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**Resource allocation and priority setting in health care:  
A Multi-Criteria Decision Analysis problem of value?**

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## **Abstract**

There is a need for a methodological approach for allocating health care resources in an efficient and fair way that gives legitimacy to decisions. Currently, most priority setting approaches tend to focus on single or limited benefit dimensions, even though the value of new health care interventions is multi-dimensional. Explicit elicitation of social value trade-offs is usually not possible and decision-makers often adopt intuitive or heuristic modes for simplification purposes given these multi-criteria problems, leading to *ad hoc* decisions which might diminish the reasonableness and credibility of the decisions.

In this paper, we suggest that multi-criteria decision analysis could provide a more comprehensive and transparent approach to systematically capture decision-makers' concerns, compare value trade-offs and elicit value preferences. We conclude that such methods could inform the development of a facilitated decision support system for decision-making in health care, contributing towards a more efficient, rational and legitimate resource allocation.

## **1 Background**

One of the foremost challenges health care systems are facing is the scarcity of resources in combination with rising demand for services, putting their sustainability in danger. As a result, decisions relating to the allocation of health care resources has been inevitable, either between different competing services and interventions (i.e. priority setting) or across different patients (i.e. rationing). However, the methodological approach of allocating resources in an efficient and fair way that gives legitimacy to decisions has been far from obvious<sup>1-6</sup>. This is in large part due to i) the complexity of the decisions, as a variety of different factors and objectives need to be balanced through the involvement of a range of stakeholders, ii) the importance of the decision outcomes, as they have a dramatic impact on human health, and iii) the ethical and social responsibilities behind the provision of health care which traditionally has been perceived as a government duty, given that health is often regarded as a public good or even a human right.

## **2 Resource Allocation Methods in the British National Health Service**

The British National Health Service (NHS) provides an insightful case study of how priority setting in health care evolved through the interplay of scientific advancements, culture changes and politics. As a result, priority setting today takes place across all levels of the organisational hierarchy of the British health care system: the central government sets the overall budget of the NHS, commissioners and providers determine their purchases among alternative services and interventions, and clinicians allocate their time and resources <sup>7</sup>.

Already in 1993 in the UK, “micro-decisions about priority setting [were] constrained by macro-decisions about resource allocation taken at superior levels in the organisational hierarchy”<sup>8</sup> (p.309), in an almost identical landscape where cabinet decided on the NHS budget, Department of Health decided the priority targets, and purchasers decided on services <sup>8</sup>.

In general terms, in a multi-level context of priority setting, rationing can be implemented in various ways: rationing by deterrence, when obstacles to patient access are imbedded; rationing by deflection, when the responsibility of service provision is passed on to another agency; rationing by dilution, when the quality of service declines; rationing by denial, when a particular treatment is refused to get funded; and rationing by selection, when a treatment is only allowed for a particular population sub-group <sup>7,9</sup>. In the UK, rationing by deterrence or delay was possibly the first of these models to emerge, with Roy Parker describing this approach in the mid-70s <sup>10</sup>. The other rationing instruments have been applied for at least two decades in the country, possibly with the exception of the relatively harsher approaches of rationing by denial and selection which became more abundant in recent years due to increased fiscal pressures <sup>8</sup>.

The decision-making tool used for budget distribution has not changed either. The quality adjusted life year (QALY), which is calculated by multiplying the value of each health state by the respective length of time of each state, provides a summary measure of total health improvement. It can be used as a simple tool for resolving complex choices, and it is the most widely used measure of health status for the assessment of health benefits <sup>11-13</sup>. However, it had been argued that the QALY is flawed as a way of priority setting in health care <sup>14</sup> and that it only partly reflects an individual’s true preferences <sup>15</sup>. Furthermore, it has been claimed that the QALY is “beset by methodological problems about the valuation of different states of health,

