mHealth for Development

The Opportunity of Mobile Technology for Healthcare in the Developing World

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The United Nations Foundation and The Vodafone Foundation are working together to harness the power of mobile technology in support of United Nations programs across the globe. Since 2005 our £15 million Technology Partnership has funded the use of wireless communications to advance global health and disaster relief work, and to further public discourse about how wireless technology can address some of the world's toughest challenges.
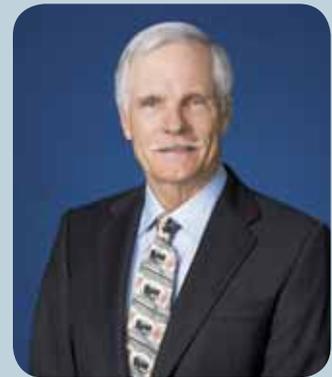
This fourth publication, "mHealth for Development: The Opportunity of Mobile Technology for Healthcare in the Developing World," in our Access to Communications series evidences, through its research and selection of case studies, the potential of mHealth—the use of mobile communications (mobile phones and PDAs) for health services and information. This field has the potential to transform the approach to a variety of healthcare challenges in the developing world by accelerating the collection and storage of patient data, training rural professionals with health updates and guidance, and personalizing to new levels the process of patients receiving and engaging in available medical treatment.

As the case studies in the report demonstrate, governments, companies, and non-profit groups are already developing mHealth applications to improve healthcare and consequently save lives. These new mobile applications, bypassing the fixed-line solutions, are creating new pathways for sharing health-related information, even in the most remote and resource-poor environments.

We invite you to review the potential of this area of activity and join the discussion of mHealth for development. We would welcome your comments and ideas at www.unfoundation.org/mHealth-report.

Vittorio Colao, CEO
Vodafone
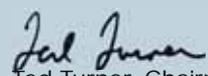
Ted Turner, Chairman
United Nations Foundation

Acknowledgements

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Introduction

Credit: DataDyne

Mounting interest in the field of mHealth—the provision of health-related services via mobile communications—can be traced to the evolution of several interrelated trends. In many parts of the world, epidemics and a shortage of healthcare workers continue to present grave challenges for governments and health providers. Yet in these same places, the explosive growth of mobile communications over the past decade offers a new hope for the promotion of quality healthcare. Among those who had previously been left behind by the 'digital divide,' billions now have access to reliable technology.

There is a growing body of evidence that demonstrates the potential of mobile communications to radically improve healthcare services—even in some of the most remote and resource-poor environments. This report examines issues at the heart of the rapidly evolving intersection of mobile phones and healthcare. It helps the reader to understand mHealth's scope and implementation across developing regions, the health needs to which mHealth can be applied, and the mHealth applications that promise the greatest impact on heath care initiatives. It also examines building blocks required to make mHealth more widely available through sustainable implementations. Finally, it calls for concerted action to help realize mHealth's full potential.

The report is organized into the following sections:

1 Identifying the potential of mobile phones to improve health in the developing world
2 Defining mHealth within the context of eHealth
3 Meeting health needs through a broad array of mHealth applications
4 Examining the impacts of mHealth projects
5 Assessing mHealth and future health needs in developing countries
6 Identifying the building blocks for sustainable and scalable mHealth programs
7 Understanding the incentives for multiple players: mHealth value chains
8 A call for action
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10 Compendium of mHealth projects

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

- Increased access to healthcare and health-related information, particularly for hard-to-reach populations
- Improved ability to diagnose and track diseases
- Timelier, more actionable public health information
- Expanded access to ongoing medical education and training for health workers

Due in large part to the successes of pioneering mHealth programs, activity in the field is rapidly gaining momentum. In 2008 alone, over a dozen new mHealth applications have been implemented or are in the trial stage. These include:

- InSTEDD, a US-based non-governmental organization (NGO) that provides technology solutions for humanitarian and disease support, opened a development center in Cambodia where mHealth-based disease and surveillance solutions are being designed for the Southeast Asian region.
- The Canadian development agency, IRDC, expanded support for a project providing nurses in the Caribbean with portable digital assistants (PDAs) to empower improved diagnosis and decision making.
- The United Nations Foundation and Vodafone Foundation Technology Partnership, together with the World Health Organization (WHO), a specialized agency of the United Nations (UN), announced plans to expand their mobile data-gathering program to more than 20 countries in sub-Saharan Africa.

This report profiles more than 50 mHealth projects taking place in the developing world. The long-term goal is that such programs will make healthcare more effective, and have a demonstrable and significant positive impact on clinical outcomes such as reduced infant mortality, longer life spans, and decreased contraction of disease.

Experts across the field, and interviewed as part of this report, assert that there is an unprecedented opportunity at hand to fulfill mHealth's promise. **To accelerate this momentum and fully unleash the potential of mHealth applications, dynamic multi-sector collaboration between groups as diverse as governments, multilateral organizations, and the private sector is needed.** Joint action should be directed toward the creation of a global mHealth infrastructure that lays out common standards and guidelines, and serves as a repository for shared resources and best practices. This is the best approach for scaling mHealth solutions and maximizing the field's capacity to serve a vital development imperative. ∎

> **"Right now, we are at an inflection point in terms of acceptance. Whether it turns out to be the peak of inflated expectation or the trough of disillusionment will depend on whether governments make the link between telecommunication policy and health, and the extent to which donors encourage transparency in sourcing and the participation of local entrepreneurs. Ultimately, the take-up of mobile communications in the health sector isn't really about technology at all."**
>
> **—Greg Elphinston,**
> **Director Community Involvement, Nokia**

Credit: DataDyne

Potential of Mobile Phones to Improve Health in the Developing World

As the first decade of the 21st century draws to a close, leaders in many developing countries can point with pride to tremendous strides in their efforts to improve the lives of their citizens. In many parts of the world, citizens in emerging economies have begun to taste the fruits of higher incomes and greater access to tools that promise to increase their quality of life and that of their children. Yet formidable obstacles remain. Health challenges present arguably the most significant barrier to sustainable global development. Disease and the lack of adequate preventative care take a significant toll on both developing populations, measurable in disability-adjusted life years (DALYs), and economies. Despite the broad economic advances of this decade, the 2008 UN report on progress toward meeting the Millennium Development Goals (MDGs) indicates continuing dire conditions in crucial public health areas. For example:[1]

- A child born in a developing country is over 33 times more likely to die within the first five years of life than a child born in an industrialized country, even though the leading causes of deaths (pneumonia, diarrhea, malaria, and measles) are preventable through basic services and vaccinations.

- Every minute, at least one woman dies from complications related to pregnancy or childbirth. And for every woman who dies in childbirth, approximately 20 more suffer injury, infection, or disease—nearly 10 million each year.

- An estimated 2.5 million people were newly infected with HIV in 2007.

- Communicable, and entirely avoidable, diseases such as tuberculosis (TB) and malaria continue to claim lives due to preventable factors such as lack of access to proper drugs and medical treatment. By current estimates, meeting the target MDG of halving the TB prevalence rate by 2015 is unlikely.

[1] United Nations, *The Millennium Development Goals Report 2008* (New York: United Nations, 2008).

Health-Related Millennium Development Goals

MDG 4. Reduce child mortality: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate.

MDG 5. Improve maternal health: Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio.

MDG 6. Combat HIV/AIDS, malaria, and other diseases: Have halted by 2015 and begun to reverse the spread of HIV/AIDS; have halted by 2015 and begun to reverse the incidence of malaria and other major diseases.

The ability of developing countries to overcome these serious health challenges is hindered by several core obstacles, among them a global shortage of healthcare workers. According to the WHO, among 57 countries, mostly in the developing world, there is a critical shortfall in healthcare workers, representing a total deficit of 2.4 million healthcare workers worldwide.[2] This human resources constraint intensifies the already increasing pressure on developing-world health systems. Not only must they cope with the burden of containing the spread of communicable diseases associated with extreme poverty, they must also contend with the growing incidence of chronic diseases, such as diabetes and heart disease, an effect of new-found (relative) affluence. Governments, businesses, NGOs, foundations, and multilateral organizations all recognize the importance of leveraging new tools and solutions to address these distinct but interrelated health challenges.

The Promise of Mobile Technologies for Health

Mobile communication offers an effective means of bringing healthcare services to developing-country citizens. With low-cost handsets and the penetration of mobile phone networks globally, tens of millions of citizens that never had regular access to a fixed-line telephone or computer now use mobile devices as daily tools for communication and data transfer. A full 64% of all mobile phone users can now be found in the developing world.[3] Furthermore, estimates show that by 2012, half of all individuals in remote areas of the world will have mobile phones. This growing ubiquity of mobile phones is a central element in the promise of mobile technologies for health.

Figure 1 illustrates that developing world citizens have plentiful access to mobile phones, even while other technologies and health infrastructure are scarce. This explosion of mobile phone usage has the potential to improve health service delivery on a massive scale. For example, mobile technology can support increasingly inclusive health systems by enabling health workers to provide real-time health information and diagnoses in rural and marginalized areas where health services are often scarce or absent altogether. ■
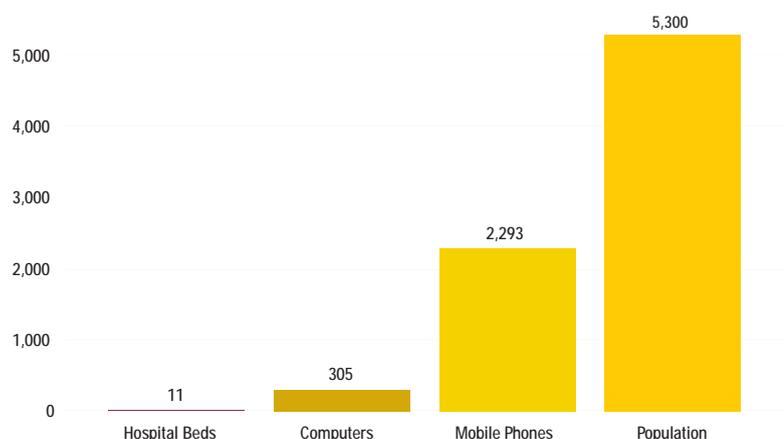
Figure 1. Technology and health-related statistics for developing countries (millions).[4]

> Mobile phones reach further into developing countries than other technology and health infrastructures.

[2] World Health Organization, *The World Health Report 2006 - Working Together for Health* (Geneva: WHO, 2006).
[3] United Nations Department of Economic and Social Affairs, Division for Public Administration and Development Management, *Compendium of ICT Applications on Electronic Government - Volume 1. Mobile Applications on Health and Learning* (New York: United Nations, 2007).
[4] Vital Wave Consulting, Business Monitor International (BMI), International Telecommunications Union, World Bank's World Development Indicators, and the United Nations.

Definition

Credit: Praekelt Foundation

Defining mHealth Within the Context of eHealth

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

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

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

mHealth and eHealth are inextricably linked—both are used to improve health outcomes and their technologies work in conjunction. For example, many eHealth initiatives involve digitizing patient records and creating an electronic 'backbone' that ideally will standardize access to patient data within a national system. mHealth programs can serve as the access point for entering patient data into national health information systems, and as remote information tools that provide information to healthcare clinics, home providers, and health workers in the field. While there are many stand-alone mHealth programs, it is important to note the opportunity mHealth presents for strengthening broader eHealth initiatives. ■

> "mHealth involves using wireless technologies such as Bluetooth, GSM/GPRS/3G, WiFi, WiMAX, and so on to transmit and enable various eHealth data contents and services. Usually these are accessed by the health worker through devices such as mobile phones, smart phones, PDAs, laptops and tablet PCs."
>
> —Dr. Adesina Iluyemi, PhD Candidate, University of Portsmouth, UK

> "With eHealth and mHealth, an ecosystem approach is recommended. Many of the basic applications and devices exist and are in use, but now we need to make them talk to each other in a way that yields strategic benefits."
>
> —Dr. Patricia Mechael, mHealth and Telemedicine Advisor to the Millennium Villages Project at the Earth Institute at Columbia University

Credit: DataDyne

Meeting Health Needs Through a Broad Array of Applications

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

- Education and awareness
- Remote data collection
- Remote monitoring
- Communication and training for healthcare workers
- Disease and epidemic outbreak tracking
- Diagnostic and treatment support

This report details 51 mHealth programs, either currently operating or slated for implementation in the near future, that are taking place in 26 different developing countries. mHealth programs are more prevalent in some countries than others for reasons that have not yet been assessed by the academic literature. In particular, India, South Africa, Uganda, Peru, and Rwanda stand out for their level of mHealth activity. As the case studies examined in this report reveal, mHealth programs are gaining strong support across regions, as well as sectors as diverse as governments, technology providers and academia. Figure 2 shows the geographic and application area breakdown of these mHealth projects.

Africa (excluding South Africa and Uganda), 9
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Uganda, 6
Worldwide, 1
Eastern Europe, 1
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India, 11
Latin America, 10

Education and Awareness, 6
Remote Data Collection, 14
Remote monitoring, 10
Communication and Training for Health Care Workers, 5
Disease and Epidemic Outbreak Tracking, 7
Diagnostic and Treatment Support, 9
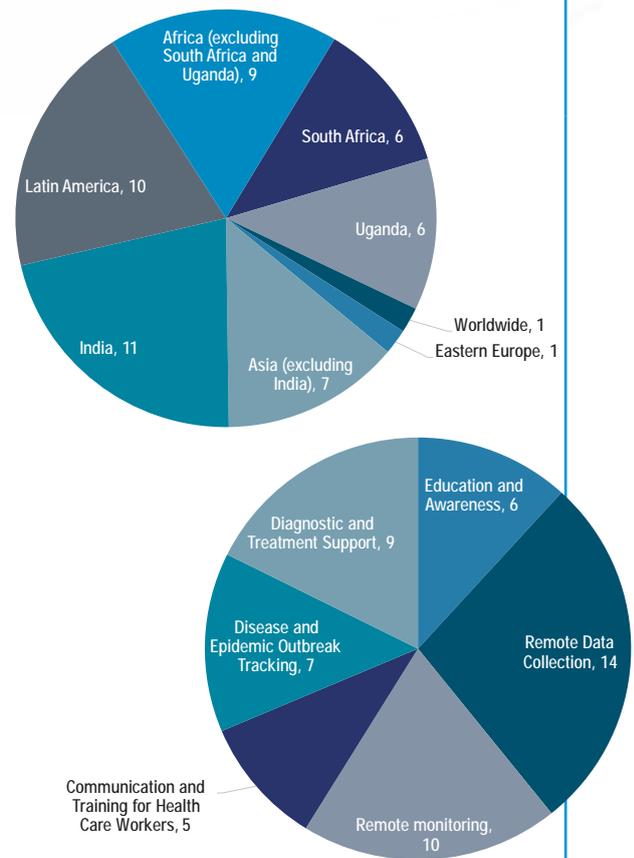
Figure 2. Distribution of mHealth programs by location and application area.

Worldwide:
FrontlineSMS +

- ● Education & Awareness
- ★ Remote Data Collection
- ▢ Remote monitoring
- ◆ Communication & Training for Health Care Workers
- ✚ Disease & Epidemic Outbreak Tracking
- ■ Diagnostic & Treatment Support

Figure 3. Distribution of mHealth programs by location and application area.

Figure 3 provides another view of the distribution of mHealth programs both geographically and by application area.

The following section describes the major mHealth applications in developing countries and provides examples of projects where the application has been put into action.

Education and Awareness

Popularized by teenagers in western countries and Japan who wanted a low-cost means of communicating with friends, short message service (SMS) messages now offer a cost-effective, efficient, and scalable method of providing outreach services for a wide array of health issues. In education and awareness applications, SMS messages are sent directly to users' phones to offer information about testing and treatment methods, availability of health services, and disease management. **Formal studies and anecdotal evidence demonstrate that SMS alerts have a measurable impact on and a greater ability to influence behavior than radio and television campaigns.** SMS alerts provide the further advantage of being relatively unobtrusive, offering recipients confidentiality in environments where disease (especially HIV/AIDS) is often taboo. In the developing world, SMS alerts have proven particularly effective in targeting hard-to-reach populations and rural areas, where the absence of clinics, lack of healthcare workers, and limited access to health-related information all too often prevent people from making informed decisions about their health.

SMS message campaigns can be set up either as one-way alerts or interactive tools used for health-related education and communication. For example, a citizen may sign up to take a survey, delivered via SMS message, quizzing them on their knowledge about HIV/AIDS and the location of the nearest testing center. Depending upon their responses, information regarding where and how to receive a free test will be transmitted. This interactive model has been deployed in several countries (e.g., India, South Africa, and Uganda) to promote AIDS education and testing and provide information about other communicable diseases (such as TB), as well as to promote maternal health and educate youth about reproductive health.

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

By promoting health-conscious behavior, the mHealth education and awareness programs currently in place have already had positive impacts. The ubiquity and low cost of SMS messages hold the potential to shift the paradigm for health education by communicating with people in an accessible, engaging manner that both respects their privacy and gives them the tools to make informed choices.

Remote Data Collection

Data collection is another crucial component of public health programs. Policymakers and health providers at the national, district, and community level need accurate data in order to gauge the effectiveness of existing policies and programs and to shape new ones. In the developing world, collecting field information is particularly important since many segments of the population are rarely able to visit a hospital, even in the case of severe illness. Gathering data where patients live is vital, and information should ideally be updated and accessible on a real-time basis. The data collection process is more efficient and reliable if conducted via smartphones, PDAs, or mobile phones rather than paper-based surveys that must be submitted in person and manually entered into the central health database.

Data collection programs have been deployed in multiple developing world countries, mainly as pilot projects. The most successful programs are scaling up and beginning to be deployed in multiple countries or regions. **These initiatives are closing the information gap that currently exists for patient data in the developing world, enabling public officials to gauge the effectiveness of healthcare programs, allocate resources more efficiently, and adjust programs and policies accordingly.**

Credit: DataDyne

Remote Monitoring

One of the areas most uniquely suited to grow in tandem with mobile technology is the remote monitoring of patients. Remote monitoring opens new possibilities for treating patients in an outpatient setting, a crucial capability in developing countries where access to hospital beds and clinics is limited. This group of applications consists of one- or two-way communications to monitor health conditions, maintain caregiver appointments, or ensure medication regimen adherence. Some applications may also include inpatient and out-patient sensors for monitoring multiple conditions.

Evidence shows that strict adherence to a medication regime is essential for effective treatment of a variety of health conditions, from AIDS to diabetes. In addition, **monitoring patients at home for chronic conditions dramatically improves survival rates.** Remote monitoring applications are being implemented on a relatively limited basis in developing countries, but they are gaining traction in the developed world, particularly for chronic diseases. As the benefits of these applications are documented in the developed world and funding models evolve in developing countries, remote monitoring is expected to become widespread and significantly improve health outcomes for a wide range of communicable and chronic diseases.

Remote Monitoring

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

Communication and Training for Healthcare Workers

An acute shortage of healthcare workers is a major challenge facing developing country health sectors. Training new cadres of health professionals and empowering current workers in order to increase job satisfaction and reduce attrition are essential to meeting human capital needs. **Connecting health workers with sources of information via mobile technology is a strong basis for empowerment, as it provides the support they need to perform their functions effectively and self-sufficiently.**[5]

There is also a pressing need to improve communication among different health units to facilitate more efficient patient care. Due to the dearth of landline phones and Internet-enabled computers, it is not uncommon, for example, for a patient to be sent to the regional hospital by the local clinic, only to find that there is no bed available. Mobile phones can help bridge these communications gaps that in the health context can often mean the difference between lives lost and lives saved.

Disease and Epidemic Outbreak Tracking

Outbreaks of communicable diseases often begin in pockets, and, when left undetected, can develop into epidemics. Recent instances of such devastating outbreaks abound, from cholera and TB to dengue fever and Severe Acute Respiratory Syndrome (SARS). **Deployment of mobile devices, with their ability to quickly capture and transmit data on disease incidence, can be decisive in the prevention and containment of outbreaks.**

Disease and epidemic outbreak tracking mHealth applications are being used in Peru, Rwanda, and India as an early warning system, allowing public health officials to monitor the spread of infectious diseases. Prior to the adoption of mobile networks, public health officials relied upon written, satellite, and radio communication for such emergency tracking. The migration of this function to mobile systems is simultaneously improving data quality and lowering costs.

Disease and Epidemic Outbreak Tracking

Incidents of Japanese Encephalitis were tracked real-time in Andhra Pradesh, India, via a combination of mobile phones and web-based technologies. The government used the information to better prioritize vaccinations based on evidence of clusters of outbreaks.

[5] Iluyemi, A. and J.S. Briggs. *Access and Connectivity for Community Based Health Workers in Developing Countries: Employing Wireless Technologies*, Med-e-Tel 2008 Conference, Luxembourg.

