



Using Cost-Effectiveness Analysis for Setting Health Priorities

Governments around the world face budget constraints that compel them to make tough decisions about how best to invest funds for public health. They need a way to evaluate which investments will address the most pressing health problems and bring the greatest health gains. Cost-effectiveness analysis is an essential evaluation tool that allows policymakers and health planners to compare the health gains that various interventions can achieve with a given level of inputs. Getting the most value for money has been a central thrust in the analysis presented in *Disease Control Priorities in Developing Countries*, 2nd edition (DCP2). The basic concepts underlying the analysis, as well as needed improvements, are described here.

What Is Cost-Effectiveness Analysis?

Cost-effectiveness analysis is the primary tool for comparing the cost of a health intervention with the expected health gains. An intervention can be understood to be any activity, using human, financial, and other inputs, that aims to improve health. The health gain might be reducing the risk of a health problem, reducing the severity or duration of an illness or disability, or preventing death.

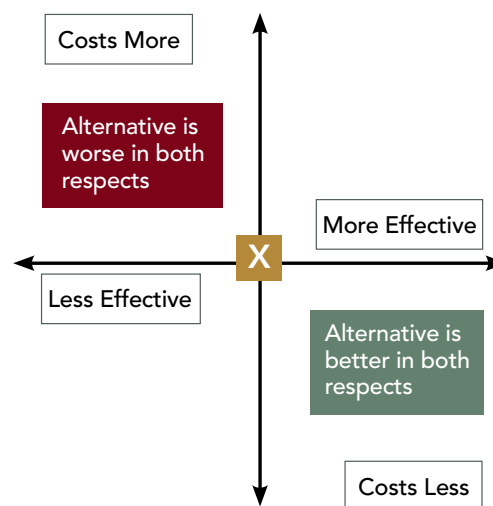
If the health outcome is the same, say preventing death from measles either by immunizing a child or by treating the disease, then analysts need only compare the costs of different interventions that can achieve that outcome. The result is a cost-effectiveness ratio, expressed as cost per outcome, which can be compared across various types of services or various service locations that perform the same function. The ratio is always discussed in relative terms, as there is no “best” or absolute level of cost-effectiveness.

The cost-effectiveness of an intervention can vary greatly depending on a program’s size and scope. Typically, as program coverage expands and more people are served, the cost per outcome drops. For example, if more children can be immunized with the same fixed costs like nurses and clinics, then each additional immunization will be cheaper until the service approaches full capacity.

On the other hand, costs can rise as coverage expands if it becomes harder to reach additional patients. Therefore, depending on the comparison undertaken, an analyst might look at the average cost-effectiveness ratio or the incremental cost-effectiveness ratio. The average cost-effectiveness ratio looks at total costs and total results, starting from zero, while the incremental ratio compares additional costs and additional results, starting from the current level of coverage or services. Using child immunizations as an example, the incremental cost of adding mobile vaccination teams might be lower than expanding fixed clinic services, particularly if the unvaccinated children are dispersed and hard to reach.

In Figure 1, several alternatives might be available for expanding the coverage of a current intervention (the status quo shown at point “X”). If an alternative is more effective and less costly, decisionmakers should usually opt in favor of adopting it, while they should abandon options that are more costly and less effective. The trade-offs are less clear in the unmarked quadrants, requiring decisionmakers to weigh whether the benefits that might be gained merit a change in strategy.

FIGURE 1: COMPARING ALTERNATIVES TO A GIVEN HEALTH INTERVENTION (X)



Source: P. Musgrove and J. Fox-Rushby, 2006. “Cost-Effectiveness Analysis for Priority Setting,” in *Disease Control Priorities in Developing Countries*, 2nd edition, ed. D.T. Jamison et al: 276.

How Do Analysts Measure and Compare Different Health Outcomes?

Cost-effectiveness analysis requires health outcomes to be expressed in common units so that comparisons among interventions can be made. All analyses start with some unit, such as cases of a disease or injury, deaths, or numbers of people who quit smoking or adopt some other behavior.

All interventions that prevent death are alike in terms of the common outcome. However, when lives are saved at different ages—averting a death from malaria at age 2 versus a heart attack at age 50—the outcome is no longer identical, and some adjustment must be made for the difference in years of life saved.

For interventions that prevent death, the analysis starts by estimating the deaths prevented and the age at death to yield the number of life-years saved. The number of life-years saved is the difference between age at death and life expectancy remaining at that age. Standard economic analysis then *discounts* the future years to take account of uncertainty and the advantage gained by investing early.

Discounting means reducing the value of the outcome in each future year by an amount that increases over time. Thus, if values are discounted at 3 percent annually, that means dividing the values for year 1 by 1.03, those for year 2 by 1.03 squared, and so on. At that rate, preventing an infant death saves not all of the 60 to 80 years of life expectancy at birth (depending on the country), but at most 30 discounted years. Even when discounted, however, saving infants' lives yields substantial health gains.

