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A comparison of 6 multi attribute utility instruments in 7 disease areas

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1. Context

Context

Economic evaluation	→	CUA
CUA	→	QALYs
QALYs	=	utility * years
Utility	←	Multi attribute utility (MAU) instruments
		(EQ-5D, SF-6D, HUI, AQoL)
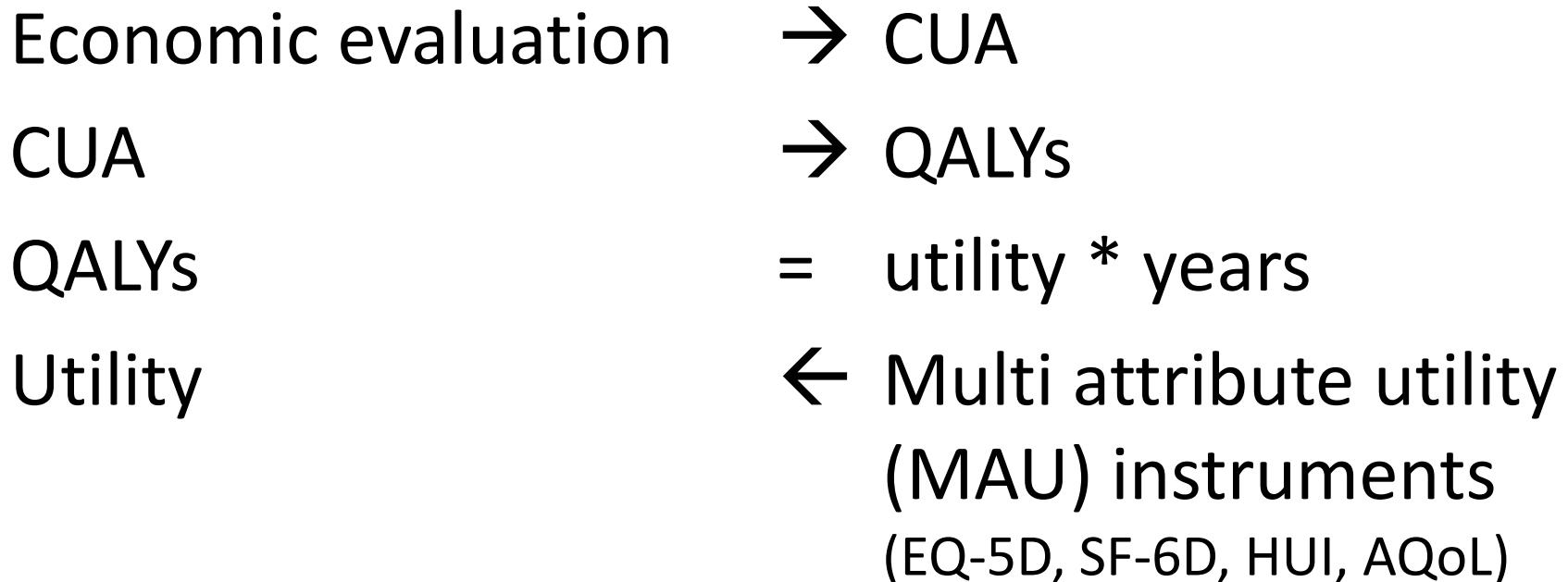
Use of cost utility analysis in pharmacoeconomic guidelines

Australia (PBAC, MSAC)	Italy
Belgium	New Zealand
Canada	Poland
France	Scotland
Netherlands	Sweden
Hungary	UK
Ireland	

Evaluations by instrument
2005-2010

(Web of Science)

|	Number	Percent
EQ-5D	1047	63.0
HUI 3 HUI 2	241	14.5
SF-6D	147	8.8
15D	117	7.0
AQoL-8D (4D, 6D)	70	4.2
QWB	41	2.5
	1,663	100.0

2. Motivating problems

Motivating problems

Problem 1:

Predicted utilities differ

Motivating problems

Predicted utilities differ

EQ-5D vs SF-6D
(pilot data)
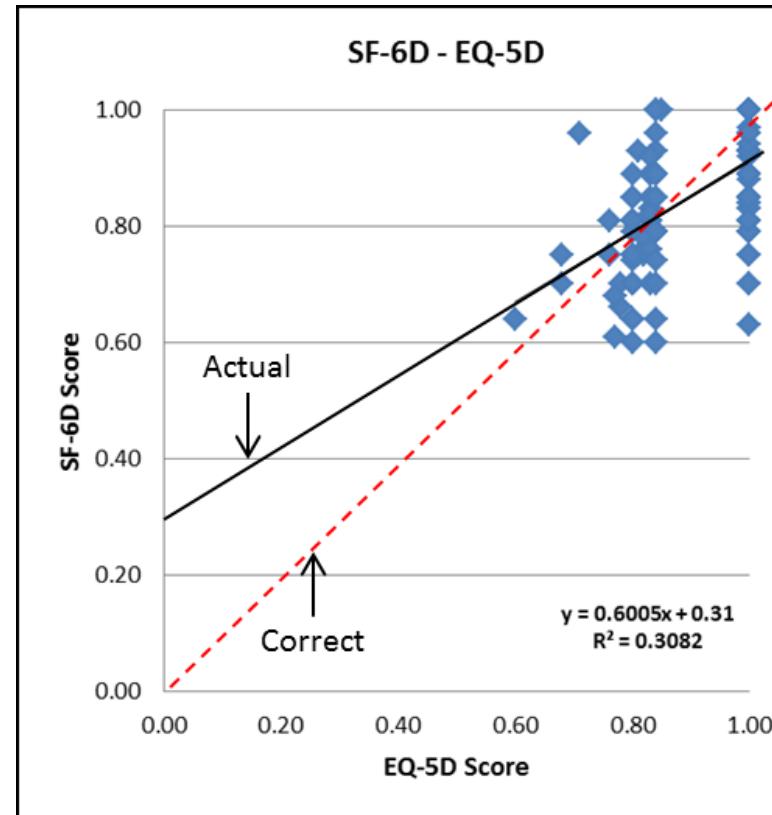
Problem 2

- Utility ← economics discipline
  - Utility = strength of preferences
- Subjective Wellbeing (SWB) ← Psychology
  - SWB subsumes happiness
- No research (Dolan & Kahneman; Layard)

3. The Multi Instrument Comparison (MIC) survey

Research questions

- How do MAU values differ?

  - Impact upon CUA

- What do different MAU measure

  - Which dimensions of QoL?

- Does increasing utility increase SWB?

The MIC Survey

Summary of MIC Database		
Countries	Australia, USA, UK, Norway, Germany, Canada	
Disease areas	Healthy (no disease), Asthma, Arthritis, Cancer, Depression, Diabetes, Hearing loss, Heart disease	
Instruments	Subjective wellbeing (happiness)	PWI, IHS, SWLS
	Multi attribute utility (MAU)	EQ-5D-5L, SF-6D, HUI 3, 15D, QWB, AQoL-4D, AQoL-8D
	Multi attribute (MA) (non utility)	SF-36
	Capabilities	ICECAP-A
	Self assessment	VAS, Self TTO, Categorical
	Other	SELF TTO, Demographics, SES

MIC Survey: Edited Sample

Diseases	Australia	UK	USA	Canada	Norway	Germany	Total
MIC sample by health state and country (n=8022)							
Asthma	141	150	150	138	130	147	856
Cancer	154	137	148	138	80	115	772
Depression	146	158	168	145	140	160	917
Diabetes	168	161	168	144	143	140	924
Hearing loss	155	126	156	144	115	136	833
Arthritis	163	159	179	139	130	159	929
Heart disease	149	167	170	154	151	152	943
COPD	66	x	x	x	x	x	66
Stroke	23	x	x	x	x	x	23
Disease sample	1165	1058	1139	1002	889	1009	6262
Healthy	265	298	321	328	288	260	1760
Total	1430	1356	1460	1330	1177	1269	8022

Items of information = 2.8 million

4. Utilities *vs* Subjective Wellbeing (SWB)

Expected correlation

Utility	=	Preference
SWB	=	Happiness

- If there is a preference for happiness, correlation should be high
- If people maximise happiness

