



Methodological Approach for Providing a Suitable Model for Financial Ranking of Educational Hospitals by using of Cross-Performance Procedures (Case Work, Hospitals of Ahvaz Jundishapur University of Medical Sciences)

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Abstract

Background: Hospitals are multi-specialist social security organizations that account for a significant portion of the health system's budget. Given the economic conditions and the importance of hospitals in the field of social health, it seems important and necessary to pay attention to financial performance and compare them with each other.

Objectives: The purpose of this study was to provide a model for evaluating the performance and financial ranking of Ahvaz Jundishapur University of Medical Sciences' Hospitals during 2018.

Methods: This cross-sectional study was conducted at Ahvaz hospitals. Twenty-two hospitals were chosen according to random stratified sampling. First, the financial performance indicators of hospital performance evaluations are identified using the previous study method. Then, the financial performance evaluation indicators of hospitals are finalized by interviews with managers and experts of Ahvaz Medical Sciences' Hospitals. To rank the hospitals, a cross-performance approach was used. Cross-performance is an acceptable approach in data envelopment analysis that provides a complete ranking of decision-making units (DMUs). In addition, a new secondary goal is presented in cross-performance. In this paper, an algorithm based on cross-performance is presented, and we will provide a model for ranking hospitals. Data were entered and analyzed using Statistical Package for Social Sciences (SPSS) and t-student and ANOVA tests.

Results: The results show that although the traditional data envelopment analysis model is not able to rank uniquely from hospitals, the introduced pattern offers a unique ranking of hospitals. According to the results of this study, Imam Khomeini Hospital of Ramhormoz has the first rank, and Baqaei Hospital has the rank (22nd) in this ranking.

Conclusions: The findings of this study represent the Hospital of financial position at the other hospitals and can be used in the hospital with good rankings in the service level of self-awareness as a template.

Keywords: Financial, Educational, Hospital, Model, Ahvaz

1. Background

Hospital is a combination of human resources and other functions such as buildings, equipment, technology, and materials (1-3). In recent decades, there has been a lot of investment in developing countries in the field of health. The construction and equipping of the hospital and other similar complexes have been among these efforts (1, 4).

The performance of the hospital shows how the activi-

ties and resources used in each hospital.

Performance appraisal provides managers with the information they need to assess and monitor the current state of the hospital (5). Hospital performance can be evaluated in different areas (5, 6). Today, health center organizations and hospitals in different societies are the basis for the physical and mental health of individuals and the prerequisites for sustainable development (7, 8). Hospital organizations, because of relationship with public health, need to use efficient methods for providing services to im-

prove quality, low health costs, and timely meet the needs of clients that are possible only in the light of using new methods of information management and allocating appropriate time to knowledge management (7-9). Hospitals' performance assessment can be useful for the creation of a common understanding of priorities for strengthening health systems, providing a context for dialogue between programs and between different sectors, and developing a common understanding of communication between the activities that impact on health outcomes. One of the problems to compile such programs is the lack of adequate data on the efficiency of hospitals and its improvement trend over various decades and geographies, especially in developing countries such as Iran. Hospitals' performance assessment helps decision-makers and policymakers to be responsible for their decisions (6). Up to now, different models of hospitals' performance assessment with different approaches and objectives, are presented, and different countries have various experiences of developing and applying these models (6, 10).

Data envelopment analysis is a non-parametric method based on mathematical planning to evaluate the performance of a set of Decision-Making Units (DMU) with multiple inputs and outputs (11). In addition, the new measure has a close relationship with other measures proposed Charnes-Cooper-Rhodes (CCR), Banker-Charnes-Cooper (BCC), slacks-based measure (SBM), and the Russell measure of efficiency (12). In recent years, the use of data envelopment analysis in the field of health and medicine has been growing (13).

2. Objectives

The purpose of this study was to provide a model for the financial ranking of Ahvaz University of Medical Sciences' Hospitals using cross-performance methods in Iran during 2018.

