Economic Evaluation: Measuring benefits

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Morris et al (2012) Ch.11-12

Measuring benefits

- To perform an economic evaluation, we need to have information of the benefits and costs of an intervention
- Who's perspective should we take?
  - Clinical measure by a test or practitioner?
  - Patient reported measures?
- How wide ranging do we want to be?
  - Include all stakeholders?
  - Include patient costs?
- These are important questions that could potentially result in different conclusions and policy recommendations

Market based pricing

- One approach to measuring the value of output could be to take the market price
- In health care there is no market price
  - You can't 'buy' health
  - In publically funded healthcare or private insurance the individual may under- or over-value the benefit of healthcare
  - Even if we value the over the counter price this may not be rational
    - Imperfect information on treatment value
    - Success of treatment
    - Side-effects
- Infer prices or omit them altogether

Monetary valuations of benefits

- One approach could be to simply ask individuals their valuations
- Revealed preferences
  - Inferred from real choices
  - Assumes people make rational choices (weigh up all benefits and costs)
  - Combined with group preferences we get the demand curve
  - Example: imagine you were selling ibuprofen – how would you reveal your customers valuations of that drug?
  - Example 2: how does this change (or does it?) if we are now selling hip replacements?
  - Concerns with the value of health generated – how can we measure this?

Monetary valuations of benefits

- Stated preferences
  - Instead of actual behavioural responses to price changes, we could ask individuals how much they would be willing to pay in surveys
  - Lacks economic reasoning provided by real choices
  - Contingent valuation method (CVM) is most popular
    - Asks individuals for valuations contingent upon a hypothetical scenario
    - Must be realistic and clear (financing, how obtained, probability they may need it, treatment probability of success etc)
    - May be
      - closed-ended (discrete or binary choice) yes no to a given price
      - open-ended (no value or reference)
      - payment scale (range of choices)
      - iterative-bidding (yes no yes) price increases and decreases until indifferent
  - Issues on strategic answers if individuals expect to pay later for treatment (undervalue) or to have this publically provided (overvalue)

Monetary valuations of benefits

- Example: let's set up a CVM for a new drug to combat stomach ulcers

- Discrete choice experiments
  - Goods and services are bundles of attributes
  - Individual's valuations of those attributes form the valuation of the good or service
  - Regression analysis can translate choices into the valuation of those attributes

Arguments against monetary valuations

- Revealed preference data is rare
- Stated preference has issues with respect to reliability
- Health is a special good, rejection of placing valuation onto life
- Dilutes practicality of choice making compared to cost-effectiveness
- Monetary valuations make decision making more abstract from key stakeholders in health care

Benefits: Natural units

- So far assessed evaluations where the benefits measured are of a common unit
  - E.g. Clinical measure (blood count) or length of life (years)
- Differ in only one aspect
- No side-effects (treatment only affects measure chosen)
- Valuations are for the same clinical outcome measurement
- In reality we may wish to compare treatments with no common clinical outcome
- Indeed, from a social maximisation position, we would prefer all outcomes to be of a common scale

Benefits: Quality of Life

- Quality of Life (QOL) enables a common measure of health
  - Permits evaluations of completely different clinical areas
- Includes all potential effects of the treatment or intervention
- Sound familiar?
  - Economists are used to working with utility
- Health Related Quality of Life (HRQOL)
  - Typically used in evaluations as a more accurate/relevant measure of an intervention
  - The value assigned to duration of life as modified by the impairments, functional status, perceptions and social opportunities that are influenced by disease, injury, treatment or policy

    (Patrick and Erickson, 1993)
- A step away from welfarism?

Benefits: Quality of Life

- Like CEA, except now ‘utility’ replace effectiveness
- Cost-Utility Analysis (CUA)
  - Independent interventions (costs and benefits independent of other interventions)
- Average Cost-Utility Ratio (ACUR)
  - Gives cost per utility unit
- Incremental Cost-Utility Ratio (ICUR)
  - Mutually exclusive interventions
  - Benefits now measured in utils

Benefits: Quality of Life

- CUA more widely applicable than CEA as it can capture several effects in one
- Otherwise identical and **names are used interchangeably**
- CUA has useful policy implications
  - Enables ranking of interventions enabling a payer to identify how many QOL units can be produced within budget and different ways this can be done
- However CUA
  - Doesn't state how QOL should be distributed
  - Whose utility function are we concerned with?
  - Doesn't say whether the intervention is cost-effective without some marker of utility threshold

Properties of QOL indicators

- HRQOL may use instruments – questionnaires/surveys completed by respondents
- We want an unambiguous measure of benefit (to identify a causal relationship), that is comparable, and can be valued
- Based on psychometric properties
  - Reliability – does the instrument generate consistent results (test-retest)?
  - Validity – does the instrument
    - Correlate with known valid measures (criterion validity)?
    - React in ways suggested by theory (construct validity)?
    - Appear to measure what it is supposed to measure (face validity)?
  - Responsiveness – does the instrument respond to changes in health?
  - Feasibility – is the instrument able to use?

