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The QALY model and individual preferences for health states and health profiles over time: A systematic review of the literature

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Aki Tsuchiya, PhD †

Centre for Well-being in Public Policy, School of Health and Related Research, University of Sheffield.

Paul Dolan, D. Phil

Centre for Well-being in Public Policy, University of Sheffield.

† **corresponding author**

Aki Tsuchiya, CWiPP, School of Health and Related Research, 30 Regent Street, Sheffield, S1 4DA

Tel: 0114.222.0710 Fax: 0114.272.4095 e-mail: a.tsuchiya@sheffield.ac.uk

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ABSTRACT

The numbers of quality-adjusted life years (QALYs) gained are increasingly being used to represent the gains in individual utility from treatment. This requires that the value of a health improvement to an individual is a simple product of gains in quality of life and length of life. The paper reports on a systematic review of the literature on two issues: whether the value of a state is affected by how long the state lasts; and by states that come before or after it. It was found that individual preferences over health are influenced by the duration of health states and their sequence. However, whilst there is much variation across individual respondents, the assumptions tend to hold much better when valuations are aggregated across respondents, which is encouraging for economic evaluations that rely on using average (mean or median) values.

(139 words)

Key Words: QALYs; individual preferences; utility measurement

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1. INTRODUCTION

Since people experience health benefits as improvements in their quality of life and/or as increases in their length of life, the quality-adjusted life-year (QALY) attempts to combine the value of these attributes into a single index number. At a broad conceptual level, the value of a QALY is the value of one year spent in full health. This is then taken as a benchmark value against which all other health profiles (of whatever duration, in whatever combination through time) are valued. However, since there are an infinite number of such combinations of health states, establishing the benchmark value of each in QALY terms would be quite impractical, and some simplifying assumptions are introduced.

In this paper, we present the results from a systematic review of the literature that was designed to examine the extent to which people's preferences satisfy some of the key assumptions of the QALY model explained below. Our aim has not been to be prescriptive about which elements of the QALY approach *should be* adhered to, and we leave it for others to make their judgements about the normative significance of some of our findings. We also consider this to be a review of empirical tests of QALY assumptions and, while we present a summary of study design (such as the sample size and composition, and the country of origin), we have made no attempt to assess the quality of empirical studies. Because people's preferences are so heavily influenced by the ways in which questions are put to them, it has not really been possible to systematically assess the quality of the empirical evidence. For instance, there are no obvious criteria that allow us to rank between a marginally poorly designed postal survey with a large and representative sample and a marginally better designed interview with a small and non-representative sample. This is in contrast to trial evidence, for example, where the criteria for assessing the quality of studies are well established.

In what follows, section two sets out the QALY model and the assumptions that are tested here. Section three describes how the systematic review was undertaken and presents some

35 summary data about the studies included in the review. Section four discusses the empirical
36 evidence and section five provides a summary of the findings and some conclusions.

37

38 **2. THE QALY MODEL AND ITS ASSUMPTIONS**

39

40 In the simplest case, with no uncertainty, no temporal discounting, and no changes in health
41 over time, the value of a health gain from treatment for an individual, $QALY_G$, can be
42 represented as:

43

$$44 \quad QALY_G = T_1Q_1 - T_0Q_0, \quad [1a]$$

45

46 where T is the number of years of survival, Q represents health state values, and the
47 subscripts 1 and 0 represent health with and without treatment, respectively (1).

48

49 Alternatively, introducing uncertainty and temporal discounting, and assuming discrete time
50 so that changes in health occur only when moving from one period to the next, the expected
51 net gain of a treatment to any one individual can be expressed as:

52

$$53 \quad QALY_G = \sum_h \sum_t {}_t p_{1ht} Q_{ht} - \sum_h \sum_t {}_t p_{0ht} Q_{ht}, \quad [1b]$$

54

55 where p_{1ht} and p_{0ht} represent the probabilities of an individual finding himself in health state h
56 in time period t with and without treatment, respectively. Q_{ht} is the value of health state h at
57 time t (the subscript t here allows for constant rate temporal discounting so that $Q_{ht} = \frac{Q_h}{(1+r)^t}$,

58 where r is the discount rate).

