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Inappropriate or Potentially Unsuitable Medication Prescribing for Older Adults Visiting Community Pharmacies in Peru

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ABSTRACT

Older adults taking multiple medications are at increased risk for complications such as adverse drug reactions, medication errors, and harmful drug interactions. This study investigated the occurrence of potentially inappropriate prescriptions (PIP) in a community pharmacy in Trujillo, Peru, applying the STOPP/START criteria (Screening Tool of Older Persons' Prescriptions/Screening Tool to Alert Doctors to Right Treatment). A total of 158 individuals participated, with the majority aged 65–69 years (66.5%), male (53.8%), and consuming 3–4 medications (77.9%). Evaluation using the updated STOPP/START version 2 revealed that 93.7% of participants had at least one STOPP criterion indicating medications that should be discontinued, and 53.8% had at least one START criterion suggesting medications that should be initiated. The most prevalent STOPP issue was the need for gradual benzodiazepine withdrawal, while the most frequent START recommendation was initiating antihypertensive therapy in patients with systolic blood pressure above 160 mmHg and diastolic pressure above 90 mmHg. Principal component analysis demonstrated a significant correlation ($p < 0.05$) between the number of prescriptions and PIP prevalence, and also showed that fewer medical diagnoses were observed in younger participants. These findings reveal a notably high rate of inappropriate prescribing in this population, emphasizing the importance of active involvement by community pharmacists to improve medication management among older adults.

Keywords: Potentially inappropriate medication, Medications, Polypharmacy, Older adults

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Introduction

In recent decades, populations worldwide have undergone notable demographic shifts, with increased life expectancy and changes in both social and physical characteristics. The World Health Organization (2022) projects that by 2050, individuals aged 60 years and older will comprise 22% of the global population, nearly doubling the current proportion of 12% [1]. This demographic transition is occurring more rapidly than in previous centuries. Peru has experienced similar trends, with the proportion of adults aged 60 and above rising to 13.3% in 2022 [2].

The growing population of older adults has led to greater demand for healthcare services, as this age group is particularly vulnerable due to multimorbidity, polypharmacy, and age-related physiological changes [3]. Pharmacological management in older adults is challenging because declining organ function affects drug pharmacokinetics and pharmacodynamics, especially in the treatment of chronic conditions [4, 5].

Polypharmacy, defined as the concurrent use of five or more medications, is common among older adults, with ten or more drugs considered excessive polypharmacy [6]. Polypharmacy has been linked to adverse outcomes, including increased risk of side effects, reduced adherence, metabolic complications, and drug-drug interactions [7]. These prescribing patterns often result in medication-related problems (MRPs), such as errors and potentially inappropriate prescriptions (PIPs) [8]. Older adults are particularly susceptible to PIPs, which are situations where

the potential harm of a drug outweighs its benefit, medications are prescribed inappropriately, therapeutic duplication occurs, interactions are overlooked, or beneficial drugs are omitted [9, 10].

To evaluate prescription quality in older adults, various assessment tools have been developed, broadly classified as implicit or explicit. Implicit methods rely on professional judgment, considering the patient's overall clinical context and whether each medication is necessary. The Medication Appropriateness Index (MAI), widely used in Spain, is an example of an implicit approach. In contrast, explicit methods use predefined criteria derived from expert consensus or scientific evidence. These methods are reproducible, straightforward, and less resource-intensive compared to implicit evaluations, which depend on clinician expertise and time [11–13].

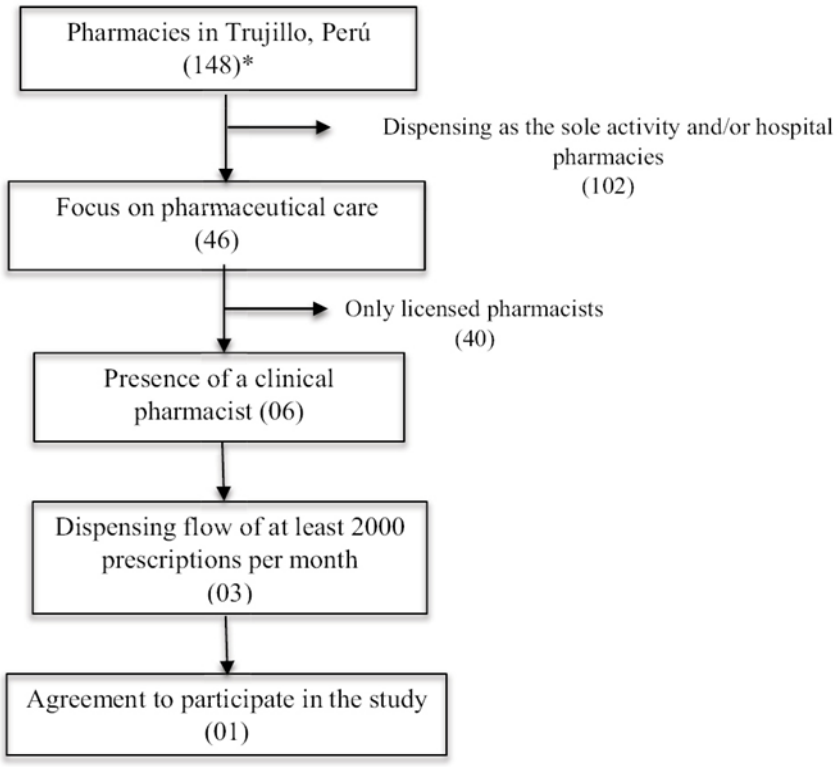
Among explicit tools, the Beers criteria, McLeod criteria, and the STOPP/START criteria are the most widely applied. While the Beers criteria have been influential, they do not address all pharmacological interactions, therapeutic duplications, or omissions [14–16]. The STOPP/START criteria, first published by Gallagher *et al*. in 2008 and updated in 2014, include 114 items (80 STOPP and 34 START criteria) and provide a practical framework to identify both inappropriate prescriptions and omissions in treatment [17–20].

