Economic Evaluation for Health Priority-Setting: Cost-Effectiveness Analysis and Benefit-Cost Analysis Primer

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Preface

Since the early 1990s, researchers involved in the Disease Control Priorities (DCP) effort have been evaluating options to decrease disease burden in low- and middle-income countries. This working paper was developed to support the Fourth Edition of this effort. It is posted to solicit comments and feedback, and ultimately will be revised and published as part of the DCP4 series.

DCP4 will be published by the World Bank. The overall DCP4 effort is being led by Series Lead Editor Ole F. Norheim, Director of the Bergen Centre for Ethics and Priority Setting. Core funding is provided by the Norwegian Agency for Development Cooperation and the Norwegian Research Council. Lisa A. Robinson (Harvard University) is the Lead Editor for DCP4 volume 3, "Interventions Outside the Healthcare System." Brad Wong (Mettalytics) is the co-Lead Editor for that volume.

More information on the project is available at: https://www.uib.no/en/bceps/156731/fourth-edition-disease-control-priorities-dcp-4.

Acknowledgements

Abstract

Economic evaluation is a powerful tool, encouraging the systematic collection and assessment of the evidence needed to support sound policy decisions. In low- and middle-income countries, where resources are especially scarce and needs are very great, such decisions are exceptionally difficult. In these settings, economic evaluation can be particularly useful in determining how to best improve health and welfare. Typically, cost-effectiveness analysis (CEA) is used to prioritize interventions within the health care sector. This approach involves comparing monetary costs to non-monetary measures of health impacts, focusing on how to best invest limited resources to maximize improvements in health. Outside the health care sector, benefit-cost analysis (BCA) is more often used. Under this approach, all impacts, including health, are valued in monetary terms. The focus is on investing to improve welfare more generally, including health and other aspects of wellbeing. Both approaches provide important and useful information, although each has limitations as well as advantages. This working paper introduces and summarizes these economic evaluation methods.

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1.0 Introduction

Determining how to best allocate limited resources to improve public health and welfare is a difficult endeavor, requiring careful assessment of both the positive and negative impacts of alternative interventions. Economic analyses, including cost-effectiveness analysis (CEA) and benefit-cost analysis (BCA), are well-established and frequently used methods for systematically assessing these impacts. Typically, CEA is used to evaluate health care interventions, where the goal is to maximize improvements in health and longevity often within a relatively inflexible budget. BCA is more often used to assess interventions outside the health care system, where the goal is to maximize welfare defined more broadly and the budget is typically not fixed. These interventions may, for example, address environmental, transportation, occupational, nutritional, behavioral, and other risks, including climate change. They may be funded directly by government programs or other organizations, or may impose direct costs on industry, households, and other entities through regulations or through taxes and subsidies aimed at changing behavior.

This working paper first summarizes the major components of BCA and CEA, highlighting key similarities and differences.[1] We next discuss how CEA and BCA each estimate values in more detail, then describe approaches for supplementing each approach to evaluate the distribution and equity of the impacts.

2.0 General Framework

As conventionally conducted, both CEA and BCA consist of seven basic components; distributional analysis is a desirable eighth component, as illustrated in Figure 1.[2] The major distinction between the two approaches is how they value health impacts, which in turn affects the options for comparison to costs.[3]

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[1] See Chang et al. (2018), Horton et al (2018), Jamison et al. (2018), and Verguet and Jamison (2018) for information on how these approaches were implemented in the Third Edition of the Disease Control Priorities project. The Fourth Edition of the Disease Control Priorities project will include updates and enhancements of these approaches.

[2] This section builds on the discussion in Robinson et al. (2019).

[3] This overview focuses on the conduct of prospective, *ex ante* analyses, that estimate impacts before the policy is implemented. Analyses may also be conducted from a retrospective, *ex post* perspective, after the impacts of the policy have materialized, to compare the results to what would likely have occurred in the absence of the policy.

