

# Evaluation of Appropriateness in Prescription of Geriatric Population in Residents of Old Age Homes in District Headquarters

Ashitha Ephrem, Liya George, Satish S, Shabaraya AR

Department of Pharmacy Practice, Srinivas College of Pharmacy, Valachil, Mangalore

Corresponding Author: Ashitha Ephrem

## ABSTRACT

Elderly population use many drugs and physiological changes make them more vulnerable to effects. Correct drug prescribing in the elderly is a laborious task; different tools to assess appropriateness of prescription in geriatric include Beer's criteria, STOPP criteria and START criteria. Objective of the study was to evaluate and assess polypharmacy and appropriateness in prescription. A cross sectional study was carried out for a period of 6 months to assess polypharmacy and medication appropriateness in the residents of old age homes. Patients of both sex above 60 years of age, with at least one chronic illness were included. Polypharmacy was present in 57% prescriptions, 46% patients were on at least one PIM as per Beers criteria, and total of 24 prescriptions had 28 inappropriate medications as per STOPP criteria. According to START criteria 31 prescribing omissions was found from 27 inappropriate prescriptions. Polypharmacy and PIM are highly prevalent in geriatric population, which has a major health care outcome. Standard criteria should be considered before prescribing the medications in geriatric population.

In the present study an effort has been made to evaluate prescription for its inappropriateness by using BEERS, STOPP, and START criteria, which should be strictly implemented in routine clinical practice.

**Keywords:** Geriatrics, Polypharmacy, Beers criteria, STOPP criteria, START criteria.

## INTRODUCTION

World Health Organization evaluated that in every nine people there is one elderly individual that is of age more than 60 years. According to population census conducted on 2011 there are nearly 104 million elderly persons (aged 60 years or above) in India. Worldwide, the proportion of individuals over the age of 65 continues to grow more rapidly than other age groups who are more prone to illnesses. Certain types of drugs or drug classes have a high risk of very serious adverse reactions. Geriatric patient's process drugs differently when compared to a normal individual, therefore considered certain drug classes are considered potentially inappropriate for this age group. [1]

Polypharmacy in elderly is becoming a considerable problem because of greater health-care costs, risk of adverse drug events, drug-drug interactions, medication noncompliance, decreased functional activity, reduced functional capacity, and can increase the prevalence of drug associated morbidity and mortality. [4]

Inappropriate prescribing is additionally a challenge in elderly people. Appropriate prescribing is the outcome of the decision-making process that maximizes net individual health gains within the society's available resources.

There are different tools to assess appropriateness of prescription in geriatric include Beer's criteria, Screening Tool Of Older Persons Prescriptions (STOPP)

criteria, Screening Tool To Alert To Right Treatment (START) criteria, and Medication Appropriate Index (MAI).

### **BEERS CRITERIA**

Beers criteria are now extensively utilized in US as a tool to evaluate potentially inappropriate medications. The criteria have been accepted by the American Geriatrics Society (AGS) to help health professionals in improving medication safety in geriatric patients. The role of these criteria is to serve as a guide for clinical judgment in prescribing drugs to provide a safe and effective treatment for the older people.

Beers criteria contain 53 inappropriate medications or medication classes which are categorized into three categories:

- Those to be avoided in geriatrics: 34 drugs or classes.
- Those to be avoided in geriatrics with certain disease or syndromes that the drugs listed can exacerbate conditions and drugs to be avoided there. 14 medications
- Drugs to be used with caution: 5 medications

### **STOPP AND START CRITERIA**

STOPP criteria for elderly patients are mainly to avoid potentially inappropriate medications. It gives information regarding medications to be avoided in certain conditions. It has 65 criteria, which are categorized under different physiological systems. It mentions drugs to be avoided in a particular condition.

They include instances of mostly observed drug-drug and drug-disease interactions with specific area concerned to analgesic drugs, drugs that adversely affect older patients at risk of falls and duplicate drug class prescriptions. This criteria helps to improve the medication appropriateness, to prevent adverse events and to reduce the cost of treatment.

Older patients suffer from more than one comorbidities and they generally require certain drugs to be prescribed for their specific conditions. START criteria incorporates 22 evidence based indicators of

common prescribing omissions and they are arranged according to the relevant physiological system into a systematic list called screening tool to alert doctors to the right treatment (that is indicated, but not prescribed)

The START criteria address frequently observed examples of potentially inappropriate under prescribing, where no contraindication to prescription exists and life expectancy and functional status are improved in the patients.

### **MATERIALS AND METHODS**

**STUDY DESIGN:** A prospective cross-sectional study to assess polypharmacy and medication appropriateness using Beers, STOPP and START criteria.

**STUDY SITE:** The study was conducted in old age homes Kasaragod.

**STUDY DURATION:** The study was conducted for a duration of 6 months from September 2018 to February 2019.

**SAMPLE SIZE:** The study was limited for a sample of 100 based on the time schedule allotted for the project including other circumstances.

**ETHICAL CLEARANCE:** The study protocol was approved by the Institutional Ethics Committee (IEC) of Srinivas Institute of Medical Science, Mukka, Mangaluru. (Ref. No: EC/0009/18-19).

### **STUDY CRITERIA**

**Inclusion criteria:** Patients selected were both sex above 60 years of age, with at least one chronic illness and taking more than 5 or more medications.

**Exclusion criteria:** Patients who are less than 60 years of age and not willing to participate and without diagnosed medical condition or prescription

### **SOURCE OF DATA**

Data(s) for the study were collected using data collection form from the medical records of Aged care homes, Kasaragod and through direct interaction with the patient, nurse and other staffs.

