

**Comments from Members of the Chartered SAB on the Draft SAB Review of EPA’s  
Proposed Methodology for Updating Mortality Risk Valuation Estimates for Policy  
Analysis (10/27/2016)**

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## Comments from Lead Reviewers

### Comments from Dr. Robert J. Johnston

1) Were the charge questions to the committee adequately addressed?

Yes, in nearly all cases the charge questions to the committee were adequately addressed. As described by the SAB report, there are concerns with EPA's proposed methods for updating mortality risk valuation estimates (as described in EPA's white paper, *Valuing mortality risk reductions for policy: a meta-analytic approach*). The SAB panel has identified most of these and has provided appropriate and detailed guidance. However, there are a few methodological issues which are either not addressed explicitly or are given too little emphasis by the SAB report. These relate to a divergence between the methods described in the agency's white paper and established approaches for economic meta-analysis, particularly related to issues such as publication bias, study screening, and the choice of methods used to meta-analyze the data.

The most important of these concerns relate to well-established publication bias in the VSL literature and its potential effects on the inferences that are drawn from both parametric and non-parametric meta-analysis. As described below, the methods proposed by EPA—and particularly some of the study screening methods—are likely to exacerbate such selection biases (see, for example, Rosenberger and Johnston 2009). EPA's white paper gives inadequate attention to challenges of selection and publication bias. I can find no mention of publication bias in the EPA white paper (or any other selection bias), and no discussion of the importance of this bias for meta-analysis. This is important, because publication bias has been shown to be pronounced in the VSL literature (see additional discussion and citations below).

A second area of concern is the divergence between some of the methods proposed by EPA and methods developed in the meta-analysis literature. The SAB mentions this concern in various sections of the report, but does not (in my opinion) give it sufficient attention. Methods and insights from the meta-analysis literature are directly relevant to many of the agency's proposed methods and the charge questions provided to the SAB. The EPA's white paper often fails to acknowledge these methods and insights from the literature. More details on these issues are provided under question #2 below.

2) Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?

The SAB panel report does an admirable job of describing a complex set of challenges for VSL meta-analysis, and the guidance in the SAB report is relatively comprehensive and technically accurate. Overall, the SAB report is excellent, and the panel includes multiple individuals with expertise in meta-analysis. However, there are a few issues that are not addressed sufficiently by the SAB report. These are outlined below.

## 2.1 Publication/Selection Bias and Study Screening

The potential for publication and selection bias is a key challenge to any meta-analysis of economic phenomena. One of the primary areas of emphasis in the meta-analysis literature is the identification and amelioration of such biases (Rosenberger and Johnston 2009; Stanley and Doucouliagos 2012). The VSL literature is known to be subject to such biases. In fact, the textbook of Stanley and Doucouliagos (2012, p. 56-60) uses the VSL literature as an iconic example of publication bias and how this bias can lead to misguided inferences when summarizing a literature. Additional references and discussion of this issue are provided in this discussion. More specifically, this discussion specifically advises *\*against\** study screening approaches such as those applied by EPA white paper, because such approaches are known to propagate and exacerbate publication bias. The SAB report touches on related issues, but does not appear to address the relationship between EPA's proposed methods and the effects of publication and other selection biases. Two issues are of particular concern in this area.

The first concern is the practice of screening studies based on empirical scope tests (i.e., showing that willingness to pay increases with the size of risk reduction). Essentially this is a screen based on the expected sign (and statistical significance) of an empirical relationship estimated using statistical methods. Screening of this type is contraindicated for the case of meta-analysis of this type. Consider the standard funnel plot used within meta-analysis to illustrate the relationship between estimated effect sizes and standard errors, and used to visualize potential publication bias (e.g., see Stanley and Doucouliagos 2012, p. 53 for an example). This relationship implies that a random sample of the literature will—due to statistical variation in the primary study estimates—generate some estimates with the “wrong” sign or otherwise unexpected results. The SAB report correctly recognizes this issue, and it is a well-known property of statistical estimates. An example would be a VSL estimate that does not pass a scope test. Although it might seem counter-intuitive to include such studies within a meta-analysis, omitting them will lead to biased mean effect size estimates. The VSL literature is known to be subject to publication bias in general—an example of the resulting asymmetric funnel plot for VSL estimates is provided by Stanley and Doucouliagos (2012, p. 57). Further screening these studies using a statistical scope test risks further exacerbating this type of selection bias, potentially leading to a mean effect size estimate that is further from the true underlying value. This issue is often described as the “selection paradox” within meta-analysis (Stanley and Doucouliagos 2012, p. 56). *Given this risk, I suggest that the SAB report clearly advise against the screening of studies based on empirical scope tests.*

The second and related concern is that EPA systematically excludes unpublished studies. The SAB report correctly suggests that EPA should consider the inclusion of (quality screened) unpublished studies. However, in my opinion, the importance of this recommendation for ameliorating publication bias is given insufficient attention. As noted by Rosenberger and Johnston (2009) and Stanley and Doucouliagos (2012), one way to at least partially ameliorate publication bias in a literature is via the inclusion of unpublished studies in a metadata—in addition to standard bias-correction methods identified in the meta-analysis literature. (Although selection biases can also pervade unpublished literature—suggesting the importance of formal tests for selection biases, where possible).

