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Drug prescription patterns and compliance with WHO and beers criteria in older patients

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Abstract

Background As the population ages, the prevalence of chronic diseases increases, leading to greater reliance on multiple medications that are conducted to increase the risk of adverse drug reactions (ADR) that may cause higher morbidity and mortality rates. This study aims to evaluate medication prescribing patterns in the older adults and assess compliance with the World Health Organization (WHO) guidelines and Beers Criteria.

Methods A cross-sectional study was conducted over six months in 2022, collecting prescriptions for patients aged 65 and above from a 24-hour community pharmacy in Iran. The prescriptions were analyzed according to the WHO prescribing guidelines, including the mean number of prescribed drugs, the number of injectable drugs and antibiotics per prescription, and also the prescription of drugs with generic names and from the list of Essential Drug List (EDL). In addition, the prescriptions were assessed according to the Beers Criteria for the frequency of prescription of potentially inappropriate medications (PIMs). Also, polypharmacy, which is defined as the prescription of more than five drugs per prescription, has been investigated based on the number of drugs prescribed per prescription.

Results 1,053 older patient prescriptions were assessed, whose average age was 72.3 ± 6.7 years, with 36.2% of prescriptions involving polypharmacy (five or more drugs). The most frequent medical discipline of prescribers was general practice (30.3%). The average number of drugs per prescription was 4.1 ± 2.1, which exceeded the WHO recommendation. Additionally, 47.3% of prescriptions contained at least one PIM according to the Beers Criteria, with non-steroidal anti-inflammatory drugs (NSAIDs) being the most common (17.9%). The relative frequency of injectable drugs and antibiotics used per prescription was 20.8 and 18.9%, respectively, while 7.6% of prescriptions did not use generic names.

Conclusions The study highlights concern about levels of polypharmacy and PIM use in older patients. While the low rate of antibiotic prescribing and relatively high use of generic drugs indicate some positive adherence to WHO guidelines, the frequent prescription of PIMs and the high average number of drugs per prescription point to substantial room for improvement.

Keywords Beers Criteria, Potentially inappropriate medications, Geriatric, Drug prescriptions, Polypharmacy

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Background

According to estimates by the United Nations Population Division, the global population of individuals aged 60 and older is projected to reach approximately 2 billion by 2050, with more than one billion comprising those aged 70 to 75 [1]. As life expectancy rises, the definitions of health and wellness in late life have evolved. Heart disease, cancer, and stroke are now the leading causes of death among older adults, while deaths from infections have decreased. Older adults often suffer from high rates of chronic diseases, with 80% having at least one and 50% having at least two chronic conditions [2]. Due to the prevalence rate of various diseases among the old adults, medications are frequently used to manage disease progression [3]. However, organ damage and physiological changes in the older patients can alter pharmacokinetics and pharmacodynamics, increasing the risk of adverse drug reactions (ADR), and the use of potentially inappropriate medications (PIMs) that leading to higher mortality rates [4–6]. PIMs may involve inappropriate dosages or durations of drug administration, drug-drug, and drug-disease interactions [6]. These issues are widespread among older populations across different healthcare systems and are linked to increased risks of ADRs, additional medical costs, inappropriate use of healthcare resources, frequent falls, and mortality [7–10]. Approximately 20–30% of all hospital admissions in older adults are estimated to be related to PIMs, and up to 10% of them can be life-threatening or fatal [11–13].

The utilization of multiple medications known as polypharmacy is prevalent among older adults with multimorbidity, as one or more medications adults may be utilized to manage different illnesses [14]. Unfortunately, as the use of multiple medications escalates, the likelihood of adverse health outcomes, such as elevated healthcare expenses, drug interactions and ADRs, medication non-adherence, decreased functional capacity, and geriatric syndromes, increase [15, 16]. These outcomes can result from various factors, including drug-drug and drug-disease interactions. Furthermore, the likelihood of side effects and harm also rise in concordance with the number of medications [17]. Hence, reducing unnecessary medications and simplifying drug regimens are crucial strategies to improve patient safety [18].

Drug interventions aim to optimize individual drug therapy, minimize risks associated with drug therapy, and ensure safety and cost-effectiveness [17]. Pharmacological interventions can be tailored based on the epidemiology of PIMs, with strategies such as specific health education and targeted interventions significantly reducing the incidence of PIMs in the older adults [19].

