WHITE PAPER
Digital Health
Intel® Health IT Value Model (HITVM)
for Developing Nations
Intel® Atom™ Processor-Based Netbook PCs

Increasing Healthcare Delivery by 270% to Underserved Communities Using a Scalable ICT Solution

A practical, disciplined approach that increases capacity and optimizes resources has moved beyond its pilot phase and is scaling successfully

In Nigeria, mobile healthcare teams armed with innovative, appropriate ICT expand healthcare capacity and increase healthcare delivery to underserved rural and urban areas and boost disease reporting rates. Since the pilot phase proved effectiveness and efficiency by increasing patients seen by 270% and disease reporting by 900%, it's been successfully scaled to include more mobile teams, more communities, more primary healthcare clinics, more hospitals, and more trained clinicians—now reaching over 400 communities and expanding to 113 Local Government Areas.

Challenge: Reaching Rural Populations with Limited Resources

The healthcare challenges presented by communicable diseases, increasingly high rates of chronic diseases, and aging populations present formidable difficulties for middle- and low-income countries, especially considering the limited healthcare resources available. These countries will see elderly populations increase four-fold to 813 million by 2015. While developing nations struggle to meet healthcare-related Millennium Development Goals (MDGs), 80 percent of deaths in these areas are due to chronic disease. In Africa, Sub-Saharan nations are hardest hit and, without healthcare reforms that build greater capacity and access to services, are subject to wide-reaching negative social and economic implications.

In early 2009, the Nigerian Federal Capital Territory Millennium Development Goals Unit (FCTMDGU), health officials, and Intel Corporation began discussing ways that Information and Communication Technology (ICT) could be used to improve health and healthcare delivery in rural areas. The FCTMDGU was committed to pursuing improvements in Millennium Development Goals 4 (reduce child mortality), 5 (improve maternal health) and 6 (combat HIV/AIDS, malaria, and other diseases).[1] But within the Federal Capital Territory (FCT), residents of over 800 villages had little or no access to primary healthcare. Health officials struggled to measure the impact of health programs and to optimize the severely constrained healthcare worker resources available. There was minimal capability to gather and use healthcare data in a timely manner to recognize disease trends and act quickly to alleviate problems (such as disease outbreaks) or mobilize the appropriate resources where needed at the right time.

Regional officials estimated that adequately serving the population would require 434 Primary Health Centers (PHCs), but only 179 existed, many of which were operating at sub-optimal levels or located long distances from rural populations. Such a large expansion of the number of traditional PHCs was clearly cost prohibitive. Effectively meeting MDGs and treating chronic illness would require a very different approach, and it was clear that ICT could play a major role if it could be effectively implemented to deliver a more cohesive continuum of care.

Conceived to address the health services delivery needs of the remote, poor communities and to fast track progress on Millennium Development Goals 4, 5, and 6, the Mailafiya Health Program is showcasing the positive impact that ICT can make on improving healthcare delivery.

These discussions led to the Mailafiya Health Program, a public-private partnership between the FCTMDGU and Intel Corporation. Mailafiya, which means "Giver of Health," is a strategic program that harnesses ICT to increase access to health services for rural and under-served urban populations in districts surrounding Abuja. "We knew that we had challenges in meeting the Millennium Development Goals 4, 5, and 6," says Isa Ari, coordinator of Millennium Development Goals for the FCT. "Even collecting baseline data was difficult. So we asked our team, how can we innovate to achieve these goals? The resulting Mailafiya Health Program is a complete health delivery service using ICT that can reach the poor effectively. Even in the pilot phase, the program reached 336 communities." Due to the program's success in the pilot phase, it has subsequently been expanded to 90 more communities.

Using ICT in a Carefully Designed Program to Address Health Disparities

In determining how ICT could best be applied to Nigeria's healthcare challenges, the FCT and Intel took a careful approach to analyze and design an appropriate program to ensure that objectives were clear, any solutions would be scalable, and success metrics were well defined upfront. A number of key strategies were identified:

- **Base plans on a robust value model.** To establish appropriate objectives and keep program design focused on them, planners utilized the Intel® Health IT Value Model (HITVM) for Developing Nations.[2] The Intel HITVM helped planners choose from established value categories to achieve agreement on key objectives that were aligned to healthcare-relevant MDGs.
- **Standardize on Electronic Health Records (EHR) and Electronic Registries for reporting MDG performance,** to reduce costs over time and greatly improve data quality and availability.
- **Utilize standards and open source technologies wherever feasible,** to keep costs down and enable easy scaling of successful solutions.
- **Link any new services or capabilities to the existing public health services structure,** to maximize effectiveness and minimize adoption costs.
- **Clearly define project outcomes and timelines** for all internal and external stakeholders.

