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EVALUATION OF RATIONAL USE OF AMLODIPINE AND CAPTOPRIL IN TYPE 2 DIABETES MELLITUS PATIENTS WITH COMORBIDITIES AT TANGERANG DISTRICT GENERAL HOSPITAL

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Abstract

Rational use of antihypertensive drugs is essential for patients with Type 2 Diabetes Mellitus (T2DM) with comorbidities to optimize therapeutic efficacy and minimize adverse drug reactions. This study aimed to evaluate the appropriateness of antihypertensive therapy in outpatient BPJS T2DM patients at RSU Tangerang District. A descriptive retrospective study was conducted on 80 BPJS T2DM patients with comorbidities who received captopril or amlodipine from January to June 2021. Data were collected from medical records and analyzed for appropriateness regarding contraindications, indications, drug selection, and dosage according to clinical guidelines including JNC VII/VIII, ACC/AHA, Pharmaceutical Care, and PIONAS. All patients received medications without contraindications, resulting in a 100% appropriateness rate. Specifically, 68.8% of patients received captopril and 31.3% received amlodipine appropriately. All indications and drug selections were fully aligned with clinical guidelines, and dosing was correct for all patients: captopril 12.5 mg in 14 cases (17.50%) and 25 mg in 41 cases (51.25%), amlodipine 5 mg in 19 cases (23.75%) and 10 mg in 6 cases (7.50%). Antihypertensive therapy in BPJS T2DM patients at RSU Tangerang District was rational and fully adherent to clinical guidelines, ensuring patient safety and therapeutic efficacy. The study was limited to two drugs and outpatient care; therefore, future research should include additional antihypertensive medications and care settings to generalize the findings.

Keywords: Amlodipine, Antihypertensive Therapy, Captopril, Rational Drug Use, T2DM

INTRODUCTION

Hypertension is a prevalent comorbidity among patients with type 2 diabetes mellitus (T2DM), affecting up to two-thirds of this population. It may be present at the time of T2DM diagnosis or even prior to the onset of hyperglycemia. The presence of hypertension significantly increases the risk of cardiovascular disease and is also associated with a higher likelihood of developing microvascular complications, including diabetic nephropathy and retinopathy (Zaman Huri & Fun Wee, 2013). Standardized diagnosis and management of hypertension in diabetic patients, along with achieving target blood pressure levels, are crucial for reducing long-term complications, prolonging life expectancy, and improving quality of life (Wang et al., 2025)

Type 2 diabetes mellitus (T2DM) is a disease whose prevalence and mortality rates have been steadily increasing over the years. Indonesia ranks fifth among countries with the highest number of diabetes cases, with 19.5 million in 2021, and it is predicted that the number of individuals aged 20–79 years with diabetes will increase to 28.6 million by 2045. Overweight, including obesity and central obesity, has been identified as a major risk factor for both hypertension and diabetes. The 2023 Indonesian Health Survey (Survei Kesehatan Indonesia, SKI) by the Ministry of Health reported an increase in diabetes prevalence based on physician diagnosis compared to the 2018 Basic Health Research (Riskesdas) results, from 1.5% in 2018 to 1.7% in 2023 across all age groups (Latief, 2024).

The appropriateness of medication use is typically assessed through studies that examine previously occurring events and patterns of drug administration. Inappropriate use of medications has been recognized as a significant concern in healthcare, as it may lead to multiple adverse outcomes. According to Pharmaceutical Care Europe, improper medication use can result in decreased therapeutic effectiveness, the occurrence of

adverse drug reactions, and unintended drug–drug interactions. In addition, it poses considerable economic challenges due to increased healthcare costs associated with treatment failures, hospitalizations, and the need for additional interventions. Therefore, ensuring the correct prescription, dispensing, and administration of medications is essential for optimizing patient outcomes and maintaining the efficiency of healthcare systems (Komalasari et al., 2025).

