



Received on 29 October 2018; received in revised form, 08 March 2019; accepted, 30 May 2019; published 01 July 2019

## DRUG UTILIZATION PATTERN IN GERIATRIC PATIENTS OF GENERAL MEDICINE IN A SECONDARY CARE HOSPITAL

G. Sumithira <sup>\*1</sup>, Amala Anilkumar <sup>2</sup>, C. V. Habeeb Rahman <sup>2</sup>, S. E. Bharanidharan <sup>3</sup> and V. Ganesan <sup>2</sup>

Department of Pharmacology <sup>1</sup>, Department of Pharmacy Practice <sup>2</sup>, The Erode College of Pharmacy & Research Institute, Erode - 638112, Tamil Nadu, India.

Government Head Quarters Hospital <sup>3</sup>, Tiruppur - 641601, Tamil Nadu, India.

### Keywords:

Geriatric, Polypharmacy, Beers criteria, Drug utilization, World Health Organization core indicators

### Correspondence to Author:

**Mrs. G. Sumithira**

Assistant Professor,  
Department of Pharmacology,  
The Erode College of Pharmacy &  
Research Institute, Veppampalayam,  
Vallipurathampalayam (PO), Erode -  
638112, Tamil Nadu, India.

**E-mail:** georgesumithira@gmail.com

**ABSTRACT:** The purpose of the research was to assess the prescribing pattern in geriatrics and to analyze the prescription using World Health Organization (WHO) core prescribing indicators and American Geriatric Society (AGS) Beers criteria 2012 for potentially inappropriate medication use in older adults. This prospective drug utilization study was conducted for a period of 6-months. Patients of either gender, age 65 or above who were admitted in the secondary care hospital. Collected data were analyzed with the WHO core prescribing indicators and American Geriatric Society Beers criteria 2012 for potentially inappropriate medication use in older adults. A total of 200 patients were taken in the study. The majority of the patients were in the age group of 65-70 years (64%) with male predominance (53%). The average number of drugs per encounter was 6.86. Out of 1372 drugs, 1157 drugs (84.32%) were prescribed by generic name. Drugs acting on the cardiovascular system (27.92%) were the most commonly prescribed. In this study, Ranitidine (24.4%) is the most commonly prescribed drug. The study shows the present prescribing practices in the hospital related to higher polypharmacy and inappropriate medication use. To enhance drug therapy for geriatric patients, it is essential for prescribers to make aware of the Beers criteria and should be surely followed for good health care outcomes in the elderly. A systematic medication chart review by the clinical pharmacist can minimize the frequency of prescribing drugs without indications and thereby decrease polypharmacy.

**INTRODUCTION:** Drugs play a vital role in providing ideal care and have a major influence on health. Throughout the last decades of the 20<sup>th</sup> century, new medicines will lead to decreased mortality, reduced hospitalization duration, and enhance the quality of life for several people.

It is necessary to identify the negative results of drug therapy and arising problem of inappropriate drug use, with issues vary from increased morbidity to enormous medicalization, polypharmacy, adverse drug reactions (ADRs) and higher antimicrobial resistance. The economic results related to inappropriate drug use are significant.

Drug utilization research is an extensive collection of descriptive and analytical methods for the quantification, the understanding and the evaluation of the processes of prescribing, dispensing and consumption of medicines, and for the testing of interventions to improve the quality of these

<b>QUICK RESPONSE CODE</b> 	<b>DOI:</b> 10.13040/IJPSR.0975-8232.10(7).3364-72
	The article can be accessed online on <a href="http://www.ijpsr.com">www.ijpsr.com</a>
<b>DOI link:</b> <a href="http://dx.doi.org/10.13040/IJPSR.0975-8232.10(7).3364-72">http://dx.doi.org/10.13040/IJPSR.0975-8232.10(7).3364-72</a>	

processes. It targets on the different medical, social, and economic view of drug use<sup>1</sup>. Drug utilization becomes necessary for the elderly, the main problem faced by this population use of incorrect use of drugs<sup>2</sup>. The main aim of drug utilization study is the rational use of drugs. The anatomical therapeutic classification (ATC)/defined daily dose (DDD) is used as a tool to enhance the quality of drug use and is advised by the WHO as the international standard for drug utilization studies<sup>3</sup>. WHO and International Network of Rational Use of Drugs (INRUD) has established a group of drug prescribing indicators used as a measure to identify the prescribing accomplishment<sup>4,5</sup>.

The defined daily dose is an average maintenance dose per day and used as a comparable unit. Prescribed daily dose (PDD) may not be identical to DDD. It is rough to estimate of drug utilization<sup>6</sup>. Geriatrics is the branch of medicine that deals with the physiological attribute of aging and the diagnosis and treatment of disorder influencing the aged<sup>7</sup>. Geriatric medicine is the branch of gerontology which deals with people who is having age more than 65 years<sup>8</sup>. People above the age of 65 years have more predominance of chronic illness than those less than 65 years<sup>9</sup>. Many physiological and pharmacological variations occur in elderly people<sup>10,11</sup>. Thus special care has to be taken as there is alteration in pharmacokinetic and pharmacodynamics due to the age<sup>12</sup>.

