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Research Article

Cost Analysis of Inpatient Stroke Treatment at PKU Muhammadiyah Yogyakarta Hospital Based on INA-CBG's Tariff in 2023

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Abstract

Stroke incidence in Yogyakarta Province is among the highest in Indonesia, frequently necessitating prolonged patient care and rehabilitation. The recent adjustment of INA-CBG's tariffs, as stipulated in Regulation of the Minister of Health of the Republic of Indonesia Number 3 of 2023, has increased reimbursement rates for inpatient hemorrhagic stroke (Classes 1, 2, and 3) and ischemic stroke (Class 1). Despite these revisions, many hospitals report disparities between operational costs and the INA-CBG's reimbursement rates. This study represents the first dedicated evaluation of INA-CBG's tariffs, specifically concerning the 2023 ministerial regulation, for inpatient stroke management. We aimed to ascertain the financial discrepancies between the average actual costs of inpatient stroke treatment and the updated INA-CBG's tariffs at PKU Muhammadiyah Yogyakarta Hospital. Employing an observational design with a cross-sectional approach, we retrospectively collected data from inpatient stroke patients treated between January and September 2023. Data analysis involved descriptive statistics and a one-sample t-test. The findings reveal that, for most cases, the average actual costs incurred by the hospital were significantly lower than the corresponding INA-CBG's tariffs, indicating a consistent profit margin for the institution.

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INTRODUCTION

Stroke, a severe cerebrovascular disease resulting from the blockage or rupture of blood vessels in the brain, has become a major global health concern, frequently stemming from unhealthy lifestyle choices[1]. The World Health Organization (WHO) identifies stroke as the second leading cause of death and the third leading cause of disability worldwide[2,3]. Incidence rates are highest in Asia, which accounts for over 60% of the world's population, followed by Eastern Europe, while Central Latin America reports the lowest rates[4,5]. In Indonesia, stroke prevalence continues to rise, with the Special Region of Yogyakarta (DIY) registering the second-highest rate nationally at 14.6% in the population aged 15 and older, as reported by the 2018 Basic Health Research (*Riset Kesehatan Dasar*; Riskesdas)[6].

Beyond its profound clinical impact, stroke imposes a significant economic burden globally. The financial strain is particularly high in developed nations; for instance, the United States reports the highest average monthly cost for stroke patients at $4,644, followed by Scandinavian and European countries[7]. Given that stroke requires extensive additional care and long-term rehabilitation, it is an "expensive" disease. Consequently, conducting a detailed cost analysis of stroke patient care is crucial for assisting public health policymakers in developing strategies to manage this burden effectively. Furthermore, evaluating hospital healthcare service costs is essential for understanding the total expenses, financing sources, and components within the healthcare system[8].

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Indonesia's National Social Security System (*Sistem Jaminan Sosial Nasional*; SJSN) operates the National Health Insurance (*Jaminan Kesehatan Nasional*; JKN) program, which utilizes a prospective payment method called the Indonesia Case Base Groups (INA-CBG's) tariff system for hospital reimbursement. This system categorizes diagnoses and procedures based on comparable clinical characteristics and resource utilization. However, many hospitals frequently report discrepancies between their actual service costs and the fixed INA-CBG's rates[9,10].

This study represents the first evaluation of the 2023 INA-CBG's tariff specifically for stroke treatment. Previous research, such as that by Hadning *et al*.[11] comparing 2013 actual costs with INA-CBG's tariffs at PKU Muhammadiyah Yogyakarta Hospital, revealed that the hospital incurred financial losses, indicating an inability to manage stroke treatment costs within the set rates. The selection of PKU Muhammadiyah Hospital for this study is strategic, as it is a key charitable institution of the Muhammadiyah Association. Our primary focus is to provide academic support to the Muhammadiyah community by evaluating the hospital's financial stability concerning stroke care, aiming to prevent operational losses and ensure the long-term sustainability of its healthcare services. This investigation, building upon previous findings, seeks to determine the average actual cost of inpatient stroke treatment at PKU Muhammadiyah Yogyakarta Hospital and to analyze the degree of conformity and the differences between these actual costs and the updated 2023 INA-CBG's rates.

MATERIALS AND METHODS

Materials

The data used in this quantitative study comprised two main components: medical record data and cost data. Specifically, we analyzed the medical records and corresponding hospitalization cost information for stroke patients who were participants in the JKN social health insurance program at PKU Muhammadiyah Yogyakarta Hospital. Data were systematically collected using logbooks designed as structured patient data recording sheets. The financial analysis and comparison utilized the official national tariff system for healthcare services, the INA-CBG's rates, as standardized for stroke disease under the Minister of Health Regulation Number 3 of 2023.

