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Telemedicine in rural Norway

Trials are reported from Norway on the use of videoconference facilities to make remote diagnoses in the fields of pathology, dermatology, otorhinolaryngology, cardiology and radiology. Telemedicine is moving from the experimental stage to become a regular feature of practice.

In collaboration with the University Hospital of Tromsø, Norwegian Telecom Research has, since 1988, been conducting a project called "Telemedicine in North Norway", in which remote diagnoses have been performed in close collaboration with health care professionals.

New ways are being sought of using telecommunications to provide health care services in rural areas equivalent to those available elsewhere. The main challenge is to give patients access to special expertise and medical services in a way that is practical, economical and reduces the need to move the patients away from their home districts. Furthermore, by providing access to a support network it is hoped to make the health professions in rural districts more attractive.

The development of telemedical services requires extensive cooperation between

information and communication technology on the one hand, and medicine on the other. The project has established an interdisciplinary research group whose members cover the fields of technology, medicine and social science. This reflects the fact that telemedicine is not just a question of suitable technology: it also deals with organizational matters and various professional issues in the health services. In order to develop telemedical solutions capable of achieving the objectives of health services it is necessary to integrate medical, technical and administrative expertise (1).

In Norway a person's first contact with the health service should take place in the primary care facilities, responsibility for which lies with the local authorities. In the larger municipalities the primary care service includes physicians in both public and private practice. The health service institutions include the local, central and five regional hospitals, the latter also being university hospitals. The University Hospital of Tromsø, for example, serves a population of 450,000. The hospital hierarchy reflects medical competence and specialization, and the regional hospitals offer a broad range of specialist services.

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Videoconferences and remote diagnoses

Norwegian Telecom started the first videoconference service in Norway in 1983. The first studios were built in the northern part of Norway and used in distance education. A videoconference involves on-line bidirectional audio and image communication between different locations using a telecommunications network. The participants both see and hear each other. The most general applications are in meetings and education. In the medical field the same basic equipment is used. In the telemedicine project, hospitals have been equipped with videoconference studios.

The University Hospital of Tromsø has, during the last few years, gained experience with remote diagnosis in dermatology, cardiology, pathology, radiology, and endoscopy of otorhinolaryngology patients. In these trials the hospital works mainly with local hospitals and general practitioners having access to videoconference studios.

The use of videomicroscopy to provide pathology services for remote hospitals was first investigated about twenty years ago (2). However, only during the last couple of years have telepathology systems been employed regularly in a few hospitals.

The Department of Pathology in the University Hospital of Tromsø now has a remote frozen-section service for local hospitals in northern Norway (3). Each of these hospitals has a workstation equipped with a motorized robotic videomicroscope and connected to videoconference facilities (Fig. 1). The microscope is controlled from the Department of Pathology, and the video signal from the microscope is transferred by the videoconference system. The Department of Pathology continuously receives dynamic images and, on demand, static images.

With this system it is possible to provide small rural hospitals with diagnostic services as if a pathologist were present. It is primarily used to provide hospitals with immediate tissue diagnosis for patients undergoing surgery. Laboratory technicians at the local hospitals have been trained to prepare tissue for microscopy according to standard frozen-section procedures, and have proved capable of making sections of good quality.

The validity of frozen-section diagnosis based on videomicroscopy has been previously tested in the Department of Pathology on stored material. The results of this and another study indicate an acceptable degree of accuracy for a frozen-section service based on videomicroscopy (2, 4).

The workstation at the regional hospital, basically a videoconference unit, also has a motorized robotic microscope. With this equipment the hospital offers clinical pathological conferences to hospitals with
videoconference facilities. The telepathology system also supports on-line consultations with other departments of pathology having compatible equipment.

The only neuropathologist at the regional hospital was recently a visiting scientist at the Mayo Clinic in the USA. In order to enable him to continue providing some of his services to the hospital, digitized images were transferred from the electron microscope to the Mayo Clinic. As a backup and control the usual print-outs were sent by ordinary mail. The results of this trial are promising and the techniques may be used in expert-to-expert consultations at a future date.

**Dermatology**

The dermatologists in northern Norway provide an outpatient service to small hospitals and health centres. In a trial that started in 1989 this service is replaced by videoconference facilities. Twice a month a general practitioner brings his patients to a videoconference studio. A dermatologist in the videoconference studio at the University Hospital of Tromsø receives from each patient and the doctor an account of the condition, and the camera is focused on the area of skin in question. The dermatologist views either a live image or a high-quality still image.