Both of these concerns relate to the screening criteria used by EPA. There is guidance for study

screening provided by the meta-analysis literature, as well as guidance for reporting and coding (Stanley and Doucouliagos 2012; Stanley et al. 2013). Among the primary conclusions of this guidance are that (a) unpublished studies should not be routinely excluded from metadata unless there is a clear justification for doing so (beyond generic and often unverified concerns of “study quality”), and (b) studies should not be screened based on whether they report an expected statistical result.

More generally, when constructing metadata, it is appropriate to screen studies based on the *methods* that are applied (i.e., choosing studies that apply methods shown to generate valid results)—as suggested by the SAB. It is *not* appropriate to screen based on whether *statistical results meet prior expectations* (e.g., pass a scope test). Screening of the latter type generally contributes to selection bias. Distinctions such as this could be better clarified by the SAB report, in addition to the other (excellent) guidance that is already provided. More generally, the EPA should revisit their study search, reporting and screening criteria to ensure that it meets standards of the meta-analysis literature.

Related to this, I am somewhat concerned that the SAB report (page 20) highlights “publication in a peer-reviewed journal” as unquestioned evidence of study validity. This is a controversial issue within meta-analysis. Stanley and Doucouliagos (2012, p. 18) state that in their experience, “there is no detectable difference in quality between published and unpublished studies as measured by the objective statistical criterion of precision.” Rosenberger and Johnston (2009) give considerable attention to the potential pitfalls of using peer-reviewed publication as a selection criterion. Although peer-reviewed publication *can* be used as a signal of study validity, I suggest that the SAB report explicitly note the potential caveats and risks in doing so.

More can also be done by the EPA report to formally diagnose publication bias in their sample. Given the availability of (at least approximate) measures of standard errors for the included estimates, the agency has the capacity to conduct more formal diagnostics and corrections for publication bias. These should be conducted and used to inform the analysis, particularly with regard to appropriate methods that are applied for the meta-analysis (see discussion below). The unavailability of estimated standard errors for some types of estimates analyzed by economists (e.g., some types of willingness to pay estimates) precludes some types of formal selection bias evaluations. However, here there appear to be (at least approximated) estimates of standard errors, making such tests possible.

Finally, there is also recent unpublished but possibly relevant work that extends findings related to selection biases in the VSL literature. Viscusi (2016) recently presented work at the Meta-Analysis of Economics Research Network Colloquium suggesting that “best estimate” selection within VSL meta-analysis can further exacerbate publication selection biases. These findings seem relevant here, particularly to the extent that EPA selects “preferred estimates” for analysis.

## *2.2 Methods Inconsistent with the Meta-analysis Literature or with Unclear Properties*

As correctly noted by the SAB report, the EPA white paper describes and applies multiple methods that are inconsistent with (or have unclear relationship to) standard practice in the meta-analysis literature. The properties of these novel approaches are not established. There is a mature literature on different approaches towards meta-analysis. This literature provides insight

into the relative performance of different types of approaches and adjustments within different meta-analysis contexts.

For example, there is guidance regarding the applicability of different types of parametric versus non-parametric methods, as influenced by factors such as heterogeneity in effect sizes and publication bias (Stanley and Doucouliagos 2012). Page 37 of the SAB report identifies one specific case, where standard tests of homogeneity (Q-tests) can be used to provide guidance regarding appropriate parametric and non-parametric methods. These tests provide insight into whether non-parametric methods are recommended to address study heterogeneity. The EPA's white paper would benefit from more systematic grounding in approaches of this type.

This concern is mentioned by the SAB report, but in my view given insufficient emphasis. EPA should clearly document the basis of their proposed methods in established approaches from the meta-analysis literature, or be prepared to illustrate both the formal econometric and empirical properties of the novel methods that are proposed. In some cases, the methods proposed by EPA are equivalent to those recommended by the literature, but this correspondence is not always made clear (e.g., see example on SAB report page 40). The applicability and properties of different approaches to parametric and non-parametric meta-analysis has been the subject of considerable work in the literature that is not recognized in the EPA's report.

3) Is the draft report clear and logical?

Yes, the draft report is clear and logical. The SAB has done a commendable job. There are a few sentences that are somewhat run-on, and that could possibly be segmented or clarified (e.g., the sentence beginning "This evaluation necessarily precludes..." on line 23, page 5). There is also a bit of redundancy across a few sections—although this is largely unavoidable due to overlap in material covered by different charge questions. However, overall the draft report is very clear and logical.

4) Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes, subject to the issues raised under question #2 above, the conclusions and recommendations are supported by the body of the draft report.

## References Cited

Rosenberger, R.S. and R.J. Johnston. 2009. Selection Effects in Meta-Analysis and Benefit Transfer: Avoiding Unintended Consequences. *Land Economics* 85(3): 410-428.

Stanley, T.D. and Doucouliagos, H.C. 2012. *Meta-Regression Analysis in Economics and Business*. Oxford: Routledge.

## **Comments from Dr. Elke Weber**

### **(1) Were the charge questions to the committee adequately addressed?**

The committee systematically and thoroughly addressed the questions posed to it by the EPA White Paper. My observations below simply complement a very good review from the perspective of behavioral decision theory and a couple of other angles.

