NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE

Briefing paper for methods review workshop on structured decision making

The briefing paper is written by members of the Institute's Decision Support Unit in collaboration with Professor Nancy Devlin from the Office of Health Economics. It is intended to provide a brief summary of the issues that are proposed for discussion at a workshop to inform an update to the Institute's Guide to Methods of Technology Appraisal. It is not intended to reflect a comprehensive or systematic review of the literature. The views presented in this paper are those of the authors and do not reflect the views of the Institute.

The briefing paper is circulated to people attending that workshop. It will also be circulated to the members of the Method's Review Working Party, the group responsible for updating the guide.

For further details regarding the update of the Guide to the Methods of Technology Appraisal please visit the NICE website at http://www.nice.org.uk/aboutnice/howwework/devnicetech/technologyappraisalprocessguides/GuideToMethodsTA201112.jsp

1 Review of the 'Guide to Methods of Technology Appraisal'

The Institute is reviewing the 'Guide to the methods of technology appraisal', which underpins the technology appraisal programme.

The original Methods Guide was published in February 2001, and a revised version was published in 2007. The Methods Guide provides an overview of the principles and methods used by the Institute in assessing health technologies. It is a guide for all organisations considering submitting evidence to the technology appraisal programme and describes appraisal methodology.

The current 'Guide to methods of technology appraisal' is available from the NICE website at

http://www.nice.org.uk/aboutnice/howwework/devnicetech/technologyappraisalprocessguides/guidetothemethodsoftechnologyappraisal.jsp

The review of the Methods Guide will take place between October 2011 and April 2012. As part of the process, a number of workshops will be held to help identify those parts of the Guide that require updating. These workshops will involve a range of stakeholders, including methods experts, patient representatives, industry representatives, NHS staff and NICE technology Appraisal Committee members.

A summary of the discussion at the workshop will be provided to the Methods Review Working Party, the group responsible for preparing the draft update of the Methods Guide. Further details of the process and timelines of the review process are available from the NICE website.

The revised draft of the Methods Guide will be available for a 3-month public consultation, expected to begin in May 2012. We encourage all interested parties to take part in this consultation.

2 Background

The appraisal of health technologies by NICE can be viewed as being founded on the principle that the primary (but not only) purpose of the NHS is to improve health. Considering whether a new technology helps to achieve this objective, some measure of health improvement is required, which ought to reflect key criteria or attributes of health (e.g., length of life and various dimensions of its quality) with weights that reflect the preferences of the community served by the NHS. Since NHS resources are limited it is also important to know what additional NHS costs are required to improve health measured in this way. For this reason much of NICE methods of appraisal focus on how evidence can be used to estimate the likely improvement in health (measured by QALYs) offered by the technology and the additional NHS costs required. The combination of health benefits offered with associated NHS cost are commonly summarised as an incremental cost-effectiveness ratio (ICER). A key question is whether the health expected to

be gained from the use of the technology exceeds the health likely to be forgone elsewhere as a consequences of additional costs displacing other NHS activities. The cost-effectiveness threshold is intended to represent this aspect of opportunity cost (the additional NHS cost likely to displace one QALY elsewhere). The determination of NICE's threshold range (£20,000 to £30,000 per QALY) currently has a limited empirical basis (House of Commons Select Committee 2008; NICE 2008a). However, recent work suggests it is likely to be an appropriate order of magnitude (Martin, Rice and Smith 2008), and further research promises to strengthen the evidence base to inform the choice, albeit in the context of considerable uncertainty. What is important to recognise, however, is that the key underlying consideration in appraisal is not cost-effectiveness per se but the likely *net* health effects of a technology. A comparison of an ICER with the threshold helps inform this assessment of whether or not these *net* health effects are likely to be positive or negative.

If the objective of the NHS was *only* to improve health, and the measure of health available (QALYs) captured *all* socially valuable aspects of health, then the task of the Appraisal Committee would be restricted to exercising judgements about the scientific evidence, i.e., considering whether the evidence and analysis on which estimates of health gained and additional costs are based are judged to be reliable and reasonable. If they are, then decisions could simply be based on a comparison of ICER to the threshold, which is equivalent to asking whether the estimate of health gained exceeds the health expected to be forgone.

However, the value judgements which must be made by the Appraisal Committee must extend beyond considerations regarding the ICER for two reasons:

i. Even if the objective of the NHS was restricted to health improvement, no metric of health, no matter how sophisticated, can hope to capture all socially valuable aspects of health. For example, some types of health gain might be deemed more important and more socially valuable than others due to the characteristics of the disease (e.g., severity and

burden) or the characteristics of the recipients (e.g., children or disadvantaged populations).

ii. Although improving health might be the primary purpose of the NHS, other objectives, not directly related to health gain, might also be important (e.g., improving equity and wider social benefits).

Therefore, while cost-effectiveness (the net health effects of a technology measured by QALYs) might be a key consideration, other factors are also considered relevant and are taken into account by NICE. Indeed NICE is increasingly clear about what these factors are (NICE 2008b), and the way that it has reflected these 'social value judgements' in its decisions (Rawlins et al. 2009). NICE says that it recognises a number of criteria as relevant to its technology appraisals, and that it does so by applying 'special weightings' to these criteria when making judgements about cost effectiveness – for an overview, see Appendix 1. The way in which these factors are taken into account is set out in NICE's social value judgement document (NICE 2008b).

