ISSN: 0975-3583,0976-2833 VOL14, ISSUE 05, 2023

Original Research Article

Assessment of the use of potentially inappropriate medication among geriatric patients in tertiary health care settings in western Uttar Pradesh, India: A cross-sectional study using Beer's criteria.

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ABSTRACT

Introduction: In geriatric patients with advancement in age may lead in radical variations in term of their pharmacokinetic and pharmacodynamic factors. Therefore, their use of potentially inappropriate medications puts them at risk of experiencing life-threatening consequences. Accordingly, the purpose of the present study is to evaluate prescribing practices among elderly patients in accordance with Beer's criteria. **Methods**: A cross-sectional and prospective study was conducted on different OPDs in a tertiary care hospital in Uttar Pradesh to scrutinise the prescribing patterns of PIMs among elderly patients in the age group of 65-85 years. Out of 120 patients' prescriptions, 108 were included after exclusion and inclusion criteria. SPSS software was used for analysis of data. **Result**: More than 90% of geriatric patient's prescriptions were exposed to polypharmacy and 70% prescriptions included PIMs. Out of 108 patients, 29 males (72.5%) and 60 females (88.2%), had PIMs in prescriptions (P =0.038), PIMs in rural residents 49 (86.1%) and in urban 40 (81.6%) (p=0.847) showing no significant difference. The difference was significant in PIMs among patients with polypharmacy taking drugs >4=22 (66.7%) and drugs <5=85 (90.5%) (p=0.001). This shows that polypharmacy significantly correlates with PIMs. **Conclusion**: As a result of the use of PIMs listed in Beer's criteria among the geriatric population, unplanned hospitalizations may arise. Our study revealed a high prevalence of potentially inappropriate medication in the geriatric population, which was associated with polypharmacy. As the patients receiving polypharmacy are at high risk, awareness of PIMs for elderly people among clinicians is essential, and polypharmacy needs to be regulated.

Key words: Beer's criteria, PIMs, Geriatric population, Polypharmacy.

INTRODUCTION

In line with various studies, the prescription of appropriate medications remains challenging, and elderly patients are more likely to receive inappropriate medication. It is estimated that the global geriatric population will continue to increase rapidly in the coming decades. Currently, 8.5% of the world's population is older than 65 years, and by 2050, the number is

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 05, 2023

expected to rise by 17%. This population is rapidly growing, making it vital to prescribe optimal medicine for better health improvement.[1] A number of aging-related characteristics make prescribing medication for geriatric patients more challenging and complex.

The pharmacodynamics and pharmacokinetics of geriatric patients are affected by multiple chronic diseases and degenerative conditions as well as age-related physiological changes. Patients who are geriatric are more likely to experience adverse events related to drugs, interactions between drugs, and increased hospitalization, as well as a higher cost of healthcare.[2,3] As a result of the impact of inappropriate prescribing on the elderly population, a number of methods have been developed to address these problems. Healthcare professionals refer to Potentially Inappropriate Medication (PIMs) as therapeutic agents whose potential benefits often outweigh their risks, particularly when more effective alternatives are available.[3]

The availability of information on drug use throughout the world is limited, which implies that drugs are not used optimally and that their inappropriate use has serious health and economic consequences.[4] Such circumstances may economically burden the healthcare system. The medications included in PIMs must be contraindicated for people of this age group in order to ensure the safety of patients, improve their quality of life, and reduce drug-related mortality and morbidity. For this reason, the American Geriatric Society (AGS) has developed guidelines, which are named AGS's Beer's Criteria for PIMs in geriatric patients.[5]

A growing trend has been observed in the use of PIMs in the previous studies using Beer's criteria. But it is still not clearly understandable whether the utilisation of PIMs listed in Beer's criteria can lead to the development of Adverse Drug Events (ADEs) in elderly people.[6] Most hospitalized patients die from ADEs, which are considered one of the leading causes of death. The major impact of ADEs on public health is the considerable economic cost that they impose on society and the health care system.[7] Drug-drug and drug-disease interactions may contribute to increased healthcare utilisation. The prevalence of drug interactions increases as the number of medications increases, ranging from 50% for patients taking five to nine medications to 100% with 20 or more medications.

