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High Prevalence of Potentially Inappropriate Medications among Geriatric Cardiovascular Patients: A Cross-Sectional Study at a Hospital in Eastern Indonesia

Nelly Kurniawati[1], Masni D[1], Sri rahayu[2], Oktaviano Mariano Alberthino Sola[2]

[1)] Department of Community and Clinical Pharmacy, Santo Fransiskus Xaverius Academy of Pharmacy, Indonesia
[2)] Diploma in Pharmacy Program, Santo Fransiskus Xaverius Academy of Pharmacy, Indonesia

e-mail: nellykurniawati.apt@gmail.com

ABSTRACT

Potentially Inappropriate Medications (PIMs) are a frequent concern among elderly patients with cardiovascular disease (CVD), where polypharmacy and age-related vulnerability increase the risk of adverse outcomes. This study investigated the prevalence and contributing factors of PIMs in elderly CVD patients at dr. TC Hillers Hospital, Maumere, Indonesia. Both the 2023 American Geriatrics Society (AGS) Beers Criteria and the Screening Tool of Older Persons' Prescriptions (STOPP) version 3 were applied to assess PIMs .

A hospital based cross sectional design was implemented from August to September 2023, enrolling outpatients aged 65 years and above with confirmed CVD diagnose. Data regarding sociodemographic characteristics, comorbidities, and medications were collected from medical records. Among 110 patients, 141 PIM events (18.1%) were identified from 779 medications using Beers 2023, and 168 PIM events (21.6%) using STOPP v3. Chi-square test was used to examine differences in the prevalence of PIMs across demographic and clinical characteristics.

The overall patient level prevalence of PIMs was 71% based on Beers 2023 and 68% based on STOPP v3. Polypharmacy was the strongest determinant, even in the absence of comorbidities. A higher Age-Adjusted Charlson Comorbidity Index (ACCI) scores showed no significant association with PIMs when using Beers 2023, but was significantly with STOPP v3. No significant associations were found with age or gender. Proton pump inhibitors, diuretics, and the combination of spironolactone with RAS inhibitors were the most frequent PIMs. In conclusion, PIM prevalence among elderly CVD outpatients in Maumere is alarmingly high, reflecting the complexity of cardiovascular pharmacotherapy.

Keywords: potentially inappropriate medication, cardiovascular disease, Beers 2023, STOPP v3, polypharmacy.

Introduction

Cardiovascular disease (CVD) continues to be a major contributor to morbidity and mortality worldwide, with its prevalence rising steadily in recent decades. In Indonesia, the burden of cardiovascular disease has risen by 120% over the past three decades, highlighting the urgency of addressing this health problem comprehensively (Muharram et al., 2024). At the same time, the proportion of the elderly population has also continued to rise, with approximately 12% of Indonesians aged 60 years and above, of which 42.8% reported health complaints with a morbidity rate of 20.7% (BPS, 2024). Physiological alterations in metabolism, and elimination during aging contribute to the elderly's heightened vulnerability to adverse drug events including the use of PIMs (Ejaz et al., 2023; Ngcobo, 2025).

PIMs are defined as medications in which the risks outweigh the potential benefits, particularly in elderly patients, especially when safer alternatives exist (Rodrigues et al., 2022). The issue of PIM use has become a global concern, particularly among older adults with cardiovascular diseases, who are frequently exposed to multiple long-term medications. Studies from various regions have documented that PIM prevalence in elderly cardiac patients can reach 85% (Alwhaibi & Alkofide, 2023; Saqlain et al., 2020; Stojanovic et al., 2022). Benzodiazepines, anticholinergic agents, nonsteroidal anti-inflammatory drugs (NSAIDs), and several cardiovascular medications, including certain antihypertensives, combined antiplatelet anticoagulant regimens, and digoxin are commonly reported as potentially inappropriate medications among elderly patients with cardiovascular disorders. The use of these drugs has been linked to negative clinical consequences such as falls, cognitive decline, gastrointestinal bleeding, worsening of heart failure, unplanned hospital admissions, and deterioration in quality of life (Chen & Zhang, 2021; Lu et al., 2022; Ngcobo, 2025; Saqlain et al., 2020; Stojanovic et al., 2022). Within the context of cardiovascular disease, PIM use becomes even more concerning because these patients often present with multiple comorbidities requiring polypharmacy, thus compounding the risks of adverse drug reactions and drug–drug interactions (Anfinogenova et al., 2021; Stojanovic et al., 2022).

