

MATERNAL AND CHILD HEALTH SERVICES
ECONOMICS IN MCH

VOLUME 1

An Introduction to Economic Analysis for MCH Practitioners

Division of Science, Education and Analysis
Maternal and Child Health Bureau, HRSA, PHS, DHHS
Parklawn Building
5600 Fishers Lane
Rockville, Maryland 20857



Abstract

Maternal and child health agencies on the state and local levels are increasingly under pressure to demonstrate the value of their services. Federal and state funding agencies are requiring increased accountability for public funds, and the rise of managed care places increased emphasis on cost containment and the provision of cost-effective services. These challenges encompass economic questions, which require specific types of economic analyses. This report is intended to help the MCH community, many of whom have little formal training in economics, to understand and use the tools of economic analysis. Not a “how-to” manual, the report is intended to explain how economic analysis can help MCH decision-makers to be better program designers and managers. By describing in clear terms the various types of economic analysis that can be of use to MCH officials and presenting examples of the ways each type of analysis can be applied, this report can help MCH professionals to think about and use economic information. Specifically, this report should help readers to identify the types of economic analyses that they need to use to address specific problems or situations, to read and understand the economic information presented in the public health literature, and to evaluate economic analyses commissioned by MCH agencies. This report is the first in a series on economics and MCH developed under the auspices of the Maternal and Child Health Bureau’s Division of Science, Education, and Analysis.

ECONOMICS IN MCH

Volume 1:

An Introduction to Economic Analysis for MCH Practitioners

Prepared by:

Renee Schwalberg, MPH
MCH Information Resource Center
Washington, DC

Norma Gavin, Ph.D.
Research Triangle Institute
Research Triangle Park, North Carolina

Russ Scarato
Chief Economist
Division of Science, Education, and Analysis
Maternal and Child Health Bureau

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I. Introduction and Overview

Maternal and child health agencies on the state and local levels are increasingly under pressure to demonstrate the value of their services. When planning programs, evaluating services, justifying budgets, and negotiating with managed care organizations, MCH officials must constantly confront basic economic questions, such as:

- How much does a program or service cost?
- Should we spend our money on one program or on another?
- Will we save money in the long run if we provide preventive services now? How much might we save?

These questions arise in a number of contexts. On the state level, MCH agencies are required to report annually on how they spend Title V Maternal and Child Health Block Grant funds and to base these funding decisions on the results of needs assessment studies. The Federal Government Performance and Results Act has placed increased pressure on agencies receiving Federal funds to account for the use of those resources. In addition, many states have begun to pass increased responsibility for funding decisions to the local level, and local health departments and community-based organizations are increasingly serving as providers of Title V-funded services. These arrangements require, first, that state officials be able to allocate funds to services and to communities based on the cost of those services and the level of need in each community. In addition, local organizations must themselves be accountable for the use of Title V funds; they must be able to demonstrate how these funds were used and, ideally, what outcomes were produced by their programs.

Finally, efforts to contain costs within the health care system have placed health expenditures within both the public and the private sectors under increased scrutiny. State Medicaid agencies and private-sector insurance purchasers are increasingly using managed care strategies to control the cost of their programs. Managed care organizations, in turn, look to the economic literature to demonstrate the cost-effectiveness of individual services. Therefore, MCH agencies, particularly those that provide services that are unlikely to be included in standard

medical benefit packages, are under pressure to show that their services will produce both positive health outcomes and economic returns if managed care plans are to contract with them.

All these challenges, which MCH and other public health officials confront every day, encompass economic questions that require specific types of economic analyses. Although economics is not an area in which many MCH professionals have much experience or training, familiarity with economic concepts has become increasingly necessary in their daily lives.

This document is the first in a series developed by the MCHB Division of Science, Education, and Analysis to help MCH professionals to understand and use economic analysis. Not a “how-to” manual, this report is intended to explain how economic analysis can help MCH decision-makers be better program designers and managers. By describing in clear terms the various types of economic analysis that can be of use to MCH officials and presenting examples of the ways each type of analysis can be applied, this report can help MCH professionals to think about and use economic information. Specifically, this report should help readers to identify the types of economic analyses that they need to use to address specific problems or situations, to read and understand the economic information presented in the public health literature, and to evaluate economic analyses commissioned by MCH agencies. Future volumes in this series will include a synthesis of what the literature says about the cost-effectiveness of selected MCH services and several analyses of the costs and cost-effectiveness of specific MCH programs.

This document is organized in the following manner: Chapter II provides a basic introduction to economic analysis, including examples of economic analyses of MCH programs and services. Chapter III describes the key challenges in conducting economic analyses, and Chapter IV gives an overview of the process of conducting these analyses. Finally, Chapter V presents a number of issues to consider when reading reports of economic analyses or when considering doing such an analysis yourself.

II. What is Economic Analysis?

Economic analysis means many things. We will focus on two types of economic analyses.

First, these analyses can look at the economic impact of health programs or of health conditions; for example, they may analyze the *costs* of a health program or a health condition. In addition, some types of economic analyses compare programs' costs to their *outcomes*. These outcomes may be measured in terms of economic benefits (that is, dollars saved) or health benefits (such as cases of infectious disease prevented or years of life gained). This chapter answers some basic questions about these types of economic analysis and their usefulness.

A. What Questions Can Economic Analysis Answer?

Economic analysis techniques can be used to answer several different types of questions, such as:

- How much does a program cost? How much would it cost to expand a program?
- What is the cost to society of a specific illness or health condition? Or, to put it another way, what is the cost to society of *failing to prevent* illnesses or health conditions?
- Will investing in a service now save money in the long run? When can we expect to see these savings, and who will benefit from them?
- Of several alternative programs, which will give the greatest return on our investment, in health benefits or in dollars saved?

Each of these questions requires a different type of economic analysis.

B. What are the Types of Economic Analysis?

Several economic tools are available to answer these questions. These tools can be divided into two main categories: descriptive analyses and economic evaluations. Descriptive analyses focus on *describing and documenting* the costs and/or outcomes of a single intervention or program; that is, they answer questions like “what does it cost?” In contrast, economic evaluations

compare the costs and/or outcomes of two or more alternative interventions or programs; they answer questions like “which is a better deal?”

The specific types of analyses within each of these categories are described below.

1. Descriptive Analyses: What Does It Cost?

Descriptive studies simply provide documentation about the cost of a single program, intervention, or health condition. They also can describe a program’s outcome. The specific types of descriptive studies available to MCH officials are:

- **Cost Description: What does it cost?** Cost description studies can be used to determine the cost of a health problem, a health strategy, or a health outcome. These are described further below.
 - *Studies that describe the cost of MCH problems* are typically used to highlight the importance of these problems to State and local legislators and other MCH decision makers.¹ Some examples in the MCH literature include studies that provide estimates of the costs of teenage childbearing (Burt, 1986; Santelli, et al., 1990; and Reis, 1987), the cost of a measles epidemic that arose from failure to immunize (Dales, et al., 1993), and the cost of cases of low birth weight that are attributable to smoking (Li, et al., 1994).
 - *Studies that describe the costs of MCH strategies* are used to estimate the potential budget impact of a policy, program, or intervention that is being considered for funding or to monitor the costs of programs that have been implemented. An example of the former is Torres and Kenney’s (1989) analysis of the costs of expanding Medicaid coverage for pregnant women.
 - *Studies that describe the cost of one or more MCH outcomes* look at the dollar value of the outcomes of a program or intervention. These studies are useful in reevaluating policies that have been proposed or implemented, aiding in the renewal application of a program, or assessing whether an intervention should be more universally adopted. Examples of such studies are the analysis by Evans, et al., (1993) of the costs to state and local

¹ This type of study includes what are often referred to as *cost of illness* or *burden of illness* studies. However, because some conditions of concern to MCH, such as pregnancy, are not “illnesses,” this label is not always appropriate and will not be used here.

Example:
Cost Description of an MCH Problem

Dales and colleagues investigated the costs of direct medical care and epidemic control activities resulting from the 1988-1990 outbreak of measles in California. The California measles epidemic of 1988-1990 was the worst in the state in more than a decade, with 16,400 reported cases, 3,390 hospital admissions, and 75 deaths. A disproportionate share of the cases were among infants and low-income Hispanic communities in southern and central California. Low immunization levels are blamed for the severity of the outbreak. Dales et al. (1993) estimated the costs of medical care from the epidemic using gross-costing techniques—applying average hospital costs obtained from a Los Angeles County survey to all measles hospitalizations during the outbreak and assuming one outpatient visit per infected individual at an average cost per visit of \$80. The costs of epidemic control activities included the costs of the additional vaccines provided, the extra staffing for special clinics, and the immunization clinic expansion. Total expenditures for direct medical care and outbreak control activities were conservatively estimated at \$30.9 million. This figure does not include indirect costs such as lost income and productivity by working adults who become ill or who missed work to care for ill children, the 75 persons who died, or staff diverted from other activities in local health departments and medical care facilities to help in epidemic control.

