Chapter 2

Allocating Scarce Resources — Tools for Priority Setting

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Abstract

Given the number of priority setting tools available, which should decision-makers use and when? The choice depends critically on the nature of the decision problem. In particular, the decision-maker needs to be clear on what is to be maximized (e.g. health or welfare more generally), whether there is a budget constraint and whether any other factors (e.g. equity) need to be considered. This chapter summarizes the key strengths and limitations of commonly applied priority setting tools with a particular focus on how they differ in terms of the elements of benefit considered, how these are valued or combined, the extent to which budgetary constraints are recognized and the implicit or explicit criteria used to make a decision on adoption of the programmes being evaluated.

1. Introduction

All health care systems need some means to determine which interventions are purchased and provided for recipient populations. The issue is fundamentally one of economics: resulting from the scarcity of resources, the need to make choices and opportunity costs (benefits forgone) as a result of choices. There is potentially unlimited demand for health care

and only finite budgets with which to provide it. As a result of market failures and concern for equity,¹ most health care systems tend not to rely solely on the free market but instead reserve important roles for public authorities. Resource allocation decisions need to be made, for example, about the composition of health benefits packages (HBPs) (the set of interventions made available to the population), which new health technologies will be reimbursed and at what price, and how to develop public health programmes. The academic field concerned with the use of technical tools to inform resource allocation is broadly known as economic evaluation (Drummond *et al.*, 2015).

The normative foundations of economic evaluation were originally set in a neoclassical welfare economics framework, relying on four key tenets: the utility principle (i.e. individuals rank their preferences according to their budget to maximize their welfare); individual sovereignty (individuals themselves are best able to quantify and value their utility); consequentialism (utility is gained only from outcomes and not processes) and welfarism (the value of anything can be judged only by the utility derived from individuals with regard to it) (Culyer, 2012b). As such, improvements in social welfare can be judged only through a Pareto improvement defined where at least one individual is made better off and none are made worse off (Garber and Phelps, 1997; Weinstein and Manning, 1997). Given the paucity of changes that meet this criterion, Kaldor (1939) and Hicks (1939) developed the concept of “potential Pareto improvement”, wherein a given change will be a potential Pareto improvement if individuals made better off can compensate those made worse off while still remaining better off (Kaldor, 1939).

Economic evaluation based upon the tenets of welfare economics has a long history and has informed decisions in many sectors of the economy. However, a critique of the Kaldor–Hicks criterion is that it is almost always applied “hypothetically” (i.e. no compensation need actually be

¹Market failures in the market for health care include the relatively high levels of uncertainty around the incidence and duration of disease, asymmetric information between health care professionals and patients inhibiting the ability of individuals to make effective choices around their own health care (e.g. supplier-induced demand) and monopoly power among health care providers (Walker *et al.*, 2011).

paid) and hence some people do inevitably “win” while others “lose”. If welfare improvement is valued in monetary terms, as it invariably is in economic analysis (e.g. through measurement of willingness/ability to pay), there is a risk that the better-off make higher expressions of value but do not ever actually have to pay compensation. They would then be more likely to benefit from public programmes, with clear adverse implications for equity.

There have been notable criticisms of the use of welfarism as a normative basis for making resource allocation decisions. Amartya Sen, for instance, was critical of its restrictive assumptions and narrow definition of benefit as a function of individual utilities (Sen, 1980). He instead proposed the use of “capabilities”, which determine *how* individuals may live their lives, which have long been seen as the measure of human progress in Aristotelian philosophy (Sen, 1993; Walker *et al.*, 2011). Welfarism is also criticized on the grounds that individuals may not be the best and only judges of their welfare (Drummond *et al.*, 2015).

