Chapter 11

Understanding and Using the Economic Evidence

THE IMPORTANCE OF ECONOMICS TO HEALTH POLICY DECISION MAKING

Obtaining evidence on the effectiveness of public health interventions is a critical first step in selecting those interventions most likely to improve population health or prevent disease. However, in addition to knowing "What works and what is the size of the impact?" policymakers need other information to answer the question "What is the best choice of interventions for our program?" Public health decision makers, faced with limited resources, must routinely make decisions about how to prioritize public health problems and related interventions and choose among several alternatives. In making such choices, decision makers can benefit by knowing the financial resources required to implement each effective intervention and how dollars invested compare to outcomes achieved. Economic evaluations provide this information by comparing the costs and consequences of public health interventions (policies, programs, and other activities) (see Table 11–1). This chapter addresses the rationale and value of systematic reviews of economic evaluations, describes the methods used by the *Community Guide* to conduct such reviews, and provides information to help decision makers interpret review findings.

OVERVIEW OF ECONOMIC EVALUATION METHODS

Four main methods are used in economic evaluations: cost analysis (CA), cost–effectiveness analysis (CEA), cost–utility analysis (CUA), and cost–benefit analysis (CBA). Table 11–2 includes a brief description of these methods, what they compare, and the economic summary measures they produce.

Cost Analysis

Cost analysis involves the systematic collection and assessment of costs associated with an intervention. These costs are typically expressed as dollars or dollars per person served by the program. For example, a multicomponent intervention program to promote child vaccinations might cost $23 per child[1] in the area served. Cost analyses can be conducted alone, but they are often

Table 11–1. Successful Use of Economic Data in Public Health: Three Examples from the Centers for Disease Control and Prevention

RTI International, in collaboration with economists from the National Center for Chronic Disease Prevention and Health Promotion (NCCDPHP, CDC), developed a lifetime economic model to assess the cost-effectiveness of screening for undiagnosed diabetes. This work resulted in the adoption of a diabetes screening policy by the state Diabetes Control Programs and a major change in the screening policy of the American Diabetes Association (ADA).
Economists from the National Center for Infectious Diseases (NCID, CDC) published the first economic estimates of the potential impact of the next influenza pandemic. The estimates of impact have been incorporated into the U.S. national influenza pandemic response plan.
NCCDPHP economists developed SAMMEC (Smoking-Attributable Mortality, Morbidity, and Economic Costs), a Web-based computational program available at www.cdc.gov/tobacco/sammec. SAMMEC allows the user to estimate the health and health-related economic consequences of smoking to adults and infants in terms of the number of annual deaths, years of potential life lost, medical expenditures, and productivity losses among adults due to smoking, as well as smoking-attributable infant deaths and excess neonatal healthcare costs. This tool is widely used by both public health departments and policymakers.

combined with measures of intervention effectiveness in a CEA or CBA. Cost analysis takes into account the costs incurred to develop and implement an intervention, including direct costs, indirect costs, and intangible costs. Direct costs represent the value of resources used specifically for the intervention. These costs may be characterized as medical or non-medical. Direct medical costs can include costs such as clinical services, diagnostic tests, and medications. Direct non-medical costs can be costs such as those associated with a mass media campaign, including media development, training, materials, and the cost of advertising. Indirect costs include the resources that are forgone to participate in an intervention, typically measured as lost wages or lost leisure time. Economic value can be assigned to each unit of time lost from normal activities. Intangible costs, such as the pain, grief, or suffering associated with an intervention, can also be considered, but they are difficult to quantify and are seldom included in an economic evaluation.

Financial costs should be distinguished from the broader concept of economic costs. Financial costs are the actual dollar costs expended for services, typically the actual costs of care, but in a public health context these also include program costs. Examples of financial costs include staff salaries, rent, and supplies. In addition to financial cost expenditures, economic costs include the opportunity costs or value of a resource for which there is no direct monetary expenditure (the value of the benefit that could be derived from the next best use of that resource) and the value of intangibles. Examples of opportu-

