The effect of Iran's Health Transformation Plan on Hospital Performance Kerman Province

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Abstract

Background Iran has performed Health Transformation Plan(HTP) from 2014 to obtain its defined goals. This study assesses and compares the efficiency and productivity of university and non-university hospitals in Kerman provinces, Iran.

Methods The data of 19 selected hospitals, two years before and two years after the Health Transformation Plan was collected in this cross-sectional study. These data included the variables of physician and nurse number, and active beds as inputs and bed occupancy rate and inpatient admission adjusted with the length of stay as outputs. Data Envelopment Analysis method used to measure hospital efficiency. Malmquist Productivity Index used to measure efficiency change model before and after the plan. The efficiency was estimated using Deap 2.1 program, and the effect of the plan on efficiency and productivity of hospitals was assessed using Stata 15.

Results The results indicated that the average efficiency of all hospitals before the HTP was 0.843 and after the HTP was increased to 0.874. However, this was not significant ($P>0.05$). Productivity also had a decreasing trend.

Conclusion Based on the results of the DEA method, it was found that the efficiency and productivity of university and non-university hospitals did not increase significantly after the HTP. Therefore, it is recommended that attention should be paid to the performance indicators of hospitals regarding how resources are allocated and decisions made.

Background

The increasing trend of healthcare costs has persuaded the governments and health policymakers to increase productivity and efficiency [1]. Health system reforms more or less have left behind favorable effects. For example, Turkey's country after performing health transformation program has gained significant improvements regarding performance indices [2].

By attention to overall missions and upstream documents, especially Iran's 20 years’ vision document, and also Iran supreme leader policies, Iran Ministry of Health and Medical Education have launched Health Transformation Plan(HTP) from 2014 [3]. The main goals of HTP included obtaining equity, financial protection and access to healthcare services through performing 7 packages of decreasing payment rate of hospitalized patients, support physician residency in the deprived areas, presence of resident specialist physicians in university hospitals, improving visit services quality, financial protection for difficult to cure patients, promotion hoteling services in the university hospitals, and promote natural delivery [4].

Hospitals because of consuming the most resources in the healthcare system, something between 50 to 80% of it, so promoting its efficiency is amongst the main goals of health policymakers all over the world.

The conservative estimates indicate that about 300 billion dollars are missed annually because of inefficiency in hospital utilization [5, 6].

A Decision-Making Unit (DMU) such as a hospital is efficient when a predefined level of its outputs are produced with the lowest amount of inputs [7]. In this regard, there are different methods to assess hospital efficiency, including Data Envelopment Analysis (DEA) [8]. DEA, as a non-parametric linear programming method, has unique measures such as simultaneous analysis of several inputs and outputs which differentiate it from other efficiency measuring methods. By attention to Return to Scale (RTS), DEA includes two models; Constant Return to Scale (CRS) which is suitable when all DMUs work in optimum level and Variable Return to Scale (VRS) which is suitable when all DMUs do not work in optimum level [9, 10].

Pirani et al. study in southwest of Iran in 2018 [11], Moradi et al. study in Kurdistan of Iran in 2017 [12], Samut and Cafrı study in OECD countries in 2016 [13], Van Ineveld et al. study in Netherlands in 2016 [14], Sahin Gok and Altındag study in Turkey in 2015 [1], Azar et al. study in Tehran in 2013 [15] have assessed the effect of HTP on hospital performance using DEA method.

In Iran, few studies have examined the impact of the HTP on the efficiency and productivity of hospitals. Thus, the goal of this paper is to compare the efficiency of the university and non-university hospitals in Kerman before and after HTP.

Methods

Study Population and sampling

The study population of this study cross-sectional study included 19 hospitals located in Kerman province in the southwest of Iran. These hospitals were selected because their full data were existence in the Kerman University of Medical Sciences databases. So, we do not use sampling, and all of the hospitals were entered into the study. Among these, ten hospitals were university, and nine were non-university (public and private).

DEA method

The non-parametric method of DEA used to measure efficiency and productivity. In this method, it is possible to determine efficient points using two hypotheses of CRS and VRS and to determine the efficiency DMUs it is possible to use two hypotheses input-oriented minimization and output-oriented maximization [16, 17].

