Original Article

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Pharmacology Section

Utilization Pattern of Potentially Inappropriate Medications in Geriatric Patients in a Tertiary Care Hospital: A Retrospective Observational Study

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ABSTRACT

Introduction: Geriatric population is on the rise throughout the world, hence the quality and the safety of prescribing in the elderly is a global healthcare concern. It is important for the healthcare providers to be aware of the limitations in prescribing certain drugs to the elderly. This study was an attempt to shed light on the utilization pattern of Potentially Inappropriate Medications (PIMs) in elderly patients admitted in the medicine wards in a tertiary care hospital in Goa.

Aim: To measure the percentage prevalence of PIMs prescribed in the admitted geriatric patients.

Materials and Methods: In this retrospective observational study, 150 case records of patients aged 60 years or more were analysed. All the prescribed medications, for each case record, were then analysed by referring to the American Geriatrics Society (AGS) Beers Criteria 2015. Data was analysed using Statistical Package for Social Sciences (SPSS) software.

Results: Of the 150 patients, 99 (66%) received at least one PIM according to the Beers Criteria 2015 (including drugs to be used with caution). However, after excluding the drugs to be used with caution, the prevalence of PIMs decreased to 44%. The most commonly prescribed PIMs were ranitidine (17.33%) and prazosin (8.66%) and the most commonly prescribed drug to be used with caution was furosemide (35.33%).

Conclusion: As the medication needs of the geriatric population are unique, it is essential that the healthcare professionals are aware of these needs and also follow the available guidelines and tools. Formulation of hospital policies and protocols in this regard would help to improve the scenario. Increased education, awareness and reporting of drug-related problems along with more doctor-patient interaction in these situations are some of the factors that could play an important role in promoting better and safer prescribing practices and a better quality of life to the older generations of our communities.

Keywords: Beers criteria-2015, Elderly, Prescribing pattern

INTRODUCTION

Advances in basic and clinical research have made our understanding of the human biological functions better and have also provided new insights into the diseases. This makes it mandatory to improve upon the treatment strategies suitably. It is well known that with advancing age, the pharmacokinetics and pharmacodynamics change. The efficient utilization of active principles of pharmacology requires integrated actions of multiple systems in the human body. Changes to any of these systems due to the effects of ageing, necessitates an overhaul in the therapies we advise.

Around 600 million people in the world were of 60 years of age or above at the turn of the new millennium and the number is expected to rise because of the substantial improvement in life expectancy throughout the world. In India, the elderly accounted for 6.7% (57 million) of the total population in 1991 and is expected to increase to more than 10% (approximately 140 million) by 2021 [1].

In view of this increase in geriatric population, the quality and the safety of prescribing for the elderly is a global healthcare concern. Physiological changes like decreased renal functions, decline in total body water etc., necessitates judicious use of drugs to prevent adverse drug reactions and hence the morbidities, thus promoting active and graceful ageing [2]. Therefore, it is important for the healthcare providers to be aware of the limitations of prescribing certain drugs to the elderly.

Several criteria are available to the medical community to identify such potentially inappropriate medications. The American Geriatric Society Beers criteria-2015 is one such tool to aid the healthcare providers for safe prescribing [3]. It is the best known and the most widely used explicit tool for identifying PIMs in elderly patients [4].

Goa, even though a small state, is second to Kerala in the 'old dependency' ratio of the population aged 60 years or above. According to the Census 2011, 11.2% of population of Goa was 60 years or above [5]. There is inflow of retirees due to peaceful atmosphere. Urban areas are thickly populated, literacy rate is high and health awareness is good; hence the rate of consumption of medications is high. Most of the population prefers allopathic therapies [6]. Studies of prevalence and predictors of PIMs are a rarity in the state. Taking this into consideration, this study is an attempt to shed light on the utilization pattern of PIMs in elderly patients admitted in the medicine wards in a tertiary care hospital in Goa. The aim of this study was to measure the percentage prevalence of PIMs prescribed in the admitted geriatric patients.

MATERIALS AND METHODS

In this retrospectively conducted observational study, scrutiny of case records of patients aged 60 years or more at the time of admission in the medicine wards of a tertiary care teaching hospital between March 2015 and July 2015 was done.

