



## Recent advances: Telemedicine

Richard Wootton

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# Clinical review

## Recent advances

### Telemedicine

Richard Wootton

As telecommunication technology has advanced and costs have declined over the past decade, there has been a steady growth in telemedicine. Much of this growth, however, has been in the form of feasibility studies and pilot trials. As a result there is little convincing evidence of the cost effectiveness of many applications, apart from teleradiology (box). This paper reviews recent evidence and describes clinical applications where there is early evidence that telemedicine is not only of clinical benefit but cost effective too.

#### What is telemedicine?

Telemedicine is an umbrella term that encompasses any medical activity involving an element of distance. In its commonly understood sense, in which a doctor-patient interaction involves telecommunication, it goes back at least to the use of ship to shore radio for giving medical advice to sea captains. A few years ago the term telemedicine began to be supplanted by the term telehealth, which was thought to be more "politically correct," but in the past year or so this too has been overtaken by even more fashionable terms such as online health and e-health.

The implementation of telemedicine in routine health services is being impeded by the lack of scientific evidence for its clinical and cost effectiveness. The British government has stated that, without such evidence, telemedicine will not be widely introduced.<sup>3</sup> Policymakers have been warned against recommending investment in unevaluated technologies.<sup>4</sup> Recent advances in telemedicine can therefore be considered to be shown by studies that have obtained evidence of cost effectiveness.

#### Methods

I searched Medline and the specialist telemedicine information exchange database for recent (in the past two years) peer reviewed publications on telemedicine that included evidence of cost effectiveness. The keywords included "telemedicine" and its approximate synonyms "telehealth," "online health," and "e-health." This search produced a total of 969 articles. I then reviewed all articles containing the terms economics or cost effectiveness (184 articles). I also consulted the editorial board of the *Journal of Telemedicine and*

#### Recent advances

The first randomised controlled trial of home telenursing showed evidence of its cost effectiveness

Electronic referrals are a cheaper and more efficient way to handle outpatients

General practitioner teleconsulting may be cheaper than traditional consulting in some circumstances

Decision support over video links for nurse practitioners dealing with minor injuries is shown to be effective and safe

Call centres and online health meet a demand from the public, but are unlikely to be cheaper for the NHS

See also *Editorial*  
by Edworthy

Centre for Online Health, University of Queensland, Royal Children's Hospital, Herston 4029, Australia

Correspondence to:  
R Wootton  
[r.wootton@pobox.com](mailto:r.wootton@pobox.com)

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*Telecare*, one of the specialist peer reviewed publications in the field.

#### Results

##### Home telenursing

In the past decade there has been considerable interest in the possibility of using telemedicine as an aid in home nursing. Various feasibility studies into a range of different kinds of technology have been driven by the hope that care of chronically ill patients can either be provided more cheaply or be of a higher quality than traditional home visits. Although these studies indicate that patient satisfaction is not a problem,<sup>5</sup> little hard evidence on cost effectiveness has been obtained.

The Kaiser Permanente organisation recently reported the first formal randomised controlled trial of home videophones. In this trial patients newly diagnosed with various chronic conditions (for example, congestive heart failure, chronic obstructive pulmonary disease, cerebral vascular accident, cancer, diabetes, anxiety, and need for wound care) were nursed at home. Patients in the intervention group were equipped with home videophones, an electronic stethoscope, and a digital blood pressure monitor

### Teleradiology

#### What is it?

Obtaining specialist opinion by transmission of digital x ray images to a radiologist elsewhere (often in a tertiary centre)

#### What equipment is required?

At the remote hospital, some means of producing a digital image (for example, by inserting plain films into a laser scanner); more modern x ray equipment can produce digital images directly

At the receiving hospital, a system for displaying high resolution images, together with a method of returning the radiologist's report to the sender

#### What are the advantages?

No need to maintain specialist staff in hospitals where the volume of radiology may not justify it

#### What are the alternatives?

Having radiologists on site

Arranging a visiting radiologist service—for example, one day a week (doctor must travel)

