

# A Novel Approach for Prioritization of Critical Factors Affecting the Performance of health care based on Best-Worst Method: A prospective approach

**Payam Shojaei**

Shiraz University

**Kimia pourmohammadi** (✉ [purmohamadi63@gmail.com](mailto:purmohamadi63@gmail.com))

Shiraz University

**Peivand Bastani**

Shiraz University of Medical Sciences

**Nahid Hatam**

Shiraz University of Medical Sciences

**Ramin Hayati**

Fasa University of Medical Science

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## Research note

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# **A Novel Approach for Prioritization of Critical Factors Affecting the Performance of health care based on Best-Worst Method: A prospective approach**

## **Authors:**

### **Payam Shojaei**

Associate Professor, Department of Management, Shiraz University, Shiraz, Iran.

Tell: 09174351208

Email: [pshojaei@shirazu.ac.ir](mailto:pshojaei@shirazu.ac.ir)

\* (corresponding author)

### **Kimia Pourmohammadi**

PhD in Health Services Management, Health Human Resources Research Center, Shiraz University of Medical Sciences, Shiraz, Iran.

Department of Health Care Management, Shiraz Branch, Islamic Azad University, Shiraz, Iran

Tell:09177079194

Email: [purmohamadi63@gmail.com](mailto:purmohamadi63@gmail.com)

Mailing Address: 4th Floor, Almas Building, Alley Number 29, Ghasredasht Street, Shiraz, Iran

### **Peivand Bastani**

Associate Professor of Health Services Management, Health Human Resources Research Center, School of Management and Medical Informatics, Shiraz University of Medical Sciences, Shiraz, Iran,

Tell:09173015665

Email: [bastianip@sums.ac.ir](mailto:bastianip@sums.ac.ir)

### **Nahid Hatam**

Professor of Health Services Management, Health Human Resources Research Center, School of Management and

Medical Informatics, Shiraz University of Medical Sciences, Shiraz, Iran.

Tell: 09171127258

Email: [hatamn@sums.ac.ir](mailto:hatamn@sums.ac.ir)

### **Ramin Hayati**

Department of public health, School of Health, Fasa University of Medical Sciences, Fasa, Iran

Tell: 09351471142

Email: [ramin.hayati202@gmail.com](mailto:ramin.hayati202@gmail.com)

## **Abstract**

**Objectives:** The Best-Worst Method is considered as a novel and innovative way to identify and prioritize ever-changing internal and external factors affecting health care performance.

**Results:** After screening the large number of factors using the “content validity ratio”, a Pairwise comparisons were conducted between the best and the worst criteria and the other one. Then Modeling the research problem through linear programming and finding the optimal weights. the most effective internal factors from the experts’ viewpoint were the financial indicators such as “the ratio of personnel wage costs to the total revenues”. The most important external factor that was “structure of the payment system and strategic service purchasing by insurance”. external factors had greater impacts on the performance of public hospitals than internal factors. Therefore, when assessing the performance and improvement interventions of hospital, not only internal indicators should be measured, but also external factors, including political and economic policies and approaches governing the health system need to be taken into account.

**Key words:** Best-Worst Method, content validity ratio, linear programming, health care

## **Introduction**

In a health system, performance refers to maintaining the patients’ health while achieving business goals. Inefficiency, lack of meeting customer needs, and increased costs always threaten health systems (1-2). Health systems must improve their performance in order to appropriately respond to the challenges and changes of today’s modern world (3-4).

Performance evaluation is a constant challenge for managers and stakeholders, and is currently playing a crucial role in the success of organizations especially in complex and dynamic environments (5-7). Hence, the lack of a comprehensive evaluation system is known as a symptom for a sick organization (7).

In order to have a comprehensive approach it seems essential to identify and prioritize the numerous and ever-changing indicators in the field of hospital performance (8-10). Multiple Criteria Decision Making (MCDM) plays an important role in solving multidimensional and complex problems (11-13). In this study, the Best-Worst Method (BWM) is considered the most innovative method in Multiple Criteria Decision Making in order to identify and prioritize the key performance indicators for public educational hospitals in Iran.

