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ORIGINAL ARTICLE

Determinants of the Length of Stay in Stroke Patients

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Abstract

Objectives: The study objective was to identify the factors that influence the length of stay (LOS) in hospital for stroke patients and to provide data for managing hospital costs by managing the LOS.

Methods: This study used data from the Discharge Injury Survey of the Korea Centers for Disease Control and Prevention, which included 17,364 cases from 2005 to 2008.

Result: The LOS for stroke, cerebral infarction, intracerebral hemorrhage, and subarachnoid hemorrhage was 18.6, 15.0, 28.9, and 25.3 days, respectively. Patients who underwent surgery had longer LOS. When patients were divided based on whether they had surgery, there was a 2.4-time difference in the LOS for patients with subarachnoid hemorrhage, 2.0-time difference for patients with cerebral infarction, and 1.4-time difference for patients with intracerebral hemorrhage. The emergency route of admission and other diagnosis increased LOS, whereas hypertension and diabetic mellitus reduced LOS.

Conclusion: In the present rapidly changing hospital environments, hospitals approach an efficient policy for LOS, to maintain their revenues and quality of assessment. If LOS is used as the indicator of treatment expenses, there is a need to tackle factors that influence the LOS of stroke patients for each disease group who are divided based on whether surgery is performed or not for the proper management of the LOS.

1. Introduction

According to the Korean Death Statistics 2011 data, cerebrovascular diseases were responsible for 5.07 deaths per 10,000 people in Korea, making them the second leading cause of death after malignant neoplasms [1]. In addition, based on morbidity rate, cerebral infarction [International Classification of Diseases 10th Revision (ICD-10) code I63] is sixth on the list of leading medical expenditures. A majority of patients in

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Korea over the age of 65 receiving treatment for geriatric diseases are treated for cerebrovascular diseases, and the number of such patients in the 40−50-year age group is increasing [2].

Although it does not necessarily result in death, stroke leaves a patient with severe neurological damage and its treatment and rehabilitation are cost intensive [3]. According to an analysis of the 2009 health insurance data, cerebral infarction in men was the first on the list of high-cost diseases that required more than US$ 3000 for treatment (excluding noncovered fees); in women, it was third on the list. Cerebral infarction is the number one disease in patients over the age of 80 [4]. Of the total medical expenses in the 1-year period beginning from the day of disease incidence, 59% is related to hospital stay and 13% to outpatient care [5]. The length of stay (LOS) is the major determinant of the portion of treatment expenses to be met by patients [6,7]. Therefore, management of the LOS is an important factor in managing the financial obligations of the patient, hospital operating costs, and health-care management.

Since 2000, medical expenses for stroke have been growing more rapidly than medical expenses in general, comprising a major share of the total treatment costs [3]. When paying for hospital stay, the number of days spent in the hospital is the proxy indicator, accounting for 43% of the treatment cost and 70% of the average cost of initial hospitalization [8]. Accordingly, managing the number of hospitalization days for patients with stroke is a very important factor in managing the overall hospitalization expenses [9].

According to a study on the medical care coverage data by the Health Insurance Review and Assessment Service, the longest duration in the average number of hospitalization days was for cerebral infarction (I63), increasing from 19.8 days in 2005 to 21.4 days in 2008. Intracerebral hemorrhage (I61) demonstrated the greatest variation in the LOS in high-level general hospitals, general hospitals, and hospitals, followed by cerebral infarction (I63) in general hospitals [10]. A study that used data during the same period reported that the LOS increased with an increase in the number of patients with stroke, and the cost per hospitalization considerably increased [3]. However, there is no clear differentiation between hospitals that address acute conditions and hospitals for long-term treatment, long-term convalescent hospitals, and rehabilitation facilities. Therefore, when the acute phase is over, patients continue their treatment in general hospital rooms [5]. A study evaluating the appropriateness of hospitalization for stroke patients revealed that as the period of hospital stay increases, hospitalization becomes less appropriate [11].

In many countries, various methods for using medical expenses effectively with limited resources are sought [12]. One of them is the change in the treatment-cost reimbursement system: from fee for service (FFS) to the diagnosis-related group (DRG). The FFS system may encourage offering of unnecessary services, and as a result, the cost per patient increases; by contrast, DRG leads to a decrease in the intensity of treatment service. One of the indicators of treatment service intensity is the number of hospitalization days [12]. Under the FFS system, the hospital can increase the number of hospitalization days to maximize revenue from treatment, but under the DRG system, hospitals seek to maintain quality in treatment by shortening the LOS. When setting priorities for management policies relating to the LOS, the order of priority depends on whether the disease belongs to medical diseases or surgical diseases [10,13]. Medical patients exhibit a wide range of variation even for the same disease, whereas surgical patients have a narrower range, which allows for effective selection of policy and differentiation. Accordingly, studies on factors that influence the number of hospitalization days, by classifying patients based on disease and the necessity of surgery, can offer detailed data to aid in defining the priority order for policies on the management of LOS.

The increasing LOS for patients with stroke, a typical disease with an increasing incidence rate given the aging tendency of the population, increases the burden of treatment expenses for patients, influences the rotation of sickbeds in the hospital, and results in the loss of profit from treatment; in clinical terms, it is also associated with a higher possibility of occurrence of adverse effects [9,14−16]. Accordingly, this study is significant because it provides basic data for rational management of the LOS that are profitable for patients, service providers, and the state.

The study objective was to identify the factors that influence the LOS of stroke patients and to provide data for managing hospital costs by managing the LOS. To achieve this goal, the characteristics of the LOS for stroke patients were investigated and the related factors that influence the LOS of stroke patients were analyzed depending on whether they undergo surgery.

2. Methods

2.1. Patients

According to the World Health Organization, stroke is defined as “a focal (or at times global) neurological impairment of sudden onset, and lasting more than 24 hours (or leading to death) and of presumed vascular origin” [17]. With respect to the cause of death, cerebrovascular diseases are diseases that suddenly occur due to abnormalities in the blood vessels in the brain, whereby brain function is impeded, resulting in collapse. Depending on the form of occurrence, they are divided into two types, namely: (1) hemorrhagic diseases that occur when part of the intracranial blood vessel is damaged; and (2) ischemic diseases that occur when blood flow in the blood vessel deteriorates or is blocked [1].

This study targeted 700,056 cases based on the system data from the Korean National Hospital Discharge In-Depth Injury Survey by the Korea Centers for Disease Control and Prevention during the period from 2005 to 2008. Patients who had stroke as defined in the ICD-10 diagnosis code were included [3,12]. Of the total 17,871 hospitalized patients who received treatment for major diseases such as cerebral infarction (G46, I63, I67, I68, and I69), intracerebral hemorrhage (I61 and I62), and subarachnoid hemorrhage (I60), 17,364 were included as patients in this study; we excluded 207 patients who were on long-term hospitalization (Table 1).

