

An observational cross-sectional study on the impact of polypharmacy on medication adherence in patients with type 2 diabetes mellitus.

Dr. Gayathri Elango¹, Dr. Athira Muralidas², Dr. Prasheeta V Praviraj^{2*}

¹Associate Professor, Department of Pharmacology, Sri Venkateswara Medical College and Research Institute, Redhills, Tamil Nadu, India.

²Assistant Professor, Department of Pharmacology, St. Peter's Medical College and Research Institute, Hosur, Tamil Nadu, India.

Abstract

Background:

Polypharmacy is increasingly prevalent among patients with Type 2 Diabetes Mellitus (T2DM) due to frequent comorbidities. While multiple medications may be clinically justified, their cumulative burden can impair adherence, ultimately affecting glycaemic control and long-term outcomes.

Objectives:

To evaluate the prevalence of polypharmacy and its impact on medication adherence in adult patients diagnosed with T2DM.

Methods:

This cross-sectional observational study included 100 patients with T2DM attending the outpatient department of a tertiary care hospital. Sociodemographic and clinical data were collected, including the number of medications prescribed. Polypharmacy was defined as the concurrent use of five or more medications. Medication adherence was assessed using the Morisky Medication Adherence Scale (MMAS-8). Chi-square test was applied to examine the association between polypharmacy and adherence levels.

Results:

The majority of participants (54%) were aged 50–69 years, and 57% were male. Polypharmacy was observed in 64% of the study population. The MMAS-8 revealed that 41% of patients had low adherence, 38% moderate, and only 21% high adherence. The mean MMAS score was 5.2 ± 1.7 . Patients without polypharmacy demonstrated significantly better adherence: 36.1% showed high adherence versus 12.5% among those with polypharmacy. Conversely, low adherence was more frequent among polypharmacy patients (51.6% vs 22.2%). The association between polypharmacy and poor adherence was statistically significant ($p = 0.002$).

Conclusion:

This study highlights a high prevalence of polypharmacy among T2DM patients and a significant inverse relationship with medication adherence. These findings underscore the need for individualized treatment regimens and regular medication reviews to reduce pill burden and improve compliance.

Recommendations:

Routine medication audits and patient education are essential to minimize unnecessary polypharmacy and promote adherence in diabetic care.

Keywords: Type 2 Diabetes Mellitus, Polypharmacy, Medication Adherence, 8-item Morisky Medication Adherence Scale, Pill Burden, Chronic Disease Management.

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Corresponding Author: Dr. Prasheeta V Praviraj

Email: prasheeta@gmail.com

Assistant Professor, Department of Pharmacology, St. Peter's Medical College and Research Institute, Hosur, Tamil Nadu, India.

Introduction

Type 2 Diabetes Mellitus (T2DM) is a progressive metabolic disorder requiring sustained pharmacological management for glycaemic control and the treatment of associated comorbidities such as hypertension, dyslipidaemia, and cardiovascular disease. Consequently, many patients with T2DM are exposed to polypharmacy, defined as the concurrent use of multiple medications, which may be clinically necessary but often complicates disease management and adherence to therapy (1).

Medication adherence is pivotal to achieving optimal glycaemic control and preventing microvascular and macrovascular complications. However, studies indicate that polypharmacy significantly impairs adherence due to regimen complexity, pill burden, adverse effects, and poor patient understanding (2,3). Inadequate adherence is strongly linked with higher rates of hospitalizations, complications, and healthcare costs (1,4).

The burden of polypharmacy is particularly pronounced in older adults with T2DM, as the likelihood of multimorbidity increases with age (3). In such populations, polypharmacy has been associated with diminished quality of life, increased risk of drug-drug interactions, and cognitive overload, further impeding adherence (3,4). Notably, global and regional studies including data from Vietnam, Saudi Arabia, and Eastern Europe have consistently reported that a substantial proportion of diabetic patients are on five or more concurrent medications (4,5).

In India and other low- and middle-income countries, where healthcare access and literacy levels vary widely, the implications of polypharmacy on adherence are understudied despite their clinical relevance. Understanding this association is essential to inform rational prescribing practices and to design adherence-promoting interventions tailored to local contexts (2,5).

This study was undertaken to assess the **prevalence of polypharmacy and its impact on medication adherence** among patients with Type 2 Diabetes Mellitus (T2DM) attending a tertiary care hospital.