## **Main text**

### **Methods**

In the best-worst method, the best and worst criteria are firstly determined for decision-making, and in the next step, the best and worst criteria are compared with the other ones. Then, the problem is optimized and the weight of each criterion is determined. The weights of the options are obtained using various criteria. In the end, using the weights obtained, the options resulted from a set of

criteria and options are calculated and the best one is selected. In this method, the inconsistency rate is also calculated. The main reason for preferring the best-worst algorithm to other multi-criteria algorithms in the present study was the application of the least pairwise comparisons and consequently, the lower likelihood of inconsistency in comparison with other methods that leads to more stable results. (14). In this study, the weights of the criteria were determined based on two features: probability and effect. The method consists of six steps:

**Step 1:** Specifying a set of decision-making criteria. In this step, the set of indicators needed to make a decision is defined as follows:

$$\{c_1, c_2, \dots, c_n\}$$

In this study, the factors affecting the performance of public hospitals were first extracted using a field review (15-16) and environmental scanning of the hospitals. Then, due to the large number of the factors and indicators affecting the performance of public hospitals, the content validity ratio (CVR) was used to screen the factors. In the CVR method, the content validity ratio was quantitatively calculated using the experts' comments. To determine the CVR, the experts were asked to examine each item based on a three-part spectrum comprising "effective", "effective but not necessary" and "not effective". The content validity ratio was calculated according to the following formula:

$$CVR = \frac{n_E - \frac{N}{3}}{\frac{N}{3}}$$

In this equation,  $n_E$  was the number of the experts who selected the "necessary" option, and  $N$  was the total number of the experts. As the panel had 32 members, the CVR higher than 0.29 was accepted (Appendix 1) (17).

**Step 2:** Determining the best (most important) and the worst (least important) criteria. At this stage, each expert selected the best and the worst criteria and indicators from his/her own point of view. No comparisons were made at this stage.

**Step 3:** Determining the superiority of the best criterion over the other criteria. The experts compared the criteria and indicators selected as the best in the second step with the other factors. This step and the fourth one dealt with the pairwise comparison approach by assigning a score of 1 to 9. The priority vector of the best indicator compared to the others was shown as  $A_B = (a_{B1}, a_{B2}, \dots, a_{Bn})^T$ .

**Step 4:** Determining the priority of the worst criterion among all the criteria by assigning a score of 1 to 9. The priority vector of other indicators compared to the worst one was shown as  $A_W = (a_{W1}, a_{W2}, \dots, a_{nW})^T$ .

**Step 5:** Modeling the research problem through linear programming. At this stage, for each pairwise comparison of the best criterion with the other criteria ( $w_b/w_j$ ) a technical coefficient of the best comparison ( $a_{bj}$ ) was obtained. Also, for each pairwise comparison of the worst criterion with the other criteria ( $w_j/w_w$ ) a technical coefficient of the worst comparison ( $a_{jw}$ ) was obtained as well. To resolve all the restrictions and establish compatibility in the following equations:

$$w_b/w_j = a_{bj}$$

$$w_j/w_w = a_{jw}$$

the maximum difference between the following equations needed to be minimized.

$$(Formula 1) \quad |w_b/w_j - a_{bj}|$$

$$(Formula 2) \quad |w_j/w_w - a_{jw}|$$

The result of minimizing the equations above was the formation of a function with restrictions as follows:

$$(Formula 3) \quad \min \max_j = \{ |w_b/w_j - a_{bj}| \cdot |w_j/w_w - a_{jw}| \}$$

s.t.

$$\sum_j w_j = 1, w_j \geq 0; \text{ for all } j.$$

To solve the preliminary problem, we first did the preparations for transforming it into linear programming. So the problem was formulated as follows:

$$\min \varepsilon$$

s.t.

$$(Formula 4) \quad |w_b/w_j - a_{bj}| \leq \varepsilon. \text{ for all } j$$

$$(Formula 5) \quad |w_j/w_w - a_{jw}| \leq \varepsilon. \text{ for all } j$$

$$\sum_j w_j = 1, w_j \geq 0. \text{ for all } j.$$

**Step 6:** Solving the linear programming problem and finding the optimal weights. At this stage, the indicators were evaluated and prioritized using the obtained weights. In this study, the LINGO software was used to analyze the data.

## **Results:**

Based on the experts' opinions, out of the 58 external driving factors and 33 internal ones affecting the performance of public hospitals, 18 and 11 factors were respectively selected using the CVR method (Table 1).

### **Results of Screening with "Content Validity Ratio"**

**internal factors:** the ratio of personnel wage costs to the total revenues, the ratio of the costs of drugs and medical consumer goods to the total costs and the ratio of total costs to available beds were the highest coefficient.

**driving forces and external macro factors:** they were most influential from the viewpoint of the experts included the structure of the payment system and strategic service purchasing by insurance companies based on quality and price, the structure of tariffs and the increased costs of drugs and treatment. (Table 1)

Of the four megatrends selected, General health insurance and a shift from employer-based to government-based insurance coverage had the highest coefficients. (Table 2)

As shown in Table 2, among the main dimensions, the economic and social ones obtained the highest and lowest ranks with the weights of 0.27 and 0.05, respectively. The internal dimensions (efficiency and effectiveness) were ranked third and fifth, respectively, in terms of their effects on the performance of public hospitals.