Diagnostics and Treatment Support

Diagnostics and treatment support are vitally important in healthcare—misdiagnosis or the inability to diagnose a condition could have serious, even fatal, ramifications. mHealth applications in this area are designed to provide diagnosis and treatment advice to remote healthcare workers through wireless access to medical information databases or medical staff. **With mHealth-enabled diagnostics and treatment support, patients are able to receive treatment in their villages and homes, averting the need for expensive hospital visits, which are beyond reach for many.**

Diagnostic and treatment applications use the phone as a point-of-care device. Health workers' phones are typically equipped with specialized tools, such as built-in software that leads the worker through a step-by-step diagnostic process. Once data are entered into the system (e.g., symptoms and an image of a patient's injury captured on the mobile phone), remote medical professionals can diagnose the illness and prescribe treatment. By eliminating the need for patient travel, these applications have the potential to dramatically increase access to care. ■

Diagnostic and Treatment Support

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

Credit: UN Tim Mc Kulka
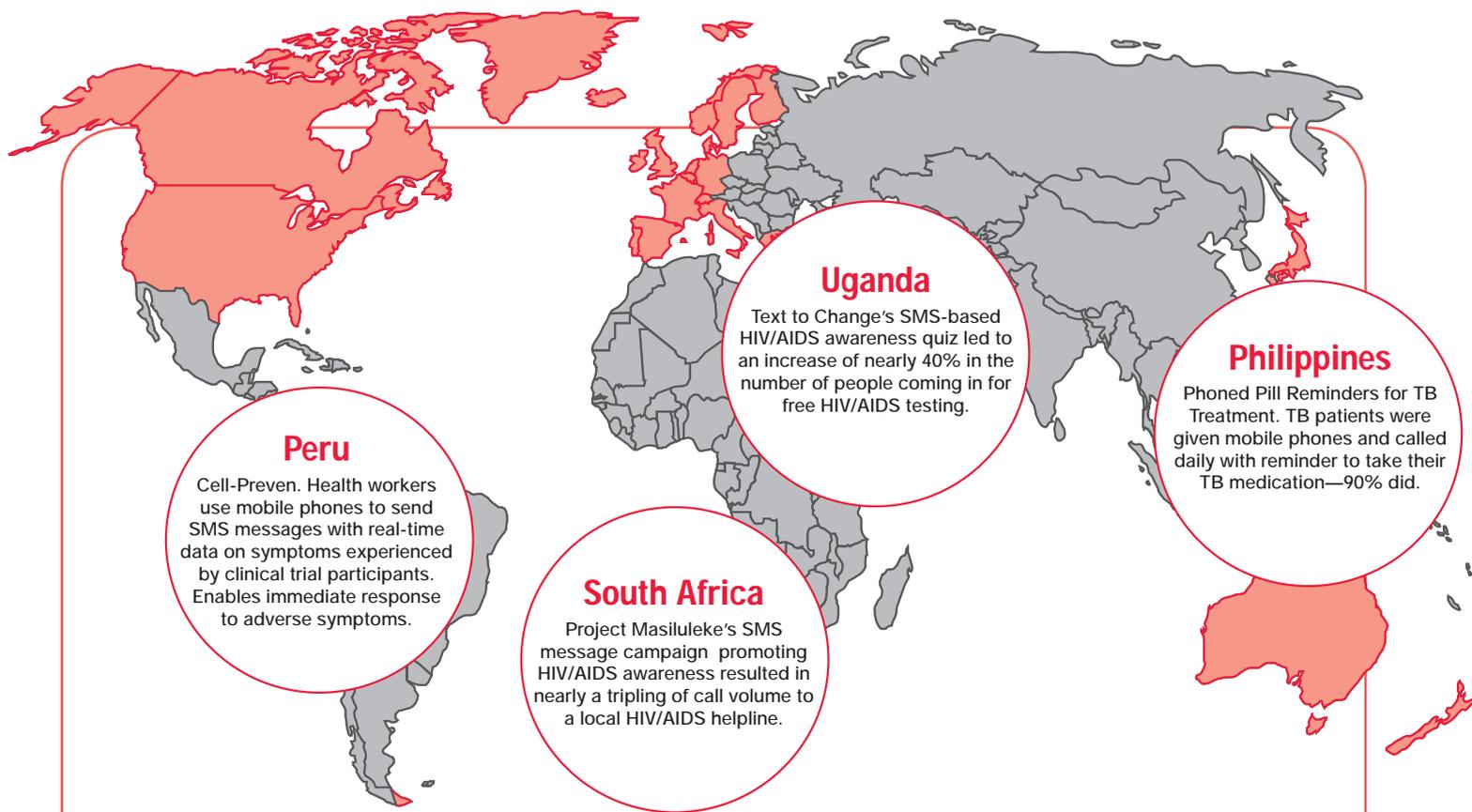
Figure 4. Impact of mHealth applications across the developing world.

Uganda
Text to Change's SMS-based HIV/AIDS awareness quiz led to an increase of nearly 40% in the number of people coming in for free HIV/AIDS testing.

Philippines
Phoned Pill Reminders for TB Treatment. TB patients were given mobile phones and called daily with reminder to take their TB medication—90% did.

Peru
Cell-Preven. Health workers use mobile phones to send SMS messages with real-time data on symptoms experienced by clinical trial participants. Enables immediate response to adverse symptoms.

South Africa
Project Masiluleke's SMS message campaign promoting HIV/AIDS awareness resulted in nearly a tripling of call volume to a local HIV/AIDS helpline.

Examining the Impact of mHealth Projects

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

Much of the excitement over the potential of mHealth centers on the developing world, where mHealth programs put in place since the early part of the decade are now yielding actionable data that indicates that some of the hoped-for benefits are materializing. These studies are complemented by those conducted in the developed world—where mobile phones achieved a high level of penetration more than a decade ago—that have begun to establish a significant body of evidence pointing to the health outcomes and efficiency gains that can result from the thoughtful design and implementation of mobile-based programs and applications. A brief review of sample mHealth programs around the world demonstrates the palpable benefits of using mobile phones in healthcare and prevention.

Improved Patient Health

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

- **Improved compliance with treatment regimes:** A 2007 Thai study showed that TB patients who received daily text message medication reminders jumped to over 90% adherence. A device called SIMpill that uses mobile technology to monitor and direct medication adherence[6] also shows promise.

[6] Phoned pill reminders make inroads against TB. *The Nation* (Bangkok), January 28, 2007.

A 2007 pilot in South Africa showed that with SIMpill, 90% of patients complied with their medication regime, compared with the typical 22 to 60% compliance rate without the system. The solution is now available worldwide. In the United States, a study found improved drug adherence rates among HIV-positive patients who received SMS reminders to take daily medication compared to patients who did not. The majority of studies conducted in Spain, Australia, Finland, and Korea on the benefits of using mobile technology in areas such as vaccination follow-up and asthma or diabetes self-care conclude that mobile technology demonstrably improves patient outcomes.

- **Improved public awareness outcomes:** In South Africa, Project Masiluleke, which promotes an AIDS hotline through SMS messages, resulted in a 350% increase in phone calls to the hotline.

- **Improved disease management**: A recent US study on the use of wireless-enabled PDAs by Type 2 diabetes patients found greater improvements in blood sugar indicators among regular users than among less frequent users.[7]

> "A 2007 pilot in South Africa showed that with SIMpill, 90% of patients complied with their medication regime, compared with the typical 22 to 60% compliance rate without the system."

Improved Health Systems Outcomes

Efficiency gains enable improved quality of care. With efficiency gains, more resources can be freed up and distributed to a broader population, and service programs can be strengthened. Examples of documented efficiency gains include:

- In Uganda, an AED SATELLIFE program that uses wireless-enabled PDAs for disease surveillance, collection, and reporting produced a 24% cost saving over the traditional paper approach. Eighty-seven percent of healthcare workers involved in the program said it allowed them to make faster and more accurate diagnoses.[8]

- A Chinese study conducted by Zhejiang University researchers found that sending text messages as appointment reminders improved attendance at a health promotion center as effectively as phone reminders, while costing over one-third less.[9]

- In the United Kingdom, researchers at the Imperial College, London, examined the health outcomes and efficiency gains that mobile device usage might bring to their national system. They found that the annual direct cost of missed hospital appointments in England each year amounts to £575 million. These costs are in addition to higher expenditures incurred by the health system for patients whose health or treatment are negatively affected by missed appointments and who then require additional medical attention.[10]

> "When talking about efficiency versus health impact, it shouldn't be about either/or. Improving efficiencies can ensure that more people receive life-saving interventions."
>
> **—John Stephenson,
> Dalberg Global Development Advisors**

[7] Forjuoh, Samuel N., Michael D. Reis, Glen R. Couchman, and Marcia G. Ory. Improving Diabetes Self-Care with a PDA in Ambulatory Care. *Telemedicine and e-Health*. 14(3), April 2008. See http://www.liebertonline.com/toc/tmj/14/3 for the article and author listing.
[8] Gebru, Berhane. Disease Surveillance with Mobile Phones in Uganda. Retrieved 16 November 2008 from http://mobileactive.org/berhane-gebru-disease-surveillance-mobile-phones-uganda.
[9] Chen, Zhou-wen, Li-zheng Fang, Li-ying Chen, and Hong-lei Dai. Comparison of an SMS text messaging and phone reminder to improve attendance at a health promotion center: A randomized controlled trial. *Journal of Zhejiang University Science*. 9(1), January 2008.
[10] The Role of Mobile Phones in Increasing Accessibility and Efficiency in Healthcare. Moving the debate forward. *The Vodafone Policy Paper Series*, Number 4 (Newbury: Vodafone Group Plc, March 2006).

While developed countries present different economic and cultural conditions from those found in developing nations, the results of the studies may contain applicable lessons, especially as 'rich world' diseases become increasingly prevalent in the developing world. The World Diabetes Foundation predicts that by 2025, 80% of all new diabetes cases will originate in developing countries, which will require new approaches for dealing with this and other chronic diseases. Studies conducted in the developed world may also provide useful lessons in monitoring and evaluation, as well as study design.

There remains a need for large-scale evidence of mHealth effectiveness, as measured by long-term, repeatable improved outcomes in either health or economic terms. Such studies would be particularly valuable in developing country contexts, and sponsors should continue to evaluate progress in order to establish clear-cut proof of concept and strengthen the case for scaling programs nationally, regionally, and beyond.

Creating a Framework for Impact Measurement

mHealth programs that define rigorous impact assessment methods will be more likely to secure continuing funding and become sustainable over the long term. A Dalberg Global Development Advisors study, commissioned by the UN Foundation and Vodafone Foundation Technology Partnership on the use of PDAs for health information, offers a potential template for determining the effectiveness of current and future mHealth programs. Dalberg worked with the Partnership, the WHO, Ministry of Health officials in pilot countries, and DataDyne—a non-profit provider of mobile health data solutions—to develop a theory of change and to conduct a baseline assessment of the test program's functionality.

The study lays out a process for monitoring the collection and analysis of health data at the local and regional levels. This approach identified unforeseen technical, logistical, and decision-making problems in the pilot case. For example, it was discovered that the high cost of fuel prevented Ministry of Health officials from going out to collect data and the short battery life of some PDAs caused a loss of data. Both of these issues significantly reduced the amount and quality of data available for decision making. Dalberg also monitored the use of data once it was collected, particularly in the context of health ministry meetings. The study identified instances where the data was not properly integrated into decision making and described how processes could be improved to ensure that resource allocation decisions are more data-driven. Overall, the study helped to determine both the cost effectiveness of data collection and the outputs that flow directly from the data.

Dalberg notes that monitoring and evaluation efforts can face critical challenges in the short term, particularly with limited budgets to fund such activities. To overcome some of these challenges, it is important to focus first on managing toward short-term outputs, such as how many PDAs are deployed. The next step is to correlate short-term outputs with actual long-term health impact. This is quite difficult, because the objective is often to measure outcomes that did not occur, such as decreased infant mortality and disease incidence, or outcomes that occur over the long term. As mHealth applications improve the process of data collection and the incorporation of data into decision making, this will provide a foundation upon which to conduct long-term impact evaluations. ■

> **"It's important to have an ROI [return on investment] model that articulates the cost savings of mHealth, and also to take into account the economic burden of health. You are trying to prevent negative health outcomes, and if you prevent them you can't easily measure that."**
>
> **—Eduardo Jezierski,
> Vice President of Engineering, InSTEDD**

Credit: Vital Wave Consulting

Assessing mHealth and Future Health Needs in Developing Countries

Equally important to the cost-effectiveness and scalability of mHealth is its ability to provide an effective tool for addressing emerging health needs. Health experts note that within the next 15 years, policymakers and health providers in the developing world will be forced to turn their focus to prevention and early detection rather than late-stage treatment of non-communicable diseases, such as diabetes and cancer, as well as to the health needs of an aging population.[11] These changes are being caused by trends such as migration from rural to urban areas, economic growth, and changing dietary habits. As developing countries tackle and make significant improvements in the spread of communicable disease, average income levels increase along with average life expectancy. Even a slight increase in income contributes to changing dietary habits, and consumption of meat products and processed foods is linked to the contraction of diabetes and cancer. Late detection of these diseases leads to lower survival rates and reduced life expectancy, and has negative consequences for social and economic development. Developing countries are therefore being confronted with a double burden of treating and containing the spread of communicable diseases while combating a wide range of unfamiliar health challenges. Table 1 illustrates these evolving trends.

Current Healthcare Picture	Global & Demographic Changes	Tomorrow's Healthcare Picture
• Communicable diseases. • Lack of immunizations. • Lack of safe water sources.	• GDP growth increases spending on healthcare. • Traditional diseases controlled (TB, smallpox) and new diseases appear (SARS, avian flu). • Aging populations mean increase in death from non-communicable causes. • Declining birth rate and climbing life expectancy. • Adoption of 'developed country' behaviors.	• Current health care picture issues continued. • Shift from 'late stage' treatments to prevention and early detection. • Increased focus on health issues of elderly. • Continued health worker shortages and distribution inequities.

Table 1. Looking ahead: Evolving mHealth services for evolving health needs.

[11] Gutiérrez-Robledo, L.M. Looking at the Future of Geriatric Care in Developing Countries. *Journals of Gerontology Series A: Biological Sciences and Medical Sciences,* 57:M162-M167, 2002.

Shift from Communicable to Chronic Disease

Over the next 10 years the cost of diabetes, heart disease, and stroke will take a tremendous toll on the national incomes of developing world countries. According to estimates by the WHO, diabetes, heart disease, and stroke together will cost about $555.7 billion in lost national income in China, $303.2 billion in the Russian Federation; $336.6 billion in India; and $49.2 billion in Brazil. Even beyond these countries the cost will be significant. The cost of these diseases for Tanzania in the same period is estimated to be $2.5 billion.[12]

mHealth is well-positioned to address these challenges using tools currently available. For example, just as SMS alerts are useful in raising public health awareness of communicable diseases, these same types of alerts can be used to ensure patient adherence with treatment of chronic diseases such as diabetes. SMS alerts can be sent out to address chronic diseases and mental health issues in urban areas such as smoking cessation and nutrition reminders.

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

[12] World Diabetes Foundation. Diabetes Facts. Retrieved on 16 November 2008 from http://www.worlddiabetesfoundation.org/composite-35.htm.

Credit: WFP Susan Schulman

The MediNet Healthcare Management System is being developed by researchers at the University of the West Indies and Microsoft for monitoring and treating diabetes and cardiovascular disease. The system will provide treatment suggestions to patients via mobile phone text or pre-recorded voice messages.

Evolution of Mobile Technologies

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

	Current Technology Picture	Key Technology Advancement Issues	Tomorrow's Technology Picture
Hardware	• Mobile phones carry range of features suitable for basic mHealth services and country varations. • Most new handsets access web (GPRS, other), download pictures and images. • Speed limits applications and country variations. • Most laptops, handhelds, PDAs easily access wireless networks where available.	• WiMAX-type chipset standard for PCs (Intel, others) becomes standard.	• Increased intelligence blurs distinction between cell phones and mobile computers. • Solar chargers, larger displays.
Software/ Applications	• Widely available for laptop and handhelds. • Only recent availability for handsets as vendors open architecture.	• Java Virtual Machine (JVM), Open Systems.	• Acceptance of OSS accelerates application development, reduces cost.
Network Access	• Cellular common in urban, less so in rural. • Broadband, Internet access limited geographically, costly.	• Greater bandwidth for new applications. • NGN, IMT-2000.	• Network transparency. • Wireless networks create near universal Internet access.
Standards	• Broadband, Standards may require policy decisions.	• Spreading IP access for standards, licensing decisions.	• Greater range of services, provider partnerships permitted.
Services	• Education/awareness programs. • Medication monitoring. • Data collection services. • Disease tracking. • Remote monitoring.		• More sophisticated diagnoses/consultation, e.g., teleradiology, teleopthamology. • More effective use of healthcare workers. • More 'personal' mHealth services. • Services for travel-restricted.

Table 2. Evolving mobile technology capabilities.

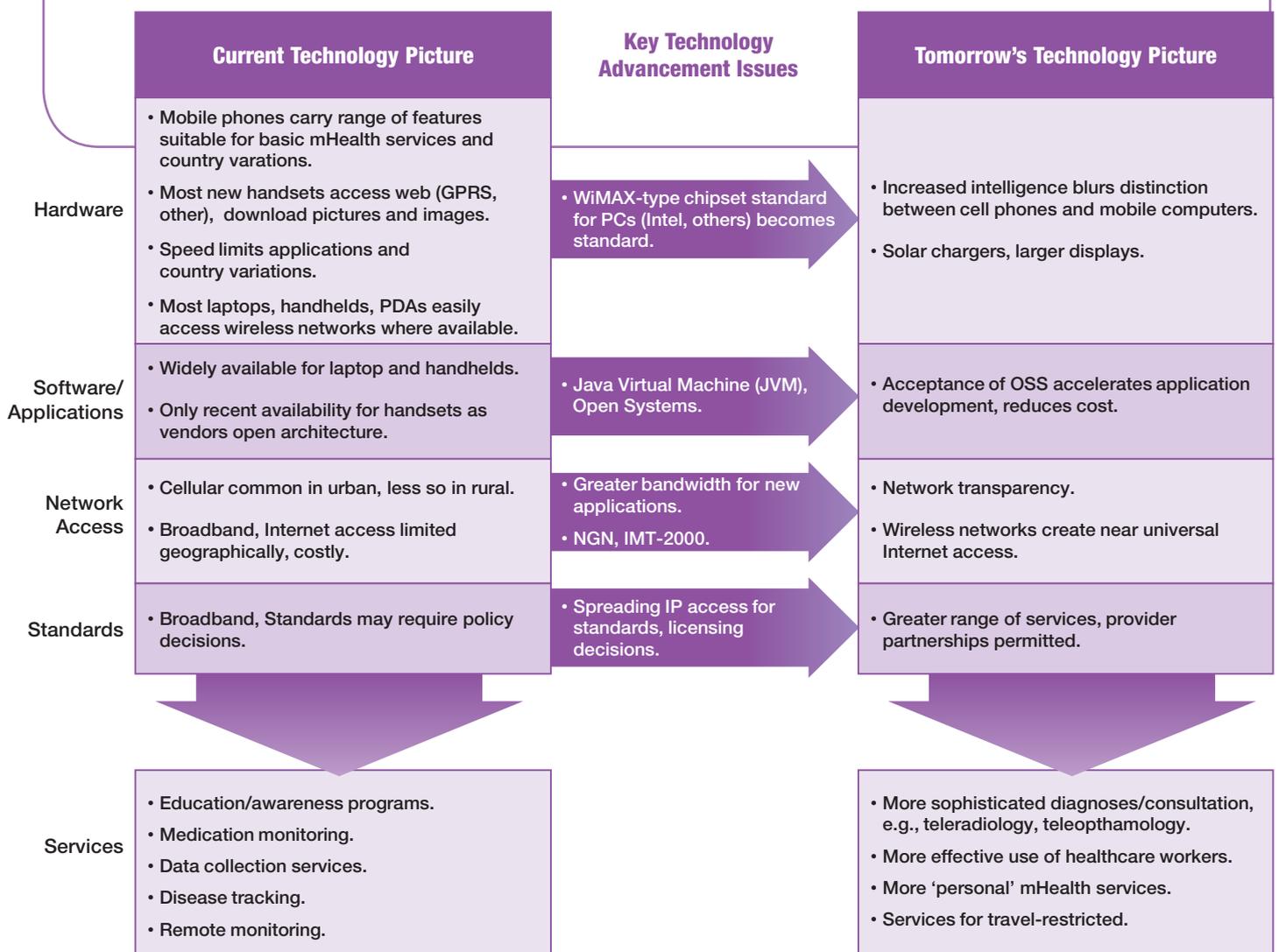# Sustainable and Scalable

Identifying the Building Blocks for Sustainable and Scalable mHealth Programs

Success can beget success in the field of mHealth if organizations enhance their opportunity to drive successful outcomes by learning from similar projects taking place within the mHealth 'ecosystem.' This section identifies mHealth projects that embody practices of highly scalable and sustainable mHealth programs. The case studies reveal some of the key benefits of mHealth, and provide examples of how to structure successful mHealth initiatives. These case studies also reflect the field's dynamism, as each was implemented within the 12 months prior to the publication of this report.

Key Building Blocks for Success

As a young field, mHealth is well positioned to benefit from best practices and available technology documented in early project reports. The case studies of mHealth projects and input from industry experts reveal common practices that collectively form the building blocks for success in this young, dynamic field.

Forge strong partnerships
Partners from multiple sectors bring diverse strengths to the project. Ensuring that each partner advances its organizational goals through the project paves the way for successful future collaborations.