3. Methods

3.1. Materials and Methods

This cross-sectional study was conducted to provide a model for the financial ranking of Ahvaz University of Medical Sciences' Hospitals using cross-performance methods during 2018. The sample size was 22 hospitals that were chosen according to random stratified sampling. After completing the questionnaire and doing the interview, the data from each source were separately entered into Excel (Office 2010), and repeated cases of each source were identified and deleted. Then, the information of the coded

questionnaire was processed through EXCEL and SPSS software.

In the next step, we evaluated the efficiency of the hospitals using data cross-performance methods. In this study, for the first time, a step-by-step recovery process for an inefficient health care network, and models for improving their cross-performance methods were presented.

3.2. A Decision-Making Unit of Efficiency

The definition of a decision-making unit (DMU) of efficiency was given, along with its interpretation as a product of input and output inefficiencies.

3.3. Definition and Computational Scheme of DMUd

Defines the decision-making unit or DMUd as "all individuals and groups that take part in the decision-making process relating to the negotiation of products/services" (14). The DMUd consists of a group of people who take collective decisions about the purchasing of goods and/or services (14, 15). To evaluate the efficiency of one of the health center organizations, for example, o ($o = 1, \dots, n$), we used the following model.

$$E_{dd}^* = \max \frac{\sum_{r=1}^s u_r y_{rd}}{\sum_{i=1}^m v_i x_{id}} \quad (1)$$

S.t

$$\frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1 \quad (2)$$

$j = 1, \dots, n$

$u_r \geq 0, v_i \geq 0, \forall r, i$

In this model, the efficiency of each of the health center organizations can be obtained, and the ranking of this health care network can be used. In fact, the purpose of this model is to create an incorrect combination of input and output of the health center organizations. If the optimal value (DMUd) of this model is equal to 1, it indicates that these health center organizations are inefficient, but (DMUd) less than 1 indicates the inefficiency of the health center organizations in using inputs to generate output.

In this study, we are looking to introduce an index that can measure the inefficiency of any health center organizations in our country. To this aim, we used the index introduced by Bogtoft and Hoggard (15), which is as follows:

$$E_{dj} = \frac{\sum_{r=1}^s u_r^d y_{rj}}{\sum_{i=1}^m v_i^d x_{ij}} \quad (3)$$

The (E_{dj}) index is called the improvement potential, and the index provides inefficiency for each of the health center organizations. This value is zero for an efficient

health care network, and this is a positive value for an inefficient health center organization, and the higher the value, the worse the health centers organization.

Healthcare policymakers are always looking for answers to the question of what efficiency an inefficient healthcare network can do to improve their performance. The recovery potential index (E_{dj}) can indicate the level of inefficiency of the health center organizations. At this stage, to achieve this goal, we propose the concept of step-by-step improvement potential. To this purpose, we used the following mathematical model, which are positive and negative deviation variables, respectively.

Now, if (v^*, u^*) is the optimal answer for model 3, then the intersecting efficiency (DMU_k) calculate with respect to the optimal weights (DMU_d).

According to the obtained values, the cross-performance matrix can be calculated and the cross-efficiency index of all DMUs can be calculated as follows:

$$E_{dk} = \frac{\sum_{r=1}^s u_r^* y_{rk}}{\sum_{i=1}^m v_i^* x_{ik}} \quad (4)$$

$$K=1, \dots, n; k \neq d$$

3.4. Description of the Study Area

This descriptive-analytical study was performed in Khuzestan Province, Southwest of Iran. It is bounded to the west by Iraq and to the south by the Persian Gulf. Khuzestan province has an area of 63,238 km². Ahvaz is the center of this province and located in the Middle East, between 48° and 29' east of the Greenwich meridian, 31° and 45' minutes north of the equator (16-25). The location of the Khuzestan province in the southwest of Iran is presented in Figure 1.

3.5. Statistical Analysis

The coded data were entered into SPSS software version 16. Data analyses were performed using SPSS-16 and Lingo 11. We used the ANOVA test for the analysis of data.

