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Evaluation of Prescribing Patterns and Guideline Based on the Therapy Management of Ischemic Stroke

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ABSTRACT: Stroke management requires a comprehensive approach to ensure that treatment addresses both the acute event and underlying comorbidities and risk factors. Adherence to clinical guidelines is essential to optimize outcomes in ischemic stroke patients. This cross-sectional study was conducted from January 2021 to January 2022 using medical record data. Based on sample size calculation, a minimum of 97 patients was required, and data from 111 patients were included. The majority were female (54.1%) with a mean age of 62.11 years. None of the patients received fibrinolytic therapy, although it is recommended as the first-line treatment for eligible ischemic stroke cases. Instead, all patients received antiplatelet therapy, predominantly clopidogrel (52.3%). The most commonly prescribed antihypertensive agent was an angiotensin receptor blocker (52.2%), while atorvastatin (43.2%) was the most frequent lipid-lowering agent. Overall, most prescribed therapies were consistent with guideline recommendations, although individualised considerations, such as delayed presentation, contraindications, and comorbidities, likely influenced therapeutic decisions.

Keywords: clinical outcomes; guideline adherence; ischemic stroke; prescribing; stroke

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INTRODUCTION

Stroke management requires a comprehensive approach to ensure that treatment addresses both the acute event and underlying comorbidities and risk factors. Adherence to clinical guidelines is essential to optimize outcomes in ischemic stroke patients. This cross-sectional study was conducted from January 2021 to January 2022 using medical record data. Based on sample size calculation, a minimum of 97 patients was required, and data from 111 patients were included. The majority were female (54.1%) with a mean age of 62.11 years. None of the patients received fibrinolytic therapy, although it is recommended as the first-line treatment for eligible ischemic stroke cases. Instead, all patients received antiplatelet therapy, predominantly clopidogrel (52.3%). The most commonly prescribed antihypertensive agent was an angiotensin receptor blocker (52.2%), while atorvastatin (43.2%) was the most frequent lipid-lowering agent. Overall, most prescribed therapies were consistent with guideline recommendations, although individualised considerations, such as delayed presentation, contraindications, and comorbidities, likely influenced therapeutic decisions.

Stroke remains one of the leading non-communicable diseases causing death worldwide, including in Indonesia. Beyond its high mortality rate, stroke is also a major cause of long-term disability, imposing significant health and socioeconomic burdens. According to the American Heart Association/American Stroke Association (AHA/ASA), the global prevalence of stroke continues to rise markedly. Indeed, between 1990 and 2021, the absolute number of incident strokes increased by about 70 %, stroke-related deaths rose by 44 %, and prevalent stroke cases grew by 86 %, while disability-adjusted life-years (DALYs) lost to stroke increased by 32 % (Feigin et al., 2025). Globally, almost 94 million people are living who have experienced a stroke, and stroke now accounts for over 7 million deaths annually, with the highest burden falling on low- and lower-middle-income countries (Martin et al., 2024), making it an urgent medical condition that requires precise and timely management.

The primary goal of stroke management is to reduce mortality and disability while preserving neurological function and improving patients' quality of life by minimizing brain injury (WHO, 2016). From a pathophysiological standpoint, stroke often develops as a consequence of multiple underlying conditions or comorbidities, such as hypertension, diabetes, dyslipidemia, and atrial fibrillation (Ruksakulpiwat et al., 2023). Therefore, effective stroke management necessitates a comprehensive and individualized approach that addresses both the acute neurological event and the associated comorbid risk factors (Salehi et al., 2024).

Stroke therapy can be broadly divided into acute-phase and maintenance-phase treatment. Acute-phase therapy is critical for limiting the extent of ischemic brain damage, while maintenance therapy focuses on long-term control of comorbidities and prevention of stroke recurrence (Hui et al., 2025). Currently, the most widely recognized evidence-based stroke management guidelines include those from the AHA/ASA, the European Stroke Organization (ESO), and the Indonesian Stroke Clinical Practice Guideline (PNPK). Adherence to these guidelines is essential to ensure optimal outcomes for ischemic stroke patients. Therefore, increasing awareness among prescribing physicians regarding the importance of guideline-based therapy is crucial to improving patient prognosis.

