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ICT Update

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Teleradiology improves diagnosis and treatment for patients in rural **Mali**

A **South African** project uses software to send low-cost text messages

A touchscreen computer system guides healthcare workers in **Malawi**

Healthcare

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ICT Update

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Technology spreads expertise

Over the last few decades, the spread of HIV/Aids and tuberculosis, along with the continued threats from measles, polio and malaria, have cost the lives of millions of people and affected countless families in ACP nations. The loss of labour potential and, in particular, the reduction of manpower in the agricultural sector, threatens food security and can severely limit a country's growth. But health projects throughout the world are using now a wide range of ICTs to connect rural communities to the expertise usually only found in big cities.

While regional hospitals and rural clinics often have very limited resources, many do have the basic equipment for analyzing and diagnosing most ailments. The problem is that the staff working in many of these smaller health centres don't always have the expertise to read the results accurately and make a precise diagnosis.

Microscopes, for example, are widely used as a diagnostic tool in many rural medical laboratories. But while local technicians might be able to take a sample and prepare it for viewing, they might not be able to identify exactly what the microscope reveals. To help solve this problem, researchers at the Netherlands Organization for Applied Scientific Research (TNO) have developed a device which connects the camera of a mobile phone to the eyepiece of a microscope. With the sample lined up, ready for analysis, the lab technician simply takes a picture and sends it via MMS (multimedia messaging service) to a specialist to examine. Within minutes, the specialist can call the health centre with the results and advise a precise course of treatment for the patient.

Faced with a similar problem, a group of doctors in Mali decided to develop a procedure where rural medical staff can send x-rays to expert radiologists in the capital, Bamako, for diagnosis or a second opinion. The Malian Society for Medical X-rays (SOMIM) involved local software developers who came up with a system where health centre staff could send confidential patient details to specialists via the internet. The result was an open source program called OpenYalim, currently used by three regional hospitals with plans to extend it further throughout the country and the region.

SOMIM also helped to set up an e-learning and e-consultation project to support medical staff working in rural areas. Nurses and doctors can now logon to a dedicated website to download lectures and seminars and ask for second opinions from colleagues located elsewhere. The system helps staff to continue their training and keep up-to-date with the latest techniques.

Supporting rural healthcare workers is also a priority for Baobab Health, an NGO based in Malawi. They developed the Touchscreen Clinical Workstation (TCW) specifically to withstand constant use in busy health centres under hot, dry, dusty conditions. The workstation has no moving parts, there's no need for an external computer mouse or keyboard and its low energy requirements mean the system can operate for many hours when disconnected from mains electricity.

The software installed on the TCW guides staff through a number of procedures ranging from patient registration to continuing care for people living with HIV/Aids. Depending on the situation, the healthcare worker follows the on-screen questions and enters the data via a touchscreen keypad. The system can record the data for later analysis or store it as part of the patient's medical record.

For years, governments and other healthcare providers have tried, often in vain, to bring medical expertise to small towns and remote areas. But communication technology can now provide rural health centres with a vital link to specialist advice located elsewhere in their own country or even abroad. The small clinics get the support they need, while health ministries save money from increased efficiency.

But, more importantly, patients benefit. They get fast, accurate diagnosis and prompt treatment. They no longer have to travel long, costly distances to an overcrowded urban hospital to be treated for a minor illness. And rural communities gain by having a strong, local workforce with more time and energy to develop their businesses, infrastructure and farmland. ■

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Mobilizing medical support

Many developing countries, faced with a drastic shortage of trained medical personnel, increasingly rely on community health workers to provide at least a basic level of care to people living in rural areas. The ubiquity of the mobile phone, however, presents an ideal opportunity to support healthcare professionals and improve the situation for patients.

There are already several initiatives in ACP countries which use text messages to deliver information and increase patients' awareness to a variety of health issues. Many projects also use this method in preventative care campaigns to provide details, for example, on HIV/Aids, reproductive health and malaria. Other services use text messaging for remote monitoring by sending messages to remind and encourage patients to take their medication at the right times.

Health workers now use mobile phones to collect data on diseases, epidemics and vaccination campaigns and transmit the information quickly to district or national health officers. ICTs are employed in the training of healthcare workers, often using text and phone messages, while some training institutes use video too. There have also been some high-profile stories where a lower-skilled healthcare worker is guided through fairly complex emergency medical procedures by a specialist over the phone. And the technology has proved very useful for disease and epidemic tracking plus diagnostic and treatment support.

VANESSA VICK/REDUX/HH

In 2006, the United Nations Foundation/Vodafone Foundation (UNF-VF) Technology Partnership began by supporting projects in the development of mobile health (m-health) applications. We were particularly interested in software for wireless devices to help healthcare workers collect better health data. We started in Kenya and Zambia, helping an NGO called DataDyne to develop a piece of equipment called Episurveyor, which is now used in 20 countries to gather health information.