As the number of drugs taken by geriatric patients and the incidence of ADR is high in this age group, it becomes increasingly essential to study patterns of drug use<sup>13</sup>. Because of various prescriptions, they use multiple drugs (Polypharmacy) for different chronic disease. Polypharmacy also increases the risk of drug interaction, which leads to higher the cost of therapy<sup>14</sup>. Manufacturers do not involve elderly in the clinical trials before marketing drugs, which are the major drawbacks concerning the use of medicine<sup>15</sup>.

WHO core indicators and Beer's criteria can be used as an assessment tool for potentially inappropriate medication for older adults<sup>16</sup>. The American Geriatrics Society (AGS) Beer's standards 2012 for the potentially inappropriate medication (PIM) has been developed to assist healthcare providers in improving medication

safety in older adults. Beer's criteria can be classified into three: category 1, category 2 and category 3.<sup>17</sup>

This study aimed to analyze the medication utilization patterns using WHO core prescribing indicators and the development of inappropriate drug prescribing according to the Beers criteria 2012 method in geriatric patients, in a secondary care hospital<sup>18</sup>.

## MATERIALS AND METHODS:

**Study Design:** This is a prospective study conducted in general medicine of the government Head Quarters, Tiruppur, a 500 bedded hospital, in Tamil Nadu, India. The study was conducted for a period of 6 months from February 2018 to August 2018 after the approval of the Institutional Ethical Committee. A total number of 200 patients were taken for this study.

**Sample Selection:** Patients of both male and female aged 65 years and above, who admitted in the general medicine of government headquarters, Tiruppur were included in the study.

### Inclusion Criteria:

- Patients of age 65 years and above.
- Either male or female.
- Admitted in general medicine.

### Exclusion Criteria:

- Patients below 65 years.
- Patients with severe disease.
- Pregnant women.
- Pediatric patient.
- Patient who was shifted to ICU.
- Patients who were mentally unstable.
- Patients who are not willing to participate.

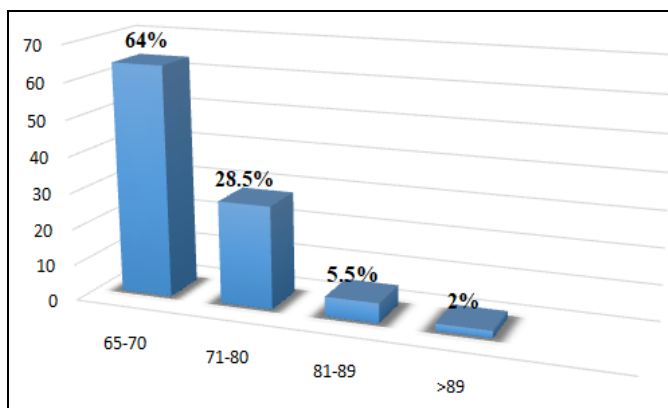
Data collection was done by daily visiting the patients from the general medicine wards. The information obtaining was transferred in predesigned proforma for this study. It includes the patient's demographic details, diagnosis, laboratory investigations, prescribed drugs, and their dose, dosage form, and route of administration.

**Ethical Consideration:** All the investigational procedures and protocols used in this study were reviewed and approved by the Institutional Ethical Committee (IHEC No.: IHEC/GH-Tiruppur/ECP/PD-003).

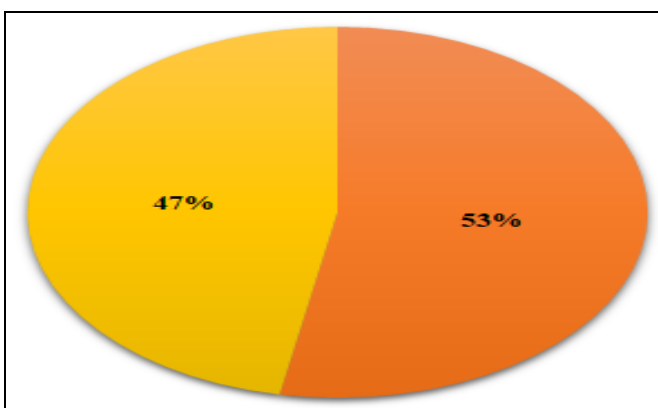
**RESULTS:** Total of 200 geriatric patients who were admitted in the general medicine ward were incorporated in the study. The patients were allocated according to age and gender. Various data were used to evaluate commonly prescribed drugs and classified as per anatomical therapeutic

classification (ATC) and WHO core indicators, the most commonly diagnosed disease, co-morbid condition and potentially inappropriate medication using Beer's criteria 2012. Among 200 prescriptions were collected, out of which 106 (53%) were males and 94 (47%) were females. Gender wise distribution depicted in **Fig. 2**.

