

# Impact of Clinical Pharmacist in Collaboration with Physicians in Minimizing Drug Therapy Problems among Hypertension and Diabetes Mellitus

Batha Tazmeen<sup>1</sup>, Kommoji Hepziba<sup>2</sup>, Pesamili Divya<sup>3</sup>,  
MD Merajul Islam<sup>4</sup>, Pragathi Reddy<sup>5</sup>, Anjali Bakshi<sup>6</sup>, B. Deepika<sup>7</sup>

<sup>1,2,3,4</sup>Student, Arya College of Pharmacy

<sup>5,7</sup>Assistant Professor, Arya College of Pharmacy

<sup>6</sup>Associate Professor, Arya College of Pharmacy

## ABSTRACT

### Background:

It is estimated that one in six people worldwide, or nearly one billion, are affected by high blood pressure and 7.6 million deaths per annum worldwide(1). Globally, an estimated 462 million individuals are affected by type 2 diabetes, corresponding to 6.28% of the world's population(2). More than 1 million deaths were attributed to this condition in 2017 alone, ranking it as the ninth leading cause of mortality(2). The clinical pharmacist's role is to assess the status of the patient's health problems and determine whether the prescribed medications are optimally meeting the patient's needs and goals of care(3).

### Objectives

To study the impact of Clinical pharmacists in collaboration with Physicians in minimizing drug-therapy problems among Hypertension and Type 2 Diabetes Mellitus.

### Methods

A Prospective interventional study was carried out at Sangareddy District Government Hospital for a period of 6 months. A structured proforma was designed to collect patient data. Descriptive analysis was analysed using MS Excel 2019 MSO to describe demographics, Drug-Related problems, Clinical pharmacist -Physician Intervention, Antihypertensive Drugs, and oral hypoglycaemic drug usage.

### Results

Out of 133 study individuals, the majority of subjects had Sub-therapeutic goal (44%), followed by an Inappropriate Drug[41%]. The majority of patients had at least one DRP(82%).

The most common Intervention performed was the addition of appropriate drugs(31%), followed by cessation of drugs(30%).

### Conclusion

Our study concludes that the collaboration of Clinical Pharmacists with Physicians can assist in identifying and preventing drug-related problems through interventions and their expertise in pharmacotherapy can assist in providing rational drug therapy.

## INTRODUCTION

### HYPERTENSION

Hypertension, also known as high or raised blood pressure, is defined as persistently elevated arterial blood pressure (BP). The systolic blood pressure (SBP) is more than or equal to 140 mmHg and Diastolic blood pressure (DBP) is more than or equal to 90 mmHg (4). The classification of BP in adults (age 18 years and older) is based on the average of two or more properly measured BP values from two or more clinical encounters.

An estimated 1.28 billion adults aged 30-79 years worldwide have hypertension, most (two-thirds) living in low-middle-income countries. An estimated 46% of adults with hypertension are unaware that they have the condition. Less than half of adults (42%) with hypertension are diagnosed and treated. The prevalence of high BP is higher in men than women before age of 65. Approximately 1 in 5 adults (21%) with hypertension have it under control. Hypertension is a major cause of premature death worldwide (4).

The patient may have a previous medical history or diagnostic findings that indicate the presence of hypertension-associated complications:

- Brain (stroke, transient ischemic attack, dementia)
- Eyes (retinopathy)
- Heart (left ventricular hypertrophy [LVH], angina, prior MI, prior coronary revascularization, HF)
- Kidney (chronic kidney disease [CKD])
- Peripheral vasculature (peripheral arterial disease [PAD]) (4)

### PATHOPHYSIOLOGY:

Multiple physiologic factors control BP and abnormalities of these factors are potential contributing components in the development of essential hypertension. These include malfunctions in either humoral (i.e., the renin-angiotensin-aldosterone system) or vasodepressor mechanisms, abnormal neuronal mechanisms, defects in peripheral autoregulation, and disturbances in sodium, calcium, and natriuretic hormones. Many of these factors are cumulatively affected by the multifaceted RAAS, which ultimately regulates arterial BP. It is probable that no one factor is solely responsible for essential hypertension (4).

### Pharmacological therapy

The overall goal of treating hypertension is to reduce morbidity and mortality from CV events. The choice of initial antihypertensive drug therapy depends on the degree of BP elevation and presence of compelling indications.

An ACEi, ARB, CCB, or a thiazide are the preferred first-line antihypertensive agents.

$\beta$ -Blocker therapy should be reserved to either treat a specific compelling indication or used in combination with one or more of those mentioned above first-line antihypertensive agents for patients without a compelling indication.

A single first-line antihypertensive drug should be started as initial therapy in most patients with newly diagnosed hypertension presenting with stage 1 hypertension. Combination drug therapy, preferably with two first-line antihypertensive drugs, should be started as initial therapy in patients with newly diagnosed hypertension presenting with more severe BP elevation (stage 2 hypertension).

There are several compelling indications where specific antihypertensive drug classes have evidence showing unique benefits in patients with hypertension.

Other antihypertensive drug classes (alpha 1 blockers, direct renin inhibitors, central alpha 2 agonists, adrenergic inhibitors, and direct arterial vasodilators) are alternative drug classes that may be used in select patients after implementing first-line agents(4).

### **Angiotensin - converting enzyme inhibitors**

ACE inhibitors are the first-line option. ACE inhibitors block the conversion of angiotensin I to angiotensin II, a potent vasoconstrictor and stimulator of aldosterone secretion.

starting doses should be low with slow dose titration. Acute hypotension may occur at the onset of therapy, especially in patients who are sodium or volume depleted, in HF exacerbation, very elderly, or on concurrent vasodilators or diuretics. Hyperkalemia occurs primarily in patients with CKD or those also taking potassium supplements, potassium-sparing diuretics, ARBs, or a direct renin inhibitor.

Acute renal failure is a rare but serious side effect. Bilateral renal artery stenosis or unilateral stenosis of a solitary functioning kidney renders patients dependent on the vasoconstrictive effect of angiotensin II on efferent arterioles. Angioedema occurs in fewer than 1% of patients. A persistent dry cough occurs in up to 20% of patients, ACE inhibitors (as well as ARBs and direct renin inhibitors) are contraindicated in pregnancy(4).

### **Angiotensin II Receptor Blockers**

ARBs are a first-line therapy option in most patients with hypertension and reduce CV events similar to ACE inhibitors. The combination of an ACE inhibitor and ARB is associated with a higher risk of side effects (renal dysfunction, hypotension). The ARBs directly block the angiotensin II type 1 receptor that mediates the effects of angiotensin II. ARBs do not block bradykinin breakdown.

The addition of a CCB or thiazide diuretic significantly increases antihypertensive efficacy. ARBs have a low incidence of side effects. Like ACE inhibitors, they may cause renal insufficiency, hyperkalemia, and orthostatic hypotension. ARBs are contraindicated in pregnancy(4).

### **Calcium Channel Blockers**

Calcium channel blockers (CCBs), including both dihydropyridine and non-dihydropyridine types, are first-line therapy options. They are also used in addition to or instead of other first-line antihypertensives for the compelling indications of coronary artery disease and diabetes. CCBs cause relaxation of cardiac and smooth muscle by blocking voltage-sensitive calcium channels, thereby reducing the entry of extracellular calcium into cells. This leads to vasodilation and a corresponding reduction in BP. Diltiazem and verapamil can cause cardiac conduction abnormalities such as bradycardia, AV block, and HF. Both can cause anorexia, nausea, peripheral edema, and hypotension. Verapamil causes constipation in about 8% of patients. Dihydropyridines cause a baroreceptor-mediated reflex increase in heart rate because of potent peripheral vasodilating effects. Other side effects of dihydropyridines are dizziness, flushing, headache, gingival hyperplasia, and peripheral edema(4).

### **Diuretics**

**Thiazides** are the preferred type of diuretic and are considered a first-line option for most patients with hypertension.

**Loop diuretics** are more potent for inducing diuresis but are not ideal antihypertensives unless relief of edema is also needed. Loops are sometimes preferred over thiazides in patients with CKD when the estimated GFR is less than 30 mL/min/1.73m<sup>2</sup>, especially when edema is present.

**Potassium-sparing diuretics** are weak antihypertensives when used alone and provide minimal additive effect when combined with a thiazide or loop diuretic. Their primary use is in combination with another diuretic to counteract potassium-wasting properties.