Sending patients for radiology at a larger centre (patient must travel)

#### Is it clinically effective and cost effective?

The economics depend on the workload, the distances involved, and what equipment needs to be purchased.<sup>1</sup> Teleradiology is widely used in the USA, where it has been shown to be safe and, in the right circumstances, economical.<sup>2</sup> It is becoming more common in Europe, especially for emergency reporting

(fig 1). Over 18 months, patients in the telemedicine group received 17% fewer home visits by nurses than the control patients, but they had more telephone contact with the nursing staff (in addition to the video "visits"). The measures of quality of care in the two groups were similar. The patients receiving telemedicine were pleased with the equipment and were nursed as effectively as the control patients. The average cost of care in the telemedicine group was 27% less than that of the care in the control group.<sup>6</sup> This is an important result, but because the practice of home nursing in the United Kingdom is rather different from that in the United States the potential of telenursing is likely to be different, and thus this work will need to be followed up in a British setting.<sup>7</sup>

Many of the practical problems of implementing telemedicine in the patient's home are reduced in institutional settings, such as nursing homes, because the costs of expensive equipment can be spread across many patients, staff can be specially trained to operate it, and better telecommunications are possible. For this reason telenursing is likely to be easier in a community nursing home than in private homes, even though the economic gain to society may be less. Early trials of telemedicine in a nursing home in Hong Kong suggest that it is clinically effective<sup>8</sup>; it may also be cost effective (J Woo, personal communication, 2000).

### Electronic referrals to specialists and hospitals

For the past 10 years general practitioners in Finland have been able to make electronic referrals to the Peijas Hospital in Helsinki. Many of these referrals can be dealt with by the hospital staff without the patient needing to attend the outpatient clinic, either by electronic messages or by arranging a teleconsultation by video link. A 20 month study found that 52% of the

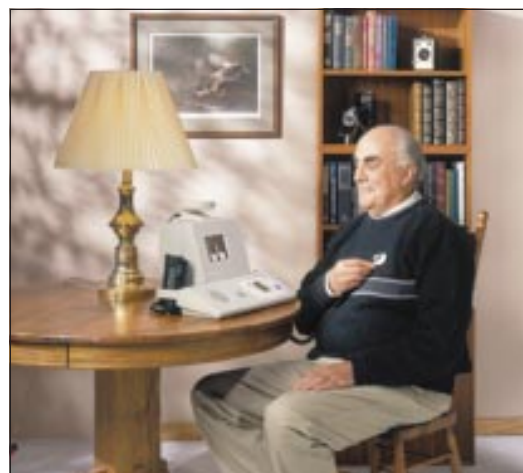
referrals from general practitioners were dealt with electronically. This was a much cheaper method of referral than the traditional method, as used by two control groups of general practitioners with similar patients: the direct costs of a visit to an outpatient clinic in internal medicine were seven times greater per patient than those of an electronic consultation.<sup>9</sup>

In an extension of the principle of electronic referral, the Swinfen Trust, a medical charity, recently proved the efficacy of email in an ongoing project to support doctors in developing countries such as Bangladesh.<sup>10</sup> Advice to doctors is provided by a panel of volunteer consultants, mainly from industrialised countries, and early results indicate that the scheme is likely to be cost effective, at least for the referring doctor and the patient.

### Teleconsulting between general practitioners and specialists

In referring a patient to a hospital, the general practitioner hands over management to a third party, the hospital specialist. An alternative is for the general practitioner to retain the patient in primary care and manage the problem by teleconsulting the specialist. Telemedicine may be an attractive option when a conventional referral to a hospital involves much travel on the part of the patient or doctors concerned. A wide range of teleconsulting applications have been trialled in general practice in such areas as cardiology, psychiatry, orthopaedics, and ophthalmology, as well as techniques such as ultrasound examinations.<sup>11-16</sup> These experiments have shown technical feasibility, but obviously it is too early to know whether such applications will come into widespread use.

