# Evaluation of Drug Use Patterns in Geriatric Patients of Hypertension and Diabetes: A Retrospective Analysis

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## Abstract

**Background**  The ongoing pandemic has resulted in high mortality in geriatric population; this has brought in sharp focus the need to study drug use in this group. Irrational drug use is the major concern in healthcare sector.

**Aim**  The main aim of the study was to evaluate and analyze the drug use in geriatric population with hypertension and diabetes on selected World Health Organization (WHO) prescribing indicators.

**Methodology**  This is a retrospective cross-sectional study and was done for the period of 1 year on the prescriptions of geriatric patients (age >60years), belonging to either sex, visiting outpatient department of private or government clinics or hospitals for routine or follow-up visit. Hundred such prescriptions were collected and evaluated for drug use and analyzed for rational drug use on the basis of selected WHO prescribing indicators.

**Observations and Results**  The results were statistically analyzed and expressed in percentage and frequencies. In our study, male:female ratio was 47:53, average number of drugs was 4.49, percentage of drugs in generic name was 3.11, percentage of encounters with antibiotic use was 8%, and percentage of drugs prescribed from essential drug list was 72.17%. Analysis of drug use in geriatric hypertensive patients ($n = 92$) showed that β-blockers and angiotensin receptor blockers were the most commonly prescribed drugs at 48.9% and 47.8%, respectively. In Type 2 diabetes mellitus ($n = 47$), antidiabetic drugs used were metformin, that was prescribed in 100% patients, followed by sulfonylureas (55.3%), dipeptidyl peptidase inhibitor-4 inhibitors (25.5%), and sodium-glucose contransporter-2 inhibitors (06.3%). Percentage of drugs prescribed in fixed dose combination was 20.26% ($n = 91$).

**Conclusion**  As per WHO prescribing indicators, the prescription practices in geriatric patients having hypertension and diabetes in our study showed deviation from ideal standards.

**Keywords**
► drug use
► geriatric
► prescription
► rational drug use

## Introduction

The elderly population accounts for a significant part of world population; due to increased life span, they are afflicted with chronic diseases like hypertension or diabetes. Elderly or senior citizens have been defined in the National Policy for Older Person (1999) as people with age more than 60 years.[1,2] Geriatric population is a vulnerable group loaded with healthcare challenges. Pharmacotherapy in this vulnerable group has additional challenges like age-related changes in pharmacokinetic and pharmacodynamic handling of drugs, increased disease load due to concomitant disorders, requirement of multiple drugs to be taken over years or sometimes the patient's entire life. Moreover, this adds to the economic stress due to reduced income and the increasing cost of healthcare.[3] Hypertension and diabetes mellitus are the most common illness of geriatric population and are major health concern. The World Health Organization (WHO) has projected that by year 2025, three hundred million people will suffer from diabetes and one and half billion will suffer from hypertension.[4] Diabetes or Type 2 diabetes mellitus is a metabolic disease characterized by high blood glucose level due to defective insulin secretion or insulin action or both. The WHO predicts that deaths caused by diabetes and associated microvascular and macrovascular complications will double between year 2005 and 2030.[5] Drugs used to treat diabetes and hypertension are the most common drugs used in geriatric group. It is imperative that elderly population gets quality healthcare and rational drug use to prevent or retard the complications associated with diseases. The common reasons for irrational drug use are self-medication, polypharmacy, inappropriate or over use of antibiotics, leading to rapidly developing resistance to the existing antibiotics, overuse of injectable preparations, and not adhering to the established treatment guidelines according to WHO.[6,7] Thus, assessment and evaluation of rational and appropriate use of drugs play an important role in providing quality healthcare to patients. The WHO has established three core elements : prescribing indicators, patient care indicators, and healthcare facility-specific indicators. To measure the performance of healthcare facilities related to drug use, the WHO in collaboration with International Network of Rational Use of Drugs in year 1993 has developed prescribing indicators. The prescribing indicators include a group of measured parameters represented as the average number of drugs per encounter, percentage of encounters with antibiotics or injection, percentage of drugs prescribed by generic, and the percentage of drugs from the essential drug list.[6–8]

Evaluation and analysis of prescriptions of elderly patients with hypertension and/or diabetes are complex as the number of drugs prescribed is high and is given together. Polypharmacy leads to increased incidence of adverse effects, drug interactions, increased cost of healthcare, and decreased compliance that in turn lead to negative health outcome.

