



THE PRACTITIONER'S GUIDE

to Cost-Effectiveness Analysis of Nutrition Interventions

written by
Patricia L. Splett, R.D., M.P.H., Ph.D.

for the
Maternal and Child Health Interorganizational Nutrition Group
(MCHING)

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Acknowledgments

The Maternal and Child Health Interorganizational Nutrition Group (MCHING) is a partnership of national professional and voluntary organizations and federal agencies committed to improving the nutrition status of mothers, children, and families. Its goals are to (1) develop and improve collaboration, communication, exchange of information, and working relationships among partner organizations and agencies; and (2) provide a forum for policy and program development and advocacy for nutrition services for these populations.

The project of developing a model to guide more studies on the cost-effectiveness of nutrition services was initiated by MCHING and its constituent organizations in 1994. Factors related to cost were recognized as especially important in decision making regarding new health care delivery systems for mothers and children. Cost-effectiveness analysis is one of many strategies initially identified at the 1990 national workshop, "Call to Action: Better Nutrition for Mothers, Children, and Families," to focus on promoting and improving nutritional health and well-being.

Participants at the April 1995 MCHING meeting engaged in a stimulating and critical discussion of the application of evaluation and cost-effectiveness analysis in practice settings. The important challenges, limitations, and opportunities they raised helped refine and focus the *Guide* as a useful tool for practitioners and organizations.

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I.

Introduction and Overview

Cost-effectiveness analysis, as defined in this *Guide*, is a systematic process of comparing the costs and outcomes of two or more competing alternatives for the purpose of making a decision that improves efficiency.

The *Practitioner's Guide* presents a tool for learning about cost-effectiveness analysis and for developing skills in planning and carrying out evaluations that assess the cost-effectiveness of competing alternatives. The purpose of this *Guide* is to make cost-effectiveness analysis achievable for any practitioner or student interested in the nutritional well-being of clients, patients, or program participants. The approach presented can be implemented in any setting where there is an interest in learning more about the effectiveness and the cost of nutrition-related activities.

The Practitioner's Guide is designed to provide you, the MCH practitioner, with:

- A general understanding of cost-effectiveness analysis;
- A step-by-step model for determining the cost-effectiveness of a nutrition intervention, program, or service; and

- Examples of cost-effectiveness analysis applied in the field of nutrition.

The content of the *Guide* was selected and organized to provide only the essential information for initiating cost-effectiveness analysis, using the perspective of the organization. Once this is mastered, practitioners will be prepared to expand to other methods and perspectives of economic analysis. Suggested resources are included for those interested in further exploring economic analysis.

Why do cost-effectiveness analysis?

- To impact the decision-making process
 - To develop awareness
 - To ensure the survival of nutrition programs
 - To promote accountability
-

Why Cost-Effectiveness Analysis?

When health and human service resources are scarce, as they are now, these resources must be carefully allocated to the activities and programs that have the highest potential for achieving important outcomes. Today, both practitioners and policymakers are asking the question: Are the

nutrition and health gains a reasonable return for the resources invested? By examining the amount or magnitude of outcome produced per unit of cost, cost-effectiveness analysis can provide the answer.

Impacting the decision-making process

Who is going to decide the best way to help people in your target audience or service population meet their nutrition and health needs? How will these decisions be made? Maternal and child health (MCH) practitioners must be informed participants in the decision-making process. Concrete information on the outcomes and costs of nutrition programs will be crucial in sorting out those programs that have the greatest impact on important nutrition needs, but do so at a reasonable cost or at a lower cost than competing intervention or program alternatives.

When MCH practitioners have actual data on expected outcomes and expected costs, not just for one program, but for a range of possible alternatives, then they can responsibly and convincingly impact the decision-making process. This decision making may happen within the nutrition unit, in the MCH program, across the organization, between organizations, or in legislative bodies.

Developing awareness

One important result of cost-effectiveness analysis is greater awareness among practitioners concerning the processes and related resource requirements of nutrition interventions and programs. This can help identify ways to streamline and improve the efficiency of program operations and improve the overall cost-effectiveness of the program. Section III will lay the groundwork for greater understanding of the process and costs of nutrition interventions, programs, and services.

Ensuring survival of nutrition programs

Not all practitioners take time to examine the outcomes of their programs and summarize them

for a year or other period of operation. In many settings, MCH practitioners focus on the success in enabling the individual client to achieve a clinical goal. Although this is important for the individual patient or client, it is not enough. To ensure the ongoing availability of nutrition services in maternal and child health, the survival of nutrition programs requires regular evaluation and good information on outcomes.

Program effectiveness must not be judged from the “best case” scenario; rather, it must be objectively determined from a systematic look at all participants who were referred, eligible, or enrolled in the program, or who received services. The effectiveness of the nutrition program is the aggregate effect over a complete range of clients (some highly motivated, others not so motivated; some with nutrition as a primary concern, others with many barriers or complications). Sections IV and V will expand the processes and issues in evaluating the effectiveness of nutrition interventions, programs, and services.

Promoting accountability

No matter how the analysis is approached, you as MCH practitioners must be accountable. You must have a thorough understanding of the resources required to operate effective programs, and must have evidence to show that nutrition programs do make a difference. Cost-effectiveness analysis can help meet accountability requirements.

The steps of determining costs and outcomes are not entirely new, nor do they need to be complex and difficult. The steps involved can build on those used in quality assurance initiatives in many organizations today, where total quality management (TQM) or continuous quality improvement (CQI) teams are charged with identifying opportunities for improving services.

Developing the Analytical Model

In 1977, the American Dietetic Association established a committee to develop a cost-benefit analysis protocol for nutrition care. The result culminated in the development of a model for potential economic benefits of nutritional counseling (Mason, 1979). That model remains valid today. During the same period, the Office of Technology Assessment (1982) directed work on the cost-effectiveness of medical technologies and defined 10 general principles for cost-effectiveness and cost-benefit analyses that examine costs and outcomes. Those principles are reflected in the model presented in the *Guide*.

Several reviews have summarized published reports on the costs, effectiveness, and methods of cost-benefit analysis and cost-effectiveness analysis of nutrition care (Mason, 1979; Disbrow, 1989; Splett, 1991; Barr, 1993). Each of these reviews pointed out the lack of reported evidence and challenged nutrition practitioners to collect and report data on the costs and outcomes of nutrition interventions and programs, and to do so following sound methodology. In recent years, the American Dietetic Association and several state dietetic associations have collected dietitians' reports of examples where cost savings resulted from nutrition intervention.

These reports present a picture of significant clinical and economic impacts resulting from nutrition intervention in a wide range of settings (Mathieu-Harris, 1994). However, case reports and anecdotes are just the beginning step in program evaluation and justification. Difficult decisions with far-reaching consequences should be based on a more comprehensive examination of nutrition programs. Considering the monumental changes being initiated by welfare and health care reform, it is now time to strengthen the information base related to the cost-effectiveness of nutrition interventions and programs, particularly those addressing the needs of the vulnerable maternal and child health population.

How to Use This Guide

This *Guide* is divided into eight sections. Sections I and II provide background information on cost-effectiveness analysis. If you are already familiar with these concepts, you may want to go on to Sections III, IV, and V—these sections focus on “how to” perform cost-effectiveness analysis. Section VI focuses on reporting results, once your cost-effectiveness analysis is complete. Section VII provides step-by-step illustrations and models for cost-effectiveness analysis. Section VIII discusses future challenges for nutritionists in performing cost-effectiveness analysis successfully.

Important points throughout the text are highlighted in the margin. Exhibits (in boxes) and examples (noted by italics) illustrate concepts described in the text. References, suggested resources, a checklist, and a glossary are also included.

Section II defines and describes the basic elements integral to cost-effective analysis. The nine elements include: (1) defining a clear *problem statement* or *evaluation objective*; (2) following specific guidelines for the *type of analysis* (in this case, cost-effective analysis); (3) determining the *perspective for analysis* (whose resources are at stake); (4) identifying two or more *program alternatives* for comparison; (5) determining one key *outcome* or *result* to be achieved by the intervention or program; (6) considering all *costs* involved (all resources consumed in the delivery of the intervention); (7) determining the *time horizon* or relevant period for implementation of the intervention and outcome measurements; (8) using *sound data* to estimate costs and outcomes; and (9) *summarizing findings and interpreting results*.

Section III explains how to calculate the costs of a nutrition intervention, using the cost analysis method. The *principal resources* or *cost components* involved in cost analysis are identified, and *time horizon* and *market price* concepts are discussed. Advanced elements in cost analysis, including sen-

sitivity analysis and discounting, are introduced in this section. *Discounting* is a procedure used to convert future costs and future outcomes to “present value,” or to convert data collected in different time periods to a standard base year. *Sensitivity analysis* is used to determine whether assumptions made in the analysis have affected the final conclusion.

This section also defines the three kinds of costs associated with economic analysis: *direct costs* (costs associated directly with the intervention or costs borne by the client), *indirect costs* (involving time and productivity), and *intangible costs* (such as pain and suffering). Cost analysis—the systematic process of quantifying costs—involves a series of seven activities, one of which involves methods of calculating costs. Costs can be calculated and reported as *full cost* (total cost of program over a period of time), *average cost* (cost per unit of outcome), *incremental cost* (cost of adding to an existing program), or *marginal cost* (the cost of doing a little more or less). Section III concludes with an example showing how a nutritionist might determine the cost analysis of prenatal nutrition services in a public health setting for a specified period of time.

Section IV defines and describes the key elements involved in determining outcome. These include: (1) clearly defining the *intervention* or treatment; (2) measuring *efficacy* or *effectiveness*; (3) determining the *criterion* against which success will be measured; (4) choosing an appropriate *target population*; (5) identifying possible *outcomes* of the intervention; (6) selecting an *indicator* to measure the outcome; (7) determining the relevant period or *time horizon* for the normal course of intervention; (8) preparing an evaluation *design*, and (9) using *sensitivity analysis* for assessing the impact of assumptions on the effectiveness of various interventions.

Section V explains how to evaluate the effectiveness of a nutrition intervention. This section tells how to define the *evaluation question* and identify

the *key outcome* and its *indicators*. It describes designing an evaluation so that equal attention is given to collecting data on the outcomes produced by each alternative under consideration. It discusses ensuring *scientific validity* and determining the study sample, including *sample size* and *sample selection*. Other variables, including *intervention variables*, *client characteristics*, and *intervening variables*, are also mentioned. This section discusses choosing *instrumentation*, the method used to measure outcomes and other important variables. Finally, *data collection* and *data analysis* are covered. Section V concludes with an example of effectiveness evaluation taken from a published study.

Section VI explains how to report results of a cost-effectiveness analysis so that the results are meaningful to the readers of the report. Possibilities include a full report, an executive summary, a *cost-effectiveness ratio*, an *array*, and other presentation styles.

Section VII ties the previous information together in a six-step process for planning a cost-effectiveness analysis of nutrition interventions. These steps include: (1) stating the objective of the analysis; (2) defining the framework for the analysis; (3) determining costs; (4) determining outcomes; (5) relating costs to outcomes; and (6) summarizing, interpreting, and reporting the findings.

Section VIII identifies future challenges for the nutrition community related to the cost-effectiveness analysis of nutrition interventions.

II.

Core Elements of Cost-Effectiveness Analysis

Cost-effectiveness analysis links costs and outcomes to determine the payoff of investing resources in a given course of action. A claim that a program or intervention is “cost-effective” can be made only in comparison to some other alternative for achieving the same outcome. Exhibit 1 provides an example of an appropriate cost-effectiveness claim.

Becoming familiar with the following nine elements and the specific definition of terms will help MCH practitioners understand economic evaluation and cost-effectiveness analysis. These elements are classified as core elements and must be understood before beginning any cost-effectiveness analysis. The advanced elements, including sensitivity analysis and discounting, will be discussed in the Cost and Outcome sections.

1. PROBLEM/EVALUATION OBJECTIVE.

What type of program or intervention options are under consideration? What are the nutrition and health aims of the intervention/program? Who needs the evaluation information? Answers to these questions help clarify the objective to be accomplished through the economic evaluation. Remember, the objective should be an unbiased determination of how to most efficiently use scarce resources for a specific purpose.

2. TYPE OF ANALYSIS. Cost-effectiveness analysis is one method of assessing options and making decisions, using the criterion of economic efficiency. There are several other types of economic analysis, including cost minimization, cost-benefit analysis, cost utility analysis, and clinical decision

Exhibit 1. Cost-Effectiveness Statement

“While the least expensive single interventions and the more costly multiple interventions were all highly effective in improving blood pressure control in low-risk patients, only the combinations of interventions were effective in improving control in the high-risk patients. This evidence suggests that targeting combinations of interventions to high-risk groups would improve the cost-effectiveness of multiple interventions.”

Cantor, JC, Morisky, DE, Green, LW, Levine, DM, Salkever, DS. Cost-Effectiveness of Educational Interventions to Improve Patient Outcomes in Blood Pressure Control. *Preventive Medicine*, 14:782–800, 1985.