Because by 1 unit increases in the inputs, the outputs do not increase the same, so VRS method used to assess efficiency. Also, because the outputs are not in the control of managers, and they can increase the efficiency only by minimize the inputs- oriented model used to analyze using DEA program [10].

Another measure used in this study is the Malmquist Index(MI), which evaluate the efficiency over time [18]. MI separates total productivity to two main ingredients id est. Technological efficiency changes and technical efficiency changes. In one hand, if MI index based on input-oriented method be lower than one, it implies on performance improvement. While the MI index higher than one implies a decrease in performance over time. In the other hand, based on the output-oriented method, MI index lower than one implies on worsen performance and bigger than one indicated improvement in performance over time [19, 20]. MI index was used in the current study to assesses changes in hospitals efficiency before and after HTP.

Data source

The most important inputs and outputs to assess hospital performance were identified by a literature review [1, 17, 21, 22]. Then, the data regarding selected parameters in the study hospitals were extracted from the databases of Kerman University of Medical Sciences for period two years before and two years after HTP in 2014.

Inputs and outputs of the model

To assess hospital performance using DEA method, the indices were categorized into inputs and outputs. Input variables included the number of physicians, nurses, active beds, and outputs variables included bed occupancy rate and inpatient admission. It is worth noting that admission variable was adjusted based on length of stay in hospital.

Data Analysis

After performing the Kolmogorov–Smirnov test to assess normality, the normal data using Pair t-test and otherwise, the data were analyzed using Wilcoxon test to compare mean efficiency and productivity of hospitals in two mentioned periods. Deap 2.1 software was used to calculate the efficiency and productivity of hospitals.

Results

Nineteen hospitals in which 10 were university and nine non-university hospitals were assessed. Before HTP, 70% and 78% of university and non-university hospitals obtained optimum efficiency score, respectively (score between 0.8 and 1). This score after HTP for university and non-university hospitals was 80% and 78% respectively.

[Insert Table1]

As table 1 indicates, the inputs and output are compared in 3 scenarios, including hospital, non-hospital, and total hospitals before and after HTP. HTP has increased significantly the inputs of the number of nurses and active beds and the inputs of bed occupancy rate and the number of inpatient admissions adjusted with the length of stay ($P<0.05$). Also, the bed occupancy rate and the number of inpatient admissions adjusted with the length of stay has increased by 15% and 20% after HTP respectively, which are among the positive effects of HTP.

There was no significant increase in the inputs and outputs after HTP in non-university hospitals ($P<0.05$), Which means that HTP has not caused a significant change in the inputs and outputs.

Study on the effect of HTP on total Kerman province hospitals indicated that the most change was in inpatient admission adjusted with the length of stay with 20% increase and the lowest change was in the number of physicians with 0.4% decrease. Increase in the inputs of nurses and active beds and also in inpatient admission adjusted with the length of stay was statistically significant ($P<0.05$).

Overall, the results indicated that non-university hospitals had obtained higher efficiency after HTP in comparison with other hospitals (Table 2). The difference between the mean efficiency score of studied hospitals (university, non-university, and total) before and after HTP was not statistically significant ($p<0.05$). The mean efficiency score of university hospitals in years after HTP id est. 2015 and 2016 had decreased from 0.877 to 0.858, respectively. The efficiency of non-university hospitals increased in 2016 in comparison with 2015, slightly. Also, considering total hospitals, the efficiency score has increased 3% after HTP in comparison with before it. The mean efficiency score of the university and non-university hospitals was 0.858 and 0.886 in 2016, respectively, which indicates hospitals' efficiency promotion capacity without any decrease in the costs and applying the same amount of inputs was 14.2% and 11.4%, respectively (Table 2).

Table 2. Technical efficiency of University and non-university hospitals

Year		University hospitals		Non-university hospitals		Total hospitals	
		Efficiency	Paired t-test (sig)	Efficiency	Wilcoxon test (sig)	Efficiency	Wilcoxon test (sig)
Before HTP	2012	0.861	0.548	0.835	0.686	0.849	0.294
	2013	0.828		0.849		0.838	
	Mean	0.845		0.842		0.843	
After HTP	2015	0.877		0.875		0.876	
	2016	0.858		0.886		0.871	
	Mean	0.868		0.880		0.874	

The productivity of 4 mentioned scenarios considering 2012 as the base year are presented in Table 3. Accordingly, hospitals in 2013 had low performance in comparison with 2012 in all scenarios. The situation has become a little better in 2015 than in 2013, but productivity has a decreasing trend. Lastly, there was a decrease in productivity and performance in 2016 than in 2012 in all the scenarios. It can be concluded that efficiency has increased after HTP but have enjoyed a decreasing trend.

