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# A Study on Prescribing Pattern of Medications and Adherence in Geriatric Patients Having Type 2 Diabetes Mellitus with Hypertension

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**Abstract**

**Background:** Type 2 diabetes mellitus (T2DM) and hypertension (HTN) are common co-morbidities in older adults and, together with age-related polypharmacy, impair rational prescribing and medication-taking behaviour. OBJECTIVES: To analyse the pattern of prescribing of oral antidiabetic and antihypertensive drugs in geriatric patients having type 2 diabetes mellitus (T2DM) and hypertension (HTN), to evaluate the medication adherence by Morisky medication adherence scale-8 (MMAS-8), and to determine barriers affecting adherence. Methods: A cross-sectional observational study was done in the Department of General Medicine, ESIC MC-PGIMSR & Model Hospital, Bengaluru for a period of three months. One hundred and fifty patients of age 65 years or more with pre-existing T2DM and HTN were enrolled following informed permission Data were extracted from medical charts and structured interviews with patients. Prescription complexity and the MMAS-8 were used to characterize regimens and adherence. Associations were examined with Spearman's rho correlation and chi-square test. Results: The mean age of participants was 69.7 ± 4.7 years and the majority were males (56%). Metformin (84%), DPP-4 inhibitors (68%) and SGLT-2 inhibitors (37%) were the most commonly given antidiabetics. Calcium channel blockers (64%) and angiotensin receptor blockers (57%) were the most commonly prescribed antihypertensives. The main treatment approach for both illnesses was combination therapy (71% in T2DM, 63% in HTN). Low adherence was seen in 40 % of the patients, medium in 29 % and high in 31 %. The main hurdles were forgetfulness (43%), cessation after feeling better (29%), polypharmacy (15%), and prescription complexity trended toward lower adherence ($p = 0.051$). Conclusion: Metformin and ARB/CCB based regimens remain the foundation of therapy in older individuals with concomitant T2DM and HTN with definite trend toward newer and better tolerated medications. However, adherence is poor in this group, due to forgetfulness, regimen complexity and polypharmacy, and so there is a need for regimen simplification and adherence-focused counselling.

**Keywords:** Type 2 Diabetes Mellitus, Hypertension, Geriatric Patients, Prescribing Pattern, Medication Adherence, Polypharmacy, MMAS-8

## Introduction

Type 2 diabetes mellitus (T2DM) and hypertension (HTN) are among the most frequent non-communica-

ble illnesses worldwide and impose a great public health burden due to their high morbidity, mortality and care cost [1]. Both disorders are increasingly prevalent in older age and their cohabitation is particularly widespread in the elderly population because of age-related physiological changes. In 2021, more than 537 million adults worldwide were living with diabetes, a figure that is expected to increase dramatically by 2045, and hypertension is likely to impact more than a billion adults with a fast rise in prevalence beyond age 60 years [2,3]. India, with one of the largest diabetic populations in the world, provides a particularly striking example of this dual burden: South Asian populations are prone to develop T2DM and HTN at an earlier age and suffer earlier complications than Western populations, a pattern attributed to rapid urbanization, dietary transition, sedentary behaviour and genetic predisposition [1,2].

In older patients, the coexistence of T2DM and HTN accelerates microvascular and macrovascular damage, due to common mechanisms of insulin resistance, endothelial dysfunction, oxidative stress, and activation of the renin-angiotensin-aldosterone system, which increases the risk of cardiovascular events, stroke, nephropathy, and death compared with either condition alone [2,3]. Age-related changes in pharmacokinetics and pharmacodynamics, a higher burden of comorbidity and the near-universal presence of polypharmacy all increase the risk of drug-drug interactions, adverse drug reactions and non-adherence [4,5], making the pharmacological management of these patients more complex.

Optimizing adherence to medication is crucial to achieving glycemic and blood pressure control in this group. However, common barriers to adherence in routine care among the elderly are frequently inadequately addressed, such as forgetfulness, cognitive decline, complex regimens, cost and the belief that treatment may be discontinued once symptoms improve [4,6,7]. Non-adherence is associated with poorer glycemic and blood pressure control, increased complication rates and more healthcare utilization [8]. There is significant regional variation in the prescribing patterns of oral antidiabetic and antihypertensive drugs, which are influenced by cost, availability of generic drugs, local recommendations, and physician practice. Thus, region-specific evidence is necessary to promote rational, safer prescribing [9].

While prescribing trends and drug adherence have been researched separately in senior individuals with T2DM and HTN, few studies have explored both in the same South Asian sample. Characterization of current prescribing practice and adherence and its determinants may assist in identifying actionable gaps between guideline-recommended therapy and real-world use and inform targeted, patient-centred strategies such as regimen simplification, fixed-dose combinations and structured counseling. Therefore, the current study was carried out with the objective of assessing the prescribing pattern and medication adherence of oral medications in geriatric patients with coexisting T2DM and HTN with specific objectives to (i) evaluate the prescribing pattern of oral antidiabetic and antihypertensive agents, (ii) determine the level of medication adherence using MMAS-8 and (iii) identify the barriers to medication adherence in this population.

## Materials and Methods

### Study Design and Setting

This was a hospital based cross-sectional observational study, conducted in the inpatient and outpatient departments of General Medicine, ESIC MC-PGIMSR & Model Hospital, Rajajinagar, Bengaluru for a period of six months, two months of planning, three months of data collection and one month of data interpretation and manuscript preparation.

### Study Population

A total of 150 patients matching the inclusion criteria were taken and informed consent was obtained. Patients 65 years of age or older, male or female, with pre-existing T2DM and HTN of at least one year's duration, attending the inpatient or outpatient department of General Medicine, with or without related problems or other co-morbidities were included. Exclusion criteria included newly diagnosed T2DM and HTN.

### Data Collection

Data were acquired from patient medical records and structured interviews using a self-designed data collecting form that included demographic parameters, reason for visit, past medical and pharmaceutical history, social history, current medications, and self-reported hurdles to adherence. Medication adherence was assessed by the 8-item Morisky Medication Adherence Scale (MMAS-8) with 7 items scored dichotomously (a "yes" response indicates non-adherent behaviour, except for the reverse-scored fifth item) and 1 item measured on a 5-point Likert scale. Total scores ranged from 0 to 8, and were classified as low (score<6), medium (scoring 6 to <8) and high (score = 8) adherence. Prescription complexity was also categorized as simple (scoring 0–1), intermediate (score 2–3), or complex (score 4–5) based on the number of drugs, dose frequency, and utilization of combination therapy.

### Statistical Analysis

Data were entered and analysed using MS Excel and SPSS. Quantitative and categorical variables were summarized using descriptive statistics (mean, standard deviation, frequencies and percentages). Spearman's rho correlation was utilized to analyse correlation between age, length of T2DM, duration of HTN, prescription complexity score and adherence score. The chi-square test was performed to assess the association between gender, prescription complexity category, total number of drugs and level of medication adherence. Statistical significance was defined as $p<0.05$.

### Results

During the three months data collecting period, a total of 150 patients with T2DM and HTN were included from the inpatient and outpatient departments of General Medicine, ESIC MC-PGIMSR & Model Hospital, Bengaluru and who fulfilled the inclusion criteria.

