

Research Article

Prevalence of potentially inappropriate medication use and drug utilization pattern in elderly patients: a prospective study from a tertiary care hospital

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ABSTRACT

Background: To investigate the prevalence of potentially inappropriate medications (PIMs) using updated Beers criteria 2012 and drug utilization study among the elderly patients attending the various outpatient departments (OPDs) of a tertiary care hospital at Pondicherry in India.

Methods: This prospective, observational study involving patients aged 65 years and above, was planned and conducted over a period of six months, who attended the various OPDs were included in the study. Prescriptions were collected from the consulting rooms and pharmacy.

Results: A total of 600 patients aged 65 years and above were involved in our study. Majority (61.83%) were in the age group of 65-70 years. There was a male preponderance (61.83%). Total of 1769 drugs were prescribed, giving an average of 2.98 drugs per person (range 1 to 9). Polypharmacy (≥ 5 drugs) were observed in 99 patients. Of the total 748 disease conditions, cardiovascular diseases were the most prevalent (29.33%) among the elderly patients. Almost 114 patients had comorbid conditions. General medicine department was the highest (28.83%) visited patients. Frequently prescribed drugs belong to the category of analgesic and anti-inflammatory agents (16.50%). Fixed Dose Combination (FDC) was 31%. Almost 110 patients received PIMs from Beers list; majority were belonging to category 1. NSAIDs (30.66%) were the highest PIMs prescribed to musculoskeletal disorders. With regard to WHO indicator, 377 (21.31%) drugs were prescribed by generic name. Utilization from Indian national list of essential medicine was 76.82%. Percentage of encounters in which an antibiotic and injections was prescribed to 23.5% and 26.33% respectively.

Conclusions: Study has shown the prevalence of disease pattern, comorbidity, drug usage in elderly. PIMs, polypharmacy and FDC were high among the elderly. Prescribers need to be educated about Beers criteria and encouraged for rational prescription.

Keywords: Beers criteria, Potentially inappropriate medications, Elderly patients, Polypharmacy

INTRODUCTION

The life span of the human has been increasing in recent years especially in the developing countries like India due to social, economic and health care improvement. As per WHO, most developed countries have accepted the chronological age of 65 years and above as a definition of

'elderly' or older person.¹ At present in India the elderly population account for 7.4% of total population, it is projected to rise to 12.4% of population by the year 2026.² India is the third country after China and USA with large elderly population in the world. People over the age of 65 years have a higher prevalence of chronic illness, disability and dependency than those less than 65

years. They are more likely to be on medication than younger people. They are often taking several drugs at once to treat concomitant disease processes. Elder people are a heterogeneous group, often presenting with multiple comorbid illnesses resulting to multiple prescriptions. Prescribing for elder people is challenging in recent era, as any new medication must be considered in the context of altered pharmacokinetics, altered physiological effect of the drug and age-related changes in body composition and physiology.³ Multiple drug use and polypharmacy is highly prevalent in elderly, the use of multiple prescriptions are justified in the treatment of multiple chronic diseases. However, polypharmacy is known to dramatically increase the risk of adverse drug reactions (ADRs), drug–drug and drug–disease interactions which results in increase cost of therapy.⁴

Among the elderly, prescription of potentially inappropriate medications (PIMs) has been found to be a common cause of morbidity and mortality, which was the most important triggering factor for the creation of criteria for the safe use of medicines among the elderly, namely the Beers criteria, which was initially released in 1997 and updated in 2002 and 2012.⁵⁻⁷ The Beers criteria are based on a consensus of experts from different disciplines like geriatrics, clinical pharmacology, and psychopharmacology who used an adopted Delphi method. The Beers criteria consist of medications to be avoided in the elderly irrespective of the patient's diagnosis, and those that should be avoided when taking a particular diagnosis into account.⁶ Potentially Inappropriate medications, according to Beers criteria, are divided into three categories, such as category 1, category 2 and category 3. Beers criteria have become established as a standardized tool for pharmacological research especially for elderly age group.⁷

Understanding the age related physiological and pharmacological changes in the elderly population, we may avoid polypharmacy and regular review of all drug treatment will help in rational prescription, since the elderly population is on the rise in recent era. Setting objectives and guidelines may reduce unwanted adverse reactions due to inappropriate or over prescribing in elderly patients.⁸

Till date there is a paucity of research work combining drug utilization pattern and potentially inappropriate prescribing in a special population such as elderly. Therefore, the overall aim of the current study was to investigate the prevalence of potentially inappropriate medications prescribed for elderly patients attending the outpatient department of a tertiary care hospital at Pondicherry in India, using recent updated Beers criteria 2012. In addition, this study has been investigated for the drug utilization pattern among this cohort with WHO core prescribing indicators.

