International Journal of Technology Assessment in Health Care, **24:4** (2008), 495–501.

doi:10.1017/S0266462308080653

Estimating the implicit value of statistical life based on public interventions implemented in The Netherlands

Adrienne F. G. Goebbels, André J. H. A. Ament
Maastricht University

Annoesjka Novák
Anovák-Services

Christiaan P. W. M. Veraart
Roche Netherlands BV

Johan L. Severens
Maastricht University and *University Hospital Maastricht*

Objectives: In the Netherlands, allocation decisions have not yet been explicitly based on the Value of Statistical Life. However, when policy makers decide whether or not to implement life saving interventions this trade-off is made implicitly. This study aimed to gain insights into this trade-off, hereafter referred to as Implicit Value of Statistical Life (IVSL), by means of a retrospective investment analysis of life saving interventions implemented in the Netherlands.
Methods: A literature search was conducted to find life saving intervention cases meeting the requirements for IVSL calculation. A final sample of ten cases was included in the study concerning interventions implemented in different societal sectors. For each case, an IVSL estimate was calculated according to a uniform method.
Results: IVSL estimates derived from the intervention cases differed considerably and ranged from €1 to almost €11 million. Differences were most extreme when comparing IVSL estimates concerning interventions implemented in different societal sectors. However, IVSL estimates also varied greatly between interventions in the same sector and even within the same interventions when critical assumptions were altered.
Conclusion: Our findings suggest that there are great imbalances between societal investments for preventing a statistical death. This highlights the need for further deliberation about how to improve transparency of policy decisions. An approach ex ante determining the Value of Statistical Life by means of empirical methods and based on societal preferences might circumvent the problems associated with the IVSL and needs further exploration.

Keywords: Value of statistical life, Life saving interventions, Investment analysis, Willingness to pay, Economic evaluation

This research was funded by an unrestricted grant of Roche Netherlands BV. We thank all authors who provided us with additional data and information about the life saving intervention cases examined in this study.

Human life is the most valuable good we have and protecting it has high priority. The belief has even been expressed that costs should not play a role in saving human lives (14). In different societal sectors, such as health care, transport, consumer safety, and the environment, regular efforts are made to develop interventions reducing mortality risk. However, because public resources are limited, implementing all of these interventions is impossible and choices have to be made between competing intervention options.

In the healthcare sector decisions about the allocation of scarce resources are increasingly based on economic evaluations (28). In these evaluations, efficiency is often expressed in terms of costs per quality-adjusted life-year (QALY). The QALY integrates life expectancy and health related quality of life in a single outcome measure (12). It can be used to compare different types of healthcare interventions, including screening, diagnosis, treatment, monitoring or a combination of these and as such contributes to allocative efficiency. Due to these advantages in The Netherlands guidelines were formulated that explicitly recommend the application of the QALY in economic evaluations of pharmaceuticals that come into consideration for reimbursement (7).

For interventions directed at mortality risk reduction, the economic literature suggests the Value of Statistical Life (VSL) as a common measure of efficiency. The VSL refers to the value that an individual or society would be willing to pay to avoid a statistical death (i.e., the risk of an anonymous premature death). It is a measure of the marginal rate of substitution of wealth for risk of death, due to a specific cause (10;13;23). Empirically, it can be determined by dividing an individual's willingness to pay (WTP) for a change in initial mortality risk, by the change in risk. WTP estimates can be determined by means of revealed or stated preference techniques (16). Revealed preference techniques draw on actual market behavior, whereas stated preference techniques are survey based approaches (11). Both methods result in individual WTP estimates that can be aggregated to determine a societal VSL.

As the VSL can be used to evaluate all kinds of mortality risk reducing interventions, it may assist policy makers in their assessment of competing intervention options across societal sectors. Hence, the VSL has the potential to support allocation decisions on a more central level, similar to role the QALY plays for allocation decisions in the healthcare sector. However, to our knowledge policy decisions in the Netherlands have not been explicitly based on VSL estimates. Instead, the trade-off between wealth and mortality risk is made implicitly when policy makers decide whether or not to implement certain life saving interventions (5;29). These policy decisions give the best available indication of societal willingness to pay for reductions in mortality risk. As there is a lack of scientific evidence regarding this Implicit Value of Statistical Life (IVSL), the present study had the objective to gain insights into its magnitude based on life saving interventions implemented in different societal sectors in the Netherlands.