Considering the high prevalence of type 2 diabetes mellitus and its frequent comorbidity with hypertension, as well as the significant challenges associated with appropriate medication use, it is crucial to evaluate and optimize pharmacotherapy in these patients. Assessing medication patterns, adherence, and potential drug-related problems can provide valuable insights for improving clinical outcomes, preventing complications, and enhancing patients' quality of life. Therefore, this study aims to evaluate the appropriateness of antihypertensive medication use among patients with type 2 diabetes mellitus, thereby contributing to evidence-based strategies for more effective disease management.

Amlodipine is a long-acting dihydropyridine calcium channel blocker (CCB) widely used for the management of hypertension and angina pectoris. It acts by inhibiting calcium ion influx through L-type calcium channels in vascular smooth muscle cells, causing vasodilation and reduced systemic vascular resistance, which effectively lowers both systolic and diastolic blood pressure without significant effect on heart rate (StatPearls., 2025).

Amlodipine exhibits high oral bioavailability and a long half-life (30–50 hours), allowing for once-daily dosing, which improves patient adherence. Pharmacokinetic studies demonstrate that it is primarily metabolized in the liver and excreted as inactive metabolites, with renal impairment having minimal effect on elimination (Abernethy et al., 1990).

Clinically, Amlodipine is effective in lowering blood pressure and preventing cardiovascular events. Its main adverse effects include peripheral edema, dizziness, headache, and palpitations, although these are usually mild and manageable. Captopril is an angiotensin-converting enzyme (ACE) inhibitor used in the management of hypertension, congestive heart failure, and diabetic nephropathy. Its mechanism involves inhibition of angiotensin I conversion to angiotensin II, leading to decreased vasoconstriction and aldosterone secretion, which lowers blood pressure and reduces cardiac workload (StatPearls, 2025).

Captopril is rapidly absorbed orally, with a bioavailability of approximately 75%, and has a short half-life of 2–3 hours, requiring multiple daily dosing. It is primarily excreted unchanged by the kidneys, and dose adjustment is necessary in renal impairment. Clinically, Captopril has proven efficacy in lowering blood pressure, improving survival in heart failure patients, and providing renal protective effects in diabetic patients. Common adverse effects include dry cough, hypotension, hyperkalemia, and rarely angioedema (Vlasses et al., 1982).

According to Cipolle, Strand, and Morley in Pharmaceutical Care Practice: The Patient-Centered Approach to Medication Management Services (3rd edition), the Pharmacotherapy Workup consists of five main steps: collecting patient information, evaluating the appropriateness of current therapy, developing a therapy plan with specific goals and follow-up, implementing the plan while ensuring patient understanding, and monitoring and adjusting therapy to achieve optimal outcomes (Cipolle, 2012).

MATERIALS AND METHODS

Study Period and Location

The research period included data collection and data processing, which were carried out from May to July 2021 at the Tangerang District General Hospital.

Materials and Instruments

The instruments used in this study included a

data collection form and medical record sheets

Population and Sample

The study population consisted of adult patients aged 35 years or older diagnosed with type 2 diabetes mellitus and hypertension who received care at Tangerang District General Hospital during the period from May to July 2021. Hypertension was defined as systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg, in accordance with standard clinical guidelines.

A purposive sampling technique was employed, which is a non-probability sampling method in which participants are deliberately selected based on specific inclusion and exclusion criteria relevant to the research objectives.

Inclusion criteria were adult patients (≥35 years old) diagnosed with type 2 diabetes mellitus and hypertension (systolic ≥140 mmHg or diastolic ≥90 mmHg) who had complete medical records. Exclusion criteria included patients with incomplete data or those who refused to participate. Based on these criteria, a total of 80 patients were selected as the study sample.

Type of Study

This study was a non-experimental observational study. Data analysis was conducted descriptively, and data collection was performed retrospectively.

Data Collection and Analysis

Data obtained from medical records were analyzed descriptively. The analysis described the types of antihypertensive drugs used by BPJS patients with type 2 diabetes mellitus and comorbidities, based on the appropriateness of the drug, patient, dose, and indication. The data were then grouped or tabulated according to patient age intervals and sex, and subsequently described in terms of indication appropriateness, dose accuracy, and outcomes after drug administration. The results of the study were compared with the guidelines from JNC VIII (JNC VIII, 2013).