Most developed countries in the world have accepted the chronological age of 65 years as a definition of 'elderly' or older person but the 'National Policy on Older Persons' adopted by Government of India defines 'senior citizen' or 'elderly' as a person of age 60 years or above [1], hence patients of 60 years and above were included in this study.

Ethical approval was taken from the Institutional Ethics Committee of Goa Medical College. All case records in which the duration of

hospital stay was less than one day, those in which patients did not receive any medication (e.g., admitted for observation only), or those in which the patients' serum creatinine levels were not recorded, were not included in this study.

Based on the 50% prevalence rate of PIMs, accounting for a standard error of 5% with a 95% confidence interval, the sample size was calculated to be 100. After randomization and discard protocols were carried out, a total of 150 case records were considered for analysis.

Data collection was done by the authors after consulting the statistician of the institute. Collected data included age, gender, diagnosis, date of admission, duration of hospitalization and relevant laboratory investigations of the patients.

The entire course of prescribed medications for each case record was then analysed by referring to the AGS Beers Criteria 2015 [3] to detect any and all PIMs resulting from drug-drug interactions, drug-disease/drug-syndrome interactions, impaired kidney function, or geriatric physiological factors as a whole [Table/Fig-1]. The resultant PIMs were then grouped as per the criteria they satisfied and the results were inferred from the observable data. A set of drugs satisfying Beers criteria for drugs to be used with caution in elderly was also tabulated.

STATISTICAL ANALYSIS

Descriptive statistics were used. Data was analysed using SPSS software version 20.0.

RESULTS

Out of the 150 case records of patients scrutinized, 98 (65%) were males and 52 (35%) were females. Age of the patients ranged from 60 to 87 years, with a maximum of 42 (28%) patients in the age group 60-64 years. The average age of patients reported in this study was 68.88 years. In the 150 prescriptions analysed, there were a total of 1745 medications. However, the total number of distinct medications used was only 212, as some prescriptions had common medications. On an average each patient was prescribed 11.63 drugs (range: 4–29). Average duration of hospitalization of a patient was 6.44 days. The average number of ailments per patient was found to be 3.37 [Table/Fig-2].

In the study population, hypertension (66%), diabetes mellitus (44%), and ischaemic heart disease (30%) were the three most common diagnoses observed.

Frequency of PIMs: It was observed that out of 1745, 258 (14.7%) times the prescribed medications satisfied the first criterion of Beers list (PIMs according to the organ system involved), of which 59 (3.38%) times they were prescribed inappropriately. Out of the 122 (6.99%) times the prescribed medications satisfied second criterion of Beers list (according to the disease or syndrome), the inappropriately prescribed PIMs were 2 (0.11%). Out of the 102 (5.84%) times the prescribed medications conformed to the third criterion of Beers list (creatinine clearance), the inappropriately prescribed PIMs were 42 (2.40%). Five instances of inappropriately prescribed drugs by criteria 4 (drug-drug interactions) were noted and 110 (6.30%) instances of drugs to be used with caution were also noted.

AGS Beers Criteria 2015	
Criteria 1	PIMs according to organ system
Criteria 2	PIMs according to drug-disease / drug-syndrome interaction
Criteria 3	PIMs according to creatinine clearance
Criteria 4	Drug-Drug interactions
Criteria 5	Drugs to be used with caution

[Table/Fig-1]: AGS Beers Criteria 2015 [3].

Number of Ailments	Number of Patients
1	13
2	28
3	45
4	33
≥5	31

[Table/Fig-2]: Number of diagnosed ailments per patient.

Total Number of prescriptions =150	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5
Number of prescriptions having PIMs	42	2	36	5	71
% Age prevalence	28%	1.3%	24%	3.33%	47.33%

[Table/Fig-3]: Prevalence of PIMs according to criteria.

Prevalence of PIMs: Of the 150 patients, 99 received at least one PIM according to Beers criteria 2015. So the percentage prevalence of PIMs was 66% (with a confidence interval of 95%); however, after excluding the 'drugs to be used with caution', the percentage prevalence of PIMs was observed to be 44%. Prevalence of PIMs according to various criteria can be seen in [Table/Fig-3].

The most commonly prescribed PIMs observed in this study were: Furosemide (as per Criterion 5), Ranitidine (as per Criterion 3), and Prazosin (as per Criterion 1). The list according to the various criteria can be seen in [Table/Fig-4].

