

Booklet A3: Cost-effectiveness Analysis



A3.1 Why perform a cost-effectiveness analysis?

Unavoidably, the implementation of SRH programmes is limited by budgetary constraints. There is not enough money to do everything that needs to be done, and managers need to make choices among different programme options in order to achieve the best results given the amount of money that can be spent. However, it is a challenge to compare or rank all the different interventions within a SRH programme.

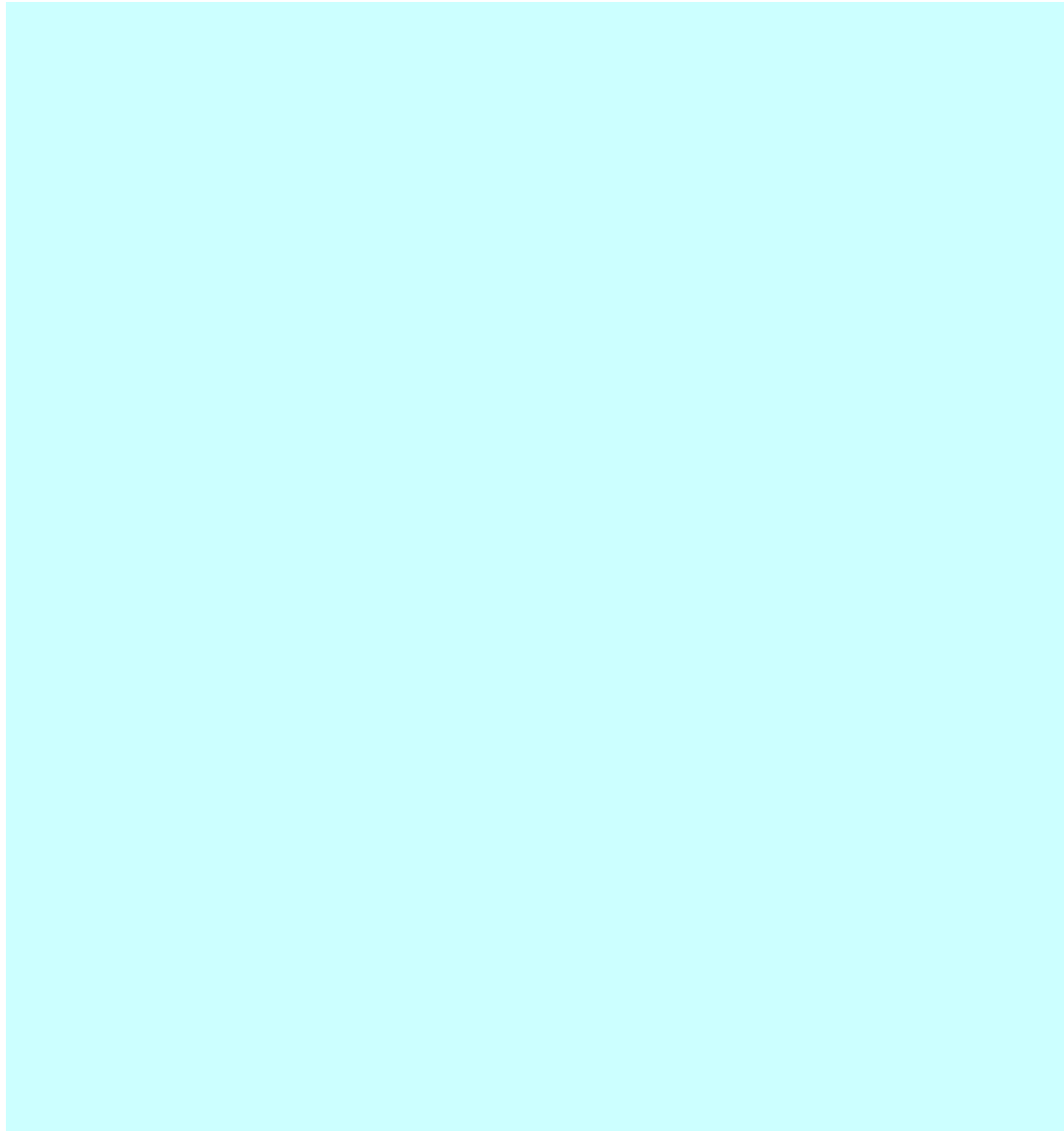
Cost-effectiveness analysis (CEA), which is a form of economic evaluation, can be an aid to making such choices, together with other criteria, such as equity or political feasibility. A health programme is said to be cost-effective if it produce relatively large health gains for relatively low costs, compared to other ways of achieving the same goal. By evaluating both costs and health effects of various programme options, their relative cost-effectiveness can be established. For example, if the aim is to reduce HIV infection amongst commercial sex workers, distribution of condoms at a workplace is probably less cost-effective than distribution through peer education, i.e. for the same cost, less HIV infection will be averted.