RESULTS AND DISCUSSION

Patient Characteristics

This study utilized medical record data of

BPJS patients with type 2 diabetes mellitus and comorbidities who were admitted to the inpatient ward at Tangerang District General Hospital during the period from January to June 2021. A total of 80 patient records were included as the study sample.

Patient characteristics in this study were described based on age and sex.

1. Sex

Sex refers to the patient's self-identified gender.

Figure 1. Distribution of BPJS Patients with Type 2 Diabetes Mellitus and Comorbidities by Sex at Tangerang District General Hospital, January–June 2021.

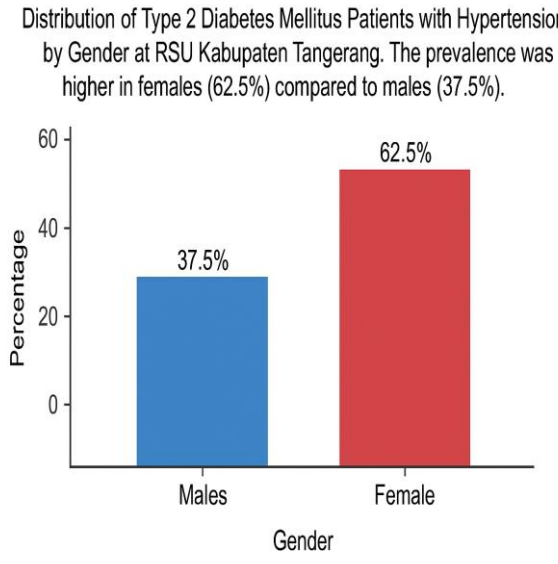
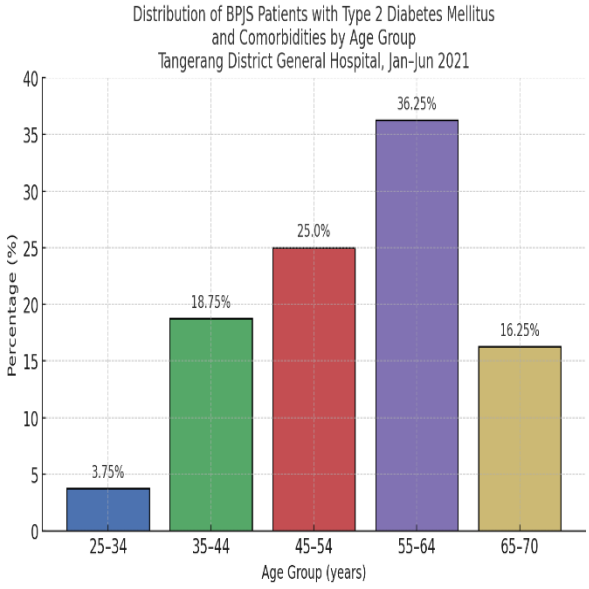


Figure 1 presents 80 cases of type 2 diabetes mellitus (T2DM) with comorbidities at RSU Kabupaten Tangerang, comprising 30 males (37.5%) and 50 females (62.5%). This aligns with the 2018 RISKESDAS data, indicating a higher prevalence in women, possibly due to menopause and the consequent decline in endogenous estrogen, which impairs vasodilation and blood pressure regulation (Barton & Meyer, 2009).

2. Age Group

Age refers to the length of life calculated from the year of birth until the present. The age distribution of patients can be seen from medical records as shown in the table below:

Figure 2. Distribution of BPJS Patients with Type 2 Diabetes Mellitus and Comorbidities by Age Group at Tangerang District General Hospital, January–June 2021.



The data presented in Figure 2 indicate that the highest proportion of Type 2 Diabetes Mellitus (T2DM) patients with comorbidities is observed in the 55–64 years age group (36.25%). This finding is consistent with the RISKESDAS 2018 report, which identified individuals aged 55–64 as having the highest risk of developing T2DM in Indonesia.

Globally, the prevalence of T2DM increases with age. For instance, in a study conducted in Australia, the prevalence was approximately 10% in individuals aged 55–64 years. Similarly, data from the United States indicate that the percentage of adults with diabetes increases with age, reaching 29.2% among those aged 65 years or older.