Figure 1. Economic Evaluation Components

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                    │  1) Define the problem  │
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                                 │
                    ┌────────────▼────────────┐
                    │ 2) Identify policy options │
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                                 │
                    ┌────────────▼────────────┐
                    │  3) Determine standing  │
                    │       (perspective)     │
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            ┌────────────────────┴────────────────────┐
 ┌──────────▼──────────┐              ┌───────────────▼───────────┐        ┌──────────────────────────┐
 │  4) Predict baseline │              │ 5) Predict policy responses │      │ Assess uncertainty and non- │
 │ conditions (comparator) │          │                           │        │    quantified effects      │
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 ┌──────────▼──────────┐              ┌───────────────▼───────────┐
 │  6a) Estimate costs │              │   6b) Estimate benefits   │
 └──────────┬──────────┘              └───────────────┬───────────┘
            └──────────┬─────────────────────┬────────┘
                ┌──────▼──────────────────────┐
                │ 7) Compare benefits to costs │
                └──────────────┬──────────────┘
                ┌──────────────▼──────────────┐
                │  8) Predict distribution of │
                │     benefits and costs      │
                └─────────────────────────────┘
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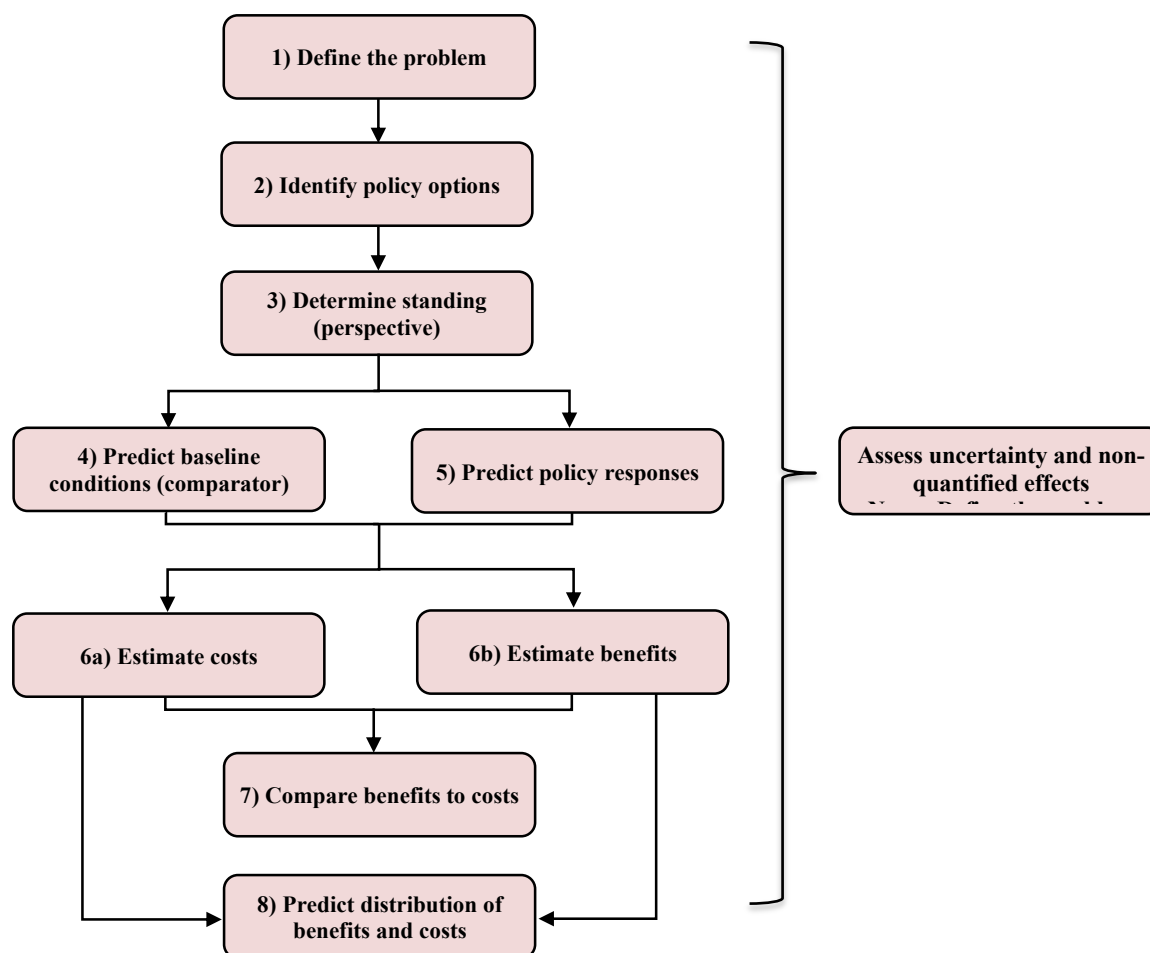
While shown as if it were a sequential process, in reality these steps are iterative. As analysts acquire additional information and review their preliminary findings, they often revise earlier components to reflect improved understanding of the issues. Each of these steps requires consideration of uncertainty as well as non-quantified effects.

We provide a brief overview of these components below. More information is available in several basic texts and guidance documents, including Drummond et al. (2015), Neumann et al. (2016), Boardman et al. (2018), and Robinson et al. (2019).

      (1) Define the problem: Policy changes are often motivated by a specific problem or policy goal, which may be identified by the analyst, a policymaker, or others. This problem, for example, may relate to the desire to prevent or treat a particular disease, or to reduce exposure to an environmental or other hazard.

      (2) Identify policy options: While many studies assess only a single option for addressing the problem, considering several reasonable alternatives is preferable. Evaluating only one option can lead decision-makers to ignore others that may be more cost-effective or cost-beneficial.

(3) Determine who has standing (perspective): Standing, or perspective, refers to identifying whose benefits and costs are counted. While either type of analysis can be conducted from a variety of perspectives, common practices vary. In CEA, two perspectives are often considered. One is a health sector perspective, which focuses on health care costs (either in total, regardless of who bears them, or the costs borne by a health ministry or payers) and compares them to the health benefits that accrue to patients (and sometimes to caregivers). The second perspective is societal, which considers all costs and benefits regardless of to whom they accrue. In BCA, the perspective is typically societal: all positive and negative impacts experienced by the population affected by the policy are included in the analysis.

Standing, or perspective, also encompasses other issues of scope. One frequent concern is geographic coverage, i.e., whether the analysis should consider impacts only on those who reside or work in a specific country or region or also consider broader impacts. When the question of standing or perspective raises difficult issues, it is often useful to report the results at different levels of aggregation rather than trying to fully resolve these concerns. For example, the results could be reported for a specific region, for the country as a whole, and at the global level, or for the health care system alone and for society at-large. In addition to aiding decision-makers in understanding the allocation of the impacts, providing disaggregated results eases comparison across analyses, allowing researchers to evaluate the extent to which differences in how standing is defined influence the results.

(4) Predict baseline conditions (comparator): Often, in CEA, a "no action" baseline is common, although at times other comparators are used. In BCA each intervention is almost always compared to a "no action" baseline. Ideally, the baseline includes prediction of future conditions in the absence of the intervention rather than assuming no changes from current conditions. For example, the health of the population and its size and composition may be changing, and the economy may be evolving, in ways that will affect the incremental impact of an intervention. Understanding what will likely occur without intervention is often important information for decision-makers and other stakeholders.

(5) Predict policy responses: This component involves predicting the impacts of each option in comparison to the baseline or other comparator. CEA and BCA face similar challenges in developing these predictions. One challenge is ensuring that changes likely to occur under the baseline are not inappropriately attributed to the policy; another is understanding the causal pathway that links the policy to the outcomes of concern. Often policy decisions need to be made in spite of considerable uncertainty regarding these causal links. Analysts need to carefully evaluate the evidence and clearly addresses the implications of uncertainty. The goal is to represent the policy impacts as realistically as possible.

