Analysis of Medication Charts of Hospitalized Elderly Patients: A Cross-sectional Study

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ABSTRACT

Objectives: The purpose of conducting the present study was to determine the frequency of PIMs among medication charts of hospitalized elderly patients based on Beer's Criteria, 2019. **Materials and Methods:** In a tertiary care hospital, a descriptive, observational cross-sectional study was conducted over the course of six months. The study comprised both male and female in-patients aged 65 years and above. A pre-structured data collection form was used to gather information from the patient case files. **Results:** A total of 100 prescriptions were included. The most prevalent disease among the elderly was found to be hypertension (15.51%) followed by type 2 diabetes mellitus (14.4%) and sepsis (6.92%). The most commonly prescribed medications among the elderly in the present study were insulin followed by proton-pump inhibitors, atorvastatin, aspirin, and furosemide. A total of 216 potentially inappropriate medications were identified in 87 prescriptions. The use of proton-pump inhibitors was found to be the leading PIM to be avoided followed by insulin. The most common PIM to be used with caution was found to be diuretics followed by aspirin. **Conclusion:** The study findings show that the frequency of prescribing PIMs is high among hospitalized elderly patients. The use of such medications can be controlled by adhering to the updated Beers criteria.

Keywords: Geriatrics, Polypharmacy, Beer's criteria, Potentially inappropriate medications, Observational study.

INTRODUCTION

Geriatrics is a field of internal medicine that give attention to the health aspects of elderly people over the age of 65 years and aims to improve well-being and prevent illnesses and disabilities.[1] The population of elderly people is predicted to increase to 12% of the total Indian population by 2025 from 7.4% in 2001.[2] It has been projected that the overall population in India will grow by 55% but the growth of elderly above 60 years will rise by 326%.[3] The Beers Criteria is a precise compilation of PIMs that should be best avoided in geriatric patients in the most of the situations or under specific circumstances, such as the presence of certain diseases or conditions. Mark H. Beers, a Geriatrician developed the Beers Criteria for the first time in 1991

to minimize irrational use of medications and Adverse Drug Events (ADEs) and to find those medications which need to be avoided in geriatric people.[4,5] The American Geriatric Society sponsored the first update of the criteria in 2011, followed by an update every three years since then, as in 2012, 2015, and 2019 using an improved, evidence-based approach.[6-8]

The term "Potentially Inappropriate" (PIMs) encompasses utilization of those medications in older adults whose risk may outweigh their possible advantages, particularly when better alternatives are available. This criterion is extensively used by researchers and clinicians to manage and improve the care of elderly. The recent Beers Criteria of 2019 include several individual criteria of medication or their classes to be

avoided in elderly, to be used with caution or avoided in certain diseases.[6] The Beer's Criteria does not say "do not use this medication," but provides a rationale behind which medications should be avoided.[4]

Elderly patients tend to have a higher incidence of diseases. They are the most medicated patients with an increased risk of developing drug interactions and other unintended adverse events due to altered physiology and are under-represented in clinical trials. Adults 65 years and older are particularly susceptible to polypharmacy, referring to the use of five or more medications, can result in improper medication prescriptions causing Adverse Drug Events (ADEs), which in turn can enhance the number of visits to the emergency department and hospitalizations increasing the economic burden.[4,6,9] Age-related physiological changes (like decreased renal and liver function), increase in the number of co-morbid conditions, and thereby increase in the number of medications prescribed alter the pharmacodynamics and pharmacokinetics of drugs among elderly making them more prone to develop adverse drug events. This study was therefore carried out with the aim to determine the frequency of potentially inappropriate medications among medication charts of hospitalized elderly patients based on Beer's Criteria, 2019.

MATERIALS AND METHODS

A Hospital based descriptive, observational cross-sectional study was conducted at a Tertiary Care Hospital, Hyderabad, India. The study duration was 6 months (December 2020 to May 2020). The patients were included in the study based on the following criteria.

Inclusion Criteria

- Elderly patients with age 65years or more.
- Patients admitted to hospital.
- Patients of both gender.

Exclusion criteria

- Patients below 65years of age.
- Patients admitted to ICU wards.
- Patient case files with missing data.

