# Avoiding opportunity cost neglect in cost-effectiveness analysis for health technology assessment

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## Abstract

Despite being a fundamental tenet of economic analysis, there is a lack of clarity regarding the relevance of opportunity costs to cost-effectiveness analysis for health technology assessment. We argue that this is in part due to the importance of the decision context in understanding the nature of opportunity costs. Taking the example of the National Institute of Health and Care Excellence (NICE) on behalf of the NHS in England and Wales, we explore the implications of existing discrepancies between policy thresholds and emerging empirical evidence for analysts presenting results of cost-effectiveness analysis. A number of conceptually related, but distinct, issues are discussed and clarified.

## Key sentences

* The health opportunity cost of a new technology is the health that would have been generated by services no longer provided in order to accommodate the costs of the new technology.
* Many jurisdictions employ a cost-effectiveness threshold (or multiple cost-effectiveness thresholds) to inform cost-effectiveness analysis. The cost-effectiveness thresholds for a jurisdiction are termed policy thresholds. A policy threshold may or may not reflect health opportunity costs.
* Cost-effectiveness analysis should compare the health benefits of the technology to the health opportunity cost where feasible in addition to presenting results using the jurisdiction relevant policy threshold(s).
* When reporting results, analysts should clearly distinguish between results using a policy threshold from results using health opportunity costs in an audience-appropriate way.

# 1. Introduction

A recent survey of economists reveals that ‘opportunity cost’ is considered one of the most, if not the most, important concepts from economics (Modig, 2020). It is widely defined as the value of the best alternative use of the resources committed to a current or planned use. However, despite this concept being fundamental it has been described as elusive (Culyer, 2018) and difficult in application (Palmer and Raftery, 1999), and has resulted in various alternative interpretations (Ferraro and Taylor, 2005; Potter and Sanders, 2012) and neglect within public policy (Persson and Tinghög, 2020) including within health technology assessment (HTA) (Claxton, Sculpher, *et al.*, 2015). The objective of this paper is two-fold: to clarify the role of opportunity costs in cost-effectiveness analysis (CEA) for HTA, (and, as part of this, to distinguish between cost-effectiveness thresholds reflecting health opportunity costs and policy thresholds applied in HTA), and to propose a way of communicating the importance of opportunity costs in CEA so that opportunity cost neglect is avoided where possible.

The nature of opportunity costs depends upon the decision context at hand (Culyer, 2018). To focus our argument, we consider the context of decisions being made by the National Institute of Health and Care Excellence (NICE) on behalf of the NHS in England and Wales and other institutions that serve a similar role in other jurisdictions. For each HTA, health is likely to be considered as a relevant consequence, the budget is exogenous (NICE cannot increase the NHS budget to accommodate a specific technology), and NICE can neither direct disinvestment from existing NHS services in order to accommodate a new technology nor can it identify the likely disinvestment (Appleby *et al.*, 2009). This decision context means that the relevant opportunity cost, when considering health consequences, is characterised by the health effects of marginal services provided by the NHS (Claxton, Martin, *et al.*, 2015; Schaffer *et al.*, 2016). Here the word ‘marginal’ serves two purposes. First, marginal because most investment decisions command a small amount of funds compared to the entire budget. Second, marginal because they are services that are funded (de-funded) when more (less) resources are available, which means that, if there are diminishing returns to scale, the productivity at the margin is smaller than on average. Calculating the health opportunity costs of a new technology therefore turns on an inherently empirical question (Culyer, 2018), which can be operationalised by examining the health returns to variations in healthcare expenditures between health (Martin *et al.*, 2008, 2012; Claxton, Martin, *et al.*, 2015) .

# 2. The role of cost-effectiveness analysis

The role of the analyst is to provide an evidence base for (and not prescribing) decisions (Drummond *et al.*, 2015). CEA to inform a HTA on behalf of a body like NICE can estimate, for a specific consequence such as health, whether the new technology represents the best available improvement upon current or planned use of resources in healthcare at the margin. This can be quantified by estimating the net health benefit of the new technology, which is equal to the health benefits in excess of the health opportunity costs. Of course, health is unlikely to be the only relevant consequence and other net benefits, such as net consumption benefit (Walker *et al.*, 2019), can be estimated to provide additional information for the decision maker.

Present practical application of CEA to inform HTA tends to revolve around the calculation of an incremental cost-effectiveness ratio (ICER): the incremental cost of the new technology next to the relevant comparator divided by the incremental effectiveness (measured using a generic measure of health like the quality-adjusted life year, QALY). This ICER can then be compared to a cost-effectiveness threshold reflecting health opportunity costs (or a policy threshold, which may or may not reflect health opportunity costs), which is a mathematically equivalent re-formulation of the net health benefit calculation.