We also organized meetings to bring people together from the health sector, the World Health Organization, government ministries, and large technology companies, including Nokia and Vodafone, to discuss how we could all work to improve healthcare delivery. This culminated in our announcement at the Mobile World Congress (MWC) in Barcelona in February 2009 to form the mHealth Alliance, initially an agreement between the UNF-VF Partnership and the Rockefeller Foundation.

Flexible

One of the reasons we launched the mHealth Alliance at the MWC was because all the major mobile operators and handset manufacturers were there too. By raising the issue of m-health at this and other conferences, we can hopefully encourage large corporations to bear this issue in mind when they design the next generation of mobile phones and networks. In fact, many mobile phone network providers and equipment manufacturers are already mainstreaming m-health into their business models. Health, after all, will always be a challenge, and the emerging economies of many ACP countries offer a huge potential market.

There are a lot of interesting examples of projects in ACP nations using mobile phones for health promotion. But there are also many instances where two projects are doing almost exactly the same thing in the same country. We would rather see one combined effort rather than five projects doing the same thing in the same region. For example, one text messaging campaign could cover a whole country rather than having five smaller projects giving a similar message but at different times. A more integrated and collaborative effort could help to sustain those projects and keep them going over a longer period of time.

Another key effort of the Alliance will be to demonstrate to governments and companies how mobile phone applications can be used to make healthcare provision more cost-effective. Using ICTs in healthcare is still very new so there is not a lot of data yet to confirm the effectiveness of these approaches, but initial results are certainly very encouraging. Some of the awareness campaigns in Africa using text messaging have seen great increases in the number of people going for HIV/Aids testing. Some projects also report that up to 90% of patients adhere to their medication programmes when alerted regularly by text messages.

As the infrastructure bringing mobile phone technology develops and expands to more and more places, we are now able to reach the people who can't get to hospital easily or who have to walk large distances to reach a clinic. But it is not only the increasing availability of mobile phones that gives them the advantage over many other types of technology. It is also their ease of use and the ease with which applications can be developed for them. All these factors combine to make mobile phones incredibly useful throughout the world, and especially suitable for health promotion in developing countries. ■

Related resources

EpiSurveyor
➜ www.datadyne.org/?q=episurveyor

Feature

Extending x-ray vision

Using locally developed software, doctors in three rural hospitals in Mali can send x-rays via the internet for expert diagnosis and treatment recommendations. The success of this teleradiology project has led to further e-health initiatives in the country.

Mahamadou Konipé remembers the time his ten-year-old nephew, Bagna Touré, was in hospital in Mopti, a small city 600 km away from Mali's capital, Bamako. 'Bagna was admitted with a strange lump in his throat. One evening I arrived at the hospital and found his grandmother arranging all his personal belongings around him as if he was already on his death bed. No one knew what he was suffering from, except that he could no longer swallow anything. And the doctors did not know how to treat him.'

The local doctors decided to send x-rays to a radiologist, Dr Mamadou Touré, in Bamako. Dr Touré immediately saw that Bagna had a foreign body stuck in his gullet. He consulted his colleagues and, drawing on years of practical experience, he came up with the diagnosis and suggested treatment. Bagna Touré's life was saved because his doctors in Mopti were able to obtain an expert opinion quickly from the hospital in Bamako.

Despite a decentralized healthcare system, which was developed to allow the regional health services to adapt effectively to local needs, many people still have problems accessing professional healthcare in Mali. Medical cover is only available to 30-40% of the people living within a 15 km radius of a hospital or health centre. This is partly due to the lack of public resources and partly because qualified medical specialists are scarce and unevenly distributed throughout the country. In fact, 57% of specialized doctors, 67% of technicians, and 41% of midwives are located in Bamako. This inequality is even more evident in certain specialist areas such as radiology.

Most of the regional hospitals in Mali have an x-ray machine, but there are only 13 trained radiologists in the whole of the country, and all of them are located in Bamako where they have better career prospects and salaries. As a result, doctors in the regional hospitals often have to refer their patients to the national hospital in the capital for an expert diagnosis of the x-ray and to determine the best course of treatment. For some patients, this can mean a journey of more than 1000 km. Not everyone can afford to make this trip or is fit enough to travel. Bagna Touré was lucky as the hospital he went to participates in a project operated by the Malian Society for Medical X-rays (Société Malienne d'Imagerie Médicale, SOMIM). The project, currently running in three rural hospitals, enables doctors to link to medical experts in other hospitals via the internet.

Second opinion

Dr Touré, also the chairperson of SOMIM, decided to try out different ICT applications to connect the rural healthcare facilities to the specialist radiologists. His idea was to train medical staff in regional hospitals to make x-rays and set up internet connections between the three rural hospitals and the academic hospital, known as Point G, in Bamako.

Each regional hospital received a desktop computer, a digital camera and a scanner. Each hospital appointed staff members to be trained to make a digital copy of an x-ray using the scanner and send it to the radiologists in Bamako. Regional doctors can now check their diagnosis with an expert at Point G and ask for treatment advice without the patient having to travel all the way to the capital. Not only does this save patients time and money, it also helps to prevent medical errors caused by wrong diagnosis and incorrect treatment in the rural hospital. Moreover, doctors feel less isolated and enjoy the opportunities to improve their own skills through peer-to-peer review and distance training.

