ASSESSMENT OF POTENTIALLY INNAPPROPRIATE MEDICATION IN OLDER ADULTS USING UPDATED AGS BEER'S CRITERIA IN TERTIORY CARE HOSPITAL

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ABSTRACT

Purpose of the study: Drug safety among the elderly population is a major problem that requires close attention in clinical practice. Older population is at highly susceptible to ADRs due to their physiological changes, co-morbidity and polypharmacy associated with it. The AGS Beers criteria consists of a list of drugs that are potentially inappropriate among the elderly patients. This information can be used as a powerful tool for healthcare professionals to prescribe safe and effective drugs to the geriatric patients. **Method of study:** A prospective observational study was conducted over a period of 6 months in a tertiary care hospital after obtaining ethical clearance from the Institutional Review Board. The Geriatric patients admitted to selected departments were enrolled in the study considering the study criteria. **Results:** PIMs were found in 69 (67.64%) prescriptions and the number of Inappropriate drugs found in the prescription was 113 drugs. The PIMs belonged to all the four categories of the criteria were, 57 (51.32%) drugs were from the category of drugs to be avoided, 40 (35.39%) drugs were the drugs listed under use with caution category, 1 (0.88%) drug-drug interactions were found, and the rest 14 (12.38%) drugs were from the category of drugs to be used with caution. **Conclusion:** The study report suggests that for the high rate of PIMs found in the prescriptions of the geriatric patients.

KEYWORDS: Geriatrics, potentially inappropriate medications, safety, efficacy, Beers criteria.

INTRODUCTION

According to National Institute of Health (NIH), elderly person refers to the person over the age of 65 years. Ageing is a complex, unavoidable process. However this process is not uniform across the population as it depends on factors such as genetics, lifestyle and overall health.[1]

Drug related problems are common in elderly patients such as, drug ineffectiveness, drug interactions, adverse drug reactions, over-treatment, under-treatment, drug overdose, underdose, non- adherence etc.[4]

Multimorbidity among elderly patients leads to the consumption of several drugs that is called as polypharmacy. There is no proper definition on considering number of drugs as polypharmacy. In general, any prescription containing two or more drugs is termed as polypharmacy. According to several researches polypharmacy is further divided into different terms based on severity of polypharmacy and appropriateness of the drugs prescribed like Minor, Moderate, Major, severe, hyper, excessive, appropriate, rational polypharmacy and indiscriminate prescribing, persistent, chronic, pseudo polypharmacy etc.[6]

Polypharmacy is linked to multiple negative clinical outcomes including falls, frailty, and mortality among elderly patients. Polypharmacy should be judged based on the rationality/appropriateness of the drugs prescribed as it has also increased the longevity of elderly patients with several chronic comorbid conditions. This can be done by using various existing criteria for assessing appropriateness of prescription in older adults such as Beers criteria, START/STOPP criteria, FORTA, and many others.[7]

Potentially inappropriate medication (PIMS) is defined as "a drug in which the risk of occurrence an adverse event outweighs its clinical benefits, particularly when there is a safer or more effective alternate drug therapy for the same condition". Many studies have shown the occurrence of adverse drug reactions due to inappropriate medications / dose / frequency of drugs prescribed. It is important to identify and manage the use of potentially inappropriate medications in older adults to minimize the pharmacotherapy related hazards.[8]

AGS Beers criteria is among the widely accepted criteria for assessment of PIMS among elderly patients (>65 yrs). The Beers Criteria was developed by the late Mark Beers, MD, and colleagues at the University of California Los Angeles in 1991, with the purpose of identifying medications for which potential harm outweighed the expected benefit and that should be avoided in nursing home residents.[9]

The 1997 update, led by Dr. Beers, expanded the criteria to apply to all older adults. The criteria was updated by an interprofessional group in 2003 and the American Geriatrics Society took over stewardship in 2010. The 2023 American Geriatrics Society (AGS) Beers Criteria for Potentially Inappropriate Medication (PIM) Use in Older Adults is the seventh overall update and Fourth since AGS became the criteria's steward [10]

