

Pattern of Antidiabetic Drug Prescriptions and Their Association with Glycemic Control among patient with type 2 Diabetes Mellitus in Qassim university Medical City diabetes center clinic

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Abstract

Background:

Type 2 diabetes mellitus (T2DM) is a significant health issue that is associated with potential complications, which necessitate good control of HbA1c. Several drug classes were developed to improve glycemic control with the provision of cardiovascular and renal benefits. The prescription pattern of such medications, including the type of medication and the number of medications, varies between different patients based on the patient's condition and requirements. However, the impact of the prescription patterns of such medications on glycemic control is inadequately declared.

Aim:

To determine the most prescribed antidiabetic agents, adherence of patients, and their correlation with glycemic control among T2DM patients.

Methods:

This was a cross-sectional retrospective observational study that was conducted between January 2025 and June 2025 on adult T2DM patients receiving at least one antidiabetic medication for six months or more. The study was conducted at outpatient diabetes clinics affiliated with tertiary care hospitals and private clinics using the medical records of the patients.

Results:

A total of 201 patients were included; the most prescribed agent was metformin (92%), and more than one-half of the patients (42.8%) were prescribed 4-6 medications. Medication adherence was good among most patients (74.1%). The mean level of HbA1c was significantly associated with SGLT2 inhibitor ($P=0.04$), insulin therapy ($P=0.0001$), number of prescribed medications ($P=0.0001$), and medication adherence ($P=0.0001$).

Conclusion:

Among patients who are prescribed ADDs, the number of prescribed ADDs and some types of ADDs affect glycemic control. Additionally, adherence to ADDs was linked with good glycemic control.

Keywords: ADDs prescription, Pattern, Glycemic control, Association.

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Introduction

Persistent hyperglycemia brought on by abnormalities in insulin production, action, or both is a hallmark of diabetes mellitus (DM), a chronic metabolic disease. The majority of cases worldwide are type 2 diabetes mellitus (T2DM), which is linked to higher morbidity and death from microvascular and macrovascular complications (1). Preventing these issues and enhancing patient outcomes depend on achieving

appropriate glycemic management, which is usually measured using glycated hemoglobin (HbA1c) (2).

With the advent of new pharmaceutical medications, T2DM therapy has changed. Newer drug classes, such as sodium-glucose co-transporter-2 inhibitors (SGLT2i) and glucagon-like peptide-1 receptor agonist (GLP-1 RA), provide additional cardiovascular and renal benefits in addition to better glycemic control, even though conventional therapies

like metformin, sulfonylureas, and insulin are still commonly used (3, 4).

Despite these advancements, prescribing patterns vary widely depending on patient comorbidities, BMI, physician preferences, and drug accessibility (5). Understanding these real-world prescription patterns and their relationship with HbA1c levels is essential to optimize treatment strategies and improve patient care (6).

Research objectives

To describe the prescribing patterns of oral and injectable antidiabetic drugs and evaluate their association with glycemic control (HbA1c) among patients with type 2 diabetes mellitus (T2DM) (7).

Specific Objectives:

1. To identify the most commonly prescribed antidiabetic drug classes, including metformin, sulfonylureas, insulin, SGLT2 inhibitors, and GLP-1 receptor agonists (8).
2. To assess the association between the number of prescribed medications and glycemic control (HbA1c) (9).
3. To evaluate the impact of patient comorbidities, such as hypertension and dyslipidemia, on HbA1c levels (10).
4. To examine the influence of body mass index (BMI) on glycemic control across different antidiabetic regimens (11).
5. To compare glycemic outcomes among patients receiving monotherapy, dual therapy, or combination therapy (12).

This study aims to provide insights into real-world prescribing behaviors and their effectiveness, which may guide clinical decisions and optimize patient outcomes

Materials and Methods

Study design:

This study is a cross-sectional observational study designed to evaluate the prescribing patterns of antidiabetic drugs and their association with glycemic control among adult patients with type 2 diabetes mellitus (T2DM) (12). Data will be collected retrospectively from medical records to assess current real-world treatment practices.