Similarly, the field of economic evaluation in health care has increasingly embraced an alternative normative paradigm, that of “extra-welfarism” (or “social decision-making”). The extra-welfarist approach differs from the welfarist approach in four general ways: (1) it permits the use of outcomes other than utility; (2) it permits the use of sources of valuation other than the affected individuals; (3) it permits the weighting of outcomes (whether utility or other) according to principles that need not be preference-based and (4) it permits interpersonal comparisons of well-being in a variety of dimensions, thus enabling movements beyond Paretian economics (Culyer, 2012a).

In its applications in health care, the extra-welfarist approach normally assumes the objective to be health gain. Therefore, the approach can be seen to align more closely with the core principles of many health care systems (e.g. the UK National Health Service (NHS), “About the NHS: Principles and values that guide the NHS”, 2013) of “equal access for equal need”; whereby, need can be defined as the capacity to improve health and access is in terms of the resources employed.

However, the framework of extra-welfarism also contains implicit value judgements that can be contested. The use of health gain as a sole

objective, for instance, does not accord exactly with Sen's capability approach because health is a functioning and not a capability. Similarly, if the tenets of welfare economics are accepted, the maximization of social welfare based on the individuals' subjective assessments of their utilities is unlikely to be realized by adopting an extra-welfarist approach. Furthermore, even if health is accepted as the sole maximand, society may also hold concern for distributional fairness.

The choice of economic evaluation tools can therefore appear as a complex array of approaches laden with assumptions and value judgements. This paper reviews the most common tools, offering examples of applications in low- and middle-income countries (LMICs), and providing guidance to analysts in the choice of tools and policymakers in their interpretation.

2. Understanding Available Priority Setting Tools for Use in LMICs

2.1. Review of priority setting tools

In this section, the following tools are reviewed: cost–benefit analysis (CBA), cost-effectiveness analysis (CEA), generalized cost-effectiveness analysis (GCEA), extended cost-effectiveness analysis (ECEA), multicriteria decision analysis (MCDA) and mathematical programming. In each case the key elements of the tool are described and an example of its use given. The main objective is to explore how the tools differ in terms of the elements of benefit considered, how these are valued or combined, the extent to which budgetary constraints are recognized and the implicit or explicit criteria used to make a decision on adoption of the programmes being evaluated.

2.1.1. Cost–benefit analysis

Traditional CBA seeks to maximize aggregate social welfare across the sectors of economy, where welfare is estimated based upon the tenets of welfare economics and recommendations adopt the Kaldor–Hicks criterion of compensation. As such, it is grounded in welfare economics. CBA studies

generally take a “societal approach” to valuing costs and consequences. In functioning markets, social welfare based on individuals’ preferences can be revealed through the market (Sculpher and Claxton, 2012). However, due to market failures in health care, individuals’ preferences must be elicited in order to value the consequences of implementing health care interventions. This can be achieved using different approaches to valuing health outcomes, such as the human capital approach, revealed preferences and stated preferences of willingness to pay (WTP) (Drummond *et al.*, 2005). Because all outcomes must be valued in monetary terms, CBA can be used to make allocation decisions across sectors, including the setting of budgets, in addition to that within health care.

The decision of whether or not to implement the intervention under consideration in CBA rests simply on whether the benefits outweigh the costs. Generally, CBAs do not take account of issues such as fixed budget constraints for particular sectors (e.g. health) and therefore fail to accurately reflect the opportunity costs of additional costs being imposed on these budgets. However, it is possible for CBA to reflect fixed budgets by explicitly taking account of the benefits of those activities foregone as a result of the costs imposed on the budget constraint. The challenge lies in knowing what to measure (i.e. what benefits will be forgone) and measuring it (i.e. monetizing the value of health outcomes).

