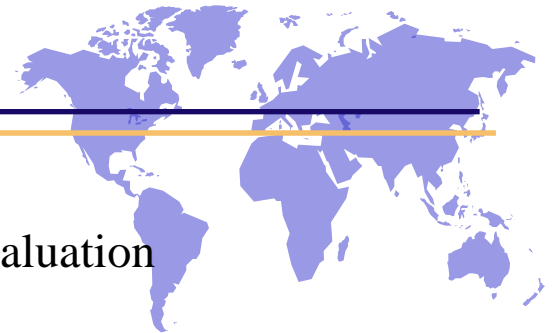Augsburg, October 16, 2010

HRQoL Index Instruments

Some Prerequisites
for Their Appropriate Use in Economic Evaluation

Michael Schlander
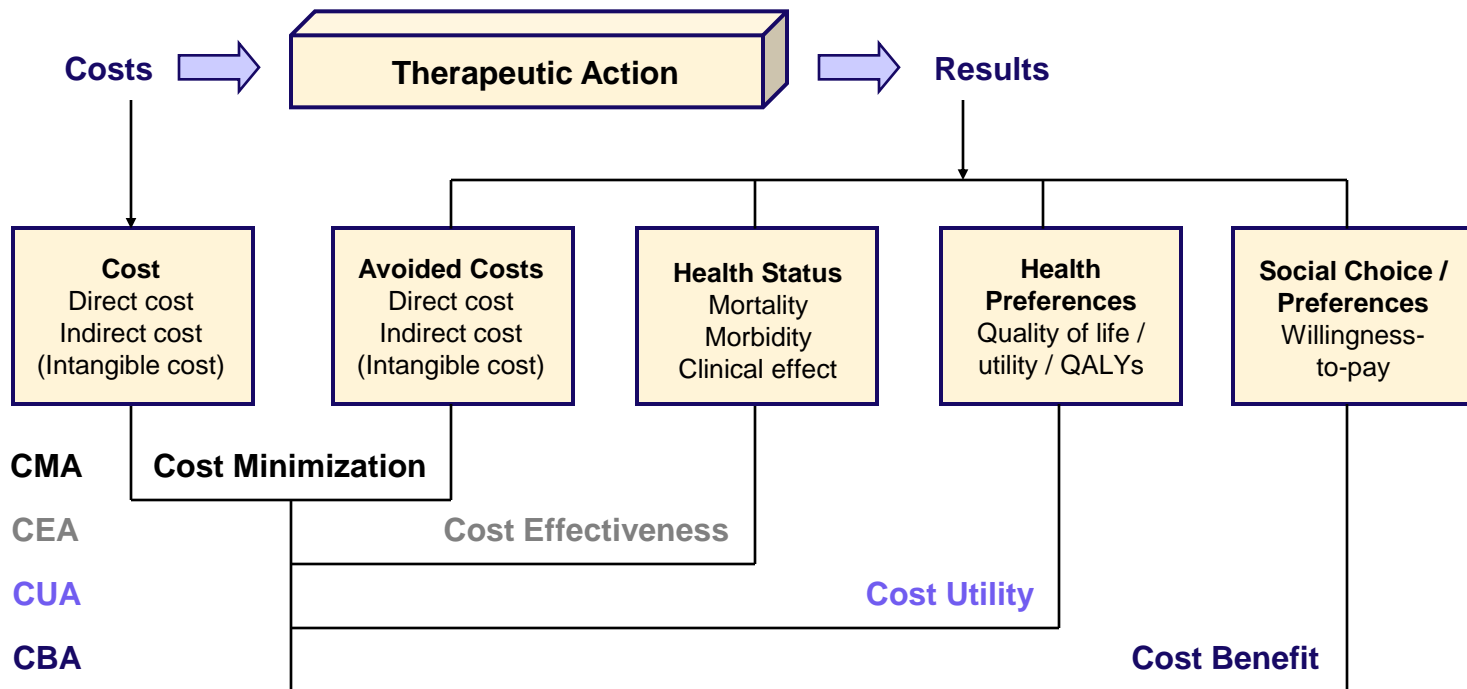**with Munir A. Khan, John McKie, and Jeffrey Richardson**

Institute for Innovation & Valuation in Health Care (INNOVAL^{HC})