The elevated prevalence of T2DM and associated comorbidities in this age group can be attributed to several factors. Aging is associated with increased insulin resistance and impaired pancreatic β-cell function, leading to higher blood glucose levels. Additionally, older adults are more likely to have other chronic conditions such as hypertension, dyslipidemia, and obesity, which are common comorbidities in T2DM patients.

Furthermore, the presence of multiple comorbidities in older adults with T2DM can complicate disease management and increase the risk of adverse outcomes. A study in the United Kingdom found that nearly 30% of T2DM patients had three or more comorbidities at diagnosis, increasing to 60% of patients ten years later.

In Indonesia, the increasing prevalence of T2DM in the 55–64 years age group underscores the need for targeted public health interventions. Strategies should focus on early detection, lifestyle modifications, and management of comorbid conditions to mitigate the impact of T2DM in this high-risk population.

3. Antihypertensive Medication Usage Profile

The distribution of antihypertensive drugs among BPJS patients with Type 2 Diabetes Mellitus and comorbidities at Tangerang

District General Hospital during the study period is illustrated in Figure 3.

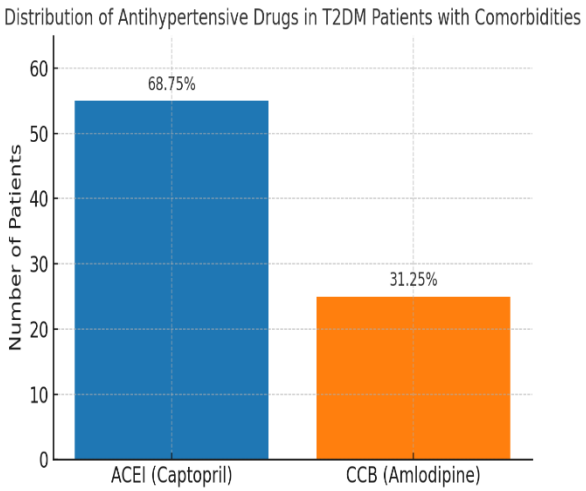


Figure 3. Distribution of antihypertensive drugs administered to BPJS Type 2 Diabetes Mellitus patients with comorbidities at Tangerang District General Hospital, January–June 2021.

As shown in Figure 3, ACE inhibitors, particularly Captopril, were the most frequently prescribed antihypertensive, administered to 55 patients (68.75%), followed by Amlodipine (31.25%). This pattern aligns with JNC 8 guidelines recommending ACEIs as first-line therapy for hypertensive patients with Type 2 Diabetes Mellitus. The high use of Captopril reflects its cardioprotective and nephroprotective benefits, helping to reduce the risk of cardiovascular events and diabetic nephropathy. In contrast, calcium channel blockers, while effective in lowering blood pressure, offer less organ protection. These results suggest that prescribing practices at Tangerang District General Hospital follow evidence-based guidelines, prioritizing both optimal blood pressure control and mitigation of diabetes-related complications.

The predominance of ACE inhibitors observed in this study is consistent with previous reports. ACEIs not only reduce blood pressure effectively but also improve endothelial function, inhibit the renin-angiotensin-aldosterone system (RAAS), and slow the progression of microvascular complications in patients with Type 2 Diabetes Mellitus. ACE inhibitors exert a protective effect on the kidneys by reducing intraglomerular pressure and proteinuria, which helps prevent or delay the onset of diabetic nephropathy(O'Driscoll et al., 1999) Similar protective effects on renal function and reduction in the risk of end-stage renal disease have been reported (Andersen et al., 2000).

In contrast, calcium channel blockers,

although effective in controlling blood pressure, primarily act by relaxing vascular smooth muscle and lowering systemic vascular resistance. They do not directly modulate the RAAS or provide comparable nephroprotective and cardioprotective benefits. Consequently, while both drug classes are effective for hypertension management, ACE inhibitors are generally preferred in patients with Type 2 Diabetes Mellitus, as they address both blood pressure control and long-term complication prevention.

