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A doctor in your pocket

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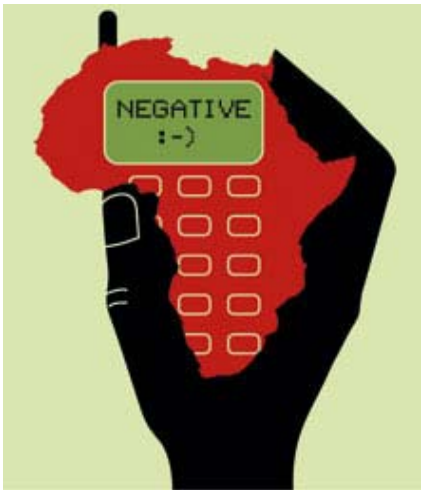
Developing countries are using mobile phones to leapfrog to personalised medicine

Illustration by Otto Steininger



CAN new technologies help to tackle the health problems of the world's poorest? At first sight, it seems a silly question. After all, the public-health systems in much of sub-Saharan Africa and parts of Asia and Latin America are rudimentary at best. With many villages having no clean water or basic sanitation, let alone reliable access to clinics and doctors, modern wizardry like molecular diagnostics and digital medical records seem irrelevant.

Bill Gates used to be on the side of the sceptics. Nearly a decade ago, when he was boss of Microsoft, he delivered a speech at a conference on technology for the developing world, inveighing against the idea that modern technologies like satellite communications links, solar power and internet-enabled computers could magically improve the lives of the poorest. Did they have any idea, he asked his listeners, what it means to live on less than $1 a day? "You're just buying food, you're trying to stay alive."

Last year Mr Gates stepped down from Microsoft to run his family's charitable foundation, which has become the richest and most influential new voice in global public health. His decade or so of experience with the foundation's work in public health seems to have changed his mind about what is good for the developing world. He now says that "poor people absolutely deserve better technology."

Sometimes those technical advances can be incremental. The poor clearly benefit from technical improvements that cut the cost of manufacturing medical devices, make drugs more effective or eliminate the need for refrigerating vaccines. But there is also the chance of big breakthroughs that save many millions of lives. Mr Gates points to the examples of mass vaccination and antibiotics. Modern antiretroviral drugs to treat HIV/AIDS could be added to that list of breakthroughs, because they too have improved countless lives in the poor world. His foundation is now spending heavily to find new vaccines for HIV/AIDS and malaria, and encouraging research into cures for antibiotic-resistant forms of tuberculosis.

Given the risk-averse culture of the health systems of the rich world, Mr Gates suggests that some great advances could emerge as leapfrogging innovations in the poor world. As it happens, the next great technology revolution in health care is even now bubbling up from the villages of Africa and may in time benefit the rich world too. It is built on the astounding success of the most famous of all leapfrog technologies: mobile phones.

Dial M for Masiluleke

To see a place where gizmos and gadgets seem utterly unequal to dealing with a health challenge, go to KwaZulu-Natal. This heavily populated province of South Africa has one of the highest rates of HIV infection in the world, despite recent advances in tackling the disease.

For years the South African government undermined efforts to contain AIDS by casting doubt on its viral origins, but the current health minister has abandoned that outrageous stance. There was also a legal

stand-off between activists and drug companies that threatened to cut off the country's access to antiretroviral drugs, but in the end Big Pharma backed off. Today South Africans can count on a supportive (albeit overstretched) public-health system, access to affordable drugs and free testing and counselling. Even so, HIV/AIDS remains rampant in KwaZulu-Natal.

Zinhle Thabethe explains why. So great is the stigma attached to the disease that some four-fifths of victims in the region will not venture into their local clinic to get an HIV test. Across South Africa perhaps a quarter of the population is HIV-positive, but fewer than 5% know their status. As an HIV patient herself, Ms Thabethe was so incensed by this state of affairs that she helped start iTeach, an outreach programme based at one of the busiest hospitals in KwaZulu-Natal. She and her collaborators came up with a clever way to use mobile phones to reach reticent sufferers.

In co-operation with MTN, a big mobile carrier in South Africa, American academics and several other innovative groups, iTeach has launched Project Masiluleke. Using a form of text messaging similar to SMS, this sends out up to a million short messages a day, encouraging the recipients in their local language to contact the national AIDS hot line. The response has been spectacular, especially among young men who have proved hard to reach in the past. When people ring, they are often told about clinics outside their immediate community; in future they will be offered special test kits they can use at home.