EQ-5D

- Derived by EuroQol
- 5 dimensions to HRQOL with 3 levels for each
  1. Mobility
  2. Self-care
  3. Usual activity
  4. Pain and discomfort
  5. Anxiety and depression

EQ-5D

- Derived by EuroQol
- 5 dimensions to HRQOL with 3 levels for each
  1. Mobility
     1. No problems in walking about
     2. Some problems in walking about
     3. Confined to bed
  2. Self-care
  3. Usual activity
  4. Pain and discomfort
  5. Anxiety and depression

EQ-5D

- Derived by EuroQol
- 5 dimensions to HRQOL with 3 levels for each
  1. Mobility
  2. Self-care
     1. No problems with self-care
     2. Some problems washing and dressing
     3. Unable to wash or dress self
  3. Usual activity
  4. Pain and discomfort
  5. Anxiety and depression

EQ-5D

- Derived by EuroQol
- 5 dimensions to HRQOL with 3 levels for each
  1. Mobility
  2. Self-care
  3. Usual activity
     1. No problems with performing usual activities (eg work, study, house work)
     2. Some problems with performing usual activities
     3. Unable to perform usual activities
  4. Pain and discomfort
  5. Anxiety and depression

EQ-5D

- Derived by EuroQol
- 5 dimensions to HRQOL with 3 levels for each
  1. Mobility
  2. Self-care
  3. Usual activity
  4. Pain and discomfort
     1. No pain or discomfort
     2. Moderate pain or discomfort
     3. Extreme pain or discomfort
  5. Anxiety and depression

EQ-5D

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- 5 dimensions to HRQOL with 3 levels for each
  1. Mobility
  2. Self-care
  3. Usual activity
  4. Pain and discomfort
  5. Anxiety and depression
     1. Not anxious or depressed
     2. Moderately anxious or depressed
     3. Extremely anxious or depressed

EQ-5D

- Derived by EuroQol
- 5 dimensions to HRQOL with 3 levels for each
  1. Mobility
  2. Self-care
  3. Usual activity
  4. Pain and discomfort
  5. Anxiety and depression
- Generates a profile of an individual's health state
- 243 possible outcomes (3^5)
  - Example: 32211
    - Confined to bed, some problems washing or dressing, some problems with performing usual activities, no pain or discomfort, and not anxious or depressed

Ranking the EQ-5D

- Can say 32211 is better than 32212
- Cannot say 32211 is better than 23211
- Need an index of weights to identify whether mobility is more important than self-care (in this example)
- York MVH project surveyed 2,997 individuals on 43 EQ-5D health states
  - Regression using dummies for each dimension and a level 3 dummy (=1 if any dimension had 3) with a constant for perfect health
- Estimates:

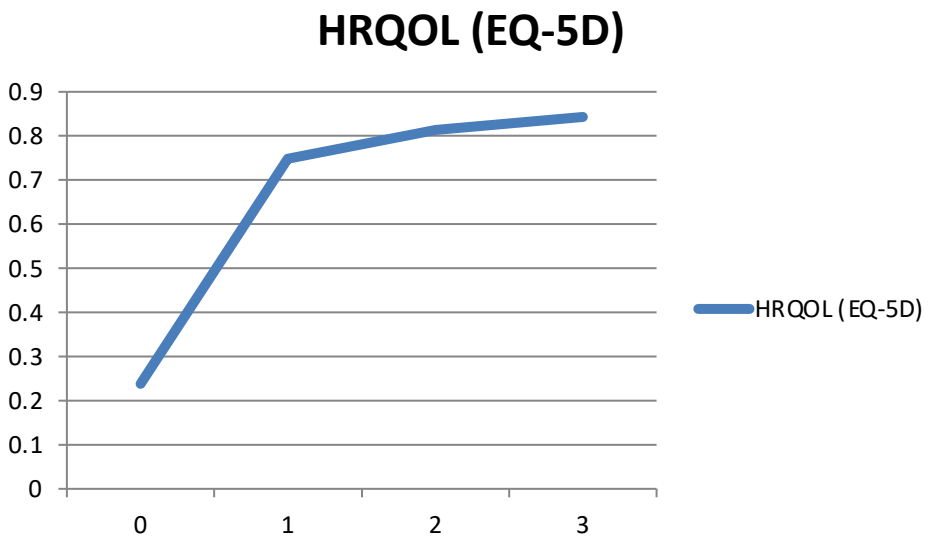
U=0.97+(-0.066M2)+(-0.271M3)+(-0.029S2)+(-0.097S3)+(-0.127U2)+(-0.224U3)+(-0.144P2)+(-0.376P3)+(-0.114A2)+(-0.259A3)+(-0.305ANY3)