Evidence suggests that applying STOPP/START criteria improves prescribing practices and reduces morbidity in older patients [21–23]. However, most research has focused on hospital settings, and studies using these criteria in community pharmacies remain limited. This study aimed to assess and identify PIPs in a model community pharmacy in Trujillo, Peru, using the STOPP/START criteria.

Materials and Methods

Study design and sampling

This observational, prospective, cross-sectional study was conducted in four phases between October 2019 and January 2020. The selection of the community pharmacy was based on three criteria: implementation of community pharmaceutical care, management by a qualified clinical pharmacist, and handling of at least 2,000 prescriptions per month to ensure a representative sample **(Scheme 1)**.



Scheme 1. Flow Chart for Community Pharmacy Selection. *https://serviciosweb-digemid.minsa.gob.pe/Consultas/Establecimientos.

Participants were chosen based on specific inclusion criteria, including being over 65 years of age and presenting a medical prescription with three or more medications. Exclusion criteria included communication or cognitive

difficulties that could interfere with data collection, illegible prescriptions, or prescriptions containing only vitamins or dietary supplements. Community members were selected using non-probabilistic sampling until data saturation was reached [24]. The sample size was determined using the finite population formula, resulting in 158 participants who met the eligibility criteria.

Phase I: Recruitment

The study sample comprised clients who visited the pharmacy, met the inclusion criteria, and consented to participate. Upon enrollment, participants signed an informed consent form, and their age and sex were recorded, along with clinical information including prescribed medications, documented using international nonproprietary names (INN) as listed in The Prescription Drug List, and diagnoses classified according to the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) (https://icd.who.int/browse10/2019/en).

Phase II: Analysis

Medical prescriptions were reviewed, and the prescribed and dispensed medications were entered into the online tool at stoppstart.free.fr/index.php. This platform allows input of medications and associated diagnoses, automatically identifying potentially inappropriate prescriptions (PIP). The clinical pharmacist validated these PIPs based on the STOPP/START criteria, version 2 [17, 18]. Direct patient interviews were conducted when additional clarification was needed.

Phase III: Study

Identified PIPs were systematically categorized according to the STOPP criteria (80 indications) and START criteria (34 indications). Pharmacological classes associated with PIPs, the total number of medications, and corresponding ICD-10 diagnoses were also determined [25]. The prevalence of PIPs was defined as the presence of at least one STOPP or START criterion in the patient relative to the total sample.

Phase IV: Data processing

Data on potentially inappropriate prescriptions among polymedicated elderly patients were analyzed according to study variables. Associations between variables were assessed using bivariate statistics with the Chi-square test. To reduce dimensionality and verify variable clustering, principal component analysis (PCA) with Varimax rotation and Kaiser normalization was applied to evaluate variance distribution [26]. Statistical significance was set at $p < 0.05$ with a 95% confidence level. SPSS v.22.0 was used for data analysis, and GraphPad Prism v.7.0 (Demo) was used for graphing.

Ethics

Participant confidentiality was strictly maintained, and individuals were free to decline or withdraw from the study at any point. Ethical standards of the National University of Trujillo were followed [27]. The study protocol was approved by the Ethics Committee of the National University of Trujillo, Peru.

Results and Discussion

A total of 158 elderly participants (85 men and 73 women) who visited the pharmacy with eligible prescriptions were enrolled. Most participants (66.5%) were aged between 65 and 69 years, reflecting a group still capable of self-care and medication management. Regarding prescription profiles, 77.9% had between three and four medications, while 22.1% had five or more medications in their prescriptions **(Table 1)**.

