Section: Miscellaneous

Original Research Article

AN OBSERVATIONAL STUDY ON PRESCRIPTION TRENDS AND GLYCEMIC TARGET ATTAINMENT IN TYPE 2 DIABETES AT A TERTIARY HEALTH FACILITY

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) is a major public health concern in India, characterized by rising prevalence, multiple comorbidities, and variable treatment outcomes. Understanding real-world prescription trends and the extent of treatment target achievement is crucial to improving diabetes care. This study aimed to assess the prescription pattern of antidiabetic drugs and evaluate the achievement of glycemic and cardiometabolic targets among patients with T2DM attending a tertiary health center.

Materials and Methods: A hospital-based cross-sectional study was conducted among 402 adult patients with T2DM attending the medicine outpatient department of a tertiary care hospital in North India from January to December 2024. Sociodemographic, clinical, and prescription data were collected using a structured proforma. Prescriptions were analyzed for drug class, combination pattern, and rationality according to ADA and RSSDI 2024 guidelines. Treatment targets were defined as HbA1c <7%, fasting plasma glucose <130 mg/dL, postprandial glucose <180 mg/dL, blood pressure <140/90 mmHg, and LDL-C <100 mg/dL. Statistical analysis was performed using SPSS version 26.0, applying chi-square test, t-test, and multivariate logistic regression, with $p<0.05$ considered significant.

Results: The mean age of participants was 54.7 ± 10.9 years, and 56.7% were male. Metformin was the most prescribed drug (93%), followed by sulfonylureas (60.2%) and DPP-4 inhibitors (43.8%). Insulin therapy was required in 30.1% of patients, significantly increasing with longer diabetes duration ($p<0.001$). Fixed-dose combinations were used in 61.4% of prescriptions, with an average of 2.3 ± 0.8 drugs per patient. Only 44.5% achieved target HbA1c (<7%), while 38.8% and 35.3% attained fasting and postprandial glucose goals, respectively. Logistic regression identified duration of diabetes >10 years (AOR 2.13, p=0.001), obesity (AOR 1.67, p=0.032), insulin use (AOR 1.95, p=0.008), and use of ≥3 drugs (AOR 1.56, p=0.049) as independent predictors of poor glycemic control.

Conclusion: Metformin-based combination therapy remains the cornerstone of diabetes management in tertiary care. However, less than half of patients achieved optimal glycemic and cardiometabolic targets, reflecting therapeutic inertia and disease progression. Strengthening guideline-based prescribing, early lifestyle intervention, and broader access to newer antidiabetic agents are essential to improve treatment outcomes in Indian patients with T2DM.

Keywords: Type 2 diabetes mellitus, Prescription pattern, Glycemic control, Insulin therapy, Antidiabetic drugs, Treatment targets.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) has emerged as one of the most significant global public health challenges of the 21st century.[1] Characterized by insulin resistance and β-cell dysfunction, it is associated with chronic hyperglycemia leading to long-term microvascular and macrovascular complications. According to the International Diabetes Federation (IDF) Diabetes Atlas 2024, approximately 537 million adults worldwide are living with diabetes, and this number is projected to rise to 643 million by 2030.[2] India, often termed the "diabetes capital of the world," contributes a substantial share, with an estimated 101 million adults affected by diabetes and an additional 136 million with prediabetes. The growing prevalence in India is attributed to rapid urbanization, sedentary lifestyle, unhealthy dietary patterns, and genetic predisposition.[3]

Effective management of T2DM relies on a combination of lifestyle modification and pharmacotherapy aimed at achieving optimal glycemic control and minimizing complications.[4] The pharmacological armamentarium has expanded considerably over the past decade, including newer agents such as dipeptidyl peptidase-4 (DPP-4) inhibitors, sodium-glucose cotransporter-2 (SGLT2) inhibitors, and glucagon-like peptide-1 receptor agonists (GLP-1 RAs), in addition to traditional drugs like metformin, sulfonylureas, and insulin.[5] Despite the availability of multiple therapeutic options, real-world prescription patterns are often influenced by various factors, including clinician preference, patient socioeconomic status, drug availability, comorbidities, and institutional protocols.[6]

