

Weighing the Economic Evidence: Guidelines for Critical Assessment of Cost-Effectiveness Analyses

Scott D. Ramsey, MD, PhD, and Sean D. Sullivan, PhD

Evidence-based medicine is concerned with the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients.¹ Increasingly, health care providers are being asked to weigh economic evidence alongside clinical evidence when making decisions about the care of their patients. Although the idea that physicians should consider economics in their decision making is viewed as an anathema to many,² this chapter takes the position that today's environment makes some consideration of economics inevitable. If one accepts the notion that economic considerations are unavoidable in clinical decision making, it seems reasonable then to take a position that only high-quality economic evidence should be used, in the spirit that evidence-based medicine is used to weigh clinical evidence. This article is devoted to giving clinicians the tools to evaluate economic evidence and determine whether that evidence is suitable for consideration in their clinical practice.

This article is written for clinicians who are not well-versed in the purposes and methods cost-effectiveness analysis. It takes a position that cost-effectiveness studies have much in common with the clinical literature that most physicians are comfortable reading and critically appraising. Thus, we will highlight important similarities and differences between sound economic and sound clinical evaluations. Some of the subtler aspects of cost-effectiveness analysis (eg, discounting of future costs and benefits, comparative measures of benefit) are not emphasized here. The interested reader can find greatly expanded discussions of these issues, along

with the major themes we discuss below, in several excellent reference texts.³⁻⁵

Before discussing the major issues that should be addressed when evaluating an article that provides economic evidence, it is useful to outline the important similarities and differences between clinical evidence and economic evidence. We begin with the similarities. Both evidence-based medicine and cost-effective analysis take a population viewpoint for decision making. This viewpoint involves basing decisions on evidence gathered from studies of populations rather than on evidence gathered on a case-by-case basis. So, for example, the clinician who is deciding whether a particular treatment is appropriate for his asthmatic patient would look to the literature reporting results from randomized controlled trials rather than how this treatment worked on his last patient (or even his colleague's patients). Similarly, cost-effectiveness analysis is designed to inform resource allocation decisions in health care based on evidence gathered from studies of populations, including the study types that are familiar to clinical readers (eg, randomized controlled trials, case control studies, cohort studies).

Even though evidence-based medicine and cost-effectiveness analysis have much in common, there are important differences between the two methodologies. First, the perspective is generally different. Clinical decisions are usually made from the perspective of what is best for the patient. Economic analyses are generally conducted from the perspective of society; that is, including all costs and benefits that are attributable to the intervention, even if they do not necessarily involve the patient directly. Taking a societal perspective is important in cost-effectiveness analysis, because costs and benefits from medical treatments often spill over to others beyond the person receiving treatment. For example, when a child is vaccinated against chicken pox, she benefits from the vaccine, but so do other children who would have been

Submitted, revised, 5 November 1998.

From the Departments of Medicine (SDR), Pharmacy (SDS) and Health Services (SDR, SDS), University of Washington, Seattle. Address reprint requests to Scott D. Ramsey, MD, PhD, Department of Medicine, Box 358853, University of Washington, Seattle, WA 98195.

exposed to her if she was not vaccinated and contracted the disease. Sometimes, taking the societal perspective leads to different conclusions than when one takes the perspective of the patient.

Second, although clinical effectiveness is necessary for a therapy to be cost-effective, a treatment can have clinical effectiveness and still not be cost-effective. Thus, the clinical information provided from evidence-based medicine will not necessarily help with economic decisions. This fact has not been lost on the proponents of evidence-based medicine, who note that practicing evidence-based health care is at least as likely to increase medical care costs as it is to decrease costs.¹

Third, economic analyses are conducted under the assumption that the decision maker operates within a budget constraint. Decisions to spend more on one program will necessarily mean spending less on one or more other programs. As a result, cost-effectiveness analyses almost always involve a comparison between alternative therapies to ascertain which therapy offers the best health value per dollar expended. Clinical evidence, more commonly, compares a new therapy with placebo care, even when placebo care (ie, no care) is not the standard of practice in the community.