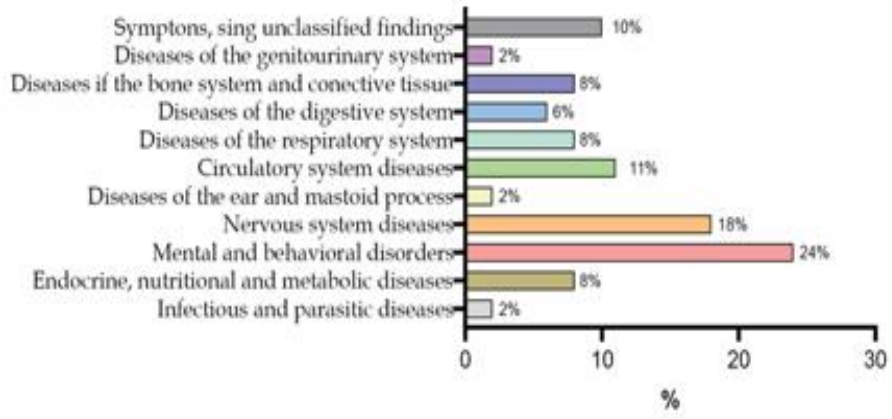
Table 1. Characteristics of the older adults included in the study.

Variables		Frequency	%
Age (years)	65–69	105	66.5
	70–74	40	25.3
	75–79	10	6.3
	80–84	3	1.9

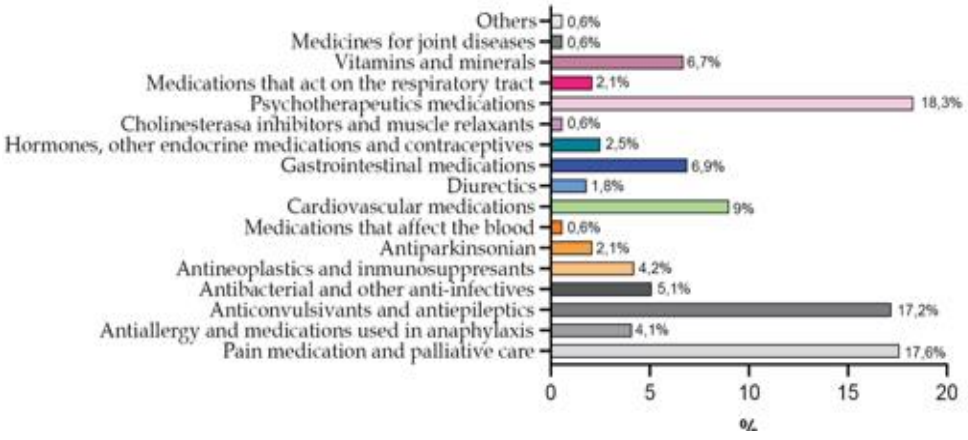
	≥ 85	0	0.0
Sex	Male	85	53.8
	Female	73	46.2
Number of medications	< 5	123	77.9
	5–9	34	21.5
	> 10	1	0.6

n (%): number of older adults (ratio)

In **Figure 1a**, the most commonly recorded diagnoses were mental disorders (24 percent) and diseases of the nervous system (18 percent). These findings highlight that the prevalent conditions among older adults are primarily associated with the aging of multiple organs and physiological systems. As shown in **Figure 1b**, the pharmacological classes most frequently prescribed included psychotherapeutic agents (18.3 percent), analgesics and palliative care medications (17.6 percent), and anticonvulsants (17.2 percent). Regarding specific medications, **Figure 1c** indicates that clonazepam had the highest prescription rate (10.3 percent), followed by paracetamol combined with tramadol (3.4 percent) and fluoxetine (2.6 percent). Notably, there was a considerable consumption of benzodiazepines within this elderly population.



a)



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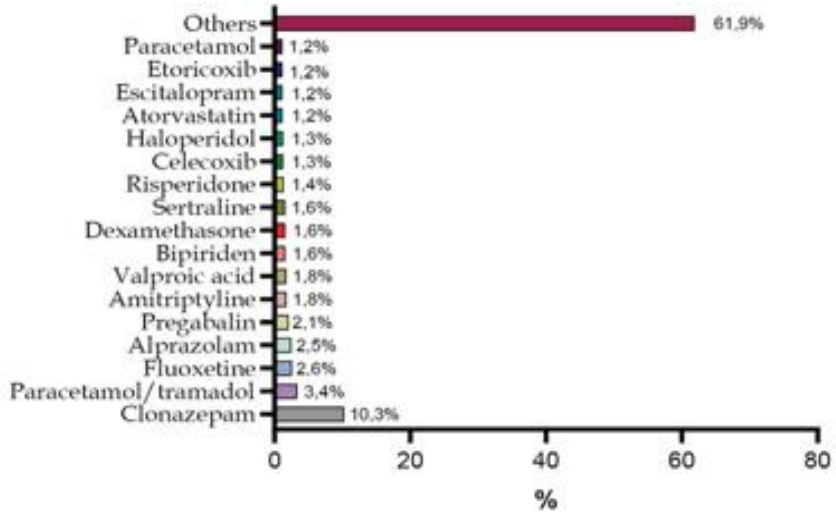

c)

Figure 1. Classification of diagnoses in older adult patients (a), distribution of pharmacological groups (b), and the main medications prescribed within the study population (c).