The patients were enrolled in the study according to their availability and accessibility at the study site (convenience sampling). Therefore all those patients presenting at the study site and meet the inclusion criteria were enrolled in the study. Data was exclusively collected from the patient case-files using a structured data collection form (patients were not interviewed). Information related to

patient demographics, allergies, family and social history, primary diagnosis, co-morbid conditions, and list of medications prescribed was collected. Using the above data, disease prevalence and prescribing patterns were determined. Information related to patient demographics, allergies, family and social history, primary diagnosis, co-morbid conditions, and list of medications prescribed was collected. Using the above data, disease prevalence and prescribing patterns were determined. The prescription data was used to determine the frequency of potentially inappropriate medications among geriatric patients using Beers Criteria, 2019. The study proposal was reviewed and approved by the Institutional ethics committee, Care Hospitals (Reference number: IEC/CARE/20569/2021/PharmD). The data obtained were analyzed using Microsoft excel.

RESULTS

One hundred and nine elderly patients admitted to hospital in non-ICU wards during the study period, were assessed for eligibility. Seven patients were excluded for missing data, two patients were excluded for ICU admission, and the study involved 100 patients in total as shown in Figure 1. It was found that 45% of the elderly patients were female and 55% were male patients. The study population's mean age $\pm$ SD was 70.67 $\pm$5.43 years. The majority of patients were found to be between the ages of 65 and 70 years (59), followed by 71 to 75 years (24) and 76 to 80 years (11) as shown in Table 1. The average length of hospital stay during the study period was 4.81$\pm$2.27 days. Most of the patients were hospitalized for 1-5 days (76) followed by 6-10 days (23) as
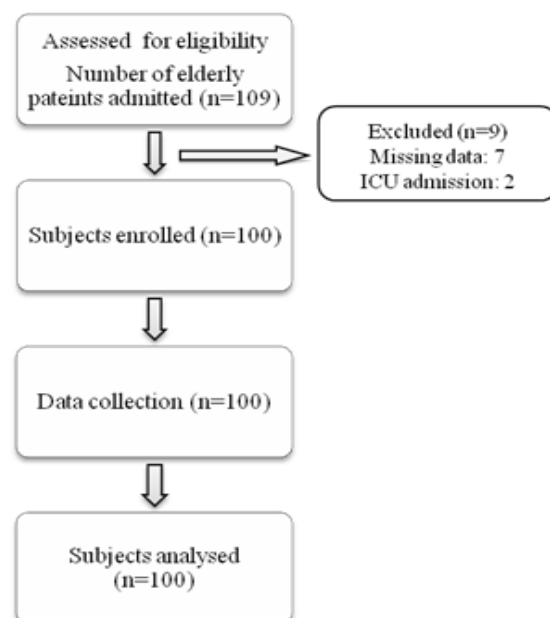

Figure 1: Flowchart representing study participants.

Table 1: Characteristics of the elderly patients (*n*=100).

Characteristics of subjects	Number of elderly	Number of diseases	Number of elderly
Gender		Single Disease	15
Male	55	Two Diseases	16
Female	45	Three Diseases	26
Age (years)		Four Diseases	14
65-70	59	Five Diseases	13
71-75	24	Six Diseases	6
76-80	11	Seven Diseases	4
81-85	5	Eight Diseases	4
86-90	1	Nine Diseases	1
Mean age±SD	70.67 ±5.43 years	Ten Diseases	1
Duration of Hospital stay		**Number of medications during hospital stay**	
1-5 days	76	1-4	0
6-10 days	23	5-9	41
>10 days	1	≥ 10	59

SD=Standard Deviation

shown in Table 1. The median length of hospital stay was found to be 4.5 days. The average number of diagnoses was found to be 3.61±2.02. Around 43% of patients were found to have five or more diseases as shown in Table 1 and 69% of the patients had ≥ 3 diagnoses.