Exhibit 2. Core Elements of Cost-Effectiveness Analysis

- Problem/Evaluation Objective
- Type of Analysis
- Perspective
- Alternatives
- Costs
- Outcomes
- Time Horizon
- Sound Data
- Results and Interpretation

analysis. All of these methods identify, quantify, and evaluate both the costs and the outcomes of alternative projects and help to inform decisions about initiating or expanding interventions or programs designed to achieve a desired outcome. MCH practitioners with limited experience in economic analysis should start with cost minimization and cost-effectiveness analysis. [The major methods of cost analysis are briefly defined in the Glossary of Terms.]

3. PERSPECTIVE. The perspective for analysis identifies those whose resources are at stake. The perspective influences which costs and which outcomes are most relevant to include in the analysis; therefore, the perspective for analysis is decided early when planning the evaluation. The perspective for analysis is selected based on the primary audience for the results. The perspective is selected from the following: the organization providing the nutrition program or service, the payer (e.g., third-party payer), patients, the health care sector, or society (taxpayers). This *Guide* focuses on the perspective of the provider organization.

4. ALTERNATIVES. Two or more alternatives must be identified for comparison. The point is to identify other alternatives that could be selected to

address the nutrition aims besides your program or the current way of doing things. All reasonable alternatives should be evaluated; however, at least two must be identified. Occasionally, a cost effectiveness analysis considers the costs and outcomes of choosing a specific alternative or doing nothing.

Example #1: Alternatives for supplementing the diet of low-income women during pregnancy might include the following: distribution of food commodities (CSFP), distribution of vitamin and mineral supplements, provision of vouchers for specific nutritious foods (WIC), provision of extra vouchers for any food (food stamps), or provision of an extra cash allowance to pregnant women (to be used for food). These alternatives vary greatly in cost and in their likely impact on the nutritional well-being of the pregnant woman and the infant.

Example #2: A WIC nutritionist might ask: Within our WIC program, is it more cost-effective to teach nutrition education on an individual basis or in a group setting? In this example, only two alternatives are under consideration.

5. COSTS. This element considers all resources that are consumed in the delivery of the intervention. The element of costs emphasizes resource requirements to put in place the intervention, which can then produce the desired outcomes. Costs can include direct costs to the health care system (such as personnel to provide the service), indirect costs experienced by the patient or participant (such as lost wages to attend clinic), or intangible costs such as pain and suffering. (This *Guide* discusses only the direct costs incurred by the provider organization to deliver the nutrition intervention.)

The framework for cost-effectiveness analysis also can be planned to consider some costs of outcomes. Costs can be assigned to the major consequences that result from the intervention. These might be added costs related to complications (e.g., the cost of treating complications related to a misplaced feeding tube), or cost savings due to the nutrition intervention (e.g., cost savings when the well-controlled woman with gestational diabetes

delivers a healthy baby). Cost on the results side are added to the input costs to yield a net cost; or savings on the results side are subtracted from the input costs to yield the net costs of nutrition services. (See Section III for additional information on costs.)

6. OUTCOMES. The term “outcome” is used in this *Guide* as a general term to include all possible intended and unintended results of the nutrition program or intervention. Other terms used in the cost-effectiveness literature include “results,” “consequences,” “effects,” “quality adjusted life years,” and “benefits.” The outcome is the result produced by the nutrition intervention or program. It can include positive as well as negative consequences. A key outcome for cost-effectiveness analysis is derived from the objective of the program or intervention. Some programs have many desired outcomes.

Example: Nutrition services in prenatal care have goals of improving the dietary intake of the women, assuring adequate maternal weight gain, and contributing to the development of a healthy, normal weight infant. From these, the key outcome for cost-effectiveness analysis could be infant birthweight.

In cost-effectiveness analysis, one key outcome is identified and used uniformly across all alternatives. This outcome must be observable and measurable. Outcomes address patient/participant achievement of the clinical goal (e.g., cholesterol reduction, weight gain, blood glucose control, risk factor reduction, improved management of food dollars, or other goal) as a result of the nutrition intervention. Secondary outcomes related to the need for or use of health care services in the future can also be measured. (See Sections IV and V for additional information on outcomes and their measurement.)

7. TIME HORIZON. The time horizon is the relevant period for the normal course of intervention (e.g., one contact, three visits during the prenatal period, or semiannual contacts across a lifetime).

The MCH practitioner must determine which time horizon is feasible for data collection for the intervention and for the outcome. The availability of resources to conduct the cost-effectiveness analysis will determine whether short-term or longer-term costs and outcomes can be measured. If a short-term time horizon is selected, conclusions about long-term costs and outcomes are beyond the scope of the analysis.

The model recommended in this *Guide* focuses on current costs and outcomes. It identifies and summarizes the costs and outcomes of nutrition intervention as they are experienced in the short term. It should be recognized that nutrition behaviors are adopted and changed over time, and while some outcomes can be observed and measured in the short term, many important outcomes are not attained until years later.

Example: Consider a cost-effectiveness analysis whose objective is to determine whether a basic intervention (one 45-minute contact) is more cost-effective than an intensive intervention (180 minutes divided into three contacts) in enabling persons with diabetes to control their blood glucose. The problem must be defined in terms of the time horizon under consideration. Some ongoing nutrition contact would be expected throughout the life of persons with diabetes, and blood glucose could be measured at any point. But for short-term analysis, practitioners could define nutrition intervention during one quarter (costs), and could measure its short-term impact on blood glucose (outcome) when patients return for their next quarterly visit. This plan measures the short-term effect of the nutrition intervention and the extent to which patients begin a regimen of blood glucose control. This analysis is balanced in that resource inputs (costs) are tracked in a reasonable period of time that is relevant to the period over which outcomes are evaluated. The analysis allows conclusions about the cost-effectiveness of nutrition intervention over a short-time horizon.

Two factors affect the specification of the time horizon. First, a meaningful temporal relationship should exist between input costs and outcomes. Second, feasibility considerations influence what outcomes can be tracked and the realistic time

period for tracking them. To illustrate these factors: A successful weight control program for children may reduce the rate of obesity, hypertension, and hypercholesterolemia as cardiovascular disease risk factors in adulthood. However, the long-term outcomes are very difficult to track, and, as time passes, it becomes more difficult to attribute such outcomes to the childhood weight control program. Furthermore, the participating clients may be exposed to additional interventions in order to control weight throughout childhood and early adulthood.

NOTE: To ensure the relationship between the nutrition intervention and the outcomes, identify a similar time horizon for both cost and outcomes, and plan a time horizon in which sound data on costs and outcomes can be tracked.

8. SOUND DATA. Data to document or estimate costs and outcomes must be precise, valid, and reliable. Data collection could be retrospective (where records from the current or past year are used as a source of cost and outcome estimates); or prospective—where plans for data collection are made and cost and outcome data are collected as the intervention is implemented during the following months.

Existing data from program reports and published studies also can be used to estimate outcomes. Use of existing data is especially relevant when the objective of the analysis is to estimate the potential cost-effectiveness of a proposed new program or intervention or modification of an existing one. Meta-analysis is a method of integrating the data from several studies to get an estimate of probable outcome. Government reports, professional journals, and other scientific literature are sources of data on the effectiveness of various nutrition intervention strategies and programs. A

checklist included in this *Guide* (see Appendix A) will assist you in critically reviewing existing reports before deciding to use data from them in your cost-effectiveness study.

Little information has been published on the costs of nutrition interventions and programs. Even when existing data are available to estimate outcomes, it will probably be necessary to collect actual data on the costs for each alternative. An important point to remember is that consistent methods should be used across all alternatives for measuring or estimating costs and outcomes.

9. RESULTS AND INTERPRETATION. The report should include a description of methods used for cost and outcome determination, assumptions made, and a summary of the costs and outcomes for each alternative. The final results of a cost-effectiveness analysis are usually reported in ratio form, as illustrated in Exhibit 3a. Since many nutrition interventions have important consequences that cannot be summarized in the key outcome, other positive and negative consequences should also be listed and discussed. Many experts recommend using an array to report a range of consequences (Exhibit 3b) and cost detail (Exhibit 3c). Presenting the results and comparisons in easy-to-understand tables and charts renders them more useful (and user-friendly) to decision makers. The results are followed by a discussion of the findings, their interpretation, and implications. Include all issues of concern to users of the report, especially the issues likely to be considered in the decision making. Tips for presentation of the results of cost-effectiveness analysis are expanded in Section VI.

Exhibit 3. Report of Results of an Economic Analysis

3a. Cost-Effectiveness Ratios for Prenatal Care Alternatives for Adolescents*

	The Corner n=180	OB Clinic n=180
Cost:		
Total cost of program (for all 180 served)	\$134,640–145,080	\$327,240–363,960
Effectiveness: No. infants > 2500 g	150	160
Cost-effectiveness ratio: Cost per infant achieving birthweight > 2500 g	\$898–967	\$2045–2275

*Calculated from data reported by Kay, et al. (1991) shown below.

3b. A Comparison^a of Outcome Measures of Prenatal Care Clients*

Measure	The Corner	OB Clinic	p Value
Percent who stopped/reduced smoking ^b	27.6	9.5	0.00
Mean gestational age (weeks)	39.1	38.9	0.38
Gestational age 37+ weeks (%)	90.4	90.0	0.91
Mean birthweight (grams)	3161	3178	0.78
Birthweight < 2500 g (%)	15.5	10.8	0.20
Mean Apgar score			
1 minute	7.5	7.5	0.99
5 minutes	8.6	8.5	0.39
Index pregnancy complications score	3.20	3.36	0.81
Percent with Cesarean section	15.4	13.9	0.69
Mean days hospitalized for mother	4.82	4.92	0.76
Mean days ICU ^c	0.00	0.01	—
Mean days hospitalized for baby	5.11	4.77	0.49
Mean days NICU ^d	0.44	0.24	0.32
Mean days moderate care for baby	1.06	0.85	0.57
Index newborn complications score	5.54	4.15	0.25

^a Adjusted for age, race, insurance coverage, and smoking status.

^b [(No. who stopped or reduced smoking during prenatal care)/Total no. who smoked] adjusted for age, race, and insurance coverage.

^c ICU, intensive care unit.

^d NICU, neonatal intensive care unit.

* Reprinted with permission. Kay, BJ, Share, DA, Jones, K, Smith, M, Garcia, D, Yeo, SE. Process, Cost, and Outcomes of Community-Based Prenatal Care for Adolescents. *Medical Care*, 29(6):531–542, 1991.

3c. Comparative Costs of Prenatal Programs: The Corner and Women's Hospital OB Clinic*

Component	The Corner	OB Clinic
Average cost/initial visit (including initial labs)	\$74–\$81	\$291–\$317
Average cost/revisit	\$18–\$23	\$86–\$107
Average number revisits	9.79	6.79
Average cost/final visit	\$18–\$23	\$89–\$112
Average cost/postpartum visit	\$30–\$37	\$89–\$112
Subtotal	\$303–\$361	\$1,053–\$1,268
Charge/NSOPV ^a	\$50	\$50
Average number NSOPV	0.64	1.04
Charge/IP room	\$456	\$456
Average number IP days	0.57	0.69
Charge/ultrasound	\$180	\$180
Average number ultrasounds	0.67	1.32
Charge/nonstress test	\$45	\$45
Average number nonstress tests	0.29	0.73
Laboratory charges not included in visits	\$20	\$118
Subtotal	\$445	\$755
Total average cost/client	\$776	\$1918
	(\$748–\$806) ^b	(\$1,818–\$2,022)

^a NSOPV, nonscheduled hospital outpatient visits.

^b The dollar ranges reported resulted from conservative and liberal estimates about salaries and wages and, in the case of the OB Clinic, varying estimates on the average number of prenatal visits per month.

* Reprinted with permission. Kay, BJ, Share, DA, Jones, K, Smith, M, Garcia, D, Yeo, SE. Process, Cost, and Outcomes of Community-Based Prenatal Care for Adolescents. *Medical Care*, 29(6):531–542, 1991.

The authors did not select one outcome as a key outcome. If they had chosen one (e.g., birthweight with the criterion for success defined as birthweight > 2500 g), then a cost-effectiveness ratio could be calculated, as in Exhibit 3a, which shows the comparative cost per successful outcome. Note that comparing ratios in Exhibit 3a leads to the same conclusion as looking at the array of outcome and cost data (in Exhibit 3b and 3c)—The Corner is the preferred alternative.

The costs in Exhibit 3c are presented as conservative and liberal estimates. This is a way of expressing uncertainty and enabling comparisons across a range of estimates. Exhibit 3b reports numerous outcome measures. Note that there was only one statistically significant difference—percent who

stopped smoking. Since the outcomes are approximately equal, costs become the deciding factor in selecting the most efficient alternative.

III.

