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Primer on Pharmacoeconomics for the Pharmacist

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LEARNING OBJECTIVES

1. Describe the purpose of conducting pharmacoeconomic evaluations and the implications these evaluations for practicing pharmacists.
2. List factors that contribute to increasing expenditures for pharmaceuticals in the United States and the categories of costs relevant to pharmacoeconomics.
3. Describe and differentiate the primary types of pharmacoeconomic evaluations.
4. Apply the concepts and techniques of pharmacoeconomics to everyday situations that involve pharmacists and pharmacy practice.

ABSTRACT: Pharmacoeconomics is a form of economic assessment that involves the description and analysis of drug therapy or services and the impact of these assessments on individuals, health care providers or systems, and society. Pharmacoeconomic evaluations

identify, measure, and compare the costs and consequences of 2 more alternatives. These “alternatives” may be pharmaceuticals, where a new drug is compared with an existing therapy, or may be some other intervention (such as a pharmacy service). The 4 basic types of pharmacoeconomic evaluations are cost-minimization analysis, cost-effectiveness analysis, cost-utility analysis, and cost-benefit analysis. Each of these evaluations has unique characteristics and purposes. Cost-minimization analysis is used when the alternatives being compared are considered equally effective. Cost-effective analysis is used when the alternatives have common outcomes but their effectiveness is not equal. Cost-utility analysis is a special form of cost-effectiveness that uses a measure of quality of life (e.g., the quality-adjusted life year), as the measure of effectiveness. Cost-benefit analysis can be used to compare 2 dissimilar programs but requires that the consequence measure be in monetary terms. The practicing pharmacist encounters situations daily where the concepts of pharmacoeconomics may be applied. Pharmacoeconomics can be used as a means to make better, more informed decisions in cases that involve costs and/or consequences of drug therapy or pharmacy services. Examples of such cases will be provided.

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Introduction

Expenditures for prescription drugs in the United States (U.S.) have been one of the fastest growing components of health care spending over the last several years. While the actual rate of increase varies from year to year, and differs based on the source data, the mean annual increase in recent years has been around 15%.¹ Between 1990 and 2000, spending on prescription drugs increased by more than 200%. In the year 2004, spending on retail prescription drugs topped \$235 billion.² Projections by the Centers for Medicare and Medicaid (CMS) are that spending for prescription drugs will increase well into the future, becoming even more acute as the Medicare prescription drug benefit is implemented.¹

Rising expenditures on prescription drugs have attracted a great deal of political and media attention in recent years. The discussion is fueled by reports of the high “prices” that patients and insurers pay for drugs, especially in comparison with neighboring countries, such as Canada and Mexico. The natural conclusion for many people is that pharmaceutical companies are gouging the U.S. public, and that actions are needed to reduce drug costs. The issue, however, is clearly much more complicated than that. Nevertheless, pharmacists often find themselves in the situation of having to defend high prescription drug prices. In these situations, it behooves the pharmacist to

be well rounded in the area of “pharmacoeconomics.”

This article provides a primer for the pharmacist on the topic of pharmacoeconomics, including the methods used to conduct pharmacoeconomic evaluations. The article also identifies common situations where pharmacists can apply pharmacoeconomic techniques. While pharmacoeconomics can be used to assess any type of invention, including a pharmacy service, the most common use is for comparing pharmaceuticals. Therefore, before discussing the basic principles and applications of pharmacoeconomics, the article first highlights some of the reasons for rising drug expenditures.

Cost of Pharmaceuticals

The factors that drive prescription spending in the U.S. are not only numerous but are very diverse. Nevertheless, 3 categories of factors are generally considered most important: use, new drugs, and price inflation. Traditional price inflation (the change in price of a commodity from one year to the next), is commonly the brunt of criticism about drug spending, but in reality accounts for only about 24% of the annual increase in drug spending. Switching to more expensive (i.e., new) drugs accounts for 28% and increased use accounts for 48% of the annual increase in drug spending.³

With respect to price inflation and new drugs, one must understand that the prescription drug industry is essentially a monopoly. Extended patent protection is given to pharmaceutical companies to encourage and compensate for the intensive and expensive research that is

involved in drug discovery. Once patent protection expires and generic competition enters the market, drug expenditures in this category generally decrease substantially.

The more significant cause of rising drug spending is increased use. Among others, factors affecting use include the following:

1. Lack of financial incentive to contain use on the part of consumers
2. Increased use of prescriptions (on a per capita basis), attributable to the aging of the population and severity of disease
3. New indications for drugs
4. Heavy marketing of prescription medications

With insurance, consumers (patients) generally do not pay for drugs. Thus, there is little or no financial incentive for consumers to reduce or contain their use. Managed care organizations have attempted to link out-of-pocket costs to consumer use by creating multi-tiered, co-pay, and deductible schemes. These have proven only somewhat effective, in part, because it is the physician who makes the decision for the consumer about the drug that will be prescribed.

