

The cost-effectiveness of cataract surgery

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ABSTRACT

Cataract surgery is an extremely cost-effective procedure when measured using a variety of benchmarks. Most of the studies published to date are cost utility studies, which include the patient's perspective on the outcome of the operation. Cost-utility values can vary considerably by country and depend greatly on how costs are calculated (third party payer or societal perspective), what kind of health system is prevalent (socialized medicine or private health insurance) and the method used to calculate utility values. Transparent and detailed reporting of these costs, as well as method utilized to calculate the utility change following surgery, and appropriate discounting to both costs and benefits can help define these values more accurately. Outcomes are generally poorer and the rate of complications higher in developing nations but can be remedied by the construction of dedicated, efficient cataract surgery centers that provide results equivalent to developed countries when appropriate surgical techniques are employed. *OFTALMOL CLIN EXP* 2008;3: 73-77

KEYWORDS: Cataract surgery, cost-effectiveness, ocular surgery, vision health.

Análisis de costo-beneficio en cirugía de catarata

RESUMEN

La cirugía de catarata es un procedimiento calificado como altamente costo-eficaz cuando se lo mide usando una variedad de puntos de referencia para comparación. La mayoría de los estudios publicados hasta la fecha son estudios de costo/utilidad e incluyen la percepción del paciente del resultado de la cirugía. Los valores de costo/utilidad pueden variar de un país al otro y dependen mucho de la forma en la que se calculan los mismos (sea pagado por terceros o con perspectiva social), el sistema sanitaria reinante (medicina socializada o seguro médico privado) y el método utilizado para calcular los valores de utilidad. Facilita mucho el contra con datos claros y detallados acerca de estos costos y el método utilizado para calcular el cambio de utilidad después de la cirugía, además de la tasa de descuento apropiado para los costos y beneficios, pueden ayudar a definir estos valores con más precisión. Los resultados son generalmente inferiores y la tasa de complicaciones más alta en los países en vías de desarrollo, pero esto es algo que se puede remediar construyendo centros eficientes dedicados a la cirugía de catarata que alcanzan resultados equivalentes a los de los países desarrollados utilizando las técnicas apropiadas. *OFTALMOL CLIN EXP* 2008;3: 73-77

PALABRAS CLAVE: cirugía ocular, catarata, costo-beneficio, salud visual

What costs are important in cost-effectiveness?

In medical practice, cost-effectiveness is an attempt to estimate the cost of an intervention, procedure, diagnosis, or screening for diseases in terms of an outcome. Therefore there are two parameters to measure in this equation: (a) the cost (the numerator), and (b) the effectiveness (the denominator).

Costs are primarily calculated from two perspectives: a third party or payer's point of view, or a societal cost. Other forms of economic cost, such as cost of illness (either the incidence cost or prevalence cost) or the burden of disease are more specialized forms of

societal cost but relevant to policy makers. For example, one could calculate the expected lifetime costs of an incident cost of cataract or the amount of money spent to treat all cataract patients in one year in a specific geographic or socioeconomic unit¹.

From a payer's perspective, for cataract surgery one would typically add up all the direct costs of the surgery and any complications that follow. For example, if a patient goes to an ophthalmic center, costs of the staff members' time, a proportion of the overheads associated with running the center, which may include capital costs, consumables, including disposable surgical supplies, the intra-ocular

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lenses (IOLs), and any pharmaceuticals are all relevant. Examinations costs and follow-up visit costs, as well as complications arising from surgery that can be quantified in terms of probability and cost of additional procedures and surgeries are also important². For cataract surgery, the most common complication in posterior capsule opacification, which has a time horizon of anywhere from 3 months to 4 years post-surgery³, so studies that primarily rely on short-term follow-up results may need to include specific data from other countries to be more accurate.

The societal perspective is much broader and can include care-giving costs, the costs of other medical problems related to the disease, such as falls in the case of cataract surgery, loss of earnings by the patients and his or her family, and disability payments incurred waiting for surgery, or post-surgery if the outcome is poor. To illustrate the difference in these approaches, consider the increasing costs (reported here 2004 US dollars) for cataract surgery in the UK (United Kingdom) as one starts with a payer's perspective and proceeds to a societal perspective: Minasian et al (\$600)⁴ and Sach et al (\$3460)⁵. This is nearly a 6-fold difference.

How do we measure the effectiveness of cataract surgery?

Outcomes of cataract surgery, such as visual acuity (VA), are an important because they tell us the clinical effectiveness of the operation, and this information is far more costly to obtain than carrying out cost-effectiveness studies⁶. One could use a direct visual outcome to calculate cost-effectiveness; for example, cost per Snellen line gained or cost per logMAR unit gained. However, cost-effectiveness studies of cataract surgery do not utilize this approach because we want to know the total value gained from the operation, and importantly, what benefit the patient feels he or she had from the operation. The most common method employed that takes these factors into account is the cost-utility analysis.

