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Inequality, Equity and Social Justice in Economic Evaluation of Health Technologies: Distributional and Implementation Perspectives

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ABSTRACT: Economic evaluations of health technologies are central to evidence-informed priority setting, yet conventional approaches may insufficiently represent how health gains, costs, and opportunity costs are distributed across population groups. This narrative and conceptual review synthesises methodological, ethical, health technology assessment (HTA), distributional cost-effectiveness analysis (DCEA), and implementation-science literature to examine the links among inequality, equity, distributive justice, and implementation. The synthesis shows that aggregate cost-effectiveness can coexist with unequal access, uptake, effectiveness, or displacement effects across socioeconomic, ethnic, gender, and geographic groups. DCEA offers a structured framework for quantifying these distributional consequences and the trade-offs between total health and inequality reduction, but its application depends on high-quality stratified data, consistent definitions of equity-relevant characteristics, representative clinical evidence, and appropriate real-world data. A further challenge is the persistent separation between economic evaluation and implementation: technologies judged cost-effective may fail to generate population benefit when implementation resources, contextual barriers, and distributional effects are overlooked. A phased strategy is therefore proposed to standardise equity-relevant data across clinical research, registries, administrative sources, and post-implementation monitoring. Integrating efficiency, equity, and implementation can make HTA more informative for public-health decision-making and support resource-allocation decisions that are efficient, transparent, feasible, and socially legitimate.

1. INTRODUCTION

Economic evaluations of health technologies are fundamental instruments in modern health systems because they provide an explicit framework for comparing the costs and consequences of alternative interventions. Methodological development has improved their precision and usefulness, particularly where decision makers must prioritise technologies under constrained budgets. Measures such as the quality-adjusted life-year (QALY), together with increasingly sophisticated decision-analytic

models, allow morbidity and mortality to be combined and long-term costs and outcomes to be extrapolated when direct evidence is incomplete (Brazier et al., 2017; Briggs et al., 2006; Drummond et al., 2015).

These advances do not eliminate a central normative limitation. Conventional economic evaluation generally emphasises aggregate health maximisation and efficiency, whereas the distribution of health gains, financial burdens, and opportunity costs across population groups may remain insufficiently represented. A technology can be cost-effective at the population level while its benefits accrue disproportionately to groups that already experience social or health advantages. Conversely, disadvantaged groups may experience lower access, lower effectiveness, or a larger share of the opportunity costs generated by resource reallocation (Bellemare et al., 2018; Cookson et al., 2021).

A second limitation concerns the translation of evidence into practice. Economic evidence has limited social value if a technology judged worthwhile cannot be adopted, scaled, financed, or delivered equitably. Implementation science has shown that effective interventions frequently fail to achieve population impact because organisational, behavioural, financial, and contextual barriers are not incorporated early enough into evaluation and decision-making (Bauer et al., 2015; Heggie et al., 2021; Roberts et al., 2019).

This review therefore asks how economic evaluation can better represent inequality, equity, and distributive justice; what DCEA contributes to that objective; which evidence gaps constrain distributive analysis; and how implementation considerations can be integrated so that economic evidence translates into equitable population benefit.

2. MATERIALS AND METHODS

2.1 Review design and scope

This article is a narrative and conceptual review rather than a systematic review. It integrates foundational texts and peer-reviewed methodological and empirical literature cited throughout the manuscript to examine the relationship between economic evaluation, health equity, distributive justice, DCEA, and implementation science. The purpose is conceptual synthesis and methodological integration, not exhaustive evidence retrieval or meta-analysis.

The review is organised around four analytical domains: (1) the role and limits of conventional economic evaluation within HTA; (2) the distinction among inequality, equity, and distributive justice; (3) methods and data requirements for incorporating equity into economic evaluation, with particular emphasis on DCEA; and (4) the implementation gap between economic evidence and realised population benefit. Findings from these domains are then used to develop a phased proposal for standardising equity-relevant primary and real-world data. Because the review is conceptual and uses published literature only, no primary participant data, intervention assignment, or statistical pooling was undertaken. Sources were selected purposively for their relevance to these predefined analytical domains, with emphasis on foundational methodological work and selected recent contributions; no protocol, exhaustive search, duplicate screening, formal risk-of-bias assessment, or meta-analysis was undertaken.