Box 1 illustrates a case where WTP is used to inform health policy decisions. It makes no claims about the efficiency (in terms of improvement

Box 1. WTP for ivermectin treatment for river blindness

This study examines the costs and consequences of distributing ivermectin to treat onchocerciasis, also known as river blindness. As the treatment is free from the manufacturer, the only cost included was that of local drug distribution, which ranged from 9 Naira (US\$0.11) to 12 Naira (US\$0.15) per unit. WTP was measured using contingent valuation, and the resulting community-level median WTP ranged from 20 Naira (US\$0.25) to 30 Naira (US\$0.38). The authors conclude that WTP for local ivermectin distribution exists in these onchocerciasis-endemic communities (Onwujekwe *et al.*, 1998).

in health outcomes for its cost) of ivermectin treatment, but simply states that people would be willing to pay a certain amount for it. Estimates of WTP can be subject to people's ability to pay, which can lead to inequalities if decisions are based on WTP. However, if not influenced by ability to pay, WTP estimates can be useful in informing decisions around changing the size of the budget for health care. If society's WTP for a given health programme is greater than the cost of providing it, theoretically this is an argument for expanding the budget. However, there are very few examples of CBAs in health care (Drummond *et al.*, 2015). In the literature, the term "CBA" is also often used to describe studies that compare the costs of providing a programme with the cost savings it generates, for example by preventing episodes of illness. Some studies also consider the benefits in terms of the productivity losses averted by preventing or shortening illness episodes. However, these studies do not fall within the welfarist framework as the health benefits are not valued using individuals' preferences.

2.1.2. *Cost-effectiveness analysis*

CEA is also concerned with the costs and consequences of alternative interventions. In contrast to CBA, the use of CEA is restricted to health care programs that produce the same units of outcomes, such as cases of diseases averted or lives saved. Outcomes can be measured in comparable units of health that account for mortality and morbidity, such as quality-adjusted life years (QALYs) or disability-adjusted life years (DALYs), which enable programmes to be compared across disease areas. This approach to CEA is sometimes known as cost utility analysis (CUA) but is more often what is understood as CEA. As outcomes reflect a measure of health, rather than benefit more broadly defined, CEA is consistent with an extra-welfarist approach. This approach allows for interpersonal comparisons of outcomes beyond individuals' expressions of utility and therefore circumvents some of the troublesome equity implications of crude applications of CBA (Culyer, 2012b).

The main components of all CEAs are the cost and effectiveness data. Traditional CEA may use intermediate outcomes (e.g. reduction in blood pressure) or final outcomes (e.g. cases averted), but only final outcomes

Box 2. Cost-effectiveness of multiple policy options for HIV treatment

This study examines the cost-effectiveness of potential responses to future high levels of transmitted HIV drug resistance in antiretroviral (ART) drug-naïve populations beginning treatment. Costs include all relevant unit costs (e.g. supply chain, transport, human resources, etc.) Outcomes are valued in terms of QALYs. Costs and QALYs are discounted at a rate of 3.5% annually. The incremental cost effectiveness ratios (ICERs) for the different interventions are compared against a threshold of \$500 per QALY, which was chosen to represent a realistic maximum level at which many interventions offering similar levels of health gains remain unfunded. The authors find that at a threshold of \$500, no policy change is cost-effective, but at a threshold of \$1,000 or above and with the prevalence of pretreatment ART resistance greater than 10%, a policy to measure viral load six months after ART initiation is cost-effective (Phillips *et al.*, 2014).

can be converted into a broad generic measure of outcomes that comprise effectiveness data in most modern CEAs (i.e. those often defined as CUA) (Drummond *et al.*, 2005).

The study in Box 2 considers the cost-effectiveness of multiple policy options for HIV treatment among treatment-naïve individuals at different levels of resistance to the treatment. The outcomes are valued in terms of QALYs, a generic measure of utility that accounts for the length and quality of life (QoL). However, this is uncommon for CEAs in LMICs: as yet, little QoL research has been conducted in low-income settings on either adults or children with HIV to inform locally relevant health outcomes. Instead, decision rules are more often based on cost per DALY averted (see Section 2.3).

