

A Prospective Observational Study on Prevalence of Polypharmacy and Medication Inappropriateness Among Geriatric Patients in a Tertiary Care Teaching Hospital, Davangere

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ABSTRACT

Introduction: Polypharmacy and the use of Potentially Inappropriate Medications (PIMs) are common among older adults because of multiple comorbidities and age-related changes in pharmacokinetics and pharmacodynamics. This study aimed to evaluate the prevalence of polypharmacy and medication inappropriateness using the 2023 AGS Beers Criteria and to assess prescribing patterns and comorbidities among elderly patients. **Materials and Methods:** A prospective observational study was conducted among 160 geriatric inpatients admitted to the Departments of General Medicine and Orthopaedics of a tertiary care teaching hospital. Prescriptions were analysed for polypharmacy, PIMs, and WHO prescribing indicators. **Results:** Among the study population, 61% were males and 39% were females, with the majority aged 65-74 years. Polypharmacy was highly prevalent, with 55% of patients receiving 5-9 medications and 28% receiving ≥ 10 medications. Overall, 77% of prescriptions were appropriate, whereas 23% contained at least one PIM, most commonly diclofenac and chlorpheniramine. An average of 7.4 drugs were prescribed per prescription. Only 39.8% of medications were prescribed by generic name, and 56.3% were from the essential drug list. Antibiotics and injections were prescribed in 78.1% and 86.25% of encounters, respectively. Hypertension and diabetes mellitus were the most common coexisting conditions among the patients. **Conclusion:** The study highlights a high prevalence of polypharmacy and identifies the presence of potentially inappropriate prescribing, emphasizing the need for regular prescription review and adherence to the Beers Criteria to improve geriatric patient safety.

Keywords: Beers Criteria, Geriatrics, Polypharmacy, Potentially Inappropriate Medications, WHO Prescribing Indicators.

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INTRODUCTION

Geriatric medicine refers to a branch of gerontology that focuses on the medical and clinical aspects of older adults (Lourda *et al.*, 2013). Ageing is a natural process with its own dynamics that occur largely beyond one's control. According to the 2011 Census, elderly individuals constitute 8.6% of the Indian population. India's elderly population is projected to increase from 138 million in 2021 to 194 million by 2031, representing a 41% rise over a decade, according to the National Statistical Office (NSO) 's Elderly in India 2021 report. Geriatric populations account for

a substantial proportion of medication use compared with other age groups (Kamath *et al.*, 2023).

Ageing is associated with several physiological changes, including altered gastrointestinal absorption, reduced dermal absorption, decreased liver size and hepatic blood flow, increased body fat composition, and reduced renal function (Gholamnezhad *et al.*, 2024). Improvements in healthcare have contributed to increased life expectancy, leading to a steady rise in the elderly population. With the increasing population of the elderly, the issue of polypharmacy has also emerged (Gupta *et al.*, 2018). Polypharmacy can be simply defined as either concomitant use of five or more drugs or the administration of more medications in treating multiple chronic diseases. Patients taking multiple medications are more likely to experience medication non-adherence, which may reduce treatment effectiveness and affect clinical outcomes. The use of a greater number of medications has been independently associated with increased risk for Adverse Drug Events (ADEs). In addition, polypharmacy



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increases the possibility of prescribing cascades (Al Ameri *et al.*, 2014). Prescribing cascades occur when a new medication is prescribed to treat or to prevent the symptoms of an Adverse Drug Reaction (ADR) caused by another medication (Jennings *et al.*, 2024).