For conceptual comparison, the approaches discussed were distinguished according to their primary decision function and normative content: subgroup analysis describes heterogeneity; equity weighting applies explicit social value judgements to outcomes; extended cost-effectiveness analysis broadens the outcome set to include dimensions such as financial protection; multicriteria approaches combine several decision criteria; and DCEA explicitly models the distribution of health gains and opportunity costs and can quantify efficiency-equity trade-offs. This classification was used to avoid treating analytically distinct approaches as interchangeable.

3. RESULTS AND DISCUSSION

3.1 Economic evaluation of health technologies

Health technology assessment (HTA) has evolved as a multidisciplinary process for examining the clinical, economic, organisational, social, and ethical implications of health technologies. In this context, a health technology includes not only medicines and devices but also methods of prevention, diagnosis, treatment, rehabilitation, organisational arrangements, and support systems used to deliver health care (Hailey, 2009; Stevens et al., 2003). Economic evaluation is a key component of this broader assessment because it makes the consequences of scarcity explicit and compares alternative uses of resources.

The value of a technology cannot be inferred solely from clinical efficacy. A complete appraisal should consider the context in which the intervention will be used, prevailing patterns of care, the structure of the health system, prices of inputs and services, risks and benefits over an appropriate time horizon, and the feasibility and cost of implementation (Drummond, 2015). The central economic question is whether the additional resources required by a technology are justified by the health and social benefits generated, while recognising that equity, ethics, and social protection may legitimately influence coverage decisions.

Full economic evaluations compare two or more alternatives in terms of both costs and consequences. Cost-minimisation analysis is appropriate only when outcomes can reasonably be considered equivalent; cost-effectiveness analysis relates costs to outcomes measured in natural units; cost-utility analysis commonly expresses health outcomes as QALYs; and cost-benefit analysis values both costs and consequences in monetary terms. Partial evaluations, such as cost descriptions, cost-of-illness studies, outcome descriptions, or comparisons that omit either costs or consequences, may be informative but cannot answer the full resource-allocation question (Drummond et al., 2015).

The economic rationale is especially important because individuals and societies seek protection against health and financial risk. Decisions that are optimal for a particular patient or group are not necessarily optimal from a societal perspective when resources are finite and competing claims exist. Public institutions therefore require transparent approaches that assess benefits, costs, risks, and opportunity costs across the population. Rapid technological innovation intensifies this need because expenditure on health technologies can grow faster than available budgets.

In health systems with explicit or implicit budget constraints, rising expenditure and unequal access to technologies create pressure for evidence-based priority setting. Economic evaluation can reduce uncertainty and improve consistency in coverage decisions, but efficiency alone is insufficient. Decision makers must also consider budget impact, uncertainty, heterogeneity, and the distribution of health gains and losses. Adopting a technology for one group may displace services elsewhere, creating health losses that can also be socially patterned (Claxton, 2008).

3.2 Inequality, equity, and distributive justice in health

Inequality is not merely a statistical property of a distribution. In social and health policy it reflects differences that may arise from income, wealth, education, employment, geography, ethnicity, gender, political power, and access to public goods. Some inequalities are descriptive; others become inequities when they are judged avoidable, unfair, or unjust. This distinction is critical because economic evaluation requires not only measurement but also normative judgement about which differences matter for policy (Atkinson, 2015; Sen, 1992).

Equity is therefore a normative principle rather than simple equality. Equal treatment can reproduce disadvantage when people begin from unequal circumstances or face different barriers. Equity seeks substantive fairness by adapting the distribution of resources, opportunities, and health interventions to relevant needs and constraints. In health, this implies asking whether individuals and groups have a fair opportunity to obtain effective care and achieve health, rather than merely whether the same nominal service is offered to everyone (Santos, 2020).

Distributive justice provides the ethical foundation for these judgements. Rawls's theory of justice as fairness emphasises impartial choice and gives particular importance to arrangements that protect the least advantaged. Sen's capability perspective shifts attention from resources alone to what people are effectively able to be and do. Although these traditions differ, both challenge a purely aggregate account of welfare and support scrutiny of who gains, who loses, and whether observed differences are ethically acceptable (Rawls, 1971; Sen, 1992).

