a short electronic letter received an electronic response almost 20 times that of print format.

Conclusions

Compared with the paper journal system as currently constituted, the global information server most certainly is faster; research findings will be presented to scientists in days rather than years. It is also less expensive and potentially more equitable, at least for the type of information transfer entailed in a short research communication. The new technology will foster much more of an interchange among scientists through electronic mail. The internet is spreading rapidly to almost all countries; thus researchers in developing countries will have access to communication that they do not have through print. For these reasons and others presented earlier, we believe that the "printing" technology of the journals will rapidly be obsolete. If journals are to survive there will have to be a profound transformation to a dimensional knowledge structures. The people with the journals are skilled and can lead in part this revolution. However, they need to shake themselves away from the current mind set.

It is time that scientists begin to take control of their research communication; the global health information server allows this to occur. We are just touching the capabilities of the systems. A discussion concerning the development of the system will become avail-

able on the global health net home page (<http://www.pitt.edu/home/ghnet/ghnet.html>). We invite you to join the dialogue.

We should consider the development of a trial system for a specific discipline, such as epidemiology or public health. This is similar to the development of the server in physics. We need to develop this not only with people in health but also with groups, such as the NASA Scientific Internet (NSI) and industry, who are more advanced than we are in telecommunications and who will allow us to take rapid advantage of the existing as well as future technologies. It is time to move beyond the vinyl records of journals articles to the CDs of research communication on the electronic information superhighway.

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Telemedicine: lessons remain unheeded

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Telemedicine, the delivery of health care with the patient and health professional at different locations, has been around for over 30 years. Its driving force has been developments in communications technology, and as new communications systems are developed health applications are proposed such as supporting the delivery of primary health care to geographically remote areas or regions underserved through the maldistribution of professional expertise. Despite rapid technological advances, evaluations of such systems have been largely superficial, and more thorough evaluations have failed to show significant advantages for more advanced and expensive technology over older technology such as the telephone. Methods for evaluating the impact of particular technologies on the health care system need to be developed and clearer benefits shown in terms of improved standards of care.

The development of high speed data transmission links on the information superhighway has stimulated a new burst of activity in the field of telemedicine. The prefix, from the Greek telos, implies only distance, but telemedicine has been defined more recently in terms of advanced communications technology. "Telecommunication that connects a patient and a health care provider through live two-way audio, two-way video transmission across distances and that permits effective diagnosis, treatment and other health care activities."¹ This preoccupation with the latest technology is a symptom of the malaise that has afflicted the field since its inception, and much of the work presented at the Telemed 94 international conference in London last November revealed that the subject is still dominated by advanced communications technology looking for health applications.

Telemedicine, however defined, is not new; early reports appeared in the 1960s. Each decade since has seen a resurgence of activity as new ways of generating images or transmitting data have been developed. The major studies were funded in North America, where telemedicine has been heralded as the answer to health care provision for geographically remote communities and the endemic maldistribution of medical resources. Such studies showed that clinical tasks such as reading a radiograph, interpreting a pathology slide, examining a skin lesion, or auscultating a chest could be performed live with the patient in one location and the physician in another. In most cases, once the technical feasibility was demonstrated, descriptive reports were written and recommendations made for further research—which rarely materialised. New technology would be developed, offering faster transmission of higher quality images, and the cycle would be repeated. Even the proponents of advanced technology recognised this pattern.² Commenting on the demise after 20 years of the StarPach (space technology applied to rural Papago advanced health care) project, which offered mobile remote medical services to an Indian reservation, Preston *et al* attributed its failure to systems management and organisational problems.¹ In the United States the reluctance of health insurers to reimburse physicians for technologically mediated consultation has been cited as a major obstacle to its acceptance.³

Enduring systems and new projects

Some systems have endured, such as that in Newfoundland, which was based on the telephone network as the core technology supporting audio-conferencing and the transmission of electrocephalo-

