Economic Evaluation in Health Care

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Economic Evaluation Methods

- Cost Minimization Analysis (CMA)
- Cost-Benefit Analysis (CBA)
- Cost Effectiveness Analysis (CEA)
- Cost-Utility Analysis (CUA)

- Cost Minimization Analysis (CMA)
    - Used when outcomes of alternatives are identical. Objective is to find the least cost program/procedure.
- Cost-Benefit Analysis (CBA)
- Cost Effectiveness Analysis (CEA)
- Cost-Utility Analysis (CUA)

- Cost Minimization Analysis (CMA)
- Cost-Benefit Analysis (CBA)
  - Used when there is either a single or multiple outputs and are not necessarily the same (for example if we want to compare hypertension screening against flu vaccination). Output is converted to a common (money) metric.
- Cost Effectiveness Analysis (CEA)
- Cost-Utility Analysis (CUA)

- Cost Minimization Analysis (CMA)
- Cost-Benefit Analysis (CBA)
- Cost Effectiveness Analysis (CEA)
  - Used when alternatives have single common output but have differential success in outcomes and in costs. Output can be measured directly in natural units (for instance, disability days reduced, body mass index, blood glucose levels etc.). CEA allows one to rank alternative uses of scarce funds.
- Cost-Utility Analysis (CUA)

- Cost Minimization Analysis (CMA)
- Cost-Benefit Analysis (CBA)
- Cost Effectiveness Analysis (CEA)
- Cost-Utility Analysis (CUA)
    - Used when different interventions result in single or multiple outputs and have differential success in outcomes and costs. Output is converted to a common metric such as health days or Quality Adjusted Life Years (QALYs). CUA is a type of CEA.

Economic Evaluation Methods

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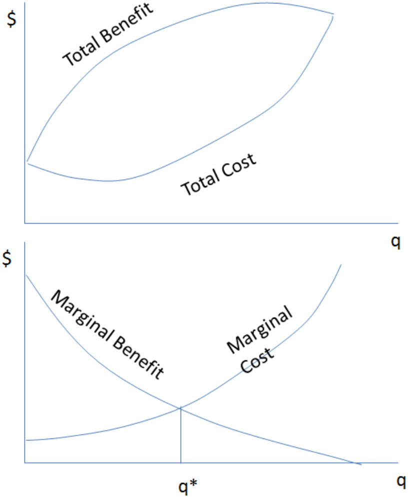
Cost Benefit Analysis (CBA)

When to use it

- Cost Benefit Analysis (CBA) is typically used to arrive at a go/no-go decision for a particular project/plan.
- Basic idea is that a project/plan will improve social welfare if the benefits (B) associated with it exceed the costs (C), i.e., if $B - C > 0$.
- When multiple projects are under consideration, projects are often ranked according to the benefit-to-cost (B/C) ratio where higher B/C ratio indicates a project will deliver greater benefit for a given monetary cost.
- The benefits and costs that are counted must include not only those directly attributed to the project but also any indirect benefits or costs through externalities or other third-party effects.

- Want to incur costs for a given intervention up to the level where the difference between the benefits and costs is maximized.
- One maximizes benefits relative to costs when the marginal, or incremental, benefit is just equal to the marginal cost, assuming declining marginal benefits and either constant or increasing marginal costs.
- The difference between total benefits and total costs is maximized where marginal costs (MC) equals marginal benefit (MB).
- Optimal level population receiving the intervention (say q*) would be where MC(q) = MB(q).



Cost Benefit Analysis (CBA)

Money Metric

- Costs and benefits must be measured on the same yardstick (e.g. monetary value)
- Application of CBA to health care requires placing a dollar value on health/human life. Common approaches to measuring benefits include:
  - **Willingness-to-pay (WTP):** The willingness to pay or willingness to accept approach measures what individuals are willing to pay (accept) to avoid (accept) additional risk to life and limb.
  - **Human capital calculations:** This approach uses the amount of human capital investment to approximate value of time of remaining life years or use foregone earnings to value loss (for instance in accident and disability cases).
  - **Contingent Valuation:** The contingent valuation approach elicits individuals valuation of alternative contingent risks.