**Aldosterone antagonists** (spironolactone and eplerenone) are also potassium-sparing diuretics but are more potent antihypertensives with a slow onset of action (up to 6 weeks with spironolactone). Acutely, diuretics lower BP by causing diuresis. The reduction in plasma volume and stroke volume associated with diuresis decreases cardiac output and BP. The initial drop in cardiac output causes a compensatory increase in peripheral vascular resistance. With chronic therapy, extracellular fluid volume and plasma volume return to near pre-treatment levels, and peripheral vascular resistance falls below baseline. Reduced peripheral vascular resistance is responsible for the long-term hypotensive effects. Thiazides also mobilize sodium and water from arteriolar walls, which may contribute to decreased peripheral vascular resistance and lowered BP. When diuretics are combined with other antihypertensive agents, an additive hypotensive effect is usually observed because of independent mechanisms of action. Furthermore, many nondiuretic antihypertensive agents induce sodium and water retention, which is counteracted by concurrent diuretic use. Side effects of thiazides include hypokalemia, hypomagnesemia, hypercalcemia, hyperuricemia, hyperglycemia, dyslipidemia, and sexual dysfunction. Loop diuretics have less effect on serum lipids and glucose, but hypokalemia is more pronounced, and hypocalcemia may occur. Hypokalemia and hypomagnesemia may result in cardiac arrhythmias, especially in patients receiving digoxin, patients with LV hypertrophy, and those with ischemic heart disease. Low-dose therapy (eg, 25 mg hydrochlorothiazide or 12.5 mg chlorthalidone daily) causes small electrolyte disturbances. Potassium-sparing diuretics may cause hyperkalemia, especially in patients with CKD or diabetes and in patients receiving concurrent treatment with an ACE inhibitor, ARB, direct renin inhibitor, or potassium supplement(4).

### **β-Blockers**

β-Blockers are only considered appropriate first-line agents to treat specific compelling indications (eg, post-MI and coronary artery disease). Their hypotensive mechanism may involve decreased cardiac output through negative chronotropic and inotropic effects on the heart and inhibition of renin release from the kidney.

Atenolol, betaxolol, bisoprolol, metoprolol, and nebivolol are cardio-selective at low doses and bind more avidly to β<sub>1</sub>-receptors than to β<sub>2</sub>-receptors. As a result, they are less likely to provoke bronchospasm and vasoconstriction and may be safer than nonselective β-blockers in patients with asthma, chronic obstructive pulmonary disease (COPD), diabetes, and peripheral arterial disease (PAD). Cardioselectivity is a dose-dependent phenomenon, and the effect is lost at higher doses. Acebutolol, carteolol, and pindolol possess intrinsic sympathomimetic activity (ISA) or partial β-receptor agonist activity. When sympathetic tone is low, as in resting states, β-receptors are partially stimulated, so resting heart rate, cardiac output, and peripheral blood flow are not reduced when receptors are blocked.

Theoretically, these drugs may have advantages in patients with HF or sinus bradycardia. Thus, agents with ISA are rarely needed.

Atenolol and nadolol have relatively long half-lives and are excreted renally; the dosage may need to be reduced in patients with renal insufficiency. Even though the half-lives of other  $\beta$ -blockers are shorter, once-daily administration still may be effective.

Myocardial side effects include bradycardia, AV conduction abnormalities, and acute HF. Blocking  $\beta_2$  - receptors in arteriolar smooth muscle may cause cold extremities and aggravate PAD or Raynaud phenomenon because of decreased peripheral blood flow.

Abrupt cessation of  $\beta$ -blocker therapy may produce unstable angina, MI, or even death in patients with coronary disease. In patients without heart disease, abrupt discontinuation of  $\beta$ -blockers may be associated with tachycardia, sweating, and generalized malaise in addition to increased BP. For these reasons, the dose should always be tapered gradually over 1 to 2 weeks before discontinuation.

## DIABETES MELLITUS

The term diabetes mellitus describes a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbances of carbohydrate, fat, and protein metabolism resulting from defects in insulin secretion, insulin action, or both. Abnormalities of carbohydrate, fat, and protein metabolism are due to deficient action of insulin on target tissues resulting from insensitivity or lack of insulin. Types of diabetes mellitus include T1DM results in Beta cell destruction usually leading to absolute insulin deficiency. T2DM This form of diabetes accounts for 90-95% of the cases. Most patients with type 2 Diabetes are obese and obesity itself leads to insulin resistance. Gestational Diabetes Mellitus is a degree of GIT with onset or first recognition during pregnancy(4).

Type 2 Diabetes affects both the old and the youth and is highly associated with morbidity, mortality, and a high health cost to individual patients, their families, and countries. Diabetes is fast gaining the status of a potential epidemic in India with more than 72.9 million people with diabetes in India 2017, which is projected to rise to 134.3 million by the year 2045 million diabetic individuals currently diagnosed with the disease in India and 463 million people have diabetes in the world rising to 10.2% (578 million) by 2030 and 10.9% (700 million) by 2045.

The global prevalence of impaired glucose tolerance is estimated to be 7.5% (374 million) in 2019 and is projected to reach 8.0% (454 million) by 2030 and 8.6% (548 million) by 2045.

The proportion of people with T2DM is increasing in most countries. 79% of adults with diabetes were living in low and middle-income countries. 1 in 5 of people who are above 65 years old has diabetes. 1 in 2 (232 million) people with diabetes were undiagnosed. 374 million people are at increased risk of developing T2DM(4).

## Pathophysiology

### T1DM

T1DM is a chronic autoimmune disorder that occurs in genetically susceptible individuals and may be precipitated by environmental factors. In some individuals, the immune system is triggered to develop an autoimmune response against altered pancreatic beta cell antigens.

## T2DM

In the etiology of T2DM, genetic factors play an important role. Identical twins reveal 10% risk of developing T2DM. Diabetic genotype is influenced by various factors. The main risk factor is obesity and other factors such as low physical activity(4).

**Pharmacological therapy:** Ameliorate symptoms, reduce risk of microvascular and macrovascular complications, reduce mortality, and improve quality of life.

**TYPE 1 DIABETES MELLITUS** All patients with type 1 DM require insulin, but the type and manner of delivery differ based on patient preference, lifestyle behaviours, clinician preference, and available resources. Therapy should attempt to match carbohydrate intake with glucose-lowering processes (usually insulin) and physical activity. The goal is to allow the patient to live as normal a life as possible(4).

## TYPE 2 DIABETES MELLITUS

Patients with A1C 7.5% (0.075, 58 mmol/mol Hb) or less are usually treated with an antihyperglycemic that is unlikely to cause hypoglycemia. Those with A1C above 7.5% but less than 8.5% (0.085, 69 mmol/mol Hb) could be treated initially with a single oral agent or combination therapy. Patients with higher initial A1C values require two agents or insulin. Obese patients without contraindications are often started on metformin, titrated to 2000 mg/day.

## Metformin

Metformin is often the drug of choice in patients with type 2 DM due to its efficacy, low cost, positive pleiotropic effects, and manageable side effect profile. It may cause a modest (2–3 kg) weight loss in overweight and obese patients. Metformin also works in nonobese patients, but they are more likely to be insulinopenic, necessitating drugs that increase insulin secretion. The durability of metformin response is suboptimal, and patients often require additional therapy over time. If the individualized target A1C is not reached with single-drug therapy, adding a second drug to metformin is the next step.

## Sulfonylurea

An insulin secretagogue (eg, sulfonylurea) is often added second. They are inexpensive but may cause weight gain and hypoglycemia. They also do not produce a durable glycaemic response.

## Dipeptidyl dipeptidase-4 (DPP-4) inhibitors

Several DPP-4 inhibitors are approved by the FDA including sitagliptin, saxagliptin, linagliptin, and alogliptin. GIP levels are normal in patients with type 2 DM and may play a role in stimulating insulin secretion. GIP has no effect on glucagon. However, levels of GLP-1 are deficient in patients with type 2 DM. As these agents block nearly 100% of the DPP-4 enzyme activity for at least 12 hours, normal physiologic, nondiabetic GLP-1 levels are achieved. DPP-4 inhibitors significantly reduce inappropriately elevated postprandial glucagon and improve  $\beta$ -cell response to hyperglycemia. DPP-4 inhibitors have a neutral impact on weight. DPP-4 inhibitors are considered second line therapy in ADA algorithm and fourth-line therapy in the AACE/ACE though they may be used sooner if other medications have intolerances. Potential advantages of the DPP-4 inhibitors include once daily dose, oral administration, weight neutrality, low risk of hypoglycemia, and they are well tolerated. They may

be used in older adults with moderate to severe renal insufficiency and with CVD. However, their ability to lower BG is modest and they are expensive.

