Original Article

Ranking of University Hospitals in Yazd based on National Nursing Indicators by AHP-TOPSIS Technique in 2016

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Abstract

Introduction: Hospitals as one of the main organizations of rendering services and the most costly operational units of the health system are of special importance. Meanwhile, nurses play a vital role in continuity of care, improvement of health, and productivity of the entire organization. This study was conducted with the aim of ranking hospitals of Yazd medical sciences university based on the national nursing indicators and with an AHP-TOPSIS combined approach.

Materials and Methods: This cross-sectional study was carried out in 2016. The statistical population consisted of 25 experts, including hospital directors and faculty members of care and health services' as well as health economics' management. The tools used were the nursing work index questionnaire and the index data collection form, validity and reliability of them were confirmed. For this purpose, initially by applying Analytic Hierarchy Process (AHP), weight and priority of nursing and then hospitals' indicators were calculated and ranked by TOPSIS technique. Prioritization of indicators was performed by Expert Choice software.

Results: Based on the AHP method and pairwise comparisons within nursing indicators, the highest weight or priority was related to nursing staff ratio indicator of female /male with a weight of 0.290. However, the lowest weight or priority was related to the average of nursing staffs' overtime hours' indicator with a weight of 0.038. Based on the results and according to the national nursing indicators, city of Yazd gained the best situation totally and was then placed in the developed group. The worst situation was related to Mehriz and Taft cities.

Conclusion: In order to reduce the differences of national nursing indicators among cities and to achieve a fair and balanced situation of health at the provincial level, it is recommended to reduce the gap among cities in enjoying from the health and care facilities by considering cities' developmental situation in this field and planning based on facts. It is also suggested to observe the sexual ratio in allocating nurses to hospitals.

Keywords: Hospital, National Nursing Indicators, AHP, TOPSIS Technique

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Introduction

Growth and development in each country or each system, such as a country's health and care system, without integrated and efficient human resources lacks the necessary and foundational tool for achieving the goals of the system. Health and care system is empowered only when it can achieve its goals and missions up to the level of national development's predeterminations. In this regard, managers and policy makers of such a system need comprehensive and accurate information about the situation of their human resources to monitor and plan for the future [1].

Therefore, such measures that would improve individual performance and organizational effectiveness are development and implementation of programs to evaluate and rank hospitals based on human resources' indicators. In fact, assessing and ranking in the management of human resources is one of the crucial and key tasks, by which the present situation of human resources is studied and its strengths and weaknesses are identified. Organizations also need to know the situation of their employees to improve their human resources, increase their volume of production and services, and create positive changes in their movements' process [2]. Now, in countries of the world, whether industrially developed or developing countries, considering the employee's performance, as well as their distribution, and justice in their workload are of great importance. This issue is counted as a positive factor for development and improvement of human resources in many countries [3].

Skilled and efficient human resources are the most invaluable and precious wealth of each country. Many communities cannot use their rich resources, because of their lack of qualification and competence [4]. Human resource is the most important asset of any health system. The findings of recent years have shown that improving the performance of health system employees will have a major share in development of health system performance [5]. In health and care system with nurses as its largest part, the importance of attraction and retention of nursing staffs is essential and vital. Recently, nurses' situation has been considered by managers to serve the patients [6].

Nurses' productivity is a crucial issue, because hospitals are places for taking care of patients who have complex needs. Also, it is well known that nurses form a great business source in the health and care system [7], so that, in many hospitals, up to 60 % of operational budget are allocated to nurses [8]. Thus, group of nurses affect an organization's productivity and progress more than any other group, thus, no health care organization can survive without efficient nursing unit [9].

Since nurses are the most important organizational strategic resources at health agencies' level, in the case of improving nursing indices, many benefits can be achieved. These

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benefits include reduction of production and services' costs, improvement of produced goods and services' quality, reduction of inflation, and ultimately achievement of welfare and higher levels of life for the society's individuals [10].

Some of the most important indicators about nurses and increase of their productivity are the National Nursing Indicators. These indicators have recently been notified by the Ministry of Health to the University of Medical Sciences. It was established that these indices of community-based nursing and professional competence of nurses are placed in the Sixth Development Plan.

On the one hand, these indices help managers to improve performance of their organizations by applying their responsibilities and powers as a lever. On the other hand, the national indicators of nursing lead to avoid subjective judgments and help to assess hospitals more logically based on the pre-specified criteria. In the current study, the national nursing indicators were weighted at first and in the second step the situations of hospitals affiliated to Yazd Medical University were ranked and rated based on these indicators and TOPSIS technique. This was done to determine the hospitals' situation based on nursing indicators while rating the national nursing indicators in hospitals. Since the national indicators of nursing have recently been determined and assessed by the Ministry of Health, Treatment, and Medical Education and because no study has been carried out in this area, the present study aimed to rank hospitals of Yazd medical sciences universities based on the national nursing indicators with AHP-TOPSIS technique in 2016.