Be accessible
Communication is more effective when tailored to specific social, ethnic, and demographic groups. Colloquial language and references to pop culture may be effective in reaching teenagers, while older populations may prefer a more formal approach.

Design with the end user in mind and maintain a focus on usability
Applications and devices must take the users work environment into account in the design phase. In the mHealth environment, ease of use is essential.

Build a long-term funding plan
Continuing the project beyond the initial seed funding can be accomplished by aligning with long-term national health goals. Integration with the national health care program of the country of operation is essential.

Set measurable goals
By setting interim goals and benchmarks, mHealth projects can provide proof of success, allowing them to secure support and funding for expansion. Setting measurable goals also helps project principals to identify the need to quickly correct a particular course of action in the event that interim targets are not met.

Collaborate with other mHealth organizations
With dozens of projects currently operating, the mHealth field is now in a strong position to move forward by sharing techniques and applications. Organizations such as the Open Mobile Consortium are facilitating the ability of the field to move forward by sharing best practices.

Credit: DataDyne

Project Masiluleke

Country: South Africa
Sponsoring Organization and Partners:
Pop!Tech Accelerator, Praekelt Foundation, iTeach, frog design, MTN, Nokia Siemens Networks, National AIDS Helpline, National Geographic Society, Ghetto Ruff Records, Children of South African Legacies, Aricent

The Project

Incubated by the Pop!Tech Accelerator, Project Masiluleke is designed to harness the power of mobile technology as a high-impact, low-cost tool in the fight against HIV/AIDS. Under the guidance of an international, multidisciplinary team, the project provides a suite of interventions targeting the entire HIV/AIDS care continuum by promoting testing, treatment connection/adherence and, ultimately, improved access to testing via an innovative home HIV test kit supported by mobile counseling.

Project Masiluleke is currently sending one million text messages per day throughout South Africa that encourage people to be tested and treated for HIV/AIDS. By capitalizing on the ubiquity of mobile devices in even the most resource constrained areas, this project has the potential to revolutionize the public health response to HIV/AIDS in South Africa and other parts of the globe. The model is designed for scale and replication and can be modified to address a variety of public health and social challenges.

Messages are written in local languages, and are used to direct recipients to the National AIDS Helpline. Once patients have called, representatives of the hotline provide information about testing services and locations.

Be Accessible

With many countries having multiple local and regional languages, communicating with people in the language they know best is critical. Similarly, it is essential to understand the target demographic. Colloquial language and references to pop culture may be effective in reaching teenagers, while older populations may prefer a more formal approach.

Objectives and Results

Project Masiluleke is designed to make more people aware of their HIV status because in South Africa, one-quarter of the population is estimated to be infected with HIV, but less than 3% know their status. The broader goal of the program is to have those infected receive treatment and to halt the spread of the disease. Initial results from a beta test of the project indicated that it helped to nearly triple call volume to the helpline in the three weeks during which it ran. The project partners are building in rigorous monitoring and evaluation of the project by, for example, linking calls to the helpline to PCM text messages through the use of distinct phone numbers that allow organizers to verify the number of calls generated by the program. Once the project is operating successfully, the system will be expanded to provide information about TB resources and treatment.

Future Plans and Scaling Challenges

The next phases of the project will be the use and extension of the Praekelt Foundation's TxtAlert program to remind HIV-positive patients to take their medication and keep medical appointments; the creation of 'virtual' call centers staffed by highly adherent patients; and the deployment of easy-to-use home HIV test kits, as the social stigma attached to HIV often prevents people from going to public clinics for testing.

Challenges remain for scaling projects like Masiluleke. Working across multiple networks, developing relevant messaging, and catalyzing resources to take the initiative to scale are all difficult, according to Robin Miller of Praekelt Foundation. Yet the project's early achievements point to some factors that increase the likelihood of success. Miller says that several ingredients have been critical for success:

- **Ensuring strong local partners to develop relevant content.** Masiluleke's partners enable the organization to tap into an already established customer base and also leverage their knowledge to build valuable content.
- **Method of interacting with the intended audience.** "We have found that mobile phone innovations already exist, even without new applications. For example, sending 'missed calls' led to the creation of the PCM message which was the starting point for the project."
- **Scaling and progress are only possible through rigorous data collection and analysis.** Only through measurement can we know what is working and where redirection is needed.

Credit: Vital Wave Consulting

Credit: UN Mark Garten

Multiple Health Issues Addressed by SMS Campaigns

Netcare Vodacom Smile for You Campaign—Hundreds of thousands of children in the developing world are afflicted with the condition known as cleft lip and palate, a relatively common birth defect that is all but invisible in rich countries where surgery to correct it is widely available and affordable. Children who are not able to have this condition remedied through surgery often have eating and speech difficulties and face social discrimination. In 2007, the Netcare Group, a private medical hospital group in South Africa, and Vodacom teamed with the Praekelt Foundation to offer 50 free cleft lip and palate surgeries to children too poor to afford them. A previous campaign to raise awareness of this service had relied on traditional media such as print and radio but yielded disappointing results, with only about 12 candidates identified for the surgery.

For the Smile for You campaign, the sponsors shifted to a mobile technology solution to improve response levels. In South Africa, 'Please Call Me' (PCM) text messages, which mobile phone users can send for free with a request to the sender to call, have become an enormously popular service, and operators subsidize them through the sale of advertising space in the unused character space of the text message. Over the course of five days, Vodacom donated space in one million PCM text messages for a message asking recipients if they knew of children in need of free cleft lip and palate surgery, using Praekelt's SocialTxt technology (also used in HIV/AIDS outreach efforts). During the first two days, recipients who wanted more information were prompted to phone a call center manned by Netcare staff. Beginning on the third day, recipients were given the option of sending an SMS with the word 'SMILE' to the Netcare call center, whereupon a representative would phone them to provide further information about the surgery offer (resulting in a lower cost to the message recipient).

The results of the campaign demonstrated the effectiveness of this concept. **Calls made to the call center, which hovered in the single digits in the weeks before and after the campaign, averaged nearly 35 per day, while staff received over 355 text messages during the three days that responding via text message was an option. In all, 42 children were identified as surgery candidates, more than three times the number identified during a traditional media campaign lasting six weeks.** The sponsors note that 203 people who did not know anyone with a cleft lip or palate responded, indicating that broadening the campaign to include languages other than English might yield even more promising results.

According to the Praekelt Foundation, several factors were essential to the campaign's success. All of the partners involved in the project brought strengths to it, as well as a desire to rigorously track results. The willingness to change tactics in the middle of the campaign also allowed the sponsors to compare communication methods in order to determine what was likely to work in future campaigns. And perhaps most critically, the partners leveraged the popularity of PCM messages and the experience Praekelt had accumulated in previous campaigns using SocialTxt software.

Text to Change (TTC)

Country: Uganda
Sponsoring Organization and Partners:
Celtel, AIDs Information Centre (AIC), Merck, and the Dutch Ministry of
Foreign Affairs

The Project

Text to Change (TTC) provided HIV/AIDS awareness via an SMS-
based quiz to 15,000 mobile phone subscribers during three months in
Uganda. TTC was founded with the goal of improving health education
through the use of text messaging, which holds the advantages of anonymity and strong uptake among
the population. Partnering with the mobile carrier Celtel and the local NGO AIDS Information Centre (AIC),
TTC conducted a pilot program from February through April 2008 in the Mbarra region of Uganda, with the
objective of increasing public knowledge of and changing behavior around AIDS. The program aimed to
encourage citizens to seek voluntary testing and counseling for HIV/AIDS.

An SMS-based multiple choice quiz was administered to 15,000 Celtel mobile phone subscribers in the rural
region of Mbarra. Free airtime was offered to users to encourage participation in the program; this was de-
termined to be a powerful incentive since users can exchange the airtime with other subscribers as a type
of currency.

The quiz was interactive. When participants gave a wrong answer they received an SMS with the correct
answer from the cell phone provider. The uptake rate of the survey was 17.4% and focused on two specific
public health areas:

- General knowledge about HIV transmission
- The benefits of voluntary testing and counseling

At the end of the quiz, a final SMS was sent to motivate participants to go for voluntary testing and coun-
seling at the local health center. Those who went to the center were asked a final question: Was this was
the first time they had an HIV test? After testing, participants were requested to leave their mobile phone
number so that post-test counseling could be arranged. For the people who came to the health centers
through TTC, HIV testing and counseling was free of charge. Initial grants from Merck, the US pharmaceuti-
cal company, and the Dutch Ministry of Foreign Affairs supported the program launch.

> **Text to Change (TTC) provided HIV/AIDS awareness via an SMS-based quiz to 15,000 mobile phone subscribers during three months in Uganda**

Forge Strong Partnerships

Successful mHealth projects require the participation of partners with expertise in the fields of technology,
healthcare, and academia. Validation and testing are key steps in the conception of mHealth programs and this
phase typically occurs within a university setting or a technical organization. In order to move to the implementa-
tion stage, however, it is essential to bring other partners into the project. Dr. Patricia Mechael of the Earth Insti-
tute notes that "The projects that have been implemented at significant scale have forged strong partnerships,
either with a government or a private corporation." Mechael further affirms that the mHealth field currently finds
itself in a place where a number of projects are in the design and testing phase that have not yet made the move
to implementation. "As the diverse sectors involved in mHealth continue to collaborate and the corporate and
political climate become more supportive we expect to see more projects move into the implementation phase."

Set Measurable Goals

As with any initiative, setting measurable goals establishes the barometer that allows mHealth projects to assess success or failure. It builds in the rigor that is required if course corrections are needed during the project. Once achieved, these goals, in turn, form the building blocks for success, allowing the project to move forward with larger implementations and broader partnerships.

Credit: Text to Change

The quiz produced a 40% increase in patients who came in for testing—from 1,000 to 1,400 during a six-week period.

Objectives and Results

The quiz had two goals:

- Collect information. In particular, the program was able to assess the rate of correct or incorrect answers within certain socio-economic sectors, and pass this information along to UNICEF.
- Promote testing and counseling. The quiz notified participants of the location of the nearest testing center. If they stated that they were referred from the quiz, testing was free (there was normally a small charge for testing).

The quiz produced a 40% increase in patients who came in for testing—from 1,000 to 1,400 during a six-week period.

In terms of information gathering, a key finding of the survey was that although people were quite knowledgeable about issues such as condom use, they did not think that AIDS testing was accurate or anonymous. This was a major finding, in that the population of Uganda had not been surveyed on this question before. TTC was able to pass this along to larger health agencies operating in the region, thereby contributing to the efficacy of existing health programs.

TTC co-founder Hajo van Beijma notes that "there was initially an element of risk for the funders since this type of project had not been conducted before, but now that we have proven results we have the opportunity to expand." TTC is planning a follow-up program in Uganda in January 2009. One of the goals of this next campaign is to promote the safety and effectiveness of the testing center, and therefore specifically encourage testing.

In this phase, collaboration with local partners will be further strengthened, with the local HIV/AIDS organizations submitting questions. Text to Change intends to shorten the duration of the program to four weeks, hoping to minimize participant drop-out rates, and to include non-English speaking subscribers by enabling them to read SMS messages in their local languages.

The pilot saw the sponsoring partners benefit as well: Celtel (now rebranded Zain) reaps benefits not only from a corporate social responsibility (CSR) perspective but also through the promotion of its texting service. The testing center increased the number of tests conducted, placing them in a position to receive expanded funding.

Future Plans and Scaling Challenges

Hajo van Beijma hopes to build upon lessons learned from the pilot. He comments, "After the pilot we saw that our initial program didn't have a good survey running. In the second round we developed a new survey with Ugandans, and used university students. Their IT knowledge is fabulous. They really know how to program these kinds of software tools in Uganda."

The new program in January 2009 will target 30,000 people, and ultimately TTC plans to do a nationwide roll-out. Van Beijma notes, "If we are able to prove that we can send out a large number of questions, that will lay the groundwork for the nationwide program. In the first pilot there were some issues with being able to send out a large number of questions at the same time."

Van Beijma cites several critical success factors for scaling Text to Change and similar mHealth projects. These include:

- **Develop surveys in the numerous local languages.** This would make their message more accessible to specific ethnic and social groups. Literacy is also an issue. However, van Beijma notes, "If people do not speak or read English and they get a text message they will ask their neighbor what it means."
- **Secure ongoing funding.** Though TTC is more cost effective than many other education programs, steady funding will allow for stable operations and growth.
- **Collaborate with other mHealth organizations.** Van Beijma notes that one of the consensus findings of the recent MobileActive conference in South Africa (October, 2008) is the need to set up a consortium to promote collaboration among mHealth organizations in different developing countries. "The goal is to work with organizations that are doing similar and complementary things in different countries. This way if we move into other countries we will combine strengths, for example, by developing software together."
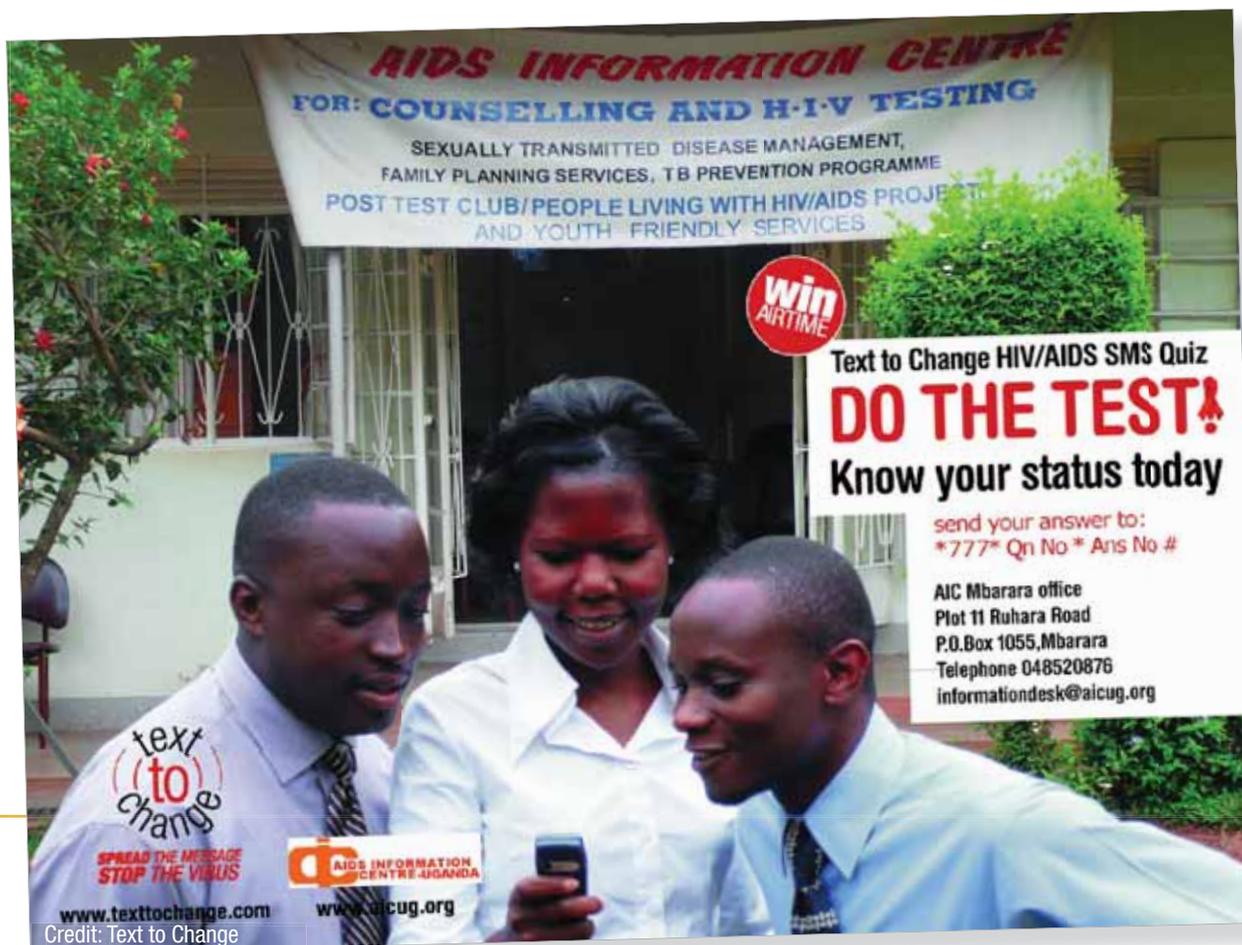
Credit: Text to Change

Data Gathering

Country: Brazil
Sponsoring Organization and Partners:
Nokia, Amazonas State Health Ministry

> "In order to stop an outbreak and the means of disease transfer, we need to have the information very fast. That's the only way to prevent the virus of dengue from circulating."
>
> —Luzia de Melo Mustafa, Health Agent coordinator, Amazonas Brazil

The Project

In the Amazonas state of Brazil, containing dengue fever is a constant challenge due to heavy rainfall during most of the year, and local methods for storing water in homes—both of which have been shown to promote mosquito breeding. The state health department must warn households constantly about the dangers of behaviors that encourage mosquito proliferation. Despite these difficulties, the state is one of the most efficient at containing the spread of the virus relative to other states in Brazil, due partly to its partnership with Nokia on the Data Gathering mHealth initiative.

The Nokia Data Gathering system enables fast and effective data collection, which is essential to containing the spread of the dengue virus. Development of the software began in the first quarter of 2007 and it was piloted in different regions of Brazil during that same year. The Amazonas Health Department undertook the first full implementation of the solution, which began in October 2008.

Data Gathering allows the creation of customized questionnaires, which are distributed to the mobile phones of health agents in the field. When the field workers finish their surveys, they send the data back to the server via a wireless connection, from which it can be integrated into the organization's existing systems for immediate analysis. Data Gathering also provides GPS location information for each record, which would otherwise require dedicated instruments.

Users report the tool is flexible and easy to use. As Luzia de Melo Mustafa, an Amazonas health agent, affirms, "It's easier, quicker and more practical. You type it and send it right away, it goes straight to the server. Then the data is consolidated and we can get the result immediately and, consequently, we may take the right actions, what we need to do. The devices are providing us with precision; the information we need to develop [effective responses] in the areas where the infection levels are high."

Objectives and Results

The goals of the project are all about saving time to save lives. Andre, project principal, states "The initial impetus for the project started with a meeting in Brasilia with the federal Ministry of Health where we tried to find a way to use mobile technology to improve current health data surveys being conducted using pen and paper. There was a real need to make the process more agile and more reliable, providing the government with a tool that could ultimately save lives through the use of smartphones."

Results of Data Gathering implementation to date are highly encouraging. The project team's preliminary evaluation has shown that the time spent in data gathering was drastically reduced, and end-user acceptability has been very high so far. Even before the full implementation, more than 400 results were gathered during the tests by a team of 20 field professionals in the course of two days, all with GPS information. Luzia de Melo confirms, "Before we used to wait for one or two months before we could get all the consolidated information. Now, we have it on a daily basis." As Greg Elphinston, Community Involvement Director for Nokia, elaborates, "If you have to wait two to three months for information in the health context, this can be the difference between life and death."

> More than 400 results were gathered during the tests by a team of 20 field professionals in the course of two days, all with GPS information. Luzia de Melo confirms, "Before we used to wait for one or two months before we could get all the consolidated information. Now, we have it on a daily basis."

Future Plans

Plans for expansion will be based on a comprehensive evaluation of current work. The immediate growth objective is to broaden the covered areas in the Amazonas state, as well as adding yellow fever and malaria to the list of diseases to be surveyed.

Project staff cite several critical success factors for Data Gathering and similar projects, including:

- **Work closely with local and regional government agencies.** The service must respond to the local needs as perceived by local officials. Their support for the project will make implementation and expansion possible.

- **Maintain a focus on usability.** According to Andre Erthal, Head of Community Group at the Nokia Technology Institute, "If the field agents do not see the device as part of their work or have difficulties in using it, it may severely damage the overall success of the implementation. That is one of the reasons why the solution was developed since the beginning with the end user in mind, so we could develop the solution to be as user-friendly as possible."

- Working in partnership with Nokia, Pan American Health Organization (PAHO), and National Foundation for Indigenous Peoples' Health (FUNASA), the UNF-VF Technology Partnership will be launching a program called Mobisus in Brazil in 2009, utilizing mobile phones for health data gathering.[13]

Design With the End User in Mind

"End-user acceptance is one of the critical success factors for the project. If the field agents do not see the device as part of their work or have difficulties in using it, it may severely damage the overall success of the implementation. That is one of the reasons why the solution was developed since the beginning with the end user in mind, so we could develop the solution to be as user-friendly as possible."

—Andre Erthal,
Head of Community Group, Nokia Technology Institute

Government Support is Critical for Long-term Success

The majority of mHealth projects are implemented with seed funding from philanthropic organizations such as foundations and multilateral institutions, or as part of a corporate social responsibility initiative by a for-profit business. The three case studies highlighted in this report provide proof of concept, and initial positive results. However, all too often, once the initial funding has been exhausted the projects find it difficult to achieve scalability and sustainability, resulting in unintended termination. Ensuring long-term sustainability is a major challenge for mHealth projects.

Expert researchers in the public health and eHealth arena are currently examining the sources of sustainability for mHealth projects. In particular, Dr. Adesina Iluyemi, a PhD Candidate at the University of Portsmouth, United Kingdom focusing on sustainable mHealth in developing countries, has noted that mHealth projects are far more likely to be sustainable in cases where buy-in from governmental or public bodies is secured. In this way, the project is institutionalized into existing government health programs and can receive budget attention.

