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Themed Section

A Threshold Inequality Aversion Parameter Approach to Interpret Distributional Cost-Effectiveness Analysis Results

Ankur Pandya, PhD, Jinyi Zhu, PhD, Andrea Luviano, MD, MPH, Lyndon P. James, MBBS, PhD, George Goshua, MD, MSc

ABSTRACT

Objectives: Distributional cost-effectiveness analysis (DCEA) requires an inequality aversion parameter to calculate the equally distributed equivalent (EDE). The DCEA decision rule is to choose the strategy with the highest EDE. However, the exact value of the inequality aversion parameter is unknown for most health disparities and settings, hindering the use of DCEA in practice. We therefore propose calculating threshold inequality aversion parameter (TIAP) values in DCEAs that can be interpreted using existing data and conventions.

Methods: We provide the rationale and methods for calculating the TIAP for pairwise and multistrategy DCEAs. TIAPs can be estimated by finding the inequality aversion parameter that sets the EDEs of 2 competing strategies equal to each other. The interpretation of TIAPs requires a lower and upper bound of an inequality aversion parameter value range (LBIAR and UBIAR, respectively).

Results: In a pairwise DCEA, a TIAP that is lower than the LBIAR can be interpreted as favoring the equity-improving strategy, whereas a TIAP that is higher than the UBIAR would favor the more cost-effective strategy. TIAPs between the LBIAR and UBIAR require additional context to determine the optimal strategy.

Conclusions: The interpretation of TIAPs is analogous in some ways to how incremental cost-effectiveness ratios are used in conventional cost-effectiveness analysis; incremental cost-effectiveness ratios can be calculated without knowing the specific cost-effectiveness threshold and are then interpreted using empirical estimates or conventions for the setting-specific cost-effectiveness threshold. Although further empirical data and attention toward inequality aversion parameters are needed, reporting TIAPs could enable widespread use of DCEA.

Keywords: cost-effectiveness analysis, distributional cost-effectiveness analysis, equity impact analysis.

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Highlights

- Distributional cost-effectiveness analysis (DCEA) quantitatively incorporates distributional equity considerations into conventional CEA. DCEA requires an inequality aversion parameter value, however, this is often not known in practice for a given setting or health disparity.
- We propose a method to calculate and interpret threshold inequality aversion parameters (TIAPs), which can be estimated by finding the inequality aversion parameters that set the equally distributed equivalents, the metric maximized in DCEA, of 2 competing strategies equal to each other.
- Researchers can report TIAPs as a primary result for their DCEA in a similar way that incremental cost-effectiveness ratios are reported in conventional CEAs. TIAPs can be interpreted based on existing information and conventions around inequality aversion, which can be setting and disparity specific.

Introduction

Conventional cost-effectiveness analysis (CEA) counts all effectiveness (eg, quality-adjusted life-years [QALYs]) and cost outcomes equally, regardless of how they are experienced across the population.[1] Although this approach does not explicitly consider distributional equity, a relatively newer extension of this method, distributional cost-effectiveness analysis (DCEA), directly accounts for this concern using an inequality aversion parameter in a concave social welfare function, such as the Atkinson Index.[2] The inequality aversion parameter quantitatively weighs trade-offs between the strategy that would maximize population health (the objective of conventional CEA under a constrained budget) versus those that would more equitably distribute health and cost outcomes but produce less total health.[2] DCEAs can handle trade-offs for interventions that are conventionally cost-ineffective but would reduce existing health disparities, such as high-priced gene therapy for sickle cell disease, or interventions that are conventionally cost-effective but could exacerbate existing health disparities based on access to care or ascertainment bias, as could potentially be the case in the management of atrial fibrillation.[3-5]

In a DCEA, decision makers can choose an inequality aversion parameter value that corresponds to their willingness to trade off total population health in favor of improving equity. Alternatively, the analyst can base the inequality aversion parameter value on an empirical estimate from a representative survey of the population that would be affected by these policy decisions. Ideally, we would have inequality aversion parameter values for every unique equity relevant dimension being evaluated. For example, preferences for reducing health disparities by income may differ from those aimed at addressing health disparities arising from systemic racism, and DCEAs should use different inequality aversion parameter values accordingly. However, these data are limited, hindering the use of DCEA in practice.[6]

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We therefore propose calculating threshold inequality aversion parameter (TIAP) values in DCEAs that can be interpreted using existing data and conventions. We demonstrate how to derive TIAPs in both pairwise and multistrategy DCEAs and provide stylized examples on interpreting TIAPs. By establishing TIAPs as a practical analytic tool, we aim to lower barriers to conducting DCEA and thereby facilitate broader consideration of equity in economic evaluations.