> *"Decisions about whether to recommend interventions should not be based on evidence of their relative costs and benefits alone. NICE must consider other factors when developing its guidance, including the need to distribute health resources in the fairest way within society as a whole." (Principle 3 – NICE 2008b p.18)*

Currently these other factors are taken into account by NICE as mitigating factors relative to the cost effectiveness threshold range of £20,000 to 30,000 per QALY gained. Specifically, the decision-making process by which the ICER and other factors are combined is described as follows:

> *"…interventions with an ICER of less than £20,000 per QALY gained are considered to be cost effective. Where advisory bodies consider that particular interventions with an ICER of less than £20,000 per QALY gained should not be provided by the NHS they should provide explicit reasons (for example that there are significant limitations to the generalisability of the evidence for effectiveness). Above a most plausible ICER of £20,000 per QALY gained, judgements about the acceptability of*

the intervention as an effective use of NHS resources will specifically take account of the following factors.

- *The degree of certainty around the ICER. In particular, advisory bodies will be more cautious about recommending a technology when they are less certain about the ICERs presented in the cost-effectiveness analysis.*

- *The presence of strong reasons indicating that the assessment of the change in the quality of life inadequately captured, and may therefore misrepresent, the health gain.*

- *When the intervention is an innovation that adds demonstrable and distinct substantial benefits that may not have been adequately captured in the measurement of health gain.*

As the ICER of an intervention increases in the £20,000 to £30,000 range, an advisory body's judgement about its acceptability as an effective use of NHS resources should make explicit reference to the relevant factors considered above. Above a most plausible ICER of £30,000 per QALY gained, advisory bodies will need to make an increasingly stronger case for supporting the intervention as an effective use of NHS resources with respect to the factors considered above." (NICE 2008b p.18-19).

Potential benefits of a more structured approach

It seems beyond dispute that factors other than net health gain measured by QALYs (i.e., cost-effectiveness) matter (Shah, Praet, Devlin et al 2011). However, it remains unclear to many outside NICE exactly how important these other considerations are, and how they are incorporated into the current deliberative approach to decision-making. The identification of these factors by NICE indicates that they must count for something, but not how much. That is, it is not clear what weight is attached to each in the decision-making process, or the trade-offs that NICE is prepared to make between QALYs gained and these other factors. Furthermore, the information provided in published NICE guidance "may not fully reflect all of the individual factors

considered by the Appraisal Committee at the time of the appraisal" (Tappenden, Brazier, Ratcliffe, et al. 2007).

Arguably, being more explicit about the factors that influence decisions, and the way these are taken into account, could serve to:

- Improve the transparency of the decision-making process and the accountability of NICE to taxpayers
- Improve the consistency of decision-making – for example, by ensuring that each of NICE's four Appraisal Committees treat these considerations in a similar manner
- Facilitate greater consistency between the way NICE decides on new technologies and the way the NHS decides how to allocate its budgets
- Provide an opportunity for NICE to engage the public in decisions about what criteria to use, and their relative importance – leading to more 'buy-in' to the difficult decisions NICE is required to make
- Sharpen the signals to industry about what aspects of innovation NICE (acting as an agent for the NHS) values and where research and development (R&D) efforts should be directed

NICE needs to consider to what extent the multiple criteria its committees need to take into account should be combined quantitatively as part of the technology appraisal process. There is a spectrum of possibilities regarding how much quantification is undertaken and it is not obvious that the optimal approach to decision making involves a highly technical solution (Devlin and Sussex 2011). Arguably, given the nature of the decisions being made by NICE, there will inevitably be a role for exercising judgement via a deliberative process (Culyer 2009). In advising NICE on the criteria which might be employed in guiding its decisions, NICE's Citizens' Council has adopted a deliberative framework to establish the strengths and weaknesses of competing criteria that might be considered (NICE 2011). The pertinent

question is therefore whether that deliberative process could be improved by the use of decision aids to structure and facilitate the consideration of multiple criteria; and to make more explicit and consistent the trade offs between criteria that are currently implicit in the deliberative process.

Recently, there have been a number of calls for decisions about resource allocation generally, and those made by NICE's Appraisal Committees in particular, to be moved along that spectrum by incorporating more quantification of other relevant criteria (Dowie 2008; NICE 2009a; Devlin and Sussex 2011). These calls have often referred to the use of multi-criteria decision analysis (MCDA) which is a set of methods of varying types which typically seek to score, weight and ultimately aggregate the various criteria relevant to a decision into an overall composite measure of benefit (Peacock, Richardson, Carter et al. 2007; Thokala 2011). MCDA approaches have been used by local NHS organisations to aid resource allocation decisions, and elsewhere in the UK public sector (for example, Department of Transport, in its evaluation of transport investment options) (Devlin and Sussex 2011),

In January 2009, NICE commissioned Professor Sir Ian Kennedy to carry out a short study of the way in which NICE values innovation when it appraises medicines (NICE 2009a). In response to the study, NICE modified its processes and documentation in order to achieve greater transparency in the way health benefits are taken into account. These changes relate to the way in which the Appraisal Committee’s deliberations are reported, but have not changed the way in which the decisions are made. However, in its submission to the Kennedy report, the Association of the British Pharmaceutical Industry called for a

> *“new structured approaches to decision-making to account for these important factors; and use of these factors should be far more transparent than currently.” The submission further suggests that “Where additional aspects of benefit and value cannot be incorporated within the QALY framework, evidence on them could be considered by NICE alongside the ICER. This will require a different decision making model capable of dealing with different sorts of evidence. Options include:*

- *the use of multi-criteria decision analysis (MCDA), where both the criteria themselves, and the weights applied to each, are explicit and transparent*

