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Journal of Hospital Pharmacy and Health Services

Original Paper

Profile of the prescription of potentially inappropriate medications in hospitalized elderly patients

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Abstract

Objective: To characterize the profile of the prescription of potentially inappropriate medications for the elderly (PIME) in hospitalized older adults, considering the aspects of necessity and safety of pharmacotherapy. **Methods:** A cross-sectional, retrospective, and descriptive study conducted in a high-complexity teaching hospital, assessing the profile of PIME usage in hospitalized patients aged 60 years or older, based on the 2023 Beers Criteria. Data were obtained from reports of the University Hospital Management Application (AGHUx) and compiled in a Microsoft Excel spreadsheet for interpretation and statistical analysis. To evaluate safety aspects, five classification categories contained in the Beers Criteria were used. **Results:** This study demonstrated that throughout the study period, 96,6% of patients used at least one PIME, and 37,3% of standardized medications appeared in at least one of the categories 2, 3, 4, or 5 of the 2023 Beers Criteria update. The most prevalent classes among the male population aged 60 to 70 years were proton pump inhibitors (PPI) (21,3%), diuretics (17,0%), and antipsychotics (8,6%), while among females aged 60 to 70 years, the use of opioids (6,3%) and benzodiazepines (6,7%) was notable. Among all prescriptions analyzed in the study, 29,8% included at least one PIME. The use of PIME is associated with the presence of polypharmacy ($\chi2 = 75{,}338$; $p<0{,}01$, d= 0,52). **Conclusion:** This study highlighted a high prevalence of PIME in hospitalized elderly individuals at the study institution, with 96,6% of patients using at least one of these medications during hospitalization. Given the risks associated with PIME use, the need for new studies to quantify the impact of these medications on the health of hospitalized elderly people, as well as the promotion of educational actions regarding PIMs to improve monitoring the safety of therapy for elderly individuals.

Keywords: potentially inappropriate medications, public hospitals, pharmacist, pharmaceutical epidemiology, elderly.

Perfil de prescrição de medicamentos potencialmente inadequados em idosos hospitalizados

Resumo

Objetivo: Caracterizar o perfil de prescrição de medicamentos potencialmente inadequados para idosos (MPII) na pessoa idosa hospitalizada, tendo em vista os aspectos de segurança da farmacoterapia. **Métodos:** Estudo transversal, retrospectivo e descritivo realizado em um hospital de ensino de alta complexidade, em que foi avaliado o perfil de utilização de MPII, em pacientes hospitalizados com idade igual ou maior a 60 anos, com base nos Critérios de Beers de 2023. Os dados foram obtidos a partir de relatórios do Aplicativo de Gerenciamento de Hospitais Universitários (AGHUx) e compilados em planilha do Microsoft Excel para interpretação e análise estatística. Para a avaliação dos aspectos de segurança foram utilizadas cinco categorias contidas nos critérios de Beers. **Resultados:** O presente estudo demonstrou que durante todo período do estudo, 96,6% dos pacientes utilizaram pelo menos 1 MPII, 37,3% dos medicamentos padronizados constavam em pelo menos uma das categorias 2, 3, 4 ou 5 da atualização dos critérios de Beers de 2023 e as classes mais prevalentes na população masculina entre 60 e 70 anos foram os inibidores de bomba de prótons (IBP) (21,3%), diuréticos (17,0%) e antipsicóticos (8,6%), enquanto no sexo feminino entre 60 e 70 anos destaca-se o uso de opioides (6,3%) e benzodiazepínicos (6,7%). Dentre todas as prescrições analisadas no estudo, 29,8% apresentavam pelo menos 1 MPII. O uso de MPII está relacionado à presença de polifarmácia ($\chi2 = 75{,}338$; $p<0{,}01$, d= 0,52). **Conclusão:** O presente estudo evidenciou alta prevalência de MPII em indivíduos idosos hospitalizados na instituição de estudo, com 96,6% dos pacientes utilizando pelo menos um destes medicamentos durante o internamento. A partir dos riscos associados ao uso dos MPII, evidencia-se a necessidade de novos estudos para quantificação do impacto desses medicamentos na saúde do idoso hospitalizado assim como a promoção de ações educativas a respeito dos MPII para melhor monitorização na segurança da terapia do indivíduo idoso.

