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Combining multi-criteria decision analysis and mini-health technology assessment: A funding decision-support tool for medical devices in a university hospital setting

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ABSTRACT

Background: At the hospital level, decisions about purchasing new and oftentimes expensive medical devices must take into account multiple criteria simultaneously. Multi-criteria decision analysis (MCDA) is increasingly used for health technology assessment (HTA). One of the most successful hospital-based HTA approaches is mini-HTA, of which a notable example is the Matrix4value model.
Objectives: To develop a funding decision-support tool combining MCDA and mini-HTA, based on Matrix4value, suitable for medical devices for individual patient use in French university hospitals – known as the IDA tool, short for 'innovative device assessment'.
Methods: Criteria for assessing medical devices were identified from a literature review and a survey of 18 French university hospitals. Weights for the criteria, representing their relative importance, were derived from a survey of 25 members of a medical devices committee using an elicitation technique involving pairwise comparisons. As a test of its usefulness, the IDA tool was applied to two new drug-eluting beads (DEBs) for transcatheter arterial chemoembolization.
Results: The IDA tool comprises five criteria and weights for each of two over-arching categories: risk and value. The tool revealed that the two new DEBs conferred no additional value relative to DEBs currently available.
Conclusions: Feedback from participating decision-makers about the IDA tool was very positive. The tool could help to promote a more structured and transparent approach to HTA decision-making in French university hospitals.

1. Introduction

Health technology assessment (HTA) is increasingly performed by health care agencies worldwide to support decision-making concerning the uptake of new health technologies such as drug therapies, equipment and medical devices. HTA, which is a multi-disciplinary field bridging scientific evidence and policy-making [1], considers a wide range of aspects, including medical, social, ethical and economic implications of the development, diffusion and use of health technologies [2]. HTA has spread beyond just national health care agencies; many hospitals have developed local HTA models with respect to purchasing new and oftentimes expensive health technologies [3].

One of the most successful hospital-based HTA approaches is mini-HTA [4,5]. This decision tool is based on a checklist designed for rapid assessment of four central aspects: technology, patient, organization and economy. The key to the success of mini-HTA is its capacity to integrate the views of end-users more effectively into hospital policy actions, which has been identified as a decisive factor in implementing hospital-based HTA [6,7].

Several authors have suggested that the future development of HTA will necessarily incorporate multi-criteria decision analysis (MCDA) [8–13]. MCDA is a methodology for helping

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decision-makers to evaluate alternatives in the context of considering multiple criteria simultaneously [8]. Multi-attribute value theory is the MCDA method most widely used in HTA, particularly with respect to approaches based on additive models for aggregating alternatives' performance across the multiple criteria [8]. A wide range of techniques for eliciting decision-makers' preferences with respect to weights on the criteria, representing their relative importance, is available [14–16].

Experiments testing approaches combining HTA and MCDA have recently been performed, including the well-known "EVIDEM" project [17,18]. Approaches combining MCDA and hospital-based HTA have also emerged, several of which use the mini-HTA model – notably the Matrix4value model [5,19]. This model comprises six criteria extracted from the mini-HTA form for each of two over-arching categories: risk and value [5]. For each of these categories, an overall score for each device under consideration is produced by multiplying the expected performance score on each criterion by its weight and then summing the weighted part-scores. These two overall scores for each device can be illustrated graphically in a similar fashion to a cost-effectiveness quadrant, which can help decision-makers to discriminate, and ultimately choose, between competing alternatives.

A tool combining MCDA and mini-HTA, such as Matrix4value, could potentially improve hospital-based HTA activities in French university hospitals by supporting a common, formal and transparent framework for evaluating new medical devices [20]. However, earlier tools and methods have several important weaknesses.

First, as we pointed out in an earlier study [20], some of the criteria within the mini-HTA model are unsuitable for medical devices for individual patient use. This issue is important because local HTAs in French hospitals do not necessarily involve the same processes or stakeholders for medical devices with respect to collective and individual patient use respectively [21]. Second, the simple weight-elicitation technique used by Matrix4value based on Likert scales has several drawbacks; for example, scales have been shown to suffer from biases associated with decision-makers not employing the scale's full range to represent their preferences [22]. These drawbacks could be remediated by using a more robust methodology [17,22]. Finally, in order to encourage medical device committees of French hospitals to adopt them, methodologies need to be easy-to-use, cost-effective and reproducible over time (which has not always been so in the past).

