Incorporating Economic Evaluation in Clinical & Translation Research

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Setting expectations...

- Not possible to be an expert in economic evaluation in one hour
- However, you will...
  1) Understand the major types of economic evaluation
  2) Describe the economic evaluation process
  3) Understand how to prepare a CTR study to be evaluated
  4) Differentiate between return on investment and social return on investment
  5) Understand the limitations of economic evaluation

Introduction

- What do we mean by “economic evaluation”?

Cost
Outcome
Effectiveness
Benefit
Utility

Why bother with economic evaluation?

- Helps with decisions on optimal/efficient distribution of resources
- Funders may expect or value a return on investment
- Can help sell a policy in a climate of fiscal austerity
Economic evaluation in 7 steps

- Calculate Ratios
- Describe Intervention
- Identify Relevant Costs/Benefits
- Determine the Time Horizon
- Collect Data
- Determine Discount Rate
- Determine Perspective

Last step...what are these “ratios”?*

- Three types of economic evaluation commonly used in healthcare:
  - Cost-effectiveness analysis (CEA)
  - Cost-benefit analysis (CBA)
  - Cost-utility analysis (CUA)

Overview of CEA

- CEA compares the costs of achieving a particular nonmonetary objective, such as lives saved
- CEA applies to problems where the goal is accepted at the start and the problem is only to find the best, most efficient, means to achieve it

Incremental Cost-Effectiveness Ratio (ICER)

Difference in costs between intervention and status quo (alternative) ($C_1 - C_0$) relative to improvement in health outcome between intervention and status quo ($E_1 - E_0$):\n
\[
\text{ICER} = \frac{C_1 - C_0}{E_1 - E_0}
\]
The cost-effectiveness plane

Advantages/disadvantages of CEA

• Conceptually, this approach amounts to identifying the lowest cost approach of producing a given benefit.
• CEA is the first step toward undertaking a cost-benefit study.
  • If you run into significant problems in undertaking a CEA, it is unlikely that a CBA will be feasible.
• A primary disadvantage is subjectivity of “willingness to pay”

Overview of Cost-Benefit Analysis (CBA)

• CBA = costs relative to monetary benefit
• Generally from a societal perspective
  • The benefits and costs of not only those directly attributed to project but also any indirect benefits or costs

Measurement issues

• May be difficult to monetize benefit or costs, especially in health care
  • Value of life
  • Value of improving quality of life
Methods in CBA

- Three methods to place value on human life:
  - The human capital approach, estimates the present value of an individual’s future earnings
  - The willingness to pay or willingness to accept approach measures what individuals are willing to pay (accept) to avoid (accept) additional risk to life and limb
  - The contingent valuation approach elicits individuals valuation of alternative contingent risks

Other estimates on value of life

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>VSL (millions of dollars)</th>
<th>Source</th>
<th>Comments</th>
</tr>
</thead>
</table>
| 1. Viscusi & Aldi | 2003 | $7.1M | | Sensitivity Analysis
| 2. Viscusi & Aldi | 2003 | $7.1M | | | |
| 3. Viscusi & Aldi | 2003 | $7.1M | | | |
| 4. Viscusi & Aldi | 2003 | $7.1M | | | |
| 5. Viscusi & Aldi | 2003 | $7.1M | | | |
| 6. Viscusi & Aldi | 2003 | $7.1M | | | |
| 7. Viscusi & Aldi | 2003 | $7.1M | | | |
| 8. Viscusi & Aldi | 2003 | $7.1M | | | |
| 9. Viscusi & Aldi | 2003 | $7.1M | | | |
| 10. Viscusi & Aldi | 2003 | $7.1M | | | |
| 11. Viscusi & Aldi | 2003 | $7.1M | | | |
| 12. Viscusi & Aldi | 2003 | $7.1M | | | |
| 13. Viscusi & Aldi | 2003 | $7.1M | | | |
| 15. Viscusi & Aldi | 2003 | $7.1M | | | |

What about ROI?