Table 11–2. Overview of Economic Evaluation Methods

Economic Evaluation Method	*Comparison*	*Measurement of Health Effects*	*Economic Summary Measure*
Cost analysis	Used to compare net costs of different programs for planning and assessment	Dollars	Net cost Cost of illness
Cost–effectiveness analysis	Used to compare interventions that produce a common health effect	Health effects, measured in natural units	Cost-effectiveness ratio Cost per case averted Cost per life-year saved
Cost–utility analysis	Used to compare interventions that have morbidity and mortality outcomes	Health effects, measured as years of life, adjusted for quality of life	Cost per quality-adjusted life year (QALY)
Cost–benefit analysis	Used to compare different programs with different units of outcomes (health and nonhealth)	Dollars	Net benefit or cost Benefit-to-cost ratio

nity costs include the value of volunteer time, space in the local public health department, and donated materials and supplies. Economic costs or financial costs can be used to compare alternative interventions, though economic and financial costs cannot be directly compared.

Cost analysis can include cost-of-illness (COI) estimates, which take into account the direct costs (medical and non-medical) and indirect costs associated with a health condition. Cost-of-illness analyses are a type of burden-of-disease measure. Cost-of-illness estimates can be incidence-based (reflecting total lifetime costs of a disease or illness) or prevalence-based (reflecting total costs of a disease in a specific time frame—for example, one year, divided by the number of cases). Cost analyses that include COI are presented as net costs, which are calculated by subtracting the cost of the illness (or injury) averted from total program costs. For example, the COI of an intervention for women with established diabetes that provides preconception care in addition to prenatal care[2] would include the total program costs less the cost of the illness averted (congenital anomalies). The result is often expressed in terms of dollars per person covered by the intervention—in this case, net cost per program enrollee. Results are sometimes also expressed as net costs per population (such as the population of a state or of the United States).

Cost–Effectiveness Analysis

Cost–effectiveness analysis (CEA) compares the costs of an intervention or policy with the measures of health improvement that are gained. These might be expressed as dollars per additional life-year saved. For example, an intensive mass media program to promote smoking cessation might cost $138 per life year saved.[3] With CEA, health improvements are measured in natural units (e.g., cases of disease prevented or number of lives saved). The summary measure for CEA is the cost-effectiveness (CE) ratio, which measures the net cost of the intervention or program relative to its health effects. In other words, it is the cost per unit of health effect (e.g., cost per year of life saved). Often, two CE ratios are reported: the incremental CE ratio, which compares a given intervention to another effective intervention, and the average CE ratio, which uses a *no-program* comparison.[4] For example, if in an effort to improve oral health within a community a public health practitioner compared a community water fluoridation program to a school-based fissure sealant delivery program, this would require an incremental CE ratio. If the community water fluoridation program was the only intervention under consideration, then this would indicate a no-program comparison, necessitating an average CE ratio.

Cost–effectiveness analysis is most useful for comparing interventions that address the same health problem. The effectiveness of an intervention can be measured using intermediate outcomes (e.g., number of people who stop smoking) or final outcomes (e.g., cases of disease prevented or years of life saved). Intermediate measures are usually of value only where they are clearly linked to final outcomes. For example, percentage reduction in tobacco smoking is considered an acceptable intermediate measure of effectiveness because it has been clearly linked to decreases in lung cancer and improvements in life expectancy. Use of final outcomes is generally preferable, since it permits a more complete assessment of the economic value of the intervention. However, for many issues, final outcomes can be difficult to quantify and expensive to assess (e.g., if they are rare or occur far in the future).

Cost–Utility Analysis

Cost–utility analysis (CUA) is a special type of CEA that compares costs of an intervention or policy with one particular measure of health improvement, the quality-adjusted life year (QALY). The QALY is an effort to take into account measures of both mortality and morbidity. For example, a year lived in perfect health may count as 1 QALY, whereas a year spent living with a serious illness might count as only 0.6 QALY. The advantage of these measures is that they allow direct comparison on the same scale of different types of

health effects. Results of CUAs are typically expressed as cost/QALY saved. For example, a mass media program to promote smoking cessation might cost $151 per QALY saved,[5] where some of the improvement is attributable to reduced mortality and the remainder is attributable to a better quality of life. Two other measures of health improvement often associated with CUA are the disability-adjusted life year (DALY) and the healthy life year (HeaLY). However, neither of these alternatives is widely used in practice. (For more information about QALYs and related measures, see[4,6,7].)

