

Determinants of Neurological Outcome at Discharge and Length of Hospital Stay among Acute Ischemic Stroke Patients at Dr. H. Abdul Moeloek Regional General Hospital, Lampung Province, Indonesia

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Abstract

Neurological status at discharge and length of hospital stay link the clinical quality of stroke care with its efficiency, yet evidence on the patient factors associated with these outcomes in Indonesian provincial referral hospitals remains limited. This study aimed to analyse the demographic and clinical factors associated with the National Institutes of Health Stroke Scale (NIHSS) score at discharge and the length of stay of patients with acute ischemic stroke. This retrospective cohort study used the medical records of all patients with acute ischemic stroke admitted to Dr. H. Abdul Moeloek Regional General Hospital, Lampung Province, between January 2022 and December 2025, selected by total sampling. Independent variables were age, sex, admission NIHSS score, and history of hypertension, diabetes mellitus, and atrial fibrillation. The outcomes were discharge NIHSS score (>5 vs 0–5) and length of stay (>5 vs 1–5 days), analysed using chi-square tests and risk ratios (RR) with 95% confidence intervals (CI). Of 989 patients, 355 (35.9%) were discharged with an NIHSS score >5 and 464 (46.9%) stayed longer than 5 days. A discharge NIHSS score >5 was associated with admission NIHSS >5 (RR 6.57; 95% CI 4.54–9.51), age ≥65 years (RR 1.64; 95% CI 1.16–2.31), atrial fibrillation (RR 1.60; 95% CI 1.30–1.98), and hypertension (RR 1.23; 95% CI 1.01–1.49). A length of stay >5 days was associated with admission NIHSS >5 (RR 1.99; 95% CI 1.67–2.38), age ≥65 years (RR 1.49; 95% CI 1.12–1.97), diabetes mellitus (RR 1.30; 95% CI 1.14–1.48), atrial fibrillation (RR 1.27; 95% CI 1.05–1.54), and hypertension (RR 1.18; 95% CI 1.01–1.37). Sex was not associated with either outcome. Initial stroke severity showed the strongest association with both outcomes, followed by older age, whereas diabetes mellitus was associated with prolonged stay but not with neurological outcome. Risk stratification based on admission NIHSS score and age may support discharge planning and bed management.

Keywords: *Ischemic Stroke, NIHSS, Length of Stay, Neurological Outcome.*

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A. INTRODUCTION

Stroke remains one of the leading causes of death and disability in adults. In 2021, approximately 93.8 million people were living with stroke and 11.9 million new strokes occurred worldwide, with stroke ranking as the third leading cause of death (Feigin et al., 2024). Most of this burden is borne by low- and middle-income countries, which account for about 87% of stroke deaths (Feigin et al., 2025). In Indonesia, the 2023 Indonesian Health Survey recorded a stroke prevalence of 8.3 per 1,000 population (Kementerian Kesehatan Republik Indonesia, 2024).

The success of stroke care cannot be judged by mortality alone. Most patients with acute ischemic stroke survive, so the degree of neurological deficit remaining at discharge determines their rehabilitation needs and the burden of care that shifts to the family. Length of hospital stay complements this picture, as it reflects both the patient's recovery burden and the efficiency of bed use and hospital financing. Together, these two outcomes connect the clinical quality of stroke care with its efficiency.

Previous studies have identified determinants of both outcomes, but their findings have been inconsistent, which suggests that the determinants of stroke outcomes are shaped by case mix and the local context of care. Evidence from Indonesia has so far been concentrated in the national referral centre, whereas provincial referral hospitals receive patients with a different spectrum of severity and referral background. Dr. H. Abdul Moeloek Regional General Hospital is the highest-level referral hospital in Lampung Province and receives stroke cases from all districts and cities in the province. Previous local data showed a large burden of ischemic stroke at this hospital, with 1,266 patients in 2023 (Yadika et al., 2026).