For HTA, these concepts imply that the value of a technology cannot always be reduced to a single average incremental cost-effectiveness ratio. The same aggregate gain may have different social significance depending on its distribution. An evaluation that explicitly reports heterogeneity and equity effects can therefore provide decision makers with information that conventional averages conceal.

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Table 1. Equity-relevant dimensions in economic evaluation and implementation

Dimension	Risk if distribution is ignored	Distributional/implementation response
Baseline health and disease burden	Average outcomes can mask socially patterned starting points.	Stratify baseline health, prevalence, and risk by equity-relevant groups.
Access, uptake, and adherence	Nominal availability may not translate into effective access.	Model subgroup-specific uptake, adherence, and barriers to delivery.
Treatment effectiveness and harms	Average effects may not represent underserved or under-represented populations.	Use representative clinical evidence and explore heterogeneous effects.
Opportunity costs and displacement	Health losses created elsewhere in the system may fall unevenly across groups.	Estimate distribution of displaced health where evidence permits.
Implementation resources	Training, infrastructure, workflows, and monitoring may alter both costs and realised effects.	Include implementation costs and context-specific constraints.
Post-implementation outcomes	An intervention that is equitable in a model may be delivered inequitably in practice.	Use registries and real-world data to monitor access, effectiveness, and equity over time.

3.3 Equity and social justice challenges in economic evaluation

One of the most persistent challenges in economic evaluation is the limited formal incorporation of equity and justice into resource-allocation decisions. Scientific interest in this issue has increased, and several frameworks now guide the identification of equity-relevant populations, the selection of stratification variables, and the explicit consideration of value judgements (Benkhalti et al., 2021; Norheim et al., 2014). Nevertheless, routine application remains heterogeneous across jurisdictions. Recent analyses of national economic-evaluation guidance and HTA systems likewise show that equity is increasingly acknowledged, while explicit quantitative approaches remain inconsistently specified or used (Avşar et al., 2024; Patikorn et al., 2025).

Methods proposed to address equity include subgroup analysis, equity weighting, extended cost-effectiveness analysis, multicriteria approaches, and DCEA. These methods differ in their informational requirements and in the normative assumptions they make. DCEA is particularly relevant because it extends conventional cost-effectiveness analysis by estimating how health benefits and opportunity costs are distributed across population subgroups and by quantifying trade-offs between total health and inequality reduction (Avanceña and Prosser, 2021; Cookson et al., 2021).

Equity-relevant criteria and distributional consequences are receiving increasing attention in HTA and priority-setting research. Frameworks such as GPS-Health and equity-focused HTA checklists encourage explicit consideration of social groups, disease severity, financial protection, and other criteria that may not be captured by conventional cost-effectiveness analysis alone (Benkhalti et al., 2021; Norheim et al., 2014). These developments indicate that equity is moving from a peripheral ethical concern towards a more explicit component of priority setting.

However, DCEA is data intensive. Analysts must characterise baseline health, disease prevalence, intervention uptake, effectiveness, costs, and opportunity costs across relevant groups. Stratifiers may include age, sex or gender, race or ethnicity, socioeconomic position, geographic location, and other social determinants. The resulting models must capture not only

average treatment effects but also socially patterned heterogeneity in access, uptake, adherence, risks, and outcomes (Meunier et al., 2023).

Some stratification variables are comparatively easy to obtain, whereas socioeconomic deprivation, ethnicity, and intersectional disadvantage are frequently inconsistently defined or incompletely measured. This creates substantial variation in how equity is operationalised and limits comparability across diseases, technologies, and jurisdictions. Composite deprivation indices can help by combining dimensions such as income, employment, education, health, housing, and local conditions, but their construction must reflect the institutional and social context in which decisions are made (Phillips et al., 2016).

Practical implementation of DCEA also requires explicit treatment of uncertainty and transferability. Uncertainty should be explored not only for average clinical and cost parameters but also for subgroup-specific baseline health, uptake, treatment effects, costs, opportunity costs, and the social value judgements used to evaluate inequality. Transferability across settings should not be assumed: distributions of baseline health, social gradients, service access, prices, budget constraints, data definitions, and equity priorities may differ substantially between health systems. Distributional evidence should therefore be adapted and, where possible, recalibrated to the decision context rather than imported without qualification.