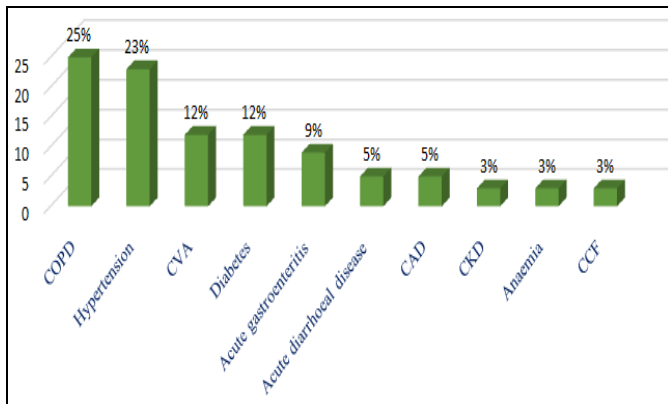
The majority of the patients were in the age group of 65-70 years (64%), followed by 71-80 years (28.5%), 81-89 years (5.5%) and only 2% of age >89 years **Fig. 1**.



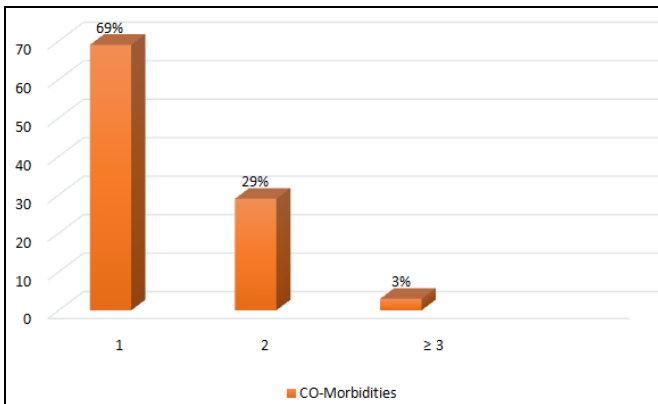
**FIG. 1: AGE WISE CLASSIFICATION**



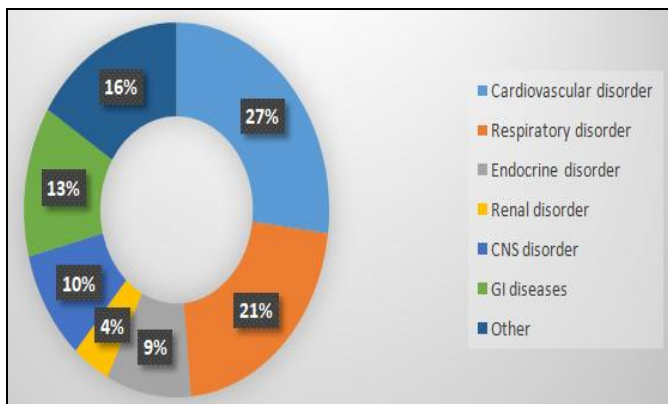
**FIG. 2: GENDER WISE DISTRIBUTION**



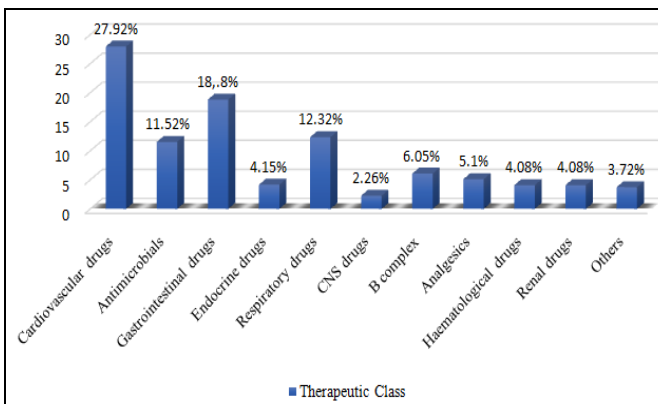
**FIG. 3: COMMONLY DIAGNOSED DISEASE**



**FIG. 5: CO-MORBIDITY PATTERN IN PATIENTS**



**FIG. 4: DISEASE OR DISORDER PATTERN BY SYSTEM INVOLVED**



**FIG. 6: DISTRIBUTION OF DRUGS ACCORDING TO THEIR THERAPEUTIC CLASS**

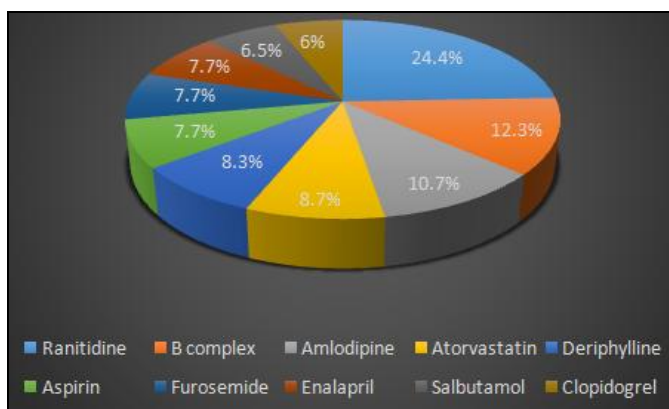


FIG. 7: TOP 10 PRESCRIBED DRUGS

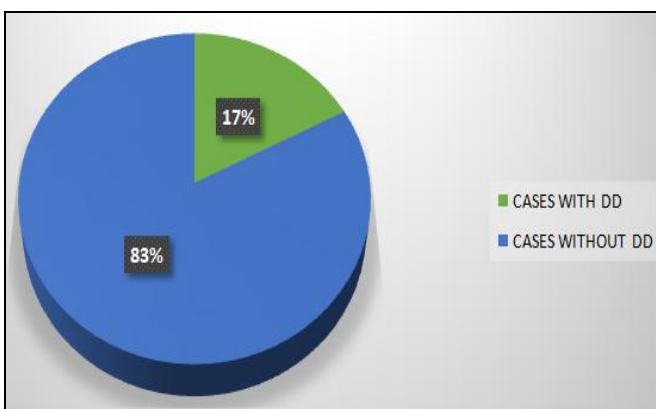


FIG. 8: THERAPEUTIC DRUG DUPLICATION

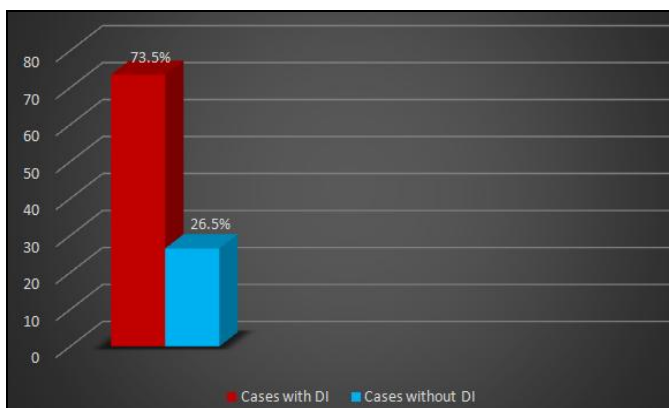


FIG. 9: DRUG-DRUG INTERACTION

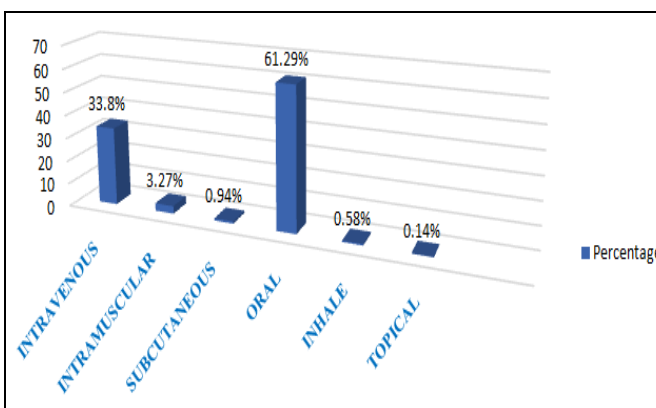


FIG. 10: ROUTE OF ADMINISTRATION

Out of 200 prescriptions, 35(17.5%), prescription contain therapeutic drug duplication, 165(83%) prescription was found to be there without drug duplication **Fig. 8**. Among 200 cases, 147(73.5%) contain drug-drug interaction, and the remaining 53 (26.5%) were without drug-drug interactions. Polypharmacy was high in each prescription; there were 73.5% clinically significant drug-drug interactions **Fig. 9**.

Out of a total number of 1372 drugs, the majority of drugs were administered in oral route 841(61.29%), followed by injectables 523(38.1%) of total routes, inhalation, and topical routes are 0.58% and 0.14% respectively **Fig. 10**.