This component focuses on the real impacts of the policy; the following component focuses on valuation. For example, the policy may lead to changes in behavior (such as safer driving habits) which are expected to lead to changes in health and longevity (such as fewer injuries and deaths due to motor vehicle accidents). In component 5, analysts estimate the expected number and types of individuals and organizations affected and the likely outcomes they will experience, including counts of expected deaths and cases of illnesses and injuries averted.

(6) Estimate costs and benefits: For costs (component 6a), both CEA and BCA rely on the same basic concepts and approaches for valuation, although CEA more often focuses on health system costs while BCA almost always takes a societal perspective. Analysts

typically concentrate on the reallocation of resources required to implement the intervention, i.e., the opportunity costs of using labor, materials, and other resources to carry out the policy rather than for other purposes. These costs may be incurred by private enterprises, government agencies, nongovernmental organizations, other nonprofits, or individuals. Analysts often estimate direct costs based on market prices, although at times these prices may need adjustment to better reflect opportunity costs.

For some policies, the impacts may be large enough to significantly affect prices, in which case the effects on market supply and demand also should be considered. Depending on the size of the impacts, partial or general equilibrium analysis may be used to estimate these impacts. Partial equilibrium analysis considers the impact on an industry sector or sectors, whereas general equilibrium analysis considers the effects on the economy as a whole.

For benefits (component 6b), CEA relies on non-monetary measures for health-related outcomes, such as life years, quality-adjusted life years (QALYs), or disability-adjusted life years (DALYs). The monetary value of other beneficial outcomes (such as improvements in environmental quality), can be netted out of the cost estimates to provide a more complete measure of policy impacts; however, it is not clear how often these other impacts are considered. BCA relies on monetary measures to value all outcomes. We discuss these valuation approaches in more detail in the next section.

(7) *Compare benefits to costs:* The final step involves comparing costs and benefits. As part of this calculation, future-year impacts are discounted to reflect time preferences and the opportunity costs of investments made in different periods. This discounting reflects the general desire to receive benefits early and to defer costs.

In CEA, the summary measure is typically a ratio of costs to the outcome measure of concern, e.g., the cost per life year, QALY, or DALY. An incremental cost-effectiveness ratio (ICER) is typically used to compare across interventions that address the same problem. The ICER is calculated by dividing the difference in total costs (i.e., the incremental cost of each increasingly expensive intervention) by the difference in effectiveness (i.e., the incremental change in life years, QALYs, or DALYs) to reflect the additional investment needed to achieve an additional unit of health impact.

To determine whether an intervention is cost-effective, typically a monetary threshold is used. An intervention is deemed cost-ineffective if its ICER is greater than the threshold (i.e., the health gains produced are not worth the net costs required to achieve these gains). Conceptually, these thresholds are intended to measure the monetary value of the effects measure – of a life-year, QALY, or DALY averted.

Numerous approaches have been proposed for establishing cost-effectiveness thresholds (e.g., Smith and Richardson 2005, Shillcutt et al. 2009, Claxton et al. 2015, Woods et al. 2016, Pichon-Riviere et al. 2023). Generally, they can be categorized as "demand-side" or "supply-side" approaches or as a combination. Demand-based values focus on the preferences of the affected population; on what they are willing to pay per unit of effect. Supply-based values focus on the opportunity cost of the intervention; on the cost per unit of effect of the most beneficial alternative that would not be funded if the intervention was implemented. In theory, these values would be equal if the preferences of the affected population were known and health budgets were set at the optimal level (the level at which the incremental benefit of further spending equals its incremental cost). In reality, demand- and supply-based values are

likely to differ, given that individual preferences vary in ways that are not well-understood and that health care decisions reflect numerous other factors.

In BCA, no threshold is needed since both costs and benefits are valued in monetary terms. The results are often reported as net benefits (benefits minus costs). Ratios may also be used, including the benefit-cost ratio (BCR). Other common summaries are the return on investment (ROI) or internal rate of return (IRR), which are useful for comparing near-term costs with future benefits. However, ratios and rates of return must be constructed and interpreted with care. The results depend on the classification of impacts as benefits or costs; inconsistent categorization will lead to misleading results. Ratios and rates are also insensitive to scale; an intervention with relatively small net benefits may result in the same ratio as an intervention with very large net benefits.

The BCR is calculated by dividing benefits by costs; the ROI is calculated by subtracting the costs of the intervention from the benefits and dividing the result by the costs.[4] The IRR is the discount rate at which the present value of net benefits is zero; it may not be unique if net benefits change sign more than once over time. The IRR also does not exist if net benefits are always positive (or always negative) in every year. If the BCR, ROI, or IRR is reported, it is useful to also report net benefits to indicate the magnitude of the impacts.

In all cases, an intervention should not be implemented solely because it results in a cost-effectiveness ratio that is less than a threshold or in positive net benefits. Comparison to other interventions is needed to determine which represent the best allocation of resources. In addition, concerns that are not addressed by the analysis must be considered, including legal, political, and budgetary constraints.

> **(8) Predict distribution of benefits and costs:** While often considered to be outside the CEA or BCA framework, the distribution of impacts across advantaged and disadvantaged members of the population is important to decision-makers and other stakeholders. Most, if not all, basic texts and guidance documents stress the importance of considering this distribution. They typically recommend that, at minimum, analysts provide descriptive information on who bears the costs and who receives the benefits, including the likely allocation across income and other groups. This information includes the variation in the cost-effectiveness ratios or ICERs across groups in the case of CEA, and the variation in net benefits, BCRs, ROIs, or IRRs across groups in the case of BCA. We discuss related issues later in this paper.