Determining Costs in Cost-Effectiveness Analysis

To analyze the cost-effectiveness of nutrition interventions and programs, it is essential to identify and quantify all costs associated with the specific nutrition intervention/program and the other alternatives under review. All costs are determined, starting with the initial client recruitment or registration through to the achievement of the final outcome. After resource requirements are measured or estimated for each alternative, they are summarized as total, average, incremental, and/or marginal costs. In addition, discounting and sensitivity analysis should be applied when appropriate. This section defines and elaborates these concepts and processes.

Important Concepts in Cost Analysis

Understanding Basic Concepts

Resources. The concept of resources is integral to the process of determining costs. To provide nutrition interventions or programs and produce the desired outcomes, resources must be consumed, making them unavailable for another purpose. When resources are scarce, consumption should be tracked and the efficiency (or productivity) of resource allocation should be assessed. The principal resource components tracked and assigned a cost value in accounting systems are personnel,

fringe benefits, supplies, materials, contracted services, facility costs, and administrative overhead. These principal cost components are organized together in activities that make up interventions or programs designed to produce important health outcomes.

Time Horizon. Few nutrition interventions are single events. Consider the intervention model and

Exhibit 4. Principal Cost Components for Cost Analysis

- Personnel
- Fringe benefits
- Food and nutrition products
and supplies
- Office supplies
- Education materials
- Equipment
- Laboratory tests
- Other diagnostic and monitoring
procedures
- Other ancillary services
- Continuing education and training of staff
- Facility/space
- Administrative overhead

the course of interaction that the client should have with the program to achieve successful health outcomes. This leads to more comprehensive costing of the intervention over a realistic time period; as well as appropriate linking of resource needs to the desired outcome. The following examples illustrate long and short time horizons.

Example (shorter time horizon): Practitioner engages in breastfeeding promotion activities with the pregnant client during the prenatal period to inform the client about all the benefits of breastfeeding and to influence her decision to initiate breastfeeding.

Example (longer time horizon): Practitioner conducts an initial series of four contacts over a six-month period with a newly diagnosed adolescent client with diabetes, in order to establish a successful nutrition plan to manage blood glucose levels. This series is followed by semiannual visits with the dietitian over the client's lifetime, as an adjunct to medical management, to prevent or delay the complications of diabetes.

Market Price. In determining costs, a monetary value is assigned to every cost component, using the actual market price to the buyer or an assigned value. In many economic evaluations of nutrition services, the buyer is the provider/ health care organization; other times the buyer is the third-party payer. Occasionally, the buyer is the government or the patient. Several reported cost-effectiveness analyses of nutrition services have used patient or third-party charges rather than actual costs. Costs based on market prices paid by the organization are generally preferred, since they provide a much better indication of the real resource requirements needed to deliver nutrition services and achieve outcomes.

Understanding Advanced Concepts

Discounting. Discounting is a mathematical procedure used to convert future costs and future outcomes to "present value." When resources are used over a long period (more than one year), analysis requires the discounting of all costs to a standard base year. Two factors make discounting necessary

in long-term analyses: (1) Inflation reduces the value of money over time; and (2) there is a tendency to prefer both dollars and benefits now, rather than in the future. In the analysis, data are discounted before costs are related to outcomes and conclusions drawn. Discounting can be done using computer accounting or statistical analysis software. The discount rate used can range between 2 and 10 percent per year, with 5 percent as the most common rate.

Example: A child with phenylketonuria (PKU) receives intensive nutrition services from a nutritionist in the early childhood years and less frequent intervention later in life. When these costs are added together, they would be quite different depending on whether the costs were projected at the beginning of life (say, for example, 1975) or at adulthood (1995). In this example, the analysis of the total cost of nutrition intervention to prevent mental retardation and support adequate growth and development so the person can become a functioning adult must include discounting of costs to a standard base year.

TIP: When comparing costs between programs in different years and when using published reports of costs, it is important to note the base year for cost analysis and adjust the figures to a common base year using the Consumer Price Index before making comparisons.

Sensitivity Analysis. When calculating costs, assumptions frequently need to be made to assign a value to each cost component. All assumptions should be documented.

Example: Nutritionists' salaries vary significantly by region of the country, by years of experience, and by job classification. Cost might be low if it is assumed that the service is provided by an entry-level nutritionist receiving the base salary in a specific state. On the other hand, if the national average salary for a public health nutritionist is used, the costs would be very different.

Example: The actual amount of time nutritionists spend with prenatal clients was not documented, but nutritionists estimated that they spent 45 minutes with clients at the first visit and 10 minutes at each follow-up visit. Because of the uncertainty, sensitivity analysis could be used to explore the results if the nutritionists underestimated or overestimated the time commitment by 25 percent, for example.

It is essential to perform sensitivity analysis whenever assumptions have been made and uncertainty exists about a value used in the analysis. To perform sensitivity analysis, “what if” scenarios are used to document and determine the impact of salary assumptions (or other uncertainties) on the cost figures. The report of costs should describe the assumptions made and how sensitivity analysis was used to explore the impact of the assumptions on the cost analysis and results.

If changing some of the assumptions used to assign value to resources significantly changes the conclusion, then greater efforts should be directed toward determining the true value for the cost

component. When this is not possible, the analyst should state explicitly that the results are “sensitive to” the value assigned to that component (e.g., “the conclusion of cost-effectiveness of alternative B over alternative A is sensitive to assumptions about salary level of nutritionists providing the education”).

Defining Costs

Costs have been grouped by economists into direct, indirect, and intangible costs (see Exhibit 5). In most cost-effectiveness analyses of nutrition programs, direct costs are estimated from principal cost components incurred by the provider organization. Direct costs include resources consumed in the prevention, diagnosis, treatment, and habilitation of a disease. In nutrition, direct costs are defined as those resources used by the provider in the delivery of nutrition and related care to achieve the health goals or outcome objectives of the intervention or program. Other perspectives for analysis would require the inclusion of other kinds of costs.

Exhibit 5. Types of Costs Used in Economic Analysis

Cost	Definition	Examples
Direct health care (or other sector) cost	<ul style="list-style-type: none"> • Costs associated directly with the nutrition intervention and related health care • Health care or other cost resulting from the intervention 	<ul style="list-style-type: none"> • Nutrition education and counseling • Supplemental foods • Related medical visits • Laboratory tests • Hospitalization (required or avoided)
Direct patient costs	<ul style="list-style-type: none"> • Costs borne by patients or their families as a result of participating in the nutrition intervention 	<ul style="list-style-type: none"> • Transportation to clinic • Cost of special food products
Indirect costs	<ul style="list-style-type: none"> • Cost of reduced productivity as a result of condition/illness and nutrition intervention 	<ul style="list-style-type: none"> • Time lost (from work, school, normal activities) because of condition • Preparation of special feeding • Time needed to participate in intervention/program
Intangible costs	<ul style="list-style-type: none"> • Difficult-to-quantify costs related to pain and suffering and quality of life 	<ul style="list-style-type: none"> • Impaired mental functioning • Social limitation due to dietary restriction

Specifying Costs and Collecting Data

The process of quantifying costs is called cost analysis. It provides a systematic and defensible estimation of resource consumption, which is necessary for cost-effectiveness analysis. The process is not complicated, but it must be approached in a systematic and careful manner. (See Splett and Caldwell [1985] for additional detail.) Cost analysis must be carried out with equal precision for each alternative being compared. Cost analysis involves:

- Listing all activities;
- Identifying principal cost components for activities;
- Collecting data or estimating resource consumption for principal cost components;
- Assigning a monetary value to each component and activity using market prices;
- Listing all assumptions made for possible sensitivity analysis;
- Calculating total, average, incremental, and/or marginal costs; and
- Performing discounting if necessary.

Summarizing and Reporting Costs

The findings of the cost analysis can be summarized and reported in a number of ways, including:

Full cost—the *total cost* of program over a period of time (usually one year).

Total costs can be further broken down into:

- Fixed costs—stable costs not related to volume of service; or
- Variable costs—resource utilization that varies with volume (number of clients) or intensity (frequency and type of contact) of service.

Average cost—the cost per unit of output/outcome, determined by dividing all fixed and variable costs involved divided by the number of units of service (e.g., cost per nutrition assessment; cost per low birthweight infant prevented).

Incremental cost—the cost for nutrition as an add-on to an existing service (e.g., nutrition assessment added to an EPSDT visit).

Marginal cost—the cost of doing a little more or a little less (e.g., adding a second nutrition follow-up visit for people completing a weight loss program).

Incremental or marginal costs are more relevant to economic analysis than total or average costs, because incremental or marginal costs relate to the extra cost to produce each added effect. Total and unit costs are especially useful for budgeting and for establishing fee and negotiating reimbursement rates.

Example: A substantial amount of resources are consumed to develop a program and system to deliver nutrition messages through local grocery stores. Once the program is developed, adding another store greatly expands the number of families reached but the “marginal” costs are considerably less than the original cost of introducing the program in the first store.

Step-by-Step Cost Analysis

The following example illustrates how a nutritionist might proceed to determine the cost of nutrition services in prenatal care from the perspective of the public health center, based on the current program year.

1. Prepare a flow chart of all activities involved in providing nutrition services to pregnant clients, including activities such as:

- Client recruitment and outreach;
- Nutrition assessment and counseling of clients;
- Record keeping and scheduling;
- Client follow-up and monitoring; and
- Program administration and evaluation.

(Note that preservice and postservice activities are included in costs.)

2. Identify the principal cost components necessary for each activity. This might include nutrition and clerical personnel, fringe benefits, nutrition educa-

tion materials and equipment, laboratory tests to monitor anemia, office and clinic space, nutrition reference materials, office supplies, and administrative overhead.

3. Specify ways costs will be measured. Use work schedules and existing reports such as service statistics or accounting records (after verifying their completeness and accuracy), or conduct time studies or productivity studies, or use other methods to accurately estimate the quantity of principal cost components necessary to carry out each activity.

4. Work with accounting staff to assign a monetary value based on the actual cost to the organization for each cost component. Keep track of all assumptions made along the way.

5. Calculate the total costs for prenatal nutrition services, then divide by the number of women served to get an average or unit cost. If the cost analysis looked only at nutrition costs as a component of an existing prenatal care program, the costs could be considered incremental costs. Freestanding nutrition services delivered at a different location requiring separate staffing and facilities would likely have significantly different, and probably higher, costs. Similar steps with similar assumptions should be carried out for each alternative to be compared in the cost-effectiveness analysis.

IV.

Determining Outcomes of Nutrition Services: Key Concepts

The following concepts are essential in determining outcomes of nutrition services. Additional, more advanced concepts, are discussed in the next section.

Intervention (treatment). An intervention is a purposefully planned service, program, policy, or other activity provided or directed to a defined population for the purpose of changing a behavior, risk factor, condition, aspect of health status, or system. Before evaluation can proceed, these elements of the intervention must be clearly defined: the service, program, policy or activity; target population; and desired effect or outcome. In research and evaluation reports, the intervention is frequently referred to as the *treatment*. In experimental studies, the intervention/treatment is carefully supervised by the investigators; in field studies, the intervention is more likely to vary as program staff implement it in real-world conditions.

Efficacy versus Effectiveness. “Efficacy” reflects the level of outcome expected when the intervention is applied under ideal conditions. Controlled experimental studies measure efficacy. “Effectiveness” involves the level of outcome achieved when services are rendered under ordinary circumstances by average practitioners for typical clients. Evaluation and the new approach to clinical research, called Medical Effectiveness Research or Outcomes Research, focus on effec-

tiveness in real-world settings (Green, Bondy, Maklan, 1994).

An intervention is “effective” when the target population is successful in reaching a meaningful outcome. Effectiveness is determined by comparison to a preestablished criterion for success. Two judgments are relevant. One is clinical importance (that is, is the degree of change important in terms of generally accepted measures of signs and symptoms of disease, health status, physical, social or mental functioning, quality of life, or other outcomes?). The second is statistical significance. Does the change from preintervention to postintervention represent a statistically significant difference? Is the difference in magnitude of change between groups or between interventions statistically significant?

Criterion. The criterion is the benchmark against which effectiveness or success is assessed. The criterion for the judgment of clinical importance is commonly selected from the following: substantial improvement from the baseline value, a standard value established by science or expert consensus, a national objective such as *Healthy People 2000* objectives, or the intervention objective (when it has been expressed in definite, measurable terms). The criterion for statistical significance is usually set at a 0.05 level of significance.

Target Population. Individuals respond in different ways to behavioral interventions such as nutrition. It is important to carefully define the characteristics of the population receiving the nutrition intervention. Evaluation results with one type of population are not necessarily applicable to populations with other characteristics.

The target population for whom the intervention was designed is the reference population for the evaluation. Characteristics such as geographic location, sociodemographics (age, economic status), disease risk, and severity of condition are frequently used to define the target population. One challenge in evaluation is to obtain a representative sample of the reference population for the study.

