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Comparison of Technical Efficiency of Hospitals Affiliated to Shahid Sadoughi University of Medical Sciences before and after Executing Health Reform Plan

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ABSTRACT

Background: Hospitals are one of the greatest and most costly operational units of the health system and a study on its performance may be a criterion for operation and efficiency assessment of its resource consumption. The present study was done in 2017 with the purpose of assessing technical efficiency of the selected hospital under the coverage of Yazd University of Medical Sciences using Data Envelopment Analysis (DEA) in context of Health Reform Plan.

Methods: This research is a descriptive-analytical study was done in 2017. In this research in order to determine assessing the efficiency of Yazd University of Medical Sciences hospitals, 10 hospitals affiliated with this university were chosen. To collect data the information collection form including specifications of hospital as well as input and output index is used and the data before and after executing Health Reform Plan were collected and compared. The input-oriented DEA method is used for estimating technical efficiency of hospitals and data analysis is done by DEAP software and two-sample paired-t test $SPSS_{21}$.

Results: The average of hospitals that have been studied before and after the reform plan is 0.985 and 0.990 respectively. In management efficiency, it is respectively 0.986 and 0.992 before and after the reform plan and the efficiency average of the hospital's scale before and after executing the health reform plan is respectively 0.999 and 0.997. There is no meaningful relationship observed between hospitals' efficiency grades before and after the reform plan in these three technical, management and scale types of efficiency (P-value > 0.05).

Conclusion: According to results we could say the efficiency of the hospitals was not so affected by reform plan. It is recommended to assess the efficiency of the Stochastic Frontier Analysis (SFA) method on a linear basis in addition to identifying indexes that are effective in efficiency of hospitals.

Keywords: Efficiency, Hospital, Amendment, Health Reform Plan, Technical Efficiency

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Introduction

Nowadays health points of view have wider perspectives and they have also pay special attention to non-medical expectations. Growth of expectations as well as people's attention to safety, quality, and justice, has increased the pressure to make a responsive health system against operation (1). Health section of most countries generally faced with asignificant increase in costs of health and medical treatment cares especially increase in hospital costs (2). This issue isa result of the combined effect of factors related to requests such as population and epidemiologic changes as well as factors related to supply including advanced technology and insufficient information to be available for customers and consumers of medical treatment cares (3). Besides, studies show that this cost increases at least maybe partly because of the inefficient use of sources (4). Hospitals as one of the important institutions that present health and medical treatment services of health section have special sensibility and importance in the medical treatment economy (5). In addition, these centers have a high percentage of sources in the health section, so that 50-60 percent of the health sectionbudget, as well as a huge share of educated and specialist forces, are allocated to hospitals. Therefore the optimization of their sources i.e. key consumers in health and medical treatment systems is very important (6).

One of the assessment methods of how hospitals use this high volume of allocated sources is studies related to efficiency. In a brief definition, the efficiency is maximum usage of sources to produce output. To determine the amount of efficiency or inefficiency each institution shall use the proper index(s) as a criterion of comparison. The efficiency of the hospital in using sources may be evaluated by taking advantage of specific indexes and by analyzing the same and planning for improvement of efficiency indexes one can expect efficiency improvement at the system (7). At the health literature, DEA has been mostly esteemed for efficiency assessment of hospitals and the medical treatment industry. Extensive studies for instance by Gannon in Ireland, Hofler and Folland in America, MiikaLinna in Finland, Parkin and Hlingsworth in Scotland, Goodarzi et al in Iran have been done that all of them emphasize on applying DEA for hospitals efficiency assessment which is a suitable method for health systems (8-13). DEA is a nonparametric mathematic programming method that estimates a frontier using all observations in a function and it is known as this name since it covers and includes all data. The nonparametric method is based on a series of optimization using linear programming. In this method, the efficient frontier curve is shaped from a series of points that are determined by linear programming. Meanwhile, by this method multi-output and multi-input analysis can be used without predetermining their weights and also this method may be applied for observed data with no need for product information according to relative efficiency measurement. However, there are different methods for determining the efficiency that all of them have advantages and disadvantages; therefore, specifying the best method may be the appropriate solution in determining production efficiency for directors (14). So that considering hospitals as an organization that faces with multiple data and output simultaneously, the DEA technic is one of the most useful models that have the ability of such assessment for hospital efficiency measurement (15).