### **STUDY METHOD**

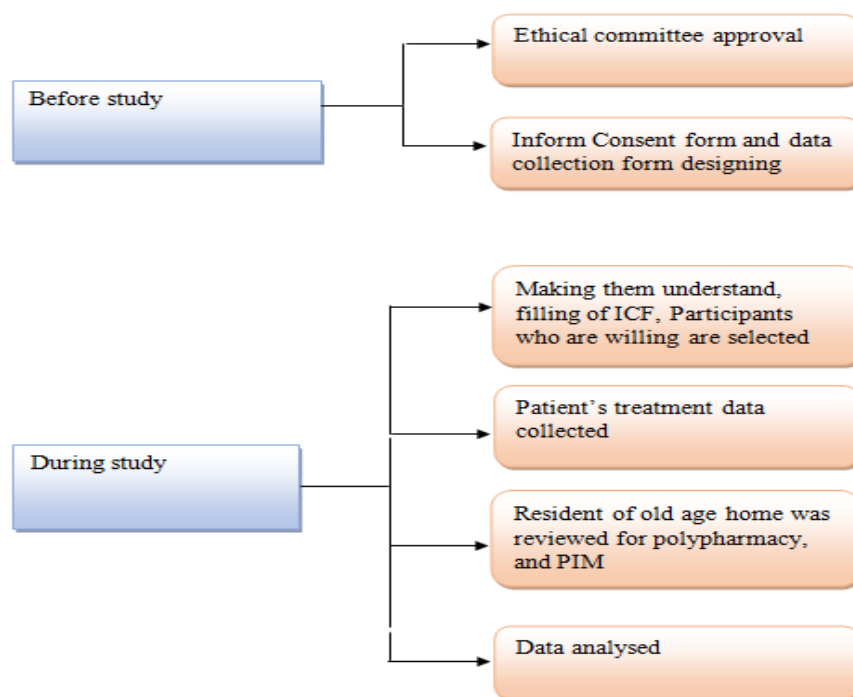
#### **Preparation of Inform Consent Form**

Inform consent form were prepared in Malayalam and English and same were used. Before selection of subjects the consent form was orally explained to the participants before filling it and non-verbally by taking help of caregiver and staffs who are well known of the subjects in old age home and made them understood. In the study only the participants willed to fill ICF were included.

### **Data(s) collection:**

Data(s) were collected using data collection form with the aid of medical records and through direct interaction with the patient, nurse and other staffs from old age homes, Kasaragod. Data collected include patient name, gender, age, diagnosis, biochemical investigations and the drug prescribed.

### **OPERATIONAL MODALITY**



The collected data(s) were analysed for polypharmacy and medication appropriateness. Medication appropriateness were analysed using BEERS criteria, Screening Tool of Older Persons Prescriptions (STOPP) criteria, Screening Tool to Alert to Right Treatment (START) criteria. The obtained results after the application of suitable tools were analysed in Microsoft excel and all the data(s) were kept confidential.

### **DATA ANALYSIS**

Statistical analysis involves collecting and analysing of every data sample in a set of items from which samples were drawn and a suitable statistical test was applied to analyse the data. The collected data(s) were analysed using Microsoft excel.

## **RESULT**

### **DEMOGRAPHIC CHARACTERISTICS OF THE STUDY PARTICIPANTS**

Among 100 participants, 54(54%) male and 46(46%) were female, distributed according to age group to compare the incidents of PIM in different age group. Majority of participants (60) were of 60-70 age group, 35 participants from 71-80 age

group. Very least participants (5) were of the range 81-90. Around 43(43%) study participants were receiving <5 medications and 57 (57%) participants were on 5 or more medications. Mean number of medicines used by participants was  $4.81 \pm 1.77$  (range 1-10), the data observation confirms polypharmacy among majority of population.

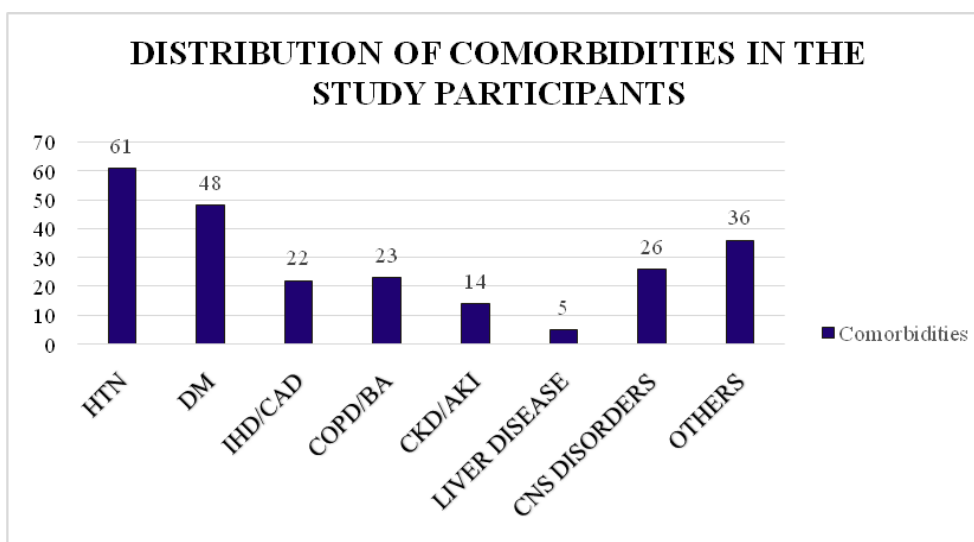
### PREVALENCE OF POLYPHARMACY

Prescription were thoroughly analysed to check polypharmacy. Out of 100 prescriptions analysed, 57 prescriptions had 5 or greater than 5 medications i.e., 57 (57%) participants were observed with polypharmacy. Of this 32(57.14%) male and

25(42.85%) females, receiving 5 or more than 5 medications.