Palavras-chave: medicamentos potencialmente inapropriados, hospitais públicos, farmacêutico, farmacoepidemiologia, idoso.

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Introduction

Population aging is a phenomenon primarily marked by an epidemiological transition, characterized by an increase in the prevalence of non-communicable chronic diseases, and a demographic transition, evidenced by the inversion of the age pyramid. In Brazil, this phenomenon is occurring rapidly, leading to, among other consequences, an increase in hospital and overall healthcare costs[1,2].

According to Rodrigues et al. (2021), by the year 2024 there will be 153 elderly individuals for every 100 young people[1]. The 2022 demographic census conducted by the Brazilian Institute of Geography and Statistics (IBGE) showed a 46.6% increase in the elderly population in Brazil compared to the 2010 census[3]. Brazil is the country with the highest volume of scholarly output on healthy aging, resulting in a larger number of public policies targeted at this population[4]. The aging process is a right guaranteed in Brazil through gerontological public policies such as the National Policy for the Elderly and the Elderly Person Statute[1], under Law No. 14,423 of July 22, 2022. However, if these policies are not implemented, there may be a lack of comprehensive care for the elderly. Thus, population aging can represent a major challenge for the healthcare system and social security[5].

From a biological standpoint, aging is a heterogeneous process influenced by intrinsic and extrinsic factors, which lead to psychological, social, functional, and structural changes[6]. These changes can directly impact the pharmacotherapy of the elderly, such as bio-pharmaceutical changes due to physiological alterations associated with aging, for example, increased adipose tissue and decreased muscle mass[7]. Among these changes, hepatic metabolism alterations—such as reduced liver blood flow—are notable factors affecting drug metabolism[7]. Additionally, aging is associated with lower activity of cytochrome P450, which is responsible for metabolizing various drugs, particularly affecting the clearance of lipophilic medications[8].

In light of this, aiming to enhance medication safety for this population, Mark Beers developed, in 1991, criteria for classifying potentially inappropriate medications for older adults (PIMs), considering both drug and patient characteristics[9]. Currently, the American Geriatrics Society develops and updates PIM lists, which should be monitored and potentially avoided in various prevalent conditions among older patients. The latest update was made in the 2023 version[10].

Consequently, due to changes in the morbidity and mortality profile of older adults, their increased need for access to high-complexity healthcare services, and the prevalence of polypharmacy, interventions in pharmacotherapy are necessary to resolve drug-related problems due to higher exposure to PIMs[11-13]. The increased prescription of PIMs contributes to risks associated with their use without proper monitoring, resulting in a higher incidence of adverse drug reactions. In older adults, these reactions—along with the increased complexity of drug therapy—are linked to poorer clinical outcomes in terms of adherence, safety, and effectiveness[14].

The high prevalence of PIM prescriptions can be observed in university hospitals in Brazil. For instance, the study by Neves et al. (2022) found that 80.2% of the studied sample were prescribed PIMs, and 95.7% of them were using polypharmacy[15]. Furthermore, deprescribing and medication therapy review are associated with reduced hospital readmissions among elderly patients, especially by reducing the prescription of PIMs[16]. Therefore, it is essential to understand the prevalence of PIM prescriptions to guide further studies on the impact of these medications on elderly health, as well as the role of healthcare professionals, such as pharmacists, in pharmacotherapy monitoring. Thus, this study aims to characterize the prescription profile of PIMs in hospitalized older adults, considering the associated risks and safety aspects of pharmacotherapy.

Methods

This is a cross-sectional, retrospective, and descriptive observational study designed to assess the prevalence of potentially inappropriate medications for older adults based on the 2023 update of the Beers Criteria. The data evaluated were obtained from medical records and prescriptions of elderly patients admitted to the internal medicine ward of the study hospital between January and June 2023. The study was conducted in accordance with the *Strengthening the Reporting of Observational Studies in Epidemiology* (STROBE) guidelines for observational studies. This study was submitted to the ethics committee of the Hospital de Clínicas Complex at the Federal University of Paraná (CHC-UFPR) and approved under CAAE No. 4954331.6.0000.0096.

