

Medication Adherence and Therapeutic Success in Type 2 Diabetes Mellitus: A Narrative Review

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Abstract

Background: Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder requiring long-term pharmacological treatment and sustained self-management. Medication adherence is a critical determinant of glycemic control and therapeutic outcomes; however, suboptimal adherence remains a persistent challenge in outpatient diabetes care. **Method:** This narrative review synthesized open-access evidence published predominantly between 2021 and 2026. Literature was identified through PubMed/MEDLINE, ScienceDirect, SpringerLink, Wiley Online Library, DOAJ, and Google Scholar, supplemented by reports from the World Health Organization, International Diabetes Federation, Indonesian Ministry of Health, and BPJS Kesehatan. The synthesis focused on evidence regarding medication adherence among outpatients with T2DM, determinants of non-adherence, and its implications for HbA1c, glycemic control, quality of life, and therapeutic outcomes. **Results:** The reviewed evidence indicates that adherence to antidiabetic medications remains suboptimal and is generally associated with poorer glycemic control. Non-adherence is influenced by multidimensional factors, including inadequate knowledge, medication beliefs, low self-efficacy, depressive symptoms, regimen complexity, polypharmacy, adverse effects, comorbidities, treatment costs, limited family support, medication accessibility, and healthcare-provider communication. Patient-centered interventions, particularly pharmacist-led counseling, regimen simplification, family engagement, and structured chronic disease management, demonstrate potential to improve adherence and clinical outcomes. **Conclusion:** Medication adherence should be routinely assessed as an integral component of T2DM management before treatment intensification. Multilevel, patient-centered, and health-system-supported interventions are required to address modifiable barriers and improve adherence, glycemic control, quality of life, and therapeutic outcomes.

Keywords: antidiabetic drugs, glycemic control, medication adherence, therapeutic success, type 2 diabetes mellitus

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a major chronic disease and an increasingly important global public health challenge. The burden of diabetes has increased substantially over the past three decades. The World Health Organization reported that the number of people living with diabetes increased from approximately 200 million in 1990 to 830 million in 2022, with the most rapid increases occurring in low- and middle-income countries [1]. Similarly, the International Diabetes Federation estimated that 589 million adults aged 20–79 years were living with diabetes in 2024 and projected this number to reach 853 million by 2050 [2]. In Indonesia, findings from the Indonesian Health Survey 2023 further indicate that diabetes remains an important non-communicable disease requiring sustained efforts in prevention, early diagnosis, treatment, and long-term monitoring [3]. The increasing disease burden highlights the need for effective strategies that extend beyond diagnosis and pharmacological treatment to ensure the achievement of meaningful long-term clinical outcomes.

The therapeutic management of T2DM extends beyond short-term reduction of blood glucose levels. Optimal management requires the achievement of individualized glycemic targets, prevention or delay of microvascular and macrovascular complications, preservation of quality of life, and

reduction of avoidable healthcare utilization. Contemporary standards of diabetes care emphasize regular HbA1c assessment, appropriate selection and adjustment of pharmacological therapy, prevention and management of hypoglycemia, and individualized treatment decisions according to comorbidities, risk profiles, and patient characteristics [4,5]. Nevertheless, the demonstrated efficacy of antidiabetic medications under controlled clinical conditions does not necessarily translate into comparable therapeutic effectiveness in routine outpatient practice. The gap between recommended treatment and actual treatment outcomes may therefore reflect not only pharmacological factors but also the extent to which patients are able and willing to follow prescribed treatment regimens.

Medication adherence represents a critical behavioral link between the prescription of antidiabetic therapy and its effectiveness in clinical practice. Patients with T2DM commonly require prolonged treatment with oral antidiabetic medications, injectable therapies, or multidrug regimens. However, evidence from meta-analyses indicates that adherence to oral antidiabetic medications remains suboptimal, with pooled adherence estimates approximating one-half of treated patients [6,7]. Suboptimal adherence may involve missed doses, inconsistent medication use, premature discontinuation, incorrect administration, or misunderstanding of treatment instructions. Such behaviors can reduce the effective exposure to antidiabetic therapy, compromise glycemic control, and contribute to persistently elevated HbA1c levels. Consequently, medication adherence should be considered an integral component of therapeutic effectiveness rather than merely a measure of patient compliance.

