Reciis – Revista Eletrônica de Comunicação, Informação & Inovação em Saúde, Rio de Janeiro, v. 18, n. 4, p. 980-1001, out.-dez, 2024
[www.reciis.icict.fiocruz.br] e-ISSN 1981-6278

https://doi.org/10.29397/reciis.v18iAhead-of-Print.3996

REVISION ARTICLE

Multi-Criteria Decision Analysis for healthcare decisions: a bibliometric study

Análise de Decisão Multicritério para decisões em saúde: um estudo bibliométrico

Análisis de Decisiones Multicriterio para decisiones sanitarias: un estudio bibliométrico

Smirna Marques Felinto da Silveira Fernandes[1,a]
smirnafelintoadm@gmail.com | https://orcid.org/0000-0002-8234-352X

Renan Felinto de Farias Aires[2,b]
renan.felinto@academico.ufpb.br | https://orcid.org/0000-0001-9326-5371

[1] Universidade Federal Rural do Semi-Árido, Programa de Pós-Graduação em Administração. Mossoró, RN, Brazil.
[2] Universidade Federal da Paraíba, Departamento de Administração. João Pessoa, PB, Brazil.

[a] Degree in Business Administration from the Universidade Federal Rural do Semi-Árido.
[b] Doctoral degree in Business Administration from the Universidade Federal do Rio Grande do Norte.

ABSTRACT

Healthcare has a direct impact on human life and involves risk factors, uncertainties and preferences. The complexity and implications of actions in this area and the demand for rational and transparent decision processes has resulted in the widespread use of Multi-Criteria Decision Analysis (MCDA) methods. As such, this study aimed to conduct a bibliometric analysis of the literature on the use of MCDA in healthcare, as well as analyzing the reasons presented in the articles for selecting MCDA methods, when applicable. The study analyzed 195 articles in the Scopus and PubMed databases between 1991 and 2019. The results were presented in graphs that focused on the main objectives of the study, highlighting the fact that only 28% of the articles presented justifications for the methods chosen. Many of the justifications were not well founded. It was concluded that care is needed to ensure appropriate selection of multi-criteria methods.

Keywords: Multi-Criteria Decision Analysis; Health; Healthcare decisions; Reliability; Bibliometric analysis.

RESUMO

A área da saúde impacta diretamente na vida humana, envolvendo fatores de risco, incertezas e preferências. A complexidade e as implicações das ações nessa área resultaram na vasta utilização dos Métodos de Análise de Decisão Multicritério (MCDA) tendo em vista a demanda por processos decisórios racionais e transparentes. Diante disso, o presente trabalho teve como objetivo realizar um estudo bibliométrico sobre a utilização do MCDA na área da saúde, bem como analisar as justificativas apresentadas nos artigos para escolha dos métodos MCDA, quando aplicável. O estudo analisou um total de 196 artigos coletados nas databases Scopus e PubMed no período de 1991 a 2019. Os resultados foram apresentados e discutidos através

de gráficos baseados nas questões que abrangem os principais objetivos do trabalho, com destaque que apenas 28% dos artigos apresentaram justificativas para escolha dos métodos, apesar de muitas não serem fundamentadas. Concluiu-se que há necessidade de um processo cuidadoso para que a seleção adequada de métodos multicritério seja feita.

Palavras-chave: Análise de Decisão Multicritério; Saúde; Decisões em saúde; Confiabilidade; Estudo bibliométrico.

RESUMEN

La salud tiene un impacto directo en la vida humana, involucrando factores de riesgo, incertidumbres y preferencias. La complejidad y las implicaciones de las acciones en esta área y la demanda de procesos de decisión racionales y transparentes han resultado en el uso generalizado de métodos de Análisis de Decisión Multicriterio (MCDA). Como tal, este trabajo tuvo como objetivo realizar um estudio bibliométrico sobre el uso de MCDA en atención médica, así como analizar las razones presentadas en los artículos para seleccionar métodos MCDA, cuando corresponda. El estudio analizó 195 artículos en las bases de datos Scopus y PubMed entre 1991 y 2019. Los resultados se presentaron en gráficos basados en cuestiones que abarcan los objetivos principales del estudio, donde solo el 28% de los artículos justificaron su elección de métodos, muchos de los cuales no estaban bien fundados. Se concluyó que es necesario tener cuidado para garantizar la selección adecuada de métodos multicriterio.

Palabras clave: Análisis de Decisión Multicriterio; Salud; Decisiones sanitarias; Confiabilidad; Estudio bibliométrico.

ARTICLE INFORMATION

Author's contributions:
Conceptualization or design of the study: Renan Felinto de Farias Aires.
Data collection: Smirna Marques Felinto da Silveira Fernandes.
Data analysis: Smirna Marques Felinto da Silveira Fernandes and Renan Felinto de Farias Aires.
Interpretation of data: Smirna Marques Felinto da Silveira Fernandes and Renan Felinto de Farias Aires.
All authors are responsible for the writing and critical review of the intellectual content of the text, for the final published version, and for all legal and scientific aspects related to the accuracy and integrity of the study.

Conflict of interest declaration: None.

Funding sources: Universidade Federal Rural do Semi-Árido (no. 23091.014013/2018-48 and no. 23091.007143/2020-68).

Ethical considerations: None.

Additional thanks/Contributions: None.

Article history: submitted: 30 Sept. 2023 | accepted: 14 Jun. 2024 | published: 25 Nov. 2024.

Previous presentation: None.

INTRODUCTION

Healthcare studies are tremendously important, providing information that can lead to discoveries that have a direct impact on human life (Kaplan; Frosch, 2005). When considering different analysis possibilities, decision making is vital. This is primarily due to human factors such as uncertainties, complexities and preferences (Adunlin; Diaby; Xiao, 2015; Gillett, 2004).

It is essential that decision makers know the implications of their actions; however, medical decisions that produce perfect agreement among those involved are rare (Kaplan; Frosch, 2005). Moreover, the need for transparency requires the use of tools that can encompass the complexity of existing problems (Muhlbacher; Kaczynski, 2016).

Multi-Criteria Decision Analysis (MCDA) has become one of the most widely used frameworks due to its diverse approaches (Adunlin; Diaby; Xiao, 2015; López-Bastida *et al*., 2019; Marsh *et al*., 2018; Muhlbacher; Kaczynsi, 2016). In summary, multi-criteria methods are a set of methods that help the decision-making process, using approaches that consider multiple and conflicting criteria. Their main goal is to improve the quality of decisions (Baltussuen; Niessen, 2006; Wang; Triantaphyllou, 2008).

Overcoming the challenges posed by conventional decision methods, multi-criteria analysis is considered an advance in the search for transparent all-encompassing healthcare decisions. Due to its potential, new research has been developed over the years to analyze its methods (Adunlin; Diaby; Xiao, 2015; Frazão *et al*., 2018; Muhlbacher; Kaczynski, 2016).

Adunlin, Diaby and Xiao (2015) carried out a study that analyzed articles published between 1980 and 2013 in order to identify the health applications of MCDA, as well as reporting on publishing trends. Frazão *et al*. (2018) developed a systematic review model to analyze 66 studies in general terms as well as their methodological aspects. Muhlbacher and Kaczynski (2016) identified current healthcare research, as well as areas best suited to the use of MCDA. Glaize *et al*. (2019) reviewed MCDA applications between 1980 and 2018 in order to provide structure and practical insights on how MCDA methods are applied in different healthcare areas.

With respect to the last two studies cited, both highlight current limitations and emphasize that future research should focus on MCDA use in the field. Among the questions raised was the following: “Which MCDA method should be selected?”.

The aforementioned authors indicate that new studies are needed to develop practice guidelines for the appropriate application of MCDA methods. Given the need to address this challenge, it is important to analyze the main studies in the area, with a focus on MCDA methods and the reasons for these choices. Thus, the aim of this study was to conduct a bibliometric analysis of the use of MCDA in healthcare, with an emphasis on selecting the methods used and reasons for doing so.

The rest of the article is divided as follows: first, an overview of the MCDA and healthcare is presented; next, methodological aspects are discussed; the overall and specific results of the use of MCDA methods are then described; and, finally, conclusions are drawn.

MCDA AND HEALTHCARE

Healthcare, in all its forms, treats human suffering caused by disease or wounds (Gillett, 2004). Human beings are the central element of this system and are responsible for both its importance and its complexity. They are affected by multiple factors, including biological, physical, pathological and psychological elements (Gillett, 2004; Kaplan; Frosch, 2005).

In order to achieve its intrinsic care value and provide the best outcomes for human life, it is necessary that health interventions seek knowledge and implement preventive measures, pharmacological and

non-pharmacological treatments and medical procedures that improve health and its understanding (Gillett, 1995; Goetghebeur *et al.*, 2008; Pellegrino, 1997).

Recently, demands for an ethical approach to procedures have led to changes to traditional healthcare models. Subsequently, questions about power, honesty and shared decisions have been raised (Gillett, 2004; Tarimcilar; Khaksari, 1991). Risks, human lives, competitiveness, profit and multiple alternatives are some of the factors that make processes in this area complex (Tarimcilar; Khaksari, 1991), as well as the fact that health itself is an irreplaceable good (Diaby; Campbell; Goeree, 2013).

The health area is one of the systems which is most impacted by decision-making with multiple objectives, prompting the need for a new paradigm that incorporates the multi-objectivity of the area (Frazão *et al.*, 2018; Ghandour *et al.*, 2015). The complexity, uncertainties, multiple alternatives and preferences involved in decision-making demand a high level of care throughout the process (Adunlin; Diaby; Xiao, 2015), especially because the decision outputs will directly impact human life quality (Diaby; Campbell; Goeree, 2013).

Resource allocation, the use of funds, development of technologies, selection of suppliers, locations, severity of illness, environmental, family and social issues are some of the factors that influence decision makers when developing a safe and efficient process for selecting an optimal solution for each case (Baltussen; Niessen, 2006; Frazão *et al.*, 2018; Muhlbacher; Kaczynski, 2016).

In order to obtain good solutions, alternatives and preferences in the decision-making process must be established (Kaplan; Frosch, 2005; Adunlin; Diaby; Xiao, 2015). Shared decisions among the various agents involved, such as doctors, patients, family members and stakeholders in general, contribute to achieving the best results (Elwyn; Edwards; Kinnersley, 1999; Kaplan; Frosch, 2005) and strengthening the processes that define health priorities (Razavi *et al.*, 2019).

One of the most important challenges is the detailed assessment of the fundamental alternatives and the multiple criteria used to analyze them (Muhlbacher; Kaczynski, 2016). This process becomes more complex with the demand for transparent decisions, which should be made using a systematic structured approach to problems (Wahlster *et al.*, 2015).

MCDA methods were created in order to increase transparency and reliability in complex problem analysis and resolution (Cleemput *et al.*, 2018; Frazão *et al.*, 2018; Muhlbacher; Kaczynski, 2016). MCDA uses qualitative and quantitative approaches to combine the preferences of those involved in the decision-making process (Adunlin; Diaby; Xiao, 2015; Dai *et al.*, 2022; Muhlbacher; Kaczynski, 2016), thereby responding to criticisms of decisions based on a single criterion (Ghandour *et al.*, 2015).

