The Opportunity of Mobile Technology for Healthcare in Development of World

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Abstract—*Mounting interest in the field of mHealth – the provision of health-related services via mobile communications-can be traced to the evolution of several interrelated trends. In many parts of the world, epidemics and a shortage of healthcare workers continue to present grave challenges for governments and health providers. Yet in these same places, the explosive growth of mobile communications over the past decade offers a new hope for the promotion of quality healthcare. Among those who had previously been left behind by the digital divide. billions now have access to reliable technology.There is a growing body of evidence that demonstrates the potential of mobile communications of radically improve healthcare services – even in some of the most remote and resource-poor-environments. This report examines issues at the heart of the rapidly evolving intersection of mobile phones and healthcare. It helps the reader to understand mHealth's scope and implementation across developing regions, the health needs to which mHealth can be applied, and the mHealth applications that promise the greatest impact on health care initiatives. It also examines building blocks required to make mHealth more widely available through*

sustainable implementations. Finally, it calls for concerted action to help realize mHealth's full potential.
The report is organized into the following sections: Identifying the potential of mobile phones to improve health in the developing world

- *Defining mHealth within the context of eHealth.*

Meeting health needs through a broad array of mHealth applications.

- *Examining the impacts of mHealth projects*
- *Assessing mHealth and future health needs in developing countries*
- *Identifying the building blocks for sustainable and scalable mHealth programs*
- *Understanding the incentives for multiple players mHealth value chains*
- *A call for action*
- *Looking forward*
- *Compendium of mHealth projects.*

Though the mHealth field is still in its early stages, it has already begun to transform health delivery. Projects throughout the developing world are demonstrating concrete benefits, including:

- *Increased access to healthcare and health-related information, particularly for hard-to-reach populations.*
- *Improved ability to diagnose and track diseases*
- *Timelier, more actionable public health information*

Introduction

Mobile communication offers and effective means of brining 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. A full 64% of all mobile phone users can now be found in the developing world. Furthermore, estimates show that by 2012. Half of all individuals in remote arears of the world will have mobile phones. This growing ubiquity of mobile phones is a central element in the promise of mobile technologies for health.

Defining mHealth Within the Context of eHealth

In recent years, mHealth has emerged as an important sub-segment of the field of electronic health (eHealth). While there is no widely agreed-to definition for these fields, the public health community has coalesced around these working definitions :

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

mHealth : Using mobile communications – such as PDAS and mobile phones – for health services and information.

mHealth and eHealth are inextricably linked – both are used to improve health outcomes and their technologies work in conjunction. For example, many eHealth initiative involve digitizing patient records and creating an electronics backbone that ideally will standardize access to patient data within a national system. 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 strenthening broader eHealth initiatives.

Meeting Health Needs Through a Broad Array of Applications :

A growing number of developing countries are using mobile technology to address health needs. The mHealth field is remarkably dynamic, and the range of applications being designed is constantly expanding. The key applications for mHealth in developing countries are :

- Education and awarness
- Remote data collection
- Remote monitoring
- communication and training for healthcare workers

- Disease and epidemic outbreak tracking
- Diagnostic and treatment support.

This report details 51 mHealth programs, either currently operating or slated for implementation in the near future, that are taking place in 26 different developing countries. mHealth programs are more prevalent in some countries than others for reasons that have not yet been assessed by the academic literature. In particular, India, South Africa, Uganda, Peru, and Rwanda stand out for their level of mHealth activity. As the case studies examined in this report reveal, mHealth programs are gaining strong support across regions, as well as sectors as diverse as governments, technology providers and academia.

Education and Awareness

In education and awareness applications, SMS messages are sent directly to users' phones to offer information about testing and treatment methods, availability of health services, and disease management. Formal studies and anecdotal evidence demonstrate that SMS alerts have a measurable impact on and a greater ability to influence behavior than ratio and television campaigns, SMS alerts provide the further advantage of being relatively unobtrusive offering recipients confidentially in environments where disease (especially HIV/AIDS) is often taboo. In the developing world. SMS alerts have proven particularly effective in targeting hard-to-reach populations and rural areas, where the 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.

While other communication mediums, such as radio, television, voice – based information hotlines, and even interactive websites can be employed in the services of education about public health issues, SMS stands out as having several advantages over each of these cost – effectiveness, scalability, convenience, broad reach and widespread popularity in the developing world.