Methods

Overview of DCEA

In contrast to conventional CEA, in which “a QALY is a QALY is a QALY,” DCEA directly considers the distribution of costs and health effects across subgroups that define important health disparities. The decision rule in a DCEA is to choose the strategy with the highest equally distributed equivalent (EDE), which collapses health and cost outcomes as they are distributed across population subgroups into a single number. The EDE is analogous to the certainty equivalent in risk preferences; it is the average amount of an equally distributed outcome, such as net health benefit (NHB), which would be viewed as equivalent to an unequal distribution of outcomes across sub-groups.[7,8] NHB uses the cost-effectiveness threshold to convert costs into forgone health due to this spending, thus combining QALYs and costs into a single metric.[8]

When no extra weight is given to a more equal distribution of NHB, as conventional CEA assumes, the strategy with the highest EDE will be equivalent to the strategy with the highest total NHB, analogous to a risk-neutral actor basing their decisions on (untransformed) expected values.[2] When extra priority is given to a more equal distribution of outcomes, the EDE of an unequal distribution of outcomes (eg, NHB) will be lower than the population-level average of the same outcome. In other words, a health policy decision maker who wants to give some priority to distributional equity will be willing to accept a lower population-level average NHB for a more equal distribution of NHB.[2,9]

The amount of population-level NHB the decision maker is willing to forego depends on the numerical value of the inequality aversion parameter, analogous to the impact of a risk preference parameter value (such as the Arrow-Pratt measures of risk aversion) on preferences over uncertain distributions of outcomes.[7] In making this analogy, we do not mean to conflate risk aversion, which concerns an individual’s preference over uncertainty of outcomes, with inequality aversion, which concerns a societal decision-maker’s preference over the distribution of outcomes across a population. Hammitt (2022) outlines how considerations for risk and inequality aversions can interact, but this interaction is beyond the scope of this article.[10] Here, we focus on how a societal decision maker weighs the potential trade-off between overall population-level well-being and the distribution of this well-being across the population.

DCEA uses a prioritarian social welfare function, typically based on the Atkinson (sensitive to relative inequality) or the Kolm (sensitive to absolute inequality) formulation. These approaches have been used for over 40 years in developmental economics, environmental health policy analysis, and are the most commonly used functions used in equity-informed economic evaluations of health interventions.[3,11-13] The Atkinson-based EDE equation is:

$$EDE = \left(\frac{1}{N}\sum h_i^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}}$$

in which N = population size, h_i = health (NHB) in each group, and ε = inequality aversion parameter. This formulation assumes a health-focused social welfare function, in which NHB is used in place of an objectively interpersonally comparable measure of well-being.[2,10]

Overview of Inequality Aversion Parameter

The inequality aversion parameter quantifies the decision-maker’s preference for a more equal distribution of outcomes. With the Atkinson Index, an inequality aversion parameter value of 0 corresponds to no preference on the distribution of outcomes; this is the assumption in conventional CEA. At the other extreme, the decision maker will be willing to sacrifice any amount of total health in pursuit of a more equal distribution as the inequality aversion parameter value approaches infinity. Values in between these extremes give some weight to total population-level NHB and some weight to reducing existing disparities in the calculation of the EDE.

In principle, these inequality aversion parameter values can be estimated empirically by asking survey respondents a series of discrete choice questions that show 2 different distributions of outcomes (such as life expectancy by income strata) then imputing the inequality aversion parameter value that produces consistent choices for that respondent. Such surveys are lacking in the health policy literature, however.[3,14] In the absence of empirical data on inequality aversion parameters, some researchers have used conventions or subjectively reasonable values to calculate the EDE for competing strategies. For example, Atkinson’s original article in 1973 used inequality aversion parameter values between 1.0 to 2.0 to illustrate how the Atkinson Index could produce similar rankings of country wealth when compared with using other conventional measures used at the time (the Gini coefficient and coefficient of variation).[12] This convention was cited in several other articles applying Atkinson’s index in the following decades.[11,15,16] As we explain shortly, establishing a range of plausible inequality aversion parameter values will help interpret TIAPs that can be calculated in any DCEA without knowing the exact inequality aversion parameter value.

Calculating TIAP

In a DCEA comparing 2 competing strategies (ie, pairwise), the TIAP can be calculated by solving for the inequality aversion parameter that sets the EDEs for each strategy equal to each other. An algebraic (closed-form) solution to calculate the TIAP for 2 options is not possible for the Atkinson Index, but it is possible to find a numerical solution for the TIAP over a prespecified range of candidate inequality aversion parameter values (eg, 0-10). In our Appendix calculation tool, we provide a spreadsheet that can produce such a numerical TIAP solution for any 2 options where the subgroup-specific population sizes and NHB values are known. It is possible that 1 of the options will always be preferred over the entire range, which suggests that there are no inequality aversion parameter values within the prespecified range that would change the policy recommendation from one strategy to another.