In Canada and the United States, criteria and guidelines have been developed to assess the quality of prescribing practices and appropriate use of medications in older adults. The Beers Criteria are the most widely used tool for identifying inappropriate medications in this population [20]. The Beers Criteria categorize drugs into five groups: (1) potentially inappropriate drugs, (2) drugs to be avoided in certain circumstances, (3) drugs to be used with caution, (4) drug-drug interactions, and (5) drugs requiring dose adjustments based on kidney function [21].

The World Health Organization (WHO) advocates the rational use of drugs, providing indicators for drug use indications, evaluating prescription patterns, and assessing drug-related services [22].

To evaluate prescription patterns in older adults, the Beers Criteria can be used in conjunction with the WHO standard prescription indicators [21]. Since the Beers Criteria introduction, numerous studies examined prescribing patterns compared to these guidelines. These studies have revealed that many medications prescribed to older adults are inappropriate, leading to significant complications, increased costs, higher mortality rates, and increased demand for medical services [23–25].

Prescription patterns reflect the proficiency of physicians in diagnosing diseases and selecting appropriate treatments for older patients [26]. This study aims to investigate drug prescription patterns in older adults, identify potentially inappropriate medications, and compare them with the Beers Criteria and WHO prescription indicators. This can help pinpoint areas for improvement and ultimately optimize drug therapy and the healthcare system in Iran.

Methods

Study design

In this retrospective cross-sectional study analyzed the prescription patterns of all patients aged 65 and above, irrespective of whether the prescriptions addressed acute or chronic conditions. These patients were referred to a designated pharmacy and insured through various health insurance providers, including the Social Security Organization, Iran Health Insurance Organization, Armed Forces Medical Services Insurance Organization, and Institutional Health Insurance Funds. All data were extracted from the pharmacy's database, which registered prescriptions issued by hospital physicians and/or private practitioners containing at least one medication. The study was conducted over a six-month period from October 2021 to March 2022 and was based in a 24-hour community pharmacy located in Yazd City, Iran. This pharmacy was selected as the representative site due to four key criteria: convenient geographical access for patients, extended working hours, the most comprehensive drug portfolio in the city, and a high concentration of doctors in the pharmacy's vicinity.

Data collection

All prescriptions that registered in the selected pharmacy prescription registration system reviewed during a six months interval regarding to insured covered patients aged over 65 years (based on the defined age of older adults by Beers Criteria) that their prescriptions containing at least one medication item (non-prescription, prescription, supplement, or herbal).

Based on a researcher-made data collection form, data gathering was performed. This form included demographic characteristics of the patients, such as age and sex, as well as details about the prescribing physician, including their classification as a general practitioner or specialist, and their specific area of specialization. Additionally, data were collected about the drugs prescribed in the prescription, based on two checklists: the WHO's standards and the Beer criteria [21, 22]. By using the WHO's checklist, the appropriateness of prescriptions by considering the total number of drugs prescribed, the use of generic names, injectable dosage forms, inclusion of drugs from the essential drug list (EDL), and the number of antibiotics prescribed, were assessed. By using the Beer criteria the prescription pattern was evaluated by checking for PIMs prescribed in general, as well as any types of PIMs, including the number, dosage, and dosage form of them (supplementary file) [27].

Ethical approval

This research was conducted with the approval of the Research Ethics Committee of Shahid Sadoughi University of Medical Sciences, as the code IR.SSU.MEDICINE.REC.1400.163. The committee confirmed that the research adhered to the ethical principles outlined in the 1964 Declaration of Helsinki and its subsequent amendments. Since the data collection relied exclusively on the pharmacy's database and did not involve direct patient interaction, the requirement for informed consent was formally waived by the Research Ethics Committee of Shahid Sadoughi University of Medical Sciences. A certificate of data confidentiality and non-disclosure of patient information was obtained from the researcher. Furthermore, the study involved the participation of the pharmacy's pharmacist, with all necessary permissions obtained, and it was supervised by a clinical pharmacist faculty member.