Remote Data Collection:

Data collection is another crucial component of public health programs. Policymakers and health providers at the national, district, and community level need accurate data in order to guage the effectiveness of existing policies and programs and to shape new ones. In the developing world, collecting field information is particularly important since many segments of the population are rarely able to visit a hospital, even in the case of severe illness.

Remote Monitoring :

TB patients in Thailand were given mobile phones so that healthcare workers (themselves former TB patients) could call these patients on a daily basis to remind them to take their medication. Medicine compliance rates reached 90% due to the introduction of this remote monitoring application.

Communication and Training for Healthcare Workers:

In the Primary Healthcare Nursing Promotion Programs, the National School for Nursery in Coban, Guatemala used an innovative combination of mobile phones. landline phones, and tele-writers to train nurses in this rainforest community. An acute shortage of healthcare workers is a major challenge facing developing country health sectors. Training new cadres of health professionals and empowering current workers in order to increase job satisfaction and reduce attrition are essential to meeting human capital needs. Connecting health workers with sources of information via mobile technology is a strong basis for empowerment, as it provides the support they need to perform their function effectively and self-sufficiently.

for a patient to be sent to the regional hospital by the local clinic, only for find that there is no bed available. Mobile phones can help bridge these communications gaps that in the health context can often mean the difference between lives lost and lives saved.

Disease and Epidemic Outbreak Tracking :

Outbreaks of communicable diseases often begin in pockets, and, when left undetected, can develop into epidemics. Recent instances of such devastating outbreak abound, from cholera and TB to dengue fever and Severe Acute Respiratory Syndrome (SARS). 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. Incidents of Japanese Encephalitis were tracked real-time in Andhra Pradesh. India, via a combination of mobile phones and web-based technologies. The government used the information to better prioritize vaccinations based on evidence of clusters of outbreaks.

Diagnostics 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, ramfications, 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, with mHealth enabled diagnostics and treatment support, patients are able to receive treatment in their villages and homes, averting the need for expensive hospital visits, which are beyond reach for many.

Diagnostic and Treatment Support :

Researchers from the University of Melbourne are creating diagnostic and analytical tools specifically for mobile phones for health workers in Mozambique. These tools include a built- in calculator for determining drug dosage and reference materials stored in the phone's memory.

Examining the Impact of mHealth Projects :

Formal studies and preliminary project assessments – in both the developed and developing world – demonstrate that mobile technology improves the efficiency of healthcare delivery, and ultimately makes healthcare more effective. The long term goal, and expectation is that mHealth programs will have a demonstrable and significant positive impact on clinical outcomes such as reduced infant mortality, longer life spans, and decreased contraction of disease. Figure 4 illustrates some early results from other mHealth programs across the developing world.

Improved Patient Health:

Published clinical studies of mHealth programs point to an increasingly strong case for expanded mHealth implementation. Patient health has been improved in three ways :

Improved compliance with treatment regimes : A 2007 that study showed that TB patients who received daily text message medication reminders jumped to over 90% adherence. A device called SIMpill that uses mobile technology to monitor and direct medication adherences also shows promise.

Improved public awareness outcomes :

In South Africa, Project masiluleke, which promotes an AIDs hotline through SMS messages, resulted in a 350% increase in phone calls to the hotline.

Improve disease management : A recent US study on the use of wireless enabled PDAS by Type 2 diabetes patients found greater improvements in blood sugar indicators among regular users than among less frequent users.

Assessing mHealth and Future health Needs in Developing Countries :

Equally important to the cost effectiveness and scalability of mHealth is its ability to provide an effective tool for addressing emerging health needs.

Health experts note that within the next 15 years, policymakers and health providers in the developing world will be forced to turn their focus to prevention and early detection rather than late – stage treatment of non-communicable diseases, such as diabetes and cancer, as well as to the health needs of an aging population. These changes are being caused by trends such as migration from rural to urban areas, economic growth, and changing dietary habits. As developing countries tackle and make significant improvements in the spread of communicable disease, average income levels increase along with average life expectancy. Even a slight increase in income contributes to changing dietary habits, and consumption of meat products and processed foods is linked to the contraction of diabetes and cancer. Late detection of these diseases leads to lower survival rates and reduced life expectancy. and has negative consequences for social and economic development. Developing countries are therefore being confronted with a double burden of treating and containing the spread of communicable disease while combating a wide range of unfamiliar health challenges.