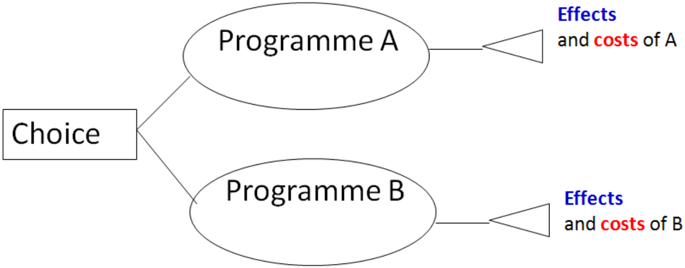
- Both costs and benefits may be realized at different points in time.
- The discount factor is $(1+d)$ where d is the social discount rate (often assumed to be the market rate of interest). The present value of the project/intervention is then

$$\text{PV} = \sum_{t=1}^{T} \frac{(B_t - C_t)}{(1+d)^t}$$

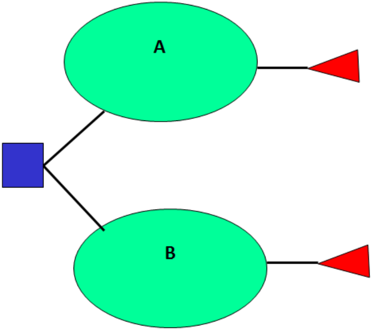
where B_t and C_t are the benefit and cost in period t.

Cost Effectiveness Analysis (CEA)

- CEA compares the costs of achieving given nonmonetary objective such as life-years saved, level of blood pressure etc.
- In terms of the CEA, a new technology or intervention is assessed by comparing the incremental costs of a new intervention with the incremental medical effectiveness where the increments are over the old or standard intervention.
- The difference in costs is compared with the difference in outcomes, to assess the cost per unit of outcome of the intervention of interest ICER = $(C_A - C_B)/(E_A - E_B)$



- Example
  Programmes to reduce average blood pressure



20 strokes avoided;
£100,000

25 strokes avoided;
£150,000

	Increased Benefit	Increased Cost
A vs. B	5 strokes avoided	50k

Cost Effectiveness Analysis

Endpoints – Pros and Cons

Advantages

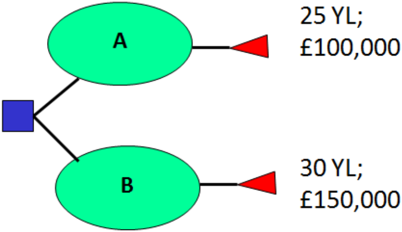
- Compare different ways of reducing same event
- Clinically meaningful
- Often easy to measure
  - deaths avoided
  - breast cancer recurrence prevented

Disadvantages

- Unable to compare intervention with different endpoints (eg. COPD exacerbations vs. stroke prevented)
- Intertemporal models (death avoided in first week = death avoided in 12th week?)

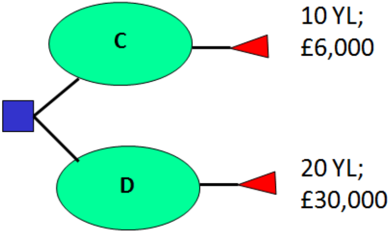
Example

- programmes to reduce average blood pressure



Example

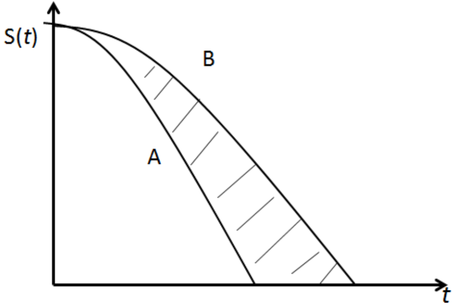
- programmes to reduce COPD exacerbations



Cost Effectiveness Analysis

Outcome Measures – Survival, Life Expectancy & Life Years Gained (LYG)

- Two programmes (A & B)
- $S(t)$ = survivor curve = probability of being alive at time t
- Life expectancy = area beneath survivor curve
- With B higher probability of surviving at any t
- B vs. A $\Rightarrow$ LYG as in shaded area



Cost Effectiveness Analysis

Survival: pros and cons

Advantages

- Clear-cut definition
- Available statistical tools (Kaplan-Meier, Cox)
- Possible to compare different conditions

Disadvantages

- Possible issues of censored data
- Implies risk neutrality with respect to LYs, or discounted LYs
- Does not consider quality of life
- Implies indifference to QoL

- Let C_N and C_O be the cost of new and old treatments and similarly let E_N and E_O medical effectiveness/health output of the two treatments.
- Then the incremental cost effectiveness ratio (ICER) is computed as

$$\text{ICER} = \frac{C_N - C_O}{E_N - E_O}.$$

DATA	Treatment A	Treatment B
Probability of Immediate Death from Treatment	5%	10%
Life Expectancy for Survivors	20	10
Initial Treatment Cost	50,000	20,000
Follow up Costs, Year 1	20,000	30,000
Follow up Costs, All Remaining Years	2,000	2,000

