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The value of life revisited: with special reference to Australia

TTPI - Working Paper 14/2024
December 2024

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Abstract

In 2008, the Commonwealth Office of Best Practice Regulation (OBPR) adopted a national value of statistical life (VSL) of $3.5m, citing the value recommended in the report by this writer (Abelson 2008) that it had commissioned. After allowing for annual per capita changes in income, in 2023 the Office of Impact Assessment (the OBPR renamed) recommended a value of $5.4m for the VSL and relatedly $235,000 for the value of a statistical life year (VSLY). This paper discusses the several major issues associated with the VSL, whether the Australian national value should be reviewed, and if so how. This paper starts by describing the meaning of VSL, the main values currently used in Australia and other countries, and the main methods for deriving these values. The paper then discusses some major issues associated with estimating and setting the VSL. These include issues with the methods for developing VSLs, the significant differences between willingness to pay and willingness to accept valuations, the treatment of tax, allowing for related morbidity effects, whether to include third party (social) values in the VSL, and whether VSL should vary with responsibility for deaths, including related ethical issues. And, topically, whether and how to review and update the current national Australian VSL. The paper then discusses the VSLY, how it is generally estimated and whether this should differ from the value of a quality adjusted life year (VQALY). Finally, the paper addresses the important practical issue of when in public policy decision making to apply the VSL or the VSLY.

Keywords: Value of statistical life; value of a statistical life-year; revealed preference; stated preference; meta-analysis; willingness-to-pay; willingness-to-accept; morbidity; third party values

** In preparing this Working Paper, I wish to acknowledge very helpful comments received on a working draft from the U.S., N.Z. and locally, from Professor Kip Viscusi, Neil Douglas (Ph.D. Leeds University) and Associate Professor Jaithri Ananthapavan. Of course, as author, I am fully responsible for all views expressed in the Paper.* Author contact: pabelson@appliedeconomics.com.au

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The Tax and Transfer Policy Institute (TTPI) is an independent policy institute that was established in 2013 with seed funding from the federal government. It is supported by the Crawford School of Public Policy of the Australian National University.

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The Value of Life Revisited: with Special Reference to Australia

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This paper starts by describing the meaning of VSL, the main values currently used in Australia and other countries, and the main methods for deriving these values. The paper then discusses some major issues associated with estimating and setting the VSL. These include issues with the methods for developing VSLs, the significant differences between willingness to pay and willingness to accept valuations, the treatment of tax, allowing for related morbidity effects, whether to include third party (social) values in the VSL, and whether VSL should vary with responsibility for deaths, including related ethical issues. And, topically, whether and how to review and update the current national Australian VSL.

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1 Introduction

The risk to life, and hence the value of life, arises in many contexts: in many workplaces, consumer products, transportation, environmental contexts, and of course widely in the provision of health services. Government is responsible for much expenditure that directly improves safety as well as for relevant regulations, including for transport, food safety, and managing pandemics. However, every $ spent on saving life is one $ less on other social services or supports. Therefore, we need to know what value to put on life. This may appear sacrilegious, but it is practically unavoidable.

The paper discusses the concepts and values associated with the value of life and a life year, generally referred to as the value of statistical life (VSL) and the value of a statistical life year (VSLY), the many issues arising in trying to establish credible values, and whether current values in Australia should be reviewed, and, if so, how. And it discusses when to apply VSL or VSLY.

The OECD (2012, p.13) notes that the VSL "represents the value a given population places ex-ante on avoiding the death of an unidentified individual". Likewise, Colmer (2020) observes: the VSL is a normalized ex-ante measure of the value of risk reduction; it is not an ex-post measure of the

loss of an individual human life. As discussed in Section 5, this ex-ante value includes both the loss of life (life years) and the directly related pain and morbidity cost of death.

Thus, OECD (*ibid.*) states the "VSL is based on the sum of money each individual is prepared to pay for a given reduction in the risk of premature death, for example from diseases linked to air pollution". To derive the VSL, the average value of a small risk reduction is divided by the size of the risk change. "Formally VSL = d*WTP*/d*R* where d represents the rate of change, *WTP* is willingness to pay, and *R* is the risk of dying. For example, if individuals are willing to pay (or accept) on average $500 for a 1 in 10,000 reduction in their risk (probability) of dying in the current year, the VSL is calculated as: WTP $500 / (1/10,000) risk change = $5.0 million."

As discussed in Section 7, the VSLY is generally derived from the VSL, assuming around 40 years of life lost and an appropriate private time preference rate.

The VSL and VSLY are described as statistical values as they are applied generally and equally to anyone's life or life year. They do not depend on, or vary with, a particular life, or life year, saved.

In this context, three further key points should be highlighted. First, **in principle**, the values would be derived from the amounts that individuals are WTP to pay to reduce the risk of death. They are not willingness to accept (WTA) values. However, as will be seen, many valuations of VSL, notably the higher ones, are based on WTA values for (very small) risks of death.

Second, these valuations are based on personal costs. They do not include public costs associated with fatalities. And they do not include related social values.

Third, the VSL does not necessarily apply to decisions when the lives at risk are identified. When a sailor is at risk of drowning in the Southern Ocean off Western Australia, it would be odd to say we will leave him / her to drown because the rescue would cost $5.6m and would therefore not meet the $5.4m (cost-benefit) threshold. As Colmer (*ibid.*) observed, "The tools of constrained optimization that economists use, and that provide the foundations of benefit–cost analysis, are not appropriate in these circumstances because the identified individual is unable to make a trade-off. Society's choice as to whether to give an ICU bed to one patient or another has nothing to do with the patients' willingness to pay or the willingness to pay of their families. The choice has to be made on some other basis."

A further issue arises with the concept of the value of a quality adjusted life year (VQALY). As we will see, VSLY and VQALY are often viewed as having a different value. But, as argued below, this is conceptually problematic.

The following five sections address the main issues around the VSL. Section 2 outlines the national VSL and VSLY currently used in Australia and how they originated. Section 3 reviews briefly VSLs in other countries. Section 4 describes the underlying valuation principles and the main valuation methods used to estimate VSL. Section 5 discusses the several major issues that arise in determining the VSL: the differences between WTP and WTA values, the relationship between mortality and morbidity costs, social (third party) values, and whether VSL should vary with the circumstances and responsibility for mortality. Section 6 then discusses whether the national Australian VSL should be reviewed and, if so, how.

Section 7 discusses the concepts of VSLY and VQALY, their values in Australia, how they are derived, and whether they should be the same or different. Section 8 discusses the hot topic of when to apply VSL or VSLY. The final section summarises the main conclusions of the paper.

2 Values of Statistical Life and Life Year in Australia

Up to the early 2000's, the value of life in Australia was generally based on the ex-post human capital method: that is, the value was based on the forecast loss of earnings associated with mortality, which was typically assumed to be around 40 years of lost earnings discounted to the present. This is also sometimes described as the cost of illness (COI) method. The COI is typically the sum of various identifiable costs, such as loss of work and medical expenses, but usually does not account for pain and suffering and cannot account for loss of life itself.

In the early 2000's, transport agencies were the main users of VSL estimates. But there was no general national value. To estimate the national cost of road crashes, the Commonwealth Bureau of Transport Economics (2000) adopted $1,359,000 for loss of life. This included $540,000 for loss of workplace labour, $500,000 for loss of home and community labour, and $319,000 for loss of quality of life. This was an ex-post cost of illness approach rather than an ex-ante willingness to pay value to avoid mortality. The loss of quality of life was based on court damages in cases of extreme health impairment. It was not clear how this was relevant to a fatal accident.

Following a similar approach, the NSW Roads and Traffic Authority (2002) recommended that, in cost-benefit studies, a VSL of $1.26 million should be used for avoided fatalities. This included two costs: $862,000 for the estimated present value of loss of income and $397,000 for other costs and loss of quality of life. This VSL was applied to fatalities of all ages and all future deaths, with no allowance for future changes in earnings.

Abelson (2003) reviewed studies done post-1990 that had used alternative ex-ante revealed and stated preference methods for valuing life. Drawing on 20 studies, the paper proposed that, in 2002 prices, public agencies in Australia adopt a VSL of $2.5 million for avoiding an immediate death of a healthy individual in middle age (about 40) and a related VSLY of $108,000. When public services essentially extended life, as in many health services, the VSLY would be applied along with the forecast number of extended years. The suggested VSL and VSLY were deliberately conservative as they represented major changes from then current practices.

In 2007, the Commonwealth Office of Best Practice Regulation (OBPR) commissioned the writer to provide an updated review of the VSL. Based on 20 selected studies, Abelson (2008) suggested a VSL = $3.5m along with a VSLY of $151,000 based on a 40-year life span lost and a 3% personal discount rate. The 20 studies were in quality-refereed journals and represented collectively both a broad methodology and a broad geography. Regarding **method**, the 20 studies included six meta studies (predominantly wage risk), seven revealed preference studies (five wage risk, two vehicle purchases) and seven stated preference studies (including six contingent valuation studies). Regarding **geography**, the studies included the US (5), Canada (3), UK (2), Sweden (2), Switzerland (2), France (1), Japan (1), others mixed (2), and two Australian wage-risk studies.