Dr. Iluyemi notes, "It is very important that a mHealth project have the support of the national or regional government. The majority of mHealth projects are currently funded by international agencies or CSR initiatives of companies. The problem is when the funding runs dry there is no more continuity. In the long term the custodian of the project will be the government. This could be national, local, or regional. During the lifetime of the pilot project it is very important to ensure that the government buys in and that the government sees the benefit so that the project can survive beyond the donor-funded period." For every mHealth project, therefore, it is critical to ensure that the program is aligned with the strategic goals of the national health system.

[13] http://commitments.clintonglobalinitiative.org/projects.htm?mode=view&rid=211710.

Open Source Movement: A Building Block for mHealth Success

A component of sustainability for mHealth programs is building capacity to enable programs to be locally implemented and maintained. The most successful mHealth projects have obviated the need for external consultants and achieved technical self-sufficiency. For many organizations, open source software is a tool for self-sufficiency, as it reduces costs, increases the available pool of programmers, and eliminates the need for outside consultants. It also encourages innovation.

Software development costs can be reduced with open source software because there is no need to purchase licenses. Because local programmers in developing countries are increasingly being trained in open source software, self-sufficiency is promoted. According to Dr. Balcha Masresha of the WHO, open source software is a key variable in the ability of EpiSurveyor, a PDA-based data collection project, to be sustainable and scale up to 20 countries in sub-Saharan Africa. "It is crucial for this kind of project because of existing longstanding experience with the EPIINFO software (freeware developed by the Centers for Disease Control) used in nearly all countries for the management of immunization and surveillance databases and analysis, and because of the inhibitive costs involved in the purchase of proprietary software for the average African user."

As Eduardo Jezierski, Vice President of Engineering at InSTEDD states, "Open source allows different projects to 'talk' to each other. In this way we can pool our very limited engineering resources and say 'here's the source code, can you help me with this.' It is allowing us to create a platform that costs less money from a licensing perspective for the countries running mHealth programs." Jezierski further notes that "This industry is at an early stage, and it is very encouraging that people are learning from each other and are sharing source code. It is very rare that an industry starts with this sort of collaboration."

Collaborations of this nature are steadily emerging in the mHealth arena—witness the 'Open Mobile' Consortium, which was conceived at the MobileActive08 conference in Johannesburg, South Africa in October 2008 and began to take shape in a series of meetings in New York the following month. The organization will focus on developing best practices and standards for the mHealth field. Organizations of this type will pave the way for coordinating the various components of mHealth on a grander scale, bringing the industry to a higher stage of evolution. ∎

> **"It is crucial for this kind of project because of existing longstanding experience with the EPIINFO software (freeware developed by the Centers for Disease Control) used in nearly all countries for the management of immunization and surveillance databases and analysis, and because of the inhibitive costs involved in the purchase of proprietary software for the average African user."**

OpenROSA

With so many community-based organizations involved in creating mHealth applications and a need for both customization and standardization, it is not surprising that many applications are created in an open source framework. With this in mind, a coalition of community health organizations and health researchers created OpenROSA in 2007. OpenROSA is a consortium that develops "open source, standards-based tools for mobile data collection, aggregation, analysis, and reporting." With university partners in the United States providing technical expertise and community health professionals in Africa testing and deploying mobile applications in the field, multiple organizations are able to share their ideas, data, code, and experiences.

As part of this effort, OpenROSA is currently developing JavaROSA, a J2ME implementation intended to run on mobile phones and PDAs. One of the programs using this architecture is CommCare, which is being tested in Tanzania and Uganda by community health workers collecting health data in rural areas. The program was designed to maximize patient data security while remaining simple for workers to use, a difficult balancing act. Participants in the project hope that as CommCare is deployed, it will not only provide better data and improved patient care and service where it is used, but that the lessons from field experience will help perfect the architecture for future projects.
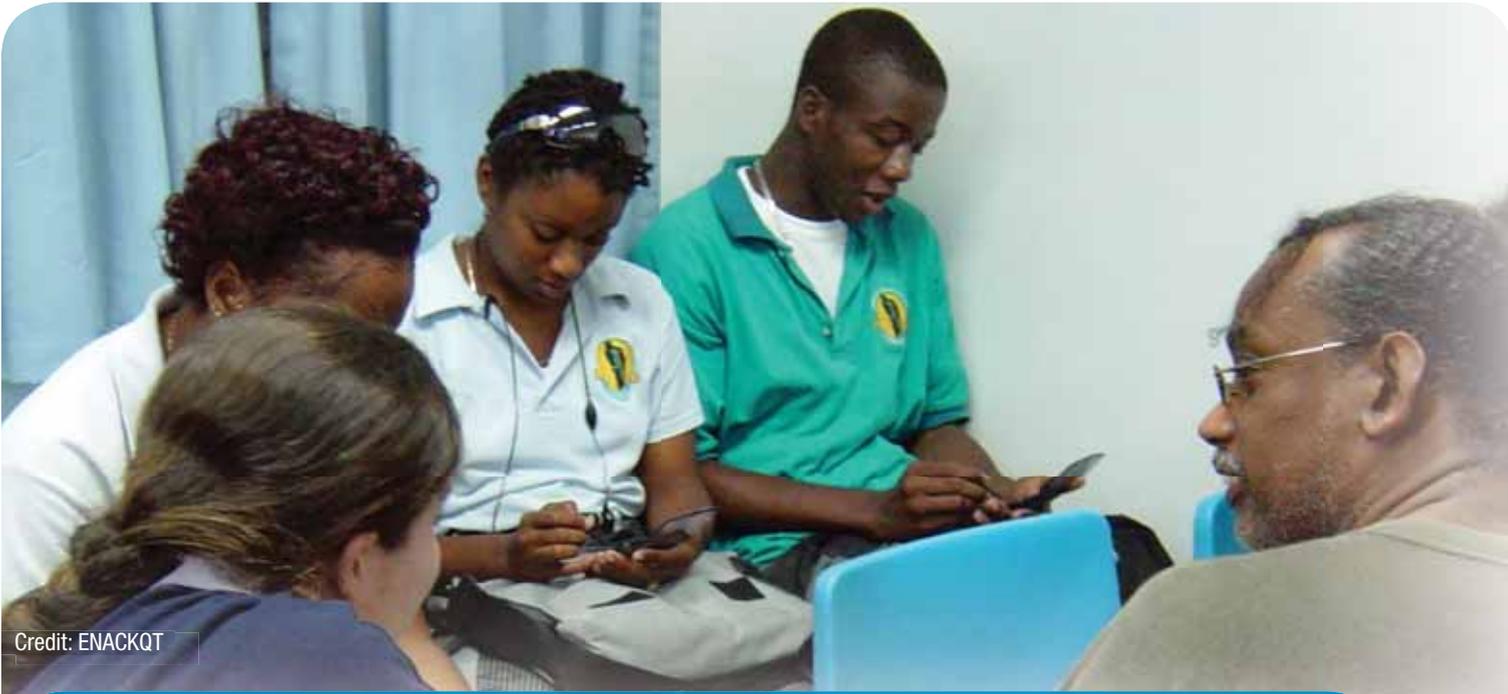
Credit: ENACKQT

Understanding the Incentives for Multiple Players: mHealth Value Chain

One of the most crucial building blocks for successful and sustainable mHealth programs is to forge strong partnerships, particularly across sectors (for-profit, non-profit and public sector). A solid understanding of the needs and interests of these multiple players is required in order to marshal their energy and resources. One method of identifying these incentives is through value chain analysis, or an evaluation of the relationship between all organizations and steps in the commercialization or delivery process of a product or service. The diverse players—spanning from the patient to the equipment vendor—in the mHealth value chain are listed in Table 3.

Value Chain Models for mHealth: One-way Data Applications

Figure 5 illustrates the most basic set of relationships and players for mHealth solutions based on a one-way messaging application. Examples of this type of application include medication regimen adherence and monitoring programs (e.g., SIMpill, which equips pill bottles with a SIM card and transmitter to track medication adherence) and education and support programs based on one- or two-way SMS alerts (FrontlineSMS, a platform for sending and receiving group SMS messages; MyQuestion/MyAnswer, providing education on HIV/AIDS via SMS communications). Figure 5 depicts the dynamics and incentives described in Table 3.

Player	Incentive
Patient or Citizen (Mobile Subscriber)	Improved health outcomes
Health Care Provider	More efficient and effective delivery of health services
NGO	Advance organizational mission, attract funding
Foundations	Advance organizational mission
Government	More efficient health care provision, effective government
Equipment Provider	Device revenue generation, improved brand recognition
Service Provider	Revenue from service fees, increased subscriber base
Application Solutions Provider	Revenue from additional applications license fees
Content Management	Increase in volume of readership or revenue
Platform Provider	Revenue from sales

Table 3. mHealth value chain players and incentives.

Considerations about project scale are crucial in planning for long-term project sustainability. Scale is a principal factor in the incentive structure of many value chain participants. For example, it is unlikely that project leaders will be able to obtain ongoing funding for special device modifications or customized features for small local initiatives, since there is not enough volume to warrant contributions from the platform developer without prohibitive development and maintenance fees. On the other hand, a basic 'one-way' messaging service can be an attractive investment even at low volumes, as it significantly reduces costs and improves efficiencies for health care providers, enabling the phase-out of cumbersome manual processes.

However, at higher levels of scale, a program can represent strategic growth for the larger value chain participants (those on the left side of Figure 5). Partnerships that are rooted in the business interests of for-profit participants have an intrinsic value beyond corporate social responsibility (CSR) and, therefore, are less at risk of being cut off during a downturn in the participant's overall business.
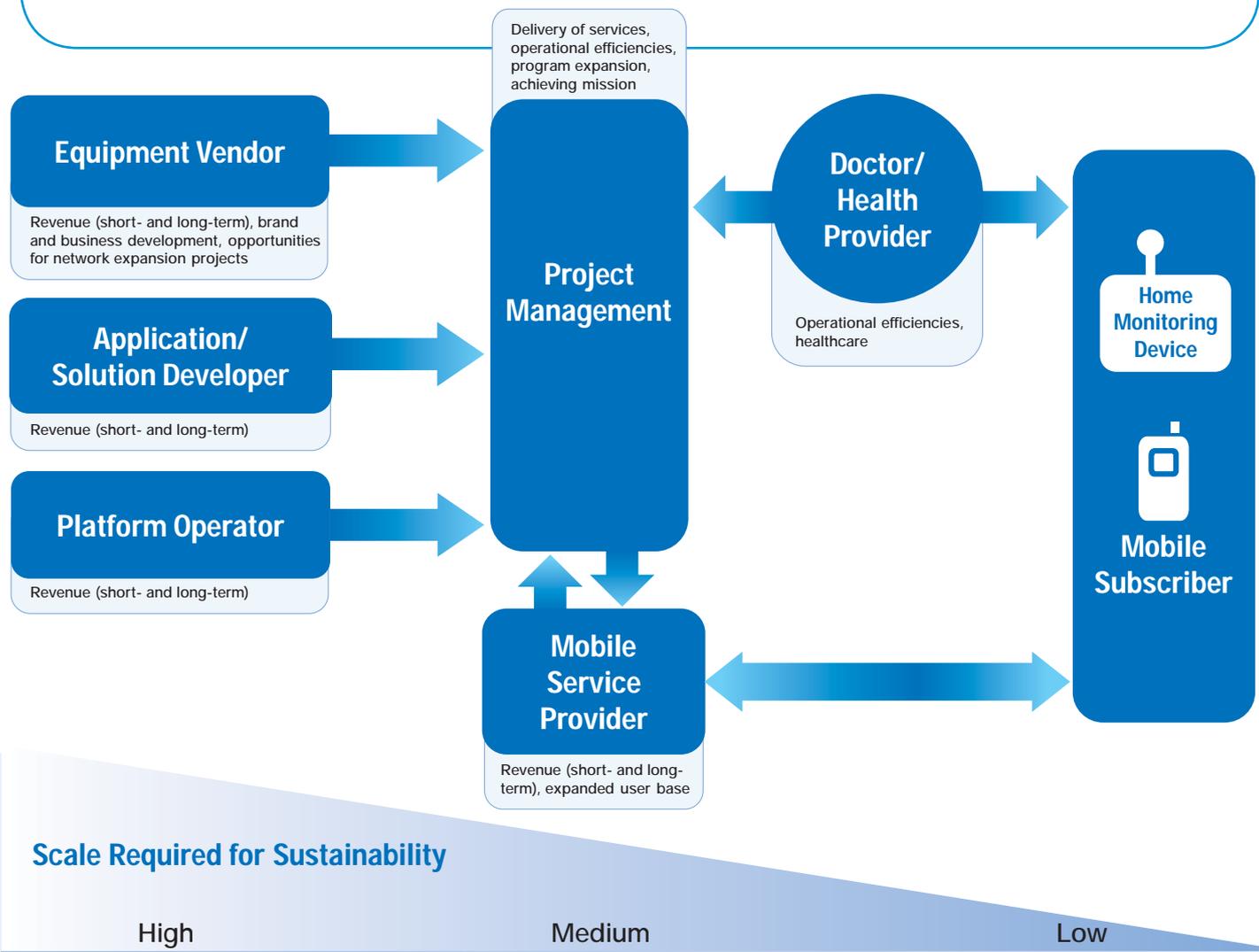

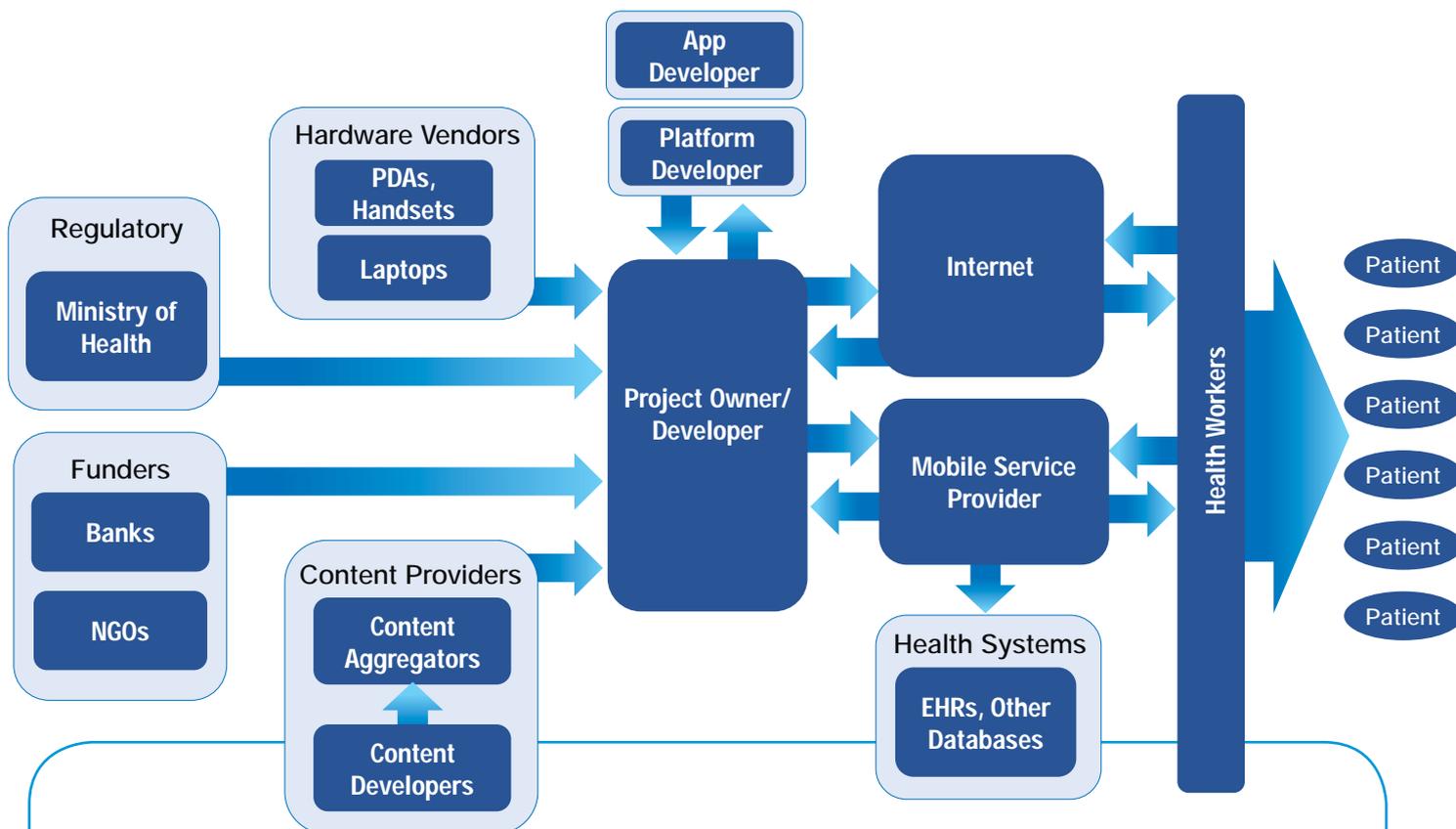Figure 5. Value chain model for 'one-way' mHealth applications.

Figure 6. Value chain model for 'two-way' mHealth applications.

Value Chain Models for mHealth: Two-Way Data Applications

Figure 6 presents a value chain model for a more complex service offering—a two-way data application. Two-way applications are developed for data access programs such as remote data collection, access to client records, access to health information databases, census taking, and electronic health records creation and storage (e.g., EpiSurveyor, a survey program for remote data collection). While it is not likely that two-way services will have the volume potential of one-way services, these services appeal to potential participants because they are Internet-based. Participants in the value chain may find incentive to integrate mHealth solutions with growth plans around Internet access, as it is an established functionality on both phones and laptops and the basis for other services (and thus revenue opportunities).

The complexity evident in Figure 6 creates opportunities for innovative health solutions, but also a number of challenges, including increased dependence on information technology (IT) infrastructure, the need for more sophisticated application development, greater support service requirements, and a more expensive hardware component. These higher-level solutions entail higher project cost and participant involvement, which in some cases may be prohibitive.

With more value chain participants and higher costs of execution, there is less reward (whether in the form of revenue gains or operational efficiencies) to go around. It therefore becomes progressively more difficult to achieve the financial impact that provides momentum and leads to partnership with larger players. These companies' contributions to the more ambitious initiatives, therefore, will likely be limited to the provision of standard services or as a one-off CSR project. ■

Credit: UN Foundation/Nothing But Nets

A Call for Action

The mHealth field offers opportunities for players across multiple sectors, from governments to businesses to NGOs. By taking a strategic approach, each of these players can advance their organizational objectives while contributing to improved health outcomes on a massive scale.

Operators

Combine mHealth with delivery of other mServices

Operators can capitalize on the popularity of mServices in developing countries to build support for mHealth initiatives. Rapidly growing mServices such as mBanking and mCommerce are proving the viability of mobile technology as a service model. Packaging such services with mHealth solutions creates economies for operators and takes advantage of shared resources and best practices. It also presents a more compelling proposition to end users by serving as a 'one-stop shop' for all their needs.

Leverage handset maker relationships

Mobile operators have tremendous influence and strong relationships with handset manufacturers, and they should leverage this position to bring to market phones and other devices that can provide the mHealth and other mobile services consumers in developing countries need. Affordability is critical, yet not sufficient to significantly increase the usage of mServices across the developing world. Low-cost phones that incorporate simple, innovative features are key to increasing access to mServices and helping to create the scale and market needed to sustain them over the long run.

Be pro-active in developing joint solutions

Operators would do well to pro-actively seek out opportunities to improve health outcomes by initiating public-private partnerships, teaming up with governments and NGOs to address pressing national health issues, and collaborating with software providers to develop targeted healthcare solutions. Joint projects help ensure that key stakeholders are on board, increasing the potential for successful outcomes.

Enhance mHealth infrastructure

Infrastructure conditions vary in the developing world, and operator services geared toward mHealth can enhance their networks to facilitated increased mHealth activity. As Eduardo Jezierski, Vice President of Engineering at InsteDD notes, "From a technical perspective you need to think not just about use of your network as a way for humans to communicate with humans but also as a way for humans to communicate with systems and information. The challenge is to build better application gateways that allow for different organizations involved in mHealth to build the applications themselves.

NGOs

For best results, think big and join forces

Think big. As Jesse Moore of the GSMA states, "Scale is of utmost importance to mobile operators. Operators evaluate value-added services, such as mHealth applications, by volume and volume is measured in millions of users, not hundreds or thousands. Scale is evaluated on three dimensions: how easy is the service to use by the end users? How easy is it to install and maintain on the operator's network and how many handsets can use the service (many handsets in Africa are very basic and hence the service must be designed for simple handsets). Without scale, the mHealth application will be evaluated as a corporate social responsibility initiative and its sustainability will be in question."

Partner

The most effective approach to achieving scale is to join forces with companies that are already offering mServices (mobile money, mobile government services, mobile education), and propose a joint effort on mHealth. NGOs bring valuable assets to the table—they understand the local environment and how to design services with cultural and behavioral patterns in mind. NGOs also have feet on the ground and can assist with training and education around the mServices. In return, they can use the existing technology platform to launch mHealth initiatives.