Methods

Ethical approval, study design, and patient selection

This study was conducted following the issuance of ethical clearance by PKU Muhammadiyah Yogyakarta Hospital (Number: 1986/PI.24.2/IX/2023). We employed an observational design utilizing a cross-sectional approach. The study population included all stroke inpatients across hospital Classes 1, 2, and 3 at PKU Muhammadiyah Yogyakarta Hospital between January and September 2023. A total sampling technique was used, including all patients who met the predefined criteria.

Inclusion criteria mandated that patients be participants of the JKN health insurance program who underwent Classes 1, 2, or 3 hospitalization for a stroke diagnosis (hemorrhagic, ischemic, or unspecified). Eligible patients had a severity classified as mild, moderate, or severe, corresponding to the INA-CBG's codes G-4-13-I/II/III, G-4-14-I/II/III, or G-4-15-I/II/III, and possessed complete medical record and treatment cost data. Exclusion criteria applied to patients who died during hospitalization, were discharged against medical advice or at their own request, were transferred to a different treatment class, or were referred to other hospitals.

Data analysis

Data analysis for this study was strictly quantitative, employing descriptive statistical methods to calculate the average actual cost of inpatient stroke treatment. This initial step was crucial for describing the financial burden and assessing the conformity of these costs with the current 2023 INA-CBG's rates at PKU Muhammadiyah Yogyakarta Hospital. To statistically determine the presence and significance of any difference between the actual treatment costs and the calculated INA-CBG's rates, inferential testing was performed. Specifically, a one-sample t-test was applied if the data satisfied the assumption of normal distribution, while the one-sample Wilcoxon test was utilized if the data were found to be non-normally distributed.

RESULTS AND DISCUSSION

From January to September 2023, a total of 202 inpatient stroke patients at PKU Muhammadiyah Yogyakarta Hospital met the established inclusion and exclusion criteria. The detailed clinical and demographic characteristics of this cohort are presented in **Table I**. The data revealed that ischemic stroke was the predominant type, which is consistent with the established literature indicating that ischemic stroke accounts for approximately 87% of all stroke incidents, compared to 13% for hemorrhagic stroke[12,13].

Analysis of demographic risk factors showed a notable difference in stroke incidence between sexes. The higher prevalence in men is often linked to lifestyle choices such as smoking, alcohol consumption, obesity, and insufficient physical activity[14]. Conversely, in women, stroke risk is more frequently associated with factors such as high blood pressure during pregnancy, the use of contraceptive medications, and elevated depression levels[15]. Furthermore, the study reinforced the strong physiological association between advanced age and stroke incidence. The risk of stroke increases exponentially, doubling or tripling per decade after the age of 50[16]. This elevated risk is primarily attributed to age-related decline in body functions, particularly the loss of flexibility in blood vessels. The concentration of stroke cases in the elderly and senior citizen age groups also underscores the subsequent burden of complex, chronic health problems and higher healthcare costs[17].

Table I. Characteristics of stroke patients at PKU Muhammadiyah Yogyakarta Hospital.

Characteristics	N=202	%
Type of Stroke		
Hemorrhagic stroke	45	22.28
Ischemic stroke	157	77.72
Sex		
Male	113	55.94
Female	89	44.06
Age (years)		
15–24	1	0.5
25–34	2	1
35–44	11	5.4
45–54	31	15.3
55–64	64	31.7
65–74	63	31.2
≥75	30	14.9

The most frequently recorded secondary diagnoses accompanying stroke in this patient cohort were hypertension, hemiplegia, and diabetes mellitus. Hypertension is a well-established cause of stroke, as it leads to changes in cerebral blood vessels that impair autoregulation, limiting their ability to contract and dilate in response to systemic blood pressure fluctuations[18,19]. Hemiplegia, or paralysis on one side of the body, is a common and debilitating complication of stroke[20,21]. Stroke survivors frequently require some form of long-term accommodative assistance due to functional impairments extending beyond the subacute and chronic stages of hemiplegia[22,23]. Finally, Diabetes Mellitus represents a significant and controllable risk factor for stroke. Hyperglycemia damages the walls of both large and peripheral blood vessels, promoting platelet aggregation and increasing blood viscosity. This cascade ultimately contributes to heightened blood pressure, hypertension, and the risk of ischemic stroke[24,25].