METHODS

For the purpose of this study, the IVSL was defined as the monetary value society commits to preventing one statistical death as revealed by public life saving interventions that have already been implemented. According to this definition, the IVSL can be calculated by dividing the total investment made for an intervention by the total number of lives saved by that intervention, where the number of lives saved equals the difference between the expected number of deaths before and after the intervention. This method has previously been referred to as Cost per Life saved (11).

To allow for the calculation of IVSL estimates based on implementation decisions of the Dutch government, we defined the following selection criteria for life saving interventions to be included in this study. First, the interventions concern a measure or strategy reducing the probability of premature death among a specified target population. Second, the decision to implement the interventions has been taken by the Dutch central government, whereas the implementation itself and the costs may also be the responsibility of private parties. Finally, the literature reports estimates of the investment made and the number of lives saved by the intervention or provides sufficient information to allow for a belated calculation of these estimates.

To find suitable cases of life saving interventions, the authors initially reviewed interventions implemented or planned for implementation in the Netherlands, that play(ed) a central role in the public debate of governmental policy and met the above selection criteria. Literature regarding economic evaluations conducted with respect to these interventions was searched using governmental and related websites. Furthermore, we contacted experts in different sectors of public policy working in ministries and research institutes that operate on behalf of the Dutch government. They were asked whether they were aware of policy documents regarding these particular interventions and other life saving interventions that might meet the inclusion criteria.

The majority of the reports and policy documents collected by this method initially did not meet the selection criteria. In several cases, however, additional information could be obtained from original authors and literature regarding the projected investment, the expected number of lives saved and the implementation status of the interventions. This process resulted in a final sample of 10 life saving interventions cases included in the study.

For each of these cases, first the investment made and the number of lives saved were determined. In case that these estimates were reported directly, the original calculations were reconstructed to gain insights into the comparability of estimates across the intervention cases. Subsequently, the IVSL was calculated according to the above described definition.

With respect to the calculations, the following choices were made. To make IVSL estimates comparable across cases, annual estimates were transferred to total estimates. Furthermore, when uncertainty was reported around the estimates of the investment and/or number of lives saved (e.g., in terms of sensitivity analyses or minimum and maximum estimates), an IVSL was calculated for each of the possible values of the estimates.

RESULTS

First, the intervention cases analyzed in this study are described according to the societal sector in which they were implemented and with particular emphasis on hours the investment and number of lives saved were estimated. Subsequently, the IVSL estimates derived from these cases are discussed.

Water Control: Measures to Reduce Mortality Risk From Flooding

In 2003 the Dutch Ministry of Transport, Public Works and Water Management commissioned the Netherlands Environment Assessment Agency (MNP) to evaluate the previous governmental policy of managing flooding risk (25). In the framework of this evaluation, the cost-effectiveness of two water control measures was assessed aiming to improve the Dutch population's protection against flooding risk: (i) the water barriers built in the southwestern part of The Netherlands after the flooding disaster in 1953 and (ii) the water barriers built in Central Holland based on the recommendations of the so-called "Delta Commission" made in 1960 (25). The MNP report did not explicitly mention the perspective from which the economic analyses were performed, but as it concerned an evaluation of governmental policy, it is assumed that a public payer perspective was used.

For both interventions the investment and number of life saved estimates were directly reported. However, the calculations underlying these estimates could not be reconstructed, due to unpublished literature and/ or inaccessible data. From the descriptions in the MNP report the following information could be derived. In the Central Holland case the investment estimate was only based on the investment directly associated with the water control measures whereas in the South West Netherlands case the investment estimate represents the investment associated with the water control measures minus additional economic benefits due to the further development of the Vlissingen harbor area. Furthermore, the number of lives saved estimate in the South West Netherlands case was based on the number of fatalities caused by the flooding disaster in 1953. For the Central Holland case, we were not able to retrieve the literature sources providing the estimated number of lives saved. Both, the investment and number of live saved estimates, were reported on an annual basis assuming an interest rate of 4 percent and administration costs of 1 percent.