While not explicitly asked to comment on a proposed change in terminology from the currently used label “value of a statistical life” (VSL) to two proposed alternatives (“value of risk reductions” (VRR) for mortality or “value of mortality risk” (VMR)), the committee wisely weighs in on the question. The report implicitly suggests that the first alternative (VRR) might be preferable, by mentioning it and not the other, as good decision in my opinion, but perhaps one that could be spelled out more explicitly (if intended) and with more justification. The proposed change in terminology derives from the fact that VSL can be misconstrued as a measure of the dollar value of avoiding certain death of a single individual and as violation of a tradeoff (money vs. human life) perceived by many to be a taboo or callous. The VMR label also seems to suggest such a taboo tradeoff violation.

A cross-cutting issue that could be spelled out more explicitly is the fact that many of the study inclusion and data analysis procedures proposed by the EPA seem to be a response to the paucity of studies that provide ideal input into their meta-analysis. Thus their somewhat ad-hoc implementation of inclusion criteria can be seen as a tradeoff between two goals: (a) purity in applying a wide set of study selection criteria and (b) use of a sufficient number of studies/data to allow for reliable VSL or VRR estimates. The excellent recommendations of the SAB report on how to expand the set of available empirical data (made in response to Q1b and Q11) should greatly increase the set of available studies and thus make it feasible to impose more stringent selection criteria. In that spirit, the committee may consider whether to also add a recommendation on how the pool of Stated Preference (SP) questions could be expanded, perhaps by adding relevant questions to national panel studies, like the National Longitudinal Surveys, though there might be consequentiality concerns.

### **(2) Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?**

Again, the committee did a thorough job. I have only a few small additions to suggest, to be used as seen as helpful.

The meta-analysis results reported by the EPA confirm the well-known fact that WTP estimates (of any quantity) tend to be far lower than WTA estimates (see e.g. Horowitz JK, McConnell KE. A Review of WTA/WTP Studies. *Journal of Environmental Economics and Management*. 2002;44:426–447). In this case, VSL is lower when inferred from Stated Preference studies than when inferred from Hedonic Wage studies. Economics attributes this to wealth constraints on WTP that do not exist for WTA, psychology to differences in information evaluation and weighting when preferences/prices are constructed under these different assessment methods. Answers to the question of *why* these differences arise should presumably

influence the way in which these estimates are weighted when being combined or which ones are being used in which policy context.

There have been a lot of recent advances in how to use Bayesian methods to “correct” estimates collected from nonrepresentative samples, known as Multilevel Regression and Poststratification (MRP) methods. These originated as corrections to political polling results, but have far broader applicability (e.g., Park, David K., Andrew Gelman and Joseph Bafumi. 2004. “Bayesian Multilevel Estimation with Poststratification: State-Level Estimates from National Polls.” *Political Analysis* 12(4):375–85).

In answer to Q12, the committee may want to more explicitly broaden the scope of what it is asking the EPA to further investigate, i.e., more than just a cancer differential. They may want to remind the EPA of the seminal work on psychological risk dimensions, identified and measured by psychologists Paul Slovic, Baruch Fischhoff, and Sarah Lichtenstein in the 1960s and 70s, who found that people’s judgments of the magnitude and acceptability of different health and safety risks were determined not just by their objective morbidity or mortality statistics but also by how well these risks were known, seemed controllable, or were dreaded. Nuclear power, at the time, scored highest on these “psychological” risk dimensions, accounting for the opposition in the US population against nuclear reactors as sources of power generation. Increased concern about specific mortality risks could, presumably, translate into differential WTP for risk reduction or WTA for taking on such risks. It raises the question though of whether any such differential, if it existed, would or should constitute a “bias” (i.e., be present in people’s judgments or decisions, but not be normatively defensible)? Arguments could be made for either answer. If cancer risks, for example, were more dreaded by the US population (and resulted in a greater WTP for their reduction), then EPA action to reduce them rather than other risks perhaps should be valued more, as fear and worry have psychological and health consequences in their own right. On the other hand, one could argue that only objective mortality statistics should matter, not subjective perceptions. The EPA may want to consider and investigate this broader set of questions and issues.

### **(3) Is the draft report clear and logical?**

The committee followed the structure of the EPA report in its responses to the questions posed to them, and tied their concerns and recommendations together in its executive summary.

### **(4) Are the conclusions drawn or recommendations provided supported by the body of the draft report?**

Yes, no concerns here. This is a well-documented report.

#### **Comments from Dr. Peter J. Wilcoxon**

##### **1. Were the charge questions adequately addressed?**

Overall, the charge questions were addressed appropriately and with admirable thoroughness. A

few issues in specific responses are discussed below, including several charge questions where the committee argued that the question could not be answered from the information given.

*Question 1a:*

The committee takes the position that the charge question cannot be answered given the information provided by EPA. It then specifies what needs to be clarified, as well as discussing how validity should be assessed. The position that the charge question cannot be answered is appropriate and the answer is responsive.

With that said, the advice provided could be clearer and more prescriptive. In places it seems to be internally inconsistent, such as on page 15, lines 41-44 which says “..the threshold for inclusion ... is not clearly stated in the White Paper. This is not a bright line decision, but a consideration of the weight of evidence...” The first sentence seems to be faulting EPA for not clearly stating a threshold (i.e., bright line) for inclusion while the second seems to be telling it not to use one. It will be difficult for EPA to comply with both.

