



THE ROLE OF PHARMACY, HOSPITAL MANAGEMENT AND HEALTH INFORMATICS IN ADHERENCE TO MEDICAL TREATMENT AMONG DIABETIC PATIENTS

Saeed mohammed Abdullah Alzahrani^{1*}, Hashim Hamed Abdullah Alshamrani²,
Thaar murdhi al Qahtani³, Anas Ali Mansi Alzahrani⁴, Abdullah Ahmed Salem alqarni⁵,
Saleh abdullah al-awadh⁶, Ahmed Mohammed Alamri⁷, Mohammed Hamdan Shaddad
Alshamrani⁸, Badr Ali Alharthi⁹, Walid Awadallah Saad Al Harithi¹⁰

^{1*}Pharmacy technician, East jeddah hospital, salzahrani181@moh.gov.sa

²Pharmacy technician, Bisha hospital king Abdullah, hahalshamrani@moh.gov

³Pharmacy Technician, Wadi Taraj Hospital, Thaarma@moh.gov.sa

⁴Pharmacy technician, King Faisal Complx To Taif, Aalzahrani526@moh.gov.sa

⁵Pharmacy technician, King Abdullah Medical Complex-Jeddah, Aalqarni80@moh.gov.sa

⁶Pharmacy technician, Mental Health Al-Ahsa, salwadh@moh.gov.sa

⁷Pharmacy technician, King Fahad hospital in Jeddah, aalamri64@moh.gov.sa

⁸Pharmacist Technician, Tabala Hospital, mohalshomrani@moh.gov.sa

⁹Pharmacist, King Faisal Medical Complex To Taif, Baalharthi@moh.gov.sa

¹⁰Male pharmacist assistant, Sabt Al-Jara Health Center, WaAwAlharthi@moh.gov.sa

***Corresponding Author:** Saeed mohammed Abdullah Alzahrani

^{*}Pharmacy technician, East jeddah hospital, salzahrani181@moh.gov.sa

Abstract:

Background: Adherence to medical treatment is crucial for managing type 2 diabetes effectively and improving health outcomes. Nonadherence can lead to complications, increased healthcare costs, and decreased quality of life for patients. Understanding the factors influencing adherence and the roles of various healthcare professionals is essential for developing effective interventions.

Objectives: This research article aims to assess the level of adherence to medical treatment among type 2 diabetes patients, identify factors influencing adherence, explore the impact of adherence on health outcomes and quality of life, evaluate interventions for improving adherence, and make recommendations for healthcare providers and policymakers. Additionally, the study aims to evaluate the roles of pharmacy, health informatics, and hospital management in promoting adherence to medical treatment.

Conclusion: Factors such as health literacy, patient-related issues, and environmental barriers significantly impact treatment adherence among type 2 diabetes patients. The study emphasizes the crucial roles of medical secretaries, pharmacy technicians, pharmacists, health informatics, and hospital management in supporting patients and improving adherence. Addressing these factors and roles can enhance adherence to medical treatment, leading to better health outcomes and quality of life for type 2 diabetes patients. By implementing targeted interventions and promoting collaboration

among healthcare providers, policymakers can work towards improving adherence and ultimately enhancing the overall well-being of individuals with type 2 diabetes.

Keywords: Medication adherence, Quality of life, Diabetes mellitus, medical secretary role.

Introduction:

Medication adherence, as defined by health care providers, refers to the extent to which a person's actions align with the agreed-upon treatment recommendations [1]. Essentially, it involves patients actively and willingly engaging in behaviors that promote positive therapeutic outcomes. Non-adherence to medication can lead to unfavorable consequences and increased financial burdens. Despite causing approximately 125,000 avoidable deaths annually and costing the healthcare system around \$100 billion each year, medication non-adherence is often overlooked by healthcare professionals [2]. In 2003, the World Health Organization emphasized that interventions aimed at improving adherence have broader implications than specific medical treatments [3]. Globally, the prevalence of chronic diseases is on the rise, yet there has been little improvement in medication adherence rates, which hover around 50% to 60% for conditions like hypertension and diabetes, even in regions with good insurance coverage. Developed countries see just over half of patients adhering to prescribed medications, with lower rates in developing nations [4].

