Management Reform at the Discretion of Public Hospitals in Japan

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Research

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Abstract

Background: The purpose of this study is to evaluate whether the management reform carried out at the discretion of each public hospital has affected the management efficiency of public hospitals.

Methods: This was a retrospective cohort study of public hospitals in Japan. The dependent variable was a technical efficiency score calculated using data envelopment analysis. The independent variable was the presence or absence of a reform plan. Nine control variables were collected in this study; hospital location conditions, nursing standards, transfer to other accounts ratio, disaster base hospital designation, clinical training hospital designation, population under 15 years old, number of hospitals per 1,000 km^2, number of beds per 100,000 population, and population density. Univariate and multivariate analysis was performed. A P value < 0.05 was considered statistically significant.

Results: There was no significant difference in technical efficiency in univariate analysis and multivariate analysis between public hospitals with and without reform plan.

Conclusions: Management efficiency did not improve among public hospitals with management reforms plans. The reason for this lack of improvement is considered to be due to the fact that the management reforms plans were formulated and implemented at each hospital’s discretion.

Background

In recent years, rapid aging of the general population has progressed not only in Japan but also all over the world.[1] The efficiency of the medical service supply system must be increased to accommodate this rapid gaing.[2] Various policies have been enacted in Japan and overseas to promote efficient service provision, including policies pertaining to public hospital management.[3–10] Several previous studies have assessed the outcomes of these policies. For example, Sahin et al. (2018) compared management efficiency before and after the government's networking policy for public hospitals.[11] Management efficiency after networking public hospitals was significantly higher than before networking. Jiang et al. (2017) also reported that efficiency improved as a result of increasing the number of beds and the number of doctors according to policy.[12] In addition, Nozao (2007) found that the subsidy ratio to the total revenue in the previous term was associated with the management efficiency of public hospitals in Japan.[13] According to the study, an increase in the ratio of subsidies to total revenue in the previous fiscal year caused softened budget constraints; thus, some entities did not perform efficient operations in anticipation of government relief. As a result, management efficiency decreased in anticipation of ex post facto relief.

Guidelines for public hospital management reform were announced in 2007 and 2015 by the Ministry of Internal Affairs and Communications (MIC) in Japan with the intention of improving the management of public hospitals.[14,15] The public hospital reform guidelines primarily focused on management efficiency, reorganization, networking, and revision of management status. However, each public hospital did not have to receive a national evaluation of the reform plan it formulated based on the public hospital reform guidelines. Unlike the aforementioned management reform of public hospitals outside Japan, Japanese public hospitals reformed management at their own discretion. To the best of our knowledge, no study has quantitatively evaluated the impact of public hospital reforms that were implemented at each hospital's discretion, rather than the government's initiative, from formulating to implementing reforms. This study evaluated whether management reform carried out at the discretion of each public hospital affected management efficiency.

Methods

Material

This was a retrospective cohort study of public hospitals in Japan, based on the “Management Strategies of Public Enterprises and Development Status of New Public Hospital Reform Plan” published by MIC.[16]

Dependent variables (technical efficiency score)

The dependent variable was a technical efficiency score calculated using data envelopment analysis (DEA). In this study, an input-oriented Charnes-Cooper-Rhodes model was used according to previous research. In DEA, a decision-making entity (DMU) produces outputs using inputs. In this study, a DMU was defined as a hospital listed in the “Management Strategies of Public Enterprises and Development Status of New Public Hospital Reform Plan.” The inputs were the number of beds, and costs of staff salaries and materials in FY2017, while the outputs were hospital and outpatient revenues in FY2017. These data were obtained from the 2017 Local Public Enterprise Yearbook (LPEY),[17] published by the MIC. These items were based on previous studies,[13, 18] which used this reference material. Since it takes a certain amount of time for the effects of a reform plan to become evident, the data used to calculate the technical efficiency scores were those from one period later than the data used to define the independent variables. In addition, all inputs and outputs were assumed to be under DMU control.

The technical efficiency score of each public hospital was calculated using DEA SolverPRO™ 15.1 (SAITECH, Holmdel, New Jersey, USA). Technical efficiency ranged from 0 to 1, whereby the greatest hospital technical efficiency was indicated by a score of 1.

Independent variables

The independent variable was the presence or absence of a reform plan. Plan development status was determined based on the information described in the “Public Enterprise Management Strategies and New Public Hospital Reform Plan Development Status.” The exposure group was defined as facilities with a statement in the “Management Strategies of Public Enterprises and the State of New Public Hospital Reform Plan” that a reform plan had been formulated. The comparison group consisted of facilities that were not described in that document as having a reform plan. There were no exclusion criteria.

