The cost-effectiveness of technology transfer using telemedicine
Johnston K, Kennedy C, Murdoch I, Taylor P, Cook C

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
A teleophthalmology service between a developed country (UK) and a developing country (South Africa) was examined. The framework of the telemedicine service comprised the following key components:

- the transfer agent (the UK hospital),
- transfer media (teleophthalmology, i.e. the practice of eye medicine at a distance),
- transfer object (specialist advice on clinical management with videoconferencing sessions held every week and lasting between 1 and 2 hours with 3 to 4 cases discussed), and
- transfer recipient (the hospital in South Africa).

Type of intervention
Diagnosis and treatment.

Economic study type
Cost-utility analysis.

Study population
The study population comprised patients referred for an ophthalmologic evaluation.

Setting
The setting was secondary care and a hospital. The economic study was carried out in the UK and South Africa.

Dates to which data relate
The effectiveness and resource use data were gathered over the 12 months from May 2000 to April 2001. The price year was 2000.

Source of effectiveness data
The effectiveness evidence was derived from a single study.

Link between effectiveness and cost data
The costing was carried out prospectively on the same sample of patients as that used in the clinical study.

Study sample
Power calculations do not appear to have been carried out to justify the size of the sample. A single group of patients
was included in the analysis. The authors stated that all patients were referred to the teleophthalmology service. A consensus process was then conducted at the end of the technology transfer project. This involved ophthalmologists reviewing the case notes of patients who had received teleophthalmology. The consensus method judged whether clinical outcomes (as well as costs) were attributable to teleophthalmology (definitely related, possibly related or not related). Overall, a sample of 113 patients was referred for teleophthalmology. Of these, case notes were available for 90. The mean age was 26 years. No other information on the patients included in the study was provided. However, the patients attending the hospital were mainly of Zulu origin. It was not stated whether some patients were excluded from the study sample or refused to participate.

**Study design**

This was a case series study, with clinical data coming from a review of the patients' charts. The evidence was obtained from a single centre, the Edendale Hospital in Edendale, KwaZulu-Natal in South Africa. Details of the follow-up were not reported, but the effectiveness data were gathered alongside a project that ran for 12 months.

**Analysis of effectiveness**

Only those patients where teleophthalmology had definitely or possibly led to an improvement in visual health, as measured by an improvement in visual acuity, were included.

The primary outcome measure was the change in visual acuity identified by the consensus process. The secondary outcome measures, which were used in the calculation of the benefit measure, were the duration of disability, mean age of onset, mean disability weight (estimated using an equation converting the measure of visual acuity before teleophthalmology into a utility), and age weighting. Four measures of practitioner benefit were also estimated:

- practitioner satisfaction with the quality of images produced;
- practitioner comfort with the process;
- a measure of the reason for seeking specialist advice; and
- the impact on medical education.

**Effectiveness results**

The mean duration of disability was 10 years (chronic disease, estimated as part of the consensus process).

The mean age of onset was 31.1 years.

The mean disability weight was 0.45 in the absence of teleophthalmology and 0.36 with teleophthalmology.

The age weighting was 0.04.

The analysis of benefit measures showed the following results:

- in 41% of cases, practitioners perceived the quality of the images to be high;
- in 49% of cases, practitioners reported high comfort with the process;
- in 72% of cases, the reason for local practitioners seeking specialist advice was that a consultant was not available locally;
- 10 novel procedures were identified during the technology transfer process.

**Clinical conclusions**
The effectiveness analysis showed that the use of teleophthalmology reduced the disability weight. The clinical data obtained from the consensus methods were used as inputs for the calculation of the final benefit measure.

**Measure of benefits used in the economic analysis**
The summary benefit measure used was the disability-adjusted life-years (DALYs). These were calculated using published methodology. The mean life expectancy used to estimate the DALYs was derived from age- and gender-specific life tables for South Africa. An annual discount rate of 3% was applied.

**Direct costs**
An annual discount rate of 6% was used for equipment costs with a life span of 5 years or over. The unit costs were not presented separately from the quantities of resources used. The health services included in the economic evaluation were set-up costs, running costs, clinical examination, test and investigation costs attributable to teleophthalmology; and inpatient admission costs. The set-up costs covered equipment (videoconferencing, slit lamps, cameras, video recorders, cabling and maintenance), installation of the telecommunication (ISDN) lines in UK and South Africa, and training. The running costs included the staff costs of those involved in the consultation in UK and South Africa, and the telecommunication costs associated with each teleconsultation.

The cost/resource boundary of the study unclear. The resource use data was estimated using patient-level data derived from the sample of patients included in the clinical study. Local sources were generally used when estimating the unit costs. The price year was 2000.

**Statistical analysis of costs**
The costs were treated deterministically.

**Indirect Costs**
The indirect costs were not included in the economic evaluation.

**Currency**
The costs were estimated in South African Rand and then converted into UK pounds sterling (€). The conversion rate in November 2001 was 1 = Rand 10.04.