Efficiency is a related economic concept, but focuses more on the way in which inputs are transformed into outputs during the process of implementation. An intervention is said to be efficient if its implementation delivers the maximum amount of output (rather than benefits) given the amount of resources used in the intervention. For example, distribution of condoms through a community-based programme might be more *efficient* than distribution through health facilities, i.e. for the same costs, more condoms will be distributed (condoms being the output).

It is important to note that cost-effectiveness is a relative concept (see example in Box A3.1).¹ A particular way of implementing an intervention is only cost-effective compared to other ways of providing the same intervention. Or one particular intervention will be considered more cost-effective than others aimed at similar outcomes. Moreover, whether the cost-effectiveness ratio is considered too high (i.e. high costs given results) will depend on the overall budget. If the budget is large, less

¹ D. Hogan et al, 2005, Cost effectiveness analysis of strategies to combat HIV/AIDS in developing countries, BMJ 331, p: 1431-1437

cost-effective – but nevertheless effective – interventions might still be included in the SRH programme.



CEA can be used in several instances. Cost-effectiveness analysis can assist decision-making about different issues, e.g. choosing between iron supplementation or rather iron fortification, between treating obstetric complications in hospitals or health centres, whether to immunize pregnant women or all women of childbearing age for tetanus toxoid. CEA does not only look at interventions in isolation, but can also be used for combinations of interventions, where costs and effects interact (e.g. cost-effectiveness of TB treatment will change if BDG vaccination is in place: higher fixed costs but fewer cases to treat). Moreover, CEA can help identify the optimal level of implementation by comparing the costs and effects of an intervention at different coverage levels (e.g. AIDS mass media at 90% or 100%).

Knowledge on the cost-effectiveness of interventions can also be used to assess whether money is well spent in a particular SRH programme. Funding agencies may be persuaded to continue support on the basis of this information. Or, when more money becomes available, CEA can indicate which additional SRH interventions produce the best results with the available resources. In other words, by providing information to assist the allocation of resources, CEA prevents overspending of scarce

resources on less effective programmes and under-spending on more effective ones. The application of economic techniques does not necessarily mean that less money should be spent, but rather that resources may be used in better ways. If resources are spent on the most cost-effective interventions, more health care services can be offered for the existing resources.

A3.2 How to perform a cost-effectiveness analysis

This section provides a step-by-step introduction to calculating and analysing the cost-effectiveness of SRH programmes. The main steps are:

1. Defining the scope of analysis
2. Choosing the perspective
3. Selecting the type of analysis
4. Designing the study
5. Identifying an effectiveness indicator
6. Identifying and valuing costs
7. Calculating the cost-effectiveness ratio
8. Generalizing cost-effectiveness studies.

Step 1- Defining the scope of analysis

As with any other research, the starting point of a cost-effectiveness study should be a clear definition of the scope of the research, i.e. its purpose and boundaries. The scope of the programme clarifies the kind of activities that are included, which costs to include, and what will not be covered. Because the cost-effectiveness of an intervention is a relative concept and will be compared to other interventions, it is very important to know exactly what each intervention does and does not include.

