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Mortality, Length of Stay, and Inpatient Charges for Heart Failure Patients at Public versus Private Hospitals in South Korea

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Purpose: This study compared in-hospital mortality within 30 days of admission, lengths of stay, and inpatient charges among patients with heart failure admitted to public and private hospitals in South Korea. **Materials and Methods:** We obtained health insurance claims data for all heart failure inpatients nationwide between November 1, 2011 and May 31, 2012. These data were then matched with hospital-level data, and multi-level regression models were examined. A total of 8406 patients from 253 hospitals, including 31 public hospitals, were analyzed. **Results:** The in-hospital mortality rate within 30 days of admission was 0.92% greater and the mean length of stay was 1.94 days longer at public hospitals than at private hospitals (mortality: 5.18% and 4.26%, respectively; LOS: 12.08 and 10.14 days, respectively). The inpatient charges were 11.4% lower per case and 24.5% lower per day at public hospitals than at private hospitals. After adjusting for patient- and hospital-level confounders, public hospitals had a 1.62-fold higher in-hospital mortality rate, a 16.5% longer length of stay, and an 11.7% higher inpatient charge per case than private hospitals, although the charges of private hospitals were greater in univariate analysis. **Conclusion:** We recommend that government agencies and policy makers continue to monitor quality of care, lengths of stay in the hospital, and expenditures according to type of hospital ownership to improve healthcare outcomes and reduce spending.

Key Words: Public hospitals, mortality, fees and charges, length of stay

INTRODUCTION

Previous studies examining differences between public and private hospitals have produced inconsistent results, and debate regarding the association of hospital ownership with the quality and cost of care has persisted.[1-4] Advocates for the private sector argue that their involvement in healthcare is associated with a higher quality of care[5-7] at competitive prices,[6] which leads to rapid and innovative responses[5] to customer demands.[6] Their criticisms of public hospitals underscore the

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latter's presumed inefficiency, which they attribute to bureaucratization; politicization; lack of incentives for workers,[8] because of strong unions that may increase the cost of firing staff, leading to a less efficient labor force; and delays in financial decision making.[9] Although empirical studies have produced mixed results regarding public hospitals, several European studies have indicated that either public hospitals are more efficient[10,11] than private hospitals or that no significant differences exist between the two types of institutions.[12]

In addition to concerns about the efficiency of public hospitals, questions about their quality of care have also been raised. Patient populations in public hospitals differ from those in other facilities, and these patient characteristics may influence outcomes.[13] Additionally, one study found that the adjusted mortality rates were significantly higher in public hospitals than in private hospitals,[14] suggesting a lower level of quality of care in the former. In contrast, some have argued that tax exemptions for[15] and lower administrative costs of[16] public hospitals may allow them to offer low-cost services. They maintain that a culture of quality assurance and patient safety is more achievable at public hospitals than at private institutions because profit is not the primary goal.[2,17] However, studies of the quality, cost, efficiency, and performance of healthcare providers according to ownership type have relied primarily on data from the United States[18-21] and countries in Europe.[22-24]

Following the Korean Civil War (1950–1953), the Korean government devoted considerable resources to rebuilding district public hospitals in order to provide necessary healthcare services to citizens. These municipal and provincial public hospitals played important roles in support of the nation's healthcare system, and the capacity of these institutions reached 4830 beds by 1979.[25] Increasing healthcare demands due to remarkable post-war economic growth, higher per capita income, increased recognition of the importance of good health, a new age distribution, and, most importantly, the introduction of the National Health Insurance (NHI) system in 1977 and its extension to the entire country in 1989 promoted the growth of private hospitals.[26] Indeed, the number of private hospitals increased from 234 in 1980 to 2548 in 2011.[27] Although the number of public hospitals has remained almost unchanged (there are currently 39 public hospitals), the private sector has quickly responded to and filled the gap between growing demand and limited supply.[28] Since the growth of the private sector has been spontaneous, it has not been necessary for the government to devote resources to the development of healthcare systems.