Among the study population, the prevalence of cardiovascular disorder 27% was high, followed by respiratory disorder (21.5%) and GI disorder (13%) **Fig. 4**. COPD (25%) was the most common disease in this study, followed by Hypertension (23%), Cardiovascular accident (12%), and Diabetes Mellitus (12%). Disease or disorder pattern by system involved is depicted in **Fig. 3**. Majority of patients (69%) were found with one co-morbidities, (29%) patients are with 2 co-morbidities and (3%)

patients with  $\geq 3$  co-morbidities **Fig. 5**. In our study 383(27.92%) drugs acting on cardiovascular system were most frequently prescribed, followed by gastrointestinal drugs (18.80%), respiratory drugs (12.32%) and antibiotics (11.52%) **Fig. 6**. Ranitidine 165 (24.4%) was the commonly prescribed drug. It was followed by B complex (12.3%), Amlodipine (10.7%) and Atorvastatin (8.7%) **Fig. 7**. The top 10 drugs were classified according to WHO-ATC (Anatomical Therapeutic Code) Classification system with DDD (Defined Daily Dose) **Table 1**.

According to WHO core indicators, the average number of drugs per prescription was 6.86. Out of 1372 drugs, 1157 drugs (84.32%) prescribed by generic name. Encounters with antibiotics and injections were to be 98(49%) and 172(86%) respectively, and 100% of drugs were prescribed from the EDL/Formulary **Table 2**. The optimal value of IRDP (Index of Rational Use of Medicines) was 2.99. In this study, the average index of generic name prescribing was 0.84. The index of prescribing of antibiotics and injections were 0.61 and 0.11, respectively.

The percentage of prescribing from EDL/formulary in our hospital was 100% **Table 3**. Based on the American Geriatric Society updated Beers criteria on 2012. Out of 200 patients, 115 patients (58%) received at least one drug which PIMs from Beers

list. Out of 1372 drugs, a total number of 166 PIMs were prescribed in all with 12 medications. Out of 115 patients, 76 patients (66.08%) were prescribed to have a single drug of PIMs from Beers list.