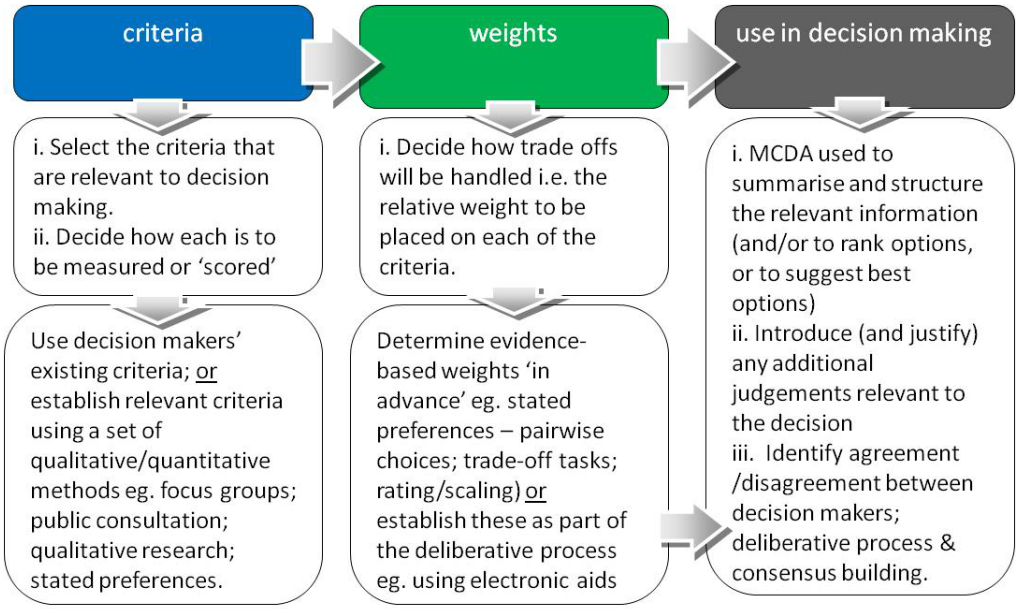
- *retention of QALYs as the principal measure of health outcome, and the ICER as the evidence on cost effectiveness, but other sorts of evidence being more formally and explicitly introduced and considered alongside these, either through MCDA or other means in a more transparent way."*

In broad terms MCDA can be regarded as a set of methods to aid decision-making, which make explicit the impact on the decision of multiple criteria that might be applied and the relative importance attached to them. This definition of MCDA encompasses a wide range of different approaches, both 'technical' and 'non-technical' in nature. Some types of MCDA involve algorithms to suggest optimal choices; others simply aim to provide some structure to a deliberative process. All aim to facilitate replicability and transparency in decision-making.

What is MCDA?

There are numerous different approaches to MCDA, which in various forms have been used in the NHS, other government departments and some HTA bodies in other countries (Devlin and Sussex 2011; Thokala 2011). All attempt to be clear about the criteria being taken into account, and the influence of multiple criteria on decisions. Beyond that, the methods and the way they are used in decision-making vary widely. An overview of the main elements is presented in Figure 1.

Figure 1 An overview of MCDA methods



Appropriately specifying MCDA requires the following questions to be addressed:

i. Which criteria should be included (see Section 3.1 below) and how can performance (that is, the extent to which a given technology achieves those criteria) be measured and scored (e.g., the criteria set out in Appendix 1 along with expected health (QALY) benefits)?

ii. What weights should be assigned to performance on each of the criteria (see Section 3.2 below)?

iii. How should the costs and opportunity costs of achieving an improvement in a composite (multi criteria) measure of benefit be considered (see Section 3.3)?

iv. Even if an appropriately specified MCDA process could be developed, unless the criteria and weights can fully reflect all aspects of social value then judgements will inevitably still need to be made. Therefore, how could the transparency of the deliberative process be improved and is there an appropriate form of MCDA that can aid rather than replace deliberative processes (see Section 3.4)?

From the outset it should be recognised that the NICE methods and process of appraisal already places it on the highly quantitative end of the spectrum of decision making that runs from the implicit and intuitive to the explicit and algorithmic. For example, decision analytic modelling is central to NICE's approach to technology appraisal, and represents an explicit, quantitative and evidence based way of transforming multiple criteria (e.g., impact on a range of clinical end-points, adverse events, resource use etc) into composite estimates of health gained (measured by QALYs) and net NHS costs. Furthermore, the QALY itself is an example of a rather sophisticated form of MCDA (see 3.2). It involves the aggregation of estimates of (changes in) life expectancy and health-related quality of life (HRQoL), where the latter is defined by different levels of performance across multiple dimensions (criteria) of health related quality of life, with a series of weights based on preferences. In NICE's Reference Case, these preferences are elicited from a sample of the general public, using stated preference techniques involving tradeoffs between length and quality of life.

The issue, therefore, is not whether NICE should use MCDA to support its decisions, but the extent to which such methods should be extended to bring together the various criteria NICE currently uses to inform its decisions or could use in the future. In other words, where on the spectrum of quantification should NICE locate its decision making approach? It is not the purpose of this briefing paper to argue for a particular location. Rather, the aim is to specify some of the key requirements that need to be adhered to if MCDA was to be more fully implemented within NICE methods, to identify some of the potential dangers of a poorly specified approach as well set out the potential benefits of a more accountable, consistent and predictable approach to making the necessary social value judgements.

3 Proposed issues for discussion

After consideration of the developments in this methodological area, the current Methods Guide and the requirements of the Institute’s Technology

Appraisal Programme, it is proposed that the following key areas are discussed at the workshop.