IV

Economic Analysis

**A comparative analysis of alternative courses of action
in terms of their costs and consequences**

Costs ⟹ **Therapeutic Action** ⟹ Results

Cost Direct cost Indirect cost (Intangible cost)	**Avoided Costs** Direct cost Indirect cost (Intangible cost)	**Health Status** Mortality Morbidity Clinical effect	**Health Preferences** Quality of life / utility / QALYs	**Social Choice / Preferences** Willingness- to-pay

CMA   Cost Minimization

CEA   Cost Effectiveness

CUA   Cost Utility

CBA   Cost Benefit

"Putting the 'Q' Into the QALY"

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HRQoL Index Instruments

IV

A formal treatment

Evaluation Types (1)[1]

CBA

$$B_1 > C_1$$

B, benefit
C, (opportunity) cost

$$P_1 \bullet E_1 > C_1$$

P, price (valuation) of effect
E, effect

$$\frac{P_1 \bullet E_1}{C_1} > 1$$

$$\frac{P_1 \bullet E_1}{C_1} > \frac{P_2 \bullet E_2}{C_2}$$

Alternative formulation,
introducing a **budget constraint**
which limits how much costs can be expended.

CEA

$$\frac{E_1}{C_1} > \frac{E_2}{C_2}$$

Eliminating the pricing of effects, thus **introducing the requirement of $P_1 = P_2$** (which is considered valid in a CEA since one is comparing a common effect E with the two interventions[1]).

Thus, *formally* CEA can be regarded as a special type of CBA under restrictive assumptions: 1. a single effect must be the outcome of interest, and 2. this effect must be exactly the same for both interventions.

[1]From R.J. Brent (2003); note that this formal treatment is greatly simplifying the differences between CBA, CEA, and CUA.

A formal treatment

Evaluation Types (2)[1]

CEA

$$\frac{E_1}{C_1} > \frac{E_2}{C_2}$$

Formally CEA can be regarded as a special type of CBA under restrictive assumptions: 1. a single effect must be the outcome of interest, and 2. this effect must be exactly the same for both interventions.

$$\frac{C_1}{E_1} < \frac{C_2}{E_2}$$

CUA

$$\frac{C_1}{QALY_1} < \frac{C_2}{QALY_2}$$

If we want to compare entirely different effects (as with headache pain relief and the precision of a diagnostic test), and if we do not want to use prices explicitly, then all effects need to be converted into a common unit. This is usually the QALY.

This (CUA) is a restricted version of CEA (and thus of CBA), adding **E = QALY** for each intervention, in addition to **P$_1$ = P$_2$ = P**, with P now relating to the **price of a QALY**.

CMA

$$C_1 < C_2$$

In cost-minimization analysis (CMA), consequences play no part in the evaluation as they are assumed to be identical: E$_1$ = E$_2$.

Note: Unless consequences are identical across interventions, a CMA would not constitute a valid evaluation of these interventions.

[1]From R.J. Brent (2003); note that this formal treatment is greatly simplifying the differences between CBA, CEA, and CUA.

COMPARATIVE HEALTH ECONOMIC EVALUATION

Foundations:
Two prevailing philosophies[1]

Welfare Economics	Decision Support

Welfare Economics

¬ **Seeking (potential) Pareto improvements**

¬ **Focused on efficient allocation of scarce resources[2]**

   ¬ Cost-benefit analysis incorporating the efficiency rationale behind markets

   ¬ Social objective assumed to be to maximize (aggregate) consumer satisfaction ("utility")

   ¬ Grounded in economic welfare theory

   ¬ Strength of preferences expressed by [max.] Willingness to Pay (WTP)[2]

Decision Support

¬ **Decision analysis as a tool to support social objectives**

¬ **In practice,** [usually] **focused on** [aggregated] **health maximization**

   ¬ Can, in principle, accommodate a variety of objectives and perspectives

   ¬ Background in operations research

   ¬ Striving to adopt the perspective of a rational "decision-maker"

   ¬ Distributive concerns representing a research frontier, not actual practice

[1]cf. R.F. Sugden, A. Williams: *The Principles of Practical Cost-Benefit Analysis*. Oxford University Press (1978); cf. also G. Torrance (2006)
[2]Note that, at least in principle, CBA can accommodate the impact of prior distribution (wealth, income; "ability to pay")

"Putting the 'Q' Into the QALY"

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COMPARATIVE ECONOMIC EVALUATION