Several tools have been developed globally to evaluate the appropriateness of prescribing practices in elderly populations. Two of the most widely accepted are the AGS Beers Criteria and the STOPP tool. The Beers Criteria, most recently updated in 2023, incorporated more categories of cardiovascular drugs, such as anticoagulants and antihypertensives, making it highly relevant to older populations (AGS, 2023). Similarly, the STOPP Criteria, updated to version 3 in 2022, emphasizes inappropriate polypharmacy, drug duplication, and potential drug–drug interactions, which are especially pertinent among elderly cardiovascular patients (O'Mahony, Cherubini, et al., 2023). Using these two tools in combination offers a more comprehensive evaluation of PIMs and provides stronger guidance for minimizing drug-related risks in elderly care, particularly in clinical settings with limited resources.

The negative impact of PIM use extends beyond clinical consequences to social and economic burdens, with multiple studies showing strong associations between

PIMs and increased morbidity, mortality, hospitalizations, and healthcare expenditures (Jenghua et al., 2024; Li et al., 2023). In addition, polypharmacy commonly observed in elderly patients with chronic illnesses further contributes to the prevalence of PIM (Li et al., 2023; Lu et al., 2022). Elderly patients with three or more comorbidities, such as hypertension, diabetes, and dyslipidemia, are more likely to take five or more medications simultaneously, thereby increasing the likelihood of harmful interactions and serious adverse effects. These consequences impose substantial financial strain not only on patients and their families but also on healthcare systems, particularly those serving rural or resource-limited areas (Alwhaibi & Alkofide, 2023; Li et al., 2023).

Several determinants have been identified as significant predictors of PIMs use in elderly patients. These include advanced age, gender, comorbidity status, and polypharmacy. For instance, a study in the United States revealed that women were more likely to be prescribed PIMs, particularly in the context of metabolic and cardiovascular multimorbidity (Ukhanova et al., 2021). In Switzerland, prevalence studies demonstrated that the use of PIMs increases with advancing age (Schietzel et al., 2024). Medical comorbidities such as diabetes, hypertension, and dyslipidemia are strongly associated with the use of PIMs among elderly patients with cardiovascular diseases (Alwhaibi & Alkofide, 2023; Lu et al., 2022). Among all determinants, polypharmacy has consistently been identified as the strongest risk factor. In fact, a recent study in China reported an odds ratio greater than 10 for polypharmacy among elderly heart failure patients (Zhang et al., 2024). These findings underscore the importance of thoroughly analyzing these determinants when evaluating the prevalence of PIMs.

Although international research has provided significant insights into PIM use in elderly cardiovascular patients, these findings cannot be directly generalized to the Indonesian context. Differences in healthcare systems, drug availability, prescribing practices, and patient characteristics limit the applicability of global evidence to local practice (Awad et al., 2023; Stojanovic et al., 2022). To date, there has been no study in Indonesia that specifically evaluates the prevalence of PIMs in elderly cardiovascular patients using the most recent updates of the BEERS 2023 and STOPP version 3 criteria. This represents a substantial research gap, particularly considering that both tools provide the most up-to-date and detailed frameworks for evaluating cardiovascular medications in elderly patients. Generating local evidence is therefore critical, especially in public hospitals that serve under-resourced communities, such as those in Eastern Indonesia, where patient populations and healthcare delivery systems differ from those in urban or developed settings.

Therefore, this study aimed to quantify the prevalence and determinants of PIMs among elderly CVD outpatients in dr. TC Hillers General Hospital, Maumere, Indonesia using both the AGS Beers Criteria 2023 and the STOPP version 3. In addition, the study seeks to explore potential determinants of PIM use, including age, gender, comorbidities, and polypharmacy. By integrating these approaches, the study aims to generate evidence on prescribing practices in elderly cardiovascular patients within a regional Indonesian hospital context, thereby providing a baseline reference

for developing safer and more effective strategies to optimize pharmacotherapy in this vulnerable population.

Methodology

This study employed an observational design with a quantitative cross-sectional approach using a descriptive-comparative method. The design was selected to evaluate the prevalence of PIMs use among elderly patients with cardiovascular diseases and to analyze differences in PIMs prevalence based on demographic and clinical factors such as age, gender, polypharmacy, and comorbidities.

The study population consisted of elderly outpatients aged 65 years and above who had a corfirmed CVD diagnosis and attended the cardiology clinic at dr. TC Hillers General Hospital, Maumere. The data collection was carried out during the period of August to September 2025. A purposive sampling technique was employed with the inclusion criteria were: (1) patients aged ≥65 years with a confirmed cardiovascular diagnosis, (2) complete and legible medical records, and (3) willingness of the patient or their legal guardian to sign an informed consent form. Purposive sampling was applied to recruit eligible participants. Based on a 95% confidence level and a presumed PIM prevalence of 50%, the required minimum sample size was 97, which was expanded to 110 to maintain statistical power.