With these strategies in place, the FCT and Intel team began designing what would become a mobile PHC services delivery system that was well integrated into the existing PHC system.

Maintaining Focus on the Right Objectives and Building an Effective Solution

The Mailafiya Health Program initially consisted of six mobile medical teams, each composed of a doctor, a nurse, a community health worker, and a driver. (After the completion of the pilot phase, 6 additional mobile teams were added.) In addition to off-road trucks, basic healthcare tools, and drug kits, each team is equipped with cost-effective Intel-powered netbook PCs and software that enable data collection into an Electronic Health Record, including patient IDs and patient pictures captured using the Intel-powered PC's camera. The teams also carry an automated lab system for on-site diagnosis and treatment planning. These ICT tools help teams improve drug dispensing, treatment follow-up, and referrals. The improved data flow enables the right healthcare interventions at the right time and has revolutionized the way healthcare is being delivered to underserved urban and rural areas. Instead of the FCTMDGU working on inaccurate, lagging indicators, more accurate and timely healthcare data has greatly improved delivery of healthcare services and optimization of resources in these communities. This means significant improvements in the allocation of healthcare workers and

medications to communities based on near real-time data regarding community needs and health profiles.

Each facet of the program was carefully designed to maximize both effectiveness and extensibility:

Project scope, milestones, and duration. The program team used the Intel HITVM as a means to determine the program's focus, scope, and milestones. Not only did this guide the project's development, but it also enabled the clear presentation of the program's value to both internal and external stakeholders. A proof-of-concept duration of one year was selected with a view to roll out on a national scale if successful based on pre-agreed objectives and success metrics.

Community leader involvement. Using the Intel HITVM as a basis, workshops were held with various stakeholders including internal stakeholders (such as Ministry of Health and FCT officials) and external stakeholders (such as village tribal leaders and participating hardware and software vendors). This helped to build stakeholders' commitment and ensure that the mobile teams would be understood and accepted in the communities they deployed to. The program also carried out public workshops using traditional village messengers and pre-site visits by doctors to educate and familiarize rural residents with the program.

Open source software. The central software component is the District Health Information System (DHIS),[3] an open source platform already adopted in 18 countries. DHIS is a flexible platform for capturing and using health information for statistical analysis, trending, and reporting. For the Mailafiya Health Program, DHIS was modified to fit the FCT's specific needs, providing data entry covering over 140 different data elements and fully customized forms for patient records, test results, diseases, and medical conditions. The program has continued to add new data elements and usage models to the platform as needed. DHIS has proven to be key in helping to increase the efficiency of healthcare delivery: healthcare workers who previously reported spending 50 to 70 percent of their time manually recording statistics on paper forms now spend more time taking care of patients, and healthcare officials no longer have to make decisions based on data that is 6 to 12 months old. Other free or open source software tools used include XML tools, graphical viewing applications, a GIS map viewer, and data compression tools.

Millennium Development Goals	MDG KPIs
MDG 4: Child Mortality	
Children under five mortality rate per 1,000 live births	▪ Number of cases of guinea worm disease identified ▪ Increased number of cases identified where child is suffering from malnutrition ▪ Percent increase in birth weight of infants recorded ▪ Percent of babies who are administered the DPT (Diphtheria, Pertussis and Tetanus)
Children one-year old immunized against measles	▪ Number of vaccines administered per day ▪ Percent of children identified with measles ▪ Number of children referred to secondary care
MDG 5: Maternal Health	
Maternal mortality rate per 100,000 live births	▪ Number of births recorded ▪ Number of births where a midwife or clinician was recorded as present ▪ Percent of planned deliveries recorded
MDG 6: Disease	
Tuberculosis prevalence rate per 100,000 population	▪ Number of patients referred from primary care ▪ Percent increase in tuberculosis cases identified
People living with HIV, 15-49 years old, percentage	▪ Percent increase in people educated on safe sex practices ▪ Number of condoms distributed ▪ Number of new HIV/AIDS cases identified

Figure 1: Key Performance Indicators for Millennium Development Goals 4, 5, and 6

Low-cost, low-maintenance ICT hardware. At the center of the Mailafiya Health Program is a semi-ruggedized, highly reliable Intel-powered netbook PC specifically designed for rural use and first-time users.[4] These netbooks enable the collection of patient data (including lab test results, drug histories, and photographs) and the sharing of data through an Internet-based central database. "Using the Intel® netbook PCs, our teams are able to easily collect extensive patient data and treatment histories on site," explains Dr. Emmanuel Okpetu, leader of one of the mobile teams. "The PCs also make it easy to upload the data into a central database where it is used by healthcare managers to watch for trends in and across communities." By using an Internet interface, the solution increases the frequency of data uploads and helps overcome a lack of dedicated networking infrastructure. The PC's touch screen has provided valuable flexibility to doctors, helping enhance their healthcare services by fitting into their clinical practices with minimal intrusion.