59

60 This algorithm – the QALY model – is an expression of the value to an individual associated
61 with a given intervention. If the quality of life associated with ‘full health’ were to be
62 assigned a value of 1, then the algorithm could be considered to express health gains
63 measured in ‘objective physical units’ i.e. life years. Any state of health less than this is
64 adjusted for its quality and hence assigned a lower value. Against a background based on
65 expected utility theory, Pliskin and colleagues first set out a set of sufficient assumptions for
66 this simple model to represent individual utility over health states and duration (2). For
67 health profiles of constant quality (i.e. “chronic” states), these are mutual utility

68 independence between quality of life and duration, constant proportional trade-off, and risk
69 neutrality over life years. Bleichrodt and colleagues have presented a smaller set of sufficient
70 assumptions consisting of risk neutrality and the “zero condition” (which implies that for a
71 duration of zero life years, all health state values are equivalent) (3). Alternatively,
72 Miyamoto and colleagues further demonstrated that, with non-linear utility functions, this set
73 becomes the zero condition and “standard gamble invariance” a special case of the utility
74 independence of duration of survival from quality of life) (4).

75

76 On the other hand, besides risk attitude and time preference (which are issues not specific to
77 health and QALYs), the empirical literature on whether the QALY model holds have
78 typically addressed one or both of the following two questions:

- 79 1. Is the value of a state affected by how long the state lasts?
- 80 2. Is the value of a state affected by the states that come before or after it?

81

82 The first question is related to three concepts: utility independence of quality of life from the
83 duration of survival, constant proportional time trade-off, and maximum endurable time. The
84 first two terms both mean that the value of a health state is independent of its duration (2;5;6).
85 *Utility independence* here means that values elicited using Standard Gamble (SG) with some
86 given fixed duration are unaffected by this specific choice of duration. *Constant proportional*
87 *time trade-off* means that values elicited using Time Trade-Off (TTO) are not affected by
88 duration i.e. the same proportional amount of time is traded-off independently of the absolute
89 duration presented in the scenario. When these concepts are applied to VAS (Visual
90 Analogue Scale) values, they mean that VAS scores should not be affected by how long the
91 state lasts. *Maximal endurable time* means that, for some severe states (independent of which
92 method is used to value them), the value of those states becomes negative after some
93 threshold duration. When maximal endurable time takes effect, utility independence and
94 constant proportional time trade-off are violated.

95

96 The second question can be broken down into two issues. The first is whether or not *additive*
97 *separability* holds; that is, the value of a health state should be independent of what precedes
98 or follows it (7). Under zero discounting, additive separability means that the value of a
99 complete health profile would be equal to the sum of the value of individual health states that
100 make up that profile, irrespective of the order of the states. Obviously, the present value of
101 the two profiles will not coincide under non-zero discounting, but then, the difference should

102 be a function of a positive discount rate alone. The second is whether or not *preference*
103 *independence* holds. This requires that “given two profiles that have the same health state
104 during interval *i*, preference between them does not depend on the level of health during
105 interval *i*” (8). The testing of this concept does not rely on any assumptions concerning time
106 preference. However, there is a large literature in experimental psychology that addresses the
107 issue of how people’s perceptions are affected by “troughs and peaks”, or sequence effects
108 (see (9) which includes a brief review). This suggests that additive separability and
109 preference independence in the context of QALYs may not be satisfied.