Table 2 presents the association between STOPP-START indicators and variables including sex, age, and the number of prescribed medications. The results indicate no significant differences in the occurrence of potentially inappropriate prescriptions (PIP) based on sex or age; nonetheless, a high prevalence of PIP was observed across all age groups. In contrast, a significant association was found between PIP and the number of prescribed medications ($p < 0.05$), demonstrating that polypharmacy is linked to an increased likelihood of PIP.

Table 2. Potentially inappropriate prescription (PIP) according to STOPP and START indicators.

Variables	STOPP Indicators		START Indicators	
	n_i/n (%) = 148/158 (93.7)		n_i/n (%) = 85/158 (53.8)	
Sex				
Male	80/85 (94.1)		46/85 (54.1)	p > 0.05
Female	68/73 (93.1)		39/73 (53.4)	
Age				
65–69	96/105 (91.4)		55/105 (52.4)	
70–74	39/40 (97.5)		21/40 (52.5)	
75–79	10/10 (100.0)		7/10 (70.0)	p > 0.05
80–84	3/3 (100.0)		2/3 (66.7)	
≥ 85	0/0 (0.0)		0/0 (0.0)	
Number of Medications				
< 5	113/123 (91.9)		59/123 (48.0)	
5–9	34/34 (100.0)		25/34 (73.5)	
> 10	1/1 (100.0)		1/1 (100.0)	p < 0.05
Male	80/85 (94.1)		46/85 (54.1)	
Female	68/73 (93.1)		39/73 (53.4)	

ni: number of older adults presenting with one or more indicators. ni/n (%): ratio of older adults with indicators in relation to the total sample.

Figure 2 illustrates that 35.4 percent of participants had between 1 and 3 STOPP indicators, while 51.9 percent had between 1 and 3 START indicators. Additionally, 33.5 percent of the study population presented 4 to 6 STOPP indicators. Notably, only 6.3 percent of participants had no STOPP indicators, and 46.2 percent showed no START indicators.

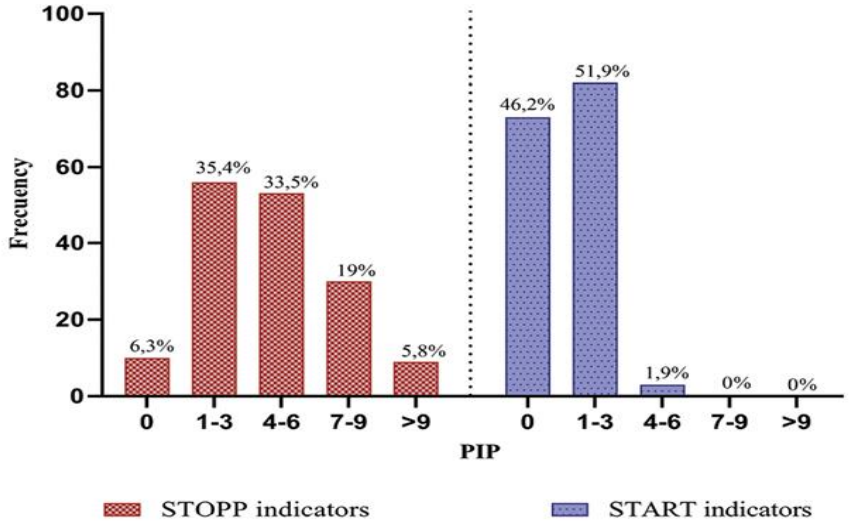

Figure 2. Distribution of STOPP and START indicators according to the number of PIP.

The analysis of PIP according to the STOPP/START framework, as summarized in **Table 3**, revealed a total of 733 STOPP-related and 140 START-related prescriptions. Within the STOPP criteria, 11.5% flagged prolonged benzodiazepine use exceeding four weeks, highlighting the associated risks such as sedation, impaired balance, confusion, and increased likelihood of falls. Additionally, 5.5% of STOPP criteria identified extended NSAID use beyond three months for osteoarthritis management, due to potential nephrotoxic effects and gastric mucosal injury.

Regarding the START criteria, 14.3% emphasized initiating antihypertensive therapy for patients with sustained high blood pressure (systolic > 160 mmHg, diastolic > 90 mmHg). Moreover, 25% recommended modifying treatment to opioid agonists when conventional analgesics—including paracetamol, NSAIDs, or weak opioids—proved ineffective. Another 17.9% of the START criteria addressed the need for laxative therapy in patients receiving regular opioid treatment.

Table 3. Number of PIP according to classification of STOPP and START criteria.