The Beers criteria is used in clinical setup for geriatric care in order to improve the overall quality of life of the vulnerable population. Beers criteria consists of list of medications that is seen to outweigh the clinical benefits among the elderly. This information can be used in regular patient care to avoid the occurrence of life threatening adverse drug effects and deliver safe and effective drug therapy to the older patients.[11]

PIMs are associated with high risk of ADRs and hence require accurate management once they are discovered. Management of such drugs depends on the which category of the beers list they belong to. If the drug belongs to the category of drugs to be avoided among geriatric.[12]

MATERIALS AND METHOD

Study Duration

The study has been carried out for a period of Six month (March-August 2024).

Study Design

"A Prospective observational study"

Study Site

The study has been conducted at department of general medicine, gulbarga institute of medical science.

Source of Data

Patient case sheets laboratory reports, 2023 updated AGS beers criteria.

Inclusion Criteria

Inpatients over the age of 65 years,

Patients of either gender.

Patients with or without co-morbid conditions.

Patients prescribed with polypharmacy.

Exclusion Criteria

Geriatric patients who are terminally ill.

Patients who are not willing to participate in the study.

Diseased patients during the hospital stay and the patients discharged against medical advice.

RESULTS

1. GENDER-WISE DISTRIBUTION OF THE PATIENTS

During the study 102 geriatric patients were analysed, among them 45 (44.11%) of the patients were female and 57 (55.88%) of the patients were males.

Table 1: Details on gender-wise distribution of the patients.

GENDER	NO. OF PATIENTS	PERCENTAGE
FEMALE	45	44.11%
MALE	57	55.88%
GRAND TOTAL	102	100%

2. AGE WISE-DISTRIBUTION OF THE PATIENTS

Out of 102 geriatric patients included in the study, 65 (63.72%) patients were in the category of Young-old i.e., in between 65 – 74 years of age, 24 (23.52%) patients were in the category of Middle-old i.e., in between 75 – 84 years of age and 13 (12.74%) of the patients were in the category of Old -old i.e., over 85 years of age. The mean age of patient was found to be 73.3.

Table 2: Details on age wise-distribution of the patients.

| AGE GROUPS	NO. OF PATIENTS	PERCENTAGE %
YOUNG-OLD (65-74 YRS)	65	63.72%
MIDDLE-OLD (75-84 YRS)	24	23.52%
OLD-OLD (>85 YRS)	13	12.74%
GRAND TOTAL	102	100 %

3. NUMBER OF PATIENTS ADMITTED TO EACH DEPARTMENT

Out of 102 patients analysed during the study, 47 (46.07%) patients were admitted to general medicine department, 28 (27.45%) patients were admitted to neurology department, 12 (11.76%) patients were admitted to orthopaedics department, 10 (9.80%) patients were admitted to general surgery departmen, 3 (2.94%) patients each were admitted to emergency medicine and 2 (1.96) patients were admitted in gastroenterology department.

Table 3: Details on number of patients admitted to each department.

DEPARTMENTS	NO. OF PATIENTS	PERCENTAGE %
GENERAL MEDICINE	47	46.07%
NEUROLOGY	28	27.45%
ORTHOPAEDICS	12	11.76%
GENERAL SURGERY	10	9.80%
EMERGENCY MEDICINE	3	2.94%
GASTROENTEROLOGY	2	1.96%
GRAND TOTAL	102	100%

