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Multiple Criteria Decision Analysis for Health Technology Assessment

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ABSTRACT

Objectives: Multicriteria decision analysis (MCDA) has been suggested by some researchers as a method to capture the benefits beyond quality adjusted life-years in a transparent and consistent manner. The objectives of this article were to analyze the possible application of MCDA approaches in health technology assessment and to describe their relative advantages and disadvantages. **Methods:** This article begins with an introduction to the most common types of MCDA models and a critical review of state-of-the-art methods for incorporating multiple criteria in health technology assessment. An overview of MCDA is provided and is compared against the current UK National Institute for Health and Clinical Excellence health technology appraisal process. A generic MCDA modeling approach is described, and the different MCDA modeling approaches are applied to a hypothetical case study. **Results:** A comparison of the different MCDA approaches is provided, and the generic issues that need consideration before the application of MCDA in health technology assessment are examined. **Conclusions:** There are general practical issues that might arise from using an MCDA approach, and it is suggested that appropriate care be taken to ensure the success of MCDA techniques in the appraisal process.

Keywords: decision making, health economics, health technology assessment, multiple criteria decision analysis.

Introduction

In the United Kingdom, the National Institute for Health and Clinical Excellence (NICE) makes recommendations to the National Health Service after assessing new and existing medical technologies. The current practice of NICE health technology appraisals is based on the incremental cost-effectiveness ratio (ICER), that is, the incremental cost per quality-adjusted life-year (QALY) gained by recipients of treatment. Even though NICE considers other criteria (e.g., severity and life saving) along with ICERs, there is concern that this approach may fail to capture other important sources of value [1–3]. In recognition of this issue, NICE commissioned Professor Sir Ian Kennedy to carry out a study on the relationship between innovation and the value of the technologies [4]. Also, recent developments such as the Patient Protection and Affordable Care Act in America [5] and the UK Department of Health's decision to use value-based pricing [6] indicate a paradigm shift toward transparency in using other criteria along with the traditional cost-effectiveness (C/E) analysis. Multicriteria decision analysis (MCDA) methods can support decision makers faced with evaluating alternatives by taking into account multiple criteria in an explicit manner [7]. They provide a structured and transparent approach to identify a preferred alternative by clear consideration of the relative importance of the different criteria and the performance of the alternatives on the criteria. In fact, a number of pharmaceutical drug manufacturers recommended the use of MCDA (in their submissions to Professor Sir Ian Kennedy) but recognized that further research is needed before their implementation in the health technology appraisal process.

The main aspects of any MCDA method are 1) the alternatives to be appraised, 2) the criteria (or attributes) against which the alternatives are appraised, 3) scores that reflect the value of an alternative's expected performance on the criteria, and 4) criteria weights that measure the relative importance of each criterion as compared with others. MCDA approaches can be classified broadly into three categories: value measurement models, outranking models, and goal, aspiration, or reference-level models [7]. Figure 1 shows these three methods.

Value measurement models

The degree to which one decision option is preferred over another is represented by constructing and comparing numerical scores (overall value). The scores are developed for each individual criterion initially and aggregated into higher-level value models. Almost everyone who has suggested using MCDA methodology for health technology assessment (HTA) suggested this approach [8–11]; however, this approach is not without its constraints. Program budgeting and marginal analysis [12–14] and analytic hierarchy process [15,16], another widely used MCDA technique, are also similar to this value measurement modeling approach.

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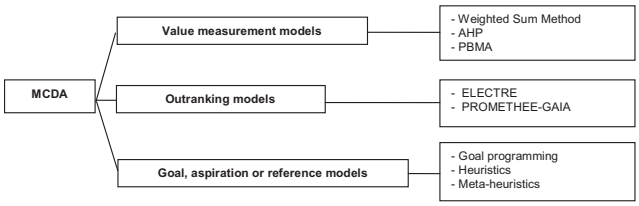

Fig. 1 – Classification of MCDA methods. AHP, analytic hierarchy process; ELECTRE, ELimination Et Choix Traduisant la REalité (ELimination and Choice Expressing Reality); MCDA, multicriteria decision analysis; PBMA, programme budgeting and marginal analysis; PROMETHEE-GAIA, preference ranking organization method for enrichment evaluations.

Outranking models

The alternatives are compared pairwise, initially in terms of each criterion, to assert the extent of preference for one over the other for that criterion. The preference information across all criteria is aggregated to establish the strength of evidence favoring the selection of one alternative over other. This approach is not widely used in health care but could also be an appropriate alternative for MCDA in HTA as it is based on direct comparison of the key characteristics of the alternatives.