### Age Distribution

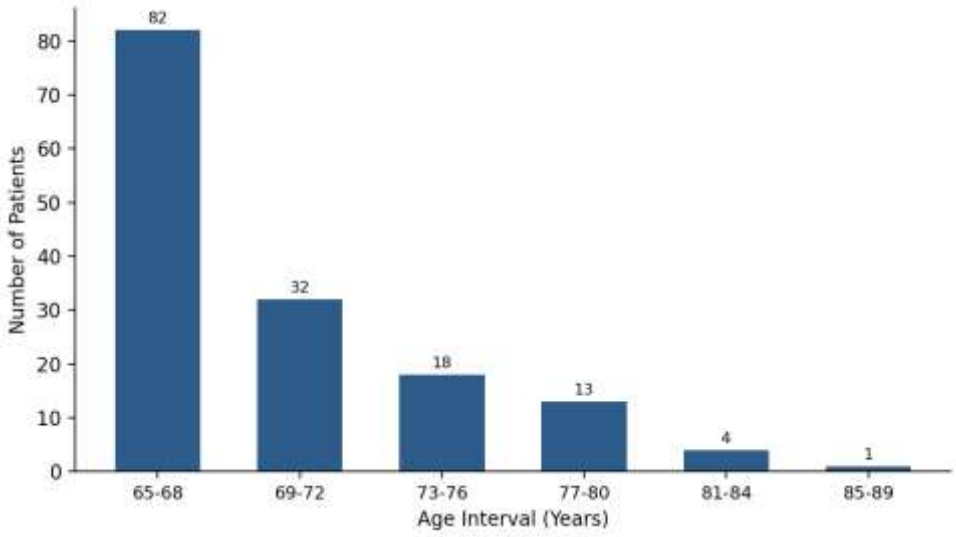
The mean age of the study population was 69.7 ± 4.7 years (range 65–86 years). Most patients (54.67%) belonged to the 65–68-year age group, followed by 21.33% in the 69–72-year group (Table 1, Figure 1).

**Table 1: Distribution of Patients Based on Age Group**

| Age Interval (Years) | No. of Patients (N) | Percentage (%) |
|---|---|---|
| 65–68 | 82 | 54.67 |
| 69–72 | 32 | 21.33 |
| 73–76 | 18 | 12.00 |
| 77–80 | 13 | 8.67 |

| Age Interval (Years) | No. of Patients (N) | Percentage (%) |
|---|---|---|
| 81–84 | 4 | 2.67 |
| 85–89 | 1 | 0.67 |

**Figure 1: Distribution of Patients Based on Age**



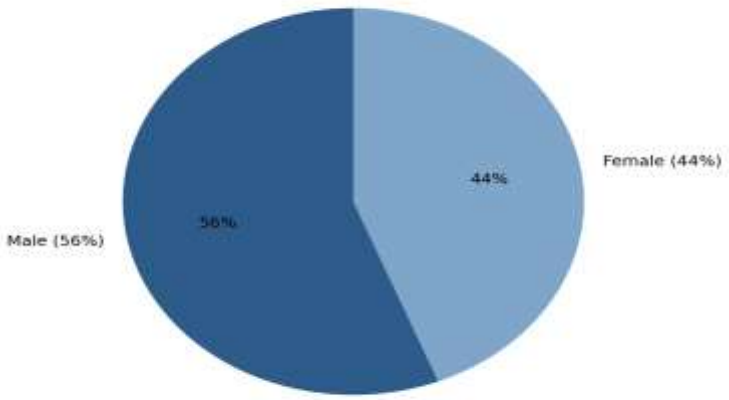

**Gender Distribution**

Of the 150 patients, 84 (56%) were male and 66 (44%) were female (Table 2, Figure 2).

**Table 2: Distribution of Patients Based on Gender**

| Gender | No. of Patients (N) | Percentage (%) |
|---|---|---|
| Male | 84 | 56 |
| Female | 66 | 44 |

**Figure 2: Distribution of Patients Based on Gender**



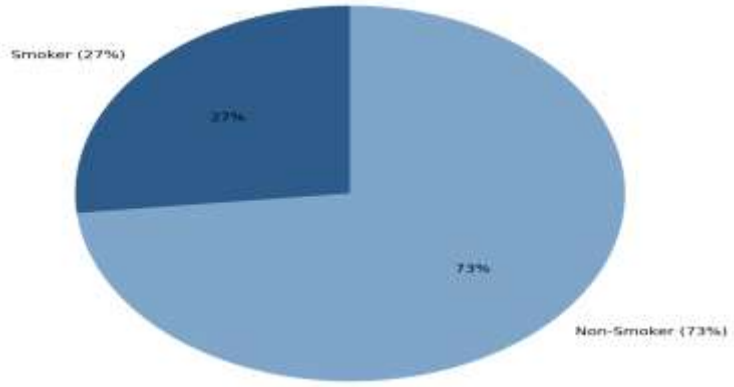
**Social Habits – Smoking**

Forty patients (27%) reported a history of smoking, while 110 (73%) were non-smokers (Table 3, Figure

**Table 3: Distribution of Patients Based on Smoking**

| Smoking | No. of Patients (N) | Percentage (%) |
|---|---|---|
| Yes | 40 | 27 |
| No | 110 | 73 |

**Figure 3: Distribution of Patients Based on Smoking**



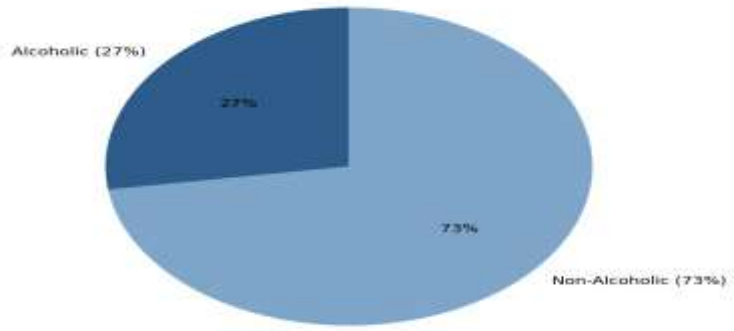

**Social Habits – Alcohol Use**

Forty-one patients (27%) reported alcohol use, while 109 (73%) were non-alcoholic (Table 4, Figure 4).

**Table 4: Distribution of Patients Based on Alcohol Use**

| Alcohol Use | No. of Patients (N) | Percentage (%) |
|---|---|---|
| Yes | 41 | 27 |
| No | 109 | 73 |

**Figure 4: Distribution of Patients Based on Alcohol Use**

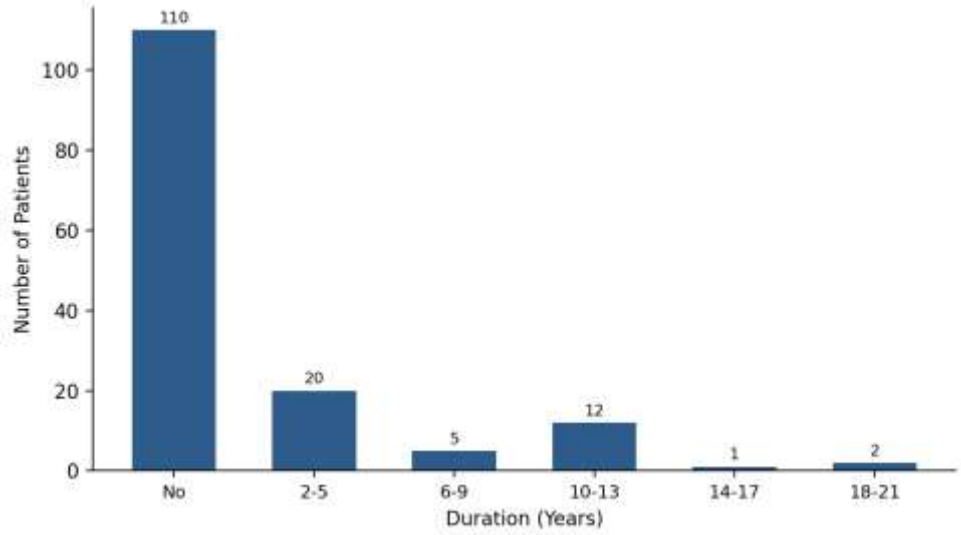



Duration of smoking among smokers was most frequently 2–5 years (13.33%), followed by 10–13 years (8%); very few patients had smoked for more than 14 years (Table 5, Figure 5).