$$\rho(U, SWB) = 1$$

Correlation in a "healthy" population

(VAS ≥ 70 n = 1,760)
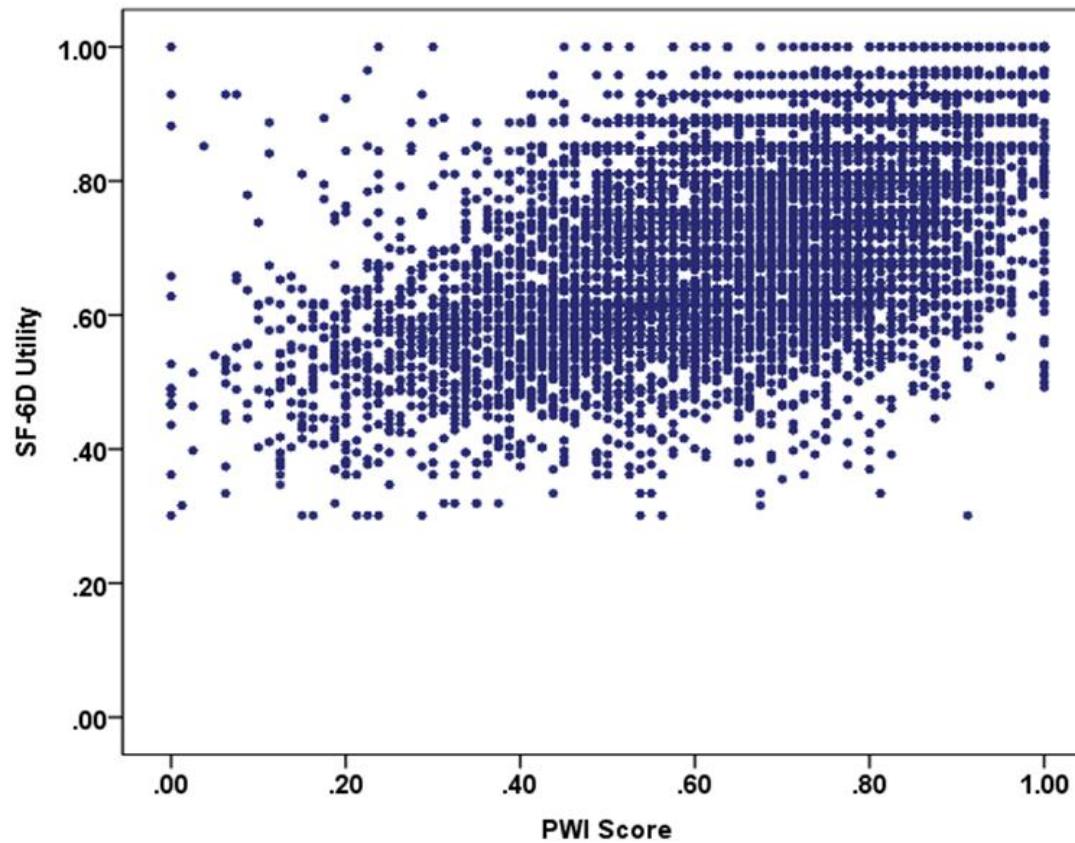
EQ-5D *vs* PWI
(total sample n = 8,022)
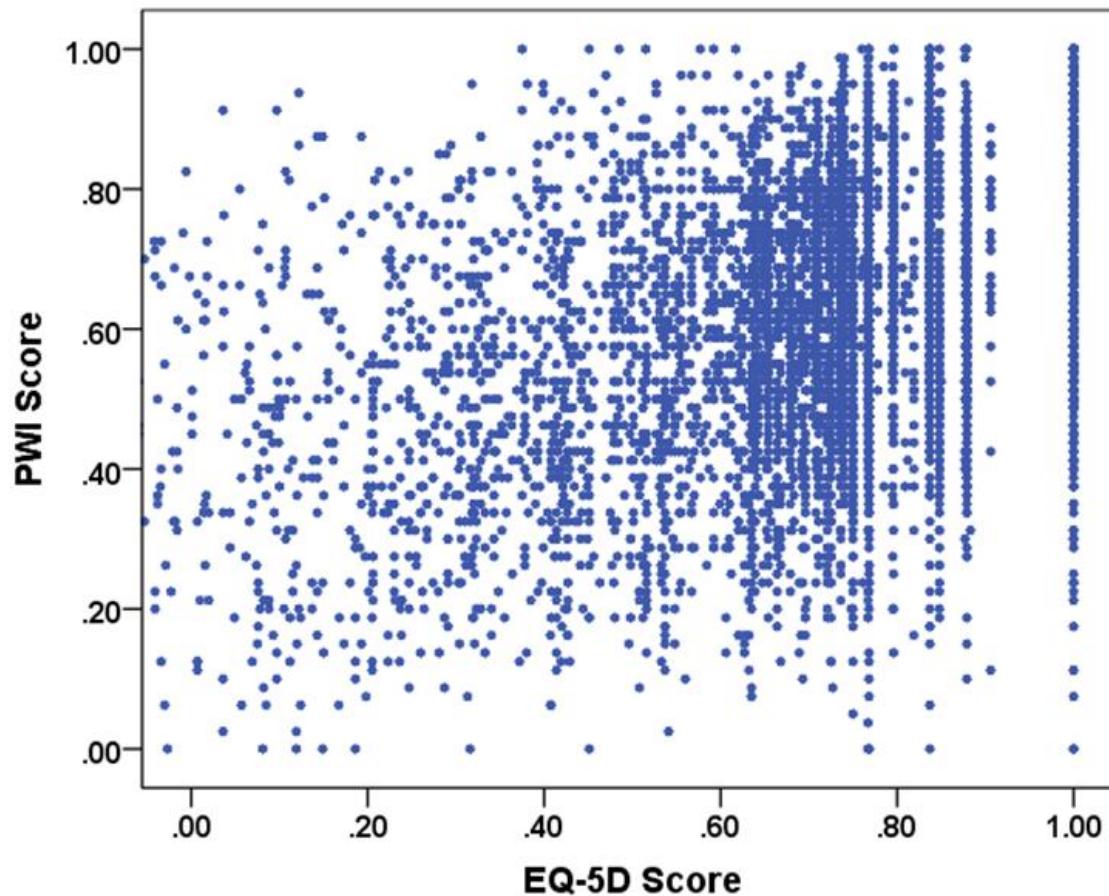
EQ-5D explains 4% (0.2) of the variance in happiness

Correlation SWB utility in the Healthy

Healthy n=1760

Ave ρ (SWB[1], utility[2])=0.26

ρ (SWB[1], EQ-5D)=0.20

Ave ρ (SWB[1], SF-36[2])=0.36

ρ (SWB[1], SF-6D)=0.31

Ave ρ (SWB[1], Capabilities[3])=0.44

ρ (SWB[1], AQoL8D)=0.49

Notes: (1) PWI; (2) Average of 6 MAUI; (3) ICECAP

5. Comparison of MAU Instruments

(a) Content

Content

$$(a)\ \text{Regress}\ U = a + \sum_{i=1}^{8} b_i \left(\text{Dimensions of SF-36} \right)$$

$$(b)\ \text{Regress}\ U = a + \sum_{i=1}^{8} b_i \left(\text{Dimensions of AQoL-8D} \right)$$

SF-36

## Relative increase in utility with a 1 standard deviation increase in each dimension of the SF-36
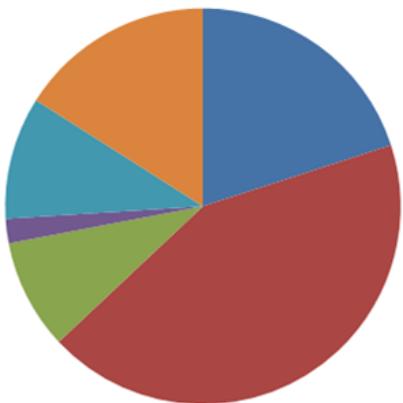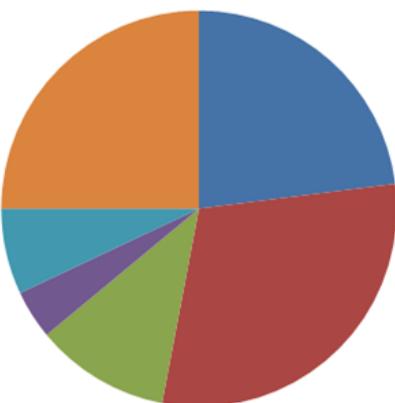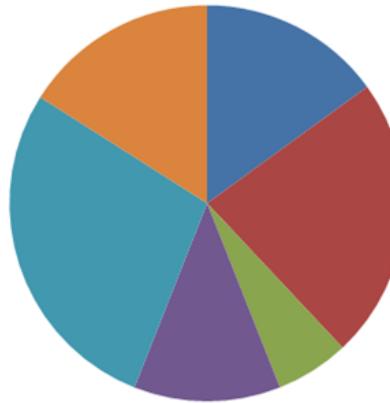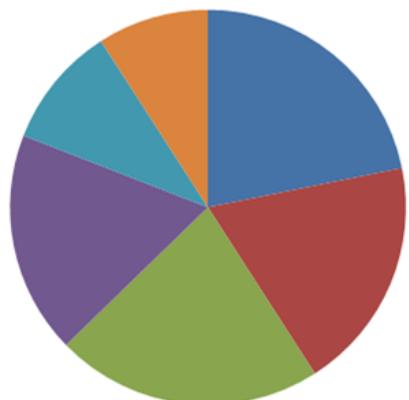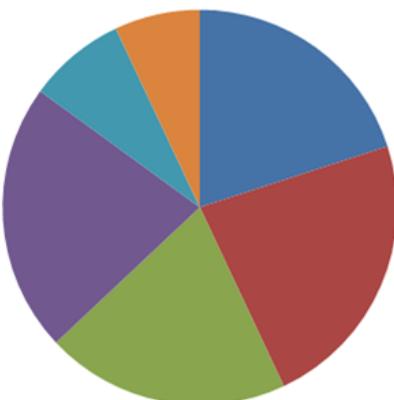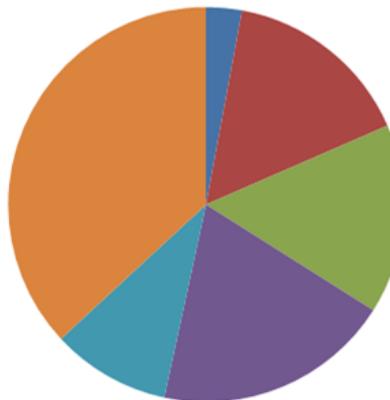
AQoL-8D
Relative increase in utility with a 1 standard deviation increase in each dimension of the AQoL-8D
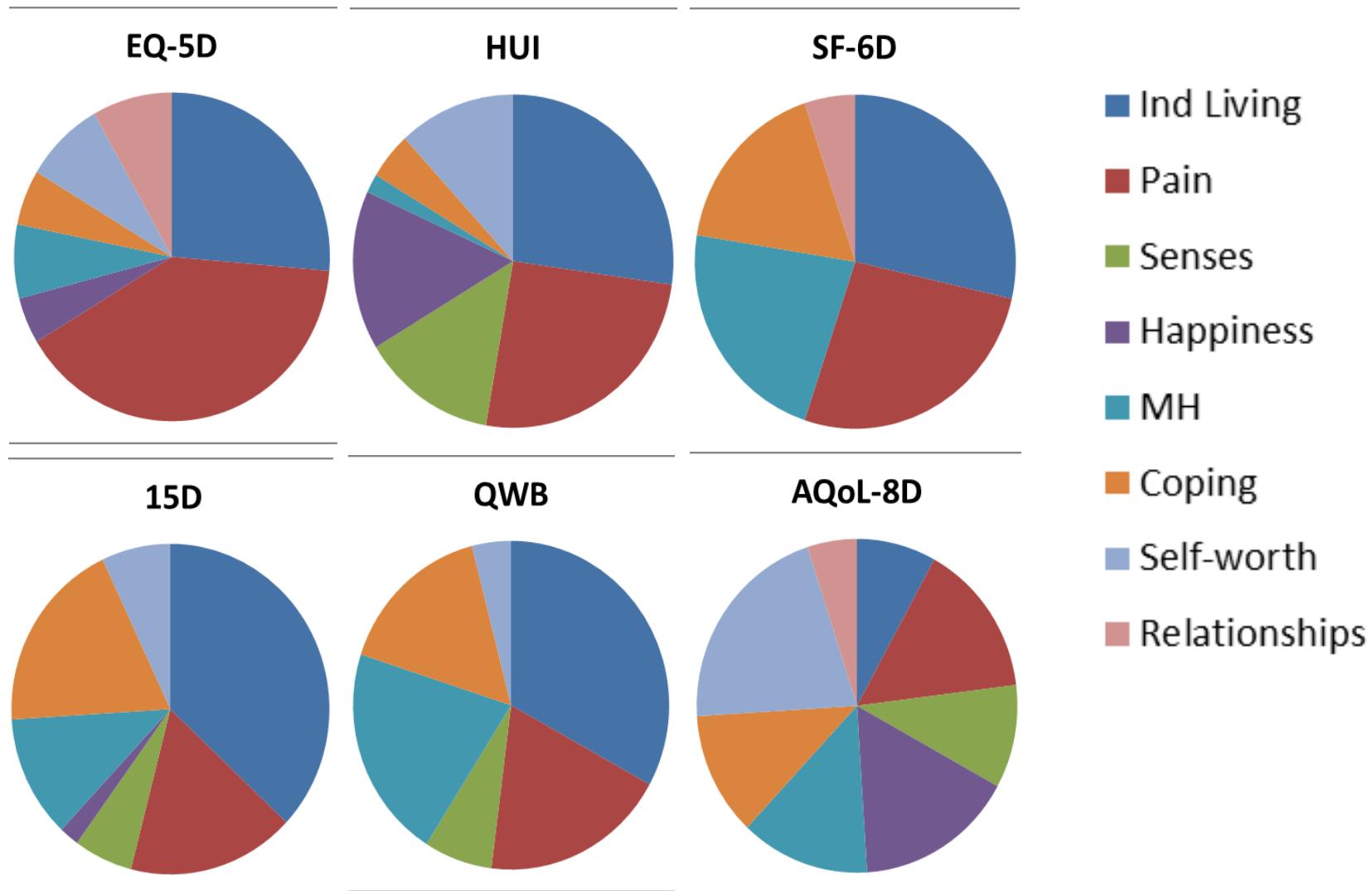
5 (b) Pairwise Comparisons