Most influential to the increased use of prescription drugs and to drug spending is the changing demographics of the U.S. population, resulting in an increase in both the number of people taking prescriptions medications and the number of prescriptions per capita. Much of this increase is owing to the aging of the population. The average annual number of prescription items increases exponentially with age. In 2003, there were over 3 billion

prescriptions dispensed in the U.S., an average of 10.7 per capita.⁴ As our population lives longer, the number and severity of diseases increase, further influencing the quantity of medications consumed.

While demographics have contributed to increased drug use, so has the change in the number and types of diseases for which drugs are indicated. Drugs are continually being developed to treat diseases for which pharmacotherapy did not previously exist. Many of these drugs are designed to treat diseases that are rare and/or life threatening and, thus, signify important advances in care. On the other hand, recently, an increasing number of new agents are for so called "lifestyle" problems, as exemplified by the increased popularity and use of BotoxTM, and these products also contribute significantly to rising drug spending.

Besides an understanding of the factors that drive prescription spending, it is also useful to know the primary components that contribute to the cost of a prescription at the retail level. These are the pharmacy, the wholesaler, and the pharmaceutical manufacturer. The pharmacy accounts for 23% of the prescription cost, the wholesaler 3%, and the pharmaceutical manufacturer 74%.³ Both the proportion of the total retail cost and the percent that represents profits are heavily weighted toward the manufacturer. For example, the average net profit of a pharmaceutical wholesaler is 1.6%, while that of an independent pharmacy is 3.1%. On the other hand, the average net profit of the pharmaceutical manufacturer is closer to 20%.

Principles of Pharmacoeconomics

Understanding why drugs cost what they do and the benefits achieved from money spent on pharmaceuticals is an important part of what pharmacoeconomics is all about. By definition, pharmacoeconomics is the description and/or analysis of the costs and/or consequences of pharmaceutical products and/or services and their impact on individuals, health care systems, and/or society.⁵ Pharmacoeconomics includes descriptions of the costs associated with a disease or treatment and it includes analyses that compare alternatives, such as 2 different treatments for the same indication.

The basic model of a pharmacoeconomic evaluation is shown in Figure 1. Most important in this model is the consideration or measurement of both costs and consequences of the service or program. Costs can be thought of as “inputs” or resources required to provide the service. Consequences can be thought of as the “outputs” of the service or program—that is, the outcomes of the care provided. Consequences can be in the form of clinical outcomes (or effects), humanistic outcomes, or economic outcomes, each defining a unique type of evaluation: cost-effectiveness analysis (CEA), cost-utility analysis (CUA), and cost-benefit analysis (CBA), respectively, which will be discussed later. Another key element of this model is the inclusion of a comparison or alternatives to the service in question. For example an alternative to a new drug might be the existing standard of care, or a control (placebo).⁶

Table 1 best depicts the range of economic evaluations that can be conducted under the umbrella of

pharmacoeconomics. The table categorizes evaluations based on 2 criteria:

1. Does the evaluation include costs and/or consequences?
2. Does the evaluation include 2 or more alternatives?

These “alternatives” may be pharmaceuticals, where a new drug is compared with an existing therapy or may be some other intervention (such as a pharmacy service). Based on the elements from the model in Figure 1 that are incorporated into the evaluation, an evaluation can be characterized as “partial” or “full.” Analyses that measure both the costs and consequences and include at least 2 alternatives (e.g., an intervention and a control group), are full evaluations and more desirable from a methodological standpoint because they are better able to reduce bias and thereby are more scientifically sound. Partial evaluations can be subdivided into 5 groups. Evaluations that include at least one alternative but only examine costs or consequences (but not both) are either “cost analyses” or “outcomes analyses,” respectively. Evaluations that do not compare 2 alternatives (i.e., only measure the intervention group), are called “descriptions.” There can be 3 types of descriptions, including “cost descriptions” (examine only costs, do not examine consequences), “outcome descriptions” (examine only consequences, do not examine costs), and “cost and outcome descriptions” (examine both costs and outcomes).

Understanding Costs

The term “costs” is one that is often ill defined. In the context

of pharmacoeconomics (and for this article), costs refer to the “inputs” or resources consumed in the provision of a pharmaceutical product (and the associated laboratory tests or related costs) of a pharmaceutical service or program. When evaluating the economic impact of an intervention, however, we may also measure costs. In this context, costs refer to an economic consequence or outcome. Regardless of the terminology, it is important to differentiate when we are measuring resources consumed versus economic consequences.

Costs are generally categorized as direct or indirect. Direct costs are defined by a financial transaction or exchange. For example, there are direct costs associated with providing prescriptions, laboratory services, emergency department visits, inpatient hospitalization, and transportation to a medical facility. Direct costs can be “medical” or “nonmedical.” Direct medical costs are incurred for medical care or health services received. Direct non-medical costs are those associated with health care, such as transportation to a health care facility.

