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mHEALTH COMPENDIUM

VOLUME THREE | TECHNICAL REPORT



November 2013

This publication was produced for review by the United States Agency for International Development. It was prepared by the African Strategies for Health project.

mHEALTH COMPENDIUM

VOLUME THREE

DISCLAIMER

The authors' views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government

mHEALTH COMPENDIUM CASE STUDIES, VOLUMES 1, 2 & 3

The mHealth Compendium documents a range of mHealth applications implemented throughout Africa and, in some exceptional cases, in other regions of the world. This summary synthesizes and highlights case study material to help USAID missions and other interested parties identify and access information contained within the Compendiums.

85 CASE STUDIES

covered five programmatic areas:

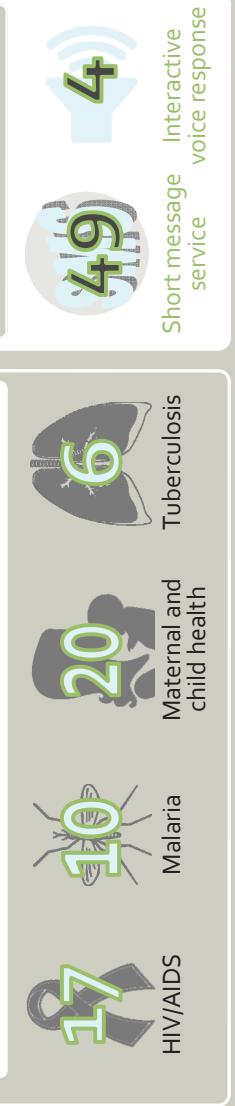
- 18 BEHAVIOR CHANGE COMMUNICATION**
- 17 DATA COLLECTION**
- 14 LOGISTICS**
- 18 BASIC MOBILE PHONE WHILE REQUIRED**
- 14 BEHAVIOR CHANGE COMMUNICATION**

THE MAJORITY OF mHEALTH PROJECTS ONLY

- 21** projects utilized smartphones and **7** utilized tablets



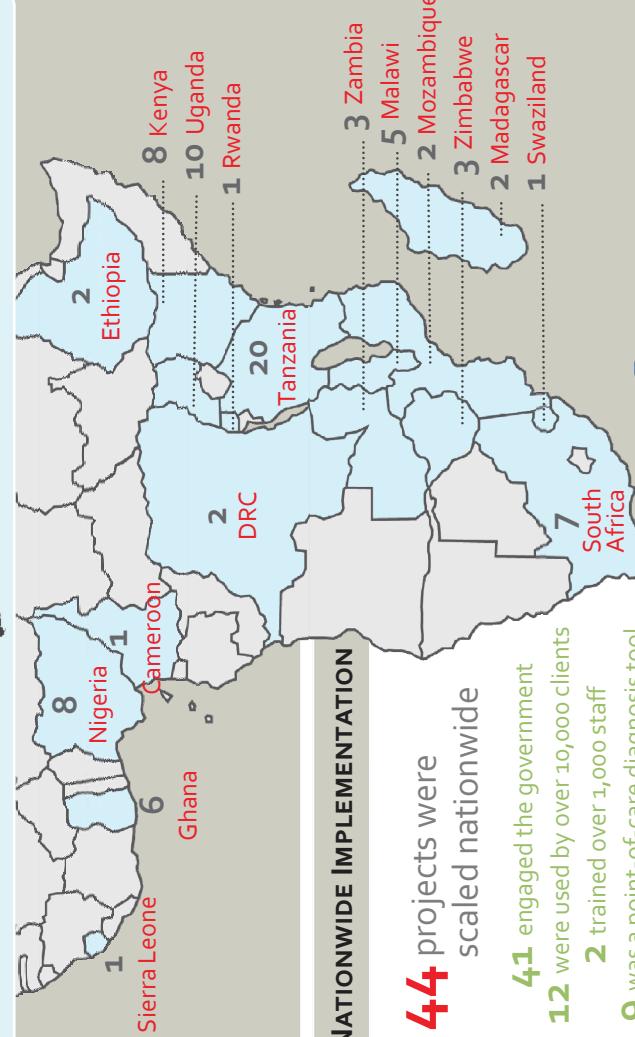
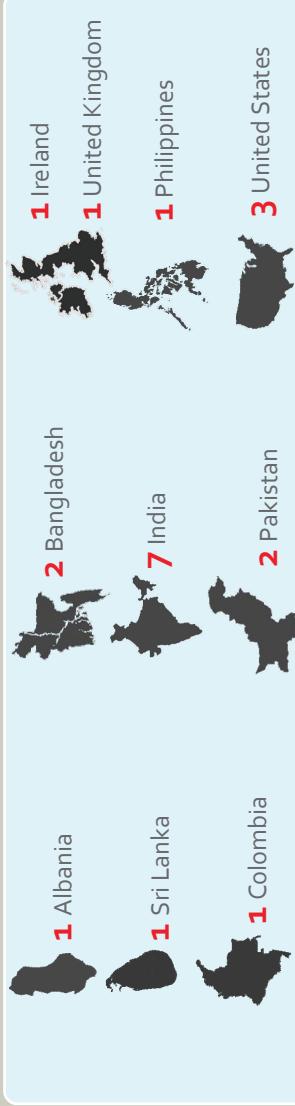
...AND COVERED THE FOLLOWING PROGRAM TYPES...



...AND FUNCTIONS.



GEOGRAPHIC LOCATION



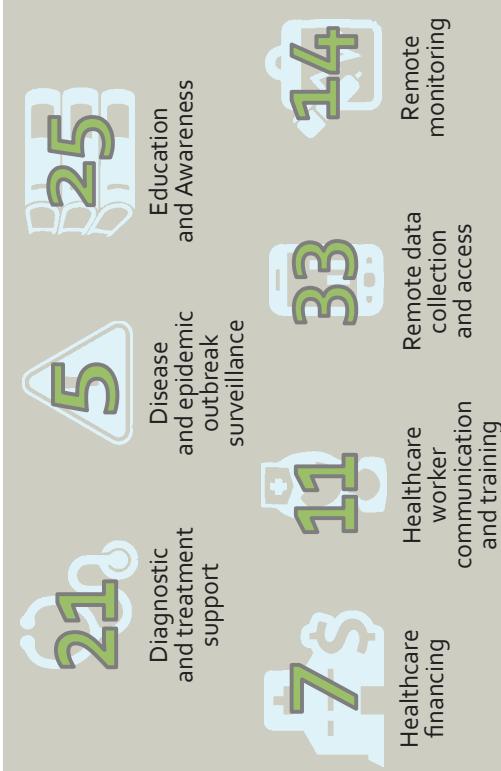
NATIONWIDE IMPLEMENTATION

- 44** projects were scaled nationwide
- 41** engaged the government
- 12** were used by over 10,000 clients
- 2** trained over 1,000 staff
- 9** was a point-of-care diagnosis tool
- 13** were a supply chain management tool

The African Strategies for Health Project



CASE STUDIES ADDRESSED VARIOUS APPLICATION



The African Strategies for Health (ASH) project is a five-year contract funded by the United States Agency for International Development (USAID). ASH works to improve the health status of populations across Africa through identification of and advocacy for best practices, enhancing technical capacity, and engaging African regional institutions to address health issues in a sustainable manner. ASH provides information on trends and developments in the continent to USAID and other development partners to enhance decision making regarding investments in health.

November 2013

For additional copies of this report, please email info@as4h.org.

This document was submitted by the African Strategies for Health project to the United States Agency for International Development under USAID Contract No. AID-OAA-C-II-0016 .

Recommended Citation: Gayle Mendoza, Lungi Okoko, Sarah Konopka and Edna Jonas. November 2013. *mHealth Compendium, Volume Three*. Arlington, VA: African Strategies for Health project, Management Sciences for Health

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ACKNOWLEDGEMENTS

This technical report was produced by the African Strategies for Health (ASH) project in collaboration with the United States Agency for International Development's Africa Bureau (USAID/AFR). Funded by USAID/AFR, the overall objective of ASH is to contribute to improving the health status of populations across Africa through identification of and advocacy for best practices, enhancing technical capacity, and engaging African regional institutions to address health issues in a sustainable manner. ASH provides information on trends and developments across the continent to USAID and other development partners to enhance decision making regarding investments in health.

Gayle Mendoza, Sarah Konopka, Lungi Okoko and Edna Jonas all contributed to the production of this document. We extend our thanks to USAID, in particular, Senior Health Adviser Ishrat Z. Husain, and Program Analyst Kaitlyn Patierno from the Africa Bureau, as well IT/KM Advisor Peggy D'Adamo and Adam Slote from the Global Health Bureau, for their support and inputs.

We are grateful for both the mHealth Working Group and the mHealth Alliance and their staff. The mHealth Working Group provided a readily available platform for engaging with project implementers and for exchanging mHealth project information, and the mHealth Alliance recommended projects to be included and shared valuable information about mHealth interventions not featured in the first two editions.

Our thanks also goes to the people and organizations whose mHealth applications are featured in this paper. They are pioneers in creative and useful mHealth applications that are designed to improve health systems and achieve health goals. We realize that there are many more people world-wide who are actively involved in mHealth applications for health. While time and budgetary constraints did not permit a more extensive review, we would like to acknowledge them for their own contributions to the field.

ACRONYMS AND ABBREVIATIONS

Acronym/ Abbreviation	Description
AIDS	Acquired Immunodeficiency Syndrome
ANC	Antenatal Care
ASH	African Strategies for Health
BCC	Behavior Change Communication
CDC	U.S. Centers for Disease Control and Prevention
CHW	Community Health Worker
CVD	Cardiovascular Disease
DFID	UK's Department of International Development
DHIS	District Health Information System
eHealth	Electronic health
GPRS	General Packet Radio Service
GPS	Global Positioning System
HHS	U.S. Department of Health and Human Services
HIPs	High Impact Practices
HIS	Health Information Systems
HIV	Human Immunodeficiency Virus
HMIS	Health Management Information System
ICT	Information and Communication Technology
IDRC	International Development Research Center of Canada
IT/KM	Information Technology / Knowledge Management
K4H	Knowledge for Health
MCH	Maternal and Child Health
MDGs	Millennium Development Goals
mHealth	Mobile health
MNCH	Maternal, Neonatal and Child Health
MOH	Ministry of Health
NGO	Non-Governmental Organization
NMCP	National Malaria Control Program
RFID	Radio Frequency Identification
SD	Secure Digital
SIM	Subscriber Identity Module
SMS	Short Message Service
USAID	United States Agency for International Development
USAID/AFR	USAID's Africa Bureau
USSD	Unstructured Supplementary Service Data
WHO	World Health Organization

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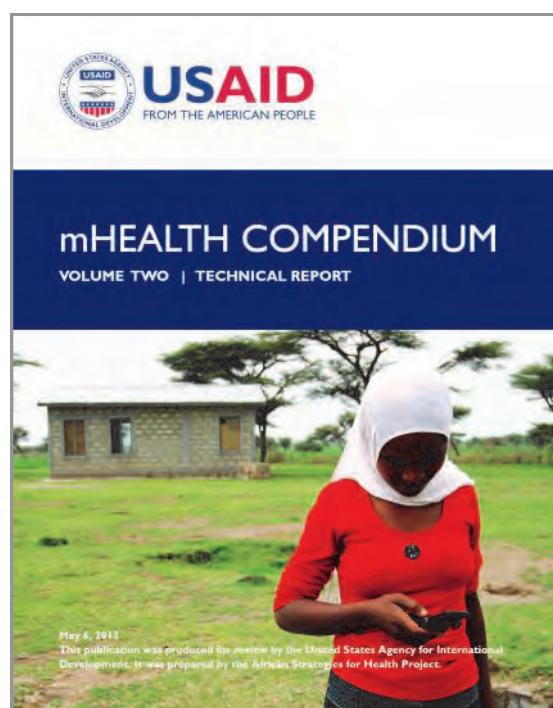
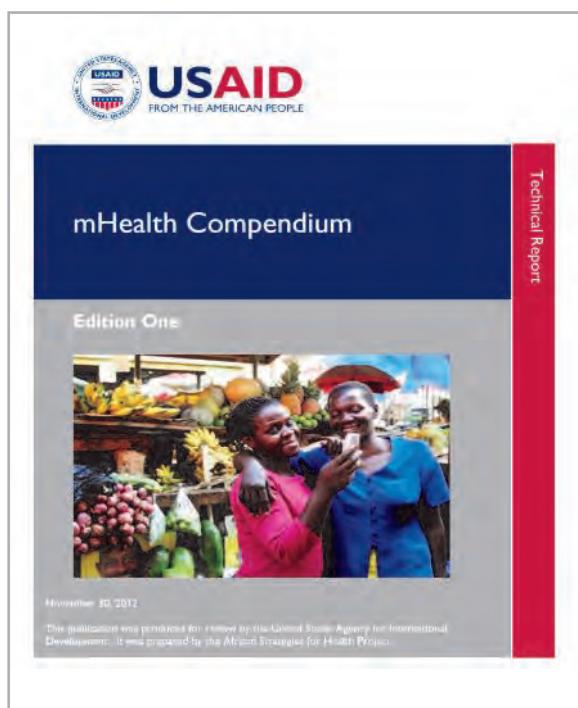
EXECUTIVE SUMMARY

Mobile health (mHealth) is the provision of health services and information via mobile and wireless technologies. Within Africa the mobile phone has become ubiquitous, making mHealth applications an important tool with which to impact the health of Africans. When applied correctly, mHealth can make real contributions to improved health outcomes. mHealth has the potential to address and overcome: (1) disparities in access to health services; (2) inadequacies of the health infrastructure within countries; (3) shortage of human resources for health; (4) high cost of accessing health; and (5) limitations in the availability of financial resources.

This third volume of the mHealth compendium contains 24 new case studies which document a range of mHealth applications being implemented mainly throughout Africa, but also in other regions. A number of mHealth interventions featured in this compendium seek to contribute to USAID's two overarching objectives of *eliminating preventable maternal, newborn and child deaths* and achieving an *AIDS free generation*. Of the 24 case studies, 2 case studies focus on mHealth applications are part of HIV/AIDS programs and 17 are part of programs providing maternal, newborn and child health services.

In order to help USAID missions access relevant mHealth information, this compendium offers project descriptions, publication references and contact information for making further inquiries. Each two-page case study includes an introduction to the health area or problem; a description of the mHealth intervention highlighted; a description of any important results or evaluation findings; lessons learned; and conclusion. In addition, the second page includes a summary of the geographic coverage, implementation partners, and donors, as well as contact information for the implementing partner and donor. The case studies in this compendium have been organized within five programmatic areas: Behavior Change Communication, Data Collection, Finance, Logistics, and Service Delivery.

The first and second volumes of the mHealth Compendium can be downloaded at <http://www.msh.org/resources/infographic-mhealth-compendium-case-studies-volumes-1-2>.



WHAT IS mHEALTH?

eHealth vs mHealth

eHealth is defined by the World Health Organization (WHO)¹ as the cost-effective and secure use of information and communications technologies in support of health and health related fields, including health care services, health surveillance, health literature, health education, knowledge and research. eHealth is a general term which includes four distinct but related components.

- Mobile Health (mHealth): Provision of health services and information via mobile and wireless technologies.
- Health Information Systems (HIS): Systems to gather, aggregate, analyze and synthesize data from multiple sources to report on health; can include information related to patient records, disease surveillance, human resources, management of commodities, financial management, service delivery and other data needed for reporting and planning purposes.
- Telemedicine: Provision of health care services at a distance; can be used for inter-professional communication, patient communication and remote consultation.
- Distance Learning (eLearning): Education and training in electronic form for health professionals.

This compendium is focused solely on the mHealth component of eHealth. For the purposes of this paper mHealth includes mobile phones, Personal Digital Assistants (PDAs), tablets, mobile applications and wireless medical devices.

WHERE IS THE EVIDENCE FOR mHEALTH?

With more than 6 billion mobile phone subscribers in the world — including 433 million users in Africa — health sector actors are excited about the opportunities offered by mHealth in terms of improving the quality of care, access to health services and health outcomes. Although still limited, the amount of evidence about the effectiveness or efficacy of mHealth interventions has recently begun to increase. In recent years, there has been a significant upsurge in mHealth focused health outcomes research — including a few studies published in the Lancet — and reviews aimed at synthesizing the evidence. Some reviews of mHealth studies, such as the February 2013 article by Tomlinson et al. and a 2011 World Bank report, point to the lack of high quality and peer reviewed randomized trials to conclude that little is known about the impacts of mHealth interventions.^{2,3}

However, the mHealth research landscape is evolving rapidly. Of the 215 unique registered studies found by a recent review of mHealth research projects on the US Government federal clinical trials tracking system,⁴ “40 new studies were added to this database in the six-month period between May and November 2012 alone.”⁵ The mHealth Alliance’s *mHealth and MNCH: State of the Evidence* report concludes that the increase in rigorous mHealth research has been remarkable, calls for greater investment of resources in studying the effect mHealth interventions have on health outcomes, and emphasizes the need to view gaps in the mHealth evidence as opportunities for future research.⁶

KEY FACTORS FOR mHEALTH SUCCESS

The potential for mHealth interventions to capitalize on mobile technology for improving the quality of programs, extend the reach of services, and strengthen health information systems is great. However, the roll out of mHealth interventions takes time and significant investment in human, technical and physical infrastructure. Continuous capacity strengthening at multiple levels in the use of mobile technology devices, information dissemination, data collection, and monitoring and evaluation must be factored into project design. Through compilation of this compendium, a range of factors that are critical to successful mHealth interventions were identified.

Country Ownership and Leadership

National ownership and full government participation are critical to long term project sustainability. Active engagement ensures the integration of mHealth into existing national and local health sector plans, strategies and systems. National governments also play a central role in the creation and maintenance of an enabling environment for mHealth to thrive through the development and implementation of mHealth-friendly policies. Ensuring that new mHealth interventions align with the country's national eHealth strategy can provide opportunities for addressing important organizational development issues, such as governance, infrastructure, architecture, workforce capacity, policy and financing.

Partnerships

Strong public-private partnerships are key to the success of mHealth initiatives. Across the projects and products profiled in this compendium, prominent partnerships include those with governments, technology software development companies, management consulting firms, international and local non-governmental organizations, mobile network service providers, health service providers, and their clients. Partnerships with different actors may vary at each stage of the process in order to leverage and capitalize on the necessary expertise.