Ranking the EQ-5D

- Is 32211 better than 23211?
- Populate the estimates:
  - 32211
    - U=0.97+(-0.271M3)+(-0.029S2)+(-0.127U2) +(-0.305ANY3)
      =0.97-0.271-0.029-0.127-0.305
      =0.238
  - 23211
    - U=0.97+(-0.066M2)+(-0.097S3)+(-0.127U2)+(-0.305ANY3)
      =0.97-0.066-0.097-0.127-0.305
      =0.375
- Can say 32211 is not better than 23211 (utility lower)

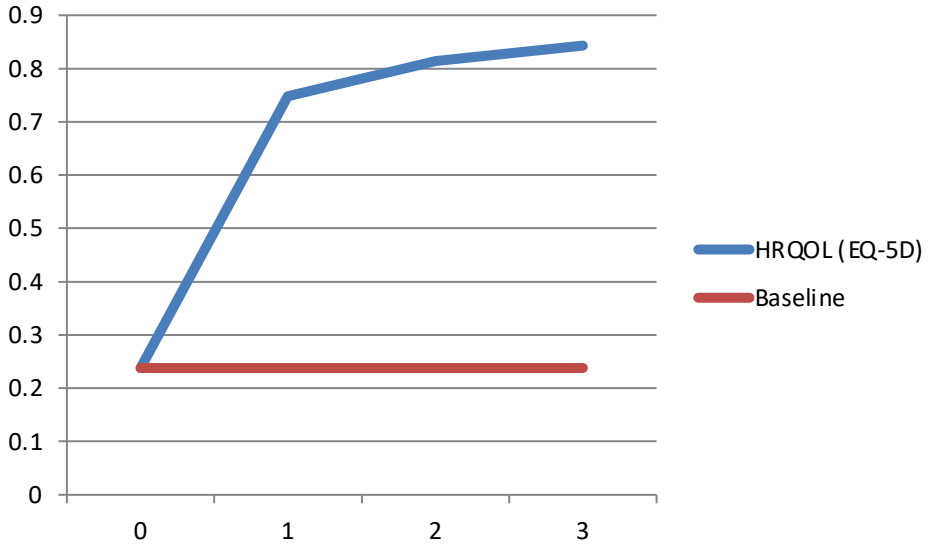
Health gains and the EQ-5D

- Since we are interested in the effect of an intervention, we wish to assess the gain in health borne from that intervention
- Likely to occur over time
- Example: 32211 (0.238), 22211(0.748), 12211(0.814), 11211 (0.843)



Health gains and the EQ-5D

- Area under the curve gives the total amount of health experienced
- Incremental effect of the intervention is the gap between what would have happened without intervention and what did with the intervention (the gain in health)



Benefits: Quality of Life

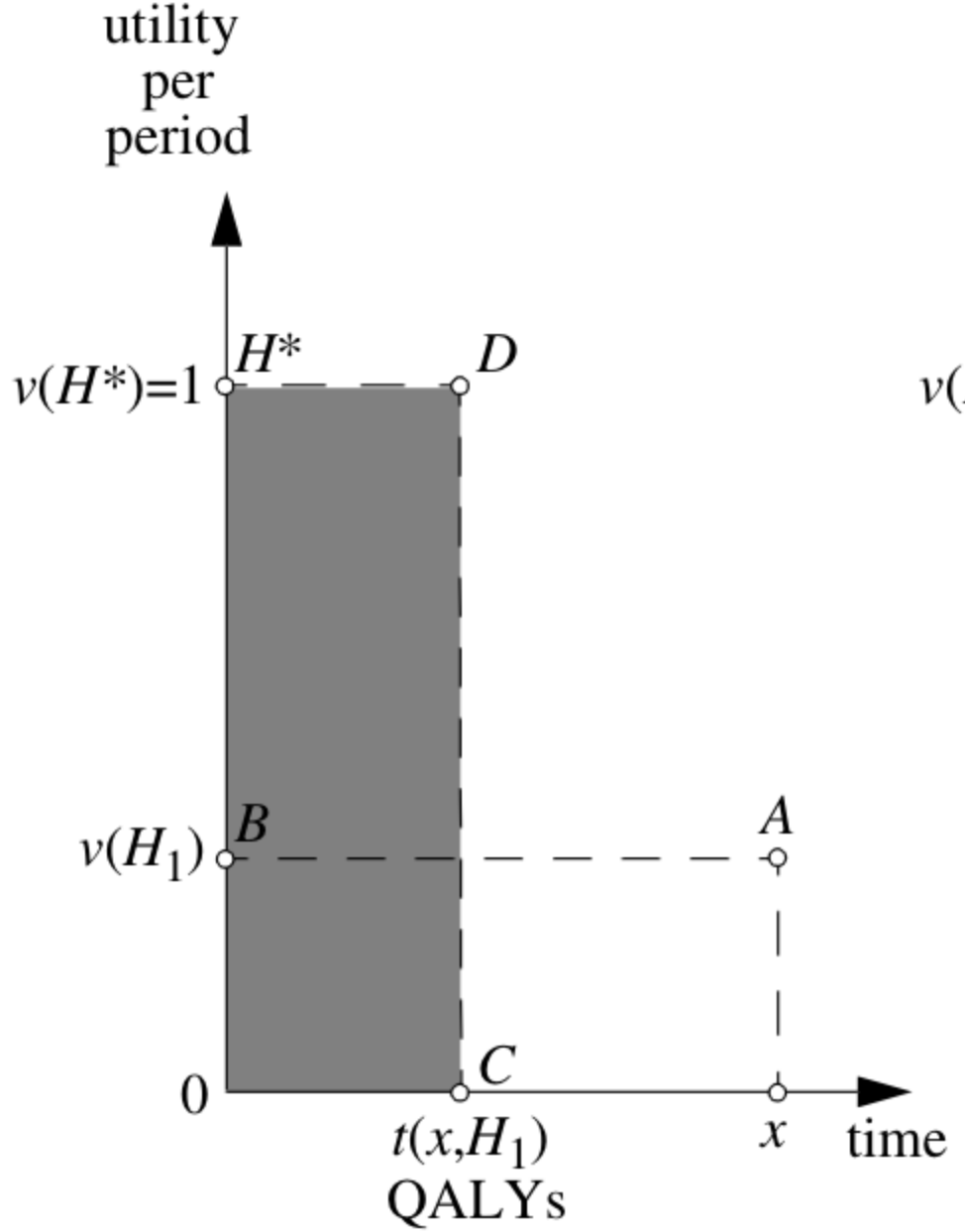
- Quality Adjusted Life Years (**QALYs**) are the most used utility index:
  - Klarman et al. (1968)
  - All health states placed within interval [0,1]
    - Death 0, perfect health 1
    - Adjusts years gained by morbidity
    - Health states assigned a morbidity weight
    - Weights updated by surveys
    - QALY is sum of years of state multiplied by morbidity weight
  - X defined by:
    - Survive one year in health state with utility index of x
    - Survive fraction x of a year in perfect health
  - All states can be measured this way, giving a 'gain in QALYs' benefit