Study setting:

The study will be conducted at selected outpatient diabetes clinics affiliated with tertiary care hospitals and private clinics. These centers provide care for a diverse population of patients, enabling assessment of varied prescribing practices across different clinical settings (13).

Study duration:

Data collection will cover a period of six months, from January 2025 to June 2025. This timeframe will allow for the inclusion of patients with recent HbA1c

measurements and stable antidiabetic therapy, ensuring reliable assessment of glycemic control in relation to prescribed medications (14,15).

Sample size:

The study will include approximately 200 adult patients diagnosed with type 2 diabetes mellitus (T2DM). The sample size was calculated to achieve 80% power at a 5% significance level to detect a moderate effect size in the association between antidiabetic drug patterns and HbA1c levels (16).

Sampling technique (with inclusion and exclusion criteria):

Sampling

Technique:

A consecutive sampling method will be applied, including all eligible patients who attend the selected clinics during the study period.

Inclusion Criteria:

- Adults aged ≥ 18 years diagnosed with T2DM.
- Receiving at least one oral or injectable antidiabetic medication for ≥ 6 months.
- Having at least one documented HbA1c measurement within the last three months.

Exclusion Criteria:

- Patients with type 1 diabetes, gestational diabetes, or secondary diabetes.
- Patients with incomplete medical records or missing HbA1c values.
- Patients participating in clinical trials of antidiabetic drugs during the study period (17,18).

Data collection methods:

Data will be collected retrospectively from patient medical records using a structured data collection sheet. Information will include:

- Demographic data: age, sex, BMI.
- Clinical data: duration of diabetes, comorbidities (e.g., hypertension, dyslipidemia).
- Pharmacological data: type and number of prescribed antidiabetic medications.
- Glycemic control: latest HbA1c measurement.

Pilot study:

A pilot study will be conducted on 10% of the sample (approximately 20 patients) to test the feasibility of the data collection tools and procedures. Any necessary adjustments will be made prior to the main data collection to ensure reliability and validity of the study (19,20).

Data management and analysis plan:

To maintain confidentiality, all gathered data will be stored in a secure electronic database with limited access. Prior to analysis, the accuracy and completeness of the data will be verified (21).

Analysis of Statistics:

Patient demographics, clinical features, and prescription patterns will be summarized using descriptive statistics (mean $\pm$ SD for continuous variables, frequencies and percentages for categorical variables).

Statistical inference: The chi-square test will look for correlations between categorical variables (drug class and comorbidities, for example). The mean HbA1c levels across various medication regimens will be compared using ANOVA or t-tests. The independent effects of drug type, number of medications, BMI, and comorbidities on HbA1c levels will be evaluated using multiple linear regression. A statistically significant p-value is one that is less than 0.05 (22, 23). SPSS version 28 (IBM Corp., Armonk, NY, USA) will be used for data analysis.

Ethical considerations:

The Declaration of Helsinki will be followed in the conduct of this investigation. Prior to data collection, the participating institutions' Institutional Review Boards (IRBs) will grant ethical permission (24).

- Each record will be given a unique code to ensure patient anonymity; personal identities will not be used in data analysis or reporting.
- The research team will only have access to de-identified data.
- There are no extra interventions required to participate in the trial; all information is gathered retrospectively from medical records to reduce patient risk.

Results:

A total of 201 patients were included; the mean $\pm$ SD age of the patients was 61.52 $\pm$ 10.78 years, and the largest proportion, 82 (40.8%), were aged 61-70 years. Females were more dominant than males, 117 (58.2%) Vs. 84 (41.8%), respectively. The mean $\pm$ SD of BMI was 31.75 $\pm$ 5.88, and more than one-half 115, 57.2% were obese. The duration of diabetes ranged between one and 40 years, with a mean $\pm$ SD of 15.08 $\pm$ 9.04 years, and the largest proportion, 54 (26.9%), had 6-10 years of diabetes, table 1.

