Original Article

A Fuzzy BWM-TOPSIS Framework for Identifying and Prioritizing Measures to Overcome Obstacles to the Regionalization of Iranian Healthcare Services

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Abstract

Background: One of the most effective strategies to improve the access of community members to health services is to regionalize health services. The purpose of this study is to examine and prioritize measures that could help to counteract obstacles and problems in implementing the regionalization of healthcare in Iran. **Methods:** The study relied on a mixed research method, including qualitative and quantitative phases. First, by conducting semi-structured interviews and analyzing them through qualitative content analysis, the obstacles and measures were identified. In the quantitative phase, the obstacles identified were weighted using the fuzzy best-worst method (FBWM), and the measures were then prioritized through the fuzzy TOPSIS (FTOPSIS) method. **Results:** The obstacles were categorized into four main dimensions: "infrastructural," "political," "human resources," and "managerial." Among the 15 obstacles identified, "absence of performance guarantees" was the most important obstacle, while "insufficient education" was the least important obstacle to the regionalization of healthcare services in Iran. Meanwhile, the following eight measures that could help to overcome the obstacles were extracted from the interviews: "conducting a needs assessment," "providing clinical guidelines," "employing specialized human resources," "reinforcing the referral system," and "preparing electronic health records," "enhancing education and information dissimilation," "building executive support," and "providing cost-effective equipment and technology." "Employing specialized human resources" was also the most effective measure to overcome the obstacles. **Conclusions:** Iranian healthcare policy-makers can use the empirical findings of this investigation to accelerate the implementation of Iran's regionalization plan to improve the access of community members to healthcare services.

Keywords: *Fuzzy best-worst method, fuzzy TOPSIS, medical services, regionalization*

Introduction

Providing access to healthcare services represents one of the crucial aspects of a functional healthcare system. The indisputable significance of facilitating services to communities of people has been a criterion for evaluating the functionality of health policy.[1-3] However, access to health services is a complex concept; generally speaking, it can be defined as individuals' or communities' right to access a specific service, provider, or institution to address their medical needs.[4] Despite the significant growth of health indicators at the national level, there is marked inequality between social groups and geographical areas in terms of their access to healthcare services.[5] Numerous studies have shown that there are problems making it difficult for people to access healthcare services in different parts of Iran.[6] Accordingly, one of the main goals of policy-makers in the health sector of every country is to facilitate access to healthcare services so that all segments of society can effectively benefit from such services.[6] One of the most effective ways to improve people's access to health services is to adopt rationing policies or *regionalization* of health services.[7,8] The World Health Organization defines regionalization as the rational distribution of healthcare across a country in a process that ensures the availability and cost-effectiveness of services/facilities at all healthcare levels (primary, secondary and tertiary).[8]

As such, regionalization helps to achieve better health-related conditions while providing full access to the healthcare network at regional/local levels by

How to cite this article: Zare Z, Haqbin A, Kalavani K, Shojaei P. A fuzzy BWM-TOPSIS framework for identifying and prioritizing measures to overcome obstacles to the regionalization of Iranian healthcare services. Int J Prev Med 2023;14:55.

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Access this article online

Website: www.ijpvmjournal.net/www.ijpm.ir

DOI: 10.4103/ijpvm.ijpvm_114_22

Quick Response Code:

decentralizing geographical areas and concentrating healthcare activities within a unified structure.[7,9] In addition, the regionalization of healthcare services arranges healthcare units/facilities in a way that would improve access to the range of services available to the public, at the lowest cost and with the best quality.[10]

Of course, the successful implementation of regionalization plans, as practiced in some countries such as Canada, Brazil, and the United Kingdom,[9] demands several basic requirements. The most fundamental concerns are specifying the responsibility of each facility and its sub-units, matching supply with people's demand (needs assessment), building a referral system, managing a continuous flow of mutually shared information, establishing scientific and technical support mechanisms, designing a proper organizational arrangement, and establishing partnerships between health professionals and technicians.[11,12]

In this process, it would be extremely important to prioritize the requirements for the implementation of regionalization by using scientific and effective methods to formulate policy interventions and practical procedures. One of the frequently used prioritization methods is multi-criteria decision-making (MCDM). From a scientific perspective, MCDM models explore problems in which the number of alternatives is already determined, and the decision-maker selects, prioritizes, and ranks a limited number of alternatives.[13]

The purpose of this study is to identify and prioritize the obstacles to the regionalization of healthcare plans while finding and prioritizing measures that could help to overcome the obstacles in Iran. Although the issues of stratification and regionalization of healthcare services have surfaced in Iran in recent months, regionalization has not yet been fully accomplished in the country. Meanwhile, no study has focused on the prioritization of the measures that could contribute to the implementation of the regionalization plan in Iran. Therefore, this research seeks to prioritize both the obstacles to the implementation of this plan and the measures to overcome the obstacles in Iran.