STOPP Criteria	**n = 733 (%)**
A. Medical Indications	
A3 Repetition of prescribing medications from the same drug class, including benzodiazepines, NSAIDs, SSRIs, loop diuretics, ACE inhibitors, beta-blockers, or anticoagulants.	10 (1.3)
B. Cardiovascular system	
B4 Use of a beta-blocker in patients with bradycardia (heart rate < 50 bpm) or with second- or third-degree atrioventricular block.	4 (0.5)
B6 Prescribing a loop diuretic solely for the management of high blood pressure.	4 (0.5)
B7 Use of a loop diuretic to treat peripheral edema in the lower limbs.	4 (0.5)
B8 Administration of a thiazide diuretic in patients with hypokalemia (K+ < 3.5 mmol/L), hyponatremia (Na+ < 130 mmol/L), hypercalcemia (corrected Ca++ > 2.65 mmol/L or > 10.6 mg/dL), or a history of microcrystalline arthritis such as gout or chondrocalcinosis.	5 (0.7)
B9 Prescribing a loop diuretic for hypertension in patients who have urinary incontinence.	4 (0.5)
B11 Use of an ACE inhibitor or ARB in patients with a history of hyperkalemia.	21 (2.9)
B12 Administration of an aldosterone antagonist (spironolactone, eplerenone) without monitoring potassium when combined with another potassium-sparing medication.	1 (0.1)
C. Antiplatelets/Anticoagulants	
C1 Prolonged use of aspirin at doses exceeding 160 mg/day, which increases bleeding risk.	4 (0.5)
C2 Use of aspirin in patients with a history of peptic ulcer without concomitant prescription of a proton pump inhibitor (PPI).	1 (0.1)

C3 Prescription of antiplatelet agents (aspirin, clopidogrel) or oral anticoagulants (vitamin K antagonists, direct thrombin inhibitors, or Factor Xa inhibitors) in patients at high risk of bleeding.	9 (1.2)
C11 Use of an NSAID alongside an antiplatelet drug without preventive PPI therapy.	3 (0.4)
D. Central nervous system and psychotropics	
D1 Use of a tricyclic antidepressant in patients with dementia, acute angle glaucoma, cardiac conduction disorders, prostatism, dysuria, or a history of acute urinary retention.	10 (1.4)
D2 Prescription of a tricyclic antidepressant as the initial treatment for depression.	10 (1.4)
D3 Administration of an anticholinergic neuroleptic (chlorpromazine, clozapine, pipotiazine, promazine) in patients with prostatism or a history of urinary retention.	2 (0.3)
D4 Use of an SSRI in patients with current or recent hyponatremia (Na+ < 130 mmol/L).	24 (3.3)
D5 Benzodiazepine use exceeding four weeks, associated with risks of sedation, confusion, imbalance, falls, or accidents; consumption should be tapered after four weeks.	84 (11.5)
D6 Prescription of a neuroleptic in patients with parkinsonism or dementia.	5 (0.7)
D7 Use of an anticholinergic/antimuscarinic drug to manage extrapyramidal symptoms caused by a neuroleptic.	6 (0.8)
D8 Administration of any drug with anticholinergic effects in patients with dementia or delirium.	3 (0.4)
D9 Use of a neuroleptic for psycho-behavioral symptoms linked to dementia.	29 (4.0)
D10 Prescription of a neuroleptic for insomnia.	29 (4.0)
D12 Use of phenothiazines as the first-choice antipsychotic.	2 (0.3)
D13 Prescription of levodopa or a dopamine agonist for benign essential tremor.	2 (0.3)
F. Gastrointestinal system	
F1 Use of prochlorperazine or metoclopramide in patients exhibiting extrapyramidal symptoms.	3 (0.4)
F2 Prescription of a proton pump inhibitor (PPI) for longer than eight weeks for peptic esophagitis or peptic ulcer.	9 (1.2)
F3 Administration of constipating medications (anticholinergics, oral iron, opiates, verapamil, aluminum-based antacids) in patients with chronic constipation when safer alternatives are available.	46 (6.3)
F4 Oral elemental iron exceeding 200 mg/day (iron fumarate > 600 mg/day, iron sulfate > 600 mg/day, iron gluconate > 1800 mg/day).	1 (0.1)
G. Respiratory system	
G2 Use of systemic corticosteroids instead of inhaled forms for long-term management of moderate to severe COPD.	24 (3.3)
G3 Prescription of anticholinergic bronchodilators (ipratropium, tiotropium) in patients with acute angle glaucoma.	1 (0.1)
G5 Use of benzodiazepines in individuals with acute or chronic respiratory failure.	1 (0.1)
H. Musculoskeletal system	
H1 Use of non-selective NSAIDs in patients with a history of peptic ulcer or gastrointestinal bleeding without concomitant gastroprotective therapy (PPI or H2 blocker).	32 (4.4)
H2 Prescription of NSAIDs in individuals with severe hypertension or severe heart failure.	3 (0.4)
H3 Long-term NSAID use (>3 months) as first-line therapy for osteoarthritis pain, despite paracetamol being effective for moderate pain.	40 (5.5)
H4 Extended corticosteroid therapy (>3 months) as monotherapy for rheumatoid arthritis, due to risk of adverse effects.	24 (3.3)
H5 Use of corticosteroids, oral or local, for osteoarthritis pain.	23 (3.1)
H7 NSAID or selective COX-2 inhibitor use in patients with uncontrolled cardiovascular disease (angina, severe hypertension).	3 (0.4)
H8 NSAID prescription in patients already on corticosteroids without preventive PPI therapy.	10 (1.4)
I. Urogenital system	
I1 Prescription of a drug with anticholinergic properties in patients with dementia, chronic cognitive impairment (risk of worsening confusion or agitation), narrow-angle glaucoma (risk of exacerbation), or persistent prostatism.	19 (2.6)