Dermatology is a specialty that lends itself well to telemedicine. Three trials—in the United Kingdom, Norway, and New Zealand<sup>17-19</sup>—have reported the circumstances in which teledermatology in primary care can be considered cost effective. The trials, which all used real time video links (fig 2), concluded that travel must be a considerable burden for patients before telemedicine is cheaper for society than the



**Fig 1** Telenursing equipment used by patients in the Kaiser Permanente trial, comprising a low resolution videophone, an electronic stethoscope, and a digital blood pressure monitor. The stethoscope was placed by the patients themselves, or care givers, at sites as requested by the nurse, who could see where the stethoscope was being positioned and recommend adjustments if necessary. (Photo courtesy of Kaiser Permanente)



**Fig 2** A general practitioner in Taupo, New Zealand, consulting a dermatologist in Hamilton, about 160 km away. The computer allows real time videoconferencing. The doctor can use the digital camera to show close up pictures of skin lesions. (Photo courtesy of Waikato Health)



**Fig 3** Teleconsultation between a nurse practitioner in a minor injuries unit and a doctor in the accident and emergency department of a main hospital. The immediate management of a fracture is being discussed. (Photo courtesy of the Ulster Community and Hospitals Trust)

conventional alternative, sending the patient to hospital to be seen by a dermatologist. This sort of teledermatology is therefore not likely to be cheaper for the NHS in London, though it would almost certainly be more economical in rural regions such as the highlands and islands of Scotland.

An interesting question is whether email messages with still pictures attached are better than real time video links. Email has the advantage of being cheaper and more convenient than a video consultation, but forwarded still pictures seem to have a lower diagnostic accuracy.<sup>20</sup> If a higher proportion of patients referred by email rather than a video consultation require a face to face consultation in the end, the overall costs and benefits may be rather finely balanced.

#### Minor injuries telemedicine

One of the most promising applications of real time telemedicine is the use of video links to aid decision making of nurse practitioners running minor injuries units (fig 3). Early work in Scotland showed that using telemedicine to avoid unnecessary transfers of patients from a community hospital resulted in major savings,<sup>21</sup> and telemedicine has now been adopted in about 20 minor injuries units around the United Kingdom.<sup>22</sup> Although we await a formal study of the cost effectiveness of telemedicine, a substantial follow up study from the Central Middlesex Hospital (one of the first hospitals to use the technique) has shown that it is both clinically effective and safe.<sup>23</sup>

#### Call centres and online health

The growth in telephone call centres that provide health information and advice shows that there is a demand from the public for these services. Many such call centres, such as NHS Direct, try to triage callers into those requiring emergency treatment, those who can be referred to primary care, and those who can be advised to treat themselves. Although there is reasonable evidence that these services are safe, little evidence exists that they reduce demand on other parts of the NHS.<sup>24</sup> They are therefore unlikely to be cheaper for the health service—a common situation in telemedicine, where a new application often improves the quality of the service but does not reduce its cost. Indeed, a study of 32 paediatric call centres in the United States showed that all were losing money, the average loss being \$500 000 (£350 000) a year.<sup>25</sup>

An analogous telemedicine service for the general public is internet consultation. "Dot.com" consulting companies, many of which are based in the United States, have proliferated, but as yet little evidence has been shown of their safety or cost effectiveness. These services seem to satisfy a public demand, so the implication is that the conventional alternatives are somehow deficient. Therefore, in parallel with an apparently unstoppable rise in online health services for the public, we need to identify the unattractive features of the conventional routes of access to medical care—and then improve them.

