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Distribution and predictors of hospital charges for haemorrhagic stroke patients in Beijing, China, March 2012 to February 2015: a retrospective study

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ABSTRACT

Objectives The purpose of this study is to analyse hospital charges for patients with haemorrhagic stroke in China and investigate potential factors associated with inpatient charges.

Methods The study participants were in-hospital patients with a primary diagnosis of haemorrhagic stroke from all the secondary and tertiary hospitals in Beijing during the period from 1 March 2012 to 28 February 2015. Distribution characteristics of detailed hospital charges were analysed. The influence of potential factors on hospital charges was researched using a stepwise multiple regression model.

Results A total of 34 890 patients with haemorrhagic stroke of mean age 61.19±14.37 years were included in the study, of which 37.2% were female. Median length of hospital stay (LOHS) was 15 days (IQR 9–23) and median hospital cost was 18 577 Chinese yuan (CNY) (IQR 10 442–39 784). The hospital costs for patients in Western medicine hospitals (median 19 651 CNY) were significantly higher (P<0.01) than those in traditional Chinese medicine hospitals (median 14 560 CNY), and were significantly higher (P<0.01) for Level 3 hospitals (median 20 029 CNY) than for Level 2 hospitals (median 16 095 CNY). The proportion of medicine fees and bed fees within total hospital charges showed a decreasing trend during the study period. With stepwise multiple regression, the major factors associated with hospital charges were LOHS, surgery, pulmonary infection, ventilator usage, hospital level, occupation, hyperlipidaemia, hospital type, in-hospital death, sex and age.

Conclusion We conclude that medicines form the largest part of hospital charges but are showing a decreasing trend, and LOHS is strongly associated with patient charges for haemorrhagic stroke in China. This implies that the cost structure is very unreasonable in China and medical technology costs fail to be fully manifested. A reasonable decrease in medicine charges and shortening LOHS may be effective ways to reduce hospital charges.

Strengths and limitations of this study

- This study is one of the few researches analysing the distribution characteristics and predictors of hospital charges for haemorrhagic stroke in China, where the hospital system, medical insurance system, practice patterns and costs are much different from those in Western countries.
- We used a large amount of data including all the Level 2 and Level 3 hospitals in Beijing, China.
- The study period was 3 years and changing trends of hospital charges were analysed during these 3 years.
- Our study findings are only applicable to patients at general hospitals in metropolitan areas because the patients with haemorrhagic stroke in this study probably differed from those admitted to hospitals in smaller cities and rural areas.

INTRODUCTION

As one of the leading causes of death in both developed and developing countries,[1] stroke imposes a heavy socioeconomic burden on the nation and has become a major public health problem. According to previous reports, about 40% of all stroke deaths are attributable to haemorrhagic stroke.[2] Compared with the USA and European countries, the incidence of haemorrhagic stroke is higher in Asia[3 4] and the percentage of haemorrhagic stroke in China is up to 23%. At present, as one of the countries with the highest incidence of stroke, China has at least 7 million patients who have experienced a stroke, which has become the first cause of death. In addition, about 2.5 million new cases occur each year and more than 1.5 million patients die of stroke.[5–8] The direct medical cost of stroke is increasing each year with an average growth rate from 2003 to 2010 of 18.04%, and the direct economic burden caused by stroke is up to 40 billion CNY every year.[9] In recent years, the incidence of stroke has shown a

Table 1 Exclusion criteria

Variable	Patients (n)
Hospital charge (yuan)	
<100	25
>300 000	177
Age (years)	
<20	447
>90	280
Length of stay (days)	
≤1	1387
≥180	70
Foreigners	221

trend towards younger people in China with an average age of onset of 65.5 years, while China has become an ageing society.

Several previous studies have examined in-hospital resource use of stroke patients in the USA and European countries.[10–12] However, there are only a few research studies which have analysed the distribution characteristics of hospital charges for haemorrhagic stroke and factors associated with medical expenditures in China, where the hospital system, medical insurance system, practice patterns and costs are much different from those in Western countries.

The present study aims to examine the distribution and proportion of patients' charges for haemorrhagic stroke, as well as factors ass ociated with hospital charges using data from all the Level 2 and Level 3 hospitals in Beijing, China. Knowledge of the factors influencing hospital charges for haemorrhagic stroke would contribute to the implementation of targeted measures, effective utilisation of health resources and reasonable control of hospital charges, which would reduce the burden on individuals and society as well as enhancing the economic effect of healthcare.