### **$\alpha$ -glucosidase inhibitors**

two  $\alpha$ -glucosidase inhibitors approved by the FDA, acarbose and miglitol.  $\alpha$ -Glucosidase inhibitors competitively inhibit maltase, isomaltase, sucrase, and glucoamylase in the small intestine, delaying the breakdown of sucrose and complex carbohydrates. There is no malabsorption of these nutrients, but merely a delay their absorption. The net effect from this action is to reduce the postprandial blood glucose rise. Postprandial glucose concentrations are reduced by 40 to 50 mg/dL (2.2-2.8 mmol/L) while fasting glucose levels are relatively unchanged. The overall glucose lowering effect of the  $\alpha$ -glucosidase inhibitors in terms of HbA1c is 0.3% to 1% (0.003-0.01; 3-11 mmol/mol Hb). Patients near target HbA1c levels with near-normal fasting plasma glucose levels but high postprandial SMBG are candidates for therapy.

**GLP-1 receptor agonists, and SGLT2 inhibitors** are better choices but they also have therapeutic and safety limitations.

**Thiazolidinediones (TZDs)** Thiazolidinediones (TZDs) produce a more durable glycemic response and are unlikely to cause hypoglycemia, but weight gain, fluid retention, risk of new onset heart failure, and other long-term safe concerns limit their use(4).

### **TREATMENT OF COMPLICATIONS:**

Retinopathy, Neuropathy, Nephropathy, Peripheral Arterial Disease and Foot Ulcers, Coronary Heart Disease, Hypertension(4).

### **AIM**

To study the impact of Clinical pharmacists in collaboration with Physician in minimizing drug-related problems among Hypertension and Diabetes Mellitus.

### **OBJECTIVES**

- To detect drug-related problems in hypertension and type 2 diabetes mellitus patients
- To evaluate the appropriateness and effectiveness of patient's medications
- To categorize and minimize Drug Related Problems and to improve patient quality of life
- To study the effectiveness of Physician -Clinical Pharmacist collaboration in reducing Drug Related Problems

### **METHODOLOGY**

#### **SITE OF STUDY**

The study on the impact of clinical pharmacist in collaboration with physician among hypertension and type 2 diabetes mellitus at a tertiary care teaching hospital in south India was carried out in a 500 bedded multispeciality hospital located at sangareddy. The hospital is unique and well known for its services to urban as well as rural people provides various diverse specialities like general medicine, general surgery,

pediatrics, orthopaedics, cardiology, pulmonology, nephrology with facility, interventional radiology, ophthalmology.

### **DEPARTMENT SELECTED FOR STUDY IN THE HOSPITAL**

The department selected for the study were out patient department of general medicine.

### **INCLUSION CRITERIA**

All the patients age >18 years case of Hypertension, type 2 Diabetes mellitus, were included. Even the patients with comorbidities HTN and Type 2 DM were included.

### **EXCLUSION CRITERIA**

Gestation Hypertension and Gestation DM were excluded.

All patients with any comorbidity other than HTN, Type 2 DM, Hyperlipidaemia were excluded.

Patients with HTN and DM <18 years were excluded.

### **STUDY PERIOD**

Prospective period November 2021-April 2022

### **CONSENT FROM HOSPITAL AUTHORITY**

A Protocol of the study which includes the objectives, methodology, Data collection form was submitted to the ethical committee of the study hospital and college.

We were permitted to utilize the hospital facilities and other healthcare professionals were well informed through the circular given.

### **DATA ENTRY FORMAT**

A separate patient data collection form was prepared for collecting the information about the patient. The format contains the details such as Name, Age, Gender, OPNO, consultation date, Department, Patient medical history, Medication, Family history, social history, Social history, Physician-clinical pharmacist intervention, Laboratory values, appropriate medication, Guidelines, sign of the physicians. The model of the form was given in the annexure for the reference.

### **DATA COLLECTION**

Permission to carry out the study was to obtained from the hospital authorities after submission of the study protocol. A prospective interventional study method was followed to collect data. In the data patients demographic details, past medical history, current medication were recorded. The details of each patients were recorded on a standard data entry forms (annexure). Data was collected for six consecutive months from November 2021 to April 2022

### **DATA ANALYSIS**

Descriptive analysis was analysed using MS Excel 2019 MSO to describe demographics, Drug-Related problems, ClinicalPharmacist-Physician Intervention and Antihypertensive Drugs and oral hypoglycemic drug usage.



**RESULTS**

A total of 190 cases were reviewed for a period of 6 months, 133 patients were found to have drug-related problems. Of the total 133 patients, 45 patients[34%] were found in the age group of 40-49 years followed by 43 patients[33%] in the age group of 50-59 years, and 33 patients[25%] were found in the age group of 60-69 years followed by 6 patients[4%] were found in the age group of 30-39 and 6 patients[4%] were found in the age group of 70-79 years. The mean age of the patients was found to be 52.17±9.35 years. The results are tabulated in table 01 and well illustrated in figure 01

AGE	NUMBER OF CASES	PERCENTAGE [%]
30-39	6	4%
40-49	45	34%
50-59	43	33%
60-69	33	25%
70-79	6	4%

Table1: Age distribution of the subjects

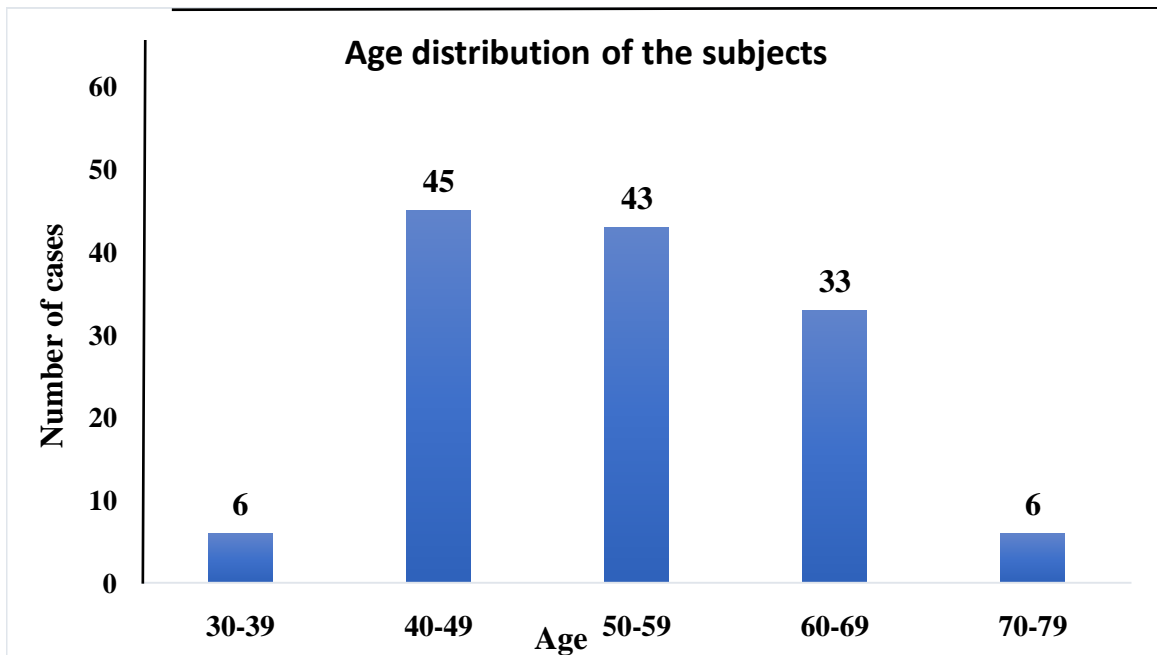


Fig: 1 Age distribution of the subjects

GENDER	NUMBER OF CASES	PERCENTAGE [%]
Male	70	53%
Female	63	47%

Table 2: Gender distribution of the subjects

Of the total 133 Patients, 70 patients [53%] were found to be males and 63 patients [47%] were found to be female. The majority of the Drug-Related problems were identified in males.