It was observed that as the number of diagnosed ailments per patient increased, the percentage prevalence of PIMs also increased, which conformed to the various criteria in Beers list, as seen in [Table/Fig-5].

We also noted that, in general, as the age of the patient increased, the prevalence of PIMs prescribed also increased. Interestingly, there was a marked decrease in the prevalence of PIMs prescribed to patients in the age group of 75-79 years, as per the first criterion of Beers list. This can be seen in [Table/Fig-6].

When we looked for the percentage prevalence of PIMs with respect to the duration of patients' stay, we expected an increase in the percentage prevalence of PIMs with an increased duration of stay. However, interestingly, after referring to Criterion 3 of Beers list i.e., PIMs according to creatinine clearance, we observed a rise in prevalence of PIMs upto two weeks of treatment duration, followed by a sudden decrease in prevalence when the treatment duration exceeded two weeks, as seen in [Table/Fig-7].

Criteria 1			Criteria 2			Criteria 3			Criteria 4			Criteria 5		
Drug	**n**	**%**	**Drug**	**n**	**%**	**Drug**	**n**	**%**	**Drug**	**n**	**%**	**Drug**	**n**	**%**
Prazosin	13	8.66	Digoxin	1	0.67	Ranitidine	26	17.33	Lorazepam	2	1.33	Furosemide	53	35.33
Alprazolam	8	5.33	Ranitidine	1	0.67	Enoxaparin	5	3.33	Diazepam	1	0.67	Mannitol	14	9.33
Insulin(S/S)	6	4	-	-	-	Levitiracetam	4	2.67	Clobazam	1	0.67	Glycerol	6	4
Lorazepam	5	3.33	-	-	-	Tramadol	3	2	Nitrofurantoin	1	0.67	Hydralazine	4	2.67
others	27	-	-	-	-	others	4	-	-	-	-	others	33	-

[Table/Fig-4]: Prevalence of most commonly prescribed PIMs.
n= number of times prescribed.

Beers Criteria	Number of Ailments						
	1	2	3	4	5	6	7
Criteria 1	15.38	17.85	22.22	36.36	35	0	75
Criteria 2	0	3.57	2.22	0	0	0	0
Criteria 3	0	14.28	17.77	30.3	35	42.85	100
Criteria 4	0	3.57	4.44	3.03	5	0	0
Criteria 5	46.15	39.28	40	45.45	55	71.42	100

[Table/Fig-5]: Percentage prevalence of PIMs with respect to the number of ailments per patient.

Beers Criteria	Age Intervals (years)				
	60-64	65-69	70-74	75-79	≥80
Criteria 1	32.55	21.62	35.29	3.7	30.76
Criteria 2	0	2.7	0	0	7.69
Criteria 3	23.25	13.51	14.7	33.33	38.46
Criteria 4	2.32	2.7	5.88	0	7.69
Criteria 5	32.55	51.35	55.88	48.14	46.15

[Table/Fig-6]: Percentage prevalence of PIMs with respect to the age.

Beers Criteria	Duration of Stay (in days)			
	1 to 5	6 to 10	11 to 15	16 and above
Criteria 1	18.33	30	38.46	28.57
Criteria 2	0	1.42	0	28.57
Criteria 3	21.66	18.57	53.84	14.28
Criteria 4	3.33	4.28	0	42.85
Criteria 5	31.66	55.71	38.46	100

[Table/Fig-7]: Percentage prevalence of PIMs with respect to duration of stay in the ward.

Beers Criteria	Number of PIMs Prescribed per patient			
	1	2	3	4
Criteria 1	31	6	4	1
Criteria 2	2	0	0	0
Criteria 3	30	6	0	0
Criteria 4	5	0	0	0
Criteria 5	56	14	1	0

[Table/Fig-8]: Number of PIMs prescribed per patient across all the criteria.