2.2. Definition of variables

2.2.1. Independent variables

2.2.1.1. Sociodemographic characteristics

To compare the sociodemographic characteristics of stroke patients in general and each disease in particular, including cerebral infarction, intracerebral hemorrhage, and subarachnoid hemorrhage, the gender, age, area of residence, and type of insurance were identified. Patients were divided by gender (male and female), age at the time of admission, area of residence (same area as the medical institution or other areas), and type of insurance [National Health Insurance (NHI), medical aid, and others, i.e., industrial accident compensation insurance, car insurance, unreported claims].

2.2.1.2. Clinical characteristics

Clinical characteristics are factors related to medical treatment received by the patient and include the admission route, result of treatment, disposition upon discharge, other diagnoses and the number thereof, the presence of risk factors, whether surgery is performed, and the number of hospitalization days before surgery. On the basis of the admission route, the patients were divided into those who were admitted to the medical institution through the outpatient department or through the emergency room. On the basis of the treatment result, the patients were divided based on whether their state had improved at discharge: "for diagnosis only," "not treated," "other," and "unidentified" cases were classified as "survival," and "hopeless" and "death" cases were classified as "death." By disposition upon discharge, that is, the phase following discharge upon completion of treatment, the patients were classified as "return to home" for "discharge to home," "escape," "discharge by death," and "unidentified" cases. If patients were transferred to a different hospital or to the referral hospital, they were classified as "transfer to another hospital." The number of other diagnoses was calculated by counting the number of diagnoses of a patient excluding the main diagnosis.

Hypertension, history of smoking, hypercholesterolemia, obesity, drinking, diabetes, and family history are

Table 1. Proportion and length of stay unit: patient, day,(%)

		All			Normal			Outlier		
		N (%)	TLOS (%)	ALOS ± SD	N (%)	TLOS (%)	ALOS ± SD	N (%)	TLOS (%)	ALOS ± SD
CI	NOP	761	29,312	38.5 ± 98.78	746 (98.0)	20,995 (71.6)	28.1 ± 31.93	15 (2.0)	8,317 (28.4)	554.5 ± 429.53
	OP	12,086	218,488	18.1 ± 31.04	11,728 (97.0)	5,920 (75.9)	14.1 ± 13.39	358 (3.0)	52,568 (24.1)	146.8 ± 97.95
	Sum	12,847	247,800	19.3 ± 38.82	12,474 (97.1)	186,915 (75.4)	15.0 ± 15.51	373 (2.9)	60,885 (24.6)	163.2 ± 150.27
IH	NOP	1,086	49,468	45.6 ± 74.01	1,049 (96.6)	36,781 (74.4)	35.1 ± 35.78	37 (3.4)	12,687 (25.6)	342.9 ± 183.73
	OP	2,243	74,156	33.1 ± 72.18	2,201 (98.1)	57,068 (77.0)	25.9 ± 27.97	42 (1.9)	17,088 (23.0)	406.9 ± 311.60
	Sum	3,329	123,624	37.1 ± 73.01	3,250 (97.6)	93,849 (75.9)	28.9 ± 31.00	79 (2.4)	29,775 (24.1)	376.9 ± 260.09
SAH	NOP	1,009	42,853	42.5 ± 56.49	965 (95.6)	32,069 (74.8)	33.2 ± 26.6	44 (4.4)	10,784 (25.2)	245.1 ± 122.48
	OP	686	13,713	20.0 ± 62.27	675 (98.4)	9,407 (68.6)	13.9 ± 17.88	11 (1.6)	4,306 (31.4)	391.5 ± 299.70
	Sum	1,695	56,566	33.4 ± 59.90	1,640 (96.8)	41,476 (73.3)	25.3 ± 25.26	55 (3.2)	15,090 (26.7)	274.4 ± 179.08
Total	NOP	2,856 (16.0)	121,633 (28.4)	42.6 ± 76.25	2,760 (96.6)	89,845 (73.9)	32.6 ± 31.88	96 (3.4)	31,788 (26.1)	331.1 ± 241.10
	OP	15,015 (84.0)	306,357 (71.6)	20.4 ± 41.94	14,604 (97.3)	232,395 (75.9)	15.9 ± 17.16	411 (2.7)	73,962 (24.1)	180.0 ± 166.39
	Sum	17,871 (100.0)	427,990 (100.0)	24.0 ± 49.73	17,364 (97.2)	322,240 (75.3)	18.6 ± 21.12	507 (2.8)	105,750 (24.7)	208.6 ± 191.99

N: Patient, TLOS: Total LOS, ALOS: Average LOS, SD: Standard deviation, CI: Cerebral infarction, IH: Intracerebral hemorrhage, SAH; Subarachnoid hemorrhage, NOP: Non-operation OP: Operation.

known risk factors for stroke [3,12,18−23]. Among them, hypertension (essential hypertension and other hypertensive diseases, 145, 146; I10, I11−I15 of Class 298) and diabetes (104; E10−E14 of Class 298), classifiable under the ICD-10 codes, were selected as comorbid diseases that are risk factors for stroke. The classification included "absence of risk factors," "hypertension," "diabetes," and "hypertension and diabetes."

Surgery was classified as "performed" in cases in which there was a recorded day of a main operation that was performed clearly for treatment purposes and not for diagnostic or exploratory purposes or to treat complications (the Organization for Economic Cooperation and Development also classifies medical and surgical categories based on whether surgery is performed). The length of preoperative inpatient stay was calculated by counting the number of days that passed between admission and main surgery, counting both the admission and discharge days.

2.2.1.3. Characteristics of the medical institution and other characteristics

For health-care facilities, the number of beds was used as a variable, classifying facilities as those with 100−299, 300−499, 500−999, and over 1000 beds. The changes in treatment conditions following the change by year in the period between 2005 and 2008 were measured. Variables were coded as shown in Table 2.

2.2.2. Dependent variables

The LOS for each group of stroke patients was separately divided by whether the patient underwent operation or not.

2.3. Analysis

The *t* test and Chi-square test were performed for comparative analyses of stroke patient characteristics such as sociodemographics, medical care utilization, and medical facilities, depending on whether surgery was performed or not. Linear regression analysis was performed to analyze factors that influenced the LOS for each group of stroke patients. Log transformation was performed for the inpatient days, a dependent variable, as the average and median values exhibited wide asymmetric distribution. The level of significance was set as $p < 0.05$; the exploration of multicollinearity of the multiple regression model was performed using the variance inflation factor (VIF). For stroke, the maximum value of multicollinearity VIF was 2.002, 1.877, 3.673 for total, nonsurgery, surgery, respectively; for cerebral infarction the value was 1.933, 1.874, 7.479, respectively. The maximum VIF value for intracerebral hemorrhage and subarachnoid hemorrhage was 1.918, 1.815, 2.241, respectively, and 4.331, 2.987, 7.767, respectively. It was decided that multicollinearity would not pose a problem while estimating the regression coefficients. Statistical analysis was performed using SPSS (SPSS Inc, Chicago, IL, USA) for Windows 19.0.

