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A STUDY ON PRESCRIBING PATTERN OF DRUGS IN GERIATRICS USING BEERS CRITERIA AT A PRIVATE CORPORATE HOSPITAL

B. Chitra *, N. Senthilvel, R. Sowmya, Sreerekha Sathyan and R. Srisha

Doctor of Pharmacy-Intern, Department of Pharmacy Practice, College of Pharmacy, Sri Ramakrishna Institute of Paramedical Sciences, Sri Ramakrishna Hospital Campus, 395, Sarojini Naidu Road, Coimbatore – 641044, India

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Correspondence to Author:
B. Chitra

Assistant professor
Department of Pharmacy Practice, College of Pharmacy, Sri Ramakrishna Institute of Paramedical Sciences, 395, Sarojini Naidu Road, Coimbatore – 641044, India

E-mail: chitrapranavi@gmail.com

ABSTRACT: The prevalence of potentially inappropriate medication (PIM) use is high among geriatrics, affecting up to 40% of patients. The objectives of the study are to evaluate the prescription pattern in geriatrics and to identify potentially inappropriate medications using Beers Criteria 2012. The data were collected and recorded in standard data entry format. The prescriptions were analyzed for appropriateness using the revised version of Beers criteria 2012. During the study period 200 prescriptions were screened. Out of 200 prescriptions 64.5% of the prescriptions were appropriate and 35.5% were inappropriate. 95% of drugs belonged to group 1 of Beers criteria (Potentially inappropriate medication use in older adults), 2% of drugs belonged to group 2 (Inappropriate medication use in older adults due to drug-disease or drug-syndrome interactions that may exacerbate the disease or syndrome) and 3% belonged to group 3(Potentially inappropriate medications to be used with caution in older adults). The use of inappropriate medications can be avoided using the Beers criteria 2012, which is one of the important clinical tools which can be wisely used by physicians, pharmacists and health care providers. Hence pharmacists need to play an important role in reducing inappropriate medication use and suggest safer therapeutic alternatives for the geriatric populationt.

INTRODUCTION: In the fore coming times the population aged above 65 years will steadily increase because of demographic evolution. Geriatrics represent the most vulnerable section of our society and tend to be the largest consumers of prescribed drugs. Treating the elderly is the most challenging part to the physicians and it can be sorted only through a holistic multidisciplinary approach.[1]

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It is predicted that the population of geriatrics in our country will rise from 8.3% - 10.7% by 2021.[2] This is because of increased life expectancy at birth which is 67.3 years for males and 69.6 years for females. It is commonly observed that geriatrics suffer from multiple co-morbid conditions and is also hospitalized several times, so there is an increased occurrence of polypharmacy and drug related issues which needs to be addressed.

Potentially inappropriate medication (PIM) is defined as "a drug in which the risk of an adverse event outweighs its clinical benefit, particularly when there is a safer or more effective alternate therapy for the same condition". Many studies have shown the occurrence of adverse drug reactions due to potentially inappropriate medications. It is

important to identify the potentially inappropriate medication use in this vulnerable group in order to minimize pharmacotherapy related hazards. [3]

There are lot of factors that affects the choice of medicines in elderly. They are more sensitive to the effects of drugs and are at increased risk of drug related problems. The biggest problem faced by health care professionals is that lack of literature regarding the use of medication in this age group and the manufacturers do not include elderly in the clinical trials prior to marketing drugs. Majority of the population suffer from multiple disease states and consume many medications together on a regular basis. [4] The various issues faced in the medication management of the elderly population are polypharmacy that directly or indirectly leads to drug interactions and adverse drug reactions. Poor patient compliance is also a major problem that needs to be addressed. Drug interaction poses to be a major problem because it can occur as a result of drug-drug interaction, drug-food interaction and drug disease interaction.

This may lead to occurrence of adverse drug reactions, synergistic effect that may lead to toxicity or antagonism that leads to reduced effectiveness of the prescribed drug. The next major problem is inadequate monitoring in which the patient is prescribed with the right drug but is not properly checked for complications or effectiveness or both. Sometimes choosing the right drug for a patient is a matter than needs to be considered. Sometimes drugs are prescribed without any proper indication. Prescribing too many medications to the elderly leads to lack of medication adherence and results in effective treatment[5]. Sometimes certain medical problems are not properly identified because of improper communication and understanding among health care professionals. The altered physiology during aging and existence of multiple diseased states makes this population vulnerable to under prescribing or over prescribing. This leads to occurrence of adverse drug events that causes significant morbidity and mortality.[6]

The frequency of occurrences of illness especially chronic ones increases with age and this makes the elderly population to receive disproportionate number of medications when compared to general population. Because of these reasons the health care providers need to improve the health care outcomes in this population by providing a balance between medically necessary and safe medicines and preventing the occurrence of adverse drug events. It is therefore necessary for the health care team to look into issues of polypharmacy, eliminate barriers to medication adherence and restrict prescribing medications to medications that pose least risk to the elderly population.[7]

Mark Beers, MD emphasized the importance of prevention of adverse drug events in older adults approximately two decades ago. One of the most widely used medication criteria in the world is the BEERS CRITERIA. The Beers Criteria for the Potentially Inappropriate Medication use in older adults commonly called as Beers list is a guideline for health care professionals to help improvise on the safety of prescribing medications for the older adults. It emphasizes on de-prescribing medication that is unnecessary.[8]

It is one of the most powerful and significant tool that was used in the past decade to improve the clinical outcomes for the geriatrics with polypharmacy. This was easily accomplished using the Beers criteria because of simple application for non-pharmacy experts, explicit nature and wide dissemination. The latest revised version of the Beers criteria was done in the year 2012 called as AGS beers criteria. It provides several benefits by increasing the awareness of inappropriate medication use in geriatrics and will continue to encourage health care professionals to stop and carefully consider the risks of usage of a particular drug in older adults while carefully considering the drug and non-drug alternatives.[9]

