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Health Technology Prioritisation: Which criteria for prioritising new technologies, and what are their relative weights?

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Objectives: To review the criteria and ‘other’ considerations used internationally for prioritising new health technologies, and to demonstrate a conjoint-analysis methodology for deriving relative weights for the criteria.

Methods: We searched the literature for criteria and other considerations used internationally for prioritising new technologies. For a set of criteria related to the ‘benefits’ from technologies, we used a conjoint-analysis survey with a convenience sample of 74 participants to derive their weights.

Results: Covering 11 countries and the US state of Oregon, we distinguished three main groups of criteria: (a) Need, appropriateness and clinical benefits; (b) Efficiency (including cost-effectiveness); and (c) Equality, solidarity and other ethical or social values. For several countries, the quality of the clinical and economic evidence and factors related to strategic issues and procedural justice respectively are also considered. The criteria in the conjoint-analysis survey and their derived weights are: ‘Lives saved’ = 0.343, ‘Life-prolongation benefits’ = 0.243, ‘Quality-of-life gains’ = 0.217, a criterion representing the availability of alternative treatments = 0.107, and ‘Other important social / ethical benefits’ = 0.087.

Conclusions: The criteria represented a pluralistic combination of needs-based, maximising and egalitarian principles, and we demonstrated a methodology for deriving their weights based on a conjoint-analysis survey.

Keywords: Health, Priorities, Technology Assessment

1. Introduction

Due to scarce health care resources and on-going advances in health technologies, which tend to be increasingly expensive, all health systems face the challenge of prioritising new technologies for funding. Such prioritisation decisions inherently involve ethical dilemmas and tradeoffs between conflicting objectives or criteria. Unfortunately, though, most attempts at explicitly prioritising technologies at the macro level have resulted in dissatisfaction [1,2]. “Mounting disenchantment with simple solutions to the problems” tends to be followed by “a shift in emphasis from the *product* of priority-setting to the *process* of priority-setting” [3; our emphasis]. These reactions can be at least partially attributed to the “lack of clarity and rigor regarding the normative/ethical issues involved in explicit prioritization” [1].

National commissions convened to outline abstract principles have had little direct impact on their countries’ prioritisation policies, whereas other decision-making forums have applied sets of criteria and principles without a clear framework for resolving conflicts between them [2]. One of the main findings of Martin *et al.*’s study of prioritisation decisions for new cancer drugs in Canada was that priority-setting rationales involve clusters of factors [4]. There is also a lack of consensus about which criteria should guide prioritisation decisions [1,5,6,7], about how they should be weighted and balanced against one another [3,5,6], and even about the definition of fundamental principles like need or the severity of a disease [3,8,9].

Scepticism has been expressed about the likelihood of resolving these issues. For example, it has been suggested that “we will never reach agreement about an explicit framework for priority-setting” [2]. Other, less pessimistic commentators claim only that these issues “are unsolved now and that we have no real prospect of arriving at solutions that would be publicly acceptable in the foreseeable future” [10]. Also, that until more work is done on the substantive issues of equity in health care, “we will not know how deep the conflicts go and the degree to which any can be resolved” [11].

It is unsurprising, therefore, that decision-makers struggle to prioritise new health technologies and that they desire an explicit framework for doing so [7]. In the absence of principles-based methodologies, decision-makers have been advised to concentrate on developing and following fair procedures in order to arrive at legitimate solutions [3,10].

Logically, though, this does not mean that we should settle for following fair procedures *only*. “In the meantime, a systematic and explicit consideration of ethical issues in the decision-making process is clearly desirable” [5]. Moreover, the ‘accountability for reasonableness’ framework includes the ‘relevance condition’: that decisions should rest on evidence, reasons and principles that all fair-minded people can agree are relevant [10].

Clearly, this requires consensus about the underlying reasons and principles. Hence, one of the criteria suggested for evaluating the success of prioritisation efforts is the articulation of appropriate principles [2], as well as reasons that are grounded in clear value choices [7].

