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Risk Factors and Prevalence of Potentially Inappropriate Medication Use among Hospitalized Older Adults: Insights from a Prospective Observational Study in Ethiopia

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ABSTRACT

Elderly patients are particularly vulnerable and face a higher risk of medication-related issues, making a thorough review of their prescriptions essential. This study aimed to evaluate the appropriateness of medication use among older adults by identifying potentially inappropriate medicines (PIMs) and determining the factors that predict their use. This prospective cross-sectional study included 162 older adults admitted to the medical wards of Jimma Medical Center. Data were collected using a structured abstraction tool. Each participant's medication regimen was evaluated for PIMs according to the 2019 American Geriatrics Society Beers Criteria. Descriptive statistics were used to summarize findings, and logistic regression analysis was performed with STATA 15.0 software. Statistical significance was set at a p-value < 0.05. During their hospital stay, 103 participants (63.6%) experienced polypharmacy (5–9 medications concurrently), and 16 (9.9%) had hyper-polypharmacy (≥10 medications). Using the Beers Criteria, at least one potentially inappropriate medicine was identified in 118 patients (73%). In total, 191 PIMs were detected (ranging from 0 to 4 per patient), of which 27 (14.1%) belonged to the "avoid" category. The most commonly identified PIMs were furosemide [83 (43 percent)], tramadol [26 (14.5 percent)], and spironolactone [22 (11.4 percent)]. Nearly all PIMs (187, or 96.9 percent) were prescribed on a regular/scheduled basis. Patients with thrombocytopenia were less likely to receive PIMs, whereas those diagnosed with heart failure had 7.35 times higher odds of being prescribed a potentially inappropriate medicine. Close to three-quarters of the older adult patients in this study were prescribed at least one potentially inappropriate medicine. These findings highlight the need for local research exploring the clinical, economic, and patient-centered impacts of PIM use to guide whether the Beers Criteria should be routinely applied when prescribing for older adults in this setting. Targeted interventions, particularly for patients with heart failure, could help decrease the use of inappropriate medications.

Keywords: Potentially inappropriate medicine list, Aged, Ethiopia, Inpatients

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Introduction

Worldwide, the population aged 60 years and older is expected to rise from 1 billion in 2020 to 2.1 billion by 2050, with approximately 80% of this group residing in low- and middle-income countries by that time [1]. Ethiopia is also experiencing a steady increase in its older population [2]. This demographic shift will influence multiple societal domains, especially healthcare systems [3]. Globally, older adults account for a substantial share of healthcare utilization and resources [4].

Due to multimorbidity, polypharmacy, and age-related changes in drug pharmacokinetics and pharmacodynamics, older patients are more prone to drug-related problems and adverse outcomes [5-7]. Numerous studies indicate that this population frequently receives medications considered inappropriate, which can lead to harmful effects [8]. To address this issue, several screening instruments have been developed to guide clinicians in optimizing prescribing practices and minimizing exposure to potentially inappropriate medicines (PIMs) [9-13]. Among these, the American Geriatrics Society (AGS) Beers Criteria® [9] and the STOPP/START criteria (version 2) [10] are the most widely recognized and applied tools.

The Beers Criteria have been used in multiple international studies, yielding varying prevalence rates of PIM use. European research has reported rates between 22.7% and 43.3% [14]. In the Middle East, studies from Saudi Arabia [15] and the United Arab Emirates [16] found PIMs in 61% and 34.7% of patients, respectively, while Kuwaiti studies documented rates of 53.1% [17] and 58.4% [18]. In Asia, Indian studies reported PIM prevalence of 23.5% [19], 24.6% [20], and 61.9% [21], while a Chinese study found 34.39% [22]. In Africa, a Nigerian study reported PIMs in 31% of older patients [23]. In Ethiopia, several studies have shown lower rates—27.72% in Gondar [24], 23% in Dessie [25], and 28.6% in Tigray [26]—although higher figures of 61.5% and 83.1% were observed in other studies from Gondar [27] and Jimma Medical Center [28], respectively. Factors previously linked to increased PIM use include sex [21, 29], older age [20, 21, 28, 29], educational level [21], polypharmacy (≥5 medications) [14, 28, 29], hypertension [28], prolonged hospital stay (≥10 days) [19], and multiple comorbidities [20].