In order to interpret the results of a cost-effectiveness analysis, and compare the results with other interventions, the intervention of the study should also be very accurately described. For example, policy makers would like to know:

- the target population covered by the intervention;
- the site of delivery (e.g. facility or community-based);
- level of care (e.g. primary, secondary or tertiary) and type of provider (e.g. government or non-government);
- the time frame for which cost data will be collected;
- the regimen of therapy (in curative interventions);
- the frequency of delivery of the intervention (e.g. for screening);

Box A3.2 illustrates how clearly defining the interventions makes it easier to interpret the results and make comparisons with other studies.



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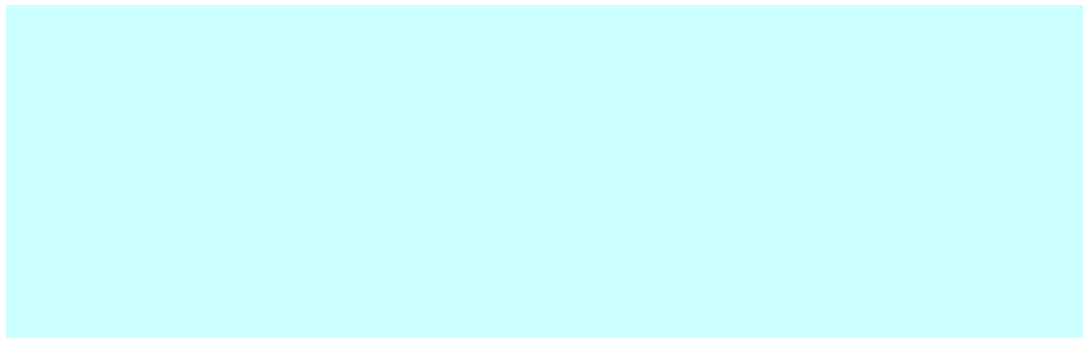
A CEA usually has a direct policy implication, e.g. when prioritizing interventions for a health sector strategy. Therefore, the scope of a study should be set through a participatory process, engaging interested parties – such as programme managers, health care staff or international funding agencies – that will benefit from the results. The input and consensus reached about the scope can be included in a short description of the research, including the background to the study and the cost elements covered (see also Booklet A2).

Step 2 – Choosing the perspective

A societal perspective implies that the cost-effectiveness analysis includes provider costs (costs incurred by the provider of services), household costs (costs incurred by the patients, such as transportation costs) and economic costs (the value of resources used for the intervention, whether or not money or resources were spent on them, e.g. cost of using volunteers). However, it is also possible to do a cost-effectiveness analysis with only the provider costs.

This choice can have important consequences for the cost-effectiveness results. For example in the case of an intervention that reduces the length of stay in hospital after assisted delivery drastically. From the provider's perspective, cost savings occur because of reduced hospital stay and the intervention appears to be cost-effective. However, from the societal perspective, if the hospital care is replaced by care provided by family-members, who are forced to stay home from work to provide care, the cost to that family must also be included (see also Booklet A2 on costing and economic costs). And if these costs are included, the intervention may not be so cost-effective at all.

CEA is often conducted to guide choices on the allocation of public – or societal – resources and, therefore, the societal perspective is usually recommended. Analyses that adopt other perspectives are no less valid, but serve different goals (see example in Box A3.3).



Step 3 – Selecting the type of analysis

There are several different techniques that can be used in an economic evaluation, distinguished from one another by how they measure the benefits of interventions. Depending on the objective of the research, one of the following analyses is possible.

Cost-minimization is used to describe and quantify the cost of particular interventions, assuming that the health outcomes are the same for all interventions. A comparison is made on the basis of cost only. For example, if two similar health centres both aim to provide safe deliveries, then an economic evaluation could report on the costs per safe delivery of each facility. The prioritizing process would include ranking according to lowest costs.