This study aimed to analyse the association of age, sex, admission NIHSS score, and history of hypertension, diabetes mellitus, and atrial fibrillation with the NIHSS score at discharge and the length of hospital stay of patients with acute ischemic stroke at Dr. H. Abdul Moeloek Regional General Hospital, Lampung Province. The findings are expected to provide a basis for risk stratification from admission, both for rehabilitation planning and for bed management.

B. LITERATURE REVIEW

1. Neurological Outcome and the NIHSS

The National Institutes of Health Stroke Scale (NIHSS) is the standard instrument for measuring neurological deficit after stroke, with scores ranging from 0 to 42; the higher the score, the more severe the deficit. The NIHSS score on admission reflects initial severity, whereas the score at discharge summarises the response to therapy, complications, and early recovery during hospitalisation (Ding et al., 2022; Panthi et al., 2025).

2. Length of Hospital Stay as a Quality Indicator

Length of hospital stay occupies a different but complementary position. This indicator reflects the patient's recovery burden as well as the efficiency of bed use and hospital financing. Donabedian's quality framework positions such measures as outcomes that are influenced by the structure and process of care, but also by the characteristics that patients bring with them on admission (Donabedian, 2005). Therefore, before length of stay is used as a performance indicator, it is necessary to know how much of its variation is determined by patient factors.

3. Determinants of Neurological Outcome and Length of Stay

A number of studies have identified determinants of these two outcomes, but the results vary. A cohort study of 2,804 patients at the Indonesian national stroke centre reported a mean length of stay of 5.1 days and showed that severe stroke, in-hospital complications, and a history of diabetes mellitus prolonged hospitalisation (Bustami et al., 2025). A study in the United States identified an NIHSS score ≥ 10 and an admission glucose level ≥ 180 mg/dL as predictors of prolonged length of stay (Abou-El-Hassan et al., 2025), whereas a study of severe stroke in Taiwan found that younger age was associated with longer hospitalisation (Lin et al., 2022). The roles of atrial fibrillation and sex have also been inconsistent across populations (Rexrode et al., 2022; Watanabe et al., 2021).

C. METHOD

This was an observational analytic study with a retrospective cohort design. Patient factors were measured on admission, whereas outcomes were assessed when patients were discharged from hospital. The study was conducted at Dr. H. Abdul Moeloek Regional General Hospital, Lampung Province, using data from 1 January 2022 to 31 December 2025.

The accessible population comprised all 1,311 patients with acute ischemic stroke who were hospitalised during this period. The sample was obtained by total sampling. Inclusion criteria were a diagnosis of acute ischemic stroke confirmed by head CT scan and/or MRI, age ≥ 18 years, admission through the Emergency Department, and a medical record containing the NIHSS score and discharge status. Exclusion criteria were a final diagnosis other than ischemic stroke, stroke occurring during hospitalisation for another illness (in-hospital stroke), transfer to another hospital or discharge against medical advice, and medical records that could not be located or were incomplete.

The first outcome was the NIHSS score at discharge, defined as the degree of neurological deficit assessed by a trained examiner when the patient left hospital, categorised as 0–5 and >5 . Patients who died during hospitalisation were categorised as having a score >5 (poor outcome). The second outcome was length of hospital stay, calculated from the date of admission to the date of discharge or death, categorised as 1–5 days and >5 days. The 5-day cut-off was based on the mean length of stay for ischemic stroke at the Indonesian national stroke centre (Bustami et al., 2025). Independent variables were age on admission (<45 , 45–64, and ≥ 65 years), sex, admission NIHSS score at the first examination in the Emergency Department (0–5 and >5), and a history of hypertension, diabetes mellitus, and atrial fibrillation recorded before or at admission.

Secondary data were extracted from electronic and paper medical records, Emergency Department and inpatient registers, NIHSS forms, and discharge summaries using a structured extraction sheet. Each subject was assigned a study code without personal identifiers. Unavailable data were recorded as missing and were not imputed. A subset of the data was re-checked to reduce extraction errors.