Foundations:
Economic efficiency
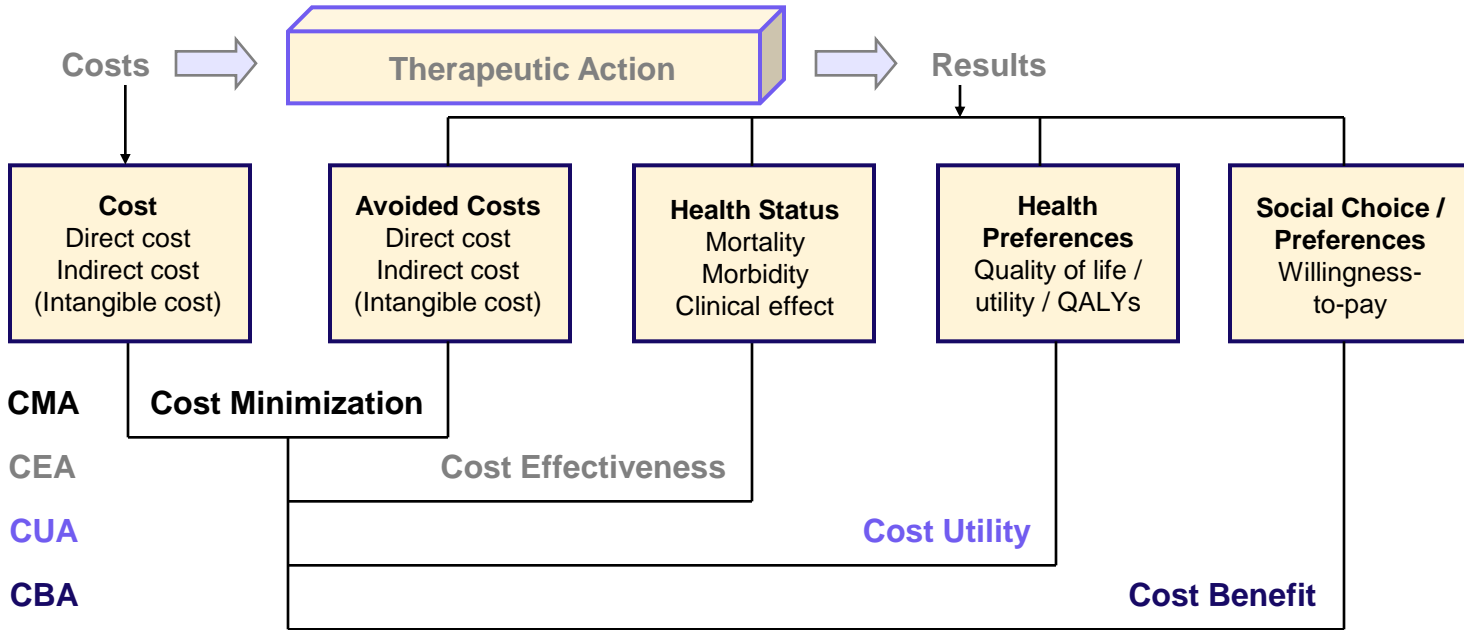
Technical Efficiency	Allocative Efficiency
¬ **Ability to produce the maximum possible output from a given set of inputs**	¬ **Choosing the most cost-effective set of programs for the given level of expenditure** (i.e.,optimal choice of input proportions, given their respective prices)
¬ **Does not routinely imply choosing between different patient (group)s** *– hence individual persons*	¬ **Does imply allocating resources across different patient (group)s** *– hence individual persons*

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Health Economic Evaluation

A comparative analysis of alternative courses of action in terms of their costs and consequences

Costs ⟹ **Therapeutic Action** ⟹ Results

| Cost Direct cost Indirect cost (Intangible cost) | Avoided Costs Direct cost Indirect cost (Intangible cost) | Health Status Mortality Morbidity Clinical effect | Health Preferences Quality of life / utility / QALYs | Social Choice / Preferences Willingness-to-pay |

CMA — Cost Minimization

CEA — Cost Effectiveness

CUA — Cost Utility

CBA — Cost Benefit

Decision Support
"The Logic of Cost-Effectiveness"

Welfare Economics

IV

In particular, two assumptions of economic welfare theory have attracted criticism from a group of health economists (often referred to as "extrawelfarists")

An Extra-Welfarist Critique[5]

1. "**The monetary measurement** [**of benefits in cost-benefit analysis**] **inherently favors the wealthy over the poor**."[1]

   ¬ "Extra-welfarists *and many decision-makers in the real world of health care* are willing to accept an approach that considers outcomes equitably (as CEA using QALYs does), rather than accept an approach in which choices are heavily influenced by ability to pay."[2]

2. "**Extra-welfarists identify 'health' as the principle output of health services**."[3]

   ¬ Then, in effect (*at least in theory*[4]), health is treated as an independent argument in the welfare function. Now, health can no more be substituted by income or consumption.

