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Reprocessing data to form QALYs

Joanna Coast

Abstract

Objectives—To determine whether reprocessing data from published sources into quality adjusted life years (QALYs), as recommended in *The QALY Toolkit*, is a useful method of helping purchasing authorities to determine the most cost effective pattern of care to buy for their populations.

Setting—United Kingdom.

Design—The method was tested for six elective surgical conditions; data from published studies were reprocessed into the Rosser index, to obtain values for change in quality of life. These were then used to form QALYs. A small validation exercise was carried out.

Main outcome measures—QALYs formed from the Rosser index.

Results—Published data could not be found for three interventions (cataract surgery, inguinal hernia repair, varicose vein surgery). For the remainder (prostatectomy, hip replacement, and knee replacement) data were found which could be reprocessed to form QALYs, though it was often hard to compare data from different studies and many assumptions had to be made.

Conclusion—The value of QALY results obtained by this method is questionable, given the large number of assumptions which had to be made. For many interventions published data are unlikely to be available.

Introduction

The current reorganisation of the National Health Service offers health authorities the opportunity to purchase the pattern of provision that best meets the needs of the populations they serve. The realisation of this potential should, however, be informed by evidence about appropriate levels of provision and priorities.¹ A lack of such evidence currently clouds decisions and will continue to do so in the near future. As a short term expedient this paper considers the practicalities of drawing on available evidence to inform choices about the balance of care and examines the value of a rapid method of deriving utility values to incorporate into cost effectiveness measures.

Rationale

Evidence about cost effectiveness is crucial to purchasing decisions.² With such evidence the costs of

treating extra patients by particular interventions can be related to the benefits and the total benefit available to patients thus maximised.³ One difficulty, however, is in measuring benefit in a comparable manner for different interventions. One method of measuring benefit which aims to solve this problem is that of using utility values, of which the quality adjusted life year (QALY) is one form.^{3,4}

*The QALY Toolkit*⁵ has been used as a source document for determining utility values.⁶ Although the toolkit does not claim to have validated any of its methods, they have recently become more widely used.⁷⁻⁹ Three methods are recommended for determining utility values: collecting disability-distress data using a self completed questionnaire (observational studies); eliciting views from selected reference groups; and reprocessing data from published sources.⁵

Observational studies of long term outcomes cannot be a speedy method of informing decisions. Eliciting views from selected reference groups is also inappropriate as no reference group holds all the relevant information; in particular, clinicians may value health states differently from patients⁷ and often have little knowledge of long term outcomes.

To inform purchasing decisions in the short term, therefore, the most appropriate method is to base utility values (QALYs) on reprocessed data from published studies which measured quality of life as assessed by the patient. This method has been used to consider medical care in end stage renal failure, upper limb joint replacement, surgery for scoliosis, and drug treatment for cystic fibrosis.¹⁰ I selected six common interventions that might be suitable for reprocessing data because they have a circumscribed purpose, the therapeutic technique is stable, and data are likely to be available on outcome: prostatectomy for benign prostatic hypertrophy, cataract surgery, inguinal hernia repair, total joint replacement to treat osteoarthritis of hip and knee, and varicose vein surgery.

Methods

The Rosser classification of illness states, or Rosser index,^{5,11,12} was used to form QALYs. This has two dimensions, disability and distress, and 29 possible health states. The index is the most commonly used in the United Kingdom,^{4,7,10} thus making the results of this study comparable with others.

A simplified version of the formula used to calculate QALYs is as follows (the equation given by Gudex *et al*⁹

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can be rearranged to give this formula; the actual formulae used were slightly more complex as failure did not always occur immediately following surgery):

$$\begin{aligned} \text{QALY gain} &= [\text{Benefit with surgery}] - [\text{Benefit without surgery}] \\ \text{QALY gain} &= \left[\begin{aligned} &\text{Benefit received by those with successful surgery} + \\ &\text{Benefit received by those with failed surgery} + \\ &\text{Benefit to those dying from the operation (zero)} \end{aligned} \right] \\ &\quad [- \text{Benefit without surgery}] \end{aligned}$$

$\text{QALY gain} = [(1-m)(1-f)(Q^* \cdot LE^*) + (1-m)f(Q \cdot LE)] - [Q \cdot LE]$ where m =operative mortality, f =failure rate of the operation, Q^* =quality of life with surgery, LE^* =life expectancy with surgery, Q =quality of life with no/failed surgery, and LE =life expectancy with no/failed surgery.

The main purpose of reprocessing data is to obtain information about the quality of life both with and without surgery (Q^* and Q in the above equation). A literature search for studies containing quality of life data was conducted using Medline 1981-91 and references cited in relevant articles.