110

111 Thus, this paper reports on a systematic literature review on these two questions. As can be
112 seen, these two questions are taken from the set of sufficient assumptions set out in the
113 literature. As they are individual assumptions within sets of sufficient assumptions,
114 demonstrating that any one of these is satisfied individually will not validate the QALY
115 model (although it may count as additional piece of evidence in favour of the validity of the
116 model). On the other hand, since each of these assumptions is also a necessary assumption,
117 demonstrating that any of these are not satisfied has the potential to invalidate the QALY
118 model.

119

120 **3. THE LITERATURE SEARCH**

121

122 The aim of the search strategy was to identify systematically all issues relating to the two
123 topics of the review through the retrieval of published and unpublished papers. A method
124 called ‘citation pearl growing’ (10) was employed, using the citation search facility of the
125 Institute of Scientific Information (ISI) citation indexes and through reference list searching
126 (as also used in (1)). These databases cover the science (including biomedical science),
127 social sciences (including economics) and arts and humanities literature. In addition the
128 websites, publication lists and research registers of relevant organisations were searched and
129 relevant experts were consulted. The process of citation searching begins from an initial list
130 of relevant references, which were put together from the authors’ own collections. Finally, a
131 keyword search strategy was developed, based on the indexing terms of included studies, in
132 order to check the completeness of the primary search method. The search was restricted to
133 papers in the English language, dated 2002 or earlier.

134

135 After three rounds of searching, no additional unique references were retrieved. This
136 provided 601 references. Using the titles and abstracts of retrieved references the first author
137 undertook the first stage of assessment for inclusion, and then the second author checked a
138 sample of the references excluded at this stage. Full papers were assessed for inclusion
139 independently by both authors. Through this process, 71 papers were identified as relevant,
140 including 20 with empirical data. Table 1 provides information on the empirical studies, in
141 terms of study design, sample population and sample size. It can be seen from this table that
142 most of the empirical studies have used structured interviews with students or patients, and
143 have often had sample sizes less than 100. The table also shows the country in which the
144 study was conducted. Most of the studies have been carried out in North America, followed
145 by the UK and Europe.

146

147 **4. EMPIRICAL EVIDENCE ON THE QALY MODEL**

148

149 **4.1 Is the value of a state is unaffected by how long the state lasts?**

150

151 4.1.1 Utility independence

152

153 McNeil and colleagues interviewed 37 volunteers (25 executives and 12 fire-fighters) and
154 asked them to value speech loss for various lengths of time (11). They found that, while
155 respondents on average accepted a 14% risk of death to avoid speech loss, none accepted a
156 positive risk of death when survival was shorter than 5 years. Bleichrodt and Johannesson
157 asked 172 students to fill in a questionnaire with SG questions of 10 and 30 year durations,
158 followed by death (6). The authors conclude that utility independence is violated at the
159 aggregate level, with 10-year SG values higher than 30-year SG ones. Bala and colleagues
160 interviewed 114 elderly people using 20-year SG and a 1-year SG, both followed by death
161 (12). About 25% satisfy utility independence but there is no systematic pattern in the
162 responses of those who do not.

163

164 4.1.2 Constant proportional time trade off

165

166 Several studies have shown constant proportional time trade off to be a pretty good
167 approximation of preferences at the aggregate level. In a questionnaire survey, Pliskin and
168 colleagues asked 10 respondents (physicians, economists, and statisticians) the number of

169 years they will sacrifice to avoid severe or mild angina pain (2). The same question was
170 asked with 5-year and 15-year survival baselines. At the individual level, most respondents
171 violated constant proportional time trade-off. However, at the aggregate level there is little
172 difference between the trade-offs from the 5-year TTO and the 15-year TTO. Cook and
173 colleagues interviewed over 500 patients with gallstone disease and, at the aggregate level,
174 trade-offs for states lasting 12 months and 12 years followed by death were not significantly
175 different from one another (13). Bleichrodt and Johannesson found that 10-year TTO and 30-
176 year TTO values (followed by death) did not differ from one another at the aggregate level
177 (6).

