1 Introduction to Pharmacoeconomics

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CONTENTS

> The desires to consume medicines and use pharmacoeconomics are perhaps the greatest features that distinguish humans from animals.
>
> —**Adapted from William Osler**

1.1 INTRODUCTION

Practitioners, patients, and health agencies face a multitude of conundrums as the development of new therapies seems boundless, while the money to purchase these cures is limited. How does one decide which are the best medicines to use within restricted budgets? The continuing impact of cost-containment is causing administrators and policy makers in all health fields to examine closely the costs and benefits of both proposed and existing interventions. It is increasingly obvious that purchasers and public agencies are demanding that health treatments be evaluated in terms of clinical and humanistic outcomes against the costs incurred.

Pharmacoeconomics is the field of study that evaluates the behavior or welfare of individuals, firms, and markets relevant to the use of pharmaceutical products, services, and programs.[1] The focus is frequently on the cost (inputs) and consequences (outcomes) of that use. Of necessity, it addresses the clinical, economic, and humanistic aspect of health care interventions (often diagrammed as the ECHO Model,

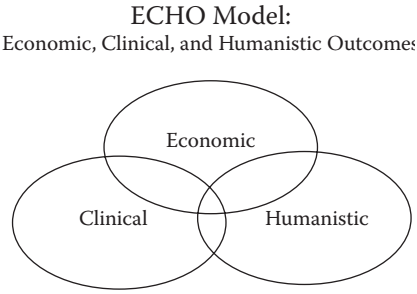

FIGURE 1.1 ECHO Model. (Kozma, CM et al. Economic, clinical, and humanistic outcomes: A planning model for pharmacoeconomic research. *Clin Ther.* 15: (1993): 1121–32.)

Figure 1.1)[2] in the prevention, diagnosis, treatment, and management of disease. Pharmacoeconomics is a collection of descriptive and analytic techniques for evaluating pharmaceutical interventions, spanning individual patients to the health care system as a whole. Pharmacoeconomic techniques include cost-minimization, cost-effectiveness, cost-utility, cost-benefit, cost of illness, cost-consequence, and any other economic analytic technique that provides valuable information to health care decision makers for the allocation of scarce resources. Pharmacoeconomics is often referred to as "health economics" or "health outcomes research," especially when it includes comparison with non-pharmaceutical therapy or preventive strategies such as surgical interventions, medical devices, or screening techniques.

Pharmacoeconomic tools are vitally important in analyzing the potential value for individual patients and the public. These methods supplement the traditional marketplace value as measured by the prices that the patient or patron is willing to pay. With government agencies and third parties' continuing concern about the higher expenditures for prescriptions, pharmaceutical manufacturers and pharmacy managers are highly cognizant that pharmaceutical interventions and services require comparative cost-justification and continual surveillance to assure cost-effective outcomes.[3–6]

From pharmaceutical research, we have seen significant therapeutic advances and breakthroughs. From health care delivery entrepreneurs we have seen numerous expanding roles for pharmacists, nurses, and physician assistants, with services such as home intravenous therapy, drug-level monitoring, parenteral nutrition management, hospice care, self-care counseling, and genetic screening for customizing therapy, among other innovations. The use of valid economic evaluation methods to measure the value and impact of new interventions can increase acceptance and appropriate use of such programs by third-party payers, government agencies, and consumers.[7–9]

There is increasing scrutiny over all aspects of health care as we attempt to balance limited finances and resources against optimal outcomes. Cost-effectiveness evaluations of pharmaceutical options are becoming mandatory for attaining adequate reimbursement and payment for services.[10,11] Pharmacoeconomic methods help document the costs and benefits of therapies and pharmaceutical services, and establish priorities for those options to help in appropriately allocating resources in ever-changing health care landscapes.