Explicit decision rules were then formed to translate points of the various quality of life scales to points on the Rosser index.¹¹ The Rosser and Kind valuation matrix¹² was then applied to obtain mean values for patients' change in health status. A simple validation exercise was performed by asking 13 other individuals independently to attempt the translation of data from the D'Aubigne and Postel numbers, with which one of the original studies valued health improvements¹³ into the Rosser index.

The change in health status, or quality adjustment, was combined with the life expectancy of patients at the mean age of operation.¹⁴ Mean age of operation, operative mortality rates, and operation failure rates were taken from published reports.

The benefit from treatment, in terms of QALY gain, depends on both the QALYs of those undergoing surgery and the QALYs of those receiving the best alternative treatment. When there was no comparable group receiving such a treatment I assumed that the patients' condition without surgery would be the same as that experienced before surgery. I also assumed that the final postoperative report was applicable to all remaining years after surgery and that failed surgery and no surgery were equivalent in terms of quality of life.

The results obtained were discounted to allow for time preference—that is, the fact that people generally prefer a nominally equal benefit sooner rather than later. Discount rates of 6% and 0% were applied: 6% is the recommended Treasury discount rate for public sector projects, but the Department of Health applies a 0% discount rate.^{14a}

Results and comment

No quality of life data were found for inguinal hernia repair or varicose vein surgery. Data were found for the treatment of cataract¹⁵ but were not sufficiently detailed after surgery to be converted to Rosser values.

PROSTATECTOMY FOR BENIGN PROSTATIC HYPERTROPHY

I found one North American study which considered quality of life after prostatectomy.¹⁶ It was associated with a further study¹⁷ in which quality adjusted life months¹⁸ were formed. I obtained from the authors a copy of the questionnaire used in the study, from which it was possible to assess that relevance of the indices used in the study to the disability and distress dimensions of the Rosser index. An activity index contained information on activities around the house, outside the home, and during leisure time and correlated most closely with the disability

dimension of the Rosser index. A combination of the symptom score, as a proxy for pain and embarrassment, and the general health index, which included information on feelings, worries and pain, correlated most closely with the distress dimension of the Rosser index. The transformation used is shown in the appendix (table AI).

As in the original study, it was possible to categorise the men undergoing prostatectomy into four groups according to their initial symptoms: mild, moderate, severe, and acute retention.¹⁸ The paper reported the distribution of men across dimensions according to their original symptoms, so they could be placed at particular points on the Rosser index without further assumptions.

Since the average age of men undergoing prostatectomy in the United Kingdom is 71 years¹⁹ and life expectancy for men aged 70 is 10.5 years¹⁴ I assumed that life expectancy at average age of operation was 10 years. Operative mortality for this operation is 1%.²⁰ The failure (reoperation) rates used were 3% at 1 year, 9% at 5 years, and 12% at 8 years.²¹

The average benefit of prostatectomy was calculated to be 0.1191 QALYs at a discount rate of 6%. When the data were divided into four severity groups, however, patients experiencing mild or moderate symptoms on average experienced a loss of QALYs as a result of prostatectomy (table I). The QALY gain was greatest among patients with the most severe symptoms.

TABLE I—QALYs gained for prostatectomy

	Discount rate	
	6%	0%
All prostatectomies:	0.1076	0.1552
Mild symptoms	-0.0042	0.0045
Moderate symptoms	-0.0247	-0.0231
Severe symptoms	0.3447	0.4747
Acute retention	0.1486	0.2105

OSTEOARTHRITIS TREATED BY JOINT REPLACEMENT

Two studies were found which considered the quality of life of patients undergoing joint replacement. Eftekhari's study of hip replacement dates from 1971 and used surgeons' assessment of quality of life.¹³ Only 61% of patients were treated for osteoarthritis. The second study provided quality of life data on patients with osteoarthritis undergoing hip or knee replacement.²² The follow up lasted six months, and the sample size was small. The data were generated in the United States.

Eftekhari's study assessed quality of life in terms of pain and function. These data were reprocessed respectively into the distress and disability dimensions of the Rosser index (see appendix, table AII). As data were not reported across both dimensions together, I assumed that pain was distributed evenly across all levels of function. It was not possible to distinguish patients with different severities of disease.