METHODS

Subjects

The study was conducted in Beijing, which has 16 370 km^2 and a permanent population of 21.148 million according to the census bulletin released in 2014. The annual morbidity of stroke was 560 and the mortality was 66.6 for every 10 million individuals up to 2013 in Beijing. Chinese hospitals are divided into three levels: Level 1 (community hospitals with only the most basic facilities and very limited inpatient capacity); Level 2 (hospitals with at least 100 inpatient beds providing acute medical care and preventive care services to a population of at least 100 000); and Level 3 (major tertiary referral centres in provincial capitals and major cities).[13] According to the treatment custom, there are two types of hospitals in China: Western medicine hospitals and traditional Chinese medicine hospitals. Although there is no difference in the facilities and therapeutic range of these two types of hospitals, their emphasis of treatment concept is a little different. Traditional Chinese medicine hospitals mainly use traditional Chinese medicine therapy to improve conventional treatment and deal with chronic diseases, while Western medicine hospitals mainly use Western medicine. For acute stroke patients, the emergency medical service sends the patient to the nearest hospital.

We collected patient data from Beijing Public Health Information Centre database including all the Level 2 and Level 3 hospitals between 1 March 2012 and 28 February 2015. Patients with a primary diagnosis of haemorrhagic stroke coded as I60–I61 according to the International Classification of Diseases 10th Revision (ICD-10) were selected. A total of 37 418 patients were initially enrolled in the study; 2528 were excluded because they did not meet the following criteria: nationality (Chinese), age (20–90 years old), length of hospital stay (LOHS) (1–180 days) or total hospital charges (100–300 000 CNY). Thus, a total of 34 890 cases were finally included.

The cost details of patients were classified into charges for treatment, laboratory tests, examination, drugs, blood transfusion, materials, beds and miscellaneous. Demographic data, hospital type, hospital level, variables relevant to hospitalisation, clinical data and insurance status were obtained from the home page of the medical records.

The Barthel Index (BI) score was used to assess the severity of stroke, higher scores indicating a less severe level of stroke.[14] In this study, each patient with haemorrhagic stroke had a BI score on admission and at discharge.

Statistical analysis

Continuous variables are described as mean±SD or median value with 25th and 75th percentiles. Comparisons of hospital charges between groups were conducted with non-parametric tests, since the finance data were not in a Gaussian distribution.

A stepwise multiple linear regression model was used to determine the predictors of various hospital charges. We performed a log transformation for the financial data in order to make it Gaussian distribution. 'Employed' was chosen as the omitted category of occupation and the remaining categories were treated as 0/1 dummy variable s (occupation 1, occupation 2 and occupation 3). 'Widowed or divorced' was chosen as the omitted category of marital status and the remaining categories were treated as 0/1 dummy variables (marital status 1, marital status 2 and marital status 3). It is possible that different subclasses of the BI score on admission might have different effects, so we divided the BI score on admission into ≤60 (degree of independence of Activities of Daily Living relatively poor) and >60 (degree of indiependence of Activities of Daily Living relatively good) to analyse their effects. The addition of variables to the model was statistically significant

(P<0.05). All analyses were conducted using Statistical Product and Service Solutions (SPSS) software Version 23.0. All statistical tests were two-sided and the significance level was set at P<0.05.

RESULTS

Our study included 115 Western medicine hospitals and 37 traditional Chinese medicine hospitals (75 Level 3 hospitals and 77 Level 2 hospitals). A total of 37 418 patients with haemorrhagic stroke were initially selected. The exclusion criteria and the number of patients who did not conform to the inclusion criteria are shown in table 1. Patients included in the study were Chinese and aged 20–90 years. Patients whose hospital charges (<100 or >300 000 CNY) or length of stay (≤1 or ≥180 days) deviated from the norm were excluded because they are exceptional cases without explanation.

