ORIGINAL ARTICLE

A prospective, cross-sectional study on Prescribing Pattern of Drugs and the incidence of potentially inappropriate medications in Geriatrics Population at a Tertiary Care Teaching Hospital in Western India

SNEHA AMBWANI[1], ARUP KUMAR MISRA[2*], NARESH KUMAR MIDHA[3], BHARAT KUMAR[4], VIKRAM SINGH[5]

[1]Professor and Head, Department of Pharmacology, All India Institute of Medical Sciences (AIIMS), Jodhpur, Rajasthan, India
[2]Assistant Professor, Department of Pharmacology, All India Institute of Medical Sciences (AIIMS), Mangalagiri, Andhra Pradesh, India
[3]Assistant Professor, Department of Medicine, All India Institute of Medical Sciences (AIIMS), Jodhpur, Rajasthan, India
[4]Assistant Professor, Department of Medicine, All India Institute of Medical Sciences (AIIMS), Jodhpur, Rajasthan, India
[5]Associate Professor, Department of Medicine, Dr. Ram Manohar Lohia Institute of Medical Sciences, Gomti Nagar, Lucknow-226010, Uttar Pradesh, India

Abstract

Background: Polypharmacy and inappropriate prescriptions are the most highlighted health issues among geriatric population, as they have multiple comorbidities. The objective of this study was to assess prescriptions using the World Health Organization (WHO) core indicators and Beers Criteria to discover polypharmacy and inappropriate prescriptions.
Methods: This was a prospective, cross-sectional study of geriatric patients (65 years and above) who were attending the medicine outpatients clinic of a tertiary care teaching hospital hospital from May to December, 2016. World Health Organization (WHO) indicators and updated Beers Criteria were used to assess the drug utilization pattern and the prevalence of potentially inappropriate medications (PIMs), respectively.
Results: The prescriptions of 250 geriatrics patients with a distribution of 57.6% male and 42.4% female were assessed for this study. The total numbers of drugs recorded from the prescriptions were 1635 drugs, with an average of 6.54 drugs per person. According to the Beers Criteria, it was found that nearly 23.05% of the total prescribed drugs were potentially inappropriate.
Conclusion: Polypharmacy and use of inappropriate medicines presents a health risk to the geriatric population. Causes could include healthcare practitioner shortage, lack of awareness of PIMs, not understanding drug interaction, and the need for multiple drugs. Prescriber training and retraining is needed.

Key words: Beers criteria; Geriatrics; Polypharmacy; Potentially Inappropriate Medications.

How to cite this article: **Ambwani S, Misra AK, Midha NK, Kumar B, Singh V. A prospective, cross-sectional study on Prescribing Pattern of Drugs and the incidence of potentially inappropriate medications in Geriatrics Population at a Tertiary Care Teaching Hospital in Western India. *Asia Pac J Med Toxicol* 2020; 9(4):136-141.**

INTRODUCTION

As a consequence of enhanced life expectancy, the population of geriatric patients is increasing (1).The elderly population in India currently accounts for 7.4% of the total population; it is expected to increase to 12.4% of the workforce by 2026. India's projected life expectancy by 2025 is 69.8 for males and 72.3 for women (2).As age increases, so do the amount of comorbidities and likelihood of polypharmacy (3).Approximately 80% of all patients over the age of 65 have at least one chronic condition (4).Older patients are taking three times as many medicines as younger patients due to chronic health problems (5).Geriatric healthcare practitioners depend highly on pharmacotherapy to enhance elderly patients' functional status and quality of life and to provide palliative remedies(5).Elderly patients experience changes in pharmacodynamics, including decreased ability of the liver and kidneys to metabolize and eliminate drugs, respectively (6). Such changes can lead to situations such as enhanced sensitivity to certain drugs like hypnotic sedatives.

Geriatric patients are frequently found to suffer from various comorbid conditions and are susceptible to frequent hospitalization, so there is a growing concern about polypharmacy and drug-related problems that need to be resolved. Prescribing possibly improper drugs (PIMs) has been discovered to be a prevalent cause of morbidity and mortality in the elderly. PIM is defined as “a drug in which the risk of an adverse event outweighs its clinical benefit, particularly when there is a safer or more effective alternate therapy for the same condition available.” Many studies have shown adverse drug reactions due to PIMs. The health care team needs to investigate polypharmacy problems, remove obstacles to medication adherence, and limit the prescribing of medication to the geriatric population (7).