A total of 361 diseases were identified among the elderly during the study period as shown in Table 2. The majority of the elderly were found to suffer from cardiovascular diseases (34.9%) followed by infections (17.72%), endocrine diseases (17.45%), renal diseases (8.58%), and neurological complications (7.47%). The most prevalent disease was found to be hypertension (15.51%) followed by type 2 diabetes mellitus (14.4%), sepsis (6.92%), coronary artery disease (4.98%), acute kidney injury (4.98%), myocardial infarction (4.43%) and congestive heart failure (4.15%) as shown in Table 2.

An average of 11.01 drugs was found in each prescription. In the current study, every patient received at least 5

Table 2: Distribution of subjects based on diagnosis.

Diagnosis	Number of elderly	Percentage
Cardiovascular Diseases HTN(56), CAD(18), MI (16), CHF(15), Atrial fibrillation(5), Pulmonary hypertension(5), Hypotension(3), MR(3), Degenerative valve disease(2), AR(1), Pericardial effusion(1), Aortic stenosis(1)	126	34.9%
Infections Sepsis (25), Pneumonia(6), Covid-19(5), UTI(8), Acute Febrile Illness(8), Gastroenteritis(4), tuberculosis(2), Cellulitis(2), Dengue(1), URTI(1), Meningitis(1), Endocarditis(1)	64	17.72%
Endocrine Diseases Diabetes mellitus(52), Hypothyroidism(11)	63	17.45%
Renal diseases AKI/AKI on CKD(18), CKD on hemodialysis(4), CKD(6), Obstructive nephropathy(2), Acute graft dysfunction(1)	31	8.58%
Neurological diseases Stroke(11), Metabolic encephalopathy(5), seizure(2), Parkinsonism(1),Cerebrovascular accidents(3), Cerebrovascular reactivity(2) Quadriparesis(1), Anxiety(1), Subdural hematoma(1)	27	7.47%
Pulmonary diseases COPD exacerbations(9), Type I respiratory failure (2), Type II respiratory failure(3), Obstructive sleep apnea(3), Bronchial Asthma(2), Interstitial lung diseases(1)	20	5.54%
Gastrointestinal diseases GERD(1), GI bleed(2), Reflux esophagitis(1), acute intestinal obstruction with perforated gall bladder(1), umbilical hernia(2)	7	1.93%
Liver diseases Chronic liver disease(2), Liver abscess(2), Ascites(1), ischemic hepatopathy(1)	6	1.66%
Musculoskeletal diseases Fractures(3), Rheumatoid Arthritis(1)	4	1.1%
Miscellaneous Anemia(6), Pancytopenia(1), Lymphoma(2), hyponatremia(1), benign Prostate Hyperplasia(3)	13	3.6%
Total	**361**	

AKI: Acute Kidney Injury; CAD: Coronary artery disease; CHF: Congestive Heart Failure; CKD: Chronic Kidney Disease; COPD: Chronic obstructive pulmonary disease; GERD: Gastroesophageal reflux disease; GI: Gastrointestinal; HTN: Hypertension; MR: Mitral Regurgitation; AR: Aortic regurgitation; URTI: Upper Respiratory tract infection; UTI: Urinary Tract Infection.

medications. 59% elderly were on ten or more medications and 41% received 5-9 medications. The most frequent drug class prescribed was found to be cardiovascular drugs (40.49%) followed by anti-infectives 912.59%), gastrointestinal agents (12.04%), and antidiabetic drugs (8.33%) as shown in Table 3. The most commonly prescribed medications among the elderly in this study were Insulins (*n*=82). All the diabetic patients admitted to the study site received at least one type of insulin. The most commonly prescribed type of insulin was human actrapid. The second most commonly prescribed medications were proton-pump inhibitors (*n*=74) followed by atorvastatin (*n*=57), aspirin (*n*=43), and furosemide (*n*=33).

Potentially inappropriate medications

Out of 100 prescriptions analyzed, 87 received at least one PIM in the present study. PIMs were found to be more prevalent in males (*n*=51, 58.6%) followed by females (*n*=36, 41.3%). In our study, the age group of 65-70 years showed the highest number of PIMs followed by 71-75 years as shown in Table 4.

PIMs under category I (drugs to be avoided) were found to be more prevalent (67.6%) in this study. The most

Table 3: Distribution of medicines based on prescriptions.