**Table 5: Distribution of Patients Based on Duration of Smoking**

| Duration (Years) | No. of Patients (N) | Percentage (%) |
|---|---|---|
| No | 110 | 73.33 |
| 2–5 | 20 | 13.33 |
| 6–9 | 5 | 3.33 |
| 10–13 | 12 | 8.00 |
| 14–17 | 1 | 0.66 |
| 18–21 | 2 | 1.33 |

**Figure 5: Distribution of Patients Based on Duration of Smoking**

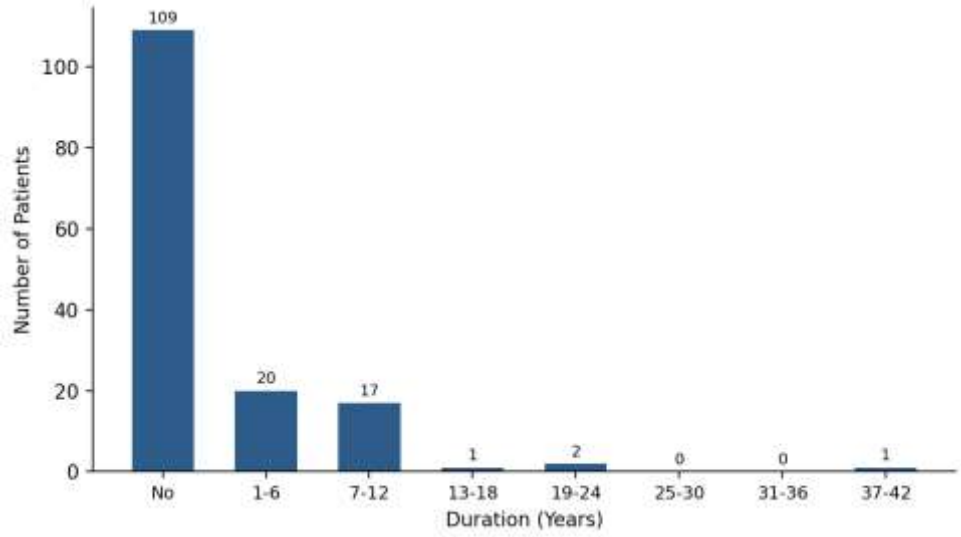



Among those consuming alcohol, the largest proportion reported a duration of 1–6 years (13.33%), followed by 7–12 years (11.33%) (Table 6, Figure 6).

**Table 6: Distribution of Patients Based on Duration of Alcohol Use**

| Duration (Years) | No. of Patients (N) | Percentage (%) |
|---|---|---|
| No | 109 | 72.66 |
| 1–6 | 20 | 13.33 |
| 7–12 | 17 | 11.33 |
| 13–18 | 1 | 0.66 |
| 19–24 | 2 | 1.33 |
| 25–30 | 0 | 0.00 |
| 31–36 | 0 | 0.00 |
| 37–42 | 1 | 0.66 |

**Figure 6: Distribution of Patients Based on Duration of Alcohol Use**



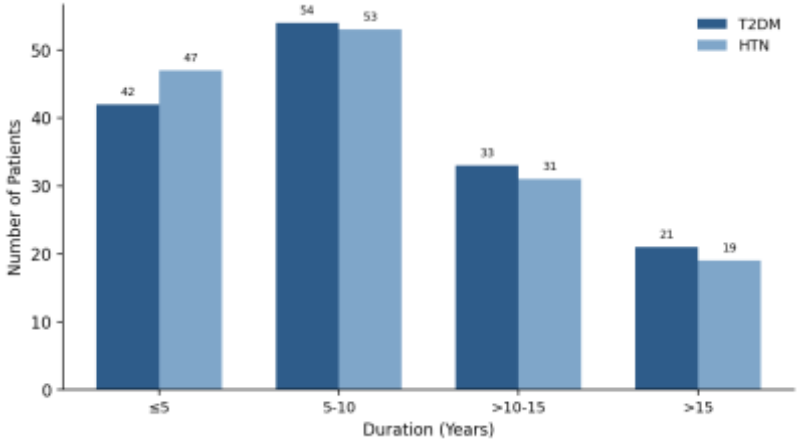

**Duration of Disease**

36% of patients with T2DM had a duration of disease more than 5 but less than or equal to 10 years. 28% of patients had a length of disease up to 5 years. There was a similar pattern identified for HTN with 35% of patients having a period of more than 5 to 10 years (Table 7, Figure 7).

**Table 7: Distribution of Patients Based on Duration of T2DM and HTN**

| Duration (Years) | T2DM – No. (N) | T2DM – % | HTN – No. (N) | HTN – % |
|---|---|---|---|---|
| ≤5 | 42 | 28 | 47 | 31 |
| >5–10 | 54 | 36 | 53 | 35 |
| >10–15 | 33 | 22 | 31 | 21 |
| >15 | 21 | 14 | 19 | 13 |

**Figure 7: Distribution of Patients Based on Duration of Conditions**




**Comorbidity Profile**

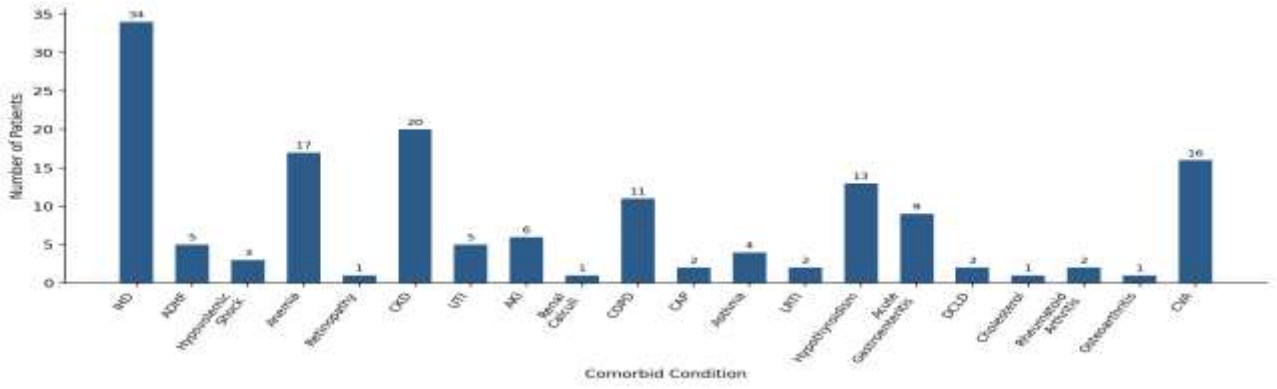
A high comorbidity burden was observed with the most common comorbidities being cardiovascular and renal diseases, ischemic heart disease (34 patients), chronic kidney disease (20), anaemia (17),

cerebrovascular accident (16), hypothyroidism (13) and chronic obstructive pulmonary disease (11), etc. (Table 8, Figure 8).