A Potentially Inappropriate Medication (PIM) is defined as a drug for which the risks of an adverse event outweigh its clinical benefit, particularly when there is a safer or more effective alternative therapy for the same conditions (Giri and Khan, 2020). Prescription of Potentially Inappropriate Medication (PIM) is a common cause of morbidity and mortality among older adults and was a key factor in the development of criteria to promote the safe use of medications in this population. Therefore, medications should be prescribed with utmost caution, keeping in mind the possibility of adverse drug reactions (Kanagasanthosh *et al.*, 2015). The use of multiple medications may contribute to inappropriate prescribing, medication errors, non-adherence, prolonged hospitalisation, poor quality of life and mortality. To minimize inappropriate medication, use and improve prescribing practices several explicit criteria have been developed. Among these, the Beers Criteria is one of the most widely used tools worldwide for identifying potentially inappropriate medications in older adults (Subeesh *et al.*, 2017). The Beers Criteria for the Potentially Inappropriate Medication (PIM) use in older adults, commonly referred to as Beer's list, is a guideline for health care professionals to help improve the safety of prescribing medications for older adults (Manjunath *et al.*, 2015).

In 1991, Dr. Mark Beers and his colleagues at the University of California, Los Angeles, developed the Beers Criteria to identify medications whose potential risk outweighed their benefits in nursing home residents. In 1997, the criteria were expanded to target all other adults. A professional panel revised the Beers criteria in 2003, and in 2010, the American Geriatrics Society (AGS) took charge for their maintenance and updates. Since its introduction, the AGS and its expert panel have regularly revised the Beers Criteria while preserving its original purpose to provide a clear list of potentially inappropriate medications that should generally be avoided in older adults, either in most situations or under specific clinical conditions and diseases (American Geriatrics Society Beers Criteria® Update Expert Panel, 2023).

Each prescription was analysed for the WHO/International Network for the Rational Use of Drugs standards, which are used to evaluate the:

- Average number of medicines per encounter.
- Percentage of medicines prescribed by generic name.
- Percentage of encounters with an antibiotic prescribed.
- Percentage of encounters with an injection prescribed.

- Percentage of medicines prescribed that are from the essential drug list (Ragam *et al.*, 2017).

The overall aim of this study is to investigate the prevalence of polypharmacy and Potentially Inappropriate Medications prescribed for elderly patients using the recently updated Beers Criteria 2023. Additionally, the study evaluates prescribing patterns based on WHO prescribing indicators to better understand prescribing and drug utilisation practices in this population.

MATERIALS AND METHODS

- **Study design and duration:** A prospective observational study was conducted over a period of six months.
- **Study site:** The study was carried out in the Departments of General Medicine and Orthopaedics, Chigateri District Hospital, Davangere.
- **Sample size:** A total of 160 geriatric inpatients were included in the study.

Inclusion criteria

Geriatric patients aged 65 years and above who were admitted to the Departments of General Medicine and Orthopedics during the study period, irrespective of gender, were included in the study.

Exclusion criteria

Outpatients, patients who were unwilling to participate in the study, and patients with missing or insufficient data were excluded from the study.

Study procedure

A prospective observational study was conducted on 160 patients admitted to the Departments of General Medicine and Orthopaedics of Chigateri District Hospital, Davangere, over six months. The study received approval from the Institutional Ethical Committee of S.C.S College of Pharmacy. A specifically designed data collection form was created to gather information, including patient demographic details, major complaints, past medical and medication history, family history, laboratory investigations, complications/comorbidities, as well as the medications prescribed for each individual. Each completed data collection form was evaluated to identify the presence of polypharmacy and potentially inappropriate medications.

Ethical Approval

The study protocol was approved by the Institutional Ethics Committee of S.C.S College of Pharmacy, Harapanahalli,

Karnataka, India, on 19 March 2025, prior to commencement of the study.

Statistical Analysis

The collected data were entered into Microsoft Excel (2024) and analysed using descriptive statistical methods. Results were expressed as frequencies and percentages.

RESULTS

According to the inclusion and exclusion criteria, a total of 160 geriatric inpatients were enrolled in this study. The collected results were analysed statistically using MS Excel.

Gender Wise Distribution Of Study Population

Out of 160 participants included in the study population, there were 97 males (61%) and 63 females (39%).

