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](http://go.unimelb.edu.au/8eqn)
Or email us: [health-economics@unimelb.edu.au](mailto:health-economics@unimelb.edu.au)

Module 2 – Identifying, Measuring, Valuing and Analysing Costs

Centre for Health Policy
Melbourne School of Population and Global Health

Overview

1. What is a cost?
2. Identifying costs
3. Measuring costs
4. Valuing costs
5. Analysing costs

What is a cost?

- **Cost**
  - to be obtained at a **price** of
  - to involve in **expenditure** of
  - to be required to be **laid out** or suffered or lost
- **Financial cost**
  - the total **money** expenditure required to achieve a goal
- **Economic cost**
  - **opportunity cost**: what must be sacrificed in order to achieve a goal; the value of the resources in their next best use
  - if you do A, you cannot do B
  - the cost of doing A, is the **foregone value** of B

Economic costs

- The “costs” are the **economic inputs** required to produce a certain intervention
- Four factors of production
  - **Labour** (doctors, admin, physiotherapists, **patient time**)...
  - **Consumables** (drugs, educational materials, heating, ...)
  - **Capital** (buildings, machines, ...)
  - **Land**
**Study Viewpoint**

- **Societal**: all costs to whomsoever they accrue
  - **Health Sector**: costs to the government and private sector
  - **Government**: Commonwealth and/or State/Territory
  - **Third Party Funder**: public or private (insurance company,...)
  - **Healthcare Provider**: Hospital, GP
  - **Patients/Carers**: out of pocket expenses, travel, waiting time
  - **Other sectors**: (Social Services; Justice;..)

**How are resources/costs categorized according to perspective/sector?**

[Diagram showing categories of costs: Healthcare Sector, Patient & Family, Other Sectors, Total Costs, etc.]

**Study Viewpoint**

“Societal” perspective is ideal

- Policy makers often want a narrower perspective
  - budgets are fixed and there are incentives to shift costs

Examples of cost shifting:

- When evaluating whether to centralize all cancer services to make efficiency savings we should consider the additional travel costs to patients and family
- Impact of GP co-payments (Federal) on ED and hospital admissions (State)

**Process of Costing**

Three steps:

1. **Identification** of the appropriate costs to include in the appraisal (i.e. the inclusion/exclusion criteria based on perspective adopted)
2. **Measurement** of the **quantity** (in appropriate units) of resources used and saved by the program alternatives
3. **Valuation** of the resources used (and saved) in appropriate **prices** per unit for comparison

**Identifying Resources**

- Important to be able to accurately describe all the elements/resources that are needed to make a program work in its intended form

- **Downstream resource use** may also differ between programs and this **needs to be recorded/estimated**
  - Future hospitalisations, GP visits, drug use,...
  - At home support services, carer time, home modifications, ...
Fixed versus Variable costs

- **Fixed costs**: accrued no matter how big the program (educational materials, machines, program set-up costs)

- **Variable costs**: rise the bigger the program - more patients increase the total cost (drugs, GP time)

When predicting the cost of a program we want to **estimate** the program cost for its **intended form**

- We are trying to inform a future decision not a past decision

Scaling up

We record the costs involved in this

- **Pilot Project**
  - Variable Costs
  - Fixed Cost

But we want to predict the costs involved in this

- **Intended Program**
  - Fixed Cost
  - Important to separate fixed and variable costs

Measuring Resources

- **Collecting resources use information is costly**

- **Focus on the key cost drivers**
  
  - Weigh up the likely **importance** of the "cost" versus the "cost" of collecting

- Make use of **routinely collected data** wherever possible to estimate the costs
  
  - Link to PBS, MBS records
  
  - Linked hospital data for future hospitalisations
  
  - Use patients postcode and treatment postcode to estimate travel time

Measuring Resources

- **Many different instruments** are used to collect resource use

- A UK project created an open-access instrument database **http://www.dirum.org/**

  - The idea is to standardise questions where possible

Measuring Resources

One of the **DIRUM** instruments for **hip replacement procedures**

<table>
<thead>
<tr>
<th>Type of service</th>
<th>Treatment cost (as defined in the Protocol)</th>
<th>Fixed cost (as defined in the Protocol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>OP theatre</strong></td>
<td>[Cost]</td>
<td>[Cost]</td>
</tr>
<tr>
<td>2. <strong>Anaesthetic</strong></td>
<td>[Cost]</td>
<td>[Cost]</td>
</tr>
<tr>
<td>3. <strong>Outpatient</strong></td>
<td>[Cost]</td>
<td>[Cost]</td>
</tr>
<tr>
<td>4. <strong>Medication</strong></td>
<td>[Cost]</td>
<td>[Cost]</td>
</tr>
<tr>
<td>5. <strong>Hospital stay</strong></td>
<td>[Cost]</td>
<td>[Cost]</td>
</tr>
<tr>
<td>6. <strong>Follow-up visit</strong></td>
<td>[Cost]</td>
<td>[Cost]</td>
</tr>
<tr>
<td>7. <strong>Additional medication</strong></td>
<td>[Cost]</td>
<td>[Cost]</td>
</tr>
</tbody>
</table>

Not only health care usage but also other social service use

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>Did you have to pay for transport?</td>
<td>[Cost]</td>
<td>[Cost]</td>
</tr>
<tr>
<td>Did you have to pay for accommodation?</td>
<td>[Cost]</td>
<td>[Cost]</td>
</tr>
<tr>
<td>Did you have to pay for lost time?</td>
<td>[Cost]</td>
<td>[Cost]</td>
</tr>
</tbody>
</table>
Once we have estimated the resources used within and after the program we then have to place a ‘value’ on each resource. 