Design With the End User in Mind

Operators
- Combine mHealth with delivery of other mServices
- Leverage handset manufacturer relationships
- Be pro-active in developing joint solutions
- Enhance mHealth infrastructure

NGOs
- For best results, think big and join forces
- Partner
- Provide proof of concept by using the simplest available technology

Policymakers
- Define an mHealth policy and provide incentives

Funders
- Ensure project sustainability
- Provide resources for impact assessment

Provide proof of concept by using the simplest available technology

Many operational mHealth programs build on the broad use of standard cell phones. Early applications provide data access and exchange in the form of one-way or basic two-way services. The infrastructure for these applications is already in place through standard telecommunications networks, and, unlike more complicated devices such as PDAs, users have widely embraced the functionality. These simple applications thus have the distinct advantages of lower start-up and operating costs and broader reach, pointing to a clearer path toward financial sustainability.

Policymakers

Define an mHealth policy and provide incentives

Define what mHealth means within the national health system. mHealth applications can be designed as an integral part of the overall health information system, and policymakers are in a unique position to shape these efforts. One of the most important roles to play in this regard is in driving innovation through incentives. Incentives can include tax rebates to telecom providers for provision of mHealth services, and funding for universities and research institutes studying mHealth solutions.

Funders

### Provide resources for impact assessment

Help grantees help themselves. Non-profit and international development funding sources are placing a growing emphasis on 'demonstrable impact.' As such, mHealth proposals and programs need to be able to specify and measure program success. This is even more critical given the early stage of the mHealth market and the attendant absence of a body of research to which program managers can refer. To mitigate this problem, funders can set aside funds to enable independent researchers to conduct rigorous evaluations of mHealth programs.

Ensure project sustainability

Partner with national governments once the initial pilot phase has been completed. By ensuring that mHealth projects are integrated into government health programs, funders gain long-term sustainability and greater health impacts for their projects. Academic researchers affirm the central role of long-term financial planning: Dr. Adesina Ilyumi of the University of Portsmouth states, "Foundations should incorporate sustainable business/financial models beyond donor funding into their strategic plan, and engage with government bodies at the level of implementation in order to ensure that the project continues beyond the seed funding." ∎

"In today's mHealth environment there's a general tendency to try and seek out solutions to the bigger health problems. Easier 'low-hanging fruit' are often overlooked. Enhancing basic communications within rural healthcare networks is a classic low-hanging fruit...Communication is fundamental to all NGO activities, particularly those working in the kinds of infrastructure-challenged environments often found in the developing world. Hospital staff often lack basic communication with their community healthcare workers...creating considerable inefficiencies in the use and allocation of scarce resources. We need to ensure that we address some of the simpler mHealth challenges...in parallel with our search for solutions to what we consider to be more complex problems."

—Ken Banks, Founder, kiwanja.net
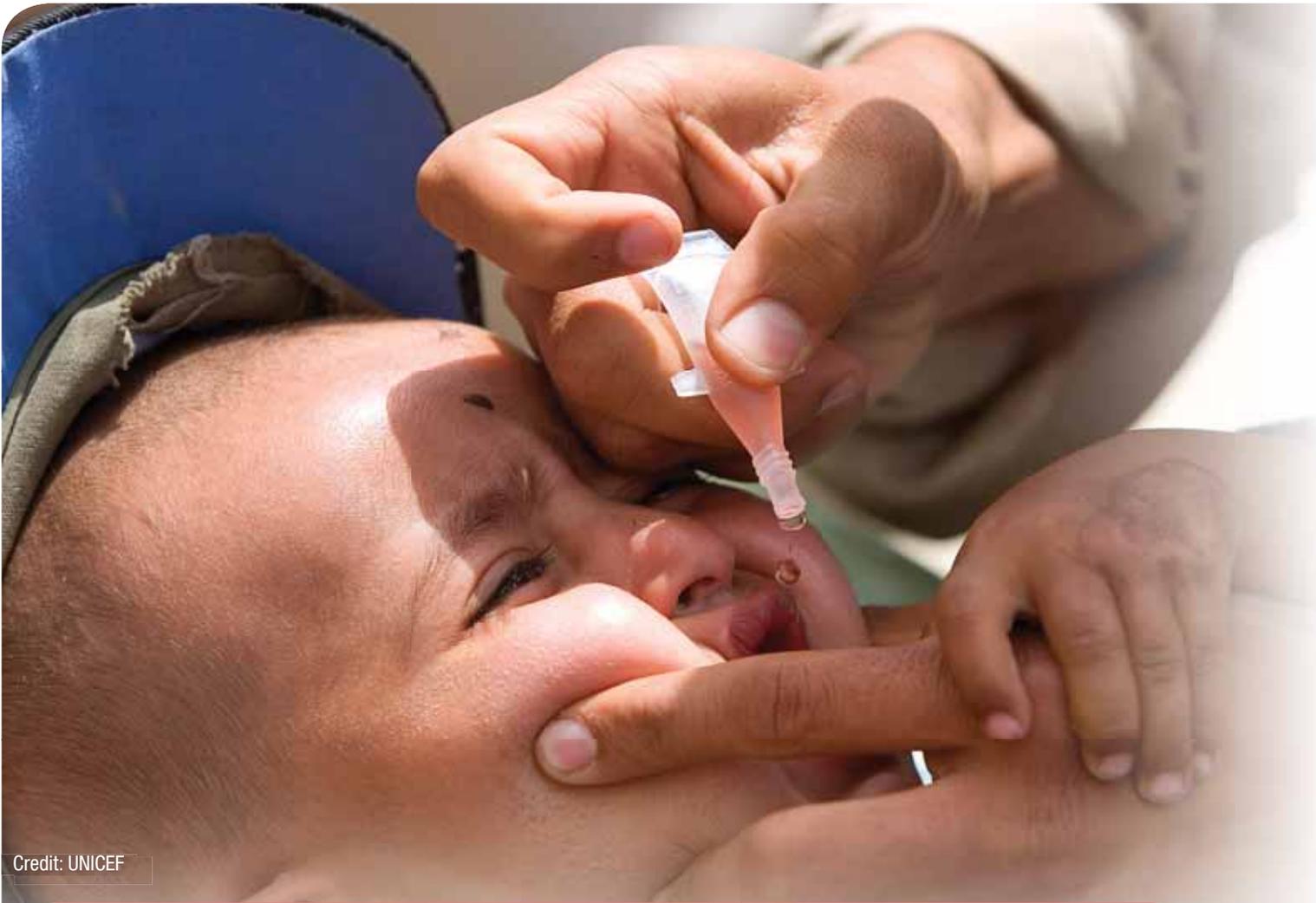
Credit: UNICEF

Conclusion: Looking Forward

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

Health needs in the developing world are rapidly evolving to include chronic diseases, in addition to the communicable diseases most often associated with developing countries. mHealth is well-positioned to address these challenges using currently available technology. For example, SMS alerts can be equally useful in raising public health awareness of HIV/AIDS and in ensuring patient adherence to treatments for chronic diseases such as diabetes. Emerging technologies, such as wide-area wireless systems, will also be an asset in tackling today's health challenges and those of tomorrow.

As this paper has shown, mHealth projects are operating in a wide variety of developing countries and providing demonstrable impacts. Documented results—in both the developed and developing world—reveal that mobile technology improves the efficiency of healthcare delivery. The next stage in the evolution of the mHealth field is to increase the scope and scale of operations. By learning from examples of similar projects, mHealth organizations will enhance their opportunity to scale and increase their health impact. Case studies detailed in this paper reveal some of the key benefits of mHealth and provide examples of how to structure successful mHealth initiatives. These studies also reveal key building blocks of success for mHealth projects, such as forging strong partnerships and designing with the end user in mind.

The transformational power of mobile networks and devices is helping drive the adoption of scalable and sustainable health initiatives, particularly in the developing world. To move forward, leading players in the field of mHealth agree that multi-stakeholder collaboration on a global level is needed.

Due to its nascent stage, mHealth presents a tremendous opportunity to create a global facilitation body, enabling maximum innovation and impact on global health. There is an agreement among participants in this arena on the need for a body to address the many informational and logistical gaps in the mHealth ecosystems; from basic market research to best practices; from policy engagement and standards advocacy; to support scalable implementations of mHealth pilot programs through public-private partnerships.

An alliance cultivating the cross-sectoral and pan regional partnerships and projects necessary to expand the existing embryonic mHealth ecosystem would be a significant step in enabling closer collaboration on mHealth initiatives by multi-sectoral organizations.

The long-term goal and expectation underlying all these efforts is that mHealth programs will have a significant and lasting positive impact on health outcomes such as reduced infant mortality, longer life spans, and decreased contraction of disease. This report is designed to move the field one step further in the achievement of this ambitious goal by outlining the current state of the field, highlighting mHealth initiatives taking root around the globe, and outlining the building blocks required for successful and sustainable mHealth initiatives. ∎

Credit: DataDyne

Credit: UN Mark Garten

Compendium of mHealth Projects

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

Education and Awareness

1. Freedom HIV/AIDS Project, India
2. Learning about Living, Nigeria
3. HIV/AIDS Video Distribution by Mobile Phone, Georgia
4. HIV Confidant, South Africa
5. Project Masiluleke, South Africa
6. Text to Change (TTC) – HIV Prevention through SMS Quiz, Uganda

Remote Data Collection

7. Cell-PREVEN, Peru
8. Community Accessible and Sustainable Health System (Ca:sh), India
9. Community Health Information Tracking System (CHITS), Philippines
10. Dokoza System, South Africa
11. EpiHandy, Uganda, Zambia, Burkina Faso
12. EpiSurveyor, Kenya, Uganda, Zambia (and 20 countries in sub-Saharan Africa by end of 2008)
13. Integrated Healthcare Information Service through Mobile Telephony (IHISM), Botswana
14. Media Lab Asia – Shared Resource for Rural Health Management and Information Infrastructure, India
15. Mobile-Based Primary Healthcare Management System, India
16. Map of Medicine for Kijabe Hospital, Kenya
17. Nokia Data Gathering, Brazil
18. PDAs for Malaria Monitoring, Mozambique
19. Phones for Health, Rwanda
20. TRACnet, Rwanda

Remote Monitoring

21. Cell-Life Project, South Africa
22. Chinese Aged Diabetic Assistant (CADA), China
23. Colecta-PALM, Peru
24. Mashavu: Networked Health Solutions for the Developing World, Tanzania
25. MediNet Healthcare Management System, Trinidad and Tobago
26. Mobile Care, Support and Treatment Manager (MCST), India
27. Mobile Phones for Health Monitoring, India and the United Kingdom
28. Phoned Pill Reminders for TB Treatment, Thailand
29. SIMpill Solution for TB, South Africa
30. Virtual Health Pet, Brazil

Communication and Training for Healthcare Workers

31. Enhancing Nurses Access for Care Quality and Knowledge through Technology (ENACQKT), the Caribbean
32. HealthLine, Pakistan
33. Mobile HIV/AIDS Support, Uganda
34. Primary Healthcare Nursing Promotion Program, Guatemala
35. Uganda Health Information Network (UHIN), Uganda

Disease and Epidemic Outbreak Tracking

36. Acute Encephalitis Syndrome Surveillance Information System (AESSIMS), India
37. Alerta DISAMAR, Peru
38. FrontlineSMS, Worldwide
39. GATHER, Uganda
40. Handhelds for Health, India
41. Remote Interaction, Consultation, and Epidemiology (RICE), Vietnam
42. Tamil Nadu Health Watch, India

Diagnostic and Treatment Support

43. Cell Phone Applications for Clinical Diagnostic Therapeutic and Public Health Use by Front Line Healthcare Workers, Mozambique
44. Digital Inclusion Kit in Health and Higher Education, Argentina
45. Ericsson and Apollo Hospitals Initiative, India
46. HIV Mobile Decision Support, South Africa
47. M-DOK: Mobile Telehealth and Information Resource System for Community Health Workers, Philippines
48. Mobile E-IMCI, Tanzania
49. Mobile Telemedicine System, Indonesia
50. Nacer, Peru
51. Teledoc - Jiva Healthcare Project, India

Credit: DataDyne

Credit: RAMP

Education and Awareness

Project 1: Freedom HIV/AIDS Project

Country: India

Sponsoring Organization and Partners: ZMQ Software Systems and Delhi State AIDS Control Society

Application Area: Education and Awareness

Communicating information in an engaging, fun way is a critical ingredient of success in mHealth programs. The Freedom HIV/AIDS games—launched in India in December 2005—have effectively enhanced HIV/AIDS awareness by applying this principle. The games are tailored to target users from different social and demo-graphic groups and run on more than 100 types of mobile phones, from the most basic to the most sophisti-cated. ZMQ Software Systems, the maker of the games, believes the "Play-and-Learn method [the games employ]…makes learning not only exciting and engaging but helps in the enhancement and retention of knowledge." This belief has been confirmed by the games' popularity: by March 2006, only four months af-ter the launch date, more than ten million games had been downloaded, many by mobile phone subscribers in small cities and towns, the most vulnerable populations.

Reference sources:
http://www.freedomhivaids.in/FreedomHivAids.htm
http://www.zmqsoft.com/

Project 2: Learning About Living

Country: Nigeria

Sponsoring Organization and Partners: The UK charity OneWorld, ActionAid International Nigeria, Action Health Incorporated, Education as a Vaccine Against AIDS (EVA), Butterfly Works Netherlands, MTN Foundation and Federal Ministry of Education and Federal Ministry of Health, Nigeria

Application Area: Education and Awareness

mHealth programs that take a holistic approach to public health challenges often have the best chance of success. Learning about Living, a collaborative pilot program, does this by providing young Nigerians with an anonymous forum to learn about health, AIDS, sex, relationships, personal development, and living skills. The program includes an interactive eLearning tool based on the Nigerian Family Life and HIV/AIDS Edu-cation (FLHE) curriculum, as well as the mobile phone-based programs MyQuestion and MyAnswer. With MyQuestion, Nigerian youth can submit questions via text message, a telephone hotline, or online. Ques-tions are promptly answered by trained volunteers. MyAnswer sends out a monthly question (e.g., what is the difference between HIV and AIDS?) and selects winners based on responses submitted via the web or text message. The two-year project, launched in February 2007, was piloted in three locations in Nigeria, and saw early success. The service received more than 2,500 questions in the first five days and received 10,000 questions in the first month.

Reference sources:
http://blog.whoiswho.de/stories/31872/
http://mobileactive.org/ask-about-sex-text-teenagers-learn-about-living-nigeria
http://uk.oneworld.net/article/archive/9789
http://www.comminit.com/en/node/269380/38
http://www.learningaboutliving.com/south/about
http://www.youtube.com/watch?v=UCHPH-Nx-hc

Project 3: HIV/AIDS Video Distribution by Mobile Phone

Country: Georgia

Sponsoring Organization and Partners: Save the Children and UNICEF

Application Area: Education and Awareness

HIV/AIDS receives little attention in regions such as the Caucasus, where the topic is taboo and many people are uninformed about the disease and its causes. Save the Children and UNICEF collaborated in January 2008 to produce a 20-minute film about HIV/AIDS aimed at educating young people in Georgia. The film content is compelling, featuring well-known young actors who portray the potential health risks of everyday decisions and behaviors. Taking advantage of the popularity of mobile phones among young Georgians, Save the Children and UNICEF converted the film into a format that is viewable on mobile phones, at which point it was sent to thousands of young people around the country, who were encouraged to pass it on to friends. The project was praised for its novelty and the ease of dissemination. This innovative social distribution model for health information had never been used in Georgia before, but is sure to be replicated in future initiatives.

Reference source:
http://www.unicef.org/ceecis/media_8237.html

Project 4: HIV Confidant

Country: South Africa

Sponsoring Organization and Partners: Dimagi, Inc. (privately held software company)

Application Area: Education and Awareness

In places where HIV-positive status remains a stigma, successful outreach efforts must address people's privacy and confidentiality concerns. The HIV Confidant project aims to encourage HIV/AIDS testing by ensuring secure distribution of test results through the use of handheld computers and standard encryption techniques. Dimagi, a US-based software company, implemented the HIV Confidant project in 2003 at the Africa Centre for Health and Population Studies in South Africa. In the pilot, 45,000 adults were tested for HIV, and results were shared with participants through a secure PDA-based system. People who were tested were provided with a unique ID code, and results were given only to those who provided the code. The HIV Confidant system runs on Palm m500 and Handspring Visor PDAs, but can be adapted for non-Palm devices for greater flexibility and extended reach.

Reference sources:
http://www.dimagi.com/content/hiv-confidant.html
http://www.technologyreview.com/computing/13776/?a=f

Credit: UN Tim McKulka

Credit: Vital Wave Consulting

Project 5: Project Masiluleke

Country: South Africa

Sponsoring Organization and Partners: Praekelt Foundation, iTeach, National Geographic, Nokia Siemens Networks, MTN, Ghetto Ruff, Children of South African Legacies, Aricent and frog design

Application Area: Education and Awareness

See case study on page 22.

Reference sources:
http://newsvote.bbc.co.uk/2/hi/technology/7688268.stm
http://www.poptech.org/project_m/
http://opensourcepbx.tmcnet.com/news/2008/10/24/3730564.htm
http://www.frogdesign.com/press-release/poptech-unveils-project-masiluleke.html

Project 6: Text to Change (TTC) – HIV Prevention Through SMS Quiz

Country: Uganda

Sponsoring Organization and Partners: Text to Change (TTC), Zain (previously Celtel), the local NGO AIDS Information Centre (AIC), the Dutch Ministry of Foreign Affairs and Merck

Application Area: Education and Awareness

See case study on page 25.

Reference sources:
http://www.texttochange.com
Interviews with the Text To Change team

Remote Data Collection

Project 7: Cell-PREVEN

Country: Peru

Sponsoring Organization and Partners: Universidad Peruana Cayetano Heredia (Peru), Imperial College (London), University of Washington (Seattle) and Peru's Ministry of Health

Application Area: Remote Data Collection

When it comes to effective data collection in remote areas of the developing world, less is often more. Cell-PREVEN was created to allow access to real-time data to members of the healthcare ecosystem in Peru. This interactive voice response system enables health workers in the field to collect and transmit data via basic mobile phones. The data is aggregated in a centralized database and made available to medical professionals, and the system is designed to send SMS or e-mail alerts if certain symptoms are recorded. During a three-month pilot test, 797 reports were collected and 374 adverse events were recorded—30 severe enough to trigger an SMS alert to a team leader. The pilot researchers believe that Cell-PREVEN demonstrates that "cell phones are a feasible means of collecting and reporting data in real-time in remote communities...it's not necessary to have the latest Palm Pilot or Tablet PC to create a sophisticated public health surveillance system."

Reference sources:
http://www.prevenperu.org/preven/
http://www.prevenperu.org/preven/presentation_curioso.pdf
http://faculty.washington.edu/wcurioso/cellpreven.pdf

Project 8: Community Accessible and Sustainable Health System (Ca:sh)

Country: India

Sponsoring Organization and Partners: Media Lab Asia (part of the Ministry of ICT India), Dimagi, Inc. (privately-held software company) and All India Institute of Medical Sciences

Application Area: Remote Data Collection

Large, rural areas in developing countries often lack comprehensive collection of health and population data. In Ballabhgarh, India, Media Lab Asia community health workers used an open source software application on PDAs called Ca:sh—the Community Accessible and Sustainable Health system—to collect medical and demographic data. The pilot aimed to improve maternal and child health, and used Compaq iPAQs, which could run a MySQL database capable of storing up to 7,000 records. An evaluation of the five-month pilot "indicated high acceptance of the technology and reduction in total time for entry of data...the [health workers] were satisfied with the user interface and were able to depend entirely on the handheld, replacing their existing paper-based records." Media Lab Asia now is exploring future applications, such as mobile surveys and disease-case management, and has ported the software to less expensive Palm OS-based devices.

Reference sources:
http://www.dimagi.com/content/cash.html
http://www.medialabasia.in/healthcare.html
http://kaash.sourceforge.net/doc/dyd02.pdf

Project 9: Community Health Information Tracking System (CHITS)

Country: Philippines

Sponsoring Organization and Partners: United Nations Development Program (UNDP) and Asia-Pacific Development Program (APDP)

Application Area: Remote Data Collection

Patient education is not the only challenge to improving health in the developing world—often health workers are not equipped with the information they need to best serve patients. The Community Health Information Tracking System, or CHITS, is an open source program that helps to 'train the trainers' by facilitating data collection and transmission in rural areas. The system allows community health workers to send SMS messages to report injuries and receive training on health surveillance via their mobile phones. The CHITS open source community believes they should teach local health workers "how to use the information system, [and] allow them to gain insight into their condition...so that they can decide to take action and be proactive in empowering others to do the same." Like many mHealth projects, CHITS had found that empowering local communities with information and enabling two-way data flows is an effective strategy.