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The telephone is an effective and stable technology that is already in place in most health care systems—but its full potential has yet to be exploited

grams.⁴ The telemedicine in north Norway project, centred on the University Hospital of Tromsø, combines geographical inaccessibility with an advanced digital communications infrastructure. It has run successful pilot studies of remote diagnosis in dermatology, cardiology, pathology, radiology, and endoscopy of otorhinolaryngology patients, but the impact on the health of the population is still uncertain.⁵ There are other new European projects: the European Commission's research and development in advanced technologies in Europe (RACE) programme funded the telemed project from 1988 to 1992; this evaluated pilot studies of applications in remote radiology, reference database management, and psychiatry. The RGIT survival centre in Aberdeen has developed a system called Camnet which allows transmission of vital signs and video and audio pictures from a remote paramedic to a secondary care centre.⁶

There is much current interest in teleradiology and telepathology and a drive to develop systems that will transmit digitised images of radiographs and slides at higher and higher rates for remote examination. While there are obvious attractions for radiologists in systems that allow remote manipulation of real time images, the benefits to the patient and the impact on delivery of health care are less clear. Economies of scale and quality improvements may be gained by handling rare cases in centralised radiological and pathological services, but these have still to be formally evaluated and weighed against potential disadvantages such as the increased use of high cost diagnostic services, greater distance between the diagnostician and the patient, and job satisfaction. The advantages of service rationalisation should not be confused with advantages for advanced technology. Centralisation does not require expensive, high speed links—communication may take place by transmitting digitised images at lower speeds along the existing telephone network or even by sending conventional images by post.

Means to an end

More rigorous evaluations have challenged the assumption that telemedicine involving patient-doctor communication must be supported by colour interactive videos. Moore *et al* compared the telephone with television for remote diagnosis, treatment, and support in a nurse practitioner based primary care service.⁷ They randomised consultations between television and telephone but found no evidence that television was a more efficient mode; it led to no overall decrease in the rate of referral to physicians. The television consultations were significantly longer and more expensive. Dunn *et al* compared diagnoses in patients attending a

primary care centre with diagnoses made by other means: colour television, monochrome television, still frame black and white television, and hands-free telephone.⁸ In over 1000 cases they found no significant differences between modes in relation to diagnostic accuracy, time for diagnostic interview, tests requested, and referral rates.

The telephone, in contrast to interactive video, has been absorbed without fuss into many health care systems,⁹ but its uses remain largely administrative. It is an established medium for conducting interviews in public health research,¹⁰ and the absence of visual cues may make it particularly suitable for some forms of psychotherapy.¹¹ The reasons for the limited clinical use of the telephone, despite its popularity for counselling in the voluntary sector, are unclear, but it has lacked the high profile champions who have advocated more expensive technologies.

Telemedicine has been presented as offering both education and service delivery to isolated practitioners, but these aims may conflict as the provider seeks to sustain or increase demand for remote diagnostic services. Remote practitioners may then have less incentive to develop their own skills and services and match them to the needs of the local population, and there is a danger that services, particularly in developing countries, will be driven towards high cost diagnostic practice.

Advanced technology

Technology has the power to mesmerise. The desire to possess the latest gadget and the fear of being left behind in a technological revolution may prove irresistible to some. The story of telemedicine is one of false dawns, and this is likely to continue while it is technology led. Dunn's conclusion, now 15 years old, still stands. "Until strong evidence appears that is clearly contrary to our present findings we question the advisability of building expensive broadband video systems to assist the delivery of primary health care. The alternative narrow band systems audio or slow scan video are substantially cheaper, generally more reliable, and appear to provide equally effective health care management."⁷ Any new communications tool should be rigorously tested against existing technology such as the telephone, a stable technology in a rapidly changing sphere, which has been shown capable of supporting many of the interpersonal tasks required for telemedicine but which has still to be exploited to its full potential. Research is needed on how existing technology can be integrated into health care delivery systems in a way that improves the effectiveness and efficiency of those systems, and methods are needed to evaluate the impact of communications media on those systems that have been developed.

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