Table 2 summarises the characteristics of the 34 890 patients included in the study. The average age at haemorrhagic stroke onset was 61.2±14.4 years and 62.8% were men. The majority of patients were in Western hospitals (86.8%) and Level 3 hospitals (67.3%). The median LOHS was 15.0 days (IQR 9.1–23.0) and 8.1% of patients died in hospital. The percentages of comorbid conditions such as hypertension, hyperlipidaemia, diabetes mellitus or pulmonary infection of patients were 72.3%, 12.7%, 16% and 29.2%, respectively. The median change in BI score between admission and discharge was 5 (IQR 0–30) and median hospital charge for each BI score increase was 805 CNY (IQR 374–1863). A minority of patients were entirely covered by self-pay (17.6%), while others had health insurance, rural cooperative medical service or state free medical care.

Table 3 shows the total patient charge and charges by category according to hospital level and hospital type. The mean total fee per patient was 33 867±40 275 CNY and the median was 18 577 CNY (IQR 10 442–39 784). The total hospital charges contain the treatment fee, laboratory and examination fee, medicine fee, blood transfusion fee, materials fee and beds fee, the median (IQR) values of which were 4013 CNY (1649–8902), 2985 CNY (1790–4967), 7218 CNY (3172–16001), 0 CNY (0–0), 1799 CNY (784–5549) and 450 CNY (264–776), respectively.

The trend in hospital charges from March 2012 to February 2015 is shown in table 4. The medicine fee as a proportion of the total hospital charges decreased slowly from 40.97% for the period March 2012–February 2013 to 37.68% for March 2014–February 2015. Similarly, the bed fee as a proportion of the total fee declined gradually from 2.34% for the period March 2012–February 2013 to 2.04% for March 2014–February 2015.

The total hospital charges were significantly higher in female patients and in those who were younger (P<0.05), as well as in patients with hypertension, hyperlipidaemia or pulmonary infection (P<0.05). Patients who died in hospital and received surgery also had higher total charges (P<0.05). The total fee increased with longer LOHS (P<0.05). In addition, in Level 3 hospitals and Western hospitals the total fee was higher than in Level 2 and traditional Chinese hospitals, respectively (P<0.05). In terms of marital status, patients who were widowed or divorced had higher total charges (P<0.05). However, no significant differences existed in total charges between patient groups divided according to insurance status and comorbid conditions of diabetes mellitus (table 5).

The statistically significant predictors of total hospital charges in the two subgroups (BI score on admission ≤60 and >60) by a stepwise multiple linear regression model are shown in tables 6 and 7. The dependent variable was the log of total hospital charges. Standardised coefficients represent the influence of variables on total hospital charges. The larger the standardised coefficient, the greater is the influence of the variable on total hospital charges. According to standardised coefficients, the factors in the subgroup with a BI score on admission of ≤60 in decreasing order were LOHS, surgery, pulmonary infection, ventilator usage, in-hospital death, hospital level, occupation 2, age, occupation 1, medical payment type, hyperlipidaemia, sex, marital status 2, hospital type, marital status 1 and hypertension. In the subgroup with a BI score on admission of >60, the factors affecting total hospital charges in decreasing order were LOHS, surgery, pulmonary infection, ventilator use, in- hospital death, hospital level, occupation 2, age, medical payment type, hyperlipida emia, sex, hospital type, hypertension and diabetes mellitus. Multivariate analysis of LOHS was also performed. The major factors associated with LOHS were pulmonary infection, in-hospital death and surgery.

DISCUSSION

Haemorrhagic stroke is a global health problem and about two-thirds of cases occur in low-income and middle-income countries where the disease still does not receive sufficient attention for reduction of the socioeconomic burden.[15 16] This study looked at hospital data of patients with haemorrhagic stroke in Beijing during the period from 1 March 2012 to 28 February 2015. Detailed descriptions as well as trends and predictors of hospital charges were studied.