Diabetes stands out as one of the most common chronic diseases worldwide, with a growing number of cases. It poses a significant public health challenge, affecting over 425 million individuals globally [5]. In India, the prevalence of diabetes is staggering, with approximately 62.4 million people having type 2 diabetes and another 77 million at the pre-diabetes stage, a number projected to reach 101 million by 2030 according to the INdiaDIABetes report [6]. India has earned the moniker of the "diabetes capital of the world," with prevalence rates ranging from 5.6% in rural areas to 12.1% in major cities. Diabetes also accounts for a substantial portion of regional mortality, with 1,065,052 deaths attributed to the disease in 2013 [7]. In 2016 alone, diabetes directly caused 1.6 million deaths, while high blood sugar levels were responsible for an additional 2.2 million deaths in 2012.

Uncontrolled diabetes leads to hyperglycemia, which can result in various microvascular (e.g., retinopathy, nephropathy) and macrovascular (e.g., coronary artery disease) complications. Effective metabolic control can delay the onset and progression of these complications in both type 1 and type 2 diabetes [8]. Consequently, individuals with diabetes require lifelong treatment with medications and regular follow-ups. Adherence to anti-diabetic medications plays a crucial role in improving glycemic control, thereby preventing complications and offering a better prognosis.

Moreover, it is cost-effective as it reduces hospitalization rates and the expenses associated with complications. Self-care practices such as adhering to dietary and medication regimens, monitoring blood glucose levels, foot care, engaging in physical activity, and recognizing symptoms are essential components for secondary prevention [9].

Objectives:

1. To assess the level of adherence to medical treatment among type 2 diabetes patients.
2. To identify factors that influence adherence to medical treatment among type 2 diabetes patients.
3. To explore the impact of adherence to medical treatment on health outcomes and quality of life in type 2 diabetes patients.
4. To evaluate the effectiveness of interventions aimed at improving adherence to medical treatment among type 2 diabetes patients.
5. To make recommendations for healthcare providers and policymakers to enhance adherence to medical treatment in type 2 diabetes patients.
6. To evaluate the roles of pharmacy, health informatics, and hospital management in adherence to medical treatment among type 2 diabetes patients.

Factors affecting nonadherence to treatment among type 2 diabetic patients:

The World Health Organization (WHO) classifies the diverse array of elements impacting adherence to treatment into five distinct categories, encompassing socioeconomics, the healthcare team and service delivery system, the disease itself, the treatment regimen, and factors specific to the patient [10]. While certain factors within these categories may be beyond modification, those related to the patient can be influenced through educational initiatives aimed at enhancing awareness and knowledge levels [10]. Yet, it is important to note that an increase in awareness and knowledge does not invariably lead to a shift in attitude, and a change in attitude may not always translate into behavioral modifications due to external constraints [11].

Numerous studies have highlighted suboptimal treatment adherence among adults diagnosed with type 2 diabetes, resulting in a rise in diabetes-related complications and health issues [12, 13]. For instance, Guenette et al. (2016) reported that nearly 38% of individuals with type 2 diabetes failed to adhere to their prescribed treatment regimen within the first year of diagnosis [14]. One significant obstacle to treatment adherence in diabetic patients is the lack of health literacy, which pertains to an individual's capacity to access, comprehend, and apply fundamental health-related information without necessitating extensive academic background or advanced reading skills [15]. Health literacy encompasses a range of abilities, including reading, listening, critical analysis, decision-making, and their application in healthcare contexts [15].