For those who wish to practice evidence-based cost-effective medicine, it will be necessary to be familiar with the methods and meanings of cost-effectiveness analysis. Thus, the purpose of this article is to review some essential concepts regarding cost-effectiveness studies and to provide some guidelines for reviewing and appraising cost-effectiveness analyses of medical technologies. First, we provide some general principles of cost-effectiveness analysis, including the motivation for the analysis and the universe of possible outcomes. Second, we present key questions regarding the methodology and appropriateness of the analysis. This process is similar to that used to evaluate clinical studies, and interested readers should be satisfied that these questions are addressed satisfactorily before accepting and possibly acting on the evidence. Finally, the article closes with some thoughts on why clinicians should care about economic evidence, and how they might use this evidence in the course of clinical practice.

Principles of Cost-Effectiveness Analysis

Cost-effectiveness analysis can be defined as a set of research methods to assess and quantify the costs

and clinical consequences of medical care treatments that can be used to estimate the economic value of the treatment in relation to alternative treatments.⁶ A cost-effectiveness analysis of competing medical treatments should incorporate evidence on the clinical consequences (efficacy and safety) and the costs and relative cost-effectiveness of treatment alternatives from a perspective designated by the analyst.⁷ Guidelines for designing and reporting cost-effectiveness analyses—including methods for incorporating evidence on costs and effects—are now available and should be read by those who are interested in conducting these type of studies.⁴

Essential Concepts

The results of cost-effectiveness analyses are derived from a simple equation that integrates costs and outcomes:

$$\begin{aligned} \text{Incremental Cost-Effectiveness Therapy A} = \\ \frac{\text{Cost}_A - \text{Cost}_B}{\text{Effectiveness}_A - \text{Effectiveness}_B} \end{aligned}$$

Here, two therapies are compared, *A* (usually the new technology) and *B* (the established therapy). The incremental cost-effectiveness of *A* vs *B* is thus the attributable benefit per incremental level of expenditure for the new technology.

Given this equation, there are only four possible outcomes from a cost-effectiveness analysis, as illustrated in Figure 1.⁸ Quadrant B illustrates a treatment that is less efficacious or more harmful and costs more than the current treatment. Quadrant C depicts a dominant technology - one that improves health outcomes and achieves cost savings. Outcomes B and C are unambiguous results, indicating that the new therapy should be rejected (B) or accepted (C) technologies adopted by clinician and the health care system. Quadrant D represents a less expensive treatment with a reduced health outcome compared with standard therapy. Quadrant A shows the cost-outcome relation of most new medical technology. Here, health benefits improve, but at an additional expense to the health care system. For outcomes in quadrant D and A, clinicians, patients, and payers must decide whether the improvement or loss in health outcome is worth the additional costs or cost saving of

		Health Outcomes	
		+	-
Medical Costs	+	A	B
	-	C	D

Figure 1. Depiction of possible outcome of pharmacoeconomic study.

A - higher cost, improved outcome (tradeoff).

B - higher cost, worsened outcome (reject).

C - lower cost, improved outcome (accept).

D - lower cost, worsened outcome (tradeoff).

providing care with the new technology. Note that in a health care system with a fixed budget for a specified time, additional expenditure on new treatments reduces the amount of resources that are available to treat other diseases.

The second question, given that the results are valid, is whether the data applicable to the reader's setting are useful for his or her purpose(s).

Seven Essential Questions to Consider When Reading a Cost-Effectiveness Analysis

A well-done cost-effectiveness analysis integrates methods from clinical medicine, economics, epidemiology, and statistics. That few practicing clinicians have equally strong backgrounds in all of these areas should not discourage potential readers from taking on these articles, however. At its core, cost-effectiveness analysis ultimately must attend to certain essential issues regarding study methods, presentation of results, and discussion of the implications of the results that will be quite familiar to anyone who reads the medical literature. The seven points listed below may be used as a guide to help the reader evaluate the economic analysis. They are taken in order below.

