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Multicriteria decision analysis for health care decision making in Brazil: a scoping review

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ABSTRACT

Everyday health care professionals and managers are invited to make complex decisions involving multiple factors and alternatives with impacts on the health of the interested population. In this sense, the multicriteria decision analysis (MCDA) considers the perception of different stakeholders about multiple attributes that can affect decision making, thus representing a decision support tool. Despite the relevance of MCDA, little is known about the application of different methods in health care in Brazil. To identify the characteristics of the Brazilian publications about MCDA in health care. A scoping review was conducted in PubMed, Scopus, and LILACS. Published primary studies, regardless of language, were included. This scoping review identified 45 studies in databases and one by manual search. Of these, 14 studies were evaluated by eligibility and included in scoping review: most of the publications were developed in health services (n=6) using MACBETH technic (n=6), including different actors (n=11), mainly for performance evaluation (n=6). Besides MACBETH, other methods of MCDA were TODIM (Interactive and Multicriteria Decision Making, in English), analytic hierarchy process, and discrete choice experiment. It was identified that the application of MCDA is still incipient in Brazilian health care. This review may contribute to the dissemination of knowledge about these methods and possibilities of applications among health professionals, as well as to alert them to the importance of using ethical, consistent and objective tools for more robust and transparent decision making.

Keywords: Delivery of Health Care. Decision Making. Decision Support Techniques. Use of Scientific Information for Health Decision Making.

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INTRODUCTION

Everyday health care professionals and managers are invited to make complex decisions involving multiple factors and alternatives with impacts on the health of the interested population, as well as social, economic, cultural or environmental. In addition, consistency, robustness, transparency and legitimacy are increasingly expected in decision-making. In this sense, the multicriteria decision analysis (MCDA) considers the perception of different stakeholders about multiple attributes that can affect decision making, thus representing a decision support tool.

Since 2000, MCDA has had its value recognized in the health area, whereas transport and logistics, immigration, education, investment, environment, energy, defense, among other areas, have employed this method since the 1960s (Thokala et al., 2016). In health, experiences include risk-benefit analysis, health technology assessment, resource allocation, and budgeting, clinical decision making shared with the patient and prioritizing patient access to services (Thokala et al., 2016). Among the different known methods, they propose in common: a) the definition of criteria and the attribution of weights, with the aim of clarifying fundamental objectives and perspectives of the stakeholders (Peacock et al., 2009); and b) the use of a score to assess the performance of each health technology for each criterion, which contributes to the identification of weaknesses and strengths of the evaluated alternatives (Baltussen & Niessen, 2006; Baltussen et al., 2006, 2010).

It should be noted that in Brazilian health care, as in other countries, even though MCDA is not used systematically quite often, inevitably multiple criteria are considered for decision-making routinely. A common example of this is the decision making of a health care professional, who in the act of prescription should consider multiple factors related to the patient's profile and the therapeutic alternatives in question, such as efficacy, effectiveness, safety, tolerability, cost, access, among others (Goetghebeur et al., 2016). Another explicit example, this time in a macro scope, is the case of decision making on the incorporation of technologies in the Unified Health System (*Sistema Único de Saúde* [SUS]). It is defined by law that the assessment of technologies should be submitted to the National Commission for Health Technology Incorporation at SUS (*Comissão Nacional de Incorporação de Tecnologias no SUS*) and it is necessary to consider the

scientific evidence on efficacy, accuracy, effectiveness, and safety, as well as comparative economic analyzes of benefits and costs in relation to technologies already incorporated (Nita et al., 2009; Brasil, 2014). Thus, the application of MCDA in these contexts does not innovate by considering multiple criteria, but rather by contributing to providing a structured and complete format of access to the evidence involved, ensuring transparency and usability of the report for decision-makers and stakeholders, as well as for providing a result that considers the criteria, according to their weights and scores, in a reproducible and explicit way.

Despite the relevance of MCDA, little is known about the application of different methods in health care in Brazil. A recent systematic review (Longaray et al., 2016b) characterized, through bibliometric techniques, the use of MCDA in health management in the world and identified that the most frequently used method is the hierarchical analytical process and the assessment of health technologies is the predominant segment of MCDA application, with 12 studies (7.64%) carried out in Brazil. However, the application and methods specifically from Brazilian studies have not been reported and the authors suggest that restricting access to some international databases may be a limitation of the results.