Consumer Safety: Measures to Reduce Mortality Risk From Contamination of Pharmaceutical Products

In 1996, patients with a new variant of Creutzfeldt Jakob disease (CJD) representing a bovine-to-human transmission of BSE (bovine spongiform encephalopathy) were for the first time discovered. Because there is no cure available for this disease, the Dutch government took a series of measures to protect consumers from contracting it. These included tracking down and slaughtering diseased cattle, banning the import of cattle from Great Britain, and testing cattle older than 30 months for BSE (26). In addition, changes in regulations were made to reduce the transmission risk of the disease by pharmaceutical products containing animal derivates. To adhere to these new regulations, pharmaceutical companies had to change production processes, conduct additional analyses and use other raw materials. The costs and benefits of these measures were recently estimated for the companies SynCo Bio Partners, Sobel, Sanquin, and Centocor using data from interviews with company representatives and additional literature (26).

The investment estimates reported consist of structural and once only costs made by the companies in an 8-year period and include both costs made to comply with the legislation and voluntary costs made to reduce the transmission risk (26). The number of lives saved were estimated based on a hypothetical population at risk for contracting the disease of 1 billion and on an estimated initial mortality risk, that was calculated as cumulative risk of the separate protection moments (i.e., each time patients take the pharmaceutical product under consideration).

Transport Sector: Measures to Reduce Mortality Risk From Road Accidents

Every year, a considerable number of people get injured or die in road accidents due to the limited field of view truck drivers have when turning right. In response to this problem, the Dutch government introduced a legal obligation to equip trucks with field of view improving systems (i.e., blind spot mirror or camera) in 2003. Shortly after this legislation was implemented, Langeveld and Schoon (17) conducted an economic evaluation of this measure from a societal perspective. The investment estimate they report includes the costs made by the government for law making and educational campaigns and the costs made by truck owners for equipping their vehicles with field of view improving systems. The number of lives saved estimate used in the report was derived from previous research (27). It was calculated using accident statistics and was based on two main assumptions: (i) the differences between the number of casualties caused by trucks turning right and trucks turning left can be accounted for by the blind spot; and (ii) field of view improving systems have a 40 percent lower effectiveness than direct view. Both the investment and the number of lives saved

https://doi.org/10.1017/S0266462308080653 Published online by Cambridge University Press

concerned an eight year period and were discounted to present value using a 4 percent discount rate.

Health Care: Measures to Reduce Mortality Risk From Pandemic Influenza

Based on WHO recommendations the Dutch Ministry of Health, Welfare, and Sports developed an Influenza Pandemic Preparedness Plan with the objective to minimize the effects of a possible influenza pandemic on population and society. In the framework of this plan, the National Institute for Public Health and the Environment (RIVM) assessed the impact of different intervention measures on health services in terms of resources needed and health consequences, including mortality (15). The intervention measures concerned two possible scenarios: (i) the situation in which an influenza vaccine is available at the beginning of the pandemic and (ii) the situation in which such a vaccine is not available. For the latter case two intervention options were assessed. First, pneumococcal vaccination of groups at risk for influenza to prevent the complications associated with influenza and second a therapeutic strategy administering neuraminidase inhibitors (i.e., antiviral agents) to people with influenza-like symptoms. Prophylactically administering neuraminidase inhibitors was another intervention option examined, but this was not included in this study as it did not meet our selection criteria. To date, the Netherlands have not been confronted with an influenza pandemic. However, the Dutch government has already invested in influenza vaccines (4 million units), pneumococcal vaccine (1 million units), and antiviral agents (5 million cures) to ensure rapid action in case a pandemic outbreak occurs (15;20).