1. *Does the study accurately reflect a question that is an important issue in clinical practice?*

Often, a cost-effectiveness analysis is motivated by the development and introduction of a new drug, device, or procedure. An economic analysis of a new medical technology should start with an accurate description of the indications and use of

the intervention as it is intended to be used in actual clinical practice. This approach includes a detailed description of the clinical indication, eligible patient population, path of diagnosis and therapy, and description of alternative intervention(s). The latter is particularly important because the choice of the comparison intervention will have a great impact on the incremental cost-effectiveness of the intervention being evaluated (remember, from the equation above, incremental cost-effectiveness is the *difference* in cost divided by the *difference* in effectiveness for two alternatives). In most instances, the comparison intervention should represent what is accepted medical practice in the absence of the new intervention. Sometimes, this option will be to do nothing (ie, conservative care). In any event, the comparison should be justified among potential alternatives. For example, it would be inappropriate to test the cost-effectiveness of a new drug for congestive heart failure against placebo, since angiotensin-converting enzyme inhibitors are considered the standard of care for this condition.

If the reader is satisfied that the clinical scenario, and choice of interventions are appropriate, she or he can turn to the next issue: the description of the treatment pathway and services used when addressing the patient's problem.

2. *Does the analysis accurately describe the treatment pathway and account for all the medical and nonmedical services that one would expect to be incurred when the intervention is used in the course of addressing the patient's problem?*

The appropriate time horizon for a cost-effectiveness analysis is the duration of the clinical condition. In some cases, such as pneumonia, this duration will be a matter of days or weeks. In others, such as emphysema or congestive heart failure, the duration is a lifetime. During the course of the illness, numerous diagnostic and treatment decisions will be made based on the results of tests and the patient's response to therapy. It is vitally important that all the relevant downstream consequences of a particular medical intervention are accounted for in the analysis. Thus, the cost-effectiveness analysis should include a detailed description of treatment pathway, and this pathway should be an accurate representation of what happens in clinical practice. For example, if the cost-effectiveness analysis is evaluating whether to use warfarin for anticoagulation of patients with severe conges-

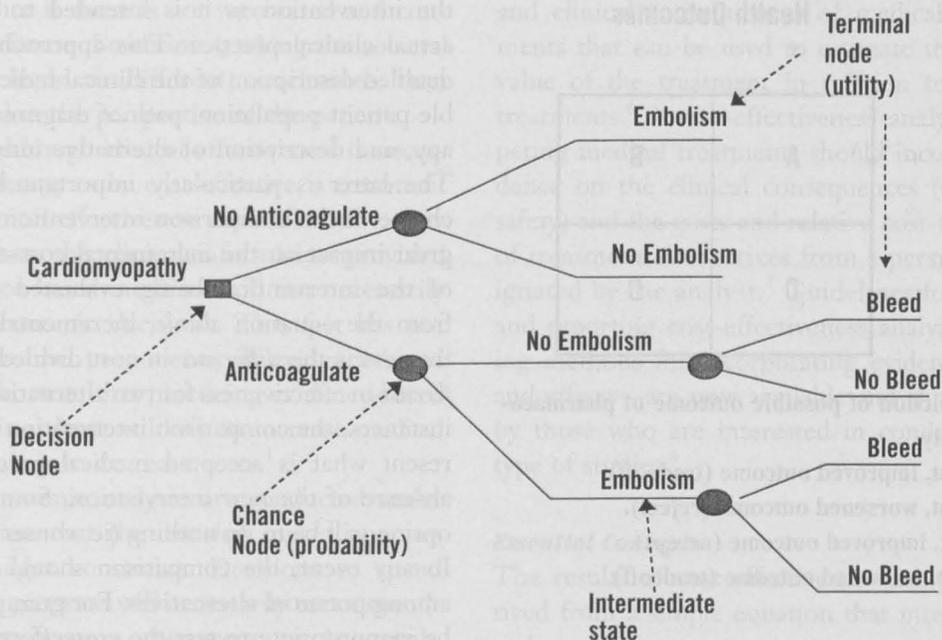


Figure 2. Decision pathway for choosing anticoagulation for patients with severe cardiomyopathy. Reprinted, with permission, from JAMA 1995;273:1292-95.

tive heart failure, the pathway should reflect all the important decisions and events that can happen during the course of treatment (Figure 2).