by lack of data about incomes, and by the problem of patient heterogeneity”<sup>8</sup> (p.310). Klein has therefore claimed that the priority-setting process was not “rational” but instead priorities were “emerging from pluralistic bargaining between different lobbies, modified by shifting political judgements made in the light of changing pressure”<sup>8</sup> (p.310). In doing so though he argued that given the multiplicity of conflicting values in such discussions, the idea of “a machine grinding out priorities” and making decisions for us would be “absurd”, and that the limitation of pluralistic bargaining was that it was not pluralistic enough but instead dominated by some (clinical) voices. As a consequence, he suggested that in order for the process to become more rational the technical characteristics of the decision-making process should be improved, according to an “open dialogue, [...], in which arguments can be tested against evidence and the conflicts between different values or preferences can be explored”<sup>8</sup>(p.310), a rationality concept that he acknowledged goes back to Aristotle’s work of finding “good reasons” to justify decisions<sup>16</sup>.

A consensus has now been reached that emphasis should be placed on the process of decision-making in order to assess the efficiency and fairness of decision outcomes. Daniel and Sabin’s Accountability for Reasonableness ethical framework has been cited by most for this reason<sup>17</sup>, which states that for decisions to be fair and legitimate their processes should meet a number of conditions: they should be publicly available, based on relevant reasoning, and revisable in light of new evidence, all three conditions of which could be assured through enforcement mechanisms (i.e. regulation)<sup>18</sup>. Given that allocation of resources is also a political process, the application of such an ethical framework is very much needed.

### **3 Explicit Priority Setting Efforts in Different Countries**

Priority setting in many countries was introduced through the form of explicit efforts taking place between late 80s and early 90s but it was only more recently that its necessity was widely acknowledged<sup>19,20</sup>, as an insightful review on the priority setting efforts of eight countries has indicated<sup>21</sup>.

In the US, the state of Oregon during the late 80s realised that there was no effective and accountable way of allocating resources through the Medicaid programme. As a result, the Health Services Commission was created in 1989 with aim of developing a list of prioritised services that would be entitled to the whole

targeted population <sup>22-24</sup>. The strategy behind this approach was to ration by excluding services, rather than by excluding people. The cut-off threshold on the list of services would take place following their cost-effectiveness ranking and up to the point that the Medicaid budget allowed for. Due to public dissatisfaction of the emerging services, however, the methodology was modified to include more broadly defined criteria.

In the Netherlands, in 1990, the Committee on Choices in Health Care (also known as the Dunning Committee) was created for the purpose of priority setting and came up with a set of four priority principles: necessity, effectiveness, efficiency and individual responsibility <sup>25,26</sup>. Necessity referred to whether the intervention could provide medical benefit, effectiveness related to the evidence base supporting the effect of the intervention, efficiency was a synonym of whether the intervention was value for money, and the last principle was meant to deduce whether it would be acceptable for services to be paid from individuals themselves. These principles should be successively applied in that order (from necessity up to responsibility), essentially acting as a strainer for filtering the priority of the services and therefore eliminating the non-essential services whose provision would be excluded. The final outcome of the so called “Dunning’s funnel” approach was a basic package of services that would be funded.

Similar to the Netherlands, the Parliamentary Priorities Commission was implemented in Sweden in 1992 to define a minimum level of health and medical care services that could be offered to all its citizens therefore acting as a basic measure of “security” <sup>27</sup> and decided that priority setting should take place following a set of three core principles: human dignity, need and solidarity, and cost-efficiency <sup>28</sup>. However, the case of the cost-efficiency principle should only be used to compare interventions for the same indication, and measures of effectiveness that incorporate quality of life dimensions such as the Quality Adjusted Life Years (QALYs) should not be applied across diseases. In 1994, a second committee was convened with the aim of eliciting public preferences which up to that time were not reflected at all in the process.