Methodology

Study Setting and Design

This hospital-based, cross-sectional observational study was conducted at the Department of General Medicine, **Dhanalakshmi Srinivasan Medical College and Hospital, Perambalur, Tamil Nadu**. The institution is a tertiary care teaching hospital catering to a large and diverse rural as well as semi-urban population, which makes it an appropriate setting for studying chronic disease patterns

and prescribing practices. The study was carried out over six months, from November 2022 to April 2023.

Study Population

A total of 100 adult patients diagnosed with Type 2 Diabetes Mellitus (T2DM) were recruited from the outpatient and inpatient services of the hospital during the study period. Patients of both sexes, aged ≥ 30 years, who had been on pharmacological treatment for diabetes for at least six months were considered eligible.

Inclusion Criteria:

Patients aged 30 years and above.

Diagnosed with T2DM as per ADA criteria.

On two or more medications (including antidiabetics and drugs for comorbid conditions).

Willing to give informed consent.

Exclusion Criteria

Patients with Type 1 diabetes mellitus.

Patients with cognitive impairment, psychiatric illness, or terminal illness.

Pregnant or lactating women.

Study Size

A total of 100 participants were included. The sample size was calculated based on a previous Indian study by Indu et al. (2018), which reported a polypharmacy prevalence of approximately 65% among patients with T2DM [6]. Using this prevalence, with a 95% confidence level, 10% allowable error, and accounting for a 10% non-response rate, the minimum required sample size was 92. We recruited 100 patients to ensure adequate power and account for any incomplete data.

Data Collection Tools and Procedure

Demographic and clinical data, including age, sex, duration of diabetes, presence of comorbidities, and number of medications taken, were recorded using a structured data sheet. Polypharmacy was defined as the use of five or more medications concurrently.

Medication adherence was assessed using the **8-item Morisky Medication Adherence Scale (MMAS-8)**, a validated self-reporting questionnaire. Scores ranged from 0 to 8 and were categorized as:

High adherence (score = 8)

Medium adherence (score = 6 to <8)

Low adherence (score <6)

Bias Mitigation

To minimize bias, consecutive eligible patients were recruited to avoid selection bias. Data collection was performed using a pre-tested structured proforma to reduce interviewer bias. The Morisky Medication Adherence Scale (MMAS-8), used for adherence assessment, is a validated tool that minimizes measurement bias. All responses were anonymized to limit social desirability bias. Statistical analysis was performed independently, and double data entry was used to reduce transcription errors.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 25. Descriptive statistics were expressed in frequencies and percentages. The association between polypharmacy and medication adherence was evaluated using the Chi-square test. A p-value <0.05 was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Ethics Committee, Dhanalakshmi Srinivasan Medical College and Hospital, Perambalur, Tamil Nadu. Written informed consent was obtained from all participants. Confidentiality, anonymity, and the right to withdraw without penalty were ensured throughout.

Results

Participants Flow

During the study period, **126 patients with T2DM** were screened for eligibility. Of these, **16 were excluded** (8 had Type 1 Diabetes Mellitus, 4 had psychiatric illness, 2 were pregnant, and 2 had terminal illness). Of the remaining **110 eligible patients**, 10 declined to participate. Finally, **100 patients were enrolled and analyzed**.