Table 2. Variables

Variation	Measure			
I. Independent Variable				
1. Personal characteristics				
Sex	0. Male	1. Female		
Age	Patient's age			
Area	0. Same	1. Other		
Payment	0. NHI	1. Medical aid	3. Other	
2. Clinical characteristics				
Admission route	0. Outpatient department		1. Emergency	
Result	0. Recover	1. Death		
Disposition	0. Home	1. Transfer other hospital		
Other diagnosis	Total number of other diagnoses			
Risk factor	0. Non	1. Hypertension	2. Diabetic mellitus	
3. Hypertension & Diabetic mellitus				
Operation	0. Yes	1. No		
Pre-operation day	Number of days between admission and initial surgery			
4. Hospital characterisitics				
Bed-scale	0. 100-299	1. 300-499	2. 500-999	3. 1000 over
5. Other				
Year	0. 2005	1. 2006	2. 2007	3. 2008
II. Dependent Variable				
Operation	0 No	1 Yes		

NHI: National Health Insurance.

3. Results

3.1. Characteristics by disease on the basis of whether surgery was performed

Of the total 17,364 stroke patients, the majority had cerebral infarction (12,474, 71.8%), followed by intracerebral hemorrhage (3250, 18.7%) and subarachnoid hemorrhage (1640, 9.4%; Table 3). The number of patients who underwent surgery (14,604, 84.1%) was 5.3-fold of those who did not (2760, 15.9%). A majority of surgeries were performed for subarachnoid hemorrhage (58.8%), followed by intracerebral hemorrhage (32.3%) and cerebral infarction (6.0%). The average patient age was 62.8 years; patients who underwent surgery were older by 8.6 years on average than those who did not.

The oldest patients in the cerebral hemorrhage group were aged 65.1 years (nonsurgery) and 51.5 years (surgery), which made it the disease group with the lowest patient age. The average number of other diagnoses in the total number of patients was 2.0; the average was 2.2 for patients who underwent surgery, which is 1.1 times more than the 2.0 for patients who did not undergo surgery. Patients who underwent surgery for intracerebral hemorrhage had the greatest number of other diagnoses (i.e., 2.4); patients who did not undergo surgery for subarachnoid hemorrhage had the least number of other diagnoses (i.e., 1.3). The average LOS for all patients before surgery was 4.2 days; it was the longest for patients with cerebral infarction (6.9 days).

3.2. LOS by disease

The average LOS for all patients was 18.6 days; patients who underwent surgery stayed for 16.7 days more (2.1 times, 32.6 days) than patients who did not (15.9 days). The condition requiring the longest hospital stay was intracerebral hemorrhage, with the average LOS being 28.9 days; patients who underwent surgery stayed in the hospital on average 9.2 days more (1.4 times; 35.1 days) than patients who did not (25.9 days). The average LOS for patients with subarachnoid hemorrhage was 25.3 days, and that those who underwent surgery stayed for 33.2 days, which was 19.3 days (2.4 times) longer than that of those who did not (13.9 days). The average LOS for patients with cerebral infarction was 15.0 days; the average LOS was 14.0 days (2.0 times) more for patients who underwent surgery (28.1 days) than that for patients who did not (14.1 days).

3.3. Determinants of the LOS by disease

3.3.1. Determinants of the LOS for patients with stroke

The factors that influenced the LOS for all patients, including patients with cerebral infarction, intracerebral hemorrhage, and subarachnoid hemorrhage, were as follows: female gender, age, receiving medical aid, having other forms of insurance, emergency room as the admission route, death as the treatment result, transfer to a different hospital as the disposition upon discharge, number of other diagnoses, hypertension, diabetes, having both hypertension and diabetes, being treated in a hospital with 500−999 or >1000 beds, and being treated in 2008 ($R^2 = 0.198$; Table 4). The factors that influenced the LOS for patients who did not undergo surgery were being from a different area, receiving medical aid, having other forms of insurance, emergency room as the admission route, death as the treatment result, transfer to a different hospital as disposition upon discharge, number of other diagnoses, hypertension, diabetes, having both hypertension and diabetes, being treated in a hospital with 500−999 or >1000 beds, and being treated in 2007 and 2008 ($R^2 = 0.185$). The factors that influenced the LOS for patients who underwent surgery were female gender, age, being from a different area, receiving medical aid, having other forms of insurance, emergency room as the admission route, death as the treatment result, number of other diagnoses, having both hypertension and diabetes, and being treated in a hospital with 300−499, 500−999, or >1000 beds in 2006 ($R^2 = 0.397$; Table 5).

3.3.2. Determinants of the LOS for patients with cerebral infarction

The factors that influenced the LOS for patients with cerebral infarction were as follows: receiving medical aid, having other forms of insurance, emergency room as the admission route, death as the treatment result, transfer to a different hospital as the disposition upon discharge, number of other diagnoses, hypertension, diabetes, having both hypertension and diabetes, and being treated in a hospital with 300−499, 500−999, or >1000 beds in 2008 ($R^2 = 0.167$; Table 4). The LOS for the patients who did not undergo surgery was influenced by the following factors: female gender, age, being from a different area, receiving medical aid, having other forms of insurance, emergency room as the admission route, death as the treatment result, transfer to a different hospital as the disposition upon discharge, number of other diagnoses, hypertension, having both hypertension and diabetes, and being treated in a hospital with 300−499, 500−999, or >1000 beds in 2006, 2007, and 2008 ($R^2 = 0.177$). The LOS for patients who underwent surgery was influenced by the following factors: emergency room as the admission route, death as the treatment result, number of other diagnoses, hypertension, having both hypertension and diabetes, and being treated in a hospital with >1000 beds ($R^2 = 0.445$; Table 5).