The primary research instrument was the patients medical records. From these records, demographic data (age, gender), clinical information (documented comorbidities), and complete medication lists were extracted. Prescribed medications were then evaluated using two established instruments, the AGS) Beers Criteria 2023 (AGS, 2023) and the STOPP version 3 (O'Mahony et al., 2023). Polypharmacy was defined as the use of 5-9 medications, and excessive polypharmacy as ≥10 medications. Comorbidity status was assessed by documenting all chronic conditions listed in the patients' medical records beyond the primary cardiovascular diagnosis. This assessment included conditions weighted in the Age-Adjusted Charlson Comorbidity Index (ACCI) as well as other chronic diseases relevant to patient morbidity . Patients were categorized as having 'no comorbidity' (absence of any additional chronic conditions) or 'present comorbidity' (presence of one or more additional chronic conditions). Comorbidities were also assessed using the Age-Adjusted Charlson Comorbidity Index (ACCI) (Zhou et al., 2022).

The data collection procedure was conducted in several steps. First, medical records of outpatients fulfilling the inclusion criteria were identified. Second, demographic and clinical characteristics were systematically recorded into a standardized data collection form. Third, all medications prescribed to these patients were classified according to AGS Beers 2023 and STOPP v.3 to determine whether they fell into the category of PIMs. This procedure enabled the identification of inappropriate prescribing patterns within the study population.

Data analysis was performed using IBM SPSS Statistics version 26. Descriptive statistics were utilized to summarize the participants' characteristics, with categorical data presented as frequencies and percentages, and continuous data as mean ± standard deviation. Inferential analyses were applied to address two key objectives. First, to compare the PIMs identified by the Beers 2023 criteria against

those identified by the STOPP v3 criteria, a Chi-square test was used to compare the overall patient-level prevalence (dichotomized as 'PIM' vs. 'No PIM'), while a Mann-Whitney U test was employed to compare the distribution of the number of PIMs per patient, as this data was not normally distributed. Second, to analyze the associations between patient characteristics and PIM prevalence, Chi-square tests (or Fisher's exact tests where cell count assumptions were violated) were conducted. These analyses were performed separately for PIMs defined by each criterion to examine relationships with gender, age group, polypharmacy status, and comorbidity status. A significance level of $p < 0.05$ was applied for all statistical tests. The research protocol received ethical approval from the Health Research Ethics Committee of Universitas Muhammadiyah Lamongan (No. 323/EC/KEPK-S1/09/2025).

Result and Discussion

A total of 110 elderly patients with cardiovascular disease were included in this study, presented in Table 1. Most participants were male (62.7%, n=69), while females constituted 37.3% (n=41). The age of respondents ranged from 65 to 92 years, with a mean of 70.54 ± 5.37 years. The majority of patients fell into the 65–74 age group (79.1%, n=87). Regarding medication count, patients received between 2 and 13 drugs, with a mean of 7.08 ± 2.25. In terms of polypharmacy status, most patients were taking 5–9 drugs (65.5%, n=72), while 20.9% (n=23) were classified as excessive polypharmacy (≥10 drugs), and only 13.6% (n=15) were taking fewer than five medications.

Table 1. Distribution of demographic and clinical features among study subjects

Characteristics	N	%
Gender		
Male	69	62,7
Female	41	37,3
Age (years)		
65-74	87	79,1
75-84	21	19,1
≥ 85	2	1,8
Mean ± SD = 70,54 ± 5,37		
Min-Max = 65 – 92		
Number of Medications		
Non Polypharmacy (<5)	15	13,6
Polypharmacy (5-9)	72	65,5
Excessive Polypharmacy (>9)	23	20,9
Mean ± SD = 7,08 ± 2,25		
Min-Max = 2 - 13		
Reported diseases and symptoms		
1-3	101	91,8
4-6	9	8,2
Comorbidity[a]		
Absent	95	86,4
Present	15	13,6
One	12	10,9
Two	3	2,7
ACCI[b]		
Low (1-2)	0	0
Intermediate (3-4)	100	91
High (≥5)	10	9

Mean ± SD = 3,6±0,85
Min-Max = 3-9

[a] Comorbidities include both ACCI-weighted conditions and other chronic diseases (e.g., osteoarthritis) relevant to patient morbidity
[b] ACCI: Age-Adjusted Charlson Comorbidity Index

With respect to disease burden, 91.8% of the patients reported having between one and three concurrent conditions or symptoms, while 8.2% had between four and six. Regarding comorbidity status, the majority (86.4%, n=95) had no documented comorbidity, while 13.6% (n=15) had at least one comorbid condition. Assessment using the ACCI indicated that 91% (n=100) were classified in the moderate risk category (score 3–4), while 9% (n=10) were in the high risk category (score ≥5). No patients were categorized as low risk. The overall mean ACCI score was 3.6 ± 0.85, with values ranging from 3 to 9.