### DISTRIBUTION OF COMORBIDITIES IN THE STUDY PARTICIPANTS

The study participants had various comorbidities (graph 2), most prevalent comorbidity observed in the participants were HTN (61%) and DM (48%).



Graph 1: Distribution of comorbidities in the study participants

### Distribution of Elderly Patients with Number of Comorbidities (N=100)

Out of the 100 prescriptions evaluated 91% patients had greater than 1 comorbidity. 33% of the patients had 2 comorbidities, 30% had 3 comorbidities, 18% of the patients had 4 comorbidities and 8% of the participants had 5 comorbidities. Out of the 100 participants only 2% had more than 5 comorbidities. (Table no 1 and 4)

Table 1: Distribution of elderly patients based on the number of comorbidities

SL NO	Number of patients	Number of comorbidities
1	9	1
2	33	2
3	30	3
4	18	4
5	8	5
6	1	6
7	1	7

### DISTRIBUTION OF DRUGS PRESCRIBED ACCORDING TO ORGAN SYSTEM

In this study, a total of 481 drugs were prescribed for 100 participants. Most frequently prescribed drugs classes were cardiovascular system drugs 168(34.9%), endocrine drugs 68(14.1%) and Central Nervous System (CNS) drugs 50(10.3%) followed by gastro intestinal tract drugs and respiratory tract drugs.

Table 2: Distribution of drugs prescribed according to organ system

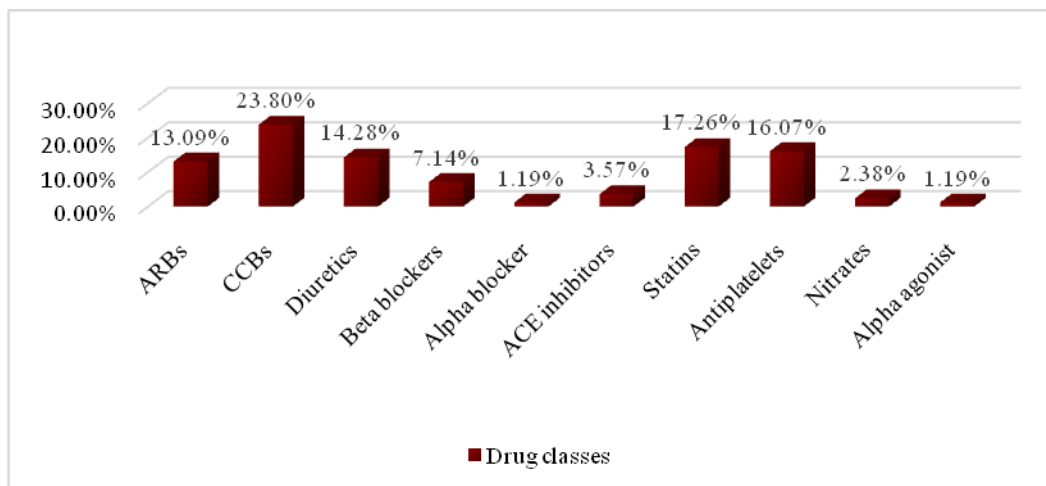
Organ system	Number (%)
Cardiovascular system	168(34.9%)
Antimicrobials	12(2.4%)
Gastrointestinal system	47(9.7%)
Multi vitamins	32(6.6%)
Respiratory system	37(7.6%)
CNS	50(10.3%)
Endocrine system	68 (14.1%)
Genitourinary System	6 (1.2%)
Analgesics	26 (5.4%)
Immunosuppressant's	8 (1.6%)
Others	26 (5.4%)

### UTILIZATION OF MEDICATIONS FOR CHRONIC CONDITIONS

Cardiovascular System Medication Utilization

A total of 168 cardiovascular system drugs prescribed for 83 participants who were on the treatment of various cardiovascular complications viz., IHD, CAD, hypertension. Calcium channel blocker

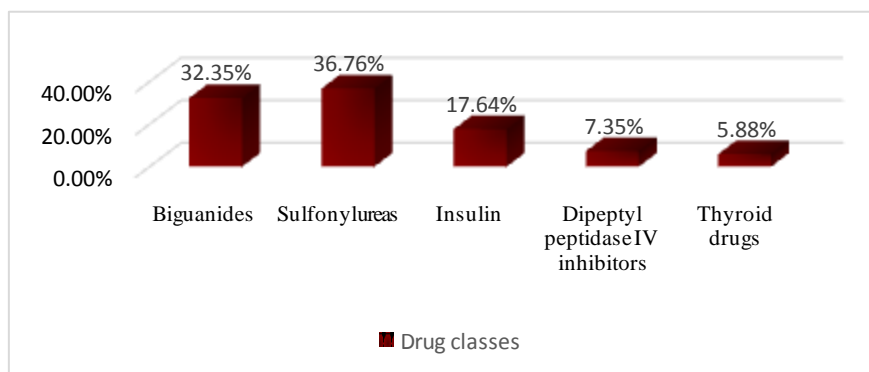
(23.80%) were most frequently prescribed drug class to the participants, followed by statins (17.26%) and anti-platelet agents (16.07%). Alpha agonist and Alpha blockers are the less frequently prescribed drugs.