#### The future

Telemedicine holds the promise of improving access to health care, especially in areas where there are geographical barriers, and of reducing costs. The field suffers from the glamorous image associated with the use of high technology equipment in medicine and has been criticised as representing little more than "toys for the boys."<sup>26</sup> Interested parties, such as the equipment and telecommunications companies, often try to force a technical "solution" on the health service without understanding the problems. The NHS's intranet, it has been observed, is a relatively unsuccessful communications medium, perhaps for these reasons.<sup>27</sup>

After my inquiry several editorial board members pointed to the availability of a ubiquitous communications network with standardised communication

#### Online information sources

##### For health professionals

<http://ie.telemed.org> Telemedicine Information Exchange database  
[www.rsm.ac.uk/pub/jtt.htm](http://www.rsm.ac.uk/pub/jtt.htm) Journal of Telemedicine and Telecare  
[www.coh.uq.edu.au](http://www.coh.uq.edu.au) Centre for Online Health  
[www.vh.org](http://www.vh.org) Virtual Hospital  
[www.rsm.ac.uk/pub/hii.htm](http://www.rsm.ac.uk/pub/hii.htm) He@lth Information on the Internet

##### For patients

[www.healthcentre.org.uk](http://www.healthcentre.org.uk) UK health sites  
*Your Guide to E-Health* by Peter Yellowlees. Published by University of Queensland Press as an e-book ([www.uqp.uq.edu.au](http://www.uqp.uq.edu.au))  
[www.who.int/ith/english](http://www.who.int/ith/english) WHO travel advice (health)

**Additional educational resources****Key review articles**

Strode SW, Gustke S, Allen A. Technical and clinical progress in telemedicine. *JAMA* 1999;281:1066-8

Mair FS, Haycox A, May C, Williams T. A review of telemedicine cost-effectiveness studies. *J Telemed Telecare* 2000;6(suppl 1):S38-40

Benger J. A review of minor injuries telemedicine. *J Telemed Telecare* 1999;5(suppl 3):S5-13

Eedy DJ, Wootton R. Teledermatology: a review. *Br J Dermatol* 2001;144:696-707

**Previously published BMJ papers**

Mair F, Whitten P. Systematic review of studies of patient satisfaction with telemedicine. *BMJ* 2000;320:1517-20 (<http://bmj.com/cgi/content/full/320/7248/1517>)

Wootton R. Telemedicine: a cautious welcome. *BMJ* 1996;313:1375-7 (<http://bmj.com/cgi/content/full/313/7069/1375>)

Wyatt JC. Commentary: Telemedicine trials—clinical pull or technology push? *BMJ* 1996;313:1380-1 (<http://bmj.com/cgi/content/full/313/7069/1380>)

Wootton R, Bloomer SE, Corbett R, Eedy DJ, Hicks N, Lotery HE, et al. Multicentre randomised control trial comparing real time teledermatology with conventional outpatient dermatological care: societal cost-benefit analysis. *BMJ* 2000;320:1252-6 (<http://bmj.com/cgi/content/full/320/7244/1252>)

protocols—the internet—as representing a fundamental advance with major implications for telemedicine. This technology may become even more important in future, as wireless access improves (for example, WAP phones). However, the main problem in telemedicine is not a lack of technology,<sup>28</sup> rather, it is the organisational problem of knowing how to take advantage of the technology. For example, how do the health services change their delivery practices to take advantage of what the technology can do? In this respect, the increasing availability of new forms of technology, such as the internet, smart cards, and satellite communications, is almost irrelevant.

Telemedicine has matured in that it has entered the public consciousness, although in association with excessive expectations. It is immature in that relatively little information exists about its cost effectiveness.<sup>29</sup> Where benefits to patients—for example, reduced travel or quicker access to appropriate expertise—outweigh the increased costs to the providers, telemedicine is worth considering. However, it is worth bearing in mind that it is much harder to change attitudes and organisations than simply to deliver new equipment.<sup>30</sup>

Competing interests: None declared.

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*One hundred years ago***The anticigarette crusade in America**

The war against the cigarette in America is assuming the proportions of a veritable crusade. In Chicago, it is announced that the law requiring a special licence to sell cigarettes will be strictly enforced, and all dealers will be reported to the police officials who fail to meet its requirements. An ordinance has been

introduced into the Council prohibiting the sale of cigarettes, cigarette paper, or cigarette tobacco within 600 feet of a school house, and also forbidding the giving away of such articles by persons unlicensed to sell them.

(*BMJ* 1901;ii:100)