# Regression of MAUI on SF-36

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	EQ-5D	SF-6D	HUI 3	15D	QWB	AQoL-4D	AQoL-8D
X	1.09	1.44	0.99	0.47	2.32	1.50	1.17
X^2	-2.02	-2.13	-1.42	-0.49	-4.44	-2.12	-1.18
X^3	2.12	1.40	1.74	0.64	3.00	1.83	1.00
Pseudo R^2	0.852	0.978	0.832	0.89	0.92	0.86	0.91
F	15,387	120,350	9,227	15,032	21,254	14,456	21,680

Independent variable: X = (1-SF-36)
Dependent variable: Y = (1-$MAUI_i$)

Cube Regression: MAU(x) on SF36
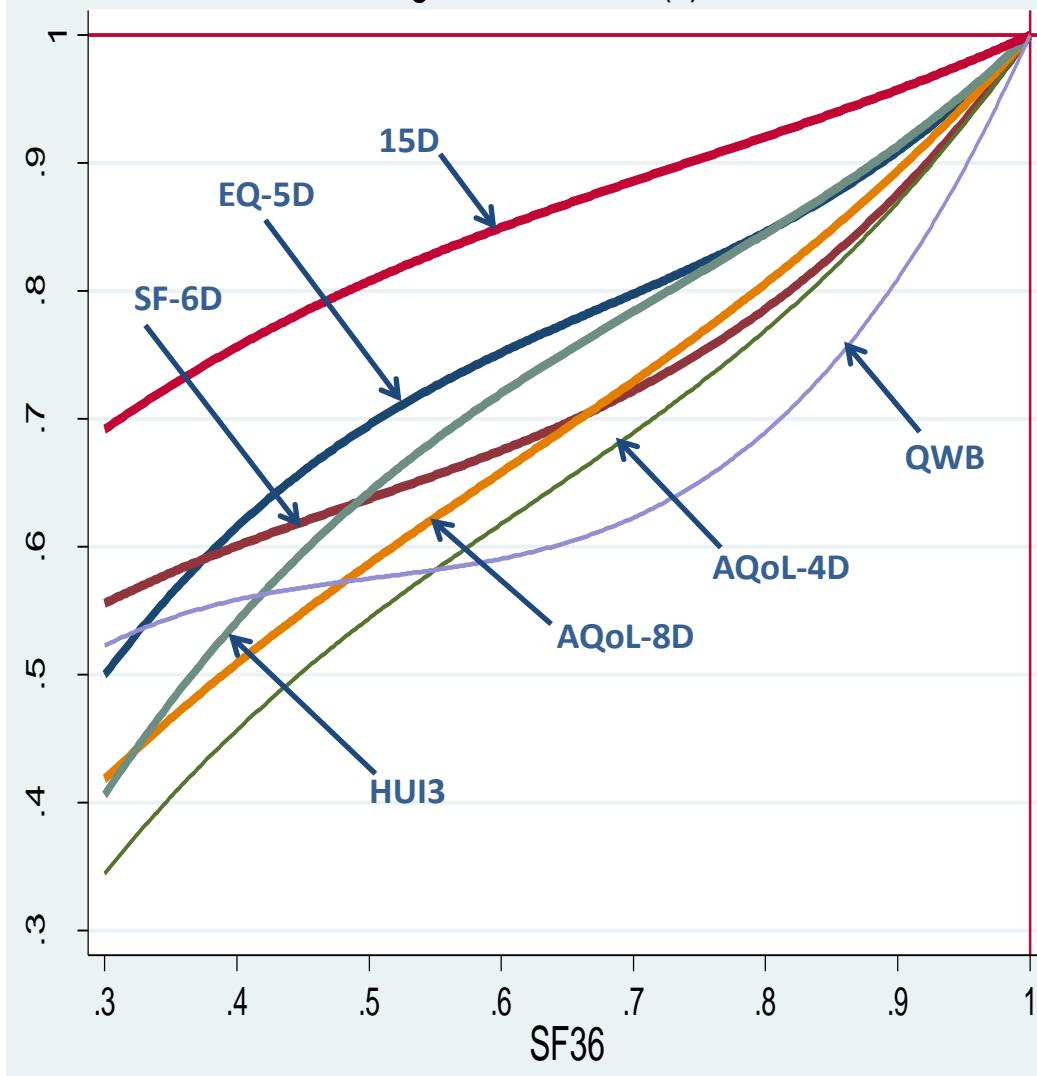
Consequences for economic evaluation
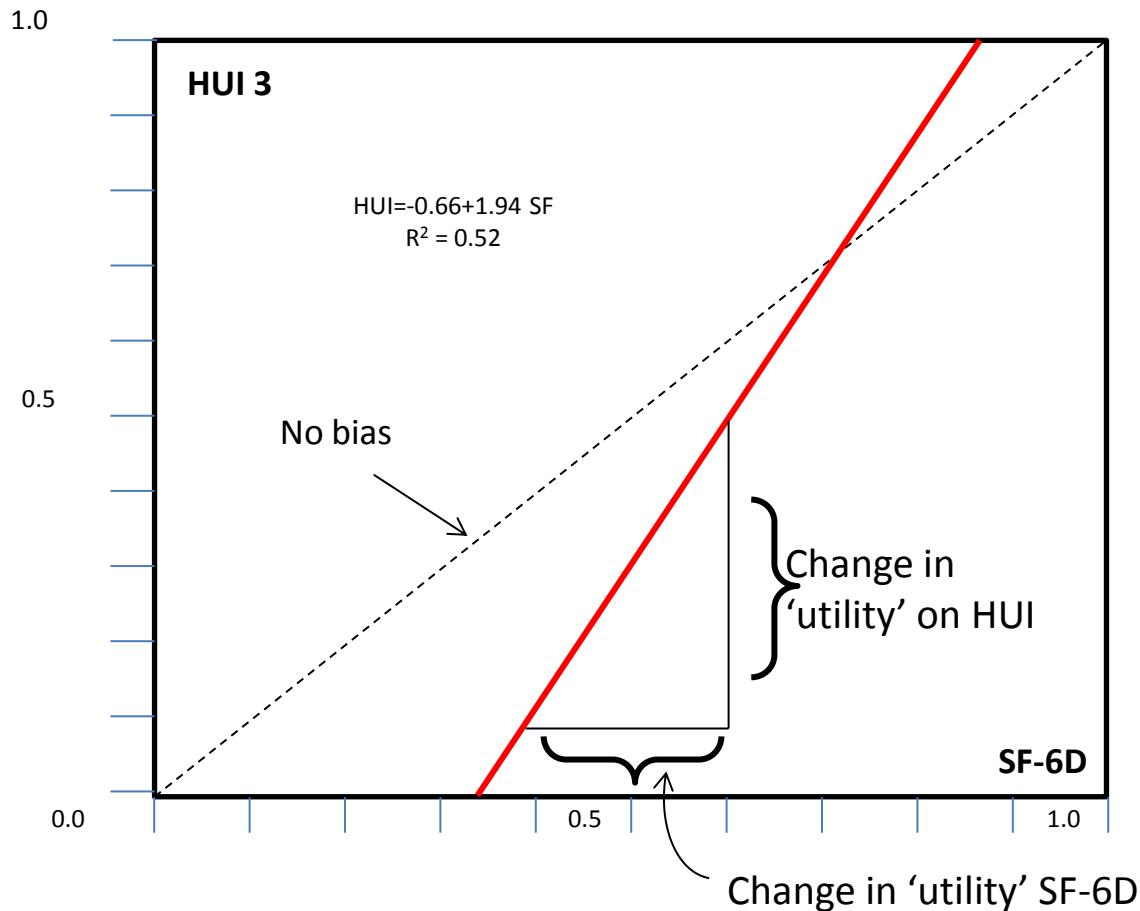
Change in QALYs ← change in utility (due to a service) change
HUI = 1.94 (change SF)

