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An Integrated FAHP–TOPSIS Approach for Evaluating and Prioritizing Medical Tourism Service Types in Vietnam

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ABSTRACT

This study proposes an integrated decision-making model combining FAHP and TOPSIS methods to evaluate and prioritize medical tourism services in Vietnam. The evaluation framework was developed through literature review and expert consultation, resulting in five main criteria groups: professional quality, cost-efficiency, supporting tourism infrastructure, integration with tourism, and market demand. FAHP was used to determine the relative importance of each criterion under uncertainty. Then, TOPSIS was applied to rank three service types: modern Western medicine, traditional Eastern medicine, and rehabilitation–physiotherapy. The results show that rehabilitation–physiotherapy holds the highest priority due to its strong integration with tourism and alignment with post-COVID-19 recovery needs. Traditional Eastern medicine ranks second, reflecting increased interest in holistic and indigenous healthcare. Western medicine ranks lowest despite its technical strengths because of high costs and limited differentiation in regional competition. This study offers practical implications for policymakers and stakeholders seeking to develop targeted medical tourism strategies in Vietnam. Additionally, it demonstrates the effectiveness of combining FAHP and TOPSIS in addressing complex multi-criteria decision-making problems under uncertain conditions.

Keywords: Medical tourism service, FAHP–TOPSIS, MCDM, Vietnam.

Introduction

Medical tourism is becoming the fastest-growing segment in the tourism industry due to the increasing demand for healthcare services and travel experiences. The global medical tourism market was valued at over USD 26.4 billion in 2023 and is projected to grow at an annual rate exceeding 16.3% from the 2024 – 2032 period (Global Market Insights, 2023). Regional leaders such as Thailand (3–5 million patients/year), Malaysia (1.2 million/year), and India (500,000–700,000/year) have successfully established strong national brands in this sector (Global Market Insights, 2024; MHTC, 2023).

Within Southeast Asia, Vietnam has great potential to develop medical tourism in many fields, such as periodic health care, recovery and convalescence, surgery and intensive treatment, dental care, infertility, and beauty treatments. According to the Vietnam National Authority of Tourism (VNAT, 2023), approximately 300,000 foreign visitors come to Vietnam each year for medical examinations and treatment, particularly in dentistry, cosmetic procedures, and traditional therapies. While there is no official benchmarking report on healthcare costs, anecdotal evidence and market feedback suggest that Vietnam holds a clear price advantage over many neighboring countries. Currently, three main categories of medical tourism services are being offered: Modern Western Medicine, Traditional Eastern Medicine, and Physical Therapy and Rehabilitation. The lack of an evidence-based, multi-criteria decision-making model to fragmented efforts rather than a unified strategy aligned with national strengths and market demand.

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Medical tourism is a rapidly growing interdisciplinary field of research, considered a separate branch of healthcare and tourism services. According to Zhong *et al*. (2021), more than 800 research papers from 1970 to 2020 in this field show three main approaches, including international patient behavior focus on motivation, satisfaction, trust, and intention to reuse services (Shahijan *et al*., 2015; Wu *et al*., 2016). However, very few studies focus on selecting specific service types that should be prioritized for investment in each country – this poses a significant academic gap, especially in the context of developing countries wanting to build a systematic medical tourism strategy.
In that context, the FAHP–TOPSIS integrated model has emerged as a suitable scientific tool to quantify the weights of evaluation criteria. According to Ghasemi *et al*. (2021), integrating FAHP and TOPSIS allows for practical assessment of qualitative criteria such as medical quality, human resource capacity, or tourism attractiveness under uncertain conditions. Other works, such as Guru *et al*. (2023) also confirmed the ability of this model to support optimal decision-making in destination selection, type, and evaluation of medical services. The FAHP–TOPSIS integrated model has proven effective in quantifying qualitative criteria and supporting optimal decision-making. Works such as Nguyen and Pham (2023) (Wang *et al*., 2021; Wu *et al*., 2022; Du *et al*., 2023) have been successfully applied in the fields of healthcare and tourism, from site selection to service quality assessment.
This study aims to develop an integrated decision-making framework that combines the FAHP -TOPSIS to evaluate and rank medical tourism service types in Vietnam. In the first stage, the FAHP method determines the relative importance (weights) of evaluation criteria based on expert judgments tailored to the Vietnamese context. In the second stage, the TOPSIS method is applied to assess and rank three representative service types—modern Western medicine, traditional Eastern medicine, and physiotherapy and rehabilitation—based on their alignment with the established criteria. The integrated approach facilitates the identification of the most suitable service type to prioritize for strategic development.

