7 Cost-Effectiveness Analysis

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CONTENTS

7.1 THE RATIONALE FOR COST-EFFECTIVENESS ANALYSIS

As noted in prior chapters, the economic evaluation of pharmacotherapies and other health care interventions is growing in importance as the resources directed toward health care account for progressively larger portions of the budgets of governments, employers, and individuals. Making rational decisions under conditions of resource constraints requires a method for comparing alternatives across a range of outcomes, allowing a direct ranking of the costs and benefits of specific strategies for preventing or treating a particular illness.

Cost-effectiveness analysis (CEA) provides a framework to compare two or more decision options by examining the ratio of the differences in costs and the differences in health effectiveness between options. The overall goal of CEA is to provide a single measure, the incremental cost-effectiveness ratio (ICER), which relates the

amount of benefit derived by making an alternative treatment choice to the differential cost of that option. When two options are being compared, the ICER is calculated by the formula:

$$\frac{C_{\text{Option 2}} - C_{\text{Option 1}}}{\text{Effectiveness}_{\text{Option 2}} - \text{Effectiveness}_{\text{Option 1}}}$$

In medical or pharmacoeconomic cost-effectiveness analysis, health resource costs (the numerator) are in monetary terms, representing the difference in costs between choosing option 1 or option 2. In cost-effectiveness analysis, the differential benefits of the various options (the denominator) are non-monetary and represent the change in health effectiveness values implied by choosing option 1 over option 2. Typically, these health outcomes are measured as lives saved, life years gained, illness events avoided, or a variety of other clinical or health outcomes. Unlike CEA, cost-benefit analysis values both the costs and benefits of interventions in monetary terms. Cost-utility analysis, a subset of CEA where intervention effectiveness is adjusted based on the desirability (or utility) of the resulting health states, is discussed in Chapter 9 as it relates to the cost-effectiveness of human papillomavirus (HPV) vaccine.

7.2 THE COST-EFFECTIVENESS PLANE

A pharmacoeconomic analysis is often interested in how much more of a health outcome can be obtained for a given financial expenditure. Limited resources may, many times, constrain choices between medical options. The cost-effectiveness plane serves to clarify when these choices may be easy or difficult.[1] The cost-effectiveness plane is typically drawn with the differences in cost (or the incremental cost) on the y-axis and the differences in effectiveness (or incremental effectiveness) between the two options on the x-axis (Figure 7.1). In this example we will compare an existing program with a new program. The existing program, acting as the comparator, will be at the origin of both the cost and effectiveness axes, depicting the current level of expenditure and benefit with which a new therapy is compared. The new therapy can be more expensive, less expensive, or equivalent in costs to the current option. Similarly, the new option can be more effective, less effective, or equivalent in clinical effectiveness as compared with the existing strategy or therapy.

This produces four possible options for the results of the analysis of a new strategy compared with an existing one. If the new program is less expensive and more effective than the existing program, then the point representing the new program falls into the southeast (SE) quadrant of the cost-effectiveness plane. Points in this quadrant are called *dominant*, and strategies that have such a characteristic should be chosen over the existing strategy due to their superior outcome at diminished costs. These strategies are “cheaper and better” than current therapy and should be adopted. Examples of strategies in this quadrant are laparoscopic cholecystectomy

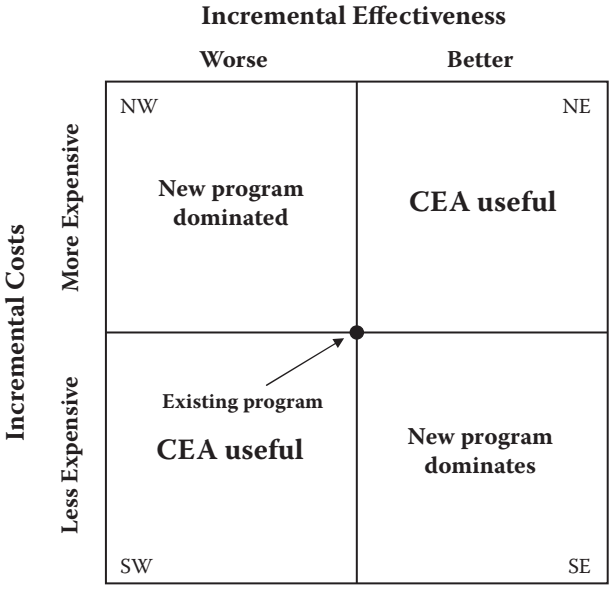

FIGURE 7.1 The cost-effectiveness plane.

