



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



COMMONWEALTH OF AUSTRALIA

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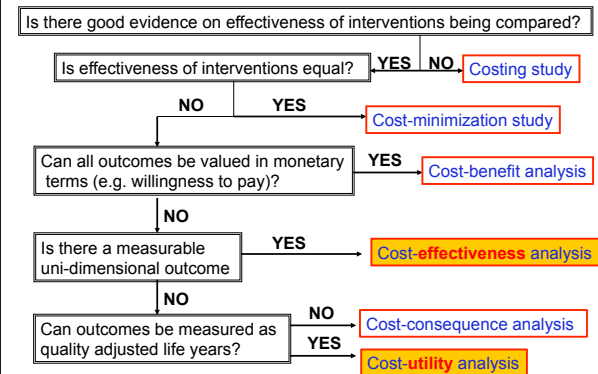


Module 3 – Identifying, Measuring, Valuing and Analysing Outcomes

Centre for Health Policy
Melbourne School of Population and Global Health



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



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

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



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

Identifying and determining outcomes (cont'd)

- Is there a **key (health)** outcome relevant for all comparators?
- Is the **outcome measurable** and how do we measure it?
- If **multiple outcomes** must be included, how do we determine **which outcome(s)** should be used?
- Can multiple outcomes be handled in a cost-effectiveness analysis (CEA)? If yes, how?
- Note: the impacts on resource use such as **cost saving** (e.g. cost saved from reduced LOS) and **cost increasing** (e.g. treating side effect) are handled on the cost side (i.e. included in the process of costing).

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 C
 - 4: Observational: non randomised with control
 - 5: Observational: non randomised 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

	Number (%) of patients with event	Favours perindopril (p=0.007)	Favours placebo	Relative risk reduction (95% CI)
Cardiovascular mortality	881 (55.9%)	938 (58.6%)		5% (0 to 12)
Noncardiovascular mortality	459 (28.6%)	570 (35.2%)		8% (-4 to 19)
All deaths	610 (38.4%)	678 (41.8%)		5% (-2 to 13)
Cardiovascular death	211 (13.3%)	252 (15.6%)		8% (-2 to 18)
Noncardiovascular death	150 (9.4%)	212 (13.2%)		8% (-2 to 18)
Total coronary events	610 (38.4%)	678 (41.8%)		5% (-2 to 13)
Major coronary events	265 (16.6%)	294 (18.4%)		10% (-4 to 24)
Other coronary events	345 (21.8%)	384 (23.9%)		14% (-1 to 27)
Total cerebrovascular events	285 (17.9%)	303 (19.0%)		6% (-3 to 13)
Major cerebrovascular events	152 (9.5%)	158 (9.8%)		2% (-8 to 10)
Other cerebrovascular events	79 (4.9%)	93 (5.8%)		20% (-6 to 46)
Total stroke events	154 (9.6%)	168 (10.5%)		7% (-2 to 17)
Nonfatal stroke events	135 (8.4%)	145 (9.0%)		6% (-2 to 14)
Stroke mortality	104 (6.5%)	122 (7.6%)		13% (-3 to 27)
Total eye events	253 (15.8%)	251 (15.6%)		5% (-1 to 10)
Nonfatal eye events	203 (12.7%)	205 (12.8%)		1% (-8 to 10)
Visual impairment	246 (15.4%)	243 (15.2%)		1% (-8 to 10)

Figure 4: Effects of study treatment on deaths, coronary events, cerebrovascular events, renal events, and eye events. *Other coronary events=ventricular arrhythmias, hospitalization, coronary revascularization or death myocardial infarction. Other cerebrovascular events=transient ischemic attack (including a transient focal or subarachnoid hemorrhage). Black square point estimates with 95% CI for overall effects. Vertical broken lines point estimates for overall effects within categories.