Cost Effectiveness Analysis

Computing ICER – A Simplified Example

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- Treatment A: Cost per survivor = 50K + 20K + 19*2K = 108K; Cost per deceased =50K. Thus, Expected Cost of Treatment A = .95*108 + .05*50K = **105.1K**

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Cost Effectiveness Analysis

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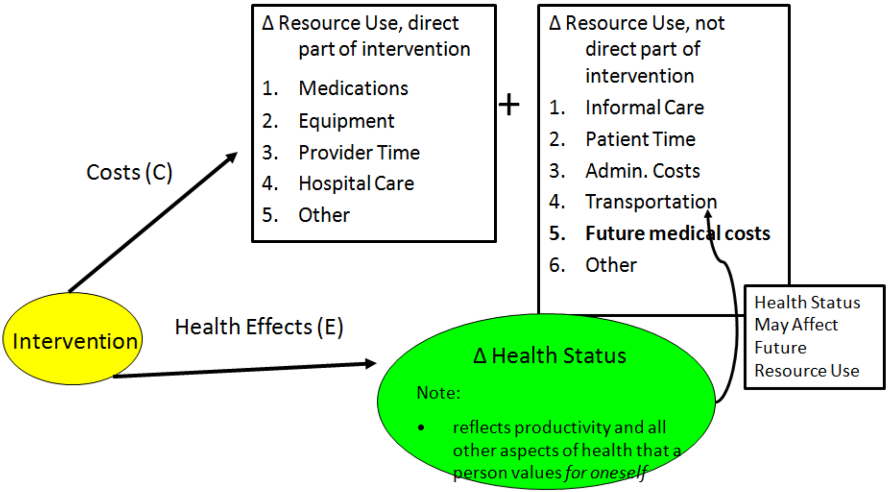
Treatment	EC	EB	IC	IB	ICER
B	$63,200	9 Yrs			
A	$105,100	19 Yrs	$41,900	10 Yrs	$4,190

Issues in Quantifying Costs



- Take the example of major depression
- Suppose we are doing a CEA comparing two interventions:
    - A: 20 therapy sessions, 1 hr each
    - B: medication with fluoxetine (generic Prozac)
- We calculate that Program A requires 50 more hours of time per person due to session times and travel/waiting time
- Is the extra time a cost?

Issues in Quantifying Costs

Time Costs

- Is the extra time a cost?
- Should we count the extra 50 hours as an incremental cost of Program A relative to B?
- Yes. But at what monetary rate?
- If the extra 50 hours is equally (un)appealing as spending that time at work
  - Then cost is simply lost wages
- What if the extra 50 hours are less appealing than work hours? (sessions may be emotionally painful, and the travel and waiting could be unpleasant)
  - Then cost is higher than wages
- What if the extra 50 hours is fun with a capital F (therapists in this town are joys to be around, and you can travel on quiet trains that smell like lavender and are always on time)
  - Then cost is lower than wages
  - Cost could even be 0, if the extra time is just as enjoyable as what you would do anyway with your free time (not a likely scenario, but perhaps not far from the truth in the case of, say, a a jazzy exercise intervention)

- Productivity
- Future Health Care Costs

Issues in Quantifying Costs

Productivity and Future Health Care Costs

- Productivity
  - Productivity is an important aspect of time costs too
  - Often your health state will affect your productivity (e.g. people are less productive when depressed)
  - If a depression intervention relieves symptoms and improves productivity, should that count as a monetary benefit in a CEA (i.e. a negative cost in the CE ratio numerator)?
- Future Health Care Costs

Issues in Quantifying Costs

Productivity and Future Health Care Costs

- Productivity
- Future Health Care Costs
  - Example: Suppose a smoking intervention targeting a group of 50 year old smokers causes them to live 5 years longer, on average. In particular, it prolongs the lives of 1 in 3 of them by 15 years each.
  - That's great, but now these fortunate folks are racking up 15 more years of health care expenses each. Should those costs be added to the CEA?

Special Adjustments to Costs

- Costs versus Charges
- Inflation
- Learning by Doing
- Capacity

- Costs versus Charges
  - Cost-to-Charge Ratio (CCR)
    - = True Social Cost / Actual Charges
  - This ratio is typically < 1, because:
    - Provider is earning a profit
    - Provider cannot actually collect all charges
    - Charges may be subsidizing other activities by the provider
- Inflation
- Learning by Doing
- Capacity

Special Adjustments to Costs

Inflation

- Costs versus Charges
- Inflation
  - Costs from previous years should be "inflated" to current year dollars
  - Consumer Price Index is a fine inflation adjustor for resources in general, but Medical Price Index may be more appropriate for medical interventions (although there is debate as to whether medical inflation is really faster than general inflation)
- Learning by Doing
- Capacity

Special Adjustments to Costs

Learning by Doing

- Costs versus Charges
- Inflation
- Learning by Doing
  - Cost increases due to an intervention may be mitigated if “learning” occurs
  - Example: Increased use of CABG in Hospital X may make Hospital X more efficient at performing CABG in the future
- Capacity

Special Adjustments to Costs

Capacity

- Costs versus Charges
- Inflation
- Learning by Doing
- Capacity
  - What if intervention A causes a hospital that was only 50% occupied to be occupied at 60%.
  - Should hospital overhead costs be assigned to intervention?