Thus, the present scoping review aimed to identify the characteristics of Brazilian publications on MCDA in health care.

METHODS

To prepare and report this research, recommendations from different institutions were considered (Moher et al., 2009; Higgins & Green, 2011; Peters et al., 2015).

To increase the consistency and transparency of this review, the research question was structured as follows: "What are the Brazilian studies and their characteristics related to the analysis of MCDA in health care?"

The searches were conducted in the PubMed, Scopus and LILACS databases, from the date of insertion until May 2017. A manual search of the reference lists of reviews and publications included was also carried out. The complete search strategies, which can be consulted in Table 1, included the following keywords, variants, and corresponding descriptors, when existing: Health care, Health technology assessment, Hospital Management, Health Management, Decision support, Decision making, Decision aid, Resource allocation, Allocating resources, Priority setting, Multicriteria, Brazil.

Published primary studies were included, regardless of language. Search, screening, eligibility and data extraction were conducted by one reviewer and reviewed by a second one. In case of disagreement, consensus meetings were held.

Data extraction was performed using Microsoft Office Excel 2016 spreadsheets, in which the study's identification, location, MCDA method adopted, stakeholders, scope and decision problem were collected.

RESULTS

Our scoping review identified 45 publications in the searched databases and 1 by manual search (Figure 1). Of these, six were excluded because they were duplicated

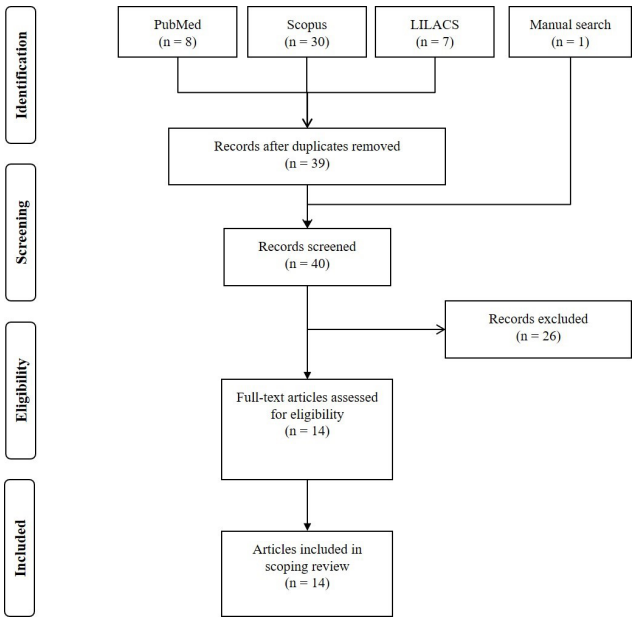

Figure 1. Study selection (Adapted from PRISMA-ScR).

Table 1. Search strategies.

PubMed
#1 "Technology Assessment, Biomedical"[MH] OR "health care"[TIAB] OR healthcare[TIAB] OR "Health technology assessment"[TIAB] OR "Hospital Management"[TIAB] OR "Health Management"[TIAB] OR (("Decision support"[TIAB] OR "Decision making"[TIAB] OR "Decision aid"[TIAB] OR "resource allocation"[TIAB] OR "allocating resources"[TIAB] OR "Priority setting"[TIAB]) AND health)
#2 (Multicriteria[TIAB] OR "Multi-criteria"[TIAB] OR MCDA[TIAB] OR "Multiple Criteria"[TIAB] OR MCDM[TIAB])
#3 Brazil OR Brazilian
#1 AND #2 AND #3
SCOPUS
#1 TITLE-ABS-KEY ("Technology Assessment, Biomedical" OR healthcare OR "health care" OR "Health technology assessment" OR "Hospital Management" OR "Health Management" OR (("Decision support" OR "Decision making" OR "Decision aid" OR "resource allocation" OR "allocating resources" OR "Priority setting") AND health)) AND TITLE-ABS-KEY (multicriteria OR "Multi-criteria" OR mcda OR "Multiple Criteria" OR mcdm) AND (Brazil OR Brazilian) AND NOT (Review)
LILACS
#1 (tw:(("Technology Assessment, Biomedical" OR healthcare OR "health care" OR "Health technology assessment" OR "Hospital Management" OR "Health Management" OR (("Decision support" OR "Decision making" OR "Decision aid" OR "resource allocation" OR "allocating resources" OR "Priority setting") AND health)))) AND (tw:((multicriteria OR "Multi-criteria" OR mcda OR "Multiple Criteria" OR mcdm))) AND (tw:(Brazil OR Brazilian))

publications and 26 when screening titles and abstracts. Thus, 14 studies were evaluated by reading in full and included in the review.