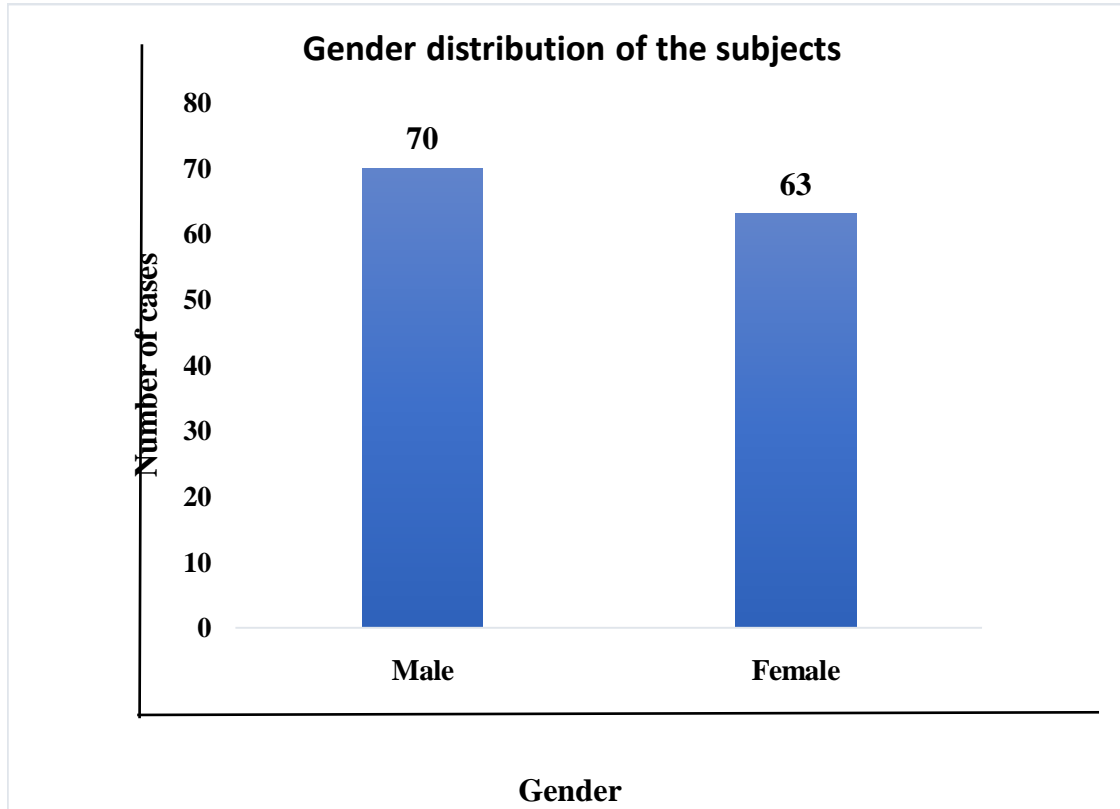
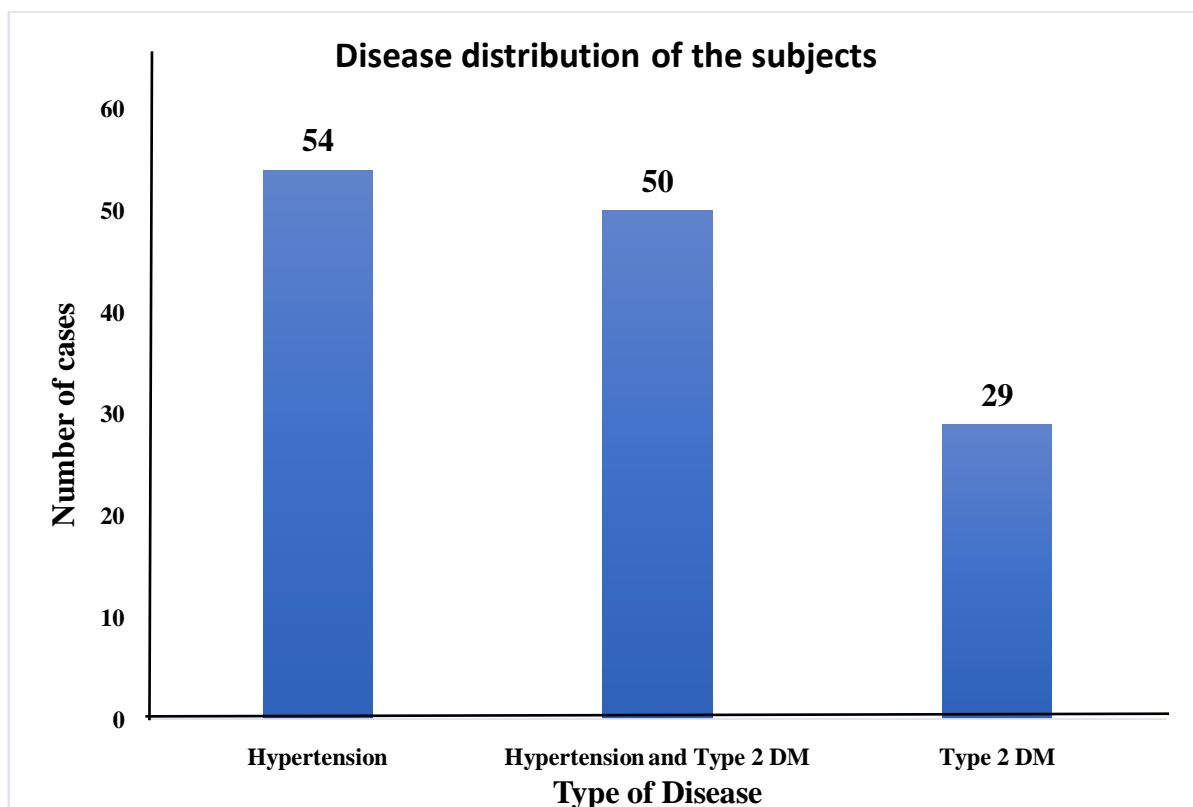


Fig 2: Gender distribution of the subjects

Out of 133 Patients, 54 patients were found to be Hypertensive followed by 50 patients were found to have hypertension with type 2 Diabetes Mellitus and 29 patients were found to have Type 2 Diabetes Mellitus.

DISEASES	NUMBER OF CASES	PERCENTAGE [%]
Hypertension	54	41%
Hypertension with Type 2 Diabetes Mellitus	50	37%
Type 2 Diabetes Mellitus	29	22%

Table 3: Disease distribution of the subjects

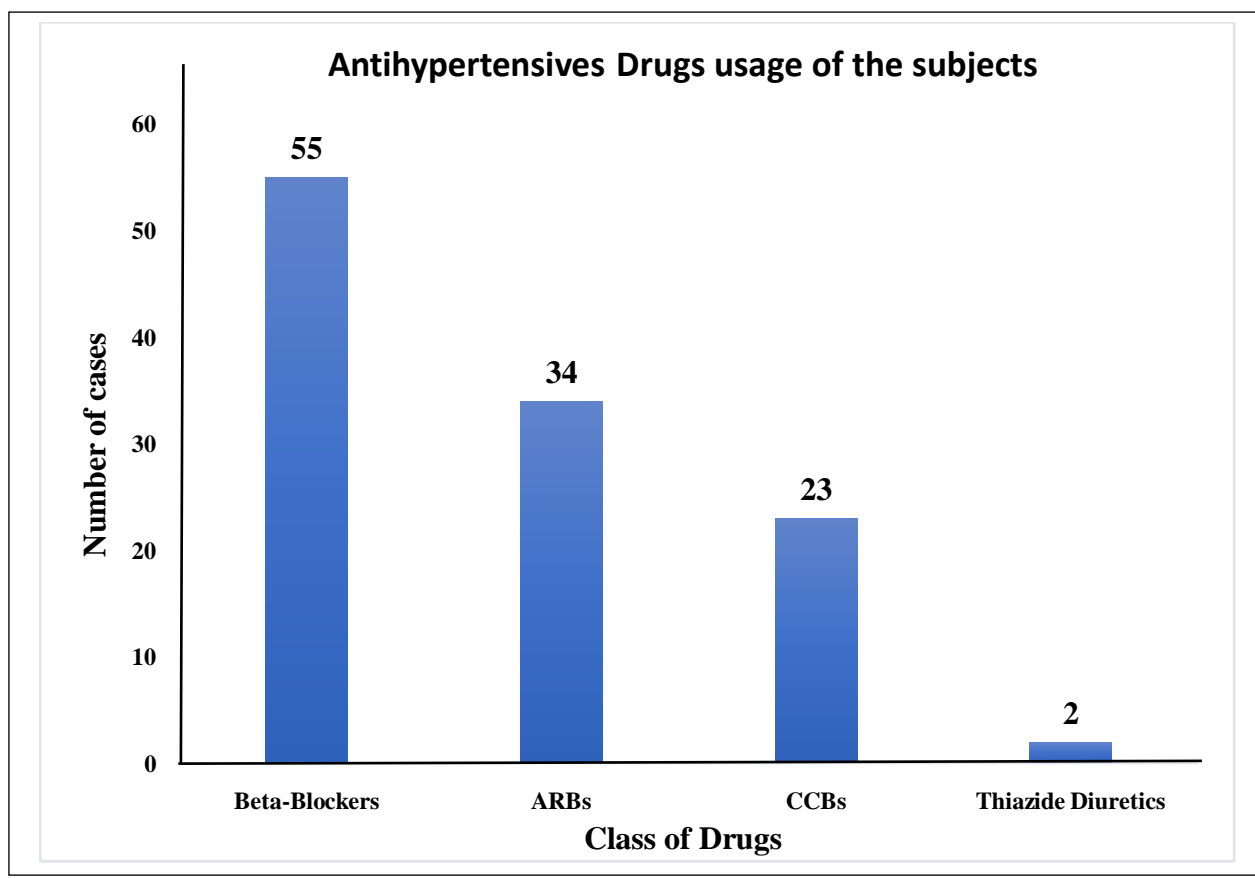


**Fig 3: Disease distribution of the subjects**

Of the total hypertensive patients, Beta-Blockers [48%] were the most commonly used antihypertensive drug followed by Angiotensin II Receptor Blockers [30%] and Calcium Channel Blockers[20%] followed by Thiazide Diuretics[2%].