Cost–Benefit Analysis

Cost–benefit analysis (CBA) takes into account all costs and consequences (which can include both benefits and harms) associated with an intervention and expresses them in dollar terms. These dollar terms are adjusted to their current or present value through a mechanism known as *discounting*. Discounting is a method used to make the value of costs and benefits comparable regardless of when they occur. Typically, costs in prevention effectiveness studies are incurred at or near the beginning of the intervention, whereas the benefits are spread out over several years. The two most commonly used summary measures for CBA are net benefits (present value of benefits less harms, minus cost of prevention) and benefit–cost ratio (present value of benefits divided by present value of costs). For example, if the present value of the benefits of an exercise program is $1100 per participant and the present value of associated costs is $450 per participant, then the net benefits are $650 per participant. The benefit–cost ratio of this intervention would be $1100 / $450 or 2.44.[8] Benefits of public health interventions, found in CBAs, CEAs, and CUAs, are often expressed in terms of increased life expectancy, decreased morbidity, averted medical costs, and increased worker productivity. In addition, CBA can capture important non-health effects (such as the increased value of housing with good sanitation systems), and the costs of harms related to an intervention can be factored into the analysis as well. For example, a potential harm could be loss in productivity incurred by a business associated with an on-site occupational health clinic. As a general rule, if the benefits exceed the cost (that is, if the benefit–cost ratio is greater than 1 or the net benefit is greater than 0), the program is considered to provide good economic value.

WHAT TYPES OF ECONOMIC EVALUATIONS CAN BE USED FOR WHAT PURPOSES?

The context in which a decision is made determines what type of economic evaluation is most useful and appropriate. If lawmakers need to allocate resources to interventions in two different sectors of the economy, such as edu-

cation and health, the outcomes of interest must be converted to a common unit (such as dollars) to make the interventions comparable. A cost–benefit analysis is appropriate here. Public health policymakers often must decide how to allocate limited funds to address diverse public health issues that have different outcomes with respect to survival and quality of life (e.g., alcohol-impaired driving, HIV, and diabetes). Cost–utility analysis is an appropriate technique to use when making such decisions because it allows diverse health outcomes to be converted to a common unit, QALYs (see Cost–Utility Analysis above). Public health practitioners must often decide between two interventions that affect the same outcome, such as reducing initiation of tobacco use. In this circumstance, they can use cost-effectiveness analysis to compare the cost and outcomes of two or more interventions designed to reduce tobacco use.

COMMUNITY GUIDE METHODS FOR SYSTEMATIC REVIEW OF ECONOMIC EVALUATIONS

For each intervention recommended by the Task Force on Community Preventive Services (the Task Force), a systematic review is conducted to assess the quality of existing relevant economic evaluations and to summarize the findings. The lack of standardized methods and reporting of economic data hampers the use of data on costs and financial benefits in evidence-based reviews of effectiveness. To improve the comparability and usefulness of the very limited body of economic evidence, the economic data presented by the Task Force are abstracted and adjusted using the standardized economic abstraction form developed as part of the *Community Guide* initiative. The objective is to make economic research more accessible to decision makers and other stakeholders in order to help them use resources in the most efficient way to achieve a given health improvement at the lowest cost.

In this section we briefly describe *Community Guide* methods for systematic reviews of economic evaluations. These methods follow the same basic steps as the reviews of evidence of effectiveness and include a systematic search for economic evidence, assessment of individual studies (data abstraction and quality assessment), and a summary of the body of evidence.

The first step is to conduct a systematic search of the literature to find studies on intervention effectiveness that include economic evaluations (such as CA, CBA, CEA, or CUA). A study must meet certain criteria, determined by the Task Force, to be included in the review. It must be a primary study (not a review), published in English, and conducted in an established market economy (a developed country, as defined by the World Bank). The study must also include sufficient detail to abstract and adjust economic results.

Finally, the study must have been published within a relevant time frame such that the costs and the intervention effectiveness are thought to be reasonably applicable to the current U.S. context.

Studies that meet the inclusion criteria are subjected to data abstraction, cost adjustment, and quality assessment by two independent reviewers. Disagreements are resolved between the two reviewers. To abstract the data, reviewers use a standardized form (available at www.thecommunityguide.org/methods/econ-abs-form.pdf) to guide them through the process of summarizing studies. The abstraction form captures important information about each study, including study characteristics, intervention description, type of economic evaluation, costs and benefits, and data sources. Abstracted economic data are converted to a common currency (U.S. dollars). Costs are then adjusted for inflation with reference to a base year. Studies are also adjusted, when possible, to reflect a discount rate of 3% over the relevant time horizon.