Coordination

The efforts of all partners need to be properly coordinated, ideally through the leadership of government. One approach is to establish a technical working group consisting of partner representatives. Collaboration at the level of implementing partners is critical, as well, to ensure that systems are interoperable.⁷

THE IMPORTANCE OF STANDARDS IN mHEALTH

One of the most promising aspects of mHealth is its potential for enhancing the smart integration of health services and the continuity of care across provider, place and time by making information available at the right place and the right time. Strengthening patient management and health systems in this fashion can only be achieved if the various mHealth and HIS platforms have sufficient common ground to reliably exchange

messages in a way that minimizes errors and misunderstandings. Known as interoperability, this ability of diverse systems and organizations to communicate and work together (inter-operate) requires the establishment of and adherence to standards. Much like speaking a common language enables communication, using common standards for how data are structured and exchanged enables mHealth platforms and HIS to share data.

mHealth interventions are significantly more powerful when health sector actors make their information systems interoperable. Through close cooperation, governments, donors and private healthcare providers can achieve interoperability by applying the same standards. Donors can champion interoperability by requiring it as a condition of their funding for mHealth interventions. These actions will maximize the power of mHealth as a tool for coordinating individual, patient-level services and public health programs.^{8,9}

NATIONAL POLICIES FOR mHEALTH

Few countries have initiated the process of regulating the development and use of mHealth applications. In the United States, the U.S. Food and Drug Administration, which regulates all medical devices, recently announced it would exercise discretion on lower risk applications, such as applications that disseminate mass information, but would instead focus its regulation on higher risk mHealth applications—namely applications that turn mobile devices into regulated medical devices, such as an ultrasound machine, and applications enabling health care workers to diagnose specific conditions by looking at an image. In addition to issues related to interoperability and the establishment of standards for sharing information, governments will have to work towards the establishment of mHealth-related policies that strike the balance between allowing innovation while protecting consumers, especially patients' rights to privacy.

mHEALTH APPLICATIONS AS TOOLS FOR STRENGTHENING HEALTH SYSTEMS

In a technical paper published in the August 2013 issue of the *Global Health: Science and Practice* journal, a group of mHealth researchers and implementers from Johns Hopkins University, UNICEF, WHO and frog Design proposed a new framework for assessing mHealth innovations through a health systems lens. The framework organizes common mHealth applications into 12 categories: 1) Client education and behavior change communication; 2) Sensors and point-of-care diagnostics; 3) Registries and vital events tracking; 4) Data collection and reporting; 5) Electronic health records; 6) Electronic decision support; 7) Provider-to-provider communication; 8) Provider work planning and scheduling; 9) Provider training and education; 10) Human resource management; 11) Supply chain management; and 12) Financial transactions and incentives. It also describes how each of these types of applications can be used to “enhance delivery of life-saving interventions through improvements in health system performance, such as coverage, quality, equity, or efficiency.” The framework seeks to help mHealth implementers and health program managers select the mHealth tools that are most appropriate for addressing specific health systems constraints. By providing a commonly understood conceptual structure that presents the relationship between mHealth applications and health systems functions, the framework also aims to facilitate communication between mHealth developers

and health managers. The framework provides a promising tool for evaluating how mHealth systems can be integrated into existing health systems structures.

The full paper can be found at <http://www.ghspjournal.org/content/early/2013/08/06/GHSP-D-13-00031.full.pdf>.

mHELP:A NETWORK FOR mHEALTH TECHNICAL ASSISTANCE

The mHealth Expert Learning Program – mHELP – is an initiative of the mHealth Alliance aimed at building the expertise and capacity of global health stakeholders using mobile technology for health by connecting them directly to consultations, tools and a network of highly qualified experts in the field. mHELP, which is supported by Johnson & Johnson, seeks to address a persistent gap in the capacity of health programs and service implementers to design and deploy mobile health (mHealth) and electronic health (eHealth) in low- and middle-income countries. mHELP offers a unique set of services to those that wish to use technology to improve the health and wellbeing of vulnerable populations around the world. In support of Millennium Development Goals 4, 5 and 6, the initiative has a particular focus on improving reproductive, maternal, newborn and child health, and the diagnosis and treatment of HIV/AIDS.

The services offered by mHELP include free tools and resources, an online question answering service, and more in-depth training, such as university-certified courses in mHealth and eHealth that will launch in 2014. Through mHELP, the mHealth Alliance will also engage in formal assessment and technical assistance by matching high-level experts with capacity building and technology partners, to address the needs of specific mHealth implementations. Currently, the Alliance has two high-level engagements of this nature: 1) technical assistance to the Elizabeth Glaser Pediatric AIDS Foundation to establish a decision support and registration system in Tanzania for the elimination of mother to child transmission of HIV and 2) technical assistance to the South African Government to develop a national maternal and child mHealth implementation.

mHELP has an expanding network of quality-assured technical experts in many areas of mHealth and eHealth. These experts are connected to mHealth projects based on their expertise and experience in order to provide technical support. Areas of expertise include:

- Implementation of mHealth services at scale
- Sustainable finance for mHealth projects
- Monitoring and evaluation for mHealth projects
- Health system operational research and study design
- Open standards and interoperability
- Appropriate technology for mHealth projects
- Working with Mobile Network Operators
- Health economics and cost effectiveness studies
- Social and behavioral change communications
- Use of communications and social media for mass interaction
- Gender issues concerning effective mHealth implementation
- Education and training¹¹

For more information, visit <http://www.mhealthalliance.org/our-work/initiatives/mhelp> or email mhelp@mhealthalliance.org.

mPOWERING FRONTLINE HEALTH WORKERS

Frontline health workers are the backbone of health systems in resource-constrained environments, yet they face numerous challenges: inadequate refresher training, weak performance incentives, difficulty reaching remote populations, a lack of supportive supervision, inadequate supply of health products and insufficient real-time access to patient data and reference information.

mPowering Frontline Health Workers is an innovative public-private partnership designed to contribute to the elimination of preventable child and maternal deaths by accelerating the use of mobile technology to improve the skills and performance of frontline health workers. The partnership will leverage the resources and expertise of its founding members: USAID, UNICEF, Qualcomm, Vodafone, Intel, GlaxoSmithKline, Frontline Health Workers Coalition, MDG Health Alliance, Praekelt Foundation, and the mHealth Alliance.

The partnership will address multiple barriers to scaling mHealth initiatives for frontline health workers, including issues regarding interoperability, shared standards, terminology, evidence, re-usable tools, sustainable financing models, and country ownership.

Over the next three years, mPowering Frontline Health Workers will :

- Build the capacity of governments, organizations and individuals to harness the power of mobile technology to strengthen maternal and child health services delivered by frontline health workers
- Support the scale up of mHealth applications for frontline health workers through country-based multi-stakeholder coalitions in six countries: India, Kenya, Nigeria, Mozambique, Tanzania and Uganda
- Generate evidence and information on the use of mobile technology by frontline health workers to mobilize resources and improve the design of mHealth applications.

It will achieve these three objectives by undertaking the following activities:

1. **Crowdsource innovative multi-media, multilingual health content** for use in multiple applications;
2. Create an **online library** of downloadable digital health content that can be accessed by organizations in developing countries;
3. Accelerate the sustainable expansion of mHealth for frontline health workers in at least **two developing countries**;
4. Rigorously **evaluate partnership activities** with a focus on cost effectiveness, impact and potential for sustainability; and
5. Share experiences through **global learning events, platforms, workshops and webinars**.

For more information, visit www.mpoweringhealth.org, or contact Lesley-Anne Long, Global Director, mPowering Frontline Health Workers at Lesley-Anne.Long@mpoweringhealth.org, or BethAnne Moskov, Deputy Director, Office of Health, Infectious Diseases and Nutrition, USAID at bmoskov@usaid.gov.

OTHER KEY mHEALTH TOOLS AND RESOURCES

The Knowledge for Health Project (K4Health) and the mHealth Working Group have developed a suite of new tools and resources for mHealth to help improve public health around the world. Some of the tools include the following:

- **mHealth Basics: Introduction to Mobile Technology for Health** - A new, free, self-paced eLearning course available on the USAID Global Health eLearning Center that provides an introduction to mHealth and an overview of best practices for mHealth solution development.
- **An mHealth Planning and Implementation Guide: How to Integrate Mobile Technology into Health Programming** - An interactive online guide intended for global health practitioners working to implement mHealth solutions in family planning and reproductive health programs and beyond.
- **The mHealth Evidence Database** - This new database includes searchable peer-reviewed and gray literature on mHealth effectiveness, cost-effectiveness and program efficiency, enabling researchers, program managers, funders and other key decision-makers to quickly get up to speed on the current state-of-the-art.
- **mHealth: Mobile Technology to Strengthen Family Planning Programs** – Commissioned by the USAID High Impact Practices (HIPs) in Family Planning series, this brief highlights evidence about mHealth and family planning programs to date and synthesizes lessons learned for implementation of mHealth programs.¹²

For more information, visit: <http://www.k4health.org/topics/mobile-technologies-health-mhealth>

HOW TO USE THE mHEALTH COMPENDIUM

This third volume of the mHealth compendium contains 24 case studies which document a range of mHealth applications being implemented throughout Africa and, in some exceptional cases, in other regions. While there are a number of existing databases with information on the many pilots being undertaken worldwide, these are often cumbersome and sometimes difficult to navigate. The authors envision that a compendium like this one is particularly needed where there is a plethora of mHealth activities at the country level—in order to help USAID missions easily access relevant mHealth information.

The case studies included in this compendium do not provide exhaustive descriptions of all aspects of the applications, however they do include references where the interested reader can seek additional information.

In order to highlight the range and versatility of mHealth as a tool for improving health and well-being, the case studies in this compendium are divided according to five programmatic areas: Behavior Change Communication, Data Collection, Finance, Logistics, and Service Delivery. Each of these five programmatic areas is briefly described below.

Behavior Change Communication (BCC)

mHealth interventions are frequently utilized for community mobilization, awareness raising, education and demand creation. It has been reported that mHealth BCC interventions are the most predominant of all mHealth interventions and also the most successful. This is because current interventions center on the use of low-cost SMS texts to reach various audiences. Important short-term changes in behavior have been observed, though modest.¹⁰

Data Collection

Data collection and surveillance can be enhanced by utilizing mobile communication and personal data devices. Instead of sending paper forms, data can be sent more quickly and reliably through electronic methods. This has been shown to increase reliability, make data more readily available (especially data from remote areas), and enhance the quality of the data submitted. Throughout Africa, mHealth applications have been used for a variety of data collection activities, from routine reporting to large national surveys.

Finance

Mobile money applications are increasingly used in Africa to facilitate payment for health services and other expenses associated with seeking care for both private patients and clients enrolled in various community health programs. These mobile money applications allow registered users to load money into their accounts, make transfers to other users (whether they are or not), and withdraw money. While registration for these services is almost always free, transactions have a predetermined fee which is often covered by the specific health program or implementing partner supporting the intervention. Examples of how mHealth applications have been utilized include vouchers for family planning clients to access counseling and services, as well as antenatal, delivery and postnatal services at participating hospitals.

Logistics

Availability of high quality logistics data has been one of the greatest challenges facing the health care system. Without these data, decision makers cannot adequately manage the supply chain, risking the possibility that patients won't receive the medicines they need. Increasingly, mHealth applications are being utilized to address this issue. Most of these applications allow a lower-level health facility to transmit information regarding their supply of essential medicines to the higher-level facility or warehouse which then provides the commodities. In some cases, these applications have even been utilized by community health workers to ensure they have the basic supplies needed.

Service Delivery

Mobile phones have been used to improve the quality of and access to health care service delivery in a myriad of ways. Applications have been developed that assist health care workers in diagnosing and treating patients, such as phone-based treatment algorithms and SMS reminders to follow up on clients' laboratory results and other services. mHealth has been successfully used to train and retrain health workers. Phone-based applications have also been developed to promote adherence to medications, provide notification of results, and remind patients to keep appointments.

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 10. Ibid
 11. Extracted from: <http://www.mhealthalliance.org/our-work/initiatives/mhelp>
 12. mHealth Working Group mailing list, October 28, 2013 posting by Laura Kaney

COMPENDIUM CASE STUDIES



BEHAVIOR CHANGE COMMUNICATION (BCC)



HEART HEALTH MOBILE

An interactive, educational, monitoring and gaming application to improve cardiovascular health

Heart disease and stroke are the first and fourth leading causes of mortality in the United States, making cardiovascular disease (CVD) responsible for one out of every three deaths in the country. Each year, over two million people suffer from heart attacks and strokes, while approximately 2,200 people die from CVD. The financial implications are also large; over \$444 billion is spent in health care expenditures and lost productivity due to these non-communicable diseases.

To tackle the burden of CVD, the Department of Health and Human Services (HHS) launched the Million Hearts national public-private initiative in September 2011, with a goal of preventing one million heart attacks and strokes in the U.S. over a five-year period. To help consumers take charge of their heart health, the initiative challenged developers to create an application to assist consumers in this process. The HHS Office of the National Coordinator for Health Information Technology, in partnership with Million Hearts, organized the Million Hearts Risk Check Challenge. In response, Marshfield Clinic Research Foundation (MCRF) developed the Heart Health Mobile (HHM) application and won the competition. HHM was first released in February 2013 for Apple products and expanded to a web-based (HTML5) version in March 2013 that works on other devices.

Implementation date: February 2013

About Heart Health Mobile

MCRF's Heart Health Mobile application is designed to achieve the following:

1. Reach individuals across the country, taking special aim at those who may be at risk for CVD and but are unaware of their risk,
2. Motivate at-risk individual to obtain an accurate risk assessments, and
3. Direct consumers to nearby community pharmacies and other locations that offer affordable and convenient blood pressure and cholesterol screenings.

The screenshot shows the Heart Health Mobile app interface. At the top, there is a blue banner with the text "Reach 30 Task Points to unlock MINI-GAME". Below this, a character wearing a green shirt with a heart on it is shown. To the right, the text "HeartHealth MOBILE" is displayed above a progress bar. The progress bar shows "25 / 100 Task Points" with a green "COMPLETED" stamp over it. Below the progress bar, there are four sections: "Risk Assessment" (+25), "Increase Risk Accuracy" (+10), "Screening Locations" (+10), and "Educate Me" (+5). Each section has a brief description and a plus sign followed by the points value.

HHM is currently available as a downloadable mobile application through the Apple Store or as a web app at www.HeartHealthMobile.com. Its interface provides the user with a brief assessment of CVD risk, taking into account self-reported behavioral, familial and biometric risk factors, including blood pressure and lipids. Based on the level of CVD risk, users are directed to nearby community pharmacies, clinics and other locations for more advanced CVD risk factor screenings, assessments, and treatments. The app also provides basic health education materials on key CVD risk factor management topics including hypertension, dyslipidemia,

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weight management and tobacco cessation. HHM can be readily shared via social media links such as Facebook and is also available in a gamified version.

Evaluation and Results

From January 28 to August 1, 2013, HHM was downloaded 3,225 times from the Apple Store across all iPhone, iPad and iPod Touch devices. During this time period, almost 90% of usage was through iPhones and iPhone users conducted 100% of the shares via email and Twitter.

The mobile app had a global reach even without explicitly promoting it in countries outside the US. From January 31, 2013 to October 8, 2013, 104 different countries logged usage in the app.

Lessons Learned

- The number of downloads was somewhat limited due to the nature of the Million Hearts Challenge. Concentrated efforts in five major US metro areas were scheduled to promote the Million Hearts Campaign, of which Heart Health Mobile was the chosen mobile tool available free of charge for users to download or use at HeartHealthMobile.com.
- Some campaigns were more effective than others in driving users to the Apple Store or directly to the app's website. Chicago saw the largest spike in users by promoting the app during Heart Month in February, in conjunction with other heart healthy activities and promotions.
- Gain of the following valuable market-related insights: 1) traditional media efforts (e.g. news segments via local television and newspapers) have been most effective, 2) feedback is limited through the site (<20 instances of user feedback submitted through the website), and 3) national attention through a government organization's \$100,000 contest does necessarily equate to high user interest or adoption of a heart health tool

Conclusion

Heart Health Mobile appears to provide users with important information but its potential for affecting improvements in CVD health is unclear. Yet, with the aid of this app, a patient can be directed towards appropriate, nearby health professionals for information and advice. Future iterations of the app could include information about how to access health care providers, thus, expanding its utility. Future development efforts will focus on expanding launch locations, strengthening involvement of local screeners, physician-patient engagement, and the capture and measurement of health outcomes via patient-reported data.

Geographic Coverage: The United States and 103 other countries

Implementation Partners: Marshfield Clinic Research Foundation, The Department of Health and Human Services (HHS) Office of the National Coordinator for Health IT (ONC), U.S. Centers for Disease Control and Prevention (CDC)

Funder: The Department of Health and Human Services (HHS) Office of the National Coordinator for Health IT (ONC)

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MOBILE INTEGRATED RESOURCES FOR AURAT-WOMEN (MIRA) CHANNEL

Providing critical MNCH services to women at the bottom of the pyramid

The lack of maternal and child health (MCH) information, communication and services reaching women in remote and low resource settings is one of the main contributors to India's high maternal mortality rate of 420/100,000 live births, and under-5 mortality rate of 72/1,000 live births. Nineteen percent, or 56,000, of annual global maternal deaths occur in India. Only 40% of deliveries occur at a health facility and less than half are attended by a skilled healthcare provider. Additionally, 22% of babies in India are born at low birthweight. To reduce maternal and infant mortality and morbidity in India, women, especially those in rural and low-income settings, must be provided quality health information and connected to primary health centers and health institutions.

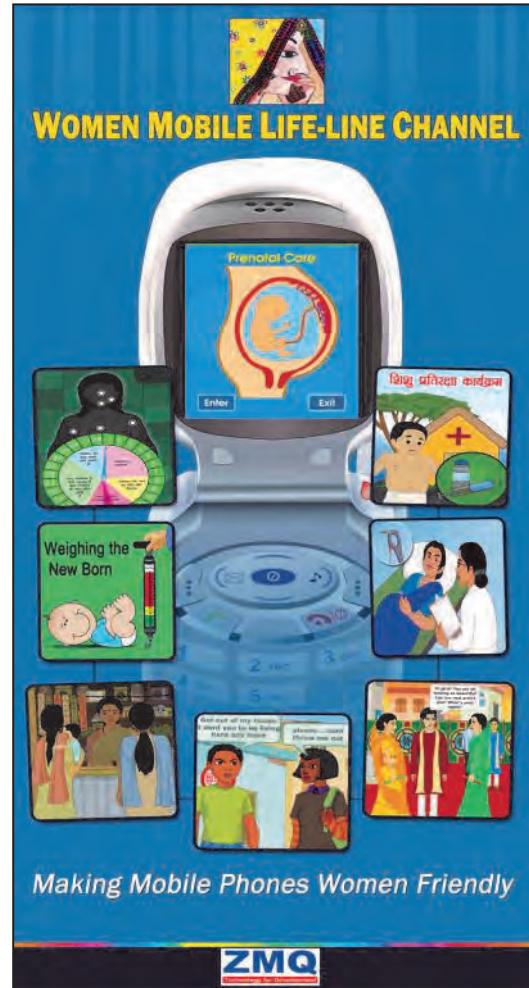
The Millennium Alliance – a new partnership between USAID, the Federation of Indian Chambers of Commerce and Industry, and India's Department of Science and Technology – is promoting technological innovations as possible solutions to addressing India's development challenges. In response, ZMQ Development, a social enterprise, created the Mobile Integrated Resources for Aurat-Women (MIRA) Channel (formerly branded the Women Mobile Lifeline Channel) to bridge the information gap among rural women, help them connect with health services, and empower their decision-making abilities related to critical health issues.

Implementation date: March 2012

About MIRA Channel

MIRA Channel is an integrated mobile phone-based application using the Global App platform. It provides lifeline sustainable development tools for low-literate women at the bottom of the development pyramid. The Windows compatible application is available on both Java mobile feature phones and Android smartphones featuring an interactive iconic messaging system that requires limited audio and text support.

MIRA Channel can be downloaded from the application site or through mobile operators. It is also embedded on new mobile handsets from OEM manufacturers and



promoted through viral marketing mechanisms of partner NGOs. Local (village level) mobile recharge kiosks assist women to download the app.

Content is delivered based on users' needs. Educational tools, iconic messaging kits, mobile games, mobile soaps and other components are available across dedicated sub-channels geared towards maternal and child health, reproductive health, family planning, home-based neonatal care and adolescent girls' health. The MCH channel features toolkits on prenatal care and universal immunization. MIRA Channel also contains tools women can use to track and manage pregnancy, immunizations, menstrual cycles, family planning and infection prevention.

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To expand MIRA Channel's reach, ZMQ development utilized Organized Human Networks to identify microfinance institutions, self-help groups and frontline healthcare networks as possible markets. They are also incorporating channels on financial literacy, functional literacy, vocational and skills training and women's entrepreneurship into the application.