CHC-UFPR is a public general hospital, certified as a teaching hospital, located in Curitiba, Paraná. It receives referred patients from primary health care units and emergency care centers. Currently managed by the Brazilian Hospital Services Company (EBSERH), it provides 400 beds to the Unified Health System (SUS), of which 36 belong to the internal medicine ward. This ward is divided into two wings: male (20 beds) and female (16 beds). Due to the hospital's high-complexity nature and the range of specialties offered, the patient profiles are diverse. The ward has a multidisciplinary team including a nurse, pharmacist, nutritionist, physical therapist, social worker, psychologist, occupational therapist, and general physicians.

Data Collection and Organization

The study included patients aged 60 years or older who were admitted to the internal medicine ward and had at least one complete 24-hour medical prescription recorded in the AGHUx system. Patients were excluded if their prescriptions contained only medications labeled as "if necessary," "at physician's discretion," or "patient's own medication," the latter being home-use drugs not standardized by the institution, due to limitations of the information system.

The database of patients admitted to the internal medicine ward during the study period was provided by the hospital's information technology (IT) team using reports from AGHUx, the standardized hospital management system used by federal university hospitals in the EBSERH network. The data were compiled into Microsoft Excel spreadsheets for subsequent analysis by the researchers.

Assessment of Population Profile and Use of PIMs

Potentially inappropriate medications (PIMs) were assessed according to the 2023 Beers Criteria published by the American Geriatrics Society[10]. A list was created including the medications available at the institution that are included in the Beers Criteria. This list specified the pharmacological class, standardized doses and formulations, AGHUx medication codes, and linked each medication to its respective Beers Criteria category.

To characterize the patient population and the prescription profile, all 24-hour prescriptions for the included patients were analyzed, as these are reviewed and renewed daily. The data provided by the IT team were filtered to exclude non-standardized hospital medications, "patient's own" medications, and medications

prescribed "if necessary" or "at physician's discretion." Retained variables included age, sex, admission diagnosis, length of stay in the ward, prescribed medications, duration of use, dosage, route of administration, dosing schedule, and AGHUx code. Based on this list and the compiled prescription data from the internal medicine ward, the prescription profile of these medications was evaluated.

To assess the prescription profile of PIMs, four classification categories from the Beers Criteria were used: medications with drug-disease or drug-syndrome interactions that may exacerbate the disease or syndrome; medications that should be used with caution in older adults; medications with clinically significant drug-drug interactions that should be avoided in older adults; and medications that are potentially inappropriate regardless of diagnosis or condition[10]. For these four selected categories, the presence of a medication on the list was sufficient to classify it as a PIM, without the need for additional clinical data evaluation or correlation for this definition. Drug interactions for each individual patient were not assessed. Each participant was classified according to whether or not they had been prescribed at least one PIM: either "at least one PIM prescribed" or "no PIM prescribed." For pharmacotherapy evaluation, all prescriptions issued during the patient's hospitalization were analyzed.

Statistical Analysis

The collected data were presented using descriptive statistics. Categorical variables were expressed as absolute and relative frequencies, and continuous variables were presented as median measures of central tendency and dispersion, according to data normality. No sampling calculations were performed, as the entire sample from the study period was evaluated. Statistical analyses were conducted using R software, version 4.4.3.

Inferential analysis was performed to assess the relationship between PIM use and variables such as age, sex, race, educational level, marital status, diagnosis, length of hospital stay, and presence of polypharmacy. The categorical variables included: sex (male and female), race (White, Black, Asian, and Indigenous), educational level (no formal education, incomplete elementary education, incomplete high school, complete elementary education, complete high school, incomplete higher education, and not declared), diagnosis (as per the International Classification of Diseases — ICD), marital status (married, widowed, single, divorced, common-law marriage, and other), and presence of polypharmacy (yes or no). The continuous variables were age and length of hospital stay.

For categorical variables such as the presence of polypharmacy, the Chi-square test was used, followed by odds ratio (OR) analysis and univariate logistic regression. For continuous variables, the Mann-Whitney test was applied with a significance level of 5%.

To evaluate the polypharmacy and non-polypharmacy groups, the effect size was calculated using Cohen's phi (ϕ) coefficient (1988), interpreted as follows: small effect (>0.1), medium effect (>0.3), and large effect (>0.5). For length of hospital stay, effect size was calculated using the methods proposed by Fritz et al. (2011) and the Common Language Effect Size approach[17-20].