Goal, aspiration, or reference-level models

This approach involves derivation of the alternative(s) that is closest to achieving the predefined desirable (or satisfactory) levels of achievement for each criterion [17]. Value-based pricing [18,19], a method to set the prices of drugs/treatments such that the ICER is under the relevant C/E threshold, can be based on mathematical programming techniques similar to those used in this MCDA approach.

Incorporating multiple criteria in health technology appraisals

Health policy decision makers internationally so far have been considering cost-per-QALY ratios alongside other criteria, such as equity and fairness and prioritization of interventions for vulnerable populations, in a deliberative manner [20]. An integrated ICER that includes other sources of value has been proposed to allow explicit incorporation of other criteria, such as societal preferences, disease severity, equity and benefits to caregivers, in the existing ICER framework. Societal preferences relating to distributional justice captured from surveys have been proposed for inclusion in the ICER calculations [21,22]. Explicit incorporation of equity in calculating ICERs for HTAs has also been considered [2,23,24], but a need for further research has been identified [25]. A hybrid method that supplements the current ICER evaluation for NICE with a comprehensive benefits and value review has also been proposed [1,8]. This approach attempts to capture the sources of value not systematically considered at the present (such as innovation, societal benefit, disease severity, unmet need, patient compliance, and related benefits) by using different ICER thresholds for different comprehensive benefits and value scores [8].

Health care organizations in a few countries have made attempts to incorporate different criteria into their decision-making processes. For example, the Netherlands health care system used four criteria (care must be necessary, effective, and efficient and cannot be left to the individual's own responsibility) for priority setting, but it made the decision-making process rather complex [26]. Some countries such as Belgium and France, in an attempt to establish a relationship between financial constraints and medical need, have proposed to vary their pharmaceutical expenditure on the basis of patients' medical need [27,28]. France classifies medicines into three categories: essential, important, and convenience, and French people receive 100% reimbursement for essential drugs, 65% for important drugs, and 35% for convenience medication [28]. In South Korea, the Health Insurance Review and Assessment service considers clinical benefit, C/E, budget impact, reimbursement status in other countries, and other features that might affect public health in determining whether a new drug receives reimbursement [29].

MCDA has also been used to inform health care decisions [30–32], setting priorities for HTAs [33], and other governmental issues [34,35]. The benefit-risk assessment of medicines, based on multiple benefit and risk criteria including the trade-offs between the benefits and the risks, was also performed by using MCDA [36,37]. MCDA techniques have also been used for shared decision making between patients and doctors in the evaluation and selection of therapies, treatments, and health care technologies [38,39]. These MCDA techniques were said to identify and include the personal preferences of the patient, but the complexity of the MCDA models and the time taken to complete the model were mentioned as disadvantages [40,41]. Program budgeting and marginal analysis [13,14,42], used for reallocation of scarce health care resources, is similar to MCDA methodologies. This method has received some attention in the health sector [12,43], but its success has been limited because of the complexity of the approach, large data requirements, and organizational barriers [44,45].

Despite the widespread use of MCDA in other health streams, it is only recently that there have been studies that advocate the use of MCDA for HTA. A framework utilizing a value matrix was developed to include quantifiable components that are currently considered in health decision making to promote transparent and efficient health care decision making [9]. This framework was also linked to a qualitative assessment including six ethical and health system–related components of decision to provide a tool for combining HTA, MCDA, values, and ethics [10]. Health England Leading Prioritisation study also used MCDA to prioritize investment in preventative health interventions [46].

Most of the proposed MCDA approaches, however, use the same technique (weighted sum approach), which may lead to the researchers/health professionals assuming that it is the only relevant MCDA method. This article attempts to provide an overview of the main MCDA methods available and the issues with their implementation in a technology appraisal process.

MCDA versus NICE Appraisal Process

This section compares the MCDA approach to the NICE appraisal process. Although NICE is chosen as the example, the findings are generalizable to other international health care decision-making organizations. MCDA is aimed at supporting decision makers faced with evaluating alternatives taking into account multiple and often concurrent criteria. The MCDA process consists of the following phases: problem identification and structuring, model building and use, and the development of action plans [7]. The appraisal process followed by NICE is divided into three phases: scoping, assessment, and decision making through deliberation by a committee that makes its recommendations on the basis of evidence and experts' and patients' opinions.

The MCDA process is compared with the current NICE technology appraisal process as shown in Figure 2. The current NICE approach includes this problem-structuring process during the "scoping" stage to set the predefined options (treatments, drugs, etc.) and the key outcomes relevant for the appraisal process. The criteria for NICE appraisals are defined in the methods guide [47], not separately for each appraisal, but the scoping process allows identification of other key issues (such as disease-specific outcomes). The first two steps of the MCDA process, that is, identifying alternatives and criteria, is known as problem structuring; this