

Telemedicine: academic and professional aspects

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Doctors have recently gained substantial experience of using telemedical applications for consultations, education and training, and conferences. What is still lacking is systematic evaluation of these new approaches compared with traditional procedures. Trials involving consultations for diagnostic, monitoring, and interpretative purposes should be blinded and multicentred, and should include tests of patient satisfaction as well as macro-economic considerations. The quality of educational programmes and conferences should be documented and compared with traditional teaching methods. International standards need to be developed for such evaluations, to allow comparisons between trials performed at national and international levels. Hong Kong is in a good position to contribute to these developments because of a well-integrated health care system and excellent telecommunication facilities. Through telemedicine, Hong Kong could resume a leading global position in the use of advanced information technology.

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Introduction

Telemedicine can conveniently be divided into three groups—teleconsultation, tele-education, and teleconferencing. These three areas are briefly reviewed below from an academic and professional point of view.

Teleconsultations and interventions

The telephone has always been and will continue to be an important means of providing health care at a distance. However, if the prime elements of clinical consultations are listening and observing, a telephone conversation only provides the verbal element of the process. Recently, the visual element has also been provided in the form of technologies for the transmission of visual as well as auditory signals. In the medical context, the use of audiovisual transmission is often called telemedicine.

There is hardly any area of medicine where telemedicine has not been tried; diagnostic, interpretative, and manipulative clinical activities in teaching and at

conferences over the past decade have included this technology.¹⁻³ As a result, many articles have appeared on the subject both in traditional journals and topic-related journals, such as the *Journal of Telemedicine and Telecare* and *Telemedicine Today*. Excellent homepages are also available on the Internet, where the progression of telemedicine can be followed (eg the Telemedicine Information Exchange*). These sources provide current information about all aspects of telemedicine. Examples of telemedical plans and activities in Hong Kong are presented elsewhere in this Journal.

One can gain experience, mainly by trial and error, of how to 'evaluate' the clinical information provided over the telephone—the tone of voice or mode of speaking by the patient, for example, will indicate how accurate and serious the verbal information may be in medical terms. Presumably, the patient's trust in their doctor and willingness to accept the advice given will depend on the way the physician speaks (few formal evaluations seem to have been performed to assess the accuracy of a telephone consultation in terms of, for example, correct diagnosis and relevance of the prescribed treatment). Adding a visual element to the communication between patient and physician should further improve the quality and effectiveness

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of the clinical consultation but this assumption needs objective proof. The way the consultation or the intervention is conducted, the allocated time, the physical conditions with regard to the lighting in the patient's accommodation and the physician's surgery, the quality of the transmission, and the psychological impact of being in indirect contact, are all factors that may affect outcome. Hence, the recent enthusiasm for using telemedicine as a means of improving the quality of health has to be balanced by the need for telemedicine as evaluated in systematic trials.

At present, there is limited documentation of the advantages and disadvantages of telemedical activities. The available documentation is often focused on time savings and convenience, and includes value statements such as "has potential for future improvement of health care" and "was well received by the patients".³ This situation is understandable, given that the technical means for performing telemedicine have only been readily available in the past decade. Telemedicine lacks documented evaluations, as do many other new clinical procedures because of clinical conservatism and scepticism, a lack of agreed evaluation protocols, lack of resources, and lack of collaborative spirit between states and countries. However, some formal evaluation studies are beginning to appear, such as a Norwegian economic review of teleradiology versus a visiting radiologist service⁴ and a cost evaluation of an Australian telepsychiatry service.⁵ And in Hong Kong, the successful outcome of transmitting radiological images of head injuries between hospitals has resulted in a reduced rate of patient transfer and complications related to transport.⁶

More objective evaluations should include the following performance criteria:

(1) Definition of minimum technical specifications for telemedical applications ('phase 1'). To date, few trials have been carried out with the aim of defining the lowest bandwidth and other technical settings for acceptable clinical performance.⁷ Such studies may require access to a wide range of communications devices (including costly satellite transmissions) and could therefore be out of reach for long-term systematic investigation even in advanced telemedical institutions. A recent report on the effect of transmission bandwidth on diagnostic accuracy in remote foetal ultrasound scanning⁸ amply illustrates the substantial effort involved in attempting to define minimum technical specifications. Many more investigations of this type are required as the basis for conducting clinical trials and will no doubt follow as soon as the costs involved are more favourable.

