

Prescription Patterns and Rational Drug Use in Patients with Type 2 Diabetes and Hypertension: A Tertiary-Care Hospital Study

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) and hypertension often coexist, increasing cardiovascular and renal risk. Management often requires multiple medications, increasing polypharmacy and irrational prescribing. World Health Organization (WHO) core drug use indicators standardize evaluation of prescribing practices.

Methods: A prospective cross-sectional study was conducted among adults with T2DM and hypertension attending the outpatient department. Data on demographics, prescriptions, antidiabetic and antihypertensive medications, and WHO prescribing indicators were collected. Indicators included average drugs per prescription, generic prescribing, and prescribing from the Essential Medicines List (EML). Polypharmacy was defined as ≥ 5 medications.

Results: A total of 2,386 medicines were prescribed in 412 prescriptions, with an average of 5.79 drugs per prescription, exceeding the WHO recommended range of 1.6–1.8. Generic prescribing accounted for 63.8% of medicines, while 84.2% were prescribed from the EML. Biguanides (34.5%) and sulfonylureas (34.0%) were the predominant antidiabetic classes, while angiotensin receptor blockers (53.4%) were the most prescribed antihypertensive class. Metformin (34.5%) and telmisartan (26.7%) were the most prescribed drugs. Polypharmacy was observed in 77.7% of patients, including excessive polypharmacy (> 7 drugs) in 17.5%.

Conclusion: Prescribing was broadly consistent with evidence-based management, particularly regarding metformin and angiotensin receptor blockers. However, polypharmacy and suboptimal generic and EML prescribing indicate opportunities to strengthen rational prescribing. Regular prescription audits and medication review may improve medication safety, affordability, and quality of care.

Key-words: Hypertension; Polypharmacy; Prescription Pattern; Rational Use of Drugs; T2DM; WHO Core Drug Use Indicators

INTRODUCTION

Type 2 diabetes mellitus (T2DM) and hypertension are two of the most common chronic non-communicable diseases worldwide and represent major public health challenges due to their increasing prevalence, long-term complications and huge healthcare costs.

They co-exist and this significantly increases the risk of cardiovascular disease, stroke, kidney disease, eye disease and early death. The prevalence of hypertension in patients with T2DM is around 60–80%, which makes the concurrent management of both conditions a major therapeutic challenge.^[1-3]

India has one of the highest global burden of diabetes due to rapid urbanization, sedentary lifestyles, dietary transitions, obesity and population ageing.^[1,4] Hypertension is also rising in urban and rural populations and is still a leading modifiable risk factor for cardiovascular morbidity and mortality.^[3,5] These diseases often co-occur, contributing to accelerated vascular

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damage, increased healthcare utilization and costs, and reduced quality of life for patients.^[6,7]

Management of patients with both T2DM and hypertension involves several medications including antidiabetic agents, antihypertensives, lipid lowering drugs and antiplatelet therapy. Polypharmacy, which is usually defined as the concomitant use of five or more drugs, is very common in this population.^[8,9] Polypharmacy is often clinically necessary but is a risk factor for adverse drug reactions, drug–drug interactions, medication errors, poor adherence, increased costs of treatment, and low quality of life.^[10] Hence, regular assessment of prescription patterns is needed to optimize pharmacotherapy and improve clinical outcomes.

Rational prescribing is an integral component of good management of chronic diseases. Rational medicine use is defined by the World Health Organization (WHO) as the provision of patients with appropriate medications in doses that meet their clinical needs for an adequate duration and at the lowest possible cost.^[11] WHO and the International Network for Rational Use of Drugs (INRUD) have developed standardized core drug use indicators to assess prescribing practices. These indicators include the average number of drugs per encounter, generic prescribing, antibiotic and injection use, and prescribing from the Essential Medicines List. These indicators have been widely used for assessing quality of prescriptions, identifying irrational prescribing and promoting rational use of cost-effective and evidence-based medicine.^[12]

There are numerous studies available on diabetes or hypertension individually but limited evidence on prescription pattern, polypharmacy and WHO core prescribing indicators in patients with coexisting T2DM and hypertension in the tertiary care settings of Northern India. Therefore, the present prospective cross-sectional study was carried out to evaluate the prescription pattern, assess polypharmacy and determine WHO core drug use indicators among patients with T2DM and hypertension attending a tertiary care hospital in Northern India.