Authors	Percentage prevalence	Place of study	Criteria used	Reference
Present study	44%	Goa	AGS Beers 2015	
Jhaveri BN et al.,	87.3%	Gujarat	AGS Beers 2012	[10]
Momin TG et al.,	40%	Gujarat	AGS Beers 2012	[11]
Chitra B et al.,	35.5%	Tamil Nadu	AGS Beers 2012	[12]
Shah KN et al.,	29.2%	Gujarat	AGS Beers 2012	[13]
Shah RB et al.,	27.25%	Gujarat	AGS Beers 2003	[14]
Zaveri HG et al.,	23.59 %	Gujarat	AGS Beers 2003	[15]
Harugeri A et al.,	23.50 %	Karnataka	AGS Beers 2003	[16]
Pradhan S et al.,	21.86 %	Odisha	AGS Beers 2012	[17]
Kanaga santhosh K et al.,	18.34%	Pondicherry	AGS Beers 2012	[18]
Mandavi et al.,	18 %	Chandigarh	AGS Beers 2003	[19]
Kumar KN et al.,	17.5%	Karnataka	AGS Beers 2012	[20]
Pauldurai M et al.,	15.38%	Tamil Nadu	AGS Beers 2012	[21]

[Table/Fig-9]: Percentage prevalence of PIMs in other studies in India [10-21].

Number of PIMs prescribed per patient: In the end, we observed the number of PIMs prescribed per patient across all five criteria of the Beers list, as seen in [Table/Fig-8].

Authors	Percentage prevalence	Place of study	Criteria used	Reference
De Oliveira et al.,	95.5%	Brazil	AGS Beers 2012	[27]
Nam YS et al.,	80.96%	Korea	AGS Beers 2012	[28]
Hwang HJ et al.,	58.2%	Korea	AGS Beers 2012	[29]
Albert SM et al.,	53.5%	USA	AGS Beers 2012	[30]
Onda M et al.,	48.4%	Japan	AGS Beers 2003	[24]
Laroche ML et al.,	43.60%	France	AGS Beers 2003	[25]
Davidoff AJ et al.,	42.6%	USA	AGS Beers 2012	[26]
Basnet S et al.,	34.67%	Nepal	AGS Beers 2012	[31]
Fadare JO et al.,	25.5%	Nigeria	AGS Beers 2012	[32]
Lin HY et al.,	23.70%	Taiwan	AGS Beers 2003	[33]
Reich O et al.,	22.5%	Switzerland	AGS Beers 2012	[34]
Maio V et al.,	18.00%	Italy	AGS Beers 2003	[35]

[Table/Fig-10]: Percentage prevalence of PIMs in other international studies [27-35].

DISCUSSION

"Medicine is not only a science; it is also an art. It does not consist of compounding pills and plasters; it deals with the very processes of life, which must be understood before they may be guided."

This sage advice by the 14th century physician Paracelsus [7] holds true just as much in today's world as it did so many hundreds of years ago.

As 20th century turned into the 21st, there has been an explosive drive in the field of pharmacological interventions to treat diseases. Whilst the positive effects of this growth are seen, there has also been a disturbing practice of prescribing medications for all ages, without a thought that a drug may act differently, even detrimentally, due to the differences in physiological and pathological processes, especially seen in the extremes of age [8,9].

In this regard, studies which bring into the spotlight this oft-ignored topic are of importance. Our study aimed to add to the relative dearth of information regarding inappropriate drugs in geriatric population in the state of Goa using the 2015 AGS Beers criteria.

In this study, we observed an overall percentage prevalence of PIMs amounting to 66%. However, this included drugs which are listed under the domain of Criterion 5 of AGS Beers criteria 2015, namely the drugs to be used with caution in older adults. When these drugs, not being officially termed as PIMs, were excluded, we arrived at a percentage prevalence of 44%. This figure is lower than a study by Jhaveri BN et al., [10] and comparable to a study by Momin TG et al., [11] but higher than most of the other Indian studies [12-21], as shown in [Table/Fig-9]. The higher prevalence may be explained on the basis that in this study Beers criteria 2015 was used, which is a considerably comprehensive list and also has a new category of PIMs depending on creatinine clearance. Other studies used the previous iterations of the Beers list i.e., AGS Beers Criteria 2012 or 2003 [22,23]. In the international studies [Table/Fig-10], results of studies conducted by Onda N et al., Laroche ML et al., and Davidoff AJ et al., were comparable to this study [24-26]; rest of the studies showed either a higher [27-30] or a lower [31-35] prevalence for reasons unknown, though they also used Beers criteria 2003 or 2012.

