



WORKING FOR A HEALTHY FUTURE

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Methodology for valuing health impacts on the SHEcan project

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SUMMARY

This report has been produced for the purpose of presenting the method used to determine the health estimates used for this study. This paper was circulated to the Commission for approval prior to the commencement of valuing health benefits, to ensure each substance covered was assessed applied the same consistent method.

Several approaches exist to assessing potential health impacts ranging from non-monetary approaches such as Quality Adjusted Life Years (QALY), Disability Adjusted Life Years (DALY) and Health Life Years (HLY) to monetary methods such as the Cost of Illness (COI), Value of Statistical Life (VSL) and Value of Life Year Lost (VLYL). There is no consensus as to the most appropriate approach and for most cases, different approaches may be more appropriate depending on the specific nature of the health impacts. For the purposes of this study the valuation of health impacts are divided into two main aspects:

- Life years lost – This is calculated by using the year's life lost (YLL) estimated by Imperial College and multiplying this with a valuation of the Value of Life Year Lost (VLYL). This values the time (years) lost due to premature death.
- Cost of Illness (COI) – This is often the main market-based approach in relation to health impact (ECHA 2008)¹. Depending on the valuations available, it can include the direct, indirect and intangible costs of cancer. This is a monetary cost of the time spent with cancer. In this study, a unit COI estimate is multiplied by the number of cancer registrations.

Each of these two impacts is explained in more detail below as well as using willingness-to-pay (WTP) estimates as an alternative approach. Details of how cancer registrations, YLD and YLL were estimated as part of the health impact assessment for the study.

The tables below summarise the cost variables used in this study. Table A1 summarises the costs variables used in this study for all types of cancer, with the exception for nonmelanoma skin cancer (NMSC) where there is a greater survival rate and costs of treatment may be less expensive. The costs specifically for NMSC are summarised in Table A2.

Table A1 Summary of cost variables used in this study for all cancers except NMSC (€ 2009 prices)

Cost/benefit elements	Low scenario	High scenario
VLYL - Each year lost	€ 50,393	€ 0 (note 1)
COI or WTP - Unit cost (per cancer registration)	€ 49,302 (COI)	€ 1,793,776 (WTP)

(Note 1) – By using WTP (€1.8m) in the high scenario instead of COI, the WTP can include the costs of premature death and therefore there was a risk of double counting benefits if VLYL costs were included.

¹ (ECHA 2008) – Applying SEA as part of restriction proposals under REACH

Table A2 Summary of cost variables used for NMSC only (€ 2009 prices)

Cost/benefit elements	Low scenario	High scenario
VLYL - Each year lost	€ 50,393	€ 50,393
COI or WTP - Unit cost (per cancer registration)	€ 2,601	€ 38,827 (WTP)

Note: As the WTP to estimate relates to not having permanent scars and does not include the costs associated with life years lost, the high scenario also incorporates the impacts of any life years lost. This differs from the approach used for other types of cancer whereby the WTP already includes life years lost (and is therefore excluded to avoid double counting benefits).

1 INTRODUCTION

Several approaches exist to assessing potential health impacts ranging from non-monetary approaches such as Quality Adjusted Life Years (QALY), Disability Adjusted Life Years (DALY) and Health Life Years (HLY) to monetary methods such as the Cost of Illness (COI), Value of Statistical Life (VSL) and Value of Life Year Lost (VLYL).

Non-monetary approaches are potentially less controversial (compared to monetary approaches which place monetary values on life and a life year lost) and are typically suitable for cost-effectiveness analysis (CEA) where the cost of different options are compared against their performance in improving human health. Where a more formal cost benefit analysis (CBA) is required to compare the costs against the benefits, then monetary approaches to health impacts is more appropriate.