compared with other therapies for symptomatic gallstones[2,3] or interventions to decrease cigarette smoking.[4,5]

If, on the other hand, the new program is more expensive and less effective than the existing one, then this program falls into the northwest (NW) quadrant of the plane. Strategies in this quadrant are considered to be *dominated* by the current strategy and should not be chosen due to poorer outcomes at greater cost. Although existing strategies in this quadrant are perhaps relatively rare, there are examples of strategies that do not appear to derive a benefit, yet incur substantially more health care costs than other options. Examples include amoxicillin prophylaxis compared with no antibiotic for dental procedures in patients at moderate risk for infective endocarditis[6] and magnetic resonance imaging vs. endocrinologic follow-up of patients with asymptomatic pituitary microadenomas.[7]

If the new program is either dominant or dominated (i.e., in the SE or NW quadrants), a formal CEA is not needed to assist the decision—the decision is (or should be) obvious. However, if the new program is both more effective and more costly, falling in the northeast (NE) quadrant, then a CEA would be useful to define the tradeoff between increases in costs and effectiveness and to calculate the cost per unit of effectiveness gained. Similarly, a CEA would also be useful if the new strategy fell into the SW quadrant as being both less costly and less effective than the existing program, once again to define the tradeoffs between programs and to ascertain the cost-effectiveness ratio. This graphical display emphasizes one of the most fundamental and important concepts of cost-effectiveness analysis; it is useful only when there is a tradeoff between the cost of a strategy and the benefit derived from that strategy.

TABLE 7.1
Basic Components of a Cost-Effectiveness Analysis

Component	Examples
Options/comparisons	Existing program compared with new program
Perspective of the analysis	Societal, health system, patient
Time horizon	1 month, 5 years, lifetime
Scope of the analysis	Population affected, inclusion (or not) of secondary or collateral effects
Measuring and valuing costs	Cost categories included in the analysis are determined by the perspective taken
Measuring and valuing outcomes	Life years saved, illnesses avoided, cases found
Time preference	Discounting future costs and effectiveness
Analytic models	Clinical trial data, decision analysis model
Accounting for uncertainty	Sensitivity analysis

7.3 BASIC COMPONENTS OF A COST-EFFECTIVENESS ANALYSIS

Several factors should be considered in the construction of a CEA (Table 7.1). A high-quality analysis will include and describe the relevant options, clearly state the perspective of the analysis, choose a relevant time horizon over which to track costs and effects, consider the appropriate population, accurately measure the costs and effectiveness of the competing options, account for the differential value of costs and outcomes that occur at different times in the future, and account for uncertainties of assumptions and values in the context of an appropriately constructed analytic model. Following is a description of these concepts in more detail.

7.3.1 Enumeration of the Options

A CEA requires a comparison between two or more options. A single option cannot be cost-effective in isolation—an option can be considered cost-effective or not cost-effective only in comparison with other options. Additionally, the cost-effectiveness of a strategy is highly dependent on the specific choice of comparators included in the analysis, and care must be taken to include all of the clinically reasonable options. At a minimum, the comparators include the current standard of care and a range of typically utilized options. A cost-effectiveness analysis of a new therapy compared with a strategy that is not typically used, or is used only in atypical circumstances, is not useful for clinicians or policy makers. It is often reasonable to include a "do nothing" option, especially if doing nothing is a legitimate clinical strategy, but also as a baseline comparator to assess the clinical realism of the model and analysis. In all cases, the strategies should be described in sufficient detail such that readers could replicate or implement the strategy in their own settings.

7.3.2 Perspective of the Analysis

Choosing the perspective or set of perspectives to be considered in a CEA is essential, as this choice determines the cost values to be contained in the analysis. For example, an analysis from the societal perspective considers all costs, while an analysis from the patient perspective would consider only costs borne by the patient. Other possible perspectives include the third-party payer (insurance) or health system perspective where costs for which these entities are responsible are considered in the analysis; the hospital or health agency perspective includes the costs of providing various health services. Whenever possible, the societal perspective should be included in the set of perspectives to be considered in analysis, because it is the broadest and is recommended for the reference case analysis by the Panel on Cost-Effectiveness in Health and Medicine.[8,9]

