

Characterization of potentially inappropriate medication prescriptions for the elderly in primary care and hospital settings

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ABSTRACT

Background: Polypharmacy cannot be defined numerically due to its varied definitions, and inclusion of comorbidities aggravates the dilemma, creating challenges for the healthcare system and the patients' course of treatment. The introduction of the potentially inappropriate medication (PIM) list developed by the American Geriatrics Society (AGS) (AGS Beers Criteria®; updated in 2019) was deemed a solution. However, several risk factors are associated with PIMs, including increased emergency room visits, hospitalization and mortality, and a decline in daily activity. Differences in PIM prescription rates have been reported; however, with the recent Beers criteria update, the number of patients exposed to PIMs is expected to increase significantly due to the addition of new medications to the list. **Objectives:** This study aimed to describe the characteristics of PIM prescriptions for the elderly in primary care and hospital settings. **Methods:** Medications for elderly patients prescribed in our hospital between 2016 and 2019 were reviewed and sorted based on Beers criteria to identify patients with the most PIMs. Correlations were made between gender and facility. **Results:** This study included 40,168 patients (51% males). The total and average numbers of PIM per elderly patient were 260,753 and 6.5, respectively. Proton pump inhibitors were prescribed the most, followed by nonsteroidal anti-inflammatory drugs. **Conclusions:** We found that increasing numbers of PIMs are prescribed to the elderly in our healthcare facilities. Therefore, further recommendations from local geriatric communities and the implementation of reminders for physicians through electronic prescription systems are needed to decrease the rate of prescribed PIMs.

Keywords: Geriatrics, polypharmacy, potentially inappropriate medication list

Introduction

Despite not having a clear definition of polypharmacy, many initiatives have been developed to address this dispute.^[1] One solution was the introduction of the potentially inappropriate

medication (PIM) list developed by the American Geriatrics Society (AGS) under the name AGS Beers Criteria® and recently updated in 2019.^[2] It is a widely used criterion among healthcare providers to modify the medical regimens and meet the needs of their target populations.

Elderly people are defined by the United Nations as any person over 60 years of age. Currently, one in eleven people worldwide can be defined as elderly with an expected increase to one in six by the year 2050.^[3,4] Following the United Nations classification, Saudi Arabia currently has nearly two million elderly, representing 5.4% of the general population, and is

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Received: 08-02-2021

Revised: 24-03-2021

Accepted: 06-05-2021

Published: 27-08-2021

Access this article online

Quick Response Code:



Website:
www.jfmpc.com

DOI:
10.4103/jfmpc.jfmpc_271_21

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How to cite this article: Yasky AF, Zawawi AH. Characterization of potentially inappropriate medication prescriptions for the elderly in primary care and hospital settings. J Family Med Prim Care 2021;10:3111-5.

expected to reach 25% by 2050.^[5,6] PIM is a neglected medical error due to many factors, but it can be prevented with simple measures.^[7]

Follow-up with elderly patients in healthcare can face many issues, one of which is the increased number of medications they are prescribed and their adverse effects. These issues can impact their health and daily life activities dramatically. Several risk factors are associated with these medications and many previous studies have found that they lead to increased emergency room visits, hospitalization, and mortality as well as a decline in daily activity.^[7]

Many initiatives attempt to govern these medications, one of which is the Beers criteria. The Beers criteria were developed in 2011 with the objective of simplifying medication management for elderly patients in healthcare.^[2] Over 40 medications were reviewed and connected to the published scientific evidence to determine their potential risk for this age group of patients. In the new 2019 update, medications were divided into two main groups: The total avoidance group and the group to be used with caution and considerations for patients' comorbidities. With the increasing ageing population, more attention should be focused on the elderly and their medical care, and the Beers criteria can be an effective tool for healthcare providers.

