Comparison of Relative Efficiency of Hospitals Affiliated to Babol and Mazandaran Universities of Medical Sciences before and after Health Development Plan with Data Envelopment Analysis Method

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ABSTRACT

BACKGROUND AND OBJECTIVE: Considering to the efficiency of hospitals as the largest and most costly unit of the health system, is important. The purpose of this study was to compare the efficacy of hospitals affiliated to the Babol and Mazandaran universities of medical sciences before and after the health development plan.

METHODS: This practical retrospective-comparative study was conducted before and after the Health Development Plan on 21 hospitals affiliated to the Health Development Plan of Babol and Mazandaran Universities of Medical Sciences. The data were collected using the form number 1-201 and 2-201 of the university's medical council. In order to calculate the relative efficiency and ranking of hospitals using the data envelopment analysis method, input parameters and output indices were measured by CCR model.

RESULTS: In 2012 and 2013 before the Health Development Plan, 61.9% of the hospitals were effective and in 2015, after the Health Development Plan, 71.45% of them were effective. The plan contributes to an increase of 10% of the number of efficient units. Also, the total efficiency ratio before the plan was equal to 34.5 and in 2015, it was 45. Thus, an increase of 25% was observed in the improvement of efficiency ratio in the year following the Health Development Plan.

CONCLUSION: The results of the study showed that the efficiency and ranking of hospitals affiliated to the Babol and Mazandaran universities of medical sciences have increased after the Health Development Plan.

KEY WORDS: *Hospitals, Efficiency , Ranking, Health Development Plan, Data Envelopment Analysis.*

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Introduction

Hospitals as the most expensive health care systems, allocated about 50-80% of the health budget and a large share of trained and expert personnel to themselves (2). In such a situation, providers must set up their services to ensure that care is fair, equitable and accountable (3). Many articles have been published on the performance evaluation of the hospital (1). The hospital is associated with the life and health of the community as a provider of health services organization, and considering its quality is more important than any other case (4).

Obviously, in order to realize this important thing, the existence of facilities and the proper use of it, is essential and inevitable (5, 6). Data Envelopment Analysis is a nonparametric method for calculating relative efficiency, first introduced in 1978 by Charnes et al. (7). CRR (Charnes & Cooper & Rhodes) is in fact the generalization of Farel's work, which Banker and colleagues continued to study on the CCR model, in which the BCC model (Banker & Charnes & Cooper) was introduced (8). In recent years, many studies have been carried out in order to calculate the relative efficiency of hospitals, like Azar et al study on evaluation the efficiency of hospitals affiliated to Tehran University of Medical Sciences using data envelopment analysis. (9).

Alam Tabriz et al. used envelopment analysis to evaluate the efficiency of hospitals affiliated to Shahid Beheshti University of Medical Sciences. The results of this assessment showed that in 2005, 43.7% and in 2006, 31.2% and in 2007, 37.5% of the hospitals were efficient (10). The study of Askari and colleagues in the evaluation of the efficiency of Yazd medical hospitals is also worth mentioning (11). Ghaderi and colleagues showed that the technical efficiency upgrade capacity in these hospitals is about 10% and the surplus of production factors, especially human resources, is evident in these hospitals (12). Peacock et al. study on 41 private and public hospitals (13) and the Gannon study on 60 Irish hospitals (14), and Mortimer et al, study on 38 Australian government hospitals per year 2002, are examples of abroad studies (15). The development plan of the health system has paid special attention to the development plans of the country in the health sector (10, 16). In this study, the relative efficiency of hospitals affiliated to Babol and Mazandaran University of Medical Sciences before the development plan of the health system and after the development plan of health system was compared.

Methods

This practical study was performed on 21 hospitals affiliated to Babol and Mazandaran Universities of Medical Sciences in 2012 and 2013, before the Health Development Plan and 2015, after the Health Development Plan. In this study, only hospitals with Latin letters are displayed to observe medical ethics. Recorded information in the form 1-201 and 2-201 of medical council of universities after obtaining a license for research from the Babol and Mazandaran universities of medical sciences was collected and using the CCR model of the input-axis with constant-scale efficiency, (7) evaluated the relative efficiency of hospitals in two stages before and after the health development plan. In addition to identifying inefficient hospitals, efficient hospitals were ranked using the AP model (Andersen-Peterson) (17).

Gams software was used for calculations. The assumption of constant-scale efficiency for a system means that with increasing inputs, the output level also increases equally. If the value of the decision-maker's efficiency in the CCR input-axis model with constant-scale efficiency is equal to one, then they are called efficient (7). AP model (Andersen-Peterson) with input nature, is used to rank decision maker units (17). In this study, with the opinion of expert specialists, treatment of five input variables - including the number of specialist physicians, physicians (general, resident)-the number of professional nurses and novice nurses, other staff and number of active beds were considered. Five outcomes were considered according to the input parameters, including the number of admitted patients, the number of emergency visits, the number of outpatient visits, the number of outpatient surgeries and the number of hospitalized surgeries. After determining the input / output indices and the number of studied hospitals for calculating the relative efficiency, the CCR model with assumption of constant-scale efficiency was used.

