

# Mobile Health:

## The potential of mobile telephony to bring health care to the majority

Rafael Anta, Shireen El-Wahab, and Antonino Giuffrida

February 2009

With the support of the  
Korea Fund for Technology  
and Innovation



The authors of this Innovation Note are Rafael Anta, Shireen El-Wahab, and Antonino Giuffrida. Rafael Anta is a senior ICT specialist, and Shireen El-Wahab is a research fellow, both at the IDB Science and Technology Division of the Vice Presidency of Sectors and Knowledge. Antonino Giuffrida is a health specialist who works at the IDB Social Protection and Health Division, from the Brazil office.

The authors are grateful to Luis Barcia, Patricia Mechael, Lisa Waits, and Walter Curioso for their contributions.

This Innovation Note is a product from a project supported by the Knowledge Partnership Korean Fund for Technology and Innovation.

This note may be freely reproduced provided credit is given to the Science and Technology Division and the IDB. The views expressed are those of the authors and do not necessarily represent the views and policy of the IDB.

This is the final version of the mobile health working paper. All earlier versions should be disregarded.

The team welcomes your comments on this paper. For further information on mobile health or other mobile services activities and events supported by the IDB, please e-mail the mobile services team at [mobile@iadb.org](mailto:mobile@iadb.org).

## Mobile Health:

### The potential of mobile telephony to bring health care to the majority

**Mexico.** Gabi is a teenager living in Benito Juarez. She doesn't know whom to ask for information on sexually transmitted diseases.

**The Bahamas.** Lewis is an ambulance nurse in Nassau, and he's just picked up two casualties from a car accident. On the way to the hospital he has no systematic way of communicating important details of his casualties to the staff that will meet them on arrival.

**Honduras.** Larissa lives in Tegucigalpa and hasn't been feeling at all well. She finally decides to make the trip to the emergency room, but she has to wait over two hours to see the doctor. Larissa didn't know that she would only have to wait 40 minutes at the primary care unit.

**Peru.** Andrea lives in the northern area of Piura and has to take a trip into the city in order to get advice and checkups on her pregnancy. Andrea already missed several appointments last trimester.

**Brazil.** Lucas lives in Cuiaba and is a keen footballer. He recently had surgery on his knee and is supposed to go to the doctor to get his sutures checked, but the clinic is about 50 kilometers from his home.

**Bolivia.** Felipe is 65 years old and lives north of Potosí. Felipe often makes a long and costly journey traveling to his doctor, just to get advice on how to control his blood sugar levels and medication.

Gabi, Lewis, Larissa, Andrea, Lucas, and Felipe are 6 of the 355 million people across Latin America and the Caribbean who own a mobile phone.

**More than 355 million people across Latin America and the Caribbean own a mobile phone**

## Why not harness the power of this mobile network for health?

**Mobile care  
could help  
improve clinical outcomes,  
and contribute  
to better public health monitoring and better public health education.**

## Executive Summary

Acute and emerging epidemiological challenges are encouraging public sector to welcome and support the development of increasingly innovative health care initiatives. Given that nearly 70 out of every 100 people carry a mobile phone in the region, if the easy-to-use mobile platform can be applied to health care to contribute to increased equity, mobile care could also contribute to improved clinical outcomes and productivity, as well as to better public health monitoring and education.

Several positive factors support the development of mobile health services (sometimes called m-health) in Latin America today. Latin America currently enjoys high population coverage by the mobile phone network. Future trends in the widening of 3G networks offer further growth opportunities for mobile services.<sup>1</sup> With better technology, more mobile health services become possible. And as user charges go down, users will tend to use their phones more, for more functions.

Currently, Latin America is home to several good examples in technology innovation, including initial efforts to link its research institutions and universities with international centers. If this collaboration is supported and deepened, technology transfer from the more mature markets can encourage local innovation in the longer term. Development partners can lend support to these mobile health initiatives through targeted interventions. A combination of diagnostics, technical assistance for market development, and pilot projects, which together will demonstrate the impact and scale of mobile health, enable market development and strengthen linkages in the value chain.<sup>2</sup>

This paper examines the current and emerging trends in mobile health, with particular emphasis on lessons learned and on potential opportunities for Latin America to apply mobile services to health care efforts to benefit the majority of people.

---

1. 3G is a term to describe third-generation mobile networks that build on current 2G and 2.5G capacity and offer users a wider range of more advanced services while achieving greater network capacity through improved spectral efficiency.

2. The traditional health sector value chain includes the following actors: ministries of health, health care providers, the pharmaceutical industry, and systems integrators.

CATEGORY	DRIVER	EXAMPLES
Surveillance	Health system	Public health survey, personal digital assistant (PDA)-based data collection, disease monitoring
Information	Health system	Doctor appointment reminders, primary health care information reminders
Consultation	Citizen	Information on waiting times, questions on sexually transmitted diseases (STDs)
Education	Health system	Primary care behavior information
Monitoring	Health system	Chronic disease severity information or testing, drug reminders
		Administrative performance
Diagnostic	System and citizen	Clinical diagnostic support
	Health system	Ambulance-to-hospital early report

## What is the buzz about mobile health services?

**Innovation in development matters.** It matters because applying new ideas to persistent problems can allow countries an alternative or complement to longer-gestating reforms that may be vulnerable to capture by special interests or affected by political cycles. Innovation is as imperative to productivity and competitiveness as human and financial capital are; it can provide additional services and channels to conduct transactions. However, it is in developing countries that innovation can have a transformational as well as additional impact, providing novel ways to conduct business and enabling financial and social systems to work better.

**No invention has provided more distinct opportunities in innovation for development than the mobile phone.** The mobile phone has traditionally offered voice and data transfer tools to connect people. With improving capabilities and cheaper rates, mobile telephony is a domain that provides a powerful opportunity for innovation, and because it is subject to lower financial and educational barriers, it provides a potentially wider sphere of influence than the Internet has to date.<sup>3</sup> As mobile phones reach

# Mobile health services jump the distance barrier between patient and doctor

increasingly remote populations, they are beginning to have a big impact outside their traditional service arena. Recent research infers that even the act of carrying a mobile phone increases feelings of safety in case of health emergencies, allowing connection to the health system and to others when needed.<sup>4</sup> But mobile phones can do more than that for health care today. And as technology renders the mobile phone a mobile computer, enabling georeferencing and consumer-centric adaptation, the mobile phone will do more still.

**Mobile health services of today have several distinct facets.** These include the possibility for almost real-time communication and two-way information exchange, the access capabilities that effectively jump the distance barrier between patient and doctor. A second facet is the widening of the health sector to involve the public and private sector, allowing new roles to emerge and nontraditional actors such as mobile network operators to become involved in innovative ways to develop health care.

**Mobile health is a recently coined term, largely defined as health practice supported by mobile devices.** For purposes of this note, mobile health practice includes public health, clinical medicine, and self-monitoring supported by mobile phones and personal digital assistants (PDAs). Currently active mobile health applications include the use of PDAs in collecting community health data; using the mobile phone to deliver health care information to practitioners, patients, and nonpatients; and real-time monitoring for citizens, both patients and nonpatients.

**Within the broader mobile-enabled development agenda, mobile technology is recognized as a resource for economic and social development.** An increasing number of pilot projects are testing mobile health applications across the globe. However, a strategic approach to scalable and sustainable mobile health activities could potentially reap greater financial and social rewards. Furthermore, within the context of development opportunities for the majority, because anyone can carry a mobile phone regardless of financial or social strata, it is the traditionally marginalized areas of society who can benefit most.