The global rate for PIM prescriptions has not been determined, and different studies report several findings. One of the biggest was in the USA showing 7.3 billion PIM doses were dispensed in 2018.^[8] A study in Cyprus reported that 12% of the elderly were on at least one PIM when discharged from inpatient care.^[9] Another study in Pakistan reported a 50% rate of PIM prescriptions among elderly inpatients.^[10] In contrast, in the USA, reports of PIM exposure reached 18.5% in elderly individuals who were independent in their daily activities and also reaching 55.1% with elderly population in Brazil with at least one PIM exposure.^[11,12]

In Saudi Arabia, PIM prescriptions are receiving increasing attention as several articles have been published on the topic, one of which reports a study conducted recently in a university hospital in the central region that found 57.6% exposure to PIM among elderly patients.^[13] Another study conducted in the western region reported at least 80% PIM exposure among elderly inpatients.^[14] In a more specialized geriatric cardiology clinic in our city, 29.4% of their patients had at least one PIM among their active medications list.^[15] Besides the variations in PIM rates reported in different studies, with the recent update to the Beers criteria and the addition of new medications, the number of patients exposed to PIM is expected to increase significantly.

This study aimed to describe the characteristics of PIM prescriptions in elderly patients in primary care and hospital settings.

Material and Methods

Our study was conducted in a large medical center that has various services based on different specialties, some of which are the primary care in remote centers, and others are in the hospital setting. Primary care services are provided across multiple centers, reaching more than 15 centers. Patients book their own appointments through a digitalized platform, or they can be referred to different specialties. Hospital-based settings include all other specialties and emergency settings. All elderly patients older than 60 years who presented to primary care and hospital settings between January 2016 and December 2019 were included. We used a convenient sampling technique from all patients included in the study period. Patient data were retrieved from electronic health record systems, while the variables recorded included demographic data and types of active medications. We cross-matched active medications with the list of PIMs mentioned in the Beers criteria. All medications that were not included in the hospital pharmacy formulary were excluded from the matching. Data retrieved were kept in password-protected computers with access restricted to the investigators of this study. Once the data were retrieved, each medical record number was encrypted into a serial number with different values to ensure the privacy of patient records. The collection was done on hospital premises and limited to local network access only to avoid any online data breaches. As for the analysis plan, data was processed using the Statistical Package for Social Sciences software (SPSS) Version 23 (Armonk, NY: IBM Corp.). The binominal test was used to test the hypothesis of occurrence for the nominal variable distributions, and Chi-square tests were used to test the differences between the categorical values with a *P* value of less than 0.05, which was considered statistically significant. This study was approved ethically and scientifically by King Abdallah International Medical Research Center (KAIMRC) under approval RC20/026/R. Ethical committee approved by 09-02-2020.

Results

Among the 40,168 patients in our study, 20,514 (51%) were men and 19,653 were women (49%). The mean age was 70 years and five months, with a standard deviation of ± 8.5 years. The oldest participant was 117 years old. For the medications, we collected 260,753 PIM prescriptions with an average of 6.5, medications actively prescribed per patient between 2016 and the end of 2019. The number of prescriptions was reduced by the exclusion of aspirin and insulin aspart as we could not confirm their concurrent usage with patients' needs or for primary prevention. The remaining 151,306 PIMs had an average of 3.7 PIMs per patient. The most prescribed PIM was esomeprazole, with 49,100 prescriptions representing 32.45% of the PIM exposure in this study. Omeprazole prescriptions 22,807 represented 15.07% of PIM exposure. Metoclopramide was found to be prescribed 19,945 times; 13.18% of PIM exposure. The most commonly prescribed PIMs, representing more than 75% of PIM exposure, are shown in Table 1. As per the type of medications, proton pump inhibitors (PPIs) were the most commonly prescribed

PIM, with exposure of 47.5% in our study sample. In addition, 17.2% of the patients used nonsteroidal anti-inflammatory drugs (NSAIDs). Prokinetics were the third most used PIM with 13.2% exposure among our study sample. The full list of the most prescribed types of medication is shown in Table 1. As for the settings where prescriptions were written, the most prescribed medications and medication types were issued in the hospital setting, as shown in Table 2. This table shows the statistical significance of all types of medications, with more prescribed in a hospital setting than in primary care centers, except for meloxicam, which was prescribed significantly more in the primary care setting. Furthermore, the likelihood of total prescriptions was higher in hospital settings than in primary care centers. Our findings divided by gender are shown in Table 3. The results showed a clear association for prescriptions based on gender, especially individual medications, in comparison to the types of medications as a whole.