Evaluation and Results

Within the first year, MIRA Channel was utilized by 27,600 women in India's Mewat and Rajasthan regions. To date, over 48,000 Mewat and 22,000 Rajasthan women in self-help groups have benefitted from the program. Approximately 16,800 pregnancies and 11,800 childhood immunizations have been registered. Women have downloaded almost 35,000 MCH-related games and Value Added Services.

When compared with primary health center data from 2011 to 2012, there has been an increase in uptake of folic acid during pregnancy, the number of pregnant women visiting frontline health workers or Anganwadi Workers, and deliveries at healthcare facilities.

Lessons Learned

- Use of iconic messaging with audio support and minimum text is an essential component and has been a successful method to convey messages to semi-literate and illiterate communities, producing substantially better results than SMS.
- Incorporating training of semi-literate women enables them to effectively and efficiently use mobile phones and is an essential component of successful mobile technology initiatives.
- The program realized that women benefactors became stakeholders rather than clients. They not only effectively test the messages but essentially act as marketers and peer educators.

Conclusion

The MIRA Channel is an innovative response to the health needs of low-socioeconomic populations in India. Designed specifically for women in rural and low-income settings, the mobile channel provides information related to critical health issues to help manage women's lives. It is important to find innovative and effective means to disseminate the women's channel and reach a larger audience, as well as to utilize innovative marketing strategies when working with low promotion and marketing budgets.

Geographic Coverage: India, Mewat and Rajasthan regions

Implementation Partners: ZMQ Development along with Mewat Mahila Vikas Society and 6 SHG Federation Partners

Funder: USAID | Federation of Indian Chambers of Commerce and Industry (FICCI) | Technology Development Board (TBD), Department of Science and Technology, Government of India

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FICCI: Eittee Gupta, Deputy Director, Centre for Innovation, Science & Technology Commercialization (eittee.gupta@ficci.com)

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NIGHTWATCH: MOBILE

Creating a Malaria Mobile Community in Tanzania

In Tanzania, over 30 million people, or 73% of the population, live in areas of high malaria transmission. Nine of mainland Tanzania's 23 regions have more than 100 confirmed malaria cases per 1,000 people annually, and approximately 8.7 million probable and confirmed cases were reported in 2010 alone.

Mass campaigns and a national voucher system have contributed to the distribution of 27 million long-lasting insecticide-treated nets (LLINs). A Zambian study suggested that behavior change communications “are necessary to improve use” and could “contribute towards closing the gap between ownership and use” of bed nets. Research conducted by Malaria No More also indicates there is a general understanding from Tanzanians that sleeping under a net is necessary year-round. To preserve malaria as a health priority and provide continual education on malaria diagnosis and treatment, Malaria No More, in partnership with Tanzania House of Talent (THT), has launched NightWatch: Mobile. The program uses celebrity-branded mobile communities and features personalized communication by mobile phone to address gaps in malaria knowledge.

Implementation date: April 2012

About NightWatch: Mobile

NightWatch: Mobile builds on the successful national mass-media campaign, branded as Zinduka! Malaria Haikubaliki! (“Wake up! Malaria is unacceptable!”), which is endorsed by the National Malaria Control Program (NMCP) and the Tanzanian government. The NMCP approves the content of the malaria messages and provides overall guidance on national malaria control priorities. The Zinduka! campaign is the Tanzanian adaptation of the same NightWatch platform (celebrity-driven mass media campaigns for behavior change, social mobilization, and advocacy) that Malaria No More supports in Cameroon, Chad and Senegal.

THT celebrities form part of a team of goodwill ambassadors who deliver malaria messaging via radio, TV and billboards. President Jakaya Kikwete also



recorded a public service announcement for the campaign that aired on national TV in 2012. Through the expansion of NightWatch via a ‘malaria-mobile community’, the program is able to reach diverse population segments via several mobile features, including tools designed to reach the illiterate. These include a new mZinduka! malaria anthem that is available as a downloadable ringtone and ringback tone; a celebrity phone tree with on-demand recorded messages from THT goodwill ambassadors; and informational messages, quizzes and surveys.

The malaria-mobile community (called mZinduka!) also links to malaria-themed, regionally broadcasted radio shows that feature the goodwill ambassadors. Listeners are able to call in and shows feature on-air contests to promote the community and share more complex information on malaria. The SMS-based elements of the campaign are designed to grow in a user-driven way, relying on networks of people to spread malaria knowledge and awareness to their family and friends.

Evaluation and Results

While an evaluation of the additional impact of more interactive messaging through the “malaria-mobile community” will not be completed until late 2014, initial evidence of the underlying Zinduka! Malaria Haikubaliki!

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campaign suggested a strong role for mobile phones. For example, 3 million Zinduka!-branded malaria messages were sent via SMS to viewers of the 2011 Tanzania Gospel Music Awards, with 192,000 viewers responding by SMS to the message to vote for their favorite artists and receiving additional malaria messages in return (an approximately 6% response rate).

Zinduka! NightWatch community radio programs in Tanzania's Lake Zone in early 2013 also demonstrated an opportunity for more interactive and personalized programming. Over 8 weeks of malaria-themed mini-programs, the community radio stations reported an average of 7 listeners calling the station during each 15-minute segment to participate in quizzes and ask questions; these callers used their own mobile phones without any subsidy, highlighting the value they saw.

Lessons Learned

- Using trusted and popular spokespeople has been critical to building a successful behavior change communication platform. By using Tanzanian celebrities and politicians as the faces and voices of the campaign, we avoid a common problem: being viewed as "spam."
- The power of music to engage the audience and deliver key messages is challenging – but worthwhile – to translate from traditional mass media to mobile. The mZinduka! platform is using downloadable ringtone/ring-back tones to put our malaria anthems in the hands (and ears) of Tanzanians.
- The additional mobile phone-based elements of the Zinduka! campaign are making it possible to harness social networks in a new way. Not only can users forward messages to their friends, but we are also looking at ways to use the social media tools that are currently growing in popularity in Tanzania to spread malaria messages in a new way.

Conclusion

Through developing public-private partnerships and a targeted communications campaign, the NightWatch:

Mobile mZinduka! program is able to build a sustainable mobile community for the promotion of malaria prevention and works actively towards the goal of near-zero malaria deaths in Africa by 2015. Final results from the NightWatch mobile expansion will be shared within the malaria control community to encourage adoption of interactive and engaging communication strategies by national malaria control programs.

Geographic Coverage: Tanzania

Implementation Partners: Malaria No More, Tanzania House of Talent, Vodacom Tanzania, Clouds Entertainment

Funder: mHealth Alliance, Vodacom Tanzania

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mHealth Alliance: Innovation Working Group Catalytic Grant program, c/o Francis Gonzales, Program Associate (fgonzales@mhealthalliance.org)

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WIRED MOTHERS

Increasing skilled delivery attendance to reduce maternal and neonatal morbidity and mortality

Every year, approximately 270,000 women die during pregnancy. Moreover, the risk in Sub-Saharan Africa is much larger, 50 times greater than in developed countries. Seven million children also die before reaching the age of five, a growing proportion of these (43%) occurs at or around the time of birth. Therefore, antenatal care (ANC), skilled delivery attendance and access to emergency obstetric care are essential in improving maternal, neonatal and child health. In Zanzibar, 99% of pregnant women attend an ANC visit at least once, yet only 51% of births are attended by a health professional and more than half do not receive any postnatal care.

Wired Mothers is an mHealth project that seeks innovative ways to ensure access to ANC and skilled attendance at delivery and to examine the beneficial impact mobile phones can have on maternal and neonatal morbidity and mortality. In 2009/2010, the University of Copenhagen, in collaboration with Zanzibar's Ministry of Health and Social Welfare and the Danida Health Sector Programme Support, conducted a study to compare differences in service delivery and health outcomes between women receiving the Wired Mothers mobile phone intervention and those receiving standard care.

Implementation date: March 2009 to March 2010

About Wired Mothers

The Wired Mothers mobile phone intervention was designed with the aim of linking pregnant women to their primary health care provider throughout their pregnancy, childbirth and post-partum period. Wired mothers, or *mama mitandao*, received appointment reminders and educational information via SMS and were provided with mobile phone vouchers to enable them to call a primary care provider to discuss any acute or non-acute issues. Additionally, mobile phones were used by health facility workers, ambulance drivers, and referral hospital employees to strengthen communication between different levels of the health system.

The intervention involved all three levels of the health system.



Evaluation and Results

The Wired Mothers intervention was evaluated in a cluster randomized controlled trial. The study involved 2,550 pregnant women (1,311 interventions and 1,239 controls) receiving care from 24 primary health care facilities in six districts in Zanzibar. Within each district, two facilities were randomized for intervention and two for no intervention (standard care). To ensure mobile phone access, the pregnant women in the intervention group received a phone credit voucher.

The intervention significantly increased the proportion of women receiving four ANC visits during pregnancy as recommended by WHO and there was a trend towards more women receiving preventive health services, more women continuing to attend ANC late in pregnancy and more women with antepartum complications who were identified and referred.

The majority of intervention women stated that the appointment reminders influenced their health seeking behavior and felt that the educational messages helped them in various areas, including learning about danger signs in pregnancy and feeling that the health system cared for them.

Results also showed that the mobile phone intervention was associated with an increase in skilled delivery attendance. 60% of the women in the intervention

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group, versus 47% in the control group, delivered with skilled attendants. While the intervention had a significant increase in skilled delivery attendance among urban women (OR, 5.73; 95% CI, 1.51–21.81), it did not influence skilled birth attendance among rural women

Lessons Learned

- The Wired Mothers intervention was highly appreciated by women and health workers.
- The study demonstrates that simple mobile phone interventions that involve community and health workers can promote the provision and utilization of essential maternal health interventions such as ANC, skilled delivery care and emergency obstetrics services.
- The study has proved that supportive supervision, clear job descriptions (responsibilities) and regular provision of logistics have the potential to improve staff moral and performance
- The intervention was developed in Tanzania using simple technology and at low cost.
- The collaboration between a government agency, a development organization and an academic institution was efficient and increased the evidence base for policy makers interested in using mHealth applications.
- Simple mobile phone solutions such as Wired Mothers are a feasible solution for strengthening access to essential maternal and child health (MCH) services in low-resource settings.

Conclusion

The Wired Mothers mobile phone intervention significantly increased the number of urban women receiving the recommended number of ANC visits and skilled delivery attendance. Evidence-based mobile phone solutions may contribute towards improved MCH and the achievement of Millennium Development Goals 4 (to reduce child mortality) and 5 (to reduce maternal mortality).

The policy implication of the Wired Mothers study is that developing countries should improve public private partnership in the area of health education and information and use the momentum of information technology in delivering health services. Specifically, mobile phone interventions should be considered as a strategy to improve provision and utilization of ANC, delivery services and emergency obstetric care, which are essential for maternal and perinatal health. mHealth interventions for maternal health should however consider the special needs of rural women.

Geographic Coverage: Tanzania (Zanzibar)

Implementation Partners: University of Copenhagen; Ministry of Health and Social Welfare, Zanzibar, Tanzania; Health Sector Programme Support Zanzibar; Danida Health Sector Programme Support

Funder: Danida Health Sector Program Support

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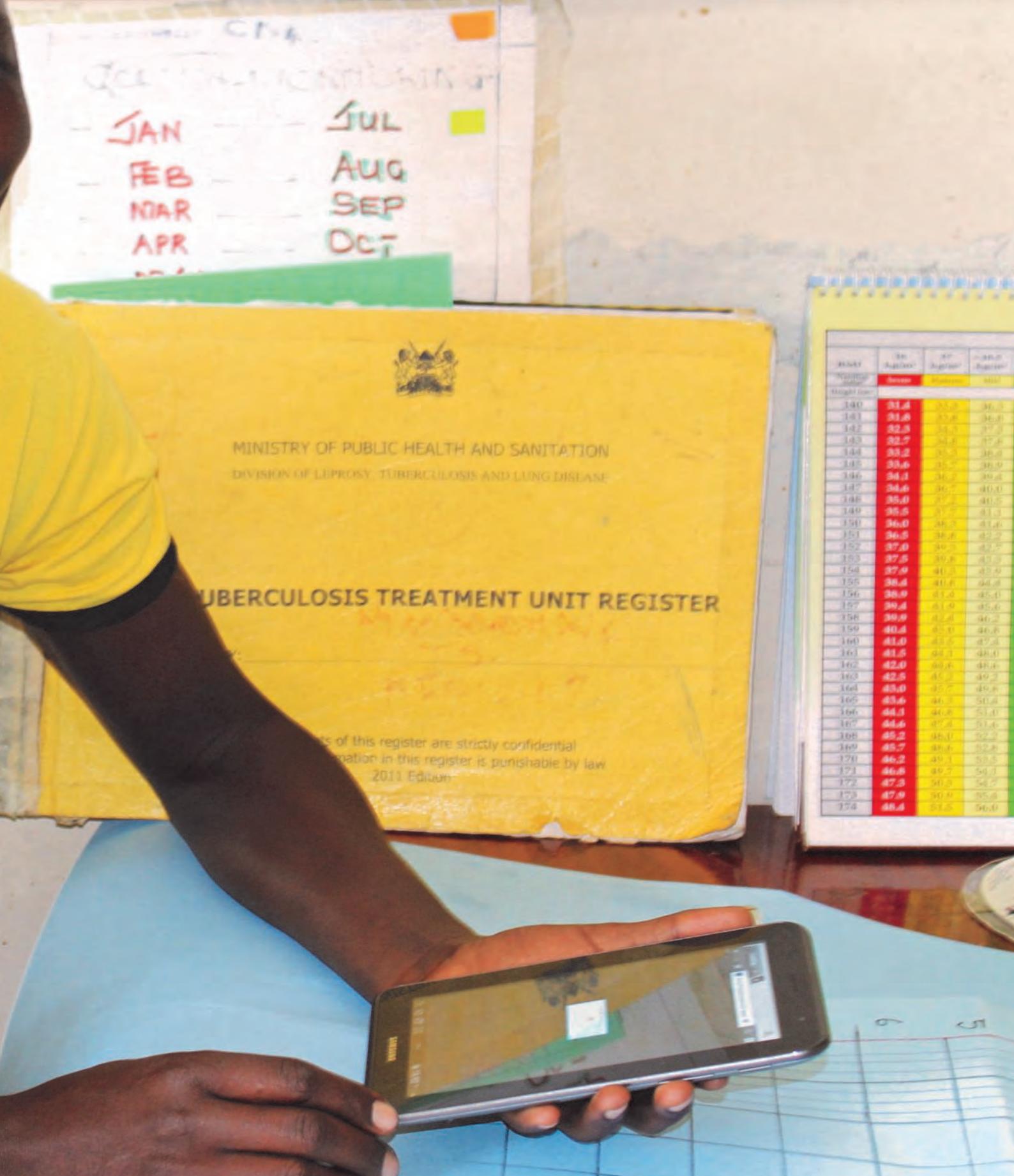
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DATA COLLECTION



CHILD PROFILING SURVEY

Providing critical MNCH services to women at the bottom of the pyramid



Civil society groups play a critical role in the fight against HIV and AIDS, especially in countries such as Swaziland where the HIV prevalence is 31% among adults 18 to 49 years old. However, weaknesses among these groups, including challenges with time, staff, funds, knowledge and systems to effectively collect and report data, have led to a critical need for capacity building. One of the key capacity challenges Pact Swaziland identified in local organizations is their limited ability to use their data for effective program planning and budgeting. Since 2010, Pact Swaziland has been implementing the Community REACH program to provide capacity building services to civil society organizations to help them deliver effective HIV prevention, care, treatment and impact mitigation services. Additionally, they are focusing on capacitating local organizations to use improved monitoring and evaluation strategies for evidence-based service delivery

In reviewing a variety of mHealth platforms, Pact Swaziland noted that the costs of mHealth technologies were generally less expensive, less time consuming and

less prone to data entry errors than traditional methods of data collection, entry and analysis. The country's mobile phone network coverage of over 80% and 73% penetration would allow these technologies to reach even the most marginalized and rural beneficiaries. Pact Swaziland, therefore, began building the capacity of six civil society organizations to use mHealth to enhance service delivery and data collection procedures as a way to improve their monitoring and evaluation systems and strengthen the evidence behind their program implementation. They supported these organizations in developing concept notes around six strategies for mobile phones usage in specific programs. This was followed by tailored technical

assistance to implement each strategy, including assisting organizations in selecting appropriate mobile platforms, developing cost-analyses comparing paper-based surveys and mobile phone data collection, conducting training on platforms, helping to troubleshoot any issues that arose during implementation, and supporting use of data for decision making. The focus of this case study is on two of the six organizations, Save the Children Swaziland (SCSWD) and the Coordinating Assembly of NGOs (CANGO).

Implementation date: May 2013

About Child Profiling Survey

In May 2013, Pact Swaziland began piloting mobile data collection technologies in partnership with SCSWD and CANGO. The MobiNzi platform was selected for use in a child profiling exercise of 10,244 orphans and vulnerable children (OVC). The survey looked at four key service needs: child protection, education, child abuse and psychosocial support needs. Through this survey, SCSWD, with support from Pact Swaziland and

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CANGO, gathered data for key programmatic and budgetary decisions to improve and provide targeted, quality services to OVCs throughout Swaziland. The pilot project used Android phones to collect data. GPS coordinates were also collected to map service coverage and target areas with the highest needs.

Evaluation and Results

Of the 10,244 children surveyed, nearly 3,000 children were orphans, while 7,284 were determined to be vulnerable. Additionally, 2,993 children did not have birth certificates or national IDs. The survey also assessed school attendance, showing 331 children had dropped out of school primarily because they could not pay school fees or became pregnant or ill. The survey also found that 386 children had been abused, of which 224 had not yet reported the abuse.

As a result of these data, SCSWD realigned its budget to cover the programmatic and administrative costs of providing targeted services to the children identified in the survey. Having GPS data at the household level allowed for budgeting of staff time and fuel costs for providing the services, as well as key programmatic costs such as assisting children to obtain their necessary national documents. SCSWD was also able to redesign its program to provide specialized support for school re-entry of children who dropped out due to lack of school fees or pregnancy. Lastly, they developed a plan to provide health care linkages and home visit support for children who reported dropping out of school due to illness.

Lessons Learned

- Training and on-going mentorship of civil society organizations during the start-up phase is essential to ensure that staff are fully capacitated to integrate the mHealth technologies into their routine data collection and monitoring activities
- Real time data allows civil society organizations to make quick, evidence-based programmatic adjustments without having to wait for the end of a long data collection period where summary data and

trends are not available until several months later

- Most mHealth platforms have built in data security systems to ensure that lost mobile phones do not compromise confidentiality of the data

Conclusion

Civil society organizations often do not have systems in place to track data that will demonstrate the outcomes of their community and household level interventions. These organizations can be capacitated to use innovative mHealth technologies to solve their data collection, reporting, and usage challenges in such a way that program evaluation becomes integrated with program delivery. As a result, the body of evidence supporting the important and unique role that civil society organizations play in the HIV response will grow and become better understood.

Geographic Coverage: Swaziland

Implementation Partners: Pact Swaziland, Save the Children Swaziland, Coordinating Assembly of NGOs

Funder: USAID

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GLOBAL TRACHOMA MAPPING PROJECT

GIS mapping to achieve the Global Elimination of Blinding Trachoma by 2020

Trachoma is a neglected tropical disease (NTD) that affects over 21 million people and is endemic in 53 countries. While it has been eliminated in most developed countries, it is still the world's leading infectious cause of blindness and affects the poorest communities. Women and children living in hot, dry and dusty areas with poor access to water and sanitation are especially susceptible. An estimated 229 million people worldwide live in highly trachoma prevalent areas and are at risk of going blind if repeated infections are left untreated. Ethiopia is the most adversely affected country by Trachoma. In Oromia and Tigray regions alone, over 30 million people are at risk.