Literature Review

Medical tourism is a specific type of tourism in which tourists travel outside their usual place of residence to receive healthcare services such as medical examination, surgery, rehabilitation, or beauty treatments combined with relaxation, sightseeing, and cultural experiences at the destination (Connell, 2006; Heung *et al*., 2011; İlaslan *et al*., 2023). According to Bookman and Bookman (2007), medical tourism is "the behavior of people who cross national borders to access high-quality health services at a more reasonable cost than in the country of origin." Medical tourism includes both specialized treatment services (such as surgery, dentistry, and infertility treatment) and extended health care services (such as spa therapy, acupuncture, and health care) - representing the intersection between modern medicine and traditional medicine - healing (Carrera & Bridges, 2006; Lunt *et al*., 2011).
According to Carrera and Bridges (2006) and Lunt *et al.* (2011), medical tourism has the following specific benefits: Increases foreign currency revenue from international visitors, promotes investment in private healthcare and medical technology, and positions the national brand on the regional tourism and healthcare map. Service users will have access to quality medical services at lower costs than in the country of origin, shorten the waiting time for treatment, and Combine health care and travel and resort experiences.
Many studies have approached medical tourism from a consumer behavior perspective, examining patient intentions, beliefs, satisfaction, and destination choice. Wu *et al*. (2016) developed a model linking patient beliefs to revisit intentions, while Shahijan *et al*. (2015) applied the Theory of Planned Behavior (TPB) to analyze decision-making. These studies often overlook healthcare services' systemic nature, limiting service design and policy planning applicability.
Another piece of research focuses on service quality and its impact on patient satisfaction. Ko (2022) proposed a model connecting brand image, perceived quality, and satisfaction. Fakur *et al*. (2025) examined how service touchpoints and marketing affect perceived value. These studies lack practical frameworks for prioritizing service types in strategic development.
A third group of studies adopts a destination-based perspective, using MCDM methods such as FAHP and TOPSIS to evaluate medical tourism centers. Ghasemi *et al*. (2021) applied–TOPSIS to assess destinations' sustainability based on infrastructure, safety, and cost. However, these models do not address prioritization among different medical

services. A more petite body of research applies AHP or FAHP to rank service quality criteria (e.g., Guru *et al*. (2023); Figueroa-Valverde *et al*., 2023) rather than service types.

Studies such as Ghasemi *et al*. (2021) and Guru *et al*. (2023) primarily focus on ranking destinations or service criteria. Some research, such as Wu *et al*. (2022); and Saravanakumar *et al*. (2022), applies FAHP only at the individual hospital level, lacking an industry-wide framework for evaluating criteria. These works often fail to establish a connection between the development of quantitative criteria (e.g., via FAHP) and their application in service-type selection (e.g., via TOPSIS). Existing research on medical tourism remains fragmented, focusing on behavioral, experiential, and destination aspects or evaluating individual criteria. Notably, there remains a lack of a comprehensive and integrated research framework.

Materials and Methods

Framework for Medical Service Quality Criteria Development

The criteria were developed based on a synthesis of relevant academic literature and adjusted to align with the specific characteristics of Vietnam's medical tourism development. **Table 1** outlines the groups of criteria, their corresponding definitions, and key academic references, which together form the theoretical basis for the model design process.

Table 1. Criteria for evaluating medical tourism services

Criteria Group	Definition / Description	References
Medical Expertise and Quality (C1)	Professional qualifications of doctors, facility quality, international accreditation, and treatment success rates.	(Guru *et al*., 2023)
Cost and Economic Efficiency (C2)	Average treatment cost, pricing transparency, and diversity of service packages.	(Guru *et al*., 2023); (Ghasemi *et al*., 2021)
Supporting Tourism Infrastructure (C3)	Availability and quality of accommodation, transportation, and surrounding amenities.	(Ghasemi *et al*., 2021) (Wu *et al*., 2022)
Tourism Integration Potential (C4)	Ability to combine treatment with leisure, local cultural experiences, and distinctive tourism activities.	(Fakur *et al*., 2025)
Market Demand (C5)	Volume of international patients using the service type, level of promotion, and international market trends.	(Guru *et al*., 2023); (Ghasemi *et al*., 2021)

Figure 1 presents the FAHP–TOPSIS research framework applied to the selection of medical service types.

