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FACTORS ASSOCIATED WITH INPATIENT HOSPITALIZATION COSTS IN STROKE PATIENTS UNDERGOING MECHANICAL THROMBECTOMY OR COILING

Ardy Oktaviandi*, Pinto Desti Ramadhoni, Legiran
Neurology, Universitas Sriwijaya, Indonesia, Jl. Raya Palembang - Prabumulih, KM 32, Inderalaya, Kabupaten Ogan Ilir, Sumatra Selatan 30662, Indonesia
*ardyoktav@gmail.com

ABSTRACT
Stroke is a catastrophic disease with a significant economic burden, particularly for neurointervention procedures such as mechanical thrombectomy and coiling. A disparity exists between standard costs and actual billing charges for these procedures at Dr. Mohammad Hoesin Hospital Palembang. This study aimed to analyze the factors influencing hospitalization costs of stroke patients undergoing mechanical thrombectomy or coiling. This was an analytical cross-sectional study with retrospective data collection from medical records of stroke patients who underwent mechanical thrombectomy or coiling at Dr. Mohammad Hoesin Hospital Palembang from January 2024 to September 2025. The study included 32 patients who underwent mechanical thrombectomy and 67 who underwent coiling. Sampling technique used was total sampling. Bivariate and multivariate analyses were performed to identify factors influencing hospitalization costs. The mean actual hospitalization cost for mechanical thrombectomy was IDR 97,679,947 ± 80,403,149, while for coiling it was IDR 119,286,035 ± 77,330,119 (approximately 20% higher). In the mechanical thrombectomy group, multivariate analysis revealed length of stay as the only significant independent factor influencing hospitalization costs ($p<0.05$). Meanwhile, in the coiling group, four significant independent factors were identified: complications, aggravating factors, NIHSS score, and number of coils ($p<0.05$). The factors influencing hospitalization costs differ between mechanical thrombectomy and coiling. For mechanical thrombectomy, length of stay is the dominant factor, whereas for coiling, clinical severity (complications, aggravating factors, NIHSS score) and procedural complexity (number of coils) are the main cost determinants.

Keywords: coiling; hospitalization costs; mechanical thrombectomy; national health insurance; stroke

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INTRODUCTION

According to the World Health Organization definition, stroke is a condition characterized by the appearance of rapidly developing clinical symptoms in the form of local or global neurological deficits, which can worsen and last for 24 hours or more, even leading to death, with no other obvious cause found except vascular factors. This condition occurs when the blood supply to the brain is stopped due to a blockage or rupture of a blood vessel in the brain, which then results in a lack of oxygen and the sudden death of a number of brain cells (Alvaet al., 2022).

To date, stroke remains a major cause of mortality and disability worldwide. According to the World Stroke Organization, 13.7 million new stroke incidence are recorded annually, with 5.5 million deaths due to the disease. As many as 70% of stroke incidence and 87% of the total deaths and disabilities resulting from them occur in low- to middle-income countries (Feigein et al., 2022). According to information from the 2018 Basic Health Research (Riskesdas), there has been a shift in disease patterns over the past two decades, with deaths now primarily caused by non-communicable diseases. The three leading causes of death are cardiovascular disease, cerebrovascular disease, and cancer. Meanwhile, data from the Social Security Administration for Health (BPJS Kesehatan) in 2021 shows that the largest financial burden is for the treatment of heart disease, cancer, stroke, and kidney disease. In an effort to realize equitable access to health services, the Ministry of Health is committed to transforming the health system by implementing a

network hospital support program that prioritizes services for cancer, cardiovascular disease, stroke, uronephrology diseases, and maternal and child health services (KJSU & KIA).

In Indonesia, according to 2015 BPJS data, stroke is categorized as a catastrophic illness (a medical condition with high costs) that drains funds reaching 16.9 trillion Rupiah from the National Health Insurance (JKN) fund. This condition is classified as a disease with a high financial burden, considering that sufferers often require ongoing treatment and long-term rehabilitation programs. This situation occurs because stroke generally causes both physical and cognitive disabilities as a result of nervous system damage triggered by impaired blood circulation in the brain, either due to blockage or leaking blood vessels (Darmawan et al., 2025).

