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# Potentially Inappropriate Medications Use and Associated Factors Among Older Patients on Follow-Up at the Chronic Care Clinic of Hiwot Fana Comprehensive Specialized Hospital in Eastern Ethiopia

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## ABSTRACT

**Background:** Potentially inappropriate medications (PIMs) use often cause to poor health outcomes in older patients. There is a dearth of information on PIMs use in this population of patients seeking treatment at Hiwot Fana Comprehensive Specialized Hospital.

**Objective:** To assess PIMs use and associated factors among older patients receiving follow-up treatment at the chronic care clinic of Hiwot Fana Comprehensive Specialized Hospital in eastern Ethiopia.

**Methods:** A retrospective cross-sectional study using medical records of 419 older patients was conducted. Older patients, aged 65 years or older, treated in the ambulatory care clinic were included. Simple random sampling technique was used. PIMs use was identified by using the 2023 American Geriatrics Society Beers Criteria (AGS Beers Criteria) and Screening Tool of Older People's Potentially Inappropriate Prescriptions Criteria and Screening Tool to Alert Doctors to Right Treatment (STOPP/START) version 2 criteria. The multivariable logistic regression analysis was employed to identify factors associated with PIMs use. The strength of statistical association was measured by adjusted odds ratio (aOR) and 95% CI. *P* values < 0.05 were considered statistically significant.

**Results:** A total of 419 patients' medical records were reviewed. Of these, 411 patients' medical records fulfilled the inclusion criteria and were considered for final analysis. About 56.9% (*n*= 234) of the study population was women. The prevalence of PIMs use was 28.5% and 18.5%, according to 2023 AGS Beers Criteria and STOPP/START version 2 criteria, respectively. In accordance with 2023 AGS Beers Criteria, male sex (aOR=1.78; 95% CI, 1.10–2.87), diabetes mellitus (aOR=0.35; 95% CI, 0.19–0.62), and chronic kidney disease (aOR=6.68; 95% CI, 2.55–9.32) were found to be the determining factors for PIMs use. According to STOPP/START version 2 criteria, deep vein thrombosis, diabetes mellitus, hypertension, and advanced age were the primary factors influencing PIMs use.

**Conclusions:** Compared with other study findings from across the world, the prevalence of PIMs use was low. Based on 2023 AGS Beers Criteria, male sex, diabetes mellitus, and chronic kidney disease were found to be the determinant factors for PIMs use. Deep vein thrombosis, diabetes mellitus, hypertension, and advanced age were significant factor of PIMs use according STOPP/START version 2 criteria.

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## Introduction

Globally, the number of people older than age 65 years is expected to double from 703 million in 2019 to 1.5 billion in 2050.<sup>1</sup>

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The proportion of people aged 65 years and older in Ethiopia is rising over time, from 2.9% in 1973 to 3.1% in 2022, and growing at an average annual rate of 0.19%.<sup>2</sup>

Risks may be outweighing benefits in certain medicine types known as potentially inappropriate medications (PIMs).<sup>3</sup> Health care professionals still prescribe PIMs despite evidence of adverse effects in older persons and heightened public health concern due to the link between PIMs use and higher rates of morbidity, hospitalization, and mortality.<sup>4–7</sup> In both industrialized and developing nations, there is a relatively high frequency of PIMs use among older populations, ranging from 1.3% to 95.2%.<sup>8–10</sup>

Due to various age-related factors, providing medications that are appropriate for older patients is difficult and complex. Among these are age-related physiological changes that influence the pharmacodynamic and pharmacokinetic profiles of medications and an increase in the number of medications prescribed as patients experience more chronic diseases and degenerative conditions. In addition, there are few reports in the literature about the use of medications by older patients, and manufacturers do not include older patients in clinical trials before marketing.<sup>11,12</sup> Older patients are therefore more likely to take PIMs, which are those in which the possibility of a negative occurrence outweighs the possibility of a positive clinical outcome.<sup>13</sup>