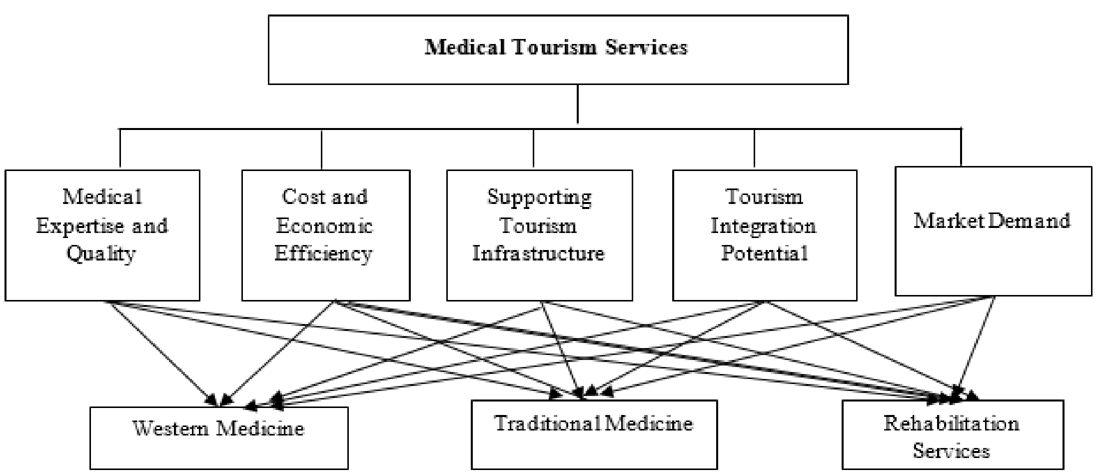

Figure 1. FAHP–TOPSIS research model for medical service type selection

Fuzzy Analytic Hierarchy Process (FAHP) Method

The FAHP method, based on Fuzzy Set Theory (Zadeh, 1965), was proposed by Buckley, (1985) and extended by Hsieh *et al*. (2004) to calculate criterion weights under uncertainty. It addresses vagueness in expert judgment by incorporating fuzzy logic. The main implementation steps are as follows:

Step 1: Define linguistic variables and construct the fuzzy pairwise comparison matrix.
In this step, linguistic terms are used to express the relative importance between criteria or alternatives (e.g., equally important, moderately more important, enormously more important). These linguistic terms are then converted into triangular fuzzy numbers (TFNs). Based on expert judgments, a fuzzy pairwise comparison matrix represents the preferences among criteria by applying Eq. 1.

$$\tilde{A}^k = \begin{bmatrix} \tilde{a}_{11}^k & \tilde{a}_{12}^k & \dots & \tilde{a}_{1n}^k \\ \tilde{a}_{21}^k & \tilde{a}_{22}^k & \dots & \tilde{a}_{2n}^k \\ \dots & \dots & \dots & \dots \\ \tilde{a}_{m1}^k & \tilde{a}_{m2}^k & & \tilde{a}_{mn}^k \end{bmatrix} \tag{1}$$

The expert evaluations are calculated using Eq. 2, and the derived matrix is presented in the form of Eq. 3.

$$\tilde{\alpha}_{ij} = (\tilde{\alpha}_{ij}^{k} \otimes \tilde{\alpha}_{ij}^{k} \dots \otimes \tilde{\alpha}_{ij}^{k})^{1/k} \tag{2}$$

$$\tilde{A} = \begin{bmatrix} \tilde{a}_{11} & \tilde{a}_{12} & \dots & \tilde{a}_{1n} \\ \tilde{a}_{21} & \tilde{a}_{22} & \dots & \tilde{a}_{2n} \\ \dots & \dots & \dots & \dots \\ \tilde{a}_{m1} & \tilde{a}_{m2} & & \tilde{a}_{mn} \end{bmatrix} \tag{3}$$

