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 4 – Policy Use and Interpretation of Cost-Effectiveness Analysis

Centre for Health Policy
Melbourne School of Population and Global Health

Purpose of economic evaluation

• In a resource constrained environment, provide information on the costs and benefits of options for intervening
• Inform decisions regarding the allocation of scarce resources, including information on opportunity cost
• Inform maximisation of health outcomes with given funding/budgets
• Use explicit criteria for choices

Types of economic evaluation analysis

<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/</td>
<td>Comparison based on</td>
<td>Incremental cost per natural unit of consequence gained</td>
<td></td>
</tr>
<tr>
<td>Cost Consequences</td>
<td>common measure on</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>health, eg LY's gained, blood pressure reduction</td>
<td>Incremental cost per preference adjusted unit of consequence gained</td>
<td></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>

Example CEA

Cost-effectiveness of lowering blood pressure with a fixed combination of perindopril and indapamide in type 2 diabetes mellitus: an ADVANCE trial-based analysis

Paul P Gloeckner, Philip Clarke, Jun Alexander, Mikael Vikman, Olga T Efles, Mark Woodhead, John Chambers, Neil Modrall and Gervase Parat

ABSTRACT

Objective: To determine the cost-effectiveness of regular antihypertensive, comparison of fixed blood pressure (BP) in a fixed dose combination of perindopril and indapamide to patients with type 2 diabetes mellitus.

Design, setting and participants: Prospective cost-effectiveness analysis within the ADVANCE (A Diabetes and Vascular Disease: Preterax and Diamicron MR Controlled Evaluation) Trial. The study included 11138 hypertensive patients with type 2 diabetes mellitus allocated to receive perindopril plus indapamide (group 1) or placebo (group 2) for a median of 6.7 years.

Main outcome measures: Health-related quality of life measured by the EuroQol-5D, resource of diagnosis, survival and morbidity. Costs were estimated at $19., average follow-up, and discounted cost per year gained by correspondence.
Main economic evaluation

- Comparison: Perindopril-Indapamide versus placebo for lowering blood pressure in Type 2 Diabetes
- Data: Patient level data on costs and LYs and QALYs from ADVANCE trial
- Time period: 4.3 years follow up
- Perspective: Australian health care purchaser

Outcomes and survival

All-cause mortality and cardiovascular mortality from the clinical trial have previously been reported. We calculated the survival time within the study for each treatment group from survival curves. Life expectancy of survivors beyond the close of the study was based on multivariate life tables under the assumption of no continuing benefits from the within-trial treatment. These life tables were constructed from parametric survival models, and estimates were based on information about all ADVANCE participants who were alive 2 years after randomization, including age, sex, smoking status, duration of diabetes and history of major cardiovascular disease.

Costs and resource use

1. Australian unit costs and their sources for the major cost items

<table>
<thead>
<tr>
<th>Resource item</th>
<th>Unit cost (2017 AUD)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard single GP visit</td>
<td>28.30</td>
<td>MBS</td>
</tr>
<tr>
<td>Perindopril-Indapamide (1 mg-1.25 mg daily) per month</td>
<td>29.83</td>
<td>PBS</td>
</tr>
<tr>
<td>Other drugs</td>
<td>Cost per item</td>
<td>PBS</td>
</tr>
<tr>
<td>The four most frequently used DRGs</td>
<td>Cost per hospital episode</td>
<td></td>
</tr>
<tr>
<td>KDIB: Diabetes episode without severe complication</td>
<td>3556</td>
<td>NHIDCC</td>
</tr>
<tr>
<td>BDIC: Stroke without other complication</td>
<td>5910</td>
<td>NHIDCC</td>
</tr>
<tr>
<td>F42B: Heart failure and shock without catastrophic complication</td>
<td>4314</td>
<td>NHIDCC</td>
</tr>
<tr>
<td>F49B: Coronary atherosclerosis without complication</td>
<td>1560</td>
<td>NHIDCC</td>
</tr>
</tbody>
</table>

DRGs = diagnosis-related group; G7 = general practitioner; MBS = Medicare Benefits Schedule; NHIDCC = National Hospital Cost Data Collection; PBS = Pharmaceutical Benefits Schedule.