Table 2. Distribution of Cardiovascular Diagnoses and Comorbid Conditions

Diagnoses	ICD-10	N (%)
Cardiovascular Conditions		
Angina pectoris, unspecified	I20.9	77 (50,7)
Hypertensive heart disease without (congestive) heart failure	I11.9	24 (15,8)
Heart failure, unspecified	I50.9	22 (14,5)
Atrial fibrilation, unspecified	I48.0	6 (3,9)
Artrial Premature Depolarisation	I49.1	3 (2,0)
Acute pulmonary edema	J81.0	3 (2,0)
Rheumatic tricuspid insufficiency	I07.1	2 (1,3)
Nonrheumatic aortic (valve) insufficiency	I35.1	2 (1,3)
Ventricular Premature Depolarisation	I49.3	2 (1,3)
Others		12 (7,2)
Total		**152 (100)**
Comorbid Conditions		
Type 2 diabetes mellitus without complications	E11.9	6 (33,3)
Chronic obstructive pulmonary disease, unspecified	J44.9	3 (16,7
Chronic kidney disease, stage 3	N18.3	2 (11,10
Others specified anemias	D64.8	2 (11,1)
Malignant neoplasm of colon, unspecified	C18.9	1 (5,6)
Chronic renal failure, unspecified	N18.9	1 (5,6)
Sequelae of cerebral infarction	I69.3	1 (5,6)
Osteoarthritis of knee, unspecified	M17.9	1 (5,6)
Hyperuricemia with arthritis	E79.2	1 (5,6)
Total		**18 (100)**

The distribution of cardiovascular diagnoses and non-cardiovascular comorbidities is detailed in Table 2. The most common diagnosis was unspecified angina pectoris (I20.9), accounting for 50.7% (n=77) of cases. This was followed by HHD without HF (I11.9; 15.8%, n=24) and heart failure (I50.9; 14.5%, n=22). The prevalence of non-cardiovascular comorbidities was relatively low, with type 2 diabetes mellitus being the most frequent (33.3%), followed by COPD (16.7%) and CKD stage 3 (11.1%). In this study, the prevalence of non-cardiovascular comorbidities was relatively low, with type 2 diabetes mellitus being the most frequent (33.3%), followed by COPD (16.7%) and CKD stage 3 (11.1%). This contrasts with previous reports from larger cohorts, which showed higher rates of diabetes and CKD, often exceeding 50% (Li et al., 2023; Alwhaibi & Alkofide, 2023; Lee et al., 2024).

The lower burden in our findings may be explained by the study setting in a type C regional hospital, where patients with complex multimorbidity are commonly referred to higher-level facilities. In addition, the cross-sectional design based on medical records may underestimate comorbidities due to underdiagnosis or incomplete documentation. These results suggest that, although polypharmacy remains the main determinant of PIM in our study, systematic screening and improved medical record keeping are needed to ensure optimal management of CVD patients in resource-limited settings.

Table 3 demonstrates that the prevalence of PIMs among patients with cardiovascular disease (CVD) at dr. TC Hillers General Hospital, Maumere, remains high when assessed using both the 2023 AGS Beers Criteria and STOPP version 3. Approximately 71% of patients were prescribed at least one PIM as identified by the Beers 2023 criteria, while 68% were identified by STOPP v.3. These findings are consistent with international evidence showing similarly high prevalence rates, such as those reported by Krustev et al. (2022) in Bulgaria (64.8%), Stojanovic et al. (2022) in Serbia (70.3%), Saqlain et al. (2020) in Pakistan (67.4%), and Zhang et al. (2024) in China (67.9%). Even higher prevalence has been observed in Morocco (84%) (Maaroufi et al., 2021) and in China during hospitalization (93.8%) (Li et al., 2023). The findings of this study confirm that inappropriate prescribing is not confined to developed health systems but represents a global challenge, including in Indonesia.

Table 3. Comparison of PIM Prevalence Between Beers 2023 and STOPP v3 Criteria

PIM Prescribed	Beers Criteria 2023 n(%)	STOOP vs.3 n(%)	P-value
No PIM	32 (29)	35 (32)	0,66[a]
PIM	78 (71)	75 (68)	
1	36 (46)	31 (42)	
2	27 (35)	14 (19)	
3	10 (13)	18 (24)	0,51[b]
4	4 (5)	7 (9)	
5	1 (1)	4 (5)	
7	0 (0)	1 (1)	
Mean ± SD	1,8±0,94	2,24±1,34	
Min-Max	1-5	1-7	

[a] Chi-square test
[b] Mann-U Whitney test

Comparisons of PIM prevalence across demographic and clinical factors are shown in Table 4. No statistically significant differences were found by gender (p=1.000 for BEERS 2023 and p=0.658 for STOPP v.3) or by age group (p=0.447 and p=0.814, respectively). In contrast, the number of prescribed medications was strongly associated with PIMs. Patients with polypharmacy (5–9 drugs) or excessive polypharmacy (≥10 drugs) were significantly more likely to have PIMs compared with those without polypharmacy (p=0.001 for both criteria).