MATERIALS AND METHODS

Study Design- A prospective cross-sectional observational study was performed in a hospital setting to assess the prescription patterns, polypharmacy and WHO core prescribing indicators in patients with T2DM

and hypertension. The observational design enabled to assess the real-life prescribing practice without impacting therapeutic decisions of physicians, thus resulting in the objective assessment of routine clinical practice.^[11,13]

Study Area- The study was conducted in Medicine OPD of Rama Medical College, Hospital and Research Centre, Mandhana, Kanpur, Uttar Pradesh, India. All the patients attending the OPD during the study period were screened consecutively for eligibility and enrolled after written informed consent.

Inclusion Criteria- Patients fulfilling all of the following criteria were enrolled:

- ✚ Adult's ≥ 18 years old; Patients of both sexes.
- ✚ Medical records confirm diagnosis of Type 2 Diabetes Mellitus and hypertension.
- ✚ Patients with diabetes and hypertension on drug therapy.
- ✚ Patients who agree to sign a written informed consent form.

Exclusion Criteria- Patients were excluded if any of the following criteria was met:

- ✚ Type 1 Diabetes Mellitus.
- ✚ Hypertension, secondary.
- ✚ hypertensive emergency or urgency
- ✚ HbA1c $>9.4\%$
- ✚ Severe mental impairment or communication difficulties
- ✚ Major comorbid illnesses that are likely to influence prescribing patterns.
- ✚ Terminal illness, life expectancy under 6 months.
- ✚ Pregnant or lactating women and women planning to conceive.
- ✚ Severe mental illness or substance abuse.
- ✚ No informed consent.

Data Gathering- The patient demographics, clinical information and prescriptions were collected using a structured Case Record Form that was developed based on WHO drug utilization methodology and previous published prescription pattern studies.^[11,12,14] The data collected included age, sex, duration of diabetes and hypertension, prescribed medications, number of drugs per prescription, generic or brand name prescribing, fixed dose combinations, concomitant medications, and

polypharmacy status. Polypharmacy was defined as the simultaneous use of five or more drugs.

WHO Prescribing Indicators- Prescriptions were analyzed using the core prescribing indicators of the WHO/INRUD.^[11] The following indicators were studied:

- ❖ Average drugs per encounter
- ❖ Generic prescribing (%)
- ❖ Percentage of visits with an antibiotic prescribed
- ❖ Percentage of visits with an injection prescribed.
- ❖ Percentage of drugs prescribed from EML

They were used to assess the quality of prescribing, the extent of polypharmacy, and the use of generic medicines, the use of antibiotics and injections, and adherence to the essential medicines recommendations.

Statistical Analysis- The collected data were checked for completeness and entered into Microsoft Excel for analysis. Categorical variables were expressed as frequencies and percentages, while continuous variables were summarized using mean and standard deviation. Appropriate statistical tests were used for analysis, wherever applicable.

RESULTS

During the study period 478 patients with T2DM and hypertension were screened. Of these, 425 patients met the inclusion criteria and were recruited. We excluded 13 patients lost to follow-up and the final analysis was composed of 412 patients with a retention rate of 96.9%. The majority of the study population were males (57.3%). Mean age was 56.8 ± 10.9 years. Most participants were from the rural population (60.2%) (Table 1).

Table 1: Characteristics of study participants (N=412)

Variable	n (%)
Male	236 (57.3)
Female	176 (42.7)
Mean age (years)	56.8 ± 10.9
Rural residence	248 (60.2)
Urban residence	164 (39.8)
Married	348 (84.5)
Literate	336 (81.6)

The total number of drugs prescribed was 2,386 among 412 patients. The mean number of drugs per prescription was 5.79, indicating a high medication burden compared with the WHO reference range of 1.6–1.8 drugs per encounter (Table 2).

Table 2: WHO prescribing indicator: Mean number of drugs per prescription

Parameter	Value
Total prescriptions analyzed	412
Total drugs prescribed	2,386
Average drugs per prescription	5.79
WHO recommended value	1.6–1.8

The overall use of generic names in writing prescribed medicines was 63.8% which was below the ideal target of the WHO. The high proportion of medicines (84.2%) found on the Essential Medicines List indicates good but not full compliance with principles of prescribing essential medicines (Table 3).

Table 3: Pattern of generic prescribing and Essential Medicines

Indicator	Value (%)
Drugs prescribed by generic name	63.8
WHO ideal	100
Drugs prescribed from Essential Medicines List	84.2
WHO ideal	100

Biguanides (34.5%) and sulfonylureas (34.0%) were the most commonly prescribed antidiabetic groups, followed by DPP-4 inhibitors (15.0%) and SGLT-2 inhibitors (10.7%). Among antihypertensives, ARBs were predominant (53.4%), followed by calcium channel blockers (26.7%) and diuretics (13.3%), and while other classes were less frequently prescribed (Table 4).

