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Original Research Article

Identification of potentially inappropriate medications used in elder patients attending outpatient departments using Beers 2015 criteria and comparing the same with 2012 criteria

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ABSTRACT

Aims: To detect the prevalence of use of potentially inappropriate medications (PIMs) in elderly patients attending outpatient departments using 2015 Beers criteria (BC) and to compare the same with 2012 BC.
Materials and Methods: This prospective study was conducted in a tertiary care teaching hospital of India between October 2018 and October 2019. Prescriptions of patients aged 65 years and above were collected from the outpatient departments and analyzed. PIMs were identified using2015 and 2012 BC and comparison was made between the two criteria. The differences between PIM use according to 2015 and 2012 BC were compared using chi-squared and kappa tests. The association between PIMs and independent variable were analyzed by chi square test.
Results: A total of 306 patients received 1,542 drugs. According to 2015 and 2012 BC, 97 (31.7%) and 90(29.4%) patients received at least one PIM and 125(8.1%) and 106(6.9%) drugs were PIMs, respectively. The most frequent PIMs class was anticholinergic drugs (47.6 %) and Pain medications (27.4 %) according to the both criteria. Diuretics used with caution were a new addition as per 2015 BC. 2015 BC detects more PIMs use than 2012 BC but not significantly (chi-squared test, P= 0.5985), but good accordance was found between the previous and updated criteria (kappa test 0.93, P<0.001).There was a significant association (Odds ratio>2) between polypharmacy and the encounter of PIMs according to both criteria (P<0.05).
Conclusion: The study showed high prevalence of prescribing PIMs in elderly Indian patients attending outpatient department which was associated with polypharmacy. The Beers 2015 criteria detected more PIMs but not significantly than the 2012 criteria.

1. Introduction

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] Older individuals are at a higher risk of developing drug-related adverse events because of age-related changes in drug pharmacokinetics and pharmacodynamics and reduced organ reserve capacity[2]. Furthermore, age-related physiological alterations and coexisting diverse underlying diseases contribute towards serious adverse drug interaction and toxicity.[3] Therefore, it is vital for the healthcare providers to be aware of the limitations of prescribing certain medications to the elderly.

PIMs are drugs identified through expert panel review when given in elderly can cause more harm than benefits.[4] PIMs can cause lots of problems like adverse drug reactions, drug-drug interactions and morbidity.[5,6] Inappropriate medication prescribing in older patients has become a public health concern due to its high prevalence.[7] A list of PIMs was developed and first published by Beers and colleagues for nursing home residents in 1991.[4] Subsequently, the BC is made by American Geriatric Society (AGS) and it is indented for better use of medications in older patients. It is an explicit list of PIMs that should be avoided in older adults in general and with certain diseases or syndromes in which

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certain drugs need to be prescribed at a reduced dosage or use with caution.[8]

The modifications in the 2015 update were not as extensive as those of the previous update (2012);[5] the following two major criteria were added in 2015 update: 1) drugs for which dose adjustment is required based on reduced kidney function and 2) clinically important drug–drug interactions[6].With the increasing use of the BC as a quality-of-care measure, a need exists to strengthen the predictive validity of criteria in all health care settings.[9]

Various risk factors may be associated with encounter of PIMs. One of the major risk factor may be polypharmacy.[10] Polypharmacy refers to the use of a large number (five or more) of medications in a single prescription.[11]

Our study was inspired by Chinese study[12] that compared these two criteria in hospitalized elder patients. To our knowledge, very few studies have compared the 2012 and 2015 versions to detect PIMs and lack of Indian data motivated us to do this present study with objectives of 1) to assess the prevalence of PIMs in Outpatients using the Beers 2015 and 2012 criteria 2) to compare performance of two versions in detection of PIMs.

2. Materials and Methods

This Prospective cross sectional study was conducted at tertiary care teaching hospital in India. Geriatric patients aged 65 years and above of either sex attending out patients departments were enrolled between October 2018 and October2019 after taking their consent. Patients without any medications were excluded. The study protocol was approved by the institutional Ethics Committee. Data including age, gender, primary diagnosis, prescribed drugs, dosages and duration, serum creatinine were collected from prescriptions and were entered in Case record form . The estimated glomerular filtration rate (eGFR) was calculated by serum creatinine using the modified, abbreviated Modification of Diet in Renal Disease equations[13].The 2015 and 2012 BC were adopted to determine the use of PIMs in the study.

Statistical analysis

All analyses were conducted using Microsoft Excel 2010 version. A chi squared test was applied to compare dichotomous variables between groups. The chi-squared test and kappa test were used to evaluate the differences of prevalence and accordance of the two criteria, respectively. Value of P less than 0.05 was considered statistically significant.