Materials and Methods

This descriptive study was conducted in 2016. Research environment included all hospitals affiliated with Yazd University of Medical Sciences. The studied society included elites such as hospital managers (12 people), human resource managers in the field of Medical Sciences (5 people), and professors of health care, treatment, and economics management in Yazd University of Medical Sciences (8 persons). They were supposed to select and rank questionnaires of national nursing indicators. Given that the study population consisted of 25 participants and was limited, thus, sampling was not conducted in this study. The society under investigation entered the study through census. It should be noted that all of the studied participants had the entry criteria of at least 5 years of administrative experience, desire to participate in the study, and conduction of scientific and practical works in the field of nursing.

The data collection tool for prioritizing and weighting of indicators was a questionnaire which included eight indices: the ratio of nurses to beds (F1), the average overtime hours of nurse staff (F2), average training hours of nurse staff (F3), the ratio of a nurse to nursing staffs (F4), the ratio of employed nursing staff (formal and with contract) to the whole nurse staffs (F5), the ratio of hospitalized patients to nurses (F6),

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the ratio of female to male nurses (F7), and the ratio of nurse staff to bed occupancy (F8).

Since the objective of this study was to compare and determine the importance of each indicator towards the other ones, questions were designed in a way that each factor was compared in relation to other factors based on numbers of 1, 3, 5, 7, and 9. These numbers respectively represent scales of completely more important, much more important, more important, a little more important, and the same. Questionnaire's validity was investigated based on expert opinions of three professors. Its reliability was also confirmed with calculation of Cronbach's alpha as 0.78.

To collect data, at first, a questionnaire containing indicators of national nursing was administered among participants to be completed thoroughly and accurately. Thus, while visiting the experts, the aim of the study as well as some instructions on how to complete the questionnaire were explained to them. They were also assured that their information will be kept strictly confidential and they can be notified of the results. All participants were given enough time to answer the questions. Information of national nursing indicators was also gathered through demographic index values forms, referring to the Statistics Department of Yazd University of Medical Sciences, and in some from Statistics unit of hospitals.

The collected data were weighted by the Analytic Hierarchy Process by the 11 Expert Choice software. Hospitals' ranking was also performed with TOPSIS technique.

Results

Based on the Analytic Hierarchy Process and paired comparisons within nursing indices, the highest weight or priority was related to the index ratio of female nursing staff to male with a weigh of 0.290. The lowest weight or priority was also related to the indicator of nurses' overtime hours with the weight of 0.038. The inconsistency rate for these indices was 0.02 which shows that the achieved weights and priorities are acceptable. There was also a reasonable consistency among opinions of participants (Fig. 1).

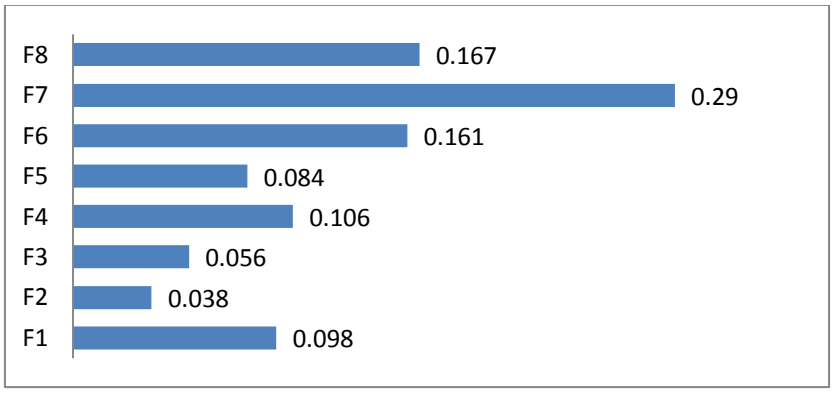

Fig. 1: Nursing indicators' weight and priority

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In TOPSIS technique, to rank hospitals based on nursing indices, at first, the decision matrix including 12 cases or hospitals and 8 indicators was formed. Then, the formed matrix was normalized so that each value of the indicator was divided to its size. In Table 1, the decision matrix of studied indicators is represented. After normalization, each indicator was multiplied by the weight resulted from the Analytic Hierarchy Process. In the next step, the positive and negative ideal solutions were determined; the results are shown in Table 2.

