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What is a QALY?

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- A **quality-adjusted life-year (QALY)** takes into account both the quantity and 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 and a year of less than perfect health 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.

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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 a 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. The National Institute for Health and Clinical Excellence (NICE) defines the QALY as a 'measure of a person's length of life weighted by a valuation of their health-related quality of life'.[1]

The QALY 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**; for example, standard gamble, time trade-off and the use of rating scales (see *What are health utilities?* for a more detailed explanation of health utilities).[2] 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

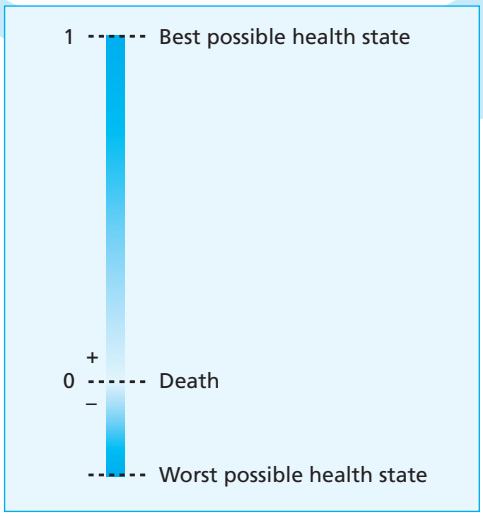

Figure 1. Health state valuations

Box 1. Using the EQ-5D[3]

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

- **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.

valuations (Figure 1). The preferred instrument for the measurement and valuation of health-related quality of life in NICE appraisals is the EQ-5D, which is shown in Box 1[3] (see *What is quality of life?* for more information on health-related quality of life and the EQ-5D).[4]

The EQ-5D is widely used and has been validated in many different patient populations. It has been designed so that people can describe the extent to which they have a problem in each of the five dimensions of health: mobility, ability to self-care, ability to undertake usual activities, pain and discomfort, and anxiety and depression. For each of the possible 245 health states, utility scores were constructed from responses from a random sample of 3,000 people in the UK, using a choice-based method of valuation (the time trade-off method). Examples of the utilities of some of the health states are shown in Table 1.

If the EQ-5D instrument has not been used, mapping of utility scores from other health-related quality of life measures that were included in the relevant clinical trial(s) can be employed, or other standardised and validated measures (for example, SF-6D, Health Utilities Index) included in the relevant clinical trial(s) may be used.

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 generate one QALY, whereas one year in a health state valued at 0.5 is regarded as being 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 (Key formula 1).

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

Effect of interventions

When data relating to both health-related quality of life and survival are available, it is then possible to chart the impact of a healthcare intervention on an individual patient. For example, it is possible to compare

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 health profile of a patient receiving an intervention with that of a patient who does not receive the intervention.

Figure 2a shows a situation where one treatment provides a consistently greater area under the QALY–time curve than another treatment. Figure 2b presents a comparison 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 the treatment become apparent, this benefit is lost and quality of life falls below that expected for 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 (Key formula 2).

A recent example of this can be found in the assessments by the Scottish Medicines Consortium[5] and All Wales Medicines Strategy Group[6] of docetaxel (Taxotere®, sanofi-aventis) in combination with cisplatin and 5-fluorouracil (5-FU) for the induction treatment of patients with resectable locally advanced squamous cell carcinoma of the