Since the implementation of NHI, all types of hospitals generally use a fee-for-service (FFS) reimbursement system.[29] Patients have considerable freedom to choose and access care providers; no restrictions on the use of primary, secondary, and tertiary medical institutions exist; and there are no penalties for repeated care.[30,31] In addition to NHI coverage, private hospitals can provide aggressive, expensive, and the latest non-NHI-covered treatment services, the costs of which are borne by patients; however, public hospitals are restricted in their ability to provide non-NHI-covered treatment services. Although NHI guarantees universal access to any hospital, co-payments (–20% for covered and 100% for non-covered services) are relatively high. Financially vulnerable individuals cannot afford the extra costs, especially for non-NHI-covered services; hence, they tend to rely on public hospitals, in which mainly NHI-covered services are provided.

The prosperity of private hospitals over the past few decades is the result of increasing demand and limited supply; however, public hospitals seem to be currently regarded as the last resort for members of the low-income population, primarily because of their financial constraints. Although private hospitals have been coping well with the dynamic healthcare market situation in Korea, public hospitals may have fallen behind private ones due to a lack of state-of-the-art medical equipment, direct control by municipal and provincial governments over all hospital operations, use of additional procedures or new treatments that are not covered by NHI, bureaucratization, politicization, lack of skilled physicians and other health professionals due to lower salaries, and lack of incentives for improved performance because hospital workers are regarded as government workers and are protected by strong labor unions.

Despite the importance of understanding the differences between public and private hospitals in terms of in-hospital mortality rates, lengths of stay (LOSs), and inpatient charges, a limited number of studies have examined these issues in South Korea.[32] In this context, this study was designed to compare in-hospital mortality rates, LOSs, and inpatient charges to inpatients suffering from heart failure at public and private hospitals in South Korea.

MATERIALS AND METHODS

Study population

We extracted nationwide data from the Korean NHI claims database for all inpatients with the diagnosis of heart failure

who were admitted to mid-size general hospitals between November 1, 2011 and May 31, 2012. Patients with heart failure were identified by International Classification of Diseases-10 codes of I110 (hypertensive heart disease with congestive heart failure), I130 (hypertensive heart and renal disease with congestive heart failure), I132 (hypertensive heart and renal disease with both congestive heart failure and renal failure), I5000–5002 (congestive heart failure), I501 (left ventricular failure), and I509 (unspecified heart failure).

This dataset contains details on inpatient claims, including patient identification, admission and discharge dates, sex, age, inpatient charges, complexity of illness, death within 30 days of admission, and identity of the hospital. Inpatient charges were the sums of the FFS claims for each patient's hospitalization. The average foreign exchange rate in 2012 was 1 USD=1126.88 KRW, and "LOS" refers to the number days per hospitalization. For patients who died within 30 days of admission, the in-hospital mortality rate was calculated as a binary variable. Complexity of illness was assessed by the provider and reported as claims data in terms of complication or comorbidity level (CCL) [CCL 0=patient does not have a complication or comorbidity (CC), CCL 1=patient has a minor CC, CCL 2=patient has a moderate CC, CCL 3=patient has a complex CC] at the time of admission of each patient. CCL was calculated via arithmetic operations performed during the grouping process and represents the cumulative effect of a patient's complications and comorbidities.[33] Two studies conducted in South Korea have used CCL as a proxy of the severity of disease.[34,35]

Our hospital-level data included the characteristics of the hospital, such as hospital type (public or private), number of beds, specialists, nurses per bed, hospital location ("metropolitan" if located in cities with a population of more than 1 million), teaching status (i.e., resident training hospitals), and bed occupancy rate. Hospital-level statistics were based on the first quarter of 2012, which was the only dataset available at the time of the study.

Korean hospitals are categorized as university research hospitals, mid-sized general hospitals, or small-sized general hospitals based on the number of beds and medical departments. University research hospitals contain more than 1000 beds and almost all possible medical departments, and mid-sized general hospitals typically contain more than 300 beds and nine major medical departments or more than 100 beds and seven major medical departments. Hospitals with fewer than 100 beds or a shortage of medical departments are classified as small general hospitals. We included only mid-sized general hospitals in the dataset, because the majority of public hospitals fell within this category (34 of 39 public hospitals). Public hospitals that did not have full data on hospital characteristics were excluded (n=3).

Of the 274 mid-sized general hospitals included in the database, only those that admitted more than one inpatient with heart failure were included. A total of 8406 inpatients were hospitalized in Korea for heart failure during the study period, and a total of 253 hospitals, including 31 public hospitals, were included in our analysis.