## Methodology

This was a cross-sectional retrospective study performed on prescriptions written between the period of November 2020 and October 2021. The approval for the study was obtained from institutional ethics committee. The prescriptions were randomly selected from hypertensive and/or diabetic patients of age more than 60 years, belonging to either sex, and resident of Punjab, India. The prescriptions were evaluated for the pattern of drug use and were analyzed on the basis of selected WHO prescribing indicators for rational drug use. Prescribing indicators are group of measured parameters represented by average number of drugs per encounter, percentage of encounter with antibiotics or injections, percentage of drugs prescribed by generic names, and percentage of drugs from essential drug list.

The prescription of patients with diagnosis of hypertension and/or diabetes visiting outpatient facility for routine or follow-up visit at either tertiary level hospital or private or government clinic who were prescribed at least one drug were randomly selected. The photo evidence of the prescription was taken. The information of the prescription was transferred on to the format prepared on paper to capture all the information and demographic details like age, gender, diagnosis, and concomitant disease if any. The prescriptions were also studied for number, name (generic or brand) of medicine prescribed, formulations, and route of drug administration. The patients with age less than 60 years, or not having hypertension and/or diabetes as their diagnosis, or requiring indoor admission were excluded from study. The contents of prescriptions were analyzed and evaluated for selected WHO prescribing indicators and drug use.

For calculating the selected WHO core prescribing indicators aimed at improving rational use of drug, following calculations were done.[6,7]

1. Degree of polypharmacy was calculated by dividing total number of drug products prescribed by total number of encounters (prerequisite was that fixed dose combination (FDC) and combination of drug would be counted as one).
2. Percentage of drugs prescribed by generic name was calculated by dividing drugs prescribed by generic name by total number of drugs prescribed and multiplying it with 100.
3. For the purpose of calculating indicator on antimicrobial use, number of encounters in which antimicrobial were prescribed divided by total number of encounters studied.
4. Percentage of encounters in which injections were prescribed was calculated by dividing number of encounters in which injections were prescribed divided by total number of encounters studied multiplied with 100.
5. Percentage of drugs prescribed from Essential Medicine List was calculated by dividing number of drugs prescribed from Essential Drug List to total number of drugs prescribed and multiplying it with 100.

The data was entered using Microsoft Excel program.

The data obtained was analyzed by calculating means, frequencies, and percentages.
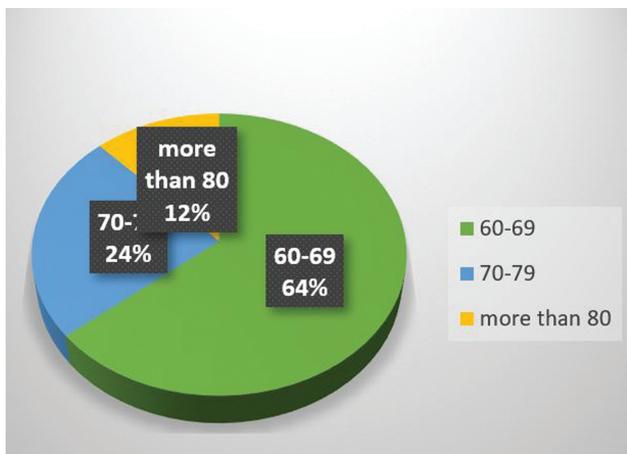
**Fig. 1** Age group distribution of geriatric patients.