Graph 2: Cardiovascular system medication utilization

### Endocrine System Medication Utilization

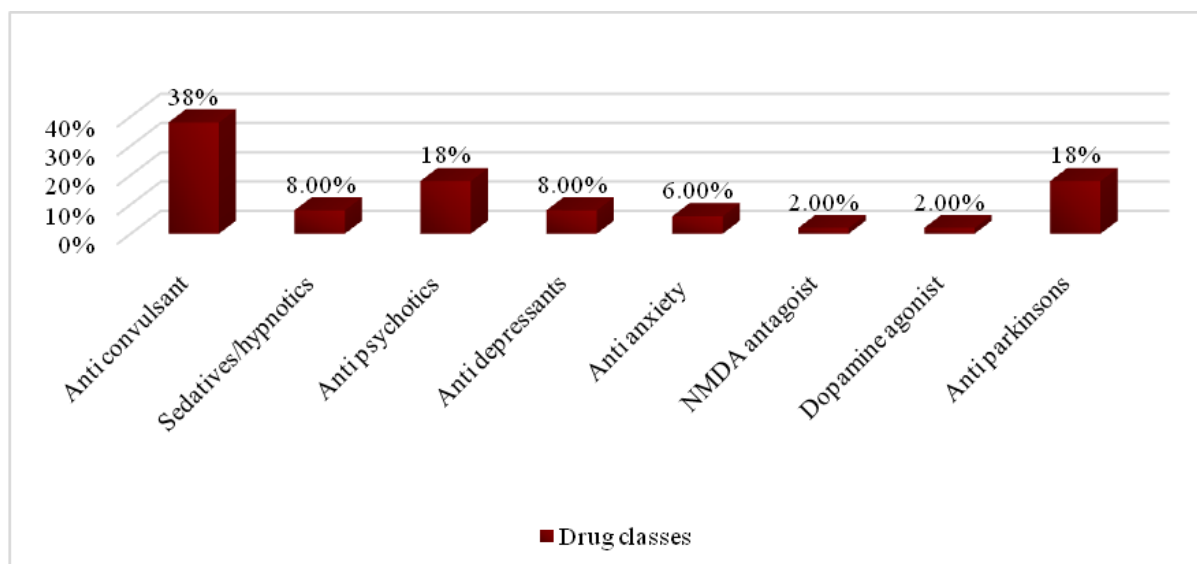
A total of 68 drugs acting on the endocrine system were prescribed for 48 participants, who were on the treatment of various endocrine complications, viz., Diabetes mellitus, Hypothyroidism, Out of which most frequently prescribed drug class were sulfonylureas (36.76%) followed by biguanides (32.35%) and insulin (17.64%).



Graph 3: Endocrine system medication utilization

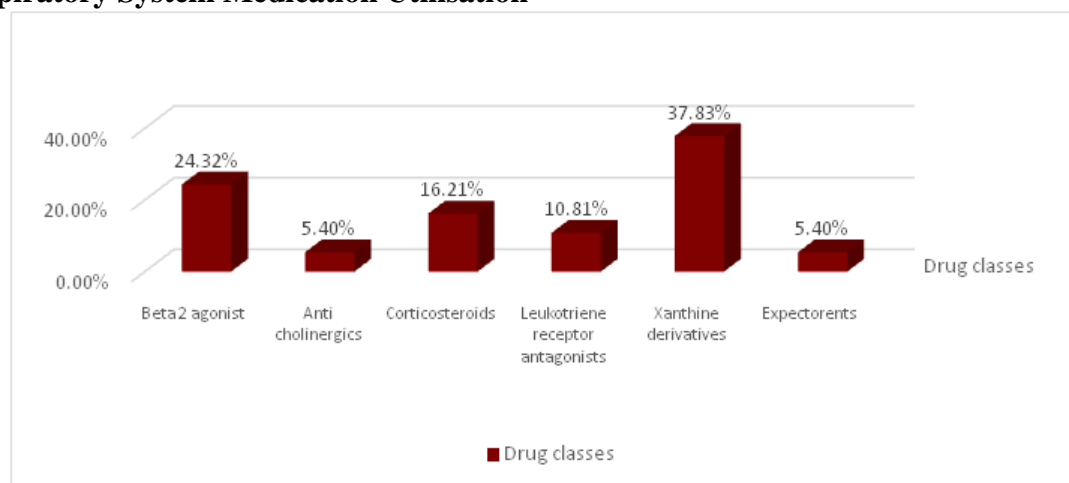
### Central Nervous System Medication Utilisation

A total of 50 CNS drugs have been prescribed for 26 participants who were on the management of various nervous system complications, viz, epilepsy, Parkinsonism, dementia, psychosis, bipolar disorder, and stroke. Out of which Anti convulsions agents were the more often prescribed drug class (38%) followed by Anti-psychotics (18%) and anti-Parkinson agents (18%).



Graph 4: Central Nervous System medication utilization

### Respiratory System Medication Utilisation



Graph 5: Respiratory system medication utilization

A total of 37 Respiratory tract system drugs have been prescribed for 100 participants who were on+ the treatment of various respiratory system complications, viz, Bronchial asthma, COPD and LRTI. Out of which Xanthine derivatives were the most frequently used drug class (37.83%) followed by  $\beta$ -2 agonists (24.32%) and corticosteroids (16.21%).

### BEERS CRITERIA

#### Potentially Inappropriate Medications Prevalence:

Prescription from the study participant were analysed by applying BEERS criteria. Among the 100 prescriptions evaluated, 46 (46%)

prescriptions were on at least 1 Potentially Inappropriate medication (PIM). Out of which 12 prescriptions had greater than 1 potentially inappropriate medication. Application of Beers criteria to 100 prescriptions resulted in 58 PIMs.