The multiple and conflicting criteria, as well the alternatives, result from the decision makers' quantified preferences and priorities that were considered in making the decision (Dai *et al.*, 2022; Muhlbacher, 2015; Muhlbacher; Kaczynski, 2016). MCDA has gained academic interest and became an attractive framework due to its potential to improve the quality of decisions (Belton; Stewart, 2002; Figueira; Greco; Ehrgott, 2005; Reddy *et al.*, 2019). Multicriteria methods have been increasingly and successfully used in healthcare interventions (La Fata; Lupo; Piazza, 2019; Lasorsa *et al.*, 2019), guiding the decision-making process and making it clearer and more rational (Adunlin; Diaby; Xiao, 2015; Reddy *et al.*, 2019).

Several studies applying MCDA analyzed different healthcare interventions, with a view to optimizing systems and providing a solution to conflicts that involve human and technical interest factors, among others (Dehe; Bamford, 2015; Muhlbacher; Kaczynski, 2016; Thokala *et al.*, 2016).

Conflict resolution among specialists, the inclusion of patient preferences in the analysis of benefits and risks, budgetary, environmental and investment decisions, resource allocation, health policy analysis and assessments of technologies are examples of the use of MCDA in the healthcare field (Frazão *et al.*, 2018; Karimi *et al.*, 2021; Marsh; Caro; Muszbek, 2012; Muhlbacher; Juhnke, 2013; Oortwijn; Baltussen; Janssen, 2018; Silva *et al.*, 2021).

Given the range of applications and multiple criteria, stakeholders and complex factors that can be considered in MCDA, it is an appropriate framework for healthcare decisions, surpassing conventional methods (Adunlin; Diaby; Xiao, 2015; Frazão *et al.*, 2018). Thus, although there are no definitive solutions for improving decision making in this area, there are extensive possibilities for applying MCDA methods, thereby guaranteeing a reliable and rigorous decision-making process (Adunlin; Diaby; Xiao, 2015; Muhlbacher; Kaczynski, 2016).

METHOD

The present study is a bibliometric analysis of the use of MCDA in healthcare. A bibliometric review is an objective approach based on quantitative data, providing original theoretical and practical contributions to literature (Donthu *et al.*, 2021; Lim, 2022). The articles selected by Frazão *et al.* (2018), up to March 2017, were initially used as a base. A further 129 articles published up to December 2019 were collected. Articles were retrieved from the Scopus and PubMed databases, including Medline, PMC (PubMed Central) and NCBI Bookshelf.

Two databases were used to avoid omission and/or bias problems in final article selection. In order to obtain the largest possible number of articles no restrictions, such as status, date of publication, or language were established. For quality control purposes, the study was limited to articles published in journals. In Scopus, the search was made based on "title, abstract and keywords", and the additional filters and sequence of steps used to select the studies are presented in Figure 1.

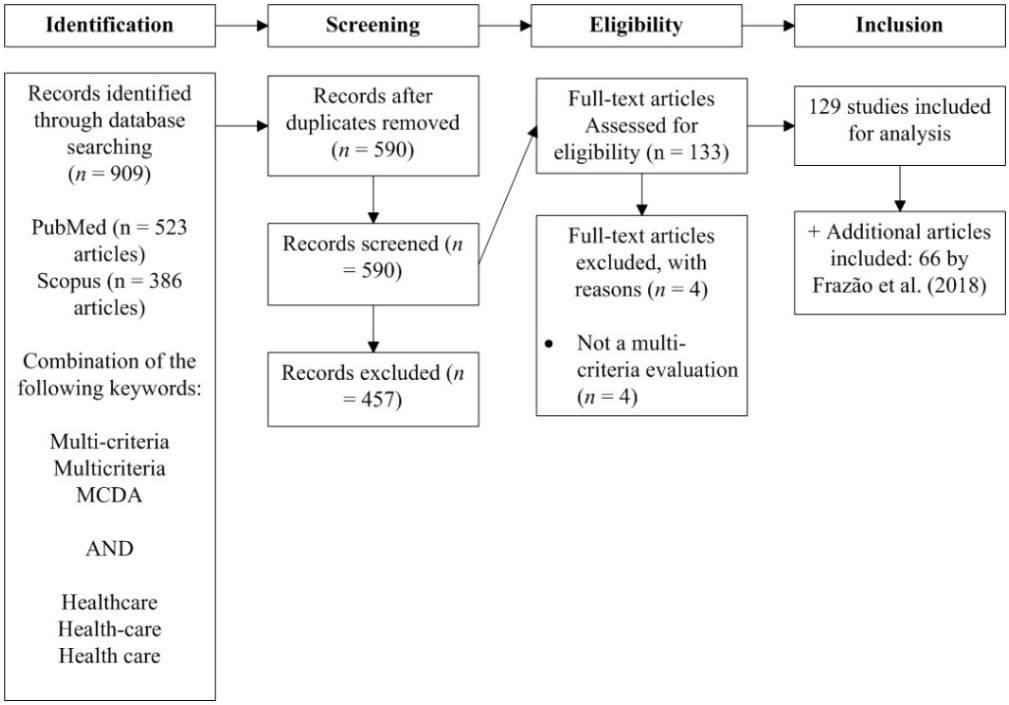

Figure 1 – Sequence of steps for article selection
Source: Prepared by the authors.

As described in section 4.1, an overall analysis of the studies was performed considering the following: date of the study; location (country where the research occurred; if not available, country of origin of the principal author); journal in which it was published, type of intervention (divided into five classes according to the characteristics of the problem); how the problem arose (how the problem was defined); how the criteria were defined (divided into five classes according to their characteristics); types of problems; and methods utilized.

In addition to the aforementioned questions, and in response to the research gap observed by Muhlbacher and Kaczynski (2016) and Glaize *et al.* (2019) the present study analyzed two additional key factors, namely: Is the choice of the MCDA method justified? If so, what is the justification? The results are presented in section 4.2.

RESULTS

Overall analysis

A total of 909 articles were identified in the Scopus and PubMed databases using the combination of keywords. After the advanced search (Scopus: only "Articles" n = 290, PubMed: only "Full Text" n = 167) and removal of duplicates, 133 articles remained. Four studies were excluded after a review of their abstracts indicated they did not meet the criteria needed for analysis. A total of 129 articles met the inclusion criteria, to which 66 articles reviewed by Frazão *et al.* (2018) were added. Thus, analysis was carried out on 195 articles.

With respect to the general aspects of the articles analyzed, the aim was to identify the growth or decline of research in the area, in addition to the main journals where articles were published, countries and authors. The data are presented in Figures 2, 3, 4 and 5.

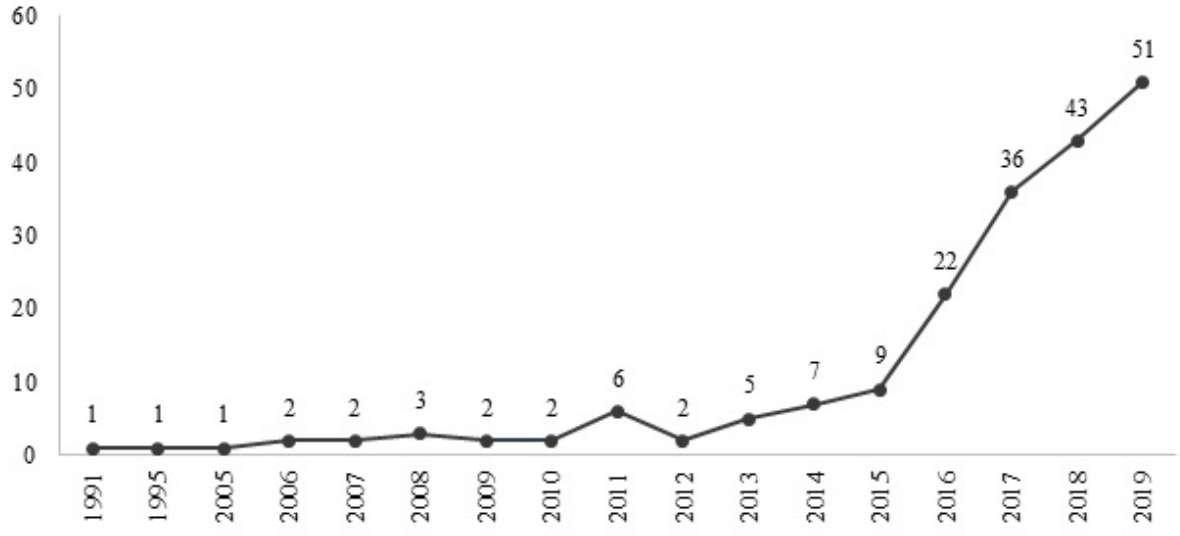

Figure 2 – Articles per year
Source: Prepared by the authors.

Figure 2 shows the number of articles involving MCDA in the healthcare area per year. There was a gradual rise from 2013 onwards, reaching a maximum value in 2019, with 51 articles.

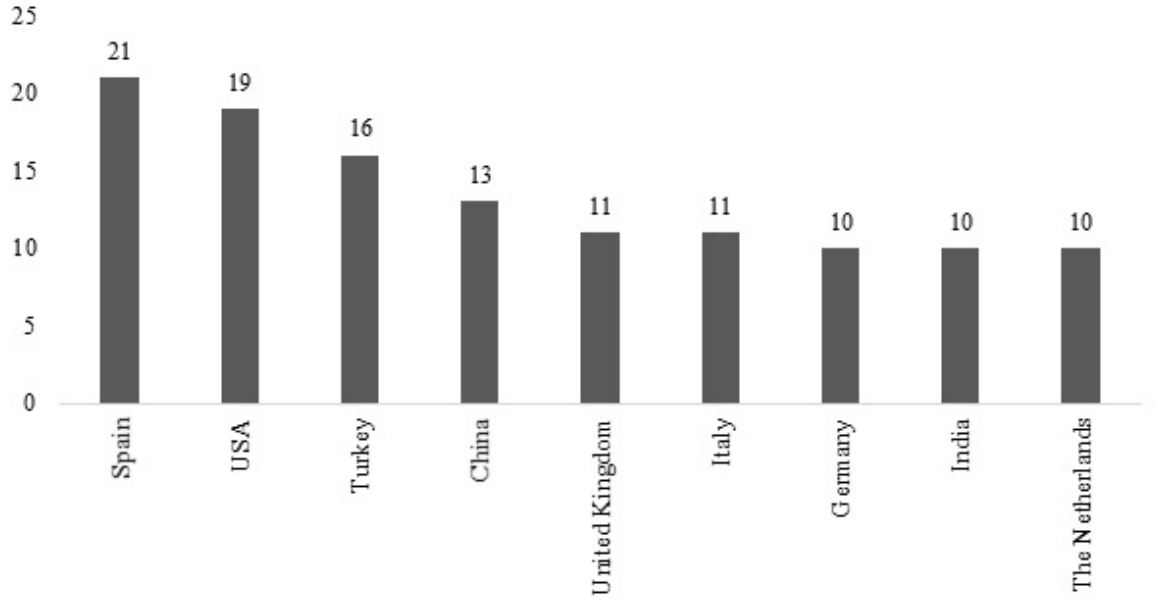

Figure 3 – Countries with the largest number of published articles
Source: Prepared by the authors.

Figure 3 demonstrates where the study was conducted or the country of origin of the principal author. During the review, 55 countries were identified, but only nine were included in the graphical analysis for having 10 or more published articles. Spain leads with 21 articles, followed by the United States and Turkey, with 19 and 16 studies, respectively.