Marginal change Pairwise Geometric Mean Squares Regression $MAU_i = a + b \ MAU_j$

	EQ-5D	SF-6D	HUI3	15D	QWB	AQoL-8D
EQ-5D	1.00					
SF-6D		1.00				
HUI3			1.00			
15D				1.00	.	
QWB					1.00	
AQoL-8D						1.00
Average*						
* Average percent difference [(larger of b or 1/b)*100]						

Percent difference in incremental utilities[1] [(change MAU$_i$)/(change MAU$_j$)]$_*$100

	EQ-5D	SF-6D	HUI 3	15D	QWB	AQoL-8D
EQ-5D						
SF-6D	65					
HUI 3	21	101				
15D	75	6	113			
QWB	45	13	76	20		
AQoL-8D	3	62	25	69	39	
Average	41	50	67	59	39	39

Note 1: Larger of (b-1) $_*$100 and ((1/b)-1)$_*$100
Overall average deviation = 49 percent

Consequences for Economic Evaluation

Assuming MIC (n=8042) pairwise (GMS) relationships apply to the evaluation of a service:

- Replacing HUI 3 with EQ-5D reduces cost/QALY by 15.2%
- Replacing SF-6D with EQ-5D raises cost/QALY by 63.8%
- Replacing SF-6D with HUI 3 raises cost/QALY by 93.1%
- Replacing HUI 3 with AQoL-8D reduces cost/QALY by 16.4%
- Replacing SF-6D with AQoL-8D raises cost/QALY by 61.5%

5 (c) Sensitivity

Instrument sensitivity

Direct approach

Calculate difference: utility (public-patients)

Interpret: Difference ↑ = Sensitivity ↑

From pairwise regressions
Magnitude of incremental utilities

HUI 3 > AQoL-4D > EQ-5D = AQoL-8D

> QWB > SF-6D > 15D

Pseudo sensitivity
Magnitude incremental utility *vs* sensitivity
(Marginal HUI 3) / Marginal SF-6D = 1.96)

	Difference in Utility		Correlation, MAUI Disease specific	
	HUI 3	SF-6D	HUI 3	SF-6D
Asthma	0.12 >	0.09	0.49 <	0.54
Cancer	0.20 >	0.11	0.78 <	0.82
Depression	0.35 >	0.20	0.63 <	0.67
Diabetes	0.20 >	0.10	0.54 <	0.65
Arthritis	0.26 >	0.13	0.75 <	0.76
CHD	0.18 >	0.10	0.74 <	0.82

Pseudo sensitivity

MAU (A)...sensitive

Gold standard

MAU (B)...pseudo sensitive

Disease severity
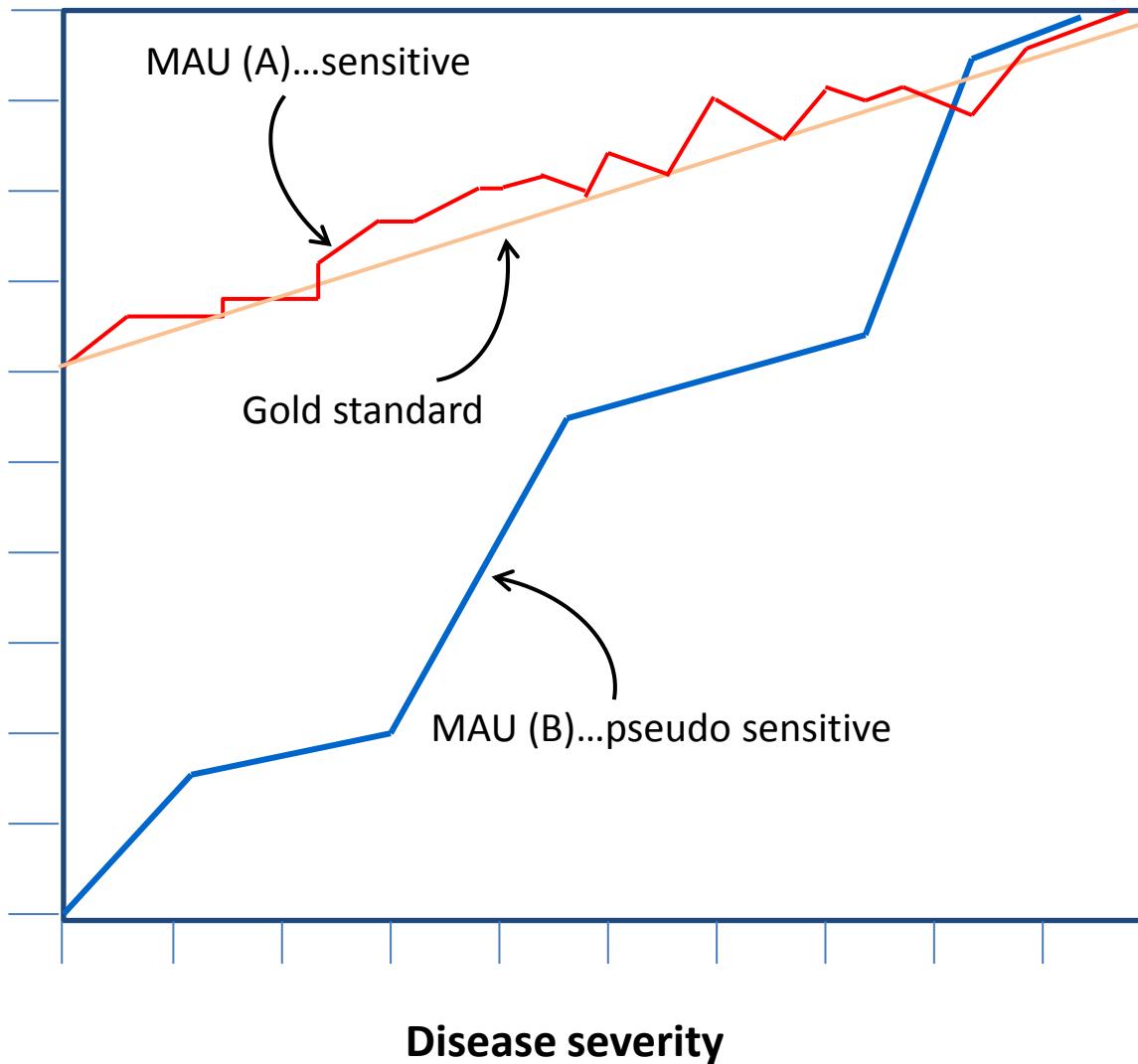
Measuring sensitivity
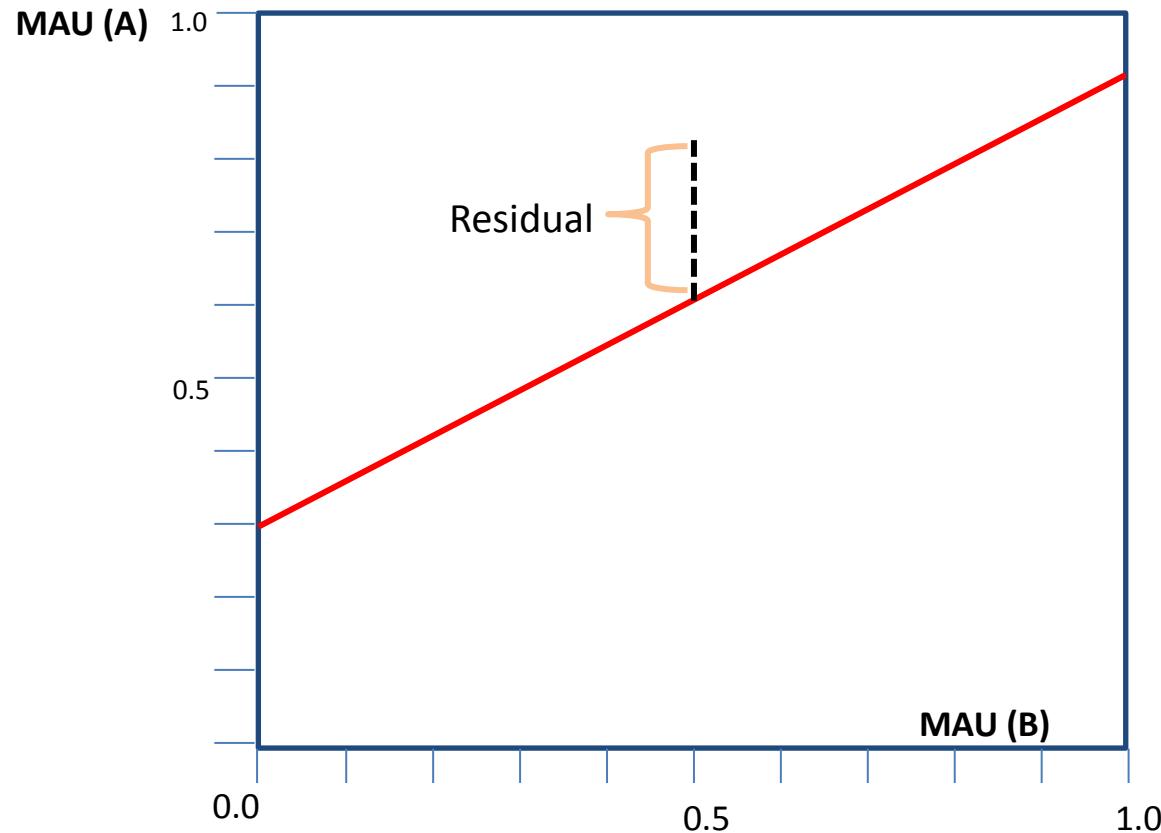
Relative sensitivity ← ρ (Residual, Dimensions)