In our opinion, it is therefore worthwhile pursuing a greater understanding of the main criteria for prioritising new health technologies and their relative weights. Accordingly, in the study reported here we surveyed the literature in order to catalogue and analyse the range of criteria and ‘other’ considerations used internationally for prioritising technologies. And then, based on this review, and primarily for the purpose of demonstrating the methodology, we derived weights for a set of criteria related to the ‘benefits’ from technologies via a conjoint-analysis survey with a convenience sample of participants. Although these weights are not generalisable to any overall population, they are intended to be indicative of the kind of results obtainable from this approach.

2. Materials and methods

2.1 Review of criteria and ‘other’ considerations for prioritising new health technologies

Using PubMed and the Google internet search engine, we searched for articles and ‘grey’ literature referring to criteria and ‘other’ considerations related to prioritisation decision-making. We used these keywords in various combinations: priority-setting, prioritisation, criteria, ethics, decision-making, need. We catalogued and reviewed the criteria and other considerations referred to for each country and compared them across countries.

2.2 Conjoint-analysis survey to derive relative weights for the criteria

Informed by the literature review, we specified an internally-consistent set of criteria, with ‘performance’ levels for each criterion, for use in the conjoint-analysis survey to derive weights for the criteria. Conjoint-analysis, sometimes also referred to as ‘discrete choice experiments’ [12], has been recommended as the best approach, theoretically and practically, for valuing health-care benefits [13]. We conducted the conjoint-analysis survey using an Internet-based software package known as ‘1000Minds’, invented by the second author and freely available for academic use from him or via www.1000minds.com.

1000Minds applies a method for deriving weights known by the acronym PAPRIKA (**P**otentially **A**ll **P**airwise **R**an**K**ings of all possible **A**lternatives) [14]. This method involves participants being asked via the software to pairwise rank pairs of hypothetical technologies

with respect to their relative priorities. Each pair of technologies is defined in terms of just two criteria at-a-time, whereby one of the technologies has a higher performance rating on one criterion and a lower rating on the other criterion than the other technology. An example of a pairwise ranking question appears in Figure 1.

Which of these 2 imaginary "technologies" – described in terms of their effects (conceivably on different patient groups) – would you prefer to fund? (These effects are additional to those from an alternative treatment, if there is one.)
 (Assume the 2 technologies are identical in all other respects.)

(Left)		(Right)
a Lives Saved, including "statistical" lives (i.e. cure or reduced risk of death) NONE (or not yet known)	OR	a Lives Saved, including "statistical" lives (i.e. cure or reduced risk of death) SOME: 51 - 250 lives saved
c Quality-of-Life (QoL) gains – in terms of baseline QoL, size of QoL gains & duration, # of patients LARGE QoL gains		c Quality-of-Life (QoL) gains – in terms of baseline QoL, size of QoL gains & duration, # of patients NONE / VERY SMALL QoL gains
this one	they're equal	this one

Fig 1. Example of a pairwise ranking question from the conjoint-analysis survey

Thus when answering such questions participants have to confront a tradeoff between the two criteria and make a choice between the hypothetical technologies presented. The advantage of this method (‘pairwise ranking’) relative to alternative methods, which usually rely on scaling or ratio measurements of participants’ preferences, is that choosing one thing from two is a natural type of decision activity that everyone has experience of in their daily lives [13,15]. The number of questions asked is minimised because each time one is answered the method eliminates all other possible questions that are implicitly answered as corollaries of those already answered. This minimises the responder burden on participants, who are encouraged to continue pairwise ranking until all possible questions involving tradeoffs between two criteria at-a-time are answered. (As reported in the next section, the survey in this study required participants to answer approximately 40 questions, typically taking about 20 minutes each.) Finally, from each individual participant’s pairwise rankings the 1000Minds software, using mathematical methods, derives the relative weights for the criteria (i.e. specific to each individual participant).

As the main purpose of including the conjoint survey in our study was to demonstrate the methodology, we administered it to a convenience sample of participants from Israel and Canada recruited through our professional networks.

3. Results

3.1 Review of criteria and ‘other’ considerations for prioritising new health technologies

Our search found relevant literature for these 11 countries: Australia [16], Canada [17,18,19,20], Denmark [1,2,21], Finland [22,23], France [24], Israel [25], New Zealand (NZ) [20,26], Norway [1,2,20,23], Sweden [1,2,20,23,27], The Netherlands [1,2,20,23], and The United Kingdom [2,20,23,28]; and also for the US state of Oregon [29].

