

Cost Effectiveness Evaluation

Day 3

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Plan for day

Morning: Costs

1. General costing rules
2. Identify, measure and value resources
3. Issues in valuing resources
4. Discounting

Afternoon: Outcomes

- Preference-based measures of outcome
- Ethical issues around QALYs

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1. General costing rules

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What do we mean by 'cost'?

- **Cost of production:**
 - Based on resources required to produce the unit
 - Example: Unit of blood
 - Facilities to collect
 - Staff
 - Equipment
 - Storage
 - Transport
 - etc.
 - \$50 per unit
- **Price:**
 - The amount that is paid per unit of resource
 - Example: \$3.00 for a plaster, \$70 for a unit of blood, \$583 for a hospital bed day
- Price = costs (of production and distribution) + profit
- **Expenditure:**
 - The amount paid per item x number of items used
 - Can be calculated with either costs or prices
 - Example:
 - 1200 units of blood used in a year
 - Expenditure = $\$70 \times 1200 = \$84,000$ on blood per year (price)
 - = $\$50 \times 1200 = \$60,000$ on blood per year (cost)

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Then there is.....

- Average cost
 - Total expenditure divided by the number of units produced
- Marginal cost
 - Cost of producing an extra unit of service
- Incremental cost
 - = $Cost_A - Cost_B$

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Counting the costs:

- Always consider the opportunity cost of a resource
 - What is the value of a resource in its next best alternative use?
- Be as accurate as resources allow
- Think in 3 steps:
 - **Identify** (ie list) relevant costs
 - **Measure** amount of resources
 - **Value** (cost) those resources
- Check out Pharmac's guidelines for costs in NZ

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2. Identify, measure and value resources

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Step 1: Identify all costs, regardless of whether or not they can be measured

- Categories of costs
 - Direct
 - health services costs, pharmaceuticals, laboratory costs, procedures, equipment, space, home care, etc
 - Programme costs (admin, promotion),
 - Patient out-of-pocket expenses, informal care at home, transportation costs
 - Productivity losses (Indirect??)
 - Time off work for patient and caregivers, reduced productivity at work
 - Intangible
 - Pain and suffering suffered by the patients (if not included in the benefit measures)

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Which resources to include?

- Define the study boundaries
 - Perspective
 - Time
 - Population
 - Disease-related complications
- Exclude
 - Insignificant costs
 - Costs common to all alternatives
 - Research-related costs
 - “Transfer” costs (taxes and social welfare benefits),

Step 2: Measure resources in physical units.

- hours of time for each professional group
- treatment regime for drugs
- kilos of laundry
- number of days in intensive care
- number of consumable items
- number of GP visits
- hours of nursing time
- number of days off work
- etc. etc.

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Sources of information

- Prospective data collection (clinical trials)
- Retrospective patient records
- Patient survey
 - Recall
 - Diary
- Expert opinion
 - Estimated average use of client group
- Administrative databases

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Step 3: Estimate the value of the resources

- | | |
|----------------------------------|----------------------|
| a) Costs v. prices | e) Overheads |
| b) Average v. marginal cost | f) Capital items |
| c) Top-down v. bottom-up costing | g) Production losses |
| d) Shadow pricing | h) Inflation |
| | i) Other issues |

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a) Costs v. prices

- Prices:
 - May not be based on actual resource use
 - Eg. Non-resident hospital charges
 - Include profits
 - Reflect cost of “average” patient
 - Reflect average not marginal cost
 - May be subsidised
- BUT prices are readily observable...

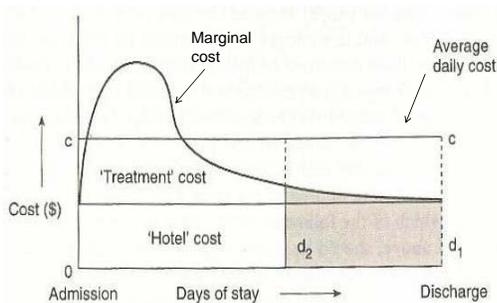
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Which should you use?

