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An observational study on prescription appropriateness in geriatric patients using different criteria at a tertiary care hospital

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Abstract

Background: Potentially inappropriate prescribing is a major challenge in geriatric healthcare because older adults frequently experience multiple chronic diseases and require several medications. Polypharmacy increases the risk of adverse drug events, drug–drug interactions, medication-related complications, and reduced therapeutic effectiveness. This study aimed to evaluate prescription appropriateness among geriatric inpatients using the 2023 American Geriatrics Society (AGS) Beers Criteria and the STOPP/START Version 3 criteria.

Methodology: A retrospective observational study was conducted among 180 geriatric inpatients (≥ 60 years) admitted to a tertiary care teaching hospital between January and July 2025. Data were collected from inpatient medical records and electronic health records. Prescription appropriateness was assessed using the 2023 AGS Beers Criteria, STOPP Version 3, and START Version 3 criteria. Descriptive statistics were used to summarize demographic characteristics, polypharmacy, comorbidities, potentially inappropriate medications (PIMs), and potential prescribing omissions (PPOs).

Results: Hyperpolypharmacy was observed in 126 (70.0%) patients, while 54 (30.0%) had polypharmacy. Hypertension (27.9%) and diabetes mellitus (23.0%) were the most common comorbidities. Among 2,119 medications reviewed, 306 (14.44%) and 381 (17.97%) were identified as potentially inappropriate by the Beers and STOPP criteria, respectively. Overall, 687 (67.62%) PIMs and 329 (32.38%) PPOs were identified. Proton pump

inhibitors and NSAIDs were the most frequently identified PIMs, whereas influenza and pneumococcal vaccinations were the most common prescribing omissions.

Conclusion: The study demonstrated a high prevalence of polypharmacy and inappropriate prescribing among geriatric patients. The combined application of the Beers, STOPP, and START criteria provided a comprehensive assessment of prescribing quality by identifying both inappropriate medications and prescribing omissions. Routine implementation of these validated tools, together with regular medication review, may improve prescribing practices, enhance patient safety, and optimize therapeutic outcomes in the geriatric population.

Keywords: Geriatric patients; Prescription appropriateness; Polypharmacy; Hyperpolypharmacy; Potentially inappropriate medications; Beers Criteria; STOPP Criteria; START Criteria; Potential prescribing omissions; Medication safety.

Introduction

The population of older patients is expanding rapidly throughout the globe due to advances in medicine, nutrition, hygiene, and standards of living. Due to aging, patients are susceptible to developing chronic illnesses that need lifelong treatment by several drugs. Some of the common illnesses seen in elderly patients include hypertension, diabetes mellitus, heart ailments, chronic kidney disease, pulmonary illnesses, and arthritis, making them difficult to manage as compared to younger patients. Physiological changes with age affect drug absorption, distribution, metabolism, and excretion from the body. Therefore, the chances of drug side effects and drug-drug interactions increase in geriatric patients. Thus, prescription of medicines to such patients needs proper evaluation to make sure that each drug prescribed is necessary, effective, and safe.^[1,2]

Polypharmacy has become one of the biggest concerns in the geriatric health care setting. Polypharmacy is described as the administration of at least five drugs simultaneously, whereas hyperpolypharmacy is described as the administration of at least ten drugs at the same time. Even though there is an urgent need for administration of different types of drugs due to the presence of various illnesses, polypharmacy increases the chances of experiencing different problems, such as drug-drug interaction, adverse drug events, non-compliance, fall risks, admission to hospitals, and decreased quality of life. The elderly population is especially prone to such side

effects because their physiological reserve is lower and organ dysfunction may occur.^[3,4]

Many screening tools that have been scientifically validated exist to promote better prescribing practice among older individuals by screening for drugs that can do more harm than good. For instance, the American Geriatrics Society (AGS) Beers Criteria tool is one of the most commonly used explicit tools for identifying potentially inappropriate medications among the elderly population. In a similar fashion, the STOPP (Screening Tool of Older Persons' Prescriptions) is used to detect inappropriate prescribing practices, while the START (Screening Tool to Alert to Right Treatment) is used to detect essential medication that has not been prescribed even though it is clinically indicated.^[5,6]

