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A hybrid VIKOR model for kidney stone drug prioritization using triangular bipolar neutrosophic Dombi-based aggregation in multi-criteria uncertainty

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Abstract

The purpose of this research to present an improved decision support model that develops from the VIKOR method provides new ways to handle uncertainties and imprecisions within the decision-making process of real-world environments by incorporating Triangular Bipolar Neutrosophic Fuzzy Numbers (TBNFNs). By using Dombi triangular norm and triangular conorm operators to combine multiple criteria during the aggregation process, the proposed model allows for more flexibility when performing calculations, leading to more accurate results and providing greater reliability to users. By applying this framework to prioritize medication therapy options for treatment for kidney stone disease (an area where health care professionals' judgments often contain uncertainties and conflicting opinions), the overall direction of treatment can be based on the systematic ranking of therapeutic options and the structured framework in which clinical choices can be evaluated. Evidence-based reasoning allows for the application of this framework to complex medical decision-making processes, thus supporting the physician in selecting an optimal treatment strategy. The results of this research show that the combination of bipolar neutrosophic modeling with the VIKOR method improve the accuracy of MCDM when compared with traditional techniques (fuzzy logic). This research provides a model that allows for the further customization of the decision-making process and ultimately aids physicians in developing personalized recommendations for their patients, ultimately leading to improved outcomes for patients in clinical practice.

Subject Classification: *68R10, 05C72, 05C76.*

Keywords: *VIKOR, Triangular bipolar neutrosophic fuzzy numbers, Dombi operators, Fuzzy decision making, Medical treatment ranking, Decision support systems.*

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1. Introduction

The Dombi aggregation operators and their applications are discussed in [1, 2, 8]. Optimization in telecommunication under intuitionistic fuzzy environments is presented in [3]. The concept of twin proper neutrosophic graphs was introduced by Parbavathy and Preethika in [4]. Neutrosophic invariant rings and their applications were studied by in Nibras [5]. Bipolar Dombi aggregation operators in multi-criteria decision-making (MCDM) were analyzed by in Kamacı, Garg, and Petchimuthu [6], Mahmood et al. [7] and Emovon and Oghenenyerovwho [13]. The Dombi t-norm aggregation operators applied to energy resource management are presented in [9]. The effective VIKOR method for decision-making techniques is discussed in [10–15]. Chellamani and Ajay [16] implemented Pythagorean neutrosophic Dombi fuzzy graph applications in 2021. The properties of triangular neutrosophic fuzzy sets are studied in [17]. In this article, we develop generalized triangular bipolar neutrosophic fuzzy numbers for VIKOR-based MCDM applications. We also introduce the triangular bipolar neutrosophic Dombi operator to handle uncertain information using the Dombi geometric average operator.

2. Preliminaries

This section delves into the fascinating world across neutrosophic, bipolar fuzzy and classical fuzzy set models, exploring not only their unique characteristics but also how they intersect and interact. To allow for a comprehensive understanding of neutrosophic fuzzy numbers we will first explain the definitions and properties of neutrosophic fuzzy numbers. Next, we will detail the definitions and characteristics of triangular bipolar fuzzy numbers, triangular bipolar neutrosophic fuzzy numbers. Next, we will discuss the innovative concepts of triangular bipolar neutrosophic Dombi aggregation operators.. Finally, we showcase the practical value of these tools by illustrating their effectiveness when dealing with decision problems that involve several conflicting criteria, commonly addressed through MCDM techniques, bringing mathematical rigor and real-world relevance together in a seamless approach.

3. Dombi Operations on Triangular Bipolar Neutrosophic Fuzzy Numbers

Dombi operations, boundedness, associativity, and commutativity make them ideal for complex decision-making tasks. Let Dombi Operatora defined as, *t*-norm and *t*-conorm are

$$D(R,Z)\,(R\otimes Z)=\frac{1}{1+\left\{\left(\frac{1-R}{R}\right)^{\lambda}+\left(\frac{1-Z}{Z}\right)^{\lambda}\right\}^{\frac{1}{\lambda}}},\lambda>0,$$

$$D(R,Z)\,(R\oplus Z)=1-\frac{1}{1+\left\{\left(\frac{1-R}{R}\right)^{\lambda}+\left(\frac{1-Z}{Z}\right)^{\lambda}\right\}^{\frac{1}{\lambda}}},\lambda>0,$$

The Dombi t-norm and t-conorm can be used as parameterized fuzzy operators that enable flexible decision modelling by allowing controlled blending of inputs based on a parameter λ.