- Partly depends on what information you have:
 - Visiting a GP
 - Hospital care
- Partly depends on your perspective:
 - Do you want to know the value of the resources (no profits included), or what it would cost to purchase (prices)?
- Recommendation
 - Ideally use costs
 - If not available, prices from competitive market are OK

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b) Average v. Marginal cost



Source: Drummond et al. (2006)
Methods for the Economic Evaluation of Health Care Programmes

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Examples of marginal costing

- Opportunistic screening for asymptomatic chlamydia of people attending primary care clinics
 - Total cost of consultation = \$49
 - Marginal cost of consultation = \$8
- Cost of inpatient day of people discharged early to hospital-at-home
 - Average cost = \$700
 - Marginal cost of these patients = \$500

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Calculating marginal cost

1. The average cost of a smoking cessation programme for 100 people is \$22 per person. After expanding the programme to 120 people, the average cost falls to \$20. What is the marginal cost for EACH of the extra 20 people?
2. The average cost of doing 10 hip replacements is \$14,000, but only \$13,000 for doing 11 hip replacements. What is the marginal cost of the 11th procedure?

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c) Top down or bottom up costing

- Top down
 - Estimate total expenditure of large unit (eg hospital)
 - Divide by number of patient days
 - Includes overheads
- Bottom up
 - Measure each item (e.g., plasters, nurses time, overheads, etc.)
 - Get prices/costs for each item
 - Multiple costs/prices for each item
 - Sum up to get total cost

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Which to use?

- Top down
 - Usually less accurate but easy
- Bottom up
 - Appears more accurate, but actually quite difficult
 - May have to make a number of assumptions
- Choice depends on
 - Availability and accuracy of data
 - Impact of any differences on results
 - Timing: accuracy less important for future costs⁹

d) Shadow pricing

- Used when
 - i) Market price does not reflect true opportunity cost (eg. Monopoly pricing)
 - ii) Item is not exchanged on the market (eg. Time of carers or volunteers, use of church hall provided free of charge)
- How to value shadow prices?
 - Imputed market value
 - Implicit social values
 - Eg. ACC payments
 - Willingness to pay

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e) Overheads

NB: Only relevant for bottom-up costing

1. Ignore

- Assume marginal cost = \$0

2. Average o/h cost per patient

- Purge total cost of all individual treatments. Divide remaining costs by total number of patients

3. Direct allocation

- Allocate each overhead directly to final cost centre on proportional basis (ask the accountants!)

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f) Capital items

- **Example:** Purchase specialized machine to conduct intervention. The programme only lasts for two years, but the machine has a life of 20
- **Options:**
 - Calculate annual cost over the life of the asset
 - Use annuity factors
 - Difference between cost and resale value
 - Rental value of similar assets
 - Depreciation cost per year

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g) Production losses

1. May exclude on the basis of:

- Not taking a societal perspective
- Double counting (for patients, included in QALYs)
- High unemployment means opportunity cost of lost production = \$0

2. How to value?

- Actual lost wages
- Average lost wages
- Cost of replacing workers (friction cost)

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h) Inflation

- Need to estimate net present value of resources TODAY
- IGNORE potential future inflation
- Adjust only for PAST inflation
- Use appropriate price index
 - Eg. Use Consumer Price Index for consumable items, wage index for labour

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Example

- You want to know the cost of a bed day for a particular procedure in 2010. The only information you have is from a study undertaken in 2001 when the cost of the bed was \$500. How to inflate to 2010 prices?
- CPI (All groups) 2001 = 876
2010 = 1097

$$\$500 \times \frac{1097}{876} = \$562$$

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i) Other issues

1. How long should we follow costs?
 - Think episodes of care
2. Should unrelated health care costs be included?
 - Example: Burden on family from stroke forces spouse to rob bank, harming two people in the process. Should these costs be included?
 - General rule:
 - Are there clear data to attribute effect to cause? (Would she have been led to a life of crime for other reasons)?

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Other issues contd....

3. Development phase (e.g., guidelines development, training, etc.)
 - Take perspective of another organization looking to introduce the programme and ask "How much would it cost them to roll out the programme?"
 - Estimate costs under different scenarios:
 - Full capacity
 - Limited capacity

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4. Discounting

- Technique to account for differences in the timing of costs and benefits
- Idea: Why do you receive interest from a bank account?
- 'Low discount' = Future valued similarly to present day
- 'High discount' = Future benefits and costs not valued as highly as today

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Discounting required because..