According to calculations by the World Economic Forum, Indonesia will experience economic losses due to non-communicable diseases between 2012 and 2030, amounting to US$4.4 trillion (equivalent to Rp. 58,542 trillion). Specifically, the economic impact of cardiovascular disease and stroke alone will reach Rp. 1.7 trillion between 2012 and 2030. This financial burden includes healthcare expenditures and lost labor productivity (Cini et al., 2023). If the prevalence rate is not controlled, stroke has the potential to create much more significant economic pressure in the future. This phenomenon is due to the fact that stroke significantly impacts the productivity of patients and poses a serious threat to economic stability at both the personal and national levels, given the substantial expenditures required, both direct and indirect (Cini et al., 2023).

The high number of BPJS participants diagnosed with stroke has resulted in an increase in the allocation of JKN funds for treating this condition. The JKN financing burden related to stroke showed an upward trend throughout the 2014–2016 period. In 2014, JKN expenditures for stroke were recorded at Rp 813,392,575,957. This figure then escalated in 2015 to Rp 1,131,104,070,060, and continued to grow to Rp 1,171,127,754,410 in 2016 (Cini et al., 2023). Currently, stroke management has advanced rapidly, including the use of thrombolytics, mechanical thrombectomy, and coiling in certain cases of hemorrhagic stroke, such as subarachnoid hemorrhage (SAH). Several studies have shown that mechanical thrombectomy, when performed appropriately, not only improves clinical outcomes but also offers cost-effectiveness compared to long-term conservative therapy. Meanwhile, coiling in cases of subarachnoid hemorrhage or ruptured aneurysms has also become a first-line therapy, requiring significant costs and resources.

Preliminary research conducted at Dr. Mohammad Hoesin Hospital showed a disparity between standard costs and billed costs for mechanical thrombectomy and coiling. This indicates that hospital billing costs often do not align with established standard rates, resulting in disparities that impact service efficiency and the sustainability of the financing system. This gap can trigger additional financial burdens for healthcare facilities and affect access and quality of care for patients. Factors such as class of care, severity, and length of hospitalization are key determinants in determining inpatient billing costs for stroke patients. However, research specifically examining the financing elements and variables influencing the cost of care for stroke patients undergoing mechanical thrombectomy or coiling in Indonesia, particularly at Dr. Mohammad Hoesin Hospital in Palembang as a national referral hospital, is still limited (Ramadhoni et al., 2025).

Considering the urgency of cost efficiency and optimization of neurointerventional services, an in-depth study of the factors influencing inpatient costs for stroke patients undergoing mechanical thrombectomy or coiling is crucial (Candio et al., 2021). The results of this study are expected to inform the formulation of fairer, more clinically needed pricing policies, as well as support the development of a sustainable financing system in the era of National Health Insurance. This study aims to examine the variables that influence the inpatient costs of stroke patients undergoing mechanical thrombectomy or coiling at Dr. Mohammad Hoesin Hospital, Palembang. The research problem formulation focuses on identifying factors that influence the inpatient costs of stroke

patients undergoing mechanical thrombectomy or coiling. In general, this study aims to determine the actual inpatient costs and factors related to these costs at Dr. Mohammad Hoesin Hospital, Palembang. Specific objectives include identifying patient demographic and clinical characteristics, stroke severity, actual costs, and analyzing the factors that influence them. The research hypothesis states whether or not there is a significant difference between clinical characteristics and severity with inpatient costs. This study is expected to provide benefits in the clinical field as a basis for decision-making and service efficiency, in the academic field as a contribution to science, especially neurology and health management, and in the research field as a basis for further studies related to the evaluation of cost-effectiveness and health financing policies in Indonesia.

METHOD

This study used a cross-sectional analytical design with a retrospective approach through the utilization of secondary data in the form of medical records of stroke patients. The study was conducted at Dr. Mohammad Hoesin Hospital, Palembang, with data collection period from January 2024 to September 2025. The population included all stroke patients who were hospitalized during that period, with the study sample consisting of patients who met the inclusion criteria and were excluded. The minimum sample size was determined using a finite formula and obtained 70 patients. However, the sampling technique used was total sampling, averaging all patients who met the criteria, especially those undergoing mechanical thrombectomy (ischemic stroke) or coiling (hemorrhagic stroke/SAH). Inclusion criteria included inpatients diagnosed with stroke, having complete medical records and financing data, and being JKN participants. While exclusion criteria included patients who were forcibly discharged, died during treatment, or upgraded to a higher class of care. The independent variables in this study included clinical and demographic characteristics such as age, gender, length of stay, risk factors, clinical scores, and aspects of medical procedures, while the dependent variable was the actual cost of patient care.