In a DCEA with 3 or more competing strategies, we propose plotting (absolute) EDE curves for each strategy as a function of the inequality aversion parameter (Fig. 1). The strategy with the highest EDE will be preferred at any point along this spectrum. TIAPs are represented by the points of intersection along the highest lines of the figure; in other words, when the optimal strategy changes as the inequality aversion parameter value changes. However, not all pairwise intersections are relevant. If a strategy’s EDE never actually rises to become the highest line for

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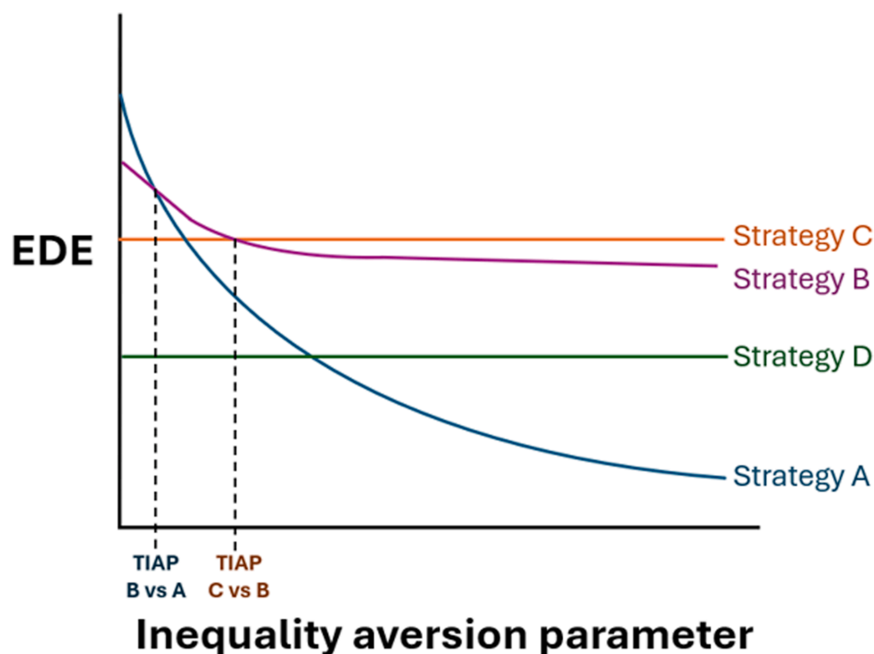
Figure 1. Absolute equally distributed equivalent (EDE) as a function of inequality aversion to identify threshold inequality aversion parameters (TIAPs). The hypothetical distributional cost-effectiveness analysis (DCEA) shown here evaluates 4 mutually exclusive strategies (A through D). The EDE quantitatively combines total population-level net health benefits (ie, the objective of conventional cost-effectiveness analysis) with societal preference for equal outcomes, which is quantified using an inequality aversion parameter. Strategies A through C vary on their impacts on total population-level net health benefits (strategy A best on that dimension, as seen by the highest EDE at the lowest inequality aversion parameter) and distributional equity. The decision rule in a DCEA is to choose the strategy with the highest EDE, which in this example changes from strategy A to B and B to C as the inequality aversion parameter value increases. These intersection points are the TIAPs, that establish the bounds for where each strategy is optimal. Strategy D is never optimal because it never has the highest EDE. The flat lines for Strategies C and D are shown for illustrative purposes; in practice, declining EDE lines, such as those shown for strategies A and B, are more realistic.



any inequality aversion parameter in the chosen range, that strategy is effectively ruled out—any intersections involving that strategy do not yield meaningful TIAPs. Thus, we recommend the following procedure for calculating TIAPs in multistrategy DCEAs: (1) plot the EDE for each strategy across a relevant range of inequality aversion parameter values (eg, 0-30 if that is determined to cover typical empirical/conventional values); (2) identify which strategies are optimal for at least some part of that range—that is, which curves ever appear on top; (3) mark the intersection points (if any) among those optimal curves. These points are the final set of TIAPs. When evaluating n strategies, there will be at most $n - 1$ TIAPs, and potentially no TIAPs if there is 1 strategy that is optimal for every inequality aversion parameter. This procedure parallels multistrategy incremental analyses in conventional CEA, in which strategies that are dominated are excluded from incremental cost-effectiveness analysis ratio (ICER) calculations.

Interpreting TIAPs

A TIAP alone cannot provide a decision rule in a DCEA without additional context on plausible or conventional inequality aversion parameter values for a specific health disparity in a given setting. If, however, we can identify a plausible lower bound of the inequality aversion range (LBIAR) and a plausible upper bound of the inequality aversion range (UBIAR), then a TIAP can be interpreted as follows.