Of the 14 studies included, most were carried out in health services (n = 6), used the MACBETH technique (n = 6), involved different stakeholders such as health professionals, technicians, managers and users of health services (n = 11), mainly for performance evaluation (n = 6) (Table 2). In addition to MACBETH, other MCDA methods used were TODIM, PROMETHEE, analytic hierarchy process (AHP) and discrete choice experiment (DCE) (Table 3).

DISCUSSION

The data in the present review demonstrate that the application of MCDA is still incipient in Brazilian health care. In a recent bibliometric analysis of MCDA applications in Brazil, the authors highlighted the 14 different areas of application most frequently, among which the area of health does not figure, demonstrating how limited is the number of studies involving the health setting (Longaray et al., 2016a).

In another review, which identified the use of MCDA in health management worldwide, the authors identified that health technology assessment is the predominant segment of

Table 2. Characterization of the included studies in scoping review.

Study	Location	Method	Stakeholders	Scope	Decision problem
Nobre et al. (1999)	University Hospital of Rio de Janeiro	TODIM	Doctors	HTA	Choose from six medical-assistance equipment for incorporation
Longaray et al. (2017)	Public teaching hospital	Macbeth	Head of storage, hospital administrator and study authors	Performance evaluation	Development of a performance evaluation model for internal hospital logistical activities to promote actions that can identify and propose alternatives to the logistical problems present at the institution
Moraes et al. (2007)	Pediatric cardiovascular surgery service	UML + MCDA	Professionals working in clinical engineering	Performance evaluation	Model to evaluate the treatment of cardiovascular surgery in pediatric patients in terms of equipment
Rolim-Ensslin et al. (2014)	4 FHS in the municipality of Jaguaruna	Macbeth	Managers, authors of the study and other members of the ESF teams and the population served	Performance evaluation	Performance evaluation model for the FHS teams
Souza & Univasf (2016)	Emergency department of a private hospital	PROMETHEE	Hospital manager	Performance evaluation	What improvement actions should be prioritized in a hospital
Wollmann et al. (2012)	7 Curitiba HPO	AHP	Users	Performance evaluation	Analyze the quality of services offered by health plan operators
Longaray & Ensslin (2014)	Federal University Hospital	Macbeth	University Hospital Decision Maker	Performance evaluation	Development of a model to assist university hospital managers to assess institutional performance in meeting the goals agreed with the MS / MEC for certification
Mirelman et al. (2012)	Health Economics Center - São Paulo	Discreet choice	National level policymakers and practitioners	Setting priorities	Preferences for equity and efficiency
Silva et al. (2010)	Regulation center	Effectiveness model	Doctors, regulators, municipal health manager, technicians on technology information and patient allocation and patient representative	Setting priorities	Which patients should have the highest care priority and which service providers can best solve a patient's specific health problem
Castro et al. (2008)	University of Fortaleza	NETICA and MACBETH	Health professionals	Diagnosis	Support for medical experts and bibliographic sources in the diagnosis of Alzheimer's disease
Nunes et al. (2009)	University of Fortaleza	Macbeth + AI	Not reported	Diagnosis	Diagnosis in psychology and psychiatry (obsessive-compulsive disorder)
Comin Nunes et al. (2015)	University of Fortaleza	Macbeth + AI	Not reported	Diagnosis	Diagnosis in psychology and psychiatry (schizophrenia)
Vasconcelos et al. (2001)	59 Brazilian municipalities	Path analysis	Specialists	Epidemiology	Explain the interrelationship between health determinants and post-neonatal infant mortality
Rocha et al. (2005)	Public health system of the State University of Campinas	ABC and AHP	Not reported	Choose between services	Choice of maintenance service (internal or third-party contract) for each category of medical equipment

AHP: analytical hierarchical process; ABC: activity-based costing, FHS: Family Health Strategy, HPO: health plan operators, HTA: health technology assessment, UML: Unified Modeling Language, MS/ MEC: Ministry of Health / Ministry of Education, AI: artificial intelligence.

