

Evaluation of Potentially Inappropriate Medications (PIMs) in Geriatric Patients at the Janti Community Health Center in Malang City Based on the 2023 Beers Criteria

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ABSTRACT

The prevalence of hypertension in Indonesia reached 34.1% in 2018, while in 2022, 56.2% of the population of Malang City suffered from hypertension. Elderly people with various diseases are generally referred to as geriatrics. Polypharmacy is one of the factors causing inappropriate medication use or what is commonly called Potentially Inappropriate Medications (PIM) which can harm geriatric patients. The incidence of PIM in geriatric patients can be prevented and reduced, namely by evaluating the appropriateness of drugs as a form of assessment and preliminary treatment prescribed for the disease suffered by geriatric patients. This study aims to determine the incidence of inappropriate medication use (PIM) using the Beers 2023 criteria instrument. This research is an observational study with a retrospective approach, using descriptive data analysis methods. The study sample was the medical records of geriatric patients with hypertension treatment at the Janti Community Health Center, Malang City in 2023 with a minimum sample of 91 medical records. The percentage of incidents of Potentially Inappropriate Medication Use (PIMS) obtained based on the 2023 Beers criteria in geriatric hypertension patients at the Janti Community Health Center was 20.09% based on Beers category 1 criteria, 2.23% based on Beers category 2 criteria, 3.72% based on Beers category 3 criteria, and 2.23% based on Beers category 4 criteria.

Keywords: Geriatrics, Polypharmacy, PIM, Hypertension, Beers 2023 criteria



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INTRODUCTION

The global elderly population is increasing, expected to double in the next 25 years (Sidani et al., 2017). This situation is causing a shift in disease patterns from infectious diseases and nutritional disorders to degenerative diseases such as diabetes, hypertension, chronic lung problems, and chronic kidney disease, driven by the increasing elderly population (Fall, 2014).

Hypertension is the most common degenerative disease affecting the elderly in Indonesia. The prevalence of hypertension in Indonesia is 34.1%, according to the 2018 Basic Health Research (Riskesdas) data (Ministry of Health of the Republic of Indonesia, 2018). According to the Malang City Health Office, hypertension is the second most common disease after diabetes

mellitus, with 56.2% of Malang City residents suffering from hypertension by 2022. The World Health Organization (WHO) estimates that at least 9.4 million people die from hypertension and its complications each year. The 2018 Basic Health Research (Riskesdas) stated that hypertension is commonly experienced by geriatric patients, who are also at risk for other diseases, such as heart failure, atrial fibrillation, stroke, kidney disorders, and dementia.

Geriatric patients generally suffer from multiple illnesses, which indirectly, degenerative diseases in geriatric patients require patients to take more than one medication, known as polypharmacy. Generally, polypharmacy is defined as the use of more than five medications intended to treat one or more diseases in a single patient (WHO, 2019). Polypharmacy is a factor in the occurrence of inappropriate medication, also known as Potentially Inappropriate Medications (PIM), which should be avoided by geriatric patients (Samuel, 2015). A study at a hospital in Banjarmasin showed a PIM prevalence of 41% (Misrina et al., 2023). The incidence of PIM (Potentially Inappropriate Medications) in geriatric patients with hypertension at one hospital was found to reach 26.8% (Muharni et al., 2019).

The incidence of PIM in geriatric patients can be prevented and reduced by evaluating the appropriateness of medications as a form of assessment and preview of prescribed treatments for the patient's disease (Wahab et al., 2014). The Beers Criteria are explicit criteria used to identify PIMs and describe medications that should be avoided or used with caution in geriatric patients. The advantages of the Beers Criteria are their simplicity, ease of use, and ability to generate reproducible data or strong evidence (Nurratri and Pardilawati, 2023). This study aimed to determine the incidence of inappropriate medication use (PIM) in geriatric patients using the 2023 Beers Criteria. This study was conducted at the Janti Community Health Center in Malang City because the prevalence of hypertension patients at the Janti Community Health Center is the second highest in Malang City.