3.3.3. Determinants of the LOS for patients with intracerebral hemorrhage

The factors that influenced the LOS for patients with intracerebral hemorrhage were female gender, age,

Table 3. Characteristics in disease

		Cerebral infarction			Intracerebral hemorrhage			Subarachnoid hemorrhage			Stroke			All	
		NOP	OP		NOP	OP		NOP	OP		NOP	OP			
		N (%)	N (%)	*p*	N (%)	N (%)	*p*	N (%)	N (%)	*p*	N (%)	N (%)	*p*	N[%]	*p*
Sex	Male	6,165 (52.6)	302 (40.5)	***	1,170 (53.2)	652 (62.2)	***	252 (37.3)	356 (36.9)		7,587 (52.0)	1,310 (47.5)	***	8,897 [51.2]	***
	Female	5,563 (47.4)	444 (59.5)		1,031 (46.8)	397 (37.8)	***	423 (62.7)	609 (63.1)		7,017 (48.0)	1,450 (52.5)		8,467 [48.8]	
Age	M ± SD	65.1 ± 13.64	51.5 ± 20.78	***	62.0 ± 14.77	59.7 ± 15.92	***	55.8 ± 15.61	54.2 ± 12.70	***	64.2 ± 14.08	55.6 ± 16.77	***	62.8 ± 14.88	***
Area	Same	9,183 (78.3)	426 (57.1)	***	1,791 (81.4)	806 (76.8)	**	478 (70.8)	664 (68.8)		11,452 (78.4)	1,896 (68.7)	***	13,348 [76.9]	***
	Other	2,545 (21.7)	320 (42.9)		410 (18.6)	243 (23.2)		197 (29.2)	301 (31.2)		3,152 (21.6)	864 (31.3)	***	4,016 [23.1]	
Payment	NHI	10,185 (86.8)	658 (88.2)		1,906 (86.6)	888 (84.7)		601 (89.0)	859 (89.0)		12,692 (86.9)	2,405 (87.1)	***	15,097 [86.9]	***
	Medical aid	1,381 (11.8)	79 (10.6)		239 (10.9)	121 (11.5)		52 (7.7)	77 (8.0)		1,672 (11.4)	277 (10.0)		1,949 [11.2]	
	Other	162 (1.4)	9 (1.2)		56 (2.5)	40 (3.8)		22 (3.3)	29 (3.0)		240 (1.6)	78 (2.8)		318 [1.8]	
Admission	OPD	4,360 (37.2)	475 (63.7)	***	388 (17.6)	156 (14.9)	**	167 (24.7)	81 (8.4)	***	4,915 (33.7)	712 (25.8)	***	5,627 [32.4]	***
	Emergency	7,368 (62.8)	271 (36.3)		1,813 (82.4)	893 (85.1)		508 (75.3)	884 (91.6)		9,689 (66.3)	2,048 (74.2)		11,737 [67.6]	
Result	Recover	11,297 (96.3)	699 (93.7)	***	1,900 (86.3)	848 (80.8)	***	511 (75.7)	832 (86.2)	***	13,708 (93.9)	2,379 (86.2)	***	16,087 [92.6]	***
	Death	431 (3.7)	47 (6.3)		301 (13.7)	201 (19.2)		164 (24.3)	133 (13.8)		896 (6.1)	381 (13.8)		1,277 [7.4]	
Disposition	Home	10,611 (90.5)	703 (94.2)	***	1,773 (80.6)	864 (82.4)		573 (84.9)	857 (88.8)	*	12,957 (88.7)	2,424 (87.8)	**	15,381 [88.6]	***
	Transfer	1,117 (9.5)	43 (5.8)		428 (19.4)	185 (17.6)		102 (15.1)	108 (11.2)		1,647 (11.3)	336 (12.2)		1,983 [11.4]	
Other diag.	M ± SD	2.1 ± 1.87	2.0 ± 2.44	***	2.0 ± 2.01	2.4 ± 2.73	***	1.3 ± 1.62	2.2 ± 2.37	***	2.0 ± 1.89	2.2 ± 2.54		2.0 ± 2.01	***
Chronic dis.	No	5,365 (45.7)	465 (62.3)	***	1,206 (54.8)	678 (64.6)	***	502 (74.4)	695 (72.0)		7,073 (48.4)	1,838 (66.6)	***	8,911 [51.3]	***
	HTN	3,574 (30.5)	184 (24.7)		726 (33.0)	244 (23.3)		131 (19.4)	210 (21.8)		4,431 (30.3)	638 (23.1)		5,069 [29.2]	
	DM	950 (8.1)	26 (3.5)		68 (3.1)	49 (4.7)		21 (3.1)	20 (2.1)		1,039 (7.1)	95 (3.4)		1,134 [6.5]	
	HTN&DM	1,839 (15.7)	71 (9.5)		201 (9.1)	78 (7.4)		21 (3.1)	40 (4.1)		2,061 (14.1)	189 (6.8)		2,250 [13.0]	
Pre-op day	M ± SD		6.9 ± 9.58	***		3.2 ± 9.25	***		3.3 ± 7.60	***		4.2 ± 8.95	***	4.2 ± 8.95	***
Bed	100-299	2,406 (20.5)	29 (3.9)	***	436 (19.8)	154 (14.7)	**	72 (10.7)	29 (3.0)	***	2,914 (20.0)	212 (7.7)	***	3,126 [18.0]	***
	300-499	1,553 (13.2)	32 (4.3)		346 (15.7)	162 (15.4)		81 (12.0)	90 (9.3)		1,980 (13.6)	284 (10.3)		2,264 [13.0]	
	500-999	5,854 (49.9)	394 (52.8)		1,135 (51.6)	573 (54.6)		388 (57.5)	668 (69.2)		7,377 (50.5)	1,635 (59.2)		9,012 [51.9]	
	1000 over	1,915 (16.3)	291 (39.0)		284 (12.9)	160 (15.3)		134 (19.9)	178 (18.4)		2,333 (16.0)	629 (22.8)		2,962 [17.1]	
Year	2005	3,037 (25.9)	151 (20.2)	***	657 (29.9)	293 (27.9)		198 (29.3)	261 (27.0)		3,892 (26.7)	705 (25.5)		4,597 [26.5]	***
	2006	3,163 (27.0)	179 (24.0)		587 (26.7)	272 (25.9)		200 (29.6)	253 (26.2)		3,950 (27.0)	704 (25.5)		4,654 [26.8]	
	2007	2,639 (22.5)	177 (23.7)		462 (21.0)	243 (23.2)		136 (20.1)	220 (22.8)		3,237 (22.2)	640 (23.2)		3,877 [22.3]	
	2008	2,889 (24.6)	239 (32.0)		495 (22.5)	241 (23.0)		141 (20.9)	231 (23.9)		3,525 (24.1)	711 (25.8)		4,236 [24.4]	
	Total	11,728 [94.0]	746 [6.0]		2,201 [67.7]	1,049[32.3]		675 [41.2]	965 [58.8]		14,604 [84.1]	2,760 [15.9]		17,364 [100.0]	
		12,474 [71.8]			3,250 [18.7]			1,640 [9.4]			17,364 [100.0]				

*$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; NOP: Non-operation, OP: Operation, N: Patient, M ± D: Mean ± Standard deviation, OPD: Outpatient department, diag.: diagnosis, dis.: disease HTN: Hypertension, DM: Diabetic mellitus NHI: National Health Insurance.

being from a different area, receiving medical aid, having other forms of insurance, emergency room as the admission route, death as the treatment result, transfer to a different hospital as the disposition upon discharge, number of other diagnoses, having both hypertension and diabetes, and being treated in a hospital with 300−499, 500−999, or >1000 beds ($R^2 = 0.301$; Table 4). For patients who did not undergo surgery, the factors that influenced the LOS were receiving medical aid, having other forms of insurance, emergency room as the admission route, death as the treatment result, transfer to a different hospital as the disposition upon discharge, number of other diagnoses, having both hypertension and diabetes, and being treated in a hospital with 500−999 or >1000 beds ($R^2 = 0.286$). For patients who underwent surgery, the factors that influenced the LOS were female gender, age, being from a different area, receiving medical aid, emergency room as the admission route, death as the treatment result, number of other diagnoses, having both hypertension and diabetes, and being treated in a hospital with 300−499, 500−999, or >1000 beds in 2006 ($R^2 = 0.398$; Table 5).