Table 1 : Description of basic characteristics of the studied sample

Variables	Description (n=201)
Age (years)	
Range	19 - 85
Mean $\pm$ SD	61.52 $\pm$ 10.78
Age (years)	
50 or less	34 (16.9)
51-60	48 (23.9)

61-70	82 (40.8)
>70	37 (18.4)
Sex	
Male	84 (41.8)
Female	117 (58.2)
BMI (kg/m²)	
Range	19.13 - 62.05
Mean $\pm$ SD	31.75 $\pm$ 5.88
BMI (kg/m²)	
Normal weight	17 (8.5)
Over weight	69 (34.3)
Obese	115 (57.2)
Duration of diabetes (years)	
Range	1 - 40
Mean $\pm$ SD	15.08 $\pm$ 9.04
Duration of diabetes (years)	
1-5	27 (13.4)
6-10	54 (26.9)
11-15	42 (20.9)
16-20	35 (17.4)
> 20	43 (21.4)

SD = standard deviation

Regarding comorbidities of the patients, 189 (94%) had comorbidities. The most common comorbidity was hypertension, 143 (71.1%), followed by dyslipidemia, 101 (50.2%). Regarding smoking status, the large majority were non-smokers, 191 (95%), table 2.

Table 2 : Description of comorbidities

Variables	Description (n=201)
Comorbidities	189 (94)
HTN	143 (71.1)
Dyslipidemia	56 (27.9)
DLP	101 (50.2)
CKD	16 (8)
Depression	11 (5.5)
Hypothyroidism	27 (13.4)
Asthma	11 (5.5)
Others	51 (25.4)
Smoking status	
Current Smoker	8 (4)
Non-smoker	191 (95)
Former smoker	2 (1)

Regarding ADDs, the most used medication was metformin 185 (92%), followed by the SGLT2 inhibitor 169 (84.1%). The largest proportion of the patients, 86 (42.8%), were using four ADDs. More than one-half of the patients, 127 (63.2%), were using 4-6 medications. The adherence level to the medication was good among most of the patients 149 (74.1%), whereas 21 (10.4%) had moderate adherence and 31 (15.4%) had poor adherence, table 3.

Table 3: Description of ADDs

Variables	Description (n=201)
ADDs	
Metformin	185 (92)
SGLT2 inhibitor	169 (84.1)
GLP-1 receptor agonist	87 (43.3)
Sulfonylurea	72 (35.8)
Insulin	99 (49.3)
DPP-4 Inhibitor	81 (40.3)
Total number of antidiabetic medications	
1	3 (1.5)
2	21 (10.4)
3	50 (24.9)
4	86 (42.8)
5	35 (17.4)
6	6 (3)
Total number of antidiabetic medications	
1-3	74 (36.8)
4-6	127 (63.2)
Medication adherence	
Good	149 (74.1)
Moderate	21 (10.4)
Poor	31 (15.4)

Regarding laboratory markers, the mean±SD of the latest HbA1c was 7.57±1.16. The mean±SD of fasting glucose was 7.8±2.85. The mean±SD of renal function was 74.58±25.67. Regarding lipid profile, the mean±SD of LDL, HDL, and TG was 2.51±0.79, 1.29±0.3, and 1.43±0.65, respectively, table 4.

Table 4 : Description of labs (glucose profile, lipid profile, and renal function)

Variables	Description (n=201)
Latest HbA1c (%)	
Range	5.04 - 12.19

Mean ± SD	7.57 ± 1.16
Fasting glucose (mmol/L)	
Range	3.33 - 19.3
Mean ± SD	7.8 ± 2.85
Renal function (Creatinine umol/L/ eGFR)	
Range	27.09 - 170.36
Mean ± SD	74.58 ± 25.67
LDL	
Range	1.1 - 5.5
Mean ± SD	2.51 ± 0.79
HDL	
Range	0.78 - 2.7
Mean ± SD	1.29 ± 0.3
TG	
Range	0.57 - 3.94
Mean ± SD	1.43 ± 0.65

The correlations between glycemic control based on HbA1c and demographics revealed significant associations between glycemic control and age categories (P=0.004) and the groups of diabetes duration (P=0.0001), table 5.