Cost-effectiveness analysis also compares costs and health outcomes. However, this is used if the health effects of interventions are different. For example, when analysing and prioritizing an AIDS programme, one could compare interventions that prevent HIV infection with ones that treat AIDS patients (see box A3.1 and A3.3). This requires finding a common way of describing the health effects, which will be described in Step 5.

Cost-benefit analysis differs from CEA in that it values both health outcome and the costs of interventions in **monetary** terms, such as dollars. Because both the costs and the effects are in monetary terms, a net benefit can be calculated by subtracting the costs from the benefits. There are different ways of attaching a monetary value to a health state, for example by asking people how much they would be willing to pay to avoid a condition or by assessing how much money people spend to avoid a condition (e.g. compensation, insurance). The **human capital approach** looks at financial losses (e.g. wages lost), but this clearly disadvantages unemployed people, people working at home and those earning less. Actually, because of such practical and ethical difficulties of attaching a monetary value to health or life saved, this technique is not widely used to compare different health interventions.

Box A3.3. CHOICE (CHOosing Interventions that are Cost-Effective)

The CHOICE project is a WHO initiative to provide policy makers with evidence for deciding on interventions that maximize health given the available resources. WHO-CHOICE reports the costs and effects (CEA) of more than 700 health interventions in 14 epidemiological sub-regions. The databases give for each programme a menu of interventions that are cost-effective, a menu that are not cost-effective (based on available resources), and another set of interventions in between, for each region.

For example, the analysis of maternal and neonatal health interventions suggests for example that there is insufficient coverage of highly cost effective preventative interventions, such as community support for breastfeeding mothers and low birth weight babies, treatment of neonatal pneumonia, and provision of tetanus toxoid. With limited resources, high priority should be given to increasing access to basic and emergency obstetric and neonatal care in clinical facilities, and less priority to high cost interventions such as antibiotics for preterm rupture of membranes.²

WHO-CHOICE databases should not be used out of context. Policy makers should assess the appropriate mix of interventions for their settings, taking into account other national health sector goals.

Step 4 – Designing the study

Once the topic of the research is clearly defined (scope, cost perspective, type of analysis), a detailed study design has to be developed. This needs to specify how all the costs and effects will be measured. Tools similar to decision trees or event pathways can be used to identify all the costs and effects associated with an intervention, by tracing the use of resources up to the health effects.

For example, an event pathway of an educational primary school campaign on sexual behaviour may outline that the intervention involves campaign costs, might also lead to cost savings in terms of a reduced number of future STIs requiring

² T. Adam, S.S. Lim et al, 2005, Cost effectiveness analysis of strategies for maternal and neonatal health in developing countries, BMJ

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treatment. The study design should make sure that this is taken into account when collecting data on the effectiveness and the costs.

The measurement of financial costs is relatively straightforward (see booklet A2). The effects of an intervention, however, can be more difficult to measure. In some cases, establishing a link between the intervention and effect may be obvious. For example, if a completely new intervention is set-up, such as school-based education on reproductive health, and the indicator of effectiveness is directly observed, e.g. pupils passing a test. However, it may be considerably more difficult in other circumstances. For example, a reduction in neonatal deaths could be due to the intervention under study, but may also be caused by some other factor, for example, a quality assurance programme being implemented at the health facility during the same period.

Therefore, ideally, data on the costs and health effects of an intervention are collected through a survey before and after the implementation of the intervention. Moreover, it is possible to separate out such external factors (e.g. other health interventions) that might influence the difference between results before and after the intervention. In order to do so, data should also be collected of a group of patients that is not exposed to the intervention. If no before/after change is observed in this so-called 'control group', it is more likely that the intervention has caused the changes in the other group.