Table 1 Demographic characteristics of patients whom prescriptions collected

Criteria	Frequency (%)
Gender	
Male	544 (51.7)
Female	509 (48.3)
Age distribution	
65–74	730 (69.3)
75–84	246 (23.4)
85–94	76 (7.2)
>= 95	1 (0.1)
Insurance coverage organization	
Armed Forces Medical Services Insurance Organization	272 (25.8)
Institutional Health Insurance Funds	497 (47.2)
Iran Health Insurance Organization	68 (6.5)
Social Security Organization	216 (20.5)
Sum	1,053 (100)

Examining the prescription pattern

The prescription patterns were initially compared with the WHO's standard prescription pattern. The standard prescribing indicators include (1) an average of ≤ 3 drugs per prescription, (2) 100% use of generic names for prescribed drugs, (3) antibiotics constituting no more than 30% of medicines prescribed, (4) injectable drugs ranging from 10%, and (5) 100% availability of prescribed drugs on the Essential Drug List (EDL) [22].

PIMs were determined based on the Beers Criteria of the American Geriatrics Society, version 2023 [21, 22]. The Beers Criteria divide the list of drugs to be avoided in older adults into five categories, either for most cases or for specific diseases or conditions. Patients using any of the potentially inappropriate drugs listed in the Beers Criteria were assigned to the PIM use group, while those not using such drugs were assigned to the no PIM use group.

Data analyzing

All data related to prescription patterns were analyzed using IBM SPSS Statistics software, version 26. Quantitative data were reported as mean ± standard deviation (SD), and qualitative data were reported using absolute frequencies and percentage. Pearson's correlation test and the Chi-square test were used to analyze variables. $p < 0.05$ was considered statistically significant in this study.

Results

In this study, 1,053 prescriptions were collected and examined during the 6-month study period. Of these prescriptions, 51.7% were belonged to female patients, and 48.3% to male patients. The patients' ages ranged from 65 to 97 years, with average of 72.3 ± 6.7 years (Table 1).

The most common categories of drugs were Antihypertensives (28.9%), Drugs for functional gastrointestinal, and acid related disorders (24.5%), and Anti-inflammatory and Antirheumatic products, non-steroids (22.3%) (Fig. 1).

