2026 Volume: 02 Issue: 01 ISSN 2347-7008 Review Article

International Journal Pharmaceutical Medicinal Research

Page: 01-09

# A REVIEW ON PRESCRIPTION PATTERN OF ANTIDIABETICS AND IMPACT OF PHARMACIST-PROVIDED EDUCATION ON OUTCOMES IN PATIENTS WITH DIABETES MELLITUS

**Shekar HS[1]*, Nagaraju B[1], Raziuddin F[1], Anilkumar KV[1], Samhitha J[1], Padmavathi GV[3], Neerajraj GN[2],**

[1]Visveswarapura Institute of Pharmaceutical Sciences, BSK-2nd Stage, Bengaluru-560070.
[2]UG-Medical, ESIC Medical College & PGIMSR, Rajajinagar, Bengaluru-560010.
[3]Dept. of Medical Surgical Nursing, Aditya College of Nursing, Kogilu, Bengaluru-560064.

**Article Received: 25 November 2025**
**Article Revised: 15 December 2025**
**Published on: 05 January 2026**

***Corresponding Author: Shekar HS**
Visveswarapura Institute of Pharmaceutical Sciences, BSK-2nd Stage, Bengaluru-560070.
DOI: https://doi-doi.org/101555/ijpmr.5949

## ABSTRACT:

Diabetes mellitus (DM) is a chronic, progressive metabolic disorder that has emerged as a major global public health challenge due to its rising prevalence, associated complications, and economic burden. Optimal management of diabetes requires not only effective pharmacotherapy but also rational prescribing practices, patient education, lifestyle modification, and adherence to treatment regimens. Prescription pattern studies provide valuable insights into current trends in antidiabetic drug utilization, identify irrational prescribing practices, and help optimize therapeutic outcomes. In addition, pharmacist-provided education has gained increasing recognition as an essential component of diabetes care, contributing significantly to improved glycemic control, medication adherence, and patient quality of life. This review critically examines the existing literature on diabetes mellitus, antidiabetic prescribing patterns, the burden of comorbidities, polypharmacy, and the role of pharmacists in diabetes management. The review further establishes the scientific and clinical rationale for conducting a prospective interventional study evaluating prescription patterns of antidiabetic drugs and the impact of pharmacist-provided education on clinical outcomes, particularly glycosylated hemoglobin (HbA1c). The integration of prescription pattern analysis with pharmacist-led educational interventions is essential to ensure rational drug use, enhance adherence, reduce complications, and improve overall diabetes outcomes.

**KEYWORDS:** Diabetes Mellitus, Antidiabetic Drugs, Prescription Pattern, Pharmacist Intervention, HbA1c, Medication Adherence, Polypharmacy, Comorbidities.

## INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both[1]. The disease is associated with disturbances in carbohydrate, fat, and protein metabolism and requires lifelong management strategies to prevent acute complications and delay the onset of chronic complications[2]. Diabetes continues to pose a substantial burden on individuals, families, healthcare systems, and society at large due to its long-term complications and associated comorbidities[3,4].

Globally, the prevalence of diabetes has increased dramatically over the past few decades, largely due to urbanization, sedentary lifestyles, unhealthy dietary habits, obesity, and population aging. India, in particular, is experiencing a rapid escalation in diabetes prevalence and has been recognized as one of the countries with the highest number of individuals living with diabetes[5,6]. Estimates indicate that the number of people with diabetes in India was approximately 69.2 million in 2015 and is projected to rise to 123.5 million by 2040[7,8]. This alarming increase underscores the urgent need for effective diabetes management strategies that focus on both pharmacological and non-pharmacological interventions[9,10].

Optimal glycemic control remains the cornerstone of diabetes management, as it significantly reduces the risk of microvascular and macrovascular complications2[2,11]. Glycosylated hemoglobin (HbA1c) is widely accepted as the most reliable marker of long-term glycemic control, reflecting average blood glucose levels over the preceding two to three months[12,13]. Poor glycemic control, often resulting from irrational prescribing, medication non-adherence, and inadequate patient education, contributes to increased morbidity, mortality, and healthcare costs[14].