4. DURATION OF STAY OF PATIENTS IN HOSPITAL
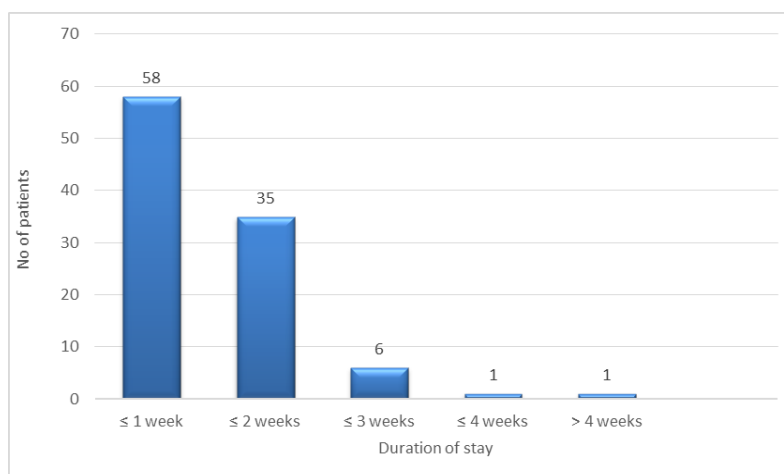
Figure 1: details on duration of stay of patients in hospital.

Out of 102 patients analysed during the study, 47 (46.07%) patients were admitted to general medicine department, 28 (27.45%) patients were admitted to neurology department, 12 (11.76%) patients were admitted to orthopaedics department, 10 (9.80%) patients were admitted to general surgery departmen, 3 (2.94%) patients each were admitted to emergency medicine and 2 (1.96) patients were admitted in gastroenterology department.

5. MAJOR DIAGNOSIS OBSERVED IN STUDY POPULATION

Table 4: Details on major diagnosis observed in study population.

| MAJOR DIAGNOSIS	NO. OF PATIENTS	PERCENTAGE %
ACUTE GASTROENTERITIS	2	1.96%
ANAEMIA	2	1.96%
AKI	1	0.98%
ASTHMA	1	0.98%
ACCELERATED HTN	1	0.98%
BROKEN IMPLANT IN-SITU	1	0.98%
BURN	1	0.98 %
CELLULITIS	7	6.86%
CKD	1	0.98%
COR PULMONALE	1	0.98%
COPD	7	6.86%
CORONARY ARTERY ANGIOGRAPHY	1	0.98%
CUSHING SYNDROME	1	0.98%
CVA	28	27.45%
DENGUE	2	1.96%
DKA	1	0.98%
ENTEROCOLITIS	1	0.98%
FEVER	1	0.98%
FRACTURE	11	10.78%
FEBRILE ILLNESS	1	0.98%
FOUNIER'S GANGREEN	1	0.98%
GOUTE	1	0.98%
HYPOGLYCEMIA	2	1.96%
IHD	4	3.92%
IMMUNE THROMBOCYTOPENIA	1	0.98%
INGUINAL HERNIA	1	0.98%
PARKINSONS DISEASE	4	3.92%
PANIC DISORDER	1	0.98%
PEPTIC ULCER DISORDER	1	0.98%
PLEURAL EFFUSION	1	0.98%
PNEUMONIA	6	5.88%
SECONDARY SUTURING TO WOUND	1	0.98%
PTB	1	0.98%
SEPSIS	2	1.96%
ULCER OVER FOOT	1	0.98%
SNAKE BITE	1	0.98%
VIRAL FEVER	1	0.98%
GRAND TOTAL	102	100%

All the 102 cases were analysed and the major diagnosis was found to be Cerebro-vascular accident, fracture, COPD, cellulitis, cataract, pneumonia, anaemia, acute gastroenteritis, inguinal hernia, IHD, bronchitis etc.

6. SEVERERITY POLYPHARMACY

Table 5: details on severerity polypharmacy.

SEVERITY OF POLYPHARMACY	NO OF PATIENTS	PERCENTAGE
HYPER	48	47.05%
MAJOR	36	35.29%
MINOR	9	8.82%
MODERATE	9	8.82%
GRAND TOTAL	102	100%