Similarly, page 18, lines 12-14 should be clearer. It currently reads “In fact, it may not be possible to determine that a study or estimate is valid, but it may be possible to decide that there is insufficient evidence to support a conclusion of invalidity and the data are therefore worthy of inclusion in the analysis.” The committee’s intent seems to be to suggest that the burden of proof should be on rejecting studies: i.e., studies are included by default and are only excluded if they fail too many validity tests. If so, a clearer way to put this might be to argue that studies will fall into three categories: (1) clearly passing most or all tests of validity; (2) clearly failing most or all tests; (3) everything else (for which validity is ambiguous). The committee’s position then seems to be that groups 1 and 3 should be included.

Along the same lines, page 18 line 46 says “... EPA needs to proceed cautiously when making validity assessments.” That will be difficult to follow unless the document takes an explicit position on the meaning of caution: i.e., whether caution means to include studies in category 3 above, or to exclude them, or to do something else.

*Question 2:*

On page 25, the paragraph beginning on line 33 provides additional references for EPA to consider but then says “However, no firm recommendations are provided on how these studies might be incorporated in the White Paper, if at all.” This section should be made less ambiguous and aligned with the corresponding bullet point on page 26, which is much clearer.

On page 26, text beginning on line 8 suggests that the EPA use hedonic wage studies based on data sets other than the CFOI. This seems to conflict with text from Question 1b on page 21 that argues that the CFOI data is essential for wage studies.

*Question 3:*

The committee provides a very detailed discussion of appropriate choices of population weights

and the need to acknowledge that some of what is now described as weighting is actually a combination of weighting and benefit transfer.

With that said, in the section on improving the approach beginning on page 30, line 18 it would be good to acknowledge that if there are indeed systematic variations in VSL across subgroups, computing and applying a nationally representative VSL may not be appropriate for some regulations. A population-weighted VSL is only appropriate if it's the expected VSL of the policy – that is, if everyone in the population has an equal chance of being exposed to the problem. If some groups are much more exposed to a risk than others, the national average VSL is likely to be biased. This is relevant for the point beginning on line 41 of page 30 which recommends aggregating subpopulation estimates, which seems inappropriate unless exposures are similar.

*Question 7:*

The committee takes the position that the charge question cannot be answered given the information provided. That is appropriate under the circumstances: EPA's proposed method is novel and not presented in enough detail to enable a key equation to be verified easily. The committee also notes that EPA does not provide any citations to prior literature that has used the proposed approach.

*Question 8:*

The committee argues that more information would be needed to answer the charge question directly and indicates what would be required. In addition, it points out that the answer is likely to be affected by EPA's response to SAB suggestions in other charge questions. It goes on to provide an alternative non-parametric estimator (a citation to the literature or source of the expression should be provided) and a discussion of improvements in the parametric estimator. Overall, the answer is appropriate and responsive.

*Question 11:*

The committee provides a particularly clear and thorough discussion of the prospects for expanding the statistical basis of the VSL.

One major suggestion it makes is that the EPA should consider using research that hasn't been published in peer-reviewed journals, which departs from typical SAB guidance. The report makes a strong argument that valuable studies are likely to exist outside the published literature but that is also true for many topics other than the VSL. To justify relaxing the usual guidance against the use of gray literature the document should argue that the need is particularly acute for the VSL.

*Questions 15 and 16:*

The responses to these questions are merged but the committee's choice to do so is appropriate and both questions are clearly and unambiguously addressed.

## **2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?**

Apart from one conspicuous error noted below (and which seems to have been a simple typo) the report appears to be correct and complete.

### *Question 4:*

In the discussion on page 33 there is an error in equation 2 where the product of 10,000 and 50 is given as 50,000 rather than 500,000. It seems most likely that line 16 should have said “per 1,000 workers” rather than “per 10,000 workers”. If so, equation 2 should also be changed accordingly.

## **3. Is the draft report clear and logical?**

Overall, the report is clear, logical, and well organized. A few suggestions for improvement are listed below.

### *Question 1a:*

Page 19, line 1-3: “The meta-analysis should be carefully scrutinized...outcomes.” This statement isn’t about validity and should be moved elsewhere.

### *Question 1b:*

Most of the response (beginning on page 21, line 30) focuses on proposals for future research that provide more and better-quality hedonic wage studies. It would be better to move this to the “Overarching Questions” section or a similar one on “Overarching Recommendations” since it’s not directly related to the charge question.

Page 22, line 14 begins “In addition to these four recommendations...” but it does not appear that four recommendations have already been given.

### *Question 1c:*

As with 1b, much of this response goes well beyond the charge question to argue that willingness to pay for reductions in the risk of immediate death is an inappropriate metric for environmental policy because it excludes morbidity. It provides an extensive list of potential studies from health care that could be used, and suggests that EPA develop a benefits-transfer approach to enable it to use them. These are good suggestions but would be more appropriate in an “Overarching Recommendations” section.

### *Question 5:*

On page 36, two paragraphs beginning on line 4 express reservations about transformations made by EPA when extracting data from some studies for use in the meta-analysis. This section could be clearer and less equivocal. It should also be made consistent with the response to Question 9, which discusses the same issues.

In some places the text seems to argue some of the transformations are inappropriate for use in deriving the overall VSL and should only be used as part of sensitivity analysis around specific rules (line 4 and line 24). However, in other places it seems to acknowledge (at least implicitly) that without such transformations the set of studies that could be used for the meta-analysis would be very limited.

