# Information technology and telemedicine

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It is widely held that information technologies will revolutionize patient care, medical research, medical education and the administration of health services. My emergency medicine group, for example, would not function nearly as well without the relatively simple technology of email. Statistics Canada reported in March 2001 that 53% of Canadians over 15 years of age (that is, 13 million) used the Internet over the past year. Commercialism aside, witness the recent explosive growth in the use of the Internet by many patients and physicians seeking information. The full text of *CMAJ*, for example, was first put online in July 1999, and last year the use of the site more than doubled, with users from around the world.[1] Access to both good-quality and poor-quality information on the Internet has already affected the patient–physician relationship.

In this issue (page 765),[2] Risto Roine and colleagues systematically review research concerning telemedicine from 1966 to early 2000 and define telemedicine as "the use of information and communications technology to provide health care services to individuals who are some distance from the health care provider." Their article analyzes many of the vast array of activities that take place under the telemedicine banner. This is a well-done and timely analysis, because many Canadian hospitals and health care providers have invested or are currently poised to invest heavily in computer-based information systems in order to improve patient care both locally and at a distance.

Roine and colleagues found the following forms of telemedicine to be valuable: "teleradiology, teleneurosurgery, telepsychiatry, transmission of echocardiographic images, and the use of electronic referrals enabling email consultations and video conferencing between primary and secondary health care providers." In general, cost savings were not impressive. This is not surprising, because such technology is expensive, especially to develop and support. However, the economic analyses that the authors reviewed did suggest that teleradiology, especially the transmission of CT images, could be cost-saving. And consider the significant benefits to patient care if even just this single application — teleradiology — was in place throughout Canada. Physicians in both rural and urban settings need this service for their patients.

The evaluation of the impact of telemedicine is difficult. Are the needs of physicians and patients well met and is the technology up to the job? Researchers in telemedicine are constantly trying to evaluate a moving target, because technological advances may make routine today what did not work well yesterday. However, such ongoing evaluations are imperative if we are to know which technologies are worth investing in. We should not be too discouraged by some of the evaluation data presented in the article by Roine and colleagues but, rather, we should learn from it to modify our efforts to meet real needs. Here, I review current trends.

## Informatics in practice

Information technology is increasingly recognized as important in clinical practice, but much remains to be done to implement its use.[3] Physicians are now often more comfortable using a keyboard rather than a pen, and this is particularly true of the new generations of medical students and residents. Nevertheless, even simple information systems are lacking in Canadian health care, and a lack of information is frequently a source of frustration when caring for patients. This access can mean the difference between life and death, or at least appropriate diagnosis and treatment. A frequent example in emergency medicine is the patient who presents with chest pain in the middle of the night and an ECG showing a myocardial infarction of uncertain duration. Often, there is no earlier ECG in the patient's file, and efforts have to be made to get other hospitals to fax an "old" ECG or to obtain one in the morning from the family physician. Urgent treatment decisions regarding thrombolysis in this patient are much more complicated than they should be, because of a lack of simple information. An electronic medical record (EMR) that details a patient's history, the results of laboratory tests, and ECG and imaging studies should be widely available in Canada and would certainly help reduce duplicate testing and inappropriate management. A patient's EMR should be available from any clinical setting, with appropriate permissions and safeguards.

The EMR itself has the potential to be far more than simply a replica of our paper-based systems, in that evidence-based or consensus-driven clinical care guidelines and "expert system" diagnostic analysis can be provided immediately at the point of care. Electronic prescriptions and monitoring have great potential to reduce medication errors and interactions and may even be cost-saving.[4,5] The system of distribution of medication warnings by Health Canada, which is currently under scrutiny by the press, could be integrated into an EMR system.

Most physicians probably still have a healthy skepticism concerning EMR systems, and few are in place yet in

Canada. The EMR faces many challenges beyond the high cost of implementation and maintenance. On a technical level, new software may need to "read" old databases, and this can be technically challenging. A system must respond quickly with the right amount of information to be of use. On the personal level, training, time for training, and the lack of ease of use of some systems can inhibit efforts to use this technology. In the past, computer systems suffered from having complicated user interfaces, but nowadays navigation through programs is much easier, even for novice users. Physicians know their own needs best and must play a central role in the design of EMR systems. Individual rights to privacy must also be protected. Advances in database storage, data encryption and firewall technology will all help prevent unauthorized access to patient information.

The Electronic Child Health Network (ECHN at www.echn.ca) is an example of efforts in Canada to develop EMR solutions. This is an alliance among the providers of maternal, newborn and child health services in the Greater Toronto area that includes the Toronto Hospital for Sick Children. ECHN runs the Health Information Network (HiNet), which is a secure electronic database for the sharing of health records across hospital sites in Ontario. ECHN also provides a public Web site concerning children's health information and a professional development Web site for health practioners.

Despite a rocky beginning, there is now a resurgence of interest in further developing the EMR, with larger companies like IBM, Microsoft and Pfizer joining forces to create a workable EMR.[6]

## Journals on the Internet

The full text of medical journals is becoming increasingly available electronically, with full search capabilities, though often with a subscription charge. The desirability of easy access to the scientific literature by the public and by health care providers must be balanced against the hard realities of financing editor-reviewed and peer-reviewed journals.[7–9] The Canadian National Site Licensing Project is a consortium of university libraries that has successfully negotiated with various journal publishers for increased accessibility to online journals for researchers. It is as yet unclear if a similar initiative in the future will benefit either university-based or community-based clinicians.