Table 3. Main characteristics of the different methods of MCDA identified.

Method	Characteristics
AHP - Analytical hierarchical process (Vargas (1990); Saaty et al. (2003))	It transforms the comparisons of alternatives into numerical values that are processed and compared. Decomposition of the problem in a hierarchy of criteria more easily comparable and assigning weights to each criterion; next, the alternatives are compared pair by pair, according to the criteria, considering concrete data or the judgment of different actors. Criteria and alternatives can be evaluated in different ways, the most common being the evaluation using an importance scale ranging from 1 to 9 (equally preferred - extremely preferred).
DCE - Discrete choice experiment (Green & Gerard (2009)	The actors are asked to choose between attributes organized in different competing scenarios. Through the technique, it is possible to identify whether specific criteria are a predictor of choice, providing information on the relative importance of the criteria used to describe the alternatives in the set of choices.
Macbeth - Measuring attractiveness by a categorical based evaluation technique (Bana & Costa et al. (1999); Sanchez-Lopez et al. (2012))	It consists of a technique that aggregates criteria performance values using an additive value function model, allowing ordinal scales (0 = indifferent to 6 = extreme difference in attractiveness) to be transformed into cardinal scales based on the judgment of the decision-maker about the difference in attractiveness between two alternatives. Subsequently, this procedure is performed with all the criteria, indicating the preferences of the decision-makers; and then, the model is used to analyze the impact of potential actions based on the established impact profile to identify the contribution of each criterion. The last phase, of recommendation, considers the alternatives that can contribute to improvements considering their performance.
PROMETHEE - Preference Ranking Organization Method for Enrichment Evaluation (Souza & Univasf (2016))	The method belongs to the French school family of overclassification methods, in which decision makers compare the alternatives side by side.
TODIM - Tomada de Decisão Interativa Multicritério/ Interactive and Multicriteria Decision Making (Gomes & Lima, (1992))	Decision makers provide weights to the alternatives considering each criterion and weights to the criteria using a semantic scale. Predefined criteria: benefit to the population, social impact, availability of human resources, dependence on facilities, dependence on maintenance, demand from the community and professional, importance to improve patient conditions and expected benefits in health outcomes.

MCDA application (Longaray et al., 2016b), a different context from that observed in the present review, which identified performance evaluation as the most frequent application, and in only one study was the application in health technology assessment identified. This discrepancy can be justified by the institutions that led the studies: in the present review, most studies were carried out in engineering, economics or computing schools, showing how the knowledge of MCDA is still restricted to the areas of origin of the methodology; and health professionals, who would be better able to identify the importance of the technique in health technology assessment, are unaware of its functioning and applications.

In reports published by the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) for MCDA design, and reporting (Marsh et al., 2016; Thokala et al., 2016), different methods of applying MCDA in health care are summarized: DCE, PAPRIKA (Potentially All Pairwise RanKings of all possible Alternatives), best-worst scale, SMART (Simple Multi-Attribute Rating Technique), SMARTER (SMART exploiting ranks), SMARTS (SMART with Swings), PHA, MACBETH e EVIDEM (Evidences decision marker). Of these, only DCE, PHA and MACBETH were identified in Brazilian studies, possibly because in the Brazilian context, performance evaluation was the scope of greatest application and, therefore, methods applied in the context of investment or patient prioritization and reimbursement policies, such as PAPRIKA, best-worst scale, SMART, SMARTER, SMARTS and EVIDEM have no application.

However, the importance of these techniques for other demands not addressed by most studies identified in Brazil is clear. As an example, the application of EVIDEM in the context of resource allocation or health technology assessment policies are considered: the tool is conceptually based on deontology (imperative to help, beneficence and non-maleficence), utilitarianism (the greatest good for the greatest number), justice and equity (prioritizing those who need it most) and valuing ethics and practical wisdom (Wagner et al., 2016). Compared to traditional MCDA, considered technocratic because it is oriented by methods and not towards the user, EVIDEM aggregates the robust characteristics of MCDA with a more reflective approach, aiming at greater procedural legitimacy in prioritization contexts such as health technology assessment. For this, the framework includes 13 normative criteria pre-defined in the base model, for which it must provide synthesized and validated evidence of each criterion for systematic consideration, as well as seven criteria, divided into normative and feasibility domains, in the tool contextual (Goetghebeur et al., 2008). In the quantitative part of the framework, the criteria are given weights (criteria preferences) and scores (perceptions of the synthesized evidence) to obtain a numerical measure of the value of an intervention (estimated value); while the qualitative part captures the impact on the value of those criteria that are difficult to quantify. Thus, practical wisdom is valued, since although there are pre-defined criteria that guarantee the consistency of the tool, they are weighted by the preferences of stakeholders, and may not even be considered in a given evaluation. This structure, generic enough to stimulate reflection on the criteria and their relative importance, creates an interpretive grid that can be used to obtain individual values and facilitate the sharing of perspectives during deliberation, allowing for additional sub-criteria specifications to reflect therapeutic areas and relevant evidence available for each criterion and sub-criterion (Goetghebeur et al., 2017).