The increasing problem of inappropriate prescription has made it clear that there is a need to assess appropriateness of prescription in regular clinical practice. The use of PIM could increase the chance of having adverse drug reactions, impaired cognition, falls, lengthened stay in hospitals, and increased cost of health care, whereas the use of PPO could deprive patients of receiving beneficial drugs which help in improving their diseases. Both PIMs and PPOs give a complete perspective on the quality of prescription. While a number of validated prescriptions have been developed for this purpose, their regular use has remained a challenge in most health care systems, especially in developing nations.^[7,8]

With the increasing trend of the elderly population and problems related to polypharmacy, the assessment of prescription appropriateness has become an important aspect of geriatric care. There are limited studies on the combined use of 2023 AGS Beers Criteria and STOPP/START Version 3 criteria in the tertiary care hospitals of India. Hence, the present study has been conducted to evaluate the prescription appropriateness amongst geriatric patients admitted in hospitals through the identification of potentially inappropriate medicines and potential prescribing omission using these criteria. The prevalence of polypharmacy, hyperpolypharmacy, and their respective co-morbidities has also been assessed to have a complete picture of the existing scenario.^[9,10]

Methodology

Study Design and Setting: A retrospective observational study was conducted to evaluate prescription appropriateness among geriatric inpatients admitted to a tertiary care teaching hospital. The study was carried out across various inpatient wards and intensive care units (ICUs) over a seven-month period from January 2025 to July 2025.

Study Population: The study included 180 geriatric patients aged 60 years and above who were admitted to inpatient wards and ICUs during the study period. Patient prescriptions were reviewed to assess polypharmacy, potentially inappropriate medications (PIMs), and potential prescribing omissions (PPOs).

Inclusion Criteria

- Patients aged ≥ 60 years.
- Patients of either sex.
- Patients admitted to inpatient wards or intensive care units with acute or chronic illnesses.

Exclusion Criteria

- Patients aged < 60 years.
- Prescriptions with incomplete clinical or medication information.

- Patients with a hospital stay of less than 24 hours or those treated on an outpatient/day-care basis.

Data Collection: Data were collected retrospectively from inpatient medical records and electronic health records. Information retrieved included demographic characteristics (age and sex), medical history, medication history, social history, comorbidities, clinical examination findings, laboratory investigations, and complete prescription details. All eligible prescriptions were reviewed after confirming that they fulfilled the study inclusion criteria.

Assessment of Prescription Appropriateness:

Prescription appropriateness was evaluated using three validated explicit screening tools. The 2023 American Geriatrics Society (AGS) Beers Criteria were used to identify potentially inappropriate medications (PIMs). The STOPP (Screening Tool of Older Persons' Prescriptions) Version 3 criteria were applied to identify inappropriate prescribing practices, while the START (Screening Tool to Alert to Right Treatment) Version 3 criteria were used to detect potential prescribing omissions (PPOs). Polypharmacy was defined as the concurrent use of 5–9 medications, whereas hyperpolypharmacy was defined as the use of 10 or more medications.

Outcome Measures: The primary outcome was the prevalence of potentially inappropriate medications identified using the Beers and STOPP criteria. Secondary outcomes included the prevalence of potential prescribing omissions identified using the START criteria, the frequency of polypharmacy and hyperpolypharmacy, and the distribution of comorbidities among the study population.

Statistical Analysis: Data were entered into Microsoft Excel for analysis. Descriptive statistics were used to summarize the findings. Categorical variables were expressed as frequencies and percentages. The results were presented in tables to compare prescription appropriateness according to the Beers, STOPP, and START criteria.