1.2 ANALYTICAL PERSPECTIVES

Point of view is a vital consideration in pharmacoeconomics. If a medicine is providing a positive benefit in relation to cost in terms of value to society as a whole, the service may not be valued in the same way by separate segments of society. For example, a drug therapy that reduces the number of admissions or patient days in an acute care institution is positive from society's point of view but not necessarily from that of the institution's administrator, who depends on a high number of patient admissions to meet expenses. Thus, one must determine whose interests are being served when identifying outcome criteria for evaluation. When considering pharmacoeconomic perspectives, one must always consider who pays the costs and who receives the benefits. A favorable economic analysis that showed savings in clinic utilization from the employer perspective would probably not be viewed positively from the clinic's budget perspective. More broadly, what is viewed as saving money for society may be viewed differently by private third-party payers, administrators, health providers, governmental agencies, or even the individual patient. It is generally agreed among health economists that the societal perspective should always be discussed in an evaluative report, even though the focus of the report might deal with other segments such as hospitals or insurance agencies. In the United States, with many different health care delivery and payer approaches, this can be complicated, and analyses are often done from multiple perspectives to assist adjudication by multiple stakeholders.

1.3 CODE OF ETHICS

The International Society for Pharmacoeconomics and Outcomes Research (ISPOR) has published a code of ethics that is vital to the honesty and transparency of the discipline.[12] The code encourages pharmacoeconomists to maintain the highest ethical standards because the academy recognizes that activities of its members affect a number of constituencies. These include but are not limited to: (1) Patients who are ultimately going to experience the greatest impact of the research; (2) practitioners who will be treating or not treating patients with therapies, medications, and procedures made available or not made available because of the research; (3) governments, employers, decision-makers, and payers who must decide what is covered so as to optimize the health of the patient and resource utilization; (4) professional outcomes researchers; (5) colleagues, where relationships in conducting research and related activities are particularly critical; (6) research employees concerned about how they are regarded, compensated, and treated by the researchers for whom they work; (7) students who work for researchers, where respect and lack of exploitation are important because they are the future of the discipline; and (8) clients for whom the research is conducted, and the researchers' relationships with them.

The ISPOR code of ethics lists many standards for researchers, but a sample section of the code related to "design and research practices" is as follows:

1. Maintain a current knowledge of research practices.
2. Adhere to the standards of practice for their respective fields of research and identify any official guidelines/standards used.

3. Research designs should be defined a priori, reported transparently, defended relative to alternatives, and planned to minimize all types of bias.
4. Respect the rights of research subjects in designing and conducting studies.
5. Respect the reputations and rights of colleagues when engaged in collaborative projects.
6. Maintain and protect the integrity of the data used in their studies.
7. Not draw conclusions beyond those which their data would support.

1.4 OVERVIEW OF ECONOMIC EVALUATION METHODS

This section will introduce the reader with a brief overview of the methodologies based on the two core pharmacoeconomic approaches, namely cost-effectiveness analysis (CEA) and cost-utility analysis (CUA). Table 1.1 provides a basic comparison of these methods with cost-of-illness, cost-minimization, and cost-benefit analysis. One can differentiate between the various approaches according to the units used to measure the inputs and outcomes, as shown in the table. In general, the outputs in CEA are related to various natural units of measure, such as lives saved, life-years added, disability-days prevented, blood pressure, lipid level, and so on. Cost-benefit analysis (CBA) uses monetary values (e.g., euros, dollars, pounds, yen) to measure both inputs and outputs of the respective interventions. Further discussion and examples of these techniques have been presented elsewhere.[1–3,13–21] It is hoped that the evaluation mechanisms delineated further in this book will be helpful in managing pharmaceutical interventions toward improving societal value and generate greater acceptance by health authorities, administrators, and the public. Using the human papillomavirus (HPV) vaccine as an example for case studies, other chapters in this book will further illustrate the various analytical methodologies related to CEA, CUA, CBA, etc.

1.5 QUALITY OF LIFE AND PATIENT PREFERENCES

Significant components in pharmacoeconomics are patient outcomes and quality of life (QoL) with an expanding list of related factors to consider (Table 1.2).[14,15] Although it is recognized that there are physical, mental, and social impairments associated with disease, there is not always consensus on how to accurately measure many of these factors. Consequently, the concept of satisfaction with care is often overlooked in cost-effectiveness studies and even during the approval process of the U.S. Food and Drug Administration (FDA). Generally, pharmacoeconomic and outcomes researchers consider QoL a vital factor in creating a full model of survival and service improvement. QoL is related to clinical outcomes as much as drugs, practitioners, settings, and types of disease. The question becomes how to select and utilize the most appropriate instruments for measuring QoL and satisfaction with care in a meaningful way.