METHODS

Study design:

A hospital based prospective, observational and cross sectional study, involving patients aged 65 years and above was planned and conducted over a period of 6 months from October 2014 to March 2015 in Pondicherry Institute of Medical Sciences, a 650 bed tertiary care teaching hospital, Pondicherry, India. Institutional ethical committee approval was obtained prior to commencement of the study procedure.

Sample Selection:

Patients of either gender aged 65 years and above, who attended the various outpatient departments, were included in the study. At the end of each working day, prescriptions were collected from the consulting rooms of various outpatient departments and from pharmacy department. The information obtained from them was transferred into a prepared data sheet.

Data analysis:

For the drug utilization aspect of the study, data was collected in a structured proforma, which included age, sex, department, diagnosis, OPD registration number and complete prescription which includes the prescribed drugs and their dosages. These data were analysed under the following headings such as, demographic details, polypharmacy, prevalence of disease conditions, comorbid illness, department wise distribution of patients, category of drugs, mostly frequently prescribed drugs and FDC.

WHO prescribing indicators were assessed such as: (1) average number of the drugs per prescription, (2) percentage of the drugs prescribed by generic name, (3) percentage of encounters in which an antibiotic was prescribed, (4) percentage of encounters with an injection was prescribed, (5) percentage of the drugs prescribed from an essential drug list.⁹

For the potentially inappropriate prescription among the elderly, American geriatric society updated Beers criteria 2012 was used and analysed such as, Category 1: PIM and classes to avoid in older adults, Category 2: Category 1 with certain diseases and syndrome that the drugs listed can exacerbate and Category 3: drugs used with caution in older adults.⁷ Along with this, we assessed the frequency of PIMs prescription and disease conditions for the use of PIMs.

Statistical analysis:

All data were analyzed with the help of Microsoft Excel 2013 and IBM SPSS Statistics version 20 software.

RESULTS

In a six month period of study, a total of 600 patients aged 65 years and above were included and analyzed. Among the 600 patients, 371 (61.83%) were male and 229 (38.17%) were female, giving a male to female ratio of 1:0.61, are shown in Table 1. The demographic data (Figure 1) shows that the majority of the patients were in the age group of 65-70 years (371/600; 61.83%), followed by age group of 71-75 years were (122/600; 20.33%), 76-80 years were (50/600; 8.33%), 81-85 years

were (21/600; 3.5%) and 86-90 years were (20/600; 3.33%); the lowest number of patients were in the age group of 91-95 years (16/600; 2.66%).

Table 1: Gender distribution of elderly patients.

Gender	No of patients	Percentage
Male	371	61.83
Female	229	38.17

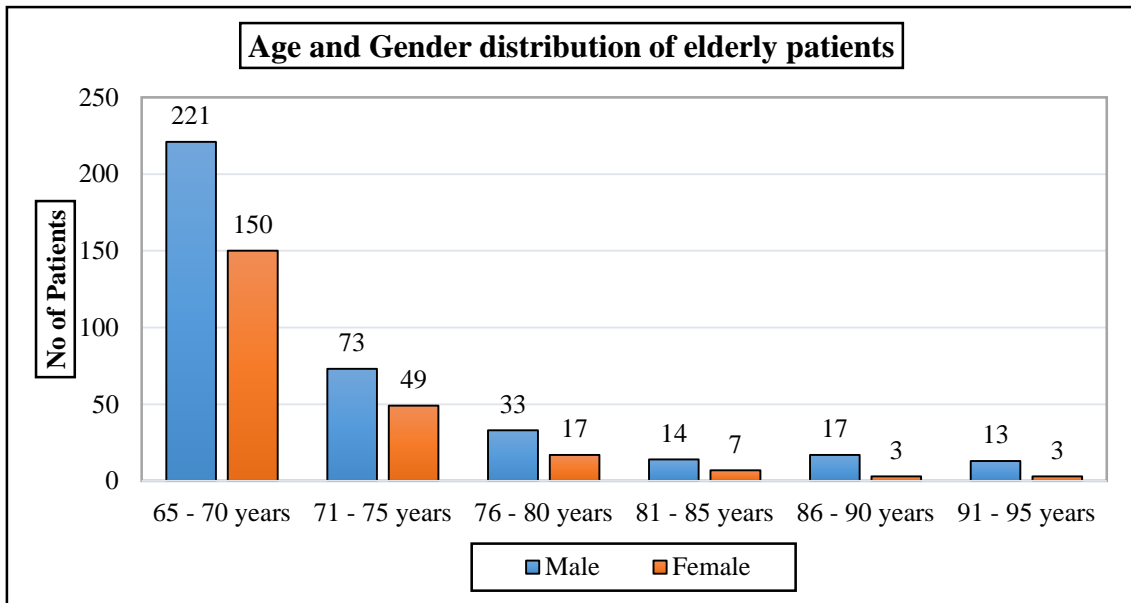


Figure 1: Demographic data.

