Cost Effectiveness Analysis: Methods and Limitations
Cost Effectiveness

DOES NOT MEAN

CHEAPER
To describe cost-effectiveness analysis (methodology)
To discuss limitations and assumptions underlying CEA
• Provide a medical service to a patient if:
  – it has any benefit (clinical paradigm)
  – its incremental benefit outweighs its incremental cost (economic paradigm)
“Opportunity Costs”

• Opportunity costs: value of what you give up
• With limited resources, providing service to one patient reduces resources for others
  – Resources limited, since society is unwilling to spend all of its money on health care
  – Health care will always be rationed somehow, so better to consciously decide tradeoffs
Cost-Effectiveness Analysis!

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What Is Cost-Effectiveness Analysis?

One type of Economic Evaluation that focuses on outcomes, e.g.,

- Lives
- DALYs
Economic Evaluation

Choice

Program A

Costs A

Comparator B

Costs B

Consequence A

Consequence B

Source: Drummond et al., 1997

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Economic Evaluation

Choice

Costs A $

Program A

LIVES SAVED

Costs B $

Comparator B

LIVES SAVED

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Source: Drummond et al., 1997
Problem:

How to compare:
- costs
- consequences

Solution:

Compare Cost-Effectiveness Ratios
Cost-Effectiveness Ratio

**Numerator:** net use of health resources

**Denominator:** net improvement in QALYs

Cost $ / Effectiveness

\[ C/E_A \text{ vs. } C/E_B \]

\[ \Rightarrow \text{Pick Program A if } C/E_A < C/E_B \]

\[ \text{Pick Program B if } C/E_B < C/E_A \]

Seems simple, but is that really the case?
First Issue: Effectiveness

- Need same measure of Effectiveness, E.g.:
  - HIV infections averted
  - DALYs
- Can’t compare “apples” and “oranges”
Second Issues: Costs

Many different kinds of costs

- Health care costs
- Patient resources (time, $, other)
- Costs in other sectors

Which ones to include?

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How Do We Measure Effectiveness?

• Lives saved
• # of complications averted
• Disability days averted
• Quality adjusted life-years (QALYs)
  – Weighs years of life by the quality of those years.
  – Example: 1 year on hemodialysis = 0.6 years of life in perfect health.

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Example 1

COSTS:

- Health Care Costs $1,000,000
- Patient/Family resources $5,000
- Costs in other sectors $50,000

CONSEQUENCES:

- Lives Saved: 100
- Health care savings $250,000
- Savings in other sectors $20,000
- Savings in pat./fam. resources $12,000
Example 1: Cost-Effectiveness Ratio

Summary:
1) C/E = 10,000 / life saved
2) C/E = 7,500 / life saved
3) C/E = 7,730 / life saved

Question: Which one is right?
Example 1: Cost-Effectiveness Ratio

1) Health Care Cost Only

$1,000,000 / 100 lives

\[ \text{C/E} = \frac{1,000,000}{100} \text{/life saved} \]

2) Health Care Resources Only

\[ \text{Health care cost - health care savings} \]

\[ \frac{(1,000,000 - 250,000)}{100} \text{/100 lives} \]

\[ \text{C/E} = \frac{7,500}{\text{life saved}} \]
Example 1: Cost-Effectiveness Ratio

3) All Resources

C/E = (All costs - All savings) / # lives saved

\[
\frac{($1,000,000+5,000+50,000) - ($250,000+20,000+12,000)}{100 \text{ LS}}
\]

= $7,730 / life saved
The “Right” C/E Ratio

• The “right” C/E ratio depends on your perspective and your objectives

• Economists argue for a societal perspective:
  ==> Include all costs and consequences
  C/E = $ 7,730 / life saved
Net Costs / Effectiveness

Net costs = Costs - Resources Saved
= C - S

C = C₁ + C₂ + C₃ +...
S = S₁ + S₂ + S₃ +...
Determining Cost Effectiveness Requires Many Value Judgments To Create A Single Measure Of Gain

- The value of diminishing different kinds of disability
- Disability versus death
- Death at different ages
- Current versus future gains (discount rate)
- Attitude toward uncertainty (risk aversion)
### Differential Timing of Costs

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost of Program A ($000s)</th>
<th>Cost of Program B ($000s)</th>
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<tr>
<td>1</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>“Total”</td>
<td>30</td>
<td>29</td>
</tr>
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</table>
• Question: Is this comparison legitimate?
• Answer: No!