Based on assumptions, the Shapiro-Wilk test was performed to assess normality of continuous data, and the Levene test was used to assess variance. The presence of outliers was evaluated through graphical boxplot analysis; however, no data classified as outliers were excluded from the analysis. Therefore, parametric (Student's t-test) and non-parametric (Mann-Whitney test) inferential statistical tests were performed depending on the normality and variance of the assessed variables[17-20].

Results

During the study period, 580 medical records of hospitalized patients were identified, of which 323 were elderly aged over 60 years, including 169 (52.3%) female and 154 (48.7%) male patients, predominantly of White ethnicity (86.4%, n = 279). Regarding marital status and declared educational level, the most common were married individuals (50.5%, n = 163) and those with incomplete primary education (30.0%, n = 97). The average age was 73.5 years with a standard deviation of 16.9. The median length of hospital stay was 10 days. A total of 303 patients (93.8%) experienced polypharmacy, and 312 (96.6%) used at least one PIM during hospitalization. The maximum number of PIMs identified for a single patient during their stay was seven. The most common admission diagnoses were unspecified septicemia and stroke not specified as hemorrhagic or ischemic. The characteristics of the 323 patients are described in Table 1.

In the evaluation of prescribed medications, a total of 42,280 prescriptions were recorded from all prescriptions issued during each patient's hospital stay. The most frequently prescribed medications were omeprazole (8.5%, n = 3596), dipyrone (6.6%, n = 2772), enoxaparin (5.8%, n = 2473), and furosemide (4.9%, n = 2106). The most commonly used routes of administration were: oral (46.5%), intravenous (30.9%), via feeding tube (12.7%), and subcutaneous (9.8%). Information regarding medications prescribed in the unit is shown in Table 2.

A total of 443 drug formulations available in the institution were identified, of which 165 (37.3%) were listed in one or more of the 2023 updated Beers Criteria categories. Among these PIMs available in the hospital, 39.4% fell under category 2, 35.8% under category 3, 14.5% under category 4, and 10.3% under category 5. The most representative pharmacological classes were cardiovascular and antithrombotic agents (16.4%), benzodiazepines (15.8%), antipsychotics (11.0%), and opioids (8.5%). These data are represented in Table 3. Regarding the use profile of PIMs, a total of 16,818 PIMs were prescribed during the study period, corresponding to 39.8% of all prescriptions. Additionally, 96% of the patients used at least one PIM during hospitalization. Table 4 describes the most prevalent pharmacological classes and specific PIMs, as well as the most common age range and sex for each class.

The most prevalent classes were proton pump inhibitors (PPIs), diuretics, and antipsychotics, representing 21.3%, 17.0%, and 8.6% of prescribed PIMs, respectively, mainly identified in male patients aged 60–70 years. These were followed by antithrombotics (10.0%) in males aged 70–80 years. In female patients, opioids and benzodiazepines stood out, representing 6.3% and 6.7% of PIM prescriptions, respectively.

The Chi-square test of independence showed an association between PIM prescription and polypharmacy (χ^2 = 75.338; p < 0.01; ϕ = 0.52). Binary logistic regression showed that polypharmacy is a predictor of PIM use ($\chi^2(1)$ = 32.36; p < 0.01). In this study, patients with polypharmacy were associated with a higher likelihood of using PIMs (OR = 66.6; 95% CI: 15.7 – 283.3).

Regarding length of hospital stay, the Mann-Whitney test showed no statistically significant difference in median length of stay between patients who used PIMs and those who did not (W = 1,137.5; p = 0.057; r = 0.106). Even though the result was not statistically significant, the median stay for PIM users (median = 10 days; IQR = 13) was higher than for non-users (median = 7 days; IQR = 6). This conclusion was based on the median, as the study used non-parametric methods. Other variables—age, sex, diagnosis, and education level—did not show statistically significant associations.