Drug class	Number of drugs prescribed	Percentage
Cardiovascular drugs Antihypertensives, antianginals, antiarrhythmic drugs, antiplatelets, thrombolytics, antihyperlipidemics, etc	447	40.49
Anti-infectives Antibacterial, antivirals, antitubercular	139	12.59
Gastrointestinal drugs Proton-pump inhibitors, Antiemetics, others	130	12.04
Antidiabetics (oral and injectables)	92	8.33
Respiratory drugs	72	6.52
Analgesic and Antipyretics	66	5.97
CNS drugs Antiparkinson, Nootropics, Antiepileptics, Antidepressants, Antipsychotics, antianxiety,	56	5.07
Corticosteroids	26	2.35
Others	73	6.61
Total	**1101**	

Table 4: Number of prescriptions having PIMs.

Characteristics	No. of prescriptions having PIMs	Characteristics	No. of prescriptions having PIMs
Gender		**Age (years)**	
Male	51 (58.62%)	65-70	49 (56.32%)
Female	36 (41.37%)	71-75	21 (24.13%)
		76-80	7 (8.0%)
Total	**87**	81-85	9 (10.3%)
		86-90	1 (1.14%)

commonly prescribed medication class to be avoided in the elderly in the present study was proton-pump inhibitors (34.25%). The second most common PIM to be avoided in category I was found to be the use of short-acting and rapid-acting insulins (16.66%). The use of CNS drugs was also prevalent among elderly people in the present study (9.72%). Alprazolam (3.7%), an intermediate acting benzodiazepine was the most common PIM prescribed in this class followed by clonazepam (1.85%), a long acting benzodiazepine and zolpidem (1.85%), a nonbenzodiazepine, benzodiazepine receptor agonist hypnotic. Prazosin (2.31%), a peripheral alpha-1 blocker for the treatment of hypertension, and clonidine (2.32%), an alpha-2 agonist were cardiovascular medications prescribed in the present study, which are to be avoided among older adults. There are only two PIMs identified in category II (PIM due to drug-disease interaction) which includes prescribing risperidone in cognitive impairment and alprazolam in presence of a history of falls. The PIMs under category III (drugs to be used with caution) accounted for 29.62% of the present study. Diuretics including furosemide, spironolactone, eplerenone, mannitol, torsemide, hydrochlorothiazide, and metolazone were the second most common PIMs found in the study accounting for 18.51%. In 8 patients, aspirin was used for the primary prevention of cardiovascular diseases (3.7%). A total of 4 PIMs in category IV (drug interactions to be avoided) were identified. Two were related to the concurrent use of three or more CNS active drugs and the other two were related to the combination of peripheral alpha 1 blocker and a loop diuretic as shown in Table 5.

DISCUSSION

As geriatric patients are more susceptible to the development of adverse outcomes with each inappropriate medication prescribed, the above study was carried out with aim of determining the frequency of PIMs as per

Table 5: PIM use as identified according to Beers Criteria 2019.

Potentially inappropriate medications	No. of PIMs	Potentially inappropriate medications	No. of PIMs
Category I: **PIMs to be avoided in older adults**		**Category II** **PIM due to drug disease interactions that may exacerbate the disease**	
Anti-cholinergics Chlorpheniramine (4) Hyoscyamine (1)	5	**Dementia or cognitive impairment** Risperidone	1
		History of falls or fractures Alprazolam	1
Cardiovascular Prazosin(5) Clonidine (5)	10	**Category III** **PIMs: drugs to be used with Caution**	
Central Nervous System Nortriptyline (1) Quetiapine (1) Dosulepin (1) Risperidone (1) Alprazolam (8) Lorazepam (1) Clonazepam (4) Zolpidem (4)	21	Aspirin Diuretics Mirtazapine SNRIs (Desvenlafaxine) SSRIs (Escitalopram) Tramadol	8 40 2 2 4 8
		Total	**64**
Endocrine Insulin, sliding scale (36)	36	**Category IV** **Drug-drug Interactions to be avoided in older adults**	
Proton-pump inhibitors	74	**Any combination of ≥3 of CNS-active drugs** Clonazepam + Mirtazapine + Desvenlafaxine and Clonazepam + Mirtazapine + Dosulepin+ Desvenlafaxine+Quetiapine	2
Total	146	**Peripheral alpha-1 blockers+Loop Diuretics** (Prazosin+ Furosemide)	2
Total number of PIMs = 216			