With concurrent augmentation of further medication may enhance the threat by 12% In an earlier investigation involving 1340 veterans who were 65 years of age or older, the predominant occurrences were noted among individuals with congestive heart failure, attributed to the administration of first-generation calcium channel blockers. Similarly, instances were recorded among patients with peptic ulcer disease due to the utilization of aspirin. Furthermore, a greater number of medications are also associated with cognitive impairment up to 54% of older patients.[1]

Specialized screening instruments featuring clear criteria have been formulated to identify different facets of improper medication usage. These tools aim to support healthcare professionals in opting for safer treatment options and reducing the elderly population's exposure to inappropriate medications. So, we choose PIMs identification tools that have acquired international recognition and combine the use of objective review with Beer's criteria. For clinical use, the AGS, which developed the Beers Criteria, recommends that clinicians utilize it as a starting point for a complete regimen assessment for all geriatric patients, and urges clinicians to take into account rationale and recommendations.[5]

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However, studies based on these criteria continue to report a high prevalence of inappropriate prescribing among older people. The question then arises whether the recommended actions are clear enough to guide prescribers less experienced in geriatric patient care. Against this backdrop, the current research aimed to analyze the prescription trends of potentially inappropriate medications (PIMs) outlined in Beer's criteria among geriatric patients. This investigation seeks to uncover patterns that could contribute to the occurrence of adverse drug events (ADEs) in the elderly population.

POLYPHARMACY

The term polypharmacy refers to taking five or more medications at once as well as it also refers to the use of multiple medicines to treat multiple health issues, which is common among the elderly with multi-morbidity. Among the adverse outcomes associated with polypharmacy are mortality, falls, adverse medication reactions, increased hospital stay, and rehospitalisation shortly after discharge. Polypharmacy is an area of concern for the elderly for several reasons.[5,8]

Due to age-related metabolic shifts and decreased drug clearance, the elderly face higher susceptibility to adverse drug reactions (ADRs), compounded by increased medication intake. Polypharmacy can lead to varied symptoms like drowsiness, falls, confusion, sleepiness, constipation, diarrhoea, tiredness, an inability to enjoy the activities you normally do. To prevent such effects, older individuals should be assessed for polypharmacy.

A comprehensive medication review and risk assessment should be carried out by an interdisciplinary team to identify polypharmacy and its adverse effects. Assessment, review, minimize, optimize, and reassess are just some of the tools which can be used. Others include screening tools to alert doctors for the right treatment, tools to screen older persons' potentially for inappropriate prescriptions. ADR probability scale and the trigger tool for measuring ADEs in the health care centres help in evaluating the cause and effect of medication errors resulting in ADRs. Studies have shown that comprehensive geriatric assessment has proven to be effective in reducing the number of prescriptions and daily drug doses for patients by facilitating the discontinuation of unnecessary or inappropriate medications.[5,9]

To mitigate the frequency and adverse consequences of complex medication regimens in older patients, regular evaluations are recommended. When feasible, a solitary drug should be chosen over multiple ones for a specific ailment. If clinically indicated, Dosages can begin with lower amounts, increasing gradually if necessary. The use of drugs that can be given once or twice a day is better than those that need to be given three times a day. Drugs that are suspected of causing a problem should be discontinued. Medications lacking therapeutic value or clinical justification should be discontinued. Unnecessary drugs must be identified and removed when different healthcare providers prescribe them for the same ailment. Replacing higher-risk medications with safer alternatives is advisable.[9]

Recognizing and mitigating polypharmacy can result in improved outcomes for elderly patients and enhance their overall quality of life. Conducting medication reviews is a crucial component of caring for elderly patients to prevent potential adverse effects associated with the use of multiple medications.

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MATERIAL AND METHOD

***Study Design*:** A quantitative, observational, cross-sectional, and prospective study was conducted on different OPDs in a tertiary care hospital in Uttar Pradesh (U.P.) to scrutinise the prescribing patterns of PIMs among elderly patients.

***Study Site*:** The patients were randomly selected from Outpatient clinic of various departments of a tertiary health care centre in U.P.

***Study Sample Size*:** 120 patients were selected who met the criteria for polypharmacy. The names of the prescription drugs were recorded at the time of enrolment.

***Inclusion criteria*:**

1. Age more than 65 years,
2. Consuming five or more medications for underlying health conditions.

***Exclusion criteria*:**

1. Age less than 65 years.
2. Not consuming at least five medications.
3. Over-the-counter (OTC) medicines
4. Herbal supplements.
5. Excluded the eye drops, intranasal sprays and dermatological medicines.

***Data collection*:** The initial section comprised inquiries aimed at gathering data on the demographic attributes of the patients, encompassing age, gender, education level, and place of residence, along with inquiries about their smoking and alcohol consumption, if applicable. In the subsequent phase of the investigation, information pertaining to the patients' chronic medical conditions and prescribed medications was collected. Specifically, there exist five categories of medications that require caution or avoidance in adults aged 65 and above.