The hospital sends the x-ray images using locally developed open source software called OpenYalim. There are other e-health software platforms available but most were too expensive and none were suitable for the specific needs of this project. Much of the existing software was developed for scientific purposes and therefore not useful for the daily consultations required for this 'teleradiology' project. The lack of broadband internet connections in Mali also ruled out some types of software that rely heavily on the transfer of large data files.

The only option, therefore, was to develop new open source software and a local company, ICT Development Centre (IDC) provided the solution. IDC developed a platform that the hospital staff involved in the teleradiology project could use to transmit, examine and archive responses to specialist requests. The software also encodes the data to protect the patient's privacy.

When one of the regional hospitals needs a consultation, the staff member simply creates a new patient file in the system, adds the clinical data and x-ray images and transfers all the information via the internet. At Point G hospital, the radiologist opens the file using the OpenYalim software, analyzes the images and writes a report that same day. The original doctor who requested the diagnosis is then able to read the report as soon as the consultant adds it to the patient's file. In an emergency, the consultant

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SCIENCE PHOTO LIBRARY STOCK/ANP

can send back a report within one hour of receiving the x-ray.

Local support

Bagna Touré is just one of many patients who has benefited from the new teleradiology service. Within the first year of the pilot project in 2006, the three hospitals sent 338 x-rays to Point G, an average of 30 per month. Out of these x-rays, 17 were urgent. In 2007, the project suffered problems with their internet connection resulting in a drop in the number of x-rays sent to Bamako. Only 166 were sent that year. The project team then invested in more robust modems for the regional hospitals that could cope with the irregular power supply. The new equipment solved the problems, resulting in a marked increase in x-ray transmissions, up to 479. This growth in number of transmissions indicates that using the teleradiology platform has become part of the hospitals' daily routine.

Despite the increase in demand on the time of such a limited number of trained radiologists, the doctors replied to 96% of requests from the regional hospitals within 24 hours. Out of the 983 x-rays that the regional hospitals sent for a second opinion in the past three years, 7% were considered urgent and were dealt with in a period of 10-15 minutes.

In a recent evaluation, the teleradiology service proved to be popular with both staff and patients. Only one patient was 'not very satisfied' at the length of time he had to wait for his report. From the medical staff, only 7% indicated that they were 'not very satisfied' with the teleradiology service. Their main complaint was that they would prefer to handle the whole process of scanning and sending the x-rays themselves.

It was clear, from the early stages of the project, that success of the service would depend on the availability of local technical experts to maintain the system and develop the relevant software. Similar electronic health (e-health) initiatives have failed in the past because of a lack of technical support and skilled developers. So far, the decision to ask a local company to develop the software has turned out to be a good one. By involving IDC, the teleradiology project has access to a pool of developers in Mali who are able to maintain and develop the OpenYalim software as well as any other applications that may be useful to the project.

One challenge remains, however, and that is retaining the software developers who have been trained by IDC. Software developers in Mali are still scarce and people easily switch to better paid jobs. IDC found itself forced to give priority to developing applications that would generate immediate financial gain, resulting in unavoidable delays in the development of software, such as OpenYalim, for the social sectors.

Expansion

Another useful lesson learned from the teleradiology project is the importance of connecting doctors in rural hospitals to their peers where they can learn from each others' medical expertise. A lack of study materials and information sources makes continuing education very difficult in Mali, and many other ACP countries. The teleradiology project showed that doctors can gain a lot by interacting with other health professionals.

Related resources

Malian Medical Information and Communication Network
REIMICOM operates the Malian e-health portal. The organization also promotes telemedicine in Mali and supports the continuing education of medical professionals through distance learning.
➜ **www.keneya.net/site**

Network in French-speaking Africa for Telemedicine (RAFT)
RAFT provides interactive courses, in English and French, targeted to physicians and other care professionals working in West Africa.
➜ **http://raft.hcuge.ch**

OpenYalim e-health software
OpenYalim was published under a general public licence which makes it free from any restrictions on its use and redistribution. This makes it possible for the rest of Mali, or any other project, to use this software within their own e-health activities.
➜ **http://openyalim.org**

ICT Development Centre
IDC specializes in developing and adapting ICT tools to help achieve the United Nations' millennium development goals, and has a strong focus on e-health systems. The company also offers consultancies and training opportunities in open source software development.
➜ **http://idcmali.com**


DIETER TELEMANS/CCBRT/HH

In response to the demand for greater professional cooperation, the Malian Medical Information and Communication Network (Reseau Informatique Malien d'Information et de Communication Medicale, REIMICOM), an NGO that promotes the use of ICTs in the health sector, started a new project to develop a national web portal to provide information to health practitioners and the general public. The portal, which is still in the early stages of development, offers further learning and consultation possibilities to healthcare workers and provides the opportunity for the various Malian institutions to connect with each other.

