

**Examining the feasibility of
using the EuroQol in a
marginal cost per QALY
analysis of elective surgery**

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1. Background

The work reported here is part of an ongoing study to assess the usefulness of routinely collecting information on patient perceived outcomes following elective surgery. My hope in bringing these results to the HESG is to get ideas for incorporation into the study, as well as your suggestions on how the analysis of the data might be improved. Your further thoughts on how the results should be presented for publication, would also be welcome. Please accept my apologies if some of this sounds patronisingly simple. Most of it was written as an early draft of a paper for a health care management journal.

2. Aims

The main aim was to find out whether the marginal cost per QALY differed substantially between 5 elective surgical procedures, and hence to determine whether a change in the pattern of purchasing would result in greater total health gain. The procedures included are: coronary artery by-pass grafting (CABG), lens replacement for cataract, hip replacement, knee replacement and repair of the outlet of the bladder for incontinence in females. A secondary purpose was to collect open ended information from the patients about their care or the health following surgery.

3. Methods

3.1 Overview

The study uses a cost utility approach, in which costs are quantified in monetary terms, and health benefits are estimated as Quality Adjusted Life Years (QALYs). Costs include both the cost of surgery, and any consequent changes in the maintenance therapies. Quality of life is assessed using the EuroQol questionnaire and tariff. Information is collected from patients who received questionnaires after they have (hopefully) recovered from their operations.

3.2 The choice of conditions

The conditions were chosen to meet the following criteria:

- They should be slowly degenerative
- It should be possible to exercise discretion concerning the point in the disease at which it is appropriate to intervene
- Patients should be able to describe disease severity in simple terms.

3.3 Sample size

All patients recorded as having undergone surgery for CABG, hip replacement, knee replacement and urinary incontinence are included in our study. Because cataract surgery is much more common than any of the above procedures we decided to reduce our workload by originally taking a 50% sample of those patients. Subsequent analysis revealed significant differences between our two main providers in cataract patients' perceptions of success. We have therefore increased the sampling fraction to 100%.

3.4 Generic quality of life (methods)

Different groups are known to have different perspectives on quality of life. It is often argued that the general public should be the judge of quality of life gains since it is through general taxation that the health service is funded. An alternative point of view is that the patient is the best judge, since it is they who experience the condition and they whose welfare we seek to improve. Our study collects data to accommodate both of these viewpoints.

3.4.1 The patients' views on quality of life (methods)

Valuation, as opposed to the brief description of health states, is difficult. The EuroQol study used a sample of 3395 people to detect statistically significant differences between the health states that they recorded. Had we attempted to obtain valuations from our patients, we would have had to conduct extensive interviews with each. Instead, we decided to use a much simpler method, in which patients are asked to indicate the change in their quality of life on a six point scale with, at one extreme, 'much worse' than before their operation, and at the other extreme, 'much better'. This simple approach seemed reasonable given that our primary instrument for judging quality of life gain was to be the EuroQol. We also collect information on whether the patient has died post-operatively.

3.4.2 A societal view of quality of life (methods)

To obtain a 'societal' view of quality of life, we ask patients to describe their states of health, both before and after surgery, using the descriptive framework of the EuroQol questionnaire¹. Work undertaken previously by the University of York has obtained valuations of the EuroQol health states and thereby enables us to assign a societal valuation to those states on a scale from zero to one, where zero is the score associated with being dead, and one is the score associated with being in full health. Comparing the valuation of health states before and after surgery should give us a measure of the value that society places on that change.

3.5 Condition specific improvements in health (methods)

'Generic' measures of quality of life, such as the EuroQol, are theoretically capable of comparing quality of life improvements for patients suffering different conditions and are essential if we wish to make comparisons between groups of patients. However, if we wish to have a more detailed understanding of the changes in symptoms that contribute to improved quality of life we must collect further information relevant to the condition. To obtain information on the symptoms of patients having undergone hip replacement, knee replacement and coronary artery by-pass grafts, we use those sections of the SF36² which record information on mobility and pain. Patients having undergone surgery for cataract are asked about indoor vision, outdoor vision and reading. Patients having undergone surgery for urinary incontinence are asked to complete a questionnaire developed recently at Kings College Hospital³.

