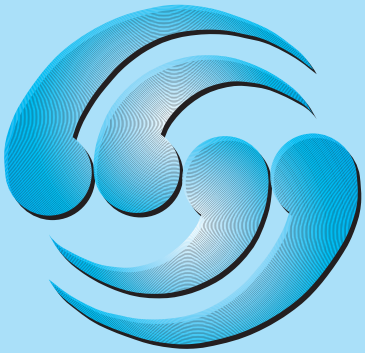
Volume 1, number 6



What is a QALY?

Sponsored by an educational grant from Aventis Pharma

Ceri Phillips
BSc(Econ) MSc(Econ) PhD
Senior Lecturer in Health Economics
University of Wales, Swansea

and

Guy Thompson
BSc DipComPharm MRPharmS
Deputy Director, Welsh Centre for Postgraduate Pharmaceutical Education, University of Wales, Cardiff

- A **quality-adjusted life year (QALY)** takes into account both quantity and the quality of life generated by healthcare interventions. It is the arithmetic product of **life expectancy** and a measure of the **quality of the remaining life years**.

- A QALY places a weight on time in different health states. A year of perfect health is worth 1; however, a year of less than perfect health life expectancy is worth less than 1. Death is considered to be equivalent to 0, however, some health states may be considered worse than death and have negative scores.

- QALYs provide a common currency to assess the extent of the benefits gained from a variety of interventions in terms of health-related quality of life and survival for the patient. When combined with the costs of providing the interventions, **cost–utility ratios** result; these indicate the additional costs required to generate a year of perfect health (one QALY). Comparisons can be made between interventions, and priorities can be established based on those interventions that are relatively inexpensive (low cost per QALY) and those that are relatively expensive (high cost per QALY).

- QALYs are far from perfect as a measure of outcome, with a number of technical and methodological shortcomings. Nevertheless, the use of QALYs in **resource allocation** decisions does mean that choices between patient groups competing for medical care are made explicit and commissioners are given an insight into the likely benefits from investing in new technologies and therapies.

Abbreviated prescribing information is on page 6

What is the concept behind QALYs?

The outcomes from treatments and other health-influencing activities have two basic components – the quantity and the quality of life. A QALY is the acronym for quality-adjusted life year, which embraces both of these components and is the arithmetic product of life expectancy and a measure of the quality of the remaining life years.

It provides a common currency for measuring the extent of health gain that results from healthcare interventions and, when combined with the costs associated with the interventions, can be used to assess their relative worth from an economic perspective.

The **quantity of life**, expressed in terms of survival or life expectancy, is a traditional measure that is widely accepted and has few problems of comparison – people are either alive or not.

Quality of life, on the other hand, embraces a whole range of different facets of people's lives, not just their health status. Even restricting the focus to a person's health-related quality of life will result in a number of dimensions relating to both physical and mental capacity. A number of approaches have been used to generate these quality of life valuations, referred to as **health utilities**[1]; for example, standard gamble, time trade-off and the use of rating scales. The utilities that are produced represent the valuations attached to each health state on a continuum between 0 and 1, where 0 is equivalent to being dead and 1 represents the best possible health state, although some health states are regarded as being worse than death and have negative valuations (Figure 1). An example of an instrument that has produced a series of health utilities is the EQ-5D, which is shown in Box 1.

Patients are asked to indicate the extent to which they have a problem in five health areas. For each of the possible 245 health states utility scores were constructed from responses to a random sample of 3,000 people in the UK. An example of the utilities

Box 1. Using the EQ-5D

Scores for the EQ-5D are generated from the ability of the individual to function in five dimensions. These are:

- **Mobility**
  1. No problems walking about.
  2. Some problems walking about.
  3. Confined to bed.
- **Pain/discomfort**
  1. No pain or discomfort.
  2. Moderate pain or discomfort.
  3. Extreme pain or discomfort.
- **Self-care**
  1. No problems with self-care.
  2. Some problems washing or dressing.
  3. Unable to wash or dress self.
- **Anxiety/depression**
  1. Not anxious or depressed.
  2. Moderately anxious or depressed.
  3. Extremely anxious or depressed.
- **Usual activities**
  (work, study, housework, leisure activities)
  1. No problems in performing usual activities.
  2. Some problems in performing usual activities.
  3. Unable to perform usual activities.

Each of the five dimensions used has three levels – no problem, some problems and major problems – making a total of 243 possible health states, to which 'unconscious' and 'dead' are added to make 245 in total.

