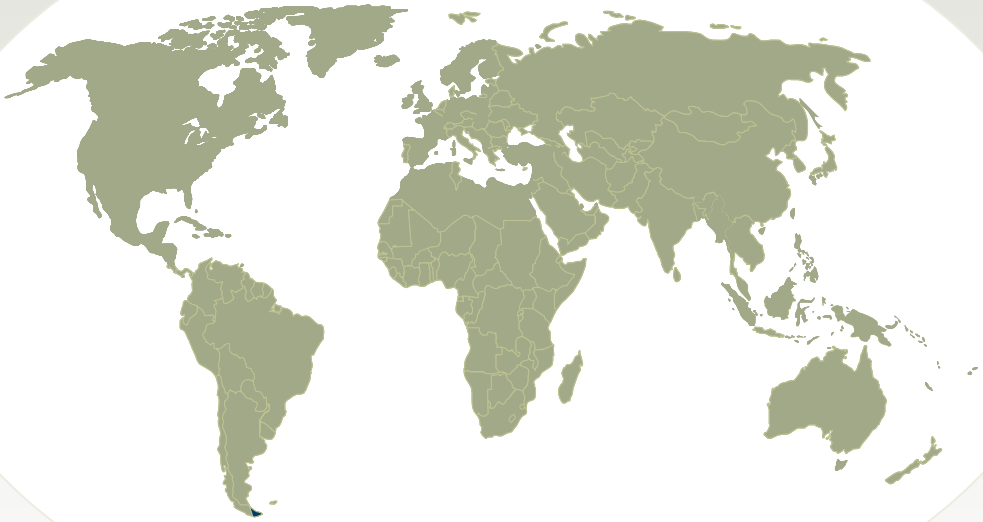
mHealth in the Global South

Landscape Analysis

Mobile Technology



Health

A report by:

VITAL WAVE CONSULTING™

Commissioned by:

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Landscape Analysis of mHealth in the Global South

The phenomenal worldwide expansion of mobile communications provides opportunities for new services across many verticals, including health care, to reach vastly larger populations across the Global South. In the late 1990s, world health and development policy-makers identified information and communication technology (ICT) as an element of improving global health care. Now, almost 10 years later, health and development organizations are beginning to highlight mobile technologies as a particularly critical part of the solution to health needs. mHealth is not just an adjunct to other ICT-enabled health services, but a technology whose unique characteristics can make it one of the driving forces in transforming health services, just as it has in other areas of society.

As in almost every other segment of life in the 21st century, mobile technology promises to bring to health services improved efficiencies (appointments, medication), greater outreach (the poor, rural populations, teens, homeless), and improved communication (between provider and clients).[1]

This report provides foundational data and analysis of the current mHealth landscape. 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 best or broadest impact on heath care initiatives. It also examines critical success factors for making mHealth more widely available through sustainable implementations.

- **Part 1** examines the **mHealth Landscape in the Global South,** providing an overview of implementations, how and where they are manifesting, and the anticipated impact different types of mHealth services may have on individuals.
- **Part 2, Dynamics of mHealth Sustainability,** consists of two **value chain analyses** for mHealth solutions. The first looks at the foundational value chain for simple text messaging. Further analysis examines the expanded value chain to accommodate more sophisticated solutions with two-way communications and clinical aspects to the service. The value chains depict various dimensions of delivery flow, such as financial flows and information ownership and movement. In doing so, the paper examines the current and potential sustainability of mHealth solutions through various strategies.
- **Part 3, Scaling mHealth Solutions,** describes the critical success factors for scaling mHealth solutions to large geographies and populations. Through an analysis of current and planned mHealth services, Vital Wave Consulting offers a set of strategies to accelerate building mHealth scale.
- **Part 4** discusses the **mHealth Evolution,** anticipated services based on changing technologies and health care needs. Through this section the paper provides various scenarios for future requirements and opportunities in the mHealth space, allowing the reader to anticipate possible shifts in strategies for maximum mHealth impact in the coming years.

This report provides professionals from across sectors and industries with a holistic view of current and potential opportunities in mHealth. Data, insights and recommendations in this report can prepare value chain participants to create sustainable solutions to address critical health needs.

Contents

mHealth: A Critical Juncture

The 2007 Global Monitoring Report—the annual assessment of progress toward the Millennium Development Goals—had encouraging data to report in most areas (global poverty down, education up, aid effectiveness improving), but the progress toward the conventions for four health-related goals was much less encouraging.[2] (See Appendix A.) Despite years of effort, the level of health and health care in developing countries has improved only marginally…and in some areas, not at all.

At the same time, information and communication technologies (ICT), especially mobile technology, have made enormous inroads in virtually every sector of the developing world. Personal, ubiquitous, connected, and increasingly intelligent mobile phones have become indispensable in much of the developing world: 64 percent of mobile users are in emerging markets and it is estimated that by 2012, 50 percent of individuals in the remote areas of the world will have mobile phones.[3] [4]

1. Vital Wave Consulting profiled 50 mHealth projects, of which fewer than 30 were found to be active.
2. mHealth projects were active in 20 developing countries.
3. Vital Wave Consulting estimates the total population served by mHealth services at the time of this survey to number fewer than 100,000.
4. In 2005, 2.5 billion people in developing countries were living on $2 or less per day.

Encouraged by the growth and impact of ICT, global health policy-makers and providers are uniting behind eHealth—and its specific segments of mHealth and telemedicine—as a new weapon for fighting global health issues: making existing efforts more effective, providing entirely new tools, and allowing health programs to reach the previously unreachable.

This report looks at the issues that mHealth solutions providers and supporting organizations will need to address in order to make mHealth that powerful weapon against disease and illness:

- Part 1 provides an overview of mHealth project activity. The picture that emerges is one of an immature market characterized by relatively small scope of projects, little global coordination, and little documentation or literature in support of these struggling efforts.
- Part 2 examines the strengths, weaknesses and power centers within the mHealth value chain. mHealth is challenged by the difficulty it has creating an attractive business case for participants. In order to build a value chain that can attract and motivate participants in mHealth delivery, Vital Wave Consulting's analysis suggests mHealth program sponsors:
    - Rely upon standardized technology as much as possible
    - Utilize minimum viable functionality for the health care goal
    - Understand and build partnership incentives for ongoing participation
- Part 3 presents strategies for scale—moving mHealth initiatives from small and local to large and regional, national, or international. The ability to build a value chain that provides incentives for participation depends largely upon the size of the market: How much "scale" can the program achieve? Vital Wave Consulting suggests that mHealth program managers will benefit from carefully choosing those solutions that offer the best opportunities for scale (such as one-

way and basic two-way data services). Moreover, they will also need to look for other partners and services with which they can grow:

  - Combine mHealth with delivery of other mServices
  - Look for collaboration with telemedicine programs
  - Build tools for impact and success assessment

- Part 4: Lastly, the report offers an assessment of evolving health care needs and how evolving technology will provide new, more effective solutions for mHealth. Demographic trends (growing urbanization, greater longevity, declining birth rates, and an increase in non-communicable diseases) mean that health care providers will be dealing with a new set of health care needs, in addition to those that they face today. Vital Wave Consulting urges health organizations to focus on the health needs of *today* that can be addressed by the technology capabilities of *today*. At the same time, health organizations will benefit from creating a parallel effort that *anticipates* future health needs and technological capabilities to begin building the appropriate solutions for the coming decade:

  - Anticipate and work toward the future state of technology capabilities and health care needs
  - Assume future areas of technology convergence between mobile and fixed technologies
  - Strengthen capacity to use mHealth applications within existing and planned IT infrastructure

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.

Strategic Conclusions

The following strategic recommendations are based upon Vital Wave Consulting's research and analysis of the current mHealth marketplace, a review of demographic trends and their health care implications, and an assessment of the technological trends in mobile communications.

Strategy # 1 – Greatest impact can be achieved through mHealth solutions that balance scale with impact.

Simple mHealth applications may offer greater impact, and can be more easily scaled. One-way and two-way data services rely upon existing technology, existing tools, and a growing knowledge base related to the effective use and application of these technologies. *Built* for scalability, text services and basic two-way data services can achieve broad outreach to large populations. (See Parts 2 and 3 for more discussion.)

Strategy # 2 – Utilize other mService programs as a means to more rapidly launch and expand mHealth initiatives.

It is the ease and familiarity of mobile telephony that has driven the uptake of mobile services in governance, banking, and commerce. In most countries where mBanking has been introduced, it operates at a profit because of pricing schemes that encourage high levels of usage with lower rates. One-way, outgoing text message programs are usually inexpensive and, in some cases, free. Mobile service providers have found one- and two-way SMS to be a lucrative business and non-profits and governments have found it to be an effective, cost-effective method of outreach. But very little is being done to apply it to health services, even at the basic public awareness level. (See Part 3 for more discussion.)

Strategy # 3 – Support mHealth initiatives by providing guidance and tools to ensure proper impact and success assessment.

Little work has been published to illustrate the social, clinical or economic impact of mHealth services on its recipients or participants. Yet, impact studies are a critical aspect of building community, sponsor and regulatory buy-in for the investments required by mHealth programs. Such research can be combined with existing tools for non-profit and social service value, benefit, and result measurement. The resulting best practices, published models, and toolkits for mHealth programs would benefit the application developers, program managers, and governments responsible for the design, development and maintenance of mHealth programs. Their ability to measure actual services impact will help maintain and build public support and funding, while stimulating replication. (See Part 3 for more discussion.)

Strategy # 4 – Drive strategies that build seamless integration between new mobile health care services and existing heath care IT systems at the national and international level.

mHealth initiatives would benefit from coordination with simultaneous efforts to build health care IT infrastructure. It is unlikely that regional or national benefits from mHealth programs will be realized if mHealth programs cannot access or share the data among a growing number of participants in the health care value chain. mHealth advocates should identify and support leading health care IT programs and electronic health records initiatives. Models for these initiatives are complex, and it becomes more difficult to provide incentives to players. Complex programs that cut across multiple users, agencies, and stakeholders benefit most from leadership at a global level. (See Part 4 for more discussion.)

Strategy # 5 – Find points of intersection with telemedicine programs that can be used to expand mHealth programs and extend mHealth reach.

There exists an overlap of telemedicine application and those of mHealth, an overlap that is expected to grow as mobile technology evolves. Over the past 20 years, telemedicine has struggled with many of the same challenges that now confront mHealth, such as demonstrable impact and sustainability.[5] [6] But telemedicine centers are multiplying throughout developing regions, in many cases riding the success of village phone centers. This expansion presents an opportunity for resource sharing, shared network access, combining outreach efforts, a common node to central health services, and a base for greater penetration of unserved populations. mHealth and telemedicine should not be seen as competitive, separate efforts, but rather as complementary efforts in providing remote health care. (See Parts 3 and 4 for more discussion.)

Strategy # 6 – Develop two parallel paths for mHealth, one focused on today's health needs, another anticipating future health needs evolving from demographic and technological changes.

This recommendation acknowledges that the technology exists today to have a substantial impact on today's health issues, particularly in applications employing one-way and two-way data exchange. Over the next two decades, significant changes will take place in global demographics: increased life expectancy, lower birth rates, and an aging population. These changes will force a shift in health care focus toward a new set of health needs. But the *success* of mHealth will rest upon its ability to demonstrate scale and impact by addressing today's core health needs. (See Part 4 for more discussion.)

Authorship

This report was compiled by Vital Wave Consulting analysts and researchers. Vital Wave Consulting enables accelerated revenue growth in emerging markets through strategic consulting, market research and business intelligence. Clients include multinational corporations, start-up firms and foundations in the information technology and telecommunications sector. To learn more about Vital Wave Consulting, visit www.vitalwaveconsulting.com.

Data Sources

The findings and commentary in this report are derived from Vital Wave Consulting's proprietary Market Modeling tools and database, coupled with additional research conducted specifically for this report and the deep expertise and field knowledge of the company's business consultants.

Specific findings in this report are supported by primary and secondary research to identify mHealth programs, services, and initiatives in developing countries. Vital Wave Consulting researchers profiled more than 50 mHealth and mHealth-related programs to determine target audience, funding, viability, and impact. Vital Wave Consulting conducted interviews with mHealth managers and professionals in India, Peru, South Africa and Uganda.

Additionally, Vital Wave Consulting research and analysis efforts were supported by input from an advisory panel of subject-matter experts who brought specific knowledge and experience to the research program.

Where appropriate, data sources are provided. Data with no attributed source(s) are generated by Vital Wave Consulting through direct knowledge and proprietary tools and methodologies.