## Observations and Results

The total number of prescriptions evaluated in this study were 100. This indicator study was done by collecting prescriptions of geriatric patients with diagnosis of hypertension and/or diabetes visiting outpatient facility of either tertiary level hospitals or clinics for initial visit or follow-up visit, or visit due to illness not requiring indoor admission. In the present study, 47% patient were males, and 53% were females. Sixty four percent patients were in age group of 60 to 69, while 24% of patients were in age group of 70 to 79 and 12% were more than 80 years (►**Fig. 1**).

Out of 100 randomly selected patients, 37% had attended outdoor facility of a tertiary level hospital and 63% received their prescriptions in clinics. Fifty three percent patients had hypertension with or without coronary heart disease, 8% had only type 2 diabetes as their primary diagnosis, and 39% had both hypertension and type 2 diabetes (►**Fig. 2**). Incidence of

concomitant disease was seen to be very high as 25% patients had coronary artery disease, 2% had angioplasty, 1% had angina, and 3% were postmyocardial infarction. Two percent patients had hypothyroidism, and 2% had bronchial asthma, 1% had fatty liver, and 3% had osteoarthritis. Eight percent patients had visited the healthcare facility for illness requiring antimicrobial use.

The WHO prescribing indicator was used for evaluating degree of polypharmacy, that is an average number of drugs. It was calculated by dividing total number of drug products prescribed by total number of encounters that was found to be 4.49 (►**Table 1**). The total number of drugs prescribed for all the included prescriptions were 449. The average number of drugs per encounter were 4.49. The highest number of drugs prescribed in a patient was 11, while 8 drugs were given to 9% patients, and only 12% of the patients were prescribed 2 drugs. None of the prescription had single drug prescription. The range for number of drugs prescribed was 2 to 11.

The percentage of drugs prescribed by generic name measures the tendency of prescribing by generic name, which is calculated by dividing drugs prescribed by generic name to total number of drugs prescribed and multiplying it with 100. It was ($n = 14$) 3.11% as compared with ideal value of 100% given by the WHO (►**Table 1**). The majority of prescriptions had drugs written in nongeneric or by their brand names.

The indicator for antimicrobial use was calculated by dividing percentage of encounters with antimicrobial use to total encounters studied. The value for core prescribing indicator on antimicrobial use was 8% (►**Table 1**). The antimicrobial drugs were 3.06% of total drugs. Out of total prescriptions, 5% had one antimicrobial use, while 3% had two antimicrobials that were prescribed simultaneously. The fluoroquinolones group of antimicrobials were commonly prescribed, followed by β-lactam antibiotics (amoxycillin



**Fig. 2** Percentage distribution of disease in geriatric patients. CAD, coronary artery disease; DM, diabetes mellitus; HT, hypertension.

**Table 1** Core prescribing indicators

| Sl no | Core prescribing indicator | Result in percentage |
|---|---|---|
| 1 | Average number of drugs | 4.49 |
| 2 | Percentage of drugs in generic name | 3.11 |
| 3 | Percentage of encounters with antibiotic use. | 8 |
| 4 | Percentage of drugs prescribed from essential drug list | 72.17 |
| 5 | Percentage of encounters with drugs by injections | 2 |

Geriatric population with hypertension and/or type 2 diabetes, $n = 100$.

**Table 2** Drug use in patients of hypertension

| S.no | Antihypertensive drugs | Percentage of patients getting a specific antihypertensive | Percentage of share of specific antihypertensive to total antihypertensive drugs | Percentage of share of specific antihypertensive to total drugs |
|---|---|---|---|---|
| 1 | Beta-blockers | 48.9 | 33.08 | 10.02 |
| 2 | ARB | 47.8 | 32.35 | 09.79 |
| 3 | CCB | 20.65 | 13.97 | 04.23 |
| 4 | Diuretics | 17.39 | 11.76 | 03.56 |
| 5 | ACEI | 9.7 | 06.61 | 02.01 |
| 6 | Miscellaneous | 3.26 | 02.20 | 00.66 |

Number of hypertensive patients ($n = 92$). Total number of antihypertensives ($n = 136$); drug combination was counted as one drug. Total number of drugs studied $= 449$.

with sulbactam, and cephalosporins) and azithromycin from macrolide group. Percentage of encounters with injectable drugs was 2% as injection of subcutaneous insulin was prescribed in two encounters. Percentage of drugs prescribed from Essential Medicine List (EML) was 72.17% as compared with ideal value of 100%, (►**Table 1**). In our study, almost 20.26% ($n = 91$) drugs were prescribed in FDC.