Dales LG, Kizer KW, Rutherford GW, Pertowski CA, Waterman SH, and Woodford G. (1993). Measles epidemic from failure to immunize. *Western Journal of Medicine*, 159, 455-64.

governments of the increase in births resulting from the Medicaid abortion funding ban, and a study by Olds, et al., (1993) in which the authors estimated the effect on government spending for AFDC, Food Stamps, Medicaid, and Child Protective Services of a prenatal and infancy nurse home visitation program in a randomized controlled trial in New York State in the late 1970s.

- **Cost-Outcome Description: What does it cost, and what are the results?**
This type of study describes both the outcomes and the costs of a single intervention or program. The outcomes may or may not be described in monetary terms. One example is a 1990 analysis of a model smoking cessation program for pregnant women. The costs of several outcomes were measured, including the cost per low birth weight (LBW) birth prevented, per death prevented, and per life-year gained. In addition, total program costs, net savings in neonatal intensive care unit use and from disability among surviving LBW infants, and a benefit-to-cost ratio were computed (Marks et al., 1990).

2. Economic Evaluations: Which is a Better Deal?

In contrast to descriptive studies, evaluative studies compare the costs and/or outcomes of two or more programs or interventions. These studies, therefore, can provide crucial information to help policymakers decide between alternative interventions or funding alternative programs.

These types of studies include:

- **Cost Analysis: How do the costs compare?** First, you may simply want to compare the costs of alternative interventions or programs. That is, this is simply a cost description study extended to two or more programs, using the same cost assumptions so that the results may be compared. The two programs' costs are examined without regard to their efficacy or effectiveness; the efficacy or effectiveness of the different alternatives may be the same, or they may vary, or they may be unknown. For example, the director of an immunization program may want to know how much her agency spends on public education to promote immunization compared to the amount spent on vaccines.
- **Cost-Minimization Analysis: Which costs less to get the same results?** If you are comparing two equally effective programs, you may want to know which provides its results for the lower cost. This model simply identifies and estimates all costs for each system or intervention under analysis, generally with the objective of identifying the cheaper option. This kind of direct comparison can only be made when the two options are equally effective.
- **Cost-Effectiveness Analysis: Which costs less per unit of outcome?** It is more likely that you will need to compare two or more interventions that have different costs and different levels of effectiveness. For this type of study, you will need to identify a single clear, measurable unit of program effectiveness that can be applied to all of the interventions being studied, such as unintended pregnancies prevented or years of life gained. To compare the cost-effectiveness of two programs, the difference in their total costs is divided by the difference in the two programs' outcomes to produce a *cost effectiveness ratio*, a measure of the additional cost per additional unit of outcome for the more effective program.
- **Cost-Utility Analysis: Which do people prefer?** Frequently, a health program may have more than one measurable outcome. Some of these outcomes may be more important to the programs' clients than others, and the outcomes of different programs may be valued differently by their users. Cost-utility analysis takes into account how the intervention's users rank its various outcomes, including quality of life. To do this, weights are assigned to the different outcomes to reflect their relative importance. The difference in the programs' weighted benefits is then compared to the difference in program cost to produce a measure of additional "utility" per additional dollar spent.

Example:
Cost-Effectiveness Analysis of Alternative Strategies

Windsor et al. (1988) conducted a cost-effectiveness analysis for program decision makers, providers, and managed care organizations to determine the most cost-effective method among three different strategies to decrease smoking among pregnant women. Three hundred and nine pregnant smokers presenting for their first prenatal care visit at three clinics were randomized to receive one of three smoking cessation interventions. All women were given standard clinic information and advice to quit. Women randomized to group 1 were given no additional smoking cessation treatment, women in group 2 were given the American Lung Association's manual, "Freedom from Smoking in 20 Days," and women randomized to group 3 were given a targeted manual called "A Pregnant Woman's Self-Help Guide to Quit Smoking". Only the costs of personnel and materials for administering the intervention were considered. Cost effectiveness was measured per smoker who quit during pregnancy. Quit rates by the end of pregnancy were 2 percent for group 1, 6 percent for group 2 and 14 percent for group 3. The method used for group 3, although the most expensive, was the most cost-effective, achieving smoking cessation at less than half the cost experienced by the other two groups.

Windsor RA, Warner KE, Cutter GR. (1988). A cost-effectiveness analysis of self-help smoking cessation methods for pregnant women. *Public Health Reports* 103, 83-88.

- **Cost-Benefit Analysis: Which will save the most money?** In a cost-benefit analysis, both the cost of the intervention and its outcomes are put in dollar terms; the result of the analysis is the net economic effect (net costs or net savings) of the program. This may be the most appropriate approach when an intervention has multiple benefits, if those benefits can be assigned dollar values, as it offers a way to combine diverse benefits. However, remember that cost-benefit analyses can be done *only* when the outcomes of the program can be put in dollar terms.

Example:
Cost-Benefit Analysis of Alternative Strategies

For another trial of smoking cessation interventions for pregnant women, Ershoff et al. (1990) conducted a cost-benefit analysis directed at program decision makers, providers, and managed care organizations to determine whether the savings in medical charges for newborn care associated with the initial hospitalization outweighed the cost of adding a self-help smoking cessation program as a standard component of prenatal care. All pregnant smokers presenting for their first prenatal visit at one of five health centers were given a two-page pamphlet on the hazards of cigarette smoking during pregnancy and the importance of quitting. A health educator reinforced the written information in a two-minute discussion. Subjects randomized to the experimental group of the trial were then given a serialized smoking cessation program oriented to women and pregnancy. The series consisted of eight 4- to 8-page booklets, the first of which was distributed at the prenatal intake conference and the remaining seven were mailed thereafter at weekly intervals. Controls received no further intervention. The direct costs of the intervention were the incremental costs for overhead, personnel time, materials, and postage in providing the self-help program. The benefits were measured as the neonatal institutional and professional payments associated with delivery for three birth outcome categories (pre-term, intrauterine growth retardation, and other). The average costs for each outcome were then multiplied by the incidence rate of the birth outcomes and summed for each group. The sums were then subtracted to get the incremental benefits of the self-help program. The total intervention cost of \$1,939 for the 165 experimental group women exposed to the self-help program was found to have a net benefit of \$3,489 and a benefit-cost ratio of 2.8:1.

Ershoff, DH, Quinn VP, Mullen PD, Lairson DR. (1990). Pregnancy and medical cost outcomes of a self-help prenatal smoking cessation program in a HMO. *Public Health Reports* 105(4):340-347.

To help compare the various types of economic analyses, Table 1 shows a number of common objectives of MCH agencies, the types of economic analyses that can help to meet these objectives, and examples from the literature of analyses that address these issues.

Table 1. Types of Economic Analyses, by Objective		
<i>Objectives</i>	<i>Study type</i>	<i>Examples</i>
Valuing problems Calculating the costs of the consequences of a single health condition (without regard to the existence, costs, and/or effects of intervention strategies).	Cost description	Low birth weight attributable to smoking Li, Windsor, and Hassan (1994) Access to obstetric care in rural areas Nesbitt et al (1990) Teenage childbearing Burt (1986); Santelli et al (1990); Reis (1987) Immunizable childhood diseases Dales et al (1993)
Prioritizing problems Estimating and comparing the costs of more than one problem or condition to decide how to allocate resources.	Cost minimization, Cost-effectiveness, Cost-benefit, and Cost-utility	Development of new vaccines National Academy of Sciences (1985)
Valuing strategies Estimating the direct costs of implementing a single strategy against the status quo or current practice without regard to outcomes.	Cost description	Expanding Medicaid coverage for pregnant women Torres and Kenney (1989) Enhanced adolescent counseling, perinatal addiction treatment, and case management services Wolff and Helminiak (forthcoming)

Table 1. (cont.) Types of Economic Analyses, by Objective		
<i>Objectives</i>	<i>Study type</i>	<i>Examples</i>
Valuing outcomes Estimating the costs of one or more outcomes of a single strategy against the status quo or current practice.	Cost description, Cost-effectiveness, Cost-benefit, and Cost-utility	Medicaid abortion funding ban Evans et al (1993) Prenatal and infancy nurse home visitation Olds et al (1993) Maternity care coordination Buescher et al (1991) Smoking cessation programs for pregnant women Marks et al (1990)
Prioritizing strategies Comparing the costs and effects of different strategies in order to determine where to allocate resources	Cost minimization, Cost-effectiveness, Cost-benefit, and Cost-utility	Strategies to reduce infant mortality Joyce et al (1988)
Monitoring resource use As in valuing strategies, estimating the cost of a program after implementation	Cost description	

III. Key Challenges in Conducting Economic Analyses

As may be evident by this point, economic analysis can become pretty complicated. Even in the simplest economic study, the analyst faces some difficult questions and important pitfalls. This chapter summarizes a few of the most potentially treacherous issues that come up in the design of an economic analysis.

