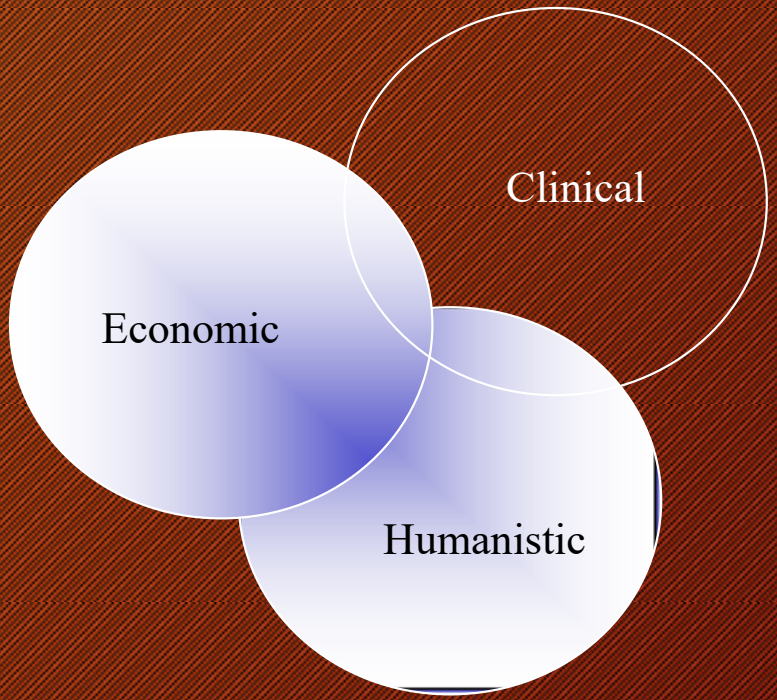
Cost Utility Analysis

Cost-Utility Analysis

- Cost-utility analysis (CUA) is a method for comparing treatment alternatives that integrates patient preferences and HRQOL.
- CUA can compare cost, quality, and the quantity of patient-years.
- Cost is measured in dollars, and therapeutic outcome is measured in a quality-adjusted life year (QALY) gained.

Cost-Utility Analysis

- Evaluates the value of an intervention or a program against the value of the outcome in terms of quality-adjusted life years (QALYs)



Cost-Utility Analysis

- Resource consumed measured in monetary units
- Health outcomes/consequences adjusted for quality
  - Quality adjusted life year (QALY)
- QALYs based upon utility (patient preference)

Cost-Utility Analysis

Utility – "The value or worth placed on a level of health status, or improvement in health status, as measured by the preferences of individuals or society."

QALY Basics

- For each year, QALYs are measured from 0 to 1 with 0 being death and 1 being perfect health.
- Need to measure Health Related Quality of Life (HRQL).
- HRQL score is a valuation of life lived in a particular health state.