Outcome. Outcomes address what happens to clients in terms of prevention, control of risk factors, and results of treatment, rehabilitation, or palliation of disease or disability. Outcomes include both intended and unintended consequences. A key desired outcome is usually expressed in the intervention objectives. In addition to the key outcome, there may be other positive or negative outcomes. Although cost-effectiveness analysis focuses on one key outcome, other outcomes may be important in overall decision making and should be considered in the evaluation.

Indicator. An indicator is an observable and measurable form of an outcome. It defines the specific terms by which the outcome will be measured. Standard indicator sets enable common data collection and documentation across sites and programs using standardized terminology and definitions. Standardization increases the efficiency and accuracy of evaluation efforts and allows for aggregation of outcome data across programs and states. Efforts are underway to define standard clinical indicators for nutrition care (Kushner, et al., 1994).

Example: The desired outcome of a weight management program is weight loss. The indicator could be defined in quantitative terms as number of pounds lost or as percent of baseline body weight lost over a six-month period. The indicator could also be defined in categorical terms such as achieved weight loss goal at six months (Yes/No).

For cost-effectiveness studies, select an indicator that has units that can logically be related to costs and that will be understood by decision makers. The reliability and validity of instruments and procedures for measuring and documenting the indicator also must be considered when selecting indicators.

Time Horizon. The concept of time horizon has a special application in determining effectiveness. Depending on the definition of the outcome indicator, there is a natural period of time that must pass before the outcome can be validly assessed. This is determined by the behavioral, physiological, or clinical response to the intervention. Change in knowledge can be assessed immediately after an educational intervention; however, the impact of the education on dietary behavior requires a period for trial and adoption into the client's lifestyle. Meaningful assessment of trial behavior change might be 3–6 months after the intervention, while assessment at 2–5 years may be necessary to assert permanent lifestyle change.

Example: A nutritionist providing the nutrition component of a wellness program designed to reduce risk factors for cardiovascular disease and ultimately reduce the incidence of cardiovascular events (angina, stroke, heart attack) must think carefully about relevant indicators of success and the appropriate time horizon to measure them. Serum cholesterol reduction could be measured in a few weeks, nutrition risks within the profile of risk factors could be assessed at the one-year follow-up screening, and cardiovascular disease events must be measured several years in the future.

Design. Evaluation design refers to a set of decisions you make in setting up the evaluation.

Design consists of:

- Identifying groups (intervention alternatives or control or comparison groups) to be studied and compared;
- Defining relevant reference population and determining the sample size and method of sampling from the population;
- Assigning clients to groups (e.g., random, self-selection);

-
- Identifying points in time when key outcome indicators will be measured in each group;
 - Selecting and defining other outcome, intervention, client, and intervening variables to be tracked;
 - Developing and testing forms and procedures for data collection; and
 - Planning for analysis of data.

Section V expands these points for application in nutrition programs.

Sensitivity Analysis. In the process of determining outcomes, many uncertainties are faced and assumptions are made to deal with the uncertainties. All assumptions should be documented. Sensitivity analysis uses “what if” scenarios to assess the impact of assumptions before final conclusions are made regarding the effectiveness of various interventions.

Example: Consider a situation where breastfeeding initiation rates were assessed in six different WIC sites across the state—three using peer educators and three offering “standard” breastfeeding promotion. The nutritionist wants to use the success rates at the peer educator sites to estimate the number of WIC infants who would shift from the formula package to breastfeeding if the peer educator program is expanded to all sites. The breastfeeding initiation rates at the three peer educator sites were 59 percent, 73 percent, and 85 percent, respectively, compared to the rates at the standard sites (49 percent, 53 percent, and 55 percent). The future rate of initiation of breastfeeding with peer educators could be the best rate, the lowest rate, the median rate, or an average rate. What rate should the nutritionist use? Answer: the median or average rate. Then the nutritionist should perform a sensitivity analysis by recalculating the results to answer the questions: “What if we get results more like the low site?” and “What if the results we get are more like the best site?” Now the nutritionist has three estimates of the number of WIC infants who could be expected to shift from the formula package, and has more outcome information to relate to costs for the cost-effectiveness analysis of this proposed expansion.

V.

Determining Outcomes of Nutrition Services: Effectiveness Evaluation

Knowledge about the efficacy and effectiveness of nutrition interventions is increasing. Nutrition counseling was identified by the U.S. Preventive Services Task Force (1989) as one of the 169 clinical preventive services for which there is empirical evidence of effectiveness. A recent review by Barr (1993) of the literature on clinical effectiveness of dietetic services identified 120 articles. While prenatal care is included, no articles are referenced on nutrition in infancy, childhood, or adolescence. Evaluations of nutrition interventions for children with special health needs are conspicuously absent from reviews of the literature. Data are also lacking on the effectiveness of nutrition intervention in health promotion and disease prevention for mothers, children, and families. The evaluation of nutrition interventions is challenging because nutrition is often an adjunct to other services such as prenatal care or management of chronic conditions; and many competing forces influence nutrition behaviors. In spite of those challenges, evaluation is possible and achievable. Effectiveness evaluation is crucial for program improvement and survival.

Estimation of effectiveness is an essential ingredient in cost-effectiveness analysis. Cost-effectiveness analysis requires careful assessment and documentation of the outcomes produced by competing interventions. Since cost-effectiveness

analysis compares the magnitude of a specific outcome per unit of cost, accurate assessment or prediction of the magnitude of outcome for each competing alternative is imperative.

The magnitude of outcomes resulting from nutrition intervention is determined through effectiveness evaluation. The steps involved in effectiveness evaluation are outlined in Exhibit 6 and discussed in this section.

Exhibit 6. Determining Outcome: Effectiveness Evaluation

Define the Evaluation Question

- Determine which interventions will be evaluated

Determine Key Outcome Indicators

Design the Evaluation and Specify Procedures for Data Collection

- Define relevant population
- Determine sample size and method of sampling
- Establish points to collect outcome data
- Define all intervention, client, intervening, and other outcome variables to be collected
- Develop and pilot test forms and procedures for data collection
- Plan data analysis methods

Collect Data According to Procedures

- Train data collectors
- Monitor quality and completeness of data

Analyze the Data

- Code and enter data
- Assess clinical importance
- Assess statistical significance

Interpret and Report Results

Act on the Findings

Formulating the Evaluation Question

Any evaluation requires explicit statement of the evaluation question. In effectiveness evaluation, the basic questions are: Does the intervention lead to a clinically important and statistically significant change in the key outcome indicator? What is the magnitude of effect? Is the magnitude of effect different between compared alternatives? Are other important outcomes achieved?

At this stage, you should have clearly determined the specific intervention you are evaluating and the relevant alternatives or comparisons.

Identifying Outcomes and Indicators

The outcome of interest in a specific evaluation must be linked to the objective of the intervention. Thus, in defining the key outcome, the first requirement is to clarify the objectives of the intervention and define the primary indicator of “success.” This is the key outcome to be compared across alternatives. Other consequences can and should be tracked and compared, but the key outcome should be the basis for determining the degree of effectiveness for the cost-effectiveness analysis.

After identifying the key outcome, the next step is to specify indicators. An outcome indicator is the precise way the outcome is measured. The indicator must be objectively determined and documented in a standardized manner, and must be logically and directly related to the process of intervention.

Example: The nutrition education message in the 5-A-Day campaign is clearly linked to the desired outcome of increasing the number of servings of fruit and vegetables consumed in a day. The indicator, compared before and after the intervention, is the number of servings of fruit and vegetables determined from a 24-hour food recall.

Nutrition interventions have many outcomes. Limiting the evaluation of effectiveness to one outcome can be misleading. In addition, users of nutrition program evaluations have different needs and interests. Physicians and other health care practitioners are interested in clinical outcomes, policymakers are interested in functional status and future utilization of health care resources, and clients and advocates place primary emphasis on general quality of life. Another consideration is that different outcomes are produced and can be measured at different points in time. Thus, it is wise to track other outcomes in addition to the key outcome. However, the choice of outcomes to evaluate is limited by the resources available, the time available to allocate to the evaluation, and the availability of valid and reliable methods for measuring and documenting relevant outcome indicators. It is better to assess a few outcomes accurately in a defined sample using standardized tools and procedures than to have a lot of data of questionable value.

One generic outcome indicator recommended for use in cost-effectiveness studies since the 1970s is the quality-adjusted life years indicator. A recent trend in outcome evaluation in health care is to assess quality of life and patient satisfaction. The global indicator of quality of life is used when the outcome is complex and has many dimensions. Quality of life is being used along with other direct

disease-related indicators in evaluations. Many tools exist for measuring quality of life. Interested readers are referred to the comprehensive list of quality of life indexes reported in Medical Care (1990). Patient satisfaction is believed to be linked to compliance with medical advice and directly linked with health outcomes. Thus, it also merits attention on the evaluation of nutrition interventions. For a review of instruments for measuring patient satisfaction, see von Campen (1995).

Exhibit 7 lists examples of outcome indicators that are commonly linked to nutrition intervention. The table also suggests outcomes for measurement at proximal, intermediate, and long-term points in the time horizon.

Exhibit 7. Outcomes of Nutrition Intervention

Short-term (proximal) outcomes—knowledge improvement, behavior change, physiological indicators of risk (e.g., weight gain or loss, cholesterol reduction, anemia), other specific indicators related to life stage, risk level, or compromised health status.

Intermediate outcomes—sustained changes in knowledge, behavior, physiological indicators or related consequences, improved functional status, changes in individual or organizational practices, delay or prevention of complications or deterioration, downstream health care, education, or social service utilization.

Long-term (distal) outcomes—chronic disease onset in later life, associated health care costs, years added to life.

Designing the Evaluation

Remember, in cost-effectiveness analysis, one alternative is assessed in comparison to other alternatives. Thus, in effectiveness evaluation, attention must be given to obtaining equally sound data on the outcomes produced by each alternative under consideration.

Exhibit 8. Sources of Data

Generally, there are four sources of data* used to estimate outcomes:

1. Existing in-house data from program statistics and client records (retrospective).
2. New data collected on program activities and outcomes (prospective).
3. Data from existing studies conducted in settings and target populations similar to yours.
4. Estimates based on a meta-analysis of all existing reports of the intervention.

**Whether collecting new data or relying on existing data generated by you or reported in the literature, you are responsible for reviewing the quality of the data. Appendix A: Worksheet to Critique Studies and Reports, may be helpful in reviewing the data.*

In-house data collection (retrospective and prospective)

Collecting actual data in your setting by doing an in-house evaluation of the clinical effectiveness of nutrition care (using either retrospective or prospective data collection) provides important information that can be used to understand, improve, and justify nutrition services. Program statistics can be used as a source of data, and client records can be audited. Existing data can be supplemented with ad hoc surveys or special studies to gain more information about outcomes or inter-

vening variables. Retrospective approaches work best if definitions and procedures, including standardized indicators and forms, have been in place to assure continuous and standardized documentation for every client by all staff. Standardized definitions and documentation should be the first priority in laying the groundwork for future effectiveness studies.

Special studies can be designed to collect quality data on your specific program and its effectiveness with a defined target audience. Carefully planned prospective data collection enables you to measure key indicators in a standard way and track other factors (e.g., intervening variables such as competing messages in the environment, and personal or organizational barriers to access) that could modify outcomes, or to explain excellent or poor results in a subset of clients (e.g., literacy level, compliance, readiness to change). Additionally, in prospective studies, you can investigate the occurrence of other positive and negative consequences beyond the standard outcome indicator. Small-scale, in-house studies can also serve as a valuable pilot study for more complex effectiveness studies.

Design considerations, such as selecting comparison groups and controlling for other factors that can influence outcomes, are necessary to show a true causal relationship between nutrition care and client outcomes. For many evaluation and decision-making purposes, this level of complexity is necessary. (See Exhibit 9 for the range of evaluation designs. In addition, the example at the end of this section illustrates a study that incorporated controls and a comparison group.)

Using data reported by others

Existing data reported in the medical and human service literature as single studies or as a meta-analysis of all available studies, and data available in program reports and government documents, may be used (after you critique its quality and consider its relevance).

A worksheet for reviewing existing reports is provided in Appendix A. Use this tool as a guide for reviewing studies before assuming their results are relevant to your situation. When using other studies as a basis for estimating the possible outcome of an intervention, carefully consider the details of the intervention reported, the population studied, and other unique features that may have enhanced or restricted actual effectiveness.

Consider the degree of match between the reported situation and the one you are considering.

Meta-analysis is a specific process of reviewing and integrating the findings of all available studies on a defined topic. Meta-analysis is believed to produce a more accurate prediction of the range of results than a single study. Refer to Louis (1985), Gerbarg (1988), and Thacker (1988) for guidance on how to conduct a meta-analysis.