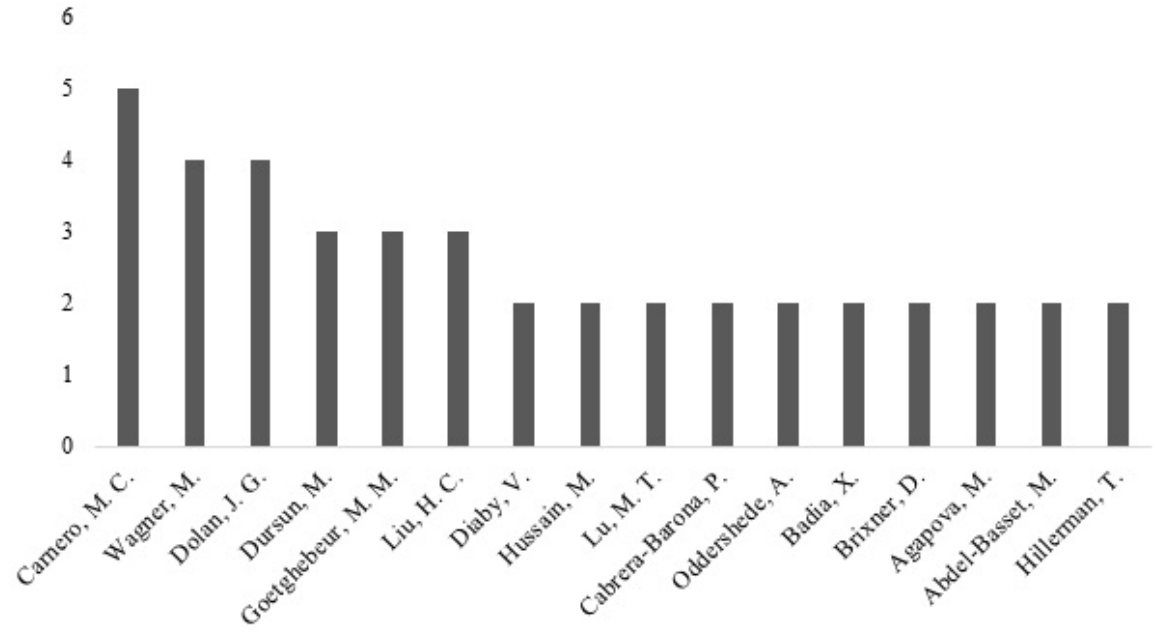

Figure 4 – Authors with the largest number of published articles
Source: Prepared by the authors.

Figure 4 shows the principal authors on the issue, according to the number of published articles. Carnero, Wagner and Dolan stand out, followed by 13 others with a similar number of articles.

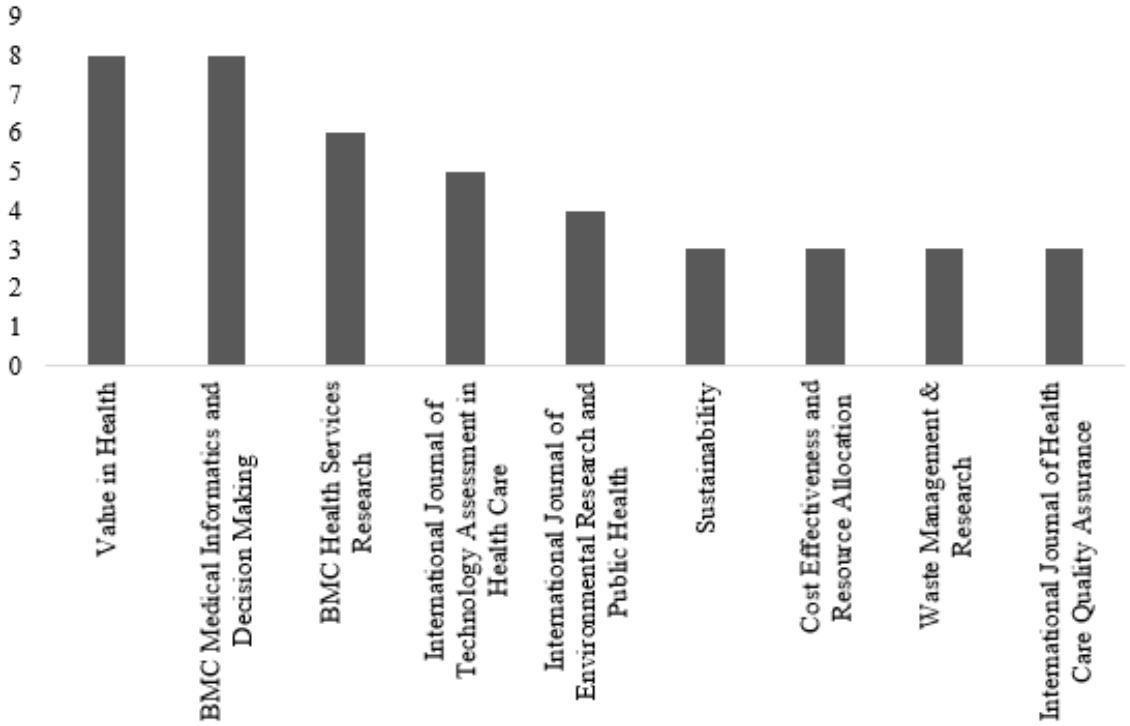

Figure 5 – Journals with the largest number of articlesa
Source: Prepared by the authors.

Figure 5 shows that the journals Value in Health and BMC Medical Informatics and Decision Making stand out among those analyzed, with 8 articles published in the area.

When it comes to the methodological steps followed by the authors, the techniques used to resolve the multi-criteria problems in healthcare were identified. Initially, we established how the problem was defined, using the following categories: Literature, Decision-makers, Specialists and Group discussion (or a combination of categories). The results are presented in Figure 6.

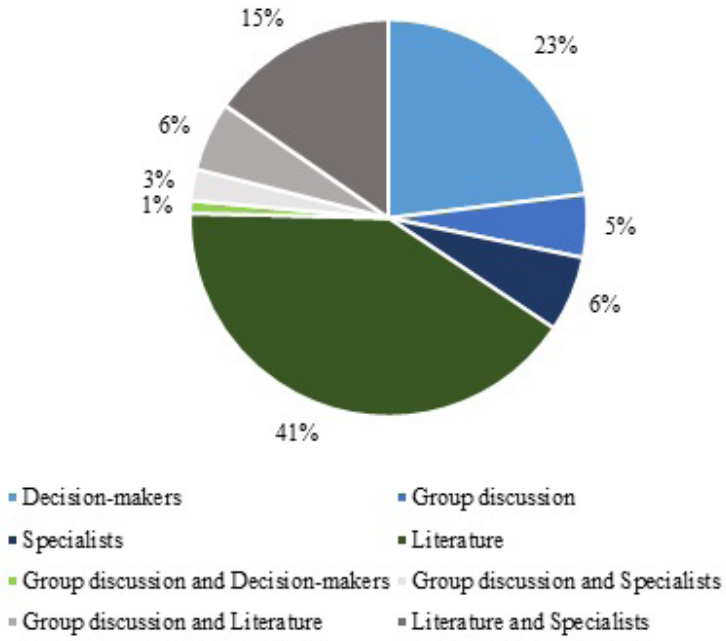

Figure 6 – Problem definition
Source: Prepared by the authors.

A definition strategy based only on the literature was found in 41% of the 195 articles analyzed. Forty-five studies defined the problem using the knowledge of decision makers, which represents 23% of the total analyzed; 15% of the articles based the definition of the problem on a combination of the literature and specialists, 6% on group discussions and the literature, 6% used only specialists, 5% group discussions involving stakeholders, 3% a combination between group discussion and specialists, and 1% a combination between group discussion and decision-makers.

Figure 7 shows the types of intervention used in the studies.

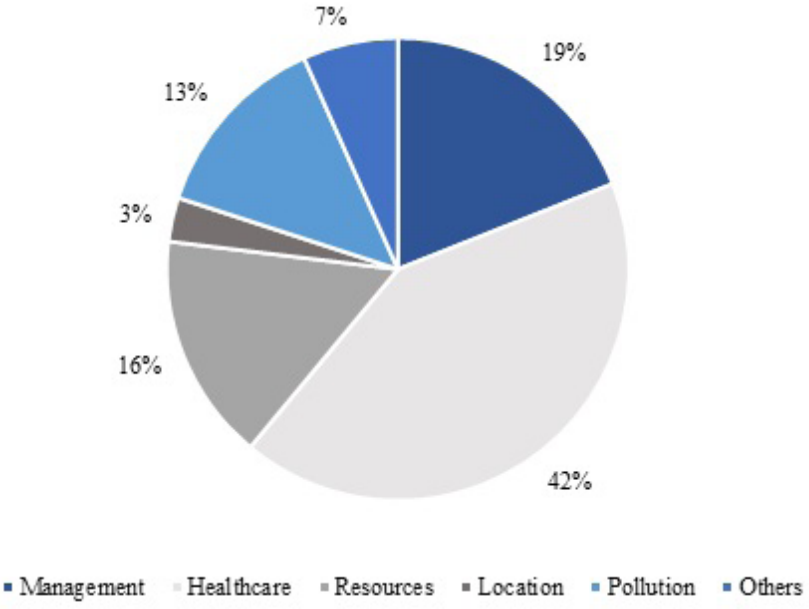

Figure 7 – Types of interventions
Source: Prepared by the authors.

the 195 studies analyzed, 42% focused on solving healthcare problems, including interventions such as disease diagnosis and prioritization, as well as medication issues. In addition, 37 articles (19%) reported on the use of MCDA to support management decisions, such as budget prioritization and doctor selection, among others.

Resource issues such as equipment and technology were discussed by 16% of the articles. Concerns over healthcare-related waste and pollution were analyzed by 13% of the studies, and 3% investigated the choice of the best location for medical facilities. Finally, 13 articles were classified under “others” because they did not fit into any of the established categories.

Figure 8 shows the methodologies used by the studies analyzed for criterion definition.

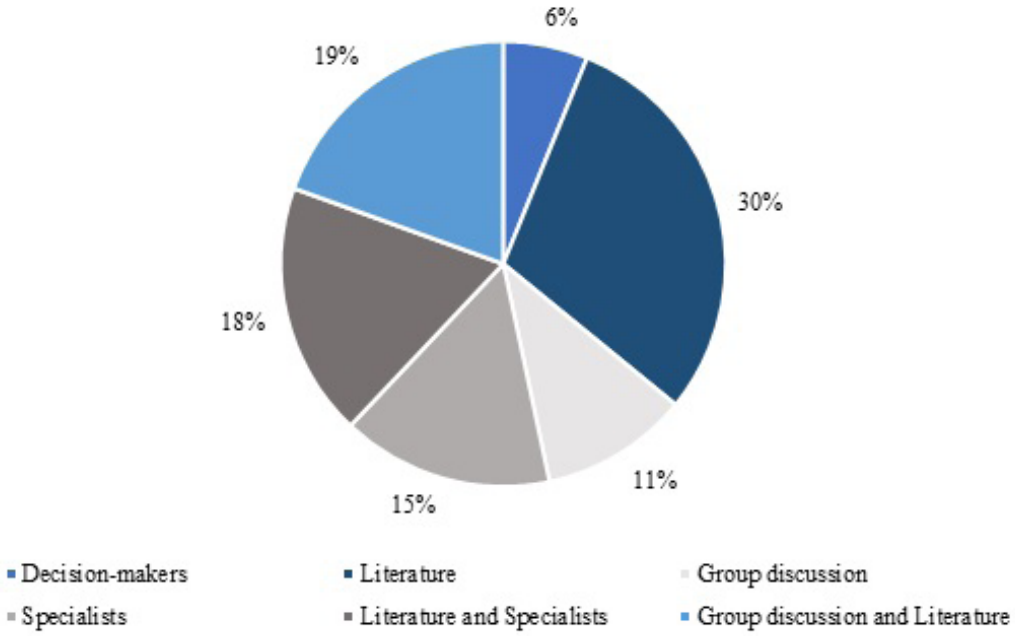

Figure 8 – Criterion definition
Source: Prepared by the authors.