**Table 8: Distribution of Patients Based on Comorbidities**

| System | Condition | No. of Patients (N) |
|---|---|---|
| Cardiovascular | Ischemic Heart Disease | 34 |
| Cardiovascular | Acute Decompensated Heart Failure | 5 |
| Cardiovascular | Hypovolemic Shock | 3 |
| Haematology | Anaemia | 17 |
| Ophthalmic | Retinopathy | 1 |
| Renal | Chronic Kidney Disease | 20 |
| Renal | Urinary Tract Infection | 5 |
| Renal | Acute Kidney Injury | 6 |
| Renal | Renal Calculi | 1 |
| Respiratory | Chronic Obstructive Pulmonary Disease | 11 |
| Respiratory | Community Acquired Pneumonia | 2 |
| Respiratory | Asthma | 4 |
| Respiratory | Lower Respiratory Tract Infection | 2 |
| Endocrine | Hypothyroidism | 13 |
| Gastrointestinal | Acute Gastroenteritis | 9 |
| Gastrointestinal | Decompensated Chronic Liver Disease | 2 |
| Lipid Disorder | Hypercholesterolemia | 1 |
| Skeletal | Rheumatoid Arthritis | 2 |
| Skeletal | Osteoarthritis | 1 |
| Central Nervous System | Cerebrovascular Accident | 16 |

**Figure 8: Distribution of Patients Based on Comorbidities**

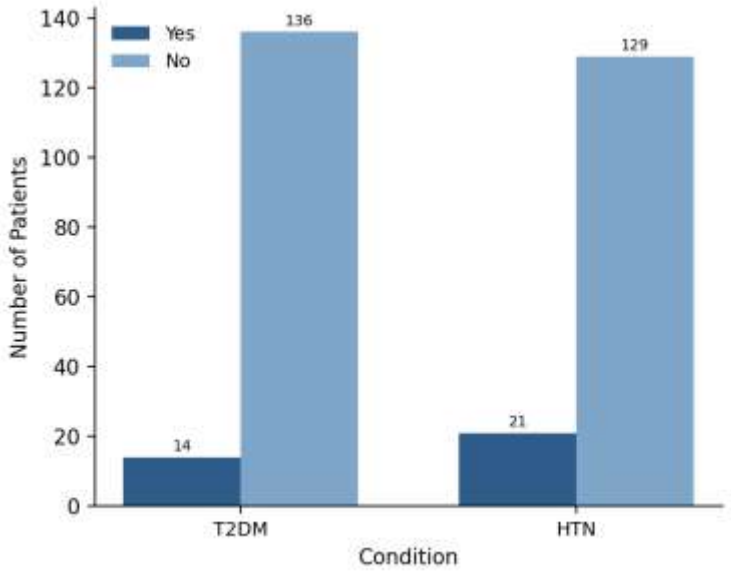


Only 14 patients (9%) reported a family history of T2DM and 21 (14%) reported a family history of HTN; the majority of patients did not report a positive family history for either condition (Table 9, Figure 9).

**Table 9: Distribution of Patients Based on Family History of T2DM and HTN**

| Family History | T2DM – No. (N) | T2DM – % | HTN – No. (N) | HTN – % |
|---|---|---|---|---|
| Yes | 14 | 9 | 21 | 14 |
| No | 136 | 91 | 129 | 86 |

**Figure 9: Distribution of Patients Based on Family History**




**Prescribing Pattern of Oral Antidiabetic Agents**

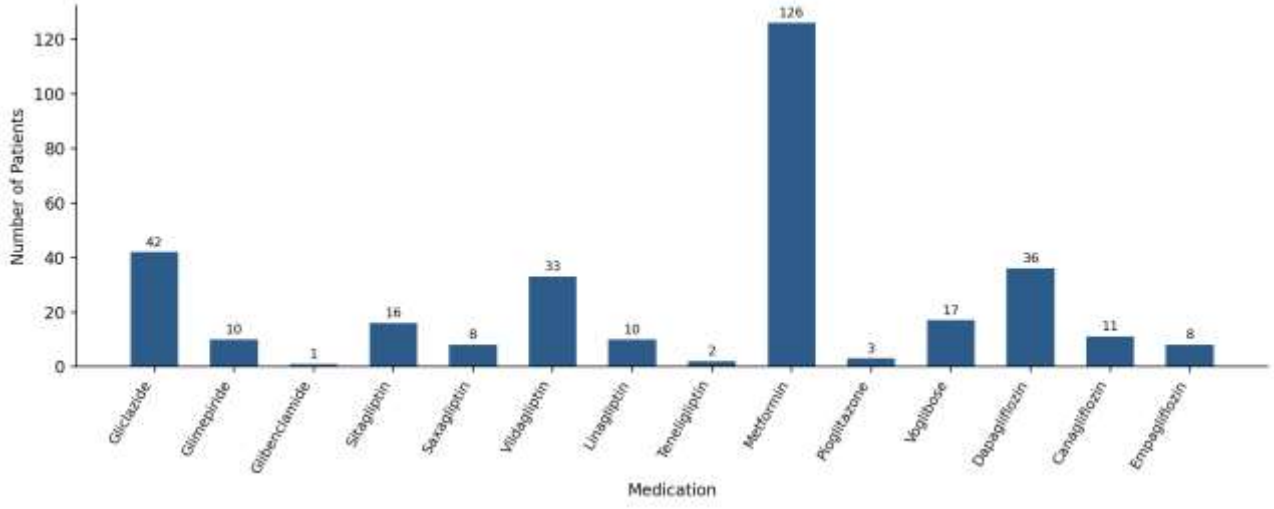
Metformin was the most frequently prescribed antidiabetic agent (84%), followed by gliclazide (28%), dapagliflozin (24%), and vildagliptin (22%); glibenclamide and teneligliptin were the least prescribed (1% each) (Table 10, Figure 10).

**Table 10: Distribution of Medications Prescribed for T2DM**

| Medication | No. of Patients (N) | Percentage (%) |
|---|---|---|
| Gliclazide | 42 | 28 |
| Glimepiride | 10 | 7 |
| Glibenclamide | 1 | 1 |
| Sitagliptin | 16 | 11 |
| Saxagliptin | 8 | 5 |
| Vildagliptin | 33 | 22 |
| Linagliptin | 10 | 7 |
| Teneligliptin | 2 | 1 |
| Metformin | 126 | 84 |

| Medication | No. of Patients (N) | Percentage (%) |
|---|---|---|
| Pioglitazone | 3 | 2 |
| Voglibose | 17 | 11 |
| Dapagliflozin | 36 | 24 |
| Canagliflozin | 11 | 7 |
| Empagliflozin | 8 | 5 |

**Figure 10: Distribution of Medications Prescribed for T2DM**




**Prescribing Pattern of Oral Antihypertensive Agents**

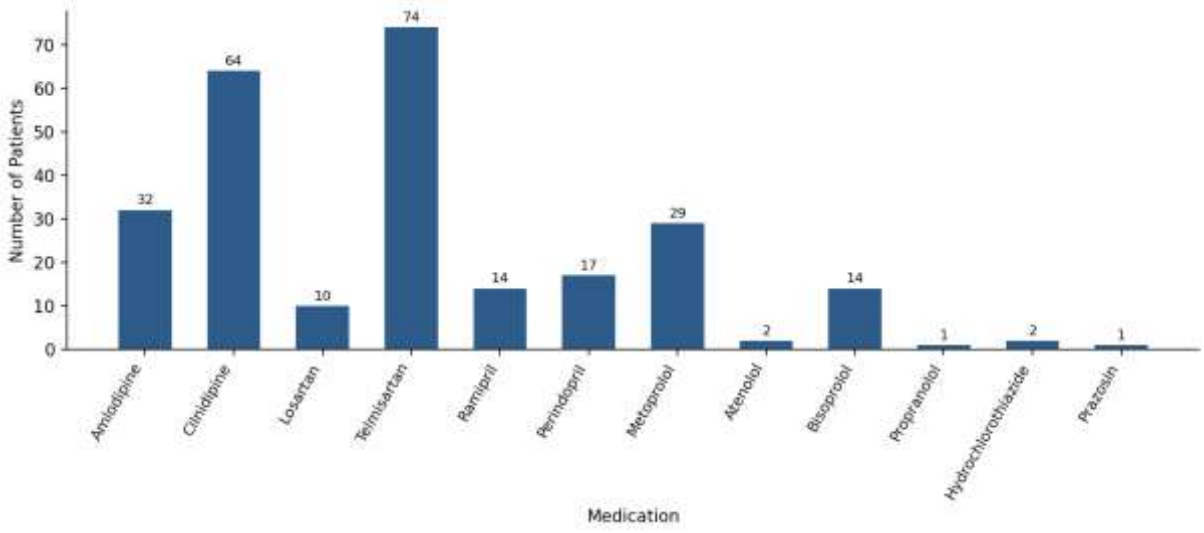
Telmisartan (49%) and cilnidipine (43%) were the most frequently prescribed antihypertensives, followed by amlodipine (21%) and metoprolol (19%); atenolol, propranolol, hydrochlorothiazide, and prazosin were each prescribed to only 1% of patients (Table 11, Figure 11).