Overall, the intent of the section seems to be that: (1) some of the adjustments made by EPA are benefit transfers and thus not unambiguously appropriate as part of constructing the input data for the meta-analysis; (2) that some benefit transfers, or benefit transfers in some circumstances, could be appropriate; (3) that more analysis and evaluation will be needed to determine the answer to point 2, so no rule can be provided now; and (4) that in the interim, benefit transfer calculations should be identified more clearly and justified explicitly. If that's the intent, the section should be revised to make that argument more clearly. If that's not the intent, clarifying it is even more important.

In addition, this section should be made consistent with the response to Question 9, which appears to argue that benefit transfer calculations are not yet ready for use in regulatory guidance.

*Question 11:*

On page 44, lines 17 and 34, the report states that "Adjustment of VSL estimates by ... income ... may not be appropriate." The sentence should be clarified: as written, it sounds as though it's unknown whether it's appropriate. The intent seems to be closer to "Adjustment .... is only appropriate in particular circumstances."

The paragraph beginning on page 47, line 9, suggesting that EPA might learn from BLS procedures to update the CPI seems unlikely to be helpful. The problem faced by BLS is different: it has plenty of data but refrains from updating the basket every year because of the design of the index. EPA faces an entirely different problem: in essence, it must decide how long it must wait for enough new literature to arrive for a VSL revision to be worthwhile. A more apt example might be the FDA's process for revising dietary and medical guidelines.

*Question 14:*

Omit lines 27 to 33 which duplicate the subsequent recommendations section.

**4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?**

Yes, the conclusions and recommendations are all supported by the body of the report.

## **5. Are the Executive Summary and Letter to the Administrator aligned and consistent with the body of the report?**

Yes. In addition, the letter to the Administrator is clear and concise.

## **6. Typos and minor comments**

Page 1, lines 24, 25: For consistency clauses numbered 1 and 2 should end with semicolons.

Page 2 line 4: “modification” should be “replacement”.

Page 2, lines 16, 17: Remove the sentence “This should include consideration of whether a valuation scenario was consequential.”

Page 2, line 46: Delete “gain permission to” (implied by the MOU suggestion).

Page 5, line 35: The first two sentences seem repetitive given the preceding paragraphs.

Page 6, line 33: This sentence should hedge less: “In addition, the SAB recommends that, without compromising accepted science-based practice for quantitative estimation, transparency be applied as a criterion for selecting an estimator.” Perhaps: “In addition, the SAB recommends that transparency be considered when choosing among estimators that are otherwise equally appropriate.”

Page 7, line 15: Add commas around “and justification for”

Page 11, line 16: Remove extra space at the beginning.

Page 11, line 30: Capitalize “paper” in White Paper

Page 12, lines 25, 26: For consistency clauses numbered 1 and 2 should end with semicolons.

Page 13, line 21: Remove extra space at the beginning.

Page 16, line 19: Change “...each component of validity.” to “each.”

Page 16, line 20: Delete “to update the VSL”.

Page 16, line 32: Change “is customized” to “focuses on applying these concepts”.

Page 17, line 16: Remove “, but this need not be the case” It’s not clear in that context and is

about to be explained in the next paragraph. Start the next paragraph with “However,”

Page 17, line 42: Change “have a” to “has a”

Page 19, line 33: Change “...information on effect on...” to “information on the effect of responses on...”

Page 19, line 35: Replace “ex ante perspective” with something clearer since ex ante suggests prior to the earlier studies.

Page 20, line 3: Change “White paper” to “White Paper”

Page 20, line 7: Change “Consideration of evidence of...” to “Evaluation of...”

Page 20, line 27: Clarify the following sentence: “For, example, insights on the validity of a body of empirical research ... can be investigated through meta-regressions.”

Page 21, line 12: Change “unequally influenced” to “biased”

Page 21, line 15: Change “inclusion” to “selection”

Page 21, lines 33-38: Change the very long sentence “First, because the Census ... VSL research.” to “First, the SAB recommends that EPA compile, regularly update, and make publicly available (e.g., on an internet web page) detailed fatality risk measures by industry and occupation. These should be derived from the U.S. Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI) and merged with appropriate data from the Current Population Survey (CPS). Doing so would sharply reduce barriers to new hedonic wage studies as access to the CFOI data is currently limited to researchers who have completed a cumbersome process with the BLS.” Omit the subsequent sentence reading “To this end ... CFOI.”

Page 21, line 44: Change “transfer using” to “transfer studies using”

Page 24, line 3: Fix section reference: there isn't a 3.1.4

Page 25, line 33: Delete the sentence “The SAB was asked ... White Paper.” It's redundant given the CQ immediately above.

Page 26, line 8: Clarify the sentence: “The SAB suggests that the EPA consider using hedonic wage studies that apply data other than the CFOI data, while acknowledging concerns that studies based on survey data may be subject to non-response biases.” It's not clear whether the SAB is acknowledging concerns or the EPA should do so.

Page 26 line 10: Split into multiple sentences for clarity: “The SAB finds that the CFOI data represent the minimum quality of data that should be considered and recommends that the EPA identify other data sources of similar or higher quality that may provide a valid foundation for estimation of VSL”

Page 27, line 8: Insert “the” in “of value”

Page 29, line 1-2: Revise for clarity: “This raises questions[, which will be discussed further below,] of whether weights should correspond to the sample the study is intended to represent or to the full U.S. population.”