The Disease Control Priorities Project discounts years of life saved at a constant 3 percent per year. The same logic applies to interventions that avert a chronic condition or disability, except that different disabilities must be compared in severity. For short (acute) episodes of illness, age is not relevant—all life years are regarded as equally valuable—and therefore discounting has no effect.

New Metric Used in Cost-Effectiveness Analysis: The DALY

The disability-adjusted life year (DALY) was introduced by the World Health Organization and the World Bank in 1993 and has been used since, with some variations, for two

related purposes. One is to measure the “burden of disease,” the extent to which premature deaths and disabilities cause a loss of health status compared to everyone’s living to old age in good health. The other purpose is to compare the value of health interventions that have multiple or different health outcomes occurring at different ages. In particular, it allows for measuring and comparing health outcomes other than saving lives. Used in *DCP2*, the DALY—or common unit of health loss or gain—takes into account the duration and severity of a health problem and discounts future years.

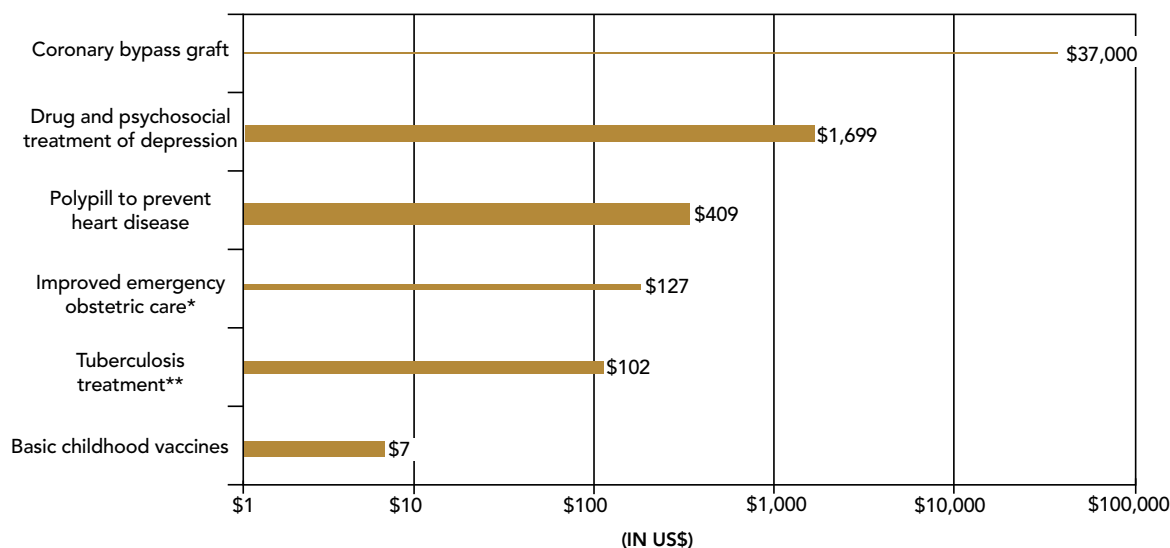
In cost-effectiveness analysis, the DALY represents the number of years of disability-free life that would be gained from a particular health intervention—yielding a cost per DALY where cost data are available or can be inferred. *Gaining* a DALY through a health intervention reduces the burden of disease; it is the same as *averting* the loss of a DALY. The calculation includes assumptions about severity (if the health condition is not fatal), the age at which an illness or intervention occurs, the duration of ill health with and without the intervention, and the remaining life expectancy at the age when the gain occurs.

For interventions that aim to reduce risk factors for health (such as stopping smoking) rather than directly affect illnesses or injuries, the analysis includes estimates of reductions in ill health that result from changes in the level of risk. Stopping smoking, for example, reduces deaths from both cardiovascular disease and cancer.

DALYs allow analysts to compare the cost-effectiveness of different interventions and different health outcomes, by expressing diverse health outcomes in a common unit. As a result, it can help guide where best to invest scarce health resources. For example, a coronary artery bypass costs, on average across world regions, US\$37,000 per DALY gained—far beyond the per capita income of most countries—compared with an average of only US\$409 for the polypill (several medications for preventing heart disease in a single pill). The latter is a “best buy” for developing countries. However, both interventions are much less cost-effective than saving life years of a middle-aged person by treating active tuberculosis (and thereby preventing transmission) at a cost as low as US\$15 per DALY. Figure 2 illustrates the relative costs of these and other health interventions.