Indirect costs are those that have no transaction or exchange of money, thus are more difficult to quantify than direct costs. An example of an indirect cost is lost productivity secondary to illness. For example, a person suffering

from migraine headaches while at work may be less productive—the value of the work not accomplished is the lost productivity cost.

It is worthwhile to note that there is a third category of costs—different from either direct or indirect costs—that is known as “intangible costs.” These are extremely difficult to measure, are associated with such things as pain and suffering, and are rarely included in pharmacoeconomic evaluations.

There are some pharmacoeconomic evaluations that only measure costs. One example is a “cost-of-illness study” (or burden of illness), in which investigators attempt to estimate the actual direct or indirect costs associated with a given disease state and its treatment. Another example is a budget impact analysis, where the budgetary implications of a new pharmaceutical product are examined. Budget impact analyses are often performed by managed care organizations or other third-party payers and may be used in making decisions about benefits provided under a specific insurance plan.

Understanding Consequences

Pharmacoeconomics is considered a subtype of the more general field of outcomes research. In outcomes research and pharmacoeconomics, there are generally 3 types of outcomes (or consequences) that are of

interest. These are clinical outcomes, humanistic outcomes, and economic outcomes.

Clinical outcomes are medical events that occur as a result of disease or treatment. Clinical outcomes may be determined in either efficacy or effectiveness assessments.

Efficacy assessments are those that occur in a controlled environment as in a randomized controlled trial (RCT) and that typically answer the question, "Can this treatment work (i.e., for this particular disease and for this particular patient population)?" Efficacy assessments are usually conducted prior to U.S. Food and Drug Administration (FDA) approval of a drug. On the other hand, effectiveness assessments are those that are conducted in naturalistic environments (e.g., actual practice) and answer the question, "Does this treatment work (i.e., given the greater variability of patient and environmental characteristics that occur in actual practice)?" Effectiveness assessments are usually conducted after a drug has been marketed.

A variety of clinical outcomes can be measured in a pharmacoeconomic evaluation, ranging from surrogate outcomes such as a laboratory value to long-term outcomes such as death.

Humanistic outcomes are the consequence of disease or treatment on a patient's

functional status or health-related quality of life. Generally, humanistic outcomes are measured by having patients directly respond to questions and are also known as patient-reported outcomes. Humanistic outcomes can be measured along several dimensions (or constructs), such as physical function, social function, general health and well-being, and life satisfaction. Patient satisfaction with health care is another category of humanistic outcomes.

Humanistic outcomes are important to measure not only because they illustrate a patient's sense of well-being but also because they can affect clinical outcomes. For example, dissatisfaction with physician services may cause aggravation and an increased frequency of tension headaches for some patients. Humanistic outcomes can also affect economic outcomes. For example, dissatisfaction with care may result in visits to other providers and thus would result in increased health care expenditures.

The final type of outcome is the economic outcome. In its simplest form, an economic outcome is a measure of value of the "output" of care. An economic outcome may be measured in the willingness of a patient to pay for a particular outcome (such as an additional year of life), or in terms of resources saved by provision of a

program. Economic outcomes and costs should not be used interchangeably, although it is often done. Costs are resources consumed to provide care (inputs), whereas the economic outcome is a measure of the impact of care provided (outputs).

Perspectives of Analysis

There are several perspectives, or points of view, that can be taken when conducting a pharmacoeconomic analysis. Understanding the perspective is important because the specific costs and consequences that should be included in the analysis will vary based on the perspective chosen. The different perspectives that one might consider in a pharmacoeconomic analysis include that of the patient and/or family, the health care provider, the payer, and that of society. The perspective chosen is largely based on the study or research question. The research question should be specific enough to identify which perspective(s) is/are relevant.

If the evaluation is conducted from the patient's or family's perspective, we would want to include only those costs and consequences that are relevant to the patient or family. Evaluations conducted from the patient's perspective are important when the patient has a role in influencing the selection of the drug or program, or for disease states that cause significant work loss or impair quality of life.

Because most patients have insurance that covers much of their medical care and their prescription drugs, we would not necessarily include those costs in a study conducted from the patient's

perspective. If the patient pays a co-payment or deductible, however, then we should include that portion of these direct medical costs. Furthermore, any direct non-medical costs that occur are likely paid by the patient and therefore should be included. More important, from a patient's perspective, we would want to include indirect costs associated with lost productivity or inability to work. Often these indirect costs are even greater than the direct medical costs incurred by the patient. The same holds true for consequences. From the patient's perspective, we are interested in consequences that relate to the patient.

The provider's perspective is used when an evaluation is conducted to help the provider make a decision among alternatives. The best example of this is the formulary decision that a hospital might make to select among drugs within a therapeutic class. Another example might be the decision by an outpatient clinic to invest in a clinical pharmacy service. The provider's perspective can apply whenever the research question stems from the viewpoint of an organization that provides health care, including (but not limited to) a hospital or hospital pharmacy department, a retail drug store or chain, a pharmacy-benefits management organization, or an outpatient clinic.