Table 1. Normalized matrix of nursing indicators based on hospitals

Hospital	H.* 1	H. 2	H. 3	H. 4	H. 5	H. 6	H. 7	H. 8	H. 9	H. 10	H. 11	H. 12
The ratio of nurse staff to bed	0.428	0.253	0.293	0.272	0.180	0.264	0.235	0.380	0.114	0.248	0.258	0.362
Nurses' average hours of overtime	0.399	0.135	0.196	0.654	0.181	0.211	0.203	0.391	0.120	0.158	0.143	0.158
Nurses' average hours of training	0.236	0.295	0.246	0.203	0.368	0.389	0.249	0.297	0.290	0.295	0.256	0.287
The ratio of a nurse to nurse staff	0.316	0.266	0.293	0.293	0.270	0.258	0.259	0.294	0.349	0.277	0.290	0.286
The ratio of employed nursing staff**	0.295	0.309	0.279	0.251	0.313	0.292	0.309	0.298	0.335	0.248	0.170	0.325
The ratio of hospitalized patients to nurses staff	0.193	0.345	0.297	0.248	0.423	0.299	0.374	0.161	0.089	0.284	0.384	0.155
The ratio of female nurses to male nurses	0.213	0.303	0.159	0.244	0.189	0.258	0.248	0.216	0.100	0.347	0.640	0.168
The ratio of nurses to bed occupancy rate	0.351	0.095	0.168	0.732	0.121	0.229	0.228	0.348	0.082	0.147	0.114	0.151

*****Hospital

****** (formal and with contract) to total nursing staff

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Table 2. Determination of the positive and negative ideal solutions in terms of nursing indicators

Hospital	A+	A-
Nurse staff to bed	0.042	0.011
Nurses' average hours of overtime	0.025	0.005
Nurses' average hours of training	0.022	0.011
Nurse to nurses staff	0.037	0.027
Employed nursing staff to total nursing staff	0.028	0.014
Hospitalized patients to nurse staff	0.068	0.014
Female nurses to male nurses	0.186	0.029
Nurses to bed occupancy rate	0.122	0.014

After determination of the positive and negative ideal solutions, the distance between them were obtained and then represented in Table 3 for each hospital. The final step was to determine the hospitals and their ranks. Finally, the development and rank factor were calculated for each hospital based on TOPSIS. Based on this technique, Hospital No. 4 was ranked as the first and Hospital No. 9 was the last among other hospitals under study (Table 2).

Table 3. Rate and Development Coefficient of hospitals by TOPSIS technique based on nursing indicators

Hospital	D+	D-	Rank	Development Coefficient
Hospital 4	0.120	0.122	1	0.158
Hospital 11	0. 108	0.164	2	0.132
Hospital 10	0.134	0.081	3	0.099
Hospital 2	0.148	0.074	4	0.087
Hospital 7	0.144	0.069	5	0.085
Hospital 1	0.145	0.068	6	0.083
Hospital 6	0.143	0.065	7	0.082
Hospital 8	0.146	0.065	8	0.080
Hospital 5	0.169	0.062	9	0.071
Hospital 3	0.171	0.045	10	0.055
Hospital 12	0.175	0.038	11	0.047
Hospital 9	0.201	0.018	12	0.021

After ranking of hospitals, hospitals of each city were categorized within a group and the average weight of development degree was calculated for each city. Then, to determine the development gap of health and treatment sector among cities, five categories of developed, relatively developed, moderately developed, less developed, and no developed were considered. After this stage, to determine distances among provinces in five levels, at first, the scores'

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change range was calculated with formula (A). Later, the formula (B) was applied and the distance between the levels was calculated. Consequently, cities were classified into five groups. A) $R = x_n - x_i$ B) $a = \frac{R}{k}$

Based on the results of the national nursing indicators, in total, Yazd achieved the best situation and was ranked in the developed group. The worst situation was also related to the cities of Mehriz and Taft, in such a way that these cities were in less developed group regarding the national nursing indicators.

Table 4. Cities' development levels in enjoyment from the national nursing indicators

Group	Levels' distances	Degree of enjoyment	Cities	Number of towns	Percent
First	0.132-0.158	developed	Yazd	1	12.5%
Second	0.104-0.132	relatively developed	Harat	1	12.5%
Third	0.077-0.104	moderately developed	Abarkooh, Bafgh, Meibod, and Ardakan	4	50%
Fourth	0.050-0.077	less developed	Mehriz and Taft	2	25%
Fifth	0.021-0.050	no developed	-	0	0%

Discussion

In the present study, to rank hospitals based on the national nursing indicators, eight scales were determined as the main scales by the experts' opinions. These scales consisted of: the ratio of nurses to beds, nurses' average hours of overtime, nurses' average hours of training, the ratio of a nurse to all nurse staffs, the employed nursing staff (official and with contract) to the all nurses, the ratio of hospitalized patients to nurses, the ratio of female nurses to male nursing staff, and the ratio of nurses to bed occupancy rate factor. Consistent with the findings of the current study, similar indicators were also used in other studies. Sahin et al. considered scales such as the number of nurses, active beds, number of hospitalized patients and outpatients, as well as the ratio of nursing indicators to performance as the main scales to assess productivity [11]. Bhat and colleagues used scales of number of doctors as well as nurses, paramedical, administrative and technical staffs, number of beds, medical expenses, physical infrastructure, equipment list, working hours, and inpatient services to measure the state hospitals in the state of Gujarat, India [12].