Special Adjustments to Costs

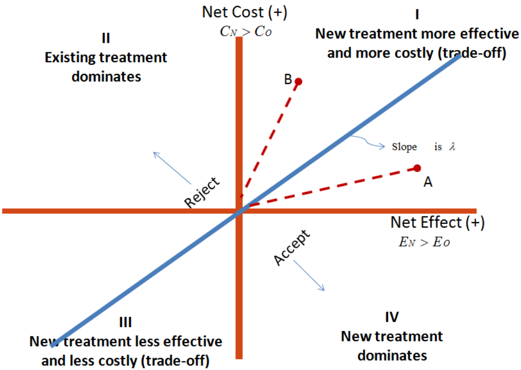
- Costs versus Charges
- Inflation
- Learning by Doing
- Capacity

The Cost-effectiveness plane

- Let C_N and C_O be the cost of new and old treatments and similarly let E_N and E_O medical effectiveness/health output of the two treatments.
- If $C_N < C_O$ and at the same time $E_N > E_O$, i.e. the new treatment costs less and is more effective than the old then the new treatment is said to dominate the old and should be adopted.
- If the situation is reversed (new is costlier and less effective, i.e. $C_N > C_O$ and $E_N < E_O$) then the old treatment is dominant and new treatment should not be adopted.
- The situation is more interesting in the remaining two cases where the new treatment costs more and is more effective or costs less but is less effective.

The Cost-effectiveness plane

- The ICER for a point such as A is equal to the slope of the ray from the origin to that point
- If the acceptable threshold is some value equal to λ (shown as the slope of the thick line through the origin in the figure), then intervention represented by A (slope less than λ) would be accepted while the intervention represented by B (slope greater than λ) would be rejected

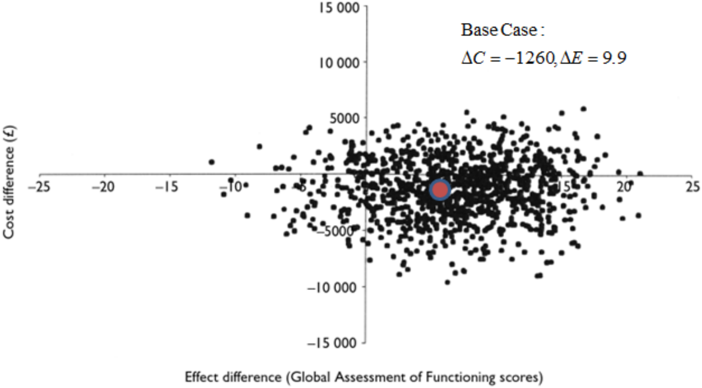


- Both the cost and the effectiveness may be subject to chance.
- In practice, then the ICER is computed using the expected (or mean) value of incremental costs and increment benefits. Thus, ICER is computed as

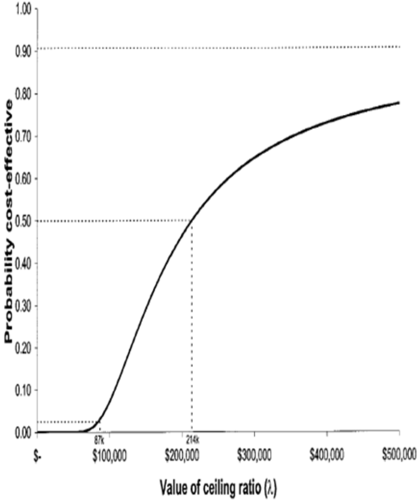
$$\text{ICER} = \frac{\mathrm{E}(C_N - C_O)}{\mathrm{E}(E_N - E_O)}.$$

- There are several methods used in practice to provide a measure of this uncertainty, i.e., to provide confidence intervals around the IECR but one growing in popularity in health economics is based on bootstrap estimates of the mean IECR and **cost-effectiveness acceptability curves (CEAC)**.

- Bootstrapping is statistical technique which (typically) takes random samples from the original data (of the same size as the original sample but with replication) and re computes the statistic of interest many times.