The identification of PIMs via tools/instruments is among the solutions (including medication review and training) that have been developed to address the issue of inappropriate prescribing among older patients. The American Geriatrics Society Beers Criteria (AGS Beers Criteria) and Screening Tool of Older People's Potentially Inappropriate Prescriptions criteria and the Screening Tool to Alert Doctors to Right Treatment (STOPP/START) criteria have both gained acceptance on a global scale.<sup>14,15</sup> Based on these screening tools, a number of studies have been done to describe the prevalence of PIMs use among older patients in diverse settings across the globe, particularly in Western countries.<sup>16-37</sup> Only a few research studies have been conducted in the Middle-East<sup>38-42</sup> and Africa (specifically in Nigeria<sup>43</sup> and Ethiopia<sup>44-47</sup>). Although the evaluation of the appropriateness of prescribing in older patients is required, there is a dearth of information on PIMs prescribing patterns among the population in Hiwot Fana Comprehensive Specialized Hospital (HFCSH). Hence, this study aimed to assess the prevalence of PIMs use and its associated factors among older patients receiving follow-up care at the chronic care clinic of HFCSH using updated 2023 AGS Beers Criteria and STOPP/START version 2 criteria.

## Methods and Materials

### Study design, study area, and study period

A retrospective cross-sectional study design was implemented at the chronic care clinic of HFCSH. The chronic care clinic at HFCSH provides services for hypertension (HTN), atrial fibrillation, ischemic dilated cardiomyopathy, hypertensive heart disease, heart failure, ischemic stroke, ischemic heart disease, chronic rheumatic valvular heart disease, deep vein thrombosis (DVT), diabetes mellitus (DM), thyrotoxicosis, peripheral neuropathy, epilepsy, Parkinson disease, asthma, chronic obstructive pulmonary disease, chronic liver disease, benign prostatic hyperplasia, chronic kidney disease (CKD), and other diseases. For the whole eastern region of Ethiopia, including Eastern Oromia, Dire Dawa City Administration, the Somali Regional State, and the Harari Regional State, HFCSH serves as a referral hospital. Around 5,800,000 people are anticipated to live in its catchment, of whom 2.85 million are women and 2.95 million are men. The older patients seeking treatment follow-up at the chronic care clinic of HFCSH between January 1, 2014, and December 31, 2022, were included in this study. The data collection was conducted from September 20, 2023, to October 20, 2023.

### Source and study population

Older patients (aged 65 years and older) who received a regular medical checkup and treatment at the chronic care clinic of HFCSH from January 1, 2014, to December 31, 2022, were the source population for this study.

### Eligibility criteria

Older patients aged 65 years and older who received treatment follow-up at the chronic care clinic of HFCSH from January 1, 2014, to December 31, 2022, were included in this study. Older patients who had incomplete medical records were excluded.

### Study variables

The dependent variable was prevalence of PIMs use according to 2023 AGS Beers Criteria and STOPP/START version 2 criteria and independent variables were sex, age, residence, HTN, atrial fibrillation, ischemic dilated cardiomyopathy, hypertensive heart disease, heart failure, ischemic stroke, ischemic heart disease, chronic rheumatic valvular heart disease, DVT, DM, thyrotoxicosis, peripheral neuropathy, epilepsy, Parkinson disease, asthma, chronic obstructive pulmonary disease, chronic liver disease, benign prostatic hyperplasia, CKD, glaucoma, number of medications per patient, and medication regimen.

### Sample size determination and sampling technique

The sample size was calculated by using a single population proportion formula,<sup>48</sup>  $n = \frac{Z^2 P(1-P)}{W^2}$  by considering a confidence level of 95% ( $Z = 1.96$ ), degree of precision of 5%, and the estimated prevalence of PIMs use from Jimma medical center  $P = 0.452$ .<sup>45</sup> Considering these in the equation, the sample size was 381. Then, the addition of 10% contingency raised the final total sample size of the study to 419. The study participants were selected by using simple random sampling technique among the older patients receiving treatment follow-up from January 1, 2014, to December 31, 2022.