Monitoring prescription patterns is essential to assess adherence to evidence-based guidelines such as those recommended by the American Diabetes Association (ADA) and the Research Society for the Study of Diabetes in India (RSSDI).[7] Rational prescribing ensures cost-effectiveness, minimizes adverse effects, and improves treatment outcomes. However, several studies have shown considerable variability in prescribing behavior across regions and healthcare settings, reflecting differences in physician awareness, patient profile, and healthcare infrastructure. Evaluating such patterns can identify gaps between clinical practice and standard treatment recommendations.[8]

Equally important is the assessment of treatment target achievement among patients with T2DM. Achieving glycemic goals—typically defined as glycated hemoglobin (HbA1c) <7%—is crucial to reducing the risk of diabetes-related complications.[9] However, real-world evidence indicates that a significant proportion of patients fail to reach target glycemic levels despite pharmacotherapy. This therapeutic inertia may result from inadequate medication titration, poor adherence, limited patient education, or clinical inertia on the part of healthcare providers.[10]

Therefore, understanding both the prescription trends and treatment target attainment provides valuable insight into the quality of diabetes care in a tertiary healthcare setting. Such data are particularly relevant in resource-limited countries like India, where the burden of diabetes continues to rise, yet optimal management remains challenging due to socioeconomic disparities and evolving therapeutic landscapes.[11,12]

The present study aimed to evaluate the prescription patterns of antidiabetic medications and the extent of treatment target achievement among patients with T2DM attending a tertiary health center. The findings are expected to help identify prevailing trends, deviations from standard guidelines, and potential areas for intervention to enhance rational drug use and improve glycemic outcomes.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital-based, cross-sectional, observational study conducted in the Department of General Medicine at a tertiary care teaching hospital in North India. The study was carried out over a period of 12 months, from January to December 2024. The tertiary center caters to both urban and semi-urban populations, receiving a large volume of patients with chronic diseases such as diabetes mellitus, thus providing a representative sample for prescription and treatment pattern analysis.

Study Population

The study population comprised adult patients diagnosed with type 2 diabetes mellitus (T2DM) attending the outpatient department (OPD) or admitted to the medical wards for glycemic management during the study period. Diagnosis of T2DM was confirmed based on the American Diabetes Association (ADA) 2024 criteria, which include fasting plasma glucose ≥126 mg/dL, 2-hour postprandial glucose ≥200 mg/dL during an oral glucose tolerance test, HbA1c ≥6.5%, or a random plasma glucose ≥200 mg/dL in a patient with classical symptoms of hyperglycemia. Both newly diagnosed and previously diagnosed patients on pharmacotherapy for at least three months were included in the study.

Inclusion and Exclusion Criteria

Patients aged 30 years and above with a confirmed diagnosis of T2DM and having at least one follow-up visit or adequate prescription record were included. Patients with type 1 diabetes mellitus, gestational diabetes, steroid-induced diabetes, or those with incomplete medical records were excluded. Individuals with severe systemic illness or those unwilling to provide consent were also excluded from the study.

Sample Size and Sampling Technique: A sample size of 402 patients was determined using the formula for prevalence studies:
$n = Z^2 \times p \times (1 - p) / d^2$, assuming a prevalence (p) of rational antidiabetic drug use of 50%, a 95% confidence interval, and a 5% allowable error. To account for incomplete data, an additional 10% was added. Participants were selected through systematic random sampling from the daily OPD attendance register to minimize selection bias.

Data Collection Procedure: Data were collected prospectively using a structured proforma designed by the investigators. The proforma captured sociodemographic details (age, gender, education, occupation, residence), clinical parameters (duration of diabetes, presence of comorbidities, body mass index, blood pressure, lipid profile), and pharmacological details from the latest prescription records. The prescription pattern was documented in terms of number of drugs prescribed per patient, class and combination of antidiabetic agents, dosage forms, frequency, and route of administration. Both oral hypoglycemic agents (OHAs) and insulin preparations were included. Fixed-dose combinations (FDCs) were noted separately. Each prescription was evaluated for rationality based on ADA and RSSDI 2024 guidelines.