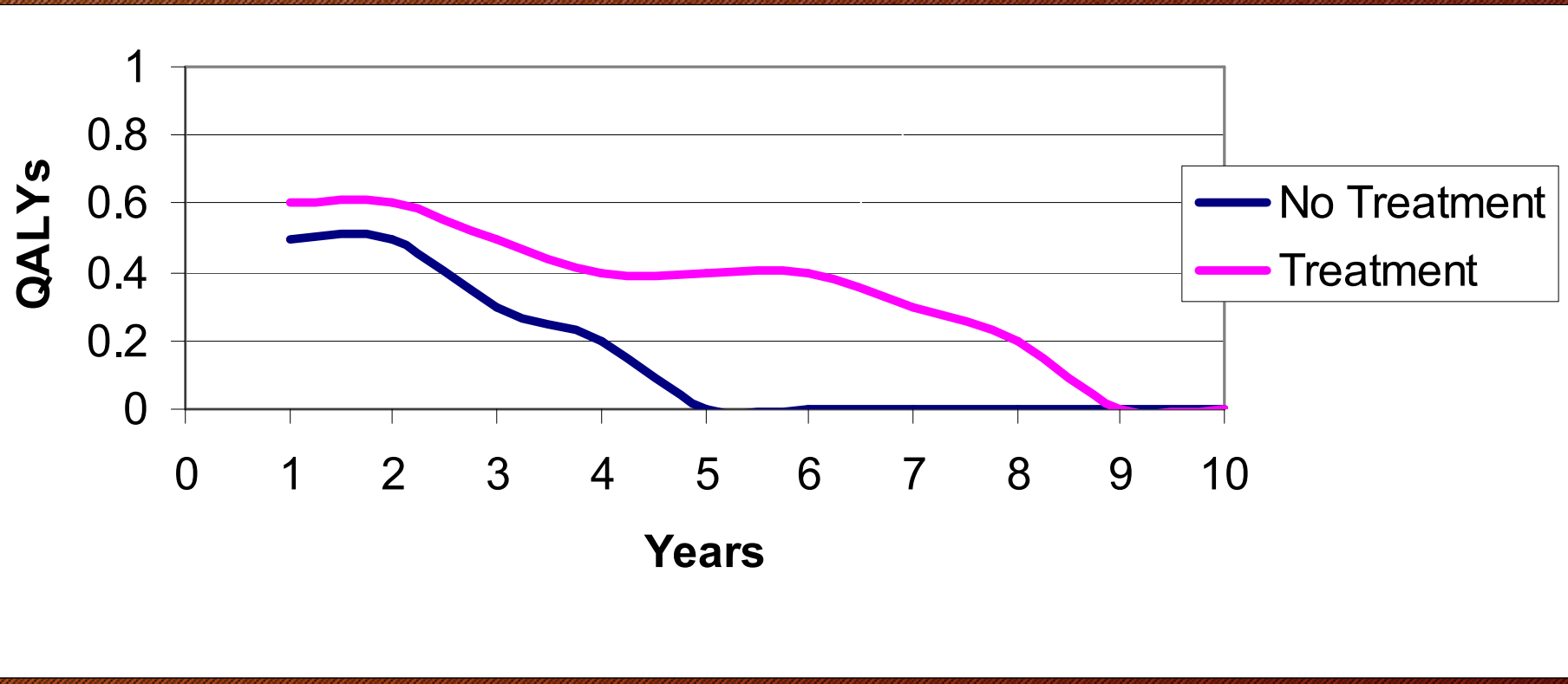
Basics of QALYs

- A simple formula:
- QALY's

= Duration of illness x ($HRQL_{treated}$ - $HRQL_{untreated}$) + (years gained x mean HRQL)

- QALY's are usually measured using survey instruments
- A quick example, a treatment for a condition called Diabetes II
- No treatment -- gradual health decline and die in 5 years
  - Treatment -- reduces the decline and and extends life by 4 years

QALY's



Change in QALY's = 1.9

CE RATIO /QALY's

- Look at the CE ratio using QALYs.
- The CE ratio is a measure of the cost of gaining one QALY. The CE ratio can be simply thought of as:

$$\frac{\text{(Net Cost of Intervention)}}{\text{QALYs}}$$

Comparing More than One Intervention

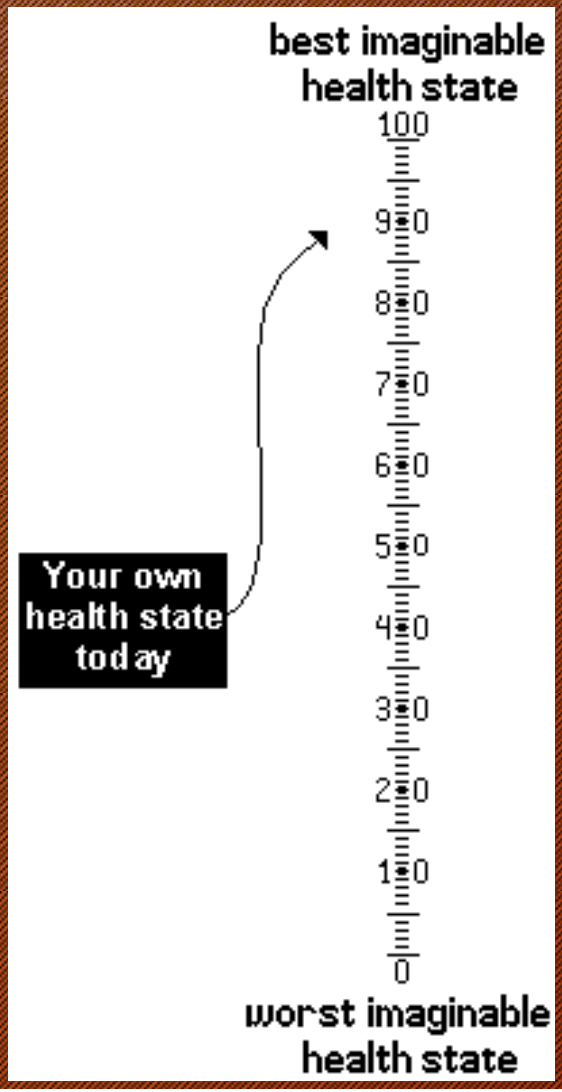
- Incremental cost-effectiveness is the differences in costs between two interventions divided by the differences in QALYs