Thus, the objective of the study reported in this article is to design and apply a mini-HTA/MCDA tool suitable for assessing medical devices for individual patient use in French university hospitals.

2. Methods

Consistent with most MCDA approaches in use internationally [23] and based on the same rationale underpinning the development of Matrix4value, we decided to build simple additive models for the over-arching risk and value categories respectively. Such 'compensatory' models, where an alternative's strengths on one criterion can offset its weaknesses on one or more other criteria, have been found to accurately reflect decision-makers' preferences [24].

We followed a three-step approach to develop the mini-HTA/MCDA tool – which we named IDA, short for 'innovative device assessment'. First, we selected relevant criteria for assessing new medical devices for individual patient use based on a literature review and a survey of 18 French university hospitals. We then implemented a weight-elicitation technique that appropriately balances methodological rigor and ease of use. Finally, as a test of its usefulness, we applied the IDA tool under real-world conditions in a university hospital by assessing two new medical devices relative to one currently available.

2.1. Selecting decision criteria

We performed a literature review of mini-HTA-like models to identify criteria considered in local HTAs for medical devices. We also surveyed 18 French university hospitals to identify criteria for assessing new medical devices. Details about the review and survey are available in an earlier article [20].

The criteria identified from both sources were coded independently by the first and sixth authors (NM and CD) and assigned to one of the four mini-HTA perspectives mentioned earlier: technology, patient, organization and economy. Criteria that, in essence, referred to the same concept were grouped under a common code; for example, "medical benefit", "clinical benefit" and "health benefit" can be grouped together under the code "CLINICAL BENEFIT". Earlier studies of health decision criteria standardized terms in a similar fashion [25].

We analyzed the criteria from both sources most frequently considered for each mini-HTA perspective, and compared their similarities and differences. Only criteria suitable for medical devices for individual patient use were selected; for example, we discarded criteria concerning devices' physical-space impact. We further reduced the number of criteria by retaining only those from both the literature review and the survey. Finally, consistent with conventional MCDA modelling guidelines, we did our best to ensure that the criteria selected are complete, non-redundant, operational and mutually independent [26].

2.2. Determining criterion weights

As explained in the Introduction, our goal was to use a weight-elicitation technique that is more methodologically robust than relying on evaluation (e.g. Likert) scales while also being easy-to-use, cost-effective and reproducible. After considering the wide range of techniques available [23], often supported by specialized software [27,28], we decided to use the PAPRIKA method [29] implemented by 1000Minds software [30].[1]

As explained below, the PAPRIKA method – a partial acronym for '**P**otentially **A**ll **P**airwise **R**an**K**ings of all possible **A**lternatives' – is based on pairwise comparisons, and so it is less cognitively burdensome for decision-makers than other methods. Another advantage is that it yields a set of weights for each participant, in contrast to other methods which produce aggregated data only, thereby permitting us to compare weights across participant subgroups. Earlier applications of PAPRIKA and 1000Minds in the area of health technology prioritisation include [31,32]; other health applications include prioritising patients for elective surgery [33,34], disease classification [35–37] and measuring clinical trial outcomes [38–40].

The PAPRIKA method begins by identifying (performed by the software) all pairs of, in the present context, hypothetical medical devices defined on two criteria at-a-time and involving a trade-off. Each participating decision-maker is repeatedly presented with pairs of devices in random order and asked to choose which device she prefers (has greater priority). An example of a pairwise-ranking question appears in Fig. 1. Each time the decision-maker ranks a pair of devices, all other hypothetical devices that can be pairwise ranked via transitivity are identified and eliminated; for example, if a decision-maker prefers device X over Y and then she prefers Y over Z, then – by transitivity – X is also prioritised over Z (and so the method would not ask a question relating to this third pair of devices).

[1] Co-invented by the second author (PH), the method and software is freely available for academic and non-commercial use from him or via www.1000minds.com.