Utility (U) is a measure of the quality of life experienced from a patient's perspective and employs a scale from 1 to 0, where 1 is perfect health and 0 is death. Therefore, any value between 1 and 0 implies less than perfect health due to the presence of a condition or disease. In ophthalmology, several methods are used to estimate the quality of life associated with a given ophthalmic disease (or combinations of two or more comorbidities). The National Eye Institute's VFQ-25 (Visual Functioning Questionnaire)⁶, is an example of an instrument that attempts to gauge the impact of ophthalmic disease, but has been criticized because it does not emphasize psychological issues, such as fear of the future or anxiety, caregiver status, economic circumstances, and other socioeconomic issues⁷. More ge-

neral (i.e., not ophthalmology-specific) instruments have been exclusively used in cost-utility studies of cataract surgery thus far and include the 15D⁸, and EQ-5D⁹.

An alternative method to using instruments is the time trade-off approach (TTO)⁷. This involves asking an individual how many years he or she expects to live and the how much time, if any, the person would be willing to trade in return for a treatment that guarantees a return to normal health state. So if the values were 10 years and 2 years, respectively, then the utility would be $1 - (2/10) = 0.8$.

Which is the better approach? Although we and some other researchers prefer the TTO approach, there is evidence from a study conducted by Badia et al¹⁰, which demonstrated that although visual analogue scales employed in the EQ-5D were easier and slightly more reliable than the TTO approach, the TTO approach was more likely to better discriminate between health states, and may have greater construct validity. Furthermore, other instruments employed to measure visual disability, including cataract, have been recently criticized on the basis of Rasch analysis¹¹. We should point out that the TTO approach has also been criticized as well¹², so all approaches to estimate the quality of life are far from ideal.

Once the difference in utility values before and after cataract surgery is known, it is then possible to calculate the utility gain and the number of quality adjusted life years (QALYs) gained. QALYs are years of healthy life lived over a period of time. In the case of cataract surgery, the benefit is expected to last over the years of remaining life expectancy¹³⁻¹⁴. So, if the life expectancy of an individual is 10 years at the time of cataract surgery, and the utility values are 0.85 and 0.9 for preoperative and postoperative conditions, respectively, then the number of QALYs gained would be $10 \times (0.85 - 0.9) = 0.5$.

An alternative way of assessing the quality of life is the DALY (disability adjusted life year). DALYs represent the sum of years of life lost and years of life lived with disability due to a disease, but use disability values (D) on a scale (0 to 1) comparable to utility values but reciprocally related (i.e., $D = 1 - U$). An important distinction between disability values and utility values is that the former is determined by panels of experts rather than patients. There is increasing evidence that untreated cataract can shorten life expectancy by a small amount, so using the same values as in the previous example and specifying that 1 year is lost due to increased risk of mortality due, the number of DALYS averted by cataract surgery would be $1 + [10 \times (0.15 - 0.1)] = 1.5$ (D and U are reciprocally related in this example). Thus it can be seen that the DALY calculation can factor in a reduction in life expectancy due to a disease, but the QALY calculation does not.

Discounting

There are many factors that affect that calculation of DALYs and the equations used to calculate them are complicated¹⁵. However, the calculation of both QALYs and DALYs has one common issue that is fiercely debated: discounting. In an ideal world the value of a benefit or the cost of an item would remain constant, but in our system of economics neither is true; an item, such as an IOL or the cost of a surgery will always be more expensive next year. Furthermore money can be invested at a certain interest rate. Another way of looking at this is to say that an item or surgery will only be valued next year at some percentage of today's value. This is the basis of the discount rate⁷. While most economists agree on the need for discounting, what the discount rate should be and whether it should be differentially applied to costs and benefits¹⁶ is still under discussion. The U.S. Panel on Cost-Effectiveness in Health and Medicine recommends a 3% discount rate for both costs and benefits¹⁴, while the National Institute for Health and Clinical Excellence (NICE) in the UK recently changed its recommendations from a 6% discount rate for costs and 1.5% rate for benefits to a 3.5% rate for both costs and benefits¹⁶.

Cost-effectiveness studies of cataract surgery

There have been few cost-utility studies of cataract surgery, and those published used different approaches to calculating the utility gain, as well as different life expectancies and discount rates.^{2,5,8-9,14} In general, those studies in developed countries that utilized the TTO approach or the 15D instrument were in the range of \$1900-\$4900/per QALY (US dollars), while those that utilized the EQ-5D instrument ranged from \$13,000 to \$24,000 per QALY, about five times as much. Calculations to estimate the cost utility in developing countries based on costs of cataract surgery in several countries and the utility gain from two other studies showed a range of \$8 to \$702 per QALY for a higher² utility gain and \$83 to 7514 for a lower⁸ utility gain¹⁴—almost an order of magnitude difference.