Individuals with limited health literacy often struggle to comprehend medical information provided by healthcare professionals, leading to difficulties in following prescribed procedures such as medication schedules and adhering to recommended health services [16]. Their understanding of medical conditions is often limited, resulting in underutilization of preventive healthcare services [16]. Adherence to treatment plays a pivotal role in enhancing health outcomes and managing the challenges associated with diabetes. To address the daily obstacles faced by individuals with diabetes, it becomes imperative to develop tailored family-oriented interventions drawing upon health promotion theories and models to bolster treatment adherence [17]. While there is a dearth of qualitative research exploring these factors across various countries from the perspectives of patients, families, and healthcare providers [17], there is a notable gap in the literature regarding the experiences of individuals with limited health literacy, their families, and healthcare providers.

Investigating the viewpoints and experiences of these groups in diverse cultural and contextual settings can inform the development of targeted educational initiatives and interventions tailored to each unique environment [18]. Hence, this qualitative study aims to identify the factors influencing nonadherence to treatment in individuals with type 2 diabetes and limited health literacy, as perceived by patients, their families, and healthcare providers in Kerman city [18].

The role of medical secretary in adherence to medical treatment among type 2 diabetes patients:

Medical secretaries are crucial in aiding patients diagnosed with type 2 diabetes to achieve improved health outcomes. Their responsibilities include but are not limited to, arranging appointments, maintaining precise medical records, and facilitating essential communication between healthcare providers and patients. By efficiently managing the administrative aspects of a medical practice, medical secretaries help to streamline the patient care process, ensuring that patients receive timely and suitable treatment. Moreover, they often act as the primary point of contact for patients seeking medical guidance or support, playing a pivotal role in providing patients with the necessary information and assistance to adhere to their prescribed treatment plans [19]. Their meticulous attention to detail, organizational proficiency, and dedication to patient care significantly contribute to the overall success of medical treatment by enhancing communication and coordination between healthcare providers and patients. Consequently, medical secretaries are indispensable members of the healthcare team, playing a critical role in enhancing patient outcomes and the overall quality of care for individuals diagnosed with type 2 diabetes [20].

The role of pharmacy technician in adherence to medical treatment among type 2 diabetes patients:

Over the past five decades, there has been a notable transformation in the responsibilities undertaken by pharmacists. Initially confined to the task of dispensing medications, pharmacists now play a multifaceted role that encompasses not only providing clinical services but also engaging in patient education, assuming direct patient care responsibilities, and managing chronic diseases as part of collaborative team-based care [21]. This evolution has been facilitated by the implementation of specialized training programs for pharmacists, such as residency programs and certificate courses, which have been instrumental in broadening the scope of their practice.

For instance, community pharmacists occupy a unique position that enables them to enhance access to healthcare services within their local communities by not only dispensing medications but also offering educational support. Furthermore, with additional certifications, they can undertake tasks like prescribing and administering immunizations and medications like naloxone. On the other hand, clinical pharmacists with residency training possess specialized expertise in providing direct patient care and are typically integrated into clinical settings alongside other healthcare providers. The American Diabetes Association has acknowledged the pivotal role of pharmacists within the diabetes care team, underscoring the significance of their contribution as healthcare transitions towards value-based models that prioritize improving population health, reducing healthcare costs, enhancing patient experience, and boosting provider satisfaction [22].

The involvement of pharmacists in managing diabetes care manifests in diverse ways, with a focus on improving medication adherence among individuals with type 2 diabetes. Pharmacy technicians, for instance, often serve as the initial point of contact for patients collecting their medications, offering crucial insights on medication usage and potential side effects. By fostering relationships with patients and providing continuous support, pharmacy technicians can significantly enhance medication adherence rates among individuals with type 2 diabetes, thereby fostering better health outcomes and improving quality of life. Additionally, they collaborate closely with pharmacists and other healthcare professionals to identify and address barriers to adherence, thereby playing a vital role in the comprehensive management of type 2 diabetes and bolstering the success of patients' treatment regimens [23].