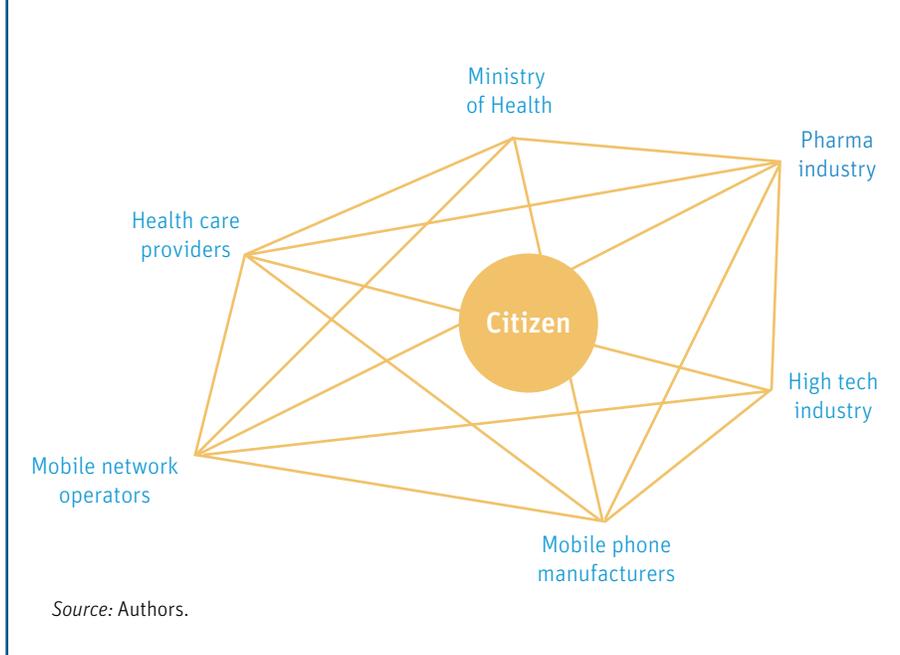
**Acute and emerging epidemiological and demographic challenges to health care systems are pressing the public sector to welcome and support the development of increasingly innovative approaches and initiatives.** Emerging fields in health care include biotechnology (gene therapy, etc.), nanotechnology (instrumental in drug delivery), and information and communication technologies (mobile health). Together these offer a basket of new tools to address health care issues. That mobile health is rapidly evolving as an industry is partly the result of market conditions. Private sector

---

3. Internet access is not widely available and subscription rates are still costly and therefore somewhat prohibitive.

4. Research on the Economic and Social Impact of Mobile Communications in Developing Countries. The GSMA Development Fund Top 20. 2008. GSM Association.

**FIGURE 1 Citizen-centric approach**



companies, mostly mobile network operators (MNOs), are responding to strategic and competitive issues, changing the shape of the traditional health care industry. One of the driving factors in developed economies is a saturated mobile communications market; as a result, MNO companies are looking for optimal new ways to stay competitive by combining attractive bundles with the implementation of innovative mobile services that reduce churn rate and help the MNOs keep their clients and also increase revenues.<sup>5</sup>

**In response to the public and private pressures, mobile health is emerging as a fresh subsector.** It is integrating players and changing the responsibilities of traditional categories of supplier and consumer and working relationships between them. These changes ultimately encourage entry and growth of new players, such as systems integrators and MNOs, and partnerships for delivering services.

**Patients can now monitor their own health.** A mobile network operator has become part of the diagnostic and monitoring processes, that is, a health care practitioner in some senses; health care providers have become technology investors, and mobile phones have become monitoring tools. Just as technology opens up new ways of doing business, the value chain for health, in both the public and private sectors, is changing.

5. *Churn rate*, the average number of customers that leave a subscription service during a year, is most sensitive in emerging markets.



**Mobile health can add efficiency and efficacy to existing systems, advance new systems, and ultimately distribute health care benefits across society. Within health care,** potential benefits include the following key aspects: increased equity, improved clinical outcomes and productivity, and better public health monitoring and education (table 1). The health benefits are not limited to active phone users, such as patients and doctors who carry a mobile phone; non-mobile phone users can also benefit passively, from improved public health information and community awareness.

**Mobile health mobilizes health care and health responsibilities by allowing the consumer more control, direct interaction, and interconnectedness with the health system.** It can lead to feelings of inclusion among traditionally isolated and

**TABLE 1 Shared benefits of mobile health**

STAKEHOLDER	POTENTIAL BENEFIT
<b>Citizens</b> (patients and nonpatients)	Remote interactive care services and information  Increased demand for health care because of awareness of benefits  Information flow for better decision making
<b>Health care professionals and management</b>	Allocation of resources away from duplicate or inefficient channels  Greater decision support among clinicians  Standardization and tracking of public health data  Increased information on disease outbreaks to improve disaster and disease management and coordination

**Mobile health provides benefits for all: patients, nonpatients, health care professionals and managers**

disenfranchised populations. The remainder of this paper examines how governments, healthcare industry and the technology sector can together realize the potential for greater health access and quality, in particular for those in more remote, dispersed, and poor areas of the region.

## Latin America and the Caribbean: What’s going on in health care?

**Health and health care are improving.** Latin America and the Caribbean are making headway in achieving key basic health outcomes with few available resources, which is reflected in an increased life expectancy across the region. Life expectancy at birth was 51.4 years in the 1950–55 period. By 2000–05, this had increased to 72 years, a gain of more than 20 years.<sup>6</sup>

6. Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, *World Population Prospects: The 2006 Revision and World Urbanization Prospects: The 2005 Revision*, <http://esa.un.org/unpp>, Sunday, September 28, 2008; United Nations Department of Economic and Social Affairs (DESA). The Millennium Development Goals Report 2008.

## Health systems are pressured to consider how best to use ICT to face the new and old health challenges

**Latin America and the Caribbean have made** good progress in Millennium Development Goal (MDG) priorities. (table 2). The under-five mortality rate per 1,000 live births went from 82 to 35 between 1990 and 2006, and maternal mortality rates per 100,000 live births decreased from 180 to 130. According to access indicators, during that same period, the percentage of births attended by skilled health care personnel went from 68 percent to 86 percent, and an increasing number of pregnant women are receiving prenatal care.<sup>7</sup> The proportion of children 12–23 months old who received at least one dose of measles vaccine went up from 76 percent to 93 percent.

**The combination of an aging population, ongoing challenges to attaining MDGs, and changes** in the pattern of diseases is an acute emerging challenge. Making headway in key health outcomes is in itself a double-edged sword; for example, the increase in life expectancy across the region will put additional burdens on society.

The region is witnessing an epidemiological shift, characterized by a reduction in the number of deaths and new cases attributed to tuberculosis, infectious diseases, malnutrition, diarrhea, and maternity complications in parallel with an increase in degenerative and lifestyle diseases such as cardiovascular disease, diabetes, and cancer. Over the next 10 years, deaths from chronic diseases are predicted to increase by 17 percent, and the major culprit is diabetes, which may increase by as much as 80 percent. Research into causes points to lifestyle choices as the driving force, risks that will only increase with age.<sup>8</sup> Prevalence rates can be as high as 17–18 percent in the Caribbean. Certainly this represents one of the region's leading public health challenges.<sup>9</sup>

**Disparities within the region also persist.** Improvements have been uneven across countries and within society, and the indigenous and African-descent populations, as well as the general poor, are the worst off. In terms of basic access to health care indicators, almost all births are assisted by skilled health care personnel in Argentina, the Bahamas, Barbados, Chile, Cuba, and Uruguay, but in Bolivia and Central America births are assisted in only 70 percent of the cases and in Haiti in only 26 percent. In Ecuador, indigenous mothers are less likely to give birth assisted by a professional health care provider and to receive prenatal checkups during their pregnancy.<sup>10</sup> Looking at the MDG in reproductive health care, the most pronounced needs persist in the poorest regions: 27 percent of women in the region's poorest households have unmet demand for reproductive health care, versus a regional average of 12 percent.

7. The proportion of women (15–49 years old) attended by skilled health personnel at least once during pregnancy increased from 77 percent in 1990 to 95 percent in 2005.