Step 2: Construct the aggregated fuzzy comparison matrix
The geometric mean values and fuzzy weights of the criteria are calculated following the method proposed by Hsieh *et al*. (2004).

$$\tilde{r}_i = \left(\prod_{j=1}^{n} \widetilde{a_{ij}} \right)^{1/n} \tag{4}$$

$$\widetilde{w}_i = \tilde{r}_i \cdot \left(\sum_{i=1}^{n} \tilde{r}_i \right)^{-1} \tag{5}$$

In this context, $\tilde{\alpha}ij$ represents the relative importance of criterion i over criterion j, and $\tilde{r}$ i denotes the geometric mean of criterion i. $\widetilde{w}$i is the fuzzy weight of criterion i, expressed as a triangular fuzzy number (TFN)

Step 3: Defuzzification
The center of area (COA) method is employed to determine the Best Non-fuzzy Performance (BNP) value for each factor.

$$BNP = \frac{(U_{wi} - L_{wi}) + (M_{wi} - L_{wi})}{3} + L_{wi} \tag{6}$$

Step 4: Calculate the consistency ratio of the matrix
The consistency index (CI) for the comparison matrix can be calculated using the following equation:

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (7)$$

If the consistency ratio (CR) of the comparison matrix is equal to or less than 0.1, the judgments are acceptable. If CR > 0.1, the pairwise comparisons should be repeated.

Fuzzy TOPSIS Method

The Fuzzy Technique for Order Preference by Similarity to Ideal Solution (FTOPSIS), developed by Hwang and Yoon (1981) is an MCDM method based on distances from positive (PIS) and negative ideal solutions (NIS). The FTOPSIS method consists of the following steps:

Step 1: Construct the fuzzy decision matrix

This study adopts the definitions of linguistic variables proposed by Hsieh *et al*. (2004). Then, expert evaluation results are aggregated using the Eqs. 8-11:

$$\tilde{D} = \begin{array}{c c} & \begin{array}{ccc} C_1 & C_2 & \dots C_n \end{array} \\ \begin{array}{c} A_1 \\ A_1 \\ \vdots \\ A_1 \end{array} & \begin{bmatrix} \tilde{a}_1 & \tilde{a}_{12} & \dots\ \tilde{a}_{1n} \\ \tilde{a}_{21} & \tilde{a}_{22} & \dots\ \tilde{a}_{2n} \\ \dots & \dots & \dots \\ \tilde{a}_{m1} & \tilde{a}_{m2} & \tilde{a}_{mn} \end{bmatrix} \end{array} \quad (8)$$

i= 1,2, …,m;j = 1,2…,n

$$\tilde{a}_{ij}\ \frac{1}{K}\ (\tilde{a}_{ij}^{-1} \oplus \dots \oplus \tilde{a}_{ij}^{k} \dots \oplus \tilde{a}_{ij}^{K} \quad (9)$$

Where $\tilde{a}_{ij}^{k}$ is the rating of alternative A_i with respect to criterion Cj evaluated by the kth expert.

$$\tilde{a}_{ij}^{k} = (l_{ij}^{k}, m_{ij}^{k}, u_{ij}^{k}) \quad (10)$$

Step 2: Normalize the fuzzy decision matrix

$\tilde{R}$ is calculated as shown in Eq. 12.

$$\tilde{R} = [\widetilde{r_{ij}}]_{mxn}\ i= 1,2\ \dots,\ m;j=1,2,\dots n \quad (11)$$

The normalization process is performed according to Eq. 12

$$\widetilde{r_{ij}} = \left(\frac{l_{ij}}{u_{ij}}, \frac{m_{ij}}{u_{ij}}, \frac{u_{ij}}{u_{ij}}\right),\ u_j^{+} = \max\ \{u_{ij}/i=1,2\dots n\} \quad (12)$$

Step 3: Calculate the fuzzy-weighted normalized decision matrix

To normalize the weighted decision matrix, Eq. 13 is used

$$\tilde{V} = [\widetilde{v_{ij}}]_{nxn},\ i=1,2,\dots,m;j=1,2\dots,\ n \quad (13)$$

$$\text{Where}\quad \widetilde{v_{ij}} = \widetilde{r_{ij}} \otimes \widetilde{w_j} \quad (14)$$

Step 4: Determine the fuzzy positive ideal solution (FPIS) and fuzzy negative ideal solution (FNIS)