## **Discussion**

In order to evaluate and improve the performance of any organization, it is necessary to first identify the factors (internal and external) influencing its performance and determine the importance of each factor. Ranking the indicators can help managers to only focus on key factors and indicators. Gupta and Barua argued that focusing on key factors would prevent waste of resources (18). Due to the space constraints, only the most important results (most effective dimensions and their important ranks and indicators) are discussed in the following.

According to the results of the BWM, the economic dimension with a weight of 0.27 was identified as the most effective on the performance of public hospitals in Iran. It was found out that in the

economic dimension, the payment system structure had the greatest impact on the performance of the public hospitals because it is designed in such a way that it encourages service providers to provide a greater number of services (19). But in recent years, a shift from severity-based payments (volume, frequency, duration, and type) towards quality-based payments has begun, and this modification of the payment system is based on performance (P4P) (20,21), so that one of the megatrends in the Iranian health system is the paradigm shift from volume to value in the provision of health services (22). In the present study, "paradigm shift from volume to value" was selected as one of the sub-criteria affecting the performance of public hospitals, and obtained the fifth rank, indicating its great importance. This change could lead to the provision of quality services and reduction of costs (23). In this regard, one of the innovative methods in value-based systems is the strategic purchase of services or service packages (24-26).

Another important criterion affecting the performance of public hospitals was the political dimension with a weight of 0.15. As the experts agreed, "downsizing the government according to different laws" was considered as the only key sub-criterion affecting hospital performance in this external dimension. Evidence suggests that government downsizing is one of the strategies considered by policymakers and managers, especially in the health sector, for organizational improvement and development (27). Downsizing is one of the most common interventions and an essential component of health system reform (28), because it can help improve the performance of public hospitals by reducing costs, reducing service delivery duration, increasing efficiency, enhancing skills, and focusing on main processes (29). One of the growing paths in this field is the collaboration of the public and private sectors in synchronizing the two sectors and increasing the value added of hospital services. This collaboration can greatly disentangle hospitals from upper organizations and strict administrative regulations, and create more flexibility in the structure, organization and performance of the management. (30-32). However, Kavosi et al. emphasized that deciding on the use of participatory models of the public-private sector was a complex and multi-criteria decision, all aspects of which needed to be addressed (33).

As an important indicator of public hospitals, the "ratio of total costs to total revenues" indicated the importance of hospitals' financial performance affecting their efficiency. In this regard, Rahimi et al. selected it as one of the key indicators of the balanced scorecard financial indicator of Iranian hospitals which is consistent with the results of the present study. Si et al. also described the role of financial indicators in improving hospital performance, which had complicated relationships with other indicators (34,35).

## **Conclusion**

This study has important implications for health system managers and public hospitals in Iran, because, contrary to previous studies that focused solely on the internal indicators of hospitals, the present research had a comprehensive approach to simultaneously identifying internal indicators and external factors affecting the performance of public hospitals in Iran. The results showed that

external factors (economic and political ones) had greater impacts on the performance of public hospitals than internal factors (efficiency and effectiveness). Therefore, when assessing the performance and improvement interventions of hospital, not only internal indicators should be measured, but also external factors, including political and economic policies and approaches governing the health system need to be taken into account.

### **Limitations**

The results of this research are a cross-sectional view of the changing health system in Iran and as the “prioritization of factors” is a dynamic process and affected by economic, political and social situation it should be updated every 3-4 years to match the ever-changing environment.

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### **Authors' contributions**

PS designed the study, finalized the data synthesis and its overall methodology; KP and RH retrieved the data and prepared the initial draft of the article. PB contributed to data analysis and edited the article. NH improving the structure and conclusion of the paper. The study was supervised by PS. All authors read and approved the final manuscript.

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### **Availability of data and material**

Data is available in an endnote library.

### **Ethics approval and consent to participate**

This study is approved by Shiraz University of Medical Sciences ethics committee with the ID number of IR.SUMS.REC.1396.S274.

### **Consent for publication**

There was no difficulty in publishing the results. All the included databases and materials are available for public use.

### **Competing interests**

Authors declare that there is no conflict of interest.

### **List of abbreviations**

MCDM: Multiple Criteria Decision Making

BWM: Best Worst Method

CVR: Content Validity Ratio

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