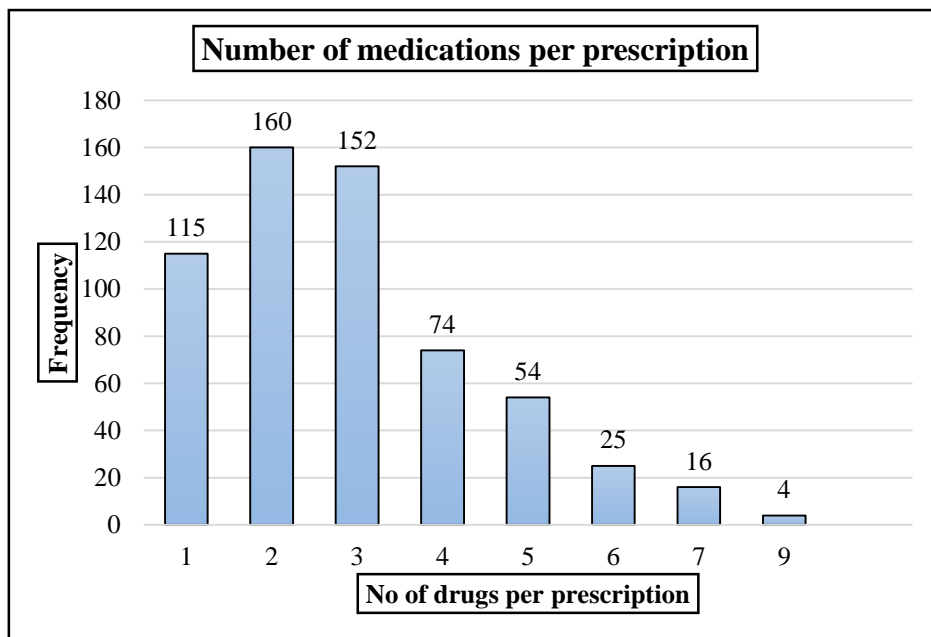


Figure 2: Frequency of medication prescription.

A total of 1769 drugs were prescribed for the patients, giving an average of 2.98 drugs per person (range 1 to 9). Almost 160 patients were prescribed by 2 drugs, followed by 152 patients had 3 drugs, 74 patients were prescribed by 4 drugs, 54 patients had 5 drugs, 25 patients were prescribed by 6 drugs and 16 patients were prescribed by 7 drugs. Combination of 9 drugs had been prescribed to 4 patients, which is shown in Figure 2.

With regard to WHO, prescribing indicator analysis shows that among the total drugs prescribed, about 377 (21.31%) drugs were prescribed by generic name. Utilization from the Indian national list of essential medicines was 1359 (76.82%). The percentage of encounters in which an antibiotic was prescribed in 141 patient encounters (23.5%) and an injection was prescribed in 158 patients encounters (26.33%), which is shown in Table 2.

Table 2: Drug usage pattern in elderly patients using WHO core drug indicator.

Prescribing Indicators assessed	Results
Total number of prescriptions analyzed	600
Total number of drugs prescribed	1769
Average number of drugs per prescription	2.95 (1-9 drugs)
Percentage of drugs prescribed by generic name	377/1769 (21.31%)
Percentage of drugs prescribed from essential drug list	1359/1769 (76.82%)
Percentage of encounters in which antibiotic prescribed	141/ 600 (23.5%)
Percentage of encounters in which injection prescribed	158/ 600 (26.33%)

Table 3: Prevalence of disease conditions among elderly patients.

Diseases / Conditions	No of diseases (% of patients suffering)
Cardiovascular Diseases	176 (29.33)
Musculoskeletal conditions	166 (27.67)
Endocrine disorder	80 (13.34)
Surgical conditions	52 (08.67)
Respiratory diseases	51 (08.50)
Dermatological diseases	34 (05.67)
Urogenital diseases	32 (05.34)
GIT diseases	31 (05.17)
CNS diseases	26 (04.34)
Renal diseases	24 (04)
Infectious diseases	20 (03.34)
ENT diseases	18 (03)
Ocular diseases	14 (2.33)
Gynaecological diseases	14 (2.33)
Psychiatric diseases	10 (1.67)
TOTAL	748

% calculated from a total of 600 patients.