Furthermore, numerous investigations have demonstrated strong associations between PIM exposure and negative clinical [15, 30-37] and economic outcomes [38-45]. Despite the well-documented burden and consequences of PIMs in older adults, research in Ethiopia remains limited [25-28, 46, 47]. Most existing Ethiopian studies are retrospective [25, 28, 46, 47] and lack several important variables (e.g., body mass index, physical function) included in the present study. Additionally, only two prior studies focused on medical ward inpatients [25, 26]. The Dessie study [25] was retrospective and thus vulnerable to incomplete data, while the Tigray study [26] only assessed PIMs in the "avoid" category and used the outdated 2012 Beers Criteria, potentially underestimating prevalence. Therefore, this prospective observational study was conducted to determine the prevalence of potentially inappropriate medicine use and identify associated factors among older adult inpatients.

Materials and Methods

Study design

This research forms part of a larger prospective observational study initiative supported by funding from the Jimma University Institute of Health in 2021 (reference: JUIH2013EFY).

Study setting

The investigation took place between 10 February 2021 and 26 December 2022 within the internal medicine wards of Jimma Medical Center (JMC). Established in 1930, JMC represents one of Ethiopia's earliest public referral hospitals. Situated in Jimma town, 352 km southwest of Addis Ababa, it serves as the sole teaching and referral facility for southwestern Ethiopia. The hospital has 659 beds and annually manages around 9000 inpatients and 80,000 outpatients, serving a catchment population of roughly 15 million individuals.

Participants' eligibility criteria

The study enrolled patients aged 60 years or older who were admitted to the medical wards and prescribed at least one medication. Exclusion criteria included lack of consent, discharge within 24 hours of admission, inability to communicate (e.g., due to aphasia), and repeat admissions during the study period. In practice, no participants declined consent or were discharged within 24 hours.

Study variables

Independent variables were grouped into three main domains.

Patient-related information: sex, age, place of residence, education, occupation, smoking status, alcohol use, khat chewing, living arrangements, baseline body mass index (BMI), and functional status at admission. Functional status was evaluated using the Katz Index of Independence in Activities of Daily Living (ADL) [48], which scores performance across six domains (bathing, dressing, toileting, transferring, continence, and feeding). Scores range as follows: 6 = fully independent, 3–5 = moderately impaired (partial dependence), ≤2 = severely impaired (high dependence) [48, 49].

Clinical and related information: prior hospitalizations in the past year, past medical history, in-hospital diagnoses (including type and number of conditions), Charlson Comorbidity Index (CCI) score, and duration of hospital stay. Psychological status on admission was measured objectively with the 15-item short-form Geriatric Depression Scale (GDS) [50]. Diseases were classified using the ICD-11 system [51], and CCI scores were computed via the online MDCalc tool [52].

Medication and related information: history of traditional medicine use, prior medication history, medications prescribed during hospitalization, and total number of in-hospital medications. Medications were classified according to the Anatomical Therapeutic Chemical (ATC) system [53].

The primary outcome variables were the prevalence of potentially inappropriate medication (PIM) use and its associated predictive factors.

Data collection

The data collection instrument was developed based on a review of pertinent literature and consisted of four parts: sociodemographic characteristics, clinical details, medication information, and outcome measures. The tool was translated into Afan Oromo and Amharic, the two main local languages. Three trained data collectors—two master's-level clinical pharmacists and one bachelor's-degree nurse—received instruction on the instrument and procedures. A pretest was performed prior to full-scale data collection, and investigators provided ongoing supervision. All eligible patients were identified upon ward admission and followed prospectively until discharge. Information was gathered from multiple sources, including patient medical records, laboratory findings, interviews with patients or caregivers, and discussions with treating clinicians. Height and weight measurements were obtained to compute BMI (formula: weight in kg divided by height in meters squared). Relevant laboratory parameters required for Beers Criteria evaluation were retrieved from charts; when unavailable, they were requested alongside other clinically indicated tests.