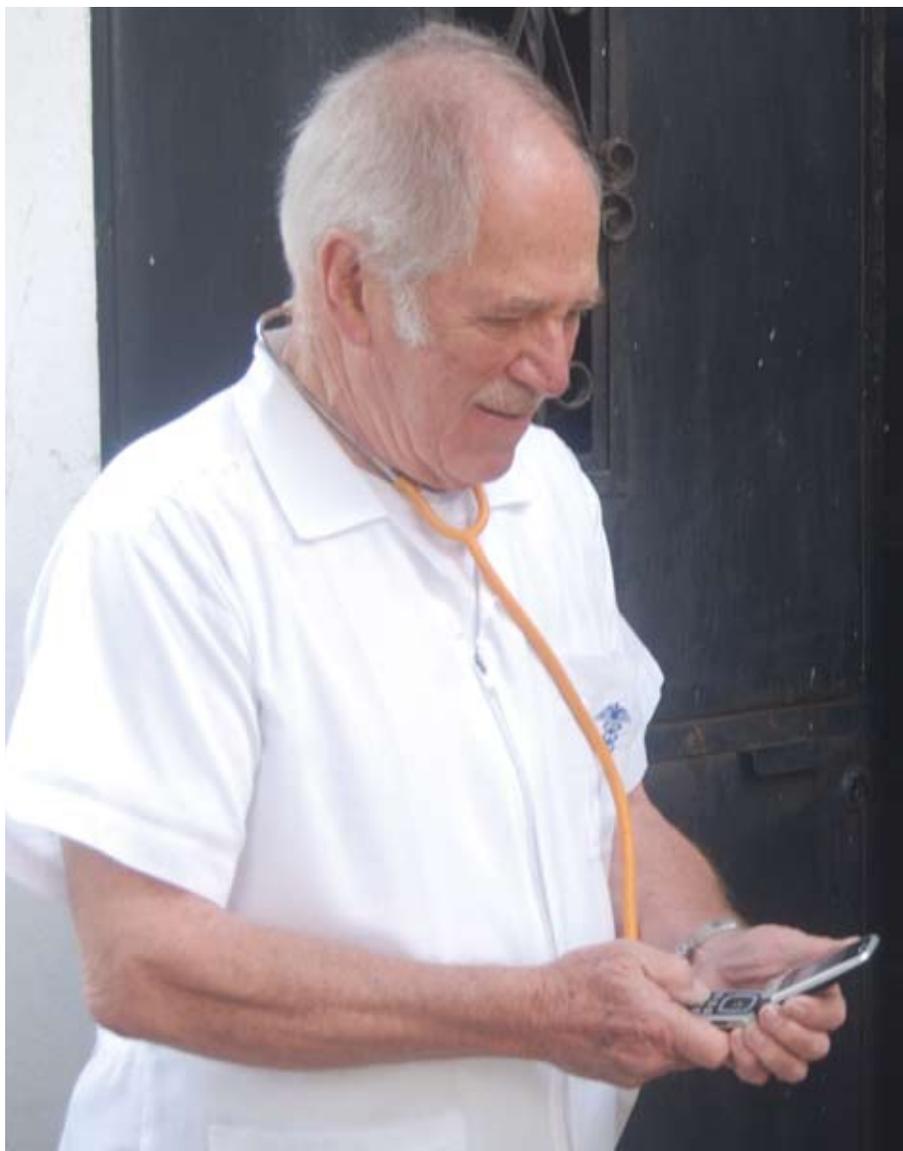
8. In 2005 for example, almost half of all women in Guatemala were rated as obese or overweight, with elderly populations at highest risk. In Brazil the number of women classified as obese doubled in the last 20 years, according to the Ministry of Health.

9. WHO Facing the facts: the impact of chronic disease in the Americas, Geneva: WHO 2005.

10. Giuffrida, A., et al. Racial and Ethnic Disparities in Health in Latin America and the Caribbean. Country Department Andean Group, IDB. Washington, DC. October 2007.

**TABLE 2 Progress toward attaining the Millennium Development Goals for health**

GOAL	TARGET	PROGRESS TO DATE	ISSUES
<b>Reduce child mortality</b>	Between 1990 and 2015, reduce the under-five mortality rate by two-thirds.	Reduction in the number of deaths per 1,000 live births by 50% since 1990, from 57 to 27.	The rate is still approximately four times higher than in developed regions.
<b>Improve maternal health</b>	Between 1990 and 2015, reduce the maternal mortality ratio by three-quarters.	Reduction in the rate of maternal mortality for the region as a whole, by about one-third, from 180 to 130 (2005). One key influence over this ratio is the presence of skilled health workers at delivery. Among those who give birth in health care institutions, 79% are now attended by skilled workers, versus 45% in 1995. Antenatal care improved, with 95% of women attended at least once during pregnancy by skilled health care personnel, an improvement of almost 25% since 1995.	The majority of countries across the region still lie in the moderate range, 100–299 deaths per 100,000 (2005).
	Achieve universal access to reproductive health.	Stagnation of adolescent fertility and decline in total fertility in the region.	Family planning remains an unmet need, which undermines achievements in this area; over 10% of married women do not have access.
<b>Combat HIV/AIDS, malaria, and other diseases</b>	Halve HIV/AIDS by 2015 and begin to reverse the incidence of malaria and other major diseases.	Increased proportion of those living with HIV/AIDS who are receiving anti-retroviral therapy (ART), up from 57% in 2006 to 62% in 2007. The incidence rate for tuberculosis (TB) per 100,000 (excluding HIV-positive populations) has been almost halved since 1990, from 99 to 53. Prevalence rates per 100,000 have also declined, from 152 to 67 between 1990 and 2005.	The ratio of affected women to men is increasing.  In TB, as elsewhere, the prevalence rate is decreasing faster than the incidence rate.



**These differences are ultimately reflected in life expectancy figures, both across the region and within countries.** Life expectancy at birth in Haiti is 58 years, and in Barbados, Cuba, Chile, and Uruguay it is above 75 years. Differences between social groups within country have in some cases widened. For example, in 2000, life expectancy at birth was 71 years for the Brazilian population as a whole, but only 65.7 years for people of African descent. In Mexico, too, the nonindigenous population's life expectancy is about 5 years longer than the indigenous population's.

**Combating these problems requires a well-managed health care system.** However, the region is allocating fewer resources to health care than required, and it is not using them in the most effective way. Spending on health care in the region is low, representing US\$536 per capita, or 6.4 percent of GDP in 2005; thus the population's health care

relies heavily on out-of-pocket expenditures, which represent 34 percent of total health spending.<sup>11</sup> Similarly, resources designated to the sector are often not used effectively, nor are new health technologies always adopted. For example, epidemiological surveillance is poorly organized and paper based in the majority of countries, which doesn't allow for timely identification of disease outbreaks and continuous monitoring. In a public health project in Peru for example, it could take several weeks or months for reports regarding a sexually transmitted disease to reach the central database in Lima.<sup>12</sup>

**Health systems in the region are pressured to consider how best to use the new technology to face the new and old health challenges.** As the Millennium Development Goals embody, the challenges posed to the health systems of Latin America and the Caribbean by changing epidemiological profiles and large social inequities are multifaceted. Infectious diseases, malnutrition, and disabilities associated with reproductive health continue to be serious problems among the region's poor populations, indigenous groups, and people of African descent. At the same time, degenerative and lifestyle diseases are pervasive among the entire population.

## Why would mobile health work in Latin America and the Caribbean?

**The potential benefit of the mobile phone as a tool in widening access and improving health care is clear** Increasing penetration, combined with a wider range of possibilities for communication and an easy-to-use platform, allows access to less technology-literate groups.

Though the penetration rate differs throughout the region, with just 23 percent in Haiti, average rates are above 65 percent. The mobile phone can offer these groups four ways to link up and interact with the network: voice; **short message service (SMS)**, which provides an almost real-time channel; multimedia message service (MMS), which allows multimedia content in a single message; and cell broadcasting, which allows georeferenced bundles of messages.