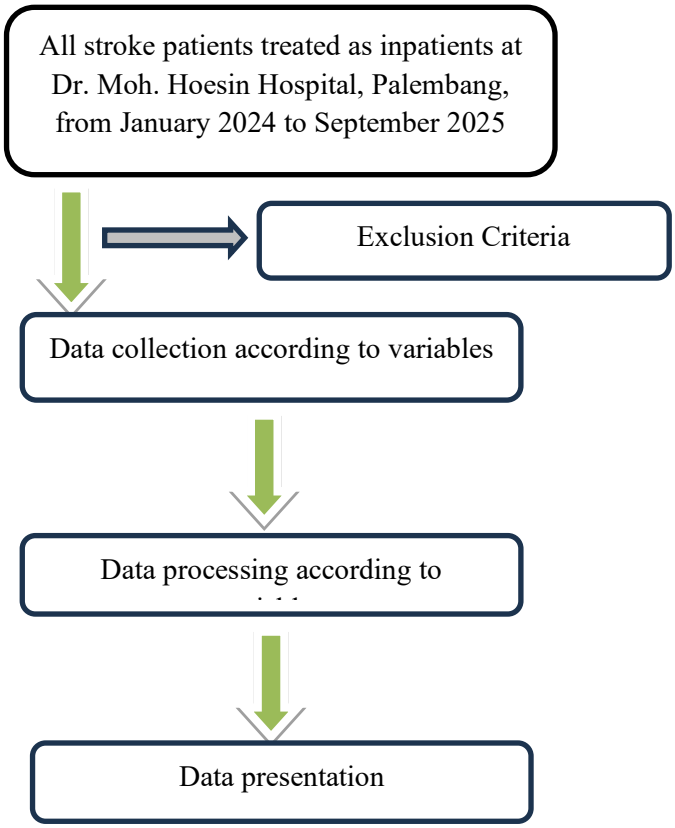

Figure 1. Workflow

The research method began by selecting inpatient stroke patients at Dr. Mohammad Hoesin Hospital, Palembang based on inclusion and exclusion criteria through medical record review. Then, clinical and demographic characteristics data were collected such as age, gender, length of stay, type of therapy, clinical score (NIHSS, ASPECT, Hunt and Hess, WFNS), recanalization

success, device usage, number of coils, and level of procedure difficulty. In addition, direct medical cost data were also collected, including the cost of drugs, medical procedures, service fees, hospital administration, laboratory, radiology (CT-scan), physiotherapy, and room costs. The data obtained were then processed through the stages of entry, cleaning, editing, and coding using Microsoft Excel, then analyzed with IBM SPSS Statistics 24. The analysis was carried out descriptively (univariate) and analytically (bivariate and multivariate), where variables with a p-value <0.25 were entered into a multivariate linear regression model, and variables with p-value <0.05 were considered significant. The results of the study are presented in narrative and tabular form.

RESULT

Table 1 presents the results of the bivariate analysis examining factors associated with hospitalisation costs among stroke patients undergoing mechanical thrombectomy. The analysis included length of stay, inpatient class, risk factors, aggravating factors, complications, and stroke onset. Hospitalisation costs are reported as mean ± standard deviation and range, while the statistical significance of the association between each variable and treatment costs was assessed using appropriate comparative tests.

Table 1.
Bivariate analysis of factors associated with the hospitalisation costs of stroke patients undergoing mechanical thrombectomy