The OBPR (2008) described this report as "comprehensive and rigorous" and formally adopted the proposed VSL and VSLY. Subsequently, in update reports each two or three years, the OBPR regularly repeated this assessment and upgraded the VSL and VSLY initially by the CPI, but now by changes in the wage price index.

In 2023, the Office of Impact Assessment (OIA), as the OBPR was renamed, stated (p.2): "Although now dated, Abelson estimates of VSL and VLY were based on empirical evidence that had been assessed to ensure that it was comprehensive and rigorous and remain the best estimates of VSL and VLY for public agencies to use. … Using ABS Wage Price Index data to express these estimates in 2023 dollars gives a VSL of $5.4 million, and a VLY of $235,000 based

on a private time preference discount rate of 3 per cent." The OIA report (*ibid*.) also noted that society may be willing to forgo more to prevent the death of a young person, or to avoid conditions that significantly reduce quality of life. But it advised against making arbitrary changes to the VSL.

Reviewing other sources, it appears that the state agencies have also generally adopted the nationally recommended VSL. See for example, Victorian Department of Treasury and Finance (2013, p.23). NSW Health (2018, p. 40) formally adopted the national value. And NSW Treasury (2023, Table 8) also recommends adoption of the national figure. The Queensland Government (2016), it may be observed, does not provide formal guidance on the VSL.

However, it should be noted that two other Australian studies in the 2000's came up with other (higher) VSLs and one of these has had significant influence in the transport sector.

In 2007, consultancy Access Economics prepared a highly detailed (194 page) report on VSL for the Commonwealth Office of the Australian Safety and Compensation Council. This report drew on 244 "western" studies (17 Australian and 227 international studies) between 1973 and June 2007. Employing meta-analysis on the more recent and higher quality studies, Access Economics (2007) recommended, in 2006 A$s, an average VSL of $6.0 million and VSLY of $252,014. These recommendations were almost twice those in Abelson (2008). But, at this time I was not aware of this study, and for some unclear reason the Access Economics report had no impact on the adopted national value.

On the other hand, the Hensher *et al*. (2009) study commissioned by NSW Transport was and remains influential, albeit in the transport sector. The study conducted stated choice experiments to estimate what individuals were WTP for a lower risk of death or injury on urban and rural roads in New South Wales. The survey presented participants with 10 choice sets for the urban and rural roads. ln each case, they were asked to choose between two routes *with 12 attributes*, including a monetary cost. The study then used mixed logit models to estimate the WTP dollar values associated with each attribute for each trip. And it estimated WTP values to avoid a fatality by multiplying the WTP value per trip to avoid a fatality by (1/*P*), where *P* was the probability of a fatality on the trip. This produced estimated fatality values of $6.4m on urban roads and $6.3m on non-urban roads in 2007 prices.

These VSL values were immediately adopted by the NSW Roads and Traffic Authority and by some federal transport agencies and duly updated with wage rate changes. Thus, the national Transport and Infrastructure Council (2016, p.25) recommended an urban VSL of $7.4m and a rural VSL of $7.3m in 2013 prices. Drawing on Hensher *et al*. along with various (now dated) international studies, Transport for NSW (2024) adopts a median figure of $7.0m in 2024 dollars, which is again well above the national VSL in 2024.

Hensher *et al.(ibid.)* was, in many respects, a high-quality stated preference study. But it had some significant limitations. It was essentially a pilot study with only 213 (road user) respondents, including 142 Sydney-based car trips and 71 rural (Bathurst)-based car trips. In their choices, respondents were asked to choose between options with 12 attributes, which raises complications. Most critically, the survey gave respondents choices based on **absolute** numbers of fatalities on urban and rural road options in a year rather than on probabilities. They were not told the probabilities of deaths or severe fatalities per trip or per trip km. Thus, respondents had to guess / imagine probabilities. As Professor Viscusi commented in correspondence with the writer: "It seems right not to use the Hensher study if people would have to guess at the denominator for calculating the probability."

Much more recently, Austroads commissioned a major national discrete choice survey of the values of travel time savings and safety by Deloitte Access Economics, which included input by the Hensher Group. The project was undertaken between 2018 and 2022, with the timeline extended because of interruptions due to the COVID-19 pandemic. The responses of 3,844 survey respondents were used to develop the final set of WTP values. The groups were weighted to ensure the resulting values and parameter estimates were proportionate to the expected distribution of incomes and trip distances. The survey produced *an extraordinarily low VSL of only $1.86m* (Australian Transport Assessment and Planning Guidelines, 2023, p.1). The report noted that these values do not represent the full social of a crash, only the pain, grief and suffering components. But as seen above, this is the standard basis for the VSL. Although dated 2023, the report appears to have been publicly available only recently and a detailed analysis of the reason(s) for this extraordinary low result is beyond the scope of this paper.

3 Some National Values of Statistical Life

Finding official national international VSLs is surprisingly elusive. Table 1 provides some VSLs adopted by national jurisdictions as guides for public policies.[1] It shows the original estimates in the relevant local currency and approximate Australian $m in 2024 prices allowing for Australian price inflation over time, but not for changes in real incomes over time.

Table 1 International Values of Statistical Life

Country / Agency	Year	Value ($m)	Reference	$m 2024
Australia	2023	A$5.4m	Office of Impact Assessment (2023)	A$5.6
New Zealand	2024	NZ$9.8	NZ Treasury, NZ CBAx tool	A$10.8
EU Countries	2005	US$3.6[a]	OECD (2012)	A$8.0
Sweden	2012	€2.4	Hultkrantz (2012)[b]	A$5.4
UK Transport	2010	£1.6	UK Dept. of Transport (2020)	A$4.5
UK Departments	2019	£1.8	UK Health and Safety (2020)	A$4.3
UK Treasury	2020	£2.0	Dolan and Jenkins (2020)	A$4.6
United States				
U.S. Environmental Protection Agency[d]	2019	US$9.7	Viscusi 2020	A$15.8
U.S. Dept. of Health and Human Services[c]	2019	US$10.2	Viscusi 2020	A$16.7
US FEMA[c]	2020	US $7.5	U.S. Federal Emergency Management Agency (2020)	A$13.6
U.S. Dept. of Transportation[c]	2021	US$12.5	U.S. Dept. of Transportation (2022)	A$22.1

(a) This reflects the recommended EU value in 2012 with 2005 prices. The recommended value for all OECD countries was slightly lower at US $3.0m in 2005.
(b) Hultkrantz (2012) paper, but not clear that this is an official Sweden valuation.
(c) These figures are official agency guidance amounts. They are advices, not required figures, as different agency branches sometimes select other values. For US EPA and Dept. of Health, the relevant 2016 Guidance is updated for inflation by Viscusi (2020).

[1] In the UK, the VSL is often described as the "Value of a Prevented Fatality" (VPF).

Based on the VSLs shown in Table 1, the national Australian VSL appears higher than UK values and in line with Sweden, but well below U.S. values for life. Up to 2023, the Australian VSL was also higher than the NZ VSL but, as noted below, the NZ VSL was doubled in 2023.

As described above, the Australian value is based on a simple meta-analysis. The recommended OECD values were derived from a much more sophisticated meta-analysis, which the OECD (2012) also described as a "benefit transfer" method. The full EU set of VSL studies consisted of 856 studies with a median value of US$2.4m compared with US$3.6m recommended following a meta-analysis based on 163 studies. It may be noted that the median value of the full 856 studies was consistent with the initial 2008 Australian value.

There are two main reasons for the differences between the US and Europe (and Australia). One is the higher income per capita in the U.S. Viscusi and Masterman (2017) estimate the income elasticity of the VSL in the US to be between 0.5 and 0.7 and to be just above 1.0 for non-U.S. countries. Assuming a unitary income elasticity, this would account for about a 25% premium on the U.S. VSL compared to Australia.

The other factor is that the US values are derived principally from revealed preference (RP) methods drawing on medium to high income markets which largely compute WTA values whereas the European VSLs are based more often on stated preference (SP) methods of valuation representing WTP values. As discussed in the next sections, RP methods applied to labour markets tend to produce significantly higher VSLs than SP studies that usually seek WTP responses.

Turning to NZ, in 2017 the NZ VSL was NZ$4.7m. This value was reviewed in 2021-22 (see Denne *et al*., 2023). Initially the review was based on a standard choice modelling approach, but the review found some difficulties in this approach, notably with understandings of very low probabilities of fatalities, and designed a novel survey approach in which respondents were asked to choose between national investment programme options with differences in the resulting total number of deaths and injuries for New Zealand as a whole. In effect, this approach extended the VSL to include social values. And it came up with a VSL between $7.9m and $8.5m in 2021$s (*ibid*., Table 7.27). This modelling approach is discussed in Section 4 below. Social value issues are discussed in Section 5.