Accordingly, the FPIS is defined as A+, and the FNIS is defined as A−. The corresponding formulas are presented in Eqs. 15 and 16

$$A^+ = (\widetilde{v_1^+}, \ldots \widetilde{v_j^+}, \ldots \widetilde{v_n^+}) \quad (15)$$

$$A- = (\widetilde{v_1^-}, \ldots \widetilde{v_j^-}, \ldots \widetilde{v_n^-}) \quad (16)$$

Where $\widetilde{v_j^+} = (1,1,1) \otimes \widetilde{w_j} = (lwj, mwj, uwj)$ and $\widetilde{v_j^-} = (0,0,0)$, j=1,2,…n
Step 5: Calculate the distances and closeness coefficients
The distances d($\widetilde{d_i^+}$ and $\widetilde{d_i^-}$) of each alternative from A+ and A−, respectively, can be calculated using Eqs. 17-19

$$D(\tilde{A}_1, \tilde{A}_2) = \sqrt{\frac{1}{3}[(l_1 - l_2)^2 + (m_1 - m_2)^2 + (u_1 - u_2)^2]} \quad (17)$$

$$\widetilde{d_i^+} = \sum_{j=1}^{n} d(\widetilde{v_{ij}}, \widetilde{v_j^+}),\ I = 1,2,\ldots, m;\ j = 1,2,\ \ldots n \quad (18)$$

$$\widetilde{d_i^-} = \sum_{j=1}^{n} d(\widetilde{v_{ij}}, \widetilde{v_j^-}),\ I = 1,2,\ldots, m;\ j = 1,2,\ \ldots n \quad (19)$$

The closeness coefficient is then determined, allowing the alternatives to be ranked so that the decision-maker can select the most appropriate option. Eq. 20 shows the calculation of the closeness coefficient.

$$CC_i = \frac{\widetilde{d_i^-}}{\widetilde{d_i^+} + \widetilde{d_i^-}} = 1 - \frac{\widetilde{d_i^+}}{\widetilde{d_i^+} + \widetilde{d_i^-}},\ i=1,2,\ldots m \quad (20)$$

Where $\frac{\widetilde{d_i^-}}{\widetilde{d_i^+} + \widetilde{d_i^-}}$ represents the fuzzy satisfaction level of alternative i, and $\frac{\widetilde{d_i^+}}{\widetilde{d_i^+} + \widetilde{d_i^-}}$, represents the fuzzy distance from the ideal solution for alternative i.
Based on the above formula, the alternative with the highest CCi is selected as the optimal choice.

Results and Discussion

Basic Information of the Research Sample

Twenty experts participated in the study, including university academics, tourism organizations, and hospital managers involved in providing medical tourism services. Five returned questionnaires were deemed invalid and returned to the experts for revision. Four responses were excluded from the analysis, as the experts declined to revise their answers. Therefore, the findings of this study are based on valid responses from 16 experts. **Table 2** presents the background information of the participating experts.

Table 2. Background information of the participating experts

No	Position	Academic Qualification	Years of Experience	Organization Type
1	Lecturer	PhD	14	University
2	Lecturer	Professor, PhD	18	University
3	Director	Master's degree	12	Tourism enterprises
4	Deputy Director	Bachelor's degree	14	Tourism enterprises
5	Director	Master's degree	19	Hospital
6	Director	Bachelor's degree	20	Hospital
7	Deputy Head	Master's degree	15	Tourism organization
8	Specialist	PhD	15	Tourism organization
9	Specialist	Bachelor's degree	13	Tourism organization

10	Deputy Head of Department	Master's degree	10	Hospital
11	Head of Department	Bachelor's degree	12	Hospital
12	Head of Department	PhD	15	University
13	Deputy Head of Department	PhD	18	University
14	Head of Department	PhD	12	University
15	Deputy Editor-in-Chief	Associate Professor, PhD	12	Journal, University
16	Head of Department	PhD	16	University

FAHP Analysis Results

Based on the aggregated pairwise comparisons of the five criteria, the authors applied the geometric mean method to calculate the elements of the fuzzy pairwise comparison matrix, as shown in Eq. 2.

$$\tilde{\alpha}_{ij} = (\tilde{\alpha}^1_{ij} \otimes \tilde{\alpha}^2_{ij} \ldots \otimes \tilde{\alpha}^{16}_{ij})^{1/16} \tag{21}$$