In a 2-strategy (ie, pairwise) DCEA, a very low TIAP (ie, lower than the LBIAR) implies that the equity-improving but conventionally cost-ineffective strategy should be favored because a low TIAP value implies that relatively little emphasis on distributional equity is required to accept this trade-off. Conversely, a very-high TIAP value (eg, higher than the UBIAR) implies that the equity-improving strategy should not be favored over the conventionally cost-effective option. This is analogous to how cost-effectiveness thresholds are used to interpret ICERs in conventional CEAs of mutually exclusive strategies; strategies with very-high ICERs (eg, >$150 000/QALY in the United States) would not be favored considering conventional ranges of cost-effectiveness thresholds ($100 000-150 000/QALY).[17]

In a multistrategy DCEA, low TIAPs need to be interpreted carefully; it is possible that the strategy with the lowest TIAP is not favored in a DCEA with more than 2 strategies, just as it is possible that the strategy with the lowest ICER is not necessarily favored in a conventional CEA with more than 2 strategies.[18] In these situations, more precision around the relevant inequality aversion parameter value (or precise cost-effectiveness threshold in the conventional CEA analogy) is needed to recommend a strategy. We provided examples of how to interpret multiple TIAPs arising from a stylized DCEA evaluating 4 mutually exclusive, hypothetical strategies in the Results section.

Results

Below, we show stylized examples for interpreting the TIAPs against the LBIAR and UBIAR from the plausible range of inequality aversion parameters for DCEAs involving pairwise

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comparisons (ie, DCEAs with at most one TIAP) and DCEA involving multiple strategies (ie, DCEAs with the potential for 2 or more TIAPs).

Stylized Example 1: Interpreting a TIAP in a Pairwise DCEA

Figure 2 provides a visual template for how to interpret a TIAP from a hypothetical DCEA that evaluates 2 competing strategies in which there is a trade-off between conventional cost-effectiveness and distributional equity dimensions. If the TIAP is lower than any bound used or estimated previously (ie, lower than the LBIAR), the equity-improving strategy would be optimal. If the TIAP is between LBIAR and UBIAR, then the strategy would depend on decision-specific context, such as the disparity under consideration and the preference for distributional equity in health for the given decision maker or population. Finally, a TIAP higher than the UBIAR would imply that the equity-improving strategy would not be favored over the more cost-effective strategy it is being compared with.

Stylized Example 2: Interpreting a DCEA With 4 TIAPs

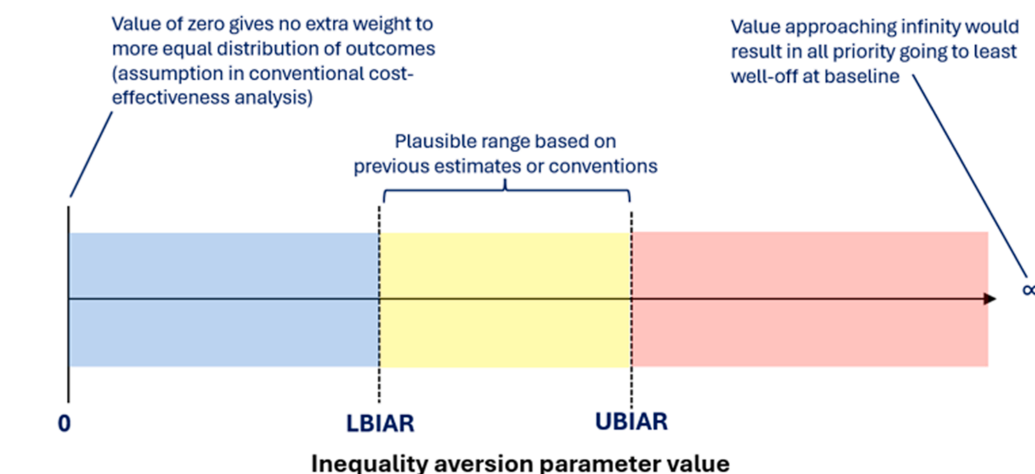
Table 1 provides similar guidance for 6 hypothetical DCEAs that each have 4 mutually exclusive strategies and 3 reported TIAPs. The interpretation in this scenario is more nuanced than the pairwise comparison, just as the interpretation of an ICER in a conventional incremental CEA with 2 more ICERs is more nuanced than the interpretation of an ICER in a pairwise conventional CEA. For example, in a conventional incremental CEA with 2 or more ICERs, the strategy with the lowest ICER might not be optimal; the optimal strategy would be the most effective strategy for which the ICER is still below the cost-effectiveness threshold.[18] Similarly, Table 1 demonstrates how to interpret TIAPs given the LBIAR and LBIAR (ie, the plausible range of inequality aversion parameters). Very-high TIAPs (eg, greater than the UBIAR) would strongly suggest the strategy is not optimal, but a very low TIAP may or may not be sufficient for that strategy to be optimal, depending on the values of the other TIAPs. This is similar to the interpretation of a low ICER in a conventional incremental CEA reporting more than 1 ICER.[18] For practical purposes, the TIAPs quantify the inequality aversion parameter value bounds that indicate for what values a given strategy is optimal in a DCEA, which correspond to the intersection points of the highest strategy-specific EDE lines in Figure 1.

