# ISSUE BRIEF:
# A REVIEW OF THE SCIENTIFIC LITERATURE ON THE VALUE OF HEALTH

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## Section 1: Introduction

There exists a large scientific literature on the value of improved health and how to incorporate that value into policy and decision making where activities impact health outcomes. The purpose of this policy brief is to review literature on the value of health in terms of a Value of a Statistical Life Year (VSLY). It discusses the range and average findings in the literature and how those have changed over time and with demographics such as socioeconomic status and age. We find that the median VSLY estimate based on academic papers is $512,422, and the median based on Meta-Analyses is $529,043. The median estimate for a VSLY used by U.S. governments agencies is $580,000 or about 10 percent larger than estimates in meta-analysis or 13 percent larger than estimates from other academic literature. Further, the academic literature has less variance than the meta-analysis reflected by 73 percent of studies between $450,000 and $650,000 versus 58 percent for meta-analysis, mainly due to the inclusion of international estimates and varying methodology in study inputs. Studies do find VSLY varies with age and has the same life cycle pattern as income and consumption, peaking at ages 50-55. We briefly conclude by discussing how common cost effectiveness thresholds that determine reimbursement for health care services and products by government bodies are significantly lower than VSLY values in scientific findings.

## Section 2: Measuring VSLY

The Value of a Statistical Life (VSL) is a measure that is used to quantify the tradeoff between small changes in mortality risk and monetary value. It measures how much a person would be willing to pay to have a small reduction to their risk of dying given their own budget constraints and preferences. It allows policy makers and other decision makers the ability to measure the monetary value of regulations and legislation related to health outcomes with consistent units. A VSL can be reduced to a Value of Statistical Life Year (VSLY) measuring the value of a single year, by discounting how much a person is willing to pay to reduce their mortality risk over their remaining years of life down to an average for one year. For example, a person’s VSLY would be $500,000 if a person is willing to pay $5 to reduce their chance of dying by 1 in 100,000 over the next year.

Markets provide prices to illustrate how much a person is willing to pay for goods and services. Mortality risk is not typically traded on markets directly, so nonmarket valuation methods have been developed to measure VSL and VSLY, the two main methods being revealed preference and stated preference.

Revealed preference measures tradeoffs between money and mortality that are revealed by economic behavior. In the labor market, this can be done by measuring the wage differences between two jobs and the mortality risk of these two jobs, usually done using Hedonic Wage Regressions (see wage composition studies in table 1). If a person accepts job A paying $5 more a year than job B but job A has a 1 in 100,000 higher chance of dying over that year, then that person's VSLY would be $500,000. Others have been able to determine VSL through looking at the tradeoff between safety when driving and time saved in terms of wages, payment for safety tools like airbags, or seatbelt use (see driving behavior studies in table 1).

Stated preference measures are usually based on surveys or behavioral experiments that survey people hypothetically to see how much they would be willing to pay to avoid a certain risk (see stated preference studies in table 1). The questions ask how much a person would be willing to pay to limit risks like not having a factory built next to a river to avoid contaminating the water or stockpiling medical equipment for pandemic response. Another example is surveyors could ask potential patients how much they would be willing to pay to take a new drug to treat a specific disease or condition.

Revealed preference tends to be a more reliable methodology as it measures real behavior that deal with real consequences, whereas stated preference tend to be more hypothetical and easily influenced. Revealed preference uses real market behavior. For example, a person may take a higher paying job after determining the higher pay is worth small additional mortality risk by factoring the risk into their job choice. Risks of using stated preference include that responses could be rushed, not given enough contextual information, influenced based on the wording of the question, or even the respondents attitude at the day and time of the survey. However, a benefit of stated preference is these surveys can be tailored to reveal people's willingness to pay toward specific situations.

## Section 3: A Review of the Literature Assessing VSLY

Estimates of the VSLY have been widely studied in the literature. There are over 1,000 published labor market estimates that either measure the VSLY or VSL (Viscusi 2018) and several meta-analyses that aggregate this extensive literature. VSLY and VSL are also studied and explicitly stated and used by government agencies, including the Food and Drug Administration (FDA) and Environmental Protection Agency (EPA), for benefit cost analyses guiding policy making.