$$\frac{\text{Total Cost Intervention 1} - \text{Total Cost Intervention 2}}{\text{QALY's, Intervention 1} - \text{QALY's, Intervention 2}}$$

Quality Adjusted Life Years (QALY)

- Quality of life index
  - 1.0 = normal health
  - 0.0 = death (extremely bad health)
- Example
  - Losing sense of sight
  - Quality of life index is 0.5
  - Life = 80 years
  - 0.5 x 80 = 40 QALYs
- Most debate about the QoL estimates

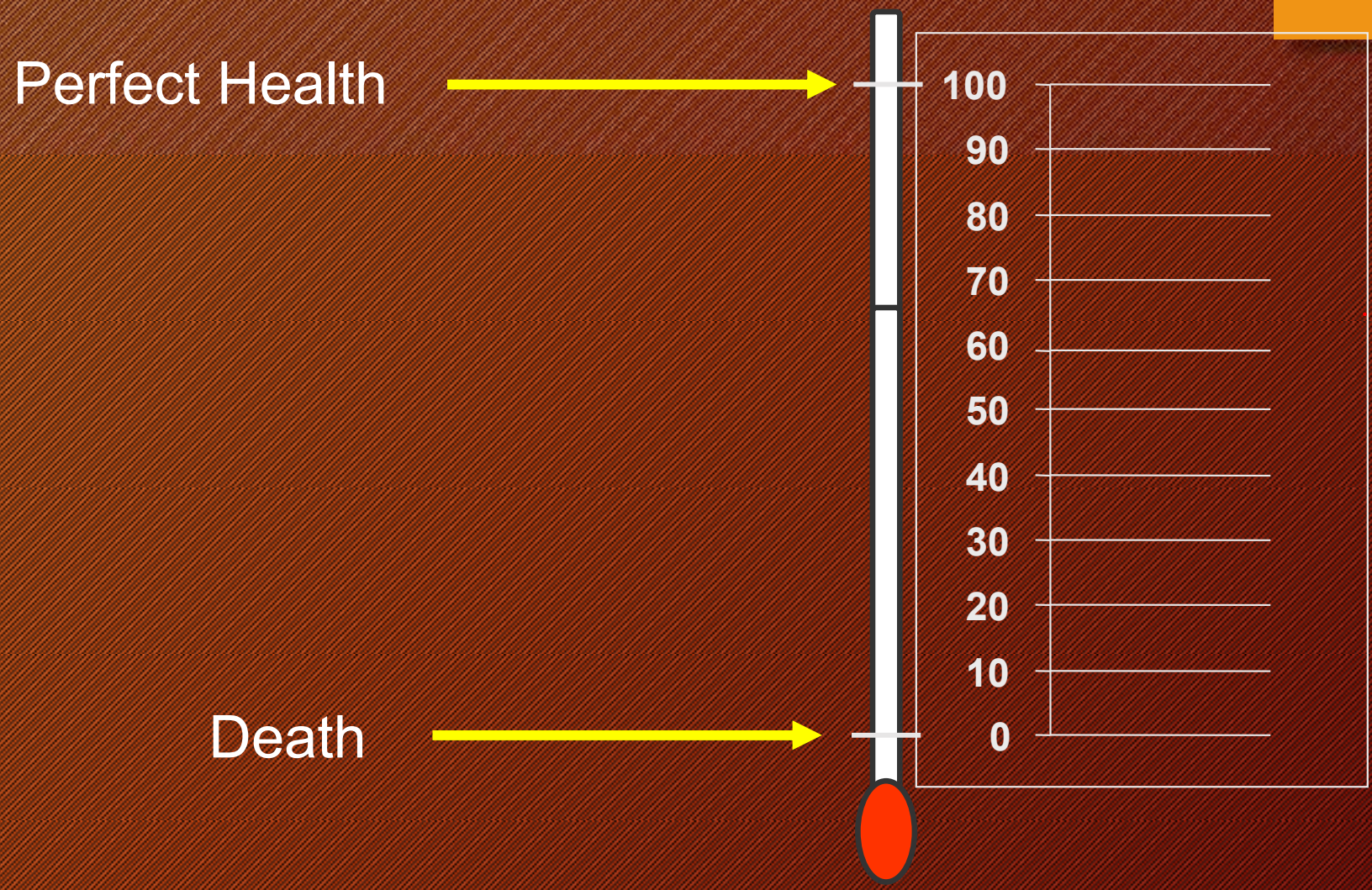
EuroQol EQ-5D: of the shelf QALY value



- 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

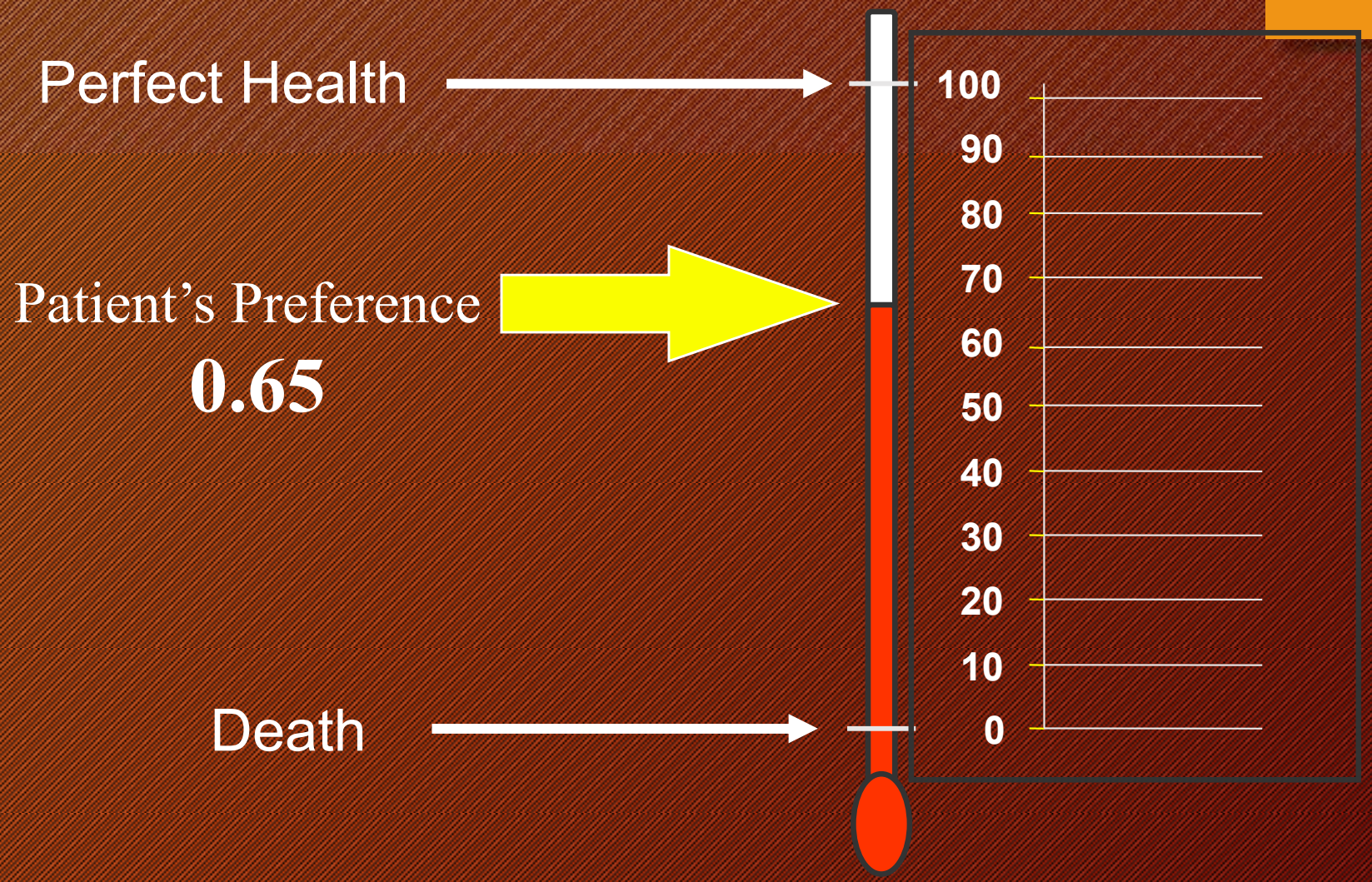