Age-Wise Distribution Of Study Population

A total of 160 participants were divided into three age groups. The largest group was those aged 65-74 years, with 82 participants (51.2%) of the total. The 75-84 years group included 49 people (30.6%), while the 85 years and above age group included 29 participants (18.2%).

Number Of Medications Prescribed Per Patient

Among the 160 prescriptions analysed, the majority (55%) comprised 5-9 medications, accounting for 88 prescriptions. This was followed by 45 prescriptions (28%) containing 10 or more medications, indicating a notable level of polypharmacy (Table 1). The least number of prescriptions, 27 in total (17%), included 1 to 4 medications, reflecting a lower prevalence of minimal drug use among the study population.

Percentage of Appropriateness and Inappropriateness of Prescriptions in Study Population

Among 160 prescriptions evaluated, 123 prescriptions (77%) were found to be appropriate, while 37 prescriptions (23%) were identified as inappropriate, indicating that most prescriptions were appropriate according to the assessment criteria (Figure 1).

Clinical Conditions For Hospitalisation

Among the various reasons for hospitalisation observed in the 160-study population, respiratory disorders were the most common, accounting for 46 cases (28.8%), followed by musculoskeletal disorders 29 (18.1%), cardiovascular disorders 18 (11.2%), CNS disorders 13 (8.1%), gastrointestinal disorders 12 (7.5%), liver disorders 11 (6.9%), endocrine disorders 10 (6.2%), renal disorders 8 (5%), and miscellaneous 7 (4.4%), and blood disorders were the least common reason for hospitalisation, with only 6 (3.8%) cases recorded.

Category-Wise Distribution of Medications

In the category-wise distribution of drugs across the 160 prescriptions, the most frequently prescribed medications were those acting on the gastrointestinal system, totaling 263 drugs (22.2%), followed by anti-infective drugs 219 (18.5%), drugs acting on the respiratory system 160 (13.4%), analgesic and anti-inflammatory 160 (13.4%), vitamins, minerals and dietary supplements 112 (9.5%), cardiovascular drugs 105 (8.8%), drugs

Table 1: No. of medications prescribed per patient.

No. of Medications	No. of prescriptions (n)	Percentage (%)
1-4	27	17%
5-9	88	55%
≥10	45	28%

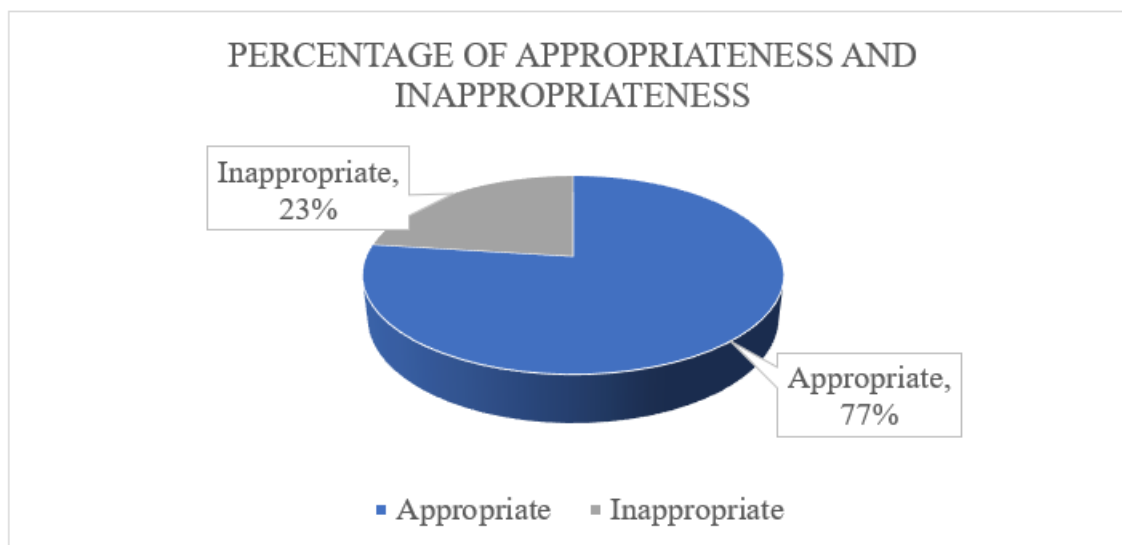


Figure 1: Percentage of appropriateness and inappropriateness.

acting on the endocrine system 54 (4.5%), drugs acting on the renal system 42 (3.6%), drugs acting on the CNS 41 (3.5%), and the drugs acting on the blood were the least prescribed, accounting for only 32 drugs (2.6%) (Table 2).