After the data are abstracted, the quality of the study is assessed across five categories: study design, measurement of costs, measurement of outcomes, evidence of effectiveness, and analysis. Based on this assessment, study quality is characterized as very good, good, satisfactory, or unsatisfactory. Results of unsatisfactory studies are excluded from further review. Studies that contain fatal flaws, as determined by the reviewers, are also considered unsatisfactory and are excluded from the review. For example, if a CEA of a smoking cessation program evaluated the outcome of quitting smoking for only one week following the intervention, the study would be considered to have a fatal flaw, because this is an insufficient time period to assess the cost-effectiveness of the intervention. For more details on the methods used in our systematic reviews, see Carande-Kulis et al.[9] The economic data abstraction form and quality assessment scale can be found on the *Community Guide* website at www.thecommunityguide.org/methods/econ-abs-form.pdf.

HOW TO INTERPRET AND USE ECONOMIC RESULTS

Although systematic reviews of economic evaluations can provide useful summaries of published information on costs and benefits of interventions, decision makers should interpret any summary economic measures with caution. In this section, we provide information on how to use and interpret economic evaluations in the *Community Guide*. The design of the economic study—study parameters, including study perspective, methods, and time frame—is important and should be taken into account when interpreting results (see details below). The parameters can be used to identify costs after the program has been completed or they can be used when the program is in effect to *frame* (define the context of) the study. Other important considerations in

interpreting and using the results of economic analysis are the baseline prevalence of disease risk factors, the nature and scale of the intervention, the target population, and the setting in which the intervention was delivered.

Study Parameters

The parameters of an economic evaluation, including study perspective, analytic methods, relevant time frame, audience for the evaluation, and other key issues, determine what types of data are included and analyzed in the study. Study parameters affect the applicability of study results to different situations and populations, and should be taken into consideration when interpreting and using study results. One important parameter is the perspective (the viewpoint from which the analysis is conducted), which determines the costs and health outcomes included in the analysis. For example, a study conducted from a government perspective includes only those costs and benefits experienced by the government and may not account for costs or benefits relevant to a health insurance purchaser.

Table 11–3 illustrates the types of costs included in a typical CEA from four perspectives: society as a whole, the insurer or other payer, the employer, and the client. Direct medical costs that are not covered by an insurer or an employer, such as deductibles and co-payments, are incurred by the client. These non-covered payments would be included in the client perspective. However, the societal perspective would include all direct medical costs, both

Table 11–3. Examples of Costs Included in a Typical Cost–Effectiveness Analysis, Based on the Perspective of the Analysis

	Perspective			
Cost	***Societal***	***Insurer/ Payer***	***Employer***	***Client***
Direct medical	Yes	Yes[a]	Yes[a]	Yes[b]
Direct non-medical (e.g., transportation, day care)	Yes	No	No	Yes
Indirect (e.g., time lost from work)	Yes[c]	No	Yes[c]	Yes[c]
Intangible (e.g., pain and suffering)	Yes[c]	No	No	Yes[c]

[a]Covered payments.

[b]Out-of-pocket payments.

[c]If not incorporated in the effect measure.

Adapted from Farnham PG, Haddix AC. Study design. In: Haddix AC, Teutsch SM, Corso PS, eds. Prevention effectiveness: a guide to decision analysis and economic evaluation. 2nd ed. New York: Oxford University Press, 2003:11–27.

covered and non-covered. Although decision makers need to consider the relevance of the perspective to their own situations, they also need to appreciate the societal perspective so that they can assess the full consequences of decisions. For example, if an employer wants to determine whether to provide reimbursement for vaccination as an employee benefit and a program to encourage employees to be vaccinated, the employer's perspective would obviously be a significant consideration, since the organization's net profit might be affected. Costs would include healthcare system and provider charges reimbursed by the employer as well as productivity losses due to employees' absence from work. However, as a corporate citizen, the employer may also be interested in the societal perspective: does this program provide good value from the perspective of the general population by enhancing the health and attractiveness of the local community? From the societal perspective, all costs and benefits would be taken into account, regardless of who pays or who receives them. By considering multiple perspectives, the employer has a better understanding of a program's overall financial impact.