Most commonly prescribed drugs for patients of hypertension ($n = 92$) were β-blockers (Beta - Blockers) and accounted for 48.9% ($n = 45$) of antihypertensive drug use in patients (►**Table 2**, ►**Fig. 3**). Among these, metoprolol was most commonly prescribed in 34% followed by atenolol in 6%, carvedilol in 4%, and bisoprolol in 1% of the patients. Angiotensin receptor blockers (ARB) ($n = 44$) were prescribed to 47.8% patients (►**Table 2**, ►**Fig. 3**). Telmisartan was most prescribed (29%), followed by losartan in 15% of patients. Calcium channel blockers (CCB) ($n = 19$) were prescribed in 20.65% of hypertensive patients (►**Table 2**, ►**Fig. 3**).

Among CCB group, Amlodipine was most frequently prescribed drug in 12% patients. Diuretics ($n = 16$), were prescribed in 17.39% of hypertensive patients (►**Table 2**, ►**Fig. 3**) with chlorthalidone in 7%, thiazide in 3%, high ceiling diuretic furosemide in 5%, and torsemide in 1% patients. Potassium sparing diuretics were prescribed in combination with furosemide (4%) and chlorthalidone in 1%. Angiotensin converting enzyme inhibitors (ACEI) ($n = 9$) were prescribed in 9.7% hypertensive patients (►**Table 2**, ►**Fig. 3**), with ramipril given in 8% patients, lisinopril in 1% patients and enalapril was given in one patient. Nitrates/clonidine ($n = 3$) were miscellaneous antihypertensives prescribed in 3.26% of patients. Evaluation

of prescriptions of patients of type-2 diabetes showed that 100% of diabetic patients ($n = 47$) were given metformin belonging to biguanide group either alone or as fixed drug combination with sulfonylureas. Sulfonylureas were prescribed in 55.3% ($n = 26$) of diabetic patients (►**Table 3**), with glimepiride (16%) being most commonly prescribed Sulfonylureas, followed by gliclazide (7%), glyburide (3%), and glipizide (3%). Vildagliptin, a dipeptidyl peptidase inhibitor (DPP-4), was prescribed in 11% and teneligliptin was prescribed in 1% of geriatric diabetes type 2 patients (►**Table 3**). Dapagliflozin, a sodium glucose cotransport-2 inhibitor, was prescribed in 3% patients (►**Table 3**). Two percent of the patients were on human insulin (►**Table 3**).

Miscellaneous drugs prescribed included antiplatelet drugs like low-dose acetyl salicylic acid and clopidogrel in 33% of patients. Proton-pump inhibitors were found in 28% of prescriptions (omeprazole, pantoprazole, and rabeprazole) with or without domperidone. Vitamins were also seen in 19% prescriptions. Clonazepam, cetirizine, montelukast, thyroxine, cetirizine, ranitidine, anxiolytics (clonazepam and diazepam) antidepressants (selective serotonin reuptake inhibitor -duloxetine), and lactulose was found to be prescribed in less than 3% of patients. Inhalation formulation of β-2 agonists such as salmeterol or formoterol in combination with budesonide was observed in 2% patients.