The Beers criteria are used in the geriatric clinical care in order to improve the overall quality of life of geriatrics. It is also used in improving health care policy, training, research, measure and document outcomes. Generally the Beers criteria contains the lists of medications that generally cause significant risks outweighing potential benefits for people older than 65 years of age. By using the information enlisted in the Beers criteria one can generally use them on a regular basis to prevent the occurrence of life threatening adverse

drug events. It is important to deliver safe and effective medications to people belonging to this age group.[10]

The Beers Criteria is meant to serve as a guide to clinicians but not a substitute for professional judgement in prescribing decisions for individual patients. The Beers Criteria also helps health care professionals to clearly identify and categorize drugs that are prescribed in geriatrics. The Beers criteria provide information based on quality of evidence and strength of recommendations. It also classifies drugs into three groups. [11]The first group of drugs are those that are potentially inappropriate for the use in older adults. The second group includes those drugs that have to be avoided in a particular drug or disease state and the third category includes the list of those drugs that have to be used with caution. This method of classification easily allows health care professionals to easily prescribe, prioritize drug selection and choose the most appropriate drug at a given point of time and reduce the drug related costs, thereby minimizing drug related problems.

Literature Review:

1. **Sujo Anathhanam *et al,*** conducted a study and found that geriatric population were particularly vulnerable to under prescribing and overprescribing because of the existence of multiple medical conditions, exclusion of elderly population from clinical trials and altered pharmacology during ageing. Lots of adverse drug events occur causing significant morbidity and mortality which has economic impact in drug therapy to geriatrics. There are lots of tools that help us in identifying people who are susceptible to adverse drug reactions by screening prescriptions. Development in the field of information technology regarding this issue still in the process of medication reconciliation across healthcare transitions and alert the prescriber to potential adverse drug events. Prescribers face problem while prescribing medications to the elderly and strategies have to be developed that would provide top tips to physicians in this regard.[12]

2. **Sven Stegemann *et al,*** revealed that the elderly are a major user group for prescribed medicines due to various chronic comorbid conditions leading to polypharmacy. Medicines and medication management are much more complex and challenging in the elderly and can only be addressed through a multidisciplinary approach. Geriatric drug therapy remains a multidisciplinary task. The health care industry, physicians, pharmacists, nurses and care givers provide and guide the patient's therapy according to individual needs.[13]

3. **Barbara Resnick *et al,*** reviewed on 2012 Beers Criteria and found that the criteria is widely used in research as well as used to train health care professionals in the area of geriatric pharmacotherapy**.** This Criteria also does quality measures organizations and agencies such as the National Committee for Quality Assurance (NCQA), who have always looked upon this criteria when developing quality measures addressing the pharmacological care of older adults.[14]

4. **Donna M. Fick and Todd P. Semla** revealed that the 2012 version of BEERS CRITERIA was more improvised version when compared to the previous versions of Beers Criteria as it contained important updates in developing a comprehensive list of drugs that were to be generally avoided while prescribing to the elderly. It also considered challenges in aiding physicians in avoiding the use of certain drugs or using certain drugs with caution in the elderly. Previously, it was found that only a very small number of medicines caused adverse dug events in the geriatrics but now, a recent study showed that individual drugs or drugs belonging to these four classes namely, (warfarin, insulin, oral antiplatelet agents) were directly linked to the majority of adverse drug events occurring in the geriatrics.[15] Beers criteria can be easily integrated and used in the form of electronic health record, so that prescriptions can be screened easily with the help of technology and minimize the further occurrence of such events.[16]

5. **Ben Reason *et al*** conducted a study with geriatric population and found that

polypharmacy will steadily rise in the fore coming years. Because all the elderly population takes higher number of prescription drugs, they are more susceptible to adverse events. One of the problems majorly identified is inappropriate prescribing in the medication management for the elderly. Another problem identified in the medication management of elderly is that the elderly population may not respond to the side effects of the medicines quickly because of their pharmacodynamic differences. So it is difficult to differentiate between minor side effects to more serious side effects. So physicians have to effectively manage prescriptions of drugs. In accordance with some research literature, it is possible to make interventions in order to improve medication use in the elderly and reduce ADR's by reviewing the Beer's Criteria, which is an internationally recognized list of drugs that are potentially inappropriate for seniors because of elevated risk of adverse effects.[17]

6. **Abeer Ahmad *et al*** found out that drug related problems increased with increasing number of drugs used. Elderly patients were found to use about three times more drugs than younger patients particularly for treating chronic diseases. Community pharmacists can help to identify, resolve and prevent problems in this special population. This can be achieved by developing strategies to prevent and manage drug related problems.[18]

Scope: Older people are the greatest consumers of medications in society. Medication use is often inappropriate in the elderly population because of under-prescribing, over-prescribing, inappropriate choice of medications, polypharmacy, drug ineffectiveness, adverse drug effects and drug interactions. Polypharmacy often leads to medication inadherence and negative consequences.[19]

Older adults are at high risk for experiencing drug-related problems (DRPs) in hospital and ambulatory settings because of their complex medical problems and use of multiple long term medications.[20] It is observed that 10% - 31% of hospital admissions (Emergency department visits) are associated with greater use of potentially inappropriate medications.[21]

It is important to avoid the use of inappropriate and high-risk drugs to decrease the financial burden of drug related issues in older adults.[22]

Commonly observed preventable drug related problems (DRPs) include:

a. Drug interactions:

Concomitantuse of a drugs results in drug-drug, drug-food, drug-supplement, or drug-disease interaction, leading to adverse effects or decreased efficacy.

b. Inadequate monitoring:

A medical problem is being treated with the correct drug, but the patient is not adequately monitored for complications, effectiveness, or both. Adequate therapeutic monitoring is required to prevent any adverse outcomes.

c. nappropriate drug selection:

A medical problem that requires drug therapy is being treated with a less-than-optimal drug. A drug is inappropriate if its potential for harm is greater than its potential for benefit. Inappropriate use of a drug may involve: choice of an unsuitable drug, dose, frequency of dosing, or duration of therapy, duplication of therapy, failure to consider drug interactions and correct indications for a drug.[23]

d. Lack of patient adherence:

Though the appropriate drug is being prescribed, the patients do not adhere to the prescriptions, which results in poor outcomes. [24] Up to half of the elderly patients do not take drugs as directed, usually taking less than prescribed (under adherence). A regimen using too frequent or too infrequent dosing, multiple drugs, or both may be too complicated for patients to follow.

e. Overdosage:

A medical problem is being treated with too much of the correct drug. An excessive dose of an appropriate drug may be prescribed for elderly patients if the prescriber does not consider age-related changes that affect pharmacokinetics and

pharmacodynamics. For example, doses of renally cleared drugs should be adjusted in patients with renal impairment.[25] Generally, although dose requirements vary considerably from person to person, drugs should be started at the lowest dose in the elderly.[26]Overdosage can also occur when drug interactions increase the amount of drug available or when different practitioners prescribe a drug and are unaware that another practitioner prescribed the same or a similar drug (therapeutic duplication).

f. Poor communication:

Drugs are inappropriately continued or stopped when care is transitioned between providers and/or facilitators. Poor communication of medical information at transition points (from one health care setting to another) causes up to 50% of all drug errors and up to 20% of adverse drug effects in the hospital.

g. Underprescribing:

A medical problem is being treated with too little of the correct drug. Appropriate drugs may be underprescribed—i.e, not used for maximum effectiveness. Underprescribing may not only increase morbidity and mortality and reduce quality of life of geriatrics.[27] Clinicians should use adequate drug doses and, when indicated, multidrug regimens.

h. Untreated medical problem:

A medical problem requires drug therapy, but no drug is being used to treat that problem, which leads to poor treatment outcomes.[28]

i. Drug-disease interactions:

A drug given to treat one disease can exacerbate another disease regardless of patient age, but such interactions are of special concern in the elderly. Distinguishing often subtle adverse drug effects from the effects of disease is difficult and may lead to a prescribing cascade. A prescribing cascade occurs when the adverse effect of a drug is misinterpreted as a symptom or sign of a new disorder and a new drug is prescribed to treat it. The new, unnecessary drug may cause additional adverse effects, which may then be misinterpreted as yet another disorder and treated unnecessarily, and so on.[29]

Beers criteria is one of the most widely used consensus criteria for assessing the appropriateness of medication use in the elderly patient population.

The goal of the 2012 AGS Beers Criteria is to improve care of older adults by reducing their exposure to PIMs (Potentially Inappropriate Medications) and to address the challenges associated with improving medication use among patients. Pharmacists are assuming an integral role in collaborative medication management. A number of studies have shown that pharmacists' interventions can improve patient outcomes in various practice settings. When pharmacists play a proactive role in performing medication reviews and in the active education of other healthcare professionals, pharmacotherapy for older patients is improved. [30] Pharmacists are well-positioned to assess and optimize drug therapy across multiple complex medical conditions and provide other patient care services including education, drug monitoring, health promotion, and continuity of care.

The prescribing problems in elderly and the consequences of DRP have to be addressed by the Pharmacists and this concept puts us forward to carry out this systematic study in geriatric population to identify and resolve any DRPs.[31]

Objective:

- To evaluate the prescription pattern in geriatrics.
- To identify Potentially Inappropriate Medications using Beers Criteria 2012.

MATERIALS AND METHODS:

Study Site:

The study entitled "A Prospective Study on Prescribing Pattern in Geriatrics Using Beers Criteria at a Private Corporate Hospital" was carried out in a 700- bedded multi-specialty hospital, one of the largest hospitals at Coimbatore. The hospital is unique and well known for its services to people who come from various parts of the country.

Department Selected For Study in the Hospital

The department selected for the study was all the wards of General Medicine. The reason for the selection of this department was the prevalence of geriatric patients in the general medicine department. The Department of Pharmacy Practice provides services to all departments and a good co-operation from medical team added up to the reason for selecting the department for conducting the study. Knowledge on the prescribing pattern in geriatrics will help the health care professionals to ensure the proper treatment outcomes.

Consent from the Hospital Authorities:

It was custom that every project work carried out in the hospital by the Pharm. D V year students has to be approved by the Dean of the hospital and should be informed to all physicians, surgeons and other health care professionals of the hospital. So a protocol of the study which includes the objectives, methodology, etc. was submitted to the Dean of the study hospital. The study was conducted with the expert guidance of senior and junior physicians of the departments selected. The authors were permitted to utilize the hospital facilities to make a follow up the cases, in the selected departments. All the health care professionals of the study site were well informed through Dean's official circular.

Literature Survey:

An extensive literature survey was carried out regarding the prescribing pattern and inappropriate medication use in geriatrics. The literatures were collected from various sources such as:

- International Journal of Pharmaceutical and Biomedical Research
- European Journal of Clinical Pharmacology
- Elsevier
- Canadian Medical Association Journal
- Journal of Gerontology Biologic Science and Medicine
- Pub Med
- Annuals of internal medicine
- Journal of American geriatric society
- Australian Journal of Basic and Applied Sciences
- Journal of Institute of Medicine
- International Journal of Pharma and Bio Sciences
- International Journal of Pharmaceutical Sciences and Research
- IOWA Drug Information Systems (IDIS), MICRO-MEDEX, World Wide Web and through latest standard reference text books.

Design of Patient Information Form:

A patient information form has been designed, to inform the patients or the bystanders about the purpose and the necessity of the study and assuring them that the confidentiality will be strictly maintained and it's for the betterment of patient's health. The format includes the details like Department address, name and signature of the investigator and supervisor, date, place and details of the study.