Control variables

Nine control variables were collected in this study. These were predominately those shown in previous studies to affect the efficiency of public hospitals. To prevent reversal of causality, these data were the most recently available before 2017, consistent with previous studies.[13, 18]

(1) Hospital location conditions

This variable indicated whether the hospital was an unprofitable district hospital. An unprofitable district hospital refers to a general hospital that meets the criteria described below. A general hospital is a hospital whose beds are predominately general beds or medical treatment beds, as opposed to a hospital that primarily provides rehabilitation, or a hospital that is primarily a child welfare facility. Among general hospitals, a hospital with fewer than 150 beds and a distance of 15 km or more to the nearest general hospital is defined as a Type 1 unprofitable district hospital. In addition, if the number of hospital beds is fewer than 150 and the population within a radius of 5 km of the hospital is fewer than 30,000 persons according to the latest national government survey, it is defined as a Type 2 unprofitable district hospital. In this study, the variable listed in the 2016 LPEY[19] was used: Type 1 unprofitable district hospitals were assigned a dummy variable value of 1 and Type 2 unprofitable district hospitals a value of 2; otherwise a value of 3 was assigned.

(2) Nursing standards

This number represented the number of patients per nurse. These data were also obtained from the 2016 LPEY.

(3) Transfer to other accounts ratio

According to the definition of the MIC, a transfer from other accounts is a transfer from accounts such as the general account. It is basically a subsidy from the government. It is used to pay expenses that, due to the nature of the company, are not appropriate to allocate income from management. It is also used to pay expenses that are objectively recognized as difficult for an enterprise to cover via its income only, even if it operates efficiently.[20] The variable used was the ratio between other accounts and the current account. The figures listed in the 2016 LPEY were used.

(4) Disaster base hospital designation

Disaster base hospitals are designated by the Ministry of Health, Labor and Welfare as facilities that satisfy the following conditions:[21]1. Emergency response to disasters is possible 24 hours a day, and there is a system that can accept and treat victims in the affected areas. 2. Seriously ill patients can be accepted and transported by helicopter. 3. There is a medical relief team dispatch system that cooperates with the fire department (emergency fire assistance team). 4. In addition to being able to dispatch doctors by helicopter, the hospital is equipped with sufficient medical equipment, medical systems, and information collection systems to support this dispatch, as well as heliports, emergency vehicles, and self-contained equipment that can be dispatched to medical teams. In this study, disaster base hospitals were assigned a dummy variable value of 1 and other hospitals a value of 0.

(5) Clinical training hospital designation

A hospital that conducts clinical training can be designated as a clinical training hospital if it meets several criteria.[22] In this study, we assigned a dummy variable value of 1 to facilities that were designated as a clinical training hospital, and 0 otherwise.

(6) Population under 15 years old (in secondary medical zone)

This figure is the population under the age of 15 in the secondary medical zone (a medical zone that can provide medical care related to general hospitalization) to which the hospital belongs. These figures were calculated by the authors with reference to the correspondence table of local governments and secondary medical areas published by the Japan Health Economics Research Organization (JHERO)[23] and the 2015 national census.[24]

(7) Number of hospitals per 1,000 km (in the secondary medical zone)

This figure represents the number of hospital facilities per 1,000 km in the secondary medical zone. These figures were independently calculated by the author with reference to the correspondence table published by the JHERO and the 2016 Healthcare Facility Survey.[25]

(8) Number of beds per 100,000 population (in secondary medical zone)

This figure is the number of beds per 100,000 people in the secondary medical area. These figures were independently calculated by the author with reference to the correspondence table published by the JHERO and the 2016 Healthcare Facility Survey.

(9) Population density (in secondary medical zone)

This figure represents the population density in the secondary medical area. This figure was independently calculated by the author, referring to the correspondence table published by the JHERO and the 2015 census.

Data analysis

The presence of significant between-groups differences was assessed for each demographic data using t-tests and Mann-Whitney's U-tests.