*Correspondence to: Dr. Arup Kumar Misra, Assistant Professor, Department of Pharmacology, All India Institute of Medical Sciences (AIIMS), Mangalagiri, Andhra Pradesh, India. Pin Code-522503
Phone no: +91- 9501988533,E-mail: arup2003m@gmail.com

It is important to identify the use of PIM in this vulnerable group to minimize the hazards associated with pharmacotherapy (8). PIM has been an important trigger for the establishment of criteria for the safe use of medicinal products among the elderly, namely the Beers criteria, which were initially released in 1997 and updated in 2002, 2012 and 2015 (9).The Beers criteria for detecting PIM in older adults is frequently referred to as the Beers list. It is the guideline for health care professionals to use drugs safely and rationally in geriatric communities. It emphasizes unnecessary drug prescriptions (10). The data based on recommendation and evidence of usage of drugs in Beers criteria will help to improve the rational and safe use of medications in the geriatric population in the long run.

METHODS

Study background

The study was done in the outpatient department of medicine of the tertiary care teaching hospital which has bed strength of 200 and out-patients footfall of nearly 1.5 lakhs patients annually. After confirming the age of the patients above 65 years of age irrespective of diagnosis, the consultant and residents of the medicine department sent the geriatric patients to the study investigator for analysis of prescriptions by BEERs criteria and WHO core indicators for prescription.

Ethical considerations

The study was conducted after taking approval from Institutional Ethics Committee.

Method

This was a prospective, cross-sectional study composed of geriatric patients aged 65 or older, who attended an outpatient department of medicine over an 8-month period from May to December 2016. Regardless of diagnosis, patients who met the age requirement were chosen. There was no calculation of formal sample size as this is preliminary research. Based on patient accessibility, it was decided to include patients on the grounds of the criteria set out in the protocol for inclusion and exclusion.

Inclusion criteria

1. Patients 65 years and older, either sex, attending outpatient department of medicine.
2. Patients willing to give consent.

Exclusion criteria

1. Patient admitted in medicine wards.
2. Patients require intensive care unit (ICU) admission and terminally ill.

The geriatric patients were included in the research after confirmation of eligibility. After approval to interview was given, patients were evaluated for their demographic information, drug prescription patterns to determine the incidence of polypharmacy, and PIMs. Demographic information, medical circumstances, dosage and number of prescription drugs were transcribed on to a prepared excel sheet for data storage and analysis. The 2015 Beers Criteria were used as guidelines for determining improper medicines in the geriatric population. This identified relevant negative drug responses due to organ dysfunction and drug interactions, adequate dose adjustment due to underlying organ dysfunction or illness, and drug-drug interactions (11).

Medscape Drug Interaction Checker was used to verify possible interactions between medicines and drugs (12). The criteria for polypharmacy were prescriptions for more than 4 drugs. The average amount of drugs, the proportion of generic drugs prescribed and the proportion of antibiotic use used in geriatric patients were assessed by the WHO guidelines for prescription (13).

Statistical Analysis

Version 20 of SPSS (IBM Corporation, Armonk, NY, USA) was used to analyze the prescription information. Means, frequencies and percentages have been expressed as research outcomes. To compare the means and standard deviation of distinct groups, ANOVA and Tukey's Post Hoc test were used. Values of $P<0.05$ were considered significant.

RESULTS

A total of 250 geriatric patients were surveyed in the outpatient department of medicine. 142 (56.8%) males and 108 (43.2%) females participated with an average age of 68.88 and 68.16, respectively. Nearly 89.6 % of the patients could be classified as younger elderly (65-74 years). The total numbers of drugs recorded from the prescriptions were 1635 with a mean of 6.54 drugs. Nearly four fifths of the patients were prescribed more than four drugs in the study and it constitutes approximately 95% of the ordered drugs. In the present study, only six persons in the age group of 75-84 had average drug consumption of more than six drugs. The average drugs prescribed was 6.43±2.66, 7.48±3.36 and 6.00±3.03 for patients within the age group of 65-74 years, 75–84 years and those of 85 years and above, respectively though there were not statistically

Table 1. Prescription Pattern of Drugs with Potentially Inappropriate Medicine (PIM) and Drug-Drug Interaction (DDI) per prescription in geriatric population

Age Group	No. of Drugs prescribed				Mean±SD	PIM	DDI
	<4	4-8	9-12	≥13			
65-74	72	886	417	75	6.43±2.66	317	443
75-84	1	66	68	14	7.48±3.36	53	127
≥85	2	16	18	0	6.00±3.03	7	15

Note: Inter-group comparisons were made by using one way ANOVA followed by Tukey's post hoc test. Results are expressed in Mean±SD:* $P<0.05$ is considered significant

significant (Table1).