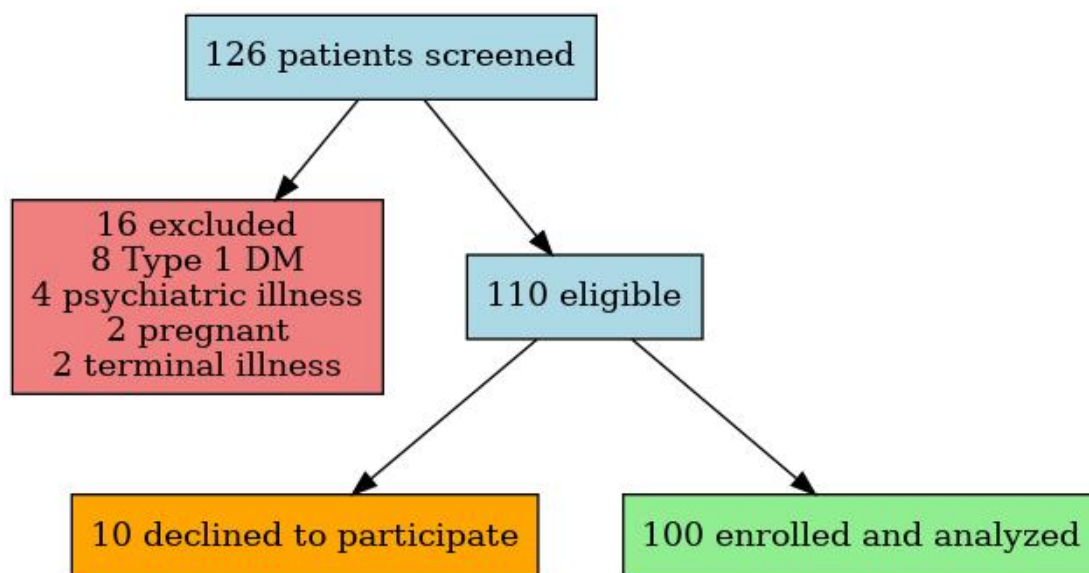


Figure 1. Participants Flow Diagram

A total of 100 patients with Type 2 Diabetes Mellitus (T2DM) were enrolled in this observational study. The majority of participants (54%) were aged between 50–69 years, followed by 28% aged 30–49 years and 18% aged ≥70 years. Males constituted 57% of the study population,

and females 43%. Nearly half of the participants (48%) had been living with T2DM for 5–10 years, while 31% had a duration of >10 years, and 21% had T2DM for <5 years. Comorbidities were present in 72% of the cohort (Table 1).

Table 1: Demographic and Clinical Characteristics of Study Participants (N = 100)

Characteristic	Frequency (n)	Percentage (%)
Age Group (years)		
30–49	28	28.0
50–69	54	54.0
≥70	18	18.0
Sex		
Male	57	57.0
Female	43	43.0
Duration of T2DM		
<5 years	21	21.0
5–10 years	48	48.0
>10 years	31	31.0
Presence of Comorbidities		
Yes	72	72.0
No	28	28.0

Regarding medication burden, 46% of participants were taking 4–6 medications per day, and 30% were on ≥7 drugs daily. Based on standard classification, 64% of participants

met the criteria for polypharmacy (≥5 medications), whereas 36% were on fewer than five drugs (Table 2).

Table 2: Medication Burden and Polypharmacy Status

Variable	Frequency (n)	Percentage (%)
Number of Medications/Day		
≤3	24	24.0
4–6	46	46.0
≥7	30	30.0
Polypharmacy Status		
No Polypharmacy (<5 drugs)	36	36.0
Polypharmacy (≥5 drugs)	64	64.0

Assessment of medication adherence using the MMAS-8 revealed that 41% of participants had low adherence, 38% had moderate adherence, and only 21% demonstrated high adherence. The mean MMAS-8 score across the study group was 5.2 ± 1.7 (Table 3).

Prevalence of Polypharmacy

Out of 100 participants, 64 patients (64%) were identified with polypharmacy, while 36 patients (36%) did not meet the criteria.

To visually present this, include a pie chart (64% polypharmacy vs 36% no polypharmacy) alongside Table 2.

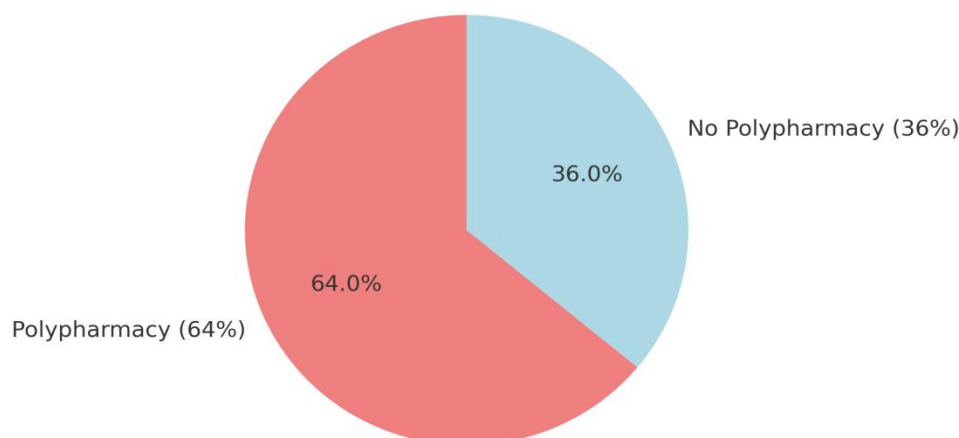


Figure 2. Prevalence of Polypharmacy Among Study Participants

Table 3: Medication Adherence According to Morisky Medication Adherence Scale (MMAS-8)