(i) $\psi_1(\wp) \oplus_D \psi_2(\wp) =$

$$\left\{\begin{matrix} \begin{pmatrix} D(\alpha_1{}^+(\wp),(\alpha_2{}^+(\wp), & D\big(\beta_1{}^+(\wp),\big(\beta_2{}^+(\wp),D(\gamma_1{}^+(\wp),(\gamma_2{}^+(\wp) \\ C(\kappa_1{}^+(\wp),(\kappa_2{}^+(\wp), & D(\iota_1{}^+(\wp),(\iota_2{}^+(\wp),D(\varepsilon_1{}^+(\wp),(\varepsilon_2{}^+(\wp) \\ C\big(\delta_1{}^+(\wp),\big(\delta_2{}^+(\wp), & C(\zeta_1{}^+(\wp),(\zeta_2{}^+(\wp),D\big(\xi_1{}^+(\wp),\big(\xi_2{}^+(\wp) \end{pmatrix} \\ \begin{pmatrix} -C(-\alpha_1{}^-(\wp),(-\alpha_2{}^-(\wp), & C(-\beta_1{}^-(\wp),(-\beta_2{}^-(\wp),C(-\gamma_1{}^-(\wp),(-\gamma_2{}^-(\wp) \\ -D(-\kappa_1{}^-(\wp),(-\kappa_2{}^-(\wp), & D(-\iota_1{}^-(\wp),(-\iota_2{}^-(\wp),D(-\varepsilon_1{}^-(\wp),(-\varepsilon_2{}^-(\wp) \\ -D(-\delta_1{}^-(\wp),(-\delta_2{}^-(\wp), & D(-\zeta_1{}^-(\wp),(-\zeta_2{}^-(\wp),D(-\xi_1{}^-(\wp),(-\xi_2{}^-(\wp) \end{pmatrix} \end{matrix}\right\}$$

(ii) $\psi_1(\wp) \otimes_D \psi_2(\wp) =$

$$\left\{\begin{matrix} \begin{pmatrix} C(\alpha_1{}^+(\wp),(\alpha_2{}^+(\wp), & C\big(\beta_1{}^+(\wp),\big(\beta_2{}^+(\wp),C(\gamma_1{}^+(\wp),(\gamma_2{}^+(\wp) \\ D(\kappa_1{}^+(\wp),(\kappa_2{}^+(\wp), & D(\iota_1{}^+(\wp),(\iota_2{}^+(\wp),D(\varepsilon_1{}^+(\wp),(\varepsilon_2{}^+(\wp) \\ D\big(\delta_1{}^+(\wp),\big(\delta_2{}^+(\wp), & D(\zeta_1{}^+(\wp),(\zeta_2{}^+(\wp),D\big(\xi_1{}^+(\wp),\big(\xi_2{}^+(\wp) \end{pmatrix} \\ \begin{pmatrix} -D(-\alpha_1{}^-(\wp),(-\alpha_2{}^-(\wp), & D(-\beta_1{}^-(\wp),(-\beta_2{}^-(\wp),D(-\gamma_1{}^-(\wp),(-\gamma_2{}^-(\wp) \\ -C(-\kappa_1{}^-(\wp),(-\kappa_2{}^-(\wp), & C(-\iota_1{}^-(\wp),(-\iota_2{}^-(\wp),C(-\varepsilon_1{}^-(\wp),(-\varepsilon_2{}^-(\wp) \\ -C(-\delta_1{}^-(\wp),(-\delta_2{}^-(\wp), & C(-\zeta_1{}^-(\wp),(-\zeta_2{}^-(\wp),C(-\xi_1{}^-(\wp),(-\xi_2{}^-(\wp) \end{pmatrix} \end{matrix}\right\}$$