Table 3: PIM's Prevalence

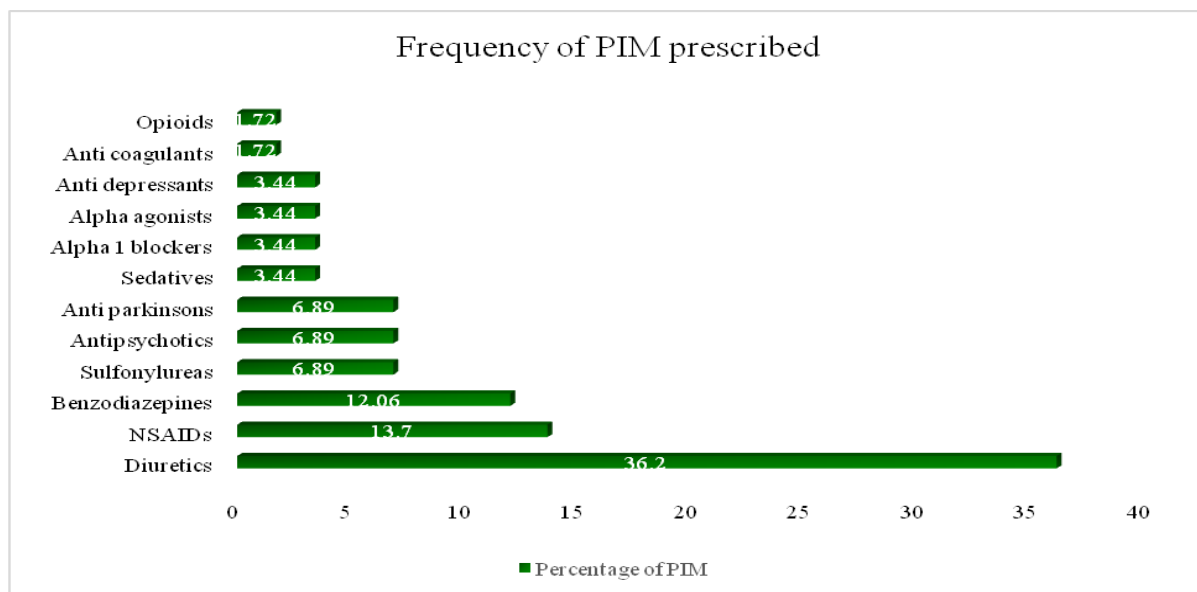
Total medications	481
Mean number of medication (range)	4.81 (1-10)
Number of participants with at least one PIM	46
Total number of PIM	58

#### Frequency of PIM prescribed as per BEERS criteria

Most frequently prescribed 3 classes of PIM was observed with Diuretics (36.2%), NSAID's (13.7%) and Benzodiazepines



(12.07%). Several other drugs and drug classes account for the remaining PIM include sulfonylurea (6.89%), antipsychotic (6.89%), ant parkinsonism agents(6.89%), sedatives(3.44%), alpha 1 blockers(3.44%), alpha agonist (3.44%), anti-depressants (3.44%), anti-coagulants (1.72%), opioids (1.72%).



Graph 6: Frequency of PIM prescribed

### BEERS criteria classification

According to 2015 Beers criteria, PIMs identified were grouped into three categories, viz, should be avoided/ used with caution, avoided in certain conditions.

Table 4: Potentially Inappropriate Medications (PIM) according to BEERS criteria

NUMBER OF PATIENT	DRUGS	TOTAL n%
3	Lorazepam	22.41% (13 drugs)
7	Aspirin	
1	Diclofenac	
1	Trihexyphenidyl	
1	Tramadol	
	AVOID	
3	Clonazepam	39.65% (23 drugs)
1	Olanzapine	
2	Prazosin	
4	Glibenclamide	
2	Zolpidem	
3	Trihexyphenidyl	
1	Alprazolam	
2	Risperidone	
1	Amitriptyline	
2	Clonidine	
1	Quetiapine	
1	Torsemide	
	USE WITH CAUTION	
1	Chlorthalidone	37.93% (22 drugs)
1	Duloxetine	
9	Furosemide	
1	Dabigatran	
3	Torsemide	
1	Lasilactone	
3	Spironolactone	
3	Hydrochlorothiazide	

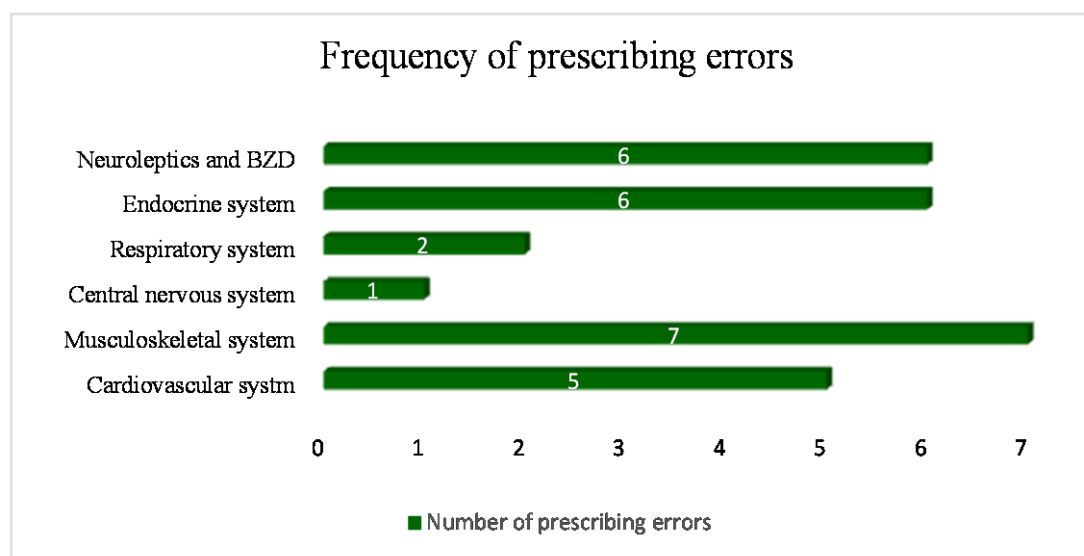
## STOPP CRITERIA

### Subgroup Analysis of PIMs as per STOPP criteria

Out of 100 prescriptions that were analysed for prescribing errors in elderly, 24 prescriptions had at least one error as per STOPP Criteria. Out of this 24 prescriptions 20 prescriptions had one error and 4 prescriptions had 2 prescribing errors. The total PIMs identified in this study was 28. The most common Potentially Inappropriate medication prescribed were NSAID with chronic renal failure, Glibenclamide with type II DM, Calcium channel blockers with chronic constipation and use of neuroleptic agents and benzodiazepines.