Along this pathway, patients consume medical and nonmedical resources. Medical resources will include such items as office visits, laboratory tests, prescribed medications, and hospitalizations. Non-medical resources can include such items as the cost incurred by the patient driving to and from the health care facility and the value of family members' time caring for patients whose ability to care for themselves is limited as a result of their illness. It is important that the cost-effectiveness analysis specifies all such relevant resources, because they must be valued and entered as costs in the numerator of the equation. The reader should ask whether any potentially important and costly resources were omitted from the analysis. For example, a study evaluating the value of computed tomographic scans compared with plain films for screening patients with head trauma for cervical spine injury would be in error if it excluded the cost of the radiologist's reading of the films, because the time involved (and fee) is different for the two types of films (fortunately, such an omission did not happen in this analysis!).⁹ In addition, all costs related to the therapy should be included, not just the costs of the therapy itself. Accordingly, in the example

above, the costs of missing a cervical spine fracture in the emergency department screening evaluation (patient suffers neurologic damage that requires lifelong care) is also included in the analysis.

If satisfied that all relevant diagnosis and treatment decisions and potential responses to therapy are included in the model, the reader should turn to the next important issue of evaluating the clinical endpoints and the strength of evidence regarding the effectiveness of the intervention at achieving those endpoints.

3. Are the clinical endpoints meaningful? When describing the effectiveness of the intervention at reaching these endpoints, are credible sources cited?

Patients and physicians are most interested in the end result of therapy, such as whether heart attacks or strokes were prevented, or whether a cure was achieved using a given therapy. Likewise, in cost-effectiveness analysis, the clinical endpoints that are of interest are the final steps in the disease pathway: restoration of pre-illness health, chronic disability, or death. Unfortunately, many clinical studies take weeks or months and often focus on intermediate markers of illness rather than clinical outcomes that are important to patients and physicians. Readers of cost-effectiveness analyses should be alert for studies that extrapolate from intermediate end points to clinical end points, because

potential fallacies can occur in this step. For example, a particular study of a chemotherapeutic regimen for lung cancer might list the percentage of patients with a tumor response as an end point. Of interest to patients and physicians, of course, are rates of long-term remission and survival among those who receive the therapy. Thus, tumor response would not be an appropriate end point for a cost-effectiveness analysis. When authors make a link between intermediate markers and clinical outcomes, the reader should be cautioned that the methods used to estimate associations should be subject to the same rigor as any other study design.

Interest is growing in including cost-effectiveness analyses directly in randomized clinical trials.¹⁰ Still, most cost-effectiveness studies continue to base their estimates of the effectiveness of a particular health intervention on data from completed clinical trials. When data from other clinical trials are used in the analysis, the reader must ask whether the sources used to establish the efficacy of the intervention are credible evidence that the intervention will actually work in clinical practice. There are two dimensions to this credibility: the robustness of the original study design to test the efficacy of the intervention, and the degree to which the original study reflects the style and level of care that occurs in actual clinical practice. The trial design methodologies that determine the robustness of a clinical efficacy study are a core element of evidence-based medicine.^{1,11} These methodologies are not discussed here other than to say that randomized controlled trials provide the highest level of confidence that the intervention indeed is associated with the clinical outcome of interest.

The degree to which the study reflects actual clinical practice is a more subtle issue for credibility but reflects the difference between clinical *efficacy* (the success of the intervention for a narrowly defined patient population treated under the tightly controlled conditions of a clinical trial) and clinical *effectiveness* (how successful the intervention is when used on real-world patients in typical practice settings). Ironically, studies that have the highest validity for determining efficacy—randomized clinical trials—have the greatest threat to validity for determining effectiveness. The reader should thus be sure to determine whether the study patients and clinical setting described in the cost-effectiveness analysis match the patients and setting described in the clinical trial. If they do not match

(common), the authors must take steps to adjust for the dissimilarities between the trial and the clinical scenario that is the basis for the economic analysis.

4. *Were costs and outcomes valued credibly?*

Up to this point, this article has concentrated on identifying the health care resources and outcomes in the economic evaluation. *Valuation* of those resources and outcomes is another area for the reader's attention and critique.