There is no consensus as to the most appropriate approach and for most cases, different approaches may be more appropriate depending on the specific nature of the health impacts. For example, Markandya (2003)² suggests when mortality occurs due to “acute” impacts (i.e. short term exposure leads to death which can easily attributable to exposure) VSL may be more appropriate, whereas for “chronic” impacts (i.e. long term exposure leads to death, but are not directly attributable) it may more appropriate to use VLYL observing the life expectancy lost over the whole population affected. In some instances, non monetary approaches have been monetised by placing monetary values on their results. For example, the UK Interdepartmental Group on Costs and Benefits (IGCB) recently published a report³ whereby a monetary value was placed using DALY values.

As part of this study, Imperial College have developed a model to estimate DALYs based on exposure data from Institute of Occupational Medicine (IOM) and the Finish Institute for Occupational Health. The DALYs uses time as a common metric taking into consideration both premature death and ‘healthy’ years lost due to problems associated with living with the disease or health condition (i.e. cancer for this study). DALYs are calculated as the sum of the years of life lost due to premature mortality (YLL) and the years lost due to disability (YLD):

$$\text{DALY} = \text{YLL} + \text{YLD}$$

Each DALY represents one lost year of ‘healthy’ state. The DALYs can be used as one approach to compare different options (e.g. cost effectiveness analysis) especially when different Occupational Exposure Limit (OEL) values have been proposed. Entec have also used the underlying data developed by Imperial College to attempt to monetise health impacts associated with introducing EU-wide OELs. This will allow for a more formal cost benefit analysis to be used to compare different policy options. This paper sets out this approach to monetising human health impacts.

² Markandya (2003): Valuation of Health Impacts in ExternE - <http://www.externe.info/prag/mo1045.pdf>

³ Defra IGCB (2008): An Economic Valuation of Noise Pollution – developing a tool for policy appraisal - <http://www.defra.gov.uk/environment/noise/igcb/pdf/igcb-first-report.pdf>

The approach used to estimate a monetary value on changes in health impacts is dependent on the data available such as the population at risk (i.e. data on the exposed population) and any evidence of dose-response relationships. Since it is not possible to develop dose-response functions for each substances, the approach to valuing changes in human health is based on estimating the monetary loss (damages or costs) that might occur if no changes were made (Business-As-Usual scenario) in comparison to the avoided health related costs under the introduction of an EU-wide OEL level(s). The difference in health impacts between the BAU scenario and the scenario(s) with an OEL is the main health benefits valued in this project.

The valuation of health impacts are divided into two main aspects:

- Life years lost – This is calculated by using the year's life lost (YLL) estimated by Imperial College and multiplying this with a valuation of the Value of Life Year Lost (VLYL). This values the time (years) lost due to premature death.
- Cost of Illness (COI) – This is often the main market-based approach in relation to health impact (ECHA 2008)⁴. Depending on the valuations available, it can include the direct, indirect and intangible costs of cancer. This is a monetary cost of the time spent with cancer. In this study, a unit COI estimate is multiplied by the number of cancer registrations.

Each of these two impacts is explained in more detail below as well as using willingness-to-pay (WTP) estimates as an alternative approach.

2 VALUE OF LIFE YEARS LOST (VLYL)

The years of life lost (YLL) are estimated by multiplying the number of disease specific deaths times average life expectancy after average age at death from the specific disease⁵. EU and Member State specific average life expectancies were used for this project. Essentially years of life lost are the difference between death and average life expectancy ('premature death'). This is illustrated in Figure 2.1.

⁴ (ECHA 2008) – Applying SEA as part of restriction proposals under REACH

⁵ Data on disease specific deaths by age were not available so age weighting factors were not used.