## Internet resources for patients

Patients increasingly obtain health care information from the Internet. The quality and accuracy of this information and the search engines used to access it need improvement.[10] Health organizations are recognizing the need to provide better up-to-date information;[11] many organizations publish listings of recommended sites ("sites about sites"). HealthWeb (www.healthweb.org) is such a site maintained by several US health sciences libraries. Some Web site providers even personalize the information for the patient and his or her condition or treatment and allow email access to an assigned health care provider for answers to questions. MediStudy (www.medistudy.com) provides patients and physicians with information about Canadian clinical research trials.

## Online and distance education

The use of computers for studying medicine is increasingly recognized as having great potential, but the effectiveness of "e-Learning" remains unproven and many pitfalls exist.[12] However, medical schools throughout the world are developing extensive online curricula. These are increasingly seen not as supplementary material but as the actual foundations of new revitalized curricula. The traditional lecture series, for example, may be recorded digitally and accompanied by online modules targeting concepts that are difficult to understand. Computers are used increasingly in lectures, labs and small group sessions by both faculty and students. Much of the material used in telemedicine is already in digital format and is readily incorporated into an online curriculum for use when required. Most of these curriculum sites are currently password protected and are not available to the public, usually because of intellectual property and copyright concerns.

This education must be pedagogically sound in design and must not compromise the face-to-face teaching that is crucial to the training of good physicians. The reliability of access to such online curricula also remains a concern, especially as computers have become essential to the day-to-day classroom experience. Various solutions exist. For example, each medical student who enters the first year of studies at the University of Ottawa in September 2001 will use a laptop computer with the computer hard drives configured to contain all the programs, data and Internet, local network and email connections that the e-Curriculum will require. The Faculty of Medicine will facilitate the acquisition of these laptop computers for students and will provide technical support to maintain the hardware and software. Such "laptop" programs are already in place in the United States and other university-level programs in Canada, but this is the first such program at a medical school in Canada.

Faculties of Medicine and Health Sciences have now recognized the need for collaboration in technology-based learning, largely because of the expense involved. Provincial and national "e-Learning" collaborations are starting, but how best to share resources remains to be determined. The McGill Canadian National Digital Medical Library provides one example. This is a searchable collection of medical images on the Internet that can be incorporated into teaching presentations. Canadian medical schools are encouraged to contribute images and thus are allowed access to the entire image library. In April 2001, the Massa-

chusetts Institute of Technology (MIT) announced an initiative called OpenCourseWare that will create Web sites that are accessible to the public at no charge that contain lecture notes and other online learning materials for most of its 2000 courses (web.mit.edu/newsoffice/nr/2001/ocw.html). This program is to be applauded, because it recognizes the responsibility of universities to educate the community beyond their traditional borders. I suspect that if the quality of materials presented is high, then worldwide student interest in enrolment at MIT will increase. It is also worth noting that a quality learning experience at any university involves far more than gaining access to a collection of online course materials, and this is particularly true of the study of medicine.

## Technological advances

Laptops and handheld computers are increasingly powerful, portable and wireless, allowing consultant expertise to be brought directly to the patient's bedside. The capability of networks and the Internet to transfer large amounts of information reliably and securely is also ever-increasing, although the downloading of images, animated material and videos can still be frustratingly slow, even on "high-speed" connections. Soon we will be able to receive, by subscription, certain types of data, such as x-ray film and real-time video, over the regular Internet at higher transfer rates. The infrastructure of the Internet is also improving. A new generation of the Internet, based on fibreoptic cables, called CA*NET3 in Canada and Internet2 in the United States is partially in place and promises extensive "broadband" capability, which will improve the quality and usability of video images on the Internet: many applications for medicine are being developed (http://apps.internet2.edu/). The delivery of much of telemedicine in both patient care and educational applications will be via this new Internet, taking advantage of the potentially "unlimited" bandwidth for data transfer.

## Challenges and questions

The development of telemedicine faces many challenges. Its high cost presents an obstacle at a time in Canada when we are still reeling from the effects of health care cuts. Health care planners and health care teams must ensure that maintenance funding and not just start-up funds are in place for telemedicine initiatives. Many telemedicine projects have functioned under a limited grant umbrella but have ceased to function when that initial funding was used up. Patient confidentiality, security concerns, medicolegal issues and copyright issues have to be considered. However, the most significant challenge is often to change the "culture" of an institution to embrace telemedicine initiatives that meet real needs.

## Conclusion

We have moved well beyond the pioneering stages of telemedicine. Longer-term planning is required, and our health care budgets must incorporate telemedicine as part of regular operating expenses. Physicians, other health care specialists and universities must lead the way. The time has come to recruit, much as we do with researchers, for telemedicine expertise. Programs and centres of excellence related to medical information technology and medical "e-Learning" should be fostered in Canada.

The article by Roine and colleagues[2] describes where we have been and will help determine where we might best go. We must remember that the human element remains most important and that the technology is just the tool. We will succeed if we always start with the medical or educational need and then determine if indeed technology might help best meet that need. It would be exciting to see this same analysis carried out in a decade from now.

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