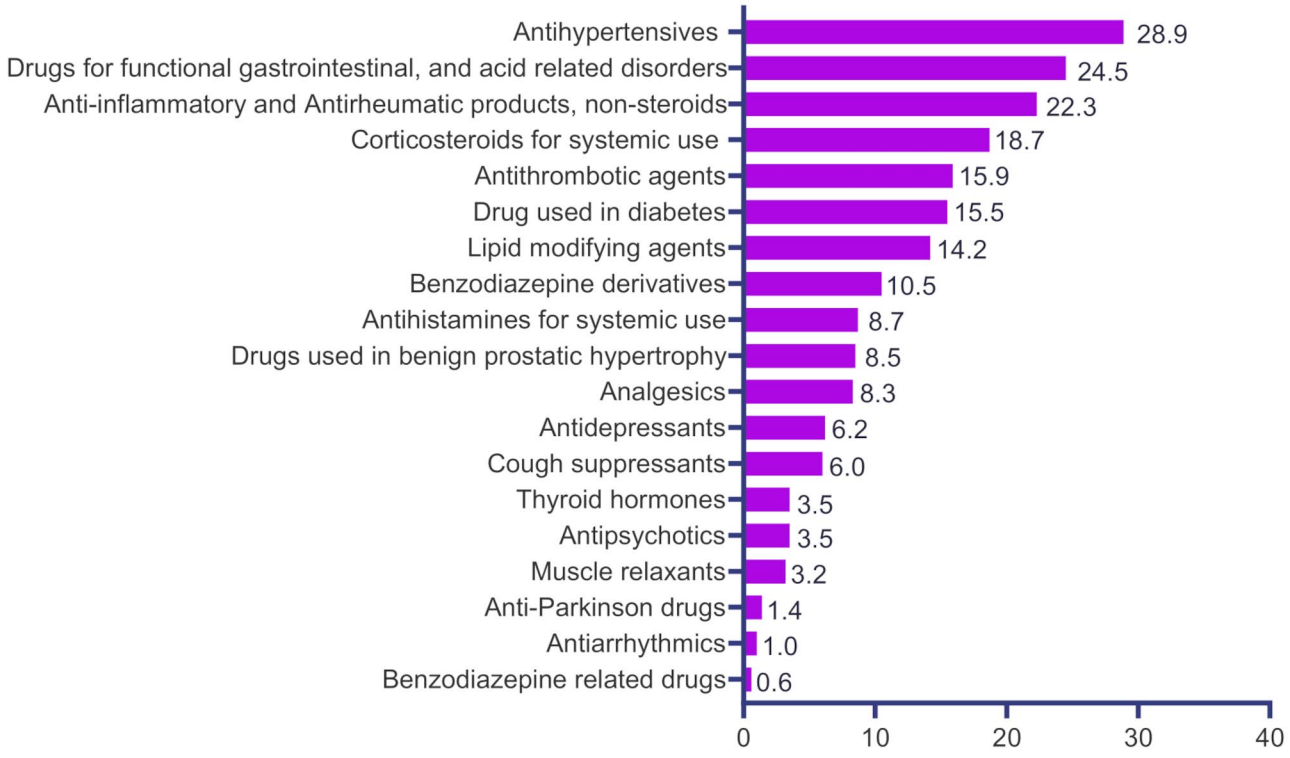

Fig. 1 Distribution of drug classifications in collected prescriptions

Prescription patterns

General practitioners (GPs) accounted for the highest percentage of prescriptions (30.3%), followed by general internal medicine specialists (11.6%). The mean number of medications per prescription was 4.1 ± 2.1, with a range of 1 to 13 medications. The median number of medications per prescription was 4.0. Polypharmacy was identified in 36.2% of the cases. Prescriptions which were prescribed by cardiologists included the highest average number of drugs prescribed per prescription (4.7 ± 2.7), while the lowest was observed in prescription which were prescribed by ophthalmologists (2.2 ± 1.2) (Table 2).

Injectable drugs were prescribed in 20.8% of the cases, with an average of 0.3 ± 0.7 injectable drugs per prescription. Antibiotic prescribing was relatively low, with oral antibiotics absent in 85.3% of prescriptions and injectable antibiotics absent in 95.4%. Furthermore, topical antibiotics were prescribed in even smaller amounts, with 99.4% of prescriptions excluding them Consequently, the mean number of antibiotics per prescription was 0.23 ± 0.5. At least one antibiotic (oral, topical, or injectable) was included in only 18.9% of prescriptions, which is below the WHO's recommended indicator of 30%. In addition, 7.6% of the prescriptions did not include generic drugs (Table 3).

Potentially inappropriate medications (PIMs)

Out of the 1,053 prescriptions, 498 (47.3%) contained at least one PIM according to the Beers Criteria. The highest frequency of PIM prescriptions was seen in the 65 to 74-year age group, which accounted for 68.1% of the PIM-containing prescriptions. No statistically significant relationship was observed between the prescription of PIM and age of patients ($p = 0.770$). Most prescriptions with PIMs included only one PIMs (66.3%); however, 33.7% of prescriptions included up to six PIMs. The highest percentage of PIM were prescribed by GPs and surgeons (e.g. neurosurgery, general surgery, etc.), and on the other hand, the least amounts of PIM were prescribed by psychiatrists and Pain management fellowship Anesthesiologist. By using the chi-square test, it revealed that there is no significant relation between PIM prescription and different physician specialty ($p = 0.897$) (Table 4).

Table 5 shows the frequency and percentage of PIM drugs prescribed according to the Beers Criteria in the collected prescriptions. The most frequently prescribed PIMs were non-COX-2-selective oral NSAIDs, accounting for 219 instances (20.8%), followed by cardiovascular and antithrombotic agents (12.2%) and proton pump inhibitors (10.8%). Benzodiazepines were prescribed in 10.4% of cases, and central alpha-agonists in 8.0%. Notably, no prescriptions for high-risk medications such as nitrofurantoin or amiodarone were identified.