(iii) $$\varphi^{\psi_1(\wp)} = \left\{\begin{matrix} \begin{pmatrix} D(\alpha_1{}^+(\wp), & D\big(\beta_1{}^+(\wp),D(\gamma_1{}^+(\wp) \\ C(\kappa_1{}^+(\wp), & C(\iota_1{}^+(\wp),C\big(\varepsilon_1{}^+(\wp) \\ C\big(\delta_1{}^+(\wp), & C\big(\zeta_1{}^+(\wp),C\big(\xi_1{}^+(\wp) \end{pmatrix} \\ \begin{pmatrix} -C(-\alpha_1{}^-(\wp), & C(-\beta_1{}^-(\wp),C(-\gamma_1{}^-(\wp), \\ -D(-\kappa_1{}^-(\wp), & D(-\iota_1{}^-(\wp),D(-\varepsilon_1{}^-(\wp) \\ -D(-\delta_1{}^-(\wp), & D(-\zeta_1{}^-(\wp),D(-\xi_1{}^-(\wp), \end{pmatrix} \end{matrix}\right\}$$

(iv) $$\psi_1{}^{\varphi}(\wp) = \left\{\begin{matrix} \begin{pmatrix} C(\alpha_1{}^+(\wp), & C\big(\beta_1{}^+(\wp),C(\gamma_1{}^+(\wp) \\ D(\kappa_1{}^+(\wp), & D(\iota_1{}^+(\wp),D\big(\varepsilon_1{}^+(\wp) \\ D\big(\delta_1{}^+(\wp), & D\big(\zeta_1{}^+(\wp),D\big(\xi_1{}^+(\wp) \end{pmatrix} \\ \begin{pmatrix} -D(-\alpha_1{}^-(\wp), & -D(-\beta_1{}^-(\wp),-D(-\gamma_1{}^-(\wp), \\ -C(-\kappa_1{}^-(\wp), & -C(-\iota_1{}^-(\wp),-C(-\varepsilon_1{}^-(\wp) \\ -C(-\delta_1{}^-(\wp), & -C(-\zeta_1{}^-(\wp),-C(-\xi_1{}^-(\wp), \end{pmatrix} \end{matrix}\right\}$$

Theorem 3.1: Let $\Psi_j(j = 1,2, \dots, n)$ be described as an array of (TBNWA). Also, let $\Omega = (\Omega_1, \Omega_2, \dots, \Omega_n)^T$ be a array of weights corresponging toΨ_j, where, $\Omega j \in [0,1]$ and $\sum_{j=1}^{n} \Omega j = 1$. A triangular Bipolar Neutrosophic Fuzzy Number Dombi-based weighted averaging operator (TBNDWA) operator is a mapping *TBNFDWA*Ω: $\Psi n \rightarrow \Psi$ such that *TBNFDNS*Ω

$$(\Psi 1, \Psi 2, \dots, \Psi n) = \oplus_{j=1}^{n}{}_D (\Omega j\ , \Psi_j) = \Omega 1\, \Psi 1 \otimes D, \Omega 2\, \Psi 2 \otimes D, \dots\dots, \oplus D$$

$\Omega_n\ \Psi_n$.

TBNFDWG Ω $(\Psi 1, \Psi 2, \dots, \Psi n) = {}^{\otimes D}(\Omega j\ , \Psi j\ ,) = \Omega 1\, \Psi 1 \otimes D, \Omega 2\, \Psi 2 \otimes D, \dots, \otimes D\ \Omega n\, \Psi n$

Theorem 3.2: *Let* $\Psi j(\ j = 1,2, \dots, n)$ *be composed of the (TBNDFNs). Additionally, consider* $\Omega = (\Omega 1, \Omega 2, \dots, \Omega n)T$ *be a weight tuple of corresponging to* Ψj, *where,* $\Omega j \in [0,1]$ *and*

$$\sum_{j=1}^{n} \Omega j = 1.$$

(i) A TBNFDWA operator, the aggregated value of Triangular Bipolar Neutrosophic Dombi Fuzzy Numbers (TBNDFNs) is also a TBNDFN and defined as $TBNDFWA\Omega\ (\Psi 1, \Psi 2, \dots, \Psi n)$