3.1 Which criteria might be included and how could performance be measured and scored?

Criteria as attributes of benefit

It is important to carefully determine which criteria or attributes should be included. In part, this involves careful consideration of which aspects of social value ought to be included alongside currently available measures of health benefit. Therefore, criteria should relate directly to attributes of a composite measure of social benefit.

A review of the use of MCDA in supporting resource allocation decisions elsewhere in health care (Thokala 2011), sometimes reveals a confusion about what are appropriately considered to be attributes of a measure of benefit and the necessity to consider the additional costs and opportunity costs associated with interventions that improve composite (multi-attribute) benefits (see Section 3.3).

Uncertainty and the relevance of evidence has sometimes been included as a separate and apparently independent attribute in some MCDA studies (Thokala 2011). This poses two difficulties:

i. All attributes of benefit, whether formally considered within a quantitative (MCDA) framework or a more deliberative approach, require evidence and will be estimated with uncertainty. The uncertainty associated with any composite measure of benefit and its expected consequences can inform research decisions and may also influence NICE Guidance if the type of research required cannot be conducted once a technology is approved or approval commits (opportunity) costs which cannot be recovered (Claxton, Palmer, Longworth, et al. 2011). Therefore, uncertainty and its consequences is not so much an attribute of benefit, but an important assessment to inform approval and research decisions intended to improve (multi-attribute) benefits for current and future

patient populations (the NICE Methods Guide Working Group will consider how only in research recommendations might be informed).

ii. Some examples of MCDA have included the quality and relevance of evidence as an attribute in its own right (Devlin and Sussex 2011; Thokala 2011). This risks confusing evidence about the effects of a technology on an attribute of benefit with choices about how important the attributes of benefit might be. It implies that the former can effectively be traded-off against the latter on the basis of preferences. This potential for confusing scientific and social value judgements should be avoided as it may threaten rather than enhance the transparency and accountability of the appraisal process. For example, important evidence might be disregarded on the basis of 'preference' rather than explicit consideration and reasoning with the implications fully explored so they can be scrutinised by stakeholders and ultimately held to account.

Characteristics of criteria

i. Criteria must be clearly defined and based on clearly articulated and generally accepted principles.

ii. To achieve the objectives of improved transparency, consistency and accountability the criteria and how performance would be measured and scored may need to be pre-specified so it can be applied consistently throughout the appraisal process.

iii. Specifying how the performance of an intervention in meeting each criterion is measured, including the type of evidence and analysis that would support any claims for improvement in the attribute, is also very important. Without it the assessment of performance may become subjective and unaccountable, undermining the very reason for taking a more quantitative approach

iv. Measures of performance might be based on the value of the attribute itself, e.g., QALYs gained or burden of disease, which would itself require careful definition with agreed and consistent measurement. However, other criteria might be categorical or qualitative (e.g. 'low',

'medium' or 'high'). Partly for this reason measures of performance are often expressed as performance scores on an ordered categorical scale (e.g., 1, 2, 3 etc). However, specifying how performance scores are related to measures of the attribute and the evidence required to support claims is important. It would also require better understanding of what constitutes 'high' or 'low' performance for each attribute (e.g. what is a high (or low) burden of disease in the NHS). Without it performance scores become subjective and might lead to lack of accountability since a judgment about the social value maybe conflated with scientific judgment about quality and interpretation of the evidence.

v. Criteria should be independent attributes of benefit. That is, they should not be alternative measures or proxies of the same underlying principle (e.g., evidence of clinical effectiveness and QALYs gained). If not there is a danger that the same attribute of benefit will be double counted when performance scores across the criteria are weighted. For the same reason the criteria should not significantly overlap and ideally should be separable and independent. Few of the criteria cited as potential candidates fully achieve this and, even those that come close (e.g., QALY gains and burden of disease), will often be related. If double counting is to be avoided the weighting of criteria would need to be much more sophisticated, providing weights of combinations of performance scores across different types of attribute (see Section 3.2).

vi. In principle, the criteria should represent a complete description of all the attributes judged to be of value and relevant to the type of decisions made in NICE appraisal. A complete description, which also meets all the requirements above, seems unlikely to be possible. Furthermore, inclusion, exclusion and measurement are likely to be contentious. Therefore, some form of deliberative process is still likely to be required (see 3.4).

How might criteria be selected?

i. A natural starting point might be the existing list of special circumstances described in NICE's social value judgements (NICE 2008b). However, it

ought to be recognised that this has been an evolving process, partly informed by the deliberative process of the NICE Citizen's Council and partly reflecting higher level concerns of the Department of health (DH) and secretary of state (SoS) (e.g., end of life (NICE 2009b)).

ii. Some of the calls for a more structured approach have also suggested adding or refining these criteria (e.g., alternative definitions of innovation (NICE 2009a)). Since relevant criteria are often disputed and the desire for completeness tends to conflict with the need to avoid double counting, consideration would need to be given to how they might be developed either though existing deliberative process of the Citizens Council or wider public consultation.

iii. However, it should also be recognised that criteria ought to reflect, or at least be consistent, with higher level objectives and policies (e.g., the SoS and DH). For example, the consultation on the Value Based Pricing (VBP) scheme, due to start in 2014, suggests that it will include criteria based on burden of illness, scale of therapeutic improvement, innovation, and wider social benefits alongside health benefits measured by QALYs (Department of Health 2010 and Claxton Sculpher and Carroll 2011). This poses a question of remit (who should ultimately be responsible for specifying the criteria), what coordination is required and when should this be done (i.e., extending MCDA prior to VBP may be premature). It is also not yet clear what analytic framework will be used to reflect these other aspects of value in VBP, i.e. some form of MCDA or applying weights when estimating costs and QALYs within existing methods of appraisal (see briefing paper on QALY weights).