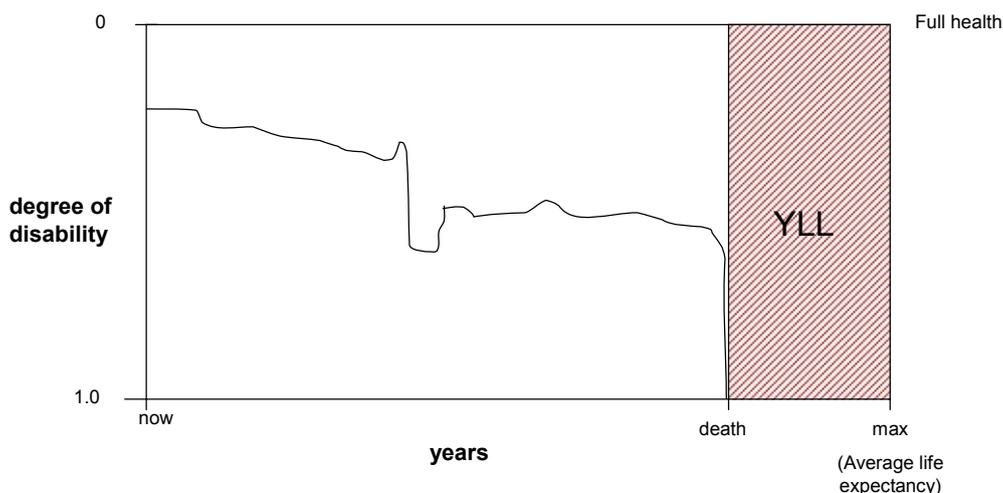


Figure 2.1 DALY component: Years of life lost (VLL)

Monetary estimates of the value of life years lost (VLYL or sometimes known as VOLY⁶) allows us to put a value on VLL. The latest EC Impact Assessment guidance (EC 2009)⁷ suggests using estimates of €50,000-100,000 in Europe for the purpose of an Impact Assessment, if no more specific estimates are available. Markandya (2003) uses an estimate of €50,000 and is also used more widely in other assessing health policies such as CAFE. Therefore for the purposes of this study the €50,000 is used as a lower estimate and €100,000 as an upper estimate. This should therefore help encompass the uncertainties associated with the VLYL.

These valuations are increased by 2% each year in the future in part to present costs in real terms (i.e. adjusting for inflation in prices) and to reflect societies increasing value attached to their health (as economic growth typically increases over a long period of time)⁸.

All costs and benefits over time in this study are discounted using a 4% discount rate as recommended by the EC Impact Guidelines⁹. As a means of sensitivity, the analysis is also presented with estimates that take into consideration a declining discount rate for impacts occurring after 30 years and no discounting. The discount rates used under the declining discount rates option are shown in Table 2.1.

⁶ Value of Life Years (VOLY)

⁷ EC (2009) Part III: Annexes to the Impact Assessment Guidelines (15th January 2009). http://ec.europa.eu/governance/impact/commission_guidelines/docs/iag_2009_annex_en.pdf

⁸ This is consistent with some other European Commission studies and is standard practice for air quality under the Clean Air for Europe (CAFE) programme.

⁹ EC impact Assessment Guidelines (Jan 2009) - http://ec.europa.eu/governance/impact/commission_guidelines/docs/iag_2009_en.pdf

Table 2.1 Declining discount rate

Time period	2010-2019	2020-2029	2030-2039	2040-2049	2050-2059	2060-2069
Declining discount rate	4%	4%	4%	3%	3%	3%

Note: The EC Impact Assessment does not give specific guidance on the rates to be used under a declining discount rate other than the decline would apply after 30 years. The UK Treasury Green Book provides long term declining discount rates by time period, with the next period after 30 years being 31-75 years. Since this study only considers impacts up to 2070 the effects of a declining discount rate are small.

It is unlikely that a consensus on discounting will emerge amongst experts as the trade off between the welfare of current and future generations is political. By analysing the implication of discounting and alternative discount rates, the reader is presented with the evidence in a transparent manner and can make a judgement about the trade off¹⁰. Figure 2.2 presents the effects of discounting the VLYL (€50,000) over time using different discount rates used in this study.

