

*External Research Digital Inclusion Program*

## Mobile Diagnostic Kit Targets the “Last Mile” of Preventive Healthcare

*Lack of access to low-cost diagnostic tools prevents many people in developing countries from receiving the kind of medical screening that can help save lives. Here’s the story of how one team of researchers is combining advanced computer science research with wireless technology to overcome these obstacles and make important medical technology and expertise available to underserved populations.*

Preventive medicine is a crucial aspect of healthcare, yet in developing countries, particularly in rural and remote areas, most people simply don’t have access to the kinds of advanced diagnostic technologies that can reveal whether they are at risk for serious ailments such as cardiovascular disease, diabetes or cancer.

Among the key factors that can make preventive care more widely available in underserved areas are access to affordable, high-quality diagnostic tools; the ability to make diagnostic data available remotely to medical specialists who can properly evaluate it; and the creation of digital patient records to replace the typical pen-and-paper medical files kept by rural clinics.

A team of researchers at the University of Buenos Aires, led by professors Guillermo Marshall and Marcelo Risk, is developing an innovative system based on these principles. Called the Digital Inclusion Kit in Health and Higher Education (DIKHAE), the system uses a smart phone—a mobile phone with PC-like functionality—that is wirelessly connected to a low-cost diagnostic tool such as an electrocardiogram (ECG) module or a blood pressure monitor. The idea is for health workers to send the diagnostic output along with other patient information to a central database, where it becomes part of the patient’s digital medical record. This record is available on demand to any medical



*The DIKHAE system uses a smart phone that is wirelessly connected to a low-cost diagnostic tool such as an ECG module.*

### Fast Facts

**Project:** Digital Inclusion Kit in Health and Higher Education (DIKHAE)

**Project Principals:** Professors Guillermo Marshall and Marcelo Risk, University of Buenos Aires

**Partner:** Fundapres

**Web Site:** <http://isc.dc.uba.ar/digital-inclusion>

**Profile:** Researchers at the University of Buenos Aires are developing a system that collects data from portable medical diagnostic equipment and transmits it wirelessly to a database that is instantly available to medical specialists in other locations. This technology can help bring preventive healthcare to many people who currently have little or no access to it, thereby allowing them to address risk factors before they develop an acute condition.

### Digital Inclusion Program

The Microsoft Research Digital Inclusion Program provided US\$1.2 million in research funding in 2006 to empower academic researchers worldwide to tackle technological challenges that could positively affect health, education and socioeconomic conditions. The 17 recipients, selected from among 162 proposals from 34 countries, received technology resources as well as project funding.

The Digital Inclusion Program is administered by the External Research group within Microsoft Research and is part of the group’s ongoing commitment to investing deeply in innovative research. The External Research group collaborates with the world’s foremost researchers in academia, industry and government to move research in new directions across nearly every field of computer science, engineering and general science.

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professional connected to the database.

In 2006, the DIKHAE research team, with assistance from the Argentinean nonprofit health agency Fundapres and funding from the Microsoft Research Digital Inclusion Program, tested the system in the agricultural community of Lobos, about 200 kilometers from Buenos Aires. The focus of this initial study was risk factors for cardiovascular disease—the leading cause of death among older people in Argentina. Health workers in the pilot program interviewed 170 middle-aged patients and entered information about their blood pressure, cholesterol levels, smoking and drinking habits, and diet into the handheld device. They also took an ECG scan to assess patients' heart function. That information was transmitted wirelessly to a central database, which stored the data and calculated the patient's risk of developing heart disease within the next 10 years.

*The researchers envision a system that will someday be capable of sharing X-rays, MRI scans, audio, video and other data.*

The patients who participated in the pilot study, like many others in their community, typically don't get regular checkups and see a doctor only if they have an acute problem. "The primary care they receive is very basic," says Professor Risk. "By the time they go to a specialist, it might be very late. This system can help them become aware of the situation before the disease is more noticeable so they can get a different kind of medical care." For example, patients who become aware that they are at high risk for heart disease might learn how to modify their lifestyle or be put on appropriate medications.

The first phase of research showed two things: a relatively high level of cardiovascular risk among many of the test group patients and high marks for the system's usability from medical professionals, according to Professor Marshall.

The second phase will focus on connecting more kinds of diagnostic devices and transmitting that information to the central database via a secure Web portal, as well as "virtual cluster" technology that will allow medical researchers to data-mine the centrally stored information from various locations in order to track disease trends. Other elements will include a global positioning system (GPS) device that can record a patient's location at the time of the medical screening to facilitate epidemiological tracking across populations and geographical areas. Such enhancements could also make the DIKHAE system useful for collecting data for clinical drug trials and even as part of an epidemic alert system. Medical schools could also find the data helpful for

discussions of clinical cases by doctors and medical students.

Professor Risk notes that the technology—both the hardware and software—can be easily adapted for tracking other conditions, such as diabetes and cancer. The researchers envision a system that will someday be capable of sharing X-rays, magnetic resonance imaging (MRI) scans, audio, video and other data.

The research team—which also includes researchers Alejandro Panelli and Alejandro Soba, and students Juan Pablo Suarez and Mariano Perez Rodriguez—ultimately hopes to develop kits with a range of diagnostic tools for use by medical doctors, as well as simpler, more specialized kits that patients can use to monitor a specific condition. The specialized kits could be used at clinics, at home or even in the workplace.

The team is optimistic that the DIKHAE technology will garner interest from both the public and private sectors because of its potential to both improve healthcare outcomes and reduce costs. In the public sector, says Professor Risk, "we envision that the government could make these devices available to underserved communities through a program where you bring in your cell phone and exchange it for a smart cell phone with sensor devices." The technology could appeal to employers and insurers because early detection and treatment of medical conditions can reduce the need for costly medical procedures in the future.

Affordability is a key to making the system feasible for widespread use. Smart phones are relatively expensive, but just one smart phone per village care center can reach a large number of people. The central server can be shared by many users, and Internet connections are already widespread in Argentina. According to Professor Risk, nonprofit health organizations in Uruguay, Brazil and Chile have been following the project closely.

One of the benefits of receiving support through the Microsoft Research Digital Inclusion Program is that the DIKHAE researchers have had access to "the very best specialists" at Microsoft Research, says Professor Marshall. This collaboration has furthered the academic team's research goals "by showing us the relevance of addressing pressing social needs and helping us achieve our task by the simple and elementary fact of providing the means."

By tackling the "last mile" of preventive medical care, the DIKHAE team is demonstrating that advanced computer science research can play a crucial role in addressing the challenges of global healthcare.