7.3.3 Time Horizon

The analyst must decide *a priori* how long the costs and effects of the various interventions in the analysis will be tracked. This is usually determined by the clinical features of the illness or its treatment. For example, a CEA of a new antibiotic for acute dysuria treatment in otherwise healthy women might appropriately have a very short time horizon of only a month, as there are virtually no long-term effects of either the disease or its treatments. On the other hand, cost-effectiveness analyses designed to value the effects of cardiovascular risk reduction need to assess the outcomes for much longer time periods; typically such an analysis would follow treatments and effects until death. In any case, all of the strategies must be followed or modeled for the same time horizon. Methods for modeling costs and effects, even in situations where this modeling extends beyond the existence of specific data, is provided in Chapters 2 and 4.

7.3.4 Scope of the Analysis

An analysis might be relevant for an entire population or for only a relatively small population subgroup; the analyst will need to appropriately choose the cohort to be considered in the analysis. For example, if an intervention is to be directed toward elderly patients with diabetes in order to prevent diabetes complications, limiting the scope of the analysis to an elderly, diabetic population is a logical choice, while if the question is regarding diabetes prevention in adults, a broader population scope is required. The scope of outcomes to be considered is another important consideration. In the example above, a broad or narrow range of diabetes outcomes could be considered in an analysis of elderly diabetics. If a small number of complications are modeled, the data requirements of the model would be less but the conclusions might be limited compared with a model with a broader range of complications considered. However, a more comprehensive model would have greater data needs and require more complex model construction. Choosing the scope of an analysis often means finding a balance between simplicity and complexity, frequently determined by the clinical situation modeled and the question to be examined.

7.3.5 Measuring and Valuing Costs

Data sources for costs must be found and incorporated into the analysis. Cost data can be obtained from clinical trials, but more often other sources will need to be utilized. In addition, the analyst will need to choose between micro-costing or macro-costing methodologies or some mix of the two, often based on the perspective taken in the analysis.[8,9] Micro-costing enumerates and identifies each item that is incorporated into a particular service, requiring detailed data on supplies used, personnel, room, and instrument costs, and often needing time-and-motion studies to accurately capture medical service costs. Macro-costing (or gross costing) uses data, often from large government databases, to estimate average costs for a care episode, for example the average cost of coronary artery bypass grafting or of a hospital stay for pneumonia. In the US, Medicare reimbursement data or the Healthcare Cost and Utilization Project (HCUP) database are often used for this purpose. Further detail on cost estimation can be found in Chapter 3.

7.3.6 Measuring and Valuing Outcomes

The effectiveness outcome for the analysis must be chosen and outcomes data found, often based on data availability. Randomized trials are excellent data sources on the effects of therapies, but study entrance criteria frequently limit applicability to a more general patient population (see Chapter 5 for more on this). Cohort studies are useful for risk factor determination and for determining the natural history of an illness. Administrative databases are excellent sources for broad population-based estimates of disease and for the effectiveness of therapies, unlike randomized trials which, in general, estimate efficacy. However, administrative databases often pose difficulties in accounting for possible confounding variables in the data set (see Chapter 5). Meta-analyses provide summary measures for parameters, but studies considered are generally limited to randomized trials, thus limiting generalizability. The perspective of the analysis may also influence the effectiveness outcome chosen. Life years or quality-adjusted life years (QALYs) gained are certainly relevant for analyses using the relatively broad-based societal or health system perspectives, but may not be as important when a narrower perspective is chosen, such as that of an individual hospital, when effectiveness measures such as bed day saved or drug administration error avoided might be more relevant.

7.3.7 Time Preference

The differential timing of costs and outcomes should be considered in the analysis. This is typically accomplished through the use of discount rates, where costs and outcomes that occur in the present have higher values than those in the future (see Chapter 10).

7.3.8 Choice of Analytic Modeling Method

The analytic model must also be selected. Cost data from clinical trials can allow relatively straightforward calculation of incremental cost-effectiveness ratios between

management options, often the intervention arms of the clinical trial. More often, data for the analysis must come from a variety of sources (see Chapter 5) and may require a decision analysis model as a framework for data synthesis.