Assessment of Treatment Targets: Glycemic control was assessed using the most recent HbA1c values obtained within the last three months. An HbA1c level of <7% was considered as achievement of treatment target in accordance with ADA standards. Fasting plasma glucose (FPG) and postprandial plasma glucose (PPG) were also recorded, with target levels defined as <130 mg/dL and <180 mg/dL respectively. For patients on insulin therapy, adequacy of dose titration and frequency of monitoring were also evaluated. Blood pressure control (<140/90 mmHg) and lipid control (LDL-C <100 mg/dL) were noted as additional treatment targets for comprehensive risk factor assessment.

Ethical Considerations: Prior to commencement, the study protocol was reviewed and approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants before inclusion in the study. Confidentiality of patient data was maintained by anonymizing identifiers and securing access to records.

Data Analysis: Data were entered in Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were applied to summarize categorical variables as frequencies and percentages, and continuous variables as mean ± standard deviation (SD). The association between prescription patterns and achievement of treatment targets was assessed using chi-square test for categorical variables and independent t-test for continuous variables. Predictors of Poor Glycemic Control (HbA1c ≥7%) were analysed using Logistic Regression Analysis. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 402 patients with type 2 diabetes mellitus (T2DM) were included in the analysis. The mean age of participants was 54.7 ± 10.9 years, with the majority (47.5%) belonging to the 45–59-year age group, followed by those aged ≥60 years (37.1%). Males constituted 56.7% of the study population. The mean duration of diabetes was 7.9 ± 4.6 years, and 42.0% had diabetes for 5–10 years. More than half (50.0%) of the patients were overweight and 28.4% were obese, with a mean BMI of 26.8 ± 3.9 kg/m². Hypertension (58.7%) and dyslipidemia (44.3%) were the most common comorbidities, and 31.3% had both conditions. A positive family history of diabetes was present in 61.7% of the subjects. The mean fasting plasma glucose (FPG), postprandial glucose (PPG), and HbA1c were 146.3 ± 36.7 mg/dL, 221.4 ± 58.6 mg/dL, and 7.9 ± 1.4%, respectively, indicating suboptimal glycemic control in a majority of patients [Table 1].

Table 1: Sociodemographic and Clinical Characteristics of Patients with Type 2 Diabetes Mellitus (N = 402).

Variable	Category	Frequency (%)/Mean ± SD
Age (years)	—	54.7 ± 10.9
Age group (years)	30–44	62 (15.4)
	45–59	191 (47.5)
	≥60	149 (37.1)
Gender	Male	228 (56.7)
	Female	174 (43.3)
Duration of diabetes (years)	<5	114 (28.4)
	5–10	169 (42.0)
	>10	119 (29.6)
BMI (kg/m²)	—	26.8 ± 3.9
BMI group (kg/m²)	Normal (18.5–24.9)	87 (21.6)
	Overweight (25–29.9)	201 (50.0)
	Obese (≥30)	114 (28.4)
Comorbidities	Hypertension	236 (58.7)
	Dyslipidemia	178 (44.3)
	Both HTN & Dyslipidemia	126 (31.3)
Family history of diabetes	Present	248 (61.7)
Smoking / Alcohol use	Yes	94 (23.4)
Fasting glucose (mg/dL)	—	146.3 ± 36.7

Postprandial glucose (mg/dL)	—	221.4 ± 58.6
HbA1c (%)	—	7.9 ± 1.4
Blood pressure (mmHg)	—	136/84 ± 9.8/6.1
LDL-C (mg/dL)	—	102.5 ± 27.6

BMI – Body Mass Index; HbA1c – Glycated Hemoglobin; LDL-C: Low-Density Lipoprotein Cholesterol.