Importantly, medication non-adherence is a multidimensional phenomenon that cannot be adequately explained by individual patient behavior alone. Observational evidence from Indonesia, Ethiopia, Nigeria, China, and Rwanda indicates that poor adherence is associated with inadequate glycemic control and is shaped by interacting patient-, treatment-, social-, and health-system-related factors [8-12]. These findings challenge the assumption that non-adherence primarily reflects a lack of patient discipline. Instead, adherence may be affected by inadequate disease and medication knowledge, negative beliefs regarding medicines, depressive symptoms, low self-efficacy, complex treatment regimens, polypharmacy, adverse drug effects, comorbidities, financial constraints, limited access to medications, inadequate family support, and ineffective communication between patients and healthcare providers [13-17]. This multidimensional nature of adherence suggests that effective interventions require a patient-centered approach addressing both individual barriers and the healthcare environment in which treatment is delivered.

Despite the growing body of evidence concerning medication adherence, its assessment in routine diabetes care remains less systematic than conventional clinical indicators such as HbA1c, fasting blood glucose, and medication intensification. This may create an important clinical gap because persistent hyperglycemia may be interpreted primarily as inadequate pharmacological efficacy, leading to treatment escalation without first determining whether the prescribed regimen is being taken consistently. Such an approach may increase treatment complexity and the potential for adverse effects without addressing the underlying behavioral or health-system barriers to adherence. Accordingly, systematic assessment of medication adherence should be integrated into therapeutic decision-making, particularly when glycemic targets are not achieved despite apparently appropriate pharmacological treatment.

Against this background, this narrative review aims to synthesize recent evidence regarding medication adherence and therapeutic outcomes among outpatients with T2DM, with particular

emphasis on the determinants of non-adherence and the relationship between adherence and glycemic control. The review further examines patient-centered and health-system strategies that may strengthen medication adherence and support more effective long-term diabetes management.

METHOD

This study employed a narrative review design to synthesize recent evidence concerning medication adherence and therapeutic outcomes among outpatients with type 2 diabetes mellitus (T2DM). The target population comprised adult outpatients with T2DM receiving pharmacological antidiabetic therapy. The literature reviewed included open-access scientific articles and official institutional reports selected according to their relevance to medication adherence, oral antidiabetic drugs, glycemic control, HbA1c, quality of life, and therapeutic outcomes. The narrative approach was selected to enable the integration of evidence from studies with diverse designs, populations, outcome measures, and clinical contexts.

A systematic literature search was conducted using PubMed/MEDLINE, ScienceDirect, SpringerLink, Wiley Online Library, and DOAJ, while Google Scholar was used as a supplementary search engine to identify additional relevant publications. Official reports from the World Health Organization (WHO), International Diabetes Federation (IDF), Indonesian Ministry of Health, and BPJS Kesehatan were also examined to provide epidemiological context and support the interpretation of health-service implications.

The search strategy incorporated combinations of controlled and free-text terms related to the review objectives. The principal search terms included: “type 2 diabetes mellitus,” “medication adherence,” “antidiabetic drugs,” “oral antidiabetic drugs,” “glycemic control,” “HbA1c,” “therapeutic success,” “therapeutic outcome,” “outpatients,” “pharmacist intervention,” “self-efficacy,” and “medication beliefs.” These terms were combined using Boolean operators such as AND and OR to broaden or narrow the retrieval of relevant literature. The search strategy was adapted to the characteristics of each database.

Studies were considered eligible when they met the following inclusion criteria: (1) open-access scientific articles published predominantly between 2021 and 2026; (2) publications with a DOI or sufficient bibliographic information to establish their scientific identity; (3) studies involving patients with T2DM; and (4) studies addressing medication adherence in relation to glycemic control, HbA1c, diabetes-related complications, quality of life, or therapeutic outcomes. Official reports were included when they provided relevant epidemiological information or evidence concerning healthcare-system and service-delivery implications.

The exclusion criteria comprised (1) publications that did not focus on T2DM; (2) studies addressing only dietary behavior or physical activity without consideration of pharmacological adherence; (3) editorials or commentaries without substantive evidence synthesis; (4) publications for which the relevant full text could not be accessed; and (5) publications lacking adequate bibliographic information for identification and verification.

Retrieved publications were assessed for their relevance to the review objectives based on their titles, abstracts, and, where appropriate, full-text content. Potentially relevant publications were further evaluated against the predefined eligibility criteria. The selection process focused on the consistency of each publication with the review scope, particularly its contribution to understanding

medication adherence, determinants of non-adherence, glycemic control, and therapeutic outcomes in outpatient T2DM management.