To aid in identifying, treating and eliminating trachoma in Ethiopia and worldwide, the International Trachoma Initiative (ITI), NGOs and academic institutions, led by the UK non-profit Sightsavers, launched the Global Trachoma Mapping Project (GTMP). The GTMP is the largest disease-mapping project ever attempted. In two and one half years, up to 4 million people will be surveyed in over 1,200 suspected-endemic districts in more than 30 countries, including more than one-third of African countries. Mapping will be completed by March 2015 to facilitate countries implementation of the SAFE Strategy (Surgery, Antibiotics, Facial cleanliness, Environmental improvement) to treat and prevent trachoma and reach the WHO-endorsed Global Elimination of Blinding Trachoma by 2020 (GET2020) target.

Data from household surveys are collected on smartphones via the LINKS System. ITI is the steward for the data, which are made available in categorical form on open-access disease maps on the Trachoma Atlas website (www.trachomaatlas.org).

Implementation date: December 2012

About Global Trachoma Mapping

Over 300 survey teams have already been trained to gather prevalence data. Each team is comprised of one grader and one data recorder who are supported by coordinators, drivers, field supervisors, local guides, and logistics and finance personnel.

Field data are collected using the ArcGIS mapping platform and Open Data Kit-based software, a flexible smart phone-based tool that runs on devices using the Android operating system. Global Positioning System (GPS) readings are also taken for every household surveyed. Data are then securely transferred from the field to a central web-based reporting and data management tool, where they are quickly analyzed, approved and shared by Ministries of Health, using a dynamic web-interface. WASH (water, sanitation and hygiene) and other NTD mapping is also conducted to gain a broader picture of poverty and development issues affecting trachoma endemic populations. If there is limited cellular connection, data are stored in the mobile device's micro SD card and uploaded when the survey team can access the internet or a cellular connection.

Data will be available in-country through the country's own Health Management Information System. Once approved by the MOH, data are published, shared and updated through the open-access Trachoma Atlas website which contains free country maps with population-based trachoma prevalence data at the district level.

Evaluation and Results

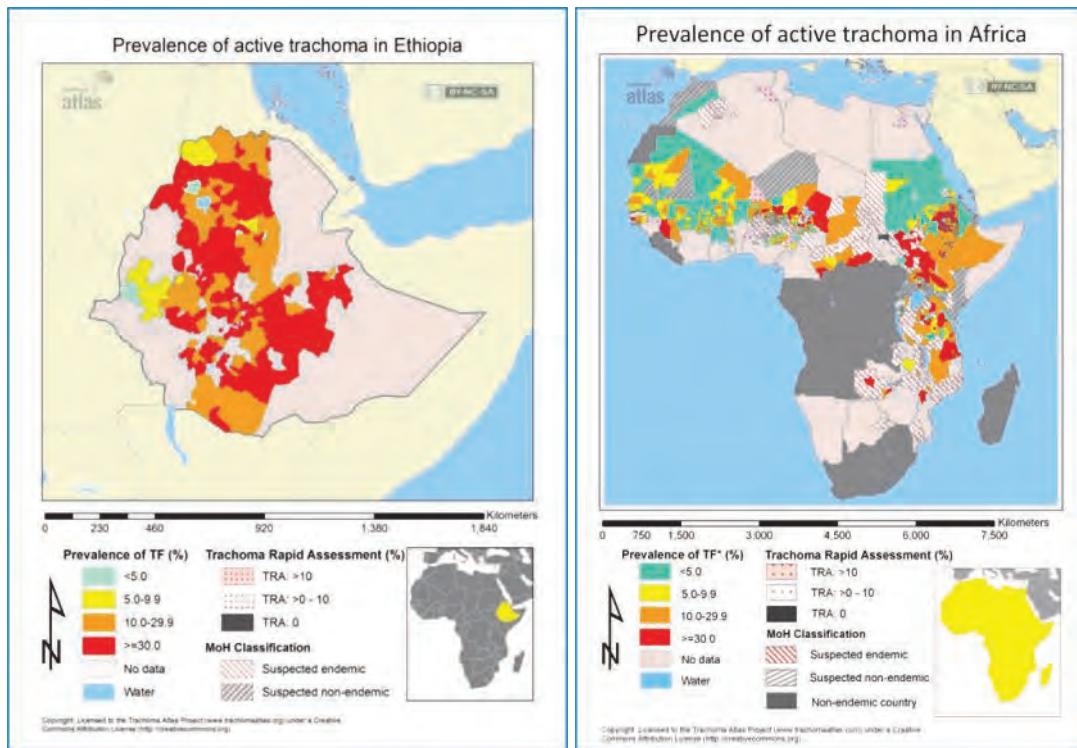
In June of 2013, trachoma prevalence data collected by 40 survey teams as part of the project's first phase in Ethiopia's Oromia (252 districts) and Tigray (48 districts) regions was approved by the Regional Health Bureaus and the Ethiopian Federal Ministry of Health. This gives health officials the ability to plan trachoma elimination programs for over 30 million people at risk in these areas.

As of September, 1 million people in Ethiopia, Nigeria, Malawi, Mozambique, Solomon Islands and Yemen have been checked for trachoma.

Lessons Learned

- Standardization is key to scale-up
- External support is welcomed by countries and communities

DATA COLLECTION



- Electronic data capture and web-based review offer significant advantages over paper-based data capture and discussion via email
- Training teams in new (not home) environments allows them to learn more effectively

Conclusion

The Global Trachoma Mapping Project is providing accurate, rapid and robust data. It will aid partners, MOHs, and other organizations in tailoring trachoma elimination programs to produce a more integrated, efficient and evidence-based global response to trachoma and reduce the devastating personal and economic impact on those affected by the NTD. The project will assist endemic countries in establishing the SAFE strategy by 2015, thereby allowing time to achieve the World Health Assembly's goal of Global Elimination of Blinding Trachoma by 2020 (GET2020)

Geographic Coverage:
Worldwide

Implementation

Partners: International Coalition for Trachoma Control, African Medical and Research Foundation, CBM, Blantyre Institute for Community Ophthalmology, Fred Hollows Foundation, Helen Keller International, International Trachoma Initiative, Johns Hopkins University, Kilimanjaro Centre for Community Ophthalmology, Light for the World, London School of Hygiene & Tropical Medicine, Mission to save the Helpless, Orbis,

Organisation pour la Prévention de la Cécité, Sightsavers, The Carter Center

Funder: UK Department of International Development (DFID)

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MALARIA CONTROL PROGRAM

A mobile rapid reporting system to strengthen surveillance in support of malaria elimination

In Zambia, malaria affects over 4 million people each year, accounting for 30% of outpatient visits and 8,000 annual deaths. Over 50% of these deaths are children under five years of age and about 20% of maternal mortality is attributable to malaria. However, in the last several years, advances in prevention and treatment have resulted in marked reductions in illness and deaths from malaria. The National Malaria Control Program set a goal of malaria elimination in five zones.

Through the use of both new and existing tools and a more focused strategy, The Malaria Control and Evaluation Partnership in Africa (MACEPA), a program at PATH, is partnering with the Government of Zambia to chart its way toward this goal. MACEPA has supported the Ministry of Health in designing and introducing a rapid reporting system that records specific points of malaria burden and commodity data each week and sends the data to a central server by mobile phone. The information is immediately available to program managers at district, provincial, and national levels, allowing them to monitor and respond faster to prevailing conditions on the ground, avoid stock outs, and better target interventions.

Implementation date: January 2011

About MACEPA



Using District Health Information System (DHIS2) open source software and its Java-based Mobile Client, staff at the clinics report weekly on small carefully chosen data sets that includes the number of tests done, number of positive tests, number of people given malaria treatment and stock information. Low-cost mobile phones and prepaid SIM cards are supplied to the health workers. The system also extends surveillance into the communities within the health facility's catchment area through a network

of community health workers (CHWs). A specially trained Data Community Health Worker (DCHW) is given the responsibility for reporting data into the DHIS2 server for groups of CHWs to improve on the disaggregation of focal transmission sites. The DCHW receives reports from the other CHWs on a monthly basis, concentrating data entry training to a smaller group of health workers and creating a cluster of data collectors around one reporter.

Only the DCHW is given a reporting mobile phone at the start of the project, but by consistently reporting timely data over a period of time, the other CHWs are able to work towards a cheaper non-Java-enabled phone. Both the DCHW and CHW receive an incentive in the form of airtime to mobile phones, improving communication channels locally for responding to malaria infections and the ability to report by DCHW. The phone and credits earned are used as a work tool, making it easier for clinic staff to reach individual health workers to alert them to malaria cases that require their attention. The DCHW and CHWs are also given a small financial incentive for completing the reporting work, based on timely reporting.

Evaluation and Results

Over 800 mobile phones in 23 southern Zambian districts have been equipped with DHIS2 software. Nearly 600 facilities have been trained, and an additional 1,200 CHWs report data through their catchment area's DCHW. Interactive dashboards of malaria surveillance and commodity data are available online. Data audits were conducted against the national health management information system (HMIS) and the malaria system also running on DHIS2 to identify process barriers to better data. An assessment was done on the use of these data. It revealed that the Rapid Report system to be a good monitoring tool for acquisition of timely data being used by district managers to improve malaria control in their areas, including identification of mentorship needs, indoor residual spraying and insecticide-treated nets distribution, focal testing and treating, as well as stock management.

DATA COLLECTION



- Providing low-end phones with ‘just enough’ capabilities reduces costs and risks of investments in the phones provided.
- Training is critical for supporting DHIS2 nationally and requires finding a training partner for the system.
- Tying reporting of data to talk time allocations encourages reporting and accountability at the end user level.

Conclusion

The malaria surveillance system delivers real time data for monitoring the disease burden and can be used as an evidence-based decision-making tool for eliminating malaria in Zambia’s five targeted zones.

Geographic Coverage: Southern half of Zambia

Implementation Partners: PATH MACEPA, Zambia Ministry of Health, Akros Research, Inc.

Funder: The Bill & Melinda Gates Foundation

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Photo credits: Anne Jennings (opposite page); Todd Jennings (same page)

Lessons Learned

- Integrating within the national HMIS system allows wider stakeholder buy-in. Rolling out the mobile platform helped leverage additional developments on the main HMIS system, including establishing the community level HMIS system.
- DHIS2 is a complex system. Having a large and consistent user base in-country is the best way to develop communities of practice for data sharing, problem solving and learning
- The cost of hosting a local server can be expensive and may require dedicated technical skills that also are expensive. A hosted server option, such as Amazon Web Services or Linode.com, minimizes server deployment and maintenance costs and works well for these efforts.
- Using a platform such as DHIS2 that works across cellular network providers allows local users to use the network with the best local coverage.

REAL-TIME BIOSURVEILLANCE PROGRAM

Utilizing information and communication technologies to improve early detection and notification of infectious disease outbreaks

Epidemiology Unit Officials in India and Sri Lanka face problems in receiving health information in a timely manner which would enable the prevention of diseases from reaching epidemic states.

Statistics on a priority list of infectious disease data, from regional and community health centers, continue to be gathered and analyzed largely through paper-based forms and procedures, and notifications are issued from the regional health administrations to local authorities using paper-based reporting. Experts in the field of biosurveillance and health informatics have argued that improvements in disease detection and notification can be achieved by introducing more efficient means of gathering, analyzing, and reporting of data from multiple locations as well as on a larger set of disease and syndromic information. New Information and Communication Technologies (ICTs) are regarded as an important means to achieve these efficiency gains.

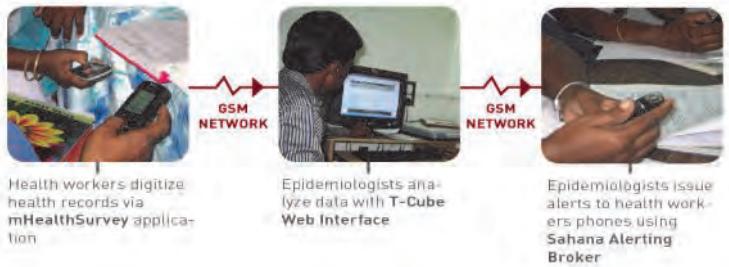
The Real-Time Biosurveillance Program (RTBP) was a multi-partner research initiative that studied the potential for new ICTs to improve early detection and notification of disease outbreaks in Sri Lanka and India. RTBP established a pilot project involving village-level nurses in select districts, and an attempt to scale up the project began in March 2011 based on evaluation of the pilot.

Implementation date: June 2008 to December 2010

About RTBP

RTBP provides the ability to detect and monitor a wide variety of health events involving communicable, non-communicable, reportable and non-reportable diseases, and follows WHO's general recommendations for disease surveillance systems. The RTBP infrastructure is composed of an interconnected network between healthcare workers via a mHealthSurvey mobile phone (J2ME) application, T-Cube web interface (TCWI) and Sahana Messaging/Alerting Module. Village level nurses are provided mobile phones with the mHealthSurvey custom software installed to message individual out-

RESEARCH QUESTION: "Can software programs that analyze health statistics and mobile phone applications that send and receive health information be effective in the early detection and mitigation of disease outbreaks?"



patient data in a prescribed format that is transmitted to a centralized database. The ICT system utilizes General Packet Radio Service (GPRS), while also storing records on the phone during times of limited or no connectivity.

Health facility health records, such as demographic information, symptoms, suspected and diagnosed diseases are collected through the mHealthSurvey that feeds into the TCWI, a browser-based statistical analysis software tool that uses cutting edge algorithms to detect adverse events. Health officials are notified of the adverse events using the Sahana Alerting module through SMS, email and web. Sahana is a free and open source software collection of disaster management modules that work as a platform for integrating multi-organization response efforts that provide critical information to responders' communication needs.

Evaluation and Results

Initial findings show significant efficiency gains in terms of disease reporting, outbreak detection, and health alerting. Over the 15-month study, the project's three components were successfully integrated into an operational system, which collected more than 450,000 and 130,000 patient records in Sri Lanka and India, respectively. A cost analysis also identified 35% savings in both countries when compared to the existing systems. Public Health Inspectors in Sri Lanka were able to detect a Chickenpox outbreak well in advance so they were able to notify the regional healthcare workers, enabling them to be better prepared. Similarly,

DATA COLLECTION

Nurses in India detected diarrhea outbreaks and identified the source of origin, which was a religious festival gathering. The value of collecting data on non-communicable diseases and non-priority communicable diseases were evident when TCWI revealed trends and population segments in specific geographic locations that were vulnerable to life-style-associated and respiratory diseases. Central healthcare workers were taking advantage of the Sahana Alerting tool to share investigation information with field-level health inspectors through SMS. Previously, the inspectors would have had to make a long journey to the central office to collect this paper-based information, and then, return to their village to conduct the investigation.

Lessons Learned

- Frontline health workers found the standard mobile phone numeric keypad difficult to use, particularly when entering large numbers of records
- Many records entered into the system contained errors that could likely be eliminated through improved user interface design and a mobile phone application
- While desktop computers, provided by the government, were harder to maintain and not often used, healthcare workers took it upon themselves to maintain the mobile phones as they served a dual purpose for both official and personal use.
- TCWI was able to apply statistical methods to detect data inconsistencies and entry errors; which the project verified as a result of occasional false reporting to maintain statistics to implicate job security

Conclusion

The project demonstrated that new ICTs can dramatically reduce turnaround time for outbreak detection and alerting from weeks to a matter of days or even hours. It also demonstrated the feasibility of using low-cost mobile phones and existing commercial cellular infrastructure and services to enable affordable,

real-time reporting of patient records from community health centers. However, further research is needed to better understand the challenges associated with scaling such a system up to a regional or national level. Further work needs to be done to optimize data entry over low cost mobile devices, to address usability and training requirements for the analytics platform, and to continue to enhance and integrate health notification into national and regional systems and practices.

Geographic Coverage: India, Sri Lanka

Implementation Partners: Carnegie Mellon University's Auton Lab, USA; Epidemiology Unit, Ministry of Health and Nutrition, Sri Lanka; Indian Institute of Technology-Madras; LIRNEasia; National Center for Biological Science, Bangalore, India; National Institute of Communicable Diseases, Ministry of Family and Welfare, Tamil Nadu, India; Sarvodaya Shramadana Movement; University of Alberta

Funder: Canada's International Development Research Center (IDRC)

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Photo credits: LIRNEasia

ZIDI

Solution design, testing and national scale-up of an enterprise health management system

Gathering reliable, retrievable and timely information on service delivery and other key indicators is an important step in improving health outcomes. Mobile Health Management Information Systems (HMIS) can help with this process. Additionally, the private sector can play a key role in the design, development and testing of such systems, especially when it is not held to the scope and scale-related constraints that come with grant-funded projects.

ZiDi™ is an innovative cloud-based enterprise health management system developed by MicroClinic Technology, Ltd., a Nairobi HMIS company. ZiDi™'s robust, easy-to-use and integrated design has primed it for large scale use in the public and private sectors. To test the system, a pilot of the ZiDi™ was undertaken in Kisumu County in September 2012. The successful 12-month pilot led to ZiDi™'s approval for use in public health facilities by the Government of Kenya.

Implementation date: September 2012

About ZiDi

ZiDi™ is a cloud-based software service that is currently optimized for use in dispensaries, health centers and out-patient departments. It allows health workers to record and access patient data at any time with web-enabled devices, preferably tablets. Regardless of connectivity, a health worker can enter a patient's demographic information, health parameters, symptoms, tests, diagnosis and prescribed drugs when offline. ZiDi™ automatically uploads the data to the cloud once connectivity is reestablished. ZiDi™ also assists health workers to adhere to clinical protocols, tracks procedures and services performed, lab tests ordered and results in a manner that facilitates supportive supervision, monitoring and evaluation of the quality of care offered. Drug inventory and facility revenues and expenses are also tracked. Patients who default on visits can be easily identified and contacted via outbound targeted or generic text messages. Data archived in ZiDi™ can be easily retrieved and exported as an Excel file for offline analytics. Auto-generated service utilization, financial and inventory reports facilitate decision-making by the health workers and district

management teams. Through tracking the productivity of health workers, it enables the MOH, in collaboration with the county governments, to correlate resource allocation with productivity in a health facility.

ZiDi™ is also interoperable with multiple existing information systems. Service utilization data are exportable into a District Health Information System (DHIS2). Consumption data on all essential medicines and medical supplies are exportable into the Kenya Medical Supplies Authority's (KEMSA) logistic management information systems. Lastly, data from the master facility list can be uploaded into ZiDi™ to update facility profiles.

Evaluation and Results

ZiDi™ has been successfully piloted in dispensaries and health centers in Kisumu County. Frequent and consistent feedback from health workers and district health management teams has been incorporated into ZiDi™ to improve the system. More than 95% of reports generated in ZiDi™ matched those housed in the facility. Fifteen health workers are currently using ZiDi™ and have fully adopted the system within their practice. Patients also report enhanced service delivery and quality of care at the pilot sites. ZiDi™ has also eliminated the need for health workers in the pilot sites to manually quantify and forecast their 90-day supplies. Instead, this information is readily available from ZiDi™. The system also allows the Kenya Medical Supplies Authority (KEMSA) to monitor consumption, rational use and stock levels in real-time. Benefits such as improved health worker efficiency, enhanced decentralized decision-making, and improved clinical decision-making are invaluable attributes of ZiDi™. It is also easy to adopt and use.

Lessons Learned

- It is important to incorporate end user feedback into the design of mHealth technology.
- Government entities should be active partners throughout the entire development and piloting process.