The impact of treatment adherence on quality of life QoL among type 2 diabetes mellitus patients:

Non-compliance with treatment protocols can lead to complications associated with the disease and can escalate both direct and indirect healthcare expenditures. Statistics indicate that approximately 10% of hospital admissions among adults can be directly linked to non-adherence to prescribed treatments. Enhancing adherence to treatment among diabetic patients by just 10% has the potential to reduce annual healthcare costs by a substantial margin, ranging from 8.6% to 28.9% [24]. Failing to adhere to medication regimens can result in the progression of uncontrolled disease states, significantly impacting patients' Quality of Life (QoL) due to the emergence of physical, social, and financial challenges [25].

Patients who adhere diligently to their prescribed treatment plans are more likely to achieve superior glycemic control, diminish the likelihood of complications, and enhance their overall health outcomes. On the contrary, non-adherence to treatment can lead to unregulated blood glucose levels, heightening the risk of severe complications like cardiovascular diseases, stroke, renal failure, vision impairments, and a decline in QoL. A study by Bezie et al. [26] revealed that individuals without diabetes-related complications exhibited a high level of adherence, potentially necessitating fewer medications. Consequently, their adherence to antidiabetic medications could increase, thereby reducing the likelihood of developing comorbid conditions. Nevertheless, the study did not establish a significant correlation between comorbidities and adherence levels.

Complications of medications non-adherence among type 2 diabetes patients:

Persistent elevation of blood sugar levels in uncontrolled diabetes mellitus can lead to a myriad of complications, encompassing both acute and chronic conditions. Diabetes mellitus stands as a primary contributor to various health issues such as cardiovascular disease (CVD), vision impairment, renal failure, and lower limb amputations [27]. Among the acute complications are hypoglycemia, diabetic ketoacidosis, hyperglycemic hyperosmolar state, and hyperglycemic diabetic coma. Hypoglycemia, characterized by abnormally low blood sugar levels, represents a significant challenge in diabetes management. Factors such as incorrect insulin dosing, strenuous physical activity, or reduced carbohydrate intake can trigger this condition. Symptoms range from irritability and profuse sweating to disturbances in consciousness, loss of consciousness, or even coma. Immediate consumption of glucose-rich substances or, in cases of unconsciousness, intravenous glucose administration becomes imperative. Signs of hypoglycemia encompass increased perspiration, blurred vision, tremors, headaches, pallor, irritability, tears, seizures, cognitive impairment, sensory disturbances, clumsiness, tingling around the mouth, and intense hunger [28].

Diabetic ketoacidosis, a critical complication, necessitates prompt medical attention and hospitalization. Dehydration, Kussmaul breathing (deep, prolonged, and labored respiration), and acetone breath are common indicators. Patients may also experience diffuse abdominal pain. While consciousness may initially remain unaffected, a gradual decline can lead to drowsiness, lethargy, and eventually coma. Severe cases may manifest with hypotension and shock. Timely intervention can effectively reverse diabetic ketoacidosis [29]. On the chronic front, microvascular complications like nephropathy, neuropathy, and retinopathy, and macrovascular complications such as coronary artery disease (CAD), peripheral artery disease (PAD), and cerebrovascular disease are prevalent. Statistics suggest that annually, 1.4 to 4.7% of middle-aged individuals with diabetes encounter a CVD event [30].

Role of health informatics in Adherence to Medical Treatment among Diabetic Patients: Health informatics plays a crucial role in improving adherence to medical treatment among diabetic patients. By utilizing technology and data analysis, health informatics can help healthcare providers track patient progress, monitor medication adherence, and provide personalized interventions [31]. Through electronic health records and remote monitoring devices, healthcare professionals can easily access and analyze patient data to identify trends and patterns that may impact adherence. Additionally, health informatics can facilitate communication between healthcare providers and patients, allowing for real-time feedback and support. Overall, the integration of health informatics in diabetes care can lead to better patient outcomes and improved adherence to medical treatment [32].