METHOD

This study evaluated polypharmacy treatment in geriatric patients. This observational study used a retrospective approach, analyzing the medical records of geriatric patients undergoing treatment at the Janti Community Health Center in Malang City in 2023. This study employed a descriptive analysis method to determine the use of Potentially Inappropriate Medications (PIMs) using the 2023 Beers Criteria using Microsoft Excel.

The study population was all geriatric outpatients undergoing polypharmacy treatment at the Janti Community Health Center in Malang City in 2023. The sample consisted of medical records from 2023 visits of patients aged 60 years and older, taking polypharmacy with more than five medications, undergoing outpatient care, and diagnosed with hypertension and/or without comorbidities. The sampling technique used in this study was purposive sampling. Descriptive categorical calculations were used to determine the sample size, resulting in a total sample size of at least 91 medical records of hypertensive patients.

This study was approved by the Ethics Committee of the Faculty of Medicine and Health Sciences, No. 68/02/EC/KEPK-FKIK/11/2024. All patient medical records used in this study will be kept confidential and adhere to ethical principles.

RESULTS

This study yielded a sample of 93 patient medical records and 239 visit data from geriatric patients with hypertension in 2023. **Table 1** showed patient characteristics by gender and age.

Table 1. Gender and Age

No.	Category	Total	Percentage
1	Gender		
	Female	65	70%
	Male	28	30%
	TOTAL	93	100%
2	Age		
	≥ 70 years	30	32%
	60-69 years	63	68%
	TOTAL	93	100%

Patient characteristics were also classified based on the type of diagnosis received, including hypertension and comorbidities. Patient characteristics based on diagnoses with or without comorbidities with the 5 highest scores are listed in **Table 2**.

Table 2. Accepted diagnosis

No.	Diagnosis	Total	Percentage
1.	(I10) + (E11)	29	11,89%
2.	(I10) + (J06.9)	27	11,07%
3.	(I10)	21	8,61%
4.	(I10) + (E78) + (E11)	16	6,56%
5.	(I10) + (E78) + (E79)	15	6,15%

The selection of therapy for geriatric hypertension patients at the Janti Community Health Center was based on the history, examination, and diagnosis performed by the examining physician, which is then written in a prescription in the patient's medical record. The use of hypertension medication in geriatric hypertension patients at the Janti Community Health Center in 2023 was divided into monotherapy and combination treatment, as listed in **Table 3**.

Table 3. Hypertension treatment profile

No.	Drug name	Total	%
Monotherapy			
1.	Amlodipine	134	57,76%
2.	Hydrochlorothiazide (HCT)	4	1,72%
3.	Irbesartan	3	1,29%

4.	Bisoprolol	3	1,29%
5.	Furosemide	2	0,86%
6.	Spironolactone	1	0,43%
Therapy combination			
1.	Amlodipine + Hydrochlorothiazide (HCT)	31	13,36%
2.	Amlodipine + Bisoprolol	10	4,31%
3.	Bisoprolol + Tanapress (Imidapril)	9	3,88%
4.	Amlodipine + Furosemide + Valsartan	4	1,72%
5.	Amlodipine + Bisoprolol + Candesartan	4	1,72%
6.	Nifedipine + Candesartan	3	1,29%
7.	Bisoprolol + Furosemide	3	1,29%
8.	Amlodipine + Furosemide	3	1,29%
9.	Amlodipine + Candesartan	3	1,29%
10.	Amlodipine + Bisoprolol + Ramipril	3	1,29%
11.	Amlodipine + Bisoprolol + Lisinopril	3	1,29%
12.	Amlodipine + Ramipril	2	0,86%
13.	Amlodipine + Lisinopril	2	0,86%
14.	Amlodipine + Bisoprolol + Furosemide + Valsartan	2	0,86%
15.	Amlodipine + Spironolactone	1	0,43%
16.	Amlodipine + Bisoprolol + Hydrochlorothiazide (HCT)	1	0,43%
17.	Amlodipine + Bisoprolol + Candesartan + Hydrochlorothiazide (HCT) + Spironolactone	1	0,43%
Total		232	100,00%

The data collected were prescriptions for geriatric hypertensive patients with or without comorbid diagnoses, including multiple medication regimens, or polypharmacy. The five most common instances of polypharmacy in geriatric hypertensive patients are listed in **Table 4**.