By the end of 2008, six hospitals had been linked to the new portal with most visitors searching the site for publications provided by the University of Bamako. The university also adds weekly medical lectures from the University of Geneva which are free for anyone to download and have proven to be very popular.

However, to make this distance learning section of the e-health portal successful, the site will need to be updated regularly with new content. So far, visitors have only been accessing articles but have not submitted any content.

Broad appeal

The combination of these three projects – teleradiology, OpenYalim software development and the new e-health portal – show that a vast country such as Mali, with its limited resources, can still use ICTs to significantly improve the quality and availability of professional healthcare.

The services provided by the teleradiology project, for example, have proven to be very valuable, but have also shown that any electronic transmission platform is dependent on the quality of the internet connection. Currently, two of the rural hospitals, in the towns of Kayes and Kidal, are still unable to participate fully as they do not have a reliable connection in their local area.

To overcome the problem of connectivity, however, the project team has recently started a pilot project with the European Space Agency to provide an internet link via satellite. Although expensive, satellite communication is currently the best solution to guarantee a continuous connection. The pilot project involves setting up and testing satellite connections in three hospitals, in Mopti, Timbuktu and Gao.

The private sector in Mali has also shown interest in the e-health schemes. The national gold mining company, which has a legal obligation to have its personnel (more than 1100 people) checked for respiratory problems once a year, are likely to start using the teleradiology services later in 2009.

If the model to provide satellite connectivity turns out to be successful, e-health could certainly take off, not only in Mali, but in other countries that currently experience similar problems. The Malian initiatives have already attracted a great deal of interest from neighbouring countries - Niger, Burkina Faso and Senegal - and have prompted them to think about developing a similar strategy for integrating ICTs into their own healthcare sectors.

The projects in Mali show that, even with limited capacity, healthcare providers can still make significant improvements by connecting regional doctors to available specialists. Linking health professionals through technology is less costly, and often more efficient and convenient, than trying to distribute medical personnel throughout the country. This represents an important shift from the current methods of healthcare provision as it still recognizes the need for rural communities to have hospitals, but shows that the presence of a medical specialist on site is perhaps not always necessary. ■

Delivering an extra message

Specially developed open source software enables a South African project to send millions of targeted health messages to mobile phones users across the country.

Case study

Mobile phones have rapidly penetrated Africa like no other technology, resulting in over 300 million subscribers on the continent today. As many as 95% of these users cannot afford a long-term contract and use their phone on pay-as-you-go terms, buying vouchers for as little as 50 US cents – when they can afford them. When they can't afford airtime credit, millions of Africans use Please Call Me (PCM) messages to communicate.

PCM is a messaging service where someone who doesn't have enough credit to make a call can send a free text message to someone else, asking them to call back. To send a PCM, the sender types a unique short code and the mobile number of the receiver into a text message. The message is sent like a normal text message and, when received, the words 'Please Call' and the sender's mobile number appear in the receiver's inbox. PCMs are free to both sender and receiver, making them hugely popular. Over 30 million PCMs are sent in South Africa alone per day, and the service has since spread to several other African countries.

JACOB SILBERBERG/HH

PCMs use 40 of the 160 characters normally allowed in a text message, leaving 120 unused characters. Praekelt Foundation, a South African technology company, developed SocialTxt, where these 120 unused characters in a PCM are then utilized to spread social messages to audiences who don't usually interact with traditional media as they don't have a television or internet access.

SocialTxt is open source software that allows an NGO or other campaigning organization to insert any social message into Please Call Me messages, and thus reach a large target audience at a low cost. Any organization can therefore work with mobile phone operators and use the software to insert a message into PCMs.

Performance

SocialTxt can be adapted to work in a variety of ways but there are three main applications. Firstly, it can insert the number of a call centre into a Please Call Me message where callers can access information and services. The receiver of the message can then dial that number to connect to the call centre which could, for instance, be an HIV/Aids helpline. Secondly, the software can be used to share information with a particular target audience by providing a WAP (wireless application protocol) link in a PCM. The link leads anyone with a WAP-enabled phone to a site with further details on the topic.

Thirdly, organizations can use SocialText to send USSD (unstructured supplementary service data) menus via PCM messages to their target audience. Almost all mobile phone handsets can access USSD, which give the user a variety of options and allow more detailed interaction between the campaign team and the recipients of their message. Typing '*101#', for example, and selecting your village / location, can trigger the system to send back information on the nearest vaccination station or even market prices for a specific commodity.

Until now, SocialTxt has been used mainly in the health sector, and more specifically in HIV awareness campaigns. Praekelt Foundation, in cooperation with their national and international partners, currently uses the software in a South African HIV/Aids project called Project Masiluleke. The project, running for one year from October 2008 until September 2009, uses SocialTxt to tag approximately one million PCM messages every day.