Variables were presented as frequencies and percentages. The association of each independent variable with each outcome was tested using the chi-square test (Fisher's exact test when expected values were <5). The strength of association was expressed as a risk ratio (RR) with a 95% confidence interval (CI), using the lowest-risk category as the reference, namely age <45 years, female sex, admission NIHSS score 0–5, and absence of comorbidity. Associations were considered significant at $p < 0.05$. The analysis was limited to the bivariate stage in line with the study objective, which was to identify patient factors associated with the outcomes.

This study received an ethical exemption from the Health Research Ethics Committee of Dr. H. Abdul Moeloek Regional General Hospital, Lampung Province, No. 143/KEPK-RSUDAM/IX/2026.

D. RESULT AND DISCUSSION

1. Characteristics of the Study Subjects

Of the 1,311 patients in the accessible population, 322 (24.6%) were excluded, leaving 989 patients (75.4%) for analysis. The most common reason for exclusion was a medical record that could not be located or had incomplete data on the main variables (223 patients), followed by a final diagnosis other than ischemic stroke (39), in-hospital stroke (23), transfer or discharge against medical advice (22), and referral with symptom onset of more than 4.5 hours (15).

The characteristics of the subjects are presented in Table 1. Most patients were aged 45–64 years (47.5%), were male (53.9%), and presented with an admission NIHSS score >5 (64.9%). Hypertension was the most common comorbidity (70.0%). A total of 355 patients (35.9%) were discharged with an NIHSS score >5 , and 464 patients (46.9%) were hospitalised for more than 5 days.

Table 1 Characteristics of the Study Subjects (n = 989)

Characteristic	n	%
Age group		
<45 years	87	8.8
45–64 years	470	47.5
≥ 65 years	432	43.7
Sex		
Female	456	46.1
Male	533	53.9
Admission NIHSS score		
0–5	347	35.1
>5	642	64.9
Comorbidity		
Hypertension	692	70.0
Diabetes mellitus	309	31.2
Atrial fibrillation	86	8.7
NIHSS score at discharge		

0–5	634	64.1
>5	355	35.9
Length of hospital stay		
1–5 days	525	53.1
>5 days	464	46.9

Source: Hospital Medical Records, 2022–2025 (processed)

2. Factors Associated with the NIHSS Score at Discharge

The association between patient factors and the NIHSS score at discharge is presented in Table 2. The admission NIHSS score showed the strongest association: 51.1% of patients with an admission score >5 were discharged with a score >5, compared with 7.8% of patients with an admission score of 0–5 (RR 6.57; 95% CI 4.54–9.51). Age ≥65 years increased the risk 1.64-fold compared with age <45 years, whereas the 45–64-year group did not differ from the reference group (RR 0.94; 95% CI 0.65–1.35). Atrial fibrillation (RR 1.60) and hypertension (RR 1.23) were also significantly associated. Sex and diabetes mellitus were not associated with this outcome.

Table 2 Association between Patient Factors and the NIHSS Score at Discharge

Variable	Category	Score >5 n (%)	Score 0–5 n (%)	χ^2	<i>p</i>	RR (95% CI)
Age	<45 years	25 (28.7)	62 (71.3)	41.135	<0.001	Reference
	45–64 years	127 (27.0)	343 (73.0)			0.94 (0.65–1.35)
	≥65 years	203 (47.0)	229 (53.0)			1.64 (1.16–2.31)
Sex	Female	163 (35.7)	293 (64.3)	0.008	0.928	Reference
	Male	192 (36.0)	341 (64.0)			1.01 (0.85–1.19)
Admission NIHSS score	0–5	27 (7.8)	320 (92.2)	183.614	<0.001	Reference
	>5	328 (51.1)	314 (48.9)			6.57 (4.54–9.51)
Hypertension	No	92 (31.0)	205 (69.0)	4.462	0.035	Reference
	Yes	263 (38.0)	429 (62.0)			1.23 (1.01–1.49)
Diabetes mellitus	No	242 (35.6)	438 (64.4)	0.089	0.766	Reference
	Yes	113 (36.6)	196 (63.4)			1.03 (0.86–1.23)
Atrial fibrillation	No	308 (34.1)	595 (65.9)	14.400	<0.001	Reference
	Yes	47 (54.7)	39 (45.3)			1.60 (1.30–1.98)

Note: Patients who died during hospitalisation were categorised as having a score >5. RR = risk ratio; CI = confidence interval.

