity to use mobile technology in the health sector. In this paper we address the applicability, feasibility and usability of mobile technology to the under-served population of rural Ethiopia (particularly Amhara region). As the magnitude, disease prevalence and the shortage of healthcare workers increases from time to time, the health service delivery becomes inefficient and ineffective. To alleviate these grounded problems an additional technology is required. The result of the study shows that assisting healthcare service delivery through ICT is very urgent and demanding. In addition, the mHealth is the main channel to address the aforementioned problem. To this end we proposed a mobile based health service discovery framework.

1. INTRODUCTION

The use of information and communication technology (ICT) is one of a range of potential solutions to the health care challenge. ICT encompasses a range of technologies which enable the exchange of data through the telephone or Internet, home based health service delivery, remote consultation and treatment, and remote capacity building and on-job training.

ICT has the potential to modify the way in which people use health services both by increasing access to information and by remotely providing other forms of support. Expectations are changing with people wanting to determine their own health needs through advice on the Internet or other technological interfaces and faster more person-centered (personalized) services from health care providers including patients and health professionals. Indeed, we may be witnessing a move from the “face to face age of health care” to the “information age of health care”.

The explosive growth of mobile communications over the past decade offers a new hope for the promotion of quality healthcare, especially for developing countries. There is a growing body of evidence that demonstrates the potential of mobile communications to radically improve healthcare services even in some of the most remote and resource-poor environments [3, 4].

Healthcare is a fundamental, but under-serviced need of citizens in developing countries. In addition to having the highest maternal mortality, child-under-five mortality and neonatal mortality ratios, these regions have the largest unmet need for health service provision in the world. Given the shortage of healthcare professionals: doctors and nurses, and the low number of medical schools in Ethiopia, the government trained health extension workers (HEW) were women chosen from their own communities trained in basic health service provision for one year, and sent back to provide health service in their community specially in prevention, consulting and awareness creation.
Some of the benefits of mHealth are (1) increased access to healthcare and knowledge transfer, (2) increased efficiency and cost reduction, (3) improved ability of diagnosis, treatment and track of diseases, (3) timely dissemination of health information, and (5) provision and expansion of training and medical education.

1.1 Potential of Mobile Phones to Improve Health in Ethiopia

In the previous years the government of Ethiopia makes tremendous strides its efforts to improve the lives of their citizens, yet formidable obstacles remain. Disease and the lack of adequate preventative care take a significant barrier to sustainable development.

1.1.1 Defining mHealth

In recent years, mHealth has emerged as an important subsegment of the field of eHealth. While there is no widely agreed-to definition for these fields, as a result [3] proposes a working definitions:

- eHealth: Using information and communication technology (ICT) - such as computers, mobile phones, and satellite communications - for health service and information.

- mHealth: Using mobile communications - such as PDAs and mobiles - for health services and information.

1.1.2 The Promise of Mobile Technologies for Health

mHealth and eHealth are inextricably linked. Both are used to improve health outcomes and their technologies work in conjunction. mHealth programs can serve as the access point for entering patient data into national health information systems, and as remote information tools that provide information to healthcare clinics, home providers, and health workers in the field. While there are many stand-alone mHealth programs, it is important to note the opportunity mHealth presents for strengthening broader eHealth initiatives [3].

Mobile communication offers an effective means of bringing healthcare services to developing-country citizens. With low-cost handsets and the penetration of mobile phone networks globally, tens of millions of citizens that never had regular access to a fixed-line telephone or computer now use mobile devices as daily tools for communication and data transfer [3]. Mobile technologies enable eHealth systems to decentralize and thus extend their reach to remote settings, as well as to individual members of the health sector and the general public. Meachel [5] stated the effect of mHealth in developing countries, “it is worthwhile to consider how mobile phones are being used organically, and then to look at some examples of formalized mHealth initiatives”. In case of Ethiopia there is an emerging mHealth project which is PDA based data collection.
Despite of the huge expansion of mobile communication in Ethiopia, mobile technology is not being used yet to assist the healthcare sector. There are some operational projects in the country, for example the remote data collection using PDAs (which is in a pilot phase) and there is a project called Smart Care (hospital information systems). Thus, the utilization of mobile technology to improve the health of the citizen is very minimal.