In the case of NICE, the policy threshold range of £20,000 to £30,000 per QALY is now part of the UK’s voluntary scheme for branded medicines between the UK government and pharmaceutical companies. This scheme caps the growth of expenditure with branded drugs, which has implications for their budget impact (DHSC, 2018c). The NICE threshold range was originally based on past decisions rather than reflecting health opportunity costs (Rawlins and Culyer, 2004; Williams, 2004) and has not been adjusted in light of subsequent empirical evidence regarding health opportunity costs generated following calls from the House of Commons Health Committee (Committee, 2008a, 2008c, 2008b). The empirical evidence regarding health opportunity costs estimates that the marginal productivity of the NHS (from 2008/09) is such that 773 QALYs are gained for every £10mn spent (or £12,936 per QALY) (Claxton, Martin, *et al.*, 2015). Based on these estimates, the UK Department of Health and Social Care uses £15,000 per QALY in their impact assessments (DHSC, 2017, 2018a, 2018b). Confusingly, however, the NICE threshold range has been justified in NICE Methods Guidance by referring to the concept of opportunity cost saying “given the fixed budget of the NHS, the appropriate maximum acceptable ICER to be considered is that of the opportunity cost of programmes displaced by new, more costly technologies” (NICE, 2013). The result is that there is an unexplained discrepancy between the policy threshold range and the empirical evidence. It is possible that the discrepancy indicates one of two things, either that there is a judgement that £20,000 to £30,000 per QALY is somehow a better estimate of the marginal cost per unit of health gained than that estimated empirically, or that the £20,000 to £30,000 per QALY threshold in fact reflects other factors besides the health opportunity cost of new technologies. If the latter is the case, then greater transparency requires that these factors and their relative importance are stated. In any case, in the absence of clarity as to the reasons for this discrepancy, the analyst is faced with a policy threshold range that is different compared to the empirical evidence on health opportunity costs, which is also found to be the case in other jurisdictions, such as Spain and Australia (Edney *et al.*, 2018).

When the policy threshold differs from the empirical estimate of the health opportunity cost we propose that results should be presented according to both. This would enable users of the research to quickly judge whether the healthcare intervention would generate a net health benefit or loss (i.e., by comparing against a cost-effectiveness threshold reflecting health opportunity costs) and whether it would be likely to be approved according to the jurisdiction-specific policy threshold.

# 3. Communication

Especially where results of cost-effectiveness analysis are presented against two different thresholds, it is critical that readers can interpret them appropriately. How best to articulate results depends on the specific audience: whether the readership is expected to be other academic health economists, clinicians, or lay people. Reporting results based on empirical evidence reflecting health opportunity costs may require additional justification since it cannot be explained by drawing reference to the precedent of approval norms and policy thresholds typically employed by the HTA body in question. However, it has the advantage of being intuitively accessible to a wide range of audiences. Simply, a programme is cost-effective if it is better value for money (in terms of health achieved) than existing services that need to be rationed to be able to afford it (Siverskog and Henriksson, 2021). The nature of the rationing will differ by context and is unlikely to centre around the complete disinvestment from a particular service. Instead, rationing may take many forms with five forms identified as deterrence, delay, dilution, deflection and denial (Hunter, 1998). Further research into mechanisms underlying health opportunity costs would help to communicate the rationale for its use in informing decision-making. While not formally validated, suggested wording for presenting results are in a blog post (Faria *et al.*, 2020). These are based on the principles outlined above, and may provide a starting point for discourse around how best to communicate these concepts to different audiences.

Communication of the principles underlying cost-effectiveness analysis has been made difficult by an over-reliance on the ambiguous term ‘cost-effectiveness threshold’, for which multiple interpretations are available. In practice it has been used to refer to a cost-effectiveness threshold that reflects health opportunity costs or to an institution’s policy threshold. In addition, another interpretation is that it reflects a societally relevant consumption value of health, perhaps that of a representative individual within society (Phelps, 2019; Basu, 2020), which is sometimes referred to as a willingness to pay or demand-side threshold (Vallejo-Torres *et al.*, 2016). When the budget is exogenous to the decision-making body, as with NICE, it is always necessary to estimate health opportunity costs using evidence on the marginal cost per unit of health and, indeed, sufficient if the only relevant consideration is health (Drummond *et al.*, 2015). This is because investing in a new technology necessarily means disinvesting from others, which has opportunity costs in terms of health losses, even if society’s willingness to pay for health is greater than the marginal productivity of the healthcare service. However, in this context, when considering benefits beyond health, the consumption value of health may also be useful to provide a common method of accounting for the value of different types of benefits (Brouwer *et al.*, 2018; Claxton *et al.*, 2019).

# 4. The consumption value of health

Unlike policy thresholds that often have no empirical basis, empirically based estimates abound for the consumption value of health. Indeed a review of 42 value of a statistical life (VSL) studies in the US context revealed a range of estimates of $40,000 to $675,000 per QALY in 2018 dollars, with the author concluding that such evidence can inform only a rough guide to an appropriate cost-effectiveness threshold (Hirth *et al.*, 2000). The conceptual basis for the VSL approach has also been called into question with Mishan (1985) pointing out that if the life ‘saved’ or ‘lost’ is known, then no compensation is possible (there is an unbounded value), which means that finite values are only possible if the life is unknown (an ex-ante valuation based on the individual facing a change in risk rather than certain death). Other empirical approaches to estimating the consumption value of health have been proposed including the use of stated preferences (as opposed to revealed preferences in the case of VSL) (Baker *et al.*, 2010), use of well-being measures in surveys to inform the trade-off between income and health (Himmler *et al.*, 2020), and calibration of models of utility functions given empirical estimates of attitudes to risk (Phelps, 2019).