DATA COLLECTION



- Plan ahead for various scenarios to better anticipate adverse situations that may impact scale up of the product and program.
- When thinking about sustainability, keep in mind the role of different stakeholders, including those in headquarters and those in the field.
- While open source systems are often preferred, it is important to note any limitations they may have regarding integrated needs of the health systems.

Conclusion

ZiDi™ offers an integrated approach to data collection that ensures health workers have constant access to patient data even in remote rural health settings, and provides access to real-time monitoring of disease trends and inventory, thereby, preventing drug stock-outs. Designed to streamline reporting, it accords the MOH and other health officials access to up-to-date, web-based reports in real time, serving as a valuable resource for future decision-making and supportive supervision. By incorporating accountability into rural healthcare, it provides the necessary foundation to improve health outcomes in Kenya.

Geographic Coverage: Kenya

Implementation Partners: Government of Kenya | Kenya Medical Supplies Authority | MicroClinic Technologies | OGRA Foundation | Microsoft 4 Africa | Yahclick – SimbaNet, Kenya | Samsung/Safaricom

Funder: Public-private partnership between private equity partners and Government of Kenya

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FINANCE





INTERACTIVE ALERTS

Improving vaccine coverage through small incentives

An estimated 17% of the 8.8 million deaths worldwide each year in children under five are attributed to vaccine-preventable illnesses. Despite major immunization coverage efforts through Pakistan's Expanded Program on Immunization (EPI), low rates of uptake and delayed immunization leave children vulnerable to diseases that are vaccine-preventable. Provinces report full immunization coverage rates from 40% to 80%. Additionally, there are limited data identifying whether vaccines were administered at age-appropriate times during infancy.

Through education and small incentives, Interactive Research & Development (IRD) hopes to decrease the burden of vaccine-preventable diseases by increasing the immunization coverage and timeliness among Pakistani children. IRD, in collaboration with the Government of Pakistan and the Department of Health in Sindh Province, implemented Interactive Alerts, a mobile phone-based vaccine registry system that uses SMS reminders to caregivers and conditional cash transfers to care givers and health workers to improve immunization coverage among children in and around Karachi, Pakistan.

Implementation date: June 2012

About Interactive Alerts

Interactive Alerts offers child tracking and referral via general packet radio service (GPRS) using near field communication (NFC) mobile phones and radio frequency identification (RFID) tags. It provides a J2ME mobile client application for data collection and a web based server side application for data monitoring and storage. Plans are to release the android version of the application in November 2013.

A child's caregiver first enrolls in a lottery system during an EPI center visit and then receives SMS reminders about vaccination appointments. To assure each child completes the scheduled vaccines on time, health workers also individually track enrolled children using the mobile phone-based RFID system. The amount of cash the caregiver is eligible to win increases with each subsequent vaccine their child completes. Caregivers

receive higher cash amounts for vaccinations that are administered at the recommended age. After winning the lottery, the caregiver is sent a winning lottery code via SMS. The lottery winnings can be used at the participating stores offering groceries and medicines located in close vicinity to each EPI center, and codes cannot be exchanged for cash. Each time a lottery prize is won, the health worker who administered the vaccination also receives a mobile money transfer payment through Easypaisa, equivalent to 40% of the lottery prize. Easypaisa is a mobile banking service offered through Telenor Pakistan cellular communications, in partnership with Tameer Bank MicroFinance.

Evaluation and Results

The pilot phase started in June 2012 and has enrolled more than 14,000 infants from 12 public and private sector EPI centers in Karachi.

Interim data analysis suggests improved immunization coverage and timeliness. Currently, an impact evaluation study is underway to determine the effectiveness of Interactive Alerts in improving immunization coverage and timeliness in children, performance of vaccinators, and the accessibility and quality of program data.

Scale-up of the project will begin in January 2014 with a target of reaching another 100,000 children from Karachi over the period of one year.

Lessons Learned

- Vaccinators are enthusiastic about using a cell phone data entry system for recording immunization events. mHealth Innovation leverages existing resources and personnel and increases their efficiency compared to the existing paper-based record keeping system.
- Lottery-based conditional cash transfers incur low costs and have the potential to induce positive behavior change in caregivers for improving immunization and improve performance of vaccinators

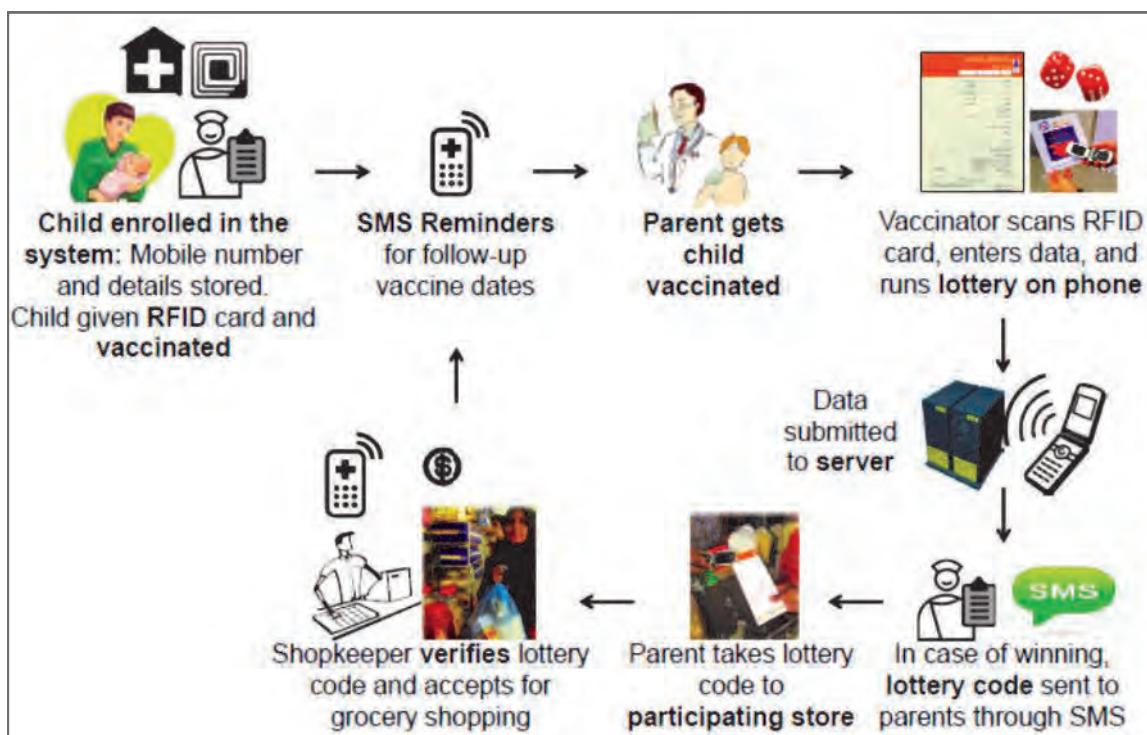


Figure 1. Participant flow

Conclusion

Small incentives can prove beneficial in public health programs. Through SMS reminders and a lottery system, caregivers are encouraged to bring in their children for timely vaccinations and health workers are incentivized to provide efficient vaccination services. Together, these innovative strategies help prevent needless childhood deaths and illnesses associated with vaccine-preventable diseases.

Geographic Coverage: Pakistan

Implementation Partners: Interactive Research & Development (IRD) | Expanded Program on Immunization (EPI), Sindh Province, Government of Pakistan | openXdata.org; Indus Hospital | Johns Hopkins Bloomberg School of Public Health

Funder: mHealth Alliance, Community Health Solutions

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mHEALTH FOR SAFER DELIVERIES: EZY PESA MOBILE BANKING SERVICE

A mobile money transfer service for traditional birth attendants



Most women, especially in low-income countries, continue to deliver at home for a variety of reasons, including cost, preference, culture and lack of information. In Zanzibar, half of all pregnant women deliver from home and only one-third of mothers and newborns receive timely postnatal checkups. Home deliveries can, in part, be made safer by assuring the provision of adequate care.

In response D-tree International, in collaboration with Etisalat Group telecommunications and their local mobile service provider, Zantel, is utilizing mobile technology to meet this challenge through the combination of mobile decision support, data storage, on-line banking and communications on a single device at the point of care. mHealth for Safer Deliveries is a complete suite of services enabling traditional birth attendants (TBAs) and midwives to ensure safer pregnancies and deliveries. It not only enables health workers to quickly and accurately identify obstetric emergencies, but also features Ezy Pesa, a mobile banking service that assists them in arranging obstetric-

related transportation for the pregnant woman to a health facility where she can receive appropriate care.

Implementation date: October 2011 to December 2014

About Ezy Pesa

The application provides a step-by-step protocol for the following: identifying dangers signs during labor and delivery, the phone number of vehicle owners who can transport the patient on an emergency basis, access to money on the phone to pay the vehicle owner for transportation, a record of permissions needed from the family or local decision makers to transport mother and infant in case of emergency, and the ability to contact the referral facility so they can be prepared for the patient's arrival.

Mobile banking accounts were established for the TBAs working with the project. After registering them with their mobile banking accounts, Zantel assisted with the project by opening pay points in the project areas and by providing training to the TBAs on Ezy Pesa. Additionally, D-tree worked with the health facilities and the villages to identify appropriate transport providers, enroll them in the program and pre-negotiate rates.

Once a month, D-tree calculated cost estimates based on the TBAs' total expected delivery estimates for the month. This was transferred to the D-tree Ezy Pesa account, and then using either a mobile phone or the Internet, the money was transferred to the TBAs' mobile banking accounts.

Evaluation and Results

The Zanzibar Ministry of Health and Social Welfare (MoHSW) helped develop the project and select two pilot areas, the North A District of Unguja and the Micheweni District of Pemba, based on their low facility

delivery rates. Twenty-four TBAs were also trained to use the mHealth application.

During the first phase, which ran until April 2012, these TBAs successfully registered 682 pregnant mothers, of which 211 delivered during the implementation period. Health facilities and hospitals in the project areas also saw their in-facility delivery rates more than double on average, and there were no maternal deaths recorded among the registered mothers.

In the second phase, the project is now being used by over 200 TBAs and CHWs who have registered nearly 7,000 women, and the facility delivery rate stands at over 70%.

As referrals and post-partum visits are made, the TBAs withdraw funds from the pay points and pay themselves and/or the drivers. Timely transfers of the money lead to smooth transactions and fast turnaround of payments. Lastly, the average cost per delivery amounted to \$22.26, a minimal expense for ensuring the safety of a mother during her pregnancy.

Lessons Learned

- It is important to take into account local cultural preferences and sensitivities during the application development process.
- When possible, provide a vertical integration of various mobile services, such as mHealth and mobile money, to enhance program impact.
- mHealth program models should be scalable and sustainable, creating incentive and/or revenue for all parties involved.
- There should be an educational and training component, as well as opportunities for end-users to provide feedback which can be applied to ongoing application optimization.
- Closely collaborate with various stakeholders and engage the government from the early stages of product development.
- Investment in systems to reconcile the mobile

money (financial) and mobile health (programmatic) data, while time consuming, can greatly facilitate scale up.

Conclusion

The combination of mobile decision support, data storage, on-line banking and communications on a single device at the point of care will lead to more successful maternal health outcomes and a greater potential for meeting MDG5.

Geographic Coverage: Zanzibar, United Republic of Tanzania

Implementation Partners: D-tree International, Etisalat, Ministry of Health, Zanzibar

Funder: The Bill & Melinda Gates Foundation

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PONA NA TIGO BIMA

Health microinsurance utilizing mobile phone-based claim payments

World Bank studies have found that poor health and the inability to access health care are key factors leading to, and resulting from, poverty. Health microinsurance can offer financial protection to the poor as well as increase access to medically needed healthcare services.

In October 2012, the social business MicroEnsure, in partnership with mobile network provider Tigo, sales and technology facilitator Bima and insurer Golden Crescent, piloted the *Pona na Tigo Bima* (“Get Well with Tigo Insurance”) health insurance product in Dar es Salaam, Tanzania, offering life insurance and hospital cash for hospital care at a defined network of hospitals.

Implementation date: October 2012

About Pona Na Tigo Bima

MicroEnsure designed the insurance product and processes to manage and deliver it to consumers. They perform daily overall administration and oversight, including claims processing and customer service. Bima developed the technical platform for enrollment and manages the agent network, and Tigo distributes the product under its local brand.

The health insurance product offers six tiers of life and hospitalization coverage paid via three monthly installments that are deducted from the customer's airtime balance. From a technical perspective, *Pona na Tigo Bima* utilizes a USSD application for product enrollment, which provides an efficient service as well as high-quality product information at low cost to the entire Tigo Tanzania subscriber base. The claims process is handled via a call center and most documents are submitted digitally in Tigo shops. MicroEnsure assists claimants throughout the claims process, helping them to find and submit the documents required to receive their claim payments. Once the claim is approved by MicroEnsure and Golden Crescent Assurance, the claim is paid immediately via mobile money transfer using the Tigo Cash service. Tigo Cash offers a safe, transparent and reliable means for MicroEnsure and its partners to pay claims wherever there is a Tigo network signal. As a result of this

process, the vast majority of claimants can submit claims and receive money without travelling to an insurance office.

Evaluation and Results

By switching from paper to mobile claims payments, MicroEnsure reduced claims processing time from 11 to 3.2 days. Claimants were willing to register for mobile money payments and expressed interest in learning about the details of the payment process. The timely and reliable nature of the payment has built client trust in both mobile payments and MicroEnsure's health product. Based on its experience, MicroEnsure is implementing new mobile health insurance products for launch in 2014 in six new markets across sub-Saharan Africa and Asia.

Lessons Learned

- MicroEnsure and Tigo built a successful partnership by clearly defining their roles and responsibilities and ensuring that all parties were in agreement from the outset and benefitted from the arrangement.
- A network of sales agents was essential in educating consumers about the *Pona na Tigo Bima* program.
- By bundling health insurance in a package of Tigo services and automatically deducting premiums via airtime, MicroEnsure established a convenient payment mechanism for its clients that ensures regular and timely contributions for premiums.
- Mobile money's potential continues to increase; however, current low utilization rates in Tanzania limit opportunities for expansion into other areas, such as premium payments.
- Client understanding of MicroEnsure's health products is lower than for its life products. The company is continuing to address this challenge through its product development, messaging and underwriting work.



Conclusion

While challenging, health microinsurance has the potential to increase access to needed healthcare services, mitigate the risks of disease and ill health, and address the need for new methods of health financing. Insurance practitioners, researchers, policy makers and the global health community should continue to seek evidence towards the benefits, as well as shortcomings, of mobile health microinsurance for the poor.

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Geographic Coverage: Tanzania

Implementation Partners: MicroEnsure, Tigo, Bima, Golden Crescent Assurance

Funders: MicroEnsure, Tigo, Bima, Golden Crescent Assurance





LOGISTICS

FONEASTRA

A safety management system for human milk banking

Breast milk is considered a pillar of child survival; it has unique immunological and nutritional properties that help infants get a healthy start to life. Infants who receive breast milk are less likely to become seriously ill or die from infections, compared to those who do not receive breast milk. This is especially true of vulnerable infants in developing countries who may face continual exposure to pathogens through unsafe water or unhygienic conditions. For infants whose mothers' milk is unavailable, the World Health Organization supports human milk banks (HMB) as a critical intervention for guaranteeing access.

To ensure safe pasteurization in resource-limited health care facilities, PATH is advancing a pasteurization management system based on a platform developed by University of Washington called FoneAstra. This system leverages the use of mobile phones to precisely monitor pasteurization of donor breast milk.

Implementation date: October 2011 to June 2013

About FoneAstra

To address the challenge of ensuring safe pasteurization in homes and resource-limited health care facilities, PATH is advancing a safety management system based on a platform called FoneAstra.

FoneAstra is a real-time temperature monitoring device and remote data recording tool. This system leverages mobile phones to precisely monitor flash-heat pasteurization of donor breast milk. FoneAstra components include a mobile phone, a USB cable and bridge, a glass jar and a temperature sensor probe. These are paired with simple

pasteurization equipment: a freezer, a pot and a heat source. A novel USB bridge connects the phone and temperature probe, allowing the phone to act as the CPU walking users through the pasteurization process through simple audio and visual instructions. The phone then transmits the data wirelessly to a central servicer for review, reports and archiving.

Evaluation and Results

In early 2012, PATH, in collaboration with the Human Milk Banking Association of South Africa, managed a one-year pilot study of FoneAstra. This included a field test to evaluate the use of FoneAstra as a low-cost HMB system compared to routine flash-heat. User assessments were performed with milk bank staff to validate they were able to correctly operate the system. A cost analysis was also conducted to guide scalability of HMB systems in South Africa.

None of the 100 samples pasteurized with the new FoneAstra system showed any bacterial growth. This finding confirmed the safety of this pasteurization method, since it was effective in completely destroying the bacteria present in 86 of the pre-pasteurized samples.

Lessons Learned

- Human milk bank technicians can successfully operate the FoneAstra devices.
- The ability to provide remote monitoring, as well as push updates remotely, is a key advantage of the platform and allows for off-site supervising and tracking.
- Some challenges that continue are the cost of the phones and the risk that they could be lost or stolen.
- Small-scale human milk banks can be fully operational even with limited staff using with simplified systems such as FoneAstra.



Conclusion

FoneAstra has undergone significant development and refinement, making the technology well-integrated with existing organizational workflows. It is a feasible, safe, and affordable tool, costing about US\$600, for resource-limited settings to ensure the safety and enhance the acceptability of donor breast milk. With its established quality measures, the pasteurization management system has the potential to prevent significant infant morbidity and mortality through increased access to contaminant-free donor milk, a critical step toward expanding HMB adoption.

donations from private foundations and individuals to the PATH Health innovation Portfolio, and the National Science Foundation Research Grant No. 11S-1111433.

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Photo credits: c. PATH, Steffanie Chritz

Geographic Coverage: South Africa

Implementation Partners: PATH, University of Washington

Funder: Funding was provided from a grant from the Bill & Melinda Gates Foundation through the Grand Challenge Explorations Initiative, the University of Washington Department of Computer Science and Engineering,

PROJECT OPTIMIZE:ALBANIA

Remote temperature monitoring for vaccine quality

Proper monitoring of temperatures is crucial to ensuring the quality of vaccines. As vaccine efficacy can be affected by exposure to excessive heat and cold, it is important that vaccines are correctly transported and stored from the point of manufacture to the point of use. Temperature monitoring, usually conducted by health workers, helps ensure the quality with which vaccines are handled, detects malfunctioning equipment and prevents temperature fluctuations that can negatively impact vaccine potency and safety. In Albania, 30-day temperature recording devices, such as Berlinger's Fridge-tag®, are used in most health centers where vaccines are stored. However, health workers cannot respond to an alarm during nonworking hours, and without supervisors' assistance, they cannot always take the appropriate remedial actions.

Project Optimize designed and implemented a study in Albania to evaluate the potential benefits of remotely connected monitoring devices. Optimize was a five-year partnership between WHO and PATH to identify ways in which supply chains can be optimized to meet the demands of an increasingly large and costly portfolio of vaccines. The project tested an SMS-based system to monitor and log temperature conditions in peripheral cold chain equipment. The aim was to assess whether these remote alarm systems facilitate better vaccine and cold chain management than non-connected temperature loggers.

Implementation date: March 2010

About Project Optimize:Albania

In collaboration with the National Immunization Program (NIP) and Berlinger, Optimize installed an SMS-based system that monitors and logs temperature conditions in peripheral cold chain equipment. In Albania's Shkoder District, 24 health centers storing vaccines were equipped with remote temperature monitoring devices that included sensors, monitors and SMS gateways. When an alarm is activated due to exceeded temperature limits, an SMS text message is immediately sent to a central server that logs the issue and sends a notification to health workers and

supervisors in charge of the storage location. Once the problem is addressed, its status is reset on the central server.