PIM assessment

Medications prescribed during the hospital stay were screened for potential inappropriateness. Data collectors compiled complete medication lists for each participant covering the entire admission period. One investigator (BTT) initially evaluated each case for PIM presence using the 2019 updated American Geriatrics Society (AGS) Beers Criteria® [9]. All assessments were subsequently verified by two additional investigators (MAY and DDB). The Beers Criteria® provide an explicit listing of medications generally best avoided in older adults, either unconditionally or in specific clinical contexts (e.g., certain diseases). The tool is designed to guide medication selection, educate providers and patients, lower adverse drug event rates, and facilitate evaluation of care quality, costs, and prescribing patterns. It includes five main tables: PIMs to avoid in most older adults, PIMs to avoid in specific conditions, medications requiring caution, potentially harmful drug–drug interactions, and medications needing renal dose adjustment. This instrument has been applied in earlier Ethiopian studies of PIM in older patients [24, 26, 28, 46, 47]. A patient was classified as exposed to PIM if the medication was continued from pre-admission or newly initiated during hospitalization. Although the Beers Criteria are intended for adults aged ≥65 years [9], the World Health Organization and other bodies define older age as ≥60 years in developing countries, including Ethiopia [20, 54]; this cutoff has been adopted in prior research [20, 26] and was therefore deemed appropriate here. When creatinine clearance estimation was required, the Cockcroft–Gault equation was used [55].

Statistical methods

Sample size was calculated using the single population proportion formula with 95% confidence, $Z = 1.96$, and an estimated PIM prevalence of 23% derived from a prior local study [25]. The source population comprised older adults admitted to JMC medical wards in 2019–2020 ($N = 398$). After applying the finite population correction, the final required sample size was 162. Eligible patients were enrolled consecutively. Data quality was ensured through regular checks during collection and prior to analysis, with double verification of all identified PIMs. Data entry was performed using EpiData version 4.2.0.0, followed by export to STATA 15.0 for analysis. Categorical data were summarized with frequencies and proportions; continuous data were presented as medians with interquartile ranges. The binary outcome (PIM: yes/no) underwent logistic regression. Cell adequacy was confirmed for all covariates before bivariable analysis; those with $p < 0.25$ were advanced to multivariable modeling. Multicollinearity was assessed via variance inflation factor (all VIF < 6, so all 15 selected covariates were retained). Model fit was confirmed by the Hosmer–Lemeshow test ($p = 0.8971$). Statistical significance was declared at $p < 0.05$.

Results and Discussion

Study overview

Over the study period, 176 hospitalized older adults were screened for eligibility; 14 did not meet criteria. Consequently, 162 participants were prospectively monitored from admission to discharge, and their complete data were incorporated into the final analysis **(Figure 1)**.

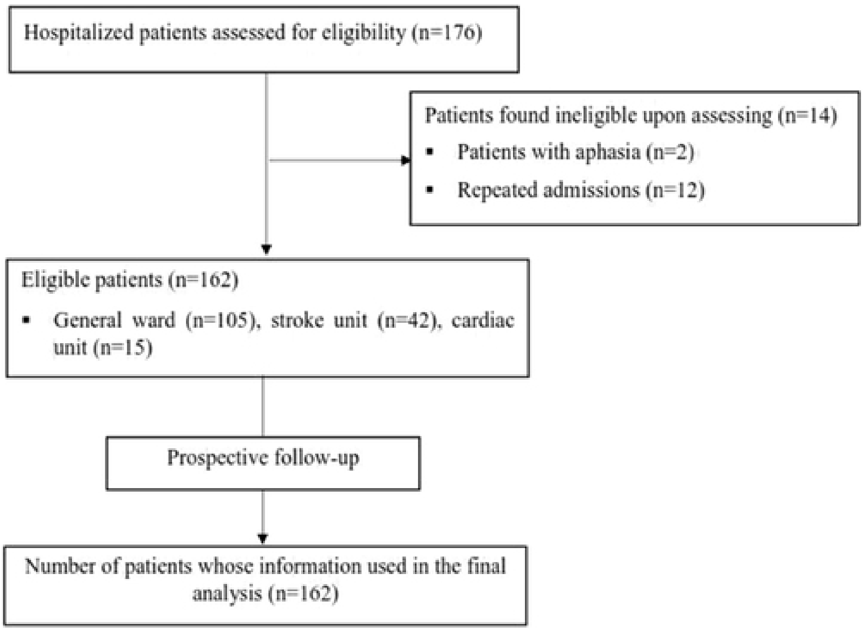

Figure 1. Flowchart illustrating the number of patients screened for eligibility and ultimately enrolled in the study.