Haemorrhagic stroke is a serious disease and is usually accompanied by consciousness. Surgical intervention is required with bleeding over 30 mL, which will pose a serious burden on the patients and their family. Families of patients with haemorrhagic stroke lose an important source of income as a result of disability. Moreover, as a lot of time and effort are invested in the intensive treatment phase, the economic and mental burdens are even heavier. Compared with developed countries in Europe and the USA, our study showed that the mean total hospital charge per person is lower (7683.8±91 430.3 USD). A study conducted in Greece showed that the average cost of haemorrhagic stroke was 12 497±9990 USD.[17] Dodel *et al* evaluated the costs of different types of

Table 2 Characteristics of patients with haemorrhagic stroke

Variable	Total	Hospital level		P value	Hospital type		P value
		Level 2	Level 3		Western medicine	Traditional Chinese medicine	
Total number of patients (n)	34 890						
Age, mean±SD	61.2±14.4	62.1±13.9	60.8±14.6	<0.05	60.9±14.4	63.3±13.9	<0.05
Sex				0.173			0.355
Men, n (%)	21 918 (62.8)	7101 (62.3)	14 811 (63.1)		19 044 (62.9)	2874 (62.2)	
Women, n (%)	12 972 (37.2)	4298 (37.7)	8674 (36.9)		11 226 (37.1)	1746 (37.8)	
Hospital level, n (%)							<0.05
Level 2 hospital	11 405 (32.7)				9643 (84.6)	1762 (15.4)	
Level 3 hospital	23 485 (67.3)				20 627 (87.8)	2858 (12.1)	
Hospital type, n (%)				<0.05			
Western medicine	30 270 (86.8)	9643 (31.9)	20 627 (68.1)				
Traditional Chinese medicine	4620 (13.2)	1762 (38.1)	2858 (61.9)				
Surgery, n (%)	8749 (25.1)	2457 (21.5)	6292 (26.8)	<0.05	8344 (27.6)	405 (8.8)	<0.05
In-hospital death, n (%)	2821 (8.1)	1051 (9.2)	1770 (7.5)	<0.05	2606 (8.6)	215 (4.7)	<0.05
Ventilator use	3141 (9.0%)	587 (5.1)	2554 (10.9)	<0.05	3051 (10.1)	90 (1.9%)	<0.05
LOHS, median (IQR)	15.0 (9.1–23.0)	16.0 (8.7–25.0)	15.0 (9.5–22.2)	<0.05	15.0 (9.0–22.8)	18.3 (12.0–26.0)	<0.05
BI score on admission, median (IQR)	25 (0–55)	20 (0–45)	30 (5–55)	<0.05	25 (0–50)	35 (10–60)	<0.05
Discharge BI score, median (IQR)	50 (10–80)	40 (0–75)	50 (15–85)	<0.05	50 (10–80)	50 (15–80)	<0.05
Median change in BI score between admission and discharge, median (IQR)	5 (0–30)	5 (0–25)	5 (0–30)	<0.05	5 (0–30)	5 (0–20)	<0.05
Hospital charge for each BI score increase, median (IQR)	805.3 (373.5–1862.6)	716.0 (341.0–1563.3)	849.2 (390.3–2008.9)	<0.05	802.2 (372.0–1873.6)	835.4 (388.6–1775.1)	0.982
Marital status, n (%)				<0.05			<0.05
Married	31 873 (91.4)	10 322 (90.5)	21 551 (91.8)		27 494 (90.8)	4379 (94.8)	
Single	1097 (3.1)	468 (4.1)	629 (2.7)		988 (3.3)	109 (2.4)	
Widowed or divorced	1369 (3.9)	601 (5.3)	764 (3.3)		1237 (4.1)	128 (2.8)	
Occupation, n (%)				<0.05			<0.05
Employed	14 679 (42.1)	5780 (50)	8971 (38.2)		12 505 (41.3)	2174 (47.1)	
Unemployed	3302 (9.5)	1799 (15.8)	1503 (6.4)		2995 (9.9)	307 (6.6)	
Retired, n (%)	8199 (23.5)	2894 (25.4)	5305 (22.6)		6735 (22.2)	1464 (31.7)	