In New Zealand, the National Advisory Committee on Core Health and Disability Support Services was established in 1993 to evaluate through discussions which services should be included in the publicly funded health package <sup>29,30</sup>. In addition to projected budget impact for common conditions and to eligibility criteria

for the case of specific services, a set of principles was also set out to guide priority setting decisions: equity, efficiency and acceptance. However, further criteria and principles, and therefore priorities, emerged following the continuing engagement of the Committee with clinicians and members of the public. In 1996 the Committee was renamed to National Health Committee (NHC) with the task of meeting annually to re-evaluate services based on new evidence.

It was only following the introduction of explicit efforts in other countries, and particularly the New Zealand experience which by some was perceived to be more suitable for the British environment due to its “pragmatic” rather than “principle” based approach, that the debate in the United Kingdom clearly leaned in favour of priority setting <sup>31-35</sup>. The Royal College of Physicians itself recommended that a National Council for Health Care Priorities should be created "to identify all the relevant issues, analyse them publicly and comprehensively, and satisfy all interested parties that their views are being considered" <sup>36,37</sup> (p.767). And although it was clear that the driving power behind such an establishment was the fact that resource allocation decision problems would never cease to exist due to ever ongoing technological advancements and evolving patient expectations, therefore suggesting a continuing debate <sup>32</sup>, the operational responsibilities and technical characteristics of such an institution were still unclear <sup>31</sup>. Consequently, the National Institute of Clinical Excellence was formed in 1999 (now called the National Institute for Health and Care Excellence) with the overall aims of promoting good health and preventing and treating ill health while ensuring equity in access and resolving uncertainty throughout England and Wales <sup>38</sup>. Its responsibilities included the appraisal of new and existing health technologies based on clinical and cost-effectiveness grounds, the development of clinical guidelines, and the development of audit methodologies. In relation to technology appraisals, NICE recommendations are binding to clinical commission groups (primary care trusts) which have to fund the respective technologies.

#### **4 Resource Allocation and Health Technology Assessment: A Decision Analysis Problem**

Due to the different levels at which resource allocation needs to take place, and the fact that priority setting is a process focusing on the general population in contrast to

the process of rationing which focuses on individual patients, a mix of slightly opposing principles act as objectives for resource allocation<sup>7</sup>. On the one hand there is the purely utilitarian principle of maximising the health impact on the whole population<sup>39</sup>, and on the other hand there is a set of, usually secondary, ethical objectives relating to the distribution of health that mainly aim to prioritise interventions which target the more vulnerable<sup>40</sup>, such as the poor<sup>41</sup>, seriously sick<sup>42</sup>, and women and children<sup>43</sup>.

In theory these objectives could be operationalised through the application of a plurality of criteria, most of which are characterising either the intervention under consideration or the condition (i.e. disease) it is indicated for. The intervention is usually assessed through the notion of benefit risk-ratio, essentially an evaluation metric reflecting whether the benefits of implementing the intervention outweigh the risks, by accounting both for the impact on health and the impact on resources needed. The condition is assessed through its burden or severity, which is usually approximated through its seriousness (morbidity and mortality related) and the availability of treatments.

As Baltussen and Niessen have described, a number of such rational priority setting approaches have already been developed over the last 20 years, but all of these tend to concentrate on single or limited value dimensions<sup>44</sup>. These include the dogma of evidence based medicine for prioritising interventions according to their established effectiveness<sup>45,46</sup>, economic evaluation methods (such as cost-effectiveness analysis) for prioritising according to efficiency by accounting both for outcomes and costs<sup>47,48</sup>, burden of disease estimates for prioritising diseases according to their burden (through morbidity and mortality)<sup>49</sup>, budget impact analysis for prioritising interventions according to their impact on resources<sup>50</sup> and equity or ethical analyses for prioritising according to distributional impact<sup>43</sup>. However these methodological approaches provide limited support to decision makers given that their findings cannot be combined nor can their value trade-offs be elicited, therefore not allowing to be appraised and compared altogether<sup>44</sup>.