Discussion

In our study, we found that the average number of medications prescribed in our sample was 6.5. This finding is consistent with a regional study conducted in Qatar in 2019, which found an average of 8 medications per patient, along with other local studies by Alsuwaidan and Alturki in 2019 and 2020 on chronic disease patients with an average of 6.4 and 4.2 medications per patient, respectively.^[16-18] Another recent local study considered PIMs and polypharmacy and found cases of patients that were prescribed ten or 12 PIMs at once, with more than 25% of their study population having more than five PIMs at once.^[19] The number of medications can be correlated to the increased number of chronic conditions in geriatrics, along with an increased number of surgeries.^[16,17,19] In addition, an Indonesian study found that the rate of PIM exposure reached 52.2% of their geriatric patients in primary care facilities was

only statistically significant to polypharmacy.^[20] In addition to the increased number of medications, we found increased statistical significance across all medications administered in hospital settings when compared to primary care centers, as shown in Table 2.

Gender was also an indicator of increased risk of exposure to PIMs, as shown in Table 3, and female sex was statistically significant for omeprazole, meloxicam, diclofenac, and hyoscine-N-butyl bromide prescriptions. In contrast, males were significantly more exposed to esomeprazole and metoclopramide. Nifedipine did not show any significance for either sex. Furthermore, NSAIDs and antimuscarinic medications were significantly associated with female sex, while prokinetics and benzodiazepines were significant for males. In addition, PPI and calcium channel blockers did not show any correlation with sex.

As for the most used PIMs, we found that PPIs were the top PIMs in our study population with a rate of 47.5%, which is lower than international studies, such as described by Delcher *et al.*^[21] with 73.9% of their patients on PPIs; however, this was not in coherence with local studies such as Alhawassi *et al.*^[13] which found 35.6% and Alturki *et al.*^[17] with 39.4% PPI exposure among their patients. PPI studies are not new to medical attention, with many studies focusing on how they are related to several adverse effects, especially in geriatric age groups. Being one of the top sold and prescribed medications to the elderly, studies have proven that they are related to increased hospitalization, clinically significant gastrointestinal bleeding, and in another broader review, were found to be related to increased community-acquired pneumonia.^[22-24] The prescription of PPIs among doctors in Saudi Arabia can be associated with physician practices, as a recent study showed that up to 42% of refilled PPIs are not reassessed by physicians, while 35% do not educate their patients about lifestyle modifications as adjuvant management.^[25] The

Table 1: Prevalence of potentially inappropriate medications by name and type among the elderly

Type of Medication	Individual Medication	n	%	n	%
Proton Pump Inhibitor	Esomeprazole	49100	32.45	71907	47.5%
	Omeprazole	22807	15.07		
Prokinetic	Metoclopramide	71907	13.18	19945	13.2%
Nonsteroidal Anti-inflammatory Drugs	Meloxicam	19945	13.18	25960	17.2%
	Diclofenac	8798	5.81		
Calcium Channel Blockers	Nifedipine	6791	4.49	4500	3.0%

Table 2: Comparison between place of prescription of potentially inappropriate medications among the elderly

Type of Medication	Individual Medication	Hospital Area		Total	P	Hospital Area		Total	P
		Hospital setting	Primary care center			Hospital setting	Primary care center		
Proton Pump Inhibitor	Esomeprazole	44134 (89.89%)	4963 (10.11%)	49097	<0.01	56983 (79.25%)	14917 (20.75%)	71900	<0.01
	Omeprazole	12849 (56.35%)	9954 (43.65%)	22803	<0.01				
Prokinetic	Metoclopramide	19391 (97.24%)	550 (2.76%)	19941	<0.01	19391 (97.24%)	550 (2.76%)	19941	<0.01
Non estradiol anti-inflammatory drugs	Meloxicam	2634 (29.94%)	6164 (70.06%)	8798	<0.01	14738 (56.77%)	11222 (43.23%)	25960	<0.01
	Diclofenac	5101 (75.11%)	1690 (24.89%)	6791	<0.01				
Calcium Channel Blockers	Nifedipine	2891 (64.24%)	1609 (35.76%)	4500	<0.01	2891 (64.24%)	1609 (35.76%)	4500	<0.01