Rating Scale

Feeling Thermometer



Rating Scale

Feeling Thermometer



Measurement of Utility

- Count life years
- Value (V) quality of life (Q)
  - *V(Q) = [0..1]*
    - 1 = Healthy
    - 0 = Dead
- Adjusted life years (Y) for value quality of life
  - QALY = Y * V(Q)
    - Y: numbers of life years
    - Q: health state
    - V(Q): the quality of life value of health state Q

QALY league table

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

Disability Adjusted Life Years (DALYs)

- DALYs for a disease are the sum of the years of life lost due to premature mortality (YLL) in the population and the years lost due to disability (YLD) for incident cases of the health condition. One DALY represents the loss of one year of equivalent full health.

Disability Adjusted Life Years (DALYs)

- Measures healthy time lost from specific diseases and injuries in a population
- Comparable and additive across diseases

  Ex: Broken scapula = .5 DALYs lost

  Protein deficiency = 2 DALYs lost
- Based on relatively accessible incidence data (ICD codes)

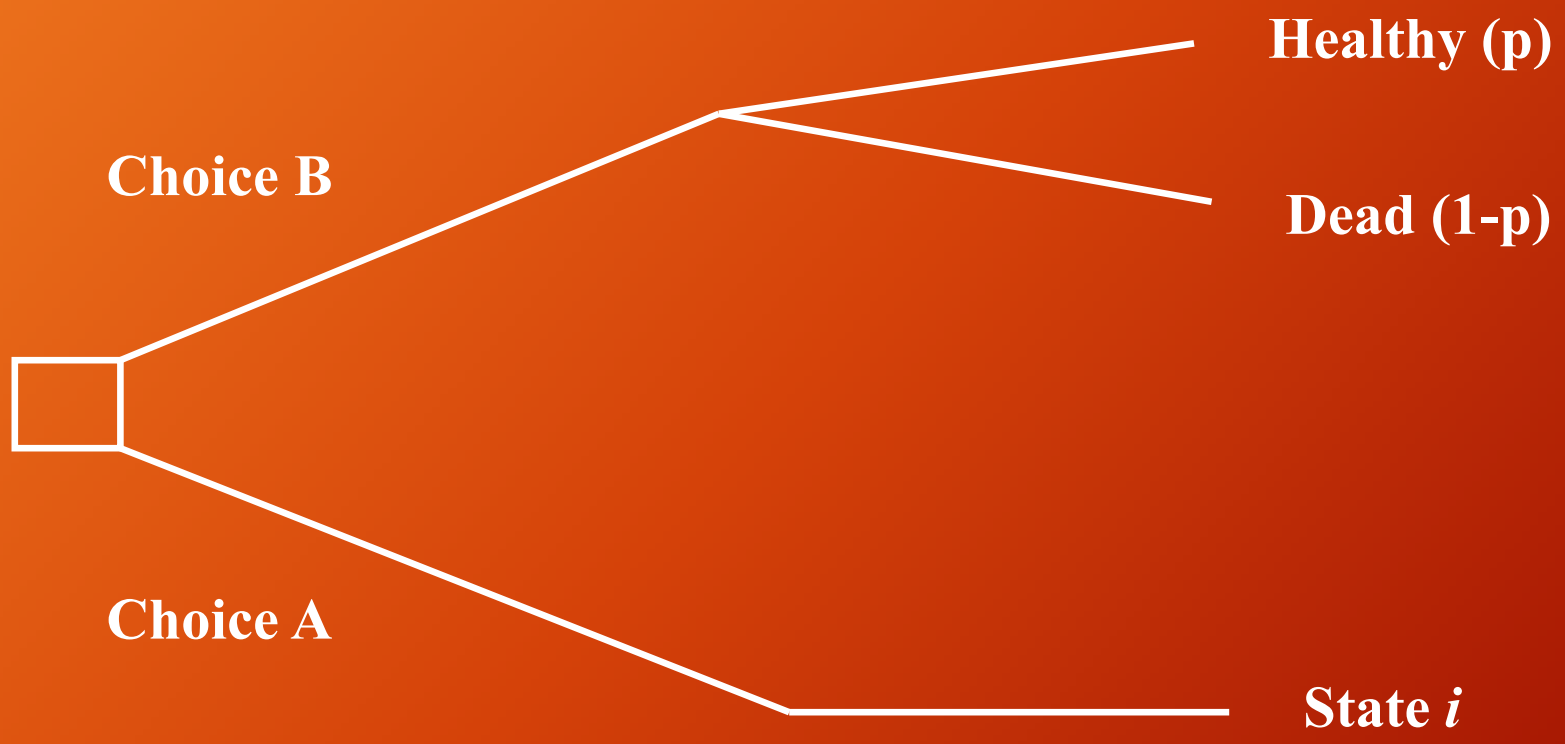
Other Measures of Benefits of Intervention