The quality-adjusted life year (QALY) has become a major concept in pharmacoeconomics. It is a measure of health improvement used in CUA, which combines mortality and QoL gains and considers the outcome of a treatment measured as the number of years of life saved, adjusted for quality.

TABLE 1.1
Comparison of Pharmacoeconomic Methods and Calculations

Method	Abbr	Basic Formula	Discounting Math	Input	Output	Results Expressed	Goal Determine:	Advantage / Disadvantage	Example
Cost of Illness	COI	(DC+IC)	$\sum^{n}_{t=1}[C_t/(1+r)^t]$	$	$	Total cost of illness	Total cost of illness	Does not look at TXs separately	Cost of migraine in U.S.
Cost Minimization Analysis	CMA	C_1-C_2 or [Preferred Formula] $(DC_1+IC_1) - (DC_2+IC_2)$	$\sum^{n}_{t=1}[C_t/(1+r)^t]$	$	Assumed Equal	Net cost savings	Lowest cost TX	Assume both TXs have same effectiveness	Assume two antibiotics have the same effects for killing infection but differ on nursing and intravenous cost
Cost-Effectiveness Analysis	CEA	$(C_1-C_2) / (E_1 - E_2)$ or [Preferred Formula] $(DC_1+IC_1) - (DC_2+IC_2) / (E_1 - E_2)$	$\sum^{n}_{t=1}[C_t/(1+r)^t] / \sum^{n}_{t=1}[E_t/(1+r)^t]$	$	Health Effect	Incremental cost against change in unit of outcome	TX attaining effect for lower cost	Compare TXs that have same type of effect units	Compare two HTN prescriptions for life years
Cost–Benefit Analysis or Net Bv enefit	CBA	$(B_1 - B_2) / (DC_1+IC_1) - (DC_2-IC_2)$ or [Preferred Formula] Net Benefit = $(B_1-B_2) - (DC_1+IC_1) - (DC_2+IC_2)$	$\sum^{n}_{t=1}[B_t/(1+r)^t] / \sum^{n}_{t=1}[C_t/(1+r)^t]$ or $\sum^{n}_{t=1}[(B_t-C_t)/(1+r)^t]$	$	Dollars	Net benefit or ratio of incremental benefits to incremental costs	TX giving best net benefit or higher B/C ratio (or return on investment)	TXs can have different effects, but must be put into dollars	Compare two cholesterol prescriptions and convert life years to wages
Cost-Utility Analysis	CUA	$(C_1-C_2) / (U_1-U_2)$ or [Preferred Formula] $(DC_1+IC_1) - (DC_2+IC_2) / (U_1 - U_2)$	$\sum^{n}_{t=1}[C_t/(1+r)^t] / \sum^{n}_{t=1}[U_t/(1+r)^t]$	$	Patient Preference	Incremental cost against change in unit of outcome adjusted by patient preference	TX attaining effect (adjusted for patient preference) for lower cost	Preferences are difficult to measure	Compare two cancer prescriptions and use QoL adjusted life years gained

Note: DC = direct cost; IC = indirect cost; r = discount rate; t = time; HTN = hpertension; QoL = quality of life; TX = treatment or intervention.

TABLE 1.2
Outcomes and Quality of Life Measurement Approaches

I. Basic Outcomes List –- Six D's
   A. Death
   B. Disease
   C. Disability
   D. Discomfort
   E. Dissatisfaction
   F. Dollars (Euros, Pounds, Yen)
II. Major Quality of Life Domains
   A. Physical status and functional abilities
   B. Psychological status and well-being
   C. Social interactions
   D. Economic status and factors
III. Expanded Outcomes List
   A. Clinical End Points
      1. Symptoms and Signs
      2. Laboratory Values
      3. Death
   B. General Well-being
      1. Pain/Discomfort
      2. Energy/Fatigue
      3. Health Perceptions
      4. Opportunity (future)
      5. Life Satisfaction
   C. Satisfaction with Care/Providers
      1. Access
      2. Convenience
      3. Financial Coverage
      4. Quality
      5. General

One approach to conceptualizing QoL and outcomes data collected in clinical trials is to consider the source of the data. There are several potential sources of data to evaluate the safety and efficacy of a new drug. Potential sources and examples are listed below:

- Patient-reported outcomes (PROs)[16]—e.g., global impression, functional status, health-related QoL (HRQoL), symptoms
- Caregiver-reported outcomes—e.g., dependency, functional status
- Clinician-reported outcomes—e.g., global impressions, observations, tests of function
- Physiological outcomes—e.g., pulmonary function, blood glucose, tumor size

1.6 DECISION ANALYSIS AND MODELING

Decision analysis is defined as "… a systematic approach to decision making under conditions of uncertainty." Decision analysis is an approach that is explicit, quantitative, and prescriptive.[1]

It is explicit in that it forces the decision maker to separate the logical structure into its component parts so that they can be analyzed individually, then recombined systematically to suggest a decision. It is quantitative in that the decision maker is compelled to be precise about values placed on outcomes. Finally, it is prescriptive in that it aids in deciding what a person should do under a given set of circumstances. The basic steps in decision analysis include identifying and bounding the decision problem; structuring the decision problem over time; characterizing the information needed to fill in the structure, and then choosing the preferred course of action.

Pharmacoeconomic models can involve decision trees, spreadsheets, Markov analyses, discrete event simulation, basic forecasting, and many other approaches.[17]

In a simplified form, a decision tree can double as an educational tool for presenting available therapeutic options and probable consequences to patients and decision makers.[18,19] Wennberg and others have explored ways to involve patients in a shared decision-making process.[19] One of his projects involved a computer interactive program on prostate surgery education. The program explains to patients the probability of success, the degree of pain that might be encountered at each step, and what the procedure actually entails. After viewing this program with visual graphic depictions of the surgery, many of the patients changed their decisions about wanting surgery rather than watchful waiting. This reduction in a major procedure resulted from a greater focus on QoL and patient satisfaction. With further evaluation and perhaps modification of the computer program, it should also produce more cost-effective care. Wennberg's work is an application of outcomes research that helped to weigh costs, utilities, and QoL for the patient.

1.7 RANKING PRIORITIES: DEVELOPING A FORMULARY LIST

Table 1.3 illustrates how cost–utility ratios can be used to rank alternative therapies as one might do for a drug formulary. The numbers in the second column of the table list the total QALYs for all of a decision maker's patient population that is expected to benefit from the treatment options in each row. The numbers in the third column detail the total cost of treatment for all of one's targeted patient population for each treatment option in each row. For the next step in the selection process, rank the therapy options by their cost–utility ratios. Options have already been ranked appropriately in this table. For the final selection step, add each therapy option into one's formulary, moving down each row until your allocated budget (using the cost column) is exhausted. In other words, if you have only $420,000, you would be able to fund therapies A, B, and C. These options have the best cost-utility for one's population given one's available budget. Cost-effectiveness and cost–utility ratios are sometimes presented in similar fashion and are called League Tables. Tengs et al.[20] have published an extensive list of interventions and Neumann and colleagues[21] maintain a website with a substantial list of cost–utility ratios based on health economic studies,

TABLE 1.3
Health Economic Selections* with Fixed Budget

Therapy or Program	QALYS [a]	Cost[b] ($thousand)	Cost–Utility Ratio ($thousand)
A	50	100	2
B	50	200	4
C	20	120	6
D	25	200	8
E	10	120	12
F	5	80	16
G	10	180	18
H	10	220	22
I	15	450	30

[a] Total Quality-Adjusted Life Years (QALYs) for all of patient population benefiting.
[b] Total cost of treatment for all of targeted patient population.
* Selection procedure: first, rank therapies by cost–utility ratios, then add therapeutic options until budget is exhausted.

with a sample in Table 1.4. These listings must be used with caution because there are a number of criticisms of rankings with league tables, including:

- Different reports use different methods
- What the comparators were (e.g., which drugs, which surgeries)
- Difficult to be flexible about future comparators
- Orphan and rare disease versus more prevalent diseases
- Randomized prospective trials versus retrospective studies
- Regional and international differences in clinical resource use
- Regional and international differences in direct and indirect costs of treatment
- Statistical confidence intervals of cost and outcomes results
- Difficult to test statistical significance between the pharmacoeconomic ratios of treatments listed