DEA was performed using variables collected for inputs and outputs, and a technical efficiency value (θ) was calculated. Since $0 \leqq \theta \leqq 1$ and $\frac{1}{\theta} - 1$ were censored data with 0 as the lower limit, the Tobit model was used for both univariate and multivariate analysis, following Chilingerian (1995)[26] and Maddala

(1983).[27]

We performed a univariate analysis. A univariate analysis was performed with the existence of the reform plan as the independent variable and $\frac{1}{\theta} - 1$ as the dependent variable. Subsequently, another univariate analysis was performed in which each of the control variables was the independent variable and $\frac{1}{\theta} - 1$ was the dependent variable.

Finally, to correct for potential confounding bias, multivariate analysis was performed that adjusting for the control variables described above. In all of the above analyses, a two-tailed significance level of 5% was adopted. STATA 14.0 (State Corporation, Lake Way, Texas, USA) was used to conduct all analyses.

Results

There were 899 hospitals from which information was collected. Assuming that missing data occurred randomly, hospitals with at least one missing value among the variables collected were excluded from analysis. Finally, 672 facilities were analyzed.

Table 1 shows the characteristics of the target facilities analyzed. There were significant differences between groups in terms of the current account balance ratio, the number of beds in the secondary medical area, and the population density of the secondary medical area.

Variable	Hospitals with reform plans (n = 634)	Hospitals without reform plans (n = 48)	
Number of beds (n; median, Q1, Q3)	181.5 (96.0, 339.0)	194.5 (76.0, 316.0)	
Staff salary (yen; median, Q1, Q3)	1592364 (745628, 3971835)	1816375 (784502, 4411184)	
Material costs (yen; median, Q1, Q3)	421517 (143252, 1464443)	436254 (127097, 2194336)	
Hospitalization revenue (yen; median, Q1, Q3)	1453023 (547503, 4345328)	1535053 (456400, 4435451)	
Outpatient revenue (yen; median, Q1, Q3)	758600 (305272, 1984942)	693860 (307287, 1750540)	
Location conditions (n; %)			
1	85 (12.65)	10 (1.49)	
2	150 (22.32)	8 (1.19)	
3	391 (58.18)	28 (4.17)	
Nursing standard (patients per nurse; mean, SD)	9.86 (3.26)	9.85 (2.87)	
Current account balance ratio (%; (mean, SD)	16.84 (11.53)	20.20 (10.64)	□
Disaster base designated hospital (n; (%)	214 (31.85)	12 (1.79)	
Clinical training designated hospital (n; %)	215 (31.99)	12 (1.79)	
Number of hospitals in the secondary medical area (facilities/1000 km^2; median, Q1, Q3)	13.74 (7.42, 35.40)	48.14 (11.53, 169.63)	□
Number of beds in the secondary medical area (beds/100,000 population; mean, SD)	1412.17 (485.53)	1418.80 (480.50)	
Population density (persons/1000 km^2; median, Q1, Q3)	1114.4 (410.6, 3203.2)	2836.85 (645.10, 15013.80)	□
Percentage of	12.12 (1.34)	12.32 (0.96)	

population younger than 15 years in secondary health care area (%; mean, SD)
* p < 0.05.

Table 1

Characteristics of the target hospitals

The results of univariate analysis are shown in Table 2. All variables other than the presence of a reform plan had a significant impact on technical efficiency. This result was the same as the result of the previous study.[13,18]

Variable	Coefficient	Standard error	95% confidence interval		
			Upper	Lower	
Existence of reform plan	-0.03	0.07	0.10	-0.18	
Nursing standard	0.06	0.004	0.07	0.05	▯
Location conditions					
(1 vs 2)	-0.28	0.05	-0.17	-0.39	▯
(1 vs 3)	-0.56	0.05	-0.46	-0.66	▯
Ratio of transfer of other accounts to current account	0.03	0.001	0.032	0.028	▯
Disaster base hospital designation	-0.37	0.04	-0.3	-0.44	▯
Clinical training hospital designation	-0.41	0.03	-0.34	-0.47	▯
Number of hospitals in secondary medical care range	-0.001	0.0002	-0.0008	-0.002	▯
Number of beds within the secondary medical care range per 100,000 population	0.0001	0.00003	0.0001	0.00003	▯
Population density	-0.000006	-0.000001	-0.000004	-0.000008	▯
Percentage of population younger than 15 years old	-0.05	0.01	-0.02	-0.07	▯
* p < 0.05.					

