ORIGINAL ARTICLE

Potentially inappropriate medication prescribed to elderly outpatients at a general medicine unit

Medicamentos potencialmente inapropriados prescritos a pacientes idosos ambulatoriais de clínica médica

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ABSTRACT

Objective: To establish the prevalence of potentially inappropriate medications prescribed for elderly patients, to identify the most commonly involved drugs, and to investigate whether age, sex and number of medications were related with the prescription of these drugs. **Methods:** Prescriptions for 1,800 elderly patients (≥ 60 years) were gathered from a database. These prescriptions were written by general physicians at a tertiary level university hospital in the city of Sao Paulo, Brazil, from February to May 2008. Only one prescription per patient was considered. The prescriptions were classified according to sex and age (60-69, 70-79 and ≥ 80). The Beers criteria (2003 version) were used to evaluate potentially inappropriate medications. **Results:** Most of the sample comprised women (66.6%) with a mean age of 71.3 years. The mean prevalence of potentially inappropriate medication prescriptions was 37.6%. The 60-69 age group presented the highest prevalence (49.9%). The most frequently prescribed potentially inappropriate medications to women were carisoprodol, amitriptyline, and fluoxetine; amitriptyline, carisoprodol, fluoxetine and clonidine were prescribed more often to men. The female sex ($p<0.001$; OR=2.0) and number of medications prescribed ($p<0.001$) were associated with prescription of potentially inappropriate medications. The chance of having a prescription of these drugs was lower among patients aged over 80 years (OR=0.7). The mean number of prescribed medications for both sexes and all age groups was 7.1. The mean number of medications per patient was higher among females ($p<0.001$); this result was not age-dependent ($p=0.285$). **Conclusion:** The prevalence of potentially inappropriate medications was similar to previously reported values in the literature and was correlated with the female sex. The chance of having a potentially inappropriate medication prescription was lower among patients aged over 80 years. The chance of having a potentially inappropriate medications prescription increased proportionally with the number of medications prescribed (≥ 5).

Keywords: Aged; Drug prescriptions; Pharmacoepidemiology; Outpatient clinics, hospital; Internal medicine

RESUMO

Objetivo: Determinar a prevalência de medicamentos potencialmente inapropriados em idosos ambulatoriais; identificar os mais comumente envolvidos; e verificar se a idade e o sexo do paciente, além do número de medicamentos, estão relacionados à prescrição de medicamentos potencialmente inapropriados. **Métodos:** Foram coletadas prescrições de 1.800 pacientes idosos (≥ 60 years) em banco de dados. As prescrições foram realizadas por clínicos gerais de hospital universitário de atenção terciária em São Paulo entre Fevereiro e Maio de 2008; foi considerada apenas uma prescrição por paciente. As prescrições foram divididas de acordo com o sexo e faixa etária (60-69; 70-79 e ≥ 80). Os critérios de Beers versão 2003 foram utilizados para a avaliação de medicamentos potencialmente inapropriados. **Resultados:** A maior parte da casuística foi composta por mulheres (66,6%) e a média de idade foi de 71,3 years. A prevalência média de prescrição de medicamentos potencialmente inapropriados foi de 37,6%, sendo que a faixa etária de 60-69 years apresentou a maior prevalência (49,9%). Os medicamentos potencialmente inapropriados mais prescritos para as mulheres foram o carisoprodol, a amitriptilina e a fluoxetina e, para os homens, foram a amitriptilina, o carisoprodol, a fluoxetina e a clonidina. O sexo feminino ($p < 0,001$; RC = 2,0) e o número de medicamentos prescritos ($p < 0,001$) foram associados à prescrição de medicamentos potencialmente inapropriados. A chance de prescrição de um medicamentos potencialmente inapropriados foi menor em pacientes com ≥ 80 years (RC = 0,7). A média de medicamentos prescritos foi 7,1, considerando ambos os sexos e todas as faixas etárias. A média do número de medicamentos por paciente foi maior no sexo feminino ($p < 0,001$), sendo que esse resultado não dependeu da faixa etária ($p = 0,285$). **Conclusão:** A prevalência de medicamentos potencialmente inapropriados encontrada foi semelhante ao relatado na literatura e está correlacionada ao sexo feminino. A chance de prescrição de medicamentos potencialmente inapropriados foi menor em pacientes com ≥ 80 years e observou-se que é maior à medida que aumenta o número de medicamentos prescritos (≥ 5).