- General class of measures is called: Health Adjusted Life Years (HALYs)
- Disability Adjusted Life Years (DALYs)
  - = Years of lost life + years lost to disability
  - DALYs differ from QALYs
- Healthy Years Equivalents (HYE)
  - Number of years in optimal health that would produce the same level of utility for an individual as produced by a lifetime health profile of the intervention
- Only QALYs should be used in reference case analysis (Gold, et al. 1996)

The Standard Gamble

- "True" utility instrument
- Requires choices between alternatives under conditions of uncertainty
- Respondents asked to select one of the two alternatives
- Captures the subject's risk attitude

The Standard Gamble

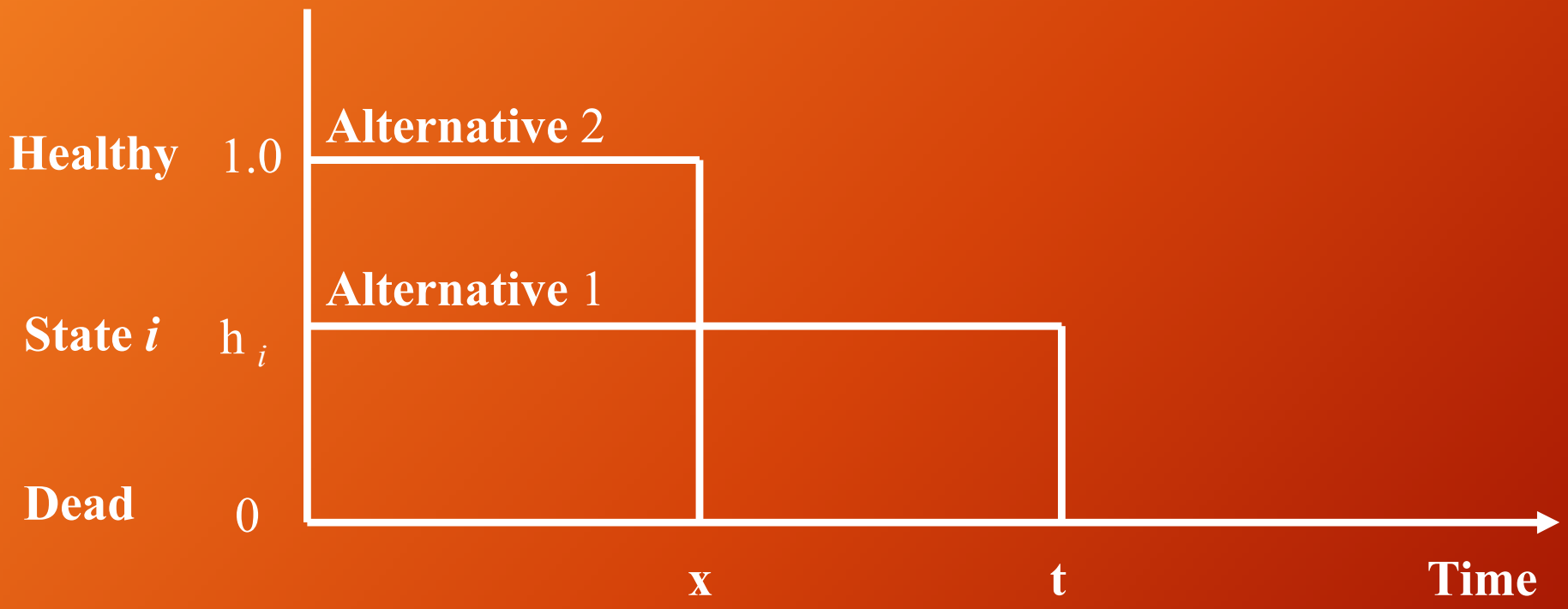


Standard gamble for a chronic health state. *i* = chronic health state; p = probability of achieving perfect health

Time-Trade Off

- Utility measure developed specifically for health care
- Involves respondents selecting between known choices (no uncertainty)
- Scale is anchored by death and perfect health
- Not a true utility instrument

Time-Trade Off



Time trade-off for a chronic health state. $h_i = x/t$, where h_i = preference value for state *i*; state *i* = chronic health state; t = life expectancy for an individual with chronic health state *i*; and x = time at which respondent is indifferent between alternatives 1 and 2.

Torrance *et al.* (1972)

Economic Analysis of Two Alternative Treatment Interventions

Intervention	(Cost) ($)	Effectiveness (Life Expectancy) (y)	Health State (Utility)	QALYS
Treatment A	20,000	4.5	0.60	2.7