Costs (the numerator of the equation) are the product of goods and services consumed and the valuation (prices) applied to those resources. When considering prices, it is important to distinguish between charges, reimbursements, and true costs.¹² Charges are the bills that patients and third party payers are sent for the health care services. Reimbursement is the amount that is actually paid to the health care providers by patients and the insurer. True costs are what health care providers (hospitals, clinics, physicians) actually expend to provide the services, before markup or profit. In today's managed care market, third party payers often negotiate reimbursements that are less than what was charged by providers. In addition, when health care is covered under capitated insurance plans, reimbursement rates from payers to providers might actually fall below costs if patients suffer a higher than expected number of complications. True costs, charges, and reimbursement levels can differ substantially. There is some disagreement among economists whether true costs or reimbursements are appropriate measures of value.⁴ Still, all agree that using charges to value health resources is inappropriate, because charges almost always greatly overstate the value of the service relative to what it actually costs to provide the service and to what most parties in today's market are willing to pay.

The choice of which cost value to apply in a cost-effectiveness analysis depends entirely on the analytic perspective. For example, if the analyst is interested in evaluating a new inpatient diagnostic technology from the perspective of a hospital provider, then true hospital costs would be the variable chosen. On the other hand, if the analyst is interested in assessing which of several technologies is most cost-effective for payment by health plans or managed care organizations, reimbursement values would be selected as the appropriate metric.

One of the most difficult (and controversial) aspects of cost-effectiveness analysis lies in choosing the measure of effectiveness (the denominator

in the equation above). Effectiveness is measured a variety of ways in cost-effectiveness analysis. Still, it is most important to distinguish whether the measure of effectiveness is a natural unit (such as years of life or number of heart attacks avoided) or a measure that incorporates the quality of life associated with the clinical end points for the analysis. Some leaders in the field have stated that all cost-effectiveness analysis should include quality of life in the measure of effectiveness.^{4,13} Unfortunately, following this guideline has proved to be impractical for many cost-effectiveness analyses. Thus, interested readers must decide whether the clinical outcomes noted in the study can be reasonably measured in natural units, or whether some sort of adjustment to account for quality of life is necessary. The advantages and disadvantages of each approach are discussed below.

Most frequently, effectiveness in a cost-effectiveness analysis is measured in natural units, such as cases prevented, days free from symptoms, or years of life saved. Such ad hoc denominators have the advantage of being readily identifiable and unambiguous aspects of a disease that are clearly affected by the treatments in question. A disadvantage is that important factors beyond that particular measure of effectiveness which might also be affected by the treatment are ignored. For example, focusing on life years gained as the measure of effectiveness ignores improvements in functional status and changes in quality of life, both of which might be affected by the therapies. In addition, it is difficult to compare multiple interventions in one disease area or across diseases when ad hoc measures are used. For example, how does one weigh two cost-effectiveness analyses of cholesterol therapy for coronary artery disease when the measure of effectiveness for one is measured in milligrams of cholesterol reduction, and the other is measured in life-years saved?

When quality of life is accounted for in cost-effectiveness analyses, the most common measure of effectiveness is quality-adjusted life-years (QALYs) gained. QALYs combine life expectancy in years adjusted for individual's perceived quality of life, measured from 0 (death) to 1 (ideal health). The quality adjustment is derived from preference weights or health utilities.⁶ The advantages of cost-utility studies are that they (1) simultaneously capture changes in mortality and morbidity in the measure of effectiveness, (2) are applicable to all

disease states and treatments, (3) consider patients preferences for health outcomes, and (4) conform to normative theory of decision making under uncertainty.¹⁴

5. *Was the analysis incremental?*

Cost-effectiveness analysis is a method for direct comparison of alternative health interventions. The comparison is most appropriately framed as the additional costs of one intervention compared with another intervention relative to the additional clinical benefit gained. This incremental analysis of costs and effectiveness allows readers to determine the additional health value realized for the expenditure on the intervention of interest.