3.6 Open ended question (methods)

All patients were invited to make "... any further comments about the care you received or your health following your operation". All replies were read and assessed for content.

3.7 Life Expectancy

Life expectancy is estimated for each patient based on their age and gender, with appropriate reductions in the case of people having undergone coronary artery by-pass grafts where life expectancy is known to be lower⁴.

3.8 Costs of surgery (methods)

Surgery has implications for both short and long term costs. In the short term there is the cost of the operation. However in the long run, there are likely to be savings, if successful surgery reduces the need for medication and consultations in hospital or general practice. We used the local price tariff to cost the surgery. Our estimates of the long term cost savings are based on medical opinion and assume that the savings will be made for the remainder of the patients' lives. Further work is in progress to obtain more accurate information on the costs of maintenance therapies. Future cost savings are discounted at 5% per annum.

4. Results

The data reported here relate to the period December 1998 until May 1998.

4.1 Response rates

The response rate was extremely high. Ninety three per cent of patients returned questionnaires answered in full or in part. Table 1 shows the response rates by condition.

Table 1 Response rates by condition

Condition	Believed received	Responders	Response Rate
CABG	95	89	94%
Cataract	247	231	94%
Hip	219	202	92%
Knee	148	142	96%
Urinary incontinence	28	25	89%

4.2 Patient views on quality of life (results)

Table 2 shows that the majority of patients reported improvements in their quality of life, however, a significant minority reported no quality of life improvement following surgery. Although we might hope that all would obtain some gains from surgery, there is likely to be a difference in the gains obtained by people who are waiting further surgery on their second eye or limb, compared with those whose treatment is complete.

Table 2 Changes in quality of life by condition

Condition	Made it much worse	Made it a little worse	Not improved it at all	Improved it just a little	Improved it quite a lot	Improved it very much
Coronary artery by-pass	4.7%	2.3%	2.3%	12.8%	23.3%	54.7%
Cataract		0.9%	11.1%	19.0%	32.4%	36.6%
Hip	1.6%	1.6%	4.8%	13.2%	38.6%	40.2%
Knee	2.2%	3.0%	5.2%	25.2%	34.1%	30.4%
Urinary incontinence		4.8%	4.8%	42.9%	9.5%	38.1%

Table 3 distinguishes these groups of patients. For cataract surgery, the difference between 1st and final cataract is not great. Similar proportions of patients reporting either a slight deterioration or no improvement in quality of life. Differences are much more noticeable for hip patients and for knee patients. For hip patients having undergone a first hip operation, 18.5% report no improvement in quality of life, compared with 6.3% reporting lack of improvement or deterioration following their final operation. The comparable figures for knee replacement are 18.2% and 9.6% respectively.

Table 3 Changes in quality of life distinguishing first and final operations

Condition	Made it much worse	Made it a little worse	Not improved it at all	Improved it just a little	Improved it quite a lot	Improved it very much
Coronary artery by-pass	4.7%	2.3%	2.3%	12.8%	23.3%	54.7%
1 st cataract		1.2%	11.8%	15.3%	40.0%	31.8%
Final cataract		.8%	10.7%	21.4%	27.5%	39.7%
First hip			18.5%	25.9%	33.3%	22.2%
Final hip	1.9%	1.9%	2.5%	11.1%	39.5%	43.2%
First knee	3.0%	6.1%	9.1%	27.3%	33.3%	21.2%
Final knee	2.0%	2.0%	3.9%	24.5%	34.3%	33.3%
Urinary incontinence		4.8%	4.8%	42.9%	9.5%	38.1%

4.3 Generic quality of life (results)

Table 4 shows the quality of life gains, grouped into 3 categories. Those people whose answers to the EuroQol imply a worsening in quality of life, those for whom there is no change, and those who register an improvement. This simple classification shows some surprising results. A large proportion of patients having undergone surgery for lens replacement and for urinary incontinence register either a reduction or no improvement in quality of life. A similar breakdown of the answers to the self reported quality of life question highlights this difference. This finding was disappointing because we were intending to use the EuroQol to calculate QALY gains by patient.

