

Telemedicine links patients in Sioux Lookout with doctors in Toronto

EARL DUNN, MD; DAVID CONRATH, PH D; HELEN ACTON, RN;
CHRIS HIGGINS, M MATH; HARRY BAIN, MD

The Sioux Lookout Zone health care system,¹ which covers an area of about 285 000 km² in northern Ontario, provides health care for about 10 000 native people. The administrative and health care centre for the zone is the Sioux Lookout Zone Hospital, a 70-bed hospital in Sioux Lookout, a town of 3500 people. Most of the native population live in 27 remote communities, whose populations range from 25 to over 1000. In addition to the zone director and assistant zone director there are four family physicians providing primary and secondary care throughout the zone.

Seven of the larger communities have well-equipped nursing stations with roentgenographic equipment. Each nursing station is staffed by two to five nurses and has a small number of inpatient beds. Under the regular supervision of the physicians in the zone the nurses provide day-to-day health care for their communities. For urgent problems the nurses contact the doctor on call at the hospital.

The other 20 communities in the zone receive day-to-day health care from community health aides. These aides are indigenous health workers who have minimal training in health care, but work under the remote supervision of one of the nursing stations.

Family physicians from the zone hospital make regular twice-weekly

visits to all the communities. And there are also frequent visits by specialty consultants to the zone hospital and to the field communities. Pediatric and family practice trainees from the University of Toronto have assignments at the zone hospital, and medical students visit, work and train in the area. Admission to hospital for diagnosis, management or childbirth is normally to the zone hospital.

Airplane usual transport

Since there are few roads the airplane is the usual form of transport to all but one of these communities. The nursing stations are an average of 300 km from the zone hospital, and the health aide stations are about 70 km from their nursing stations. Traditionally communications have been maintained by high-frequency radio, although the telephone has recently appeared in most of the larger communities. The usual backup to this communication system — air transport of the patient, doctor or both — is expensive and often unreliable. In addition, the nearest tertiary care centre is over 500 km away.

Administration in the Sioux Lookout Zone health system is similar to that throughout northern Canada. Since the north consists of many small remote communities with limited resources, it is a problem to improve the health care in these areas at a reasonable cost. Telemedicine, however, represents

one feasible way to augment the traditional health care system.

Telemedicine is simply the use of telecommunications technology to assist or augment health care delivery. Every time a physician uses the telephone to manage a patient or to conduct a consultation he is using a form of telemedicine. Although for more than a decade the telephone has been used to transmit electrocardiograms and to make pacemaker checks, in recent years technology more sophisticated than the standard telephone has been used in health care.

The first feasibility testing of a visual communication system took place in 1950. In this test a telex mechanism was used to transmit roentgenographic images via standard telephone lines.² Though little happened for the next 20 years — the appropriate technology was being developed — since 1969 there have been many feasibility studies of visual communication systems.³⁻⁶ Many of these systems used satellite technology, and the various programs have been reviewed by Park⁷ and Conrath and colleagues.⁸

Besides studying the feasibility of diagnosis and consultation, several groups, including Canadian,⁹ have considered the potential of telemedicine to deliver continuing medical education to health workers in the remote regions. Although few of these studies have included comparison of the various technologies or analysis of their costs and benefits, several researchers¹⁰⁻¹³ have

Reprint requests to: Dr. Earl Dunn,
Sunnybrook Medical Centre, 2075
Bayview Ave., Toronto, Ont. M4N 3M5

compared the various technologies but have found no or only minimal benefits from the more sophisticated or expensive kinds. Recently, researchers have begun examining the feasibility and effectiveness of slow-scan video systems. These systems are relatively inexpensive and can use standard telephone lines, which makes it possible to install them wherever a telephone exists.

Telecommunications in health care

Beginning in 1973 two of us (D.C. and E.D.)^{12,13} conducted a series of experiments on the uses of telecommunications in health care delivery to remote communities. The studies were phased so that each step built on the previous one, saving money and giving clearer directions for subsequent studies.

In phase one of the series the work of a group of family physicians was observed, with special attention to data retrieval and communications. The physicians were also questioned about their needs for visual images and colour to help make their diagnoses.

With this information we developed phase two, a test of a methodology to study various technologies.⁸ Thirty-two patients were examined by each of four communication modes: colour television, black-and-white television, telephone and face-to-face consultation. Each examination was conducted by a different physician, and each patient was accompanied by a nurse during each of the telecommunication consultations. Since the study used a modified latin-square design each physician examined an equal num-

ber of patients through each of the four modes, each patient experienced all modes and the nurses rotated between communication modes.

The telecommunication mode used made no significant difference to a doctor's ability to manage a patient or to make a diagnosis. Although the patients reacted positively to all modes, they, the doctors and nurses all preferred the colour television mode.