KEY FORMULA 2

Cost–utility ratio – an example

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

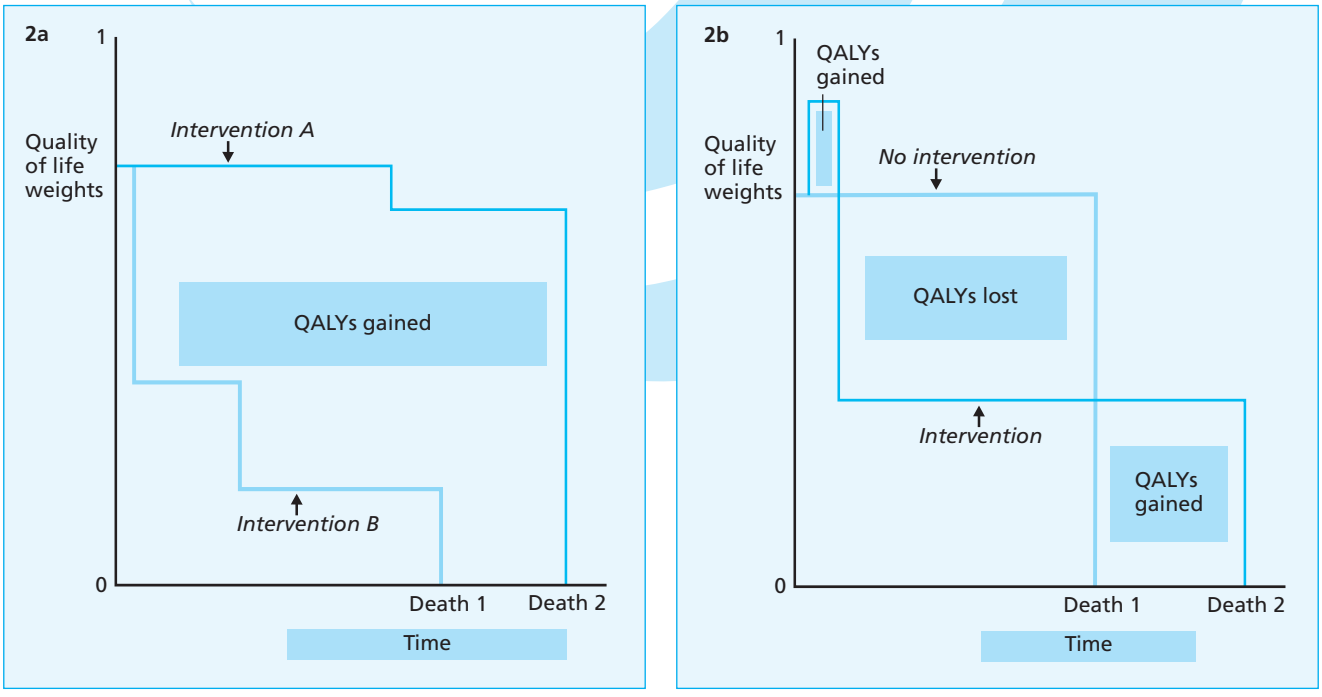

Figure 2a. Comparison of two different treatments. Figure 2b. Comparison between treatment and non-treatment of a condition with a poor prognosis

head and neck. Here, the addition of docetaxel to cisplatin and 5-FU compared with the use of cisplatin and 5-FU alone produces an additional 2.08 QALYs at an additional cost of £3,824 per patient, which means that it costs £1,832 (£3,824/2.08) to generate an additional QALY by using docetaxel in combination with cisplatin and 5-FU. Further analysis shows that there is a 95% probability that the docetaxel-based induction therapy regimen is cost-effective compared with the standard induction therapy at a willingness to pay of £20,000/QALY.[6]

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, the use of QALYs as a single outcome measure for economic evaluation means that important health consequences are excluded. QALYs also 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. For example, 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.

Further criticisms have surrounded the inadequate weight attached to emotional and mental health problems, and the lack of consideration of the impact of health problems on the quality of life of carers and other family members, while much debate surrounds who should be involved in placing values on health states.[7,8]

Discussion has also focused on how much society should be prepared to pay for a QALY. While there is a degree of consensus that it should generally be between £20,000 and £30,000, considerable debate has arisen in relation to, for example, treatments used at the end of life or for ultra-orphan conditions, where higher thresholds have been advocated and used.

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 faced with resource constraints and have to prioritise their expenditure against an incessant flow of new technologies and therapies that all claim to enhance the health status of particular patient groups. QALYs and cost–utility analysis provide additional information for decision-makers as they grapple with addressing the healthcare dilemma of where to allocate resources to generate the maximum health benefits for their communities and society as a whole.

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Further reading

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