Table 5: Sub group analysis of PIM by STOPP Criteria

Drug category as per STOPP criteria	Type of STOPP criteria to which prescribing error was attributed	Number of population
Cardiovascular system	CCB with chronic constipation	3
	Aspirin without coronary, cerebral/ peripheral arterial symptoms/occlusive arterial events	1
	Loop diuretics for dependent ankle edema /i.e. no clinical signs of Heart Failure(HF)	2
Musculoskeletal system	NSAID with heart failure	1
	NSAID with chronic renal failure	6
Central Nervous system	Tricyclic antidepressant with opiate /calcium channel blocker(CCB)	1
Respiratory system	Theophylline as monotherapy for COPD	2
Endocrine System	Glibenclamide with Type II Diabetes Mellitus	5
	B-Blockers in those with Diabetes Mellitus & frequent hypoglycaemic episodes	1
Drugs that adversely affect those prone to falls	Neuroleptic drugs	3
	Benzodiazepine	3
Total number of PIMs		28



Graph 7: Frequency of prescribing errors

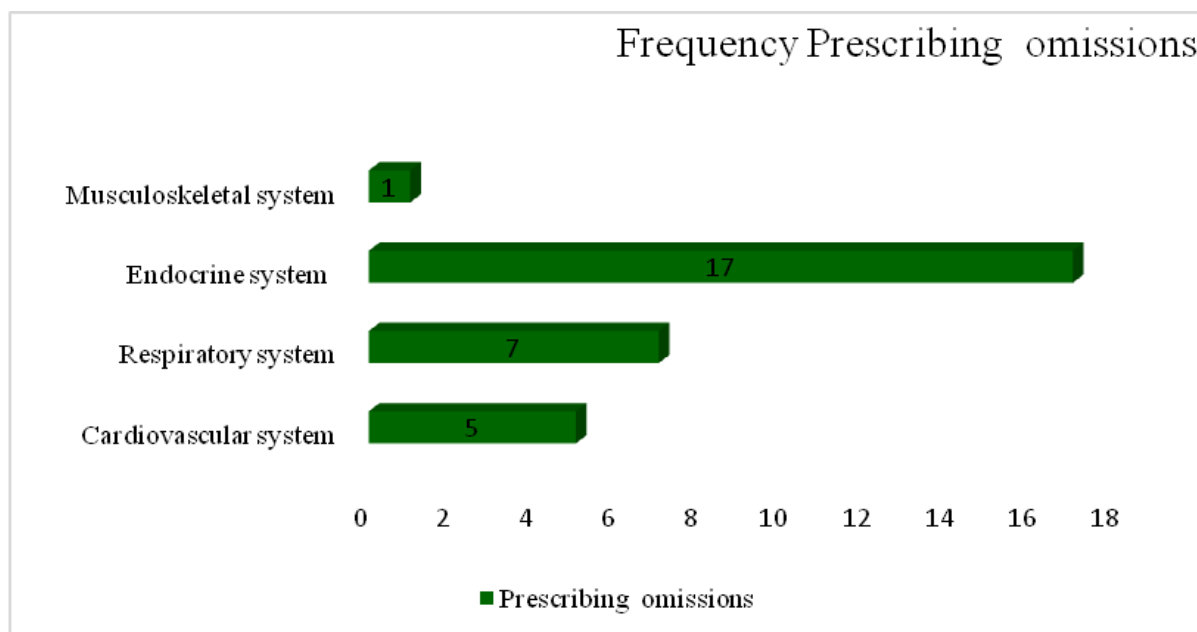
## START CRITERIA

Application of START criteria to 100 prescriptions under study showed incidences of 31 potentially prescribing omissions (PPOs). There are 27 prescriptions with at least one PPOs, out of which 23 prescriptions had only one PPO while 4 prescriptions had 2 PPOs. Most commonly observed PPOs were Metformin with Type II Diabetes Mellitus+/- metabolic syndrome(17), Regular inhaled  $\beta$ 2 agonists or Anticholinergic agents for mild to moderate asthma or COPD(8) and Statin therapy with history of coronary, cerebral, or peripheral vascular disease without contraindication(3).



**Table 6: Subgroup analysis (organ system) of PIMs as per START criteria**

Drug category as per START criteria	Type of START criteria to which prescribing error was attributed	Number
Cardiovascular system	Statin therapy with history of coronary, cerebral, or peripheral vascular disease without contraindication	3
	B- Blocker with chronic stable angina.	1
	ACE Inhibitor with chronic heart failure.	1
Respiratory system	Regular inhaled $\beta$ -2 agonists or Anticholinergic agents for mild to moderate asthma or COPD	8
Endocrine system	Metformin with Type II Diabetes Mellitus+/- metabolic syndrome	17
Musculoskeletal system	Bisphosphonates in patients who are taking maintenance oral corticosteroid therapy.	1
Total number of PPO		31



**Graph 8: Frequency of prescribing omissions**

**Table 7: Tally of PIM as per STOPP /START, BEERS Criteria**

Criteria	Number of prescriptions with at least one PIM or PPO	Proportions of patients receiving prescription with at least one PIM or PPO	Total number of PIM or PPO
BEERS	46	46%	58
STOPP	24	24%	28
START	27	27%	31