Continued

Table 2 Continued

Variable	Total	Hospital level		P value	Hospital type		P value
		Level 2	Level 3		Western medicine	Traditional Chinese medicine	
Others, n (%)	8710 (25)	1004 (8.8)	7706 (32.8)		8035 (26.5)	675 (14.6)	
Comorbidities at admission, n (%)							
Hypertension	25213 (72.3)	8892 (78)	16321 (69.5)	<0.05	21731 (71.8)	3482 (75.4)	<0.05
Hyperlipidaemia	4446 (12.7)	1531 (13.4)	2915 (12.4)	<0.05	3548 (11.7)	898 (19.4)	<0.05
Diabetes mellitus	5593 (16)	1841 (16.1)	3752 (16.0)	0.692	4793 (15.8)	800 (17.3)	<0.05
Pulmonary infection	10203 (29.2)	3906 (34.2)	6297 (26.8)	<0.05	9152 (30.2)	1051 (22.7)	<0.05
Medical payment type, n (%)				<0.05			<0.05
Health insurance	14336 (41.1)	4282 (37.5)	10054 (42.8)		12038 (39.8)	2298 (49.7)	
Rural cooperative medical service	7431 (21.3)	3075 (27.0)	4356 (18.5)		6197 (20.5)	1234 (26.7)	
State free medical care	2167 (6.2)	910 (8.0)	1257 (5.4)		2011 (6.6)	156 (3.4)	
Entire self-pay	6126 (17.6)	2183 (19.1)	3943 (16.8)		5388 (17.8)	738 (16.0)	

Statistical significance P<0.05 (χ^2test, Mann–Whitney U-test or Kruskal–Wallis H test.
BI, Barthel Index; LOHS, length of hospital stay.

Table 3 Distribution of hospital charges for patients with haemorrhagic stroke

		Hospital level			Hospital type		
Hospital charge	Median (IQR)	Level 2	Level 3	P	Western medicine	Traditional Chinese medicine	P
Treatment fee	4013 (1649–8902)	3808 (1542–8494)	4120 (1750–9128)	<0.05	4034 (1630–9285)	3923 (1783–7028)	<0.05
Surgery	0 (0–30)	0 (0–0)	0 (0–203)	<0.05	0 (0–274)	0 (0–0)	<0.05
Intervention therapy	0 (0–0)	0 (0–0)	0 (0–0)	<0.05	0 (0–0)	0 (0–0)	<0.05
Monitoring and assisted respiration	1557 (143–4017)	1375 (65–3749)	1655 (157–4082)	<0.05	1727 (298–4275)	533 (0–2327)	<0.05
Rehabilitation therapy	0 (0–40)	0 (0–10)	0 (0–50)	<0.05	0 (0–20)	0 (0–448)	<0.05
Oxygen	455 (94.5–1120)	487 (120–1159)	440 (84–1092)	<0.05	490 (126–1169)	217 (217–784)	<0.05
Nursing treatment	357 (182–848)	323 (165–796)	371 (192–872)	<0.05	378 (189–903)	262 (153–531)	<0.05
Others	198 (3–1010)	218 (0–1304)	189 (6–890)	0.941	150 (0–840)	796 (112–2226)	<0.05
Laboratory and examination fee	2985 (1790–4967)	3052 (1855–5362)	2953 (1763–4820)	<0.05	3053 (1808–5154)	2632 (1649–3904)	<0.05
Laboratory	1680 (962–3004)	1717(1046–3154)	1657(923–6462)	<0.05	1708 (964–3129)	1565 (944–2372)	<0.05
Imaging	660 (272–1220)	602 (184–1120)	720 (330–1262)	<0.05	720 (330–1280)	440 (180–844)	<0.05
Ultrasound	165 (0–665)	180 (0–980)	120 (0–545)	<0.05	120 (0–655)	210 (0–671)	<0.05
Pathology	0 (0–0)	0 (0–0)	0 (0–0)	<0.05	0 (0–0)	0 (0–0)	<0.05
Others	20 (20–140)	32 (20–105)	20 (20–150)	<0.05	20 (20–126)	20 (20–170)	<0.05
Medicine fee	7218 (3172–16 001)	6175 (2971–12 748)	7850 (3303–17 644)	<0.05	7696 (3310–17 010)	5154 (2441–9940)	<0.05
Western medicine	5889 (2415–13 594)	4716(2013–10 630)	6621 (2668–15 036)	<0.05	6597 (2769–14 552)	2793 (1068–6298)	<0.05
Antibiotic medicine	1 (0–1556)	0 (0–1421)	15 (0–1634)	<0.05	15 (0–1660)	0 (0–1027)	<0.05
Chinese traditional patent medicine	36 (0–333)	72 (0–546)	20 (0–254)	<0.05	21 (0–230)	330 (26–1571)	<0.05
Chinese herbal medicine	0 (0–0)	0 (0–0)	0 (0–0)	<0.05	0 (0–0)	97 (0–619)	<0.05
Blood transfusion	0 (0–0)	0 (0–0)	0 (0–0)	<0.05	0 (0–0)	0 (0–0)	<0.05
Beds	450 (264–776)	432 (252–754)	462 (280–780)	<0.05	448 (264–784)	480 (308–720)	<0.05
Materials fee	1799 (784–5549)	1205 (536–3541)	2189 (953–6462)	<0.05	2102 (897–6470)	808 (396–1672)	<0.05
Others	202 (108–434)	172 (94–306)	222 (116–556)	<0.05	201 (105–442)	210 (118–406)	0.163
Total fee	18 577(10 442–39 784)	16 095 (9158–32 187)	20 029 (11 197–43 630)	<0.05	19 651 (10 632–43 041)	14 560 (9308–23 217)	<0.05