4. Results

This study was conducted on 22 hospitals in Ahvaz Jundishapur University of Medical Sciences, Iran, during 2018. Table 1 summarizes the factors affecting the input and output information related to hospitals. This information is extracted from the financial statements of the hospitals.

Coverage analysis of traditional data considers the number obtained from model (1) as the basis for ranking hospitals. That is, according to the efficiency number

(E_{dd}^*), they proceed to the ranking of hospitals. But the main problem of this method is the existence of the first rank for hospitals, Shafa Ahvaz, Shahid Tabatabai Baghmalek, Salamat, Abuzar, Imam Khomeini Ramhormoz, Taleghani Ahvaz, Ramhormoz's mother, and the Hendijan because each one had a perfect score. In fact, these 8 hospitals could not be ranked in this way. To solve this problem, we used the algorithm introduced in this research.

The first step to calculate the hospitals used the algorithm (1).

In the following, model (2) is implemented for each hospital, and the answer (n) is obtained for each hospital. By this optimal answer and the relationship (3), we formed a cross-performance matrix table that included 22 rows and 22 columns (Table 2).

Finally, by averaging the columns from the columns of this matrix, a cross-performance score for each hospital is obtained, the results of which are shown in Table 3. The second column of Table 3 shows the cross-performance score for each hospital. The higher the score, the better the hospital's performance. So Imam Khomeini Hospital in Ramhormoz had the highest cross-performance score and in the best position, and Baghaie Hospital had the lowest efficiency score and was in the worst position in terms of performance. In addition to this feature, the efficiency score obtained from this algorithm is that it evaluates hospitals without any performance interference. So this efficiency score can be used as a model for hospital rankings, which is given in the third column of Table 3. According to the results, Imam Khomeini Hospital in Ramhormoz, Abuzar, and Shohada Hindijan Tribune are in the first to third ranks of this ranking. The hospitals of Imam Ali (as) Andimeshk, Sina Ahvaz, and Baghaie are in the last ranks, i.e. 20 to 22 ranks, respectively.

5. Discussion

In this study, we provided a model for the financial ranking of Ahvaz University of Medical Sciences' Hospitals using cross-performance methods in Iran during 2018. The findings of this study represent the essential use of the capture-recapture model to determine efficiency and step by step improvement in hospitals. Based on the results of this research, it seems that the aim of this research is to find a suitable model for evaluating the performance and financial ranking of Ahvaz Medical Sciences' hospitals. To this aim, we proposed an algorithm based on a cross-performance model in data envelopment analysis. As shown, the feature of this algorithm is to provide a non-node ranking for hospitals, which traditional