[1]M.R. Gold et al. (1996), p.26; [2]M.C. Weinstein and W. Manning (1997), p. 127; [3]A.J. Culyer (1989), p. 51; [4]C. Donaldson et al. (2002); [5]Thomas Rice (1998, 2002) has provided a systematic critique of welfare theory as a foundation of health economics.

Quality-Adjusted Life Years (QALYs)
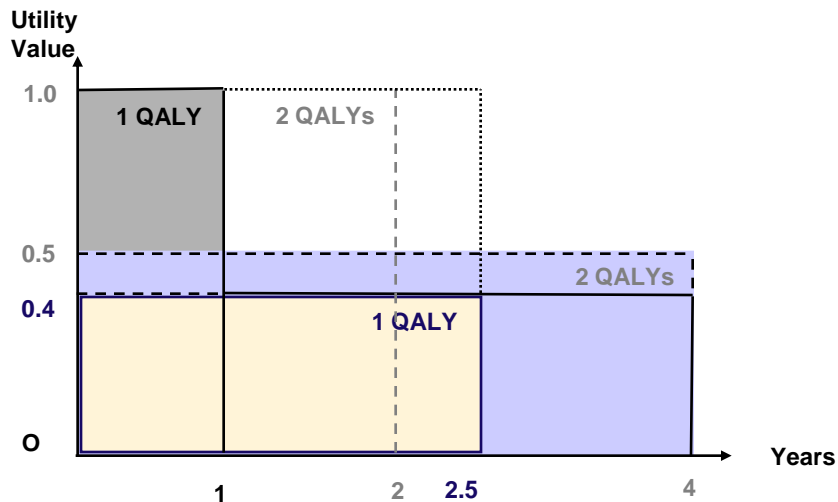
Quality and Quantity of Life as Outcomes

¬ **Basic idea underlying the QALY**

   ¬ Combination of (health-related) quality of life and length of life into **one comprehensive and universal measure**

   ¬ Intended to facilitate comparisons between different kinds of treatments and diagnoses

   ¬ Should be measured on a cardinal scale to enable computations[1]

¬ **The concept of the QALY**

   ¬ If the health state "blind" gives a quality weight (utility index) of 0.4, then one year as blind gives 0.4 QALYs ...

   ¬ ... or 1 year in full health gives the same number of QALYs (1) as 2.5 years as blind

[1]According to expected utility theory (EUT), this can be achieved using standard gamble (SG) experiments.
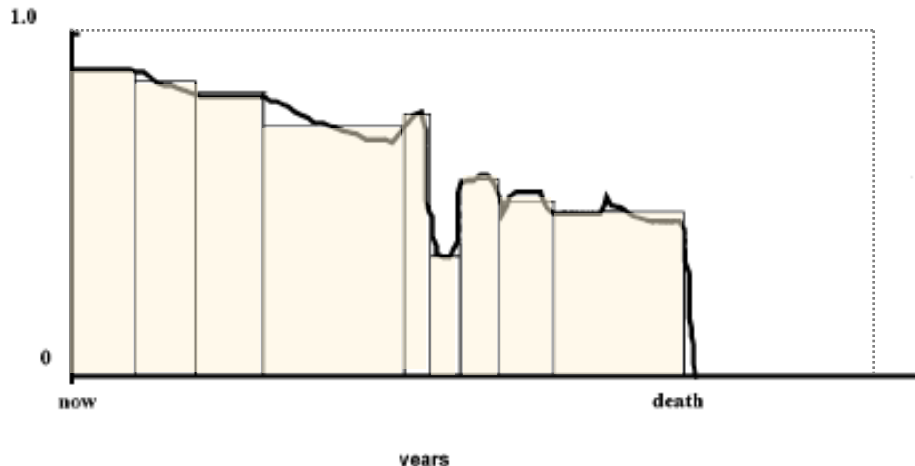
Quality-Adjusted Life Years (QALYs)

Quality and Quantity of Life as Outcome

QALY: Quantity and Quality of Life = AUC

"Putting the 'Q' Into the QALY"   **Verein für Socialpolitik – Augsburg, Oct. 16, 2010**   HRQoL Index Instruments

IV

Quality-Adjusted Life Years (QALYs)

Calculating QALYs

The area under the curve is the QALYs accumulated by the person over the respective portion of her life time.

