Introduction to Economic Analysis of Healthcare

Henry A. Glick, Ph.D.
Decision Analysis Workshop
August 17, 2009
www.uphs.upenn.edu/dgimhsr

Evaluation of Medical Care (I)

TRADITIONAL ISSUES

Safety

Efficacy

Effectiveness

Side effects acceptable?

Can it work?

Does it work?

Evaluation of Medical Care (II)

ECONOMIC ISSUES

Efficiency

Are we getting the best outcome for the expenditure
Principles of Economic Assessment

- Rules exist for assessing costs and benefits
- Assumptions are made explicit
- As a result:
  - There is consistency of approach
  - It is clear what is included and excluded from calculations

Resources

- Resources are limited
- Choices must be made
- When a resource is used, the opportunity to use it for something else is lost
- The value of a resource in its best alternative use is its "opportunity cost"

Health Economic Analysis

Types of Costs and Benefits

- Intangible
- Indirect
- Direct

Types of Analysis

- Society
- Patient
- Payor
- Provider

Bombardier and Eisenberg, 1984
Types of Analysis

- Generally distinguished by what outcomes are included (e.g., costs only vs costs and effects) and how they are quantified (e.g., all in terms of money or in terms of health and money)

Cost Identification

- Also referred to as cost minimization and cost-cost analysis
- Estimates costs of an intervention, but not benefits
- Appropriate only when two options of equal efficacy are compared

Cost Identification of Herniorrhaphy

<table>
<thead>
<tr>
<th></th>
<th>Present System</th>
<th>Proposed System</th>
<th>Savings*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel</td>
<td>82.0</td>
<td>51.5</td>
<td>30.5</td>
</tr>
<tr>
<td>Drugs and Supplies</td>
<td>68.0</td>
<td>28.0</td>
<td>40.0</td>
</tr>
<tr>
<td>Overhead &amp; Depreciation</td>
<td>217.0</td>
<td>108.5</td>
<td>108.5</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>390.0</td>
<td>0.0</td>
<td>390.0</td>
</tr>
<tr>
<td>Total</td>
<td>757.0</td>
<td>188.0</td>
<td>569.0</td>
</tr>
</tbody>
</table>

* All costs in Columbian pesos (1975 value).
Source: Velez-Gil et al., 1975
Cost-Effectiveness Analysis (I)
• Estimates costs and outcomes of intervention
• Costs and outcomes are measured in different units
• Results meaningful in comparison with other interventions or a predetermined standard
  - (e.g., $50,000 per quality-adjusted year of life saved)

Cost-Effectiveness Analysis (II)
• Incremental cost-effectiveness ratio:

\[
\frac{\text{Costs}_1 - \text{Costs}_2}{\text{Effects}_1 - \text{Effects}_2}
\]

Cost-Utility Analysis
• Outcomes expressed in units of utility (e.g., QALYs)
• Referred to either as a fourth type of analysis or as a subset of cost-effectiveness analysis
Choosing Among Alternative Interventions

<table>
<thead>
<tr>
<th>Costs</th>
<th>Effects</th>
<th>Incremental Cost-Effectiveness Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>A &gt; B</td>
<td>A &lt; B</td>
<td>Dominant</td>
</tr>
<tr>
<td>A &lt; B</td>
<td>Incremental Cost-Effectiveness Analysis</td>
<td>A Dominant</td>
</tr>
</tbody>
</table>

Treatment for Chlamydia

- The data *

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Cost</th>
<th>Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29.84</td>
<td>0.941</td>
</tr>
<tr>
<td>2</td>
<td>33.02</td>
<td>0.953</td>
</tr>
</tbody>
</table>

- Cost-effectiveness ratio

\[
\frac{33.02 - 29.84}{0.953 - 0.941} = \frac{3.18}{0.012} = 265
\]

* Source: Nettleman et al., 1986

League Table Cost per QALY

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Ratio (US $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CABG for Left Main CAD</td>
<td>4,200</td>
</tr>
<tr>
<td>Neonatal Intensive Care (Birthweight 1-1.499 kg)</td>
<td>4,500</td>
</tr>
<tr>
<td>Neonatal Intensive Care (Birthweight .500-.999 kg)</td>
<td>31,800</td>
</tr>
<tr>
<td>CABG for Single Vessel Disease</td>
<td>36,300</td>
</tr>
<tr>
<td>School TB Testing Program</td>
<td>43,700</td>
</tr>
</tbody>
</table>

* 1983 value  
Source: Torrance, 1986
### Alternatives to QALYS

- Years of life gained
- Lives saved
- Successful treatments
- Cases of illness avoided
- Intermediate outcomes gained

### Cost-Benefit Analysis (I)

- Estimate costs and benefits in the same (usually monetary) units
- Results meaningful in themselves (No need to compare with other programs, unless there is a budget constraint)

### Cost-Benefit Analysis (II)

- Net benefits
  
  Benefit – Cost

- Cost-Benefit Ratio
  
  Cost / Benefit
Cost-Benefit Analysis of Inpatient Versus Domiciliary Antibiotic Treatment for Osteomyelitis

Net Monetary Benefit
- Composite measure (part cost-effectiveness, part cost benefit analysis), usually expressed in dollar terms, that is derived by rearranging the cost-effectiveness decision rule:
  \[ W^* > \frac{(\text{Costs}_1 - \text{Costs}_2)}{(\text{Outcomes}_1 - \text{Outcomes}_2)} \]
- where \( W^* = \) maximum acceptable cost-effectiveness ratio (e.g., \$50,000 per QALY)
- NMB routinely (but not necessarily) expressed on the cost scale, known as net monetary benefits (NMB):
  \[ (W \times (\text{Outcomes}_1 - \text{Outcomes}_2)) - (\text{Costs}_1 - \text{Costs}_2) \]
- Particularly important for statistical evaluation of cost-effectiveness analysis (e.g., sample size; direct statistical testing by use of patient-level data; etc.)