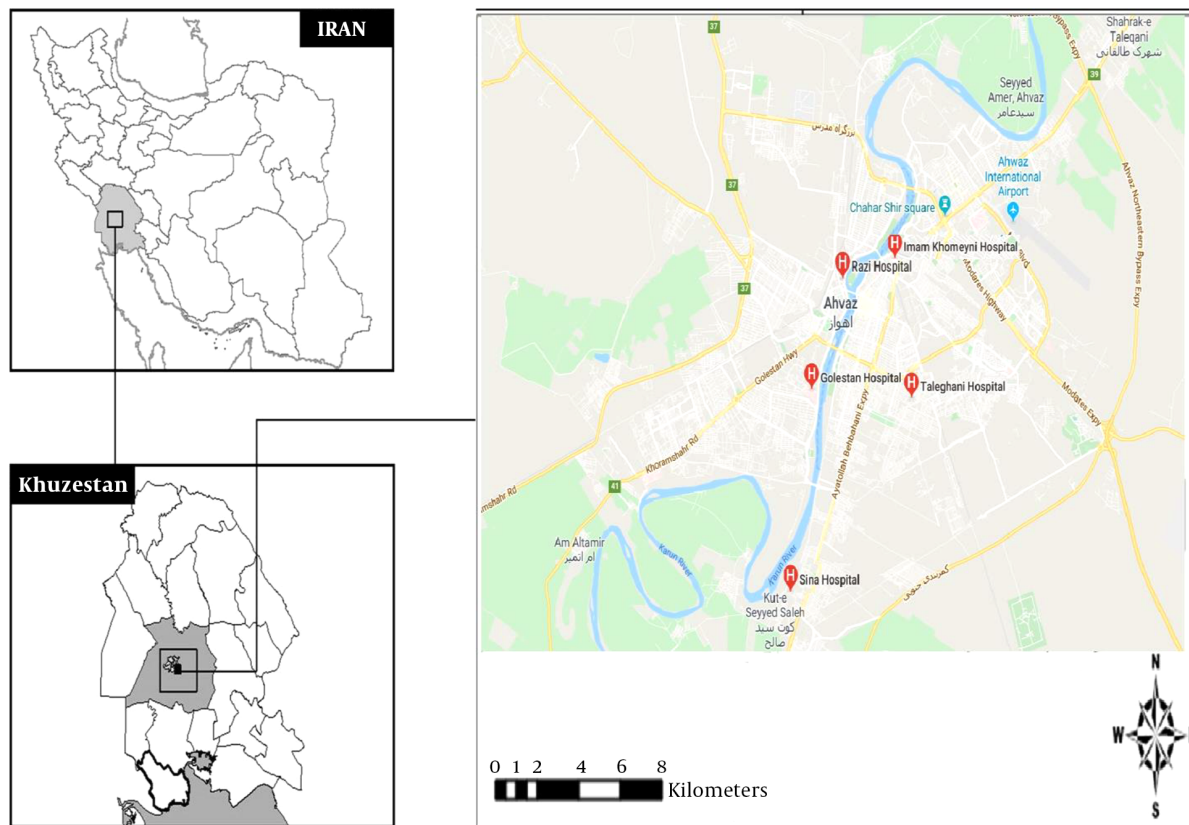


Figure 1. Location of the Khuzestan Province in the Southwest of Iran.

data analytics models are not able to do. In this model, Imam Khomeini Hospital in Ramhormoz won first place, and Baghaie Hospital won the last place. Also, the score of cross-efficiency for hospitals in this method is between 0.51 and 0.95, and the average score of cross-performance for hospitals was 0.78. In order to compare the results obtained for cross-performance, the inputs and outputs of the two hospitals can be compared.

In a study performed by Nazari (26), the statistical population included 158 managers and 472 employees working in urban health centers (28 centers), 63 managers, and 947 employees who were employed in the affiliated hospitals of the two provinces (25 hospitals) and 900 patients (20 years and up) in Semnan and Mazandaran health network. The results of their research showed that there was a significant difference between the scores of staff evaluation from the performance of health network managers, the scores of health network managers, as well as between the scores of staff evaluation from the performance of hospital managers in the two provinces (26). This observation

is in agreement with the findings of our study. Also, based on the results of Dargahi and Darrudi study (27), the performance assessment of health care centers in south Tehran had a significant correlation with several assessment indicators of the health centers.

In another study, Muldoon et al conducted community orientation in primary care practices: results from the comparison of models of primary health care in Ontario, Canada (28). The results of their study showed that community health centers had significantly higher community orientation scores than the other models did ($P < 0.001$ for most differences); in fact, the other models rarely reported significant levels of orientation scores. This observation is in agreement with the findings of our study.

Jonidi Jafari et al. (29) studied disaster risk assessment in health centers of Iran University of Medical Sciences in functional, non-structural, and structural components in 2015 - 2016. Based on their results, the functional preparedness level in health centers for Iran University of Medical Sciences was 23% (29). Shi et al. (30) studied primary care

Table 1. Input and Output Information Related to Hospitals in Ahvaz Jundishapur University of Medical Sciences