The investment associated with the alternative intervention options was not reported by the RIVM, but it could be calculated due to the detailed description provided of the resources needed for the different intervention options. Given that only healthcare resources were described in the report, we conducted the analysis from a healthcare perspective. The investment estimate includes drug costs, pharmacy prescription fees and the costs of GP visits for the number of patients that is expected to receive the interventions (8;9;21;22). The numbers of lives saved were estimated using a mathematical model synthesizing data from various literature sources, including GP registries and Statistics Netherlands. The model was based on several assumptions regarding age dependency of attack rates, the spreading time of influenza and the conversion of death rates in the normal epidemic to the pandemic situation and was validated by an expert panel. Due to the uncertainty regarding the extent of a possible pandemic, the estimates of the investment and the number of lives saved were reported for the situation in which the pandemic hits 30 percent and 50 percent of the population. Given the lack of knowledge regarding the efficacy of neuraminidase inhibitors when used for therapeutic purposes, the investment made and the number of lives saved was also calculated for different degrees of efficacy (25 percent and 75 percent).

IVSL Estimates

The IVSL estimates derived from the intervention cases included in this study differ substantially with a minimum of €1 per statistical death prevented, estimated for the measures taken by the pharmaceutical company Sanquin to reduce mortality risk from Creutzfeldt Jakob disease, and a maximum of almost €11 million per statistical death prevented, estimated for the water control measures taken in South West Netherlands (see Table 1). The differences between IVSL estimates are most extreme when comparing interventions between different societal sectors. However, there are also great differences between IVSL estimates of similar intervention cases within the same sector. For example when comparing the water control measures in Central Holland and with the ones in South West Netherlands case (difference >€10 million). Even within the same interventions IVSL estimates vary considerably when critical assumptions are altered. This is for example the case for therapeutic use of neuraminidase inhibitors in case of an influenza pandemic, where IVSL estimates range from just under €100,000 to more than €300,000.

DISCUSSION

This study aimed to provide insights into the magnitude of the Implicit Value of Statistical Life (IVSL) by means of ten cases of life saving interventions implemented in different societal sectors in the Netherlands. Our findings show that IVSL estimates differ considerably between the intervention cases and range from €1 to almost €11 million per statistical death prevented. This indicates that society's investments for mortality risk reductions vary extremely. However, one can question whether the IVSL estimates in this study give a good indication of which life saving interventions represent a better investment than others in terms of efficiency. The IVSL estimates derived in this study have the advantage that they were calculated according to a uniform method and express the efficiency of different types of interventions in the same terms. Ideally, such a common efficiency parameter allows for a comparison of different types of interventions. However, the differences existing between crucial input parameters for the IVSL calculation (i.e., the investment and number of lives saved estimates) hamper valid comparison of the interventions in this study. The differences have several reasons.

First, the investment and number of lives saved estimates derived from the intervention cases were determined using different perspectives. In the pharmaceutical sector cases the perspective of individual companies was applied, while in the other intervention cases a healthcare, societal, or public payer perspective was used. As a result the types of costs included

https://doi.org/10.1017/S0266462308080653 Published online by Cambridge University Press

Table 1. IVSL Estimates and Input Parameters for the IVSL Calculation

Case (per sector)	Investment (* € 1000)	Lives saved (N)	IVSL (€) Min	Point estimate	Max
Water control					
Central Holland	300 000	100-5 440	55 147		3 000 000
South West Netherlands	700 000	64	—	10 937 500	—
Consumer safety					
SynCo Bio Partners	50	28 908	—	2	—
Sobel	113 200	11 095	—	10 203	—
Sanquin	191 000	192 719 815	—	1	—
Centocor	36 000	73 000	—	493	—
Transport					
Field of view improving systems	13 610	12	—	1 134 167	—
Health care/Public Health					
Influenza vaccination					
pandemic hits 30%	69 825	2 251	—	31 020	—
pandemic hits 50%	69 825	3 752	—	18 610	—
Neuraminidase inhibitors					
pandemic hits 30%; efficacy 25%	294 690	1 010	—	291 772	—
pandemic hits 50%; efficacy 25%	501 600	1 600	—	313 500	—
pandemic hits 30%, efficacy 75%	294 690	3 030	—	97 257	—
pandemic hits 50%, efficacy 75%	501 600	5 000	—	100 320	—
Pneumococcal vaccination					
pandemic hits 30%	63 884.4	137	—	466 309	—
pandemic hits 50%	63 884.4	230	—	277 758	—

Notes. All estimates presented in this table were rounded to absolute numbers.

in the investment estimate and the population at risk used to estimate the number of lives saved are not comparable across cases.

