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Searching for the social value of a QALY in the Netherlands:

The Willingness to Pay for a QALY

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Abstract

Objective: the aim of this study was to elicit the social willingness to pay (WTP) for a Quality Adjusted Life Year (QALY) from the Socially-Inclusive Individual (SII) perspective in the Netherlands.

Methods: Respondents valued a hypothetical health state scenario by means of a web-based contingent valuation exercise. The respondents first valued their own health state, using the EQ-5D profile, and were asked to rate their own health, perfect health, death and the hypothetical health state scenario on the Visual Analogue Scale (VAS). Furthermore respondents expressed their WTP for avoiding a decline in health from their own current health state (better) to the hypothetical health state scenario (worse) using a payment scale, followed by a bounded open contingent valuation question.

Analysis: WTP per QALY was calculated for QALY gains using both VAS valuations, as well as the Dutch EQ-5D tariffs. Three different scenario's were created in order to calculate QALY losses (i.e. QALY gains) due to premature death. Differences in WTP per QALY estimates were examined from the perspective of household income and the level of certainty in WTP expressed by respondents. Theoretical validity was analyzed using multivariate regressions. By means of a sensitivity analysis it was investigated whether expressed WTP was sensitive to scale.

Results: 498 respondents, representative of the Dutch population, participated in the survey. Mean WTP per QALY was € 65,797 based on Dutch EQ-5D tariffs and € 65,194 based on VAS valuations. Incorporating discounting and a correction for age-related quality of life decline lead to much higher WTP estimates. WTP for a QALY was strongly associated with income, varying from an average of € 43,611 (EQ-5D) and € 43,211 (VAS) in the lowest income group to an average of € 84,505 (EQ-5D) and € 83,730 (VAS) in the highest income group. Regression analyses confirmed expected relations between WTP, size of the QALY gain, income, and some other socio-economic characteristics.

Conclusion: Social WTP per QALY values elicited in this study are higher than those found in studies reporting individual WTP values. Social WTP for a QALY is a rather unexplored item and requires more research.

Keywords: cost-effectiveness, ICER threshold, social decision-making, QALY, WTP, socially-inclusive individual perspective

Preface

By means of this thesis I am completing the Master Health Economics, Policy & Law and its specialisation Health Economics at the Institute of Health Policy and Management of the Erasmus University of Rotterdam.

Although it was a struggle from time to time, I have learned a great deal about doing research, analysing data and writing (and rewriting) my findings. Moreover, I gained much insight into the literature concerning the value of health and regarding health technology assessment in general. Hopefully, I will be able to apply this knowledge into practice in the future as I would love to make a career in the field of HTA.

Finally, I would like to thank my tutor Ana Bobinac, PhD, for guiding me during the entire process from analysing the empirical data to writing my thesis and being a great and skilful tutor who has helped me to finalize my master thesis.

Also, I would like to thank Job van Exel, PhD, and Renske Hoefman, MSc for taking the time and trouble to function as my co-readers and everyone else at the Institute of Health Policy and Management for giving me an opportunity to obtain a Masters degree in science.

Rotterdam, October 2012

"Money is the most envied, but the least enjoyed.

Health is the most enjoyed, but the least envied "

~ Charles Caleb Colton

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List of Abbreviations

CV: Contingent Valuation

EQ-5D: EuroQol 5D (5 dimensions)

HRQOL: Health-Related Quality of Life

QALY: Quality Adjusted Life Year

QOL: Quality of Life

SII: Socially-inclusive individual (perspective)

SOC : Social (perspective)

VAS: Visual Analogue Scale

WTP: Willingness to Pay

1. Introduction

In most countries no market[1] for health and healthcare exists, due to specific market failures [2], and most health services are provided directly or subsidized by the government. In the absence of a market, healthcare decision-makers require some explicit criteria to help them optimize the allocation of resources and the distribution of healthcare (Smith & Richardson, 2005). Economic evaluation can aid decision-makers in doing so. Economic evaluation is an accepted method for the appraisal of healthcare programs and may be defined as '*the comparative analysis of alternative courses of action in terms of both their costs and consequences*' (Drummond et al., 2005). The main aim of economic evaluation is to maximize health from an available budget. Economic evaluations in healthcare are becoming increasingly important, because healthcare resources are limited by the total funds available. This raises the question of how to decide how the resources should be allocated most appropriately (Evans, 2004).

There are different methods to perform economic evaluation in healthcare, but the majority is performed by either cost-effectiveness (CEA) or cost-utility analysis (CUA) (Drummond et al., 2005). CUA is a specific type of CEA[3] and is particularly a popular method in the field of health economics, because all healthcare outcomes are expressed in one comprehensive measure, the *Quality Adjusted Life Year* (QALY) (Smith & Richardson, 2005). QALYs can be used to describe the benefit of any intervention, making all benefits mutually comparable (unlike, for instance CEA, where these benefits are expressed in natural units[4] and thus mostly incomparable). QALYs combine both quality and length of life into one single measure. This measure ranges between zero and one on a cardinal scale, where a QALY of one stands for one year in perfect health and a QALY of zero reflects death[5] (Weinstein et al., 2009). QALYs are quantified by eliciting individuals' preferences over health states using standard gamble (SG), time trade-off (TTO) or rating-scale techniques (mostly VAS) (Adler, 2010). When using the QALY in economic evaluation, all the alternatives under evaluation have the same outcome measure, which makes it relatively easy to compare alternatives with different health effects. Comparison is done by calculating the incremental cost-effectiveness ratio (ICER) of the competing alternatives. The ICER is the ratio of the difference in costs, i.e. incremental costs (measured in

[1] Some (developed) countries are increasingly relying on regulated competition and market principles in healthcare in order to contain costs

[2] Market failures in health care include: asymmetric information, externalities, moral hazard, adverse selection etc.

[3] The terms CEA and CUA are often used interchangeably as CEA is a particular type of CUA. Since CEA is a more general term and widely used in the health economics literature, in this thesis the term CEA will be used for both CUA en CEA

[4] Natural health units are for example: life years gained, amount of deaths averted, percentage serum cholesterol reduced, etc.

[5] Negative QALYs also exist, expressing health states worse than death

monetary units) and the difference in effects, i.e. incremental effects (measured in QALYs) and is expressed as the cost per additional QALY. The healthcare program with the lowest cost per QALY gained, i.e. lowest ICER, is deemed more cost-effective (Birch & Gafni, 2006). Evaluation of the ICER of a healthcare intervention however requires a certain threshold value. This threshold functions as a cut-off point to determine if a particular intervention is cost-effective (Evans et al., 2004). Healthcare programs with an ICER below this threshold are deemed cost-effective. In the absence of such a value, CEA is not a useful tool for societal decision-making as it lacks a systematic and universally recognizable decision criterion (Johannesson, 1995; Johannesson & Meltzer, 1998). This decision rule can be formalized by the following equation:

$\Delta C / \Delta E < R_t$

in which ΔC denotes the incremental costs of a healthcare intervention and ΔE denotes the patient's incremental QALY gain. The left-hand side of the equation is the ICER of a healthcare intervention. R_t denotes the ICER threshold (Drummond et al., 2005). This formula basically shows the framework of economic evaluation: an intervention can be considered cost-effective or welfare improving if the incremental costs, incurred to produce incremental health benefits, do not exceed the ICER threshold.

Mccabe et al. (2008) have noted three broad approaches for determining the size of the ICER threshold. One way is to infer the threshold value from reviews of previous decisions as to what was deemed a cost-effective intervention. Taking this approach would imply that (a) decision-maker's objective(s) is (are) consistent over time, since the same decision rule would be used for current decisions as which was used for previous ones. This however is not necessarily true, which in turn implies that the ICER threshold may change over time. Another proposed way of setting the ICER threshold is by optimally exhausting a budget. In practice this means that the least efficient treatment within this budget should represent the ICER threshold. Any new intervention must be more efficient than the least efficient program currently funded. The problem with this approach is that it is assumed that all previous decisions were optimal. The third way of setting the ICER threshold is identifying what monetary value the society attaches to health, i.e. discovering the Willingness to Pay (WTP) for a health gain in a representative sample of the society). Given that CUA is the most popular method to perform economic evaluation in healthcare (e.g. Drummond et al., 2005), this approach implies estimating the WTP for a QALY as the most informative result.

The WTP for a QALY can be estimated using contingent valuation (CV) studies, which is the most commonly used stated preference method (Hammit, 2002). In CV studies a representative sample of the society is asked what maximum amount it is willing to pay for a hypothetical health

benefit in question and thereby placing a monetary value directly on health benefits where no market prices exist (Drummond et al., 2005). This third approach has gained quite some support in the literature so far (Johannesson & Meltzer, 1998; Hirth et al., 2000; Abelson, 2003; Gyrd-Hansen, 2003; Drummond et al., 2005; Mccabe et al., 2008). It has been repeatedly argued that the estimates of the WTP per QALY can provide information on the debate about the size of the cost-effectiveness threshold. However, currently there are no valid empirical WTP per QALY estimates that can be directly applied in societal policy-making in the Netherlands. The thresholds currently in use (such as the threshold in the UK or the Netherlands) lack empirical underpinning (Appleby, 2007; Bobinac, 2010), meaning that CUA studies in healthcare base their decisions on arbitrarily set thresholds (e.g. <£30.000 per QALY in the UK (Appleby et al., 2007)). This can lead to suboptimal allocation decisions. Thus, finding an appropriate value of a QALY is an important but an unanswered and underexplored empirical problem. This thesis addresses this important issue.

Researchers trying to obtain useful WTP for a QALY estimates to provide information on the ICER threshold that can be applied in a policy setting face several challenges and methodological issues (e.g. Drummond et al., 2005; Gyrd-Hansen, 2005; Smith & Richardson, 2005; Baker et al.,2010). One of those issues is the appropriate perspective from which WTP values should be elicited. So far, most researchers have focussed on eliciting WTP values from the individual perspective (King et al., 2005; Gyrd-Hansen et al., 2003; Bobinac et al., 2010), reflecting individuals' monetary valuation of their own health gain. These valuations are quite important to consider from the Welfare economics perspective, which assumes that use of individual WTP is predicated on the notion that the payment made by each individual will reflect the benefit that he or she receives from the good or service paid for and that an individual is the best judge of his or her own welfare (Dolan & Edlin, 2002; Dolan et al., 2003). However, although these valuations seem essential from the Welfare economics perspective, one may question whether they provide the most relevant information for societal decision-making, such as the healthcare sector, where interventions are usually delivered through collective financing. The 'social value of a QALY' may therefore be considered more relevant in this context, reflecting broader objectives and principles than purely individual ones, such as altruism and solidarity (Dolan et al., 2003; Gyrd-Hansen, 2005; Smith & Richardson, 2005). The ICER threshold might therefore have be based on values that incorporate such broader social objectives. A social WTP for a QALY should include aspects like option and externality values (Bobinac, 2010) and can be elicited by taking a social perspective (Dolan et al., 2003). Although important for the debate about the size of the ICER threshold, valid estimates of WTP for a QALY are lacking, particularly social values, and to date no study that elicited the WTP for a QALY from a broader social perspective currently exists in the healthcare arena.