Potentially inappropriate for older adults.

- Should considerably avoid in older adults with known special conditions.
- Drugs to use with caution.
- Drug-drug interactions.
- On the basis of kidney function, appropriate drug dose adjustment is required.

Health-related characteristics: Prescriptions were used to collect medical data, while patients' attendants were consulted for demographic, socioeconomic, and health-related data. The health-related aspects encompassed the following criteria: self-assessed health status (categorized as good, moderate, or poor), utilization of healthcare services, health risk factors (comprising smoking, alcohol consumption, and obesity), and the presence or absence of comorbidities. These comorbidities encompassed chronic conditions like diabetes mellitus, coronary vascular disease, respiratory ailments, gastrointestinal disorders, joint problems, hypertension, and central nervous system disorders.[10,11]

***Drug utilization evaluation*:** After surveying, all the medicines were enlisted in the Performa.[9,12]

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***PIMs' evaluation*:** To assess potentially inappropriate medications (PIMs), the drugs prescribed to the chosen patients were scrutinized in alignment with the 2019 Beer's criteria. The identification of PIMs hinged on the patients' historical medication records. Every medication listed in their past medical history underwent a thorough evaluation to determine their appropriateness in terms of indications and potential interactions.[10,12]

STATISTICAL ANALYSIS

Data entry was made from the case record into the Microsoft excel programme. Chi-square test and the T test are applied. SPSS was used for the statistical analysis. Statistical analysis employing logistic regression was conducted to examine the factors linked to the prescription of potentially inappropriate medications (PIMs) in geriatric patients. The odds ratios were accompanied by 95% confidence intervals to assess statistical significance, and a significance level of $p < 0.05$ was applied to identify statistically meaningful results.

RESULT

A total of 120 older patients in a tertiary care centre in U.P. were approached, and 112 patients gave their consent for the study and 108 were included according to inclusion and exclusion criteria. Among the 108 participants in the study, 40 were male, and 68 were female, ranging in age from 65 to 85 years. All of the participants were subject to polypharmacy, and 79 of them received at least one potentially inappropriate medication (PIM). Of the total participants, 54 had no formal education, 49 lived in urban areas, and 59 resided in rural communities. A portion of the participants were smokers, and comorbidities were present in more than three-quarters of the participants. The participants generally reported their health status as ranging from moderate to severe, and they had made 2-3 clinic visits in the preceding month. The most common indication for clinic visits is related to Internal medicine, Cardiology, Neurology, endocrinology, gastroenterology, pulmonary, and orthopaedic diseases (Table 1).

Table 1: Indication for hospital visits associated with geriatric patients.

S. No.	Indication	Male (*n*=40) *n*= (37.1%)	Female (*n*=68) *n*= (62.9%)	Total (*n*=108)
1	Internal medicine and Cardiology	20 (37.7%)	26 (47.2%)	46 (42.5%)
2	CNS (Neurology)	10 (18.8%)	12 (21.8%)	22 (20.3%)
3	GIT (Gastroenterology)	9 (16.9%)	4 (7.2%)	13 (12%)
4	Nephrology	12 (22.6%)	6 (10.9%)	18 (16.6%)
5	Orthopaedics	2 (3.7%)	7 (12.7%)	9 (8.3%)

Table 2: Analysis of Characteristics in geriatric patients associated with PIMs.

Characteristics		PIMs		*p*- Value
		Yes	No	
Gender	Male Female	29 (72.5%) 60 (88.2%)	11 (27.5%) 8 (11.5%)	0.038
Age	65-75 76-80	76 (83.5%) 9 (75%)	15 (%) 3 (25%)	0.025

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	< 81	4 (80%)	1 (20%)	
Education level	Illiterate Literate	50 (92.6%) 39 (72.2%)	4 (7.4%) 15 (27.8%)	0.005
Residence	Urban Rural	40 (81.6%) 49 (83.1%)	9 (18.4%) 10 (16.9%)	0.847
Number of drugs (polypharmacy)	>4 drugs <5 drugs	22 (64.7%) 85 (90.5%)	12 (35.3%) 7 (9.5%)	0.001

SPSS (SPSS Statistics for Windows Version 21.0) and Microsoft Excel (MS Office 2019) were used for data analysis, Chi-square test and the T test is applied, confidence intervals of 95%, with a *p*-value of 0.05 used to detect statistical significance.

Table 3: PIMs prescribing pattern among geriatric patients.