Each of the above components requires appropriate consideration of uncertainty, including non-quantified effects. In summarizing the results, analysts should address the extent to which uncertainties affect the ratio of costs to effectiveness or costs to benefits, as well as the estimates of net benefits when BCA is used. These uncertainties and non-quantified effects may influence the likelihood that an intervention yields benefits that exceed costs and the relative ranking of the policy options.

Because analytic resources are limited, the ideal analysis will not assess all policy options nor quantify all impacts with equal precision. In some cases, the cost of analyzing an option or quantifying an impact will be greater than the likely benefit of assessing it, given its relative importance for decision-making. In other words, the analysis may not sufficiently improve

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[4] In other words, the ROI is equal to the BCR minus 1.

the basis for decision-making to pass an implicit benefit-cost or value-of-information test. Conversely, options and impacts that are important for decision-making should receive substantial attention.

To implement either framework, ideally analysts should begin by listing all potential costs, benefits, and other impacts, then use screening analysis to identify the impacts most in need of further investigation, as illustrated in Figure 2.

Figure 2. Scoping and Screening Analysis
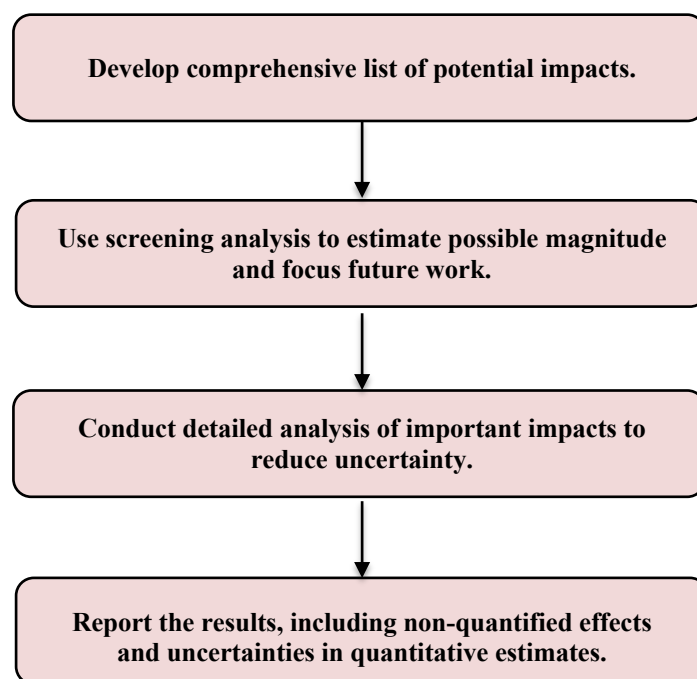
Screening analysis relies on easily accessible information and simple assumptions to provide preliminary insights into the direction and magnitude of effects. For example, upper-bound estimates of parameter values can be used to determine whether particular impacts may be significant. Screening aids analysts in justifying decisions to exclude impacts from more detailed assessment and in determining where additional research is most needed to reduce uncertainty. It also provides data that can be used to indicate the rough magnitude of impacts that are not assessed in detail.

3.0 Valuation Approaches

As introduced above, when applied to interventions that aim to improve health, the major difference between CEA and BCA is how they value health and longevity. CEA provides information on the cost per unit of effect. The effect may be measured as life years gained if the intervention is primarily targeted on mortality risks, or as an improvement in QALYs or DALYs if the intervention is expected to significantly affect health-related quality of life. [5] Although QALYs and DALYs differ in concept and application, both translate the impact of nonfatal health effects into a life year measure, so that the years of life lived in different health states or lost to premature fatality can be combined into a single indicator.

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[5] See the Tufts Medical Center CEA Registry for a comprehensive database of these studies: https://cear.tuftsmedicalcenter.org/about.

QALYs are widely used to rank and prioritize public health programs, analyze the cost-effectiveness of health policy and medical treatment decisions, and compare health status across individuals or population groups, largely in high-income countries. QALYs are derived by multiplying the amount of time an individual spends in a health state by a measure of the health-related quality of life (HRQL) associated with that state and summing this product across time periods. HRQL is estimated using a scale anchored at zero and one, where one corresponds to full health and zero corresponds to death or to a state that is as bad as dead; values cannot be greater than one but may be less than zero for states that are judged to be worse than dead.

The DALY measure is more commonly used in global health. It was originally developed to assess the global burden of disease (Murray, Lopez, and Jamison 1994, Murray and Lopez 1996, Salomon et al. 2012, Murray et al. 2012, Salomon et al. 2015) and is now often used when estimating the cost-effectiveness of health-related interventions. For nonfatal effects, the loss from disability is measured as a value between zero (for full health) and one (equivalent to dead). For example, a health condition assigned a disability weight of 0.2 is equivalent to 80 percent of a year in full health. The disability weight is multiplied by the duration of the condition.
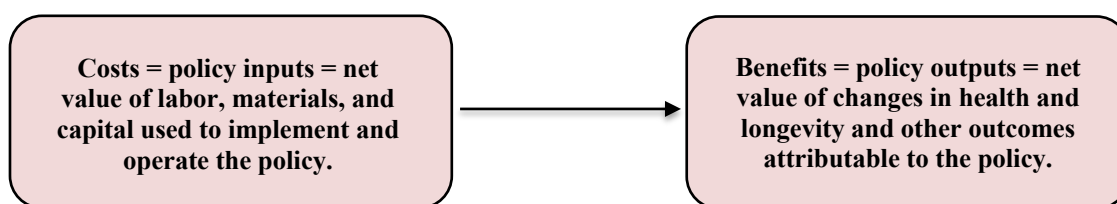
In CEA, impacts other than those captured in these measures may be included in the cost estimate, as noted in the previous section. In BCA, the appropriate categorization of benefits and costs is less clear. Whether a consequence is categorized as a "cost" or "benefit" is somewhat arbitrary and varies across BCAs. As long as the sign is correct (positive or negative), the categorization of impacts will not affect the estimate of net benefits, but will affect summary measures based on ratios. Consistent categorization is essential for comparability of ratios as well as for comparison or aggregation of total costs and total benefits across analyses.