Technology has now evolved to a point that delivering telemedicine services is economically feasible, the graphics quality of the mobile media is acceptable, and the data transfer is reliable and at an acceptable speed. The cost of technology, once a critical barrier, is now providing e-Health opportunities for new services because the costs of hardware, software and telecommunications technology continue to decrease, meanwhile, the capabilities continue to increase [4].

Frühling [4] says telemedicine offers many opportunities for rural e-health consumers for example, patient consultations from and referral services to medical providers, and training for health care professionals via distance education.

1.2 Objectives

The last few years witnessed a rapid development and deployment in both wireless technologies and mobile Internet based mHealth system with pervasive computing technologies. The increasing data traffic and demands from different medical applications will be compatible with the data rates of 3G and 4G systems [4]. In this paper we investigate the feasibility and applicability of mHealth for remote areas of Ethiopia. The objectives of this study are:

- To assess the viability of mobile phones to facilitate healthcare services in the rural areas
- To understand the exposure of healthcare workers to ICT equipments and technologies
- To assess the availability of minimal infrastructure in order to deploy eHealth services specially in the rural areas
- To investigate the interaction of healthcare institutions towards using ICT in healthcare to reach the unreached and to widen the coverage of healthcare services in the country.

The paper is structured as follows: in section 2 we discuss the application of mHealth. Section 3 addresses Ethiopia’s health services and the methodology used to gather data and the tools to analyze the collected data is presented in section 4. Section 5 we present the mHealth framework. Finally, we conclude the paper and pinpoint future work in section 6.2

2. Application of mHealth

mHealth applications are numerous and diverse. They range across remote diagnostics and monitoring, diagnosis and treatment, collecting medical data remotely, ease communication and reduce hospitalization and self-diagnostics. Figure 1 shows mHealth intervention areas.
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2.1 Education and Awareness

A short messaging service (SMS) is the most cost effective, efficient and scalable method of providing outreach services for a wide array of health issues [3, 1]. In education and awareness applications, in most developed countries SMS messages are sent directly to users’ phone to offer information about testing and treatment methods, availability of health services, and disease outbreaks [2]. SMS alerts have proven particularly effective in targeting hard-to-reach populations and people in rural areas, where absence of clinics, lack of healthcare workers, and limited access to health-related information all too often prevent people from making informed decisions about their health. For example Uganda’s ‘Text to changes’ and South Africa’s ‘Masilekis’ send SMS message to create HIV/AIDS awareness. Philippines’s ‘Phoned Pill Reminder projects’ sends SMS for tuberculosis treatment.

However, SMS alerts cannot be used for citizens with illiteracy and low level education. Besides the SMS need to be localized. Hence, to educate and create awareness to the majority of rural population, an automatic voice alert system is required to be designed.

2.2 Remote Data Collection

Data collection is one of the most important areas of mHealth. Policy makers and health providers at the national, district, and community level need accurate data in order to gauge the effectiveness of existing policies and programs, and in order to shape new ones [3]. Currently there is a data collection program (using PDAs) in Ethiopia as a pilot project (‘RapidSMS’) for data collection and outbreak tracking. This project is first used in 2008 for food distribution program to supply a high protein plumpy’nut to under-nourished children in different feeding centers of the country. It has been reported that in five weeks of pilot study 939 unique reports and 10-15 reports everyday were received [8]. Later on this project has been used for healthcare data collection and outbreak reporting. Recently, ‘SMS

Tech for Health	extsuperscript{2}, a new pilot project is launched in Amhara, Oromia, Tigray and Southern. This pilot project is designed for health professionals and expectant mothers; its aim is to improve healthy babies by reducing complications during the birth process and improving maternal health. Besides, the projects provide an opportunity for healthcare workers to consult the knowledge database for additional information regarding complications. ‘txt4Enat’ is another component of the project which will provide opportunities for about 100,000 women to send SMS messages when they encounter a complication during their pregnancy.

When this mobile based data collection is implemented full-fledged, it will solve the current problem of lacking patient data, enabling the governmental officials to gauge the effectiveness of healthcare programs, to allocate resources more efficiently, and to adjust programs and policies accordingly.

