Cost-utility analysis of cataract surgery in the second eye

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
Second-eye cataract extraction with intraocular lens implantation was compared with unilateral pseudophakia.

Type of intervention
Treatment.

Economic study type
Cost-utility analysis.

Study population
The study population comprised patients aged 73 years, as determined by the US National Cataract Patient Outcomes Research Team (PORT) study, who were undergoing cataract extraction.

Setting
The setting was secondary care. The economic study was carried out in the USA.

Dates to which data relate
The studies used to derive effectiveness and resource use dated from 1988 to 2002. The price year was 2001.

Source of effectiveness data
The effectiveness data were derived from a review and synthesis of completed studies.

Modelling
The clinical situation of cataract surgery was simulated in a decision tree analysis (Treeage, Inc.). Complications associated with cataract surgery, the rates of adverse events, and mortality within the group of patients were incorporated into the microcomputer model that performed the decision analysis. The median age in the PORT study (73 years) was applied to current life tables to determine life expectancy.

Outcomes assessed in the review
The outcomes assessed in the review were:

visual acuity data;

complication rates, including posterior capsular opacification (PCO), endophthalmitis, cystoid macular oedema, lost lens fragments, intraocular lens dislocation, retinal detachment, pseudophakic bullous keratopathy, and PCO with subsequent retinal detachment;
visual outcomes for each complication after treatment; and
the proportion of patients using different treatment options for complications associated with cataract surgery.

**Study designs and other criteria for inclusion in the review**
Not reported. As in the study by Busbee et al. (see Other Publications of Related Interest), only the patients in the US arm of the PORT study were used for the current analysis.

**Sources searched to identify primary studies**
Not reported.

**Criteria used to ensure the validity of primary studies**
Not reported.

**Methods used to judge relevance and validity, and for extracting data**
Not reported.

**Number of primary studies included**
Visual acuity data for patients undergoing cataract extraction were taken from the report of the US National Cataract PORT. This study used complication rates associated with cataract extraction that were identical to those described by Busbee et al. The same complication rates were used in an attempt to standardise the two studies. The authors believed that the studies used to derive the complication rates in Busbee et al. were among the best evidence-based data for each complication. The utility values were derived using data from a large study of patients with ophthalmic disease. The frequency of using a certain treatment option was estimated by using prior studies relating to the treatment of certain complications. Approximately 12 studies were included in the review.

**Methods of combining primary studies**
Not relevant.

**Investigation of differences between primary studies**
Not reported.

**Results of the review**
After first-eye surgery, the mean postoperative Snellen visual acuity was 20/27 for either eye.

The postoperative visual acuity for second-eye surgery was equal to that of the first eye.

PCO occurred at a rate of 28% over a 5-year postoperative period. The mean time of treatment after surgery was 2 years. Retinal detachment occurred at a rate of 0.81% after cataract surgery. Retinal detachment repair after the treatment of PCO occurred 3 years after cataract surgery. Intraocular lens dislocation occurred at a rate of 1.1% after cataract extraction. Pseudophakic bullous keratopathy occurred at a rate of 0.3%, and the mean time to postoperative treatment was one year after cataract extraction. PCO with subsequent retinal detachment was assumed to occur at a 3.9-fold increase from the cumulative retinal detachment rate of 0.81%.

The visual outcomes for each complication after treatment, with the exception of PCO, were assigned a utility value of 0.858 or 20/27. PCO without retinal detachment was associated with a utility value of 0.97 and with bilateral 20/27 visual acuity. The reference-case utility value for an ocular health state after second-eye cataract surgery was 0.967. The
utility value corresponding to unilateral pseudophakia was 0.858.

For PCO, yttrium-aluminium-garnet capsulotomy was the only treatment option for this entity. In the case of endophthalmitis, 80% of patients received vitreous tap and antibiotic injection, while the other 20% received vitrectomy and antibiotic injection. For cystoid macular oedema, all patients were treated with topical ketorolac and prednisolone. In the case of lost lens fragments, all patients were treated with vitrectomy and retrieval of the lens material. For retinal detachment, treatment was assumed to be split equally between a scleral buckling procedure and pars plana vitrectomy. For dislocation of the intraocular lens, 89% of patients had repositioning or exchange alone, whereas 11% had repositioning or exchange and vitrectomy. Pseudophakic bullous keratopathy was treated by penetrating keratoplasty in 70% of the patients and by topical medications alone in 30% of the patients.

**Measure of benefits used in the economic analysis**

The measure of benefits used was the number of quality-adjusted life-years (QALYs). These were derived by multiplying the utility change by the number of years the typical patient would expect to live. All utility values were derived from patient preferences using a time trade-off model. This consisted of a patient determining the quantity of life he or she would sacrifice to have the quality of life associated with permanent 20/20 vision in each eye (associated with a utility of 1).

**Direct costs**

The costs and the quantities were not reported separately. The direct costs of the health service were included in the analysis. These were for drug expenditure associated with cataract surgery, ambulatory and surgery procedures, and retinal procedures. The drug expenditure costs included both medical and postoperative treatments associated with cataract surgery, and were obtained from the average wholesale prices in the 2001 Drug Topics Red Book. The costs associated with ambulatory and surgical procedures were obtained from the Medicare 2001 outpatient-facility fee schedule. The costs associated with retinal procedures were assigned to diagnosis-related group 36. When multiple evidence-based treatment options were available, the costs for a certain complication were estimated from the weighted average of the costs relating to each treatment option. In the cases in which complications were assumed to occur some designated time after surgery, an annual discount rate of 3% was used to account for the time value of money. The study reported the incremental costs of second-eye surgery. The price year was 2001.