**Sensitivity analysis**
A univariate sensitivity analysis was performed to examine the robustness of the cost-utility ratio to changes in the duration of disability and the number of patients whose benefits were directly attributable to teleophthalmology. The authors set the ranges of values used.

**Estimated benefits used in the economic analysis**
The estimated DALYs averted with teleophthalmology in comparison with conventional care were 6.8. When only patients who had improved visual acuity were considered (57 patients), the estimated DALYs were 10.4.

**Cost results**
The incremental total cost per consultation with teleophthalmology in comparison with conventional care was 359 (242 for set-up costs, 91 for running costs, and 26 for costs of clinical examinations, tests, investigations and admissions).

The authors pointed out that not all of the additional average total cost was incurred by the South African hospital, as set-up costs were also incurred by the UK hospital. Further, the only element of the 91 consultation cost incurred by the district hospital was local staff costs (1 of the 91 consultation cost). The South African hospital incurred the increased...
clinical examination, tests, investigations and inpatient admission costs (26 per patient).

**Synthesis of costs and benefits**
An incremental cost-utility ratio was calculated to combine the costs and benefits of teleophthalmology in comparison with conventional care. The incremental cost per DALY averted was 53.

The sensitivity analysis showed that increasing the duration of disability to 20 years led to fewer DALYs averted and to a higher cost per DALY averted (73 per DALY averted). Decreasing the duration of disability led to a cost of 44 per DALY averted. Changing the eligibility of included patients from the base-case to only those with definite improvements reduced the DALYs averted and increased the cost per DALY averted to 449.

**Authors' conclusions**
The teleophthalmology service, which provided specialist advice to practitioners in South Africa, led to a cost per disability-adjusted life-year (DALY) of 53. This was in the range of thresholds used for cost-effectiveness suggested in developing countries. Further, the telemedicine service also resulted in clear benefits for practitioners in the remote site (the developing country).

**CRD COMMENTARY - Selection of comparators**
The selection of the comparator (conventional care) was appropriate as it reflected the standard pattern of care for patients referred for an ophthalmic visit. You should decide whether this represents a valid comparator in your own setting.

**Validity of estimate of measure of effectiveness**
The effectiveness analysis used evidence coming from a single group of patients who attended the new telemedicine service. The changes in clinical outcomes due to the new intervention, compared with standard care, were defined by experts’ opinions rather than an objective process. In fact, no control group was used because the authors stated that it would have been unethical to exclude some patients (those potentially included in the control arm) from a more advanced technology. Information on the follow-up and clinical results was unclear. No justification for the size of the sample of patients was provided. These issues tend to limit the validity of the clinical analysis.

**Validity of estimate of measure of benefit**
The use of DALYs as the summary benefit measure was appropriate as they represent a commonly used measure for interventions implemented in developing countries. DALYs are comparable with the benefits of other health care interventions. DALYs incorporate two dimensions of health (disability and survival). A published approach was used to derive the disability weights. Expected survival was discounted.

**Validity of estimate of costs**
The perspective adopted in the study was not explicitly stated. A detailed breakdown of the cost items was provided, but the unit costs were not provided separately from the quantities of resources used. In fact, the costs were presented as macro-categories, which limits the possibility of replicating the cost analysis in other settings. The source of the data was reported and, in general, local charges were used. The price year was reported, which aids refation exercises in other settings. The cost estimates were treated deterministically and were specific to the study settings. No economic estimates were varied in the sensitivity analysis.

**Other issues**
The authors did not compare their findings with those from other studies. They also did not address the issue of the generalisability of the study results to other settings. Limited sensitivity analyses were carried out, which reduces the external validity of the study results. The study referred to patients undergoing an ophthalmic visit in a developing
country and this was reflected in the authors' conclusions.

Implications of the study
The study results supported the implementation of technology transfer using teleophthalmology. The authors highlighted issues relating to the future sustainability of the project and noted two key issues. First, funding from the international community is required. Second, the success of the project relies on the goodwill of practitioners in the UK to participate. In the future, as it was pointed out, once the skill base has improved in South Africa, it would be appropriate to run the service between eye clinics within South Africa. Finally, the authors stated that if the learning effects could be measured in such a way that they could be included in the cost-effectiveness ratio, this would improve the cost-effectiveness of the project.

Source of funding
Funded by the British Council for the Prevention of Blindness.

Bibliographic details

PubMedID
15310665

Other publications of related interest


Indexing Status
Subject indexing assigned by NLM

MeSH
Cost of Illness; Cost-Benefit Analysis; Developing Countries; Great Britain; Hospital Costs /statistics & numerical data; Hospital Departments /economics; Humans; International Cooperation; Ophthalmology /economics /instrumentation /methods; Quality-Adjusted Life Years; South Africa /epidemiology; Technology Transfer; Telemedicine /economics /instrumentation /methods; Vision Tests /economics /instrumentation /methods; Visually Impaired Persons /statistics & numerical data

AccessionNumber
22004008313

Date bibliographic record published
31/12/2005

Date abstract record published
31/12/2005