7.3.9 Accounting for Uncertainty

Finally, a sensitivity analysis to elucidate the effects of uncertainty on model results should be performed. There are many goals of sensitivity analysis, and methods for conducting such analyses are detailed in Chapter 12. During model construction and validation, sensitivity analysis is useful as a "debugging tool" to assure that the model behaves as it was designed to behave. After the model is finished, sensitivity analysis is useful to determine which variables have a large impact on the outcomes. Sensitivity analyses can be used to determine the cost-effectiveness ratio in specified subgroups of an analysis, as well as to determine how much a change in one variable will alter the cost-effectiveness ratio. Finally, probabilistic sensitivity analyses (described in Chapter 12) can be used to produce a version of a confidence limit or probability range around the cost-effectiveness ratio.

7.4 CALCULATION OF INCREMENTAL COST-EFFECTIVENESS RATIOS

The ICER requires a detailed enumeration of the costs and benefits of the strategies being compared. Methods for measuring and estimating the costs and benefits of strategies and interventions are often quite complicated, and are detailed in Chapters 3 and 10. In this section, we use the results of two existing pharmacoeconomic studies to illustrate the calculation and use of the ICER. Details of the enumeration of costs and outcomes in these studies are detailed in the studies themselves.[10,11]

The following example considers low molecular weight heparin (LMWH) compared with warfarin for the secondary prevention of venous thromboembolism in patients with cancer. Aujesky[10] used a decision analysis model and data from a variety of sources to estimate the incremental cost-effectiveness of two anticoagulant regimens. Analysis results, with effectiveness in life years, are outlined in Table 7.2.

Typically, the first step in calculation of ICERs among mutually exclusive options is to order the options by cost. LMWH is both more costly and more effective than warfarin, thus, neither strategy is dominant or dominated and a CEA would be useful. Subtracting the cost of the warfarin strategy from that of the LMWH strategy produces the incremental cost; the difference in life expectancy between strategies is the incremental effectiveness. Dividing the incremental cost by the incremental effectiveness produces the ICERs, $115,847 per life year gained, the unit cost of an additional life year occurring as a result of LMWH use rather than warfarin.

7.4.1 Dominance and Extended Dominance

Calculation of the ICER can be more complicated when more than two strategies are being considered. One of the complicating characteristics of the analysis of many

TABLE 7.2
Cost-Effectiveness of LMWH Compared with Warfarin for the Secondary Prevention of Venous Thromboembolism

Strategy	Cost	Life Expectancy (yrs)	Incremental Cost	Incremental Effectiveness	Incremental Cost-Effectiveness Ratio
Warfarin	$7720	1.377	–	–	–
LMWH	$15,329	1.442	$7609	0.066	$115,847

options is that some strategies may be dominated by others and should be removed from further analysis. As noted in the description of the cost-effectiveness plane, any strategy that is more expensive and less effective than an existing option for the same illness (e.g., is in the left upper quadrant compared with the existing strategy) is said to be strictly dominated; one would never choose such a strategy when an alternative would produce a better outcome at a cheaper price. Strict dominance is also termed strong dominance by some authors. A second type of dominance occurs when a particular strategy is more expensive and less effective than a linear *combination* of two other strategies. This is called *extended dominance*, and represents a situation where one could achieve a better outcome at less cost by treating a proportion of the population with a combination of two alternative strategies. Extended dominance can also be referred to as weak dominance. We illustrate both types of dominance in the following example.

Using a decision analysis model, we[11] performed a CEA of testing and antiviral treatment strategies for adult influenza, using days of influenza illness avoided as an effectiveness term in the analysis. Cost and effectiveness values estimated by this analysis are shown in Table 7.3. (Please note that in a separate analysis the other neuraminidase inhibitor, oseltamivir, was substituted for zanamivir, with similar cost-effectiveness results.) Once again, the first step in calculation of incremental

TABLE 7.3
Cost and Effectiveness Values for Influenza Management Strategies

Strategy	Cost	Illness Days Avoided
No testing or treatment	$92.70	0
Amantadine	$97.50	0.54
Rimantadine	$119.10	0.59
Zanamivir	$137.10	0.74
Testing then amantadine	$115.00	0.44
Testing then rimantadine	$125.50	0.48
Treating then zanamivir	$134.30	0.60