Out of 102 cases analysed during the study, all the 102 patients were prescribed with more than 2 drugs (polypharmacy), out of which 9(8%) patients were prescribed with minor polypharmacy (2 – 4 drugs), 9 (0.72%) patient was prescribed with moderate polypharmacy (4 – 5drugs), 36 (36%) patients were prescribed with major polypharmacy (5 – 9 drugs) and 48 (55%) patients were prescribed with hyper-polypharmacy (≥ 10 drugs). The average number of drugs prescribed in the study is 9.8 drugs. The maximum and minimum number of drugs prescribed during the study to a single patient is 20 and 4. drugs respectively. Average number of drugs per prescription was found to be.
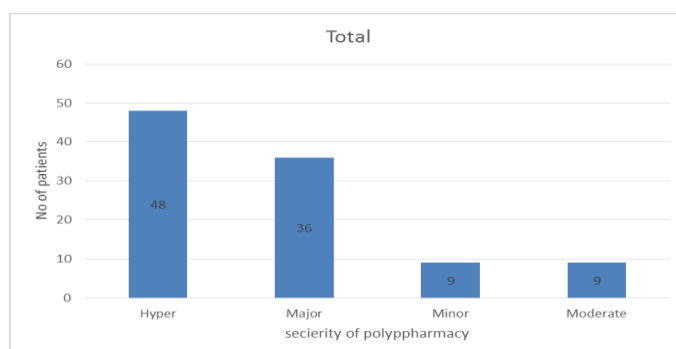

Figure 2: details on polypharmacy.

7. NUMBER OF PIMS FOUND PER PRESCRIPTION

Out of 102 treatment charts of the patients, 69(67.64%) of the treatment charts had PIMS in it varying in number. In which 40 (57.97%) cases had 1 PIM, 16 (23.18%) cases had 2 PIMS, 11(15.95%) cases had 3 PIMS, 1 (1.44%) of treatment chart had 4 and 5 PIMs.

Table 6: details on number of pims found per prescription.

| PIMS PER PRESCRIPTION	NO OF PRESCRIPTIONS	PERCENTAGE %
1	40	57.97%
2	16	23.18%
3	11	15.95%
4	1	1.44%
5	1	1.44%
GRAND TOTAL	69	100%
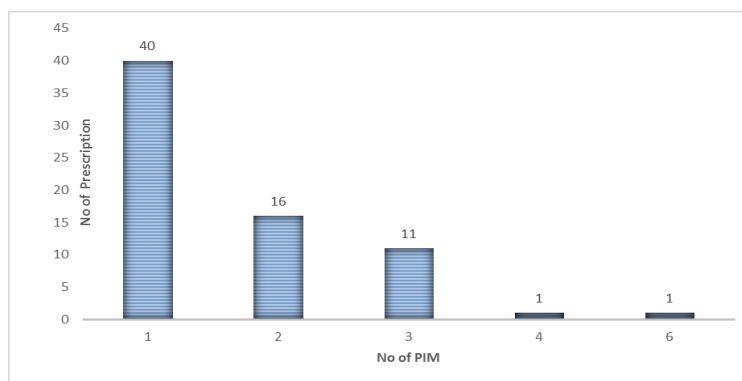
Figure 3: details on number of pims found per prescription.

8. CATEGORIES OF PIMS FOUND IN TREATMENT CHARTS

Table 7: Details on categories of pims found in treatment charts.

CATEGORY OF PIM	TOTAL PIMS	PERCENTAGE %
AVOID	57	51.32%
USE WITH CAUTION	40	35.39%
DRUG-DRUG INTERACTION	1	0.88%
RENAL IMPAIRMENT	14	12.38%
TOTAL	113	100%

Out of 102 patients assessed during the study, 69 patient's treatment charts contained PIMS. The total number of PIMS in those 69 cases was found to be 113 PIMS. The 113 PIMS where from 4 different categories according to Beers criteria, They are; 57(51.32%) PIMs were from category of drugs to be avoided, 40(35.39%) PIMs were from category of drugs to be used with caution, 1 (0.88%) PIMs were from category of Drug-Drug Interactions (DDI), and 14 (12.38%) PIMs were from category of drugs to be avoided or used with caution in renal impaired patients.
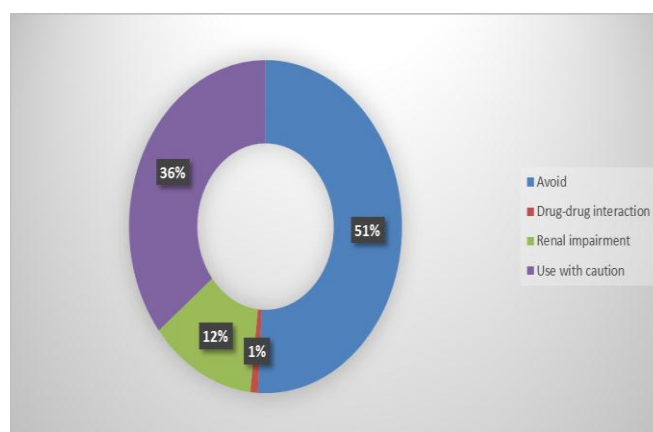
**Figure 4: Details on categories of pims found in treatment charts.**

