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Cost-Effectiveness of Antihypertensive Therapy in Ischemic Stroke Patients

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Abstract . Ischemic stroke is an acute condition caused by the interruption of blood flow to the brain due to blood vessel obstruction, which can lead to permanent disability and death. Hypertension is a major risk factor and the most common comorbidity in ischemic stroke patients. The use of antihypertensive therapy in stroke patients plays a crucial role in controlling blood pressure and preventing complications, but it also increases the burden of medical costs. Therefore, a pharmacoeconomic evaluation is necessary to assess the cost-effectiveness of the therapy. This study aims to analyze patient characteristics and evaluate the cost-effectiveness of oral antihypertensive therapy in ischemic stroke patients at Hospital "X" from September 2024 to August 2025. The method used was Cost-Effectiveness Analysis (CEA) with the Average Cost-Effectiveness Ratio (ACER), in which the therapy with the lowest ACER is considered the most cost-effective. The results showed that the majority of patients were male (32 patients), and the largest age group was elderly aged 56–65 years (23 patients), with an average length of stay of 4.63 days. As a single therapy, calcium channel blockers (CCBs) demonstrated the lowest ACER value of Rp34,013.77, making them the most cost-effective therapy. In combination therapy, the combination of CCBs and beta-blockers had the lowest ACER value (Rp29,766.44). These results indicate that selecting the right antihypertensive therapy can improve cost efficiency and support more rational healthcare delivery.

Keywords: Ischemic stroke, antihypertensives, Cost-Effectiveness Analysis, Average Cost-Effectiveness Ratio, Calcium Channel Blockers

INTRODUCTION

Ischemic stroke is a condition characterized by a sudden loss of blood flow to the brain, spinal cord, and retina, resulting in loss of neurological function with symptoms lasting more than 24 hours. This is caused by

a blockage or narrowing of a blood vessel caused by thrombosis or embolism (1). Discusses research findings showing that in the productive age group, people with hypertension are 45 times more likely to develop stroke than those without hypertension (2). Hypertension is a condition in which blood pressure readings are≥ 140/90 mmHg (3).

Research by Alfisah et al. comparing Candesartan 8 mg, Nifedipine 10 mg, Amlodipine 10 mg, Candesartan 16 mg, Bisoprolol 2.5 mg, Propranolol 10 mg, Lisinopril 10 mg, and Ramipril 2.5 mg found that propranolol 10 mg therapy was the most cost-effective therapy with the lowest ACER value of Rp 4,020,000 (4).

Antihypertensive therapy for stroke patients will undoubtedly increase the cost of treatment. The wide range of antihypertensive medication prices makes it crucial to choose a hypertension therapy that is both cost-effective and effective (5).

Patients with hypertension undergo lifelong therapy to control their blood pressure. Antihypertensive therapy for stroke patients undoubtedly increases the cost of treatment (6). Therefore, a pharmacoeconomic study using the Cost-Effectiveness Analysis (CEA) method is needed. This is a pharmacoeconomic analysis method used to determine the most effective intervention by comparing outcomes with costs (7). The goal is to choose more effective therapies at lower costs.

This study aims to analyze the characteristics of ischemic stroke patients who received oral antihypertensive therapy at Hospital X from September 2024 to August 2025, calculate the average cost of the oral antihypertensive therapies used, and determine the most cost-effective type of oral antihypertensive therapy for ischemic stroke patients in the study period and location.

METHODS

The research objective was to determine the direct medical costs of oral antihypertensive therapy for ischemic stroke patients in the inpatient unit of Hospital X from September 2024 to August 2025.

The sample in this study was ischemic stroke patients receiving oral antihypertensive therapy in the inpatient unit of Hospital X from September 2024 to August 2025. The study population consisted of 365 patients, and, based on the inclusion criteria, a sample of 49 patients (51 cases) was obtained (two patients had 2 visits during the study period).