P<0.05 (Mann–Whitney U test).

Table 4 Distribution of hospital charges and their changing trends during 3 years

	Treatment fee (%)	Laboratory and examination fee (%)	Medicine fee (%)	Marterials fee (%)	Blood transfusion (%)	Bed fee (%)	Others (%)	Total fee (%)
March 2012–February 2013	21.17	12.37	40.97	20.31	0.88	2.34	2.07	100
March 2013–February 2014	21.63	12.66	38.11	22.1	1.13	2.2	2.33	100
March 2014–February 2015	21.54	12.49	37.68	23.82	0.97	2.04	1.88	100

stroke in Germany and showed the mean cost of haemorrhagic stroke was 26 602 USD.[18] A report from the USA collected 97 374 hospitalisations with stroke and conducted a comprehensive analysis of the hospitalisation costs, which showed the mean cost of haemorrhagic stroke was 32 035±32 046 USD.[19] The conversions of US dollars above were carried out using purchasing power parity (PPP) in 2016. However, these countries are at different stages of development with different local wage rates, so comparisons are difficult and are not necessarily meaningful.

A prominent finding was that the median total hospital charge of patients in Level 3 hospitals was higher than that in Level 2 hospitals (20029CNY vs 16095 CNY, P<0.05). There are several possible reasons for this. First, the equipment used in examinations in Level 3 hospitals is usually more complex and advanced than those in Level 2 hospitals, so patients may spend more money on examinations in Level 3 hospitals. In addition, the professional level of doctors in Level 3 hospitals is generally higher, and higher professional skills require higher fees. Furthermore, Level 3 hospitals have more imported and new drugs, which are usually more expensive. We also found that patients with haemorrhagic stroke had a higher median BI score on admission (milder) in Level 3 hospitals than in Level 2 hospitals (30 vs 20, P<0.05). This phenomenon could be explained by the fact that the emergency medical service sends acute stroke patients to the nearest hospital.

Hospital type also had an effect on hospital charges. The median total cost of patients in Western hospitals was significantly more than in traditional Chinese hospitals (19651 NCY vs 14560 NCY, P<0.05). One possible reason is that Western hospitals mainly used Western drugs, which were more expensive than Chinese traditional patent and Chinese herbal medicine used in traditional Chinese hospitals. The other reason is that Western hospitals had more inspection equipment. Patients spent more money on laboratory tests and examinations. The medicine fees for Chinese traditional patent and Chinese herbal medicine and rehabilitation therapy fees were higher in traditional Chinese hospitals than in Western hospitals.

In the cost structure of patients with haemorrhagic stroke, the proportion of the medicine cost is 38.7%, which is more than the sum of the treatment fee, laboratory fee and examination fee. The cost structure is very unreasonable and medical technology costs failed to be fully manifested, which is quite different from studies reported in developed countries. In Greece, Gioldasis *et al* reported in their study that about 12% of the total charge for haemorrhagic stroke was attributed to medicines.[17] Asil *et al* analysed the cost of acute ischaemic and haemorrhagic stroke in Turkey and found that 29.9% of the total charge was used for medicines.[20] Previous studies have researched the distribution of hospital costs in 121 hospitals in Beijing in 2012 and showed that 44.6% of the total cost was attributed to medicines,[6] which is in accordance with our results. In recent years the Chinese government

Table 5 Median hospital charges (in CNY) for patients with different characteristics