QALYs

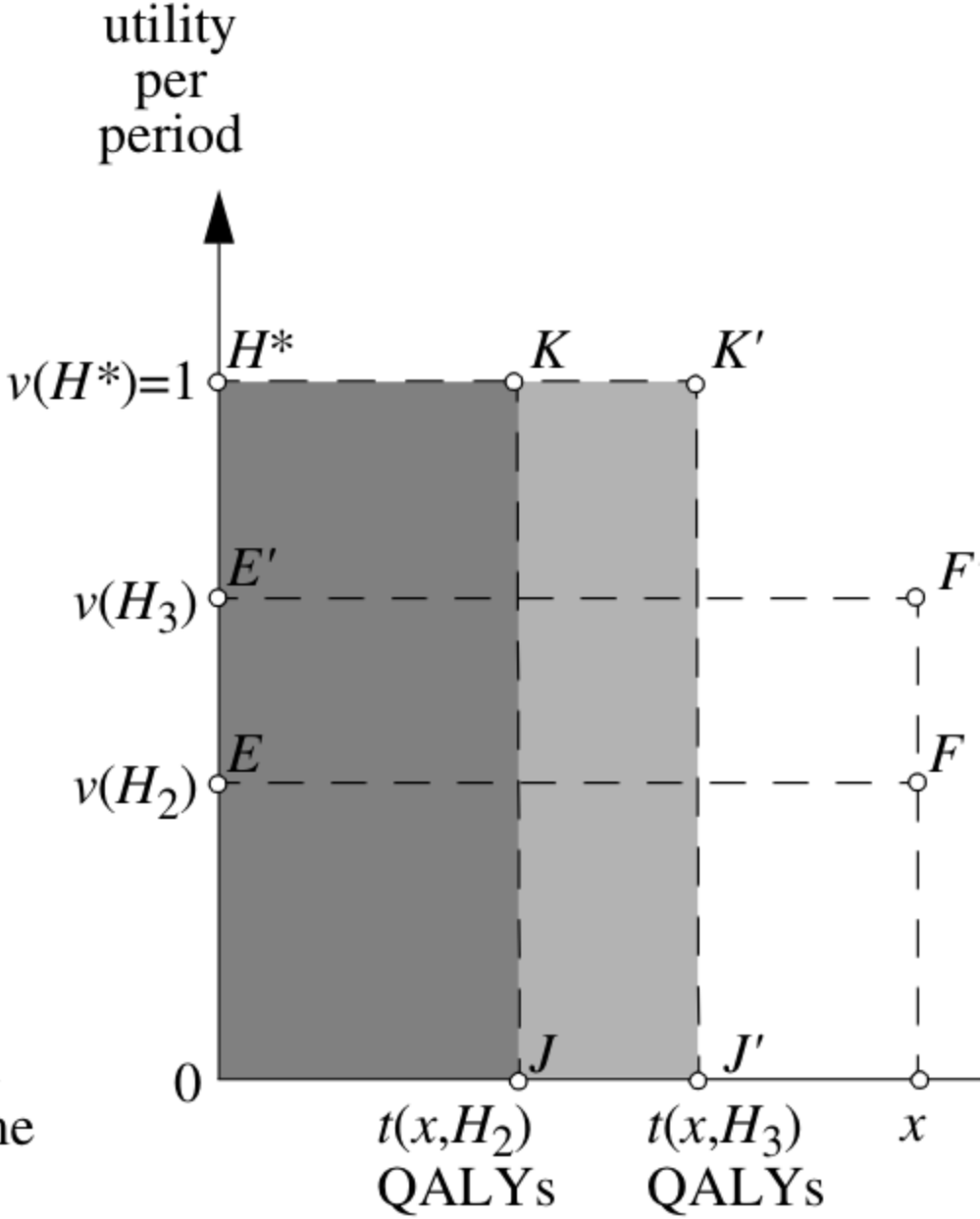
- Enables comparisons of changes in quality of life with changes in length of life
- Example 1
  - Increase in length of life (*x* years) but at health state H_1
    - Utility :
      (utility of state H_1=*v*(H_1))x(*x* years)
    - Respective years in perfect health:
      (utility of perfect health(*v*(H*)=1))x(*y* years)
    - y obtained by algebraic manipulation:
      v(H_1)x(*x*)=*v*(H*)x(*y*)=*y*
      and *y*<*x*