This study aims to evaluate the pharmacological management of ischemic stroke patients in a hospital setting and assess its adherence to established clinical guidelines or clinical pathways, which serve as the ideal standards for stroke management in current

literature. Although many studies describe prescribing patterns in ischemic stroke, limited evidence exists on how well real-world pharmacological management aligns with guideline recommendations and the clinical rationale behind deviations. Most previous studies have focused on the frequency of medication use without evaluating the appropriateness of prescribing, barriers to guideline implementation, or patient clinical characteristics that influence therapeutic decisions. Additionally, a few analyses link real-world prescribing to evidence-based standards such as AHA/ASA, ESO, or PNPK guidelines. This evidence creates a gap in understanding how closely inpatient stroke management aligns with recommended best practices in Indonesia.

METHODS

Data collection

This observational study was conducted from January 2021 – January 2022 at RSUP dr. Sardjito, Yogyakarta. The study was conducted using medical records as a data source, we included adult patients (> 18 years old) diagnosed with ischemic stroke. Subjects would be excluded if they had a length of stay of less than 2 days or had incompletion of medical records. The required number of patients was calculated with a confidence interval of 95%, proportion of 50%, and absolute precision of 10%, resulted in minimum number of included patients were 97. This study screened 200 inpatient stroke's data, 89 data were excluded for incomplete medical record, and this study used data from 111 patients.

Data analysis

Continuous variables were summarized using mean and standard deviation, while categorical variables were described by percentages.

Ethical statement

This study was approved by the Medical and Health Research Ethics Committee (MHREC) on September 16th, 2021 (Approval reference number: KE/FK/1030/EC/2021) and conducted by following the Declaration of Helsinki and the Good Clinical Practice guidelines.

RESULT AND DISCUSSION

The descriptive analysis presented in Table 1 indicates that among the 111 samples, 60 patients (54.1%) were female, while 51 patients (45.9%) were male. Although research suggests that ischemic stroke is more prevalent in geriatric patients (>60 years), this study found a relatively equal distribution between geriatric (n=66) and non-geriatric (n=45) patients. The number of geriatric and non-geriatric patients was relatively the same, with 66 and 45 patients, respectively. The most common comorbidities observed were hypertension in 66.7% of patients (n = 74), diabetes mellitus in 37.8% (n = 42), and dyslipidemia in 38.7% (n = 43) (Rajati et al., 2023). NIHSS data were collected for all patients to classify stroke severity and to assess the potential need for fibrinolytic therapy. In this study, 43.2% of patients presented with a moderate stroke (NIHSS 5–15), 28.8% with a minor stroke (NIHSS <5), 19.8% with a severe stroke (NIHSS >20), and 8.1% with a moderately severe stroke (NIHSS 16–20). These findings indicate that the majority of patients had moderate neurological impairment upon admission, which suggests a relatively high proportion of patients were still eligible for reperfusion therapy if presented within the therapeutic window.

Table 1. Demographic characteristics of hospitalized ischemic stroke patients

Demographic Characteristics	Numbers (n=111)
Age	62.11 ± 14.048 (29-92)
> 60 years old	66 (59.5)
≤ 60 years old	45 (40.5)
Gender	
Female	60 (54.1)
Male	51 (45.9)
Comorbidity	
Diabetes mellitus	42 (37.8)
Dyslipidemia	43 (38.7)
Hypertension	74 (66.7)
National Institute of Health Stroke Scale (NIHSS) Score	32 (28.8)
Minor (< 5)	48 (43.2)
Moderate (5 – 15)	9 (8.1)
Moderate Severe (16 – 20)	22 (19.8)
Severe (> 20)	

Variables are presented as n (%) for nominal data; mean ± standard deviation (minimum value – maximum value)

This distribution aligns with previous studies, which report that most ischemic stroke patients admitted to hospitals fall within the mild-to-moderate NIHSS category, as seen in research by Salehi et al. (2024) and Makharia et al. (2024), where moderate severity was the most common presentation. Moderate NIHSS scores are often associated with a favourable prognosis when timely and appropriate pharmacologic management is provided. Conversely, severe stroke (NIHSS >20) is commonly related to larger infarct volumes and poorer outcomes, including increased mortality and disability (Panthi et al., 2025; Zhang et al., 2024). The predominance of moderate cases in this study may also reflect improved public awareness and earlier hospital arrival times, which could positively influence functional recovery.