TABLE 7.4
Strategies Ordered by Cost

Strategy	Cost	Illness Days Avoided
No testing or treatment	$92.70	0
Amantadine	$97.50	0.54
Testing then amantadine	$115.00	0.44
Rimantadine	$119.10	0.59
Testing then rimantadine	$125.50	0.48
Testing then zanamivir	$134.30	0.60
Zanamivir	$137.10	0.74

cost-effectiveness ratios among mutually exclusive options is to order the options by cost. Doing so with these data results in Table 7.4. Next, options of lesser effectiveness and of equal or greater cost than another option are removed due to strict, or strong, dominance. These strictly dominated options, which are inferior both in terms of cost and effectiveness, do not need to be considered further in the analysis.[12] In this example, "Testing, then amantadine" costs more and is less effective than "Amantadine (without testing)." Thus, "Testing, then amantadine" is strictly dominated and can be removed from consideration. Similarly, "Testing, then rimantadine" also costs more and is less effective than the "Amantadine" strategy and the "Rimantadine (without testing)" strategy and, thus, can be eliminated due to strict dominance. Removal of these two strategies results in Table 7.5.

Then, starting with the second row, the differences in cost and effectiveness between that row and the preceding row are calculated. These results are the incremental cost and incremental effectiveness between the two adjacent strategies. The incremental cost divided by the incremental effectiveness produces the ICER, the cost per illness day prevented. This same procedure is then followed for the remaining rows in Table 7.6.

Next, the calculated ICERs are examined for extended, or weak, dominance of strategies.[13] This occurs when the ICER of a strategy is greater than the strategy below it, signifying that the subsequent strategy would be preferred. In this case

TABLE 7.5
Remaining Strategies when Strictly Dominated Strategies are Removed

Strategy	Cost	Illness Days Avoided
No testing or treatment	$92.70	0
Amantadine	$97.50	0.54
Rimantadine	$119.10	0.59
Testing then zanamivir	$134.30	0.60
Zanamivir	$137.10	0.74

TABLE 7.6
Calculation of the Incremental Cost-Effectiveness Ratio (ICER)

Strategy	Cost	Illness Days Avoided	Incremental Cost	Incremental Effectiveness	ICER
No testing or treatment	$92.70	0	–	–	–
Amantadine	$97.50	0.54	$4.90	0.54	$9.06
Rimantadine	$119.10	0.59	$21.50	0.05	$430.00
Test/Zanamivir	$134.30	0.60	$15.20	0.01	$1520.00
Zanamivir	$137.10	0.74	$2.80	0.14	$20.00

TABLE 7.7
Removal of Strategies Due to Extended Dominance

Strategy	Cost	Illness Days Avoided	Incremental Cost	Incremental Effectiveness	ICER
No testing or treatment	$92.70	0	–	–	–
Amantadine	$97.50	0.54	$4.90	0.54	$9.06
Zanamivir	$137.10	0.74	$39.60	0.20	$198.00

both "Rimantadine" and "Test/Zanamivir" have higher ICERs than Zanamivir; thus, these strategies would not be preferred over Zanamivir due to extended dominance and can be removed from consideration. Removing these strategies from the table and recalculating the ICER of Zanamivir compared with Amantadine results in Table 7.7.

This same procedure can be performed graphically using the cost-effectiveness plane.[8] Figure 7.2 depicts all the testing and treatment strategies on the cost-effectiveness plane. Starting with "No testing or treatment," the least costly option, a line is drawn to the strategy that produces the shallowest slope (i.e., the smallest ICER), which is "Amantadine." From Amantadine, the shallowest positive slope is to Zanamivir. The resulting line is the cost-effectiveness efficient frontier; any point not on this frontier is dominated, either by strict dominance or extended dominance, as illustrated by the "Testing" strategies and by the "Rimantadine" strategy.

All reasonable strategies should be included in cost-effectiveness analyses so that true ICERs can be calculated. For example, if the Amantadine strategy were omitted from the analysis above, the ICER of Zanamivir would be $60 per illness day avoided when compared with "No testing or treatment" rather than $198 when compared with Amantadine. Omitting Amantadine would not give a true picture of the incremental value of Zanamivir, i.e., it would not tell us how much more would be paid for the gains in effectiveness seen with Zanamivir compared with all other reasonable strategies.[8]