### Data collection methods

A data abstraction format was adapted from the literature.<sup>13,15,45,49</sup> The English language was used to prepare the data abstraction format. The data abstraction sheet had 3 components: sociodemographic, medical, and medication-related data. Two clinical pharmacy bachelor's degree holders collected the data, and 1 clinical pharmacy master's of science degree holder was their supervisor.

The data abstraction sheets were used by data collectors to collect pertinent socio-demographic and clinical data as well as to compile a list of all medications that patients had taken recently and had been prescribed since their last visit to the chronic care clinic at HFCSH. Before the data collection started, the patients' medical record registration numbers were taken from the chronic care department's registration manual. Second, the list of older patients was prepared based on medical record registration number. After this, the list of older patients was prepared and the study participants were selected by the lottery method. Finally, the medical records of study participants were taken from the medical records room and the data were extracted using an abstraction sheet.

### Assessing appropriateness of medications

After completion of data collection, 2 clinical pharmacists independently reviewed the collected data. Any disagreements were debated until an agreement was found. The PIMs were determined based on the following 2 stated criteria that centered on either the medication or the disease:

- 2023 AGS Beers Criteria.<sup>14</sup> PIMs in the 2023 AGS Beers criteria were organized into 5 categories: medications considered potentially inappropriate, medications potentially inappropriate in

patients with certain diseases or syndromes, medications to be used with caution, potentially inappropriate drug–drug interactions, and medications whose dosages should be adjusted based on renal function.

- STOPP/START version 2 criteria.<sup>15</sup> STOPP criteria were used to assess PIMs use in patients aged 65 years and older by giving an explanation of why the medication is potentially inappropriate. The explanations were categorized based on the indication of the medication (ie, any drug prescribed without an evidence-based clinical indication, any drug prescribed beyond the recommended duration, and any duplicate drug class prescription) and the medication used in the respective physiological system (eg, cardiovascular system, central nervous system and psychotropic drugs, renal system, gastrointestinal system, respiratory system, musculoskeletal system, urogenital system, endocrine system, antiplatelet/anticoagulant drugs, drugs that predictably increase the risk of falls, analgesic drugs, and antimuscarinic/anticholinergic drug burden). The START version 2 criteria used to assess potential prescribing omissions (PPOs) without valid clinical reason. START version 2 criteria require drug therapies to be organized based on physiological system: cardiovascular system, respiratory system, central nervous system and eyes, gastrointestinal system, musculoskeletal system, endocrine system, urogenital system, analgesics, and vaccines.

#### Data quality control

Pretesting was done at Jugol General Hospital on 5% of the sample size to determine the clarity of the data abstraction sheet. The checklist was then modified as needed based on the input from the pretest. The supervisors and data collectors received training on how to collect data. Every day, supervisors and investigators verified the data to make sure it was accurate, clear, complete, and consistent. Any mistakes, ambiguities, or incompleteness were fixed appropriately. Before receiving the completed data abstraction sheets from each data collector, the investigators and supervisor conducted a thorough review. They also randomly selected a checklist to cross-check the checklist's completeness and errors while the data were being collected, cleaned, and properly coded. Before beginning the analysis, the data were validated and twice entered by various data entry clerks.

#### Method of data analysis and presentation

EPI-data version 3.1 was used to enter the data, which was subsequently exported to SPSS version 22 (IBM-SPSS Inc, Armonk, New York) for additional analysis. To describe the pertinent variables, frequency, percentages, and summary statistics were computed. Cross-tabulation was used in bivariate analysis to see the relationship between each independent variable and the dependent variable (PIMs use according to AGS Beers Criteria version 2023 and STOPP version 2 criteria), and a crude odds ratio (OR) with a 95% CI was obtained. Variables observed in the bivariate analysis with  $P < 0.25$  were subsequently included in the final model of multivariable logistic regression. Multivariable logistic regression analysis was employed to identify factors associated with PIMs use according to AGS Beers Criteria version 2023 and STOPP version 2 criteria. The strength of statistical association was measured by adjusted OR (aOR) and 95% CI. The aOR tells how changes in 1 predictor variable influences the odds of a response variable occurring after controlling for other predictor variables in a model. A  $P$  value  $< 0.05$  was considered statistically significant. The Hosmer-Lemeshow goodness-of-fit test was used to assess the model's fitness, and if a  $P$  value was larger than 0.05, the model was deemed to be fit. finally, the result was presented by using texts and tables.