Relevant information was extracted from the selected literature and organized according to the characteristics and objectives of the review. The extracted information included the study population, medication adherence-related variables, determinants of adherence or non-adherence, glycemic-control indicators, particularly HbA1c, reported clinical or patient-centered outcomes, and interventions or strategies designed to improve medication adherence.

Data were analyzed using a narrative thematic synthesis approach. Because the included literature comprised heterogeneous evidence from different study designs, populations, settings, and outcome measures, quantitative statistical pooling was not performed. Instead, findings were critically compared and synthesized according to five predefined themes: (1) medication adherence among patients with T2DM; (2) the relationship between medication adherence and glycemic control; (3) patient-, treatment-, social-, and health-system-related factors influencing medication adherence; (4) the implications of medication non-adherence for therapeutic outcomes; and (5) interventions and healthcare strategies for improving medication adherence.

The synthesis emphasized patterns of agreement and divergence across studies and considered the potential clinical and health-service implications of the reported findings. Particular attention was given to evidence linking medication-taking behavior with HbA1c and other indicators of therapeutic effectiveness, as well as to modifiable barriers that may be addressed through patient-centered and health-system interventions.

This review used secondary data obtained from previously published scientific literature and publicly available institutional reports. No direct interaction with human participants, collection of biological specimens, or use of identifiable individual patient data was undertaken. Therefore, ethical clearance was not required for this study.

RESULTS AND DISCUSSION

Medication Adherence in Type 2 Diabetes Mellitus

Recent systematic reviews consistently indicate that adherence to oral antidiabetic medications remains suboptimal among patients with type 2 diabetes mellitus. Reported an adherence rate of approximately 54%, while another reported a comparable pooled prevalence of adherence to oral antidiabetic medications [6,7]. These findings indicate that a substantial proportion of patients may not take their medications according to the prescribed dose, frequency, or schedule. In outpatient settings, suboptimal adherence represents an important clinical challenge because medication-taking behavior predominantly occurs outside direct supervision by healthcare professionals. Consequently, the effectiveness of pharmacological therapy observed in clinical trials may not be fully realized in routine practice when medication use is inconsistent.

The interpretation of medication-taking behavior also requires a clear distinction between adherence and persistence. Adherence refers to the extent to which a patient's medication-taking behavior corresponds with the prescribed dose, timing, and frequency, whereas persistence refers to the length of time a patient continues treatment from initiation until discontinuation. These concepts are related but represent different dimensions of medication use and should therefore not be considered interchangeable. A patient may demonstrate adequate adherence while taking a medication but discontinue treatment prematurely, or conversely, remain persistent with therapy

while taking doses inconsistently. Another research demonstrated that both medication adherence and persistence are associated with clinical and economic outcomes among patients with type 2 diabetes mellitus [18]. Thus, achieving therapeutic success requires not only appropriate and consistent medication use but also sustained continuation of therapy over time.

From a clinical perspective, these findings highlight the importance of incorporating medication-taking behavior into routine assessment of patients who do not achieve their individualized glycemic targets. Persistent hyperglycemia should not automatically be interpreted as evidence of inadequate pharmacological efficacy or an indication for immediate treatment intensification. Assessment of adherence and persistence may help distinguish between insufficient treatment response and suboptimal medication use, thereby supporting more rational, individualized, and patient-centered therapeutic decision-making

Relationship Between Medication Adherence and Glycemic Control

Evidence from analytical studies consistently indicates an important relationship between medication adherence and glycemic control among patients with type 2 diabetes mellitus. In Indonesia, there was reported that medication adherence and glycemic control were influenced by patient- and treatment-related factors, highlighting the multidimensional nature of treatment effectiveness in routine diabetes care [8]. Similarly, the research demonstrated a significant relationship between medication adherence and glycemic control among patients with type 2 diabetes mellitus and comorbidities [9]. Others also reported an association between medication adherence and glycemic control among patients with type 2 diabetes mellitus in Nigeria [10]. Taken together, these findings suggest that adherence represents an important modifiable component of diabetes management across different healthcare and sociocultural settings. However, differences in study populations, adherence measurement methods, treatment regimens, and definitions of glycemic control should be considered when interpreting the consistency and magnitude of this relationship.