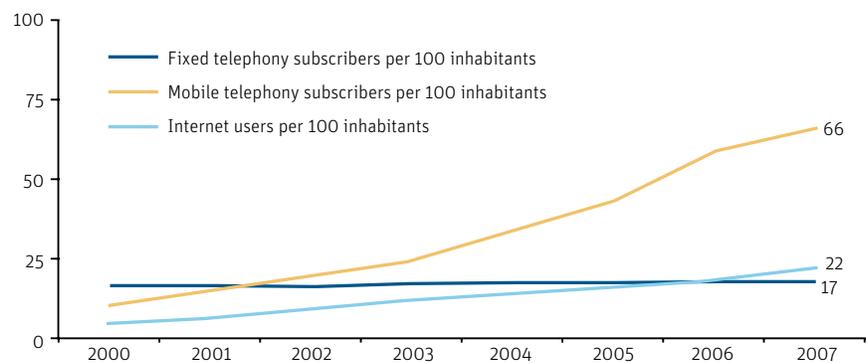
11. Source: <http://www.who.int/nha/country/en/>. In 2005, health expenditures in Organisation for Economic Co-operation and Development (OECD) countries were US\$2,749, or 8.9% of GDP, and out-of-pocket expenditures represented 20 percent of total health spending.

12. Curioso, W. H. 2006. "New technologies and public health in developing countries: The Cell PREVEN Project." In Murero, M., and Rice, R., eds., *The Internet and Healthcare: Theory, Research and Practice*. Mahwah, N.J.: Lawrence Erlbaum Associates, pp. 375–93.

**Getting mobile health right will require an understanding of what is happening and what is possible across the globe.** Of the 360 million people who live on less than US\$300 a month (the majority), 160 million are mobile phone subscribers. This level of penetration gives these groups direct interactive access capabilities for the first time. Though not a panacea, it is a real opportunity to improve health systems and benefit the majority. Table 3 provides examples of current and emerging practice.

**Along the continuum of technology in health care, different mobile health applications are being used in different ways, depending on the specific country health demands.** In general terms, developed health care systems are more concerned about increasing cost pressures brought on by aging populations and wastage of care, compared with the urgent access issues that are the primary burden in less developed systems. Mobile health services tend toward preventive care and support for wellness, essentially helping individuals take care of their health before they become patients. For example, in the United States, mobile health applications are emerging out of necessity, to make overburdened systems more efficient. On one side of the spectrum are some smart devices and borderline science fiction applications that exist currently in the lab and testing grounds. For example, IBM is working toward the “smart medical home,” aiming to personalize medicine for the consumer. NTT Docomo is on the verge of launching a “wellness handset,” complete with a built-in sensor that can measure body fat, heart rate, and halitosis; a pedometer; plus onscreen applications. The device allows users to build up their own mobile medical record and to give health care professionals access as necessary.

**FIGURE 2 Growth of fixed and mobile telephony subscribers and Internet users in the Region**

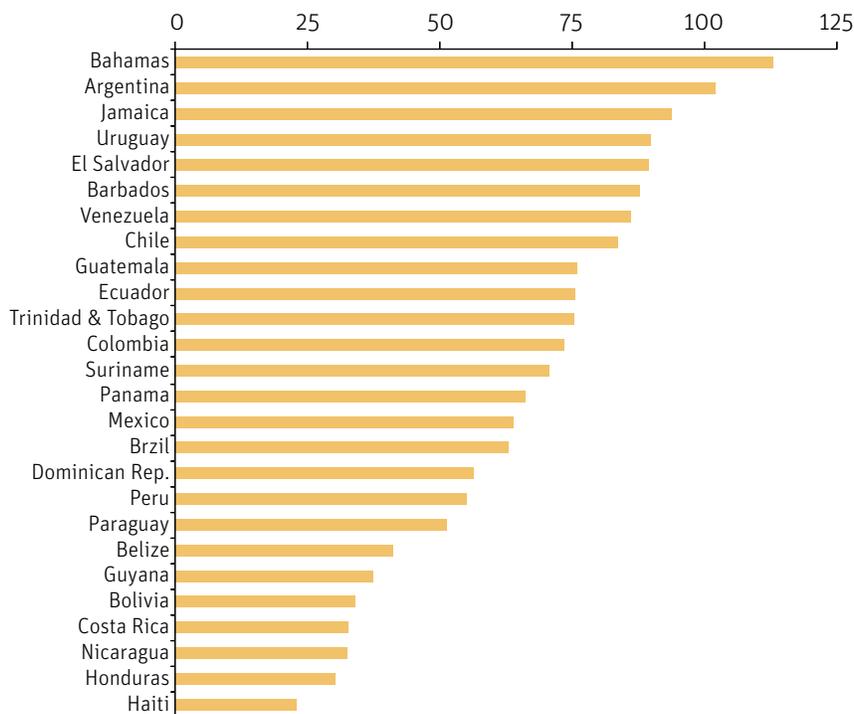


Source: International Telecommunications Union (ITU). 2007.

Given that the private sector is becoming more consumer centric in areas such as transport (global positioning systems, or GPS), entertainment (iPod), and even government services—allowing consumers to adapt services for their specific needs or demands—there will be no reason why health care service delivery mechanisms cannot be more flexible and personalized also.

The first ubiquitous health care service was introduced in September 2005 in Daejeon, South Korea. This mobile health care system connects a patient with the medical treatment center using a mobile terminal connected to wireless Internet, providing remote medical treatment service without the temporal or spatial restriction and enabling citizens to check and manage their own health condition.

**FIGURE 3 Mobile telephony subscribers per 100 inhabitants**



Source: ITU 2007.

**TABLE 3 Selected current practice**

<b>USER GROUP</b>	<b>APPLICATION</b>	<b>MOBILE TECHNOLOGY</b>	<b>EXAMPLE</b>	<b>RESULTS</b>
<b>Health system</b>	<b>Disease reporting using cellphones</b> Disease surveys on PDAs for field data collection.	Smartphone or PDA	Voxiva Alerta, Peru	In pilot results: faster data collection time over paper collection.
	<b>Public health data</b> Disease surveys on PDAs for field data collection.	Smartphone or PDA	Nokia, Brazil	Anticipated results: faster data collection time over paper collection.
	<b>Monitoring adverse events</b> Real time surveillance system of adverse events using cell phones for field data collection. System sends alerts to doctors as SMS/email.	Entry level phone.	Cell PREVEN, Peru (University Peruana Cayetano, Heredia, University of Washington, Peruvian Ministry of Health.	Both health care interviewers and female sex workers reported satisfied with cellphones as a method of data collection, and the system led to much earlier and more complete reports of adverse effects (www.perupreven.org)
	<b>Public health awareness</b> Game applications to teach youth and target groups.	Entry-level phone	ZMQ India, New Delhi	Increased awareness of HIV/AIDS among youth groups; expansion of program into Latin America.
	<b>Public Health Information Gateway</b> SMS questions and answers, in conjunction with electronic learning system in schools.	SMS	Learning about Living, Nigeria	Has regularly received 200 texts per day, answering questions regarding sexually transmitted infections and HIV, through PC center.
	<b>Public health disease management</b> Trial of a conditional minute transfer scheme to increase drug compliance and reduce the need for daily health monitoring. Patient tests urine, and sends result via SMS to doctor. In return they receive patient free minutes.	Smartphone	X out TB, Nicaragua	Achieved higher compliance of patients taking TB drugs (in trial stage).
<b>Health care provider</b>	<b>Remote diagnosis decision support</b> Program using decision-making tree to support clinician diagnoses.	Java-enabled phones or PDA	Commcare	Reduced isolation and increased professional confidence, motivation, and credibility of community health workers.