KEY FORMULA: 1

Calculating QALYs: an example

Intervention A: Four years in health state 0.75	3 QALYs
Intervention B: Four years in health state 0.5	2 QALYs
Additional number of QALYs generated by A	1 QALY

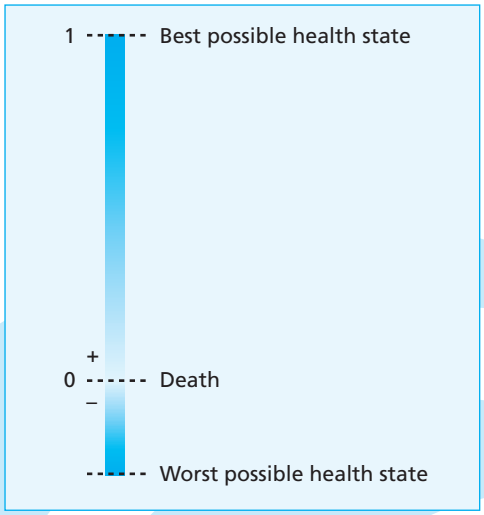


Figure 1.

of some of the health states is shown in Table 1. Health status measures have attempted to encompass these dimensions in a profile of an individual's health (eg, SF-36, Sickness Impact Profile, Nottingham Health Profile) or as a single score (eg, EQ-5D, Health Utilities Index).

Only instruments that result in a single score can be used to adjust the quantity of life generated by the intervention.

How are QALYs arrived at?

The basic idea of a QALY is straightforward. The amount of time spent in a health state is *weighted* by the utility score given to that health state. It takes one year of perfect health (utility score of 1) to be one QALY, but regards one year in a health state valued at 0.5 to be equivalent to half a QALY. Thus an intervention that generates four additional years in a health state valued at 0.75 will generate one more QALY than an intervention that generates four additional years in a health state valued at 0.5 (see Key Formula 1).

KEY FORMULA: 2

Cost-utility ratio – an example

$$\text{Cost–utility ratio} = \frac{\text{Cost of Intervention A} - \text{Cost of Intervention B}}{\text{No. of QALYs produced by Intervention A} - \text{No. of QALYs produced by Intervention B}}$$

Effect of interventions

With data relating to both health-related quality of life and survival, it is then possible to chart the impact of a healthcare intervention on an individual patient. For example, it is possible to compare the health profile of a patient receiving an intervention with that of a patient who does not receive the intervention.

Figure 2a (overleaf) shows a situation where treatment provides a consistently higher area under the QALY–time curve than does no treatment. In Figure 2b (overleaf) a comparison is shown between the treatment and non-treatment of a condition with a poor prognosis. As shown, the treatment has an initial improvement on health-related quality of life, but as adverse effects associated with it become apparent this benefit is lost and quality of life falls below that expected of a non-treated patient. This quality of life deficit associated with the treatment generates 'QALYs lost' compared with a non-treated patient. At a point in time when the latter patient dies, the treated patient demonstrates 'QALYs gained' by virtue of their continued life, albeit at a lower quality of life. Given the difference in survival, the issue then becomes one of 'deciding' between a longer survival time with a reduced health-related quality of life and a shorter survival time with a better health-related quality of life.

Using QALYs – an example

QALYs provide a common currency to assess the extent of the benefits gained from a variety of interventions in terms of health-related quality of life and survival for the patient. They are used to assess the effectiveness of interventions and are combined with the costs incurred in providing the interventions to generate cost–utility ratios. A cost–utility ratio is the difference between the costs of two interventions divided by the difference in the QALYs they produce (see Key Formula 2). An example of this is to be found in an evaluation of two taxoids in the treatment of recurrent metastatic breast cancer.[2]

Here, a series of health states representing various stages of the patients' experience in