Dimensions   ← SF-36
                   ← AQoL-8D

Pairwise comparison of instrument sensitivity

MAU with less sensitivity	MAU with greater sensitivity				
	EQ-5D	SF-6D[1]	HUI 3	15D	AQoL-8D[2]
EQ-5D		(1) Cope Rel Sense Hap Worth MH	**Sense** Hap	Gen Vital Rel Worth MH RoleE Cope Hap **Sense**	(2) **Vital** RoleE Social **MH**
SF-6D	Pain Ind		Sense	Role P MH Social Ind **Role E** Sense	(1) (2)
HUI3	Pain	(1) MH		Gen Vital Role P MH Role E Cope	(2) Gen **Vital** Social RoleE **MH**
15D	Pain	(1) **Sense**			(2) Vital RoleE **MH**
AQoL-8D	Pain	(1)	Phys	RoleP Pain **Phys**	

6. Disease specific comparisons

MIC comparison of utility means and differences

	Mean MAUI score					
	EQ-5D	SF-6D	HUI 3	15D	AQoL-8D	Ave
Healthy	0.88	0.80	0.88	0.94	0.83	0.87
HEALTHY-PATIENT						
Healthy Asthma	0.12	0.09	0.12	0.09	0.14	0.12
Healthy Cancer	0.18	0.11	0.20	0.12	0.17	0.16
Healthy Depression	0.29	0.20	0.35	0.18	0.38	0.28
Healthy Diabetes	0.17	0.10	0.20	0.10	0.17	0.15
Healthy Hearing loss	0.09	0.05	0.18	0.06	0.11	0.10
Healthy Arthritis	0.24	0.13	0.26	0.12	0.20	0.19
Healthy Heart disease	0.16	0.10	0.18	0.11	0.15	0.14

Summary of correlations with disease specific instruments

	Highest to lowest								
Arthritis	**AQoL-8D**	>	15D	>	SF-6D	>	HUI 3	>	**EQ-5D**
Asthma	15D	>	SF-6D	>	**AQoL-8D**	>	**EQ-5D**	>	HUI 3
Cancer	15D	>	HUI 3	>	**AQoL-8D**	>	SF-6D	>	**EQ-5D**
CHD	**AQoL-8D**	>	HUI 3	>	15D	>	SF-6D	>	**EQ-5D**
Depression	**AQoL-8D**	>	HUI 3	>	15D	>	SF-6D	>	**EQ-5D**
Diabetes	**AQoL-8D**	>	HUI 3	>	15D	>	SF-6D	>	**EQ-5D**

Decomposition of health states

Physical Summary Scores
Ratio of patient group to public
(SF-36, AQoL-8D physical scores)
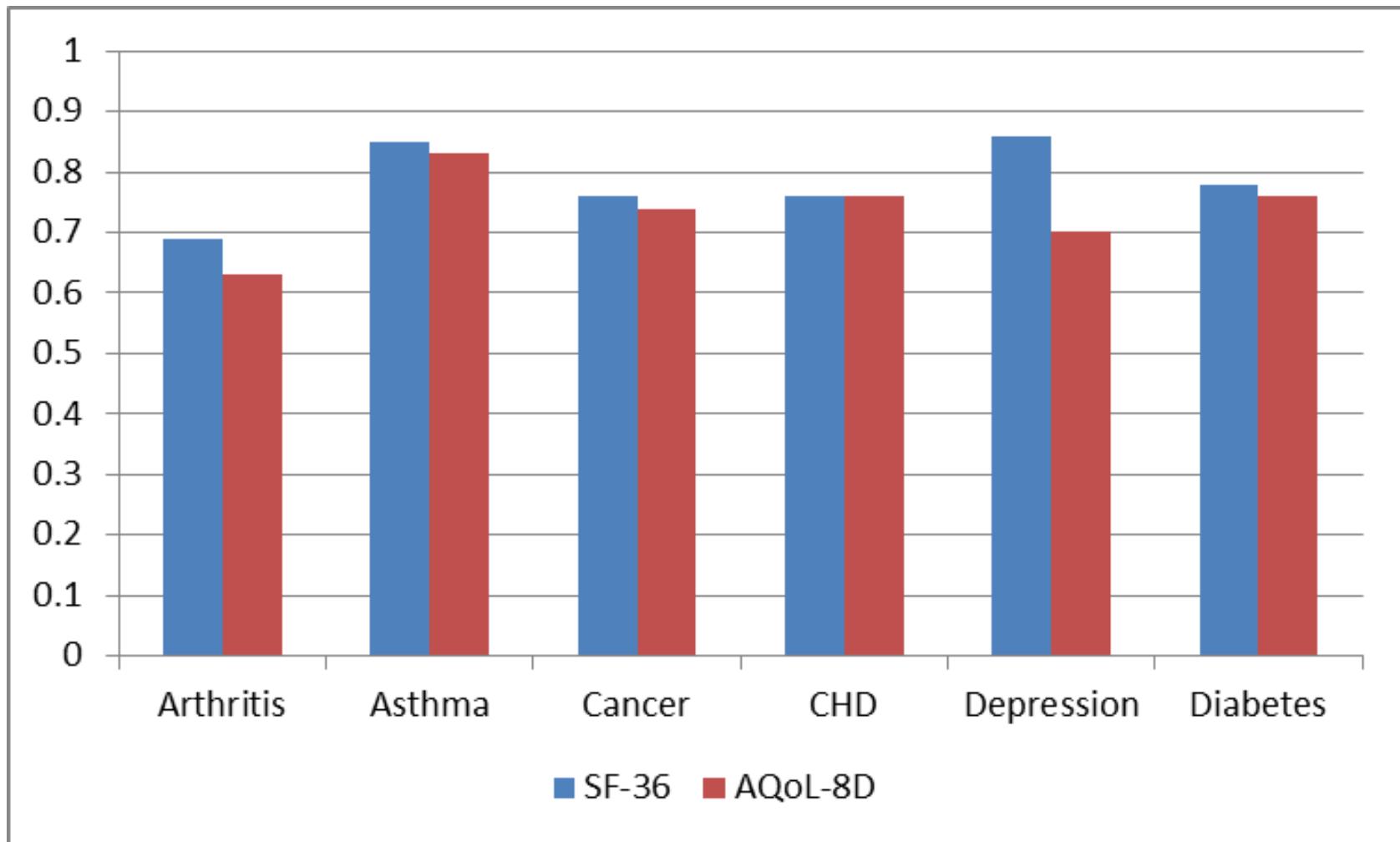
Mental (Psycho-Social) Summary Scores
Ratio of patient group to public
(SF-36, AQoL-8D psycho-social scores)
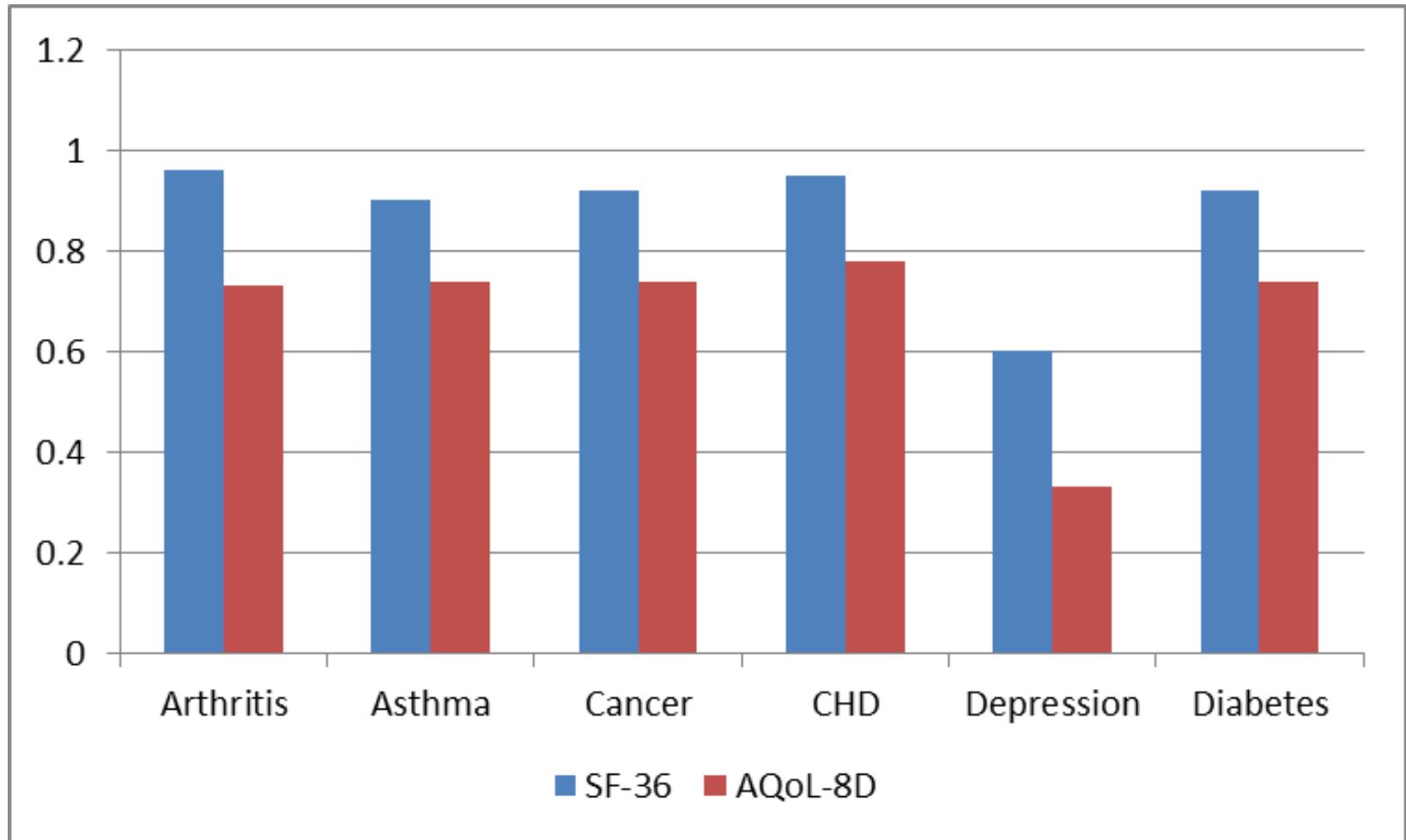
Happiness (Subjective Wellbeing*)
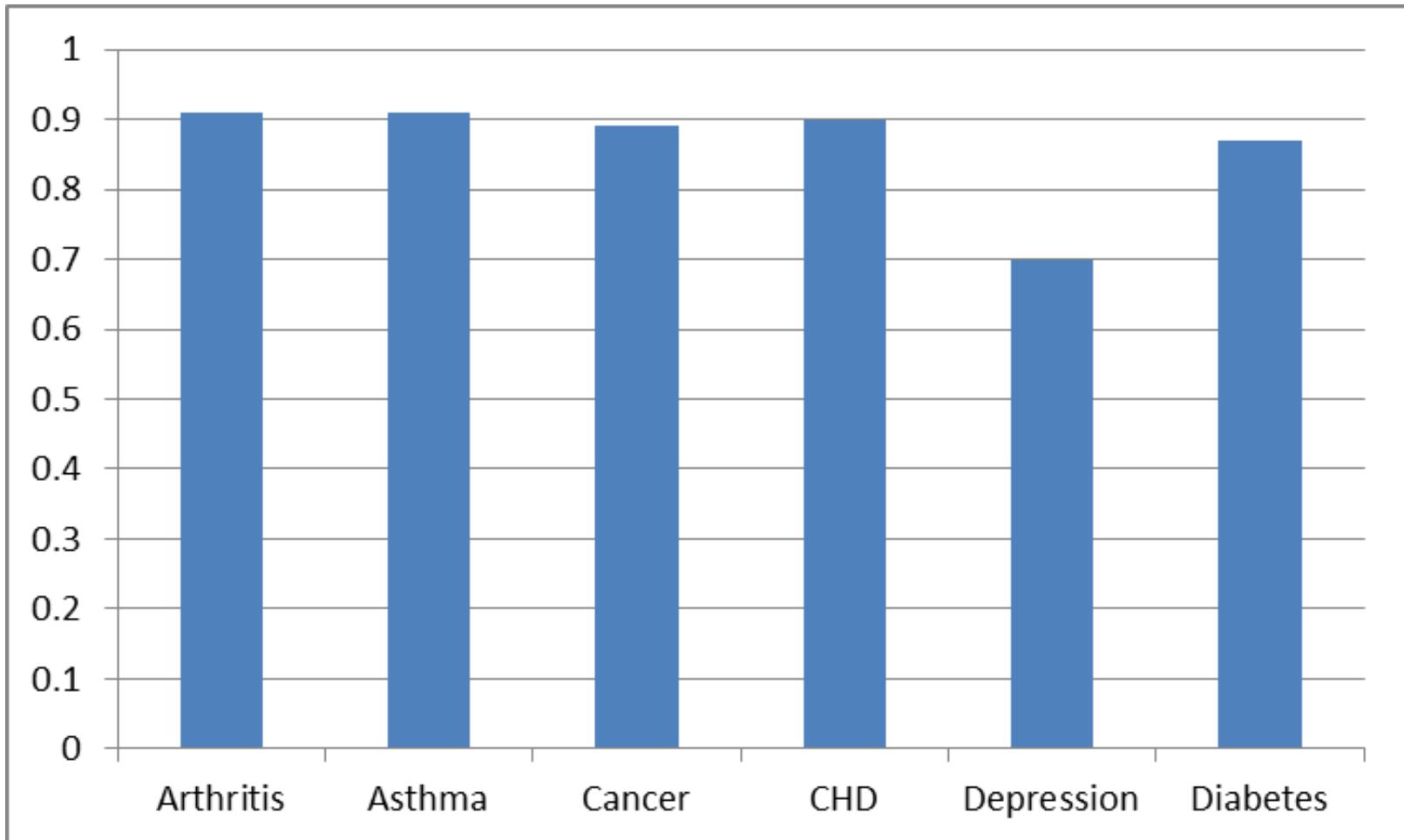
*PWI