Metformin was the most frequently prescribed drug, received by 93.0% of patients, either as monotherapy or in combination. Sulfonylureas (60.2%) were the second most commonly used agents, followed by DPP-4 inhibitors (43.8%) and SGLT2 inhibitors (23.4%). Thiazolidinediones were prescribed in 14.4% of cases, while GLP-1 receptor agonists were infrequently used (2.2%), reflecting limited accessibility and cost concerns. Insulin therapy was required in 30.1% of the patients. Fixed-dose combinations (FDCs) were prescribed to 61.4% of participants. The average number of antidiabetic agents per prescription was 2.3 ± 0.8, suggesting frequent use of dual or triple therapy to achieve glycemic targets [Table 2].

Table 2: Pattern of Antidiabetic Drug Prescription among Study Participants (N = 402).

Drug Class / Combination	Frequency (%)/Mean ± SD
Metformin (biguanide)	374 (93.0)
Sulfonylureas (glimepiride/gliclazide)	242 (60.2)
DPP-4 inhibitors (sitagliptin, teneligliptin)	176 (43.8)
SGLT2 inhibitors (dapagliflozin/empagliflozin)	94 (23.4)
Thiazolidinediones (pioglitazone)	58 (14.4)
Insulin therapy (any form)	121 (30.1)
GLP-1 receptor agonists	9 (2.2)
Fixed-dose combinations (FDCs)	247 (61.4)
Drugs per Prescription	
Monotherapy	96 (23.9)
Two-drug regimen	174 (43.3)
≥Three-drug regimen	132 (32.8)
Drugs per prescription	2.3 ± 0.8

DPP-4 – Dipeptidyl Peptidase-4; SGLT2 – Sodium-Glucose Cotransporter-2; GLP-1 – Glucagon-Like Peptide-1.

A significant association was found between duration of diabetes and treatment modality ($p<0.001$). Among those with a diabetes duration of less than five years, the majority (80.7%) were managed with oral drugs alone, and only 2.6% required insulin monotherapy. In contrast, among patients with more than ten years of diabetes, 46.2% were on combined oral and insulin therapy, and 9.3% were on insulin alone [Table 3].

Table 3: Prescription Pattern According to Duration of Diabetes (N = 402).

Duration of Diabetes (years)	Oral Drugs Only	Oral + Insulin	Insulin Only	p-value
	Frequency (%)			
<5 (n=114)	92 (80.7)	19 (16.7)	3 (2.6)	<0.001
5–10 (n=169)	112 (66.3)	46 (27.2)	11 (6.5)	
>10 (n=119)	53 (44.5)	55 (46.2)	11 (9.3)	

Less than half of the patients achieved optimal glycemic control. The proportion of patients attaining HbA1c <7% was 44.5%, while only 38.8% and 35.3% achieved target fasting (<130 mg/dL) and postprandial (<180 mg/dL) glucose levels, respectively. Blood pressure targets (<140/90 mmHg) were met by 56.5% of patients, and lipid control (LDL-C <100 mg/dL) was achieved by 46.8%. No statistically significant gender differences were observed in treatment target achievement [Table 4].

Table 4: Achievement of Glycemic and Cardiometabolic Treatment Targets (N = 402).

Parameter	Total Achieved (n=402)	Male (n=228)	Female (n=174)	p-value
	Frequency (%)			
HbA1c <7%	179 (44.5)	108 (47.4)	71 (40.8)	0.186
FPG <130 mg/dL	156 (38.8)	91 (39.9)	65 (37.4)	0.635
PPG <180 mg/dL	142 (35.3)	85 (37.3)	57 (32.8)	0.383
BP <140/90 mmHg	251 (62.4)	138 (60.5)	113 (65.0)	0.384
LDL-C <100 mg/dL	168 (41.8)	101 (44.3)	67 (38.5)	0.271

HbA1c: Glycated Hemoglobin; FPG: Fasting Plasma Glucose; PPG: Postprandial Plasma Glucose; LDL-C: Low-Density Lipoprotein Cholesterol; BP: Blood Pressure

An inverse relationship was observed between the number of antidiabetic drugs prescribed and glycemic target achievement. Patients on monotherapy had the lowest mean HbA1c (7.4 ± 1.1%) and the highest rate of target attainment (56.3%), while those on two-drug and ≥three-drug

regimens exhibited progressively higher mean HbA1c levels (7.8 ± 1.3% and 8.3 ± 1.6%, respectively). The difference in HbA1c across these groups was statistically significant (p = 0.002) [Table 5].