The example of the application of EVIDEM in health technology assessment, the scope more identified in the international literature, demonstrates how MCDA is useful

for different contexts in health care in addition to those identified in this review. However, the interchangeability between the tools is limited, since their different characteristics may favor certain alternatives to the detriment of others. Therefore, it is important to know the conceptual basis of the tool, its characteristics, and limitations, in choosing the most appropriate method for decision making and to prefer ethical frameworks known in English for accountability for reasonableness (A4R) or responsibility for reasonability, especially in the context of prioritization of investments (Goetghebeur et al., 2017). Another important aspect to keep in mind is that a non-technocratic MCDA is not meant to be the end providing a cutoff value for decision making, but rather to be a support for it; thus, depending on the application context, other analyzes should be considered together with the findings of the MCDA.

A limitation of the present review was not summarizing and evaluating some aspects that would make this analysis richer, due to the disharmonized reporting of the studies, namely the justification for choosing the criteria, their performance, scoring process and weight assignment, calculations aggregated scores and uncertainty assessment. Thus we highlight the importance of the ADM rapporteur to follow ISPOR's recommendations (Marsh et al., 2016), which despite not being prescriptive, are useful to ensure uniformity of minimum information that must be considered for reliable reporting and reproducibility.

The present review allowed identifying that the application of MCDA is still incipient in Brazilian health care, despite the numerous possibilities of applications, as in other countries. It is hoped that this review can contribute to the dissemination of knowledge of these methods and possibilities of applications among professionals working in a health setting, as well as alerting them about the importance of using consistent and objective tools for more robust and transparent decision making.

RESUMO

Análise de decisão multicritérios para tomada de decisão na atenção à saúde no Brasil: uma revisão de escopo

Todos os dias, profissionais e gestores de saúde são convidados a tomar decisões complexas envolvendo múltiplos fatores e alternativas, com impactos na saúde da população interessada. Nesse sentido, a análise de decisão multicritério (ADM) considera a percepção de diferentes atores sobre vários atributos que podem afetar as tomadas de decisão, representando assim uma ferramenta de apoio à decisão. Apesar da relevância do ADM, pouco se sabe sobre a aplicação de diferentes métodos na atenção à saúde no Brasil. Identificar as características das publicações brasileiras sobre ADM em atenção à saúde. Uma revisão de escopo foi conduzida nas bases de dados PubMed, Scopus e LILACS. Foram incluídos estudos primários, publicados, independentemente do idioma. A revisão de escopo identificou 45 estudos nas bases de dados buscadas e um por busca manual. Destas, 14 foram avaliadas pela leitura na íntegra e incluídos nesta revisão de escopo: a maioria foi realizado em serviços de saúde (n=6), utilizou a técnica de MACBETH (n=6), envolveu diferentes atores (n=11), principalmente para avaliação de desempenho (n=6). Além de MACBETH, outros métodos de ADM utilizados foram TODIM (Tomada de Decisão Interativa Multicritério), PROMETHEE, processo hierárquico analítico e experimento de escolha discreta. Identifica-se que a aplicação da ADM ainda é incipiente na atenção à saúde brasileira. Espera-se que esta revisão possa contribuir para a difusão do conhecimento destes métodos e possibilidades de aplicações entre profissionais de saúde, bem como alertar os mesmos sobre a importância da utilização de ferramentas éticas, consistentes e objetivas para tomadas de decisão mais robustas e transparentes.
Palavras-chave: Assistência à Saúde. Tomada de Decisões. Técnicas de Apoio para a Decisão. Uso da Informação Científica na Tomada de Decisões em Saúde.

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