The number of concurrent conditions or symptoms did not show a significant association with PIM use (p=1.000 for BEERS 2023 and p=0.716 for STOPP v.3). However, comorbidity status revealed mixed results. Using BEERS 2023, the association was not statistically significant (p=0.063), whereas STOPP v.3 showed a

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Table 4. Comparison of PIM Incidence Based on Patient Demographic Characteristics

Demographic Characteristic	Beers 2023					STOPP vs.3				
	No PIM n (%)	PIM n (%)	Total	OR (95% CI)	P-value	No PIM n (%)	PIM n (%)	Total	OR (95% CI)	P-value
Gender										
Male	20 (29)	49 (71)	69 (100)	0,98	1,000[c]	23 (33)	46 (67)	69 (100)	1,2	0,658[c]
Female	12 (29)	29 (71)	41 (100)	(0,4-2,3)		12 (29)	29 (71)	41 (100)	(0,52-2,79)	
Age (years)										
65-74	27 (31)	60 (69)	87 (100)	N/A	0,447[c]	28 (32)	59 (68)	87 (100)	N/A	0,814[c]
75-84	4 (19)	17 (81)	21 (100)			6 (29)	15 (71)	21 (100)		
≥ 85 tahun	1 (50)	1 (50)	2 (100)			1 (50)	1 (50)	2 (100)		
Number of Medications										
Non Polypharmacy (<5)	11 (73)	4 (27)	15 (100)	N/A	0,001[c]	10 (67)	5 (33)	15 (100)	N/A	0,001[c]
Polypharmacy (5-9)	21 (29)	51 (71)	72 (100			24 (33)	48 (67)	72 (100)		
Excessive Polypharmacy (>9)	0 (0)	23 (100)	23 (100)			1 (4)	22 (96)	23 (100)		
Reported diseases and symptoms										
1-3	30 (30)	71 (70)	101 (100)	1,48	1,000[d]	33 (33)	68 (67)	101 (100)	1,69	0,716[d]
4-6	2 (22)	7 (78)	9 (100)	(0,29-7,54)		2 (22)	7 (78)	9 (100)	(,33-8,63)	
Comorbidity[a]										
Absent	31 (33)	64 (67)	95 (100)	6,78	0,063[d]	34 (36)	61 (64)	95 (100)	7,8	0,034[d]
Present	1 (7)	14 (93)	15 (100)	(0,85-53,9)		1 (7)	14 (93)	15 (100)	(0,98-61,9)	
ACCI[b]										
Low risk(1-2)	0 (0)	0(0)	0(0)	1,71	0,721[d]	0 (0)	0(0)	0(0)	1,97	0,498[d]
Intermediate risk (3-4)	30 (30)	70 (70)	100 (100)	(0,344-8,554)		33 (33)	67 (67)	100 (100)	(0,39-9,80)	
High risk (≥5)	2 (20)	8 (80)	10 (100)			2 (20)	8 (80)	10 (100)		

[a] Comorbidities include both ACCI-weighted conditions and other chronic diseases (e.g., anemia, osteoarthritis) relevant to patient morbidity
[b] ACCI: Age-Adjusted Charlson Comorbidity Index
[c] Chi-Square test
[d] Fisher's Exact test

significant relationship between comorbidity and PIM use (p=0.034). Analysis by ACCI category demonstrated no significant differences, with p=0.721 for BEERS 2023 and p=0.498 for STOPP v.3. Collectively, these findings highlight polypharmacy as the strongest determinant of PIM prevalence in elderly cardiovascular patients.

Polypharmacy emerged as the strongest determinant of PIMs in this study, increasing the likelihood of exposure to inappropriate medications in line with international findings. Jaber et al. (2022) demonstrated that polypharmacy significantly increased the risk of PIMs in heart failure patients (RR 1.34; p<0.001), while Jenghua et al. (2024) in Thailand found that polypharmacy (aOR 3.15) and hyper-polypharmacy (aOR 3.80) were strong predictors of PIMs. Alwhaibi & Alkofide (2023) similarly noted that polypharmacy was the most consistent determinant of PIMs in geriatric with dyslipidemia, and Malakouti et al., (2021) showed that variation in prevalence across studies is largely explained by differences in polypharmacy. Importantly, this study also found that the majority of cardiovascular patients received polypharmacy even in the absence of comorbidities, indicating that the complexity of cardiovascular pharmacotherapy alone is sufficient to increase the risk of PIMs. Thus, even without multiple chronic conditions, elderly CVD patients remain vulnerable to inappropriate prescribing simply because of the high number of drugs required in their management.