Page 31, lines 8-10: Revise the sentences beginning “Although this approach...” through the end of the paragraph to take a less ambiguous position. One option: “This approach would improve the resulting estimate, which would be based on a wider foundation of literature.”

Page 32, lines 14-16: Delete the sentences “In the White Paper, ... scientifically sound.” They are redundant given the CQ immediately above.

Page 32, line 24-25: Delete “for calculating the standard error for each study where the standard error of VSL is not reported.” Not needed.

Page 32, line 43: Insert text: “estimates [using] the”

Page 34, line 42: The terms  $\sigma_{\eta}^2$ ,  $\sigma_{\mu}^2$  and  $se_{ij}$  should be defined explicitly prior to the sentence beginning “Thus, once ...” They are carried over from the White Paper but should be explained in the report as well.

Page 38, line 46: Delete extraneous “and identify;”

Page 41, line 46: The apostrophe in “EPA’s” is actually an open single quote.

Page 42, line 43: For clarity, change “regard them as” to “regard those 12 as”

Page 49, lines 5-6: Remove the colon after “used to” and change “or improve” to “or to improve”.

Page 49, lines 26-27: Add parentheses around “and possibly additional .... the authors”.

Page 50, line 2: Change “censuring” to “censoring”

Page 50, line 8: Change “providing an opportunity to: ...” to “providing opportunities to: (1) replicate research results; (2) improve quality control on reported estimates; and (3) carry out “after the fact” estimates of parameters of importance ...”

Page 52, line 41: Change “trade-off between current health risks and future health risks” to “trade off current and future health risks”.

Page 53, paragraph beginning on line 7: Correct the use of “mortality” in several places where “morbidity” is intended.

Page 53, line 13: Change “associate” to “associated”

Page 57, line 21: Add a comma as follows: “... constitutes income, and to suffer ...”

Page 59, line 8: Replace “IEVSL” with “income elasticity of VSL”

## **Comments from other SAB Members**

### **Comments from Dr. Michael Dourson**

1. Were the charge questions adequately addressed?

This is not my area of expertise but the committee appears to have been very well appointed and appears to have addressed the given charge questions very well.

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?

Please see response to question 4.

3. Is the draft report clear and logical?

Yes, the report was very easy to read and it generally made sense.

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Many of the conclusions seemed reasonable. Other lines of thought were not as clear. In particular,

- Please explain (perhaps again) what the phrase “hedonic wage” means in layman’s terms (e.g., see page 2).
- I agree that a term “Value of Risk Reduction for Mortality” (VRRM) is a better term than “Value of Statistical Life” (VSL) for communication with non-economists.
- I am reminded of a quote from Aristotle – “It is the mark of an instructed mind to rest satisfied with the degree of precision which the nature of the subject permits and not to seek an exactness where only an approximation of the truth is possible.”

So what is the overall imprecision of these VRRMs? Arithmetic at one digit? Logarithmic at 1 digit? Something else?

### **Comments from Dr. Susan Felter**

The Draft SAB report is well-written, follows a logical flow, and responds clearly to the charge questions posed by the EPA.

**1. Were the charge questions to the committee adequately addressed?**

Yes

**2. Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?**

None that I am aware of (but I note that this is not my area of expertise)

**3. Is the draft report clear and logical?**

Yes

**4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?**

Yes. However, one thing that is not clear is whether all of the additional work that is recommended is really needed (vs. ‘nice to have’). Is the proposed methodology essentially fit-for-purpose but can be improved by the various recommendations, or is it considered to be inherently flawed? Given limited resources and competing priorities that the Agency needs to juggle, it seems important to distinguish between recommendations that will lead to substantial changes/improvements and those that are expected to have an incremental impact. This is especially true for recommendations that involve additional research.

**Comments from Dr. Robert Mace**

As requested, I’ve organized my comments according to four quality review questions. In summary, I found that the report adequately addressed the quality review questions.

**A: Were the charge questions to the committee adequately addressed?**

I found the charge questions to be adequately addressed.

**B: Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?**

No.

**C: Is the draft report clear and logical?**

Yes.

**D: Are the conclusions drawn or recommendations provided supported by the body of the draft report?**

Yes.

**As part of the quality review, Board members should also comment on the alignment and consistency of the message given in the Letter to the Administrator, the Executive Summary, and body of the report.**

I found the letter, executive summary, and body of the report to be consistent.

**Additional comments (not needing a response):**

1. Not being an expert in this field, I found it interesting that estimates for real income growth are based on projections of GDP per capita or earnings projections from the Congressional Budget Office’s *Long-Term Budget Outlook Report*. While these provide macro views of earning growth over time, they don’t capture what happens at a micro level where (I would hypothesize that) income grows more rapidly based on the experience of an individual.
2. Actuarial information may be useful for future modifications to the approach.
3. I wholeheartedly support the recommendation that the EPA consider commissioning

more studies to improve future reviews of VSL.

### **Comments from Dr. Sue Marty**

1) Were the charge questions to the committee adequately addressed?