Organizations using the software can also get detailed information on how their campaign is performing. Praekelt Foundation provides statistics, updated in real-time, for each individual campaign. This allows organizations to track the performance of their messages. The types of indicators, depending on the type of application used – a call centre, WAP or USSD – include: the number of messages dispatched, how many people actually called the number (in the case of call centre campaigns), which languages attracted the most callers and a rough geographic position of where the calls came from.

SocialTxt could be useful for any organization trying to get information to a large group of people at low cost. But it can be particularly useful to get short, targeted messages across to farmers, and people living in rural communities generally, who often use their mobile phones on a pre-paid basis and who are already familiar with sending and receiving Please Call Me messages.

An organization could, for example, insert a number into a PCM message which would link the receiver to a call centre providing weather reports, pest control alerts and advice on planting or crop irrigation. Although it has not been tested in the agricultural sector, the software offers a wide variety of opportunities for organizations to interact with and deliver information to small-scale farmers in ACP countries. ■

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For more information on SocialTxt visit http://praekeltfoundation.org/products.html


ROEL BURGLER/HH

A touch of good health

A locally developed touchscreen computer system helps to guide staff in rural health centres in Malawi through diagnosis and treatment procedures.

Case study

Malawi only has 280 doctors to serve its population of 14 million people (according to WHO statistics). Average life expectancy is just 43, maternal mortality rates are high and an estimated one million people are HIV positive. Since 85% of Malawians live in rural areas, the majority of people receive their medical care in health centres where, on average, one nurse is responsible for the medical needs of 25,000 people. These healthcare workers provide a vital service but to maintain even a minimum standard of care it is essential that they follow a series of rigorous procedures when dealing with each individual patient.

To support rural health professionals and guide them through diagnosis and treatment processes, Baobab Health, a Malawi-based non-governmental organization, has developed a touchscreen clinical workstation (TCW). The TCWs are more robust than desktop computers or even laptops. They can withstand hot, dusty environments and are less reliant on mains electricity. This last feature which is very important in many areas of Malawi where the power supply can be unstable and unreliable. The touchscreen system also removes the need for external devices such as a mouse or keyboard.

When a patient visits a clinic equipped with the workstation, a nurse or medical assistant can quickly register the patient and go through a routine series of questions. The software programmed into the TCW ensures that no important details are overlooked. The data captured on the system during patient visits can also be used at the national level for policy making and analysis.

During such a visit, an HIV positive patient taking anti-retroviral drugs, for example, is typically asked 10-15 questions like: Able to walk?; Evidence of side effects?; Number of tablets remaining? The TCW leads the healthcare worker through these questions, analyzes the results and recommends further treatment. This allows minimally trained care workers

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to perform complex diagnoses and treatment for HIV care.

The TCW also helps to improve the accuracy of clinical data gathering, especially when compared to more traditional paper-based form methods. Written details can be inaccurate or misread which can lead to critical mistakes in decision making, but the TCW can validate data as soon the nurse or assistant enters it.

For instance, a child attending the clinic may have a height of 119 cm. A nurse enters the height into the device but accidentally transposes the last two digits, entering the height as 191 cm. Based on the patient's current age, the TCW will alert the nurse that a height of 191 cm falls outside the expected range of height for a child of that age. The nurse can then immediately recheck the data and enter the correct figure. In a more traditional system where the information is captured and analyzed retrospectively it would be impossible to verify the data so quickly.

The nurse is also able to use the TCW to view the patient's past medical history with, for example, previous weight values displayed as a graph. The nurse can easily see that a child has had consistently low weights, compared to age and height, which could indicate a chronic condition such as failure to thrive due to mother-to-child transmission of HIV. A child with historically normal weight values but showing a sudden loss could suffer from an acute condition such as gastroenteritis.

The value of past medical history is not limited to a series of vital signs. The frequency with which a patient has sought care, the nature of past illness, results of laboratory and x-ray or ultrasound investigations and medications prescribed can provide valuable information for managing a patient's illness.

Solutions

Baobab had two main challenges when it came to designing the TCW. Firstly, the device had to be strong enough to withstand regular, daily use in harsh environments. It, therefore, has no moving parts, using a solid state drive instead of the more usual hard disk drive, and it has a fanless cooling system. The device uses a read-only Linux operating system which is less vulnerable to virus attacks and doesn't allow anyone to save or install unnecessary software or files. This makes it impossible for users to do anything except what the system was designed to do.

A typical clinic is fitted with one server computer, a battery charger, four TCWs and two label printers, all of which can run reliably for more than 24 hours if the mains electricity supply fails. The server computer uses very little electricity. It has an external power supply with a backup system consisting of four, 12 volt batteries that recharge when grid electricity is available. These batteries need to be replaced every two to three years but new batteries are available locally and replacing them is very simple.

The second challenge was to make sure that the device would be easy to use for people with little or no experience with computers. While training people to use a mouse or a keyboard is certainly an important task for the modern age, the healthcare crisis in Malawi requires a more urgent approach. The touchscreen interface means that a literate person can learn to use the workstation with very little training. In fact, a healthcare worker with no previous experience with computers can learn to input data into the TCW within 10 minutes. Colleagues can provide most of the training which removes the need for expensive specialist trainers and courses.