Review
- Investigators compared 2 treatments, “LessCost” and “MoreCure”
- They found that “LessCost” was less expensive and recommended its adoption by physicians
- What type of economic analysis are the investigators carrying out?
- Do you agree with their conclusion?
Example 2

• Investigators compared 2 treatments, “LessCost” and “MoreCure.” They observed the following:

<table>
<thead>
<tr>
<th></th>
<th>LessCost</th>
<th>MoreCure</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>100,000</td>
<td>300,000</td>
<td>-200,000</td>
</tr>
<tr>
<td>Benefit</td>
<td>100,000</td>
<td>600,000</td>
<td>500,000</td>
</tr>
</tbody>
</table>

• The authors concluded that MoreCure is net beneficial.

• What type of economic analysis are the investigators carrying out?
• Do you agree with their conclusion?

Example 3

• Investigators compared 2 treatments, “LessCost” and “MoreCure.” They observed that MoreCure cost 200 more than LessCost and provided 0.03 additional QALYs

• The authors recommended that MoreCure was good value for the cost

• What type of economic analysis are the investigators carrying out?
• Do you agree with their conclusion?

Types of Costs and Effects Included

- Intangible
- Indirect
- Direct

- Society
- Patient
- Payor
- Provider

- Identification
- Effectiveness
- Benefit

- Types of Analysis
  - Factors
  - Decision
  - Economics

- Types of Costs and Benefits Included
  - Costs
  - Benefits
Marginal Cost (I)

- Costs incurred in providing an extra unit of service, or savings realized by providing one less unit
- Calculation unaffected by fixed costs

Marginal Cost (II)
Marginal Versus Average Cost

- Suppose that:
  - Total drug costs = $50
  - Total doses = 10
  - Average cost / dose = $5

- Suppose, however, that:
  - 9 doses = $49
  - 10 doses = 50
  - Marginal cost of 10th dose = $1

Cost Estimation

- Standard economic assumption
  - Purchase price = cost

- Health care (particularly U.S.)
  - Purchase price ≠ cost or there is no price to observe

- Difference relates to
  - Regulation; free care; cross-subsidization
  - High levels of insurance
  - Health care consumers not having adequate information

Indirect Cost (I)

- Human capital approach
  - Advantages
    - Easy to measure
    - Assess actual gains / losses in productivity
  - Disadvantages
    - Not theoretically correct measure
    - Poor proxy for "Willingness to Pay" (although in some common situations may be a lower bound)
    - "Undervalues" anyone not earning a wage
Indirect Cost (II)

- Willingness to pay approach
  - Advantages
    - Theoretically correct measure
  - Disadvantages
    - Function of ability to pay
    - May be difficult to measure in practice

Utility Assessment (I)

- Methods of utility assessment
  - Standard gambles
  - Time – tradeoff
  - Category scaling
  - Difference method

Point of View

- Types of Analysis
  - Costs and Benefits Included
  - Society
  - Patient
  - Payor
  - Provider

- Intangible
  - Direct
  - Indirect

- Effectiveness
  - Efficiency
Sensitivity Analysis
- Demonstrates dependence/independence of a result on a particular assumption
- Identifies critical values of variables
- Identifies uncertainties requiring further research

Discounting
- Costs and benefits incurred now are greater than those with a similar nominal value incurred later
- Future costs and benefits must be expressed in terms of present value

\[ PDV = \sum_{t=0}^{n} \frac{C_t}{(1+r)^t} \]

Discounting: an Example
- Assume that a program costs $1,000 this year and for the next 2 years

\[ PDV = \frac{1000}{1.03^0} + \frac{1000}{1.03^1} + \frac{1000}{1.03^2} \]

i.e., \( PDV = 1,000 + 970.87 + 942.60 \)

Hence, \( PDV = 2,913.47 \)
Issues in Discounting

- What is the appropriate discount rate for costs?
- Should the monetary costs and non-monetary outcomes be discounted at the same rate?

### Distributional Issues

<table>
<thead>
<tr>
<th></th>
<th>Program 1</th>
<th>Program 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Cost</td>
<td>250,000</td>
<td>250,000</td>
</tr>
<tr>
<td>Net Effect</td>
<td>10 Years</td>
<td>10 Years</td>
</tr>
<tr>
<td>C/E Ratios</td>
<td>25,000</td>
<td>25,000</td>
</tr>
<tr>
<td># of Patients who Benefit</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

### Features in Health Economic Analysis

- Consistent application of rules
- Marginal costs
- QALYS (and other measures of preference)
- Perspective
- Discounting
Objectives of Health Economic Assessments

- Economic assessments of health care aim at demonstrating the most efficient use of available resources, not cuts in expenditures.