Discussion

In this article, we show that using TIAPs can enable the use of DCEA when the exact value of the inequality aversion parameter is not known. TIAPs can be interpreted based on existing information and conventions around inequality aversion, which can be setting and disparity specific. We provide specific guidance for how to interpret TIAPs in a pairwise DCEA (ie, a DCEA that only has 1 TIAP) and for DCEAs that result in multiple TIAPs.

A TIAP is only calculated when there is a trade-off between conventional cost-effectiveness (ie, total population-level health NHB) and distributional equity. This is analogous to an ICER in conventional CEA, which is only calculated when there is a trade-off between health gains and costs.[18] This analogy can be extended to compare the EDE in a DCEA with NHB in a conventional CEA. The decision rule in a DCEA and conventional CEA is to pick the competing strategy with the highest EDE or NHB (we will call these “comprehensive metrics” later in this section), respectively, but this requires knowing the inequality aversion

Figure 2. Interpretation of threshold inequality aversion parameter (TIAP) in a hypothetical pairwise distributional cost-effectiveness analysis (DCEA) performed for the US setting. When there is a trade-off between cost-effectiveness and distributional equity outcomes in a pairwise comparison (ie, only 2 strategies being compared), the TIAP represents the minimum amount of preference for equal outcomes that would be needed to favor an equity-improving strategy over a more cost-effective strategy. The plausible range of inequality aversion parameter values would be based on the current literature on inequality aversion parameters, which could change over time as more evidence emerges.



How to interpret threshold inequality aversion parameter (TIAP)

- TIAP <LBIAR (lower bound of inequality aversion range) implies equity-improving strategy optimal
- TIAP between LBIAR-UBIAR implies more precise inequality aversion parameter value could be needed
- TIAP >UBIAR (upper bound of inequality aversion range) implies equity-improving strategy not optimal

LBIAR indicates lower bound of inequality aversion range; UBIAR, upper bound of inequality aversion range.

Table 1. Interpretation of threshold inequality aversion parameters (TIAPs) from 6 stylized DCEAs (1-6) of 4 competing strategies (W-Z).

TIAP comparison*	TIAP values from 6 stylized DCEAs of 4 (hypothetical) competing strategies that differ on cost-effectiveness and equity impacts†					
	DCEA 1	DCEA 2	DCEA 3	DCEA 4	DCEA 5	DCEA 6
X versus W	30	0.2	0.2	0.1	0.2	1.5
Y versus X	35	35	0.4	0.2	2.5	2.0
Z versus Y	40	40	40	0.4	5.5	5.5
Optimal strategy‡	W§	X‖	Y	Z	Depends on context¶	Depends on context£

*This table assumes 6 stylized DCEAs. Each DCEA compares 4 mutually exclusive strategies in which strategy W provides the highest population-level net health benefit (ie, would be optimal in a conventional CEA) followed by strategies X, Y, and Z. In these stylized DCEAs, strategy Z has the most equal distribution of net health benefit, followed by strategies Y, X, and W. Note that this is a separate hypothetical example from that shown in Figure 1.
†The TIAPs are the inflection points at which the optimal strategy in a DCEA would change as a function of the inequality aversion parameter. Each column presents a set of TIAP results from a hypothetical DCEA (ie, we show the results of a different hypothetical DCEA in each of the 6 columns), which can be interpreted based on a range of empirically estimated or conventions for inequality aversion parameter values.
‡This row shows the optimal strategy from the DCEA based on the TIAP values that are interpreted using the inequality aversion parameter ranges for the United States shown in Figure 1 and Table 1; a commonly used range of 0.5-3.0 in the United States is used for illustrative purposes, with 0.5 being the LBIAR (lower bound of inequality aversion range) and 3.0 being the UBIAR (upper bound of inequality aversion range).
§In this DCEA, all TIAPs are above the UBIAR of 3.0; therefore, the strategy with the highest population-level net health benefit (strategy W) would be optimal.
‖In this DCEA, the TIAP for X versus W is low enough (0.2, which is below the LBIAR of 0.5) to sacrifice higher population-level net health benefit for the more equal distribution X provides, but the TIAPs for Y versus X and Z versus Y are too high to make such a trade-off.
¶In this DCEA, strategy W would be preferred for inequality aversion parameters less than 0.2, strategy X between 0.2 and 2.5, strategy Y between 2.5 and 5.5, and strategy Z above 5.5. Either strategy X or Y could be optimal with a plausible inequality aversion parameter range of 0.5 to 3.0; therefore, a more precise inequality aversion parameter value would be needed to determine the optimal strategy.
£In this DCEA, strategy W would be preferred for inequality aversion parameters less than 1.5, strategy X between 1.5 and 2.0, strategy Y between 2.0 and 5.5, and strategy Z above 5.5. Depending on the exact inequality aversion parameter value within the 0.5 to 3.0 plausible range, any option among strategy W, X, or Y could be optimal; therefore, a more precise inequality aversion parameter value would be needed to determine the optimal strategy.