**TABLE 1: CLASSIFICATION OF PRESCRIBED DRUGS ACCORDING TO WHO-ATC CLASSIFICATION SYSTEM WITH DDD**

Drugs	WHO-ATC	DDD	Route
Ranitidine	A02BA02	0.3 g	O, P
Multivitamins & another mineral including combination	A11AA03	-	O
Amlodipine	C08CA01	5 mg	O
Atorvastatin	C10AA05	20 mg	O
Deriphylline	R03DA04	0.4 g	O,P,R
Aspirin	B01AC06	1 tablet	O
Furosemide	C03CA01	40 mg	O,P
Enalapril	C09AA02	10 mg	O,P
Salbutamol	R03AC02	0.8 mg, 0.8 mg, 10 mg	Inh. aero., powd., sol
Clopidogrel	B01AC04	75mg	O

O- Oral, P- Parenteral, R-Rectal, Inh.aero- Inhalation aerosol, Inh. powder – Inhalation powder, Inh. sol- Inhalation solution.

**TABLE 2: ASSESSMENT OF DRUG USE PATTERN USING WHO PRESCRIBING INDICATORS**

Prescribing indicators assessed	Average / percentage	WHO Standard
Average number of drugs per encounter	6.86	1.6-1.8%
Percentage of drugs prescribed by generic name	84.32%	100%
Percentage of encounter with antibiotics	49%	20.0-26.8%
Percentage of encounter with injection	86%	13.4-24.1%
Percentage of drugs from essential drug list/formulary	100%	100%

**TABLE 3: INDEX OF RATIONAL USE OF MEDICINES**

Prescription indicators	Optimal value	Observed value	Individual index (optimal index =1)	IRDU (Maximum IRDP=5)
Average number of drugs / encounter (polypharmacy)	≤ 3	6.86	0.43	2.99
Generic name prescribing	100%	84.32%	0.84	
Antibiotics prescribing	≤ 30%	49%	0.61	
Injection prescribing	≤ 10%	86%	0.11	
EDL/Formulary prescribing	100 %	100%	1	

**TABLE 4: LIST OF POTENTIALLY INAPPROPRIATE MEDICATION USE IN OLDER ADULTS BASED ON UPDATED “BEERS CRITERIA 2012”**

Category	Name of the drug	Frequency	Percentage (%)
<b>1</b>	<b>Medication and class of drugs to be avoided in older adults</b>		
	Diclofenac	29	17.47
	Spironolactone	4	2.41
	Alprazolam	5	3.01
	Amitriptyline	3	1.81
	Digoxin	1	0.60
	Dicyclomine	13	7.83
	Metoclopramide	14	8.43
	Diazepam	12	7.23
	Chlorpheniramine	29	17.47
	Nifedepine	3	1.81
Verapamil	1	0.60	
<b>2</b>	<b>To be avoided in combination with specific co-morbidity</b>		
<b>3</b>	<b>Medications to be used with caution in older adults</b>		
	Aspirin	52	31.33

35 patients (30.43%) were prescribed two different PIMs, and 4 patients (3.47%) were prescribed to have three different PIMs from the Beers list. Medications to be avoided in elderly (category 1) being the most common category of inappropriate use. Diclofenac was prescribed PIMs in 29 cases, followed by Spironolactone and Alprazolam. Least prescribed PIMs were Nifedipine and Verapamil in 3 and 1 case respectively. Under category 3, aspirin was the only drug which was prescribed to 52 patients **Table 4**.

**DISCUSSION:** Drug utilization studies (DUS) is conducted to know the prescribing, dispensing, and distribution of drugs. The main purpose of DUS is to facilitate the rational use of medicine (RUM) in population. These studies are used to determine the reported adverse drug reactions, to monitor the utilization of different categories of drugs and regulatory activities. The geriatric population is increasing worldwide. Geriatric population treating the health problems and face several challenges as these patients have susceptible to many diseases and drug-related problem. So the present study was done to describe and evaluate the pattern of drug utilization and related issues in geriatric patients. The majority of the patients were in the age group of 65-70 years (Male=65%, Female=63%) followed by 71-80 years (M= 30%, F=27%), 81-89 years (M=5%, F=6%) and more than 89 years (M=0, F=4%) which is related to studies on geriatric patients done in India<sup>14</sup>. In this study total of 200 patients were collected out of which 106 (53%) were males, and 94 (47%) were females who are close to other studies conducted in India<sup>14, 19, 20</sup>.

In our study, the most commonly diagnosed disease were Chronic obstructive pulmonary disease (25%), Hypertension (23%), Cerebrovascular accident (12%), Diabetes Mellitus (12%), Acute gastroenteritis (9%), Acute diarrheal disease (5%), Coronary artery disease (5%), Chronic kidney disease (3%), Anaemia (3%) and Congestive cardiac failure (3%). On the system wise disease analysis the prevalence of Cardiovascular disorder such as Hypertension, Coronary artery disease and Congestive cardiac failure was high (27%). The second-most system affected was a Respiratory system like COPD (21.5%) followed by GI system such as Acute gastroenteritis and Acute diarrhoeal disease (13%), CNS disorder (9.5%) like a

Cerebrovascular accident (CVA). The most commonly found co-morbidity was Hypertension, Diabetes mellitus, which was similar to the study conducted in India<sup>21</sup>, followed by CVA, CCF, MI, and CAD. Among 200 patients, 69% has a single co-morbid disease in comparison with the other study by Sharma *et al.*,<sup>22</sup> 29% had two co-morbidity, whereas 3% had  $\geq 3$  co-morbid conditions together. Loss of functional reserve with aging makes geriatric patients vulnerable to the development of multiple diseases affecting different body system.