Metformin was the most frequently prescribed antidiabetic drug (34.5%), followed by glimepiride (19.9%), gliclazide (9.7%), and sitagliptin (9.2%). Empagliflozin (6.8%), vildagliptin (5.8%), and glipizide (4.4%) were prescribed less frequently, while the remaining agents accounted for smaller proportions (Table 5).

Table 4: Distribution of Prescribed drugs classes

Antidiabetic Drug Groups		Antihypertensive Drug Groups	
Drug Group	Frequency (%)	Drug Group	Frequency (%)
Biguanides	34.5	ARBs	53.4
Sulfonylureas	34	Calcium channel blockers	26.7
DPP-4 inhibitors	15	Diuretics	13.3
SGLT-2 inhibitors	10.7	ACE inhibitors	4.4
Alpha-glucosidase inhibitors	2.9	Beta blockers	1.9
Thiazolidinediones	2.4	Alpha blockers	0.2
Insulin	0.5	-	-

Table 5: Antidiabetic prescribing pattern (N=412)

Drug	Frequency	Percentage (%)
Metformin	142	34.5
Glimepiride	82	19.9
Gliclazide	40	9.7
Sitagliptin	38	9.2
Empagliflozin	28	6.8
Vildagliptin	24	5.8
Glipizide	18	4.4
Dapagliflozin	16	3.9
Pioglitazone	10	2.4
Voglibose	8	1.9
Acarbose	4	1.0
Insulin	2	0.5

Telmisartan was the most commonly prescribed antihypertensive drug (26.7%), followed by losartan (17%), cilnidipine (14.6%), and amlodipine (12.1%).

Among antihypertensive drug classes, ARBs were the most frequently prescribed (53.4%), followed by calcium channel blockers (26.7%) and diuretics (13.3%) (Table 6).

Table 6: Antihypertensive prescribing pattern (N = 412)

Drug	Frequency	Percentage (%)
Telmisartan	110	26.7
Losartan	70	17.0
Cilnidipine	60	14.6
Amlodipine	50	12.1
Olmesartan	40	9.7
Hydrochlorothiazide	22	5.3
Chlorthalidone	18	4.4

Indapamide	15	3.6
Ramipril	10	2.4
Enalapril	8	1.9
Metoprolol	4	1.0
Nebivolol	2	0.5
Bisoprolol	1	0.2
Atenolol	1	0.2
Prazosin	1	0.2

The overall use of five or more medications was 77.7%. The majority of participants (60.2%) were treated with

five to seven drugs and 17.5% suffered from excessive polypharmacy (>7 drugs) (Table 7).

Tab: 7. Polypharmacy in study participants

Category	n (%)
Non-polypharmacy (<5 drugs)	92 (22.3)
Polypharmacy (5–7 drugs)	248 (60.2)
Excessive polypharmacy (>7 drugs)	72 (17.5)
Overall polypharmacy (≥5 drugs)	320 (77.7)

DISCUSSION

The present study was carried out to evaluate the prescription patterns, polypharmacy and WHO core prescribing indicators among patients with coexisting T2DM and hypertension attending a tertiary care teaching hospital in Northern India. The high retention rate (96.9%) in the study supports the validity of the results. The demographic profile of the patients shows that the majority were male (57.3%) with a mean age of 56.8 ± 10.9 years and a higher proportion of participants from rural areas (60.2%). These findings are in agreement with earlier Indian studies which have consistently reported middle-aged and older males as the majority of patients with T2DM and hypertension due to increasing cardiovascular risk factors, ageing and lifestyle-related metabolic disorders.^[1,15]

The average number of drugs prescribed per encounter was 5.79, which was higher than the WHO recommended range of 1.6-1.8 medicines per encounter.^[11] Similar results have been reported from tertiary care centres in India where patients with diabetes are often prescribed multiple drugs due to co-morbid hypertension, dyslipidaemia, cardiovascular disease and other chronic complications.^[12,16] The observed value suggests a high medication burden; how-

ever, it should be interpreted in the context of appropriate polypharmacy, in which multiple evidence-based medicines are required to achieve comprehensive reduction in cardiovascular risk.