2.3 Remote Monitoring

One of the area’s most uniquely suited for mobile technology application is remote monitoring of patients. As much as 85 percent of the people of Ethiopia live in rural area. The limited number of hospitals in the country may urge to use remote monitoring of patients in outpatient settings. It is impossible to provide mobile phones for the total population but patients with a chronic disease (AIDS, diabetes, TB, etc) who own a mobile phone can use the monitoring services such as health condition monitoring, maintaining healthcare workers appointments, and receiving SMS reminders to take the daily medication or to take a test (such as measuring the blood sugar level). Accordingly, the United Nations Foundation and Mishra and Singh [3, 6] assert that monitoring patients at home for chronic conditions dramatically improves their survival rate.

2.4 Communication and Training for Healthcare Workers

mHealth education for health workers is introduced about 4 years ago, that can enable health workers to learn new treatment procedures, test their knowledge after training course, take certification exams and look on information from medical references and to decide on diagnosis. Some research reports disclosed mHealth education applications improves provision of care and levels of knowledge [2].

An acute shortage of healthcare workers is a major challenge facing Ethiopia. To alleviate such a devastating problem, Ethiopia has trained about 32,000 front line health community workers (called Heath extension workers, HEW). They took a one year preventive healthcare training. The majority of the HEWs want to upgrade to the next level. However, there is no such opportunity yet. Training HEW using mobile technology can close this gap and will help to empower, motivate and reduce attrition. The

\textsuperscript{2}http://www.healthunbound.org/content/new-sms-project-ethiopia-improve-maternal-health
training enables health extension workers to perform many of the simpler medical tasks currently done by doctors and nurses.

Our assumption is that mobile technology improves the communication mainly between health posts and health centers for the purpose of performance reporting and providing and asking guidance and assistance.

2.5 Diagnostic and Treatment Support

“Diagnostics and treatment support are vitally important in healthcare—misdiagnosis or the inability to diagnose a condition could have serious, even fatal, ramifications” [3]. mHealth applications in this area are designed to provide diagnosis and treatment advice to remote healthcare workers through wireless access to medical information databases or medical staff. There are two possibilities to provide remote diagnostics and treatment, first the remote medical professionals can diagnose the illness and prescribe a treatment (eliminating patients travel), and second the local medical professionals can access the remote medical database through the mobile technology.

Furthermore, Bill Gates in his keynote speech in mHealth Alliances conference said “Diagnosis of malaria and TB will likely be the first ones you can assign a number to and say without this mobile phone app these people would have died,” Gate said, “In the diagnostics areas we are seeing some very good stuff come through.”

Deployment of mobile devices, with their ability to quickly capture and transmit data on disease incidence, can be decisive in the prevention and containment of outbreaks. For instance, Peru, Rwanda, and India use mHealth applications to track disease and epidemic outbreaks [3].

3. Health Services of Ethiopia

In this section we address the available health services in Ethiopia, especially in one of the biggest and most highly populated region, Amhara.

The Amhara National Region State covers an area of 170,752 sq. kilometers and encompasses a population of about 17 million3. Almost 90% of Amhara’s population is rural, living in heavily populated (111 persons/sq. kilometre) farming communities. It has about 105 districts. The health coverage is not sufficient compared to urban administration regions of Addis Ababa and Dire Dawa.

3.1 Health Institutions

The region consists of 23 hospitals, 632 health centers, 1235 health clinics and 2941 health posts. The number of available health institutions is very limited compared to the size of the population. It has only three referral hospital, among them only one is a teaching hospital. According to health experts, the Bahir Dar Felege Hiwot hospital serves about 9 million people. It is estimated that the region has approximately 2209 hospital beds.

32007 national census (www.csa.gov.et)
3.2 Health Professionals

One of the acute problems is a shortage of healthcare workers. The number of health professionals is very small compared to the size of the population which accounts 25% of the country’s population. The health facilities are equally distributed over the districts based on their population. The number of health workers in the state is displayed in Figure 2.

![Figure 2: Number of Health Professionals in Amhara Region (March 2011)](image)

Malaria, TB and HIV/AIDS are among the common diseases in the region besides other causes for morbidity. Figure 3 displays the number of patients diagnosed in year 2010.