	Total fee		P value
	Median	IQR	
Hospital level			<0.05
Level 2 hospital	16095	9158–32 187	
Level 3 hospital	20029	11197–43 630	
Hospital type, n (%)			<0.05
Western medicine	19651	10632–43 041	
Traditional Chinese medicine	14560	9308–23 217	
Sex			<0.05
Men	18011	10297–38 139	
Women	19506	10670–42 378	
LOHS (days)			<0.05
≤10	10554	6094–19 647	
<10–≤20	16222	10444–28 784	
>20	35446	20056–72 701	
Medical payment type			<0.05
Health insurance	19364	11391–38 515	
Rural cooperative medical service	16016	9328–33 309	
State free medical care	16676	8372–37 181	
Self-pay	18583	9869–41 863	
Medical payment type			0.489
Insured	18273	10505–37 797	
Uninsured	18583	9869–41 863	
In-hospital death			<0.05
Yes	30792	15195–62 846	
No	17912	10197–37 569	
Age, n (%)			<0.05
≥65	18449	10607–36 878	
<65	18662	10311–42 132	
Marital status			<0.05
Married	18423	10344–39 745	
Single	19317	10536–42 778	
Widowed or divorced	21395	11643–40 247	
Occupation			<0.05
Employed	16892	9562–34 490	
Unemployed	19960	10489–44 916	
Retired	20147	11704–40 002	
Others	19952	11043–46 806	
Hypertension			<0.05
Yes	19807	10603–49 521	
No	18194	10382–36 922	
Hyperlipidaemia			<0.05
Yes	19839	10944–43 068	
No	13173	8235–21 950	
Diabetes mellitus			0.129
Yes	18632	10352–40 687	
No	18316	10846–35 467	
Pulmonary infection			<0.05
Yes	34049	17495–69 065	

Continued

Table 5 Continued

	Total fee		P value
	Median	IQR	
No	15341	9140–28 215	
Surgery			<0.05
Yes	50215	23208–86 042	
No	15287	9097–26 235	

Statistical significance: P<0.05 (Mann–Whitney U test or Kruskal–Wallis H test), (P value refers to the equality of the median value for all categories).
LOHS, length of hospital stay.

Table 6 Multivariate analysis of total hospital costs for haemorrhagic stroke in the subgroup with a Barthel Index (BI) score on admission of ≤60

Variable	β	SE	Standard coefficient	t	P value
LOHS	0.035	0.001	0.419	82.006	<0.01
Surgery	0.922	0.015	0.320	60.330	<0.01
Pulmonary infection	0.443	0.014	0.167	32.435	<0.01
Ventilator use	0.421	0.022	0.104	19.094	<0.01
In-hospital death	0.341	0.023	0.080	14.913	<0.01
Hospital level	0.122	0.013	0.046	9.248	<0.01
Occupation 2	−0.164	0.016	−0.055	−10.151	<0.01
Age	−0.005	0.002	−0.056	−10.324	<0.01
Occupation 1	−0.158	0.021	−0.037	−7.455	<0.01
Medical payment type	−0.063	0.009	−0.033	−6.658	<0.01
Hyperlipidaemia	−0.120	0.019	−0.030	−6.144	<0.01
Sex	0.072	0.013	0.028	5.702	<0.01
Marital status 2	0.115	0.026	0.026	4.427	<0.01
Hospital type	0.060	0.020	0.015	3.039	<0.01
Marital status 1	0.135	0.046	0.017	2.933	<0.01
Hypertension	−0.035	0.014	−0.012	−2.446	<0.01

LOHS, length of hospital stay.

has introduced policies that reduce prescribing and costs of medicine in order to lower the proportion of drug fees. The policies have shown initial results as the proportion of the medicine cost fell from 40.97% to 37.68% during the 3 years of our study. However, this is far from enough and the Chinese government needs to further standardise drug treatment. First, the management of drug examination and use must be strengthened. Second, doctors should be encouraged to regularly use drugs with low prices, which are recommended by guidelines and have definite curative effects. Third, the efficiency of clinical nursing and the results of rehabilitation training for a better patient outcome should be taken seriously.