The disease condition prevalent among these 600 patients was almost 748 diseases. Diseases related to cardiovascular system were the most common cause for attending the hospital (176; 29.33%), followed by musculoskeletal conditions (166; 27.67%) and endocrine disorder (80; 13.34%). The least frequently encountered were psychiatric diseases (10; 1.67%), which is shown in Table 3. Out of 600 patients almost 486 patients had just one disease; the remaining 114 patients had comorbid conditions ranging from 2 to 5, which are shown in Table 4.

Table 4: List of patients simultaneously suffering with comorbid illness.

No of diseases	No of patients (%)
1	486 (81)
2	81 (13.50)
3	16 (2.67)
4	9 (1.50)
5	8 (1.33)
Total	600 (100)

The department wise distribution of patients are shown in Table 5. The highest number of patients visited to general medicine department (173; 28.83%), followed by orthopaedic department (150; 25%) and cardiology department (95; 15.83%). The lowest number of patients visited to obstetrics and gynaecology department (06; 1%) and psychiatry department (05; 0.84%).

The category wise distribution of drugs prescribed is shown in Table 6. A total of 1769 drug formulations were prescribed to 600 patients. Out of the 1769 drugs, the most frequently prescribed drugs were belong to analgesic and anti-inflammatory drugs (292; 16.50%), followed by drugs acting on gastrointestinal system (252; 14.24%), antimicrobial agents (141; 7.97%), drugs acting on haematological system (127; 7.18%) and anti-hypertensive drugs (101; 5.71%). The least prescribed drugs were belonging to iron supplementation (22; 1.24%) and ocular drugs (09; 0.5%).

The most frequently prescribed drug was ranitidine 150mg (100 cases), followed by aceclofenac 100mg + paracetamol 500mg combination (69 cases), clopidogrel 75mg (63 cases), pantoprazole 40mg (63), methylcobalamin 1500mcg (53 cases), metformin 500mg to 1000mg (49 cases), calcium 500mg (47 cases), amlodipine 5mg to 10mg (42 cases), aspirin 75mg (37 cases) and atorvastatin 10mg (35 cases), which is shown in Table 7.

Fixed dose combinations were found in 186 (31%) patients, which is shown in Table 8. The most frequently

prescribed fixed dose combination was aceclofenac + paracetamol prescribed to 69(11.5%) patients, followed by amoxicillin + clavulanic acid 19(3.17%), clopidogrel + aspirin were 13 (2.17%) and Dutasteride + tamsulosin were prescribed to 10 (1.67%) patients.

Based on 2012 updated beers criteria by the American Geriatric Society, in our study we identified, out of 600 patients, 110 patients (18.34%) received at least one drug which was potentially inappropriate medication from Beers list. Out of 1769 drugs, a total of 137 PIMs were prescribed in all with 19 responsible medications identified. Among the 110 patients, 89 patients (89.91%) were prescribed to have single drug of PIMs from Beers list. Almost 15 patients (13.64%) were prescribed to have two different PIMs and 6 patients (5.45%) were prescribed to have three different PIMs from Beers list, which is shown in Figure 3. Medications to be avoided in elderly patients (Category 1) being the most common category of inappropriate use, which is shown in [Table 9]. Diclofenac was identified PIMs in 21 cases, followed by spironolactone in 17 cases, chlorzoxazone in 16 cases, digoxin in 15 cases, indomethacin in 12 cases, ibuprofen and sliding scale insulin were to 7 cases. Hydroxyzine and alprazolam were implicated in 6 and 5 cases, respectively. Drugs like prazosin, amiodarone and amitriptyline were implicated in 4 cases. Nitrofurantoin, clonazepam, diazepam and glyburide were implicated in 3 cases. Piroxicam and dicyclomine were implicated in 2 cases. Under Category 3, carbamazepine was the only drug they prescribed to 3 patients.

Table 5: Department wise distribution of patients.

Department	No of patients	Frequency (%)
General Medicine	173	28.83
Orthopaedics	150	25.00
Cardiology	95	15.83
General Surgery	42	7.00
Chest and TB	25	4.17
Nephrology	23	3.83
Dermatology and Venereology	21	3.50
Urology	21	3.50
Neurology	15	2.50
ENT	14	2.34
Ophthalmology	10	1.67
Obstetrics and Gynaecology	06	1.00
Psychiatry	05	0.84

% calculated from a total of 600 patients

Table 6: Category wise distribution of drugs.