Patient Consent Form:

A patient consent form has also been prepared and written consent was collected from all the patients or from the caregivers by using patient consent form after providing the information format. The format contains details like address, date, place, provision for signature of the patient or caregivers, investigator and supervisor.

Design of Data Entry Form:

A separate data entry form for incorporating patient details was also designed and the format contains provision of enter the details such as name, age, sex, height, weight, inpatient no., date of admission, date of discharge, vital signs, reason for admission, past medical history, past medication history, social history and allergies. Provision was given in the format for entry of details like blood sugar levels, blood counts, liver function tests, renal function tests, electrolytes, urine examination, culture and sensitivity, drug chart, ADR monitoring

chart, drug interaction chart, any interventions, IV compatibility chart and irrationality of the antibiotics chart.

Study Site: General Medicine Department

Study Design: Prospective Study

Study Period: 6 months (March 2014-August 2014)

Inclusion Criteria:

- Patients of either sex getting admitted to the study site during the study period.
- Patients above 65 years.
- Patients willing to participate.

Exclusion Criteria:

- Pregnant and lactating women.
- ICU patients and terminally ill.
- Patients below 65 years.

Data Collection:

Ward Round Participation:

Daily regular ward rounds were carried out in the study site during the study period along with the junior and senior physicians. The data were collected and recorded in a specially designed data entry format. Prior to data collection, written consent from the patient/bystander was obtained on a patient consent form. Patient/bystander were also well informed about the study, its objective etc. through a patient consent form after informing about the current study through patient information form.

Data Analysis: The obtained data during the ward rounds were thoroughly analysed to evaluate inappropriateness in geriatrics using Beers criteria 2012. Data analysed also included the results on patient's demographics [age, gender, length of stay etc.].

RESULTS AND DISCUSSION:

During the study period 200 prescriptions were screened randomly. Age distribution of the patients were analyzed and it was found that 42 % of the prescription were in the age group of 65-69 years, followed by 21% in the age group 70-74 years, 21% in 75-79 years, 11% in the age group of 80-84 years, 3.5% in the age group of 85-89 years and 1.5% in the age group of 90-94 years

TABLE 1: AGE DISTRIBUTION (n = 200)

Age	No. of Prescription	Percentage (%)
65-69	84	42
70-74	42	21
75-79	42	21
80-84	22	11
85-89	7	3.5
90-94	3	1.5

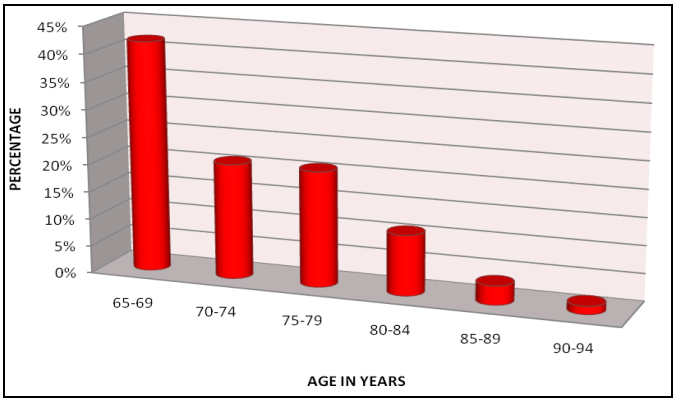

FIG.1: AGE DISTRIBUTION

The current study revealed that the maximum number of hospital admissions were in the age group of 65-69 years.

The study showed a male predominance (64.5%) and female patients (35.5%).

TABLE 2: SEX DISTRIBUTION (n=200)

Sex	No. of Prescription	Percentage (%)
Male	129	64.5
Female	71	35.5

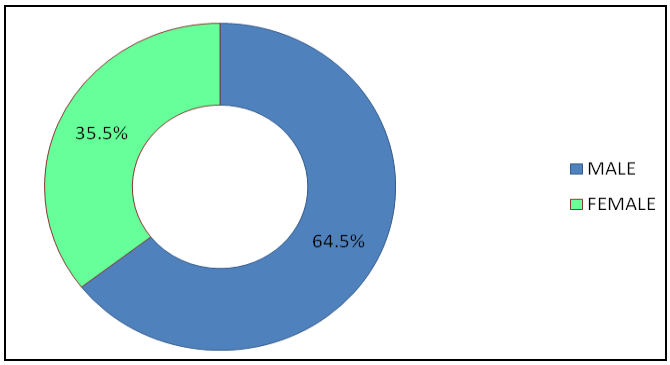

FIG. 2: SEX DISTRIBUTION

Among the patients admitted in the hospital, the percentages of men were more when compared to female patients. It was found that 16% of patients stayed for a period of 1-4 days, 66% of patients stayed for a period of 5-9 days, 13% of patients stayed for a period of 10-14 days and 1.5% patients stayed for a period of 15-19 days.

TABLE 3: LENGTH OF STAY IN HOSPITAL (n=200)

Length of Stay	Number of Patients	Percentage (%)
1-4	32	16
5-9	132	66
10-14	26	13
15-19	3	1.5

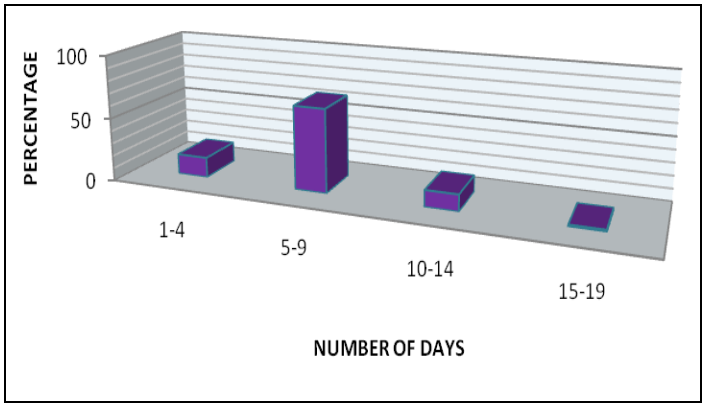

FIG.3: LENGTH OF STAY IN HOSPITAL

The average length of stay of patients in the hospital was found to be between 5-9 days. Major diagnosis include type 2 diabetes mellitus (35%), systemic hypertension (28.5%), lower respiratory infection (17%), chronic obstructive pulmonary disease (12%), and others as shown in the table below.

