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Integrating Multi-Criteria Decision Analysis in Healthcare Policy and Practice [1,2]

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Abstract

Decision-making in healthcare financing requires balancing diverse and often competing criteria. Multi-Criteria Decision Analysis (MCDA) offers a structured framework for evaluating multiple factors simultaneously, enhancing efficiency, transparency and consistency. This policy brief explores the integration of MCDA in healthcare, detailing its advantages in supporting comprehensive evaluations and succinctly presenting various prominent MCDA models. Moreover, a step-by-step framework for applying MCDA in healthcare decision making is presented, emphasizing stakeholder engagement and criterion selection. Finally, the brief addresses the challenges that accompany MCDA implementation and offers strategies to mitigate these issues.

Keywords: MCDA, Resource Allocation, Priority Setting, Decision-Making, Healthcare, Health Systems

Introduction

The allocation of resources in healthcare has traditionally been guided by the principle of cost-effectiveness. This perspective, deeply rooted in mainstream economic theory, seeks to maximize health benefits per unit of expenditure, operating under the assumption that resources are finite and must be used to achieve the greatest possible return in health outcomes (Thomas & Chalkidou, 2016).

While cost-effectiveness provides a practical framework for making decisions, it should be balanced with other methods that recognize the multifaceted nature of healthcare (Donaldson et al., 2002; Klein, 2010). This is because cost-effectiveness, by its very nature, simplifies the complex reality of healthcare, which includes not only the physical health of individuals but also their psychological, social, and ethical well-being. By embracing a more holistic approach, policymakers can better ensure that healthcare policies and interventions cater to the diverse needs and values of individuals and communities (Wouterse et al., 2023).

This policy brief argues that the existing paradigm, with its heavy reliance on cost-effectiveness, may inadvertently sideline critical aspects of healthcare that are harder to quantify but equally important for societal welfare. A more holistic approach to resource allocation in healthcare is needed, to incorporate broader criteria such as equity, accessibility, and the right to health. Building on this

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critique, the policy brief advocates for the integration of additional criteria into healthcare resource allocation decisions, alongside economic evaluations.

Multi-Criteria Decision Analysis (MCDA) stands out as a strategic tool capable of integrating a variety of health metrics, economic assessments, and ethical considerations into a coherent framework for decision-making. Research interest in the application of MCDA methods in healthcare decision-making is fairly recent, since the majority of the relevant studies have taken place after 2010 (Marsh et al., 2014). This approach is not merely about optimizing economic outcomes, but is deeply rooted in enhancing the quality and accessibility of healthcare. By employing MCDA, policymakers and healthcare administrators can better evaluate and balance the trade-offs between competing needs and preferences, ultimately leading to more informed, transparent, and accountable decision-making (Devlin & Sussex, 2011; Thokala & Duenas, 2012). Thus, the need for a methodological shift to MCDA is driven by its potential to transform healthcare resource allocation into a more dynamic, inclusive, and strategic process, thereby improving health systems and patient outcomes.

Advantages of Multi-Criteria Decision Analysis

MCDA aids decision-makers in systematically evaluating various programs by incorporating multiple criteria such as health outcomes, cost-effectiveness, equity, condition severity, and patient preferences (Thokala & Duenas, 2012). This approach fosters a structured, transparent methodology that targets interventions offering the highest overall value. This enables the allocation of resources to those interventions that ensure optimal value for money or the best potential to realize desired health outcomes.

A particular strength of MCDA lies in its ability to manage conflicting objectives within resource allocation (Lloyd-Williams, 2019). It allows for the explicit definition and balancing of diverse goals, such as equitability in healthcare access versus cost efficiency. Through this structured approach, MCDA aids decision-makers in navigating trade-offs and making informed choices that resonate with the overarching values and objectives of the healthcare system. Additionally, MCDA can enhance stakeholder engagement in the allocation process (Marttunen et al., 2015). It can incorporate a wide array of viewpoints including those of patients, healthcare professionals, policymakers, and the public, ensuring that decisions reflect a comprehensive range of criteria, from patient preferences to ethical considerations. This inclusivity promotes decisions that are not only effective, but also in line with the respective societal values.