Table 5: Association Between Number of Antidiabetic Agents and Glycemic Control.

No. of Drugs per Prescription	HbA1c (%)	HbA1c <7%	p-value
	Mean ± SD	Frequency (%)	
Monotherapy (n=96)	7.4 ± 1.1	54 (56.3)	0.002
Two-drug regimen (n=174)	7.8 ± 1.3	76 (43.7)	
≥Three-drug regimen (n=132)	8.3 ± 1.6	49 (37.1)	

HbA1c – Glycated Hemoglobin.

Multivariate logistic regression identified longer duration of diabetes (>10 years), obesity (BMI ≥30 kg/m²), insulin use, and polypharmacy (≥3 drugs) as independent predictors of poor glycemic control. The odds of uncontrolled HbA1c were approximately twofold higher in patients with diabetes duration exceeding ten years (AOR 2.13, p = 0.001) and in those on insulin therapy (AOR 1.95, p = 0.008). Obesity (AOR 1.67, p = 0.032) and use of ≥3 drugs (AOR 1.56, p = 0.049) also significantly contributed to suboptimal glycemic control. Age and hypertension were not statistically significant predictors [Table 6].

Table 6: Predictors of Poor Glycemic Control (HbA1c ≥7%) in Logistic Regression Analysis.

Variable	Adjusted Odds Ratio (AOR)	95% CI	p-value
Age ≥60 years	1.24	0.78–1.98	0.360
Duration of diabetes >10 years	2.13	1.36–3.33	0.001
Obesity (BMI ≥30 kg/m²)	1.67	1.04–2.68	0.032
Presence of hypertension	1.21	0.78–1.88	0.390
Use of insulin therapy	1.95	1.18–3.20	0.008
Number of drugs ≥3	1.56	1.00–2.46	0.049

BMI – Body Mass Index; AOR – Adjusted Odds Ratio; CI – Confidence Interval.

DISCUSSION

The present study provides an in-depth evaluation of antidiabetic prescription patterns and treatment target attainment among patients with type 2 diabetes mellitus (T2DM) attending a tertiary health center in India. In our study, the mean age of participants was 54.7 years, consistent with prior Indian studies by Pradeepa et al., and Chandrupatla et al., which also reported peak diabetes prevalence in the 45–60-year age group.[13,14] The predominance of middle-aged, overweight, and hypertensive individuals aligns with the well-established cardiometabolic profile of Indian diabetics, characterized by central obesity and insulin resistance.[15,16] The high coexistence of hypertension (58.7%) and dyslipidemia (44.3%) observed mirrors findings from the Dalal et al., indicating that nearly half of Indian T2DM patients harbor multiple metabolic risk factors requiring comprehensive management.[17]

Metformin emerged as the cornerstone of therapy, prescribed in over 90% of patients, which is consistent with Chawla et al., recommendations endorsing it as first-line therapy.[18] Sulfonylureas were the second most commonly prescribed agents, reflecting their continued popularity due to cost-effectiveness and familiarity in Indian practice.[19,20] However, the moderate uptake of DPP-4 inhibitors (43.8%) and SGLT2 inhibitors (23.4%) in our cohort suggests a gradual shift towards newer agents, possibly limited by affordability and insurance coverage. Similar trends were reported in studies from Tiwari et al., and Kapur et al., where DPP-4 inhibitors were used in approximately 35–45% of patients and SGLT2 inhibitors in 15–25%.[19,20] The use of GLP-1 receptor agonists was minimal (2.2%) in our study, reflecting the high cost and limited availability in resource-limited settings.