#### Ethical consideration

The Institutional Health Research Ethics Review Committee at Haramaya University College of Health and Medical Sciences provided the letter of ethical clearance. Hiwot Fana Specialized University Hospital received official letters of collaboration for the study. Before data collection started, the hospital administrator provided informed, volunteer, written, and signed consent on the behalf of patients because the study was retrospective. The hospital administration was also made aware that any information gleaned from medical records would be handled in strict confidence. All methods were performed in accordance with the Declaration of Helsinki.

#### Result

##### Sociodemographic and clinical characteristics of patients

A total of 419 patients' medical records were reviewed. Of these, 411 patients' medical records fulfilled the inclusion criteria and were considered for final analysis. About 56.9% ( $n=234$ ) of the study population was women and the remaining 177 (43.1%) were men. The mean (SD) age was 69.95 (4.67) years. The most common chronic diseases among study participants were DM (56.0%), HTN (39.7%), and heart failure (21.2%) (Table 1).

##### PIMs use

The prevalence of PIMs use was 117 (28.5%) (95% CI, 24.2–33.1%) and 76 (18.5%) (95% CI, 14.9–22.6%), according to 2023 AGS Beers Criteria and STOPP version 2 criteria, respectively. According to START version 2 criteria, about 17 (4.1%) patients had at least PPO. Based on 2023 AGS Beers Criteria and STOPP version 2 criteria, about 73 and 66 patients had at least 1 PIM, respectively (Table 2).

Based on the 2023 AGS Beers Criteria, aspirin (92; 43.8%) was the most frequently prescribed medication to be avoided for primary prevention of cardiovascular diseases followed by glibenclamide (33; 15.7%), which should be avoided for patients aged 65 years or older (Table 3).

Using STOPP version 2 criteria, glibenclamide (23; 27.1%) was the most frequently prescribed medication followed by metoprolol (21; 24.7%) and aspirin (11; 12.9%). In addition to this, the omitted medications were angiotensin-converting enzyme inhibitors, antiplatelet therapy, statin therapy, and beta-blockers (Table 4).

##### Factors associated with PIMs use based on 2023 AGS Beers Criteria

To identify factors related to PIMs use according to 2023 AGS Beers criteria, a multivariable logistic regression analysis was performed. Male sex (aOR = 1.78; 95% CI, 1.10–2.87;  $P=0.018$ ), DM (aOR = 0.35; 95% CI, 0.19–0.62;  $P < 0.001$ ), and CKD (aOR = 6.68; 95% CI, 2.55–9.32;  $P < 0.001$ ) were found to be the determinant factors for PIMs use (Table 5).

##### Factors associated with PIMs use based on STOPP version 2 criteria

Multivariable logistic regression analysis was done to determine factors associated with PIMs use per STOPP version 2 criteria. The older patients with DVT were more than 3.51 times more likely to have PIMs use compared with those without DVT (aOR = 3.51; 95% CI, 1.19–4.32). In addition to this, DM (aOR = 0.56; 95% CI, 0.34–0.86), HTN (aOR = 0.43; 95% CI, 0.21–0.73), age 71 to 76 years (aOR = 0.23; 95% CI, 0.18–0.31) and 77 years or older (aOR = 1.09; 95% CI, 1.02–2.89) were found to be significant determinant of PIMs use (Table 6).