As mentioned above, the transparency and accountability of decision-making processes can also be significantly enhanced through MCDA (Devlin & Sussex, 2011; Thokala & Duenas, 2012), as it provides a systematic framework that details decision criteria, weightings and trade-offs, and allows stakeholders to scrutinize and comprehend the decision-making process. At the same time, it empowers policymakers to justify their decisions based on well-defined, evidence-based criteria, thereby curbing the influence of subjective biases and enhancing accountability (Baltussen et al., 2019). Moreover, MCDA's flexibility allows it to be adapted to the unique contexts and values of different healthcare systems (Jit, 2018). It accommodates the specific priorities and resource limitations of various regions or nations by allowing for the customization of criteria and weightings, making MCDA a versatile tool in global health economics.

Multi-Criteria Decision Analysis Models

Several MCDA models have been developed to address the varied needs of healthcare decision-making, each tailored to specific types of decision contexts and objectives. Each of these models offers distinct advantages and may be preferable depending on the specific characteristics of the decision scenario, such as the type of healthcare interventions under consideration, the availability and type of data, and the decision-makers' preference for certain types of analytical processes.

One prominent model is the *Analytic Hierarchy Process* (AHP). AHP assists decision-makers in structuring complex problems into a hierarchy of more comprehensible sub-problems, each of which can be analyzed independently (Galo, 2017; Schmidt et al., 2015). This process involves pairwise comparisons of criteria and alternatives, facilitating a detailed assessment of options. AHP is particularly useful in healthcare for engaging diverse stakeholder groups in the decision-making process, as it simplifies complex decisions into a series of questions that are easier to understand and answer (Corvin et al., 2020; Muñoz et al., 2014).

Another important MCDA model is the *Multi-Attribute Utility Theory* (MAUT). It involves assigning utility values to outcomes based on decision-makers' preferences across multiple attributes combining into a single, composite index of preference (Mateo, 2012). This model is advantageous in healthcare settings as it allows for the incorporation of diverse criteria such as effectiveness, safety, patient convenience, and cost into a unified decision-making framework (Chung et al., 2010). MAUT is particularly useful when dealing with a large number of alternatives (Akpan & Morimoto, 2022) and can be adapted to changing healthcare and regulatory circumstances (Chung et al., 2010).

The *Technique for Order Preference by Similarity to Ideal Solution* (TOPSIS) is yet another model that is used to identify solutions from a finite set of alternatives based on their geometric distance from an ideal point (Uzun et al., 2021). TOPSIS can handle both quantitative and qualitative criteria, and it involves determining criteria weights, constructing a decision matrix, and calculating TOPSIS scores (Madanchian & Taherdoost, 2023). This model is beneficial in scenarios where decision-makers need to rank health interventions not only by their cost-effectiveness but also by their performance on other critical health and non-health criteria.

The *Elimination and Choice Expressing Reality* (ELECTRE) method, a family of outranking methods, is used to compare alternatives by systematically identifying and emphasizing the strengths of one alternative over others. It utilizes an outranking relation based on concordance and non-discordance tests, allowing for the consideration of both positive and negative aspects in preference modeling without requiring commensurable performance scales (Figueira et al., 2013). This method is particularly adept at handling qualitative data and can be used to address scenarios in healthcare where precise quantification of benefits or costs is challenging. While the method's main advantage is its robustness, a potential weakness is the difficulty in interpreting results (Uzun et al., 2021).

