

The emergency clinician must be aware that the absence of radiological abnormality reduces the chances of spinal injury but does not exclude it. About 8% of patients have injuries to the cervical spine in more than one place and 15% of patients with cervical injury also have a thoracolumbar injury

Make sure all seven cervical vertebrae and the C7/T1 junction are visible. The spinous processes may not be clear. If you suspect an injury obtain a further view.

Physiological subluxation of the bodies of C2 on C3 (seen in a quarter of cases) and C3 on C4 (seen in 15% of cases) occurs up to 8 years of age. However, the posterior spinal line is maintained.

Artefactual shadows can sometimes cause confusion. In the open mouth view the vertical cleft between the upper two incisor teeth may be mistaken for a vertical fracture of the peg. Do not forget to examine the soft tissue shadows; these may be the only clues to an underlying fracture.

## Summary

### *Adequacy and quality*

Ensure that the vertebrae C1-C7 and the C7/T1 junction are visible

### *Alignment*

Assess the contours of the cervical spine and appendages

### *Bones*

Check each vertebra for shape, height, and fractures

Check the shape of the odontoid peg

Check spinal canal size

### *Cartilage and joints*

Check the intervertebral disc spaces

Check the facet joints

Check the interspinous distance

Check the C1/C2 distance

### *Soft tissues*

Check the precervical and paracervical spaces

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## Economic Evaluation and Health Care

### Cost-utility analysis

Ray Robinson

*This is the fourth in a series of articles that describes the ways in which methods of economic evaluation may be used to assess the economic costs and consequences associated with different forms of health care intervention*

**Decisions have to be made about allocating health resources. Currently the best economic evaluation method for doing this is cost-utility analysis. This compares the costs of different procedures with their outcomes measured in "utility based" units—that is, units that relate to a person's level of wellbeing. The most commonly used unit is the quality adjusted life year (QALY). QALYs are calculated by estimating the total life years gained from a procedure and weighting each year to reflect the quality of life in that year. To compare outcomes of different programmes the Rosser index is one measure that is widely used to assign quality of life scores to patients. Combined with a measure of life years gained from a procedure, this enables QALYs to be calculated and procedures ranked according to cost per QALY gained. In this article Ray Robinson explains the measures used and discusses how QALY league tables can be used to guide decisions on resource allocation.**

Cost-utility analysis is a form of economic evaluation in which the outcomes of alternative procedures or programmes are expressed in terms of a single, "utility based" unit of measurement. Utility is a term used by

health economists to refer to the subjective level of wellbeing that people experience in different states of health. The most widely used utility based measure in cost-utility analysis is the quality adjusted life year (QALY). To calculate the number of QALYs resulting from a particular intervention, the number of additional years of life obtained are combined with a measure of the quality of life in each of these years to obtain a composite index of outcome. Comparison between alternative procedures or programmes can then be based on the marginal cost per QALY gained.

### Measuring quality

Measuring a person's quality of life is, of course, difficult. None the less, it is important to have some means for doing so because many modern health care programmes are concerned primarily with improving the quality of a patient's life rather than extending its length. For this reason various quality of life scales have been developed in recent years. These seek to measure quality on a number of different dimensions.

The Nottingham health profile is one quality of life scale that has been used quite widely in Britain.<sup>1</sup> This comprises two parts. The first measures health status by asking for yes or no responses from patients to

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a set of 36 statements relating to six dimensions of social functioning: energy, pain, emotional reactions, sleep, social isolation, and physical mobility. These responses are then "weighted" and a score of between 0 and 100 is assigned to each dimension (table 1). The second part asks about seven areas of performance that can be expected to be affected by health: employment, looking after the home, social life, home life, sex life, hobbies, and holidays. The Nottingham health profile has been applied, for example, in studies of heart transplantation,<sup>3,4</sup> rheumatoid arthritis and migraine,<sup>5</sup> and renal lithotripsy.<sup>6</sup>

Other quite widely used measures of quality include the sickness impact profile<sup>7</sup> and the quality of well-being scale.<sup>8</sup> Recently, a new outcome measure, the SF-36 health survey questionnaire, has been gaining popularity. After testing it on 1980 patients in two general practices in Sheffield, Brazier and colleagues concluded that it is a promising measure which is "easy to use, acceptable to patients, and fulfils stringent criteria of reliability and validity."<sup>9</sup>

Although all of these scales embody some form of scoring scheme, they do not usually generate a single quality of life score. This means that, although they are of considerable value in assessing the outcomes of interventions in the case of particular diseases or