The area is approximated by summing the areas of the rectangles.

The area of each rectangle is the product of an HRQoL weight and the time for which the individual is assumed to experience this HRQoL level.

Some assumptions underlying the QALY concept:

¬ Utility independence (quality / quantity of life; from a welfare economic perspective also for health / non-health arguments of the utility function)

¬ Constant proportional trade-off

¬ Additive separability

[1]From M. R. Gold et al. (2002)

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Quality-Adjusted Life Years (QALYs)
as a measure of (health-related) outcomes[1]

QALYs: Utility-Adjusted Life Years

Expected Utility (Theory)

Utility = Maximum WTP (Jules Dupuit)
Objective: Maximization of Expected Utility
Fear? Attention? Maximization or else?

Experienced Utility

"Hedonimeter" (Francis Edgeworth)
 "instant utility" (Daniel Kahneman)
Adaptation? Maximization or else?

<u>Note</u>: These approaches do not consider each person as an end, but are willing to promote an overall 'social good' in ways that may in effect use some people as means to the enrichment of others[1]

Limitations of "Utility"

Key entitlements (capabilities)? (Amartya Sen)
Distributional blindness; maximin? (John Rawls)
Trade-Offs against primary goods
(e.g., political and religious liberty)?
Preference adjustment?

[1]Martha C. Nussbaum, *Frontiers of Justice* (2006)

THE LOGIC OF COST-EFFECTIVENESS

Quality-Adjusted Life Years (QALYs)
as a measure of (health-related) outcomes[1]

Three Distinct Ways How to Use QALYs

Same intervention for **Same indication** (same patient group)

"Does the Utility Gain Outweigh the Disutility of Treatment?"
e.g., cancer chemotherapy

Typical Questions

q

t
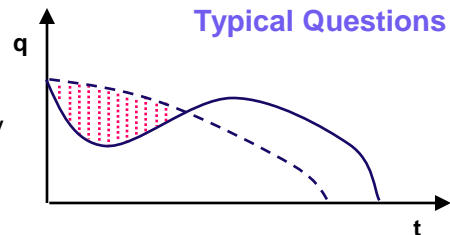
Different interventions for **Same indication** (same patient groups)

"How Can We Integrate a Variety of Clinical Outcomes in one Summary Measure?"
Alternative: disaggregated (cost-consequence) analysis

Different interventions for **Different indications** (different patient groups)

"How Can We Determine the Most Efficient Allocation of Scarce Health Care Resources across a Wide Range of Competing Interventions?"
"Efficiency" usually defined in terms of QALY maximization

[1]This is *not* a comprehensive list. For example, QALYs may also be used in descriptive (non-comparative) economic analyses.

QALYs as a utility measure of health-related consequences

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Quality-Adjusted Life Years (QALYs)
Measurement methods to generate quality weights

Instruments	Example

¬ **Profile Instruments**
 	
   ¬ **Disease specific instruments**
 	
   ¬ **Generic instruments**
 	
¬ **Validated (MAU) Instruments**
 	
   ¬ **Preference-based instruments**
 	
      ¬ AQoL
 	
      ¬ EQ-5D
 	
      ¬ HUI-3
 	
      ¬ SF12 / SF6D
 	
   ¬ Non-preference-based instruments (15D, QWB)
	¬ **EQ-5D** (formerly known as "EuroQol")
	
	   ¬ Five dimensions
	
	      ¬ Mobility
	
	      ¬ Self-care
	
	      ¬ Usual activities
	
	      ¬ Pain/discomfort
	
	      ¬ Anxiety/depression
	
	   ¬ Three levels for each dimension ("no problem", "some problem", "unable, or extreme problem")
	
	¬ **3^5 = 243 health states**
	
	   ¬ TTO (general population)

THE LOGIC OF COST-EFFECTIVENESS

Quality-Adjusted Life Years (QALYs)
Measurement methods to generate quality weights

Decomposed Measurement	Holistic Measurement
Use a MAU[1] Instrument ¬ **Creation of a Validated Generic Index Instrument** ¬ Descriptive system ¬ Scaling of instrument: development of a scoring system 2. **Application of Instrument** ¬ Matching health states ¬ Reading utility scores	1. **Health State Vignette** 2. **Scaling of Scenario:** ¬ **Standard Gamble (SG)** **>** ¬ **Time Trade-Off (TTO)** **>** ¬ **Visual Analogue Scales (VAS) [?]**

?