As summarised in Table 1, the criteria for prioritising technologies used by each of these countries and Oregon can be sorted into three main groups: (a) Need, appropriateness and clinical benefits; (b) Efficiency; and (c) Equality, solidarity and other ethical or social values. These three groups are consistent with the main principles of allocative justice for rationing health care traditionally recognised in the academic literature [9].

In addition, the quality of the clinical and economic evidence was also explicitly mentioned as an ‘other’ consideration for several countries. Three countries also referred to factors related to strategic issues and procedural justice respectively, which we have grouped in Table 1 under the heading “other considerations not elsewhere classified”.

The following discussion is organised around these three main groups of criteria and these two ‘other’ considerations (all as summarised in Table 1).

Table 1. Main criteria and ‘other’ considerations used internationally for prioritising new health technologies

Principles of allocative justice	Criteria	Australia	Canada	Denmark	Finland	France	Israel	New Zealand	Norway	Oregon	Sweden	The Netherlands	UK
• Need	– general	√	√					√		√			√
	– severity of the condition			√		√	√		√		√	√	
	– availability of alternatives		√			√	√	√					
• Appropriateness	– efficacy and safety					√	√	√				√	√
	– effectiveness			√	√			√		√			
• Clinical benefits	– general	√	√	√			√	√			√		
	– effect on mortality (life saving)						√		√	√	√		
	– effect on longevity						√			√			
	– effect on health-related quality-of-life	√	√				√			√			
• Efficiency	– cost-effectiveness/benefit	√		√		√		√	√	√	√	√	√
	– budgetary impact		√		√		√	√					
	– cost		√				√						
• Equality	– general	√		√				√	√	√	√	√	√
	– accessibility to the service	√	√	√									
	– affordability to the individual						√	√				√	
• Solidarity		√	√			√		√		√	√		
• Other ethical or social values	– autonomy	√		√							√		√
	– public health value					√							
	– impact on future generations	√											
‘Other’ considerations													
• Quality of the clinical and economic evidence			√		√				√				√
• Other considerations not elsewhere classified	– strategic issues							√					√
	– consistency with previous decisions and precedents		√										

3.1.1 Need, appropriateness and clinical benefits

‘Need’ is most commonly defined in terms of the degree of ill health [9] or the severity of a health condition [3,6]. The meaning of these terms varies according to how disease burdens are assessed and each condition’s degree of impairment relative to a ‘normal’ health-related quality-of-life (HRQoL) [6,9]. Any definition of need must also incorporate patients’ capacity to benefit from treatment [3,6], usually expressed in terms of the technology’s effectiveness or appropriateness [6]. If ‘need’ is interpreted instrumentally as being goal-related [8,30] then need for a technology implies an expected positive effect on patients’ health. “The great value of the instrumental view is that it confronts practice with the necessity to be explicit about whether it is effective, how effective it is and for whom” [8].

All health systems relate to needs-based principles. The severity of the conditions to be treated appears to be the primary criterion for prioritising patients in Sweden, Norway, Denmark, The Netherlands and France. The Australian guidelines ask if “the importance of human disabilities [is] appropriately evaluated” [16], and NICE refers to “the degree of clinical need of the patients with the condition or disease under consideration” [28].

Need is mentioned for NZ and Sweden as a comparative criterion with respect to the health needs of all eligible people with various diseases. Need is also considered from the community perspective for Canada and Israel, as represented by the number of patients affected. A combination of the individual and communitarian aspects of need may be found in the Oregon principles, where “efficiency” is defined as requiring “that the greatest amount of appropriate and effective health benefits for the greatest number of persons are provided with a given amount of money” [29].

The appropriateness criterion is discussed in terms of effectiveness (Denmark, Finland, Oregon and The Netherlands) or efficacy and safety (UK, France), or with respect to clinical benefits or outcomes (Canada, Israel, NZ, Norway, Oregon). Clinical outcomes are represented in terms of effects on mortality, morbidity, longevity and HRQoL (Israel, Oregon, Sweden and, to some extent, Australia and Norway), as well as convenience (Canada), and whether the disease is acute or chronic, and also whether the technology is therapeutic or preventive (Norway, Oregon and Sweden). Another facet of the clinical benefit is whether or not existing alternative treatments are available and suitable (Canada, France, Israel, NZ).