## DISCUSSION

Rationalizing drug prescriptions in this group is a difficult task which requiring a multistep approach like identifying problem areas, and suggesting interventions to improve prescribing pattern. [6] The use of multiple medications is common in elderly patients due to the presence of complicated chronic diseases and comorbidities. In a study conducted by K. B. Rakesh, *et al.*, The incidence of Polypharmacy is 66.2%, and there is no significant difference in the percentage of polypharmacy among both the genders. [6] Polypharmacy can also leads to prescribing cascade. Continuous medication reviews reduces the number and frequency

of medications in elderly and could serve as a remedial step to reduce polypharmacy. [19]

Polypharmacy in the elderly patients is a result of multiple comorbidities like hypertension, diabetes, cardiac diseases and their complications. HTN and DM were seen in a majority of elderly population, similar to the study carried out by Al Ameri *et al.* [18] In our present study out of the 100 prescriptions evaluated 91% patients had greater than one comorbidity.

When evaluating drug utilisation for chronic illness showed high utilisation of medications related to CVS, where CCBs are most frequently used followed by statins and antiplatelet agents. Similar study was

conducted by Hasan *et al.*, where most frequently prescribed were statins followed by CCBs. [5] Our study shows a high utilisation of drugs related to cardiovascular system (39.4%) similar to the study by Murthy *et al.*, [18] due to high proportion of cardiovascular diseases in the study participants.

The appropriateness of medications prescribed were analysed by using different criteria i.e., Beers criteria, STOPP criteria, and START criteria. These criterias are widely used by researchers, regulators, and policy-makers for medication review in multi morbid older patients, these criteria are more relevant, because of the use of an Evidence Based approach to regularly updates. All these criteria alert the clinicians and help to identify the potentially inappropriate medications used in elderly patients.

Analysis of PIM shows there was a relatively high prevalence of PIM (potentially inappropriate medication) use among study participants. Among the 100 prescriptions evaluated, 46 (46%) prescriptions had on at least one Potentially Inappropriate medication according to AGS BEERS Criteria 2015. Out of which 12 prescriptions had more than one potentially inappropriate medication. Application of Beers criteria to 100 prescriptions resulted in 58 PIMs.

Davidoff *et al.*, in his study, reported 42% of the prescriptions had at least 1PIM according to BEERS criteria, and Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) were the highly prevalent (10.9%) drug class. In the present study the most prevalent potentially inappropriate medication classes in accordance with BEERS criteria include Diuretics (36.2%), NSAID's (13.7%) and Benzodiazepines (12.07%). Other drugs and drugs classes account for the remaining PIM include sulfonylurea (6.89%), antipsychotic(6.89%), anti-parkinsonism agents(6.89%), sedatives (3.44%), alpha 1 blockers(3.44%), alpha agonist (3.44%), anti-depressants(3.44%), anti-coagulants (1.72%), opioids(1.72%).

In a study by Edward Ket *et al.*, in a US Military hospital 73% of the patient had at least 1 PIM and top 3 classes of PIM were Antihistamines (11, 15.3%), NSAIDs(10, 13.9%),& benzodiazepines (6, 8.3%). [20] A study conducted in South Korea by Grace JuyunKim showed that the number of participants with at least 1 BEERS criteria medication was 77.2%. The prevalence of inappropriateness of medication was high may be because of the large sample size (n=166,822). [23]

Next step in our study was to identify prescribing errors in geriatric patients with the use of START/STOPP criteria. STOPP criteria comprises of 65 clinical criterias arranged in accordance with the physiological system accompanied by explanations why the prescription is potentially inappropriate. START Criteria was used along with STOPP Criteria to identify correct treatment for elderly. 22 medications were arranged as per the physiological system and that should be considered for patients with certain conditions.

The study was done by analysing the prescriptions to identify the prescription errors such as inappropriate medication and prescription omissions with the use of STOPP and START criteria. In our study 24 prescriptions has at least one prescription error or PIM as per STOPP criteria, in which 4 prescriptions had more than one potentially inappropriate medications. A study by Managala B *et al.*, conducted in Maharashtra showed proportion of patient receiving PIM to be 21%. [19] In the present study PIM was observed slightly higher than some studies conducted in the same area.

A study carried out in Netherland by Van der Stelt CA *et al.*, showed that 34.1% of patients receiving PIM as per STOPP Criteria [14] while a study from Brazil by Mori AL *et al.*, showed a prevalence of 13.9%. [15] In a study carried out by Olivia Dalleur prevalence of inappropriate medication was found to be high as 51%. Considering the type of drug prescribed in the geriatric patient as said by STOPP

criteria, the most prevalent PIMs was found to be the overuse and misuse of benzodiazepines, NSAIDs and opiates. [21] The present study also witnessed the use of NSAIDs more prevalent.

The proportion of PIM in our study was 28%, similar to the study carried out by Gallagher *et al.*, reports that the percentage of PIMs to be between 12-40% and the result of our study falls between the same ranges. [3]

Considering the START Criteria for PPOs (Potential Prescribing Omissions), it was found that the patients exposed to PPOs in the current study was 27, out of which 23 prescriptions had only one PPO while 4 prescriptions had 2 PPOs. A total of 31 PPOs had been observed.

Most common instances of underutilisation include Metformin with Type II Diabetes Mellitus +/- metabolic syndrome (17), Regular inhaled  $\beta_2$  agonists or anticholinergics for mild to moderate asthma or COPD and Statin therapy with history of coronary, cerebral, or peripheral vascular disease without contraindication,  $\beta$ -blocker with chronic stable angina, ACE inhibitor for chronic heart failure, Bisphosphonates in patients who are taking maintenance oral corticosteroid therapy. Underutilization of metformin for Type II Diabetes Mellitus may increase the risk of hypoglycemic episodes and diabetes related mortality, ACE inhibitors, statins and Beta blockers can reduce the survival benefit and increase mortality and morbidity from cardiovascular disorders. Underutilization of regular inhaled  $\beta_2$  agonists or anticholinergic agents can increase the exacerbation of acute asthma and further leading to hospitalization.