TABLE 4: MAJOR DIAGNOSIS OBSERVED IN THE STUDY POPULATION (n=200)

S.No.	Major Diagnosis	No. of Patients	Percentage(%)
1.	Ischemic heart disease	13	6.5
2.	Coronary Artery Disease	14	7
3.	Systemic hypertension	57	28.5
4.	Diabetes mellitus	70	35
5.	Lower Respiratory tract infection	34	17
6.	Bronchial asthma	3	1.5
7.	Anemia	3	1.5
8.	COPD	24	12
9.	Pulmonary Tuberculosis	4	2
10.	Cirrhosis	10	5
11.	Acute Gastritis	1	0.5
12.	Urinary tract infection	10	5
13.	Acid peptic disease	1	0.5
14.	Viral hepatitis	3	1.5
15.	Acute renal failure	9	4.5
16.	Cerebral vascular accident	4	2
17.	Gastro esophageal reflux disease	2	1
18.	Atrial fibrillation	1	0.5
19.	Parkinsonism	2	1
20.	Chronic renal failure	13	6.5
21.	Congestive heart failure	6	3
22.	Malignancy	4	2
23.	Benign prostate hypertrophy	6	3

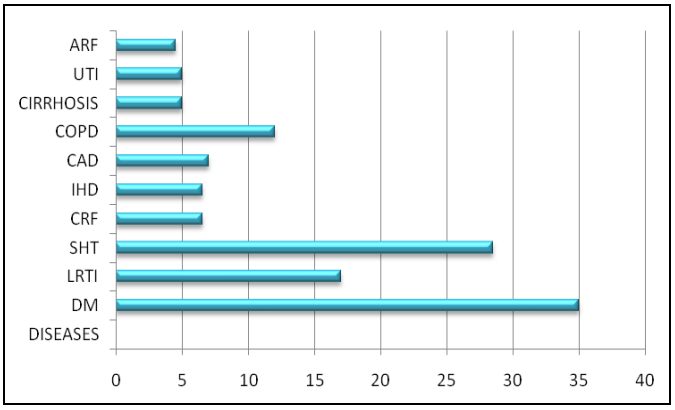

FIG. 4: MAJOR DIAGNOSIS OBSERVED IN THE STUDY POPULATION

Major diagnosis observed in the study population were Diabetes mellitus, Systemic Hypertension, Lower Respiratory Tract Infection, Chronic Obstruction Pulmonary Disease, Ischemic Heart Disease, Liver cirrhosis and Urinary Tract Infection. Diabetes was the most commonly identified disease among the study population followed by Systemic Hypertension, Lower Respiratory Tract Infection, Chronic Obstructive Pulmonary Disease, Ischemic Heart Disease, Liver cirrhosis, and Urinary Tract Infection. The drugs prescribed in each prescription was evaluated and it was found that 23.5% of the prescription had 1-4 drugs, 5% had 5-9 drugs, 6 % of the prescriptions had 10-14 drugs and 1% of the prescription had 15-19 drugs.

TABLE 5: NUMBER OF MEDICATIONS PER PRESCRIPTION (n=200)

Number of Drugs	Frequency of Occurrence	Percentage
1-4	47	23.5
5-9	10	5
10-14	12	6
15-19	2	1

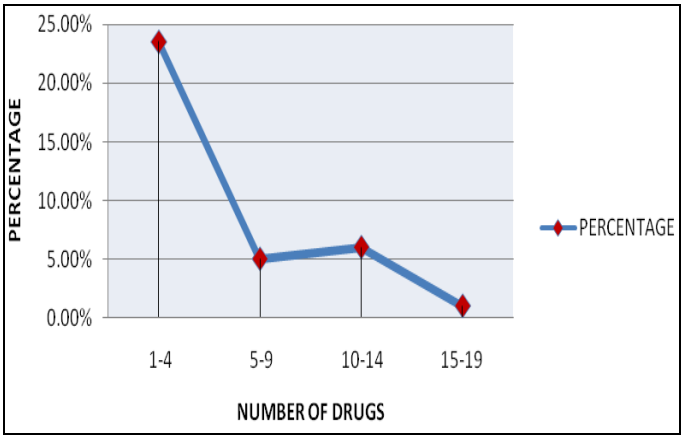

FIG. 5: NUMBER OF MEDICATIONS PER PRESCRIPTION

Polypharmacy was also observed in some of the prescriptions that were prescribed to the patients.

The major categories of drugs in the prescriptions were drugs acting on gastro intestinal system (21.3%), cardio vascular system (13%), anti-microbial agents (15.8%), respiratory system (16.3%) and others. The appropriateness of these drugs was evaluated using Beer's Criteria 2012.

Table 6: CATEGORIES OF DRUGS PRESCRIBED (n=200)

S. No.	Drug Category	No. of drugs	Percentage (%)
1	Gastrointestinal drugs	262	21.3
2	Cardiovascular drugs	142	13
3	Antimicrobial drugs	172	15.8
4	Drug acting on central nervous system	74	6.8
5.	Respiratory drugs	178	16.3
6.	Drugs acting on blood and blood forming agents	117	10.7
7	Analgesics	75	6
8.	Antidiabetic drugs	69	6.4
9.	Anti-gout drugs	8	0.7
10.	Anti hyperlipidemic drugs	48	4.4
11.	Anti-epileptics	11	1.2

The commonly prescribed category of drugs to the elderly patients were Gastrointestinal agents, Respiratory drugs, Antibiotics, Cardiovascular drugs, Drugs acting on blood forming agents, Antidiabetic agents, Analgesics, Antiepileptics, Drugs acting on central nervous system, Antihyperlipidemic, Antiepileptics and Antigout drugs.