TABLE II—Rosser's classification of states of ill health<sup>10</sup>

Disability		Distress
I	No disability	A No distress
II	Slight social disability	B Mild
III	Severe social disability and/or slight impairment of performance at work	C Moderate
IV	Able to do housework except very heavy tasks Choice of work or performance at work very severely limited	D Severe
V	Housewives and old people able to do light housework only but able to go out shopping Unable to undertake any paid employment Unable to continue any education Old people confined to home except for escorted outings and short walks and unable to go out shopping	
VI	Housewives able to perform only a few simple tasks Confined to a chair or wheelchair or able to move around in the house only with support from an assistant	
VII	Confined to bed	
VIII	Unconscious	

disabilities, they cannot be used to compare outcomes between different programmes. To do this a single, generalisable measure of quality is necessary. One of the earliest measures to be developed—and one which has subsequently been used widely to calculate QALYs—is the Rosser index.<sup>10</sup>

### Rosser index

Rosser and her colleagues described health status in terms of two dimensions: disability and distress. Table II gives definitions of her eight categories of disability and four categories of distress.

By combining these categories of disability and distress 32 (8 times 4) different states of health were obtained. Rosser then interviewed 70 respondents (a mixture of doctors, nurses, patients, and healthy volunteers) and, by using psychometric techniques, sought to establish their views about the severity of each state relative to every other state. The final results of this exercise were expressed in terms of a numeric scale extending from 0 = dead to 1 = perfect health. Table III gives the median scores obtained from the original sample.

With this classification system it becomes possible to assign a quality of life score to any state of health as long as it is placed in an appropriate disability or distress category. Although actual scores generated through the Rosser study have been the source of some criticism, Gudex and Kind reported that a single training session on the approach was sufficient to obtain a high level of agreement between doctors on rating patients and that these descriptions could be used to categorise patients reliably, accurately, and quickly.<sup>1</sup>

### Calculating QALYs

With both a measure of the life years gained from a particular intervention and of the quality of life in each of these years it is possible to calculate the number of QALYs obtained. Thus, drawing on the values shown in table III, it follows that one year of life in health state IIA would equal 0.99 QALYs ( $1 \times 0.99$ ), two years of life in health state VC would equal 1.8 QALYs ( $2 \times 0.9$ ), and so on.

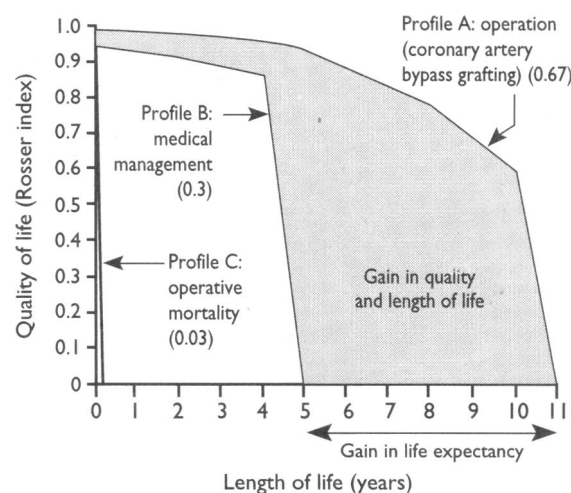
One well known economic evaluation that used the QALY approach was a study by Williams of treatment options facing patients with angina.<sup>12</sup> To obtain QALY estimates he asked three well informed cardiologists to give their judgments about the life expectancy and comparative states of health of patients with angina, some of whom had undergone coronary artery bypass grafting and some of whom had not.