Fibrinolytic

According to the guidelines, fibrinolytic therapy is recommended for patients who meet the inclusion criteria and have no contraindications. The preferred fibrinolytic agent for ischemic stroke treatment is intravenous (IV) alteplase, administered at a dose of 0.9 mg/kg (maximum 90 mg), with 10% given as an initial bolus and the remainder infused over 60 minutes. Eligible patients are those diagnosed with acute ischemic stroke causing measurable neurological deficits, aged ≥18 years, and who can receive treatment within 4.5 hours of symptom onset. Primary exclusion criteria include intracranial hemorrhage on imaging, recent major surgery or trauma, uncontrolled hypertension (systolic >185 mmHg or diastolic >110 mmHg), active internal bleeding, platelet count <100,000/mm^3, or blood glucose <50 mg/dL or >400 mg/dL (Berge et al., 2021; Kemenkes, 2019; Powers et al., 2019). However, in this study, no patients received fibrinolytic therapy for acute ischemic stroke. One possible reason for this is that the optimal time window for administering IV alteplase had already passed. The classification of patient ineligibility is presented in Table 2.

Table *2*. In-eligibility of fibrinolytic administration in ischemic stroke patients

Criteria for in-eligibity	Number (n=111)	Percentage (%)
Onset		
Golden hour (within 4.5 hours onset)	15	13.5%
> 4.5 hours *onset*	96	86.5%
Age		
> 80 years old	12	10.8%
Clinical history		
Diabetes mellitus	42	37.8%
Stroke	8	7.2%
NIHSS > 25	16	14.4%
History of oral anticoagulant	21	18.9%

As shown in Table 2, the majority of patients (86.5%) had exceeded the therapeutic window, also known as the "golden hour," for intravenous (IV) alteplase administration. According to the American Heart Association/American Stroke Association (AHA/ASA) guidelines, the benefit of IV alteplase in ischemic stroke is highly time dependent, and treatment should be initiated as early as possible. The recommended administration window is within 3 to 4.5 hours of symptom onset (Berge et al., 2021; Kemenkes, 2019; Powers et al., 2019). The narrow therapeutic window represents one of the main reasons many patients are unable to receive alteplase as first-line therapy, particularly in Indonesia, where access to acute stroke care remains limited and public awareness of stroke symptoms is relatively low. Previous studies have shown that most high-risk individuals in Indonesia demonstrate poor stroke prevention behaviour and limited recognition of stroke warning signs (Laksono et al., 2023; Setyopranoto et al., 2022).

According to AHA/ASA recommendations, IV alteplase may be administered within 3–4.5 hours only in patients aged ≤80 years who do not have a history of both diabetes mellitus and prior stroke, have an NIHSS score ≤25, and are not taking oral anticoagulants. In this study, 12% of patients were aged >80 years, 37.8% had diabetes mellitus, 7.2% had a prior stroke, 14.4% had NIHSS scores >25, and 18.9% were using oral anticoagulants. These clinical characteristics likely contributed to the non-administration of IV alteplase in acute ischemic stroke patients. Furthermore, this study did not assess the extent of ischemic injury, which is another important factor, as IV alteplase is not recommended in patients with evidence of infarction involving more than one-third of the middle cerebral artery (MCA) territory (Powers et al., 2019).

Upon further analysis, among the 15 patients (13.5%) who did not receive IV alteplase, specific contraindications or clinical conditions were identified that precluded its use. Details of these individual cases are presented in Table 3.

Antiplatelet

Table 4 presents the prescribing patterns of antiplatelet agents among ischemic stroke patients. As shown, patients received either antiplatelet monotherapy or dual antiplatelet therapy (DAPT). According to current ischemic stroke management guidelines, antiplatelet therapy is recommended for all patients without contraindications and should be initiated within 24–48 hours after stroke onset. For patients with minor stroke, defined as an NIHSS score ≤3 According to the ESO and AHA/ASA guidelines (Dawson et al., 2021; Powers et al., 2019; Wang et al., 2019), or ≤4 based on the Indonesian Stroke Clinical

Practice Guideline (Kemenkes, 2019), the use of DAPT, which combines aspirin and clopidogrel, is specifically recommended.