This scheme is already the world's biggest field trial of mobile health technology (or mHealth), and Ms Thabethe is convinced it can be copied across Africa. She believes it works not just because so many people have mobiles but because it "sidesteps the stigma as mobile phones are very personal. And unlike radio or billboard ads, a message on your phone forces you to take a moment to think and maybe act."

She is not alone in putting her faith in the ubiquity, personal convenience and interactivity of mobile phones. "It's not just about technology," says Karl Brown of the Rockefeller Foundation, a charity with expertise in this area. "Because mobile phones enable multidirectional flows of information even in the most remote parts of the world, they have the power to transform health care."

The most promising applications of mHealth for now are public-health messaging, stitching together smart medical grids, extending the reach of scarce health workers and establishing surveillance networks for infectious diseases. The use of the technology is spreading: a recent report funded by the UN Foundation and the Vodafone Foundation, two charities, documented more than four dozen projects across the developing world.

In Uganda, Text to Change uses an SMS-based quiz to raise awareness among phone users about HIV/AIDS that brought a 40% increase in the number of people getting tested. A study in Thailand in 2007 showed that compliance with a drug regimen to tackle TB jumped to over 90% when patients were sent daily text reminders to take their pills on time.

Another promising application of mHealth involves integrating mobiles into EHRs and software for clinical-decision support. In western Kenya a new counselling and HIV-testing project allows rural health-care surveyors to set up EHRs from patients' homes by putting their data into mobile phones. Developed by a team led by Kenya's Moi University, this aims to establish EHRs for some 2m patients. Public-health officials think this will help them identify and treat HIV patients and improve continuing patient care.

One lesson emerging from these various experiments is that the visible face of any mHealth or e-health scheme, regardless of where it operates, needs to be as simple and user-friendly as possible, whereas the hidden back end should use sophisticated software and hardware.

The mobile-based technology provided to Rwandan health workers by Voxiva, an American firm, should make users in rich countries jealous. Local officials in Rwanda now have mobile phones loaded with software that allows them to enter and transmit health data back to their base so they can access information on potential outbreaks, shortages of medicines and so on in real time. They also use mobiles to order medicines, send public-health alerts and download medical guidelines.

On call

Another area in which mHealth could make a big difference is in helping to get the most out of the inadequate

staff of health-care systems in the poor world. Some critics maintain that what Africa needs most is more money for doctors, not fancy technology. But Laurie Garrett of the Council on Foreign Relations (CFR), a think-tank, argues that even with extra money for medical training Africa cannot realistically hope to have enough doctors in rural areas in the near future. Training doctors takes time, and many of them do not want to work in remote areas. So Ms Garrett wants to see community health workers trained to perform many of the simpler medical tasks currently done by doctors.

This new sort of remote medicine is gaining currency. CFR has come up with a concept it calls “doc in a box”, which is a standard cargo container fitted up to serve as a basic rural health clinic. The box, which costs a few thousand dollars to make, allows trained villagers to offer many services, such as vaccinations and basic malaria treatment, that would otherwise require a trip to a faraway clinic. The units will be linked by mobile phone to fully trained professionals.

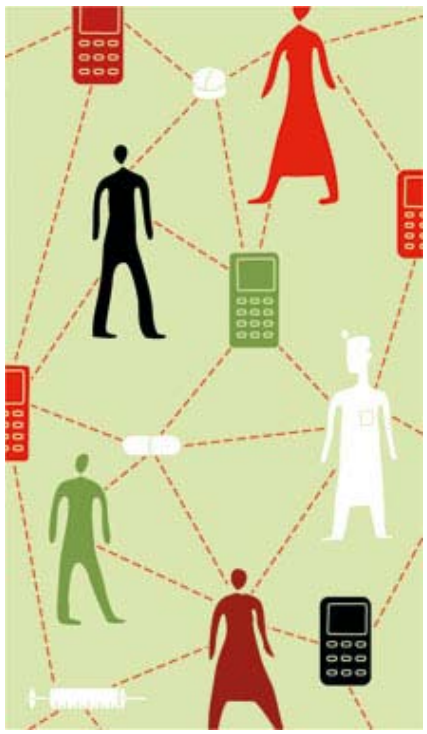
In Mexico an mHealth initiative is already turning a profit. Some 4.5m Mexicans are customers of Medicall Home, a firm that provides unlimited consultations by mobile phone with doctors for a flat fee of about $5 a month. Pedro Yrigoyen, one of its founders, explains that many of his countrymen lack health insurance or live in remote areas far from hospitals, but almost always have mobile phones. His firm is now working with Voxiva to offer more mHealth services and to extend them across Latin America. With funding from Fundación Carso, a charity funded by Carlos Slim, a Mexican telecoms magnate, the group hopes to mine its data to benefit both patients and public-health officials.