Statistical analysis

Continuous variables were analyzed in terms of means and standard deviations, and categorical variables were analyzed in terms of frequencies and percentages. Univariate analyses of in-hospital mortality rates, LOSs, and inpatient charges were performed to determine the unadjusted effects of hospital characteristics on these measures. Analysis of variance and chi-square tests were performed to identify group differences (Table 1 and 2).

As the unit of analysis was each patient's hospitalization, this study utilized multi-level generalized estimating equation regression (GEE) models to avoid the potential problems created by the nesting of patient observations within hospital-level data and the overestimation of significance. The GEE regression models were used to investigate the performance and characteristics of public hospitals, including in-hospital mortality rates, LOSs, and inpatient charges, after adjusting for patient- and hospital-level confounders (Table 3). Since the distributions of dependent variables (LOSs and inpatient charges, all continuous variables) were skewed, we utilized log transformations. Additionally, we employed the GEE of binary outcome variables for in-hospital mortality rates within 30 days of admission. SAS 9.2 (SAS Institute, Cary, NC, USA) was used for all calculations and analyses.

RESULTS

The sample, which consisted of 8406 patients, included more females, patients with higher CCL scores (CCL=2 and 3), and patients older than 65 years. A total of 7422 (88.3%) patients were admitted to private hospitals, and these patients had more comorbid conditions (CCL=2 and 3, 73.9%) than those admitted to public hospitals (CCL=2 and 3, 60.0%). Approximately 50.8% of patients were ad-

mitted to private hospitals located in metropolitan areas, and 63.5% of patients were admitted to private teaching hospitals. Additionally, 984 (11.7%) patients were admitted to public hospitals, while only 22.8% of patients were admitted to public hospitals located in metropolitan areas. A total of 20.0% of patients were admitted to public teaching hospitals (Table 1).

Table 2 presents the characteristics of the hospitals to which the patients included in this study were admitted. Of the 253 hospitals in our study, 31 (12.3%) were public hospitals. Of these public hospitals, seven were teaching hospitals and seven were located in metropolitan areas (22.5%). Half of the private hospitals were located in metropolitan areas, and two-fifths had teaching status. In general, private hospitals were somewhat larger than public hospitals in terms of number of beds, number of specialists, number of nurses per bed, and bed occupancy rates (Table 2).

Fig. 1 presents the results of the univariate analyses. Both the in-hospital mortality rates within 30 days of admission and the LOSs were higher in public than in private hospitals (mortality rate: 5.18% and 4.26%, respectively; LOS: 12.08 and 10.14 days, respectively). The inpatient charge per case was 13% higher and the inpatient charge per day was 32.5% higher in private hospitals than in public hospitals (per case: KRW 1598129 and KRW 1415575, respectively; per day: KRW 182554 and KRW 137787, respectively).

The results of our multi-level analysis are presented in Table 3. After adjusting for patient- and hospital-level confounders, public hospitals had a 1.62-fold higher in-hospital mortality rate within 30 days of admission than private hos-

Table 1. Characteristics of Heart-Failure Inpatients

Characteristics of inpatients	Public hospitals (n=984)		Private hospitals (n=7422)		Chi-square Pr>|t|
	n	%	n	%	
Sex					0.087
Male	339	34.50	2765	37.30	
Female	645	65.50	4657	62.70	
Age group					<0.001
Less than 65	123	12.50	1181	15.90	
65–74	172	17.50	1663	22.40	
75–84	421	42.80	3110	41.90	
85+	268	27.20	1468	19.80	
Severity (clinical complexity level)					<0.001
0 (no CC effect)	189	19.20	726	9.80	
1 (minor CC effect)	204	20.70	1213	16.30	
2 (moderate CC effect)	337	34.20	2531	34.10	
3 (severe CC effect)	254	25.80	2952	39.80	
Number of patients by geographic area					<0.001
Metropolitan area	224	22.80	3774	50.80	
Non-metropolitan area	760	77.20	3648	49.20	
Number of patients by teaching status					<0.001
Teaching hospital	197	20.00	4710	63.50	
Non-teaching hospital	787	80.00	2712	36.50	

CC, complication and comorbidity.