Adherence Level	Frequency (n)	Percentage (%)
High Adherence	21	21.0
Moderate Adherence	38	38.0
Low Adherence	41	41.0
Mean MMAS Score	—	5.2 ± 1.7

A significant inverse association was observed between polypharmacy and medication adherence. Among patients without polypharmacy, 36.1% demonstrated high adherence, compared to only 12.5% in the polypharmacy

group. Conversely, low adherence was markedly higher in the polypharmacy group (51.6%) compared to those without polypharmacy (22.2%). This association was statistically significant ($p = 0.002$) (Table 4).

Table 4: Association Between Polypharmacy and Medication Adherence

Polypharmacy Status	High (n, %)	Moderate (n, %)	Low (n, %)	p-value (Chi-square)
No Polypharmacy	13 (36.1%)	15 (41.7%)	8 (22.2%)	
Polypharmacy	8 (12.5%)	23 (35.9%)	33 (51.6%)	0.002

Discussion

This observational study assessed the impact of polypharmacy on medication adherence among patients with Type 2 Diabetes Mellitus. The findings revealed a high prevalence of polypharmacy (64%) and a significant inverse association between the number of medications taken and adherence levels. This indicates that the greater the medication burden, the lower the adherence,

underscoring the clinical challenge of managing complex drug regimens in diabetic care.

The demographic profile showed that most participants were aged 50–69 years (54%) and were male (57%). A considerable proportion (72%) had comorbidities such as hypertension and dyslipidaemia, which contributed to the necessity for multiple medications. Previous studies from Indian diabetic populations have similarly demonstrated

that comorbidity-driven polypharmacy is highly prevalent and complicates adherence [6].

Medication adherence, as measured by the MMAS-8 scale, showed that only 21% of patients demonstrated high adherence, while 41% had low adherence. Comparable adherence patterns were observed in Bulgarian diabetic populations, where regimen complexity and pill burden were reported as the primary reasons for poor adherence [7]. Similar results from Indian tertiary care centers have confirmed that polypharmacy impairs adherence, with patients struggling due to dosing frequency and concerns about side effects [11].

The significant association between polypharmacy (≥ 5 medications) and poor adherence ($p = 0.002$) in this study is consistent with data from Japanese cohorts, where an increase in the number of prescribed classes was directly related to declining adherence [8,9]. Findings from the Dutch Diabetes Pearl cohort further indicate that polypharmacy reflects not only disease severity but also prescribing practices shaped by comorbidities and demographic factors [10].

Multiple barriers such as pill fatigue, drug-drug interactions, cognitive overload, and financial burden may underlie the observed poor adherence. Importantly, interventional studies have shown that structured pharmacist-led education programs substantially improve adherence, highlighting the value of patient-centered strategies [12].

Generalizability:

The findings of this study are particularly relevant to similar tertiary care settings in India, where multimorbidity and limited health literacy are common among diabetic patients. However, as this was a single-center study, caution should be exercised in extending the results to other populations. Variations in prescribing practices, patient education, and healthcare infrastructure across regions may influence both the prevalence of polypharmacy and adherence behaviors. Nonetheless, the observed trends are consistent with global data, suggesting that these results are likely to apply to comparable clinical contexts.

The implications of this study highlight the importance of periodic medication audits, deprescribing when feasible, and adopting individualized treatment regimens. Simplified dosing schedules, fixed-dose combinations, and enhanced patient education should be prioritized to reduce pill burden and improve adherence in patients with T2DM.

Conclusion

This study demonstrated a high prevalence of polypharmacy (64%) among patients with Type 2 Diabetes Mellitus in a tertiary care setting. Polypharmacy was significantly associated with poor medication adherence, as only 21% of patients showed high adherence, while 41% reported low adherence. The findings highlight the need for clinicians to carefully evaluate the necessity of each prescribed medication, implement strategies to reduce pill burden, and strengthen patient education to improve long-term adherence and outcomes.

Limitations

This study was conducted at a single tertiary care center with a relatively small sample size, which limited the generalizability of the findings. The cross-sectional design did not allow the establishment of causal relationships between polypharmacy and adherence. Medication adherence was self-reported using the MMAS-8 scale, which may have been influenced by recall and social desirability biases. Additionally, socioeconomic status, health literacy, and psychological comorbidities were not evaluated, although they could have affected adherence outcomes.