The most common clinical conditions were hypertension (35.2%), diabetes mellitus (20.8%), acute peptic disease (20.4%), ischemic heart disease (15.6%), and musculoskeletal disorders (12.4%).

Drug utilization pattern

The average number of drugs prescribed per patient in this study was 6.54. Drugs prescribed by generic name made up 0.30%, antibiotic drugs 5.01% and injections 0.97%. The total number of drugs prescribed from the Essential Drug List (EDL) was 32.23% (Table 2). A total of 1635 drugs were prescribed to 250 patients. Drugs prescribed for cardiovascular disease accounted for more than one quarter of the total prescribed drugs (28.62%). This included anti-hypertensives, anti-platelets and hypolipidemics. Drugs acting on the gastrointestinal system accounted for 17.98% of the total prescribed drugs. Proton pump inhibitors, Histamine-2 blockers and antacids are the most prescribed class of drugs for geriatric patients suffering from gastrointestinal disorders. Multi-vitamins constituted about 16.14% of the total drugs. Drugs used in endocrine disorders accounted for 9.66% and included drugs used for diabetes and thyroid disorders (Table 3). The drug utilization pattern in the study showed that brand name drugs constituted 99.70% of all drugs, while generic drugs constituted a meagre 0.30 percent (Table 2).

Potentially inappropriate medication

According to Beer's criteria, it was found that 377 drugs (23.05%) were potentially inappropriate. Nearly 1.50 PIMs were recorded per prescription (Table 4). The most frequently prescribed PIMs were proton-pump inhibitors (29.17%), antidepressants (12.46%), antipsychotics (9.81%), diuretics (9.54%), benzodiazepines (7.95%), analgesics (5.57%), antispasmodics (4.77%), anticholinergic (3.97%) and other miscellaneous drugs. PIMs were most prevalent in patients 75-84 years with a value of 2.65PIMs per prescription. This was greater than patients 65-74 years, who had 1.41PIMs per prescription (Table 1).

Drug-drug interaction

As per the Medscape drug interaction checker, 202 patients which constitute 80.8% of the sample population had more than one potential drug-drug interaction (DDI) in their treatment regimens. It was found that 23 drug interactions were serious and 435 drugs required close monitoring (Table 4). The average DDI per prescription for each age group was as follows: 6.35 for patients 75-84; 2.66 for patients over 85; and 1.97 for patients 65-74 (Table 1). The most common potential interactions were between the classes of calcium channels blockers (amlodipine), beta blockers (metoprolol), antiplatelets (aspirin), diuretics (furosemide and spironolactone), antidepressants (escitalopram and amitrypline) and statins(atorvastatin).

Table 2. Summary of results from WHO's manual for prescribing indicators assessment

Prescription Indicators	Total Drugs	Average or percent per prescription	WHO's Standard derived or ideal
Drugs prescribed	1635	6.54	1.6-1.8
Drugs prescribed by generic name	5	0.30%	100%
Drug encounter with antibiotics	82	5.01%	20%-26.8%
Drug encounter with injections	16	0.97%	13.4%-24.1%
Drugs prescribed from Essential Drug List	527	32.23%	100%

Table 3. Summary of class of drugs with most number of drugs in the geriatric prescription

Class of Drugs	Number of Medications	Percentage
Drugs acting in Respiratory System	86	5.25%
Drugs acting in Gastrointestinal System	294	17.98%
Analgesics	72	4.4%
Antimicrobials	82	5.01%
Drugs acting in Cardiovascular System	468	28.62%
Drugs acting in Endocrine System	158	9.66%
Antihistaminics	14	0.85%
Drugs acting on Central Nervous System	128	7.82%
Drugs acting in Autonomic Nervous System	69	4.22%
Vitamins and Minerals	264	16.14%