178

179 However, other studies have shown constant proportional time trade off to be violated. All of
180 these except the one by Unic and colleagues have found that shorter periods of time are
181 associated with less trade-offs (i.e. higher implied health state values) (14). Sackett and
182 Torrance interviewed 246 members of the public and 29 patients on home dialysis (15). They
183 asked respondents to value 15 scenarios covering various health conditions from tuberculosis
184 to kidney transplant, with durations of 3 months, 8 years, and the life expectancy of a
185 respondent, all followed by death. They found that values declined with duration. In a study
186 on utility independence of duration on quality of life where 64 hospital inpatients with a
187 range of conditions were interviewed, Miyamoto and Eraker also explored constant
188 proportional time trade off, and report that about 25% of respondents did not trade off any
189 time to improve their current health when the duration was under 1 year, whilst time was
190 traded off when the duration was over a year (16).

191

192 Stalmeier and colleagues asked four groups of university and high school students (total
193 respondents 176) to rank two scenarios, one living for a longer time with a severe health
194 condition and dying, and another living for a shorter time with the same health condition and
195 dying (17). The proportion of those who ranked the shorter scenario over the longer one
196 varied from 44% to 71%. The vast majority of these (73% to 94%) displayed a *preference*
197 *reversal*, where their TTO value for the shorter scenario was lower than that for the longer
198 scenario. Furthermore, regarding those respondents whose preferences were not reversed, the
199 authors go on to discuss the possibility of a “proportional heuristic” in the TTO. When
200 respondents are asked to give the number of healthy years that is equivalent to living in a
201 given state for 10 years, and then the same for 20 years, respondents may give proportional
202 answers not because they satisfy constant proportional time trade off but because they see

203 that the numeraire of the exercise has been doubled. Since this indicates that certain tests
204 of constant proportional time trade off may be too easy to pass, this has important
205 implications for earlier studies that demonstrated satisfaction of this requirement.

206

207 Buckingham and colleagues conducted a postal survey of over 4000 members of the public,
208 with over 1500 usable replies (18). They report aggregate results from three different TTO
209 formats for a condition that lasts for the rest of one's life. These were: a daily TTO which
210 was about trading off the number of hours awake per day; a yearly TTO which was about
211 trading off the number of active days per year; and the lifetime TTO which was about trading
212 off years of life expectancy. Assuming that time spent sleeping, 'lost' days and lost years are
213 all valued at zero, constant proportional time trade off will require that the proportion of a
214 day that is traded off is equal to the proportions of a year and of a lifetime that are traded off
215 in exchange for full health. The study found that the yearly values are the highest and the
216 daily values the lowest. This suggests that the relationship between the length of the period
217 and the size of the trade off may not be linear. There has been one study that has looked at
218 the effect of duration on VAS responses. From interview with 236 members of the general
219 public, Dolan reports values for health states lasting for one month, one year and ten years
220 "and what happens thereafter is not known and should not be taken into account". (19). In
221 general, the shorter the duration, the higher the value. Olsen has presented a method whereby
222 positive implicit time preference rates can be derived for such responses (20).

223

224 4.1.3 Maximal endurable time

225

226 Sutherland and colleagues interviewed 20 health professionals (physicians, biophysicists,
227 biologists) and asked them to value 7 states, each lasting for 3 months, 8 years, and the
228 respondent's life expectancy, each followed by death, using the SG (21). They were also
229 asked for the preference between each scenario and death. A maximal endurable time was
230 observed for up to 75% of respondents, depending on the health state. The worse a health
231 state was considered to be the more respondents indicated maximal endurable time.

232 Stalmeier and colleagues asked three groups of female university and high school students
233 (totalling 86 respondents) to value breast cancer related health states (22). 58% indicated
234 maximal endurable time such that 25 years with metastasised breast cancer (implicitly
235 followed by death) was preferred to 50 years in the same state (again implicitly followed by
236 death). However, 74% of these also indicated preference reversals in TTO such that the

237 number of healthy years equivalent to 25 years with metastasised breast cancer was
238 proportionally smaller than that for 50 years in the same state.