SSRIs: *Selective serotonin reuptake inhibitors;* SNRIs: Serotonin and Norepinephrine reuptake inhibitors.

the Beer's criteria 2019. The current study witnessed male predominance (55%) which was found to be similar to other studies[10,11] whereas Zhang H, *et al*.[12] reported predominance of female. The mean age ± SD of the present study population (70.67 ±5.43 years) was found to be less than reported earlier as 75.17 ± 7.66 years[11] and 75.3±7.3 years[12] and higher than reported by Narvekar RS, *et al*.[13] (68.88 years). Most of the patients were found in the age group of 65-70 years followed by 71-75 years and 76-80 years. This was found to be consistent with other studies.[10,11] Median length of hospital stay (4.5 days) was found to be less when compared to 6 days in the study conducted by Sharma, *et al*.[10] and 6.44 days *by* Narvekar R, S *et al*.[13]

A higher proportion of the elderly had multiple co-morbidities in the present study and only 15% had a single disease. The average number of diagnoses was found to be 3.61±2.02 This was found to be less than that reported (4.0±2.0) by Zhang H, *et al*.[12] and slightly higher than that reported (3.37) by Narvekar R, S *et al*.[13] 69% of the elderly had ≥ 3 diagnoses in the current study which was found to be greater than reported in the study conducted by Sharma, *et al*.[10] (62.5%). Hypertension

followed by type 2 diabetes mellitus, sepsis, and coronary artery disease were found be to more common ailments found which is found to be different from a previous study conducted by Sharma, *et al*.[10] where diabetes (36.2%) was the most common disease followed by cerebrovascular events, chronic kidney disease, cardiovascular disease, and hypertension. Polypharmacy among the elderly was found to be very high in the present study. This looks to be consistent with the presence of multiple co-morbidities which are mostly chronic in nature. The average number of drugs per prescription in the present study was found to be similar to that reported (11.63) by Narvekar R, S *et al*.[13] and was higher than reported (9.4) by Zhang H, *et al*.[12] Ten or more medications were prescribed to 59% of the elderly and 41% received 5-9 medications. Whereas an earlier study reported only 29.1% of elderly were on ≥ 10 medications and 59.7% received 5-9 medications.[10]

Potentially inappropriate medications

87% of medication charts for elderly inpatients were found to have at least one PIM. This prevalence of PIM use among hospitalized elderly was found to be higher than reported earlier at 65.6%,14.66%,[13] and 80.6%.[11] The age group of 65-70 years was observed to have a

maximum number of PIMs (56.32%) followed by 71-75 years (24.13%). This was similar to a previous study[12] which reported 32.8% PIMs in the 65-69 age group followed by 20% in the 70-74 age group.