Source: Hospital Medical Records, 2022–2025 (processed)

3. Factors Associated with Length of Hospital Stay

The association between patient factors and length of hospital stay is presented in Table 3. Five of the six variables were significantly associated. The proportion of stays >5 days was 56.9% among patients with an admission NIHSS score >5 and 28.5% among those with a score of 0–5 (RR 1.99; 95% CI 1.67–2.38). Age ≥65 years (RR 1.49), diabetes mellitus (RR 1.30), atrial fibrillation (RR 1.27), and hypertension (RR 1.18) were associated with longer hospitalisation. Diabetes mellitus was the only comorbidity associated with length of stay but not with the NIHSS score at discharge. Sex was not associated with length of stay.

Table 3 Association between Patient Factors and Length of Hospital Stay

Variable	Category	>5 days n (%)	1–5 days n (%)	χ^2	<i>p</i>	RR (95% CI)
Age	<45 years	33 (37.9)	54 (62.1)	28.282	<0.001	Reference
	45–64 years	187 (39.8)	283 (60.2)			1.05 (0.78–1.40)
	≥65 years	244 (56.5)	188 (43.5)			1.49 (1.12–1.97)
Sex	Female	215 (47.1)	241 (52.9)	0.018	0.892	Reference
	Male	249 (46.7)	284 (53.3)			0.99 (0.87–1.13)
Admission NIHSS score	0–5	99 (28.5)	248 (71.5)	72.556	<0.001	Reference
	>5	365 (56.9)	277 (43.1)			1.99 (1.67–2.38)
Hypertension	No	124 (41.8)	173 (58.2)	4.547	0.033	Reference
	Yes	340 (49.1)	352 (50.9)			1.18 (1.01–1.37)
Diabetes mellitus	No	292 (42.9)	388 (57.1)	13.807	<0.001	Reference
	Yes	172 (55.7)	137 (44.3)			1.30 (1.14–1.48)
Atrial fibrillation	No	414 (45.8)	489 (54.2)	4.764	0.029	Reference
	Yes	50 (58.1)	36 (41.9)			1.27 (1.05–1.54)

Note: Length of stay for patients who died was calculated up to the date of death. RR = risk ratio; CI = confidence interval.

Source: Hospital Medical Records, 2022–2025 (processed)

This study shows that more than one-third of patients with acute ischemic stroke were discharged with moderate to severe neurological deficits and almost half were hospitalised for more than 5 days. The admission NIHSS score was the factor most strongly associated with both outcomes, followed by age ≥65 years. Comorbidities showed different patterns across the two outcomes: atrial fibrillation was more strongly associated with neurological outcome, whereas diabetes mellitus was associated only with length of stay.

The proportion of stays >5 days (46.9%) is consistent with the mean length of stay of 5.1 days at the Indonesian national stroke centre (Bustami et al., 2025), but much shorter than the median of 11.2 days reported by a referral hospital in Brazil (Poll et al., 2024). This difference probably reflects different patterns of care and financing between countries, including the availability of post-acute rehabilitation facilities. Meanwhile, 64.9% of patients presented with an admission NIHSS score >5. This proportion is consistent with the hospital's position as the highest-level referral hospital in the province, which receives cases with a more severe spectrum.