parameter or cost-effectiveness threshold, respectively. TIAPs can be calculated without knowing the inequality aversion parameter, just as an ICER can be calculated without knowing the cost-effectiveness threshold, although both require additional information to be interpreted. For example, there is no official cost-effectiveness threshold used in for the US context, but there are commonly used conventions ($100 000/QALY to $150 000/QALY).[17] Similarly, the interpretation of TIAPs requires a sense of a plausible range for inequality aversion parameter values.

A formal systematic review of the literature on inequality aversion parameter values was beyond the scope of this article, but our informal review of the literature found substantial variation in values reported and methods used to estimate these values. We found that conventions based on commonly used values (broadly ranging from 0.5-3.0) are more common for analyses applied to the US setting,[11,15,16,19] whereas empirically estimated values are higher (broadly ranging from 2.24-28.9) and are also more common for analyses applied to non-US settings.[20-29] Appendix Table A1 in Supplemental Materials found at https://doi.org/10.1016/j.jval.2025.09.3064 reports findings from 14 previously published studies, but this is an active area of research and systematic reviews of inequality aversion parameter values should be routinely performed in the future to adapt this range to emerging evidence.

Whether using a specific inequality aversion parameter value or interpreting TIAPs based on plausible ranges, DCEA researchers and decision makers should understand methods used to estimate the values. For example, Boujaoude et al[28] estimated different values from a representative sample of Australian respondents for inequality aversion based on income, Indigenous status, and rural status. These equity dimensions are often correlated, and such intersectionality could be reflected in the estimated inequality aversion parameter values.[28] Alternatively, Robson et al[24] (2024) developed methods to estimate the "pure" aversion to health inequality, decoupled from aversion to income-related or income-caused health disparities. Whether to use a "pure" aversion parameter value(s) or not could be the subject of future normative and empirical investigations because it is not obvious whether and which causes of health inequalities should be reflected in inequality aversion parameter values.

Previous articles by Elbasha[30] (2022) and Sendi et al[31] (2021) developed methods to incorporate risk aversion into conventional CEA decision rules. Although DCEA similarly adopts a concave function (such as the Atkinson-based social welfare function) on the outcome of interest (NHB), there are important differences worth highlighting.[12] Assuming an inequality aversion parameter greater than 0, DCEA accounts for aversion to inequality across individuals in a population. Assuming risk averse posture, the cost-effectiveness risk-aversion curve proposed by Elbasha[30] accounts for aversion to uncertainty in outcomes experienced within a population, whether or not these outcomes are equally or unequally distributed across the population.[30]

In principle, our methods could be extended to uncertainty analyses where the TIAPs are estimated for each probabilistic iteration or scenario being evaluated; however, TIAPs have similar issues to ICERs in probabilistic uncertainty analyses with multiple comparators as the decision rules are nuanced (the lowest TIAP or ICER might not be optimal, thus limiting the usefulness of reporting credible intervals around these metrics, for example).[8] Yang et al[32] (2021) provide methods for incorporating uncertainty in outcomes into DCEA, which can identify the parameters for which resolving this uncertainty would provide the most value in a DCEA framework. The framework by Yang et al[32] uses the EDE as a comprehensive metric in their calculations, the same way conventional value of information analysis uses NHB as the comprehensive metric of interest.[33] In this analogy, the TIAP and the ICER serve as metrics for interpretation in DCEA and conventional CEA, as opposed to comprehensive metrics used to calculate the value of additional information. Future methodological research could expand uncertainty analyses in DCEA, perhaps displaying the probability of an intervention being optimal (ie, highest EDE) as a function of the

inequality aversion parameter, similar to a cost-effectiveness acceptability curve in conventional CEA.[34]

Our article has several limitations. First, the starting point for our article assumes current DCEA methodology, including an emphasis on using an EDE (calculated using an Atkinson- or Kolm-based inequality aversion parameter) as the metric to be maximized and that NHB can be used as well-being in the social welfare function.[2] Future research on the theoretical basis and implications of using current DCEA methodology can further interrogate these assumptions. Second, our literature search was not performed as a formal systematic literature review because the focus of this article is to establish the TIAP as a useful metric to report from DCEAs. There is clearly a need for more empirical data on the level of societal preferences for distributional equity in health and systematic reviews of this evidence base. Third, the decision rules for TIAPs can be nuanced, especially when there are multiple TIAPs arising from the same DCEA. This could work against widespread use of TIAPs. Again, we can draw upon the analogy of TIAPs to ICERs because some in the field have called for NHB to replace ICERs as the primary metric reported in conventional CEA.[35] We argue here that TIAPs (and ICERs) provide useful information, especially when putting results of DCEAs (or CEAs) in context against other DCEAs, such as how league tables of ICERs are used in conventional CEA.[36] Finally, the interpretation of TIAPs requires decision makers to have a thorough understanding of the subgroups included (or excluded) in the DCEA and how to give priority to such permutations. For example, disease severity and income might be correlated within a given disease or population, and TIAPs can be calculated for each dimension independently or by further stratifying into severity-income subgroups.