(2) Comparisons of outcome by telemedical and conventional clinical procedures ('phase 2'). Well-designed clinical trials are needed to compare the accuracy and precision obtained in particular clinical applications by telemedicine and conventional clinical procedures—a requirement that is well recognised in the literature^{3,9} but difficult and costly to perform in practice, as is illustrated by a comparative international trial in teleradiology.¹⁰ Such trials should be blinded and involve multiple centres. They should also include measures of satisfaction among the patients and health professionals involved.

The increasing use of teleconferencing will facilitate multicentre trials as participating physicians and centres do not need to be present in the same location. Internationally agreed protocols for telemedical trials should be used, if they are available.

(3) Resource implications ('phase 3'). The resource implications of the introduction of telemedicine could be substantial. From the patient's point of view, saved time could increase their financial resources to meet family commitments and the patient's employer could count on more hours spent at work. The health care provider (general practitioner, out-patient clinic, or hospital) will only save time in relative terms as another patient will take the vacated time slot. The health care provider may even find that more time needs to be spent on the same number of patients by having to run two types of health care delivery systems in parallel; this results in increased stress in an often underfinanced system and with increased overall costs. Consequently, the effects of introducing telemedical applications need to be carefully considered. In the longer term, indirect effects of telemedicine also need to be evaluated; the planning of the communal telephone network and the integration of information systems for medicine, social services, and education sectors is important—these systems having often developed independently in the past.¹¹ In addition, health care planners need to consider the effect of telemedicine on the future size and staffing needs of out-patient departments and wards.¹²

Patients may be a decisive factor in accelerating the introduction of telemedicine in general and the documentation of the performance of particular telemedical applications. People will increasingly have access to audiovisual communications at home for a wide range of applications, where the question of quality will be present. The step from purchasing a commercial product on the television screen and enquiring about its quality to booking a telemedical

consultation and asking how certain it is that a health problem can be diagnosed is not great. The so-called health industries need to have the answers ready, when the 'market forces' soon descend on them!

Despite the caveats presented above, there is no doubt that patients will profit substantially from a wide range of telemedical applications in the longer term. The articles about specific applications of telemedicine in this journal reflect this sentiment as do a series of presentations made at the recent 'TeleMed 97' conference.¹³

Tele-education

Audiovisual means are increasingly used for educational purposes in many countries, for example, to improve the range of courses available to students living in remote areas and as a way for a teacher or a group of teachers in several locations to reach students also in several locations. It is likely that audiovisual means will be used to teach many aspects of medicine and that tele-education will be a primary goal in the development of telemedicine for some time to come, involving all categories of health workers and all levels of education.

In one difficult area, tele-education could pay off handsomely—in providing a powerful means of implementing the problem-based teaching of medicine. Local teleconferencing can enable a group of teachers and their students to be present during a particular time slot without all parties being physically present in one location. Hence, information technology can elegantly solve what otherwise would require complicated time schedules and cumbersome organisational measures. As with desktop publishing, effective 'desktop teaching', both in terms of quality of presentation and effective use of time is now a reality.

Teleconferencing

The most frequent use of telemedicine is for teleconferencing. The obvious advantages are that two or more conference sites can be linked independent of distance, thus accommodating almost any number of participants, and the travel time and cost of travel are dramatically reduced in many instances. Traditional formats for a conference with even hundreds of participants can still be kept, including parallel sessions. In one instance, a 45-minute conference between Hong Kong and Perth, saved an expert in Hong Kong 3 days and the cost of an air fare and hotel accommodation to the order of HK\$30 000 compared with the cost

for the connection and use of audiovisual equipment of approximately HK\$3000. In another instance, two centres in Hong Kong and Beijing together visited 16 medical centres in four continents in turn during a 24-hour period at a fraction of the cost for organising the same exchange of information with all participants present in one place. It was estimated that in total about 1000 people participated. However, what is true for teleconsultations is also true for teleconferencing—namely, that this form of communication can only serve as a 'second best' to face-to-face contact. Telemedical conferences also need to be carefully planned to run smoothly.¹⁴

Means of implementation locally

The basic requirements for telemedicine include: suitable technical infrastructure for information technology; professional and organisational infrastructure; and appropriate funding.