Hospitals	x_1	x_2	y_1	y_2	y_3	y_4	y_5
Imam Khomeini of Ahvaz	1,255,501,096,593	647,924,259,000	195,722,162,011	369,979,011,013	1,034,692,837,182	881,612,010,520	118,730,182,949
Shohadaie Izeh	289,713,766,212	160,276,586,888	85,475,296,268	136,381,549,415	233,234,330,202	255,002,395,188	21,197,144,649
Baghaie	522,390,586,336	12,862,051,520	67,246,834,632	4,081,762,120	0	96,341,453,061	2,350,808,363
Shafa Ahvaz	578,207,133,485	121,870,284,070	444,671,117,931	218,244,719,841	438,616,763,964	372,914,056,911	18,100,818,043
Imam Reza Omidieh	74,152,300,955	43,869,372,325	39,911,710,321	32,303,076,211	65,545,951,703	67,113,846,182	8,642,265,090
Shahid Tabatabai Baghmalek	180,055,155,178	72,144,791,968	87,880,153,628	106,132,676,048	171,769,940,262	152,021,782,310	19,927,044,932
Salamat	55,041,095,866	68,609,678,147	76,126,038,697	68,445,321,642	79,675,723,775	60,940,043,010	12,055,547,792
Narges Moarefi Mahshahr	233,149,604,874	113,048,611,516	48,547,979,280	54,729,250,902	165,566,265,981	188,223,844,208	26,645,626,685
Razi	396,704,508,281	205,132,552,714	154,750,012,003	151,497,257,348	346,092,419,221	275,314,194,906	51,615,167,702
Ramshir	28,259,314,917	33,479,332,731	133,853,476,950	124,506,291,116	22,804,059,713	36,649,690,633	4,836,526,766
Rah Zeinab Mahshahr	34,436,805,302	26,136,479,264	16,460,943,062	21,531,502,715	26,148,165,141	26,496,370,737	8,567,472,404
Sina Ahvaz	336,430,751,517	185,116,983,138	399,468,360,621	343,071,290,510	333,485,919,959	300,423,696,125	25,336,421,467
Abuzar	193,811,299,466	150,115,515,003	122,997,977,110	146,402,752,167	195,945,029,041	164,864,340,396	54,876,964,185
Dasht Azadegan	242,007,896,100	108,924,879,457	981,149,100	36,742,817,966	195,385,806,749	177,592,963,912	27,432,659,735
Omid Lali	29,242,946,473	25,369,296,218	4,330,373,153	3,786,067,973	13,599,674,159	24,269,904,978	4,277,419,266
22 Bahman Masjed Soleiman	235,574,898,830	148,204,425,672	89,099,834,259	100,581,812,510	199,404,727,320	190,673,561,833	20,810,533,050
Imam Khomeini Ramhormoz	111,848,321,957	117,104,428,999	27,091,108,142	66,853,634,682	112,920,806,067	156,670,911,798	30,874,532,557
Imam Ali Andimeshk	187,386,525,191	142,534,259,047	41,499,854,342	50,566,734,178	165,942,502,443	192,531,813,478	22,552,868,864
Taleghani Ahvaz	201,288,419,597	109,598,733,361	180,919,754,832	166,964,127,947	222,025,290,524	128,251,695,740	21,090,931,028
Golestan Ahvaz	1,474,435,315,476	480,084,917,853	372,266,869,559	374,796,120,279	970,566,653,989	904,316,397,504	111,378,822,910
Mother Ramhormoz	97,145,985,798	229,280,165	48,170,482,283	1,519,920,269	44,849,854,207	32,114,100,124	81,400,000
Shohada Hendejan	19,817,446,498	15,574,449,186	682,602,302,315	679,805,792,506	12,196,819,479	19,179,553,585	2,138,647,768

quality in a study entitled “community health center and health maintenance organization in USA”. They showed that the performance of health care centers, as well as community health centers in these countries, are higher than average, which is not consistent with the results of the present study (30).

5.1. Limitations and Strengths

This study was done in 2018 because of the limited time usage of data. Another limitation was selecting only Ahvaz Jundishapur University of Medical Sciences in Khuzestan, Iran, because it is the largest University of Medical Sciences in Southwest Iran. It should be noted that future further studies are required to verify the observed efficiency trends of hospitals.