Category of drugs	No of drugs	Percentage
Analgasic and anti-inflammatory drugs	292	16.50
Drugs acting on gastrointestinal system	252	14.24
Antimicrobial agents	141	7.97
Drugs acting on haematological system	127	7.18
Anti-hypertensive drugs	101	5.71
Drugs used in skeletal muscle relaxant	99	5.60
Multivitamin and Minerals	97	5.48
Drugs acting on respiratory system	88	4.97
Drugs used in Diabetes mellitus	86	4.86
Calcium and Vitamin D granules	81	4.58
Drugs acting on central nervous system	77	4.35
Drugs acting on renal system	59	3.33
Drugs used in dyslipidemia	52	2.94
Anti-histamine drugs	51	2.88
Drugs used in dermatological conditions	48	2.71
Drugs acting on cardiac system	44	2.48
Drugs used in urogenital disorders	23	1.30
Iron supplementation	22	1.24
Ocular drugs	09	0.50
Others	20	1.13

% calculated from a total of 1769 drugs

Table 7: List of 10 most frequently prescribed drugs.

Name of the drug	No of prescriptions
Ranitidine 150mg	100
Aceclofenac 100mg + Paracetamol 500mg	69
Clopidogrel 75mg	63
Pantoprazole 40mg	63
Methylcobalamin 1500mcg	53
Metformin 500mg to 1000mg	49
Calcium 500mg	47
Amlodipine 5mg to 10mg	42
Aspirin 75mg	37
Atorvastatin 10mg	35

Table 8: Fixed Dose Combination used in elderly patients (% consumptions out of 600 prescriptions).

Combinations used	Frequency of Prescription (%)
Aceclofenac + Paracetamol	69 (11.5)
Amoxicillin + Clavulanic acid	19 (3.17)
Clopidogrel + Aspirin	13 (2.17)
Dutasteride + Tamsulosin	10 (1.67)
Trypsin + Chymotrypsin	9 (1.5)
Cinnarizine + Dimenhydrinate	9 (1.5)
Gabapentin + Methylcobalamin	8 (1.33)
Montelukast + Levocetirizine	7 (1.17)
Ibuprofen + Paracetamol	7 (1.17)
Aceclofenac + Paracetamol + Chlorzoxazone	7 (1.17)
Salmeterol + Fluticasone MDI	7 (1.17)
Tiotropium + Formoterol + ciclesonide MDI	7 (1.17)
Metformin + Glimepiride	5 (0.83)
Carbidopa + Levodopa	5 (0.83)
Levocetirizine + Phenylephrine + Paracetamol	4 (0.67)

Table 9: List of potentially inappropriate medication use in older adults based on updated “Beers criteria 2012”.

Category	Name of the drug	Total =137	Frequency (%)
1	Medications and class to avoid in older adults:		
	Diclofenac	21	15.33
	Spirolactone	17	12.41
	Chlorzoxazone	16	11.68
	Digoxin	15	10.95
	Indomethacin	12	8.76
	Ibuprofen	07	5.11
	Sliding scale Insulin	07	5.11
	Hydroxyzine	06	4.38
	Alprazolam	05	3.65
	Prazosin	04	2.92
	Amiodarone	04	2.92
	Amitriptyline	04	2.92
	Nitrofurantoin	03	2.19
	Clonazepam	03	2.19
	Diazepam	03	2.19
	Glyburide	03	2.19
	Piroxicam	02	1.46
	Dicyclomine	02	1.46
2	To be avoided in combination with specific co-morbidity	NIL	
3	Medications to be used with caution in older adults		
	Carbamazepine	03	2.19

% calculated from a total of 137 PIMs drugs

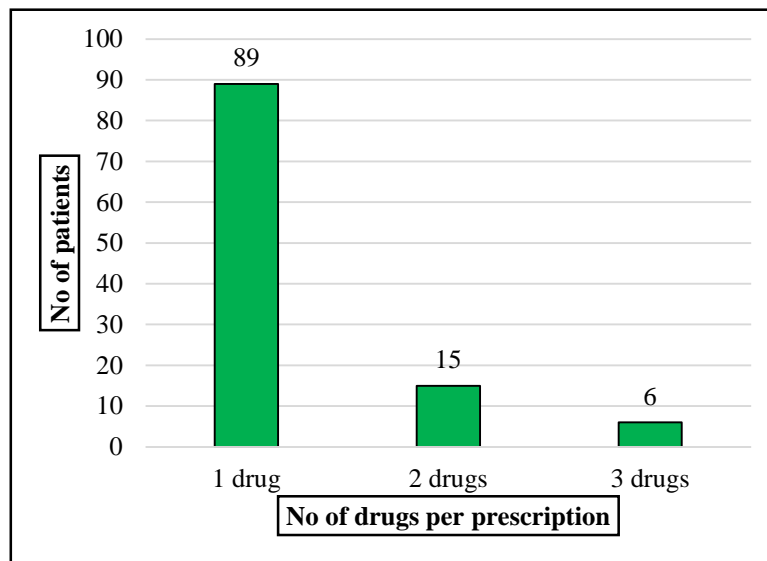


Figure 3: Frequency of PIMs prescribed from the list of updated Beers Criteria.