9. TYPES OF PIMS FOUND IN THE CATEGORY OF DRUGS TO BE AVOIDED IN ELDERLY PATIENTS

Table 8: details on types of pims found in the category of drugs to be avoided in elderly patients.

DRUG TO BE AVOIDED	NO OF PATIENTS
PANTAPRAZOLE	8
ASPIRIN	27
LORAZEPAM	2
NIFIDIPINE	1
MIDAZOLAM	1
INJ HUMAN ACTRAPID	17
PHENOBARBITOL	1
GRAND TOTAL	57

Out of 113 PIMs found during the study, 57 PIMs were found in the category of drugs to be avoided in elderly patients according to Beers criteria. The highest number of PIMs in this category was the use of Aspirin (46.55%) followed by sliding scale Inj Human actrapid (29.32%), followed by pantoprazole (13.79%), Lorazepam (3.44%), Brivacitam (1.72%), midazolam (1.72%) , Nifidipine (1.72%), phenobarbitol (1.72%)
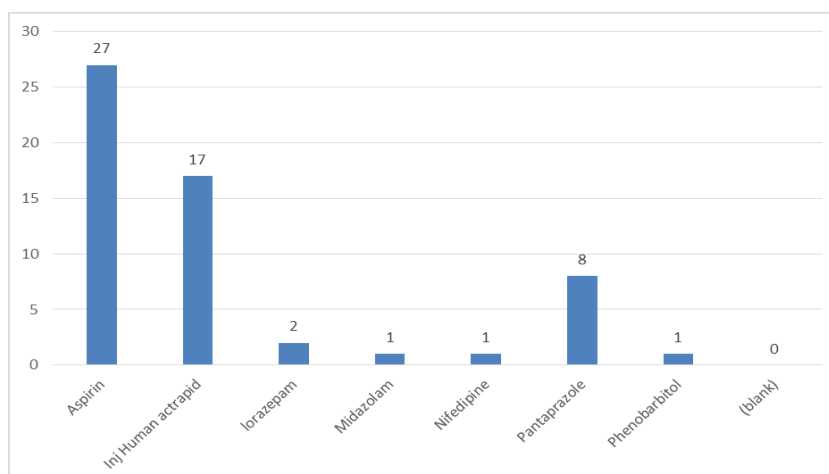
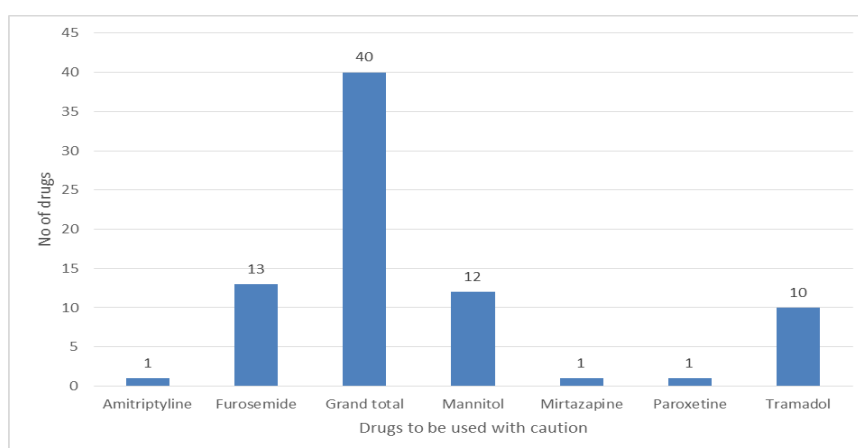**Figure 5: details on pims found in the category of drugs to be avoided in elderly patients.**