- CEAC is constructed to inform the decision maker about the probability that new intervention is cost-effective (compared to the alternative) for a range of maximum acceptable ceiling ratio (λ).
- Specifically, the probability is simply the proportion of the scatter plot points that fall to the south and east of a ray with slope of λ drawn through the origin (i.e., proportion of incremental cost-effect pairs with a value below λ).
- The CEAC provides a plot of these probabilities (y-axis) against λ (x-asis).



Cost-utility analysis

- Cost Utility Analysis (CUA) is a type of cost effectiveness analysis but provides
  - a method for comparing interventions when the outcomes are not similar (or there are multiple outputs) and
  - adjusts the number of life years gained (if that was the measure used in CEA) with the quality of life. The adjustment is done using an index that reflects health status of an individual.
- Several indexes are available such as
  - Idea: Combine survival and quality of life
  - Disability Adjusted Life Years (DALYs)
  - Quality Adjusted Life Years (QALYs).

Cost-utility analysis

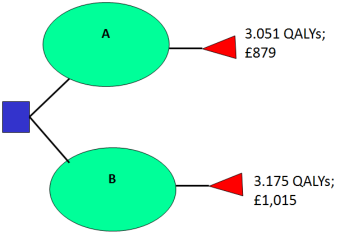
Quality of life as an outcome measure

- Different definitions of quality of life
- Same definition for all interventions
- Comparable across treatment areas
- Increasing acceptability of measurement
- Generally health state defined relative to perfect health and to a given time period
- Each health state weighted by the preference of individual for one state compared to another

Cost-utility analysis

Quality adjusted life-years (QALYs)

- Main advantage
  - Simple metric that combines survival and quality of life
- What does a QALY mean?
  - If full health = 1 QALY; death = 0 QALY; disabled (blind) = 0.6 QALY
  - Then 5 years in full health = 5 QALYs
  - And 5 years being blind = 3 QALYs = (0.6 * 5)
- Example: Two treatment options



COST-UTILITY ANALYSIS

HOW DO WE COME UP WITH QALYS?

- To calculate QALYs we need weights that represent the health-related quality of life of a specific health status
- A QALY is the product of life expectancy and health utility index where the latter is a measure of quality of life of the remaining years and is typically normalized between 0 (death) and 1 (one year of life in perfect health). However, it is possible to have negative values since some health states may be considered to be worse than being alive.
- Suppose that an individual could expect to live 10 years if they were to receive a particular intervention but the quality of life for each of those years is .75. Then the QALY score for the person would be 7.5 years.
- The quality weights must be:
  - Based on preferences
  - Anchored on perfect health and death

Making QALYs: A 4 Step Process

1. Step 1: Identify Generic Health States
2. Step 2: Describe Elements of Health States
3. Step 3: Assign Weights to Health States
4. Step 4: Multiply Weights by Time in States

Cost-utility analysis

4 Steps: Simplified Example

Suppose were doing a CEA of an obesity intervention

1. Identify Generic Health States
2. Describe Elements of Health States
3. Assign Weights to Health States (More on this later)
4. Multiply Utility Weights by Time in States

COST-UTILITY ANALYSIS

4 STEPS: SIMPLIFIED EXAMPLE

Suppose were doing a CEA of an obesity intervention

1. Identify Generic Health States
   - Dead
   - Severe Heart Disease
   - Moderate Heart Disease
   - Perfect health
2. Describe Elements of Health States
3. Assign Weights to Health States (More on this later)
4. Multiply Utility Weights by Time in States

Suppose were doing a CEA of an obesity intervention

1. Identify Generic Health States
2. Describe Elements of Health States
    - Dead
    - Severe Heart Disease
        - Very limited mobility
        - High level of pain
        - High level of emotional distress
    - Moderate Heart Disease
        - Limited mobility
        - Mild pain
        - Moderate level of emotional distress
    - Perfect health
3. Assign Weights to Health States (More on this later)
4. Multiply Utility Weights by Time in States

Cost-utility analysis

4 Steps: Simplified Example

Suppose were doing a CEA of an obesity intervention

1. Identify Generic Health States
2. Describe Elements of Health States
3. Assign Weights to Health States (More on this later)
   - Dead = 0.0
   - Severe Heart Disease = 0.5
   - Moderate Heart Disease = 0.8
   - Perfect health = 1.0
4. Multiply Utility Weights by Time in States