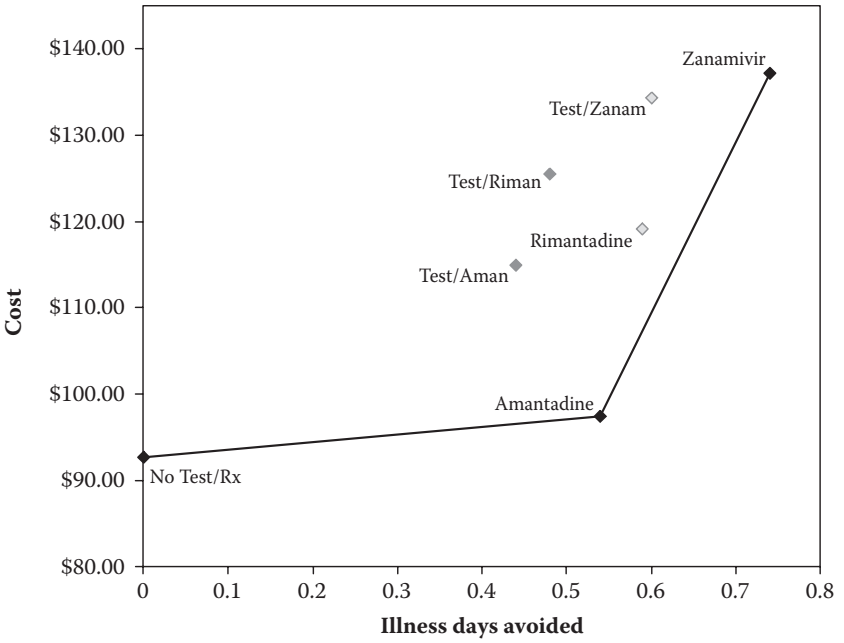

FIGURE 7.2 Cost and effectiveness values for influenza management strategies plotted on the cost-effectiveness plane. The line represents the cost-effectiveness efficient frontier, gray points denote strategies that are strictly dominated, and open points show strategies that are eliminated from consideration by extended dominance.

Similar considerations apply to the average cost-effectiveness ratio, here the cost divided by the illness days avoided; for example, the average cost-effectiveness ratio for Zanamivir is $137.1/0.74 or $185.27 per illness day avoided. When comparing mutually exclusive strategies, as we are in this example, the absence of incremental comparisons between strategies in the average cost-effectiveness calculation does not allow for elimination of dominated strategies or for calculation of incremental gains and costs between strategies.[8] The average cost-effectiveness ratio is useful in the evaluation of mutually compatible programs that are subject to a budget constraint, where programs are ranked, lowest to highest, by average cost-effectiveness ratio, then funded in that order until the budget is exhausted (see Chapter 1). Use of the average cost-effectiveness ratio in this fashion would maximize the health benefit for a given monetary expenditure; however, its use for this purpose has been largely theoretical to this point.

7.4.2 Sensitivity Analysis

The next step in a CEA is the performance of sensitivity analyses. Typically, univariate, or one-way, sensitivity analyses are performed on parameter values, and further multiple parameter sensitivity analyses may also be performed. Further consideration of sensitivity analysis issues can be found in Chapter 12.

7.4.3 Interpretation of CEA Results

To reiterate a prior point, CEA hinges on comparisons between strategies. A single option alone cannot be cost-effective; options can only be cost-effective compared with other options. The relative cost-effectiveness of one option compared with another is subject to interpretation and, perhaps as a result, the term "cost-effective" has been misused (although perhaps less so now than in the past, due to increasing familiarity with the true meaning of the term).[14] Cost-effective does not necessarily mean cost-saving. New health programs that are less costly and more effective than existing programs are clearly good buys, but a new program that costs more and is more effective than the existing program can be cost-effective without costs being saved, depending on how much is willing to be paid for a given health benefit. Cost-effective has also been incorrectly used to mean cost-saving when no determination of effectiveness differences between options has been performed; buying health insurance from one carrier that costs less than insurance from another carrier is not making a cost-effective decision when there is no comparison of health benefits between insurance plans; this would be a cost-minimization evaluation (see Chapter 6). Similarly, "cost-effective" has been misused to mean "effective" when there is no cost comparison. The correct meaning of "cost-effective" is that a program or strategy is worth the added cost because of the benefit it adds compared with other interventions. The application of the method requires a determination of the value of health care benefits as well as costs.