239

240 **4.2 Is the value of a state is unaffected by the states that come before or after it?**

241

242 4.2.1 Additive separability

243

244 Richardson and colleagues interviewed 63 women who did not have breast cancer to value
245 four breast cancer related health scenarios using VAS, TTO and SG (23). Three scenarios
246 consisted of a single health state while the last one was a profile combining these three states
247 in deteriorating order followed by death. Using a 3% and a 9% discount rate, they found that
248 the number of QALYs calculated indirectly from the individual health states was 30-50%
249 higher than number of QALYs calculated from the direct value of the profile. The authors
250 argue that “the knowledge of future death casts a shadow over, or devalues, the enjoyment of
251 earlier life years”. Thus, there is the possibility that the results are driven by the dread of
252 suffering and death at the end of the scenario in addition to a systematic violation of the
253 additivity assumption.

254

255 Kuppermann and colleagues interviewed 121 pregnant women and asked them to value
256 (using VAS and SG) eight “paths”, involving two prenatal diagnostic tests for chromosomal
257 abnormalities of the foetus at different stages of the pregnancy, different test results, and
258 outcomes including spontaneous abortion of the foetus possibly related to the test and the
259 effect on the woman’s fertility afterwards (24). The paths were then broken down into
260 discrete states, and the direct valuation of the paths was compared to the indirect values
261 calculated from the values of the discrete states, assuming no temporal discounting. At the
262 individual level, preferences were not additive, and there does not seem to be any obvious
263 pattern. At the aggregate level, the mean direct value could be predicted from the mean
264 values of the discrete states but this was not by means of an additive model weighted by
265 duration, as suggested by the additivity assumption. The results were not affected by the
266 introduction of a 5% discount rate. In general terms, the indirect values of the paths tended to
267 be higher than the direct values, including the case where the path was not a deteriorating
268 one.

269

270 Krabbe and Bonsel asked 104 (mostly medical) students to value 13 hypothetical health states
271 on two separate occasions using the TTO (25). The health states lasted for 10 years. On the
272 first occasion the respondents were given two alternatives, one of living in a fixed state
273 (EQ5D state 21232) and the other of living for x years in the ‘best imaginable’ state followed
274 by $(10-x)$ years in the ‘worst imaginable’ state. On the second occasion the second
275 alternative was changed to to live for z years in ‘worst imaginable’ state followed by $(10-z)$
276 years in ‘best imaginable’ state. Under both formats, after the 10-year period, health was to
277 return to the current level. If additive separability holds, then, with appropriate discounting,
278 the number of years spent in the best health state in the two scenarios should coincide. This
279 held for two-thirds of respondents when a discount rate of 5% was used for everybody. Thus,
280 on the one hand, by allowing for individual discount rates, a higher proportion of respondents
281 may have achieved convergence of the numbers of years. On the other hand, there is also the
282 possibility that the discount rate that makes the numbers of years converge may not reflect
283 the genuine temporal preference of the individual, in which case two-thirds could be an
284 overestimate. A small proportion of the remaining wanted “best things first”, while the
285 majority wanted a “happy ending”.

286

287 Mackeigan and colleagues interviewed 89 patients with type-2 diabetes (26). Nine scenarios,
288 covering 30 years and followed by death, consisting of diet therapy, insulin use, three
289 “mono” therapies, three “dual” therapies, and one “triple” therapy were valued using VAS
290 and TTO. The study found that the indirect and direct values of the combination therapies
291 were not statistically significantly different from one another. However, the agreement
292 between the two approaches was poor, suggesting that the differences between the health
293 states may have been too small to invoke the sequence effect. Spencer conducted interviews
294 with 29 members of the public that tested for additive separability in two ways whilst
295 controlling for risk attitude and time preference (27). In the first test, using the SG method,
296 the *difference* between profiles $x-y$ and $x-z$ was compared to the *difference* between profiles
297 $w-y$ and $w-z$, where all profiles lasted 10 years and were followed by death. The differences
298 were statistically significant, thus violating additive separability. The second test was first
299 proposed by Bleichrodt (28) and consists of a choice between two gambles: one offers a 50-
300 50 chance of the best and worst health states, and the other involves a 50-50 chance of the
301 best-then-worst profile and the worst-then-best profile. The respondents were split roughly in
302 half, 13 preferring the former gamble and 15 preferring the latter, while one was indifferent.