Liang *et al* assessed quality of life using the Bush index of well being.²³ By combining the authors' results with information about this index²⁴ I was able to reprocess both hip and knee data from this study into the Rosser index. The list of symptom-problem complexes was fitted to the relevant categories of the Rosser distress dimension. For the disability dimension of the Rosser index, categories of the index of well being were matched with the equivalent disability categories on the Rosser index. As Liang *et al* reported scores rather than categories of disability, the transformation to the Rosser index involved calculating an average score for each category. This was then taken to be the midpoint of a range of scores corresponding to each discrete point on the Rosser index. The trans-

formations used are shown in the appendix (table AIII). The number of patients studied was too small to form QALYs for different severities of disease.

The average ages of patients undergoing hip replacement in the two studies were 66.4 years²² and 64.25 years (assuming that ages were distributed symmetrically in each age group).¹³ I assumed that the typical age of hip replacement was 65, at which age life expectancy is 15.3 years (average for men and women).¹⁴ For hip replacement I assumed an operative mortality of 0.4%²⁵ and a failure rate of 1.5% per annum.²⁶

The average age for knee replacement was 68.5 years in the study by Liang *et al.*²²; a further study of over 8000 cases in Sweden found an average age for knee replacement of 69.6 years.²⁷ I therefore assumed that the typical age for knee replacement was 70 years, with a life expectancy of 12 years.¹⁴ A 2% failure rate was used.²⁷ In the absence of other information the operative mortality was assumed to be similar to that for hip replacement.

Table II shows considerable differences in the reprocessed data obtained from the two studies.

TABLE II—QALYs gained for lower limb joint replacement

	Discount rate	
	6%	0%
Hip ¹³	3.6535	5.5518
Hip ²²	0.1598	0.2420
Knee ²²	0.1870	0.2700

VALIDATION EXERCISE

The results of the validation exercise are shown in table III. For each category, and in both dimensions, both the median and the modal choices were equivalent to the transformation used. In addition, disagreement was never by more than one category either side of the transformation used.

PROBLEMS ASSOCIATED WITH THE ORIGINAL DATA

The most obvious difficulties in this exercise were obtaining data on quality of life for many conditions. This problem has been found by other researchers.^{5,28} Most conditions have not been studied in this way, and this is particularly so for "low technology" treatments such as minor surgery.⁷

Even when data are found and can be reclassified into QALYs, both the location and timing of the original studies may affect their usefulness. At the time of the original study technology now commonly used may not have been available, and there may have been changes in the criteria for operation, thus altering the type of patients being treated. Thus effectiveness of treatment as measured in the original study may not reflect effectiveness in the local population.

In all but one case the data used in this study were generated in the United States. For many conditions, including benign prostatic hypertrophy,²⁹ more operations are carried out in the United States than in the United Kingdom, and therefore the average patient may not be the same. The "extra" patients treated in the United States may have less severe disease. Interestingly, the study of hip replacement in the United Kingdom¹³ showed a higher average QALY benefit than the United States study.²² There were, however, other differences between the studies.

The method of measuring patient outcomes might

also affect the QALY values obtained. Although my aim was to use patient based values, data were included from one study in which quality of life was assessed by clinicians.¹³ The clinician based assessments of that study gave much higher QALY scores than the patient based assessments obtained from the study by Liang *et al.*²²

The study design of the original research may limit the data that can be reprocessed into QALYs. Data must be detailed enough to allow information to be extracted about the effects both of surgery and of no surgery. When quality of life is compared before and after treatment no information is provided about patients not receiving surgery. All the original studies used here were of the before and after design, so I made the assumption that patients' quality of life neither improved nor deteriorated without surgery. There is some evidence that this is so for patients with benign prostatic hypertrophy,³⁰ but other assumptions may be equally valid. The before and after study design may also limit information on differences in life expectancy between treated and untreated individuals. With all study designs there may be inadequate follow up.

PROBLEMS RELATED TO REPROCESSING OF DATA

Decision rules for reprocessing data are likely to depend on value judgments and assumptions. Decisions must be made about which dimensions of the original data set are closest to those in the new index. These decisions may be difficult to make, particularly when the connections between the original dimensions and those of the new index are not obvious. Specific points on the chosen dimensions must then be mapped on to specific points in the new index. No guidance is available about the best way of making these judgments; nor is there research which tests the reliability or validity of using data in this way. Although the validation exercise lent some validity to the way I had reprocessed the data, the D'Aubigne and Postel numbers were the most simple of the three measures transformed, and much more diversity would probably have been obtained with more complicated measures.

Further assumptions must be made when data on disability and distress are published in separate tables. Then it becomes impossible to determine both sets of values for particular individuals. Different assumptions about the distribution of patients across the dimensions of the Rosser index will then lead to different overall QALY results. As an example of a possible assumption Williams suggests that patients who are more disabled tend to be more depressed.²⁸ Here I assumed that distress was distributed evenly among patients with different levels of disability. If this information is not published, however, there is no way of knowing which is the more plausible assumption.