This study uses a decision-making threshold that represents the cost per QALY of other interventions offering similar levels of health gains that remain unfunded. In doing this, the authors have used a maximum acceptable level of cost per QALY based on past funding decisions, which aims to reflect a realistic cost-effectiveness threshold. A good estimate of the cost-effectiveness threshold (Sculpher and Claxton, 2012; Woods *et al.*, 2015), which reflects the opportunity cost (i.e. health forgone elsewhere in the system as a consequence of implementing a given intervention) is critically important in CEA.

This highlights the key difference between CBA and CEA, which is the decision rule that is used. When outcomes are valued in terms of comparable units of health, CEA takes account of the budget for health care explicitly through the comparison of an incremental cost-effectiveness ratio (ICER), which gives the additional cost per additional unit of health outcome (Sculpher and Claxton, 2012). If the ICER falls below the cost-effectiveness threshold, the intervention should be accepted. Alternatively, the decision rule can be framed in terms of either net monetary benefit or net health benefit, where interventions should be accepted if either is greater than 0. Mathematically, the decision rule is identical when using any of the ICER, net health benefit or net monetary benefit for interventions that increase costs and QALYs. Net monetary benefit involves monetizing QALYs where the number of incremental QALYs are multiplied by the value of the cost-effectiveness threshold. This appears similar to CBA where QALYs are also monetized, but in CBA the monetization is typically calculated using the consumption value of a QALY (Sculpher and Claxton, 2012).

2.1.3. *Generalized cost-effectiveness analysis*

The World Health Organization (WHO), through the CHOosing Interventions that are Cost-Effective (CHOICE) team, has played a central role in the application of CEA in LMICs with the development and use of GCEA (Murray *et al.*, 2000; Hutubessy *et al.*, 2003). GCEA studies typically estimate the cost-effectiveness of interventions at the level of whole WHO regions (e.g. sub-Saharan Africa or Southeast Asia). The approach is also grounded in an extra-welfarist framework, but this is usually not made explicit. The aim is to simultaneously evaluate a wide range of alternatives, often clustered by disease area, and to provide “broad brush” recommendations to inform more specific decision-making within jurisdictions. By providing generalized evidence, it is hoped that cost-effectiveness criteria can inform decisions in settings where more detailed analyses, reflecting localized constraints, are unlikely to be feasible to routinely undertake.

GCEA analyses begin from a “null” position whereby it is assumed that no interventions are provided within a health care system and the

task is to build up the set of interventions for provision. This is in part motivated by a concern that use of CEA is often dominated by prospective studies of new interventions compared to current practice, and the potential of larger scale changes in the health sector and identifying appropriate disinvestment opportunities remains unrealized (Murray *et al.*, 2000). However, a problem with assuming a null situation is this does not reflect how existing health care infrastructures need to be adjusted to deliver interventions. Therefore, the real-world costs of implementation are typically underestimated and new interventions may be deemed “cost-effective” whereas the cost of implementing them may be greater than is reflected in the analysis.

A notable, although somewhat cosmetic, difference between generalized and conventional CEA is the choice of outcome measure. Whereas CEA would usually present health outcomes in the form of QALYs, GCEA studies use the DALY measure. Both measures combine morbidity and mortality effects into a single generic unit, but instead of being a measure of health gain, DALYs — which have their origins in burden of disease studies — are a measure of health loss from full and healthy life expectancy. Disability is a more restricted measure of health-related QoL (HRQoL) as represented by QALYs and relates only to functional status. However, DALYs are widely used in studies in LMICs, because of their endorsement by the WHO and because QALYs estimates are not available for many countries (Kularatna *et al.*, 2013).