**Table 1**

Sociodemographic and clinical characteristics of elderly patients on follow-up at the chronic care clinic of Hiwot Fana Comprehensive Specialized Hospital in eastern Ethiopia.

Characteristic		Result*
Sex	Female	234 (56.9)
	Male	177 (43.1)
Age, y	65–70	267 (65.0)
	71–76	87 (21.2)
	≥77	57 (13.9)
Current residence	Urban	228 (55.5)
	Rural	183 (44.5)
Hypertension	Yes	163 (39.7)
	No	248 (60.3)
Atrial fibrillation	Yes	16 (3.9)
	No	395 (96.1)
Ischemic dilated cardiomyopathy	Yes	7 (1.7)
	No	404 (98.3)
Hypertensive heart disease	Yes	19 (4.6)
	No	392 (95.4)
Heart failure	Yes	87 (21.2)
	No	324 (78.9)
Ischemic stroke	Yes	18 (4.4)
	No	393 (95.6)
Ischemic heart disease	Yes	77 (18.7)
	No	334 (81.3)
Chronic rheumatic valvular heart disease	Yes	11 (2.7)
	No	400 (97.3)
Deep vein thrombosis	Yes	46 (11.2)
	No	365 (88.8)
Diabetes mellitus	Yes	230 (56.0)
	No	181 (44.0)
Thyrotoxicosis	Yes	7 (1.7)
	No	404 (98.3)
Peripheral neuropathy	Yes	13 (3.2)
	No	398 (96.8)
Epilepsy	Yes	19 (4.6)
	No	392 (95.4)
Parkinson disease	Yes	11 (2.7)
	No	400 (97.3)
Asthma	Yes	16 (4.6)
	No	392 (95.4)
Chronic obstructive pulmonary disease	Yes	7 (1.7)
	No	404 (98.3)
Chronic liver disease	Yes	17 (4.1)
	No	394 (95.9)
Benign prostatic hyperplasia	Yes	5 (1.2)
	No	406 (98.8)
Chronic kidney disease	Yes	21 (5.1)
	No	390 (94.9)
Glaucoma	Yes	3 (0.7)
	No	408 (99.3)

\* Values are presented as frequency (%).

**Table 2**

Prevalence of potentially inappropriate medications (PIMs) use based on 2023 American Geriatrics Society Beers Criteria, Screening Tool of Older People's Potentially Inappropriate Prescriptions (STOPP) version 2 criteria, and Screening Tool to Alert Doctors to Right Treatment (START) version 2 criteria among elderly patients in eastern Ethiopia.

Characteristic		Result*
According to Beers criteria, patients on PIMs	Yes	117 (28.5)
	No	294 (71.5)
According to Beers criteria, number of PIMs per patient	1	73 (62.4)
	2	28 (23.9)
	3	16 (13.7)
According to the STOPP criteria, Patients on PIMs	Yes	76 (18.5)
	No	335 (81.5)
According to the STOPP criteria, number of PIMs per patient	1	42 (55.3)
	2	21 (27.6)
	3	13 (17.1)
According to the START criteria, Patients with PPOs	Yes	17 (4.1)
	No	394 (95.9)

PPO = potential prescription omission.

\* Values are presented as frequency (%).

**Table 3**  
Potentially inappropriate medications (PIMs) prescribed to elderly patients based on 2023 American Geriatrics Society Beers Criteria.