The aim of this study is to estimate the social value of a QALY in the Netherlands and to provide an input in the debate on the size of the cost-effectiveness threshold. To estimate the broader societal value of a QALY gain, we apply the socially-inclusive individual perspective (SII). To our knowledge, no study in healthcare has elicited the WTP for a QALY from the socially-inclusive individual perspective (SII).

This Master thesis is constructed as follows: the second section describes the background information about previous research in this field and addresses in more detail the possible perspectives and their features in conducting CV studies in healthcare. The third section describes the methods to conduct our research project as well as the methods to analyse our empirical data; section four presents our results. The discussion of our findings is given in section five.

2. Background

2.1. Previous literature

In recent years, there have been several attempts to estimate the monetary value of a QALY in various countries. The NICE for example has estimated the ICER threshold ranging from £ 20,000 (€ 24,415) to £ 30,000 (€ 36,632) in the UK (Appleby et al., 2007). King et al. (2005) have elicited WTP values ranging from $ 12,500 (€ 9,547) to $ 32,000 (€ 24,440) in the US and Gyrd-Hansen et al. (2003) elicited a WTP of € 12,000 from the general Danish population. An international survey on the WTP for a QALY by Shiroiwa et al. (2010) revealed WTP values of JPY 5 million in Japan (€ 49,935), NT$ 2.1 million (€ 55,923) in Taiwan, £ 23 000 (€ 27,885) in the UK, AU$ 64,000 (€ 50,632) in Australia and US$ 62,000 (€ 47,155) in the US. None of the studies estimated the social value of a QALY as they were carried out from an individual perspective and thus represent individual WTP values. Social WTP values can be estimated by taking another perspective than the individual in CV studies designed to elicit WTP for a QALY. It is important to disentangle the spectrum of the different perspectives that could be applied in CV studies.

2.2. The framework of perspectives in CV studies

There are multiple perspectives that can be termed 'individual' and 'social'. In particular, Dolan et al. (2003) have developed a conceptual framework in which six different perspectives are distinguished to elicit people's WTP for health (Table 1). In our study, we opt for the perspective termed 'socially-inclusive individual (personal)[6]' perspective.

Table 1. A framework of perspectives (Dolan et al., 2003)

	A *Ex ante*		B *Ex post*	
1. Personal	$0<p_p<1$ $p_o=0$	What value do you attach to treatment being available should you need it?	$p_p=1$ $p_o=0$	What value do you attach to your own treatment?
2. Social	$p_p=0$ $0<p_o<1$	What value do you attach to treatment being available to others should they need it?	$p_p=0$ $p_o=1$	What value do you attach to the treatment of others?
3. Socially inclusive personal	$0<p_p<1$ $0<p_o<1$	What value do you attach to treatment being available to a group of people amongst whom you might find yourself?	$p_p=1$ $p_o=1$	What value do you attach to the treatment of yourself and others?

[a] p_p – the probability of one's own need for treatment. P_o – the probability that others in society will need treatment.
Note: The term treatment is used here in the widest possible sense to refer to any health-related intervention.

[6] In their framework, Dolan et al. (2003) use the term 'personal' perspective, whereas we choose to use the term 'individual' perspective

This framework has two dimensions: the first dimension concerns the relative point in time at which the WTP values are elicited. The question(s) in a WTP study could either be framed from an *ex ante* or an *ex post* perspective. In the ex ante perspective respondents are assumed not yet to have fallen ill, but might be at risk of ever needing healthcare in the future. In WTP studies carried out from the ex post perspective on the other hand, respondents are asked to value health benefits derived from a treatment they will in fact utilize or have already utilized (Olsen & Smith, 1999; Dolan et al., 2003; Gyrd-Hansen, 2005). An advantage of the ex ante perspective is that might activate both option and externality values (discussed below), whereas the ex post perspective only enables researcher to elicit so-called use values. Use values are obtained from patients or target groups with an identified need for the intervention in question (Olsen & Smith, 1999). The second dimension of Dolan's framework relates to the issue of framing the WTP question(s) from an individual or social perspective. There are three approaches to this: 1) WTP questions could be asked from an *individual perspective*, in which a person is asked to value health benefits that will accrue to him- or herself. 2) The question(s) in a WTP study could also entail valuing someone other's health instead by taking the *social perspective*. 3) Respondents may be asked for their WTP for a health gain that will accrue to both the respondent as to other people, by taking the *socially-inclusive individual (personal) perspective*. Thus, in total there are six different perspectives an individual could be asked to adopt (table 1). The appropriate perspective depends on the normative considerations and the particular policy context to which it will be applied (Dolan et al., 2003). Additionally, it has been argued that the use of WTP values has to take account of the institutional arrangements of the market in which a study is carried out (Shackely & Donaldson, 1999). This might best be reflected in the prevailing financing arrangements for healthcare of a country. The individual perspective would seem the most appropriate if there is a direct link between payment and use at the individual level. Private insurance schemes or out of pocket payments are good examples of this. On the other hand, in a tax-based healthcare system such as the NHS, the social perspective would seem more appropriate as people should be asked to express their WTP for the health benefits of other people. Lastly, the socially-inclusive individual perspective would seem the most appropriate perspective in a social insurance system, particularly when social insurance is having the dual role of being an insurance agent for each insuree and a social institution that facilitates redistribution (Dolan et al., 2003). This perspective, chosen in our study as well, is further discussed below.

2.3. The Socially-inclusive Individual Perspective

In this study we employed the socially-inclusive individual perspective (SII). This perspective combines both individual and social values that are deemed important for social decision-making. In particular, individual and social WTP values may be driven by quite different motivations. A person is both driven

by individual utility as by the utility of others. As a completely self-interested person, an individual bases the maximum amount he or she is willing to pay on his or her own estimate of the likelihood of using the health service in question and the estimate of the monetary benefits he or she would receive. As a citizen on the other hand, an individual is motivated by the utility of the collective and may adopt a different criterion when he or she is asked to value health (Smith & Richardson, 2005). Individual utilities are likely to reflect other-regarding preferences in which altruism is one of the many aspects of an individualistic utility function. The socially-inclusive individual perspective (SII) would therefore seem the most appropriate perspective for the elicitation of social WTP, rather than the social perspective (SOC) that does not take self-interest into account. If respondents are faced with WTP question(s) stating that health gain(s) might accrue to the community as a whole in which the respondent is only one of the members, this might activate preferences for voluntary redistribution due to caring externalities, next to option values. To date, there have been only a few studies that have elicited socially-inclusive individual WTP values in healthcare (Dolan et al, 2003) and to our knowledge, no study has elicited WTP for a QALY values in healthcare from the SII perspective.

2.4. Externality & Option values

A great deal of evidence shows that other's people health in fact matter to individuals, i.e. that altruism in healthcare exists (Jacobsson et al., 2005). Altruism in the context of the WTP for a health gain raises the possibility of deriving values from those with no probability of future use of health care (Olsen et al., 2004). Such values are called (caring) externalities (Smith & Olsen, 1999). Research has shown that externality values form a significant source of value in individuals' WTP for health (Neumann & Johannesson, 1994; Olsen et al., 2004; Jacobsson et al., 2005; Smith, 2006). The presence of externalities in relation to health care has been acknowledged and has been used as a part of the justification for extensive government intervention in the health care arena (Cuyler, 1971). Although externality values are commonly mentioned in theory in economic evaluation in healthcare, they are often not taken into account in empirical research (Jacobsson et al., 2005) and have not be accounted for in estimating the social WTP for a QALY. Another important value overlooked in individual WTP valuations is option value (Palmer & Smith, 2000). Option values reflect the utility obtained from having the option, the possibility, to use health services in the future. In healthcare, this concept is related to that of purchasing insurance in conditions of uncertainty as it reflects individuals' insurance motive for being willing to pay should they ever need care in the future (Olsen et al., 2004). Since both externality and option values are important to consider in the context of social decision-making in healthcare, one could argue that these should be incorporated into the estimation of the ICER threshold. Both externality and option values can be elicited by taking an ex ante socially-inclusive individual perspective in empirical WTP exercises, as it is done in this study.

3. Methods

The elicitation of the Willingness to Pay for a QALY (WTP per QALY) was performed by means of contingent valuation (CV) in a representative sample of the Dutch population in terms of age (18 to 65 years), gender and education. The data was collected online, by a professional internet sampling company. The dataset was created for the purpose of exploring the WTP per QALY from different perspectives, varying from individual to social. In this study, we present the subset of the results on WTP per QALY, estimated from the social perspective. The social perspective was defined in this study as a socially-inclusive individual perspective (SII). From the SII perspective respondents are asked to state the maximum WTP for a hypothetical health gain that could accrue to both the respondent him- or herself as to other people, thus making the respondent part of a larger group of beneficiaries.

3.1. Design of the questionnaire

The questionnaire offered one WTP question to each respondent. In the beginning of the questionnaire, the respondents were introduced to the purpose of the study. Next they were offered two 'warm-up' questions for two non-health items to familiarize themselves with the WTP exercise. These questions include the WTP for a car and a pair of shoes. After the introduction and the warm-up questions, the respondents were asked to describe their own health status using the EQ-5D profile (Lamers et al., 2005) and to rate their own health, perfect health (11111) and death on the Visual Analogue Scale (VAS).

Next the respondents were asked to perform the CV exercise. They were provided with a hypothetical health state (described below) and asked to rate it on the VAS, so that a direct valuation of this health state from the sample could have been obtained. The VAS showed the respondents' previous valuations of own health, death and perfect health. The hypothetical health state on which the contingent valuation exercise was based, equalled the EQ-5D profile of 23322 (corresponding to 0.24 on the QALY scale (Lamers et al., 2005)). These two different methods for the valuation of health were applied, because former research showed that the WTP per QALY estimates can differ substantially with the health state valuation method (King et al., 2005).