Currency

Unless otherwise specified, all data and findings in this report are presented in real US dollars.

eHealth, mHealth, and Telemedicine: Definitions and Relationships

Many and diverse definitions of the terms eHealth, mHealth, and telemedicine exist. However, there is "general" agreement that eHealth represents a superset of mHealth and telemedicine since it is seen as encompassing the use of *all* electronic technology to provide *any* health service, hence it is independent of patient/provider proximity or use of specific technology. (See Figure 1.)

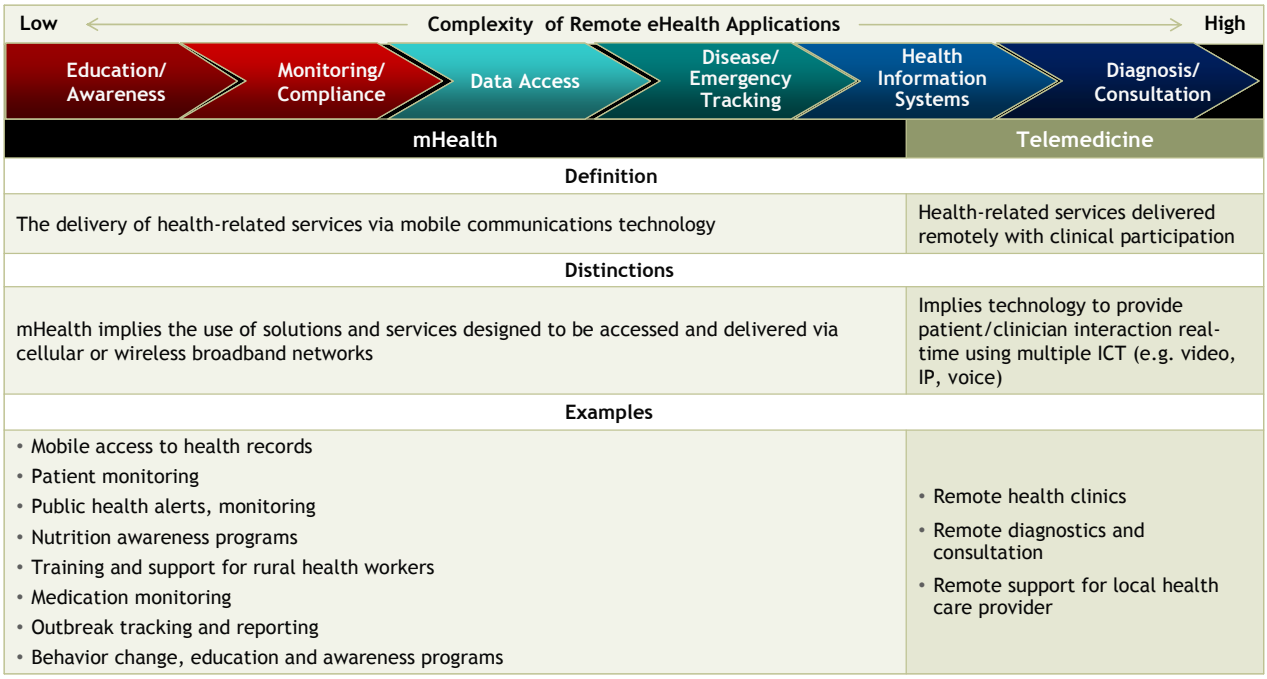
For the purposes of this paper, Vital Wave Consulting, relying upon the input of industry experts and research, has utilized the following definitions:

- **eHealth**: the delivery of health-related services via information and communication technology
- **mHealth:** a subset of eHealth referring to the delivery of health-related services via mobile communications technology

- **Telemedicine:** a subset of eHealth referring to health-related services delivered remotely with clinical participation via electronic communications. Telemedicine also has overlap with mHealth when mobile communications technologies are employed in the delivery process. (Telemedicine is often associated with the term "telehealth," which may encompass a broader definition of remote health care that does not necessarily involve clinical services.)

Figure 1, below, presents the above terms mapped against appropriate or corresponding health care application segments, as developed by Vital Wave Consulting.

Figure 1: Positioning eHealth, mHealth and Telemedicine



Definition	
The delivery of health-related services via mobile communications technology	Health-related services delivered remotely with clinical participation
Distinctions	
mHealth implies the use of solutions and services designed to be accessed and delivered via cellular or wireless broadband networks	Implies technology to provide patient/clinician interaction real-time using multiple ICT (e.g. video, IP, voice)
Examples	
• Mobile access to health records • Patient monitoring • Public health alerts, monitoring • Nutrition awareness programs • Training and support for rural health workers • Medication monitoring • Outbreak tracking and reporting • Behavior change, education and awareness programs	• Remote health clinics • Remote diagnostics and consultation • Remote support for local health care provider

The segments shown at the top of the above table reflect growing sophistication of application and/or technological requirements as they move from Education and Public Awareness, at the left, to Diagnosis and Consultation on the far right. It is mobile technology's unique characteristics of portability and access that provide completely new solutions to health care needs across a broader range of health care applications.

This segmentation will be examined in Section 1 but is shown here to illustrate the key differences between mHealth and telemedicine in providing remote health services, and how those differences make each of these areas of eHealth better suited for different applications.

While there may be a great deal of overlap between mHealth characteristics and those of telemedicine, the key distinctions are:

- **mHealth solutions** are designed expressly to employ elements of mobile communications technology as a means of providing remote health care services.
- **Telemedicine solutions** are designed expressly to deliver a clinical "presence" in remote health services.

Due to the limitations of today's mobile technology (primarily bandwidth or transmission speed), the key element of telemedicine—clinical presence (imagery, video, other "real time" diagnostic

requirements)—is best delivered in conjunction with fixed wireline (or possibly wireless) service through a "fixed" location. As mobile technology evolves, there will likely be increasing overlap between mHealth and telemedicine services.

Developing Countries and the Global South

Throughout this paper, the terms "Developing Countries" or "Global South" are used interchangeably. Vital Wave Consulting follows established World Bank economic benchmarks to define "Developing Countries" or "Global South" as countries that have a gross national income (GNI) of $10,725 or less per capita. In the private sector, the term "Emerging Markets" is frequently used interchangeably with "Developing Countries," as well. For purposes of clarity, this paper does not employ the term "Emerging Markets."

Within developing countries, Vital Wave Consulting distinguishes between three sub-groups according to population size and economic status. More information about these terms and segmentations may be found on the Vital Wave Consulting website http://www.vitalwaveconsulting.com/insights/insights.htm.

Value Chain

The term "value chain" refers to the collection of and relationship between all organizations and steps in the commercialization or delivery process of a product or service. This includes the individual solution components, design process, assembly and packaging of parts, delivery, promotion, support and training to the end user. Each step adds value to the final, commercialized solution. For sustainability, each member of the value chain must have sufficient and ongoing incentive in terms of financial return or impact achievements to justify continued participation in the existing value chain.

Part 1— *The mHealth Landscape*

Early and Isolated

The playing field for mHealth appears to be starting with a strong technology base, a growing list of mobile applications, and increasing global support:

- **Technology readiness**: Eighty percent of the world's population now lives in areas with mobile phone coverage and the GSM Association (GSMA) expects that figure to rise to 85 percent by 2010.[7]
- **Growing menu of public service needs are finding mobile solutions:** Around the world, business, local and national governments, and development organizations are turning to mobile technologies as a cost-effective, high-impact means of targeting populations through mGovernance[8], mBanking and mCommerce.
- **Growing organizational force behind ICT initiatives from world development agencies and global health partnerships.**[9] The leading initiative was taken on a global level with the signing in 2005 of Resolution WHA 58.28 [1] (the "eHealth resolution"), which officially recognized the value of the information and communication technologies for health purposes.

Still, there is little organizational agreement about mHealth goals, importance, definitions, and market structure.

- A search of six major health and technology development websites—including WHO, WSIS, UN, ITU, World Bank, and infoDev—returned no substantive references to mHealth documents and only one reference to mHealth mentioned within any document on those websites.
- Of almost 50 mHealth projects identified by Vital Wave Consulting researchers, nearly 20 were found to be no longer operating, still awaiting funding, or not true mHealth implementations.
- While there exists a tremendous amount of research and activity in ICT-related health issues at the global level, dating back as many as nine years, there is virtually no organization whose focus is expressly mobile health. (In February 2007, the GSMA established a partnership with MTN, Motorola, and other industry vendors with the stated goal of applying mobile technology to health issues. However, it is still too early to expect results.[10])
- mHealth is a relatively new application of the mobile technology paradigm when compared to other mServices in governance, banking, and commerce. Yet, even these are recent services and only now beginning to reach a level of scale that can demonstrate impact. The dynamics of mHealth and its various applications will present additional challenges, compared to other mServices, for scaling at the national or international level. This point will be discussed further in Part 3.

Current Global Presence of mHealth Implementations

The global distribution of mHealth programs in the Global South and their application types, surveyed by Vital Wave Consulting, are represented below. In Figure 2, the location and application type of each mHealth program is shown on a global map. Figure 3 presents the quantitative distribution of those programs by region and by application type.

Figure 2: mHealth Initiatives in Developing Countries

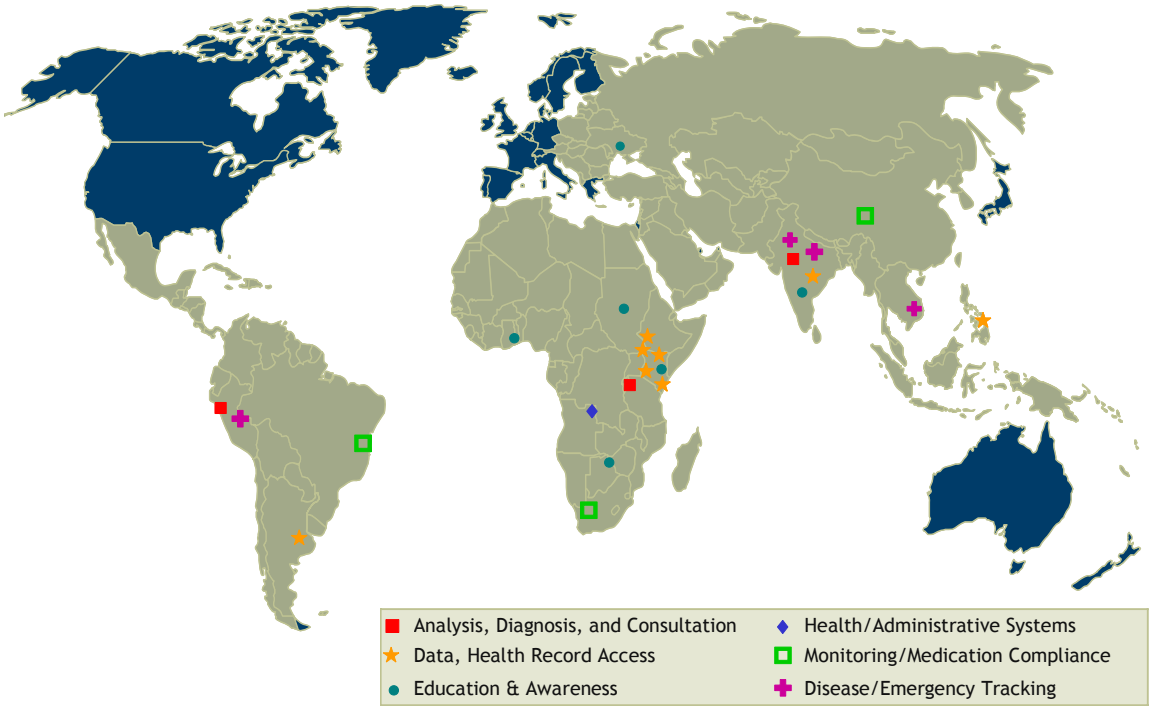
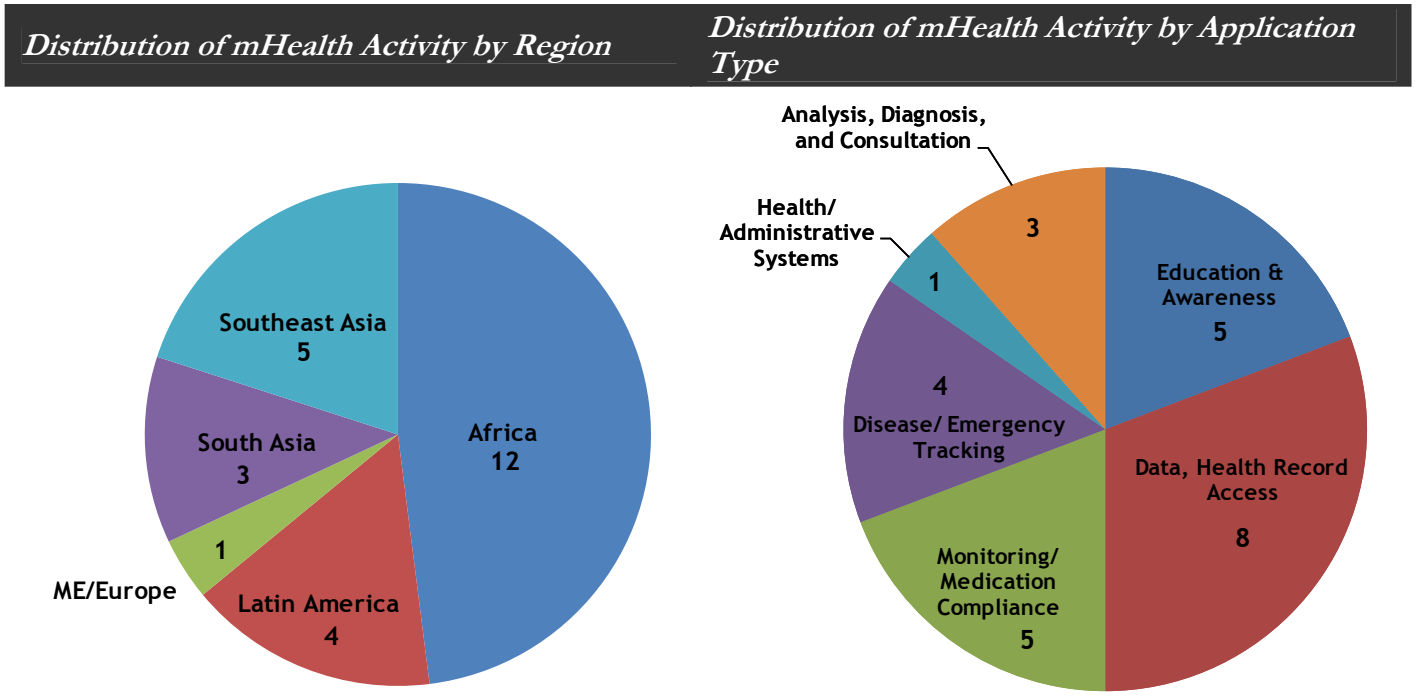