Second, discounting is not applied consistently. In the transport sector case discounting is used to adjust future monetary and health effects for their differential timing. In all other cases discounting was not applied or not reported. Due to the preventive nature of the interventions in this study, benefits are generally produced in the future, while costs are generated immediately. Therefore, the choice whether or not to use discounting and the choice for the method of discounting can have profound effect on the cost-effectiveness of these interventions (3;6). Although there is still ongoing discussion regarding whether or not to discount the benefits of preventive interventions, the methods used should at least be consistent to allow for comparison (24).

Third, additional economic benefits produced by the interventions are not consistently included in the investment estimate. As part of the water control measures in South West Netherlands, the Vlissingen harbor area was further developed. The additional economic benefits resulting from these measures were subtracted from the total investment made for the intervention. In the remaining intervention cases, benefits other than mortality risk reduction were either not accounted for or this was not reported.

Finally, the investment and number of lives saved estimates vary in the accurateness by which they were estimated. This is due to differences in the quality and scope of the economic evaluations performed in relation to the intervention cases. The estimates derived from the consumer safety cases are for instance based on a short explorative study, whereas the estimates derived from the healthcare sector cases are based on a decent and comprehensive analysis. The estimates in the transport sector case appear to be based on a rather global estimation and for the water control cases we could not reconstruct how estimates were calculated. These accuracy differences may for instance explain why IVSL estimates derived from the consumer safety cases are so low compared with IVSL estimates of other cases. The mortality risks in the consumer safety cases were largely based on ad hoc estimates made by company managers. As people generally have difficulties appraising small risks (19), it is possible that this approach has resulted in an overestimation of the initial mortality risk and the risk reductions achieved by the intervention and hence in biased IVSL estimates.

Given the potential bias introduced by studies with a rather limited scope and suboptimal research methods, it would have been advisable to use the quality of the data as an additional selection criterion for the cases included in this study. However, as the availability of intervention cases meeting the requirements for the IVSL calculation was limited, we chose not to use the quality of the data as a separate selection criterion.

In addition to the limited comparability of IVSL estimates, there are also some conceptual problems inherent to

https://doi.org/10.1017/S0266462308080653 Published online by Cambridge University Press

the IVSL. The IVSL is based on investment decisions that have often been taken by policy makers in an ad hoc manner. As a result the trade-off between wealth and mortality risk may be a highly imperfect process not adequately reflecting policy preferences (29).

Furthermore, the IVSL only gives an indication of the lower bound of society's willingness to pay for a statistical death prevented. It reveals the amount society has paid in the past, while it would be more relevant to know what society would be willing to pay as a maximum.

A third problem of the IVSL is related to the fact that it has to be determined retrospectively based on secondary data sources. Hence, data about the decision contexts of the wealth-risk trade-offs is not readily available, which limits the opportunity to systematically examine possible determinants of IVSL estimates. Meta-analyses of empirical VSL studies, suggest that VSL estimates are influenced by a variety of factors, including characteristics of the sample (e.g., income), characteristics of the affected population at risk (e.g., life expectancy and average mortality risk) and context-specific factors (e.g., country of origin, year of publication or "unionization" in labor market studies) (2;30). Insights into these factors and their relationship with the VSL are important as they contribute to our understanding of the variations found between VSL estimates from different studies.

Fourth, it may be argued that the IVSL concept does not reflect preferences of society, but rather the revealed preferences of policy makers themselves, which is in contrast to the widely shared opinion among economists that the monetary value of safety in public sector cost-benefit analyses should reflect the preferences of those affected by the measure (11).