To analyze temperature curves for the working status of refrigeration equipment, mobile phones were also used to transmit frequent temperature measurements. The FoneAstra system was used for this process and installed at six sites. Temperature probes were placed inside equipment and the mobile phone and accessory mounted externally, which sampled and aggregated data from the temperature sensors every few minutes. Detailed temperature logs are periodically sent to the central server via SMS, which also stores alarm notification data. All data can be easily viewed using a standard web browser.

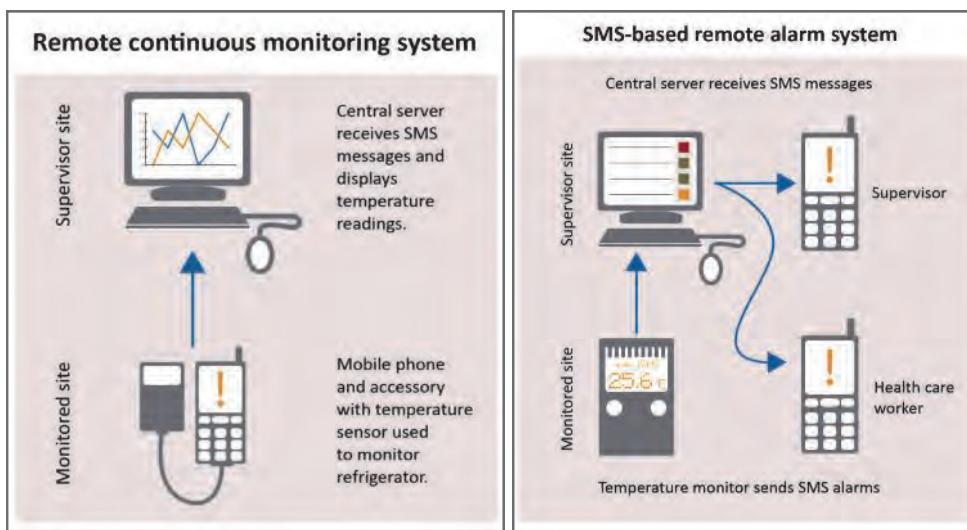
Evaluation and Results

Over a 10-month period, 136 alarm incidents were detected, including 22 low- and 114 high-temperature alarms. The system also demonstrated certain managerial benefits. For example, supervisors phoned health workers or storekeepers in 41% of incidents to confirm detection of the problem and assisted in taking appropriate follow-up measures in 15% of these.

In focus group discussions, nurses and supervisors reported that the technology was beneficial for their work. However, while the study highlighted some qualitative benefits of the technology, it did not find any situation in which remote monitoring saved a vaccine from freezing or excessive temperature exposure. Therefore, a case for positive cost-benefits could not be made.

Lessons Learned

- The study increased awareness of the importance of temperature monitoring, improved collaboration between vaccinators and supervisors to resolve alarm events and cold chain problems, and served to improve the entire cold chain system in Shkoder district
- There was a sense that this technology provided a "best-in-class" level of quality control.



- Since the study was designed to establish the potential benefits of the concept, there was no attempt to produce the devices at low cost, thereby making scalability and sustainability unknown. At USD\$1,000 per monitoring device, the Fridge-tag®-based system is unaffordable for limited-resource locations. However, a prior FoneAstra project suggests costs may drop to about \$100 per device.
- Ongoing communication costs of almost \$1,500 each year may also present a barrier to project adoption.

Conclusion

The adoption of non-connected recording devices has demonstrated willingness to invest in temperature monitoring equipment to safeguard expensive vaccines. The prospects for adoption of remote monitoring systems will likely be driven by their costs. The experience in Albania suggests it may become a niche product, mostly suitable for places where high vaccine stock values are at stake or for remote storage points with unreliable storage conditions.

The demonstration was a partial success. Further research is needed to quantify potential benefits, such as the number of vaccines saved, and to produce lower-cost devices.

Geographic Coverage: Albania

Implementation Partners: Ministry of Health, Albania | Institute of Public Health, Albania | Health Insurance Institute, Albania | PATH | Shkoder Directorate of Public Health, Shkoder, Albania | Albania Country Office, World Health Organization

Funder: The Bill & Melinda Gates Foundation

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SMS FOR LIFE

Preventing malaria and other medicine stock-outs at the remote health facility level in sub-Saharan Africa

Malaria is a preventable and treatable mosquito-borne disease whose main victims are children under five years of age in Africa. Although highly effective antimalarial drugs are available, countries continue to experience stock-outs due to systematic shortcomings. It is essential to have adequate supplies of drugs when and where they are needed. However, this continues to be a major challenge, especially in remote rural communities where widespread antimalarial stock-outs frequently prevent patients from receiving treatment.

In response, Novartis, utilizing public-private partnerships, has led the development of the SMS for Life system. Leveraging the availability of mobile phones in remote areas, the internet and mapping technologies, the solution increases the visibility of antimalarial stock levels at remote health facilities, thereby ensuring district medical officers have the information they need to adequately manage antimalarial commodities at each and every facility.

**Implementation date:
2010**

About

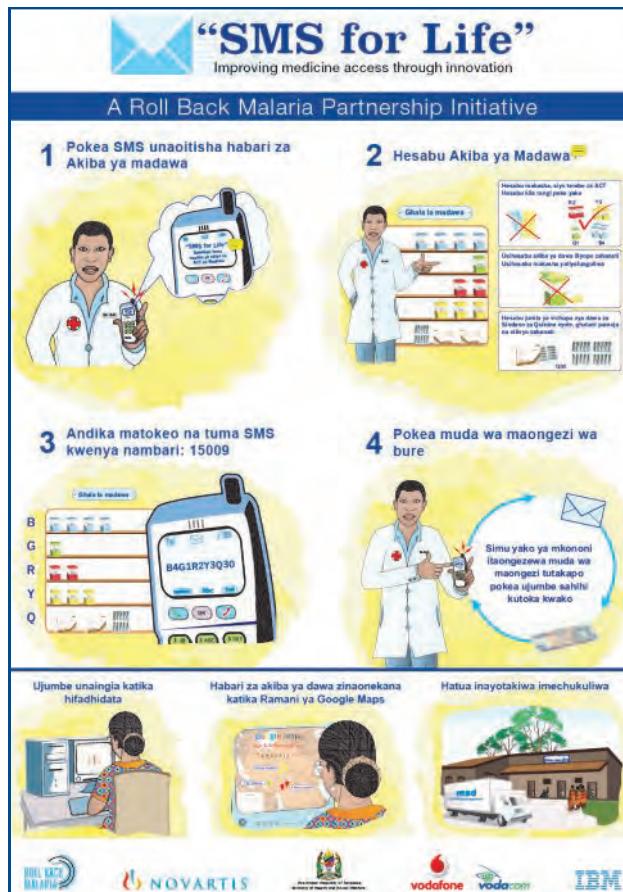
Each country's system provider, guided by the Ministry of Health (MOH), the National Malaria Control Program (NMCP) and the SMS for Life Team, configures the SMS for Life system to national needs. It can flexibly address the priorities of the local MOH, including better availability of commodities, prevention of stock-outs and better forecasting of drug needs, and provide timely surveillance information to support best practices in disease management.

Each week, automatic SMS text messages are sent to mobile phones at health facilities requesting information on current stock levels and disease surveillance. Responses are reported via SMS, centrally stored in a database and made accessible to key health-care staff via the internet and email. The website provides the following: current and historical data on stock levels of antimalaria medicines, antibiotics and rapid diagnostic tests at the health facility and district level. The system also provides disease surveillance current and historical information, in addition to calculated indices such as percentage of confirmed cases under and over the age of five. The system also tracks and reports on system usage statistics, such as numbers of received messages, errors and system accesses, and has a data extraction function.

Reports are created and can be delivered by mobile phone, email or the internet to staff at all system levels. District medical officers can utilize reporting data for decisions about transferring commodities between facilities in response to stock-outs or make emergency orders to replenish stocks that are running low. National health authorities can view disease surveillance and various data

such as numbers of patients, testing rates and test positivity rates, by facility, District, Region or Country.

Any mobile phone can be used at the health facility level for data reporting, with district managers using smart phones or internet to access email and web-based information. District medical officers and regional- and national-level authorized users can use any personal computer with Internet access to view the website.



Evaluation and Results

SMS for Life has been rolled out nationally in Tanzania and pilots have been completed in Ghana and Kenya. Both countries have indicated interest in national scale-ups. Cameroon has begun nationwide implementation and the program has also been implemented in five provinces in Democratic Republic of the Congo. In addition, the system is being used to track blood supplies in all blood stocking locations in one region of Ghana and countrywide scale-up is planned for 2014.

Lessons Learned

- The key to long-term sustainability lies with local ministries of health. They should commit at early stages to taking over the system after successful roll-out and to running it for an extended period, until it is integrated into the mainstream health system and can continue to evolve in that context.
- It can be a challenging and time consuming, albeit worthwhile process to establish and manage partnerships between ministries of health and mobile phone companies.
- An in-country presence would be very helpful and early discussion on funding and funding sources is essential.
- It would be beneficial to find evidence-based solutions through publications and pilots, as well as a cost analysis of necessary full country scale-up prior to implementing the pilot

Conclusion

The improved visibility of medicine stock levels at remote health facilities allows better management of essential commodities and increased availability and access. Sustainability of the SMS for Life intervention is increasingly attainable because of productive public-private partnerships among local authorities and telecommunications companies, the system provider, major funders and NGOs, and their goal of eliminating almost all malaria deaths in Africa by 2015.

Geographic Coverage: Cameroon, Ghana, Kenya, United Republic of Tanzania, Democratic Republic of the Congo

Implementation Partners and Funders: Novartis, Ministry of Health United Republic of Tanzania, Medicine for Malaria Ventures (MMV), Swiss Agency for Development and Cooperation, Vodacom Tanzania, IBM, Google, Vodafone, Ghana Health Service, Swiss Tropical and Public Health Institute, Ministry of Public Health Cameroon, Malaria No More, Ministry of Public Health and Sanitation Kenya, Safaricom Kenya, Management Sciences for Health, PSI/PMI, Norad

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SERVICE DELIVERY



ACT FOR BIRTH, UGANDA

Ensuring safe delivery through fetal heart rate monitoring and a mobile phone-based mortality audit system

In Uganda, almost half of births take place in facilities. However, even when emergency care is available, many opportunities for saving lives are missed. In 2010, there were an estimated 6,000 maternal deaths, 39,000 neonatal deaths and 38,000 stillbirths. Poor quality care at the time of birth, including the lack of fetal monitoring during labor, has been highlighted as a key gap through Uganda's maternal and perinatal mortality audit process. The baby's heart rate is one of the most important markers of distress in labor and a key indicator of the need for prompt intervention. Current devices for monitoring labor in high-income countries can be expensive, complex, electricity-dependent and unreliable in resource-limited settings ,where they may be ill-suited for use.

ACT for Birth, Uganda is an initiative to improve quality of care at birth using high-impact, low-cost technology to promote timely decision-making for safe and successful delivery. The project involved testing an innovative fetal heart rate monitor (FHRM) and an action-oriented mobile phone-based mortality audit system. The integrated pilot was implemented in Uganda by Save the Children's Saving Newborn Lives Program and partners from 2011-2013.

Implementation date: April 2011 to 2013

About ACT for Birth

ACT for Birth comprises three components:

A = Audit and Accountability: Uganda's national paper-based mortality audit forms were adapted to a mobile phone platform to capture and input information on maternal and neonatal deaths and stillbirths in real time by midwives that is fed into a central database. It captures information on causes of deaths and missed opportunities for care. Data is analyzed on-site and used to inform decision-making for improved quality of care.



C = Connecting Communities: Village Health Team (VHT) members equipped with mobile phones and maternal and newborn health training are directly connected to referral facilities. VHTs assist with referral of mothers and newborns with danger signs, report births and deaths at the community level, and conduct pre- and postnatal visits to promote best maternal and newborn care practices, including care seeking, facility based deliveries and the identification of danger signs.

T = Technology and Training: The innovative wind-up Doppler FHRM is powered by human energy and designed by South African non-profit medical device company Powerfree Education Technology. It is paired with training on intra-partum care, and thus, empowers health workers to provide better care.

Evaluation and Results

ACT for Birth consisted of four phases. The year-long startup phase included meetings with stakeholders, feasibility assessments, baseline data collection using maternity register data and protocol development. During Phase Two, health workers and VHTs were trained and facilities equipped with FHRMs and mobile phones. Project implementation (Phase 3) occurred from July 2012 – July 2013. Regular support and supervision meetings were held to assess progress and evaluate implementation. The final phase included documentation and dissemination of findings.

Audit and Accountability: Mortality audits can reduce deaths by up to 30% if data are used effectively and clearly linked to action. Working with the Ministry of Health (MOH), the project simplified the MOH death audit form and adapted it for use on cell phones to make it more user-friendly. Twenty-five health workers involved in service delivery were trained to capture data using the adapted audit software which allows midwives to code the direct cause of death, as well as the avoidable factors linked to each death. During the

project period, all five maternal deaths were audited. In addition, 75% (121/162) of all newborn deaths were audited, compared to 7% (9/123) during the baseline.

Connecting Communities: The intervention to link women to health facilities through VHT also proved successful. As a result of the training provided, VHTs were highly motivated to perform their work, health workers knew and respected them and honored the referrals they made, and the communities developed trust in them.

Technology and Training: In the endline evaluation, 17 of the 25 health workers interviewed indicated that they had recently received in-service training on intrapartum care. All who attended thought that the trainings were effective. However, training alone is not sufficient to maintain skills; ongoing supervision and mentorship are also essential. Correct use and completion of partographs during deliveries was also monitored and markedly improved during the course of the project.

The Doppler FHRM registered high levels of success in Nakaseke in terms of acceptability, usefulness, and appropriateness. Health workers and mothers found the devices effective in monitoring the fetal heart rate before, during and after contractions. However, there were noted challenges related to the inability of the device to display the remaining battery life.

Lessons Learned

- ACT for Birth functioned as an integrated whole resulting in a sustainable package ready for scale up.
- The level of quality improvement would not have been reached if any of the three interventions were implemented as a stand-alone solution.
- At the health facility level, quality of care and accountability improved through the training, technology and frequent audit meetings.
- The use of an electronic audit platform was successful and is promising even in sites with limited connectivity due to cell phone adaptation.
- Improved knowledge and skills of VHTs improved accountability.

Conclusion

In light of ACT for Birth's findings and engagement of the National Newborn Steering Committee with the project, the Ugandan MOH is currently updating the Maternal and Perinatal Death Review strategic plan and guidelines. **There is strong government commitment and high potential for uptake of the whole package, including audit and the FHRM and Helping Babies Survive Labor training, as well as the connection between the district, VHTs and health facilities.** Additionally, the training package is being adapted for pre-service training for nurses and midwives in partnership with the Ministry of Education and Academic Institutions, and the Uganda Association of Ob/Gyn.

Geographic Coverage: Nakaseke District, Uganda

Implementation Partners: Save the Children, in partnership with the Ugandan Ministry of Health, the Association of Obstetrics and Gynaecology of Uganda, Powerfree Education Technology, MTN

Funder: Saving Lives at Birth Grand Challenge partners, including USAID, the Government of Norway, the Bill & Melinda Gates Foundation, Grand Challenges Canada, and the World Bank

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BABY MONITOR

Preventing maternal and newborn deaths through mobile phone-based screening

Despite significant global progress in reducing maternal and infant mortality rates, nearly 300,000 maternal deaths and an estimated 5 million infant deaths occur each year. Prenatal care and a series of proven interventions delivered by a skilled attendant could prevent nearly 80% of maternal deaths and 66% of newborn deaths. However, many women and infants are never assessed and connected to healthcare. Baby Monitor, a new mHealth platform that takes clinical screening directly to pregnant women, aims to change this.

The goal of Baby Monitor is to save lives, improve health outcomes, and optimize the use of community health workers (CHWs) in rural and remote regions where access to health systems is limited and clinical assessment often occurs too late or not at all. With seed funding from the Saving Lives at Birth Grand Challenge, Population Council and its partners developed and tested a beta version of Baby Monitor, a mobile-phone based screening, referral and patient management service that targets hard-to-reach pregnant women as end-users. The formative study was conducted in a periurban catchment area in Nairobi, Kenya in 2012. Baby Monitor is currently being further refined and tested in a second study in Bungoma East District, Kenya.

Implementation date: October 2011

About Baby Monitor

Baby Monitor is an open source mobile phone application that uses interactive voice response (IVR) technology to offer free mobile screenings to pregnant women and new mothers. When it is time for a prenatal or postnatal exam, a registered user receives a text message with a code that can be redeemed by “flashing” the Baby Monitor phone number to trigger a free call back. The woman selects her preferred language, listens to recorded audio prompts asking her how she and her baby are feeling, and presses keys on her phone’s number pad to respond. All of her responses are logged in an electronic medical record. The analysis engine determines whether the woman is likely to need referral to a medical facility or more immediate assistance.

When fully operational, Baby Monitor will include an “action” component that uses screening results to trigger automated referrals and emergency dispatch.

Baby Monitor uses Verboice, a free IVR platform, installed on an Amazon Elastic Compute Cloud (EC2) server connected to a Voice over IP (VOIP) provider in Kenya. Each call costs Baby Monitor USD \$0.04 per minute, which could be reduced through bulk pricing.

Evaluation and Results

The initial study conducted in Nairobi in 2012 allowed Baby Monitor developers to:

1. evaluate the feasibility and acceptability of Baby Monitor through interviews and focus group discussions with study participants and consultations with our clinical partner and
2. assess reliability and accuracy of the mobile screening protocols by comparing results from mobile screenings to follow-up, in-person clinical assessments.

Four health screening protocols were developed for different stages of the birth continuum. The antenatal protocol included screening questions about maternal physical and mental health. The postnatal protocol, used one and three days after delivery, assessed maternal and infant physical health (but not mental health or infant development). The postnatal protocol, used seven days after delivery, assessed maternal physical health, perinatal depression and infant physical health, and the postnatal screenings, delivered at 6, 10 and 14 weeks, assessed maternal physical health, perinatal depression, infant physical health and infant development.

Ninety-five (95) women in their second trimester were enrolled for the study. Women completed automated screenings and, one day later, completed the same screening with a nurse.

In the prenatal period, Baby Monitor correctly identified 88.5% of positive cases—those classified by the nurse as having “any problems”. The screening tool was less successful in the postnatal period, only correctly

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identifying 23.8% of positive cases. The tool demonstrated high specificity, positive predictive value and negative predictive value in both periods.

Overall, the screening tool proved to be a valid assessment of medical need. It also had acceptable initial measures of reliability, meaning that the women largely provided the same responses to the automated service as they did to the live nurse. Reliability can be improved as the system moves to production by increasing the stability of the platform and enhancing the audio quality of the phone connection.

Lessons Learned

- The Baby Monitor system is feasible to implement and acceptable to users.
- Automated screening can be used as a tool to identify women and infants with medical needs.

Conclusion

For many women in rural and remote settings, a mobile phone signal is more likely to reach their home than a community health worker. The formative study of Baby Monitor demonstrates the potential of using an automated IVR screening on mobile phones to identify women and infants with medical needs. Through

integration with existing electronic medical records systems, the developers of Baby Monitor will be able to build an interoperable service that encourages women to seek healthcare, optimizes the use of health system resources, tracks outcomes and offers women a more personalized health experience.