The specific health state (23322) was chosen, because it resembles the symptoms and conditions of an influenza, which is a well-known disease and therefore respondents were assumed to be able to imagine being in that health state rather well. The questionnaire stated that only less than one percent of the Dutch population and children up to 18 years have no chance of getting the described disease. The WTP question was introduced to our sample as follows:

“Imagine a new virus is likely to affect the Dutch population in the upcoming months. Children (up to 18 years) appear to be immune to the virus. The disease causes symptoms a lot like influenza: fever, moderate pain and being unable to perform usual daily activities. A general description of the health state is as follows:

I have some trouble walking
I am not able to wash or dress myself
I am not able to perform my usual activities
I have moderate pain or discomfort
I am moderately anxious or depressed

Just like the entire adult Dutch population you have a 10 percent chance of getting this disease. This chance is independent of age, income, life-style, etc. From everyone that gets ill in the Dutch population, every one out of 500 persons dies as a consequence of complications. The remaining people that get diseased will stay for four weeks in the health state described above. After these four weeks they will fully recover and return to their initial health state. There is a painless medicine that will protect adults from the virus (with no side-effects). This medicine prevents everyone from getting the disease and thereby also prevents all deaths. Everyone will then stay *for sure* in the better health state. The Dutch government has decided to provide this medicine to everyone. The medicine will be financed through an increase in the monthly insurance premium for *all* the Dutch residents. The increase of the premium is paid out of pocket. After twelve months, the monthly premium will return to its initial level. Keep in mind that you belong to the group at risk. “

After this introduction, the respondents were asked to express their willingness to pay to avoid being (or someone else being) in the described health state scenario. The respondents were asked to express their willingness to pay as an increase in their monthly health insurance premium. The WTP was elicited in a two step procedure. First a payment scale was presented, expressed in monthly installments in Euro’s. These monthly installments were: 0; 1; 2; 3; 4; 5; 6; 8; 10; 12; 15; 18; 20; 22; 25; 30; 40; 50; 75; 100; 150; 250; 500. Respondents were asked to indicate the maximum amount they would certainly pay and the maximum amount they would certainly not pay on this payment scale.

In the next step, the respondents were provided with an open-ended question, asking them to state the maximum amount they would be willing to pay if they would have been asked to do so right now. This estimate was bounded by the higher and lower values the respondents chose on the payment scale before and was used for further analysis.

Respondents providing a zero valuation were asked to clarify why they're not willing to pay for a health gain. They could choose out of three explanations: 1) I cannot afford more than € 0, 2) I think that avoiding the worse health state and remaining in the better health state is not worth more than € 0 or 3) I have ethical objections to pay anything. The first two explanations are considered true WTP values, while the third explanation is considered as a protest answer.

Finally, respondents were asked to express the level of certainty regarding their stated maximum WTP in the range of: 1) totally sure I would pay the stated amount; 2) pretty sure I would pay the stated amount; 3) neither sure nor unsure I would pay the stated amount; 4) not very sure I would pay the stated amount; or 5)unsure I would pay the stated amount. Asking this follow-up question may identify the values that reflect respondents' 'true' WTP. However, the extent of certainty does not necessarily imply that an elicited WTP value is true (Smith, 2006).

3.2. Analysis

3.2.1. Exclusion criteria

The respondents that valued the described health state (23322) higher than their own current health were excluded for the analysis as the aim of the WTP exercise was to investigate what the respondents are willing to pay for a health gain (i.e. avoiding the potential health loss). Valuing the health state scenario higher than one's current health state means that no health gain can be calculated, thus making this data meaningless for the analysis.

3.2.2. Rescaling of VAS health states

In order to set the VAS health state values for death at zero and perfect health (11111) at one, it was necessary to rescale the VAS values and thus these values were all truncated to (–1)/(+1). To rescale the mean VAS values for each of the directly valued health states by our respondents, the following formula was applied: VAS rescaled = (VAS own current health – VAS death)/(100 – VAS death)(Wittrup-Jensen et al., 2008).

3.2.3. Utilities

With respect to the utility scores, a correlation test between the EQ-5D health gain and the VAS health gain was performed to test for consistency. Here we tested the null hypothesis that there is no association between the VAS and EQ-5D variable.

3.2.4. WTP for a QALY calculation

In order to obtain the total maximum WTP per year, we multiplied the expressed mean WTP by twelve. This number then was multiplied by the total amount of people over 18 living in the Netherlands (CBS, 2010). WTP per QALY was calculated as the ratio of the WTP for avoiding the move from the own current (better) to the scenario 23322 (worse) health state, to the QALY difference between the two health states, using both utility elicitation techniques, i.e. VAS scores and EQ-5D tariffs. As determined by the design of the exercise, the total expected QALYs lost, i.e. the total expected QALY gained, were disentangled in the QALYs lost due to the described disease and QALYs lost due to premature death. Regarding the expected QALY loss due to premature death, three scenarios were created (details of the calculations are given below):

(A) In scenario A, no discounting of future QALY losses was performed and a constant quality of life for the remaining life-span of people was assumed.

(B) In scenario B, we also assumed a constant quality of life for the respondents' remaining life-span, but contrary to scenario A, discounting was applied taking a discount rate of 3 percent.

(C) In scenario C, future QALYs were discounted with a discount rate of 3 percent as well, but here we assumed a non-constant quality of life for the remaining life-span of people, i.e. a correction for age-related quality of life decline was applied.

Discounting was applied in scenario B and C, because the QALY losses due to premature death would appear in the future. The consideration of a constant quality of life for the remaining life-span (scenario A and B) is the most common approach used by health economists to calculate QALY gains (or losses) (Hirth et al, 2005; Gold et al, 2002)[7]. However, as people's health in fact deteriorates over time (Chappel & Cooke, 2010) it would seem realistic to take an age-related quality of life decline into account. No data on the average age (group)-related health states of the Dutch population was found and therefore we used data from the US, UK and Swedish literature to infer the weights for the Dutch population. We assumed that the age-specific health states in these countries are similar to the average Dutch numbers as these are Western countries with a high welfare level as well.

[7] Gold et al. (2002) state that "for simplicity, QALY modelers frequently omit adjusting for gradations of HRQL during different segments of a life path—once a diminution in health has occurred it is frequently handled as persisting throughout the remaining years of life."

All the calculations that were performed are summed in table 2, in which:

- $QALY_{own}$ denotes the mean current health state of the respondents, expressed in QALYs
- $QALY_{scenario}$ denotes the hypothetical health state scenario, expressed in QALYs
- age refers to the mean age of our sample
- age_{gr} refers to the different age groups described in table 3
- $QALY_{gr}$ denotes the average health state per age group, expressed in QALYs
- LE denotes the average life expectancy of Dutch people

The calculations are all based on mean values and are calculated the same way for both of the health state valuation methods (EQ-5D and VAS). In the next subsections we explain in detail the calculation procedure. The exact calculation procedure is explained in the following two subsections.

Table 2. Summary calculations WTP for QALY in the Dutch population

Outcome	***Calculation***
Expected QALY loss disease	$(0{,}1 * 13{,}060{,}511) * (((QALY_{own} - QALY_{scenario}) / 52) * 4)$
Expected QALY loss premature death (scenario A)	$(0.1 * (0.002 * 13{,}060{,}511)) * ((80{,}55 - age) * (QALY_{own}))$
Expected QALY loss premature death (scenario B)	$(0.1 * (0.002 * 13{,}060{,}511)) * ((80{,}55 - age) * (\Sigma QALY_{own} / (1 + 0.03)^{LE}))$
Expected QALY loss premature death (scenario C)	$(0.1 * (0.002 * 13{,}060{,}511)) * \Sigma (((age_{gr} - age) * QALY_{gr})/ (1 + 0.03)^{LE})$
Total expected QALY loss	expected QALY loss disease + expected QALY loss premature death
Maximum WTP	13,060,511 * (WTP * 12)
WTP/QALY (€)	Maximum WTP/Total expected QALY loss

QALY loss due to illness calculation

As shown in table 2, the expected QALYs lost due to the described health sate scenario were calculated by subtracting the valuation of the health state offered in the scenario (using the EQ-5D tariffs and the VAS-scores) from the respondents' own health for every respondent individually. We took the mean of these outcomes, which represents the respondents' mean QALY gain. The hypothetical health state scenario only takes four weeks and after taking the medicine, people will fully recover to their initial health state. This should be taken into account in the calculation, since QALYs are calculated on annual basis. We accounted for this by dividing the mean health gain by 52 and then multiplying this number by four. Furthermore, the questionnaire stated that ten percent of the population of 18 years and older is at risk of getting the disease. Therefore we multiplied 0.10 by 13,060,511 (in 2010 there were 13,060,511 people of 18 years and older living in the Netherlands

(CBS, 2010)). Finally this result was multiplied by the average monthly health gain, giving us the total expected health loss in the Dutch population due to the disease**.**

QALY loss due to premature death calculation

In order to calculate the expected QALYs lost due to premature death, 3 different approaches were taken (Table 2). The three scenarios (A, B, C) are described below. Overall, in the contingent valuation exercise, we stated that one out of 500 persons is likely to die as a consequence of the disease. As shown in table 2, this amounts to 0.1 (probability of getting disease) * 0.002 (probability of dying) * 13,060,511 (amount of adult people living in the Netherlands) equals 2,612 people that are likely to die without treatment in the Dutch population. Then in order to calculate how much QALYs will be lost due to prematurely dying, respondents' average remaining life expectancy was calculated. We subtracted respondents' average age from the average life expectancy of the Dutch population. Mean age of death of the Dutch population in 2009 was 80,55 for both men and women taken together (CBS, 2009). The three scenarios differ in terms of the assumption about discounting future health gains and the constancy of the health-related quality of life throughout ones life. The total expected QALY lost because of the disease and premature death is simply the sum of the two calculations described above: QALY loss disease + QALY loss premature death.

Scenario A: QALY loss, undiscounted and unadjusted by QOL decline

In this scenario the assumption is that people will remain in their current health state over the entire span of their remaining life expectancy. The mean of our sample's initial health state was taken. So the total amount of the expected QALYs lost in the population due to premature death as a consequence of the disease is (current health) * (remaining life expectancy) * (amount of people dying).