4 Principal Methods for Estimating the Value of Life

As noted in the Introduction, VSL and VSLY are generally defined as the dollar amounts that society is WTP to save a life or a life year (or to reduce the risk of dying). In principle, these values are derived from the amounts that individuals are **willing to pay** to reduce their risk of death. However, rather confusingly, as described below, many estimates of VSL and indirectly VSLY are based on the amounts that individuals are **willing to accept** to reduce their risk of death.

This section describes the two principal methods for valuing life: revealed and stated preference methods. In revealed preference (RP) studies, analysts examine the choices that individuals make in various market contexts that involve some risk of loss of life. Most of these studies are studies in labour markets. A small proportion involve product markets. Stated preference (SP) methods draw on surveys of individual preferences, including contingent valuation and choice modelling studies.

Following our outline of the RP and SP methods, along with some related issues, this section discusses meta-analysis that draws on, and analyses, multiple studies to obtain a preferred VSL.

The last part of this section summarises the main conclusions. The next section takes up several important valuation issues, including several associated with these valuation methods.

Revealed preference studies: labour markets

Most labour market studies examine the wage compensation associated with jobs with higher risks of fatality. Drawing on labour market data, researchers generally estimate the amount of income that individuals are WTA as compensation for taking on extra risks in the relevant workplace. On the other hand, when workers move to safer lower-paid jobs, the income sacrifice arguably represents a WTP value for safety (an important assumption which is debated below). But these movements are less often examined.

Viscusi (2018b) reported that there had then been over 1000 published labour market estimates of the VSL. And, as noted by Kniesner and Viscusi (2019), labour market estimates are generally facilitated by the availability of extensive and accurate occupational risk and employment / wage rate data.

The values attributed to safety are estimated by multivariate regressions where wages are a function of the work-related fatality rate, various demographic variables (such as age and education), and other job characteristic variables (such as non-fatal injury risk, workers' insurance coverage, and industry and occupation indicators). Formally, the wage-risk equation is typically of the following kind:

$$w_i = \alpha + \beta_1 H_i + \beta_2 X_i + \gamma_1 \pi f_i + \gamma_2 \pi nf_i + \gamma_3 WC_i + \varepsilon_i \quad (1)$$

where w is the annual wage of worker i, α is a constant term, H is a vector of personal characteristic variables for worker i (such as age and level of education), X is a vector of job characteristics variable for worker i, πfi and πnfi are the probabilities of a fatal or non-fatal injury, WC is workers compensation for an injury, and ε is an error term reflecting unmeasured factors. In this equation, γ_1 shows the change in wage rate associated with an increased risk of a fatality.[2] To derive VSL, the average value of a small risk reduction (Δw) is divided by the size of the risk. Thus, if the risk of fatality in a year is say 1 in 5,000, the value of a life = $\Delta w * 5000$. This process is known as the hedonic wage risk method.

Hedonic wage risk studies have two significant advantages. They combine real-world data on worker wages with objective data about on-the-job risks. And they infer VSLs from worker's actual trade-offs between money and mortality risks in real-world decisions.

The common assumption in the econometric literature is that workers and employers are well aware of the actual risks in the workplace. In the econometric models, the risk measures, such as those from the highly regarded and widely used Census of Fatal Occupational Injuries (CFOI) in the United States, are expected to represent workers' subjective beliefs of health and safety hazards at work. Viscusi and Aldy (2003) found a strong correlation between workers' stated risk beliefs and governmentally collected publicly available injury rates.

However, some others have expressed significant caveats. Sunstein (2004) contended that many wage studies are conducted in non-competitive labour markets where workers have insufficient information about their working conditions to accurately determine the risk of death from taking a particular job. Jones-Lee and Loomes (2004) also expressed concern that wage-risk studies are

[2] In correspondence, Prof. Kip Viscusi noted that "wage equations are easier to talk about though most of the literature focuses on the log wage specifications."

constrained by the weak perceptions of risk, often small risk differentials, by economic agents. They expressed further concerns whether workers in safe occupations have similar safety preferences to workers who are willing to take on risks, whether the models distinguished accurately between the premiums for fatal and non-fatal accidents, and about the sensitivity of the results to the various (linear, log-linear and semi-logarithmic) functional forms of the wage risk equation.

Another issue is the nature of the risk: whether workplace risks are qualitatively similar to those in the policy context and whether people feel similarly about the different kinds of risk. For example, Itaoka *et al*. (2006) found evidence that Japanese households would pay more to avoid risks from nuclear power than quantitatively equivalent risks from fossil fuels.

Two further important issues should be noted. First, labour market studies tend to focus on high wage industries. Few RP studies relate to rural workplaces or services which often combine low wages and high fatality rates. The US National Institute for Occupational Health and Safety (2024) reported that "In 2021, workers in the agriculture, forestry, fishing and hunting industry experienced one of the highest fatal injury rates at 18.6 deaths per 100,000 equivalent full-time workers, compared to a rate of 3.7 deaths per 100,000 workers for all U.S. industries. Transportation incidents, which include tractor overturns and roadway crashes, were the leading cause of death for these farmers and farm workers. Other leading causes were contact with objects and equipment, violence by other persons or animals, and falls, slips, trips."

Secondly, and critically, true WTA values should reflect *after-tax income* impacts. From the author's reading, this appears to have been widely neglected. Working with gross wage rates inflates the VSL by the marginal tax rates, typically around 30%. In the U.S. in 2024, most workers fell under a 22% or 24% marginal federal tax rate. State income tax rates vary considerably but a marginal tax rate of around 5% is common. Marginal tax rates in other countries tend to be higher. Working with a 30% marginal tax rate, *a WTA value that ignores this marginal tax is 43% too high* (100/70).

Product markets

Product markets provide another, but much less used, RP valuation method. This method observes the premium that consumers pay for safer products, such as buying bottled water to reduce mortality risk from contaminated tap or well water. Here, analysts are estimating explicitly or implicitly a hedonic price equation rather than a hedonic wage equation. If a product, that reduces the likelihood of death by say 1 in 10,000, costs an extra $x, it can be inferred that the purchaser places a value on life of $x / (1/10,000). Product studies have included choice of motor vehicle, seatbelt use, home smoke detectors, bicycle helmets, house prices and hazardous waste sites.

For example, Andersson (2005) analysed the price premiums that Swedish consumers were willing to pay for safer motor vehicles and estimated that the VSL was between US$1.0m and US$1.5m in 1998 prices, which he noted was significantly lower than the values inferred from several other U.S. and Swedish studies of motor vehicle purchases. Drawing on a study of automobile air bags in the U.S., Rohlfs *et al*. (2015) found the median WTP for the VSL was in the range US$9m - $11m (in 2010 $s).

Of course, RP applications for products that reduce or eliminate mortality risks depend on strict assumptions about the market and the respondents' information and behaviour.

A related approach to valuing mortality (and morbidity) risk is the Averting Cost or Self-protection approach. Here, expenditures that people make to reduce the probability or severity of a bad outcome are usually assumed, under certain plausible conditions, to be a lower bound on the ex-ante value that they assign to reduced risks.

Stated preference studies

Stated preference (SP) valuation methods derive estimates of VSL from responses to survey questions about mortality risks. The two main forms of SP methods are: contingent valuation (CV) and choice modelling (CM).

CV studies typically ask respondents in one or another way what they would be WTP for a reduction in various risks of death (or occasionally what they are WTA to take on extra risks). But they are generally more complex than a straightforward question of "how much do you value your own life?". For example, participants may be asked how much they would be WTP for a halving of the risk of death (e.g. from say a 2% risk of death to a 1% risk). A VSL can then be derived by dividing the WTP by the change in mortality probability. Of course, the question can be phrased in many ways. For example, respondents may be given $ amounts to choose between. Also, the payment mechanism, such as increased taxes or higher product prices, must be credible.

A problem with CV surveys is that individuals may find it hard to provide accurate responses to direct WTP questions, such as, what would you be WTP to avoid a small risk or change in risk, especially for unfamiliar options and small changes in risks. On the other hand, the provision of monetary cues, such as a set of possible dollar amounts to choose between, may bias the results. Another problem is the "protest bid," where a participant will place an unrealistically high figure on safety.

Consequently, in recent years, SP studies have tended to adopt CM methods, also called choice experiments. CM studies typically offer respondents a set of choices (options) with various attributes, such as risk levels, other factors, and payments, and ask them to choose in each case which option they would prefer. WTP values for VSL can be estimated from the respondents' trade-offs between the payments and risk levels shown in their responses. These questions can be tailored to directly value the outcomes of concern, for example a particular type of mortality from a particular type of exposure. They can be particularly useful for studying risky outcomes for which market data are not readily available. When conducted initially in focus groups more information can be obtained. The focus group results can then be a guide to content for a population survey follow-up to ensure that the results are representative. Austin and Withers (2020) adopted this approach to value prevention of cyber-attacks on public transport in New South Wales.