5.2. Conclusions

This study was conducted to provide a model for the financial ranking of Ahvaz University of Medical Sciences' Hospitals using cross-performance methods during 2018. As a result, each country is required to design specific assessment models based on the political, economic, social structure, and expected objectives of the health system. The results of this study showed that all countries' hospitals and health centers are very important for planning health managers. Transparency and accountability, designing and implementation of the performance assessment model at different executive levels of the health system are needed so that each executive unit accepts the responsibility of their activities. To assess the performance, each executive unit has to clear objectives and appropriate planning of these activities. Because any assessment model is not perfect, therefore, the results of the assessment's models designing for constructive criticism of ex-

Table 2. Results of Model Implementation (1) and Calculation of Performance Values E_{dd}^* ($d=1, \dots, n$)

Hospitals	Performance Calculation E_{dd}^*
Imam Khomeini of Ahvaz	0.8
Shodaie Izeh	0.9
Baghaie	0.52
Shafa Ahvaz	1
Imam Reza Omidieh	0.90
Shahid Tabatabai Baghmalek	1
Salamat	1
Narges Moarefi Mahshahr	0.88
Razi	0.87
Ramshir	0.96
Rah Zeinab Mahshahr	0.90
Sina Ahvaz	0.97
Abuzar	1
Dasht Azadegan	0.86
Omid Lali	0.86
22 Bahman Masjed Soleiman	0.82
Imam Khomeini Ramhormoz	1
Imam Ali Andimeshk	0.89
Taleghani Ahvaz	1
Golestan Ahvaz	0.82
Mother Ramhormoz	1
Shohada Hendejan	1

Table 3. Cross-Efficacy Score for Hospitals in Ahvaz Jundishapur University of Medical Sciences

Hospitals	Cross-Performance Score	Hospital Rank
Imam Khomeini of Ahvaz	0.74	16
Shodaie Izeh	0.88	5
Baghaie	0.51	22
Shafa Ahvaz	0.89	4
Imam Reza Omidieh	0.83	10
Shahid Tabatabai Baghmalek	0.84	9
Salamat	0.78	13
Narges Moarefi Mahshahr	0.68	19
Razi	0.72	17
Ramshir	0.81	12
Rah Zeinab Mahshahr	0.75	15
Sina Ahvaz	0.58	21
Abuzar	0.94	2
Dasht Azadegan	0.82	11
Omid Lali	0.69	18
22 Bahman Masjed Soleiman	0.77	14
Imam Khomeini Ramhormoz	0.95	1
Imam Ali Andimeshk	0.67	20
Taleghani Ahvaz	0.85	8
Golestan Ahvaz	0.86	7
Mother Ramhormoz	0.87	6
Shohada Hendejan	0.91	3

perts and to resolve its defects should be published both before and after applying. The findings of the present study showed that further studies should be performed for more understanding of the agent effects on the efficiency of health centers. All hospitals are required to improve their performance by reviewing and modifying the measures, goals, policies, and managers' performance.

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Footnotes

Authors' Contribution: Conception and design of the study: Soliman Kamaei, Bahman Bani Mahd, Hamidreza Vakilifard, and Fereydoun Rahnamay Rudpashti. Analysis and/or interpretation of data: Soliman Kamaei and Bahman Bani Mahd. Drafting the manuscript: Soliman Kamaei, Bahman Bani Mahd, Hamidreza Vakilifard, and Fereydoun Rahnamay Rudpashti.