Table 4 Comparison of changes in self reported and societal (inferred EuroQol) quality of life

	Societal quality of life (EuroQol)			Self reported quality of life		
	Worse	No improvement	Improved	Worse	No improvement	Improved
Coronary artery bypass graft	9.9%	7.4%	82.7%	7.0%	2.3%	90.8%
Lens replacement for cataract	9.0%	36.7%	54.2%	0.9%	11.1%	88.0%
Hip replacement	5.0%	7.2%	87.8%	3.2%	4.8%	92.0%
Knee replacement	6.5%	9.7%	83.9%	4.8%	4.8%	90.5%
Repairs for urinary incontinence	26.3%	26.3%	47.4%	4.8%	4.8%	90.5%

4.4 Condition specific improvements in health (results)

To investigate this further, we analysed data from the condition specific questions. For lens replacement (see Table 5) they tend to corroborate the patients' perceptions of improved quality of life. We can see that improvements in vision are frequently reported, particularly improvement in reading small print. A more stringent indicator of success is provided by the final row of this table which shows that 69% of respondents reported an unequivocal improvement in their vision, that is to say they were improved on at least one aspect of vision without being worse on any. We would expect such people to record improved quality of life (provided that their operation did not have side-effects resulting in a deleterious effect on other aspects of their lives).

Table 5 Improvements in vision

	Worse	No change	Improved
Change in difficulty reading small print	5%	23%	73%
Change in difficulty getting about indoors	2%	58%	39%
Change in difficulty getting about outdoors	5%	34%	62%
Unequivocal overall improvement in vision	31%		69%

For urinary incontinence, the answers to the condition specific questions neither confirm nor contradict, self perceived changes in quality of life and so do not help us to understand the discrepancy between it and the EuroQol findings (see Table 6). There are certainly some aspects of health in which gains are common and reported problems are few, for example, stress incontinence, where 83% of patients report an improvement, however, only 39% of respondents are unequivocal in the health gains they report. In part, this may be accounted for by post operative infection which should resolve in time.

Table 6 Improvements in incontinence

	Worse	No improvement	Improved
Change in frequency	4%	52%	43%
Change in nocturia	4%	43%	52%
Change in urgency	5%	50%	45%
Change in urge incontinence	5%	37%	58%
Change in stress incontinence	4%	13%	83%
Change in nocturnal enuresis	5%	62%	33%
Change in intercourse incontinence	0%	53%	47%
Change in infections	27%	36%	36%
Change in pain	14%	64%	23%
Change in difficulty passing urine	20%	65%	15%
Unequivocal overall improvement in incontinence	61%		39%

Patients having undergone CABG, hip replacement and knee replacement were asked those sections of the SF36 which recorded mobility and pain (see Table 7). The majority (76%) obtained unequivocal gains in health, with reduction in pain the most frequently reported symptom.

Table 7 Proportion of patients having undergone surgery for CABG, hip replacement and knee replacement who recorded improvement on various aspects of the SF36 questionnaire

	CABG	Hip	Knee
Change in vigorous activity	62%	49%	47%
Change in moderate activity	57%	56%	51%
Change in lifting	63%	53%	51%
Change in climbing several flights	63%	58%	51%
Change in climbing 1 flight	61%	61%	56%
Change in bending	48%	47%	35%
Change in walking 1 mile	68%	46%	42%
Change in walking half mile	67%	57%	50%
Change in walking 100 yards	54%	63%	59%
Change in SF36 Pain	74%	81%	79%
Unequivocal improvement in any aspect of SF36	76%	69%	69%

4.5 Open ended question (results)

Many people took our invitation to comment as an opportunity to report on the care they had received. Potentially this information offered us the possibility of monitoring the care provided by the various hospitals treating patients from within our catchment. There were too few complaints to analyse differences between hospitals, however there were marked differences (even within the same condition) in the proportions of patients who made favourable comments. This was particularly true for patients having undergone surgery for hip replacement, where, in the 'best' hospital, 88% of patients made favourable comments compared with 47% in the worst hospital.

4.6 Life expectancy and Quality Adjusted Life Years (QALYs)

Table 8 shows the mean age and mean life expectancy at the time of the patients' operation. Although patients undergoing cardiac surgery tended, on average, to be younger than the patients receiving prostheses, their life expectancy was no greater. The literature suggests that, even for those patients surviving surgery, life expectancy is similar to those medically managed after about 10 years.