Based on the Analytic Hierarchy Process and paired comparisons, within the parameters of nursing, the highest weight or priority was related to the ratio of female nursing staff to male nurses with a weight of 0.290. However,

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the lowest weight or priority was for nurses' average overtime hours weighted as 0.038. Various studies also indicated several factors for nurses and hospitals' productivity, some of which are in accordance with the results of this study and others are inconsistent with these results. For example Moosazadeh and Amiresmaili mentioned managerial, motivational, and facilities' factors in their study [13].

Bordbar conducted a study entitled as "Effective factors on productivity of human resources by multi-criteria decision-making techniques in Shahid Sadoughi university of Yazd". They introduced management and organizational factors, organizational supporting factors, service compensation system, the environment physical and psychological factors, as well as factors of staffs' freedom and independence in performing duties as the most important factors affecting productivity of human resources [14].

Regarding the ratio of male to female nurses' indicator that achieved the highest rank, the reason can be due to the large difference between male and female nurses in the hospital of Yazd. Another reason is that nursing jobs in some cases entails conflicts with patients' relatives, but female nurses have less power in dealing with disputes of clinical departments, therefore, presence of male nurses can be useful in some cases. Moreover, female nurses are less inclined to get evening and night shifts; this issue has doubled the importance of this scale. Considering the scale of nurses' average overtime hours that has achieved the lowest weight, the reason can be the low importance of overtime for nurses after implementation of Ghasedak system in hospitals and the plan of nurses' productivity improvement.

Based on TOPSIS technique, Hospital No. 4 was ranked as the first while Hospital No. 9 was ranked as the last among hospitals under study. The development coefficient of TOPSIS technique also showed that there is difference among hospitals on nursing indicators. In line with the results of this study, Askari et al, in their study entitled as "Evaluation of Yazd medical hospitals' efficacy" showed that there are differences among hospitals in Yazd [15].

Abedi et al, in their study evaluated economic efficiency of ICUs in hospitals related to Yazd Shahid Sadooghi University of Medical Sciences [16]. Also, Assadi et al. [17], studied performance of state hospitals in Yazd province by using a combination of balanced score-card models, DEA, and Servqual. They showed that there is a difference among the performance of hospitals in Yazd that is in line with the results of this study.

Based on the results, regarding the national nursing indicators, Yazd city gained the best situation among all cities, thus, it was placed in the developed group. The worst situation was also related to the cities of Mehriz and Taft. However, there was a major difference

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among cities of this province in national nursing indicators. In a study Mousavi et al, suggested that health facilities and services are not distributed symmetrically in Yazd province and there is a large difference among cities regarding development of health services [18]. Zangiabadi studies in Kordestan province [19] and Anjomshoa study in Kerman province achieved similar results about existence of difference and inequality in utilization of health facilities. Given that hospitals of Yazd city gained the highest rates in national nursing indicators, therefore, they achieved the best situation in development.

Conclusion

Since hospitals consider different strategies for survival and development of their human resources, identification of key indicators related to nurses is important for health organizations. It also can be used to remove obstacles and limitations in this field. Based on findings of the current study, it can be confirmed that considering strategic actions simultaneously to improve priority of all eight indicators, can impose great costs to the system. So, indicators should be monitored periodically and based on their priority to maintain system's efficacy and improve actions' effectiveness.

Regarding the involvement of top and middle managers in determining these indicators and prioritizing them, it can be expected for them to have more desire and commitment on the development of these indicators. Further, balanced allocation of nursing staff in hospitals of Yazd Medical Sciences, in the context of proportional distribution of gender as well as allocation of facilities and resources to hospitals based on the ratio of nurses to performance scales can help efficiency and performance of the health sectors to a great deal.

In order to reduce the difference among cities about national nursing indicators and in order to reach a fair and balanced situation in health throughout the whole province, efforts should be taken to reduce the gap in enjoying health as well as treatment facilities and amenities among cities based on the development situation of cities in this field and programs based on facts. By doing this, more real and tangible ratios are presented to compare hospitals and to reduce the shortage of nursing forces.

Acknowledgment

None

Conflict of Interest

None

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