3.1.2 Efficiency

According to maximising principles, allocative justice requires that health care is distributed so as to achieve the best possible consequences. From a utilitarian perspective, a health care's relative priority depends on the extent to which it contributes to aggregate population health [6,9].

Efficiency-based criteria are common to all health systems. Most countries relate explicitly to cost-effectiveness or cost-benefit considerations (Australia, Denmark, France, NZ, Norway, Sweden, The Netherlands, Oregon, UK). Other countries mention the cost and the budgetary impact of technologies without referring to the offsetting value of the associated benefits (Canada, Israel, Finland). The total cost of the technology to society *per se* is also considered (Canada, Israel) or in relation to the budgetary impact (NZ, Finland), and not in terms of economic efficiency, as referred to above.

It appears, too, that some decision-makers are perhaps embarrassed to acknowledge that cost is an important consideration for prioritisation decisions. For example, a study of drug reimbursement in Finland revealed that although administrators reported that “decisions are based on scientific data and that non-scientific arguments and considerations are not as important”, it turned out in fact that budgetary impacts and drug prices were very important [22]; these considerations were described by the authors as “hidden non-scientific criteria behind the decisions” [23]. Similarly, a study of the decision-making process in France found that “despite the fact that cost considerations are at the very heart of the evaluation procedure, *at no time are financial issues raised*. Yet cost-effectiveness assessment is an important criterion for determining whether a drug should be reimbursed” [24, our emphasis].

3.1.3 Equality, solidarity and other ethical or social values

Egalitarianism requires that health resources are used to reduce health inequalities. This goal is usually combined with other principles of justice, such as health maximisation [6].

Most countries mention equality and non-discrimination in their prioritisation criteria (Australia, Denmark, NZ, Norway, Oregon, Sweden, The Netherlands, UK). Some countries mention other egalitarian-based criteria, such as solidarity (Canada, Denmark, Israel, Norway, Sweden, The Netherlands), accessibility to services (Australia, Canada), and affordability of the technology by individual patients (Israel, NZ, The Netherlands). Other ethical or social considerations explicitly referred to by decision-makers include autonomy (Australia,

Denmark, Sweden, UK), public health value (France), and impact on future generations (Australia).

3.1.4 Quality of the clinical and economic evidence

As well as the three main groups of criteria discussed above, ‘quality of the clinical and economic evidence’ and, what we refer to as “other considerations not elsewhere classified” are also used internationally for prioritising new health technologies, as we now discuss.

Assessing the quality of the evidence is the first stage of technology assessment, and good evidence is a precondition for reimbursement [31]. Nonetheless, especially for some life-threatening diseases, a technology may be admitted for prioritisation despite relatively poor evidence. In these special cases (e.g. orphan drugs), decision-makers may need to accept a lower quality of evidence in return for the perceived promise of benefit for patients with very serious conditions [32].

Quality of the evidence is mentioned relatively rarely as a criterion for prioritising technologies (Canada, Finland, Norway, UK). This may be because this consideration generally relates to the preliminary assessment of candidate technologies – in effect, serving as a screening criterion before the prioritisation stage is reached.

3.1.5 Other considerations not elsewhere classified

Finally, several other considerations related to strategic issues and procedural justice respectively were mentioned for three countries (see Table 1). In NZ the government’s priorities for health funding more generally are also considered, and in the UK the potential for long-term benefits to the health system overall are also taken into account. Considerations of procedural justice, in particular consistency with previous decisions and precedents, are mentioned for Canada.

3.2 Conjoint-analysis survey to derive relative weights for the criteria

Informed by the above review, we specified the set of criteria reported in Table 2 (column 1) for use in the conjoint-analysis survey. We initially included ‘cost of the technology’ as a criterion. However, when we pilot-tested the survey, feedback from participants revealed that tradeoff questions involving this criterion (e.g. see Figure 3 in the next section) were

ambiguous, and so we excluded cost from the final survey. This ambiguity and the likely reasons for it are explained in the Discussion section.

