mHealth: Saving Lives with Mobile Technology

Mobilizing healthcare to the most underserved and remote populations

How mHealth initiatives in developing nations will accelerate the progress in achieving the Millennium Development Goals towards improving women and child’s health by 2015

Vanessa Victoria
PUBP 757 Fall 2011
Global Health & Medical Practice
Professor Dr. Arnauld Nicogossian
Citation: Chicago style
December 9, 2011
# Table of Contents

Abstract .................................................................................................................................................. 1  
Purpose .................................................................................................................................................. 2  
Background and Context ....................................................................................................................... 2  
   The Millennium Development Goals ................................................................................................. 2  
   MDG 4: Reducing Child mortality by two-thirds for children under-five by 2015 ......................... 3  
   MDG 5: Improve Maternal Health by three-quarters reduction in maternal mortality ratio and universal access to reproductive health ......................................................................................... 3  
   Underserved Demographic: socio-economic and geographic barriers ............................................. 4  
   The Global Policy Challenge ............................................................................................................. 5  
Methodology ......................................................................................................................................... 6  
Results and Discussion ......................................................................................................................... 7  
   mHealth initiatives and programs for MNCH .................................................................................. 8  
Policy and Ethical Implications ........................................................................................................... 11  
Conclusion ........................................................................................................................................... 13  
Limitations/Bias ................................................................................................................................... 14  
Bibliography ......................................................................................................................................... 15  
Appendix A ........................................................................................................................................... 19  
   Figure 1: Causes of Maternal deaths and deaths of children under five ........................................... 19  
   Figure 2: Mortality risk for mothers and children over the continuum of care .............................. 19  
Appendix B ........................................................................................................................................... 20  
   Figure 3: The Reproductive, Maternal, Newborn, and Child Health continuum of health care .......... 20  
   Table 1: Comprehensive definitions for E-health, Telemedicine, and mHealth ............................ 20  
Appendix C ........................................................................................................................................... 21  
   Table 2: Three Quantitative case studies on mHealth application and evidence in LMCs ............. 21
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANC</td>
<td>Antenatal Care</td>
</tr>
<tr>
<td>CHW</td>
<td>Community Health Worker</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GNI</td>
<td>Gross National Income</td>
</tr>
<tr>
<td>GOe</td>
<td>Global Observatory for eHealth</td>
</tr>
<tr>
<td>HIV</td>
<td>Human Immunodeficiency Virus</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
</tr>
<tr>
<td>ITU</td>
<td>International Telecommunication Union</td>
</tr>
<tr>
<td>LHV</td>
<td>Lady Health Visitor</td>
</tr>
<tr>
<td>LHW</td>
<td>Lady Health Worker</td>
</tr>
<tr>
<td>LMIC</td>
<td>Low-and-middle-income countries</td>
</tr>
<tr>
<td>MDG</td>
<td>Millennium Development Goals</td>
</tr>
<tr>
<td>MNCH</td>
<td>Maternal, newborn, and child health</td>
</tr>
<tr>
<td>MoH</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>NGO</td>
<td>Non Governmental Organization</td>
</tr>
<tr>
<td>PAHO</td>
<td>Pan American Health Organization</td>
</tr>
<tr>
<td>PDA</td>
<td>Personal Digital Assistant</td>
</tr>
<tr>
<td>PDP</td>
<td>Product-development Partnership</td>
</tr>
<tr>
<td>PPP</td>
<td>Public Private Partnership</td>
</tr>
<tr>
<td>SMS</td>
<td>Short Message Service</td>
</tr>
<tr>
<td>TBA</td>
<td>Traditional Birth Attendants</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
<tr>
<td>UNICEF</td>
<td>United Nations Children’s Fund</td>
</tr>
<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
</tr>
<tr>
<td>VHW</td>
<td>Village Health Worker</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
<tr>
<td>WHOSIS</td>
<td>World Health Organization Statistical Information System</td>
</tr>
</tbody>
</table>
**Abstract**

**Purpose:** To evaluate the utility of mobile devices to for improving the health of women and children in rural and remote regions in developing nations.

**Background:** Women and children are the foundation of society and contribute extensively to economic development, yet they face social, environmental, political, and economic barriers that have deleterious impacts on their health and well-being. Every year, more than 350,000 women and about 9 million children die from preventable deaths and diseases that occur during pregnancy and after childbirth. Poor women and children that live in remote settings in low-and-middle-income countries (LMICs) bear the greatest burden of health inequities. With the United Nations’ Millennium Development Goals for 2015 approaching, developing nations will not achieve their goals in reducing child mortality and improving maternal health unless they begin applying innovative strategies that will greatly accelerate their progress. The global phenomena of broadband internet access and mobile technology has encouraged collaborations between national governments and diverse international stakeholders in applying mobile-based health solutions (mHealth) as a powerful opportunity for improving health and development in poor and remote areas.