Distribution Of Comorbidity In The Study Population

Among the 160 patients analysed, hypertension was the most common comorbidity, observed in 65 patients, followed by diabetes mellitus in 35 patients, ischemic heart disease in 15, acute kidney injury in 4, cerebrovascular accident in 3, and the least common comorbidity was liver disease, accounting for 2 cases.

Distribution Of Specific Potentially Inappropriate Medication In The Elderly According To 2023 Beers Criteria

Based on the 2023 AGS Beers Criteria, in our study, we identified, out of 160 patients, 37 patients (23%) received potentially inappropriate medications according to the Beers Criteria. Among 37 patients, diclofenac was the most frequently prescribed PIM, accounting for 12 cases (32.4%), followed by chlorpheniramine 8 (21.6%), glimepiride 5 (13.5%), glibenclamide 4 (11%), amitriptyline 3 (8%), phenobarbital 3 (8%), and the least prescribed PIM was trihexyphenidyl 2 (5.5%) (Table 3).

Drug Usage Pattern In Elderly Patients Using Who Drug Use Prescribing Indicators

Among 160 prescriptions analysed, the total number of drugs prescribed was 1188, with an average of 7.4. Among the total number of drugs prescribed, about 474 drugs (39.8%) were prescribed by generic name (Table 4). Utilisation from the essential drug list was 670 (56.3%). The percentage of encounters in which antibiotics are prescribed in 160 prescriptions is 78.1%. The percentage of encounters in which injections are prescribed is 86.2%.

DISCUSSION

In terms of drug prescribing, the geriatric age group is considered to be a special risk group. Identifying the problem areas, suggesting interventions to improve the prescribing pattern, and reviewing current prescription patterns are all part of rationalising prescriptions for geriatric patients. Prescribing medications for elderly patients with multiple chronic diseases and polypharmacy is a challenging task.

In the present study, out of 160 participants, males (61%) outnumbered female patients (39%). This finding was consistent with previous studies conducted in the UAE and Hyderabad by Al Ameri *et al.* (2014) and Sultana *et al.* (2019).

In this study, among the three age groups, the majority of the patients were found to be within the age range of 65-74 (51.2%), followed by 75-84 age group (30.6%), the age group of ≥ 85

(18.2%) had the fewest number of patients which is similar to the findings in a study conducted by (Prabahar *et al.*, 2024; Umar *et al.*, 2015).

In the present study, analysis of the number of medications prescribed per patient revealed that the majority of prescriptions 55% contained 5-9 drugs, while 28% contained 10 or more medications, indicating a high prevalence of polypharmacy in the study population. These results are comparable to findings from the studies conducted by Sharma *et al.* (2020). Which has a prevalence of 88.8% where as in our study, the prevalence of polypharmacy was 83%. The predominance of polypharmacy in the study may be attributed to several factors, including advanced patient age and multiple comorbidities.

In this study, the prescriptions were reviewed using the Beers Criteria by the American Geriatrics Society, which identified 23% of prescriptions were inappropriate and 77% of prescriptions were appropriate. This trend is similar to the study conducted by Mangi *et al.* (2020). Inappropriate prescribing is common in elderly patients since they may receive several drugs simultaneously on account of chronic diseases or multiple health problems. The high rate of appropriate prescriptions reflects adherence to standard treatment guidelines and rational drug use principles in most cases.