From the provider's perspective, we would include the costs that are incurred by the provider and the consequences that impact the provider. In the case of the costs associated with pharmaceuticals, we would include the acquisition cost, or the true cost incurred by the provider to procure and perhaps administer the drug. We would also

want to include the actual cost of providing care to the patient, whether that occurs in the hospital or during an office visit. Sometimes these true costs are unknown and instead we may use a cost-to-charge ratio to convert charges to estimated costs. Note that the provider's perspective would not include indirect costs because the provider does not incur indirect costs. The same holds true for direct non-medical costs.

The next perspective is that of the payer. Again, this perspective is relevant when the research question involves a decision to be made by the payer. For example, an insurance company may want to know if it should reimburse for a particular drug, or a government program like Medicare might want to decide if it should provide a pharmaceutical benefit. These are pharmacoeconomic analyses that take the perspective of the payer. The payer's perspective can also include employers who provide health and prescription benefits to their employees.

As before, from the payer's perspective, we are only interested in those costs incurred by the payer. In the case of pharmaceuticals, the payer may have a negotiated rate (such as average wholesale price (AWP, 15%), that is reimbursed to pharmacies. This reimbursement amount is the payer's "cost" and is what should be included in the analysis. The same holds true for other direct medical costs such as hospitalizations and physician office visits. The payer's perspective, however, does not include any direct non-medical costs. Indirect costs are not important to most traditional payers such as insurance companies or managed care organizations; however, they may be

important to employers who incur financial losses if their employees are not able to work because of illness.

The final perspective is that of society. From the societal perspective, all costs and all consequences are important and should be included in the analysis. In a way, the societal perspective is a combination of all the other perspectives. Some people argue that the societal perspective is the most important one and should be taken for all economic evaluations. While this may be true in principle—because the purpose of a pharmacoeconomic evaluation is to assist in decision making and because these decisions usually do not involve the entire society (at least in the U.S.)—the societal perspective is not always the most informative approach. Certainly, in many countries that have universal health care the societal perspective would be most appropriate.

Types of Analyses

The 4 basic types of pharmacoeconomic evaluations are cost-minimization analysis (CMA), cost-effectiveness analysis (CEA), cost-utility analysis (CUA), and cost-benefit analysis (CBA). Each of these evaluations has unique characteristics and purposes, as shown in Table 2. CMA is used when the alternatives being compared are considered equally effective. CEA is used when the alternatives have common outcomes but where effectiveness is not equal. CUA is a special form of cost-effectiveness that uses a measure of quality of life, such as the quality-adjusted life year, as the measure of effectiveness. CBA can be used to compare 2 dissimilar programs but requires that the consequence measure be in monetary terms.

Cost-effectiveness Analysis

Of the 4 types of analyses, CEA is the most important to understand because the other methods are really just variations of CEA. Furthermore, traditionally, CEA has been the most frequently used and discussed—and perhaps misinterpreted—among the 4 types of pharmacoeconomic analyses.

As the other 4 types of evaluation, CEA measures the costs or resources consumed in providing the programs, drugs, or interventions being compared in monetary terms (dollars). As shown in Table 2, where the 4 methods differ in the outcomes measure. In CEA, the consequence or outcome under study is the efficacy or effectiveness of the drug therapy. Ideally, we are interested in effectiveness, but in many cases we only have efficacy data with which to work. As a reminder, efficacy is whether or not the drug works in a controlled setting

(such as in a clinical trial), whereas effectiveness is whether or not the drug works in actual practice. In its simplest definition, CEA is a method to determine which program or treatment has the lowest cost for a given level of effectiveness.

In CEA, a common clinical outcome is compared among different alternatives. For example, in comparing a new antihypertensive agent with an older one, we might compare the reduction in blood pressure in millimeters of mercury. Similarly, for 2 antihyperlipidemic drugs, we might compare reductions in serum low-density lipoprotein (LDL). Alternatively, we might compare longer-term outcomes, which for these examples, might be the rate of strokes (for antihypertensives) or myocardial infarctions (for antihyperlipidemics) in patients who received each drug.

The results of CEAs are usually presented as an incremental cost-effectiveness ratio (ICER). The ICER is defined as the difference in costs between the 2 alternatives divided by the difference in effectiveness. The ratio tells us the additional cost required to achieve a specific level of additional effectiveness.

To illustrate CEA, consider the following example. Drug Y is a new agent for a rare fatal disease. Drug Y is said to cost more but be more effective than drug X, which is used for the same disease. Consider that, on average, drug X can extend life for 5 years at a cost of \$10,000, while drug Y can extend life for 6 years but costs \$80,000. Note that the common measure of effect in this example is years of life saved. The ICER comparing drug Y with drug X is

\$70,000:1, or \$70,000 per additional year of life saved.

Note that CEA in this example still leaves us with a seemingly difficult decision. Should we use drug Y instead of drug X? To answer this question we must consider how much money a year of life is worth. Are we willing to spend \$70,000 for one additional year of life? This issue is one of the major problems with CEA.