Sociodemographic and behavioral characteristics of participants

The median age (interquartile range) of the participants was 65 (60–70) years, with the majority classified as young-old (aged 60–74 years; n=126, 77.8%). Most participants were male (n=134, 82.7%). More than three-quarters resided in rural areas (n=129, 79.6%). Financially, 128 patients (79.0%) reported being self-sufficient in covering their healthcare costs. Only 7 participants (4.3%) lived alone. Based on the Katz Index of Independence in Activities of Daily Living (ADL), 65 patients (40.1%) were identified as physically dependent **(Table 1)**.

Table 1. Sociodemographic and Behavioral Characteristics of the Study Participants

Variable	Frequency (%)
Age (years)	Median (IQR) 65 (60–70)*
60–74	126 (77.8)
75–84	30 (18.5)
≥85	6 (3.7)
Sex	
Male	134 (82.7)
Female	28 (17.3)
Residence	
Urban	33 (20.4)
Rural	129 (79.6)
Marital Status	
Never married	1 (0.6)
Married	134 (82.7)

Divorced	8 (4.9)
Widowed	19 (11.8)
Education Level	
Illiterate	120 (74.1)
Nonformal education	33 (20.4)
Primary education (grades 1–8)	6 (3.7)
College and above	3 (1.9)
Currently Working	
Yes	53 (32.7)
No	109 (67.3)
Occupation	
Retired	20 (12.4)
Employed	1 (0.6)
Housewife	23 (14.2)
Private work	52 (32.1)
Unemployed	66 (40.7)
Financial Status	
Dependent	34 (21)
Independent	128 (79)
Alcohol Use	
Never	116 (71.6)
Past use	44 (27.2)
Current	2 (1.2)
Cigarette Use	
Never	121 (74.7)
Former smoker	39 (24.1)
Current smoker	2 (1.2)
Khat Chewing	
Never	45 (27.8)
Past use	105 (64.8)
Current	12 (7.4)
History of Traditional Medicine Use	
Yes	21 (13)
No	141 (87)
Cohabitation	
With spouse and children	85 (52.5)
With spouse only	41 (25.3)
With children only	29 (17.9)
Lives alone	7 (4.3)
Activities of Daily Living (Katz Score)	Median (IQR) 3.5 (0–6)*
Dependent	65 (40.1)
Partially dependent	51 (31.5)
Fully independent	46 (28.4)
BMI (kg/m²)	Median (IQR) 19.5 (17.8–20.7)*
Underweight (<18.5)	46 (28.4)
Normal (18.5–<25)	107 (66.1)
Overweight (25–<30)	9 (5.6)

BMI = Body Mass Index, IQR = Interquartile Range

Clinical and related information of the participants

Among the participants, 105 (64.8%) had a documented medical history. The most common diagnostic category was diseases of the circulatory system, affecting 112 (69.1%) individuals. Roughly one-third [53 (32.8%)] had at least one hospitalization in the year preceding the study period **(Table 2)**.

Table 2. Clinical and Related Characteristics of the Study Participants

Clinical and Related Information	Frequency (%)
History of prior medical conditions	105 (64.8)
Hospitalizations in the year preceding the study	
None	109 (67.3)
Once	49 (30.3)
Two or more	4 (2.5)
Psychological status at admission (GDS score)	
No psychological issues (0–4)	34 (21)
Mild dementia or depression (5–9)	96 (59.3)
Severe dementia or depression (10–15)	32 (19.8)
Current diagnoses based on ICD-11	
Certain infectious or parasitic diseases	20 (12.4)
Neoplasms	3 (1.9)
Immune system disorders	5 (3.1)
Endocrine, nutritional, or metabolic disorders	35 (21.6)
Mental, behavioral, or neurodevelopmental disorders	2 (1.23)
Nervous system diseases	21 (13)
Circulatory system diseases	112 (69.1)
Respiratory system diseases	70 (43.2)
Digestive system diseases	12 (7.4)
Skin diseases	1 (0.6)
Blood or hematopoietic disorders	33 (20.4)
Genitourinary system diseases	37 (22.8)
Symptoms, signs, or abnormal clinical findings (unspecified)	13 (8)
Number of diagnosed conditions	
Median (IQ)	3 (3, 4)
1 disease	8 (4.9)
2 diseases	30 (18.5)
3 diseases	46 (28.4)
4 diseases	39 (24.1)
5 or more diseases	39 (24.1)
Charlson Comorbidity Index (CCI) score	
Median (IQ)	4 (3, 5)
Mild	12 (7.4)
Moderate	93 (57.4)
Severe	57 (35.2)
Duration of hospital stay (days)	
Median (IQ)	10 (6, 14)
Short stay (0–5 days)	24 (14.8)
Medium stay (6–10 days)	67 (41.4)
Long stay (≥10 days)	71 (43.8)