S. No.	PIMs	Male	Female	Total
1	Aspirin	12	15	25
2	Amlodipine	8	11	19
3	Amitriptyline	5	7	12
4	Alprazolam	5	5	10
5	Diclofenac	9	14	23
6	Dexamethasone	6	9	15
7	Clonazepam	5	19	24
8	Insulin	3	6	9
9	Ibuprofen	6	9	15
10	Nifedipine	1	5	6
11	Lactulose/ Bisacodyl	4	9	13
12	Propranolol	5	13	18
13	Tramadol	8	15	23
14	Theophylline/ Doxofylline	14	11	25

DISCUSSION

This study appears to be the inaugural literature account focusing on the identification and concurrent comparison of PIMs prevalence among geriatric patients through the application of international screening tools. PIMs were present in the study - aspirin, omeprazole, insulin, nifedipine, amlodipine, amitriptyline, clonazepam, alprazolam, diphenhydramine, lactulose / bisacodyl, tramadol, propranolol, theophylline/doxophylline, and diclofenac had been suffering from disorders of the CVS, respiratory system, endocrine, and gastroenterology department (Table 3). PIMs were taken according to Beer's criteria, respectively. These drugs are more frequently used by elderly people than by any other age group. This is probably due to the reason that elderly people mostly suffer from hypertension, diabetes, heart burn-GERD, headache, muscle cramps-pain, joint pain. Due to these multiple comorbidities, the physicians in developing countries, like India, are apparently amateurish at diagnosing the underlying cause, which results in prescribing of multiple drugs for symptomatic relief to patients, lead to polypharmacy.

Our study shows, that more than 90% of geriatric patients' prescriptions were exposed to polypharmacy, and 85% of prescriptions included PIMs. Out of 108 patients, 29 males

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(72.5%) and 60 females (88.2%), had PIMs in prescriptions with 95% CI, (p =0.038), PIMs in rural residents 49(86.1%) and in urban residents 40(81.6%) with 95% CI (p=0.847) showing no significant difference. The difference was significant in PIMs among patients having polypharmacy taking drugs >4 is 22(66.7%) and drugs <5 are 85(90.5%) with 95% CI (p=0.001). This shows that polypharmacy significantly correlates with PIMs (Table 2).

The study revealed that respondents who were taking five medications were notably more likely to use PIMs as per Beer's criteria. These findings establish the initial prevalence rate of PIMs as a crucial starting point for assessing potential interventions aimed at reducing PIMs in tertiary care settings in the future.[1] In light of the fact that more than one possible element of variability should be taken into consideration when comparing previous literature, all comparisons should be viewed with caution, such as differences in methodologies, including the period of data collection, the retrospective or potential data, health systems, including pathways for the care of affected persons, prescribing practices, and availability of remedies.[13] Beside-the-point prescribing guidance demonstrated by this have a look at can partly be explained with the aid of polypharmacy, which has been recognized as a huge predictor of PIMs use amongst respondents.[13,14] There is a study in Nepal where cardiovascular drugs (e.g., amlodipine) and antihistaminic agents (e.g., diphenhydramine) were commonly prescribed to 23.16 and 4.6% of the elderly patients, respectively.[15]

A nationwide survey conducted in the United States identified insulin use in 206 elderly patients per 100,000 outpatient prescription visits as a significant factor leading to unplanned hospitalizations, primarily due to its association with hypoglycaemia and seizures[16]

In Karachi, Pakistan, another study reported that at least one potentially inappropriate medication (PIM) was prescribed to 64% of the geriatric population. [17] The correlation is in line with the study conducted in Brazil and Switzerland, where elderly patients who receive multiple medications (polypharmacy) face an elevated risk of unplanned hospitalizations.[18,19]

It is estimated that antihistaminic agents (e.g., diphenhydramine), proton pump inhibitors (e.g., omeprazole and esomeprazole), and analgesics (e.g., aspirin and non-steroidal anti-inflammatory drugs) are more frequently used by elderly people than by any other age group. This phenomenon is likely attributed to the fact that, during old age, individuals frequently experience conditions such as insomnia, heartburn, acid reflux, headaches, muscle pain, and joint pain. The use of painkillers in response to these issues can potentially lead to renal diseases. Due to these multiple comorbidities, physicians in developing countries such as India are sometimes inexpedient in diagnosing the underlying cause, and as a result prescribe multiple drugs for symptomatic relief to patients. This leads to polypharmacy in the geriatric age group. This results in the phenomenon of polypharmacy within the elderly population. Furthermore, it's worth noting that in India, there are no clinical guidelines specifically tailored for the diagnosis and treatment of illnesses in geriatric patients. To establish a statistically meaningful connection with potentially inappropriate medications (PIMs), logistic regression analysis was employed. The results indicated that as age increases, particularly within the 65 to 75 age group, patients exposed to a high number of medications (polypharmacy) were the most influential factors in the prescription of PIMs. Based on prior research and available evidence, the avoidance of potentially inappropriate medications (PIMs) in geriatric patients has the potential to lower the risk of unplanned hospitalizations by approximately 6% to 8%.[20] Due to multiple comorbidities, the geriatric age group tends to have multiple visits to clinicians and thus is at higher risk of being prescribed various medicines, leading to polypharmacy.[21]