The biological plausibility of this relationship is supported by the pharmacological mechanisms of antidiabetic therapy. Different classes of antidiabetic medications exert their glucose-lowering effects through complementary mechanisms, including improvement of insulin sensitivity, stimulation of insulin secretion, reduction of hepatic glucose production, delayed carbohydrate absorption, enhancement of incretin-mediated responses, and increased urinary glucose excretion [4,5]. The therapeutic benefits of these mechanisms depend substantially on adequate and sustained exposure to the prescribed medication. When patients miss doses, take medication inconsistently, or discontinue treatment prematurely, pharmacological exposure may become insufficient or unstable, potentially reducing treatment effectiveness and contributing to persistent hyperglycemia and failure to achieve individualized HbA1c targets [4,5].

Importantly, the association between adherence and glycemic control should not be interpreted as a simple one-directional relationship. Glycemic control may also influence patients' perceptions of treatment effectiveness, motivation, treatment burden, and subsequent medication-taking behavior. In addition, comorbidities, adverse drug effects, regimen complexity, healthcare access, socioeconomic conditions, and patient-provider communication may simultaneously influence both adherence and glycemic outcomes. Therefore, medication adherence should be considered within a multidimensional therapeutic framework, rather than as an isolated patient behavior.

From a clinical perspective, these findings support the routine assessment of medication adherence when glycemic targets are not achieved. Before intensifying or adding antidiabetic therapy, healthcare professionals should consider whether inadequate glycemic control reflects insufficient pharmacological efficacy, inappropriate treatment selection, or suboptimal medication use. Integrating adherence assessment into therapeutic decision-making may reduce unnecessary treatment escalation, facilitate individualized care, and improve the likelihood of achieving sustained glycemic control.

Factors Affecting Medication Adherence

Medication adherence in patients with type 2 diabetes mellitus is a multidimensional behavior resulting from the interaction of patient, treatment, disease, social, and health system related factors. Patient-related determinants include diabetes knowledge, medication beliefs, self efficacy, motivation, forgetfulness, and psychological conditions such as depressive symptoms. Others demonstrated that diabetes-related knowledge and patient perceptions were associated with medication adherence and glycemic control, indicating that patients' understanding of their disease and beliefs regarding treatment may influence their ability to maintain recommended medication-taking behaviors [13]. These findings suggest that improving adherence requires more than providing medication instructions; it also requires addressing patients' perceptions, expectations, and confidence in their ability to manage long-term treatment.

Psychological and behavioral factors may further influence the relationship between medication beliefs and adherence. There was reported that medication adherence mediated the relationship between depressive symptoms and quality of life among older adults with type 2 diabetes mellitus, suggesting that psychological well-being may affect patient-centered outcomes partly through medication taking behavior [14]. Similarly, others found that self efficacy functioned as both a mediator and moderator in the relationship between medication beliefs and adherence [15]. These findings indicate that self efficacy may represent an important modifiable mechanism through which patients' beliefs about medications are translated into actual treatment behavior. Consequently, adherence interventions should consider psychological and behavioral dimensions alongside conventional education about diabetes and medications.

Treatment related characteristics also play an important role in determining adherence. Regimen complexity, polypharmacy, adverse drug effects, route of administration, and dosing frequency may increase treatment burden and make consistent medication use more difficult. The burden may become particularly pronounced in patients receiving multiple medications for diabetes and other chronic conditions. Similarly, disease-related factors, including longer disease duration, diabetes-related complications, comorbidities, and treatment fatigue, may influence patients' motivation and capacity to sustain long term pharmacological therapy. These factors demonstrate that adherence cannot be considered independently of the clinical context in which treatment is delivered.

Social and health-system determinants further contribute to variations in medication adherence. Family support, medication costs, availability and accessibility of medicines, quality of provider communication, and continuity of care may facilitate or constrain patients' ability to follow prescribed treatment. Evidence from Rwanda and China indicates that treatment duration, healthcare communication, diabetes complications, and treatment characteristics are relevant to medication adherence and/or glycemic outcomes [11,12]. These findings reinforce the importance of viewing

adherence as a shared outcome of interactions between patients and healthcare systems rather than solely as an individual responsibility.

From a health-service perspective, the multidimensional nature of these determinants has important implications for intervention design. Educational interventions alone may be insufficient when non-adherence is driven by treatment complexity, financial barriers, psychological distress, or inadequate access to medicines. A more comprehensive approach should combine medication counseling with regimen simplification, assessment of treatment-related barriers, psychological support, family engagement, and effective communication between patients and healthcare professionals. Such a patient-centered and health-system-supported approach may provide a more sustainable strategy for improving medication adherence and, ultimately, glycemic and therapeutic outcomes in patients with type 2 diabetes mellitus.