Treatment B	10,000	3.5	0.72	2.5

$$\text{Incremental cost-effectiveness ratio} = \frac{\$20{,}000 - \$10{,}000}{4.5 - 3.5} = \$10{,}000/\text{life-year gained}$$

$$\text{Incremental cost-utility ratio} = \frac{\$20{,}000 - \$10{,}000}{2.7\,QALYs - 2.5\,QALYs} = \$50{,}000 \text{ per QALY gained}$$

Cost-Utility Analysis

- Example: Incremental CU ratio

$$= \frac{\text{Cost drug A - Cost drug B}}{\text{QALY drug A - QALY drug B}}$$

$$= \frac{\$20{,}000 - \$16{,}000}{2.6 \text{ QALYs} - 2.0 \text{ QALYs}}$$

$$= \$6{,}400 \ / \ \text{QALY}$$

Cost-Utility Analysis

- Criteria for Interpreting Cost-utility Ratios

Average CU Ratio	Interpretation
Less than $20,000/QALY	Good value
$20,000 to $100,000/QALY	Intermediate value
More then $100,000/QALY	Cost prohibitive

CUA Example (cont.)

- Assume Life Expectancy=50
- Utility with mumps=0.8
- What's the outcome measure ?
  - QALY
- That is, 10 years with mumps infection= 8 years in good health

CUA Example (cont.)

- Calculate ICER
  - ICER for vaccine A (vs. do nothing)

    $\Delta C=5000$

    $\Delta E=$(quality adjusted life years saved from death avoided)+(QALY saved from mumps avoided) $=(2*50)+(50)*(50-30)*0.8=900$

    - Therefore,

    ICER (A) = \$5000/900 = \$5.55 (per QALY saved)

CUA Example (cont.)

- Calculate ICER (cont.)
  - ICER for vaccine B (vs. do nothing)

    $\Delta C=8750$

    ΔE=(quality adjusted life years saved from death avoided)+(QALY saved from mumps avoided) =(3*50)+(50-5)*0.8*50=1950

    - Therefore,

    ICER (B) = \$8750/1950 = \$4.48 (per QALY saved)
- ICER(A)=\$5.55 > ICER(B)=\$4.48