One intuitively appealing option is to distinguish between inputs and outputs in BCA.[6] Under this scheme, costs are the required inputs or investments needed to implement and operate the policy – including real resource expenditures such as labor and materials, regardless of whether these are incurred by government, private or nonprofit organizations, or individuals. Benefits are then the outputs or outcomes of the policy, i.e., changes in welfare such as reduced risk of death, illness, or injury.

Under this framework, counterbalancing effects should be assigned to the same category as the impact they offset. For example, "costs" might include expenditures on improved technology as well as any cost-savings that result from its use; "benefits" might include the reduction in disease incidence as well as any offsetting health risks, such as adverse reactions to medications or post-surgical infections. This categorization is illustrated in Figure 3.

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[6] This approach is followed, for example, in U.S. Department of Health and Human Services (2016) guidelines for regulatory BCA as well as in the Robinson et al. (2019) BCA guidelines for global health.

Figure 3. Categorization of Impacts as Costs or Benefits

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┌─────────────────────────┐              ┌─────────────────────────┐
│  Costs = policy inputs = net │  ──────▶  │  Benefits = policy outputs = net │
│  value of labor, materials, and │        │  value of changes in health and │
│  capital used to implement and │         │  longevity and other outcomes │
│  operate the policy. │                    │  attributable to the policy. │
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In BCA, monetary values are used to measure the extent to which individuals are willing to exchange their income – which can be spent on other things – for the health and non-health outcomes they will likely experience if an intervention is implemented.[7]

One frequent source of confusion is the use of the term "value per statistical life" (VSL) to refer to the value of small changes in mortality risk. VSL measures the rate at which individuals would be willing to spend money to decrease their mortality risk in a specified period, often one year (see Hammitt 2000, Robinson, Hammitt and O'Keefe 2019, Hammitt 2020, and Hammitt 2023, for more discussion).[8] It is typically calculated by dividing an estimate of individuals' willingness to exchange their own income for a very small change in their own risk by the risk change. It is not a value that the government, the researcher, or anyone else applies to saving a particular person's life with certainty. For commonly assessed interventions, such as those focused on environmental hazards, occupational risks, or traffic accidents, it not unusual for these individual risk reductions to be on the order of 1-in-10,000 or 1-in-100,000 per year.

Prices are generally used to value costs as well as benefits associated with marketed goods or services such as increased agricultural yields or labor market participation. If outcomes are not directly bought and sold in the marketplace, then nonmarket valuation methods are necessary. These methods are particularly important in BCA, given the need to value changes in health (illness and injury) and longevity in monetary terms. Such methods are also needed to value other nonmarketed outcomes, such as changes in environmental quality, regardless of whether the value of these outcomes is netted out of the cost estimate in CEA or included in the benefit estimate in BCA.

Nonmarket valuation methods include revealed- and stated-preference studies; at times experiments may also be used. Each approach has advantages and limitations: the choice of approach depends on the quality of the available research and the extent to which it measures an outcome similar to the outcome of the intervention.

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[7] Conceptually, beneficial outcomes are generally measured by individuals' willingness to pay (WTP) for the improvement and detrimental outcomes by their willingness to accept compensation (WTA) for the harm. An alternative approach is to measure benefits by WTA to forgo the benefit and harms by WTP to prevent the harm, but this is less attractive as the implied baseline assumes the policy will be implemented. Typically, analysts rely on estimates of WTP rather than WTA to value beneficial consequences, in part because interventions usually provide improvements from the status quo. In addition, WTP is more frequently studied and the estimates are generally considered more reliable; the reasons for the large and variable differences between estimated WTP and WTA are not well understood. For costs, market values are often used, reflecting the interaction of supply and demand in the marketplace rather than the types of changes that underlie WTP and WTA measures.

[8] For example, if an individual is willing to pay $100 for a 1-in-10,000 reduction in their risk of dying in the current year, the equivalent VSL is $1 million ($100 divided by 1/10,000).

Revealed-preference studies rely on observed market behavior to estimate the value of related nonmarket goods. For example, wage-risk (hedonic-wage) studies examine the compensation associated with jobs that involve differing risks of death or nonfatal injury, using statistical methods to separate the effects of these risks from the effects of other job and personal characteristics. While such methods have the advantage of relying on actual behavior with real consequences (giving individuals an incentive to choose wisely), it may be difficult to find a market good that can be used to estimate the value of the outcome of concern.

Stated-preference methods typically employ survey techniques to ask respondents about their willingness to exchange income for the outcome of concern compared to a defined baseline. Such surveys may directly elicit values for a particular scenario, or may present respondents with two or more scenarios involving different attributes and prices. Although the terminology is not always used consistently, the first type of study is usually referred to as a contingent valuation survey; the second as a choice experiment. In the latter case, values are estimated based on the way in which respondents choose, rank, or rate alternatives.

Stated-preference methods are attractive because researchers can tailor them to directly value the outcomes of concern; for example, the survey can describe a particular type of illness from a particular type of exposure. A potential weakness is that respondents do not directly experience the consequences of their decisions and may have limited incentives to consider the questions carefully. Such surveys must be carefully designed and administered and satisfy various tests for coherence to be considered reliable enough for application when informing policy decisions.

Experimental methods (see, for example, Shogren 2005, Canavari et al. 2019) are less frequently applied but may be useful in some cases.[9] Economic experiments have some characteristics of revealed-preference and some characteristics of stated-preference approaches. Individuals are typically asked to participate in an artificial (laboratory) environment, in which they make multiple economic choices. The set of choices and associated information is controlled by the experimenter, as in stated-preference studies. In general, these choices have real consequences as the individuals are paid to participate and their pay depends on their behavior, as in revealed-preference studies. However, the range of possible payments is often quite small. Moreover, because the environment is artificial, some scholars question how well behavior in the laboratory predicts behavior in the field; for example, subjects may treat the money used in the experiment differently than their own money.