**Methodology:** The systematic research for this paper contains qualitative and quantitative studies published in 2002, 2009, 2010, and 2011. The literature review searches specified in the areas of eHealth, telemedicine, mHealth, Millennium Development Goals, maternal and child health, developing nations, low-and-middle-income countries, Information and Communication Technology (ICT), and broadband networks. The analysis will use the Millennium Development Goals—reduce child mortality (MDG4) and improve maternal health (MDG5)—as health indicators to illustrate their casual relationship with other social and health determinants and to measure the potential role mHealth has in providing new opportunities in reenergizing the commitment to these health outcomes, simultaneously. The rest of the analysis will discuss the effectiveness of several mHealth initiatives by evaluating its players, approach, innovation, and evidence in low-and-middle income countries (LMICs). The concluding assessment will present the implementation barriers and offer policy recommendations for the success and sustainability of mHealth intervention specifically tailored to developing nations.

**Discussion:** The expected outcomes are to empower underserved communities and improve the well-being of women and children by offering timely access of health services and quality of care.

**Policy Implication:** To apply strategic approaches that encourage the alignment of mHealth technological solutions to maternal, newborn, and child health’s (MNCH) Millennium Development Goals in the strengthening of local health systems in developing nations.

**Ethics:** Should consider effective policies that address legitimate issues such as security and cultural concerns to achieve sustainability and scalability of mHealth interventions.

**Limitations:** Evidence regarding the costs and benefits of mHealth programs in developing nations and marginalized communities is still limited and currently consist of small-scale projects. There is a growing collection of grey literature (i.e. technical reports, working papers, white papers, and preprints) and scientific publications that suggest mHealth as a promising development for the improvement of healthcare services to the most poor and underserved populations.
Key Words: eHealth, telemedicine, mHealth, innovative mobile technologies, Millennium Development Goals, developing nations, low and middle income countries, maternal and child health, reproductive health, health indicators, preventive interventions, accessibility of healthcare and delivery services, continuum of care, disparity gap, digital divide, empowerment, vulnerable populations.

Purpose
This paper will examine the global impact of Information and Communication Technologies (ICTs) in health through the application of mobile devices targeting women and children in rural and remote regions in developing nations.

Background and Context

The Millennium Development Goals
Under the United Nation’s Millennium Declaration in 2000, 189 nations pledged on eradicating poverty, health inequalities, and multiple deprivations by 2015, which became known as the eight Millennium Development Goals (MDGs). The declaration was reaffirmed in 2010 to accelerate the progress of these goals, and since the resolution, noticeable improvements have been made in promoting human dignity, equality and equity to “all the world’s people, especially the most vulnerable and, in particular, the children of the world.” However, these efforts are not on track and are lagging behind in the investment on maternal, newborn, and child health (reduce child mortality and improve maternal health, MDG 4 and 5, respectively).

As we are getting closer in our attempts of achieving some of the MDG targets for 2015, global leaders are intensely working in collective action for solutions that will improve the conditions of women and children as it has become clear that this vulnerable group is lagging behind in terms of other health indicators, and are recognized as key in the advancement of all development goals. The emergence of regional and global partnerships, alliances, projects, and strategies investing women’s and children’s health is its cost-effectiveness and positive relationship in reducing poverty, stimulating economic productivity and growth, universal access to healthcare, and empowering women. Even though the MDG resolution and international treaties—International Covenants of Economic Social and Cultural Rights, the Convention on the Elimination of All Forms of Discrimination against Women, and the Convention on the Rights of the Child—recognize the fundamental human rights of these two interconnected groups and have spurred much-needed attention for immediate preventive policies, we are still off-track in bridging the gap in health outcome disparities.

---

MDG 4: Reducing Child mortality by two-thirds for children under-five by 2015

Albeit, considerable progress has been made world-wide in the reduction of child deaths, its current rate has fallen short of the MDG 4 target, with little-to-no progress in low and middle income economies—also referred to as developing countries according to the World Bank’s classification of economies in relation to information and communication technology analysis. Some of the accounting factors that illustrate where we are now are:

- Each year worldwide, nine to ten million children still die before they reach their fifth birthday, 2.6 million stillbirths occur, and about 3.3 million newborns die in their first month of life.8,9
- The highest rates of child mortality are found in Sub-Saharan Africa and Southern Asia where its progress is also ‘insufficient’ for the MDG target.
- Only 10 out of 67 countries where there is high child mortality are on track in reaching the target by 2015.

Every year millions of children die of diseases that could have been prevented if they and their mothers had access to early, high-quality care. Growing empirical evidence over the last decades have shown the interdependency of children’s health risks to detrimental reproductive patterns, such as maternal death or illness (i.e. transmitting chronic diseases, and lack of maternal care)10. In effect, children die from array of different causes—from infectious diseases to chronic diseases—but the leading killers are easily treatable with adequate sanitation and the availability of generic and cheap medications. In rural developing nations alone, 20 percent of children under the age of five die of conditions like diarrhea because of poor awareness, scarce medical and sanitation sources, and lack of local health services.11 The main causes of death among children under five years of age in 2008 were: Pneumonia (14%); Diarrheal diseases (14%); and neonatal (premature) (41%).12

MDG 5: Improve Maternal Health by three-quarters reduction in maternal mortality ratio and universal access to reproductive health

According to population-based studies and reports done by the World Health Organization (WHO) and the United Nations Development Programme (UNDP), poor maternal health has injurious consequences on children’s health and early development. According to the reproductive health chapter of Michael H. Merson’s book, Global Health, the results of various population-studies conducted in 1988 and 1994 state maternal death is “usually defined as a death of a woman while pregnant or up to 42 days post-delivery from any cause (except