Variable	Treatment Costs		p-value
	Mean ±SD	Min-Max	
Length of Stay			
≤10 days	66,802,970±20,986,460	33,221,773–103,700,867	0.000[a]
>10 days	207,954,866 ± 116,100,319	90,065,956–415,187,500	
Inpatient Class			
Class III	79,414,505	79,414,505	
Class II	92,236,903 ± 83,146,316	33,221,773–415,187,500	0.634[b]
Class I	129,636,867 ± 73,078,323	57,192,242–209,885,895	
Risk Factors			
None	69,186,772 ±23,151,660	42,682,616–85,463,195	
1 Risk Factor	67,655,875 ±23,206,448	36,644,364–109,385,604	
2 Risk Factors	89,214,053 ±72,584,552	33,221,773–296,488,622	0.082[b]
3 Risk Factors	178,535,388 ± 143,862,845	57,192,242–415,187,500	
4 Risk Factors	149,975,925 ±84,725,491	90,065,956–209,885,895	
Aggravating factorss			
None	71,772,894 ±22,043,500	42,682,616–109,385,604	
1 Aggravating factors	110,866,166 ±85,237,629	33,221,773–296,488,622	0.286[b]
2 Aggravating factors	142,503,675 ±156,854,499	36,644,364–415,187,500	
3 Aggravating factors	133,539,068 ± 107,970,717	33,221,773–209,885,895	
Complications			
None	84,321,170 ±58,413,649	33,221,773–296,488,622	0.194[b]
1 Complication	122,060,688 ± 121,823,767	43,370,994–415,187,500	
2 Complications	209,885,895	209,885,895	
Onset of Stroke			
≤6 hours	108,730,152 ±103,185,062	33,221,773–415,187,500	0.529[a]
>6 hours	90,119,281 ±62,345,484	36,644,364–296,488,622	

Table 1, length of hospital stay was the only variable significantly associated with hospitalisation costs (p<0.001). Patients with a hospital stay of more than 10 days incurred substantially higher costs than those hospitalised for 10 days or less, with mean costs of Rp 207,954,866 ± 116,100,319 and Rp 66,802,970 ± 20,986,460, respectively. In contrast, inpatient class (p=0.634), risk factors (p=0.082), aggravating factors (p=0.286), complications (p=0.194), and stroke onset (p=0.529) showed no statistically significant association with treatment costs. These findings suggest that the duration of hospitalisation is the primary factor influencing healthcare expenditure among stroke patients undergoing mechanical thrombectomy, whereas the other clinical and demographic characteristics examined in this study did not significantly contribute to cost variation.

Table 2.
Bivariate analysis of factors associated with hospitalisation costs in stroke patients undergoing *coiling*

Variable	Treatment Costs		p-value
	Mean ±SD	Min-Max	
Length of Stay			
≤10 days	97,976,089±50,429,078	64,520,724–368,641,118	0.017[a]
>10 days	142,593,787±94,174,404	71,445,248–566,712,861	
Inpatient Class			
Class III	95,874,646 ± 24,651,319	72,103,066–130,153,355	
Class II	121,821,338±81,115,861	64,520,724–566,712,861	0.739[b]
Class I	99,795,158±21,547,014	75,491,346–116,558,720	
Risk Factors			
None	119,751,587 ± 61,449,349	64,520,724–243,656,977	
1 Risk Factor	125,805,667±95,829,330	68,764,784–566,712,861	0.823[b]
2 Risk Factors	111,135,733±40,944,786	64,541,799–223,308,420	
3 Risk Factors	94,560,552±15,781,688	69,346,628–112,872,853	
Aggravating factors			
None	98,434,432 ± 51,780,393	64,520,724–368,641,118	
1 Aggravating factors	126,664,892±61,281,398	72,130,066–293,919,843	0.007[b]
2 Aggravating factors	114,428,602±36,155,527	76,998,626–174,319,465	
3 Aggravating factors	213,184,540 ± 179,795,627	95,923,320–566,712,861	
Complications			
None	94,285,791 ± 27,206,543	64,520,724–223,308,420	
1 Complication	129,385,178 ± 60,125,859	83,889,154–293,919,843	0.000[b]
2 Complications	134,460,100 ± 51,635,034	86,055,167–243,656,977	
3 Complications	566,712,861	566,712,861	
4 Complications	368,641,118	368,641,118	
Onset of stroke			
≤6 hours	93,871,732	93,871,732	0.743[a]
>6 hours	119,671,100 ± 77,857,942	64,520,724–566,712,861	

Table 2, length of hospital stay, aggravating factors, and complications were significantly associated with hospitalisation costs among stroke patients undergoing coiling procedures. Patients with a length of stay of more than 10 days incurred significantly higher costs than those hospitalised for 10 days or less (Rp 142,593,787 ± 94,174,404 vs. Rp 97,976,089 ± 50,429,078; $p = 0.017$). Hospitalisation costs also increased significantly with the presence of aggravating factors ($p = 0.007$), with the highest mean cost observed among patients presenting with three aggravating factors. Similarly, complications demonstrated a strong association with treatment costs ($p < 0.001$), with costs generally increasing as the number of complications rose. In contrast, inpatient class ($p = 0.739$), risk factors ($p = 0.823$), and stroke onset ($p = 0.743$) were not significantly associated with hospitalisation costs. These findings indicate that prolonged hospitalisation, greater clinical complexity, and the occurrence of complications are the main factors contributing to increased treatment costs in stroke patients undergoing coiling procedures.