It has been argued that in principle and under strong assumptions, the consumption value of health and the marginal cost per unit of health produced by the healthcare system should be equal, but that this is not supported by available empirical literature (van Baal *et al.*, 2019). In the UK, for example, government guidance indicates that £60,000 per QALY is considered to be the best estimate of the consumption value of health (Treasury, 2018), based on an estimate of VSL, while £15,000 per QALY is taken as the best estimate of marginal cost per unit of health produced by the healthcare system (DHSC, 2019; Lomas *et al.*, 2019).

Expecting differences between the consumption value of health and the marginal cost per unit of health produced by the healthcare system is considered mainstream within economics beyond health, where the marginal value of public funds (“the ratio of beneficiaries' willingness to pay for the policy to the net cost to the government”) is taken to be an empirical question in part to reflect the deadweight welfare loss associated with taxation (Finkelstein and Hendren, 2020). Crudely, in the context of healthcare in a country like the UK, the marginal value of public funds in health could be obtained as the ratio of the consumption value of health to the marginal cost per unit of health produced by the healthcare system, i.e. equal to 4 (£60,000 per QALY divided by £15,000 per QALY). Calculations of this sort may be useful in informing broader resource allocation decisions such as those made by the UK government in distributing resources across different sectors and departments.

# 5. Benefits beyond health

We have focused on the estimation of net health effects of a new technology, which is likely to represent important information to decision-makers such as NICE. Analysts may wish to quantify other net benefits to inform decision-making. An important consideration concerns whether changes in health (QALYs) are given equal weight. Decision-making bodies may require net health estimates where QALYs are weighted according to the beneficiaries’ (or losers’) baseline level of health-related quality of life, as suggested by the recent proposal to update the NICE Methods Guidance (NICE, 2020). This is often referred to an equity weight based on severity of disease. A related approach to incorporating concerns for equity is to consider the QALY beneficiaries’ (or losers’) expected lifetime health profile, which can be operationalised using distributional cost-effectiveness analysis (DCEA) (Asaria *et al.*, 2015). In either case it is logically imperative that QALYs gained by patients receiving the new technology are treated symmetrically with respect to QALYs lost due to displaced marginal healthcare services. Current approaches that do not take this into account run the risk of reducing not only population health, but also equity-weighted population health in direct contravention of the intended consequence of the approach (Paulden and McCabe, 2021).

Methods to incorporate other considerations within CEA are not as developed. These include analysing the impact of new technologies in terms of objectives beyond health such as improving consumption and considering opportunity costs resulting from costs falling on other non-health sectors. Where these factors are considered important to the decision at hand, the ‘extended impact inventory’ approach may be useful to consider (Walker *et al.*, 2019), as applied with an intervention aimed at improving air quality and an alcohol misuse intervention (Griffin *et al.*, 2020; Ramponi *et al.*, 2021). This approach attempts to quantify the impact of a new technology on a range of objectives net of the opportunity costs. Rather than combining the net impacts into a single composite metric, as would be the case in standard welfarist cost-benefit analysis, they are presented separately to the decision-maker hence the term ‘inventory’.

# 6. Other decision contexts

In this paper we have structured the discussion around the decision context faced by NICE and similar bodies. However, the concept of opportunity cost is fundamental and so should impact economic analysis across all decision contexts (Sculpher *et al.*, 2017). The application of the concept of opportunity costs to other decision contexts is a live area of research in which we encourage additional work. Notably, the context is very different in low- and middle-income countries (LMICs), where cost-effectiveness analysis is used both for HTA and also for addressing broader policy questions such as the optimal design of health benefits packages, in Malawi for example (Ochalek *et al.*, 2018). In this context, one of the primary sources of opportunity cost results from constraints imposed by donors who finance a large proportion of healthcare through vertical funding channels in Malawi – an issue not relevant to analysis in the UK context. Furthermore, opportunity costs may also exist in LMICs in terms of constraints on human resources and infrastructure to provide healthcare (van Baal *et al.*, 2018). Among other high-income countries, the context can also be markedly different. A recent study sought to quantify the health opportunity cost of expensive new technology that is financed through an increase in insurance premium in the US direct-purchase private insurance market. Here the budget is endogenous to the decision about the new technology, rather than exogenous as in the UK context, which motivates a different form of analysis that quantifies the link between an increase in premium and health losses among the newly uninsured (Vanness *et al.*, 2020).

# 5. Conclusion

As argued by Culyer (2018) the concept of opportunity costs is dependent upon the decision context. This paper has discussed the relevance of opportunity costs to decisions made on behalf of NICE in the UK. In particular, we argue that CEA in this context should include the impact of a new technology on net health, if feasible given the specific decision context, in addition to comparison to the relevant policy threshold. We hope that this contributes to avoiding neglect of opportunity costs in public policy, but also, more directly, provides a means for applied health economists (particularly those based in the UK) to not neglect opportunity costs within their CEA.

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