3.2 How can weights be assigned to performance on each of the criteria?

Once criteria have been identified and the measurement of performance and any associated score defined, the weights to be applied to performance on each attribute need to be established.

How can weights be established?

The range of alternative approaches can be considered as falling into four broad areas:

i. Weights can be established as part of the decision making process itself, e.g., they can emerge during the process of decision making. Some MCDA approaches, such as 'decision conferencing' (Phillips 2006), help to structure those discussions, feeding back the decisions and implied weights via an iterative process. The outcome is a consensus on both the decisions themselves and the set of weights that have been applied. The advantage of this approach is that it would make the judgements that emerge from the deliberative process more explicit. The difficulty is that to achieve improved predictability and full consistency the weighting of attributes may need to be pre-specified so they can be applied consistently throughout the appraisal process, including across each of the four appraisal committees.

ii. It is also possible to conduct forms of sensitivity analysis by asking which criteria and weights would have to be deemed appropriate for each of the alternatives to be regarded as offering the most benefit. Although instructive to explore how sensitive decisions might be to the definition of criteria and specification of weights, it is unlikely that transparency and consistency would be improved in this way.

iii. Simple approaches which add up performance scores to arrive at an 'overall score' or number of 'benefit points' have been used and were proposed in submissions to the Kennedy review (e.g., Comprehensive Benefits and Value; Precision Health Economics (NICE 2009a and Thokala 2011). The problem with these rudimentary approaches is that the empirical question of performance is conflated with the question of social value. Their use would imply that each criterion was equally valuable or that the (sometimes arbitrary) scale for performance scores reflected relative social value. It would also imply that each of the attributes is valued in a separable and additive way (see below).

iv. Alternatively, weights might be pre-specified based on other evidence, gathered via related studies or processes. Sets of weights can be generated by asking selected participants to state their preferences. This draws on a set of well-established methods to uncover preferences about the importance of the various attributes (criteria) through the choices participant make between alternatives with different levels of the attributes to be valued (Ryan et al. 2008). These sorts of choice based exercises are widely used in health services research including NICE's use of QALYs where the weighting of HRQoL against the length of life uses choice-based methods (the value one attribute is expressed in terms of a willingness to forgo others). There are a number of approaches to preference elicitation which satisfy the choice-based criterion including standard gamble, time trade-off, as well as discrete choice experiments and contingent valuation methods. This logic of requiring choice-based methods of preference elicitation in NICE's current use of MCDA through QALYs would seem also to apply to the evidence required to inform the selection of weights in MCDA.

Who might provide the weights?

i. Improving transparency and consistency suggests that weights may need to be pre-specified rather than be determined by the Appraisal Committee during its deliberations. Since appropriate weights are questions of social value that are necessarily disputed, some claim for legitimacy, in terms of whose preferences are used to establish them, will be important. Therefore, adopting the view of any particular stakeholder group would seem inappropriate.

ii. Inclusive deliberative processes could be used, e.g., NICE's Citizens' Council has approached many of its topics by reflecting on the value of a given attribute on the basis of what others may need to be forgone to achieve it.

iii. NICE's current use of MCDA through HRQoL could be taken as a starting point where the preferred source of preference for weights, defining trade-offs between length of life and different attributes of

quality, is the UK general public. Although there is also a case for the use of patients' preferences for this purpose (Brazier, Akehurst, Brennan et al. 2005), few have advocated the adoption of the preferences of other stakeholders. The logic behind NICE's current use of public preferences to define weights within the QALY would seem relevant to deciding whose preferences should be used to supply the weights for a wider set of benefit attributes.

iv. Some potential criteria, however, are not directly related to the characteristics of patients or the type of health benefit, but to economic effects outside the NHS (e.g., wider social benefits). The relative weight that ought to be attached is not so much a preference but rests on estimates of the relative values of the NHS threshold and the consumption value of health (Claxton, Walker, Sculpher, et al. 2010). Which estimates of value are appropriate and which economic effects ought to be included and how they should be measured are judgments of social value. However, once these have been made, the appropriate weight (relative to health effects) is not so much a preference but a logical deduction (see Perspective briefing paper).

How can the weights be used?

i. Once appropriate weights have been assigned they need to be combined with measures of performance on each attribute. The most obvious approach is simple linear aggregation, i.e. each score on each criterion is multiplied by the weight for that criterion and these weighted scores are then summed to determine an overall score for that option, which may be compared to the scores for other options under consideration. This is a simple and very common approach in MCDA. However, there are serious drawbacks. It implies that attributes are valued in an additive and separable way, so the value of an improvement in one is independent of the level of that attribute and also of the levels of all the other attributes (i.e. the value of the combination of levels of attributes is simply the sum of its parts). In other contexts (e.g., HRQoL) this strong assumption generally doesn’t hold and would not be

regarded as acceptable. This problem is likely to be particularly acute when criteria inevitably overlap to some extent or are related in some way. Therefore, the need for completeness in specifying criteria combined with simple linear aggregation might mean that the alternative with the highest score might not necessarily offer the greatest social value and lead to decision based on MCDA that are widely regarded as unacceptable.