1.8 INCREMENTAL ANALYSIS AND QUADRANTS

Whether one is dealing with cost analyses or decision analysis, it is important to properly compare one treatment with another, and one should understand the concepts in incremental analysis. Incremental analysis does not mean that one is adding a second therapy to the patient's regimen, but it is a technique for comparing one therapy with another. The basic incremental formulas are as follows:

$$\text{CEA: } (\text{Cost}_1 - \text{Cost}_2) \,/\, (\text{Effectiveness}_1 - \text{Effectiveness}_2)$$

or

$$\text{CUA: } (\text{Cost}_1 - \text{Cost}_2) \,/\, (\text{QALYs}_1 - \text{QALYs}_2)$$

TABLE 1.4
Selected Cost–Utility Ratios from the CEA Registry

Intervention vs. Comparator in Target Population	C/U Ratio in 2002 US$
Elective cesarean section vs. vaginal delivery in 25-year-old HIV-infected women with detectable HIV RNA	Cost-saving
Treatment with interferon alpha for 6 months vs. no treatment (conventional management only) in 40-year-old patients with chronic hepatitis C infection	$ 5,000/QALY
Initial screen for presence of protective antibody with vaccination against hepatitis A if susceptible vs. no vaccination in 2-year-old healthy children in developed countries	$ 8,100/QALY
Combined outreach initiative for pneumococcal and influenza vaccination vs. usual vaccine availability in people 65 years and older	$ 13,000/QALY
Statin therapy vs. usual care in patients aged 75–84 with a history of myocardial infarction	$ 21,000/QALY
Intensive school-based tobacco prevention program—over 50-year period, assumes 30% smoking reduction, dissipates in 4 years vs. status quo (current average national tobacco educational practices) in every 7th and 8th grade in the United States	$ 22,000/QALY
Driver side air bag vs. no air bags in driving population and car passengers	$ 30,000/QALY
Systematic screening for diabetes mellitus vs. none (usual practice) for all individuals aged 25 and older	$ 67,000/QALY
Tamoxifen chemoprevention vs. surveillance in women at high risk for breast cancer	$ 84,000 - 160,000/ QALY
Annual screen of primary care patients for depression vs. no screening in 40-year-old primary care patients	$ 210,000/QALY
Bisphosphonates vs. no treatment in women aged 50 with average risk of hip fracture	$ 300,000/QALY
National regulation against using a cellular telephone while driving vs. no regulation in United States population in 1997	$ 350,000/QALY
Varicella vaccination without testing vs. Varicella antibody testing followed by vaccination if negative in 20–29-year-old adults with no history of chickenpox	$ 2,300,000/QALY
Examination and culture for herpes virus vs. examination only in pregnant women with a history of genital herpes, active disease during pregnancy, or sexual partners with a proven history of genital herpes	$57 million/QALY
Thrombolysis vs. surgery in 65-year-old patients presenting with acute lower extremity ischemia	Dominated

Source: Reprinted with permission from Neumann, P and Olchanski, N. A Web-based Registry of Cost-Utility Analyses. *ISPOR Connections* Vol.10 No. 1: February 15, 2004.[22]

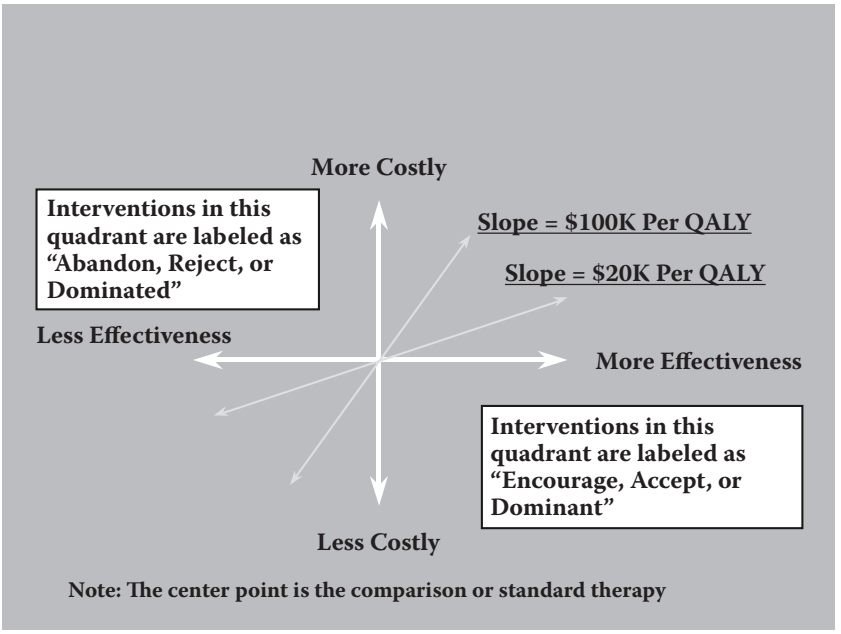

FIGURE 1.2 Incremental ratios and quadrants.