Table 3. Conditions that do not support iv alteplase recommendations

Patient Number	Age	Conditions That Do Not Support IV Alteplase Recommendations
14	58	Patient with recurrence stroke with NIHSS 29
20	44	Patient with recurrence stroke and on oral anticoagulant Warfarin
24	81	Patient's age > 80 years old
36	65	Patient with diabetes mellitus
44	80	Patient on oral anticoagulant Warfarin
54	70	Patient with recurrence stroke and diabetes mellitus
56	47	Patient with diabetes mellitus
63	44	Patient with diabetes mellitus
69	34	Patient on oral anticoagulant Warfarin
76	67	Patient with diabetes mellitus
80	52	Patient with diabetes mellitus with NIHSS 32
82	39	Patient with recurrence stroke and on oral anticoagulant Warfarin
84	44	Patient with recurrence stroke and on oral anticoagulant Warfarin
94	65	Patient with diabetes mellitus
97	74	Patient on oral anticoagulant Warfarin

Table 4. Patterns of Antiplatelet Use in Ischemic Stroke Patients

Antiplatelet	Number (n=111)	Percentage (%)
Not using antiplatelet	16	14.4
Clopidogrel monotherapy	58	52.3
Aspirin monotherapy	17	15.3
Dual antiplatelet (Aspirin + Clopidogrel)	17	15.3
Cilostazol	3	2.7

In this study, clopidogrel monotherapy was the most frequently prescribed regimen (52.3%), followed by aspirin monotherapy (15.3%), DAPT (15.3%), and cilostazol (2.7%). Previous research reported a different pattern, with DAPT dominating (65.38%), followed by aspirin monotherapy (30.76%) and clopidogrel monotherapy (3.84%) (Megawati et al., 2021). Systematic reviews and meta-analyses also indicate that aspirin monotherapy remains the most commonly used antiplatelet regimen in ischemic stroke patients globally (Del Giovane et al., 2021).

The variation observed in this study may be influenced by differences in stroke severity among the patients. In this cohort, only 32 patients (28.8%) experienced minor stroke (NIHSS <5), and because DAPT is generally recommended only for this subgroup, the overall proportion of DAPT use was lower. The comparable efficacy and safety profiles of aspirin and clopidogrel in preventing recurrent ischemic stroke may also contribute to the preference for either monotherapy. Systematic reviews have shown no significant

difference between the two agents in terms of preventing stroke recurrence and reducing bleeding risk (Qin et al., 2020).

In this study, cilostazol was prescribed to patients who developed melena while previously receiving antiplatelet or anticoagulant therapy with aspirin or clopidogrel. The substitution with cilostazol is supported by meta-analyses showing that cilostazol not only reduces the incidence of recurrent ischemic stroke compared with aspirin but also lowers the risk of bleeding complications (Chai et al., 2022; Lin et al., 2021; Qin et al., 2020).

Antihypertensive

Table 5 presents the pattern of antihypertensive use among ischemic stroke patients. The most commonly prescribed agents were angiotensin II receptor blockers (ARBs) (52.2%), followed by calcium channel blockers (CCBs) (35.1%), beta-blockers (22.5%), diuretics (14.4%), and angiotensin-converting enzyme inhibitors (ACEIs) (3.6%).

Table 5. Patterns of Antihypertensive Use in Ischemic Stroke Patients

Antihypertensive agent	Number (n=111)	Percentage (%)
ARB	**58**	**52.2**
Valsartan	16	14.4
Candesartan	36	32.4
Irbesartan	5	4.5
Telmisartan	1	0.9
ACEI	**4**	**3.6**
Ramipril	2	1.8
Captopril	2	1.8
CCB	**39**	**35.1**
Amlodipine	36	32.4
Nicardipine	2	1.8
Nifedipine	1	0.9
Beta-blocker	**25**	**22.5**
Bisoprolol	20	18
Metoprolol	1	0,9
Propranolol	2	1.8
Carvedilol	2	1.8
Diuretik	**16**	**14.4**
Furosemide	12	10.8
Spironolactone	2	1.8
HCT	2	1.8
Alfa-2-agonis	**1**	**0.9**
Clonidine	1	0.9