Preventing the next AIDS

How far can this technology go? Larry Brilliant, a physician who is the official “chief philanthropy evangelist” for Google’s charitable arm, has an audacious goal. He believes that a combination of mobile telephony and information technologies, deployed in a robust global surveillance system, can catch the next SARS or HIV long before it turns into a global pandemic. The key, he says, is “early detection and effective early response.”

That is easier said than done, as Gabriel Leung knows all too well. Dr Leung is the Hong Kong government official in charge of pandemic preparedness. The city is especially important to the rest of the world for two reasons. First, it is close to the Pearl River delta, one of a handful of viral “hotspots” which, thanks to close contact between humans and wild animals, is the source of many potential viral threats. Second, Hong Kong is a major hub for air travel, so a deadly bug that passes undetected by the city’s health officials could quickly travel around the world and cause a potential pandemic, as SARS did a few years ago. “We are the world’s sentinel for pandemics,” Dr Leung says. But he is confident that his city is well equipped for its task.

Illustration by Otto Steininger



Dr Brilliant explains that his scheme for predicting and preventing infectious diseases depends on information fed in from the grassroots. The need for this was brought home to him in India where he was helping to eradicate the last remnants of smallpox. “We couldn’t just periodically blanket every home with vaccinations,” he says. “We had to know where to look.”

One relatively new tool in the box is digital detection. Researchers at Google, MIT’s Media Lab, IBM and other outfits are applying sophisticated software tools to try to predict outbreaks of disease. For example, software can “crawl” the web and look for press reports in many languages that point to the outbreak of an unusual disease. In a study published in *Nature* in February, Google demonstrated how this technique was able to predict flu outbreaks in America a week or more before the government’s Centres for Disease Control did.

Such “rumour registries” are useful, but any leads must be validated by boots on the ground. Public-health surveillance systems are increasingly using mobile phones and smart hand-held devices for this task too. When Kenyan officials last autumn suspected that Somali refugees might have brought polio into the country for the first time in 20 years, they alerted health workers in the area who used their mobile phones to log

patient symptoms, medications dispensed and so on. By analysing those data remotely, health officials in the capital were able to contain the outbreak.

Nathan Wolfe wants to transform surveillance into a predictive tool rather than wait for signs of trouble. He recently left his post at the University of California, Los Angeles, to head the Global Viral Forecasting Initiative (GVFI). Since most deadly viruses, like HIV and SARS, originate in wild animals, he spends much of his time testing the blood of humans such as hunters of bushmeat who are in constant contact with such animals.

One technology he considers promising is the “lab on a chip”. Researchers around the world are now working to develop portable, fast and affordable ways of analysing samples out in the field. Dr Wolfe thinks he will soon have a device that will identify an unknown bug by using advanced genetic analysis.

On the spot

Dr Wolfe sees great potential in the mobile phone. When he visits remote parts of Congo not connected by road or electricity grid, he often finds that locals are able to use a mobile-phone service, recharging their phones at night using portable generators. His team is developing a software system to offer hunters a tiny financial reward to send an SMS message letting him know when they are ill, which would provide a useful early warning. Health workers would then be sent to test the ailing person to see if there is cause for alarm.

Global-health visionaries are now pondering a much more interactive smart grid that can make sense of that hunter’s initial warning. One possible technology is Frontline SMS, a free application that allows health officials to analyse a huge flood of text messages without the need for central servers or internet access.

Eric Rasmussen, chief executive of InSTEDD, a not-for-profit software developer in California, believes that “first-world solutions simply won’t work in places with constrained resources and intermittent connectivity.” For a global surveillance system to be robust, he says, it must provide the people closest to the trouble with the information and authority they need to act swiftly. His outfit has created an open-source application that puts together data from disparate mobile sources and combines it with maps and other data to be used by field workers to act on a warning. Rockefeller, along with the UN Foundation and others, is now encouraging such mobile innovators to agree on best practices and common standards to allow the most promising ideas to spread easily, quickly and widely. “If the internet is humanity’s planetary nervous system, we are now building our planetary immune system,” says Dr Wolfe.

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