In Iran by coming to the work of the new government, the health system amendments were formed at the framework of health system reform plans approval and financial supply of these plans. The collection of health system reform plans have been started since 5 May 2014 all over the country with the purpose of financial protection of people, creating justice in accessing health services and development of service quality (16). Regarding the allocation of a significant share of the government budget to the health and medical treatment section in this plan, the need for service assessment of this section is

important relatively (17). Some studies have been done in Iran as to the effect of reform plan on indexes of health section that it is worthy to mention the study of Kheiri and colleagues at the hospitals under the coverage of Iran universities of medical sciences. The result of this study showed that regarding purposes of reform plan it had positive effects on a decrease in patients' payable amount, increase in natural childbirth, hospitalization services development and increase of physicians stay in deprived areas (18). Meanwhile, at the study of Dadgar and colleagues after executing the reform plan all the indexes under study were at the situation better than before. Yet, most studies in this field have investigated the efficiency only in one section while the present study investigates the effect of reform plan too. In addition in the present study input and output index have been chosen based on 4 pack of health reform plan existed in all hospitals, hence, objective-based indexes entered the study. Efficiency assessment as one of the effective factors on the efficiency of hospitals as one of the executive elements of the health system reform plan may help its planners and executive agents in order to identify the strengths and weak points better and improve that. Therefore, this study with the purpose of measuring the efficiency of hospitals under the coverage of Shahid Sadoughi University of Medical Sciences of Yazd was done before and after executing the health system reform plan.

Materials and Methods

The present study is a descriptive-analytical was done in 2017 based on data of 2013 and 2014 that are respectively the years before and after the health reform plan. Although the main purpose of the present research was hospital efficiency measurement and the principles and technics applied in it may be used in solving executive and real issues, therefore this research is practical research that is done retrospectively. The research population in this research is all hospitals under the coverage of Yazd University of Medical Sciences that entered the study on a complete enumeration basis. Taft Psychiatric hospital for having psychiatry specialty and Bahabad Hospital for being newly established were exited the study. A data collection tool is a researcher-made form that was prepared by taking opinion polls from experts in the field of health management and economy. This form includes the name of the hospital, number of beds, hospital's budget, number of house physicians, number of outpatient referrals, bed occupation factor, payments by patients, number of patients determined less than six hours and the average period of visits.

The data collection methods in this research are field and library research methods. In a way that some data related to research subject had been obtained from library research and by referring to books, articles, and the internet. The other part of data related to hospitals, their inputs, and outputs had been extracted by university medical treatment deputy in a way that the researcher gave the designed form electronically to the statistics expert of medical treatment deputy by cooperating with medical treatment deputy and management of Shahid Sadoughi University of Medical Sciences of Yazd and thereafter data completion the completed form was received.

The health reform plan packages had been used to choose data and output and to achieve logistic results in context of health reform plan, in a way that among eight defined package in health reform plan including promotion of natural childbirth, hoteling quality upgrade, decrease in patients payables, emergency services upgrade, visits quality upgrades, house physicians stay, health services tariffs and presence of specialists at the hospital, four packages that were fully in process in all Yazd Medical Sciences hospitals were chosen. These four packages include: hoteling quality upgrade, decrease in patients payables, emergency services upgrade and visit quality upgrades. Other packages did not exist in some hospitals and/or they were not fully executed. Based on four packages, four data (number of beds, hospital's budget, number of house physicians, number of outpatient referrals)

and four outputs (bed occupation factor, payments by patients, number of patients determined less than six hours and average period of visits) were conducted in context of efficiency assessment of reform plan; in a way that one data and one output were considered for each package. Input and output indexes were selected by taking advantage of health reform plan documents as well as the opinion of three specialists in the field of health and medical treatment management and two physicians of Committee on Statistics and IT.

All collected data entered the software with utmost accuracy and precision, and to ensure its accuracy the statistic expert of the university has confirmed the data. Meanwhile, the researcher has analyzed and explained data without any prejudice.

After collecting data from relevant centers, the data entered DEAP software divided by the year of study and the amount and type of hospital efficiency as to the scale were determined. DEA was applied for computing technical, management and scale efficiency. Then the software output including hospital operation results had been processed and analyzed on a comparative basis according to the selected approach. So that the closer technical efficiency is to number one the more efficient it is. This amount may be a maximum of 1 and a minimum zero. The type of efficiency to scale is analyzed based on scale efficiency and the amount of input surplus and output deficiency is analyzed based on net technical efficiency. $SPSS_{21}$ software and a two-sample *paired t-test* were also applied for comparing efficiency results. Required permits were obtained from Yazd University of Medical Sciences.

The authors declare that they have complied with the principles of the Helsinki Declaration.