Because stated preferences are hypothetical expressed preferences, researchers have also developed criteria to test for whether respondents have understood the survey task and have provided consistent responses, such as avoiding dominated choices. Kniesner and Viscusi (2019) describe how researchers have used various ways to communicate risk probabilities such as risk ladders that provide risk levels for a variety of common hazards (such as the annual risk of being killed in a car accident).

A principal test is that of scope tests, whereby respondents should be WTP more for a larger risk reduction than a smaller risk reduction. There are also behavioural scope tests. For example, estimates of the VSL should be positively related to the respondent's income level. Various other validity tests have been suggested. Responses should display convergent validity in that they

should provide broadly similar results to other SP or RP studies of the issues. Also, valuations should satisfy construct validity in that the stated WTP amounts should be similar to what actual payments would be. Finally, the survey should satisfy content validity with the scenario description, survey structure, and statistical analysis consistent with best economic practices.[3]

However, the stated probabilities provided in the survey may not correspond to how respondents perceive the stated probability. If the actual baseline risk is 1/1,000 and the survey states that the risk is 10/1,000, the respondent may incorporate their prior beliefs in assessing the magnitude of the risk instead of the stated risks. Viscusi *et al*. (1997) describes how, when people are asked to assess the overall risks to the population, their assessments are strongly influenced by their personal circumstances such as the mortality risk for their age group.

A general problem with SP models is that they usually offer hypothetical choices and are weak, or non-existent, on budget constraints. Thus, Viscusi (2020) observes that respondents may overstate their WTP amounts. There are also concerns that respondents may not give accurate answers to questions involving small risk reductions and that answers may depend on the way in which questions are presented. Notwithstanding, SP studies usually produce lower VSLs than do labour market studies.

As noted in Section 3, due to concern about how survey respondents understood very low probabilities of fatalities, the major New Zealand review by Denne et al. (2023) adopted a quite different approach. Rather than asking survey respondents to choose between journey route options with different levels of fatality risk that might affect them individually, the survey adopted an investment choice approach. The survey asked respondents to choose between national investment programme options that differed in the total resulting number of deaths and injuries for New Zealand as a whole. It turned out that, on average, respondents were willing to pay $4.30 per annum to save one annual road death. But when multiplied by the NZ population (presumably adults), this very modest amount doubled the VSL in New Zealand. Arguably this high value reflected in part the contributions that people are WTP in part for the common good. As we discuss below, this is a broader social value than the values usually elicited from SP or RP studies.

Meta-analysis

Meta-analysis combines the results of multiple studies. The common aim is to find an appropriate VSL, sometimes for a particular environment, from numerous studies which are deemed to be quality studies but which, for one or another reason, provide different results. Typically, statistical techniques are used to analyse how the VSL varies with a set of explanatory variables. There have now been many meta-analyses of the value of life. This section cites two examples of quality meta-analyses (OECD, 2012 and Keller *et al*., 2021) to demonstrate the process and notes a further major study, a meta-analysis of meta-analysis studies by Banzhaf (2021). Section 6 below discusses a major meta-analysis (Ananthapavan *et al*., 2021) that focussed on deriving an Australian VSL.

The major OECD review (2012) drew on 856 VSL studies carried out since 1970. These included **only** SP studies as nearly all the RP studies at that time had been conducted in the US and a major focus of the report was on obtaining plausible values for the 27 EU countries. Further, the review observed that hedonic wage studies provide estimates of VSL for only a small (working-age)

[3] These requirements are similar to those in NSW Treasury, TPG 23-08, *NSW Government Guide to Cost-Benefit Analysis*.

segment of the population. The review also excluded any VSL studies based on WTA values as respondents may cite unrealistic values when not bounded by income constraints.

As noted in Section 3 above, in $2005 prices, the OECD report recommended an average adult VSL of US$3.6m for the EU countries and US$3.0m for OECD countries (including EU and non-EU countries). Indicating issues with a uniform value, the report also proposed a range US$1.8m – 5.4m for the EU countries and U$1.5-4.5m for OECD countries.

The study involved two main steps. (1) Selection of 405 high quality studies for analysis: a high proportion. The report stated that "a range of quality screening criteria were used to limit the meta-analysis to high-quality studies." But these criteria are not explicitly described.

(2) Explaining differences in the VSL results. The report found the most important explanatory variables were GDP per capita and the magnitude of the risk change being valued. Overall, an income elasticity of VSL of 0.7 to 0.9 was found. On the other hand, the report found that VSL fell with the size of the risk. As the report observed, in theory the VSL should be independent of the size of the risk.

Turning to Keller *et al*., (2021), the authors identified 1455 VSL studies in various databases and selected 120 studies for the meta-analysis. This included 76 studies employing SP methods, with 51%, 41%, and 8% being contingent valuation studies, discrete-choice experiments, or both, respectively. A RP approach was used in 43 articles, of which 74% were based on compensating-wage differentials. The human capital approach was used in only 1 article. The paper assessed most publications (87%) as being of high quality. However, estimates for VSL varied substantially by context (notably the economic sector, developed or developing country, and socio-economic status of respondents). The median of midpoint purchasing power parity–adjusted estimates was 2019 US$5.7m, but $6.8m, $8.7m, and $5.3m for health, labour market, and transportation safety sectors, respectively. The paper concludes that the large variations in published VSLs depends mainly on the context rather than the method used, with higher median values for labour markets and developed countries. It also concludes that health economists and policymakers should use context-specific VSL estimates.

On the other hand, Banzhaf (2021) notes that there are now so many competing meta-analyses and reviews, with a wide range of resulting VSL estimates, it is hard to pick a single "best meta-study" and responds by going a step further, estimating a meta-analysis of six meta-analyses applicable to the U.S. To do this, he places subjective weights on eight models from five recent meta-analyses of VSL estimates applicable to the U.S. He then derives a mixture distribution by, first, randomly drawing one of the eight meta-analyses based on the mixture weights and, second, randomly drawing one value from the distribution describing that component's VSL (e.g., a normal distribution with given mean and standard deviation), and, finally, repeating these draws until the simulated mixture distribution approximates its asymptotic distribution. His baseline model yields a central VSL of $7.0m, which is well below official US VSLs, along with a huge 90% confidence interval of $2.4m to $11.2m.

Banzhaf contends that this approach encapsulates "the idea that the truth is probably somewhere in the middle of all of these studies" and that it allows sensitivity analysis through changing the weights. However, the extreme range is not helpful to enabling consistent practice across government agencies,

Evidently, the very large number of VSL studies, now running into thousands, represents two major problems. Which studies to include in the long list and how to get to a short list? Neither

OECD (2012) nor Keller *et al*. (2021) is clear about the selection process for the short list. Also, the results appear sensitive to the probability risks set out in the included surveys and associated morbidity issues, especially cancer or not cancer. In Keller *at al.*, SP studies with a cancer context had a median of midpoint estimates of $7.0m compared with $3.4m for non-cancer studies. To show the rigour of the results, it is important to explain how a meta-analysis moves from general methodology to specific results and conclusions.

Some Conclusions

The aim is to find a society value of life based on how individuals value their life. This reflects the cost-benefit principle that the benefits of public programs should reflect individual preferences. Usually this involves trying to find WTP values to avoid mortality, or risks of mortality, rather than WTA values for taking on risks (an issue discussed further below).

RP studies, principally hedonic wage studies but also product markets, have the significant advantage of being based on behaviour and on actual market metrics of payments and risks. But they also have several limitations. Hedonic wage studies provide estimates of VSL for only a small (generally well paid) part of the population, assume that workers understand the risk probabilities, and that other factors that drive variations in wages, including risks of injuries, are recognised. Importantly, they are often WTA values. And it appears that the labour market studies may substantially overstate real WTA amounts by working with pre-tax wage payments.

SP studies explicitly ask individuals how much they would be WTP (or WTA) for a small reduction (or increase) in risk. They include direct and indirect approaches (CV and CM methods). The CV method typically asks the respondent for their WTP for a reduction in a mortality risk directly as an open-ended maximum WTP question, or as a dichotomous choice (referendum; yes-no) approach. On the other hand, CM asks respondents to make a series of choices between mortality risks with different characteristics and monetary costs. SP methods can elicit WTP from a broad segment of the population and can value risks of death in a range of contexts. The main drawback of the SP methods is that they are hypothetical, so that the amounts people say they are WTP may be different from what they would actually be WTP in any given situation. Words do not always match actions!

However, SP studies are a widely accepted method for measuring values for goods and services that are not traded in markets. They can focus on policy relevant risks and avoid features peculiar to labour markets, such as worker's compensation insurance and life insurance benefits offered through work. They also can include large part of the population outside formal labour markets.

Accordingly, notwithstanding their limitations, both RP and SP approaches are used to assess VSL. And, as has been seen, meta-analysis studies can draw on both approaches to elicit VSLs that are not dependent on single studies and the potential limitation that a single study may have.

