Neurology at a distance

New telemedicine technologies are not only improving neurologists' access to remote patients and the ability to make diagnoses at a distance, but they are also offering the opportunity to gather anonymous data for research. Ruth Williams reports on assorted innovations in teleneurology and current limitations to their more widespread use.

The provision of clinical care via a communication system is nothing new, but advances in communication technologies and computing are bringing new and exciting innovations into the realm of remote medicine. The day of modern telemedicine is dawning.

In the area of neurology, patients with stroke have been early beneficiaries of telemedicine. Several hospitals around the world offer an emergency telestroke service, where a trained neurologist is available 24 hours a day to consult via video link on patients with acute stroke in remote hospitals. In addition to stroke, however, telemedicine developments look set to benefit patients with all sorts of neurological conditions, such as Parkinson's disease, Alzheimer's disease, and epilepsy.

A web-based evaluation system to test motor skills of patients with Parkinson's disease has been developed by a team in Texas, USA. Researchers George Kondraske and Malcolm Stewart used nothing more than a home computer and their web-based program to test coordination, visual reaction times, and the ability to perform repetitive movements (finger tapping) in people with and without Parkinson's disease. They found the results to be in good agreement with those obtained using standard lab-based tests and equipment. It is hoped that the system will assist in the early detection of Parkinson's disease, remote monitoring of ongoing symptoms, and assessment and optimisation of drug treatments.

In remote regions of Saskatchewan, Canada, patients with Alzheimer's disease and other types of dementia are benefiting from a telemedicine-supported memory clinic organised by Debra Morgan (University of Saskatchewan) and colleagues. Instead of having to travel multiple times to a memory clinic at a major hospital, patients go just once for an all-round assessment and then follow-up takes place by video-linked consultations at their local health centre or hospital. "The aim of the Rural and Remote Memory Clinic is to increase the availability and accessibility of specialised services for diagnosis and management of early-stage dementia", says Morgan. She explains that, "Rural areas have a higher proportion of older people yet limited access to specialised services."

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It is not just Alzheimer's disease and dementia that affect the elderly. Conditions such as Parkinson's disease and stroke are also age-related, creating a clear need for general teleneurology coverage in rural areas. On top of this, the elderly are generally less mobile. In the case of Morgan's telehealth memory clinic, the mean distance saved by attending a video-linked consultation rather than a face-to-face appointment is "over 428 km for a round trip", says Morgan.

Also set to save patients' time and petrol money is a home-based telerehabilitation system that has been devised for the remote monitoring of patients who have had a stroke or traumatic brain injury, or who have multiple sclerosis. Rehabilitation with therapists is not only costly, but also involves regular, time-consuming trips to a clinic. A Home Care Activity Desk system, which monitors exercises performed by a patient and transmits the data to a clinic, has been tested on patients in Belgium, Italy, and Spain. Barbara Huigen (Roessingh Research and Development, Enschede, Netherlands) and colleagues reported comparable outcomes for patients using the home-based system and those receiving normal rehabilitative care.

In London, UK, John Duncan, Anthony Linklater, and colleagues at The National Hospital for Neurology and Neurosurgery (NHNN), together with UCB Pharmaceuticals, have devised a very simple, but hopefully successful telemedicine initiative for management of epilepsy. "If you ask me what is the commonest reason for failure of epilepsy drug treatment in someone that has good control, it's non-compliance", says Ley Sander, neurologist at the NHNN. Duncan concurs: "Just missing one dose can have a serious effect, because then the drugs are not in the system and the brain is vulnerable to a seizure." So, what is Duncan's simple idea? Text message reminders. "We wanted to have something that was user-friendly, and non-intrusive, as a reminder to people to take their medicines." Of course people can lose mobile phones or even read text messages and still forget their medication. "It's not going to sort everything out", says Sander, "but I have no doubt that it's an improvement."

A second part to Duncan's initiative, which was launched in January, 2010,

is a web-based diary. Patients with epilepsy are encouraged to keep diaries to help spot trends in seizure occurrence, allowing treatments to be better tailored to their needs. But naturally patients sometimes forget, or they write things down inconsistently. Duncan hopes that the web-based diary will make it easier for patients to keep a systematic record.

In the USA, a similar web-based diary and text-messaging service is available on Epilepsy.com, a website edited by Robert Fisher (Stanford University, CA). The data from these online diaries might also be beneficial to researchers, says Fisher. "Someday it might be interesting to be able to look at anonymous data and detect trends and generate interesting questions", he says. With this in mind, he suggests securely sharing data between different website diaries, "so that we can pool data and make a larger data set".