Generic substitution was found in 63.8% of medicines, which was significantly lower than the WHO ideal of 100%. A number of Indian studies have reported similar rates of prescribing, despite national initiatives to promote generic medicines.^[12,14] This finding suggests moderate adherence to rational prescribing principles but also room for improvement through institutional prescribing policies, continuing medical education, and better availability of quality-assured generic formulations. The increased use of generics may reduce the costs of treatment, especially for patients who require lifelong multidrug treatment.

EML accounted for 84.2% of all medicines indicating a relatively high level of adherence to essential medicines prescribing, but not meeting the WHO target of 100%. Similar findings have been reported from tertiary care hospitals in India.^[12,16] Part of the reason for the use of medicines not in the EML might be the increasing uptake of newer antihyperglycaemic agents, especially SGLT-2 inhibitors and DPP-4 inhibitors, which are recommended by current clinical guidelines for selected patients with



cardiovascular or renal disease. Regular prescription audits and periodic updating of institutional formularies can further improve compliance with WHO recommendations.

The overall distribution of drug classes was generally in accordance with contemporary guidelines for management of diabetes and hypertension. The most frequently prescribed antidiabetic drugs were biguanides and sulfonylureas and the most frequently prescribed antihypertensives were ARBs. This pattern is consistent with prior data from Indian studies and indicates the adherence to evidence-based treatment strategies that focus on metformin for glycaemic control and renin-angiotensin system blockade for cardiovascular and renal protection.^[17,18]

Analysis of individual drugs, showed that metformin (34.5%) was the most commonly prescribed antidiabetic medicine, followed by glimepiride and gliclazide. Telmisartan (26.7%) was the most commonly prescribed antihypertensive agent, followed by losartan and cilnidipine. The findings are quite similar to the findings reported in Indian studies on prescription patterns.^[14,15,19] The high use of metformin is in line with international recommendations that advise to use it as the first-line therapy for T2DM due to its good efficacy, safety and cardiovascular profile. This preference for ARBs, especially telmisartan, is consistent with the most recent hypertension guidelines, which recommend renin-angiotensin system blockers as first-line therapy in patients with diabetes due to their nephroprotective and cardioprotective benefits.^[17] Increased use of DPP-4 inhibitors and SGLT-2 inhibitors indicates a gradual move towards novel evidence-based therapies in patients with further cardiovascular or renal risk.

Polypharmacy was highly prevalent in the present study, where 77.7% of participants received five or more medications and 17.5% had excessive polypharmacy. These findings are consistent with findings from Indian and international studies where diabetes and hypertension are found to be major contributory factors for polypharmacy due to the need to manage simultaneously hyperglycaemia, hypertension, dyslipidaemia and associated complications.^[8,9,15] While most of the polypharmacy seen likely reflects guideline-directed therapy, excessive medication burden increases the risk of adverse drug reactions, drug-drug

interactions, decreased adherence, and increased healthcare costs.

Thus, the prescribing patterns in the present study mostly reflected the present evidence-based recommendations for the management of T2DM and hypertension. But there are opportunities to improve the rational use of medicines through increased generic prescribing, better adherence to the Essential Medicines List and introduction of regular prescription audits to monitor polypharmacy. These measures can improve medication safety, reduce treatment costs and optimize long-term outcomes for patients with chronic cardiometabolic diseases.

CONCLUSIONS

The present study demonstrates that prescribing practices in patients with coexisting type 2 diabetes mellitus and hypertension were generally consistent with evidence-based pharmacotherapy, with metformin and angiotensin receptor blockers, particularly telmisartan, being the predominant agents. However, the high average number of medicines per prescription (5.79) and substantial prevalence of polypharmacy (77.7%) indicate a considerable medication burden, warranting regular medication review to minimize unnecessary therapy, drug-drug interactions, and potential adverse drug reactions. Generic prescribing (63.8%) and prescribing from the EML (84.2%) also indicate scope for improvement. These findings highlight the need to balance clinically appropriate multidrug therapy with principles of rational prescribing to enhance medication safety, affordability, and quality of care. Future studies should involve multicentre, larger and more diverse populations, with longitudinal assessment of clinical outcomes, medication adherence, adverse drug reactions, and pharmacoeconomic impact. Regular prescription audits and multidisciplinary medication review may further promote rational and cost-effective pharmacotherapy.