A. Identifying and Measuring Costs

“Cost” may seem like a straightforward concept, and in general it is—it can be defined as what must be given up to acquire or produce something. However, this general idea comprises many components, some of which are easy to conceptualize and estimate and others that are much more difficult to understand.

When thinking about cost, a common mistake is to look at cost too narrowly, missing important elements of the total cost of a program or of a health condition. Breaking the broad concept of “cost” into its individual components helps to assure that no important elements are left out of the analysis. A thorough analysis of the total cost of a health program or condition should include the following:

- **Direct cost.** This is the cost of materials and labor that go directly into implementing an intervention or treating the symptoms of a health condition. These costs include the costs of supplies, use of specialized equipment, and professionals’ time or salaries.²
- **Indirect cost.** This term describes costs that flow from a program or condition but do not directly relate to implementation or treatment. These costs might include the costs of lost productivity due to illness or death, or the cost of treating secondary conditions caused by a health condition or by the intervention. For example, an indirect cost of a screening program for tuberculosis may include the cost of treating cases of TB identified by the screens.

² One element of direct cost is *overhead cost*. This is the cost of all resources other than materials or labor—such as rent, utilities, and administrative services—that go into implementing an intervention or treating a health condition. These costs are often referred to in the accounting literature as “indirect costs”; note that this is not how this term is used in the cost-effectiveness literature.

Sometimes information is readily available to help to estimate the level of these costs. In other cases, assigning a dollar value to specific resources or benefits is more difficult. Two specific kinds of costs can present a particular challenge:

- **Non-market resources.** These costs, also known as “opportunity costs,” include the costs of a volunteer time and the costs of donated goods and services. The resource cost of volunteer time would equal the wages the volunteers could have earned if they had been working elsewhere. These kinds of costs are easy to overlook, because they represent resources that appear to the user to be free; however, remember that these resources have value to the provider, and cost should represent what someone *gives up*. Thus, that copier that was donated to the clinic actually “costs” the donor the amount he could have received if he had sold it.
- **Intangible cost.** This is the human cost, such as pain or suffering, incurred as a result of the implementation of an program or the existence of a health condition. Unlike direct costs, these costs are generally quite difficult to quantify in dollar terms. Units of pain, for example, are very difficult to define or measure, particularly since a unit of pain for one person may not be equivalent to a unit of pain for another person. However, even if dollar values cannot be assigned to them, any cost analysis should take these costs into account, or at least acknowledge that they exist.

It is important not to confuse any of these types of cost with the *price* of a service. The price, or the charge, is the amount paid, at the agreement of both buyer and seller, for the use of a given resource. Price is rarely the same as cost; for example, in valuing services financed by Medicaid, the actual value of a provider’s time (to the provider) is the service’s *cost*, while the Medicaid reimbursement rate is its *price*.

**Example:
Identifying and Measuring Costs**

A mass immunization campaign similar to those used in developing countries was undertaken in New York City in 1993. A Child Immunization Day (CID) was planned and conducted with the goals of increasing immunization coverage of children under five, with special emphasis on children up to age two. Fairbrother and DuMont (1995) conducted a cost-effectiveness analysis of the event. A semi-structured interview of key members of the planning group and Steering Committee was used to gather information with which to estimate costs. This information was supplemented by an examination of financial records for the event from various agencies.

Interviewees were asked to identify the numbers and types of individuals that contributed to planning and staffing the CID (i.e., event planners, outreach coordinators, physicians, pediatric nurse associates, public health nurses, public health assistants, and custodial and security personnel) and the number of hours each group of individuals contributed to the effort. Hourly wages plus fringe benefits were calculated from the financial records. Total labor costs were increased by 10.15 percent to account for overhead costs. Other itemized costs included expenses for clinic supplies, a special hot line at the Department of Youth Services, publicity, refreshments and educational materials, and the cost of vaccine.

The total estimated cost of the CID was \$822,073, with only \$95,043 of this amount attributable to the vaccines. A major element of the costs was for event planners and outreach coordinators.

The event was not as successful as hoped; only 829 children—less than 1 percent of the targeted group—were immunized. CID's cost was \$279 per immunized child whereas, the authors reported, it costs between \$75 to \$115 per visit to immunize a child at a health clinic. However, the authors did not evaluate whether the program reached children who would otherwise not have been immunized and, if it did, the degree of cost savings from averted morbidity and mortality among these children.

Fairbrother G and DuMont KA. (1995). New York City's 1993 Child Immunization Day: Planning, Costs, and Results. *American Journal of Public Health*, 85, 1662-5.

B. Measuring Outcomes

The next problem an analyst faces is in identifying and measuring the outcomes, or results, of an intervention. The first thing to remember about outcomes is that they can't be analyzed if they aren't known. That is, you can do cost-effectiveness studies of a program only if, first, the program has been shown to be effective and, second, if those effects can be defined and

measured. Therefore, the first challenge in doing economic analysis of many MCH services is in finding concrete evidence of those services' effectiveness.

The second challenge comes in measuring those effects. In general, outcomes are defined as the direct health consequences, positive or negative, of an intervention on the targeted population. These outcomes can be measured in the specific terms of a program or strategy, such as the number of cases of infectious disease prevented by an immunization program. As long as all of the strategies being analyzed share this outcome measure, this type of measure may suffice. However, you may want to be able to measure *different* kinds of outcomes using a common unit, so that different outcomes of a strategy can be summed to produce a measure of total outcome, or so that programs with different outcomes can be compared.

Two major approaches to quantifying outcomes using a common measure are *net savings*, which measures both inputs and outcomes in dollar terms, and *Quality-Adjusted Life Years* (QALYs), a measure of outcomes. These are described below.

- **Net Savings.** This represents the net benefit, in dollar terms, of all inputs and outcomes associated with an intervention. (That is, the benefits minus the costs.) The advantage of measuring outcome in dollar terms is that it allows for the direct comparison of benefits and costs.
- **QALYs.** This represents a measure of the change in the quality and quantity of life of persons affected by a given intervention. The health-related quality of life of children can be evaluated by parents, teachers, or by the children themselves. Several tools are available to measure children's quality of life, including the Health Utilities Index Mark 2, the Pediatric Asthma Quality of Life Questionnaire, and the Feeling Thermometer. For example, the Health Utilities Index Mark 2 has been used to measure the dimensions of emotion, pain, and self-care for children with cancer (Trudel, et al., 1998). One major advantage of using QALYs as a measure of the effectiveness of an intervention is that it avoids the controversy surrounding the assignment of a dollar value to lives saved.

A final challenge in defining and measuring outcomes comes in the question of how far in the future to look for these outcomes to happen. Many programs, particularly prevention programs, do not expect to show results until many years after the initial intervention. Our analyses will therefore have to account for this time lag between the expenditure and the ultimate benefit. We will discuss this problem further below.

Example:
Measuring Outcomes in Terms of QALYs

As part of a randomized controlled trial of an HIV-prevention intervention for high-risk women, researchers conducted a cost-utility analysis of the program, which offered training to enrolled women in skills such as condom use, problem-solving, assertiveness in sexual situations, self-management, and peer support. The program had been shown to increase the likelihood of condom use compared to a comparison group of similar women who did not receive the intervention; this study examined the cost of the program per Quality Adjusted Life Year (QALY) saved through HIV prevention.