QALYs

- Example 2
  - Change in health state (H_2 to H_3) for *x* years
    - Comparisons of two health state is possible
    - Same technique as Example 1 - Convert each health state into years of perfect health
    - Difference between the *y*'s give gains in years of perfect health = change in utility of going from H_2 to H_3 for *x* years



a.Converting years into QALYs



b.Converting a health status

QALYs and the EQ-5D

- Area under the curve (assumes linear progression)
  - Year 1= (U0+U1)/2= (0.238+0.748)/2=0.493 QALYs
  - Year 2= (U1+U2)/2= (0.748+0.814)/2=0.781 QALYs
  - Year 3= (U2+U3)/2= (0.814+0.843)/2=0.8285 QALYs
  - Sum=2.1025 QALYs (note this is smaller than 3 years)
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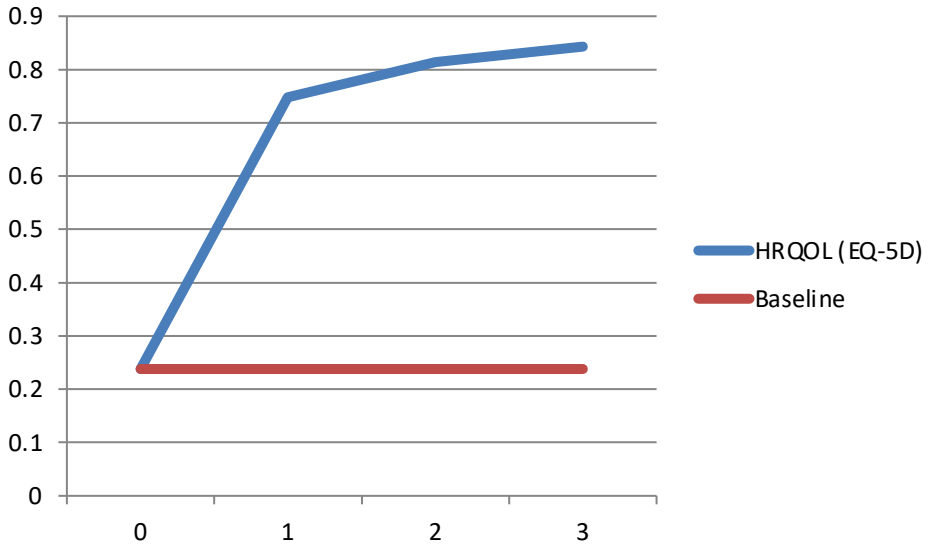