Cost-utility analysis

4 Steps: Simplified Example

Suppose were doing a CEA of an obesity intervention

1. Identify Generic Health States
2. Describe Elements of Health States
3. Assign Weights to Health States (More on this later)
4. Multiply Utility Weights by Time in States
   - Average person with intervention:
     - 25 years of perfect health = 25 QALYs
     - 3 years of severe HD = 3*0.5 = 1.5 QALYs
     - 5 years of moderate HD = 5*0.8 = 4.0 QALYs
     - TOTAL = 30.5 QALYs
   - Average person in usual care:
     - 22 years of perfect health = 22 QALYs
     - 4 years of severe HD = 4*0.5 = 2 QALYs
     - 6 years of moderate HD = 6*0.8 = 4.8 QALYs
     - TOTAL = 28.8 QALYs
   - Health Effect of Intervention = 1.7 QALYs (note: but only 1 unadjusted life-year)

Cost-utility analysis

4 Steps: Simplified Example

Suppose were doing a CEA of an obesity intervention

1. Identify Generic Health States
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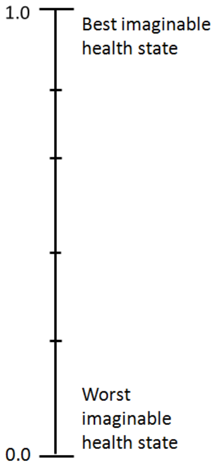
Three popular methods to develop the health utility index

1. rating scale
2. standard gamble
3. time trade-off

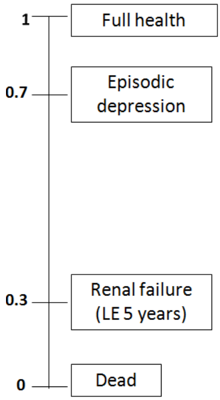
Health Utility Index

The Rating Scale

- Suppose that you gave a score of 50 points to "complete health."
  - Imagine some condition that you consider to be only half as healthy as complete health. You give a score of 25 points to this condition.
  - Now let X denote the score you would give to some specific health condition (say needs a walking stick but otherwise healthy).
  - Then the QALY score for this health condition is simply X/50.



- Consistency check for interval scales: Is the difference between meaningful?



- Due to an accident you require a walking stick for the rest of your life. There is a free and painless procedure that can restore your complete health, but will cause your immediate death if unsuccessful.
  - Suppose that the operation is successful only Y% of the time.
  - Obviously, if Y is 100, then you would agree to go ahead with the operation. If Y is 0, you would surely forego the operation.
  - For what value of Y would you be undecided about receiving the operation?
  - Then the QALY score for this health condition is Y/100.

- You have a choice between living 30 more years with a walking stick (and then dying a painless death), or living Z more years in complete health.
  - How big must Z be so that you are indifferent between the two choices?
  - Then the QALY score is Z/30.

Health Utility Index

Weight Assignments

- Direct Assignment
  - You can do this if youre collecting primary data (as part of an RCT, e.g.)
  - Basic Idea: elicit preference weights from patients regarding each generic health state affected by the intervention
- Mapping Based on Previously Gathered Utility Weights
  - Basic Idea: use information on elements of each generic health state (recall: you collected this information in Step 2 of the overall process), in combination with known information on how these elements are associated with preference weights to infer overall preference weights for generic health states
- Example:
  - Direct Assignment: Severe Heart Disease ⇒ 0.5 HRQL
  - Mapping: Severe HD ⇒ Very limited mobility, High level of pain, and High level of emotional distress ⇒ 0.5 HRQL
- Indirect utility assessment
  - Disease Specific
    – e.g. Quality of Life Adult Growth Hormone Deficiency Assessment (QoL-AGHDA has 25 yes/no questions)
  - Or General (e.g. EQ5D, SF16). The EuroQol EQ5D is specially designed to measure the quality of life index for QALYs

EQ5D Questionnaire

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 washing or dressing myself ☐
- I am unable to wash or dress myself ☐

Usual Activities *(e.g. work, study, housework, family or leisure 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

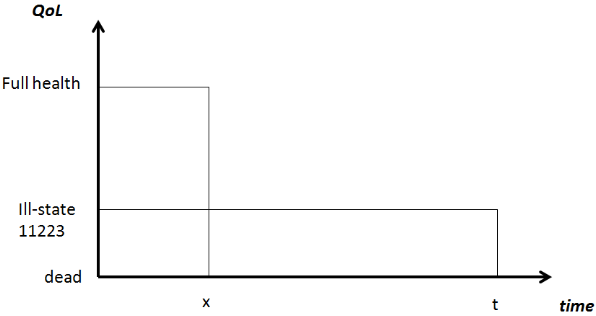
- I have no pain or discomfort ☐
- I have moderate pain or discomfort ☐
- I have extreme pain or discomfort ☐

