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Analysis of Minimized Costs of Stroke Patient Therapy in the Inpatient Facility of A. Wahab Sjahranie Hospital, Samarinda

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ABSTRACT
Stroke is a catastrophic disease with a high cost burden. This study aims to analyze the lowest-cost therapy for ischemic stroke patients in the inpatient unit of Abdul Wahab Sjahranie Regional Hospital, Samarinda. The method used was descriptive-retrospective with pharmacoeconomic analysis of Cost Minimization Analysis. Patients were predominantly men aged 40–60 years with a length of stay of 1–5 days. Therapies used included antihypertensives, neuroprotectives, antihyperlipidemics, antidiabetics, and antiplatelets. CMA results showed the lowest cost for amlodipine, citicoline, simvastatin, and metformin, while clopidogrel was the only antiplatelet used. This study provides information on therapy costs that can support the efficiency of stroke treatment.

INTRODUCTION

Stroke is the leading cause of death worldwide, alongside cancer. In addition to changes in lifestyle, increased life expectancy, resulting in an increase in the elderly population, also contributes to the high incidence of stroke. Indonesia shows a trend of increasing stroke cases, both in terms of mortality, incidence, and disability. The stroke mortality rate by age is 26.8% in those aged 55-64, 23.5% in those aged 65 and over, and 15.9% in those aged 45-55. These data indicate that stroke currently affects not only the elderly but also those of productive age. According to various hospital reports, 80% of acute cerebrovascular accidents are ischemic strokes, with the remainder being - hemorrhagic strokes. Various risk factors are associated with stroke, including diabetes mellitus, hypertension, heart disease, dyslipidemia, and hypercoagulability [15].

The drug therapy guidelines for ischemic stroke patients include antihypertensives, treatment for hypoglycemia or hyperglycemia, thrombolysis, anticoagulants, antiplatelets, and neuroprotectants. Citicoline is a commonly used neuroprotectant. Improvement in neurological function in ischemic stroke patients can be detected based on a patient assessment conducted upon hospital admission within 24 hours [20].

The varying guidelines for stroke treatment result in varying costs for stroke patients and their insurance providers. Inappropriate medication selection can lead to longer hospital stays, potentially leading to other complications and ultimately increasing treatment costs. The use of a drug in the treatment of a disease requires consideration of not only effectiveness but also safety and pharmacoeconomic aspects.

Therefore, a health economic analysis study was conducted, which is called cost minimization analysis, or Cost Minimization Analysis (CMA), which is a health economic analysis technique for comparing two or more drug options that provide equivalent health results [12].

Pharmacoeconomic research is the process of identifying, measuring, and comparing the costs, risks, and benefits of programs, services, or therapies and determining which alternatives produce the best health care outcomes for the investment of resources. This information can assist clinical decision-makers in selecting the most effective and economical health care options [22].

LITERATURE REVIEW

Stroke is a rapidly developing neurological syndrome characterized by focal or global disturbances of brain function lasting more than 24 hours, unless specific medical intervention is provided, and is generally caused by vascular factors [4]. Epidemiological literature shows that men have a higher prevalence of stroke than women, while the incidence increases with age due to the process of atherosclerosis and physiological changes in blood vessels [2]. In addition, the increased risk in older age is explained by pathophysiological mechanisms such as vascular stiffness, chronic hypertension, and decreased blood vessel elasticity [4]. Thus, previous theories and research findings consistently confirm that age and gender are important determinants in the epidemiology of ischemic stroke.

Variations in stroke therapy guidelines also impact differences in treatment costs. Inaccurate therapy selection can prolong hospitalization and increase the risk of complications, thereby increasing the burden of treatment costs. PERDOSSI (2011) explains that pharmacological therapy in stroke patients includes: (1) antihypertensives, to maintain blood pressure stability and prevent the spread of cerebral damage; (2) neuroprotectors such as citicoline, which plays a role in repairing nerve cell membranes; (3) antihyperlipids such as statins, which have been shown to reduce the risk of recurrent vascular events; (4) antidiabetics, where sulfonylureas rapidly lower blood glucose, while metformin increases insulin sensitivity, so both play a role in preventing and inhibiting the progression of ischemic stroke; and (5) antiplatelets such as clopidogrel, which is the standard therapy to prevent platelet aggregation and cerebral artery occlusion [16]. This variety of therapies demonstrates the complexity of clinical decisions that also impacts variations in treatment costs.