Likewise, we did not include ‘quality of the clinical and economic evidence’ or ‘other considerations not elsewhere classified’ (as discussed in the sub-sections above) in the survey. It was obvious to us, a priori, that their relative importance to decision-makers is highly idiosyncratic to the particular technology being considered, and so they do not lend themselves to the survey’s tradeoff questions, which are of a more general nature.

Thus the conjoint-analysis survey concentrated exclusively on criteria related to the possible ‘benefits’ associated with technologies. In essence, we adopted a goal-related definition of need by which each technology is evaluated according to its potential benefits in terms of ultimate health goals [8,29]. These goals were defined with respect to life saving, life prolongation and HRQoL gains. This also include the effectiveness of the technology. Thus, the first three criteria in Table 2 (“Lives saved”, “Life-prolongation benefits” and “Quality-of-life gains”) implicitly relate to both the severity of the conditions being treated and the technologies’ appropriateness for treating them.

The fourth criterion in the survey – “If this technology were not to be funded ...” – represents an aspect of the degree of clinical need for the particular technology, and also its impact on equality with respect to patients’ abilities to access alternative treatments if they exist. The final criterion – “Other important social / ethical benefits, e.g. targeted to children / minorities; reduces health gaps, etc.” – is intended to encompass the range of common egalitarian considerations.

Through our professional networks we recruited a convenience sample of 74 participants for the survey. This sample comprised 61 Israelis – specifically, 44 professionals or researchers in healthcare or related fields (including 10 physicians and 7 health journalists), 5 representatives of patients’ organisations, and 12 members of the general public – plus 13 researchers from the Joint Center of Bioethics in Toronto, Canada.

The 74 participants answered the conjoint survey during September 2008 using the 1000Minds software (Internet-based) introduced in the previous section. Each participant answered, on average, approximately 40 pairwise ranking questions – typically taking about 20 minutes each – from which the 1000Minds software derived each participant’s relative weights for the criteria.

The mean values for the weights for the sample as a whole are reported in Table 2 (column 2), where, corresponding to the relative magnitudes of the weights, the criteria are listed in decreasing order of importance. Thus the most important criterion is “Lives saved, including ‘statistical’ lives (i.e. cure or reduced risk of death)”. The mean weights for

“Quality-of-life gains” and “Life-prolongation benefits” are very similar; likewise (though lower) for “If this technology were **not** to be funded ...” and “Other important social / ethical benefits”.

With respect to the participants’ individual results (not reported here, but available on request), the weight on the ‘Lives saved ...’ criterion exceeded 0.4 for over a quarter of the participants, and for over three-quarters of them it was their most or second-most important criterion. More than half of the participants (58%) attached greater weight to “Life-prolongation benefits” than “Quality-of-life gains”. The relative importance of the criterion concerned with the availability of alternative treatments (“If this technology were not to be funded ...”) vis-à-vis “Other important social / ethical benefits” was about equal across the 74 participants: 49% ranked the former ahead of the latter and 51% in reverse.

Table 2. Criteria included in the conjoint-analysis survey (column 1), and their mean relative weights (column 2)

Criteria	Relative weight (mean)
Lives saved, including ‘statistical’ lives (i.e. cure or reduced risk of death)	
None (or not yet known)	0
Few: 1 - 50 lives saved	0.091
Some: 51 - 250 lives saved	0.192
Many: 251 - 500 lives saved	0.268
Very many: > 500 lives saved	0.343
Life-prolongation benefits – in terms of increase in life expectancy and its quality-of-life, and number of patients	
None / Very small (or not yet known)	0
Small benefits	0.053
Medium benefits	0.152
Large benefits	0.244
Quality-of-life gains – in terms of baseline QoL, size of QoL gains and duration, and number of patients	
None / Very small (or not yet known)	0
Small QoL gains	0.051
Medium QoL gains	0.138
Large QoL gains	0.217
If this technology were <i>not</i> to be funded ...	
Many / most patients will be able to pay for it themselves (privately)	0
Many / most patients will get an alternative treatment (less effective) already funded by government	0.055
Many / most patients will not receive any treatment for condition	0.108
Other important social / ethical benefits, e.g. targeted to children / minorities; reduces health gaps, etc	
None / Very small (or not yet known)	0
Yes	0.087

Note: The bolded values represent the relative weights of the criteria overall (i.e. these bolded values sum to 1.0).