3. Results

Data of total 306 participants aged 65 years or older were scrutinized. The average age was 69.43± 5.47 years (range 65–93 years) and 185 (60.46%) patients were male. On an average each patient was prescribed 5.04± 2.44 drugs (range: 1–13) and total 1542 medications were used. Out of the total study population, 37.58 % patients belonged to medicine department followed by orthopedics department 22.55 % and dermatology department 15.7 %.

According to the Beers 2015 criteria, our study identified 97 patients (31.7%) using 125 PIMs (1.29±0.68PIMs per patient). Among 97 PIMs users, 79 patients have only one PIM in their Prescription while 18 patients have ≥2 PIMs with highest 4 PIM in single prescription. The most frequent PIMs were anticholinergic and pain medications. Diuretics were most commonly prescribed drugs which should be used with caution. (Table 1)

Comparison of Beers 2015 versus 2012 Criteria

A total of 90(29.4%) patients were identified using 106 PIMs (1.18±0.44PIMs per patient) according to the Beers 2012 criteria. Among 90 PIMs users, 76 patients have only one PIM in their Prescription while 14 patients have ≥2 PIMs with highest 3 PIMs in single prescription. Changes of PIMs (includes addition of diuretics used with caution, drug-drug interactions and drugs avoided with reduced kidney function) in 2015 BC since 2012 BC as shown in table 2. BC 2015 detected more patients with PIMs use within our sample than BC 2012 but not significantly (P=0.5985) as per chi square test. A kappa test showed good accordance among the previous 2012 and updated 2015 criteria (kappa =0.93, P<0.001).Table 3 showed age and gender was not associated with use of PIMs. Polypharamacy was significantly associated with use of PIMs as per both criteria. (P<0.05)

4. Discussion

The present study compared the prevalence of PIMs between two versions of the Beers criteria in elderly outpatients in India. The major findings were as follows: 1) relatively high prevalence rate of PIMs were detected, 31.7 and 29.4%, by the 2015 and 2012 BC, respectively; 2) Anticholinergic drugs (mostly first generation antihistamines) and pain medications (mostly skeletal muscle relaxants) are more frequently prescribed PIMs as per both criteria; 3) the prevalence of PIMs use identified according to the previous criteria and the updated criteria exhibited minor differences; 4) according to both criteria, PIM use was significantly associated with polypharmacy.

Prevalence of PIMs varies between 11.66%.[14] to 66%.[15] in other studies done in India according to 2015 BC. Our study detected 31.7% prevalence of PIMs as per 2015 BC.

First generation antihistamines have untoward side effects like decreased reaction time and anticholinergic effects particularly notable in the elderly patient.[16] Anticholinergic side effects (e.g. cognitive impairment, mydriasis, flushing, dry mouth, constipation, and urinary retention) are more prevalent in elderly due to altered anticholinergic sensitivity by ageing.[17,18] Therefore, anticholinergic drugs are generally categorized as potentially inappropriate

Table 1: PIMs according to the Beers 2015 criteria (n=97)

PIMs should be avoided independent of diagnosis or condition		n=84	%
	Pheniramine	17	20.2
	Chlorpheniramine	11	13.1
Anticholinergic Drugs	Dicyclomine	8	9.5
	Hyoscine	2	2.4
	Trihexyphenidyl	2	2.4
	Chlorzoxazone	20	23.8
Pain medications	Methocarbamol	3	3.6
	Lorazepam	8	9.5
brain and spinal cord	clonazepam	4	4.8
	Quetiapine	3	3.6
GIT	Liquid paraffin	4	4.8
	Clonidine	1	1.2
CVS Drugs	Digoxin	1	1.2
PIMs due to drug-disease or drug syndrome interactions that may exacerbate the disease or syndrome		n=6	%
Dementia or cognitive impairment	Quetiapine	1	16.7
Chronic Kidney Diseases	Aspirin	2	33.3
Chronic Kidney Diseases	Paracetamol	3	50.0
PIMs to be Used with Caution		n=30	%
	Furosemide	11	36.7
	olanzapine	6	20
	spironolactone	6	20
	Escitalopram	4	13.3
	fluoxetine	2	6.67
	carbamazepine	1	3.33
Clinically important Drug -Drug interactions that should be avoided		n=3	%
	fluoxetine +olanzapine +clonazepam	2	66.7
	Risperidone + Trihexyphenidyl	1	33.3
Medications to be avoided or reduce dose with decreased kidney function		n=7	%
	Tramadol	3	42.9
	Pregabalin	2	28.6
	Ranitidine	2	28.6

Total exceeds 100% as there were patients who were prescribed more than one PIMs.