## TYPES OF DIABETES MELLITUS AND CLINICAL MANIFESTATIONS

Diabetes mellitus is broadly classified into Type 1 diabetes mellitus (T1DM), Type 2 diabetes mellitus (T2DM), and gestational diabetes mellitus[15]. T1DM is characterized by autoimmune destruction of pancreatic β-cells, leading to absolute insulin deficiency[16]. In contrast, T2DM is characterized by insulin resistance combined with a progressive decline in insulin secretion[17]. T2DM accounts for the majority of diabetes cases worldwide and is strongly associated with lifestyle factors such as obesity, physical inactivity, and unhealthy diet[18].

Common clinical manifestations of diabetes include polyuria, polydipsia, polyphagia, unexplained weight loss, fatigue, blurred vision, and slow wound healing[19]. Patients with T2DM may also present with additional symptoms such as recurrent infections, numbness or tingling of extremities, sexual dysfunction, and skin changes[20]. If left inadequately managed, diabetes can lead to serious complications including cardiovascular disease, nephropathy, neuropathy, retinopathy, and increased risk of infections[21].

## BURDEN OF COMORBIDITIES AND POLYPHARMACY IN DIABETES

Comorbid conditions are highly prevalent among patients with diabetes, particularly those with T2DM. Studies indicate that nearly 98% of adults with T2DM have at least one comorbid condition, and approximately 90% have two or more comorbidities[22]. Common comorbidities include hypertension, obesity, dyslipidemia, chronic kidney disease, and cardiovascular disease. The presence of multiple comorbidities significantly complicates diabetes management and often necessitates the use of multiple medications[23].

Polypharmacy, defined as the concurrent use of multiple medications, is common among diabetic patients with comorbidities[24]. While polypharmacy may be necessary in certain clinical situations, it increases the risk of drug-drug interactions, adverse drug reactions, medication errors, and poor adherence[25]. Additionally, complex medication regimens can overwhelm patients, particularly elderly individuals, leading to reduced compliance and suboptimal therapeutic outcomes[26].

Clinical guidelines often focus on the management of individual diseases and may not adequately address the complexities of multimorbidity[27]. This highlights the need for individualized, patient-centered approaches that consider overall treatment burden, patient preferences, and feasibility of care.

## PRESCRIPTION PATTERN STUDIES IN DIABETES MELLITUS

Prescription pattern studies are an important component of drug utilization research and medical audit. These studies evaluate the prescribing behavior of healthcare professionals, identify trends in drug use, and assess the rationality of therapy[28]. According to the World Health Organization (WHO), prescription pattern analysis is essential for promoting rational drug use, minimizing medication errors, and optimizing patient outcomes[29].

In diabetes management, prescription pattern studies help in understanding[30]:

- The selection of antidiabetic drugs
- The use of monotherapy versus combination therapy
- The extent of insulin utilization
- Adherence to standard treatment guidelines
- The impact of comorbidities on prescribing decisions

Several studies have reported that metformin remains the most commonly prescribed first-line antidiabetic agent, consistent with clinical guidelines. Sulfonylureas, DPP-4 inhibitors, thiazolidinediones, and insulin are frequently used either as monotherapy or in combination therapy[31]. However, concerns persist regarding the irrational use of expensive newer agents, excessive brand-name prescribing, and inappropriate combinations that may increase treatment costs without proportional clinical benefits.

## CHALLENGES IN DIABETES PHARMACOTHERAPY

Despite the availability of a wide range of antidiabetic drugs, achieving optimal glycemic control remains challenging. Factors contributing to poor outcomes include irrational prescribing, lack of adherence to treatment guidelines, medication non-adherence, inadequate patient education, socioeconomic constraints, and limited follow-up[32].