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Table 1. Sociodemographic and Clinical Profile

Sociodemographic and Clinical Characteristics	
Sociodemographic Characteristics	**n = 323 | %**
Age (years)	
60 – 70	136 | 42
70 – 80	110 | 34
>80	77 | 24
Sex	
Female	169 | 52
Male	154 | 48
Race	
White	279 | 86.4
Black	40 | 12.4
Indigenous	2 | 0.6
Asian	2 | 0.6
Marital status	
Married	163 | 50.5
Widowed	59 | 18.3
Single	62 | 19.2
Divorced	15 | 4.6
Other	22 | 6.7
Common-law marriage	2 | 0.6
Education level	
No formal education	43 | 13.3
Incomplete primary education	97 | 30
Incomplete secondary education	7 | 2.2
Complete primary education	23 | 7.1
Complete secondary education	35 | 10.8
Incomplete higher education	3 | 0.9
Complete higher education	7 | 2.2
Not declared	108 | 33.4
Clinical Characteristics	
Length of hospital stay (median | SD*)	10 | 16.9
Polypharmacy (≥ 5 medications)	303 | 93
Patients with ≥ 1 PIM prescribed	312 | 96
Hospital admission diagnosis / ICD	
Unspecified septicemia / A41.9	43 | 13.3
Stroke, not specified as hemorrhagic or ischemic / I64	30 | 9.3
Unknown and unspecified causes of morbidity / R69	13 | 4
Other septicemias / A41	9 | 2.8
Heart failure / I50	8 | 2.5
Chronic kidney failure / N18	8 | 2.5
Acute kidney failure / N17	7 | 2.2
Unspecified bacterial pneumonia / J15.9	6 | 1.9
Acute myocardial infarction / I21	6 | 1.9

SD = standard deviation

Table 2. Fifteen Most Commonly Prescribed Medications

Medication	Medication	n° (prescriptions) | %*	Total
Omeprazol	Omeprazol 20mg COMP	2497 | 5.9	3596
	Omeprazol 40mg FR	1083 | 2.6	
	Omeprazol 2mg/mL Susp	16 | 0.04	
Dipirona	Dipirona 500mg COMP	587 | 1.4	2772
	Dipirona Gotas	43 | 0.1	
	Dipirona 1000mg AMP	2142 | 5	
Enoxaparina	Enoxaparina 20mg	87 | 0.2	2473
	Enoxaparina 40mg	1987 | 4.7	
	Enoxaparina 60mg	296 | 0.7	
	Enoxaparina 80mg	103 | 0.2	
Furosemida	Furosemida 40mg COMP	1080 | 2.5	2106
	Furosemida 20mg AMP	1026 | 2.4	
Atorvastatina	Atrovastatina 20mg COMP	127 | 0.3	1601
	Atrovastatina 40mg COMP	875 | 2.0	
	Atrovastatina 80mg COMP	599 | 1.4	
Anlodipino	Anlodipino 5mg COMP	1496 | 3.5	1496
Ácido acetilsalicílico	AAS 100mg COMP	1164 | 2.7	1164
Carvedilol	Carvedilol 3.125 mg COMP	219 | 0.5	1089
	Carvedilol 6.25 mg COMP	546 | 1.3	
	Carvedilol 12.5 mg COMP	324 | 0.8	
Levotiroxina	Levotiroxina 25mcg COMP	774 | 1.8	1010
	Levotiroxina 100 mcg COMP	236 | 0.6	
Risperidona	Risperidona 1mg COMP	903 | 2.1	903
Heparina	Heparina 5000 UI AMP	766 | 1.8	773
	Heparina 25000 UI FR	7 | 0.01	
Metoclopramida	Metoclopramida 10mg AMP	640 | 1.5	776
	Metoclopramida 10mg COMP	136 | 0.3	
Morfina	Morfina 10mg COMP	589 | 1.4	747
	Morifna 10mg AMP	158 | 0.4	
Ceftriaxona	Ceftriaxona 1000mg FR	704 | 1.7	704
Bisacodil	Bisacodil 5mg COMP	632 | 1.5	632
Total prescriptions			21826

COMP – tablet, FR – vial, AMP – ampoule, Susp – suspension
*The percentage of each formulation was calculated based on the total number of medications prescribed in the study (42.280)

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Table 3. Prevalence of Pharmacological Classes Listed in the 2023 Beers Criteria