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References

- Asefzadeh S. Responding to demand for inpatient care in the process of health development. *J Res Med Sci.* 2005;**10**(3):129-34.
- Jafari H, Mohammadian M, Pour Hossein D. Organizational Health and its Relation to Organizational Commitment in Personnel of Selected Teaching Hospitals Affiliated with Ahvaz Jundishapur University of Medical Sciences: 2011. *Jundishapur J Health Sci.* 2012;**4**(1):45-58.
- Salavati S, Abobakri O, Kamel Hoseini S. The relationship between organizational justice and organizational commitment from the view of administrative and supportive personnel in Teaching Hospitals of Ahvaz Jundishapur University of Medical Sciences. *Jundishapur J Health Sci.* 2013;**5**(3):193-200.
- Najarzadeh M, Torabipour A, Ghasemzadeh R, Salehi R. Assessment of hospitals efficiency by Data Envelopment Analysis in Ahvaz in 2006-2010. *Jundishapur J Health Sci.* 2012;**4**(3):77-87.
- Duma O, Munteanu L. The resources utilization pattern in a general university hospital. *J Prevent Med.* 2002;**10**(2):3-11.
- Nasrollahpour Shirvani SD. A review of health systems performance assessment models. *Clin Excellence.* 2016;**5**(2):98-116.
- Mirghafoori SH, Nejad F, Sadeghi Arani Z. Performance Evaluation of Yazd's Health Sector on Applying Knowledge Management Process. *J Health Admin.* 2010;**13**(39):79-88.