Results

Result out of assessment pattern of technical, management and scale efficiency are presented in 10 hospitals of Yazd University of Medical Sciences. In technical efficiency, before executing reform plan 2 hospitals (EmamJafarSadegh of Meibod and Khatamolanbia of AbarKouh) and after executing reform plan 3 hospitals (Shahid Sadoughi, EmamJafarSadegh of Meibod and Khatamolanbia of AbarKouh) affiliated with Yazd University of Medical Sciences did not have full efficiency. However, the average of hospital efficiency grade had 0.005 increases.

Among hospitals affiliated with Yazd University of Medical Sciences, excluding two hospitals, the amount of management efficiency was one in other hospitals. In addition, the amount of hospitals efficiency before executing reform plan was 0.986 that was increased to 0.006 after executing reform plan, however, the increase was not significant as in terms of statistics (P-value > 0.05).

At scale efficiency 2 hospitals did not have full efficiency and the amount of hospitals efficiency after executing reform plan had some decrease. Yet, the results of two sample paired-t test did not show any significant relation between grades of hospitals efficiency before and after executing reform plan (P-value > 0.05).

Totally the efficiency of hospitals under study did not have any significant change after health reform plan (P-value > 0.05).Yet, the amount of technical and management efficiency had respectively 0.005 and 0.006 increase after executing health reform plan.

Table 1. Technical Efficiency of Educational Hospitals affiliated with Yazd University of Medical Sciences

Hospital	Before executing reform plan	After executing reform plan
Shahid Sadoughi	1	0.986
Shahid Dr. Rahnamoon	1	1
Mohammad SadeghAfshar	1	1
Zeyaei of Ardakan	1	1
ShahidBeheshti of Taft	1	1
EmamJafarSadegh of Meibod	0.881	0.942
Fatemeh Al-Zahra of Mehriz	1	1
Ayatollah Khatami of Khatam	1	1
Valiasr of Bafgh	1	1
Khatamolanbia of AbarKouh	0.975	0.972
Average & Standard Deviation	0.985 ± 0.37	0.990 ± 0.19
Amount of t	- 0.683	
Significance Level	0.512	

Table 2. Management Efficiency of Educational Hospitals affiliated with Yazd University of Medical Sciences

Hospital	Before executing reform plan	After executing reform plan
Shahid Sadoughi	1	1
Shahid Dr. Rahnamoon	1	1
Mohammad Sadegh Afshar	1	1
Zeyaei of Ardakan	1	1
Shahid Beheshti of Taft	1	1
EmamJafarSadegh of Meibod	0.885	0.943
Fatemeh Al-Zahra of Mehriz	1	1
Ayatollah Khatami of Khatam	1	1
Valiasr of Bafgh	1	1
Khatamolanbia of AbarKouh	0.976	0.979
Average & Standard Deviation	0.986 ± 0.36	0.992 ± 0.18
Amount of t	- 1.05	
Significance Level	0.318	

Table 3. Scale Efficiency of Educational Hospitals affiliated with Yazd University of Medical Sciences

Hospital	Before executing reform plan	After executing reform plan
Shahid Sadoughi	1	0.986
Shahid Dr. Rahnamoon	1	1
Mohammad Sadegh Afshar	1	1
Zeyaei of Ardakan	1	1
Shahid Beheshti of Taft	1	1
EmamJafarSadegh of Meibod	0.996	0.998
Fatemeh Al-Zahra of Mehriz	1	1
Ayatollah Khatami of Khatam	1	1
Valiasr of Bafgh	1	1
Khatamolanbia of AbarKouh	0.999	0.993
Average & Standard Deviation	0.999 ± 0.001	0.997 ± 0.004
Amount of t	1.19	
Significance Level	0.262	

Discussion

In this research, the efficiency of hospitals under the coverage of Shahid Sadoughi University of Medical Sciences of Yazd was assessed before and after executing the health system reform plan. According to results of this research, the technical