For valuation as well as other analytic components, analysts transfer estimates from research conducted in other settings to the policy context, due to the substantial time and expense associated with conducting new primary research. For example, survival rates may be transferred from research conducted in a particular health care system in a previous time period to estimate future survival rates among a national population, adjusting for differences in these populations to the extent possible. Cost estimates may be transferred from a different country or time period, adjusted as needed to address variation in economic and other conditions. This variation may include, for example, the likelihood that some components will need to be imported rather than manufactured locally.
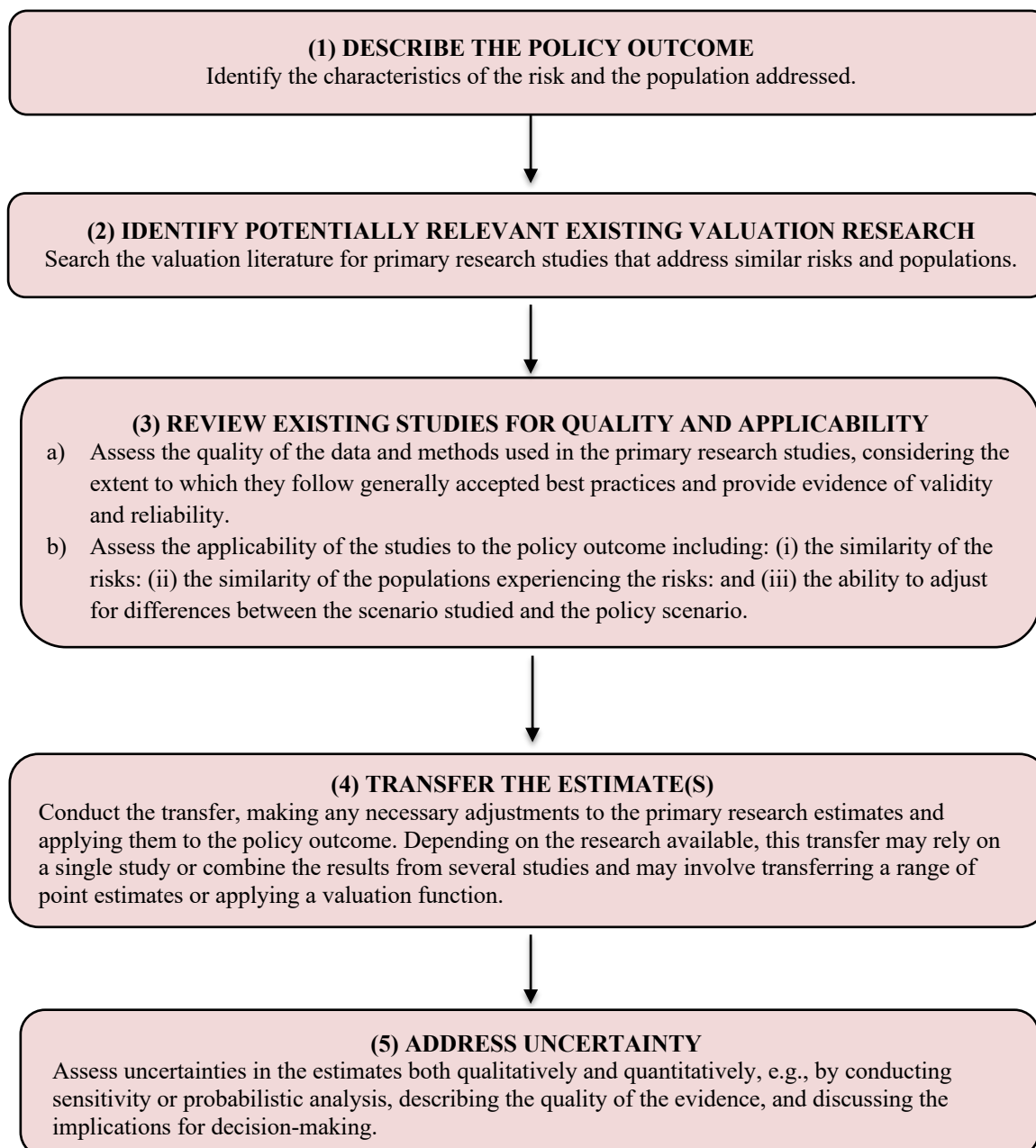
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[9] At times, structural models that combine theoretical expectations with data from various sources may also be useful (see, for example, Smith et al. 2006, Newbold 2011).

Any type of transfer requires careful review of the literature and other data sources to identify high-quality studies that are suitable for use in a particular context. "Quality" can be evaluated by considering the likely accuracy and reliability of the data and methods used, referencing current guidance on best practices. "Suitability" or "applicability" involves considering the similarity of the outcomes and the populations affected. When estimating the monetary value of benefits, this approach is typically described as "benefit transfer" or "value transfer." Figure 4 illustrates the process when valuing risks to health or longevity in BCA. Similar considerations are relevant when estimating costs or other effects.

Figure 4. Value Transfer Process

(1) DESCRIBE THE POLICY OUTCOME
Identify the characteristics of the risk and the population addressed.

↓

(2) IDENTIFY POTENTIALLY RELEVANT EXISTING VALUATION RESEARCH
Search the valuation literature for primary research studies that address similar risks and populations.

↓

(3) REVIEW EXISTING STUDIES FOR QUALITY AND APPLICABILITY
a) Assess the quality of the data and methods used in the primary research studies, considering the extent to which they follow generally accepted best practices and provide evidence of validity and reliability.
b) Assess the applicability of the studies to the policy outcome including: (i) the similarity of the risks: (ii) the similarity of the populations experiencing the risks: and (iii) the ability to adjust for differences between the scenario studied and the policy scenario.

