E-health's future frontiers

E-health technologies are expanding, as Michael Dumiak finds out, and the future holds even more possibilities.

In the Ghanaian capital of Accra only 5.3% of Ghanaians had access to broadband in May 2011. A year later little has changed. The buzz of dialup modems can still be heard in street-side cybercafés. Even so, says Ghana Health Service systems analyst Dominic Atweam, the country has detailed plans for the introduction of digital health services and may well be a step ahead in its m-health progress by virtue of the widespread use of mobile telephones.

The introduction of e-health services – digitally-based, networked, Internet-aided, rapid transfer of medical and scientific information for clinical, research and convenience purposes – is already under way in many countries, with mixed results.

In the United Kingdom of Great Britain and Northern Ireland, the National Health Service started implementing electronic medical records a decade ago; its US$ 1.5 billion programme has been marked by lengthy debate over the scope of e-health, the degree of centralization and who would be responsible.

With the world's population recently hitting the seven billion mark, digital systems are not just vital but inevitable for managing health, says International Telecommunications Union secretary general Hamadoun Touré. "Information and communications technology will play a key role in delivering health care in the future – that's true in developing and in developed countries," Touré says. "In the developed world the driver is the ageing population. In the developing world it is a rapidly growing young population."

Estonian government

Pille Kink is proud of the progress Estonia has made in e-health

Digital health services are under development – or already in service – for a vast array of purposes. These include consumer services for everyday patient use and clinical systems and specialists, to exchange advice or teach over long distances.

> "Information and communications technology will play a key role in delivering health care in the future."
>
> *Hamadoun Touré*

E-health services and tools are generally web-enabled and are built for standard uses on personal computers or laptops and, increasingly, for mobile devices, smartphones and tablets. All must wrestle to some degree with the complex issue of interoperability to gain wider and better use in the future: e-health programming requires crossing boundaries in technical, organizational and cultural aspects and it's vital to have systems that communicate clearly and easily with each other.

There are communication blocks at every turn: in semantic ways, in terms of vast areas of terminology, language, definition, meaning and context that must be negotiated; and also in terms of raw technology, of operating systems and programmes and filing nomenclatures that must work smoothly together.

The lack of interoperability is an entrenched problem that must be taken into account in every e-health project, says Zoi Kolitsi, an e-health strategist based in Athens, Greece.

Pille Kink, an official at the Estonian Ministry of Social Affairs in Tallinn and head of the country's e-health department, is proud of the progress made in her small Baltic state but not completely satisfied. In 2005 a coalition of private and state health-related institutions got together to launch the Estonian eHealth Foundation. It laid the groundwork for the country's centralized electronic health record system by tying it to the nation's electronic identification network.

Electronic identification, a unique number assigned to every citizen according to law, has gained widespread acceptance; foreign nationals are also assigned so-called e-IDs, and so many issues plaguing the introduction of consumer e-health services are eased in Estonia. In Germany, the United Kingdom and the United States of America and other wealthy countries, there is cultural and historical resistance to heavy centralization of record-keeping and privacy concerns about the potential intrusion of government or business into sensitive personal documents. In the developing world, a lack of electronic infrastructure might be a drag on effective digital record-keeping.

If you are an Estonian patient in need of a prescription, your doctor can send it to the central system, Kink says, and any pharmacist in the country can dispense the medicine. The pharmacist inputs these data in his or her computer and they are sent back to the central system. The insurer receives the invoice, cutting out the step of the patient having to invoice the insurer.

Patients can see all of this information – as well as all of their personal records – via their ePatient portal, a web-based interface launched in 2008 and accessed via their ID card, PIN code and security question.

Kink says the system cost €2 million (US$ 2.65 million) to develop and costs €750 000 a year to run, excluding the costs in staff time in hospitals and pharmacies. But she says the system isn't yet where they want it – work is still under way to establish standards and rules on how to send information to the central system. Old documents are still in different formats and use different terminology, and not everyone in the system uses it in the same way. "It's one thing to put these codes on paper. Real life is another thing," she says.