Table 2. Characteristics of Hospitals Admitting Heart Failure Inpatients

Characteristic of hospitals	Public hospitals (n=984)		Private hospitals (n=7422)		Chi-square Pr>|t|
	n (%)	Mean (SD)	n (%)	Mean (SD)	
Number of hospitals (n=253)	31 (12.3)		222 (87.7)		
Number of teaching hospitals (n=97)	7 (7.2)		90 (92.8)		
Number of hospitals in metropolitan areas (n=117)	7 (6.0)		110 (94.0)		
Number of beds		269.02 (121.29)		470.17 (206.62)	<0.001
Number of specialists		26.80 (16.06)		68.58 (47.81)	<0.001
Number of nurses per bed		0.44 (0.12)		0.52 (0.21)	<0.001
Bed occupancy rates		80.98 (16.57)		86.45 (15.64)	<0.001

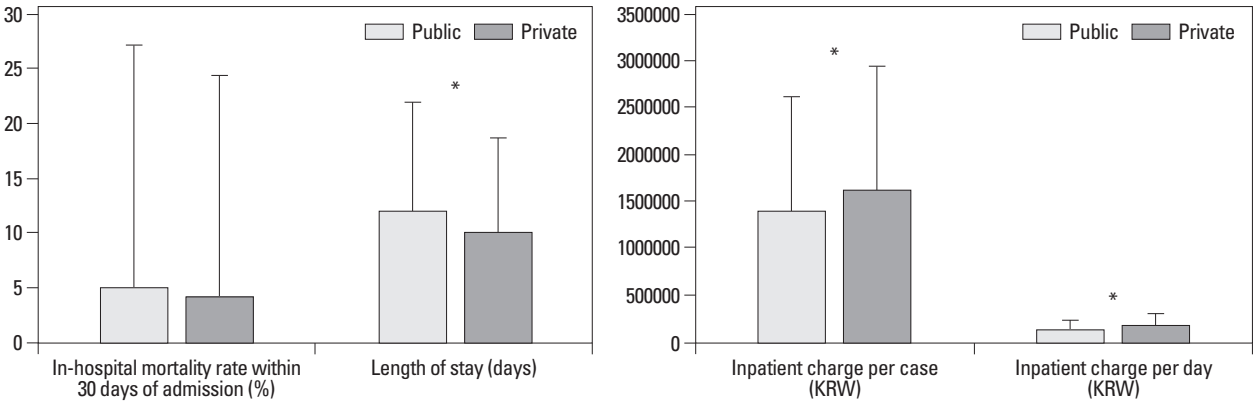

Fig. 1. The difference of outcome variables between public vs. private hospitals. Data is shown as mean±SD. *Significant (p<0.001).

pitals (p=0.030). In terms of hospital-level factors, teaching status [odds ratio (OR): 0.669, p=0.048] was associated with lower in-hospital mortality rates. More complex patients had a higher in-hospital mortality rate (CCL=2: OR=2.31 times higher mortality rate, CCL=3: OR=11.54-fold higher mortality rate). Being older than 75 years of age was also significantly associated with in-hospital mortality (age=75–84: OR=1.619, age=85+: OR=2.628). Also, LOSs were 16.5% longer at public hospitals than private hospitals (p=0.001). Having more specialists and nurses was associated with shorter LOSs; however, LOS was associated with degree of disease complexity, such that patients with more complex cases stayed in the hospital longer (9.6%, 24.4%, and 49.5% longer for CCL=1, 2, and 3, respectively, than for CCL=0).

Although univariate analyses revealed higher charges among private hospitals, the inpatient charge per case was 11.7% higher in public hospitals (p=0.048) after adjusting for patient- and hospital-level confounders. The inpatient charge per day was somewhat lower in public hospitals (-4.3%), although this difference was not statistically significant (p=0.545). Higher inpatient charges per case and per day were associated with more complex patients and those older than 75 years. Finally, those who were younger and male tended to accrue lower inpatient charges.

DISCUSSION

In this study, we determined in-hospital mortality rates within 30 days of admission, LOSs, and fees at both private and public hospitals using a South Korean NHI inpatient claims dataset comprising information about patients who had suffered from heart failure. The results of univariate analyses revealed higher in-hospital mortality rates, longer LOSs, and lower inpatient charges for public hospitals than for private hospitals. After adjusting for patient- and hospital-level confounders, we found that the in-hospital mortality rates within 30 days after admission were 1.62-fold higher, along with a 16.5% longer LOS, at public hospitals than at private hospitals.