Most of the current value assessment approaches adopted as part of Health Technology Assessment (HTA) mainly consider (comparative) clinical efficacy with or without clinical cost-effectiveness, while increasingly incorporating real world evidence, therefore capturing value concerns relating to comparative effectiveness and efficiency<sup>51</sup>. Still, although different countries might assess similar types of evidence,

the specific evaluation criteria and endpoints used to derive clinical benefit and determine overall value, their level of provision and requirement as well as the way they are incorporated (e.g. explicitly vs. implicitly) varies across countries, with their relative importance remaining generally unknown<sup>52</sup>.

The value of new health care interventions is multi-dimensional and not strictly limited to clinical benefit and cost but spans the disease severity and target population size, the nature of the intervention and whether, for example, it is curative or preventive, and economic impact and budgetary constraints, alongside other factors such as the evidence quality<sup>44,52-54</sup>. Therefore, these value assessment methodologies are inadequate and at best partial because the evaluation criteria used to assess evidence and determine value are incomplete. Many important social value considerations falling under the burden of disease which the treatment addresses, the treatment's innovation level and its overall socioeconomic implications are not appropriately incorporated in the evaluation process<sup>55</sup>. These value dimensions are not always considered, and if they are, this might be done in an implicit and non-methodical or structured manner, such as through committee deliberation as in the case of life-extending end-of-life (EOL) treatments in England with NICE or orphan drug modifiers in Scotland with the Scottish Medicines Consortium (SMC)<sup>55,56</sup>, thus raising important questions about the transparency and consistency of the whole process<sup>57</sup>. In addition, there are technical issues in achieving consensus on value, including how to derive and incorporate the relative importance of each criterion and elicit their value trade-offs. Ultimately, an explicit definition of value that relies on a comprehensive set of parameters is missing in HTA<sup>58</sup> and value could be regarded as an elusive concept given that a multitude of evaluation criteria (of varying intensity) are applied differently across settings in a non-systematic or transparent manner<sup>52</sup>.

To simplify the complexity of these multi-criteria problems in value assessment and resource allocation, decision-makers might use intuitive or heuristic approaches but as a consequence important information might get lost or under-utilised therefore giving rise to an *ad hoc* priority setting process<sup>44</sup>. It could therefore be suggested that they are not well equipped to make well-informed and rational decisions under these complex conditions which require the elicitation of multiple trade-offs and the construction of value preferences across a range of scientific and societal values, which could diminish the reasonableness of the decisions and their credibility<sup>59,60</sup>.

## **5 Multiple Criteria Decision Analysis in Health Care: An Answer to a Multi-Criteria Problem?**

The need has arisen for a rational methodological approach that can aid decision-makers to understand, elicit and construct their preferences across a multitude of value concerns in a transparent way. Such an approach could help to improve the efficiency of resource allocation decisions across the field of health care with the ultimate goal of maximising societal welfare.

Decision-makers have shown interest in incorporating additional dimensions of value through the use of multi-criteria methods <sup>61</sup>. These include the European Medicines Agency (EMA) for benefit risk assessment <sup>62</sup>, the Institute of Medicine in the US for prioritising vaccines <sup>63</sup>, the Institute for Quality and Efficiency in Health Care (IQWiG) in Germany for distinguishing between multiple clinical endpoints <sup>64</sup>, as well as the National Institute for Health and Care Excellence (NICE) in England for the assessment of ultra-rare therapies <sup>65</sup>. As a result, it would be expected that decision-makers and other stakeholders would benefit from clear and comprehensive ways that allow them to assess all critical value dimensions of new health care interventions, in order to make rational decisions about resource allocation and priority setting.

Decision analysis could provide the foundation for an alternative way of measuring and eliciting the value of new therapies as it provides a comprehensive approach for quantitative modelling <sup>66</sup>. It was originally defined by Howard as “a logical procedure” for balancing the factors that influence a decision allowing to incorporate values, preferences and uncertainties in a basic structure to model the decision <sup>67</sup>. The logic of decision analysis was then described by Raiffa as “divide and conquer: decompose a complex problem into simpler problems, get one’s thinking straight on these simpler problems, paste these analyses together with logical glue, and come out with a program of action for the complex problem” <sup>66</sup> (p.271).