Another limitation of CEA that is important to recognize here is that the analysis must be limited to options that have the same clinical outcomes. That is, we can compare 2 drugs for hypertension or 2 drugs for hyperlipidemia but we cannot compare a drug for hypertension with one for hyperlipidemia because the measures of effectiveness for each drug are different. The most common use of CEA in pharmacoeconomics is to compare drugs in the same therapeutic class with different effectiveness, or to compare drugs in the same general therapeutic category (used for the same indication) with different effectiveness.

Previously, we suggested that CEA is sometimes misinterpreted. What this refers to is the inappropriate use of the term “cost-effective.” Often we see in pharmaceutical advertisements or journal articles the misuse of this term. Because a drug is cheap or somehow saves money does not mean that it is cost-effective. The appropriate use of the term cost-effective is in comparing one drug with another (i.e., drug A is more cost-effective than drug B) in expressing the results of a CEA. For example, an alternative drug can be said to be more cost-effective if it has a lower

cost and a higher level of effectiveness than the comparison agent.

Cost-minimization Analysis

Perhaps the simplest type of economic analysis is that of CMA. CMA can be considered identical to CEA except that the alternatives are assumed to be, or are proved in the analysis to be, therapeutically equal. Because the outcomes measure is equal, we are left just comparing the costs of the alternatives. The alternative with the lowest cost is the preferred agent—hence the name “cost minimization.”

Given this description, it would seem that CMA would be very easy to conduct. This is true, except that extreme caution has to be taken when determining that the alternatives are equal with respect to the clinical outcomes. While 2 drugs may have equal effectiveness on one measure there may be differences in other measures (such as adverse events). To be truly equal there can be no differences. For this reason CMA is limited to selected situations. Probably the best application of CMA is in comparing drugs that are generically equivalent. In the case of most generic equivalents (assuming equal bioavailability), there is equivalency across all clinical measures. In such cases then, we only compare the costs associated with the alternatives.

Cost-utility Analysis

CUA has many similarities to CEA. For example, both CUA and CEA compare alternatives based on a common outcome, and in both forms of analysis we are interested in the incremental costs and incremental consequences between alternatives. Because of this, CUA is often considered a special form of CEA.

The difference between the 2 methods lies in the nature of the outcomes compared. Where CEA compares alternatives based on a common clinical effect, CUA incorporates a measure of quality of life into the outcomes being compared.

In CUA the outcomes measure that is used to compare alternatives is one that combines both the quality and quantity of life. The most commonly used measure in CUA is the quality-adjusted life year (QALY). A QALY is the product of the length of life (e.g., the additional years of life gained by taking a drug) and the patient's assessment of the quality of health during that period of time, or the utility of the health status, to which people in this field refer.

There are several ways to determine utilities. Sometimes utilities are determined by asking actual patients to assign utility weights to their own health status. In other cases, utilities are determined by asking people who do not have the disease to think about a hypothetical situation and then assign utility weights to the state of health described in the scenario. There are also different techniques that have been developed to measure utilities, such as rating scales, the Standard Gamble method, or the Time Trade-off method. In each case, a numerical value between 0 and 1 is identified, with 0 being the worst health and 1 being the best health. Of course there are problems with these methods, which primarily stem from the subjectivity of the assessment. For example, one person's definition of the worst state of health may be very different from that of a different person's definition.

To illustrate CUA, let us return to our example of drug Y and drug X. Suppose that we knew that the quality of life of people living with the disease that these drugs treat is relatively poor. In fact, previous research has shown that the utility value for this health status is 0.3. With this information, we can now calculate the QALYs associated with each drug. Drug Y saves 6 years of life. If we multiple that by 0.3 we get 1.8 QALYs. Likewise, the QALYs associated with drug X are 1.5.

At this point, we might wonder what the QALY value tells us. The QALY can be thought of as the number of years of perfect health. In the case of drug Y, we achieve the equivalent of 1.8 years of life at a utility of 1 (or the best possible health). By converting the years of life and utilities to QALYs we can more easily compare alternatives.

Once we have calculated the QALYs for drugs Y and X, we can now determine the incremental difference in the costs and outcomes, or incremental cost utility ratio (ICUR), just as we did in CEA. The ICUR in this example is \$233,333:1, meaning that we would have to spend an additional \$233,333 for drug Y over drug X to achieve one additional QALY. By most measures, this cost would be considered excessive. In fact, many experts in this area consider a threshold of \$50,000 per QALY to be the cut-off point, above which the cost is in excess of the benefits gained. Like the ICER, however, the point where one is no longer willing to pay the additional cost for the outcome gained can be very personal and subjective. In our society, we are often willing to pay more for even marginal improvements in health.

Cost-benefit Analysis

The problems of subjectivity in decision making associated with CEA and CUA are solved by CBA. CBA is a method that uses a monetary value in the comparison of consequences or outcomes. Because both costs and consequences are monetary values, it becomes much clearer to determine if the additional benefits are worth the additional costs associated with an alternative therapy or program.