The results of this study provide empirical evidence in support of the argument that public hospitals may have higher in-hospital mortality rates due to their organizational structure. As noted, public hospitals in South Korea are totally controlled by district governments, and this may contribute to difficulties recruiting well-trained physicians, acquiring medical equipment, and the higher in-hospital mortality rates. Additionally, the relatively lower salaries for physicians and other healthcare professionals, the lack of incentives for improved performance due to employees' status as government workers, and restrictions on the use of aggressive treatments that are not covered by NHI may lead to higher in-hospital mortality rates within the first 30 days after admission to public hospitals.

The agency for Health Insurance Review and Assessment services is responsible for the overall quality assessment of South Korean hospitals. This agency's goal should involve not only identifying and punishing those responsible for substandard care; it should also promote the enhancement of the quality of the healthcare services available in this country, including those offered by public hospitals, using a systematic approach that is able to detect quality-related problems by monitoring reimbursement policies or delivery systems, as well as by conducting retrospective quality assessments.[36] Additionally, public hospitals should implement their own strategic initiatives to improve quality of care. The relationship between continuous quality improvement (CQI) and hospital management strategies has been limited in many hospitals in Korea.[37] However, policy incentives that enhance CQI should be instituted within the framework of

Table 3. Multi-Level Analysis of Outcome Variables: Mortality Rate, LOS, Inpatient Charges

n=8406	Odds ratio_ In-hospital mortality within 30 days of admission	*p* value	Ln_LOS	*p* value	Ln_Inpatient charge per case	*p* value	Ln_Inpatient charge per day	*p* value
Main factor								
Types of hospitals								
General hospital (ref.)								
Public hospitals	1.620	0.030	0.165	0.001	0.117	0.048	-0.048	0.545
Hospital level factors								
Number of beds	1.000	0.869	0.00021	0.191	0.0002	0.392	-0.0001	0.860
Number of specialists	1.005	0.216	-0.002	0.025	0.002	0.236	0.004	0.010
Number of nurses per beds	0.303	0.064	-0.372	0.005	0.085	0.644	0.456	0.032
Geographic								
Non-metropolitan area (ref.)								
Metropolitan area	1.023	0.891	0.042	0.225	-0.004	0.934	-0.046	0.421
Teaching status								
Non-teaching hospitals (ref.)								
Teaching hospitals	0.669	0.048	0.012	0.776	0.056	0.350	0.029	0.683
Bed occupancy rate	0.999	0.786	0.001	0.201	-0.0003	0.858	-0.001	0.424
Patient level factors								
Severity (clinical complexity level)								
0 (no CC effect) (ref.)								
1 (minor CC effect)	1.337	0.487	0.096	0.003	0.261	<0.001	0.145	<0.001
2 (moderate CC effect)	2.310	0.003	0.244	<0.001	0.498	<0.001	0.234	<0.001
3 (severe CC effect)	11.540	<0.001	0.495	<0.001	0.977	<0.001	0.457	<0.001
Sex								
Female (ref.)								
Male	1.029	0.816	0.006	0.733	-0.003	0.080	-0.025	0.058
Age group								
Less than 65 (ref.)								
65–74	1.158	0.534	-0.020	0.468	0.029	0.289	0.047	0.019
75–84	1.619	0.022	0.052	0.041	0.150	<0.001	0.103	<0.001
85+	2.628	<0.001	0.069	0.017	0.179	<0.001	0.141	<0.001

LOS, length of stay.

the strategic management requirements.

Public hospitals had longer LOSs than private hospitals. In our study, the mean LOS in the former was roughly 16.5% longer than that in the latter after adjusting for patient- and hospital-level confounders. One plausible explanation for this phenomenon may relate to the "No Financial Pressure" environment, which provides no incentives for public hospitals that emphasize efficiency. Although many public hospitals have a negative net income according to their financial statements, district governments have been responsible for these losses, as these institutions must continue providing medical services to indigent patients in their area. Thus, public hospitals do not experience pressure related to financial viability. The characteristics of the patients at public hospitals may also contribute to the longer LOSs.[38,39] It is also possible that the relative efficiency of private and public institutions may be driven by different motives, given that private providers have a strong incentive to minimize costs and practice more efficiently.[40] Additionally, it is possible that the profit motive encourages private hospitals to discharge patients early, leading to subsequent re-admission.