?
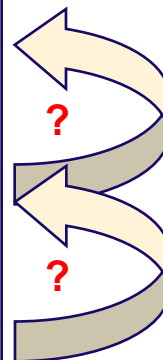
[1]MAU, multi-attribute utility theory

"Putting the 'Q' Into the QALY"

HRQoL Index Instruments

IV

Deconstructing
Health-Adjusted Life Years (HALYs)

Some Dimensions of Choice[1]

¬ Scaling instrument (VAS, SG, TTO, PTO, …)

¬ Time horizon (life time, episode, one year, …)

¬ Personal versus social (community) perspective

¬ Ex ante versus ex post perspective

¬ Respondent (patient, public, insured population, expert)

¬ Social values (age weights, severity, etc.)

Result:

¬ Large number of potential options

¬ Justification for selected option(s) **?**

[1] J. Richardson (2002); cf. also J. Richardson (1994)

IV

Deconstructing
Health-Adjusted Life Years (HALYs)

Choices Actually Made[1]			
	QALY (traditional)	**DALY** (WHO)	**HYE** (Mehrez and Gafni)
Scaling instrument	SG (or TTO)	PTO	SG (two-stage)
Time Horizon	One year	Episode	Episode
Perspective 1	Personal	Social	Personal
Perspective 2	Ex post	Ex post	Ex post
Respondent	Patient	Expert	Patient

[1]From J. Richardson (2002); cf. also J. Richardson (1994)

"Putting the 'Q' Into the QALY"

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HRQoL Index Instruments

IV

Quality-Adjusted Life Years (QALYs)
Measurement methods to generate quality weights

HRQoL: Generic Index Instruments[1]

Are they all the same?

¬ Coverage of descriptive system

¬ Sensitivity of dimensions

¬ Model used to combine the dimensions / items

¬ Valuation method (scaling instrument (VAS, SG, TTO, …))

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Quality-Adjusted Life Years (QALYs)

[Health-Related] Quality of Life

¬ **World Health Organization (WHO 1946/48[1])**

 Health … is a state of complete

- ¬ physical,
- ¬ mental, and
- ¬ social well-being

and not merely the absence of disease or infirmity

[1]Preamble of the Constitution of the World Health Organization as adopted by the International Health Conference, New York, NY, June 19-22, 1946; signed on July 22, 1946, by the representatives of 61 states (Official Records of the World Health Organization, no. 2, p. 100, and entered into force on April 7, 1948.
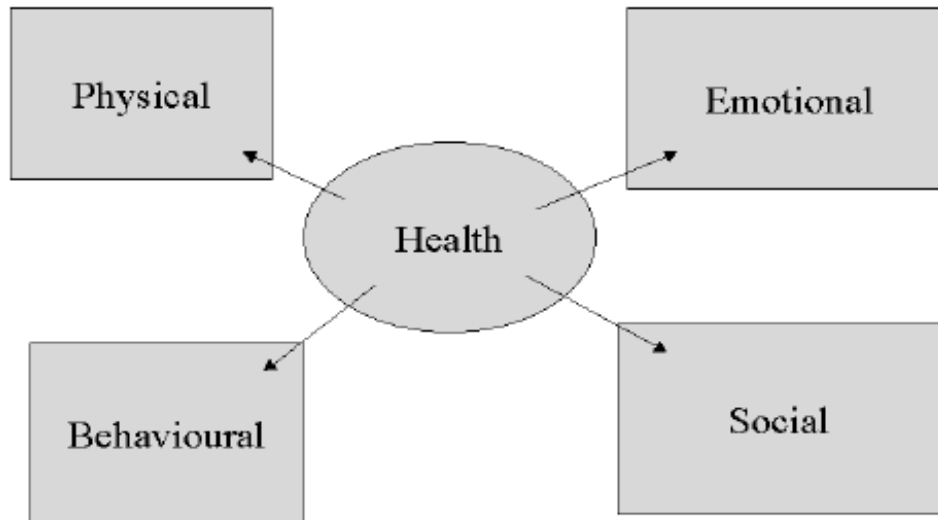
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Quality-Adjusted Life Years (QALYs)

[Health-Related] Quality of Life

Health

Health has a physical and psychosocial
(emotional, behavioural, social) dimension.