Reference sources:
http://www.stockholmchallenge.se/datacommunity_health_informat
http://www.apdip.net/resources/case/rnd48/view
http://www.chits.ph/wiki/indexphp?title=WhatisCHITS
http://chits.ph/wiki/index.php?title=CHITS_Manifesto

Credit: UN UNHCR

Credit: Vital Wave Consulting

Project 10: The Dokoza System

Country: South Africa

Sponsoring Organization and Partners: Dokoza, State Information Technology Agency (SITA), Centre for Public Service Innovation (CPSI), Centre for Scientific and Industrial Research (CSIR) and the Meraka Institute, with the cooperation of South Africa's National Department of Health

Application Area: Remote Data Collection

Integrating mobile data collection solutions with existing health information systems is essential to advancing patient care. The Dokoza system in South Africa seeks to meet this need. It is an SMS-based mobile system designed to fast-track and improve critical services to HIV/AIDS and TB patients. Dokoza relies on SIM cards that can be used across networks, which interact with a more complex back-end system that integrates with existing hospital information systems. The integration with existing infrastructure offers the possibility of dramatic improvements to existing patient health information records, and in the 2004 pilot, both doctors and patients found the system to be user-friendly. Challenges encountered during the pilot include the duplication of data entry in instances where paper-based systems already existed, and staff shortages that hampered information collection. Despite the promise of this technology, little new data exists on its impact since the end of the pilot.

Reference sources:
http://www.changemakers.net/node/1014
http://www.dokoza.co.za/content/patent.asp
http://www.ehealth-connection.org/files/conf-materials/mHealth_%20A%20Developing%20Country%20Perspective_0.pdf

Project 11: EpiHandy

Country: Uganda, Zambia, Burkina Faso

Sponsoring Organization and Partners: Center for International Health, Norway

Application Area: Remote Data Collection

Health data collection in the developing world is often hampered by the high costs and inefficiencies of traditional large-scale paper-based surveys. The EpiHandy tool, a mobile health data collection and record access program enabled by PDAs, helps to mitigate these issues. EpiHandy has been deployed in many countries and by many different organizations since its first release in 2003, and has been used in multi-year studies in Uganda, Zambia, and Burkina Faso. In the Uganda study, mobile phones were deployed to participating clinics and Ministry of Health experts trained the local staff on using the open source JavaRosa software to fill and submit medical forms. The data from the forms was transmitted across the standard services available on the local mobile network. EpiHandy has yielded positive results during a five-year assessment in which 14 interviewers collected information on breastfeeding habits and child anthropometry in rural areas of eastern Uganda. Outcomes include greatly reduced data entry errors and broad user acceptance, as well as cost effectiveness relative to traditional paper-based surveys, increasing the potential for this already successful solution to scale further.

Reference sources:
http://www.epihandy.com/
http://www.cih.uib.no/

Credit: UN Marco Dormino

Project 12: EpiSurveyor

Country: Kenya, Uganda, Zambia (and 20 countries in sub-Saharan Africa by end of 2008)

Sponsoring Organization and Partners: The United Nations Foundation and Vodafone Foundation Technology Partnership, the World Health Organization and DataDyne

Application Area: Remote Data Collection

A lack of health data is among the greatest obstacles facing health decision makers. One of the largest and most heralded mHealth projects, EpiSurveyor, developed by non-profit software provider DataDyne, enables public health and development professionals to create, share, and deploy health surveys and other forms on mobile devices. The program runs on free and open software, is easy to use, and can be downloaded to handheld devices to be used by workers in the field. Successful pilot programs in two countries resulted in more timely and accessible healthcare data, making it easier to strengthen district level healthcare programs like immunizations and responses to disease outbreaks. An added benefit is that country health workers become fully self-sufficient in programming, designing, and deploying health surveys, eliminating the need to contract outside consultants. Building upon the success of the initial programs, in fall 2008 the partners announced that with the financial backing of the United Nations Foundation and Vodafone Foundation, and the scaling and expertise of the WHO and participating ministries of health, the EpiSurveyor-based mHealth program would be rolled out in a further 20 countries in sub-Saharan Africa.

Reference sources:
http://www.datadyne.org/?q=episurveyor/home
http://siteresources.worldbank.org/DEVMARKETPLACE/Resources/205097-1099409088482/
Brief-DataDyneEpiSurveyor.pdf
http://www.unfoundation.org/global-issues/technology/mobile-health-for-development.html

Project 13: Integrated Healthcare Information Service Through Mobile Telephony (IHISM)

Country: Botswana

Sponsoring Organization and Partners: Microsoft Research Digital Inclusion Program and the University of Botswana

Application Area: Remote Data Collection

In those developing countries boasting near-saturation of mobile phones, the potential benefits of mHealth strategies are the greatest. Microsoft and the University of Botswana are taking advantage of mobile telephony's broad reach in the country to develop an Integrated Healthcare Information Service (IHISM). The system serves both health workers and the general public. It uses a mobile phone-based software application to allow health workers to capture, store, process, transmit, and access patient records. This results in lower costs and greater efficiency by eliminating redundancy and reducing the amount of time devoted to data input. The public can also turn to IHISM for information: individuals pose frequently asked questions about HIV/AIDS via SMS messages and receive a reply straight to their mobile phones. The project partners have identified several challenges, including localization and customization for illiterate users, but overall feel that the system has the potential to become a valuable tool and take on increased scope.

Reference sources:
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http://research.microsoft.com/enus/um/redmond/events/fs2006/presentations/40_Nyongesa_071806.ppt

Project 14: Media Lab Asia – Shared Resource for Rural Health Management and Information Infrastructure

Country: India

Sponsoring Organization and Partners: Media Lab Asia (part of the Ministry of ICT, India)

Application Area: Remote Data Collection

The immense size of India, coupled with the fact that approximately 70% of its one billion citizens live in rural areas, makes affordable and flexible health data collection techniques a necessity. India's Media Lab Asia is working on a project—Shared Resource for Rural Health Management and Information Infrastructure—to improve health data collection and analysis to better serve the needs of its citizens. The mHealth component of this project is focused on data collection. Health workers will use handheld devices to collect a wide array of data in the field—medical history, demographics, immunizations, and instances of disease. This data will be transmitted from the devices to the health information system database, where it can be accessed on a real-time basis. The solution will be implemented initially in the Mallapuram District of Kerala in India. No exact dates for project implementation have been published.

Reference source:
http://www.medialabasia.in/healthcare.html

Project 15: Mobile-Based Primary Healthcare Management System

Country: India

Sponsoring Organization and Partners: Center for Development of Advanced Computing (CDAC)

Application Area: Remote Data Collection

Primary Health Centers are critical in rural India as they provide direct patient care and link patients to the national health system via referrals. The Center for Development of Advanced Computing (CDAC) is developing a 'Mobile-Based Primary Healthcare Management System' to strengthen primary health centers in both rural areas and urban slums in India. The CDAC was created in 1988 and is a research and development society overseen by India's Department of Information and Ministry of Communications and Information Technology. A key component of the Mobile-Based Primary Healthcare Management System will be an SMS-based interface, which will allow patients to transmit information to or receive information from a central database via a basic mobile phone. Medical staff and health officials will be able to access this database from more sophisticated, web-enabled mobile phones. The project is in the development stage, but is expected to have a broad geographic scope.

Reference sources:
http://www.w3.org/2008/02/MS4D_WS/papers/cdac-mobile-healthcare-paper.pdf
http://www.cdacbangalore.in

Credit: DataDyne

Project 16: Map of Medicine for Kijabe Hospital

Country: Kenya

Sponsoring Organization and Partners: UK National Health Service (NHS), Cisco's Internet Business Solutions Group (IBSG)

Application Area: Remote Data Collection

Doctors in rural areas are often forced to treat individual patients with little or no information about resources in neighboring areas, impeding them from providing optimum care. A joint project was launched in Kenya in 2006 to address this problem. The project gives Kenyan health workers at Kijabe Hospital access to the Map of Medicine, a medical information database. The Map of Medicine is a web-based tool that provides comprehensive, up-to-date information on diagnosis and treatment, presented in easy-to-use flowcharts or 'care pathways.' Doctors participating in the pilot study were given PDAs and access to data on HIV/AIDS, TB, malaria, abdominal pain, diarrhea, and typhoid fever. Results were promising: hospital staff reported that the data access and entry via the PDAs has led to greater efficiency, more time with patients, and reduced administrative costs.

Reference sources:
http://www.cisco.com/web/about/ac79/docs/wp/Kijabe_Hospital_CS_1009a.pdf
http://www.medic-to-medic.com/

Project 17: Nokia Data Gathering

Country: Brazil

Sponsoring Organization and Partners: Nokia, Amazonas State Health Ministry

Application Area: Remote Data Collection

Please see case study write up on page 28.

Reference source:
http://www.nokia.com/nokiadatagathering

Project 18: PDAs for Malaria Monitoring

Country: Mozambique

Sponsoring Organization and Partners: AED-SATELLIFE

Application Area: Remote Data Collection

Malaria is the prime cause of morbidity and mortality in much of sub-Saharan Africa. Prevention and treatment of the disease are essential to reducing its effects on the population, and the rapid capture of accurate information is a key part of these efforts. The PDAs for Malaria Monitoring project, based in Mozambique, deploys PDAs and GPS devices to increase the ability of health workers implementing malaria programs to make informed decisions. The workers use the devices to collect data and transmit it via the GPRS network to a central database. A technical team then maps the geographic data to public health and resource information. Despite some technical challenges, the results of the project have been positive. Users are able to use the PDAs without difficulty, new data tools and training programs have been created, and information gathered has helped the Health Ministry to influence and shift the allocation of resources.

Reference sources:
http://www.crdi.ca/iicr/ev-118198-201_102534-1-IDRC_ADM_INFO.html
http://www.idrc.ca/uploads/user-S/12053478761102534_Final_technical_Report--_PDAs_for_Malaria_Monitoring.pdf

Credit: Vital Wave Consulting

Credit: UN Martine Perret

Project 19: Phones for Health

Country: Rwanda

Sponsoring Organization and Partners: The GSMA Development Fund, the U.S. President's Emergency Plan for AIDS Relief (PEPFAR), Accenture Development Partnerships, Motorola, MTN and Voxiva

Application Area: Remote Data Collection

Most mHealth programs strive to leverage the growth and penetration of mobile phones in developing countries to strengthen health systems and improve health outcomes. Phones for Health, a large public-private partnership, is pursuing this goal using a system developed and deployed by Voxiva at health ministries in Peru, India, and Rwanda. The program enables health workers in local communities to use a standard handset equipped with a downloadable application to collect and enter health data. Once the data is entered and transmitted, it can be integrated into health information systems and accessed by health officials in real time at all levels using the Internet. The system also allows workers to order medicines, send public health alerts, and download treatment guidelines. The Rwanda pilot follows the successful deployment of a related system—TRACnet—that manages the country's HIV/AIDS program. Rollouts are planned for other areas of the health sector in Rwanda and other African countries.

Reference source:
http://gsmworld.com/documents/gsma_case_study_mhealth.pdf

Project 20: TRACnet

Country: Rwanda

Sponsoring Organization and Partners: TRAC (Treatment and Research AIDS Center)—an institution of the Ministry of Health of Rwanda, Voxiva and the US Center for Disease Control and Prevention (CDC)

Application Area: Remote Data Collection

TRACnet is a comprehensive data entry, storage, access, and sharing system created in Rwanda in 2005 by the Treatment and Research AIDS Center (TRAC), part of the Rwandan Ministry of Health. The system is used to manage critical information on HIV/AIDS patients and monitor anti-retroviral treatment (ART) programs nationwide. Medical personnel can use TRACnet to monitor drug distribution, create and submit reports electronically, and access the most up-to-date information on HIV/AIDS care and treatment. TRACnet was designed for use with all types of technology and information systems, but today, 90% of the system's users access it via mobile phones, rather than more expensive and less reliable computers and Internet connections. Results of the gradual deployment and development of TRACnet have been promising. By the end of 2005, 21 medical centers had switched from inefficient paper-based systems to TRACnet's electronic records system. By 2007, TRACnet covered all 168 health facilities that provide ART treatment, and there were plans to extend the system to 400 more health facilities. Rwanda's Ministry of Health also hopes to expand the system to cover other chronic illnesses.

Reference sources:
http://www.un.org/esa/sustdev/publications/africa_casestudies/tracnet.pdf
http://www.tracrwanda.org.rw/index1.htm
http://www.voxiva.com/casestudies.php?caseid=22
Excerpts from "Local Case Studies from Africa" prepared by the Department of Economic and Social Affairs, Division for Sustainable Development, United Nations

Remote Monitoring

Project 21: The Cell-Life Project

Country: South Africa

Sponsoring Organization and Partners: The University of Cape Town, the Cape Peninsula University of Technology and Cell-Life

Application Area: Remote Monitoring

Providing home-based care for HIV/AIDS is critical in the African context, where the stigma attached to the disease often discourages patients from visiting health facilities. Cell-Life, a social enterprise based in South Africa, is developing innovative approaches to home care with their 'Aftercare' program. In this program, Aftercare health workers monitor patients whom they visit at home. Workers use data-enabled mobile phones to record information about the patients' medical status, medication adherence, and other relevant factors. The data are then transmitted via SMS to the central Cell-Life database, where care managers use a web-based system to access and monitor incoming patient information. Initial program results were encouraging, but significant challenges remain. Although South Africa's mobile penetration rate is high, the system is currently used on only one network using prepaid accounts, and the software is not yet available in any of South Africa's national languages other than English. Cell-Life is currently working to address these issues so the program can be adopted on a national scale.

Reference sources:
  http://update.cell-life.org/accolades/Commonwealth%20Health%20Ministers%20Handbook%20-%20June%202006.pdf
  http://www.wired.com/medtech/health/news/2004/11/65585
  http://mobileactive.org/files/MobilizingSocialChange_full.pdf

Credit: Mobiles in Malawi/Josh Nesbit

Credit: WFP Paulette Jones

Project 22: Chinese Aged Diabetic Assistant (CADA)

Country: China

Sponsoring Organization and Partners: Microsoft Research, researchers from St Louis University, Old Dominion University, Beijing Medical University and Peking University First Hospital

Application Area: Remote Monitoring

Economic development and the resultant lifestyle changes are contributing to rapidly rising diabetes rates in fast-growing nations such as China. To counter this trend, Microsoft Research and a group of researchers from several universities and Chinese medical centers are developing a smartphone-based self-manage-ment and support system for elderly diabetics in China. The project will use smartphones to send elderly diabetics recommendations and guidelines related to physical activity, glucose and blood pressure monitor-ing, weight measurement, and diet. Patients will be trained to enter and send data on glucose levels, and doctors will be able to track patient data and graphically display data for patients. The system designers will use a user-centered design approach to develop software that reflects the preferences and capabilities of the targeted population to achieve maximum usability. The project's software will be available free of charge and will work on PDAs and smartphones that run the Windows Mobile operating system.

Reference sources:
http://www.cadaproject.com/
http://www.cadaproject.com/data/poster.pdf
http://research.microsoft.com/enus/um/redmond/about/collaboration/awards/cellphone-healthcare_awards.aspx#ECE
http://www.cadaproject.com/data/Smart_Phones_for_Older_Chinese_with_Diabetes.pdf

Project 23: Colecta-PALM

Country: Peru

Sponsoring Organization and Partners: The University of Washington, the Peruvian University of Cayetano Heredia and two Peruvian health clinics (Via Libre and Impacta)

Application Area: Education and Awareness, Remote Monitoring

Patient-based mHealth strategies must have patient buy-in to succeed. Colecta-PALM, an open source, secure web-based application that delivers Spanish-language surveys via audio on PDAs, was designed to ensure patient buy-in. A pilot test of this technology was conducted with HIV/AIDS patients in Peru. The pa-tients used PDAs to enter and submit information regarding their ART adherence and behaviors that could potentially lead to additional HIV transmission. Patients' medicine compliance and behaviors were assessed and different types of feedback were provided depending on the user's risk profile. Of the 31 patients tested, 27 (74%) reported openness to using PDAs for HIV treatment support. The researchers in this study believe that these results "suggest that PDAs may be a culturally appropriate way to support ART adher-ence and safer sex for PLWHA [people living with HIV/AIDS]. Use of tools such as PDAs among PLWHA in some resource-constrained settings may be acceptable and can build on existing use patterns."

Reference sources:
http://colectapalm.org/
http://faculty.washington.edu/wcurioso/emulator/e/Poster_Colecta_Palm_07.pdf
http://faculty.washington.edu/wcurioso/kurth_amia_2007.pdf

Credit: DataDyne

Project 24: Mashavu: Networked Health Solutions for the Developing World

Country: Tanzania

Sponsoring Organization and Partners: Pennsylvania State University and Ideablob.com

Application Area: Remote Monitoring

Lack of sustained, regular care for children is often responsible for the spread of preventable diseases in the developing world. The 'Mashavu: Networked Health Solutions for the Developing World' project was initiated by students at Pennsylvania State University to tackle this challenge through mobile solutions. Mashavu (which means 'chubby-cheeked' in Swahili) is a computer-based system that enables doctors to connect with children in developing countries via mobile phones. Essential medical data (e.g., height, weight, blood pressure, and lung capacity) are collected at Mashavu stations in developing communities and sent by mobile phone to a remote server. Medical professionals can then 'electronically adopt' children by logging on to a web portal to monitor the children's health, provide feedback or advice to the child's caregivers, and collect health statistics. The student team from Pennsylvania State University is working with the Mount Meru Peak School and Good Hope orphanage in northern Tanzania to pilot test the system.

Reference sources:
    http://live.psu.edu/story/29485
    http://www.ideablob.com/ideas/1528-Mashavu-Networked-Health-Solu

Project 25: MediNet Healthcare Management System

Country: Trinidad and Tobago

Sponsoring Organization and Partners: Microsoft Research and University of the West Indies

Application Area: Remote Monitoring

The Caribbean is a region with very poor healthcare facilities, but a comparatively strong cellular phone infrastructure. Microsoft Research has provided a grant to professors at the University of the West Indies to create a mobile phone-based healthcare management system, to be deployed first in Trinidad and Tobago, followed by a broader regional rollout. The long-term goal is to build a network that integrates medical re- sources and promotes the sharing of medical information and expertise. The healthcare management sys- tem, 'MediNet,' will target diabetes and cardiovascular disease. The system is designed to relay information from patient monitoring devices to a central server via a cellular network. At the server, a data reasoning engine extracts all relevant information and alerts medical officers about severe cases. It also recommends appropriate responses such as a follow-up visit or phone call. The system can also send suggestions di- rectly to patients via SMS message or pre-recorded voicemail.

Reference source:
    http://research.microsoft.com/enus/um/redmond/about/collaboration/awards/cellphone-healthcare_
    awards.aspx#EAD

Project 26: Mobile Care, Support and Treatment Manager (MCST)

Country: India

Sponsoring Organization and Partners: ZMQ Software Systems

Application Area: Remote Monitoring

Keeping HIV/AIDS patients informed of their health status is one of the most basic ways of empowering them. With that in mind, the Mobile Care, Support and Treatment Manager (MCST) is being created by ZMQ Software Systems as an attempt to use technology to improve the logistical challenges of HIV/AIDS management in developing countries. The solution is conceived as a global model, but ZMQ admits that localization and adaptation to rural, urban, and peri-urban contexts will be a challenge. MCST will enable HIV/AIDS patients to use their mobile phones to access their lab tests and medical history reports. They can also use the system for nutritional planning, create alerts to remind them to take their medication, and connect with a help line. In addition, the solution can be used in 'Group Management' mode for organizations that work with HIV/AIDS patients. ZMQ is currently seeking partners for this project.

Reference sources:
    http://www.freedomhivaids.in/mCST.htm
    http://www.zmqsoft.com/

Project 27: Mobile Phones for Health Monitoring

Country: India and the United Kingdom

Sponsoring Organization and Partners: The UK – India Education and Research Initiative (UKIERI), Loughborough University, Indian Institute of Technology, All India Institute of Medical Sciences, Aligarh Muslim University and London's Kingston University

Application Area: Remote Monitoring

Long considered a 'rich country disease,' diabetes is spreading rapidly in the developing world as affluence changes traditional dietary habits. In 2005, engineers at Loughborough University developed a mobile phone health monitoring system to monitor diabetes and other diseases. The system allows doctors to use mobile phone networks to monitor up to four key medical signals (electrocardiogram heart signal, blood pressure, levels of blood glucose, and oxygen saturation levels) from patients who are on the move. Engineers from the UK and India are working to 'miniaturize the system' so that sensors are small enough to be carried by patients while procuring the necessary biomedical data. In Britain, the solution will be used to improve healthcare delivery, while in India it will connect 'centers of excellence' to hospitals and clinics in more remote areas. Over the next three years, clinical trials will occur in both the United Kingdom and India.