Geographic Coverage: Kenya (initial study in Nairobi, current study in Bungoma East District)

Implementation Partners: Population Council, in partnership with InSTEDD, Jacaranda Health and Moi University

Funder: Saving Lives at Birth Grand Challenge partners, including USAID, the Government of Norway, the Bill & Melinda Gates Foundation, Grand Challenges Canada, and the World Bank

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eNUT

Supporting the diagnosis and treatment of childhood malnutrition

Nearly 12% of children in Zanzibar suffer from acute malnutrition. However, when this entirely treatable condition progresses to severe acute malnutrition (SAM), it becomes life threatening and requires urgent treatment. Prior to 2009, 20% to 30% of children who were admitted with SAM died despite receiving treatment, but this number could be reduced to as low as 5% if children with SAM were treated according to the WHO-UNICEF standard treatment guidelines. In response, the Government of Zanzibar is working to nationally eradicate malnutrition, especially among young children, by collaborating with UNICEF on a comprehensive program for the identification and treatment of malnourished children in the community using national standards of care.

D-tree International designed the nutrition software, eNUT to facilitate implementation of these guidelines and standards. eNUT was built to streamline the management of information and support the decision-making needs of health workers, helping them to implement the national guidelines for providing effective treatment to children suffering from malnutrition. Launched in November of 2010 and continuing to scale through December of 2013, eNUT is an integral component of Zanzibar's national nutrition program and is fully supported by the Ministry of Health and Social Welfare.

Implementation date: 2010 to 013

About eNUT

The eNUT software provides an interactive mobile version of the government-approved treatment guidelines for acutely malnourished children. Used by government health workers, primarily nurses, the application takes them step-by-step through the



guidelines using data from past and current visits to assess the child's progress and determine the next steps for effective treatment. Nurses can access patient data, enter new data and schedule appointments. The software captures the data that the nurse enters during the patient visit, providing the health service administrators with real-time access to program data and improving overall decision-making abilities.

The software runs on the Android™ operating system and combines on-device electronic medical records with protocol execution, using a password-protected login procedure for data security. Information is drawn from several major parts of the electronic protocol to contribute to the patient record, including screening and registration, physical examinations, treatment, counseling for the caregiver and appointment scheduling. D-tree's private-sector partner, Zantel, is currently supporting the project with reduced fees for data transfers and technical support, helping to keep program costs low.

Evaluation and Results

An independent evaluation carried out on the first six sites of the project concluded that the intervention sites were 20% more accurate in diagnosis than the non-project sites. A qualitative survey of the health workers' perceptions about the application was also completed. The majority of the users reported an improved ability to register and screen children, an easing of workload, and improved skills and capacity.

Currently, the scale up has reached 3 districts and 12 health facilities. It is now focused on integrating the existing application with the Integrated Management of Childhood Illness (IMCI) strategy, developed by WHO and UNICEF, to better incorporate the use of the application into the routine clinical workflow.

Lessons Learned

- Success in the clinics where D-tree has been working can be attributed to close follow-up, flexibility, and an understanding of the environment and needs that stem from user feedback.
- Underpinning its ability to scale-up, D-tree has found that the key factor influencing the level of grassroots support among patients and FWHs is integration of the mobile service into the flow of care. For the mobile service to be integrated effectively into the health system, it must be seen as lessening the burden on FHWs and improving the quality of health services for clients.
- mHealth interventions are not a panacea – they cannot be viewed as a quick fix to an underlying public health problem. By working with the government at multiple levels, D-tree has learned how to integrate its mobile solution into broader public health initiatives and into the health system.
- Though effective scale-up depends on successfully engaging with government partners, D-tree has found that engaging with the right government actors is challenging, as these actors are scattered across multiple levels and departments.
- An additional challenge for D-tree has been a low

number of patients reached. Although the Tanzania DHS survey indicated high levels of SAM, D-tree has not seen a corresponding high number of patients.

Conclusion

eNUT provides an innovative delivery mechanism and decision support system for Zanzibar's national standards of care for the identification and treatment of malnourished children. This component of the national nutrition program is integral in aiding the Government of Zanzibar eradicate malnutrition as a public health problem, and thus reduce overall morbidity and mortality in the population, especially among young children.

Geographic Coverage: Zanzibar, United Republic of Tanzania

Implementation Partners: D-tree International, Zanzibar Ministry of Health and Social Welfare, Zantel, Edesia, UNICEF

Funder: UNICEF, mHealth Alliance

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MOBILE MEDIA RICH INTERACTIVE GUIDELINES

Mobile-phone based media-rich clinical guidelines to improve community health worker performance

The screenshot shows a mobile application interface for 'guideVue'. At the top, it displays 'AIEPI 1s-2m [español]'. Below this are five buttons: 'Previous', 'Repeat', 'Restart', 'Search', and 'End'. The main content area features a video thumbnail of a baby's face. Below the thumbnail is the text 'Busque signos de dificultad respiratoria'. Underneath this, there is a question: 'Los signos son aleteo nasal, retracciones subcostales o supraesternales, estridor. Hay alguno de estos signos presentes?'. At the bottom left, there are two buttons: 'Ausentes' (green) and 'Presentes' (yellow). To the right of these buttons is a 'Progress' section containing a list of items: 'Bienvenido a AIEPI para lactantes de 1 semana a 2', 'Que tipo de visita es esta', 'Recuerde lavarse las manos', and 'Busque signos de dificultad respiratoria'.

Community health workers (CHWs) play a vital role in developing countries, often serving as the primary and sometimes sole providers of healthcare to many people, especially in areas where there is a shortage of physicians and nurses. Since the educational background, literacy and clinical training of CHWs varies, it is important to provide means towards

improving and maintaining their knowledge and performance. One strategy is the use of job aids that provide just-in-time knowledge and information. However, paper-based versions have not produced ideal results due to poor design, incomplete explanations and lack of explicit workflow, all leading to a possible increase in the user's workload.

One solution is the development of mobile phone-based job aids enhanced by rich media such as text, audio and visual aids. These tools can provide CHWs with the point-of-care clinical information and decision support they need to improve their performance and subsequently health outcomes within their communities.

Implementation date: 2008 to 2009

About Media Rich Interactive Guidelines

A study funded Microsoft Research and performed by the University of Texas and University of Antioquia in Medellin, Colombia investigated and analyzed the possible benefits on CHWs' performance of point-of-care clinical guidelines (MRIGs, also known as Interactive structured m-rich media guidelines) presented as interactive rich media job aids on small-format mobile platforms. The MRIGs were used to diagnose and treat pediatric and adult medical conditions in a simulated setting. Fifty CHWs were

divided into an intervention (rich media job aids) or control (traditional paper-based job aids) group. Each CHW treated a total of 30 standardized cases using both methods in a randomized cross-over design.

The Spanish version of the WHO's Integral Management of Childhood Illnesses, and two common Colombian

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evidence-based, peer-reviewed, published guidelines were presented in both paper and mobile phone format. HTC Tilt cell phones running Windows Mobile 6.1 used a system called GuideVue® to present the guidelines interactively, step by step. Guidelines were also loaded into cell-phone memory or micro-SD cards so CHWs could access the tool during times of poor connectivity. The instructions of each step were presented simultaneously with voice/audio, text and/or images/video. Video was used if the step was an instruction for performing a task. Otherwise, a static image of the relevant medication, supply item, or other object was presented. Each step provides up to five options that the CHW can select, leading to the next step in the clinical practice guideline, based on information provided in the current step. Each executed step was saved into a time-stamped history log in the phone for later upload into a database and analysis.

An additional report analyzed the perceived workload and usability aspects of the interactive, structured media-rich clinical guidelines by the health workers.

Evaluation and Results

A total of 1,394 cases were evaluated. The intervention reduced errors by an average of 33% and increased protocol compliance with approved guidelines by 30%. CHWs using the mobile phone MRIGs also reported statistically significant decreases in mental demand (cognitive load), frustration and overall workload as compared to using paper-based job-aids.

Lessons Learned

- Presenting clinical guidelines in an interactive rich media structured format on small phones can decrease error rates and enhance protocol compliance, indicating significant potential benefits for health outcomes and standardization of care.
- Acceptance of new technologies can be inhibited if the ensuing workload is perceived as excessive compared to existing methods.
- Medical cases were presented on human patient

simulators in a laboratory setting, not on real patients. Further research using human patients, rather than patient simulators, and with CHWs and patients across a spectrum of educational levels is needed.

Conclusion

The use of MRIGs on mobile phones by CHWs in developing countries has the potential to decrease their perceived workload, fatigue, and enhance their ability to provide better care for more patients. These results indicate encouraging prospects for mHealth technologies in general, and for the use of rich media clinical guidelines on cell phones, for improving CHW performance. Future work could include enhancing the user interface, adding features such as GPS location, and repeating the study with human patients in Colombia and elsewhere.

Geographic Coverage: Colombia

Implementation Partners: University of Texas, University of Antioquia

Funder: Microsoft Research

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MOBIUS ULTRASOUND IMAGING SYSTEMS

Point of care ultrasound diagnostic imaging on a smartphone or tablet

Mobile ultrasound imaging is a non-invasive diagnostic tool that has the potential to greatly improve access to quality health care in more remote areas. In Zambia, ultrasound findings from a focused maternal ultrasound-training program for midwives had a positive effect on clinical decision-making. Additionally, findings from a study in Senegal point towards the utility of a mobile ultrasonography service in managing health problems for both rural communities and healthcare structures.

MobiSante, a company based in Washington State, has developed a mobile diagnostic system that allows health professionals to conduct ultrasound assessment at the point of care. After receiving FDA clearance in 2011, MobiSante launched the MobiUS SPI smartphone system, followed by a tablet version entitled the MobiUS TC2 system.

Implementation date: 2011



About MobiUS

The complete ultrasound imaging system includes a smartphone (SPI System) or tablet (TC2 System), transducer probe and pre-installed software. Devices are both battery powered and rechargeable and the entire system can either be purchased or leased. Currently, SPI capabilities are limited to ultrasound imaging and cannot be used for text messaging or phone

calls, however, the patient exam can be emailed for archive or second opinion. The system's versatile performance for diagnosis include routine screenings, abdominal and pelvic examinations to determine cause of pain, monitoring women throughout their pregnancy, determining extent of trauma, and various ultrasound-guided procedures. Multiple probe types are available for different clinical applications, and customers have access to training videos and manuals.

There is a five-step process to scanning with the MobiUS: select exam type, optimize image (optional), add annotations (optional), save image or video, and review the images and send directly from the system. Images are readily stored and quickly shared via cellular or Wi-Fi networks. In areas without network connectivity, patient data can be stored on the device and transmitted at a later point. All data transfer is encrypted when the device is password protected. Users have the option of sending emails securely or stripping data out of non-encrypted emails, as well as transmitting data to a cloud server for archive and off-site analysis by trained health professionals.



Evaluation and Results

Several studies have been done or are in process with the MobiUS systems. Studies have been done in Rochester, NY where the systems were successfully used for thoracic ultrasound to help identify pneumothorax and congestive heart failure. In another study, users compared field trauma evaluations using the MobiUS SPI system and a Sonosite device. Equal success rates were obtained by identifying intra-abdominal fluid in the pre-hospital environment. Additionally, this study demonstrated that images could be created, then pushed to a remote location to be read by the ultrasound fellowship director with similar success rates. A wilderness medicine study was also conducted on Denali. Pulmonary edema and IVC volumes were observed in climbers using the MobiUS SPI system. Finally, broad screening of 100+ patients in Sierra Leone were conducted with over-read services provided by a radiologist in Seattle. Short studies were also conducted with the MobiUS SPI system in Nepal, Philippines and India.

A study in progress is looking at post-operative wounds to identify small amounts of fluid accumulation, which can indicate early stages of infection. Ongoing studies include a residency program conducting a central venous access project with the MobiUS SPI system.

Lessons Learned

- While MobiUS systems cost only a fraction of conventional ultrasound machines, the current price may still keep this product out of reach for financially constrained health facilities and low-resource settings. However, MobiSante is offering special discounts for NGOs and not-for-profit organizations.
- The current system only works with a MobiSante provided smartphone or tablet which all feature USB 2.0 host support to connect the ultrasound probes. However, future applications are expected to be compatible with other platforms, including Android, Apple iPhones and iPads, thus expanding its reach.

- Ultrasound education is a critical component in planning a successful implementation. Several resources and partners are available to users for becoming competent in acquiring and interpreting images.

Conclusion

Data captured from the MobiUS system provides point-of-care diagnostic capabilities in a wide range of settings, including more remote locations. These data can be combined with electronic medical records thereby improving clinical decision-making capabilities. Future iterations should involve lower cost models and expanded platform compatibility to aid in expanded market usage. Lastly, additional research will be needed to determine whether ultrasound ultimately improves health outcomes in rural areas and if the benefits outweigh the costs of such devices.

Geographic Coverage: United States of America

Implementation Partners: MobiSante

Funder: WRF Capital, W Fund, Alliance of Angels

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mSAKHI

An interactive mobile phone-based job aid for accredited social health activists (ASHAs)



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With 56,000¹ maternal and 876,000² newborn deaths each year, India accounts for 19% of all maternal and 29% of newborn deaths globally. Accredited social health activists (ASHAs), instituted as part of India's National Rural Health Mission (NRHM)³, can prevent many of these deaths by helping women and their families recognize maternal and neonatal danger signs and promptly seek care. However, a majority of these community health workers (CHWs) are low-literate village women and face significant operational challenges in conducting routine maternal, newborn, and child health (MNCH) activities and in keeping their skills updated. In particular, ASHAs' lack of access to healthcare information, refresher training, supportive supervision and user-friendly job aids compromise their ability to contribute to improve maternal and newborn health outcomes^{4,5}.

The near ubiquity of mobile phones throughout the developing world, including India, has led to the emergence of mHealth applications that are potentially effective tools for supporting CHWs across a range of activities. The Manthan Project, funded by the Bill & Melinda Gates Foundation and led by IntraHealth International, developed and tested mSakhi, a mobile phone-based multimedia job aid for ASHAs. Two

operations research (OR) studies were carried out between April 2012 and June 2013 in Uttar Pradesh.

Implementation date: April 2012 to June 2013

About mSakhi

mSakhi, ('a friend' in Hindi) is an interactive audio/video-guided application that provides support to ASHAs in conducting routine activities across the continuum of MNCH care. It combines the functions of existing paper-based tools, thereby eliminating the need for difficult-to-use-and-carry flipbooks, manuals, registers, and other job aids. mSakhi content is based on the NRHM ASHA manuals and home-based newborn care (HBNC) guidelines and formats.

The Manthan Project initially developed mSakhi on the open-source CommCare platform using Java-enabled, keypad-based mobile phones. Based on ASHA and beneficiary feedback for more intuitive and multimedia-enabled applications, the Project modified mSakhi for touch phones using an open-source Android platform available on Google Play.

ASHAs register pregnant women and/or newborns into mSakhi during home visits. Upon registration, mSakhi generates a home visit schedule for each beneficiary and provides a set of audio-video guided instructions for counseling, assessment and referral specific to each visit. Auxiliary nurse midwife (ANM) supervisors receive the data, which is stored in the mSakhi central database, allowing for real-time tracking of both ASHAs and beneficiaries. The database is designed for seamless integration with existing government information and communication technology (ICT) systems such as the Mother-Child Tracking System (MCTS) and the Health Management Information System (HMIS), saving time and reducing delays.

Evaluation and Results

The Manthan Project conducted two OR studies, in collaboration with the Government of Uttar Pradesh (GOU), to compare the feasibility and effectiveness of mSakhi against existing paper-based tools. The pre-test/

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post-test quasi-experimental design involved a total of 143 ASHAs. The first study was conducted from April to December 2012 in Bahraich District. The feasibility and effectiveness of mSakhi was tested as a self-learning and counseling tool. A total of 86 ASHAs (46 experimental, 40 comparison) participated, covering a population of 46,000. The second study was conducted from November 2012 to June 2013 in Jhansi District. IntraHealth evaluated the effectiveness of mSakhi as an integrated tool (self-learning, beneficiary registration, counseling, decision-support and real-time monitoring) for the postnatal period. Fifty-seven ASHAs (29 experimental, 28 comparison) participated, covering a population of 39,000.

ASHAs reported that mSakhi enabled them to articulate correct and complete counseling messages due to the voice-enabled and video-supported guided instructions, without having to carry manuals and flipbooks during home visits. Beneficiaries found mSakhi to be engaging and also reported other family members' interest in the counseling messages because of the multimedia mobile content.

mSakhi users also demonstrated greater recall of at least six critical newborn conditions warranting referral compared to paper-based ASHAs. mSakhi users in the first study delivered complete messages for several MNCH topics significantly better than those not using the application. Lastly, observations of ASHAs using mSakhi showed them to have significantly better newborn assessment skills while also being able to register more births and identify more sick newborns needing referral for both immediate and home-based treatment.

Lessons Learned

- mSakhi can help ASHAs identify and make correct referrals of sick newborns.
- mHealth applications can improve CHW knowledge and skills, but require periodic refresher training and supervision to support acquisition and retention.
- A simple, intuitive and voice navigated user interface is important for uptake of mHealth applications.

- ICT support is critical for sustained support on mobile maintenance and application updates to CHWs. ASHAs also need regular supervisory feedback to ensure high and effective use of the application.
- mHealth interventions require initial and recurring costs, with the mSakhi program costing INR 10,280 and INR 4,680 per ASHA, respectively. This outlay needs to be compared with the benefit of potentially improved newborn health outcomes.

Conclusion

The two operational research studies demonstrated that, compared with existing paper-based job aids, mSakhi is a more user-friendly and effective ASHA tool for a range of activities, including self-learning, counseling, and newborn assessment. Although the two studies' limited sample size and short duration do not permit measurement of mSakhi's effect on community-level health outcomes, these promising data suggest that mobile applications may be an important tool to support ASHAs in improving MNCH outcomes and for implementing and evaluating mSakhi at scale.

Geographic Coverage: Bahraich and Jhansi districts in Uttar Pradesh, India

Implementation Partners: IntraHealth International | Government of Uttar Pradesh, India

Funder: Bill & Melinda Gates Foundation

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PRE-ECLAMPSIA INTEGRATED ESTIMATE OF RISK ON THE MOVE

Preventing the deadly complications of pre-eclampsia using a mobile phone

Pre-eclampsia is the second-leading cause of maternal death in childbirth globally, killing 76,000 pregnant women and 500,000 fetuses and infants each year. Over 99% of the women and babies who die or suffer complications related to pre-eclampsia live in middle and low income countries. Pre-eclampsia, a rapidly progressive condition characterized by high blood pressure and the presence of protein in the urine, arises during pregnancy and following delivery, and affects both the mother and the unborn baby. Deaths related to pre-eclampsia are often preventable and typically due to delays in diagnosis and treatment.

The Child & Family Research Institute (CFRI) at the University of British Columbia developed a ground-breaking solution to this global health challenge with Saving Lives at Birth seed funding in 2011. The technological solution integrates two separate previously successful innovations: the miniPIERS (Pre-eclampsia Integrated Estimate of Risk) predictive model and a Phone Oximeter. By combining these innovations in a mobile phone application, they can be made immediately available in rural, low-resource community settings. Together they produce a cutting-edge mHealth application that empowers community healthcare providers in rural, low-resource settings to rapidly and reliably assess risks to mothers and children, and to save lives by providing appropriate treatment and/or referral to higher level health centers.

Implementation date: September 2012 to October 2013

About PIERS on the Move

"PIERS on the Move" integrates the miniPIERS (Pre-eclampsia Integrated Estimate of RiSk) predictive model, which can accurately stratify women into risk categories up to one week before complications arise and without laboratory tests with a Phone Oximeter, a cellphone based pulse oximeter (a non-invasive device which can measure blood oxygen saturation levels). The mobile phone application assists community health workers in rural, low-resource settings to provide local, rapid and accurate risk assessment, referral, and treatment advice for pre-eclampsia, and transmits information to referral

centers for coordination of triage, transportation and treatment.