How valuable ($) is:
- 1 hr of a GP’s time?
- the use of a operating theatre for 1 hr?
- 1 hr of a volunteer’s time?
- preventing an A&E visit?
- reducing a patient’s treatment time by 1 hr?
- reducing family and friends travel time by 2 hrs?

Opportunity Cost
- how valuable would the resources be if they were used in the next best process instead?

Often the price paid for a resource represents a reasonable estimate of its opportunity cost; but not always
- Volunteer time; Volunteer’s could be engaged in some other valuable activity
- Patient & Family travel time; how valuable do patients regard having services close to their home?

Volunteer and patient time often costed at 1/3 of average wage

Some Australian health cost information
- Independent Hospital Pricing Authority
- “Manual of Resource and their Associated Cost” from DoHA; for use in PBAC submissions
- Victorian hospital cost information

Micro costing
- Ingredients method
- Bottom up costing
  - E.g. – number of tests ordered, time with counsellor, dosing minutes, visits
  - Type and number of medications

Macro costing
- Top down
- Ignores variation
  - Average per day
  - DRG cost weight
  - MBS fee
  - PBS fee

Costs over time

All ($) values should be the current resource cost rather than their past cost
We ignore inflation - covert all costs into “real dollars” based on what a current dollar is worth
- Even though we expect the nominal wage of a GP to increase over time we consider the current GP wage
- Budgets will normally also increase with inflation

Australian Consumer Price Index

Costs over time

<table>
<thead>
<tr>
<th>Costs over time</th>
<th>Costs over time</th>
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<tbody>
<tr>
<td>$900</td>
<td></td>
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<tr>
<td>$600</td>
<td></td>
</tr>
<tr>
<td>$300</td>
<td></td>
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</tbody>
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Time period (years)

Treatment A- surgery
Treatment B- fitness program for five years
Key issues in costing: Discounting

- Delaying costs is valuable as these funds could be invested elsewhere now and gain "returns"
- We wish to convert future costs into the "equivalent" cost today = present value
  - How much would you need to save & invest today in order to be able to pay for these future costs tomorrow?

We also discount future outcomes

Costs over time

Total Costs
- Treatment A: $900
- Treatment B: $1000

Discounted Costs (at 5% annual rate - PBAC recommended)
- Treatment A: $905
- Treatment B: $905

Importance of discounting

- Difference between 5% (AUS) and 3.5% (UK) discount rates for $100 of future cost savings

Discounted costs for Treatment B

Analysing Costs

- Costs are often "skewed" - a few patients "cause" some very large costs
  - But these costs are important as they can strongly influence the total cost of the intervention
- The median (middle cost) is NOT a good indicator
  - The mean cost is often a lot higher than the median
- In cost-effectiveness we mostly use the MEAN as this is what is relevant to a funder

Analysing Costs (capturing the uncertainty)

- Slightly off pilot estimates can result in large differences in the projected versus actual costs of the intended program!

Knowing the uncertainty allows us to quantify the financial risk to budgets and the risk of whether it is cost-effective

US Medical Expenditure Survey 2014

- Median = $US 10
- Mean $US 735

<table>
<thead>
<tr>
<th>Number of People</th>
<th>Individual US Medical Expenditure in 2014</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>5000</td>
</tr>
<tr>
<td>5000</td>
<td>10000</td>
</tr>
<tr>
<td>10000</td>
<td>15000</td>
</tr>
<tr>
<td>15000</td>
<td>20000</td>
</tr>
</tbody>
</table>

Approximately 5% of the sample accounted for over 56% of the total medical costs recorded

Pilot Project

And use these estimates to predict the cost of

Intended Program

2014 $US in thousands
US Medical Expenditure 2014 Survey

Sample Mean $US 735 (Uncertainty around the "true" mean)

There is a chance that the true mean is actually either lower or higher.

%  
0  
0.02  
0.04  
0.06  
0.08  
0.1  
0.12  
0.14  
0.16  
0.18  

“True” Mean $US

0  
670  
690  
710  
730  
750  
770  
790  
810  
830

Analysing Costs (capturing the uncertainty)

Total Medical Expenditure if the “true” average cost was $US 690

$US 213 billion

Total Medical Expenditure if the “true” average cost was $US 770

$US 237 billion

A $US 24 billion difference

Analysing Costs (Sensitivity)

• It is wise to undertake a number of sensitivity (what if) tests around some of the key assumptions
  – What if fewer/more patients get seen than expected?
  – What if a more effective intervention becomes available in the near future?
  – What if a machine lasts for fewer years than expected?

Reporting Costs

• Key assumptions regarding the costs should be clearly stated and justified
• Fixed and variable costs should be reported separately
• Cost should be broken down into components (clearly state who will bear each cost)
• The mean and uncertainty (95% confidence intervals) around the costs along with other sensitivity analysis should be reported