Table 2 Distribution of prescriptions and average number of drugs by physician specialty

Physician specialty		Numberof prescriptions (%)	Mean number of drugs prescribed per prescription (mean ± SD)	Minimum and maximum number of drugs prescribed per prescription
General Practitioner		319 (30.3)	4.3 ± 2.2	1–13
Cardiology		81 (7.7)	4.7 ± 2.7	1–12
Dermatology		19 (1.8)	3.2 ± 1.7	1–6
Emergency Medicine		15 (1.4)	3.3 ± 1.3	1–6
Infectious Diseases		19 (1.8)	3.5 ± 1.2	1–5
General Internal Medicine		122 (11.6)	4.6 ± 2.1	1–11
Subspeciality in	Pneumatology	10 (0.9)	3.8 ± 1.3	2–6
	Rheumatology	37 (3.5)	4.4 ± 1.5	2–10
	Gastroenterology	10 (0.9)	3.9 ± 1.6	2–6
	Endocrinology and Metabolism	35 (3.3)	4.2 ± 2.0	1–8
Neurology		70 (6.6)	3.9 ± 1.7	1–9
Obstetrics and Gynecology		11 (1.0)	4.2 ± 1.9	1–7
Ophthalmology		78 (7.4)	2.2 ± 1.2	1–9
Orthopedics		51 (4.8)	4.2 ± 1.9	1–12
Pain management fellowship Anesthesiologist		5 (0.5)	3.4 ± 2.5	1–7
Psychiatry		3 (0.3)	3.3 ± 1.5	2–5
Surgery (e.g. Neurosurgery, General Surgery, etc.)		131 (12.4)	4.4 ± 2.0	1–11
Urology		37 (3.5)	3.3 ± 1.0	2–5
Total		1,053 (100)	4.1 ± 2.1	1–13

Table 3 Compliance of prescription patterns with the WHO prescription guidelines for older patients

WHO Criteria [22]	Frequency (%) of 1,053 prescriptions
Number of drugs per prescription	
Mean (± SD) number of drugs per prescription	4.1 (2.1)
The range (minimum-maximum) of the number of drugs per prescription	1–13
Prescription with generic name	
The number of prescriptions without generic drugs	80 (7.6)
Mean (± SD) generic drugs prescribed per prescription	2.6 (1.6)
Range (minimum-maximum) of generic drugs prescribed per prescription	0–12
Administration of injectable drugs	
The number of prescriptions without injectable drugs	834 (79.2)
Mean (± SD) injectable drugs per prescription	0.3 (0.7)
Range (minimum-maximum) of injectable drugs prescribed per prescription	0–5
Prescribing antibiotics	
The number of prescriptions without	
Any *antibiotics* dosage form	854 (81.1)
Oral *antibiotics* dosage form	898 (85.3)
Injectable *antibiotics* dosage form	1005 (95.4)
Topical *antibiotics* dosage form	1047 (99.4)
Mean (± SD) antibiotics prescribed per prescription	0.2 (0.5)
Prescribing from the EDL list	
Mean (± SD) drugs prescribed from the EDL list per prescription	2.7 (1.6)
The range (minimum-maximum) of drugs prescribed from the EDL list per prescription	0–10

EDL: Essential drug list; SD: Standard Deviation

Discussion

This study reveals an examination of prescribing patterns within a 24-hour community pharmacy in Yazd, Iran, over a six-month period, with a particular emphasis on older patients. The findings reveal both positive trends and areas of concern, especially regarding adherence to WHO prescription guidelines, the frequency of polypharmacy, and the usage of PIMs in this vulnerable population [21, 22, 28].

Overall, the study demonstrated that the average number of drugs per prescription exceeded the WHO's recommended maximum of three. Generic prescribing was

Table 4 The frequency distribution of PIM prescription in order to the age of patients and specialty of physician

Criterion		Frequency (%)	*p* value
Number of Prescribed PIM per prescription			
1		330 (66.3)	Not indicated
2		124 (24.9)	
3		35 (7.0)	
4		8 (1.6)	
5		0 (0.0)	
6		1 (0.2)	
Prescribing PIM across different age ranges (years)			
65–74		339 (68.1)	0.770*
75–84		129 (25.9)	
85–94		30 (6.0)	
>= 95		0 (0.0)	
Physician specialty			
General Practitioner		150 (30.1)	0.897**
Cardiology		38 (7.6)	
Dermatology		7 (1.4)	
Emergency Medicine		7 (1.4)	
Infectious Diseases		8 (1.6)	
General Internal Medicine		60 (12.0)	
Subspeciality in	Pneumatology	3 (0.6)	
	Rheumatology	15 (3.0)	
	Gastroenterology	5 (1.0)	
	Endocrinology and Metabolism	16 (3.2)	
Neurology		36 (7.2)	
Obstetrics and Gynecology		6 (1.2)	
Ophthalmology		36 (7.2)	
Orthopedics		26 (5.2)	
Pain management fellowship Anesthesiologist		0 (0.0)	
Psychiatry		2 (0.4)	
Surgery (e.g. Neurosurgery, General Surgery, etc.)		67 (13.5)	
Urology		16 (3.2)	
Sum		498 (100)	