- The committee adequately addressed the charge questions. The selection criteria were adequately described and rationale for the selection of studies for the meta-analysis was provided. The EPA's rationale for selecting variables [e.g., balanced estimates, mean primary value of a statistical life (VSL), mean of group means] is clearly stated in the report. The technical memorandum includes consideration of the recommendations made in the Robinson and Hammit report (2015) with the recognition of consistent approaches (e.g., equal weighting to VSL elasticity estimates with hedonic wage and stated preference studies) as well as difficulties incorporating some study data (e.g., including very low income elasticity estimates, which disagree with the VSL theory).

2) Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?

- No omissions or errors were identified.

3) Is the draft report clear and logical?

The draft report is clearly written and provides clear support for the selection of VSL parameters. It would be helpful to more clearly link the Technical Memorandum with the meta-analysis report.

4) Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes, the conclusions and recommended VSL are supported by the body of the report. This reviewer appreciates the EPA's decision to select a new term for VSL – both “value of mortality risk” and “value of risk reductions” are better options as they more accurately describe the purpose of this value. Secondly, it is reassuring to see on-going work to update the VSL value at periodic intervals with studies meeting the selection criteria. Furthermore, as more information becomes available, it would be useful to address the question as to whether valuations for willingness to pay for reductions in cancer risk might be different from other risks.

### **Comments from Dr. Kristina D. Mena**

1) Were the charge questions to the committee adequately addressed?

YES

2) Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?

NO

3) Is the draft report clear and logical?

YES

4) Are the conclusions drawn or recommendations provided supported by the body of the draft

report?

YES – The conclusions about the limited number of available studies to inform the value of statistical life (VSL), and the needed clarity regarding EPA’s evidence of study validity are particularly critical. The former supports the recommendation for EPA to consider funding opportunities that address VSL estimations, especially for subpopulations.

### **Comments from Dr. Thomas Parkerton**

#### **1) Were the charge questions to the committee adequately addressed?**

Yes, each charge question was systematically addressed by the committee.

#### **2) Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?**

Page 4, Line 26

It is not clear what is meant by “using standard procedures”

Suggest revising this sentence to better link to the specific recommendations that are latter provided in the report pertinent to this topic (pages 31-32)

“It is important to clarify the process for population weighting using the recommendations provided”

Page 18, Line 19

This sentence provides little constructive guidance to EPA. This seems like a missed opportunity for providing a better path forward in assisting how EPA could proceed in making validity decisions. For example, the SAB may wish to encourage the development and application a transparent scoring system (based on the considerations detailed earlier in this section) to categorize studies into different validity classes, e.g. reliable, reliable with restrictions, unassignable, unreliable. Studies that are deemed unreliable can then be excluded in subsequent meta-analysis, but other categories can be considered, either alone or in combination, as part of weight of evidence evaluation. Such a categorization scheme would also facilitate evaluating the influence of including/excluding studies with varying confidence in validity.

Page 60, Line 4

Text states “fatal” should be “non-fatal”

#### **3) Is the draft report clear and logical?**

The report is clearly written and organized.

The committee correctly recognizes EPA’s effort to (1) incorporate recommendations from the earlier SAB review performed in 2011 and (2) the innovativeness of the strategy that is applied in the draft White Paper developed for VSL estimation. The report then details a number of concerns with the present draft report including study validity, underlying assumptions, transparency and technical issues of the proposed methodology and additional published and non-published studies that warrant further consideration.

#### **4) Are the conclusions drawn or recommendations provided supported by the body of**

## **the draft report?**

Yes conclusions seem in general to be well substantiated. A few specific comments may warrant consideration in finalizing the report.

Page 23, Lines 10-24

The first two recommendations indicate short term priorities, the second two bullets indicate longer-term priorities. It is not clear what time frame is envisioned. Further, none of the other recommendations incorporate a temporal dimension. Hence, I question if these qualifiers are needed.

Page 52, Line 12

I question if sponsoring a journal on this specific topic is within EPA's mandate? It seems to me that the recommendations provided in the previous bullet provide several practical options that EPA could pursue to promote advances in this field if deemed a strategic priority. I suggest considering to delete this recommendation.

Page 60, Line 21

The committee recommends that EPA considers "transportation literature on reduced risk for highway fatalities" could be a helpful complement to the present study. However, no mention or clear justification is provided earlier in this section to support this recommendation. Further, it is not clear why the broader transportation literature (beyond highway fatalities) would not be potentially relevant? Further, unlike health and health care literature that are documented in Appendix C, no relevant transportation studies are cited for EPA to specifically consider. It is suggested that the committee provides further documentation to support the recommendation that EPA consider evaluation of specific transportation safety literature (or more broadly other relevant safety literature on fatalities).

## **Comments from Dr. Tara Sabo-Atwood**

1. Were the charge questions to the committee adequately addressed?

Yes, the report and executive summary is clear in identifying several important gaps and outlining recommendations.

2. Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?

No, I did not identify and technical errors or omissions/issues in the report.

3. Is the draft report clear and logical?

Yes, for the most part, the report is clear and logical with a few minor edits and areas of clarification noted below.

In the Executive summary page 2 overarching comments section, there is a reference to utilizing

the terminology 'VRMM' rather than 'VSL'. It is not clear whether these terms are directly interchangeable which could provide additional confusion. Perhaps this could be clarified in the summary.

In the Executive summary page 2 question 1b second paragraph there are several references to the 'short run' and the 'long run'. Can these terms be better clarified as to the time frame that is being referred to?

Minor edits:

Executive summary page 1 (paragraph 2) and introduction page 12 (paragraph 3) – use semi-colons consistently when listing topics.