The necessary technical infrastructure includes a local audiovisual station and a network with a sufficient bandwidth for transmitting sound and vision of an acceptable quality (usually a minimum of 384 kbit/s by integrated services digital network for ordinary teleconsultations, tele-education, and teleconferencing). For transmissions requiring a larger bandwidth (eg for the transmission of microscopic images) satellite transmission can be used. These facilities are widely available. Costs are still prohibitive for many of the more advanced applications but will no doubt decline in the future.

The professional and managerial infrastructure should include organisations capable of developing, introducing, and evaluating telemedicine and of managing telemedical sessions, both locally and with external stations. In the countries that have been most successful in developing and introducing telemedicine—for example, Australia, Norway, the United Kingdom, and the United States—special academic units have been established. The development in Norway is especially interesting as telemedicine emerged as a result of a government decision (in the mid-1980s) to provide decentralised health care to the many small communities along the Norwegian fjords and other remote areas. By this decision, it was hoped to save communities living in a healthy environment and with a long cultural history but without easy communication to a secondary or tertiary medical centre. To facilitate the implementation of this decision, a telemedical unit was created at the University of Tromsø. This unit has been instrumental in building

one of the most sophisticated national telemedical systems in existence. Similar developments supported by academic units have taken place in Australia, France, the United Kingdom, the United States, and more recently, in Hong Kong. Well-established telemedical centres also have managerial staff employed to deal with bookings and set up the necessary internal and external telemedical links.

Initially, extra funding will be required for the implementation of telemedicine. As an example, it is estimated that the United States government has spent more than US\$500 million in the past 3 years and is annually going to make US\$100 to 200 million available for the reimbursement of teleconsultations under the Medicare health plan from 1999.¹⁵

Telemedicine in Hong Kong

The introduction of telemedicine in Hong Kong only began in 1994. The late start may actually have some advantage, as the implementation of telemedicine here can rely both on state-of-the-art communications technology and the practical experience of other countries.

The telecommunications network in Hong Kong is of a high international standard and will allow transmission even of large data volumes; for example, real-time radiological images of a high quality can be sent both locally and to other sites worldwide. The Intranet, used for the communication of patient information within the Hospital Authority (HA), is also of the highest quality and there are advanced plans to use this information superhighway for telemedical applications within all of the HA hospitals in Hong Kong.

Several academic, professional, and organisational structures have been put in place to ensure the gradual and efficient use of telemedicine. There is a 'Task Force on Telemedicine' at The Chinese University of Hong Kong; this group is charged with organising telemedical trials at the University's teaching hospital. The Hong Kong Telemedical Association was founded in 1996 to serve as a broad platform for dissemination of information and exchange of views about telemedicine among health care professionals and administrators, experts on information technology, and others with an interest in the area. The technical and professional components of the growing system for telemedicine in Hong Kong has been successfully tested at several major teleconferences, notably at the 24-hour teleconference held in 1997. This conference was a contribution to mark the return of Hong Kong to China. It

linked Hong Kong and two major hospitals in Beijing with 16 major medical centres in four continents.

It can safely be predicted that the implementation of telemedicine in Hong Kong will be swift, that a substantial number of evaluated applications of telemedicine will be in place in Hong Kong within the next couple of years, and that telemedical links will be forged with major medical centres in mainland China, where advanced technology for telecommunications is rapidly being installed. Such a development would be entirely in line with the intention of making Hong Kong an international leader in the application of information technology.

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