Role of hospital management in Adherence to Medical Treatment among Diabetic Patients: The role of hospital management in promoting adherence to medical treatment among diabetic patients is crucial for ensuring positive health outcomes. Hospital management plays a key role in creating an environment that supports patient education, medication management, and lifestyle modifications. This includes implementing effective communication strategies to ensure patients understand the importance of adhering to their treatment plans, as well as providing resources and support to help patients manage their condition effectively. Additionally, hospital management can also facilitate collaboration between healthcare providers to ensure a coordinated approach to patient care. By prioritizing adherence to medical treatment, hospital management can contribute to improving the overall health and well-being of diabetic patients, ultimately reducing the risk of complications and improving long-term health outcomes [33].

Conclusion:

In conclusion, this research article highlights the critical importance of adherence to medical treatment among type 2 diabetes patients. Factors influencing nonadherence include health literacy,

patient-related factors, and environmental barriers. The roles of medical secretaries and pharmacy technicians are essential in supporting patients and improving adherence. Treatment adherence significantly impacts the quality of life for diabetic patients, with nonadherence leading to complications and increased healthcare costs. The role of pharmacists, health informatics, and hospital management is crucial in promoting adherence and improving patient outcomes. By addressing these factors and roles effectively, healthcare providers and policymakers can enhance adherence to medical treatment among type 2 diabetes patients, ultimately leading to better health outcomes and quality of life.

References:

1. Patient medication adherence: measures in daily practice. Jimmy B, Jose J. *Oman Med J*. 2011;26:155–159. [PMC free article] [PubMed] [Google Scholar]
2. Medication adherence: its importance in cardiovascular outcomes. Ho PM, Bryson CL, Rumsfeld JS. *Circulation*. 2009;119:3028–3035. [PubMed] [Google Scholar]
3. Assessment of medication adherence in type II diabetic patients: a cross-sectional study. Khotkar K, Chudhari S, Jadhav P. https://ortholibrary.in/doi/MGMJMS/pdf/10.5_005/jp-journals-10036-1142 *MGM J Med Sci*. 2017;4:65–69. [Google Scholar]
4. The unmet challenge of medication nonadherence. Kleinsinger F, Perm J. 2018;22:1–3. [PMC free article] [PubMed] [Google Scholar]
5. A community-based study on diabetes medication nonadherence and its risk factors in rural Tamil Nadu. Venkatesan M, Dongre AR, Ganapathy K. <https://pubmed.ncbi.nlm.nih.gov/29899603/> *Indian J Community Med*. 2018;43:72–76. [PMC free article] [PubMed] [Google Scholar]
6. Barriers and facilitators to medication adherence: a qualitative study with general practitioners. Kvarnström K, Airaksinen M, Liira H. *BMJ Open*. 2018;8:0. [PMC free article] [PubMed] [Google Scholar]
7. A study of medication adherence and selfcare practices among type- 2 diabetes patients in Davangere. Anurupa MS, Aditya A, Angadi N. <https://njcmindia.com/index.php/file/article/view/415> *Int J Community Med*. 2019;10 [Google Scholar]
8. Treatment compliance among previously diagnosed type 2 diabetics in a rural area in Southern India. Pattnaik S, Ausvi SM, Salgar A, Sharma D. <https://pubmed.ncbi.nlm.nih.gov/31041225/> *J Family Med Prim Care*. 2019;8:919–922. [PMC free article] [PubMed] [Google Scholar]
9. Compliance to anti-diabetic drugs: observations from the diabetic clinic of a medical college in Kolkata, India. Mukherjee S, Sharmasarkar B, Das KK, Bhattacharyya A, Deb A. *J Clin Diagn Res*. 2013;7:661–665. [PMC free article] [PubMed] [Google Scholar]
10. Zomahoun HT, Moisan J, Lauzier S, Guillaumie L, Gregoire JP, Guenette L. Predicting noninsulin antidiabetic drug adherence using a theoretical framework based on the theory of planned behavior in adults with type 2 diabetes: A prospective study. *Medicine (Baltimore)*. 2016;95:e2954. [PMC free article] [PubMed] [Google Scholar]
11. Traina SB, Mathias SD, Colwell HH, Crosby RD, Abraham C. The Diabetes intention, attitude, and behavior questionnaire: evaluation of a brief questionnaire to measure physical activity, dietary control, maintenance of a healthy weight, and psychological antecedents. *Patient Prefer Adherence*. 2016;10:213–22. [PMC free article] [PubMed] [Google Scholar]
12. Guenette L, Lauzier S, Guillaumie L, Gregoire G, Gregoire JP, Moisan J. Patients' beliefs about adherence to oral antidiabetic treatment: A qualitative study. *Patient Prefer Adherence*. 2015;9:413–20. [PMC free article] [PubMed] [Google Scholar]
13. Wu P, Liu N. Association between patients' beliefs and oral antidiabetic medication adherence in a Chinese type 2 diabetic population. *Patient Prefer Adherence*. 2016;10:1161–7. [PMC free article] [PubMed] [Google Scholar]
14. Guenette L, Breton MC, Guillaumie L, Lauzier S, Gregoire JP, Moisan J. Psychosocial factors associated with adherence to non-insulin antidiabetes treatments. *J Diabetes Complications*. 2016;30:335–42. [PubMed] [Google Scholar]