Clinical evidence presents an additional problem. Trials may not recruit populations that adequately represent the groups who will receive an intervention in practice. Under-representation of ethnic minorities, disadvantaged communities, older adults, or people with complex social needs reduces external validity and constrains subgroup analysis. Equity-relevant trials should therefore consider representativeness at the design stage and collect variables that permit analysis of differential effects (Hussain-Gambles et al., 2004; Jull et al., 2017; Mbuagbaw et al., 2017).

Real-world data are also necessary. Registries, administrative databases, and observational studies can reveal differences in access, adoption, adherence, and effectiveness that are not visible in efficacy trials. Post-implementation evaluation is particularly important because a technology that is equitable under model assumptions may be delivered inequitably in practice. Equity assessment should consequently extend across the technology life cycle rather than end at the reimbursement decision.

These analytical choices are inherently normative. Giving greater priority to disadvantaged groups can reduce inequality but may, in some circumstances, involve a trade-off with total health maximisation. Transparent reporting of the equity objective, the groups considered, the source of social value judgements, and the consequences for both aggregate health and distribution is therefore essential for legitimacy and accountability.

3.4 Consequences of omitting equity from economic evaluation

The most direct risk is an adverse distributional impact. If differential access and effectiveness are ignored, benefits may accrue disproportionately to already advantaged groups. At the same time, disadvantaged populations may bear a larger share of displaced services or financial burdens. Aggregate cost-effectiveness can therefore coexist with an unfavourable distributional effect.

A second consequence is epistemic: decision makers may not know who bears opportunity costs or how multiple dimensions of disadvantage interact. Conventional datasets often measure socioeconomic position incompletely and rarely capture the intersection of occupation, income, geography, ethnicity, gender, and other determinants. Weak measurement can make inequity invisible and create false confidence in apparently precise averages (Meunier et al., 2023).

A third concern is representation. When the clinical evidence underpinning HTA excludes or under-represents vulnerable populations, the external validity of the economic model is compromised. Recommendations may then be applied uniformly even though effectiveness, risks, uptake, and costs differ materially across groups. More inclusive research design and explicit equity-relevant reporting are therefore prerequisites for credible distributive evaluation.

3.5 The implementation gap in health technology evaluation

A further challenge is the disconnect between evaluation and implementation. Health technologies that are clinically effective and economically attractive may not achieve population benefit if they are not adopted, financed, delivered, or sustained. Implementation barriers can arise at patient, professional, organisational, system, and policy levels. Economic evaluation that ignores these barriers risks estimating benefits that cannot be realised in practice (Bauer et al., 2015).

Implementation also has economic consequences. Introducing a technology may require training, infrastructure, information systems, changes in workflows, communication, monitoring, and quality assurance. These resources are not incidental: they can materially alter both costs and effectiveness. Updated guidance for complex interventions and HTA increasingly recognises the importance of context and implementation costs, although a universally adopted method for integrating implementation science and economic evaluation remains lacking (Skivington et al., 2021).

Evidence from the United Kingdom suggests that implementation is often considered through stakeholder engagement and process review but remains analytically separate from the economic evaluation itself. Reviews of implementation and improvement science similarly show that economic analyses are still relatively uncommon, although their scope is becoming more comprehensive (Heggie et al., 2021; Roberts et al., 2019). A more recent scoping review identified policy cost-effectiveness, value-of-information/value-of-implementation, mixed-methods, and costing approaches, but found no single method capable of integrating all implementation considerations within economic evaluation (Heggie et al., 2024).

A more useful approach is interdisciplinary and iterative. Health economists, clinicians, implementation scientists, public-health professionals, patients, communities, and policy authorities should jointly define the pathway from evidence to delivery. This makes it possible to identify implementation resources, distributional barriers, and context-specific constraints before a coverage decision is finalised, and to reassess equity after implementation.

3.6 Methodological proposal: a strategic plan for standardising equity-relevant data

The limitations described above suggest that distributive economic evaluation cannot become routine without a stronger information infrastructure. A long-term strategy is therefore proposed for the standardisation and collection of primary data that capture variables relevant to equity. At minimum, datasets used for HTA should seek consistent information on age, sex and gender, race and ethnicity where contextually and ethically appropriate, geographic location, and socioeconomic position. Additional measures should capture dimensions of deprivation such as income, employment, education, housing, and neighbourhood conditions.