In the present study, a total of 1372 drugs was prescribed to a total of 200 patients for different disease. The most commonly prescribed drugs are cardiovascular drugs (27.92%). This is because the first most morbidity condition was Hypertension, Coronary heart disease for which they prescribed either single or multiple numbers of Cardiovascular drugs. Following this descending order of frequency, the prescribed category included drugs acting on GIT (18.80%), drugs acting on the Respiratory system (12.32%) and Antimicrobials (11.52%).

The most frequently prescribed drugs in this study were Ranitidine (24.4%). Even though the prevalence of cardiovascular disease is high in our study, but ranitidine was probably prescribed prophylaxis against NSAID induced gastric ulcer. This can be justified if we compare with an Indian and Brazilian study has also reported ranitidine was one of the most frequently prescribed drugs. Acid-suppressive drugs were used more. Drugs which change acid secretion may vary absorption of many drugs and interact with other drugs, which lead to toxicity.

The 2<sup>nd</sup> most prescribed drugs were B complex (12.3%) as micronutrient on the brain and cognitive performance for geriatrics. Amlodipine (10.7%), Atorvastatin (8.7%), Aspirin (7.7%), Frusemide (7.7%), Enalapril (7.7%) and Clopidogrel (6.0%) were the frequently prescribed drugs as the morbidity pattern of cardiovascular disease was highest in our study. Deriphyllin (8.3%) and Salbutamol (6.5%) were the frequently prescribed drugs for COPD. The above top 10 prescribed drugs were classified according to WHO-ATC classification<sup>23, 24</sup>.

Out of a total number of prescription (200) out of this 35 (17.5%) prescription contain drug duplication (unnecessary drug therapy). Patients who are revealed to drug duplication can only notice the toxic potential of that drug and have small or no chance of realizing any positive outcome related to such unnecessary treatment. Among 200 prescriptions, only 147 (73.5%) contain drug-drug interaction and remaining 53 (26.5%) were without drug interaction. Polypharmacy and multiple prescribers will lead to the occurrence of potential drug interactions<sup>25</sup>. Most of the drug administered by oral route (61.29%) followed by injectables (38.01%) which are similar to the study conducted by Jhaveri *et al.*, 26 possible reasons for high use of oral route could be less aggressiveness of the therapy and avoidance of unnecessary selection of the parenteral route. While the parenteral route is very expensive when compared to other dosage form and require trained person for administration and it produces the faster onset of action.

The study found that polypharmacy was common due to inappropriate prescription. The number of drugs prescribed per prescription was 6.86, which is much lesser than a similar study on geriatric population, which is conducted in India<sup>20</sup>, where the average number of drugs per prescription is 7.3. Maximum 9 drugs given to the patient, whereas up to 27 drugs were prescribed in a similar study. The rise in polypharmacy may be due to more illiterate geriatric patients or their caretakers. It is preferable to keep the number of drugs per prescription as low as possible since polypharmacy leads to increased risk of drug interaction and errors of prescription and increased hospital cost.

Total of 84.32% medicines prescribed by generic name which is nearer to the standard value WHO recommendation of 100%<sup>14</sup>. Prescribing by generic names allows flexibility of stocking and dispensing of various brands of drugs that are cheaper than effective as proprietary brands. This is the basis of EDL/formulary use. From our study, we found 100% of drugs prescribed from EDL/formulary, which is very similar to the WHO standard (100%) derived as ideal. List of EDL prepared with public health relevance, evidence of safety and efficacy of that drugs and cost comparative effectiveness.

From our study the percentage encounters in which antibiotic was prescribed to 49%, which is high compared to standard 20-26.8% derived from being ideal<sup>27</sup>. The use of this much antibiotics, which leads to antibiotic resistance. The percentage encounters with an injection prescribed 86%, which is much higher than the WHO standard 13.4-24.1% derived from being ideal<sup>27</sup>. This may be due to the psychological advantage of infection and treating doctors and patients.

The optimal value of IRDP was 2.99 which is less than WHO standard value 5. The optimal index was 1 for all indicators. The values are adjacent to 1 designated rational drug use and *vice versa*. The index of polypharmacy was 0.43 shows more deviation from the WHO standard, which indicates polypharmacy. The optimal value of a generic prescription is 100%; in our study, the index of generic name prescribing was 0.84. The optimal value of antibiotic prescribing is ( $\leq 30\%$ ), and the observed value was found to be 0.61. The index of injection prescribing 0.11, which shows a difference from the optimal value. The percentage of prescribing from EDL/formulary in our hospital was 100% as recommended by WHO. Awareness should be given to the prescribers to adjust the polypharmacy, generic prescription; antibiotic prescription and injection thereby increase the importance of rational prescribing and medication adherence<sup>28</sup>.