5 Major Issues in Valuing Lives

We have noted above several issues arising in valuing life including both the concept and the methods of valuation. For completeness, we include below all the major issues but attempt to minimise repetition where the issues have already been discussed.

Accordingly, this section discusses: the critical WTP / WTA divide in values including related tax issues, adjusting for income, the gap between mean and median VSLs, the impact of risks (probabilities) on valuations, treatment of morbidity effects, social (third party) values of life, possible variations in VSL with the circumstances (causes) of death including ethical issues, possible alternative valuation principles: ALARP and SFAIR, possible selection bias, the one value principle including the treatment of VSL over time, and the VSL for known versus unknown persons.

Willingness to pay versus willingness to accept values

In standard public economics (Abelson 2012, 2017), the application of WTP or WTA values is a function of property rights. WTP is appropriate when an individual does not have property rights — we seek to know what he or she would be WTP for something to which they have no formal legal right. WTA is appropriate when the individual does have property rights — we are compensating an individual for the loss of something to which they do have a right. The right to life is conventionally regarded as the primary natural or human right (Garnsey, 2007). As such, when considering reductions in mortality risk, WTA is arguably the more appropriate measure.

On the other hand, if we are seeking to determine the resources that government should apply to save life / reduce fatalities, arguably the appropriate value is the sum of the amounts that individuals are WTP to achieve these outcomes. On balance, this is the view of this paper.

WTP values are expected to be lower than WTA values for two reasons: (1) because WTP values are income constrained while WTA values are not and (2) because loss aversion adds to the underlying disparity between WTP and WTA values.

This WTA / WTP divide could explain, partly at least, why RP values in labour markets tend to be higher than SP values. Most RP studies, though not all, are in effect WTA studies. On the other hand, most SP studies are based on WTP answers, though again not all. For example, Hensher *et al*. (2009) posed WTA as well as WTP question (by offering reductions in accidents at a cheaper user cost, so the results were a hybrid).

Some meta-analyses of SP studies have found large differences between WTA and WTP values. Horowitz & McConnell (2002) found a very large mean WTA/WTP ratio of 7.2. Tuncel & Hammitt (2014) found a geometric mean ratio of 3.3.

On the other hand, surprisingly, in RP markets, analysing payments associated with job changes, Kniesner *et al*. (2014) found that WTP estimates of VSL derived from workers taking safer jobs for less pay were not statistically different from the WTA values for workers who were paid more to accept jobs with greater risk levels. But, arguably, workers choosing safer work and lower pay could be described as WTA lower wages.

Resolving these differences is beyond the scope of this paper. But, to reiterate, the VSL should represent community WTP values and WTA values need to be converted into WTP values.

Adjustments for income

In principle, national WTP values should reflect either the spectrum of household incomes across the community or the average community income, usually mean income as a fuller representation of the community. As remarked above, RP studies in markets tend to include

higher income workers. It is not clear that meta-studies of VSL values make adjustments to fit average income workers.

For completeness here, we should also reiterate our concerns that WTA payments in RP studies usually include tax and that to estimate a true WTA value, marginal taxes should be taken out. The effect would be substantial.

Mean or median VSLs

Another issue is where to adopt mean or median VSLs. This may appear a minor issue, but it turns out that the gap between the mean and median values is often consequential. Lindhjem et al. (2011) conducted a meta-analysis of 856 stated preference studies of the VSL and found (in $2005) a mean VSL of $6.1m and a median VSL of $2.4m. The substantial difference reflected the right-skewed nature of the VSL distribution. After taking out the VSL estimates at the top and bottom 2.5% of the distribution of VSL relative to per capita GDP, the trimmed mean was $5.0m and the trimmed median unchanged.

Technically, in cost-benefit studies, following Arrow and Lind (1970), mean values are more appropriate than median values as this maximises the net benefits over multiple projects. But, according to Jones-Lee and Spackman (2013), U.K. policymakers selected the median estimate as the policy guide partly because it was more similar to the previous human capital measures.

Risk probabilities and VSLs

Several issues arise with risk probabilities. Do people understand them? If not, what are the implications? Do people put lower WTP values on risks they think they can control and hence minimise? And do people put inconsistent values on small and large risks of death?

As OECD (2012, p.46) observed, a major issue in VSL surveys is whether respondents understand the magnitude of the risks they are asked to value. Clearly, many people may have difficulty understanding differences between risks with small probabilities, between say a 2 in a 1,000 risk and 1 in a 1,000 risk. Many mathematicians find that people process large numbers (very low probabilities) on a logarithmic scale, not a linear scale. Consequently, they effectively put relatively high WTP values on very low-risk events, which in turn increases the VSL associated with these events.

Control issues

Turning to control issues, it is plausible that people are WTP more for safety in circumstances where they think they have less control over the risk, say in airplanes rather than in motor vehicles, even when the probabilities of fatality may be similar. Thus, the ANCOLD (2023) *Guidelines on Risk Assessment* suggest that "there is an efficiency argument for … increasing VSL for the risks over which individuals have little or no control". And the *Guidelines* suggest "a 50% increase would be a defensible adjustment" for flood related deaths.

Also, reflecting income constraints, individuals may be WTP proportionately less for safety when considering large reductions in risk than small ones. This implies that the VSL would be lower when associated with large changes in risks than with smaller one.

The impact of these issues needs to be considered when attempting to establish a national VSL. But, as discussed below, this paper does not support raising the VSL for risks where individuals have less control.

Morbidity issues

Nearly all fatalities have some directly related morbidity impacts which are included in VSL. As shown by Gentry and Viscusi (2016), these impacts are often well picked up in RP labour market studies and are estimated to account for 6–25% of the total fatality and morbidity effect. Evidently the morbidity aspect of fatalities is often consequential and varies considerably across different fatality events. Deaths from falls, fires, and bodily exertion are the largest classes of traumatic fatalities in which death is not instantaneous.

This raises two main issues. (1) Should the VSL vary with the severity of direct morbidity effects? And (2) when should other related morbidity effects be added to the VSL?

A national VSL typically includes average morbidity pain that is related directly with the mortality. The general approach is to adopt a uniform VSL, but to consider an extra allowance for extreme cases of direct morbidity effects which involve prolonged illnesses and painful treatment periods before death. For example, Viscusi *et al*. (2014) found a premium for cancer of 21% on the median VSL for acute fatalities. And Hammitt (2020) observes, VSL is plausibly larger for risks like COVID-19 that are dreaded, uncertain and catastrophic.

Social Values of Life

As described above, the common valuation of VSL reflects private risks and individual values. As Colmer (2020) notes, these VSLs generally do not capture the value of a person's life to the rest of society. As such, the total social benefits of interventions to reduce mortality risk are almost certainly understated, possibly significantly so.

Ideally there would be some plausible valuations of these social costs of loss of life. But there appear to have been few attempts to value these costs or their equivalent, the social benefits of saving life. This is surprising but perhaps reflects the difficulty of measuring these costs. There are thus large uncertainties about the social benefits of saving life.

Inevitably, this means that such considerations are not included in benefit–cost analyses. However, as Colmer (*ibid*.) argues, not including something in the formal numbers doesn't mean that it should be ignored. The social benefit of saving lives cost can be acknowledged, even if it is not formally valued.

Should VSL vary with the circumstance of death?

Cost-benefit analysis is based on the concept of utilitarianism, or equivalently consequentialism. In these philosophies, values are based on outcomes. Thus, the premise is that the same value applies to lives lost or saved whatever the circumstances.

The principal alternative is the deontological (ethical) approach where decisions are evaluated as a function of following moral duties or rules. Clearly, we would not assess a murder as a cost of $5.4m and allow the murderer to go free on payment of $5.4m. Evidently, in this case , the value of life varies with the circumstances of death

But suppose that a public policy may results in some lives lost and others saved, should all the lives have the same value? A major water authority asked the writer this question in the context of dam management where a change in policy could result in some fatalities as well as saved lives.

The view of this writer was yes – in this context all lives, lost or saved, should have the same value. For several reasons. First, this is the standard utilitarian approach. Second, there are many marginal differences between action an inaction: between causing death by accidentally knocking someone off a cliff and by failing to save someone by pulling them away from danger. And, third, there are numerous moral duties or rules – so no there is no simple alternative method of evaluation. Thus, in general, VSL of lives lost = VSL for lives saved.

But this should be an explicit approach. Where mixed outcomes may occur due to action or inaction, these outcomes should be acknowledged as part of the decision-making process. This is especially the case when underrepresented groups, or those unable to advocate for themselves, may be impacted by a policy, project, or program.

A further related issue arises with the application of the VSL in compensation issues. As reviewer, Neil Douglas, observed in correspondence, in New Zealand the national VSL is applied for purposes of public investments, regulations and policies. But the national VSL appears irrelevant for compensation payments by Government. For these, government payments are orders of magnitude lower.