A total of 30% of the studies defined their criteria based on the literature; 38 (19%) combined the literature and group discussions among stakeholders, and 36 articles (18%) used the literature and specialists. Definition based solely on specialists occurred in 15% of the studies, and 11% used only group discussions. Moreover, 12 articles relied only on decision makers to define the criteria, corresponding to 6% of the articles analyzed.

Figure 9 shows the types of problems that appeared in the studies that were analyzed.

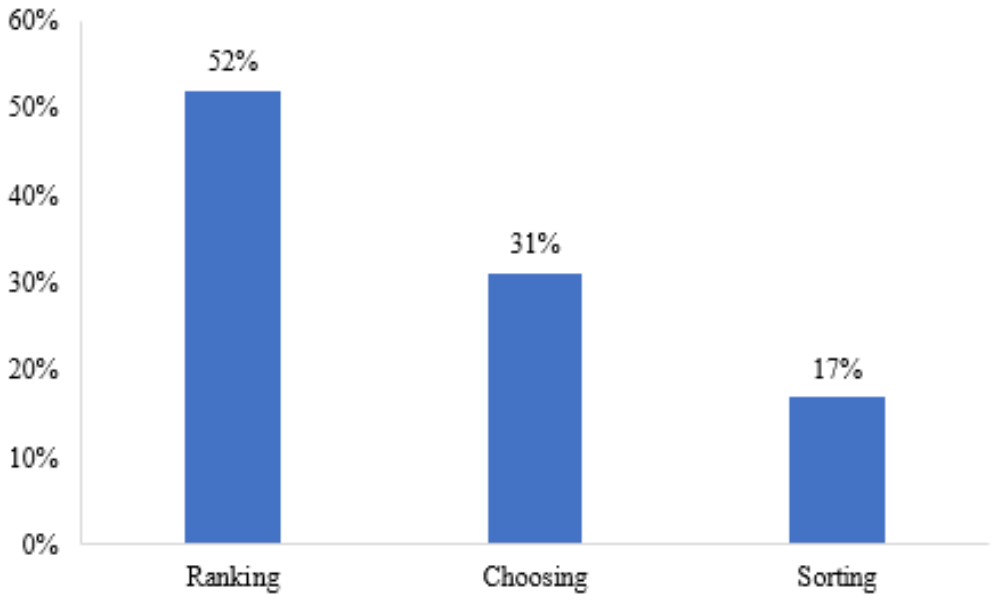

Figure 9 – Types of problems
Source: Prepared by the authors.

The majority of the papers analyzed (52%) presented a rank problem, while 32% approached choosing problems, aiming to select the adequate alternative between a set of alternatives. Moreover, 17% articles presented sorting problems.

Figure 10 shows the main methods used in the studies.

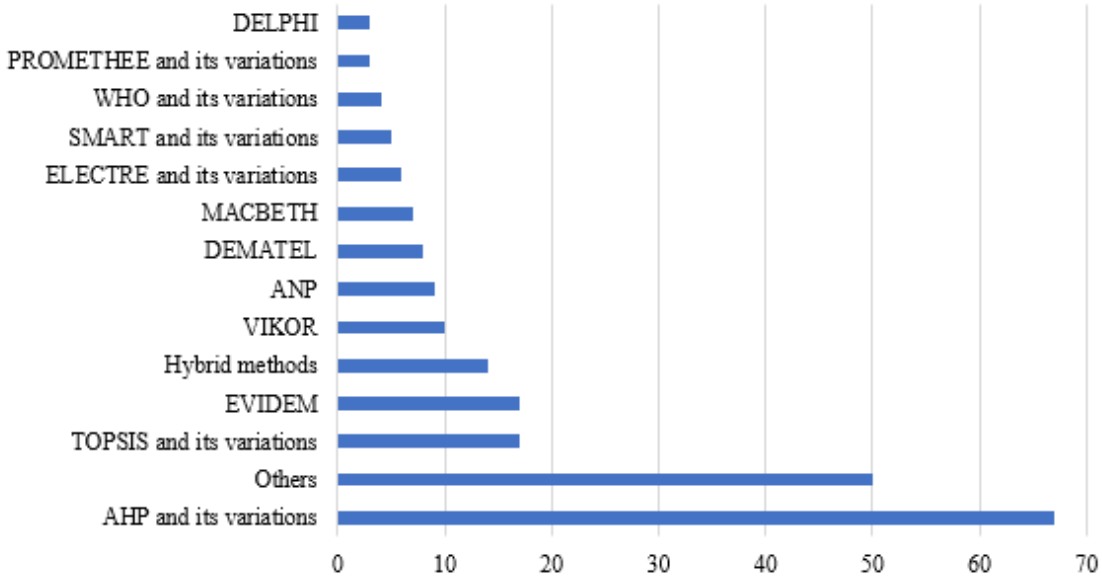

Figure 10 – Methods utilized
Source: Prepared by the authors.

First, to better comprehend the graphic it's important to explain that: (1) most papers utilized more than one MCDA method; and (2) methods that appear in less than two articles were included in the "others" category to provide a better visualization tool. The expressive majority of articles (67 papers) utilized the AHP method or a variance of AHP in their proposed approach. The following bar up shows a variety of methods that appeared once in a total of 50 articles (such as "ELICIT", "TROOIL" and "GRA"), combined here in the "Others" category. The third most popular methods were "TOPSIS and its variations" and "EVIDEM", being used in 17 articles each. Hybrid methods were adopted by 14 articles, and the "VIKOR" method establishes itself in fifth place appearing in 10 papers.

Following this overall analysis to help establish the scenario of MCDA healthcare articles, section 4.2 will present an in-depth discussion regarding the reason, if any, for selecting the method used.

Reason for using the MCDA method

In relation to the aforementioned questions, only 28% of the articles analyzed explained why they selected the multi-criteria method, while 72% offered no explanation, corresponding to 55 and 140 studies, respectively. This reveals the lack of attention to selecting the most suitable method for each problem. This choice should be based on an analysis that considers factors such as the characteristics of the problem analyzed, the context, the decision maker's preferences and the problem itself (Munier; Hontoria; Jiménez-Sáez, 2019).

In addition, an important aspect to consider is the classification of methods according to how they compensate for the aggregation of criteria, which may be considered a form of reasoning (Munier; Hontoria; Jiménez-Sáez, 2019). De Almeida *et al.* (2015) presented a procedure for building MCDM/A models with three main phases, each one with several steps, as shown in Figure 11.

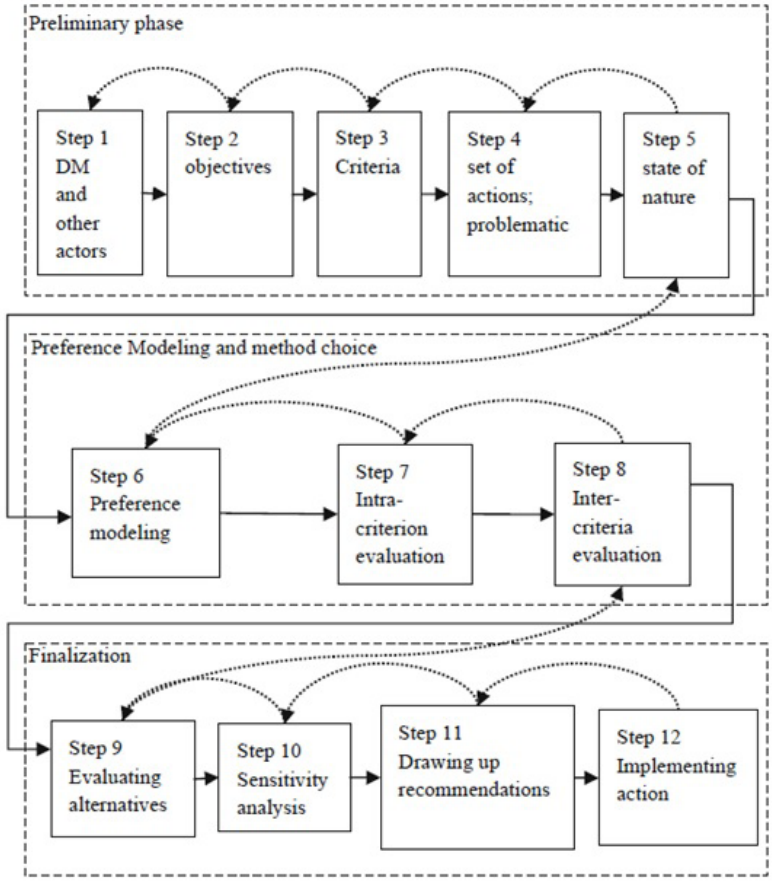

Figure 11 – Procedure for resolving an MCDM/A problem
Source: De Almeida *et al*. (2015).

Briefly, in the first phase the main elements of the MCDM/A problem are approached and problem structuring methods may be applied. In the second phase preference modeling is conducted, and the MCDM/A method is chosen. The third phase presents the final resolution of the problem, although it is still possible to return and make revisions and changes in the built model (De Almeida *et al*., 2015).

There are also other MCDM/A building models, such as the models proposed by Roy (1996), Polmerol and Barba-Romero (2000) and Belton and Stewart (2002). However, according to Muhlbacher and Kaczynski (2016) and Glaize *et al*. (2019), there is still a worrisome gap in the use of MCDA in healthcare. The absence of a reason for selecting the method implies possible indiscriminate use.

The use of the aforementioned models could facilitate proper method selection and avoid haphazard usage. Preventing possible problems ranging from compromised results to serious decision errors is critical since they impact the health area.

Other problems may also be created. Incorrectly selecting one method over another can produce completely different results, for example (Guitouni; Martel, 1998; Zanakis *et al*., 1998). More specifically, it is important to underscore the reliability problems that the MCDA methods may exhibit, such as rank reversal - see Aires and Ferreira, (2018).

The 55 articles that contained reasons for the method selected are classified into five categories (Figure 12) and are shown in Table 1.

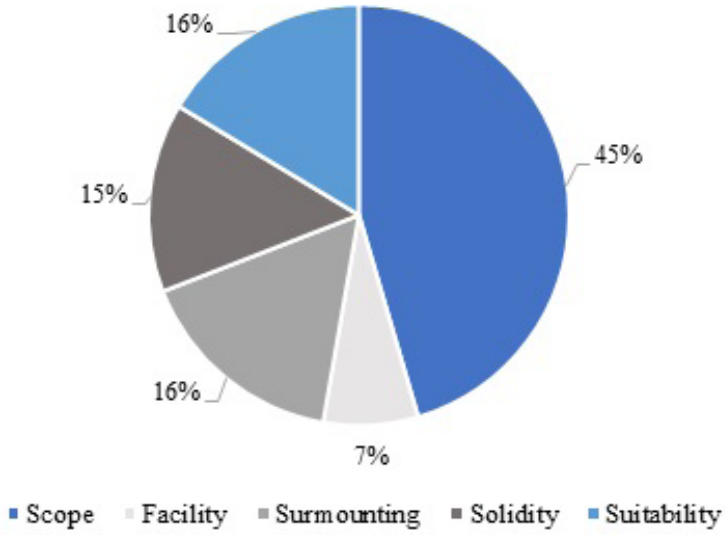

Figure 12 – Reason categories
Source: Prepared by the authors.