efficiency average of units understudy is 98.5 % and their management efficiency and scale efficiency are 98.6 % and 99.9 % respectively before health system reform plan, and after executing health reform plan the technical efficiency, management efficiency and scale efficiency are 99 %, 99.2 %, and 99.7 % respectively. Based on these results although the average efficiency increased shortly after the health reform plan, this increase was not significant in terms of statistics and the health reform plan did not increase outputs significantly. According to studies of Dehghan and Colleagues in evaluating the performance of health system reform plan, in 2015 academic hospitals of Yazd province showed that health reform plan goals achievement is at "Good" level from viewpoint of executive managers, but the performance of some instructions of reform plan was not as expected (19). The results from studies of Joshan and Colleagues in 2016 showed that the health reform plan had a slight change in the efficiency of hospitals and efficiency of hospitals understudy in all three universities was not significant in terms of statistics (14). The results from studies of Nabilou and Colleagues in 2016 for evaluating the performance of hospitals under the coverage of Oroumieh universities of Medical Sciences before and after making a health system reform plan showed that by executing this plan the hospitals performed efficiently and they had a significant increase in performance (15). In a study by Poorreza and Colleagues in Tehran University of Medical Sciences, the efficiency of educational and public hospitals was separately assessed and there was a significant difference between these two groups of hospitals (20). In research of Ghazizadeh and Colleagues in 2018 on performance indexes in hospitals under the coverage of East Azerbaijan province health network before and after the reform plan, it can be observed that execution of health system reform plan had a considerable effect on performance index of hospitals (21). The results from study of Amouzadeh and Colleagues in 2017 showed that the efficiency and efficiency rank of hospitals of Babol University of Medical Sciences and Mazandaran University of Medical Sciences increased after health reform plan that 61.9 % of hospitals studied in this research were efficient before the plan and 71.45 % of the hospitals was efficient after reform plan (22).

In foreign studies, the results were somewhat in line with the results of the present study. For instance, Jiang and Colleagues in the assessment of China's hospitals showed that scale and amount of hospital services have been increased sharply but the efficiency was relatively low and it had a slight decrease as of 2008 up to 2012 (23). Unlike the present study efficiency assessment in hospitals of Turkey showed that after amendments the efficiency improved (24).

It is worthy to mention the type of studied hospitals in different researches as well as the specialty of the hospital as to differences between the abovementioned studies and the results of the present study. Since in efficiency the input indexes are highly depended on type and specialty of the hospital, these results may be different in different universities. Meanwhile, efficiency assessment in the different years may be also another reason for the difference in results in a way that in the first years of health reform plan hospital performance indexes were better than in recent years.

Yet, we can deduce the reason for the slight difference in the efficiency of hospitals understudy, before and after executing the reform plan studied indexes may not indicate the activities in the health reform plan. Also, since in the DEA method an institution is considered as reference, the simultaneous correlation between hospitals affected by one plan may be another reason for this issue. Temporary impact of some health reform plan packages as well as non-entering all health reform plan packages in this research because of the lack of some packages in all hospitals may be one of the reasons.

One of the limitations of this research may be a lack of data and information for indexes before executing a health reform plan that makes it difficult for the selection of a special index. Also, to compensate for self-correlation and the

simultaneous correlation between hospitals it is recommended to use super DEA in further studies. One of the strengths of the present study in the ratio of other studies in this field is the selection of input and output indexes fit to reform plan packages to assess the effects of reform plan on efficiency in a logistic method.

Conclusion

Generally, although the efficiency of hospital understudy was ideally, the directors shall try more for more improvement of hospitals' efficiency and make necessary plans for that. Meanwhile, familiarizing directors with economic technics and analysis and applying these principles for accurate needs assessment and planning for preventing sources to be waste and evaluating reasons for not using all sources at inefficient sections could be an effective and breakthrough. Considering the efficiency measurement makes a criterion for comparing the amount of using existed sources as to standard criteria and/or an index for assessment of hospital performance, the university authorities can use their efficiency rank for budgeting and supplying hospital credit.

This research may be a tool for a better policy of health reform plans in addition to helping better source management. Efficiency assessment helps hospitals to identify their efficient usage and the inefficient hospitals compare their performance with efficient hospitals of the same level and determine the capacity of their progress and improvement. The health system reform plan has increased patients access to medical treatment hospitals by decreasing payment and plans such as clinic development, visit quality improvement, the resistance of physicians in deprived areas, and it is useful for people who do not follow up their illness and medical treatment because of bad financial affordability. The continuation of this kind of plan will be a useful step in the fulfillment of public envelopment of health and justice under the condition of planning for stable financial resources and supplying proper manpower and physical resources. Yet, the results of present study shows that the efficiency of hospitals under study did not have any significant change before and after executing health reform plan and some these results short term consequences of some health reform plan packages such as visit upgrade, hoteling, and some results may be done by changes in reform plan packages in other economic dimensions such as effectiveness. It is recommended to assess the efficiency of the SFA method on a linear basis in addition to identifying indexes that are effective in efficiency of hospitals.

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Conflict of interests

The writers declared that there is no conflict of interests in this research.

Authors' contributions

Zarezadeh M designed research; Zarezadeh M collected data; Mahboubi P analyzed data; Mahboubi P wrote manuscript. Zarezadeh M had primary responsibility for final content. All authors read and approved the final manuscript.

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