Returning to our influenza example, how can one interpret the incremental cost-effectiveness ratios of the amantadine and zanamivir strategies? One of the first steps in interpreting cost-effectiveness analyses is to understand what cost-effectiveness cannot do. It cannot make the "correct" choice; instead, it provides an analysis of the consequences of each choice. Cost-effectiveness analysis is not designed to address the social, political, or legal issues that might arise from a medical decision. Thus, if differing strategies involve questions of equity, social justice, legal responsibilities, or public opinion that need to be weighed in making a medical decision, consideration of more than strategy cost-effectiveness is necessary. Cost-effectiveness is one of many aspects of a decision to be considered and interpreted by decision-makers, be they physicians in the care of an individual patient or health policy makers in a broader population-based medical care context.[8]

Let us assume for now that sociopolitical issues are similar between our example strategies, allowing us to concentrate on the cost-effectiveness results as a major basis for the decision. In this case the question is: which strategy should we choose based on the ICERs calculated for each strategy? Or more bluntly, which strategy is the most "cost-effective"? The answer depends on the willingness-to-pay per unit health outcome (here, per illness day avoided). If the willingness-to-pay is less than $9 per illness day avoided, then "No testing or treatment" would be chosen, since the ICERs of the other strategies are ≥$9 per illness day. If willingness-to-pay thresholds are higher, other strategies would be chosen: Amantadine is chosen if the willingness-to-pay is $9 – $197, and Zanamivir is chosen if the willingness-to-pay is ≥$198 per illness day avoided.

How, then, is a reasonable cost-effectiveness willingness-to-pay threshold determined? This is a difficult question with no clear answer at this point, complicated by the many possible effectiveness values (life years gained, lives saved, illness days avoided, etc.) that could be considered. Cost-effectiveness comparisons between interventions using a common effectiveness measure can be useful in gaining a sense of an intervention's relative value. For example, if Treatment x for Disease X costs $100 per illness day prevented and is considered economically reasonable while Treatment y for Disease Y costs $500 per illness day avoided and is considered too expensive, then Treatment z for Disease Z costing $550 per illness day prevented might also be considered too expensive. However, the usefulness of this comparison depends on the similarity of illness days between Diseases X, Y, and Z. If Disease Z is worse than X or Y, then there might be a higher willingness-to-pay to avoid a more severe illness day from Disease Z than to avoid a more moderate illness day due to X or Y.

Sensitivity analysis may also be useful in the interpretation of results. If variation of analysis parameter values does not change the conclusion drawn from the base case analysis results, the analysis is said to be "robust," and increases the confidence in analysis results. Analyses that are not robust, where conclusions may change with variation of one or more parameter values, are termed "sensitive to variation," and their results are viewed with less confidence. Depending on the data used in the analysis, this confidence or uncertainty can be quantified through development of confidence intervals for cost-effectiveness ratios in empiric data sets or the use of probabilistic sensitivity analysis and acceptability curves when empiric data sets are not available. These issues are covered in greater detail in Chapter 12.

A number of other factors can make interpretation of CEAs challenging. Differences in analysis results can be due to methodologic differences between analyses. Cost-effectiveness analysis results are often dependent on the perspective, time horizon, and assumptions used in the analysis and, unless these factors are well-aligned between analyses, discordant results can arise based solely on these technical differences. Analyses using effectiveness values that are very specific to the medical scenario being examined, such as deep venous thrombosis prevented or lumbar discectomies avoided, may have few similar analyses available for comparison, making interpretation of their results challenging. Even if analyses with similar effectiveness values are available, their results could be difficult to compare with those of interventions for other disease processes using other effectiveness measures, thus limiting their comparability and interpretability. In these cases, a common effectiveness measure would facilitate cost-effectiveness comparisons over a broad spectrum of medical interventions. The use of quality-of-life utilities and QALYs in cost-utility analysis (as discussed in Chapter 9), along with methodologic recommendations to standardize analysis practices, such as those of the U.S. Panel on Cost-Effectiveness in Health and Medicine,[8] is largely motivated by the need to facilitate such comparisons, and has resulted in resources such as the online CEA Registry from Tufts University[15] to make direct comparisons possible.

7.5 SUMMARY

Cost-effectiveness analyses compare medical intervention strategies through the calculation of the incremental cost-effectiveness ratio, a measure of the cost of changes in health outcomes. These analyses can be performed on clinical trial data when information on both costs and effectiveness is available or, more commonly, through the use of decision analysis models to synthesize data from many sources. Interpretation of CEA results can be challenging due to the variety of health outcomes that can be used as the effectiveness term in these analyses and to the absence of a definitive criterion for "cost-effective." A subset of CEA, cost-utility analysis, attempts to make interpretation of results less difficult through the use of a common effectiveness term, the QALY.

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