---

12 “Millennium Development Goals: Where do we stand?”
accidents) [related to the pregnancy or management].”¹³,¹⁴ There are several causalities with maternal mortality and morbidity with prenatal/antenatal mortality risks (death of newborns in their first week of life) as a result of direct labor delivery-related consequences as well as the transmission of infectious diseases from the mother to the fetus.¹⁵ The former cause is the most common for maternal deaths and deaths of children under five, (as show in Figure 1 and 2), in which occur during labor and the first few weeks after birth—highest cause of death for newborns is preterm births by 21%, and for women is hemorrhage during labor by 35%—and highest risk setting for both is in institutional (birth) deliveries.¹⁶ Due to both serious pregnancy and childbirth complications, each year more than 350,00 women die—99 percent of which occur in developing nations.¹⁷,¹⁸

Maternal mortality, like child mortality, is highly avoidable, but some countries still are short in meeting the MDG 5 target. As mentioned earlier, the leading detrimental causes for maternal deaths are mainly preventable diseases during pregnancy, like hemorrhage (35%), hypertension (18%), obstructed labor (11%), and unsafe abortion and miscarriage (9%) (Figure 1). These diseases are preventable by simply offering access to healthcare/reproductive services and equipment, early detection, treatment from skilled healthcare workers, and educating the population. However, we still encounter slow growth and inequalities in maternal mortality rates—maternal mortality risk¹⁹ is higher in Sub-Saharan Africa than in developed regions, 1 in 30 in comparison to 1 in 5,6000, respectively.²⁰

**Underserved Demographic: socio-economic and geographic barriers**

Global awareness has accrued within an array of stakeholders towards improving the health conditions of poor women, children, and newborns in remote communities located in developing nations (low-middle income countries or LMIC). Women and children in LMICs face financial, social, and geographic challenges in accessing a continuum of care—starting from antenatal care to skilled assistance during delivery—and are subjected to the highest risk of poor pregnancy outcomes and mortality rates. This underserved group is exposed to higher incidences of morbidity and overall health risks because of their low-resource settings (functional hospitals and trained health professionals) and inaccessibility to life-saving care.

Studies have shown that poor women in developing countries have the lowest access to necessary and quality care—lowest use of hospitals for delivery, postnatal care, and life-saving interventions—especially in remote regions where there is low presence of skilled health workers and high maternal mortalities.²¹ According to a health indicators sample of selected developing

---

¹⁵ Ibid., 147.
¹⁷ USAID, *Collective Action to Advance the Health of Women and Newborns*, 1.
¹⁹ Definition according to *Global Health text*, 3rd ed, page 149, is a measure for maternal mortality “as the ratio of the number of maternal deaths to the number of pregnancies...denominator used is live births.”
and developed nations from the World Health Organization Statistical Information System (WHOSIS), showed that the former has higher infant mortality rates, maternal mortality ratio, and percentage of years of life lost due to communicable diseases as a result of defective health care systems.22 Due to these indicators, women are excluded from receiving cost-effective preventive interventions and health service at each stage of the care continuum (see Figure 3) that would greatly enhance their and their baby’s health outcomes. The Clinton Initiative thematic report states:

Only about 50% of women in low-income countries complete the recommended series of four antenatal care visits with a doctor or nurse to detect risk factors and manage problems. About 40% of women in developing countries give birth without a skilled attendant, such as a midwife, on hand. And although most maternal and newborn deaths occur during childbirth or in the immediate postnatal period, fewer than 40% of women have a postnatal visit by a skilled health worker.23

The Global Policy Challenge

As we get closer to the Millennium Development Goals, collaborations between key stakeholders at the public and private levels are accelerating the search for innovative interventions and outreach initiatives that will successfully close the disparity gap in quality of healthcare management—throughout the spectrum of reproductive, maternal, newborn, and child care—and preventive measures that do not exist or reach rural and disadvantaged communities in LMICs. National governments and international institutions, like the WHO, are shifting their focus towards the use of e-health (see Blaya et al, 2010)—“defined as the use of information and communication technologies (ICTs) in support of health and health-related fields”—as an effective tool in assisting and promoting the target health outcomes for women and children in developing nations.24

Telemedicine has been tried as one of the main tool for improving maternal, newborn, and child health (MNCH) to those in hard-to-reach and medically-underserved communities by providing them with efficient and timely primary health care services.25 Telemedicine26—the use of interactive audio-visual media, such as video-conferencing or telephony for medical purposes27—is making a significant impact in developing countries through the use of its mobile technology devices (mHealth).28 According to the ubiquitous presence of mobile devices in LMICs, funding constraints and slow progress in achieving the MDGs for MNCH, has given

---


26 See Table 1 for complete definitions of eHealth, telemedicine, and mHealth.


priority for innovative measures like mHealth as the complementary public health tool to address this global burden of disease.

**Methodology**

The approach this paper was to gather information and identify sources that contained either quantitative or qualitative studies, or both. The literature review consisted of peer-reviewed articles and journals, annual reports, working papers, statistical analyses, global surveys and interviews, agenda items, resolutions, and systematic evaluations. The searches for empirical and economic analysis specified in the areas of eHealth, telemedicine, mHealth, Millennium Development Goals, maternal and child health, developing nations, low-and-middle income countries, Information and Communication Technology (ICT), and broadband networks.