Abbreviations: CCI, Charlson Comorbidity Index; ICD-11, International Classification of Diseases 11th Revision; IQ, interquartile range

The most common diagnoses during hospitalization were community-acquired pneumonia (n=61), hypertension (n=61), and heart failure (n=57) **(Figure 2)**.

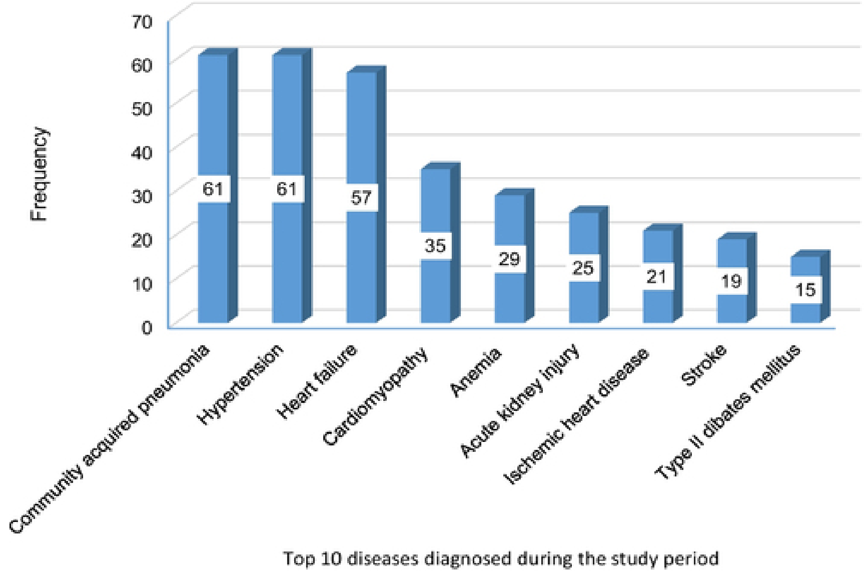

Figure 2. Ten most frequently diagnosed conditions among elderly patients during their hospitalization.

Medication and related information of the participants

Close to half of the study participants [75 (46.3%)] indicated that they had taken medications in the three months leading up to the study period. Among reported prior medication use, agents targeting the cardiovascular system were noted in 38 patients (23.5%). Throughout the course of hospitalization, polypharmacy—defined as the concurrent use of five or more drugs—was observed in 109 patients (63.6%) **(Table 3)**.

Table 3. Medication and related information of the participants

ATC code	Medications category according to ATC	In-hospital medications, *n* (%)
A	Alimentary tract and metabolism	90 (55.6)
B	Blood and blood forming organs	98 (60.5)
C	Cardiovascular system	120 (74.1)
H	Systemic hormonal preparations	32 (19.8)
J	Anti-infective for systemic use	110 (67.9)
M	Musculo-skeletal system	2 (1.2)
N	Nervous system	40 (24.7)
P	Antiparasitic products, insecticides and repellents	1 (0.6)
R	Respiratory system	29 (17.9)
V	Various agents	4 (2.5)
	In hospital medications	
	Median (IQ) number	6 (4, 7)
	1–4	43 (26.5)
	5–9	103 (63.6)
	≥ 10	16 (9.9)
	Total number	989

Abbreviations: ATC, Anatomical Therapeutic Chemical; IQ, Interquartile

Evaluation of potentially inappropriate medications (PIMs)

According to the 2019 Beers Criteria applied to in-hospital medications, at least one potentially inappropriate medication (PIM) was identified in 118 (73%) of the participants. A total of 191 PIMs were recorded, with 27 (14.1%) of these being medications that the Beers Criteria explicitly recommend avoiding **(Table 4)**.