Table 5: The correlations between glycemic control and demographics

Variables	Latest HbA1c (%) Mean ± SD	P value
Age (years)		
50 or less	7.1 ± 1.22	0.004
51-60	7.74 ± 1.21	
61-70	7.47 ± 0.98	
>70	8 ± 1.24	
Sex		
Male	7.43 ± 0.95	0.321
Female	7.67 ± 1.28	
BMI (kg/m²)		
Normal weight	7.48 ± 1.2	0.159
Overweight	7.36 ± 0.93	
Obese	7.71 ± 1.26	
Duration of diabetes (years)		
1-5	6.98 ± 1.19	0.000
6-10	7.4 ± 1.24	
11-15	7.59 ± 0.88	

16-20	8.03 ± 1.17	
> 20	7.75 ± 1.11	

Glycemic control displayed no significant correlations with any of the comorbidities, except for asthma, where a significantly higher mean of HbA1c was linked with asthma (P=0.01). However, there was no considerable correlation between glycemic control and smoking status (P=0.5), table 6.

Table 6: The correlations between glycemic control and clinical data

Variables	Latest HbA1c (%)	P value
Comorbidities		
Yes	7.59 ± 1.16	0.215
No	7.25 ± 1.01	
HTN		
Yes	7.53 ± 1.13	0.555
No	7.67 ± 1.22	
Dyslipidemia		
Yes	7.77 ± 1.26	0.174
No	7.49 ± 1.11	
DLP		
Yes	7.64 ± 1.17	0.294
No	7.5 ± 1.14	
CKD		
Yes	7.31 ± 1.12	0.354
No	7.59 ± 1.16	
Depression		
Yes	7.76 ± 1.2	0.510
No	7.56 ± 1.16	
Hypothyroidism		
Yes	7.68 ± 1.27	0.610
No	7.55 ± 1.14	
Asthma		
Yes	8.47 ± 1.31	0.010
No	7.52 ± 1.13	
Others		
Yes	7.72 ± 1.29	0.292
No	7.52 ± 1.11	
Smoking status		
Current Smoker	7.18 ± 1.24	0.556
Non-smoker	7.59 ± 1.16	
Former smoker	7.23 ± 0.21	

Regarding different ADDs, significant correlations were found between the mean of HbA1c and both SGLT2 inhibitors (P=0.04) and insulin (P=0.0001). Additionally, the mean of HbA1c was significantly linked with the total number of antidiabetic agents (P=0.0001), and medication adherence (P=0.0001), table 7.

Table 7 : The correlations between glycemic control and ADDs

Variables	Latest HbA1c (%)	P value
Metformin		
Yes	7.55 ± 1.14	0.600
No	7.81 ± 1.39	
SGLT2 inhibitor		
Yes	7.61 ± 1.07	0.048
No	7.33 ± 1.53	
GLP-1 receptor agonist		
Yes	7.63 ± 1.26	0.502
No	7.53 ± 1.08	
Sulfonylurea		
Yes	7.74 ± 1.16	0.064
No	7.47 ± 1.15	
Insulin		
Yes	7.96 ± 1.17	0.000
No	7.19 ± 1.01	
DPP-4 Inhibitor		
Yes	7.61 ± 1.15	0.806
No	7.54 ± 1.17	
Total number of antidiabetic medications		
1	6.38 ± 0.55	0.000
2	6.48 ± 0.66	
3	7.36 ± 0.99	
4	7.76 ± 1.07	
5	7.91 ± 1.28	
6	8.89 ± 1.38	
Total number of antidiabetic medications		
1-3	7.07 ± 0.98	0.000
4-6	7.86 ± 1.16	

Medication adherence		
Good	7.32 ± 0.9	0.000
Moderate	7.69 ± 0.97	
Poor	8.7 ± 1.62	

Different correlations between HbA1c and other variables were assessed; there were significant positive correlations between HbA1c and age ($r=0.16$, $P=0.02$), diabetes duration ($r=0.237$, $P=0.001$), number of ADDs ($r=0.394$, $P=0.0001$), and fasting glucose ($r=0.56$, $P=0.0001$), with significant positive and weak correlations with LDL ($r=0.192$, $P=0.001$) and TG ($r=0.241$, $P=0.001$). On the other hand, there was a significant negative correlation between HbA1c and medication adherence ($r=-0.342$, $P=0.0001$), Table 8.