Taking $\tilde{\alpha}$ 12 as an example, since the experts rated the importance of criteria C1 and C2 within the range of 3 to 8, we have:

$$\begin{aligned}\tilde{\alpha}_{12} &= (2,3,4) \otimes (3,4,5) \otimes \ldots \otimes (7,8,9)^{1/16} = ((2\times3\times\ldots\times7)^{1/16}, (3\times4\times\ldots\times8)^{1/16}, (4\times5\times\ldots\times9)^{1/16}) \\ &= (1.2,\ 1.55, 1.91)\end{aligned} \tag{22}$$

The next step is to aggregate the elements of the fuzzy pairwise comparison matrix, as shown in **Table 3**.

Table 3. TFN-based comparison matrix of criteria

	C1	**C2**	**C3**	**C4**	**C5**
C1	(1.0, 1.0, 1.0)	(1.21, 1.55, 1.91)	(0.86, 1.05, 1.32)	(0.8, 1.07, 1.48)	(1.71, 2.08, 2.47)
C2	(0.52, 0.65, 0.83)	(1.0, 1.0, 1.0)	(0.77, 0.97, 1.24)	(0.4, 0.49, 0.61)	(0.49, 0.6, 0.73)
C3	(0.76, 0.95, 1.17)	(0.81, 1.04, 1.29)	(1.0, 1.0, 1.0)	(0.93, 1.12, 1.39)	(0.57, 0.7, 0.84)
C4	(0.68, 0.93, 1.24)	(1.65, 2.03, 2.47)	(0.72, 0.89, 1.07)	(1.0, 1.0, 1.0)	(0.57, 0.7, 0.87)
C5	(0.4, 0.48, 0.59)	(1.36, 1.67, 2.04)	(1.19, 1.44, 1.74)	(1.14, 1.43, 1.74)	(1.0, 1.0, 1.0)

To compute fuzzy weights, the geometric mean ($\tilde{r}$ i)for each criterion is first calculated using Eq. 4. The value $\tilde{r}$ 1 is provided as an example.

$$\begin{aligned}\tilde{r}_1 &= (\tilde{\alpha}11 \otimes \tilde{\alpha}12 \otimes \tilde{\alpha}13 \otimes \tilde{\alpha}14 \otimes \tilde{\alpha}15)^{1/5} \\ &= ((1\times2.21\times\ldots\times1.71)^{1/5}, (1\times1.55\times\ldots\times2.08)^{1/5}, (1.91\times\ldots\times 2.47)^{1/5}) \\ &= (1.07, 1.29, 1.56)\end{aligned} \tag{23}$$

The fuzzy weight of each factor ($\tilde{w}$i) is calculated using Eq. 5. The value of $\tilde{w}$1 is provided as an example

$$\begin{aligned}\tilde{w}_1 &= \tilde{r}_1 \otimes [\ \tilde{r}3 \oplus \tilde{r}2 \oplus \tilde{r}4 \oplus\ \tilde{r}5)^{-1} \\ &= ((1.07, 1.29, 1.56) \otimes (1/1.07+\ldots+0.94), 1/(1/1.29+\ldots+1.11), 1/(1.56+\ldots+1.29)) \\ &= (0.25, 0.36, 0.27)\end{aligned} \tag{24}$$

By applying the COA method, the Best Non-fuzzy Performance (BNP) value of the fuzzy weight for each criterion can be calculated. Taking criterion C1 as an example, the BNP value is computed based on Eq. 6 as follows.

$$BNP = \frac{[(0.36-0.18)+(0.25-0.18)]}{3} + 0.18 = 0.27 \quad (25)$$

After obtaining the crisp weights through the BNP values, **Table 4** presents the fuzzy weights and the corresponding defuzzified values for the evaluation criteria of medical tourism services. The consistency ratio was calculated using Eq. 7, and the results are as follows:

λmax=5.21, CI=0.05, with n=5, RI=1.12, λmax=5.21, CI=0.05, with n=5, RI = 1.12 CR = CI/RI = 0.05 <0.1. Therefore, the consistency of the matrix is acceptable.

The calculated fuzzy weights and their corresponding defuzzified BNP values for each evaluation criterion are summarized in **Table 4**.