Table 4. Demographic data of prescription and PIM in geriatric population (BEERs Criteria 2015)	
Total Prescription	250
Total Drugs	1635
Average Prescription of Drugs	6.54
Potential Inappropriate Medicine (PIM)	377
PIM per prescription	1.50
Drug Interaction per prescription	2.34
(Need Minor Monitoring: 127, Monitor Closely: 435 and Serious Monitoring: 23)	
Adverse Drug Interaction	0

DISCUSSION

Polypharmacy is the leading cause of health care hazard in the geriatric population (14). It occurs when patients are using 4 or more drugs. The likely reason for polypharmacy in geriatric patients could be correlated with the primary disease with its associated comorbid conditions requiring various therapeutic agents (15).In our study, average number of drugs per prescription was 6.54 which is higher than previous studies done by Zaveri et al. in India and Guaraldo et al. in Brazil (16,17). In one of the prescriptions, the most number of drugs prescribed was 17 which was also a finding in the study done by Rajska-Neumann, et al (18). In addition, it was discovered that with increasing age, the average amount of drugs increased. Multiple co-morbidities in the geriatrics necessities multiple drugs in the regimens which leads to polypharmacy. Cardiovascular drugs consisting of anti-hypertensive, anti-platelets and hypolipidemics (together 35.2%); antacids (17.98%) followed by multivitamins, minerals and enzymes (16.14%) were the most commonly prescribed drugs in the geriatrics. The frequently prescribed cardiovascular drugs by the healthcare professionals for geriatrics were anti-hypertensive agents. In the study population, it was found that the incidence of hypertension was comparably higher and it was a major determinant of the cardiovascular risk in the geriatrics. It was postulated that various environmental factors like diet, stress, inactivity and pathological changes in the cardiovascular system due to aging might results in reduced blood vessel compliance and also reduced sensitivity of baroreceptor might contribute to increased resistance and increase blood pressure in the geriatrics (19). In the present study, the number of multivitamins in the prescriptions were less as compared to a relevant study which shows that the physicians were rational in prescribing and were not under undue pressure from the geriatrics to give them medications related to strength and wellbeing (20). The prescription pattern in the geriatrics needs modification as per the rational use of medicine so that a cost-effective and safe drug reaches the geriatric communities.

As per the World Health Organization, the standard laid down for the ideal prescription is 100% usage of generic drugs in all the health scenarios. In the present study, it was quite contrary and far below the ideal indicators of WHO in regard to usage of generic drugs, it was found only 0.30% of the total prescribed drugs was in generic names (21).This finding is similar to Curtis LH, et al (22). Reasons for reduced use of generic drugs could be not understanding of WHO's prescribing rules, profitable promotions by pharmaceutical companies, less confidence in the quality of generic drugs and shortage of generic drugs in hospital. Another reason could be that prescribers are more familiar with brand names than generic names. Generic drugs allow pharmacists and physicians to be more flexible and to dispense and prescribe drugs which are cheaper than their proprietary brand counterparts. Moreover, our study found that only 32.23% of prescribed drugs fall on the WHO essential drug list. This could be due to limited awareness of the Essential Drug List in India. It is quite alarming, requires more attention and necessities training to the prescribers as it is the only solution to implement rational use of drugs in the geriatric population (23).

In the ideal WHO's standard prescription, the number of antibiotics prescribed should be between 20.0%-26.8% (21). In the present study, it was only 5.01% which mean that the prescription contains less amount of antibiotics as compared to the WHO's ideal criteria. It shows that the prescribers were using antibiotics judiciously and rationally. Only 0.97% of the injectable drugs were accounted in the prescription. This finding was less than the standard for injectable drugs (13.4%-24.1%) as per as WHO (21).

The pattern of disease is shifting from infectious to chronic in developing nations; however, the burden of infectious diseases remains high (24).In this research, most patients suffered from non-communicable diseases, with circulatory system disorders being the most common followed by endocrine disorders. Among the circulatory diseases, hypertension (35.2%) was the main cause of morbidity in the cohort. Hypertension incidence among geriatric patients is the highest in the current research among all co-morbidities. This incidence was discovered to be quite similar with other research, which also revealed that hypertension in the geriatric diabetic population is the main cause of morbidity (25). Our study correlates well with the current trend of disease distribution as it shows that non communicable diseases are the leading cause of health hazards especially in the developing countries.