Medication adherence is a critical determinant of therapeutic success in diabetes management. Non-adherence may result from complex regimens, side effects, high medication costs, lack of understanding of the disease, and poor patient-provider communication[33]. Studies have consistently shown that poor adherence is associated with higher HbA1c levels, increased risk of complications, and greater healthcare utilization.

## ROLE OF PHARMACIST-PROVIDED EDUCATION IN DIABETES MANAGEMENT

Pharmacists play a vital role in the multidisciplinary management of diabetes. As accessible healthcare professionals, pharmacists are well positioned to provide patient education, medication counseling, adherence support, and lifestyle modification guidance. Pharmacist-provided education has been shown to significantly improve glycemic control, medication adherence, and patient knowledge[34].

Educational interventions by pharmacists typically include[35]:

- Counseling on disease understanding
- Proper use of antidiabetic medications and insulin
- Importance of medication adherence
- Lifestyle modification including diet and physical activity
- Self-monitoring of blood glucose
- Recognition and management of hypoglycemia

Several studies have demonstrated that pharmacist-led interventions result in significant reductions in HbA1c levels, fasting blood glucose, and postprandial blood glucose[36]. These interventions also improve patient satisfaction and quality of life.

## REVIEW OF PREVIOUS STUDIES

Numerous studies have explored prescription patterns of antidiabetic drugs and their clinical implications. Earlier studies reported predominant use of sulfonylureas and insulin, while more recent studies highlight increased use of metformin and combination therapy[37]. Research has also demonstrated that newer drug classes such as DPP-4 inhibitors and GLP-1 receptor agonists offer additional benefits, including cardiovascular risk reduction in selected patient populations[38].

Studies evaluating pharmacist interventions consistently report improved clinical outcomes, particularly reductions in HbA1c levels[39]. However, many existing studies

are limited by small sample sizes, short follow-up periods, or lack of integration between prescription pattern analysis and outcome evaluation.

## RATIONALE FOR CHOOSING THE PRESENT RESEARCH WORK

The selection of the research topic entitled **"A Study on Prescription Pattern of Antidiabetics and Impact of Pharmacist-Provided Education on Outcomes in Patients with Diabetes Mellitus"** is scientifically and clinically justified for several reasons as stated here under:

1. **Rising Prevalence of Diabetes:** The growing burden of diabetes necessitates continuous evaluation of treatment practices to ensure effective and rational care.
2. **Complexity of Diabetes Management:** The presence of multiple comorbidities and polypharmacy increases the risk of irrational prescribing and poor adherence.
3. **Need for Rational Drug Use:** Prescription pattern analysis helps identify deviations from standard guidelines and promotes cost-effective therapy.
4. **Gap in Literature:** There is limited prospective interventional research combining prescription pattern analysis with pharmacist-led educational interventions in Indian tertiary care settings.
5. **Role of Pharmacists:** Evidence supports the positive impact of pharmacist-provided education on glycemic outcomes, yet this role remains underutilized.
6. **Outcome-Based Evaluation:** Assessing changes in HbA1c before and after pharmacist intervention provides objective evidence of clinical benefit.
7. **Public Health Importance:** Improving medication adherence and glycemic control can significantly reduce complications, healthcare costs, and disease burden.

## CONCLUSION

Diabetes mellitus remains a major public health challenge requiring comprehensive management strategies that extend beyond pharmacotherapy alone. Prescription pattern studies play a crucial role in evaluating current prescribing practices and identifying opportunities for rational drug use. Pharmacist-provided education is a powerful intervention that enhances medication adherence, lifestyle modification, and glycemic control. Integrating prescription pattern analysis with pharmacist-led educational interventions offers a holistic approach to diabetes management. The proposed research is timely, relevant, and essential to generate evidence that can improve clinical practice, patient outcomes, and healthcare delivery in diabetes care.