- Myopia - society places a premium on money and benefits today relative to the future
- Opportunity cost of capital - expect return on investment
- Positive economic growth - future costs and benefits relatively lower value

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Discounting: Method

$$\text{Present Value} = \frac{\text{Cost in Year } ^n}{(1 + r)^n}$$

$$\text{Present value} = \text{Cost Yr 0} + \frac{\text{Cost Yr 1}}{(1 + r)} + \frac{\text{Cost Yr 2}}{(1 + r)^2}$$

r = discount rate

Discount factors	
Year	0.05 per year
1	1
2	0.952381
3	0.907029
4	0.863838
5	0.822702

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Discounting - Example

YEAR	Cost of Programme
0	20,000
1	5,000
2	5,000

If discount rate = 5% then

$$\text{Present value} = 20,000 + \frac{5,000}{1.05} + \frac{5,000}{1.05^2} = 20,000 + 4,762 + 4,535 = \mathbf{\$29,297}$$

If discount rate = 10% then

$$\text{Present value} = 20,000 + \frac{5,000}{1.10} + \frac{5,000}{1.10^2} = 20,000 + 4,545 + 4,132 = \mathbf{\$28,677}$$

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Issues to consider in discounting

- What rate?
 - Pharmac currently recommends 3.5% for NZ
 - 3% more common in other countries
 - Adjust rate in sensitivity analysis
- Should future benefits be discounted?
 - Intergenerational equity
 - Consider varying discount rate over time
 - Current practice: discount costs and benefits (QALYs, LYS) at same rate

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Discounting exercise

1. For a prevention programme in which most of the costs are incurred in the first three years but the benefits are expected some years in the future, a higher discount rate would make the programme appear:
 - More cost effective
 - Less cost effective?
 - The same?
2. What would be your answer if you discounted the costs but not the benefits?

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Part 2: Measuring Outcomes

- What do you want your measure of health to do?
 - Convey information to reader about comparability of two treatments or procedures
 - Choose a measure that is seen as clinically significant for the intervention
 - Help the reader understand how this treatment or procedure increases health status when compared with other treatments or procedures, some of which may be dissimilar
- A trade-off:
 - Choosing a measure that is accurate (e.g., objectively measures what is intended to be measured) vs. captures the broad spectrum of health status

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Measures of effectiveness (non-preference-based)

1. Mortality indicators
 - Live years gained, lives saved
2. Morbidity indicators
 - Clinical indicators (eg. episode-free days, percent reduction in serum cholesterol, blood pressure, etc)
 - Prevalence and incidence of disease
3. Disease specific scales
 - Arthritis Impact Measurement Scale
 - Kidney Disease Questionnaire
4. Generic scales
 - SF36
 - Nottingham health profile

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Measures of effectiveness (Preference-based)

5. Utility-based indexes (QALYs, HYE)
6. Willingness to pay for health improvement

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Outcomes from health promotion

Intervention → Awareness → Attitudes → Behaviour → Risk factors → Health status

Sun smart

Drink driving

Smoking

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What measure(s) of outcome?

1. Adding an exercise regime to a smoking cessation programme?
2. Comparing a pedometer-based Green prescription with the standard (time-based) prescription for increasing exercise?
3. An intervention to increase uptake of repeat prescriptions for antihypertensive drugs.

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Health valuation: Some terms

- Utility
- Health state or health status
- Health related quality of life (HRQL)
- Health status measures
- Health status profiles
- Preferences for health states
- Health of an individual at a point in time
- Value assigned to different health states
- Systems used to describe health states
- Instrument that describes the health status of a person on each of a set of domains

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QALYs

- Are based upon utility which measures the strength of individual preferences
- Combine duration of life and quality of life in a single measure
- Can be used generically or be disease-specific
- Should be used incrementally by combining incremental costs and incremental benefits (QALYs)

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Examples of utility values

Health state	Utility value	
Full health	1.00	1.00
Mild angina	0.90	↑
Kidney transplant	0.84	
Hospital dialysis	0.57	
Severe angina	0.50	
Hospital confinement	0.33	
Dead	0.00	0.00

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Calculation of QALYS

QALY =
utility value x length of time
eg. $0.6 \times 5 \text{ years} = 3 \text{ QALYs}$