Although the association between ACCI and PIM prevalence in this study was not statistically significant, there was a trend toward increased PIM exposure among patients with higher ACCI scores. This is in agreement with Zhao et al. (2021), who confirmed that higher ACCI scores predicted increased PIMs among patients with chronic coronary syndrome, and with Lee et al. (2024), who identified CCI as a strong predictor alongside clinical and laboratory markers. Zhang et al. (2024) further emphasized that greater disease burden, particularly valvular heart disease and insomnia, significantly increased PIM odds. In contrast, this study found no significant association between age or gender and PIM prevalence, whereas Kitapçı et al. (2023)reported greater risk among men and those ≥80 years, and Krustev et al. (2022) and Stojanovic et al. (2022) found higher prevalence among women, highlighting contextual variability across populations.

Table 5 shows the distribution of specific medications classified as PIMs by BEERS 2023. The most frequently identified were proton pump inhibitors (PPIs), primarily lansoprazole (28.5%) and omeprazole (1.4%). Cardiovascular medications such as digoxin (3.5%), warfarin (2.8%), and amiodarone (0.7%) were also categorized as PIMs. In addition, small numbers of patients were prescribed gliclazide, metoclopramide, or sodium diclofenac. Within the “use with caution” category, furosemide was most common (32%), followed by spironolactone (13.5%). Notably, 17 cases (12.1%) involved combinations of spironolactone with renin-angiotensin system inhibitors (lisinopril, candesartan, ramipril, or sacubital-valsartan), which are considered clinically risky drug interactions. Overall, 141 PIM events (18.1%) were identified out of a total of 779 prescribed medications using BEERS 2023 criteria.

STOPP v.3 identified a slightly different distribution of PIMs, as shown in Table 6. The most frequent category was PPI use without clear clinical indication, with

lansoprazole prescribed in 41 cases (24.6%) and omeprazole in 2 cases (1.2%). Sucralfate was identified in 26 cases (15.5%), and furosemide in 19 cases (11.3%). Other drugs flagged as PIMs included cetirizine, digoxin, ranitidine, methylprednisolone, salbutamol, and amiodarone. Similar to BEERS 2023, STOPP v.3 also highlighted potentially inappropriate use of spironolactone in combination with ACE inhibitors or ARBs. In total, 168 PIM events (21.6%) were detected out of 779 prescribed medications using STOPP version 3.

Table 5. PIM Category in Beers Criteria 2023

Drug	Quality of Evidence	Strength of Recommendations	Total (%)
Category 1: Potentially Inappropriate Medication (PIM) Use in Older Adults			
Proton Pump Inhibitor			
Lansoprazole	High	Strong	40 (28,5)
Omeprazole	High	Strong	2 (1,4)
Digoxin	Moderate	Strong	5 (3,5)
Warfarin	High	Strong	4 (2,8)
Gliclazid	High	Strong	2 (1,4)
Amiodarone	Higgh	Strong	1 (0,7)
Metoclopramide	Moderate	Strong	1 (0,7)
Na Diclofenac	Moderate	Strong	1 (0,7)
Category 3: Drugs to be used with caution in older adults			
Diuretic			
Furosemide	Moderate	Strong	45 (32,0)
Spironolactone	Moderate	Strong	19 (13,5)
Hydrochlorthiazide	Moderate	Strong	1 (0,7)
Ticagrelor	Moderate	Strong	2 (1,4)
Dapagliflozin	Moderate	Weak	1 (0,7)
Category 4: potentially clinically important drug–drug interactions that should be avoided in older adults			
Spironolactone+ RAS Inhibitor			
Spironolactone+Lisinopril	Moderate	Strong	10 (7,1)
Spironolactone+Candesartan	Moderate	Strong	5 (3,5)
Spironolactone+ramipril	Moderate	Strong	1 (0,7)
Spironolactone+sacubital-valsartan	Moderate	Strong	1 (0,7)
TOTAL			141(100)