According to our multivariate analysis, including LOS, inpatient charges per case were 11.7% higher in public hospitals, while the results of univariate analyses showed the charges per case were higher in private hospitals (the inpatient charges per day did not differ significantly). Significant attention to LOSs and inpatient charge is required, as they are closely related to overall healthcare spending at the national level. Among Organization for Economic Co-operation and Development (OECD) countries, the average inpatient LOS for all causes was highest in Japan, followed by Korea. The abundant supply of beds and the structure of hospital payments in Japan and Korea may provide hospitals in these countries with incentives to prolong hospitalization durations.[41]

This study has several limitations that should be noted, and caution should be used in interpreting and generalizing our findings. First, although we analyzed nationwide health insurance inpatient claims data for the study period, which strengthens the generalizability of our results, South Korea's unique healthcare delivery and insurance system may mitigate against generalizing our findings to other countries. Inpatient charges, in particular, are likely to depend on the type of health insurance system and the ability of healthcare providers to negotiate the fees for medical services. The hospital reimbursement system in South Korea is predominantly FFS-based; inpatient charges were measured as a sum of the FFS claims from each patient's hospitalization, but we were unable to identify components of these FFS claims. Inpatient claims are not the same as costs; however, claims represent costs from the perspective of the purchaser, which is the National Health Insurance Service of Korea.[42] The unique organizational structure of public hospitals in Korea may also reduce the generalizability and weaken the arguments advanced in this study.

Second, this study investigated only 31 of 39 public hospitals and focused exclusively on patients with heart failure. Furthermore, teaching hospitals were also unevenly distributed between private and public institutions; therefore, the results of this study may generally over- or underestimate the true performance of public hospitals, which could compromise the reliability of our findings. Another potential limitation of our study involves our study period, as the interval for which data were available was not sufficient for rigorous investigation of the effects of hospital type. Further research using ample datasets should be conducted to elucidate the long-term performance of public hospitals.

Third, this study was able to access the in-hospital mortality rates for only the first 30 days after admission due to the format of the claims data, which may have led to an underestimation of the true mortality rates at both public and private hospitals. Our study also lacked data regarding patient socio-economic status (SES). Due to their financial constraints, economically vulnerable populations are more likely to be admitted to public hospitals; however, due to the limitations of our dataset, we were not able to examine the patients' SES.

The final limitation of the study was its failure to include several important variables. As our dataset did not contain information about patients' route of admission, we were unable to determine whether patients with heart failure were admitted through emergency departments, transfers from other facilities, or the regular admission process. We assumed that the majority of patients were acute, as our claims data were related to inpatient admissions, but we were unable to determine how the patients included in our sample were admitted. Furthermore, echocardiogram data, information about the reason for hospitalization, and the results of other laboratory measures related to the severity of heart failure (e.g., brain natriuretic peptides, kidney function, etc.) were not available, which also limits our ability to draw definite conclusions. We were also unable to assess other indicators of the quality of hospitals, which may have limited our ability to assess their overall quality of care.

Although our study was based solely on patients with heart failure and an administrative health insurance inpatient claims dataset, to our knowledge, it represents the first attempt to evaluate in-hospital mortality rates, LOSs, and fees of public hospitals in South Korea. We believe that our findings will be useful to healthcare policy makers, particularly those in countries with national health insurance programs based on FFS payments and a mixed public/private hospital system. Our findings contribute to the increasing evidence about the quality, efficiency, and characteristics of public hospitals, and may enhance the evidentiary basis for the design and implementation of public hospital systems. Additional research covering a longer time frame and a wider variety of diseases is needed to increase the reliability and generalizability of our findings.

In conclusion, the results of our multi-level regression analysis showed that patients with heart failure admitted to public hospitals may have higher in-hospital mortality rates and longer LOSs and accrue higher inpatient charges, compared with those admitted to private hospitals. However, it should be remembered that public hospitals play a significant role in Korean healthcare systems by providing healthcare services to indigent, financially vulnerable populations in South Korea. To improve healthcare outcomes and reduce spending, we recommend that the government and policy makers continue to monitor overall quality indicators, LOSs, and spending according to type of hospital ownership. Hospital managers and clinicians, especially those in public hospitals, are also required to improve their performance and quality through managerial efforts and CQI actions.

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S.J.K. designed the study, collected data, performed statistical analyses, and wrote the manuscript. E.C.P., T.H.K., J.W.Y., and S.G.L. contributed to the discussion and reviewed and edited the manuscript. S.G.L. is the guarantor of this work, and, as such, had full access to all data in the study and accepts responsibility for the integrity of the data and the accuracy of the data analysis.

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