Table 1 – Classification of reviewed articles

Categories	%	Authors
Scope	45	Tarimcilar and Khaksari (1991), Sinuany-Stern *et al.* (1995), Kuzma *et al*. (2008), Sustersic *et al*. (2009), Dursun, Karsak and Karadayi (2011a, b), Padma and Balasubramanie (2011), Ozkan (2013), Venhorst *et al.* (2014), Ahmadi, Nilashi and Ibrahim (2015), De Graaf, Postmus and Buskens (2015), Kulak, Goner and Supciller (2015), Kuruoglu *et al*. (2015), Mahfoud, El Barkany and El Biyaali (2016), Wagner *et al*. (2016), Ajmera (2017), Carnero and Gomez (2017), Tervonen *et al*. (2017), Carnero and Gomez (2018), El Mokrini, Benabbou and Berrado (2018), Rutten-Van Mölken *et al*. (2018), Abdel-Basset *et al*. (2019), Adar and Delice (2019), Blythe *et al*. (2019) and La Fata, Lupo and Plazza (2019).
Surmounting	16	Dursun, Karsak and Karadayi (2010), Lu, Lin and Tzeng (2013), Liu *et al*. (2014), Liou *et al*. (2017), Sun *et al*. (2018), Agapova *et al*. (2019), Dang, Wang and Dang (2019), Pathania and Rasool (2019) and Wang *et al*. (2019).
Suitability	16	Lee and Kwak (2011), Lu *et al*. (2016), Hancerliogullari, Hancerliogullari and Koksalmis (2017), Kwon *et al*. (2017), Bowers *et al*. (2018), Baños Roldán *et al*. (2018), Badia *et al*. (2019), Doualle *et al*. (2019) and Guarga *et al*. (2019).
Solidity	15	Dolan (2005), Danner *et al*. (2011), Hummel *et al*. (2013), Liu, Wu and Li (2013), Dehe and Bamford (2015), Hussain and Malik (2016), Hussain, Malik and Al Neyadi (2016) and Gul, Fatih Ak and Guneri (2017).
Facility	7	Van Til *et al*. (2014), Mohamadi *et al*. (2017), Goetghebeur *et al*. (2017) and Czkester *et al*. (2019).

Source: Prepared by the authors.

Of the 55 articles analyzed, 25 (45%) presented reasons based on the scope of the method used. This category includes articles in which the method selected promotes the scope, facilitates the inclusion of diverse opinions, unquantifiable dimensions and conflicting aspects. Two examples of this category are the studies of Dursun, Karsak and Karadayi (2011b), who described the tendency of Fuzzy Logic to incorporate

inaccurate data as the determining factor for their choice, and Tarimcilar and Khaksari (1991), who raised the possibility of integrating the conflicting objectives of the Analytic Hierarchy Process (AHP) as decisive in their selection.

A total of 16% justified their selection on the suitability of the method, that is, the method used was the most suitable for the problem analyzed. The complexity (Rutten-van Molken *et al.*, 2018) and objectives (Doualle *et al.*, 2019) of the situations analyzed are examples of the reasons used. Another 16% based their decisions on the ability of the method to overcome the limitations and close the gaps left by classic methods (Lu; Lin; Tzeng, 2013), that is, the method selected rectifies the problems present therein (Liu *et al.*, 2014).

Moreover, 15% mentioned the solidity of the method as the predominant selection factor, describing characteristics such as validation, efficiency and empirical base (Dehe; Bamford, 2015; Baños Roldán *et al.*, 2018). Finally, 7% (four articles) cite easy application of the method to justify their choice (Goetghebeur *et al.*, 2017).

For the most part, the method selection process was not carefully executed, evident in the presence of initial analyses and arguments with no theoretical framework. In none of the 55 articles was a systematic process to establish the method discussed.

Given their distinct characteristics, it is vital to select a suitable method for the problem in question, depending on different factors considered while defining the problem (De Almeida *et al.*, 2015). Failure to do so may lead to poor results and a lack of reliability.

According to De Almeida *et al.* (2015), there are not many studies in the literature covering the choice of a proper MCDM/A method for a decision problem. Watróbski *et al.* (2019) try to solve the problem of which MCDA method to use, presenting a practical methodological framework to select the most suitable multi-criteria method for each problem situation. The tool determines the most suitable method based on the literature, considering the characteristics of the methods, the influence of the decision maker in the selection process and the characteristics of the problem (Watróbski *et al.*, 2019).

In a different perspective, Munier, Hontoria and Jiménez-Sáez (2019) use an MCDM proxy, called SIMUS, as a benchmark. They propose comparing its results with the other methods and measuring the proximity between certain methods and the proxy, using the Kendall tau rank correlation coefficient. According to the authors, this procedure can help decision makers to select the MCDM method with the best results.

In summary, the results obtained in the present study reveal the importance of directing efforts to ensure the appropriate use of MCDA methods in order to produce reliable and satisfactory results. Appropriate application is essential for the decision itself and to disseminate multi-criteria methods.

CONCLUSION

The multiple factors that involve human life make healthcare decisions complex and painstaking. MCDA became popular because of its ability to achieve conflicting objectives and promote a transparent and rational decision-making process.

The present study proposed to conduct a bibliometric analysis on the application of the MCDA in healthcare, including overall analyses and focusing on the selection of methods used based on the gap identified by Muhlbacher and Kackzynski (2016) and Glaize *et al.* (2019). The two main objectives are summarized in the following questions: Is the selection of the MCDA justified? If so, what is the justification?

A total of 129 articles were retrieved from the Scopus and PubMed databases, in addition to the 66 analyzed by Frazão *et al.* (2018), resulting in 195 studies. The increase in the number of studies using MCDA in healthcare observed demonstrates the need to investigate the reasons why these methods were chosen.

The few studies that justified their selection did so inadequately and based on incipient analyses. These factors may produce erroneous results in an area where decisions are critical and often involve human lives.

The results obtained reveal the need for careful multi-criteria method selection, in line with the problem analyzed. It is hoped that the information presented here contributes to the search for the appropriate use of MCDA. The study was limited by difficult access to some articles. Finally, it is recommended that future research attempts to solve the problems presented, thereby contributing to adequate decisions being made.

REFERENCES

ABDEL-BASSET, Mohamed *et al*. A group decision making framework based on neutrosophic TOPSIS approach for smart medical device selection. **Journal of Medical Systems**, London, v. 43, n. 2, p. 38-51, 2019. DOI: https://doi.org/10.1016/j.ejor.2015.06.047. Available from: https://link.springer.com/article/10.1007/s10916-019-1156-1. Accessed: 14 Jul. 2021.

ADAR, Tuba; DELICE, Elif Kılıç. New integrated approaches based on MC-HFLTS for healthcare waste treatment technology selection. **Journal of Enterprise Information Management**, Bradford, v. 32, n. 4, p. 688-711, 2019. DOI: https://doi.org/10.1108/JEIM-10-2018-0235. Available from: https://www.emerald.com/insight/content/doi/10.1108/JEIM-10-2018-0235/full/html. Accessed: 15 Jan. 2020.

ADUNLIN, Georges; DIABY, Vakaramoko; XIAO, Hong. Application of multicriteria decision analysis in health care: A systematic review and bibliometric analysis. **Health Expectations: an international journal of public participation in health care and health policy**, Oxford, v. 18, n. 6, p. 1894-1905, 2015. DOI: https://doi.org/10.1111/hex.12287. Available from: https://pubmed.ncbi.nlm.nih.gov/25327341/. Accessed: 10 Jan. 2020.

AGAPOVA, Maria *et al*. Using the analytic hierarchy process for prioritizing imaging tests in diagnosis of suspected appendicitis. **Academic Radiology**, Reston v.24, n. 5, p. 530-537, 2017. DOI: https://doi.org/10.1016/j.acra.2017.01.001. Available from: https://pubmed.ncbi.nlm.nih.gov/28363670. Accessed: 15 Abr. 2020.

AHMADI, Houssein; NILASHI, Mehrbakhsh; IBRAHIM, Othman. Organizational decision to adopt hospital information system: an empirical investigation in the case of Malaysian public hospitals. **International Journal of Medical Informatics**, London, v. 84, n. 3, p. 166-188, 2015. DOI: https://doi.org/10.1016/j.ijmedinf.2014.12.004. Available from: https://www.sciencedirect.com/science/article/abs/pii/S1386505614002494. Accessed: 8 Feb. 2021.

AIRES, Renan Felinto de Farias; FERREIRA, Luciano. The rank reversal problem in multi-criteria decision making: a literature review. **Pesquisa Operacional**, Rio de Janeiro, v. 38, n. 2, p. 331-362, 2018. DOI: https://doi.org/10.1590/0101-7438.2018.038.02.0331. Available from: https://www.scielo.br/j/pope/a/BPwgsywPZqgctBDcfPXxczg/?lang=en. Accessed: 15 Abr. 2020.

AJMERA, Puneeta. Ranking the strategies for Indian medical tourism sector through the integration of SWOT analysis and TOPSIS method**. International Journal of Health Care Quality Assurance**, Bradford, v. 30, n. 8, p. 668-679, 2017. DOI: https://doi.org/10.1108/IJHCQA-05-2016-0073. Available from: https://pubmed.ncbi.nlm.nih.gov/28958199. Accessed: 13 Nov. 2021.

BADIA, Xavier *et al*. Patient involvement in reflective multicriteria decision analysis to assist decision making in oncology. **International Journal of Technology Assessment in Health Care**, Cambridge, v. 35, n. 1, p. 56-63, 2019. DOI: https://doi.org/10.1017/S0266462318003641. Available from: https://pubmed.ncbi.nlm.nih.gov/30730288. Accessed: 2 Dec. 2020.

BALTUSSEN Rob; NIESSEN, Louis. Priority setting of health interventions: the need for multi-criteria decision analysis. **Cost Effectiveness and Resource Allocation**, London, v. 4, n. 1, p. 14-14, 2006. DOI: https://doi.org/10.1186/1478-7547-4-14. Available from: https://resource-allocation.biomedcentral.com/articles/10.1186/1478-7547-4-14. Accessed: 22 Jan. 2020.

BAÑOS ROLDÁN, Úrsula *et al*. Multi-criteria decision analysis as a decision-support tool for drug evaluation: a pilot study in a pharmacy and therapeutics committee setting. **International Journal of Technology Assessment in Health Care**, Cambridge, v. 34, n. 5, p. 519-526, 2018. DOI: https://doi.org/10.1017/S0266462318000569. Available from: https://pubmed.ncbi.nlm.nih.gov/30348241. Accessed: 23 Dec. 2021.

BELTON, Valerie; STEWART, Theodor J. **Multiple criteria decision analysis:** an integrated approach. Boston: Kluwer Academic Publishers, 2002.