The researchers estimated (1) the total societal cost of the intervention, (2) the number of HIV infections averted and QALYs saved based on the program's behavioral effects, and (3) the estimated cost per QALY. The cost of the program included the salaries and fringe benefits for the group facilitators and their supervisors, materials (condoms), client incentives, overhead costs (calculated as a percentage of materials and labor costs), and the cost of transportation and child care during sessions, which were borne by the clients themselves. The total program cost was estimated to be \$26,914, or \$269 per client. Mathematical models were used to estimate the number of HIV infections averted and the number of QALYs saved per infection averted. These models produced estimates of 0.38 infections averted and 7.64 QALYs saved per prevented case.

The cost-utility ratio was calculated as the net program cost (that is, the total intervention cost minus the savings in treatment costs for the HIV cases averted) divided by the total benefit of the program, measured in QALYS (that is, the number of cases averted multiplied by the number of QALYs saved per case averted). This calculation produced a cost-utility ratio of \$2,024 per QALY saved.

The researchers concluded that this result was within the range that is generally considered to be cost-effective. Sensitivity analyses were used to test many of the assumptions used in the cost-utility model, and all produced results within this range, leading to the conclusion that the intervention is likely to be cost-effective and may even be cost-saving.

Holtgrave, DR and Kelly, JA. (1996). Preventing HIV/AIDS among high-risk urban women: the cost-effectiveness of a behavioral group intervention. *American Journal of Public Health*, 86, 1442-45.

C. Expressing Results

After defining the measures of cost and outcome, the analyst must then determine how to express the final results of the analysis. The cost of a health program may be summarized in two ways. One is the *total resource cost*—the sum of all direct, overhead, indirect, and

intangible costs incurred as a result of the implementation of an intervention or the existence and treatment of a health condition.

A more useful number, however, may be not the *total* cost but the *cost per unit of output*. The “unit of output” is the basic measure of a positive outcome resulting from an intervention.

There are generally three different ways to measure cost per unit of output:

- **Average cost.** This is the most straightforward of the three types of unit cost. It is simply the total resource cost divided by the total number of units of output. The average cost is appropriate only for examining the cost of a single program or intervention; it should not be used to compare two or more programs.
- **Marginal cost.** This is the added cost of producing one additional unit of output by increasing activity under the current intervention strategy. Marginal cost uses the economic concept that the additional cost of producing the last unit of output will not be exactly the same as the additional cost that was incurred when the next to last unit of output was produced, and so forth. This measure is useful, for instance, when the study in question is examining the value of expanding an existing program.
- **Incremental cost.** This measure is relevant only when comparing the costs of two or more alternative intervention strategies. It is based on the assumption that, if policymakers are planning to implement one of a number of alternative strategies, then they are definitely prepared to pay something. In this situation, the cost figure to be concerned about is, for each alternative, the *additional* cost above that minimum cost alternative. The incremental cost of an intervention, therefore, is that intervention’s cost over and above the cost of the least expensive alternative (or whatever is currently in place).

**Example:
Costs per Unit Outcome**

Marks et al. (1990) computed the associated cost per unit outcome for a hypothetical smoking cessation program using different outcome measures, including the program cost per low-birthweight (LBW) birth averted, per perinatal death prevented, and per year of life gained. They also compared estimated program costs to the estimated cost savings from short- and long-term health care costs for LBW births prevented and computed the associated benefit-to-cost ratios.

The authors estimated that a program that would reach all 783,510 female smokers early in their pregnancy and enable 15 percent of them to quit would cost \$23,404,300 and would prevent about 5,876 LBW births at a cost of \$4,000 per LBW birth prevented. They also estimated that such a program would prevent about 338 perinatal deaths a year and cost an estimated \$69,542 per death prevented. With a life expectancy of 75 years per additional survivor, discounted at 4 percent, the costs would be \$2,934 per year of life gained.

The authors also estimated that if the program were available to all pregnant women who smoke, the net savings in NICU hospitalization costs would total more than \$77,807,054 and would save \$3.31 for every \$1 spent on the program. An additional \$76,858,080 in long-term costs, or \$3.26 per \$1 spent on smoking cessation programs, would be averted by preventing disability among LBW infants who survive, for a total benefit-to-cost ratio of 6.6:1.

Marks JS, Koplan JP, Hague C, Dalmat ME. (1990). Cost-benefit/cost-effectiveness analysis of smoking cessation for pregnant women. *American Journal of Preventive Medicine*, 6, 282-289.

D. Setting Time Frames

As we mentioned earlier, one of the major challenges of analyzing prevention programs comes in assigning values to benefits that we expect to gain in the future. Mathematically, this can be done through the use of a *discount rate*. Simply put, this concept reflects the fact that money that we have now is worth more than money we expect to receive in the future—not only because of inflation, but also because if we receive money now, we could invest it and its value would grow. Thus, when we postpone receiving economic benefits (or incurring costs), we must *discount* the future value of these benefits or costs before we can compare them with amounts spent today. For example, we may estimate that a prevention program will produce

\$10,000 in savings one year from now. To compare this figure meaningfully with the cost of the intervention, it must be *discounted*; that is, we must calculate the value today (also called the “present value”) of the \$10,000 we expect to receive one year from now. The tool used to discount future costs and benefits, and thus convert them to present value terms, is called the *discount rate*. A variety of rates have been justified depending on the analysis design, among them market interest rates and the marginal productivity of investment. As a point of reference, the CDC in *Prevention Effectiveness* recommends discount rates of 3 to 5 percent (after adjustment for inflation) (Haddix, 1996). Thus, in our example, if we use a 5- percent discount rate, we calculate that the \$10,000 we expect to receive next year is worth \$9,524 today (because increasing \$9,524 by 5 percent produces \$10,000) and the \$10,000 we expect to receive in two years is worth \$9,070 today.³ This calculation is displayed below.

Sample Calculations of Present Value Based on a Discount Rate of 5 Percent	
<i>If the benefit will be received in one year:</i>	<i>If the benefit will be received in two years:</i>
$10,000 = ? \times 1.05$	$10,000 = ? \times 1.05 \times 1.05$
$10,000 / 1.05 = ?$	$10,000 / (1.05)^2 = ?$
$10,000 / 1.05 = 9,523.81$	$10,000 / (1.05)^2 = 9,070.29$

Benefits that will be received farther in the future would be discounted more deeply. In addition, of course, dollar figures based on different years must be adjusted for inflation; standard inflation factors, such as the Consumer Price Index or the Medical Consumer Price Index, can be used for this purpose.

E. Choosing and Maintaining a Perspective

One crucial question to ask when thinking about an economic analysis is what the *perspective* of the analysis will be. That is, when we think about the cost of a program or a health condition, we have to ask *whose* costs we are going to consider. A simple example is the case of

³ \$10,000 discounted one year is computed by dividing 10,000 by (1+r), where r is the discount rate.
\$10,000 discounted n years is computed by dividing 10,000 by (1+r)ⁿ.

adolescent childbearing. A cost analysis of the problem of teen motherhood from the perspective of the health care system would consider only the medical costs (in prenatal care, delivery, and neonatal and postpartum care) associated with adolescent births. An analysis from the societal perspective may be more relevant, however, because it would take into account the broader costs across all systems that touch teen mothers. These may include the cost of the social services they receive as well as the opportunity costs of lost wages due to the reduced earning power that results from early motherhood.

When an analysis compares costs and outcomes, it is important that the same perspective be taken in all aspects of the analysis.

F. Dealing with Uncertainty

Estimates of incidence, prevalence, costs, and diagnosis and treatment effectiveness used in economic analyses are frequently based on imprecise data, educated guesses, or a sample of cases. Complete information is unlikely to be available for many important elements of these studies, such as the costs of lost productivity associated with illness or the exact number of infant deaths averted through a SIDS prevention campaign. Therefore, many important numbers that form the basis of any economic analysis are likely to be estimated based on available data, and are therefore subject to uncertainty.

These estimates may be relatively straightforward and easy to support—such as the value of an hour of a nurse’s time—or they may be more complex and subject to error—such as the proportion of teen pregnancies that could be averted by abstinence education. Therefore, a good analysis will include a test for the effect of errors in these assumptions. These tests are known as *sensitivity analyses*. This technique will be discussed further in the next chapter.

Example: Dealing with Uncertainty

In 1988, the U.S. Congressional Office of Technology Assessment conducted a cost-benefit analysis to determine the how many low birth weight (LBW) births would need to be averted for an expansion of Medicaid prenatal care benefits to pay for itself (i.e., the break-even costs). Costs were estimated as the expenditures for additional prenatal care visits that would result from expanding Medicaid coverage. To assess savings, the authors used three types of expenditures: the additional expenditures on initial hospitalization for LBW babies compared to normal weight babies, the likelihood and cost of rehospitalization during a LBW infant's first year of life, and the cost of long-term health care for early intervention, special education, and institutional or foster care for LBW children (adjusted for the net present value of these future expenditures).