Bull World Health Organ 2012;90:328–329 | doi:10.2471/BLT.12.030512

Estonia's e-health system results in more convenient services for patients, while at the other end of the spectrum, there are digital health applications that are designed for doctors. Seiryo Sugiura is part of a team run by Toshiaki Hisada in the Graduate School of Frontier Sciences at the campus of the University of Tokyo. They are developing a heart simulator to support individually-tailored patient care for people with heart disease. A heart simulator is a detailed 3-D image of a person's heart that uses magnetic resonance imaging data or multi-slice computerized tomography to show the person's heart contracting.

Its minute detail can, Sugiura says, reproduce the macroscopic activities of that person's heart, such as contraction, pressure generation and blood-flow ejection based on molecular and cellular functions. "We can diagnose our virtual heart," he says. "We can also treat the virtual heart with drugs – i.e., modulation of molecular function – or by surgery." Although the heart simulator is still at the research stage, with two prototypes having been built, its digital construction means that a person's heart can be accessed and seen remotely. "We don't expect this simulator to be in every hospital," Sugiura says. "Doctors will send clinical data with specific questions to 'heart simulator centres' and get results they can use as a guide."

Clouds and grids are the electronic lattices on which Alberto Redolfi at the Italian National Centre for Research and Care of Alzheimer's and Mental Diseases in Brescia is building his e-health network. Cloud computing offers a place to remotely store and access gigantic sets of experimental data, says Redolfi, who does research for the outGRID project. OutGRID is a global infrastructure for neuroscientists, who study how the brain processes information to understand degenerative brain diseases. Grid networks – large distributed linkages of servers or even personal computers, which when linked together produce vast computing power – offer users pure computational muscle.

"Scientists can proceed with very complicated analysis using a simple connection," Redolfi says. "These technologies can provide researchers around the globe with free access to a great amount of data," he says of their potential growth in the future. Researchers are already able to share data and run large experiments on the progression of hard-to-diagnose neurodegenerative diseases; they hope one day to be able to predict the build-up of debilitating neural plaques, discover what produces them and eventually how to prevent them.

If a future filled with e-health tools and systems seems likely, equitable international use of these technologies is likely to be difficult to achieve. A heart patient in Tokyo may not necessarily want their simulated organ to be transmitted for viewing in the United Kingdom or Argentina, and if something goes wrong, who handles the lawsuit? Redolfi's cloud could go down, taking data with it. The cost of sustaining digital health technologies could be out of reach for low-income countries. Then there is the question of getting the thousands of agencies and stakeholders – patient groups, pharmaceutical companies, insurers, governments of all sizes, software firms – to agree on a common set of standards.

Cathy Greenblat

e-health could help people with brain diseases such as dementia

> "Before you can agree [on interoperability], you have to establish collaboration and ethics."
>
> *Zoi Kolitsi*

Kolitsi is starting very methodically. The Athens-based e-health strategist, who headed up an European Union-funded initiative coordinating efforts for e-health interoperability, says it begins with agreement. "We had a number of workshops where we invited the experts and we reached agreements," she says. In other words, building a future of digital health services starts with getting people together in a room. "Before you can agree, you have to establish collaboration and ethics."

This is where institutions such as the World Health Organization may be able to help, she says. Kink says even within tiny Estonia it's still difficult to gain interoperability. "There is not 100% coverage of outpatient visits at the moment," she says, as not all records make it into the central system. "It depends on the hospitals and the doctors. Sometimes one doctor sends his information, the other doctor does not."

Many African countries did not wait for expensive copper land-line infrastructures to be built, but jumped straight to mobile phones. Touré points to a low-cost application, which can be used to diagnose malaria, processing a picture taken by mobile phone of a blood sample used to detect parasites. "There is virtually no one on this earth that is not connected somehow to a mobile device. This makes it a very powerful tool for health-care delivery," he says. ■