DRUG CLASS	DRUG USAGE	PERCENTAGE [%]
Beta- Blockers	55	48%
Angiotensin II Receptor Blockers	34	30%
Calcium Channel Blockers	23	20%
Thiazide Diuretics	2	2%

**Table 4: Antihypertensive Drugs Usage in the subjects**



**Fig 4: Usage of Antihypertensive drugs in the Subjects**

Of the total Type 2 Diabetes Mellitus Patients, Biguanides -Metformin was the most commonly used Oral Hypoglycemic drug followed by Sulfonylureas and DPP 4 inhibitors followed by Alpha Glucosidase Inhibitors and Insulin.

DRUG CLASS	DRUG USAGE	PERCENTAGE [%]
Biguanides	74	58%
SulfonylUreas	47	36.7%
DPP4 Inhibitors	3	2.3%
Alpha Glucosidase Inhibitors	2	1.5%
Insulin	2	1.5%

**Table 5: Oral Hypoglycemics with insulin in the subjects**

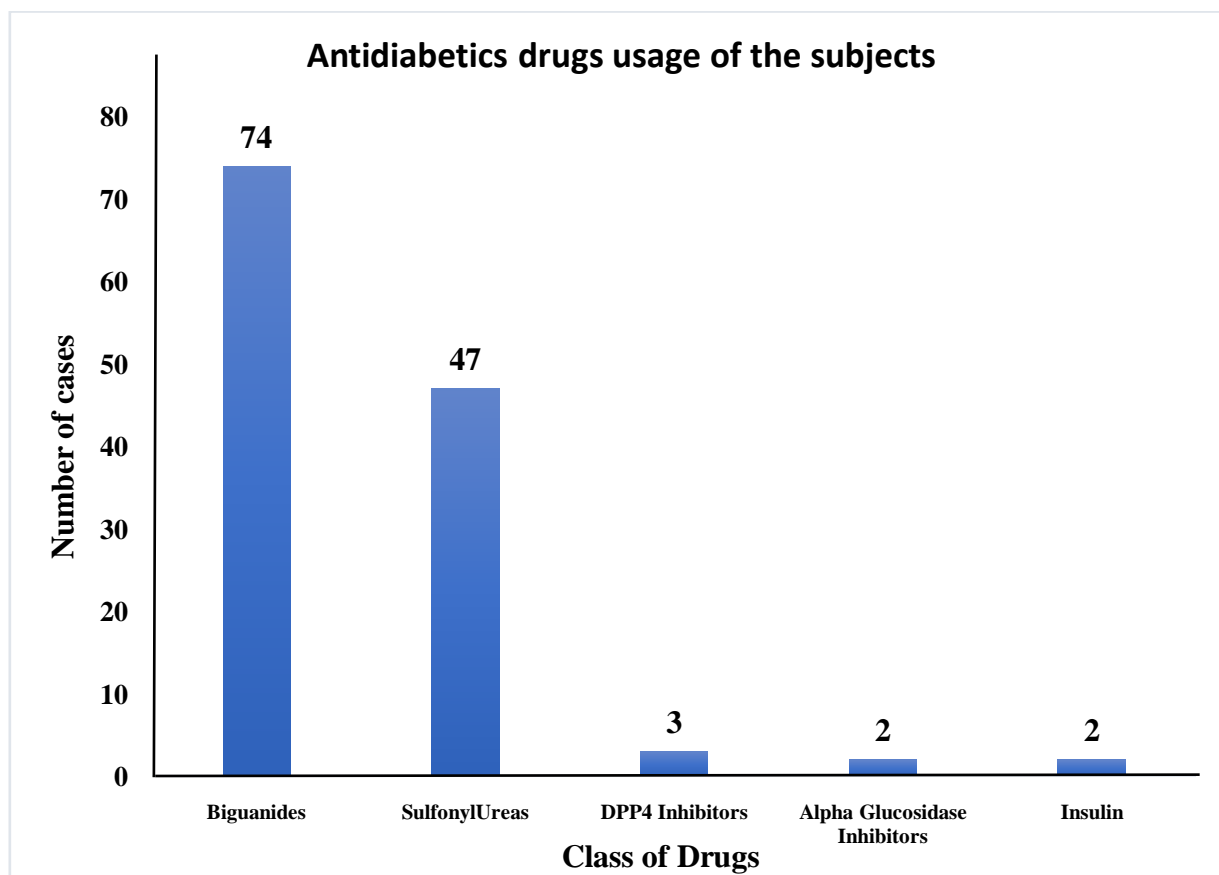
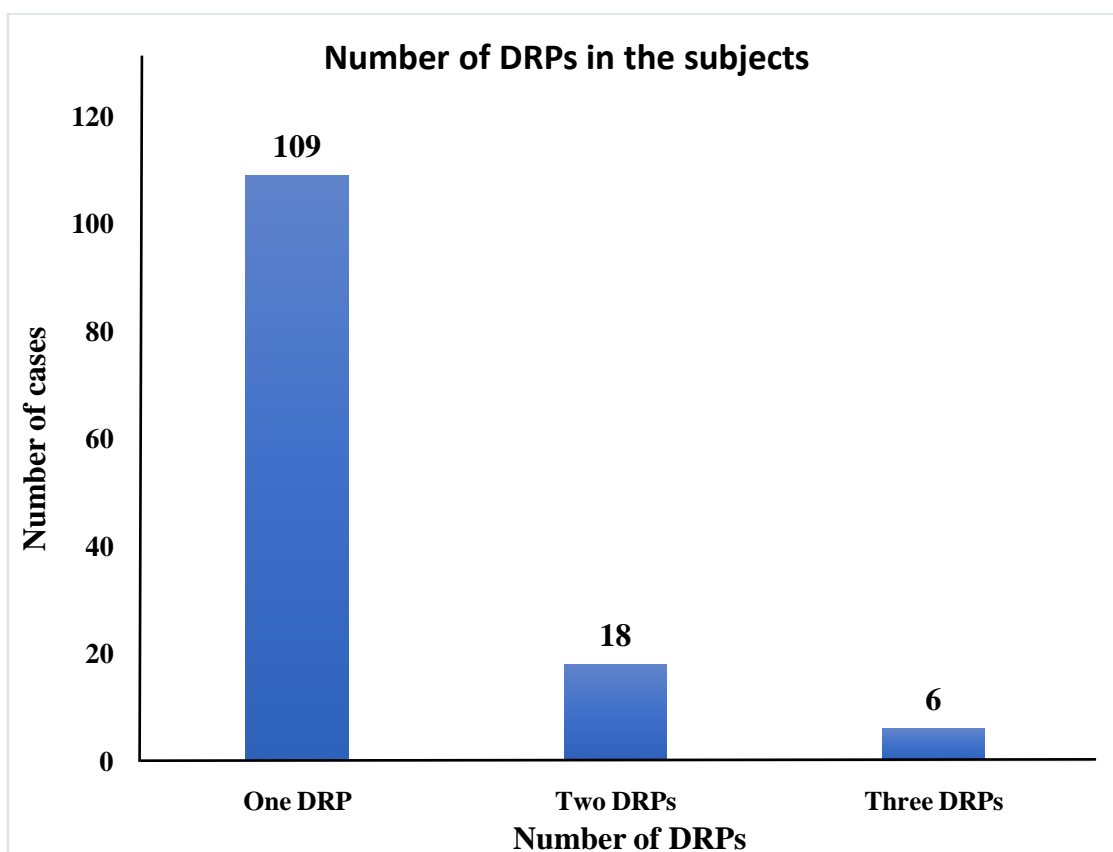


Figure 5: Oral Hypoglycemics with insulin in the subjects

Out of 133 Patients, 109 patients [82%] were found to have at least one Drug-Related Problem followed by 18 patients [14%] found to have two Drug-Related Problems and 6 patients were [4%] found to have three Drug-Related Problems. The mean number of DRPs was  $1.22 \pm 0.51$ .