Scenario B: QALY loss, discounted and unadjusted by QOL decline

In scenario B future health benefits were discounted. Taking a discount rate of 3 percent (Gold et al, 2002) assured that future QALYs are converted into present values, which is a common approach in estimating the Quality Adjusted Life Expectancy (QALE) (Sassi, 2006). The formula is given by:

$$\Sigma \, QALY_{own} / (1 + r)^{LE}$$

In which $QALY_{own}$ denotes the mean own current health of the respondents, r denotes the discount rate and LE denotes the remaining life expectancy which is equal to 80,55 (average life expectancy of Dutch people) minus the average age in our sample. In summary, we are calculating the sum of the

respondents' mean current health state divided by the discount factor (1+0.03) to the power of the remaining life expectancy. The summation consists of the number of people dying multiplied by the remaining life expectancy, which will give us the total *discounted* QALYs lost due to premature death. As in scenario A, this amount must be summed by the total QALYs lost as a consequence of the hypothetical health state scenario.

Scenario C: QALY loss, discounted and adjusted by QOL decline

Since it's known that people's average health-related quality of life declines with ageing (Chappel & Cooke, 2012) this should be taken into account in the calculation of the QALYs lost due to premature death. However, no systematic data on the average (self-reported) age-specific health state valuations of the Dutch population was found. Therefore this data was taken from the Swedish (Burström et al, 2001), US (Lubetkin et al, 2005) and UK literature (Kind et al, 1999) with respect to the EQ-5D utilities. Regarding the VAS-scores, the European average age-specific valuations were obtained from the EuroQol Group (2004) and used for the calculation of lost QALYs due to premature death. The US population was divided in 4 different age groups; 18-39, 40-59, 60-69 and 70+. The populations of the other countries on the other hand showed ranges of five or ten years. Therefore we first converted the Swedish and UK age groups into the same age categories as the US, taking the average of different categories. These utilities are presented in table 3.

To calculate the Dutch QALY decline due to ageing, we took the average decline of the UK, US and Swedish data. Then we subtracted the mean age of our sample from the age groups and multiplied this number by the average quality of life in the corresponding age group: e.g. mean age of our sample is 39.39 years, so the first 0.61 years the respondent loses 0.909 QALYs, measured by the EQ-5D, and the next twenty years the respondent loses 0.849 QALYs. Then finally we summed and discounted this amount taking a discount rate of three percent. The discounting procedure was equal to that described in scenario B.

Table 3. Average age-specific HRQOL

Age categories/ Average HRQL (QALYs)	**18-39**	**40-59**	**60-69**	**70+**
UK (EQ-5D)	0.927	0.852	0.790	0.755
US (EQ-5D)	0.901	0.856	0.823	0.785
Sweden (EQ-5D)	0.900	0.840	0.760	0.660
Average (EQ-5D)	**0.909**	**0.849**	**0.791**	**0.733**
Average VAS	**0.825**	**0.765**	**0.700**	**0.645**

3.3. Subgroup analysis

As we have taken the mean WTP to calculate WTP for a QALY values, we were also interested in examining what average amount different income groups were willing to pay and whether these amounts significantly differ from each other and from the sample mean. We took four different income groups: 1) respondents earning less than 1000 euro's per month, 2) respondents earning between 1000 and 2000 euro's per month, 3) respondents earning between 2000 and 3500 euro's per month and 4) respondents earning more than 3500 euro's per month. Then we tested the null hypothesis that there is no significant difference between the different subgroups. Moreover, we suspect that the higher income groups will express higher WTP values. Finally, we examined the level of certainty the respondents from the different income groups indicated and we expect the respondents in higher income groups to be more certain about their expressed WTP than the respondents in the lower income groups.

3.4. Theoretical Validity

To investigate the theoretical validity of our dataset, we estimated different multivariate regression analyses, with the maximum WTP as the dependent variable. The only independent variable that varied across the four regression models was the different specification of respondent's expected health gain. In two regression models, the included health gain variable was measured by the VAS, while the other two models included the EQ-5D health gain. Moreover, we performed a regression including the 'raw' mean variable of a health gain and a regression including different health gain (small to large) categories, for both the VAS and the EQ-5D. Prior to making these categories, the distribution of these variables was investigated.

Overall, nine different independent variables were included into the model. Prior to performing the regression analyses, a normality test was performed on both the independent and the dependent variables. The continuous variables showing a non-normal distribution were log transformed. The independent variables included income, health gain, employment, age and others. A priori we expected the income to have a positive effect on the WTP. People's willingness to pay is highly related to their ability to pay, which is best reflected by their income (e.g. Donaldson, 1999).

3.5. Sensitivity Analysis

To test the validity of our WTP values, we investigated whether the WTP estimates are sensitive to the scale of the QALY gains on offer. Insensitivity points to the fact that WTP will not discriminate between different sizes of health gains. Since economic theory assumes a positive relation between WTP and the size of a benefit, an insensitivity to scale would not be in accordance with economic theory and is

therefore said to not possess ‘construct validity’ (Smith, 2005). Testing for the sensitivity to scale was done by examining whether a higher potential health gain was accompanied by a higher WTP. In order to do so, different categories of health gain size were made for both of the health state valuations techniques. First the distribution of these health gain variables was investigated in order to make adequate categories. Then we tested whether the potential differences between the WTP values per health gain category were significant.

All the analyses were performed using Stata 11.0 for Windows.

4. Results

4.1. Data

498 respondents, representative of the Dutch population with respect to age, gender, income and other socio-economic characteristics have participated in this survey. 56 respondents were excluded for the analysis as they valued the health state scenario higher than their own current health. Table 4 shows the summary statistics. The majority of our sample had an income between € 1999 and € 3500 a month, is married and employed. The average respondent is fairly healthy.

Table 4. Summary statistics

(N=442)	**Mean**	**Std.dev**	**Min**	**Max**
Age	39.17	12.35	18	65
Sex (% men)	50.45			
Children(%yes)	46.61			
Number of children	2.08 (N=206)	1.3	1	15
Age oldest child	18.23	11.69	0	44
Income	2587.25	1470.14	999	10000
Income groups (%)				
< 1000	14.48			
> 999 and < 2000	34.39			
>1999 and < 3500	36.20			
> 3499	14.93			
People living on household income	2.45	1.44	1	15
Higher Education (% yes)	36.88			
Employment status (%)				
Employed	67.88			
Unemployed	11.99			
Student	10.63			
Housewife/man	9.5			
Marital Status (%)				
Married	56.56			
Divorced	8.82			
Single	26.70			
Widow	0.69			
Marital status unknown	7.24			
Paid work partner (% yes)	75.60			
Health state VAS-score	81.92	13.75	30	100
Health state VAS-score rescaled	0.99	0.23	0.13	1.29
Health state EQ-5D	0.91	0.11	0.516	1
Duration completion survey (min)	16.23	6	4.2	44.15

4.2. WTP for non health items

The respondents indicated plausible WTP estimates for their favourite car and a pair of shoes. The results are shown in table 5.[8]

Table 5. WTP non-health items

	Mean	Std.dev
WTP car	14,020 (n=442)	39,401
WTP shoes	111.28 (n=439)*	252.67

* 3 observations were excluded for the analysis as these were extreme outliers, showing no plausible estimates for the WTP for a pair of shoes

4.3. Utilities

The average health gain was 0.67 on the QALY scale, measured by the EQ-5D. VAS utilities averaged at 0.68 on the QALY scale. We tested the null hypothesis that there is no association between the VAS and EQ-5D variable and we cannot reject this hypothesis as there is strong evidence that there is no association between the two different health state valuations methods in this study (p=0.00).

4.4. WTP values

The expressed mean WTP was 45.79 Euro's per month. This equals 549,48 Euro's per year. Table 6 shows the amount of respondents expressing a zero WTP and their motive for doing so. Approximately six percent of our sample expressed a zero WTP. Most of these respondents gave explanation three for not willing to pay anything for a health gain, which is deemed as a protest answer rather than true WTP. However, this percentage is still relatively small, so we did not exclude this data for our analysis. Furthermore, table 7 shows that 14 percent of the respondents were totally sure they would pay the stated amount and almost 38 percent of our sample indicated that they were pretty sure about paying the amount they indicated. Respondents indicating uncertainty about their expressed WTP were found to be a minority in our sample (3.17 %).

Table 6. Clarifications Zero WTP

Explanations	Frequency
1. I am unable to pay more than € 0	11 (2.5%)
2. Avoiding the worse health state and remaining in the better health state is not worth more than € 0	5 (1.13%)
3. I am not willing to pay out of ethical considerations	12 (2.7 %)
Total	28 (6.33%)

[8] Even though these estimates may imply that the respondents understood the exercise, it's quite different to value health monetarily, since no market prices for health (care) exist.

Table 7. Certainty level of expressed WTP

Certainty level	Frequency	Percentage
1.Totally sure I would pay the stated amount	62	14.03
2. Pretty sure I would pay the stated amount	167	37.78
3. Neither sure nor unsure I would pay the stated amount	177	40.05
4. Not very sure I would pay the stated amount	22	4.98
5. Unsure I would pay the stated amount	14	3.17
Total	442	100

In table 8 the mean age, mean own health state, mean health gain and mean WTP are presented which were necessary for our calculations of the WTP for a QALY. These values are the same across the three different scenarios for calculating WTP for a QALY. Table 9 shows the results of the calculations of the WTP for a QALY, of which the formulas were described in table 1. The expected QALY losses differed substantially, since we have taken different approaches to the calculation of QALY losses due to premature death in the three different scenarios. This leads to different average WTP for a QALY values. Table 9 shows a WTP for a QALY of € 41,919 (VAS) and € 44,196 (EQ-5D) in scenario A. The other scenario's show higher WTP for a QALY values, respectively € 73,362 (VAS) and € 74,924 (EQ-5D) in scenario B, and € 80,300 (VAS) and € 78,270 (EQ-5D) in scenario C.