Results

Table 1. Demographic characteristics of the study participants (N = 180)

Variable	Category	Male n (%)	Female n (%)	Total n (%)	χ^2 value	df	P-value
Age Group (years)	60–69	62 (34.4)	27 (15.0)	89 (49.4)	0.59	2	0.74
	70–79	45 (25.0)	25 (13.8)	70 (38.8)			
	≥80	13 (7.2)	8 (4.4)	21 (11.6)			
Sex		120 (66.6)	60 (33.3)	180 (100)	-		

A total of 180 geriatric patients were included in the study, comprising 120 (66.6%) males and 60 (33.3%) females. Nearly half of the patients (89, 49.4%) belonged to the 60–69 years age group, followed by 70–79 years (70, 38.8%) and ≥80

years (21, 11.6%). There was no statistically significant association between age group and gender ($\chi^2 = 0.59$, $df = 2$, $p = 0.74$), indicating that the age distribution was similar among male and female patients.

Table 2. Polypharmacy among geriatric patients (N = 180)

Variable	Male n (%)	Female n (%)	Total n (%)	χ^2 value	df	P-value
Polypharmacy (5–9 drugs)	36 (20.0)	18 (10.0)	54 (30.0)	0.00	1	1.00
Hyperpolypharmacy (≥10 drugs)	84 (46.6)	42 (23.3)	126 (70.0)			

Polypharmacy was highly prevalent among the study participants. Of the 180 patients, 54 (30.0%) received 5–9 medications, while 126 (70.0%) received 10 or more medications, indicating hyperpolypharmacy. Among patients with hyperpolypharmacy, 84 (46.6%) were males

and 42 (23.3%) were females. There was no significant association between gender and polypharmacy ($\chi^2 = 0.00$, $df = 1$, $p = 1.00$), suggesting that medication use was comparable in both genders.

Table 3. Number of comorbidities per patient (N = 180)

Number of comorbidities	Frequency (n)	Percentage (%)	Mean ± SD	Range
0	30	16.7	2.14 ± 1.4	0 – 5
1	40	22.2		
2	30	16.7		
3	45	25.0		
4	24	13.3		
≥5	11	6.1		
Total	180	100		

The study showed that most geriatric patients had one or more comorbidities. The highest proportion of patients (45, 25.0%) had three comorbidities, followed by 40 (22.2%) with one comorbidity. Patients with no comorbidity and

two comorbidities each accounted for 30 (16.7%), while 24 (13.3%) had four and 11 (6.1%) had five or more comorbidities. The mean number of comorbidities was 2.14 ± 1.4 , with a range of 0–5, indicating a moderate burden of multimorbidity.

Table 4. Distribution of comorbidities among geriatric patients

Comorbidity	Male	Female	Total (n)	Percentage (%)
Hypertension	69	36	105	27.9
Diabetes mellitus	64	23	87	23.0
Respiratory diseases	25	18	43	11.4
Kidney diseases	21	8	29	7.7
Heart diseases	9	9	18	4.8
Urinary tract infection	9	9	18	4.8
Hypothyroidism	11	5	16	4.2
Anaemia	11	4	15	4.0
Oedema	6	3	9	2.4
Eye diseases	8	0	8	2.1
Liver diseases	6	0	6	1.6
Others	19	4	23	6.1
Total comorbidities	258	119	377	100

A total of 377 comorbidities were identified among 180 patients. Hypertension was the most common condition, affecting 105 (27.9%) patients, followed by diabetes mellitus in 87 (23.0%) patients. Respiratory diseases (43,

11.4%) and kidney diseases (29, 7.7%) were also frequently observed. Other conditions included heart disease, urinary tract infection, hypothyroidism, anaemia, oedema, eye diseases, liver diseases, and miscellaneous disorders.

Table 5. Medications identified by Beers and STOPP criteria (N = 2,119 medications)

Criteria	Number of medications	Percentage (%)	χ^2 value	df	P-value
Beers Criteria	306	14.44	5.5	1	0.02
STOPP Criteria	381	17.97			
Not identified by either criterion	1432	67.59			
Total medications	2119	100			

A total of 2,119 medications prescribed to the study participants were evaluated using the Beers and STOPP criteria. The STOPP criteria identified 381 (17.97%) potentially inappropriate medications, whereas the Beers Criteria identified 306 (14.44%) medications. The remaining 1,432 (67.59%) medications were not identified by

either screening tool. A statistically significant difference was observed between the Beers and STOPP criteria ($\chi^2 = 5.5$, $df = 1$, $p = 0.02$), indicating that the STOPP criteria detected significantly more potentially inappropriate medications than the Beers Criteria.