Prospective hypothetical analysis

Another approach used in cost-effectiveness analysis to estimate outcomes was suggested by Drummond (1987). This approach requires the investigator to make assumptions about intervention processes and outcome indicators and to generate estimates of effectiveness, using available data and professional judgment. The investigator then undertakes sensitivity analysis to determine whether the results of the economic evaluation hold up over a range of assumptions. If the final result is positive for the program and is not sensitive to varying assumptions related to uncertainty about outcomes or costs, then expending further effort and resources to gather additional data is not warranted. Likewise, if the economic analysis results are negative and remain so when varying assumptions are tested using sensitivity analysis, the program should not be initiated or continued and no further data collection is indicated. This approach is particularly useful when considering establishing a new program, substantially modifying an existing program, or expanding an existing program to a new location or new target audience.

Ensuring Scientific Validity

Whether you design your own study or use data reported by others, you have the responsibility to use data that meet accepted standards of scientific validity. Before asserting a causal relationship between a nutrition intervention and an observed outcome, all of the following conditions must be met:

1. The evidence must demonstrate a definite relationship between the intervention and the outcome (correlation).
2. The intervention must take place before the effect (time-order sequence).
3. Other possible explanations for the observed relationship between the intervention and the outcome must be ruled out (confounding).

In nonrandomized (quasi-experimental) studies, additional conditions also must be met:

4. The possibility that the effect is due to preexisting differences between clients in compared alternatives must be ruled out or controlled for (selection bias).
5. Other studies using other designs carried out in different settings and with different subsets of the populations help confirm the causal relationship and identify setting or population or intervention characteristics that may moderate the magnitude of outcome (replication).

Exhibit 9 illustrates a range of evaluation designs. Note that each design varies in terms of number of groups, number of points when data are collected, and methods for assigning individuals to group. Limitations and common applications of each design are noted. In general, the higher the level of design (indicated by the higher letters on the exhibit), the stronger the basis for asserting a causal relationship between the nutrition intervention and the outcome.

Lower level designs give little basis for conclusions about the true effectiveness of nutrition interventions, but they are useful as preliminary

steps to understanding the intervention, refining the definition of variables, and developing workable procedures for documentation and data collection and aggregation.

Higher level designs reduce the possibility that

findings are spurious (not valid) or are caused by some external, unobserved factor (such as clients' exposure to influences in their environment, or normal aging).

Experimental designs require a control/compari-

Exhibit 9. Practical Evaluation Designs for Nutrition Interventions

DESCRIPTIVE, INTERPRETIVE DESIGNS

What is happening?

- | | | |
|-------------------|---|--|
| A. Case Study | post
pre-post
series | In-depth observations to gain insight. Focus on relationship between services and participants. Especially useful in first-of-a-kind situations. |
| B. Ex Post Facto | retrospective
self-reports
for pre-post | Measure change by comparison with client's self-reported status prior to service. Used when pre-program documentation is unavailable. |
| C. Before & After | pre-post | Good data collection before and after intervention. |

COMPARATIVE, QUASI-EXPERIMENTAL DESIGNS

Does the change follow after the nutrition intervention?

- | | | |
|--|----------------------|--|
| D. Staged Designs
(replication) | pre-post
pre- | Data from successive sets of participants are compared. Requires definition of outcomes and indicators and stable data collection over time. |
| E. Comparison Group
(participants/
non-participants) | pre-post
pre-post | Comparison of change experienced by participants with a similar (matched) group of people who did not participate in the program. Bias of self-selection a problem. Most popular evaluation design. |
| F. Program Comparison
Program A
Program B | pre-post
pre-post | Provides comparison of results using different methods to achieve similar objectives (e.g., videotape vs. one-on-one instruction). This is the basis for cost-effectiveness analysis. |
| G. Time Series Design | pre-123-post-123 | Separates true program effects from natural history and maturation effects and can be used to determine long-term changes. Important in nutrition intervention to demonstrate maintenance or continued improvements. |

EXPERIMENTAL DESIGNS

Does the nutrition intervention cause the effect?

- | | | |
|---|--------------|--|
| H. Randomized Clinical
Trials (RCTs)
Treatment
Alternative | post
post | The acid test of research and evaluation. Rules out the possibility that outside factors are responsible for the changes in health outcomes. Subjects are randomized to experimental treatment and alternatives that may be no treatment, standard treatment, different level of intensity, etc. |
|---|--------------|--|

son group, randomization, and tight control of the intervention by the investigators. This is often impractical to implement. Quasi-experimental designs, when carefully planned and executed, offer a compromise that can yield sound information for use in cost-effectiveness analyses. When using quasi-experimental designs, the characteristics of the subjects in each compared alternative should be as nearly identical as possible (except for the characteristic being addressed through the intervention).

Controlled studies are essential for attributing observed changes in the outcome indicator to the nutrition intervention. Control can take two forms: random assignment to the intervention alternatives (or to intervention and nonintervention), and statistical controls to adjust for factors that are unequally represented in the study groups (Cook and Campbell, 1979; Mohr, 1992).

Decisions about which evaluation design to use must take into account available time and resources, access to relevant comparison groups, and considerations of client and provider burden for data collection, as well as selection of the design that will produce results with the strongest basis for attributing outcomes to the nutrition intervention. Suggested evaluation designs for specialized nutrition interventions have been published along with steps to consider in planning effectiveness evaluations (Splett, 1991). For additional references, see Suggested Resources and References or discuss design options with evaluation experts in your organization or at universities or health departments.

Determining the Study Sample

Sample Size

Adequate sample size is necessary to approximate the true distribution of results among clients in the reference population. One of the hazards of small sample sizes is that statistical tests will not detect a significant effect of the intervention, even if an effect is present.

Formulas exist for calculating the sample size needed for various types of studies (Cheney and Boushey, 1992). The information you need to calculate sample size consists of: minimum value for clinically meaningful change (the magnitude of change you want to be able to detect), the normal range of variation of the key outcome indicator (standard deviation), the statistical test that is appropriate for the data, and a prediction of attrition (dropout) rates. You can get this information from similar studies reported in the literature, a pilot study, or informed estimates.

Sample Selection

To determine true effectiveness you'll want to study all or a representative subset of the target population (called the study sample). The study sample can be randomly selected from program clients. Using volunteers or a convenience sample may seem easier, but could be problematic. The conveniently available subset may be different from the whole population in systematic or serendipitous ways that bias the study. If random selection is not possible, then it is important to document more client characteristics and make statistical adjustments for characteristics known to be different from the total population, or at least consider the possible impact of selection bias when the results are interpreted.

Obtaining a representative sample for the evaluation is one challenge. Retaining them in the study is another. Ideally, you'll want to track all subjects ("subjects" is used here to indicate the members of the client population who are selected for the evaluation) through all scheduled data collection points. A high dropout or attrition rate reduces the validity of the results. To prevent bias due to differential dropout of some types of clients, you'll need to plan and carry out activities to track clients and encourage full participation in data collection. In reality, some subjects will move away; others will refuse or be unable to participate. The remaining subjects may no longer be representative of the total population of interest. In performing

the evaluation, the characteristics of dropouts should be compared with the characteristics of the remaining sample to determine if bias is present.

Defining Other Variables to Be Documented

In addition to outcome indicators, many other data elements (or variables) must be documented for a complete evaluation. The selection and importance of these variables depends on each evaluation situation. You will need to consider which intervention, client, and intervening variables to track as you design the evaluation.

Intervention variables are specific and meaningful descriptors of the type and amount of nutrition care to which clients are exposed (e.g., number of visits, content of education event, type of provider, compliance with care plan).

Client characteristics are factors unique to the client, that could account for degree of participation in the intervention and acceptance and adoption of nutrition intervention messages (e.g., disease severity, attitude, readiness to change, literacy level, social support, previous exposure to nutrition services).

Intervening variables are factors external to the intervention or client, that could (1) mediate the effectiveness of the nutrition intervention (e.g., clients' increased interest in the intervention due to media coverage of a nutrition-related topic); or (2) independently affect the outcome as the "real" reason for the change or lack of change rather than the nutrition intervention (e.g., increased consumption of fruits and vegetables in summer due to greater availability, or school lunch regulations requiring attention to a child's special nutrition needs).

Indicators and procedures for measuring and documenting relevant intervention, client, and intervening variables must also be defined. Reliability and validity issues must also be considered.

Choosing Instrumentation

Instrumentation is the evaluator's term for the method chosen to measure outcomes and other important variables. The method could be a nutrition knowledge test, a food frequency questionnaire, a balance beam to measure weight, a laboratory test, client self-report, sales receipts, or observation and judgment of a practitioner or evaluator. When deciding which method to use, the issues of validity and reliability come into play. Validity means the instrument measures what it is intended to measure. Reliability deals with the ability of the measurement procedure to produce consistent, repeatable results. Types of reliability include test-retest reliability, interrater reliability, and interinformant reliability.

Validity and reliability of measurement instruments and procedures are important to quality data and appropriate interpretation of study findings. Each area of nutrition has its share of challenges and successes in defining valid and reliable methods for assessing the outcome of nutrition intervention. The best source of information on instruments is published articles in the specific area of interest and research sessions at professional and scientific meetings.

Pilot Testing Procedures for Data Collection

If you have not done so by this point, you should consult with a statistician to review design, sample size estimates, and data analysis plans. Planning and pilot testing procedures for data collection are the final steps in evaluation design.

Pilot testing allows you to "work out the bugs" before expending resources on a full-scale evaluation. During pilot testing, reassess assumptions about the availability and accessibility of clients and data, and about staff or others skilled in administering tests and documenting data. Clarify procedures, revise forms if necessary, and identify training and coaching needs for accurate and

complete data collection.

You are now ready to train data collectors and implement the evaluation. Throughout the data collection period, review and supervise data collection to assure consistency. Consistency is important during the implementation of a prospective study as well as in a retrospective evaluation where data are abstracted from existing records.

When implementing group comparison designs at a single location, you must be alert to cross-contamination of groups and to the potential for biased observations and interpretation when investigators/data collectors are aware of a client's group assignment.

Quantifying the Magnitude of Effectiveness: Data Analysis

Preliminary steps to data analysis include quality checks of data collection forms, data coding, and data entry into a computer program. Next, you will review a printout of the data for possible coding or entry errors (evidenced by unusual distribution of the data or outlying values).

After the data are "cleaned up," the analysis stage begins. Your job is to summarize the findings to make inferences about the population from which the sample was drawn. This involves three steps: (1) aggregate the raw data into summary statistics, (2) estimate the magnitude of change in each group and the difference between groups, and (3) test for statistical significance. First, compare the magnitude of change with the criterion for clinical importance. This judgment is just as important as the assessment of statistical significance. Commonly used tests of statistical significance include t-tests, chi-square, Wilcoxon's signed-rank test, analysis of variance (ANOVA), and analysis of covariance (ANCOVA). The statistical test used depends on the evaluation design and the level of measurement of the indicator.

Don't be intimidated by the analysis-statistics stage. Computerized software is becoming easier to

use. (See EPI Info and Minitab, for example). For small pilot studies, statistical calculations available on spreadsheet software (such as Excel or Lotus) can be used. Consult with a software distributor to find the software that is best suited to your needs.

The important thing is to select the correct statistical test for the data. Refer to Cheney (1992) for helpful guidance on selecting the correct statistical test and for presenting results of each type of test. Another very helpful reference for selecting the appropriate statistical test is *A Guide for Selecting Statistical Techniques for Analyzing Social Science Data* (1981). It is also a very good idea to consult with a statistician at the analysis stage.

At minimum, you should plan to summarize, analyze, and report:

- Descriptive data about the sample;
- Group averages and range of variation (e.g., mean and standard deviation or frequency and percent) of the key outcome indicator before and after the intervention;
- Assessment of the clinical importance of the magnitude of change;
- Comparison of the magnitude of change with other groups/alternatives; and
- Assessment of statistical significance of the difference between groups/alternatives.

Depending on the evaluation questions, complexity of the evaluation, and quality of the data available, you should also analyze and report:

- Descriptive data about intervening variables;
- Descriptive and inferential statistics about other outcomes of interest;
- Statistical adjustment of the magnitude of outcome for preexisting group differences and for intervening variables; and
- The relationship of the degree of outcome with the amount of exposure to the nutrition intervention.

Exhibit 10. Example of an Effectiveness Evaluation

Bruce and Tchabo (1989) studied the effect of nutrition counseling on weight gain in pregnancy and on birthweight of the infant in underweight and failure-to-gain pregnant women. The specific question to be answered was, "Does nutrition intervention that provides intensive nutrition education and follow-up improve maternal weight gain and infant birthweight?"

Two groups of underweight, failure-to-gain women were studied. The first group (57 women) received intensive nutrition care from a nutritionist (counseling in diet and weight during every maternity visit throughout pregnancy). The second group (52 women), who underwent prenatal care in the same clinic one year later, received no nutrition care beyond routine advice given by the nurse or physician. The no-treatment comparison group allowed the investigators to assess the course of pregnancy among this high-risk group when specialized nutrition care was not included. The comparison between groups helped provide evidence that any change seen was a result of the intervention and not caused by other factors in the environment.