Table 3, none of the stroke severity-related variables were significantly associated with hospitalisation costs among patients undergoing mechanical thrombectomy (all $p > 0.05$). The mean treatment costs were slightly higher among patients with NIHSS scores ≥17 compared with those with NIHSS scores ≤16; however, this difference was not statistically significant ($p = 0.958$). Similarly, no significant differences in hospitalisation costs were observed according to ASPECT score ($p = 0.348$), recanalisation success ($p = 0.488$), or equipment use ($p = 0.794$). Although patients with lower ASPECT scores and unsuccessful recanalisation tended to incur higher treatment costs, these trends did not reach statistical significance. Overall, the findings suggest that stroke severity indicators and procedural characteristics examined in this study were not major determinants of hospitalisation costs among stroke patients undergoing mechanical thrombectomy.

Table 3.
Bivariate analysis of stroke severity against hospitalisation costs for stroke patients undergoing mechanical thrombectomy

Variable	Treatment Costs		p-value
	Mean ± SD	Min-Max	
NIHSS score			
Score ≤ 16	90.131.201±88.083.668	33,221,773–415,187,500	0.958[a]
Score ≥ 17	108,712,731 ± 69,571,540	36,644,364–296,488,622	
ASPECT Score			
≤6 points	111,250,492 ± 95,886,223	36,644,364–415,187,500	0.348[a]
>6 points	84,109,403 ± 61,426,938	33,221,773–296,488,622	
Success of Recanalisation			
Successful	88,236,029 ± 87,428,864	33,221,773–415,187,500	0.488[a]
Failed	108,383,055 ± 73,128,663	43,127,400–296,488,622	
Use of Equipment			
Reuse	92,434,489 ± 117,887,735	33,221,773–415,187,500	0.794[a]
New	100,427,569 ± 55,212,442	43,676,653–296,488,622	

Table 4.
Bivariate analysis of stroke severity against costs in stroke patients undergoing *coiling*

Variable	Treatment Costs		p-value
	Mea±SD	Min-Max	
NIHSS score			
Score ≤ 16	103,508,145 ± 34,341,597	64,520,724–223,208,420	0.000[a]
Score ≥ 17	235,647,973 ± 170,405,450	83,303,184–566,712,861	
Hunt and Hess score			
Good: 1–2 points	92,647,260 ± 23,237,995	64,520,724–178,257,922	0.001[a]
Poor: 3–5 points	154,192,014 ± 105,626,741	76,383,756–566,712,861	
WFNS Score			
Good: 1–3 points	99,478,852 ± 29,980,286	64,520,724–219,512,853	0.000[a]
Poor: 4–5 points	210,068,955 ± 143,230,285	90,759,841–566,712,861	
Total Coils			
1 Coil	105,588,991 ± 43,152,689	64,520,724–243,656,977	0.087[a]
>1 Coil	138,364,060±106,528,853	76,586,766–566,712,861	
Difficulty Level			
Difficult	96,293,728 ± 14,687,047	83,889,154–116,740,467	0.410[a]
No	121,968,470 ± 81,224,737	64,520,724–566,712,861	

Table 4, several stroke severity indicators were significantly associated with hospitalisation costs among patients undergoing coiling procedures. Patients with NIHSS scores ≥17 incurred substantially higher costs than those with NIHSS scores ≤16 (Rp 235,647,973 ± 170,405,450 vs. Rp 103,508,145 ± 34,341,597; $p < 0.001$). Similarly, patients with poor Hunt and Hess scores (3–5) had significantly greater treatment costs than those with good scores (1–2) (Rp 154,192,014 ± 105,626,741 vs. Rp 92,647,260 ± 23,237,995; $p = 0.001$). A comparable pattern was observed for WFNS scores, where patients in the poor category (4–5) experienced markedly higher hospitalisation costs than those in the good category (1–3) (Rp 210,068,955 ± 143,230,285 vs. Rp 99,478,852 ± 29,980,286; $p < 0.001$). In contrast, the total number of coils used ($p = 0.087$) and procedural difficulty level ($p = 0.410$) were not significantly associated with treatment costs. Overall, these findings indicate that greater stroke severity, as reflected by higher NIHSS, Hunt and Hess, and WFNS scores, is associated with substantially increased hospitalisation costs among stroke patients undergoing coiling procedures.