Patients with an admission NIHSS score >5 had a 6.57-fold risk of being discharged with a score >5 and a 1.99-fold risk of being hospitalised for >5 days compared with patients with an admission score of 0–5. This finding is consistent with studies in Indonesia and other countries that identify the admission NIHSS score as the strongest prognostic predictor (Panthi et al., 2025; Yamanie et al., 2024). For length of stay, Abou-El-Hassan et al. (2025) reported an NIHSS score ≥10 as an independent predictor of prolonged hospitalisation, and Bustami et al. (2025) found that severe stroke prolonged length of stay with an incidence rate ratio of 1.56 compared with mild stroke.

The magnitude of the RR for neurological outcome should be interpreted critically. The predictor and the outcome were measured with the same instrument,

so part of the strength of the association reflects the persistence of neurological deficit from admission to discharge. In addition, patients who died were categorised as having a poor outcome, and deaths occurred more frequently in severe stroke. Clinically, severe deficits are associated with dysphagia, immobilisation, and reduced consciousness, which increase the risk of aspiration pneumonia and other complications. These complications prolong hospitalisation; Bustami et al. (2025) showed that in-hospital complications almost doubled length of stay. Early dysphagia screening has been shown to be associated with reduced pneumonia, mortality, and length of stay (Sherman et al., 2021), making it a reasonable target in patients with high admission scores.

Age ≥ 65 years was associated with both outcomes, whereas the 45–64-year group did not differ from the <45 -year group. This pattern indicates that risk does not increase gradually but rises sharply after the age of 65. Ageing is accompanied by declining physiological reserve and neural recovery capacity. Miranda et al. (2024) showed that age is an independent risk factor for post-stroke disability, with frailty mediating part of this association, and Ding et al. (2022) used age together with the NIHSS score as the main components of a model predicting three-month outcome. This finding differs from Lin et al. (2022), who found that younger age was associated with hospitalisation ≥ 30 days in severe stroke. Differences in the definition of prolonged stay and a population restricted to severe stroke probably explain this discrepancy.

Atrial fibrillation was associated with poor neurological outcome (RR 1.60) and longer hospitalisation (RR 1.27). Strokes in patients with atrial fibrillation are generally cardioembolic and more severe (Watanabe et al., 2021). Therefore, the observed association may operate partly through initial severity and is not necessarily an independent effect. Hypertension showed a weak association with both outcomes, with the lower limit of the 95% CI close to 1. The high prevalence of hypertension (70.0%) narrowed the contrast between groups, and the history variable did not capture blood pressure control before the stroke or during the acute phase.

Diabetes mellitus was associated with length of stay (RR 1.30) but not with neurological outcome (RR 1.03). This finding is in line with Bustami et al. (2025), who reported that diabetes mellitus prolonged length of stay at the national stroke centre, and with Abou-El-Hassan et al. (2025), who found an admission glucose level ≥ 180 mg/dL to be a predictor of prolonged hospitalisation. Possible mechanisms include the need for glycaemic stabilisation before discharge, susceptibility to infection, and therapy adjustment. The absence of an association with neurological outcome may be related to how this variable was measured, namely as a history of disease rather than as the admission glucose level, which is more closely related to neurological deterioration.

Sex was not associated with either outcome. Differences in stroke outcomes between men and women are influenced by a combination of biological factors, risk factor profiles, and clinical presentation, so their direction and magnitude vary across populations (Rexrode et al., 2022). In this study population, the proportion of poor

outcomes was almost identical between men and women.

The two variables most strongly associated with the outcomes, the admission NIHSS score and age, are available as soon as the patient arrives at the Emergency Department. This allows simple risk stratification from admission. Patients with an admission NIHSS score >5 who are aged ≥ 65 years can be flagged early for early discharge planning, physical medicine and rehabilitation consultation, family education, and dysphagia screening. For hospital management, these findings also indicate that length of stay as a performance indicator should be interpreted with consideration of the patient severity mix. Comparing length of stay between units or periods without adjusting for severity risks leading to erroneous conclusions about the efficiency of care (Donabedian, 2005).