Table 4. Polypharmacy treatment

No.	Therapy combination	Diagnosis	Total	%
1.	Amlodipine + Glimepiride + Metformin + Simvastatin + Vitamin B12	(I10) + (E78) + (E11)	5	2,10%
2.	Amlodipine + Glimepiride + Meloxicam + Metformin + Simvastatin + Vitamin B12	(I10) + (E78) + (E11)	4	1,68%
3.	Irbersartan + Lantus (insulin glargine) + Metformin + Novomix (biphasic insulin aspart) + Vitamin B12	(I10) + (E10)	3	1,26%

4.	Amlodipine + Allopurinol + Furosemide + Valsartan + Vitamin B12	(I10)	3	1,26%
5.	Amlodipine + Acarbose + Bisoprolol + Metformin + Ramipril + Simvastatin	(E11) + (I50.9)	3	1,26%

A total of 1,344 medications were used, including 380 medications. The 2023 Beers Criteria are divided into five drug categories. In this study, four categories were identified, as shown in **Tables 5, 6, 7, and 8.**

Table 5. Category 1-Drugs generally avoided in the elderly

PIMs category	Drug classes	Drug name	Total	Percentage
Category 1	NSAID	Meloxicam	49	18,15%
		Sodium diclofenac	20	7,41%
		Ibuprofen	5	1,85%
		Total	74	27,41
	Cardiovascular and Antithrombotics	Salicylic acid	60	22,22%
		Nifedipine	3	1,11%
		Total	63	23,33%
	Sulfonylureas	Glimepiride	65	24,07%
		Total	65	24,07%
	Benzodiazepines	Diazepam	33	12,22%
		Total	33	12,22%
	Gastrointestinal	Omeprazole	22	8,15%
		Total	22	8,15%
	Antihistamines	Diphenhydramine	8	2,96%
		Clorfeniramin maleate (CTM)	5	1,85%
		Total	13	4,81%
TOTAL			270	100,00%

Table 6. Category 2-Drugs to be avoided in certain diseases or syndromes

PIMs category	Diseases or syndromes	Obat	Total	Percentage
Category 2	Cardiovascular			
	Heart failure	Meloxicam	7	23,33%
		Mefenamic acid	1	3,33%

		sodium diclofenac	5	16,67%
		Total	13	43,33%
	Gastrointestinal			
	History of gastric or duodenal ulcers	Salicylic acid	10	33,33%
		Ibuprofen	2	6,67%
		sodium diclofenac	5	16,67%
		Total	17	56,67%
	TOTAL		30	100,00%

Table 7. Category 3 - Drugs to be used with caution in the elderly

PIMs category	Drug classes	Drug name	Total	Percentage
Category 3	Diuretic	Hydrochlorothiazide (HCT)	34	68,00%
		Furosemide	13	26,00%
		Spironolactone	3	6,00%
TOTAL			50	100,0%

Table 8. Drug interactions that pose clinical risks and should be avoided in the elderly