As explained in section 2, VSL is similar to VSLY except instead of valuing a single year of life, VSL estimates a value for all the remaining years in an individual's life at a given age. With a discount rate and future survival information, VSLs can be converted to VSLYs. For example, in its official guidance, Health and Human Services (HHS) used a VSL for 40-year-olds of $11.4 million in 2020 dollars which it shows can be converted into a VSLY of $580,000 using a three percent discount rate with approximately 30 years of survival (HHS 2016; HHS 2021).

Table 1 provides an overview of the estimates of a VSLY based on three sources: key academic studies that estimate VSLY, meta-analyses in the academic literature that summarize the VSLY estimates, and estimates cited by different US Government agencies. We adjusted each paper's estimates to 2020 dollars using the Consumer Price Index from the Bureau of Labor Statistics (BLS) and Median Usual Weekly Earnings from the Current Population Survey conducted by BLS, as done by HHS (2021) and Department of Transportation (2021).

The willingness to pay to reduce mortality risk has been found to rise with income. We used an income elasticity of 1 as noted in HHS (2021) and DOT (2021), though, as these two agencies also note, income elasticity estimates range from about 0.5 (Masterman and Viscussi 2018; Viscussi and Aldy 2003) to 1.7 (Costa and Kahn 2004) depending on the study.[1] [2] In the event that the source uses a VSL estimate, we use the same conversion rate discussed by HHS which is a three percent discount rate with 30 years of expected life remaining. In addition, each

[1] EPA (2010) reports a VSL estimate of $7.4 million in 2006 dollars. Their official guidance indicates to update this to the study year, they use the GDP Deflator price index and an income elasticity of 0.5 as cited in EPA (2011) based on the income elasticity from Viscussi and Aldy (2003). We follow this process to update their estimate to 2020.

[2] An estimated VSLY changes based on income, so income elasticities tell us by how much VSLY will change based on a change in income. With an elasticity of 1, if income increases by 4 percent then the VSLY will increase by 4^1 = 4. A smaller (larger) elasticity will lead to smaller (larger) income adjustments leading to lower (higher) VSLYs.

study is classified by the methodology used, or in the case of meta-analyses, the methodologies of the studies used in their analysis. We also indicate if the study is based on international data.

We only identified U.S. estimates in the academic literature, and they all used revealed preference methodology: either wage composition or driving behavior. On average, studies based on driving behavior tended to have lower VSLY estimates than wage composition studies. The meta-analysis literature is comprised primarily of studies that used estimates from both the United States and the rest of the world, though 4 studies focus on just the United States. Half of these meta-analyses focused solely on wage composition studies, then the rest are split between using stated preference studies and multiple types of studies. Finally, we found official guidance for 5 different government agencies for VSLY or VSL estimates. The Department of Homeland Security uses the Department of Transportation estimate. Overall, the findings are of the same orders of magnitude across several ways of measuring the value of health gains, particularly when compared to government metrics discussed later in the report.

