19.2: Types of economic analyses

The main types of economic analyses are cost-effectiveness analysis (CEA), cost-utility analysis (CUA), and cost-benefit analyses (CBA). How the results of these different kinds of analysis are expressed is shown in Table 19.1. CEA and CUA are those most commonly used in the analysis of health interventions. The problem with CBA is that it requires putting a monetary value on a life saved.

Analysis of the costs involved in providing the health interventions under comparison in a trial is needed for all three types of analysis. Measurement of these costs can be made in the context of an intervention study, provided due account is taken of the fact that the costs associated with an intervention in a trial may be different from those which would apply if the intervention was applied in a public health programme. It is important therefore to separate out any trial-specific costs that would not be incurred in more widespread deployment of the intervention. For example, often checks are made in a trial that the intervention has been delivered to participants in the appropriate fashion at an appropriate time. Such checks might not be made, or not be made with the same rigour, in the context of the deployment of the intervention in the routine public health system. However, there may be additional costs in the public health deployment of an intervention that would not be incurred in a trial. For example, drugs or vaccines for use in a trial are often donated, whereas, for public health use, they may have to be purchased.

Table 19.1 Types of economic analysis

<table>
<thead>
<tr>
<th>Type of analysis</th>
<th>Costs</th>
<th>Outcome (effect)</th>
<th>Results expressed as:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Monetary units (commonly US $)</td>
<td>Not relevant</td>
<td>$ per unit of output (for example, $ per fully vaccinated child)</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Type of analysis</th>
<th>Costs</th>
<th>Outcome (effect)</th>
<th>Results expressed as:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEA</td>
<td>Monetary units (commonly US $)</td>
<td>Effect of intervention (for example, cases prevented)</td>
<td>$ per effect (for example, $ per case prevented)</td>
</tr>
<tr>
<td>CUA</td>
<td>Monetary units (commonly US $)</td>
<td>Premature mortality and disability averted (measured in DALYs) or healthy life time gained (QALYs)</td>
<td>$ per DALY averted or QALY gained</td>
</tr>
<tr>
<td>CBA</td>
<td>Monetary units (commonly US $)</td>
<td>Monetary units (for example, value of a statistical life)</td>
<td>Benefit–cost ratio or net present value (for example, money value of benefits–costs)</td>
</tr>
</tbody>
</table>

DALY, disability-adjusted life-year; QALY, quality-adjusted life-year.

### 2.1 Cost-effectiveness analysis

CEA has been the most commonly employed type of economic analysis used in relation to randomized trials of health interventions. CEA compares the costs to accomplish a specific technical goal by a new method with the costs of the present method such as the costs per case of a particular disease diagnosed by the new method with the costs per case of disease diagnosed using the current diagnostic method, or the costs of the prevention of a death from a given cause by the new intervention compared to the costs of the prevention of a death with the present intervention. Note that it is the incremental cost-effectiveness ratio that captures the value of the new method being examined, i.e. the difference in costs between the new method and the present method, divided by the difference in effects between the new method and the present method. This summary measure thus captures the extra cost per additional unit of effect and begs the question ‘is it worth it?’.

### 2.2 Cost-utility analysis

For CUA, the effects of an intervention are expressed as a measure of ‘utility’. Simply, the utility is a measure of the impact of the intervention on the health status of the individual or population, commonly stated as a combined measure of mortality (amount of life lost due to premature death) and morbidity (amount of life lived with disability, weighted according to its seriousness and duration). Commonly used utility measures are the disability-adjusted life-year (DALY) and the quality-adjusted life-year (QALY) (Hyder et al., 2012).

### 2.2.1 Disability-adjusted life-years and quality-adjusted life-years

The DALY was first given prominence in the *World development report 1993* (World Bank, 1993) and has become the most widely used composite measure of population health in LMICs. It built on earlier work by the Ghana Health...
Assessment Project Team (1981) who introduced the similar concept of ‘amount of healthy life lost’, combining measures of the effects of a disease, in terms of life lost both from mortality (expected years of life remaining had the disease not occurred) and from morbidity (severity and duration of disability).

DALYs are calculated by combining the years of life lost (YLL) from premature mortality with the years of life lived with disability (YLD), weighted according to a severity grading. Thus:

\[
\text{DALY} = \text{YLL} + \text{YLD}
\]

As originally formulated, the DALY directly incorporated three social value choices: (1) life expectancy values, (2) discount rates for future life, and (3) variable weighting for life lived at different ages. The recent Global burden of disease report for 2010, however, has dropped both discounting and age weighting (Murray et al., 2012).

A related measure, the QALY, was introduced in 1976 to provide a guide for individuals to select among alternative tertiary health care interventions (Zeckhauser and Shepard, 1976). The idea was to develop a measure of quality of life that would enable investigators to compare expected outcomes from different interventions, a measure that valued possible health states both for their impact on the quality of life and for their duration. The measure sums the time an individual spends in different health states, using weights on a scale of 0 (in a state equivalent to being dead) to 1 (perfectly healthy) for each health state; it is the sum of arithmetic products of the duration of time spent in a state and a measure of the quality of life in that state. QALYs in modified forms have come into widespread use in the UK (by the UK National Institute for Health and Clinical Excellence), Europe, and the USA (by the US Agency for Healthcare Quality and Research).

Despite distinctly different origins, DALYs and QALYs, with appropriate formulation and comparable parameters, can be considered equivalent indicators to assess intervention utility. However, there are many versions of both DALYs and QALYs, and it is very important to know exactly what is being counted in the study under consideration.

### 2.3 Cost–benefit analysis

CBA goes a step beyond CEA or CUA and expresses both costs and effects (or utility) of interventions in monetary terms. It directly compares the monetary costs of an intervention with the monetary benefits from the intervention. If the monetary benefits from an intervention exceed the monetary costs, the decision is straightforward in purely economic terms—implement the intervention. For most sectors, other than health, CBA is the standard form of economic analysis, and it lies at the centre of decision making in these sectors. For example, the decision to build a new road would be based on considerations of the cost of building the road, compared to the economic benefits it would bring (which might include reduction of wear and tear on vehicles, increased speed of delivery of people and goods, increase in trade, and also reduction in injuries and deaths from accidents). The aspect that has impeded its use in the health sector is that, in order to use CBA, a monetary value must be placed on human life. Some argue that this is done implicitly in any decision process, but there has been a reluctance to do this explicitly. Nevertheless, it should be recognized that decisions are regularly being taken in both public and private sectors that implicitly do place a monetary value on life. There are several different approaches to valuing human life which may give marked different results (Australian Safety and Compensation Council, 2008; Viscusi and Aldy, 2003), but further discussion is beyond the scope of this book.

Sometimes, a narrower perspective may be taken with respect to CBA. For example, in consideration of whether the
public health service should introduce a vaccine against pneumonia, the costs assessed may be limited to those for the health system. If the vaccine reduces the incidence of pneumonia, the costs of delivering the vaccine to the at-risk population could be compared with the reduction of health service costs from fewer cases of pneumonia to treat. If there is a clear benefit, simply based on a CBA that only considers costs spent and saved by the health system, the decision about the introduction of the vaccine may be relatively straightforward. It becomes more complicated if there is not a monetary saving to the health system (for example, it costs more to deliver the vaccine than the saving in health service costs), but there is a reduction in mortality and/or morbidity in the population. In fact, a ‘true’ CBA requires a comprehensive and comparable range of inputs and outcomes, all expressed in monetary terms and, for fatal diseases, that would include putting an explicit monetary value on human life at different ages.