Table 8. Mean values

	EQ-5D	VAS
Mean own health state (QALY)	0.91	0.99
Mean health gain (QALY)	0.67	0.68
Mean age	39.39	39.39
Mean WTP (€ per month)	45.74*	45.74*

* WTP is 560.88 euro's per year

Table 9. Average WTP for QALY values (€)

	Scenario A: WTP for a QALY, undiscounted and unadjusted by age-related QOL decline		Scenario B: WTP for a QALY, discounted and unadjusted by age-related QOL decline		Scenario C: WTP for a QALY, discounted and adjusted by age-related QOL decline	
	EQ-5D	***VAS***	***EQ-5D***	***VAS***	***EQ-5D***	***VAS***
Expected QALY loss disease	67,915	68,317	67,915	68,317	67,915	68,317
Expected QALY loss death	97,834	106,435	29,856	31,536	25,676	22,908
Total expected QALY loss	165,749	174,751	97,771	99,853	93,591	91,225
Average WTP/QALY (€)	44,196	41,919	74,924	73,362	78,270	80,300

4.5. Subgroup analysis

In table 10 the mean monthly WTP value of each of the four income groups is presented. As suspected, the respondents in the higher income groups expressed a higher mean WTP value. The highest income group expressed an average WTP value almost twice as high as the lowest income group. However, no significant difference was found between the WTP values across either of the income groups. Nor did we find a significant difference between the mean WTP expressed by our total sample and the mean WTP of either of the income groups. Table 11 shows the WTP for a QALY estimates within each income group, using the calculations described in table 2 of section three. As can be seen, the highest WTP for a QALY estimates are found in scenario C within the highest income group, reaching a value beyond 100,000 Euro's per QALY gained.

Table 10. WTP by income groups

Income groups (€)	Mean WTP	Frequency	Percentage
Income < 1000	30.98*	64	14.5
1000 < Income < 2000	38.50*	152	34.4
2000 < Income > 3500	53.03*	159	36
Income > 3500	60.03*	66	14.9

* These values represent monthly WTP values

Table 11. Average WTP for a QALY by income groups (€)

	Scenario A: WTP for a QALY, undiscounted and unadjusted by age related QOL decline		Scenario B: WTP for a QALY, discounted and unadjusted by age related QOL decline		Scenario C: WTP for a QALY, discounted and adjusted by age related QOL decline	
	EQ-5D	***VAS***	***EQ-5D***	***VAS***	***EQ-5D***	***VAS***
Income < 1000	29,294	27,785	49,661	48,625	51,879	53,224
1000 < Income < 2000	36,404	34,529	61,715	60,428	64,472	66,144
2000 < Income < 3500	50,143	47,560	85,007	83,234	88,803	91,106
Income > 3500	56,762	53,838	96,228	94,221	100,525	103,133

Table 12 presents the certainty levels of the stated WTP values in the different income groups. The highest percentage of respondents indicating being totally sure was found in the highest income group, whereas being unsure about the indicated WTP amount was slightly higher in the lowest income group compared to the other income groups. Being indifferent or pretty sure whether to pay the stated amount is overall the most indicated level of certainty.

Table 12. WTP certainty level by income groups

Certainty level / Income	999		1000-2000		2000- 3500		>3500	
	Freq	%	Freq	%	Freq	%	Freq	%
1.Totally sure I would pay the stated amount	4	6.25	22	14.47	20	12.58	16	24.24
2. Pretty sure I would pay the stated amount	15	23.44	54	36.84	74	46.54	21	31.82
3. Neither sure nor unsure I would pay the stated amount	36	56.25	65	42.76	52	32.70	24	36.36
4. Not very sure I would pay the stated amount	6	9.38	5	3.29	8	5.03	3	4.55
5. Unsure I would pay the stated amount	3	4.69	4	2.63	5	3.14	2	3.03
Total	64	100	152	100	159	100	66	100

4.6. Theoretical validity

Table 13 shows the results of the multivariate logarithmic regressions with the (log) maximum WTP estimates as the dependent variable. This table presents four regression models in which only the health gain variable varied. Models 1 and 2 include respectively the raw and categorical EQ-5D health gain variable as the dependant variable, whereas models 3 and 4 include the VAS, also respectively raw health gain and health gain categories as the dependant variable. Due to its distribution, the EQ-5D health gain variable was separated into a small gain and large gain, whereas the distribution of the VAS variable allowed for three categories (including a moderate health gain category).

Model 3 reported the highest R^2, but overall the explained variance was low in all of the models. The models showed statistically significant F-tests. As expected, WTP was positively associated with income and its coefficient was significant in all of our models. On the other hand, the size of the VAS health gain (presented as a continuous or a categorical variable) was not found to be a significant predictor of WTP. Moreover, the sign of this variable was opposite from what one might expect. The models show negative coefficients of the categorical dummy variables, as compared to the reference category, which was the smallest health gain. This would imply that the higher the health gain, the smaller the maximum WTP. Regarding the EQ-5D health gains, the models show no significance of these variables. The socio-economic variables show betas that are quite similar in each model, except for having a higher education, which is higher in models 3 and 4. The log income betas on the other hand are somewhat smaller in models 3 and 4 compared to models 1 and 2. Finally, the effect of the large health gain variable in model 2 is relatively low compared to its reference category whereas this effect is larger in models 3 and 4. However, this relationship in models 3 and 4 is negative.

Table 13. Multivariate Regression Analysis

	Model 1: EQ-5D raw health gain			Model 2: EQ-5D health gain categories			Model 3: VAS raw health gain			Model 4: VAS health gain categories		
Dependent variable: Log Maximum WTP	**Coef.**	**Std. Error**	**P>|t|**	**Coef.**	**Std. Error**	**P>|t|**	**Coef.**	**Std. Error**	**P>|t|**	**Coef.**	**Std. Error**	**P>|t|**
Age	-0.034*	0.007	0.000	-0.035*	0.007	0.000	-0.034*	0.007	0.000	-0.034*	0.007	0.000
Employed	-0.172	0.147	0.244	-0.164	0.148	0.269	-0.133	0.147	0.365	-0.140	0.146	0.340
Higher education	0.011	0.044	0.805	0.011	0.044	0.797	0.216	0.139	0.121	0.221	0.140	0.114
Gender	0.132	0.133	0.321	0.142	0.132	0.283	0.130	0.131	0.323	0.129	0.131	0.326
Children	0.324**	0.196	0.100	0.330**	0.196	0.092	0.320	0.196	0.103	0.315	0.196	0.109
Married	-0.146	0.163	0.372	-0.149	0.164	0.364	-0.160	0.163	0.325	-0.147	0.163	0.365
Log income	0.468*	0.151	0.002	0.473*	0.151	0.002	0.437*	0.150	0.004	0.434*	0.150	0.004
Log income people	-0.265	0.167	0.118	-0.265	0.169	0.119	-0.214	0.170	0.209	-0.221	0.171	0.197
Log health gain (EQ-5D)	0.187	0.355	0.599	-	-	-	-	-	-	-	-	-
Large health gain (EQ-5D)	-	-	-	0.005	0.185	0.977	-	-	-	-	-	-
Health gain (VAS)	-	-	-	-	-	-	-0.237	0.167	0.158	-	-	-
Moderate health gain (VAS score)	-	-	-	-	-	-	-	-	-	-0.117	0.157	0.457
Large health gain (VAS score)	-	-	-	-	-	-	-	-	-	-0.215	0.159	0.176
Intercept	1.029	1.118	0.358	0.753	1.104	0.492	1.018	1.095	0.353	1.076	1.099	0.328
R^2	0.0888			0.0902			0.0996			0.0970		
Prob > F	0.0000			0.0000			0.0000			0.0000		
N	414			414			414			414		

* Significant at 5 %

** Significant at 10 %

4.7. Sensitivity analysis

The results of our sensitivity analysis (table 14) show that the sensitivity to scale of our study is somewhat supported by the EQ-5D data. This is shown by the large health gain category being accompanied by a larger WTP than the small health gain category. This result however is not statistically significant at 5% (p = 0.1015).

Table 14. EQ-5D sensitivity to scale

Health gain EQ-5d	Obs.	Mean EQ-5D health gain	Mean WTP (€)	Std. dev	Min	Max
Small gain (0- 50%)	221	0.59	39.06	80.75	0	500
Large gain (50% - 100%)	221	0.76	52.51	94.18	0	500

The VAS-variable lends no support for the sensitivity to scale of WTP to the size of the health gain on offer, as table 15 shows. The health gain in quartile 1 was accompanied by a higher WTP than the WTP in quartile 2 and 4. This is in line with the regression results presented in the former paragraph, showing a reversed association between VAS health gain size and WTP than we a priori expected.

Table 15. VAS sensitivity to scale

Health gain VAS	Obs*	Mean VAS health gain	Mean WTP (€)	Std. dev	Min	Max
First quartile (0- 25%)	110	0.20	46.54	93.95	0	500
Second quartile (25% - 50%)	110	0.55	38.95	81.92	0	500
Third quartile (50% - 75%)	110	0.80	57.80	95.11	0	500
Fourth quartile (75%- 100%)	110	1.18	39.38	79.50	0	500

* 2 random observations were deleted so that we could create equally sized groups

5. Discussion

A commonly mentioned ICER threshold in the Netherlands is € 20,000 per QALY (Boersma, 2010) with a maximum of € 80,000 proposed by the RVZ (RVZ, 2006). This value however is set arbitrarily, which necessitates further empirical research into the monetary value of a QALY in the Netherlands. The first empirical results on the Dutch monetary value of a QALY show that the WTP for a QALY equals €24,500 (Bobinac et al., 2010). The elicitation of the WTP for a QALY in that study was performed by taking the individual perspective. However, taking the individual perspective may not lead to an optimal resource allocation in collective decision-making in healthcare. A social WTP for a QALY would seem more relevant in social decision-making, as this value should include aspects like option and externality values. In this study we have therefore elicited WTP values from the social perspective - more specifically, the socially-inclusive individual perspective. Our results show (mean) WTP values ranging from € 41,919 to € 80,300 per QALY gained. Aggregating and taking the average of the different scenarios leads to a WTP for a QALY of € 65,500.

The results of this study are systematically higher than the estimates published in the literature so far (King et al., 2005; Gyrd-Hansen et al., 2003; Shiroiwa et al., 2010). There are potentially several explanations for this difference. First, these differences could be explained by the fact that most WTP for a QALY studies were performed by eliciting WTP values under certainty and from the individual perspective. As our contingent valuation questions were stated under risk, this could (partly) explain why we have found higher values than those reported by other researchers in the literature. Secondly, another explanation of why we have found higher WTP values is because we have elicited WTP values from the social perspective, defined as the socially-inclusive individual perspective. The WTP for a QALY values reported in the literature so far were elicited from an individual perspective and thus reflect use and/or option value only, but exclude the externality value. Some researchers have found that the addition of externality values could possibly lead to considerably higher WTP estimates. A study of Smith (2006) for example, showed that the addition of externality value will lead to a higher average WTP estimate than the elicitation of use and option value alone (Smith, 2006). Comparable results were also demonstrated by Neumann and Johannesson (1994) when investigating the WTP of in vitro fertilization. They showed that eliciting ex ante WTP estimates by way of public insurance questions may ceteris paribus disclose higher WTP estimates than taking the (ex post) individual perspective. An explanation for this may be that the individual perspective will include respondents' valuations of their own potential treatment only, whereas answers to WTP questions from a social perspective also include altruistic preferences for the treatment of other members of the community, which could lead to altruistic 'add-ons' to the WTP

values (Gyrd-Hansen, 2003). A study of Olsen et al. (2004) however rejected this hypothesis, showing that the WTP values from respondents valuing health from a community perspective (comparable to the socially-inclusive individual perspective) did not differ significantly from those respondents that valued health gains from an insurance perspective (comparable to the individual perspective). They showed instead that a higher amount of respondents were willing to pay in the community-based sample as opposed to the insurance-based sample, rather than expressing an altruistic add-on to the WTP estimate(s). Given the variability in these findings, more research is needed to investigate the existence and the extent of such an 'altruistic add-on' to individual valuations. Moreover, none of these studies investigated the WTP for QALY gains and to date this study is the first in which WTP for QALY gains are elicited from the socially-inclusive individual perspective.