Table 4. Summary of fuzzy weights and defuzzified BNP values

Criteria	r (l,m,u)	w (l,m,u)	BNP (defuzzified)	Normalized Defuzzified Values
Medical Expertise and Quality (C1)	(1.07, 1.29, 1.56)	(0.18, 0.25, 0.36)	0.27	0.26
Cost and Economic Efficiency (C2)	(0.6, 0.71, 0.86)	(0.1, 0.14, 0.2)	0.15	0.14
Supporting Tourism Infrastructure (C3)	(0.8, 0.95, 1.12)	(0.13, 0.19, 0.26)	0.19	0.18
Tourism Integration Potential (C4)	(0.86, 1.03, 1.24)	(0.14, 0.2, 0.29)	0.21	0.20
Market Demand (C5)	(0.94, 1.11, 1.29)	(0.16, 0.22, 0.3)	0.23	0.22

The criterion "Medical Expertise and Quality" (C1) has the highest weight, with a normalized defuzzified value of 0.26. The criteria "Market Demand" (C5) and "Tourism Integration Potential" (C4) have normalized weights of 0.22 and 0.20, respectively. "Supporting Tourism Infrastructure" (C3) has a normalized weight of 0.18. In contrast, the criterion "Cost and Economic Efficiency" (C2) has the lowest normalized weight at 0.14.

TOPSIS Analysis Results

Eqs. 8- 14 to get the aggregated fuzzy decision matrix. The fuzzy FPIS, denoted as A+, and FNIS, denoted as A−, are determined using Eqs. 15 and 16, as follows:

A+ = [(1,1,1), (1,1,1), (1,1,1), (1,1,1), (1,1,1),] $\otimes \tilde{w}j$
= [(1,1,1), (1,1,1), (1,1,1), (1,1,1), (1,1,1),] $\otimes$ [(0.18, 0.25, 0.36), (0.10, 0.14, 0.20), (0.13, 0.19, 0.26), (0.14, 0.20, 0.29), (0.16, 0.22, 0.30)]
= (0.18, 0.25, 0.36), (0.10, 0.14, 0.20), (0.13, 0.19, 0.26), (0.14, 0.20, 0.29), (0.16, 0.22, 0.30) (26)

A- = (0, 0, 0), (0, 0, 0), (0, 0, 0), (0, 0, 0), (0, 0, 0) (27)

By applying Eqs. 17-19, the distance matrices d− and d+ are obtained, as shown in **Table 5**.

Table 5. Distance matrix to the fuzzy positive and negative ideal solution

	A	B	C	D	E	d+
T1	0.08	0.05	0.06	0.06	0.07	0.32
T2	0.08	0.05	0.05	0.05	0.05	0.27
T3	0.05	0.05	0.04	0.05	0.05	0.24
	A	**B**	**C**	**D**	**E**	**d-**
T1	0.21	0.12	0.15	0.18	0.18	0.85

T2	0.22	0.13	0.15	0.19	0.20	0.89
T3	0.24	0.13	0.15	0.18	0.21	0.91

The final step is to estimate the ranking and performance of the alternative options. The closeness coefficient is calculated as follows (using Model T1 as an example):

$$d_1^+ = 0.32;\ d_1^- = 0.85 \tag{28}$$

The closeness coefficient can be calculated using Eq. 20. Accordingly, the closeness coefficientCC_{T1} for the first alternative (T1) is computed as follows:

$$CC_{T1} = \frac{0.85}{0.32 + 0.85} = 0.73 \tag{29}$$

Table 6. Closeness coefficients and priority ranking of medical tourism service

Type of Medical Tourism Service	Closeness Coefficient (CC)	Priority Level
Western Medicine (T1)	0.73	3
Traditional Medicine (T2)	0.76	2
Rehabilitation Services (T3)	0.79	1

The calculation results for the three types of medical tourism services in **Table 6** show that Rehabilitation (T3) has the highest closeness coefficient (CC = 0.79). Traditional Medicine (T2) ranks second, with a CC = 0.76. In contrast, Western Medicine (T1) has the lowest closeness coefficient (CC = 0.73).