The average actual cost of stroke treatment for inpatient cases in 2023 at PKU Muhammadiyah Yogyakarta Hospital was categorized based on the patient's treatment class and stroke severity, with data grouped according to the INA-CBG's code. A detailed summary of the actual cost components for each class is presented in **Table II**. The analysis revealed that the most significant cost drivers were room/accommodation, radiology, medicine, and consultation services. The magnitude of these components is strongly influenced by three main factors: the number of secondary diagnoses, the selection of treatment interventions, and the overall severity of the patient's condition. Specifically, the presence of multiple secondary diagnoses or a high severity index often necessitates prolonged hospitalization, which directly inflates the room/accommodation costs. This complexity also leads to an increase in high-cost components such as radiology, due to the need for extensive diagnostic imaging, and medication and consultation expenses, as patients require more specialized drugs and frequent expert consultations to manage their complicated clinical presentations[26].

Table II. Average cost components for inpatient stroke patients Class 1 to 3 at PKU Muhammadiyah Yogyakarta Hospital.

Cost components	Average cost of Class 1									
	G-4-13-I n=4		G-4-13-II n=1		G-4-14-I n=15		G-4-14-II n=9		G-4-14-III n=2	
	Average (IDR)	%	Average (IDR)	%	Average (IDR)	%	Average (IDR)	%	Average (IDR)	%
Non-surgical procedures	121,250	2.43	100,000	1.66	103,650	2.69	145,222	2.82	154,750	2.2
Consultation	462,500	9.27	600,000	9.99	460,000	11.95	**741,111**	**14.38**	**1,075,000**	**15.29**
Nutritionist	8,750	0.18	-	-	8,167	0.21	5,833	0.11	8,750	0.12
Nursing	624,000	12.51	**1,008,000**	**16.78**	428,900	11.14	559,889	10.87	709,750	10.09
Support	-	-	-	-	21,800	0.57	12,889	0.25	-	-
Radiology	490,445	9.83	-	-	**772,271**	**20.06**	714,448	13.87	1,281,785	18.23
Laboratory	**741,375**	**14.86**	201,500	3.35	433,740	11.27	466,700	9.06	704,450	10.02
Blood services	-	-	-	-	-	-	-	-	-	-
Rehabilitation	15,000	0.3	120,000	2	43,600	1.13	206,000	4	408,000	5.8
Medicine	725,550	14.55	928,200	15.45	399,533	10.38	463,022	8.99	755,097	10.74
Medical consumables	267,750	5.37	970,000	16.15	153,367	3.98	386,333	7.5	400,000	5.69
Equipment rental	-	-	149,400	2.49	-	-	42,244	0.82	60,000	0.85
Room/Accommodation	**1,531,250**	**30.7**	**1,929,500**	**32.12**	**1,021,967**	**26.55**	**1,408,833**	**27.34**	**1,474,500**	**20.97**
Total cost	**4,987,870 ± 2,995,258**	**100**	**6,006,600**	**100**	**3,849,389 ± 1,415,560**	**100**	**5,152,526 ± 1,831,764**	**100**	**7,032,082 ± 3,500,449**	**100**

Cost components	Average cost of Class 2							
	G-4-13-I n=5		G-4-14-I n=11		G-4-14-II n=5		G-4-14-III n=2	
	Average (IDR)	%	Average (IDR)	%	Average (IDR)	%	Average (IDR)	%
Non-surgical procedures	313,000	7.80	137,909	3.20	133,000	2.85	50,000	1.28
Consultation	392,000	9.77	434,091	10.07	518,000	11.11	577,500	14.77
Nutritionist	5,000	0.12	6,818	0.16	10,000	0.21	6,250	0.16
Nursing	312,400	7.79	302,636	7.02	340,450	7.30	283,000	7.24
Support	-	-	4,182	0.10	18,400	0.39	-	-
Radiology	178,498	4.45	**776,774**	**18.02**	**820,758**	**17.60**	**812,990**	**20.8**
Laboratory	361,200	9.01	521,055	12.09	385,000	8.26	299,250	7.65
Blood services	-	-	-	-	486,100	10.42	-	-
Rehabilitation	-	-	142,909	3.32	108,000	2.32	60,000	1.53
Medicine	**825,420**	**20.58**	452,655	10.50	542,080	11.62	**708,650**	**18.13**
Medical consumables	373,800	9.32	344,864	8	317,300	6.80	366,000	9.36
Equipment rental	89,000	2.22	3,818	0.09	114,480	2.45	57,750	1.48
Room/Accommodation	**1,160,100**	**28.93**	**1,182,773**	**27.44**	**870,100**	**18.66**	688,000	17.60
Total cost	**4,010,418 ± 1,391,464**	**100**	**4,309,665 ± 3,019,599**	**100**	**4,663,668 ± 1,644,742**	**100**	**3,909,390 ± 1,071,550**	**100**