Table 5.
Multivariate analysis of factors associated with the hospitalisation costs of stroke patients undergoing mechanical thrombectomy

Variable	B	β	T	p	95% CI
Length of Stay	141.151.896	0.737	5.979	0.000	92,935,858 to 189,367,933[c]

[c] Linear Regression Test

The multivariate analysis revealed that length of hospital stay was the only variable independently and significantly associated with hospitalisation costs among stroke patients undergoing mechanical thrombectomy after adjusting for potential confounding factors (B = 141,151,896; β = 0.737; t = 5.979; p < 0.001). The results indicate that longer hospital stays were associated with substantially higher treatment costs, with each unit increase in length of stay corresponding to an increase of Rp 141,151,896 in hospitalisation expenses. Furthermore, the high standardized beta coefficient (β = 0.737) demonstrates that length of stay was the most influential predictor of treatment costs, highlighting the duration of inpatient care as the primary determinant of hospitalisation costs in patients undergoing mechanical thrombectomy.

Table 6.
Multivariate analysis of factors associated with hospitalisation costs in stroke patients undergoing *coiling*

Variable	B	β	T	p	95% CI
NIHSS	57.137.160	0.241	2.318	0.024	7,844,865 to 106,429,454[c]
WFNS	39,466,045	0.197	1,854	0.069	-30,891,870 to 82,021,279[c]
Aggravating factors	18,163,316	0.230	2.615	0.011	4,275,135 to 32,051,496[c]
Complications	29,921,259	0.349	3,541	0.001	13,023,673 to 46,818,846[c]
Total Coils	29,086,239	0.187	2,195	0.032	2,590,138 to 55,582,339[c]

[c] Linear Regression Test

The multivariate analysis demonstrated that, after adjusting for potential confounding factors, NIHSS score, aggravating factors, complications, and the total number of coils used were independently associated with increased hospitalisation costs among stroke patients undergoing coiling procedures (p < 0.05). Complications emerged as the strongest predictor of hospitalisation costs (β = 0.349; p = 0.001), followed by NIHSS score (β = 0.241; p = 0.024), aggravating factors (β = 0.230; p = 0.011), and the total number of coils used (β = 0.187; p = 0.032). Each one-point increase in NIHSS score was associated with an additional cost of Rp 57,137,160, while the presence of aggravating factors, complications, and each additional coil increased costs by Rp 18,163,316, Rp 29,921,259, and Rp 29,086,239, respectively. In contrast, the WFNS score was not significantly associated with hospitalisation costs (p = 0.069), although it showed a tendency toward higher costs with increasing severity. Overall, patient clinical severity, the occurrence of complications, and greater coil utilisation were the main determinants of higher hospitalisation costs in stroke patients undergoing coiling treatment.

Table 7.
Multivariate analysis of factors associated with medication costs for stroke patients undergoing mechanical thrombectomy

Variable	B	β	T	p	95% CI
Length of Stay	41,303,312	0.569	4.513	0.000	22,584,119 to 60,022,504[c]
Use of equipment	27,095,916	0.429	3,401	0.002	10,802,950 to 43,388,882

[c] Linear Regression Test

Table 8.
Multivariate analysis of factors associated with medication costs for stroke patients undergoing *coiling*

Variable	B	β	T	p	95% CI
Aggravating factors	3,663,779	0.191	2,176	0.033	297,715 to 7,029,843[c]
Complications	4,935,113	0.237	2,410	0.019	839,662 to 9,030,564
NIHSS	13,662,033	0.238	2.287	0.026	1,715,110 to 25,608,957
WFNS	10,879,057	0.224	2,109	0.039	564,988–21,193,126
Coil	14,936,148	0.395	4,651	0.000	8,514,315–21,357,981

[c] Linear Regression Test

The actual cost of stroke care comprises various components, namely medication, electromedical equipment, accommodation, consultations, radiology, laboratory tests, blood services, nursing, and

rehabilitation. Based on the research findings, the medication and electromedical components are the largest contributors to the total cost of stroke patient care.