Table 1. Estimates of the Value of a Statistical Life Year

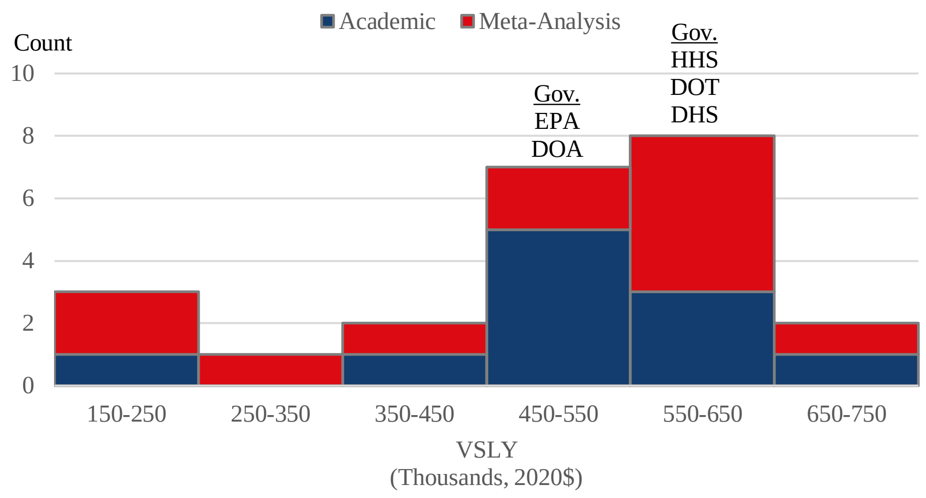
| Source | VSLY ($2020) | Methodology |
|---|---|---|
| Academic Literature | | |
| Aldy and Viscusi (2008) | $512,422 | Wage Composition |
| Kniesner et al. (2012)*^ | $576,663 | Wage Composition |
| Viscusi (2004)* | $464,236 | Wage Composition |
| Viscusi and Hersh (2008)^ | $568,498 | Wage Composition |
| Scotton and Taylor (2011)*^ | $488,953 | Wage Composition |
| Ashenfelter and Greenstone (2004)* | $152,112 | Driving Behavior |
| Rohlfs, Sullivan, and Kniesner (2015)*^ | $659,458 | Driving Behavior |
| Lee and Taylor (2019)*^ | $534,946 | Wage Composition |
| Kniesner, Viscusi, and Ziliak (2010)*^ | $502,126 | Wage Composition |
| Hakes and Viscussi (2007)*^ | $372,470 | Driving Behavior |
| Costa and Kahn (2004)*^ | $579,567 | Wage Composition |
| Academic Literature: Meta-Analysis | | |
| Robinson and Hammitt (2015)* | $575,896 | Multiple Types of Studies |
| Viscusi (2015)*^ | $595,092 | Wage Composition Studies |
| Masterman and Viscusi (2018)** | $575,270 | Stated Preference Studies |
| Viscusi (2018)* | $694,141 | Wage Composition Studies |
| Viscusi and Aldy (2003)** | $580,003 | Wage Composition Studies |
| Mrozek and Taylor (2002)**^ | $186,234 | Wage Composition Studies |
| Banzhaf (2021)** | $376,576 | Multiple Types of Studies |
| Kochi, Hubbell, Kramer (2006)** | $467,465 | Multiple Types of Studies |
| Lindhjem, Navrud, Braathen, Biausque (2011)** | $568,302 | Stated Preference Studies |
| Doucouliagos, Stanley, Giles (2012)** | $237,195 | Wage Composition Studies |

| | | |
|---|---|---|
| Masterman and Viscussi (2020)* | $489,785 | Wage Composition Studies |
| Keller, Newman, Ortmann, Jorm, Chambers (2021)** | $306,641 | Multiple Types of Studies |
| Government Agencies | | |
| Department of Health and Human Services | $580,000 | |
| EPA* | $502,356 | |
| Department of Transportation* | $591,823 | |
| Department of Agriculture* | $528,056 | |
| Department of Homeland Security* | $591,823 | |

*Adjusted from VSL using a 3 percent discount rate at 30 years.
** Adjusted from VSL using a 3 percent discount rate at 30 years and includes studies from multiple countries
^ Used midpoint of an estimated range.

Figure 1 shows the histogram illustrating the distribution of these estimates by count of studies. The majority (65 percent) of the studies—as well as estimates used by government agencies-- generated estimates of VSLY that fall between $450,000 and $650,000.[3] However, the variance in the academic literature is lower than the meta-analysis literature. Nearly three-quarters (73 percent) of studies from the academic literature generate estimates between $450,000 and $650,000, while the meta-analysis literature has 58 percent of their studies in this same interval. The standard deviations in table 2 also illustrate this point.

**Figure 1. Histogram of Study Estimates**




[3] All of the studies in the $550,000 to $650,000 interval are actually below $600,000, so 65 percent of studies are really between $450,000 and $600,000.