Table 8: The correlations between glycemic control and quantitative variables

Variables	Latest HbA1c (%)	
	r	p
Age (years)	0.160	0.023
BMI (kg/m ²)	0.131	0.064
Duration of diabetes (years)	0.237	0.001
Total number of antidiabetic medications	0.394	0.000
Medication adherence	-0.342	0.000
Fasting glucose (mmol/L)	0.560	0.000
Renal function (Creatinine umol/L/ eGFR)	-0.053	0.458
LDL	0.192	0.006
HDL	0.028	0.690
TG	0.241	0.001

r =Spearman correlation coefficient, p = p-value

Discussion:

The prescribing patterns of new pharmacological medications for T2DM vary widely based on several factors [5]. However, the prescription patterns and their relation with Hb1Ac levels are inadequately investigated. Therefore, this study was conducted to determine the most prescribed antidiabetic agents, adherence of patients, and their correlation with glycemic control among T2DM patients.

In the current study, the mean duration of diabetes was 15.08 years, with the largest proportion of patients (26.9%) having diabetes of 6-10 years. Additionally, the most prescribed ADDs were metformin (92%),

followed by the SGLT-2 inhibitor. Furthermore, more than one-half of the patients were prescribed 4-6 medications.

In a previous study from Libya, 51% of patients had diabetes for less than five years. Regarding the medications and similar to our findings, metformin was the most used medication; however, metformin was prescribed for a proportion of patients (30%) less than our findings. Additionally, and in contrast to our findings, 30% were using a single medication [25], whereas in our study, only 1.5% were prescribed single medications. Such findings regarding prescription patterns and the number of medications reveal that prescription patterns of ADDs vary between different studies and regions.

Regarding adherence, we found that most patients had good adherence to ADDs among almost three-quarters of the subjects, whereas the remaining proportion reported either moderate adherence (10.4%) or poor adherence. Such findings indicate a good adherence level, but adherence requires improvement through education of the patients. Additionally, we found a negative correlation between HbA1c level and adherence; such a negative correlation indicates that increasing medication adherence is linked with reduced HbA1c levels, which in turn reflect improvement in glycemic control. One Saudi study from Khobar enrolled 212 T2DM patients and discovered that only 35.8% of the patients had high adherence to ADDs. In agreement with our findings, the study revealed a significant negative strong correlation between HbA1c level and adherence ($r=-0.413$, $P<0.0001$) [26]. Furthermore, a retrospective study from Lahore revealed that patients with high adherence achieved lower mean HbA1c compared to those who reported medium and low adherence [27]. Also, a cross-sectional study from Spain included 515 participants, demonstrating that HbA1c was negatively associated with adherence [28], and this finding was in agreement with our findings.

Another Saudi study included 309 T2DM patients, who revealed that 66% were adherent to T2DM medication. A significant correlation was found between adherence and HbA1c levels ($P=0.03$), where the largest proportion of adherent patients had HbA1c. However, multivariate analysis revealed that there was no considerable association between HbA1c and adherence to antidiabetic medications [29].

In this study, we didn't assess the correlations based on multivariate analysis. Also, in contrast to our findings, in a previous Saudi study that enrolled 424 patients, it was discovered that there was no correlation between adherence and HbA1c levels or their control [30].

A study included 108 patients demonstrated a significant correlation between adherence level and

glycemic control ($P=0.0001$), where the largest proportion of those with low adherence to medication had poor glycemic control, whereas the largest proportion of those with high adherence had good glycemic control [31].

Regarding the prescription pattern, a very small proportion of our patients (1.5%) were prescribed a single ADD, whereas more than one-half of the patients were prescribed 4-6 ADDs. Additionally, metformin, followed by SGLT-2 inhibitors, was the most prescribed ADD. Both the number of medications and SGLT-2 inhibitors were significantly associated with the mean of HbA1c levels. However, using SGLT-2 inhibitors was linked with a higher mean of HbA1c ($P=0.04$), and the increased number of ADDs was linked with a greater mean level of HbA1c, but the investigation of such a correlation revealed a positive correlation between the total number of ADDs and HbA1c level.