Table 8 Life expectancy

Condition	Mean Age	Life Expectancy
Coronary artery	64.1	10.6
Cataract	76.3	10.2
Hip	70.2	13.9
Knee	70.3	13.9
Urinary Incontinence	52.6	29.0

QALYs are a measure of outcome which, in theory, enable comparisons to be made between interventions that affect health in different ways. This implies that we can use them to compare the health gains arising from the various interventions considered in our study. They combine changes in life expectancy (of relevance to cardio-vascular surgery) and

changes in the value assigned to the patients' quality of life. They are calculated by attributing a value, of between zero and one, to each year of a person's expected life and adding together all such valuations for a persons remaining life expectancy. Thus, a person who is expected to live for two years, the first year in full health, the second year in health valued at one half a full year equivalent, would have a life expectancy of two years and a quality adjusted life expectancy of 1.5 QALYs.

It had been our intention to use EuroQol health state valuations to estimate QALY gains for all patients, however, we were concerned that nearly half of cataract patients would not have recorded any QALY gains had this method been applied. To calculate QALY gains we were forced, either to accept these questionable results, or adopt an 'ad hoc' approach to estimate quality of life gains for cataract and urinary incontinence patients. We decided on the latter course of action, while acknowledging the fact that the results will be less than perfect. We hope they will be sufficiently robust to give an indication of the 'broad picture' but recognise that such an approach confounds the self perceived improvements in quality of life with public perceptions concerning the value of health states.

A regression with dummy variables was used to predict an 'inferred' change in EuroQol score for each level of self reported health improvements (see Table 9). The baseline against which changes were compared was that of no improvement in quality of life. Reassuringly the magnitude and sign of the coefficients were generally as might be expected. However, predictions for patients who reported their health to be a little worse and who reported no change were both positive (although not significantly different from zero). We might have expected them to be negative and zero respectively.

Table 9 Regression equation of EuroQol change against self reported quality of life

	Coefficients	Significance of variable	Predicted EuroQol change
(Constant term used in predicted scores)	0.07	0.327	
Much worse	-0.562	0.000	-0.492
a little worse	-0.04	0.762	0.030
not improved it at all	Baseline case		0.070
improved it a little	0.303	0.000	0.373
improved it quite a lot	0.450	0.000	0.520
improved it very much	0.637	0.000	0.707

Dependent Variable: Change in EuroQol Tariff

Adjusted R² = 0.37

4.7 Costs of surgery (results)

As mentioned above, we used provider prices as a proxy for the cost of the surgical procedures. There are considerable cost reductions when changes in maintenance costs are included (see Table 10 on the next page), particularly in the case of coronary artery by-pass surgery. At present the maintenance costs are based on medical opinion. There does seem to be a general lack of information in the published literature about this sort of information.

Table 10 Costs and cost savings by surgical procedure

Condition		Mean	Std. Deviation	Sample size
Coronary artery	Price	6029.0	0.0	90
	Price net of future savings	-723.4	2028.6	90
Cataract	Price	839.7	217.4	244
	Price net of future savings	385.3	312.1	244
Hip	Price	3938.3	493.5	217
	Price net of future savings	1968.1	793.1	217
Knee	Price	4784.4	173.7	149
	Price net of future savings	2810.0	663.6	149
Urinary Incontinence	Price	2216.4	267.1	23
	Price net of future savings	412.1	332.2	23

4.8 Cost per QALY

If a Health Authority is to obtain maximise QALYs, it should operate on those patients who will obtain the greatest QALY gains per pound spent. Figure 1 shows a scatterplot recording, for each individual in our study, the estimated net costs of surgery and the estimated QALY gains. The most surprising result is the apparent cost savings to be achieved in some of the CABG patients treated. If our figures are correct, this is a 'win win' situation for the Health Authority. It provides health improvements and saves money at the same time. However, this does not necessarily imply that we should be doing more CABG surgery, since it is possible that we are already operating on all those people for whom health gains could be achieved.