ii. This problem is widely recognised when constructing measure of HRQoL. For example, NICE's preferred measure (EQ-5D) comprises 5 dimensions (criteria) of quality of life each with 3 levels (performance scores). However, the tariff for EQ-5D (the weights for different possible combinations of levels of each attribute of quality) are not simply based on 5 weights (one for each criteria) or 15 weights reflecting every level in each dimensions (one for each performance level within each criteria) but a weight for each of the 243 possible combinations which define the possible health states. This is a considerable task, entirely comparable to the problem of weighing criteria in MCDA, which requires a large and representative sample of respondents (nevertheless some assumptions are still required). Measures of HRQoL have gone much further than most examples of MDCA in estimating weights (although some have used multi-attribute utility theory). Therefore adopting MCDA with weights that impose much stronger assumptions than are acceptable in current QALY measures are likely to be widely criticised especially when approval is restricted or withheld based on poor performance on some attributes. Relaxing these assumptions to provide a more complete tariff of weights for the possible combinations of levels of performance across all criteria would require a considerable valuation task but would not avoid all assumptions even if undertaken.

iii. Some approaches to MCDA seek to establish the dominance or extended dominance of options, by drawing on various ways of establishing weights and combining scores across criteria (e.g., strong dominance, outranking and data envelopment analysis). However, those

measures of dominance that are unaffected by assumptions of separability and additivity (e.g., an alternative is better on all criteria; or better on some criteria and no worse on others), is unlikely to have discriminatory power in most circumstances. Furthermore, the additional cost associated with an alternative also needs to be considered (see Section 3.3) even if it strongly dominates others in the multi-attribute benefit it offers.

3.3 How should the costs and opportunity costs of achieving an improvement in a composite measure of benefit be considered?

The criteria included in MCDA should relate directly to attributes of a composite measure of benefit. However, some of the recent calls for extending the use of MCDA for HTA bodies like NICE seem to have confused attributes of a measure of benefit and the necessity to consider the additional costs and opportunity costs associated with interventions that improve composite (multi-attribute) benefits by including cost-effectiveness (summarised as an ICER) as a criterion. Interestingly, where MCDA has actually been used to inform investment decisions in health care the attributes of benefit have been scored and weighted first and then the composite benefits of the options have been compared to their costs, sometimes summarised as a cost-benefit score (Wilson, Sussex, Macleod, et al. 2007; Epsom and St Helier University Hospitals Trust, 2009).

Weighting ICERs?

As outlined in Section 2 it is not cost-effectiveness (the ICER) per se that is an attribute of benefit but an assessment of the health benefits (in QALYs) and likely net health effects (also in QALYs) offered by the intervention. Of course, an ICER is related to both, although both require knowledge of the value of the denominator (not just the ratio) and the latter also requires knowledge of the numerator and an estimate of the threshold. Therefore, including an ICER as criteria to be weighted in MCDA poses a number of problems:

i. Since an ICER is derived from estimates of health effects and resource use it will not be mutually exclusive and will overlap considerably with others related to health effects and cost (e.g., evidence of clinical effect).

ii. Although ICERs are related to health gains offered, any weight assigned to an ICER implies different weights assigned to health benefits (because the ICER is a ratio). Without knowledge of the denominator and numerator in the ICER it is not possible to know the implied weight that is being assigned to the health (QALY) gains. Therefore, deriving weights that show how health gains should be traded against other aspects of social value cannot be achieved by asking respondents to weight ICERs. It is for this reason that implementation and evaluation of end of life criteria focuses on the weights that might be attached to QALY gains at the end of life rather than weights applied directly to ICERs or the threshold (NICE 2009b; Shah, Tsuchiya, and Wailoo 2011). Once weights for health gains (and other attributes) have been derived it is possible to solve for the implied equivalent weight attached to the ICER (or the threshold to be applied) for the particular intervention. However, this will differ depending on weights associated with other attributes, the numerator and denominator in the ICER and what other aspects of value are forgone due to additional costs (see below).

iii. In many NICE appraisals, including Single Technology Appraisal, there is more than one alternative to the technology being considered. In these circumstances, there are a number of ICERs that summarise the trade-off between QALYs gained and NHS cost. Weighting ICERs in MCDA, poses the question of which ICER to weight - with dangers of weighting inappropriate comparisons (comparators which are dominated or extendedly dominated).

Opportunity costs and the threshold

If attributes directly related to social benefits are specified and appropriate weights derived then the application of MCDA would generate an estimate of the additional composite (multi-attribute) benefit offered by each intervention, along with estimates of their additional cost, i.e., in the same way that current methods provide quantitative estimates of additional cost and QALY gains. Any decision will turn on whether the composite benefits gained are likely to

exceed the same composite benefits forgone due to the additional costs. It will require comparison with a threshold that not only reflects the QALYs forgone but also the other attributes associated with displaced NHS activities.

i. Current research to estimate the QALY threshold for the NHS is based on estimating how changes in expenditure and outcome are allocated across disease areas (groups of ICD codes) so can indicate the types of QALYs most likely to be forgone. Therefore, in principle, at least, any weights attached to the different types of health gained (e.g., burden of disease or other criteria that can be linked directly or indirectly to ICD code) can also be attached to the types of health forgone, providing an estimate of a weighted QALY threshold or a composite cost-benefit threshold. An ICER with a denominator of composite benefits could then be compared to a threshold for the same composite benefits.

ii. This is very important because if additional criteria are only applied to the benefits offered but are not reflected in opportunity costs, then decisions lead to more social value forgone than is gained; defeating the purpose of extending the use of MCDA because it may reduce rather than improve the definition of social value embodied in the section of criteria and weights.

iii. This also has an important implication which did not seem to be recognised in some of the submissions to Kennedy review (NICE 2009a) – given that budgets are fixed, incorporating other criteria (if done appropriately) will inevitably mean that some technologies, that would have been regarded as cost-effective based only on a QALY ICER, will be rejected or access restricted because they perform relatively poorly on some attributes compared to their comparators and/or what is likely to be forgone elsewhere in the NHS.