Anxiety/Depression

- I am not anxious or depressed ☐
- I am moderately anxious or depressed ☐
- I am extremely anxious or depressed ☐

- 5 dimensions
  1. Mobility
  2. Self-care
  3. Usual activity
  4. Pain/discomfort
  5. Anxiety/ depression
- 3 possible levels for any dimension
  1. no problem = 1
  2. some problems = 2
  3. major problems (e.g. confined to bed) = 3
- 243 possible states (e.g 11223)
- Each state associated with a value (e.g. 11223 = 0.255)

Time trade-off elicitation in EQ5D



- Imagine you are expected to live t years with a disease (health profile is 11223). Clearly you would prefer t years in full health.
- For how many years (x) in full health would you be indifferent?
- Value of ill state 11223 = x/t = 0.29

Scoring EQ-5D Health States

UK General Population

Health state	Score	Health state	Score	Health state	Score	Health state	Score
1 1 1 1 1	1.00	1 2 1 3 2	0.09	1 3 2 2 3	0.04	2 1 3 2 1	0.36
1 1 1 1 2	0.85	1 2 1 3 3	-0.08	1 3 2 3 1	0.01	2 1 3 2 2	0.29
1 1 1 1 3	0.41	1 2 2 1 1	0.78	1 3 2 3 2	-0.06	2 1 3 2 3	0.13
1 1 1 2 1	0.80	1 2 2 1 2	0.71	1 3 2 3 3	-0.22	2 1 3 3 1	0.10
1 1 1 2 2	0.73	1 2 2 1 3	0.27	1 3 3 1 1	0.34	2 1 3 3 2	0.03
1 1 1 2 3	0.29	1 2 2 2 1	0.66	1 3 3 1 2	0.27	2 1 3 3 3	-0.13
1 1 1 3 1	0.26	1 2 2 2 2	0.59	1 3 3 1 3	0.11	2 2 1 1 1	0.75
1 1 1 3 2	0.19	1 2 2 2 3	0.15	1 3 3 2 1	0.22	2 2 1 1 2	0.68
1 1 1 3 3	0.03	1 2 2 3 1	0.12	1 3 3 2 2	0.15	2 2 1 1 3	0.24
1 1 2 1 1	0.88	1 2 2 3 2	0.05	1 3 3 2 3	-0.02	2 2 1 2 1	0.62
1 1 2 1 2	0.81	1 2 2 3 3	-0.11	1 3 3 3 1	-0.04	2 2 1 2 2	0.55
1 1 2 1 3	0.38	1 2 3 1 1	0.45	1 3 3 3 2	-0.11	2 2 1 2 3	0.12
1 1 2 2 1	0.76	1 2 3 1 2	0.38	1 3 3 3 3	-0.28	2 2 1 3 1	0.09
1 1 2 2 2	0.69	1 2 3 1 3	0.22	2 1 1 1 1	0.85	2 2 1 3 2	0.02
1 1 2 2 3	0.25	1 2 3 2 1	0.33	2 1 1 1 2	0.78	2 2 1 3 3	-0.14
1 1 2 3 1	0.23	1 2 3 2 2	0.26	2 1 1 1 3	0.35	2 2 2 1 1	0.71
1 1 2 3 2	0.16	1 2 3 2 3	0.09	2 1 1 2 1	0.73	2 2 2 1 2	0.64
1 1 2 3 3	-0.01	1 2 3 3 1	0.07	2 1 1 2 2	0.66	2 2 2 1 3	0.21
1 1 3 1 1	0.56	1 2 3 3 2	0.00	2 1 1 2 3	0.22	2 2 2 2 1	0.59
1 1 3 1 2	0.49	1 2 3 3 3	-0.17	2 1 1 3 1	0.20	2 2 2 2 2	0.52
1 1 3 1 3	0.32	1 3 1 1 1	0.44	2 1 1 3 2	0.12	2 2 2 2 3	0.08
1 1 3 2 1	0.43	1 3 1 1 2	0.37	2 1 1 3 3	-0.04	2 2 2 3 1	0.06
1 1 3 2 2	0.36	1 3 1 1 3	0.20	2 1 2 1 1	0.81	2 2 2 3 2	-0.02
1 1 3 2 3	0.20	1 3 1 2 1	0.31	2 1 2 1 2	0.74	2 2 2 3 3	-0.18
1 1 3 3 1	0.17	1 3 1 2 2	0.24	2 1 2 1 3	0.31	2 2 3 1 1	0.38
1 1 3 3 2	0.10	1 3 1 2 3	0.08	2 1 2 2 1	0.69	2 2 3 1 2	0.31
1 1 3 3 3	-0.07	1 3 1 3 1	0.05	2 1 2 2 2	0.62	2 2 3 1 3	0.15
1 2 1 1 1	0.82	1 3 1 3 2	-0.02	2 1 2 2 3	0.19	2 2 3 2 1	0.26
1 2 1 1 2	0.74	1 3 1 3 3	-0.19	2 1 2 3 1	0.16	2 2 3 2 2	0.19
1 2 1 1 3	0.31	1 3 2 1 1	0.40	2 1 2 3 2	0.09	2 2 3 2 3	0.02
1 2 1 2 1	0.69	1 3 2 1 2	0.33	2 1 2 3 3	-0.08	2 2 3 3 1	0.00
1 2 1 2 2	0.62	1 3 2 1 3	0.16	2 1 3 1 1	0.49	2 2 3 3 2	-0.07
1 2 1 2 3	0.19	1 3 2 2 1	0.28	2 1 3 1 2	0.42	2 2 3 3 3	-0.24
1 2 1 3 1	0.16	1 3 2 2 2	0.21	2 1 3 1 3	0.25	2 3 1 1 1	0.37
2 3 1 1 2	0.30	3 1 1 1 2	0.27	3 2 1 1 2	0.16	3 3 1 1 2	0.05
2 3 1 1 3	0.13	3 1 1 1 3	0.10	3 2 1 1 3	0.00	3 3 1 1 3	-0.11
2 3 1 2 1	0.24	3 1 1 2 1	0.21	3 2 1 2 1	0.11	3 3 1 2 1	0.00
2 3 1 2 2	0.17	3 1 1 2 2	0.14	3 2 1 2 2	0.04	3 3 1 2 2	-0.07
2 3 1 2 3	0.01	3 1 1 2 3	-0.02	3 2 1 2 3	-0.13	3 3 1 2 3	-0.24
2 3 1 3 1	-0.02	3 1 1 3 1	-0.05	3 2 1 3 1	-0.15	3 3 1 3 1	-0.26
2 3 1 3 2	-0.09	3 1 1 3 2	-0.12	3 2 1 3 2	-0.22	3 3 1 3 2	-0.33
2 3 1 3 3	-0.25	3 1 1 3 3	-0.29	3 2 1 3 3	-0.39	3 3 1 3 3	-0.50
2 3 2 1 1	0.33	3 1 2 1 1	0.30	3 2 2 1 1	0.20	3 3 2 1 1	0.09
2 3 2 1 2	0.26	3 1 2 1 2	0.23	3 2 2 1 2	0.13	3 3 2 1 2	0.02
2 3 2 1 3	0.10	3 1 2 1 3	0.06	3 2 2 1 3	-0.04	3 3 2 1 3	-0.15
2 3 2 2 1	0.21	3 1 2 2 1	0.18	3 2 2 2 1	0.07	3 3 2 2 1	-0.04
2 3 2 2 2	0.14	3 1 2 2 2	0.11	3 2 2 2 2	0.00	3 3 2 2 2	-0.11