To value these costs, the authors used estimates from large data files and the literature. The estimated average fee for a prenatal care visit was taken from a 1986 survey of physician fees. The increased expenditures for the initial hospitalization were estimated from the average 1986 hospital expenditures for newborn care by birthweight category in Maryland; the authors added an additional 10 to 20 percent for the costs of physician visits to newborns in the hospital. For the cost of rehospitalizations in the first year of life, they used estimates of the number of extra hospital days used by LBW infants and multiplied this number by the national average daily expenditures for a hospital stay in 1986. Long-term health care estimates were based on services received by severely and moderately mentally retarded people in the U.S.; the estimated expenditures on these services came from various published studies.

Because of the great uncertainty in these cost estimates, the authors conducted sensitivity analyses. They obtained high and low estimates for three key assumptions:

- **The additional cost of initial hospitalizations for LBW babies.** The range of estimates varied based on the assumptions regarding the length of stay and the percentage of total hospital expenditures used to estimate physician costs.
- **Long-term health care expenditures.** The range of estimates varied based on different assumptions regarding the percentage of children institutionalized from age five to 35, the percentage receiving foster care from age five to 20, and the costs of early intervention from birth to age three.
- **The discount rate.** Two factors were used to estimate the present value of future costs: 7 percent was used for the low estimate of costs and 4 percent for the high estimate.

The resulting estimates of short- and long-term savings in health care costs associated with the prevention of each LBW birth ranged from \$14,000 to \$30,000.

The authors concluded that the expansion of Medicaid eligibility to all pregnant women in poverty would cause an additional 18.5 percent of women in this category to initiate prenatal care in the first trimester of pregnancy. Nationally, the extra prenatal care would cost about \$4 million per year. Because the estimated costs averted from LBW births were so great, they concluded that prenatal care would need to have only marginal effects on the LBW rate to be justified on cost grounds alone.

Congress of the United States. Office of Technology Assessment. (1988). *Healthy Children: Investing in the Future*. OTA-H-345. Washington, DC: U.S. Government Printing Office.

G. In Search of Data

Finally, do not underestimate the challenge and importance of gathering data. All the analyses described here will require access to a variety of types of data—data on program costs, on the number and characteristics of people served by health programs, on the effectiveness of interventions, and on the expected cost of health conditions. The ability to conduct a thorough and accurate economic analysis will depend on the availability of timely, useful data.

Numerous sources of data may be available to MCH programs in conducting these analyses. It is unlikely that all the necessary data will be available in one place. Several potential data sources are described below.

- **Results of surveys, focus groups, and time studies.** Although these sources are unlikely to be the main source of data, it may be necessary to collect primary data on a program or intervention’s costs or outcomes. This might include conducting time/motion studies to determine the proportion of time that clinic staff devote to a specific program or surveying program clients to identify and quantify the effects of a service.
- **Medicaid data.** To the extent that economic analyses focus on the cost of services provided to low-income or disabled populations, data on expenditures for these services may be estimated using Medicaid data. The advantage of databases of Medicaid claims is that they usually represent a substantial enough population from which to generalize about the level of service use and expenditure. In addition, the existence of a standard Medicaid reimbursement schedule provides standard prices for services. However, Medicaid databases have two main disadvantages. First, they are generally large, complex data sets and may require an analyst with considerable skill and experience to derive meaningful information from them. In addition, these data are not always easily accessible to MCH officials. In addition, the introduction of Medicaid managed care in many states may make Medicaid claims databases considerably less accessible. Managed care organizations under contract with state Medicaid agencies are generally required to submit data on each service (or each “encounter”) that they provide to their Medicaid enrollees; however, in many states these databases are still under development and may not be consistent or accessible outside of the Medicaid agency.
- **Vital records.** State vital statistics data can provide a wealth of demographic and health information about infants and women who give birth in each state. In addition to information about the number of births in various demographic and geographic categories, birth certificate data can provide information on maternal

and infant risk factors and congenital anomalies in infants. In addition to birth certificates, of course, state vital records offices also maintain databases of death certificates, which can provide information on the rate of infant and child deaths from various causes.

- **Budget information from MCH programs.** An initial step in calculating the costs of MCH programs will, of course, involve assessment of the program's budget. While this will not necessarily provide information about all of the costs of a program or intervention, it will provide crucial information about the program's direct costs. In addition to information about existing MCH programs, budget information can be used to estimate the expected costs of a proposed intervention, by using the direct costs of similar program elements (such as nurses' salaries or the cost of comparable supplies).
- **Administrative data from other programs, such as WIC, disease registries, Community Health Centers.** In addition to MCH budget information, other sources of state-level data are likely to exist. These may include budget data from other programs that serve MCH populations (such as WIC and TANF), which can provide information on expenditures on social, support, or nutrition services; registries of birth defects or other reportable conditions, which can provide state-level prevalence data; or local providers, such as Community Health Centers or local health departments, who may be the ones implementing MCH programs and can provide information on their operating costs.
- **National survey data.** In addition to information available from state programs or agencies, important information can be derived from national surveys. Although these data sources may not provide information about any individual state, they may provide national or regional data; in some cases, this information may be applied with some demographic adjustment to the state or sub-state level. These surveys include the following:
 - *Current Population Survey (March supplement).* Each year, the U.S. Census Bureau conducts a population-based sample survey of households in each state, asking questions about household demographics, income, employment, and health insurance status. This survey can be an important source of information on the types of insurance coverage of children and families at different income levels. State-level information is available from this survey, although the sample size may be too small to produce meaningful results in small demographic categories.
 - *National Health Interview Survey.* This is a national survey conducted by the National Center for Health Statistics on health conditions and the use of health services among children and adults. Although it does not provide state-level data, it is an invaluable source for prevalence estimates for specific conditions that can be adjusted for the state's demographics.

- *Medical Expenditure Panel Survey*. This survey, conducted jointly by the Agency for Health Care Policy and Research and the National Center for Health Statistics, includes information on health insurance, the use of health services, and expenditures for services. This can be a useful source of information on the estimated price of services where local estimates are unavailable; however, this too is a national, not a state-level, survey.
- **Hospital discharge data.** State-level hospital discharge databases can provide important information on the procedure and diagnosis codes, length of stay, source of payment, and hospital charges associated with each hospital stay. Again, these charges do not represent the actual cost of the services; however, the Federal government publishes an annual table of conversion factors (known as “cost-to-charge ratios”) for urban and rural areas of each state that allow hospital costs to be estimated from charges (Haddix, et al., 1996).
- **The health services research literature.** When beginning any economic analysis, it is important to consult the literature for previous findings that may be relevant to the question being analyzed. Specifically, the research literature can be used to provide standard, supportable estimates of the efficacy and effectiveness of specific services. For example, previous research can provide estimates of the proportion of cases of SIDS that can be prevented through social marketing campaigns on infant sleeping position.

In devising a data collection strategy for any economic analysis, a balance must be struck between the use of secondary data (which may provide estimates that are directly applicable to the local environment) and collecting primary data (which is expensive and time-consuming). In general, it is most sensible to use only those primary data that an agency can gather inexpensively (such as a time study to determine the proportion of time devoted to a service), relying on state- or national-level secondary data and results from the literature for other estimates.

IV. The Process of Economic Analysis

Now that we have reviewed the basics of economic analysis, we can turn to a more detailed discussion of the basic steps involved in conducting these studies. Although this overview does not necessarily provide the tools to conduct an economic analysis, it should provide an understanding of the steps involved in the design of an economic analysis, which will help you to critically review analyses in the literature as well as to assist in the development of a new

analytic effort. (Of course, an actual economic study will rarely proceed in an orderly, sequential fashion; nonetheless, it is useful to see these methodological elements laid out in a linear way to understand all of the various decisions that go into such an analysis.) The steps presented here are adapted from the work of the Centers for Disease Control and Prevention (Haddix et al., 1996). To help illustrate these steps, we have developed hypothetical situation that provides an example of how each step might be applied to a real-world MCH problem.