Descritores: Idoso; Prescrições de medicamentos; Farmacoepidemiologia; Ambulatório hospitalar; Medicina interna

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INTRODUCTION

Concern with the impact of prescriptions in aging populations has led to several strategies to deal with this situation, such as detecting potentially inappropriate medications (PIMs). Drugs are potentially inappropriate in elderly patients when there is no evidence-based indication for their use, when they increase the risk of adverse effects compared to younger patients, or when they are not cost-effective. These drugs may also be associated with increased morbidity, mortality, and the cost of health services[1-3].

Avoiding high-risk medication is an important strategy for reducing adverse events to drugs – particularly the adverse reactions[2].

OBJECTIVE

Aiming to support interventions for promoting the rational use of drugs, the purposes of this study were as follows: to describe the prevalence of PIMs prescribed to elderly patients according to age and sex at a General Medicine Unit within a tertiary care hospital in the city of Sao Paulo; to identify the most commonly prescribed drugs; and to verify whether age, sex, and number of medications were related with the prescription of PIMs.

METHODS

An observational descriptive study was undertaken of outpatient prescriptions from February to May 2008 at the General Medicine Unit of the Central Institute of the Hospital das Clínicas - Faculdade de Medicina da Universidade de São Paulo (FMUSP). Data were gathered by generating reports from the Hospital Management and Information System (HIS) database used by the outpatient pharmacy of the aforementioned hospital. This HIS, which is used for dispensing and controlling inventory of medications, was established and is maintained by a data-processing company - Companhia de Processamento de Dados do Estado de São Paulo - PRODESP [Sao Paulo State Data Processing Company], a state-owned information technology company in Sao Paulo.

Prescriptions were classified by sex and age (patients aged 60-69 years, 70-79 years, and over 80 years). Elderly persons were adults aged 60 years or above at the time data was gathered (as defined by the World Health Organization, WHO, for developing countries). Age was calculated based on the date of the prescription form; only the first prescription for each patient was taken into account.

The hospital consists of several general or specific subspecialty units. Patients requiring special care – such as homecare – are referred to specific subspecialty units; the remaining patients are sent to general care subspecialty units. This study included only the latter patients, to reduce the confounding factors in the analysis of results.

Prescriptions made for patients seen in the context of brief outpatient visits and prescriptions for patients that were not registered at the institution were not taken into account in this study.

The 2003 version of the Beers criteria was applied for evaluating the PIMs; only drugs that did not depend on diagnosis were included[3].

The PIMs digoxin, ferrous sulphate and lorazepam were excluded because their dose could not be calculated. Clonazepam and nitrazepam were considered PIMs because of their over 20-hour half-life, although they are not included in the Beers criteria[4-5]. Nitrazepam is sold in Brazil, but not in the United States[5]. Primidone is a barbiturate anticonvulsivant drug that is also not included in the Beers criteria, but that is standardized at our institution. It is a highly addictive drug and causes more adverse effects in the elderly than most other sedative or hypnotic drugs; thus it was also included as a PMI[6]. Drugs were classified according to the Anatomical Therapeutic Chemical (ATC) classification of the WHO[7].

A logistic regression model was used for the statistical analysis; references were male sex and age 60-69 years. The number of drugs was categorized into the quartile intervals 1-4, 5-6, 7-8, and ≥ 9. The Hosmer and Lemeshow test was applied to assess model adjustment[8]. The term odds ratio (OR) was translated into Portuguese to *razão de chances* (*RC*) as was used in this study. The significance level for hypothesis testing was 0.05. The statistical analysis was done using the Minitab software version 15 and the Statistical Package for the Social Sciences version 11.

RESULTS

Characteristics of the study population

The analysis comprised 1800 prescription forms. The majority of elderly patients were female (66.6%); there were more females than males at all age groups. Female elderly patients aged 60-69 years comprised most of the sample of women in this study (Table 1). The mean age of patients was 71.3 years; the mean age of female subjects was 71.6 years and the mean age of male subjects was 70.9 years.