BLYTHE, Robin *et al*. Development and pilot of a multicriteria decision analysis (MCDA) tool for health services administrators. **BMJ Open,** London, v. 9, n. 4, p. e025752, 2019. DOI: https://doi.org/10.1136/bmjopen-2018-025752. Available from: https://bmjopen.bmj.com/content/9/4/e025752. Accessed: 15 Feb. 2021.

BOWERS, John *et al*. A multicriteria resource allocation model for the redesign of services following birth. **BMC Health Services Research,** London, v. 18, n. 1, p. 1-12, 2018. Article 656. DOI: https://doi.org/10.1186/s12913-018-3430-1. Available from: https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-018-3430-1. Accessed: 13 Mar. 2020.

CARNERO, María Carmen; GOMEZ, Andrés. A multicriteria model for optimization of maintenance in thermal energy production systems in hospitals: a case study in a Spanish hospital. **Sustainability**, Basel, v. 9, n. 4, p. 493-534, 2017. DOI: https://doi.org/10.3390/su9040493. Available from: https://www.mdpi.com/2071-1050/9/4/493. Accessed: 24 Jul. 2020.

CARNERO, María Carmen; GOMEZ, Andrés. Optimization of maintenance in production and storage systems for domestic water. **Water Resources Management**, Berlin, v. 32, p. 359-380, 2018. DOI: https://doi.org/10.1007/s11269-017-1815-2. Available from: https://link.springer.com/article/10.1007/s11269-017-1815-2. Accessed: 21 Jun. 2020.

CLEEMPUT, Irina *et al*. A multi-criteria decision approach for ranking unmet needs in healthcare. **Health Policy**, Amsterdam, v. 122, n. 8, p. 878-884, 2018. DOI: https://doi.org/10.1016/j.healthpol.2018.06.010. Available from: https://pubmed.ncbi.nlm.nih.gov/29983193. Accessed: 20 Jun. 2020.

CZKESTER, Ricardo M *et al*. Selection of enterprise resource planning software using analytic hierarchy process. **Enterprise Information Systems**, London, v. 13, n. 6, p. 895-915, 2019. DOI: https://doi.org/10.1080/17517575.2019.1606285. Available from: https://www.tandfonline.com/doi/abs/10.1080/17517575.2019.1606285. Accessed: 19 Jul. 2021.

DAI, Zeqi *et al.* Knowledge mapping of multicriteria decision analysis in healthcare: a bibliometric analysis. **Frontiers in Public Health**, Lausanne, v. 10, p. 895552, 2022. DOI: https://doi.org/10.3389/fpubh.2022.895552. Available from: https://pubmed.ncbi.nlm.nih.gov/35757629/. Accessed: 7 Nov. 2024.

DANNER, Marion *et al*. Integrating patients' views into health technology assessment: Analytic hierarchy process (AHP) as a method to elicit patient preferences. **International Journal of Technology Assessment in Health Care**, Cambridge, v. 27, n. 4, p. 369-375, 2011. DOI: https://doi.org/10.1017/S0266462311000523. Available from: https://pubmed.ncbi.nlm.nih.gov/22004779. Accessed: 2 Jun. 2020.

DANG, Van Thac; WANG, Jianming; DANG, Wilson Van-Thac. An integrated fuzzy AHP and fuzzy TOPSIS approach to assess sustainable urban development in an emerging economy**. International Journal of Environmental Research and Public Health**, v. 16, n. 16, p. 2902-2922, 2019. DOI: https://doi.org/10.3390/ijerph16162902. Available from: https://www.mdpi.com/1660-4601/16/16/2902. Accessed: 12 Feb. 2021.

DE ALMEIDA, Adiel Teixeira; *et al*. **Multicriteria and multiobjective models for risk, reliability and maintenance decision analysis.** New York: Springer, 2015. DOI: https://doi.org/10.1007/978-3-319-17969-8. Available from: https://link.springer.com/book/10.1007/978-3-319-17969-8. Accessed: 10 Jan. 2019.

DE GRAAF, Gimon; POSTMUS, Douwe; BUSKENS, Erik. Using multicriteria decision analysis to support research priority setting in biomedical translational research projects**. BioMed Research International,** New York, v. 2015, n. 12, p. 1-9, 2015. DOI: https://doi.org/10.1155/2015/191809. Available from: https://pubmed.ncbi.nlm.nih.gov/26495288. Accessed: 19 Jul. 2020.

DEHE, Benjamin; BAMFORD, David. Development, test and comparison of two multiple criteria decision analysis (MCDA) models: A case of healthcare infrastructure location. **Expert Systems with Applications**, London, v. 42, n. 19, p. 6717-6727, 2015. DOI: https://doi.org/10.1016/j.eswa.2015.04.059. Available from: https://www.sciencedirect.com/science/article/pii/S0957417415003012. Accessed: 22 Jun. 2020.

DIABY, Vakaramoko; CAMPBELL, V. Kaitryn; GOEREE, Ron. Multi-criteria decision analysis (MCDA) in health care: a bibliometric analysis. **Operations Research for Health Care**, London, v. 2, n. 1-2, p. 20-24, 2013. DOI: https://doi.org/10.1016/j.orhc.2013.03.001. Available from: https://www.sciencedirect.com/science/article/abs/pii/S2211692313000027. Accessed: 7 Nov. 2024.

DOLAN James G. Patient priorities in colorectal cancer screening decisions. **Health Expectations**, Oxford, v. 8, n. 4, p. 334-344, 2005. DOI: https://doi.org/10.1111/j.1369-7625.2005.00348.x. Available from: https://pubmed.ncbi.nlm.nih.gov/16266421. Accessed: 19 Jul. 2019.

DONTHU, Naveen *et al.* How to conduct a bibliometric analysis: an overview and guidelines. **Journal of Business Research**, London, v. 133, p. 285-296, 2021. DOI: https://doi.org/10.1016/j.jbusres.2021.04.070. Available from: https://www.sciencedirect.com/science/article/pii/S0148296321003155. Accessed: 7 Nov. 2024.

DOUALLE, Benjamin *et al*. Selection method of sustainable product-service system scenarios to support decision-making during early design stages. **International Journal of Sustainable Engineering**, London, v. 13, n. 1, p. 1-16, 2019. DOI: https://doi.org/10.1080/19397038.2019.1660432. Available from: https://www.tandfonline.com/doi/full/10.1080/19397038.2019.1660432. Accessed: 1 Feb. 2021.

DURSUN, Mehtap; KARSAK, E. Ertugrul; KARADAYI, Melis Almula. Fuzzy group decision making for the assessment of health-care waste disposal alternatives in Istanbul. **International Journal of Economics and Management Engineering**, [*s. l.*], v. 4, n. 6, p. 1045-1049, 2010. DOI: https://doi.org/10.5281/zenodo.1075418. Available from: https://zenodo.org/record/1075418. Accessed: 19 Jul. 2019.

DURSUN, Mehtap; KARSAK, E. Ertugrul; KARADAYI, Melis Almula. A fuzzy MCDM approach for health-care waste management. **International Journal of Industrial and Manufacturing Engineering**, [*s. l.*], v. 5, n. 1, p. 176-182, 2011a. DOI: https://doi.org/10.5281/zenodo.1085221. Available from: https://zenodo.org/record/1085221/files/15532.pdf. Accessed: 19 Jul. 2019.

DURSUN, Mehtap; KARSAK, E. Ertugrul; KARADAYI, Melis Almula. Assessment of health-care waste treatment alternatives using fuzzy multi-criteria decision making approaches. **Resources, Conservation and Recycling**, London, v. 57, p. 98-107, 2011b. DOI: https://doi.org/10.1016/j.resconrec.2011.09.012. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0921344911001832. Accessed: 20 Jul. 2019.

EL MOKRINI, Asmae; BENABBOU, Loubna; BERRADO, Abdelaziz. Multi-criteria distribution network redesign: case of the public sector pharmaceutical supply chain in Morocco. **Supply Chain Forum**, London, v. 19, n. 1, p. 1-13, 2018. DOI: https://doi.org/10.1080/16258312.2018.1433436. Available from: https://www.tandfonline.com/doi/abs/10.1080/16258312.2018.1433436. Accessed: 11 Feb. 2020.

ELWYN, Glyn; EDWARDS, Adrian; KINNERSLEY, Paul. Shared decision-making in primary care: the neglected second half of the consultation. **British Journal of General Practice**, London, v. 49, n. 443, p. 477-482, 1999. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1313449/. Accessed: 12 Sept. 2020.

FIGUEIRA, José; GRECO, Salvatore; EHRGOTT, Matthias. **Multiple Criteria Decision Analysis**: state of art surveys. Boston: Springer Science, 2005.

FRAZÃO, Talita D. C. *et al*. Multicriteria decision analysis (MCDA) in health care: a systematic review of the main characteristics and methodological steps. **BMC Medical Informatics and Decision Making**, London, v. 18, n. 1, p. 90, 2018. DOI: https://doi.org/10.1186/s12911-018-0663-1. Available from: https://bmcmedinformdecismak.biomedcentral.com/articles/10.1186/s12911-018-0663-1. Accessed: 2 Jan. 2019.

GHANDOUR, Rula *et al*. Priority setting for the prevention and control of cardiovascular diseases: multi-criteria decision analysis in four eastern Mediterranean countries. **International Journal of Public Health**, Lausanne, v. 60, suppl. 1, p. 73-81, 2015. DOI: https://doi.org/10.1007/s00038-014-0569-3. Available from: https://pubmed.ncbi.nlm.nih.gov/24879318/. Accessed: 22 Nov. 2021.

GILLETT, Grant. Medical ethics in a multicultural context. **Journal of Internal Medicine**, Oxford, v. 238, n. 6, p. 531-537, 1995. DOI: https://doi.org/10.1111/j.1365-2796.1995.tb01236.x. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1365-2796.1995.tb01236.x. Accessed: 13 Jan. 2019.

GILLETT, Grant. Clinical medicine and the quest for certainty. **Social Science & Medicine**, Oxford, n. 58, p. 727-738, 2004. DOI: https://doi.org/10.1016/s0277-9536(03)00224-7. Available from: https://pubmed.ncbi.nlm.nih.gov/14672589/. Accessed: 13 Jan. 2019.

GLAIZE, A. *et al*. Healthcare decision-making applications using multicriteria decision analysis: A scoping review. **Journal of Multi-Criteria Decision Analysis**, London, v. 26, n. 1-2, p. 62-83, 2019. DOI: https://doi.org/10.1002/mcda.1659. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1002/mcda.1659. Accessed: 14 Jan. 2019.

GOETGHEBEUR, Mireille M. *et al*. Evidence and Value: Impact on Decision Making and the EVIDEM framework and potential applications. **BMC Health Services Research**, London, v. 8, n. 270, p. 1-16, 2008. DOI: https://doi.org/10.1186/1472-6963-8-270. Available from: https://pubmed.ncbi.nlm.nih.gov/19102752. Accessed: 21 Jul. 2020.

GOETGHEBEUR, Mireille M. *et al*. Exploring values of health technology assessment agencies using reflective multicriteria and rare disease case. **International Journal of Technology Assessment in Health Care**, Cambridge, v. 33, n. 4, p. 504-520, 2017. DOI: https://doi.org/10.1017/S0266462317000915. Available from: https://pubmed.ncbi.nlm.nih.gov/29019295/. Accessed: 10 Aug. 2020.