3.3.4. Determinants of the LOS for patients with subarachnoid hemorrhage

The LOS for patients with subarachnoid hemorrhage was influenced by the following factors: receiving medical aid, having other forms of insurance, emergency room as the admission route, death as the treatment result, transfer to a different hospital as the disposition upon discharge, number of other diagnoses, having both hypertension and diabetes, and being treated in a hospital with 500−999 beds ($R^2 = 0.366$; Table 4). For patients who did not undergo surgery, the factors that influenced the LOS were age, emergency room as the admission route, death as the treatment result, transfer to a different hospital as the disposition upon discharge, number of other diagnoses, and having both hypertension and diabetes ($R^2 = 0.267$). For patients who underwent surgery, the factors that influenced the LOS were age, receiving medical aid, having other forms of insurance, emergency room as the admission route, death as the treatment result, number of other diagnoses, having both hypertension and diabetes, and being treated in a hospital with >1000 beds ($R^2 = 0.404$; Table 5).

4. Discussion

The advent of a rapidly aging society will greatly influence the social financial burden related to stroke [24]. In Korea, patients who have passed the acute stage of illness continue receiving treatment in the general ward [5]. Accordingly, effective management of the LOS that greatly influences treatment expenses will affect the use of beds, reduce hospitalization

Table 4. Multiple regression models for disease

		Cerebral infarction			Intracerebral hemorrhage			Subarachnoid hemorrhage			Stroke		
		Estimate	*t*	*p*	Estimate	*t*	*p*	Estimate	*t*	*p*	Estimate	*t*	*p*
Intercept		2.084	48.251	*	2.609	27.604	*	1.778	11.708	*	2.265	57.632	*
Gender (male)	Female	−0.007	−0.481	—	0.073	2.213	**	−0.019	−0.400	—	0.034	2.578	***
Age		0.000	−0.470	—	−0.002	−2.060	**	0.002	1.434	—	−0.003	−6.960	*
Area (same)	Other	−0.013	−0.769	—	−0.095	−2.365	**	−0.014	−0.291	—	−0.030	−1.894	—
Payment (NHI)	Medical aid	0.203	9.179	*	0.272	5.319	*	0.167	2.035	**	0.201	9.692	*
	Other	0.220	3.634	*	0.338	3.553	*	0.339	2.646	***	0.344	7.094	*
Adm. (OPD)	Emergency	0.203	13.531	*	0.285	6.518	*	0.701	11.272	*	0.347	24.141	*
Res. (Recover)	Death	−0.365	−9.814	*	−1.121	−24.645	*	−1.279	−21.815	*	−0.663	−26.137	*
Dis. (Home)	Transfer	−0.102	−4.147	*	−0.326	−7.739	*	−0.507	−7.572	*	−0.127	−6.108	*
Other diagnosis		0.174	40.089	*	0.201	25.656	*	0.196	17.016	*	0.192	51.358	*
Risk factor (non)	HTN	−0.105	−5.931	*	0.002	0.062	—	−0.076	−1.303	—	−0.125	−7.797	*
	DM	−0.065	−2.332	**	−0.118	−1.345	—	−0.116	−0.816	—	−0.180	−6.550	*
	HTN and DM	−0.181	−7.618	*	−0.286	−4.533	*	−0.473	−3.843	*	−0.319	−14.109	*
Bed (100−299)	300−499	−0.052	−2.032	**	−0.114	−2.047	**	0.174	1.549	—	−0.044	−1.851	—
	500−999	−0.156	−8.031	*	−0.263	−5.966	*	0.249	2.638	***	−0.144	−7.884	*
	>1000	−0.293	−12.048	*	−0.317	−5.491	*	0.034	0.323	—	−0.311	−13.604	*
Year (2005)	2006	0.053	2.748	—	0.036	0.847		0.018	0.313		0.030	1.689	—
	2007	−0.029	−1.411	—	0.048	1.048		0.029	0.465		−0.029	−1.570	—
	2008	−0.047	−2.377	**	0.071	1.589		0.081	1.306		−0.040	−2.175	**
$R^2=$		0.167			0.301			0.366			0.198		
Adj $R^2=$		0.166			0.297			0.359			0.198		
$F=$		139.000			77.350			52.027			238.539		
$p=$		0.000			0.000			0.000			0.000		

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; Adm. = admission route; Dis = disposition; DM = diabetic mellitus; HTN = hypertension; NHI = National Health Insurance; OPD: outpatient department; Res. = result; t = t value.