Table 6. Potentially inappropriate medications (PIMs) and potential prescribing omissions (PPOs)

Parameter	Number	Percentage (%)
PIMs (Beers + STOPP)	687	67.62
PPOs (START)	329	32.38
Total drug-related problems	1016	100

A total of 1,016 prescribing issues were identified during the study. Of these, 687 (67.62%) were classified as potentially inappropriate medications (PIMs) using the Beers and STOPP criteria, whereas 329 (32.38%) were identified as potential

prescribing omissions (PPOs) using the START criteria. The findings indicate that inappropriate prescribing was more common than omission of appropriate therapy.

Table 7. Drug classes identified as potentially inappropriate medications (PIMs)

Drug class	Beers n (%)	STOPP n (%)
Proton pump inhibitors	150 (49.01)	148 (38.85)
NSAIDs	43 (14.05)	36 (9.45)
Sulfonylureas	18 (5.88)	0
Laxatives	0	57 (14.96)
Antibiotics	2 (0.65)	32 (8.40)
Multivitamins	0	32 (8.40)
Anticonvulsants	0	18 (4.72)
Diuretics	3 (0.98)	15 (3.94)
Benzodiazepines	14 (4.58)	0
Vitamins	2 (0.65)	12 (3.15)
Expectorants	10 (3.27)	7 (1.84)
Others	64 (20.91)	24 (6.30)
Total	306 (100)	381 (100)

Proton pump inhibitors were the most frequently identified potentially inappropriate medications by both the Beers [150 (49.01%)] and STOPP [148 (38.85%)] criteria. NSAIDs were the second most common class. The STOPP criteria

additionally identified inappropriate use of laxatives (57, 14.96%), antibiotics (32, 8.40%), and multivitamins (32, 8.40%), whereas Beers uniquely identified sulfonylureas and benzodiazepines as common PIMs.

Table 8. Drug classes identified as potential prescribing omissions (START criteria)

Drug class	Frequency (n)	Percentage (%)
Influenza vaccine	141	42.86
Pneumococcal vaccine	141	42.86
β2-agonists	17	5.17
Bone protection therapy (Calcium/Vitamin D)	12	3.65
ACE inhibitors	9	2.74
Others	9	2.74
Total	329	100

The START criteria identified 329 potential prescribing omissions. Influenza and pneumococcal vaccines were the most frequently

omitted therapies, with 141 (42.86%) omissions each. Other commonly missed treatments included β2-agonists [17 (5.17%)], bone

protection therapy [12 (3.65%)], ACE inhibitors [9 (2.74%)], and other medications [9 (2.74%)], indicating gaps in preventive and supportive care among geriatric patients.

Discussion

The present study included 180 geriatric inpatients, with males accounting for 66.7% of the study population and females for 33.3%. Nearly half of the participants (49.4%) belonged to the 60–69-year age group, indicating that younger elderly individuals constituted the majority of hospital admissions. Hyperpolypharmacy was highly prevalent, with 70.0% of patients receiving ten or more medications, while 30.0% were prescribed 5–9 medications. This finding reflects the increasing complexity of managing older adults with multiple chronic illnesses. Similar observations were reported by Rakesh et al., who found a high prevalence of polypharmacy among hospitalized geriatric patients in India. Likewise, Keche et al. demonstrated that increasing age and multiple drug use significantly increased the risk of inappropriate prescribing, emphasizing the need for routine medication review in elderly patients.^[11,12]