Table 3. The comparison of Malmquist productivity index of hospitals before and after HTP

Year	University hospitals	Non-university hospitals	Total
2013	1.661	1.544	1.670
2015	1.162	1.349	1.324
2016	1.447	1.176	1.360
Mean	1.408	1.340	1.443

Discussion

Health system reforms, including HTP, encourage hospitals at the same time have higher efficiency with higher quality in the services [8]. This study indicated the comparison between the efficiency of the university and non-university Kerman hospitals before and after HTP using the non-parametric method of DEA approach and also the productivity of hospitals using the Malmquist Index between years 2012–2016. The inputs included the number of physicians, nurses, and active beds, and the outputs included bed occupancy rate, patient length of stay, and the number of inpatient admission.

The results indicated that the mean of inputs (excluding the number of physicians) and outputs after performing HTP have increased for university and non-university hospitals. These increases were significant in some cases. So, the number of hospital beds and the number of admissions adjusted with the mean length of stay have increased after HTP significantly in university hospitals.

By attention to observed significant difference between the inputs (the number of active beds) and the outputs (admission adjusted with mean length of stay) in university hospitals after HTP, it can be concluded that since university hospitals are among university and great ones and also since there is relationship between the efficiency and size of hospitals (for example hospitals with 200–400 beds have higher efficiency than hospitals above 400 and lower 200 beds) [23, 24], so the university hospitals after HTP have obtained higher accessibility to the inputs than other hospitals.

Performing HTP packages have been accompanied by a decrease in patient payment and an increase in access to the services. These factors have increased patients burden of the visit to hospitals, long waiting lists, and as a result, increase in inpatient admission adjusted with the mean length of stay in university hospitals than non-university ones. Accordingly, it can be said cautiously that HTP has had a significant effect on the inputs and outputs. The study of Sahin et al. showed that the number of nurses and the average number of inpatient and outpatients after the HTP increased significantly [25], which is in agreement with our findings.

The trend of changes in the efficiency of DMUs using Malmquist Index and two its sub-indices, including technical efficiency promotion index and change in efficiency frontier (innovation) was assessed based on the 2012 year. The results indicated that the trend of change in efficiency scores before and after HTP in hospital universities had a decreasing one, but this difference was not statistically significant.

The results in the non-university hospitals indicated that the trend of changes in the efficiency score both before and after HTP has been increasing. By attention that there was no significant difference between the efficiency score of hospitals before and after HTP in both groups of university and non-university hospitals, it can be inferred that HTP has not had a significant effect on the trend of changes in hospitals' efficiency. However, because of the short study period, this impression should be stated with cautious. How to design and implement reforms in the health system are amongst the determinants of reforms' outcomes.

Jiang et al. have reported that the efficiency scores of their studied hospitals have decreased after the reforms [9]. Pirani et al. indicated that the efficiency scores of hospitals both before and after HTP have been increasing [11] while another study in Turkey after launching Turkish health reforms indicated that the efficiency of university hospitals has increased and it has decreased for private hospitals [1].

Malmquist index used in this study to indicate the difference in hospital efficiency in different years and especially was used to indicates changes in efficiency before and after HTP. The MPI results of this study showed that the productivity of university and non-university hospitals decreased in the period before the

HTP, but in the first year after the HTP, the situation improved slightly and the decline in productivity decreased, but in years later, it returned to the previous situation.

By attention to being DEA method as data-oriented, increase in productivity trend indicates a decline in hospital performance which can be inferred that changes in productivity may be because of creating a shock or the effect of HTP on the inputs. Gok and Altindag indicated that the productivity of university hospitals after performing the Turkish health sector reform has increased and the productivity of private hospitals has decreased [1]. Another study on productivity and quality of Netherlands hospital services during 2005–2010 through input-oriented DEA indicated that the productivity index has decreased from 1.1 in 2005 to 0.99 in 2010 which is an indication of an increase in hospital productivity [17].