Between September 2011 and January 2012 the following sources were compiled: database portals (Royal Tropical Institute: mHealth in Low-Resource Settings, and MobileActive.org); Web 2.0 sites containing virtual communities and social professional networking sites (mHealth Working Group from k4health.org., Pan American Health Organization’s (PAHO) eHealth twitter, and Hub Health Unbound connecting communities); list servers and e-newsletters (PAHO/WHO’s Equity, mHealth, and Knowledge Management Communications email lists); and regional and global data collections and reports from online libraries and archives of International organizations, academic institutions, and philanthropic foundations (mHealth Alliance, WHO, United Nations Children’s Fund (UNICEF), World Bank, International Telecommunication Union, The Partnership for Maternal, Newborn & Child Health, GMSA Development Fund, International Development Research Centre, Inter-American Development Bank, The Bill & Melinda Gates Foundation, and the Rockefeller Foundation). Additional supporting information, specifically addressing reproductive, maternal, and early child health came from the book *Global Health 3rd Edition* by Michael H. Merson et al.

The collection of higher-quality evidence-based publications, containing randomized controlled clinical trials, cohort and prospective studies, and meta-analysis, for the evaluation of different platforms of mHealth interventions in developing countries were accessed through the Lancet, Pubmed, and Medline. Reviews and publications that were consulted as guiding sources in analyzing systematic reviews were: Health Affairs article on *E-Health Technologies Show Promise in Developing Countries*; CMAJ publication on *Assessing telemedicine: a systematic review of literature*; Patricia Mechael’s *Barriers and Gaps Affecting mHealth in Low and Middle Income Countries: Policy White Paper*; and Karin Kallander’s working paper, *Landscape analysis of mHealth approaches which can increase performance and retention of community based agents*.

The system for rating the strength and quality of each of the 38 sources used in this document was ranked in the hierarchical order of: A or excellent (benefits are greater than the risks); B or good (benefits are greater or equal to risks); and C or indifferent (benefits are equal to risks). The common criteria used for the evaluation were utilization, policy significance, ethics, and bias. Out of the 38 literature sources in this report, 18 were basic or fundamental research that was not considered in the system for grading high-quality literature. The resulting 20 were categorized as applied research and were categorized into the three main categories: experimental studies; quasi-experimental studies; and systematic reviews. Experimental studies are the accepted conventional design for scientific evidence-based analysis because of its meticulous and superior methodology (i.e. randomized critical trials). Under this category, three sources were identified as excellent. For quasi-experimental or observational studies, their findings face more bias due to their subjects not being randomly assigned as the latter. However,
because it doesn’t employ assigned randomization, operational studies don’t violate ethical standards (i.e. prospective cohort study, regression analysis; and survey methodology). Fourteen of the literature references fell into this category and were marked as good. The final three documents were classified as systematic reviews (i.e. meta-analysis and white papers) and were graded as indifferent—in comparison to the previous categories. The Agency for Healthcare Research’s “Rating the Strength of Scientific Research Findings Fact Sheet”29 and Peter H. Ross’ book, Evaluation: A Systematic Approach Seventh Ed. 30 was utilized as frameworks and guiding sources for formulating this document’s literature evaluations.

The methodology terms used included, eHealth, mHealth, and telemedicine, followed the descriptions stated in PAHO/WHO’s Strategy and Plan of Action on eHealth Provisional Agenda Item that was passed in August 1, 2011 in the 51st Directing Council of the 63rd Session of the Regional Committee31. This formal document states that telemedicine (or telehealth)—“involves the delivery of health services using ICTs, specifically where distance is a barrier to health care—and mHealth (or health through the mobiles devices)—“medical and public health practice supported by mobile devices”—are all components of eHealth defined as “the cost-effective and secure use of [ICTs] in support of health and health-related fields…” The document also frames telemedicine as a function of as well as a counterpart to eHealth. The research of this paper followed these guidelines and used sources that had the same or similar definitions and connotations of these terms.

Results and Discussion

Since mHealth was stated as one of the key innovations to achieving the goals set out in the United Nations and WHO’s new Global Strategy for Women’s and Children’s Health launched in 2010, there has been a rapid integrations of its services as a result of the immense penetration of mobile telephony coverage in developing nations32: “The mobile phone … is the first ICT tool that has reached even remote areas in [LIMCs].”33 The deployment of these new ICTs for health present a powerful opportunity for populations that formerly were part of the digital divide and now are connected to more effective treatments and service delivery. Mobile technology has proven to be extremely valuable to societies in developing countries, regardless the topic area of development applications. 34 The International Telecommunication Union’s (ITU) 2010 world statistics state that over two-thirds (70%) of the world’ five billion mobile subscribers reside in LMICs, and 80 of the 90 percent living in rural areas have access to mobile

---

networks.\textsuperscript{35,36} The United Nations also acknowledges the unprecedented potential of mHealth and estimates that by 2012, half of the people living in remote areas will have mobile phones.\textsuperscript{37}