Reference sources:
    http://www.lboro.ac.uk/service/publicity/newsreleases/2007/09_health_monitor.html
    http://www.ukieri.org/docs/ukieri-awards-details-2007.doc

Project 28: Phoned Pill Reminders for TB Treatment

Country: Thailand

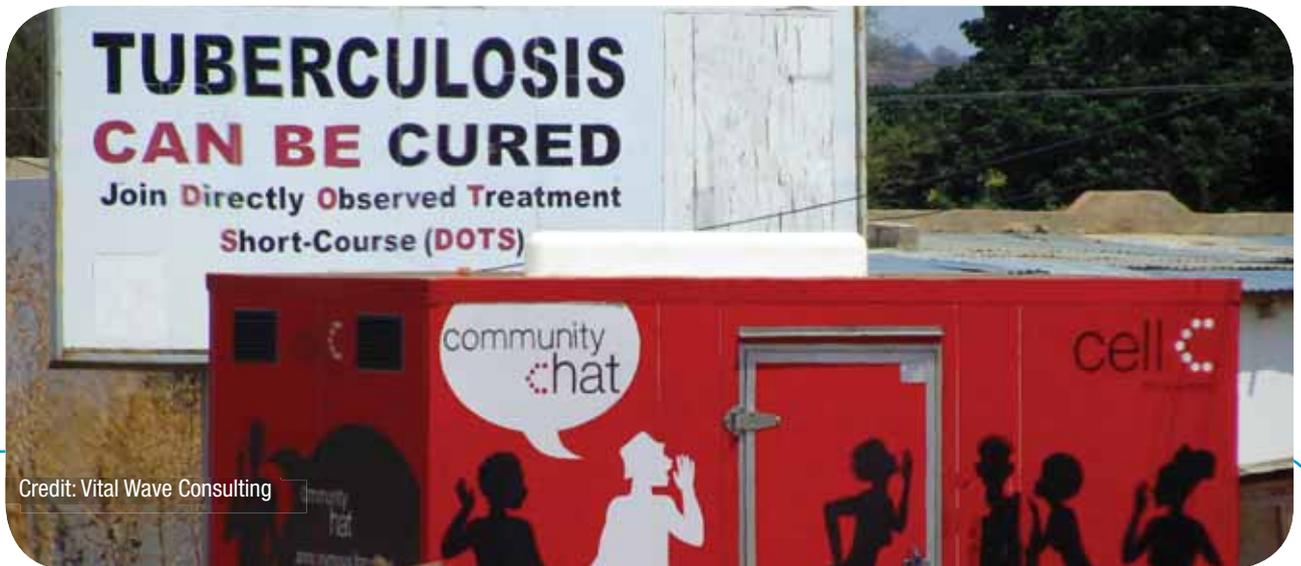**Sponsoring Organization and Partners:** The Chiang Mai Public Health Department

Application Area: Remote Monitoring

The province of Chiang Mai in northern Thailand has a high number of patients with TB—a major cause of death in much of the developing world. A prime reason for high TB mortality rates is the failure of patients to take their medications on a regular basis. To combat this trend, the Chiang Mai Public Health Department piloted a program involving 60 TB patients who were provided with mobile phones that could only receive incoming calls. Patients then received daily reminder calls to take their medication. Dr. Surasing Visrutarana, Chief Provincial Health Officer, noted that during a three-month pilot in 2007 the drug-taking consistency rate for the patients was over 90%, a significantly higher rate of successful treatment than that observed in the province's standard TB treatment program. The project was not only effective but inexpensive, with a cost of just 100 baht ($3) per person.

Reference sources:
    http://listmanager.bps-lmit.com/read/messages?id=49295
    http://nationmultimedia.com/2007/01/28/national/national_30025286.php

Credit: Vital Wave Consulting

Project 29: SIMpill Solution for TB

Country: South Africa

Sponsoring Organization and Partners: SIMpill and Tellumat

Application Area: Remote Monitoring

Reminders to take daily medication are an effective means to ensure drug regime adherence, which is critical for diseases like TB, where 99% of those infected can be cured with proper medication compliance. The SIMpill solution is designed to help ensure compliance. SIMpill works by equipping a pill bottle with a SIM card and transmitter. When the pill bottle is opened, an SMS message is sent to a designated healthcare worker. If the pill bottle is not opened when expected, the patient gets a text message reminder to take the medication. If the patient then fails to comply, the health worker is prompted to call or visit to encourage the taking of medication. A 2007 pilot in South Africa to test the system's efficacy yielded impressive results. The pilot showed that with SIMpill, 90% of patients complied with their medication regime, compared to the typical 22 to 60% compliance rate without the system. The solution is now available worldwide.

Reference sources:
    Paton, C. Thinking in the box. Financial Mail. 19 September 2008. Retrieved via Factiva.
    http://www.SIMpill.co.uk
    http://free.financialmail.co.za/innovations/07/0302/minn.htm
    http://www.itweb.co.za/sections/computing/2005/0501241215.asp?S=IT%20in%20Healthcare&A=ITH&O=TE

Project 30: Virtual Health Pet

Country: Brazil

Sponsoring Organization and Partners: VIDATIS and the Atech Foundation

Application Area: Remote Monitoring

Virtual Health Pet has taken advantage of the popularity of the Japanese Tamagotchi virtual pets to improve medication compliance and patient health in Brazil. The virtual health pet, a J2ME software application running on the patient's mobile phone and linked to an electronic health records system, interacts with the patient to remind them to take their medications on time and to monitor their overall health. Alerts are sent out to caregivers or emergency services if the patient does not respond to its pet's messages in a timely manner. Because the software is linked to an electronic health records system, the Virtual Health Pet is able to both collect patient data and to provide the patient with near real-time information from their medical team. The Virtual Health Pet won a Special Jury Award at Simagine 2006, but it is uncertain whether the application is currently being deployed in the field.

Reference sources:
    http://developers.sun.com/champions/nardon.html
    http://www.tridedalo.com.br/fabiane/index.htm

Communication and Training for Healthcare Workers

Project 31: Enhancing Nurses Access for Care Quality and Knowledge through Technology (ENACQKT)

Country: The Caribbean

Sponsoring Organization and Partners: The International Development Research Centre (IDRC) and the University of Saskatchewan

Application Area: Communication and Training for Health Care Workers

In order for health workers to provide effective patient care, access to timely information is essential. In the Caribbean, nurses often lack basic resources, work remotely, and are isolated, which makes data sharing challenging. Enhancing Nurses Access for Care Quality and Knowledge through Technology (ENACQKT) empowers nurses by providing training and other services via PDAs. A key component of ENACQKT is building nurses' capacity through technology instruction, giving them the means to access healthcare applications through the PDAs provided by the program. This enhances professional development and improves quality of care for patients. Project principals report several achievements, including time savings for nurses and greater access to information, particularly in the areas of medication and treatment support. The project also reports success in imparting a sense of empowerment to the nurses in terms of speaking to physicians about conditions, treatments, and diagnosis.

Reference source:
Interview with Pammla Petrucka, Associate Professor with the College of Nursing, University of Saskatchewan

### Project 32: HealthLine

Country: Pakistan

Sponsoring Organization and Partners: Microsoft Research, Carnegie Melon University (CMU), Aga Khan University (Karachi) and Health and Nutrition Development Society (HANDS)—a Pakistani NGO

Application Area: Communication and Training for Health Care Workers

One of the chief obstacles to mHealth solutions is literacy, or the lack thereof. To ensure that semi-literate community health workers have access to critical information, Microsoft and others are developing HealthLine, a speech recognition-based information system. The solution is based on Microsoft Speech Server2007 beta software. The menu-driven program can be accessed via landlines or mobile phones. Callers specify a topic (or disease) and are walked through a set of menus until they reach the information they are seeking. The information is then read to them—from a prerecorded message—in their local language. HealthLine was tested among a group of low-literate maternal and child health community health workers in Pakistan in mid-2007. It will continue to be tested in the field with the results informing new features, functionality, and enhancements. Ideally, the solution will be scaled across Pakistan for maximum impact.

Credit: Vital Wave Consulting

Reference sources:
http://www.cs.cmu.edu/~healthline/flash/detail/
http://research.microsoft.com/enus/um/redmond/about/collaboration/awards/digitalinclusion_awards.aspx#Speech_Interfaces_for_Health_Information-Access
http://research.microsoft.com/enus/collaboration/papers/carnegie_mellon.pdf

Credit: DataDyne
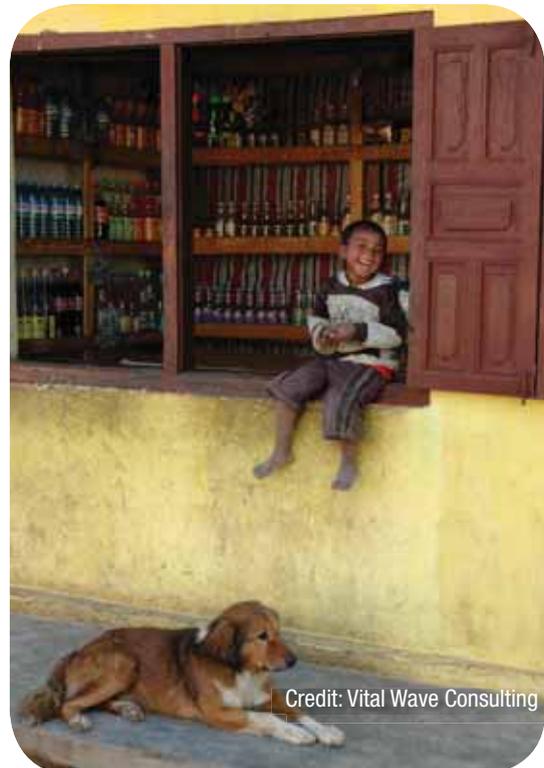
Project 33: Mobile HIV/AIDS Support

Country: Uganda

Sponsoring Organization and Partners: Trinity College Dublin

Application Area: Communication and Training for Health Care Workers

'Training the trainers'—providing healthcare workers in the field with accessible and reliable medical information—is essential for improved health delivery in the developing world. Trinity College Dublin (TCD) is collaborating with the medical school at Makerere Hospital in Kampala, Uganda to explore the potential advantages of using PDAs in HIV/AIDS care and treatment. The project aims to provide high-quality medical information and advice to healthcare workers in Uganda and throughout sub-Saharan Africa. After an initial needs assessment, the project leaders—a group of academic clinicians from TCD, the Dublin Institute of Technology, and North American universities—developed a prototype of a training program on the clinical care, research, and prevention of HIV/AIDS. The program was to be evaluated by a select group of healthcare workers in the field. Results of the testing and evaluation have not yet been published.

Reference source:
http://www.universitiesireland.ie/pubs/report0306.pdf

Project 34: Primary Healthcare Nursing Promotion Program

Country: Guatemala

Sponsoring Organization and Partners: The National School for Nurses of Coban (Guatemala), Canadian Agency for International Development and the Centre for Nursing Studies (Newfoundland, Canada)

Application Area: Communication and Training for Health Care Workers

Nursing shortages, especially in rural areas, are common in developing countries (and increasingly in developed ones as well). The National School for Nurses of Coban in Guatemala created the Primary Healthcare Nursing Promotion Program to increase the number of nursing personnel available to work in rural areas. One component of this program is a virtual nursing course, which is taught via a combination of telephone and two-way data communications. Of the first virtual nursing course graduates in 2004, a subset became 'community tele-facilitators.' These tele-facilitators were each given a mobile (or satellite) phone, which they used to link their rural communities with health specialists in urban areas. The pilot test was launched in 2005 in five municipalities in northern Guatemala and covered 150 communities with a total population of 45,000. At this time, there appears to be continued progress on the virtual nursing training component, but it is not certain whether the tele-facilitator program continued after the initial pilot test.

Reference sources:
http://www.mspas.gob.gt/
http://www.enecav.edu.gt/

Project 35: The Uganda Health Information Network (UHIN)

Country: Uganda

Sponsoring Organization and Partners: Uganda Chartered HealthNet (UCH), AED-SATELLIFE, Makerere University Medical School, Connectivity Africa and the International Development Research Center (IDRC) of Canada

Application Area: Communication and Training for Health Care Workers

Uganda has become a laboratory for efforts to improve two-way data flows between health workers and government officials, and the Uganda Health Information Network (UHIN) is a prime example of these efforts. UHIN uses PDAs to collect data and to provide continuing medical education services to physicians. The PDAs send and receive messages via infrared beams that send the signals to battery-operated access points. The program was launched in 2003 and currently 350 PDAs are being used. They are connected to 20 access points in different districts of Uganda. Positive impacts were recorded early on: "The network delivered a 25% savings in the first 6 months...health workers using the handheld technology now have better job satisfaction and [it] is contributing to staff retention..." The UHIN is planning an analysis to determine if the project has had an impact on health outcomes such as healthcare planning, resource allocation, and delivery.

Reference sources:
    http://unpan1.un.org/intradoc/groups/public/documents/UN/UNPAN030003.pdf
    http://pda.healthnet.org/
    http://mobileactive.org/files/MobilizingSocialChange_full.pdf

Credit: DataDyne

Credit: DataDyne

Disease and Epidemic Outbreak Tracking

Project 36: The Acute Encephalitis Syndrome Surveillance Information System (AESSIMS)

Country: India

Sponsoring Organization and Partners: Voxiva, Program for Appropriate Technology in Health (PATH) and the Government of Andhra Pradesh

Application Area: Disease and Epidemic Outbreak Tracking

Every year, more than two million children die from preventable diseases in the developing world, and millions more are left impaired. One such culprit, Japanese Encephalitis, a devastating mosquito-borne illness, can be prevented by a vaccination, but it is not always administered due to its high cost and a lack of data on the disease's true prevalence and impact. To begin to tackle this problem, the Government of Andhra Pradesh, where the disease is endemic, pilot tested an Acute Encephalitis Syndrome Surveillance Information Management System (AESSIMS) in one of its districts. Local health workers used mobile phones (or web-based technologies) to report incidences of the disease to the AESSIMS system. Decision makers could access and analyze this data in real time via a variety of tools, including GIS-based maps. It was envisioned that if the pilot test were a success, the AESSIMS system could be rolled out across India and into other Asian countries. There is no evidence yet, however, that this project was either scaled up or extended.

Reference sources:
    http://unpan1.un.org/intradoc/groups/public/documents/UN/UNPAN030003.pdf
    http://www.voxiva.com/casestudies.php?caseid=21

Project 37: Alerta DISAMAR

Country: Peru

Sponsoring Organization and Partners: The US Navy, the Peruvian Navy and Voxiva

Application Area: Disease and Epidemic Outbreak Tracking

When disease outbreaks occur, timely transfer of information is of the essence. Alerta DISAMAR is a disease surveillance system, based on Voxiva technology, deployed by the Peruvian Navy with support from the US Navy. The system's strength lies in its 'multi-platform flexibility,' which allows users to transmit or access data through multiple technologies, including mobile phones and the Internet. Alerts of disease outbreaks are also sent via multiple mechanisms (text messages, voice mail, and e-mail). An evaluation of the project conducted in 2003 found that within the first year of deployment, Alerta DISAMAR "rapidly improved disease reporting, allowed officials to obtain quality data in real time, and, most importantly, facilitated improved response to disease outbreaks in a remote region." Since its launch, the system has reported more than 80,500 health events over a wide range of medical problems, including diphtheria, yellow fever, snake bites, diarrhea, and acute respiratory infections.

Reference sources:
http://www.thepresidency.gov.za/learning/cell_tech4.pdf
http://www.govhealthit.com/online/news/94946-1.html
http://revision.dev.voxiva.net/news/121603.asp

Project 38: FrontlineSMS

Country: Worldwide

Sponsoring Organization and Partners: kiwanja.net, the MacArthur Foundation and the Open Society Institute

Application Area: Education and Awareness, Remote Data Collection, and Disease and Epidemic Outbreak Tracking

One of the largest and most ambitious mHealth programs in the world is FrontlineSMS. FrontlineSMS is a PC-based software application used for sending and receiving group SMS messages. It allows NGOs to run awareness-raising campaigns and competitions, and carry out text-based surveys, or to simply keep in touch with fieldworkers and supporters. FrontlineSMS gives access to 'bulk' SMS technology designed specifically with the NGO sector in mind. Although other bulk SMS systems do exist, almost all require reliable Internet connectivity—not an option in many developing countries. FrontlineSMS does not require an Internet connection and works with any GSM network. The software communicates via a mobile phone or modem, which can be attached to a computer with a USB cable. Users are encouraged to share views, experiences, and ideas in an online forum and to provide feedback for future versions of the product.

FrontlineSMS has been used for many healthcare campaigns worldwide including:

Africa-wide: Reporting and monitoring avian flu outbreaks

Benin: Sending health alerts to young people about HIV/AIDS, TB, and malaria

Botswana: Coordinating a blood donation program

Ecuador: Running surveys among rural healthcare workers and radio listeners

Malawi: Coordinating healthcare workers and collecting data in the field

South Africa: Providing HIV/AIDS information services to teachers

Tanzania: Tracing patients who fail to keep clinic appointments and sending patient reminders

Uganda: Aiding community-based healthcare in rural communities

Reference sources:
http://www.frontlinesms.com/who/
http://mobilesinmalawi.blogspot.com
http://wiki.mobiles.tacticaltech.org/index.php/FrontlineSMS

Project 39: GATHER

Country: Uganda

Sponsoring Organization and Partners: Dimagi, Inc. (privately held software company), AED-SATELLIFE and the Rockefeller Foundation

Application Area: Disease and Epidemic Outbreak Tracking

Achieving data and device interoperability is one of the central challenges in improving data collection in developing countries. GATHER is a consortium that has developed a set of tools that enable data entry from a broad range of devices, including desktops, laptops, telephones, PDAs, GPS systems, and bar-code scanners. GATHER's first field test is currently taking place in Uganda with the collaboration of the Ugandan Ministry of Health. Weekly disease surveillance data for 20 health clinics is being collected by mobile phone and sent to a GATHER server located at the Health Ministry's Department of Epidemiology. The results of the Ugandan field test will inform future phases of GATHER development. The developers hope the technology will be ready for broader deployment by late 2009.

Reference sources:
http://www.gatherdata.org/
http://www.dimagi.com/content/gather.html

Project 40: Handhelds for Health

Country: India

Sponsoring Organization and Partners: St. John's Medical College (Bangalore), Indian Institute of Management (Bangalore) and Encore Software

Application Area: Disease and Epidemic Outbreak Tracking

Disease outbreaks often start in small clusters. Technology can play a crucial role in quickly detecting and containing initial outbreaks so that broader spread of communicable disease can be prevented. In India, Shashank Garg and Dr. Isha Garg have created Handhelds for Health, a social enterprise that is developing an open source disease surveillance system. With this system, health workers will be able to use mobile devices to collect, validate, and transmit data to a centralized server. The server will be accessible to resident experts, who can use the real-time data to rapidly identify disease trends and make informed public health decisions. Handhelds for Health will also be able to track non-communicable diseases, such as diabetes, that require continual medical attention and follow-up. The founders further hope to use the solution to collect and transmit the data required for large, community-based, longitudinal studies of diseases and other health issues.

Reference source:
http://handheldsforhealth.org/

Project 41: Remote Interaction, Consultation, and Epidemiology (RICE)

Country: Vietnam

Sponsoring Organization and Partners: Microsoft Corporation, Thayer School of Engineering at Dartmouth College and the National Hospital of Pediatrics (Hanoi)

Application Area: Disease and Epidemic Outbreak Tracking

Rural locales in China and Southeast Asia have been identified as potential high-risk areas for SARS and avian influenza transmission. The Remote Interaction, Consultation, and Epidemiology (RICE) telemedicine system will include a disease tracking component to facilitate the early detection of such communicable diseases. Through mobile technology, RICE will also enable "remote medical consultation, epidemiological surveillance and access to medical knowledge in regions of the world without access to computers or the Internet." Most of the interactions among the rural clinics, regional hospitals, and national hospitals will be conducted via smartphones. A pilot test of the RICE solution was conducted in March 2007 in Vietnam. Volunteers from Dartmouth tested the connection between clinics and hospitals in rural areas and the National Hospital of Pediatrics (NHP) in Hanoi. The researchers also investigated the information needs of rural clinics to inform continuing development of the solution.