QALYs and the EQ-5D

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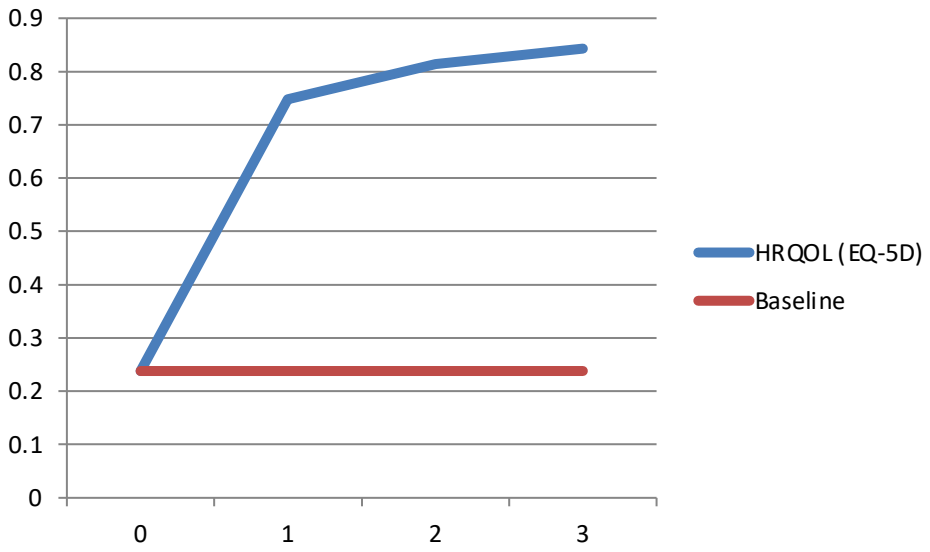


Alternative utility weights

- Rating scales
- Visual Analogue Scales
- Standard Gamble
- Time Trade-Off

Alternative utility weights

- Rating scales
  - Scale in which individuals assign a rating for a health state
- Visual Analogue Scales
  - Single line with descriptions
- Standard Gamble
- Time Trade-Off

Alternative utility weights

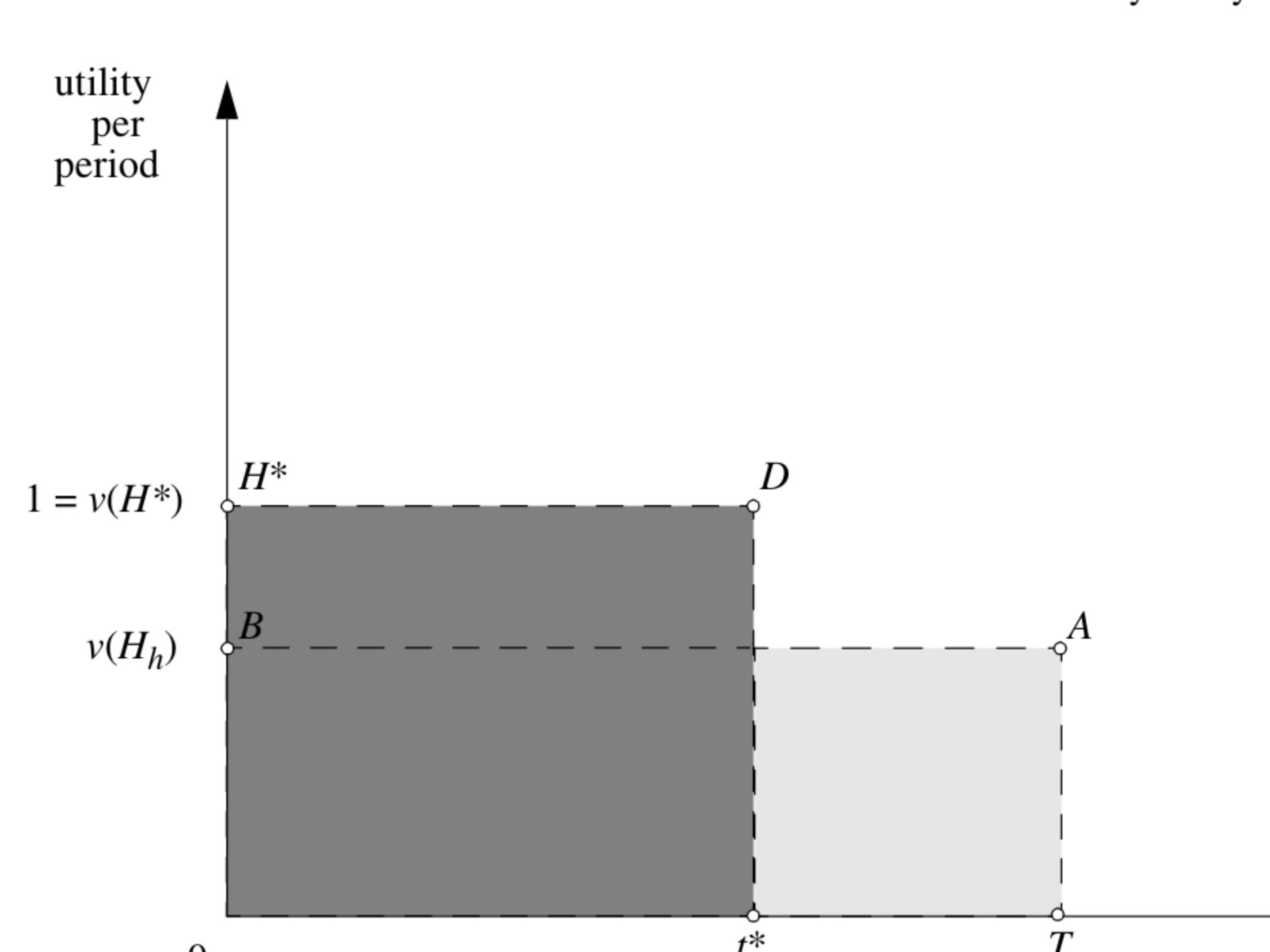
- Rating scales
- Visual Analogue Scales
- Standard Gamble
  - Probabilities assigned to health states
  - "Imagine you had a disease leaving you in health state H_h without treatment. The only treatment is free but would cure you with probability π or lead to death with probability (1- π)"
  - π varies until individual is indifferent between treatment and no treatment
- Time Trade-Off