The *Evidence and Value: Impact on Decision-Making* (EVIDEM) model is one of the most widely used MCDA frameworks in healthcare, designed to facilitate transparent, structured, and inclusive decision-making, particularly for resource allocation. EVIDEM combines both quantitative and qualitative factors, allowing decision-makers to evaluate healthcare interventions based on multiple criteria such as clinical benefit, safety, cost-effectiveness, ethical considerations, and societal impact (Wagner et al., 2015). A key strength of EVIDEM lies in its flexibility, as it can be tailored to different healthcare systems and contexts, adapting to the needs and preferences of diverse stakeholders (Tony et al., 2011). The model is also designed to foster transparency by making the decision-making process and the criteria used explicit, thus improving accountability in resource allocation (Goetghebeur & Cellier, 2018). However, its complexity can sometimes pose challenges, requiring significant stakeholder engagement and careful criterion weighting to avoid bias (Garau et al., 2017).

Adding to these, the *Preference Ranking Organization METHod for Enrichment Evaluations* (PROMETHEE) is a flexible and user-friendly approach to ranking and evaluating alternatives based on their outranking relationships. PROMETHEE is particularly effective for healthcare decisions involving conflicting and incommensurable criteria, as it can incorporate expert opinions to assign weights and assess the trade-offs between different policy options directly (Makan and Fadili, 2020).

Finally, the *Weighted Sum Model* (WSM) offers a straightforward method where each criterion is assigned a weight according to its importance, and scores are calculated by summing the weighted performance ratings of each alternative across all criteria (Hansen & Devlin, 2019). WSM has been applied to various healthcare problems, including personnel allocation in health institutions (Sawik, 2015). It is commonly used for its simplicity and effectiveness in situations where all criteria are measured on a common scale, making it suitable for quantifiable healthcare decisions.

Integrating MCDA into Healthcare Decision-Making

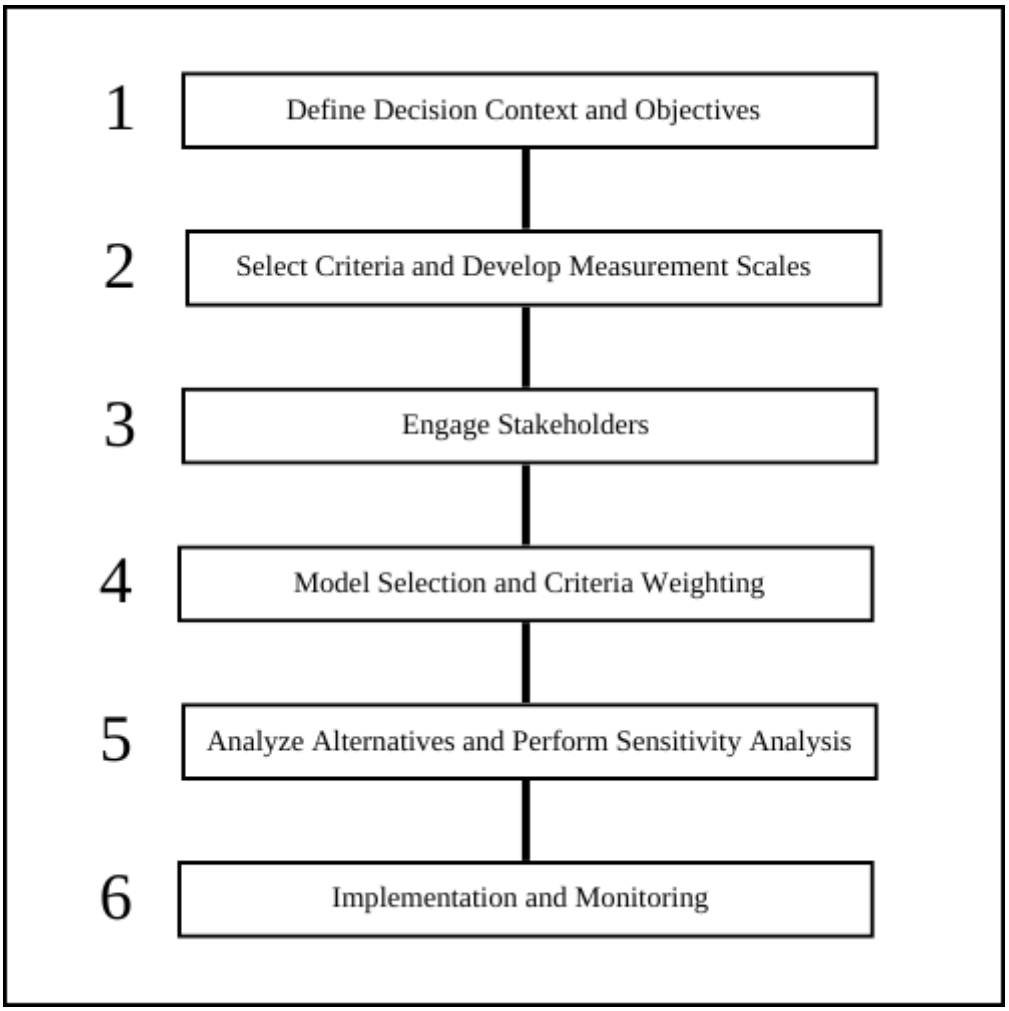
The effective implementation of MCDA in healthcare requires a structured framework that guides the integration of this approach into existing decision-making processes. Moreover, while MCDA provides significant advantages, it is crucial to acknowledge and address its inherent limitations to ensure effective implementation. One primary challenge is the complexity involved in constructing and applying MCDA models. Selecting appropriate criteria, developing measurement scales, and aggregating diverse data types require substantial expertise, which can be daunting for decision-makers who lack quantitative skills or access to detailed data. Thus, training stakeholders to understand and effectively use MCDA models is essential (Thokala & Madhaven, 2018). This involves developing comprehensive training programs that focus on the principles of MCDA, its various models, and the interpretation of results.