The time frame of an economic study is also important in interpreting economic findings. The *time frame* is the period during which the intervention or treatment is delivered along with any necessary follow-up. In contrast, the *analytic horizon* (or *time horizon*) refers to the entire period during which the costs and benefits are measured. If all the important results of an intervention can be measured in the short term, then the analytic horizon will be short. For most prevention programs, the analytic horizon should be sufficient to assess all of the benefits of the program. However, it is important to note that health effects may be realized long after the intervention has concluded and may span a person's lifetime. For example, consider a tobacco cessation program. With such a program, the time frame during which the intervention is delivered may be relatively short, possibly one year or less. However, the analytic horizon would include the lifetime of the (former) smoker to account for the period over which the benefits of reducing tobacco-related illnesses (e.g., cancer or heart disease) are realized. The value of the benefits that accrue during the analytic horizon must be included in the economic analysis.

Additional Considerations

Decision makers should also consider the current prevalence of risk factors, the nature and scale of the intervention at start-up versus maintenance phase, the target population, and the setting in which the intervention was delivered. The prevalence of risk factors has economic implications. For example, a mass media smoking cessation intervention aimed at a large population will have both higher costs and greater potential benefits in settings

with high smoking prevalence than a telephone smoking cessation counseling intervention. A program may have high intervention costs, but through economies of scale, the cost per person of the program might be less than if it were aimed at a smaller population. In addition, costs may vary by geographic region, which could also affect the applicability of an economic evaluation. Decision makers should consider all of these factors, which affect the costs of interventions and the potential returns on investments. Other factors to consider include the feasibility of implementing an intervention, the acceptability of the intervention to a population, ethical and political concerns, and regulatory and legal issues.[3]

Limitations of Economic Evaluations

The usefulness of economic findings may be limited by aspects of the methods of economic evaluation. One issue is the various methods for measuring costs and benefits. The lack of one standardized method of measurement may limit the comparability of studies. Significant progress in this area has recently been made with the publication of several books that provide guidelines for conducting economic evaluations of health care,[6,7,10] public health programs,[4] and HIV prevention.[11]

Another issue is the highly variable quality of published economic evaluations. Such variation in quality was apparent in assessing economic evidence associated with most interventions. For example, when we reviewed economic evaluations of vaccine programs in schools, one evaluation, which received a "very good" quality score, reported quantities and costs of resources attributable to personnel, communications, transportation, advertising, overhead, follow-up, supplies, medication, diagnostic procedures, outpatient services, and disease complications, all from a societal perspective. This study also calculated income lost due to illness and death. The summary measures were reported as cost per life-year saved and cost per child vaccinated. In comparison, a second study failed to specify the study perspective, did not report quantities of resources separately from resource prices, omitted volunteer time, and neglected to discount future costs and outcomes. The resulting "unsatisfactory" quality score led to its exclusion from the overall review of the intervention. To improve quality, checklists have been developed to assess adherence of an economic evaluation to specific quality standards.[12] *The Community Guide* uses a quality assessment scale (on p. 31 at www.thecommunityguide.org/methods/econ-abs-form.pdf) to determine if studies meet minimum quality requirements for inclusion in a review. This scale also identifies areas of deficiencies in study quality.

Specific economic measures also raise concerns about appropriate interpretations. For example, important limitations of CE ratios have been de-

scribed.[4] These ratios sometimes indicate that an intervention is both more costly and more effective than comparable interventions. For example, the most cost-effective approach to hepatitis B vaccination (in terms of cost per case prevented) might be vaccination of selected healthcare workers. However, that would have only a minor impact on the overall burden of hepatitis B. Universal newborn vaccination may have a higher cost per case prevented, but it prevents many more cases. In such cases, decisions have to be made about the reallocation of resources away from another program. However, CE ratios do not provide information on the opportunity costs of such decisions.[13] Many researchers also question the appropriateness of different types of health-related quality-of-life measures that are used in CUA. Some measures are based on general improvements in health, and others are based on disease-specific health improvements.[14–17] Such differences can make it impractical to compare one QALY with another. Therefore, prior to making comparisons between prevention strategies targeting different diseases or health problems, the decision maker should be aware of the methodology used to derive the QALYs.