QALYs gained =
QALY after treatment minus QALY
before treatment

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Cost per QALY

Treatment A:
10 years survival @ .75 utility
Cost: \$10000

Treatment B:
6 years survival @ .90 utility
Cost: \$5000

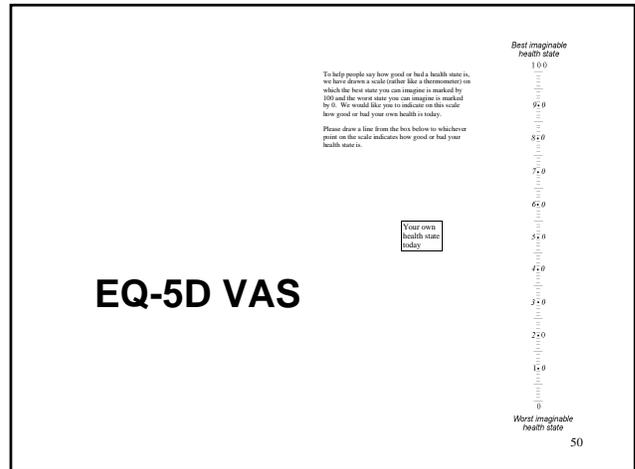
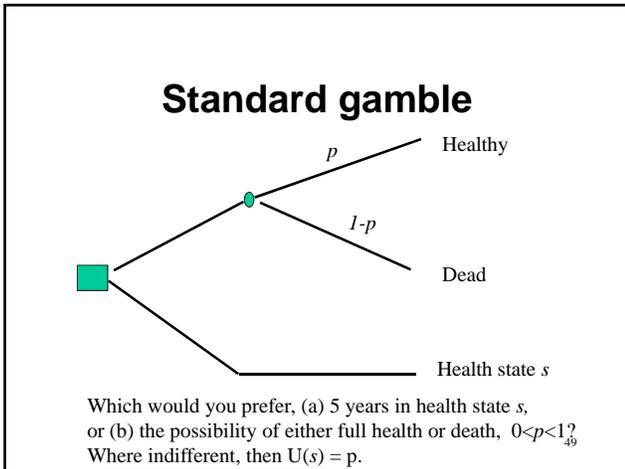
What is the incremental cost per QALY gained from
Treatment A?

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How to measure utility?

1. Which index?
2. Source of data?
3. How to determine utility?

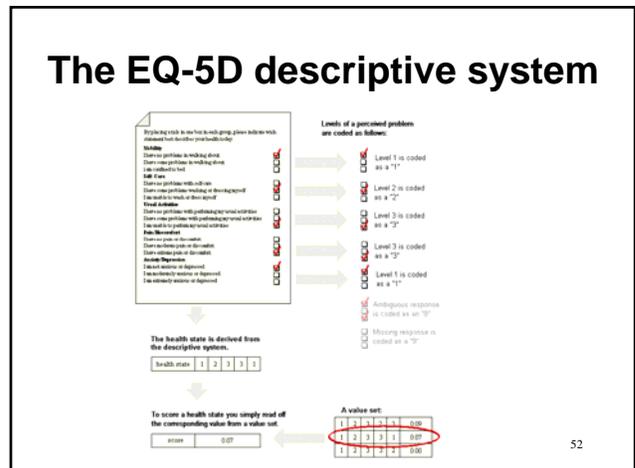
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EQ5D Descriptive system

5 attributes	3 levels		
Mobility	No problems	Some problems	Confined to bed
Self-care	No problems	Some problems	Unable to wash or dress
Usual daily activities	No problems	Some problems	Unable to perform UDA
Pain, discomfort	No pain	Some pain	Extreme pain
Anxiety, depression	Not anxious or depressed	Moderately anxious or depressed	Extremely anxious or depressed

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What is the difference between the VAS and the descriptive system?

VAS

- Patient-based
- 0 = worst imaginable state 100 = Best imaginable health state
- Does not require reference to a value set
- Should not be used in QALY calculations

Descriptive

- Population-based
- 0 = dead, 1 = full health
- Requires a Value set to translate into utility values
- Can be used in QALY calculations