An interesting way of displaying this information is illustrated in Figure 1.2. By displaying this information in quadrants, one can more easily visualize the relationship between therapies. Drugs that are cheaper and more effective would fall in the "accept" or "dominant" sector, while drugs that are more expensive and less effective would be "dominated." The slopes of the lines represent the incremental cost–effectiveness ratios and, in general, therapies between $20,000 to $100,000 per life year saved (or per QALY) are often considered acceptable in public policy reports.

A classic paper involving incremental analysis deals with the comparison of tissue plasminogen activator (TPA) to streptokinase.[23] In this study, the important question did not involve looking at the CEA ratio of each drug individually; instead, it analyzed the incremental differences of the new drug, TPA, over the standard therapy at the time. The analysis demonstrated that TPA, when compared with streptokinase, had an incremental cost per life year saved of about $40,000, which was considered a socially acceptable value.[23]

1.9 FOURTH HURDLE AND DRUG APPROVALS

The classic basic elements required for approval of new drugs are (1) therapeutic efficacy, (2) drug safety, and (3) product quality. But more recently, with the realization of limited national and global financial resources, another drug approval step has been added that considers factors related to pricing and reimbursement. Therefore,

in at least two dozen countries, there is an additional jump before the marketing of pharmaceuticals that is often called "the fourth hurdle." This criterion, usually involving cost-effectiveness and pharmacoeconomic analyses, is required even when efficacy, safety, and quality have been demonstrated. Such a fourth hurdle was initially introduced in Austria for the reimbursement of new drugs. Despite the extra development costs to conduct these studies, and concern from the pharmaceutical industry, this fourth step can also be viewed as a positive opportunity to better support more innovative medicines over me-too drugs. Pharmacoeconomic analyses can provide quantitative evidence for more rational new drug approvals. And with post-marketing surveillance and patient registries, pharmacoeconomics should be able to help sustain cost-effective drug utilization throughout the life cycle of the therapy.

1.10 FROM BOARD ROOM TO BEDSIDE

Figure 1.3 provides a basic consult form that suggests a framework for pharmacoeconomic assessments. If a decision between alternative treatments needs to be made, this form could help structure the calculations and considerations related to pharmacoeconomics. With the current technology and resources in most facilities, at an individual patient level, certainly, it would be impossible to have sufficient time with each patient to individually apply detailed calculations. Evolving e-health technologies and the Internet may facilitate patient applications in the future. This consult worksheet is a basic template, then, for evaluating therapeutic options for a drug formulary, framing a formal pharmacoeconomic study. In an ideal pharmacoeconomic world, it could be used for a basic calculation sheet to be discussed with a physician or patient and maintained in a patient's medical record.

Although a pharmacoeconomic analysis of a new treatment may indicate that the intervention is cost-effective versus existing therapy, the continued clinical success of the new treatment is paramount. The least cost-effective drug, from an individual patient perspective, is the drug that does not work. Substantially more research remains to be performed not only on future drugs in the pipeline but also on existing interventions in the marketplace so that we can maximize patient outcomes and enhance cost-effectiveness. Computer technology and the Internet are tremendous resources for disseminating and applying pharmacoeconomic techniques, and then continually documenting outcomes for practitioners and patients.[24] It is expected that reimbursement plans will include more incentives (paying for performance) for improvements in these economic, clinical, and humanistic outcomes.[25] Thus, pharmacoeconomics reaches from the societal (macro) and board room level out to the clinical and patient (micro) level, as envisioned in Figure 1.4.

Even health practitioners will be increasingly expected to allocate scarce resources based on pharmacoeconomic principles. Using pharmacoeconomics and disease management concepts, health providers can produce more cost-effective outcomes in a number of ways.[26] For example:

- Decrease drug–drug and drug–lab interactions.
- Increase the percentage of patients in therapeutic control.