Table 2 provides descriptive statistics for these estimates, which illustrates that some government agencies use slightly higher estimates than the academic literature would suggest. A total of 28 academic studies, meta-analyses, and government agency estimates were included. The estimates have a wide range between $152,112 and $694,141, as expected. The mean and median show a similar trend, but we report the median to avoid any skewing from outlier estimates. The median estimate for academic papers is $512,422, about 3 percent below the median for Meta-Analyses of $529,043.[4] Comparing the median of Meta-Analyses and the government agencies' median of $580,000, we find government agency estimates are about 10 percent larger.

Table 2. Descriptive Statistics of the Value of a Statistical Life Year Across Studies

| | Count | Mean | St. Dev. | Median | Min | Max |
|---|---|---|---|---|---|---|
| Academic Papers | 11 | $491,950 | $128,518 | $512,422 | $152,112 | $659,458 |
| Meta-Analyses | 12 | $471,050 | $152,880 | $529,043 | $186,234 | $694,141 |
| Government Agencies | 5 | $558,812 | $36,774 | $580,000 | $502,356 | $591,823 |
| Total | 28 | $494,932 | $133,130 | $531,501 | $152,112 | $694,141 |

The U.S. Office of Management and Budget (2015) points out that the benefits used in cost benefit analysis in U.S. government regulations primarily reflect mortality risk benefits and, as such, it is crucial to use the most accurate VSLY estimates.

The literature continues to develop and address methodological issues such as correcting for publication selectivity bias that may overestimate the actual VSLY estimates (Doucouliagos et al 2012; Masterman and Viscusi 2020; Viscusi 2015; Viscusi 2018). Another important development has been the need to contextualize variability around estimates by sector like health, labor market, or the transportation sector as well as socio-economic status (Keller et al 2021).

Finally, a literature demonstrates the need to also adjust VSL and VSLY by age. Adjusting to 2020 dollars using inflation and income, Aldy and Viscusi (2008) show VSLY increasing from $296,933 for people aged 18 to a peak of $680,402 at age 54 that then falls to about $593,867 at age 62. Murphy and Topel (2006) quantify a similar trend of VSLY across a

[4] We do note how higher incomes lead to higher VSLYs, so higher income countries like the United States will most likely have higher VSLYs than an average across multiple countries.

typical person's life cycle by examining benefits of health improvements that lead to longer and greater quality of life. They find the VSLY follows a similar life cycle as consumption and income, increasing through prime-working years then decreasing after about age 50. Costa and Kahn (2004) find a positive income effect and discuss how as longevity has increased through increased job safety conditions; the value of life has also increased.

## Section 4: Implications for Health Care Reimbursement Policies by Public Payers

Table 1 shows that the estimates of the VSLY are generally between $450,000 and $600,000. These estimates are far higher than cost effectiveness thresholds used by foreign governments when determining medical care reimbursements, usually in terms of a quality-adjusted life year (QALY).[5]

A key reason for the larger values of health measured by various methods in the scientific literature and the government thresholds may be due to foreign governments budget concerns, such as fixed health care budgets, rather than the primary aim being to determine value of additional health to their citizens. However, the increasing share of private income spent on health care in these markets indicates that the private sector deems it desirable to expand their overall health care budgets and the same may well be true for desirable public spending. In short, many other factors than the value to patients of improved health seem to influence government thresholds such as budget pressures and other political tradeoffs. The thresholds used by government agencies do not seem to be consistent with the science and highlight the subjective nature of using these approaches in making health care decisions

[5] A QALY measures the burden of disease by combining the remaining quantity of years of a patient living with the disease and the quality of those years. For example, if a patient with a disease has 1 year to live and the disease takes away half of their abilities, they have a QALY of 0.5 years. Governments create a cost-effectiveness threshold by creating an incremental cost-effectiveness ratio which is the additional cost a new drug is compared to current treatments divided by the additional QALY benefit a new drug provides. A VSLY measures the value of one full QALY.

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