Category of Beers criteria	PIMs	Drug class	Result*	Recommendation
Independent diagnosis	Aspirin	Antiplatelet	92 (43.8)	Avoid initiating aspirin for primary prevention of cardiovascular disease
	Warfarin	Antithrombotic	18 (8.6)	Avoid starting warfarin as initial therapy for the treatment of nonvalvular atrial fibrillation or VTE unless alternative options are contraindicated or there are substantial barriers to their use
	Nifedipine	Calcium channel blocker	26 (12.4)	Avoid
	Amitriptyline	Tricyclic antidepressants	3 (1.4)	Avoid
	Phenobarbital	Barbiturates	6 (2.9)	Avoid
Depend-on diagnosis	Regular insulin	Hormone	19 (9.0)	Avoid
	Glibenclamide	Sulphonyl urea	33 (15.7)	Avoid
	Metoclopramide	Antiemetics	4 (1.9)	Avoid
	Enalapril + spironolactone	ACEIs and potassium-sparing diuretics	6 (2.9)	Avoid routinely using a RAS inhibitor and potassium-sparing diuretic, concurrently in those with chronic kidney disease Stage 3a or higher
Medications whose dosages should be adjusted based on renal function	Spironolactone	Potassium-sparing diuretics	3 (1.4)	Avoid when CrCl <30 mL/min
Total PIMs			210 (100)	

ACEI = angiotensin-converting enzyme inhibitor; CrCl = creatinine clearance; RAS = renin-angiotensin system; VTE = venous thromboembolism.

\* Values are presented as frequency (%).

**Table 4**  
Specific potentially inappropriate medications (PIMs) and potential prescription omissions (PPOs) according to Screening Tool of Older People's Potentially Inappropriate Prescriptions criteria (STOPP) and the Screening Tool to Alert Doctors to Right Treatment (START) version 2 criteria.

PIMs	Drug class	Result*
Using STOPP version 2 criteria	Furosemide	Loop diuretics
	Digoxin	Digitalis glycosides
	Metoprolol	Beta blocker
	Enalapril	Angiotensin-converting enzyme inhibitors
	Spironolactone	8 (9.4)
	Aspirin	Aldosterone antagonists
	Metformin	Anti-platelet
	Glibenclamide	Biguanides
	Sulphonyl urea	23 (27.1)
Total		85 (100)
Using START version 2 criteria (PPOs)	Antiplatelet therapy	Anti-platelet
	Beta blocker	Beta blocker
	Statin therapy	Statin
	Angiotensin-converting enzyme inhibitors	Angiotensin-converting enzyme inhibitors
Total		25 (100)

\*Values are presented as frequency (%).

## Discussion

The current study is the first conducted in eastern Ethiopia using 2023 AGS Beers Criteria and STOPP/START version 2 criteria to assess the proportion of PIMs use and its associated factors among older patients who were receiving follow-up treatment at the chronic care clinic of HFCHS. PIMs were present in 117 (28.5%) and 76 (18.5%) study participants based on 2023 AGS Beers Criteria and STOPP version 2 criteria, respectively. Based on START version 2 criteria, about 17 (4.1%) of patients had at least 1 PPO.

According to the 2023 AGS Beers Criteria used in the present study, the prevalence rate of PIMs is 28.5%, which is lower than the results of previous studies where the prevalence of PIMs ranged between 42.7% and 72.5%<sup>19,27,38,40,50-55</sup> based on 2012, 2015, and 2019 AGS Beers Criteria. It is also higher than from other studies that showed prevalence rates of PIMs from 18.3% to 26.9%<sup>19,22,26,28</sup> using the 2003 AGS Beers Criteria to define PIMs use. The vari-

ations in patient and disease characteristics, screening standards, length of data collection, retrospective or prospective data, prescribing methods, and medication accessibility may account for the variations in PIMs prevalence reported in different research.<sup>26</sup> As far as we are aware, there are no studies in the literature using the 2023 AGS Beers Criteria in hospital settings elsewhere.

This study found that 18.5% of participants received at least 1 PIM based on STOPP version 2 criteria, which is less than in previous studies with reported prevalence rates of 35.4%<sup>22</sup> and 40.2% to 55.7%<sup>44,45,54,56,57</sup> using STOPP version 1 and version 2 criteria, respectively. This discrepancy might be lack of comprehensive medicine evaluations for older patients, lack of awareness by primary care physicians regarding the risks of prescribing PIMs, lack of continuing professional education programs addressing this matter, the limited availability of some medications, sample size and population differences, and absence of geriatric specialists.<sup>56</sup>

In the current study, in 17 patients (4.1%) 1 or more medications were omitted from the treatment plan according to the



**Table 5**

Multivariable analysis of factors associated with potentially inappropriate medications (PIMs) use based on 2023 American Geriatrics Society Beers Criteria.