1. Define the Audience

The first step in any economic analysis is identifying the primary users of the analysis and determining how the results of the analysis will be used. This is important so that the analysis can be targeted to the information needs and objectives of the target audience. For example, an audience of MCH professionals may be interested in a combination of the costs and expected outcomes of specific programs and interventions; legislators may want to know the impact of the investment of public funds and their potential for savings to public programs over the long and the short terms; and an audience of managed care organizations may be interested primarily in the short-term economic impact of specific services, particularly in their effect on medical costs. This is a critical step in the design of an economic analysis, as the study's audience will help to determine both the objectives and the design of the study.

When the audience for an analysis is primarily made up of MCH program administrators, it is essential that the analysis be targeted to provide the information they need for program planning and decision-making. This is addressed in the next step, Defining the Question.

Example: Defining the Audience

A state MCH Director is considering developing an economic analysis of efforts to prevent the transmission of sexually transmitted diseases (STDs) in adolescents. Deciding who will be the target audience for this analysis, she comes up with three choices, each of which will require a different type of analysis:

<i>Audience</i>	<i>Issue to be Analyzed</i>
MCH program planners	The relative cost-effectiveness of different prevention programs
State policymakers	The long-term cost savings to public programs produced by each program
Managed care organizations	Short-term costs and savings attributable to medical interventions

2. Define the Question

The second step in designing an economic analysis is determining the specific question that the analysis is to answer. This will help to identify the most appropriate economic analysis technique.

The study question will depend on the purpose of the economic analysis. A study conducted as part of a problem analysis, for example, may focus on the costs (to the health care system or to society as a whole) of a particular health problem or condition. An analysis conducted to support the identification or selection of health interventions may be concerned with the total cost of the intervention or with comparing the potential costs and outcomes of two or more possible interventions. The example below presents a range of these types of questions and the analytic strategies that are required by each.

Example: Defining the Question

The MCH Director chooses to target her analysis toward the audience of state policymakers. She is then faced with the task of determining the specific question she wants her analysis to answer and, thus, the approach her analysis will use. Some of her choices are listed below.

<i>Question</i>	<i>Analytic Approach</i>
What are the costs of sexually transmitted diseases (STDs) in youths?	Cost description of problem (including cost of screening, treatment, follow-up, contact tracing, and the cost of infertility and pelvic inflammatory disease later in life)
What are the costs of outreach activities in school-based clinics?	Cost description of interventions (for program design and implementation)
What were the costs of the outreach program in the public schools in 1997?	Cost description of interventions (for program monitoring)
What are the costs of outreach activities in school-based clinics per case of STD prevented?	Cost description of outcome using cost-effectiveness ratio
What is the incremental savings per dollar spent on outreach activities in school-based clinics?	Cost description of outcome using benefit-cost ratio
Which is the most cost-effective approach to preventing STDs in youth: outreach activities in school-based clinics, general media campaigns aimed at youth, or condom distribution programs?	Cost-effectiveness evaluation
What is the break-even level of spending for outreach activities in school-based clinics?	Decision analysis with cost-benefit model

3. Define Alternative Strategies

The next step is to define the precise program(s) or intervention(s) to be analyzed. A cost description of a problem may involve no programs or interventions, while an economic evaluation will have two or more programs or interventions. In such studies, the specific strategies to be evaluated must be defined. In addition, all the alternatives being evaluated must be compared to one of the alternatives, to maintaining the status quo, or to the option of doing

nothing at all. This program or intervention is known as the *baseline comparator*. The number of strategies that may be included in any one analysis will be limited by three major factors:

- The question posed;
- The amount of time and money available for the evaluation; and
- The availability of cost and effectiveness data for the strategies identified.

The list of alternative strategies should include all reasonable, feasible options that are appropriate for answering the question at hand, as well as the baseline comparator. For each strategy, the following information is needed:

- The cost of the intervention;
- An understanding of the target population for the intervention;
- Knowledge of the delivery system to be used to implement the strategy; and
- If the evaluation compares the effectiveness or economic benefits of the interventions, information on these outcomes.

The interventions being compared may differ in important ways. For example, interventions may differ in their frequency (e.g., a screening intervention can be conducted once, every year, every other year), in the ages and types of individuals targeted, or in their delivery systems. For example, a recent cost-effectiveness analysis of efforts to prevent Hepatitis B infection compared interventions targeted to three different populations: pregnant women, newborns, and adolescents (Margolis, et al., 1995).

The information needed to describe each alternative intervention will also be required for the baseline comparator. However, the status quo may not consist of a single, clearly defined approach; in many cases, it is a mixture of different approaches or interventions. In these cases, this mixture of interventions may be used as a single comparator, each intervention may be used as a separate comparator, or the new intervention may be compared to the best of the approaches currently used. Alternatively, the baseline scenario may be that no program at all is implemented.

Example: Defining Alternative Strategies

The MCH Director has received extra funding and can expand one of three strategies:

- Outreach activities in school-based clinics;
- General media campaigns aimed at youth; or
- Condom distribution programs.

Because all three strategies are currently being implemented in various communities, the baseline comparator is continuing to implement all three initiatives.

4. Define the Perspective

The “perspective” of the analysis reflects the source of the *resources* evaluated in the analysis, including both the costs and the benefits to be analyzed. Examples of different types of perspectives include:

- **The societal perspective.** This is the broadest perspective and is therefore the most appropriate for cost-effectiveness, cost-benefit, and cost-utility analyses. It includes all the costs and benefits of a program in both the public and the private sectors. The benefits of a program may continue to be felt far into the future; using the societal perspective, these long-term benefits should be estimated and included in the analysis. An example of an analysis from the societal perspective may be an analysis of the total cost of adolescent childbearing, including direct health care costs and the cost of lost wages to the teen mother.
- **The health care system perspective.** Slightly narrower than the societal perspective, the health care system perspective takes into account the implications of an intervention only for public- and private-sector health care expenditures. For MCH interventions, this will mean disregarding the impact of programs on the education system, the foster care system, the juvenile courts, and other programs that affect children and families. An analysis of the cost impact of preterm birth may take the health care system perspective and examine the costs of complicated deliveries and neonatal care for preterm infants.
- **The public-sector perspective.** Policymakers may be interested in the impact of a health program specifically on public-sector expenditures. Therefore, only public-sector costs and benefits would be included in the cost analysis. These costs and benefits can cross program or agency lines; expenditures for the WIC program, for example, may be balanced against benefits to the Medicaid

program. However, because state and local agencies typically do not borrow or lend money for long periods of time, usually only short-term benefits are examined from this perspective.

- **A specific program perspective.** A specific health program or agency, such as a Title V MCH agency, may be interested in the impact of a program on its budget alone. This perspective is narrower than the public-sector perspective, since a program-specific perspective only evaluates the impact of a program investment on that program's resources.
- **The provider or payer perspective.** Alternatively, a private-sector provider or payer, such as a managed care organization, may be interested in the implications of a program or service on its patients' or members' well-being and their related expenditures. Because of the rapid rate of turnover in managed care enrollment, short-term benefits are likely to be of greatest interest from this perspective.
- **The individual perspective.** Finally, a study can take the perspective of the individual consumer or user of services, balancing the cost of using a service (in inconvenience, out-of-pocket expenditures, and lost wages) with the projected benefits or costs of the condition avoided.

The perspective of an analysis may coincide with the intended audience for the study, but the two may not be the same. For example, although government agencies or policymakers may be interested only in the impact of public-sector investments, a broad, societal perspective may also be appropriate for this audience, as their ultimate responsibility is for the well-being of society as a whole.

The choice of perspective will affect the types of costs included in the analysis. From a broad, societal perspective, all types of costs should be included in the analysis: *direct program cost* to government agencies, providers, and consumers (in out-of-pocket costs, travel expenses, etc.) as well as *indirect costs* due to lost wages or premature death. Economic benefits, if they are included in the analysis, will be similarly broad, including the economic value of years of life gained, disabilities averted, and program costs saved. Other, narrower perspectives may evaluate only direct program costs and benefits. The types of costs that should be included in each perspective are summarized in Table 2. Most economic analysts agree (and Haddix et al. recommend) that a broad, societal perspective is the appropriate one for most cost evaluations; this perspective provides consistency in the manner that economic and clinical outcomes are typically expressed because it takes all costs into account.

Carrying out an economic analysis from more than one perspective may add valuable information for policymakers. Performing the analysis under multiple perspectives not only tests the robustness of findings but also provides information on the costs to the various decision makers, thereby identifying potential implementation and/or compliance problems.

