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.⁰ 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 2050.¹⁰ Following the United Nations classification, Saudi Arabia currently has nearly two million elderslies, representing 5.4% of the general population, and is

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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 Abdullah 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 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 the PIM exposure in this study. Omeprazole prescriptions 22,807 represented 15.07% of the PIM exposure in this study. 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.[16,17,18] 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.[19] 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 | 3.0%  |
| 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%) | 1609 (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  | Gender | Total  |
|--------------------|-----------------------|--------|--------|--------|--------|
| Proton Pump Inhibitor | Esomeprazole | Female | 23226 (47.31%) | 10400 (45.61%) | 36629 (49.55%) | 4500 <0.01 |
|                     | Omeprazole | Male | 25871 (52.69%) | 10400 (45.61%) | 36271 (49.55%) | 4500 <0.01 |
| Prokinetic | Metoclopramide | Female | 12403 (54.39%) | 9599 (48.14%) | 21994 (44.55%) | 2265 <0.01 |
| Non estradiol anti-inflammatory drugs | Meloxicam | Male | 10342 (51.86%) | 11565 (44.55%) | 21907 (45.46%) | 11565 <0.01 |
| Calcium Channel Blockers | Nifedipine | Female | 6791 | 8798 | 15583 (44.55%) | 23226 >0.01 |
|                     | Male | 2040 (47.12%) | 19941 | 11565 (44.55%) | 23226 >0.01 |

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.

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Conflicts of interest

There are no conflicts of interest.

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