Neither figure 1 nor figure 2 (which focuses down on the margin) show any clearly defined boundaries to the clouds of data points for the various treatments. If there had been distinct boundaries we might have been able to judge whether treating the marginal patient in some conditions was less cost effective treating the marginal patient in other conditions. This reflects the results we saw in table 4 which implied that there are significant minorities of patients undergoing all procedures who obtain little or even negative health gain. The message from the data seems to be that it is more important to identify those people who will not gain anything from surgery, than to alter the allocation of resources between surgical procedures in Cornwall

Table 11 provides a list of the assumptions used in the cost per QALY analysis.

Figure 1 Qaly against cost by condition

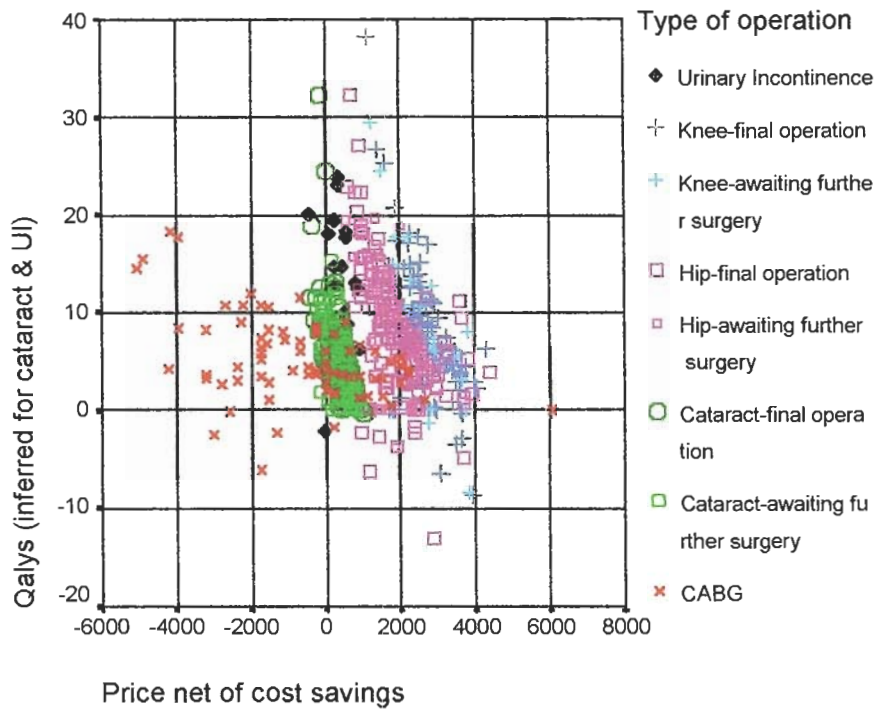


Figure 2 Focusing on marginal costs per QALY

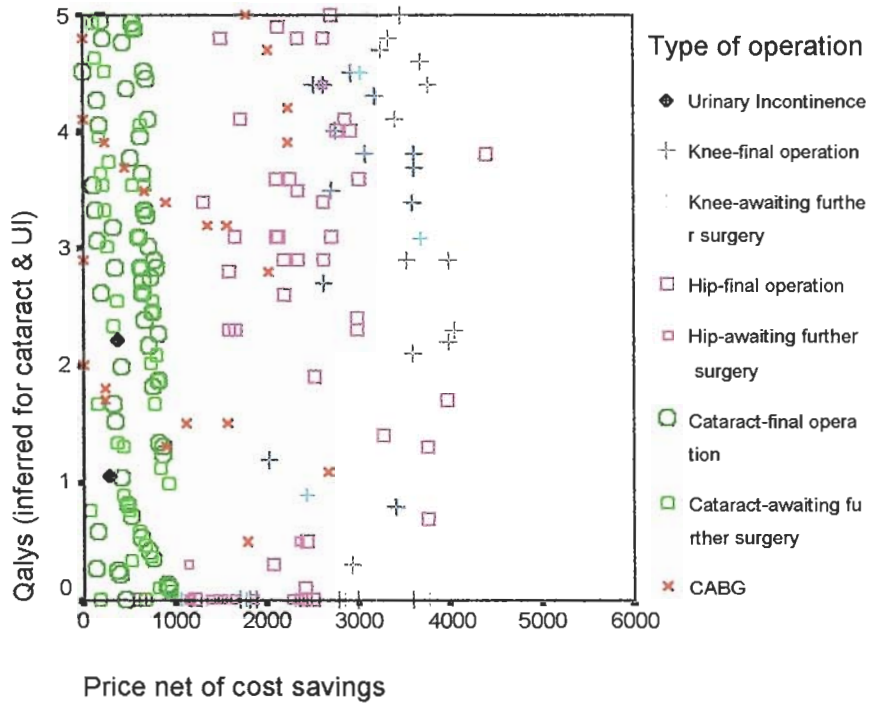


Table 11 Assumptions used in the Cost per QALY analysis

Assumption	CABG	Cataract	Hip	Knee	Urinary incontinence
Cost per operation	Mean Cornish costs £6,029	Mean Cornish costs c£863	Mean Cornish costs c£3967	Mean Cornish costs c£4788	Mean Cornish costs c£2297
Monthly pre operative recurrent costs	Drugs £47-40 OPD £8 GP £6 inpatient £37.5 Total say £100	£5/month	Drugs £15 GP visits £2	Drugs £15 GP visits £2	£10/month
Monthly post operative recurrent costs	Drugs £24-40 OPD £4 GP£3 Tot say £31-40				
Discount rate - recurrent costs	5%	5%	5%	5%	5%
Quality of life measure	EuroQol using the recommended tariff	Prediction of Euroqol value based on self reported improvement in Q of life	EuroQol using the recommended tariff	EuroQol using the recommended tariff	Prediction of Euroqol value based on self reported improvement in Q of life
Future health benefits	Constant as reported post-operatively	Constant as reported post-operatively	Constant as reported post-operatively	Constant as reported post-operatively	Constant as reported post-operatively
Life expectancy	65% of normal life expectancy if operated on, 50% of normal life expectancy otherwise	Normal life expectancy for age	Normal life expectancy for age	Normal life expectancy for age	Normal life expectancy for age
Peri-operative deaths	Assumed to result in 0 Qalys	Assumed to result in 0 Qalys	Assumed to result in 0 Qalys	Assumed to result in 0 Qalys	Assumed to result in 0 Qalys

5. The cost and benefits of the monitoring exercise

Table 12 shows the costs of this sort of monitoring exercise. For comparison, a typical outpatient appointment would cost approximately £50.