Example: Defining the Perspective

The MCH Director can choose to evaluate these three initiatives from a number of perspectives. For example:

The societal perspective (evaluating the long-term effects of the interventions on prevention of STDs, prevention of infertility, and prevention of unplanned pregnancy)

The perspective of the health care system (evaluating the effects of each intervention on the use of screening, follow-up, and treatment services and the need for future treatment for sequelae of STDs, in the public and private sectors)

The perspective of public-sector programs (evaluating the effects of each intervention on public-sector expenditures for health and social services)

The MCH Director chooses the societal perspective, with a particular focus on the effects of the intervention on the health care system.

5. Define the Time Frame and Analytic Horizon

The next step is to determine the time period over which the interventions will be evaluated. This involves two components: the time period over which the *interventions are provided* (known as the time frame) and the period over which *benefits are expected to accrue* (known as the analytic horizon). In MCH, the specification of an analytic horizon is especially complex, since benefits of many MCH prevention services may accrue far into the future; however, the longer the analytic horizon is, the more difficult it is to estimate the economic benefits of these services and to attribute positive outcomes directly to a specific intervention.

The time frame and analytic horizon also depend on the perspective of the analysis. Cost analyses from the societal perspective typically include the discounted present value of costs and savings in future years. However, government agencies cannot generally borrow or lend funds

across budget years, and insurance policies are typically written for a limited time period, frequently a single year. In these cases, costs beyond the current budget period are either not relevant, and therefore are excluded, or are more heavily discounted. Table 2 below summarizes the types of costs and time horizons for the different perspectives discussed under Step 5.

Table 2. Alternative Perspectives for Cost Analyses and the Related Cost Components and Analytic Horizon						
	Society	Health Care System	Public Sector	Payer	Provider	Patient
Cost Components						
Direct health care costs	X	X	X	X	X	X
Direct personal costs	X					X
Direct non-health costs	X		X			X
Indirect costs	X					X
Intangible costs	X					X
Analytic Horizon						
Future generations	X					
Patient's lifetime						X
Budget period		X	X	X	X	

Example: Defining the Time Frame and Analytic Horizon

The MCH Director chooses to examine these interventions over a time frame of one year. The analytic horizon, since this analysis will take the societal perspective, will extend over the lifetimes of the teens who are reached by the programs. The analysis from the perspective of the health care system will examine the effects of the programs over a one-year budget period.

6. Select an Analytic Method

At this point, there is enough information with which to select the specific analytic method to be used in identifying, measuring, valuing, and comparing the costs and consequences of the MCH intervention strategies that are being implemented. As described earlier, each method provides different information to fulfill different needs; therefore, the selection of a method will depend heavily on the decisions made in the previous steps.

It is possible and sometimes desirable to employ more than one method in a single study, as different analyses provide different types of information. For example, Margolis, et al., (1995) use both cost-effectiveness and cost-benefit methods to evaluate different strategies for preventing Hepatitis B Virus (HBV) transmission. The cost-effectiveness analyses allowed the analysts to calculate, for each strategy, the costs incurred per year of life saved and the costs incurred per chronic HBV infection prevented, and while the cost-benefit analysis provided estimates of the net cost-savings in medical and work-loss costs for each alternative strategy. This calculation of several different measures provided more information with which to compare and evaluate the alternative strategies than a single measure would.

Example: Selecting an Analytic Method

Because several interventions are being compared, the MCH Director chooses to conduct a cost-effectiveness study comparing the three strategies. To evaluate the effects of these interventions on future health care costs, she chooses to include cost-benefit analyses in the study plan as well. The study will therefore evaluate the following:

Cost per case of STD avoided for each intervention (cost-effectiveness analysis)

Cost savings per adolescent reached by each intervention (cost-benefit analysis)

7. Estimate Costs

Estimation of the cost of providing an intervention forms the heart of an economic analysis. On the surface, cost estimation may seem relatively straightforward—each program probably has an allocated budget, and it may be reasonable to expect that this budget provides much of the information needed about the cost of implementing the intervention. However, as the earlier

discussion of the economic perspective on costs implied, the development of cost estimates for an economic analysis may be complex, since several types of costs are involved in the analysis.

The process of cost estimation seeks to arrive at a measure of the number of dollars that must be devoted to a particular program or intervention to “produce” one unit of a given desirable outcome. This cost per unit measure is calculated through the following three basic steps:

- **Identifying the sources of intervention costs.** The goal of this first component is to identify all the categories of resources that were expended to carry out the intervention. From the discussion of costs in the previous chapter, recall that this is likely to involve much more than budgeted staff time and supplies; it will also include overhead costs (such as the portion of rent and utilities attributable to the intervention); opportunity cost (such as forgone productivity due to lost work time); and other indirect costs (such as the cost of treating conditions identified by a screening program).
 - Remember that the breadth of these cost categories will be determined by the perspective of the analysis. In an analysis from the MCH program perspective, for example, only the direct and indirect costs to MCH programs will be included, while an analysis from the societal perspective will also take into account costs to the education system, the juvenile justice system, the welfare system, etc.
- **Measuring the utilization of resources.** Once the sources of intervention costs have been identified, the next stage is to quantify, for each resource category, the number of units of that resource that were used in implementing the intervention. The complexity in this step comes in defining the unit of measurement for each resource category, and in accurately estimating the number of units of each resource expended specifically on the intervention in question.
- **Valuing the unit and total cost of resources.** The last piece of information needed to calculate resource cost is the unit cost of each resource. This is rarely completely straightforward; for example, the value of a nurse’s time may vary according to geographic area, level of experience, and employer, so you may need to calculate a workable average figure. As we discussed earlier, the assignment of dollar values to indirect or intangible costs may be even more complex.
 - Once estimates of the number of units employed and the cost per unit for each identified resource have been developed, the resource costs for each individual resource can be directly calculated by multiplying these two figures as follows:

$$\text{Resource cost for a given category} = (\# \text{ Units}) \times (\text{Unit Cost})$$

- Summing the resource costs for all resource categories employed in the intervention then yields the total resource cost for the intervention. Once an estimate is made of the number of units of the relevant outcome that have been “produced” by the intervention, the cost per unit of output for the intervention can be calculated as the total resource cost divided by the number of outcome units “produced:”

$$\text{Cost per unit of output} = (\text{Total Cost}) \div (\# \text{ Units})$$

Of course, perfect information is unlikely to be available for all the elements of cost in each of these steps. The need to develop accurate estimates of all aspects of the cost of an intervention must be balanced against the time and budget available for analysis activities. In addition, also various technical issues influence the estimation process, including:

- **How finely to break down resource categories and unit costs.** In general, two approaches are available to estimate resource costs. One approach, called *micro-costing*, requires the analyst to list and assign a value to each individual resource consumed by a program or intervention. This can be costly and difficult. The alternative, called *gross-costing*, groups cost items into larger categories to ease the task of estimation. This approach may be less precise, but it is also less expensive and often more feasible.
- **What discount rate should be used.** As discussed in Chapter II, economic studies with analytic horizons of more than a year must take into account both the changing value of money (inflation) and its opportunity cost (the amount sacrificed by not investing funds). The *discount rate* is intended to account for the second of these problems: the amount that could be gained had resources been invested. The actual amount of the rate, therefore, will depend on the analysts’s assumptions about the amount an investment could have earned.
- **How to express unit costs.** The cost per unit of output can be calculated as either *average costs* or *marginal costs*. The key point to note in this decision is that, when comparing the costs of two or more interventions, costs of each intervention must be of comparable type, whichever that type may be.

While a detailed discussion of the considerations guiding these decisions is beyond the scope of this paper, it is important to note that these decisions must be carefully thought through by the analyst and explicitly stated in the analysis report.

Example: Estimating Costs

To analyze the costs of the three interventions to prevent transmission of STDs in adolescents—outreach in school-based health centers (SBHCs), media campaigns, and condom distribution—the MCH Director and her economic analyst decide to compare the *average* cost of each intervention.

Because this analysis compares three interventions, the *incremental* costs of the three programs will be compared. That is, the cost per unit of each of the three strategies will be calculated and the differences among them compared.