↓

(4) TRANSFER THE ESTIMATE(S)
Conduct the transfer, making any necessary adjustments to the primary research estimates and applying them to the policy outcome. Depending on the research available, this transfer may rely on a single study or combine the results from several studies and may involve transferring a range of point estimates or applying a valuation function.

↓

(5) ADDRESS UNCERTAINTY
Assess uncertainties in the estimates both qualitatively and quantitatively, e.g., by conducting sensitivity or probabilistic analysis, describing the quality of the evidence, and discussing the implications for decision-making.

Value transfer often requires significant judgment on the part of the analyst given the complexity of the issues, the limited number of studies available, and the lack of consistent reporting standards for valuation research. As a result, careful documentation of the approach and discussion of its limitations is essential. More generally, as when estimating almost any parameter in policy analysis, such transfers require careful consider of uncertainties and their implications. In some cases, these uncertainties may have relatively little effect on the conclusion that an intervention is, or is not, cost-effective or cost-beneficial. In other cases, these uncertainties may have a more profound effect.

4.0 Distribution and Equity

As discussed above, conventionally both CEA and BCA focus on the total effects of an intervention, summing costs and effects, or costs and benefits, across all those affected. There is widespread agreement that information on how the impacts are distributed across advantaged and disadvantaged individuals is also needed to support sound decisions. Despite this agreement, little attention is paid to assessing the distribution of impacts (see, for example, Robinson, Hammitt, and Zeckhauser 2016, Robinson, Hammitt, and Adler 2018). The extent to which the reasons for this inattention are technical, political, legal, or ethical is unclear. However, in recent years, several scholars have been making significant progress in developing methods for assessing these impacts.

In both CEA and BCA, the starting point is to estimate how benefits and costs are distributed across groups of concern, whether defined by income, baseline health, or other metrics. Ideally, this distribution would be estimated from data on the impacts of the specific intervention. When such data are not available, analysts may be able to estimate this distribution based on the literature or on data for similar interventions or populations. Otherwise, it may be necessary to assume the distribution is the same as for the overall population in that region or country, with careful assessment of associated uncertainties.

In CEA, two approaches have been developed to evaluate distributional concerns. The first is extended CEA (ECEA) (Verguet, Kim, and Jamison 2016, Verguet and Jamison 2019).[10] As currently applied, this approach focuses on the effects of interventions on impoverishment, expanding the focus of conventional CEA to include financial risk protection. Such protection may significantly decrease income inequality by reducing the disproportionate effects of poor health and out-of-pocket medical expenditures on low-income groups. Rather than combining all impacts into a single measure, ECEA reports separate ratios for each outcome of concern across income subgroups. These include the ratios of each of the following to costs: health gains, financial risk protection, and private expenditures. The approach can be expanded to report ratios for other non-health benefits, such as educational, agricultural, and environmental improvements.

The second approach is distributional CEA (DCEA) (Asari, Griffin and Cookson et al. 2016, Cookson et al. 2020), which can be used as an umbrella term to cover many forms of analysis.[11] Generally, it involves evaluating the effect of the intervention on the distribution

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[10] For more information on ECEA, see:
https://repository.chds.hsph.harvard.edu/repository/collection/resource-pack-extended-cost-effectiveness-analysis/.
[11] For more information on DCEA, see:
https://www.york.ac.uk/che/research/equity/economic_evaluation/.

of health across population subgroups, defined by income or other attributes. This change is evaluated using a social-welfare function that incorporates measures of inequality aversion (as equity weights), equating the distribution associated with the intervention with a distribution that distributes health equally throughout the population. The results aim to help decision-makers better assess the trade-offs between improving population health and reducing health inequality.

In BCA, describing the distribution may be more complex than in CEA, given the variety of benefits that may be considered, the numerous ways in which costs may be imposed, and the challenges of combining distributions of costs and benefits to estimate the distribution of net benefits. Figure 5 illustrates the process of assessing the distribution of benefits in simple terms, using improved health and longevity as an example. In this context, the analyst estimates the changes in risks and their monetary value across the population subgroups of concern. This component is often relatively straightforward, since analysts usually have some information on the characteristics of those affected, e.g., their geographic location, activity patterns, age, and so forth.

Figure 5. Distribution of Health Benefits
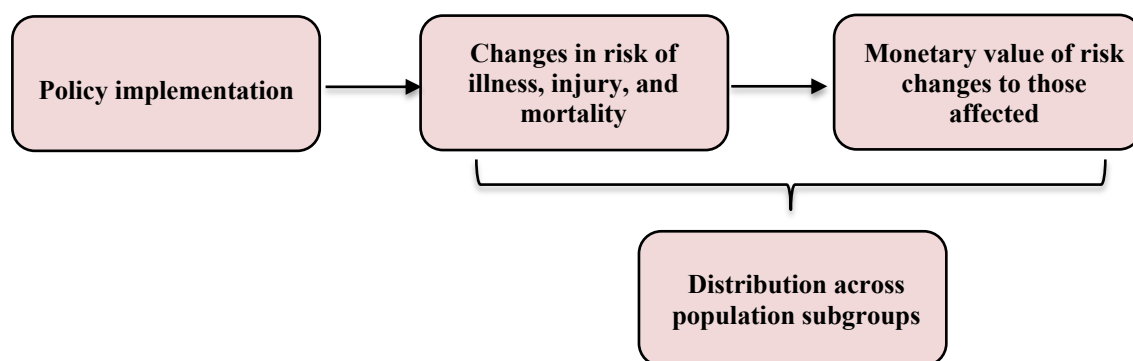
Estimating the distribution of costs is often more difficult. Figure 6 illustrates the steps, assuming that analysts are interested in the monetary expenditures needed to implement the intervention and the ultimate effect on the disposable income of the groups of concern.