Like the present study, Zhang H, *et al.*[12] and Simões PA[15] also reported a higher prevalence of PIMs under category I (46.79% and 68.6% respectively). Proton-pump inhibitors were reported as the most common inappropriate medication class prescribed under category I by Alshehri, *et al.*[11] (40.3%) and Sharma, *et al.*[10] (51.3%) as found in this study (34.25%), whereas Ang *et al.*[16] and Kumar N, *et al.*[14] reported diuretics (15.7% and 16.16% respectively) as most common inappropriate medication class prescribed. The use of proton-pump inhibitors is found to be associated with the risk of bone loss and fractures.[17] Their use is also associated with a higher risk of *Clostridium difficile* infections.[18] The use of short-acting and rapid-acting insulins (16.66%) was found to be the second most common PIM to be avoided in category I in this study and also by Sharma, *et al.*[10] (19.7%). Alshehri, *et al.*[11] reported 5.4% use of insulin as PIM. Elderly people who use short-acting insulin have a higher chance of developing hypoglycemia. The Beer's criteria, 2019 recommended avoiding the use of short-or rapid-acting insulin regimens based on blood glucose levels in elderly without basal or long-acting insulin being used concurrently. Insulin regimens which include basal or long-acting insulin are not covered in this recommendation.[4] The use of benzodiazepines is linked to a higher risk of cognitive impairment, delirium, falls, and fractures. The geriatric population has a higher benzodiazepine sensitivity and slower metabolism of long-acting benzodiazepines.[4] Kumar N, *et al.*[14] reported 5.05% use of alprazolam as PIM in the elderly. Sharma, *et al.*[10] reported a higher use of clonazepam (11.4%) as PIM to be avoided and a similar use of zolpidem (1.3%) when compared to the present study. Yeon-Jung Lim *et al.*[19] found alprazolam as the most commonly prescribed PIM followed by clonazepam (10.8%) and zolpidem (8.7%). Alshehri, *et al.*[11] identified an 8.4% prevalence of benzodiazepines as PIM whereas in the present study the use of benzodiazepines as PIM to be avoided accounted for 6.01%. Cardiovascular drugs such as prazosin and clonidine were also found to be prescribed, which are to be avoided. In older adults, these medications are linked to a significant risk of orthostatic hypotension. As a result, they are not advised as a standard form of treatment for hypertension.[4] Diuretics, tramadol, mirtazapine, selective serotonin reuptake inhibitors, and serotonin-norepinephrine reuptake inhibitors are all linked to an aggravation of SIADH or hyponatremia. Sodium levels need to be closely monitored before starting therapy or when altering the dosage. Diuretics were found to be the second most common PIMs in the study accounting for 18.51%. In older adults with established cardiovascular disease, aspirin is typically given for secondary prevention of cardiovascular events. It should be used with caution in individuals 75 years of age or older as it is linked to an increased risk of bleeding in the elderly. The present study witnessed the use of aspirin in 8 patients (3.7%).

A combination of peripheral alpha 1 blocker and a loop diuretic was found in two prescriptions. Inappropriate use of Prazosin and furosemide combination was also reported in a study conducted by Sharma, *et al.*[10]

The present study was carried out as a part of the curriculum for the doctor of pharmacy course. The study limitations include a shorter study duration, a single study site, and the impact of the COVID-19 pandemic on data collection. This may limit the application of the findings in our study to other hospital settings. This study strongly advocates the implementation of tools like Beers criteria in hospitals. There is a need to increase awareness about such tools among healthcare professionals. In order to prevent the use of PIMs among the elderly more interventions are required including medication reconciliation, electronic system messages to alert healthcare providers, deprescribing, substituting alternative safe and more appropriate medications, and continuous monitoring of inappropriate prescribing.

CONCLUSION

The study findings show that the frequency of prescribing PIMs is high among hospitalized elderly patients. The use of such medications can be controlled by adhering to the updated Beers criteria.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

PIMs: Potentially Inappropriate Medication; **ADEs:** Adverse Drug Events; **AGS:** American Geriatric Society; **SD:** Standard Deviation.

REFERENCES

1. Sieber CC. Der Ältere Patient-wer ist das? [The elderly patient--who is that?]. (Berl). 2007;48(11):1190-4. doi: 10.1007/s00108-007-1945-3, PMID 17934704.

2. Jeyalakshmi S, Chakrabarti S, Gupta N. Situation analysis of the elderly in India. Central Statistics Office, Ministry of Statistics and Programme Implementation [Government of India document]; 2011.

3. Biswas AK, Leshabari K, Gebuis EPA. Living with family at old age. Int J Collab Res Intern Med Public Health. 2015;7(10):186-95.

4. Marcum ZA, Hanlon JT. Commentary on the new American Geriatric Society Beers criteria for potentially inappropriate medication use in older adults. Am J Geriatr Pharmacother. 2012;10(2):151-9. doi: 10.1016/j.amjopharm.2012.03.002, PMID 22483163.

5. Levy HB, Barney KF. Pharmacology, pharmacy, and the aging adult: Implications for occupational therapy. In: Barney KF, Perkinson MA, editors. Occupational therapy with aging adults. St.Louis: Elsevier; 2016:14-34.