It was important for Baobab that all of the software for the system was developed in Malawi. This has helped to develop local expertise and ensures that on-going development and maintenance can be carried out quickly and easily. The developers released the software with an open source licence and have made the code available for anyone to download from the internet.

Adaptable

Seven sites currently use the TCW for patient registration and they have now registered more than 800,000 people, over 7% of the total population of Malawi. Patient registration used to take more than ten minutes per patient and caused long queues. Now the process takes less than one minute for new patients, and less than ten seconds for returning patients.

Six health centres use the technology to manage the anti-retroviral treatment (ART) of more than 18,400 patients (13% of all patients receiving ART in Malawi). The Ministry of Health has found that HIV clinics relying on paper forms struggle when they have to deal with more than 1500 patients on ART, but the Baobab ART system allows clinics to reliably handle many more. The largest site using the Baobab system has more than 6000 patients receiving treatment at this time.

Baobab intend to introduce their 'point-of-care' touchscreen devices to more rural sites in Malawi, many of which are off the main electricity grid where the low-power system will run entirely on alternative energy sources, such as solar or wind power. The company recognizes too that its approach to managing HIV positive patients could be applied to other chronic illnesses like diabetes and hypertension. They also plan to work more closely with the Ministry of Health to develop a central repository of patient data and provide a mechanism to make the information available to all hospitals and clinics.

Pragmatists may argue that money should not be spent on computers when pharmacy shelves are bare. But many people who work in the field acknowledge that shelves are bare not because of lack of funds to buy drugs, but because of the lack of systems to manage the inventory effectively. The situation is clearly complex, but it is likely that the solution to understanding these problems will come from trying alternative approaches and learning as we go. ■


BAOBAB HEALTH

Connecting technology and experts

A device that connects a mobile phone to a microscope lets rural lab workers in Uganda send photos of microscopic samples for expert analysis and diagnosis.

Case study

In many ACP countries, the microscope is the most common tool used in medical laboratories to identify illnesses. Although essential for diagnosing diseases such as malaria and tuberculosis, microscopes are expensive and laboratory services in general are one of the most neglected areas of healthcare provision in sub-Saharan Africa. A lack of training and staff shortages often result in misdiagnosis and patient mismanagement. This, in turn, can lead to a culture of mistrust, as patients lose confidence in healthcare professionals, and clinical staff question the competence of the laboratory workers.

The rapid development of mobile phone networks in rural areas, however, provides an opportunity to improve the accuracy of disease diagnosis as researchers work to develop a product to link microscopes and mobile phones. In countries like Uganda, for example, where mobile phone networks cover more than 90% of the country, this combination could give rural communities far greater access to specialized health care. Most people in rural areas are treated in local health clinics.

Although these small clinics do not have many facilities, most of them do have a simple light microscope. Often these clinics only have one trained laboratory worker with limited training and basic knowledge of microscopy. The larger hospitals, on the other hand, usually based only in large cities or the capital, have more specialized staff.

Linking these two groups to allow the exchange of relevant diagnostic information could help improve the accuracy of identifying many common diseases and help in the development of epidemic counter-measures and intervention responses. Current microscope systems with cameras are very expensive and need a connection to a computer and the internet. These are often not available in rural health centres but the need for communication between laboratory workers remains, and should be ideally achieved without having to introduce new technology.

Integration

Since mobile phones are locally available in many countries and are often equipped with a camera, it seems logical to use them to deliver photos taken through a microscope to experts in distant medical laboratories. But the question is: how do to do this? One option is to send a picture by MMS (multimedia messaging service), a method of sending photographs over a mobile phone network, rather like text is sent via SMS (short messaging service).

In this project, researchers at TNO (the Netherlands Organization for Applied Scientific Research) designed the Microscopic Imaging Connector, a product that connects the built-in camera of a common, bar-shaped mobile phone (one that does not flip or slide open) to the eyepiece of a light microscope. With this system, rural laboratory technicians can capture images of microscopic tissue samples and send them via the mobile phone network to specialists elsewhere.

This new tele-microscopy system makes use of locally available products: the microscopes already present in many rural health centres and mobile phones. But in order to capture an image of sufficiently good quality it is important that the mobile phone is focused and stabilized properly. The Microscopic Imaging Connector, therefore, is a mechanical tool that ensures accurate positioning and stability to the mobile phone when connected to the eyepiece of the microscope.

With the phone placed in the connector, the laboratory technician can adjust the position of the phone in three directions: horizontally and vertically to centre the image in the microscope's eyepiece, and backwards and forwards from the eyepiece in order to focus the image, depending on the focal distance of the lens. A camera with minimum of 5 megapixels is recommended to acquire images in which, for example, malaria parasites can be detected.