Conclusion

The aim of this research was to test a "quick and dirty" method of obtaining utility values (QALYs) to use in informing purchasing decisions by district health authorities. The results show a number of difficulties in using the reprocessing method suggested in *The QALY toolkit*³—even for relatively straightforward interventions. While the problems are not necessarily insurmountable, the value of the QALY estimates obtained should not be overstated. The findings in the three interventions for which data could be reprocessed were insufficiently robust to guide policy.

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TABLE III—Results of validation exercise. Results are Rosser distress and disability scores transformed from D'Aubigne and Postel numbers used in original study¹³ to measure, respectively, pain and walking function. Scores used in this study are compared with those chosen by 13 other people

	D'Aubigne and Postel Nos					
	1	2	3	4	5	6
Pain→distress						
Rosser scores:						
Used in study by author	D	D	C	B	B	A
Median choice of 13 people	D	D	C	B	B	A
Modal choice of 13 people	D	D	C	B	B	A
No choosing modal score	13	12	12	11	12	13
Walking function→disability						
Rosser scores:						
Used in study by author	VI	V	IV	III	II	I
Median choice of 13 people	VI	V	IV	III	II	I
Modal choice of 13 people	VI	V	IV	III	II	I
No choosing modal score	8	7	10	9	13	11

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Oestrogen replacement after oophorectomy: comparison of patches and implants

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Premenopausal women undergoing prophylactic oophorectomy are given oestrogen replacement to prevent menopausal symptoms. Oestrogen implants are effective in treating castrated women.¹ The aim of this study was to compare the implant with the newer, transcutaneous system (the patch) in terms of hormone

Appendix

TABLE AI—Transformation used for prostatectomy, based on Fowler et al¹⁶ and Rosser and Kind¹¹

Original study scores	General health index	Rosser score
Disability		
Activity index		
15		I
12-14-99		II
9-11-99		III
Distress		
Symptom score		
Mild	15-18	A
Mild	12-14-99	B
Moderate	15-18	B
Moderate	12-14-99	C
Severe	15-18	C
Severe	12-14-99	D

TABLE AII—Transformation used for total hip replacement, based on Eftekhar¹³ and Rosser and Kind¹¹

D'Aubigne and Postel number	Description	Rosser score
Disability		
6	Normal in activity for age	I
5	Walks without aid but has limp	II
4	Long distance walks possible but limited without aids	III
3	Walking limited, but can stand for long periods	IV
2	Duration and distance can walk limited with and without walking aid	V
1	Bedridden or can walk only a few yards	VI
Distress		
6	No pain	A
5	Slight or intermittent, decreasing with activity	B
4	Present only after activity, disappears quickly with rest	B
3	Tolerable, permits limited activity	C
2	Severe on attempts to walk, prevents all activity	D
1	Severe, spontaneous	D

TABLE AIII—Transformation used for total hip and total knee replacement, based on Liang et al²² and Rosser and Kind¹¹

Original study scores						Rosser score
<i>Mobility</i>	<i>Physical</i>	<i>Social</i>	<i>Disability Weight*</i>	<i>BUCPX</i>	<i>Average</i>	
5	4	5	0	1	0-970-1	I
5	4	4	-0-061	0-939	0-939-0-970	II
5	4	3	-0-061	0-939	0-909-0-939	III
5	3	2	-0-121	0-879	0-815-0-909	IV
4	3	1	-0-248	0-752	0-744-0-815	V
4	1	1	-0-265	0-735	0-731-0-744	VI
2	1	1	-0-273	0-727	0-727-0-731	VII
<i>Distress</i>						
<i>Symptom/problem complex score</i>						
0-0-2-0						A
2-0-2-5						B
2-5-3-0						C
3-0-4-07						D

*As weights for the points equating to Rosser disability II and III were identical, this number was taken to be the lower limit for II and the upper limit for III, rather than the midpoint (as for all other levels).

concentrations achieved and prevention of hot flushes.

Subjects, methods, and results

Premenopausal women undergoing bilateral oophorectomy were randomly allocated either oestradiol patches (0.05 mg oestradiol/24 hours; n=12) or oestradiol implants (50 mg crystalline oestradiol pellet; n=16) administered seven days after surgery. Blood samples for measurement of oestradiol, follicle stimulating hormone, and luteinising hormone concentrations were taken preoperatively, six days postoperatively, and after two and four months of treatment. Hormone concentrations were measured by routine radioimmunoassay. Oestradiol concentrations

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