In the current study, only 5.01 percent of antibiotics are used, which demonstrates that in the current study there are fewer comorbid conditions of urinary tract infection and skin infections. Cephalosporins are the most prevalent antibiotics used in the study.

As compared to the incidence of PIMs in the USA (27.5%) and Ireland (25%), we have got a higher percentage of PIMs in the study i.e.76.4% (26,27,28). This might reflect the need of proper tools like Beers Criteria and implementation of the same for rational prescription of medicines for the geriatric population. We have found that PIMs were mostly encountered in patients prescribed drugs and drug classes like insulin, amitriptyline, nortriptyline, anti-epileptics, diuretics, and benzodiazepines. In the Beers Criteria, the usage of these medicines requires cautions in geriatric population as they may be suffering or having deteriorating kidney function for

which the dose need to be reduced, there may be drug-drug interactions and also drugs which have strong anticholinergic properties should be avoided or used cautiously as they may lead to increase deterioration of central nervous system.

LIMITATIONS

In the study set-up, computerized systems and information technology which highlight or give warning signal when encountered with PIMs were not available.

CONCLUSION

Polypharmacy and PIMs are associated as they go hand-in-hand owing to numerous comorbid circumstances in geriatric communities that require polypharmacy, leading to harmful PIMs. On the other side, the motivation of physicians and patients for quick relief of symptom also led to consumption of inappropriate drugs and irrational combinations of fixed drugs. The significant health risks in geriatric population are these variables. In the care of geriatric patients, healthcare professionals should be educated. The prescribers should be familiar with the understanding of the generic name and EDL to use drugs rationally, thereby reducing the financial strain on society. It is vital to create the national list of PIMs based on race and ethnicity in the nation to prevent adverse drug reactions in the geriatric population. The prescription patterns of prescriber should be periodically assessed to provide feedback, training and awareness on rational drug use. In the study, potential inappropriate medications, polypharmacy, irrational fixed drug combination and use of brand names in prescription were some of the anomalies observed which needs to be rectified by improving practices.