Possible alternative valuation principles: ALARP and SFAIR

Brief mention should also be made of two related alternative valuation principles (ALARP and SFAIRP) that originated in the UK, which are also employed in various industrial circumstances in Australia.

Under the ALARP principle, initiated in Edwards v UK National Coal Board in 1949, any risk should be "As Low as Reasonably Practical". The general legal interpretation is that this requires a risk to be reduced so long as the cost of doing so is not "grossly disproportionate" to the benefit obtained. The principle was confirmed in 2001 in the Australian High Court in Slivek v Lurgi (Australia) Pty Ltd.

The SFAIRP principle is that workplaces should be maintained to be "So Far as is Reasonably Practical" safe and without risks to health. This also originated in UK legislation (*Health and Safety at Work etc Act 1974)*. The SFAIRP principle became a cornerstone in Australian legislation, in the *Work Health & Safety Act 2011*. This mandates that any person leading a business or an enterprise must ensure the health and safety of their team to the best of their ability.

Although originating in the UK, ALARP and SFAIR are common terms in Australian regulations, for example in: *Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009* and in the *NSW Dams Safety Act 2015*. Also, the Queensland *Guideline for Safety Assessments for Referable Dams* (2023) states that risks, lower than the limit of tolerability, are tolerable only if risk reduction is impracticable or if its cost is grossly disproportionate (depending on the level of risk) to the improvement gained.

However, the ALARP and SFAIRP principles do not provide clear practical guidance on what represents tolerable risks – i.e. risks that are "as low as reasonably practical". Fundamentally, weightings based on the ALARP or SFAIRP approach are inconsistent with the core premise of CBA that costs and benefits should be measured in comparable units. Cost-benefit analysis, and related policy prescriptions, cannot rely on general abstract and qualitative concepts such as "involuntary risk", "extraordinary circumstances", "tolerable" outcomes, "reasonableness"

and “grossly disproportionate”. These concepts do not provide practical operational or numerical guidelines for undertaking cost-benefit analysis.

Thus, weighting values with ALARP or SFAIR principles in a CBA is not consistent with the basic principle of CBA that “all effects must be put in comparable units”. (Viscusi, 2018b, p.9).

Applications of VSL over time

As has been described, the Australian VSL is adjusted annually for increases in average per capita income. But this does not apply going forwards. Indeed, in Australian cost-benefit studies, future cost and benefits are discounted by the social opportunity cost of capital, usually in the range of 5% to 7% (in real terms). This means that future lives are discounted quite significantly. Of course, the same applies in other countries, albeit the discount rates may be lower.

Biases: Publication Selection and Politics?

Does journal paper selection of papers create a bias towards higher or lower VSLs? This is an important issue both in relation to existing estimates of VSLs and for ongoing attempts to draw a VSL from existing published studies.

Detailed analysis by Viscusi (2018a) found that published work from “all-set” RP studies is reasonably representative and unbiased, but he found a small upward bias in publications of small “best set” meta-analyses possibly reflecting selection bias.

On the other hand, Masterman and Viscusi (2020) found significant publication selection bias in SP studies leading to overstated average SP values. They concluded that relying on SP research is most problematic when the population of interest has relatively higher incomes. They recommend that policymakers in higher income countries should avoid using published SP VSLs as the distribution of published estimates substantially overstates real individual WTP values. Instead, they recommend that national VSLs should be calculated by adjusting a U.S. VSL from labour market CFOI studies for income differences between the population of interest and the USA. This finding is a little strange as published SP studies usually reveal significantly lower results than RP studies.

There is a related possible issue of selection bias, related to politics. Namely, do government agencies prefer consultants who produce high VSLs, which in turn help to justify public projects? In his comments on an earlier draft of this paper, Neil Douglas observed that: “The massive increases in VSL (in NZ) since the 2000s are more symptomatic of government seeking values to justify what they do, rather than an increase in the intrinsic value of us the people.” In this paper, this observation is viewed as a hypothesis, albeit a potentially important one.

Conclusions

There are several substantial issues in trying to establish a VSL for a given country or community. These include whether to apply WTP or WTA values, the treatment of tax in WTA values in RP studies, representing average national household incomes, drawing on estimated mean or median values, possible variations for different morbidities, the inclusion or exclusion of social (third party) values, and selection of appropriate RP or SP studies as a basis for determining official values. And relatedly, in what contexts, if ever, to adopt variations from a uniform VSL.

The standard treatment in cost-benefit evaluations, as recommended by the OECD (2012), is to adopt a uniform value for VSL and to apply separate sensitivity tests as may be appropriate for

age differences, morbidity pre death, and altruism (social values). Viscusi (2018b) recommends a uniform VSL as suitable for most relevant regulatory policies.[4]

This paper agrees with the uniform (one) value principle along with sensitivity tests where appropriate. This applies especially to unidentified persons. This reflects the core ethic that all people in the relevant society should be treated equally. It is also the most practical approach as varying VSL according to circumstance would risk unfair outcomes.

This core VSL value should reflect what the country or community is WTP. Where WTP values are derived from unrepresentative groups, they may need to be income adjusted.

However, two exceptions should be noted. The first relates to identified persons at risk of death. If the victims are identified, societal altruism may be substantial.

Second, there is the major issue: should the VSL be adjusted for age, with younger people having higher values and older persons lower values? The principle of equal value of life for all implies very unequal values for life years. This potentially traumatic issue is taken up in Section 8.

6 Reviewing the National VSL: Whether and How

Should the national VSL be reviewed? If so, how?

Certainly, it is timely to review the national VSL. The current VSL is based on relatively few (20) meta-analyses done in the 1990's and early 2000's. Well over a thousand new VSL studies have been published since then. Of course, a review does not necessarily mean that the VSL should be changed.

The first step in a review would be to consider how far, if at all, the Australian VSL is out of step with other national values and/or with other prominent studies of relevance to Australia. This should guide the size and kind of review required. If the Australian VSL is broadly consistent with comparable OECD VSLs and some appropriate relevant meta-studies, a review may not be needed. Ananthapavan et al. (2021) recently provided a detailed and competent in-depth meta-analysis with the special aim of determining a VSL relevant to Australia. This major paper review suggests a significant uplift in the Australian VSL. But for the reasons given below, the take here is that further work is needed.

Ananthapavan et al. 2021 meta-analysis

Ananthapavan *et al*. (*ibid*.) found 1,450 studies of VSL potentially suitable for inclusion. They then did a full text review of 74 studies that were considered potentially suitable for more detailed review and selected 18 studies for detailed study including the two Hensher *et al*. (2009 and 2011) stated preference studies, and 16 international meta-analyses published between 2007 and January 2019. The international estimates were adjusted for income differences and the median VSL estimate was extracted from each review study.

The paper recommended that the A$7.0m (in 2017 prices) found in the two Australian studies should be adopted as the base case VSL for people of all ages and across all risk contexts in Australia. Sensitivity analyses could use a high value of A$7.3m, which was the median value in the 16 international studies (converted to Australian income levels by applying an income elasticity of 0.5), and a low value of A$4.3m which reflected the value then "currently

[4] In reviewing this paper, Prof. Kip Viscusi confirmed that this is still his view.

recommended by the Australian government". This would now be inflated using income per capita changes since then.

Ananthapavan *et al*. (*ibid*.) is a very thorough paper. But, on a subject as complex as the VSL, it is perhaps inevitable that some issues arise.

(1) Given the relatively small number of studies selected for detailed review, it would be helpful to know more about how the sample selection was made and if, and to what extent, the results are sensitive to sample selection.

(2) In Table 2, the paper reports the result separately for 6 RP studies and 7 SP studies, along with their median results, using an international income elasticity of 0.5. These produce a median RP value of A$8.7m and median SP value of $7.6m in A$2017. But it is not clear how these findings are used to reach a recommended VSL.

(3) Citing five reviews, the paper (p.14) notes that publications tend to be biased towards studies citing higher results. It "allows" for this by giving prominence in its recommendations to the two Australian sets of results.

(4) The assumption of a country income elasticity of 0.5 seems low. Viscusi (2018b, p.124), the leading authority on international VSLs, recommends an income elasticity across countries of 1.0. Ananthapavan *et al (p.8)* reports that using an elasticity of 0.5 reduces the median VSL from $7.9 million to $7.3 million. Presumably, an elasticity of 1.0 would further reduce the median.

(5) The paper (p.11) puts high reliance on the two Australian studies (Hensher et al.). On page 10, the authors state that "both studies either fully or partially meet all 10 IPSOR good research practice for conjoint studies". And these papers are the basis for their recommended $7.0m for the VSLY. As discussed in Section 2 above, the findings of these two Australian SP studies are questionable on several grounds, but notably because they did not provide probabilities in their surveys. Also, the studies focused only on road fatalities, which is a narrow basis for a national VSL.

However, given the significant disparity between the findings of Ananthapavan *et al (ibid.)* and the current national value, there is a good case for conducting a review of the national VSL.