The analysis of specific drugs offers important insights into prescribing practices and clinical implications. Proton pump inhibitors, particularly lansoprazole, were the most common PIMs identified in this study. Lansoprazole was frequently prescribed as prophylaxis against gastrointestinal bleeding in elderly patients who received antiplatelet or anticoagulant therapy. STOPP v3 identifies PPIs as inappropriate in two important sections, Section A (use without clear indication) and Section F.2 (continuation beyond 8 weeks in uncomplicated disease). Beers 2023 likewise cautions against prolonged use due to risks such as osteoporosis, vitamin B12 deficiency, hypomagnesemia, and infections. From a clinical standpoint, routine PPI prophylaxis in all patients receiving antiplatelet therapy is not evidence-based, as gastroprotective therapy is only justified in high-risk subgroups such as those with a history of peptic ulcer, gastrointestinal bleeding, or concomitant NSAID or corticosteroid therapy (Kahali et al., 2024). The blanket use of lansoprazole as a preventive measure for all CVD patients receiving aspirin or anticoagulants therefore

represents an inappropriate extension of therapy, contributing to the high prevalence of PIMs in this cross-sectional population. This finding underscores the importance of individualized risk assessment when considering gastroprotective therapy, balancing the risk of bleeding against the well-documented harms of long-term PPI use in older adults.

Table 6. PIM Category in STOPP vs.3

Section and Drug	N (%)
Section A: Indication of medication	
1. Any drug prescribed without a clinical indication	
Lansoprazole	30 (18,0)
Sucralfate	26 (15,5)
Furosemide	19 (11,3)
Salbutamol	4 (2,4)
Cetirizine	8 (4,8)
Digoxin	4 (2,4)
Methylprednisolon	3 1,8)
Ranitidin	2 (1,2)
Omeprazole	2 (1,2)
Amiodarone	1 (0,6)
Aminophylin	1 (0,6)
Section B: Cardiovascular System	
13. Aldosterone antagonists with concurrent potassium conserving drugs without monitoring of serum potassium	
Spironolactone+Lisinopril	10 (6,0)
Spironolactone+Candesartan	5 (3,0)
Spironolactone+ramipril	1 (0,6)
Spironolactone+sacubital-valsartan	1 (0,6)
15. Drugs that predictably prolong the QTc interval in patients with known with demonstrable QTc prolongation	
Digoxin	1 (0,6)
Amiodarone	1 (0,6)
Section C: Coagulation System	
5. Antiplatelet agents with vitamin K antagonist, direct thrombin inhibitor or factor Xa inhibitors in patients with stable coronary, cerebrovascular or peripheral arterial disease	
Clopidogrel+Warfarin	1 (0,6)
11. Vitamin K antagonist as first-line anticoagulant for atrial fibrillation, unless there is concurrent metallic heart valve in-situ, moderate-to-severe mitral stenosis, or eGFR < 15 mls/min./1.73m2	
Warfarin	4 (2,4)
Section F: Gastrointestinal System	
2. Proton pump inhibitor (PPI) for uncomplicated peptic ulcer disease at full therapeutic dosage for > 8 weeks	
Lansoprazole	41 (24,6)
Omeprazole	2 (1,2)
Section J: Endocrine System	
4. Sodium glucose co-transporter (SGLT2) inhibitors with symptomatic hypotension	
Dapagliflozin	1 (0,6)
TOTAL	**168 (100)**

Digoxin was also commonly used and is considered inappropriate at doses higher than 0.125 mg/day in elderly patients according to Beers 2023, while STOPP v3 highlights its risk in patients with prolonged QTc. Spironolactone and its

combination with RAS inhibitors were observed, this regimen is included in Beers 2023 category 4 for drug–drug interactions due to risk of severe hyperkalemia, while STOPP v3 Section B.13 specifically advises against the combination without potassium monitoring (AGS, 2023; O'Mahony et al., 2023). Furosemide, though clinically useful, was considered inappropriate when prescribed without indications such as heart failure or nephrotic syndrome (STOPP v3 Section A). Beers 2023 categorizes all diuretics as "use with caution" due to their potential to cause hyponatremia and SIADH (Syndrome of Inappropriate Antidiuretic Hormone secretion), conditions that are particularly dangerous in older adults because of increased susceptibility to electrolyte imbalance, confusion, falls, and seizures (Emektar et al., 2024). These risks are exacerbated in frail elderly CVD patients who may already be on multiple medications affecting renal and fluid balance (Docherty et al., 2021). Clinically, this highlights the importance of strict monitoring of electrolytes and fluid status in patients receiving diuretics, with deprescribing considered in the absence of clear indications.