The emerging applicability and interest in mHealth as a platform for strengthening systems and achieving health-related MDGs is manifested in documented literature reviews, program evaluations, and surveys of more than 100 nations that report using this innovative technology. WHO Global Observatory for eHealth survey shows that the majority (83\%) of its Member States report using at least one type of mHealth service, and for the most frequently reported initiatives mobile telemedicine was at 49 percent.\textsuperscript{38} Depending on a nation’s development status, different types of ICTs will be applied in correlation to their priority setting and technological capabilities.\textsuperscript{39}

For MNCH in rural and remote areas in developing countries, mobile devices play a vital role to services related to their continuum of care: “…can dramatically improve the efficiency of healthcare delivery models, from simple text message reminders, to improving complex supply chain processes in remote areas…to improving patient care, offering medical professionals the ability to collect real-time diagnosis for clinical trials…and providing healthcare workers access to information so that they can treat patients more effectively.”\textsuperscript{40}

\textit{mHealth initiatives and programs for MNCH}

The selections of mHealth demonstration projects for analysis were chosen from LMICs in Latin America, Sub-Saharan Africa, East Asia and Pacific, and South Asia. The World Bank’s 2011 data report of ICTs was used as a guide for the selection of countries based on its classification of income: gross national income (GNI) per capita of $995 or less in 2009 are low-income economies, and GNI per capita of more than $995 but less than $12,196 are middle-income economies.\textsuperscript{41} For the following mHealth interventions, several components were analyzed: scenario, innovation, players, approach, and evidences of health solutions.

The evidence for each mHealth initiative was produced from quantitative and qualitative studies. The case reviews under qualitative studies were a combination of grey literature and publications. Uganda’s 1996 (RESCUER) telemedicine project was a retrospective study conducted in 1999 to investigate the effect of simple mobile devices on maternal health care after its implementation.\textsuperscript{42} The rest of the literature reviews were evaluations conducted by private consulting firms for annual reports released by international organizations as seen in the

\begin{itemize}
  \item \textsuperscript{35} \textit{mHealth: New horizons for health through mobile technologies; Based on the findings of the second global survey on eHealth}, 19.
  \item \textsuperscript{37} United Nations Secretary-General, \textit{Global Strategy for Women’s and Children’s Health}, 10.
  \item \textsuperscript{38} \textit{mHealth: New horizons for health through mobile technologies; Based on the findings of the second global survey on eHealth}, 10.
  \item \textsuperscript{39} Vital Wave Consulting, \textit{mHealth for Development: The opportunity of Mobile Technology for Healthcare in the Developing World} (Washington, DC and Berkshire, UK: UN Foundation-Vodafone Foundation Partnership, 2009), 9, \url{http://www.mobileactive.org/files/file_uploads/mHealth_for_Development_full.pdf}.
  \item \textsuperscript{40} Tim Jones et al., \textit{Vodafone mHealth Solutions/Evaluating mHealth Adoption Barriers: Human Behaviour; Insight Guide}, Vodafone Health Debate (Newbury, England: Vodafone, 2011), 8, \url{http://mhealth.vodafone.com/health_debate/insights_guides/}.
  \item \textsuperscript{41} \textit{The Little Data Book on Information and Communication Technology 2011}, 9.
  \item \textsuperscript{42} Maria G.N. Musoke, “Simple ICTs reduce maternal mortality in rural Uganda: A telemedicine case study; Bulletin No.85,” \textit{Medicus Mundi Switzerland}, July 2002, \url{http://www.medicusmundi.ch/mms/services/bulletin/bulletin200202/kap04/16musoke.html}.
\end{itemize}
following cases: Senegal’s pilot project that used web and mobile phone-based technology for maternal health data collection (interview evaluation); Peru’s Nacer project that connected remote healthcare workers with other health professionals while providing diagnostic referrals and real-time access to health records; and Guatemala’s TulaSalud program that empowers indigenous communities by offering its indigenous nurses connectivity with health centers for advice, remote health training, and diagnostic and treatment support. The qualitative studies selected for review were: South Africa’s Project Masihambisane cluster-randomized controlled trials, Thailand’s prospective and cohort study on its community-based module in its Thai-Myanmar border; and Gambia’s case-control study using log-book evaluations to enhance its emergency ambulance service system (please refer to Table 2 for complete analysis of these cases).

The rest of the case analyses did not have evidence-based documentation because they are currently pilot studies or local projects that recently started operating and are small in scale. The evaluation of these projects and programs are presently in operation and receiving international recognition. Pakistan’s Lady Health Worker pilot project is aiming to empower midwives or community workers in remote areas by bringing them low-cost mobile communication devices to help them access emergency consultation by bridging the gap in communication. The cross-country pilot projects in the Philippines, Pakistan, and Indonesia, funded by International Development Research Center, are testing the effectiveness of mobile phone solutions through Short Message Service (SMS) messaging to promote prenatal care and offer insight into higher scale interventions. Lastly, the Millennium Villages Project’s program, ChildCount+, which targets much of Sub-Saharan African children through epidemiological monitoring (malnutrition, malaria, among others) and reporting alert systems.

Software development was a crucial component for success in the deployment of mHealth programs in each of the cases. The mobile technologies implemented, either simple SMS or EpiSurveyor, are innovative devices that are inexpensive, simple, and available—open-source software therefore requires no purchase licenses—through one-way or two-way communication systems.