Alternative utility weights

- Rating scales
- Visual Analogue Scales
- Standard Gamble
  - Value H_h at T= $v(H_h)T$
  - With treatment:
    $(1- \pi^*)xv(death)xt(death) +$
    $\pi^*xv(perfect\ health)xt(perfect\ health)$
    $= \pi^*xT$
  - $v_{sg}(H_h)=(\pi^*xT)/T= \pi^*$
  - Utility weight of H_h is π^*
  - Also routed in expected utility
  - Compatible with risk attitudes (the T cancels)
- Time Trade-Off

Alternative utility weights

- Rating scales
- Visual Analogue Scales
- Standard Gamble
- Time Trade-Off
  - Iterative procedure to determine indifference in health states
  - Individuals asked whether they would have treatment or not in hypothetical situations:
  - "Imagine you have a condition that results in health state H_h for T years if untreated. A treatment is available for free that cures you but shortens your life to t years"
  - Once individual is indifferent we obtain t
  - Trade off of quality of life for length of life


utility
per
period
$1 = v(H^*)$
$v(H_h)$
H^*
D
B
A
0
t^*
T

Alternative utility weights

- Rating scales
- Visual Analogue Scales
- Standard Gamble
- Time Trade-Off
  - Utility weight for health state H_h is: $v_{tto}(H_h)=t^*(T,H_h)/T$
  - Uses expected valuations of life and hence expected utility theory
  - Unbiased if individuals are risk-neutral to remaining life
    - If risk-averse, then the trade-off would be a downward biased estimator of the true utility weight

Viewpoints

Viewpoints

- The viewpoint is an extremely important factor in determining what benefits and costs to measure
  - Taking an NHS perspective, for example, may lead to shifting costs elsewhere (unemployment benefit? Pensions?)
- From a welfare perspective it can be argued that the societal perspective should be taken. In CEA and CUA however, we may get different viewpoints for the numerator and denominator

Measuring costs

- Drummond et al (2005) advocate a societal perspective since this is the broadest viewpoint and is always relevant
- Gerard and Mooney (1993) however, argue that if we are maximising budgets, only costs relevant to the budget should be noted
- Whilst a societal perspective is welfare maximising, it may not maximise NHS budgets
- But does this mean therefore that we should not evaluate future costs because they form future budget levels?

Measuring benefits

- Although costs tend to be taken at the provider level benefits are typically at a societal level
- Weights used to transform QOL indicators into QALYs are usually taken from social values rather than those of patients
- Why might they differ?
  - Individual in treatment v general public may value health states differently and have alternative preferences
  - Individual may not incorporate spill-over effects in their valuations
- Bodies such as NICE have guidelines on the perspective to take

Estimating costs

- The perspective is important when determining costs
- Societal costs of an intervention will differ from a health care sectors costs
- Need to
  1. Identify changes in resource use
  2. Quantify those changes
  3. Value them
- Rely on several constraints, most notably, data
  - Average costs may only be available (assumes providers are efficient and changes in quantity do not affect price!)
  - Shadow pricing may be imperfect (values on leisure time, caring)
- Transparency and sensitivity analysis is key!