The elderly population suffers from numerous chronic disorders. In this study, respiratory disorders (28.8%) were the most common reason for hospitalization, followed by musculoskeletal disorders (18.1%), cardiovascular disorders (11.2%), CNS disorders (8.1%), gastrointestinal disorders (7.5%), liver disorders (6.9%), endocrine disorders (6.2%), renal disorders (5%), miscellaneous (4.4%) and the least condition for hospitalization was blood disorders (3.8%). These results are comparable to the findings from the study conducted by Prakash Goudanavar *et al.* (2016)

Table 2: Category-wise distribution of drugs.

System	No. of Medications	Percentage
Vitamins, minerals and dietary supplementation	112	9.5%
Anti-infective	219	18.5%
Cardiovascular drugs	105	8.8%
Drugs acting on the renal system	42	3.6%
Drugs acting on the GI system	263	22.2%
Drugs acting on blood	32	2.6%
Drugs acting on the respiratory system	160	13.4%
Drugs acting on the endocrine	54	4.5%
Drugs acting on the CNS	41	3.5%
Analgesic and anti-inflammatory	160	13.4%

Table 3: Distribution of specific potentially inappropriate medications according to 2023 Beers Criteria.

Category	Name of the drug	Total no of drugs	Percentage
I	Generally, to be avoided in older adults		
	Amitriptyline	3	8%
	Chlorpheniramine	8	21.6%
	Phenobarbital	3	8%
	Trihexyphenidyl	2	5.5%
	Glimepiride	5	13.5%
	Diclofenac	12	32.4%
	Glibenclamide	4	11%
II	Drugs to be avoided in combination with specific comorbidities	Nil	Nil
III	Drugs to be used with caution	Nil	Nil

Table 4: Drug use pattern using WHO prescribing indicators.

Prescribing indicators assessed	Results
Total number of prescriptions analysed	160
Total number of drugs prescribed	1188
Average no. of drugs per prescription	7.4
Percentage of drugs prescribed by generic name	474/1188 (39.8%)
Percentage of drugs prescribed from essential drug list	670/1188 (56.3%)
Percentage of encounters in which antibiotic was prescribed	125/160 (78.1%)
Percentage of encounters in which injections was prescribed	138/160 (86.2%)

this pattern of morbidity is not uncommon among the elderly, as age-related changes in pulmonary function, such as impaired mucociliary clearance and diminished pulmonary host defences, make them prone to respiratory morbidities.

In the present study, a total of 1188 drugs were prescribed to a total of 160 patients for different diseases. The most commonly prescribed drugs in our study belonged to the category of drugs acting on the GI system (22.2%). This could be attributed to the increased prescription of drugs damaging the gastrointestinal mucosa, such as NSAIDs, in the elderly population. This was followed by anti-infective (18.5%) for the management of infections, such as lower respiratory tract infections and urinary tract infections. This may reflect age-related progressive impairment in immune function, making them more susceptible to infection. This trend was similar to the findings in the study conducted by Chandrappa *et al.* (2019).

In this study, hypertension emerged as the most common comorbidity, observed in 65 patients, followed by diabetes mellitus in 35 patients. This trend is similar to the findings in the study conducted in Bangalore and Jammu by Mydhily *et al.* (2023) and Gupta *et al.* (2018) respectively. Liver disease was

the least common comorbidity observed, which is similar to the study conducted by Kamath *et al.* (2023).

According to the American Geriatrics Society Updated Beers Criteria 2023 for potentially inappropriate medication use in the elderly, in this study, 3.11% of total drugs prescribed were PIMs, which is less when compared to the study conducted by Kanagasanthosh *et al.* (2015). Which has about 7.75% of drugs that were PIMs. Among the three different categories in the Beers Criteria, category I, which includes medications to be avoided in older patients, forms a major category of inappropriate use of drugs. From our study, almost 7 different drugs were prescribed to the patients from category I. Diclofenac was the most commonly prescribed PIM, which is in agreement with the study conducted by Kanagasanthosh *et al.* (2015) and the least prescribed PIM was Trihexyphenidyl. This trend was similar to the study conducted by Giri and Khan, (2020).