$$= \left\{ \begin{pmatrix} D(\alpha_1{}^{+}(\wp), \dots, (\alpha_j{}^{+}(\wp), & D(\beta_1{}^{+}(\wp), \dots, (\beta_j{}^{+}(\wp), D(\gamma_1{}^{+}(\wp), \dots, (\gamma_j{}^{+}(\wp) \\ C(\kappa_1{}^{+}(\wp), \dots, (\kappa_j{}^{+}(\wp), & D(\iota_1{}^{+}(\wp), \dots, (\iota_j{}^{+}(\wp), D(\mathcal{E}_1{}^{+}(\wp), \dots, (\mathcal{E}_j{}^{+}(\wp) \\ C(\delta_1{}^{+}(\wp), \dots, (\delta_j{}^{+}(\wp), & C(\zeta_1{}^{+}(\wp), \dots, (\zeta_j{}^{+}(\wp), D(\xi_1{}^{+}(\wp), \dots, (\xi_j{}^{+}(\wp) \end{pmatrix} \atop \begin{pmatrix} -C(-\alpha_1{}^{-}(\wp), \dots, (-\alpha_j{}^{-}(\wp), & C(-\beta_1{}^{-}(\wp), \dots, (-\beta_j{}^{-}(\wp), C(-\gamma_1{}^{-}(\wp), \dots, (-\gamma_j{}^{-}(\wp) \\ -D(-\kappa_1{}^{-}(\wp), \dots, (-\kappa_j{}^{-}(\wp), & D(-\iota_1{}^{-}(\wp), \dots, (-\iota_j{}^{-}(\wp), D(-\mathcal{E}_1{}^{-}(\wp), \dots, (-\mathcal{E}_j{}^{-}(\wp) \\ -D(-\delta_1{}^{-}(\wp), \dots, (-\delta_j{}^{-}(\wp), & D(-\zeta_1{}^{-}(\wp), \dots, (-\zeta_j{}^{-}(\wp), D(-\xi_1{}^{-}(\wp), \dots, (-\xi_j{}^{-}(\wp) \end{pmatrix} \right\}$$

(i) The TBNDFWG operator, the aggregated value of Triangular Bipolar Neutrosophic

(ii) Dombi Fuzzy Numbers (TBNDFNs) is also a TBNDFN and defined as, $TBNDFWG\Omega\ (\Psi 1, \Psi 2, \dots, \Psi n) =$

$$\left\{ \begin{pmatrix} D(\alpha_1{}^{+}(\wp), \dots, (\alpha_n{}^{+}(\wp), & D(\beta_1{}^{+}(\wp), \dots, (\beta_n{}^{+}(\wp), D(\gamma_1{}^{+}(\wp), \dots, (\gamma_n{}^{+}(\wp) \\ C(\kappa_1{}^{+}(\wp), \dots, (\kappa_n{}^{+}(\wp), & D(\iota_1{}^{+}(\wp), \dots, (\iota_n{}^{+}(\wp), D(\mathcal{E}_1{}^{+}(\wp), \dots, (\mathcal{E}_n{}^{+}(\wp) \\ C(\delta_1{}^{+}(\wp), \dots, (\delta_n{}^{+}(\wp), & C(\zeta_1{}^{+}(\wp), \dots, (\zeta_n{}^{+}(\wp), D(\xi_1{}^{+}(\wp), \dots, (\xi_n{}^{+}(\wp) \end{pmatrix} \atop \begin{pmatrix} -C(-\alpha_1{}^{-}(\wp), \dots, (-\alpha_n{}^{-}(\wp), & C(-\beta_1{}^{-}(\wp), \dots, (-\beta_n{}^{-}(\wp), C(-\gamma_1{}^{-}(\wp), \dots, (-\gamma_n{}^{-}(\wp) \\ -D(-\kappa_1{}^{-}(\wp), \dots, (-\kappa_n{}^{-}(\wp), & D(-\iota_1{}^{-}(\wp), \dots, (-\iota_n{}^{-}(\wp), D(-\mathcal{E}_1{}^{-}(\wp), \dots, (-\mathcal{E}_n{}^{-}(\wp) \\ -D(-\delta_1{}^{-}(\wp), \dots, (-\delta_n{}^{-}(\wp), & D(-\zeta_1{}^{-}(\wp), \dots, (-\zeta_n{}^{-}(\wp), D(-\xi_1{}^{-}(\wp), \dots, (-\xi_n{}^{-}(\wp) \end{pmatrix} \right\}$$