## Discussion

A total of 100 prescriptions were evaluated in our study. Among the study population, the proportions of females
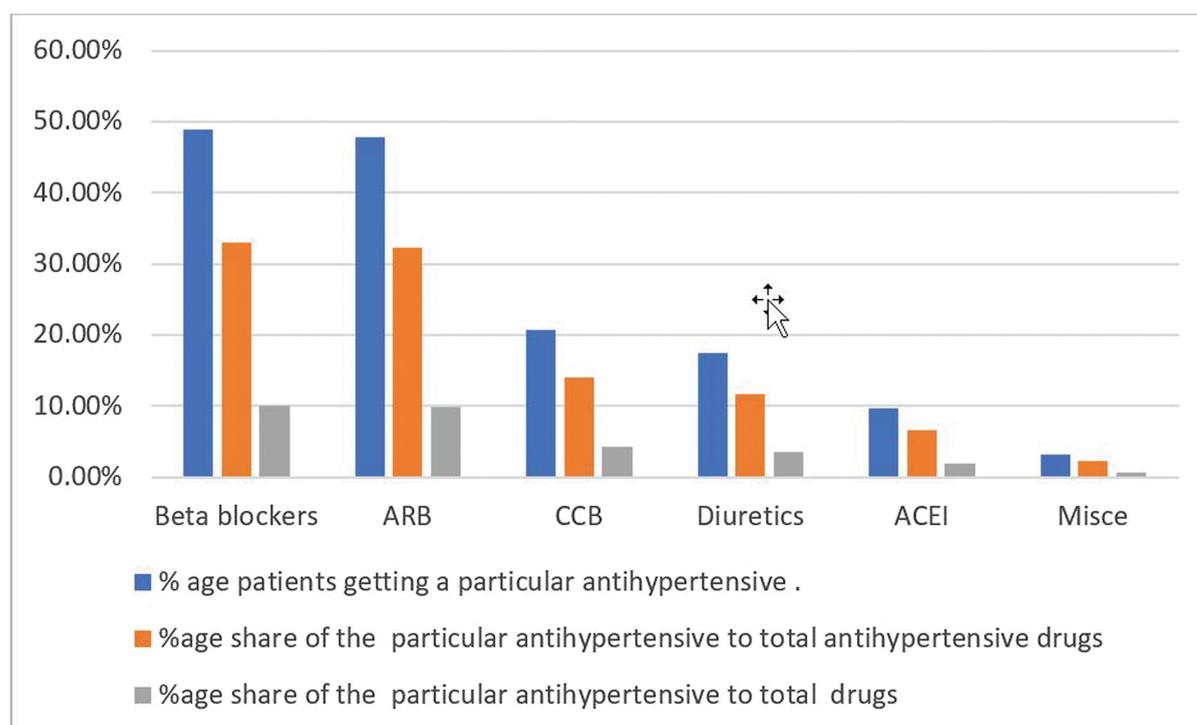
**Fig. 3** Category wise distribution of antihypertensive drugs.

(53%) was on the slightly higher side as compared with males (47%). This is in concordance with the national data.[1,2] However, Pandey et al reported higher ratio of males (57.31) to female (42.69).[9]

The objective of this study was evaluation and analysis of prescriptions on the basis of selected prescribing indicators of WHO in geriatric patients with diagnosis of hypertension and/or diabetes mellitus. The WHO has established three core elements to improve rational drug use based on degree of polypharmacy, percentage of encounters with antimicrobial use, and injectables preparations. In addition to these, other indicators such as percentage of drugs prescribed by generic names, and percentage of drugs from essential drug list measure the performance of healthcare providers in core values and rational drug use in outpatient department.[6–8]

Polypharmacy that is studied by the WHO indicator based on average number of drugs prescribed is an important parameter of rational drug use. Polypharmacy leads to increased incidence of adverse drug effects, drug interactions, decreased compliance, and increased cost.[2] The average number of drugs per prescription in our study was 4.49 that is very high when compared with standard value of 1.6 to 1.8 given by the WHO.[7] This is in contrast to international studies where lower values for were reported in China (1.76)[11] Ethiopia (1.9)[12] and Nigeria (3.2 to 5.6)[13] while, a study in Jordan reported average number of drugs prescribed per encounter to be 2.93.[14] Lower value was also reported in study done in Indian patients (3.03)[15] by Ragam et al. This indicator is, however, comparable to the similar finding in India by Shelat and Kumbar (4.98)[16] and Upadhyay et al