Table 1. Frequencies and percentages of patients by gender and age in relation to total of patients

Age	Gender		Total
	Female n (%)	Male n (%)	n (%)
60-69	559 (31.0)	287 (15.9)	846 (47.0)
70-79	410 (22.8)	218 (12.1)	628 (34.9)
≥ 80	230 (12.8)	96 (5.3)	326 (18.1)
Total	1,199 (66.6)	601 (33.3)	1,800 (100.0)

The mean number of drugs prescribed was 7.1 (standard deviation: 3.5) for both sexes at all age groups. The mean in the 60-69-year age group was 7.3; the mean for the 70-79-year and over-80-year age groups was 6.9. There were no differences among the drug number means in the three age groups (p = 0.370); this result applied to both sexes (p = 0.285). The mean number of drugs prescribed for females was 7.6 (standard deviation: 3.5), and for males, 6.0 (standard deviation: 3.1) in all age groups. The mean number of drugs per patients was higher in females (p < 0.001). This results was independent of age (p = 0.285).

PIMs

The mean prevalence of PIM prescription was 37.6% (677 prescription orders). The highest prevalence (49.9%) was found in the 60-69-year age group, followed by the 70-79-year (34.7%) and ≥ 80-year (15.4%) age groups. The group with the highest prevalence of PIMs was that of elderly females aged 60-69 years (Table 2).

Table 2. Frequencies and percentages considering only the universe of prescriptions of potentially inappropriate medications

Age	Gender	Prescription of PIMs n (%)
60-69	F	270 (39.9)
	M	68 (10.0)
70-79	F	179 (26.4)
	M	56 (8.3)
≥ 80	F	77 (11.4)
	M	27 (4.0)
Total		677 (100.0)

PIMs: potentially inappropriate medications; F: female; M: male.

The mean number of PIMs indicated per prescription form was 1.31. The PIMs ketorolac, diphenhydramine, nitrazepam, indomethacin, amfepramone, fenproporex, mazindol, sibutramine, chlorpheniramine and dipyridamole were absent in all prescription forms. Except for clonidine, all PIMs that were encountered are among the most harmful in the Beers criteria version 2003 (Table 3).

Female sex and prescription of over five drugs were associated with PIM prescription orders; this was not observed in the over-80-year age group (Table 4). The Hosmer and Lemeshow test indicated a good adjustment of the model (p = 0.198).

DISCUSSION

The prevalence of PIMs in this study (37.6%) is within the range found in studies in other countries where researchers applied the 2003 version of Beers criteria to evaluate prescription orders (13 to 40.7%)[1,9-11]. Buck et al. studied the database of two hospitals in the United States and found that the prevalence of PIMs in elderly outpatients was 23% in both cases[12]. Maio et al. evaluated 50 registries of elderly patient at a Geriatric Unit and found a prevalence of PIMs in 26% of patients[13]. As in the present study, researchers chose and adapted the instruments according to data availability and the list of drugs used at each institution or approved in each country.

In Brazil, Carvalho found that the prevalence was around 15.4% in a population sample from the year 2000, based on the Beers criteria version 2003[14]. Coelho Filho et al. found that 20% of drugs were inadequate according to the indications for which they had been prescribed[15]. Gorzoni et al. applied the Beers criteria version 2003 and found that 41% of elderly patients in their study used one or two PIMs[16].

If on the one hand similar percentages to other published results were found, on the other hand comparisons are difficult. The prevalence in different populations varies according to the time and site of data

Table 3. Potentially inappropriate medications most prescribed according to patient's gender

PMIs	Female n (%)	Male n (%)
Muscle relaxant HC*	193 (27.2)	34 (19.1)
Amytriptyline	192 (27.1)	42 (23.6)
Fluoxetine	140 (19.7)	16 (9.0)
Clonidine	46 (6.5)	16 (9.0)
Naproxen	32 (4.5)	9 (5.0)
Methyldopa	30 (4.2)	10 (5.6)
Mineral oil	17 (2.4)	6 (3.4)
Amiodarone	16 (2.3)	14 (7.9)
Hydroxyzine	11 (1.6)	9 (5.0)
Others	32 (4.5)	22 (12.4)
Total	709 (100.0)	178 (100.0)

* Produced by the Pharmacotechnic Unit of Pharmacy Division of the Science Institute of Instituto Central do Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (HC-FMUSP). It contains carisoprodol 100 mg (potentially inappropriate mediation), dipirona 200 mg and paracetamol 200 mg. PMIs: potentially inappropriate medications.