The above examples are merely a handful of the neurology telemedicine innovations and initiatives currently under development around the globe. And there is always room for more. As David Hess, telestroke neurologist at the Medical College of Georgia, GA, USA, puts it, "[Telemedicine] is like apple pie: it makes so much sense." Brett C Meyer (University of California, San Diego, CA, USA) agrees, but recommends caution before neurologists jump on the telemedicine-wagon. "There is a perception of low downsides with telemedicine: that it's safe and effective. In the right hands, with the right training, and with reliable telemedicine systems, we believe it is." But, he stresses, "If you are going to use a telemedicine system, make sure you feel comfortable that it has shown reliability in real-life clinical care settings. Critical decisions may hang in the balance."

He's not talking about online diaries and text messaging, of course, but about systems such as telestroke,

in which the ability to make a diagnosis and assist with treatment might vary considerably depending on the resolution of a camera, the processing speed of a computer, and the robustness and reliability of an internet connection. Although there is no official requirement for validation, researchers like Meyer are beginning their own independent trials to test telemedicine systems. "Because of the perception that all telemedicine systems are created equal, it is our duty as scientists to raise the caution flag", he says. Meyer and colleagues recently tested and validated a BF Technologies telemedicine system for use in telestroke in a National Institutes of Health-funded STRokE DOC trial.

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Even if a telemedicine system has been validated for a specific use (or uses), however, there are still financial, bureaucratic, and computing limitations to its widespread use. There are initial set-up costs, such as the purchasing of equipment, and the training of staff, which might be prohibitively expensive for small rural hospitals and practices. Even if the funding can be found to start an initiative, there is "a real issue with sustainability", says Hess. "A lot of telemedicine [systems] come and go."

As for bureaucracy, in the USA doctors must hold licences for every state and have credentials for every hospital in which they practise. Setting up a system to serve a large number of remote and out-of-state hospitals is thus complicated, lengthy, and, again, expensive.

As far as computing limitations are concerned, adequate processing power and reliability of connections are obvious requirements, but the ultimate aim, on a nationwide scale, would be to seamlessly integrate
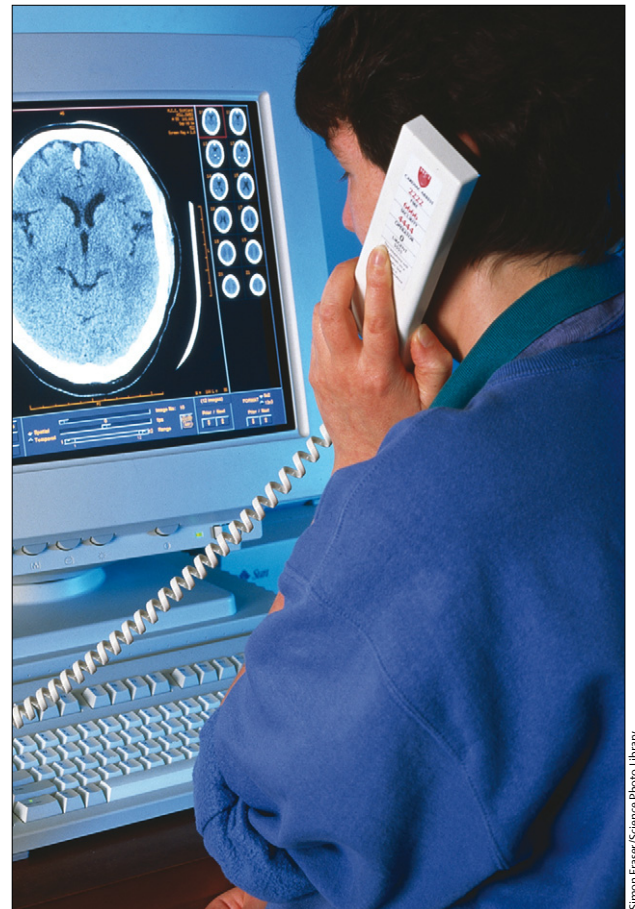
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data from telemedicine consultations and online diaries into one universal secure electronic health system.

According to a recent report, Denmark is leading the world in digital care. Virtually all of Denmark's primary care physicians and almost half of its hospitals are using electronic records. In the USA, however, the figures are just 17% for doctors and about 10% for hospitals, while in the UK, the National Health Service (NHS) national programme for IT—the government's plan for a digital upgrade of the NHS—is both behind schedule and over budget. When such electronic systems are finally in place and all-encompassing, however, then telemedicine will truly have its day.

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For more on the **STRokE DOC trial** see *Lancet Neurol* 2008; **7:** 787–95

For the **recent report** see *New York Times* January 12, 2010 http://www.nytimes.com/2010/01/12/health/12denmark.html?scp=1&sq=health%20electronic%20records&st=cse

For more on **use of electronic records in ambulatory care** see *N Engl J Med* 2008; **359:** 50–60

For more on **use of electronic records in hospitals** see *N Engl J Med* 2009; **360:** 1628–38