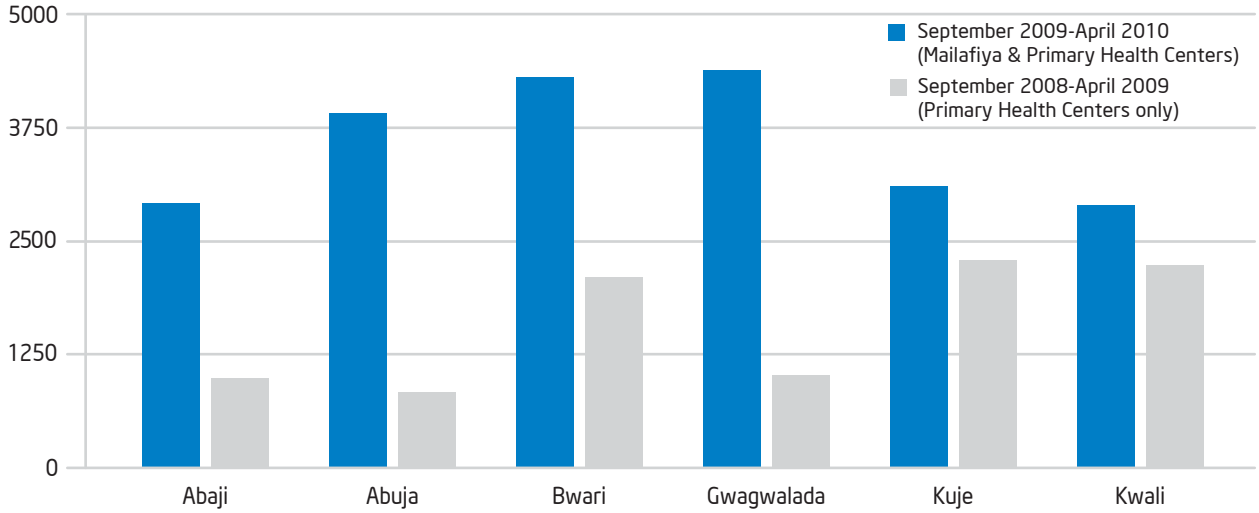


Figure 2: Increases in Patients Served

"Using the Intel netbook PCs, our teams are able to easily collect extensive patient data and treatment histories on-site. The PCs also make it easy to upload the data into a central database where it is used by healthcare managers to watch for trends in and across communities."

– Dr. Emmanuel Okpetu, Mailafiya Mobile Team Leader

Anticipating Issues Before Deployment

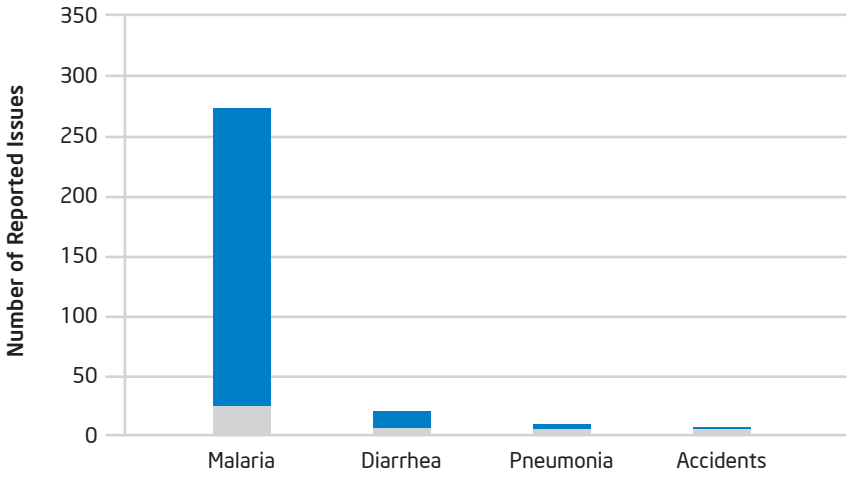
In addition to involving stakeholders in the program design in order identify key issues and potential problems, FCT officials and Intel focused on training healthcare workers prior to their deployment in mobile teams. This helped ensure that they would be able to use the tools and minimize problems in the field. All mobile team members received a full week of hands-on training which covered Intel PC Basics (using the Intel-powered netbooks being deployed with them), Microsoft Office* applications, database management software and the DHIS data entry tools.