We found considerable variation within WTP per QALY estimates obtained in this study. The WTP estimates varied substantially with the chosen method of calculation. The results depend, for instance, on the way in which the future health gains are calculated (VAS or EQ-5D) and whether discounting was applied. Particularly the assumption of a non-constant quality of life profile over a lifetime lead to WTP per QALY values that were approximately € 30,000 to € 40,000 higher than assuming a constant quality of life over people's remaining life expectancy. King et al. (2005) pointed out that "there is no standard method for extrapolating health state valuations into cumulative lifetime quality adjusted survival" and we cannot infer from our results which method should be used. However, we can argue that the WTP estimates of scenario C might be the most realistic ones, since this scenario has both taken discounting and age-related quality of life decline into account. Other assumptions on future QALY gains would have undoubtedly yielded different WTP estimates as well. Furthermore, the different health valuation techniques also yielded different WTP estimates, which has been already found by King et al (2005) and Bobinac et al (2010) as well. The VAS is known to elicit higher utility scores than the TTO (on which the EQ-5D is based) (King et al, 2005), thus leading to lower WTP for a QALY estimates. However, after rescaling the VAS-scores, these values did not differ much from the EQ-5D tariffs in our study; we found a difference of 0.01 QALY. In spite of this, we can argue that the WTP estimates based on EQ-5D tarrifs are more relevant in our study as this utility valuation method is most commonly used and there are many more caveats to the VAS than there are to the TTO method. Our results perhaps also point to the inapplicability of VAS-scores in this study, as the regression models showed a counter-intuitive negative relationship between the WTP and health gains measured by the VAS. This was also confirmed by our sensitivity analysis: as opposed to the WTP for a health gain measured by the EQ-5D, the WTP for VAS health gains revealed more insensitivity to scale. It must be noted however that comparisons regarding the sensitivity to scale may be biased, as we were only able to make two categories with respect to the EQ-5D health gains, whereas the VAS

health gains contain four categories. Furthermore, as we were not able to find systematic data on the average age-related quality of life of Dutch residents, measured by the VAS, we used this data from the UK, US and Sweden to calculate WTP values in scenario C. Regarding the age-related quality of life measured by the EQ-5D, we took the European average from the EuroQol group. The true Dutch age-related quality of life numbers may however differ somewhat and lead to different WTP estimates. The method of calculating the WTP for a QALY may have influenced our results. Instead of taking the means of the relevant values as was done in this study, one may argue to take median values instead. Even though there are no guidelines concerning this matter, it must be noted that taking median values may have resulted in different WTP values. The chosen discount rate may be a point of discussion as well. In order to convert future QALY gains to present values, we took a discount rate of 3 percent, but other rates could have been chosen instead. Most studies for the economic evaluation in healthcare show a range between 1 and 8 percent (Gravelle & Smith, 2001).

Finally, our subgroup analysis showed that people in the highest income groups are willing to pay a higher average amount than those in the lower income groups. However, as no significant differences were found between any of the income groups regarding the expressed WTP, nor between any of the income groups and the sample mean WTP, we could argue that the WTP for a QALY estimates based on the sample mean represent a rather reliable estimate of the 'true value of a QALY', which is not constrained by the level of income. This is a common problem in any WTP study, inside or outside healthcare. One may argue that the elicited WTP values could be severely constrained by budget restrictions, which could limit our results. If this were the case, the estimates would reflect ability to pay rather than willingness to pay. This however appeared to be a minor problem in this study as the average WTP as a proportion of the average monthly income appeared to be only 1,77 percent. This shows that the respondents were not bidding to the point where the opportunity costs become catastrophic.

Some other methodological issues need mentioning. First, the payment scale and payment vehicle may have biased our results. The range of the payment scale may have affected the respondent's maximum WTP. A further inspection shows that only eight respondents expressed the highest amount offered. We can thereby conclude that end-point bias was not present in our results. In order to minimize mid-point bias, respondents were asked to state their maximum WTP in a two-step procedure; first by using the payment scale and then stating their maximum WTP, bounded by the minimum and maximum of the provided scale. The payment vehicle and frequency may have influenced individual's WTP as well. We asked our respondents to imagine paying for health out-of-pocket as monthly instalments, instead of taking out insurance, for example, or paying the stated

amount all at once. Even though Dutch people are to some extent familiar with paying out of pocket for healthcare[9], it is questionable to what extent this scenario seemed realistic to the respondents. Stating the questions in monthly instalments instead of a lump sum for example has the advantage of spreading the burden of payment over time, which prevents problems with ability to pay and budget constraints to some extent. Finally, as in any other stated preferences study, the hypothetical character of the exercise may have formed an important limitation to this study. Respondents might have found it difficult to imagine being in a health state which they have never experienced before. Even though the hypothetical bias was tried to minimize by designing the survey as much realistically as possible, by stating aspects like 'painless medicine' and 'no side-effects', it remains a hypothetical scenario, which is most definitely valued differently than truly experienced scenario's.

The mentioned variability in WTP for a QALY estimates in this study suggests that it may be difficult to derive a unitary ICER threshold. The large differences we found between our elicited WTP values, but also between our WTP values and those elicited from the individual perspective in the Netherlands (Bobinac et al, 2010), add to the evidence that applying one WTP for a QALY as a decision-making tool is not without problems and caution must be taken when using the term 'the value of a QALY'. As we have shown, the precise estimates of WTP per QALY depend on the method used to calculate both the WTP values as QALY gains or losses, and the perspective applied. As the Dutch healthcare system is characterized by a social insurance system, following Dolan et al. (2003) would make the socially-inclusive individual perspective the most appropriate perspective to elicit WTP for a QALY in the Netherlands in order to inform decision-makers on the size of the ICER threshold. Solidarity and altruism play a role in collective decision-making in healthcare and these aspects appear to form a significant source of value in individuals' WTP for health (Neumann & Johannesson, 1994; Olsen et al, 2004; Jacobsson et al, 2005; Smith, 2006). Such externality values are not likely captured by the individual perspective, and thus eliciting WTP for a QALY from the socially-inclusive individual seems a better approach. Since self-interest in the form of option value is already taken into account in the socially-inclusive individual perspective, we can argue that the individual perspective is indeed irrelevant to elicit WTP values in the Dutch healthcare context.

Finally, there is the question of applying one single and unique value of a QALY as the ICER threshold value. The alternative would be to have context-specific ICER thresholds to evaluate healthcare interventions aimed at different diseases or different population groups. The rationale behind this approach is that aspects like disease severity, the amount of beneficiaries, the age of the

[9] In order to contain the rising costs in health care in the Netherlands, the Dutch government is increasingly relying on forms of out-of-pocket payments, like the introduction of deductibles and slimming the basic benefit package

beneficiaries and other things *beyond the QALY* tend to affect people's WTP for health (Baker et al., 2010). In this context, we would refer to the Social Value of a QALY project (Donaldson et al., 2011) conducted in the UK. The purpose of this research project was to investigate whether QALYs gained by different beneficiaries of healthcare should be weighted equally and to evaluate the monetary value of a QALY. Although Donaldson et al. (2011) point out that this study did not provide compelling evidence for moving the NICE cost-effectiveness threshold up or down, many members of the public in fact appear to be open to the possibility of using different QALY weights for different groups of beneficiaries. More research however is needed to reveal more reliable WTP estimates in order to decide to what extent the NICE threshold should change. Future research in the Netherlands should also focus on such aspects 'beyond the QALY ', as these may lead to significantly different WTP estimates than elicited so far. If the Dutch Health Care Insurance Board (CVZ) is to adopt (a) formal ICER threshold(s) in order to evaluate the cost-effectiveness of healthcare interventions, we would argue that different threshold values for different beneficiaries in healthcare should definitely form a key aspect to be taken into account into future research and into the debate about the threshold values that can be applied in policy settings. As the quest for the monetary value of a QALY goes on, this study hoped to give insight into the social value of a WTP for a QALY in the Netherlands, particularly in the context of choosing the right perspective from which this WTP value is elicited.