• Question: What to do?
• Answer: Convert future costs to ‘present’ costs
Value of a 1-year Investment

• Deposit $100 in the Bank @ 10% / year
  ==> get $110 after 1 year
• How much is $100 in 1 year worth today?
  ==> $91

• Deposit $100 in the Bank @ 5% / year
  ==> get $105 after 1 year
• How much is $100 in 1 year worth today?
  ==> $95
Conclusion:

– Timing matters
– The interest rate matters
### Choice of Discount Rate Makes a Difference

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<th></th>
<th>$r=0%$</th>
<th>$r=1%$</th>
<th>$r=5%$</th>
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<tbody>
<tr>
<td><strong>Costs</strong></td>
<td>($000s)$</td>
<td>($000s)$</td>
<td>($000s)$</td>
<td>($000s)$</td>
</tr>
<tr>
<td>$P_A$</td>
<td>30</td>
<td>29.31</td>
<td>26.79</td>
<td>24.08</td>
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<tr>
<td>(late costs)</td>
<td></td>
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</tr>
<tr>
<td>$P_B$</td>
<td>29</td>
<td>28.54</td>
<td>26.81</td>
<td>24.91</td>
</tr>
<tr>
<td>(early costs)</td>
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</tbody>
</table>
Important Issues in C/E Analysis:

- In/exclusion of costs and consequences
- Difficulty estimating cost and effectiveness
- Timing of costs (and consequences)
- Discount rate
Compute cost–effectiveness (CE) ratio

\[ CE = \frac{\text{Net costs (in monetary terms, e.g., dollars)}}{\text{Net health effects (in utility terms, e.g., DALYs or QALYs)}} \]
Conceptual uses of CEA

- Objective: Develop more cost-effective programs
- Start with an existing or proposed program
- Identify potential modifications that improve effectiveness (e.g., more powerful intervention, improved patient adherence)
- Identify potential modifications that reduce costs (e.g., offer intervention only to selected clients, deliver faster, use lower cost personnel)
Efficacy ≠ Effectiveness

• **Efficacy** is how well treatment works in ideal circumstances

• **Effectiveness** is how well treatment works in real life

• Interventions may be less (more) when implemented at scale than in research/pilot settings, due to lower quality implementation (due to social change effects)

• C/E analysis always based on effectiveness
• Cost-Effective ≠ Cost-Minimizing
  – An intervention can be cost-effective even if it increases costs

• Effective ≠ Cost-Effective
  – An intervention can provide a health benefit without giving the best health “value” for the $
  – Example: HIV antigen testing of blood for transfusion is effective, but not cost-effective in this region
Decision Rules Based on Cost-Effectiveness

• Pay for a treatment if and only if it is found to be cost-effective
  – Primary concern: Money is wasted on a therapy that is not cost-effective

• Withhold payment for a treatment if and only if it is shown not to be cost-effective
  – Primary concern: A cost-effective therapy is excluded from coverage
Use of C/E Analysis for Policy

• C/E ratios only useful for policy if they are calculated in a consistent manner.

• Fundamental problem in comparing C/E ratios to allocate resources has been the use of very different methods and definitions.
  – e.g., misleading to compare cost per quality-adjusted life year for
    
    IEC for MSM vs. harm reduction for IDU

    when different costs are included and QALYs measured differently.
C/E Ratio = Difference in Costs/ Difference in Effectiveness

- Costs and effectiveness of what? Compared to what? What is the relevant alternative?
- With which population and over what time period is the C/E of the treatment measured?
- Whose costs and benefits?
- What type of costs should we measure?
- How do we measure effectiveness?
- How are the intervention effects determined?
Important Assumptions to Remember

• Ignores equity issues
• Ignores political concerns
• Assumes people are rational (they’ll demand what’s “good” for them)
Cost Effectiveness Possibilities

I. Higher Costs but Higher effectiveness
   ACCEPTABLE

II. Higher Costs but Lower Effectiveness
    AVOID

III. Lower Costs and Lower effectiveness
     ACCEPTABLE

IV. Lower Costs and Higher Effectiveness
    BEST SITUATION

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Every point in this box dominates point A

More effective, more expensive

Increasing effectiveness

Increasing cost
Conclusions

- Cost-effectiveness analysis can be a useful tool in allocating resources.

- Quantitative application requires data about program effectiveness compared to the absence of program.

- Conceptual uses are very powerful tools to plan alternative design.

- C-E analysis is relatively simple in theory but difficult in practice.

- Extreme care must be taken when confronting the methodological challenges inherent in CEA.

- CEA does not consider equity issues and is based on objective utilitarianism.