Introduction to Cost-Effectiveness Analysis in Health

Health Economics Short Course

For more information and course dates, please visit our website: http://go.unimelb.edu.au/8eqn
Or email us: health-economics@unimelb.edu.au

Module 3 – Identifying, Measuring, Valuing and Analysing Outcomes

Centre for Health Policy
Melbourne School of Population and Global Health

Types of economic evaluation analysis (based on the nature of data)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>COSTS</th>
<th>OUTCOMES</th>
<th>DECISION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Minimisation</td>
<td>Dollars</td>
<td>Not compared, assumed identical in all aspects</td>
<td>Least cost alternative</td>
</tr>
<tr>
<td>Cost Effectiveness/ Cost Consequences</td>
<td>Dollars</td>
<td>Comparison based on a common measure on health, eg LY’s gained, blood pressure reduction</td>
<td>Incremental cost per natural unit of consequence gained</td>
</tr>
<tr>
<td>Cost Utility</td>
<td>Dollars</td>
<td>A summarised measure of impacts on health related quality of life, Valued as &quot;utility&quot;, eg QALY</td>
<td>Incremental cost per preference adjusted unit of consequence gained</td>
</tr>
<tr>
<td>Cost Benefit</td>
<td>Dollars</td>
<td>A summarised measure of impacts on health and non health benefits valued in monetary term (i.e., Dollars)</td>
<td>Net $; Cost/benefit ratio</td>
</tr>
</tbody>
</table>

Which type of economic evaluation to use? (based on the nature of data)

Is there good evidence on effectiveness of interventions being compared?

<table>
<thead>
<tr>
<th>Is effectiveness of interventions equal?</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost-minimization study</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Can all outcomes be valued in monetary terms (e.g. willingness to pay)?

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost-minimization study</td>
<td></td>
</tr>
</tbody>
</table>

Is there a measurable uni-dimensional outcome?

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost-effectiveness analysis</td>
<td></td>
</tr>
</tbody>
</table>

Can outcomes be measured as quality adjusted life years?

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost-utility analysis</td>
<td></td>
</tr>
</tbody>
</table>

Firstly, identifying and determining outcomes

Surrogate/Intermediate = change in clinical indicator resulting from the program

Final = change in health (status) resulting from the program
Identifying and determining outcomes (cont’d)

• Surrogate/Intermediate Outcome
  - Changes in risky/healthy behaviours rates
  - Viral load (HIV)
  - Glucose control (HbA1c)
  - Diastolic blood pressure
  - Vaccine uptake, attack rate
  - Schizophrenia relapse
  - Adverse event averted
  - Disease/cases averted or detected
  - Symptom-free days
  - Episode-free days

• Final Outcome (mortality and morbidity)
  - Survival (change in life expectancy) expressed as life years (LYs) gained
  - Disability days avoided
  - Disability adjusted life years (DALYs) avoided
  - Quality adjusted life years (QALY) gained

Secondly, determining effective size

• What will be the difference in outcomes between intervention and comparator if we did one versus the other tomorrow?
  - We need to be able to get an estimate of this?

• Many different options to estimate effective size
  1. Meta-analysis, systematic analysis for RCTs
  2. Head-to-head RCTs
  3. 2 sets of randomised trials using a indirect common reference e.g. Program A vs Program B vs Program B vs Program C
  4. Observational non randomized with control
  5. Observational non randomized without control
  6. Observational case-study, case report
  7. Expert opinion
    - Different methods may contain different levels of bias
    - Remember: efficacy does not imply effectiveness

The outcome of interest in Cost Effectiveness Analysis

• Not helpful in assessing a single programme without a comparator (i.e., cannot claim cost-effective by a program stands alone)

• Many outcome measures have been reported in CEA e.g. cases detected; cases prevented; symptom-free days; years of vision; life years …...

• All of these contain a quantity (duration) of life dimension and imply homogeneous quality of life
  - Cost per life year saved
  - Cost per cancer detected

Various outcomes/effects of study treatment in ADVANCE trial

Example of single (intermediate) outcome: Blood pressure reduction
Example of combined (intermediate) outcome – cumulative macrovascular incidence

Example of final outcome: All cause mortality

Why do we need health economists

Statistical Analysis:
Testing for difference

Economic Evaluation:
Estimating shaded areas of within trial plus beyond trial

Fig. 3.3 Survival curves for two hypothetical cohorts from age 80 years.