303 This suggests a violation of additive separability but it is not systematic and so could, in the
304 extreme, simply represent noise in the valuation process.

305

306 4.2.2 Preference Independence

307

308 Treadwell presented 163 psychology students with pairwise choices of health profiles (8).
309 Each combination consisted of two scenario pairs: A with B and A' with B' , all with a 30-year
310 duration followed by death, constructed such that independence is satisfied when a
311 respondent who prefers A (B) in the first pair also prefers A' (B') in the second pair. The
312 author concludes “independence was more commonly satisfied than it was violated”. Out of
313 42 combinations tested, the requirement was satisfied in 36. Treadwell and colleagues asked
314 67 outpatients with type-C hepatitis to fill out a questionnaire that asked them six pairwise
315 choices of health profiles (29). The profiles were either both followed by “normal” health or
316 both ended in death. About two-thirds of respondents satisfied independence. However,
317 when respondents were asked to give reasons for their choices, explanations implying
318 sequence effects were observed e.g. to “get [bad states] out of the way” or to have a relatively
319 good state before death.

320

321 **5. CONCLUSIONS**

322

323 Let us summarise the empirical evidence relating to the two questions posed at the beginning:

324

325 1. Preferences over different health states when they are valued using different fixed
326 durations. There have been two empirical studies addressing utility independence of SG
327 responses from duration. The respondents in these studies did not satisfy this, although
328 there is no clear pattern in the violations. There have been eight studies that have looked
329 at whether constant proportional time trade-off holds for TTO responses. In general, the
330 results suggest that the assumption holds at the aggregate level but is violated (albeit in a
331 largely non-systematic way) at the individual level. Shorter durations typically have
332 higher values, and longer durations are sometimes associated with a maximal endurable
333 time, after which time death is preferred to additional survival in the state.

334

335 2. Preferences over profiles of different health states. The five studies that have addressed
336 additive separability suggest that this requirement does not hold but we cannot really

337 point to any clear systematic violations. Two studies have addressed preference
338 independence, and both found that the majority of respondents satisfy the requirement.

339

340 Thus, contrary to the assumptions of the QALY model, it would seem that an individual's
341 preferences over health are influenced by the duration of health states and their sequence.
342 Given that each of these are necessary conditions for the QALY model to hold, they cast
343 serious doubt to the validity of the QALY model as a representation of individual utility with
344 respect to their own health. Unfortunately, none of these factors appears to impact upon the
345 QALY model in a straightforward way and so it is not possible at this stage to provide a
346 simple algorithm to adjust the QALY model to better represent individual preferences over
347 own health. However, there have been two developments to generalise the QALY model in
348 order to overcome known and systematic violations. The first is the HYE (Health Years
349 Equivalents), introduced by Mehrez and Gafni (30). Mehrez and Gafni argue that the
350 standard QALY concept is flawed because, while the quality adjustment component of the
351 QALY is preference-based, the life year component is not. In order to reflect this, they
352 proposed the HYE, which is based on measuring the value of whole profiles directly, as
353 opposed to constructing this through values of individual states. Therefore, it does not
354 require the additive separability assumption or preference independence (31-35). However,
355 its major practical disadvantage is that it is virtually impossible to estimate a value set for all
356 possible profiles, given the infinite number of profiles there would be.