The most commonly prescribed PIM observed in this study was prazosin followed by alprazolam (as per Criterion 1) and ranitidine (as per Criterion 3). Prazosin has a higher chance of causing orthostatic hypotension in elderly patients, and has a lower risk benefit ratio than the other anti-hypertensive drugs [3]; erroneous prescription of prazosin by doctors is possibly because of relative safety of the drug in patients with renal dysfunction [36]. Similarly, under the purview of Criteria 3 i.e., PIMs according to creatinine clearance, it was found that most often ranitidine was prescribed inappropriately. Ranitidine

undergoes renal excretion, and in the presence of renal dysfunction, plasma levels rise which may lead to mental status changes [3,37]. The most common 'drug to be used with caution' prescribed was furosemide followed by mannitol.

It was observed that there was an increase in the incidences of prescribing PIMs with the increment in the number of ailments, which corresponded with observations made by Laroche ML et al., and Passarelli MC et al., [25,38]. However, with the advancement of age of patients, no increased incidences of PIMs were noted, in contrast to the studies by Lin HY et al., and Maio V et al., [33,35]. We also observed that upto 15 days of hospitalization, there was increased use of PIMs, followed by a drop, unlike the study by Harugeri A et al., which showed increased use of PIMs beyond 10 days of hospitalization [16].

Our study is focused on geriatric patients, a segment of the population that was often ignored, but is now proving to be one of the fastest growing demographics in the world. Geriatrics, or geriatric medicine, is a speciality that is concerned with healthcare of elderly people. It stems from the Greek words 'geron' meaning 'old man', and 'iatros' meaning 'healer'. Getriatrics differs from adult medicine, in that it takes into account the unique changes which elderly people undergo. The physiological systems of the aged body are quite different from that of the younger adult body, and previous health issues and complications can produce a very different set of symptoms and diseases in older patients [39,40].

Thus adhering to framed guidelines for safe prescribing of medications is of utmost importance. One such guideline in the field of geriatrics is the Beers list or the Beers criteria for potentially inappropriate medication use in older adults. It was originally published in 1991, and is periodically updated; last updated in October 2015, with an addition of two major components: drugs for which dose adjustment is required based on kidney function and drug–drug interactions [3].

It consists of five subclasses, in which recommendations for drug use in older adults have been made, according to not only the quality of the evidence, but also the strength of the recommendations. Thus 'Beers criteria' serves as a guide to the clinicians, in addition to their clinical examinations and judgment of prescribing medications tailor-made to the needs of the patients.

Use of Beers Criteria in conjunction with other tools such as the 'Screening Tool of Older Persons' potentially inappropriate Prescriptions' (STOPP) and 'Screening Tool to Alert doctors to Right Treatment' (START) criteria allow for a safer and more judicious prescription of drugs at the geriatric age level, and is of immense use to the physicians in their day-to-day clinical practice [41].

LIMITATION

This being a retrospective study, involved looking through case records, it was not possible to ascertain whether patients in the study population were also consuming medications other than those listed in their case files; adverse reactions (if any) due to medications could not be reported; and as the study considered patients only from the tertiary care hospital, the overall prevalence of PIMs in the state of Goa could not be estimated in this study. A few drugs which are considered as PIMs depending on the duration of therapy, e.g., proton pump inhibitors and nitrofurantoin, could not be rightly assessed. Thus, there is a need for more such studies.

RECOMMENDATION

We recommend that healthcare professionals should be aware of the rather unique medication needs of geriatric population and apply the guidelines and tools while prescribing medications to this population. It is important for us to realize that knowledge of such medications and avoidance of their use would finally contribute to decreased adverse event-related healthcare outcomes. More prospective studies of a similar nature from India would help us quantify the extent of PIMs prescription and adverse event burden in elderly using other criteria like 'STOPP and START' criteria, PRISCUS, Phadke's criteria, Zhan criteria etc.

Formulation of hospital policies and protocols in this regard would help to mend the situation as well. Increased education, awareness and reporting of drug–related problems along with more doctor-patient interaction in these situations are some of the factors that could play an important role in promoting better and safer prescribing practices and a better quality of life to the older generations in our communities.

CONCLUSION

The inferences thus drawn, by applying Beers criteria to the observable data, give us a remarkable insight into the current status of drug prescribing in geriatric population, and the other problems which still plague this field. But as this was a retrospective study conducted on hospitalized medicine department patients, we aim to strengthen our observations by conducting more studies involving other specialties, patients attending out-patient departments and also those being treated by private practitioners.

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