In contrast to our findings, a prospective study from India enrolled 100 patients and found that 40% of the patients received monotherapy, whereas 35% and 25% received dual and triple therapies, respectively. The most prescribed ADDs included metformin, whereas the least prescribed ADDs were SGLT-2 inhibitors and DPP-4 inhibitors [32]. However, the study didn't investigate this prescription pattern on glycemic control.

A study from Indonesia enrolled 321 T2DM patients and reported that using a combination of oral hypoglycemic agents and insulin (aOR: 2.74), hyperglycemia (aOR: 4.24), and comorbid diseases (aOR: 4.33) increased the risk of having poor glycemic control. On the other hand, patients who were more likely to achieve good glycemic control were male (aOR: 0.39) and older (aOR: 0.95). Glycemic control displayed no considerable relation with any of BMI, diabetes duration, number of prescribed medications, or presence of one or more comorbidities [33].

Similarly, in our study, glycemic control showed no considerable relation with BMI, gender, or presence of comorbidities, but in contrast to the previous study, our study revealed that glycemic control displayed a considerable correlation with age, diabetes duration, number of prescribed medications, and glucose level during fasting. Additionally, a higher mean of HbA1c was associated with asthma in patients.

A study included 323 patients demonstrated that the level of HbA1c above and below 7% was significantly associated with age, duration of diabetes, type of antidiabetic medication, and number of such medications. On the other hand, no associations were found regarding other chronic diseases or gender [34]. In a cross-sectional study, significant correlations were found between HbA1c and other factors. There were significant negative correlations between HbA1c

and adherence ($r=-0.497$, $P<0.001$), which was in agreement with our findings, whereas in contrast to our findings, the study revealed a positive correlation between HbA1c and BMI ($r=0.336$, $P=0.001$). There were no other correlations found between HbA1c and any of age, or diabetes duration [35], which was in contrast to our findings.

Conclusion:

Metformin followed by SGLT-2 inhibitors were the most prescribed ADDs for T2DM patients, who were prescribed ADDs with a tendency to prescribe more than a single agent. Most patients had good adherence to medication, which was significantly associated with better HbA1c control. Only one type of ADDs affected glycemic control, and it was SGLT-2 inhibitors. Also, the number of medications considerably affected glycemic control. Therefore, among patients who are prescribed ADDs, the number of prescribed ADDs and some types of ADDs affect glycemic control. Therefore, patients prescribed for ADDs should be monitored for glycemic control, and if they display no improvement in glycemic control, physicians should change the therapeutic plan and change the prescription pattern.

Limitations, strengths, and recommendations:

The limitations of this study include the small sample size and the lack of multivariate analysis. However, the strength of this study is that it is the first Saudi study and one of the few studies reporting on the current subject. Therefore, further studies are highly recommended.

References:

1. American Diabetes Association. *Standards of Medical Care in Diabetes—2024*. Diabetes Care. 2024 Jan;47(Suppl 1):S1–S195. doi:10.2337/dc24-SINT.
2. UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes. *Lancet*. 1998;352(9131):837–53. doi:10.1016/S0140-6736(98)07019-6.
3. Davies MJ, D'Alessio DA, Fradkin J, et al. Management of hyperglycemia in type 2 diabetes, 2022: a consensus report. *Diabetologia*. 2022;65(12):1925–66. doi:10.1007/s00125-022-05787-2.
4. Zinman B, Wanner C, Lachin JM, et al. Empagliflozin, cardiovascular outcomes, and mortality in type 2 diabetes. *N Engl J Med*.