More specifically, multiple criteria decision analysis (MCDA) has been suggested as the most comprehensive approach to quantitative benefit-risk modelling of new medicines <sup>68</sup>, enabling all favourable and unfavourable effects to be presented as quantified utilities or values <sup>69</sup> and has been proposed as a pragmatic way to

aggregate different elements of value for the purpose of operationalising value-based pricing <sup>70</sup>.

The MCDA methodology acts both as an approach and a set of techniques, ordering a set of alternative options by looking at the degree to which a number of objectives are achieved <sup>71,72</sup>. It is a way of eliciting preferences for a sum of options which are characterised by varying levels of performance with respect to a number of, often conflicting, objectives; it does so by disaggregating a complex problem into simpler components or objectives, measuring the performance of options against the objectives, weighting up these objectives according to their relative importance, and re-assembling the components by aggregating scores and weights to show the overall picture <sup>66,71</sup>. Although a number of different MCDA methodologies and techniques exist they share a number of common phases involving the definition of the decision problem, understanding of value concerns, identification of alternative options, assessment of options' performance, establishment of value trade-offs between the criteria and an overall elicitation of aggregated value preferences for the options (Table 1) <sup>71-75</sup>.

**Table 1: The methodological process of Multiple Criteria Decision Analysis**

<i>Decision-making phase</i>	<i>Decision analysis tasks</i>
Definition of the decision problem	Frame the decision context, analysis aim, decision makers and key stakeholders
Understanding of value concerns	Establish the objectives of the decision-makers and choose criteria to measure them
Identification of alternative options	Identify the decision alternatives to be assessed against the criteria and collect evidence on their performance
Assessment of options performance	Describe the consequences of the options and score their desirability
Establishment of criteria value trade-offs	Assign criteria weights to reflect their relative importance to the decision

Elicitation of overall value preferences	Aggregate scores and weights together to produce overall weighted value preference scores
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One of the key aims of MCDA techniques is to help decision-makers to reach a decision by laying out the problem, objectives, values and options they are faced with in a clear and transparent way. This is achieved by organising, synthesising and summarising information to decision-makers, which is of complex and, often, of conflicting nature <sup>73</sup>. It should be noted however that although MCDA can aid the decision-making process, it cannot replace decision-makers' judgement or experience <sup>73</sup>; instead, it can supply detailed information for a comprehensive set of parameters of interest to decision-makers and help them elicit value trade-offs, while allowing to incorporate the value preferences of other stakeholders. Overall, MCDA acts as an aid to decision-making, seeking to explicitly integrate objective measurement with value judgement in a structured and transparent way.