Recommendations

Regular medication reviews should be conducted to minimize unnecessary drug prescriptions and reduce the burden of polypharmacy in patients with Type 2 Diabetes Mellitus. Clinicians should adopt a patient-centered approach, prioritizing simplified treatment regimens such as fixed-dose combinations or once-daily dosing where feasible. Structured patient education programs and counseling on the importance of adherence must be integrated into routine care. Digital tools like reminder apps or pill organizers can be encouraged to improve compliance. Multidisciplinary collaboration involving physicians, pharmacists, and diabetes educators is vital to ensure rational prescribing, enhance patient understanding, and optimize long-term clinical outcomes.

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Ethics Committee for approving the study and ensuring that ethical standards were maintained at every stage.

Abbreviations

T2DM – Type 2 Diabetes Mellitus

MMAS-8 – 8-item Morisky Medication Adherence Scale

ADA – American Diabetes Association

OPD – Outpatient Department

SPSS – Statistical Package for the Social Sciences

SD – Standard Deviation

Source of funding

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Conflicts of interest

The Author declares no conflict of interest.

Author's contribution

GE-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. **AM**-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript, revision of the manuscript. **PVP**-Review of literature and preparing the first draft of the manuscript. Statistical analysis and interpretation.

Data Availability

Data Available on request

Author Biography

Dr. Gayathri Elango is an Associate Professor in the Department of Pharmacology at Sri Venkateshwara Medical College and Research Institute, Redhills, Tamil Nadu, India. She completed her MBBS from ACS Medical College and Hospital, Chennai, in 2016, and pursued her MD in Pharmacology from Sri Ramachandra Medical College, Chennai, graduating in 2019. With a strong academic foundation, Dr. Gayathri is actively involved in pharmacological research and undergraduate teaching. Her key areas of interest include clinical pharmacology and pharmacovigilance, with several academic contributions to her credit. **ORCID ID:** <https://orcid.org/0000-0003-4295-6206>

Dr. Athira Muralidas is currently working as an Assistant Professor in the Department of Pharmacology at St. Peter's Medical College and Research Institute, Hosur, Tamil Nadu, India. She completed her MBBS from MOSC Medical College, Kolenchery, Kerala, in 2015, followed by an MD in Pharmacology from the Regional Institute of

Medical Sciences (RIMS), Imphal, in 2021. Dr. Athira has over seven years of teaching experience, complemented by two years of industry exposure. Her research interests include experimental pharmacology and pharmacoeconomics, with more than three scientific publications to her credit. **ORCID ID:** <https://orcid.org/0000-0001-5000-6978>

Dr. Prasheeta V Praviraj is currently serving as an Assistant Professor in the Department of Pharmacology at St. Peter's Medical College, Hospital and Research Institute, Hosur, Tamil Nadu, India. She completed her MBBS from Hassan Institute of Medical Sciences, Karnataka, and earned her MD in Pharmacology from Rangaraya Medical College, Andhra Pradesh. With over a decade of professional experience, Dr. Prasheeta has worked in various capacities within the pharmaceutical industry and Contract Research Organizations (CROs) before transitioning to academia. She has a keen interest in clinical research and pharmacovigilance, with successful publications to her credit. **ORCID ID:** <https://orcid.org/0009-0003-8345-6010>

References

1. Grant RW, Devita NG, Singer DE, Meigs JB. Polypharmacy and medication adherence in patients with type 2 diabetes. *Diabetes Care*. 2003 May;26(5):1408-12. doi: 10.2337/diacare.26.5.1408. PMID: 12716797. <https://doi.org/10.2337/diacare.26.5.1408>
2. Dobrică EC, Găman MA, Cozma MA, Bratu OG, Pantea Stoian A, Diaconu CC. Polypharmacy in Type 2 Diabetes Mellitus: Insights from an Internal Medicine Department. *Medicina (Kaunas)*. 2019 Aug 3;55(8):436. doi: 10.3390/medicina55080436. PMID: 31382651; PMCID: PMC6723949. <https://doi.org/10.3390/medicina55080436>
3. Remelli F, Ceresini MG, Trevisan C, Noale M, Volpato S. Prevalence and impact of polypharmacy in older patients with type 2 diabetes. *Aging Clin Exp Res*. 2022 Sep;34(9):1969-1983. doi: 10.1007/s40520-022-02165-1. Epub 2022 Jun 20. PMID: 35723858; PMCID: PMC9464133. <https://doi.org/10.1007/s40520-022-02165-1>
4. Thi Bui DH, Nguyen BX, Truong DC, Meyrowitsch DW, Søndergaard J, Gammeltoft T, Bygbjerg IC, Jannie N. Polypharmacy among people living with type 2 diabetes mellitus in rural communes in Vietnam. *PLoS One*. 2021 Apr 8;16(4):e0249849. doi:

- 10.1371/journal.pone.0249849. PMID: 33831073; PMCID: PMC8031303. <https://doi.org/10.1371/journal.pone.0249849>
5. Alwhaibi M, Balkhi B, Alhawassi TM, Alkofide H, Alduhaim N, Alabdulali R, Drweesh H, Sambamoorthi U. Polypharmacy among patients with diabetes: a cross-sectional retrospective study in a tertiary hospital in Saudi Arabia. *BMJ Open*. 2018 May 24;8(5):e020852. doi: 10.1136/bmjopen-2017-020852. PMID: 29794097; PMCID: PMC5988096. <https://doi.org/10.1136/bmjopen-2017-020852>
6. Indu R, Adhikari A, Maisnam I, Basak P, Sur TK, Das AK. Polypharmacy and comorbidity status in the treatment of type 2 diabetic patients attending a tertiary care hospital: An observational and questionnaire-based study. *Perspect Clin Res*. 2018 Jul-Sep;9(3):139-144. doi: 10.4103/picr.PICR_81_17. PMID: 30090713; PMCID: PMC6058506. https://doi.org/10.4103/picr.PICR_81_17
7. Dinkova R, Marinov L, Doneva M, Kamusheva M. Medication Adherence among Patients with Diabetes Mellitus and Its Related Factors-A Real-World Pilot Study in Bulgaria. *Medicina (Kaunas)*. 2023 Jun 26;59(7):1205. doi: 10.3390/medicina59071205. PMID: 37512017; PMCID: PMC10383103. <https://doi.org/10.3390/medicina59071205>
8. Horii T, Iwasawa M, Kabeya Y, Atuda K. Polypharmacy and oral antidiabetic treatment for type 2 diabetes characterised by drug class and patient characteristics: A Japanese database analysis. *Sci Rep*. 2019 Sep 10;9(1):12992. doi: 10.1038/s41598-019-49424-2. PMID: 31506542; PMCID: PMC6736933. <https://doi.org/10.1038/s41598-019-49424-2>
9. Horii T, Momo K, Yasu T, Kabeya Y, Atsuda K. Determination of factors affecting medication adherence in type 2 diabetes mellitus patients using a nationwide claim-based database in Japan. *PLoS One*. 2019 Oct 8;14(10):e0223431. doi: 10.1371/journal.pone.0223431. PMID: 31593574; PMCID: PMC6782087. <https://doi.org/10.1371/journal.pone.0223431>
10. van Oort S, Rutters F, Warlé-van Herwaarden MF, Schram MT, Stehouwer CD, Tack CJ, et al; Diabetes Pearl from the Parelsnoer Initiative. Characteristics associated with polypharmacy in people with type 2 diabetes: the Dutch Diabetes Pearl cohort. *Diabet Med*. 2021 Apr;38(4):e14406. Doi: 10.1111/dme.14406. Epub 2020 Oct 17. PMID: 32961611; PMCID: PMC8048843. <https://doi.org/10.1111/dme.14406>
11. Shah S, Barot P, Patel H, Shukla A. Assessment of Medication Adherence in Diabetes Mellitus Patients at a Tertiary Care Teaching Hospital in India. *Cureus*. 2025 Feb 2;17(2):e78391. doi: 10.7759/cureus.78391. PMID: 40046369; PMCID: PMC11879787.
12. Badi S, Suliman SZ, Almahdi R, Aldomah MA, Marzouq ME, Ibrahim EEM, Ahmed M, Ahmed MH, Elkheir HK, Ibrahim MIM. The Impact of Clinical Pharmacist Diabetes Education on Medication Adherence in Patients with Type 2 Diabetes Mellitus: An Interventional Study from Khartoum, Sudan. *J Pers Med*. 2024 Jan 8;14(1):74. Doi: 10.3390/jpm14010074. PMID: 38248775; PMCID: PMC10817637. <https://doi.org/10.3390/jpm14010074>



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