The diagnosis is worked out collaboratively by the general practitioner and the specialist. In addition to making a diagnosis and proposing a treatment the dermatologist transfers some of his knowledge to the general practitioner. This approach is now in routine use and will be extended to other remote locations.
Cardiology

Examinations with ultrasound equipment are performed by specialists in cardiology at the University Hospital of Tromsø, who also provide outpatient services to smaller hospitals in the region.

One remote hospital has been furnished with ultrasound equipment. In telemedicine trials, a physician controls this equipment of this procedure is that it has been accredited as part of the training programme in specialist education.

Tests comparing 40 diagnoses made during direct consultations and those made via videoconference showed no major differences.

Otorhinolaryngology

The equipment utilized to make endoscopic examinations consists of a light source, endoscope, camera, camera controller and monitor. The examination of ear, nose and throat by endoscopy is gradually replacing other methods. We have started trials on a remote consultation service in this field by integrating endoscopic equipment and a videoconference studio. A general practitioner, suitably trained in endoscopy, takes patients to the local studio. A specialist, located in the regional hospital, can see the endoscopic examination on a monitor and can influence the control and movement of the endoscope by

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communicating with the doctor over the two-way audiovisual link (Fig. 3). A remote endoscopic picture containing immobile structures is very detailed. Thus it is possible, for example, to detect small blood vessels along the leg of the malleus bone on the eardrum. When the remote endoscopic picture contains movable structures, e.g., vocal cords during phonation, the image is accurate enough to exclude or confirm the presence of ulcerations and tumours.

The results from the trials so far show that it is quite possible to examine a patient at one site while the evaluation is made elsewhere (5).

**Radiology**

In radiology, trials have been conducted on expert consultation involving the use of videoconference facilities and high-quality image transfer between workstations. The image quality in videoconference is not good enough for displaying all details and grey levels in, for example, a thorax image.

By zooming into the region of interest and by grey contrast manipulation, however, the technology has been useful for remote education and some kinds of remote consultation.

To get diagnostic quality for a routine teleradiological service it is necessary to use high-quality digitizers and monitors. A weekly outpatient service provided in a small regional clinic by radiologists from the regional hospital is being replaced. The new procedure involves daily scanning of analog films, transmission of the digital images to the hospital, diagnostic examination on a multiscreen workstation, and digital transmission of dictated reports back to the local clinic (Fig. 4). New work procedures have been designed and the necessary equipment installed.

The results so far show that teleradiology may represent a viable solution for small clinics lacking qualified radiologists, as well as for clinics with a single radiologist who needs ready access to colleagues. The project also shows that teleradiology can now be

**Fig. 3. Remote consultation on ear, nose and throat conditions**
Troms Military Hospital

employed routinely to service local clinics, with little loss in picture quality and substantial gains in the quality of care (6).

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In Norway, telemedicine is progressing from the experimental stage to become a regular feature of practice. The main challenge in the future will probably be to create an organization able to take advantage of the new technology. It is necessary to consider the following questions, among others. What determines the diffusion of the technology in organizations? What are the consequences and the benefits of telemedicine? How will telemedicine affect the structure of health care systems? Does telemedicine conform to existing legislation?

Some answers are known. Remote hospitals gain access to new services and specialist competence and can obtain consultations without sending patients to the regional hospital. Physicians can be educated to perform, for example, ultrasound examinations and interpret the pictures. If difficulties arise, the physicians can receive almost immediate evaluation from the specialist in the regional hospital. Thus telecommunication technology breaks through the professional isolation associated with geographical separation.
Telemedicine renders medical expertise available to more people than used to be the case; it has nothing to do with the development of new diagnostic or therapeutic procedures.

Telecommunication satellites and mobile satellite antennae make it possible to connect almost all locations on earth to each other in videoconferences and make expert services potentially available everywhere. This perhaps seems expensive for developing countries but may not be if the alternative is to send doctors or patients thousands of kilometres by air.

The applications of telemedicine described above can help to ensure equity of access to high-quality health services in large countries with sparse populations, or even between countries and continents.

References


Symptom management

In managing a persistent symptom, drugs should be administered regularly on a prophylactic basis. This principle is now generally accepted in relation to analgesics and pain management, but its application to the use of anti-emetics and laxatives is not as fully appreciated. The use of drugs 'as needed' instead of on a regular basis is often the cause of much unrelieved stress.