Methods

The primary purpose of this study was to prioritize the potential measures to counteract the obstacles to the regionalization of healthcare services in Iran. To accomplish this, the study relied on a mixed research design composed of both qualitative and quantitative phases. The methodology of this study is based on qualitative content analysis and soft operations research techniques. Each method is regulated and referred to as a valid reference.

Primarily, in the qualitative phase, the obstacles and the measures were identified through semi-structured interviews with 21 experts selected through the purposeful sampling method [Table 1]. The experts were selected based on their experience in the management and policy-making of health systems and their rich background of valid research in the field of regionalization of health services.

The content of the obtained interviews was then analyzed in MaxQDA 10.1 software according to the following steps suggested by Mayring[14]: identifying and collecting data, determining coding categories, checking validity and reliability, and presenting the results.

The entire content was broken into categories that simplified the analysis and contributed to the manageability of the content. In doing so, primarily, the interviews were transcribed, and the resultant texts were inspected several times so that they could be holistically understood. Next, following an informed understanding of the texts, codes were assigned to the keywords and phrases reflecting the participants' opinions. The coding procedure was examined and reviewed several times in joint sessions, and the content of the interviews was categorized based on conceptual similarities and differences through a focus group discussion.

Then, to measure the validity and reliability, the four criteria proposed by Guba and Lincoln were used: credibility, transferability, dependability, and confirmability. These factors ensured the validity, accuracy, and reliability of the qualitative data.[15] To include various experts, maximum variation sampling was used. The voice-recorded interviews were meticulously analyzed, while notes were taken during each interview session. The codes extracted from the interviews were submitted to the participants who evaluated the ideas. After implementing the corrections suggested by the participants, the codes were finally confirmed. To increase the transferability factor, highly experienced managers/specialists from various fields of specialty were included. Of course, many of the findings obtained from the interviews were already confirmed in other studies.

To verify the reliability, the interviews were separately coded by two analysts and were accurately compared with the codes observed by the research team. The findings were also monitored by experts in qualitative research. As the three criteria mentioned above were precisely controlled, it could be argued that confirmability was automatically established as well. After the analysis, several sets of information were organized and stored as a file. Next, it was necessary to present the findings in the form of a report that could be easily understood by readers. In doing so, the researchers reviewed the final results, identified possible patterns, sorted all the information sequentially, and finally prepared a full report.

In the next phase, the obstacles and the measures identified were further analyzed quantitively through MCDM methods in a fuzzy environment. The weights of the

Table 1: The experts' panel

Expert	Responsibility	Educational background	Experience (year)
E1	Hospital administrators	Ph.D. in Healthcare Management	4
E2	Hospital administrators	Medical Doctor	6
E3	Hospital administrators	Medical Doctor	2
E4	Hospital administrators	Ph.D. in Healthcare Management	3
E5	Hospital administrators	MS.C. in Healthcare Management	8
E6	Hospital administrators	MS.C. in Healthcare Management	3.5
E7	Hospital manager	Medical Doctor	6
E8	Hospital manager	Medical Doctor	2
E9	Hospital manager	Ph.D. in Healthcare Management	5
E10	Hospital manager	Medical Doctor	3
E11	Deputy of treatment	MS.C. in Healthcare Management	3
E12	Deputy of treatment	Medical Doctor	4
E13	Director of regionalization	MS.C. in Healthcare Management	3
E14	Director of regionalization	MS.C. in Healthcare Management	2
E15	Regionalization expert	Ph.D. in Management	16
E16	Regionalization expert	Ph.D. in Management	10
E17	University professor	Ph.D. in Healthcare Management	7
E18	University professor	Ph.D. in Healthcare Management	13
E19	University professor	Ph.D. in Healthcare Management	12
E20	University professor	Medical Doctor	8
E21	University professor	Ph.D. in Healthcare Management	10

obstacles were calculated according to the fuzzy best-worst method (FBWM) processed in LINGO 18 software. Then, the measures were prioritized according to the fuzzy TOPSIS (FTOPSIS) technique. To collect data, copies of a questionnaire were submitted to six of the panel experts who were more familiar with regionalization. Below, the FBWM and FTOPSIS are explained in more detail.

Fuzzy best-worst method (FBWM)

The best-worst method was developed by Rezaei[16] for the first time. This method benefits from fewer pairwise comparisons and more consistent results compared to other weighting techniques.[16] However, to cope with the vagueness and uncertainty of the decision-making environment, Guo and Zhao[17] integrated the classic BWM with fuzzy set theory to reduce ambiguities in the experts' judgments and to obtain more reliable results. According to Guo and Zhao,[17] the steps of Fuzzy BWM are as follows:

Step 1. First, a set of decision criteria will be determined, which are depicted as $\{C_1, C_2,\ldots, C_n\}$. Then, the best (most important and most desirable) and worst (least important or least desirable) criteria will be identified. The best criterion is C_B, whereas the worst criterion is C_W.