10. PIMS FOUND IN THE CATEGORY OF DRUGS TO BE USED WITH CAUTION IN ELDERLY PATIENTS

Out of 113 PIMS found during the study, 40 PIMS were from the category of drugs to be used with caution in elderly patients. Furosemide 13(32.5%) patients, followed by Mannitol in 12 (30%) patients Tramadol in 10(25%) patients, Amitriptyline, Mirtazapine and

Paroxetine in 1 (2.5%) patient each.

Table 9: details on pims found in the category of drugs to be used with caution in elderly patients.

| PIMS TO BE USED WITH CAUTION	NO OF PIMS
AMITRIPTYLINE	1
FUROSEMIDE	13
MANNITOL	12
PAROXETINE	1
MIRTAZAPINE	1
TRAMADOL	10
GRAND TOTAL	40

Figure 6: Details on pims found in the category of drugs to be used with caution in elderly patients.

11. PIMS FOUND IN THE CATEGORY OF DRUG- DRUG INTERACTIONS ACCORDING TO BEERS CRITERIA

Out of 113 PIMs found in treatment charts during the study, 1 PIMS is from the category of Drug-Drug interactions, that is; Tramadol, midazolam, Valproic acid, quetiapine and Brivaracetam in 1 (33%) patient each.

Table 10: details on pims found in the category of drug- drug interactions according to beers criteria.

| DRUG-DRUG INTERACTION	NO OF PATIENTS
TRAMADOL + MIDAZOLAM + VALPROIC ACID + QUETIAPINE + BRIVARACETAM	1
GRAND TOTAL	1
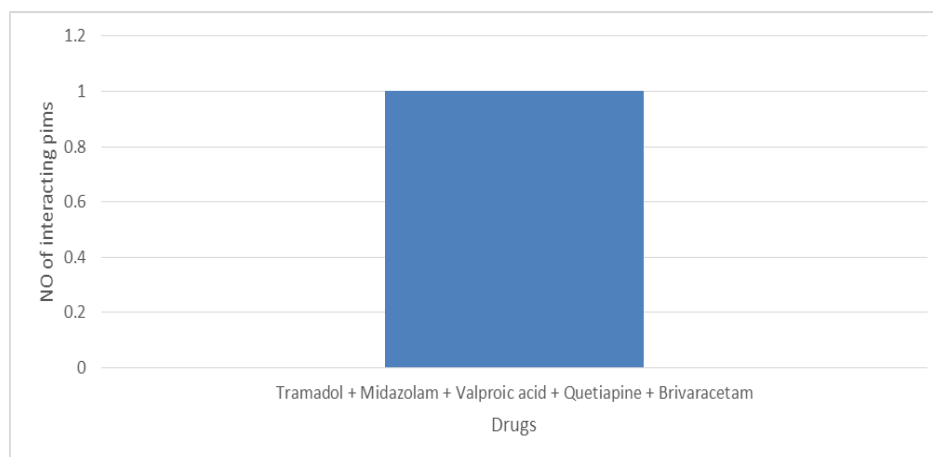
Figure 7: Details on pims found in the category of drug-drug interactions according to beers criteria.

12. PIMS FOUND UNDER THE CATEGORY OF DRUGS TO BE AVOIDED OR USED WITH CAUTION IN PATIENTS WITH RENAL IMPAIRMENT

Out of 113 PIMs found during the study, 14 PIMS were from the category of drugs to be avoided or used with caution in patients with renal impairment. Where Enoxparin was seen in highest number of cases in this category i.e., in 7 (50%) patients, followed by Tramadol (21.4%), Rivoroxoban 1(7%), Nitrofurantoin 1(7%), Spironolactone 1(7%), Gabapentin in 1(7%) patients.