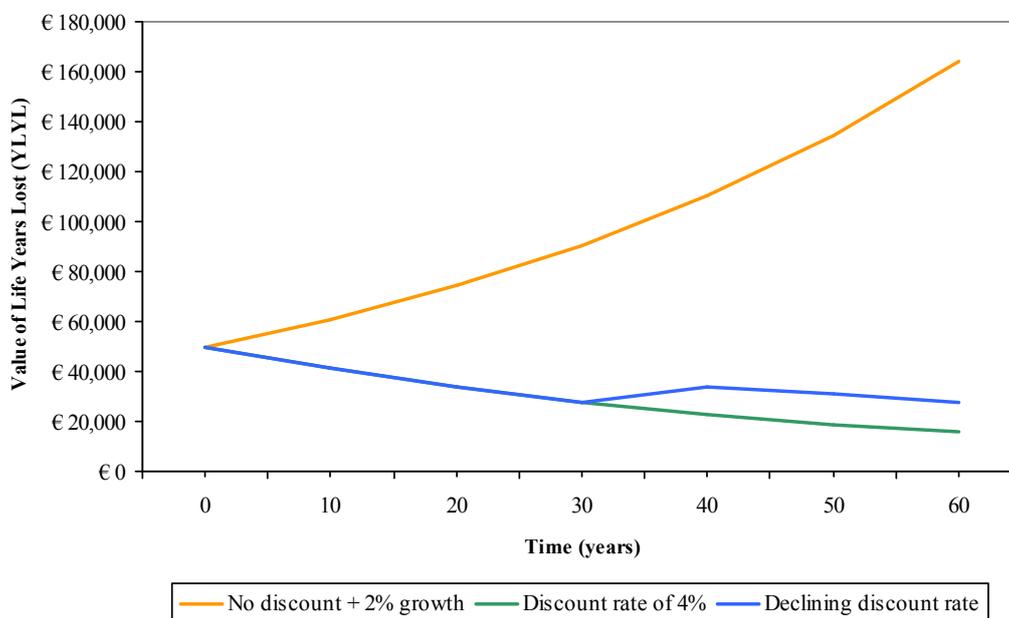


Figure 2.2 Effects of different discount rates over time on the VLYL

¹⁰ Further information on discounting can be found in Appendix D of the ECHA REACH Guidance on Socio-Economic Analysis – Restrictions: http://guidance.echa.europa.eu/docs/guidance_document/sea_restrictions_en.htm?time=1233561701

3 COST OF ILLNESS (COI)

3.1 INTRODUCTION

The cost of illness (COI) is one of the most common market based approaches to valuing health impacts. It involves multiplying the number of cancer registrations occurring under each scenario (i.e. with and without proposed changes) with the valuation for COI.

The COI might include health sector costs (direct costs), the value of lost productivity by the patient (indirect cost), and the cost of pain and suffering (intangible costs)¹¹. This will however depend on data availability as in most cases intangible costs are unlikely to be included in valuations of COI. These three components are described in Table 3.1.

Table 3.1 Components making up a valuation of COI

Components of the COI	Description
Direct costs	<p>These include both the direct medical costs and direct non-medical costs of the disease:</p> <ul style="list-style-type: none"> • Direct medical costs can include costs associated with the direct treatment of pain, including analgesic medication, medical procedures and technology, hospitalisations, use of emergency department services, and physician office visits for pain (Fortner et al. 2003)¹². • Direct non-medical costs might include: transportation related expenses, childcare expenses, household expenses, medicine expenses, household assistance, educational materials and counselling or psychotherapy. <p>From a social perspective, it is also possible to divide the costs into costs borne by the health service and those borne on the household:</p> <ul style="list-style-type: none"> • Costs to the health Service – hospitalisation, medication, emergency (ambulance) transportation and care, outpatient and primary clinic • Costs to the household - Out-of-pocket payments (user fees) for hospitals and drugs, medication, transportation of the patient and family, costs for taking care of dependents and modifications in home as a result of illness
Indirect costs	<p>Indirect costs or productivity losses are the labour earnings that are forgone as a result of an adverse health outcome. The decreased productivity can be a result of illness, death, side effects, or time spent receiving treatment. Indirect costs include lost earnings and productivity of both patients and the family members who take care of them. For some diseases with premature death, the indirect cost is the loss in potential wages and benefits. Indirect costs associated with premature death might be very high. Examples of indirect illness costs include</p> <ul style="list-style-type: none"> • the value of time spent when unable to work as productively because of an illness or side effect, • earnings lost while travelling to health-care facilities, and • productivity losses associated with caregiver time.