Reference sources:
http://media.americantelemed.org/conf/2007/concurrent.htm#t3d
http://dartmed.dartmouth.edu/summer07/pdf/vs_hanoi.pdf

Project 42: Tamil Nadu Health Watch

Country: India

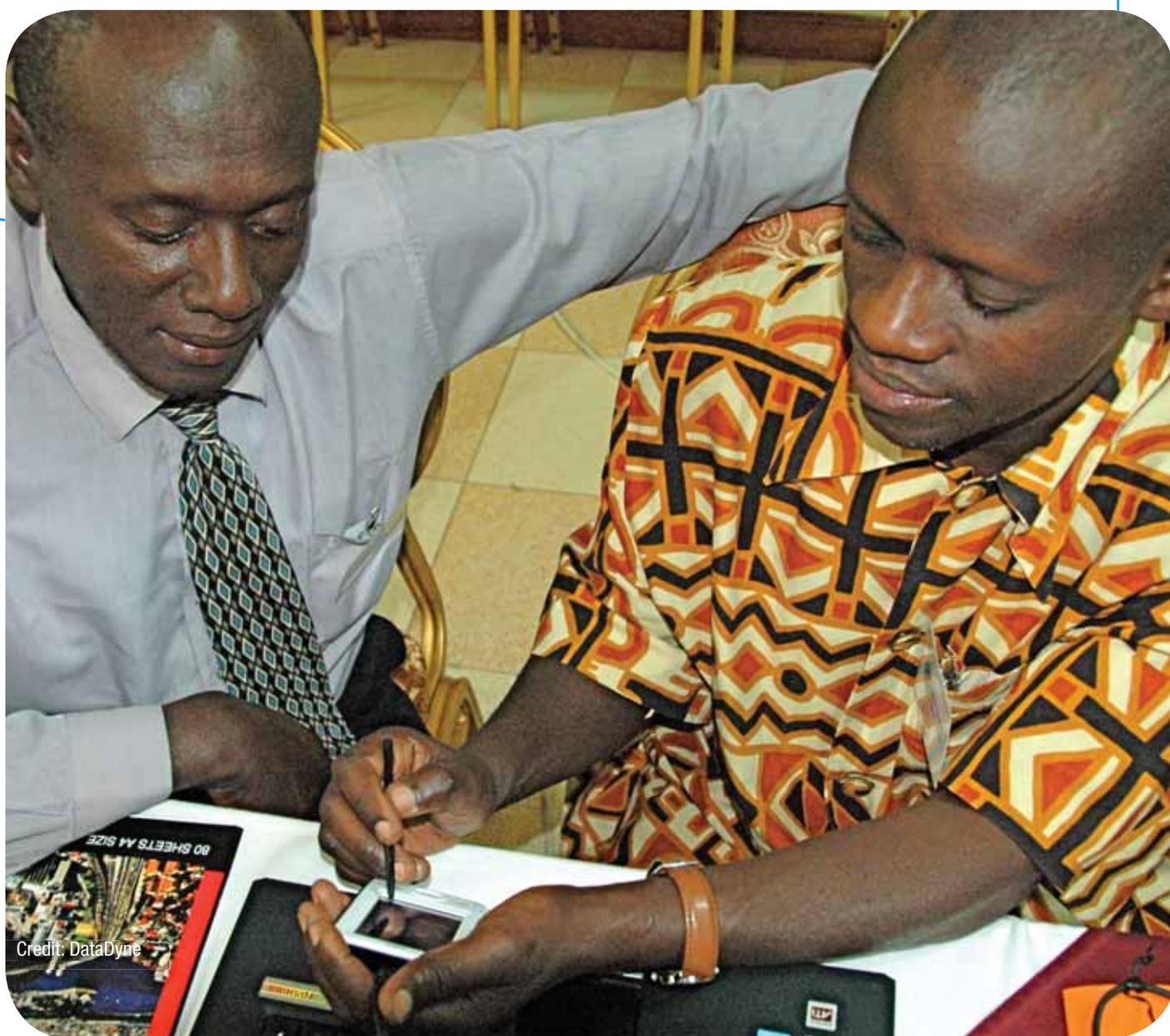**Sponsoring Organization and Partners:** Voxiva

Application Area: Disease and Epidemic Outbreak Tracking

Following the devastating 2004 tsunami, the US-based technology company Voxiva deployed a phone- and web-based data collection and disease surveillance system in India's hard-hit Tamil Nadu state. The 'Health Watch' program, launched in May 2005, makes use of existing communications infrastructure (i.e., mobile phones, fixed-line phones, and the Internet) to allow health workers in remote areas to report disease incidence data to health officials in real time. The program also allows health professionals in distant medical centers to quickly analyze and share information and resources, and to adequately respond to specific health-related questions. For the Tamil Nadu project, over 300 primary health center doctors were trained by Voxiva. The interactive training sessions featured simple, easy-to-use bilingual manuals. Training was coordinated with local authorities so that disease surveillance and outbreak response protocols were promoted and reinforced.

Reference sources:
   http://unpan1.un.org/intradoc/groups/public/documents/UN/UNPAN030003.pdf
   http://news.asiaone.com/News/the%2BStraits%2BTimes/Story/A1Story20080627-73159.html

Credit: DataDyne

Diagnostic and Treatment Support

Project 43: Cell Phone Applications for Clinical Diagnostic Therapeutic and Public Health Use by Front Line Healthcare Workers

Country: Mozambique

Sponsoring Organization and Partners: Microsoft Research, Department of Information Systems and the University of Melbourne

Application Area: Diagnostic and Treatment Support

Despite being one of the world's poorest countries, Mozambique has extensive cellular network coverage and a high percentage of health workers who own mobile phones. This project, supported by Microsoft Research, aims to take advantage of Mozambique's 'wired' reality. The project principals, researchers from the University of Melbourne, have created a suite of applications that can run on standard mobile phones. The applications provide Mozambican health workers with diagnostic and analytical tools including reference material in the phone's memory, a calculator for determining drug dosage, and a program for analyzing inputs from medical sensors (e.g., low-cost pulse oximeter probes or a simple electrocardiogram). The project runs from March 2008 to March 2009 and will conclude with an evaluation of the impact and efficacy of the applications suite.

Reference sources:
http://research.microsoft.com/en-us/um/redmond/about/collaboration/awards/cellphonehealthcare_awards.aspx#E2B
http://www.ni.unimelb.edu.au/Research%20and%20Activities/Projects/cell.html
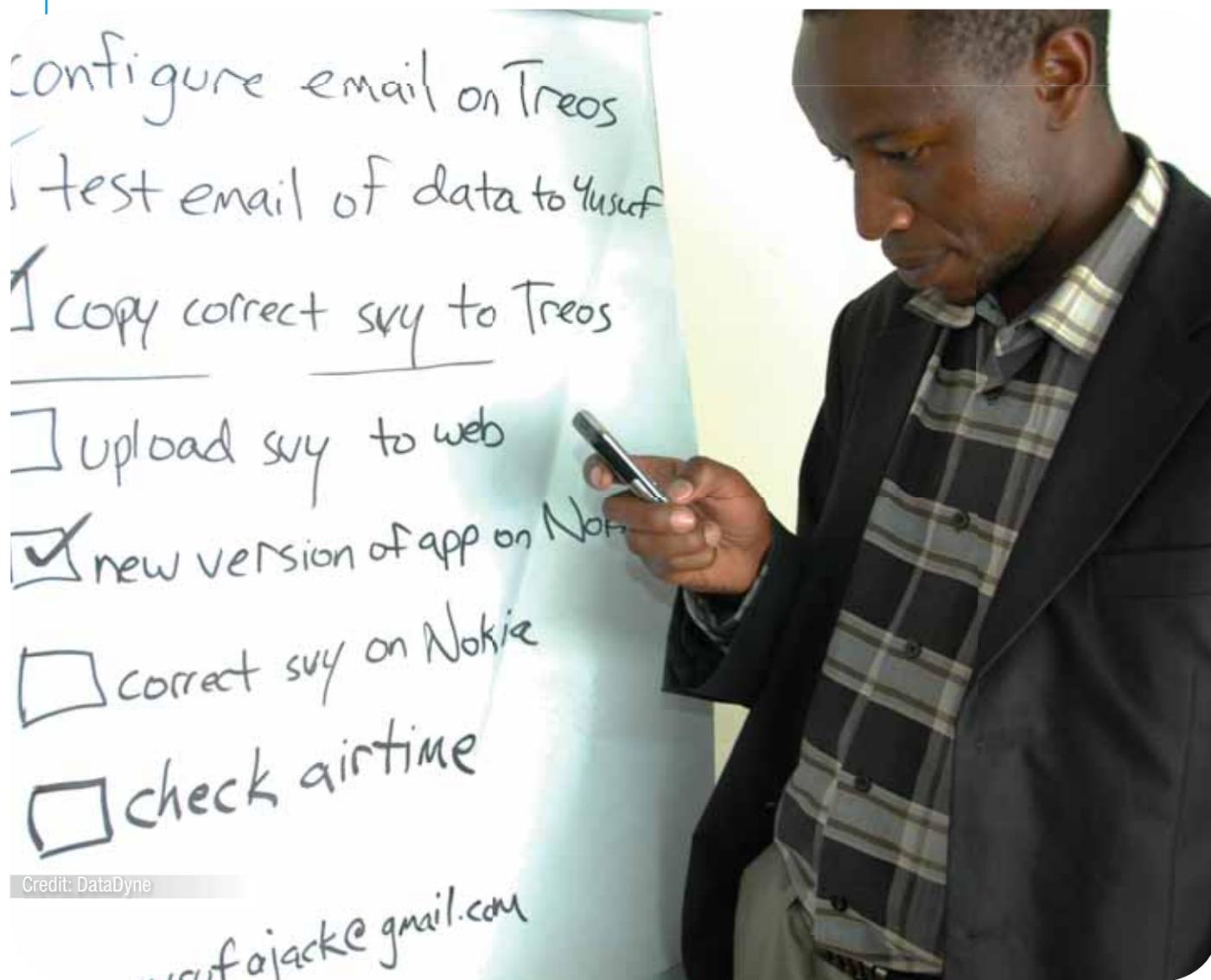
Credit: DataDyne

Project 44: Digital Inclusion Kit in Health and Higher Education

Country: Argentina

Sponsoring Organization and Partners: University of Buenos Aires, Fundapers (an Argentinean NGO) and the Microsoft Research Digital Inclusion Program

Application Area: Diagnostic Treatment and Support

Patients in marginalized areas in both urban and rural Argentina lack access to specialized medical centers, which are often the only sites where vital diagnostic tools are available. Researchers at the University of Buenos Aires are creating a Digital Inclusion Kit in Health and Higher Education (DIKHAE), which will allow smartphones to wirelessly connect to diagnostic tools like electrocardiograms, enabling sophisticated diagnoses to be conducted remotely. The test results can be stored on the smartphone until it is in range of a cellular signal, and then uploaded to a patient records system. A pilot conducted in 2006 received high marks from medical professionals for the system's usability. Project sponsors also envision that the DIKHAE will be able to connect to X-ray, MRI, and other tools in the future.

Reference sources:
    http://lsc.dc.uba.ar/digital-inclusion
    http://research.microsoft.com/enus/us/collaboration/papers/buenosaires.pdf

Project 45: Ericsson and Apollo Hospitals Initiative

Country: India

Sponsoring Organization and Partners: Ericsson and Apollo Telemedicine Networking Foundation (ATNF)

Application Area: Diagnostic and Treatment Support

In summer 2008, Ericsson and Apollo Telemedicine Networking Foundation (ATNF) signed a Memorandum of Understanding to "implement telemedicine applications over broadband-enabled mobile networks" in India. The initiative is anticipated to both decrease costs and improve health care outcomes, particularly for rural populations. The project specifics have not yet been announced, but mHealth will play a central role. According to the Chairman of Apollo Hospitals Group: "With the availability of wireless technology, mobile health will be integrated into the healthcare delivery system. The new mantra could well be 'Healthcare for anyone, anywhere, anytime.' "

Reference source:
    http://www.ericsson.com/ericsson/press/releases/20080605-1225191.shtml

Project 46: HIV Mobile Decision Support

Country: South Africa

Sponsoring Organization and Partners: Dimagi, Inc. (privately held software company), D-Tree International, the Harvard School of Public Health and the Harvard University Program for AIDS (HUPA)

Application Area: Diagnostic and Treatment Support

Dimagi and its partners have been working since 2005 on a software program for handheld mobile devices that will help field health workers screen HIV/AIDS patients and determine their medical needs. Dimagi is partnering with the Harvard University Program for AIDS (HUPA) to develop the solution. A three-month pilot program was implemented in several hospitals in Tygerberg, South Africa. For this pilot, health workers were able to use any Windows Mobile 5 device, including most PDA's and Windows Mobile-based smartphones. The software was designed to be sensitive to local needs, providing support in several local languages and a general user-friendly experience. Data were entered and stored in an embedded MySQL database, and then synchronized with a host computer via Internet or USB connection. Though this project focused on HIV/AIDS screening, the software and devices could be modified to assist with screening for other illnesses, or with triage and diagnosis.

Reference sources:
    http://www.dimagi.com/content/hiv-support.html
    http://www.d-tree.org/index.html

Credit: ENACKQT

Project 47: M-DOK: Mobile Telehealth and Information Resource System for Community Health Workers

Country: Philippines

Sponsoring Organization and Partners: UN Development Programme (UNDP) and the Philippine Council for Health Research and Development (PCHRD)

Application Area: Diagnostic and Treatment Support

In the Philippines, like most island states, many remote communities do not have access to medical specialists. Technology may be limited in these areas and although basic mobile communication is common, data services such as Internet access may not be available. M-Dok was designed to allow rural community health workers to use simple SMS technology, with a specially designed graphical user interface, to send diagnosis and treatment information to specialists in urban areas. M-Dok requires a Java-enabled mobile phone with Adobe Acrobat Reader software. The project was given a one-year grant by the UNDP, and part of those funds will be used to develop a network of community health workers and referral physicians for the system.

Reference sources:
    http://www.synapsehealth.com/portfolio.htm
    http://www.apdip.net/resources/case/rnd54/view
    http://www.idrc.ca/en/ev-81925-201-1-DO_TOPIC.html

Project 48: Mobile E-IMCI

Country: Tanzania

Sponsoring Organization and Partners: Dimagi, Inc. (privately held software company), D-Tree International, the Rockefeller Foundation, WHO and the Jerre D. Noe Professorship

Application Area: Diagnostic and Treatment Support

Often, health protocols are instituted but implementation falls short due to lack of resources in developing countries. D-Tree International, Dimagi, and other partners conducted a joint study that used PDAs to improve adherence to the Integrated Management of Childhood Illness (IMCI) protocols in rural Tanzania. The WHO and UNICEF developed the IMCI as part of their strategy of combating some of the most common diseases afflicting children in the developing world. While the IMCI has shown positive results in Tanzania, a lack of adequate supervision, insufficient training, and less-than-rigorous implementation have weakened its potential impact. The project's research team attempted to address these problems by creating a program called e-IMCI, which runs on a PDA and guides health workers through the IMCI process with step-by-step instructions. The pilot results for e-IMCI were encouraging, suggesting that the technology employed is user-friendly enough for clinicians to use, and that both patient care and caregiver efficiency can be improved. Larger-scale and long-term studies are needed to bolster this argument, but early indicators are positive.

Reference sources:
    http://www.dimagi.com/content/mobile-e-imci.html
    http://www.d-tree.org/index.html
    http://www.cs.washington.edu/homes/bderenzi/Papers/chi1104-bderenzi.pdf
    http://www.who.int/child_adolescent_health/topics/prevention_care/child/imci/en/index.html

Project 49: Mobile Telemedicine System

Country: Indonesia

Sponsoring Organization and Partners: Institut Teknologi Bandung (ITB), the International Development Research Centre (IDRC) of Canada, the United Nations Development Programme's Asia-Pacific Development Information Programme (UNDP-APDIP), Sukabumi Health Office, the Local Authority Development of Sukabumi and the Information and Communication Department of Sukabumi

Application Area: Diagnostic and Treatment Support

Providing adequate health services in all locales in Indonesia, like most island states, is extremely challenging. To overcome this challenge, a large number of technical and health-oriented organizations are collaborating on a prototype mobile telemedicine system. The system will enable remote consultation and diagnostics and also facilitate the collection of patient data. Depending on the communications infrastructure available at a specific location—radio, mobile, or landline phones, and the Internet—information will be shared between patients at 'mobile telemedicine units' and doctors at 'medical service centers.' As a first step, researchers conducted field surveys in West Java to inventory health and communications infrastructure. The results of these surveys informed the prototype development. Further enhancements to the system are being made and the team reports that "the project is challenging" as it integrates so many disciplines and technologies.

Reference sources:
    http://www.researchsea.com/html/article.php/aid/1998/cid/3?PHPSESSID=92ae156683bf
    http://www.idrc.ca/en/ev-81916-201-1-DO_TOPIC.html

Credit: RAMP

Project 50: Nacer

Country: Peru

Sponsoring Organization and Partners: Voxiva, USAID-funded Pathfinder International program, Ministry of Health of Peru and Peru's Regional Health Directorate of Ucayali

Application Area: Remote Data Collection, Remote Monitoring, Diagnostic and Treatment Support, and Disease and Epidemic Outbreak Tracking

Maternal and child mortality remains excessively high in most developing countries. Nacer was created to decrease by half the number of maternal and infant deaths in the Ucayali region in Peru. The Nacer solution allows remote healthcare workers to share data with other remote workers, medical experts, and hospitals, using any telephone (mobile, satellite, or fixed-line telephone systems—personal or public) or Internet technology. A centralized database hosts all of this data and allows for real-time access. Through Nacer, the entire health ecosystem can send and receive information in order to monitor patient health, provide referrals and follow-up care, and track supplies and disease outbreaks. Madhu Krishna of Voxiva claims that, "should health personnel report symptoms that are indicative of a serious, underlying health condition in a pregnant woman, regional health workers can review her records and send voicemail messages and other support to ensure the woman is receiving appropriate care."

Reference sources:
http://www.voxiva.com/casestudies.php?caseid=29
http://www.i4donline.net/articles/current-article.asp?articleid=350&typ=News

Project 51: TeleDoc – Jiva Healthcare Project

Country: India

Sponsoring Organization and Partners: The Soros Foundation and Jiva Institute
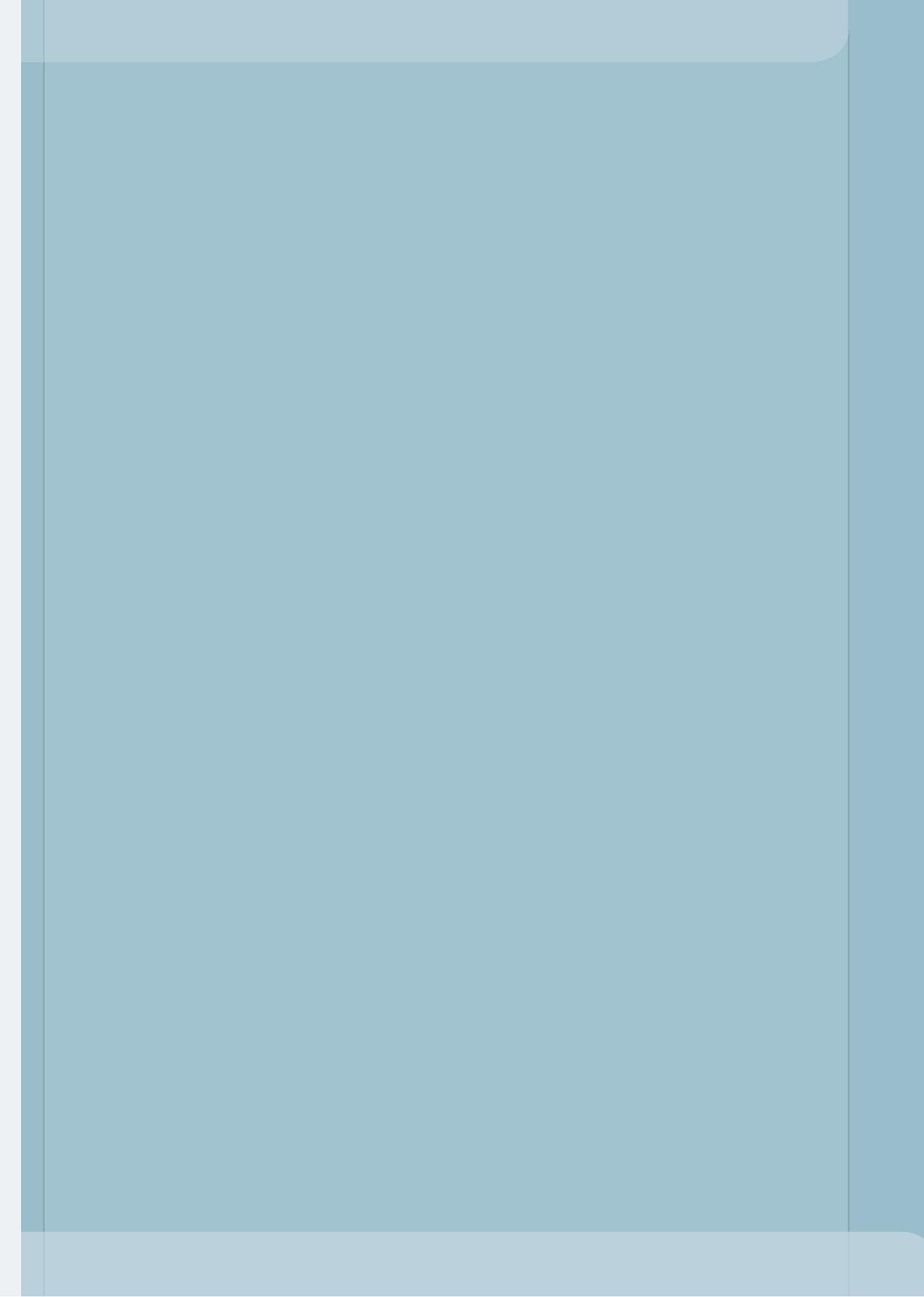
Application Area: Diagnostic and Treatment Support

A shortage of doctors spells inadequate treatment for many in the developing world, especially in remote rural areas. Connecting health workers in rural areas with doctors through mobile technology is a promising solution to this endemic problem. TeleDoc uses Java-enabled mobile phones to connect village-based healthcare workers with doctors in urban areas for remote diagnosis and treatment. Doctors receive real-time diagnostic information entered by the healthcare workers and prescribe appropriate treatments. TeleDoc field workers prepare any prescribed medicines at regional offices. These medications are delivered directly to the home of patients in rural areas by a combination of pharmacies and delivery personnel. In the spring of 2003, TeleDoc was tested in 15 villages in Haryana, India. The program won the World Summit Award for eHealth at the World Summit on the Information Society in Geneva in 2003, and has aggressive plans for expansion.

Reference source:
http://www.comminit.com/en/node/116145 ■

Credit: DataDyne

www.unfoundation.org/vodafone