A drawback of CBA, however, is that it is sometimes difficult to place a monetary value on a clinical outcome. For example, if a drug reduces blood pressure by 10%, what is the dollar value of that? Nevertheless, in many cases outcomes can be measured monetarily or can be converted to dollar values. In the case of an antihypertensive agent, instead of considering the effect on blood pressure we might consider the number of strokes averted. Clearly there are costs associated with the treatment of stroke, namely, the cost of hospitalization and/or follow-up care. If we prevent a stroke, then we also prevent those costs. Thus the clinical outcome is in effect converted to an economic one by determining these costs avoided.

Another way to determine monetary value is to ask patients how much they would be willing to pay for a particular clinical or humanistic outcome. For example, how much would you be willing to pay to gain an additional year of life? If the consequence of the drug(s) under evaluation is/are years of life gained, then we can convert this to a monetary value using the responses from the willing-to-pay method. A third method that is useful in some

circumstances is the human capital approach. This is a method for converting time, such as life years, into a monetary value by considering average wage rates and the productive value of a person.

In all of the methods described above we are left with both the costs and consequences being expressed in monetary or dollar values. From here there are several ways that we can compare the alternatives. First, for each alternative we can derive a benefit-to-cost (B/C) ratio by dividing the dollar value of the benefits by the dollar value of the costs. The resulting number is the benefit obtained for every dollar invested in that option. Obviously if the B/C ratio is less than or equal to one then we would probably not want to pursue it (unless there were other non-monetary reasons to do so). We can also compare B/C ratios of 2 or more programs and perhaps select that with the higher ratio. Similarly, we can determine the net benefit for each option. The net benefit is determined by subtracting the costs from the benefits. Because net benefit is expressed in total dollars (rather than as a ratio or percentage) it is possible that a program with a lower B/C ratio has a larger net benefit. In making a decision between programs we may want to consider this. Last, we can calculate the percentage return from our investment (also called return on investment), by dividing the net benefit by the cost.

Table 3 demonstrates the various analyses that can be done in CBA. As you can see, drug A has a lower B/C ratio than drug B, so if we base our decision strictly on that we would choose drug B over drug A. But drug A

involves both greater costs and greater benefits, so the net benefit of drug A is greater than drug B. In some cases we might choose drug A because of this. Once we have decided which measure to base our decision on there is no ambiguity in making the decision.

CBA has another advantage. Unlike CEA, the options being considered do not have to have the same clinical effect. Because the consequence measure is monetary, it is very easy to compare alternatives that are dissimilar. For example, we could compare the B/C ratio of 2 completely unrelated options, such as investing in a new pharmacy service or purchasing a new piece of equipment in the radiology department. CBA allows one to determine the best use of limited financial resources.

Applications

For the practicing pharmacist, there are many different situations where knowledge and understanding of pharmacoeconomics are important and where pharmacoeconomics may be applied to help make a decision or to help inform a customer or colleague. Table 4 lists some of the most common applications of pharmacoeconomics in pharmacy practice. Each of these is discussed below.

The most commonly discussed use of pharmacoeconomics is in formulary decision making. As you know, formularies exist in many different health care organizations and systems, including managed care plans, insurance companies, hospitals, government programs (Medicaid, Medicare) and governmental provider organizations (veterans administration [VA]), to name a few. The decision to include a new

drug on a formulary must take into account not only the safety and efficacy of the drug but also the cost. In the formulary scenario, pharmacoeconomic analyses such as CMA, CEA, or CUA are very useful and are often combined with formal decision analysis.

Another application is in analyzing spending. In most pharmacy practice settings, pharmacists are responsible to help analyze trends in utilization and expenditures for pharmaceuticals. This type of evaluation, while it may not include consideration of patient outcomes, clearly is an application of pharmacoeconomics. These cost descriptions can provide important information to help identify areas for future study or support of clinical programs to encourage appropriate drug prescribing and use.

Pharmacoeconomics can also be applied as a form of literature evaluation. All pharmacists, regardless of practice setting or site, are responsible to keep abreast of the latest research on pharmaceuticals; physicians and other health care professionals seek out pharmacists for their knowledge on this topic. Patients also have an expectation that pharmacists are the most knowledgeable health care professionals on drugs and the latest developments in pharmacotherapy. Pharmacists should read, understand, and critically appraise new publications of pharmacoeconomic research. Such studies are now commonly included in all of the major pharmacy and medical journals. The basic principles described in this paper can help the pharmacist to understand the technical aspects of these publications. There are also “checklists” available to assist pharmacists in

systematically critiquing such studies, the most recognized of which comes from a textbook by Drummond and others.⁷ This and other checklists provide key elements that are important to the design and interpretation of a pharmacoeconomic evaluation and can be used to rate the quality of such studies.