The inclusion criteria for this study were patients who were hospitalized and patients diagnosed with ischemic stroke and receiving oral antihypertensive therapy, and receiving BPJS class 3 service status. The data collection technique is carried out retrospectively, namely, collecting past data from medical records and patient financial data (8).

This research has received ethical approval from the ethics committee of the Semarang Pharmacy Foundation College of Pharmacy with number: 821/EVM-NA/KEPK/STIFAR/EC/XI/2025.

The collected data included patient identification and direct medical cost data. These data were then analyzed using the Average Cost-Effectiveness Ratio (ACER) and the Incremental Cost-Effectiveness Ratio (ICER). The lower the ACER, the more cost-effective the therapy. The ICER was calculated only when the therapy had a higher cost and high effectiveness, or a lower cost and low effectiveness.

RESULT

Table 1. Characteristics Of The Respondent

Variable	Category	Frequency (n)	Percentage (%)
Sex	Male	32	65.31
	Female	17	34.69
Age group (years)	25–35	1	2.04
	36–45	3	6.12
	46–55	12	24.49
	56-65	23	46.94
	>65	10	20.41

Table 2. Average Total Treatment Costs, Number of Cases, and ACER of Oral Antihypertensive Drug Classes in Ischemic Stroke Patients at the Inpatient Unit of "X" Hospital, Semarang, September 2024 - August 2025

Antihypertensive Class Name	Total Maintenance Cost (Rp)	Number of Cases	Average Total Cost (Rp)	Number of Cases Meeting Target Blood Pressure	Effectiveness	ACER (Rp)
ARB	33.439.086	13	2.572.237,38	9	69,23%	37.154,95
CCB	17.007.227	7	2.429.603,86	5	71,43%	34.013,77
B-blocker	10.019.837	3	3.339.945,67	2	66,67%	50.096,68
CCB + ARB	45.918.939	16	2.869.933,69	9	56,25%	51.066,44
CCB + B-blocker	11.906.577	4	2.976.644,25	4	100,00%	29.766,44
CCB + ACE-I	23.631.805	8	2.953.975,63	3	37,50%	78.772,68

Table 3. Direct Medical Cost Components in Ischemic Stroke Patients Receiving Oral Antihypertensive Drugs in the Inpatient Unit of X Hospital, Semarang, September 2024-August 2025

Components	Total Cost (Rp)	Average Cost (Rp)	Percentage
Antihypertensive Costs	1.186.933,00	23.273,20	0,84%
Other Medication Costs	25.456.538,00	499.147,80	17,94%
Doctor Visit Fees	24.200.000,00	474.509,80	17,05%
Hospitalization Fees	57.645.000,00	1.130.294,12	40,62%
Laboratory Fees	33.435.000,00	655.588,24	23,56%
Total average cost	141.923.471,00	2.782.813,16	100,00%

DISCUSSION

This study was conducted to analyze the cost-effectiveness of antihypertensive drug therapy in ischemic stroke patients at the inpatient unit of X Hospital in Semarang City during the period September 2024 – August 2025. Patient characteristics based on age and gender are presented in Table 1. The study results, by gender, found that 32 patients were male, representing 65.31%. This is because men have slightly different lifestyles than women, which impact their health, such as smoking and alcohol consumption, which are risk factors for ischemic stroke (3). The study results, based on the age ranges established by the Ministry of Health (9), showed that the largest number of patients, by gender, were aged 56-65 years, with 23 patients (46.04%). This could be due to the decline in organ and tissue function with increasing age, which can reduce blood vessel elasticity, which can accelerate the process of atherosclerosis, which is one of the causes of stroke (10).

The assessment of the effectiveness of administering antihypertensives to ischemic stroke patients is the reduction in blood pressure from the time the patient is first admitted to the hospital until the patient goes home, and is seen in blood pressure measurements before the patient goes home or at night on the patient's last day of treatment, where it can be said to be effective if the blood pressure reaches the target, namely <150/90 mmHg (3).