Table 4. Prevalence of Potentially Inappropriate Medications and Related Information

Variable	Frequency (%) / Value
PIM prescription during hospitalization	
Patients receiving ≥1 PIM	118 (73)
Total PIMs prescribed	191
Median (IQR) PIMs per patient	1 (0–2)
Range of PIMs per patient	0–4
Mode of PIM administration	
Regularly scheduled	185 (96.9)
As needed (PRN)	6 (3.1)
Beers criteria recommendations	
Should be avoided	27 (14.1)
Use with caution	133 (69.6)
Dose reduction recommended	31 (16.2)

Abbreviations: IQR – interquartile; PIM – potentially inappropriate medication

The most commonly prescribed potentially inappropriate medications were furosemide [83 (43 percent)], followed by tramadol [26 (14.5 percent)] and spironolactone [22 (11.4 percent)] **(Table 5)**.

Table 5. Detailed List of Potentially Inappropriate Medications (PIMs) According to Beers Criteria, with Guidance and Justifications

Medication	Frequency (%)	Beers Guidance	Reasoning
Amitriptyline	2 (1.0)	Avoid use	Strong anticholinergic properties, sedative effects, may cause postural hypotension
Aspirin	1 (0.5)	Use cautiously in patients ≥70 years	Intended for primary cardiovascular prevention; risk–benefit should be assessed
Warfarin combined with Aspirin	3 (1.5)	Avoid if feasible; if necessary, monitor INR	Co-use increases likelihood of bleeding complications
Cimetidine	14 (7.2)	Dose adjustment if CrCl <50 mL/min	Can impair cognitive function in older adults
Warfarin combined with Ciprofloxacin	2 (1.0)	Avoid if possible; monitor INR closely if used	Combination raises risk of excessive anticoagulation and bleeding
Dexamethasone with NSAID	1 (0.5)	Avoid; if unavoidable, implement GI protection	Higher chance of gastrointestinal bleeding or ulcers
Digoxin	4 (2.1)	Not recommended as first-line for atrial fibrillation	Less safe than alternatives for rate control; risk of toxicity
Furosemide	83 (43)	Exercise caution	May induce or worsen hyponatremia or SIADH; monitor sodium during therapy
Hydrochlorothiazide	4 (2.1)	Exercise caution	Potential to trigger hyponatremia or SIADH; monitor sodium levels
Metoclopramide	9 (4.7)	Avoid unless treating gastroparesis; limit to ≤12 weeks	Risk of movement disorders such as tardive dyskinesia, particularly in frail elderly
Ranitidine	17 (8.8)	Adjust dose if CrCl <50 mL/min	Possible cognitive side effects
Sliding-scale insulin only	2 (1.0)	Avoid	Using short-acting insulin alone raises hypoglycemia risk without improving glycemic control
Risperidone	1 (0.5)	Avoid	May precipitate or worsen delirium in older patients
Spironolactone	22 (11.4)	Avoid if CrCl <30 mL/min = 2; use cautiously = 20	Risk of hyperkalemia; can contribute to hyponatremia or SIADH; sodium monitoring recommended

Tramadol	26 (14.5)	Avoid if CrCl <30 mL/min = 1; use cautiously = 25	CNS side effects; may exacerbate hyponatremia or SIADH; monitor sodium levels

Abbreviations: CrCl – creatinine clearance; SIADH – syndrome of inappropriate antidiuretic hormone secretion; PIM – potentially inappropriate medication; CNS – central nervous system

Predictors of potentially inappropriate medication use

The final multivariable analysis identified thrombocytopenia and a diagnosis of heart failure as significant factors linked to the prescription of potentially inappropriate medications (PIMs). Elderly patients with thrombocytopenia had a reduced likelihood of being prescribed PIMs, whereas those with heart failure were found to have a 7.35-fold increased probability of receiving such medications **(Table 6)**.