Step 2. Next, the preference of the best criterion in comparison to other criteria will be determined according to the linguistic scale mentioned in Guo and Zhao[17] from equally important to absolutely important. The best-to-others vector is depicted by:

$$\tilde{A}_B = (a_{B1}, a_2, ..., a_{Bn}) \quad (1)$$

where a_{Bj} indicates the preference of the best criterion (B) over criterion j, and: $a_{BB} = (1,1,1)$.

Similarly, the preference of the worst criterion compared to other criteria will be determined, and The others-to-worst vector is as follows:

$$\tilde{A}_W = (a_{1W}, a_{2W}, ..., a_{nW}) \quad (2)$$

Where a_{jW} indicates the preference of criterion j over the worst criterion (W). Needless to say: $a_{ww} = (1,1,1)$

Step 3. Then, the optimal weights $\left(\tilde{w}_1^*, \tilde{w}_2^*, \ldots, \tilde{w}_n^*\right)$ will be found. To calculate the optimal weights of each criterion, the following model must be solved.

$$\min \max_j \left\{ \left| \frac{\tilde{W}_B}{\tilde{W}_j} - \tilde{a}_{B_j} \right|, \left| \frac{\tilde{W}_j}{\tilde{W}_W} - \tilde{a}_{j_W} \right| \right\}$$

$$\text{s.t.} \begin{cases} \sum_{j=1}^{n} R\left(\tilde{W}_j\right) = 1 \\ l_j^w \le m_j^w \le u_j^w \\ l_j^w \ge 0 \\ j = 1, 2, \ldots, n \end{cases} \quad (3)$$

To solve the above-mentioned model, it can be transformed into the following nonlinearly constrained optimization model, where $\tilde{\varepsilon}$ is also a TFN.

$$\min \ \tilde{\varepsilon}$$

$$\text{s.t.}\begin{cases}\left|\dfrac{\tilde{W}_B}{\tilde{W}_j}-\tilde{a}_{B_j}\right|\le\tilde{\varepsilon}\\ \left|\dfrac{\tilde{W}_j}{\tilde{W}_W}-\tilde{a}_{j_W}\right|\le\tilde{\varepsilon}\\ \sum_{j=1}^{n}R\left(\tilde{W}_j\right)=1\\ l_j^w\le m_j^w\le u_j^w\\ l_j^w\ge 0\\ j=1,2,\ldots,n\end{cases}\tag{4}$$

Since $l^\varepsilon \le m^\varepsilon \le u^\varepsilon$, it can be assumed that $\tilde{\varepsilon}^*=(k^*,k^*,k^*)$ and $k^*\le l^\varepsilon$. Thus, the model can also be transformed to:

$$\min\ \tilde{\varepsilon}^*$$

$$\text{s.t}\begin{cases}\left|\dfrac{\left(l_B^w,m_B^w,u_B^w\right)}{\left(l_j^w,m_j^w,u_j^w\right)}-\left(l_{Bj},m_{Bj},u_{Bj}\right)\right|\le\left(k^*,k^*,k^*\right)\\ \left|\dfrac{\left(l_j^w,l_j^w,u_j^w\right)}{\left(l_W^w,m_W^w,u_W^w\right)}-\left(l_{jW},m_{jW},u_{jW}\right)\right|\le\left(k^*,k^*,k^*\right)\\ \sum_{j=1}^{n}R\left(\tilde{W}_j\right)=1\\ l_j^w\le m_j^w\le u_j^w\\ l_j^w\ge 0\\ j=1,2,\ldots,n\end{cases}\tag{5}$$

By solving the model in Eq. (7), the optimal weights $\left(\tilde{w}_1^*,\tilde{w}_2^*,\ldots,\tilde{w}_n^*\right)$ will be determined.

Step 4. Finally, the consistency of the model must be calculated. The consistency ratio (CR) is a significant index to evaluate the consistency degree of the pairwise comparison. According to Rezaei,[16] models with a CR, less than 0.1, are considered consistent. For the steps of calculating the CR, readers can refer to Guo and Zhao.[17]

Fuzzy TOPSIS (FTOPSIS)

Being one of the inveterate multicriteria decision-making techniques, TOPSIS was first developed by Hwang and Yoon.[18] The foundation of TOPSIS is based on the concept that the best alternative should have the shortest distance from the positive ideal solution (PIS) and the farthest from the negative ideal solution (NIS). Similar to BWM, in the classic TOPSIS, the experts express their judgment using crisp values. However, to increase the reliability of the results, the fuzzy set theory could be integrated by TOPSIS. In the following, the steps of Fuzzy TOPSIS proposed by Patil and Kant[19] are explained:

Step 1. First, a linguistic scale for rating the alternative with respect to criteria must be selected. To this end, suppose there are m alternatives called A = $\{A_1,A_2,...,A_m\}$ and n criteria, C = $\{C_1,C_2,...,C_n\}$. Also, the weights of each criterion are shown by W_j(j = = 1, 2.,n), and the performance ratings of each expert are D_k (K = 1, 2., k) A_i (i = 1, 2,…, m) with respect to criteria C_j (j = 1, 2., n) are shown by $\tilde{R}_k=\tilde{X}_{ijk}(i=1,2,..,m;j=1,2,\ldots,n;k=1,2,\ldots,k)$ membership function $\mu\tilde{R}k(x)$. The linguistic scale for rating the alternatives is mentioned in Patil and Kant[19] from very poor to very good.