Common conditions for PIMs use was most frequently in musculoskeletal disorder which accounts for 58 cases (42.33%) followed by congestive cardiac failure 36 cases (26.28%) and insomnia 15 cases (10.95%). Conditions like diabetes mellitus and in chronic urticaria the use of PIMs were 10 cases (7.30%) and 6 cases (4.38%) respectively, which is shown in Table 10.

Table 10: Common conditions for use of PIM in elderly (% calculated out of 137 PIMs).

Condition	Frequency (%)
Musculoskeletal disorder	58 (42.33%)
Congestive cardiac failure	36 (26.28%)
Insomnia	15 (10.95%)
Diabetes mellitus	10 (7.30%)
Chronic urticaria	6 (4.38%)

DISCUSSION

In our current study, out of 600 elderly patients, more male patients (61.83%) visited the outpatient department and most of them were in the age group of 65 to 70 years (36.83%) followed by (12.17%) in the age group of 71 to 75 years, this finding is similar to previous other studies on geriatric patients conducted in India,^{10,11} confirms male preponderance. However, the situation is different in a few countries and this is clearly shown by some Nigerian and other studies among the elderly where a predominantly female population.^{12,13}

With regard to WHO drug prescribing indicator, the average number of drugs prescribed in our study was 2.9, which is in the same range as results from other geriatric prescription studies done in Turkey, Brazil and Nigeria found an average of 2.9, 3.2 and 3.8 drugs per prescription respectively.¹² Studies carried out among geriatric patients in India and USA found an average of 7.3 and 8.1 drugs per prescription respectively.^{11,14} The average number of drugs in our study is less than the other similar studies mentioned earlier. The prescription with the highest number of drugs in our study had nine, while similar study had 25 and 27 drugs prescribed.^{10,11} It is preferable to keep the number of drugs per prescription as low as possible since polypharmacy leads to increased risk of drug interactions, increased hospital cost and errors of prescribing. Use of five or more medications is considered as polypharmacy, which was observed in 99 (16.5%) patients in our study. In similar studies from India, Singapore and Germany, polypharmacy was found in 75.25%, 60% and 26.7% of patients, respectively.^{11,15,16} It has been claimed that patients taking two drugs face a 13% risk of adverse drug interactions, rising to 38% when taking four drugs and to 82% if seven or more drugs are given simultaneously.³ The magnitude of polypharmacy in our study is significantly less, when compare to 3 other earlier studies, the decreased polypharmacy in our study could be due to increased awareness about drugs, drug-drug interactions and its adverse effects among physicians, literate elders or care takers anticipating increased cost of medications.

The percentage of drugs prescribed by generic name was just 21.31%, which is very much less than the standard value of (100%),⁹ which indicate brand names are more popular among practitioners and they are directly influenced by various drug company representatives for undue favours. Similar hospital based study carried out by Shah RB et al. from Gujarat¹¹ reported to only 15.6%, which is low compared to the standard and to our findings. Similar other studies by Fadare JO et al. from Nigeria¹² and Neha Sharma et al. from Rajasthan¹⁷ reported to have 43.2% and 31.94% respectively, which is better than our finding but still low compared to the standard. Thus, we must educate and encourage our medical practitioners to adhere strictly to generic name for prescription. Prescribing by generic name also facilitate cheaper treatment for the patients.

In our study the percentage of encounters in which an antibiotic was prescribed to be 23.5%, which is acceptable and less than the standard value (20.0% - 26.8%), derived to be ideal.⁹ Study conducted by Uchenna IH et al. from Nigeria showed the similar percentage of antibiotic prescription (23%).¹⁸ This results revealed the importance of the judicious use of antibiotic to prevent emergence of resistance and ideal to use after culture and sensitivity. The percentage of encounters in which an injection was prescribed in our study was 26.33%, which is acceptable and slightly higher than the standard value (13.4% - 24.1%) derived to serve as ideal.⁹ Minimum use of injections is preferred and this reduces the risk of infection through parenteral route and cost incurred in therapy.