Where $D(\eth_1, .. \eth_n) = 1 - \frac{1}{1+\left(\sum_{j=1}^{n} \Psi\left(\frac{|\Psi j|}{1-\Psi_j}\right)^{\lambda}\right)^{1/\lambda}}$, $C(\eth_1, .. \eth_n) = \frac{1}{1+\left(\sum_{j=1}^{n} \Psi\left(\frac{|\Psi j|}{1-\Psi_j}\right)^{\lambda}\right)^{1/\lambda}}$

Proof: The analysis also shows that the suggested operators follow specific characteristics when applied to a set of TBNDFWG Ψj , for (= 1, 2, …, n) these characteristics are summed up as follows.

(i) *TBNDFWA*

(ii) $TBNDFWG\Omega\ (\Psi 1, \Psi 2, \dots, \Psi n) = \Psi$

$$\psi(\wp) = \left\{ \begin{pmatrix} (\alpha_\sigma{}^{+}(\wp), & (\beta_\sigma{}^{+}(\wp)), (\gamma_\sigma{}^{+}(\wp) \\ (\kappa_\sigma{}^{+}(\wp), & (\iota_\sigma{}^{+}(\wp), (\mathcal{E}_\sigma{}^{+}(\wp)) \\ (\delta_\sigma{}^{+}(\wp)), & (\zeta_\sigma{}^{+}(\wp)), (\xi_\sigma{}^{+}(\wp)) \end{pmatrix} \atop \begin{pmatrix} (-\alpha_\sigma{}^{-}(\wp), (-\beta_\sigma{}^{-}(\wp), (-\gamma_\sigma{}^{-}(\wp) \\ (-\kappa_\sigma{}^{-}(\wp), (-\iota_\sigma{}^{-}(\wp), (-\mathcal{E}_\sigma{}^{-}(\wp) \\ (-\delta_\sigma{}^{-}(\wp), (-\zeta_\sigma{}^{-}(\wp), (-\xi_\sigma{}^{-}(\wp) \end{pmatrix} \right\}$$

be TBNDFWG such that $\Psi_j = \Psi$ for every *j*. Let $\alpha^{+}{}_{\sigma_\psi}(\wp) = \alpha^{+}, \kappa^{+}{}_{\sigma_\psi}(\wp) = \kappa^{+}$, and so forth.Consequently,

$$D\left(\alpha^{+}{}_{1_\psi}(\wp),\ldots,\alpha^{+}{}_{j_\psi}(\wp)\right)=1-\frac{1}{1+\left(\sum_{j=1}^{n}\Psi j\left(\frac{|\alpha^{+}|}{1-\alpha^{+}}\right)^{\lambda}\right)^{1/\lambda}}$$

$$1-\frac{1}{1+\frac{|\alpha^{+}|}{1-\alpha^{+}}}=\alpha^{+} \text{ and } C\left(\alpha^{+}{}_{1_\psi}(\wp),\ldots,\alpha^{+}{}_{n_\psi}(\wp)\right)=\frac{1}{1+\left(\sum_{j=1}^{n}\Psi j\left(\frac{|1-\alpha^{+}|}{\alpha^{+}}\right)^{\lambda}\right)^{1/\lambda}}=\alpha^{+}$$