NB: Both parts of the EQ 5D should always be used in clinical trials 53

EQ-5D value sets

Table 14 Health State preferences of New Zealanders

worse			better		
state	Eq. (1)	Eq. (2)	state	Eq. (1)	Eq. (2)
11111	1.000	1.000	11111	0.229	0.237
11112	0.962	0.956	11112	0.251	0.246
11113	0.926	0.919	11113	0.273	0.267
11114	0.890	0.883	11114	0.295	0.289
11115	0.854	0.847	11115	0.317	0.311
11116	0.818	0.811	11116	0.339	0.333
11117	0.782	0.775	11117	0.361	0.355
11118	0.746	0.739	11118	0.383	0.377
11119	0.710	0.703	11119	0.405	0.399
11120	0.674	0.667	11120	0.427	0.421
11121	0.638	0.631	11121	0.449	0.443
11122	0.602	0.595	11122	0.471	0.465
11123	0.566	0.559	11123	0.493	0.487
11124	0.530	0.523	11124	0.515	0.509
11125	0.494	0.487	11125	0.537	0.531
11126	0.458	0.451	11126	0.559	0.553
11127	0.422	0.415	11127	0.581	0.575
11128	0.386	0.379	11128	0.603	0.597
11129	0.350	0.343	11129	0.625	0.619
11130	0.314	0.307	11130	0.647	0.641
11131	0.278	0.271	11131	0.669	0.663
11132	0.242	0.235	11132	0.691	0.685
11133	0.206	0.199	11133	0.713	0.707
11134	0.170	0.163	11134	0.735	0.729
11135	0.134	0.127	11135	0.757	0.751
11136	0.098	0.091	11136	0.779	0.773
11137	0.062	0.055	11137	0.801	0.795
11138	0.026	0.019	11138	0.823	0.817
11139	0.000	0.000	11139	0.845	0.839
11140	0.000	0.000	11140	0.867	0.861
11141	0.000	0.000	11141	0.889	0.883
11142	0.000	0.000	11142	0.911	0.905
11143	0.000	0.000	11143	0.933	0.927
11144	0.000	0.000	11144	0.955	0.949
11145	0.000	0.000	11145	0.977	0.971
11146	0.000	0.000	11146	0.999	0.993
11147	0.000	0.000	11147	1.000	1.000



Uses of EQ-5D

- To measure patient reported outcomes in RCTs
- To measure patient reported outcomes of service use (PROMS in UK)
- To measure changes in population health via patient reported outcomes
- To calculate QALYs in economic evaluations
- To set service priorities via QALY league tables

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Underlying assumptions

- Social welfare is maximised when the sum of individual utilities is maximised
- Interpersonal utilities are independent
- QALY maximisation leads to socially preferred allocation of resources
- Value of quality of life is independent of its likelihood and duration

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Underlying assumptions (contd)

- A healthy year of life is of equal value to all, regardless of age, ethnicity etc.
- 10 QALYS gained for 1 person is of equal value to 1 QALY gained for 10 people
- Cardinal index: a gain in utility from 0.2 to 0.4 is equal to a gain from 0.8 to 1.0
- More QALYs are always better

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Summary of QALYs

- Can be a useful common currency for measuring health outcomes
- Are based on a number of important assumptions
- Have lots of fish-hooks – SHOULD BE USED WITH CAUTION!!

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DALYS

- Measure life years lost from disease and life years lived with a disability
- Weighted combination of
 - Life expectancy
 - Value of life at different ages
 - Value of future time
 - Value of avoiding disability
- Disability weights for different conditions

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QALYs

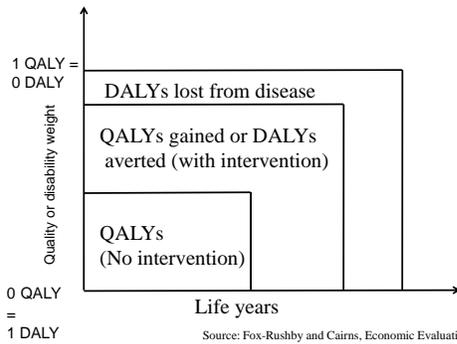
- Based on impact of disease on dimensions of health
- Use primary data on health status
- Weights are self-reported
- Full health = 1
- Measure QALYs gained
- Used for economic evaluation

DALYs

- Based on descriptions of disease
- Use secondary data on disease prevalence
- Weights predetermined by WHO "experts"
- Full health = 0
- Measure DALYs lost
- Used to compare health status across countries

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QALYs and DALYs



Options for valuing benefits in monetary terms

1. Human capital approach

- Estimate life time income under both health states
- Difference is the benefit from the intervention
- Advantages and disadvantages?

2. Observed behaviors

- Look at how much others value life
- E.g., court awards for loss of life
- Amount people spend on insurance
- Advantages and disadvantages?

3. Stated preference

- Ask people to place a monetary value on different health states
- E.g., Contingent valuation or discrete choice experiments which measure "willingness to pay" for a reduction in risk
- Advantages and disadvantages?

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