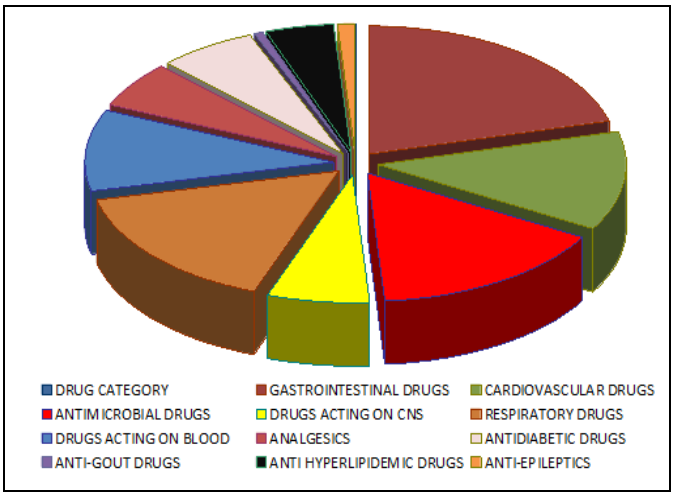

FIG.6: CATEGORIES OF DRUGS PRESCRIBED

Among all the categories of drugs prescribed, Gastrointestinal drugs were commonly used followed by Respiratory drugs and Cardiovascular drugs. Out of 200 prescriptions 64.5% of the prescriptions were appropriate and 35.5% were inappropriate.

TABLE 7: EVALUATION OF PRESCRIPTION USING BEERS CRITERIA 2012 (n = 200)

Category of Prescription Screened	No. of Prescription	Percentage (%)
Inappropriate Prescription	71	35.5
Appropriate Prescription	129	64.5

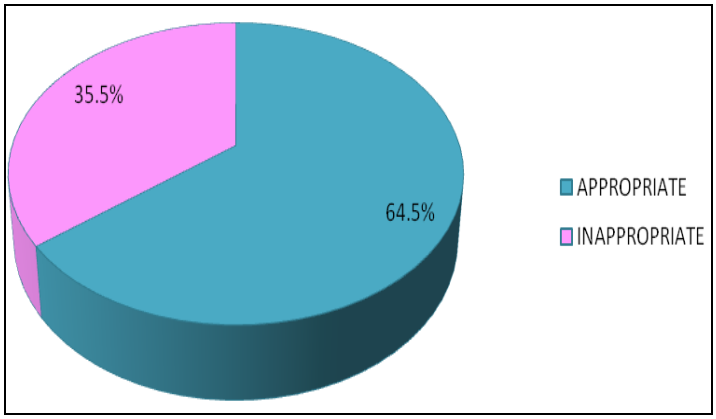

FIG. 7: EVALUATION OF PRESCRIPTION USING BEERS CRITERIA 2012

The prescriptions were thoroughly screened using Beers Criteria 2012 and the results indicate that 35.5% of prescriptions were inappropriate. The following drugs were identified in prescriptions based on Beers Criteria 2012 and presented in the table below.

TABLE 8: ERRORS IDENTIFIED IN PRESCRIPTIONS

S. No.	Drugs under Beers criteria	Frequency of occurrence (%)	Recommendations
1.	Alprazolam	19 (25.9)	Avoid BZD, because it increases risk of cognitive impairment, delirium, falls, fractures and motor vehicle accidents in elderly.
2.	Amitriptyline	1(1.4)	Use with caution as it may exacerbate syndrome of inappropriate antidiuretic hormone secretion (SIADH) or hyponatremia.
3.	Lorazepam	2 (2.7)	Avoid BZD, because it increases risk of cognitive impairment, delirium, falls, fractures and motor vehicle accidents in elderly.
4.	Clonazepam	10 (13.4)	Avoid BZD, because it increases risk of cognitive impairment, delirium, falls, fractures and motor vehicle accidents in elderly.
5.	Ketorolac	6 (8)	Avoid ketorolac because it increases the risk of GI bleeding or PUD in high risk groups.
6.	Prazosin	1 (1.4)	Avoid prazosin as it increases risk of orthostatic hypotension or bradycardia.
7.	Spironolactone	6 (8)	It causes hyperkalaemia in heart patients if taken greater than 25mg/day.
8.	Hyoscyaminehydrobromide	1 (1.4)	Do not use in long term treatment as it is highly anticholinergic and has uncertain effectiveness.
9.	Diclofenac	5 (6.7)	Avoid chronic use in elderly as it leads to bleeding / peptic ulcer disease.

S. No.	Drugs under Beers criteria	Frequency of occurrence (%)	Recommendations
10.	Hydroxyzine	4 (5.4)	Avoid use as it is highly anticholinergic and its clearance is decreased with age.
11	Indomethacin	1 (1.4)	Avoid as it increases the risk of GI bleeding or PUD in high risk groups. Of all the NSAIDs Indomethacin has most adverse effects.
12.	Sertraline	1 (1.4)	Use with caution as it may exacerbate or cause syndrome of inappropriate antidiuretic hormone secretion (SIADH) or hyponatremia.
13.	Zolpidem	2 (2.7)	Avoid chronic use (>90 days) Benzodiazepine-receptor agonists Have similar adverse effects as those of benzodiazepines in older adults (e.g., delirium, falls, fractures); minimal improvement in sleep latency and duration.
14	Metoclopramide	1(1.4)	Avoid as it may cause extrapyramidal effects including tardive dyskinesia, risk may further increase in frail older adults.
15.	Trihexyphenidyl	1(1.4)	Avoid as more effective anti-Parkinson's agents available.
16.	Aspirin	2 (2.7)	Use with caution in adults >80 years old. Lack of evidence of benefit v/s risk in such individuals.