Number of DRPs	NUMBER OF CASES	PERCENTAGE [%]
One DRPs	109	82%
Two DRPs	18	14%
Three DRPs	6	4%

Table 6: Number of DRPs in the subjects

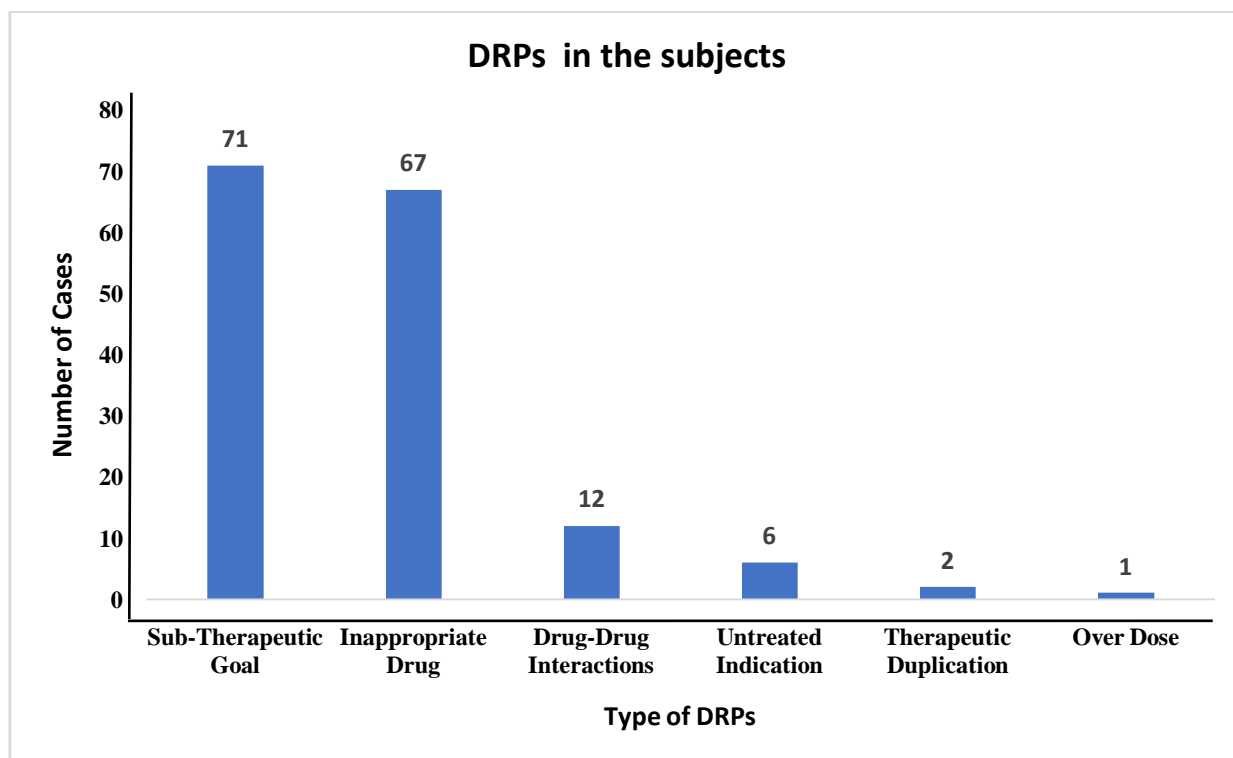


**Fig 6: Number of DRPs in the subjects**

Out of 133 patients, 163 Drug- Related Problems were identified. The sub-Therapeutic goal[44%] was found to be highest among other DRPs followed by Inappropriate Drug selection[41%] Drug-Drug Interactions [7%] were followed by untreated indication [4%], Adverse Drug Reactions [2.4%] Therapeutic Duplication[1%] and Over Dose[0.6%].

Type of DRPs	NUMBER OF DRPs	PERCENTAGE [%]
Sub- Therapeutic Goal	71	44%
Inappropriate Drug	67	41%
Drug-Drug Interactions	12	7%
Untreated Indication	6	4%
Adverse Drug Reactions	4	2.4%
Therapeutic Duplication	2	1%
Over Dose	1	0.6%

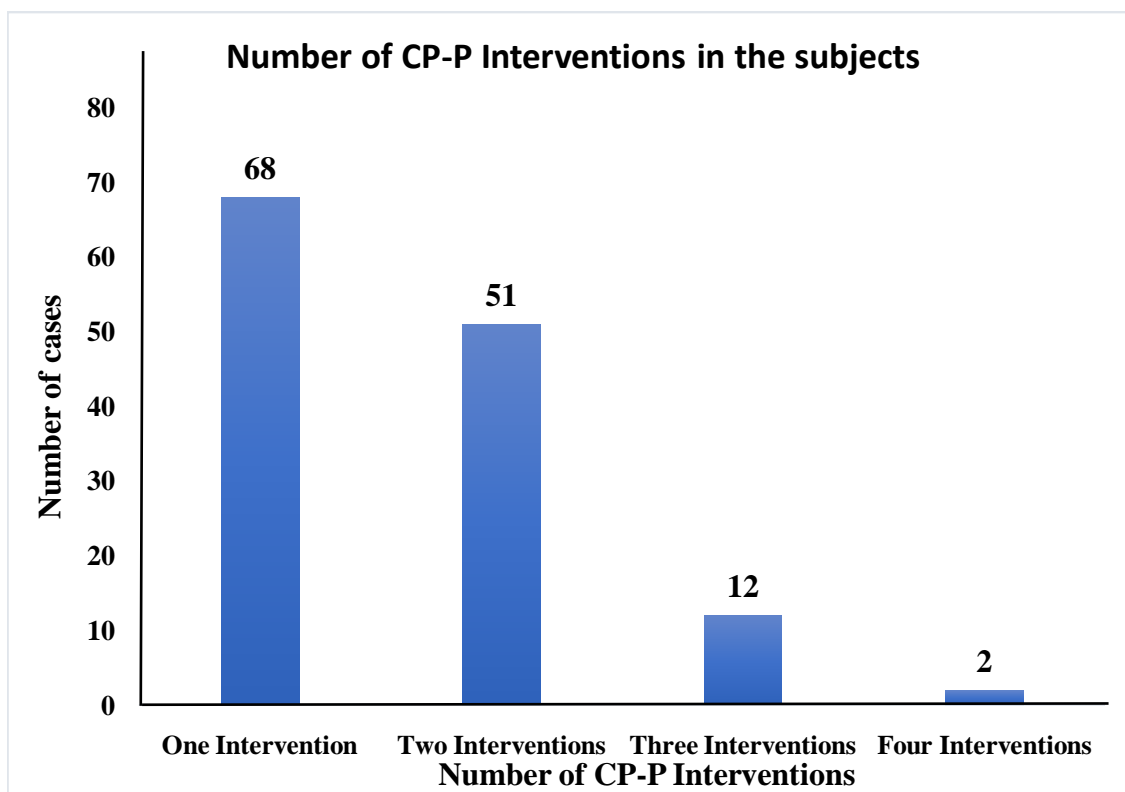
**Table 7: DRPs in the subjects**



**Fig 7: DRPs in the subjects**

Among 133 Patients, 214 Clinical Pharmacists and Physician interventions were performed. Out of 113 patients, 68 patients [51.1%] were found to have at least one Clinical Pharmacist and Physician Intervention followed by 51 patients [38.3%] found to have two Interventions and 12 patients were [9%] found to have three Interventions and 2 patients were found to have four interventions. The mean number of interventions was  $1.60 \pm 0.71$

Number of CP-P Interventions	NUMBER OF CASES	PERCENTAGE [%]
One Intervention	68	51.1%
Two Interventions	51	38.3%
Three Interventions	12	9%
Four Interventions	2	1.6%



**Figure 8: Number of Interventions in the subjects**

Among 133 Patients, 214 Clinical Pharmacists and Physician interventions were performed. The most common Intervention performed by Clinical Pharmacist and Physicians was the selection of appropriate drugs [31%] followed by cessation of drugs [30%] and the need for additional drug therapy [23%].