This "controlled" approach is often used in **randomized** controlled clinical trials, so that these provide an excellent opportunity for cost-effectiveness analyses as well. However, this should be agreed prior to the trial, as cost-effectiveness studies are likely to require the collection of additional data, both on costs and non-clinical effects.



If it is not possible to combine the cost-effectiveness analysis with a randomised controlled clinical trial, and there is not enough money or time to measure the effectiveness first hand, effectiveness and cost data can also be gathered from separate, secondary sources and combined afterwards. Of course, this information should then be made comparable and appropriate for the study context. One cannot use impact data from a hospital in the USA to analyse an intervention in a health facility in a rural area of Uganda (more on generalising cost-effectiveness results in Step 8).

Step 5 – Identifying an effectiveness indicator

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Health effects can be assessed either in terms of **outputs** (e.g. the number of condoms distributed), **intermediate outcomes** (e.g. teen pregnancies prevented) or **final outcomes** (e.g. lives saved, life years gained).

Intermediate outcome measures are only a partial measure of effectiveness, but have the advantage of being easy to measure and interpret (see box A3.7). In the absence of data on health status, they may provide a good indication of what a programme achieves. For example, in a campaign to increase condom use among commercial sex workers, it may take a long time – and a lot of research money – before the impact on mortality and morbidity can be assessed. The monitoring of an intermediate effect, such as knowledge of condom use or the actual use of condoms, can be a more measurable alternative. More examples of intermediate effects are given in Box A3.6.

Although the measurement of intermediate outcomes may be more straightforward than that of final health outcomes, it may still be difficult and costly. In many cases, researchers therefore resort to service output measures that are routinely collected in registries. Examples are the annual number of children vaccinated, the amount of condoms distributed or the number of ANC visits.

Because a cost-effectiveness analysis typically compares two or more interventions, the intermediate measure should be carefully selected to ensure it makes sense for all of the options being evaluated. For example, when comparing peer-to-peer education with the distribution of leaflets in a condom campaign, the number of people reached is not a good outcome measure, since the two interventions have such a different approach (targeted and generalised). Therefore, the indicator “number of people reached” will not lead to a fair comparison of which option is best at changing behaviour (rather use something like “people aware of need to use condoms”).

In addition, intermediate effect measures should capture all the desired effects of an intervention. For example, the success of a mass media programme to reduce STI infections could be measured by the decline in the number of STI treatments provided. However, a successful campaign can also create a higher level of awareness and increase the number of STI-infected people seeking treatment. Measures that are not able to capture the intended effect – the number of STI infections prevented – could lead to the wrong conclusions. One could conclude, for example, that the higher number of treatments is due to greater awareness rather than an increase in STIs.

Final outcome measures measure death and morbidity directly, e.g. deaths averted or life years gained. But life years gained isn't even enough, because the final effect would preferably be "as healthy as possible life". Therefore, economists use measures of health, which summarise changes in both the duration and quality of life in a single figure. Such summary measures are: Quality-Adjusted Life Years (QALYs) or Disability-Adjusted Life Years (DALY), whereby a life year is adjusted to account for changes in the quality of life as well as life expectancy. A DALY is the sum of the life years lost due to premature mortality and disability. A QALY adjusts this to account for the quality of the remaining life years (e.g. mobility, pain, self-care), measured in different ways, amongst which by letting patients score their illness. As such, cost-effectiveness studies will estimate the cost of a SRH intervention per DALY averted. Box A3.7 provides an example of the use of the final effect measure, DALYs, to evaluate interventions in SRH.

Such summary measures of health weigh different states of health to reflect the desirability of living in that state. The higher the value, the less desirable it is (lower life expectancy and/or higher degree of disability), with 0 indicating a state of perfect health and a 1 indicating a state equivalent to "death". DALYs take into account key elements such as the age at which disease or disability occurs, how long its effects remain, and its impact on quality of life. Losing one's sight at age 7, for instance, is assumed to be a greater loss than losing one's sight at 67. Similarly, a bout of acute illness that is over quickly counts less in the DALY calculation than one that leaves lingering weakness, such as from persistent worm infections. Moreover, the DALY methodology also incorporates a time preference (see also booklet A2), whereby more weight is given to saving lives right now than in the future.