In some circumstances this problem of estimating a threshold that reflects the other attributes and their value that are likely to be forgone can be avoided.

i. If the circumstances described in Appendix 1 are indeed special, in the sense that they are very uncommon (in other NHS activities) then taking

them into account without suitable adjustment to the threshold might be reasonable on the basis that health and heath care associated with these characteristics are very unlikely to be forgone. This may be reasonable when special circumstances are narrowly defined as exceptions (even then it is an empirical question). However, extending the criteria to attributes which are more common or associated with all health effects (e.g., burden of illness) will require these aspects of value to be reflected in the threshold. Adding criteria to the benefits side which are not possible to incorporate in the opportunity cost side would seem self defeating – leading to decisions which reduce rather improve social value.

ii. If approval (investment) of a new technology could be considered alongside the current NHS activities which could be curtailed to accommodate the additional NHS costs, then all investment and matching disinvestment options could be evaluated using the same criteria and weights. Some applications of MCDA are undertaken in this way, e.g., its use in Programme Budgeting and Marginal Analysis. There are many examples of these sorts of approaches to decision making being used by Primary Care Trusts. Similarly, if the context is making an investment decision when the resources available to the decision maker have already been allocated specifically for that purpose, only the attributes of each of the options available within that budget constraint need be considered. In the longer term, there may be scope to develop a set of criteria and weights for use across the NHS. However, at present there is no mechanism for reconciling local and national priorities or for NICE to consider the specific disinvestments which would be required to accommodate a new technology. Therefore, the impact on the threshold of extending the use of MCDA cannot be avoided unless other criteria are restricted to exceptional and special circumstances.

3.4 How could the transparency of the deliberative process be improved?

The current deliberative process in NICE appraisal recognises that current measures of health gain (QALYs) cannot reflect all aspects of social value associated with the decisions that NICE must make. However, it also recognises that questions of social value are complex, nuanced and quite naturally disputed.

Moving to an entirely algorithmic process, where the only judgments required are ones of scientific rather than social value, would avoid deliberation. However, it would require criteria and weights to fully reflect all aspects of social value in a way that was regarded as legitimate and carry some broad consensus. The discussion in Sections 3.1, 3.2 and 3.3 suggested that this is unlikely to be possible. For example, the criteria would need to represent a complete description of all the attributes judged to be of value. This seems unlikely, not least because views about social value (the purpose of the NHS) quite legitimately differ and are disputed. Even if some broad consensus was possible about which attributes should be included, which weights should be applied and which assumptions are reasonable when doing so, are also not self evident. Therefore, extending the use of MCDA seems unlikely to avoid deliberation. Nor would it avoid disputes about social values and their relative weights when technologies are rejected or their use restricted and especially when some technologies, which would have been acceptable based on health gain alone, are unacceptable once other criteria are applied.

If a complete and legitimate description of social value is not possible then maybe the most important question is not whether extending quantitative use of MCDA can overcome some of the difficulties or substitute for deliberation, but how an unavoidably deliberative process can be improved in two respects: i) how the considerations are undertaken; and ii) how the reasoning and impact on decisions can be reported to improve transparency and accountability. This chimes well with the findings of the Kennedy review:

> *"Because I have concluded that those benefits which I say should be taken account of should (be – sic) incorporated into NICE's estimation of*

> *health gains as against health losses, the appraisal system should make it clear how this is to be done…But it must do so in a way that does not perpetuate the unfortunate idea, which could currently be entertained, that there is a methodology based on ICER/QALY and then there is some set of afterthoughts. If indeed social judgements, values or benefits do form part of NICE's appraisal as NICE claims and it is a "deliberative process", then they should overtly be identified as part of that deliberative approach…" (Kennedy Review 2009 p. 29-30 – emphasis added)*

The principles of MCDA may help to identify ways in which deliberation can be undertaken in a more structured and transparent way throughout the appraisal process, i.e., aiding rather than substituting for deliberative decision making.

For example, Appendix 2 illustrates a sort of simple recording template suggested by Devlin and Sussex 2011 that could be used. This could be seen as building on and extending the table that is currently provided at the end of the 'considerations' section of ACDs, FADs and Guidance. This would address some concerns about the lack of transparency in the importance attached to these 'other criteria', i.e. those not captured in the ICER, while preserving the character of the NICE deliberative process.

What are the options?

NICE *already* uses multiple criteria in its decision making: both quantitatively, through its use of decision analytic modelling and measures of HRQoL; and qualitatively, through its use of a deliberative process. The proposed introduction of value based pricing suggests that future decision making about new health care technologies is likely to be based on weighting the types of QALYs gained and forgone.

The question of what constitutes social value is inevitably complex, nuanced and disputed. There is no obvious broad consensus nor is this question one with a 'correct' empirical answer. For this reason deliberation is unavoidable. The crucial question is what form of quantitative analysis would provide the best (secure, accountable and evidence based) starting point for deliberation and decision?

The options for NICE range from:

- Taking health improvement as the primary purpose of the NHS, for which there might be some general broad consensus, and QALYs as the best currently available metric of health improvement, i.e., taking cost per QALY gained as the start point for deliberation, with some discretion in some limited circumstances (e.g., the metric of health improvement was shown not to capture important aspect of health). The primary role of the Appraisal Committee would be to make scientific value judgements about the evidence and analysis rather than social value judgements, i.e., representing early NICE appraisal prior to 2008.