GUARGA, Laura *et al*. Implementing reflective multicriteria decision analysis (MCDA) to assess orphan drugs value in the Catalan Health Service (CatSalut). **Orphanet Journal of Rare Diseases**, London, v. 14, n. 1, p. 157-156, 2019. DOI: https://doi.org/10.1186/s13023-019-1121-6. Available from: https://ojrd.biomedcentral.com/articles/10.1186/s13023-019-1121-6. Accessed: 3 Jun. 2021.

GUITOUNI, Adel; MARTEL, Jean-Marc. Tentative guidelines to help choosing an appropriate MCDA method. **European Journal of Operational Research**, London, v. 109, n. 2, p. 501-521, 1998. DOI: https://doi.org/10.1016/S0377-2217(98)00073-3. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0377221798000733. Accessed: 11 Apr. 2019.

GUL, Muhammet; FATIH AK, M.; GUNERI, Ali Fuat. Occupational health and safety risk assessment in hospitals: A case study using two-stage fuzzy multi-criteria approach. **Human and Ecological Risk Assessment**, London, v. 23, n. 2, p. 187-202, 2017. DOI: https://doi.org/10.1080/10807039.2016.1234363. Available from: https://www.tandfonline.com/doi/abs/10.1080/10807039.2016.1234363. Accessed: 15 Nov. 2021.

HANCERLIOGULLARI, Gulsah; HANCERLIOGULLARI, Kadir Oymen; KOKSALMIS, Emrah. The use of multi-criteria decision making models in evaluating anesthesia method options in circumcision surgery**. BMC Medical Informatics and Decision Making**, London, v. 17, n. 1, p. 14-29, 2017. DOI: https://doi.org/10.1186/s12911-017-0409-5. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5260115. Accessed: 23 Aug. 2020.

HUMMEL, J. Marjan *et al*. Preferences for colorectal cancer screening techniques and intention to attend: a multi-criteria decision analysis. **Applied Health Economics and Health Policy**, Auckland, v. 11, n. 5, p. 499-507, 2013. DOI: https://doi.org/10.1007/s40258-013-0051-z. Available from: https://pubmed.ncbi.nlm.nih.gov/23979875. Accessed: 4 Feb. 2019.

HUSSAIN, Matloub; MALIK, Mohsin. Prioritizing lean management practices in public and private hospitals. **Journal of Health Organization and Management**, Bradford, v. 30, n. 3, p. 457-474, 2016. DOI: https://doi.org/10.1108/JHOM-08-2014-0135. Available from: https://pubmed.ncbi.nlm.nih.gov/27119397. Accessed: 24 Sept. 2020.

HUSSAIN, Matloub; MALIK, Mohsin; AL NEYADI, Hamda S. AHP framework to assist lean deployment in Abu Dhabi public healthcare delivery system. **Business Process Management Journal**, Bradford, v. 22, n. 3, p. 546-565, 2016. DOI: https://doi.org/10.1108/BPMJ-08-2014-0074. Available from: https://www.emerald.com/insight/content/doi/10.1108/BPMJ-08-2014-0074/full/html. Accessed: 5 Feb. 2021.

KAPLAN, Robert M.; FROSCH, Dominick L. Decision making in medicine and health care. **Annual Review of Clinical Psychology**, Palo Alto, v. 1, p. 525-556, 2005. DOI: https://doi.org/10.1146/annurev.clinpsy.1.102803.144118. Available from: https://pubmed.ncbi.nlm.nih.gov/17716098/. Accessed: 12 Apr. 2019.

KARIMI, Milad *et al.* Evaluating complex health and social care program using Multi-Criteria Decision Analysis: a case study of "better together in Amsterdam North". **Value in Health**, Malden, v. 24, n. 7, p. 966-975, 2021. DOI: https://doi.org/10.1016/j.jval.2021.02.007. Available from: https://pubmed.ncbi.nlm.nih.gov/34243840/. Accessed: 7 Nov. 2024.

KULAK, Osman; GUNER, Hacer Guner; SUPCILLER, Aliye Alyca. A new multi criteria decision making approach for medical imaging systems considering risk factors. **Applied Soft Computing**, London, v. 35, n. 1, p. 931-941, 2015. DOI: https://doi.org/10.1016/j.asoc.2015.03.004. Available from: https://www.sciencedirect.com/science/article/abs/pii/S1568494615001477. Accessed: 23 Nov. 2020.

KURUOGLU, Emel *et al*. Which family physician should I choose? The analytic hierarchy process approach for ranking of criteria in the selection of a family physician. **BMC Medical Informatics and Decision Making**, London, v. 2015, n. 1, p. 63-71, 2015. DOI: https://doi.org/10.1186/s12911-015-0183-1. Available from: https://bmcmedinformdecismak.biomedcentral.com/articles/10.1186/s12911-015-0183-1. Accessed: 10 dec. 2020.

KUZMA, Jennifer *et al.* An integrated approach to oversight assessment for emerging technologies. **Risk Analysis**, New York, v. 28, n. 5, p. 1197-1220, 2008. DOI: https://doi.org/10.1111/j.1539-6924.2008.01086.x. Available from: https://pubmed.ncbi.nlm.nih.gov/18631303/. Accessed: 2 Apr. 2019.

KWON, Sun-Hong *et al*. Eliciting societal preferences of reimbursement decision criteria for anti cancer drugs in South Korea. **Expert Review of Pharmacoeconomics & Outcomes Research**, Abingdon, v. 17, n. 4, p. 411-419, 2017. DOI: https://doi.org/10.1080/14737167.2017.1277144. Available from: https://pubmed.ncbi.nlm.nih.gov/28019130. Accessed: 22 Jul. 2021.

LA FATA, Concetta Manuela; LUPO, Toni; PIAZZA, Tommaso. Service quality benchmarking via a novel approach based on fuzzy ELECTRE III and IPA: an empirical case involving the Italian public healthcare context. **Health Care Management Sciences**, Bussum, v. 22**,** p. 106-120, 2019. DOI: https://doi.org/10.1007/s10729-017-9424-4. Available from: https://link.springer.com/article/10.1007/s10729-017-9424-4. Accessed: 19 Dec. 2021.

LASORSA, Irene *et al.* Multi-criteria decision analysis for the assessment of non-clinical hospital services: Methodology and case study. **Operations Research for Health Care**, London, v. 23, p. 100171, 2019. DOI: https://doi.org/10.1016/j.orhc.2018.08.002. Available from: https://www.sciencedirect.com/science/article/pii/S2211692317301522. Accessed: 7 Nov. 2024.

LEE, Chang Won; KWAK, N. K. Strategic enterprise resource planning in a health-care system using a multicriteria decision-making model. **Journal of Medical Systems**, New York, v. 35, n. 2, p. 265–275, 2011. DOI: https://doi.org/10.1007/s10916-009-9362-x. Available from: https://pubmed.ncbi.nlm.nih.gov/20703564. Accessed: 26 Sept. 2020.

LIOU, James J. H. *et al*. A hybrid MCDM model for improving the electronic health record to better serve client needs. **Sustainability***,* Basel, v. 9, n. 10, p. 1819-1832, 2017. DOI: https://doi.org/10.3390/su9101819. Available from: https://www.mdpi.com/2071-1050/9/10/1819. Accessed: 3 Jul. 2021.

LIU, Hu-Chen; WU, Jing; LI, Ping. Assessment of health-care waste disposal methods using a VIKOR-based fuzzy multi-criteria decision making method. **Waste Management**, London, v. 33, n. 12, p. 2744-2751, 2013. DOI: https://doi.org/10.1016/j.wasman.2013.08.006. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0956053X13003796. Accessed: 12 Aug. 2020.

LIU, Hu-Chen *et al*. Application of interval 2-tuple linguistic MULTIMOORA method for health-care waste treatment technology evaluation and selection. **Waste Management**, London, v. 34, n. 11, p. 2355-2364, 2014. DOI: https://doi.org/10.1016/j.wasman.2014.07.016. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0956053X14003201. Accessed: 21 Dec. 2020.

LÓPEZ-BASTIDA, Julio. *et al*. Using a stated preference discrete choice experiment to assess societal value from the perspective of decision-makers in Europe. Does it work for rare diseases? **Health Policy**, Amsterdam, v. 123, n. 2, p. 152-158, 2019. DOI: https://doi.org/10.1186/s13023-019-1126-1. Available from: https://ojrd.biomedcentral.com/articles/10.1186/s13023-019-1126-1. Accessed: 1 Nov. 2021.

LU, Ming-Tsang; LIN, Shi-Woei; TZENG, Gwo-Hshiung. Improving RFID adoption in Taiwan's healthcare industry based on a DEMATEL technique with a hybrid MCDM model. **Decision Support Systems***,* London, v. 56, n. 1, p. 259-269, 2013. DOI: https://doi.org/10.1016/j.dss.2013.06.006. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0167923613001772. Accessed: 23 Jul. 2020.

LU, Chao *et al*. Health-care waste treatment technology selection using the interval 2-Tuple Induced TOPSIS method. **International Journal of Environmental Research and Public Health**, Basel, v. 13, n. 6, p. 562-578, 2016. DOI: https://doi.org/10.3390/ijerph13060562. Available from: https://www.mdpi.com/1660-4601/13/6/562. Accessed: 19 Jul. 2020.

MAHFOUD, Hassana; El BARKANY, Abdellah; El BIYAALI, Ahmed. A hybrid decision-making model for maintenance prioritization in health care systems. **American Journal of Applied Sciences***,* Dubai, v. 13, n. 4, p. 439-450, 2016. DOI: https://doi.org/10.3844/ajassp.2016.439.450. Available from: https://thescipub.com/abstract/ajassp.2016.439.450. Accessed: 2 Apr. 2021.

MARSH, Kevin; CARO, Jaime; MUSZBEEK, Noemi. Does the future belong to MCDA? **ISPOR Connections**, Lawrenceville, v. 18, n. 6, p. 9-11, 2012. Available from: https://michaelschlander.com/publications-2010-2014.html?file=files/downloads/publications/2012/Schlander-ISPOR-Connections-Vol18-No6-NovDec2012.pdf&cid=3100. Accessed: 10 Feb. 2019.

MARSH, Kevin *et al*. The use of MCDA in HTA: great potential, but more effort needed. **Value in Health**, Malden, v. 21, n. 4, p. 394-397, 2018. DOI: https://doi.org/10.1016/j.jval.2017.10.001. Available from: https://www.sciencedirect.com/science/article/pii/S1098301517336082. Accessed: 22 Aug. 2021.

MOHAMADI, Efat *et al*. Coverage decision-making for orthopedics interventions in the health transformation program in Iran: a Multiple Criteria Decision Analysis (MCDA). **Shiraz E-Med Journal***,* s-Hertogenbosch, v. 17, n. 12, p. e40920, 2017. DOI: https://doi.org/10.17795/semj40920. Available from: https://brieflands.com/articles/semj-20476.pdf. Accessed: 3 Jul. 2020.

MUHLBACHER, Axel C. Patient-centric HTA: Different strokes for different folks. **Expert Review of Pharmacoeconomics & Outcomes Research**, London ,v. 15, n. 4, p. 1-7, 2015. DOI: https://doi.org/10.1586/14737167.2015.1038245. Available from: https://pubmed.ncbi.nlm.nih.gov/25896756. Accessed: 21 Jul. 2019.