The project team also anticipated that improved healthcare services in the field would increase the demand for services at the PHCs. With this in mind, ward capacities were analyzed and needed changes in resource scheduling and training requirements were identified. In the initial pilot phase, PHC personnel in 62 facilities were trained on minimum ward services so that as new patients entered the system they were appropriately cared for. As of July 2011, this has been expanded to 300 PHCs. By linking mobile services to existing PHC facilities and community structures, follow-up care and sustainable health practices were improved.

Real Improvements to Healthcare Delivery and Health Outcomes

The Mailafiya Health Project has shown significant measured improvements to the delivery of healthcare and the tracking of health trends. Using the Intel HITVM as a basis for program design has ensured a focus on the pre-agreed Key Performance Indicators (KPI) associated with Millennium Development Goals 4, 5, and 6 (see Figure 1, on the previous page).

Better healthcare delivery. The introduction of the Mailafiya Health Program has corresponded with a dramatic increase in the number of patients receiving health services within the FCT. The total number of patients seen by PHCs within the pilot area in 2008 was 3,730. In 2009, after the launch of the project, the same PHCs served 10,043 patients—an increase of 270 percent (see Figure 2). "The villages we're serving with the Mailafiya Health Program are remote, and the roads are poor or nonexistent," says team leader Dr. Gideon Adagun. "The Intel PCs with DHIS are enabling the teams to provide effective healthcare in very remote places, as well as capturing data for later use."



	Malaria	Diarrhea	Pneumonia	Accidents
Mailafiya	273	22	5	1
Pre-Mailafiya	24	4	3	3

Figure 3: Increased diagnoses from Kwali, Kuje, Gwagwalada, Abuja, and Abaji Area Councils (during the pilot period only)

Faster response to critical health trends. With better data capture enabled by the Intel netbook-based platform, health officials in the FCT have gained a much better understanding of disease trends and opportunities. Positive impacts are being seen in the recognition and reporting of malaria, diarrhea, pneumonia, hypertension and other diseases. In one district, initial findings showed that Mailafiya teams increased the disease reporting rate to 301 cases from the pre-Mailafiya period of 34 cases in just two months—an increase of over 800 percent (see Figure 3) which continued to grow to 900% within six months. "Before the Mailafiya Health Program, a common challenge was poor data management," notes Dr. Okpetu. "Data was often not collected and often not adequately stored. Now, using our Intel® Atom™ processor-based netbooks, better data management helps us bring integrated health services to communities that are hard to reach."

This improved visibility allows the FCT to plan more effective interventions and deliver appropriate care earlier. For example, data collected by Mailafiya teams helped to identify an increased incidence of schistosomiasis (a parasitic disease) in several communities along the banks of rivers in the Lower Usman Dam area. Using this data, a program was developed for mass treatment and the provision of portable water sources—thus containing a potentially extensive outbreak of the disease.

Design for Scalability and Impressive Measured Results Lead to Wider Adoption

Based on the significant improvements to healthcare delivery within the project's pilot area, the project is being expanded across Nigeria. While the pilot covered 62 PHCs, today over 300 PHCs are capturing patient data through the Mailafiya Project. The Nigeria Ministry of Health intends to standardize on DHIS as a crucial element of the national Health Information System for all primary, secondary, and tertiary healthcare facilities. Increased synchronization of patient data between PHCs and secondary facilities is currently being implemented. Plans include, for the first time, the ability for public and private healthcare providers to share common patient data from the central database. As of July 2011, nine public and three private general hospitals are using the program to capture patient diagnosis and lab results. This expansion is expected to have large positive impacts on the quality of life of previously unreached citizens and to strengthen the local and national economies.

In addition, 80 clinicians (doctors and health assistants) have been given mobile PCs with wireless connectivity to enable seamless access to the Mailafiya Project portal. The FCT Ministry of Health is working on a policy to make use of the portal mandatory for all healthcare professionals in the territory.

Key Learnings

After 12 months of experience, the leaders of the Mailafiya Health Program have identified a number of key learnings and best practices:

Establish common goals with a broad set of stakeholders. Implementation of a Healthcare ICT project will impact numerous stakeholders, including community leaders, healthcare officials at many levels, and various healthcare practitioners. Using a strategic model such as the Intel HITVM and executing a design process that includes a broad set of stakeholders avoids many potential issues and increases the level of ownership felt by the stakeholders.