Cost components	Average cost of Class 3											
	G-4-13-I n=31		G-4-13-II n=3		G-4-13-III n=1		G-4-14-I n=66		G-4-14-II n=39		G-4-14-III n=8	
	Average (IDR)	%	Average (IDR)	%	Average (IDR)	%	Average (IDR)	%	Average (IDR)	%	Average (IDR)	%
Non-surgical procedures	137,597	3.62	676,667	11.37	100,000	1.14	106,508	3.27	139,141	3.29	142,856	1.85
Consultation	375,161	9.88	505,000	8.48	**1,460,000**	**16.61**	348,106	10.7	458,205	10.84	830,625	10.73
Nutritionist	6,855	0.18	4,167	0.07	12,500	0.14	4,924	0.15	6,731	0.16	7,813	0.1
Nursing	493,831	13	597,417	10.04	522,500	5.94	322,311	9.91	363,410	8.6	728,688	9.41
Support	8,903	0.23	-	-	46,000	0.52	9,106	0.28	7,077	0.17	17,250	0.22
Radiology	226,992	5.98	614,263	10.32	**1,412,290**	**16.07**	**726,671**	**22.34**	**666,256**	**15.77**	639,716	8.26
Laboratory	355,058	9.35	464,000	7.8	1,093,000	12.44	357,686	11	515,079	12.19	**1,391,288**	**17.97**
Blood services	-	-	-	-	-	-	-	-	132,359	3.13	378,375	4.89
Rehabilitation	60,387	1.59	240,000	4.03	120,000	1.37	110,455	3.4	202,462	4.79	195,000	2.52
Medicine	**740,667**	**19.5**	**991,967**	**16.67**	1,297,500	14.76	422,098	12.98	610,413	14.44	**1,397,625**	**18.05**
Medical consumables	388,339	10.23	576,667	9.69	1,205,500	13.72	221,614	6.81	329,462	7.8	830,500	10.73
Equipment rental	117,323	3.09	194,500	3.27	115,500	1.31	19,170	0.59	15,792	0.37	93,238	1.2
Room/Accommodation	**887,016**	**23.36**	**1,087,167**	**18.27**	1,404,500	15.98	**603,788**	**18.56**	**779,487**	**18.45**	1,089,750	14.07
Total cost	**3,797,803 ± 1,661,098**	**100**	**5,951,813 ± 1,810,561**	**100**	**8,789,290**	**100**	**3,252,437 ± 1,007,219**	**100**	**4,225,871 ± 2,083,695**	**100**	**7,742,723 ± 3,738,524**	**100**

The financial performance of stroke patient care was evaluated by comparing the average actual costs incurred during hospitalization against the corresponding INA-CBG's tariff rates, segmented by treatment class and severity. The detailed results of this cost-difference analysis are presented in **Table III**. Our findings reveal that for several patient groups—specifically, those with codes G-4-13-I (Classes 1 and 2), G-4-13-II (Class 3), G-4-14-I (Class 2), and G-4-14-III (Class 3)—the average actual cost was lower than the assigned INA-CBG's tariff. Critically, the statistical analysis for these groups yielded a significance value of $p > 0.05$, indicating no statistically significant difference between the average actual costs and the INA-CBG's tariffs.

Conversely, for patients falling under codes G-4-13-I (Class 3), G-4-14-I (Classes 1 and 3), and G-4-14-II (Classes 1, 2, and 3), the average actual cost was also lower than the INA-CBG's tariff, but the significance value was $p < 0.05$. This denotes a statistically significant difference, suggesting that while the hospital covered its costs for these groups, the INA-CBG's tariff provided a substantially larger margin than necessary. To assess the overall financial sustainability, the total actual cost for all 202 stroke patients (IDR 813,723,673) was compared to the total INA-CBG's reimbursement (IDR 1,271,902,300). The resulting difference of IDR 458,178,627 demonstrates that PKU Muhammadiyah Yogyakarta Hospital operated at a profit for the stroke caseload during the study period, as the total INA-CBG's tariff successfully exceeded the total cost of treatment.

Table III. The difference between actual costs and INA-CBG's tariff in 2023 at PKU Muhammadiyah Yogyakarta Hospital.