In this study the percentage of drugs prescribed from the Indian national essential drug list was 76.82%, though it was comparable with other Indian studies^{11, 17} but was still on lower side when compare to standard (100%).⁹ Hence we should educate and encourage our medical practitioners to understand the importance of prescribing from essential drug list, so as to ensure rational use of medicines in elderly patients.

The morbidity pattern in our study was commonly found to be cardiovascular conditions (29.33%) like hypertension, coronary artery disease and congestive cardiac failure. The second most common system affected was musculoskeletal conditions (27.67%) such as osteoarthritis, muscle sprain and fracture due to fall. Third most common condition was endocrine disorder (13.34%) such as diabetes mellitus. From our study it is clearly indicated that most of the elderly patients have been suffering with cardiovascular disorders, as many of the developing county the morbidity pattern is high for cardiovascular condition. This can be justified, if we compare with similar other study done in India and Nigeria, two Indian and one Nigerian geriatric study by Shah RB et al. from Gujarat,¹¹ Neha Sharma et al. from Rajasthan¹⁷ and Fadare et al. from Nigeria¹² respectively, confirms our morbidity pattern. The prevalence of comorbidities in our study were 19%, which is contradict to other similar study done in India, in which there were more comorbidities.^{11,17}

Our current study shows that among the total 600 patients who were attended the OPDs, majority were consulted the general medicine OPD followed by orthopaedic and cardiology department. This can be justified, as most of the patients were suffering from hypertension, coronary artery diseases, osteoarthritis and congestive heart failure, they consulted the particular department. Among the 13 departments where the patients visited for our study, the department of psychiatry was the least consulted department, which is in sharp contrast to the data from western countries, where psychiatric conditions are most common.¹¹ In the Indian setting most of the elderly people live with their family members with adequate

family support and care, which prevents psychiatric problems.

In the present study, a total of 1769 drugs were prescribed to a total of 600 patients for different disease. The most commonly prescribed drugs in our study were belong to the category of analgesic and anti-inflammatory drugs, this is because the second most morbidity condition was musculoskeletal disorder, for which they prescribed either single NSAIDs or FDC of analgesic and anti-inflammatory agents. It could be the reason for highest category than cardiovascular condition, where in such condition drugs were categorised into antihypertensive, antiplatelet and cardiac drugs. Following this in descending order of frequency, the prescribed category included drugs acting on gastrointestinal tract, antimicrobial agents, drugs acting on haematological system was mostly antiplatelet drugs, drugs of antihypertensive and skeletal muscle relaxant category drugs.

The most frequently prescribed drugs in our study were ranitidine 150mg, followed by aceclofenac 100mg with paracetamol 500mg FDC. Even though the prevalence of cardiovascular disease is high in our study, ranitidine was probably being prescribed for prophylaxis against NSAIDs induced gastric ulcer, as musculoskeletal disorder is the second most morbidity in our study, for which NSAIDs were prescribed frequently. This can be justified if we compare with an Indian¹¹ and a Brazilian study¹⁹ has also reported ranitidine as one of the most frequently prescribed drug followed by NSAIDs. Our previous study²⁰ on the orthopaedic population of Pondicherry region also reported the drug ranitidine was the most frequently prescribed among the antiulcer drugs. Clopidogrel 75mg was found to be third frequently prescribed drug, as the morbidity pattern of coronary artery diseases and hypertension were the highest in our study. Among the antidiabetic drug metformin 500mg to 1000mg was frequently prescribed. Amlodipine 5mg to 10mg, a calcium channel blocker was the frequently prescribed drug for hypertension. Aspirin 75mg and atorvastatin 10mg were prescribed for cardiovascular morbidity, a similar study by Fadare et al. also confirms aspirin 75mg is widely used for primary prevention of cardiovascular complications.¹² Calcium 500mg and methylcobalamin 1500mcg were frequently prescribed for musculoskeletal conditions, correlates with our earlier orthopaedic studies.²⁰

In this study almost 31% patients were prescribed FDCs. The use of FDCs can improve compliance with therapy by decreasing the number of formulations to be taken, but their benefit/risk ratio should be assessed before they are prescribed. The routine use of FDCs is irrational, inappropriate use of unwanted drugs in the combination may lead to adverse effect or drug interactions. Judicial use of FDCs should be avoided unless necessary. However, in India the frequent of prescribing FDCs is around 60% of all available formulations,²¹ the use of

FDCs in our study is relatively low, which reflects the judicial use of medicines in elderly by the prescribing physicians in our institution.