4. Discussion

4.1 Earlier studies

Relatively few earlier studies have compared the criteria for prioritising new health technologies used internationally [1,2,20,23]. Such studies that exist have mostly concluded that the criteria are ambiguous and there is little practical guidance available for making prioritisation decisions [1,2,3,9]. Clear and consistent definitions of important, multifaceted ethical concepts seem to be missing [1,3,8], and there is scant clear guidance available about how to weigh and balance identified principles and criteria against each other [1,2,3,6].

Studies of actual prioritisation experiences also revealed that they tend to be very technical exercises in nature, seldom involving explicit deliberations about core values and ethical principles [1,2,6]. Practical shortcomings most frequently mentioned include the lack of simple algorithms to assist with prioritisation decision-making [3], and the rarity of pluralistic combinations of needs-based, maximising and egalitarian principles, as seems to be favoured by the public [9].

4.2 The present study

As a potential antidote to the shortcomings discussed above, our study sought to contribute to a greater understanding of the main criteria for prioritising new health technologies used internationally, and to demonstrate a methodology for deriving their relative weights. Our review of the criteria and other considerations for prioritising technologies used by 11 countries and the state of Oregon revealed many similarities and also differences between them; and no two countries applied the same criteria (see Table 1).

Informed by the review, the five criteria specified for the conjoint-analysis survey were intended to capture the essence of possible choices between technologies involving comparisons of alternative combinations of needs-based benefits, where need is determined by the extent to which a technology is expected to achieve any of the ultimate health goals of saving or prolonging life and/or improving HRQoL. This representation of need is consistent with the widely-accepted argument that “any definition of need [only] in terms of ill health is inadequate because it pays no attention to how much benefit the health care is likely to bring. No matter how ill a patient is, it is hard to see how she can ‘need’ health care that does no good” [9].

In real-world settings involving prioritising technologies, the most important criterion has been found to be the clinical benefit of technologies [23]. Thus, having it as the main focus of the criteria for our conjoint-analysis survey – as well as other social benefits, presenting egalitarian principles – matches actual prioritisation processes in a way that might be attractive for actual decision-makers as well as having public support [9].

So that the responder burden on survey participants was not excessive, it was necessary for us to specify the criteria and their levels in general terms, without much detail. For example, we did not include factors like the severity of the patients' pre-treatment health state [33]. Participants were required to consider the magnitude of benefits in terms of “small”/“medium”/“large” with respect to the increase in life expectancy and HRQoL for life-prolongation benefits, and in terms of baseline HRQoL, size of HRQoL gains and their duration (see Table 2). These evaluations also related to the number of patients expected to benefit. However, for real-life decision-making the degree of benefit for the individual and the number of patients could be separated.

4.3. Participants' confusion about 'cost of the technology' as a criterion in the pilot conjoint-analysis survey

As we explained briefly in the previous section, although 'cost of the technology', 'quality of evidence' and 'other considerations not elsewhere classified' featured in our survey of the literature, we excluded these criteria/considerations from the survey. We excluded these last two considerations because their relative importance to decision-makers is likely to be highly idiosyncratic to specific technologies, and so they do not lend themselves to the tradeoff questions, which are of a more general nature.

With respect to 'cost', an important finding from the survey's pilot study was that many participants found pairwise ranking pairs of technologies where 'cost' was one of the criteria, such as illustrated in Figure 2 below, to be ambiguous. From their comments and upon reflection ourselves, the source of this ambiguity seems clear, as we now explain.

How a survey participant answers a question like the one in Figure 3 depends on how she thinks about the difference in the costs between the two hypothetical technologies. The technology on the left is one-fifth of the price of the technology on the right. If a participant were to choose 'left', would that mean that she has \$20,000 in 'change' to do something else with? What else? Might she 'spend' the \$20,000 on another four 'left' technologies? In other words, is she in fact being asked whether she prefers five 'lefts' instead of one 'right'? Or is she being asked whether she prefers 'left' plus \$20,000 change to spend on something else, or

whether she prefers ‘right’? She might become so confused thinking about these cost issues that all she pays attention to is the other criterion (and so chooses ‘right’ automatically). The fundamental source of the confusion here is the budget constraint implied by the questions being asked. Thus it makes more sense to consider tradeoffs only between combinations of ‘benefits’, as in the final survey implemented.