CP – P INTERVENTION	NUMBER OF INTERVENTIONS	PERCENTAGE [%]
Appropriate Drug	67	31%
Cessation of Drug	64	30%
Additional Drug Therapy	49	23%
Increase in Dose	31	14%
Reduction of Dose	3	2%

**Table 9: CP-P Interventions in the subjects**



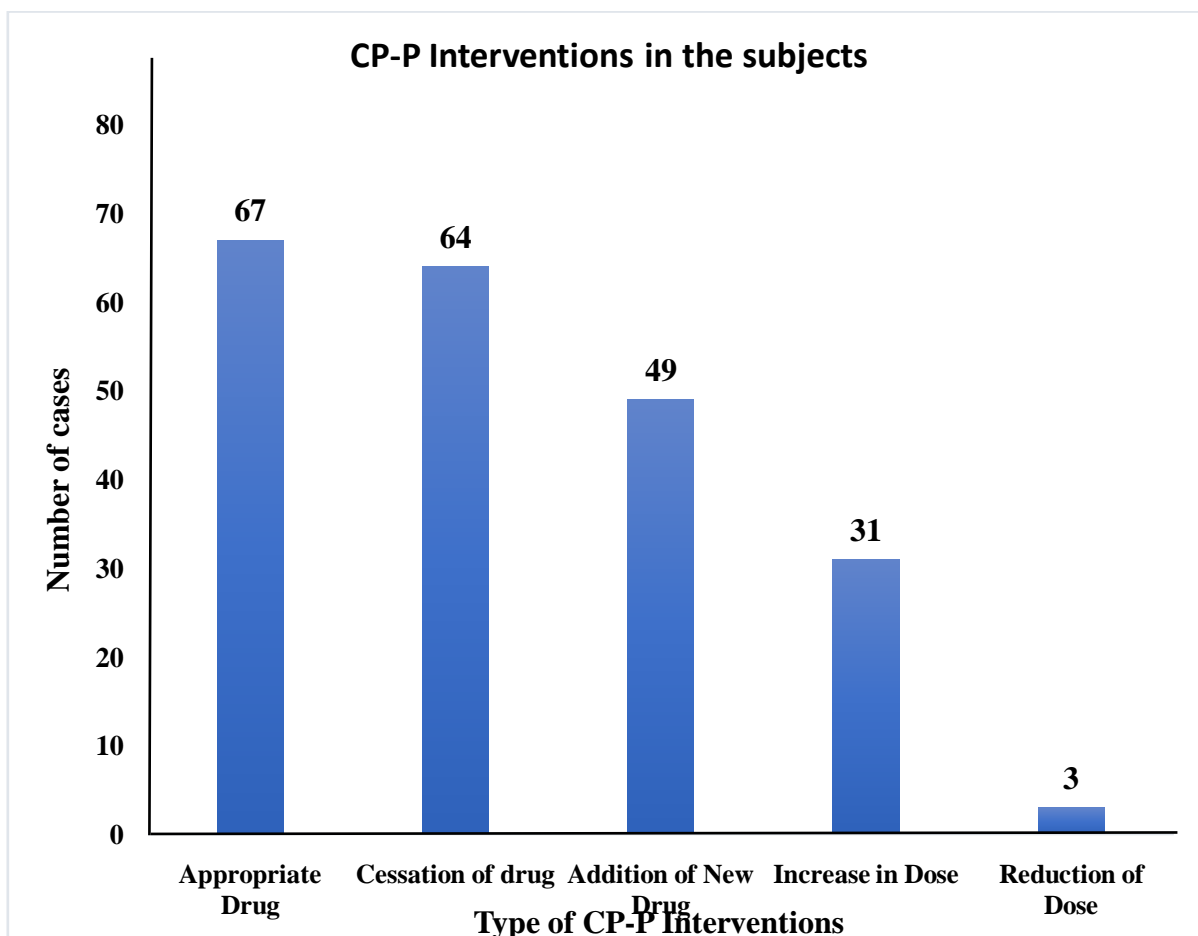
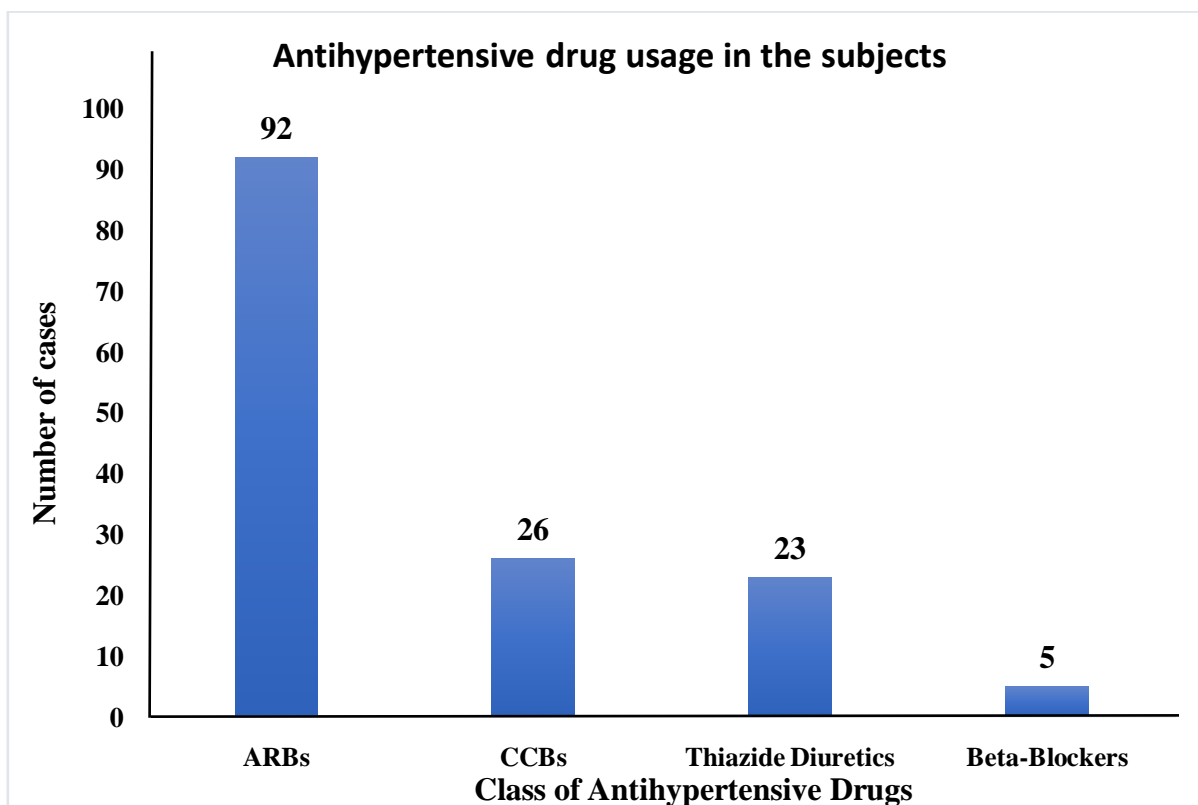


Figure 9: CP-P Interventions in the subjects

After Clinical Pharmacist and Physician Intervention, the most common class of drug used were Angiotensin Receptor Blockers [63%] followed by Calcium Channel Blockers[18%] and Thiazide Diuretics [16%]. The least commonly used drugs were beta-blockers [5%].

DRUG CLASS	DRUG USAGE	PERCENTAGE [%]
Angiotensin II Receptor Blockers	92	63%
Calcium Channel Blockers	26	18%
Thiazide Diuretics	23	16%
Beta - Blockers	5	3%