It may also be noted that, using a future-focused, multi-national, discrete choice experiment, Lancsar *et al*. (2023) found that the tax-paying Australian public was prepared to pay a high US$7.2m in forgone GDP per death avoided in the next pandemic. But this includes major pain and suffering, and loss of employment, from a Covid fatality event.

Reviewing the national VSL

So how to conduct a national review? How would the questions raised in Section 5 be resolved. Should the VSL be based on WTP or WTA values for safety? How to represent the diversity of household incomes and preferences? What kind of morbidity effect would be considered? Would the VSL include any social values? How to translate international findings into Australian values?

The response here would be that the VSL should be based on WTP values, that it should represent a mild form of morbidity (with more severe forms being added to costs where appropriate), that (subject to available evidence) it should consider some allowance for social values, and it should adopt an income elasticity of 1.0 when drawing on international findings.

So where to from here? One approach would be to conduct a national SP study of WTP values in Australia. But this would face major challenges. WTP values depend on personal or household income and culture and vary with social groups across both cities and regions. Accounting for all these groups in society creates a major practical challenge for a single SP survey. In addition, WTP values for avoiding fatality are likely to depend on related morbidity effects, perceived personal control over the presented events, and importantly respondents' perceptions of the probabilities on offer. Also, care must be taken to ensure that $ options don't provide cues to responses.

These are major issues for a single survey. Accordingly, while a well-constructed national SP study could certainly provide valuable information, it is problematic whether it should be acceptable as the sole basis for a new Australian VSL.

Turning to a review of existing VSLs and studies, there are two (not exclusive) approaches.

1. A review would draw directly on the findings of a few selected existing meta-analysis studies deemed to be relevant, such as Ananthapavan *et al*. (*ibid*.).

2. Undertake a new meta-analysis of a large no of studies, principally SP studies, determine their relevance to Australia and their competence, short-list select studies that are relevant and competent, and draw conclusions either qualitatively or using a formal econometric analysis.

In lieu of new Australian studies, the analysis would focus most on studies and valuations in countries deemed closest to the Australian economy and culture. These would be Canada, New Zealand and northern European countries. Also, studies have found that median values provide more valid estimates of central tendencies than mean values.

Conclusions

The Australian VSL should be reviewed, but the issue is not urgent. There is a case for a national SP study, but the statistical challenges are large given the issues of mortality context, difficulties in responding to very small probabilities, and the potential range and variety of responses from around the country. Thus, any such study would need to be supplemented by some meta-analysis.

Meta-analysis can synthesise results from multiple studies, including meta-analyses themselves. Ideally, this review would identify the various factors that influence the VSL estimates, given the various methods and contexts from which the VSL is estimated. However, the aim would be to find a central VSL suitable for Australia, with possible sensitivity tests to allow for outlying circumstances. As Banzhaf (2021) notes, when choosing a VSL or range of VSLs, analysts must sift through a vast literature of hundreds of empirical studies and numerous commentaries and reviews to find estimates that are (i) up to date, (ii) based on samples representative of the relevant policy contexts, and (iii) scientifically valid.

7 Values of a Statistical Life Year and a Quality Adjusted Life Year

This section reviews the VSLY and the value of a quality adjusted life year (VQALY), how they are valued and applied, and considers whether, and when (if ever) different values for VSLY or VQALY may be justified. As shown below, the concept and measurement of VSLY is relatively straightforward. The concept of a quality adjusted life year (QALY) is also quite straightforward, but its value (VQALY) is more contentious.

Estimating VSLY

There has been little independent research on VSLY. The UK Health and Safety Executive (2020, p.3) concluded: "Due to the limited number of UK VOLY studies, a VOLY cannot be generated from secondary data. Appropriate revealed preference/ behavioural data does not exist in the UK to estimate a VOLY." (In this citation VOLY represents VSLY).

Thus, the VSLY is usually derived from the VSL. Accordingly, the VSLY equals the annual dollar value over the average remaining life, typically around 40 years, which discounted = VSL, as in Equation 2 below. Drawing on ABS lifetime data[5], Ananthapavan *et al*. (2021) observed that the average life years post fatality was approximately 44 years, but agreed that calculating the VSLY assuming 40 years life expectancy was acceptable. Viscusi (2018b, p.105) supports this approach.

The discount rate of 3% p.a. is here the typical individual's private time preference rate, which is is the relevant form of discount for this calculation. Thus, $5.4m VSL converts to a VSLY = $235,000 (as per OIA, 2023).

$$\$5.4 \text{ million} = \$235{,}000 / 1.03 + \$235{,}000 / 1.03^2 \ldots + \$235{,}000 / 1.03^{40} \quad (2)$$

In their meta review, Ananthapavan *et al*. (2021) used the median VSL estimate in each of the included review papers and adopted this same process to calculate the VSLY.

QALY, VQALY and VSLY

We turn now to the concept of a QALY and discuss whether VQALY should equal VSLY.

In the health economics literature, a QALY is a generic measure of health status that integrates the duration and severity of illness. A year in high health has a score of 1.0. A year of less than high quality health has a score between 0 (a state of death) and 1. Data on disability weights can be found on the Australian Institute of Health and Welfare website. Vos *et al* (2020) provide an authoritative international set of weights.

One approach assumes that VQALY is essentially equal VSLY. Certainly, in principle this seems appropriate. This was my advice to the Office of Best Practice Regulation (Abelson 2008): "The value of a life year may also be described as the value of a quality adjusted life year". Viscusi (2018b, p. 245, footnote 32) also contends that VQALY should equal VSLY. Ananthapavan *et al*. (2021) also suggests that in principle QALY should have the same value as VSLY and recommends that more research be done on the reasons for the estimated differences. Adopting VQALY = $235,000, as per the current (2023) Australian value, improving the QALY status of someone from 0.5 to 1.0 would be valued at $235,000 * 0.5 = $117,500.

The other more common approach is to infer VQALYs from practical settings, principally in health care. Thus, Social Value UK (2016 p.7) noted that "a study by The Department for Health has valued one QALY at £60,000, although a general figure of £20,000 - 30,000 per QALY has been identified as the upper limit for treatments being deemed cost effective in the U.K. In the U.S., a figure of $50,000 per QALY has often used to determine cost-effectiveness of treatments. Research indicates this is likely an undervaluation, identifying $109,000 and $297,000 per QALY as plausible lower and higher bounds respectively for a treatment being cost effective."

[5] Australian Bureau of Statistics. 3302.0.55.001—*Life Tables, States, Territories and Australia, 2016–2018*.

UK Treasury (2018, Annex A2) also recommended that both VOLY and QALY should equal £60,000.

In a recent and more extensive report prepared by several academics from three British universities, the UK Health and Safety Executive (2020) found that the existing UK Green Book values for a QALY are based on a very small sample-survey of the UK public carried out in the 1990s. Also, the only UK study to directly elicit a VOLY was carried out on larger sample but was also outdated. The report found that the studies did generate a value close to current UK value of a QALY (£60,000) but some fundamental concerns were raised with respect to their reliability for policy purposes. Similarly, it was noted that whilst there were a few primary studies converging around a value of £30,000-£40,000, these were too few and they varied too much in terms of timing and/or methodology to provide a reliable corpus of studies as a whole.

The report (*ibid*. p.3) concluded that: "Due to the limited number of UK VSLY studies, a VSLY cannot be generated from secondary data. Appropriate revealed preference/ behavioural data does not exist in the UK to estimate a VSLY. As such, a stated preference survey drawing on the most up to date methodological practices is the only viable option." Further, the report concluded (p.20) that to estimate VSLY the process would be to: "Aggregate willingness to pay, summed over a large group of people, for marginal reductions in the hazard rate for the coming year (or some future year or years) where, taken over the group of people affected, the marginal gains in remaining life expectancy generated by the hazard rate reductions sum to one year".

In the U.S., Neuman and Coghen (2018) cited the value of a QALY as then averaging around $150,000. This was said to reflect the WTP value or alternatively the marginal cost of saving one QALY. According to these authors, the U.S. Institute for Clinical and Economic Review was using between $100,00 and $150,000 per QALY. Citing consensus at the World Health Organization on QALY values at 1-3 times per capita GDP of the country, produced a wider range from $57,000 to $171,000.

In Australia, Huanga *et al* (2018) used life satisfaction as an indicator of 'experienced utility', and estimated the dollar equivalent value of a QALY using a fixed effect model with instrumental variable estimators. Using a nationally-representative longitudinal survey including 28,347 individuals followed during 2002–2015 in Australia, they estimated that individual's WTP for one QALY was approximately A$42,000-A$67,000.