Warfarin used in atrial fibrillation, was classified as a PIM because Direct Oral Anticoagulant (DOAC) are preferred in non-valvular AF, both in Beers 2023 and STOPP v3 (Section C.11), due to lower bleeding risk and fewer monitoring requirements. Amiodarone was also detected and is considered inappropriate as first-line therapy for atrial fibrillation under Beers 2023, given its long-term toxicities including pulmonary fibrosis, thyroid dysfunction, hepatotoxicity, and proarrhythmia, STOPP v3 likewise discourages its first-line use in supraventricular arrhythmias (AGS, 2023; O'Mahony et al., 2023). Salbutamol was prescribed to some patients with angina pectoris presenting with dyspnea and productive cough. While STOPP v3 (Section A) lists beta-2 agonists as inappropriate when given without indication or in the presence of cardiovascular risk, and although Beers 2023 does not explicitly include them, salbutamol is clinically problematic in elderly CVD patients as it can cause tachycardia and exacerbate angina or heart failure (Cazzola et al., 2024).

Nonsteroidal anti-inflammatory drugs, especially diclofenac, were also identified; STOPP v3 cautions against their use in CVD due to fluid retention and renal impairment, and Beers 2023 similarly warns of cardiovascular and renal risks. Gliclazide, a sulfonylurea, was flagged as a PIM because of prolonged hypoglycemia risk in older patients, consistent with Beers 2023 which advises against sulfonylureas in general. Finally, metoclopramide was noted; Beers 2023 categorizes it as inappropriate (Category 2) for long-term use due to risk of extrapyramidal symptoms and tardive dyskinesia, though STOPP v3 does not explicitly list it (AGS, 2023; O'Mahony et al., 2023). Together, these ten drugs illustrate the breadth of inappropriate prescribing patterns in elderly CVD patients and highlight the utility of combining Beers and STOPP criteria to capture drug–drug interactions, dose thresholds, and clinical indications.

The consequences of PIMs extend well beyond theoretical concerns, with significant clinical and economic burdens. Li et al. (2023) demonstrated associations between PIM exposure and increased readmission, mortality, and composite adverse outcomes. Saqlain et al. (2020) reported that the use of PIMs was significantly associated with lower health related quality of life among older adults with

cardiovascular diseases. Anfinogenova et al. (2021)reported that PIMs increase hospitalization rates by 10–33% and mortality risk by 1.6 fold. Economically, Malakouti et al. (2021) estimated that PIMs raise healthcare expenditures by an average of USD 2,000 per patient annually, contributing to substantial systemic costs. These findings confirm that inappropriate prescribing contributes to preventable morbidity, higher healthcare utilization, and reduced patient well-being.

In Indonesia, similar patterns are evident. Septiani & Rahmawati (2025) reported that 97% of elderly CVD patients at Wangaya Hospital experienced drug–drug interactions, with 280 PIMs identified using Beers 2019. Most were on moderate polypharmacy (8–10 drugs/day), mirroring findings in Maumere and underscoring that inappropriate prescribing is not limited to tertiary hospitals but is widespread across regional facilities. The novelty of this study lies in being the first to evaluate PIMs among elderly CVD patients in Maumere, East Nusa Tenggara, a region with limited resources and scarce prior data. By documenting the prevalence, determinants, and clinical implications of PIMs in this setting, the study addresses an important research gap and provides valuable evidence from a regional Indonesian context that is rarely represented in the literature.

The implications of these findings are multifaceted. Routine deprescribing interventions and structured medication reviews should be incorporated into clinical practice to reduce PIM burden. As emphasized by Anfinogenova et al. (2021), Implementing a multidisciplinary strategy that actively involves clinical pharmacists is essential for evaluating medication regimens, detecting potential drug interactions, and minimizing the risk of adverse drug events. Tools such as BEERS 2023 and STOPP v3 should be institutionalized in prescribing protocols to ensure consistent screening. Patient and caregiver education on polypharmacy risks and adherence to appropriate regimens must also be prioritized to ensure long-term safety. Several limitations should be acknowledged in this study, such as the cross-sectional nature that precludes causal interpretation, the single-institution setting which may restrict the external validity of findings, and the retrospective data retrieval that could potentially introduce bias. Nevertheless, the consistent findings on prevalence and determinants provide a strong foundation for future multicenter, prospective research in Indonesia, ideally incorporating intervention studies to test deprescribing models adapted to local contexts.

Conclusion

This study quantified a notably high and comparable prevalence of potentially inappropriate medication (PIM) use among elderly cardiovascular outpatients in Maumere, Indonesia. There was no statistically significant difference in PIM prevalence between the Beers 2023 Criteria (71%) and the STOPP version 3 (68%), as determined by the Chi-square test ($p = 0.66$). Polypharmacy was the strongest determinant, while age, gender, and comorbidity scores were not significantly associated. Three major drug groups contributed to the PIM burden, including proton pump inhibitors, diuretics, and spironolactone with RAS inhibitors. These findings highlight the importance of applying explicit prescribing criteria, structured

medication review, and deprescribing strategies to optimize therapy and improve patient safety.

Declaration of Competing Interest

The authors confirm that there are no conflicts of interest associated with this publication

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