Cost-effectiveness & economic evaluation in health care

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Introduction & outline

- What is economic evaluation (EE) and why is it useful for priority setting?
- A case study
- Discussion and summing up:
  - The steps of EE
  - Methods for the EE of health care interventions: techniques, advantages & disadvantages
  - A few important technical issues: costing, discounting, sensitivity analysis, interpretation of findings
  - The role & limitations of EE in priority setting
The priority setting dilemma

- What we have done so far?
  - Identified the need for interventions (capacity to benefit)
  - Assessed the costs for the various interventions
- We have a limited budget
- What can we do if needs exceed the available resources? (Funding gap)
The priority setting dilemma

- One option to address this dilemma:
  - to fund those interventions, which will provide the most health improvement (health gain) from the available budget
  - this means NOT to fund (exclude) certain interventions

- For this, we need to consider the costs as well as the benefits (effects) of the various interventions > EFFICIENCY
  - make one step further from production (technical) efficiency
  - whatever we produce (fund) should not just be done at least cost, but also to produce those services, which is valued most by the society: ALLOCATIVE EFFICIENCY
What is economic evaluation?

- In its broadest sense, economic evaluation is the systematic identification and comparison of the resources needed to carry out an activity and the values (benefits) created by this activity.

- So it is an efficiency analysis, because it compares both the costs and effects of the various interventions (health technologies).

- It is a comparative analysis in that the efficiency of at least two interventions are compared to each other.
The case study
Discussion and summing up
The steps of an economic evaluation (1)

- Specification of question/objective:
  - *Which combination of preventive & curative services should be financed from the available budget to maximize the overall health gain?*
  - *Which intervention is more cost-effective among the interventions needed?*
  - *Establish the need for the various services!*

- Perspective: Societal or other (patient, purchaser)
  - *Societal*

- Time horizon: time period for accounting for costs and outcomes
  - Very important for HIV/AIDS interventions: e.g. the benefits of prevention programs are realized on the long term
The steps of an economic evaluation (2)

- **Identification of competing interventions:**
  - *Prevention, Treatment & care*
  - *Basis of comparison: Do nothing, Present practice, New interventions*

- **Identification & measurement of costs**
  - Always measured in terms of money

- **Identification & measurement of outcomes**
  - Different measures of health gain
  - *Infections averted, Life years gained, QALYs gained*

- **Collation of costs with outcomes and comparison of competing interventions:**
  - Cost-effectiveness (cost-benefit) ratio
The types of economic evaluation

- What is covered?
  - full economic evaluation
    - at least two options are considered
    - both the costs and effects (benefits) of these options are compared
  - partial evaluation

- How are the effects/benefits measured?
  - Cost Minimization Analysis (CMA) > same
  - Cost Effectiveness Analysis (CEA) > natural units
  - Cost Utility Analysis (CUA) > preference over health states (e.g. quality)
  - Cost Benefit Analysis (CBA) > money
Key features of the various techniques

- The scope of interventions that can be compared
- How subjective is it?
Cost effectiveness analysis

- Outcomes are measured in natural units
  - Intermediate: e.g. number of people practising safe sex, number of IDUs using sterile equipment, number of infections averted
  - Final: e.g. lives saved, life years saved

- Advantages:
  - objective
  - relatively easy to measure

- Disadvantages:
  - only interventions which have the same type of outcome can be compared
Cost utility analysis

- Outcomes are measured in terms of preferences regarding health status
  - e.g. quality index > QALY = Quality Adjusted Life Years

- Advantages:
  - all health care interventions can be compared with each other

- Disadvantages:
  - the assessment of quality of life is subjective (depends on from whom you get the rating of quality)

- Always look at how the quality of life scores were derived!
Cost benefit analysis

- Outcomes are measured in monetary terms
  - e.g. willingness to pay

- Advantages:
  - activities in different sectors can be compared with each other (e.g. health care vs. agriculture or education)

- Disadvantages:
  - Can the value of life be expressed in terms of money? If yes, how much human life (health) worth?