## 6 Multiple Criteria Decision Analysis as a Decision-Making Tool

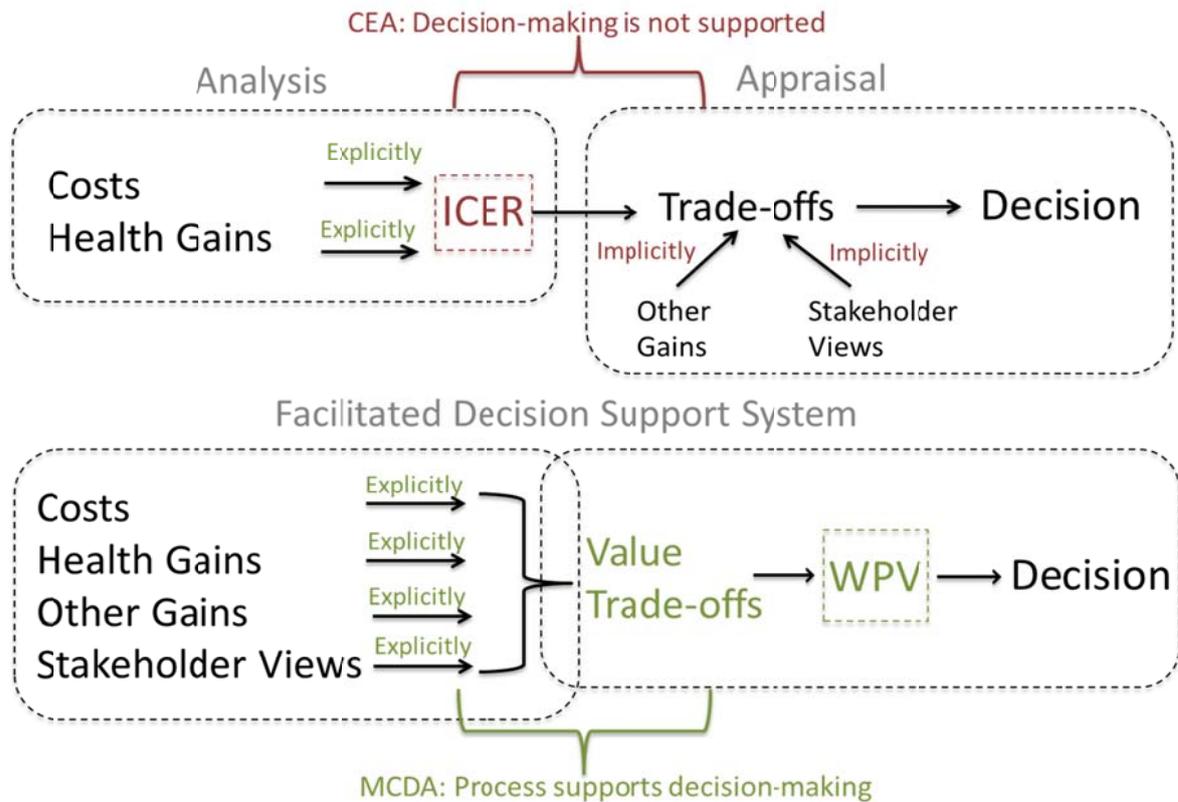
The application of MCDA methods have been proposed for use in the field of health care <sup>44,76,77</sup>, including for priority setting of health programmes or interventions <sup>78-81</sup>, the regulatory approval of pharmaceuticals <sup>82-84</sup>, and more recently for use in HTA <sup>57,85-90</sup> and treatment selection <sup>91-93</sup>, recognising its potential value in the evaluation process and arguing that it could be used as an aid to decision-making. However, attention should be paid on the theoretical foundations of decision theory and particularly in the required properties the criteria need to possess in order for the analysis to be robust and results useful to decision-makers <sup>94-96</sup>.

Compared to economic evaluation methods such as cost-effectiveness analysis (CEA), an important advantage of MCDA is that it facilitates a decision support system because it enables a structured and transparent process. In CEA, the analysis of costs and health gains takes place first as part of the assessment stage, typically producing an incremental cost effectiveness ratio (ICER) as a value-for-money metric; any value trade-offs (possibly involving other types of benefit gains and stakeholder views) are then usually elicited implicitly on an *ad hoc* basis as part of the

appraisal stage, before a decision recommendation can be ultimately made. In contrast, in MCDA the analysis for all types of benefit gains and their value trade-offs are explicitly incorporated in the overall decision-making process which can be formally informed through engagement with stakeholders; overall weighted preference value (WPV) scores are produced which are more comprehensive value metrics and fully transparent, thus better linking the assessment and appraisal stages and supporting decision-making (Figure 1).

The explicit consideration of decision-makers' concerns in combination with a more structured approach for the elicitation of value preferences and their trade-offs, while allowing the incorporation of views from all relevant stakeholders, could inform the development of a more comprehensive and reasonable definition of value in health care. Such a methodological approach could be used as a supporting tool for transparent decision-making, being flexible enough for decision-makers to exercise their judgment by enabling them to elicit value trade-offs and their value preferences when pursuing multiple objectives, which could contribute to the debate on more efficient resource allocation.

**Figure 1: Differences between cost effectiveness analysis (CEA) and multiple criteria decision analysis (MCDA) in decision-making**



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