Establish clear success metrics and use them. Clear success metrics help articulate the program value—both potential and actual—to stakeholders and increases positive mindshare.

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– Dr. Gideon Adagun, Mailafiya Mobile Team Leader

User training is critical. Many of the healthcare workers in the program were first-time computer users. Training them adequately on both the PC and the software was key to smooth adoption and effective use of the ICT tools.

Leverage the entire existing connectivity infrastructure. The program successfully leveraged the existing infrastructure by enabling the netbooks to connect using any protocol typically available in the service areas. Any project designs should comprehend all local connection protocols (3G, GPRS, HSDPA, WiMax, etc.) to maximize functionality and ease of use.

Maximize data sharing. The "front end" of the Mailafiya Health Project is data collection. The more "back end" uses of the data—that is, trending, analysis, and collaboration made possible by the central database—the greater the return on the solution investment.

Think in terms of scalability. A successful pilot will need to be expanded; successful expansion depends upon sustainability (including capacity building and optimization of existing resources) and scalability. DHIS is well designed as a scalable tool: adding new capabilities is straightforward, as is integration with secondary and tertiary hospitals. E-forms were developed to supplement the DHIS solution and as an interim step towards EHR. E-forms are being used, for example, to capture patients' personal data and to demonstrate the possibilities and benefits of full EHR including individual treatment and follow-up capabilities. Based on the early success with DHIS and e-forms, the intention is to drive a full EHR solution as a national standard. Open standards-based hardware and software elements keep costs low and reduce interoperability challenges that may not appear in a small-scale pilot.

Take Advantage of Intel's Unique Capabilities

Intel's healthcare activities in developing nations grow out of comprehensive efforts to extend the benefits of technology to the next billion people. The Intel World Ahead Program accelerates access to relevant technologies and broadband infrastructure with 200 programs in more than 70 nations. We work with governments to maximize the value of their technology investments by using digital infrastructure to address policy goals (such as improving healthcare) which can realize both social and economic benefits.

Focusing on practical solutions, we collaborate with technology companies, banks, telecommunication operators, service providers, health authorities, universities, the development community, and other contributors. We involve local and regional vendors to promote job growth while developing sustainable frameworks for long-term change.

The scalability designed into the project has proven crucial as the project's initial measured success during the pilot phase led to expansion to more mobile teams, more communities, more PHCs, more hospitals, and more connected healthcare professionals. From the original six Local Government Areas covered by the pilot, the program is being expanded to an additional 113 Local Government Areas.

Based on the success of the project, the intention is to roll out these ICT solution capabilities on a national scale.

Building Better Healthcare Delivery

Conceived to address the health services delivery needs of remote, poor communities and to fast track progress on Millennium Development Goals 4, 5, and 6 in the Federal Capital Territory of Nigeria, the Mailafiya Health Program is showcasing the positive impact that ICT can have on improving healthcare delivery. As a result, 426 rural populations are now receiving health services on a regular basis. The project is proving that ICT can play a critical role in building healthcare delivery capacity and enabling greater access to effective healthcare—which in turn can have far-reaching effects on social and economic strength.

With the significant burdens on limited healthcare resources set to increase even further, Ministries of Health, NGOs, and public agencies tasked with accomplishing MDGs must consider ICT as a strategic enabler and an essential element to help transform health services delivery. Low- and middle-income nations need to "Start Now" for a healthier tomorrow.

For More Information

For more information on the Intel World Ahead Program and working with Intel to improve healthcare delivery, contact your Intel representative.

For more information on how the Intel World Ahead Program is impacting healthcare delivery around the world, visit the Intel World Ahead Program Web site at www.intel.com/about/companyinfo/worldahead/index.htm.

[1]For more information on the United Nations Millennium Development Goals, see www.undp.org/mdg/

[2]The Intel Health IT Value Model (HITVM) for Developing Nations addresses the specific concerns of Developing Nations where environmental factors such as accessibility, connectivity and education have a significant impact on the delivery of healthcare services. For more information on the Intel HITVM, see www.intel.com/healthcare/hit/providers/hit_value_model_whitepaper.pdf

[3]For more information on the District Health Information System, see www.dhis2.com

[4]The netbook PCs used in the Mailafiya Project are based on an Intel reference design and are ruggedized netbooks powered by the Intel® Atom™ processor. They include features that make them ideal for use in the delivery of rural healthcare services including a reversible touch screen, a camera, and long battery life.

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