According to American Geriatric Society Updated Beers Criteria 2012 for potentially inappropriate medication use in elderly, our study shows almost 18.34% of elderly patient had encountered with at least one drug of PIMs. Our finding is relatively agreeable and lower than the various similar other studies reported from India (23.59%), Nigeria (25.5%), USA (27.5%) and Iran (27.6%),^{10,12,22,23} but higher than the study from Croatia (2.2%) and Turkey (9.8%) respectively.^{24,25} In this study, 7.75% of total drugs prescribed were PIMs, which are in agreement with a study from India (7.45%) and Nigeria (7.88%) respectively.^{10,12} Among the 3 different categories in Beers criteria, in category 1 which is medications to be avoided in elderly, forms a major category of inappropriate use of drugs. From our study almost 18 different drugs were prescribed to these patients from category 1. NSAIDs (30.66%) like diclofenac, indomethacin, ibuprofen and piroxicam were commonly encountered PIMs, followed by spironolactone a potassium sparing diuretics, chlorzoxazone a muscle relaxant, digoxin for congestive cardiac failure, sliding scale insulin, antihistamine like hydroxyzine, benzodiazepines like alprazolam, clonazepam and diazepam were frequently encountered PIMs. Other drugs like prazosin a selective alpha 1 blocker used in hypertension, amiodarone a class III antiarrhythmic, amitriptyline an antidepressant drug with sedative property, nitrofurantoin a urinary antiseptic, glyburide for diabetes, an antispasmodic drug dicyclomine were prescribed from the category 1 of PIMs. In a similar study by Fadare et al. from Nigeria, NSAIDs were the common PIMs, followed by antihistamine and amitriptyline.¹² An Iranian study by Azoulay et al showed that antihistamines were the most common PIMs, followed by NSAIDs and benzodiazepines.²⁵ In our study the PIMs were not prescribed with other comorbidity disease conditions, which comes under the category 2 of Beers criteria. Similar study by Veena et al. from India also confirms our findings.²⁶ In category 3, the medications to be used with caution, carbamazepine an antiepileptic drug was prescribed frequently in this study by the neurologist and general physician for the follow up epileptic patients.

In our study the PIMs were frequently prescribed for musculoskeletal disorder (42.33%), followed by congestive cardiac failure, insomnia, diabetes mellitus and chronic urticaria. In a similar study by Fadare et al., drugs prescribed to musculoskeletal disorder was the most common one.¹² Another study by Eze et al. shows PIMs were frequently prescribed for hypertension.¹⁸ A study by Zaveri et al. from India reported, upper respiratory tract infection was most common condition for the use of PIMs in elderly.¹⁰

It is clear from our study that, even though the incidence of PIMs prescription is less when compare to similar other study from various developing and developed county, yet we need to take more effort to give awareness about rational prescription and Beers criteria updated list for prescribing elderly patients to all the practicing physicians in the hospital. This will improve the overall performance and reduce the incidence of adverse drug reaction, drug - drug interaction in the elderly people. In developing country like India, many corporate hospital and medical college does not have separate geriatric department, instead many elderly people have been treated by various speciality doctors for comorbid illness. So, it is very important to give awareness to all the speciality doctors about Beers criteria for potentially inappropriate medication use and rational prescription. The training of medical students, doctors, as well as pharmacists and nursing staff in appropriate pharmacotherapy is more important for drug utilization screening tools to be a success in the elderly patients.

To best of our knowledge, ours is the first detailed study from south India, where an effort has been made to analyse the current trend of drug utilization pattern in elderly patient with detail classification of disease prevalence, comorbid pattern, department wise distribution and category wise drug therapy. Along with this detailed study, we analysed the prevalence of potentially inappropriate medications among the elderly using updated Beers criteria 2012.

CONCLUSION

Our study reveals much new information to the medical practitioners in the prescribing practice of drug utilization to facilitate the rational use of drugs in elderly populations. We were able to use very comprehensive method and diagnosis data to assess drug utilization study and potentially inappropriate medications prescribing to elderly patients applying the most complete and recent updated Beers criteria. It is clear from our study that the PIMs prescribing are highly prevalent. Even though Beers criteria has been the widely referenced in many study, yet have not made their way into mainstream clinical practice. It is very important for the prescribers to make themselves aware about Beers criteria and it should be strictly followed for the elderly population. The present study has been an eye opener on the geriatric population and would inspire others to do further research in this area.

Limitations:

Our study subjected to some limitations. Only out patients were included in the study. It would have been in depth analysis if we had included the elderly patients admitted in various clinical departments.

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