Step 2. In the Next step, the aggregated fuzzy ratings for all the alternatives must be calculated. Assume the fuzzy ratings of all experts are described as TFN $\tilde{R}_k=(ak,bk,ck)$, k = 1, 2,…,k then the aggregated fuzzy rating is given by $\tilde{R}_k=(a,b,c)$, k = 1,2,…,k where,

$$a=\min_k\{a_k\},b=\frac{1}{k}\Sigma_{(k=1)}^{k}b_k,c=\max_k\{C_K\}\tag{6}$$

Step 3. After aggregating the fuzzy ratings for all the experts, the fuzzy decision matrix will be developed. The fuzzy decision matrix for the alternatives ($\tilde{D}$) is as follows

$$\tilde{D}=\begin{array}{c}\\A_1\\A_2\\\vdots\\A_M\end{array}\begin{array}{c}\begin{array}{cccc}C_1&C_2&\cdots&C_n\end{array}\\\begin{bmatrix}\tilde{x}_{11}&\tilde{x}_{12}&\cdots&\tilde{x}_{1n}\\\tilde{x}_{21}&\tilde{x}_{22}&\cdots&\tilde{x}_{2n}\\\vdots&\vdots&\ddots&\vdots\\\tilde{x}_{m1}&\tilde{x}_{m2}&\cdots&\tilde{x}_{mn}\end{bmatrix}\end{array}\tag{7}$$

Step 4. The constructed fuzzy decision matrix then must be normalized to bring all the criteria scales into a comparable one. The normalized fuzzy decision matrix $\tilde{R}$ is calculated according to linear scale transformation as follows:

$$\tilde{R}=\left[r_{ij}\right]m\times n,\ i=1,2,..,m;\ j=1,2,\ldots,n\tag{8}$$

Also:

$$\tilde{r}_{ij}=\left(\frac{a_{ij}}{c_j},\frac{b_{ij}}{c_j},\frac{c_{ij}}{c_j}\right)\text{ and }c_j=\max_i C_{ij}\ (\text{benefit criteria})\tag{9}$$

$$\tilde{r}_{ij}=\left(\frac{a_j}{c_{ij}},\frac{a_j}{b_{ij}},\frac{a_j}{a_{ij}}\right)\text{ and }a_j=\min_i a_{ij}\ (\text{cost criteria})\tag{10}$$

Step 5. Next, the weighted normalized matrix must be calculated by multiplying the weights (W_j) of the criteria with the normalized fuzzy decision matrix as follows:

$$\tilde{V}=\left[\tilde{v}_{ij}\right]m\times n,\ i=1,2,..,m;\ j=1,2,\ldots,n\quad\text{where }\tilde{v}_{ij}=\tilde{r}_{ij}(.)W_j\tag{11}$$

Note that V_{ij} is a TFN shown by $\left(\tilde{a}_{ijk},\tilde{b}_{ijk},\tilde{c}_{ijk}\right)$.

Step 6. The fuzzy ideal solution (FPIS) and fuzzy negative ideal solution (FNIS) must be determined as follows:

$$A^*=(\tilde{v}_{1^*},\tilde{v}_{2^*}\ldots\tilde{v}_{n^*})\text{ where }\tilde{v}_{j^*}=(\tilde{c}_{j^*},\tilde{c}_{j^*},\tilde{c}_{j^*})\text{ and }\tilde{c}_{j^*}=\max_i\{\tilde{c}_{ij^*}\}\tag{12}$$

$$A^{-} = (\tilde{v}_{\bar{1}}, \tilde{v}_{\bar{2}} \ldots \tilde{v}_{\bar{n}}) \text{ where } \tilde{v}_{\bar{j}} = (\tilde{a}_{\bar{1}}, \tilde{a}_{\bar{2}}, \tilde{a}_{\bar{j}}) \text{ and } \tilde{a}_{j^*} = \min_i \{\tilde{a}_{ij^*}\} \quad \forall i = 1, 2, \ldots, m; j = 1, 2, \ldots, n \tag{13}$$