**Table 3** Drug use in patients of type 2 diabetes

| Sl. no | Drugs groups for type 2 diabetes | Percentage of diabetic patients ($n = 47$) receiving a specific drug | Percentage of of the specific antidiabetic to total drugs prescribed for diabetes ($n = 88$) | Percentage of share of the specific antidiabetic to total drugs ($n = 449$) |
|--------|----------------------------------|--------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------|
| 1 | Biguanides | 100 | 53.4 | 10.46 |
| 2 | Sulfonylureas | 55.3 | 31.3 | 5.79 |
| 3 | Dipeptidyl peptidase-4 inhibitors | 25.5 | 14.4 | 2.67 |
| 4 | Sodium glucose Cotransport-2 inhibitor | 06.3 | 03.6 | 0.66 |
| 5 | Human insulin | 4.25 | 2.27 | 0.44 |

Number of patients with diabetes mellitus ($n = 47$). Total number of antidiabetic drugs ($n = 88$), percentage of age share in total drugs = 19.5%. (Prerequirement: drug combination was counted as one drug). Total number of drugs studied = 449.

(3.76).[17] The value of 4.49 in our study is, however, less than other studies done in Indian population, which shows that the patients were prescribed an average of 5.15[18] to 6.45[19] drugs. Reason for polypharmacy in our study could be due to the selected population sample of geriatric age group with diabetes and hypertension; in this group chronic and multiple conditions are common. Polytherapy increases with increase in comorbidities. Fifty two percent of the patients received more than five medications concurrently, which is similar to another study done in Indian geriatric patients, wherein (57.9%)[19] received higher than five medications concurrently.

Generic prescribing is an important and economical method, it prevents confusion, and more importantly the medication errors. Percentage of drugs prescribed by generic names was 3.11, which is very low when compared with standard set by the WHO, wherein ideal valve is 100%. This finding is similar to other studies in India wherein values reported were 1.53%[15], 0.8%[19] and 0.05%[20], depicting poor generic prescribing practice. This value is, however, in variance to other studies done in India by Tripathy et al[21], who reported 68% of the medicines were prescribed by their generic names, while Ramachandran et al[18] reported this value to be at 25.37%. Reasons for not writing medicine by generic names may be due to regular and aggressive promotional activities of pharmaceutical companies. This practice, however, increases the noncompliance and cost burdens on patients as well as society at large.

Essential medicines are those drugs that satisfy the priority healthcare needs of the population based on disease prevalence, efficacy, safety, and should be available to population in cost-effective and timely manner.[8] The percentage of drugs prescribed according to the WHO list of essential medicines was 72.17%, which is close to other studies conducted in India, reporting prescriptions from the essential drug list at 74.30%[18] and 67.1%.[22] These percentages are in variance to the ideal standard values of 100%[6,7] and much less when compared to international studies that reported values of 99%, 99.6%, and 85%.[12–14] Among the Indian studies, Chandelkar and Rataboli[20] reported 99.6% prescribing from the WHO essential drugs list, whereas Ragam et al[15] reported a much lower value of 49.30%. Prescription writing in accordance with the WHO list of essential medicines will decrease the cost of treatment, thus improving the adherence of patient to treatment, leading to improved health outcomes.[23]

Some drugs were prescribed in FDC, which has advantage of being synergistic and lesser fewer number of medications to be taken. FDC may also offer the advantage of reduced dosage of an individual component, or in opposing the adverse effects of each other. However, some FDC may not be rational or synergistic, thus are not a part of WHO list of essential medicines. In our study, almost 20.26% ($n = 91$) drugs were prescribed in FDC. In concordance to this, other studies done in India reported 29.12% to 40.8% FDC.[15–24]