Unfortunately, phones with such a high-resolution camera are currently not widely available in many countries. And it should be noted that the connector is solely an aid for capturing images by mobile phone. It does not help with the focusing or illumination of the sample under the microscope. The quality of the image, and therefore the accuracy of the diagnosis, is still dependent on the skills of the laboratory technician and the ability of the camera to capture a good enough picture. The display quality of both the mobile phone capturing the image and the one receiving it also plays an important role when it comes to the accurate analysis of the image.

The project team hope to start testing the connector in medical laboratories in Uganda in May 2009. But, to have any real impact, the equipment will have to be just one part of a more integrated tele-microscopy service where telecom network providers and local health authorities would also be encouraged to participate.

The connector system makes use of existing technologies and removes the need for an expert to be present in every rural health centre. Improved microscopy diagnosis can lead to more efficient treatment of patients. This will not only lower medical costs, but may also lead to a healthier society where people can work more effectively to increase their income, continue their education and improve food security. ■

Regine van Limmeren (ravanlimmeren@gmail.com) designed the Microscopic Imaging Connector in collaboration with TNO, the Netherlands Organization for Applied Scientific Research (www.tno.nl). For further please contact Nicolas Chevrollier (nicolas.chevrollier@tno.nl)

Setting up a telemedicine system

TeleMedMail is an open source software developed to simplify the process of sending patient details, including photos, from a hospital or health centre to a specialist for diagnosis or second opinion. One main advantage of TeleMedMail is that it can store requests for information, making it useful for clinics with irregular or dial-up internet connections. Also, the software is written in Java, which means it can run on any operating system (requires Java 1.3 or higher).

Getting started

The software is free to download from the TeleMedMail project page on the SourceForge website: http://sourceforge.net/projects/telemedmail

Click on 'Download'. You can then choose whether to download a compact version of the software (1.3 MB) or the full version (7.6 MB). The file has been compressed to make it quicker and easier to download.

Open the downloaded folder and click on the install icon. Your computer will ask if you want to extract the files, click 'Yes' and the computer will automatically extract the install files in a new folder. Open the new TeleMedMail folder and click on the Install TeleMedMail.bat file. Your computer might flash up a security warning asking if you want to run the software, click 'Run' to continue.

Taking a digital photo of an x-ray

Modern x-ray equipment often automatically takes digital images. There are also specialized scanners to digitize x-rays but it is also possible to take a photo of a traditional x-ray using a digital camera. Ideally, the camera should be on a tripod to make sure there image is not blurred by movement. Then take the picture with the x-ray on a normal x-ray viewing lightbox, although you might have to dim the lights in the room to get a good, sharp photo. Download and save the photo onto the computer in the usual way (usually via the USB cable).

A window will pop up with the words 'Enter value' and suggest a location on your computer to install the software, for example, 'c:\TeleMedMail'. If this location is acceptable click the 'Install' button on the right hand side of the box, or change the location then click 'Install'. This will load the software onto your computer.

If installation was successful you will see a dialogue box with the words 'TeleMedMail installation complete' and there should be a small TeleMedMail icon on your desktop. Click the icon to start the program.

Set Up

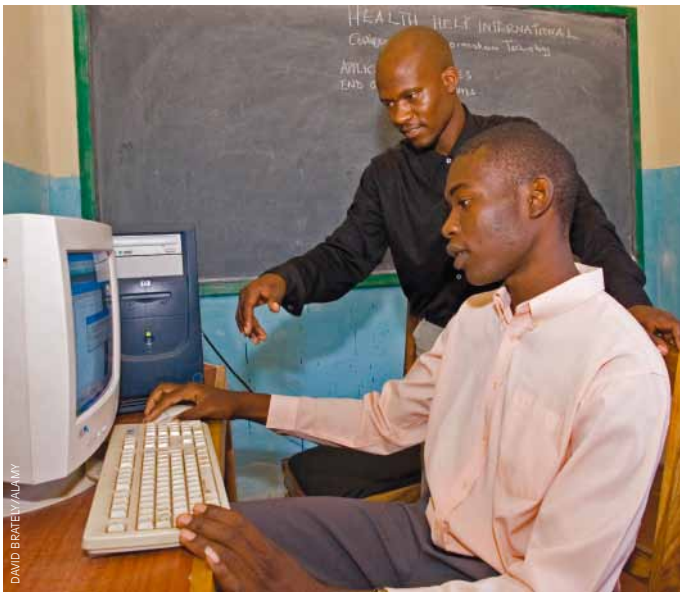
The first time you start the program you will be asked to fill in a few details to configure the software. Add your email address and the outgoing (SMTP) server address. You can also include a different return address if you want replies to be sent to another email account, otherwise leave the field marked 'SMTP username' blank. You can add multiple email address, just separate them with a comma.

You can choose the operating language although, at the moment, the only options are English and Spanish. You can also set the 'Default Image Directory' folder which will be the first folder the program opens when you want to attach an image file (e.g. a digital x-ray photo). You can choose the 'images' folder created within the TeleMedMail directory or link it to your own 'My Pictures' folder, for example. Once you have completed the configuration click 'Apply'. You can always change these details later from the 'Edit settings menu'.