Many middle-income countries in the developing world (i.e. Brazil, Argentina, Thailand, Mexico, and Turkey) are already seeing a shift away from communicable diseases towards chronic diseases (such as heart disease and diabetes). In these countries, there is already evidence that mHealth programs are experimenting with addressing a wider range of chronic non-communicable diseases, with a focus on early treatment.

Evolution of Mobile Technologies :

Addressing future health needs will be facilitated by the development of mobile technologies and network expansion. The key technology trends in mobile technology continue to be the same trends that have characterized technological progress for the past 40 years: miniaturization, greater speed, and cost reduction. These advances are reflected in mobile telephony by some of the advancement issues shown inTable 2. A greater range of services becomes possible with more uniform, faster, and more affordable broadband access; greater access and coverage expands the subscriber base, building volume, creating incentives for players, and helping push sustainable mHealth applications beyond simple one-way data services.

Current Technology Picture :

- Mobile phones carry range of features suitable for basic mHealth services and country varations.

- Most new handsets access web (GPRS, other), download pictures and images.

- Speed limits applications and country variations.

- Most laptops, handhelds, PDAs easily access wireless networks where available.

- Widely available for laptop and handhelds.

- Only recent availability for handsets as vendors open architecture.

- Cellular common in urban, less so in rural.

- Broadband, internet access limited geographically, costly.

- Broadband, Standards may require policy decisions.

Value Chain Models for mHealth : Two – Way Data Applications

A two-way data applications. Two-way applications are developed for data access programs such as remote data collection, access to client records, access to health information databases, census taking, and electronic health records creation and storage (e.g., EpiSurveyor, a survey program for remote data collection). While it is not likely that two-way services will have the volume potential of one-way services, these services appeal to potential participants because they are Internet-based. participants in the value chain may find incentive to integrate mHealth solutions with growth plans around internet access. As it is an established functionality on both phones and laptops and the basis for other services (and thus revenue opportunities).

Conclusion : Looking Forward :

The field of mHealth is at an inflection point. With dozens of projects implemented and proven benefits, all trends indicate the investment will continue and mHealth projects will serve an ever wider range of constituents in the years ahead. At the same time, technological innovations will bring enhanced benefits, particularly in the areas of data collection, patient monitoring, and remote diagnostic and treatment support, where application development is already proceeding at breakneck speed.

Health needs in the developing world are rapidly evolving to include chronic diseases, in addition to the communicable diseases most often associated with developing countries. mHealth is well positioned to address these challenges using currently available technology. For example, SMS alerts can be equally useful in raising public health awareness of HIV/AIDs and in ensuring patient adherence to treatments for

chronic diseases such as diabetes. Emerging technologies, such a wide area wireless systems, will also be an asset in tackling today's health challenges and those of tomorrow.

Compendium of mHealth Projects :

The mHealth project case studies are organized by primary application area, from least specialized (education and awareness) to most specialized (diagnostic and treatment support). Although several projects offer multiple applications, they are categorized here by their more specialized function.

Education and Awareness

- Freedom HIV/AIDS Projects India

- Learning about Living, Nigeria

- HIV/AIDS video Distribution by Mobile Phone, Georgia

- HIV Confidant, South Africa

- Project Masiluleke, South Africa

- Text to Change (TTC) – HIV prevention through SMS Quiz, Uganda

- Community Health Information Tracking System (CHITS), Philippines

- Dokoza System, South Africa.

- EpiHandy, Uganda, Zambia, Burkina Fasco

- EpiSurveyor, Kenya, Uganda, Zambia (and 20 countries in Sub-Saharan Africa by end of 2008)

- Integrated healthcare Information Service through Mobile Telephone (IHISM), Botswana

- Media Lab Asia – Shred Resource for Rural Health Management and Information Infrastructure, India.

- Mobile based Primary Healthcare Management System, India.

- Map of Medicine for Kijabe Hospital Kenya

- Nokia Data Gathering, Brazil

- PDAs for Malaria Monitoring Mozambique

- Phones for Health, Ravanda

- TRACnet, Rwanda

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