The incremental analysis is performed using the equation above. Total costs and effects are tallied for each intervention, and the ratio of the difference in costs divided by the difference in effects yields the incremental cost-effectiveness of the intervention of interest. For example, Welch and Larson performed a cost-effectiveness analysis of bone marrow transplantation compared with chemotherapy for acute nonlymphocytic leukemia. They found that traditional chemotherapy cost an average of \$136,000 per patient and yielded 2.24 years of life expectancy. Bone marrow transplantation cost an average of \$193,000 per patient and yielded 3.32 years of life expectancy. Thus, the incremental cost-effectiveness of bone marrow transplantation compared with chemotherapy for nonlymphocytic leukemia was \$59,300 per life-year gained.¹⁵

It is important to note that cost-effectiveness is a relative term—there is no generally agreed upon threshold value below which health care interventions are considered cost-effective. Thus, whether the additional health effect justifies the additional expenditure for a technology that is more expensive than an existing technology (the converse is whether the savings are justified for an intervention that has a worse health outcome but saves money compared with another intervention) is ultimately a value judgment. In the case above, the authors suggest that spending an additional \$59,300 per year of life gained for bone marrow transplantation does represent good health value for expenditure.

6. *Were confidence intervals or some measure of certainty provided with the estimate of cost-effectiveness?*

Clinical evaluations include statistical analyses to determine the level of certainty that the observed effect was due to the intervention itself rather than

chance (for example, the *P* value). Likewise, it is important for cost-effectiveness analyses to include some measure of evaluation that conveys the degree of confidence that the incremental cost per incremental benefit is accurate and precise. For example, suppose an article describing a cost-effectiveness analysis of a new drug for myocardial infarctions reports a cost-effectiveness of \$50,000 per life-year gained for the new treatment. Even though this result might seem reasonable, imagine that the true effectiveness of the drug was in fact quite uncertain. As a result, depending on whether the best or worst level of effectiveness of the drug was entered into the cost-effectiveness analysis, the cost-effectiveness value that was derived varied between \$10,000 and \$150,000 per life-year gained. Clearly, readers of the cost-effectiveness analysis would want to know that there was a reasonable possibility that the drug might be extremely cost-effective or very cost-ineffective. Without providing some type of confidence interval with the original \$50,000 per life-year estimate, this important issue would not be apparent to the reader.

Measuring certainty is important in cost-effectiveness analysis because almost every study of this type makes assumptions about the relation between the intervention and the outcome that are not derived directly from clinical trial data. For example, a particular cost-effectiveness analysis might link one study showing that a certain drug lowers serum cholesterol levels by a certain amount and another study showing that reducing serum cholesterol reduces the incidence of myocardial infarctions. Because assumptions are just that—hypotheses about cause and effect—it is important for the reader to understand how varying each assumption changes the outcome of the analysis.

Assessing levels of certainty in cost-effectiveness analysis is more complicated than evaluating certainty in clinical studies, because the outcome in a cost-effectiveness analysis is a *ratio* of two different entities (costs and effects), rather than an estimate of a single outcome (say, a cholesterol level). There are two general ways in which certainty is evaluated in cost-effectiveness analysis. One method, known commonly as *sensitivity analysis*, involves varying the value of important parameters that were used in the cost-effectiveness analysis from worst case to best case values, then rerunning the analysis to determine how varying the input affects the ultimate cost-effectiveness value. For example, in a study of

the cost-effectiveness of pneumococcal vaccine for older adults, Sisk and colleagues¹⁶ varied the cost of the vaccine from \$4 to \$20 per injection. In the worst case (\$20) the cost-effectiveness was \$1,121 per quality-adjusted life-year gained; in the best case (\$4), giving the vaccine saved money and added quality-adjusted life expectancy compared with withholding the vaccine (it was a dominant intervention in the language of cost-effectiveness analysis). It is possible to vary two or more values simultaneously and track the interaction of the variables as well as their impact on the ratio. If the cost-effectiveness ratio changes little despite wide variation in the input parameter, analysts say that the result is *robust* to changes in that parameter. If varying the input parameter has a great impact on the cost-effectiveness ratio, the result is said to be *sensitive* to changes in the value. Readers should scrutinize carefully those parameters to which the outcome is highly sensitive, and decide, if they are based on assumptions, whether they are reasonably accurate estimates of the real world.