GCEA assesses whether or not interventions are “cost-effective” based upon the per capita income in a country. Interventions that offer ICERs at less than three times gross domestic product per capita (GDP pc) are deemed “cost-effective” and those at less than one times GDP pc as “cost-effective”. Whereas strict application of these decision rules may not be in the spirit of GCEA in providing “broad brush” recommendations to decision-makers, they have been widely used in both GCEA and CEA applications to LMICs. These benchmarks have, however, been criticized as being aspirational and not reflective of what is known about the likelihood of opportunity costs resulting from the use of limited health care budgets (Sculpher and Claxton, 2012; Woods *et al.*, 2015). Their use therefore risks reducing population health and exacerbating health care inequalities. Box 3 provides an example of GCEA.

Box 3. Cost-effectiveness of introducing the RTS,S malaria vaccine

This study examines the cost-effectiveness of the RTS,S malaria vaccine, which reduces the likelihood of contracting malaria from an infected mosquito, compared to non-vaccination. Costs are taken from a societal perspective and include provider costs, including the cost of the vaccine and case management, as well as out-of-pocket (OOP) patient costs. Outcomes are measured as DALYs averted. The authors present ICERs for a range of numbers of infectious bites per year, and compare these to a range of decision thresholds using cost-effectiveness acceptability curves (CEACs). Results are presented for both undiscounted costs and DALYs averted and with both discounting using an annual rate of 3%. They find that the introduction of RTS,S would be most cost-effective in settings with low levels of malaria exposure (Maire *et al.*, 2011).

2.1.4. Extended cost-effectiveness analysis

Policymakers and the public are often concerned with maximizing more than just health, and researchers may therefore wish to reflect these other societal preferences explicitly within their decision-making. ECEA aims to incorporate the equity effects of interventions and policies on health as well as financial risk protection outcomes to assist in decisions around extending the coverage of existing interventions/policies. It provides information on the consequences of the programme or intervention disaggregated across different population strata relevant to the decision (by, for example, geography or socio-economic status); first, in terms of health gains and, second, in terms of financial risk protection (as measured by, for example, household expenditure averted). The tool gives policymakers a “dashboard” of information on the joint benefits and tradeoffs in terms of equity in health and financial risk protection associated with different health interventions. Box 4 provides an example.

The study in Box 4 considers deaths averted and private expenditures averted as outcome measures. While these measures are relevant to diarrhoea in this particular context, failing to use a generic measure of utility (e.g. QALY, DALY, etc.) means that these estimates cannot be compared to estimates from other ECEA studies where a different

Box 4. An ECEA of treatment and prevention of diarrhoea in Ethiopia

This study assesses the impacts of universal public finance (UPF) of diarrhoeal treatment alone compared to diarrhoeal treatment along with rotavirus vaccination in children under-five in Ethiopia across socio-economic quintiles. The authors first calculate the baseline number of deaths due to diarrhoea and rotavirus by quintile, and then estimate the number of deaths that would occur by quintile following the introduction of UPF of diarrhoeal treatment and the introduction of UPF and rotavirus vaccine combined. For the financial protection measure, the authors calculate private expenditures averted by each intervention as a function of the number of diarrhoeal episodes, the probability of seeking treatment, the associated costs and the proportion of those costs being paid OOP. They find that without factoring in private expenditure averted, the cost per life saved is lower from the intervention with both rotavirus vaccination and diarrhoeal treatment, and thus this intervention dominates (Pecenka *et al.*, 2015).

outcome measure is used, and particularly if changes in quality, as opposed to length, of life are the primary outcome. Different ECEAs may use different health outcome measures (e.g. deaths averted and life years (LYs) gained) as well as different measures of financial risk protection (e.g. reduction of private expenditure and reduction in impoverishing health care expenditures). As such, they may not be directly comparable. Common to these and all ECEA studies is that interventions are assumed to be funded by the tax system, and therefore no account is taken of the opportunity costs falling on the budget for health care, when in reality most health interventions are funded through the health care system and displace health gains elsewhere in the system.