Among different methods of hospital efficiency assessment, DEA method is the most beneficial one [26]. One of the unique features of DEA than other methods is the simultaneous analysis of several inputs and several outputs [9], which determine efficiency as the ration between corresponding weights of outputs to corresponding weights of inputs [27]. Also, through precise estimation of efficiency, it can provide the comparability of each hospital with the peer ones [28]. Another advantage of DEA method than others in efficiency analysis is the determination of surplus production factors in hospitals or other DMUs, as this can be used in other sectors such as banks and financial services, investment companies and transport and shipping [29]. This is a managerial method that presents the solutions and is suitable for not-for-profit entities and hospitals which their services is not possible for precise pricing [30].

Among the strengths of this study can point out simultaneous measurement and analysis of several inputs and outputs and precise calculation of efficiency and productivity in university and non-university hospitals before and after HTP. The absence of case mix index in the output of hospitals, the absence of permanent physicians as an essential hospital resource because of physician workflow in different hospitals, and lastly not checking the impact of factors in the external environment on the efficiency of studies hospitals are among the weaknesses.

Conclusion

Overall, this study showed that the HTP had not had a significant impact on the efficiency of the university and non-university hospitals, and also the productivity of hospitals has not significantly improved. Support plans such as HTP may be encountered with a decrease in efficiency if hospitals cannot use the resources to provide higher quality services for more patients. So it is proposed to allocate resources to the hospitals based on assessment performance indices in the previous periods and rooting the issues to obtain higher efficiency. Given that this study was conducted in one of the provinces of Iran, therefore, to generalize the results should be considered cautiously. Hence, broader empowerment of local healthcare officials to making decisions regarding how to allocate the university resources by attention to the needs and necessities and then the assessment of changes in hospitals’ efficiency score, providing feedback for hospital managers and supporting interventional plans to improve performance seems necessary.

Declarations

Abbreviations

HTP: Health Transformation Plan; DEA: Data Envelopment Analysis; MPI: Malmquist Productivity Index; DMU: Decision-Making Unit; RTS: Return to Scale; CRS: Constant Return to Scale; VRS: Variable Return to Scale

Acknowledgments

Not applicable.

Authors' contributions

RG, MTG, SN, SA, and SU, contributed to the conception and design of the study. RG and SN contributed to the acquisition of the data. RG, MTG performed the analysis. All authors contributed to the interpretation of the results. MTG and SU drafted the manuscript. All authors revisited the manuscript critically. All authors read and approved the final manuscript.

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Availability of data and materials

The dataset used during the current study is available from the corresponding author, MTG, on reasonable request.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Kerman University of Medical Sciences (No. IR.KMU.REC.1398.431).

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Table 1

Table 1. Comparison the mean of inputs and outputs of university and non-university hospitals before and after HTP

University hospitals				
Inputs	Mean before HTP	Mean after HTP	Type of test	P-value
Physician	12.40	11.80	Pair T-Test	0.749
Nurse	141.85	174.60	Wilcaxon	0.013
Active beds	179.30	198	Wilcaxon	0.005
Outputs				
Bed occupancy rate	56.31	65.03	Pair T-Test	0.015
Inpatient admission adjusted with length of stay	41022.65	49287.98	Wilcaxon	0.005
Non-university hospitals				
Inputs				
Physician	9.17	8.89	Wilcaxon	0.715
Nurse	74.33	91.44	Pair T-Test	0.184
Active beds	85.94	102.89	Wilcaxon	0.528
Outputs				
Bed occupancy rate	49.14	50.56	Pair T-Test	0.765
Inpatient admission adjusted with length of stay	15700.01	19236.26	Wilcaxon	0.139
Total hospitals				
Inputs				
Physician	10.87	10.42	Wilcaxon	0.624
Nurse	109.87	135.21	Wilcaxon	0.003
Active beds	135.08	152.95	Wilcaxon	0.008
Outputs				
Bed occupancy rate	52.92	58.18	Pair T-Test	0.069
Inpatient admission adjusted with length of stay	29027.71	35052.96	Wilcaxon	0.001