The initial step in implementing MCDA involves a clear definition of the decision-making context and the specific objectives that the healthcare system aims to achieve. This includes identifying the key issues to be addressed, the scope of the decisions, and the desired outcomes (Goetghebeur & Cellier, 2018). Establishing clear objectives is crucial, as it guides the selection of appropriate criteria and MCDA models that align with the healthcare system's strategic goals (Guarga et al., 2019; Goetghebeur et al., 2011). Once the objectives are set, relevant criteria must be selected to evaluate the healthcare interventions. These criteria should encompass a range of dimensions such as clinical effectiveness, cost, patient quality of life, and equity (Baltussen et al., 2019). Each criterion needs a corresponding measurement scale, which can be quantitative or qualitative, depending on the nature of the data available and the aspect of healthcare being assessed.

A notable limitation is the subjectivity inherent in the weighting and scoring processes (Thokala & Duenas, 2012). Therefore, active stakeholder engagement is vital in order to ensure that the criteria and the resulting decisions reflect the values and preferences of those affected by them (Kolasa et al., 2018). This step involves identifying and involving various stakeholders, including patients, healthcare providers, payers, and policymakers. Engaging these groups early in the process helps in

ensuring that diverse perspectives are adequately represented and considered, thus enhancing the legitimacy and acceptance of the decision-making process (Thokala & Madhaven, 2018).

Figure 1: Step-by-Step Application of MCDA



Choosing the right MCDA model is also crucial. The selection should be based on the decision context, the nature of the data, and the specific requirements of the problem that is being addressed (Oliveira et al., 2019; De Montis et al., 2005). After selecting a model, criteria weighting is conducted to reflect the relative importance of each criterion. This can be achieved through methods such as direct weighting, pairwise comparison, or statistical methods, depending on the MCDA model used (Holtorf et al., 2021).