(continued)

TABLE 3 Continued

USER GROUP	APPLICATION	MOBILE TECHNOLOGY	EXAMPLE	RESULTS
Health care provider (continued)	<b>Ambulance-to-hospital prediagnosis detail</b> Application for transmitting data from ambulance to hospital to prepare for patient’s arrival.	Smartphone	Athens trial	Reduced time before a patient transported by ambulance is seen by a doctor.
	<b>Health administration management</b> Forms uploaded onto a handheld device and sent to central database.	Smartphone	RIM	Reduced the time required to fill out forms (from 5 to 3 minutes per patient), resulting in US\$25,000 saved per review nurse pa. Time allocation shift to more patient care and reduced errors.
	<b>Patient recording: Charge capture and rounds</b> Forms uploaded onto a handheld device and sent to central database.	Smartphone or PDA	IQMAX	Increased revenues (20%) as a result of saving 90 minutes per round per day; higher quality of work reported by physicians because of greater organization.
	<b>Interactive access to patient records and lab tests</b> Handheld device with connection to central server and e-health system.	SMS	Torre Vieja Hospital, Spain	Could eliminate the distance barrier between doctor and patient, allowing the doctor instant access to patient results from anywhere (i.e., mobile patient health care).
Patient	<b>Chronic disease management</b> Self-management application uploaded with connection to server on nutrition regime and connection to physician.	SMS	Bewellmobile, USA	Reduction in diabetes patients’ average blood sugar level, of 1% in one year, as patients became more involved in their own care; and patient-centric flexibility that can be loosened or tightened according to monitoring needs and risks.
	<b>Chronic disease management</b> Device that shows patient’s blood sugar level using blood sample on litmus paper.	Smartphone	LG, Korea	Design pilot phase; Expected to help busy people keep their body in check against obesity, stress, and diabetes.
	<b>Chronic disease management</b> Nurse-based telephone-care service, linked with key clinical events and outpatient visits.	Entry-level phone	Ministry of Health, Chile	Resulted in improved glycemia levels, healthy eating, blood pressure, self-care perception, and perception of health.

(continued)

TABLE 3 Continued

USER GROUP	APPLICATION	MOBILE TECHNOLOGY	EXAMPLE	RESULTS
Patient (continued)	<b>Remote diagnosis</b> Surveys or photos of symptoms or injury sent to the hospital server for review by the doctor and medical advice.	Smartphone	Dermamóvil Telefonica, Spain	Reduced number of visits to the specialist, perceived augmentation of quality of health care, continuous on-demand monitoring.
	<b>Hospital performance communication</b> Central number that allows patients to receive notifications of waiting times.	SMS	Torrevieja Hospital, Spain	Reduction in waiting times to less than 40 minutes.
	<b>Hospital patient communication</b> Patient enrollment in system to receive SMS notifications of upcoming appointments.	SMS	Texts for Health, Vodafone, and Imperial College, United Kingdom	Reduction in missed appointments with family doctors by 26%–39% and of hospital visits by 33%–50%, with annual savings of 300 million British pounds.
	<b>Hospital patient communication</b> Weekly notifications and advice throughout pregnancy, after patient signs up online or through kiosk at the hospital.	SMS	Mobile Milestones, University Hospital, South Carolina	Potential for increased patient awareness and fewer missed appointments, resulting in safer deliveries.
Nonpatient use	<b>Wellness self-check and progress in nutrition</b> Program to measure fat levels using finger touch on the measuring device, displayed by daily, weekly, and monthly units in a chart.	Smartphone	Samsung, Korea	Pilot phase for tracking daily, weekly, and monthly fat levels in individuals, to measure progress.
	<b>Wellness self-checks</b> Embedded device in phone to check vital signs such as blood pressure, body mass.	Smartphone	NTT DOCOMO, Japan	Predicted to come out in 2008; potential to aid in self-care monitoring.

*Note:* Control group trials in Chile’s largest commune have shown pretty impressive clinical results in glycemia (aggregate of how doing over last 3 months), blood pressure, perception of efficacy, and perception of health, as well as possible cost savings. For example, healthy eating improved, with an increase in healthy eating from 3 days per week to 5–6 days per week Blood pressure: significant difference at 12 months.

## Enabling efficiency for hospitals: The case of Torrevieja

by Luis Barcia, Managing Director, Torrevieja Salud

Torrevieja Hospital, located on the south coast of the Comunidad Valenciana in the Alicante, Spain, opened its doors in October 2006. The hospital serves a population of 200,000 habitants, which swells to a maximum of 600,000 during the holiday season.

To manage the fluctuating demand, Torrevieja developed an electronic medical record system called Florence. The system was created by the internal systems management team, at low cost, to suit the organization needs of the hospital and to cater to suppliers' software requirements, enabling full synchronization between different management area systems. Florence, a computer health management system covering all the business of a hospital, is the key success factor in this initiative.

**Technology used by patients.** Patients can text the word URGENCIAS to 5013, and receive SMS information on the waiting time of the different emergency points. Patients also can receive reminders by SMS about their general appointments and receive alerts about radiology tests. Another important function is georeferencing, which allows relatives to follow the whereabouts of the patient (e.g., the operating room or emergency room) by means of a code from any of the computers located at the hospital access points.

**Technology used by doctors.** Doctors use SMS to receive lab test results; surgeons use the surf-table, [[okay?]] a mobile table-computer that allows them to access a patient's clinical history from the surgical table. Finally, doctors and managers receive alarms via SMS regarding hospital performance.

**Technology used for management.** Florence is also used for management purposes and offers information about waiting time in emergencies, surgery performance, appointment performance, and so forth. All of this information contributes to evidence-based decision making. But this system does not involve only hospital management. All hospital executives receive a personalized, balanced scorecard by SMS on their mobile phones every morning.

### Results of the Florence initiative.

- Significant drop in waiting times after first-year implementation of SMS service. Emergency waiting times were reduced to less than 40 minutes on average.
- Patient satisfaction. In four surveys, patients rated the system 9 out of 10 points, which is the highest result among Spain's national hospitals.
- Efficiency. The system was rated highest in Spain for health care and cost efficiency rates, with average hospitalization time of 4.2 days, 57 percent rating on outpatient surgery, based on 17,000 surgery acts made during first year.

## For Latin America, which applications are most likely to accelerate access and address key health issues for the majority?

Current pilot applications in mobile health across the region have focused on data monitoring and voice-based disease management. Now it is time to move on to the use of applications that take full advantage of the technology available to the region for health services.

Different health care priorities will lead to different approaches to using mobile telephony in health care. However, some applications could be implemented easily, with low upfront investments and demonstrated value in the short term, to achieve better and more accessible health care for the majority of a population. The following services focus on health education, in particular prevention, information, and monitoring.

Some mobile health applications could be implemented easily with low upfront investments



- Games to teach youth and target groups
- Messages with tips on preventive health habits
- Messages with tips on precautions to reduce exposure to diseases
- Messages with tips for pregnant women, baby care, hygiene, and nutrition, among others
- Early alerts on pollen and other issues (location-specific alert delivery may be possible)
- Medical appointment reminders
- Drug intake reminders

Apart from using SMS, MMS, or voice messages, one inexpensive option for delivering information to mobile phones is unstructured supplementary service data (USSD), which is the standard for transmitting information over GSM signaling channels. USSD's main characteristics include advantages such as real-time interaction, response times that are quicker than SMS in general, and no overhead or additional usage costs. However, USSD has no storage or forward capability and it remains network dependent.

What are some of the issues to consider in supporting mobile health in the region?

Several factors suggest that Latin America and the Caribbean may be ready. Latin America and the Caribbean enjoy high population coverage by mobile phone service. Coupled with this, 81 percent of mobile users in Latin America and the Caribbean own their own mobile device, unlike in Africa, where many users share mobile phones.

**TABLE 5 Indicators of Latin America’s readiness to absorb the benefits of mobile health**

<b>Positive factors</b>	Technology trends
	Technology transfer
	Usage culture
<b>Context factors that require attention</b>	Some services require existing e-health systems to be in place.
	Fragmented smartphone markets may hamper smarter applications. <sup>a</sup>
	The high percentage of prepaid users could limit options to provide some data-based services.
<b>Enabling environment factors</b>	Security and privacy
	Interoperability
	Sustainability of business models

a. The smartphone market is fragmented in several operative system technologies: Symbian, Windows Mobile, BlackBerry, PalmOS, and most recently Android.