Discussion of Results

The ranking results of the three medical tourism service types using the integrated FAHP–TOPSIS model indicate that Rehabilitation Services (T3) are the highest-priority area for development in the context of medical tourism in Vietnam, followed by Traditional Medicine (T2) and Western Medicine (T1). These findings indicate a shift from focusing on technical treatment capabilities to integrated healthcare with the cultural and wellness experiences of the medical tourism market.

Firstly, the high weights assigned to the criteria groups "Tourism Integration Potential" and "Market Demand" suggest that while medical expertise remains a core component (Guru *et al*., 2023; Thazha *et al*., 2023), it is no longer the sole driver in selecting medical tourism service types. As emphasized by Fakur *et al*. (2025), integrating medical treatment with experiential elements—such as wellness tourism and local cultural immersion—is a strongly emerging trend, particularly in the post-pandemic period.

The Rehabilitation Services model (T3) holds significant advantages due to its compatibility with wellness tourism, natural health care, and the growing demand for post-COVID-19 recovery treatments. This result aligns with Wu *et al*. (2022), who emphasized supporting tourism infrastructure—such as accommodation and transportation—in enhancing the perceived value of integrated medical–tourism services. Furthermore, Ghasemi *et al*. (2021) also asserted that the connection between medical services and tourism infrastructure is a prerequisite for improving a destination's competitive advantage.

Secondly, the ranking of Traditional Medicine (T2) highlights the role of cultural embeddedness, cost-effectiveness, and a high degree of local authenticity in medical tourism services. This finding is consistent with Shahijan *et al*. (2015) while emphasizing the role of brand recognition and alignment with international consumer preferences in shaping medical service selection behavior.

In contrast, the Western Medicine model (T1) ranks lowest, suggesting that medical proficiency alone—without accompanying service experience and tourism integration—may struggle to generate a distinctive competitive

advantage in international competition. This aligns with Wu *et al*. (2016), who argue that hospitals' intrinsic quality must be expanded into a holistic experience to meet the expectations of medical tourists.
Finally, the criterion “Cost and Economic Efficiency” received the lowest weight in the FAHP system, reflecting a shift in value perception from “low cost” to “value-added” in the selection of international medical services (Ghasemi *et al*., 2021; Savva *et al*., 2023). Sustainable competitive advantage no longer lies in offering the cheapest services but in the ability to deliver integrated, personalized, and healing-oriented medical tourism experiences

Conclusion

This study proposed and implemented an integrated FAHP–TOPSIS model to evaluate and prioritize different types of medical tourism services for development in Vietnam. By constructing a framework consisting of five main criteria groups and incorporating expert assessments based on fuzzy set theory, the results indicate that Rehabilitation Services (T3) are the top-priority option. Traditional Medicine (T2) ranks second and Western Medicine (T1), despite its strong clinical foundation, ranks lowest in priority.
Based on the findings, key policy recommendations include prioritizing rehabilitation–wellness tourism in areas with natural advantages, and promoting integrated healthcare-tourism models with professional training. Traditional medicine should be positioned as a “wellness and heritage” product by combining natural therapies with cultural experiences. A cross-sector medical tourism ecosystem should be developed through coordinated efficiency among ministries and local authorities. Finally, research on tourist behavior and demand must be strengthened to enhance service design and boost Vietnam’s competitiveness in regional medical tourism.
By combining quantitative analysis through a multi-criteria decision-making (MCDM) model with a solid theoretical foundation from previous studies, this research contributes a scientific evaluation tool to support planning and policymaking for the development of medical tourism in Vietnam. The results offer not only practical value in the post-COVID-19 context but also a foundation for future applied research across regions, target groups, or specific service models.

Limitations and Dimensions for Future Research
Although this study successfully proposed and implemented an integrated FAHP–TOPSIS model to evaluate the priority levels of medical tourism service types in Vietnam, several limitations remain and should be acknowledged. First, the number of experts participating was relatively limited and mainly drawn from the fields of healthcare, tourism, and service management. Second, this study focused only on three representative types of medical services: Western medicine, traditional medicine, and rehabilitation. Finally, the study remains at a national level and has not explored regional or subregional comparisons. Based on the limitations, the directions for future research should be considered: Expand the expert sample to include international medical tourists, investors, and insurance organizations. Additional specialized medical services. Apply the model at regional or local levels to develop strategies that align with each area's specific natural conditions, socio-cultural characteristics, and local capacities.

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