This study has several limitations. First, the analysis was limited to patient factors and did not control for care process factors, so the results describe clinical determinants rather than the effectiveness of interventions. Second, the analysis stopped at the bivariate stage, so the reported RRs were not adjusted for other variables; the associations of atrial fibrillation and hypertension in particular may be confounded by initial severity. Third, the NIHSS score at discharge was measured on different days of discharge, and categorising patients who died as having a poor outcome combines death with disability. Fourth, early death shortens length of stay, while non-clinical factors such as administrative processes, bed availability, and family readiness were not recorded. Fifth, comorbidities were available only as a history of disease without information on disease control. Sixth, 17.0% of the accessible population was excluded because medical records could not be located or were incomplete, so selection bias cannot be ruled out. Finally, the study was conducted in a single provincial referral hospital, so generalisation to facilities with a different case mix should be made with caution.

E. CONCLUSION

Among patients with acute ischemic stroke at the provincial referral hospital of Lampung Province, an admission NIHSS score >5 was the factor most strongly associated with poor neurological outcome at discharge and a length of stay >5 days, followed by age ≥ 65 years. Atrial fibrillation and hypertension were associated with both outcomes, whereas diabetes mellitus was associated only with length of stay. Sex was not associated with either outcome. Hospitals can use the admission NIHSS score and age as a basis for risk stratification from admission for discharge planning, rehabilitation, and bed management. Further studies with multivariate analysis, care process variables, and long-term functional outcomes such as the 90-day modified Rankin Scale are needed to strengthen these findings.

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REFERENCES

1. Abou-El-Hassan, H., Massoumi, S., Akhlaghi, S., Sarsour, R., Pillai, K., Petersen, M., Chang, E., Kuo, J., Nareddy, S., & Giraldo, E. A. (2025). High National Institutes of Health Stroke Scale scores, hyperglycemia, and anemia as predictors of length of stay in patients hospitalized for acute ischemic stroke. *Cureus*, 17(10), e94792. <https://doi.org/10.7759/cureus.94792>
2. Bustami, M., Idaiani, S., Putri, N. D., Satyagraha, A. W., Dewi Panjaitan, N. S., Ritonga, A. M., Mutiara Putri, A. N., Asyahida, S. R., Nurkhalizah, M. S., Nitisara, D. A., Rilianto, B., Susanto, N. H., Felistia, Y., & Santoso, A. (2025). Determinants of hospital length of stay in ischemic stroke patients: A retrospective cohort study at Indonesian national stroke center. *PLOS One*, 20(11), e0334355. <https://doi.org/10.1371/journal.pone.0334355>
3. Ding, G., Xu, J., He, J., & Nie, Z. (2022). Clinical scoring model based on age, NIHSS, and stroke-history predicts outcome 3 months after acute ischemic stroke. *Frontiers in Neurology*, 13, 935150. <https://doi.org/10.3389/fneur.2022.935150>
4. Donabedian, A. (2005). Evaluating the quality of medical care. *The Milbank Quarterly*, 83(4), 691–729. <https://doi.org/10.1111/j.1468-0009.2005.00397.x>
5. Feigin, V. L., Abate, M. D., Abate, Y. H., ElHafeez, S. A., Abd-Allah, F., Abdelalim, A., Abdelkader, A., Abdelmasseh, M., Abd-Elsalam, S., Abdi, P., Abdollahi, A., Abdoun, M., Abd-Rabu, R., Abdulah, D. M., Abdullahi, A., Abebe, M., Zuñiga, R. A. A., Abhilash, E. S., Abiodun, O. O., ... Murray, C. J. L. (2024). Global, regional, and national burden of stroke and its risk factors, 1990–2021: A systematic analysis for the Global Burden of Disease Study 2021. *The Lancet Neurology*, 23(10), 973–1003. [https://doi.org/10.1016/S1474-4422\(24\)00369-7](https://doi.org/10.1016/S1474-4422(24)00369-7)
6. Feigin, V. L., Brainin, M., Norrving, B., Martins, S. O., Pandian, J., Lindsay, P., Grupper, M. F., & Rautalin, I. (2025). World Stroke Organization: Global stroke fact sheet 2025. *International Journal of Stroke*, 20(2), 132–144. <https://doi.org/10.1177/17474930241308142>
7. Kementerian Kesehatan Republik Indonesia. (2024, October 25). *Cegah stroke dengan aktivitas fisik*. Retrieved from: <https://sehatnegeriku.kemkes.go.id/baca/umum/20241025/4046682/cegah-stroke-dengan-aktivitas-fisik>
8. Lin, K.-H., Lin, H.-J., & Yeh, P.-S. (2022). Determinants of prolonged length of hospital stay in patients with severe acute ischemic stroke. *Journal of Clinical Medicine*, 11(12), 3457. <https://doi.org/10.3390/jcm11123457>
9. Miranda, L. A., Luvizutto, G. J., Bessornia, P. A. C., Furlan, N. E., Winckler, F. C., Ferreira, N. C., Hamamoto Filho, P. T., de Souza, J. T., Martin, L. C., Zanati Bazan, S. G., Pinheiro Modolo, G., de Freitas, C. C. M., Vidal, E. I. de O., & Bazan, R. (2024). To what extent does frailty mediate the association between age and the outcomes of brain reperfusion following acute ischemic stroke? *Frontiers in Aging Neuroscience*, 16, 1305803. <https://doi.org/10.3389/fnagi.2024.1305803>