Based on Table 2, the single antihypertensive drug class with the highest therapeutic effectiveness is CCB, with a therapeutic effectiveness of 71.43%. In accordance with research conducted by Siti et al. (11), which found that the CCB group is most often used in non-hemorrhagic stroke patients, compared with ARB and ACE-I, their study also found that CCB is more effective in preventing stroke than other antihypertensive classes. Furthermore, the combination group that has the highest therapeutic effectiveness is CCB + β-blocker, with a percentage of 100.00% (12).

Based on the data, the highest percentage of cost components is hospitalization costs at 40.62%, totaling Rp 1,130,294. In ischemic stroke patients, treatment can include close observation, CT scans, regular neurological monitoring, anticoagulant/antiplatelet therapy monitoring, and physiotherapy (13). These factors can increase the length of hospitalization in ischemic stroke patients. The longer the hospitalization, the higher the cost.

Based on the length of hospitalization, the results of the study showed that ischemic stroke patients who received oral antihypertensive therapy received treatment for an average of 4.63 days (14). The longer the hospitalization, the greater the costs incurred, and the less optimal the therapeutic effectiveness. Based on average hospitalization length, CCB and CCB + beta-blocker therapy are more cost-effective than other therapies.

Based on Table 2, the lowest average treatment cost was observed in the CCB group, at Rp 2,429,603.86. Meanwhile, the results of the combination oral antihypertensive therapy study showed that the lowest average total cost was in the CCB + ARB group, at Rp 2,869,933.69.

Based on Table 2, CCBs are the most cost-effective single oral antihypertensive therapy, with the lowest ACER value (Rp 34,013.77) compared to other drug classes. This means that increasing the effectiveness of CCB therapy by 1% would cost Rp 34,013.77 (15).

Furthermore, in combination therapy, CCBs and beta-blockers are the most cost-effective oral antihypertensive therapy, with the lowest ACER value among drug classes at Rp 29,766.44. This means that increasing the effectiveness of CCB therapy by 1% would cost Rp 29,766.44.

In this study, an ICER (Incremental Cost-Effectiveness Ratio) calculation is required, as some therapy groups have high effectiveness at higher costs, according to the Ministry of Health 2013 Cost-Effective Grid. Based on the ICER calculation for CCB + beta blocker therapy compared to CCB + ARB therapy, increasing the effectiveness of CCB + ARB therapy by 1% over CCB + beta blocker therapy requires an additional cost of IDR 2,436.31. Meanwhile, for CCB + beta blocker therapy compared to CCB + ACE-I therapy, increasing the effectiveness of CCB + beta blocker therapy by 1% requires an additional cost of IDR 362.70.

CONCLUSION

The characteristics of 49 ischemic stroke patients receiving oral antihypertensive therapy were most pronounced: 32 (65.31%) were male, 23 (46.94%) were aged 56-65 years, and the average length of stay was 4.63 days. The most frequently used oral antihypertensive medications were ARBs (25.00%) and CCBs + ARBs (30.77%).

The average cost of oral antihypertensive therapy in ischemic stroke patients was Rp 2,782,813. The lowest average cost was found for CCB monotherapy (Rp 2,429,603.86) and CCB + ARB combination therapy (Rp 2,869,933.69).

The results of the cost-effectiveness analysis using the ACER method showed that the single cost-effective oral antihypertensive therapy was the CCB group with an ACER value of Rp 34,013.77. Meanwhile, in the combination group, the most cost-effective therapy was the CCB + beta-blocker group with an ACER value of Rp 29,766.44. The ICER value of CCB + beta blocker therapy compared to CCB + ARB was Rp 2,436.31, and CCB + beta blocker therapy compared to CCB + ACE-I was Rp 362.70.

For further research, other pharmacoeconomic analysis methods can be used over different periods to maintain the novelty of the research results.

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