Finally, the IVSL assumes that decisions to implement life saving interventions are solely based on the trade-off between wealth and mortality risk. However, this trade-off is only one of the many factors that may be considered by decision makers. Additional factors taken into account include for instance the broader benefits the intervention has for society, the potential unrest or panic that may be reduced by the intervention, and the consideration that we can be better safe than sorry, which is referred to as the precautionary principle (1;18). Moreover, policy decisions are not only based on a rational weighing of arguments, but often represent a political compromise. Decision makers have to argue with different stakeholders and have to sell their decisions in the light of being re-elected (4). Hence, the IVSL does not provide an adequate reflection of the complex reality of decision making.

CONCLUSION

This study has demonstrated that an IVSL derived by means of an ex post investment analysis is not an adequate means to compare the efficiency of different life saving interventions. This is due to the incomparability of input data for the IVSL calculation when these are derived from secondary data sources, but primarily, due to conceptual problems inherent to the IVSL. Despite the limitations of this approach, the IVSL estimates derived in this research suggest that there are great imbalances between society's investments for avoiding a statistical death. At this moment, we lack information about the possible reasons of these imbalances. This highlights the need for further deliberation about how policy decisions can be made more transparent. A decision-making approach explicitly and ex ante taking the VSL into account could be a step forward. When determined by means of empirical methods and based on societal preferences, the VSL might circumvent the problems associated with the implicit VSL approach and might provide a useful decision aid for policy makers. Further research efforts are needed to examine applications of this method in the practice setting.

CONTACT INFORMATION

Adrienne F. G. Goebbels, MSc (a.goebbels@beoz.unimaas.nl), Junior Researcher, **André J. H. A. Ament**, PhD (A.Ament@beoz.unimaas.nl), Associate Professor, Department of Health Organization, Policy, and Economics, Maastricht University, P.O. Box 616, Universiteitsingel 40, 6200 MD Maastricht, The Netherlands

Annoesjka Novák, MSc (annoesjka@anovak-services.com), Managing Director, Anovák-Services, Venuslaan 10, 7314 KZ Apeldoorn, Netherlands

Christiaan P. W. M. Veraart, MSc (christiaan.veraart@roche.com), Pharmaco-Economics Manager, Department of Commercial Affairs, Roche Netherlands BV, Beneluxlaan 2a, 3446 GR Woerden, The Netherlands

Johan L. Severens, PhD (h.severens@beoz.unimaas.nl), Professor of Medical Technology Assessment, Department of Health Organization, Policy, and Economics, Maastricht University; Department of Clinical Epidemiology and MTA, University Hospital Maastricht, P.O. Box 616, 6200 MD Maastricht, The Netherlands

REFERENCES

1. Alban S. The 'precautionary principle' as a guide for future drug development. *Eur J Clin Invest*. 2005;35(Suppl 1):33-44.
2. Bellavance F, Georges D, Lebeau M. *The value of a statistical life: A meta-analysis with a mixed effects regression model*. Working paper 06-12. Montreal: Canada Research Chair in Risk Management; 2006.
3. Bos JM, Beutels P, Annemans L, Postma MJ. Valuing prevention trough economic evaluation: Some considerations regarding the choice of discount model for health effects with focus on infectious diseases. *Pharmacoeconomics*. 2004;22:1171-1179.
4. Brownson RC, Royer C, Ewing R, et al. Researchers and policymakers: Travellers in parallel universes. *Am J Prev Med.* 2006;30:167-172.
5. Card WI, Mooney GH. What is the monetary value of human life? *BMJ*. 1977;2:1627-1629.

https://doi.org/10.1017/S0266462308080653 Published online by Cambridge University Press