Table 2: Medication changes in Beers 2015 criteria since Beers 2012 criteria

Added PIMs		**Number of patients**
Diuretics used with caution	furosemide and spironolactone	17
Important Drug -Drug interactions to be avoided	three or more CNS active drugs and anticholineric-anticholinergic	3
Drugs to be avoided or reduce dose with decreased kidney function	tramadol,pregabalin and ranitidine	7

Table 3: Clinical characteristics of PIMs users as per 2015 and 2012 Beers Criteria (n=306)

Characteristics	Beers 2015 Criteria		p-value	Beers 2012 Criteria		p-value
	PIM	Non-PIM		PIM	Non-PIM	
Age, years (mean ± SD)	69.14±5.46	69.57 ± 5.50	0.66	69.13 ± 5.47	69.56 ± 5.5	0.6585
Gender						
Male,N (%)	57(18.6)	128(41.8)		52(17)	133(43.5)	
Female,N (%)	40(13.1)	81(26.5)	0.7738	38(12.4)	83(27.1)	0.6237
Prescribed medications						
≥5, N (%)	71(23.2)	105(34.3)		64(20.9)	112(36.6)	
<5, N (%)	26(8.5)	104(34)	**0.0003**	26(8.5)	104(34)	**0.0029**
Odds Ratio(95% CI)	2.705(1.600-4.572)			2.286(1.348-3.877)		

CI-Confidence Interval, PIM-potentially inappropriate medication, SD-standard deviation

medications (PIMs)[17].Similarly antihistamines are used as one of the most common PIMs class in the study by Shade MY et al.[19]

Pain medications particularly skeletal muscle relaxants were used commonly in elderly patients.

In a nationwide case-control study shows the use of skeletal muscle relaxants was associated with a 40% increase in fracture risk (adjusted odds ratio = 1.40; 95% CI, 1.15–1.72, $P < 0.001$).[20]

Similar to other agents in this class, chlorzoxazone can cause CNS side effects like dizziness, drowsiness, and light-headedness, and use in the older population is generally not recommended.[21]

Diuretics should be used with caution is a new addition in 2015 BC. Hyponatremia caused by loop diureticscan prevent the body's cells from functioning correctly, especially in the brain so monitoring of sodium level closely when starting or changing dosages in older adults is recommended.[6]

Potassium sparing diuretics like Spironolactone can cause hyperkalemia which is a severe and even cause fatal consequence[22] similar to our study, another Indian study[15] showed most common 'drug to be used with caution' prescribed was furosemide followed by mannitol as per 2015 BC.

Two new criteria were added in update of BC 2015 which added more medications to be PIMs thus had detected more PIMs and even 4 PIMs in a single patient in our study.

1) Drug-drug interaction: Simultaneous use of two anticholinergic drugs can leads to increase risk of cognitive decline and thus to be avoided. Avoid use of total 3 or more CNS active drugs which can leads to increase risk of falls and fractures in older adults.[6]

2) Drugs to be avoided in reduced kidney function: spironolactone which can cause hyperkalemia should be avoided while reduce dose of ranitidine (cause mental status changes) and pregabalin (cause CNS adverse effects) is recommended.[6]

New 2015 criteria detects more patients with PIMs in Chinese study[12] which was done on hospitalized patients but in our outpatient study there was no such statistically significant difference in detection of PIMs. This may be because drugs like PPI, NSAIDs used for a brief period in outpatient department and will not be considered as PIMs.

Kappa value 0.92 indicates high degree of agreement of PIMs detection made by both criteria which is similar to Chinese study[12] data (kappa>0.7).

Age and gender was not found to be a predictor of getting a PIM in our study. So encounter of PIMs is irrespective of age and sex.Age and gender was not associated with PIMs in study done in Saudi Arabia.[23]

In our study, significant factor associated with PIMs was polypharmacy. A strong association between polypharmacy and PIMs has been reported in many other studies detecting PIMs as per both criteria.[12,23–25] This may be due to multiple comorbidities tend the elderly patients to visit multiple specialties and thus are at higher risk of prescribing various medicines especially from the list of BC.

Limitations of this study was only out patients department were included and they were not representative of older, community-dwelling patients and the consequences of PIMs were not analyzed.

Beers criteria is supported by evidence, still the AGS advises that clinicians must consider multiple factors in prescribing decisions, including using common sense and clinical judgment, understanding that strict adherence to the criteria is not always possible.[26]

5. Conclusion

Our study described a high prevalence of PIMs in older patients attending outpatient department. PIMs defined by both Beers 2012 and 2015 criteria were shown to be associated with polypharmacy. Beers 2015 criteria are not significantly effective in identifying more PIMs than Beers 2012 criteria. The most frequent PIMs class was anticholinergic drugs (mostly first generation antihistamines) and pain medications (mostly skeletal muscle relaxants) according to both criteria.

6. Source of Funding

None.

7. Conflict of Interest

None.

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