Table 9.
Multivariate analysis of factors associated with electromedical costs for stroke patients undergoing mechanical thrombectomy

Variable	B	β	T	p	95% CI
Length of Stay	3,362,176	0.309	1.742	0.092	-585,462 to 7,309,816[c]
Success of re-channelling	-2,907,453	-0.323	-1.818	0.079	-6,177,744 to 362,837[c]

[c] Linear Regression Test

Table 10.
Multivariate analysis of factors associated with electromedical costs for stroke

Variable	B	β	T	p	95% CI
Ward	3,289,726	0.443	3.980	0.000	-1,638,918 to 4,940,534[c]

[c] Linear Regression Test

Based on the analysis in Table 9, for patients undergoing mechanical thrombectomy, medication costs were significantly influenced by length of hospital stay and the use of devices, whether new or reused. Meanwhile, in Table 10, for patients undergoing coiling procedures, medication costs were significantly influenced by aggravating factors, complications, NIHSS score, Hunt and Hess score, WFNS score, and the number of coils used.

DISCUSSION

Factors Associated with the Cost of Stroke Patients Undergoing Mechanical Thrombectomy

The results of this study indicate that, of the various variables analysed, only length of hospital stay had a statistically significant association with the cost of care for stroke patients undergoing mechanical thrombectomy. Patients with a length of stay of ≤10 days had an average cost of Rp 66,802,970 ± 20,986,460, whilst patients with a length of stay of >10 days showed a highly significant increase in costs to Rp 207,954,866 ± 116,100,319. These findings confirm that the duration of hospitalisation is a key determinant in the formation of treatment costs in this group. These results are consistent with research by (Grunwald et al., 2022), which showed that patients undergoing thrombectomy had shorter hospital stays and lower costs compared to the control group. Furthermore, the proportion of patients who were able to be discharged home was also higher (60% vs 28%), which implies greater overall cost efficiency. These findings are supported by (Setiani, 2021) study, which states that length of stay is influenced by disease severity, comorbidities, and the quality of clinical management.

Other literature also supports these results, such as the systematic review by (Rochmah et al., 2021), which reported that the average length of hospital stay for stroke patients ranges from 11 to 27 days and is strongly correlated with increased treatment costs. A longer length of stay increases cost accumulation through various components such as medication use, diagnostic tests, and the risk of complications during care. Consequently, controlling the length of hospital stay is a key strategy in reducing the cost of stroke patient care. Meanwhile, other variables such as hospitalisation class, risk factors, aggravating factors, complications, and stroke onset did not show a significant association with costs. This indicates that these factors likely influence costs indirectly, primarily through the intermediary of length of stay as the dominant variable in this study.

Factors Associated with the Costs of Stroke Patients Undergoing Coiling

Unlike mechanical thrombectomy, in the group of patients undergoing coiling, several factors were found to be significantly associated with treatment costs, namely length of stay, aggravating factors, and complications. Length of stay showed a significant association (p=0.017), with patients with a length of stay >10 days having higher costs compared to those with ≤10 days. This finding suggests that the duration of hospitalisation remains an important factor in determining costs, particularly in cases of haemorrhagic stroke such as subarachnoid haemorrhage (SAH). Clinically, SAH patients do indeed require longer treatment than those with ischaemic stroke, Thompson et al., (2025)

reported a median length of stay of 14–16 days for SAH patients, with variation depending on severity. Furthermore, the 2023 AHA/ASA guidelines recommend a minimum hospital stay of 14 days for monitoring complications such as vasospasm. This explains why the group with a longer length of stay incurred higher costs. Complicating factors also showed a significant association with costs (p=0.007), with a consistent pattern of rising costs as the number of complicating factors increased. Religioni et al., (2025) reported that patients with complex clinical conditions have high mortality rates and require intensive interventions, which directly contribute to increased treatment costs.

The complication variable was the most dominant factor (p=0.000), with a very sharp increase in costs as the number of complications increased. These findings are consistent with the study by Maier et al., (2024), which showed that patients with ≥3 complications have high mortality rates and a significant need for intensive care. Conversely, the variables of admission class, risk factors, and stroke onset did not show a significant association, indicating that acute clinical factors play a greater role than the patient's baseline characteristics.

Relationship Between Stroke Severity and Costs in Mechanical Thrombectomy

In the mechanical thrombectomy group, all indicators of stroke severity such as the NIHSS score, ASPECTS, recanalisation success, and device usage showed no significant association with treatment costs. Although there was a trend towards increased costs in more severe conditions, these differences were not statistically significant. These findings can be explained through indirect mechanisms, whereby stroke severity influences costs via intermediary variables such as complications and length of hospital stay. This aligns with the study by Yang et al., (2023), which showed that the NIHSS ' ' score plays a greater role in predicting long-term costs than acute costs, with the pathway of influence involving increased complications and length of stay.