The outcome indicators selected by the investigators (weight gain and birthweight) were appropriate for two reasons: (1) They would be expected to improve as a result of the nutrition intervention, and (2) higher weights would suggest improved health status of the woman and infant, improved clinical management of pregnancy by practitioners, and a measure of success to the third-party payer. Recognizing that smoking, race, age, start of prenatal care, medical complications, and access to supplemental foods can affect these outcomes, the investigators also tracked these intervening factors in the study and considered them in the analysis.

The data collection procedures that were used had been tested for reliability and validity, and all data were collected following established procedures. After the data were collected and summarized, the results were compared to existing standards for weight gain and birthweight to determine if differences were clinically meaningful, and statistical tests were performed to make judgments about the statistical significance of differences between the groups. The results, showing that the group receiving nutrition counseling had significantly higher weight gain (1.3 kg more) and infant birthweight (300 g more) than the no-treatment group, were reported in a widely circulated medical journal. This study represents a reasonable pilot study carried out in a clinical setting.

However, the study design could be improved to provide stronger evidence of effectiveness and greater confidence regarding the impact of nutrition intervention on pregnancy outcomes of underweight and failure-to-gain women.

Considerations in the design of similar clinical studies:

- Evaluate two or more methods of intervention at the same time to remove the possible influence of outside forces on outcomes.

(continued on next page)

-
- Evaluate varying aspects of the content and intensity of nutrition care rather than care or no care. This gets beyond defending nutrition services (versus no nutrition care) to developing a greater knowledge about what kind of nutrition intervention leads to effectiveness.
 - Determine the magnitude of a clinically important outcome ahead of time; then use that value to calculate a sample size for the study.
 - Randomly or systematically assign women to intervention alternatives (rather than haphazardly or by self-selection) to prevent bias in the groups.
 - Implement the study prospectively, monitor quality and completeness of data, and encourage complete participation of study participants. This leads to higher quality data, reduces attrition, and improves the generalizability of the results.
 - Track other outcomes including short-term, proximal outcomes of nutrition interventions like dietary intake, and consider measuring quality of life issues as was done by Walker et al., 1994.
 - Continue the study until a large enough sample size has been enrolled in each intervention alternative.
 - Verify that study participants fairly represent the population to which results are to be applied. Examine characteristics of participants in each intervention and compare those characteristics with the reference population.
 - Get appropriate statistical advice to conduct statistical analysis of data and interpret findings.

VI.

Cost-Effectiveness Analysis: Reporting Results

The report of your effectiveness evaluation ideally should include the standard parts of a research or technical report: abstract; introduction/statement of the problem and relevant background information including past research in the area; explicit listing of evaluation objectives and questions; description of the evaluation design including alternatives/groups compared, sample selection, key outcomes and other variables assessed, and data collection methods; findings including clinical meaning and statistical significance; discussion; and recommendations for application.

Also consider a one- to two-page executive summary highlighting the intervention evaluated—the type and amount of service delivered to clients, characteristics of the target population, brief description of evaluation methods, rate of success in terms relevant to decision makers (including clinical terms and statistical significance), and implications of the evaluation findings for pending decisions.

In the full report, describe the specific intervention(s) evaluated and the characteristics of the sample population studied. Include variations and problems in the delivery of the intervention if this is the reality of your evaluation situation (and a fact of real-world conditions). Disclose the data collection and analysis processes along with prob-

lems encountered and how you dealt with them. Report positive as well as negative findings. Present the findings for the key indicator as well as other important consequences experienced by the client as a result of participating in the intervention. If subgroups of the population had different levels of success, describe these differences. With this information, other users can judge the scientific validity and appropriate application of your findings. Complete reporting enables you and others to appropriately use the findings from carefully executed effectiveness evaluations in cost-effectiveness analysis.

Present the results in a concise, easy-to-read form and in terms that are meaningful to the readers of your report. Refer to Suitor (1992) for help in using tables and graphs to present evaluation results more effectively. Today's spreadsheet and graphics software makes this task considerably easier.

Relating Outcomes to Costs for Cost-Effectiveness Analysis

Reports of cost-effectiveness often present the results in ratio form (as illustrated at the bottom of Exhibit 11). The ratios communicate the cost for a unit of outcome and allow direct comparison between the efficiency of one alternative and the

efficiency of another. When the ratio is used, it is more difficult to visualize the total cost of implementing the intervention, and the actual magnitude of change is not evident. Decision makers ultimately will need additional descriptive or graphic information to consider budgetary ramifications and numbers of persons who are likely to have access to the proposed nutrition interventions and to benefit from them.

Occasionally, evaluators create a weighted outcome composed of more than one outcome indicator or use a global outcome such as quality of life or quality-adjusted-life-years in the cost-effectiveness ratio. Use of quality of life estimates is illustrated in Exhibit 12.

In a recent meta-analysis that used a global cost-effectiveness ratio of median cost per life-year saved, many MCH interventions ranked very efficient compared to other public health measures (see Exhibit 13).

Various audiences may be interested in other outcomes beyond the key outcome identified for the cost-effectiveness ratio. Furthermore, most nutrition interventions have several outcomes that are not easily condensed into a single unit of measure. Presenting outcomes and costs in an array or table allows the audience to consider simultaneously a range of outcomes in relation to the resource requirements needed to produce the outcomes. Exhibit 14 illustrates the presentation of cost-effectiveness results in an array. This approach also allows for reporting intangible costs and effects that are important in the decision making context but not quantified in the cost-effectiveness analysis.

Reporting Cost-Effectiveness Analysis Results

In reporting the results of economic evaluations, consider the target audiences for the findings. Early in the process of planning the economic evaluation, you considered who needs to know

about the costs and effectiveness of nutrition interventions. Now your challenge is to provide useful information relevant to their needs and decision-making responsibilities. Relate the findings of the cost-effectiveness analysis to decisions that need to be made.

There are numerous decision makers in health, social service, and education systems who are appropriate target audiences for the results of cost-effectiveness studies of nutrition interventions. Consider policymakers at the state and federal level, health service planners, administrators and benefits managers in managed care organizations at local and corporate levels, local and state health departments, underwriters in insurance companies, and physicians and other health care providers.

Present results in ways that help decision makers recognize the relevance of nutrition outcomes to their decisions. This means you have to understand the pressures and constraints of your target audience. For example, adding or expanding a cost-effective nutrition intervention is likely to be more readily accepted in settings that have current experience with nutrition services and programs. In settings that lack experience, trained staff, and infrastructure to provide nutrition services, greater hesitancy can be expected. In addition, these two types of settings can be expected to incur different levels of cost in initiating the nutrition intervention. Another factor affecting the target audience's receptivity to information about the cost-effectiveness of nutrition interventions is the prevalence of nutrition-related problems in their jurisdiction and their awareness of nutrition as a problem area.

The results of the cost-effectiveness analysis will be more relevant to decision makers if the perspective for analysis is clearly identified and matches their perspective. The administrator of the managed care organization, for example, will appreciate the organizational perspective that analyzes costs and outcomes as experienced at the organizational level; the U.S. senator may be more interested in an analysis applied at the societal level. One strength of economic analysis methodology is that

Exhibit 11. Cost-Effectiveness Ratio

Costs, Effects, and Cost-Effectiveness Ratios for Cholesterol Intervention Alternatives*

	Education Only (n=132)	Education + Drug (n=44)	Drug Only	No Inter- vention (n=32)	Total (n=219)
Costs					
Baseline Medical Supervision	\$31,858.00	\$10,619.00	\$2,654.00	\$7,723.00	\$52,855.00
Intervention Marginal Costs	13,828.00	29,044.00	7,922.00	0	50,795.00
Total Costs	45,686.00	39,663.00	10,578.00	7,723.00	103,650.00
Total Cost/Patient	346.11	901.45	961.60	241.35	473.29
Marginal Cost/Patient	104.76	660.10	720.25	0	231.94
Effects					
Cholesterol Reduction (mg/dL)					
Observed ± se	-33.8 ± 3.5	-60.7 ± 6.9	-74.8±15.8	-17.5±9.5	
Net (Obs - No Interv)	-16.3	-43.2	-57.3	0	
Adjusted ± se	-14.6 ± 8.3	-31.9±9.9	-38.4±10.1	—	
Cholesterol Change (% of initial chol)					
Observed ± se	-11.8 ± 1.2	-19.5 ± 2.2	-22.9 ± 4.6	-5.1 ± 3.2	
Net (Obs - No Interv)	-6.7	-14.4	-17.8	0	
Adjusted ± se	-6.3 ± 2.9	-12.2 ± 3.5	-14.3 ± 5.0	—	
Cost-Effectiveness Ratios					
(\$/1% change)					
Marginal Cost/Observed 1%	8.88	33.85	31.45	47.32	
Marginal Cost/Net 1%	15.64	45.84	40.46	—	
Marginal Cost/Adjusted 1%	16.60	54.11	50.54	—	

*Reproduced with permission. Splett, PL. *The Cost Effectiveness of Education for Cholesterol Reduction: A Three State Clinical Investigation*. Doctoral Thesis, University of Minnesota, 1990.

the perspective for analysis is made explicit from the start.

Finally, it is important to recognize that economic efficiency is not the only factor used in the decision-making process. Outcomes resulting when decisions are based solely on the economic criterion of cost-effectiveness are not necessarily consistent with other program goals. Often, it is more costly, for example, to deliver services to “hard-to-reach” populations and these populations may have

lower levels of success because of numerous barriers and competing needs. Thus, cost-effectiveness results might not favor provision of services to this population. Interpretation of the results of the cost-effectiveness analysis should include discussion of the ethical implications of going with the preferred alternative, based strictly on the efficiency criterion. Ethical considerations of results should be explored and discussed in cost-effectiveness reports.

When considering target audiences for the

Exhibit 12. Cost-Effectiveness Ratio Using Quality of Life

Illustration of Cost-Effectiveness Ratio Calculations Using Hypothetical Data*

Strategy	Treatment Costs	Effectiveness (Life Expectancy)	Utility (Quality of Life)	Utility (Quality Adjusted Life Expectancy)	Benefits
Treatment A	\$20,000	4.5 years	0.80	3.6 QALYs**	\$4,000
Treatment B	\$10,000	3.5 years	0.90	3.15 QALYs	\$2,000
Incremental cost-effectiveness ratio	=	$\frac{\$20,000 - \$10,000}{4.5 \text{ years} - 3.5 \text{ years}}$		=	\$10,000 per life-year gained
Incremental cost-utility ratio	=	$\frac{\$20,000 - \$10,000}{3.6 \text{ QALYs} - 3.15 \text{ QALYs}}$		=	\$22,222 per QALY gained
Incremental cost-benefit ratio	=	$\frac{\$20,000 - \$10,000}{\$4,000 - \$2,000}$		=	5

*Reproduced with permission. Detsky, AS, Naglie, IG. A Clinician's Guide to Cost-Effectiveness Analysis. *Annals of Internal Medicine*, 113:147-154, 1990.

**QALYs = quality-adjusted life.

results of cost-effectiveness analyses, also consider clients, the public, and advocates. Information about the cost-effectiveness of nutrition interventions mobilizes these audiences to demand nutrition services within the systems they use and prepares them for a role in influencing policy decisions at local, state, and federal levels.

Organizing the elements of traditional reporting

Reports of research and evaluation studies, including economic analysis, traditionally are organized in the following way:

- Abstract;
- Evaluation context: intervention purpose, alternatives studied;
- Research/evaluation questions—cost-effective analysis framework, including perspective, alternatives, time horizon, key outcome(s) of interest;

- Methods—evaluation design, sample, data collection procedures for cost and outcomes;
- Results—costs and outcomes, cost-effectiveness findings, sensitivity analysis;
- Discussion;
- Recommendations (not included in all reports); and
- References.

Be prepared to report cost-effectiveness results in this way for publication through traditional channels of journal publication and for presentations at professional and scientific meetings. Disseminating the data and methodology to other practitioners and researchers is essential.

Considering other presentation styles

Also consider other presentation styles for other purposes. In the traditional style of reporting, the

Exhibit 13. Cost-Effectiveness Ratios in a Meta-Analysis

Median Cost/Life-Year Saved Estimates Within Intervention Sub-Category*

Life-Saving Intervention Sub-Category	No. of Estimates	Median Cost/ Life-Year Saved
Childhood immunization	6	<\$0
Drug and alcohol treatment	4	<\$0
Prenatal care	12	<\$0
Venous thromboembolism prevention	17	<\$0
Influenza vaccination	3	\$1000
Helmet protection	4	\$2000
Cholesterol screening	2	\$6000
Smoking cessation advice	15	\$6000
Cervical cancer screening	21	\$12000
Neonatal intensive care	4	\$12000
Gastrointestinal screening and treatment	15	\$12000
Organized health services	6	\$14000
Osteoporosis screening	3	\$18000
Coronary artery bypass graft surgery	8	\$26000
Hormone replacement therapy	13	\$42000
Cholesterol treatment	19	\$154000
HIV/AIDS screening and prevention	4	\$447000

*Abstracted from Tengs, TO, Adams, ME, Pliskin, JS, Safran, DG, Siegel, JE, Weinstein, MC, Grahln, JD. *Five-Hundred Life-Saving Interventions and Their Cost-Effectiveness*. Center for Risk Analysis, Harvard School of Public Health: Boston, MA, 1994.

decisions and recommendations are separated from the results. For many audiences, reporting can be more effective when the results and the decision implications are linked together—by stating the evaluation question, presenting the results, then immediately following with the conclusion or recommendations. Conclude with a discussion of special issues such as sensitivity analysis to explicitly identify and explore the implication of uncertainty for various situations, and cite any ethical considerations. Exhibit 15 illustrates this approach, which is useful in both written and verbal presentations.