These choices behind the methodology are open for discussion, especially because of the way in which disability and premature mortality of women is probably underestimated.³ For example, DALY does not measure socioeconomic and cultural factors that form the burden of many reproductive health problems (e.g. stigma, exclusion, discomfort). For example, the importance of social and economic consequences, as opposed to the physical disability, from fistula or infertility will not be taken into account. Moreover, because of the time preference the DALY methodology would favour curative over preventative measures.

However, though criticized, DALYs are widely used in cost-effectiveness analysis as they allow for comparison of health interventions with very different health effects. For more on the use of DALYs and WHO's burden of disease studies, see also Booklet B1.

³ See for example, C. Abouzahr and J.P. Vaughan (2000). "Assessing the burden of sexual and reproductive ill-health: questions regarding the use of disability adjusted life years". Bulletin of the World Health Organization 2000 78(5), World Health Organization, Geneva. E. Nygaard (2000). H. Bastian (2000). "A consumer trip into the world of the DALY calculations: an Alice-in-Wonderland experience". Reproductive Health Matters, Vol. 8, No.15, May 2000.



Step 6 – Identifying and valuing costs

The step-by-step approach to costing is described in detail in Booklet A1. This same method should be used for the cost part of the cost effectiveness study.

First of all, as discussed in step 3, the perspective taken will determine what kinds of costs will be collected: only provider costs or also household cost and economic costs? It is important to capture the full spectrum of costs. Even if only provider costs are taken into account, there will be a lot to collect. The first cost component that springs to mind is that which is directly related to service delivery. This includes the costs of tests, drugs, supplies, and specialised health care personnel. For example, the health care costs of STI screening include the costs associated with the act of screening itself, such as the cost of doing and interpretation of the test by the physician; the cost of the test kits and other supplies used during testing; the cost of the drugs used for treatment; and the cost of follow-up by the health care staff. However, this should also include programme costs such as training of the physician and other health care workers involved or supervision visits. Moreover, one should not forget to include the costs savings at the point of service delivery due to reduced costs of STI treatment thanks to early detection.

A cost-effectiveness study could also include health system costs. These are costs of an intervention that are not directly related to service delivery, but do fall onto the wider health system. This includes, for example, the costs of the infrastructure (building and equipment) or health facility administration that should be allocated to the intervention under study. Investments in health units other than those used for the intervention are excluded.

Moreover, prior to analysis, costs need to be adjusted for time preference, just as the benefits have (see step 5 on DALYs). The process of discounting in cost-effectiveness analysis adjusts for time preference and opportunity costs by valuing current costs as higher than those occurring in the future. Booklet A2 describes how this is done in more detail.

Step 7 – Calculating cost-effectiveness ratios

Once both the costs and the effectiveness of different alternative options have been measured, the cost-effectiveness ratio can be calculated. Because for each option the costs and the effects are measured in the same way and with the same units (e.g. US\$ and DALYs), cost-effectiveness ratios can be compared.

When evaluating a programme with a mix of interventions, economists will often calculate the average cost-effectiveness ratio (ACER) of each intervention compared to the scenario of doing nothing (or sticking to what is currently done). In that case the CER is calculated as follows:

$$\text{Average cost-effectiveness ratio} = \frac{\text{total costs of intervention}}{\text{health effects (e.g. DALYs averted)}}$$

To assess the optimal level of implementation, i.e. the level where most health effects are reached at lowest costs or each intervention, one could also calculate the marginal cost-effectiveness ratio (MCER). This ratio measures changes in costs and effects as the interventions gets expanded or reduced. This is useful.

$$\text{Marginal cost-effectiveness ratio} = \frac{\text{change in costs of intervention}}{\text{change in health effects}}$$