These findings indicate that the prescribing patterns at Tangerang District General Hospital align with evidence-based international guidelines, supporting optimal clinical outcomes. The high utilization of Captopril reflects a rational, guideline-directed strategy that prioritizes both cardiovascular and renal protection in diabetic patients with comorbid hypertension.

4. Classification and Types of Non-Antihypertensive Drugs

The classification and types of non-antihypertensive medications prescribed to BPJS Type 2 Diabetes Mellitus patients with comorbidities are presented in Figure 4.

Figure 4. Distribution of non-antihypertensive medications prescribed to BPJS Type 2 Diabetes Mellitus patients with comorbidities

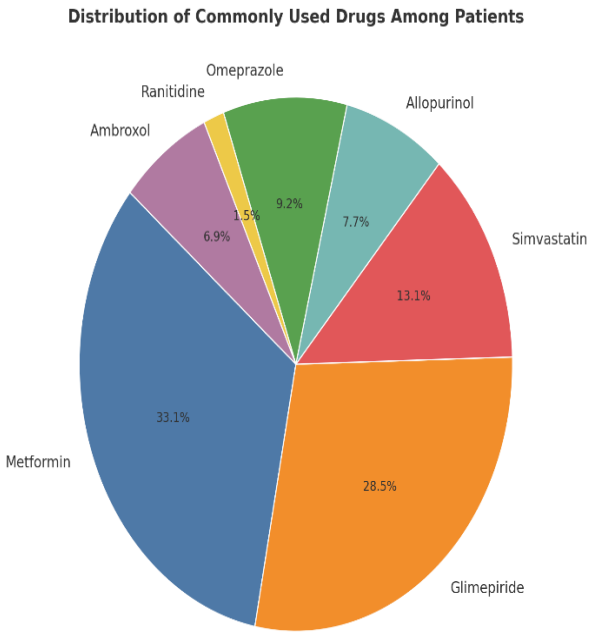


Figure 4 illustrates the distribution of non-antihypertensive drugs administered to BPJS Type 2 Diabetes Mellitus patients with comorbidities. Among antidiabetic medications, Metformin was the most frequently prescribed, given to 43 patients (33.08%), followed by Glimepiride to 37 patients (28.46%). For patients with hypercholesterolemia, Simvastatin was used in

17 cases (13.08%), while Allopurinol was prescribed to 10 patients (7.69%) for gout management. Gastrointestinal medications included Proton Pump Inhibitors (Omeprazole) administered to 12 patients (9.23%) and H2 receptor antagonists (Ranitidine) to 2 patients (1.54%). Additionally, the mucolytic Ambroxol was given to 9 patients (6.92%). The total number of non-antihypertensive drug prescriptions was 130 (100%).

These findings indicate that patient management not only targeted glycemic control but also addressed comorbid conditions such as hypercholesterolemia, gout, and gastrointestinal disorders, reflecting a comprehensive and evidence-based therapeutic approach. The high utilization of Metformin aligns with international guidelines recommending it as the first-line therapy for Type 2 Diabetes Mellitus due to its efficacy, safety profile, and potential cardiovascular benefits (Inzucchi, 2017). The use of Simvastatin corresponds with evidence suggesting statins reduce cardiovascular risk in diabetic patients with dyslipidemia. Prescription of Allopurinol for gout management highlights attention to comorbid metabolic disorders, which is critical to prevent long-term complications. Gastrointestinal medications, such as Omeprazole, indicate proactive management of potential gastrointestinal side effects from polypharmacy. Overall, the prescribing pattern demonstrates adherence to evidence-based practice and emphasizes holistic care for patients with Type 2 Diabetes Mellitus and multiple comorbidities.

Evaluation of Rational Drug Use

Rational drug use is an essential aspect of clinical practice, ensuring that medications are prescribed appropriately according to patients' medical conditions, contraindications, and therapeutic needs. Evaluating the rationality of drug use provides insight into the safety, effectiveness, and quality of pharmacological management in a specific patient population. The following table presents the assessment of

medication appropriateness in BPJS Type 2 Diabetes Mellitus patients with comorbidities, including the frequency and percentage of appropriate versus inappropriate prescriptions during inpatient care at Tangerang District General Hospital.