Conclusions

In conclusion, we show how calculating the TIAP(s) can be used to interpret DCEAs in the absence of knowing the specific inequality aversion parameter for the specific health disparity and policy decision being evaluated. TIAPs can be interpreted based on existing information and conventions around inequality aversion, which can be setting and disparity specific. This is analogous in some ways to how ICERs are used in conventional CEA; they can be calculated without knowing the specific cost-effectiveness threshold but require some sense (based on empirical estimates or conventions) around what the setting-specific cost-effectiveness threshold could be. Although our approach does not eliminate the need for more empirical data and attention on inequality aversion parameters, it could enable the widespread use of DCEA, especially if enough TIAP results eventually accumulate to create league tables for DCEAs (analogous to the use of ICER league tables in conventional cost-effectiveness analysis).

Author Disclosures

Author disclosure forms can be accessed below in the Supplemental Material section. The contents of this article are solely the responsibility of the authors and do not necessarily represent the official views of the funding sources.

Supplemental Material

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Author Affiliations: Department of Health Policy and Management, Harvard T.H. Chan School of Public Health, Boston, MA, USA (Pandya); Center for Health Decision Science, Harvard T.H. Chan School of Public Health, Boston, MA, USA (Pandya, Luviano, James); Department of Health Policy, Vanderbilt University Medical Center, Nashville, TN, USA (Zhu); Boston University Chobanian and Avedisian School of Medicine, Boston, MA, USA (James); Section of Medical Oncology and Hematology, Yale University School of Medicine and Yale Cancer Center, New Haven, CT, USA (Goshua); Center for Outcomes Research and Evaluation, Yale New Haven Hospital, New Haven, CT, USA (Goshua).

Correspondence: Ankur Pandya, PhD, Department of Health Policy and Management, Harvard T.H. Chan School of Public Health, 718 Huntington Ave, 2nd Floor, Boston, MA 02115, USA. Email: anpandya@hsph.harvard.edu

Author Contributions: *Concept and design:* Pandya, Zhu, Luviano, James, Goshua
Acquisition, analysis, or interpretation of data: Pandya, Zhu, Luviano, James, Goshua
Drafting of the manuscript: Pandya
Critical revision of the manuscript: Zhu, Luviano, James, Goshua
Accountability for all aspects of the work: Pandya, Zhu, Luviano, James, Goshua

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REFERENCES

1. Weinstein MC, Stason WB. Foundations of cost-effectiveness analysis for health and medical practices. *N Engl J Med*. 1977;296(13):716–721.
2. Asaria M, Griffin S, Cookson R. Distributional cost-effectiveness analysis: a tutorial. *Med Decis Making*. 2016;36(1):8–19.
3. Goshua G, Calhoun C, Ito S, et al. Distributional cost-effectiveness of equity-enhancing gene therapy in sickle cell disease in the United States. *Ann Intern Med*. 2023;176(6):779–787.
4. Okafor C, Byrnes J, Stewart S, Scuffham P, Afoakwah C. Cost effectiveness of strategies to manage atrial fibrillation in middle- and high-income countries: a systematic review. *Pharmacoeconomics*. 2023;41(8):913–943.
5. Tamirisa KP, Al-Khatib SM, Mohanty S, et al. Racial and ethnic differences in the management of atrial fibrillation. *CJC Open*. 2021;3(12 suppl):S137–S148.
6. Cadham CJ, Prosser LA. Eliciting trade-offs between equity and efficiency: a methodological scoping review. *Value Health*. 2023;26(6):943–952.
7. Pratt JW. Risk aversion in the small and in the large. *Econometrica*. 1964;32(1/2):122–136.