In the context of pharmacoeconomics, the Ministry of Health (2013) emphasizes the importance of optimizing resources to ensure that the therapy provided remains effective and efficient for both healthcare facilities and patients [12]. Cost Minimization Analysis (CMA) is used when two therapies have equivalent clinical effectiveness so that the total direct and indirect treatment costs become the primary basis for selection [2]. This principle aligns with the goal of pharmacoeconomic analysis to ensure that drug choices provide optimal clinical outcomes with minimal economic burden. Overall, the literature demonstrates a strong association between research findings and patient epidemiology, pharmacological therapy patterns, and pharmacoeconomic approaches like CMA.

METHODOLOGY

Research Methods and Types

This study is a non-experimental study with a descriptive design method from retrospective data sourced from patient medical records and details of the costs of therapy for ischemic stroke patients from the finance department at the Inpatient Installation of Abdul Wahab Sjahranie Hospital, Samarinda.

Population and Sample

The study population was inpatients with stroke at Abdul Wahab Sjahranie Regional General Hospital in Samarinda.

1. The inclusion criteria for this study were ischemic stroke patients from January to December 2021; independent patients not receiving health insurance or other health insurance.
2. The exclusion criteria for this study were ischemic stroke patients with incomplete medical records.

Data Retrieval

The data sources used are data collected from the medical records of ischemic stroke patients at the Inpatient Installation of Abdul Wahab Sjahranie Hospital, Samarinda, in the form of name, gender, age, occupation, and drug use

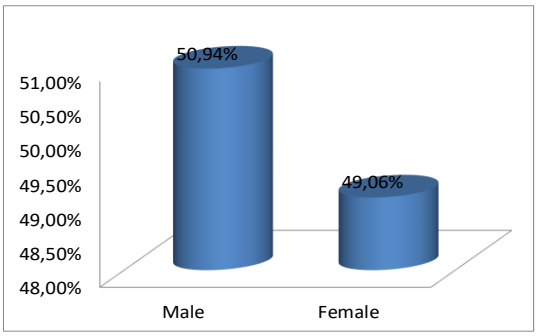
in patients from January to December 2021 and patient treatment costs from the finance department.

Data Analysis

CMA is an analytical technique for comparing two or more options that provide equivalent health outcomes. The CMA formula is :

Direct Cost + Indirect Cost

RESULTS AND DISCUSSION



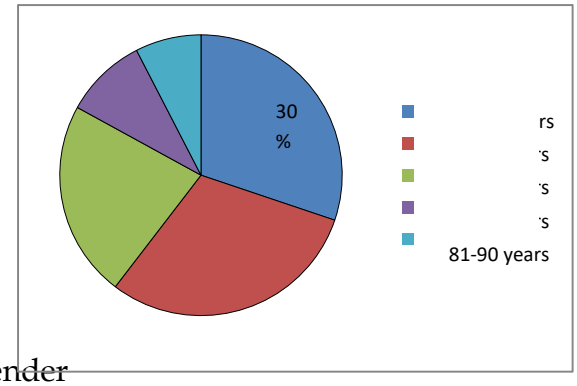


Figure 1. Patient Characteristics Based on Gender

Figure 2. Patient Characteristics Based on Age

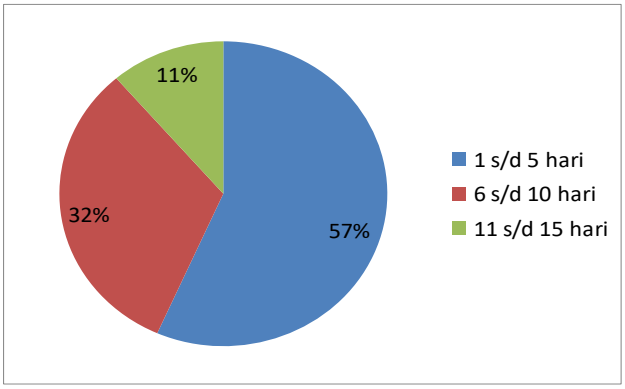


Figure 3. Patient Characteristics Based on Length of Hospitalizatio

Based on figure 1 shows that men suffer from stroke more often than women. This study's results align with those of Andersen et al. (2010), which found that stroke prevalence is higher in men than in women. Men are at higher risk of stroke than women, but women who suffer strokes are more likely to die [11].