Sending patient details

To prepare a new file for a patient click 'File', 'New Case'. There are several fields for the nurse or doctor to fill in, including the name of the referring hospital, the date, case number and basic patient information such as name, age and gender. There is also space for entering patient history, details of any physical exams and investigations already carried out and a provisional diagnosis.

Enter the data as required along with the email addresses of the referring hospital or doctor and of the specialist who is to receive the data.



You can also attach a digital photo relevant to the case, an image of the injury, for example, or skin rash or even an x-ray. Click on the 'Import Image' button on the right-hand side of the TeleMedMail window. A new window will open where you can browse for the correct image file that goes with the patient's information. Find the file, click on it and then click 'Open'. The software will then load the image. TeleMedMail then allows you to 'Crop' the image so that only the relevant area of the photo is sent, or 'Rotate' the image to face the right way and 'Annotate' the image with detailed comments indicating specific points.

When all the information has been entered click 'Send Email'. A new window will open with the email address of the referring hospital and the receiving specialist. There is also space to add extra information to the receiving doctor. At the top of the window is a small box with 'Encrypt Case'. When you click and then 'Send' you will be prompted to enter a password. These case files can then only be opened by anyone with the password. Confirm the password in a separate phone call to the specialist. It should also be noted that TeleMedMail will need to be installed on the specialist's computer too.

Click 'File' and 'Save Case' to save this file if you want to refer to it at a later date. ■

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The best of health

How do rural communities benefit from electronic health (e-health)?
➜ E-health can benefit rural communities in so many ways. It is only when you are healthy that you can sustain work on the land to provide food and fetch safe drinking water. There is a huge amount of time and labour hours lost due to travelling long distances to specialist hospitals where patients often wait in long queues. The money and effort involved in this process can be better used for other family needs.
The most important thing is to create access to quality and affordable care and to improve the overall health of people in rural areas.

Does a rural clinic need to have an expensive computer, internet link and specialized software to take part in a e-health scheme?
➜ I don't think so. If a rural clinic has a mobile phone that is connected through a dedicated line to a specialist centre, then it can quite easily ask for a second opinion and receive significant support in their healthcare provision from a distance.
I think mobile phones will be particularly useful in e-health provision because they are affordable to many people and demand little power to operate. These are major considerations in rural areas not connected to the main electricity grid.
But, in places where resources are already limited, cost is going to be one of the major challenges for proponents of e-health. Supporters have to convince policymakers to spend money on technology when they are still battling with basic needs like drug supplies.

Should governments invest in these basic needs, delivering safe drinking water and sanitation, for example, as well as drug supplies, or would the money be better spent on e-health schemes?
➜ There is a need for both. Governments need to invest in safe drinking water and sanitation because these are primary healthcare concerns. E-health is a tool to help achieve the provision of, or support, primary healthcare. Governments need to spend wisely and decide on the priorities for any e-health scheme depending on the needs of the population.

How can e-health reduce the cost of providing healthcare to rural areas?
➜ There are very few studies that have looked specifically into the cost-effectiveness of e-health projects and those that did only reported on small-scale projects. However, the main problems of rural healthcare include access to qualified professionals and the burden on patients who have to travel long distances to see a specialist. E-health solves this by providing timely access to medical experts and removes the need for patients to travel long distances. Put simply, telehealth allows increased healthcare coverage to a larger population.
For example, when there is no radiologist in a rural hospital, trained staff can take a digital picture of the x-ray and forward it via email to a radiologist several hundred kilometres away, and get a diagnosis back the same day [see page 4]. Hospitals can use technology to avoid unnecessary delay in the treatment of patients and that is more cost-effective than paying for a specialist in every health centre.

Can e-health ever be as effective as a physical visit to a doctor?
➜ This is debatable. You cannot replace face-to-face consultation in all clinical practice with technology but the doctor involved in a face-to-face consultation can easily seek a second opinion using e-health techniques in real time. We should not forget that e-health is a tool to complement face-to-face care rather than replacing it as a new form of providing care.

Can e-health also be applied to prevent disease?
➜ There is a major role for telehealth in preventive care. Today a lot of projects worldwide have demonstrated the use of short message service (SMS) to provide health education and introduce campaign programmes to the target population. In Nigeria, the national AIDS agency uses SMS to send information detailing where patients can receive voluntary HIV counselling, testing and care. Parents are also reminded of immunization days using SMS.

Will taking part in e-health schemes only give busy doctors extra work? Do we still ultimately need more doctors?
➜ The doctor to patient ratio in Nigeria is very low compared to World Health Organization standards. The African Commission said Africa needs to train one million health workers in order to achieve the Millennium Development Goals by 2015. This is not possible even in places with the resources to establish new training institutes. We have to look for alternative means of training and technology can help there too.
We can use the whole range of ICTs to train students on long-distance health courses at under- and post-graduate level. But any e-health scheme has to be planned appropriately, based on the needs of the target population and available healthcare workers. We have to be careful not to thin out resources and give too much extra work to busy doctors.■


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