In high-income countries, some analyses include quality-adjusted life years (QALYs), an alternative measure of how much a year of life is diminished if a person suffers health limitations. This

FIGURE 2: COST PER DALY GAINED FOR SELECTED HEALTH INTERVENTIONS



*Refers to South Asia only; includes measures to address life-threatening pregnancy complications

**Directly observed treatment short-course (DOTS) for epidemic infectious tuberculosis

Notes: The cost per DALY represents an average for low- and middle-income countries, except where noted. The width of the bars represents the relative burden of disease that could be averted by the intervention (or package of interventions) shown if applied to everyone who needs it.

The horizontal scale is logarithmic and thus the length of the bars is not proportional to the dollar values.

Source: Calculations based on Chapters 2, 16, 26, and 33. 2006. *Disease Control Priorities in Developing Countries, 2nd ed.*, ed. D.T. Jamison, et al.

measure can account for people suffering from more than one illness or disability and in varying degrees. But it is used little in the Disease Control Priorities Project that focuses on burden of disease in low- and middle-income countries.

Some Shortcomings of Cost-Effectiveness Analysis

Cost data can be extremely hard to find in developing countries. Ideally, cost-effectiveness analysis should include direct costs (such as doctors' or nurses' time and supplies used) as well as indirect costs (such as a portion of administrative costs). The cost of equipment also needs to be spread across its many uses. These costs are usually not readily available, however, and thus the costs of interventions reported in developed countries are often used and adjusted for developing-country settings. Alternatively, a study conducted in one low-income setting is sometimes used to estimate costs in all or several low-income countries.

Cost-effectiveness is only one criterion for judging whether an intervention has merit. Policymakers also must take into account total cost and whether an intervention is affordable at all, the capacity of the system to deliver it, and whether people will demand and use the service provided. Also, cost-effectiveness analysis might show that an intervention is worth doing, but it doesn't necessarily mean that the public sector should undertake all of it. Private-sector services might be available and affordable for some portion of the population.

Equity is also a concern, because it can be more cost-effective to serve many people in large urban centers, where the cost per outcome is relatively low. Providing the same service in a poor, rural area—where fewer patients are seen or where staff and other inputs are harder to make available—might be less cost-effective but more worthy of public investment because it is more equitable.

What About Benefits Other Than Health?

Cost-effectiveness, whether expressed as a single health outcome or a DALY, only takes account of health benefits, which means it may underestimate the total benefit of some health interventions that also improve people's productivity and other aspects of quality of life. Piped water and sanitation, for example, bring environmental as well as health benefits to communities, and save people's time. Some interventions may not appear cost-effective on health grounds alone but may be justified by large non-health gains.

Estimating the value of all benefits of an intervention, including both health and non-health outcomes, requires expressing gains in monetary terms because "apples and oranges" such as life-years, income, and better school performance can't be added together. Such comparisons are the domain of cost-benefit analysis, where the aim is to compare the total gains from different investments.

The preference for cost-effectiveness analysis in health stems in part from concern about the ethical implications of placing a monetary value on people's lives. In cost-benefit analysis, the value of life years is most often expressed in terms of income lost or gained, which can be impractical to compute and also problematic to justify when addressing the needs of vulnerable (old, young, or disadvantaged) populations.

Improvements Needed

More and better data are needed in low- and middle-income countries so that analysts do not need to use cost data and assumptions from high-income countries or rely on expert judgments. The need for information starts, in some cases, with better estimates of the incidence and prevalence of particular diseases, and with data on the coverage and outcomes of health

interventions. In most countries, estimating what it would cost to expand the coverage of existing interventions or to add new interventions relies heavily on assumptions.

Whenever possible, cost-effectiveness analyses should be conducted at the national or subnational level. This would allow planners to take full account of all the reasons cost-effectiveness varies from one place to another, and to develop priorities on the basis of analysis appropriate to local circumstances.

Conclusion

While many considerations, such as affordability, equity, and non-health benefits, may factor into decisions about health spending, cost-effectiveness analysis is an essential tool for decision makers. It can guide decisions about where best to spend limited resources and what to include in a package of health services that responds to a population's greatest health needs.

For More Information

Philip Musgrove and Julia Fox-Rushby, "Cost-Effectiveness Analysis for Priority Setting." In *Disease Control Priorities in Developing Countries*, 2nd ed., ed. D. T. Jamison, J. G. Breman, A. R. Measham, G. Alleyne, M. Claeson, D. B. Evans, P. Jha, A. Mills, and P. Musgrove: 271-285. New York: Oxford University Press.

Ramanan Laxminarayan, Jeffrey Chow and Sonbol A. Shahid-Salles. 2006. "Intervention Cost-Effectiveness: Overview of Main Messages." In *Disease Control Priorities in Developing Countries*, 2nd ed., ed. D. T. Jamison, J. G. Breman, A. R. Measham, G. Alleyne, M. Claeson, D. B. Evans, P. Jha, A. Mills, and P. Musgrove: 35-86. New York: Oxford University Press.