QALY league table

- Economic evaluation produces information on cost-effectiveness
- If using comparable outcomes (eg QALY) can rank according to c/e
- Can use resultant league table to allocate resource to most c/e first

Intervention	$ / QALY
GM-CSF in elderly with leukemia	235,958
EPO in dialysis patients	139,623
Lung transplantation	100,957
End stage renal disease management	53,513
Heart transplantation	46,775
Didronel in osteoporosis	32,047
PTA with Stent	17,889
Breast cancer screening	5,147
Viagra	5,097
Treatment of congenital anorectal malformations	2,778

Summary

- Economic evaluations are employed to help decision makers allocate resources to new interventions and technologies.
- CBA
  - Helps evaluate if a particular project should be undertaken and can be seen as a tool for a go/no-go decision towards a project.
  - Costs and Benefits must be measured on the same yardstick – invariably in monetary terms.
  - In turn it requires putting a value on human life and health status. The methods include Willingness to Pay and Human Capital evaluations.
- CEA
  - Difficulty of valuing human life is avoided in cost effectiveness analysis
  - Compares the costs of achieving a particular nonmonetary objective, such as lives saved
  - Cost effectiveness analysis cannot answer if a particular project should be undertaken but can only evaluate whether one alternative is better than another.
  - Benefits may be measured in additional life years.
- CUA
  - Is a variation of cost effectiveness analysis and often uses quality adjusted life years (QALYs) to measure benefits.
  - QALYs are difficult to measure since in turn they require placing a weight on a different health conditions.
  - Methods for doing so include standard gamble, time-tradeoffs and ratings on a scale.