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Section C: Quality Adjusted Life Years

Richard H. Morrow, MD, MPH
Quality Adjusted Life Years (QALYs)

- Introduced in 1976
- A measure of health status
- Originally developed as a differentiating indicator for individual choices (not to measure burden of disease in populations)
## Comparisons of SMPH

<table>
<thead>
<tr>
<th></th>
<th>Healthy Life Years</th>
<th>Disability Adjusted Life Years</th>
<th>Quality Adjusted Life Years</th>
<th>Health Adjusted Life Expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose</strong></td>
<td>Assist in resource allocation decisions</td>
<td>Compare disease burdens in many different populations on a comparable basis</td>
<td>Assess individual preferences for various outcomes from complex interventions</td>
<td>Compare national disease burdens</td>
</tr>
<tr>
<td><strong>Level of use</strong></td>
<td>National- and district-level decisions</td>
<td>Broad policy decisions</td>
<td>Personal decisions</td>
<td>Global comparisons</td>
</tr>
<tr>
<td><strong>Data</strong></td>
<td>▪ National and local data from multiple sources ▪ Expert review</td>
<td>Global data and expert opinion</td>
<td>Tertiary hospital data and personal interviews</td>
<td>Global data and expert opinion</td>
</tr>
<tr>
<td><strong>Discipline base</strong></td>
<td>Epidemiologists/clinicians/national planners</td>
<td>Economists/statisticians</td>
<td>Economists/clinicians</td>
<td>Demographer/economists/statisticians</td>
</tr>
<tr>
<td><strong>Social values incorporated</strong></td>
<td>Future life discounted</td>
<td>▪ Age weighting ▪ Future life discounted</td>
<td>Generally not included</td>
<td>Not relevant</td>
</tr>
</tbody>
</table>
Guided by the principle of selecting among alternate health interventions that result in different outcomes based on how an “informed” individual will choose

An assessment of individual preferences for different health outcomes from alternate interventions
Quality Adjusted Life Years (QALYs)

- Central notion behind QALYs is the realization that a year spent in one health state may be preferred over a year spent in another health state.

- Comparing time spent in a health state with the value given to that state.

- QALYs have been used under the assumption of maximizing utility—based on utilitarian theories of individual choices.
**QALYs—Quality Adjusted Life Years**

- Definition: a single health state measure combining quantity and quality of life

- A generic measure that sums time spent in different health states using weights on a scale of 0 (dead) to 1 (perfectly healthy) for each health state—the arithmetic product of *duration of life* and a measure of *quality of the remaining life years* (health state weight)

- So, five years of perfect health = 5 QALYs; two years in a state measured as 0.5 of perfect health followed by three years of perfect health = 4 QALYs
Quality Adjusted Life Year

- Measure that combines quality and quantity of life into a single metric

- Scaled from 0 to 1
  - 0 = death
  - 1 = perfect health
  - Many scales allow scores below zero

- Graph and measure “area under the curve” (see next slide)
QALY Graph

Health utility

Years

0

1
QALYs Gained

Quality-Adjusted Life Years (QALYs) Gained from an Intervention

- Health-related quality of life (weights)
- Duration (years)
- With program
- Without program

| 1. Time trade-off | Subject asked to choose between two alternatives  
|                  | ▪ Perfect health for \((n)\) years  
|                  | ▪ Less than perfect health for a longer time period |
## Methods of Weighting (States of Illness)

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Time trade-off</td>
<td>Subject asked to choose between two alternatives</td>
</tr>
<tr>
<td></td>
<td>- Perfect health for ( n ) years</td>
</tr>
<tr>
<td></td>
<td>- Less than perfect health for a longer time period</td>
</tr>
<tr>
<td>2. Standard gamble</td>
<td>Subject asked to choose between two alternatives</td>
</tr>
<tr>
<td></td>
<td>- Imperfect health</td>
</tr>
<tr>
<td></td>
<td>- A gamble between death with probability ( P ) and</td>
</tr>
<tr>
<td></td>
<td>perfect health with probability ( 1-P ); ( P ) varied until</td>
</tr>
<tr>
<td></td>
<td>the subject is indifferent between the two alternatives</td>
</tr>
<tr>
<td>Method</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 1. Time trade-off           | Subject asked to choose between two alternatives  
  - Perfect health for (n) years  
  - Less than perfect health for a longer time period                                                                                     |
| 2. Standard gamble          | Subject asked to choose between two alternatives  
  - Imperfect health  
  - A gamble between death with probability (P) and perfect health with probability (1-P); (P) varied until the subject is indifferent between the two alternatives |
| 3. Rating scales            | Subject asked to rank and attribute values between 0 & 1 to a series of states of health, e.g., Rosser index—a ratio scaling method         |
# Methods of Weighting (States of Illness)

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<p>| 3. Rating scales     | Subject asked to rank and attribute values between 0 &amp; 1 to a series of states of health, e.g., Rosser index—a ratio scaling method                                                                         |
| 4. Person trade-off  | Indifferent between, say, curing three people in state B and one in state A                                                                                                                                   |</p>
<table>
<thead>
<tr>
<th>Domain</th>
<th>EQ-5D</th>
<th>SIP</th>
<th>SF-35</th>
<th>6D5L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-care</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usual activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain, discomfort</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety, depression</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Different Health States

Best possible health state

Death

Worst possible health state

1

+ 0 -
The most famous application of the QALY method occurred in the state of Oregon.