As a pragmatic policy proposal, a phased, long-term implementation horizon is suggested for harmonising equity-relevant data across clinical research, administrative datasets, registries, and health-system information. The objective is not to create a single universal index, but to establish interoperable minimum data standards, transparent definitions, and governance mechanisms that permit meaningful stratification while protecting privacy and avoiding discriminatory use. The pace and sequencing of implementation should be adapted to local data maturity, institutional capacity, and legal requirements.

The strategy should adopt an intersectional perspective. Disadvantage rarely results from a single characteristic; rather, multiple determinants can combine to shape exposure, access, treatment uptake, outcomes, and financial risk. Data systems should therefore support analyses of intersections when sample size and privacy protections permit, while avoiding the assumption that any single category fully captures vulnerability.

Standardised equity-relevant data would improve DCEA, facilitate comparison across technologies, identify evidence gaps, and support post-implementation monitoring. Over time, this infrastructure could make distributive analysis a practical component of HTA rather than an exceptional research exercise and could help align resource allocation with the goals of efficiency, fairness, and social justice.

Table 2. Phased strategy for standardising equity-relevant data for HTA

Phase	Priority action	Expected output
1. Minimum data standards	Agree on core equity-relevant variables and operational definitions appropriate to the jurisdiction.	Comparable stratifiers across studies and data systems.
2. Data harmonisation	Align definitions and coding across trials, registries, administrative sources, and routine information systems.	Interoperable data suitable for subgroup and distributional analyses.

3. Governance and safeguards	Establish privacy protections, rules for ethically sensitive variables, and transparent data governance.	Responsible use of equity data with lower risk of discriminatory application.
4. Analytical integration	Incorporate stratified baseline health, uptake, effectiveness, costs, and opportunity costs into economic models.	More credible DCEA and explicit efficiency-equity trade-offs.
5. Post-implementation monitoring	Track real-world access, adoption, adherence, effectiveness, and distributional outcomes.	Feedback for reassessment, implementation improvement, and life-cycle HTA.

4. CONCLUSIONS

Economic evaluation of health technologies has achieved major methodological advances, but aggregate efficiency alone is an incomplete basis for socially legitimate priority setting. Equity and distributive justice require explicit attention to who receives health gains, who bears costs and opportunity costs, and whether observed differences reflect avoidable or unfair disadvantage.

DCEA offers a structured way to make these trade-offs visible, but its usefulness depends on high-quality, stratified, and representative data. Better inclusion of underserved and historically under-represented populations in clinical research, stronger real-world evidence, and more consistent measurement of social determinants are therefore essential for credible distributional analysis.

The value of economic evidence also depends on implementation. Evaluations should anticipate implementation requirements and costs and should be connected to strategies that enable technologies to be adopted, sustained, and delivered equitably. Integrating economic evaluation, equity analysis, and implementation science can support decisions that are not only efficient, but also transparent, feasible, fair, and responsive to public-health priorities.

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AUTHOR CONTRIBUTIONS

Jeison Sarria-Blanco: conceptualisation, literature synthesis, methodology, and writing - original draft.

José Ivo Montaño-Caicedo: methodology, critical appraisal, and writing - review and editing.

Herney Andrés García-Perdomo: subject-matter interpretation, critical appraisal, and writing - review and editing.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest related to the preparation or publication of this manuscript.

ETHICS STATEMENT

This manuscript is a narrative and conceptual review based exclusively on published literature and does not report primary research involving human participants, identifiable human data, or animals. Therefore, review and approval by an institutional research ethics committee were not applicable.

DATA AVAILABILITY STATEMENT

No new datasets were generated or analysed for this narrative and conceptual review. All sources used in the synthesis are cited in the manuscript.

GENERATIVE AI DISCLOSURE

OpenAI ChatGPT (GPT-5.6 Sol, accessed September 2026) was used for English-language editing, grammatical and stylistic consistency, structural organisation, presentation of author-provided content, and manuscript-formatting support. It was not used to generate or analyse primary data or to determine the scientific conclusions. The authors reviewed and verified the scientific content, citations, interpretations, and final submitted version and remain fully responsible for the manuscript.

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