Using the same basic methodology we conducted a 6-month experiment in Toronto. During this experiment more than 1000 patients were examined by several family physicians through one of four telecommunication modes: colour television, black-and-white television, slow-scan black-and-white video and hands-free telephone.^{12,13} (The slow-scan video mode was added because it can use standard telephone lines and is relatively cheap.)

Daily variation

Each patient, accompanied by a nurse, was examined by a physician using one of the four modes. The physician then made his diagnosis and outlined management of the patient. After this, the physician's decisions were compared with the diagnosis and management of the case decided by the patient's own treating physician. Each day telemedicine modes were varied, and in the course of the 6-month experiment about 250 patients were examined through each mode. Again the results showed no significant differences between telemedicine modes in diagnosis, the

time taken to make a diagnosis and in subsequent management of patients. All modes were well-accepted by the patients, and there were no apparent benefits from the more expensive broad-band television systems over the technologies that used telephone lines.

Complexity of delivery

Despite the lack of differences between modes we felt that a study in a large city could not truly reflect the complexity of health care delivery in remote areas. And to investigate the costs and benefits of the relatively cheap slow-scan video system and the hands-free telephone a 2-year study was carried out in the Sioux Lookout Zone.

In August 1977 a slow-scan video system was installed in the Sioux Lookout Zone Hospital and three communities in the zone, and one unit was installed in Sunnybrook Medical Centre in Toronto. In March 1978 three more units were installed; two north of Sioux Lookout and one at the Hospital for Sick Children in Toronto. The study now has eight telemedicine units, each of which contains a hands-free telephone and a slow-scan video system. The slow-scan video systems have receive and send capacity, a video camera and roentgenogram viewbox. The three hospital units each have a tape-recorder and two extra monitors for simultaneous viewing of several pictures. Pictures are transmitted within 79 seconds using standard dial-up telephone lines. Using Bell Telephone conference bridging, pictures can be transmitted to sev-



Usual form of transport



Typical northern nursing station

Telemedicine in action

● A preteenage girl developed hemoptysis. The nurses and doctors were worried that she might have tuberculosis. The girl, who had never before left her community, was promptly transferred to the zone hospital. Once there she stayed in isolation for about a week until it was fairly certain that she did not have open tuberculosis. The girl was frightened and angry because she didn't know why she had been separated from her community and family. A telemedicine session in which she saw her family reassured her.

● A woman who had several children had to leave her community for investigation of several symptoms in hospital. Two days later she said that all her symptoms were gone. After seeing and talking to her children via telemedicine she admitted that she had been worried about them and that her symptoms were still present. She agreed to stay in hospital for investigation.

● A patient with a complicated fracture of a finger attended a

nursing station. Roentgenograms were transmitted to a family physician in Sioux Lookout who transmitted back a page from a textbook. This showed the nurse at the nursing station how to splint the finger properly.

● A young man was stabbed in the chest. The physician in Sioux Lookout, worried that the patient might have a laceration of the diaphragm or the pericardium or both, transmitted roentgenograms to Toronto. The Sioux Lookout physician had advice from a chest surgeon and a radiologist in Toronto, which helped him prepare the patient for transport to a tertiary care centre for treatment.

● A dermatologist on a regular visit to Sioux Lookout had his rounds delayed by bad weather. He decided to conduct his dermatology clinics with a nursing station and a health aide station using telemedicine. All the consultations were successful, and the patients were satisfied with the services rendered.

quently, when equipment or telephone problems have made transmission unsatisfactory.

Telemedicine is regularly used for educational purposes. For example, there are weekly 1-hour roentgenographic rounds for the physicians at Sioux Lookout, which are conducted by a senior radiologist at Toronto's Sick Children's. The roentgenograms discussed are a selection of the previous week's films from Sioux Lookout. As many as 14 films have been transmitted and discussed within 1 hour, demonstrating the feasibility of rapid set-up and transmission of images. Once a month a radiologist conducts roentgenogram rounds for the nurses at the nursing stations. In addition weekly medical rounds at Sioux Lookout are conducted by internists from Sunnybrook Medical Centre. Both the roentgenogram and medical rounds are accepted hour-for-hour as study credits by the College of Family Physicians of Canada.

Frequently, medical consultations are taped, and the tapes retained for in-service educational purposes.

Most of the patients who are admitted to the zone hospital travel several hundred kilometres from their communities. They are often away from home for several months, either for prenatal care and delivery or for hospitalization. The effects on the patient and family are often traumatic. And it is to help lessen the isolation and fears of patients while away from their families that telecommunications are used.