¹¹ <http://www.cdc.gov/owcd/eet/Cost/3.html#costofillness>

¹² (Fortner et al. 2003) – “Description and Predictors of Direct and Indirect Costs of Pain Reported by Cancer Patients” – Journal of Pain and Symptom Management – Volume 25. No 1 January 2003.

Components of the COI	Description
Intangible costs	<p>The intangible cost components of illness are usually substantial, and in many cases, might dominate the policy agenda. Examples include</p> <ul style="list-style-type: none"> • disfigurement (e.g., breast cancer with surgery), • functional limitations (e.g., paralysis from polio), • pain (e.g., rheumatoid arthritis or bone metastasis), or • fear (e.g., HIV, rabies, or bovine spongiform encephalopathy [BSE]). <p>One approach to estimating the intangible costs is through willingness-to-pay (WTP) studies.</p>

Source: Centers for Disease Control and Prevention – U.S. Department of Human Health & Services:

<http://www.cdc.gov/owcd/eet/Cost/3.html#costofillness>

3.2 ESTIMATING COI

Outlined below is an approach to valuing COI for cancer (excluding intangible costs):

$$\text{Cost of Illness (COI)} = \text{Number of cancer registrations} \times \left(\frac{\text{Direct cost per registration}}{\text{registration}} + \frac{\text{Indirect cost per registration}}{\text{registration}} \right)$$

Where:

$$\frac{\text{Direct cost per registration}}{\text{registration}} = \text{Direct outpatient costs} + \text{Direct inpatient costs} + \text{Direct homecare costs}$$

$$\frac{\text{Indirect cost per registration}}{\text{registration}} = \text{Value of production} \times \left(\frac{\text{Production lost because of illness}}{\text{illness}} + \frac{\text{Production lost because of care-giving}}{\text{care-giving}} \right)$$

It is extremely difficult to gather information required to estimate direct and indirect costs for each type of cancer and estimate values of production and production lost for each sector affected. In most cases, this information is not publicly available. Therefore, COI estimates have been taken from existing studies related to cancer.

Rabl (2004)¹³ provides values of unit costs (i.e. per patient) that are used in France for different morbidity risks. It includes estimates for COI and willingness-to-pay (WTP) related to avoiding the suffering and inconvenience of disease. The COI includes direct and indirect costs of cancer but not the intangible costs of cancer. Intangible costs are however included in the WTP estimates. These estimates are set out in Table .

¹³ Rabl (2004) – “Valuation of Health End Points for Children and for Adults”, Working Paper.

Table 3.2 Estimated unit costs of cancer (€ 2009 prices) – except for NMSC

Health endpoint	Cost of Illness (COI)	WTP to avoid suffering
Cancer, fatal (per incident)	€ 48,601	€ 1,768,256
Cancer, non-fatal (per incident)	€ 48,601	€ 486,271

Note: Prices have been updated from USD to EUR using historical exchange rates for 2004 and updated to 2009 prices using the EU harmonised index of consumer prices (HICP).

It was not possible to find an estimate for COI for each type of cancer and therefore the estimate (€ 48,601) is used for all cancers, with the exception for nonmelanoma skin cancer (NMSC) where there is a greater survival rate and costs of treatment may be less expensive.

Costs for NMSC are presented in Table 3.3. Costs for NMSC are based on a simple meta-analysis of various studies examining the economic costs of NMSC. Of particular relevance was a study by Miljoministeriet (2004)¹⁴ in which the direct costs of NMSC and willingness to pay (WTP) studies to avoid the permanent scars were reviewed. The study (along with other studies) suggests that NMSC can typically be treated within a year and is assumed, in general, to not result in death.

The WTP to avoid scarring (249,424 DKK in 2002 prices) is taken from the Miljoministeriet (2004) study and converted to Euros (€38,827 in 2009 prices) and is used as a high estimate. The study also provides a possible low COI estimate of €2,926 (18,795 DKK in 2002 prices). A comparable estimate is also derived from Morris et.al (2005)¹⁵ which estimates COI at €2,601 in 2009 prices (based on an estimate of £1,413 in 2002 GBP prices). The latter is used as the low estimate in the current analysis.