PIMs category	Drug classes	Drugs	Total	Percentage
Category 4	RAS inhibitors (ACEI, ARB, ARNI, aliskiren) or potassium-sparing diuretics	Candesartan + Spironolactone	1	3,33%
		Total	1	33,33%
	Anticholinergic	Metformin + Loratadine	5	16,67%
		Metformin + Omeprazole	3	10,00%
		Metformin + Diazepam	2	6,67%
		Metformin + Omeprazole + Guaiafenicin	2	6,67%
		Metformin + Dexamethasone + Omeprazole	2	6,67%
		Omeprazole + Diazepam	2	6,67%
		Omeprazole + Dexamethasone	2	6,67%
Category 4	Anticholinergic	Metformin + Dexamethasone cream + Loratadine	1	3,33%
		Metformin + Hydrocortisone Cream	1	3,33%

		Metformin + Pramipexole	1	3,33%
		Metformin + Loratadine + Guaiafenisin	1	3,33%
		CTM + Dexamethasone + Loratadine	1	3,33%
		CTM + Loratadine	1	3,33%
		ISDN + Omeprazole	1	3,33%
		Omeprazole + Grantusif	1	3,33%
		Omeprazole + Guaiafenicin	1	3,33%
		CTM + Guaiafenicin	1	3,33%
		Total	29	96,67%
Total			30	100,00%

DISCUSSION

Patient Characteristics Based on Gender and Age

This study found that women had a higher prevalence of hypertension (65 patients) compared to men (28 patients) (30%). The high incidence of hypertension in women is due to menopause, which occurs later in life. During menopause, estrogen levels decrease in the body. Estrogen functions to increase HDL (High Density Lipoprotein) levels and lower total cholesterol and LDL (Low Density Lipoprotein) levels. A decrease in estrogen levels disrupts these functions, leading to atherosclerosis. Decreased estrogen levels trigger increased renin-angiotensin activity, which causes vasoconstriction and endothelial dysfunction. This also contributes to the development of atherosclerosis (Riyadina, 2019).

Patient Characteristics Based on Comorbidities

The most common comorbidity was Non-Insulin Dependent Diabetes Mellitus (E11), or type 2 diabetes mellitus, which is not caused by the insulin ratio in the circulation, in 20 patients (19.80%). According to the International Hypertension Society, diabetes mellitus is an additional risk factor in hypertension patients, affecting 15-20% (Unger et al., 2020). Diabetes mellitus is a disease that occurs when the pancreas does not produce enough insulin to regulate blood glucose or when the body is unable to use insulin properly. This results in elevated blood glucose levels, which, if prolonged, can cause serious damage to other organs, such as the heart, blood vessels, eyes, kidneys, and nerves. Elevated blood sugar levels, known as hyperglycemia, are a contributing factor to high blood pressure (WHO, 2016).

Hypertension Treatment for Geriatric Patients at Janti Community Health Center in 2023

In monotherapy, the most commonly prescribed medication for geriatric hypertension patients at Janti Community Health Center in 2023 was the calcium channel blocker (CCB), specifically amlodipine, with 134 prescriptions (57.76%). Calcium Channel Blockers (CCBs) act as calcium channel antagonists by blocking L-type calcium channels in the cell membranes of cardiac and smooth muscle cells in blood vessel walls, reducing myocardial oxygen demand,

thereby reducing blood pressure resistance (Ministry of Health of the Republic of Indonesia, 2019). CCBs also work by increasing oxygen supply to the heart through coronary vasodilation, allowing more oxygen to reach the heart (PERKI, 2015).

The most commonly prescribed combination therapy is amlodipine and hydrochlorothiazide (HCT). Combination therapy with these two drugs can be given to patients with stage 2 hypertension, namely those with blood pressure $\geq 140/90$ mmHg (Dipiro et al., 2020). The mechanism of action of hydrochlorothiazide is by inhibiting sodium absorption in the distal tubule (Ministry of Health of the Republic of Indonesia, 2019). This results in increased urine production (diuresis) and urine excretion (natriuresis), thereby reducing body fluid volume, which in turn lowers blood pressure (Akbari and Zadeh, 2023). Research by Anggraini et al. (2021) showed that the combination of amlodipine and HCT was the most common and exhibited a synergistic interaction. This indicates that the antihypertensive effect, resulting in lower blood pressure, is more effective when the two drugs are used together (Anggraini et al., 2021).