The second way certainty is assessed in cost-effectiveness analysis is through the use of *confidence intervals*. Discussion of the derivation of confidence intervals is beyond the scope of this article, but suffice it to say that they perform much like confidence intervals that are derived around estimates of effectiveness for clinical studies. As in clinical studies, narrow interval bands for the ratio of costs over effects are preferred to wider bands.

7. *Are the results discussed in the context of previous economic evaluations and the realities of clinical practice?*

Cost-effectiveness studies are most useful for decision making at the population level rather than at the level of physician and patient. Nevertheless, the discussion and conclusion sections of a cost-effectiveness analysis have much in common with the discussion and conclusion sections of clinical studies. First, the results of the study should be compared with those of others who have investigated the same question. When making such comparisons, the discussion should address differences in study methodology between the current study and previous analyses. Second, the authors should discuss whether the results are generalizable to other settings and populations (as in clinical studies, generalizability is usually limited). Finally, the authors should discuss issues of implementation, such as the feasibility of adopting the preferred

program. Since most programs, even cost-effective ones, will consume additional resources compared with the status quo, it is important to discuss from where the additional funds might come (eg, a new publicly funded program) and within what period costs and benefits might accrue.

Finally, a word on the method of presentation of the results of a cost-effectiveness analysis. Although most analyses continue to be presented as a ratio of costs over consequences, there is growing consensus that cost-effectiveness results should also be presented in a cost-consequence format.¹⁷ Here, all measures of resources used (and saved) and measures of effectiveness for the interventions are listed in tabular format, allowing the reader to review each separately. For example, the number (and cost) of all hospital days, emergency department visits, and key medications used might be listed for each treatment, alongside measure of benefit, such as measures of quality of life and life expectancy. Since different readers might value the various outcomes differently, this format allows readers to draw conclusions on the study based on their own perspective and needs as decision makers.

Why Bother? Further Motivation for Reading Cost-Effectiveness Analyses

In general, cost-effectiveness studies are not designed for decision making at the physician-patient level because they take the perspective of *populations* rather than individuals. This perspective does not mean that such studies should not be of interest to clinicians, however. There are three important reasons why physicians should familiarize themselves with the cost-effectiveness literature. First, cost-effectiveness studies could some day determine the practice boundaries within which clinicians operate and sometimes can influence national practice recommendations. For example, Medicare's decisions to pay for pneumococcal and influenza vaccines were based in part on the economic analyses of these interventions. Because physicians can be directly affected by the outcomes of these studies, their effectiveness in contributing to discussions regarding appropriate use of new technologies will be a function of their sophistication in understanding their methods and implications.

The second issue relates to the general concept on which cost-effectiveness is grounded: given that health care budgets are limited, for each medical

intervention it is important to know what health effect is realized for the expenditure (compared with no care or an alternative intervention). We would argue that of all stakeholders in the health care system, physicians are in the best position to determine health value for expenditure for new and existing interventions. The other interested parties—patients, product manufacturers, and managed care organizations—usually have limited information or particular perspectives on the intervention of interest. Physicians see most closely how patients are affected by new medical interventions and can observe the downstream implications of a particular therapy on patients' use of health resources throughout the medical care system.

Finally, physicians can take their time-honored position of serving as patient advocates when the inevitable ethical dilemmas arise as economic arguments are used to limit access to expensive technologies. Because cost-effectiveness analysis focuses broadly on the cost impact of therapies and takes a long-term perspective on outcomes, it can be valuable evidence to counter narrower views that could lead to inappropriate restriction or overuse of those therapies. For example, varicella vaccine has been shown to be effective in reducing rate of chicken pox among US children.¹⁸ The vaccine is expensive and might not be attractive to managed care organizations because chicken pox is usually self-limited and rarely requires costly medical therapy. From the perspective of society, however, the cost of varicella includes work-loss costs for the parents (indirect costs) as well as medical care costs. From this perspective, varicella vaccine could be *cost-saving*, because both children and their parents benefit from the intervention.¹⁹ The clinician who understands the implications of well-designed cost-effectiveness analyses might be able to advocate for using medical interventions in ways that most benefit society rather than those with narrower perspectives and shorter time horizons.