**Table 11: Distribution of Medications Prescribed for HTN**

| Medication | No. of Patients (N) | Percentage (%) |
|---|---|---|
| Amlodipine | 32 | 21 |
| Cilnidipine | 64 | 43 |
| Losartan | 10 | 7 |
| Telmisartan | 74 | 49 |
| Ramipril | 14 | 9 |
| Perindopril | 17 | 11 |
| Metoprolol | 29 | 19 |
| Atenolol | 2 | 1 |
| Bisoprolol | 14 | 9 |
| Propranolol | 1 | 1 |

| Medication | No. of Patients (N) | Percentage (%) |
|---|---|---|
| Hydrochlorothiazide | 2 | 1 |
| Prazosin | 1 | 1 |

**Figure 11: Distribution of Medications Prescribed for HTN**

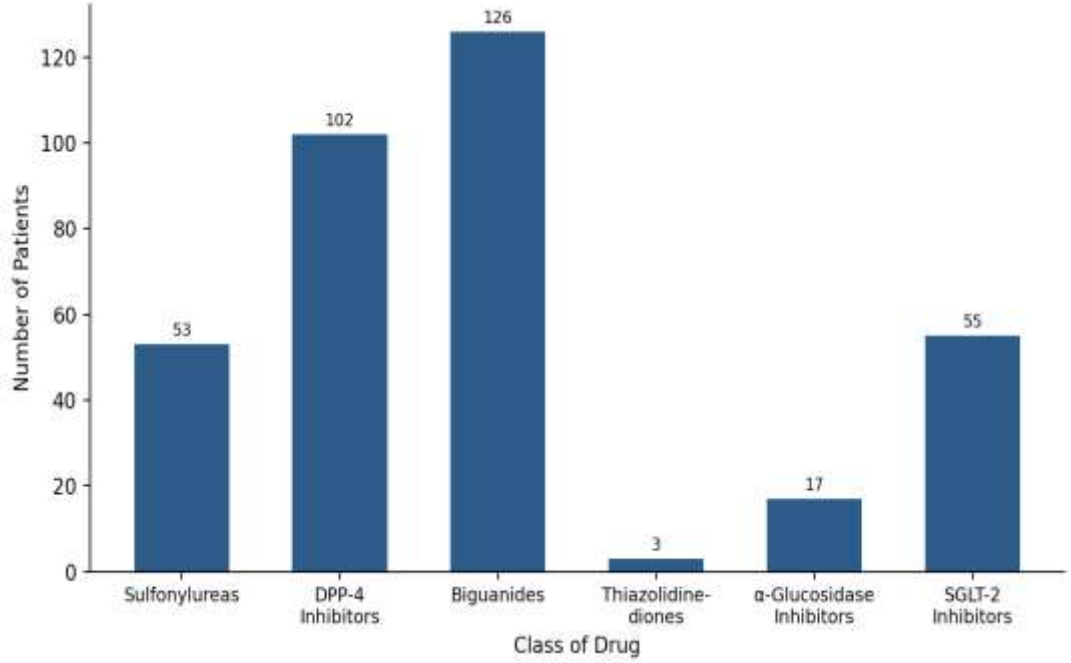



By drug class, biguanides (84%) and DPP-4 inhibitors (68%) were the most frequently used for T2DM, followed by SGLT-2 inhibitors (37%) and sulfonylureas (35%); thiazolidinediones (2%) were rarely used, and amylin analogues and dopamine D2 agonists were not prescribed (Table 12, Figure 12).

**Table 12: Distribution of T2DM Medications Based on Drug Class**

| Class of Drug | Medication Count (N) | Percentage (%) |
|---|---|---|
| Sulfonylureas | 53 | 35 |
| DPP-4 Inhibitors | 102 | 68 |
| Biguanides | 126 | 84 |
| Thiazolidinediones | 3 | 2 |
| α-Glucosidase Inhibitors | 17 | 11 |
| SGLT-2 Inhibitors | 55 | 37 |
| Amylin Analogue | 0 | 0 |
| Dopamine D2 Agonist | 0 | 0 |

**Figure 12: Distribution of T2DM Medications Based on Drug Class**

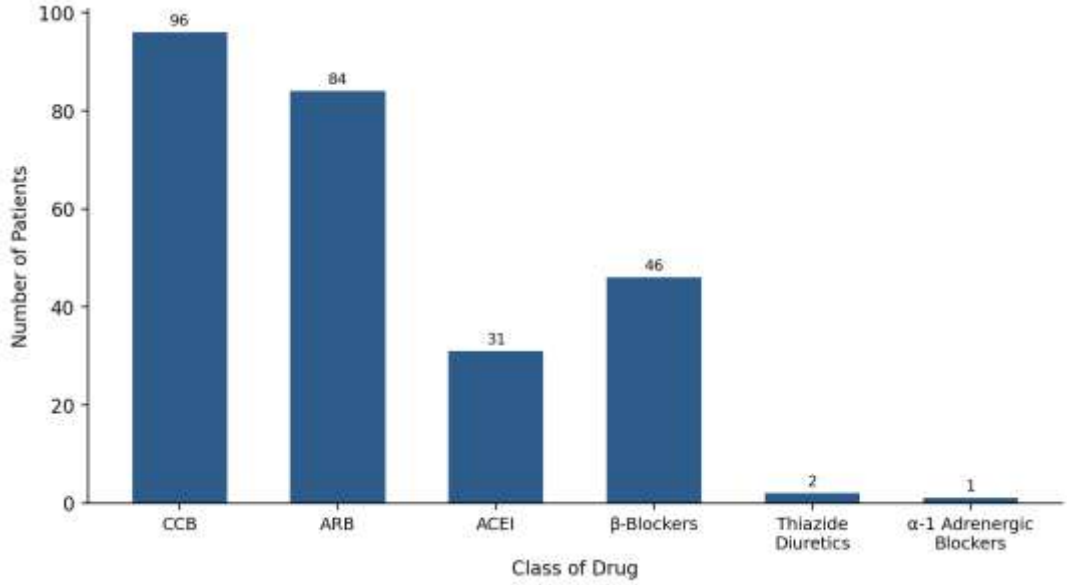



For HTN, calcium channel blockers (64%) and angiotensin receptor blockers (57%) predominated, followed by beta-blockers (31%) and ACE inhibitors (21%); thiazide diuretics (3%) and alpha-1 adrenergic blockers (1%) were least prescribed (Table 13, Figure 13).