4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes. In my limited expertise in this area the general the conclusions and recommendations seem to be supported by the report.

### **Comments from Dr. Daniel O. Stram**

1. *Were the original charge questions adequately addressed*

All the original charge questions seemed to be quite adequately addressed in this report

2. *Are there technical errors or omissions in the report*

None that I am aware

3. *Is the Committee's report clear and logical?*

Yes overall it is quite readable even to a complete outsider in this field. I must say however that I didn't completely follow the derivation of equation 3 (page 34). I don't think all the notation used (e.g. the various  $\sigma^2$ ) are defined.

4. *Are conclusions/recommendations supported by the body of the committee report*

My main question is that I don't know why current population characteristics (e.g. recent census data) should not be used to weight VSL estimates from studies that were performed using older data. Specifically, I don't understand the recommendation 1 on page 27 which indicates that sampling weights should be based on census (or other) data contemporaneous with the time the original data were generated. Why would we want to have each study results be relating to a different population distribution? I think this aspect needs better justification

### **Comments from Dr. Edwin Van Wijngaarden**

1. Were the original charge questions to SAB Standing or Ad Hoc Committees adequately addressed?

This document represents a tremendous effort by the SAB committee to respond to the charge

questions which appear to have been adequately and thoroughly addressed.

2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the Committee's report?

Not that I am aware.

3. Is the Committee's report clear and logical?

The report is well written and provides a comprehensive discussion of each charge question before summarizing key recommendations. I do have some minor suggestions:

- For those who are not intimately familiar with EPA's white paper or with its methodology in general, it may be helpful in the SAB report to summarize EPA's methodology in one or two paragraphs such that the SAB recommendations are more clearly put into context.
- It may be helpful to summarize key recommendations in a table organized by the various components in EPA's analysis along the lines of for example the more generic PRISMA guidelines or the MOOSE guidelines for meta-analysis and systematic reviews of observational studies.

4. Are the conclusions drawn or recommendations provided supported by the body of the Committee's report?

Yes, I believe so.

### **Comments from Dr. Jeanne VanBriesen**

#### **1. Were the charge questions adequately addressed?**

Yes.

The report does an excellent job of summarizing a response to each charge question in the executive summary and the report. In some cases, the Environmental Economics Advisory Committee (EEAC) identifies 'short term' (or sometimes 'near term') and 'long term' approaches, thus, increasing the likelihood that EPA will be able to use the advice given immediately and plan for longer-term research needs in this area. This distinction should be expanded to areas where lists of recommendations are made without this guidance.

The report pays careful attention to areas where the limitations in the question posed might have limited the relevance of the response (e.g., p.41, lines 36-42). The EEAC is to be commended for calling out these discrepancies and answering the questions with a depth that identifies critical issues.

#### **2. Are there any technical errors or omissions in the report or issues that are not adequately dealt with in the draft report?**

I did not note any technical errors or omissions.

In some places, especially the executive summary, the text is jargon-heavy, and this obscures understanding by a general audience. For example, executive summary page 3, lines 22-25: “confounded morbidity values in converting future deaths to equivalent immediate death values.” And executive summary page 4 lines 6-7 “economic decision conditioned the eligibility for inclusion in the sample.” This language is likely clear to experts in the field, but the executive summary will be widely read by non-experts. Some simplification of this language is warranted, while maintaining the necessary detail in the main report.

### **3. Is the draft report clear and logical?**

Yes, the report is clear and logical. The EEAC is to be particularly commended for drawing attention to the need for more transparent documentation of assumptions and methods and greater justification for methodological choices. Of particular importance are areas where the EPA’s methods are atypical and the choices appear to yield large differences (e.g., p. 43).

ES P. 4, line 44 “theoretically better” This has a colloquial meaning that I don’t think is intended here. I think the EEAC means “an alternative approach that is grounded in theory”

ES P.6, line 34-35 “transparency be applied as a criterion for selecting an estimator” I’m not sure what this means.

p. 18 lines 12-14. It is not clear what the EEAC is trying to say here. If there is insufficient evidence to support a conclusion of invalidity while it is not possible to determine that a study or estimate is valid, should it be included or not? And, why? And is the recommendation to include the study in the analysis but the analysis might find it invalid and then it wouldn’t be part of the summary?

### **4. Are the conclusions drawn or recommendations provided supported by the body of the draft report?**

Yes, the conclusions are valid and the recommendations are supported by the body of the draft report.

Of particular note, the EEAC notes that the VSL construct could use a new name (P14 lines 22-31). The EEAC suggests VRRM (Value of Risk Reduction for Mortality). I would suggest also carrying this recommendation forward to the letter to the administrator.

Also of note, the EEAC recommends EPA encourage data publication that would enhance the utility of peer-reviewed studies to be incorporated into meta-analyses used to inform policy decisions (p 49-50).

### **Comments from Dr. John Vena**

Insert

### **Comments from Dr. Charles Werth**

1) Were the charge questions to the committee adequately addressed?

Yes. I thought the responses were detailed and clear.

2) Are there any technical errors or omissions or issues that are not adequately dealt with in the draft report?

Not that I could find.

3) Is the draft report clear and logical?

Yes, it is very well organized.

4) Are the conclusions drawn or recommendations provided supported by the body of the draft report?

Yes, to the best of my judgment.