A challenge in the greater use of economic evaluation to support decisions is the continued debate about what represents *good economic value.*[18–20] Differences in study perspective and methodology can greatly affect study results. Therefore, a judgment about the relative economic value of an intervention requires the economic evaluation of other interventions by similar methods, but such evaluations are not usually available. Finally, economic evaluations can present challenging ethical issues, such as equity concerns: Who "wins" and who "loses" in an economic evaluation? Does a particular economic evaluation favor the concerns of the younger members of a population at the expense of the elderly?[21] Another area of concern is that health values (preferences) are generally elicited from a small segment of a population and may not be representative of the population as a whole.[22] Attempts are made to address these challenges and concerns through the derivation and use of QALYs. However, the success of these attempts may be considered subjective.

GAPS IN THE ECONOMIC DATA ABOUT PREVENTIVE SERVICES

We conduct systematic reviews of economic data in the hope of providing useful summaries for decision makers. However, we frequently find that no economic evaluations are available for interventions recommended by the Task Force (economic evidence was available for only about half of the interventions recommended by the Task Force as of February 2004, and the available evidence was frequently just a single study).[23] These gaps in our knowledge are created because so few studies exist, and available studies

often do not fit the intervention recommended by the Task Force or do not meet the quality requirements for inclusion in the review.

Evidence gaps can also be seen in a positive light. Because interventions chosen for Task Force review address important health issues, evidence gaps guide the research agenda for future economic evaluations of public health prevention programs.

SUMMARY OF ECONOMIC EVALUATION IN PUBLIC HEALTH DECISION MAKING

There is a great deal of interest in determining the economic impact of health promotion and disease prevention.[24] Despite the inconsistencies in the methods employed in many published, peer-reviewed economic evaluation studies to date, researchers have applied methods of economic evaluation to virtually all areas of public health.[25,26] As the number of economic studies has increased over time, the opportunity to summarize and compare economic information to inform public health decision making has increased as well. One of the goals of the *Community Guide* is to help decision makers and other stakeholders to use resources wisely through careful assessment of the value of public health prevention interventions. Economic evaluations provide explicit descriptions of the costs and consequences of different courses of action in public health. They also provide a framework for thinking about costs, benefits, and the *structure* of a decision. Although these evaluations have limitations that need to be assessed carefully, they are nonetheless a useful tool for public health decision making. Systematic reviews of economic evaluations contribute to that goal by summarizing a body of economic evidence, adjusting economic data to facilitate study comparisons, raising awareness of the limitations and applicability of the existing evidence, and guiding a research agenda for future economic evaluations of public health prevention programs. By summarizing and interpreting economic studies, systematic reviews make economic information available in a more useful and accessible form. The real value of economic information is that it can improve the efficiency of public health programs, furthering the public health mission by making the greatest possible improvement in the health of a population using available resources.

Glossary

Analytic horizon The period of time after an intervention ends, during which costs and outcomes accrue and are measured.

Cost analysis (CA) An economic evaluation technique that involves the systematic collection, categorization, and analysis of program costs.

Cost–benefit analysis (CBA) An analysis that compares both costs and benefits in dollar terms.

Cost–effectiveness analysis (CEA) An analysis used to compare the cost of alternative interventions that produce a common health effect.

Cost–utility analysis (CUA) A type of cost– effectiveness analysis that uses years of life saved combined with quality of life during those years as a health outcome measure.

Costs The value of resources (people, buildings, equipment, and supplies) used to produce a good or service.

Economic costs The value of resources, including opportunity costs, often used to compare alternative interventions.

Final outcomes The ultimate outcome of interest, such as diseases averted or years of life saved.

Financial costs The actual dollar costs for services, typically the actual costs of care.

Intermediate outcomes The near-term effects of a policy, program, or intervention, such as persons screened or cases prevented.

Opportunity costs The value of the alternatives given up in order to use the resource as the program so chooses.

Perspective The viewpoint of the bearers of the costs and benefits of an intervention (e.g., society, government, healthcare providers, business, or clients).

Productivity loss Costs associated with the decrease in production and income attributable to a disease, disability, or death.

Time frame The period during which the intervention or treatment is delivered, including any follow-up.

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