**Table 13: Distribution of HTN Medications Based on Drug Class**

| Class of Drug | Medication Count (N) | Percentage (%) |
|---|---|---|
| Calcium Channel Blockers | 96 | 64 |
| Angiotensin Receptor Blockers | 84 | 57 |
| ACE Inhibitors | 31 | 21 |
| β-Blockers | 46 | 31 |
| Thiazide Diuretics | 2 | 3 |
| α-1 Adrenergic Blockers | 1 | 1 |
| Vasodilators | 0 | 0 |
| α-2 Receptor Agonists | 0 | 0 |

**Figure 13: Distribution of HTN Medications Based on Drug Class**



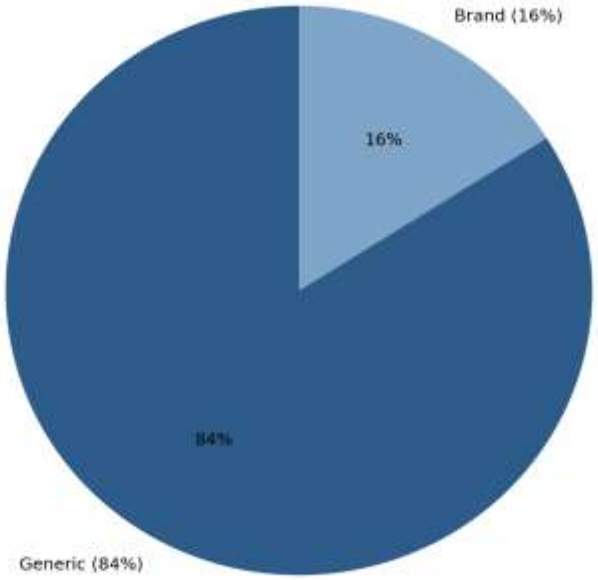

**Rationality of Prescribing**

The majority of medications (84%) were prescribed by generic name, with only 16% prescribed by brand name, reflecting a largely rational prescribing pattern (Table 14, Figure 14).

**Table 14: Distribution of Drugs Prescribed by Generic Name**

| Prescribed by Generic Name | Medication Count (N) | Percentage (%) |
|---|---|---|
| Yes | 126 | 84 |
| No | 24 | 16 |

**Figure 14: Distribution of Drugs Prescribed by Generic Name**



**Monotherapy versus Combination Therapy**

For T2DM, 106 patients (71%) were on combination therapy and 44 (29%) on monotherapy (Table 15, Figure 15). A similar pattern was seen for HTN, where 94 patients (63%) received combination therapy and 56 (37%) received monotherapy (Table 16, Figure 16).

**Table 15: Distribution of Patients Based on T2DM Therapy Type**

| Therapy | No. of Patients (N) | Percentage (%) |
|---|---|---|
| Monotherapy | 44 | 29 |
| Combination Therapy | 106 | 71 |

**Figure 15: Distribution of Patients Based on T2DM Therapy Type**

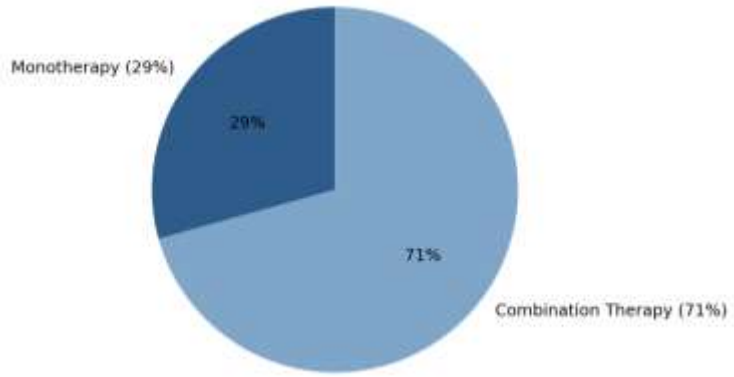
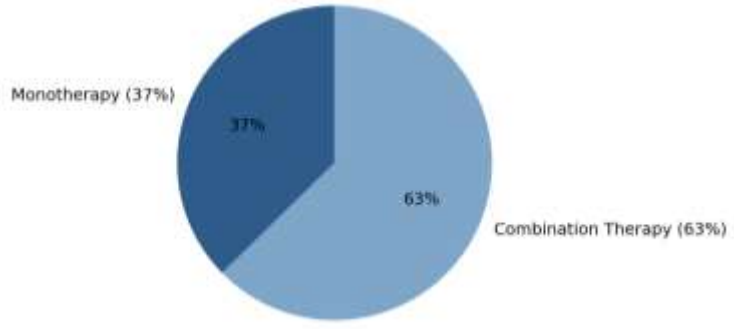



**Table 16: Distribution of Patients Based on HTN Therapy Type**

| Therapy | No. of Patients (N) | Percentage (%) |
|---|---|---|
| Monotherapy | 56 | 37 |
| Combination Therapy | 94 | 63 |

**Figure 16: Distribution of Patients Based on HTN Therapy Type**



**Drug Combination Patterns**

Two-drug combinations were most common in T2DM (38%), typically biguanide with a DPP-4 inhibitor, followed by three-drug combinations (26%) and single-agent therapy (29%, predominantly biguanides); four-drug combinations were least frequent (7%) (Table 17, Figure 17).

**Table 17: Distribution of T2DM Drug Combinations**

| Regimen | Combination | Patient Count (N) |
|---|---|---|
| Monotherapy | Biguanides | 26 |
| Monotherapy | DPP-4 Inhibitors | 3 |
| Monotherapy | SGLT-2 Inhibitors | 13 |
| Monotherapy | Sulfonylureas | 2 |
| Monotherapy – Total | | 44 |
| Dual Therapy | Biguanides + DPP-4 Inhibitors | 20 |
| Dual Therapy | Biguanides + SGLT-2 Inhibitors | 13 |
| Dual Therapy | Biguanides + Sulfonylureas | 15 |
| Dual Therapy | Biguanides + α-Glucosidase Inhibitors | 1 |
| Dual Therapy | Sulfonylureas + DPP-4 Inhibitors | 1 |
| Dual Therapy | DPP-4 Inhibitors + SGLT-2 Inhibitors | 6 |
| Dual Therapy – Total | | 56 |
| Triple Therapy | Biguanides + DPP-4 + α-Glucosidase Inhibitors | 4 |
| Triple Therapy | Biguanides + DPP-4 + SGLT-2 Inhibitors | 8 |
| Triple Therapy | Biguanides + SGLT-2 + α-Glucosidase Inhibitors | 2 |
| Triple Therapy | Sulfonylureas + Biguanides + α-Glucosidase Inhibitors | 3 |
| Triple Therapy | Sulfonylureas + Biguanides + DPP-4 Inhibitors | 14 |
| Triple Therapy | Sulfonylureas + Biguanides + SGLT-2 Inhibitors | 4 |
| Triple Therapy | Sulfonylureas + Biguanides + Thiazolidinedione | 3 |
| Triple Therapy | Sulfonylureas + DPP-4 + α-Glucosidase Inhibitors | 1 |
| Triple Therapy – Total | | 39 |
| Quadruple Therapy | Biguanides + DPP-4 + SGLT-2 + α-Glucosidase Inhibitors | 1 |
| Quadruple Therapy | Sulfonylureas + Biguanides + DPP-4 + α-Glucosidase Inhibitors | 4 |
| Quadruple Therapy | Sulfonylureas + Biguanides + DPP-4 + SGLT-2 Inhibitors | 6 |

| Regimen | Combination | Patient Count (N) |
|---|---|---|
| Quadruple Therapy – Total | | 11 |

**Figure 17: Distribution of T2DM Drug Combinations**

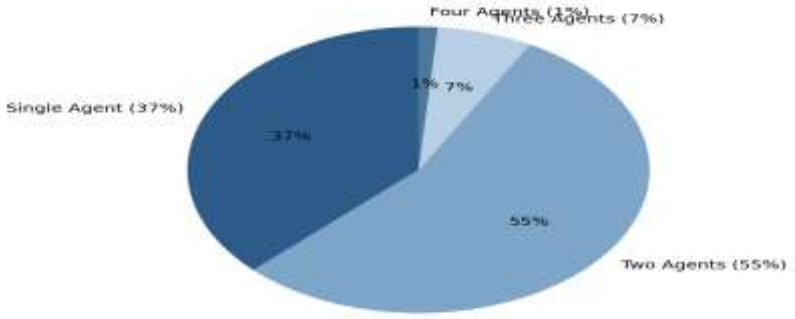

For HTN, two-drug combinations predominated (55%), most often a calcium channel blocker with an ACE inhibitor, followed by single-agent therapy (37%, mainly calcium channel blockers or ARBs); three- and four-drug combinations were uncommon (7% and 1%, respectively) (Table 18, Figure 18).