A common simple no-cost tool, primarily used in African countries, is a web and mobile based device called EpiSurveyor that allows its health workers to download and fill in forms and send them to a central database to be analyzed and synthesized in real time. EpiSurveyor makes it simple to collect epidemiological or other data on common mobile phones, handheld devices (personal digital assistant or PDAs), and smart phones. Even though it only requires basic cell phone skills to use, it is effective in low-resource settings and versatile for immunization and emergency responses because of its included features: automated chart and graphs analysis,

43 mHealth: New horizons for health through mobile technologies, 44-46.
45 mHealth Education: Harnessing the Mobile Revolution to Bridge the Health Education & Training Gap in Developing Countries, mHealthEd 2011, 5.
reporting by email, and upload data via SMS. Examples of programs using this mobile technology are: Thailand’s smart phone application to improve MNCH by focusing on antenatal care (ANC), immunization program, and prevention and treatment of malaria outbreaks along the border; and Senegal’s handheld devices (PDAs) loaded with this software that community health workers (CHWs) used to expedite health data collection to their Ministry of Health (MoH). Another two-way communication application is RapidSMS that “empowers stakeholders with a dynamic tool for advanced data collection, analysis and communication that is fast, efficient, and accurate.” The Millennium Villages Project’s ChildCount+ in Sub-Saharan Africa applied this application for community health reporting and alert systems to reduce gaps in treatment. In both Peru’s Nacer and Guatemala’s TulaSalud programs, Rapid SMS was implemented to assist and empower their CHWs by giving them the ability to provide referrals, follow-up care, and monitor disease outbreaks on real-time access (TulaSalud used both RapidSMS and EpiSurveyor tools).

SMS Frontline is another SMS-based communication tool that can be set up as one-way alerts or interactive tools for maternal and reproductive health education and communication. South Africa’s Project Masihambisane used this tool to assist peer mentors in collecting routine information, completing questionnaires, and maintaining contact with pregnant mothers living with Human Immunodeficiency Virus (HIV). In Gambia, mobile phones were equipped with SIM cards (donated by Gamcel, a network company) to enable Traditional Birth Attendants (TBAs) and Village Health Workers (VHWs) to contact emergency ambulance service for high-risk pregnancies and obtain access to surgical obstetric care. Pakistan’s Lady Health Workers (LHW) original scheme, launched in 1994, were set out to be primary health care providers in rural, remote districts, nonetheless they still faced challenges in preventing high mortality and infant rates due to their lack of communication and delays in accessing emergency care. As a result, a joint effort was initiated between international organizations (GMSA Development Fund and United Nations Population Fund), MoH, and the network company, Mobilink, to distribute low cost mobile handsets containing prepaid SIM cards to support, monitor, and regulate LHW services.

The review of each country’s mHealth program illustrated not only the global popularity and trend of mobile telephony towards MNCH through the use of innovative software developments, but as well as in the participation of its multiple players.

All the evaluated case studies were implemented and carried out through the collaboration of multiple players across sectors (public, private, for-profit, and non-profit) and levels (national, regional, and international). In each mHealth project, joint forces were present with their own important role to play, ranging from sponsors, philanthropic foundations, non-governmental organizations (NGOs), international organizations, development banks, professional associations, multilateral institutions, national and regional agencies, private providers, and so on. The most successful initiatives that harnessed the strongest potential in impact assessment were the coordinated actions between public and private partnerships; each with distinctive incentive structures for the same mHealth solutions for this underserved demographic. This joint action was present in diverse scenarios as seen in the following examples: Gambia’s formal partnership between its MoH, the WHO, Maternal Childhealth Advocacy International, the Advanced Life Support, and the mobile phone network provider

Gamcel; and the global initiative, Mobile Alliance for Maternal Action (MAMA), between the collective efforts from its founding partners—United States Agency for International Development (USAID) and Johnson & Johnson—and supporting partners—United Nations Foundation, mHealth Alliance, and BabyCenter LLC—in deploying mobile health programs in Bangladesh, India, and South Africa.  

Policy and Ethical Implications

Women and children should be a priority in the global and national agenda; although MNCH are essential to socio-economic progress around the world and are the gateway to improving the health of entire populations and future generations, they still face the greatest health inequities and vulnerabilities. MNCH is an investment to a sustainable society due to their contribution to the well-being of families and the development and productivity in communities. This is especially true to LMICs like Uganda—women constitute 60 to 80% of the labor force in agriculture—where women also play a crucial role in the productive sector but are burdened with otherwise preventable ill-health.

The subsequent recommendations contain key building blocks for success and learnt lessons from the previous identified projects, and from a collection of global frameworks and models towards the planning and development of sustainable and effective mHealth initiatives. Prior to tailoring policy considerations for LMICs, the World Bank’s income group evaluation results on implementation barriers were taken into account. In the commitment to maximizing the impact of mHealth towards women and children in LMICs, the following top barrier trends were used to formulate the recommended policy guidelines: policy, knowledge, and managing conflicting health priorities; and specifically for low-income countries was operating costs and lack of infrastructure. The recommendations below are strategic approaches that encourage the alignment of mHealth technological solutions to MNCH’s Millennium Development Goals in the strengthening of local health systems:

**Public Private Partnership (PPP) Models.** PPP allows greater innovation and efficiency when available resources are limited, and when dealing with technological innovations that are often too expensive and complex to apply in rural ecosystems. Due to the expansive presence of PPs in developing nations, recent studies have gathered comprehensive lists of successful models—Private sector social responsibility model, Product-development partnership (PDP), and Global and national public-private partnerships—that perform service delivery, financing, supply and contracting, and self-regulation.