Scattergram: Satisfaction with Life Scale (SWLS)
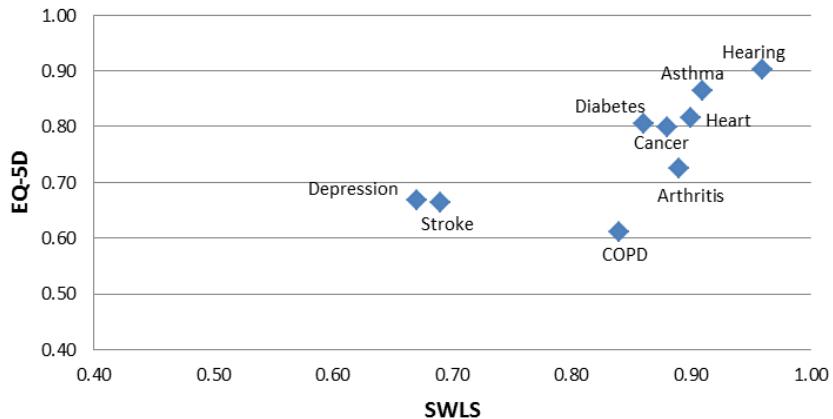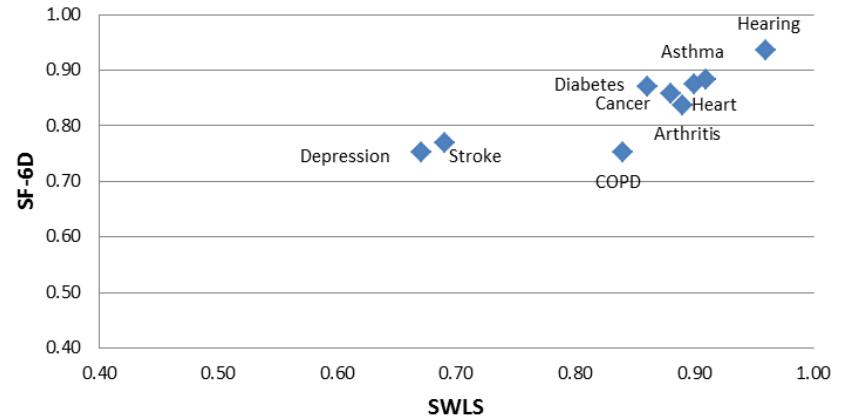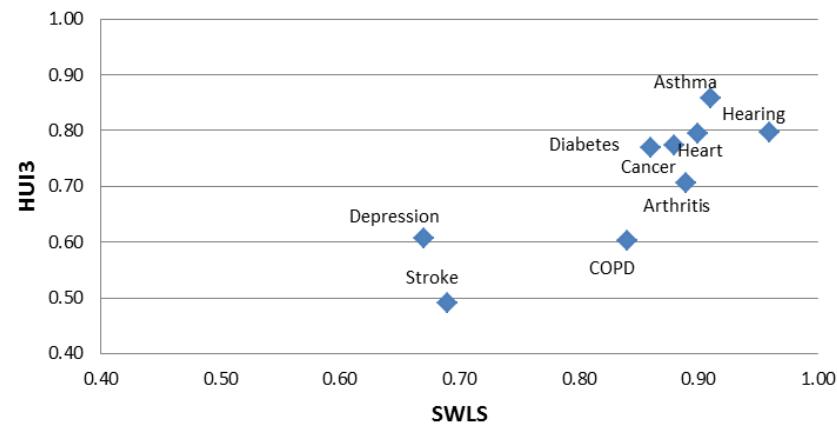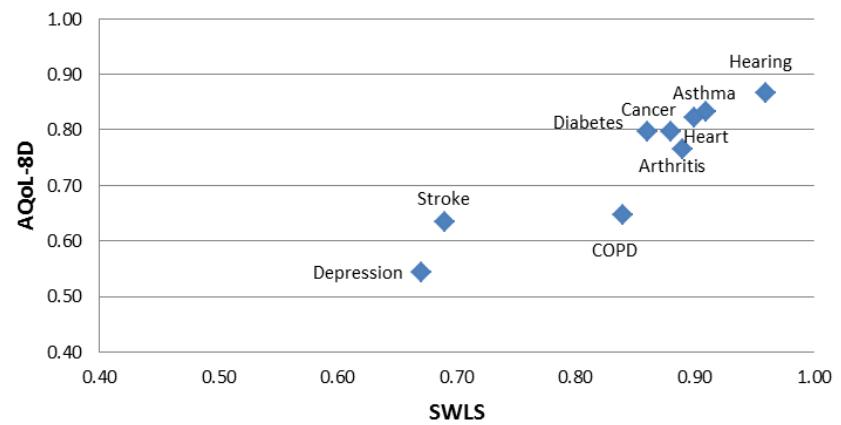
# Physical dimensions: Ratio patient/public SF-36
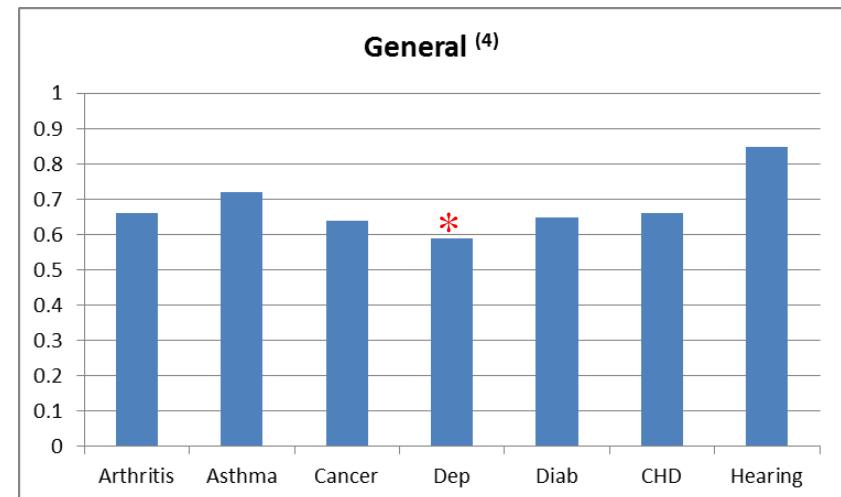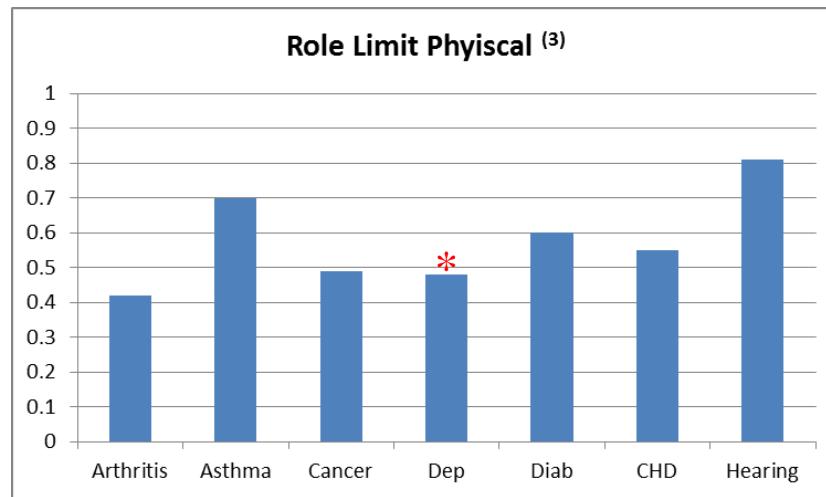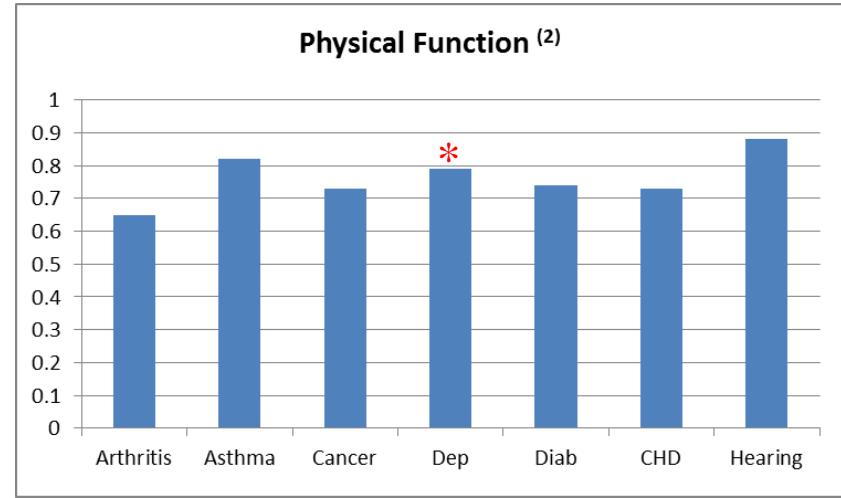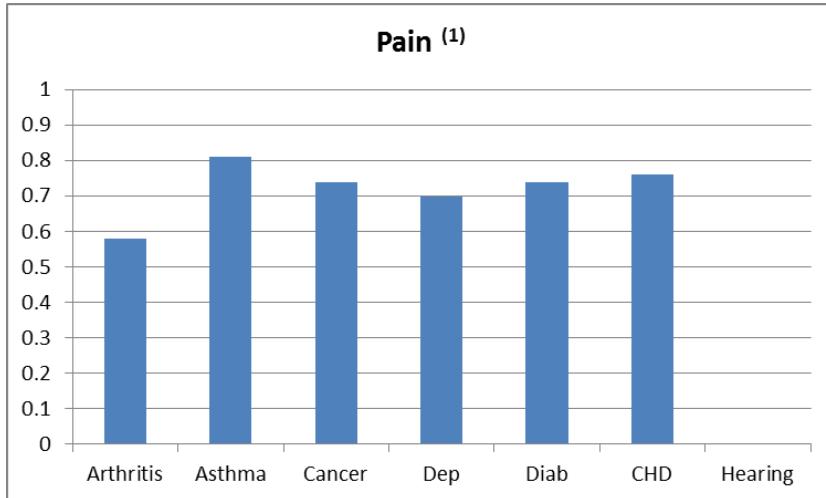
1. Pain: Degrees of pain/interferes with work
2. Physical function: Vigorous activities
3. Role limit: Time spent on work/difficulty
4. General: Self rating

