Teleradiology in KwaZulu-Natal

A pilot project

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Objective. This was a pilot teleradiology project connecting two secondary KwaZulu-Natal hospitals' radiography departments to a central Durban teaching hospital. The purpose of the study was to assess the usefulness of same-day teleradiology reports to the medical staff and whether such a service changed patient management.

Design. After 1 month's service at each hospital, the first 200 teleradiology reports, original radiographs and patients' case notes were reviewed to determine whether any errors in interpretation of the radiographs had been made and whether the reports had changed patient management.

Results. The service changed patient management in 10% of cases. Undetected pathology was recognised by the radiologist in 20 patients — pulmonary tuberculosis in 10, spinal tuberculosis in 3, miliary tuberculosis in 2 and fractures in 5. Problems were encountered with transmission of data using the current telephone network, loss of data at the receiving station and the increased workload of the radiographer transmitting the data.

Conclusions. Teleradiology services do make a positive impact on patient management in rural hospitals. However, there are many technical pitfalls that must be avoided in order to establish an effective service.

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Telemedicine promises to alleviate some of the difficulties rural doctors and hospitals have in accessing specialist advice in South Africa. Telemedicine programmes between remote rural hospitals and central hospitals have been successfully implemented in Canada, the USA, Saudi Arabia and Australia.[1] In all these countries telemedicine has allowed the specialist to come to the patient rather than the patient's having to travel vast distances to visit the specialist. Applications include teleradiology, telepathology and teleconferencing between general practitioner and specialist.[1] South Africa, with a large rural population, urban-based medical specialists and sophisticated communications, is ideally suited to the development of a national telemedicine network.

There is an acute shortage of radiologists in rural regions of the country, particularly in KwaZulu-Natal. We were interested to determine whether two personal computer-based point-to-point teleradiology systems could effectively provide a same-day reporting service to two different secondary hospitals in KwaZulu-Natal and, more importantly, whether this service changed patient management.

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Patients and methods

Point-to-point teleradiology systems were used to connect two secondary hospitals: GJ Crookes Hospital, Scottburgh (40 km south of Durban) and Stanger Hospital (100 km north of Durban) to the radiology department of the University of Natal. Stanger Hospital has 449 beds and performs 27 000 X-ray examinations and 6 000 ultrasound examinations annually. GJ Crookes Hospital has 300 beds and performs 16 000 X-ray and 900 ultrasound examinations annually. A standard telephone line with a transmission rate of 28 kilobytes per second was used.

The transmitting station in the rural radiology department consisted of a film digitiser (Lumnisys, Fremont, USA) and a pentium (Intel, USA) personal computer (Philips SA, South Africa and Cemax, USA). The receiver station consisted of a pentium-based personal computer with 32 Mb random access memory and a large hard disc of 1 Gb capacity to store incoming data. The monitors had 1.2k X 1.6k X 8 bit resolution. Both systems were based on Windows operating systems (Windows 95, Microsoft and McIntosh, USA) for ease of use. Both systems were DICOM 3 compatible. There was a 20:1 lossless compression algorithm to compress the transmitted data and shorten time of transmission.

The radiographs of the first 100 consecutive patients were transmitted the same day to the receiving station. A relevant history was sent in text mode with each image. Images were reported on the same day or early the following morning by the author and the report was sent by facsimile to the transmitting hospital within 2 hours of the report generation. The original films were sent by provincial transport to the author for comparison with the electronic images within 3 days of being produced. Patient notes were recalled after 200 patients had been reported on; these were reviewed by the author. A questionnaire was sent to the two radiographers involved in the study to determine their opinion on ease of use, technical difficulties and problems with receiving reports from the receiving station in Durban.

Results

Seventy-five per cent of radiographs were of the chest, followed by abdomen (15%), and skull and extremities (10%). All radiographs were considered to be of acceptable diagnostic quality by the author once the grey scale and contrast had been optimised by image manipulation. Mean time of transmission for a chest radiograph was 15 minutes, with a range of 12 - 30 minutes.

Patient management was altered in 20 cases (10%). The most common reasons were the detection of pulmonary tuberculosis (10 patients (5%)) and miliary tuberculosis (2 patients). Undiagnosed spinal tuberculosis was detected in 3 patients. Undiagnosed fractures were detected in 5

patients (2 femoral necks, 2 supracondylar fractures and 1 cervical spine fracture).

Review of the original radiographs of 2 patients (1%) revealed two cortical fractures missed on teleradiology: one metacarpal and one metatarsal fracture. A number of technical problems were encountered: the operating system 'froze or hung' and occasionally required rebooting. The telephone line bandwidth proved inadequate for the data transmission. The transmission process proved problematic for the radiographer at Crookes Hospital and time-consuming in a busy department.

Discussion

This study demonstrates the value of teleradiology to a rural South African hospital. Unlike our current practice of reporting on the radiographs a few days after they are generated, teleradiology allows same-day reporting. Although considered high-technology medicine, most teleradiology systems are actually based on personal computers with pentium processors (Intel, USA) with Windows-based software. The hardware is freely available in this country and can be purchased for as little as R10 000 per station.[1] The total cost of the system including digitiser is R120 000. The cost of each transmission is the cost of the telephone call.

Access to immediate reports allows timely decisions on patient diagnosis and management to be made. We were encouraged by the detection of unsuspected pathology and fractures in our patients. We found the 1.2k X 1.6k X 8 bit monitor we used insensitive for the detection of cortical fractures. We recommend that all skeletal trauma reports are checked with the original radiographs to prevent missing these fractures. The American College of Radiology recommends a 2k X 2k X 12 bit resolution system as the minimum standard for reading radiographs.[2] This increases the sensitivity to the detection of crack fractures significantly.[2] However, the cost and telephone transmission times are substantially increased, compared with the 1k resolution system.

We encountered problems with lost data following transmission and unreliability of transmission using standard telephone lines. This is a reflection of the variable quality of the telephone network in rural KwaZulu-Natal, which is an analogue system and antiquated in some regions. With the introduction of an integrated services digital network (ISDN) by Telkom these problems will be minimised in the future. Alternatively, a dedicated data line can be used (Diginet) which will allow a 64 Kb per second transmission; however, the line is considerably more expensive than a conventional telephone line. The use of satellite transmission has been used in Saudi Arabia for intercontinental consultations with the USA, but costs are very high compared with those of the conventional telephone system.[3]

Training of health care professionals in the use of the digitiser was straightforward, even with staff who were previously computer illiterate. However, the radiographers found the process of transmission to be time-consuming and that it interfered with other work. Training of clerical staff to use the digitiser correctly appears to be one solution to this problem.

In summary, simple teleradiology systems are valuable in patient management in rural hospitals; however, their full effectiveness will not be realised until there are improvements in rural telephone lines.

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