8. Sverlinger PO. Managing knowledge in professional service organisations. *Tech Consult Servi Construct Ind Chalmers Reproservice Gothenburg Sweden*. 2000.
9. Holm MG. Service management in housing refurbishment: a theoretical approach. *Construct Manag Econ*. 2010;**18**(5):525-33. doi: [10.1080/014461900407338](https://doi.org/10.1080/014461900407338).
10. Khodadost M, Yavari P, Babaei M, Mosavi-Jarrahi A, Sarvi F, Mansori K, et al. Estimating the completeness of gastric cancer registration in Ardabil/Iran by a capture-recapture method using population-based cancer registry data. *Asian Pac J Cancer Prev*. 2015;**16**(5):1981-6. doi: [10.7314/apjcp.2015.16.5.1981](https://doi.org/10.7314/apjcp.2015.16.5.1981). [PubMed: 25773798].
11. Farrell MJ. The Measurement of Productive Efficiency. *J Royal Stat Soc*. 1957;**120**(3). doi: [10.2307/2343100](https://doi.org/10.2307/2343100).
12. Tone K. A slacks-based measure of efficiency in data envelopment analysis. *Eur J Oper Res*. 2001;**130**(3):498-509. doi: [10.1016/s0377-2217\(99\)00407-5](https://doi.org/10.1016/s0377-2217(99)00407-5).
13. Emrouznejad A, Yang G. A survey and analysis of the first 40 years of scholarly literature in DEA: 1978-2016. *Socio Econ Plan Sci*. 2018;**61**:4-8. doi: [10.1016/j.seps.2017.01.008](https://doi.org/10.1016/j.seps.2017.01.008).
14. Kotler P, Armstrong G. *Principles of marketing*. Pearson education; 2010.
15. Bogetoft P, Hougard JL. *J Product Anal*. 1999;**12**(3):233-47. doi: [10.1023/a:1007848222681](https://doi.org/10.1023/a:1007848222681).
16. Davar H, Taghvirad SS, Mohammadi MJ. The investigation of effects of silica on the environment and prevention of release of the silica particles with simulation of gas-solid flow in a gas cyclone. *Res J Chem Environ*. 2014;**18**(11):28-30.
17. Dobaradaran S, Geravandi S, Goudarzi G, Idani E, Salmanzadeh S, Soltani F, et al. Determination of cardiovascular and respiratory diseases caused by PM10 exposure in Bushehr, 2013. *J Mazandaran Univ Med Sci*. 2016;**26**(139):42-52.
18. Geravandi S, Goudarzi GR, Vosoughi Niri M, Mohammadi MJ, Saeidimehr S, Geravandi S. Estimation of the cardiovascular and respiratory mortality rate resulted from exposure to sulfur dioxide pollutant in Ahvaz. *J Environ Stud*. 2015;**41**(2):341-50.
19. Goudarzi G, Geravandi S, Forouzandeh H, Babaei AA, Alavi N, Niri MV, et al. Cardiovascular and respiratory mortality attributed to ground-level ozone in Ahvaz, Iran. *Environ Monit Assess*. 2015;**187**(8):487. doi: [10.1007/s10661-015-4674-4](https://doi.org/10.1007/s10661-015-4674-4). [PubMed: 26141926].
20. Goudarzi G, Geravandi S, Idani E, Hosseini SA, Baneshi MM, Yari AR, et al. An evaluation of hospital admission respiratory disease attributed to sulfur dioxide ambient concentration in Ahvaz from 2011 through 2013. *Environ Sci Pollut Res Int*. 2016;**23**(21):22001-7. doi: [10.1007/s11356-016-7447-x](https://doi.org/10.1007/s11356-016-7447-x). [PubMed: 27539470].
21. Khaefi M, Goudarzi G, Yari AR, Geravandi S, Dobaradaran S, Idani E, et al. An association between ambient pollutants and hospital admitted respiratory cases in Ahvaz, Iran. *Fresenius Environ Bull*. 2016;**25**(10):3955-61.
22. Neisi A, Goudarzi G, Akbar Babaei A, Vosoughi M, Hashemzadeh H, Naimabadi A, et al. Study of heavy metal levels in indoor dust and their health risk assessment in children of Ahvaz city, Iran. *Toxin Reviews*. 2016;**35**(1-2):16-23. doi: [10.1080/15569543.2016.1181656](https://doi.org/10.1080/15569543.2016.1181656).
23. Yari AR, Goudarzi G, Geravandi S, Dobaradaran S, Yousefi F, Idani E, et al. Study of ground-level ozone and its health risk assessment in residents in Ahvaz City, Iran during 2013. *Toxin Rev*. 2016;**35**(3-4):201-6. doi: [10.1080/15569543.2016.1225769](https://doi.org/10.1080/15569543.2016.1225769).
24. Khaefi M, Geravandi S, Hassani G, Yari AR, Soltani F, Dobaradaran S, et al. Association of Particulate Matter Impact on Prevalence of Chronic Obstructive Pulmonary Disease in Ahvaz, Southwest Iran during 2009-2013. *Aerosol Air Quality Res*. 2017;**17**(1):230-7. doi: [10.4209/aaqr.2015.11.0628](https://doi.org/10.4209/aaqr.2015.11.0628).
25. Nashibi R, Afzalzadeh S, Mohammadi MJ, Yari AR, Yousefi F. Epidemiology and Treatment Outcome of Mucormycosis in Khuzestan, Southwest of Iran. *Arch Clin Infect Dis*. 2016;**12**(1). doi: [10.5812/archcid.37221](https://doi.org/10.5812/archcid.37221).
26. Nazari. Evaluate the performance of the managers of the health network of Semnan and Mazandaran provinces and provide a suitable model. *J Qazvin Univ Med Sci*. 1999;**2**(4):48-57.
27. Dargahi H, Darrudi AR. Performance Assessment of Health Care Centers in South Tehran Health Network. *Q J Manag Strategies Health Sys*. 2019. doi: [10.18502/mshsj.v3i4.510](https://doi.org/10.18502/mshsj.v3i4.510).
28. Muldoon L, Dahrouge S, Hogg W, Geneau R, Russell G, Shortt M. Community orientation in primary care practices: Results from the Comparison of Models of Primary Health Care in Ontario Study. *Can Fam Physician*. 2010;**56**(7):676-83. [PubMed: 20631283]. [PubMed Central: PMC2922817].
29. Jonidi Jafari A, Baba M, Dowlati M. Disaster Risk Assessment in Health Centers of Iran University of Medical Sciences in Functional, Non Structural & Structural Components in 2015-2016. *Iran Occupat Health J*. 2018;**15**(1):76-85.
30. Shi L, Starfield B, Xu J, Politzer R, Regan J. Primary care quality: community health center and health maintenance organization. *South Med J*. 2003;**96**(8):787-95. doi: [10.1097/01.SMJ.0000066811.53167.2E](https://doi.org/10.1097/01.SMJ.0000066811.53167.2E). [PubMed: 14515920].