6. Claxton K, Sculpher M, Cuyler A, et al. Discounting and cost-effectiveness in NICE-stepping back to sort out a confusion. *Health Econ*. 2006;15:1-4.
7. CVZ. *Richtlijnen voor farmaco-economisch onderzoek*. Diemen: CVZ; 2006.
8. CVZ. *Farmacotherapeutisch Kompas*. http://www.fk.cvz.nl. Accessed 22 May 2007.
9. CVZ. *Medicijnkosten*. http://www.medicijnkosten.nl. Accessed 28 June 2007.
10. De Blaeij A. *The value of statistical life in road safety: Stated preference methodologies and empirical estimates for the Netherlands*. Amsterdam: PhD Thesis, VU University; 2003.
11. De Blaeij A, Florax RJGM, Rietveld P, et al. The value of statistical life in road safety: A meta-analysis. *Accid Anal Prev*. 2003;35:973-986.
12. Drummond MF, Sculpher MJ, Torrance GW, et al. *Methods for the economic evaluation of health care programmes*. New York: Oxford University Press; 2005.
13. Evans MF, Smith VK. Do we really understand the age-VSL relationship? *Resour Energy Econ*. 2006;28:242-261.
14. Fuchs VR, Zeckhauser R. Valuing health: A "priceless" commodity. *Am Econ Rev*. 1987;77:263-268.
15. Genugten MLL, Heijnen MLA, Jager JC. *Scenario analysis of the expected number of hospitalisations and deaths due to pandemic influenza in the Netherlands*. Bilthoven: RIVM; 2002.
16. Johansson P, Kriström B. Introduction. *Resour Energy Econ*. 2006;28:193-198.
17. Langeveld PMM, Schoon CC. *Kosten-batenanalyse van maatregelen voor vrachtauto's en bedrijven* (report no.: R-2004-11). Leidschendam: SWOV; 2004.
18. Mathijssen J, Petersen A, Besseling P, et al. *Omgaan met Onzekerheid in Beleid*. Den Haag: CPB, MNP & RAND Europe.
19. Miller TR. Variations between countries in values of statistical life. *J Transport Econ Pol*. 2000;34:399-416.
20. Ministry of Health Welfare and Sports. *Hoogervorst tekent contract levering antivirale middelen*. Press report from September 9th 2005. The Hague: Ministry of Health Welfare and Sports.
21. NZA. *Tarievenlijst Huisartsenzorg-Bijlage bij tariefbeschikking 5000-1900-07-1*. Utrecht: NZA; 2006.
22. Postma MJ, Novak A, Scheijbeler HW, et al. Cost effectiveness of oseltamivir treatment for patients with influenza-like illness who are at increased risk for serious complications of influenza: Illustration for the Netherlands. *Pharmacoeconomics*. 2007;25:497-509.
23. Rabl A, Spadaro JV. Environmental impacts and costs of energy. *Ann N Y Acad Sci*. 2006;1076:516-526.
24. Severens JL, Milne RJ. Discounting health outcomes in economic evaluation: The ongoing debate. *Value Health*. 2004;7:397-401.
25. Ten Brinke WMBJ, Bannink BA. *Risico's in bedijkte termen: een thematische evaluatie van het Nederlandse veiligheidsbeleid tegen overstromen* (Report no. 500799002). Bilthoven: RIVM; 2004.
26. Van Der Baan F, Donk S, Jansen H, et al. *The price of precaution: Measures to reduce the risk of contamination with vCJD via pharmaceutical products*. Utrecht: University of Utrecht, Faculty of Geosciences; 2006.
27. Van Kampen LTB, Schoon CC. *De veiligheid van vrachtauto's : een ongevals- en maatregelanalyse in opdracht van Transport en Logistiek Nederland*. Leidschendam: SWOV; 1999.
28. Van Velden ME, Severens JL, Novak A. Economic evaluations of healthcare programmes and decision making: The influence of economic evaluations on different healthcare decision-making levels. *Pharmacoeconomics.* 2005;23:1075-1082.
29. Viscusi WK, Harrington JE, Vernon JM. *Economics of regulation and antitrust*. Cambridge: MIT Press; 2005.
30. Viscusi WK, Aldy JE. The value of a statistical life: A critical review of market estimates throughout the world. *J Risk Uncertain*. 2003;27:5-76.

https://doi.org/10.1017/S0266462308080653 Published online by Cambridge University Press