Table 11: details on pims found under the category of drugs to be avoided or used with caution in patients with renal impairment.

DRUG	NO OF PATIENTS
ENOXPARIN	7
GABAPENTIN	1
SPIRONOLACTONE	1
RIVAROXABAN	1
TRAMADOL	3
NITROFURANTOIN	1
GRAND TOTAL	14
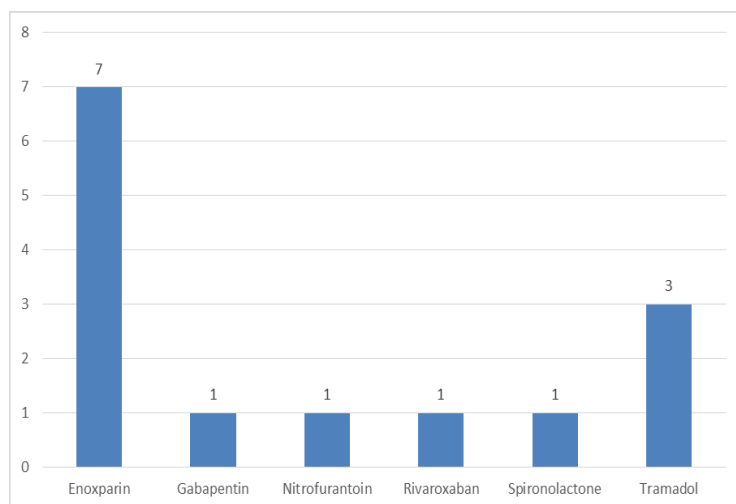
Figure 8: details on pims found under the category of drugs to be avoided or used with caution in patients with renal impairment.

Table 12: Details on PIMs.

DRUG	NO. OF PIMS	RECOMMENDATIONS
PANTOPRAZOLE	8	AVOID>8WEEKS OF USE
ASPIRIN	27	AVOID
LORAZEPAM	2	AVOID
NIFEDIPINE	1	AVOID
MIDAZOLAM	1	AVOID
INJ HUMAN ACTRAPID	17	AVOID
PHENOBARBITAL	1	AVOID
AMITRIPTYLINE	1	AVOID
FUROSEMIDE	13	USE WITH CAUTION
MANNITOL	12	USE WITH CAUTION
PAROXETINE	1	AVOID
MIRTAZAPINE	1	USE WITH CAUTION
TRAMADOL	10	USE WITH CAUTION
ENOXAPARIN	7	REDUCE DOSE
GABAPENTIN	1	REDUCE DOSE
SPIRONOLACTONE	1	AVOID
RIVAROXABAN	1	AVOID IF CRCL<15ML/MIN AND REDUCE DOSE IF CRCL 15-50 ML/MIN
TRAMADOL	3	IMMEDIATE RELEASE AVOID , EXTENDED RELEASE REDUCE DOSE
NITROFURANTOIN	1	AVOID IF CRCL IS <30ML/MIN
TRAMADOL + MIDAZOLAM + VALPROIC ACID + QUETIAPINE + BRIVARACETAM	1	AVOID TOTAL OF THREE OR MORE CNS-ACTIVE DRUGS; MINIMIZENUMBER OF CNS-ACTIVE DRUGS
GRAND TOTAL		

DISCUSSION

The purpose of the study was to evaluate the use drugs among geriatrics using Beers criteria and manage the use of potentially inappropriate medications in a tertiary care hospital at Kalaburagi. During the study 102 patients were incorporated based on the consents, exclusion, and inclusion criteria, out of which 69 prescriptions had one or more inappropriate drug(s) in it and 31 prescriptions were appropriate. Out of the 69 prescriptions, 113 drugs were found to be inappropriate.