357

358 The second development concerns generalisations of expected utility theory. The theory has
359 offered the main theoretical background to the QALY model, and yet the extent to which
360 individual choice behaviour violates its axioms is well documented. The new developments
361 base the QALY model on, for instance, rank dependent expected utility theory (36-38). This
362 line of research consists of identifying theoretical models that satisfy both some notion of
363 what is rational and real choice behaviour, in order to better explain the way the human mind
364 behaves when faced with choices regarding health. However, it should also be noted that
365 expected utility theory could remain as the theoretical basis on which to make policy choices,
366 even if actual individual choices violate their axioms. Or, in other words, the particular
367 notion of rationality that best fits real individual behaviour does not have to be the one that
368 forms the basis for policy choices.

369

370 It should also be noted that, once we turn to putting the numbers to policy use (as opposed to
371 positive uses), it is usually not the individual preferences but the aggregate (mean or median)
372 preferences that are applied. While not all studies report whether or not aggregate
373 preferences satisfy the assumptions of the QALY model, when they are reported, they appear
374 to perform much better than individual preferences. Moreover, many of the violations at the
375 individual level do not follow a systematic pattern i.e. some people violate an axiom in one
376 direction and others violate it in another direction, which might simply represent noise in the
377 valuation process. Ultimately, it is a matter of judgement about whether the inability of the
378 QALY model to accurately represent all individual preferences is compensated for by the fact
379 that it more accurately represents aggregate preferences.

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Table 1: Empirical references

Author(s)	Year	Reference no.	Design	Sample	Sample size	Country of study	Assumptions tested	Technique used
Bala et al	1999	13	SI	GP (c)	114	USA	UI	SG
Bleichrodt et al	1996	5	SQ	S	172	Sweden, the Netherlands	UI, CPT	SG, TTO
Buckingham et al	1996	18	PQ	GP (r)	1500+	UK	CPT	TTO
Cook et al	1994	14	SI	P	500+	Australia	CPT	TTO
Dolan	1996	19	SI	GP (r)	236	UK	CPT	TTO, VAS
Krabbe et al	1998	25	E	S	104	the Netherlands	AS	TTO
Kuppermann et al	1997	24	SI	P	121	USA	AS	SG, VAS
MacKeigan et al	1999	26	SI	P	89	Canada	AS	VAS, TTO
McNeil et al	1981	12	SI	GP (c)	37	USA	CPT	SG
Miyamoto et al	1988	11	SI	P	64	USA	CPT	TTO
Pliskin et al	1980	2	SI	HP	10	USA	CPT	TTO
Richardson et al	1996	23	SI	GP (c)	63	Australia	AS	VAS, TTO, SG
Sackett et al	1978	17	SI	GP (r) P	246 29	Canada	CPT	TTO
Spencer	2000	27	SI	GP (c)	29	UK	AS	SG
Stalmeier et al	1997	16	SI	S	176	the Netherlands	CPT	RP, TTO
Stalmeier et al	1996	22	SI	S	86	the Netherlands	MET	TTO
Sutherland et al	1982	21	SI	HPA	20	Canada	MET	SG
Treadwell	1998	8	SQ	S	163	USA	PI	RP
Treadwell et al	2000	29	SQ	P	67	USA	PI	RP
Unic et al	1998	15	SI	GP (c)	54	the Netherlands	CPT	TTO

Key:

Design: PQ = postal questionnaire; SQ = self-completion questionnaire; SI = structured interview; E = experiment

Sample: GP (r) = general public (random/quota); GP (c) = general public (convenience); S = students; P = patients; HPA = health professionals or academic staff.

Assumptions tested: UI = utility independence; CPT = constant proportional time trade off; MET = maximal endurable time; PI = preference independence; AS = additive separability

Technique used: SG = standard gamble; TTO = time trade-off; VAS = visual analogue scale; RP = ranking or pairwise choice