Table 4. Associated factors to prescription of potentially inappropriate medication

Characteristics	p-value	RC	IC95%
Women	<0.001	2.0	[1.6-2.5]
Age	0.027	-	-
70 to 79	0.481	-	-
≥ 80	0.007	0.7	[0.5-0.9]
Medications	<0.001		
5 or 6	<0.001	2.0	[1.5-2.8]
7 or 8	<0.001	2.1	[1.6-2.9]
9 or +	<0.001	4.5	[3.4-6.1]

RC = *razão de chances* = odds ratio (OR)

gathering, as well as other aspects such as the criteria, study design and data gathering period[17].

The possibility of prescribing a PIM was lower in patients aged over 80 years – a trend that has been seen by other authors[17-20]. Piecoro et al. found that elderly patients aged over 85 years in the United States were less likely to be prescribed PIMs[17]. Passarelli et al. found that use of PIMs was significantly lower in patients aged over 80 years admitted into a Brazilian hospital[20]. There is no consensus in the literature about increased or decreased prescription orders of PIMs as patients get older[21-23]. Stuck et al. found that patients aged over 80 years were more likely to use PIMs[21]; Lechevallier-Michel et al. noted that the frequency of PIM use increased with age[22].

In our study women were more likely to be prescribed a PIM compared to men; other investigations, including the only Brazilian article on this topic[15], reported the same finding[17,18,22]. It is not clear why female patients are more likely to be prescribed PIMs; our findings show that the mean number of drugs prescribed to women was higher (7.6) compared to men (6.0), which may have influenced this association. Further studies are needed to clarify the dynamics of sex differences in interactions between healthcare providers and patients, as well as the setting of healthcare systems, which increases the likelihood of women being given more medication[24]. For instance, if women tend to report pain and symptoms of depression more often than men, they are more likely to be diagnosed and treated for these conditions; male patients may be less exposed to these drugs by not having reported their symptoms[24]. It is possible that women are more concerned with their health than men, which would in itself increase the mean number of drugs prescribed to them[24].

The majority of results in studies that reported different prevalences in PIM prescription orders at various medical institutions were not statistically different[18,25]. For instance, Maio et al.[13] found a prevalence of 26% of PIMs in one hundred registries of elderly patients at a Geriatrics Unit; the prevalence was 22% in patients seen by family doctors, although no difference was found in the odds of using PIMs in both units[13]. Pugh et al.[26] suggested that geriatric health care has a protective effect over the quality of drug therapy provided to elderly patients; in such cases, statistical differences were found in the prevalence of PIMs between specialists (geriatricians) and non-specialists. The reasons whereby geriatric specialists had a "protective" effect remained unclear, although their training was thought to have been a possible explanation.

Our study showed that the likelihood of prescribing PIMs increases with the number of prescribed items, as follows: the odds ratio was two times higher if the prescription order form had 5 to 6 drugs, 2.1 times higher if there were 7 to 8 drugs, and 4.5 times if there were more than 9 drugs. Most studies have shown an association between use of multiple drugs and prescription of PIMs[9,17,18].

The most frequently prescribed PIMs for female patients were carisoprodol, amitriptyline, and fluoxetine. Amitriptyline, carisoprodol, fluoxetine, and clonidine were the most frequently prescribed drugs to male patients. Carisoprodol and amitriptyline are thus common to both sexes as the most prevalent PIMs. Adverse effects of carisoprodol include lethargy, agitation, delirium, psychosis, and liver toxicity[27]. Carisoprodol is available at our institution as a mixed preparation with other drugs, which results in further issues for elderly patients. No clinical studies were found demonstrating the efficacy of this mixture in elderly patients. Thus, when carisoprodol is prescribed, patients in fact are given three different drugs, compounding the problem of polypharmacy and increasing the risk for patients allergic to any of the components. Furthermore, the adverse effects of each drug – such as hypotension and liver failure – may reinforce those of others[27]. When analgesics and muscle relaxants are prescribed, drugs with a similar therapeutic effect may overlap.

Tricyclic antidepressants affect several neurotransmitters and may cause several pharmacological effects, including adverse reactions. The most common result from cholinergic receptor blocking, such as dry mouth, constipation, blurred vision, urinary retention, tachycardia, and delirium, if at high dosages[27]; furthermore, this category has a long list of drug interactions[27].