- Take cost per QALY as the start point but incorporate other aspect of social value through deliberation (reported textually in the considerations section of Guidance), but indicate how considerations might influence decisions through application of the threshold, i.e. representing the current approach post 2008.

- The use of MCDA alongside and as a supplement to existing deliberative process, serving to structure those discussions; to feed back to decision makers the weights implicit in their decisions. The current approach to the cost effectiveness threshold range might potentially be maintained, but with more explicit reporting of the way that other criteria influenced a decision to accept a technology with an ICER within or above that range.

- The use of MCDA to identify, score and weight (for example, using weights derived from stated preferences exercises with the general public) multiple criteria, to determine some aggregate incremental benefit score, to be weighed up against incremental cost. Opportunity cost would therefore need to be considered in commensurate terms (e.g. as a ‘cost per benefit points’ threshold), so the cost effectiveness threshold would need to be re-assessed on that basis.

Appendix 1. Special weightings applied by NICE in making judgements about cost effectiveness.

NICE takes a number of factors into account – and these are "given special weighting when making judgements about cost effectiveness" (Rawlins et al. 2009). The factors noted by NICE, with the examples provided by Rawlins et al. (2009) of specific decisions where these factors were taken into account, are:

1. **Severity of the underlying illness**

More generous consideration is given to the acceptability of an ICER in serious conditions, reflecting society's priorities.

Taken into account in decisions about: Riluzole (for MND); Trastuzumab (advanced breast cancer); Imatinib (for chronic myeloid leukaemia); Imatinib (for gastrointestinal stromal tumour); Pemetrexed (for malignant mesothelioma); Omalizumab (for severe asthma); Sunitinib (for advanced renal cancer); and Lenalidomide (for multiple myeloma).

2. **End of life treatments**

The public places special value on treatments that prolong life at the end of life, providing that life is of reasonable quality.

Taken into account in decisions about: Riluzole (for MND); Imatinib (for gastrointestinal stromal tumour); Pemetrexed (for malignant mesothelioma); Sunitinib (for advanced renal cancer); and Lenalidomide (for multiple myeloma).

3. **Stakeholder persuasion**

Insights provided by stakeholders e.g. on the adequacy of the measures used in clinical trials in reflecting symptoms and quality of life.

Taken into account in decisions about: Riluzole (for MND); Ranibizumab (age related macular degeneration); Omalizumab (for severe asthma); Sunitinib (for advanced renal cancer); Somatropin (growth hormone deficiency); and Chronic subcutaneous insulin infusion (childhood type 1 diabetes).

4. **Significant innovation**

Some products may produce demonstrable and distinct benefits of a substantive nature, and which are not adequately captured in the quality of life measures.

Taken into account in decisions about: Trastuzumab (advanced breast cancer); Imatinib (chronic myloid leukaemia; Imatinib (for gastrointestinal stromal tumour); Ranibizumab (age related macular degeneration); Omalizumab (for severe asthma); Sunitinib (for

advanced renal cancer); Somatropin (growth hormone deficiency); and Lenalidomide (for multiple myeloma).

5. Disadvantaged populations

Special priority is given to improving the health of the most disadvantaged members of the population e.g. poorer people and ethnic minorities.

Taken into account in decisions about: Pemetrexed (for malignant mesothelioma).

6. Children

Given methodological challenges in assessing quality of life in children, society would prefer to give 'the benefit of the doubt'.

Taken into account in decisions about: Somatropin (growth hormone deficiency); and Chronic subcutaneous insulin infusion (childhood type 1 diabetes).

Source: Devlin and Sussex (2011), based on Rawlins et al (2009).

Appendix 2. A template for explicit and transparent consideration of social value judgements in NICE's deliberative process.

	To be considered at scoping:	To be considered at the appraisal committee:	
SVJ criteria	Relevant to this technology?	Record of committee's deliberations on each SVJ deemed relevant at scoping: key points considered (free text)	Summary of the committee's view of the importance of this SVJ in considering this technology: (1 = very important to 5 = not important)
End of life	Yes ❑ No ❑		
Severity	Yes ❑ No ❑		
Children	Yes ❑ No ❑		
Social disadvantage	Yes ❑ No ❑		
Small patient numbers	Yes ❑ No ❑		
Lack of alternative treatments	Yes ❑ No ❑		
Aspects of innovation not taken into account in the ICER	Yes ❑ No ❑		
(other_____)	Yes ❑ No ❑		
(other_____)	Yes ❑ No ❑		
(other_____)	Yes ❑ No ❑		
Record of the overall (combined) impact of SVJs on the decision about this technology with respect to the cost effectiveness threshold range: Most plausible ICER for this technology £_____ Implicit weight applied to QALYs gained from combined SVJs at £20k threshold*:_____ Implicit weight applied to QALYs gained from combined SVJs at £30k threshold*: _____ Summary of the overall influence of SVJs in the deliberative process for this technology: *"As the ICER of an intervention increases in the £20,000 to £30,000 range, an advisory body's judgement about its acceptability as an effective use of NHS resources should make explicit reference to the relevant factors… Above a most plausible ICER of £30,000 per QALY gained, advisory bodies will need to make an increasingly stronger case for supporting the intervention as an effective use of NHS resources…"(NICE 2008, p.19).			

Note: **The criteria shown in this template are illustrative only. This template is reproduced with permission from Devlin and Sussex (2011).**

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