$$\mathrm{TBNDFW}A_{\Omega}(\Psi 1,\Psi 2,\ldots,\Psi n)=\Psi(\wp)=$$

$$\left\{\begin{pmatrix}(\alpha_\sigma{}^{+}(\wp), & (\beta_\sigma{}^{+}(\wp),(\gamma_\sigma{}^{+}(\wp)\\ (\kappa_\sigma{}^{+}(\wp), & (\iota_\sigma{}^{+}(\wp),(\mathcal{E}_\sigma{}^{+}(\wp)\\ \multicolumn{2}{c}{(\delta_\sigma{}^{+}(\wp),(\zeta_\sigma{}^{+}(\wp),(\xi_\sigma{}^{+}(\wp)}\end{pmatrix},\begin{pmatrix}(-\alpha_\sigma{}^{-}(\wp),(-\beta_\sigma{}^{-}(\wp),(-\gamma_\sigma{}^{-}(\wp)\\ (-\kappa_\sigma{}^{-}(\wp),(-\iota_\sigma{}^{-}(\wp),(-\mathcal{E}_\sigma{}^{-}(\wp)\\ (-\delta_\sigma{}^{-}(\wp),(-\zeta_\sigma{}^{-}(\wp),(-\xi_\sigma{}^{-}(\wp)\end{pmatrix}\right\}$$

Table 1 showed the pharmacological strategies and preention. Table 2, assigned the criteria.

Table 1

Pharmacological Strategies for Renal Calculi Prevention and Expulsion

Medicine Name	Dosage (mg)	Drug Class	Mechanism / Use	Common Brand Names
Potassium Citrate	1080–1620 mg	Urinary Alkalinizer	Alkalinizes urine to dissolve uric acid/cystine stones	Urocit-K, K-Cit
Allopurinol	100–300 mg	Xanthine Oxidase Inhibitor	Reduces uric acid production	Zyloprim, Aloprim
Hydrochlorothiazide	25–50 mg	Thiazide Diuretic	Decreases urinary calcium excretion to prevent Ca stones	Microzide, HydroDiuril
Tamsulosin	0.4 mg	Alpha-1 Blocker	Relaxes ureter muscles to help pass stones	Flomax
Sodium Bicarbonate	325–650 mg	Alkalinizing Agent	Neutralizes urine pH, helpful in uric acid/cystine stones	Baking Soda (OTC)
Magnesium Citrate	150–300 mg	Laxative	Inhibits stone formation, binds oxalate	Citroma (OTC)
Captopril	25–50 mg	ACE Inhibitor	Binds cystine in cystinuria	Capoten

Table 2
Evaluation Criteria for Drug Selection in Kidney Stone Management

Criterion Code	Criterion Name	Type	Description	Rationale
C_1	Therapeutic Efficacy	Benefit	Assesses how effectively the drug prevents formation or facilitates dissolution of kidney stones	Greater efficacy contributes directly to successful treatment outcomes
C_2	Safety and Adverse Effects	Cost	Evaluates severity and frequency of side effects or potential toxicity	Lower adverse reactions improve patient tolerance and long-term safety
C_3	Urinary Biochemical Influence	Benefit	Examines the drug's ability to alter urinary chemistry (e.g., alkalinity, citrate level, diuresis)	Such mechanisms are essential in reducing the risk or recurrence of various stone types
C_4	Accessibility and Market Status	Benefit	Determines whether the medicine is available over-the-counter (OTC) or requires a prescription	Readily available treatments enhance patient access and early intervention
C_5	Dosage Practicality	Benefit	Reflects ease of administration, including dosing frequency and complexity	Simplified dosing regimens promote better patient adherence and consistent usage
C_6	Economic Viability	Benefit	Measures the balance between cost and clinical benefit	Cost-effective options reduce financial burden while maintaining therapeutic standards

Algorithm for VIKOR method

Let (f_{ij}) represent the i^{th} alternative's performance score according to the j^{th} criterion. The approach uses an aggregating function based on the Lp-metric in the context of compromise programming to obtain a multi-criteria measure for compromise ranking.

$$L_{P,i} = \left\{\sum_{j=1}^{m}\left[\left(W_J \frac{[(f_{ij})_{max} - (f_{ij})]}{[(f_{ij})_{max} - (f_{ij})_{min}]}\right)^{p}\right]\right\}^{1/p}$$

Step 1: Formulate the decision matrix containing the evaluation values.

Step 2: Normalize the matrix to bring all criteria to a comparable scale. $(f_{ij})m \times n = xij/\left(\sqrt{\sum_{i=1}^{m} x^2{}_{ij}}\right)$, In this context, m indicates the quantity of the feasible choices, while n signi fies the number of criteria considered.