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8. Stinnett AA, Mullahy J. Net health benefits: a new framework for the analysis of uncertainty in cost-effectiveness analysis. *Med Decis Making*. 1998;18 (2 suppl):S68–S80.
9. Goshua G, Varghese M, Ito S, Pandya A. Using distributional cost-effectiveness analysis to improve equity and efficiency. *J Am Coll Cardiol*. 2025;85(12):1376–1378.
10. Hammitt JK. Prevention, treatment, and palliative care: the relative value of health improvements under alternative evaluation frameworks. *J Health Econ*. 2022;84:102643.
11. Glassman B. *Multidimensional Inequality: Measurement and Analysis Using the American Community Survey. SEHSD Working Paper Number 2019-17, US Census Bureau*; 2019. https://www.census.gov/content/dam/Census/library/working-papers/2019/demo/sehsd-wp2019-17.pdf. Accessed March 13, 2025.
12. Atkinson AB. On the measurement of inequality. *J Econ Theor*. 1970;2(3):244–263.
13. Kolm SC. Unequal inequalities. *J Econ Theor*. 1976;12(3):416–422.
14. Muir JM, Radhakrishnan A, Ozer Stillman I, Sarri G. Health equity considerations in cost-effectiveness analysis: insights from an umbrella review. *Clinicoecon Outcomes Res*. 2024;16:581–596.
15. Kawachi I, Kennedy BP. The relationship of income inequality to mortality: does the choice of indicator matter? *Soc Sci Med*. 1997;45(7):1121–1127.
16. Levy JI, Greco SL, Melly SJ, Mukhi N. Evaluating efficiency-equality tradeoffs for mobile source control strategies in an urban area. *Risk Anal*. 2009;29 (1):34–47.
17. Neumann PJ, Kim DD. Cost-effectiveness thresholds used by study authors, 1990-2021. *JAMA*. 2023;329(15):1312–1314.
18. Hunink MM, Weinstein MC, Wittenberg E, et al. Chapter 9.6. Incremental cost-effectiveness analysis. In: Wittenberg E, Wong JB, Pliskin JS, eds. *Decision Making in Health and Medicine: Integrating Evidence and Values*. 2nd ed. Cambridge, United Kingdom: Cambridge University Press; 2014:267–278.
19. Cropper ML, Krupnick A, Raich W. Preferences for equality in environmental outcomes. SSRN. Preprint. https://ssrn.com/abstract=2851945. Accessed March 21, 2025.
20. Regidor E, Calle ME, Navarro P, Domínguez V. Trends in the association between average income, poverty and income inequality and life expectancy in Spain. *Soc Sci Med*. 2003;56(5):961–971.
21. Aristei D, Bracalente B. Measuring multidimensional inequality and well-being: methods and an empirical application to Italian. *Statistica*. 2011;71 (2):239–266.
22. Hurley J, Mentzakis E, Walli-Attaei M. Inequality aversion in income, health, and income-related health. *J Health Econ*. 2020;70:102276.
23. Pinho M, Botelho A. Inference procedures to quantify the efficiency-equality trade-off in health from stated preferences: a case study in Portugal. *Appl Health Econ Health Policy*. 2018;16(4):503–513.
24. Robson M, O'Donnell O, Van Ourti T. Aversion to health inequality - pure, income-related and income-caused. *J Health Econ*. 2024;94: 102856.
25. Edlin R, Tsuchiya A, Dolan P. Public preferences for responsibility versus public preferences for reducing inequalities. *Health Econ*. 2012;21(12):1416–1426.
26. Paulden M. Why it's Time to Abandon the ICER. *Pharmacoeconomics*. 2020;38(8):781–784.
27. Cookson R. (2023). Distributional cost-effectiveness: putting money where your mouth is on health equity. Ann Int Med. 2023;176(6):866-7.
28. Boujaoude MA, Dalziel K, Cookson R, Devlin N, Carvalho N. Aversion to income, ethnic, and geographic related health inequality: evidence from Australia. *Soc Sci Med*. 2025;364:117495.
29. Dolan P, Tsuchiya A. Determining the parameters in a social welfare function using stated preference data: an application to health. *Appl Econ*. 2011;43 (18):2241–2250.
30. Elbasha EH. Cost-effectiveness risk-aversion curves: comparison of risk-adjusted performance measures and expected-utility approaches. *Pharmacoeconomics*. 2022;40(5):497–507.
31. Sendi P, Matter-Walstra K, Schwenkglenks M. Handling uncertainty in cost-effectiveness analysis: budget impact and risk aversion. *Healthcare (Basel)*. 2021;9(11):1419.
32. Yang F, Duarte A, Walker S, Griffin S. Uncertainty analysis in intervention impact on health inequality for resource allocation decisions. *Med Decis Making*. 2021;41(6):653–666.
33. Claxton K. The irrelevance of inference: a decision-making approach to the stochastic evaluation of health care technologies. *J Health Econ*. 1999;18 (3):341–364.
34. Fenwick E, Marshall DA, Levy AR, Nichol G. Using and interpreting cost-effectiveness acceptability curves: an example using data from a trial of management strategies for atrial fibrillation. *BMC Health Serv Res*. 2006;6:52.
35. Paulden M. "Why it's Time to Abandon the ICER." *Pharmacoeconomics*. 2020;38(8):781–784.
36. Cookson R. "Distributional Cost-Effectiveness: Putting Money Where Your Mouth Is on Health Equity." *Annals of internal medicine*. 2023.