Table 6. Bivariable and multivariable logistic regression analyses

Variables	PIM (Yes)	PIM (No)	Bivariable analysis		Multivariable analysis	
			COR (95%CI)	*p* value	AOR (95%CI)	*p* value
			Sex			
Male	93 (78.81)	41 (93.18)	1		1	
Female	25 (21.19)	3 (6.82)	3.67 (1.05, 12.86)	**0.042**	2.69 (0.49, 14.92)	0.255
Khat chewing				0.155		
Never	35 (29.66)	10 (22.73)	1		1	
Former	77 (65.25)	28 (63.64)	0.79 (0.34, 1.79)	0.567	0.60 (0.19, 1.9)	0.388
Current	6 (5.08)	6 (13.64)	0.29 (0.07, 1.08)	0.065	0.25 (0.04, 1.74)	0.162
Activities of daily living				0.105		
Dependent	42 (35.59)	23 (52.27)	0.38 (0.15, 0.96)	0.041	0.59 (0.16, 2.23)	0.441
Partially dependent	38 (32.20)	13 (29.55)	0.62 (0.23, 1.65)	0.336	0.51 (0.14, 1.86)	0.305
Fully independent	38 (32.20)	8 (18.18)	1		1	
			Acute kidney injury			
Yes	21 (17.80)	4 (9.09)	2.16 (0.69, 6.71)	0.181	1.59 (0.38, 6.66)	0.528
No	97 (82.20)	40 (90.91)	1		1	
			Asthma			
Yes	5 (4.24)	4 (9.09)	0.44 (0.11, 1.73)	0.241	0.12 (0.01, 0.17)	0.068
No	113 (95.76)	40 (90.91)	1		1	
			Community acquired pneumonia			
Yes	50 (42.37)	11 (25)	2.21 (1.02, 4.78)	**0.045**	0.77 (0.26, 2.23)	0.625
No	68 (57.63)	33 (75)	1		1	
			Heart failure			
Yes	55 (46.61)	2 (4.55)	18.33 (4.24, 79.25)	**0.000**	7.35 (1.25, 43.2)	**0.027**
No	63 (53.39)	42 (95.45)	1		1	
			Hemiplegia			
Yes	6 (5.08)	5 (11.36)	0.42 (0.12, 1.45)	0.168	3.66 (0.39, 34.43)	0.256
No	112 (94.92)	39 (88.64)	1		1	
			Systemic hypertension			
Yes	42 (35.59)	19 (43.18)	0.73 (0.36, 1.47)	0.376	0.64 (0.18, 2.27)	0.490
No	76 (64.41)	25 (56.82)	1		1	
			Stroke			
Yes	7 (5.93)	12 (27.27)	0.17 (0.06, 0.46)	**0.001**	0.17 (0.02, 1.57)	0.119
No	111 (94.07)	32 (72.73)	1		1	
			Pulmonary hypertension			
Yes	10 (8.47)	1 (2.27)	3.98 (0.49, 32.05)	0.194	1.07 (0.09, 13.43)	0.956
No	108 (91.53)	43 (97.73)	1		1	
			Thrombocytopenia			
Yes	4 (3.39)	6 (13.64)	0.22 (0.06, 0.83)	**0.025**	0.17 (0.03, 1.88)	**0.035**
No	114 (96.61)	38 (86.36)	1		1	
			Cardiomyopathy			
Yes	33 (27.97)	2 (4.55)	8.15 (1.87, 35.61)	**0.005**	2.55 (0.34, 18.9)	0.360

No	85 (72.03)	42 (95.45)	1		1	
Number of diseases, median (IQ)	4 (3, 5)	3 (2, 4)	1.52 (1.16, 1.99)	**0.002**	1.28 (0.89, 1.84)	0.188
1	5 (4.2)	3 (6.8)	1			
2	15 (12.7)	15 (34.1)	0.6 (0.12, 2.97)	0.532	0.92 (0.13, 6.65)	0.937
3	34 (28.8)	12 (27.3)	1.7 (0.35, 8.21)	0.509	2.58 (0.35, 18.97)	0.351
4	29 (24.6)	10 (22.7)	1.74 (0.35, 8.63)	0.498	1.47 (0.2, 10.8)	0.705
≥ 5	35 (29.7)	4 (9.1)	5.25 (0.9, 30.7)	0.066	4.99 (0.49, 51.27)	0.176
Number of in hospital medications						
1–4	22 (18.6)	21 (47.7)	1	**0.000**		
5–9	81 (68.6)	22 (50)	3.51 (1.64, 7.52)	**0.001**	2.25 (0.84, 6.01)	0.107
≥ 10	15 (12.7)	1 (2.3)	14.32 (1.73, 118.18)	**0.013**	10.75 (0.99, 116.2)	0.051

AOR= adjusted odd ratio, COR= crude odd ratio, PIM= potentially inappropriate medication

This prospective cross-sectional investigation monitored patients from the time of their admission to various medical ward units through to discharge. The presence of at least one potentially inappropriate medication (PIM) was identified in 118 (73%) individuals. These results indicate suboptimal medication prescribing practices in roughly three-quarters of hospitalized elderly patients.