Age wise distribution of the study population

In a total of 102 patients, 65 (63.72%) patients were in the age group of young-old (65 – 74 yrs), 24 (23.52%) patients were in the age group of Middle-old (75 – 84 yrs) and 13 (12.74%) patients were in the age group of Old-old (>85yrs) and the mean of patients were found to be 73.3 and which was similar to the study conducted by the **PRAVEEN KD et al.**

Gender wise distribution of the study population

Out of the 138 patients analysed, 57 (55.88%) patients were males and the rest 45 (44.11%) patients were females which was similar to the study conducted by **G MANJUNANTH et al.**

The major diagnosis observed were Cerebro-vascular accident, fractures, COPD, cellulitis, pneumonia, Ischeic heart disease, Parkinson disease, sepsis, anaemia, acute gastroenteritis and anaemia, acute gastroenterities which was similar to the study conducted by the **B CHAITRA et al.**

Out of the 102 cases admitted in the hospital, major population was admitted to the general medicine department i.e., 47(45.07%) patients. 28 (27.45%) patients were admitted to the neurology department, 12 (11.76%) patients were admitted to the orthopaedic department, 10(9.80%) patients were admitted to the general surgery department, 3 (2.94%) patients were admitted in the Emergency medicine department, 2 (1.96%) each were admitted in the gastroenterology department which was similar to the study conducted by the **M ANJUM S et.al**.

The distribution of PIMs across the department is as follows: general medicine department had 51 PIMS, neurology had 41 PIMs, orthopaedics had 10 PIMs, general surgery had 7 PIMs and emergency medicine had 5 PIMs in the prescriptions. Polypharmacy of varying severity was observed among all the patients admitted to the hospital. Where 48 prescriptions

(47.05%) contained hyper-polypharmacy. 36 prescriptions (35.29%) had major polypharmacy, 9 prescriptions (8.82%) had moderate polypharmacy and 9 prescription (8.82%) had minor polypharmacy.

Out of 113 PIMs found during the study, 58 PIMs were found in the category of drugs to be avoided in elderly patients according to Beers criteria. The highest number of PIMs in this category was the use of Aspirin (46.55%) followed by sliding scale Inj Human actrapid (29.32%), followed by pantoprazole (13.79%), Lorazepam (3.44%), midazolam (1.72%), Nifedipine (1.72%), phenobarbital (1.72%).

The overall potentially inappropriate medications prescribed are sliding scale insulin, tramadol, aspirin, Pantoprazole, Furosemide, mannitol, enoxaparin, rivaroxaban, gabapentin, spironolactone mirtazapine, amitriptyline, paroxetine, nitrofurantoin.

CONCLUSION

Our study concludes that prevalance of PIMs is high. Our study also highlights the need for creating awareness among the general practitioners and clinicians on this public health issue by conducting medical education programs on pharmacotherapy in elderly. The prescription patterns assessed during the study suggest the need to establish the concept of rational drug therapy. Polypharmacy is an unavoidable event in elderly patients; hence the healthcare professionals must be fully aware of the risks and evaluate each medication of the patient to avoid complications related to polypharmacy. Individualization of drug therapy can be used as a key to prevent drug safety issues among the older patients.

The use of inappropriate medications can be avoided using the Beers criteria 2023, which is one of the important clinical tools which can be wisely used by Physicians, Clinical pharmacist and health care providers. Beers criteria can be used as a guideline by the physicians while prescribing the drugs to the geriatric population. Before dispensing a medicine to the geriatric patient, the pharmacist should play an important role in assessing the appropriateness of the prescription so that the quality and efficacy of medical care given to geriatrics can be increased.

Clinical pharmacist can also discuss with the physician about drugs and suggest a better and a safer alternative to the geriatrics so that a proper decision is made regarding the right choice of a drug. Hence this study will help physicians and clinical pharmacists in clinical decision

making in geriatrics, where better pharmaceutical care can be provided to the geriatric patients.

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AUTHOR'S CONTRIBUTION

All the authors have contributed equally.

CONFLICT OF INTEREST

All authors declare that there are no conflicts of interest.

ETHICS DECLARATION

The Institutional Ethics Committee at RMES's College of Pharmacy approved the protocol. All residents in the hospital provided informed consent.

CONSENT FOR PUBLICATION

All authors have consented to the publication of their work.

COMPETING INTERESTS

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