PIM: potentially inappropriate medications

*Pearson's correlation test, ** Chi-square test

reasonably high, and a small percentage of prescriptions included brand-name prescriptions. However, according to the WHO guideline, which has stated that 100% of the drugs prescribed in the prescriptions should be with generic names, it has not been able to fully comply. According to WHO standards, the use of injectable drugs and antibiotics in prescriptions is limited to a maximum of 10 and 30%, respectively, and in this study, the administration of injectable drugs and antibiotics was within the acceptable range of control [22]. Nevertheless, the high rate of PIM prescribing, particularly in the 65–74 age group, suggests the need for more cautious prescribing practices to reduce the risk of ADRs.

Prescription patterns and the frequency of polypharmacy

While polypharmacy is sometimes unavoidable, it heightens the risk of adverse reactions, drug interactions, and medication non-adherence, risks that are exacerbated in older adults due to age-related physiological changes [15].

The study's finding of an average of 4.1 drugs per prescription highlights a substantial prevalence of polypharmacy, with 36.2% of prescriptions containing multiple drugs. This aligns with similar study in comparable settings, where older patients' complex medical needs often necessitate multiple medications [29].

The role of GPs, who issued 30.3% of prescriptions, is particularly significant. GPs are often the primary care providers for older patients, managing a wide range of health issues [30]. The relatively higher frequency of drug prescribing by GPs may reflect a more reactive approach to healthcare, where symptoms are treated with additional medications which need additional attention to audit of GP's clinical approach, and encourage them to recommend the non-pharmacological interventions [31].

Table 5 The frequency distribution of prescribed PIM based on Beers Criteria [21]

Potentially Inappropriate Medications	Frequency (%)
Antihistamines	
First-generation antihistamines	58 (5.5)
Anti-infective	
Nitrofurantoin	0 (0.0)
Cardiovascular and Antithrombotic	
Aspirin (for cardiovascular indication)	0 (0.0)
Warfarin	128 (12.2)
Rivaroxaban	0 (0.0)
Dipyridamole	0 (0.0)
Non-selective peripheral alpha-1 blockers	
Doxazosin	0 (0.0)
Prazosin	0 (0.0)
Terazosin	41 (3.9)
Central alpha-agonists	
Clonidine	84 (7.9)
Nifedipine	0 (0.0)
Amiodarone	0 (0.0)
Dronedarone	0 (0.0)
Digoxin	1 (0.1)
Central nervous system	
Antidepressants with strong anticholinergic activity	
Tricyclic antidepressants (TCAs)	65 (6.2)
Antiparkinsonian agents with strong anticholinergic activity	
Benztropine (oral)	0 (0.0)
Trihexyphenidyl	15 (1.4)
Antipsychotics, First and second generation	
Aripiprazole	6 (0.6)
Haloperidol	3 (0.3)
Olanzapine	12 (1.1)
Quetiapine	9 (0.9)
Risperidone	7 (0.7)
Barbiturates	
Phenobarbital	1 (0.1)
Benzodiazepines	
Alprazolam	25 (2.4)
Chlordiazepoxide*	57 (5.4)
Clonazepam	16 (1.5)
Diazepam	2 (0.2)
Lorazepam	3 (0.3)
Midazolam	0 (0.0)
Oxazepam	7 (0.7)
Nonbenzodiazepines hypnotics	
Zolpidem	2 (0.2)
Endocrine	
Androgens	0 (0.0)
Estrogens with or without progestins	0 (0.0)
Insulin (all types)	40 (3.8)
Sulfonylureas	20 (1.9)
Desiccated thyroid	37 (3.5)
Megestrol	0 (0.0)
Growth hormone	0 (0.0)
Gastrointestinal	
Proton-pump inhibitors	

Table 5 (continued)