Example of single (intermediate) outcome: Blood pressure reduction

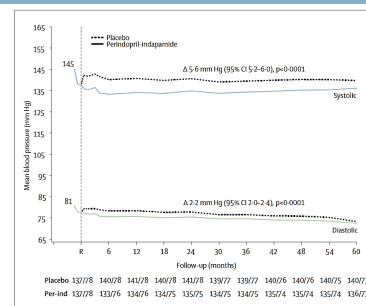
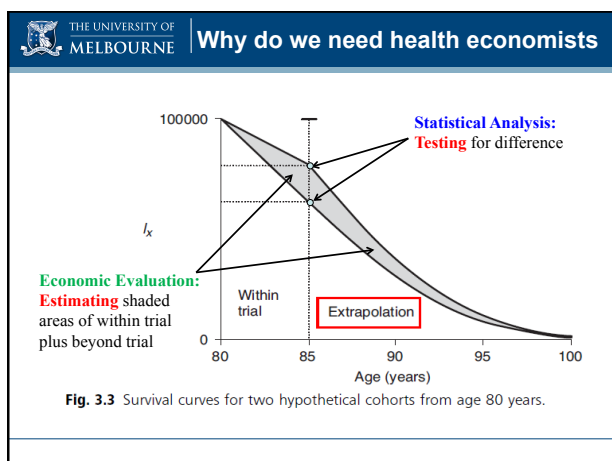
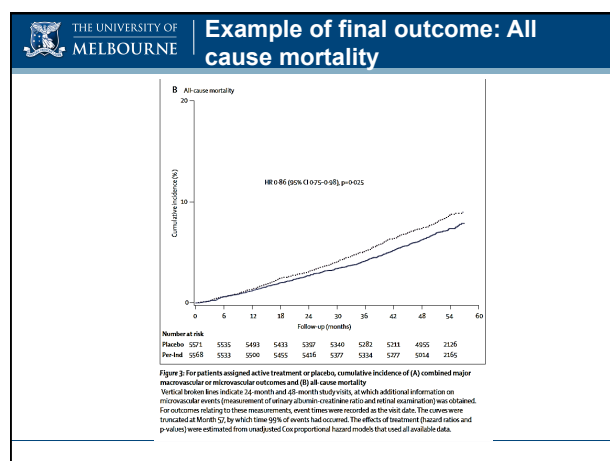
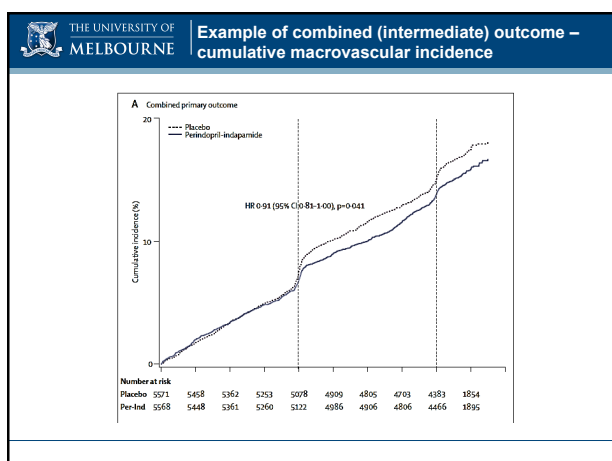


Figure 2: Mean systolic and diastolic blood pressure during run-in on active treatment and after randomization to active treatment or placebo. Δ=average difference between randomised groups during follow-up. R= randomisation. Peri=perindopril-indapamide.



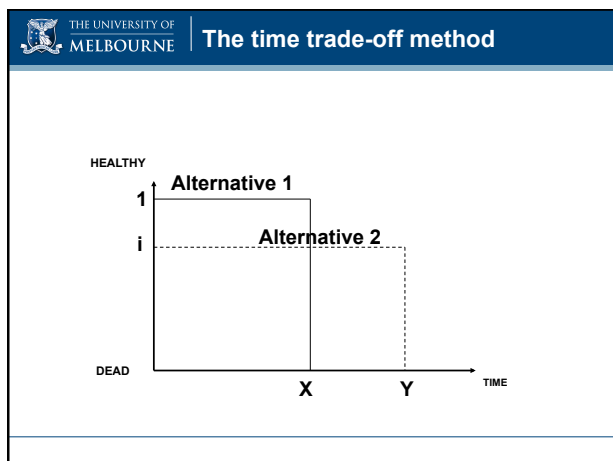
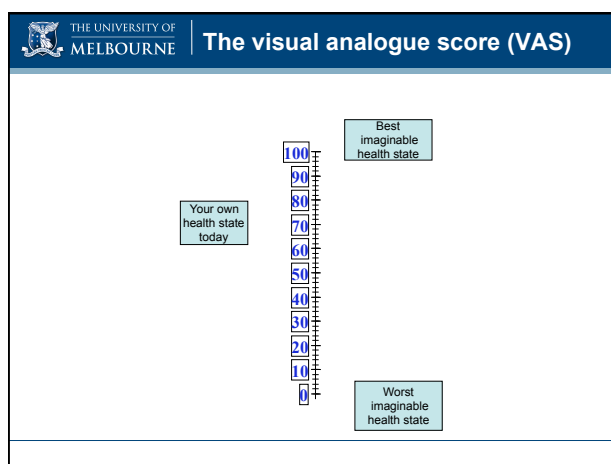
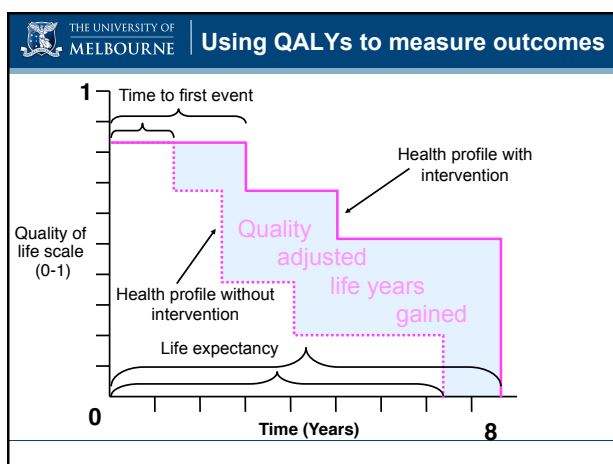
THE UNIVERSITY OF MELBOURNE | **Within trial estimation vs beyond trial (life time) extrapolations**