According to Sitorus et al. (2008), gender has been shown to have no significant relationship with stroke incidence, but there is no significant difference between men and women in old age. Risk factors associated with the female gender increase during the menopausal transition. During this transition, estrogen concentrations decrease by 60%, causing a decrease in LDL (low-density lipoprotein) catabolism and hepatic HDL (high-density lipoprotein) uptake, which increases the risk of atherosclerosis. Furthermore, low physical activity can make women more susceptible to stroke [2] [21].

Based on figure 2 shows that the highest percentage of ischemic stroke patients, based on age, is in the 40-60 age group, which is considered a productive age group. The risk of stroke begins at age 35, and the risk increases with each

ten-year increase in age. The risk of stroke doubles after age 55. The incidence of stroke increases with age due to decreased arterial elasticity, which causes blood vessels to gradually narrow and stiffen [10].

Based on figure 3 shows that the longest hospital stay was 1-5 days. There were significant differences in length of stay between each group (1-5 days, 6-10 days, and 11-15 days) in ischemic stroke patients. The results of this study on ischemic stroke patients are similar to those of Guijing et al. (2015) where length of stay significantly differed, with the longer the stay, the higher the cost [6].

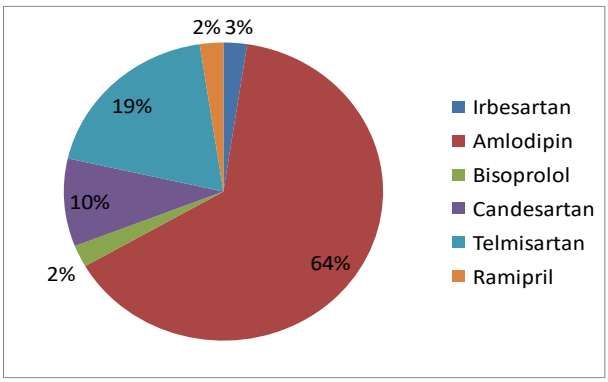


Figure 4. The most widely used antihypertensive in ischemic stroke patients

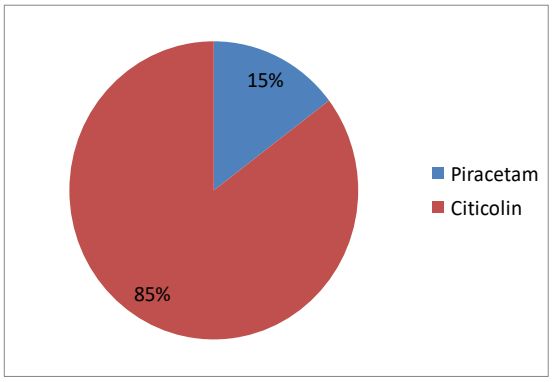


Figure 5. The most widely used neuroprotector in ischemic stroke patients

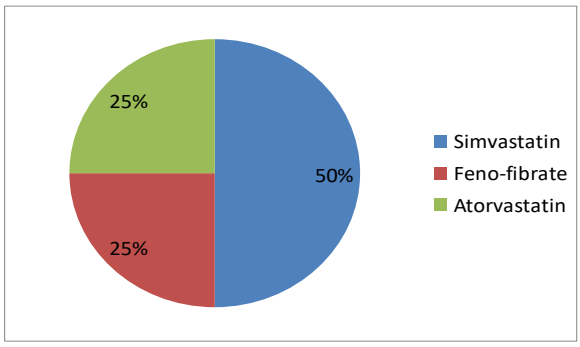


Figure 6. The most widely used antihyperlipid in ischemic stroke patients

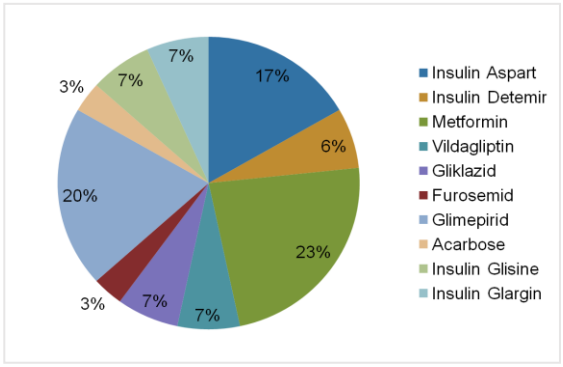


Figure 7. The most widely used antidiabetic in ischemic stroke patients

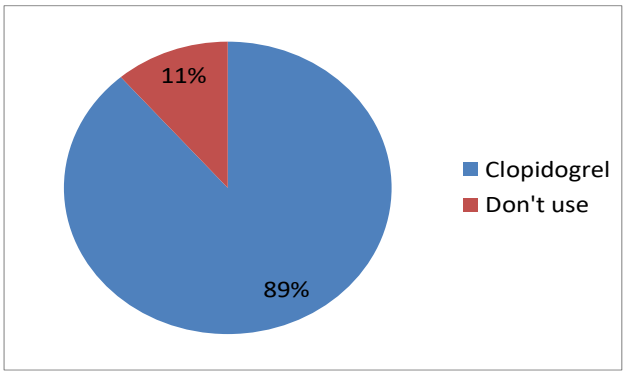


Figure 8. The most widely used antiplatelet in ischemic stroke patients

Based on drug use in ischemic stroke patients at AWS Samarinda Regional Hospital from January to December 2021, Figure 4 shows that the use of amlodipine with a percentage of 69% (27 patients) and telmisartan with a

percentage of 19% (8 patients) was the most frequently prescribed antihypertensive drug class for stroke patients, which is the calcium channel blocker class. Amlodipine is the drug most often chosen as therapy for ischemic stroke patients compared to other drugs. This calcium channel blocker drug is given either as monotherapy or in combination therapy via the oral route. Amlodipine is included in the antihypertensive drugs recommended by PERDOSSI in the management of hypertension in ischemic stroke patients [14][16].