**Broadband Infrastructure.** Broadband inclusion has given women, especially in rural and remote areas, easier access to information on various reproductive health issues—two out of

---


52 Maria G.N. Musoke, “Simple ICTs reduce maternal mortality in rural Uganda.”

53 mHealth: New horizons for health through mobile technologies; Based on the findings of the second global survey on eHealth, Global Observatory for eHealth series, 67-69.

three new mobile subscribers are women\textsuperscript{55}—and established networks that empower and connect health workers with its community. Although there are burgeoning implications of ICT innovations as drivers of economic progress—for every 10 percent increase in broadband penetration it is expected an average of 1.3 percent additional growth in national gross domestic product (GDP)\textsuperscript{56}—it can also be the causation of inequity in rural environments. Therefore it is imperative to understand the “value chain models for mHealth”\textsuperscript{57} that identifies the relationship between the collaboration of multiple players to leverage simultaneous ethical and professional business models and market-led approaches. In turn, this will incentivize “adequate returns on broadband investment at minimum income levels with maximum spill-over benefits across multiple sectors of the local society and economy.”\textsuperscript{58}

**Long-term Funding.** Spending on MNCH is an investment not just a cost, but to sustain the progress of self-sustaining programs and operational capacity building a funding platform is vital to sustaining its fixed and rising costs. The Health Systems Funding Platform is being implemented by the GAVI Alliance, the Global Fund, and the World Bank, facilitated by the WHO, as a mechanism to support countries’ national health strategies and systems that are striving to reach MDG targets by offering the management and mobilization of existing and new international resources.\textsuperscript{59}

**Evaluations.** Evaluations on cost-effectiveness are a requirement for mHealth initiatives in order for them to become a program priority when health systems deal with various challenges, ranging from a limited budget to a shortage of health workers. This tool offers high-quality evidence that can set goals and benchmarks for policy formulation, public awareness on mHealth, and determine cost and benefit outcomes oriented for funding expansion. An available evaluation framework tool for mHealth programs is the Global Observatory for eHealth (GOe), a developing global database with measurable indicators and selected evaluation research findings with emphasis on developing countries.\textsuperscript{60}

**Ethical considerations**

An effective policy must address legitimate issues in the implementation of mHealth interventions for its maturity and scalability. Security concerns will arise when applying two-way communication software that contains patient’s personal data files. Policymakers and managers must be aware of these security issues and keep these activities strictly accessed with the authorization and informed consent. The WHO, in collaboration with ITU, are providing guidance to member states on the scope of data privacy and security policy in regards to the application of mobile telephony in health.\textsuperscript{61}

In regards to patient consent, the consultation of female patients by male health professionals is a critical concern because of the underlying cultural norms that may not allow these interactions to take place. The global problem of unequal distribution of health care


\textsuperscript{57} Vital Wave Consulting. mHealth for Development, 33.

\textsuperscript{58} A 2010 Leadership Imperative: The Future Built on Broadband; A Report by the Broadband Commission. 18-19, 32.

\textsuperscript{59} The Partnership for Maternal, Newborn & Child Health, Every Woman Every Child: Investing in our Common Future, 15.

\textsuperscript{60} mHealth: New horizons for health through mobile technologies; Based on the findings of the second global survey on eHealth, 11.

\textsuperscript{61} Ibid.
practitioners between urban and rural regions, with its severe consequence for the availability and quality of health services, aggravates the severity of this particular issue. With this in mind, the next step to consider may be the implementation of models that focus on antenatal care in rural populations such as the Human Development Model by the National ICT R&D Fund and Next Generation Intelligent Networks Research Center that centers on a community health team of TBAs, LHW, and lady health visitors (LHV) to assist doctors in all community based activities (i.e. provision of maternal child health care at home).  

At the community level, mHealth deployment must be approved by the local staff, especially when dealing with factors that may be ostracized within the community, such as dealing with pregnant mothers that are HIV positive or traditions that may prevent women from seeking or receiving care during delivery.

Conclusion

Women and children in rural developing nations have endured several limitations in obtaining adequate and accessible healthcare services during their continuum of care, but now we are seeing a significant emergence in the national and international community’s joint commitment to improve their safety and well-being. As we are getting closer to achieving the MDG targets for 2015, the limited progress and investment towards the health indicators for reducing child mortality and improving maternal health has catapulted innovative platforms like mHealth toward providing new opportunities in reenergizing the local and global community in eliminating their disparity gap in the quality of care and service delivery. Although there is a rapid penetration and interest of mHealth services and mobile telephony in developing nations, it is necessary for the amalgamation of strategic approaches and key building blocks in its interventions for its success as an effective tool in: the promotion of health outcomes for MNCH; the strengthening of local health systems; and in the achievement of health-related MDGs.