There are several "soft" benchmarks of cost-effectiveness against which we can compare these results. The World Health Organization (WHO) has suggested benchmarks for the cost effectiveness of interventions based upon regions¹⁴. Cost-effectiveness values below the GDP (gross domestic product) per capita are very cost-effective, while values of 1-3 x GDP are considered cost-effective, and values > 3 x GDP are not considered cost effective. On this basis, the cost-effectiveness of cataract surgery in all countries analyzed in our previous study¹⁴ and a new study we have conducted easily meets the WHO definition of cost-effective. Cataract surgery also meets the definition of the empirical older benchmarks of cost effectiveness,

\$100,000 per QALY,¹⁹ or \$50,000 per QALY²⁰⁻²¹, and since new estimates place the cost-effectiveness threshold range at \$109,000-\$297,000 per QALY²², it is certain that cataract surgery will remain cost-effective by any measure.

Using the WHO's Choosing Interventions that are Cost Effective Methodology, Baltussen et al²³, calculated a range of cost-effectiveness values for different regions of the world for extracapsular cataract extraction and IOL implantation using an 80% coverage figure and a 3% discount rate. For Africa the range was \$91-106 per DALY averted, while the figure for Central and South America was \$139 per DALY averted (all figures in 2000 international dollars). Against a benchmark of US\$150/DALY averted²⁴, this assures us that cataract surgery is cost-effective using this methodology.

As a final caveat when comparing different cost-effectiveness studies, one should not use the values alone —i.e., \$ per QALY; one should also examine the comparative effectiveness (QALY gain or quality of life change)²⁵. For example, if there were two studies with cost utility values of \$8,000 per QALY gained and \$15,000 per QALY gained, with the first study using ECCE and the second phacoemulsification, one might be inclined to think that the first intervention is more cost effective than the second. However, if the associated QALY gains were 0.15 and 1.1, respectively, one can see that the second intervention provides a much superior result in terms of the quality of life change, and may be the better intervention.

Other factors that affect cost-effectiveness

While remaining life expectancy at the time of operation clearly influences cost-effectiveness, there are other issues that affect both sides of the equation to a degree. Ophthalmic surgery centers that are dedicated to cataract surgery or just a few types of operation, which have efficient staffing and infrastructures where specific surgeons spend much more time performing cataract surgery, are likely to have better outcomes of surgery compared to centers that do not have the same kind of infrastructure; moreover, complication rates are likely to be lower and the operation itself cheaper. In addition, the type of cataract surgery should be appropriate for the setting; otherwise the surgery will be less cost effective. For example, in developed countries, the use of phacoemulsification is appropriate. In developing countries, use of this technique has started to appear in the private sectors of large cities, but if one studies the cost-effectiveness of this technique versus manual small incision surgery, its cost-effectiveness is comparatively lower because the cost is much higher and insufficient experience has been gained to produce the potentially better outcomes.

The visual acuity threshold at which cataract surgery is undertaken and the VA of the companion eye will also affect cost-effectiveness. If one operates on an eye at a VA of 6/18 or better, the amount of benefit that can be theoretically gained will be far less than if one operates on an eye with a VA of 3/60, regardless of the operative technique used. Furthermore, if both of the patient's eyes have relative low VA, the QALY gain is likely to be relatively high, because quality-of-life improvements are linked to vision in the better-seeing eye²⁶. As a result, even if surgery outcomes are not particularly good, a relatively successful operation on a bilaterally blind person will yield a relatively good cost-effectiveness value.

Finally, when evaluating cost-effectiveness studies, when costs do not reflect true costs, because the operation itself is subsidized, or because not all relevant costs are included, the cost-effectiveness can seem better than it actually is.

Final comments

Although cataract surgery is extremely cost-effective when compared to current benchmarks, evaluation of cost-effectiveness studies can provide a wealth of data regarding costs, complications associated with surgery, the efficiency of surgery centers, and techniques used. Space here precludes a detailed analysis of such factors, but a few points are worth making.

Previously, we attempted to define the affordability of cataract surgery by comparing costs to the gross national income per capita in various countries¹⁴. An analysis of this data showed some strange results; for example cataract surgery is much more affordable in Canada than any other country. Furthermore, in developing countries, the affordability in Malaysia, Brazil, and Nepal was very poor, being more expensive than the United States. Another method for comparison might be to look at the cost of living in major cities²⁷ in relation to local incomes.

High complication rates are more likely in developing countries, especially when converting to new techniques, setting up new centers, or using "camp" or mobile surgical units. When the costs and outcomes associated with these complications are not accounted for, values for cost-effectiveness can be considerably overrated.

Finally, as was demonstrated in Brazil²⁸, the efficiency of a surgical center can considerably impact its cost-effectiveness. This is a classical example of defying the old adage that throwing more money at a problem will improve the situation²⁹. Instead, improving procedures, infrastructure, and staffing can make a huge difference without costing much to institute.

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