15. Jafarian-Amirkhizi A, Sarayani A, Gholami K, Taghizadeh-Ghehi M, Heidari K, Jafarzadeh-Kohneeloo A, et al. Adherence to medications, self-care activity, and HBA1c status among patients with type 2 diabetes living in an urban area of Iran. *J Diabetes Metab Disord*. 2018;17:165–72. [PMC free article] [PubMed] [Google Scholar]
16. Pashaki MS, Eghbali T, Niksima SH, Albatineh AN, Gheshlagh RG. Health literacy among Iranian patients with type 2 diabetes: A systematic review and meta-analysis. *Diabetes Metab Syndr*. 2019;13:1341–5. [PubMed] [Google Scholar]
17. Pourhabibi N, Mohebbi B, Sadeghi R, Shakibazadeh E, Sanjari M, Tol A, Yaseri M. Determinants of Poor Treatment Adherence among Patients with Type 2 Diabetes and Limited Health Literacy: A Scoping Review. *J Diabetes Res*. 2022;2022:1–10. doi: 10.1155/2022/2980250. [PMC free article] [PubMed] [Google Scholar]
18. Khosravi A, Ahmadzadeh K, Arastoopoor S, Tahmasbi R. Health literacy levels of diabetic patients referred to Shiraz health centers and its effective factors. *Health Inf Manage*. 2015;12:205. [Google Scholar]
19. Medford, Andrew R L, and Sharon Standen. “In praise of medical secretaries: pay and conditions should reflect crucial role of medical secretaries in clinical teams.” *BMJ (Clinical research ed.)* vol. 327,7421 (2003): 991. doi:10.1136/bmj.327.7421.991-a
20. Alis J, Blair M. Life as a medical secretary— a new learning experience for the aspiring consultant. *BMJ*. 2003 Feb 15;326(7385):403.
21. Orabone, Amanda Wojtusik et al. “Pharmacist-Managed Diabetes Programs: Improving Treatment Adherence and Patient Outcomes.” *Diabetes, metabolic syndrome and obesity : targets and therapy* vol. 15 1911-1923. 20 Jun. 2022, doi:10.2147/DMSO.S342936
22. Bodenheimer T, Sinsky C. From triple to quadruple AIM: care of the patient requires care of the provider. *Ann Fam Med*. 2014;12:573–576. doi: 10.1370/afm.1713 [PMC free article] [PubMed] [CrossRef] [Google Scholar]
23. Norton MC, Haftman ME, Buzzard LN. Impact of physician-pharmacist collaboration on diabetes outcomes and health care use. *J Am Board Fam Med*. 2020;33:745–753. doi: 10.3122/jabfm.2020.05.200044 [PubMed] [CrossRef] [Google Scholar]
24. Healy AM, Shubrook JH, Schwartz FL, Cummings DM, Drake AJ, Tanenberg RJ. Endocrinologists’ opinions of diabetology as a primary care subspecialty. *Clin Diabetes*. 2018;36:168–173. doi: 10.2337/cd17-0097 [PMC free article] [PubMed] [CrossRef] [Google Scholar] [Ref list]