Pharmacological Class	Category 2 (n°)	Category 3 (n°)	Category 4 (n°)	Category 5 (n°)
Anti-histamínico	4			
Nitrofurano	1			
Cardiovascular e antitrombótico	13	3	5	6
Antidepressivos tricíclicos	1	1	1	
Antipsicóticos	4	7	7	
Barbituricos	3			
Benzodiazepinicos	14	12		
Estrogenos	1	1		
Insulinas	2			
Sulfoniureias	1			
Inibidores de bomba de prótons	3	3		
Procinéticos	2	1		
Anticolinérgicos	8			
Laxantes	1			
Hemostático	2			
AINE's	5	5		
Corticoides		5	1	
Opioide		11	3	
ISCS		2	2	2
Anticonvulsivantes		5	2	4
Antimania				1
Sulfonamidas			3	3
Macrolideos				1
Total	65	59	24	17

Category 2 = Potentially inappropriate medications in older adults.
Category 3 = Medications potentially inappropriate due to drug–disease or drug–syndrome interactions.
Category 4 = Medications potentially inappropriate and should be used with caution in older adults.
Category 5 = Clinically significant drug–drug interactions that should be avoided in older adults.

Discussion

This study showed that 37.3% of the medications available in the hospital were listed in at least one of the evaluated categories of the 2023 Beers Criteria. The most prevalent drug classes among males aged 60 to 70 years were proton pump inhibitors (PPIs) (21.3%), diuretics (17.0%), and antipsychotics (8.6%), while among females aged 70 to 80 years, antithrombotics (10.0%) stood out. Among all prescriptions analyzed in the study, 29.7% contained at least one PIM. The use of PIMs was associated with the presence of polypharmacy and an increase in length of hospital stay.

Population aging in Brazil is occurring rapidly. According to data from the Brazilian Institute of Geography and Statistics (IBGE), the proportion of elderly individuals increased from 11.3% to 15.1% over 10 years, with a predominance of White individuals and females. These data align with the demographic characteristics observed in our study. This aging trend, combined with a high prevalence of patients with low literacy identified in our study, presents new challenges in adherence to, management, and monitoring of pharmacotherapy. Older individuals are more susceptible to chronic non-communicable diseases, which increases the complexity of pharmacotherapy in this population, requiring greater organization, attention, and memory regarding medication schedules[21].

A systematic review reported a 65% prevalence of PIM use among older adults, totaling 221,879 elderly patients who used these medications. The most prevalent were opioids, drugs acting on the central nervous system, and PPIs[22]. A study conducted by Moreira et al. (2020) also showed a high prevalence of medications included in the Beers Criteria, with 54.6% of patients affected[23]. Isidoro et al. (2021) found that, among 413 patients evaluated, 321 used at least one PIM, equivalent to 75.9% of the sample. These results align with the scenario presented in our study, indicating a high prevalence of PIM use among hospitalized elderly patients[24].

The high prevalence of PPI use among elderly patients is well documented in the literature. Praxedes et al. (2021) reported that approximately 27.7% of prescribed PIMs were PPIs[22]. Another study conducted at a public hospital in Minas Gerais found that this high prescription rate persists even at hospital discharge, with 58.4% of discharged patients continuing PPI therapy[25]. The inappropriate and prolonged use of this class may be associated with a greater predisposition to infections caused by *Clostridioides difficile*[10].

The presence of diuretics among the most used PIMs varies across the literature. Our study revealed a high number of diuretic prescriptions, mainly furosemide, differing from studies such as that by Constantino et al. (2020), which also reported a high number of diuretic prescriptions, but none listed in the Beers Criteria[26]. However, the study by Narvekar et al. (2017) supports our findings, showing furosemide as one of the most frequently prescribed PIMs, present in 35% of the sample[27].

Antipsychotics, opioids, and benzodiazepines have a higher prevalence among older adults and are well described in the literature[22,23]. Gardiam et al. (2020) demonstrated an association between the use of benzodiazepines and opioids and the occurrence of falls in trauma patients aged over 51.9 years[28]. Physiological changes in the elderly, such as a gradual decrease in glomerular filtration rate and reduced hepatic activity, must be considered when prescribing opioids, as these factors can affect drug elimination[29]. This accumulation may lead to impaired consciousness, dizziness, respiratory depression, and constipation[30].