Finally, remember to apply techniques for effective communication whether you are preparing for oral or written presentations. See Exhibit 16 for tips.

Exhibit 14. Cost-Effectiveness Analysis Results Presented in an Array

Nutrition Visits, Costs, Outcomes, and Cost-Saving for Nutrition Care in NIDDM*

Level of Nutrition Care	No. Visits	Average Contact Time	Total Costs	Per Patient Cost**	Mean Change FPG (mg/dl)	Mean Change HbA1c (% point)	No. of Therapy Changes	Average Cost Savings Due to Therapy Changes
Basic Care (BC) (n=85)	1	1 hr	\$3,565.55	\$41.95	-7.3 ± 49.4	-0.69 ± 1.67	9	\$3.13
Practice Guideline Care (PGC) (n=94)	3	2½ hr	\$10,534.33	\$112.07	-19.2 ± 49.9	-0.93 ± 1.63	17	\$31.49

*Reproduced with permission. Franz, M, Splett, PL, Monk, A, et al. Cost Effectiveness of Medical Nutrition Therapy Provided by Dietitians for Persons with Non-Insulin-Dependent Diabetes Mellitus. *Journal of the American Dietetic Association*, 95(9):1018-1024, 1995.

**Incremental costs for medical nutrition therapy as a component of diabetes care, expressed in 1993 dollars.

Exhibit 15. Quick Style Presentation of Cost-Effectiveness Analysis Results

CLINICAL PREVENTIVE SERVICES ARE MOST EFFECTIVE IF TREATMENT COSTS ARE KEPT LOW AND TARGETED TO THOSE WHO ARE AT GREATEST RISK.*

Cholesterol testing and follow-up treatment with diet and/or medicines is cost-effective if the treatment costs are kept low and testing is targeted to men and women who already have heart disease and only middle-aged men among those without known heart disease.

BOTTOM LINE:

In prevention of coronary heart disease deaths, a year of life gained costs roughly \$1000 for smoking cessation counseling, \$10,000 for organized exercise programs, and \$20,000+ for cholesterol reduction in high-risk middle-aged men.

These estimates are very sensitive to selection of patients and cost of the test and treatment. We can expect many new tests to be developed, especially with the rapid advances in genetics, starting with genetic tests for predisposition to colon cancer and breast cancer, which will have to be evaluated carefully and be used in ways designed to maximize cost-effectiveness.

*Hatziaandreu, EI, Koplan, JP, Weinstein, MC, Caspersen, CJ, Warner, KE. A Cost-Effectiveness Analysis of Exercise as a Health Promotion Activity. *American Journal of Public Health*, 78:1417-1421, 1988. As reported in Omenn, GS. *Prevention: Benefits, Costs, & Savings*. Washington, DC: Partnership for Prevention, 1994. Reproduced with permission.

Exhibit 16. Tips for Effective Communication on the Cost-Effectiveness of Nutrition Interventions

Apply these practical, proven tips for effective communication in written and verbal presentations.

Get ready for the presentation

- Know your audience and their need for information and their decision-making roles
- Relate the information to decisions that must be made
- Do not give the audience more than they need

Do it

- Start with the most important information
- Be brief
- Be memorable
- Use graphs and tables to present information
- Give them a short quotable summary

Follow through

- Be accurate, be credible, avoid overgeneralizing the results
- Time communication early in the decision process and send reinforcing information at later stages.

VII.

Pulling It All Together: Illustrating the Concepts

Exhibit 17. Before You Begin . . .

Ask yourself these questions:

- What problem is to be addressed in the cost-effectiveness analysis? What is the nutrition intervention or program? What are the alternatives?
- Who are the recipients/target audience?
- What is the desired key outcome of the intervention for the target audience?
- What are the other positive or negative consequences? For whom?
- When are the key outcome and other consequences experienced?
- Do good data exist on the cost of the intervention? Are data on the key outcome and other consequences currently available or will new data collection be necessary?
- Who will be the primary users of the results? Will there be other users? Who?

Exhibit 18 presents a schematic for the process of performing a cost-effectiveness analysis.

Exhibit 18. Six Steps for Cost-Effectiveness Analysis (CEA)

Step 1. State OBJECTIVE

Step 2. Define CEA FRAMEWORK

- perspective
- alternatives
- time horizon

Step 3. Determine COSTS

- define all activities
- specify measurement
- collect cost data
- calculate costs
- discount

Step 4. Determine OUTCOMES

- define outcomes
- select design
- collect data
- analyze data
- discount

Step 5. RELATE costs to outcomes

- ratio
- array

Step 6. Summarize, Interpret, and REPORT findings

- ethical implications
- sensitivity analysis
- usefulness to decision makers

An expanded look at the steps for planning and implementing cost-effectiveness analysis follows. Use this as a checklist to move through the process.

Planning a Cost-Effectiveness Analysis of Nutrition Interventions

Step 1. State the objective of the cost-effectiveness analysis.

- 1.1 What type of program or intervention are you evaluating?

- 1.2 Why are you doing the cost-effectiveness evaluation?

Step 2. Define the framework for the cost-effectiveness analysis.

- 2.1. What is the perspective for the economic analysis? Whose resources are at stake?

- | | |
|--|---|
| <input type="checkbox"/> Provider/organization | <input type="checkbox"/> Society |
| <input type="checkbox"/> Payer | <input type="checkbox"/> Health care sector |
| <input type="checkbox"/> Patient/family | <input type="checkbox"/> Other |

- 2.2. What intervention alternatives will be evaluated?

- Identify your target intervention or program.

- Identify one or more relevant comparisons.

- 2.3. Define the time horizon for costs and outcomes.

- Over what time horizon are the input costs incurred?

- What is the appropriate time horizon to track the key outcome (and other consequences) of the intervention alternatives?

Steps 3 and 4. Determine costs and outcomes. These are parallel steps in which accepted methods of evaluation are applied to identify, measure, and quantify costs and outcomes for each alternative. Discount costs and outcomes to a standard base year if time horizon is longer than one year or if data for some alternatives were collected in different time periods.

Step 3. Determine costs.

3.1. Types of costs

Direct costs to the organization:

- Define all activities related to implementation of the intervention or program.

- Will other costs be included? (If yes, describe.)

- Direct cost to patients _____

- Indirect costs _____

- Intangible costs _____

3.2. Specify how costs will be measured or estimated.

- List principal cost components for each activity.

- Specify source of cost data.

3.3. Collect data on costs.

- Make plans for monitoring cost data collection.

3.4. Calculate costs.

- Total costs for intervention _____

- Unit cost _____

- Marginal cost _____

- Incremental cost _____

3.5. Is discounting indicated?

- Yes No

Step 4. Determine outcomes.

4.1a Key outcome

- Define the key outcome to be tracked _____
- Select indicator _____
- Measurement/documentation method _____
- Criterion or benchmark for determining effectiveness _____

4.1b List other important positive and negative outcomes/consequences to be tracked.

- Identify the appropriate indicators and measurement methods for each.

Outcome/consequence	Indicator	Measurement/documentation method

4.2 Select the evaluation design and procedures.

Type of study

- Refer to Exhibit 9 for evaluation design options.

Sources of data

- In-house existing data
- New data collection
- Data from existing studies
- Estimates based on meta-analysis

Sample

- Determine sample size _____
- Determine how client population will be sampled _____

Other variables to be documented

- List variables (including intervention variables, client characteristics, and intervening variables) and define indicators and how each will be measured.

Variable	Indicator	Measurement/documentation method

Data collection procedures/instrumentation (consider for every outcome and variable listed)

- Measurement techniques and documentation procedures exist.
- Need to develop new procedures.

Data analysis

- Consult with statistician to plan appropriate analysis of data.

4.3. Gather data on outcomes and other variables.

- Make plans for monitoring data collection processes.

4.4. Analyze data. Determine:

- Clinical importance
- Statistical significance
- Other consequences (positive and negative)

4.5. Is discounting indicated?

- Yes
- No

Step 5. How will you relate costs to outcomes for each alternative?

- Cost-effectiveness ratio
- Cost and outcome findings in an array
- Both

Step 6. Summarize, interpret, and report the findings in terms of the objectives of the cost-effectiveness analysis and the decision for a sensitivity analysis to be made.

- List possible uncertainties sensitivity for analysis.

- Note possible ethical considerations.

- Plan to make report meaningful for decision makers/audience.

Example: A Comparison of Three Staffing Models

This section of the *Guide* illustrates the six-step model for cost-effectiveness analysis. The example chosen does not include nutrition, but was selected because it is a good study that addresses the question: What is the most cost-effective staffing model to provide essential care? This kind of question is important to developing and evaluating strategies that incorporate nutrition intervention into health promotion and disease prevention initiatives.

The following example is taken from A Cost Effectiveness Analysis of Three Staffing Models for the Delivery of Low-Risk Prenatal Care as reported by Graveley, EA, Littlefield, JH, in the *American Journal of Public Health*, 82(2):180–184, 1990.

Step 1. State the objective of the cost-effectiveness analysis.

This analysis will compare the cost-effectiveness of three low-risk prenatal staffing models.

The results will help public officials make future decisions about safe and efficient methods to provide quality prenatal care to low-income women in a predominantly Hispanic population. This is important to the Texas community where the study was done, and it also produces information related to the *Healthy People 2000* national objectives for reducing the rate of low birthweight infants, improving access to early prenatal care, and closing the gap in perinatal outcomes among minority populations.

Step 2. Define the framework for the cost-effectiveness analysis.

2.1. What is the perspective for the economic analysis?

Provider organizations (three clinics) are the perspective for analysis.

In addition, the evaluators collected information on patients' out-of-pocket costs for prenatal care.

2.2. What intervention alternatives will be evaluated?

Three alternatives will be evaluated:

- a. A physician-based clinic operated by a private, not-for-profit entity (MDC).
- b. A mixed staffing clinic operated by city health department (MSC).
- c. A nurse-based clinic operated by a county hospital and a university (RNC).

2.3. Define the time horizon for costs and outcomes.

Outcomes were measured by interviewing women after delivery at the county hospital for three months in 1989. Costs were provided by the financial officers at each clinic. (The authors do not state the time of cost data. It is assumed to be 1989 for the period of prenatal care preceding delivery.)

Step 3. Determine Costs

3.1. Define all activities.

Activities included appointments made, prenatal care delivered, nurses' consultations with physicians.

3.2. Specify how costs will be measured.

Costs were limited to personnel costs, which were calculated from hourly wages/salaries of personnel x standard appointment times (15 minutes per visit at MDC, 30 minutes at RNC, and preset times for each personnel category at MSC). Personnel included a physician, nurse practitioner, clinical nurse specialist, registered nurse, licensed vocational nurse, nurse's aide, social worker, caseworker, and clerk. Facility costs were excluded because they were not considered germane to determining the clinic's staffing model costs. This cost analysis thus considers the marginal cost of personnel and assumes the facility and support activities are in place and unaffected by the staffing model.

3.3. Gather data on costs.

Financial officers provided data on five variables: number of staff, hourly wages, number of prenatal appointments made, number of prenatal appointments kept, and number of hours spent delivering prenatal care. (The authors note that the nurses kept flow charts of the amount of time spent conferring with physicians.)

3.4. Calculate costs.

Salary levels used by authors to calculate total personnel costs for each clinic are reported in the article. Cost per clinic visit was determined by dividing the personnel costs by the number of kept appointments. Clinic productivity was determined by dividing the number of patients seen for prenatal care by the number of hours spent delivering prenatal care.

For cost-effectiveness analysis, the differences among clinic costs and appointment outcomes were calculated using a percent difference (with the lowest percent as baseline). To calculate this difference, the clinic with the lowest cost or outcome value was identified, then the percentage difference between this model and the other two was calculated (see Exhibit 19c). Note that this results in an incremental cost or outcome.

3.5. Perform discounting.

Because the time horizon of the study was limited to a short period of time, no discounting is indicated. (Note: To apply these results to a current decision, the 1989 dollars would need to be adjusted to present value using the Consumer Price Index.)

Step 4. Determine Outcomes

4.1. Define the key outcome and other important consequences to be tracked.

The key outcome of interest for the cost-effectiveness analysis was the number of appointments kept. When related to cost, this is the indicator or productivity of each clinic and forms the basis for future policy decisions.