In the present study, concerning the WHO drug prescribing indicator, a total of 160 prescriptions were analysed, which have a total of 1188 drugs prescribed. The average number of drugs prescribed in our study was 7.4, which is in the same range as results from other geriatric prescription studies conducted by Jyothsna *et al.* (2019); Shah *et al.* (2012) found an average of 6.7 and 7.3, respectively.

The percentage of drugs prescribed by generic name was just 39.8%, which is much less than the standard value of 100%, which indicates that brand names are more popular among practitioners. The low rate of generic prescribing may reflect institutional prescribing practices, physician preference, or medication availability. This trend is similar to findings in a study conducted by Fadare *et al.* (2013) from Nigeria. Similar studies carried out by Shah *et al.* (2012) from Gujarat reported only 15.6%, which is low compared to the standard and to our findings.

The percentage of encounters in which an antibiotic was prescribed was 78.1%, which is very high when compared to the standard value of 20%-26.8%. It is similar to the study

conducted by Singh, (2017), where antibiotics were prescribed to 83.42% of the subjects. This may be because elderly patients are more susceptible to infections due to immunosenescence and a weakened immune system, making them more prone to bacterial infections.

The percentage of encounters in which injections were prescribed was 86.2%, which is very high when compared to standard values of 13%-24%. It is comparable to the study conducted by Jyothsna *et al.* (2019). Where injections were prescribed to 67.5% of the subjects. This can be attributed to several factors, including difficulty in swallowing, poor gastrointestinal absorption, and the need for rapid onset of action in managing acute conditions.

The percentage of medicines prescribed from the essential drug list was found to be 56.3%, which is less when compared to the standard values of 100%. This is similar to the study conducted by Giri and Khan, (2020) which has 42.44%. The low proportion of medications prescribed from the essential medicines list may be related to limited awareness of the essential medicines concept.

LIMITATIONS

The study was conducted in a single tertiary care hospital, which may limit the generalizability of the findings to other healthcare settings.

The study did not evaluate clinical outcomes such as adverse drug reactions, hospital readmissions, or mortality.

CONCLUSION

The present study highlights that polypharmacy and inappropriate prescribing remain important concerns among elderly patients. A significant proportion of prescriptions contained five or more drugs, reflecting the high prevalence of polypharmacy in this population. Although most prescriptions were found to be appropriate, the presence of potentially inappropriate medications, particularly NSAIDs and anticholinergic agents, indicates the need for cautious prescribing.

The analysis of WHO prescribing indicators further revealed gaps such as low use of generic drugs, high rate of antibiotic and injection prescribing, and suboptimal use of essential medicines. These findings emphasise the importance of regular prescription review, adherence to standard guidelines, and awareness of the Beers Criteria to improve medication safety and rational drug use in geriatric patients. Strengthening prescriber education and promoting rational prescribing policies can ultimately reduce adverse drug events, healthcare costs, and improve the quality of life for elderly patients.

The findings of the present study contribute to a better understanding of the geriatric population and emphasise the importance of regular medication review, adherence to the Beers Criteria, and the involvement of clinical pharmacists in

optimising drug therapy and improving patient safety among geriatric patients.

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ABBREVIATIONS

ADE: Adverse Drug Event; **ADR:** Adverse Drug Reaction; **AGS:** American Geriatrics Society; **CNS:** Central Nervous System; **GI:** Gastrointestinal; **NSO:** National Statistical Office; **PIM:** Potentially Inappropriate Medication; **WHO:** World Health Organization.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

SUMMARY

This study of 160 geriatric inpatients revealed that 83% experienced polypharmacy and 23% were prescribed Potentially Inappropriate Medications (PIMs). Hypertension and Respiratory disorders were primary health concerns. Results underscore the necessity of using clinical tools like the Beers Criteria to optimize therapy and reduce medication related risks.

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