Step 7. Afterward, the distance of each alternative from FPIS (d_{i+}) and FNIS (d_{i-}) must be determined as follows:

$$d_{i^+} = \Sigma_{j=1}^{n} dv(\tilde{v}_{ij}, \tilde{v}_{j^*}), i = 1, 2, \cdots, m \tag{14}$$

$$d_{i^-} = \Sigma_{j=1}^{n} dv(\tilde{v}_{ij}, \tilde{v}_{\bar{j}}), i = 1, 2, \cdots, m \tag{15}$$

Step 8. Finally, the closeness coefficient (CCi) for each alternative must be computed. The closeness coefficient CCi shows the distances to the fuzzy PIS (A*) and the fuzzy NIS (A^{-}) simultaneously and is determined as follows:

$$CCi = \frac{d_{i^-}}{d_{i^-} + d_{i^+}} \tag{16}$$

The alternatives can be prioritized by CCi. Higher CC means a more ideal alternative.

Ethical approval and consent to participate

The Ethical Approval Code is IR.KMU.REC.1400.528. Moreover, consent for participation was taken from the experts in written and oral form.

Results

By analyzing the content of the interviews with the experts, two themes of regionalization implementation obstacles and measures to overcome them were identified, each of which had its own category and codes [Table 2].

To calculate the weights of each obstacle through the FBWM, the four dimensions obtained from the analysis of experts' interviews were used. Meanwhile, the following eight measures that could help to overcome the obstacles were extracted from the interviews and were also listed for weighting, and finally, the study model was designed. Figure 1 illustrates the MCDM model utilized in this study.

After constructing the MCDM model, the overall weight of each obstacle was calculated through the FBWM. To this end, five separate questionnaires for pairwise comparisons (including the main dimensions and obstacles falling under each dimension) were submitted to the experts so that they could express their judgments based on the linguistics mentioned by Guo and Zhao.[17] The FBWM was developed and solved according to Eqs. (3)–(7). The consistency of each questionnaire was determined by calculating the consistency index mentioned by Guo and Zhao.[17] After ensuring that all the questionnaires were consistent, the final weight of each obstacle was computed by multiplying each measure's weight in their dimension by the weight of each dimension. Moreover, the arithmetic mean, as the most frequently used technique for aggregating individual priorities, was used to aggregate the weights specified by each expert.[20] Table 3 shows the weights of the main dimensions and their respective obstacles.

The fuzzy weights were then used to prioritize the measures through the FTOPSIS technique. To accomplish this, the experts were asked to use the linguistic scale mentioned in Patil and Kant[19] and construct their decision matrices by comparing each measure in light of the obstacles.

Then, the aggregated fuzzy decision matrix was constructed using Eq. (8). Next, the normalized fuzzy decision matrix and the weighted normalized matrix were constructed via Eqs. (9)–(13). Because all the factors were obstacles, they were "cost" elements by nature. After that, the fuzzy ideal solution (FPIS or d+) and fuzzy negative ideal solution were calculated (FNIS or d−) through Eqs. (14)–(15), the CC was computed for each alternative according to Eqs. (16)–(18). The alternatives were ultimately prioritized based on their CC measures. Table 4 shows the FPIS, FNIS, and CC values for each alternative.

As mentioned earlier, the ideal alternative had the highest CC value. Therefore, according to Table 4, the best measure to overcome the obstacles to the regionalization of healthcare services in Iran was employing specialized human resources (A3), followed by providing cost-effective equipment and technology (A8), conducting a needs assessment (A1), enhancing education and information dissimilation (A6), preparing electronic health records (A5), building executive support (A7), and reinforcing the referral system (A4). Furthermore, providing clinical guidelines (A2) was the least significant measure that could help to overcome the obstacles.

Discussion

After developing an MCDM model, the FBWM-TOPSIS method was used as a comprehensive and systematic method to determine the priorities of the obstacles to the regionalization of healthcare services, as well as the priorities of the measures to overcome these obstacles. The results of the FBWM revealed that, among the "managerial," "political," "human resources," and "infrastructural" dimensions of the obstacles, the "managerial" dimension was the most important factor, followed by "infrastructural," "political," and "human resources," respectively. More specifically, the results [see Table 3] obtained by analyzing the experts' opinions suggested that, among the 15 obstacles identified, the main factors were as follows:

1. The absence of performance guarantees: When implementing new policies in the healthcare system, guarantees are used to ensure the successful implementation of plans, as well as the provision of the necessary prerequisites/infrastructure. In this relation, trustees, policy-makers, and other stakeholders in the healthcare system must undertake the obligation to establish input agencies/organizations and to form