There are three main types of medical insurance in China: health insurance for enterprise employees, rural cooperative medical service for rural residents and state free medical care for staff members of institutions. These three types of medical insurance have big differences in terms of security level, premium payment and government subsidies.

According to multivariate regression analysis, total charges in the two BI subgroups were significantly higher for patients with longer LOHS, receiving surgery, pulmonary infection, using a ventilator, higher hospital level, no hyperlipidaemia, Western hospitals, in-hospital death, unemployment or retirement, younger age, female sex and uninsured. LOHS was the key contributor to the increased total charge for patients with haemorrhagic stroke, which is in accordance with the results of several previous studies.[20–25] LOHS was associated with the clinical treatment and management level of the hospital. Therefore, as one of the controllable factors, LOHS can be reduced in the following ways: (1) by improving utilisation of beds and avoiding the waste of medical resources; (2) by reducing nosocomial infection; and (3) by shortening the time of appointments and the delay of laboratory and examination results by better coordination of various hospital departments.

Other factors such as surgery, ventilator use, pulmonary infection and in-hospital death may represent the

Table 7 Multivariate analysis of total hospital costs for haemorrhagic stroke in the subgroup with a Barthel Index (BI) score on admission of >60

Variable	β	SE	Standard coefficient	t	P value
LOHS	0.045	0.002	0.398	34.259	<0.01
Surgery	1.034	0.039	0.327	60.330	<0.01
Pulmonary infection	0.461	0.059	0.092	7.816	<0.01
Ventilator use	0.560	0.097	0.069	5.804	<0.01
In-hospital death	0.566	0.120	0.055	4.717	<0.01
Hospital level	0.164	0.036	0.053	4.571	<0.01
Occupation 2	−0.092	0.041	−0.028	−2.256	<0.01
Age	−0.010	0.001	−0.101	−8.070	<0.01
Medical payment type	−0.071	0.023	−0.035	−3.053	<0.01
Hyperlipidaemia	−0.216	0.041	−0.061	−5.288	<0.01
Sex	0.120	0.034	0.040	3.565	<0.01
Hospital type	0.147	0.046	0.037	3.215	<0.01
Hypertension	0.148	0.034	0.052	4.352	<0.01
Diabetes mellitus	–/108	0.042	−0.029	−2.538	<0.01

LOHS, length of hospital stay.

severity of the illness. Patients with severe haemorrhagic stroke have a tendency to require more medication and to stay in hospital longer than those with milder stroke. As a consequence, the hospital cost for patients with severe illness may be higher. Diabetes mellitus and marital status do not influence the total cost.

Although we are concerned about the cost of hospitalisation and the factors that influence it, the therapeutic effect is still the most important. Even if certain observable characteristics are the major factors affecting cost, as long as they have higher benefits they are not such a problem.

Diagnosis-related groups (DRGs) are assigned by a 'grouper' programme based on International Classification of Diseases diagnoses, procedures, age, sex, discharge status and the presence of complications or comorbidities. Its original objective was to develop a classification system that identified the 'products' that the patient received; patients within each category are clinically similar and are expected to use the same level of hospital resources. DRGs can guide medical insurance. With standardisation of diagnosis and treatment, clinical pathway provides security for pay systems of DRGs. Although several studies in other countries have shown that the clinical pathway reduced LOHS and hospital costs,[26 27] some of the problems such as poor coverage and poor medical quality control made the mode difficult to extend to China. Therefore, the management of DRGs and the clinical pathway should be promoted to improve the efficiency of medical work and reduce hospital charges in China.

This study has some limitations. The patients with stroke in the present study came from the national capital Beijing. They probably differed from those admitted to hospitals in smaller cities and rural areas in terms of hospitals as well as medical care. Therefore, our findings are only applicable to patients in general hospitals in the metropolis of China.

CONCLUSION

The findings of our study suggest that medicines form the largest proportion of the hospital charge for patients with haemorrhagic stroke in China, far outstripping that in developed countries like America and Europe, although it has decreased in recent years. Moreover, LOHS is the key contributor to hospital charges. Our study conducted in China provides a good reference point for other developing countries with an ageing population attempting to provide high quality healthcare services while avoiding increasing the socioeconomic burden. Reducing hospital charges and the economic burden of haemorrhagic stroke in China are most likely to be achieved by decreasing drug fees and LOHS.

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