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In our research, we observed a noteworthy correlation between potentially inappropriate medications (PIMs) and females who had comorbid conditions. Furthermore, we identified that factors like educational status (illiterate and literate) exhibited significant associations with the prescription of PIMs and the occurrence of unplanned hospitalizations. Evidence suggests that patients with low literacy skills and multiple comorbidities are 2-3 times more likely to utilise PIMs and experience adverse effects from medicine.[22] But other factors, such as rural vs. urban residence, show no such information in our study. Therefore, further studies are required to explore these factors to recognise the adverse events and also ensure patient safety due to polypharmacy.

To promote the prudent utilization of medications among geriatric patients, it is essential to restrict their access to potentially inappropriate medications (PIMs). A well-defined protocol is required for disease management and improving the quality of life in the geriatric age group because the negligence of PIMs is associated with adverse effects of medicine. Emergencies in healthcare resulting in unanticipated hospital admissions can place a substantial strain on both society and the healthcare system. Therefore, it is imperative for policymakers to devise a comprehensive national action plan, and healthcare practitioners should integrate international treatment guidelines into their regular clinical practices.

CONCLUSION

Unanticipated hospitalizations can result from the use of PIMs by the elderly population who meet Beer's criteria. Our study showed a high prevalence of potentially inappropriate medication in the geriatric population, which was associated with polypharmacy. A significant association was also found between the prescribing practice of PIMs and unplanned hospitalizations. The use of PIMs and adverse effects of medicine are 2-3 times more likely to occur in patients with low literacy skills and multiple comorbidities. Clinical awareness of PIMs for elderly people is essential, and polypharmacy needs to be regulated for such patients who are at high risk. The factors involved in polypharmacy are thus worthy for further study so that adverse events can be recognized and patient safety can be ensured.

ACKNOWLEDGEMENT

The authors thanks for the support to the Medical Superintendent and hospital staff of the Uttar Pradesh University of Medical Sciences, Saifai, Etawah, Uttar Pradesh, India.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

ADEs: Adverse Drug Events; **ADRs**: Adverse Drug Reactions; **ED**: Emergency Department; **CNS**: Central Nervous System; **GIT**: Gastro Intestinal Tract; **NSAIDs**: Nonsteroidal anti-inflammatory drugs; **PPI**: Proton Pump Inhibitor; **PIMs**: Potentially Inappropriate Medications; **START**: Screening Tool to Alert doctors to Right Treatment; **STOPP**: Screening Tool of Older Persons' Prescriptions; **AGS**: American Geriatrics Society; **SPSS**: Statistical Package for the Social Sciences; **OTC**: Over-the-counter; **GERD**: Gastro Oesophageal Reflex Disease.

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SUMMARY

The aging process significantly alters the pharmacokinetic and pharmacodynamic characteristics of geriatric patients, making them highly susceptible to life-threatening effects from the consumption of potentially inappropriate medications. Therefore, this study aims to investigate the prescribing practices among the elderly population using Beer's criteria. A cross-sectional and prospective study was conducted on different OPDs in a tertiary care hospital in Uttar Pradesh to scrutinise the prescribing patterns of PIMs among elderly patients in the age group of 65-85 years. Following the application of strict inclusion and exclusion criteria, our study included 108 out of the initial 120 patients. Polypharmacy was detected in more than 90% of prescriptions for geriatric patients and PIMs were included in 70% of prescriptions. The study revealed that polypharmacy is significantly correlates with PIMs. The study established a significant correlation between polypharmacy and the presence of PIMs. The use of PIMs outlined in Beer's criteria among the geriatric population was identified as a potential factor leading to unplanned hospitalizations.

Our research also underscored a high prevalence of potentially inappropriate medication use in the geriatric population, primarily linked to the practice of polypharmacy.

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