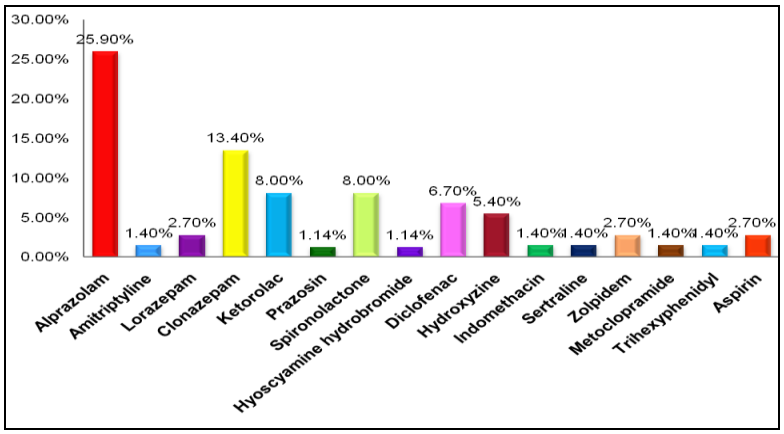

FIG. 8: DRUGS IDENTIFIED IN PRESCRIPTIONS BASED ON BEERS CRITERIA (n=71)

Based on the results, the drugs prescribed inappropriately were alprazolam, clonazepam, lorazepam, amitriptyline, ketorolac, indomethacin, prazosin, spironolactone, hyoscyamine, diclofenac, hydroxyzine, sertraline, zolpidem, metoclopramide, trihexyphenidyl and aspirin which are to be avoided in the elderly patients.

TABLE 9: CATEGORISATION OF DRUGS ACCORDING TO BEERS CRITERIA

The inappropriate drugs identified are categorized under Group I, Group II and Group III.

Group-I	Group-II	Group-III
• Alprazolam • Clonazepam • Lorazepam • Amitriptyline • Indomethacin • Ketorolac • Spironolactone • Hyoscyamine • Diclofenac • Zolpidem • Hydroxyzine • Prazosin • Trihexyphenidyl • Metoclopramide	• Sertraline	• Aspirin

- **Group I -** Drugs which are considered to be potentially inappropriate in older adults.
- **Group II-** Drugs which may exacerbate existing disease or syndrome.
- **Group III-** Drugs to be used with caution in older adults.

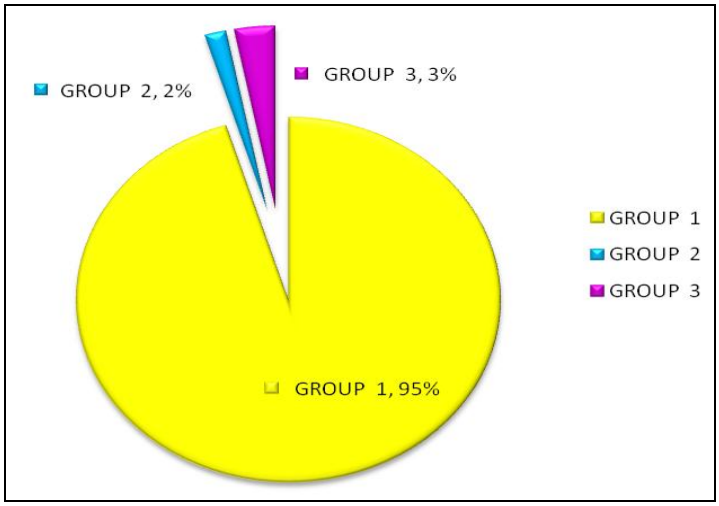

FIG. 9: CATEGORISATION OF DRUGS ACCORDING TO BEERS CRITERIA

SAFER ALTERNATIVE IN GERIATRICS

Drugs	Indication	Concern	Alternative
Alprazolam, Clonazepam, Lorazepam, Zolpidem	Sleep	Increased sensitivity to BZD, increased risk of cognitive impairment, delirium, unsteady gait, syncope, falls, accidents and fractures. [32, 33]	Ramelteon: 8mg half an hour before sleep at night. Low dose doxepin: 3-6 mg half an hour before sleep at night.[34, 35]
Sertraline	Depression	Syndrome of inappropriate antidiuretic hormone (SIADH)/ hyponatremia.	Mirtazapine: 7.5 mg/day at night time; increase by 7.5-15 mg/day no more frequently than 1-2 weeks; not to exceed 45 mg/day.[36]
Amitriptyline	Depression	Highly anticholinergic effects, sedating and orthostatic hypotension.	Fluoxetine 10 mg daily. Citalopram 10 mg daily.[37]
Hydroxyzine	Itching	Anticholinergic effects.	Triamcinolone 0.025% cream- Apply thin layer 2-4 times daily.[37]
Metoclopramide	Vomiting	Extra pyramidal side effects including tardive dyskinesia.[38]	Domperidone: 10-20 mg 3-4 times daily. Ondansetron: 4mg twice daily.[39]
Prazosin	Systemic hypertension	Orthostatic hypotension.	Lifestyle modifications. Start low and go slow. Thiazide diuretics, Angiotensin Converting Enzyme Inhibitors, Angiotensin Receptor Blockers, Calcium Channel Blockers.[39]
Spironolactone	Congestive heart failure	In heart failure, the risk of hyperkalemia is higher in older adults if taking >25 mg/day.	Low dose. Monitor serum potassium levels.
Trihexyphenidyl	Parkinson's Disease	Not effective for Parkinson's disease. Anticholinergic effects	Carbidopa/Levodopa: Initially 25mg/100mg thrice daily or 10 mg/100 mg 3-4 times/day. Pramipexole: 0.125mg thrice daily initially. Ropinirole: 0.25mg thrice daily for 1 week initially.[39] Titrate or taper the dose based on literatures according to individual response