- Always look at the method for the valuation of life and health!
The value of human life and health

- Human capital method:
  - assessing income

- Revealed preference method:
  - market behavior related to health
  - e.g. people working in areas with considerable health risk

- Stated preference method:
  - assessing willingness to pay using hypothetical scenarios
Costing in EE (1)

- Analytical cost accounting focuses on the production process from the perspective of the provider organization.
- Costing in EE takes a different (population-wide) perspective:
  - not just the costs of production matter, but other costs incurred by other actors (e.g. patients, other health care providers…)
  - not just health care related, but productivity costs
  - not just costs incurred, but costs avoided (costs of the disease) > net costing
Costing in EE (2)

- Main cost categories:
  - Direct: costs related to the delivery of the health service (intervention)
  - Indirect: the costs of productivity losses due to ill-health (the value of unpaid time > opportunity cost)
  - Intangible: the costs of pain and suffering

- NOTE that direct and indirect costs have a different meaning in ACA and in EE:
  - both direct & indirect costs in a provider organization are considered direct costs in EE, because both are related to the delivery of the health service concerned

- Always look at how indirect costs have been treated!
Discounting (1)

- For most health care interventions costs and benefits occur in different points in time:
  - Prevention of HIV infection: you need to spend on the program now, but benefits are realized in the future (8-12 years)
  - For the treatment of AIDS patients (chronic diseases) spending and health gain is spread over the life span of the patients

- To make the various interventions comparable you need to adjust for the different timing > DISCOUNTING:
  - Time preference: benefits earlier, costs later
  - The present value of both future benefits and costs are less than their nominal value
  - How much less? Discount rate (0-10%)
Discounting (2)

- What is the appropriate discount rate?
  - no agreement
  - discounting benefits debated, differential discounting debated (postponing paradox, inconsistency paradox)

- Always look at the method of discounting used!
Sensitivity Analysis (1)

● Tests the impact of uncertain or controversial data on the conclusion of the EE study

● Uncertain data, e.g:
  ○ Effectiveness of new technologies
  ○ The prevalence of HIV+, risky behavior among difficult to reach groups

● Controversial data, e.g:
  ○ Inclusion of indirect costs in the analysis
  ○ Choice of discount rate
  ○ Valuation of health outcome
Sensitivity Analysis (2)

- Specify a plausible range:
  - Upper and lower values
  - Base case, best case & worst case scenarios

- Look at whether the authors performed a sensitivity analysis, for which variables and for what range!
How to interpret the findings of a CEA or CUA? (1)

- Cost-effectiveness ratio = Cost per unit of health gain (C/E ratio = C/E)
  - The smaller the ratio the more cost-effective the program

- Types of C/E ratios:
  - Average (ACER) = total cost / effectiveness (compared to doing nothing)
  - Incremental (ICER) = incremental (additional) cost / incremental (additional) effectiveness compared to the next most effective intervention
How to interpret the findings of a CEA or CUA? (2)

- When to use ACER?
  - two or more independent interventions (e.g. the treatment of two different diseases)

- When to use ICER?
  - two or more interventions that are either mutually exclusive, or not independent in that they affect each other’s costs and/or effectiveness
  - e.g. different drugs to treat the same disease; combination of drugs; simple and complex prevention programs; laboratory tests with different sensitivity and/or specificity to detect an infection
## Comparison of 2 interventions

<table>
<thead>
<tr>
<th>Cost of Intervention A compared to B</th>
<th>Effectiveness of Intervention A compared to B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>higher</td>
</tr>
<tr>
<td>more</td>
<td>(1) ?</td>
</tr>
<tr>
<td>same</td>
<td>(4) A</td>
</tr>
<tr>
<td>less</td>
<td>(7) A</td>
</tr>
</tbody>
</table>
Comparison of 2 interventions

- Program A costs the same or less, but more effective than program B (cells 4, 7) or same effectiveness, but less costly (cell 8) > STRONG DOMINANCE (Program A dominates Program B) – production efficiency
- Program A is less effective less costly (cell 9) or more effective more costly (cell 1) > need to compare with other alternative uses of the resources: is the extra cost worth the extra benefit (ICER)? – allocative efficiency
Comparison of more than 2 interventions (1)