Distributional cost-effectiveness analysis (DCEA) offers an alternative framework for incorporating equity concerns into CEA. Unlike ECEA, DCEA allows for the analysis of multiple distributional variables in addition to wealth quintile group. DCEA is set within an extra-welfarist framework that incorporates society's concern for the distribution of health as well as overall health gains. When a setting-specific inequality aversion parameter is specified, DCEA can be used to determine the strategy that results in the best improvement in both average health and

reduction in unfair health inequality in the population. As DCEA is relatively new, to date there have been no applications of DCEA in LMICs or HICs. Asaria *et al.* (2015) apply DCEA to compare alternative ways of implementing a Bowel Cancer Screening Programme (BCSP) in the UK.

2.1.5. *Multicriteria decision analysis*

MCDA is an approach that can be used to assist policymakers in choosing between options where there are two or more relevant criteria. The two main criteria in making choices in health care are efficiency and equity, as discussed before in the context of ECEA and DCEA. However, policymakers may wish to introduce other considerations, such as severity of disease, potential for poverty reduction or the recipients of the health programmes being considered. Of course, many criteria are considered, albeit informally, whenever decisions are made, but MCDA can contribute to the transparency and accountability of the decision-making process by providing an explicit organizing framework.

There are several key steps in conducting an MCDA, including structuring the decision problem, specifying the relevant criteria, measuring the programmes' or alternatives' performance against the criteria, scoring the alternatives on the criteria and weighting the criteria and applying the scores and weights to rank the alternatives. There are several approaches for scoring and weighting, including point allocation and discrete choice experiments. This latter approach, often favoured by economists because of its theoretic foundations in random utility theory, involves asking decision-makers to choose between sets of options that meet the various criteria (attributes) to different degrees (levels).

MCDA has been widely applied in priority setting in LMICs. Jehu-Appiah *et al.* (2008) discuss how MCDA was used to guide the Ministry of Health in Ghana to set priorities between interventions (see Box 5). Mirelman *et al.* (2012) applied a similar methodology to explore the preferences of policymakers for efficiency and equity criteria in Brazil, Cuba, Nepal, Norway and Uganda. Baltussen *et al.* (2013) illustrate how MCDA could be used to improve decision-making in the HIV programme in South Africa.

There is still debate among analysts on how best to conduct MCDAs, although some proposals for good practice have been suggested (Marsh *et al.*,

Box 5. Balancing equity and efficiency in health priorities

In this study, MCDA was used to quantify the trade-off between equity, efficiency and other societal concerns in health priority setting in Ghana. Several criteria were defined: number of potential beneficiaries, severity of disease, cost-effectiveness, poverty reduction and vulnerability of the (recipient) population (e.g. not vulnerable, children <5 years, women of reproductive age, old people >65 years). Discrete choice experiments were conducted with policymakers to determine the relative importance of the criteria. Respondents chose their preferred intervention from sets of hypothetical interventions, each consisting of a bundle of criteria that described the intervention in question, with each criterion varying over a range of levels.

The results showed that interventions that target vulnerable populations, (very) severe diseases, many beneficiaries, diseases of the poor and are (very) cost-effective have a higher probability of being selected than interventions without one of those characteristics. The relative contributions showed that the targeting of vulnerable populations was the most important criterion, followed by cost-effectiveness, severity of disease and number of potential beneficiaries. In the rank ordering of interventions, childhood interventions had the highest probability of selection, followed by most interventions targeting communicable diseases, plus two reproductive health interventions (Jehu-Appiah *et al.*, 2008).

2016). One particularly important issue is how to incorporate cost-effectiveness as a criterion. In the study by Jehu-Appiah *et al.* (2008), “costs” and “effects” were combined into a single attribute “cost-effectiveness”, which was then traded off against the other attributes. An alternative approach would be to define the utility/attractiveness of an intervention on the basis of all criteria except “costs” and then to link this estimate to costs in a cost-utility analysis/CEA (Jehu-Appiah *et al.*, 2008). The advantage of this approach is that it explicitly reflects the opportunity costs of selecting a given programme in terms of the other alternatives that are forgone, or displaced.