Figure 3: Distribution of mHealth Activity by Region and Application Type



Implications of mHealth Geographic Distribution and Applications

From the analysis of current mHealth programs in the Global South, the following observations are made:

- The **distribution of mHealth activity is concentrated in diverse developing countries.** Some are considered to be strategic opportunities with high growth (such as Brazil, South Africa, China, India) and others present long-term growth challenges (such as Rwanda, Myanmar, Sudan, Nigeria, Uganda). The ability to provide incentives for value chain participants is a critical component for scaling mHealth programs. Yet, incentives for anything but full pricing may be hard to demonstrate to private-sector (i.e., for-profit) participants in countries of low-economic opportunity and lower volume of mHealth activity.

- **Most current mHealth programs are small and targeted at focused local populations** (except in some programs in India). The impacted population is estimated at fewer than 100,000 people worldwide.

- At the same time, **small, local programs are more likely to be funded by aid sources.** Partnership and support (beyond traditional vendor engagement) with the private sector is not likely until scale is reached. (The importance of incentive to building mHealth applications from the bottom up will be discussed in greater depth in Parts 2 and 3.)

- There appears to be **no predominant trend within mHealth applications.** This is typical of any immature market such as mHealth. As the health community becomes more able to demonstrate impact of mHealth solutions (and with a model that rewards participation), Vital Wave Consulting expects to see trends within and among the application segments become more pronounced.

Because mHealth is such a recent development, very few of the programs surveyed were more than 3 to 4 years old. This immaturity means that there is little basis for measuring success and few examples from which to draw direct conclusions about the future of mHealth. For example, an ICT R&D grants program for Asia-Pacific countries funded 56 programs from 2002 to 2005. Of that number, only 10 were health- and medicine-related and only one was an mHealth program. (That single mHealth program received only trial program funding from the Pan-Asia ICT R&D Grants Programme and, to date, is still looking for funding to launch a complete implementation.[11]) Yet, initial activities in mHealth and the relative success and scale of other mServices in developing countries provide enough data and experience to inform realistic strategies and critical success factors for achieving sustainability and scale of mHealth solutions.

mHealth Application Segmentation

Using the results of the survey of mHealth programs, initiatives, and applications, Vital Wave Consulting created an application segmentation model based on targeted health care goals. Table A lists these segments, with corresponding descriptions and examples of specific mHealth programs in the Global South. Reading the list from top to bottom, the application segments have increasing technology requirements and complexity of implementation. These application characteristics have an inverse relationship with their potential for scale. Therefore, Education and Awareness mHealth programs have the simplest technology requirements and implementation methods with the highest potential for scale. The opposite is true for Analysis, Diagnosis and Consultation applications via mobile technology.

Recognizing the distinctions between these segments and understanding the characteristics of relating technologies is a critical part of being able to build applications that promise sustainability and, possibly, scale. In looking at health care applications, it is important to note that mobile technology provides a means to address some specific tasks better and faster, as well as enabling completely novel solutions to current needs. However, current mobile technology is not ideal for some mHealth applications that require more bandwidth or lower costs for sustainability and effectiveness. Mobility's appropriateness to any given application is dependent upon a balance of technical performance, cost and efficacy, conditions that will continue to evolve.

Table A: Segmentation of mHealth Applications, Descriptions, and Programs

APPLICATION	DESCRIPTION	PROJECT EXAMPLES
Education & Awareness	Primarily one-way communication programs to mobile subscribers via SMS/text messaging in support of public health, behavior change campaigns.	• Freedom HIV/AIDS • Frontline SMS • Mobile4Good • UNICEF/Georgia
Data, Health Record Access	Applications designed to use mobile phones, PDAs, or laptops to enter and access patient data. Some projects may also be used by patients to access their own records.	• Rwanda TRACnet • Satellife PDA projects • EpiHandy • EpiSurveyor • RESCUER
Monitoring/ Medication Compliance	One-way or two-way communication to the patient to monitor health conditions, maintain care giver appointments, or ensure strict medication regimen adherence. Some applications may also include in-patient and out-patient monitoring sensors for monitoring of multiple conditions (such as diabetes, vital signs, or cardiac.)	• Cell-Life • Virtual Health Pet • SIMpill • On-Cue
Disease/ Emergency Tracking	Applications using mobile devices to send and receive data of disease incidence, outbreaks, geographic spread of public health emergencies, often in association with GPS systems and backend applications for visualization.	• InSTEDD • Voxiva Health Watch • AESSIMS
Health/ Administrative Systems	Applications developed for "back office" or central health care IT systems allowing for access by and integration with mHealth application. Such applications often tie in to regional, national, or global systems.	• The Africa Health Infoway
Analysis, Diagnosis, and Consultation	Applications developed to provide support for diagnostic and treatment activities of remote care givers through internet access to medical information data bases or to medical staff.	• Peru Nacer • Tele-Doc

Part 2 — *Dynamics of mHealth Sustainability*

Participants in the mHealth Value Chain

To appreciate the effectiveness and sustainability of any value chain, one must first understand the participants in each link of that value chain and assess their incentive structure as organizations. This background will enable a more sophisticated understanding of the strengths, weaknesses and power centers within the mHealth value chain(s) and the impact they have on specific services delivered.

Critical Success Factors:
The Sustainable mHealth Value Chain

1. Rely upon standardized technology as much as possible.
2. Utilize minimum viable functionality for the health care goal.
3. Understand and build partnership incentives for ongoing participation.

Within any mHealth implementation, the roll of value chain participants may include those shown in Table B. Participants bring their own contributions, their own incentives, and their own set of concerns. The strategic design of a value chain and the relationships, financial and otherwise, between the participants can impact the efficiency and motivation of each involved organization. Higher-level incentives (whether in the form of revenue or cost efficiencies) can cause value chain participants to consider innovative business models, product modifications or reduced pricing in return for the benefits the program can bring. Minimum incentives, however, likely will gain standard involvement, products and pricing from value chain participants.

Table B: Participants in the mHealth Value Chain

Players	*Incentive*
Patient: The recipient of the health care service.	• Improved treatment, education, illness prevention
Caregiver: The party delivering health care service; may be a physician, nurse, midwife or other health care worker.	• Improved operational efficiencies; improved quantity, effectiveness of health care
Project Management: The entity responsible for direct management of the project including business (e.g., budget, staffing) and programmatic (design, implementation, objectives). May be an independent organization or a government agency.	• More effective delivery of health care services • Improved operational efficiencies • Organizational mission may be closely tied to program success • Expansion or scale of program
Equipment provider: Generally the manufacturer of any hardware relative to the services including customer devices (e.g., phones, laptops) or network devices (e.g., switches, routers). May provide training, support to operator or health care practitioner. As a network equipment provider, may have a more active role in service provision.	• Revenue from hardware sales • Strategic market positioning for short and long-term brand and business development • Revenue from training or support contracts • Opportunities for placement in network expansion projects
Service provider: The mobile telephony operator; generally the owner of the network but may also include mobile virtual service operators (MVSO) that lease network capacity.	• Revenue from service fees (monthly access, per unit charges, server usage) through increased subscribers and increased average revenue per user (ARPU) • In some countries (e.g., Mexico and Brazil), revenue from handset device sales • Expanded mobile subscriber base for increased revenue from other services
Application Solutions Provider: The entity providing the mHealth application, either as a standalone software application or an integrated application.	• Revenue from application license fees • Revenue from application customization fees • Revenue through training contracts and hardware system support • Opportunity to become a standard in mHealth • Potential for add-on sales as program scales

Players	*Incentive*
Content Management **Provider:** The original content creator; may be a publisher or an online database. **Aggregator:** A service that brings together and organizes independent pieces of original content providing a single source for user access. Can be either for profit or not-for-profit.	• Increase in volume of readership and revenue • Achieve brand recognition • For governmental or non-profit groups, constituency reach through dissemination of health literature, research, and medical journals. Also interested in volume.
Platform Provider: The supplier of the basic system upon which the mHealth program runs. Platform may be either a hardware base (such as a PC with Windows XP or a PDA with Windows Mobile) or a system-wide application upon which multiple health- or non-health-related applications run.	• Revenue from sales • Potential for add-on sales as program scales
Government: This category includes all relevant government entities for which health or technology is a part of its mission. May include local or national branches, health or communication ministries. May help support programs by channeling third-party funding to new projects.	• Additional tax revenues or expense savings • Independent funding to supplement budget • Accelerate achievement of health care goals
Funding Sources: Local, national or international organizations that provide financial support for a project. May be non-profit development organizations as well as local or national governments. May support projects directly or indirectly.	• Organizational mission to improve health care or the proliferation of technology
NGO: a non-governmental organization, generally privately funded, that pursues social or humanitarian goals, often provides funding, monitoring functions. **Industry Associations:** association organized around a specific industry, technology, marketplace or product. Often advocate in development causes; activities tend to promote the focus of the association.	• Advance organizational mission • Encourage continued or increased contributions for supporters

Understanding Value Chain Incentives: ROI and Volume

In general, incentives for mHealth value chain participants can be categorized as **cost savings**, **increases in operational effectiveness**, or **revenue generation.** The ability to demonstrate and deliver appropriate incentives to *every* participant in the value chain is the essential to building a sustainable initiative.

Scale plays a dominant role in the ability to demonstrate incentives for certain value chain participants: high volume of network traffic is a clear example of an incentive to the mobile service operator. High volume of data exchange may be an incentive to content providers, just as a large numbers of unique text messages or robust and scalable behavior-change campaigns might serve as incentive to the platform and application developers.