Within trial estimation vs beyond trial (life time) extrapolations

6 Life expectancy and life-years gained, from the within-trial effect of treatment with fixed combination of perindopril and indapamide

<table>
<thead>
<tr>
<th>Type of outcome</th>
<th>Perindopril–Indapamide</th>
<th>Placebo</th>
<th>Mean life-year gain per patient (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within trial</td>
<td>15.94 (15.87–16.01)</td>
<td>15.14 (15.03–15.24)</td>
<td>0.80 (0.00–0.16)</td>
</tr>
<tr>
<td>Total life expectancy</td>
<td>14.97 (14.61–15.33)</td>
<td>14.88 (14.59–15.17)</td>
<td>0.09 (0.00–0.12)</td>
</tr>
<tr>
<td>3% discount per year</td>
<td>12.98 (11.96–13.99)</td>
<td>12.22 (11.42–13.17)</td>
<td>0.06 (0.01–0.07)</td>
</tr>
<tr>
<td>5% discount per year</td>
<td>10.88 (10.27–11.49)</td>
<td>10.34 (10.03–11.65)</td>
<td>0.05 (0.01–0.09)</td>
</tr>
<tr>
<td>10% discount per year</td>
<td>8.36 (7.94–8.77)</td>
<td>8.34 (7.97–8.71)</td>
<td>0.02 (0.02–0.03)</td>
</tr>
</tbody>
</table>

Limitations of CEA

• Narrow uni-dimensional measure of success (e.g. look at physical health and mental health separately)
• So cannot compare disparate outcomes
• Only clinical outcome measured, no impact(s) (especially caused by morbidity) on patient’s quality of life included/reflected.
• More of technical efficiency (for a single disease) than allocative efficiency (across diseases or sectors)

Cost Utility Analysis (CUA)

• Broader than CEA because weigh different health conditions based on patient preference
• Combines more than one attribute of health (e.g. physical health and mental health)
• Therefore can capture disparate outcomes via utility so can compare across diseases.
Using QALYs to measure outcomes

The visual analogue score (VAS)

The time trade-off method

The questionnaire of EQ5D and an example of using EQ5D

Algorithm of Utility Scores – EQ5D

Calculating utility scores of EQ5D (Cont’d)
An example of how to convert intermediate outcomes into final outcomes

Unsafe injecting drug use rate → Hep B infected

Utility score = ?

Serocovered

Compensated cirrhosis

Liver cancer

Discounted sum of time spent in each health multiplied by utility score associated with each health state = QALY

Allowed transition → Low probability event

Example of drug therapy on Hepatitis B - Life Years (LYs) vs QALYs Gained

<table>
<thead>
<tr>
<th>Health State</th>
<th>Survival</th>
<th>Utility</th>
<th>QALY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>Seroconverted</td>
<td>19.9</td>
<td>14.8</td>
<td>0.78</td>
</tr>
<tr>
<td>Chronic hepatitis B</td>
<td>3.3</td>
<td>3.8</td>
<td>0.61</td>
</tr>
<tr>
<td>Compensated cirrhosis</td>
<td>5.1</td>
<td>5.7</td>
<td>0.56</td>
</tr>
<tr>
<td>Decompensated cirrhosis</td>
<td>0.6</td>
<td>0.7</td>
<td>0.15</td>
</tr>
<tr>
<td>Liver cancer</td>
<td>0.2</td>
<td>0.2</td>
<td>0.12</td>
</tr>
<tr>
<td>Total years alive</td>
<td>29.1</td>
<td>25.2</td>
<td>20.5</td>
</tr>
<tr>
<td>Gain (years)</td>
<td>3.9</td>
<td></td>
<td>3.2</td>
</tr>
</tbody>
</table>

Choice of MAU (Multi-Attribute Utility) Instrument

- EQ-5D (European utility weights)
- HUI III (Canadian)
- SF-36; SF-12; SF-6D (measuring health status, mapping to utility)
- AQoL (Australian)
- 15-D (Finland)
- Rosser-Kind Index (UK)
- Quality of Wellbeing scale (US)
- Others: CHU-9D-child instrument

Choice between instruments should be based upon their suitability for and sensitivity to the characteristics of particular population and intervention.

Differences among Utility Instruments – the ADVANCE trial

Stroke/TIA

Bypass

Treated Hypertension

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