Physical		Emotional

Health

Behavioural		Social

Quality-Adjusted Life Years (QALYs)
Measurement methods to generate quality weights

HRQoL: Comparison of Generic Index Instruments[1]

RS: Rating Scale (Visual Analogue Scale, VAS); SG, Standard Gamble; TTO, Time Trade-Off; *ein Item je Dimension

Instrument	15D	AQoL8D	EQ-5D	HUI-3	QWB	SF12 (SF-6D)
Messung (*Skalierungsinstrument*)	RS	TTO	TTO	SG	RS	SG
Dimensionen	15	8	5	8	5	2
Ausprägungsgrade (*Levels*)	4-5	4	3	5-6	2-3	4-6
Gesundheitszustände (*Health States*)	31bn	16.8m	243	972.000	945	7.500

HRQoL: Comparison of Generic Index Instruments[1]

RS: Rating Scale (Visual Analogue Scale, VAS); SG, Standard Gamble; TTO, Time Trade-Off; *ein Item je Dimension

Dimension	Items	15D	AQoL8D	EQ-5D	HUI-3	QWB	SF12
Independent Living	Mobility	1	2	1	1	2	0
	Bodily Care	0	1	1	0	2	0
	Bodily Function	3	0	0	0	32	0
	Acts / daily living	0	1	1	1	14	4
	Bodily aids	0	0	0	0	7	0
Satisfaction	General Satisfaction	0	4	0	1	0	0
Mental Health	Depression	3	2	0	0	1	2
	Anger	0	2	0	0	1	0
	Anxiety	0	3	0	0	4	2
	Sleeping	1	1	0	0	1	0
Coping	Physical Ability / Vitality	1	1	0	0	0	0
	Coping / Control	0	3	0	0	2	1
Relationships	Social Function	0	5	0	0	1	1
	Family Role	0	1	0	0	0	0
	Intimacy / Relationships	1	1	0	0	0	0
Self Worth	Self Esteem	0	3	0	0	0	0
Pain	Pain	1	2	1	1	5	1
Senses	Senses	2	2	0	2	4	0
	Cognition	1	0	0	1	0	0
	Communication	1	1	0	1	2	0
Self Health	Own Health	0	0	1	0	3	1
Dimensions		15*	8	5*	8*	5	2
Items (number)		15	35	5	8	10	12
Utility Weight Elicitation		RS	TTO	TTO	SG	RS	SG

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Comparison of Generic Index Instruments[1]

	EQ-5D	HUI-3	SF-6D	SF-12	15D	QWB
AqoL	Holland et al., 2004 (und zwei weitere Studien*)	Barton et al., 2002 Fisk et al., 2005 Marra et al., 2004 Marra et al., 2005 Pickard et al., 2005	Barton et al., 2002 Fisk et al., 2005 Marra et al., 2004 Marra et al., 2005 Pickard et al., 2005		Stavem et al., 2001 Stavem et al., 2005	
EQ-5D		Conner-Spady / Suarez-Almazor, 2003 Franks et al., 2006 Haacke et al., 2006 Kaplan et al., 2005 McDonough et al., 2005 Moock / Kohlmann, 2008 Luo et al., 2003, 2005, 2009 Naglie et al., 2006 Pickard et al., 2004 (und neun weitere Studien*)		Asadi-Lari et al., 2005 Carr et al., 2005 Franks et al., 2003 Franks et al., 2006 Johnson / Pickard, 2000	Linde et al., 2008 Moock / Kohlmann, 2008 Saarni et al., 2008 (und vier weitere Studien*)	Lee et al., 2006 Naglie et al., 2006 Paz et al., 2009 (und drei weitere Studien*)
HUI-3				Franks et al., 2006	Moock / Kohlmann, 2008 (und zwei weitere Studien*)	Moock / Kohlmann, 2008 Naglie et al., 2006 (und vier weitere Studien*)
15D						Moock / Kohlmann, 2008 (und zwei weitere Studien*)

"Putting the 'Q' Into ... Index Instruments

IV

Quality-Adjusted Life Years (QALYs)
Measurement methods to generate quality weights