A comparable investigation in India found inappropriate prescribing in 61.9% of cases [21]. In contrast, markedly lower rates of PIMs were documented in two other Indian studies, at 23.5% [19] and 24.6% [20]. These earlier reports utilized the 2003 edition of the Beers criteria. Additionally, in the research conducted by Nagendra [20], general medicine ward physicians were made aware of the Beers criteria for detecting PIMs, which may have encouraged more cautious prescribing during the study timeframe. Thus, factors such as the open-label design [20] and variations in the Beers criteria version applied could account for the reduced PIM rates observed relative to the current results.

Likewise, research from the United Arab Emirates [16] and China [22] indicated PIM prescribing in 34.7% and 34.39% of elderly participants, respectively—figures notably below those in the present work. Differences in methodology may contribute to this variation. For instance, the UAE study [16] focused on discharged older adults taking five or more drugs, while the current analysis encompassed all hospitalized elderly receiving at least one medication and evaluated drugs administered throughout the hospital stay. The Chinese study [22], meanwhile, was performed in ambulatory care settings.

Within Ethiopia, prior comparable research revealed PIM rates below one-third: 23% in Dessie [25] and 28.6% in Tigray [26]. As detailed in the methods, this investigation applied the 2019 Beers criteria and included all PIM categories (medications to avoid, those requiring caution, and dose adjustments). In comparison, the Tigray study [26] used the 2012 criteria and restricted analysis to drugs strictly to be avoided, likely leading to an underestimation of overall prevalence. Indeed, medications to be avoided were noted in only 27 (14.1%) patients here—about half the rate reported in Tigray [26]. The Dessie study [25], being retrospective, may have understated PIM occurrence due to limitations like incomplete records.

Diagnoses of thrombocytopenia and heart failure emerged as independent predictors of PIM prescribing in this analysis. Patients with thrombocytopenia had lower odds of receiving PIMs compared to those without, while individuals with heart failure faced a 7.75 times greater likelihood of PIM exposure. Such patterns may stem from differences in the quantity and categories of drugs typically prescribed for these conditions.

Although elevated odds of PIMs were observed among patients with polypharmacy or hyperpolypharmacy, these associations did not reach statistical significance. Concurrent administration of numerous drugs can heighten risks of drug-drug and drug-disease interactions, complicating care and elevating the chance of inappropriate prescribing [28]. This link has been substantiated across diverse settings [14, 17, 19, 20, 25, 26, 29]. European [14], Kuwaiti [17], and Ethiopian [25, 26] reports identified polypharmacy (≥5 concurrent medications) as a significant driver of increased PIM risk. Indian studies noted heightened PIM likelihood with 9 or more [19] or 10–14 [20] concurrent drugs. Yet, in the current work, polypharmacy as defined in those reports [14, 17, 25, 26] showed no significant association with PIMs.

Additional research has linked greater PIM risk to female gender [21, 29], advancing age [29], education at the 11th–12th grade level [21], hospital stays of 10 days or longer [19], and comorbidity counts of four or more [20]. In this investigation, females and those with more comorbidities exhibited higher PIM likelihood, with significance in univariable analysis; however, these effects dissipated in the multivariable model. Age and education level showed no association even univariably, possibly due to the limited sample size.

Based on these results, the authors recommend that clinicians exercise greater caution when prescribing for elderly patients and incorporate PIM screening tools to promote appropriate medication use in this population. Policymakers should prioritize safe prescribing for older adults in healthcare policies and guidelines, potentially by establishing performance metrics for medication quality in facilities.

To the authors' knowledge, this represents the initial thorough evaluation of PIMs and associated factors among older adults admitted across all medical wards in an Ethiopian facility. Strengths include its prospective design, application of the most recent Beers criteria available at the time, and inclusion of often-overlooked variables. Limitations involve the modest sample size and single-center setting, which may restrict broader applicability and statistical power.

Conclusion

Nearly three-quarters of hospitalized older adults were found to be receiving potentially inappropriate medications. To address this, future efforts should evaluate the clinical and financial impacts of PIMs locally; promote the adoption and adaptation of Beers criteria in geriatric prescribing; and develop targeted strategies for heart failure patients to minimize PIM exposure in this vulnerable group.

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