**Statistical analysis of costs**

The costs were treated as point estimates (i.e. the data were deterministic).

**Indirect Costs**

The indirect costs were not included in the analysis.

**Currency**

US dollars ($).

**Sensitivity analysis**

A one-way sensitivity analysis was performed in which the utility values, costs and discount rates were varied within a +/- 25% range.

**Estimated benefits used in the economic analysis**

Second-eye cataract surgery resulted in 1.308 QALYs gained. Discounting the QALYs gained by an annual 3% rate resulted in 0.92 QALYs gained over 12 years.
Cost results
The costs of second-eye cataract surgery with a weighted average of all complications resulted in a total discounted health care cost of $2,509. These costs were zero for unilateral pseudophakia.

Synthesis of costs and benefits
The costs and benefits were combined by calculating a cost-utility ratio (additional cost required per QALY gained). The cost-utility of second-eye cataract surgery was $2,727 per QALY gained.

>From the sensitivity analysis, increasing the discounted costs by 25% resulted in $3,408 per QALY gained, whereas decreasing the costs by 25% resulted in $2,405 per QALY gained. The cost-effectiveness was $2,182 per QALY gained when all the utility values were increased by 25%, and $3,646 when they were decreased by 25%. Varying the annual discount rate resulted in $1,918 per QALY for a 0% discount rate and $5,964 per QALY for a 10% rate.

Authors' conclusions
The results suggested that cataract surgery in the setting of unilateral pseudophakia was an extremely cost-effective procedure.

CRD COMMENTARY - Selection of comparators
Although no explicit justification was given for the comparator used (i.e. surgery in only one eye), it would appear to have represented current practice in the authors' setting. You should decide if the comparator represents current practice in your own setting.

Validity of estimate of measure of effectiveness
The authors did not report that a systematic review of the literature had been undertaken to identify relevant research and minimise biases. However, it appears that the authors have used the results of another review to obtain most of the estimates included in their model. In some instances, for example the proportion of patients using certain treatment options, it was unclear whether the authors derived their estimates from the literature or their own assumptions. Differences between the different studies do not seem to have been investigated. Hence it was unclear, for example, whether all the studies investigated the same population of patients. The authors did, however, investigate uncertainty in the data in the sensitivity analysis, which tends to minimise the limitations highlighted.

Validity of estimate of measure of benefit
The estimation of benefits was modelled over a 12-year period. The utility values were derived from a time trade-off model. The use of QALYs as a measure of health benefit seems to be warranted, as the life expectancy is the same for both patient cohorts. All the benefits were appropriately discounted at a rate of 3%.

Validity of estimate of costs
All the categories of cost relevant to the perspective adopted were included in the analysis. Further, for each category of costs, all the relevant costs seem to have been included. The costs and the quantities were not reported separately, which will limit the generalisability of the authors' results. The sources of where the costs were derived from were appropriately reported, and for many procedures the relevant Current Procedural Technology and DRG codes were reported. A sensitivity analysis of these costs was conducted, using appropriate ranges. Since some costs were incurred over a long time, discounting was appropriately performed. Medicare reimbursement fees were used to proxy prices in some cases. The dates to which the prices related were reported, which will ease any future reflation exercises.

Other issues
Even though the authors did not explicitly compare their results with those from other studies, they reported that other studies investigating second-eye cataract surgery uniformly found improvements in specific outcome measures after
surgery, but that the amount of improvement for most measures was less than after initial cataract surgery. The issue of generalisability to other settings was addressed in the sensitivity analysis. The authors do not appear to have presented their results selectively, and their conclusions reflected the scope of the analysis. The authors reported a number of further limitations of their study. First, the societal costs were not addressed in this model. Second, the utility values were not based solely on a cataract population, but rather a broad range of ophthalmic diseases. This included a number of patients with irreversible retinal disease. As these patients might put more value on regaining better vision because of their knowledge that their disease state is not reversible, this could potentially inflate the utility value for good vision and thus inflate its cost-effectiveness. However, the authors pointed out that other studies have found that ocular utility values are largely independent of the underlying cause of visual loss, and that utility values do not vary with length of time of disease, age, gender, or education level.

**Implications of the study**
The authors reported that the assumption of benefit from second-eye cataract surgery, which is evident to every practising ophthalmologist, should be conferred to others outside this speciality using cost-utility or cost-effectiveness analyses. Such outsiders consist of patients, other physicians, insurance providers and policymakers who will define the practice of medicine in the 21st century.

**Source of funding**
Supported in part by the Retina Research and Development Fund, Philadelphia (PA), USA; the Principals Initiative Research Ward, Kingston (ON), Canada; and the Premier’s Award for Research Excellence, Kingston (ON), Canada.

**Bibliographic details**

**PubMedID**
14644712

**DOI**
10.1016/S0161-6420(03)00796-6

**Other publications of related interest**


**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Cataract /economics; Cataract Extraction /economics; Cost-Benefit Analysis; Health Care Costs; Humans; Models, Econometric; Outcome Assessment (Health Care) /statistics & numerical data; Prospective Studies; Quality of Life; Quality-Adjusted Life Years; United States; Value of Life

**AccessionNumber**
22004000008