Table 2

Results of univariate analysis

The results of multivariate analysis are shown in Table 3. Even after incorporating the control variables, there was no significant difference in technical efficiency values between hospitals that developed reform plans and those that did not (95% confidence interval: -0.06–0.12). However, there was a significant effect of the ratio of the current account balance to other accounts transfer. Specifically, if the ratio of current account balance to other account transfer increased by 1%, the inefficiency score $(\frac{1}{\theta} - 1)$ increased by 0.03. In addition, there was a significant effect of the number of hospitals in secondary medical care range. Specifically, the inefficiency score ($\frac{1}{\theta} - 1$) increased by -0.0007; that is, efficiency increased as the number of hospitals in secondary medical care range increased.

Variable	Coefficient	Standard error	95% confidence interval		
			Upper	Lower	
Existence of reform plan	0.03	0.05	0.12	-0.06	
Nursing standard	0.003	0.004	0.01	-0.005	
Location conditions					
(1 vs 2)	-0.05	0.04	0.02	-0.13	
(1 vs 3)	-0.06	0.04	0.02	-0.14	
Ratio of transfer of other accounts to current account	0.03	0.001	0.030	0.025	□
Disaster base hospital designation	-0.06	0.03	0.005	-0.13	
Clinical training hospital designation	0.02	0.04	0.09	-0.05	
Number of hospitals in secondary medical care range	-0.0007	0.0002	-0.0002	-0.001	□
Number of beds within the secondary medical care range per 100,000 population	0.00002	0.00002	0.00007	-0.00002	
Population density	-0.000001	0.000001	-0.000004	0.000009	
Percentage of population younger than 15 years old	0.001	0.008	0.02	-0.02	
* p < 0.05.					

Table 3
Results of multivariate analysis

Discussion

There were no statistically significant differences in management efficiency between public hospitals that underwent management reform at the discretion of each hospital and those that did not. This result demonstrated that management efficiency did not improve among public hospitals with management reforms plans. This study is the first to investigate the impact of public hospital reforms that were implemented at each hospital's discretion, rather than the government's initiative, from formulating to implementing reforms. The results of this study will be useful for improving the management efficiency of public hospitals, which has recently become a topic of worldwide interest.

The mechanism underlying the results of this study is suggested as the following. Each public hospital was told to formulate a reform plan to improve management efficiency based on the guidelines of MIC. In addition, as Nozao[13] indicated, public hospitals have soft budget constraints, which was the case in the current sample. Consequently, the public hospitals believed that they would receive relief from the government without executing the plan; thus, they did not execute the plan. However, costs associated with formulating the reform plan were incurred. Therefore, the management efficiency changed minimally.

The relationship with previous research is as follows. First, unlike Sahin and İlgün[11] and Jiang et al.,[12], the formulation of reform plans based on discretion to some extent did significantly affect efficiency values. In addition, the current study also suggests that public hospitals have soft budget constraints, consistent with Nozao.[13]

There are some limitations to this study. The firts limitation is the definition of technical efficiency. In this study, efficiency was calculated using the number of beds and salary costs as inputs, and outpatient revenue as the output. However, it is debatable whether hospital inputs and outputs are properly reflected in the above combinations. Depending on the definition of technical efficiency, the results obtained could change.

The second limitation is that it may take longer than expected to observe the effects of implementing a reform plan. In this study, we investigated whether there was a difference in efficiency in the subsequent fiscal year between the group that formulated a reform plan by the end of 2016 and the group that did not. There was no significant difference in efficiency in 2017, but differences may have become evident later, as implementation of the reform plan progressed.

The third limitation is not scrutinizing the content of the reform plans prepared by each public hospital. That is, even if a management reform plan that was unlikely to improve management efficiency was formulated, the associated hospital was classified into the group of hospitals that formulated reform plans. Indeed, there are hospitals that cannot achieve the numerical targets set even if the items described in the reform plan are executed, and there are hospitals where the numerical targets set in the plan are insufficient to engender improved management.[28] In the future, one might exclude such hospitals, using an appropriate index.

Conclusions

Management efficiency did not improve among public hospitals with management reforms plans. The reason for this lack of improvement is considered to be due to the fact that the management reforms plans were formulated and implemented at each hospital's discretion.

Declarations

Ethics approval and consent to participate

Ethics approval and consent to participate were not required because we used publicly available data.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used during the current study are available from the corresponding author on reasonable request.

Competing interest

The authors declare that they have no competing interests

Funding

Not applicable.

Author's contributions

Motoi Miura constructed the study design and analyzed the data and a main contributor in writing the manuscript. Masayasu Murakami and Yoshinori Nakata constructed study design. All authors read and approved the final manuscript.

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