Technology trends and usage culture are also encouraging. GSM is the dominant technology in the region, being present in 80 percent of handsets in South America by end 2007 according to Informa. Research predicts a potential for immense regional growth of more sophisticated 3G mobile services.<sup>13</sup> With better technology, more mobile health services become possible, and as rates go down, users tend to use their phones more. In addition, handsets are becoming cheaper and smarter. And though the global replacement cycle is lengthening, that is not the case within the young adult males segment.<sup>14</sup> Throughout the region, replacement demand is growing, with customers increasingly replacing entry-level phones with mid-range handsets that provide more functionality. All of these factors will expand the future mobile health application frontier.<sup>15</sup>

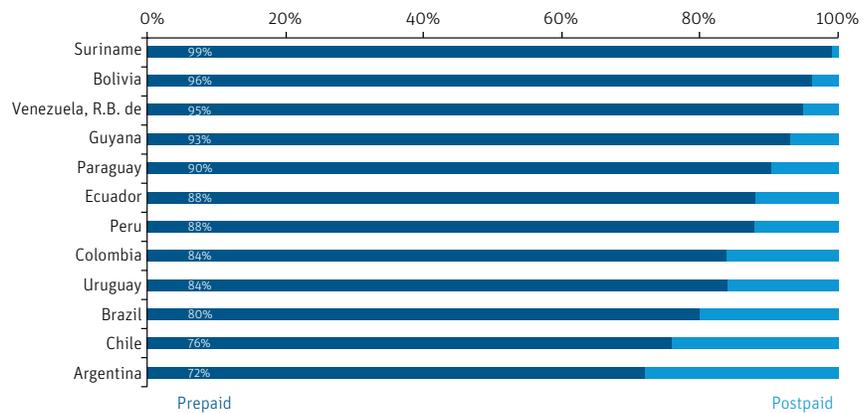
**The Latin America and the Caribbean region presents some specific conditions that affect the potential for complex mobile health applications.** In some mobile health applications, electronic health management systems (e-Health) are a necessary precondition, especially with regard to administrative efficiency. Though some applications, such as SMS notification and PDA-enabled data collection, bypass such systems

13. 3G Americas website.

14. Nokia.

15. ‘3G for all’ project to offer cost-effective devices , led by 3G Americas.

**FIGURE 4 Distribution of postpaid and prepaid mobile subscribers**



Source: ITU 2007.

requirements, other applications require adequate underlying support systems such as demonstrated by Torrevieja’s experience with Florence. Latin America and the Caribbean suffer from an absence of integrated information and communication technology (ICT) systems, and two of the causes are weak capacity for management and lack of capacity in locally driven technology development. Without software developers and systems integrators, producing homegrown solutions or adapting existing solutions is more difficult, making the applications more costly and lowering the chances of acceptance and success.

In addition, mobile phone usage may also create future hindrances to mobile health development, because the majority of mobile phone users in the region are prepaid subscribers (82.5 percent of all mobile lines in Latin America and the Caribbean are prepaid). Moreover, many MNOs cannot currently bill prepaid users for data transfer, thereby restricting available functions for prepaid to just voice, SMS and MMS—a future constraint for smarter applications. According to one recent study, prepaid users pay up to 29 percent more for their services.<sup>16</sup>

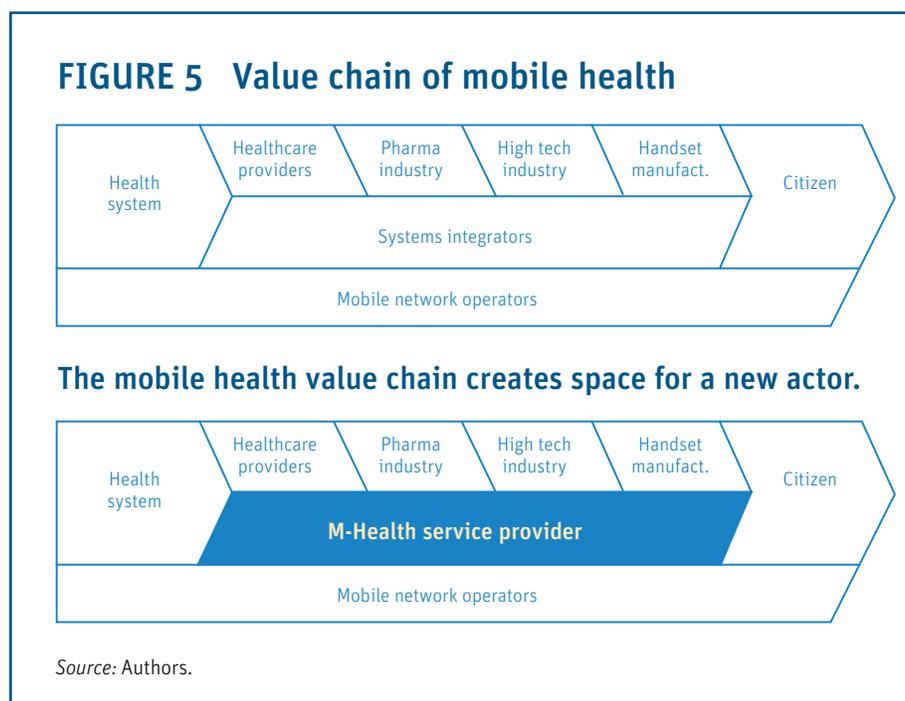
**Among the currently debated topics in mobile health is the enabling environment, that is, the set of conditions necessary to ensure the greatest chance of success in market development.** And in a new industry where business models are not yet stabilized, and where demonstration of commercial feasibility is required to attract the private sector, the enabling environment is a key factor. Both the public and private sectors are grappling with some fundamental issues surrounding business models, standardization of technology, and regulatory issues, including security of information.

16. Nokia.

**As with all ICT-enabled services, privacy and security are paramount.** Any mobile service field that comprises mobile telephony *plus* sensitive data transmission straddles several regulatory domains of payments, telecommunications, and consumer protection. Furthermore, the transnational aspect means that services are subject to differing laws and standards. Given this situation, coordination to ensure security of networks is difficult and the risk of breakdown is high. Ultimately, as a starting point, service providers can and must turn to general data protection and privacy principles in countries where they do business. Building on this, e-services, where they exist, will provide further guidance.

**Private sector companies are currently grappling with the issue of identity.** They are asking what they are trying to achieve, whether it's new customers, additional revenue streams, or new approaches to customer retention; what their business model is; whether they act as a channel; and whether they invest in software development and license a product, or invest and sell only to their own customers. Many MNOs are conducting their own research through demand analyses and pilots, as well as looking to similar more developed mobile services fields for guidance, such as mobile banking. Figure 5 provides a framework for thinking of the different partnership options along the mobile health value chain.

**Currently, the mobile health services field consists of three real options to drive the service—public sector, private sector, or a hybrid (most likely a public-private partnership).** The mobile health service provider is a new technology-based actor in this environment that can be publicly funded, private, or a public-private partnership.



Such a partnership would offer value-added services by connecting the health system and health care providers with the citizen's mobile phone over mobile networks. This option would guarantee interoperability across health care providers and MNOs with different network technologies.

## What factors will drive a successful mobile health implementation?

**Innovation is just invention unless it enjoys practical application; it has to work in reality to have an effect.** Technology alone does not drive change; rather, innovation in management and other processes together drive the adoption of beneficial technologies for good. Those projects that have achieved particular success or scale have done it through an integrated, locally driven initiative, with a high level of political support, good public-private partnerships, and a pervasive communication strategy along the value chain.

### A handset manufacturer's viewpoint: Partnerships across the value chain are fundamental to future development

By Lisa Waits, Director of Corporate Business Development, Nokia.

Mobile service providers must build applications that work across a wide range of handsets. Services must be transferable across devices over time.

A mobile health architecture therefore cannot rely solely on the capability of the handset but must also include a centralized (or series of decentralized) repository or service backbone system, or both. This is necessary in order to provide services for handsets with different processing capabilities. In addition, mobile health services are unlikely to be able to sustain high transaction or subscription costs.

Taken together, these factors indicate the tremendous possibility of mobile health services; however, there are significant challenges to resolve before such services will enjoy widespread distribution and usage.

As part of its consumer Internet services strategy, Nokia is seriously considering where and how to enter the mobile health value chain. Among other ideas, Nokia is considering a common, global platform that supports a number of connected health care and wellness services; however, the consumer-facing services built on such a platform and offered to the market would almost certainly differ by region. There does not appear to be any one-size-fits-all approach to health care in the mobile space (or any other).