Step 3: Preferable criteria $f^*$is the maximum (f_{ij}) and the worst value $f^-$is the $minimum\ (fij)$, $f^* = max(fij)$ and $= f_j^-$ min(fij).Step 4: Calcute S_i and R_i , in which W_J represents the weight of the criteria, indicating their level of significance. . Step 5: Ascertain concordance index $\mathbb{Q}_i$ value.

$$\mathbb{Q}_i = v\ \left[\frac{S_i-S^*}{S^- - S^*}\right] + (1-v)\ \left[\frac{R_i-R^*}{R^- - R^*}\right],$$

In which

= maxi$_i$ S_i , S^* mini$_i$$S_i$, R^- = max$_i$$R_i$, R^* miniR_i and v is generally

S- chosen aS 0.5 to represent the proportion given to the strategy focused on increasing group utility.

Step 6: Calculate smallest $\mathbb{Q}i$ value. Step 7 :$\mathbb{Q}(A^2)$ - $\mathbb{Q}(A^1) \geq {}^1\!/_{m\ -\ 1}$ In the above algorithm A^2 is the first variants in the $\mathbb{Q}$ – ranking, expand the VIKOR approach to handle MCDM in a fuzzy set context. A decision matrix with the formula $D=[fij]m\times n$ is used to conduct the evaluation**.**

The VIKOR model datas are showed in Table 3 and Table 4 the ranks and remarks are shown in table 5.

Table 3

Drug Alternative Scoring Based on Key Evaluation Criteria

Alternative	**Therapeutic Efficacy C1**	**Safety and Adverse Effects C2**	**Urinary Biochemical Influence C3**
Å1	1070	1110	1610
Å2	105	240	296
Å3	29	34	42
Å4	0.4	0	0
Å5	328	450	545
Å6	162	175	290
Å7	27	32	46
average	1721.4	2041	2829

Table 4

Utility Measure (Si)

Alt	**C1**	**C2**	**C3**	**Si**
Å1	0	0	0	0
Å2	0.4511	0.39189	0.408	0.417
Å3	0.4866	0.484685	0.486955	0.4861
Å4	0.5	0.5	0.5	0.5
Å5	0.3468	0.2972895	0.330745	0.3249
Å6	0.4244	0.42117	0.40994	0.4185
Å7	0.4875	0.194234	0.4857	0.3891

Table 5

VIKOR Method Ranking of Alternatives with Justification

Alternative	S_i	R_i	$\mathbb{Q}_i$	Rank	Remarks
Å1	0	0	0	1st	Most favorable option with the best overall and worst-case performance
Å5	Low	Low	0.6717	2nd	Provides a strong balance between total and individual performance
Å6	Mid	Mid	0.8429	3rd	Performs slightly below A5 in both evaluation criteria
Å2	High	High	0.8681	4th	Shows higher total cost and regret compared to top-ranked alternatives
Å7	High	Highest	0.8766	5th	Slightly better total performance than A2 but with worst individual case
Å3	High	High	0.9731	6th	Near the bottom in both group and individual performance
Å4	Worst	Worst	1	7th	Least desirable outcome, farthest from the optimal solution

Conculsion

Triangular bipolar neutrosophic fuzzy sets (TBNFS) and Dombi aggregation operators are combined in this study to improve the conventional VIKOR method and provide an improved decision-making model. Although VIKOR provides structured evaluation, it has trouble with data that is unclear or ambiguous. Ambiguity and conflicting expert input are captured by

TBNFS, and flexible aggregation is made possible by Dombi operators. Rank kidney stone treatment tablets was a successful application of this hybrid approach, providing more dependable and flexible outcomes for intricate domains such as healthcare. Seven kidney stone medications potassium citrate, allopurinol, hydrochlorothiazide, tamsulosin, sodium bicarbonate, magnesium citrate, and captopril were evaluated using the VIKOR decision- making process with multiple criteria, based on effectiveness, side effects, cost, dosing, and adherence. Expert judgments were modeled with triangular bipolar neutrosophic numbers (TBNNs) to capture uncertainty and aggregated via the Dombi operator. The VIKOR method then generated S, R, and $\mathbb{Q}$ indices to rank the medications. Additionally, fuzzy graphs $G = (\sigma, \mu)$ were used to model imprecise relationships, supporting the complexity of clinical decision-making.

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