Examples of the types of cost categories to be analyzed for each of the three interventions include:

<i>Type of Cost</i>	<i>Outreach in SBHCs</i>	<i>Media Campaigns</i>	<i>Condom Distribution</i>
Direct Cost	Salaries of outreach staff; portion of rent and supplies attributable to this program	Cost of development of marketing materials; paid air time, billboards, etc.	Supplies; cost of developing promotional materials
Indirect Cost	Cost of treating conditions found during outreach visits	Value of donated air time, billboards, etc.	Political unpopularity

In addition to estimating the cost of each intervention, the cost-benefit analysis requires an estimate of the costs saved by preventing the transmission of STDs. This will require our analyst to estimate the following:

- The expected average cost of treating chlamydia, syphilis, gonorrhea, and HIV (the average cost of treating each case of these diseases times the probability of their occurrence under each alternative)
- The lifetime cost of the sequelae of untreated STDs, such as ectopic pregnancy, infertility, and AIDS

8. Identify the Health Outcomes of Interest

The next step in the design of an economic analysis is the identification of the specific outcomes that will be measured and included in the analysis. The selection of a set of outcome measures will be one factor in determining the type of study being conducted, as the different study designs require different types of outcome measures. Examples include:

- **Cost-effectiveness analysis.** These analyses require that outcome measures for all strategies be based on a single health effect. For example, the cost-effectiveness of prenatal HIV testing and prenatal HIV counseling can be analyzed in terms of the number of cases of perinatal HIV transmission avoided.

- **Cost-utility analysis.** These analyses take into account both the objective outcome and the subjective value of that outcome to the beneficiary. For example, the outcome measure in a cost-utility analysis would include not only years of life gained, but also improvements in the quality of that life.
- **Cost-benefit analysis.** In this type of analysis, both the cost and the benefit of an intervention are presented in dollar terms and compared. Thus, only those outcomes that can be valued in economic terms can be included. For example, the cost of providing prenatal care can be compared to the cost of providing neonatal care to a premature infant. The hardest part of a cost-benefit analysis is assigning dollar values to non-monetary benefits, such as pregnancies or cases of disease averted or lives saved.

In some cases, information about the final outcome of an intervention may not be available. In these instances, *intermediate outcomes* may be identified and included in the analysis. For example, a public information campaign to encourage the use of bicycle helmets may have as its intended final outcome the prevention of head injuries. However, analysts may not know how many head injuries were prevented as a result of the campaign. Instead, they may be able to use an intermediate outcome measure such as the number of children who report that they use helmets or the number of helmets sold in the community during a given month.

In other cases, the intended outcome may be a broad goal such as “the improvement of perinatal health.” To measure this outcome, multiple *indicators* will be needed to measure this overarching goal, such as rates of low birth weight, rates of preterm birth, or rates of perinatal mortality. Many newly-developed MCH indicators may be drawn upon for economic analyses (Peoples-Sheps, et al., 1996).

<i>Example: Identifying Outcomes</i>	
For each element of the analysis, the MCH Director selects the following outcomes:	
Cost-effectiveness analysis:	Cases of STD (chlamydia, gonorrhea, syphilis, HIV) prevented Cases of pelvic inflammatory disease (PID) prevented Cases of ectopic pregnancy prevented
Cost-benefit analysis:	The cost of treating each case of STD The cost of treating each case of PID The cost of treating each case of ectopic pregnancy

9. Identify Sources of Uncertainty

As we mentioned in the previous chapter, our lack of perfect information means that the estimates and assumptions used in these analyses will always have some uncertainty, as will the analyses' results. This uncertainty can be accounted for by the use of *sensitivity analyses*.

To conduct a sensitivity analysis, the analyst first identifies those estimates that are most likely to be subject to uncertainty. For these estimates, the analyst develops a range of estimates, including an upper and lower bound. The analytic model will then be recalculated using each of these extremes to test how much they affect the result of the analysis. If the final result does not change dramatically, the model is *insensitive* to the uncertainty in this estimate; if it changes significantly, the model is *sensitive* to this estimate. The importance of this estimate should then be clearly noted by the analyst.

Example: Identifying Sources of Uncertainty

The assumptions in this analysis that may need to be tested include:

- The number of adolescents that will be reached by a media campaign
- The proportion of STD cases that could be expected to be prevented by each intervention
- The discount rate applied to future economic benefits

10. Determine Summary Measures

The *summary measure* is the result of the analysis. Each type of analysis discussed here will produce a different type of summary measure. The examples below present the summary measures that each major type of analysis discussed here will produce.

- For a **cost description**, the summary measure is the net incremental cost of the illness or condition (above the cost of services used by a woman or child without the condition).
- For a **cost-effectiveness analysis**, the summary measure is an incremental cost-effectiveness ratio, which presents the additional cost of an intervention per unit of effectiveness gained. Thus, if the measure of effectiveness were years of life

saved, the incremental cost-effectiveness ratio would provide the additional cost per additional year of life saved by choosing one intervention over the other.

- For a **cost-utility analysis**, the summary measure is also a ratio, comparing the amount of investment needed to obtain one more quality-adjusted life year.
- For a **cost-benefit analysis**, the summary measure is a ratio that shows the number of dollars saved for each dollar spent on a given service.

Example: Determining Summary Measures

Our analysis has two parts: a cost-effectiveness analysis and a cost-benefit analysis.

For the cost-effectiveness analysis, our analyst will calculate incremental cost-effectiveness ratios by comparing the the costs and effectiveness of the interventions:

$$\frac{\text{Cost of program A} - \text{cost of program B}}{\text{Total cases of STDs prevented by program B} - \text{total cases of STDs prevented by program A}}$$

Total cases of STDs prevented by program B – total cases of STDs prevented by program A

For the cost-benefit analysis, our analyst will calculate incremental benefit-to-cost ratios for the three strategies:

$$\frac{\text{Cost savings of program A} - \text{cost savings of program B}}{\text{Cost of program B} - \text{cost of program A}}$$

Cost of program B – cost of program A

11. Determine Who Pays and Who Benefits

A final step in an economic analysis of MCH services is to assess the economic impact of health programs or conditions on the distribution of resources. By spending resources on specific programs or interventions and anticipating cost savings or other positive outcomes, each intervention is redistributing resources and utility from those who bear the program’s costs to those who receive its benefits. These distributional effects may cross program or agency lines; for example, cost-benefit analyses have shown that every dollar spent on the WIC program saves \$2.91 in infant medical costs (Buescher, *et al.*, 1993). However, these savings accrue not to the WIC program but to Medicaid, public health, and private-sector medical expenditures on behalf of pregnant women and infants. It is important that the study clearly identify these distributional effects.

Distributional effects may be different for each strategy. Therefore, information on the comparative distributional effects of different intervention strategies may play a role in deciding which of two strategies is preferred or more feasible.

Example: Determining Who Pays and Who Benefits

In this case, the costs and benefits of the three interventions center on the health care system. However, although the cost of the interventions come entirely from public-sector health care budgets, some of the benefits may accrue to private health insurers, as the teens reached by each of the three strategies may have private insurance.

The MCH Director may decide to analyze more closely the distribution of the economic benefits of these three interventions by attempting to estimate the proportion of those reached by each outreach strategy who are privately insured.

V. Things To Consider...

...When Reading an Economic Analysis

As the previous chapters should have made clear, the process of designing and conducting an economic analysis can be complex and involve a number of important decisions. It is our hope that, even if this introduction does not necessarily equip you to do such an analysis yourself, it will help you to be more a critical reader of the economic studies you see in the literature. Specifically, you will be able to ask a number of key questions as you read these studies:

- What question does this study try to answer?
- What study methodology is used? Is this the right one for the question?
- What perspective does the analysis take?
- What were the key assumptions the analysts used?

...When Planning an Economic Analysis

In the first chapter, we described the potential for economic analysis to answer a range of questions that MCH officials face. We have also discussed the importance, and the difficulty, of gathering data to support these analyses.

Given the critical importance of economic information in MCH planning and evaluation, one important step that state and local MCH officials can take is to plan to collect the data that will be needed to conduct these analyses. To do this, you can ask the following questions:

- **What can we do now?** Look at the data you have available about MCH programs and services. What cost data are available? What information do you have about the outcomes of programs and the value of their benefits? What analyses could you conduct with this information, and what additional information would you need?
- **What will we need to do in the future?** Next, think about the types of questions you might need to answer using economic analysis. If you can identify the types of data you would need to conduct these analyses and avenues to use to collect these data, you will be in a stronger position to conduct these analyses later.

This overview has, ideally, provided you with the basic tools to plan economic analyses of MCH programs and to critically read and understand economic analyses reported in the literature.

Volume II in this series will present a synthesis of what analysts have found in conducting cost-effectiveness, cost-benefit, and cost-utility studies of MCH services.

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