MUHLBACHER, Axel C.; JUHNKE, Christin. Patient preferences versus physicians' judgement: does it make a difference in healthcare decision making?. **Applied Health Economics and Health Policy**, Auckland, v. 11, n. 3, p. 163-180, 2013. DOI: https://doi.org/10.1007/s40258-013-0023-3. Available from: https://pubmed.ncbi.nlm.nih.gov/23529716. Accessed: 10 Feb. 2020.

MUHLBACHER, Axel C.; KACZYNSKI, Anika. Making good decisions in healthcare with multi-criteria decision analysis: the use, current research and future development of MCDA**. Applied Health Economics and Health Policy**, Auckland, v. 14, n. 1, p. 29-40, 2016. DOI: https://doi.org/10.1007/s40258-015-0203-4. Available from: https://pubmed.ncbi.nlm.nih.gov/26519081. Accessed: 2 Jan. 2019.

MUNIER, Nolberto; HONTORIA, Eloy; JIMÉNEZ-SÁEZ, Fernando. Analysis of Lack of Agreement Between MCDM Methods Related to the Solution of a Problem: Proposing a Methodology for Comparing Methods to a Reference. *In:* MUNIER, Nolberto; HONTORIA, Eloy; JIMÉNEZ-SÁEZ, Fernando. **Strategic approach in Multi-Criteria Decision Making:** a practical guide for complex scenarios. Cham: Springer International Publishing, 2019. p. 203-219. DOI: https://doi.org/10.1007/978-3-030-02726-1_11. Available from: https://link.springer.com/chapter/10.1007/978-3-030-02726-1_11. Accessed: 11 Apr. 2021.

OORTWIJN, W.; BALTUSSEN, R.; JANSSEN, M. Priority setting: towards evidence-informed deliberative processes. **European Journal of Public Health**, Oxford, v. 28, n. suppl. 4, p. 276, 2018. DOI: https://doi.org/10.1093/eurpub/cky213.810. Available from: https://academic.oup.com/eurpub/article/28/suppl_4/cky213.810/5192125. Accessed: 19 Jul. 2021.

ÖZKAN, Aysun. Evaluation of healthcare waste treatment/disposal alternatives by using multi-criteria decision-making techniques. **Waste Management & Research**, London, v. 31, n. 2, p. 141-149, 2013. DOI: https://doi.org/10.1177/0734242X12471578. Available from: https://pubmed.ncbi.nlm.nih.gov/23315364/. Accessed: 11 Feb. 2020.

PADMA, T.; BALASUBRAMANIE, P. A fuzzy analytic hierarchy processing decision support system to analyze occupational menace forecasting the spawning of shoulder and neck pain. **Expert Systems with Applications**, London, v. 38, n .12, p. 15303-15309, 2011. DOI: https://doi.org/10.1016/j.eswa.2011.06.037. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0957417411009328. Accessed: 1 Apr. 2020.

PATHANIA, Anjali; RASOOL, Gowhar. Investigating power styles and behavioural compliance for effective hospital administration. **International Journal of Health Care Quality Assurance**, Bradford, v. 32, n. 6, p. 958-977, 2019. DOI: https://doi.org/10.1108/IJHCQA-02-2018-0059. Available from: https://pubmed.ncbi.nlm.nih.gov/31282263. Accessed: 19 Jul. 2021.

PELLEGRINO, Edmund D. Praxis as a keystone for the philosophy and professional ethics of medicine: the need for an arch-support: commentary on Toulmin and Wartofsky. *In*: CARSON, Ronald A.; BURNS, Chester R (ed.). **Philosophy of Medicine and Bioethics**. Dordrecht: Kluwer Academic Publishers, 1997. p. 69-84. (Philosophy and Medicine, 50). DOI: https://doi.org/10.1007/0-306-48133-2_5. Available from: https://link.springer.com/chapter/10.1007/0-306-48133-2_5. Accessed: 11 Aug. 2019.

POLMEROL, Jean-Charles.; BARBA-ROMERO, Sergio. **Multicriterion decision in management:** principles and practice**.** Boston: Kluwer Academic Publishers, 2000.

RAZAVI, S. Donya *et al*. Who is in and who is out? A qualitative analysis of stakeholder participation in priority setting for health in three districts in Uganda. **Health Policy and Planning**, Oxford, v. 34, n. 5, p. 358-369, 2019. DOI: https://doi.org/10.1093/heapol/czz049. Available from: https://pubmed.ncbi.nlm.nih.gov/31180489. Accessed: 22 Sept. 2021.

REDDY, Brian P. *et al.* A role for MCDA to navigate the trade-offs in the National Institute for Health and Care Excellence's public health recommendations. **Operations Research for Health Care**, London, v. 23, p. 100179, 2019. DOI: https://doi.org/10.1016/j.orhc.2019.02.001. Available from: https://www.sciencedirect.com/science/article/pii/S2211692317301674. Accessed: 7 Nov. 2024.
ROY, Bernard. **Multicriteria methodology for decision aiding**. Boston: Springer, 1996.

RUTTEN-VAN MÖLKEN, Maureen *et al*. Strengthening the evidence-base of integrated care for people with multi-morbidity in Europe using Multi-Criteria Decision Analyses MCDA. **International Journal of Integrated Care**, London, v. 18, n. 1, 576, 2018. DOI: https://doi.org/10.1186/s12913-018-3367-4. Available from: https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-018-3367-4. Accessed: 5 Nov. 2021.

SILVA, Hudson *et al*. Fostering responsible innovation in health: an evidence informed assessment tool for innovation stakeholders. **International Journal of Health Policy and Management**, Kerman, v. 10, n. 4, p. 181-191, 2021. DOI: https://doi.org/10.34172/ijhpm.2020.34. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8167270. Accessed: 21 Oct. 2021.

SINUANY-STERN, Zilla *et al*. The location of a hospital in a rural region: the case of the Negev. **Location Science**, London, v. 3, n. 4, p. 255-266, 1995. DOI: https://doi.org/10.1016/0966-8349(96)00002-2. Available from: https://www.sciencedirect.com/science/article/abs/pii/0966834996000022. Accessed: 11 Jan. 2019.

SUN, Ruixiao *et al*. A hesitant fuzzy linguistic projection-based MABAC method for patients' prioritization. **International Journey of Fuzzy Systems**, London, v. 20, p. 2144-2160, 2018. DOI: https://doi.org/10.1007/s40815-017-0345-7. Available from: https://link.springer.com/article/10.1007/s40815-017-0345-7. Accessed: 24 Jul. 2021.

SUSTERSIC, O. *et al*. Evaluating patients' health using a hierarchical multi-attribute decision model. **The Journal of International Medical Research**, Northampton, v. 37, n. 5, p. 1646-1654, 2009. DOI: https://doi.org/10.1177/147323000903700544. Available from: https://pubmed.ncbi.nlm.nih.gov/19930874/ Accessed: 1 Feb. 2019.

TARIMCILAR, M. Murat; KHAKSARI, Shahriar Z. Capital budgeting in hospital management using the analytic hierarchy process. **Socio-Economic Planning Sciences**, New York, v. 25, n. 1, p. 27-34, 1991. DOI: https://doi.org/10.1016/0038-0121(91)90026-n. Available from: https://pubmed.ncbi.nlm.nih.gov/10111675/. Accessed: 11 Apr. 2019.

TERVONEN, Tommi *et al*. MCDA swing weighting and discrete choice experiments for elicitation of patient benefit-risk preferences: a critical assessment. **Pharmacoepidemiology and Drug Safety**, Chichester, v. 26, n. 12, p. 1483-1491, 2017. DOI: https://doi.org/10.1002/pds.4255. Available from: https://pubmed.ncbi.nlm.nih.gov/28696023. Accessed: 13 Jul. 2021.

THOKALA, Praveen *et al*. Multiple criteria decision analysis for health care decision making – an introduction: Report 1 of the ispor MCDA emerging good practices task force. **Value in Health**, Malden, v. 19, n. 1, p. 1-13, 2016. DOI: https://doi.org/10.1016/j.jval.2015.12.003. Available from: https://pubmed.ncbi.nlm.nih.gov/26797229/. Accessed: 7 Jan. 2020.

VAN TIL, Janine *et al*. Does technique matter: a pilot study exploring weighting techniques for a multi-criteria decision support framework. **Cost Effectiveness and Resource Allocation**, London, v. 12, p. 1-11, 2014. Article 22. DOI: https://doi.org/10.1186/1478-7547-12-22. Available from: https://resource-allocation.biomedcentral.com/articles/10.1186/1478-7547-12-22. Accessed: 11 Nov. 2020.

VENHORST, Kristie *et al*. Multi-criteria decision analysis of breast cancer control in low and middle income countries: Development of a rating tool for policy makers. **Cost Effectiveness and Resource Allocation**, London, v. 12, n. 1, p. 13-23, 2014. DOI: https://doi.org/10.1186/1478-7547-12-13. Available from: https://resource-allocation.biomedcentral.com/articles/10.1186/1478-7547-12-13. Accessed: 22 Dec. 2020.

WAGNER, Monika *et al*. Can the EVIDEM framework tackle issues raised by evaluating treatments for rare diseases: analysis of issues and policies, and context-specific adaptation. **PharmacoEconomics,** Auckland, v. 34, n. 3, p. 285-301, 2016. DOI: https://doi.org/10.1007/s40273-015-0340-5. Available from: https://pubmed.ncbi.nlm.nih.gov/26547306. Accessed: 19 Jul. 2021.

WAHLSTER, Phillip *et al.* Exploring the perspectives and preferences for HTA across German healthcare stakeholders using a multi-criteria assessment of a pulmonar heart sensor as a case study. **Health Research Policy and Systems**, London, v. 13, p. 1-11, 2015. Article 24. DOI: https://doi.org/10.1186/s12961-015-0011-1. Available from: https://pubmed.ncbi.nlm.nih.gov/25928535. Accessed: 26 Sept. 2020.

WANG, Xiaojia *et al*. An integrated model to evaluate the impact of social support on improving self-management of type 2 diabetes mellitus. **BMC Medical Informatics and Decision Making**, London, v. 19, n. 1, p. 197-205, 2019. DOI: https://doi.org/10.1186/s12911-019-0914-9. Available from: https://pubmed.ncbi.nlm.nih.gov/31640691. Accessed: 20 Aug. 2021.

WANG, Xiaoting; TRIANTAPHYLLOU, Evangelos. Ranking irregularities when evaluating alternatives by using some ELECTRE methods. **Omega**, Amsterdam, v. 36, n. 1, p. 45-63, 2008. DOI: https://doi.org/10.1016/j.omega.2005.12.003. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0305048305001696. Accessed: 11 Feb. 2019.

WATRÓBSKI, Jarosław *et al.* Generalised framework for multi-criteria method selection. **Omega**, Amsterdam, v. 86, p. 107-124, 2018. DOI: https://doi.org/10.1016/j.omega.2018.07.004. Available from: https://www.sciencedirect.com/science/article/pii/S0305048317308563. Accessed: 1 Jul. 2021.

ZANAKIS, Stelios H. *et al*. Multi-attribute decision making: A simulation comparison of select methods. **European Journal of Operational Research**, London, v. 107, n. 3, p. 507-529, 1998. DOI: https://doi.org/10.1016/S0377-2217(97)00147-1. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0377221797001471. Accessed: 12 Dec. 2020.