Polypharmacy Treatment of Geriatric Hypertension Patients at Janti Community Health Center in 2023

The most common polypharmacy was combination therapy with amlodipine, glimepiride, metformin, simvastatin, and vitamin B12, with a comorbid diagnosis of Disorders of Lipoprotein Metabolism and Other Lipidemias (E78) or dyslipidemia, and Non-Insulin Dependent Diabetes Mellitus (E11) or type 2 diabetes mellitus, with 5 incidents (2.10%). The antidiabetic drugs used were glimepiride and metformin. Glimepiride is a sulfonylurea that increases insulin secretion, while metformin increases insulin sensitivity and decreases hepatic glucose production. This combination of drugs is recommended if first-line monotherapy does not show a significant reduction in blood sugar levels (PERKENI, 2021).

Another medication most frequently prescribed for polypharmacy is treatment for dyslipidemia. Simvastatin is a statin class of dyslipidemia therapy that has a mechanism to reduce cholesterol formation in the liver, thus reducing intracellular cholesterol levels. This results in increased LDL receptor expression on the surface of hepatocytes, thus increasing LDL-C excretion. Statins are recommended as first-line therapy for patients with hypertriglyceridemia and high cardiovascular risk (PERKENI, 2019). Administration of vitamin B12 or cobalamin aims to prevent vitamin B12 deficiency in the body. As many as 10-30% of patients experience anemia due to impaired vitamin B12 absorption due to metformin use (Thambiah et al., 2015 in Irfayanti and Djabir, 2016). A study by Irfayanti and Djabir (2016) stated that there is a significant relationship between the incidence of anemia and vitamin B12 administration. The use of vitamin B12 has been shown to reduce the risk of anemia in patients with type 2 diabetes mellitus on metformin therapy (Irfayanti and Djabir, 2016).

Potentially Inappropriate Medications (PIMs) Based on the 2023 Beers Criteria

Category 1 medications are generally avoided in geriatric patients due to their high risk of causing adverse effects that outweigh the potential benefits. Of all medication use, the incidence of category 1 was 270 (20.09%). Category 1 medications include NSAIDs (meloxicam, diclofenac sodium, ibuprofen), cardiovascular and antithrombotic medications (salicylic acid and nifedipine), sulfonylureas (glimepiride), benzodiazepines (diazepam), gastrointestinal

medications (omeprazole), and antihistamines (chlorpheniramine maleate (CTM) and diphenhydramine).

Non-selective NSAIDs simultaneously inhibit the production of COX-1 and COX-2, resulting in gastric mucosal damage due to the inhibited production of the gastric mucosal lining (Indonesian Rheumatology Association, 2020). Non-selective NSAIDs can be used if other alternatives are ineffective, including the addition of gastroprotective agents (proton-pump inhibitors or misoprostol) (American Geriatric Society, 2023).

Among the antithrombotic and cardiovascular drugs, aspirin has a platelet antiaggregation mechanism, which plays a role in preventing and inhibiting platelet activation or aggregation. The 2023 Beers criteria do not recommend aspirin for primary prevention of cardiovascular disease, but rather for secondary prevention. It works by inhibiting prostaglandin formation in COX-1, which has a protective and lining mechanism for the gastric mucosa (Piepoli et al., 2016 in Yunita et al., 2020). Based on the 2023 Beers criteria, it is recommended to avoid fast-acting nifedipine, which is considered to cause hypotension. This occurs due to a drastic reduction in oxygen supply to the bloodstream, which affects blood pressure (Rahma et al., 2024). The sulfonylurea class primarily acts by increasing insulin secretion by pancreatic beta cells. The main side effects of this class of drugs are low blood sugar levels, or hypoglycemia, and weight gain (PERKENI, 2021). Benzodiazepines work by binding to benzodiazepine receptors in the central nervous system (CNS) and have a seizure-stopping effect (Batas and Patel, 2024). According to the Beers 2023 criteria, benzodiazepine use carries a risk of abuse and addiction. PPIs reduce gastric acid secretion by blocking the enzyme that produces gastric acid, the H⁺/K⁺ ATPase (Ahmed et al., 2023). PPI use for more than 8 weeks should be avoided except in high-risk patients (patients taking oral corticosteroids or chronic NSAIDs), erosive esophagitis, Barrett's esophagitis, pathological hypersecretory conditions, or indicating the need for maintenance treatment (American Geriatrics Society, 2023).