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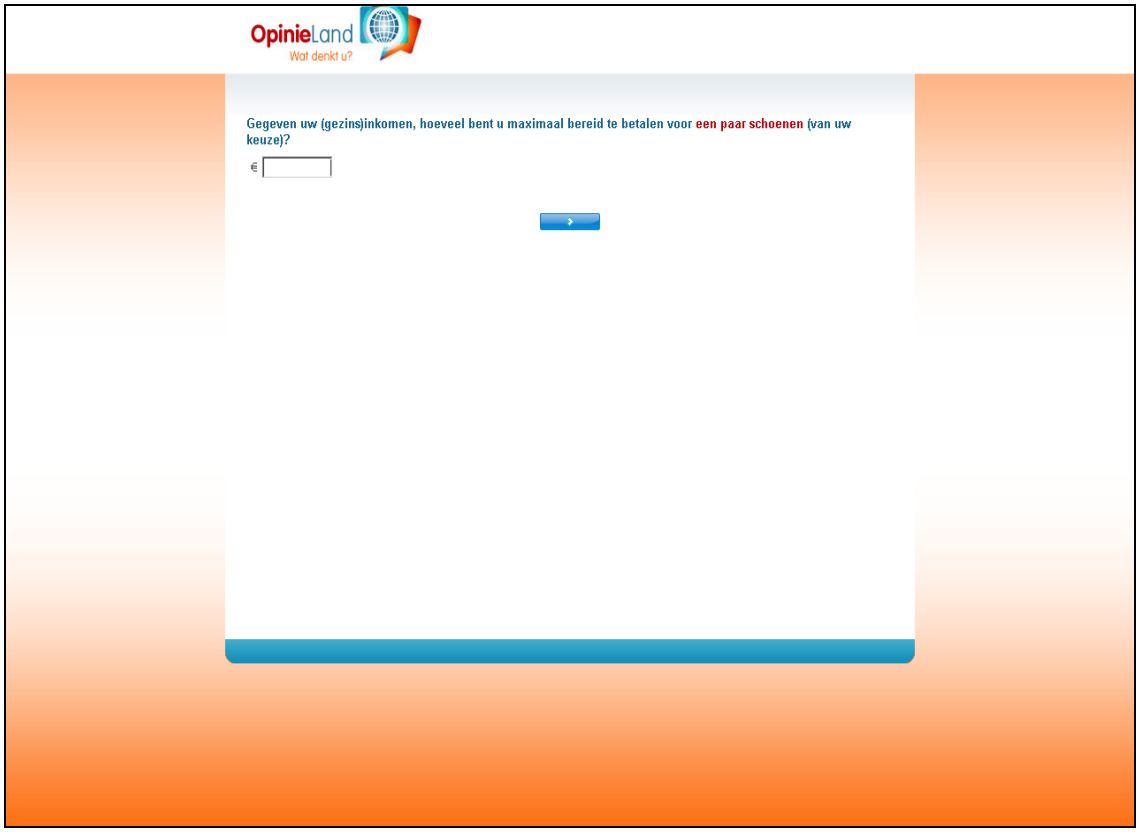
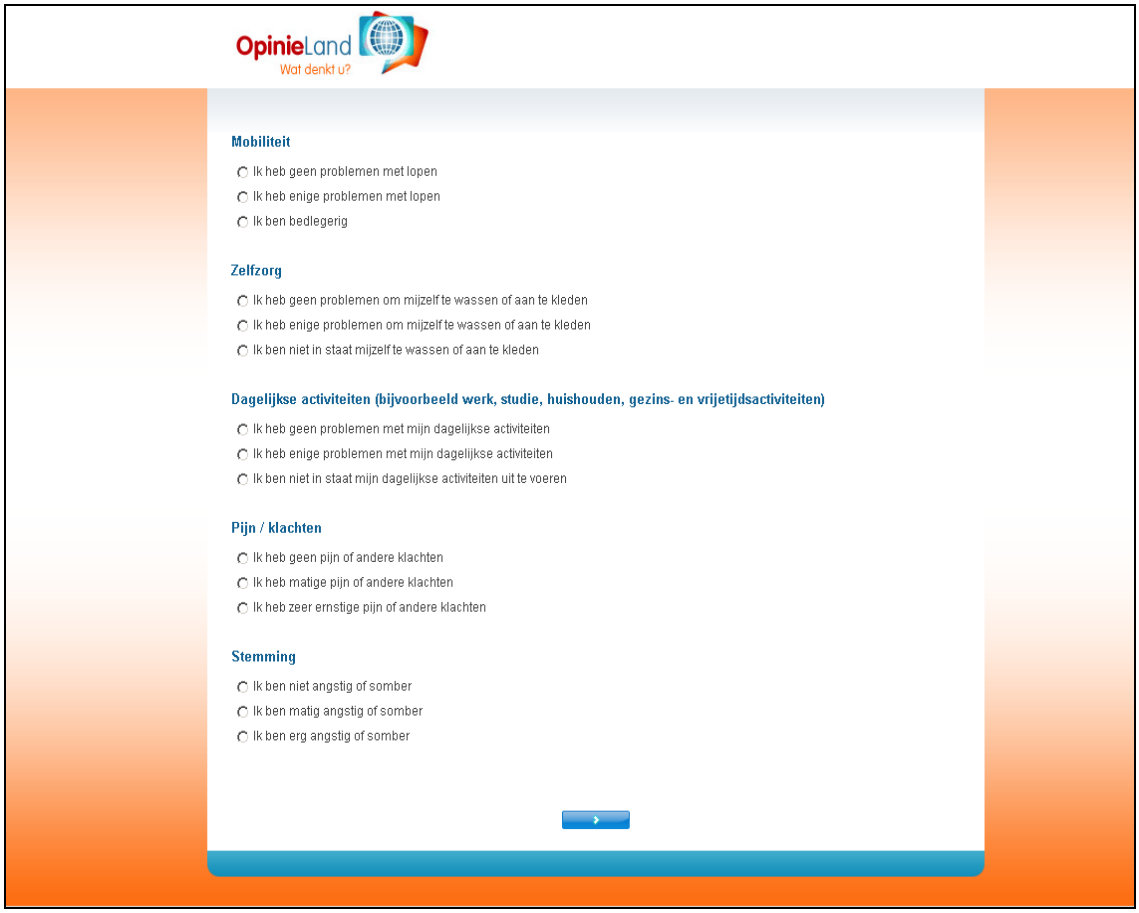
Appendix: Questionnaire

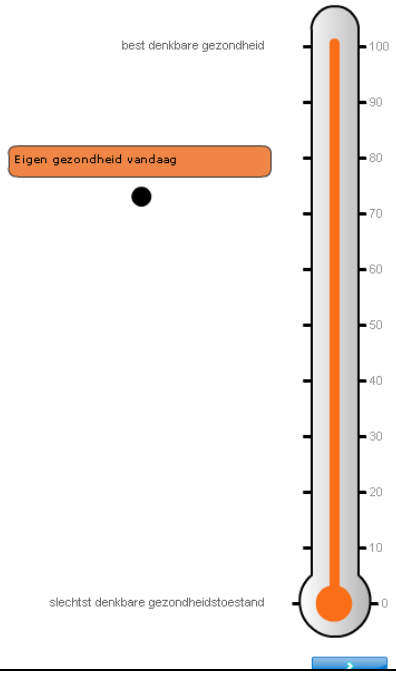



OpinieLand
Wat denkt u?
Nu gaan we verder met het waarderen van gezondheidstoestanden.
Hoe gezond voelt u zich? Selecteer de beschrijving die het best past bij uw gezondheidstoestand vandaag.


OpinieLand
Wat denkt u?
Mobiliteit
Ik heb geen problemen met lopen
Ik heb enige problemen met lopen
Ik ben bedlegerig
Zelfzorg
Ik heb geen problemen om mijzelf te wassen of aan te kleden
Ik heb enige problemen om mijzelf te wassen of aan te kleden
Ik ben niet in staat mijzelf te wassen of aan te kleden
Dagelijkse activiteiten (bijvoorbeeld werk, studie, huishouden, gezins- en vrijetijdsactiviteiten)
Ik heb geen problemen met mijn dagelijkse activiteiten
Ik heb enige problemen met mijn dagelijkse activiteiten
Ik ben niet in staat mijn dagelijkse activiteiten uit te voeren
Pijn / klachten
Ik heb geen pijn of andere klachten
Ik heb matige pijn of andere klachten
Ik heb zeer ernstige pijn of andere klachten
Stemming
Ik ben niet angstig of somber
Ik ben matig angstig of somber
Ik ben erg angstig of somber

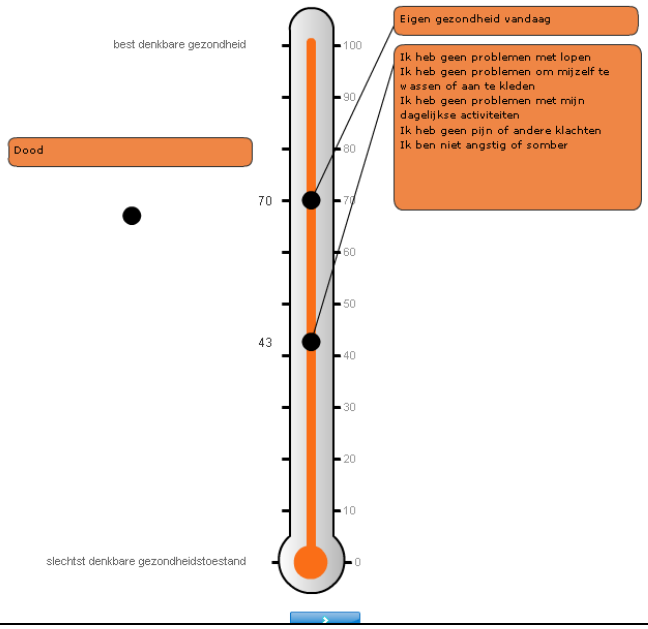
OpinieLand
Wat denkt u?

Wij vragen u drie gezondheidstoestanden te beoordelen door deze op onderstaande schaal te plaatsen op de plek waar ze volgens u horen. De schaal loopt van 0 (slechtst denkbare gezondheid) tot 100 (best denkbare gezondheid). U dient op het zwarte bolletje te klikken en deze te slepen naar de schaal op de plek waar die volgens u hoort. Nadat u een gezondheidstoestand beoordeeld heeft, verschijnt automatisch de volgende op het scherm totdat u alle drie de gezondheidstoestanden heeft beoordeeld. Zodra u alle drie de toestanden beoordeeld heeft, kun op de 'volgende' knop klikken.



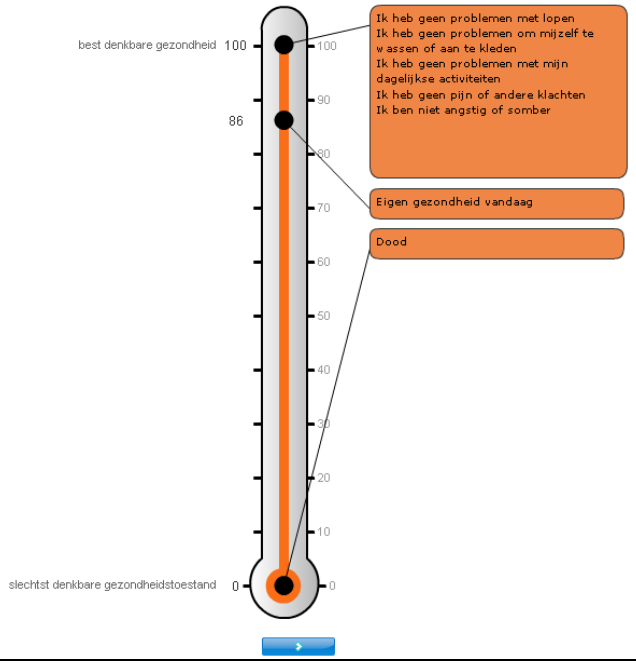
OpinieLand
Wat denkt u?