Table 1. EQ-5D health state valuations

Health state	Description	Valuation
11111	No problems	1.000
11221	No problems walking about; no problems with self-care; some problems with performing usual activities; some pain or discomfort; not anxious or depressed	0.760
22222	Some problems walking about; some problems washing or dressing self; some problems with performing usual activities; moderate pain or discomfort; moderately anxious or depressed	0.516
12321	No problems walking about; some problems washing or dressing self; unable to perform usual activities; some pain or discomfort; not anxious or depressed	0.329
21123	Some problems walking about; no problems with self-care; no problems with performing usual activities; moderate pain or discomfort; extremely anxious or depressed	0.222
23322	Some problems walking about, unable to wash or dress self, unable to perform usual activities, moderate pain or discomfort, moderately anxious or depressed	0.079
33332	Confined to bed; unable to wash or dress self; unable to perform usual activities; extreme pain or discomfort; moderately anxious or depressed	-0.429

the progress of the disease from pretreatment to terminal disease were 'scored' by oncology nurses. Paclitaxel generates 0.5111 QALYs and docetaxel (Taxotere®) 0.6016 QALYs – a difference of 0.0905 QALYs, equivalent to an additional 33 days of perfect health (0.0905 x 365). The additional costs of docetaxel amount to £220 per patient, which means that it costs £2,431 (£220/0.0905) to generate an additional QALY by using docetaxel. The cost/QALY ratio can be compared with ratios from other interventions, as shown in Table 2.

The construction and use of **QALY league tables** has generated considerable discussion and debate, and they should be used with extreme caution. The fact that the studies included in such tables have been carried out at different times and in different locations

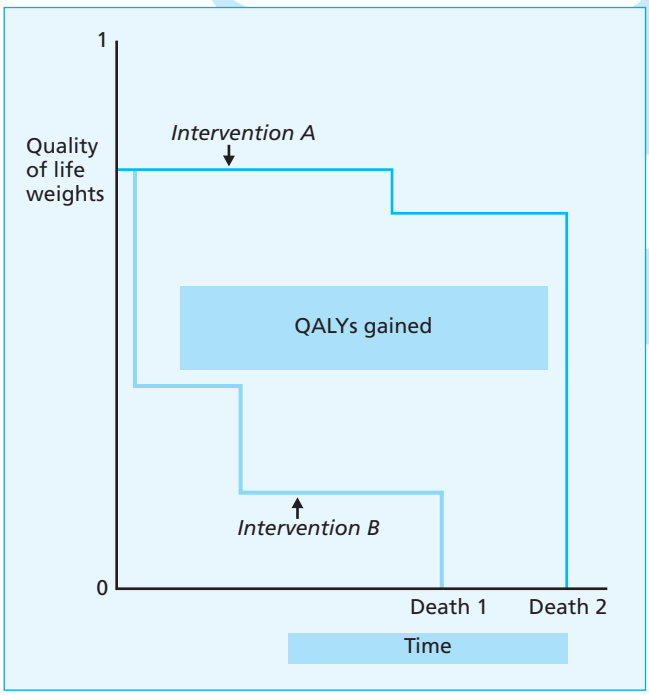


Figure 2a.

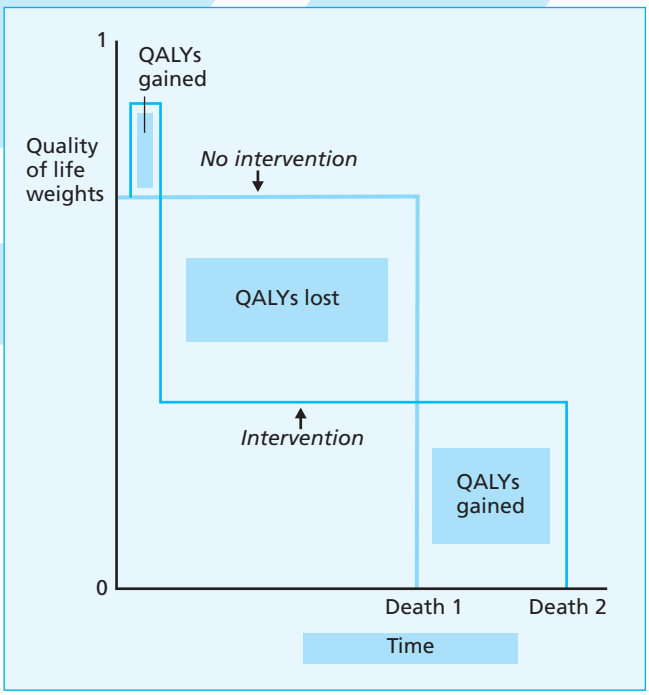


Figure 2b.

and settings, and have used different quality of life measures should be taken into account.

Limitations of QALYs

While QALYs provide an indication of the benefits gained from a variety of medical procedures, in terms of quality of life and survival for patients they are far from perfect as a measure of outcome. For example, they suffer from a lack of sensitivity when comparing the efficacy of two competing but similar drugs and in the treatment of less severe health problems.