These drugs are known to provide a protective effect for stroke patients by inhibiting calcium influx, resulting in muscle relaxation. Furthermore, they are effective therapeutic agents in reducing systolic and diastolic blood pressure compared to other antihypertensives in stroke patients [8] [9].

Based on figure 5 shows that the use of citicoline was 85% (29 patients) and piracetam was 15% (5 patients). The neuroprotective drugs recommended by PERDOSSI (2011) are citicoline, piracetam, nicergoline, naftidrofuril, nimodipine, and neuropeptides. Citicoline, as a neuroprotectant in neurons, repairs cell membranes by increasing the synthesis of phosphatidylcholine, a major component of cell membranes, especially in the brain. Increased phosphatidylcholine synthesis will improve cell membrane function, leading to cell repair. Citicoline can increase blood flow to the brain, increase oxygen consumption, and decrease vascular resistance. As a neuroprotectant, it has clinical evidence that it can improve functional outcomes and reduce neurological deficits [5].

Piracetam increases erythrocyte deformability, which is the elasticity and ability of red blood cells to pass through the microvasculature without changing shape and function. Increased erythrocyte deformability facilitates blood flow through small cerebral blood vessels, thereby improving ischemia. Piracetam's vascular effects can increase erythrocyte deformability, thereby increasing cerebral blood flow, reducing platelet hyperaggregation, and improving microcirculation. Piracetam administration should be monitored for patients with severe renal impairment (creatinine clearance <20 ml/min) [7] [17].

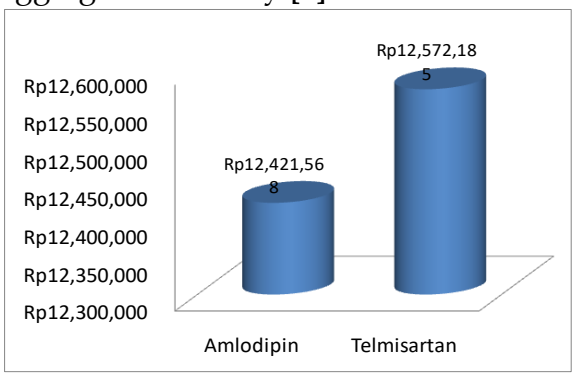
Based on figure 6 shows that simvastatin was used in 50% of patients (2), atorvastatin in 25% of patients (1), and fenofibrate in 25% of patients (1). The presence of dyslipidemia reduced the risk of poor clinical outcomes in stroke patients. This result differs from the study by Khalil et al. (2013), which found that dyslipidemia increased mortality. This difference may be due to the protective effect of statins on stroke risk in patients with dyslipidemia. Amarenco et al. (2006) explained from their research that administering 80 mg of simvastatin to patients with acute stroke or TIA reduced the incidence of stroke [1] [13].

Dyslipidemia is a protective predictor of poor clinical outcomes in ischemic stroke patients, thus reducing the incidence of adverse clinical outcomes in patients with statin use. Atrial fibrillation is another risk factor that worsens the clinical outcomes of stroke patients. Patients with atrial fibrillation have a threefold greater risk of ischemic stroke than those without atrial fibrillation. Atrial fibrillation worsens the condition of stroke patients because it increases the

risk of recurrence. Patients with atrial fibrillation have a twofold increased risk of death compared to those without atrial fibrillation [3] [18].