Similar to evaluating the literature, pharmacists can apply pharmacoeconomics in assessment of economic claims made by pharmaceutical manufacturers. Advertising and detailing by pharmaceutical manufacturers constantly bombard pharmacists and physicians. It is common for advertisements, especially those directed specifically at pharmacists, to include claims about “cost savings” or “cost-effectiveness” of one drug over another. Pharmacists need to be able to evaluate the legitimacy of these claims. To do this, it is always advisable to ask the manufacturer for the source material that supports the claim they are making. Sometimes this source material is published literature and sometimes it is not. Regardless, with this source material one can again critique the methods used to determine the validity of the claims and then make one’s own conclusions.

In the introduction section of this article we identified that patients often question pharmacists about the cost of pharmaceuticals. Clearly the materials presented previously on factors that impact pharmaceutical spending and the components of the cost of a prescription help in formulating answers to these questions. Given our discussion of pharmacoeconomics principles and

techniques, it should also be clear that we need to put cost into context and instead focus on the value of pharmaceuticals and how to compare value among agents.

In many cases, pharmaceuticals reduce downstream health care costs by improving health and thus avoiding hospitalizations, emergency room visits, additional physician office visits, and expensive laboratory tests. By making patients aware of this kind of information we can help them see the larger picture—and perhaps begin to understand that pharmaceuticals, while not always inexpensive, are well worth the cost in both economic terms and in terms of their own quality of life. This is the information that patients are not aware of and that in many cases may change their attitudes about the cost of their medications.

Pharmacists can also assist physicians in understanding the relationship between the costs of pharmaceuticals and other health care expenditures and use this information in making individual patient therapy decisions. Clearly, consideration of economic factors should play a role in drug selection. Pharmacists, by understanding both the clinical and economic issues that impact successful pharmacotherapy, can assist physicians in making decisions about particular agents.

Last, pharmacoeconomics can be successful if applied when evaluating new pharmacy services, especially cognitive or clinical pharmacy services. Pharmacists are frequently in the position of needing to economically justify new or existing pharmacy services. There are several methods that

can be used to do this, all of which involve aspects of pharmacoeconomics.⁸ Clearly one place to start is the pharmacy literature. There is ample literature support for the economic value of clinical pharmacy services in just about every conceivable practice setting.⁹ Pharmacists can gain access to this literature via a searchable data repository called “VclinRx,” housed at the University of Illinois Center for Pharmacoeconomic Research.¹⁰ Pharmacists can also conduct their own internal evaluations of the impact of new services, or even project the outcomes of a pharmacy service by using modeling techniques.

Conclusion

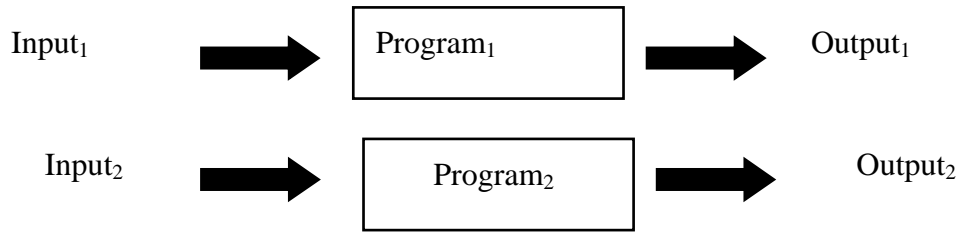
This article has provided an overview of concepts and applications of pharmacoeconomics. Key to the discussion is that pharmacoeconomics is a form of economic assessment that involves the description and analysis of drug therapy or services and the impact of such on individuals, health care providers or systems, and society. As this author outlined in the 4 basic types of pharmacoeconomic evaluations—CMA, CEA, CUA, and CBA—each has unique characteristics and purposes. Daily, the practicing pharmacist encounters situations where the concepts of pharmacoeconomics may be applied. Pharmacoeconomics can be used as a means to make better, more informed decisions in cases that involve both costs

and consequences of drug therapy or pharmacy services.

Those interested in pursuing additional learning in this area will find many resources that can be of assistance. Pharmacists interested in a text that also provides many examples of application might consider the second edition of *Pharmacoeconomics and Outcomes*, published by the American College of Clinical Pharmacy.¹² That particular text not only comes with a supplemental volume of “case studies” but also includes self-assessment questions and solutions to test understanding of the material. The reader may also wish to visit the website of the International Society of Pharmacoeconomics and Outcomes Research (ISPOR) at <http://www.ispor.org/>. That organization publishes a journal titled *Value in Health* and has many other resources for researchers in this field.

In the end, the pharmacist who is well-grounded in pharmacoeconomics will be more effective in his or her job and highly valued by his or her customers, physicians, and employer.