Conclusion

Cost-effectiveness analysis is a standardized methodology designed to help decision makers choose health care interventions that maximize the health of their populations, given the conflicts generated by constrained health budgets and rising demand for medical care. Physicians can and should be a part of the process of critically evaluating economic

evidence for new medical interventions as they now evaluate clinical evidence. The task of becoming an effective evaluator of cost-effectiveness analyses is not as daunting as it might first seem, because these studies have more similarities than differences with the clinical literature. The knowledgeable clinician can play a role in ensuring that only high-quality cost-effectiveness studies are used for decision making in their organizations. In addition, enlarging the audience of sophisticated, critical readers of cost-effectiveness analyses will ultimately improve the quality of studies that are published in the medical literature. As economic evidence becomes more important in medical decision making, it is essential that clinicians can effectively participate in the process of translating this evidence into practice.

References

1. Sackett DL, Richardson WS, Rosenberg W, Haynes RB, editors. Evidence-based medicine: how to practice and teach EBM. New York: Churchill Livingstone, 1997.
2. Ethical issues in managed care. Counsel on Ethical and Judicial Affairs, American Medical Association. *JAMA* 1995;273:330-5.
3. Drummond MF, O'Brien B, Stoddart GL, Torrance GW. Methods for the economic evaluation of health care programmes. 2nd ed. New York: Oxford University Press, 1997.
4. Gold MR, Siegal JE, Russell LB, Weinstein MC, editors. Cost-effectiveness in health and medicine. New York: Oxford University Press, 1996.
5. Prevention effectiveness. a guide to decision analysis and economic evaluation. Haddix AC, et al, editors. New York: Oxford University Press, 1996.
6. Drummond MF, Stoddart GL, Torrance GW. Methods for the economic evaluation of health care programmes. New York: Oxford University Press, 1987.
7. Banta HD, Luce BR. Health care technology and its assessment: an international perspective. New York: Oxford University Press, 1993.
8. Ellwood PM. Outcomes management. A technology of patient experience. *N Engl J Med* 1988;318:1549-56.
9. Blackmore CC, Ramsey SD, Mann FA, Deyo RA. Cervical spine screening with computed tomography in trauma patients: a cost-effectiveness analysis. *Radiology* 1999;212:117-25.
10. Drummond MF, Davies L. Economic analysis alongside clinical trials. Revisiting the methodological issues. *Int J Technol Assess Health Care* 1991;7:561-73.
11. Gray JA. Evidence-based health care: how to make health policy and management decisions. New York: Churchill Livingstone, 1997.
12. Evans RW. Organ transplantation costs, insurance coverage, and reimbursement. In: Terasaki PI, editor. *Clinical transplants*, 1990. Los Angeles: UCLA Tissue Typing Laboratory, 1990;343-55.
13. Detsky A. Guideline for economic analysis of pharmaceutical products: a draft document for Ontario and Canada. *Pharmacoeconomics* 1993;3:354-61.
14. Von Neumann J, Morgenstern O. Theory of games and economic behaviour. Princeton, NJ: Princeton University Press, 1994.
15. Welch HG, Larson EB. Cost-effectiveness of bone marrow transplantation in acute nonlymphoblastic leukemia. *New Engl J Med* 1989;321:807-12.
16. Sisk JE, Moskowitz AJ, Whang W, et al. Cost-effectiveness of vaccination against pneumococcal bacteremia among elderly people. *JAMA* 1997;278:1333-9.
17. Stergachis A. Overview of cost-consequence modeling in outcomes research. *Pharmacotherapy* 1995;15(5 Pt2):40S-42S.
18. White CJ. Varicella-zoster virus vaccine. *Clin Infect Dis* 1997;24:753-61.
19. Lieu TA, Cochi SL, Black SB, et al. Cost-effectiveness of a routine varicella vaccination program for US children. *JAMA* 1994;271:375-81.