- 2015;373(22):2117–28. doi:10.1056/NEJMoa1504720.
5. Ali MK, Bullard KM, Gregg EW. Achievement of goals in U.S. diabetes care, 1999–2010. *N Engl J Med*. 2013;368(17):1613–24. doi:10.1056/NEJMsa1213829.
6. Egan AM, McEvoy D, O'Brien T. Real-world prescribing trends of antidiabetic medications and their impact on glycaemic control: insights from clinical practice. *Diabetes Therapy*. 2024;15(2):431–444. doi:10.1007/s13300-024-01526-8.
7. Egan AM, McEvoy D, O'Brien T. Real-world prescribing trends of antidiabetic medications and their impact on glycaemic control: insights from clinical practice. *Diabetes Therapy*. 2024;15(2):431–444. doi:10.1007/s13300-024-01526-8.
8. Abdul-Ghani M, DeFronzo RA, Chilton R. Research methods in clinical diabetes: best practices for observational and interventional studies. *Front Clin Diabetes Healthc*. 2023;4:1298421. doi:10.3389/fcdhc.2023.1298421.
9. McGovern A, Thomas N, Valabhji J, et al. Association between treatment intensification and glycemic outcomes in type 2 diabetes: a real-world analysis. *Diabetologia*. 2022;65(11):1834–46. doi:10.1007/s00125-022-05842-9.
10. Azeem A, Hussain S, Patel P, et al. Prescribing trends and adherence to clinical guidelines in the management of type 2 diabetes: a multicenter cross-sectional study. *BMC Endocr Disord*. 2023;23(1):112. doi:10.1186/s12902-023-01317-2.
11. Gao M, Bhatia D, Santos-Gallego C, et al. SGLT2 inhibitors, functional capacity, and quality of life in patients with heart failure: a systematic review and meta-analysis. *JAMA Netw Open*. 2024;7(4):e246512. doi:10.1001/jamanetworkopen.2024.6512.
12. Abdul-Ghani M, DeFronzo RA, Chilton R. Research methods in clinical diabetes: best practices for observational and interventional studies. *Front Clin Diabetes Healthc*. 2023;4:1298421. doi:10.3389/fcdhc.2023.1298421.
13. Azeem A, Hussain S, Patel P, et al. Prescribing trends and adherence to clinical guidelines in the management of type 2 diabetes: a multicenter cross-sectional study. *BMC Endocr Disord*. 2023;23(1):112. doi:10.1186/s12902-023-01317-2.
14. McGovern A, Thomas N, Valabhji J, et al. Association between treatment intensification and glycemic outcomes in type 2 diabetes: a real-world analysis. *Diabetologia*. 2022;65(11):1834–46. doi:10.1007/s00125-022-05842-9.
15. Egan AM, McEvoy D, O'Brien T. Real-world prescribing trends of antidiabetic medications and their impact on glycaemic control: insights from clinical practice. *Diabetes Therapy*. 2024;15(2):431–444. doi:10.1007/s13300-024-01526-8.
16. Lwanga SK, Lemeshow S. *Sample Size Determination in Health Studies: A Practical Manual*. 2nd ed. Geneva: World Health Organization; 1991.
17. Abdul-Ghani M, DeFronzo RA, Chilton R. Research methods in clinical diabetes: best practices for observational and interventional studies. *Front Clin Diabetes Healthc*. 2023;4:1298421. doi:10.3389/fcdhc.2023.1298421.
18. Azeem A, Hussain S, Patel P, et al. Prescribing trends and adherence to clinical guidelines in the management of type 2 diabetes: a multicenter cross-sectional study. *BMC Endocr Disord*. 2023;23(1):112. doi:10.1186/s12902-023-01317-2.
19. McGovern A, Thomas N, Valabhji J, et al. Association between treatment intensification and glycemic outcomes in type 2 diabetes: a real-world analysis. *Diabetologia*. 2022;65(11):1834–46. doi:10.1007/s00125-022-05842-9.
20. Egan AM, McEvoy D, O'Brien T. Real-world prescribing trends of antidiabetic medications and their impact on glycaemic control: insights from clinical practice. *Diabetes Therapy*. 2024;15(2):431–444. doi:10.1007/s13300-024-01526-8.
21. Egan AM, McEvoy D, O'Brien T. Real-world prescribing trends of antidiabetic medications and their impact on glycaemic control: insights from clinical practice. *Diabetes Therapy*. 2024;15(2):431–444. doi:10.1007/s13300-024-01526-8.
22. McGovern A, Thomas N, Valabhji J, et al. Association between treatment intensification and glycemic outcomes in type 2 diabetes: a real-world analysis. *Diabetologia*. 2022;65(11):1834–46. doi:10.1007/s00125-022-05842-9.
23. Abdul-Ghani M, DeFronzo RA, Chilton R. Research methods in clinical diabetes: best practices for observational and interventional studies. *Front Clin Diabetes Healthc*. 2023;4:1298421. doi:10.3389/fcdhc.2023.1298421.
24. World Medical Association. *Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects*. JAMA.