Chronic diseases, where quality of life is a major issue and survival less of an issue, are difficult to accommodate in the QALY context and there is a tendency to resort to the use of **disease-specific measures** of quality of life. Similarly, preventive measures where the impact on health outcomes may not occur for many years, may be difficult to quantify using QALYs because the importance attached to each of the health dimensions is highly dependent on age, life context and life responsibilities.

Thus, it is very difficult to compare the health status of a potential Olympic champion who suffers a hamstring twinge in the warm-up session, with that of an elderly person who has been restored to some measure of mobility as a result of an intervention.

Table 2. Cost per QALY of healthcare interventions (adapted from references 2–4)

Intervention	£/QALY at 1990 prices
Cholesterol testing and diet therapy (all adults aged 40–69)	220
Neurosurgical intervention for head injury	240
GP advice to stop smoking	270
Neurosurgical intervention for subarachnoid haemorrhage	490
Antihypertensive treatment to prevent stroke (ages 45–64)	940
Pacemaker implantation	1,100
Hip replacement	1,180
Valve replacement for aortic stenosis	1,410
Cholesterol testing and treatment (all adults aged 40–69)	1,480
Docetaxel (as opposed to paclitaxel) in treatment of recurrent metastatic breast cancer	1,890*
CABG (left main-vessel disease, severe angina)	2,090
Kidney transplantation	4,710
Breast cancer screening	5,780
Heart transplantation	7,840
Cholesterol testing and treatment incrementally (all adults aged 25–39)	14,150
Home haemodialysis	17,260
CABG (one-vessel disease, moderate angina)	18,830
Hospital haemodialysis	21,970
Erythropoietin treatment for anaemia in dialysis patients (assuming 10% reduction in mortality)	54,380
Addition of interferon-α2b to conventional treatment in newly diagnosed multiple myeloma	55,060§
Neurosurgical intervention for malignant intracranial tumours	107,780
Erythropoietin treatment for anaemia in dialysis patients (assuming no increase in survival)	126,290

* Adjusted to 1990 prices using *Hospital and Community Health Service Pay and Prices Index, Unit Costs of Health and Social Care*. PPSSRU, 1996. (2,431 ÷ 200.7 x 155.6 = 1,890. § Translated into 1990 prices, as above

What is a QALY?

Further criticisms relate to the inadequate weight attached to emotional and mental health problems, and the lack of consideration of the quality of life of carers and other family members, while much debate surrounds who should be involved in placing values on health states.

Nevertheless, the use of QALYs in resource allocation decisions does mean that choices between patient groups competing for medical care are made explicit. Commissioners are increasingly having to prioritise their expenditure because they have limited resources to meet the demands that are placed on healthcare services. New technologies and therapies are being made available that will compound the problems they face in determining which services to provide for their communities. QALYs and cost–utility analysis provide additional information and are another piece in the complex jigsaw-puzzle – the health service – which they are endeavouring to solve.

References

1. *What are health utilities?* London: Hayward Medical Communications, December 1997.
2. Hutton J, Brown R, Borowitz M *et al*. A new decision model for cost–utility comparisons of chemotherapy in recurrent metastatic breast cancer. *PharmacoEconomics* 1996; **9** (Suppl 2): 8–22.
3. Maynard A. Developing the health care market. The *Economic J* 1991; **101:** 1277–86.
4. Nord E, Wisloff F, Hjorth M, Westin J. Cost–utility analysis of melphalan plus prednisone with or without interferon-α2b in newly diagnosed multiple myeloma: results from a randomised controlled trial. *PharmacoEconomics* 1997; **12:** 89–103.

Further reading

Drummond M, O'Brien B, Stoddart G, Torrance G. *Methods for the Economic Evaluation of Health Care Programmes*. Oxford: Oxford University Press, 1997.
Kobelt G. *Health Economics: An Introduction to Economic Evaluation*. London: Office of Health Economics, 1996.

This publication, along with the others in the series, is available on the internet at www.evidence-based-medicine.co.uk

Sponsored by an educational grant from *Aventis Pharma*

Any enquiries please contact:
Team Assistant to the Health Economics Unit
Aventis House
Kings Hill
West Malling
Kent
ME19 4AH
Tel: 01732 584 254
Fax: 01732 584 029

Published by Hayward Medical Communications, a division of Hayward Group plc.