Potentially Inappropriate Medications	Frequency (%)
Esomeprazole	12 (1.1)
Lansoprazole	6 (0.6)
Omeprazole	31 (2.9)
Pantoprazole	65 (6.2)
Rabeprazole	0 (0.0)
Metoclopramide	3 (0.3)
GI antispasmodics with strong anticholinergic activity	
Clidinium-chlordiazepoxide	1 (0.1)
Dicyclomine	5 (0.5)
Hyoscyamine	3 (0.3)
Scopolamine	0 (0.0)
Mineral oil, given orally	0 (0.0)
Genitourinary	
Desmopressin	0 (0.0)
Pain medications	
Non-COX-2-sective NSAIDs, oral	
Aspirin > 325 mg/day	0 (0.0)
Diclofenac	31 (2.9)
Ibuprofen	27 (2.6)
Indomethacin	3 (0.3)
Ketorolac	0 (0.0)
Meloxicam	49 (4.7)
Naproxen	78 (7.4)
Piroxicam	0 (0.0)
Indomethacin (Suppository)	8 (0.8)
Ketorolac (Parenteral)	23 (2.2)
Skeletal muscle relaxants	
Methocarbamol	32 (3.2)

* alone or in combination with amitriptyline or clidinium

Adherence to WHO Guidelines

Several discrepancies were observed when comparing prescription patterns with WHO standards. WHO guidelines recommend that no more than three drugs be prescribed per prescription; however, the average prescription in this study contained 4.1 drugs, more than the recommended limit [22]. While this may be necessary for treating multiple chronic conditions, it raises concerns about over-prescription and the risks associated with polypharmacy. Over-prescription can trigger a cascade effect, where the side effects of one medication led to the prescription of additional drugs, complicating treatment and increasing the risk of adverse outcomes [15, 29]. This aligns with findings of Mosleh A and et al. study, in which the average prescription contained 3.6 drugs [32]. Furthermore, the polypharmacy rate in this study (36.2%) is notably higher than those reported in countries such as Argentina (20.5%) [33], Switzerland (17%) [34], and Singapore (14.5%) [35], suggesting either a greater reliance on pharmacological interventions in our study or more complex patient conditions requiring multiple medications.

Despite concerns about polypharmacy, the study revealed some encouraging results in relation to WHO prescribing criteria [22]. The relatively low use of injectable drugs (20.8% of prescriptions) reflects best practices in older adult care, where non-invasive treatments are preferred to minimize risks such as infection and adverse reactions [36]. Additionally, the reduced rate of antibiotic prescribing (only 18.9% of prescriptions included antibiotics) is a positive outcome, well below the national average of 39% in Iran [37, 38]. This indicates a trend toward more conservative antibiotic use, which is critical for preventing the spread of antibiotic resistance [39].

However, the study also identified shortcomings in adherence to WHO recommendations regarding generic prescribing [22]. Although most prescriptions included generic medications, 7.6% did not, representing a missed opportunity for cost-effective treatment. This finding aligns with other studies in Iran, where generic prescribing rates range from 76.8 to 95% [37]. Increasing the use of generics could help reduce the financial burden on older patients and improve medication adherence [40].

Potentially inappropriate medications

One of the most concerning findings of the study is the high frequency of PIMs, with 47.3% of prescriptions containing at least one inappropriate medication. PIMs pose a significant risk to older patients, who are more vulnerable to ADRs and drug interactions due to polypharmacy [41]. The Beers Criteria, which are designed to identify medications that should be avoided in older adults, were not consistently adhered to by prescribers, suggesting a lack of awareness or consideration of these guidelines. As Kargar M and et al. reported a lower PIM rate (31.2%) [27], while studies in Turkey (63.5%) [42], India (65%) [43], and China (64.8%) [44] indicated higher rates, with common PIMs including diuretics, proton pump inhibitors (PPIs), and aspirin [43–45]. The variation in PIM rates across these studies highlights the influence of local prescribing practices and healthcare system differences on PIM use [31].

The frequent prescription of NSAIDs, which accounted for 17.9% of all PIMs, is particularly troubling. Although NSAIDs are effective for pain and inflammation management, their use in older patients carries significant risks, including gastrointestinal bleeding, renal impairment, and cardiovascular complications. This finding points to a gap in the awareness or application of safer alternatives, such as acetaminophen or non-pharmacological interventions like physical therapy [45].

