The assessment of telemedicine: general principles and a systematic review

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Authors' objectives
To undertake a systematic review of assessments reporting the effectiveness and cost-effectiveness of telemedicine in specific applications.

Searching
MEDLINE was searched from 1966 to November 1998, HealthSTAR from 1975 to October 1998, EMBASE from 1988 to August 1998, and CINAHL from 1982 to August 1998, using a strategy reported in the publication. In addition, the HSTAT database, DARE, NHS EED and the Cochrane Controlled Trials Register were searched using the search term 'telemedicine'. Details of language restrictions (if any) are not reported. No effort to look for unpublished studies is reported.

Study selection

Study designs of evaluations included in the review
The selected studies included comparison between a telemedicine application and a control group. Study designs ranging from small sample randomised controlled trials (RCTs) to non-controlled clinical series were included.

Specific interventions included in the review
Telemedicine (defined as the use of information and communications technology to provide health care services to persons who are some distance from the provider, including technologies such as facsimile, medical data transmission, audio-only format (telephone and radio), still images and full-motion video) compared to a control group of 'what would exist in its absence'.

Participants included in the review
The participants included in the review included urology patients, attendants at a well-baby clinic, prison inmates, ear-nose-and-throat patients, primary care patients awaiting referral, cardiac rehabilitation patients, people with diabetes, people with high blood-pressure, neurosurgical patients, military personnel, people having radiological diagnostic examinations, emergency patients, psychiatric patients, dermatology patients and cardiology patients.

Outcomes assessed in the review
Articles were looked for which reported outcomes in terms of administrative changes, patient outcomes and economic assessment. Articles which were limited to describing the feasibility of a certain system, or the technical evaluation of a system, were excluded.

How were decisions on the relevance of primary studies made?
All abstracts were read by two of the authors. Selection of relevant articles was based on information obtained from the abstracts and agreed in a consensus meeting between the two reviewers. Full-text articles were evaluated similarly by two reviewers.

Assessment of study quality
The strength of evidence in each of the included studies, other than those concerned only with economic analysis, was judged according to the classification by study design given by Jovell and Navarro-Rubio (see Other Publications of Related Interest).

It is stated that each level of evidence was further qualified by conditions of scientific rigour for the study, but the results of this enquiry are not presented. The authors do not state how the papers were assessed for validity, or how many of the reviewers performed the validity assessment.
Data extraction
The authors do not state how the data were extracted for the review, or how many of the reviewers performed the data extraction.

Data were extracted in the following categories: authors and name of study, strength of evidence according to the nine-level classification, objectives of the study, study design, setting and patients, type of economic analysis, results and conclusion.

Methods of synthesis
How were the studies combined?
Economic analyses were combined in a brief narrative synthesis. Clinical assessment studies were presented in tables but not combined.

How were differences between studies investigated?
There was no investigation of heterogeneity.

Results of the review
Twenty-nine studies were included in total: 18 studies assessed at least some clinical outcomes (more than 18,000 participants, visits, consultations or transmissions) and 11 were mainly economic analyses. Study designs were as follows: 2 small sample RCTs, 2 non-randomised controlled prospective trials, 2 non-randomised controlled retrospective studies, 9 cohort studies, 2 case-control studies, 4 non-controlled clinical series, 7 economic analyses and 1 cost-benefit analysis.

The authors state that the most convincing evidence regarding the effectiveness of telemedicine deals with teleradiology, teleneurosurgery, telepsychiatry and transmission of echocardiographic images. Promising results have also been obtained for the transmission of electrocardiograms. However, even in these applications, most of the available literature refers only to pilot projects and short-term outcomes. Most other telemedicine applications still lack scientific evidence regarding their effectiveness.

Cost information
Economic analyses mostly revealed that teleradiology, especially transmission of CT-images, can be cost-saving, although one of the included studies did not find this to be the case. One study on the cost-effectiveness of teleradiology stated the workload that has to be exceeded in order to achieve cost-savings by using teleradiology. A similar study has shown that specialist consultations in the field of otorhinolaryngology can be performed in a cost-saving way when the workload exceeds a certain number of patients. Another field in which telemedicine has been shown to be cost-effective in two studies is telepsychiatry. For applications other than these mentioned above, scientific data on cost-effectiveness of telemedicine remains limited.

The quality of the economic analysis in the reviewed papers was relatively low, with few exceptions. The costs included varied significantly between studies so that comparison of the cost estimates may not be feasible in many cases.

Authors' conclusions
The most convincing evidence from the review regarding the effectiveness of telemedicine deals with teleradiology, teleneurosurgery, telepsychiatry and transmission of echocardiographic images. Promising results have also been obtained for the transmission of electrocardiograms. However, even in these applications, most of the available literature refers only to pilot projects and short-term outcomes. Further scientific assessment studies in the field of telemedicine are needed. Decision makers under public and commercial pressure to start new telemedicine services should link introduction of new, and in many instances costly, technology to realistic development of a business case and subsequent data collection and analysis. Decision makers should also note that an assessment of a telemedicine application will be strongly influenced by the context in which it is undertaken. Assessments will typically be closely
linked to local circumstances and their results may not be generalisable to other situations.

**CRD commentary**

In this review, the literature search is fairly comprehensive, although it is unclear whether language restrictions were applied and no attempt was made to look for unpublished studies; this leads to the possibility that some studies may have been missed. Inclusion criteria are broad although not always clearly stated. Validity assessment is reported to have been undertaken but the results of the assessment are not presented. Study details and results of the twenty-nine included studies are presented in a table but are not synthesised for clinical effectiveness, and more attention is given to economic analyses than clinical assessments in the text. The authors’ conclusions should be treated with caution given the lack of any meaningful assessment of validity or data synthesis.

**Implications of the review for practice and research**

Practice: The authors state that decision-makers under public and commercial pressure to start new telemedicine services should link introduction of new, and in many instances costly, technology to realistic development of a business case and subsequent data collection and analysis. Decision makers should also note that an assessment of a telemedicine application will be strongly influenced by the context in which it is undertaken. Assessments will typically be closely linked to local circumstances and their results may not be generalisable to other situations.

Research: The authors state that further scientific assessment studies in the field of telemedicine are needed. A systematic comparison of the costs, and more work on the effects of the alternatives should be done in the future. The assessment literature has yet to address aspects of telemedicine applications as they move into routine use or their longer-term impact on health status, costs and organisation. Other dimensions will require consideration when formulating approaches to further economic analysis. These will include sustainability of the telemedicine service, decisions on equipment and telecommunications, impact on the overall use of health programme resources and measurement of outcomes.

**Bibliographic details**


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**Other publications of related interest**


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Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.