Based on figure 7 shows that metformin was used in 23% of patients (7 patients) and glimepiride in 20% of patients (6 patients). Treatment for stroke and diabetes mellitus patients is not significantly different from non-diabetic patients. The recommended blood sugar level is 80-140 mg/dL. Too low a blood sugar level is also undesirable because it can also cause decreased consciousness, while hyperglycemia will cause the formation of more lactic acid, which will damage brain tissue itself. High blood sugar levels will cause damage to large and peripheral blood vessels and will attract platelet aggregates, resulting in the formation of free radicals. Increasing free radicals will widen the patient's infarction [19].

Based on figure 8 shows that the percentage of clopidogrel use was 89% (47 patients). Antiplatelet is a drug used to inhibit platelet aggregation, thus inhibiting the formation of thrombi, which are often found in the arterial system. The antiplatelet drug commonly used in cases of ischemic stroke patients is clopidogrel to repair blood clots in areas of the brain that have experienced an infarction. Clopidogrel is a thienopyridine derivative, a prodrug whose active metabolite irreversibly binds to the adenosine diphosphate P2Y12 receptor found on the surface of platelets, thereby reducing platelet degranulation and aggregation activity [4].



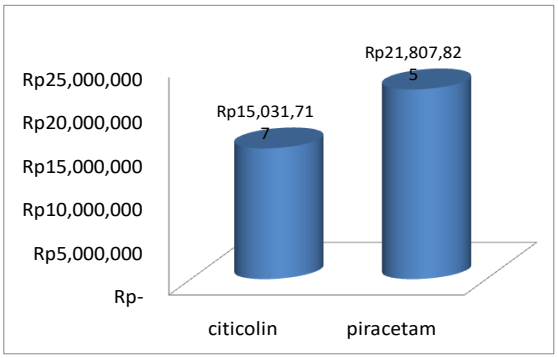
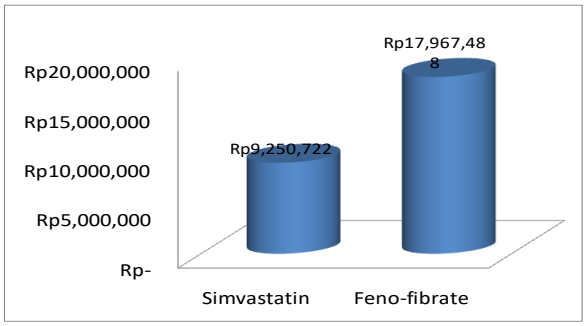


Figure 9. Antihypertensive in ischemic stroke patients at a lower cost

Figure 10. Neuroprotection in ischemic stroke patients at a lower cost



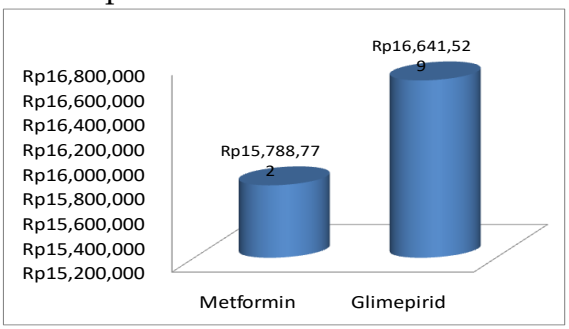


Figure 11. Antihyperlipid in ischemic stroke patients with minimal cost

Figure 12. Antidiabetic in ischemic stroke patients with minimal cost

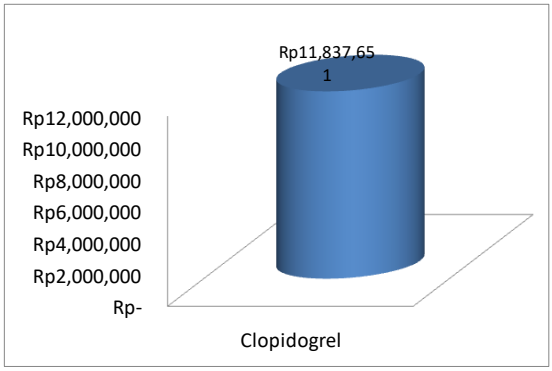


Figure 13. Antiplatelet in ischemic stroke patients with minimal cost

Pharmacoeconomic analysis of CMA is used to identify the most cost-minimizing treatment for ischemic stroke. Treatment selection is based on the two drugs with the highest percentage of use in each therapeutic category (e.g., amlodipine and telmisartan in the antihypertensive group). CMA determines direct and indirect costs. Total treatment costs are obtained by summing direct and indirect costs, then dividing by the number of patients receiving each drug to compare the lowest-cost drug. CMA studies are limited in their use because the outcomes of both treatment interventions must be equivalent. As long as the clinical outcomes of the strategies being compared are equivalent, these studies are highly effective.