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REFERENCES

- [1] Mishra R, Sharma SK, Verma R, Kangra P, Dahiya P, et al. Medication adherence and quality of life among type 2 diabetes mellitus patients in India. *World J Diabetes*, 2021; 12(10): 1740-49.
- [2] Khan MAB, Hashim MJ, King JK, Govender RD, Mustafa H, et al. Epidemiology of type 2 diabetes—global burden of disease and forecasted trends. *J Epidemiol Glob Health*, 2020; 10(1): 107-11.
- [3] Mills KT, Stefanescu A, He J. The global epidemiology of hypertension. *Nat Rev Nephrol.*, 2020; 16(4): 223-37.
- [4] Sahoo SK, Zaidi G, Vipin VP, Bhatia E, et al. Heterogeneity in the aetiology of diabetes mellitus in young adults: a prospective study from North India. *Indian J Med Res.*, 2019; 149(4): 479-88.
- [5] Zhou B, Perel P, Mensah GA, Ezzati M. Global epidemiology, health burden and effective interventions for elevated blood pressure and hypertension. *Nat Rev Cardiol.*, 2021; 18(11): 785-802.
- [6] Berbari AE, Daouk NA, Nasr EM. Coexistence of diabetes mellitus and hypertension. In: *Blood Pressure Disorders in Diabetes Mellitus*. Cham: Springer International Publishing, 2023: 3-17.
- [7] Pavlou DI, Paschou SA, Anagnostis P, Spartalis M, Spartalis E, et al. Hypertension in patients with type 2 diabetes mellitus: targets and management. *Maturitas*, 2018; 112: 71-77.
- [8] Masnoon N, Shakib S, Kalisch-Ellett L, Caughey GE. What is polypharmacy? A systematic review of definitions. *BMC Geriatr.*, 2017; 17(1): 230.
- [9] Alwhaibi M, Balkhi B, Alhawassi TM, et al. Polypharmacy among patients with diabetes: a cross-sectional retrospective study in a tertiary hospital in Saudi Arabia. *BMJ Open*, 2018; 8: e020852.
- [10] Kumari S, Jain S, Kumar S. Effects of polypharmacy in elderly diabetic patients: a review. *Cureus*, 2022; 14(9): e29068.
- [11] World Health Organization. How to investigate drug use in health facilities: selected drug use indicators. Geneva: World Health Organization, 1993.
- [12] Chenchula S, Gupta R, Gupta SK, Padmavathi R, Pathan S. Assessment of WHO core drug use indicators at a tertiary care institute of national importance in India. *Bioinformation*, 2022; 18(10): 888-93.
- [13] Meena DK, Jayanthi M. Drug utilization research: a review. *Int J Basic Clin Pharmacol.*, 2019; 8(2): 354.
- [14] Verma N, Vinayagam S, Mittal N, Mittal R, Bansal N. Prescription audit in outpatient pharmacy of a tertiary care referral hospital in Haryana using World Health Organization/International Network for Rational Use of Drugs (WHO/INRUD) core prescribing indicators: a step towards refining drug use and patient care. *Pharmacy (Basel)*, 2025; 13(2): 48.
- [15] Kumar A, Halder S, Srivastava S, Gupta R. Increased pill burden and adverse effects of psychotropics correlated with poor quality of life and medication nonadherence: a cross-sectional drug utilization study at a tertiary care hospital in Delhi during COVID-19 pandemic. *J Assoc Physic India*, 2023; 71(9): 14-18.
- [16] Joshi R, Medhi B, Prakash A, Chandy SJ, Ranjalkar J, et al. Assessment of prescribing pattern of drugs and completeness of prescriptions as per the World Health Organization prescribing indicators in various Indian tertiary care centers: a multicentric study by Rational Use of Medicines Centers-Indian Council of Medical Research network under National Virtual Centre Clinical Pharmacology activity. *Indian J Pharmacol.*, 2022; 54(5): 321-28.
- [17] American Diabetes Association. 9. Pharmacologic approaches to glycemic treatment: standards of medical care in diabetes—2020. *Diabetes Care*, 2020; 43(1): S98-S110.



- [18] Davies MJ, Aroda VR, Collins BS, Gabbay RA, Green J, et al. Management of hyperglycaemia in type 2 diabetes, 2022. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetologia*, 2022; 65(12): 1925-66.
- [19] Sharma B, Nam EW, Karmacharya BM, Kim Y, Hamal S, et al. Prevalence of self-reported hypertension and non-communicable disease risk behaviors among adult population in rural communities of Nepal. *J Glob Health Sci.*, 2026; 8(1): e12. doi: 10.35500/jghs.2026.8.e12.

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