## REFERENCES

1. Nagaraju B, Anil Kumar KV, Ravindran M, Shekar HS, Anatha NN, Padmavathi GV. Multicenter study on prescribing practice of oral hypoglycemic agents in selected hospitals at Bangalore city. Eur J Pharm Med Research.2016;3(2):210-13.
2. Bhushanam YC, Ravi CM, Nagaraju K, Shekar HS, Nagaraju B, Padmavathi GV. A Study to Assess the Effectiveness of Structured Teaching Programme on Prevention of Microvascular and Macrovascular Complications Among Patients

with Diabetes Mellitus in Selected Hospitals at Bangalore. American Journal of Phytomedicine and Clinical Therapeutics.2013; 1(5):445-69.

3. Nagaraju B, Anilkumar KV, Ramachandrasetty S, Ravindran M, Shekar HS, Satyanarayana S, et al. Patterns of antihypertensive mono therapy in hypertensive Type-2 diabetics on glimepiride metformin combination. Int J Pharmacother.2016;6:19-23.
4. Kirankumargoud V, Sekhar HS, Kiran N, Nagaraju B, Ravi CM, Hossein N,Drug Interaction of Repaglinide and Mangiferin in Rats. Drug Interaction of Repaglinide and Mangiferin in Rats. International Journal of Pharmaceutical and Chemical Sciences.Jul-Sep 2013; 2(3):1218-26.
5. Sunil RP, Puranik DS, Harishkumar DH, Meerasumath, Anilkumar KV, Ravi CM. Antidiabetic activity of Callicarpa macrophylla flower extract by Dexamethasone Induced Insulin Resistance. internationale pharmaceutica sciencia. Jan-Mar 2013; 3(1):70-83.
6. Nagaraju B, Patel SR, Nagaraju K, Shekar HS, Buden RP, Bhushanam YC. Evaluation Of Alcoholic Extract Of Callicarpa Macrophylla Flower For Its Antidiabetic Activity. World Journal of Medicine.2013; 1(3):137-57.
7. Surendranath B, Nagaraju B, Padmavathi GV, Anand SC, Patanfayaz, Balachandra G. A study to assess the knowledge and practice of insulin self-administration among patients with diabetes mellitus. Asian J Pharm Clin Res.2012;5(1):63-66.
8. Nagaraju B, Anil Kumar KV, Maryam GF, Shekar HS, Ravindran M. Potential Drug interations with oral hypoglycemics. International Journal of Pharmacy and Pharmacy Research.2016;7(3):229-32.
9. Nagaraju B, Bhavesh PR, Ravi CM, Kiran N, Shekar HS, Bhushanam YC. Antidiabetic activity of leaf extract of holoptelea integrifolia on streptozotacin induced diabetic rats. World Journal of Pharmacy 2013; 1(4):233-42.
10. Puranik DS, Mohammed F, Nagaraju B, Patan F, Nazeer A, Purohit S, Ali B. Preclinical evaluation of Antidiabetic activity of Noni Fruit Juice. International Journal of Bioassays. 2013; 2(2):475-82.
11. Nagaraju B, Anilkumar KV. Effect of olmesartan on pharmacodynamic and pharmacokinetics of glimepiride and metformin combination in animal models. Indian Drugs.2020;57:60-8.
12. Puranik DS, Mohammed F, Nagaraju B, Patan F, Nazeer A, Purohit S, Buden RP. Studies on Hypoglycemic effect of Morinda Citrafolia.L Fruit Juice. Int. J. Biopharm.Nanomed.Sci, 2013; 2(1): 84-92.
13. Nagaraju B, Anilkumar KV. Influence of Telmisartan on Pharmacodynamic and Pharmacokinetic Properties of Glimepiride-metformin Combination using Rodent and Non-Rodent Models. Indian J of Pharmaceutical Education and Research.2021;55(4):1060-5.
14. Nagaraju B, Anilkumar KV. Pharmacodynamic and pharmacokinetic interaction of losartan with glimepiride-metformin combination in rats and rabbits. Indian J Pharmacol 2021;53:465-70.
15. Solis-Herrera C, Triplitt C, Reasner C, et al. Classification of Diabetes Mellitus. [Updated 2018 Feb 24]. In: Feingold KR, Adler RA, Ahmed SF, et al., editors.