Variable		PIMs use*		Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)	P value
		Yes	No			
Sex	Male	60 (33.9)	117 (66.1)	1.59 (1.04–2.45)	1.78 (1.10–2.87)	<b>0.018</b>
	Female	57 (24.4)	177 (75.6)	1	1	
HTN	Yes	29 (17.8)	134 (82.2)	0.39 (0.24–0.64)	0.72 (0.38–1.34)	0.29
	No	88 (35.5)	160 (64.5)	1	1	
DVT	Yes	22 (47.8)	24 (55.2)	2.61 (1.39–4.86)	1.33 (0.65–2.73)	0.42
	No	95 (26.0)	270 (74.0)	1	1	
DM	Yes	40 (17.4)	190 (82.6)	0.28 (0.18–0.44)	0.35 (0.19–0.62)	<b>0.00</b>
	No	77 (42.5)	104 (57.5)	1	1	
Chronic liver disease	Yes	10 (58.8)	7 (42.7)	3.83 (1.42–5.32)	2.04 (0.68–6.61)	0.20
	No	107 (27.2)	287 (72.8)	1	1	
Ischemic stroke	Yes	9 (50)	9 (50)	2.64 (1.02–6.82)	1.20 (0.41–3.52)	0.73
	No	108 (27.5)	285 (72.5)	1	1	
CKD	Yes	12 (57.1)	9 (42.9)	3.62 (1.48–8.83)	6.68 (2.55–9.32)	<b>0.00</b>
	No	105 (26.9)	285 (73.1)	1	1	

DM = diabetes mellitus; DVT = deep vein thrombosis; CKD = chronic kidney disease; HTN = hypertension.

Bold *P* values explains variables significantly associated with Potentially inappropriate medications(PIMs) use.

Under COR and aOR column heads the values 1 represents reference group to the existing variables.

\* Values are presented as n (%).

**Table 6**

Multivariable analysis of factors associated with potentially inappropriate medications (PIMs) use based Screening Tool of Older People's Potentially Inappropriate Prescriptions (STOPP) version 2 criteria.

Variable		PIMs use*		Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)	P value
		Yes	No			
Sex	Male	40 (22.6)	137 (77.4)	1.61 (0.97–2.64)	1.58(0.72–2.31)	0.31
	Female	36 (15.4)	198 (84.6)	1	1	
Residence	Yes	48 (21.1)	180 (78.9)	1.48 (0.88–2.47)	1.29 (0.53–2.12)	0.41
	No	28 (15.3)	155 (84.7)	1	1	
Age, y	65–70	55 (20.6)	212 (79.4)	1	1	<b>0.01</b>
	71–76	8 (9.2)	79 (90.8)	0.39 (0.21–0.49)	0.23 (0.18–0.31)	
	≥77	13 (22.8)	44 (77.2)	1.13 (1.08–3.61)	1.09 (1.02–2.89)	
DM	Yes	30 (13.0)	200 (87.0)	0.44 (0.26–0.73)	0.56 (0.34–0.86)	<b>0.00</b>
	No	46 (25.4)	135 (74.6)	1	1	
HTN	Yes	23 (14.1)	140 (85.9)	0.60 (0.32–0.86)	0.43 (0.21–0.73)	<b>0.01</b>
	No	53 (21.4)	195 (78.6)	1	1	
DVT	Yes	19 (41.3)	27 (58.7)	3.80 (1.23–5.67)	3.51 (1.19–4.32)	<b>0.02</b>
	No	57 (15.6)	308 (84.4)	1	1	

DM = diabetes mellitus; DVT = deep vein thrombosis; HTN = hypertension.

Bold *P* values explains variables significantly associated with Potentially inappropriate medications(PIMs) use.