Another study by O'Dea (2009)¹⁶ estimated the overall costs of NMSC to New Zealand. If divided by the number of incidents, this gives a broad estimate of €538 per incident (867 NZD in 2007/08 prices). However this was excluded as the per-registration costs was not explicitly estimated and also may not necessarily be representative of costs for the EU.

¹⁴ Miljoministeriet (2004) - "Valuation of Chemical Related Health Impacts - Estimation of direct and indirect costs for asthma bronchiale, headache, contact allergy, lung cancer and skin cancer" - Report prepared by COWI A/S for the Danish Environmental Protection Agency <http://www2.mst.dk/udgiv/publications/2004/87-7614-295-7/pdf/87-7614-296-5.pdf>

¹⁵ Morris et.al (2005) - "cost of skin cancer in England" - Report by S. Morris, B. Cox and N. Bosanquet for Tanker Business School, Imperial College London - <http://www3.imperial.ac.uk/pls/portallive/docs/1/43013.PDF>

¹⁶ O'Dea (2009) - "The estimated costs - economic and human - of skin cancers in New Zealand" - <http://www.niwa.co.nz/?a=103433>

Table 3.3 Summary of cost variables used for NMSC only (€ 2009 prices)

Cost/benefit elements	Low scenario	High scenario
VLYL - Each year lost	€ 50,393	€ 50,393
COI or WTP - Unit cost (per cancer registration)	€ 2,601	€ 38,827 (WTP)

Note: As the WTP to estimate relates to not having permanent scars and does not include the costs associated with life years lost, the high scenario also incorporates the impacts of any life years lost. This differs from the approach used for other types of cancer whereby the WTP already includes life years lost (and is therefore excluded to avoid double counting benefits).

There are relatively few alternative monetised estimates of COI for cancer in existing literature and therefore it is very different to understand how representative these costs are for the rest of Europe. Fortner et al. (2003) estimates the mean monthly direct medical and non-medical pain related costs per patient (in the US) at around \$891 (~\$10k p.a.), with a maximum cost of \$20k per month. Rabl’s actual unit estimate of \$54,970 (2004 USD price) would seem an appropriate estimate for cancer treatment in the EU for this project, when taking into consideration the typical times spent in cancer stages related to treatment.

As part of the calculations to estimate the years lived with disability (YLD), Imperial College needed to estimate the mean duration spent in each cancer stage for each disease. The names and number of stages presented in blue in Figure may differ in existing literature, but the increased segregation allows us to better assign time that may be spent in each cancer stage.