Table 10: Antihypertensive drug usage after intervention in the subjects

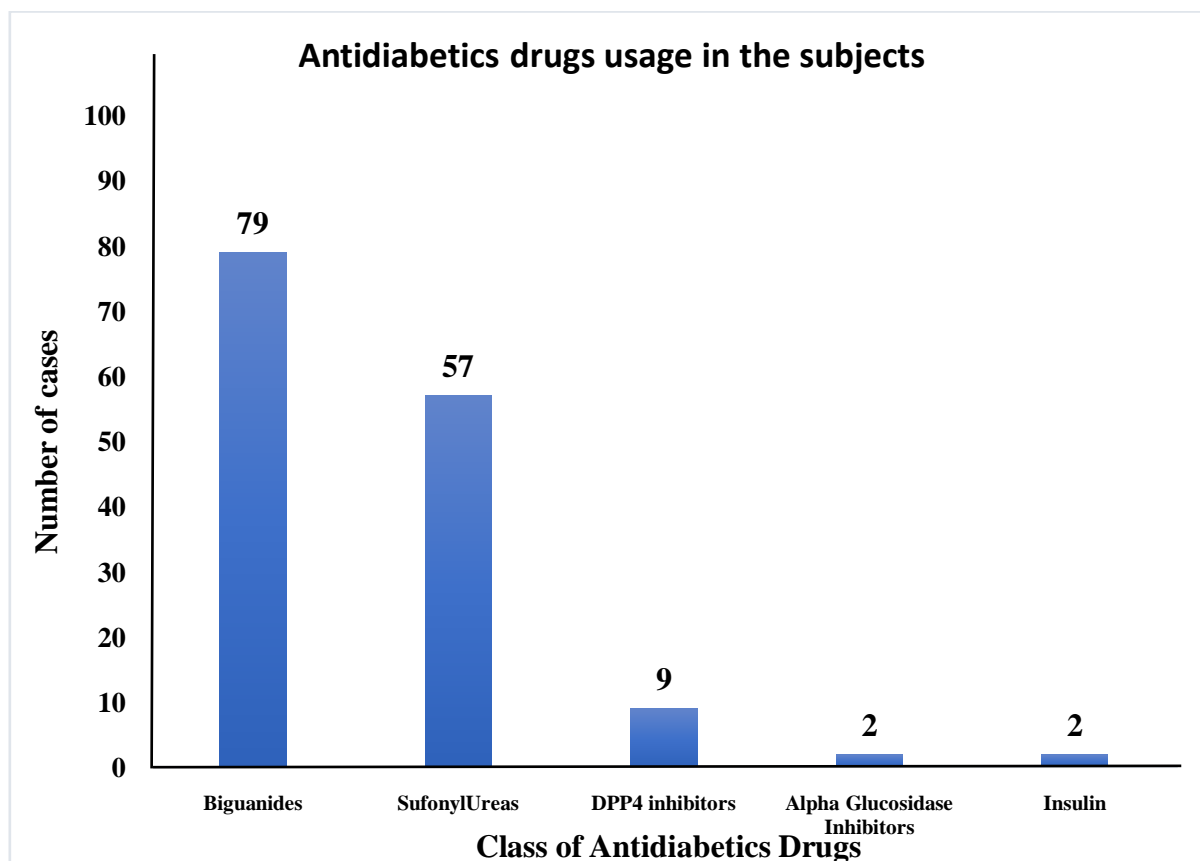


**Fig 10: Usage of Antihypertensives drugs after interventions in the subjects**

After Clinical Pharmacist and Physician Intervention, the most common class of drug used were Biguanides [53%] followed by SulfonylUreas[38%] and DPP4 inhibitors [6%].

DRUG CLASS	DRUG USAGE	PERCENTAGE [%]
Biguanides	79	53%
SulfonylUreas	57	38%
DPP4 Inhibitors	9	6%
Alpha Glucosidase Inhibitors	2	1.5%
Insulin	2	1.5%

**Table 11: Antidiabetics drug usage in the subjects**



**Fig 11: Antidiabetics drug usage in the subjects**

## DISCUSSION

Majority of patients with HTN and Type 2 Diabetes mellitus may have poor therapeutic response to medications, it may be controlled multiple medications which can lead to drug therapy problems in their regimen. Most common drug related problems identified were inappropriate drug selection, sub – therapeutic dose, overdose, drug interaction, untreated indication. The clinical pharmacist role is to assess the status of the patient’s health problems and determine whether the prescribed medications are optimally meeting the patient’s needs and the target goals and also evaluate the appropriateness and effectiveness of the patient’s medications.

Our present study demonstrate that In relation to age, out of 133 patients included ,the age group which is at high risk of having drug therapy problems is 40-59 years with a percentage of (67%) which is similar to study conducted by yimama et al., were the age group which is at high risk of having drug therapy problems is 41-60 years and our study is in contrast with the study conducted by Duedahl TH, Hansen WB, Kjeldsen LJ ,et al. were the age group which is at high risk of having prescription errors is 77 years.

In relation to gender, out of 133 patients, Male patients were found to have more drug related problems when compared to female patients,71 patients with 53% were male and 63 patients with 47% were female, this is similar to the study conducted by Yimama et al., were majority patients were male (64%). The study is contrast with the study conducted by Kusumawardani et al., were the females 59.6% patients have more DRP than males. Such a high prevalence of DRPs in males has been associated with a high number of male patients with Hypertension and Diabetes mellitus than females.

Among 81 males, 53 patients (65%) were found to be smokers and 28 patients (35%) were found to be non-smokers. All female patients were non-smokers.

Of total 133 patients, 28 patients (21%) have a family history of hypertension or Type 2 Diabetes Mellitus and 105 patients (79%) do not have any family history

In our study the drug related problems in prescription indicates (86%) 115 participants have at least one drug related problem and 18 cases (14%) participants have two DRPs which is alike the study conducted by Yimama et al., in which 82% of participants had at least one drug related problem.

Among 133 interventions performed, 68 (51.1%) cases had one intervention, 51 (38.3%) had two interventions, 12 (9%) had three interventions and 2 cases (1.6%) had four interventions.

Among 133 patients HTN was most common disease in patients, 54 (41%) patients were having HTN, 50 patients (37%) were having HTN with type 2 DM and 29 patients (22%) were having Type 2 DM.

Among 133 patients, 163 drug therapy problems were found, the most common problem was identified as sub-therapeutic goal in 71 (44%) cases, followed by improper drug selection 67 cases (41%) this study results were consistent with the study carried out by Shareef et al., where improper drug selection was the common identified drug related problem. The increased incidence of improper drug selection may be attributed to lack of standard treatment protocol in the hospital or the use of drug which are contraindicated to the patient health condition. followed by drug-drug interaction in 12 (7%) cases, one of the least drug therapy problems was found to be untreated indication (4%), which is similar to the study conducted by Shareef, et al., and adverse drug reaction was found in 4 (2.4%) cases which is alike the study conducted by Yimama et al., where the least found DRPs was ADR.

Our study highlights the clinical pharmacist- Physician interventions. Among 133 patients, 214 clinical pharmacist-physician interventions were done in drug related problem, the most common intervention was providing appropriate drug which was done in 67 (31%) cases, followed by cessation of drug in 64 cases (30%), additional drug therapy given in 49 (23%) cases, increase in dose 31 (14%) cases, reduction in dose in 3 cases (2%), which is similar to the study conducted by Shareef, et al., in which cessation of drug and additional drug therapy was given to 30.6% and 26% patients for drug related problems respectively. Physician – clinical pharmacist collaboration can minimize the drug related problems which will help to rationalise the drug therapy, achieve better therapeutic outcomes and improved quality of patient care.

Antihypertensive drugs used before the intervention, Beta blockers were the most commonly used in 55 patients (48%) (atenolol, metoprolol, carvedilol) followed by ARBs in 34 patients (30%) (telmisartan), CCBs in 23 patients (20%) (amlodipine, cilnidipine) and Thiazide diuretics in 2 patients (2%)

Oral hypoglycemic drugs used before the intervention, Biguanides were the most commonly used in 74 patients (58%) (metformin) followed by sulfonylureas in 47 patients (36.7%) (glimepiride), DPP4 inhibitors in 3 patients (2.3%) alpha glucosidase inhibitors in 2 patients (1.5%) (voglibose), and insulin in 2 patients (1.5%).

Most commonly used antihypertensive drugs after clinical pharmacist intervention were ARBs (telmisartan) which is used in 92 (63%) patients followed by CCBs (amlodipine) 26 patients (18%), thiazide diuretics in 23 (16%) patients and the least used were beta blockers in 5 (3%) patients.

Most commonly used oral hypoglycaemic drugs were biguanides used in 79 (53%) patients followed by sulfonylureas in 57 (38%), DPP4 inhibitors in 9 (6%) and the least used were alpha glucosidase inhibitors in 2 (1.5%) and insulin in 2 (1.5%) patients.

Atorvastatin was the only HMG CoA Reductase inhibitors used to treat hyperlipidaemia condition. From result and discussion analysis, the collaboration of physicians and clinical pharmacists can improve the medical management of diseases and provides rational drug therapy.

## CONCLUSION

The present study highlighted the impact of clinical pharmacists in collaboration with physicians the clinical pharmacist's participation in outpatient departments can be helpful in identifying and preventing drug-related problems through interventions and their expertise in pharmacotherapy can be helpful in providing rational drug therapy.

The collaboration of clinical pharmacists and physicians will help in achieving better therapeutic outcomes in hypertension, diabetes mellitus, and hypertension with type 2 diabetes mellitus.

Our study concluded that significant improvement in the management of hypertension, diabetes mellitus, and hypertension with diabetes mellitus through a collaboration of the clinical pharmacist and physicians.

In future perspectives, there is a need for more collaboration between clinical pharmacists and physicians to improve rational drug therapy.

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