![Figure 3: Patient Treated in Amhara Region in 2010](image)

4. METHODOLOGY

In this case study observation and interview is employed. To select zones and woredas/or districts we use purposive sampling techniques. We choose 5 districts in the region for the assessment purpose. In each district we select two health centers to assess the available infrastructure as a benchmark for the implementation eHealth (particularly mHealth) projects. The main purpose of the study is:

- To study the existing gap of the health center especially on the availability of ICT facilities and devise a mechanism how to implement IT services with the available infrastructure in the health centers;
- To assess the perception of healthcare workers in utilizing eHealth specially mHealth;
- To identify barriers preventing e-health services from reaching their potential in rural communities and to study the feasibility of mHealth in tackling the protruded health problem;
• To observe and assess the healthcare workers readiness in using the available ICT services and facilities and how much do they acquainted with IT devices in their day to day life;

• To understand the intention of healthcare workers towards using ICT in diagnosis and treatment, in prevention, in patient monitoring and in awareness creation;

4.1 Sampling Technique
We use purposive sampling techniques to choose the health centers in each district. Each districts health office provides the number of health services available in the district, the overall coverage, and the common diseases affected the population, and the total number of healthcare workers. We select two health centers in each district. Based on the recommendation of district health office, we choose one health center with very poor infrastructure: (no electricity, no roads, and no telecommunication service and far from the district town) and the second health center is relatively with better infrastructure and close to the district town in distance or near to the highway.

According to the country policy, a health center coordinates and manages 5 health posts. A health center and a health post are supposed to serve 25000 and 5000 people respectively.

4.2 Data Gathering Tools
We employ interview and observation to gather data for the study. In each health center we interviewed the health center head and three health extension workers. Among the thirteen interviewees, nine are nurses and, one health officer and three HEWs. The average work experience of the interviewee is 3 years and the average age is 24. Five females and eight males were participated in the interview. Each interview took from one hour up to one and half hours. The interviewees are presented with both open-ended and close-ended questions.

In the subsequent subsections we present the population size, number of health facilities (Table 1 summarizes the health facilities of the woredas/districts) and the number of health professionals in the respective districts.
4.2.1 Fogera Woreda/ District

The district consists of 28 kebeles/villages with a total population of 220,926. The district has 11 health centers, 41 health post but there is no any hospital. The nearest hospital is about 55 kilometres. Malaria is the common disease which affects the rural population. We manage to visit two health centers: Kidist Hana Health Center and Kuahar Abo Health center which is 23 kilometres and 8 kilometres far from the district town (Woreta). The furthest health center is 49 Kilometres far from the district capital.

<table>
<thead>
<tr>
<th>Woreda</th>
<th>Health Centres</th>
<th>Health Posts</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fogera</td>
<td>11</td>
<td>41</td>
<td>220,926</td>
</tr>
<tr>
<td>Farta</td>
<td>10</td>
<td>41</td>
<td>271,951</td>
</tr>
<tr>
<td>Dera</td>
<td>10</td>
<td>36</td>
<td>248,464</td>
</tr>
<tr>
<td>Mecha</td>
<td>11</td>
<td>33</td>
<td>313,068</td>
</tr>
<tr>
<td>Yilmana-Densa</td>
<td>12</td>
<td>33</td>
<td>230,546</td>
</tr>
</tbody>
</table>

One of the unique features of this district is, it assigns IT professional in all health centers to facilitate health service delivery through information technology; however, most of the clinics we visited do not have IT equipments and electricity (see Table 2). Nonetheless, there is mobile network coverage in the clinics. Therefore all the healthcare workers use their mobile phone for communication purposes.

Infrastructure is one of the problems of the district for example only two health centers has all weather roads but others have only seasonal roads as a result transportation is a grand problem. Except two urban health centers none of the health centers have access to electricity which makes the available medical equipments unutilized and malfunctioning. On the contrary in most of the health centers mobile network is accessible though the healthcare workers used for reporting and for communication purpose only.

4.2.2 Farta Woreda/ District

Farta is one of the 105 woredas in the Amhara Region of Ethiopia. Part of the Debub Gondar Zone, Farta is bordered on the south by Este, on the west by Fogera, on the north by Ebenat, and on the east by Lay Gayint. Towns in Farta include Gasay and Kimir Dingay.