Table 1. Appropriateness of Medication Use in BPJS Type 2 Diabetes Mellitus Patients with Comorbidities at RSU Tangerang District, January – June 2021

Contraindication	Total Patients (n)	Appropriate Patients (n, %)	Inappropriate Patients (n, %)
Amlodipine is contraindicated in patients with cardiogenic shock, unstable angina, significant aortic stenosis, and breastfeeding mothers.	55	55 (68.8 ± 0%)	0 (0 ± 0%)
Captopril is contraindicated in patients with a history of severe hypersensitivity to ACE inhibitors, renovascular obstruction, heart obstruction, pregnancy, and dry cough.	25	25 (31.3 ± 0%)	0 (0 ± 0%)
Total	80	80 (100 ± 0%)	0 (0 ± 0%)

Table 2. Appropriateness of Indication in BPJS Type 2 Diabetes Mellitus Patients with Comorbidities at RSU Tangerang District, January – June 2021

Antihypertensive Drug	Total Patients (n)	Appropriate Indication (n, %)	Inappropriate Indication (n, %)
Captopril	55	55 (68.8 ± 0%)	0 (0 ± 0%)
Amlodipine	25	25 (31.3 ± 0%)	0 (0 ± 0%)
Total	80	80 (100 ± 0%)	0 (0 ± 0%)

Table 3. Appropriateness of Drug Choice in BPJS Type 2 Diabetes Mellitus Patients with Comorbidities at RSU Tangerang District, January – June 2021

Antihypertensive Drug	Total Patients (n)	Appropriate Drug (n, %)	Inappropriate Drug (n, %)
Captopril	55	55 (68.8 ± 0%)	0 (0 ± 0%)
Amlodipine	25	25 (31.3 ± 0%)	0 (0 ± 0%)
Total	80	80 (100 ± 0%)	0 (0 ± 0%)

Table 4. Appropriateness of Dosage in BPJS Type 2 Diabetes Mellitus Patients with Comorbidities at RSU Tangerang District, January – June 2021

Drug	Guidelines	Standard Dose (mg)	Frequency per Day	Study Data (mg)	Frequency per Day	Cases (n)	Appropriateness	(%)
Captopril	JNC VII	25–100	1×	12.5	2×	14	Appropriate	17.50
	JNC VIII	50–150	2–3×					
	Pharmaceutical Care	12.5–150	2–3×					
	ACC/AHA	12.5–150	2–3×					

	PIONAS (Low dose)	12.5	2×	25	2×	41	Appropriate	51.25
	PIONAS (Usual dose)	50–100	2×					
Amlodipine	JNC VII / JNC VIII	2.5–10	1×	5	1×	19	Appropriate	23.75
	Pharmaceutical Care	2.5–10						
	ACC/AHA	–						
	PIONAS (Low dose)	2.5		10	1×	6	Appropriate	7.50
	PIONAS (Usual dose)	5–10						
Total						80	100%	100

DISCUSSION

The results in Table 1 indicate that all 80 BPJS Type 2 Diabetes Mellitus patients with comorbidities received medications without contraindications, yielding a 100% appropriateness rate. Specifically, 68.8% of patients were prescribed amlodipine appropriately, while 31.3% received captopril appropriately.

These findings demonstrate that antihypertensive therapy at RSU Tangerang District was fully aligned with patient-specific clinical conditions. The absence of inappropriate prescriptions suggests strict adherence to clinical guidelines and careful consideration of individual contraindications, such as cardiogenic shock, unstable angina, hypersensitivity to ACE inhibitors, and pregnancy. Such rational drug use is crucial in preventing adverse drug reactions, optimizing therapeutic efficacy, and ensuring patient safety, particularly in patients with multiple comorbidities like diabetes mellitus and hypertension.

Compared to previous studies, the high appropriateness rate observed in this study is notable, as other reports often find gaps in adherence to drug safety protocols. Factors contributing to this result may include the implementation of standardized treatment protocols, active pharmacist involvement, and rigorous monitoring of patient medical records. Despite these positive findings, the study is limited to only two antihypertensive

agents and outpatient care, which may not represent inpatient settings or the use of other antihypertensive medications. Future research should expand to include additional drugs and care settings to generalize the findings.