In the examples of value chains in Figures 4 and 5 below, participants at the left end of the scale (the "higher end," or father away from the service recipient) are those that rely most on the ability of the program to scale or to reach volume in order for it to be a worthwhile investment. These participants are generally large companies or organizations, requiring higher volume of business to reach levels of profitability and a more attractive ROI. Without volume, as one moves higher up in the value chain, participants have increasingly less incentive to partner actively in programs. In the absence of "market size," they prefer to provide their standard offering and pricing through existing business models for their contributions to the value chain. The more scale there is, the more likely it is that participants to

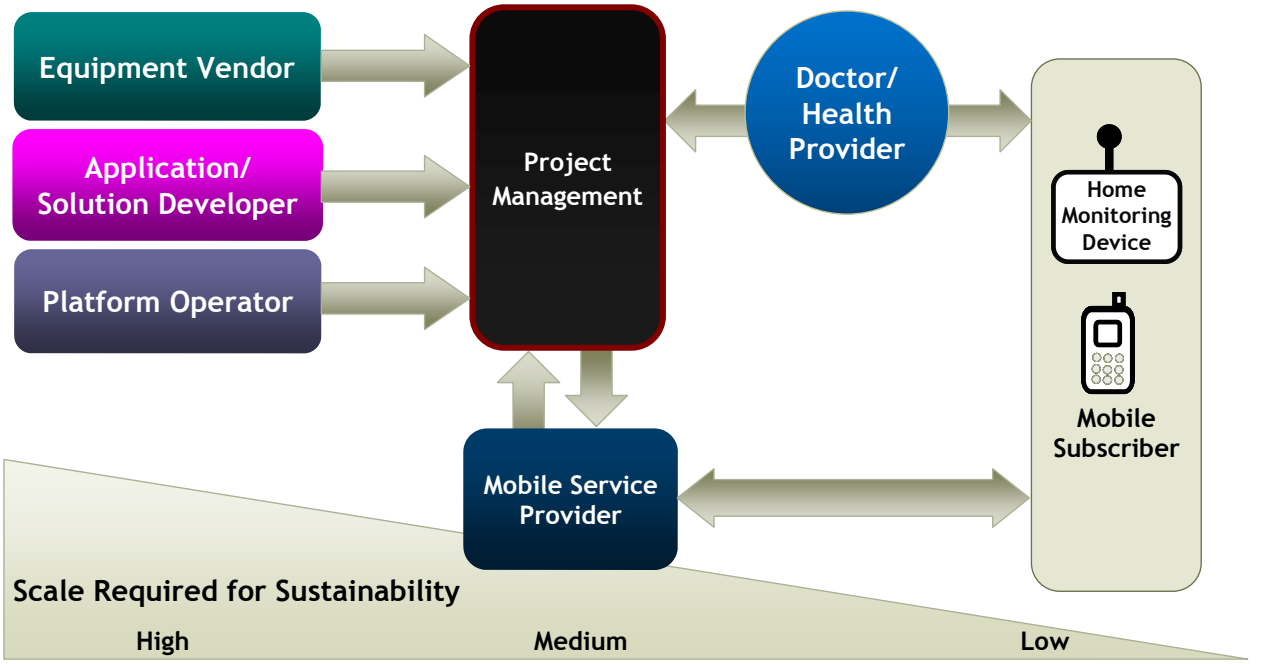
the left of the value chain can be engaged as partners with creative and mutually beneficial terms of engagement.

Not all incentives are related to revenue. As noted above, cost savings and operating efficiencies are also important incentives. But even in these areas, the ability to demonstrate cost savings or efficiencies of time, labor, or money will rely upon achieving a volume at which the start-up and ongoing costs of the program provide a positive return on investment.

Value Chain Models for mHealth: One-way Data Applications

Figure 4 illustrates the simplest value chain for mHealth solutions based on a one-way messaging application. Examples of this type of application are medication regimen adherence and monitoring programs (such as SIMpill) and education and support programs based on one- or two-way SMS alerts (FrontlineSMS, Mobile4Good). It depicts the dynamics and incentives described above in Table B. (For details on the mHealth programs mentioned in this paper, see Appendix B.)

Figure 4: Value Chain Model for "One-way" mHealth Applications



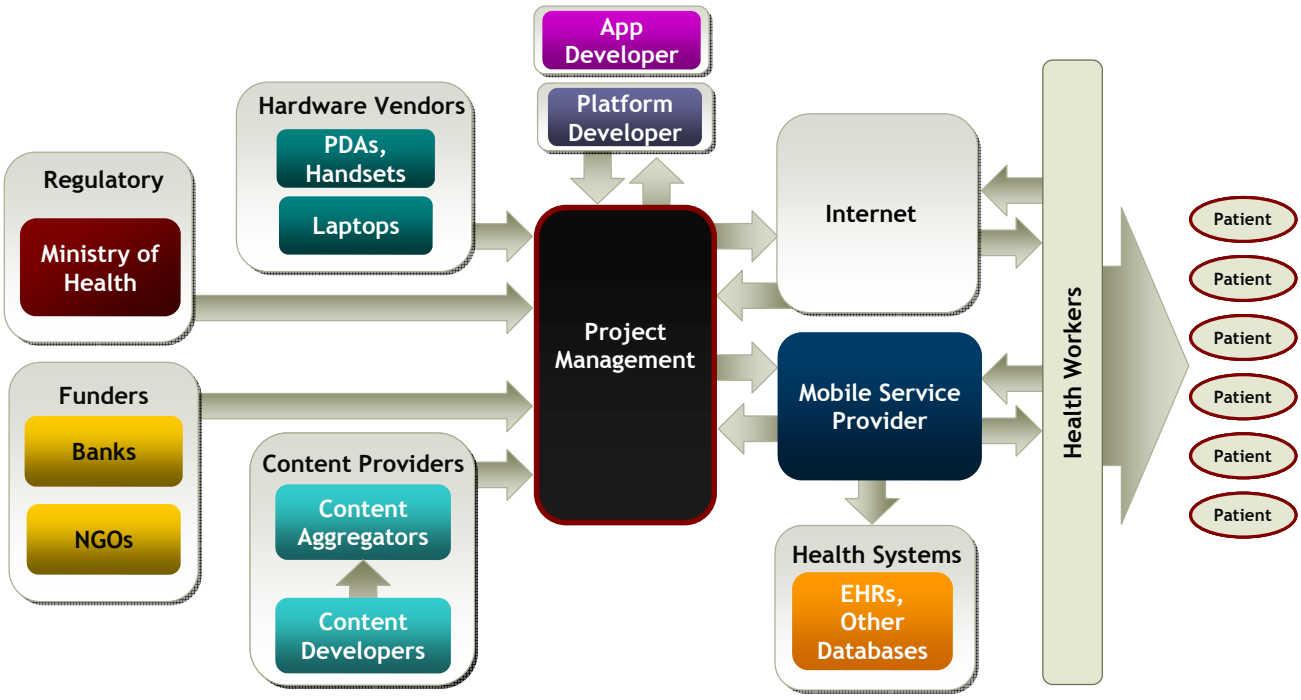
For a small, local program, it is unlikely that one can obtain ongoing support for special modifications to handsets, for example. It is also unlikely that the program will be able to implement highly customized features for messaging functionality, since there is not enough volume to warrant contributions from the platform developer without prohibitive development and maintenance fees. On the other hand, the messaging service, even at small volumes, might dramatically reduce the costs and improve efficiencies of the health care provider who will no longer have to use manual labor to remind, educate or otherwise promote certain aspects of health care with patients.

However, at higher levels of scale, a program can represent strategic growth for the larger value chain participants (represented on the left side of the graphic). As such, they would find strong incentive to partner with program organizers to ensure sustainable success of the program. 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. This is especially true because the larger value chain participants—mainly information and communication technology vendors—are under exceptional pressure from the marketplace as well as from investors to grow company revenue and profit margins.

Value Chain Models for mHealth: Two-Way Data Applications

Figure 5 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: remote data collection, access to client records, access to health information databases, census taking, and electronic health records creation and storage. While it is not likely that two-way services will provide the volume potential of one-way services, two-way data services have a much broader appeal to potential participants because of their reliance upon Internet access. Because Internet access is an established mobile functionality on both phones and laptops and is the basis for other services, including voice over IP, participants in this value chain will have broadly based market interests and may find incentive to integrate mHealth services with those.

Figure 5: Value Chain Model for "Two-way" mHealth Applications



The complexity evident in Figure 5 creates a number of challenges and opportunities for participants.

- **Complexity of interactions**: More participants in the value chain means more costs to be spread out among more organizations who need to share the return. With multiple players in the chain, scaling becomes more difficult and may make service provision more expensive as it becomes harder to motivate additional organizations to participate in any way form of creative partnership. A higher number of participants also increases the need for oversight by all parties in the chain.
- **Increased dependence on IT infrastructure:** This model assumes a solid base of networks and infrastructure upon which the application can sit: databases, patient records and medical content, all accessible via mobile phones and laptops.
- **More sophisticated application development:** A more complex network and infrastructure environment puts more integration and programming demands upon value chain participants. Use of standardized programs can mitigate some of those demands.
- **More support service requirements**: Multiple value chain participants represent multiple components of the service. As applications expand, so do the requirements for training, IT services, platform management, and hosting.

- **More expensive hardware component**: Basic two-way data services can rely upon the functionality of most mobile phones. But as applications become more sophisticated, it becomes incumbent on hardware devices to offer the requisite functionality. This may push device suitability away from low-end mobiles toward high-end mobiles, handhelds and laptops, creating an additional hurdle of affordability to service success.
- **More complex solutions may need supplemental funding from aid agencies**: Complex programs with lower scale will struggle to find ways to motivate participation from for-profit partners as anything but a vendor of standard components at full price. As such, the provision of funding through aid agencies might be required as part of a program's model.

These differences between and dynamics within the value chain models are important for the coordination of a sustainable and scalable mHealth program with viable partners. The value chain depicted in Figure 4 above is for simple, one-way messaging. These types of applications, relying upon basic functionality and technical platforms, lend themselves to the largest scale and lowest cost in mHealth delivery. With volume, therefore, they offer compelling partnerships with the larger members of the value chain (those on the left of the value chain in Figure 4).

With more value chain participants and higher costs of execution, there is less financial reward (whether in the form of profitable revenue or operational efficiencies) to go around. It therefore becomes progressively more difficult to reach the financial impact that gains interest and partnership with larger organizations. Their contribution to the more complex programs, therefore, will likely be limited to the provision of standard services or as a one-off corporate social responsibility project.

For further discussion of concepts and challenges of the value chain, readers are encouraged to see *Promoting Private Sector Investment and Innovation*[12], a World Bank report funded by Alcatel and infoDev. Of particular relevance to this discussion is that report's case study of a telemedicine program to provide remote radiology services in Mali. As a more "complex" solution, growth of this otherwise successful program was hampered by many of the issues described above, including Mali's exorbitant loan collateral requirements, lack of trained staff, costly Internet fees, and high Internet traffic latency.

Project Example: Uganda Health Information Network (UHIN)

Overview: UHIN is an AED-Satellife- and IDRC-backed program in Uganda that uses hand-held computers (PDAs) for data-collection and transmission purposes. Launched in 2003, there are now 350 PDAs in use through this program connected via the local GSM cellular network. The project is run in collaboration with Makerere University Medical School in Kampala.

Health workers in remote villages collect and enter data on their PDAs using digitized Ministry of Health (MoH) forms. To exchange data with the MoH or other health centers, the health care worker travels within range of an "access point," generally within a 5 km radius. Using Bluetooth and infrared technology, PDA users transfer data to an access point. Access points are battery-operated units, containing a GSM cellular transceiver and a data cache. Data can be cached for uploads during off-peak times to keep costs low. Uploaded to Makarere University medical school, the data is parsed and forwarded to appropriate health centers.

With each upload, the PDA is updated with new data: communications from the ministry, weekly health guidelines, and thrice weekly broadcasts of latest and appropriate articles. Each PDA can be separately identified and tracks whether health workers have picked up any new info as required by the MoH.

Each district typically has 34 different forms that are now completed and submitted electronically in all pilot districts. The program operates in five districts with 174 health centers, 600 health workers sharing PDAs, and a population of a million.

Funding for hardware (PDA devices) comes primarily from IDRC, Canada. Uganda Charted Healthnet, Makerere Medical School faculty, and District Health Services provide assistance in implementing and maintaining the database. Satellife provided implementation and training to develop and maintain electronic forms and content.

Status: Started as a pilot program 5 years ago and, with initial capital expenses and programming costs covered by start-up funding, it is now considered "self-sustaining;" operating costs are covered by the MoH. Among benefits cited by project managers, the program points to the elimination of printing charges for questionnaires and forms. Further, impact studies in one pilot region claimed 25 percent fewer errors when compared to re-entry of paper-based data.

Impact: Several studies were done with varying results:

- two districts reported obtaining close to a 100 percent compliance rate when using the network for their weekly disease surveillance reporting, compared to the national average of 63%;
- users reported improved data quality at point of collection and more timely access to data;
- for analysis, the use of PDAs in decision-making and rapid response to emerging situations was deemed to be "24% higher in cost benefits" than manual methods;
- several hospitals have modified software to use PDAs or laptops for digitizing internal administrative purposes such as tracking supplies, inventory and personnel records.

Sources: Uganda Health Information Network Project [13], AED-Satellife interview

Part 3 – *Scaling mHealth Services*

Despite the frequently touted claim of "near-universal" coverage by industry groups, and 80 percent cellular coverage in terms of global population, geographic coverage remains spotty in most developing countries.