Programme budgeting and marginal analysis (PBMA) is another approach that allows multiple criteria to be applied to the assessment of programmes. Some criteria may directly relate to efficiency and equity, others may relate to organizational and managerial objectives. PBMA can

be used to determine how a particular budget can be spent optimally, according to the decision-makers' stated criteria, by investing more in some programmes and disinvesting in others. Our literature review did not find any applications of PBMA in LMICs, but Ball *et al.* (2009) used PBMA to determine the priorities for investment and disinvestment in mental health services in a health authority in the United Kingdom, and Mitton *et al.* (2011) used the approach to determine disinvestment and investment opportunities in a health authority in Canada that was experiencing funding cuts.

2.1.6. *Mathematical programming*

All of the tools presented so far can be viewed as offering “partial” solutions to larger and more complex underlying resource allocation problems. The extent to which and how the tools reflect the larger challenge of constrained optimization of population health benefits from within available resources differs across them. For instance, CEA uses the notion of a cost-effectiveness threshold to reflect the shadow price of the budget constraint whereas traditional CBA would implicitly assume the available budget will adjust to the level required for the funding of the evaluated interventions. A weakness of others, in particular ECEA and MCDA, is that they can be relatively detached from such notions and often do not explicitly consider opportunity costs.

Increasingly, as information improves and computing power increases, analyses are exploring the use of methods — in the form of mathematic programming — to directly inform the full allocation of available resources. In principle, mathematical programming can inform how much to spend on what interventions, for whom, when and where within a country — all while remaining within budget. Box 6, for instance, outlines the use of mathematical programming to allocate the HIV budget in Zambia. The national planner/budget holder's problem is, in effect, solved.

The reason full budget allocation models are not more widely used is that they are difficult to implement and their informational requirements are immense — requiring knowledge of the costs and benefits of all feasible alternatives, for all policy areas. Also, they tend to rely on the

Box 6. Prioritizing the allocation of HIV resources in Zambia using mathematical programming

This study uses the Optima mathematical programming model to address the question of “How can HIV funding be optimally allocated to the combination of HIV response interventions that will yield the highest impact?” It both informed the allocation of different given levels of resources and estimated the financial commitments required to meet the national strategic targets.

The model was populated using demographic, epidemiological, sexual behaviour, service use/existing coverage, as well as economic and cost data and was calibrated to the HIV epidemic in Zambia. The relationship between expenditure and outcomes was then established using a mathematical optimization process.

The allocation of resources across HIV programmes depends upon the level of resources available. At 70% of the current budget, funding should be prioritized to HIV treatment and prevention of mother-to-child HIV. If funding were to increase beyond current levels, other interventions such as male circumcision and behavioural change should start to be considered (Masaki *et al.*, 2015).

available budget being known, and fixed, so cannot easily inform the allocation of resources between budget areas. Moreover, as everything is estimated at once, the full models need to be re-estimated once a new intervention or piece of information becomes available. Nevertheless, it is likely such approaches will become increasingly prominent as information and computing power further improves in future.

3. Discussion

Given the number of priority setting tools available, which should decision-makers use and when? The key strengths and limitations of each of the tools are summarized in Table 1. It can be seen that no single tool is superior in all respects, so the choice of tool depends on the decision problem being faced and the particular philosophy the decision-maker wishes to apply.

Table 1. Key features of priority setting tools.