Discounting

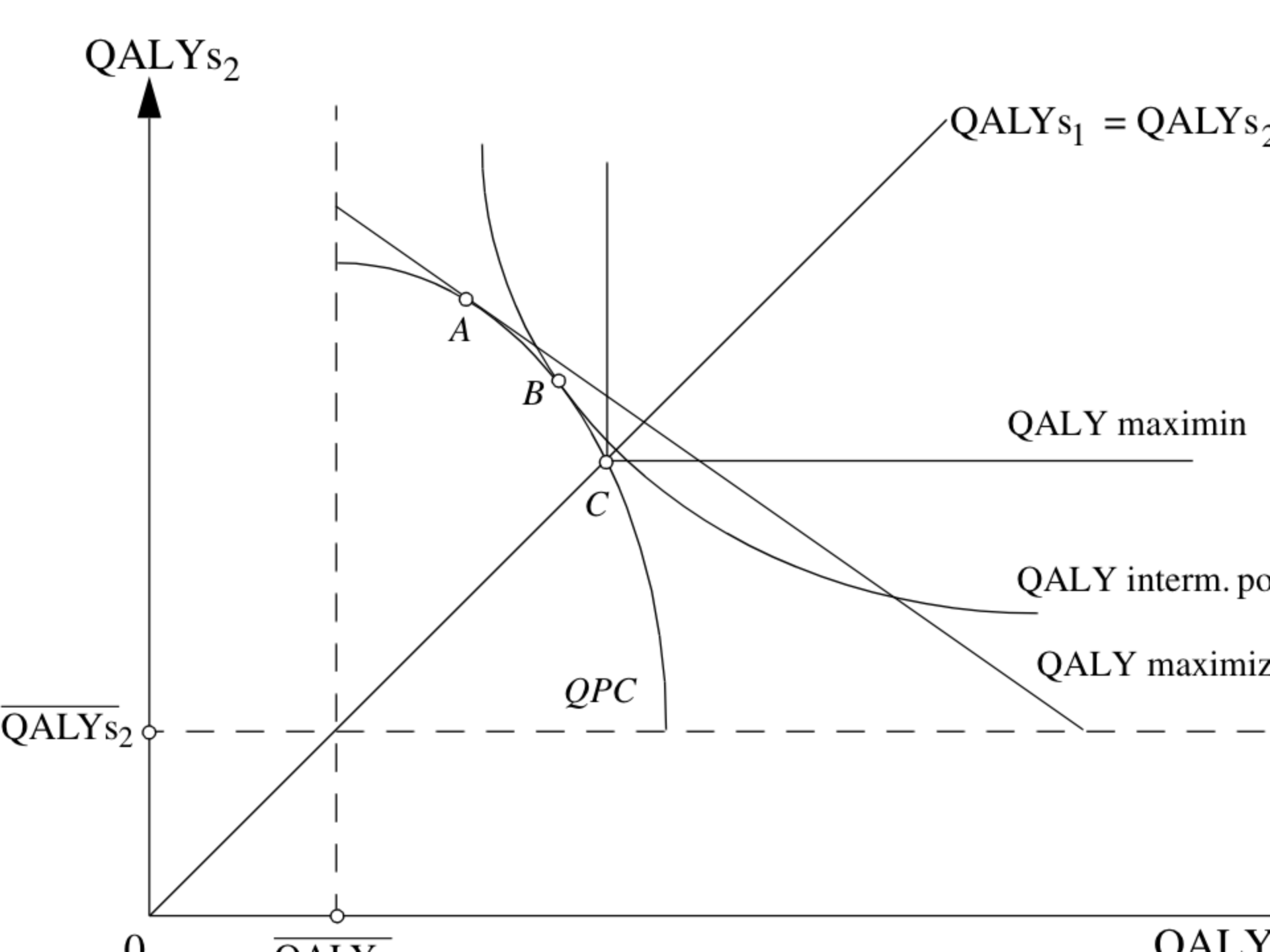
- Some times benefits and costs are far in the future
- Discounting accounts for time preferences
  - Gives less weight for future events
  - Provides a present value (PV) of the intervention
  - $PV=FV(1/(1+r)^t)$
  - Current HM Treasury (2003) rate for *r* is 3.5%
- Positive time preferences are standard, people prefer now to the future
- For comparison with private investments, we need to make sure alternatives are comparable else we overstate returns in public investment

Discounting

- What about benefits?
- Not discounting benefits overstates the effectiveness of an intervention and favours interventions with longer running benefit streams
- NICE recommend discounting benefits at 3.5% (previously 1.5%)
- Contentious on the grounds of health being a tradable good, individuals cannot trade health now for later like they can do money

Equity revisited

- Recall the social maximisation issue – what viewpoint do we take?
- CUA is essentially a welfarist approach, adopting individual level valuations of health interventions (note the importance of where the utility weights come from here)
- Maximisation of QALYs has no factor for equity – who gets what?
- Treating like for like may result in a less socially optimal outcome if society values equity (see welfarism slides)


QALYs2
QALYs1 = QALYs2
A
B
C
QALY maximin
QALY interm. po
QALY maximiz
QPC
QALYs2
0
QALY

Which to use?

- Neither CBA, CEA or CUA consider distribution concerns
  - Particular concern for policy makers concerned with equity
- CUA/CEA can ONLY identify if an intervention should go ahead if there is a pre-determined threshold
  - How is the threshold chosen?
- CEA is an extra-welfarist approach – only health related utility is captured, while CBA (and CUA) relies on wider (subjective) utility (welfarist)
- CBA relies on assigning a monetary value to utility

Summary

- There are three broad approaches to determining what should be provided with health care budgets (CEA, CUA, CBA)
- Each have respective benefits and drawbacks
- Each require information from individuals which may be open to bias
- Each require normative judgements on the decision of what should be valued
- Viewpoint is crucial for estimation of costs and benefits
- Equity concerns are a key problem with evaluations