CTM and diphenhydramine are first-generation antihistamines. H-1 antihistamines generally cause clinically visible side effects, especially first-generation antihistamines, because they readily cross the blood-brain barrier into the central nervous system and bind to H-1 receptors (Farzam et al., 2023).

Category 2 antihistamines were potentially inappropriate for patients with certain diseases or syndromes due to the high risk of worsening the disease or syndrome. Of all drug uses, the incidence of category 2 was 30 (2.23%). NSAIDs and COX-2 inhibitors should be used with caution in asymptomatic cardiac patients and should be avoided in symptomatic cardiac patients (American Geriatrics Society, 2023). Inhibition of the COX enzyme reduces prostaglandin production in the kidneys, which has an inhibitory effect on sodium reabsorption, resulting in increased sodium absorption. This results in increased total body volume and exacerbation of heart failure (Ungprasert et al., 2015).

In patients with a history of gastric or duodenal ulcers (gastritis), non-selective NSAIDs and aspirin should be avoided. Non-selective NSAIDs simultaneously inhibit the production of COX-1 and COX-2, resulting in gastric mucosal damage due to the inhibited production of the gastric mucosal lining (Indonesian Rheumatology Association, 2020). This condition can worsen the condition in patients with a history of gastritis.

Category 3 drugs required careful monitoring and consideration. They are not completely prohibited, but require special monitoring to prevent unwanted side effects. Of all drug use, the

incidence of category 3 was 50 (3.72%). According to the 2023 Beers criteria, diuretic use in elderly patients can worsen or cause Syndrome of Inappropriate Antidiuretic Hormone Secretion (SIADH) or hyponatremia (American Geriatrics Society, 2023).

Category 4 drug interactions are clinically significant and should be avoided because they increase the risk of side effects or reduce the effectiveness of treatment when used concurrently. Of all drug interactions, the incidence of category 4 was 30 (2.23%). Spironolactone is a potassium-sparing diuretic, while candesartan is an angiotensin receptor blocker (ARB). The concomitant use of Renin-Angiotensin System (RAS) inhibitors (ARBs) and potassium-sparing diuretics can increase the risk of hyperkalemia (American Geriatrics Society, 2023).

The next drug interaction involves anticholinergic drugs. The most common anticholinergic interaction is between metformin and loratadine. Metformin has a mechanism that normalizes cholinergic responses, involving the M3 muscarinic acetylcholine receptor in pancreatic beta cells (Franco et al., 2021). Meanwhile, loratadine is a second-generation antihistamine with mild anticholinergic effects that affect muscarinic receptors (Catli et al., 2016). The use of more than one medication with anticholinergic effects can increase the risk of cognitive decline, delirium, and falls or fractures.

CONCLUSION

Based on research conducted at the Janti Community Health Center in Malang City, it was concluded that PIMs occurred in the treatment of geriatric patients with hypertension. The percentage of Potentially Inappropriate Medications (PIMS) incidence based on the Beers 2023 criteria in geriatric patients with hypertension was 20.09% in category 1, 2.23% in category 2, 3.72% in category 3, and 2.23% in category 4. This study did not find data related to category 5. Based on these results, it is clear that PIMs or inappropriate medication use occurs in geriatric patients treated for hypertension.

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