Table 5. Multiple regression models for disease treated by surgery

		Cerebral infarction						Intracerebral hemorrhage						Subarachnoid hemorrhage						Stroke					
		NOP			OP			NOP			OP			NOP			OP			NOP			OP		
Operation		Est	t	p	Est	t	p	Est	t	p	Est	t	p	Est	t	p	Est	t	p	Est	t	p	Est	t	p
Intercept		1.928	43.248	*	2.620	15.431	*	2.493	21.362	*	2.771	18.194	*	1.377	6.298	*	3.026	17.023	*	2.051	48.828	*	2.767	31.579	*
Gender (male)	Female	−0.042	−2.908	**	0.072	1.399	—	0.052	1.282	—	0.168	3.260	**	0.010	0.126	—	−0.048	−1.092	—	−0.021	−1.501	—	0.093	3.344	**
Age		0.003	4.892	*	−0.002	−1.315	—	0.000	−0.303	—	−0.003	−2.127	***	0.005	2.016	***	0.004	2.025	***	0.001	1.821	—	−0.002	−2.102	***
Area (same)	Other	−0.040	−2.312	***	−0.011	−0.211	—	−0.079	−1.541	—	−0.185	−3.165	**	−0.025	−0.298	—	−0.044	−0.998	—	−0.055	−3.261	**	−0.090	−2.975	**
Payment (NHI)	Medical aid	0.195	8.773	*	0.147	1.819	—	0.311	4.825	*	0.177	2.277	***	−0.049	−0.344	—	0.263	3.450	**	0.200	9.190	*	0.188	4.126	*
	Other	0.242	3.987	*	−0.005	−0.021	—	0.371	2.916	**	0.123	0.947	—	0.181	0.855	—	0.377	3.083	**	0.299	5.545	*	0.233	2.800	**
Adm. (OPD)	Emergency	0.234	15.406	*	0.425	7.231	*	0.223	4.173	*	0.368	5.180	*	0.550	6.032	*	0.191	2.602	**	0.296	19.712	*	0.407	12.173	*
Res. (recover)	Death	−0.416	−10.892	*	−0.639	−6.055	*	−1.221	−20.356	*	−1.029	−15.843	*	−1.067	−11.433	*	−1.198	−19.990	*	−0.657	−22.627	*	−1.032	−25.358	*
Dis. (home)	Transfer	−0.112	−4.571	*	0.128	1.171	—	−0.445	−8.606	*	−0.014	−0.213	—	−0.742	−6.806	*	−0.070	−1.061	—	−0.157	−7.132	*	−0.022	−0.507	—
Other diagnosis		0.165	36.829	*	0.174	13.985	*	0.207	18.288	*	0.170	16.845	*	0.214	8.058	*	0.132	13.655	*	0.179	42.025	*	0.161	26.328	*
Risk (non)	HTN	−0.073	−4.089	*	−0.177	−2.756	**	0.014	0.292	—	0.110	1.764	—	−0.081	−0.777	—	−0.015	−0.291	—	−0.062	−3.652	*	−0.014	−0.408	—
	DM	−0.020	−0.730	—	−0.098	−0.709	—	−0.182	−1.544	—	−0.070	−0.590	—	−0.081	−0.362	—	0.003	0.018	—	−0.088	−3.113	**	−0.063	−0.828	—
	HTN and DM	−0.126	−5.277	*	−0.292	−2.984	**	−0.279	−3.554	*	−0.214	−2.102	***	−0.528	−2.320	***	−0.345	−3.165	**	−0.195	−8.236	*	−0.268	−4.541	*
Bed (100−299)	300−499	−0.049	−1.968	***	−0.076	−0.442	—	−0.099	−1.465	—	−0.229	−2.520	***	0.213	1.353	—	−0.253	−1.839	—	−0.045	−1.885	—	−0.214	−3.269	**
	500−999	−0.198	−10.254	*	0.013	0.101	—	−0.271	−5.078	*	−0.311	−4.224	*	0.076	0.597	—	−0.200	−1.638	—	−0.212	−11.347	*	−0.188	−3.561	*
	>1000	−0.345	−14.021	*	−0.436	−3.214	**	−0.264	−3.668	*	−0.530	−5.834	*	−0.029	−0.196	—	−0.440	−3.426	**	−0.357	−14.944	*	−0.500	−8.470	*
Year (2005)	2006	0.046	2.366	***	0.108	1.457	—	−0.029	−0.547	—	0.190	2.831	**	−0.038	−0.393	—	0.048	0.862	—	0.017	0.897	—	0.113	2.979	**
	2007	−0.043	−2.130	***	0.032	0.430	—	0.078	1.376	—	−0.049	−0.711	—	0.055	0.514	—	−0.007	−0.127	—	−0.039	−1.997	**	−0.017	−0.426	—
	2008	−0.073	−3.640	*	0.033	0.471	—	0.076	1.365	—	0.055	0.788	—	0.009	0.084	—	0.096	1.667	—	−0.065	−3.377	*	0.049	1.289	—
$R^2=$		0.177			0.445			0.286			0.398			0.267			0.404			0.185			0.397		
Adj. $R^2=$		0.176			0.431			0.280			0.387			0.247			0.393			0.184			0.393		
$F=$		139.826			32.342			48.544			37.826			13.282			35.619			184.148			100.233		
$p=$		0.000			0.000			0.000			0.000			0.000			0.000			0.000			0.000		

$^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

waiting time, improve the financial structure of the hospital, and reduce the burden of treatment cost on patients and insurers [7,8,15,16].

Thus, based on the LOS of stroke inpatients [7–9,12,24], we sought to analyze the factors that influence the LOS according to each disease group in patients who underwent surgery and those who did not. There were differences in the number of patients and LOS in patients with cerebral infarction, intracerebral hemorrhage, and subarachnoid hemorrhage; factors that influenced the length of hospitalization also varied according to the pathological types of stroke and between patients who underwent surgery and those who did not.

The incidence rate by type was highest for cerebral infarction (71.8%), followed by intracerebral hemorrhage (18.7%) and subarachnoid hemorrhage (9.4%). According to the data on medical care claims by the Health Insurance Review and Assessment Service cited in Kwon et al with respect to patients who were admitted and discharged with a diagnosis of stroke [3], the order was cerebral infarction (70.8%), intracerebral hemorrhage (15.2%), transient ischemic attack (8.9%), and subarachnoid hemorrhage (5.0%). According to the Korean Stroke Society, of all stroke patients in 29 big hospitals, excluding cases of hemorrhagic stroke and transient ischemic attack, 10,811 patients (89.6%) had ischemic stroke, 667 (5.5%) had hemorrhagic stroke, and 594 (4.9%) had transient ischemic attack [20]. The difference in the percentages is thought to result from methodological differences in disease-type classification and data collection.

The average LOS for all stroke patients was 18.6 days. It is shorter than the 25.8 days reported for the Netherlands [12] and longer than the 6–8 days reported for the United States [7] and the 10.6 days reported for Germany [25]. Such variation in the LOS by country is attributable to the difference resulting from the inclusion or exclusion of recurrent cases and the influence of the medical system, payment compensation system, etc. In the Health Insurance Review and Assessment Service study that used data gathered over a 10-year period, the LOS was 27.2 days in 2008 and 21.4 days in 2007 [3,10]. According to the data of a 2009 study on patients that excluded long-term inpatients, the LOS was 29.0 days for ischemic stroke (I63–I67) and 45.57 days for hemorrhagic stroke (I60–I62) [26]. The difference in the LOS, as in the abovementioned patient composition, reflects the difference based on the scope of pathological subtype in sample selection and on whether long-term inpatients are included. In this study, 507 (2.8%) of the total number of selected patients were long-term inpatients whose cumulative LOS was 105,750 days, which constituted 24.7% of the total number of hospitalization days (Table 1). In particular, 1.6% of the patients who underwent surgery for cerebral infarction and whose LOS comprised 31.4% of the total LOS were excluded from the study. In the study by Evers et al, 2.6% of patients were long-term hospitalized patients [12].

Surgery was performed on 15.9% of all patients: 58.8% for subarachnoid hemorrhage, 32.3% for intracerebral hemorrhage, and 6.0% for cerebral infarction. There was a 2.1-fold difference in the LOS between surgery and nonsurgery cases, being 32.6 and 15.9 days, respectively. According to a 25-year study (1967–1991) on reducing the LOS for stroke patients in the United States, as the incidence of stroke increased over the years, the LOS was increased to a greater extent in surgery cases [13]. Whether or not surgery was performed was the factor that most influenced the LOS and treatment expenses [9,15,16]. In nonsurgery cases, there was a wider variation in the average hospital stay than that in surgery cases, and the severity of disease varied to a greater degree even within the same pathological subtype [10]. Accordingly, the results of this study, which analyzed the factors that influenced the LOS depending on whether surgery was performed or not for each disease, can be used to address the change in the payment system and as reference data for managing the LOS.