With the model and weights established, the next step is to apply the MCDA model to analyze the alternatives. This analysis provides a ranked list of options based on how well they meet the weighted criteria (Xu et al., 2022; Glaize et al., 2019). Sensitivity analysis is also conducted to examine how changes in the weights or other model parameters affect the outcomes, thus ensuring robustness and

reliability in the results (Baran-Kooiker et al., 2018; Holtorf et al., 2021). Finally, the implementation of the decision should be accompanied by continuous monitoring and evaluation to assess the impact of the decision on healthcare outcomes and to ensure that the objectives are being met (Frazão et al., 2018). Feedback from this phase should inform future decision processes, creating a dynamic cycle of improvement.

Along the engagement of the stakeholders, transparency and accountability must be promoted throughout the MCDA process (Sparrevik et al., 2011). This involves documenting and clearly communicating all aspects, including the rationale behind model selection, the criteria and weights used, and the reasoning behind decision outcomes. Such transparency fosters accountability and builds trust among stakeholders (Baltussen et al., 2019; Sparrevik et al., 2011). Moreover, the standardization of MCDA procedures is recommended to ensure consistency and reliability across different healthcare settings. Standardized guidelines should be established covering the selection and weighting of criteria, choice of models, and data handling practices, as they will facilitate the comparison of results across different contexts and interventions and ensure that the application of MCDA is both robust and reproducible (Schey et al., 2017).

The effectiveness of MCDA is also heavily dependent on the availability and quality of data (Oliveira et al., 2019; Glaize et al., 2019). In healthcare, where data privacy concerns, variable collection standards, and the dynamic nature of health information prevail, obtaining comprehensive and reliable data can be challenging (Gäebel et al., 2020). Inadequate data can lead to inaccurate or misleading analyses, potentially compromising decision-making quality. Thus, investments should be made in robust data systems that provide accurate, timely, and comprehensive data essential for MCDA. Enhancing healthcare IT systems to facilitate data sharing and interoperability across various providers and stakeholders can support more reliable and precise decision-making (Bates et al., 2015).

It is important to note, however, that MCDA often emphasizes quantifiable criteria, potentially leading to the overlook of important but unquantifiable factors such as ethical considerations, cultural values, or patient experiences (Wagner et al., 2015). Decision-makers must be alert to this, as well as to the risk of overreliance on MCDA models, which can lead to a 'black box' scenario where decision-makers accept outputs without adequate scrutiny of the underlying assumptions and limitations (DiStefano & Krubiner, 2020).

Conclusions

The implementation of MCDA in healthcare resource allocation presents a profound opportunity to enhance the decision-making processes that underpin the delivery of healthcare services. As explored in this policy brief, the strategic use of MCDA models not only promotes a more systematic, transparent, and evidence-based approach but also incorporates a wide range of health outcomes and values into the decision-making framework.

The inherent flexibility and comprehensive nature of MCDA support the integration of multiple, often competing, health-related criteria and stakeholder preferences. This is crucial in a landscape where healthcare needs are diverse and resources are limited. By facilitating a structured evaluation of various health interventions and their impacts, MCDA can help ensure that resource allocation decisions are both efficient and equitable. Moreover, the adaptability of MCDA to various local contexts enhances its utility as a decision-support tool across different health systems with varying priorities and challenges.

Moving forward, it is essential for policymakers, healthcare providers, and the relevant stakeholders in general to embrace the principles and practices of MCDA. Training and development in MCDA techniques should be promoted within health economics and public health education to build a robust workforce capable of implementing these sophisticated decision-making tools. Additionally, continuous research and refinement of MCDA methods should be encouraged to adapt to the evolving challenges of healthcare management.

The adoption of MCDA in healthcare resource allocation is not merely a theoretical enhancement but a practical necessity. It offers a path towards more informed, transparent, and just healthcare decisions that can significantly improve health outcomes and system sustainability. As such, healthcare systems worldwide should consider integrating MCDA into their policy frameworks to better address the complex, multidimensional challenges of modern healthcare.

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