Hypertension is a common disease in geriatric patients ($n = 92$). Hypertension treatment has changed widely over time in terms of initial drug of choice from a diuretic to an Angiotensin converting enzyme inhibitors (ACEI)/Angiotensin II receptor blockers (ARB)/ Calcium channel blockers (CCBS), from monotherapy to low-dose combinations[24]. A total of 92 geriatric patients were hypertensive; most of the patients were on more than one antihypertensive drug category. β-Blockers and angiotensin receptor blockers were the most commonly prescribed drugs in hypertensive patients[25] at 48.9% and 47.8%, respectively. Calcium channel blockers (amlodipine) were prescribed in 17.39% of the hypertensive patients followed by diuretics (thiazide, chlorothiazide, spironolactone) in 17.39% and angiotensin-converting enzyme inhibitors (ramipril, lisinopril, enalapril) in 9.7% patients. This is similar to findings of Pandey et al[9] wherein 40.8% patients utilized combination therapy.[26] This is, however, in variance to some studies done in past by Mohd et al, where calcium channel blockers, angiotensin receptor blockers, and β-blockers were prescribed in 37%, 21%, and 11% hypertensive geriatric patients, respectively.[27] Antihypertensive drugs formed 30.28% of the total drugs in our study. Choice of antihypertensive drugs is based on many factors and research shows that, good control of blood pressure protects the patient from cardiovascular, as well as microvascular complications, thus decreasing overall mortality.[25,26,28] Type 2 diabetes also increases the risk of macrovascular and microvascular complications.[5]

The current pharmacotherapy is focused on decreasing insulin resistance, increasing insulin secretion, delaying gastric emptying, and giving insulin as per current guidelines of American Diabetes Association (ADA) and the European Association for the study of diabetes[5,29,30]. In the present study, 100% of diabetic patients ($n = 47$) were prescribed metformin belonging to biguanide group either alone or as a fixed drug combination with sulfonylureas. This is in concordance to finding by Agarwal et al[22] and Sultana et al.[31] Sulfonylureas were prescribed in 55.3% ($n = 26$) of prescriptions, with glimepiride (16%) being the most commonly prescribed sulfonylureas, followed by gliclazide (7%), glyburide, and glipizide (3%). These findings are similar to other studies done in the past[10]. Vildagliptin, aDPP-4 inhibitor, was prescribed in 11% of prescriptions and teneligliptin in 1%. Dapagliflozin and canagliflozin, and sodium glucose cotransport-2 inhibitors were prescribed in 3% patients. Two percent of the patients were on human insulin.

Antiplatelet drugs like low-dose acetyl salicylic acid and clopidogrel with or without statins were prescribed in 33% of prescriptions. Low-dose aspirin therapy is recommended in type 2 diabetes mellitus patients depending on their cardiovascular risk, especially if they have both hypertension and diabetes.[30,32] Proton-pump inhibitors were found in 28% of prescriptions (omeprazole, pantoprazole, and rabeprazole) with or without domperidone. Vitamins were prescribed in 19% patients.

Limitations of our study are its small sample size, also other WHO prescribing indicators like patient care indicator and facility indicators were not evaluated. One must keep in mind that difference in individual prescriber's skills and practices cannot be assessed.

## Conclusions

In our study, prescription practices in geriatric patients having hypertension and diabetes show deviation from the ideal standards set by WHO; however, this might be an observation that needs to be studied further. Baseline data of this study can be used further to improve the rational drug use. Need of the hour is to give lot of emphasis on the established treatment guidelines, essential drug use, rational drug use in medical school, and practice years of clinicians by regular information, drug bulletins. Practice of prescription writing is influenced by a prescribers' training, their competencies, attitude toward the disease being treated, and setting of healthcare system within which they work. There is need for continuous training and educational programs on rational drug use in geriatric patients, and these programs should be implemented and monitored so that the required changes in prescribing practices may be made for the benefit of community.

Conflict of Interest
None declared.

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