Wij vragen u drie gezondheidstoestanden te beoordelen door deze op onderstaande schaal te plaatsen op de plek waar ze volgens u horen. De schaal loopt van 0 (slechtst denkbare gezondheid) tot 100 (best denkbare gezondheid). U dient op het zwarte bolletje te klikken en deze te slepen naar de schaal op de plek waar die volgens u hoort. Nadat u een gezondheidstoestand beoordeeld heeft, verschijnt automatisch de volgende op het scherm totdat u alle drie de gezondheidstoestanden heeft beoordeeld. Zodra u alle drie de toestanden beoordeeld heeft, kun op de 'volgende' knop klikken.



OpinieLand
Wat denkt u?

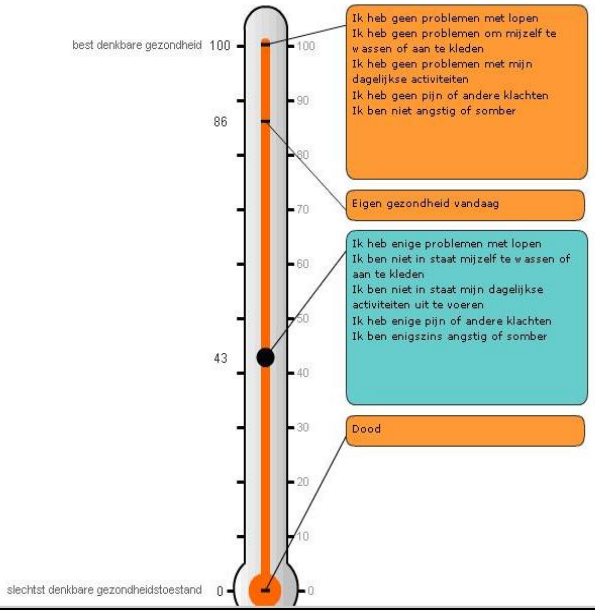
Hieronder ziet u de drie gezondheidstoestanden nogmaals met uw beoordeling. Indien u accoord bent met deze beoordeling, klik dan op de 'volgende' knop.

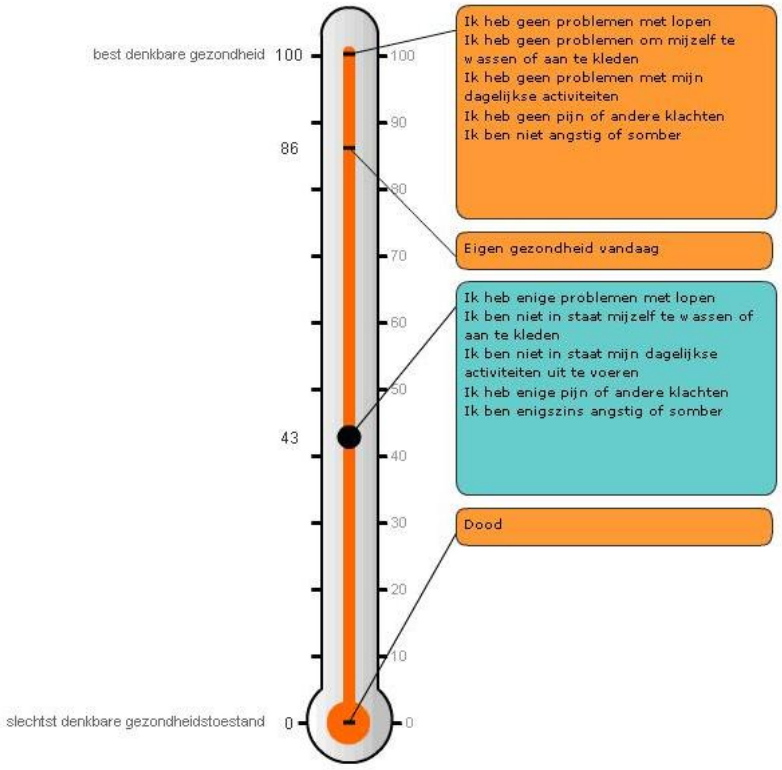


OpinieLand
Wat denkt u?

Stel een nieuw virus zal de volwassen Nederlandse bevolking treffen in de komende maanden.

De ziekte slaat volkomen willekeurig toe: iedereen heeft evenveel kans om de ziekte te krijgen. Alleen kinderen (tot 18 jaar) en minder dan 1% van de volwassenen blijken immuun voor het virus. De ziekte veroorzaakt symptomen die sterk lijken op een griep: koorts, en wat pijn en moeite om de normale dagelijkse activiteiten uit te voeren.





Bijna alle volwassenen hebben 10% kans om deze ziekte te krijgen. Van iedereen die ziek wordt sterft 1 op de 500 mensen door complicaties. De anderen blijven vier weken in de gezondheidstoestand zoals hierboven beschreven. Daarna herstellen ze volledig. U behoort WEL tot de risicogroep en loopt dus zelf risico op de ziekte.

Er bestaat een medicijn (zonder bijwerkingen) tegen de ziekte dat alle ziekte en ook alle sterfgevallen vermijdt. Iedereen blijft dan zeker in de betere gezondheidstoestand. De overheid wil dit medicijn aan iedereen geven.

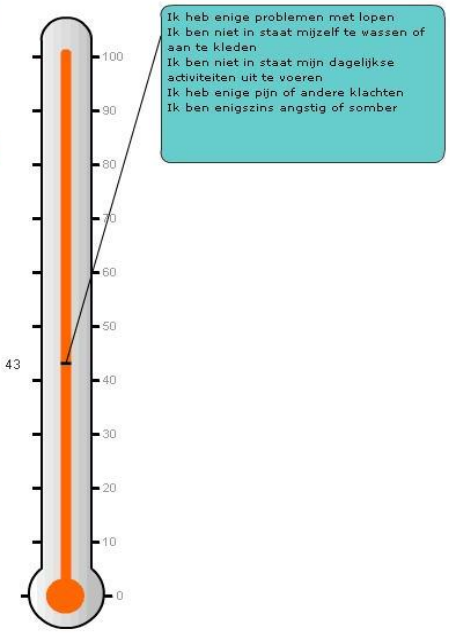
Het medicijn wordt betaald door een tijdelijke verhoging van de maandelijkse verzekeringspremie voor alle Nederlanders, gedurende 1 jaar. De premie betaalt iedereen uit het eigen (gezins)inkomen.

OpinieLand
Wat denkt u?

Wilt u de onderstaande rij met bedragen afgaan, van links naar rechts, en het hoogste bedrag aankruisen dat u, gedurende 1 jaar, zeker wel extra per maand zou willen betalen aan ziektekostenpremie om dit risico op gezondheidsverslechtering volledig te vermijden?

Denk eraan, u behoort NIET tot de risicogroep.

€0	€1	€2	€3	€4	€5	€6	€8	€10	€12	€15	€18	€20	€22	€25	€30	€40	€50	€75	€100	€150	€250	€500
○	○	○	○	○	○	○	○	○	○	◉	○	○	○	○	○	○	○	○	○	○	○	○

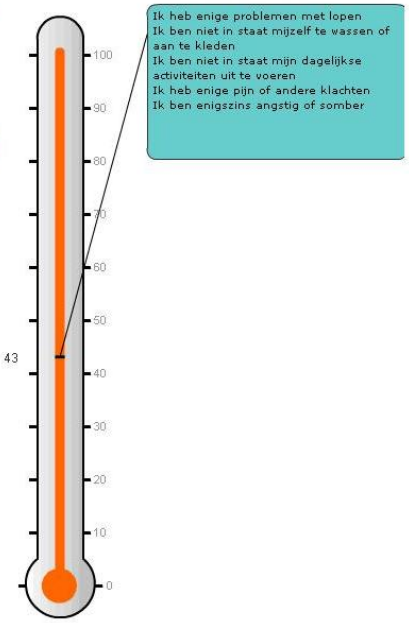


OpinieLand
Wat denkt u?

Wilt u de onderstaande rij met bedragen afgaan, van links naar rechts, en het hoogste bedrag aankruisen dat u, gedurende 1 jaar, zeker niet extra per maand zou willen betalen aan ziektekostenpremie om dit risico op gezondheidsverslechtering volledig te vermijden?

Denk eraan, u behoort NIET tot de risicogroep.

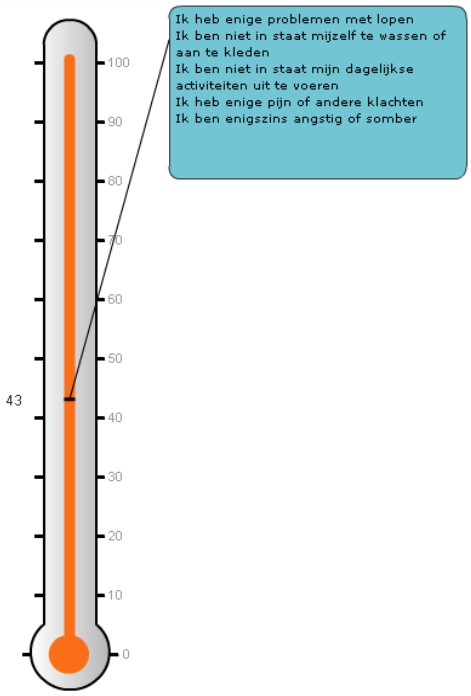
€0	€1	€2	€3	€4	€5	€6	€8	€10	€12	€15	€18	€20	€22	€25	€30	€40	€50	€75	€100	€150	€250	€500
○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	◉	○	○	○	○	○



OpinieLand
Wat denkt u?

U heeft aangegeven dat u voor dit medicijn, dat voor de risicogroep het risico op een jaar in de slechtere gezondheidstoestand vermijdt, zeker €15 extra per maand aan verzekeringspremie wilt betalen maar zeker geen €50. Wilt u het bedrag aangeven (tussen €15 en €50) dat het maximale wat u bereidheid bent om te betalen voor dit medicijn het best benadert?

€ [ ]



OpinieLand
Wat denkt u?

U heeft aangegeven dat u maximaal €45 per maand wilt betalen voor het medicijn waarmee u een jaar in de mindere gezondheidstoestand voorkomt. Hoe zeker bent u er van dat u dit bedrag daadwerkelijk zou betalen als het op dit moment van u gevraagd zou worden?

zeker wel	waarschijnlijk wel	misschien wel, misschien niet	waarschijnlijk niet	zeker niet
○	◉	○	○	○

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