Endotext [Internet]. South Dartmouth (MA): MDText.com, Inc.; 2000-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK279119/

16. Lucier J, Mathias PM. Type 1 Diabetes. [Updated 2024 Oct 5]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK507713/
17. Brereton MF, Rohm M, Ashcroft FM. β-Cell dysfunction in diabetes: a crisis of identity? Diabetes Obes Metab. 2016 Sep;18 Suppl 1(Suppl 1):102-9. doi: 10.1111/dom.12732. PMID: 27615138; PMCID: PMC5890905.
18. Sami W, Ansari T, Butt NS, Hamid MRA. Effect of diet on type 2 diabetes mellitus: A review. Int J Health Sci (Qassim). 2017 Apr-Jun;11(2):65-71. PMID: 28539866; PMCID: PMC5426415.
19. American Diabetes Association Professional Practice Committee. 4. Comprehensive Medical Evaluation and Assessment of Comorbidities: Standards of Care in Diabetes-2025. *Diabetes Care*. 2025;48(1 Suppl 1):S59-S85. doi:10.2337/dc25-S004.
20. Ramzan MA, Rehman H, Kumar B, Ghafoor A, Maheshwary N, Asif W, Anwar A, Hashmi AA. Neurological Complications of Type 2 Diabetes Mellitus: A Duration-Based Comparative Study at a Secondary Care Hospital in Karachi, Pakistan. Cureus. 2025 Jul 23;17(7):e88562. doi: 10.7759/cureus.88562. PMID: 40861697; PMCID: PMC12371383.
21. Edwards E, Yosipovitch G. Skin Manifestations of Diabetes Mellitus. [Updated 2025 Mar 21]. In: Feingold KR, Adler RA, Ahmed SF, et al., editors. Endotext [Internet]. South Dartmouth (MA): MDText.com, Inc.; 2000-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK481900/
22. Shuvo SD, Hossen MT, Riazuddin M, Hossain MS, Mazumdar S, Parvin R, Elahi MT. Prevalence of comorbidities and its associated factors among type-2 diabetes patients: a hospital-based study in Jashore District, Bangladesh. BMJ Open. 2023 Sep 11;13(9):e076261. doi: 10.1136/bmjopen-2023-076261. Erratum in: BMJ Open. 2023 Sep 29;13(9):e076261corr1. doi: 10.1136/bmjopen-2023-076261corr1. PMID: 37696641; PMCID: PMC10496697.
23. Iglay K, Hannachi H, Joseph Howie P, Xu J, Li X, Engel SS, Moore LM, Rajpathak S. Prevalence and co-prevalence of comorbidities among patients with type 2 diabetes mellitus. Curr Med Res Opin. 2016 Jul;32(7):1243-52.
24. 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.
25. Varghese D, Ishida C, Patel P, et al. Polypharmacy. [Updated 2024 Feb 12]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK532953/
26. Samajdar, Shambo Samrat, Tripathi, Rohan, Venkatraman, Shravan Mukherjee, ShatavisaPal, Jyotirmoy, Tripathi, Santanu Kumar, Joshi, Shashank R, Maheshwari, Anuj. Medication adherence in the elderly: A comprehensive review. National Journal of Pharmacology and Therapeutics. Sep-Dec 2024; 2(3):143-7.DOI: 10.4103/NJPT.NJPT_60_24.