Development of the user interface for the PIERS on the Move application involved three phases of usability testing with target end-users in South Africa. Users were asked to complete clinical scenarios, speaking aloud to give feedback on the interface and then to complete a questionnaire to rate all aspects of the tool. A final stage in development included piloting the tool in Tygerberg Hospital, Cape Town, South Africa to confirm accuracy of the decision algorithm.

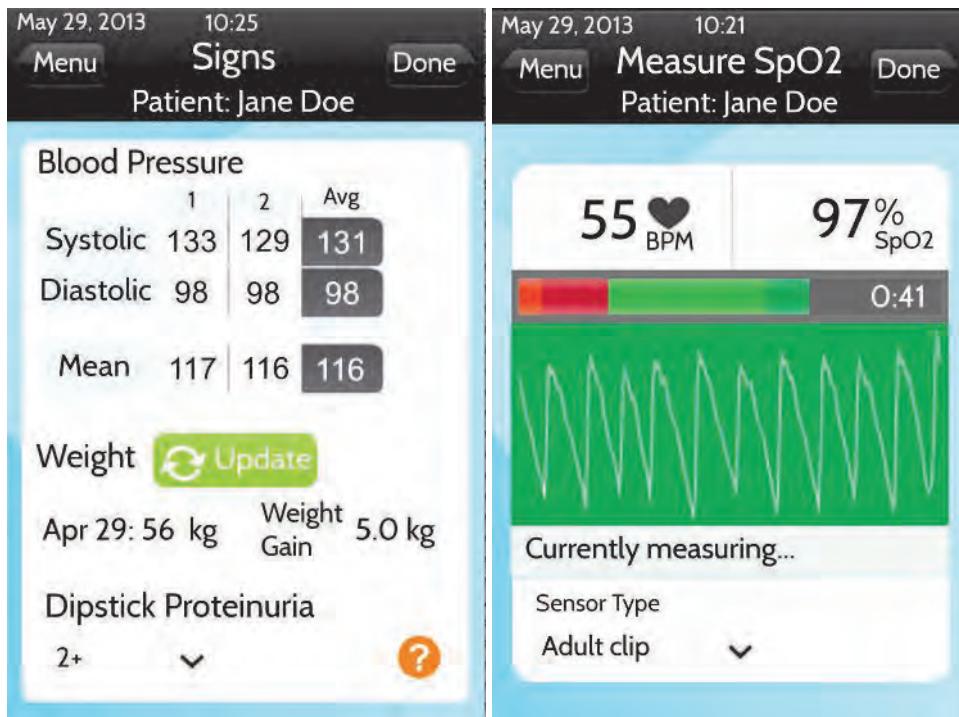
Evaluation and Results

Thirty-seven nurses and midwives (15: Tygerberg Hospital; 22: Frère Maternity) evaluated the user interface between November 2011 – January 2013. During the first round of usability testing, major issues in the functionality of the touch-screen keyboard and date scroll wheels were identified; during the second, major improvements in navigation of the application were suggested; and finally during the third round, the feedback was satisfactory and only minor improvements to navigation were required. Overall, users felt the application was pleasant and would improve their ability to care for hypertensive women.

Pilot clinical evaluation at Tygerberg Hospital occurred from September 2012 -October 2013. During this time, 165 inpatient women with a hypertensive disorder of pregnancy were evaluated. Among them, three had an adverse maternal pregnancy outcome, two of whom were correctly classified as high-risk by the PIERS on the Move tool.

The next step is a larger clinical evaluation when the developers will seek to leverage the existing research framework and collaborations in Mozambique and Pakistan to provide clear evidence of the innovation's impact and develop a sustainable economic model for its implementation through local demand, value and supply chain creation in Mozambique.

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Lessons Learned

- Usability evaluation with target end-users leads to a user friendly, intuitive application even for those who have little familiarity or training with smartphone technology
- Larger scale evaluation is required to determine the full scope and breadth of the possibility of global application
- By using ubiquitous smartphone technology, health care workers in low-resource settings are empowered to make decisions that can save lives

Conclusion

In low-resource settings, referrals for pregnant and delivering women typically occur only when life-threatening events have occurred. By harnessing the processing and battery power of mobile phones, and leveraging the widespread availability of cellular services in Africa and South Asia, "PIERS on the Move" overcomes the barriers of skill, distance and resources.

Geographic Coverage: South Africa; planned for Mozambique and Pakistan

Implementation Partners: Child & Family Research Institute (CFRI) at the University of British Columbia

Funder: Saving Lives at Birth Grand Challenge partners, including USAID, the Government of Norway, the Bill & Melinda Gates Foundation, Grand Challenges Canada, and the World Bank

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SKY SOCIAL FRANCHISE NETWORK

Using mobile technology to improve a multi-tiered health and family planning telemedicine network

In India, one in 170 women die from pregnancy-related complications and 47 out of 1,000 infants die within the first five years of life. Over 85% of these women and children live in remote locations and do not travel far outside of their village, making access to quality health services and essential medicines a challenge. While only 32% of women own mobile phones, 83% have access to one. Mobile phones are also ubiquitous among healthcare providers, including the 200,000 informally trained first-line providers that serve people in rural areas.

World Health Partners (WHP) launched a multi-tiered telemedicine network of mutually beneficial franchise providers drawing on private sector capacity through social franchising, innovations in labor management, and low-cost technologies to develop a scalable and sustainable health care service delivery model that includes reproductive health, family planning, maternal health, childhood diseases and TB care. WHP began incorporating the use of simple voice and text-based functions to extend the reach of their services and have made these mobile tools an essential component of their rural health infrastructure.

WHP currently operates its telemedicine-enabled franchise in eight districts of Uttar Pradesh, focused on demand generation and service provision of family planning and maternal health services. A larger scale program operates in 13 districts of Bihar and is geared towards improving the detection and treatment of four diseases: tuberculosis, visceral leishmaniasis, childhood pneumonia, and diarrhea.

Implementation date: 2011

About Sky Social Franchise Network

The social franchise consists of a tiered health and family planning service delivery network, bringing together trained urban doctors and informally trained rural private providers, all earning revenue for providing patient services. Mobile devices are used for multiple functions allowing increased value and cost-effectiveness for both WHP programs and network providers.

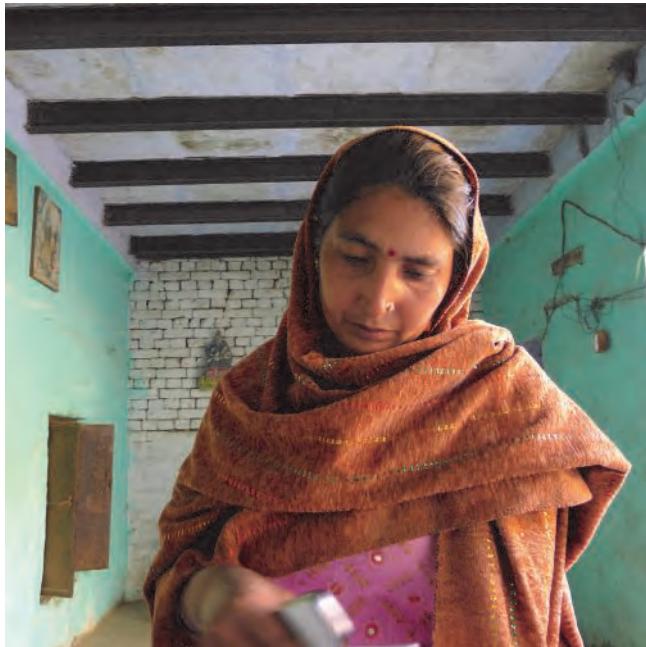
Each village's mobile-based SkyCare Provider diagnoses and treats minor ailments, initiates tele-consultations for more complex cases, and refers the most difficult cases to entrepreneur-run telemedicine SkyHealth Health Centers equipped with additional telediagnostic technologies for measuring vital signs. A last-mile supply chain delivers a range of medicines and family planning products, and collects lab samples, all the way down to the village level. If needed, patients may be referred to WHP-approved urban clinics for further examination by doctors. The costs of tele-consultations vary from USD\$0.20 for patients below the poverty line to USD\$2.00.

Providers and the community are supported by various IVR and SMS-based mobile applications that enable efficient data collection, helplines for franchisees, and health information lines for the community. mHealth tools are also used for franchise management – field staff are equipped with tablets loaded with simple applications for survey data collection, lab sample tracking, and product inventory management. Most of these tools are IVR-based, with the program returning calls after a missed call is registered.

Evaluation and Results

As of October 2013, the service has provided over 93,000 telemedicine consultations. Most consultations focus on common ailments such as fever, gastroenteritis, infections and various reproductive health issues. Electronic data collection by field staff improved data integrity. A newly launched community health line that provides basic health information aimed at client empowerment received over 11,000 authentic calls in its first two months.

Sky Health Centers are able to provide care at more affordable rates. For example, IUD insertion costs USD\$2.40 compared to USD\$10 to \$18 at an urban clinic. Unit costs of WHP's mHealth tools are decreasing with an increase in number of applications being hosted on the same platform. WHP's programs in UP and Bihar are making close to 45,000 calls per month at less than USD\$0.20 per call to WHP.



Lessons Learned

- In Uttar Pradesh, rural clients are willing to adopt family planning if quality services are provided close to home
- In Bihar, there is a need for mobile phone-based applications (IVR preferred over SMS) for data collection to monitor patient adherence, alerts and reminders, and mobile training.
- A large set of mHealth applications that leverages the same platform can reduce per call costs greatly and enable quicker addition of new tools.
- WHP is piloting the use of simple mobile and web communications and applications to boost client awareness of quality standards – the demand is strong with over 11,000 calls received in the first two months.
- Additional efforts must be put towards recruiting enough medical specialists to see patients in remote locations and having patients trust the opinion of virtual doctors
- With the addition and stabilization of various

technology platforms, there are fewer challenges with videoconferencing and other technical issues

Conclusion

Patients are connected with remote, qualified doctors through internet and mobile-based consultation and diagnostic systems. Using simple forms and interactive voice response application improve patient tracking, provide alerts and reminders, and improve data integrity. WHP will continue to develop appropriate mobile phone-based solutions to bring telemedicine services to even lower level providers/remote areas and to improve provider capabilities, monitoring and data collection.

Geographic Coverage: India

Implementation Partners: World Health Partners, Partners Consulting (communications), Government of Bihar, WayGeNext, MOTECH

Funder: Bill and Melinda Gates Foundation, anonymous donor

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SMART

SMS printer technology for early infant diagnosis of HIV/AIDS

In Nigeria, approximately 230,000 HIV-positive pregnant women are at risk of infecting their babies due to the absence of adequate care. Early infant diagnosis (EID) and immediate treatment with antiretroviral therapy (ART) are necessary measures to reduce this burden. However, almost 50% of infants tested for HIV across sub-Saharan Africa never receive their test results. Moreover, EID of HIV requires sophisticated virologic testing using PCR, which can only be performed at a handful of laboratories in Nigeria. This creates challenges for communicating the results back to the health facilities, and thus, contributes to delays in providing timely treatment. To address these challenges, the Government of Nigeria, in collaboration with a range of partners, has coordinated an aggressive response by scaling up prevention of maternal-to-child transmission (PMTCT) programs from 2010 to 2015.

The Clinton Health Access Initiative (CHAI) chose to address one of the primary objectives of Nigeria's PMTCT scale-up plan: to ensure that at least 90% of all HIV-exposed infants have access to EID services. CHAI partnered with two engineering companies to develop a new technology, SMS printers, to strengthen EID services by reducing the turnaround time for test results by more than half. These SMS Printers to Accelerate Return of Test Results for Early Infant Diagnosis of HIV/AIDS became known as the SMART Program. To keep

pace with the rapid expansion of EID, CHAI, in partnership with the Federal Ministry of Health and Implementing Partners (IPs), scaled up SMART in January 2010, integrating the program into local and national management structures.

Implementation date: January 2010

About SMART

Nearly every district in Nigeria has network coverage for mobile telecommunications, even in remote areas lacking roads and electricity. SMS printers combine mobile SMS technology and small, battery-operated printers, allowing health facilities to receive and print EID test results without the need for computers and internet access or waiting for hard copies to be delivered. The only consumable involved is thermal paper for printing.

When an infant is tested at a remote health facility, the sample is sent to the lab. HIV test results are immediately reported back to the health facility via SMS technology, received and printed by the SMS printer, and shared with the baby's caregiver. Unskilled health workers are easily trained on operating the printers and minimal maintenance requirements.

CHAI works closely with the Federal Ministry of Health, the PCR lab units and the IPs from both the President's Emergency Plan for AIDS Relief (PEPFAR) and the Global Fund to Fight AIDS, Tuberculosis and Malaria to develop management and technical expertise, both locally and nationally. The Hewlett-Packard Company also works with local universities to provide a centralized computing infrastructure as well as software applications for labs to enable real-time management and monitoring of program data.

Evaluation and Results

Since scale-up in January 2010, a total of 203 SMS printers have been installed in health facilities across all 6 geopolitical zones of Nigeria and over 500 skilled and unskilled health workers have been trained on printer operation. In 2012, a large scale, national impact



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assessment of the SMS printer program to evaluate its impact on the National EID Program and generate robust evidence on its benefits was carried out in 33 study sites.

The impact assessment report was disseminated in 2013 to serve as an advocacy tool for partner buy-in on the technological innovation. Analysis of results showed significant reduction in turnaround time by approximately 21 days when compared to traditional paper-based methods, and the SMS printer system was 4.6 times cheaper than the paper-based method. Further analysis suggested that infant loss-to-follow-up was reduced through the use of SMS printers to facilitate return of results.

The report highlighted key recommendations to address programmatic and operational challenges with the SMART program. One recommendation was to demonstrate the needed support from all IPs for the successful operation of SMS printers on the field. Thus far, CHAI has secured buy-in from 50% of IPs who carry out routine monitoring and evaluation of health facilities and the SMS printers in the field, and provide troubleshooting assistance when required. Some partners have also procured SMS printers for use at their EID sites. CHAI continues to partner with the Federal Ministry of Health to provide technical support to IPs on SMS printer-related matters, when needed.

Lessons Learned

- The ability to instantly transfer results from the lab to the health facility via SMS has been demonstrated to reduce turnaround time significantly, thereby helping caregivers and clinicians to promptly initiate life-saving ART, resulting in fewer infants being lost to follow-up.
- IPs lacked a sense of ownership over the technology because they were not involved in the initial stages of design. To resolve this issue, CHAI adjusted its installation approach by adopting a “train-the-trainer” model in order to foster a greater sense of ownership among partners.
- CHAI created and disseminated a troubleshooting

guide in response to many sites that failed to report if printers were not functioning properly

Conclusion

The SMART program addresses a critical barrier to EID by leveraging simple mobile technology and design to more rapidly communicate HIV test results from the laboratories back to the health facilities. By providing aggregated data across all SMART-implemented sites, the government is then able to track PMTCT performance indicators nationally, thereby tailoring prevention and treatment efforts.

Geographic Coverage: Nigeria

Implementation Partners: Clinton Health Access Initiative (CHAI), Federal Ministry of Health of Nigeria, HIV/AIDS Division; Hewlett-Packard Company; Institute of Human Virology, Nigeria; PEPFAR Implementing Partners; Global Fund Implementing Partners

Funder: mHealth Alliance, WHO's Department of Reproductive Health and Research

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CHAI: Zachary Katz, Director of Diagnostic Services (zkatz@clintonhealthaccess.org)

mHealth Alliance: Francis Gonzales, Program Associate (202.419.6412, fgonzales@mhealthalliance.org)

References:

1. Children and AIDS: fourth stocktaking report, 2009. UNICEF, UNAIDS, WHO, UNFPA, 2009.
2. Federal Ministry of Health of Nigeria. National scale-up plan towards elimination of mother-to-child transmission of HIV in Nigeria 2010-2015. Government of Nigeria, 2011.
3. Francis Gonzales. IWG Grantee Year I Update: CHAI Nigeria. Health UnBound, May 3, 2013. Web.
4. mHealth Alliance. IWG Round I Grant Winners. CHAI – SMART (Nigeria) Project Profile. The World Health Organization, 2013. Web.
5. SMART Impact Assessment Report 2013

ANNEX I

mHEALTH COMPENDIUM EDITION ONE CASE STUDIES

BEHAVIOR CHANGE COMMUNICATION

Chakruok Interactive Radio Program

CycleTel™

iCycleBeads™ Smartphone Apps

La Ligne Verte Family Planning Hotline

Mobile 4 Reproductive Health (m4RH)

SMS and IVR to Improve Family Planning Services

Text Me! Flash Me! Call me!

Workplace-based SMS Awareness Campaign

DATA COLLECTION

Automating Data Collection for HIV Services

Child Status Index (CSI) Mobile App

EpiSurveyor/Magpi

Integrated Health Systems Strengthening Project – IHSSP: RapidSMS

JSI Early Warning System

FINANCE

Changamka Maternal Health Smartcard

Mobile Finance to Reimburse Sexual and Reproductive Vouchers

LOGISTICS

cStock

Delivery Team Topping Up System

Integrated Logistic System – ILSGateway

International Quality Short Message Services (IQSMS)

Mobile Product Authentication MPA

mTrac: Monitoring Essential Medicine Supply

Tupange SMS Community Tracking System

SERVICE DELIVERY

CommCare for Home-Based Care

Community IMCI (cIMCI)

eFamily Planning (e-FP)

eNutrition

Maternal Health (Antenatal and Postnatal Care)

mHealth for Safe Deliveries in Zanzibar

Mobiles for Quality Improvement (m4QI) – SHOPS Project

MOTECH Suite

Project Mwana – SMS for Early Infant Diagnosis of HIV

SIMPILL® Medication Adherence Solution

Supportive Supervision (SS) for TB in Nigeria

The Malawi K4Health Mobile Learning Pilot

mHEALTH COMPENDIUM VOLUME TWO CASE STUDIES

BEHAVIOR CHANGE COMMUNICATION

CommCare for Antenatal Care Services in Nigeria

JustTested: SMS-Based Support and Information for HIV Testing and Counseling Clients

MAMA Bangladesh

MAMA South Africa

Tobacco Kills: Say No & Save Lives

Wazazi Nipendeni (Parents, Love Me): mHealth Initiative to Support Maternal Care in Tanzania

DATA COLLECTION

Community-based Health Promotion for Safe Motherhood using mHealth

DataWinners Platform

iHRIS and Mobile Reference Dictionary

iPhones for Malaria Indicator Survey

The Last 10 Kilometers: What it Takes to Improve Health Outcomes in Rural Ethiopia

Mobile Phone Microscopy for the diagnosis of Parasitic Worm Infections

OpenHDS

FINANCE

Heartfile Health Financing - an mHealth enabled innovation in health social protection

Jamii Smart | KimMNCHip—referrals, mSavings and eVouchers

Tanzania National eVoucher Scheme

transportMYpatient: Facilitating access to treatment for obstetric fistulae

LOGISTICS

Enat Messenger for Maternal Health in Ethiopia

Mobile Phone Survey Software for End-Use

mPedigree

mTRAC Stop Malaria Program (SMP)

SERVICE DELIVERY

AliveCor Heart Monitor - Mobile ECG

FioNet: Mobile Diagnostics Integrated with Cloud Information Services

GxAlert

MarieTXT: A Mobile Powered Management Information System

mCARE: Enhancing Neonatal Survival in Rural South Asia

txtAlert for Patient Reminders

The First and Second Volumes of the Compendium are available at www.as4h.org/ash-publications.html.

For more information, please visit
<http://www.africanstrategies4health.com/resources.aspx>



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