Nokia has not ruled out the possibility of integrated devices; however, this decision has not yet been made. Whether Nokia chooses a product, a product plus services, or a stand-alone services approach, the company expects to approach the market from a partnership stance rather than as an isolated effort. The health care value chain demands an element of trust and expertise that is not core to the current business of Nokia; therefore, Nokia expects to partner with well-respected private health care entities (and perhaps others) to successfully address this market.

## Enough technology for the sake of technology

by Patricia Mechael, Mobile Health advisor, The Earth Institute at Columbia University

In the mid-1990s, with the dot-com boom under way in high-income countries, dialogue and action directed toward minimizing the digital divide in low- and middle-income countries favored bringing computers and Internet connectivity to the masses. However, efforts to achieve development objectives did not seriously consider what those objectives were.

Programs named key sectors that could benefit from connectivity, such as education, health, agriculture, but they did not explicitly identify what aspects of those sectors might benefit most from the use of information and communication technology. Ministries of health, including that in Egypt, in an effort to keep up with the technology trends, prioritized the acquisition of computers for their staff and clinics. A decade later, they are now posing the question, “Technology for what?”

More recently, movements have emerged, led by the World Health Organization’s Global Observatory for eHealth and other key e-health policy makers, to develop national e-health strategies. Many of the computers, purchased in the 1990s, however, remained covered on the desks of their original recipients because of the lack of training in how to use them, lack of capacity in upgrading software and maintaining hardware, and lack of vision for how these devices could be used to attain key strategic health objectives. These conversation pieces have become the archeological remnants of development investments.

These early failures to leverage technology to support health have yielded great hesitation among health policy makers. But it is not the technology that is to blame. It is the lack of planning to have all the other necessary parts in place that will ensure that the technology can do what it is meant to do, namely, automate processes, create efficiencies, create standards, improve access to information, enhance communication, and ultimately improve access to health care, quality of care, and health outcomes.

The lack of strategic vision, planning, and appropriate budgeting have hampered the ability for e-health to gain traction in low- and middle-income countries where resources are already spread too thin.

Fast-forward to 2008, when the technology that was disregarded in the digital-divide discourse, the mobile phone, is attracting interest within the health sector. A few recommendations that will help ensure the success of mobile health are (1) study how members of the general population and the health sector are already using mobile phones to support health, and leverage these patterns through the creation of standard protocols; (2) clearly identify target health objectives (particularly those contributing to the Millennium Development Goals for health) and how the mobile phone and relevant software applications can best be leveraged to achieve them; (3) involve users and target beneficiaries in software design and development processes; (4) set up clear measures of success and evaluation systems to help establish the evidence base needed for scale-up and policy making; and (5) allocate the necessary resources to support overall implementation, infrastructure, software adaptation and development, maintenance, training, and upgrading.

A growing number of mobile health pilot projects, studies, and reports now provide learning for those new to the field. In particular, the work of SatelLife—in supporting the use of PDAs for data collection and improving access to health information for health workers in Africa—provides a solid case study of a strategic approach to the use of mobile technology. SatelLife’s focus on monitoring and evaluation throughout the implementation process is a welcome contribution to the evidence base for mobile health and has positioned the organization well to scale up an enhanced version (Gather) that incorporates lessons learned from early experiences.

Using a slightly different strategic approach, the Millennium Villages Project, in partnership with Ericsson and mobile phone operators in 10 African countries, has prioritized key mobile health interventions that specifically target the achievement of the MDGs for health, including improving access to emergency transportation through a toll-free number, improving real-time monitoring of births and deaths for enhanced planning and service provision, and improving service delivery through decision support tools and systems for health care workers.

Technology is a tool and a means to an end, but it is only as good as the structures within which it is integrated. Over half the world’s population has a mobile phone. Not only is mobile health an increasingly critical component of e-health, it also is part of a growing body of mobile services. It is now up to the health sector, in partnership with companies and organizations in the mobile phone industry, to identify how best to leverage mobile technology to improve health and well-being and establish a business case that will ensure its sustainability.

<http://www.millenniumvillages.org>

**TABLE 4 Factors that stop projects from getting to scale**

PROJECT	IMPLEMENTATION	CRITICAL OBSTACLES TO SCALE-UP
<p><b>Nigeria.</b> Learning About Living project. SMS-based question-and-answer service for HIV/ AIDS awareness and prevention program</p>	<p>Implemented nationally in 1997 with much initial success. Complemented e-based learning in schools. 2007.</p> <p>Implemented in partnership with NAC (content provider) and MTN network.</p> <p><b>Finances:</b> Project pays for all texts.</p> <p><b>Results:</b> Since November 2007 the project received 28,000 text messages. Average 200 per day plateau. Feedback survey arranged for October 2008.</p> <p><b>Future plans:</b> The project is trying to gain Rockefeller grants to introduce this in Mexico.</p>	<p><b>Network rates:</b> The project had negotiated a reduced-rate tariff from MTN, but now they want to open the service to Celtel and Star comm. The project faces financial negotiation difficulties.</p> <p><b>Project funding: Network rates apply only.</b> The project aims to keep the service itself free, which would allow them to increase reach to more remote and poorer youth, and so are trying to find funding from government ministries and others, including underwriters such as MTN foundation, to support the project.</p> <p><b>Technology and network difficulties:</b> During this first year the service has faced occasional network problems, including a company charging a premium rate of 50 naira a text, which had volumes at an all-time low. In addition, customer retention dropped because the networks experienced sporadic delays of 3 days in responses and lost messages.</p> <p><b>Customer feedback:</b> Monitoring the feedback is difficult, with not all reporting problems—no idea of the numbers of users lost due to technical difficulties.</p>
<p><b>Western Europe.</b> Chronic disease management</p>	<p>Nokia feasibility trials (sugar monitoring), 1993.</p> <p>Sensors and monitor are plugged into the phone to upload details, which provide a readout of blood sugar levels.</p>	<p><b>Technology and network difficulties:</b> The trials came at the wrong time in the market (1993). Complex and expensive devices were not commercially viable according to a customer-demand survey conducted in Western Europe. Too many special devices were necessary, and the public had little education regarding the benefits of this mobile health application. Also, the trial was device-centric.</p>

(continued)

TABLE 4 Continued

PROJECT	IMPLEMENTATION	CRITICAL OBSTACLES TO SCALE-UP
<p><b>Nicaragua.</b> MIT (Massachusetts Institute of Technology) Innovations in International Health initiative A public health management initiative called X-Out TB: TB Therapy Adherence.</p>	<p>This feasibility trial was conducted to put patients more in control using MIT-based technology and a system of rewards (phone-service credits).</p> <p>Implemented by MIT Innovations in International Health initiative</p> <p><b>Finances:</b> MIT grants.</p> <p><b>Results:</b> Costs of this therapy are only 45% of standard health care.</p> <p>Another pilot is currently being implemented in Pakistan with MIT funding. Again funded by MIT although government and health care provider should be funding the program.</p>	<p><b>Marketing:</b> Cost-benefit studies are needed to increase active awareness of the benefits of investing in new technology to integrate into current practice. Studies would help communicate and justify initial investment.</p> <p><b>Cultural acceptance:</b> Changing the current community-based system to a completely remote system requires cultural acceptance of the technology as a complement to the traditional system.</p> <p><b>Technical difficulty:</b> Some patients encountered technical problems with the litmus testing paper.</p>
<p><b>South Africa.</b> On Cue. Patient Management and Care.</p>	<p>Project to send SMS reminders has been run since 2002 in partnership with Cape Town Health Directorate.</p>	<p><b>Cultural acceptance:</b> Lack of ownership at clinic for implementation meant that there was no proactive participation of staff who didn't see the benefit to their routine of using this new system.</p> <p><b>Cost-effectiveness:</b> The clinic and patients benefited, but benefits to staff were not clear. Staff were also frustrated since they were not involved nor consulted on the project from the beginning.</p>
<p><b>Peru.</b> Information exchange between health centers.</p>	<p>Information exchange between health centers for mother and child health in the Amazon basin.</p>	<p><b>Sustainability:</b> Internal politics and bureaucratic issues at the implementing agency undermined financial sustainability.</p> <p><b>Technology issues:</b> The models being used supported only very short SMS, which limited exchanges to very short questionnaires.</p>

Countries that want to use mobile health to extend health care need to develop strong partnerships. Two main elements are at play. First, along the chain, complex actors have different motivation; for example, mobile health has to make commercial sense for the mobile network operator, social sense for the health care provider, and strategic sense for the Ministry of Health. Second, the end users must be factored in from the very start, since they can often determine the success or failure of an initiative. A high degree of consensus building is needed from the start .