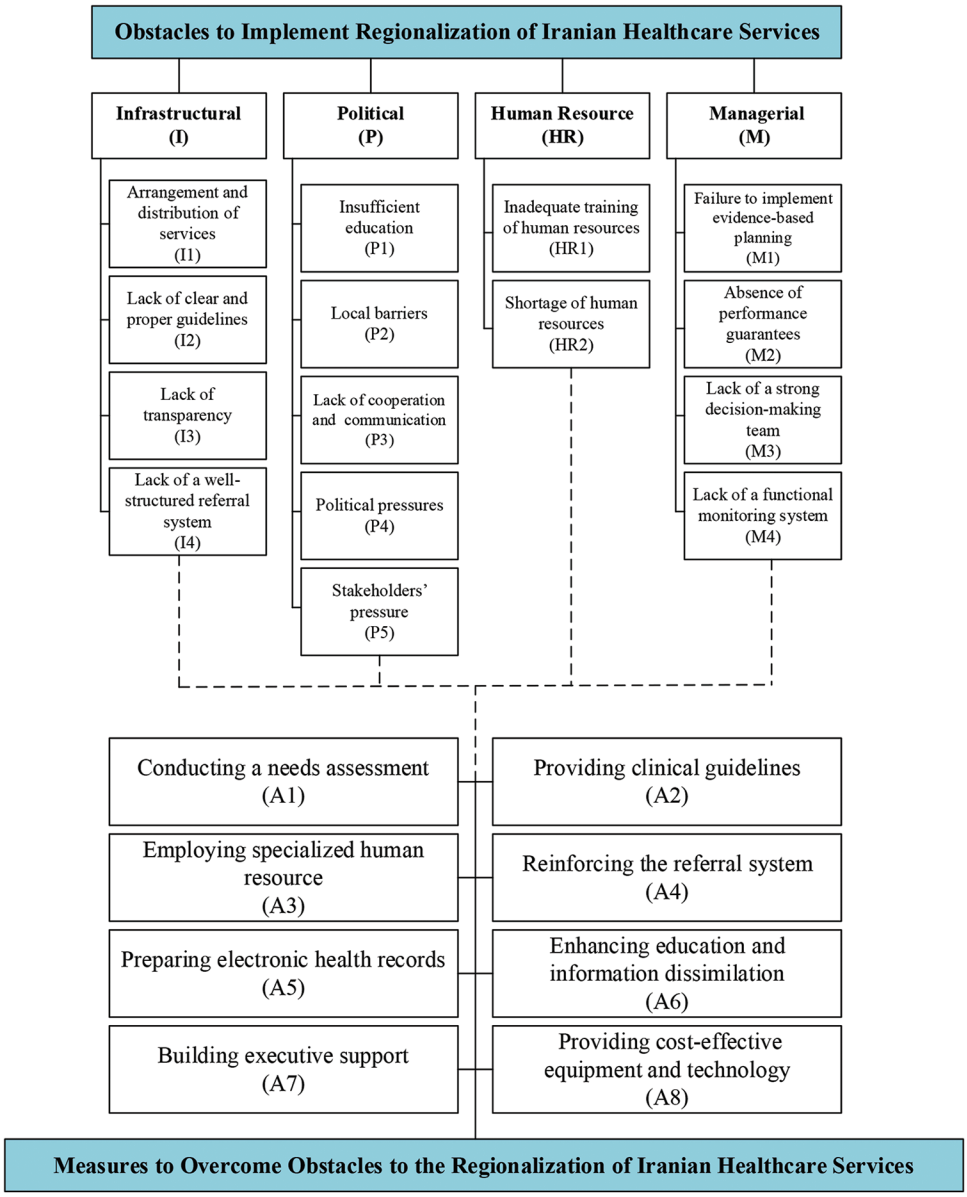

Figure 1: The MCDM Model of the Study

a law-making team so that they can monitor the implementation of regionalization plans and ensure accountability during such plans; Neville *et al*.[21] also identified this as a barrier.

2. A lack of a strong decision-making team: Decision-making in relation to healthcare issues is very important in the face of increasing social change. Therefore, there should be an expert and specialized decision-making team that can help the healthcare system to accomplish its main goals (e.g., to meet the needs of people and society, improve the health of individuals, and provide quality services) through evidence-based planning, despite many issues and problems;
3. The arrangement and distribution of services: The arrangement of units providing healthcare services and the distribution of such services among different regions of a country should be accomplished in a way that can improve people's access to services. Moreover, community members should access quality health services at the lowest cost. The arrangement of services should also take into account local barriers, including the culture and customs of community members and the customs of each region;
4. Failure to implement evidence-based planning: In the current unstable period, it would be highly important to rely on systematic and continuously updated statistics and evidence in areas such as problem identification, planning, and selection. As such, evidence-based planning can clarify the policy-making and planning process, detect possibly existing shortcomings, and specify the necessary infrastructure for the