This high number of PIMs prescribed to hospitalized older adults may be associated with the broad availability of medications in tertiary institutions due to their high complexity. Our study showed that 24% of the medications available in the institution were listed in at least one of the 2023 Beers Criteria categories. Other factors related to the medical team and the patients themselves may also explain these figures. A study conducted in Minas Gerais found that 40% of physicians rarely use the Beers Criteria in clinical practice, 13.3% had never heard of it, and 13% reported patients' unwillingness to stop medications prescribed by another provider[24].

Table 4. Characterization of Potentially Inappropriate Medication Use According to Age and Sex

Class	Medication	Prescriptions	N° | % Total n° of prescriptions 16818	Age	Sex
IBP	Omeprazol	3596	3596 | 21.3	60-70	Male
Diuréticos	Furosemida	2106	2852 | 17.0	60-70	Male
	Espironolactona	746			
Antitrombóticos	AAS	1164	1682 | 10.0	70-80	Male
	Rivaroxabana	284			
	Varfarina	234			
Antipsicóticos	Risperidona	903	1449 | 8.6	60-70	Male
	Haloperidol	424			
	Clorpromazina	106			
	Levomepromazina	16			
Opioides	Morfina	747	1132 | 6.7	60-70	Female
	Fentanila	166			
	Tramadol	101			
	Codeina + Paracetamol	76			
	Metadona	42			
Benzodiazepínicos	Midazolam	270	1073 | 6.3	60-70	Female
	Lorazepam	267			
	Clonazepam	251			
	Diazepam	190			
	Clobazam	95			
Procinéticos	Metoclopramida	776	776 | 4.6	60-70	Female
Total			12582 | 74.5%		

PIMs were more prevalent among patients experiencing polypharmacy; however, the presence of polypharmacy does not necessarily indicate overuse or poorly optimized therapy—it is often necessary and beneficial. Sangaleti et al. (2023) supports our findings, showing that polypharmacy increases the use of PIMs by 2.69 times, highlighting the need for greater attention to these patients' pharmacotherapy[31].

This study did not demonstrate a significant association between the use of PIMs and an increased length of hospital stay. However, a study by Sichieri et al. (2024) revealed that patients using PIMs were associated with longer hospital stays and a higher number of medications[30]. That study, however, was conducted in an intensive care setting with critically ill patients, where the benefits of using such medications often outweigh the risks, and their clinical condition also contributes to extended hospitalization.

Thus, the present study provided a perspective aligned with existing literature, showing an increase in PIM prescriptions among hospitalized older adults and establishing a correlation between such prescriptions and polypharmacy. These findings contribute to guiding future research aimed at quantifying the impact of PIM use on the health of older adults. Additionally, they highlight the opportunity for studies focused on the role of healthcare professionals—such as pharmacists—in evaluating and assisting with the deprescription of these medications when necessary.

Despite the methodological rigor of this cross-sectional study, certain limitations should be considered: the retrospective nature of the study did not allow for an evaluation of the clinical impact of these prescriptions on the patients. It was not possible to account for the number of PIMs prescribed on an "as-needed" basis or those classified as the patient's own medications due to limitations in the data collection tool. The database was collected automatically by third parties, which prevented complete recording of patients' comorbidities, limiting information to the primary diagnosis for hospitalization. Not all categories of the Beers Criteria were considered due to restrictions such as the lack of access to all laboratory results and clinical data. The presence of a medication in one of the four evaluated categories classified it as a PIM, without correlation to clinical context, which may have led to underestimation. A registration bias was also noted, due to the high number of patients with undeclared education levels. Nonetheless, while these elements represent limitations, they also signal the need for deeper exploration of this topic.

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Conclusion

This study revealed a high prevalence of potentially inappropriate medications (PIMs) among hospitalized older adults, with their use associated with polypharmacy. The increase in PIM prescriptions for older adults may pose risks to this population's health, reinforcing the need for further research to quantify the impact of PIM use and assess the role of healthcare professionals, such as pharmacists, in supporting the safety of pharmacotherapy in hospital inpatient units.

Funding

Contributions

Arruda RS, Ferreira WS, and Lima PS were responsible for data analysis, interpretation, and manuscript drafting. Ferreira AM was responsible for the statistical analysis. Mendes AM and Veroneze C contributed to the critical revision of the article.

Acknowledgments

Conflict of Interest Statement

The authors declare no conflicts of interest.

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