Evidently, finding an official regulatory value for a QALY is elusive. Australian *Guidelines for preparing a submission to the Pharmaceutical Benefits Advisory Committee* provide no value for a QALY. "Recent documents suggest new drugs are generally recommended if their expected incremental cost per QALY is somewhere between $45,000 and $75,000."[6]

There appear therefore to be three reasons why VQALY is typically around only a quarter of VOSL based on the VSL. One is that the values were based initially on per capita incomes. In a recent email correspondence on this topic, Professor Viscusi (25 November 2020) observed to the writer: "The drawback of most but not all QALY research is that it is not based on economic willingness to pay values."

[6] https://theconversation.com/new-cancer-drugs-are-very-expensive-heres-how-we-work-out-value-for-our-money-44014

Secondly, when VQALY is derived from surveys, people are asked how much they are WTP for events with much higher probabilities. In effect, these responses are much more income constrained than WTP values for very small probabilities.

Thirdly, practically and importantly, VQALYs often reflect the budget constraints of health services. For example, the American College of Cardiology adopted a range of US $50,000-$150,000 per QALY (see Anderson et al., 2014). A higher VQALY would mean more demands than the services could meet. In this case, VQALYs may be based more on professional opinions than on patient WTP preferences. But VQALYs do account for patient conditions.

8 Applying VSL or VSLY

Finally, yet another important and ethically difficult issue! When to apply VSL or VSLY? It is not possible to have an equal VSL and an equal VLY. If VSL is constant for all ages, VSLY rises with age. If VSLY is constant with age, VSL falls with age.

In practical terms, there are two main questions. Should the VSL for children be higher than the usual national VSL? And when should the VSLY be applied to evaluate services with relatively short temporal outcomes, notably for elderly persons?

In his major work on *Pricing Lives*, Viscusi (2018b, p.105) advocates adopting a uniform VSL "for the preponderance of regulations affecting transportation safety, occupational safety and environment". With regulations and investments that affect large numbers of the population of many ages, largely unidentified, this certainly seems appropriate.

On the other hand, OECD (2012) suggested that, if a regulation is targeted on reducing children's risk, the VSL for children should be a factor of 1.5 – 2.0 higher than adult VSL. And as Social Value UK (2016, p.7) noted, "a common criticism of the concept of a VSL is that the age of an individual is often not taken into account. Most people would agree it is reasonable to suggest that the life of a new-born baby should carry a far higher value than that of a centenarian. The VSLY can be used to account for this." More recently, Kniesner and Viscusi (2024) reported that in 2023 the U.S. Consumer Product Safety Commission proposed that the VSL for a child should be double that of adult at $23.2m compared with $11.6m (in 2021 US$). But they noted considerable practical difficulties with the value of life halving when someone turns 18! They conclude (*ibid*., p.12) that "based on the evidence in the literature, there is not a sufficiently large set of estimates or a consistent pattern in these findings to adopt a VSL premium for children." Thus, while a premium for children appears desirable, establishing practical guidance as to when and how this would apply which avoided inconsistent outcomes would need to be worked out.

At the other end of the age spectrum, OECD (2012, p.25) also noted that where age-differentiated VSLs have been applied, there has sometimes been considerable controversy. For instance, in the United States, the use of age-differentiated weights in an EPA analysis of the *Clear Skies Initiatives* (with a 37% lower VSL applied for those over 65) resulted in a spate of newspaper articles opposing this. And the US EPA abandoned this adjustment due to new studies not showing a clear decline in VSL at high age.

However, there are many regulatory contexts and health services that involve short or very short increases in life expectancy, such as for pharmaceutical regulations. Thus, the U.S. Department of Health and Human Services, Food and Drug Administration (2016) declared using a VSLY of $360,000 for its services, implying a much lower benefit than would apply with VSL.

In such cases, Viscusi (2018b, p.105) advocates using a VSLY constructed from the VSL as described above in section 7, to value the gain in life years, not using the quite different VQALY. This was also this writer's view when conducting substantial cost-benefit analyses on public health programs to reduce tobacco consumption, coronary heart disease, HIV/AIDS, measles and Hib Disease, and road trauma albeit many years ago.[7] Arguably, this is a low value VSL for someone with only a few years life expectancy.

To add to these already complex issues, as I completed this paper, my attention was drawn to a just published paper by Ketcham *et al*. (November 2024) that derived VSL measures specifically for seniors from a random sample of Americans over age 66. This found, for the central case, a mean VSL of just under $1 million at age 67 (in 2024 US $s) along with a mean VSLY of approximately US $70,000 in the late 60's, $40,000 in the mid 70's, and $20,000 in the early 90's. As would be expected the results varied substantially with both health status and reported income.

The practical guidance for agencies is therefore: in most regulatory cases, agencies should use the average VSL to monetize mortality risk reductions. However, when services yield short life extensions, as in the case of many medical treatments, agencies should apply a VSLY pertinent to that age group. Arguably, the VSLY should carry a premium when life expectancy is short (value is a function of scarcity), but this would need to be subject to national guidance in order to avoid discriminatory outcomes. And, as one reviewer observed, this conclusion may be further nuanced by the application of QALY values when there is a constrained health care budget.

9 Main Conclusions

In their 2019 paper, Kniesner and Viscusi observed that "since the 1980's, the VSL has become the most important economic parameter for the evaluation of U.S. government regulations, and it has been adopted internationally as well. The evaluation of the mortality risk benefits of proposed new regulations is the largest component of all new regulatory benefits, with regulations by the U.S. Environmental Protection Agency and the U.S. Department of Transportation accounting for the largest share of the benefits of regulations targeting mortality risk reduction".

I am not sure that such a strong claim could be made for Australia, but certainly the VSL has become an increasingly important feature of many regulations, and of policies more generally, in Australia over the last two decades. The VSL and VSLY are the bedrocks of cost-benefit analysis for health and safety issues.

I have cited above the key findings in each section of this paper. For convenience, I summarise the major conclusions here.

Our starting point is that VSL and VSLY represent the dollar amounts that society is **willing to pay** (WTP) to save a life or a life year respectively. They are described as statistical values as they are applied generally and equally to anyone's life or life year. WTP values may be significantly lower than WTA values.

[7] Applied Economics, 2001, *Returns on investment in public health: an epidemiological and economic analysis,* report prepared for the Commonwealth Department of Health and Ageing.

The national VSL cited by the Office of Impact Analysis (2023) is $5.4 million and the VSLY is $235,000 (in 2023 $s). These values are based on a simple meta-analysis by Abelson (2008) with the then recommended VSL and VSLY updated annually by changes in per capita income.

Finding current international VSLs is surprisingly elusive. But it appears that the Australian VSL is broadly comparable with European VSLs but well below the various US agency VSLs.

Many issues arise in estimating a national VSL. These include: the potentially large difference between WTP and WTA values, excluding tax transfers notably from WTA results, applying mean or median values from SP surveys, the potentially weak public understanding of very low probabilities, especially in surveys, the role that personal control has on valuation of risks, possible variations in VSL with different morbidity effects, and the potentially significant exclusion of third party (social) values.

RP studies have the advantage of being based on actual behaviour and market metrics of payments and risks. But labour markets studies usually provide VSL estimates for only a small part of the population, usually above average income groups, which may not be representative of the whole. Adjustments for income differences should be made, but it is not clear if this has been done. RP studies are often WTA values, not WTP values. They may also overstate WTA amounts by working with pre-tax payments.

SP studies are a widely accepted method for measuring values for non-market goods. However, the survey questions are hypothetical, there is no direct income constraint, and respondents may not accurately understand the, generally, very low probabilities cited.

Meta-analysis studies can draw on both approaches to elicit VSLs so that they are not dependent on the potential limitations of a single study. But there are over a thousand studies to choose from and they are dependent on study selection and the quality of the studies included.

It is timely to review the Australian VSL, but the issue is not urgent. A national SP study would be very challenging, given the issues of mortality context, the limited responder understanding of very small probabilities, and the potential range and variety of responses from around the different social groups in the country. Thus, any such study would need to be supplemented by some meta-analysis.

To conduct a relevant meta-analysis, the analysts would need to sift through hundreds of empirical studies and reviews to find estimates that are (i) up to date, (ii) based on samples representative of the relevant policy contexts, and (iii) meet survey and statistical standards.

Turning to the **value of a statistical life year** (VOSL) and the **value of a quality adjusted life year** (VQALY). In the health economics literature, a QALY is a generic measure of individual health status. In Australia, VSLY is generated from VSL, allowing for 40 years as average life years lost and a 3% private time preference rate. In principle VQALY should equal VOSL.

In practice, VQALY is typically around only a quarter of VOSLs. This appears to reflect their valuation based on per capita incomes rather than on economic willingness to pay values. But, importantly, it may also reflect the practical budget constraints of health services.

Finally, there is the issue of **when to apply VSL or VSLY.** With regulations and investments that affect large numbers of the population of many ages, largely unidentified, the VSL is appropriate. Arguably VSL should be higher for children, but applications would need to be clarified. When policies or services are directed at elderly (or other) persons involving short increases in life

expectancy, applying either an adjusted VSL or a VSLY is more appropriate. But where the borders lie, the reader may decide!

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