Furthermore, the ASPECTS score, which is theoretically linked to clinical outcomes, also showed no significant association with costs. (Kaesmacher et al., 2020) stated that a low ASPECTS score correlates with poor outcomes; however, its impact on acute costs is not always immediately apparent as it is influenced by other factors such as clinical management and therapeutic response. success of recanalisation and the use of devices also showed no significant association, despite being clinically important in determining outcomes. This suggests that, in the context of acute costs, operational factors and length of stay are more dominant than initial clinical parameters.

The Relationship Between Stroke Severity and Costs in Coiling

Unlike mechanical thrombectomy, in coiling procedures it was found that stroke severity has a highly significant association with treatment costs. The NIHSS, Hunt and Hess, and WFNS scores all showed a positive correlation with increased costs, such that the more severe the clinical condition, the higher the costs required. A high NIHSS score reflects more severe neurological deficits, which correlate with the need for intensive care, the risk of complications, and a longer hospital stay. This is supported by the study by (Garavelli et al., 2021), which states that a high NIHSS score is a predictor of in-hospital complications.

Furthermore, the Hunt and Hess and WFNS scores also show a strong association with costs. (Aggarwal et al., 2017) reported that patients with high Hunt and Hess scores had poorer outcomes and required more complex interventions. Meanwhile, (Nguyen et al., 2023) demonstrated that the WFNS is a strong predictor of poor clinical outcomes, which implies increased treatment costs. The variable of the number of coils showed a trend towards increased costs, although this was not yet statistically significant. A study by (Prasetyo et al., 2024) indicated that cost-effectiveness is more influenced by coil usage strategies than by the number of coils. Meanwhile, the level of procedural difficulty does not correlate directly with costs, suggesting that clinical outcomes play a greater role than the technical complexity of the procedure.

Multivariate Analysis of Factors Influencing Inpatient Costs

In the multivariate analysis, length of hospital stay was found to be the primary determinant of costs in mechanical thrombectomy. This finding is consistent with the meta-analysis by (Luengo-Fernandez et al., 2020), which showed that length of stay accounts for up to 45–60% of the variation in stroke care costs. The longer a patient is hospitalised, the greater the accumulation of costs from various healthcare service components. In the coiling group, factors with independent influence included the NIHSS score, risk factors, complications, and the number of coils. Complications were the most dominant factor, indicating that clinical events during treatment have a significant impact on costs. This is supported by the literature, which notes that complications such as aspiration pneumonia can prolong hospital stays and significantly increase costs. Furthermore, risk factors and the number of coils also contribute to costs through increased treatment complexity. Lee et al., (2022) demonstrated that the size and morphology of the aneurysm influence the number of coils used, which directly impacts procedural costs. Overall, the results of this study indicate that the cost of stroke care is heavily influenced by a combination of clinical factors, duration of care, and the complexity of the intervention . Therefore, cost-control strategies need to focus on the prevention of complications, optimisation of clinical management, and the efficient use of healthcare resources.

CONCLUSION

Based on the results of a study of 32 stroke patients who underwent mechanical thrombectomy and 67 patients who underwent coiling at Dr. Mohammad Hoesin Hospital in Palembang during the period 2023–2024, it was found that the average actual inpatient cost in the coiling group was higher than that of mechanical thrombectomy, with a difference of approximately 20%. Cost variation in both groups was considerable, reflecting the heterogeneity of patients' clinical conditions. Bivariate analysis showed that in mechanical thrombectomy, only length of hospital stay was significantly associated with costs, whereas in coiling, several factors were influential: length of hospital stay, risk factors, complications, and clinical severity as measured by the NIHSS, Hunt & Hess, and WFNS scores. The largest cost component in both groups stemmed from the use of medication during treatment.

Furthermore, multivariate analysis confirmed that length of hospital stay was the sole independent factor influencing hospital costs in mechanical thrombectomy. Meanwhile, in coiling, significant independent factors included complications, risk factors, the NIHSS score, and the number of coils used. In the analysis of medication costs, mechanical thrombectomy was influenced by length of stay and the use of devices, whereas in coiling, it was influenced by complications, risk factors, NIHSS scores, WFNS scores, and the number of coils.

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