Figure 1. Basic Model of a Pharmacoeconomic Analysis



COSTS = (resources consumed)

Units of measurement = currency
(e.g., dollars)

CONSEQUENCES = (outcomes)

Effect (clinical outcome)
Utility (humanistic outcome)
Benefit (economic outcome)

Units of measurement = depends on
outcome

Table 1. Partial and Full Pharmacoeconomic Evaluations

	Does not Compare Alternatives	Compares at Least One Alternative
Examines only Costs	Partial evaluation “Cost Description”	Partial evaluation “Cost Analysis”
Examines only Consequences	Partial evaluation “Outcome Description”	Partial evaluation “Outcome Analysis”
Examines both Costs and Consequences	Partial evaluation “Cost-Outcome Description”	Full evaluation “Cost-Outcome Analysis” (e.g., CEA, CUA, CBA)

Adapted from: Drummond MF, O’Brien B, Stoddart GL, Torrance GW. *Methods for the Economic Evaluation of Health Care Programmes*, second ed. Oxford (UK). Oxford Medical Publications. 1997;10.

Table 2. Comparison of Methods Used in Pharmacoeconomic Evaluations

Method	Unit of Measure of Costs	Unit of Measure of Consequences	Use
CMA	Currency (e.g., dollars)	None, assumed equivalent	Compare efficiency of alternatives
CEA	Currency (e.g., dollars)	Natural units (e.g., lives saved)	Least costly way to achieve clinical objective
CUA	Currency (e.g., dollars)	Natural units adjusted for quality of life (e.g. QALYs ^c gained)	Least costly way to achieve quality of life
CBA	Currency (e.g., dollars)	Currency (e.g., dollars)	Best investment

Adapted from: Drummond MF, O'Brien B, Stoddart GL, Torrance GW. *Methods for the Economic Evaluation of Health Care Programmes*, second ed.: Oxford (UK). Oxford Medical Publications. 1997;2.

Table 3. Comparison of Different Cost-Benefit Approaches

Alternatives	Costs (C)	Benefits (B)	B:C Ratio (B/C)	Net Present Value (B-C)	Internal Rate of Return (B-C)/C
A	\$100,000	\$140,000	1.4:1	\$ 40,000	40%
B	\$ 10,000	\$ 15,000	1.5:1	\$ 5,000	50%

Adapted from McGhan WF. Pharmacoeconomics and the evaluation of drugs and services. *Hosp Formul.* 1993;28:365-78. p.371.

Table 4. Uses of Pharmacoeconomics in Pharmacy Practice

Applications

Making formulary decisions

Analyzing spending trends

Evaluating literature

Assessing pharmaceutical claims

Informing patients about drug prices

Helping physicians prescribe

Making decisions to implement new pharmacy services

References

1. Centers for Medicare and Medicaid Services. 2003 Data Compendium. <http://www.cms.hhs.gov/researchers/pubs/datacompendium/current/> (accessed May 17, 2005).
2. Zaugg AM, Conmy D. The IMS health report. *Medical Marketing and the Media* 2005;5(May):36-50. Available at <http://offlinehbpl.hbpl.co.uk/Misc/MMM/Features/MAY05%2036-50%20IMS.pdf> (accessed May 25, 2005).
3. Kreling DH, Mott DA, Weiderholt JB, Lundy J, Levitt L. Prescription Drug Trends: A Chartbook Update, Kaiser Family Foundation, Menlo Park, CA, 2001.
4. Total Retail Prescriptions Filled, 2003. State Health Facts. Kaiser Family Foundation, Menlo Park, CA, 2000. <http://www.statehealthfacts.org/cgi-bin/healthfacts.cgi?action=compare&category=Health+Costs+%26+Budgets&subcategory=Prescription+Drugs&topic=Total+Number+of+Retail+Rx+Drugs> (accessed May 25, 2005).
5. Bootman L, Townsend R, McGhan W. *Pharmacoeconomics*. Second ed. Cincinnati: Harvey Whitney Books Co., 1996.
6. Schumock G. Methods to assess the economic outcomes of clinical pharmacy services. *Pharmacotherapy*. 2000;20(10Pt2):243S-252S.
7. Drummond MF, O'Brien B, Stoddart GL, Torrance GW. *Methods for the Economic Evaluation of Health Care Programmes*, second edition: Oxford (UK). Oxford Medical Publications;1997.
8. Schumock G, Butler M. Evaluating and justifying clinical pharmacy services. In Grauer D, Lee T, Odom T, Osterhaus J, Sanchez L, and Touchette D, eds. *Pharmacoeconomics and Outcomes*, second edition. Kansas City: American College of Clinical Pharmacy;2003.
9. Schumock GT, Butler MG, Meek PD, Vermeulen LC, Arondekar BV, Bauman JL. Evidence of the economic benefit of clinical pharmacy services: 1996-2000. *Pharmacotherapy*. 2003;23(1):113-132.
10. VClinRx. Center for Pharmacoeconomic Research, University of Illinois at Chicago. <http://vclinrx.pharm.uic.edu/myJSPApp/jsp/VClinRx.jsp> (accessed May 25, 2005).
11. Grauer D, Lee T, Odom T, Osterhaus J, Sanchez L, and Touchette D, eds. *Pharmacoeconomics and Outcomes: Applications for Patient Care*. Second Ed. Kansas City: American College of Clinical Pharmacy;2003.