Psycho-social dimensions: Ratio patient/public SF-36
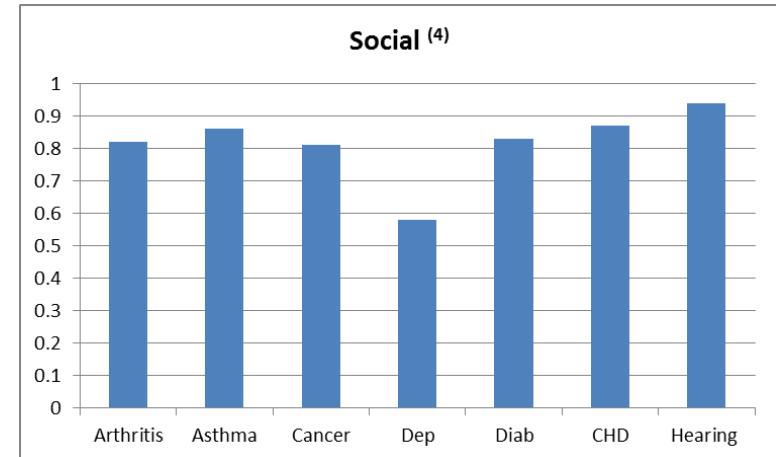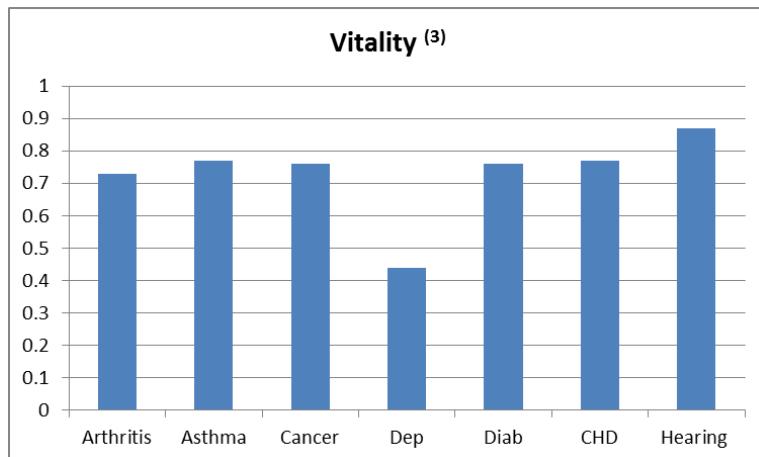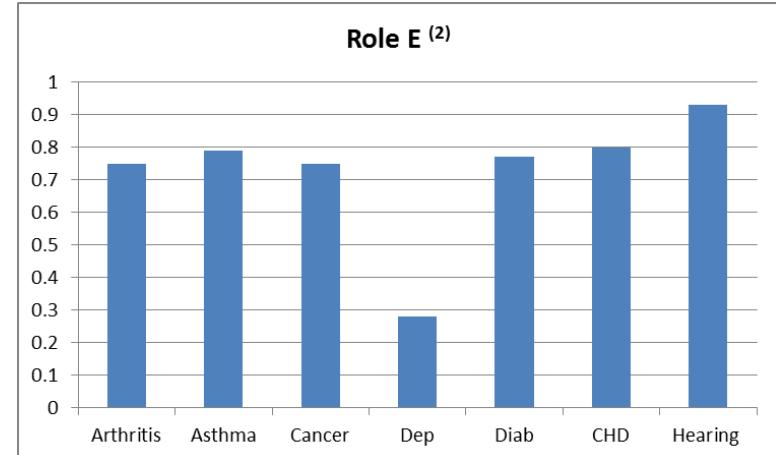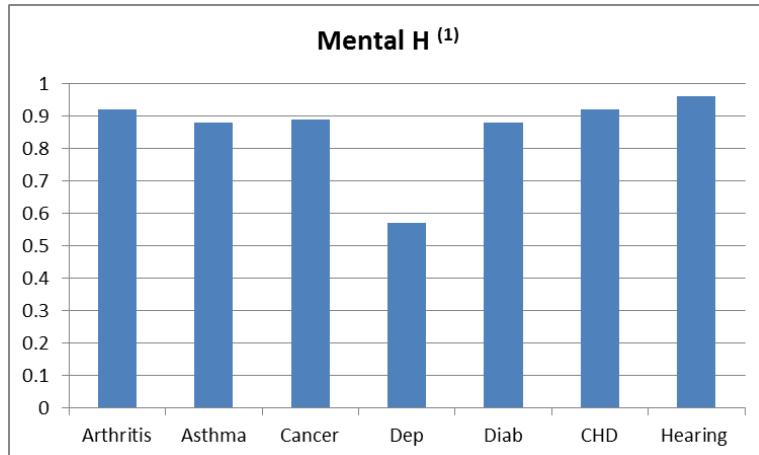
1. Mental: Nervous/down/happiness
2. Role E: Time at work/less careful
3. Vitality: Full of life/worn out
4. Social: interferes with social activities