Results

The results showed that 13 hospital units (61.9%) were effective in 2012 and 2013 (units with a relative efficiency equal to one), and the rest of them were inefficient hospitals. The number of efficient units increased to 15 hospitals (4.71%) in 2015. In 2015 (after the Health Development Plan), in addition to increasing the number of efficient units, the efficiency ratio of units also increased. Also, the results showed

that, of 21 relative efficacy values obtained from hospital units in 2015 compared to the average efficiency of two years before the health development plan, 11 hospital units had an increase, and 6 hospital units with no changes and only 4 hospital units had decreased in their relative efficacy Table (1). The average inefficiency in 2012 is 0.83 and in 2013 it is 0.79. In 2015, the average inefficiency, compared to the average of two years ago, has risen to 83% by 4 percentage points (Table 2).

Table1. Calculation of the efficiency of hospitals in Babol and Mazandaran during 2012-2015

Row	Hospital units	Efficiency				Efficiency comparison
		2012	2013	Average of 2012 and 2013	2015	
1.	DMU A	0.83	1	0.91	1	Increase
2.	DMU B	1	1	1	1	No change
3.	DMU C	1	1	1	1	No change
4.	DMU D	0.92	1	0.96	1	Increase
5.	DMU E	1	0.65	0.82	1	Increase
6.	DMU F	1	1	1	1	No change
7.	DMU G	0.68	0.69	0.65	1	Increase
8.	DMU H	0.98	1	0.99	1	Increase
9.	DMU I	1	0.95	0.97	1	Increase
10.	DMU J	1	1	1	0.84	Decrease
11.	DMU K	1	0.84	0.92	0.78	Decrease
12.	DMU L	1	1	1	1	No change
13.	DMU M	0.7	0.71	0.71	0.81	Increase
14.	DMU N	1	0.92	0.96	1	Increase
15.	DMU O	1	1	1	0.93	Decrease
16.	DMU P	0.89	0.83	0.86	0.96	Increase
17.	DMU Q	0.77	0.79	0.78	1	Increase
18.	DMU R	1	1	1	0.89	Decrease
19.	DMU S	0.94	1	0.97	1	Increase
20.	DMU T	1	1	1	1	No change
21.	DMU U	1	1	1	1	No change

Table2. Ratings of Babol and Mazandaran Hospitals (Anderson & Peterson Model)

Hospital units	Ranking of efficient units 2012	Hospital units	Ranking of efficient units 2013	Hospital units	Ranking of efficient units 2015
DMU F	14.07	DMU H	5/62	DMU H	5.21
DMU E	1.87	DMU F	2.68	DMU C	2.31
DMU N	1.81	DMU B	2.36	DMU F	2.23
DMU O	1.78	DMU U	1.67	DMU A	2.19
DMU U	1.45	DMU C	1.47	DMU G	2.10
DMU C	1.40	DMU A	1.46	DMU B	1.94
DMU R	1.29	DMU T	1.34	DMU U	1.64
DMU I	1.21	DMU D	1.33	DMU E	1.60
DMU B	1.19	DMU S	1.24	DMU Q	1.45
DMU L	1.14	DMU O	1.19	DMU N	1.43
DMU T	1.14	DMU L	1.17	DMU S	1.42
DMU K	1.12	DMU J	1.05	DMU T	1.19
DMU J	1.01	DMU R	1.04	DMU I	1.18
DMU H	0.98	DMU I	0.95	DMU D	1.13
DMU S	0.95	DMU N	0.93	DMU L	1.13
DMU D	0.92	DMU K	0.84	DMU P	0.96
DMU P	0.89	DMU P	0.83	DMU O	0.93
DMU A	0.83	DMU Q	0.79	DMU R	0.89
DMU Q	0.77	DMU E	0.74	DMU J	0.84
DMU M	0.70	DMU M	0.71	DMU M	0.82
DMU G	0.68	DMU G	0.69	DMU K	0.78

Discussion

The results of this study showed that the relative efficiency of hospitals affiliated to Babol and Mazandaran Universities of Medical Sciences during the two years of 2012 and 2013 in the fixed number and the relative efficiency ratio of inefficient units had little changes, in 2015, the relative efficiency of hospitals in a greater number (about ten percent) and the efficiency of inefficient units was also enhanced. In the present study, the percentage of effective units in the two years before the health development plan and the year after that was higher than previous studies. According to Azar et al. study (9) and Salehzadeh et al. study (19), to solve this problem, we need to add some constraints to the model (1) to reduce the number of efficient units and bring the results closer to reality. Also, in the study of Azar et al. input-axis with variable-scale efficiency model (BCC) was used in which we can calculate the ultra-efficient model of hospitals and compare it with the input-axis with constant-scale efficiency model.

In a study conducted by Pourreza et al. in Tehran University of Medical Sciences, the efficiency of educational and public hospitals was examined separately and there was a significant difference between the two groups of hospitals (20). However, in a study by Ghaderi et al. in Iran University of Medical Sciences, there was no significant difference in the mean of the efficiency of educational and therapeutic hospitals and general and specialized hospitals in none

of the two dimensions and types of activities (12), therefore, the manner of Hospital efficacy has not been compared with regard to the type of activity (educational and therapeutic, therapeutic), and overall, we saw the growth of hospitals efficiency regardless of their type of activity.

In Saronga et al., there is evidence of surplus inputs in hospitals and the need to pay more attention to utilization of more resources and more supervision by the headquarters (21). The health development plan is really important in this matter.

Therefore, according to the above, we conclude that the health development plan had a positive effect on the efficiency of hospitals affiliated to Babol and Mazandaran universities of medical sciences and has increased the relative efficiency of hospital units compared with the years before the plan, 2012 and 2013.

Research Limitations: Due to the lack of access to information for 2014 (the first year of the Health Development Plan), we were not able to participate in this study this year.

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