Most patients in the present study had multiple comorbidities, with 25.0% having three concurrent diseases, while only 16.7% had no comorbidity. Hypertension (27.9%) and diabetes mellitus (23.0%) were the most frequently observed conditions, followed by respiratory diseases (11.4%) and kidney diseases (7.7%). The presence of several chronic illnesses explains the high medication burden seen in elderly patients and increases the likelihood of drug-related problems. These findings are consistent with the study by Rodrigues et al., who reported that cardiovascular and endocrine disorders were the predominant chronic conditions associated with inappropriate prescribing among older adults. Similarly, Niehoff et al. concluded that multimorbidity is one of the strongest contributors to potentially inappropriate prescribing and emphasized the use of validated screening tools such as the Beers and STOPP/START criteria to improve medication safety in geriatric patients.^[13,14]

The present study identified 381 medications (17.97%) using the STOPP criteria and 306 medications (14.44%) using the Beers criteria, indicating that STOPP detected more potentially inappropriate medications than Beers. Overall, 687 prescribing issues (67.62%) were classified as potentially inappropriate medications (PIMs), while 329 (32.38%) were identified as potential prescribing omissions (PPOs) using the START criteria. These findings suggest that combining the Beers, STOPP, and START criteria provides a more comprehensive assessment of prescribing quality in older adults. Similar findings were reported by Tang et al., who demonstrated that combining the Beers and STOPP criteria detected significantly more inappropriate prescriptions than either tool alone in older hospitalized patients with chronic diseases. Likewise, O'Mahony et al., in the updated STOPP/START Version 3, emphasized that the combined application of STOPP and START criteria improves the identification of both inappropriate medications and omitted therapies, thereby enhancing medication safety and optimizing treatment outcomes in elderly patients.^[15,16]

Proton pump inhibitors were the most frequently identified potentially inappropriate medications by both the Beers and STOPP criteria in the present study, followed by NSAIDs. The START criteria further revealed that influenza and pneumococcal vaccines were the most commonly omitted therapies, accounting for 42.86% each, highlighting important gaps in preventive healthcare among older adults. Long-term use of proton pump inhibitors and NSAIDs is associated with an increased risk of adverse drug events, while omission of recommended vaccinations leaves elderly patients more susceptible to preventable infections. Similar findings were reported by Chang et al., who observed that proton pump inhibitors and NSAIDs were among the most common potentially inappropriate medications detected using Beers, STOPP, and MALPIP criteria. Likewise, Rodrigues et al. found that proton pump inhibitors, benzodiazepines, and NSAIDs were frequently identified as inappropriate medications among older adults, emphasizing the importance of regular medication review and deprescribing

strategies to improve prescribing quality and patient safety.^[17]

Conclusion

The present study successfully assessed prescription appropriateness among 180 geriatric inpatients using the 2023 AGS Beers Criteria, STOPP, and START criteria. Hyperpolypharmacy was observed in 126 (70.0%) patients, while 54 (30.0%) had polypharmacy, reflecting the high medication burden in older adults. Hypertension (27.9%) and diabetes mellitus (23.0%) were the most prevalent comorbidities. Among the 2,119 medications reviewed, 306 (14.44%) were identified as potentially inappropriate by the Beers Criteria and 381 (17.97%) by the STOPP Criteria. Overall, 687 (67.62%) potentially inappropriate medications and 329 (32.38%) potential prescribing omissions were detected. Proton pump inhibitors and NSAIDs were the most common potentially inappropriate medications, whereas influenza and pneumococcal vaccinations were the most frequent prescribing omissions. These findings demonstrate that the combined use of the Beers, STOPP, and START criteria provides a comprehensive evaluation of prescribing practices and can facilitate rational prescribing, reduce medication-related risks, and improve therapeutic outcomes and patient safety among geriatric patients.

Study limitations

The present study has a few limitations. Since the study was based on retrospective medical records, some minor clinical details or medical history may have been missing if they were not documented properly. The study was conducted over a short period with a relatively small sample size, which may limit the generalizability of the findings. Only geriatric patients admitted to inpatient departments were included, while patients from the emergency department were excluded. In addition, over-the-counter (OTC) medications were not considered during data collection. Therefore, some adverse drug events related to OTC drug use may not have been identified, which could have resulted in an underestimation of potentially inappropriate medications.

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