The Oregon plan used the QALY approach to develop 709 condition-treatment (CT) pairs—a fairly comprehensive set of all possible interventions—for those receiving Medicaid.
Oregon Health Plan: Setting Health Care Priorities

- Origins of the Oregon health plan for setting health care priorities
  - Political strategy for health plan: who, what covered, and how paid
  - 1987-1989, John Fitzhaber and Neil Goldschmidt
- Principles
  - Universal access to care
  - Society responsible for financing poor
  - Process for defining basic level of care
  - Process for publicly debated criteria based on consensus of social values and society as a whole
  - Health care just one factor in health and must show balance with other programs
  - Funding explicit and sustainable
  - Accountability
Ranked health care services provided by Medicaid of all conditions

Condition–treatment pairs arranged on a cost-benefit basis using QALYs and ranked on four factors

1. Cost
2. Estimates of effects (QALYs) of service made by panels of MDs (more than 50)
3. Duration of benefits (QALYs)
4. Citizens views on seriousness of symptoms/functional limitations by telephone polls and many many community hearings and meetings

Many many problems and uproars

- The first list ranked treatment of dental diseases higher than appendectomy!
- Special issues with federal Medicaid and the Americans with Disabilities Act
- Complex history over the next few years
- QALYs were dropped by decisions made by citizens groups
Advantages of QALYs

- If large studies using quality of life measuring tools/instruments are used, e.g., EQ-5D, leads to good validity and reliability
- Single measure combining quality and quantity measures
- Used in cost utility analysis—which allows comparison between interventions which nominally differ in terms of outcomes
Disadvantages of QALYs

- Individual, not population based
- Scoring based on hypothetical questions
- Difficult to understand consequences when healthy
- Calculation is dependent on who asked—patient, doctor, general population
- Calculation dependent on how asked, i.e., which method
QALY League Tables

- Procedure aimed at determining priorities in health care

- QALY league table ranks different interventions according to “cost per QALY”

- Essential that scope and perspective of comparisons are identical or virtually so

- As with all cost-effectiveness analyses—always comparative and always inclusive of all possible alternatives
## CE League Table of Recent Studies

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Setting</th>
<th>$ per dose</th>
<th>$ per DALY averted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hib</td>
<td>Indonesia</td>
<td>$3.60 &amp; $3.00</td>
<td>$47 or $62 (2006 US$)</td>
</tr>
<tr>
<td>(Gessner et al., forthcoming)</td>
<td></td>
<td>3 doses</td>
<td></td>
</tr>
<tr>
<td>Pediatric dengue</td>
<td>SE Asia</td>
<td>$0.50 &amp; $10</td>
<td>$50 (2001 US$ ?)</td>
</tr>
<tr>
<td>(Shepard et al., 2004)</td>
<td></td>
<td>2 doses</td>
<td></td>
</tr>
<tr>
<td>Live attenuated JE</td>
<td>Andhra Pradesh, India</td>
<td>$1.00</td>
<td>$58 or $76 (2000 US$)</td>
</tr>
<tr>
<td>(Suraratdecha et al., 2006)</td>
<td></td>
<td>1 dose</td>
<td></td>
</tr>
<tr>
<td>Pneumococcal conjugate</td>
<td>72 GAVI-eligible countries</td>
<td>$5.00</td>
<td>$100 ($57-185 95% CI)</td>
</tr>
<tr>
<td>(Sinha et al., 2007)</td>
<td></td>
<td>3 doses</td>
<td>(2000 IUS$)</td>
</tr>
<tr>
<td>Rotavirus</td>
<td>Asia (low- and middle-</td>
<td>$5.00</td>
<td>$105 &amp; $201 (2002 US$)</td>
</tr>
<tr>
<td>(Podewils et al., 2005)</td>
<td>income countries)</td>
<td>2 doses</td>
<td></td>
</tr>
</tbody>
</table>

Source: Damian Walker.
Benefits and Costs of 47 Health Interventions

Cost per intervention or per intervention-year (dollars, log scale)

Greater effectiveness

Lower cost

Post Script

- DALYs compared to QALYs
Comparison of QALYs and DALYs

- DALYs = YLL (years of life lost due to death before expectation of life had the disease not occurred) + YLD (years lived with disability * disability weight)

- QALYs = YLDs when ...
  1. Age weighting is not applied to YLDs \textit{and}
  2. Disability weights are the same \textit{and}
  3. Discount rates are the same

- QALYs do not normally count YLL, that is, the remaining life expected at time of death had the disease not occurred, and normally do not discount for future life
Quality-Adjusted Life Years (QALYs) Gained from an Intervention