10. Panthi, S., Sankhi, S., Bhandari, B., Paudel, S., & Marasine, N. R. (2025). Predictors of in-hospital mortality among stroke patients at a tertiary care hospital in Nepal: A prospective cohort study. *Inquiry*, 62. <https://doi.org/10.1177/00469580251385397>
11. Poll, M., Martins, R. T., Anschau, F., & Jotz, G. P. (2024). Length of hospitalization and mortality among stroke patients before and after the implementation of a specialized unit: A retrospective cohort study using real-world data from one reference hospital in Southern Brazil. *Healthcare*, 12(8), 836. <https://doi.org/10.3390/healthcare12080836>
12. Rexrode, K. M., Madsen, T. E., Yu, A. Y. X., Carcel, C., Lichtman, J. H., & Miller, E. C. (2022). The impact of sex and gender on stroke. *Circulation Research*, 130(4), 512–528. <https://doi.org/10.1161/CIRCRESAHA.121.319915>
13. Sherman, V., Greco, E., & Martino, R. (2021). The benefit of dysphagia screening in adult patients with stroke: A meta-analysis. *Journal of the American Heart Association*, 10(12), e018753. <https://doi.org/10.1161/JAHA.120.018753>
14. Watanabe, K., Okazaki, S., Kitano, T., Sugiyama, S., Ohara, M., Kanki, H., Sasaki, T., Sakaguchi, M., Mochizuki, H., & Todo, K. (2021). Stroke severity and outcomes in patients with newly diagnosed atrial fibrillation. *Frontiers in Neurology*, 12, 666491. <https://doi.org/10.3389/fneur.2021.666491>
15. Yadika, A. D. N., Saftarina, F., Zuraida, R., Sumekar, D. W., & Susianti, S. (2026). Determinan faktor-faktor yang memengaruhi kualitas hidup pasien stroke iskemik di RSUD dr. H. Abdul Moeloek Bandar Lampung [Determinants of factors affecting the quality of life of ischemic stroke patients at Dr. H. Abdul Moeloek Regional General Hospital, Bandar Lampung]. *MAHESA: Malahayati Health Student Journal*, 6(2), 443–460. <https://doi.org/10.33024/mahesa.v6i2.24575>
16. Yamanie, N., Felistia, Y., Susanto, N. H., Lamuri, A., Sjaaf, A. C., Miftahussurur, M., & Santoso, A. (2024). Prognostic model of in-hospital ischemic stroke mortality based on an electronic health record cohort in Indonesia. *PLOS ONE*, 19(6), e0305100. <https://doi.org/10.1371/journal.pone.0305100>