The average cost per patient is calculated by adding up the costs of treatment, procedures, laboratory support costs, medication costs, room administration costs, and other costs (doctor visits, nursing insurance, doctor consultations, radiology, medical rehabilitation, and patient nutrition). This is then divided by the number of cases to obtain the average direct medical cost per patient. Based on figure 9 shows that the antihypertensive with the lowest cost is amlodipine, with an average total cost of Rp. 12,421,568 compared to telmisartan, which is Rp. 12,572,185. Although not significantly different, it was found that the laboratory support costs for patients in the telmisartan group were greater than those in the amlodipine group, where amlodipine cost Rp. 740,742.37, while telmisartan cost Rp. 809,458.25.

Based on figure 10 shows that the neuroprotector with the lowest cost is citicoline, with an average total cost of Rp. 15,031,717 compared to piracetam, which is Rp. 21,807,825. Similarly with figure 11 shows that the antihyperlipid with the lowest cost is simvastatin, with an average total cost of Rp. 9,250,722 compared to fenofibrate, which is Rp. 17,967,488. This is because the piracetam group had a longer hospitalization than the citicoline group. Similarly, the fenofibrate group had a longer hospitalization than the simvastatin group.

Length of hospitalization contributes to the increased cost of required procedures. This occurs because length of stay is closely related to the patient's current condition, which increases treatment costs. Increased morbidity increases the risk of death and length of stay. This phenomenon leads to higher costs for treatment, laboratory tests, and inpatient care. Therefore, the longer the hospitalization, the higher the costs.

Based on figure 12 shows that the antidiabetic with the lowest cost is metformin, with an average total cost of Rp. 15,788,772 compared to glimepiride, which is Rp. 16,641,529. Treatment costs are the costs incurred by patients for all medical procedures received since the diagnosis was established. The cost of metformin treatment is greater than the cost of glimepiride treatment, where the metformin group received Rp. 1,665,785 while the glimepiride group received Rp. 1,598,500. The price difference occurs because there were more procedures in the metformin group. Although the cost of metformin treatment was greater than the cost of glimepiride, this price difference did not significantly affect the total cost of antidiabetic therapy, so the metformin group remained more cost-minimizing than the glimepiride group.

Based on figure 13 shows that the only antiplatelet used was clopidogrel, with an average total cost of IDR 11,837,651. Researchers only obtained one drug group, clopidogrel, in the antiplatelet therapy class from the patient samples the researchers determined.

Based on the pharmacoeconomic analysis of CMA, this study demonstrates that selecting the right ischemic stroke therapy can provide cost efficiency without compromising clinical effectiveness. Comparison results across various therapy classes antihypertensives, neuroprotectives, antihyperlipidemics, and antidiabetics confirm that variations in total costs are primarily influenced by differences in length of hospital stay and the need for supportive medical interventions. Amlodipine, citicoline, simvastatin, and metformin were shown to provide lower total costs than their class-specific alternatives, thus potentially contributing to cost-minimizing therapeutic decisions. These findings confirm that as long as clinical outcomes across interventions remain equivalent, CMA is an effective approach to determining the most economical treatment option in the management of ischemic stroke.

CONCLUSION

Most ischemic stroke patients are male (50.94%), aged 40-60 years (60.37%), and hospitalizations last 1-5 days (56.60%).

The most commonly used medications in each therapeutic category are antihypertensives (amlodipine and telmisartan), neuroprotectives (citicoline and piracetam), antihyperlipidemics (simvastatin and fenofibrate), antidiabetics (metformin and glimepiride), and antiplatelet agents (clopidogrel).

Amlodipine is more cost-minimizing than telmisartan; citicoline is more cost-minimizing than piracetam; simvastatin is more cost-minimizing than fenofibrate; metformin is more cost-minimizing than glimepiride; and clopidogrel is the only antiplatelet agent used in ischemic stroke patients.

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