The prescribed medication was reviewed using Beers criteria by the American Geriatric Society. In 2012 updated Beers criteria, for potentially inappropriate medications (PIMs) use in elderly. It is divided into 3 categories. Category A which includes drugs that should be avoided in elderly and it should not be prescribed – found the major category of inappropriate use of drugs. In our present study, 11 drugs were entitled to this category. NSAIDS (Diclofenac) 17.47%, CNS drugs (Alprazolam, Amitriptyline and diazepam) to (12.05%) and cardiovascular drugs (Digoxin, Nifedipine, Verapamil and Spironolactone) to (5.42%) of patients found the majority of PIMs under the category A. In our study PIMs, the category B of Beers criteria which includes the drugs to be avoided in combination with specific co-morbidity, were not prescribed. In category C in which medicines to be used with cautions.

Aspirin as an antiplatelet drug was prescribed frequently our study by most of the physician for the follow up on the cardiovascular disease. The medication error also occurred in many prescriptions due to illegible handwriting, failure to write the dose, dosage form, and decimal points. Pharmacist involvement in patient care and computerized decision support help to reduce medication error<sup>29</sup>.

**CONCLUSION:** This study reveals data of drug use in geriatric patients in this secondary care hospital. Our study discloses that drug utilization accelerates the rational use of drugs in older adults. Patients positive findings were prescription by generic name, from EDL / Formulary, free government supply and choice of the oral route. Free health services are the major demand for developing countries because many people who are with poor financial resources could use it.

Particular awareness and training should be given to the prescribers concerning geriatric patients. To enhance drug therapy for geriatric patients, it is essential for prescribers to make aware of the Beers criteria and should be surely followed for good health care outcomes in the elderly. The maximum number of drug utilized by males is greater compared to that of female because the prevalence of the disease is more in the male in our study. The average number of drugs per encounter was high.

Our studies propose the present prescribing practices in the hospital related to higher polypharmacy and inappropriate medication use. A systematic medication chart review by the clinical pharmacist can minimize the frequency of prescribing drugs without indications and thereby decrease polypharmacy. It will also lower the cost of therapy, which will eventually benefit the patients. A high number of prescription errors were found.

Many of these were small and unlikely to have had serious effect, some were of great importance. Further extensive studies on medication error are essential to predict the scale of the problem and their economic impact.

**ACKNOWLEDGEMENT:** We express a very humble thanks to The Erode College of Pharmacy & Research Institute, Erode and Government Head

Quarters Hospital, Tiruppur for providing facilities and great facilitation to accomplish this research work.

**CONFLICT OF INTEREST:** The authors do not have any conflicts of interest regarding the publication of this paper.

## REFERENCES:

1. Wettermark B, Elseviers M, Almarsdottir AB, Andersen M, Benko R and Bennet M: Drug utilization research: methods and applications. John Wiley & Sons Ltd., Edition 1<sup>st</sup>, 2016: 1-12.
2. Kanwal H and Zaka M: Drug utilization pattern in geriatrics a review. World Journal of Pharmacy and Pharmaceutical Sciences 2018; 7(1): 203-06.
3. World Health Organization. Introduction to Drug Utilization Research. Geneva: World Health Organization; 2003; 8-12. Available from: <http://apps.who.int/medicine/docs/pdf/s4876e/s4876e.pdf>. [Accessed 9<sup>th</sup> August 2018].
4. EI-Mahalli AA: WHO/INRUD Drug use indicators at primary healthcare centers in Alexandria, Egypt. Journal of Taiban University Medical Sciences 2014; 9(1): 54-64
5. Bello SI, Ojieabu WA and Bello IK: World Health Organization indicators for rational use of drugs in a Nigerian Secondary hospital, Rajiv Gandhi University of Health Science. J Pharm Sci 2016; 6(2): 38-40.
6. Meena VK, Atray M and Agrawal A: Evaluation of drug utilization pattern in indoor patients of medicine department at a tertiary care teaching hospital in southern Rajasthan. International Journal of Pharmaceutical Sciences and Research 2016; 7(9): 3835-40.
7. Kumar V: Geriatric medicine. API Textbook of Medicine. Jaypee Brothers Medical Publishers (P) Ltd., Edition 9<sup>th</sup>, 2012: 2038-42.
8. Borah A, Devi D, Debnath PK and Deka D: A study of drug utilization pattern of geriatric patients in the department of geriatric medicine in a tertiary care hospital in Assam, India. AJPCR 2017; 10(2): 122-26.
9. Gallagher P, Barry P and O'Mahony D: Inappropriate prescribing in the elderly. J Clin Pharm Ther 2007; 32(2): 113-21.
10. Klotz U: Pharmacokinetics and drug metabolism in the elderly. Drug Metab Rev 2009; 41(2): 67-76.
11. Corsonello A, Pedone C and Incalzi RA: Age-related pharmacokinetic and pharmacodynamic changes and related risk of adverse drug reactions. Curr Med Chem 2010; 17(6): 571-84.
12. Goudanavar P, Keerthi Y, John SE, Jacob J and Krishna MSR: A prospective study on medication prescribing pattern for geriatric patients in a Tertiary Care Teaching Hospital. Asian Journal of Biomedical and Pharmaceutical Sciences 2015; 6(56): 23-27.
13. Lalwani US, Pillai A and Piparva KG: Drug utilization pattern among geriatric patients in a tertiary care teaching hospital. International Journal of Pharmaceutical Sciences and Research 2017; 8(3): 1249-54.
14. Kanagasanthosh K, Topno I and Aravindkumar B: Prevalence of potentially inappropriate medication use and drug utilization pattern in elderly patients: A prospective study from a tertiary care hospital. International Journal of Research in Medical Sciences 2015; 3(8): 2062-72.
15. Raut B, Kharel S, Tiwari K and Kela AK: Drug utilization pattern in geriatric patients admitted in the medicine