Finally, economists use the so-called incremental cost-effectiveness ratio to compare 2 alternative interventions, looking at the additional costs occurred per additional health effect of one option (A) compared to the next best comparable option (B, e.g. less effective or less costly alternative). For example, one could compare an intervention (e.g. AIDS mass media) with an expansion of that intervention (e.g. AIDS mass media + peer education and treatment of STIs for sex workers). This is useful when more resources become available and a decision has to be made about adding a new intervention or expanding the first one.

$$\text{Incremental cost-effectiveness ratio} = \frac{(\text{costs of intervention A} - \text{costs of intervention B})}{(\text{health effects A} - \text{health effects B})}$$

Because of the many uncertainties in most cost-effectiveness analysis, for example due to lack of reliable data on the impact of interventions on neonatal morbidity or stillbirth, a **sensitivity analysis** should be conducted. This sensitivity analysis recalculates the cost-effectiveness ratios using slightly different assumptions to assess how robust the results are, i.e. whether the ranking of interventions holds under different assumptions. For example, in the sensitivity analysis the cost-effectiveness ratios can be calculated without discounting or age-weighting in the DALYs, or using higher drug prices or salaries.

In any case, all such cost-effectiveness ratios have to be read with care. For example, one option might be most cost-effective, i.e. lowest costs per health effect, but another option might be more effective though at higher costs. Though the second cost-effectiveness ratio will be higher, it could still be a good choice if there is enough funding, if it is more efficient and cost-effective than other alternatives or if there are other criteria for funding (e.g. equity, pro-poor, feasibility). Moreover, cost-effectiveness depends on what is affordable given the available budget. For example, one could decide that interventions with a CER smaller than income per person of a country are cost-effective in that country, while interventions with a CER of more than 3 times the income per person of the country should not be considered cost-effective in that setting.

Step 8 – Generalizing cost-effectiveness studies

This booklet has discussed the 7 basic steps to carry out a CEA. However, since performing a CEA is a costly undertaking and requires advanced technical expertise, it may be more practical to use already available evidence on cost-effectiveness of interventions when using this as an input for prioritising SRH interventions. The kind of evidence required – primary research or secondary sources – will depend on the decision to be made. If the purpose is to advocate broadly for a SRH intervention, then international evidence may suffice. But policy-makers might feel the need to demonstrate the cost-effectiveness of an intervention in their own setting.

The use of available evidence is most straightforward when the objective of the study has already been convincingly addressed by a recent study in a similar decision-making context, or when evidence has repeatedly been demonstrated by different studies in different settings. For example, studies of the cost-effectiveness of prevention of mother-to-child transmission of HIV in many different settings share the same conclusion that this is generally a relatively cost-effective intervention. In such circumstances, there may be no need to repeat the same analysis.

However, evidence from other studies in other countries should be treated with caution. Many factors may affect estimates of costs and health effects and, thereby, cost-effectiveness. For example, costs vary considerably due to different institutions (primary or secondary level), health care systems (travel time to facilities) or prices (drug prices vary enormously between countries). Health effects may depend on the burden of disease (what is the potential for disease prevention?), attitudes of patients (do they comply with treatment?) or doctors' competence (do they deliver quality health care?). The consequence is that cost-effectiveness results cannot be readily generalized. It is advisable to consult an economist if you need to use these methods to generalize study results (for more detail on generalising cost data, see A2 Step 8).

Summary

This booklet has described the main steps of cost-effectiveness analysis:

1. Defining the scope of analysis
2. Choosing the perspective
3. Selecting the type of analysis
4. Designing the study
5. Identifying an effectiveness indicator
6. Identifying and valuing costs
7. Calculating the cost-effectiveness ratio
8. Generalizing cost-effectiveness studies.

It is recommended that trained analysts or economists carry out this work. However, SRH managers need to have some knowledge on how this is done, in order to ensure that the analysis meets their needs.