These findings are consistent with several studies reporting that agents targeting the renin–angiotensin–aldosterone system (RAAS) and CCBs are the most frequently used antihypertensive classes in ischemic stroke patients. Hwong et al. (2016) found that most ischemic stroke patients received RAAS inhibitors, including ACEIs and ARBs, while Widayanti (2016) reported that CCBs were the most frequently prescribed. Both classes are strongly supported by current guidelines and literature as preferred options for blood pressure control in stroke patients. The use of CCBs has been associated with a reduced risk of mortality and dependency, whereas RAAS inhibitors have been linked to a lower risk of death (Heeley et al., 2014; Hwong et al., 2016). Furthermore, a meta-analysis

demonstrated that CCBs can reduce the incidence of stroke by 30%, while ACEIs and ARBs achieve an 18% reduction, highlighting the importance of these classes in secondary stroke prevention (Zhong et al., 2021).

In this study, additional antihypertensive agents were utilized based on clinical indications. Beta-blockers were administered for rate control in patients with atrial fibrillation or for the management of heart failure, in accordance with the recommendations of the European Society of Cardiology (ESC) and the American Heart Association (AHA) (Hindricks et al., 2021; Ponikowski et al., 2016; Unger et al., 2020). Diuretics were prescribed for patients with comorbid congestive heart failure or kidney failure (Cheung et al., 2021; Mancia et al., 2018; Ponikowski et al., 2016; Unger et al., 2020). Clonidine was used in cases of resistant hypertension (Mancia et al., 2018; Unger et al., 2020).

Anticholesterolemic

Table 6 presents the pattern of lipid-lowering agent use among hospitalized ischemic stroke patients. The most frequently prescribed agent was atorvastatin (48%). Previous studies have shown that statin therapy is associated with a significant reduction in mortality among ischemic stroke patients, with high-intensity regimens such as atorvastatin 80 mg/day and simvastatin 40 mg/day providing the most significant benefit compared to other statin regimens (Tramacere et al., 2019).

Table 6. Patterns of Anti-cholesterol Use in Ischemic Stroke Patients

Anti-cholesterol	Number (n=111)	Percentage (%)
Not using anti-cholesterol	50	45
Atorvastatin	48	43.2
Simvastatin	5	4.5
Rosuvastatin	3	2.7
Fenofibrate	3	2.7
Gemfibrozil	2	1.8

According to current ischemic stroke management guidelines, patients are recommended to receive high-intensity statin therapy if tolerated. In this study, not all patients received high-intensity statins, likely due to the predominance of geriatric patients, in whom treatment is commonly initiated with moderate-intensity statins in accordance with AHA/ASA recommendations (Powers et al., 2019).

Fibrate therapy, including fenofibrate and gemfibrozil, was prescribed for patients with hypertriglyceridemia (>500 mg/dL). This practice aligns with the recommendations of the Indonesian Society of Endocrinology (PERKENI), which supports the use of fibrates as first-line therapy for patients with triglyceride levels exceeding 500 mg/dL(PERKENI, 2019).

CONCLUSION

This study found that although fibrinolytics are the first-line therapy for acute ischemic stroke, none of the patients received fibrinolytic treatment. In contrast, the use of antihypertensive, cholesterol-lowering, and antiplatelet agents was largely in accordance

with applicable guidelines. This finding highlights the numerous considerations involved in patient therapy to ensure that patients receive treatments where the benefits outweigh the risks.

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None.

AUTHOR CONTRIBUTION

FAW: Concepts or ideas; design; definition of intellectual content; literature search; experimental studies; data analysis; manuscript preparation.
YDK: definition of intellectual content; literature search; experimental studies; data analysis.
AF: literature search.
KAC: literature search.

ETHICS APPROVAL

This study was approved by the Medical and Health Research Ethics Committee (MHREC) on September 16th, 2021 (Approval reference number: KE/FK/1030/EC/2021)

CONFLICT OF INTEREST

None to declare.

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