The recommendations for the development of sustainable and scalable mHealth initiatives for their effective impact on women and children’s health in LMICs were formulated after the comprehensive evaluation and analysis of available quantitative and qualitative studies and lessons learned on mHealth demonstrations in these targeted regions. The following policy guidelines are substantial in covering the areas of research, high quality and cost-effective clinical evidence, sustainable and scalable programs, and high-cost capacity building: the integration of Public Private Partnership Models; the implementation of broadband infrastructure; the allocation of long-term funding; and the elaboration and expansion of rigorous evaluations.

With the help of pioneering preventive and medical measures like the use of ICT for health through mobile applications, and the collaborative action between multiple stakeholders, mother’s and children’s health has become the forefront in the global development agenda and a pressing priority in national health programs. The mHealth Summit held in Washington D.C., from December 5-7, 2011, highlighted and awarded the continued effort and success of national mobile health projects in developing nations: “from providing maternal and newborn health information via mobile phones to building technology that supports clinical decision

---

making...these initiatives all focus on helping the world’s most vulnerable populations lead a healthier life.”

Limitations/Bias
The general assessment drawn on mHealth programs for marginalized communities in LMICs is that they lack strong substantive cost-benefit analysis, are scarce on empirical evidence for funding solution strategies, and are still small-scale implementations. At the moment, the majorities of these initiatives are at the pilot stage and lack measurements of clinical outcomes, implemental validity, cost-effectiveness research, long-term follow-up, and rigorous impact assessment studies. The consensus for the barriers and challenges inhibiting strong favorable conclusions towards mobile-based health solutions is related to scalability and sustainability:
“The integration of mobile health for prenatal and newborn health services has demonstrated positive outcomes, but the sustainability and scalability of operations requires further feedback from the evaluation of ongoing programs.”

The accessibility of mobile technology and the variety of documentation (qualitative and quantitative) makes it difficult to form a complete overview of projects, its intervention’s effectiveness, and a definitive policy for obtaining funding assistance. However, even with the lack of evidence-based research in this pioneering field, there is a growing base of grey literature and scientific publications that suggest “mHealth as a promising development for the provision of improved healthcare services to poor people and to those living in marginalized areas.”

---

66 Royal Tropical Institute, “What is mHealth?”
Bibliography


Appendix A

Figure 1: Causes of Maternal deaths and deaths of children under five


Figure 2: Mortality risk for mothers and children over the continuum of care

Appendix B

Figure 3: The Reproductive, Maternal, Newborn, and Child Health continuum of health care

Table 1: Comprehensive definitions for E-health, Telemedicine, and mHealth

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-health</td>
<td>“Describes the application of information and communications technologies [ICT] across the whole range of functions that affect the health sector. Includes tools for health authorities and professionals as well as personalized health systems for patients and citizens. …It can also include health information networks, electronic health records, telemedicine services, and personal wearable and portable communicable systems for assisting the prevention, diagnosis, treatment, and health monitoring and lifestyle management of patients.”</td>
</tr>
<tr>
<td>Telemedicine</td>
<td>“Is the overarching definition covering Telehealth, Telecare, mHealth, and Teledisciplines…It can be defined as the delivery of healthcare services through the use of ICTs in a situation where the actors are not at the same location. The actors can be either two healthcare professionals or a health care professional and a patient…includes all areas where medical or social data is being sent/exchanged between at least two remote locations, including both caregiver to patient/citizen as well as doctor to doctor communication.”</td>
</tr>
<tr>
<td>mHealth</td>
<td>“Also written as m-health, is the use of mobile communications-such as personal digital assistants and mobile phones—for health service and information. A subset of telemedicine. Application ranges from SMS medication reminders to collecting community and clinical health data, delivery of healthcare information to practitioners, researchers, citizens and patients, real-time monitoring of patient vital signs, and direct provision of care.”</td>
</tr>
</tbody>
</table>
### Table 2: Three Quantitative case studies on mHealth application and evidence in LMCs

<table>
<thead>
<tr>
<th>Country</th>
<th>Application</th>
<th>Innovation</th>
<th>Approach</th>
<th>Players</th>
<th>Evidence</th>
<th>Feasibility and scalability impact</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thailand</td>
<td>Outreach; education/health promotion; alerts/follow-ups; data collection; remote monitoring; and diagnosis.</td>
<td>One-way communication (Simple and Frontline SMS alerts for immunization follow ups). Two-way communication (Rapid SMS).</td>
<td>Community-based module with “Better Border healthcare program” for mother and child care. Smart phone application as health communication tool to improve antenatal care and expand program immunization (EPI) services (schedule reminders) for pregnant Thai and non-Thai women (migrants or permanent residents) living at Thai-Myanmar area.</td>
<td>Thailand’s Ministry of Public Health; WHO; healthcare providers; and regional healthcare clinics.</td>
<td>Prospective (before-after design with no controls)-and cohort study.</td>
<td>Successful in integrating antenatal care and EPI operations in rural and remote areas. Study revealed it could enhance mother and child health in rural areas, can be adaptable to different settings, and expanded to larger scale implementations.</td>
<td>Jaranit, Kawekungwal, et al., “Application of smart phone in “Better Border Healthcare Program”: A module for mother and child care,” <em>BioMed Central Public Health</em> 10 (2010): 69, <a href="http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2989931/?tool=pubmed">http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2989931/?tool=pubmed</a></td>
</tr>
</tbody>
</table>