

Figure 4. Impact of mHealth applications across the developing world.

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 adherence⁶ 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

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

“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.”

“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/doi/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
<ul style="list-style-type: none"> • Communicable diseases. • Lack of immunizations. • Lack of safe water sources. 	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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.

¹²World 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. ■

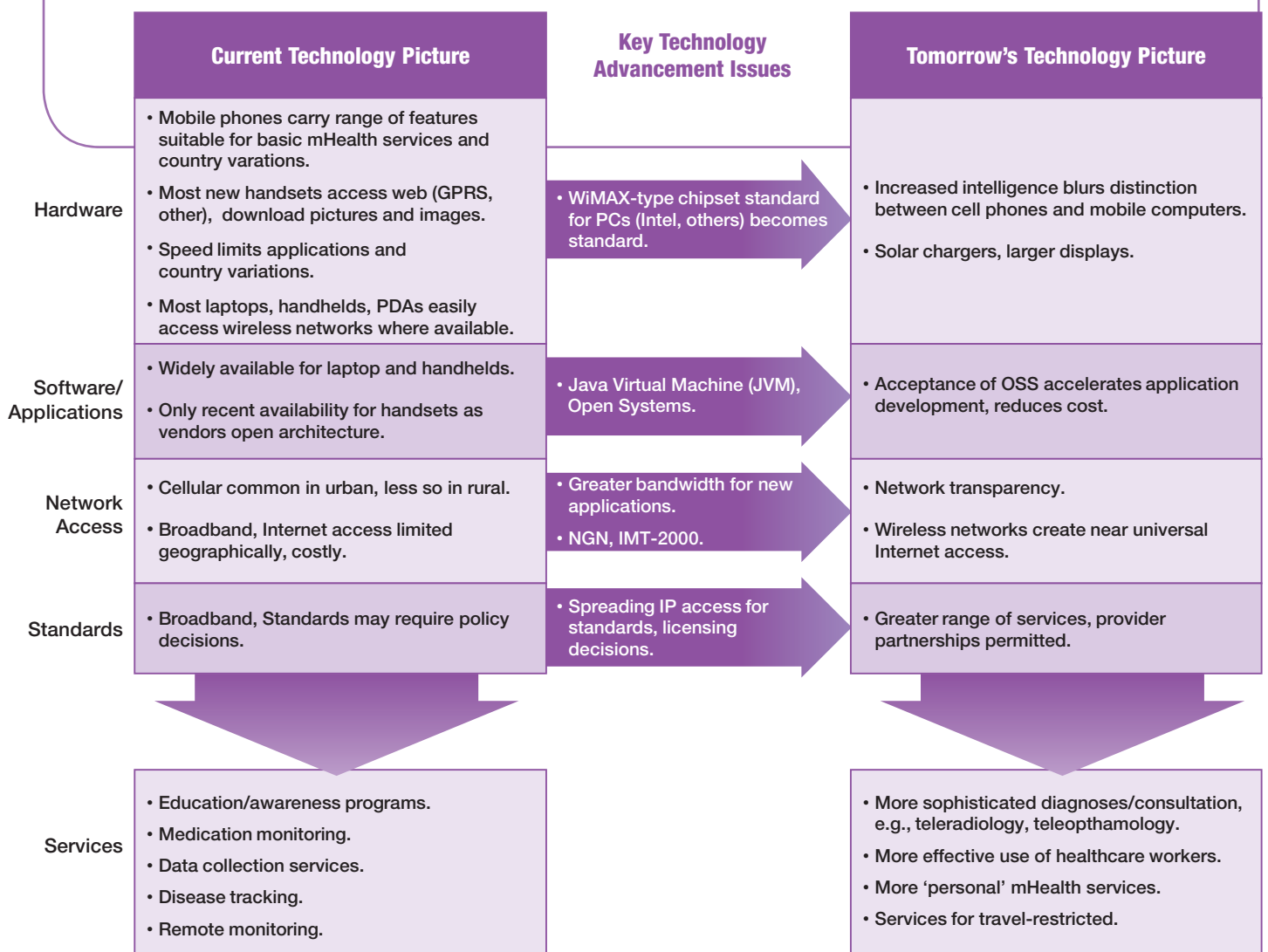


Table 2. Evolving mobile technology capabilities.