Aspirin Indomethacin Ketorolac Diclofenac	Pain	GI bleeding risk increased in elderly population.	Mild-moderate pain: Acetaminophen: 500mg-1g 4-6 hourly. Celecoxib: Initially 400mg, followed by 200 mg twice daily. Ibuprofen: 200-400 mg 4-6 hourly. Naproxen: 250 mg twice daily or 8 hours once as needed. Meloxicam: 7.5-15 mg as a single dose.[39] Use gastro protective agent like Proton pump inhibitors or Histamine Receptor Antagonists.
Nitrofurantoin	Urinary Tract Infection	Peripheral neuropathy. Hepatic Toxicity.	Ciprofloxacin: Acute uncomplicated: 250 mg twice daily for 3 days. Mild/moderate: 250 mg PO q12hr or 200 mg IV q12hr for 7-14 days Severe/complicated: 500 mg PO q12hr or 400 mg IV q12hr for 7-14 days Trimethoprim: 100 mg twice daily for 3 days.[39]

Tips to Prevent Drug Related Problems in the Elderly [40, 41]

Approach to Medication Prescribing in the Elderly—For Clinicians and Pharmacists:

Before starting a new drug:

To reduce the risk of adverse drug effects in the elderly, clinicians should do the following before starting a new drug:

- Obtain an accurate drug and disease history in order to avoid drug–disease or drug–drug interactions.
- Consider psychosocial causes of symptoms.
- Consider nondrug treatment.
- Discuss goals of care with the patient or patient care takers.
- Avoid treating symptoms rather than their underlying cause.
- Document the indication for each new drug (to avoid using unnecessary drugs).
- Consider age-related changes in pharmacokinetics or pharmacodynamics and their effect on dosing requirements.
- Use the fewest drugs necessary. Start with a lower dose for most drugs and titrate slowly.
- Do not add a medication to combat the side effects of another one.
- Avoid medications known to be potentially harmful in the elderly Assess the risks as well as benefits. Consider Beers Criteria 2012. Where appropriate involve a pharmacist in prescribing decisions.
- Match each medication with its diagnosis, and eliminate those without a clear indication.
- Eliminate medications that are having no benefit.
- When multiple medications are used for one diagnosis, consider maximizing doses and decreasing the number of medications.
- Choose the safest possible alternative (eg, for non inflammatory arthritis, acetaminophen instead of an NSAID).
- Consider individual factors, e.g. renal function, alcohol intake, body fat, diet, cigarette smoking.
- Consider practical factors such as packaging and dose scheduling.
- Use a team approach; involve the family, caregiver, pharmacist.

After starting a drug:

The following should be done after starting a drug:

- Monitor for clinical benefit and side effects in initial stages.
- Ensure where appropriate that drug levels and biochemical markers are measured.
- Adjust the doses of prescribed medications according to patient's renal and liver function.
- Undertake regular (at least annual) medication review of existing medications including 'over-the-counter' therapies, and assess adherence.
- Medicines that are not providing benefit or that are producing unacceptable side effects should be stopped. Enquire patients whether if they experience any untoward effects after taking a particular drug.
- Provide effective and accurate communication of medication regime upon transition of care.
- Assume a new symptom may be drug-related until proved otherwise (to prevent a prescribing cascade).
- Monitor patients for signs of adverse drug effects, including measuring drug levels and doing other laboratory tests as necessary.
- Document the response to therapy and increase doses as necessary to achieve the desired effect.
- Regularly reevaluate the need to continue drug therapy and stop drugs that are no longer necessary.

Ongoing:

The following should be ongoing:

Medication reconciliation: is a process that helps ensure transfer of information about drug regimens at any transition point in the health care system. The process includes identifying and listing all drugs patients are taking (name, dose, frequency, route) and comparing the resulting list with the physician's orders at a transition point. Medication reconciliation should occur at each move (admission, transfer, and discharge).

Computerized physician ordering programs: can alert clinicians to potential problems (eg, allergy, need for reduced dosage in patients with impaired renal function, drug-drug interactions). These programs can also cue clinicians to monitor certain patients closely for adverse drug effects.

Tips to Improve Patient Understanding and Medication Adherence---For Pharmacists:

- ✓ Provide information and education to the patient and their care givers (patient counselling).
- ✓ Check for potential drug-disease and drug-drug interactions.
- ✓ Note coexisting disorders and their likelihood of contributing to adverse drug effects.
- ✓ Explain the uses and adverse effects of each drug to patient or their care givers.
- ✓ Provide clear instructions to patients about how to take their drugs (including generic and brand names, spelling of each drug name, indication for each drug, and explanation of formulations that contain more than one drug) and for how long the drug will likely be necessary.
- ✓ Anticipate confusion due to sound-alike drug names and pointing out any names that could be confused.
- ✓ Have patients bring all medication bottles to each visit.
- ✓ Include the diagnosis on the prescription so it will appear on the medication bottles.
- ✓ Have the patient use only one pharmacy so the pharmacist can help identify duplicate medications from different providers and monitor for possible drug interactions.
- ✓ Have visiting nurses check medications.

- ✓ Use reminder devices such as pillboxes; some pharmacies will pre-package pills.

- ✓ Write down medication directions.

CONCLUSION: The current study could assess the prescribing pattern of medicines in the geriatrics according to Beer's criteria 2012. The study report shows that the prevalence of PIMs are steadily increasing. The use of inappropriate medications can be avoided using the Beers criteria 2012, which is one of the important clinical tools which can be wisely used by physicians, pharmacists 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. Pharmacists 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 in clinical decision making in geriatrics, where better pharmaceutical care can be provided to the geriatric patients.

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