The primary limitation of this study was the absence of access to a comprehensive database of older patients' prescriptions in Yazd City, which would have facilitated a more exhaustive analysis. Additionally, the exclusion of prescription data from other pharmacies within Yazd City, coupled with the relatively short study duration, further restricted the scope of the findings. The lack of information regarding patient comorbidities and the number of concurrent illnesses represents another significant limitation, as this precluded the ability to contextualize prescription patterns and assess potential correlations with the number of medications prescribed.

Furthermore, the study did not account for seasonal variations in prescribing patterns. Although data collection spanned the fall and winter months (October to March), the study was not specifically designed to investigate seasonal fluctuations, particularly in the prescription of antibiotics. Another notable limitation is the potential underestimation of overall medication use due to the analysis being confined to prescribed medications. Over-the-counter (OTC) and nonprescription medications, which are widely utilized by older populations, were not included in the dataset. This omission may result in an incomplete representation of medication use patterns. Future studies should incorporate data on OTC and nonprescription medications to provide a more comprehensive and accurate assessment of medication use among older patients.

One of the important factors influencing drug prescribing practices in Iran is the challenge of drug importation. Limited access to some drugs, due to sanctions or logistical difficulties, often forces prescribers to substitute internationally recommended drugs with less appropriate or available alternatives. This limitation may inadvertently contribute to the higher prevalence of PIMs and deviations from prescribing guidelines such as the Beers criteria and WHO indicators. Furthermore, inconsistent access to essential drugs can exacerbate polypharmacy as prescribers attempt to compensate for unavailable drugs by combining multiple agents to achieve the desired therapeutic effects [46, 47]. These findings highlight the need for policy interventions that address supply chain challenges to ensure the availability of appropriate drugs.

The findings of this study emphasize the urgent need for more cautious and evidence-based prescribing practices for older patients. Regular medication reviews, ideally conducted by multidisciplinary teams including pharmacists, are essential for identifying unnecessary medications, reducing polypharmacy, and ensuring that PIMs are avoided when safer alternatives exist [48, 49]. Additionally, greater adherence to guidelines such as the Beers Criteria and the integration of these criteria into electronic prescribing systems could reduce prescription errors by flagging potentially inappropriate medications and suggesting safer options.

Future research should examine prescribing trends in both public and private hospital pharmacies to gain a more comprehensive understanding of prescription practices across different healthcare settings.

Conclusions

This study reveals high rates of PIM use and polypharmacy among older patients in Yazd, Iran, with prescribing patterns that do not align with WHO guidelines. These discrepancies pose significant health risks for older patients and underscore the need for a shift in prescribing practices. Physicians must adopt a more judicious approach to medication prescriptions, and pharmacists should play a more active role in ensuring appropriate drug use. Collaboration between doctors and pharmacists, along with patient education about the risks of inappropriate medications, is essential to improving prescription practices and achieving better health outcomes for older patients.

Abbreviations

ADRs	Adverse drug reactions
EDL	Essential Drug List
GPs	General practitioners
NSAIDs	Non-steroidal anti-inflammatory drugs
OTC	Over-the-counter
PIMs	Potentially inappropriate medications

PPIs Proton pump inhibitors
TCAs Tricyclic antidepressants
WHO World Health Organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12877-025-05780-5.

Supplementary Material 1

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G.A. contributed to the design of the work. G.A and S.S. contributed to design methodology of this study. M.M. contributed to data collection. Y.K. and G.A. contributed to data analysis. G.A. and S.S. supervised the project. G.A. and S.S. and Y.K. contributed to Validation and Visualization this study. Y.K. writing the original draft. All authors reviewed the manuscript and approved the submitted version of manuscript.

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Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This research was conducted with the approval of the Research Ethics Committee of Shahid Sadoughi University of Medical Sciences, as the code IR.SSU.MEDICINE.REC.1400.163. The committee confirmed that the research adhered to the ethical principles outlined in the 1964 Declaration of Helsinki and its subsequent amendments. Since the data collection relied exclusively on the pharmacy's database and did not involve direct patient interaction, the requirement for informed consent was formally waived by the Research Ethics Committee of Shahid Sadoughi University of Medical Sciences. A certificate of data confidentiality and non-disclosure of patient information was obtained from the researcher. Furthermore, the study involved the participation of the pharmacy's pharmacist, with all necessary permissions obtained, and it was supervised by a clinical pharmacist faculty member.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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