STOPP Criteria (*Continued*)	**n = 733 (%)**
J. Endocrine system	
J1 Use of long-acting sulfonylureas (glibenclamide, chlorpropamide, glimepiride, extended-release glycolazide) in patients with type 2 diabetes mellitus.	1 (0.1)
J6 Prescription of androgens without confirmed hypogonadism, which carries a risk of androgen toxicity and lacks proven benefit outside hypogonadism.	1 (0.1)
K. Drugs that predictably increase the risk of falls in older people	
K1 Use of benzodiazepines in any situation due to sedative effects, potential reduction in consciousness, and impaired balance.	84 (11.5)
K2 Prescription of neuroleptics in all cases, considering sedative effects, gait disturbances, and risk of extrapyramidal symptoms.	28 (3.8)
K3 Use of vasodilators (alpha1-adrenergic blockers, calcium channel blockers, long-acting nitrates, ACE inhibitors, ARBs) in patients with persistent orthostatic hypotension, increasing the risk of syncope and falls.	22 (3.0)
K4 Administration of hypnotic-Z drugs (zopiclone, zolpidem, zaleplon) due to risks of prolonged daytime sedation and ataxia.	2 (0.3)
L. Painkillers	
L1 Use of strong oral or transdermal opioids (morphine, oxycodone, fentanyl, buprenorphine, diamorphine, methadone, tramadol, pethidine, pentazocine) as first-line therapy for mild pain.	26 (3.5)
L2 Maintenance opioid therapy without concurrent laxative treatment, increasing the risk of severe constipation.	26 (3.5)
L3 Prescription of long-acting opioids without short-acting opioids for breakthrough pain, which may result in uncontrolled pain.	26 (3.5)
N. Anticholinergics	
N1 Concurrent use of two or more antimuscarinic or anticholinergic medications (e.g., antispasmodics, first-generation antihistamines).	2 (0.3)
START Criteria	**n = 140 (%)**
A. Cardiovascular system	
A3 Prescription of antiplatelet agents (aspirin, clopidogrel, prasugrel, or ticagrelor) in patients with coronary artery disease (angina, stent placement, or prior myocardial infarction), history of stroke, or peripheral arterial disease.	1 (0.7)
A4 Use of antihypertensive medication in patients with persistent hypertension, treated or untreated (systolic > 160 mmHg and/or diastolic > 90 mmHg); for diabetic patients, targets of 140 mmHg systolic and 90 mmHg diastolic are preferred.	20 (14.3)
A5 Prescription of a statin in patients with coronary artery disease, peripheral arterial disease, or a history of stroke, unless the patient is over 85 years old or at the end of life.	1 (0.7)
B. Respiratory system	
B1 Use of inhaled beta2-adrenergic agonists or antimuscarinic bronchodilators (ipratropium, tiotropium) in patients with mild to moderate asthma or COPD.	1 (0.7)
B2 Prescription of inhaled corticosteroids in patients with moderate to severe asthma or COPD, particularly when FEV1 is below 50% or when frequent exacerbations necessitate oral corticosteroids.	2 (1.4)
C. Central nervous system and visual apparatus	
C1 Use of levodopa or a dopamine agonist in patients with confirmed idiopathic Parkinson's disease causing significant functional impairment.	5 (3.6)
C2 Prescription of a non-tricyclic antidepressant for patients experiencing major depressive symptoms.	12 (8.6)
C3 Administration of an acetylcholinesterase inhibitor (donepezil, rivastigmine, galantamine) for mild to moderate Alzheimer's disease or rivastigmine for Lewy body disease.	5 (3.6)
C5 Use of an SSRI for severe, persistent anxiety; if contraindicated, consider a serotonin-norepinephrine reuptake inhibitor or pregabalin.	7 (5.0)
D Gastrointestinal tract	
D1 Prescription of a proton pump inhibitor for patients with severe gastroesophageal reflux or peptic strictures requiring dilation.	3 (2.1)