First, successful programs require clarity and realism in their determination of what can be achieved; therefore it is paramount that they not lose sight of the strategic vision of the whole health agenda. Second, programs don't begin with the technology; they begin by identifying the problems they want technology to help solve. Finally, governments cannot apply global good practice models without making adjustments to the environment and the particular health issues of the country. Therefore, decisions regarding the use of mobile health services as a tool in health care should be based on policy relevance, value chain feasibility, and the potential for wide dissemination.

### **What opportunities do the donor partners have to support this?**

A combination of reforms is needed to protect and further the health gains in the Latin America and the Caribbean region, but mobile health can be a tool. The region is well positioned to take advantage of lessons learned from abroad, and to build on what has worked, to make mobile health work for the region's future. So why has mobile health not developed? Research infers that a combination of reasons persist, including lack of awareness of the potential benefits, risk aversion on the part of government, unclear roles of private sector actors, and lack of capacity for mobile health-oriented software development. There is a strong case for donor support, but how can donors best get involved? Table 5 lists three main areas of need, based on analysis of cases to date.

**TABLE 5 Needs and recommended action for developing mobile health**

GAP	NEED	REASONS TO ACT	RECOMMENDATION
Diagnostics	Successful environment and business models	Two of the problems in the nascent mobile health sector are scale and sustainability. The value chain needs to work out how to approach mobile health to achieve clinical outcomes that are at scale and are sustainable. First, the public and private sectors need to understand what is needed to support an enabling environment for mobile health to grow. Further, if mobile network operators (MNOs) cannot see the bottom line, they will not be able to scale up services commercially.	Support should be continued for a regular dialogue between value chain actors to broker discussions on complex regulatory issues, analyze business models, and give specific support to the innovation R&D of the MNOs and other high-tech companies.
	Systematic information collection to increase knowledge on costs versus benefits of mobile health applications	The state of knowledge and awareness on mobile health is fragmented across the region and across value chain actors. By helping public and private sector decision makers tap into global good practice, donors can disseminate knowledge and enable technology transfer to the region.	<p>Donors may support coordination among value chain actors to strengthen dialogue on mobile health.</p> <p>Donors can carry out research to disseminate knowledge on global good practice in mobile health.</p> <p>Donors may partner with government to match mobile health applications to key challenges and pilot cases that demonstrate the potential impact and cost-effectiveness of applications.</p>
	Sufficient understanding of commercially viable applications	Analysis is needed to identify key bottlenecks and determine if real demand (willingness to pay) exists. <sup>a</sup>	Several MNOs are investigating this as part of their business model study. Donors can partner to support regional analysis.
	Support for strong value chain actors	Diagnostics that identify weaknesses in the value chain (e.g., lack of capacity for local software development) will enable targeted intervention to help strengthen the capacity for mobile health.	A systematic analysis of the value chain can identify gaps; donors can target capacity-building activities to help strengthen the value chain.

(continued)

TABLE 5 Continued

GAP	NEED	REASONS TO ACT	RECOMMENDATION
Demonstration		Small businesses and universities play a key role in the innovation process. Development banks can further this process more so than domestic actors, taking the initial risks others cannot, to help scale up some of this work. Support to entrepreneurial and for-profit activities should be aimed at advancing the knowledge base on how mobile technologies can assist the poor.	Development partners can provide specific capacity-building and other technical support to build up the market. Donors can provide technical support and funding to pilots. IDB is committed to supporting at least three pilot projects during 2009. Among other factors, attention will be given to those projects that address severe health constraints and reach a wide range of beneficiaries.
Linking the value chain		<p>The mobile services industry is characterized by uncertainty about the future direction in mobile health and is just now discussing strategic focus. The time is now to broker dialogue and alleviate some of the structural problems of mobile health. Development partners should stop duplicative efforts and come together to provide a clearly strategic approach.</p> <p>Efforts to strengthen international institutional ties will allow long-lasting direct channels of technology and knowledge transfer from more mature markets to the region.</p>	<p>Development partners are establishing global alliances that will allow comprehensive and strategic approaches to supporting mobile health. The learning processes have a network structure that increasingly includes multiple countries.<sup>b</sup> Regional development agencies can leverage their regionalism to contribute to this learning process and encourage productive links and collaborative efforts of international and local institutions</p>

a. Research on the Economic and Social Impact of Mobile Communications in Developing Countries. The GSMA Development Fund Top 20. 2008. GSM Association.

b. Caroline Wagner, George Washington University, IADB workshop September 2008

### Additional Resources

For further information on mobile health or other mobile services activities and events supported by the IDB, please e-mail the mobile services team at [mobile@iadb.org](mailto:mobile@iadb.org).

The following links may also be useful resources on mobile health:

Inter-American Development Bank, <http://www.iadb.org>  
(Topics: Science and Technology, ICT, Health)

The Rockefeller Foundation, <http://www.ehealth-connection.org>

MobileActive.org Community, <http://mobileactive.org>

ShareIdeas.org Community, <http://www.shareideas.org>

International Telecommunications Union, <http://www.itu.int>

Pan American Health Organization, <http://www.paho.org/>

## Selected Bibliography

Albacar, L.B., and M.O. Garcia. 2008. Torrevieja Hospital: How ICT Provides Efficiency in Health-care Management, powerpoint presentation.

Curioso, W.H., B.T. Karras, P.E. Campos, C. Buendia, K.K. Holmes, and A.M. Kimball. 2005. "Design and implementation of Cell PREVEN: A real-time surveillance system for adverse events using cell phones in Peru." *AMIA Annu Symp Proc*, pp. 176–80.

Curioso, W.H. 2005. "New technologies and public health in developing countries: The Cell PREVEN Project." In Murero, M., and R. Riced, eds., *The Internet and Healthcare: Theory, Research and Practice*. Mahwah, N.J.: Lawrence Erlbaum Associates, pp. 375–93.

Curioso, W.H., A.E. Kurth, R. Cabello, P. Segura, and D.L. Berry. 2008. "Usability evaluation of personal digital assistants (PDAs) to support HIV treatment adherence and safer sex behavior in Peru." *AMIA Annu Symp Proc*, p. 918.

Fundación Telefónica. 2008. Las TIC y el Sector Salud en Latinoamérica.

IBM Global Business Services. 2007. Healthcare 2015 and Care Delivery. IBM Institute for Business Value.

Istepanian, R. S. H., S. Laxminarayan, and C. S. Pattichis. 2006. *M-Health: Emerging Mobile Health Systems*. Springer-Verlag NY, LLC, November 2005.

Mechael, P. 2007. WHO m-Health Review: Towards the Development of an m-Health Strategy. World Health Organization.

Pan American Health Organization. 2007. Health in the Americas. WHO.

Vodafone. 2005. Africa: The Impact of Mobile Phones. Policy Paper Series, March. Vodafone.

Vodafone. 2006. The Role of Mobile Phones in Increasing Accessibility and Efficiency in Healthcare

Waegemann, P. 2008. The Next Big Wave Is m-Health: Smart Phones in Healthcare. Medical Records Institute Inc.



**Inter-American Development Bank**

1300 New York Avenue, NW  
Washington, DC 20577

[www.iadb.org](http://www.iadb.org)  
[mobile@iadb.org](mailto:mobile@iadb.org)

 Printed on 100% post-consumer recycled paper using soy-based inks.