In studies based on the Beers criteria version 2003, long-acting benzodiazepines, propoxyphene, amitriptyline, and antihistamines were the most frequently prescribed PIMs[9,10,12,23]. Estrogens, muscle relaxants, ticlopidine, chlordiazepoxide, and anti-inflammatory drugs were also mentioned[10,23]. In Brazil, Carvalho found that anti-inflammatory drugs, methyldopa, digoxin, and long-acting benzodiazepines were the PIMs used most frequently by elderly patients in the city of Sao Paulo[14]. Gorzoni et al. found that benzodiazepines, methyldopa, ergot derivatives, and cyclandelate were encountered more frequently in patient records[16]. Passarelli et al. noted that the most frequently found PIMs in elderly patients admitted to hospital wards were diazepam, amiodarone, nifedipine, methyldopa, and cimetidine[20].

PIM prescription differences among studies may occur for several reasons. Some drugs in the Beers criteria are not standardized at our institution, such as chlorpropamide, guanethidine, reserpine, and

cimetidine. Others have not been registered at the Brazilian drug administration office (National Health Surveillance Agency, or ANVISA); these include oxazepam, quazepam, halazepam, and doxepin, which are not available commercially in Brazil.

There are limits to the Beers criteria. Its list of PIMs is inflexible, does not take into account individual differences, and may yield false-positive results (for instance, signaling non-existent issues). Problems that have not been described are not mentioned; thus, it may fail to provide a complete evaluation of patients[28].

A few drugs are not absolutely contraindicated in the elderly, especially in patients with a short life expectation; these drugs include amitriptyline, bisacodyl, and naproxen[29]. The Beers criteria do not mention underuse of medication, drug interactions, or duplicated therapeutic classes. The list is confusing, because drugs are not listed alphabetically, or by action site or therapeutic class[29].

The advantages of the Beers criteria are that they may be adapted to computer systems, they support pharmacoepidemiological studies of large populations, gather information from the literature and from specialist consensuses, and may be used readily for educational purposes[1].

A database electronic spreadsheet was used to collect results of this study. The advantages of using computerized databases for verifying prescribed medications are the accuracy of the prescription registry and the fact it did not depend on information from patients. The sample of prescription order forms was gathered over a considerable time period (four months); and care was taken to evaluate only the general healthcare subspecialties. On the other hand, adapting a business-oriented spreadsheet into a research form required complex formulae and standardization of alphanumeric data. These steps hinder pharmacoepidemiological studies by healthcare professionals at the organization.

There are some caveats to this study. Because of the number of comorbidities, elderly subjects may have been seen by other specialists, which may have influenced the prescription profile. Incorrect or unmade diagnoses may have also affected the prescription orders. There may have been typing errors; we believe that these were few because of triple verification of prescription typing at the outpatient clinic pharmacy.

The system used to generate the spreadsheet for this study does not interface with the electronic medical record system; therefore, there was no information about diagnoses or other medical data on which physicians based their prescriptions. Thus, it was not possible to check whether drugs considered as PIMs in this study were really potentially inappropriate for specific patients. Furthermore, when using the Beers criteria, it is not possible to state if or which adverse effects occurred if the outcomes of therapy are not monitored. The criteria only suggest that adverse effects have a higher probability of occurring in the elderly[17].

There are limitations to generalizing the results to the general population; this study focused on the profile of prescription orders for patients at a tertiary healthcare organization. Many of these patients were referred to that hospital because of complex comorbidities.

A few authors suggested that profiles of patients, comorbidities, and drug or therapeutic classes related more frequently with unfavorable outcomes are required to deal with the complexity of medication use in the elderly; the idea being to prioritize risk groups for drug-related issues. Otherwise, medication use in the elderly is an ample issue that requires a multidisciplinary approach.

For this purpose, it is essential to improve the recording systems and information access to medication use. Healthcare professionals should be able to easily access prescription order profiles. Adequately filled in electronic medical records, which are connected to the prescription database, make it possible to systematically make in depth analyses of medication use[30].

Secondly, healthcare professionals that treat elderly patients should learn the appropriate prescription practices, by accessing medication use guidelines and continue education. Knowledge about good practices reduces the possibility of potentially inappropriate practices.

Third, we underline the need for generating a PIM list for the Brazilian context. Such a list, based on medication use, consensuses, and evidence-based literature, could guide drug selection and guidelines for using drugs in elderly patients[30].

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