D2 Use of fiber supplements (bran, methylcellulose) in patients with diverticular disease accompanied by chronic constipation.	1 (0.7)
E Musculoskeletal system	
E1 Use of disease-modifying antirheumatic drugs (methotrexate, hydroxychloroquine, minocycline, tocilizumab, etanercept, adalimumab, infliximab, rituximab, certolizumab) in patients with disabling rheumatoid arthritis.	3 (2.1)
E3 Vitamin D (cholecalciferol 800–1000 IU/day) and calcium (1–1.2 g/day) supplementation in patients with osteoporosis or a history of fragility fractures.	1 (0.7)
E4 Administration of bone resorption inhibitors (e.g., bisphosphonates, strontium ranelate, teriparatide, denosumab) in patients with confirmed osteoporosis or a history of fragility fractures.	1 (0.7)
E5 Vitamin D supplementation (cholecalciferol 800–1000 IU/day) for older adults who are homebound, have a history of falls, or present with osteopenia.	1 (0.7)
F Endocrine system	
F1 Prescription of ACE inhibitors or ARBs in patients with diabetic nephropathy, overt proteinuria, or microalbuminuria (>30 mg/24 h), regardless of the presence of renal failure.	4 (2.9)
H Analgesics	
H1 For moderate to severe pain, consider opioid agonists when paracetamol, NSAIDs, or weak opioids are insufficient or unsuitable.	35 (25,0)
H2 Prescription of laxatives for patients on regular opioid therapy.	25 (17,9)
I Vaccines	
I2 Administration of the pneumococcal vaccine at least once after age 65, following national guidelines.	12 (8,6)

Factorial analysis was conducted using Principal Component Analysis (PCA) **(Table 4 and Figure 3)**, which grouped the six examined variables into two significant components ($p < 0.05$). The first component included the number of prescribed medications, as well as the counts of STOPP and START criteria, while the second component comprised age, sex, and diagnosis. Component 1 revealed a significant association between a higher number of prescribed medications and an increased prevalence of potentially inappropriate prescriptions (PIP), indicating that polypharmacy raises the risk of PIP. In component 2, age carried a negative loading, indicating that younger patients tend to have fewer diagnoses.

Table 4. Distribution of potentially inappropriate prescriptions in components*, according to factor analysis**.

Variables	Components	
	1	**2**
Age	0.155	**-0.552**
Sex	0.159	**0.742**
Diagnosis	0.013	**0.650**
Number of Medications	**0.841**	-0.063
Number of STOPP Criteria	**0.693**	0.128
Number of START Criteria	**0.712**	-0.080

* Extraction method: Principal Component Analysis; **Rotation method: Varimax with Kaiser normalization.

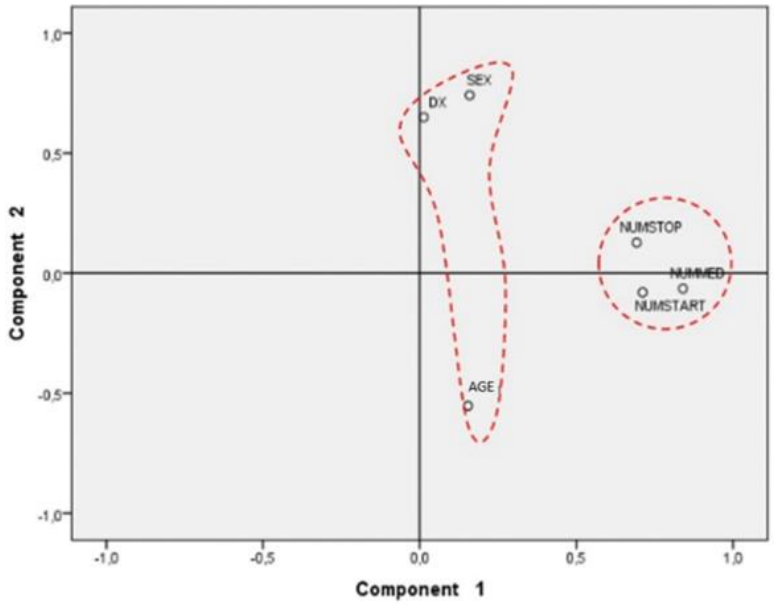

Figure 3. Study variables were grouped into two components in rotated space based on factor analysis. DX: diagnoses; NUMSTOP: number of STOPP criteria; NUMSTART: number of START criteria; NUMED: number of medications.

Polypharmacy represents a major public health concern, particularly among older adults with multiple chronic conditions, as it contributes significantly to multimorbidity. This issue is often driven by the use of potentially inappropriate medications and adverse drug reactions, which are exacerbated by age-related changes in physiological function as well as pharmacokinetic and pharmacodynamic alterations [28, 29].

In this study, high usage of psychotropic, neurological, and analgesic medications was observed, reflecting the prevalence of neurodegenerative disorders in the elderly population [30]. Older adults with multiple comorbidities typically require more medications, which is evident in the prescribing patterns analyzed here. For example, the likelihood of being prescribed a benzodiazepine is higher compared to other drug classes [31]. Additionally, in low- and middle-income countries, there is a general tendency toward overprescribing medications, a pattern consistent with the context of this study [32].