25. Saleem F, Hassali MA, Shafie AA. A crosssectional assessment of health-related quality of life (HRQoL) among hypertensive patients in Pakistan. *Health Expect*. 2014;17(3):388– 395. doi: 10.1111/j.1369-7625.2012.00765.x [PMC free article] [PubMed] [CrossRef] [Google Scholar]
26. Mishra R, Sharma SK, Verma R, Kangra P, Dahiya P, Kumari P, Sahu P, Bhakar P, Kumawat R, Kaur R, Kaur R, Kant R. Medication adherence and quality of life among type-2 diabetes mellitus patients in India. *World J Diabetes* 2021; 12(10): 1740- 1749 [PMID: 34754375 DOI: 10.4239/wjd.v12.i10.1740]
27. Carrillo-Larco RM, Barengo NC, Albitres- Flores L, Bernabe-Ortiz A. The risk of mortality among people with type 2 diabetes in Latin America: A systematic review and meta-analysis of population-based cohort studies. *Diabetes Metab Res Rev*. 2019 May;35(4):e3139. [PubMed]
28. Vijan S. In the clinic.Type 2 diabetes. *Ann. Intern. Med*. 2010;152(5):ITC31–ITC35. doi: 10.7326/0003-4819-152-5-20100302001003. [PubMed] [CrossRef] [Google Scholar] [Ref list]
29. Fasanmade O.A., Odeniyi I.A., Ogbera A.O. Diabetic ketoacidosis: Diagnosis and management . *Afr. J. Med. Med. Sci*. 2008;37(2):99–105. [PubMed] [Google Scholar] [Ref list]
30. Patoulas D, Papadopoulos C, Stavropoulos K, Zografou I, Doumas M, Karagiannis A. Prognostic value of arterial stiffness measurements in cardiovascular disease, diabetes, and its complications: The potential role of sodium-glucose co-transporter-2 inhibitors. *J Clin Hypertens (Greenwich)*. 2020 Apr;22(4):562-571. [PMC free article] [PubMed]

31. Besemah, N. A., Sartika, R. A. D., & Sauriasari, R. (2021). Effect of Pharmacist Intervention on Medication Adherence and Clinical Outcomes of Type 2 Diabetes Mellitus Outpatients in Primary Healthcare in Indonesia. *Journal of research in pharmacy practice*, 9(4), 186–195. https://doi.org/10.4103/jrpp.JRPP_20_59
32. Lester, W. T., Zai, A. H., Chueh, H. C., & Grant, R. W. (2008). Diabetes information technology: designing informatics systems to catalyze change in clinical care. *Journal of diabetes science and technology*, 2(2), 275– 283. <https://doi.org/10.1177/193229680800200218>
33. Olomu, A., Kelly-Blake, K., Hart-Davidson, W., Gardiner, J., Luo, Z., Heisler, M., & Holmes-Rovner, M. (2022). Improving diabetic patients' adherence to treatment and prevention of cardiovascular disease (Office Guidelines Applied to Practice-IMPACT Study)-a cluster randomized controlled effectiveness trial. *Trials*, 23(1), 659. <https://doi.org/10.1186/s13063-022-06581-6>