- department at Tertiary Care Hospital. Indian Journal of Basic and Applied Medical Research 2017; 7(1): 36-44
16. Weng MC, Tsai CF, Sheu KL, Lee YT, Lee HC and Tzeng SL: The impact of number of drugs prescribed on the risk of potentially inappropriate medication among outpatient older adults with chronic diseases. Q J Med 2013; 106: 1009-15.
  17. The American Geriatrics Society: 2012 Beers Criteria Update Expert Panel: AGS updated Beers Criteria for potentially inappropriate medication use in older adults. J Am Geriatr Soc 2012; 60: 616-31.
  18. Abraham F, Varughese G, Mathew JC, John PM and Sam GK: Drug utilization pattern among geriatric patients in a Tertiary Care Teaching Hospital. Asian Journal of Pharmaceutical and Clinical Research 2015; 8(6): 191-94.
  19. Zaveri HG, Mansuri SM and Patel VJ: Use of potentially inappropriate medicines in elderly: A prospective study in medicine Out-Patient Department of a Tertiary Care Teaching Hospital. Indian Journal of Pharmacology 2010; 42(2): 95-8.
  20. Shah RB, Gajjar BM and Desai SV: Drug utilization pattern among geriatric patients assessed with the anatomical therapeutic chemical classification defined daily dose system in a rural tertiary care teaching hospital. Int J Nutr Pharmacol Neurol Dis 2012; 2(3): 258-65.
  21. Gopinath S, Rajalingam B, Sriram S and Vijayakumar S: An individual-based study of the geriatric population: A polypharmacy. Int J Pharm Pharm Sci 2011; 3(4): 63-6.
  22. Sharma N, Advani U, Kulshreshtha S, Parakh R, Bansal A and Sinha RR: Screening of prescriptions in geriatric population in a Tertiary Care Teaching Hospital in North India. J Phytopharmacol 2013; 2(5): 38-45.
  23. WHOCC - ATC/DDDIndex. Available from: www.whocc.no/atc\_ddd\_index. [Accessed 5<sup>th</sup> Aug 2018].
  24. Sharma P, Parakh R and Sharma N: Pattern of prescribing prescriptions among the patients attending the Department of Respiratory Medicine in a Tertiary Care Teaching Hospital in India. Indo Amer J Pharm Res 2013; 3(12): 1544-51.
  25. Bjerrum L, Lopez-Valcarcel BG and Petersen G: Risk factors for potential drug interactions in general practice. Eur J Gen Pract 2008; 14: 23-29.
  26. Jhaveri NB, Patel KT, Barvaliya JM and Tripathi BC: Drug utilization pattern and pharmaco-economic analysis in geriatric medical inpatients of a tertiary care hospital of India. J Pharmacol Pharmacother 2014; 5(1): 15-20.
  27. Isah AO, Ross-Degnan D, Quick J, Laing R and Mabadeje AF: The development of standard values for the WHO drug use prescribing indicators ICUM/EDM/WHO. Available from: [http://www.archives.who.int/prduc2004/rducd/ICIUM\\_Posters/1a2\\_txt.htm](http://www.archives.who.int/prduc2004/rducd/ICIUM_Posters/1a2_txt.htm). [Accessed 25<sup>th</sup> Jul, 2018].
  28. Senthilselvi R, Simon A, Anagha R, Joseph A and Mohan A: Drug utilization study and evaluation of rational use of medicines in the Medical Emergency Poison Department and Intensive Care Unit of a Government Hospital; a prospective study. World Journal of Pharmacy and Pharmaceutical Sciences 2018; 7(1): 1169-89.
  29. Gupta M and Agarwal M: Understanding medication errors in the elderly. The New Zealand Medical Journal 2013; 126(1385): 62-70.

**How to cite this article:**

Sumithira G, Anilkumar A, Rahman CVH, Bharanidharan SE and Ganesan V: Drug utilization pattern in geriatric patients of general medicine in a Secondary Care Hospital. Int J Pharm Sci & Res 2019; 10(7): 3364-72. doi: 10.13040/IJPSR.0975-8232.10(7).3364-72.

All © 2013 are reserved by International Journal of Pharmaceutical Sciences and Research. This Journal licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License.

This article can be downloaded to **Android OS** based mobile. Scan QR Code using Code/Bar Scanner from your mobile. (Scanners are available on Google Play store)