<table>
<thead>
<tr>
<th>Program</th>
<th>Cost (USD)</th>
<th>Health gain (in life years gained)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (old)</td>
<td>40 000</td>
<td>8</td>
</tr>
<tr>
<td>B (new 1)</td>
<td>40 000</td>
<td>10</td>
</tr>
<tr>
<td>C (new 2)</td>
<td>60 000</td>
<td>19</td>
</tr>
<tr>
<td>D (new 3)</td>
<td>70 000</td>
<td>20</td>
</tr>
<tr>
<td>E (new 4)</td>
<td>80 000</td>
<td>22</td>
</tr>
</tbody>
</table>
Comparison of more than 2 interventions (2)

- Eliminate strongly dominated interventions
- For the rest use ICER, from the least costly to the most expensive
- Weak (extended) dominance:
  - with the combination of program C and E, more health gain can be achieved for the same number of patients within the same budget than with Program D
  - The ICER of Program D is higher than the ICER of the next more effective intervention (program E)
Comparison of more than 2 interventions (3)

<table>
<thead>
<tr>
<th>Program</th>
<th>Incremental cost (USD)</th>
<th>Inc. health gain (life years)</th>
<th>ICER (USD/life year gained)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (old)</td>
<td>40 000</td>
<td>8</td>
<td>50 000</td>
</tr>
<tr>
<td>B (new 1)</td>
<td>40 000</td>
<td>10</td>
<td>40 000</td>
</tr>
<tr>
<td>C (new 2)</td>
<td>20 000</td>
<td>9</td>
<td>2 222</td>
</tr>
<tr>
<td>D (new 3)</td>
<td>10 000</td>
<td>1</td>
<td>10 000</td>
</tr>
<tr>
<td>E (new 4)</td>
<td>10 000</td>
<td>2</td>
<td>5 000</td>
</tr>
</tbody>
</table>
Comparison of more than 2 interventions (4)

- You have USD 1,400,000
- You can treat 20 patients with intervention D; total life years gained = 400
- With the combination of intervention C & E you can still treat 20 patients:
  - 10 patients receive intervention C; total life years gained = 190 (total cost US$=600,000)
  - 10 patients receive intervention D; total life years gained = 220 (total cost US$=800,000)
  - Total life years gained = 410
Comparison of more than 2 interventions (5)

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Cost (USD)</th>
<th>Health gain (life years gained)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention E</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The values: is EE the ultimate tool for priority setting?

- Same intervention two different target populations:
  - e.g. Prevention program for street-based vs. brothel based SWs
- Different interventions for different target populations:
  - e.g. prevention vs. treatment
- Weak dominance
The values: is EE the ultimate tool for priority setting?

Comparison of the same intervention in two different subpopulations

(Source: Julian Naidoo, 2007)
# Cost / QALY of some health technologies (NHS, 1990)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>cost / QALY (GBP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholesterol testing and diet therapy (ages 40-69)</td>
<td>220</td>
</tr>
<tr>
<td>Neurosurgery for head injury</td>
<td>240</td>
</tr>
<tr>
<td>Advice to stop smoking from GP</td>
<td>270</td>
</tr>
<tr>
<td>Neurosurgery for subarachnoid haemorrhage</td>
<td>490</td>
</tr>
<tr>
<td><strong>Antihypertensive treatment to prevent stroke (ages 45-64)</strong></td>
<td>940</td>
</tr>
<tr>
<td>Pacemaker implantation</td>
<td>1100</td>
</tr>
<tr>
<td><strong>Valve replacement for aortic stenosis</strong></td>
<td>1140</td>
</tr>
<tr>
<td>Hip replacement</td>
<td>1180</td>
</tr>
<tr>
<td>Coronary artery bypass graft</td>
<td>2090</td>
</tr>
<tr>
<td>Kidney transplant</td>
<td>4710</td>
</tr>
<tr>
<td>Heart transplant</td>
<td>7840</td>
</tr>
<tr>
<td>Hospital haemodialysis</td>
<td>21970</td>
</tr>
<tr>
<td>Neurosurgery for malignant intracranial tumor</td>
<td>107780</td>
</tr>
</tbody>
</table>

(Source: Alan Maynard, 1991)
The role of economic evaluation in priority setting

- Provides a methodology to rank proposals on the basis of efficiency (cost-effectiveness):
  - more informed decisions can be made

- Limitations:
  - methodological
  - values and preferences are not technical questions; supports the decision-making process and not replaces it
  - economic evaluation costs money (CBA of CBA)
Thank you!