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

Type of outcome	Mean (95% CI) life expectancy (years) per patient		Mean life-year gain per patient (95% CI)
	Perindopril-indapamide	Placebo	
Within-trial	4.17 (4.15-4.18)	4.14 (4.12-4.16)	0.03 (0.00-0.05)
Total life expectancy	14.97 (13.77-16.44)	14.88 (13.69-16.35)	0.09 (0.06-0.12)
3% discount per year	12.28 (11.48-13.23)	12.22 (11.42-13.17)	0.06 (0.04-0.07)
5% discount per year	10.88 (10.27-11.60)	10.84 (10.23-11.56)	0.05 (0.03-0.06)
10% discount per year	8.36 (8.04-8.72)	8.34 (8.01-8.70)	0.02 (0.02-0.03)

- THE UNIVERSITY OF MELBOURNE** | **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)

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- 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.



The questionnaire of EQ5D and an example of using EQ5D

Following a car accident, a person has some problem with moving around, no problems with self-care and usual activities, has moderate pain and is extremely anxious/depressed

Mobility

☐ I have no problems in walking about

☒ I have some problems in walking about

☐ I am confined to bed

Self Care

☒ I have no problems with self-care

☐ I have some problems with self-care

☐ I am unable to wash or dress myself

Usual activities

☒ I have no problems with performing my usual activities

☐ I have some problems with performing my usual activities

☐ I am unable to perform my usual activities

Pain/Discomfort

☐ I have no pain or discomfort

☒ I have moderate pain or discomfort

☐ I have extreme pain or discomfort

Anxiety/Depression

☐ I am not anxious or depressed

☐ I am moderately anxious or depressed

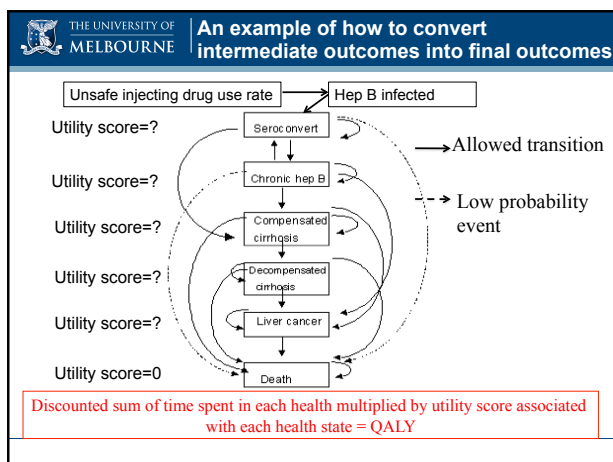
☒ I am extremely anxious or depressed

Algorithm of Utility Scores – EQ5D

Utility score = 1-sum (coefficients)		coefficient	example
Constant		0.081	0.081
Mobility	2. some problems	0.069	0.069
	3. confined to bed	0.314	
Self care	2. some problems	0.104	
	3. unable to wash or dress myself	0.214	
Usual activities	2. some problems	0.036	
	3. unable to perform normal activities	0.094	
Pain/discomfort	2. moderate pain	0.123	0.123
	3. extreme pain	0.386	
Anxiety /depression	2. moderate problems	0.071	
	3. extreme problems	0.236	0.236
Level 3 at least once		0.269	0.269
Utility score = 1-sum (coefficients)			0.222

Calculating utility scores of EQ5D (Cont'd)

- Following a car accident, a person has some problems with moving around, no problem with self-care and usual activities, has moderate pain and is extremely anxious/depressed
 - EQ-5D health state = 21123
 - Valuation = $1 - [0.081(\text{constant}) + 0.069(\text{mob}) + 0.000(\text{sc}) + 0.000(\text{usual act}) + 0.123(\text{pain}) + 0.236(\text{dep}) + 0.269(\text{level 3})]$
= 0.222
 - QALYs = survival time * QoL
 - 1 year in this health state = 0.222 QALYs
 - 10 years in this health state = 2.22 QALYs



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Health State	Survival		Utility	QALY	
	A	B		A	B
Serocconverted	19.9	14.8	0.78	15.5	11.5
Chronic hepatitis B	3.3	3.8	0.61	2.0	2.3
Compensated cirrhosis	5.1	5.7	0.56	2.9	3.2
Decompensated cirrhosis	0.6	0.7	0.15	0.1	0.1
Liver cancer	0.2	0.2	0.12	0.0	0.0
Total years alive	29.1	25.2		20.5	17.2
Gain (years)	3.9			3.2	

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- EQ-5D (European utility weights)
 - HUI II/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
 - <http://www.sheffield.ac.uk/scharr/sections/heds/rmh>
- Choice between instruments should be based upon their **suitability** for and **sensitivity** to the characteristics of particular population and intervention.