Critical Success Factors: *Scaling mHealth*

1. Assure "fit" between mHealth applications and health care needs
2. Use simplest possible technology implementation
3. Combine mHealth with delivery of other mServices
4. Look for collaboration with telemedicine programs
5. Build tools for impact and success assessment

- Cellular coverage in Latin America covers more than 50 percent of the population in all except two countries. However, large and challenging geography limits *area coverage* to well less than half in all except four relatively small countries, while 10 of the countries have less than 20 percent coverage.[14]
- The Philippines population is 62 percent urbanized, compared to 29 percent for India. In the Philippines, almost the entire population has been served while covering only 50 percent of the geographical territory, while India has reached just 60 percent population coverage with area coverage of 40 percent.[15]

These data point to one of the many challenges in scaling mHealth programs. Since rural populations account for 2.9 billion of developing countries' 5.3 billion inhabitants[16], mHealth providers are sure to find themselves up against profound access problems in rural communities. Addressing these areas will require a mix of solutions including technology, government incentives and direct development aid.

Figure 6 (next page) represents the relationship between the number of patients served by each doctor and the level of care and follow-up possible with today's medicine ("comprehensiveness of care") in developing and developed countries. While the level of health care in developing countries is unlikely to approach that of developed countries in the foreseeable future, mHealth has the potential to drive health care improvements in both quality of care (comprehensiveness) and quantity (number of patients per doctor). The figure represents a future scenario in which mHealth enables doctors to provide better and more comprehensive care to more people—in developed countries as well as in the Global South.[17]

Figure 6: Scaling mHealth and its Impact on Health Care

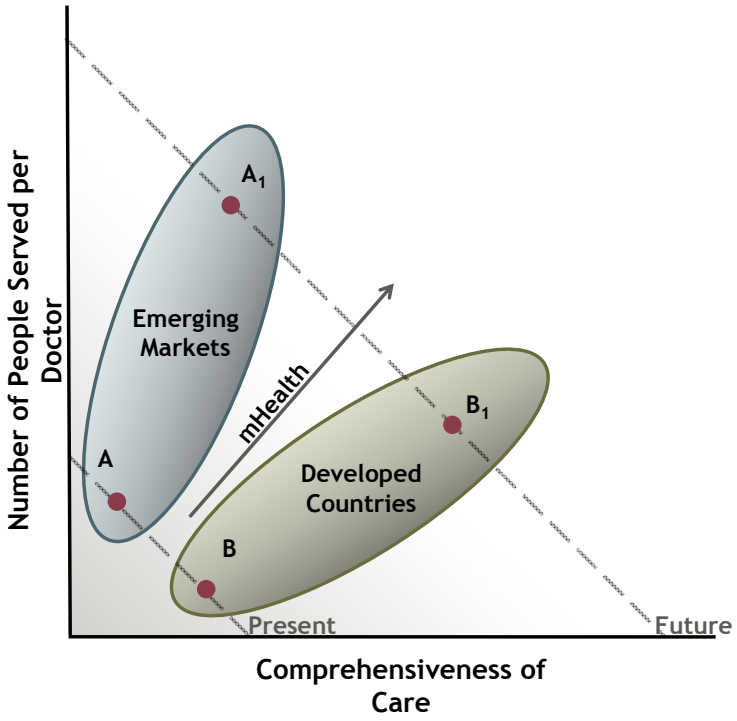


Figure adapted from Information Technology: Advancing Global Health [18]

Scaling mHealth: Critical Success Factors

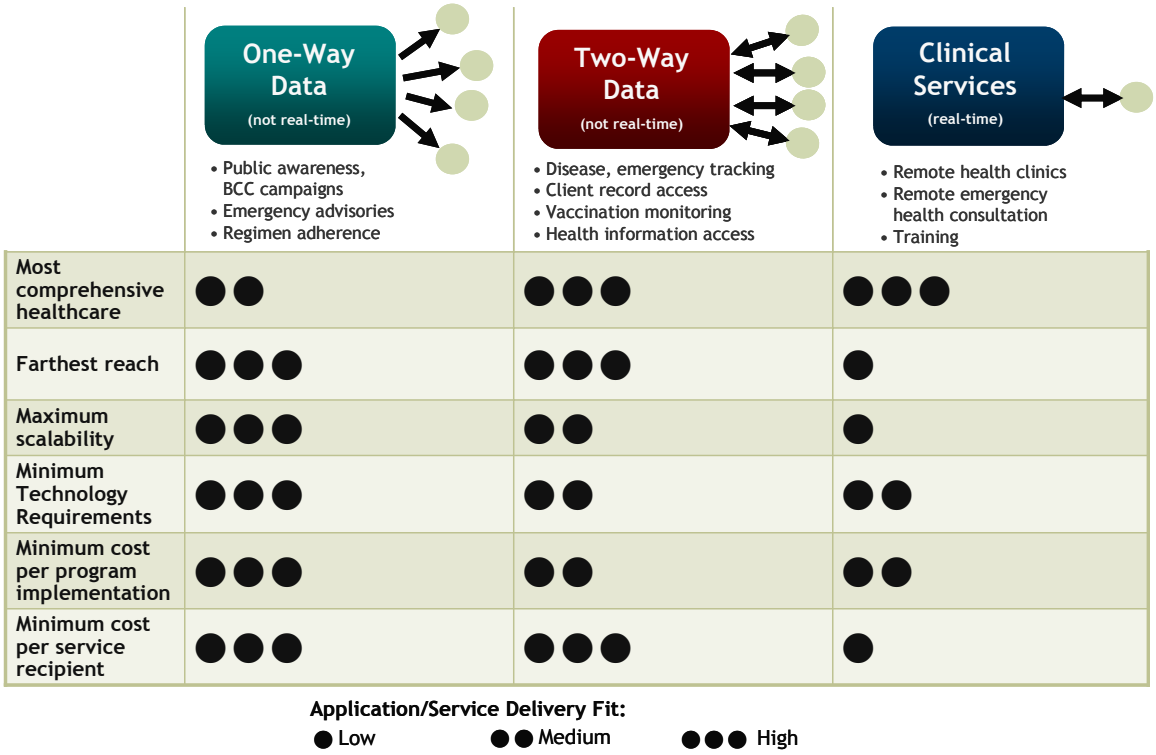
Based on its experience with and knowledge of scaling mServices in the developing world, and coupled with the mHealth project profiles developed for this report, Vital Wave Consulting has identified five key considerations for successful scale of mHealth programs. These are:

- Create the right "fit" between mHealth applications and health care needs
- Use the simplest, proven technology implementations
- Combine mHealth with delivery of other mServices
- Build upon the growing intersection of eHealth, mHealth, and telemedicine
- Support mHealth initiatives by providing guidance and tools to ensure proper impact and success assessment

Creating the Right "Fit" Between mHealth Applications and Health Care Needs

Figure 7 (next page) shows the relationship of mHealth technology options and how their characteristics may dictate appropriate target applications. In this graphic, mHealth solutions have been organized according to three corresponding technical application categories: one-way data, two-way data, and clinical services delivery. Each technology category has been rated (high, medium or low) for its ability to have positive impact on the program objectives stated in the left-hand column.

Figure 7: Fitting Technology and eHealth Applications to Health Needs



As reflected in Figure 7, the best application fit of mHealth services, given current technology, is through one-way and, to a lesser degree, two-way data services. The one-way data applications include education and awareness programs, emergency advisories, and medication adherence monitoring. Two-way applications involve disease and emergency tracking, client record access, vaccination monitoring and health information access. Conversely, clinical services (telemedicine services provided in real-time) are more costly and scale with difficulty compared to other mHealth applications but are best at delivering what is most critical in those applications, which is more comprehensive health care services.

Using the Simplest, Proven Technology Implementation

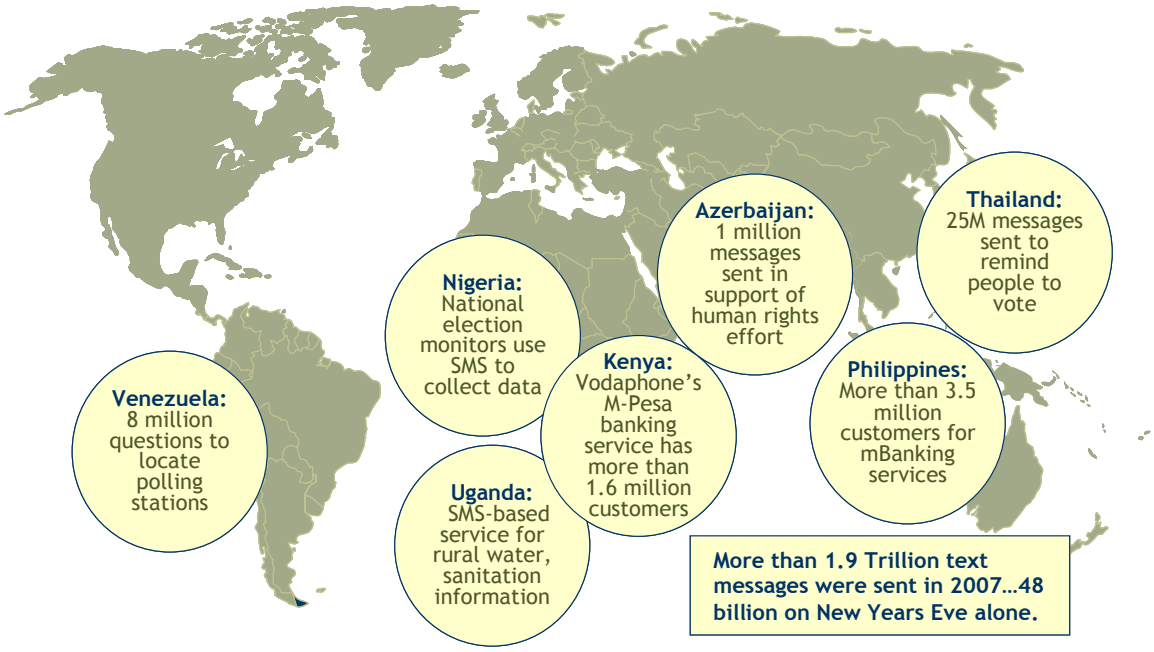
Many current mHealth programs build on the "cell phone" paradigm—services that can be delivered to and utilized by cell phone users. Early applications involve basic data access and exchange in the form of one-way or basic two-way services. The infrastructure for these applications is already in place through standard telecommunications network services. As a result, low-cost applications exist, and users have widely embraced the functionality. These simple applications have the distinct advantage of lower start-up and operating costs as well as broader reach and an easier path to a financially sustainable model.

Combining mHealth with Delivery of Other mServices

Figure 8, below, shows some of the rapidly growing mServices in developing countries. mServices, including mGovernance, mBanking, mCommerce, capitalize on the almost universal comfort and familiarity with text messaging. These services have been made even more accessible and popular through such programs as pre-paid SIM cards and widespread phone sharing.

But most importantly, many of these mServices demonstrate a convincing business model, not only for the service provider, but for banks or other partnering institutions. Likewise, there is some evidence to support the claim of a growing impact on the economic development of its users.[19]

Figure 8: mServices Growth in Developing Countries



Source: 2005 International Institute for Sustainable Development (IISD); Adeya, Nyaki [20]

Promoting mHealth with Social Networking

In the same period that cellular access has improved connectedness, community, and communication around the world, "social networking" has become one of the most widespread and effective means of changing behavior, developing awareness, and examining and advocating policy. Social networking initiatives are low-cost, can be created with country-specific and issue-specific orientations, and are easily tied to other services.

Social Networking in the Global South

- Orkut is the most visited website in Brazil and 3rd most visited site in India.
- Hi-5 is the leading social networking website in Latin American outside of Brazil.
- Friendster is the most popular site in the Philippines, Indonesia, and Malaysia.

The significance of social networking to mHealth is as a means to build "market presence" and gain traction for its services. Social networking sites with a development focus provide access to technical and health program professionals who contribute advice, education, and skills while supporting collaboration among and between nonprofit organizations and non-governmental agencies.

As social networking sites move to handsets, youth-oriented sites (Facebook, MySpace Orkut, Friendster, Hi-5, and others) will become important means of education and outreach.

"Information technology," says NetSquared founder Daniel Ben-Horin, "is moving away from what nonprofits have the least of [money] and toward what we have the most of [people and community]." [21]

Build upon the Growing Intersection of eHealth, mHealth, and Telemedicine

Telemedicine made the cover of *Radio News* magazine in 1924 with a picture of the "radio doctor" in front of a two-way video console examining a child.[22] Telemedicine initiatives became more common as a solution to rural or remote health care needs in the 1990s but it was not until the early 2000s that research results started to present convincing evidence of telemedicine's impact.

Telemedicine programs have sprung up throughout the Global South (more than 500 in India, one of the countries to have embraced the solution). Telemedicine centers provide access to real-time medical consultants and diagnosis but have increasingly been tied to other remote initiates (for example, village phone operators). Building collaboration with telemedicine programs helps build scale for mHealth initiatives, provides access to Internet-based content and infrastructure, provides an "office" from which health workers can operate, and provides a means of rapid referral when more severe intervention is required.