**Table 18: Distribution of HTN Drug Combinations**

| Regimen | Combination | Patient Count (N) |
|---|---|---|
| Monotherapy | ACE Inhibitors | 3 |
| Monotherapy | α-Blockers | 1 |
| Monotherapy | β-Blockers | 6 |
| Monotherapy | Calcium Channel Blockers | 25 |
| Monotherapy | Angiotensin Receptor Blockers | 21 |
| Monotherapy – Total | | 56 |
| Dual Therapy | β-Blockers + ACE Inhibitors | 10 |
| Dual Therapy | β-Blockers + ARBs | 11 |
| Dual Therapy | β-Blockers + CCBs | 9 |
| Dual Therapy | CCBs + ACE Inhibitors | 13 |

| Regimen | Combination | Patient Count (N) |
|---|---|---|
| Dual Therapy | CCBs + ARBs | 37 |
| Dual Therapy | Thiazide + ARBs | 2 |
| Dual Therapy – Total | | 82 |
| Triple Therapy | β-Blockers + CCBs + ACE Inhibitors | 2 |
| Triple Therapy | β-Blockers + CCBs + ARBs | 7 |
| Triple Therapy | CCBs + ACE Inhibitors + ARBs | 1 |
| Triple Therapy – Total | | 10 |
| Quadruple Therapy | β-Blockers + CCBs + ARBs + α-Blockers | 1 |
| Quadruple Therapy | β-Blockers + CCBs + ACE Inhibitors + ARBs | 1 |
| Quadruple Therapy – Total | | 2 |

**Figure 18: Distribution of HTN Drug Combinations**



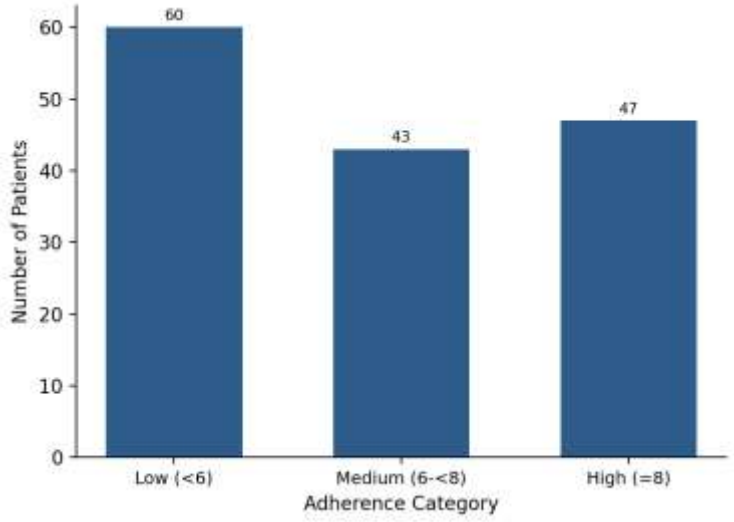

**Medication Adherence**

On the MMAS-8, 60 patients (40%) showed low adherence, 43 (29%) medium adherence, and 47 (31%) high adherence (Table 19, Figure 19).

**Table 19: Distribution of Patients Based on Adherence Category**

| Adherence Category | Adherence Score | No. of Patients (N) | Percentage (%) |
|---|---|---|---|
| Low | <6 | 60 | 40 |
| Medium | 6 – <8 | 43 | 29 |
| High | =8 | 47 | 31 |

**Figure 19: Distribution of Patients Based on Adherence Category**



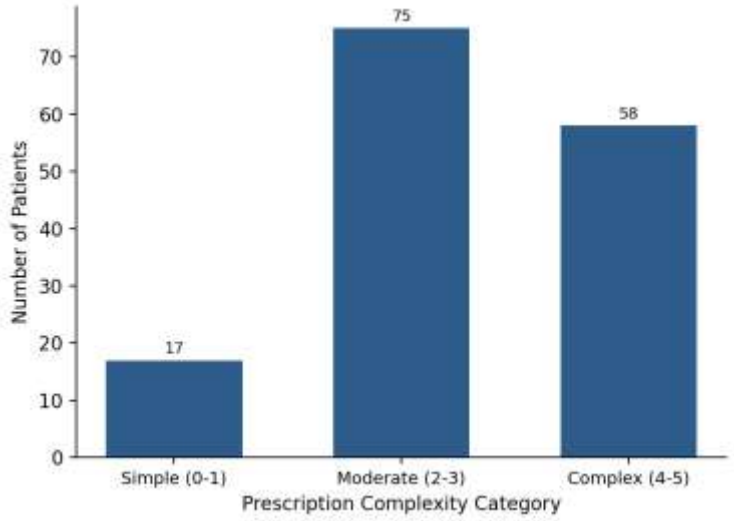

**Prescription Complexity**

Most patients (50%) had a moderate-complexity regimen, 39% had a complex regimen, and 11% had a simple regimen, indicating that the majority of patients were on multi-drug therapy (Table 20, Figure 20).

**Table 20: Distribution of Patients Based on Prescription Complexity**

| Complexity Category | Complexity Score | No. of Patients (N) | Percentage (%) |
|---|---|---|---|
| Simple | 0–1 | 17 | 11 |
| Moderate | 2–3 | 75 | 50 |
| Complex | 4–5 | 58 | 39 |

**Figure 20: Distribution of Patients Based on Prescription Complexity**



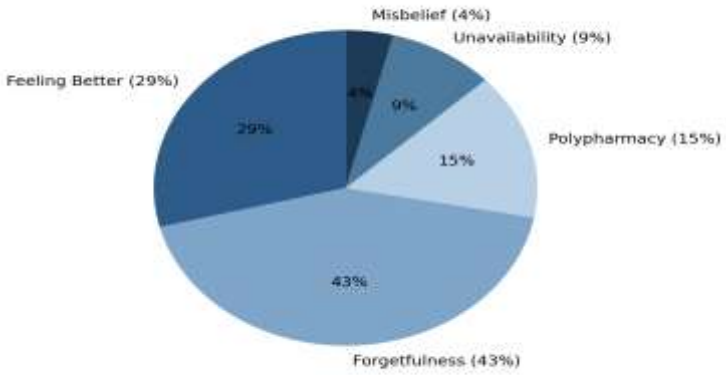

**Barriers to Medication Adherence**

Forgetfulness (43%) was the most frequently reported barrier to adherence, followed by discontinuation of medication after feeling better (29%) and the burden of polypharmacy (15%); unavailability (9%) and misbelief regarding treatment (4%) were less common (Table 21, Figure 21).

**Table 21: Distribution of Barriers to Medication Adherence**

| Barrier | Percentage (%) |
|---|---|
| Forgetfulness | 43 |
| Feeling Better | 29 |
| Polypharmacy | 15 |
| Unavailability | 9 |
| Misbelief | 4 |

**Figure 21: Distribution of Barriers to Medication Adherence**




**Correlates and Associations of Medication Adherence**

Age showed a very weak, statistically non-significant negative correlation with adherence score (Spearman's ρ = -0.069, df = 148, p = 0.401), indicating that adherence did not vary meaningfully with age in this cohort (Table 22).