Clinic productivity cannot be judged in the absence of information about pregnancy outcome and patient satisfaction; thus, the evaluators also tracked those important outcomes. The analysis was planned to investigate differences between clinics on a range of outcomes relevant to prenatal care. To accomplish this, four categories of patient variables were tracked:

- a. Demographic variables—age, ethnicity, education, Medicaid status, marital status, gravida, number of prenatal visits, adequacy of prenatal visits using the Kessner Index, prenatal classes;
- b. Physiological variables—maternal weight gain, hemoglobin, complications at time of delivery, neonatal weeks of gestation, birthweight, Apgar score, admission to NICU;
- c. Satisfaction with care (using a patient satisfaction tool); and
- d. Cost to patient—subjects' reported out-of-pocket costs for prenatal care.

4.2. Select evaluation design.

The three existing clinic modules were studied in a cross program comparison. The study is a quasi-experimental design using retrospective data collection.

A power analysis was used to estimate the sample size (156 subjects, with 52 seen at each clinic) needed to identify a significant difference in infant birthweight among the three clinics. Existing research reports were used to develop the variables and responses included in the patient interview. Eligibility criteria were specified, and eligible women were identified from hospital records.

4.3. Gather data on outcomes and other variables.

All women who met eligibility criteria were interviewed within 48 hours of delivery; no one declined to participate. (No information is provided about the interviewers.) Hospital records were audited.

4.4. Analyze data. Determine the degree of effectiveness. Describe other consequence (positive and negative).

Numbers of appointments made and kept at each clinic were reported (see Exhibit 19b). There were no significant differences among the clinics for any of the maternal physiological variables. Babies born through the three clinics did not differ on any of the five neonatal variables. Maternal satisfaction was not significantly different for accessibility or affordability, but significant differences were found for availability, acceptability, and accommodation (see Exhibit 19a).

4.5. Perform discounting.

Discounting is not needed in this short-term study.

Step 5. Relate costs to outcomes for each alternative using a cost-effectiveness ratio or an array.

Example 19b presents the costs and key outcome for each clinic. This information, along with other tables in the article, gives readers a good understanding of the range of costs and outcomes experienced by the three staffing models. This type of presentation of data is called an array. The last two lines of Exhibit 19b

present cost-effectiveness ratios. The cost per kept appointment is the key index for comparing the three staffing alternatives. Exhibit 19c is an incremental cost-effectiveness analysis that shows the added cost or outcome compared to the lowest cost. Consideration of additional cost and additional outcome (over the lowest alternative) is useful to decision makers.

Step 6. Summarize, interpret, and report findings.

- Conduct sensitivity analysis.
- Include ethical considerations.
- Make report meaningful to decision makers.

The authors conclude: “The study found that increasing the availability of low-risk prenatal care professionals through the use of nonphysician maternal health providers, with physicians available for consultation, might substantially reduce the cost of providing this care while maintaining quality. Therefore, such a system might save valuable resources.” The report includes easy-to-read tables, which allow the reader to consider the actual outcome and cost data behind this conclusion.

The discussion section explores some of the processes in clinics that are related to differences in staffing, and notes that these are not associated with differences in outcomes. “The absence of significant differences among the three clinics for the maternal-neonatal physiological variables was expected and supports other reports that nurses prepared for a specific area of health care can provide quality care.”

No sensitivity analysis is reported. The authors do note that one clinic (MSC) frequently was open for more than the four hours per week reported by the financial officer. Discussions with RNC staff revealed concern about time spent waiting for physician consultation and the subsequent impact on productivity of some staff at that clinic. Differences in missed appointment rates among clinics was noted to increase costs because fixed personnel costs are expended whether or not care is delivered. The role of the case manager in following up on missed appointments was a factor in improving appointments kept and improving productivity at one clinic (MDC).

Exhibit 19. Results from an Economic Analysis of Three Staffing Models

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19a. Student Newman-Kauls Significant PST^a Category Means by Clinic

Significant Category	Clinic Mean Score		
	MDC ^b	MSC ^c	RNC ^d
Availability	22.3	18.5 ^e	23.5
Acceptability	52.3	51.6 ^f	53.9
Accommodation	36.2 ^b	32.3 ^e	37.9
Total PST score	124.5 ^b	116.6 ^f	129.1

^a PST, patient satisfaction tool.

^b MDC, physician-based clinic.

^c MSC, mixed-staffing clinic.

^d RNC, nurse-based clinic.

^e Significantly lower score compared with MDC and RNC.

^f Significantly lower score compared with RNC.

19b. Cost and Outcome Data for Three Clinic Staffing Models

Measure	Alternative		
	MDC	MSC	RNC
Cost			
Personnel costs	\$18,965	\$12,381	\$13,008 ^a
Outcome			
Appointments made	1695	1341	1665
Appointments kept	1395	984	1216
Hours	804	962	590
Productivity	1.7	1.02	2.06
Cost-effectiveness			
Cost per appointment	\$11.19	\$9.23	\$7.81
Cost per kept appointment	\$13.58	\$12.58	\$10.70

^aIncludes six hours of consultation time.

**19c. Percentage Differences in Cost and Outcome Data for
Clinic Staffing Models for Three Study Months**

Measure	Clinic, %		
	MDC	MSC	RNC
Personnel costs	53	0	5
Appointments kept	42	0	24
Hours delivering prenatal care	35	63	0
Productivity	67	0	101
Cost per kept appointment	27	18	0

VIII.

Future Challenges

In the nutrition community, we need better linkage between the process of nutrition care and its outcomes. This is increasingly necessary as resources are cut for maternal and child health, public health, and nutrition programs, as well as clinically based services. Available resources must be applied as efficiently as possible to the most effective activities and interventions within the field of nutrition. This means moving toward well-defined interventions based on what works. Practice guidelines, protocols, and standards that outline appropriate nutrition care for specific circumstances need to be further developed and disseminated. Efforts can build on CQI and other quality management programs within institutions which evaluate and continuously improve the process of nutrition intervention and program delivery.

We need to improve and expand the standardization of nutrition outcome indicators and encourage the development of systems to document and track these indicators. We need more reliable and valid measures of nutrition outcomes. We urgently need core data sets with standardized indicators to document nutrition interventions and their outcomes. We need computerized data systems to collate and aggregate data. We need more studies concerning the outcomes, costs, and cost-effectiveness and cost-benefit of nutrition interventions.

With these steps, we will have greater comparability across studies, intervention settings, and population subgroups. This will give us the ability to assess and understand the effectiveness of universal nutrition programs—will there be any?—and specialized target interventions. Better data will allow for greater efficiency in nutrition practice and provide an empirical basis for policy decisions involving nutrition interventions.

Not all nutrition interventions will produce financial benefits that exceed the cost of the indicated and appropriate nutrition intervention. This does not mean such nutrition interventions should be eliminated. The contribution of nutrition service to the desired outcome must be known—and the outcome valued in human as well as economic terms. We should attempt to achieve the outcome as efficiently as possible. Through these steps, services and interventions will be available to support optimum nutrition for mothers, children, and families.

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Appendix A: Worksheet to Critique Studies and Reports on the Effectiveness of Nutrition Interventions

Use this worksheet to determine if the findings from nutrition intervention evaluations reported in published articles, program reports, government documents, etc., apply to your situation.

I. Initial Screening of Report

A. Title

Is the topic potentially related to your interest?

B. Authors and Source

Do they have experience and credibility?

C. Evaluation Context

• Intervention

What was the exact intervention studied in terms of intensity, content, duration?

What was the setting for application of the intervention?

Who were the providers of service?

Is the intervention sufficiently similar to yours?

• Target Population

Who was the target audience?

Are the subjects similar to yours in terms of age, ethnicity, disease, severity, risk factors, socio-economic status, and other features bearing on the intervention and desired outcome?

• Outcomes

What key outcomes were assessed?

Are these outcomes relevant?

• Evaluation Purpose

What was the purpose (objectives, research questions, hypothesis) of the study?

Does the approach allow an unbiased investigation of the effectiveness of the nutrition intervention?

II. Detailed Critique of the Quality of the Study and Report

If the report passes the initial screening questions, then do a more detailed review. Use the following questions to determine if you can use the data with confidence as to their scientific validity.

A. Evaluation Design and Data Collection Procedures (Methodology)

What was the evaluation design?

Does it allow for attribution of outcomes to the nutrition intervention?

What groups/alternatives were compared?

Is there a clear description of samples studied?

What was the mode of sample selection (random assignment, matching, voluntary participation, convenience)?

Does the sample represent the reference population?

What was the attrition/dropout rate? Did it differ between groups?

Are all relevant intervention, client, intervening, and key outcome and other outcome variables defined?

Are the indicators used for measurement appropriate?

Are measurement instruments and procedures reliable and valid?

Is description of procedures for data collection complete—where, when, and how data obtained?

Is there protection against investigator bias in data collection?

Are methodological assumptions such as adequacy of reliability and validity of measures, representativeness of samples, and fulfillment of appropriate requirements for statistical tests reported?

B. Analysis and Presentation of Findings

Objective (data based) rather than speculative presentation of results

Findings presented in readable charts, tables, figures, graphs

Both clinical meaning and statistical significance addressed

Appropriate statistical tests used

Statistical adjustments for preexisting differences between groups

Uncontrolled factors appropriately cited

Negative as well as positive findings reported

C. Discussion

Separation of findings from interpretation and discussion

Weaknesses of the evaluation and data honestly discussed

Contradictions or inconsistencies within the data and in comparison with previous reports discussed

D. Conclusions and Recommendations

Conclusions consistent with and supported by data

Conclusions within scope justified by the evaluation and data

Appropriate implications and recommendations for application

Questions for further investigation identified

Appendix B: Glossary of Terms

Analyses

Cost-Minimization Analysis—focuses on identifying and quantifying costs. This method is used when the outcomes between alternatives are assumed to be equal. Cost minimization analysis identifies the least costly way to proceed.

Cost-Effectiveness Analysis—compares two or more alternative interventions for achieving a specified outcome. It relates the cost of resources, expressed in dollars, to the amount of outcome achieved, expressed in natural units such as pounds of weight loss or reduction in number of cases of anemia.

Cost-Benefit Analysis—assigns dollar values to both resource inputs and health care and other cost savings or losses associated with positive or negative outcomes. Input costs are then related to outcomes in either a ratio or as net cost or net benefit (when the dollar value of costs is subtracted from the dollar value of outcomes). Cost-benefit analysis can compare interventions with different goals or desired outcomes.

Cost Utility Analysis—evaluates costs and outcomes in terms of the patient's quality of life, or preference. Utility refers to satisfaction. Cost utility analysis incorporates the concept of "willingness to pay" to get the expected level of satisfaction or quality of life from the intervention.

Clinical Decision Analysis—an emerging area for application of economic evaluation methodology in health care. Clinical decision trees or algorithms illustrate decision options and give the estimated probability that specific outcomes will result from a course of action. The probability that adverse events will occur with or without clinical intervention is used to estimate the rate of adverse outcomes. This can then be used to estimate health care costs based on the dollar value to treat the resulting adverse event.

Costs

Direct costs (in nutrition)—those resources used by the provider in the delivery of nutrition and related care to achieve the health goals or outcome objectives of the intervention or program.

Full (or total) cost—the total cost of the program over a period of time (usually one year).

- *fixed costs*—stable costs not related to volume of service; or
- *variable costs*—resource utilization that varies with volume (number of clients) or intensity (frequency and type of contact) of service

Average cost—cost per unit of output/outcome (all fixed and variable cost involved divided by the number of units of service) (e.g., cost per nutrition assessment; cost per low birthweight infant prevented).

Incremental cost—cost for nutrition as an add-on to existing service (e.g., nutrition assessment added to an EPSDT visit).

Marginal costs—cost of doing a little more or a little less (e.g., adding a second nutrition follow-up visit for people completing a weight loss program).

Other Terms

Intervention—a purposefully planned service, program, policy, or other activity provided or directed to a defined population for the purpose of changing a behavior, risk factor, condition, aspect of health status, or system.

Efficacy—the level of outcome expected when the intervention is applied under ideal conditions. (Controlled experimental studies measure efficacy.)

Effectiveness—the level of outcome achieved when services are rendered under ordinary circumstances by average practitioners for typical clients.

Reference population—in an evaluation, the target population for whom the intervention was designed.

Time horizon—the defined period for tracking costs and outcomes; usually coincides with the normal course of intervention.

Discounting—a mathematical procedure used to convert future costs and future outcomes to “present value.”

Indicator—an observable and measurable form of an outcome. It defines the specific terms by which the outcome will be measured.

What additional resources or assistance does your organization need to carry out a cost-effectiveness study?
(check all applicable boxes)

- Funding
- Technical assistance
- Staff
- Other (specify) _____

Who else should receive this book? *(specify groups or names and contact information if possible)*

Today's date: _____

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