Table 3: Comparison of gender-based prevalence of potentially inappropriate medications among the elderly

Type of Medication	Individual Medication	Gender		Total	P	Gender		Total	P
		Female	Male			Female	Male		
Proton Pump Inhibitor	Esomeprazole	23226 (47.31%)	25871 (52.69%)	49097	<0.01	35629 (49.55%)	36271 (50.45%)	71900	>0.01
	Omeprazole	12403 (54.39%)	10400 (45.61%)	22803	<0.01				
Prokinetic	Metoclopramide	9599 (48.14%)	10342 (51.86%)	19941	<0.01	9599 (48.14%)	10342 (51.86%)	19941	<0.01
Non estradiol	Meloxicam	5347 (60.78%)	3451 (39.22%)	8798	<0.01	14395 (55.45%)	11565 (44.55%)	25960	<0.01
anti-inflammatory drugs	Diclofenac	3591 (52.88%)	3200 (47.12%)	6791	<0.01				>0.01
Calcium Channel Blockers	Nifedipine	2235 (49.67%)	2265 (50.33%)	4500	>0.01	2235 (49.67%)	2265 (50.33%)	4500	<0.01

AGS suggested in their latest Beers criteria recommendation to substitute the use of PPIs with histamine type-2 blockers, as they have proven their efficacy in decreasing gastrointestinal-related bleeding risk and fewer side effects.^[2,26] In addition, risk factors for long-term exposure can be attributed to female sex, nursing home stay, and polypharmacy.^[27]

NSAIDs were the second most commonly used PIMs in 17.2% of our sample of elderly patients, which is expected due to increased complaints of pain in this population. Various studies have shown increased NSAID prescriptions, such as in Portugal, where they found that 29.7% of their elderly patients were chronically exposed to NSAIDs.^[28] This is consistent with local studies' finding nearly the same percentage, such as 13.9% in Jeddah and 10.3% in Jordan in a recent study.^[14,29] The prescription of these medications has been linked to an increased risk of stroke, cardiovascular disease, and upper gastrointestinal bleeding.^[2,30] Physician behavior toward pain management in the elderly can be influenced by many factors, some of which are related to the complexity of cases with multiple conditions or a decrease in cognitive function, along with low education level and low socioeconomic status.^[31,32] For physician factors, it can vary from lack of experience in managing pain and unfamiliarity with indications for prescribing NSAIDs, and surprisingly, increased physician work experience was associated with increased prescriptions.^[33]

Following up with elderlies can have significant challenges, not just logistically or with clinical services, but also in maintaining the quality of the healthcare provided. Extra precautions, such as following the medication recommendations, and keeping up with the preventive measures recommended for advanced age are required. In many cases, patients and physicians can be overwhelmed with a long list of comorbidities that force them to cross into polypharmacy situations by trying to cover all health management needs. Lack of local and regional attention toward elderly medications can be one reason for this growing problem, as the elderly population is expected to increase dramatically in the region.

Limitations of the study included the lack of complete medical history of the patients to ensure the appropriateness of their prescriptions. While patients were admitted for various reasons, many of the medications were administered intravenously or

short-term only; therefore, those medications were removed from this study analysis to focus only on outpatient clinical practice.

Conclusion

We found that there is an increased number of PIMs being prescribed to the elderly in our healthcare facilities. We believe that further recommendations from local geriatric communities and the implementation of pharmaceutical reminders for physicians through electronic health prescription systems can decrease the rate of prescribed PIMs. Furthermore, future studies should focus on the use of lifestyle modification advice from physicians and how often they revise the active medication lists of their patients. Also, the implementation of such preventive measures in primary care will ensure better outcomes overall.

Acknowledgments

The authors would like to thank Family Medicine Department for their support and specially Dr. Imad Abduljawad for his keen follow up for this project.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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