While medical aid recipients accounted for 3–4% of the entire population in a previous study [23], they comprised 11.2% in this study. When patients with cerebral infarction (I60–I69) treated in university hospitals were classified by whether surgery was performed and by the type of insurance, the hospital stay of the surgery patients benefitting from industrial accident compensation insurance or medical aid was 56.57 days, which was 2.1 times longer than that for patients with NHI (27.80 days). If surgery was not performed, the LOS for patients with industrial accident compensation insurance or medical aid was 16.76 days, which was 1.5-fold higher than that for patients with NHI (13.41 days) [15]. In this study, receiving medical aid or other forms of insurance was identified as a statistically significant factor that led to a longer hospital stay for patients with stroke in general, as well as separately for patients with cerebral infarction, intracerebral hemorrhage, and subarachnoid hemorrhage. This was also a determinant factor for significantly prolonging the LOS when all stroke patients were divided into surgery and nonsurgery groups. However, when the surgery/nonsurgery classification was made according to pathological subtype, receiving medical aid or other forms of insurance was not significant in terms of NHI and other forms of insurance for patients with cerebral infarction who underwent surgery and patients with subarachnoid hemorrhage who did not, and being on other forms of insurance was not significant for patients with intracerebral hemorrhage who underwent surgery. According to Chang et al, who studied the influence of health service coverage on medical services in patients with acute cerebral infarction (I63, I67–I69) [23], no difference was found in the average LOS for patients with NHI and medical aid. When the LOS for elderly patients was classified into "shorter than 30 days" and "longer than 30 days," there was no significant difference according to insurance type [14]. In the evaluation of the appropriateness of hospital stay according to insurance type, no difference was found based on health service coverage [11]. According to Kim et al [16], insurance type was a significant factor for all patients with stroke; it was not a significant factor for patients with intracerebral hemorrhage (I61), but was a significant factor for patients with cerebral infarction (I63). Such difference is believed to originate from the difference between the pathological subtype code scopes and study patients. However, the results were consistent in that the factor of insurance type was significant for all patients with stroke, but varied according to different subtypes.

There were a total of 11.4% of transfers to a different hospital. The highest percentage of transfers was for patients with intracerebral hemorrhage who did not undergo surgery (19.4%), and the lowest was for patients with cerebral infarction who underwent surgery (5.8%). Transfer to a different hospital was a factor that decreased the LOS for all stroke patients and for patients in each disease group. Among patients who underwent surgery, it was the factor that increased the LOS in patients with cerebral infarction and decreased the LOS in patients with intracerebral hemorrhage and subarachnoid hemorrhage, although neither the increase nor decrease was statistically significant. Treatment of stroke occurs in three stages, namely, treatment of the acute stage, rehabilitation, and prevention of reoccurrence [11,15]. In cases in which surgery was performed, the state of patients was acute, which required the concentration of resources such as man power, operating room, intensive care unit; before the patient was stabilized, it was impossible to shorten the LOS through a transfer to a different hospital. In cases where surgery was not performed, the patient was comparatively stable, and led to the continuous treatment process that requires long-term treatment for the chronic condition and rehabilitation service. Accordingly, based on whether or not surgery was performed, transfer to a different hospital was another factor that influenced the increase or decrease in the LOS.

The component ratio of patients significantly differed according to the number of hospital beds for each disease and whether surgery was performed. According to Kwon et al, who classified medical institutions into high-level general hospitals, general hospitals, hospitals, convalescent hospitals, and clinics, the ratio of patients with cerebral infarction was highest for all medical institutions [3]. However, when viewed by type of medical institution, there was a tendency for a slight increase in the ratio of patients with cerebral infarction and transient ischemic attacks, and at the same time, for a decrease in the ratio of patients with hemorrhagic stroke in high-level general hospitals and general hospitals. In hospitals, there was a tendency for the ratio of patients with cerebral infarction to increase, but there was not much variation in the number of transient ischemic attacks over the years. There was a distinct tendency for the ratio of patients with intracerebral hemorrhage to decrease, and the ratio of patients with subarachnoid hemorrhage remained similar. Being treated in a hospital with 500−999 beds was a factor for decreased LOS for patients with cerebral infarction and intracerebral hemorrhage and a factor for increased LOS for patients with subarachnoid hemorrhage. Undergoing surgery for cerebral infarction and not undergoing surgery for subarachnoid hemorrhage contributed to increased LOS; undergoing surgery for subarachnoid hemorrhage contributed to decreased LOS, but the contributions were not statistically significant.

According to a number of non-Korean studies performed based on all pathological types, the larger the number of beds, the longer the LOS [27−30]. According to the studies that connected a higher number of hospital beds with the increased risk for patients [27,28], the severity of disease and LOS were proportional. Further, if it is assumed that more severe diseases are likely to be treated in bigger hospitals, it is natural that more the number of beds, longer the hospital stay. However, this study observed that the tendency for decreased LOS was more marked in bigger hospitals. Ahn explained that the increased LOS in smaller hospitals was due to the inappropriate use of hospital beds, whereas in large-scale hospitals, there is excessive medical service due to the high intensity of service; therefore, correction of the form of treatment in different types of hospitals requires different emphasis [31].

When dividing stroke patients by disease and whether they had surgery, admission through the emergency room and the number of other diagnoses were factors that increased the LOS, whereas death as a treatment result and having both hypertension and diabetes contributed to decreasing the LOS; both the increase and decrease were statistically significant. Admission through the emergency room, number of other diagnoses, and having both hypertension and diabetes are all risk factors that increase the use of medical resources [14].

When admission routes that allowed the use of disease severity as a proxy variable were considered, 67.6% of cases were found to have had admission through the emergency room. Further, 91.6% of patients with subarachnoid hemorrhage who had undergone surgery had been admitted through the emergency room. For these patients, the average LOS was 33.2 days, followed by patients who underwent surgery for intracerebral hemorrhage (35.1 days). Of the patients who underwent surgery for cerebral infarction, 36.3% had been admitted through the emergency room, which was the lowest percentage of admissions through the emergency room, and the average LOS was 28.1 days. According to a study that evaluated the appropriateness of the LOS for acute diseases, the appropriateness was significantly higher when patients were admitted through the emergency room than that in cases of admission through the outpatient department [11].