During the project data were collected on the diagnoses and management of patients in Sioux Lookout, and at the end of the project there will be more than 100 000 consultations to analyse. Any dif-

eral units at once. The video system can transmit in black and white any still pictures — the camera can freeze a picture — including roentgenograms, electrocardiograms and skin rashes. Pictures of microscopic slides have been successfully transmitted between Sioux Lookout and Toronto. Since the video system uses dial-up telephone lines, any unit can contact any other unit at any time.

The telemedicine system was used more than 600 times during the first 2 years of operation, and it is now used more than 40 times a month on average. We found that telemedicine has three main types

of use: medical consultation and diagnosis; education; and social-therapeutic.

The ability of the telemedicine system to help medical diagnosis was shown many times — mostly when it was used to transmit roentgenographic images, although there have been successful cardiology, plastic surgery, dermatology and other consultations. The most common use in the Sioux Lookout Zone has been the transmission of roentgenographic images from a nurse in a nursing station to the zone hospital. Consultants have not had any difficulty in interpreting the images presented except, infre-

CMAJ retrospect

"Every newspaper seeks to have an individuality of its own and to carry this individuality right through its pages. For this reason, the concentrated wisdom of all the doctors, if it be distributed to the press generally, will be set aside in favour of the contribution of a lowly general practitioner with a lively pen." — *CMAJ*, February 1930

ferences between those communities with the telemedicine system, and those with the telephone and those with high-frequency radio should appear. Patient transfers, communications and other facets of community health, will also be studied. All this should make a cost-benefit analysis possible.

The availability of telemedicine 24 hours a day is essential for its effective use. Telemedicine does make some patient transfers unnecessary, but it also makes the appropriate transfer of other patients faster. In theory, if the present system prevents one unnecessary patient transfer per month, the system will pay for itself within 2 years.

References

1. BAIN HW, GOLDTHORPE G: The

University of Toronto "Sioux Lookout Project" — a model of health care delivery. *Can Med Assoc J* 107: 523, 1972

2. GERSHON-COHEN J, COOLEY AG: Telognosis. *Radiology* 55: 582, 1950

3. MURPHY RLH JR, BIRD KT: Telediagnosis: a new community health resource: observations on the feasibility of telediagnosis based on 1000 patient transactions. *Am J Public Health* 64: 113, 1974

4. HURWITZ MM: Phone diagnosis: a practical but perilous method. *Geriatrics* 27: 42, 1972

5. STECKEL RJ: Daily X-ray rounds in a large teaching hospital using high-resolution closed-circuit television. *Radiology* 105: 319, 1972

6. WEBBER MM, CORBUS HF: Image communication by telephone. *J Nucl Med* 13: 379, 1972

7. PARK B: *Introduction to telemedicine: Interactive television for delivery of health services*, Alternate Media Center, New York University, New York, 1972

8. CONRATH DW, BUCKINGHAM P, DUNN EV, et al: An experimental evaluation of alternative communication systems as used for medical diagnosis. *Behav Sci* 20: 297, 1975

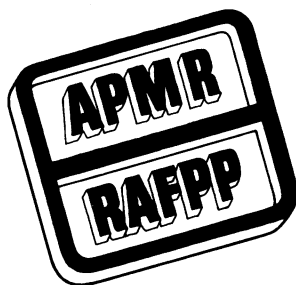
9. HOUSE AM, ROBERTS JM: Telemedicine in Canada. *Can Med Assoc J* 117: 386, 1977

10. SANDERS JH, SASMOR L, NATIELLO TA: *An evaluation of the impact of communications technology and improved medical protocol on health care delivery in penal institutions*, National Science Foundation, Grant GI-39471, Washington, DC, 1976

11. MOORE GT, WILLEMAIN TR, BONNANO R, et al: Comparison of television and telephone for remote medical consultation. *N Engl J Med* 292: 729, 1975

12. CONRATH DW, DUNN EV, BLOOR WG, et al: A clinical evaluation of four alternative telemedicine systems. *Behav Sci* 22: 12, 1977

13. DUNN EV, CONRATH DW, BLOOR WG, et al: An evaluation of four telemedicine systems for primary care. *Health Serv Res* 12: 19, 1977



An APMR won't bother you with details.

We know you won't sit still for a memorized product presentation. In the past, that's what "detailing" was all about. And that's what a "detail man" did. New communication techniques make that approach obsolete. Today's pharmaceutical representative is fully trained to be of greater service to you. APMR stands for Accredited Pharmaceutical Manufacturer Representative. To become accredited, he must successfully complete his company's training program. That's just the beginning. He then must complete a one-year course of study and pass a final examination to earn his diploma. It's not easy. Most things worth achieving rarely are.

Next time you talk to an APMR, we think you'll notice the difference.

Council for the Accreditation of Pharmaceutical Manufacturers Representatives of Canada.