27. Uhlig K, Leff B, Kent D, Dy S, Brunnhuber K, Burgers JS, Greenfield S, Guyatt G, High K, Leipzig R, Mulrow C, Schmader K, Schunemann H, Walter LC, Woodcock J, Boyd CM. A framework for crafting clinical practice guidelines that are relevant to the care and management of people with multimorbidity. J Gen Intern Med. 2014 Apr;29(4):670-9.
28. Idris SA, Hussien TMA, Al-Shammari FF, Nagi HA, Bashir AI, Elhussein GEMO, Abdalla RAH, Mohammed HME, Abdelaziz WE, Alshammari AD, Alreshidi HFH, Alshammari HNM, Ibrahim SIB. An Evaluation of Drug Prescribing Patterns and Prescription Completeness. Healthcare (Basel). 2024 Nov 7;12(22):2221. doi: 10.3390/healthcare12222221. PMID: 39595419; PMCID: PMC11594192.
29. Anwar MF, Daud NAA, Hussain R. From prescribing indicators to rational drug use: a medication safety perspective. J Pharm Policy Pract. 2025 Aug 27;18(1):2544656. doi: 10.1080/20523211.2025.2544656. PMID: 40896173; PMCID: PMC12392430.
30. Atal S, Joshi R, Balakrishnan S, Singh P, Fatima Z, Jain N. Pattern of Disease and Therapy for Diabetes along with Impact of Generic Prescribing on Cost of Treatment among Outpatients at a Tertiary Care Facility. J Pharm Bioallied Sci. 2021 Jan-Mar;13(1):93-101. doi: 10.4103/jpbs.JPBS_405_20. Epub 2020 Dec 16. PMID: 34084054; PMCID: PMC8142908.
31. Drzewoski J, Hanefeld M. The Current and Potential Therapeutic Use of Metformin-The Good Old Drug. Pharmaceuticals (Basel). 2021 Feb 5;14(2):122. doi: 10.3390/ph14020122. PMID: 33562458; PMCID: PMC7915435.
32. Polonsky WH, Henry RR. Poor medication adherence in type 2 diabetes: recognizing the scope of the problem and its key contributors. Patient Prefer Adherence. 2016 Jul;22(10):1299-307.
33. Araya EM, Gebrezgabiher HA, Tekulu GH, Alema NM, Getnet D, Gebru HT, Adamu BA. Medication Non-Adherence and Associated Factors Among Diabetic Patients Visiting General Hospitals in the Eastern Zone of Tigrai, Northern Ethiopia. Patient Prefer Adherence. 2020 Oct;29(14):2071-83.
34. Hughes JD, Wibowo Y, Sunderland B, Hoti K. The role of the pharmacist in the management of type 2 diabetes: current insights and future directions. Integr Pharm Res Pract. 2017 Jan 16;6:15-27.
35. Orabone AW, Do V, Cohen E. Pharmacist-Managed Diabetes Programs: Improving Treatment Adherence and Patient Outcomes. Diabetes Metab Syndr Obes. 2022 Jun 20;15:1911-23.
36. Christy A, Fernanda F, Insani WN, Abdulah R. Pharmacist-Led Digital Health Interventions for Patients with Diabetes: A Systematic Review. J Multidiscip Healthc. 2025 Jan 11;18:101-12.
37. Cea-Soriano L, Moreno A, Calonge M, Rivas A, Pulido-Manzanero J, Colchero MC, Artola S, Serrano R, Franch-Nadal J, Regidor E; PRECOZIN Study Group. Changes in prescription patterns of antidiabetic medication in patients newly diagnosed with type 2 diabetes in Spain: an observational study. BMJ Open. 2025 Sep 22;15(9):e106069.

38. Collins L, Costello RA. Glucagon-Like Peptide-1 Receptor Agonists. [Updated 2024 Feb 29]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK551568/
39. Hussain TB. Impact of Pharmacist Interventions on Health Outcomes of Patients with Type 2 Diabetes Mellitus in the Middle East: A Systematic Review. Integrated Pharmacy Research and Practice 2025;14:85-98.
40. Maduabuchi Romanus Ihekoronye, Kanayo Patrick Osemene, Theophilus Ehidiamen Oamen, Pharmacist-led intervention to improve treatment outcomes in type 2 diabetes: a randomized controlled trial, *Journal of Pharmaceutical Health Services Research*, Volume 15, Issue 2, June 2024, rmae005, https://doi.org/10.1093/jphsr/rmae005