According to the woreda health office, this woreda has a total population of 271,951, of whom 140,878 men and 131,073 women; about 2.97% are urban inhabitants. With an area of 1099.25 square kilometers, Farta has a population density of 212.22 per square kilometre. Farta consist of 39 kebeles/villages among these two are urban kebeles which has an electricity access. The woreda has 10 health centers (from which two are urban health centers), 2 health clinics, and 41 health posts. Four of the health centers have an access to all weather roads. The remote health center is 65 km far from the district city. Alike other districts, scarcity of infrastructures are one of the pressing problems of the district.
4.2.3 Dera Woreda/ District

This district is found in South Gondar zone. The district has a total population of 248,464, of whom 126,961 men and 121,503 women. It has about 36 kebeles/villages. The district consists of 10 health centers, 31 health posts and about 10 private clinics. The distribution of the healthcare workers is as follows: 72 nurses, 5 health officers, 7 lab technicians, 9 pharmacists, 3 sanitarian and 3 midwifery and 81 health extension workers. Some of the health centers lack physical infrastructure like road, electricity, and telephone infrastructure. For example Sana one of the sample health centers in our study has no electricity, only a seasonal road, and even mobile networking is not yet reached.

4.2.4 Mecha Woreda/ District

Mecha is one of the districts/woredas found in West Gojjam zone. The woreda/district has a total population of 313,068, of whom 158,218 men and 154,858 women. Among the total population 26,824 lives in urban and 286,244 in rural. It has 44 kebeles/villages 4 of them are urban kebeles/villages. The district consists of 11 health centers, 30 health posts, 20 private clinics, 11 private own pharmacies and 5 diagnostic laboratories. The number of healthcare workers incorporates 78 nurses, 3 health officers, 9 lab technicians, 10 pharmacists, 4 sanitarian, 5 midwifery and 89 health extension workers.

4.2.5 Yilmana-Densa Woreda/ District

Yilmana-Densa is one of the districts/woredas found in West Gojjam zone. The woreda/district has a total population of 230,546, of whom 115,734 men and 114,812 women. Among the total population 26824 live in urban and 286,244 in rural. It has 44 kebeles/villages 4 of them are urban kebeles/villages. The district consists of 12 health centers, 33 health posts, 20 clinics and 1 hospital under construction. Acute shortage of healthcare workers is one of the astounding problems of the district; the distribution of the healthcare workers is as follows: 78 nurses, 3 health officers, 9 lab technicians, 10 pharmacists, 4 sanitarian, 5 midwifery and 89 health extension workers.

Table 3 shows the ICT facilities available in the health centers. All the health centers neither have any ICT facilities nor equipments. Each health center except one gets mobile network coverage; therefore there is a possibility of accessing Internet through mobile phones. However, only one healthcare worker, a head of the Dremo health center, uses his mobile phone to access Internet, on the other hand most of the healthcare workers even do not know the availability of the services. Among 13 interviewees none of them have email account. The interview result reveals that the healthcare workers has very limited IT training, some of them took basic computer training in the university or college others have never taken IT training at all. This depicts that healthcare workers working in rural are as require basic IT training.
Table 2: Infrastructure of the Health Centers

<table>
<thead>
<tr>
<th>Health Center</th>
<th>Electricity</th>
<th>Transportation</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fixed</td>
<td>Mobile</td>
<td></td>
</tr>
<tr>
<td>Wanzaye</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Korata</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Sana</td>
<td>0</td>
<td>0*</td>
<td>0</td>
</tr>
<tr>
<td>Kidist Hana</td>
<td>0*</td>
<td>0*</td>
<td>0</td>
</tr>
<tr>
<td>Kuahar Abo</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Maynet</td>
<td>0*</td>
<td>1</td>
<td>0</td>
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<tr>
<td>Dremo</td>
<td>0</td>
<td>0*</td>
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<tr>
<td>Goshye</td>
<td>1</td>
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<tr>
<td>Ageta</td>
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<td>Ambo mesk</td>
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</tbody>
</table>

Table 3: Availability of ICT Services and Equipments

<table>
<thead>
<tr>
<th>Health Center</th>
<th>Computer</th>
<th>Internet Service (broadband/ dial up)</th>
<th>Email Service</th>
<th>Mobile Internet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wanzaye</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Korata</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Sana</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Kidist Hana</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Kuahar Abo</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Maynet</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Dremo</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Goshye</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Ageta</td>
<td>No</td>
<td>No</td>
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<td>Ambo mesk</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
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</table>

4.3 Result and Discussion

4.3.1 Availability of Infrastructure

The finding shows that 30% of the health centers have electricity and 30% power transmission line is already installed, 60% have all weather roads, 40% seasonal roads, no health centers have fixed telephone and all of the health centers get mobile network coverage. For details see table 2.