Which of these 2 imaginary 'technologies' – in terms of their effects (conceivably on different patient groups) – would you prefer were funded? (Benefits mentioned are additional to those from an alternative treatment, if there is one.)

(given they're identical in all other respects)

(Left)	OR	(Right)
a Lives Saved , including 'statistical' lives (ie. cure or reduced risk of death) SOME: 51 - 250 lives saved		a Lives Saved , including 'statistical' lives (ie. cure or reduced risk of death) MANY: 251 - 500 lives saved
b Cost of the technology \$5000		b Cost of the technology \$25,000
<input type="radio"/> this one	<input type="radio"/> they're equal	<input type="radio"/> this one

Fig 2. Example of a pairwise ranking question from pilot-tested initial version of the conjoint-analysis survey whereby ‘cost’ was included as a criterion

4.4 Conclusions from the conjoint-analysis survey results

Across the individual participants, the relative magnitudes of the weights, reflecting the relative importance of the criteria, were relatively similar and apparently consistent, which was reassuring. Although the sample was not representative, these results show that such ‘agreements’ are possible.

The criteria and weights in Table 2 are, in effect, a points (or ‘scoring’) system that could be used to rank technologies according to a single measure (index) of benefit encompassing the five criteria. Each technology would be rated on the criteria and then the corresponding point values summed to get a ‘total score’. The technologies could then be ranked according to their total scores from highest to lowest ‘benefits’, represented on an index ranging from 0 (no benefit) to 1 (maximum benefit).

4.5 Incorporating cost, quality of the evidence and other considerations not elsewhere considered

Despite excluding ‘cost’, ‘quality of evidence’ and ‘other considerations not elsewhere classified’ from the survey, clearly these criteria/considerations are very important for prioritisation decision-making – indeed, ‘cost’ is the *raison d’être* for such decision-making.

A range of rating systems are available for measuring and comparing ‘quality of evidence’ [34]. In addition to factors related to strategic issues and procedural justice respectively (as catalogued in our survey), ‘other considerations not elsewhere classified’ might include, for example, whether the technology challenges the moral, religious or cultural values of a society [35]. In certain cases there may be political or public pressures [36,37] that decision-makers should be mindful of.

We believe that ‘cost’, ‘quality of evidence’ and ‘other considerations not elsewhere classified’ should be incorporated *after* the technologies have been ranked according to the single measure (index) of benefit encompassing multiple criteria, as discussed above. That is, decision-makers can choose the ‘best’ technologies in terms of their benefits, subject to their cost, quality of evidence and other considerations, as appropriate.

4.6 Future directions for research

Further research is worthwhile into the implementation of this methodology for real-life prioritisation decision-making. For the methodology to be implemented, a conjoint-analysis survey to derive weights on the criteria involving a randomly-selected sample representative of the relevant population would be required.

5. Conclusions

Our study sought to contribute to a greater understanding of the main criteria for prioritising new health technologies used internationally, and how their relative weights might be determined. The criteria represented a pluralistic combination of needs-based, maximising and egalitarian principles, and we demonstrated a methodology for deriving their weights based on a conjoint-analysis survey. The main advantage of this overall approach – involving explicitly specifying criteria and their weights, and also explicitly recognising ‘other’ considerations for prioritisation decision-making – is that, in contrast to current prioritisation methods [1,2,3,6], it offers clear guidance for weighing and balancing identified principles and criteria against each other.

This approach seems to be in accord with the conceptual standards for evaluating the success of prioritisation frameworks suggested by Sibbald *et al.* [7]. First, the approach enables a process to be followed that is based on clear criteria with predetermined weights that are transparent and, as can be validated via a conjoint-analysis survey, are likely to be acceptable to the public. Second, the decisions made via the conjoint analysis-based

methodology are, by definition, based on reasons that are grounded in clear value choices, and that can be easily shielded from ‘outside’ considerations that may be irrelevant or inappropriate. Third, the approach improves the quality and efficiency of decision-making, and ensures consistency of reasoning. Ultimately, if the approach were to be adopted it could be expected to improve stakeholders’ understanding of priority-setting and of the rationales for the decisions, and therefore their acceptance and overall satisfaction.

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