**Table 22: Correlation Between Age and Adherence Score**

| Variable | Statistic | Value |
|---|---|---|
| Age (Years) | Spearman's rho | -0.069 |
| | df | 148 |
| | p-value | 0.401 |

Neither duration of T2DM (ρ = 0.014, df = 148, p = 0.867) nor duration of HTN (ρ = 0.025, df = 148, p = 0.766) showed a statistically significant correlation with adherence score, suggesting that disease duration alone did not determine adherence behaviour in this population (Tables 23 and 24).

**Table 23: Correlation Between Duration of T2DM and Adherence Score**

| Variable | Statistic | Value |
|---|---|---|
| Duration of T2DM (Years) | Spearman's rho | 0.014 |
| | df | 148 |
| | p-value | 0.867 |

**Table 24: Correlation Between Duration of HTN and Adherence Score**

| Variable | Statistic | Value |
|---|---|---|
| Duration of HTN (Years) | Spearman's rho | 0.025 |
| | df | 148 |
| | p-value | 0.766 |

Although low adherence was more frequent among females (46.3%) than males (34.9%) and high adherence more frequent among males (36.1%) than females (25.4%), the chi-square test did not show a statistically significant association between gender and adherence level ($\chi^2 = 2.57$, df = 2, N = 150, p = 0.277) (Table 25).

**Table 25: Association Between Gender and Level of Medication Adherence**

| Gender | Low Adherence (<6) | Medium Adherence (6–<8) | High Adherence (=8) | Total |
|---|---|---|---|---|
| Female | 31 (46.3%) | 19 (28.4%) | 17 (25.4%) | 67 (100%) |
| Male | 29 (34.9%) | 24 (28.9%) | 30 (36.1%) | 83 (100%) |
| Total | 60 (40.0%) | 43 (28.7%) | 47 (31.3%) | 150 (100%) |

Chi-square = 2.57, df = 2, p = 0.277, N = 150.

Patients with simple prescriptions had the highest proportion of high adherence (58.8%), compared with 32.9% among those with moderate-complexity regimens and 21.1% among those with complex regimens. This association approached but did not reach statistical significance ($\chi^2 = 9.45$, df = 4, N = 150, p = 0.051), indicating a trend toward reduced adherence with increasing prescription complexity (Table 26).

**Table 26: Association Between Prescription Complexity and Level of Medication Adherence**

| Complexity Category | Low Adherence (<6) | Medium Adherence (6–<8) | High Adherence (=8) | Total |
|---|---|---|---|---|
| Simple | 5 (29.4%) | 2 (11.8%) | 10 (58.8%) | 17 (100%) |
| Moderate | 28 (36.8%) | 23 (30.3%) | 25 (32.9%) | 76 (100%) |
| Complex | 27 (47.4%) | 18 (31.6%) | 12 (21.1%) | 57 (100%) |
| Total | 60 (40.0%) | 43 (28.7%) | 47 (31.3%) | 150 (100%) |

Chi-square = 9.45, df = 4, p = 0.051, N = 150.

Similarly, patients taking six or more medications had the lowest proportion of high adherence (22.2%) and the highest proportion of low adherence (66.7%), compared with those taking four to five medications (31.5% high adherence) or three or fewer (33.9% high adherence). This association also approached statistical significance ($\chi^2 = 9.40$, df = 4, N = 150, p = 0.052) (Table 27).

**Table 27: Association Between Total Number of Medications and Level of Medication Adherence**

| Total Medications | Low Adherence (<6) | Medium Adherence (6–<8) | High Adherence (=8) | Total |
|---|---|---|---|---|
| ≤3 | 25 (42.4%) | 14 (23.7%) | 20 (33.9%) | 59 (100%) |
| 4–5 | 23 (31.5%) | 27 (37.0%) | 23 (31.5%) | 73 (100%) |
| ≥6 | 12 (66.7%) | 2 (11.1%) | 4 (22.2%) | 18 (100%) |
| Total | 60 (40.0%) | 43 (28.7%) | 47 (31.3%) | 150 (100%) |

Chi-square = 9.40, df = 4, p = 0.052, N = 150.

Adherence score also showed a very weak, non-significant negative correlation with prescription complexity score (Spearman's ρ = -0.075, df = 148, p = 0.360) (Table 28).

**Table 28: Correlation Between Adherence Score and Prescription Complexity Score**

| Variable | Statistic | Value |
|---|---|---|
| Adherence Score vs Complexity Score | Spearman's rho | -0.075 |
| | df | 148 |
| | p-value | 0.360 |

## Discussion

This study assessed the prescribing pattern of oral antidiabetic and antihypertensive medications, medication adherence, and prescription complexity in 150 geriatric patients with coexisting T2DM and HTN. Metformin was the most prescribed antidiabetic medication, which is in line with the findings of Aziz et al. and Mohd et al. who identified metformin as the backbone of therapy in this population [12,17]. However, whereas Aziz et al. and Mohd et al. reported greater reliance on sulfonylureas, the present study showed comparatively higher use of DPP-4 inhibitors (68%) and SGLT-2 inhibitors (37%), which may reflect a more recent, guideline-concordant shift toward agents with a lower hypoglycaemia risk in older adults.

Calcium channel blockers and angiotensin receptor blockers were the most used antihypertensive drugs in this cohort, although Dhanaraj et al. and McAlister et al. reported a greater utilization of ACE inhibitors and diuretics [13,16]. This disparity may be the result of a temporal shift to medicines considered better tolerated and more efficacious for isolated systolic hypertension, which is prevalent in the elderly. Both the present study and these older publications, however, are in agreement that combination therapy is the rule rather than the exception in senior individuals with T2DM and HTN, which is consistent with the progressive, multifactorial nature of both diseases.

Using the MMAS-8 to statistically assess medication adherence, 40% of patients had low adherence, a number broadly comparable to adherence gaps reported in earlier South Asian cohorts where descriptive

descriptions of poor compliance are more common than standardized quantitative assessment [13,17,18]. Forgetfulness, cessation after symptomatic improvement, and polypharmacy emerged as the top obstacles in this investigation, reflecting variables described by Kishor et al. and Chew et al. in hypertensive and diabetic populations respectively [11,14]. The observed trend toward reduced adherence with increasing prescription complexity ($p = 0.051$) and increasing number of medications ($p = 0.052$), although not reaching conventional statistical significance, is directionally consistent with prior work linking regimen burden to non-adherence, and highlights medication regimen complexity as a modifiable target for intervention [10]. Neither age nor length of disease was substantially correlated with adherence in this cohort, suggesting that regimen-related and behavioural factors, rather than patient age or disease chronicity per se, are more proximate determinants of adherence in this population.

## Conclusion

In this cohort of 150 geriatric patients with coexisting T2DM and HTN, metformin remained the cornerstone of antidiabetic therapy, with a detectable shift toward DPP-4 and SGLT-2 inhibitors and a commensurate drop in sulfonylurea use. Calcium channel blockers and angiotensin receptor blockers were the favoured antihypertensives, and combination therapy predominated for both diseases, showing largely logical, guideline-concordant management.

In this cohort of 150 geriatric patients with coexisting T2DM and HTN, metformin remained the cornerstone of antidiabetic therapy, with a detectable shift toward DPP-4 and SGLT-2 inhibitors and a commensurate drop in sulfonylurea use. Calcium channel blockers and angiotensin receptor blockers were the favoured antihypertensives, and combination therapy predominated for both diseases, showing largely logical, guideline-concordant management.

## Limitations

Despite this, medication adherence remained unsatisfactory, with 40% of patients indicating low adherence on the MMAS-8. Forgetfulness, termination of therapy after feeling better, and the difficulty of polypharmacy were the primary barriers found, and adherence tended to drop as prescription complexity and the overall number of prescriptions increased. These data show that regimen simplification, higher use of fixed-dose combinations when appropriate, systematic patient education, and adherence-focused counselling could considerably enhance treatment outcomes in elderly patients with T2DM and HTN.

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