Table 12 Cost per person in the sample

Paper, postage etc including a single reminder	£0.63
Clerical costs of assembling address lists, arranging for mailings, data entry etc	£2.08p
Total	£2.71

The benefits are difficult to quantify (where have we heard that before?). Hopefully the exercise is useful for planning health care. The results have been presented to the Health Authority directors. A public health consultant will be discussing the quality issues, that were revealed in orthopaedic surgery, with the relevant trust. He will also discuss whether it is possible to select cataract patients more carefully and reduce the proportion who receive no quality of life gains. He will further discuss with all specialties on whether postal questionnaires might be used to replace some of the routine post operative outpatient appointments (with open appointments available for patients who have problems). The Director of Performance Management is keen to extend the data collection to include prostate surgery and angioplasty.

6. Discussion

In the spirit of the HESG, the work presented here is for your discussion. I have jotted down some thoughts on some of my own areas of concern.

Given the pre-operative uncertainty about outcomes and the consequent stochastic nature of the data, exactly what do these results tell us?

Is the collection of this sort of information a worthwhile exercise for a Health Authority to undertake.

The cost per QALY for most of the people in our study was very low. This probably reflects the choice of conditions as those that are well proven. It may be that there is a pool of unmet need waiting to be treated.

Should I have used other conditions whose health gains are more questionable?

Because of difficulties with the descriptive part of the EuroQol we are piloting the use of the EuroQol 'thermometer', particularly to find out whether it will affect our response rate. How else might we obtain a quality of life valuation for cataract and urinary incontinence?

Was it very wrong to infer EuroQol values from the patients response to the question on self perceived quality of life?

More than 10% of cataract patients do not report improvements in quality of life. Is this likely to be the result of poor case selection or unrealistic expectations and how should we find out?

The assumption that quality of life remains constant for the patients' entire life expectancies is almost certainly unrealistic, but is it likely to influence the results radically.

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