Costs and resource use

Outcomes (LYs)

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>Periodindopril-Indapamide</th>
<th>Placebo</th>
<th>Mean life-year gain per patient (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within-trial</td>
<td>4.17 (4.15-4.19)</td>
<td>4.14 (4.12-4.16)</td>
<td>0.03 (0.00-0.05)</td>
</tr>
<tr>
<td>Total life expectancy</td>
<td>14.57 (13.37-15.77)</td>
<td>14.88 (13.69-16.05)</td>
<td>0.31 (0.08-0.52)</td>
</tr>
<tr>
<td>5% discount per year</td>
<td>12.28 (11.14-13.23)</td>
<td>12.22 (11.02-13.17)</td>
<td>0.06 (0.04-0.09)</td>
</tr>
<tr>
<td>5% discount per year</td>
<td>10.68 (9.27-11.96)</td>
<td>10.64 (9.02-11.96)</td>
<td>0.05 (0.03-0.08)</td>
</tr>
<tr>
<td>10% discount per year</td>
<td>8.36 (6.94-8.76)</td>
<td>8.14 (6.01-8.74)</td>
<td>0.22 (0.05-0.39)</td>
</tr>
</tbody>
</table>

Cost-effectiveness

- Comparative (intervention A vs B)
- Common outcome measure
- Incremental cost-effectiveness ratio (ICER)
- ICER = difference in costs (C_A - C_B) divided by the difference in effects (E_A - E_B)
Cost-effectiveness analysis

From the ADVANCE trial

<table>
<thead>
<tr>
<th></th>
<th>Perindopril-indapamide</th>
<th>Placebo/standard practice</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs</td>
<td>$21,001</td>
<td>$20,499</td>
<td>$502</td>
</tr>
<tr>
<td>Years of life</td>
<td>10.88</td>
<td>10.84</td>
<td>0.05</td>
</tr>
<tr>
<td>EQ-5D</td>
<td>0.8</td>
<td>0.8</td>
<td>-</td>
</tr>
<tr>
<td>QALY</td>
<td>8.70</td>
<td>8.67</td>
<td>0.03</td>
</tr>
</tbody>
</table>

CEA = $502/0.05 = $10,040 per life year saved
CUA = $502/0.03 = $16,733 per QALY saved

Graphing costs and effects

Cost-effectiveness plane

New treatment more costly
Existing treatment dominates
New treatment more effective but more costly
New treatment less costly

Costs

Effects

Decision rules for CEA

• Recommend – If new intervention dominates
• Reject – If new intervention is dominated
• Develop a decision rule for NE & SW quadrants
  – Use a league table to compare with other interventions
  – Compare to established ceiling ratio

League tables

• Involves ranking of options for intervening/treating with most cost-effective on top of list
• Allocated a fixed budget down the list until budget is expended
• Method to prioritise activities that generate greater health gains per dollar invested

Priority setting example

<table>
<thead>
<tr>
<th>Program</th>
<th>Cost of mal-treatment avoided /100 families</th>
<th>Cost of program minus cost of control /100</th>
<th>ICER</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Safe Environment for Every Kid (SEEK) Model</td>
<td>5.9</td>
<td>$79,700</td>
<td>$13,537</td>
</tr>
<tr>
<td>Triple P – Positive Parenting Program</td>
<td>0.31</td>
<td>$6,560</td>
<td>$21,438</td>
</tr>
<tr>
<td>Parents under Pressure (PUP)</td>
<td>19.8</td>
<td>$820,100</td>
<td>$41,327</td>
</tr>
<tr>
<td>Child FIRST</td>
<td>12</td>
<td>$1,000,400</td>
<td>$83,366</td>
</tr>
<tr>
<td>Special Families Care Project</td>
<td>19</td>
<td>$3,006,600</td>
<td>$158,244</td>
</tr>
<tr>
<td>Healthy Families New York</td>
<td>1.05</td>
<td>$706,300</td>
<td>$672,684</td>
</tr>
</tbody>
</table>
Problems with league tables

- Concept
  - Too simplistic, what about other factors?
  - Conceptually difficult to compare very different interventions (e.g. high cost life saving to low cost screening)
  - Context may not translate across countries settings
  - May not match funding structures (e.g. different state/federal health responsibilities)

- Methodology
  - Similarity of comparators
  - Perspective of costs may differ
  - Mutually exclusive options

Size of financial impact not considered

- Very important to disaggregate costs and outcomes

Example:

<table>
<thead>
<tr>
<th>Programs</th>
<th>Cost of maltreatment avoided /100 families</th>
<th>Cost of program</th>
<th>ICER</th>
<th>Financial impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parents under Pressure (PUP)</td>
<td>19.8</td>
<td>$8,201</td>
<td>$41,327</td>
<td>1,000 families $8.2 million</td>
</tr>
<tr>
<td>Triple P – Positive Parenting Program</td>
<td>0.31</td>
<td>$65.60</td>
<td>$21,438</td>
<td>500,000 families $32.8 million</td>
</tr>
</tbody>
</table>

Ceiling cost effectiveness ratio

- The maximum amount society is willing to pay for an extra unit of health gain
- Australian estimates
  - No official statement of ‘thresholds’
  - between $42K-$76K per life year (George et al, 2001)
- UK
  - NICE states £20k to £30k (McCabe, 2008)
  - Upper threshold £47-50K per QALY (Devlin and Parkin, 2004)
  - 50% probability of funding £39k to £43k (Dakin, 2014)
- Developing countries = 1-3 x GDP

Considerations with ceiling ratios

- Vary across countries
  - Prices change
  - Different budgets
  - Different finance/government structures
- Decision makers may prefer different thresholds for different types of interventions
  - e.g. life saving versus prevention
- Difficulties determining threshold relative to absolute budget, hard to change once set
- Can lead to uncontrolled expenditure growth

Uncertainty

- By nature economic evaluation is uncertain
  - All inputs potentially uncertain (clinical effectiveness, utilities, resource costs, downstream cost savings, long term outcomes, disease progression)
  - Combinations of primary/secondary data
  - Assumptions

- Types of uncertainty
  - Parameter (precision of estimates)
  - Structural
  - Methodological

Sensitivity analysis

- Type of sensitivity analysis
  - One-way
    - To determine largest sources of uncertainty i.e. what your economic evaluation is most sensitive to
  - Multi-way
    - Combined impact of a couple of main drivers of uncertainty
  - Probabilistic
    - Combined simulated impact of parameter uncertainty, able to be graphed, produce CIs
Cost-utility results

- Intervention less effective, more costly
  - Perindopril-indapamide
    - For blood pressure control
    - $10,040 per LY gained
- Intervention more effective, more costly

INCREMENTAL QALYs

INCREMENTAL COST

CE plane

Costs & QALYs discounted at 3.5% p.a.

Example: impact of uncertainty

  - Economic analysis of a school-based obesity prevention program
- Key assumptions
  - Weight loss maintained into adulthood
  - No structural possibility of relapse
  - Full downstream cost savings of obesity applied

Guidelines for reporting

- PBAC and MSAC guidelines
- Journal guidelines
  - BMJ: http://www.bmj.com/about-bmj/resources-authors/article-types/research
- ISPOR

Limitations of CEA

- Tells us relative efficiency, not absolute
- Doesn’t consider total cost
- Not helpful in assessing a single programme
- Narrow uni-dimensional measure of success
- Cannot compare disparate alternatives
- Only as strong as the underlying evidence
Other factors informing decisions

Ross 1995 survey of Australian decision makers
- 58% political factors
- 58% nature of existing policies
- 47% administrative feasibility
- 47% equity
- 23% availability of resources
- 20% opinions of influential groups

Factors associated with funding

- Quality and certainty of evidence (Mason and Drummond, 2009; Devlin and Parkin, 2004)
- Severity/burden of disease (Cookson et al, 2008; Devlin and Parkin, 2004)
- Life extension (Foy et al, 1999)
- Availability of other options (Devlin and Parkin, 2004)
- Cost-effectiveness (Segal et al, 2010; Bryan et al, 2007; Dakin et al, 2014)
- Total cost to government (Harris et al, 2008)

Assessment of Australian C/E results

- 245 interventions that had been subject to cost-effectiveness analysis and reported a cost/LY or cost/QALY to 2005
- Median CE: $18,100 per LY/QALY gained
- Diagnostics higher, children higher, drug and alcohol and metabolic syndrome lower ICERs
- For any given condition, modality or setting are likely to be examples of interventions that are cost-effective
- Need decision based on the individual merits of an intervention rather than rely on broad generalisations

Factors predicting funding

- Australian study of 245 published economic evaluations and their funding outcomes
- Predictors of funding (model correctly classified 85% of funded programs)
  - Lower ICER
  - Eligible for subsidy under MBS/PBS
  - Medical treatment interventions (compared to lifestyle, screening, diagnosis)
  - Interventions where individual could not reduce their own risk of disease
  - Interventions aimed at averting or slowing disease

Multi criteria decision analysis (MCDA)

MCDA example (Baltussen & Niessen, 2006)