The cardiologists were asked to distinguish cases of

TABLE I—Nottingham health profile (section one)<sup>2</sup>

	Weights
Energy:	
I soon run out of energy	24.00
Everything is an effort	36.80
I'm tired all the time	39.20
	100.0
Pain:	
I'm in pain when going up and down stairs or steps	5.83
I'm in pain when I'm standing	8.96
I find it painful to change position	9.99
I'm in pain when I'm sitting	10.49
I'm in pain when I walk	11.22
I have pain at night	12.91
I have unbearable pain	19.74
I'm in constant pain	20.86
	100.0
Emotional reactions:	
The days seem to drag	7.08
I'm feeling on edge	7.22
I've forgotten what it's like to enjoy myself	9.31
I lose my temper easily these days	9.76
Things are getting me down	10.47
I wake up feeling depressed	12.01
Worry is keeping me awake at night	13.95
I feel as if I'm losing control	13.99
I feel that life is not worth living	16.21
	100.0
Sleep:	
I'm waking up in the early hours of the morning	12.57
It takes me a long time to get to sleep	16.10
I sleep badly at night	21.70
I take tablets to help me sleep	23.37
I lie awake for most of the night	27.26
	100.0
Social isolation:	
I'm finding it hard to get on with people	15.97
I'm finding it hard to make contact with people	19.36
I feel that there is nobody I am close to	20.13
I feel lonely	22.01
I feel I am a burden to people	22.53
	100.0
Physical mobility:	
I find it hard to reach for things	9.30
I find it hard to bend	10.57
I have trouble getting up and down stairs and steps	10.79
I find it hard to stand for long (for example, at the kitchen sink, waiting for a bus)	11.20
I can only walk about indoors	11.54
I find it hard to dress myself	12.61
I need help to walk about outside (for example, walking aid or someone to support me)	12.69
I'm unable to walk at all	21.30
	100.0

severe, moderate, and mild angina and within each of these subgroups to distinguish cases with left main vessel, triple vessel, double vessel, and one vessel disease. The figure shows the quality of life profiles comparing coronary artery bypass grafting with medical management in a patient with severe angina and left main vessel disease. These indicate that a patient for whom a bypass would be a success gains an increase in life expectancy of six years. Initially the quality of life score for such a patient is close to one but it tails away as the years progress. The shaded area between profile A and profile B indicates the total amount of QALYs gained through surgery. According to Williams, these amounted to an average gain of between 1.5 QALYs for patients with mild angina to 3.5 QALYs for patients with severe angina. (Williams also pointed out that the clinicians believed that only 67% of patients with the disease could be expected to benefit from surgery. Another 30% could expect no improvement over medical management, while 3% would, on average, die as a result of surgery. Hence the overall measure of QALYs gained would be 67% of the shaded area minus 3% of the unshaded area.)



Expected value of quality and length of life gained for patients with severe angina and left main vessel disease with coronary artery bypass grafting and medical management

### QALY league tables

With information on the QALYs obtainable from different procedures and the costs of these procedures it becomes possible to rank them in terms of their respective costs per QALY gained. Table IV shows one such QALY league table.<sup>12</sup> It indicates considerable variation in costs per QALY with, at the extremes of the scale, erythropoietin treatment for anaemia in dialysis patients amounting to over 570 times the cost per QALY of cholesterol testing and treatment by diet for adults aged 40-69.

TABLE III—Rosser's valuation matrix. Median scores from 70 people<sup>10</sup>

Disability rating	Distress rating			
	A	B	C	D
I	1.000	0.995	0.990	0.967
II	0.990	0.986	0.973	0.932
III	0.980	0.972	0.956	0.912
IV	0.964	0.956	0.942	0.870
V	0.946	0.935	0.900	0.700
VI	0.875	0.845	0.680	0.000
VII	0.677	0.564	0.000	-1.486
VIII	-1.028	NA	NA	NA

NA = Not applicable.

TABLE IV—Cost per QALY for various interventions<sup>13</sup>

Treatment	Cost per QALY (August 1990) (£)
Cholesterol testing and treatment by diet (adults aged 40-69)	220
Neurosurgical intervention for head injury	240
Advice to stop smoking from general practitioner	270
Neurosurgical intervention for subarachnoid haemorrhage	490
Antihypertensive treatment to prevent stroke (aged 45-64)	940
Pacemaker implantation	1100
Hip replacement	1180
Valve replacement for aortic stenosis	1140
Cholesterol testing and treatment	1480
Coronary artery bypass graft (patients with left main vessel disease, severe angina)	2090
Kidney transplantation	4710
Breast cancer screening	5780
Heart transplantation	7840
Cholesterol testing and treatment (incrementally) of all adults aged 25-39	14 150
Home haemodialysis	17 260
Coronary artery bypass graft (patients with one vessel disease, moderate angina)	18 830
Continuous ambulatory peritoneal dialysis	19 870
Hospital haemodialysis	21 970
Erythropoietin for anaemia in patients receiving dialysis (assuming 10% reduction in mortality)	54 380
Neurosurgical intervention for malignant intracranial tumours	107 780
Erythropoietin for anaemia in patients receiving dialysis (assuming no increase in survival)	126 290

The ultimate use of a QALY league table is to guide resource allocation decisions—that is, to seek to shift resources away from activities that are costly in terms of the health benefits they generate and towards activities that are of relatively low cost.<sup>14</sup> In this context Cullis discussed how information on costs per QALY is relevant in the management of waiting lists.<sup>15</sup> Indeed, Gudex and colleagues had earlier worked with general surgeons at Guy's Hospital and ranked the top 22 patient conditions on their waiting lists in terms of QALY gains per hour of operating time and per day bed occupied.<sup>16</sup>