- Special case of CBA
  - Perspective narrowed to a particular institution
  - Reported as either net present value (PV) dollar return or percentage return
  - %ROI = 100 * (Dollar benefit – Dollar cost) / Dollar cost
  - CBA reported as an ICER (cost per dollar benefit gained), ratio of dollar benefit to cost, or as dollar difference between benefit to cost (net benefit)
Social Return on Investment (SROI)

- Similar to calculating ROI, PV of benefits relative to PV of costs
- Benefits include non-traditional monetary measures using multiple perspectives
  - Like CBA, non-pecuniary outcomes must be monetized, e.g., using “willingness to pay” approach
- Expansive view of return on investment

Overview of Cost-Utility Analysis

- CUA uses quality-adjusted life-years as health-related outcome (QALY)
- Projects evaluated on basis of their incremental costs per extra QALY delivered to the patients

Measurement

\[ QALY = \sum_{i=0}^{\text{life expectancy}} \frac{F_i q_i}{(1 + d)^i} \]

where \(F_i\) is the probability that the person is still alive at age \(i\), \(d\) is the time discount factor, and the value \(q_i\) is the quality weight.

Cost utility and quality-adjusted life years (QALYs)

- Scale bounded by 0 and 1
- Death = 0 and perfect mental/physical health = 1
- Mental and physical health assessed using self-reported general or disease-specific quality of life instruments
Afterward, use an algorithm to derive utility weights...

<table>
<thead>
<tr>
<th>Health State</th>
<th>Utility Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Health</td>
<td>1.000</td>
</tr>
<tr>
<td>Mobility: level 1</td>
<td>0.853</td>
</tr>
<tr>
<td>Usual Activities: level 2</td>
<td>0.805</td>
</tr>
<tr>
<td>Anxiety/Depression: level 2</td>
<td>0.757</td>
</tr>
</tbody>
</table>

Hence, the predicted value for state 11223 is:

\[ 1.000 - 0.853 - 0.805 - 0.757 = -0.880 \]

Advantages of QALYs

- "Standardized" outcome (common yardstick)
- Can evaluate a wide range of disparate interventions & programs
- Relatively easy to implement
- Measures "high level" outcomes from healthcare services
  - Increased life span
  - Decreased morbidities
Critique of QALYs

- Some may view it as “age-ist”
- Different survey instruments may provide different utility weights
- Construction of QALYs is not really grounded in economic theory

Illustration: organ transplant

- Intervention costs $350,000, including direct and indirect costs
- Fourteen patients lived an average of 4.46 months.
- CER = (Cost – Averted Future Costs) / Life-years gained.
- CER = ($350,000 – 0) / (4.46/12) = $942,000.

QALY activity scale definitions

<table>
<thead>
<tr>
<th>Activity Limitation</th>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Limited</td>
<td>1.00</td>
<td>0.92</td>
<td>0.84</td>
<td>0.73</td>
<td>0.47</td>
</tr>
<tr>
<td>Limited-other</td>
<td>0.67</td>
<td>0.79</td>
<td>0.72</td>
<td>0.52</td>
<td>0.38</td>
</tr>
<tr>
<td>Limited-major</td>
<td>0.61</td>
<td>0.64</td>
<td>0.67</td>
<td>0.48</td>
<td>0.34</td>
</tr>
<tr>
<td>Unable-major</td>
<td>0.60</td>
<td>0.62</td>
<td>0.55</td>
<td>0.38</td>
<td>0.25</td>
</tr>
<tr>
<td>Limited in IADL</td>
<td>0.57</td>
<td>0.51</td>
<td>0.45</td>
<td>0.29</td>
<td>0.17</td>
</tr>
<tr>
<td>Limited in ADL</td>
<td>0.47</td>
<td>0.41</td>
<td>0.36</td>
<td>0.21</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Source: [Erickson et al. 1995]

Cost-effectiveness after adjusting for quality of life

- Assume health is poor after the operation.
- Assume ‘Limited in ADL’ after the operation.
- CER = $350,000 / ((4.46/12)×0.10) = $9,420,000.
- Is this cost-effective?
10/9/17


Additional Reading

- Cape JD, Brot, JM. Health J. Introduction to cost-effectiveness analysis for clinicians. UTMJ 2013;90(3):103-5
- Ubel PA, Hirth RA, Chenow ME, Fendrick AM. What is the price of life and why doesn’t it increase at the rate of inflation? Arch Intern Med. 2003 Jul 28;163(14):1637-41
- Neumann PJ, Cohen JT, Weinstein MC. Updating cost-effectiveness—the curious resilience of the $50,000-per-QALY threshold. NEJM 2014;371(9):796-7
- Gargani J. The leap from ROI to SROI: Farther than expected? Eval Prog Plan 2017; [Epub ahead of print]

Thank you!

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