4.3.2 Tawareness of Healthcare Workers for Diagnosis and Treatment

The interview result shows that the majority of the healthcare workers do not have awareness that IT can be applied as an enabler to facilitate health service delivery. However, some of them use mobile phones to consult doctors and friends whenever they come across complicated or unusual patients’ cases. Besides, mobile phone is used for reporting and data collection purposes to the district health office and to communicate with cluster health posts. Even if they did not know the impact of ICT in healthcare, they suggest that if a mobile based healthcare is developed that will contribute in prevention and diagnosis of health problems. Hence, from the interview and informal discussion made, we learned that mHealth is an option to assist the healthcare sector. One of the woreda/district recognizing the implication of ICT in improving the healthcare system assigns IT professionals in every health centers.
4.3.3 Utilizing mHealth

In all the visited health centers all the healthcare workers own mobile phone, so if any mHealth application is offered, they can use the system easily without longer term training.

4.3.4 Internet Service

The expansion of Internet services such as (broadband and dial up) in the country is still at its infancy. However, the proliferation of mobile network and the provision of Internet service through mobile phone by the telecom company make the mobile based healthcare service delivery viable for tackling the burden of healthcare in the country. The result of the study shows that all the health centers included in study has no broadband or dial up Internet services. On the other hand, all health centers have almost 100% mobile based Internet services.

4.3.5 Internet Usage

As shown in Table 3 all the health centers do not have any Internet services, however, the telecom company provides mobile based Internet access to the users with the price of air time. Except the IT professionals in the two health centers and one nurse, other health workers have never used Internet services. In the interview they were asked why not they use Internet as it is free and costs only the air time rate; they replied that they expect that Internet may incur much cost and others did not know whether the service is provided. Some also do not know the use of Internet due to lack of training. After the discussion with the interviewers, they show a certain enthusiasm to use Internet. In fact, mobile phone is used as a daily communication tools in the health centers and health posts.

As we mentioned in the above, the majority of the population live in rural areas but the health coverage is very insignificant. As we can see from figure 6, one health post serves about 5000 population and one HP has a maximum of two HEW, this increases the magnitude of the problem and one health center is designated to 25000 people.

The study also solicited comments from the participants regarding their opinion of e-Health services and the likelihood of using such services.
Based on the results of this study, three of the major challenges of expanding e-health service to rural healthcare concern the availability of the broadband Internet, access to computers and education on how to use computers. Regardless, if the technology is robust enough for telemedicine and physicians are willing to participate, the digital divide overpowers the drivers mentioned earlier [4].

The findings in the study have valuable implications for practitioners of e-Health services and will help them better understand the characteristics and challenges to extending the reach of e-healthcare services to rural citizens [4].

5. mHEALTH FRAMEWORK

Based on the result of the study we propose a mobile based service discovery. As mentioned in our previous work [7], the framework consists of: service consumers, service providers, dialogue system and service discovery engine and service repository.

The components of the framework are described as follows: 1) Service consumer requests a health services using a mobile phone. 2) Service providers: publishes services to the service repository. 3) Dialogue system: it mainly accomplishes two tasks. First it converts voices into text using speech recognition and vice versa. The main benefit of using dialogue system is to enable a user to request services using voices. Similarly when requested services found the response is converted form text to voice. 4) Service discovery engine finds services from the services repository. As shown from figure 7, service discovery engine consists of different components: query interpreter (interprets user query), user profile and context (stores user profile and context data), matchmaking (matches requested services with offered services), ranking and selecting. 5) Service repository stores services advertised by the service provider.
6. CONCLUSION
The proliferation of mobile technology in the world makes the healthcare service easily addressable. In this study we assessed the readiness of implementing electronic healthcare in Ethiopia. The study shows that mobile based healthcare service delivery is feasible, since the affordability of mobile phone by low income citizen and the expansion of mobile network in the rural areas help to utilize mobile based health services to consult, create awareness, diagnosis and treat the patients in the country. Thus we propose mHealth service discovery and delivery framework.

REFERENCES