Support mHealth Initiatives by Providing Guidance and Tools to Ensure Proper Impact and Success Assessment

Two of the first three mHealth projects contacted during the interview phase of this study had either lost or failed to receive funding. While this speaks to issues within the funding and aid community, both project spokespersons felt the bigger challenge was measurement of project success—how to demonstrate outputs and impact of mHealth services.

Measuring Impact in mHealth Services

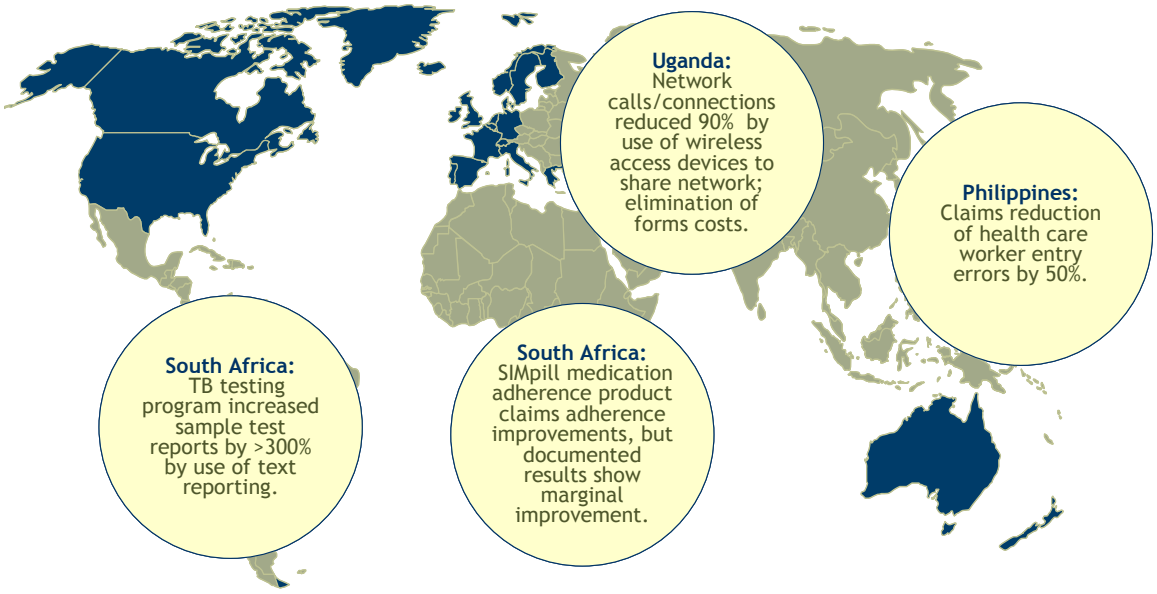
- "There are over 100 medications with over $1B in revenues and compliance numbers below 50%...can increase that to 95%."
- "In the first three months the number of samples referred for TB testing by six clinics increased by 333%, as compared with the three-month period before the project started."
- "…71% of the TB patient population had access to a mobile phone. The monthly cost of the SMS service to the local health authority was US$1.30 per patient. In the initial pilot study there was only one failure to complete the treatment amongst the 138 patients involved in the study."
- "40 percent of hospital readmissions for heart failure happen because patients fail to take their medications properly."
- "Fewer lost wages (27 visits, or 33.75 working hours) and lower travel costs (Rand 16 X 27 = Rand 432)."

Source: E-Health Insider [23], Technology Review [24], Vodafone Policy Paper Series [25]

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 absence of an existing body of data and literature to which program managers can refer as evidence.

Most of the impact data available has been reported by solutions vendors. Of the data reported in Figure 8 above, all came from vendor-sponsored studies. Figure 9 shows some of the data to date.

Figure 9: Demonstrating mHealth Impact: Measurement and Assessment



Scaling up mHealth by Scaling up Networks

In dramatically remote locations, satellite services have provided telephony and data services, but these services are expensive. The growing deployment of WiMAX, WiBRO, and other wide-area wireless solutions will undoubtedly help improve Internet coverage to remote areas, but wide-area build-outs will require a number of regulatory and licensing decisions.

Government and regulators have an opportunity to support this expansion through the licensing processes that includes such conditions as "pro-poor license obligations" for service providers and operators, creating space for local initiatives, and by helping make rural telephony profitable through supportive policies and multi-sector partnerships, an approach used successfully in Tanzania, Bulgaria, Lithuania and Romania.[26] [27]

Project Example: EpiHandy

EpiHandy is a mobile data collection and record access tool developed at the Center for International Health in Bergen, Norway. Initially the service was developed in response to problems faced by relief workers and researchers in remote rural areas of Ethiopia providing child nutrition, breastfeeding and HIV prevention service. EpiHandy is now deployed in Uganda, Zambia and South Africa, and has been used by Satellife as part of a program in Nepal.

EpiHandy was originally developed to run on handheld computers (PDAs), but has since been ported to mobile phones. The application is composed of three components: a study manager (a desktop application for designing forms), server (import and export of data) and a mobile client (data entry and validation, GPS positioning). Designed to run on any Java-enabled platform, the product has been tested on PDAs and mobile phones.

FUNDING: Initially funded through the Center for International Health, EpiHandy is a member of OpenROSA, an effort to coordinate the various programs developing open-source mobile data collection products. Partially funded by IDRC and WHO, EpiHandy says a 20-country project is presently underway. EpiHandy reports four-year funding to work with OpenROSA and also to collaborate with the IT faculty at Makerere University in Uganda to establish a set of tools such as medical records, surveys, clinical trials and regular data collection protocols.

STATUS: As an open-source application, EpiHandy is free to the user. Although it has been a part of many trials and projects, the extent of its deployment is not clear. Part of the collaboration effort is exploring new vertical markets requiring mobile data collection, such as census taking or clinical trials.

IMPACT: EpiHandy literature includes the results of a five-year user assessment of the system with 14 interviewers collecting information on breastfeeding habits and child anthropometry in rural areas of eastern Uganda. Results pointed to greatly reduced data entry errors and general user acceptance of the technology. Additionally, EpiHandy compared costs to those of the traditional paper-based surveys showing it to be cost effective in large surveys where paper, printing and data-entry costs were high.

Part 4 - *mHealth Evolution*

Looking Ahead: Evolving mHealth Services for Evolving Health Needs

World population demographics are evolving, technology is evolving, and both relatively quickly. There is general agreement on the basics of global change: increased spending on health care results in increased life expectancy, a declining birth rate and an aging population (see Appendix A).

Within 15 years, health care policy-makers and providers will be forced to turn their focus to prevention and early detection (rather than late-stage treatment) of non-communicable diseases as well as the health issues of an aging population: orthopedics, mental disorders, cancer, and elder care. Swelling urban populations will also see a rise in respiratory and other environmental health hazards.[28] [29]

At the same time, health services are expected to experience a possibly greater shortage of health care workers and inequality of health care worker distribution.[30]

Mobile technology can scale well to combat these evolving health challenges by helping to achieve lower-cost, wider coverage, multiplying mHealth solutions. Technology advances (next generation networks, WiMAX, more intelligent devices, specialized wireless devices, miniaturization of devices) will mean that mobile technology can tackle more health issues with more sophisticated solutions.

Critical Success Factors: mHealth Evolution

1. Anticipate and work toward the future state of technology capabilities and health care needs
2. Assume future areas of technology convergence between mobile and fixed technologies
3. Strengthen capacity to use mHealth applications within existing and planned IT infrastructure

Table 3: Evolving Health Care Needs

	Current Health Care Picture	Key Global & Demographic Changes	Tomorrow's Health Care Picture
Developing Country Health Needs	• Domestic violence. • Lack of resources for family planning. • Communicable diseases. • Fake, tainted pharmaceuticals. • Lack of immunizations. • Lack of safe water sources. • Household/workplace dangers - fire, accidents. • Improper nutrition. • Substance abuse, violence among school-aged children. • Mental health: depression, suicide. • Physical fitness, elder care. • Chronic disease care.	• **GDP growth increases spending on health care.** • **Traditional disease controlled (TB, smallpox); new diseases appear (SARS, avian flu).** • **Aging populations mean increase in death from non-communicable causes.** • **Declining birth rate, climbing life expectancy.** • **Adoption of "developed-country" behaviors.**	• Shift from "late stage" treatments to prevention, early detection. • Increased focus on elder care. • Increased focus on health issues of elderly. • Continued health worker shortages, distribution inequities.

Source: World Health Organization [31]

Future Health Needs and mHealth in Urban Populations

Much attention has been given to the challenges of rural health. Often overlooked is the growing crisis in urban health care. In 2008, the number of urban dwellers (3.4 billion) will equal, for the first time in history, the number of rural dwellers.[32] Although urban populations are often generalized as having better health levels than those of rural areas, many researchers believe that urban inequalities mask health differences.[33] Further, estimates put the slum population of developing countries at 38 percent of those countries' populations.[34]

Growing health care concerns of the urban population include[35]:

- Lack of *affordable* health services, water supplies, and sanitation facilities
- Poor sanitation and overcrowding conditions contribute to easy spread of communicable diseases
- Employment and income demands often conflict with health problems, delaying treatment
- Lifestyle and diet impact physical and mental health
- Threat of substance abuse

Evolving mHealth Solutions: Evolving Urban Health Needs

- Urban populations will provide the volume needed to scale mHealth services resulting in more care, better care, and more affordable care
- Health education and public awareness programs widely distributed via cellular services
- Mobile phones act as medical monitoring devices, health data and records managers
- Increase in scope and sophistication of mHealth applications enables greater care for travel-challenged, elderly populations
- Mobile devices dispense pills, monitor medication
- Handsets equipped with sensors and GPS to track and report air or water quality

Future Health Needs and mHealth in Rural Populations

Rural populations account for 56 percent of developing countries' 5.3 billion people.[36] The combination of geography, isolation, and poverty conspires with dramatic urban-rural disparities in resource allocation to create unique and often intractable health care challenges. Health care needs among rural populations are largely, though not entirely, aggravated by remoteness. Rural concerns include:

- Distance from health centers limits pre-natal and maternal care
- Distance from specialty services, even greater shortage of health care workers than in urban areas
- Lack of good education sources
- Susceptibility to climatic crises
- Nutrition, dietary issues
- Greater frequency of work-related injuries, burns
- Unpredictable mobile coverage and Internet access make even basic health services rare
- Threatened by civil strife, violence, displacement

Evolving mHealth Solutions: Evolving Rural Health Needs

- Greatly expanded, faster Internet and cellular coverage support health care worker training, distance learning
- Truly mobile health centers, not simply health centers on wheels; with broadband access for diagnosis, access to full health care services
- Health care IT systems include supply chain management applications, tracking availability of medical supplies
- Dangerous reptile or insect images broadcast to mobile phones
- GPS-enabled devices: health care workers have complete location confidence
- Monitoring and transmission of vital signs, blood sugar via mobile phones
- Handsets equipped with sensors and GPS to track and report air or water quality

Evolution of Mobile Technologies

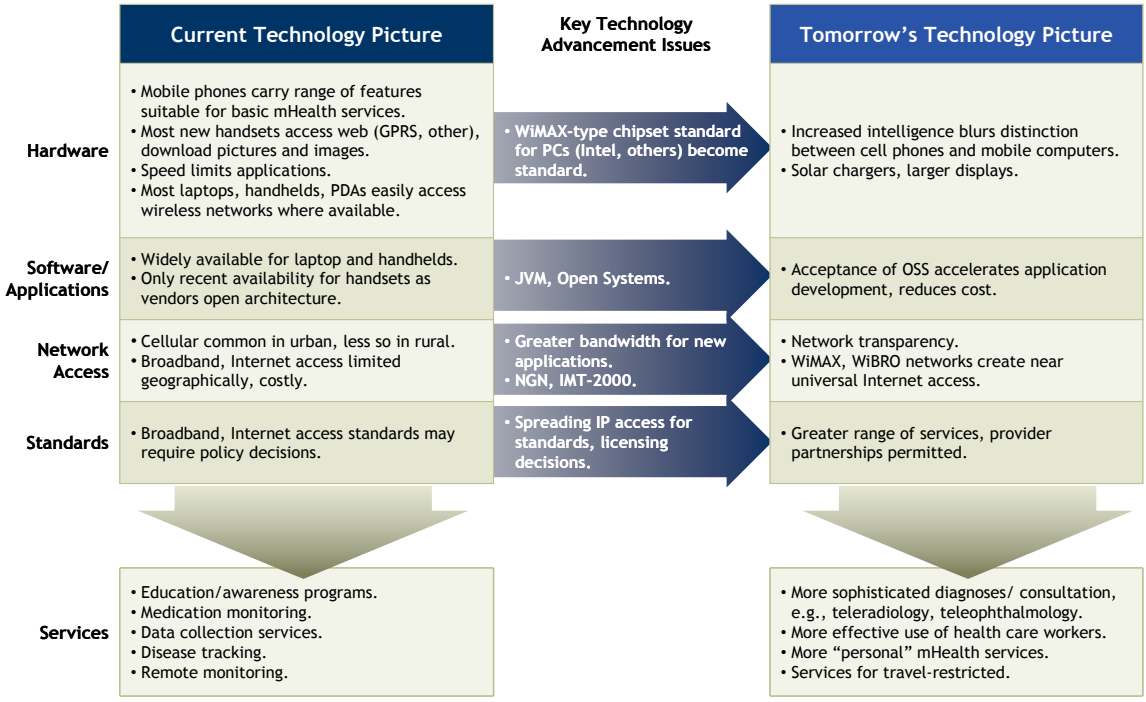
The key technology trends in mobile technology continue to be the same trends that have characterized ICT progress for the past 40 years: miniaturization, greater speed and cost reduction. These advances are reflected in mobile telephony by some of the advancement issues shown in Table 4. While the evolving technology picture will surely result in many mobile innovations, for developing countries the key focus remains access to technology—closing the digital divide. According to the 2007 Global Monitoring Report, ICT strategies in most regions have kept up pace with the MDG goals (with the exception of Africa).[37]

Access to ICT services—cellular or Internet—is the advancement that will most affect the uptake and success of mHealth services. 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 incentive for players, and helping push sustainable mHealth applications beyond simple one-way data services.