6. By the 2019 American Geriatrics Society Beers Criteria® Update Expert Panel. American Geriatrics Society 2019 updated AGS beers Criteria® for potentially inappropriate medication use in older adults. J Am Geriatr Soc. 2019;67(4):674-94. doi: 10.1111/jgs.15767, PMID 30693946.

7. American Geriatrics Society 2012 Beers Criteria Update Expert Panel. American Geriatrics Society updated Beers Criteria for potentially inappropriate medication use in older adults. J Am Geriatr Soc. 2012;60(4):616-31. doi: 10.1111/j.1532-5415.2012.03923.x, PMID 22376048.

8. By the 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(11):2227-46. doi: 10.1111/jgs.13702, PMID 26446832.

9. Mannesse CK, Derkx FH, De Ridder MA, Man in 't Veld AJ, Van der Cammen TJ. Contribution of adverse drug reactions to hospital admission of older patients. Age Ageing. 2000;29(1):35-9. doi: 10.1093/ageing/29.1.35, PMID 10690693.

10. Sharma R, Bansal P, Garg R, Ranjan R, Kumar R, Arora M. Prevalence of potentially inappropriate medication and its correlates in elderly hospitalized patients: A cross-sectional study based on Beers criteria. J Family Community Med. 2020;27(3):200-7. doi: 10.4103/jfcm.JFCM_175_20, PMID 33354151.

11. Alshehri S, Alshibani M, Magboul G, Albandar A, Nasser R, Yaqoub RM, *et al*. Adherence to beers criteria in geriatrics: A retrospective study in a Saudi teaching hospital. Geriatrics (Basel). 2020;5(4):97. doi: 10.3390/geriatrics5040097, PMID 33233330.

12. Zhang H, Wong EL, Wong SY, Chau PY, Yip BH, Chung RY, *et al*. Prevalence and determinants of potentially inappropriate medication use in Hong Kong older patients: A cross-sectional study. BMJ, (Open). 2021;11(7):e051527. doi: 10.1136/bmjopen-2021-051527, PMID 34301670.

13. Narvekar RS, Bhandare NN, Gouveia JJ, Bhandare PN. Utilization pattern of potentially inappropriate medications in geriatric patients in a tertiary Care Hospital: A retrospective observational study. J Clin Diagn Res. 2017;11(4):FC04-8. doi: 10.7860/JCDR/2017/21080.9731, PMID 28571163.

14. Kumar NS, Reji GK, *et al*. Prescription analysis and prevalence of potentially inappropriate medication use in older adults; an observational study. Int J Pharm Pharm Sci. 2020;12(2):108-12. doi: 10.22159/ijpps.2020v12i2.36209.

15. Simões PA, Santiago LM, Maurício K, Simões JA. Prevalence of potentially inappropriate medication in the older adult population within primary care in Portugal: A nationwide cross-sectional study. Patient Prefer Adherence. 2019;13:1569-76. doi: 10.2147/PPA.S219346, PMID 31571839.

16. Ang WC, Zulkepli NS, Mukhtar NS, Zulkefli NA. Prevalence, factors and cost comparison due to Potentially Inappropriate Medications (PIMs) of elderly outpatients in a state hospital in Malaysia. JoP. 2021;1(1):27-33. doi: 10.31436/jop.v1i1.54.

17. Yang YX, Lewis JD, Epstein S, Metz DC. Long-term proton pump inhibitor therapy and risk of hip fracture. JAMA. 2006;296(24):2947-53. doi: 10.1001/jama.296.24.2947, PMID 17190895.

18. Freedberg DE, Salmasian H, Friedman C, Abrams JA. Proton pump inhibitors and risk for recurrent Clostridium difficile infection among inpatients. Am J Gastroenterol. 2013;108(11):1794-801. doi: 10.1038/ajg.2013.333, PMID 24060760.

19. Lim YJ, Kim HY, Choi J, Lee JS, Ahn AL, Oh EJ, *et al*. Potentially inappropriate medications by beers criteria in older outpatients: Prevalence and risk factors. Korean J Fam Med. 2016;37(6):329-33. doi: 10.4082/kjfm.2016.37.6.329, PMID 27900070.