These results were similar to the study carried out by Krishna Jagtap *et al.*, where it was found that proportion of patient exposed to PPOs in the study was 33.33%. The most common underutilization of drugs included ACE Inhibitors with heart failure, statins with evidence of coronary, cerebral, or peripheral vascular disease without contraindication.

## CONCLUSION

The use of medications in a disease condition is mandatory. But unnecessary use of medications in the patients can increase the safety issues. Polypharmacy and PIM are frequently observed problems in geriatric population, in our study an attempt has been made to evaluate prescription for its inappropriateness by using BEERs, STOPP, and START criteria, which should be strictly implemented in routine clinical practice.

## REFERENCES

1. Oliveira M, Amorim W, Jesus S, Heine J, Coqueiro H, Passos L. A comparison of the Beers and STOPP criteria for identifying the use of potentially inappropriate medications among elderly patients in primary care. *Journal of Evaluation in Clinical Practice*. 2015 Apr;21(2):320-5.
2. Emily R, Hanlon J, Hajjar E. Polypharmacy in elderly patients. *American Journal of Geriatric Pharmacotherapy*. 2007 Dec;5(4): 345-51.
3. Gallagher PF, M N O' Connor, D O' Mahony. Prevention of potentially inappropriate prescribing for elderly patients: a randomized controlled trial using STOPP/START criteria. *Clinical pharmacology and therapeutics*. 2011 Jun;89(6):845-54.
4. Mahony OD, Gallagher P, Ryan C, Byrne S, Hamilton H, Barry P *et al.* STOPP & START criteria: A new approach to detecting potentially inappropriate prescribing in old age. *European Geriatric Medicine*. 2010 Feb;1(1):45-51.
5. Rakesh KB, Mukta N Chowta, Ashok K Shenoy, Rajeshwari Shastri, Sunil B Pai. Evaluation of polypharmacy and appropriateness of prescription in geriatric patients: A cross-sectional at a tertiary care hospital. *Indian Journal of Pharmacology*. Jan-Feb 2017;49(1):16-20.
6. Steinman M, Beizer J, DuBeau C, Laird R, Lundebjerg N, Mulhausen P. How to Use the American Geriatrics Society 2015 Beers Criteria-A Guide for Patients, Clinicians, Health Systems, and Payors. *Journal of the American Geriatrics Society*. 2015 Dec; 63(12):e1-e7.

7. Salbu R, Feuer J. A Closer Look at the 2015 Beers Criteria. *Journal of Pharmacy Practice*. 2017 Aug;30(4):419-424.
  8. Terrery C, Nicoteri J. The 2015 American Geriatric Society Beers Criteria: Implications for Nurse Practitioners. *The Journal for Nurse Practitioners*. 2016 Mar; 12(3):192-200.
  9. Mahony OD, Gallagher P, Lavan A. Methods to reduce prescribing errors in elderly patients with multimorbidity. *Clinical Interventions in Aging*. 2016 Jun ;23(11):857-66.
  10. Alfaro Lara E, Vega Coca M, GalvánBanqueri M, Marín Gil R, Nieto Martín M, Pérez Guerrero C et al. Selection of tools for reconciliation, compliance and appropriateness of treatment in patients with multiple chronic conditions. *European Journal of Internal Medicine*. 2012 Sep; 23(6):506-12.
  11. Van der Stelt C, VermeulenWindsant-van den Tweel A, Egberts A, van den Bemt P, Leendertse A, Hermens W et al. The Association between Potentially Inappropriate Prescribing and Medication-Related Hospital Admission. *Drug Safety Journal*. 2016 Jan;39(1):79-87.
  12. Mori A, Carvalho R, Aguiar P, de Lima M, Rossi M, Carrillo J et al. Potentially inappropriate prescribing and associated factors in elderly patients at hospital discharge in Brazil: a cross-sectional study. *International Journal of Clinical Pharmacy*. 2017 Apr;39(2):386-393.
  13. Ryan C, Mahony OD, Kennedy J, Weedle P, Byrne S. Potentially inappropriate prescribing in an Irish elderly population in primary care. *British Journal of Clinical Pharmacology*. 2009 Dec;68(6):936-47.
  14. Al Ameri MN, Makramalla E, Albur U, Kumar A, Rao P. Prevalence of polypharmacy in the elderly: Implications of age, gender, comorbidities and drug interactions. *Journal of Pharmacy and Pharmaceutical Science*. 2015 Sep;1(3):1-7.
  15. Ryan C, O'Mahony D, Byrne S. Application of STOPP and START criteria: interrater reliability among pharmacists. *Annals of Pharmacotherapy*. 2009 Jul;43(7):1239-44.
  16. Sharma N, Advani U, kulshreshtha S, Parakh R, Bansal A, Sinha RR. Screening of prescriptions in geriatric population in a tertiary care teaching hospital in north India. *The Journal of Phytopharmacology*. 2013; 2(5): 38-45.
  17. Pyszka LL, SeysRanola TM, Milhans SM. Identification of inappropriate prescribing in geriatrics at a Veterans Affairs hospital using STOPP/START screening tools. *Consult Pharm*. 2010 Jun;25(6):365-73.
- How to cite this article: Ephrem A, George L, Satish S et.al. Evaluation of appropriateness in prescription of geriatric population in residents of old age homes in district headquarters. *Int J Health Sci Res*. 2020; 10(6):309-320.

\*\*\*\*\*