Figure 6. Distribution of Costs
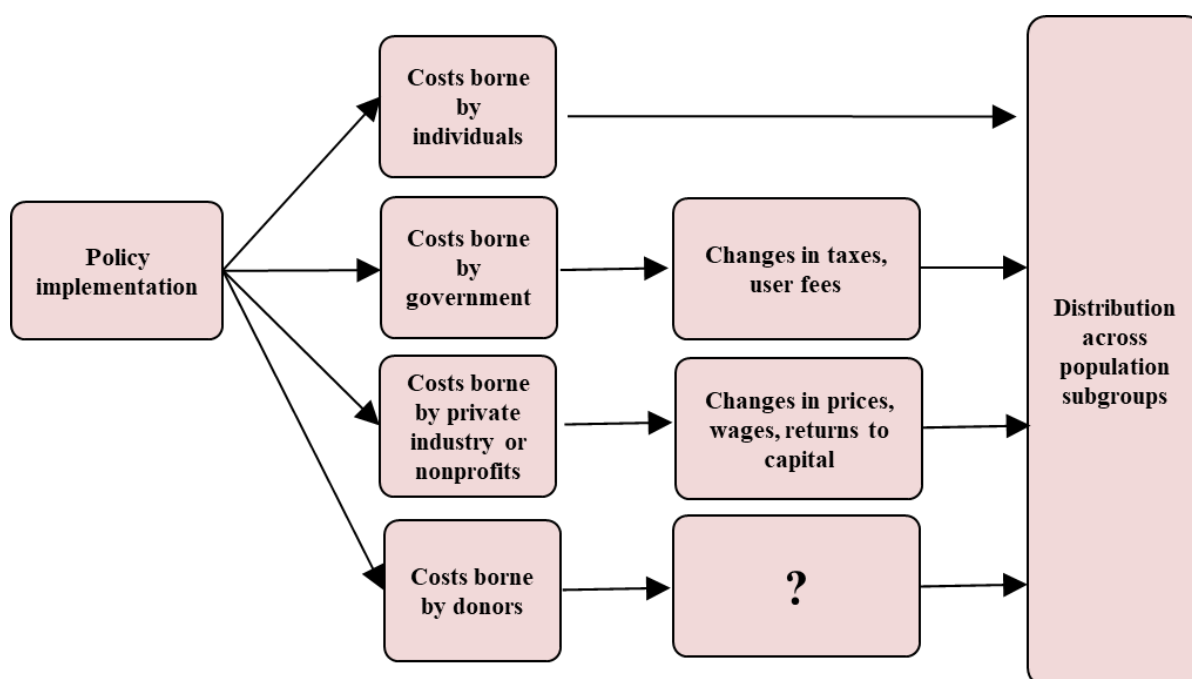
If costs are borne directly by individuals, the main challenge is determining how the costs are distributed across those who belong to different groups. If costs are borne initially by the government, industry, donors, or other organizations, assessing the effects on individuals requires additional steps. For government programs, the analyst first needs to estimate how the costs translate into changes in taxes or user fees or are otherwise financed, then estimate the incidence of these taxes or fees. For programs funded by nonprofit or for-profit organizations, the analyst must determine how costs are allocated among owners, workers, and consumers. This allocation will be affected by how the costs translate into changes in unit prices (which have both income and substitution effects on consumer expenditures), in wages paid to employees, and in returns to capital that accrue to owners. Costs paid by external donors (e.g., aid from foreign governments or foundations) raise other issues. In the short-term, donor-financed costs may have little or no direct impact on the income or wealth of members of the target population. However, the donor agency may be interested in estimating how these costs would be distributed if the policy were instead funded using in-country resources.

Once costs and benefits are estimated for members of each group of concern, they can be combined to determine the net effects. The net benefits (supplemented by ratios if desired) can then be reported as a table, chart, or graphic that indicates the costs, benefits, and net benefits that accrue to individuals at different points in the distribution, e.g., to income quintiles. Standard inequality indices can be used to summarize the distribution and to compare across differing distributions.

Distribution can be more fully integrated by conducting weighted BCA, in which the costs and benefits accruing to different groups are multiplied by distributional weights that reflect estimates of society's preferences for reducing inequalities. Alternatively, policies can be evaluated using a social welfare function to represent preferences for both the level and distribution of wellbeing.

Two normative frameworks are frequently referenced in this context. The first is utilitarianism, which focuses on the total wellbeing in a society and typically assumes that an incremental dollar received by a poor person yields a greater increase in wellbeing than the same amount received by a rich person. Prioritarianism also evaluates total wellbeing but counts changes in the wellbeing of individuals who are worse off as more important than comparable changes to individuals who are better off (see Adler and Norheim 2022). It goes beyond utilitarianism by weighting improvements in wellbeing differently across the population. Prioritarianism seems consistent with many people's intuition about what might be just or fair.

5.0 Summary and Conclusions

CEA and BCA are both designed to inform policy and other decisions by providing evidence on the likely consequences of alternative interventions, including their costs and benefits. The primary difference is that in CEA, the costs and benefits of an intervention are typically measured in different units and the result is described as a monetary cost per unit of health benefit (such as life years gained, QALYs gained, or DALYs averted). In contrast, in BCA all impacts are measured in the same (monetary) units, including both health and non-health outcomes. The summary measure is often net benefits (benefits minus costs), although the ratios may also be reported.

While CEA can be conducted without estimating the monetary value of the health outcomes, monetary valuation is implicit in the decision-making process. Choosing to expend resources on a policy indicates that the decision-maker values the outcomes of that policy at least as much as the costs required to implement it. Valuation is more explicit when monetary thresholds are used to distinguish between policies that are and are not cost-effective.

CEA and BCA each provide useful information; whether one or both should be applied depends on the decision-making context. CEA aids in prioritizing policies targeted on a specific outcome such as improving health; BCA explores preferences for allocating resources across policies that address health and non-health outcomes. Each must be supplemented by consideration of legal, budgetary, ethical, and other concerns as well as information on the distribution of the impacts.

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