Over the next 10 to 20 years, advancements in mHealth technology will produce dramatic solutions to health needs in the Global South. But the *success* of mHealth will rest upon its ability to demonstrate scale and impact:

- Using appropriate technology for simple, effective and local applications
- Build participation by demonstrating benefits and incentives at all levels of the value chain
- Strengthen capacity to use mHealth applications within existing and planned IT infrastructure
- Support and drive greater monitoring and evaluation as a means to demonstrate impact and increase participation

Table 4: Evolving Mobile Technology Capabilities



Millennium Development Goals: 2007 Status

	MDG Performance 2007[38]		
	Reduce child mortality	Improve maternal health	Reverse HIV/AIDS, malaria, and other diseases
Sub Saharan Africa			
South Asia			
Latin America			
East Asia			
ME/North Africa			
Europe Central Asia			
Developing Countries			
■: more than 50% of countries in region off-track ■: more than 50% of countries in region on-track			

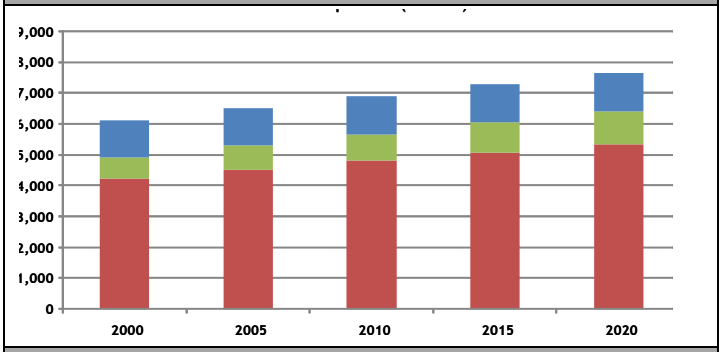
Information & Communication Technology Indicators

Key ICT Indicators:2006 (per 100 persons)				
	Main Lines	Cellular Subscribers	Internet Users	Broadband Subscribers
WORLD	19	42	18	4
Africa	3	22	4	<1
Americas	32	62	37	9
Asia	16	30	13	3
Europe	41	98	37	11
Oceania	37	73	40	14

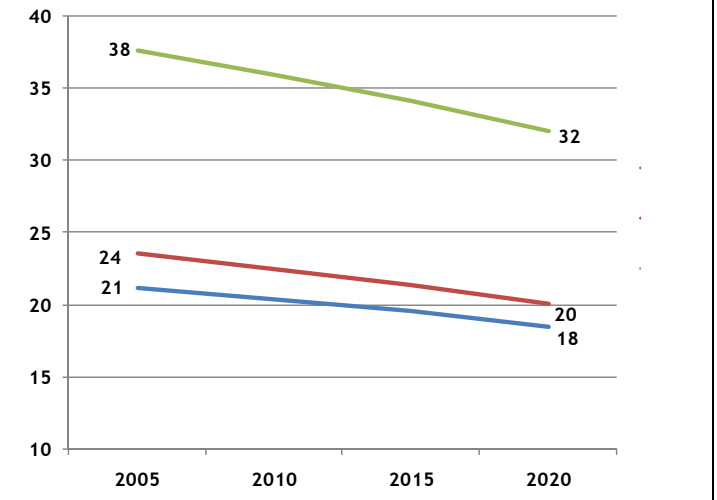
Source: International Telecommunication Union [39]

Evolving Demographics in the Global South

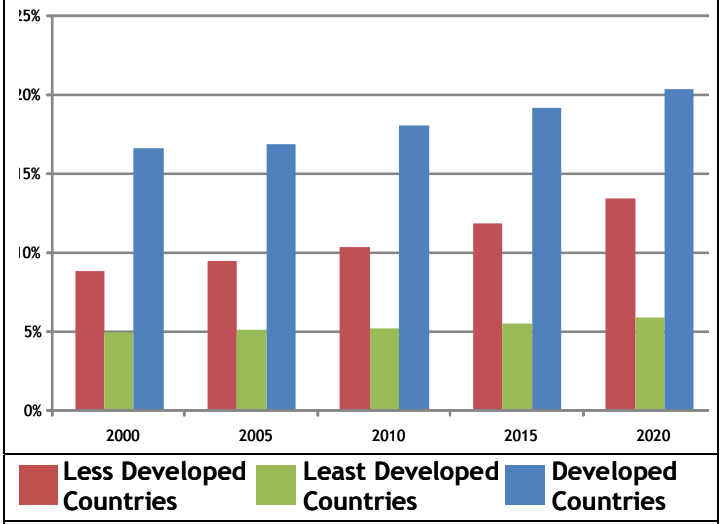
World Population (millions)



Birth Rate (per 1,000 people)



Population Over 60 Years of Age (% of region total population)



Source: UN Department of Economic and Social Affairs

Appendix B — mHealth Project List

The following tables represent the results of Vital Wave Consulting's research of mHealth programs, projects and initiatives. Although this data was supplemented through interviews with project representatives, most of it comes from available company sources.

The project listing does not include telemedicine projects or eHealth projects (unless they specifically employed mobile technology as a key element of the project), nor do they include mHealth projects in developed countries (unless there was a specific link to developing country implementation).

Many of the projects listed here have been determined to be inactive due to funding or partnership issues. An effort was made to identify those projects. Likewise, some projects are not truly projects; they may be programs in search of funding or sponsorship, or they may be software offerings. Again, an effort was made to identify those listings appropriately.

Project				
Project name	Alerta DISAMAR	Andhra Pradesh AESSIMS	Cell-Life	EpiHandy
Address	1990 K Street NW, Suite 400, Washington, DC 20006 USA	Voxiva India Pvt.Ltd. G-44, First Floor, Sector - 3, Noida, Uttar Pradesh (U.P.) - 201301	CPUT BARC Buildling 80 Roeland Street Cnr Brandweer/Waterloo St Gardens, 8001 Cape Town South Africa	Centre for International Health Armauer Hansen Bd, N-5021 Bergen, Norway
Phone	(202) 419 0130	91 120 4034700	27 (0)21 469-1111	47-55-97-49 61
URL	www.voxiva.net/news/121603.asp	www.voxiva.com/aessims.asp	www.cell-life.org	www.epihandy.com
Email	info@voxiva.net	info@voxiva.net	info@cell-life.org	epihandy@gmail.com
Contact name		Laura Cooley, Communications Officer	Simon Kelly, Technical Development Manager	Jorn Klungsoyr
Address		PATH 1455 NW Leary Way Seattle, WA 98107		Skype ID: jornklung
Phone		(206) 285-3500		47-913-65-731
Email		lcooley@path.org	simon@cell-life.org	Jorn.Klungsoyr@cih.uib.no
Key health care need addressed	Disease monitoring	Improve immunization services for diphtheria, hepatitis B, Japanese encephalitis, measles, pertussis, tetanus, polio and tuberculosis	HIV/AIDS	Survey design and data collection for health research using PDAs
Project description	Report and access disease incidence data using either telephone or Internet	Report disease by telephone and web-based technology	Program to support the provision and distribution of Anti-Retroviral Treatments (ART), continuous patient monitoring, communication of data via mobile phones, Internet	Product for developing data collection surveys, forms for health research; runs on PDAs
Type	Disease tracking	Disease, emergency tracking	Medication monitoring, compliance	Data access
Implementing Organization				
Name(s)	Peruvian Navy	PATH, Voxiva and the Government of Andhra Pradesh (GoAP)	Cell-Life (a collaboration of academics and students from the University of Cape Town, Cape Peninsular Institute of Technology and the corporate sector)	EpiHandy, Centre for International Health and University of Bergen
Funding				
Funding source(s)	Government spending	PATH and the Government of Andhra Pradesh (Part of a larger 5-year $27 million grant from the Gates Foundation to PATH to specifically reduce the incidence of Japanese encephalitis)	Vodacom Foundation and the Raith Family Trust	Centre for International Health, University of Bergen and IDRC
Government/Regulatory Involvement				
Health agency, health ministry		Government of Andra Pradesh; Dr. Mastan Rao, Director of Health in Andhra Pradesh		
Demographics				
Location(s)	Peru	Andhra Pradesh (Kurnool district)	South Africa	Ethiopia and Uganda
Targeted health care providers or users	Public health workers, doctors	Public health workers	Doctors, nurses, hospitals	Remote health care workers
Activity Dates				
Launched	2002	2004	2000	2003
Technology				
Hardware type and provider	Mobile phone		Mobile phone	Computers, mobile phones, PDAs
Software product and provider	Voxiva	Voxiva	Open source - iDart	EpiHandy
Mobile service provider				
Service Cost Issues				
Who pays for application?		Government		CIH
Who pays for hardware?				
Who pays for service/airtime?				
Impact Measurement				
Metrics: How? When?		More than two million women and children vaccinated under this program each year confirmed by 2006 study		

Project				
Project name	EpiSurveyor	Freedom HIV/AIDS (also Africa Reach Program)	FrontlineSMS	HealthMapper
Address	804 Vernon St NW, 2nd Floor Washington, DC 20009 USA	Freedom HIV/AIDS Initiative ZMQ Software Systems 187, Vaishali, Pitampura New Delhi 110088, India		Public Health Mapping and GIS Programme International Health Regulations Coordination World Health Organization 20 Avenue Appia CH-1211 Geneva 27 Switzerland
Phone	202-470-0810	91-9871981960		(41-22) 791-3836/1861
URL	www.datadyne.org	www.freedomhivaids.in/About.htm	www.frontlinesms.com/index.htm	www.who.int/health_mapping/tools/healthmapper/en/index.html
Email	info@datadyne.org	Hilmi@zmq.in		health_mapping@who.int
Contact name	Joel Selanikio, DataDyne.org	Hilmi Quraishi, Co-founder, CTO	Ken Banks www.kiwanja.net	
Address				
Phone		91-9871981960		
Email		Hilmi@zmq.in		
Key health care need addressed	Remote data collection	HIV/AIDS awareness	mServices SMS program	Surveillance information, disease alert
Project description	Data collection on vaccination, HIV	HIV/AIDS awareness using mobile phone games	Frontline SMS text-message program offered free-of-charge to non-profit organziations for use in various mServcies	Surveillance and mapping software product for infectious disease information; facilitates data standardization; allows collection and updating of data on epidemiology and interventions, visualization of data
Type	Data access	Education, awareness	Education, awareness	Disease, emergency tracking
Implementing Organization				
Name(s)	In trial	ZMQ Software Systems	kiwanja.net	WHO and Google Maps
Funding				
Funding source(s)	UN Foundation, Vodafone Group Foundation and WHO	Delhi State AIDS Control Society and Chief Minister of Delhi		WHO and state governments
Government/Regulatory Involvement				
Health agency, health ministry	Ethiopia Ministry of Health, Ghana Ministry of Health, Uganda Ministry of Health, Zambian Ministry of Health	Ministry of Health & Family Welfare		WHO, UNICEF
Demographics				
Location(s)	Ethiopia, Ghana, Uganda and Zambia	India and Africa	Africa	Indonesia, East Africa, Afghanistan, Niger, Ethiopia
Targeted health care providers or users	Remote health care workers	School-age cellular subscribers	Non-governmental organization sector	Government, health agencies
Activity Dates				
Launched	2007	2002		1993
Technology				
Hardware type and provider	PDAs	Mobile phone, computer	Mobile phone, computer	
Software product and provider	EpiSurveyor	ZMQ Software Systems		GIS programme, based on ArcView
Mobile service provider	Datadyne		User organization	
Service Cost Issues				
Who pays for application?	EpiSurveyor is a free, open-source software	Most from Delhi State AIDS Control Society	The FrontlineSMS software	WHO and governments
Who pays for hardware?				
Who pays for service/airtime?	Health agency, health organizations			
Impact Measurement				
Metrics: How? When?		Download of 10.3 million game sessions in 15 months from launch; more games downloaded in smaller cities and towns than large urban areas		