Table 1. Thematic synthesis of medication adherence and therapeutic outcomes

Theme	Evidence Summary	Clinical Meaning	Main Sources
Adherence prevalence	Adherence to oral antidiabetic drugs remains suboptimal.	Routine assessment is needed in outpatient visits.	[6,7]
Glycemic control	Better adherence is associated with improved HbA1c or glycemic outcomes.	Uncontrolled HbA1c should trigger adherence evaluation before therapy escalation.	[8-10]
Psychosocial factors	Knowledge, beliefs, depression, and self-efficacy influence adherence.	Counseling should address emotional and behavioral barriers.	[13-16]
Treatment burden	Regimen complexity, polypharmacy, adverse effects, and comorbidities reduce adherence.	Medication review and regimen simplification are needed.	[11,12,18]
Intervention	Pharmacist-led care, family support, and chronic disease programs may improve adherence.	A multidisciplinary and system-supported approach is recommended.	[17,19,20]

Impact of Non-Adherence on Therapeutic Outcomes

Medication non-adherence may compromise the effectiveness of pharmacological treatment and contribute to persistent hyperglycemia and failure to achieve individualized HbA1c targets. In the longer term, inadequate medication use may increase the risk of diabetes-related microvascular and macrovascular complications, potentially resulting in greater healthcare utilization and deterioration in quality of life. The clinical consequences of non-adherence therefore extend beyond immediate glycemic control and may influence the long-term trajectory of disease management. Another reported that better medication adherence and persistence were generally associated with more favorable clinical and economic outcomes, including reduced hospitalization and lower

healthcare costs [18]. These findings highlight that medication adherence should not be conceptualized solely as an individual behavioral concern but also as an important component of effective chronic disease management and a potential determinant of healthcare system burden.

The consequences of inadequate adherence may be particularly important among older adults and patients with multiple comorbidities, whose treatment regimens frequently involve several medications with different dosing schedules. Polypharmacy may increase medication burden and contribute to confusion, dosing errors, adverse drug reactions, drug–drug interactions, and difficulties maintaining consistent medication-taking behavior. These challenges may become more complex when patients experience cognitive, psychological, functional, or socioeconomic limitations. Consequently, medication non-adherence in these populations should be considered within the broader context of treatment burden and multimorbidity rather than attributed solely to patient motivation or discipline.

From a clinical management perspective, medication non-adherence represents a potentially modifiable risk factor. Systematic assessment of adherence should therefore be incorporated into routine outpatient diabetes care, particularly among patients who do not achieve their individualized glycemic targets despite receiving apparently appropriate pharmacological therapy. Identification of the underlying barriers can guide targeted interventions, including medication-regimen simplification, pharmacist-led counseling, patient education, family involvement, improved provider communication, and measures to reduce access and cost barriers. Such strategies may improve treatment continuity while minimizing unnecessary therapeutic escalation and its associated clinical and economic consequences.

Strategies to Improve Medication Adherence

Improving medication adherence in patients with type 2 diabetes mellitus requires a multidimensional and patient-centered strategy that addresses behavioral, clinical, social, and health-system determinants simultaneously. Patient education remains a fundamental component of adherence interventions; however, its effectiveness may depend on whether education is translated into sustained behavioral change. Educational interventions should therefore provide patients with a clear understanding of the indication and expected benefits of each medication, potential adverse effects, dosing schedules, and the relationship between consistent medication use and glycemic outcomes, particularly HbA1c. Importantly, education should extend beyond the provision of information by addressing patients' medication beliefs, motivation, emotional barriers, self-efficacy, and daily routines. This approach may facilitate the integration of medication taking behavior into patients' everyday activities and support long-term treatment persistence.

Pharmacist-led interventions represent another potentially effective strategy for improving medication adherence and glycemic outcomes. Others reported that pharmacist-led interventions improved medication adherence and glycemic control among patients with type 2 diabetes mellitus [17]. The contribution of pharmacists may extend beyond conventional medication counseling to include identification of drug-related problems, assessment of adherence barriers, monitoring of medication refills, management of adverse effects, reinforcement of appropriate medication use, and collaboration with physicians to simplify complex therapeutic regimens. These functions position pharmacists as an important component of multidisciplinary diabetes care, particularly when medication-related barriers contribute to inadequate treatment outcomes.

In the Indonesian healthcare context, the Program Pengelolaan Penyakit Kronis (Prolanis) provides a relevant platform for integrating several of these adherence-support strategies. Prolanis facilitates ongoing chronic disease management through routine monitoring, health education, and patient engagement, and therefore has potential value in supporting continuity of diabetes care [20]. Nevertheless, the effectiveness of such programs in improving medication adherence may depend on the intensity, continuity, accessibility, and quality of patient engagement and healthcare-provider interaction. Thus, the existence of a chronic disease management program alone should not be assumed to guarantee sustained adherence or therapeutic success.