HRQoL: Convergent Validity of Generic Index Instruments[1]					
	AQoL-4D	**EQ5D**	**HUI 3**	**15D**	**SF-6D**
AQoL-4D	1				
EQ-5D	0.53	1			
HUI 3	0.55	0.41	1		
15D	0.64	0.58	0.55	1	
SF6D	0.55	0.56	0.44	0.59	1
MEAN	0.57	0.52	0.49	0.59	0.53

Proportion of variance explained by another instrument (R^2)

R^2 = correlation coefficient squared

Source: Hawthorne et al (2001) p365, Tab. 6

IV

Quality-Adjusted Life Years (QALYs)
Measurement methods to generate quality weights

HRQoL: Convergent Validity of Generic Index Instruments[1]				
	EQ5D	**HUI 3**	**QWB SA**	**SF6D**
EQ5D	1			
HUI 3	0.49	1		
QWB SA	0.41	0.45	1	
SF6D	0.50	0.52	0.43	1
MEAN	0.47	0.49	0.43	0.48

Proportion of variance explained by another instrument (R^2)

R^2 = correlation coefficient squared

Source: Fryback et al (2010) p. 8, Tab. 2

Health dimension	HUI-3	EQ-5D
Physical health and mobility	Walks without difficulty Full use of hand and fingers	No problems walking around
Activities of daily living	Bathes, eats and dresses normally	No problems with personal care No problems performing usual activities
Bodily pain, general health	Moderate pain , occasionally disturbing activities Health rated as fair	Moderate pain or discomfort
Social function	No problems with communicating	
Emotional and mental health	Occasionally fretful, angry or depressed Somewhat forgetful, but able to think clearly	Not anxious or depressed
Utility Score	**0.74**	**0.80**

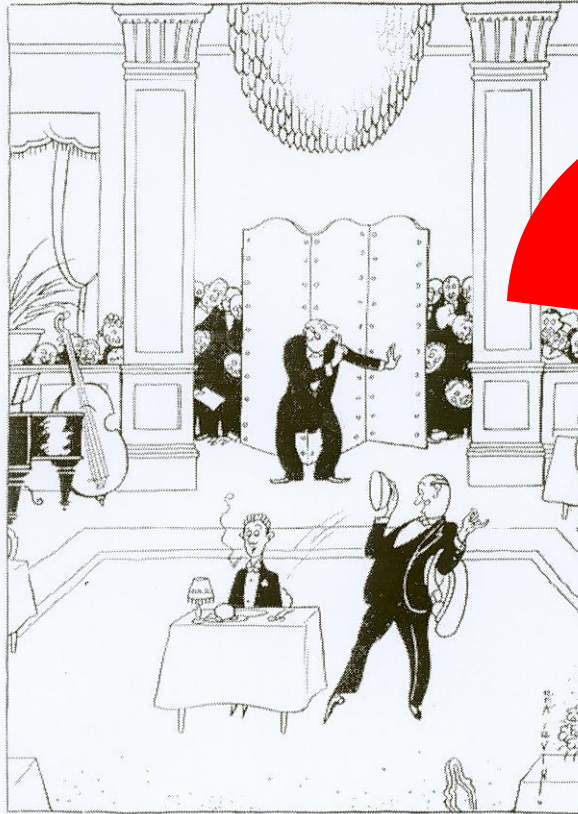| Health dimension	HUI-3	EQ-5D
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Social function	No problems with communicating	
Emotional and mental health	Occasionally fretful, angry or depressed Somewhat forgetful, but able to think clearly	Not anxious or depressed
Utility Score	**0.74**	**0.80**
Additional: physical health and mobility	Unable to see well even with glasses Some hearing difficulty	[=>senses not included in EQ-5D]
Utility Score	**0.14** (new score)	**0.80** (no change)

THE LOGIC OF COST-EFFECTIVENESS

Quality-Adjusted Life Years (QALYs)
Measurement methods to generate quality weights

Standardization?

SF-6D	EQ-5D
Pain	Pain/discomfort
Mental health	Anxiety/depression
Physical functioning	Mobility
Role limitation	Self care
Social functioning	Usual activities
Vitality	./.

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HRQoL Index Instruments

IV

"What More Could Anyone Ask For?"

THE QALY SURPRISE

THE NEW YORKER 1925

"Putting the 'Q' Into the QALY"

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HRQoL Index Instruments

IV