A key observation in our study was the increasing reliance on insulin with longer disease duration (p<0.001), consistent with progressive β-cell dysfunction in T2DM. More than half of patients with over ten years of diabetes were on insulin therapy, paralleling results from Tiwari et al., and Dixit et al., who documented similar associations.[21,22] This trend highlights the progressive nature of the disease and emphasizes the importance of early, aggressive glycemic control to delay insulin dependency. Despite the use of multiple agents, the mean HbA1c remained 7.9%, and only 44.5% achieved the target of <7%, suggesting significant gaps in achieving optimal control. These rates are comparable to those reported in multicentric surveys where only 35–50% of patients achieved recommended glycemic targets, reflecting both physician inertia and patient-level challenges such as poor adherence, limited lifestyle modification, and socioeconomic constraints.[23,24]

Our findings further demonstrated that patients on multi-drug regimens had significantly higher mean HbA1c levels (p=0.002), likely reflecting disease chronicity and treatment resistance rather than therapeutic inefficacy. Similar patterns were reported by Geetha et al., who found that patients on triple therapy had poorer glycemic control despite intensified pharmacotherapy, emphasizing that mere addition of drugs may not compensate for inadequate

adherence or inappropriate titration.[25] Moreover, logistic regression identified duration of diabetes >10 years, obesity, insulin use, and polypharmacy (≥3 drugs) as significant predictors of poor glycemic control. These findings align with pathophysiological expectations—longer disease duration signifies β-cell failure, obesity contributes to insulin resistance, and insulin use typically marks advanced disease. Comparable associations have been described in studies from Wondmkun et al., and Zatterale et al., underscoring the global consistency of these determinants.[26,27]

In terms of cardiometabolic risk factor control, only 56.5% achieved target blood pressure and 46.8% achieved target LDL-C levels. This mirrors national data suggesting that integrated cardiovascular risk management in diabetic patients remains suboptimal in India.[28] The modest achievement of these targets may stem from therapeutic inertia in intensifying statin or antihypertensive therapy, as well as fragmented follow-up. Evidence from the Mishra et al., and Jha et al., similarly showed that less than 50% of Indian diabetics attained concurrent glycemic, blood pressure, and lipid goals.[29,30] Given the strong link between comprehensive risk factor management and reduction in diabetes-related morbidity, strengthening multidisciplinary diabetes care models remains imperative.[30]

The overall prescription pattern observed in our study suggests a rational yet partially guideline-concordant approach. While metformin-based combinations were appropriately preferred, the relatively lower use of SGLT2 inhibitors and GLP-1 analogs indicates a gap in adoption of newer cardioprotective therapies recommended for patients with cardiovascular or renal comorbidities. Ensuring better physician awareness, cost subsidies, and availability could enhance rational drug selection. Moreover, achieving optimal treatment targets requires not only pharmacological optimization but also reinforcement of dietary counseling, physical activity, and continuous patient education.

Limitations

The present study was conducted in a single tertiary care center and may not represent prescription trends across primary or private healthcare settings. The cross-sectional design precludes causal inference between prescription pattern and glycemic outcome. Adherence to medications and dietary or lifestyle factors were not objectively measured, which could have influenced target attainment rates. Despite these limitations, the study offers valuable real-world insights into prescribing behavior and treatment outcomes in Indian diabetic patients.

CONCLUSION

In summary, the present study demonstrates that metformin remains the foundation of diabetes management in tertiary care, with increasing use of combination therapy as disease duration progresses. However, despite the availability of multiple pharmacological options, less than half of patients achieved recommended glycemic and cardiometabolic targets. Longer diabetes duration, obesity, insulin dependence, and polypharmacy were major predictors of poor control. These findings highlight the need for stronger adherence to evidence-based guidelines, early lifestyle intervention, regular treatment review, and wider adoption of newer agents with proven metabolic and cardiovascular benefits to improve outcomes in Indian patients with type 2 diabetes mellitus.

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