The conceptual framework developed from this synthesis is presented in Figure 1. The framework proposes that medication adherence is influenced by interconnected patient, therapy, disease and social, and health-system factors. Medication adherence subsequently represents a central pathway linking prescribed pharmacological treatment with therapeutic outcomes, including improved glycemic control, reduced risk of complications, better quality of life, and potentially lower healthcare utilization and associated costs. The framework should be interpreted as a conceptual synthesis rather than a confirmed causal model, particularly because the evidence included in this narrative review comprises heterogeneous observational and intervention studies.

This review has several limitations. First, because a narrative review design was employed, a formal risk-of-bias assessment and quantitative meta-analysis were not performed. Consequently, the relative strength and magnitude of associations across the included studies cannot be directly compared or statistically pooled. Second, substantial heterogeneity existed in study designs, geographical settings, patient characteristics, methods used to measure medication adherence, definitions of glycemic control, and assessment of therapeutic outcomes. Third, differences in healthcare systems and access to antidiabetic medications may limit the direct generalizability of findings across countries and healthcare contexts. Despite these limitations, the consistency of findings across multiple studies indicates that medication adherence should be regarded as a central and potentially modifiable determinant of therapeutic success in outpatient type 2 diabetes management [6,8,9,18]. Future research should prioritize standardized adherence measures, longitudinal designs, and adequately powered intervention studies to determine which multidimensional strategies produce sustained improvements in adherence and clinically meaningful glycemic outcomes.

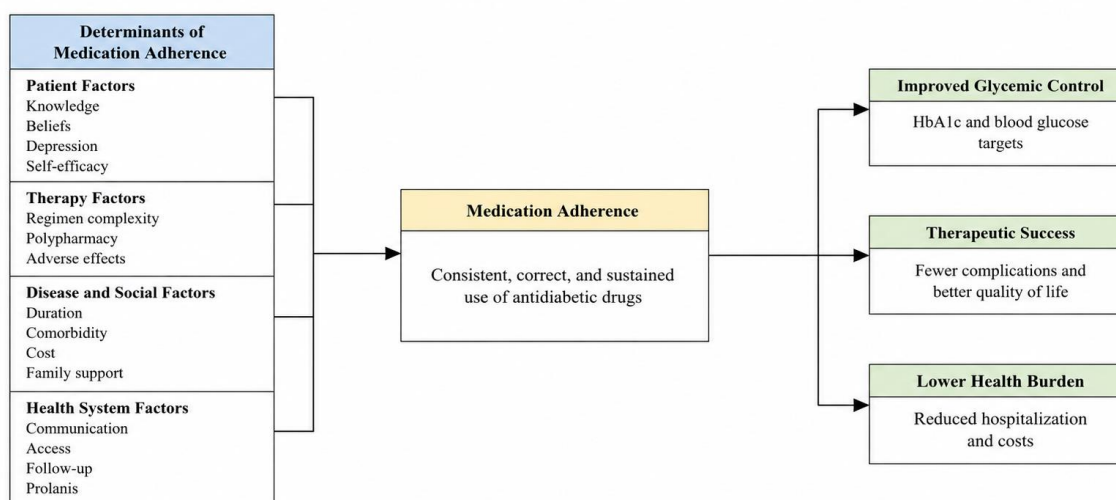




Figure 1. Conceptual framework of medication adherence and therapeutic success in T2DM

CONCLUSION

Medication adherence is a modifiable determinant of therapeutic success in outpatients with type 2 diabetes mellitus. Consistent medication use is generally associated with better glycemic control and HbA1c outcomes, whereas non-adherence may compromise treatment effectiveness and contribute to persistent therapeutic targets and poorer quality of life.

Adherence is influenced by interacting patient, treatment, disease, psychosocial, socioeconomic, and health-system factors. Therefore, routine adherence assessment should be integrated into outpatient diabetes management, particularly before treatment intensification. Patient-centered education, regimen simplification, pharmacist involvement, family support, and Prolanis strengthening may help address individual barriers.

Improving adherence requires a multidisciplinary and patient-centered approach, with adherence monitored alongside HbA1c and other indicators of diabetes control. This strategy can strengthen the effectiveness and sustainability of long-term diabetes management.

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