K10
Dimension Analysis

SF-36 Dimensions on K10

Social fn* = $-0.16 + 1.3$ K10
$R^2 = 0.37$

Mental Health = $-0.8 + 1.0$ K10
$R^2 = 0.66$

Vitality = $-0.22 + 1.0$ K10
$R^2 = 0.35$

SF-36

K-10
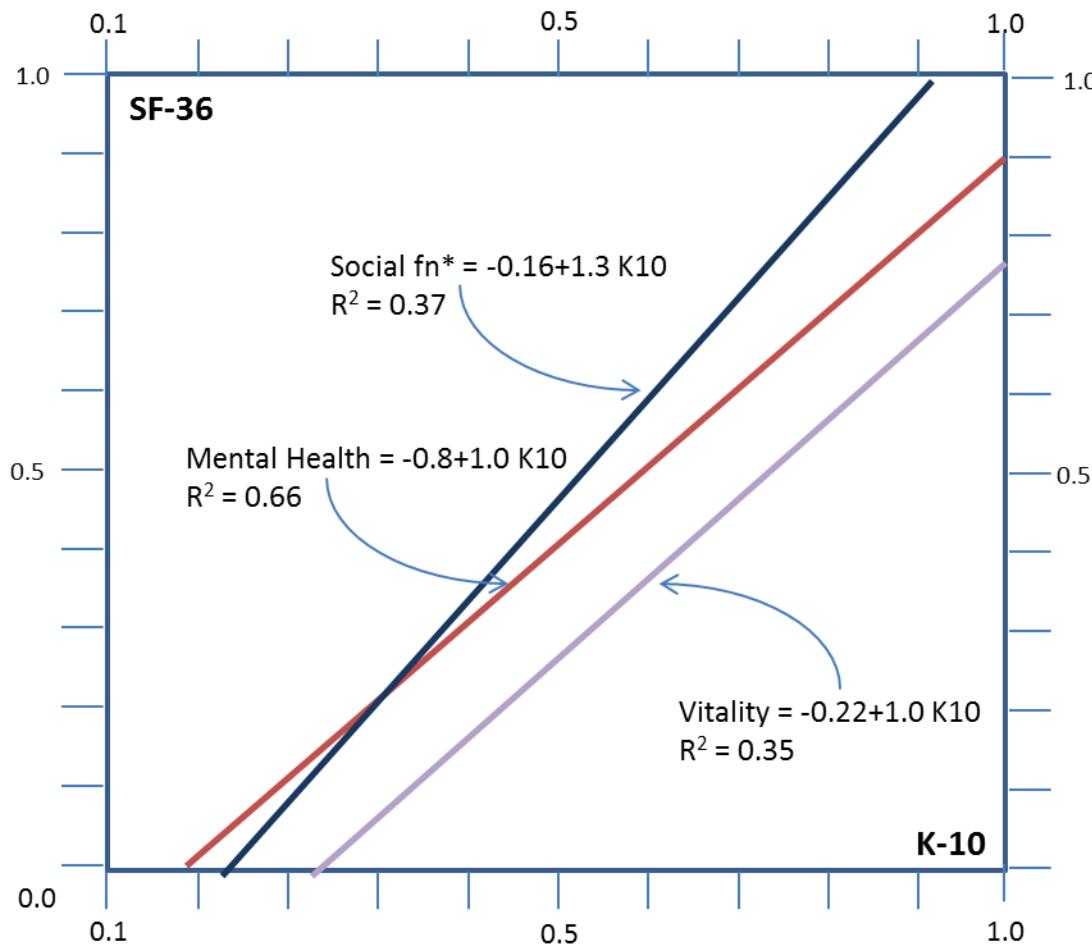
AQoL-8D dimensions on K10

AQoL-8D

Self worth = 0.14+0.88 K10
$R^2 = 0.48$

Coping = 0.16+0.78 K10
$R^2 = 0.43$

Happiness(PWI) = 0.1 K10
$R^2 = 0.43$

Mental Health = 0.18+0.68 K10
$R^2 = 0.60$

Relationships = -0.28+0.55 K10
$R^2 = 0.28$

K-10
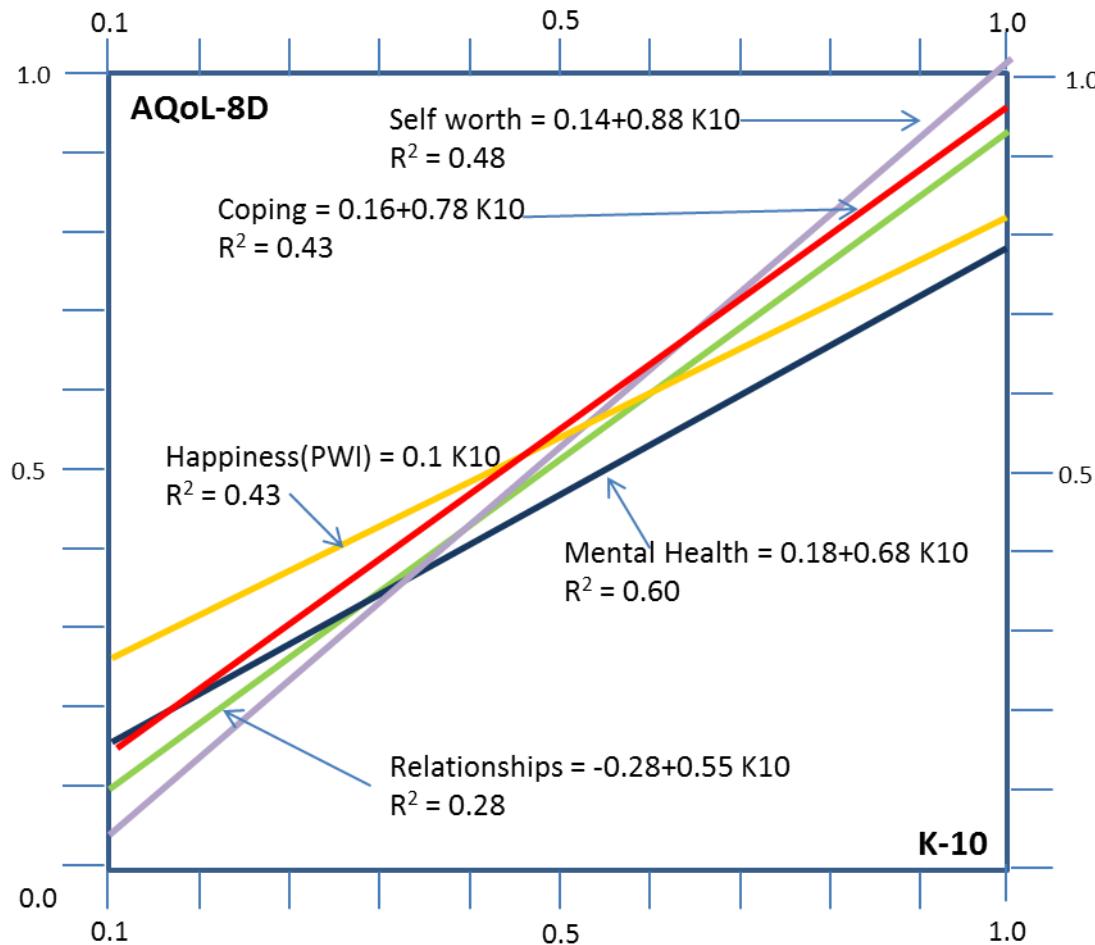
7. Conclusions

Conclusions

1. SWB
   - Utility ≠ happiness
     - ie CUA ↛ maximum happiness
   - Choice of utility not happiness
     - ← history

2. Predictive invalidity
   - Result of CUA ← choice of MAU

3. Content of MAUI
   - Highly variable: requires social choice

4. Disease specific analyses
   - Suggest EQ-5D least sensitive

5. MIC data
   - Available *st* conditions now
   - Freely available from mid 2014

International differences

- Reports for Australia/Canada/Norway/Germany/UK/US
- Main results very similar
- Ongoing research

Differences by Disease

As above

MIC study