REFERENCES

1. Momin TG, Pandya RN, Rana DA, Patel VJ. Use of potentially inappropriate medications in hospitalized elderly at a teaching hospital: a comparison between Beers 2003 and 2012 criteria. Indian J Clinic Pharmacol 2013;45(6):603-7.
2. Annual Report to the People on Health. Government of India Ministry of Health and Family Welfare. 2011. [updated 2011December; cited 2018 July 18] Available from: http://www.cgsird.gov.in/images/pdf/indiafacts.pdf
3. Amann U, Schmedt N, Garbe E. Prescribing of potentially inappropriate medications for the elderly: an analysis based on the PRISCUS list. Dtsch Arztebl Int 2012;109(5):69-75.
4. Jackson S, Jansen P, Mangoni A. Prescribing for elderly patients. Clinical Pharmacology of Ageing. 1st edition. New York: John Wiley and Sons, Wiley-Blackwell; 2009. pp. 1-12.
5. Fillit HM, Rockwood K, Woodhouse K. Broklehurst's textbook of geriatric medicine and gerontology. 7th edition.Philadelphia:Saunders Elsevier; 2010.
6. Katzung BG, Masters SB, Trevor AJ. Basic and clinical pharmacology. 11th ed. California:Tata Mcgrow hill; 2009. pp. 1037-46.
7. Khanna R, Pace PF, Mahabaleshwarkar R, Basak RS, Datar M, Banahan BF. Medication adherence among recipients with chronic diseases enrolled in a state Medicaid program. Popul Health Manag 2012;15(5):253-60.
8. Fick DM, Cooper JW, Wade WE, Waller JL, Maclean JR, Beers MH. Updating the Beers criteria for potentially inappropriate medication use in older adults: Results of a US consensus panel of experts. Arch Intern Med 2003;163(22):2716-24.
9. Chitra B, Senthilvel N, Sowmya R, Sreerekha S, Srisha R. A study on prescribing pattern of drugs in geriatric using beers criteria at a private corporate hospital. Int J Pharm Sci Res 2015;6(11):4810-25.
10. Abeer A, Mast MR, Nijpels G, Petra JM, Dekker JM, Hugtenburg JG. Identification of drug-related problems of elderly patients discharged from hospital. Dove Med Press J 2014;8:155-65.
11. American Geriatrics Society 2015 Beers Criteria Update Expert Panel. American Geriatrics Society 2015 Updated Beers Criteria for potentially inappropriate medication use in older adults. J Am Geriatr Soc 2015;63:2227-46.
12. Drug Interaction Checker. Medscape Reference. [Accessed Dec 24, 2018]. Available from: https://reference.medscape.com/drug-interactionchecker.
13. Misra AK, Ambwani S, Bharat K, Midha NK, Singh V. Prevalence of Potentially Inappropriate Medications among Geriatric Diabetes Mellitus Patients and Prescription Pattern at a Tertiary Care Hospital. J Basic Clin Pharma 2017;8:S24-8.
14. Kidon MI, See Y. Adverse drug reactions in Singaporean Children. Singapore Med J 2004;45:574-7.
15. Kumar MA, Nizar A, Shailaja K, Jayasutha J, Ramasamy C. A study on prescribing pattern and potentials drug-drug interactions in type-2 diabetes mellitus (inpatients) in a tertiary care teaching hospitals. Der Pharmacia Lettre 2011;3:13-9.
16. Zaveri HG, Mansuri SM, Patel VJ. Use of potentially inappropriate medicines in elderly: A prospective study in medicine out-patient department of a tertiary care teaching hospital. Indian J Pharmacol 2010;42:95-8.
17. Guaraldo L, Cano FG, Damasceno GS, Rozenfeld S. Inappropriate medication use among the elderly: a systematic review of administrative databases. BMC Geriatr 2011;11:79.
18. Rajska-Neumann A, Wieczorowska-Tobis K. Polypharmacy and potential inappropriateness of pharmaco-logical treatment among community-dwelling elderly patients. Arch Gerontol Geriatr 2007;44:303-9.
19. Adibe MO, Aguwa CN, Ukwe CV, Okonte JM, Udeogaranya PO. Outpatient utilization of antidiabetic drugs in the south-eastern Nigeria. International Journal of Drug Development and Research 2009;1(1):27-36.
20. Shah RB, Gajjar BM, Desai SV. Drug utilization pattern among geriatric patients assessed with the anatomical therapeutic chemical classification/defined daily dose system in a rural tertiary care hospital. Int J Nutr Pharmacol Neurol Dis 2012;2:258-65.
21. DesalegnAA. Assessment of drug use pattern using WHO prescribing indicators at Hawassa University teaching and referral hospital, south Ethiopia: a cross-sectional study.BMC Health Serv Res 2013;13:170.
22. Curtis LH, Ostbye T, Sendersky V, Hutchison S, Dans PE, Wright A, et al. Inappropriate prescribing for elderly Americans in a large outpatient population. Archives of Internal Medicine 2004;164(15):1621-5.
23. Goulding MR. Inappropriate medication prescribing for elderly ambulatory care patients. Archives of Internal Medicine 2004;164(3):305-12.
24. Bhandari GP, Angdembe MR, Dhimal M,Neupane S,Bhusal C. State of non-communicable diseases in Nepal. BMC Public Health 2014;14:23.
25. Das S,Haroled Peter PL, Bhavani ML, Naresh P, Ramana MV. Age- and Sex-related Prevalence and Drug Utilization Pattern in the Management of Type 2 Diabetes Mellitus and its Comorbidity with Cardiovascular Diseases: A Comparative Study. Indian J Pharm Sci. 2015;77(4):478–84.

26. Sultana G, Kapur P, Aqil M, Alam MS, Pillai KK. Drug utilization of oral hypoglycemic agents in a university teaching hospital. J.Clinic Pharmacol & Therapeut 2010;35:267-77.
27. Gallagher P, O'Mahony D. STOPP (Screening Tool of Older Persons' potentially inappropriate Prescriptions): application to acutely ill elderly patients and comparison with Beers' criteria. Age Ageing 2008;37:673-9.
28. Page RL, Ruscin JM. The risk of adverse drug events and hospital-related morbidity and mortality among older adults with potentially inappropriate medication use. Am J Geriatr Pharmacother 2006;4:297-305.