However, undoubtedly the most ambitious application of cost-utility analysis to date has been the widely publicised Oregon demonstration project.<sup>1</sup> As part of its initial methodology the Oregon approach sought to rank some 1600 condition and treatment combinations in cost-utility terms. To do this quality of wellbeing scores for 30 different states of health and activity were obtained through a telephone survey of 1000 Oregonians chosen by random dialling. In the event, problems in obtaining reliable data on cost and quality led to the provisional list being set aside. Subsequently, a revised list of 709 items based on quality of life—but not cost—data was published in April 1992. However, in response to federal government objections to the use of quality of wellbeing scores yet another list was produced in November 1992. This list comprises 688 items but is based on only three outcome measures: the probability of death, of an asymptomatic state, and of a symptomatic state.

The Department of Health has drawn up a QALY league table in the United Kingdom, although no decision has yet been made about its suitability for publication. There is certainly good cause for caution for, as Mason and colleagues point out, considerable care needs to be exercised in interpreting league tables.<sup>13</sup> Often individual studies cited in a table are not comparable because the analyses were undertaken in different years, with the result that prevailing technologies and relative prices differ between studies; because approaches to the measurement of health status commonly differ; and because studies often vary in terms of the categories of costs they include.

There is also the question of the comprehensiveness and quality of the data. Gerard, in a review of cost-utility studies published during 1980-1990, was able to identify only 51 studies in the English language.<sup>12</sup> After a comprehensive evaluation of these studies, based on a set of carefully defined criteria, she concluded that a third of them were of poor quality and a further 10% were not worthwhile given the nature of the decisions





How best to measure a person's quality of life?

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they examined. Moreover, as she and Mooney pointed out in a later paper, the results of individual cost-utility studies will often be locally specific.<sup>19</sup> As such, the transfer of results to another area may be inappropriate if the incidence and prevalence of disease, the level of service, or the way medicine is practised differ between the two areas.

### Conclusion

The QALY approach, which forms a key part of most cost-utility analyses, has been the subject of some criticism. It has been accused of discriminating against elderly people, making illegitimate interpersonal comparisons, disregarding equity considerations, and introducing bias into quality of life scores.<sup>20-24</sup> Rival measures that are claimed to be more sound theoretically, such as "healthy years equivalents" (HYEs), have also been put forward.<sup>25</sup> It has, however, recently been claimed that under most assumptions QALYs and HYEYs will lead to identical project rankings.<sup>25</sup>

Amid all this debate it is as well to bear in mind that decisions have to be made about the allocation of resources and cost-utility analysis is probably the most sophisticated form of economic evaluation available at present. However, sensible use of the technique and interpretation of research findings based on the approach should recognise that cost-utility analysis is still at a fairly early developmental stage and treat it

accordingly. In the words of Mason and colleagues, decision makers should exercise "the appropriate caution, care and intelligence."<sup>213</sup>

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## COPING WITH CHANGE IN GENERAL PRACTICE

When the NHS was created in 1948 primary care was seen as a necessary appendage to the real site of medical care—the hospitals—and its main role was seen to be that of a triage system to filter out self limiting and minor illness. Until the general practice charter in 1966 primary care was in the doldrums, deprived of resources and respect. The charter created many features of general practice today, including the partial reimbursement of rents, rates, and staffing, and incentives for group practices. For many doctors this was a time of considerable change, but one they largely welcomed. The changes were, by and large, seen to be for the better.

The next 20 years saw a remarkable evolution within primary care. The ugly duckling metamorphosed into a triumph of socialised medicine—quality care accessible to everybody. This period had its fair share of change, of course, including the introduction of items of service payments, vocational training, the teaching of medical students, and the formation of primary health care teams.

It was, however, an era in which practices developed opportunistically in response to the incentives and culture of an evolving health service.

Without doubt we are now in turbulent times. Although the government's consultative document on primary care in 1986 clearly acknowledged the extraordinary development in primary care over two decades, it ushered in a period of imposed change from which we are all still reeling. . . .

There were parts of this avalanche of imposed changes that were widely welcomed. Medical audit was thought to be the medical equivalent to motherhood and apple pie, while the setting of public health objectives in *The Health of the Nation* was felt both appropriate and overdue. As their full implications for primary care become evident, even these may be seen as two edged swords.

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