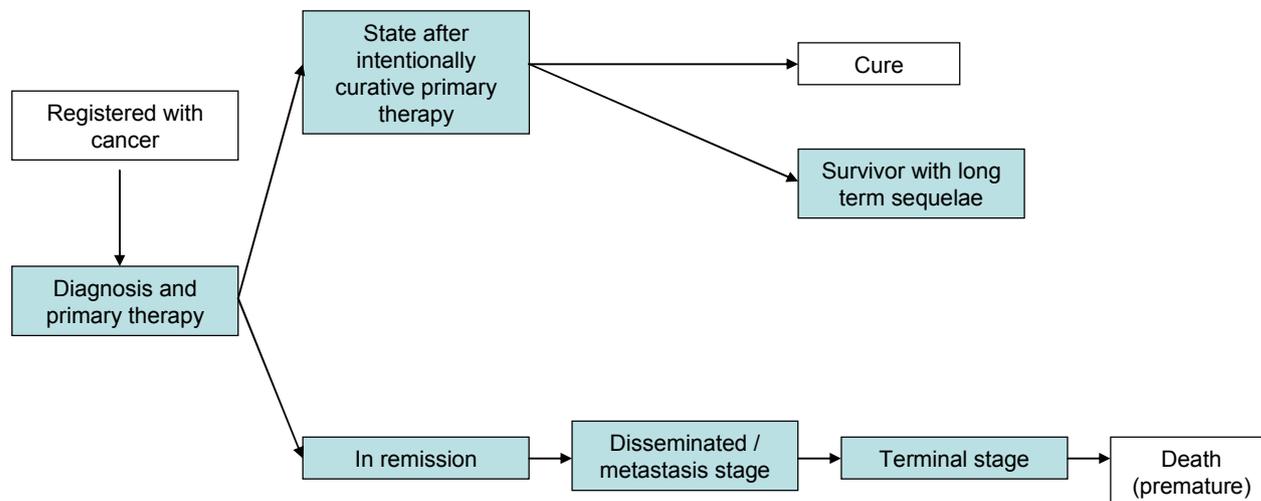


Figure 3.1 Cancer stages

The SHEcan health impact assessment has estimated the duration of time spent a patient may spend in each cancer stage and what proportion survive and die prematurely from cancer. The time spent in diagnosis and primary therapy is particularly relevant for assessing the costs of treatment. The time spent varies

significantly with each type of cancer, ranging from 2 weeks for Non-Melanoma Skin Cancer (NMSC) to up to 18 months for leukaemia.

Taking into consideration that Fortner et al's mean estimate (~\$10k p.a.), does not include indirect costs due to a loss of productivity, it is reasonable to assume that the updated Rabl estimate (€ 48,601) is suitable for the purposes of this study in the absence of further COI estimates for cancer. As with the estimate of VLYL, the COI unit cost is increased by 2% each year to account for inflation and discounted using a 4% discount rate and using a declining discount rate (for impacts occurring after 30 years). For sensitivity analysis, the discount rate is changed; using a declining discount rate and no discounting is also considered.

4 WILLINGNESS TO PAY (WTP)

An alternative to COI is Willingness-to-pay (WTP). WTP typically includes¹⁷:

1. Lost wages¹⁸;
2. Medical expenses;
3. The monetary value of the disutility of illness; and
4. The impact of preventive expenditures.

The WTP estimates reflect what people are willing to pay to avoid the having cancer (both fatal and non fatal). These estimates also include intangible costs which are very difficult to value within COI estimates (i.e. 3 and 4). As shown in Table , WTP costs are significantly higher than the COI estimates which only estimate those impacts which can be calculated using market prices. It has been suggested that the COI can be used as a lower bound to WTP estimates. For the purposes of this study, the low benefits scenario is estimated using COI + YLYL and the high scenario using WTP only. The reader can make their own judgement on either COI should be viewed as a lower bound to the WTP results.

In order to use the estimate for the WTP to avoid suffering under each scenario, it is necessary to be able to split cancer registrations to those that result in fatalities (premature death) and those which result in non fatal cancers. It is however very difficult to make this split without making critical assumptions, since most studies are based on cancer survival times in intervals of 1, 5 and 10 years rather than fatal and non-fatal cancers. It is not possible for this study, to determine (with sufficient confidence) what proportion of cancer registrations will be fatal and non-fatal. Since WTP is used as a high cost scenario, the WTP estimate for fatal cancers is used (€1.8m). Since NMSC is not considered to necessarily be fatal a lower WTP is used (€38,827).

It is recognised in reality, that the average proportion of cancer registrations being fatal or non-fatal may vary depending on several factors such as; the type, size and spread

¹⁷ See: <http://www.ers.usda.gov/publications/aer784/aer784f.pdf>

¹⁸ In some instances with premature death, this term drops out the calculations of WTP unless a bequeath motive is specified

of the cancer (e.g. can vary depending on if the cancer has been identified at an early or late stage) and the patient itself; age, gender, general health, marital status and income level. However the range of costs in the low and high scenarios might provide a useful comparison to the reader.

5 SUMMARY – VALUES USED IN THIS STUDY

The tables below summarise the cost variables used in this study. Table 5.1 summarises the costs variables used in this study for all types of cancer, with the exception for nonmelanoma skin cancer (NMSC) where there is a greater survival rate and costs of treatment may be less expensive. The costs specifically for NMSC are summarised in Table .

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