Benzodiazepines, which were frequently prescribed in this study, are linked to confusion, dizziness, and increased fall risk, especially when long-acting forms are used. Polypharmacy that includes benzodiazepines alongside other central nervous system depressants should be avoided due to additive effects that raise morbidity and mortality risks [33–35]. Another commonly prescribed medication was paracetamol, alone or combined with tramadol, used for managing acute and chronic pain as well as fever. While paracetamol is generally safe in older adults, age-related reductions in clearance and distribution volume necessitate careful dose adjustments. Prolonged use may also increase hepatotoxicity risk due to metabolism by CYP2E1, which produces the toxic metabolite NAPQI [36, 37]. In Peru and other countries, paracetamol is available over-the-counter in certain dosages [38]; therefore, pharmacist guidance is critical to prevent overdose and toxicity [39, 40].

The STOPP-START criteria were initially developed to assess potentially inappropriate prescribing (PIP) among older adults in Europe, with STOPP prevalence ranging from 35% to 77% and START from 51% to 73% [41]. More recent studies report STOPP prevalence as high as 86% [42] and 91% [43]. In South America, Brazil reported PIP prevalence at 95.4% [44], similar to the findings in the current study. These results underscore suboptimal healthcare coverage for elderly populations, highlighting the need for improved pharmacotherapy management to reduce unnecessary and avoidable adverse drug events.

In the European OPERAM trial, a pharmacotherapy team evaluated the occurrence of STOPP/START criteria in a hospital setting and found that 99% of patients met at least one criterion. The most common issues were prescriptions without evidence-based indications, duplicate therapy, and prolonged benzodiazepine use (>4 weeks), which aligns with the most frequent criterion observed in this study [45]. Similarly, a multicenter retrospective study in Palestine by Abukhalil *et al*. reported that 66.8% of elderly inpatients experienced PIP due to polypharmacy and multiple comorbidities. In that study, START criteria were most prevalent within the cardiovascular system, and the most frequent STOPP criterion was therapy duplication [46].

In Mexico and Brazil, studies have also evaluated potentially inappropriate prescriptions (PIP) in hospitalized older adults. The Mexican study reported a PIP prevalence of 67% based on the STOPP/START criteria, while in Brazil, the highest frequency of STOPP criteria (24.8%) was related to central nervous system medications. The most common START errors were omissions of necessary medications (59.9%), though these rates significantly decreased when assessed at hospital admission [47, 48]. In Spain, Mud Castelló *et al*. (2014) analyzed older adults in two community pharmacies and found that 67% of patients were polymedicated according to the Beers criteria, with short-, intermediate-, and long-acting benzodiazepines being the most frequently prescribed drugs, mirroring the results of the present study [49]. Regarding the STOPP/START criteria, prolonged use of PPIs (>8 weeks) was the most common STOPP criterion identified.

In Lima, Peru, pharmacy prescriptions assessed using the Beers criteria showed that 69.2% of older adults had potentially inappropriate prescriptions, primarily involving anxiolytics, with a higher prevalence among women (61.6%) [50]. Similarly, a study evaluating a pharmacy chain found a 69.2% PIP rate among adults aged 65–70 years, again with a higher proportion in women [51]. These studies used the Beers criteria, which may detect fewer PIPs compared to the STOPP/START criteria [52]. Most prior studies focused on hospital settings, highlighting the need to apply explicit criteria like STOPP/START in community pharmacy contexts to ensure appropriate pharmacotherapy for older adults. However, a major limitation in countries such as Peru is the lack of coordination in the healthcare system and insufficient policies incentivizing pharmacists to perform activities beyond medication dispensing to optimize therapy outcomes [53].

In the community pharmacy setting, a Bulgarian study using the EU(7)-PIM List criteria found that 67% of polymedicated patients had at least one PIP [54], comparable to our findings **(Table 2)**, although the criteria used differ, and STOPP/START tends to identify more PIPs [55]. Implementing STOPP/START criteria in both public and private healthcare services could help reduce adverse effects and optimize pharmacotherapy in older adults. Nevertheless, these criteria have limitations; for instance, Verdoorn *et al*. (2015) found that only 19% of medication-related problems (MRPs) in Dutch community pharmacies were detected by STOPP/START, highlighting the need to integrate explicit criteria into broader pharmaceutical care practices [56].

Our study emphasizes the importance of clinical pharmacists in community settings, with the skills to identify and manage potential medication-related problems in older adults, and to refer patients for medical attention when necessary. Limitations of this study include reliance solely on prescription data without full access to patients' medical histories and its cross-sectional design, which precludes follow-up and precise assessment of medication adherence. Although a high prevalence of PIP was detected, the clinical relevance of these prescriptions was not assessed, which should be addressed in future multidisciplinary research.

Conclusion

Polypharmacy is prevalent among older adults due to age-related physiological changes and is closely linked to a higher incidence of PIP. In this study, a substantial number of STOPP and START criteria were identified in the analyzed prescriptions. Component analysis revealed a clear association: as the number of prescribed medications increases, so does the likelihood of PIP. It is crucial for community pharmacies to establish systems for detecting PIPs in geriatric populations, alongside other strategies, to optimize pharmacotherapy for older adults. However, this remains a challenge in countries where primary care processes are not well integrated.

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