Tool	Strengths	Limitations
Cost–benefit analysis (CBA)	Can inform broad comparisons of programmes having both health and non-health benefits.	In practice, benefit measurement often focuses on productivity gains. Policy choices may lead to inequalities if WTP is constrained by the ability to pay. Assumes that the budget will be increased to accommodate the new programme.
Cost-effectiveness analysis (CEA)	Using a generic measure of health gain (i.e. QALYs or DALYs), comparisons can be made among all health programmes. The opportunity cost of new programmes, in terms of health forgone in displaced programmes, can be identified.	Benefits are restricted to health gains. Normally assumes all QALYs are of equal value.
Generalized CEA (GCEA)	An internationally standardized approach, allowing cross-country comparisons. Can provide “broad brush” recommendations to inform more specific local decision-making.	Assumes a “null alternative”, of no current interventions/costs, which may not be realistic. DALYs focus on disability, not HRQoL, more generally. The decision-making threshold often used has been aspirational and does not reflect the budget constraint.
Extended cost-effectiveness analysis (ECEA)	Explicitly considers the impact of programmes on equity, alongside efficiency/cost-effectiveness.	Decision-makers still need to make their own trade-off between efficiency and equity.
Distributional cost-effectiveness analysis (DCEA)	Explicitly considers the impact of programmes on defined subgroups of the population.	The relevant subpopulations need to be specified (e.g. socio-economic status, gender, age).

Table 1. (Continued)

Tool	Strengths	Limitations
Multicriteria decision analysis (MCDA)	Enables the consideration of other relevant attributes of programmes in addition to their impact on health.	The opportunity cost of new programmes, in terms of health forgone in displaced programmes, is not identified. The relevant criteria, and the weights to be assigned to them, need to be specified.
Programme budgeting and marginal analysis (PBMA)	Enables the consideration of other relevant attributes of programmes in addition to their impact on health. Disinvestment options can be considered alongside new investments in programmes.	The relevant criteria, and the weights to be assigned to them, need to be specified.
Mathematical programming	Directly answers the overall problem of allocation given resources.	Information- and data-intensive, and must be re-estimated whenever something changes.

For example, if the interest is solely in health gain, perhaps because the decision-maker feels that this is the most legitimate use of the health care budget, then one of the forms of CEA could be the most useful tool. CEA could also be a favoured tool in situations where the decision-makers are conscious that they are operating with a fixed budget and are therefore keen to understand the opportunity cost, in forgone health, of the displacement of existing programmes when new ones are introduced.

On the other hand, if other benefits of programmes, beyond health gain, are considered relevant, a favoured tool could be CBA, if it could be appropriately applied using WTP as the measure of benefit. However, if CBA is used, it should be remembered that this approach implicitly assumes the budget will be increased to accommodate the new programme. If the budget is fixed, it is possible that programmes generating more health could be displaced. Also, if the major additional factor to be considered beyond health gain is equity, decision-makers should be wary of using CBA as it may lead to inequalities. In this situation, a preferred

tool would be ECEA or DCEA. In addition, MCDA or PBMA could also be used to consider equity or other attributes of programmes beyond health gain. However, with MCDA it is not easy to identify opportunity costs if operating with a fixed budget and care has to be taken over how “cost” or “cost-effectiveness” is incorporated in the approach.

Nevertheless, MCDA and GCEA are useful “broad brush” approaches for considering a wide range of policy options, whereas the other forms of CEA and CBA usually involve a detailed analysis, meaning that it is only possible to consider a small number of alternative programmes/options in a given study.

Another possibility would be to use two or more of the tools in conjunction with one another. For example, in a project to determine which health programmes and treatments should be included in the health benefit package in Thailand, Youngkong *et al.* (2012) used MCDA to judge the broad acceptability of programmes against several general criteria, but then used CEA to assess the cost-effectiveness of a short list of treatment options in more detail.

Ultimately, however, all approaches are concerned with informing the allocation of the given available resources. If full information on the costs and consequences of all possible alternatives is available, and the budget is known, an approach of mathematical programming could inform the optimal allocation of all resources.

In conclusion, users of these approaches to priority setting should recognize that each approach has its strengths and weaknesses. The choice among them depends critically on the nature of the decision problem. In particular, the decision-maker needs to be clear on what is to be maximized (e.g. health or welfare more generally), whether there is a budget constraint and whether any other factors (e.g. equity) need to be considered.

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