INA-CBG's code	Class	n	Total costs		Average costs		Sig. (normality)	*P* (2-tailed)
			Actual cost (IDR)	INA-CBG's tariff (IDR)	Actual cost (IDR)	INA-CBG's tariff (IDR)		
G-4-13-I	1	4	19,951,480	23,277,200	4,987,870	5,819,300	0.997	0.617
	2	5	20,052,090	25,487,000	4,010,418	5,097,400	0.359	0.156
	3	31	117,731,890	135,640,500	3,797,803	4,375,500	0.001	0.019
G-4-13-II	1	1	6,006,600	7,976,400	6,006,600	7,976,400	-	-
	2	-	-	-	-	6,986,800	-	-
	3	3	17,855,440	17,991,900	5,951,813	5,997,300	0.672	0.969
G-4-13-III	1	-	-	-	-	9,991,100	-	-
	2	-	-	-	-	8,751,600	-	-
	3	1	8,789,290	7,512,100	8,789,290	7,512,100	-	-
G-4-14-I	1	15	57,740,830	105,288,000	3,849,389	7,019,200	0.000	0.001
	2	11	47,406,310	67,632,400	4,309,665	6,148,400	0.000	0.0504
	3	66	214,660,860	348,321,600	3,252,437	5,277,600	0.200	0.000
G-4-14-II	1	9	46,372,730	86,951,700	5,152,526	9,673,300	0.366	0.000
	2	5	23,318,340	42,366,100	4,663,668	8,473,200	0.258	0.007
	3	39	164,808,980	283,294,800	4,225,871	7,273,200	0.000	0.000
G-4-14-III	1	2	14,064,163	24,606,000	7,032,082	12,303,000	-	-
	2	2	7,818,780	21,553,400	3,909,390	10,776,700	-	-
	3	8	61,941,780	74,003,200	7,742,723	9,250,400	0.920	0.292
Total		202	813,723,673	1,271,902,300				
Difference (+/-)				+ 458,178,627				

A previous cost analysis conducted by Hadning *et al*.[11] for the year 2014, based on the former Ministry of Health Regulation Number 69 of 2013, revealed that PKU Muhammadiyah Yogyakarta Hospital incurred a financial loss of IDR 9,183,729 in treating stroke patients under the INA-CBG's tariff system. That study identified drugs, medical equipment, and room costs as the most significant drivers of expenditure. Factors such as diagnostic accuracy, therapeutic choices, and the presence of stroke comorbidities were recognized as major determinants influencing the overall cost of treatment.

In contrast, the current study, which analyzed costs under the revised INA-CBG's tariff set by Minister of Health Regulation Number 3 of 2023, found that the primary cost components remain centered on room charges, radiology, drugs, and consultation fees, suggesting that these areas continue to be sensitive financial points. Crucially, however, the present analysis indicates that PKU Muhammadiyah Yogyakarta Hospital is now operating at a profit under the new tariff structure. This reversal suggests that the hospital has successfully improved its efficiency and resource management in stroke care, effectively aligning its service delivery and cost structure with the updated INA-CBG's claim tariffs.

CONCLUSION

The findings of this study demonstrate that the average actual costs incurred by PKU Muhammadiyah Yogyakarta Hospital for stroke treatment were, in the majority of cases, lower than the assigned INA-CBG's tariff. Crucially, these cost differences were statistically insignificant. This outcome signifies that, throughout 2023, the hospital effectively managed its resources and optimized its clinical pathways, successfully aligning stroke treatment expenditures with the national reimbursement scheme. Consequently, it can be concluded that PKU Muhammadiyah Yogyakarta Hospital has not only achieved efficiency in cost management based on INA-CBG's tariff claims but has also been able to generate a financial surplus from stroke patient care.

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AUTHORS' CONTRIBUTION

Conceptualization: Ingenida Hadning
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Formal analysis: Aulia Oktaviani
Funding acquisition: Ingenida Hadning
Investigation: Aulia Oktaviani
Methodology: Ingenida Hadning, Aulia Oktaviani
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Software: -
Supervision: Ingenida Hadning
Validation: Ingenida Hadning
Visualization: Aulia Oktaviani
Writing - original draft: Aulia Oktaviani
Writing - review & editing: Ingenida Hadning, Aulia Oktaviani

DATA AVAILABILITY

The datasets supporting the findings of this study were derived from patient medical records at PKU Muhammadiyah Yogyakarta Hospital. To strictly protect the privacy and confidentiality of the patients, these data are not publicly available. However, the anonymized data may be accessible from the corresponding author upon a reasonable, written request and contingent upon obtaining the necessary approvals from the institutional ethics and data governance committees.

CONFLICT OF INTEREST

The authors declared no conflict of interest related to this research.

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