Table 2: Themes and sub-themes

Theme	Sub-theme	Code
Obstacles to regionalization implementation	Infrastructural	Arrangement and distribution of services
		Lack of clear and proper guidelines
		Lack of transparency
		Lack of well structural referral system
	Political	Insufficient education
		Local barriers
		Lack of cooperation and communication
		Political pressure
		Stakeholders pressure
	Human resource	Inadequate training in human resource
		Shortage of human resources
	Managerial	Failure to implant evidence-based planning
		Absence of performance guarantees
		Lack of strong decision-making team
		Lack of a functional monitoring system
Measures to overcome obstacles	Policy-making	Providing cost-effective equipment and technology
		Conducting a needs assessment
		Providing clinical guidelines
		Building executive support
	Coordination and networking	Preparing electronic health records
		Reinforcing the referral system
	Health resource management	Employing specialized human resource
		Enhancing education and information dissimilation

Table 3: The fuzzy weights of the obstacles

Dimensions	Fuzzy weights	Criteria	Fuzzy weights (relative)	Final fuzzy weights	Final crisp weights	Ranking
Infrastructural	(0.2420, 0.2898, 0.3471)	I1	(0.3872, 0.4277, 0.4315)	(0.0937, 0.1240, 0.1498)	0.1232	3
		I2	(0.1965, 0.2552, 0.2920)	(0.0476, 0.0740, 0.1014)	0.0741	5
		I3	(0.1607, 0.1979, 0.2210)	(0.0389, 0.0574, 0.0767)	0.0575	8
		I4	(0.1202, 0.1296, 0.1490)	(0.0291, 0.0376, 0.0517)	0.0385	11
Political	(0.1398, 0.1431, 0.1538)	P1	(0.0909, 0.1014, 0.1141)	(0.0127, 0.0145, 0.0176)	0.0147	15
		P2	(0.1778, 0.2283, 0.2330)	(0.0249, 0.0327, 0.0358)	0.0319	12
		P3	(0.2985, 0.3445, 0.3703)	(0.0417, 0.0493, 0.0570)	0.0493	9
		P4	(0.1335, 0.1487, 0.1614)	(0.0187, 0.0213, 0.0248)	0.0214	14
		P5	(0.1713, 0.1880, 0.2054)	(0.0240, 0.0269, 0.0316)	0.0272	13
Human resource	(0.1182, 0.1227, 0.1403)	HR1	(0.4406, 0.5280, 0.5285)	(0.0521, 0.0648, 0.0742)	0.0642	6
		HR2	(0.3499, 0.5056, 0.5466)	(0.0414, 0.0620, 0.0767)	0.0610	7
Managerial	(0.4095, 0.4351, 0.4863)	M1	(0.2257, 0.2794, 0.3200)	(0.0924, 0.1216, 0.1556)	0.1224	4
		M2	(0.2829, 0.3279, 0.3657)	(0.1158, 0.1427, 0.1778)	0.1441	1
		M3	(0.2578, 0.3084, 0.3490)	(0.1056, 0.1342, 0.1698)	0.1353	2
		M4	(0.0884, 0.0895, 0.0895)	(0.0362, 0.0390, 0.0435)	0.0393	10

implementation of regionalization plans; This result was consistent with the study of Neville *et al*.[21]

5. A lack of clear and proper guidelines: One of the main obstacles to the implementation of the regionalization plan is a lack of accurate and specific clinical guidelines., Formulating guidelines based on current and updated knowledge is an attempt to improve the provision of clinical services, which not only helps physicians/patients in the medical practice process[22] but also serves as a planning tool for policy-makers and healthcare providers.[23] The design of these guidelines raises people's awareness of these activities. An efficient referral system, in turn, contributes to the proper regionalization of healthcare services. This result was consistent with the study of Seymour and Kahn.[24]

It should be noted that in various articles, other obstacles such as education and information,[21-25] political pressures, lack of evidence-based programming,[21] lack of expert human resources, local barriers,[25] inter-sectoral cooperation,[26] and stakeholder pressures[24] were identified, which are consistent with the results of this study.

Table 4: The FPIS (d+), FNIS (d−), and CC values for each measure

	FPIS (d+)	FNIS (d−)	CC	Rank
A1	0.1266	0.3715	0.7458	3
A2	0.2039	0.2890	0.5864	8
A3	0.0786	0.4216	0.8428	1
A4	0.1914	0.3197	0.6255	7
A5	0.1634	0.3342	0.6716	5
A6	0.1390	0.3749	0.7295	4
A7	0.1822	0.3271	0.6422	6
A8	0.0943	0.4136	0.8144	2

The results [see Table 4] also revealed the following necessary measures that the experts found important in overcoming the existing obstacles:

1. Employing specialized human resources: Every organizational strategy/policy must consider the human resources working for the organization. The success or failure of the organization depends entirely on how human resources are recruited and retained.[27] Therefore, skilled and specialized human resources would have a significant role in various areas, such as policy-making, planning, project implementation, and other issues; this result was consistent with the study of de Oliveira and Artmann.[25]
2. Providing cost-effective equipment and technology: Another way to overcome the obstacles to the implementation of the regionalization plan is to provide technology, infrastructure, and equipment compatible with medical goals. More specifically, the technology effectively increases productivity, enhances workplace safety and facilities operations, reduces staff workload, and reduces potential risks to staff members;
3. Conducting a needs assessment: To implement the regionalization of healthcare services, a needs assessment can help to identify urgent needs in each area/city where, for instance, a hospital should be established or patients should be transferred from one area to a neighboring one. Before implementing this plan, policy-makers and healthcare providers must gain complete information about the population coverage of the region in question, its specialized needs, its disease burden, and even its demographic profile; this result was consistent with the study of Lewis.[28]
4. Enhancing education and information dissimilation: Educating community members and training human resources can serve as an effective measure to overcome the obstacles to the implementation of regionalization plans. To overcome local barriers, as highly important issues, it is possible to educate people in the community through various channels such as local networking programs, lectures delivered by well-known and popular people in the area, or local gatherings[29]; Articles also mentioned this point.[30,31]
5. Preparing electronic health records: The full implementation of electronic health records in the Iranian health system represents one of the important strategies in formulating a regionalization plan. Having access to integrated and organized available data of patients is one of the main goals of the electronic health record. Preventing rework in diagnostic and clinical trials and tests, along with avoiding the risks of drug-prescribing interference, constitutes one of the basic infrastructural aspects that could strengthen the referral system and subsequently coordinate the series of medical services provided in the regionalization system;
6. Building executive support: As the experts suggested, another way to overcome obstacles is to foster executive support when implementing a healthcare services regionalization plan. During the implementation of such a plan, various approaches take shape. Yet, according to the experts, scrutinizing the integral elements of the implementation plan and post-implementation inspection can serve as practical strategies to overcome the obstacles to regionalization plans; This result was consistent with the study of Neville *et al*.[21]
7. Reinforcing the referral system: In actualizing regionalization plans, the referral system has the important function of providing services in the form of a consistently evolving chain. In this process, if a patient needs more specialized services, s/he could be transferred to a specialized service provider unit. This procedure would help patients to stir clear of complexities in specialized medical centers. This advantage is made possible by providing care at different levels by using the referral system. However, given the inefficiency of the presently used referral system, which addresses referrals based on informal communication and patients' personal decisions, policy-makers should strengthen the referral system. This result was consistent with the study of Seymour and Kahn.[24]
8. Providing clinical guidelines: As mentioned in the previous section, one of the main obstacles to regionalization is a lack of specific and accurate clinical guidelines. Therefore, formulating clinical guidelines based on real-world evidence can further enhance the ability of the measures to overcome obstacles. This result was consistent with the study of Seymour and Kahn.[24]

Strengths and Limitations

The findings of this study can provide a foundation for policy-makers and decision-makers responsible for the health system. Using the findings, they can understand the obstacles to the implementation of regionalization plans and have an insight into the necessary strategies to increase such plans' success rate. The observations are highly important because the regionalization of healthcare services has not been seriously implemented in Iran. From the perspective of research, too, there is a dearth of studies in

the literature in relation to the obstacles to regionalization and the necessary measures to overcome these obstacles. In addition, this study ranked the factors based on their importance levels, which will improve decision-making in terms of regionalization and its successful implementation.

Although in-depth interviews were used to collect data in this study, some interesting findings were observed. Yet, the findings reflected the observations of the experts reporting the situation in a developing country; therefore, caution should be exercised in generalizing the findings of this study to other communities. Similar studies conducted in other developing or advanced countries could help to discover other obstacles through other MCDM techniques.

Conclusions

A successfully implemented regionalization of healthcare services in Iran would demand due consideration of obstacles existing in the process and the necessary measures that could help to overcome these obstacles. The main contributions of this study were the identification and prioritization of the most important obstacles, along with the evaluation of the most effective measures to overcome the obstacles that would lead to unsuccessful/ incomplete implementations of regionalization plans. Such measures could be practiced step-by-step, as it would be hardly possible to implement them simultaneously in the healthcare system.

Although several measures have been adopted in Iran, such as electronic health records and the referral system, more efforts are needed to reinforce and fully accomplish the regionalization of healthcare services in the country. The present study relied on an integrated version of fuzzy BWM-TOPSIS to compute the weights of the obstacles and to rank healthcare regionalization solutions. The findings revealed that the main obstacles to the implementation of regionalization were "the absence of performance guarantees," "a lack of a strong decision-making team," "the arrangement and distribution of services," "failure to implement evidence-based planning," and "the existence of clear and proper guidelines."

In addition, the evaluation and ranking of the measures showed that "employing specialized human resources" and "providing cost-effective equipment and technology" were among the most important measures that could contribute to the regionalization of healthcare services. The other important measures were "conducting a needs assessment," "enhancing education and information dissimilation," "preparing electronic health records," "building executive support," "reinforcing the referral system," and "providing clinical guidelines."

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Received: 07 Apr 22 **Accepted:** 27 Oct 22
Published: 28 Apr 23

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