Table 2 shows that all 80 BPJS Type 2 Diabetes Mellitus patients with comorbidities received antihypertensive drugs with appropriate indications, resulting in a 100% appropriateness rate. Specifically, 68.8% of patients were prescribed captopril for the correct indications, while 31.3% received amlodipine appropriately.

These findings indicate that prescribers at RSU Tangerang District carefully considered each patient's clinical condition when selecting antihypertensive therapy, ensuring that the chosen medications matched the therapeutic needs and underlying comorbidities. The absence of inappropriate indications highlights adherence to clinical guidelines and best practices in rational pharmacotherapy. Maintaining correct indications is crucial for optimizing treatment efficacy, minimizing adverse drug events, and enhancing patient safety.

Although this study demonstrates excellent adherence for these two drugs, it is limited to only captopril and amlodipine and only includes outpatient care, which may not represent inpatient settings or other antihypertensive agents. Future studies should include a broader range of medications and care settings to validate these findings further.

Table 3 shows that all 80 BPJS Type 2 Diabetes Mellitus patients with comorbidities received the appropriate antihypertensive drugs, resulting in a 100% appropriateness rate. Specifically, 68.8% of patients were prescribed captopril appropriately, while 31.3% received amlodipine appropriately.

These findings indicate that prescribers at RSU Tangerang District carefully selected antihypertensive therapy, ensuring that the chosen drugs matched each patient's clinical condition and underlying comorbidities. The absence of inappropriate drug choices highlights strict adherence to clinical

guidelines and principles of rational pharmacotherapy. Maintaining correct drug selection is essential to optimize therapeutic outcomes, prevent adverse drug reactions, and ensure patient safety. Factors contributing to these results may include standardized treatment protocols, active involvement of pharmacists, and thorough monitoring of patient medical records.

This study is limited to only two antihypertensive agents (captopril and amlodipine) and outpatient care, which may not reflect inpatient settings or the use of other antihypertensive medications. Future research should include a broader range of drugs and care settings to validate these findings further. Overall, the results emphasize the importance of rational drug use in managing patients with multiple comorbidities, ensuring both safety and effectiveness in antihypertensive therapy.

Based on Table 4, aptopril at a dose of 12.5 mg was administered in 14 cases (17.50%), and a dose of 25 mg in 41 cases (51.25%). Amlodipine at a dose of 5 mg was administered in 19 cases (23.75%), and a dose of 10 mg in 6 cases (7.50%). All these dosages were in accordance with technical guidelines for the detection and treatment of hypertension, resulting in a 100% appropriateness rate for dosage.

These findings indicate that prescribers at RSU Tangerang District carefully adjusted doses according to clinical guidelines, including JNC VII/VIII, ACC/AHA, Pharmaceutical Care, and PIONAS standards. Correct dosing is crucial for optimizing therapeutic efficacy, minimizing adverse drug reactions, and ensuring patient safety. Administering non-standard drug dosages can lead to various adverse effects in patients. If the dosage indicated on a prescription is incorrect or does not meet established standards, patients may not receive appropriate treatment for their condition, potentially resulting in disease complications.

Although this study demonstrates excellent adherence to guidelines for captopril and amlodipine in outpatient care, it is limited

by the small sample size, single-center setting, and the focus on only two antihypertensive drugs. The study also did not analyze potential adverse effects, patient adherence, or long-term outcomes. Future research should include a broader range of medications, additional clinical guidelines, multiple centers, and longer follow-up to generalize the findings.

CONCLUSION

All 80 BPJS Type 2 Diabetes Mellitus patients with comorbidities received antihypertensive therapy that was appropriate in terms of contraindications, indications, drug selection, and dosage, achieving a 100% appropriateness rate. Captopril and amlodipine were administered according to clinical guidelines, ensuring patient safety and therapeutic efficacy. However, the study is limited to these two drugs and outpatient care, which may not reflect inpatient settings or other antihypertensive agents. Future studies should include a broader range of medications and care settings to generalize these findings.

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