The number of other diagnoses for all patients was 2.0. It was 2.2 for patients who underwent surgery, which was 1.1 times more than the 2.0 for patients who did not. The LOS was 2.1 times longer for patients who underwent surgery (32.6 days) than that for patients who did not (15.9 days). The number of other diagnoses was highest in patients with intracerebral hemorrhage who underwent surgery (2.4), and these patients had the longest hospital stay (35.1 days). The number of other diagnoses was lowest in patients with subarachnoid hemorrhage who did not undergo surgery (1.3), and these patients had the shortest hospital stay (13.9 days). According to studies on the relation between the number of diagnoses for comorbidities and complications and the LOS, the greater the number of comorbidities and complications, the longer the hospital stay and the higher the mortality [32].

In this study, which defined “death” and “hopeless discharge” as “death,” the mortality rate for all patients was 7.4%, with the mortality rate for patients who underwent surgery being 2.3 times higher (13.8%) than that for patients who did not (6.1%). According to a study that classified stroke cases as hemorrhagic and nonhemorrhagic, the mortality rate for hemorrhagic stroke was 13.4%, which was 3.8 times higher than that for nonhemorrhagic stroke, which was 3.5% [33]. Death was the factor that decreased the LOS for all stroke patients and for each disease group depending on whether surgery was performed. Other studies also found that death was a factor that decreased the LOS [9,16]. An analysis of the period of death of stroke patients revealed that 83 people (52.5%) died within 7 days, 58 people (36.7%) died between 8 and 30 days, and 17 people (10.8%) died 31 days after the disease occurred [34].

Hypertension was a risk factor in 42.2% of patients; 19.5% had diabetes (Table 3, restructured), and according to two studies that divided patients by hemorrhagic and nonhemorrhagic stroke, 45.7% and 59.7% of patients had a history of hypertension, and 14.9% and 28.7% had a history of diabetes, respectively [19,33]. Following an examination of the difference in the LOS depending on hypertension and diabetes, which were risk factors identifiable by disease code and classified into “absence of risk factors,” “hypertension,” “diabetes,” “hypertension and diabetes,” we determined that having both hypertension and diabetes was a significant factor for decreased LOS in all groups. In patients with cerebral infarction, hypertension, and diabetes, each condition was a significant factor separately, and they held significance only for patients with cerebral infarction. Further, they were significant factors for stroke patients who did not undergo surgery and for patients with cerebral infarction independent of whether surgery was performed or not, contributing to the decreased LOS. Diabetes was a factor that significantly decreased the LOS in patients with stroke and cerebral infarction. However, when patients were divided on the basis of whether surgery was performed, it was a significant factor only for the stroke patients who underwent surgery; it was not a significant factor for other disease groups. In general, the more severe the comorbidity and complications were, the longer was the hospital stay [7,9,12,31]. A study of the LOS and death as a treatment result in patients with acute thrombotic occlusion depending on comorbidities concluded that the higher the comorbidity index number, the longer the hospital stay [35].

This study aimed to investigate the factors that influence the LOS in stroke patients. One limitation of this study is that it did not reflect other variables that influence the LOS, such as the part of the brain in which stroke occurred and other clinical characteristics such as characteristics of the doctor, characteristics of the hospital (e.g., foundation entity), characteristics of the patient’s family, social support. Further, reoccurrence of the disease or absence thereof was not reflected in the analysis and there were issues with the accuracy of diagnosis and coding; these may be limitations in the methodology [36]. However, we believe that this study is significant in that it used data from hospitals with >100 beds from all over the country, and the analysis data were extracted mainly from that stored in medical records department, where hospital data are best managed. Moreover, for noncomputerized hospitals, a person in charge of sampling or a researcher from the Korea Centers for Disease Control and Prevention was dispatched. We used system data from the Korean National Hospital Discharge In-Depth Injury Survey, which included variables for analysis such as inpatient days by pathological subtypes as well as hypertension and diabetes that influence the severity of disease [35,37].

Based on this study, the following is suggested: First, standardization is required to produce a comparison with valid data. Every study used a different scope of disease codes for stroke, and at the data-classification stage, a standardized scope of diseases adds validity not only to analysis of the treatment expenses and LOS, but also to that of medical resources and cost, which aids the decision-making stage. Second, there is a need to consider when the data are made public. A change in policy brings about changes in the LOS [12,13]. Long-Term Care Insurance for the Aged was introduced in July 2008, and the data of the Korean National Hospital Discharge In-Depth Injury Survey used in this study covered the period from 2005 to 2008, such that the analysis of the change in the LOS could not reflect the policy change. It will be more than 2 years before the current data become public and can be used in research. Another disadvantage is that there is a difference in the survey time and the hospitals targeted for the survey, leading to partial correspondence between the information provided and the patient survey; further, the low sample-extraction rate reduces its accuracy. Third, there is a need to consider the survey interval. The study results suggest that there was not much change in the LOS every year over a 4-year period. Considering this, it is suggested that the survey interval be increased to every 2−3 years.

5. Conclusion

Even if the LOS of stroke patients decreased, it would not influence the death rate, repeat hospitalization rate, and other aspects of the quality of treatment [38]. This study has significance because it seeks the appropriate plan for managing the LOS of stroke patients for each disease and depending on whether surgery was performed to decrease the burden of treatment expenses on the insurer, the hospital, and patients through effective management of the LOS in the wake of the changing treatment-cost reimbursement system.

The LOS for all stroke patients was 18.6 days, and the LOS for each disease group was 15.0 days for patients with cerebral infarction, 28.9 days for patiets with intracerebral hemorrhage, and 25.3 days for patients with subarachnoid hemorrhage. When patients were divided based on whether they had surgery, there was a 2.4-time difference in the LOS for patients with subarachnoid hemorrhage, 2.0-time difference for patients with cerebral infarction, and 1.4-time difference for patients with intracerebral hemorrhage. The common factors that influenced the LOS for all diseases and for each disease, divided by whether or not patients had surgery, were admission route through the emergency room and the number of other diagnoses increased the LOS, whereas death and having both hypertension and diabetes decreased the LOS. When patients were divided by disease, receiving medical aid or other types of insurance was the factor that contributed to increased LOS, and based on whether surgery was performed, it was not a significant factor for patients with cerebral infarction who underwent surgery and in patients with subarachnoid hemorrhage who did not undergo surgery; it was also not significant in patients with intracerebral hemorrhage who used other methods of payment. Transfer to a different hospital was a factor that decreased the LOS for all patients and for each disease; when patients were divided based on whether surgery was performed, it was a factor that increased the LOS for patients with cerebral infarction who underwent surgery and that decreased the LOS of patients with intracerebral hemorrhage and subarachnoid hemorrhage who underwent surgery, but neither had statistical significance.

As the treatment-cost reimbursement system is changing from FFS to DRG worldwide, there is a need for a different policy approach for managing the LOS so that hospitals can maintain profits and perform their inherent role of providing good-quality treatment. If we assume that it is appropriate to use the LOS as the indicator of treatment expenses, there is a need to tackle factors that influence the LOS of stroke patients for each disease group who are divided based on whether surgery is performed or not for the proper management of the LOS.

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