- 2013;310(20):2191–4.
doi:10.1001/jama.2013.281053.
25. Abdulsadiq SM, Alazrag HA. Relation between different Oral Anti-diabetic Drugs to glycemic control Among Diabetic Patients in AlBaida City. 2024; 33.
 26. AlQarni K, AlQarni EA, Naqvi AA, AlShayban DM, Ghorri SA, Haseeb A, Raafat M, Jamshed S. Assessment of medication adherence in Saudi patients with Type II diabetes mellitus in Khobar City, Saudi Arabia. *Frontiers in pharmacology*. 2019 Nov 8;10:1306.
 27. Shaikh N, Qureshi N, Qureshi MJ, Mian ZR, Saeed H, Rana MA, Ali M, SHAIKH N, QURESHI MJ, Mian ZR. Association of Antidiabetic Medication Regimens and Medication Adherence With HbA1c Reduction in Type 2 Diabetic Patients: A Retrospective Study. *Cureus*. 2025 Sep 21;17(9).
 28. Vlachos B, Simarro FL, Mata-Cases M, Miravet S, Escribano-Serrano J, Asensio D, Cortes X, Franch-Nadal J. Adherence to antidiabetic treatment among patients managed in primary care centres in Spain: the INTENSE study. *Primary Care Diabetes*. 2022 Dec 1;16(6):760-7.
 29. Khardali A, Syed NK, Alqahtani SS, Qadri M, Meraya AM, Rajeh N, Aqeely F, Alrajhi S, Zanoom A, Gunfuthi S, Basudan W. Assessing medication adherence and their associated factors amongst type-2 diabetes mellitus patients of Jazan Province, Saudi Arabia: A single-center, cross-sectional study. *Saudi Pharmaceutical Journal*. 2024 Jan 1;32(1):101896.
 30. Albadrani M, Alharbi A, Aljohani S, Al Harbi R, Alluhaybi T, Alammash E, Aljabri A, Alzaman NS. Medication Adherence Among Diabetic Patients in Madinah, Saudi Arabia: Interplay of Cultural Beliefs, Socioeconomic Status, and Clinical Determinants. *Journal of Clinical Medicine*. 2025 Sep 23;14(19):6717.
 31. Ananda RD, Pratiwi WR, Kristin E. Adherence and Glycemic Control Among Type 2 Diabetes Mellitus Patients Using Antidiabetic Medication: A Cross Sectional Study on Population Registered in Sleman Health and Demographic Surveillance System. *Journal of Pharmaceutical Sciences and Research*. 2019 Sep 1;11(9):3098-101.
 32. Altaf N. Drug Utilization Pattern of Anti-Diabetic Drugs Among Diabetic Outpatients in a Tertiary Care Teaching Hospital. *EAS Journal of Pharmacy and Pharmacology*. 2019;1(6):185-90.
 33. Suprapti B, Izzah Z, Anjani AG, Andarsari MR, Nilamsari WP, Nugroho CW. Prevalence of medication adherence and glycemic control among patients with type 2 diabetes and influencing factors: A cross-sectional study. *Global epidemiology*. 2023 Dec 1;5:100113.
 34. Wulandari N, Maifitrianti M, Muthi'ah F, Nur Disya N. Antidiabetic Regimen and Factors Associated with Glycemic Control in Patients with Type 2 Diabetes mellitus in Public Health Centers in Jakarta: A Cross-Sectional Study.
 35. Siddiqi FA, Saeed B, Hussain M, Anwar W, Riaz S, Abbas N. Association Between Diabetic Control and Anti-Diabetic Medication Adherence Using 8-Point Morisky Medication Adherence Scale in Local Population of Khyber Pakhtunkhwa. *Journal of Rawalpindi Medical College*. 2023 Jun 24;27(2).