Under COR and aOR column heads the values '1' represents reference group to the existing variables.

\* Values are presented as n (%).

START version 2 criteria without justification, which is much lower than the rates reported in previous studies, with a range of 10.9% to 59.4%.<sup>21,22,29,44,45,56</sup> Some physicians may not follow the therapeutic recommendations and instead choose to treat patients depending on their clinical experience, which is 1 probable justification for medication omissions.<sup>58</sup> Physician fear of nonadherence while prescribing multiple medications for a patient may be an additional plausible causes for omission of essential medications.<sup>59</sup> In this study, angiotensin-converting enzyme inhibitors were the most commonly omitted medications, in line with prior the studies conducted at University of Gondar Hospital<sup>44</sup> and Jimma Medical Center.<sup>45</sup>

In the present study, being a man increased the probability of PIMs use by 2 times compared with their female counterparts using the 2023 AGS Beers Criteria, which is contrary to the results of the prior studies using the 2019 AGS Beers criteria at Jimma Medical Center<sup>45</sup> and 2015 AGS Beers Criteria at 10 primary health care centers (polyclinics) that provide geriatric care through specialized geriatric clinics in Kuwait.<sup>56</sup> A possible explanation could be that women are more likely to care about their health status; they consult doctors more regularly and earlier than men. This could be because women are more prone than men to be concerned about their health and to seek medical advice early in life. Women may therefore have greater experience and knowledge regarding the use

of medications than men.<sup>60</sup> Other predictors for PIMs use based on 2023 AGS Beers Criteria were having DM or CKD, which is inconsistent with prior studies' findings.<sup>45,56</sup> The possible explanation could be a reduction in drug clearance and increase in drug–drug interactions.

In this study, PIMs use was substantially correlated with advanced age and having HTN, based on STOPP version 2 criteria, which is consistent with other earlier literature.<sup>45,61</sup> Patients aged 77 years or older were 1.1 times more likely to be prescribed PIMs. The possible explanation could be as a patient's age increases, the number of chronic diseases might increase, which leads to the probability of multiple medication utilization without appropriate indication.<sup>62</sup> In the present study, compared with patients without HTN, patients with HTN had a lower risk of being prescribed PIMs. The older patients with DVT were more than 3.51 times more likely to have PIMs use compared with those without DVT based STOPP version 2 criteria. This result is incongruent with a study that was conducted at University of Gondar Hospital and Jimma Medical Center.<sup>44,45,63</sup> The possible explanation could be that a large number of patients were taking antithrombotic therapy in the present study.

This study had the following limitations. First, a cross-sectional, retrospective study design was used. Second, because only older patients who visited ambulatory care clinics at 1 tertiary hospital

in eastern Ethiopia were included in this study, results cannot be extended to all older patients throughout Ethiopia. Although this study was designed using the most recent 2023 AGS Beers Criteria and STOPP/START version 2 criteria, which are also the most widely used criteria for detecting PIMs use among older persons in clinical settings, it can still be deemed unique.

## Conclusions

This study found that the prevalence of PIMs use was 28.5%, and 18.5% according to 2023 AGS Beers Criteria, and STOPP version 2 criteria among older patients. According to START version 2 criteria, 4.1% patients had at least 1 PPO. According to 2023 AGS Beers Criteria, CKD and being a man increased the odds of PIMs use, whereas having of DM decreased the probability of PIMs use. According to STOPP version 2 criteria, having DM, advanced age, and HTN were significantly associated with PIMs use. The duty of health care professionals should be expanded to include taking the required measures when managing the problems of older patients to prevent providing inappropriate medications. Pharmacists can also significantly contribute to the improvement of the appropriateness of medication use by recommending medication discontinuation, medication reviews, and clinical application of tools to assess PIMs like the 2023 AGS Beers Criteria and STOPP/START version 2 criteria.

## Declaration of competing interest

The authors have indicated that they have no conflicts of interest regarding the content of this article.

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