I. ID NUMBER:

II. TREATMENT OBJECTIVES:

III. PERSPECTIVE: ☐ Society ☐ Patient ☐ Payer ☐ Provider ☐ Hospital ☐ Other

IV. TYPE OF ANALYSIS ☐ COI ☐ CMA ☐ CBA ☐ CEA ☐ CUA ☐ Other

V. TREATMENT OPTIONS:

	Treatment A	Treatment B	
Names of Treatment:			
Disease/Symptom:			
Major Outcome Measure:			

VI. COST FACTORS

A. DIRECT COSTS: (HEALTH CARE RESOURCES)	Treatment A	Treatment B	Incremental
Practitioner			
Clinic/Hospital			
Acquisition			
Administration			
Monitoring			
Managing			
ADRs			

B. DIRECT COSTS: (NON-HEALTH CARE RESOURCES)			
Transport			
Telephone			

C. INDIRECT COSTS			
Morbidity Costs (time lost from work in dollars)			

	Treatment A	Treatment B	Incremental
D. INTANGIBLE COSTS (difficult to put into dollars)			
Discomfort/Pain			
Emotional			
QoL Quality of Life Index (as percentage of full health)			
TOTAL COST			

VII. MEASUREMENT CONSIDERATIONS of effectiveness, benefit, or utility.

Unit of measurement

COI (direct and indirect costs of illness)

CMA (input costs only, outcomes assumed equivalent)

CBA & NB (input = $, outcomes all in dollars)

CEA (input = $, outcomes in natural units, mmHg, etc.)

CUA (input = $, outcomes in utiles, QALYs)

Other

VIII. CALCULATED RESULTS: (Ratios are results of Inputs divided by Outcomes.)	Treatment A	Treatment B	Incremental
COI (direct & indirect costs of illness)			
CMA (total direct & indirect costs)			
CBA (benefit over cost ratio)			
NB (benefit minus cost)]			
CEA (cost over effectiveness ratio)			
CUA (cost over utility ratio)			
Other			

FIGURE 1.3 Pharmacoeconomic consult template. See Table 1.1 for definitions. Developed by McGhan, W.F. and Smith, M.D. Reprinted with permission. Interactive version available through www.healthstrategy.com

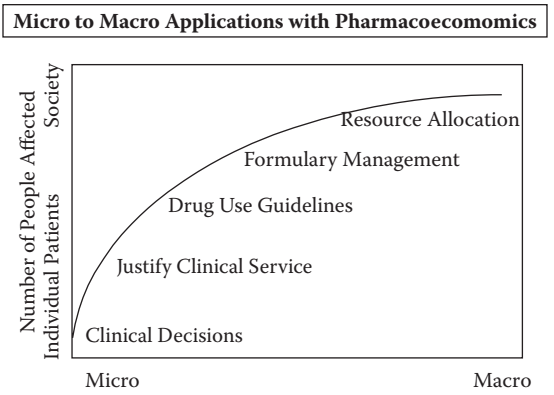

FIGURE 1.4 Micro to macro applications with Pharmacoeconomics.

- Reduce the overall costs of the treatment by utilizing more efficient modes of therapy.
- Reduce the unnecessary use of emergency rooms and medical facilities.
- Reduce the rate of hospitalization attributable to or affected by the improper use of drugs.
- Contribute to better use of health manpower by utilizing automation, telemedicine, and technicians.
- Decrease the incidence and intensity of iatrogenic disease, such as adverse drug reactions.

By improved monitoring and assessment of drug therapy outcomes, practitioners can provide early detection of therapy failure and provide cost-effective prescribing.

1.11 CONCLUSIONS

In this chapter, a general introduction to pharmacoeconomics has been provided. There are many reports in the literature that demonstrate that the benefit of medicines is worth the cost to the payer(s) for numerous disease states. Still, it must be realized that even though most research is positive, there is a need to continue to develop interventions and services that maximize the benefit-to-cost ratio to society. Even though new drugs can demonstrate positive ratios of benefit to cost, society or agencies will ultimately invest their resources in programs that have the higher benefit-to-cost or the best cost–utility ratio. Similarly, the health system must be convinced that any new therapy is worth utilizing, with a resultant modification or even deletion of other, less effective, therapeutic options, if necessary. All sectors of society, and certainly the pharmaceutical arena, must fully understand pharmacoeconomics if everyone around the globe is to have optimal health care and a better future.[27]

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