Project				
Project name	InSTEDD	m-CST Manager	M-DOK	Mobile4Good/Kazi560
Address	400 Hamilton Avenue, Suite 120 Palo Alto, CA 94301 USA	ZMQ Software Systems 187, Vaishali, Pitampura New Delhi-110088, India	SynapseHealth Solutions Unit 308 Amberland Plaza, Dona Julia Vargas Avenue Ortigas Center, Pasig City, Philippines 1500	Mobile for Good Ltd, 4th Floor, Kimathi House Kimathi Street, Nairobi, Kenya
Phone	(650) 353-4440 (877) 650-4440 (toll-free within the US)	91-9871981960	63 2 6345495	254 (0)20 251 892
URL	instedd.org	www.freedomhivaids.in/About.htm	www.synapsehealth.com	www.kiwanja.net/database/kiwanja_searchdetails.php?id=100
Email	info@instedd.org	Hilmi@zmq.in	info@synapsehealth.com	kazi560@gmail.com
Contact name	Dr. Eric Rasmussen, CEO	Hilmi Quraishi, Co-founder, CTO	Dr. Ayedee Ace Domingo	
Address			SynapseHealth 8A Malumanay Street, Sikatuna Village Quezon City 1101, Philippines	P.O. Box 43017-00100, Nairobi, Kenya
Phone	(650) 353-4440	91-9871981960	63 917 537 2023	
Email	Rasmussen@InSTEDD.org		ayedee.domingo@synapsehealth.com	
Key health care need addressed	Disease tracking and disaster response	Monitoring of HIV/AIDS patients	Electronic patient record	Information services
Project description	Designs programs using technologies and services to more rapidly detect and respond to global health threats and natural disasters	Client-server application for people lliving with AIDS	SMS-based health data collection program for PDAs	Provide information about health, employment and community via SMS to inform and empower disadvantaged individuals
Type	Disease, emergency tracking	Monitoring	Data access	Education, awareness
Implementing Organization				
Name(s)	InSTEDD (Innovative Support to Emergencies Diseases and Disasters)			Mobile For Good Kenya company
Funding				
Funding source(s)	Benificus Foundation, Jane and Peter Carpenter, Google.org, The Rockefeller Foundation, Wilson, Sonsini, Goodrich & Rosati, Silicon Valley Community Foundation and Philanthropic Ventures Foundation		Partial funding from IDRC (US$29,784)	Originally funded by Vodafone Group Foundation, now under Mobile for Good Kenya company with additional support by Accenture and MacArthur foundations
Government/Regulatory Involvement				
Health agency, health ministry	Particpating countries' ministries of health		Philippine Council for Health Research and Development (PCHRD)	
Demographics				
Location(s)	Cambodia, Lao, Myanmar, Thailand, Vietnam, Yunan Province of China	Seeking partners	Philippines (not presently opertaing)	Kenya
Targeted health care providers or users	Government, health agencies	People living with AIDS	Remote health care workers	Cellular subscribers
Activity Dates				
Launched	2007		2005	2006
Technology				
Hardware type and provider	Computers, mobile phones, PDAs		GPRS, PDA	Mobile phone
Software product and provider		ZMQ Software Systems	Mobile telehealth system. Symbian C/C++ and Java	
Mobile service provider				Mobile service provider
Service Cost Issues				
Who pays for application?	Governments and companies			End users
Who pays for hardware?				
Who pays for service/airtime?				End users
Impact Measurement				
Metrics: How? When?				Approximately 70,000 use mobile phone services; 60,000 got employment through the Kazi560

Project				
Project name	mPedigree	On Cue Compliance	Peru Nacer	Rural Extended Services and Care for Ultimate Emergency Relief (RESCUER)
Address	Accra, Ghana New Hampshire and Essex	64-74 White Rd Retreat 7945 South Africa	Voxiva SRL Calle Arica 628, Piso 4 Miraflores, Lima 18 Peru	Makerere University, P.O. Box 7062 Kampala Uganda
Phone		27 21 710 6202	511 712 5444	256-41-534149/533475
URL	mpedigree.com/home	www.simpill.com	www.voxiva.com/nacer.asp	www.worldbank.org/afr/ik/iknt40.pdf
Email	agogo@mpedigree.org	info@simpill.com		lip97mgm@Sheffield.ac.uk
Contact name	Bright B. Simons and Ashifi Gogo	Dave Rosa, President	Guillermo Delgado Aparicio, Managing Director, Peru	Dr. Maria G.N. Musoke, Uganda Population Secretariat
Address		Clinical Technology Advisors, Inc. P.O. Box 2800 Acton, MA 01720 USA		
Phone		(978) 263-9596		
Email	ashifi@gmail.com	david@simpill.com		lip97mgm@Sheffield.ac.uk
Key health care need addressed		Medication adherence	Maternal and child health	Maternal health and family planning
Project description	SMS service for drug verification	SMS or text messages sent to patients as reminders for medication, appointments	A phone- and web-based database information and communication system for exchange of health information among providers and regional hospitals; accessed by wireless or wireline	RESCUER program was a referral project designed to address the high maternal mortality rate in Uganda and to empower Traditional Birth Attendants (TBAs)
Type	Monitoring, compliance	Monitoring	Data access, diagnosis, consultation	Data access
Implementing Organization				
Name(s)	Syncrytel	SIMpill	Voxiva and Pathfinder International	Ugandan Ministry of Health
Funding				
Funding source(s)	NCIIA- Advanced E-Team grant (National Collegiate Inventors and Innovators Alliance)		USAID	Ugandan Ministry of Health and United Nations Population Fund (UNFPA)
Government/Regulatory Involvement				
Health agency, health ministry			Regional Health Directorate of Ucayali	Ugandan Ministry of Health
Demographics				
Location(s)	Ghana	South Africa	Ucayali, Peru (not presently operating)	Uganda
Targeted health care providers or users	Pharmaceutical stores		Health posts, medical experts, regional hospitals	Traditional birth attendants, midwives, technicians
Activity Dates				
Launched	2007	2005		1996
Technology				
Hardware type and provider	Mobile phone		Phone (satellite, fixed-line, mobile or community pay phone)	A solar-powered VHF radio system, "walkie talkies"
Software product and provider		SMS	Voxiva	
Mobile service provider				
Service Cost Issues				
Who pays for application?	Syncrytel, its partners and its end-users			
Who pays for hardware?				
Who pays for service/airtime?				
Impact Measurement				
Metrics: How? When?		Pilot test in 2005 with Bridges		Maternal morality reportedly declined by more than 50 percent over three years

Project				
Project name	Rwanda TRACnet (MTN system)	Satellife	SIMpill	TeleDoc
Address	Voxiva Rwanda S.A.R.L. 5th Floor Telecom House ICT Park, P.O. Box 6439, Kigali, Rwanda	30 California Street Watertown, MA 02472 USA	64-74 White Rd Retreat 7945 South Africa	Jiva Ayurveda, Jiva Marg, Sector 21B Faridabad, Haryana, India
Phone	250 0830 1291	(617) 926-9400	27 21 710 6202	91-129-2431198
URL	www.voxiva.com/rwanda.asp	www.satellife.org/index.php	www.simpill.com	www.jiva.com
Email	jbkoama@voxiva.net	Online email: www.satellife.org/contact.php	info@simpill.com	info@jiva.com
Contact name	Dr. Jean Baptiste Koama		Dave Rosa, President	Partap Chauhan, Director
Address			Clinical Technology Advisors, Inc. P.O. Box 2800 Acton, MA 01720 USA	
Phone			(978) 263-9596	
Email		Online email: www.satellife.org/contact.php	dave@clintechadvisors.com	
Key health care need addressed		Health improvement in rural areas and health information	Medication adherence for tuberculosis	Remote health care needs
Project description	Program to collect, store, retrieve, and disseminate critical program, drug and patient information related to HIV/AIDS care and treatment	Global communication network with free or low-cost email and access to HealthNet Information Services; provides locally generated information resources, information technology (IT) training, electronic conferences and web-based services	Medication dispenser with mobile phone technology to remind patients to take medicine; tracks records, collects data of patients	The TeleDoc Mobile Information System (MIS) uses mobile phones to input patient data
Type	Data access	Data access, content	Monitoring	Data access
Implementing Organization				
Name(s)	Rwandan government in partnership with Voxiva, MTN and GSM Association	AED-SATELLIFE and East African ministries of health	SIMpill, City of Cape Town	
Funding				
Funding source(s)	Ministry of Health and the Treatment Research and AIDS Centre (TRAC)	Multiple funding partners	Self-funded	George Soros Foundation, The Flora Family Foundation, Media Lab Asia and the Center for Future Health (Univ. of Rochester)
Government/Regulatory Involvement				
Health agency, health ministry	Treatment Research and AIDS Centre (TRAC), Rwanda Ministry of Health	Local ministries of health, Academy for Educational Development	City of Cape Town, South Africa	
Demographics				
Location(s)	Rwanda	Uganda	South Africa	India
Targeted health care providers or users	Public health workers	Care providers in rural areas	Doctors of tuberculosis patients	
Activity Dates				
Launched	2005	1999	2002	2002
Technology				
Hardware type and provider	Mobile phone, computer	Web telephone, PDAs	Mobile phone	
Software product and provider			SIMpill	
Mobile service provider	National phone company, RwandaTel, and the country's cell phone provider, MTN-Rwandacell			
Service Cost Issues				
Who pays for application?	Government	Collaborating organizations (including WHO) and governments	Project owner	
Who pays for hardware?				
Who pays for service/airtime?	90% access via toll-free PSTN			
Impact Measurement				
Metrics: How? When?	More than 200 site level users; more than 90% of users access the system via a toll-free PSTN interface	HealthNet Uganda has trained nearly 100 medical personnel in basic Internet tools; currently about 60 sites connected to HealthNet, including the Mulago Hospital, the main referral and teaching hospital in Uganda	At the pilot clinic, 71% of TB patients had access to a cell phone; SIMpill claims only one treatment failure in 138 patients	

Project			
Project name	The Africa Health Infoway	Virtual Mascot (Virtual Health Pet)	Wireless Health Monitoring System
Address	World Health Organization Avenue Appia 20 CH - 1211 Geneva 27 Switzerland	Atech Tecnologias Criticas Rua do Rocio, 313 - 11º andar Vila Olímpia 04552-000 - São Paulo - SP	Beijing Perfect Sky Information Technology Company 东城区和平里东街 民旺乙19号 中粮凯达大厦308室
Phone	41 22 791 2111	55 (11) 3040-7300	13801354892
URL	www.who.int/kms/initiatives/ahi/en/index.html	www.atech.br/_new/en/aatech/quemsomos.php	
Email		Online email: www.atech.br/_new/en/misc/faleconosco.php	
Contact name	Dr. Yunkap Kwankam	Fabiane Bizinella Nardon, Director of Technology	
Address		Vidatis	
Phone	41 22 791 2527		
Email	kwankamy@who.int	www.vidatis.com.br	
Key health care need addressed	Health IT	Monitoring elder health	Remote health care
Project description	System to support the collection of sub-national health data and statistics, dissemination of data, strengthen capacity of African countries to use information in decision making	A tamagochi, or virtual pet, is installed in the cellular phone and interacts with the user, reminding to take medication while it checks the patient's well-being	Monitors health data for cardiogram readings, pulse, blood pressure, body temperature, vital signs; wireless transmission
Type	Health care IT systems	Monitoring	Monitoring
Implementing Organization			
Name(s)		Atech and Vidatis	Beijing Perfect Sky Information Technology Company
Funding			
Funding source(s)	DFID (UK)	Self-funded	
Government/Regulatory Involvement			
Health agency, health ministry			
Demographics			
Location(s)		Brazil	China
Targeted health care providers or users		Care providers of elderly, diabetics	Physicians
Activity Dates			
Launched	2006	2006	2006
Technology			
Hardware type and provider		Mobile phone	Wireless technology
Software product and provider		Atech and Vidatis	
Mobile service provider			
Service Cost Issues			
Who pays for application?		Company	
Who pays for hardware?			
Who pays for service/airtime?			End users
Impact Measurement			
Metrics: How? When?			

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