INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD)
© 2026 IJNRD | Volume 11, Issue 5, May 2026 | ISSN: 2456-4184 | IJNRD.ORG

"TO ASSESS MEDICATION ADHERANCE IN PATIENTS WITH TYPE 2 DIABETES MELLITUS WITH CHRONIC KIDNEY DISEASE - A SYSTEMIC LITERATURE REVIEW"

D. Ajin Raj[1]*, DR. Nithin Manohar.R[2], Ms. Anjana. UJ[3], Nahid Nazimuddin[1], Asheena. A[1], Sona Manzoor.M[1], Dr. Prasobh. G. R[4].

[1]Student Fifth Year Doctor of Pharmacy, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram, kerala, India.

[2] Professor and HOD, Department of Pharmacy Practic, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapurm, Kerala, India.

[3]Associate Professor, Department of Pharmacy Practice, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram, Kerala, India.

[4]Principal, Sree Krishna College of Pharmacy and Research Centre, Parassala, Thiruvananthapuram, Kerala, India.

ABSTRACT

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance and progressive Beta-cell dysfunction, leading to persistent hyperglycemia. Chronic Kidney Disease (CKD) is one of the most common and serious microvascular complications of T2DM and affects approximately 30-40% of diabetic patients globally. The coexistence of T2DM and CKD increases disease burden, treatment complexity, and risk of complications. Patients often require multiple medications, including antidiabetic drugs, antihypertensives, lipid-lowering agents, and nephroprotective agents, which may negatively influence medication adherence.

Mediation adherence is defined as the extent to which a patient's medication-taking behavior corresponds with the agreed recommendations from a healthcare provider. Poor adherence among patients with T2DM and CKD can lead to poor glycemic control, rapid progression of kidney disease, cardiovascular complications, hospitalization, and increased mortality. This review discusses the etiology, epidemiology, risk factors, pathophysiology, staging, and medication adherence in patients with T2DM with CKD. It also highlights barriers affecting adherence and evidence-based interventions to improve adherence and patient outcomes.

KEYWORDS

Type 2 Diabetes Mellitus, Chronic Kidney Disease, Medication Adherence, Diabetic Nephropathy.

INTRODUCTION

Diabetes Mellitus is a group of metabolic disorders characterized by chronic hyperglycemia due to defects in insulin secretion, insulin action, or both. T2DM accounts for approximately 90-95% of all diabetes cases worldwide. Persistent hyperglycemia damages various organs, especially kidneys, nerves, eyes, and blood vessels.

CKD is defined as abnormalities of kidney structure or function present for more than three months, with implications for health. It is diagnosed by decreased glomerular filtration rate (GFR<60ml/min/1.73m2) or markers of kidney damage such as albuminuria.

Diabetic nephropathy is the leading cause of CKD and end-stage renal disease (ESRD). Managing T2DM with CKD requires complex treatment regimens, making medication adherence a major challenge. Non-adherence can be intentional or unintentional and may significantly worsen clinical outcomes.[1][2]

ETIOLOGY

The etiology of chronic kidney disease (CKD) in patients with type 2 diabetes mellitus (T2DM) is multifactorial and primarily driven by persistent hyperglycemia and associated metabolic disturbances. Chronic hyperglycemia leads to insulin resistance and progressive β-cell dysfunction, which are key initiating factors in T2DM. Over time, sustained high glucose levels cause structural and functional damage to renal tissues through mechanisms such as oxidative stress, inflammation, and the formation of advanced glycation end products. These processes result in glomerular hyperfiltration, endothelial dysfunction, and progressive renal injury. Hypertension, obesity, dyslipidemia, and genetic susceptibility further contribute to the development and progression of diabetic kidney disease. Additionally, lifestyle factors such as smoking, sedentary behavior, and poor dietary habits exacerbate disease progression. The interaction between metabolic abnormalities and hemodynamic changes ultimately leads to nephron damage and declining kidney function, making diabetes the leading cause of CKD worldwide.[3][4]

EPIDEMIOLOGY

Type 2 diabetes mellitus (T2DM) is a major global health problem and is the leading cause of chronic kidney disease (CKD) worldwide. The epidemiology of CKD among T2DM patients shows a substantial and growing burden, with studies reporting that approximately 27% of patients with T2DM have CKD globally, although prevalence varies widely across regions due to demographic, environmental, and socioeconomic factors [5]. In some populations, particularly in India, the prevalence is even higher, with around 32% of T2DM patients affected by CKD, especially among older individuals and those with longer disease duration and poor glycemic control [6]. Earlier epidemiological evidence also suggests that up to 50% of patients with T2DM may develop CKD over time, highlighting the strong association between diabetes and renal complications [7].

The burden of medication adherence in this population is equally significant. Studies indicate that medication non-adherence among T2DM patients ranges widely from 11% to 68%, with a pooled estimate of about 48% in India, reflecting substantial variability influenced by socioeconomic and healthcare factors [8]. In patients with coexisting CKD, adherence tends to be even more challenging due to polypharmacy, complex treatment regimens, and high pill burden, often exceeding multiple medications per day [9]. Epidemiological data from multinational cohorts also show that only about 50% of patients remain on prescribed therapies after one year, indicating persistence issues in long-term management [10].

Overall, the epidemiology of medication adherence in T2DM with CKD reflects a dual burden: a high and increasing prevalence of disease along with a substantial proportion of patients failing to adhere adequately to treatment. This contributes to poor glycemic control, faster progression of kidney disease, and increased risk of cardiovascular morbidity and mortality, making it a critical public health concern requiring targeted interventions.

PATHOPHYSIOLOGY OF T2DM WITH CKD

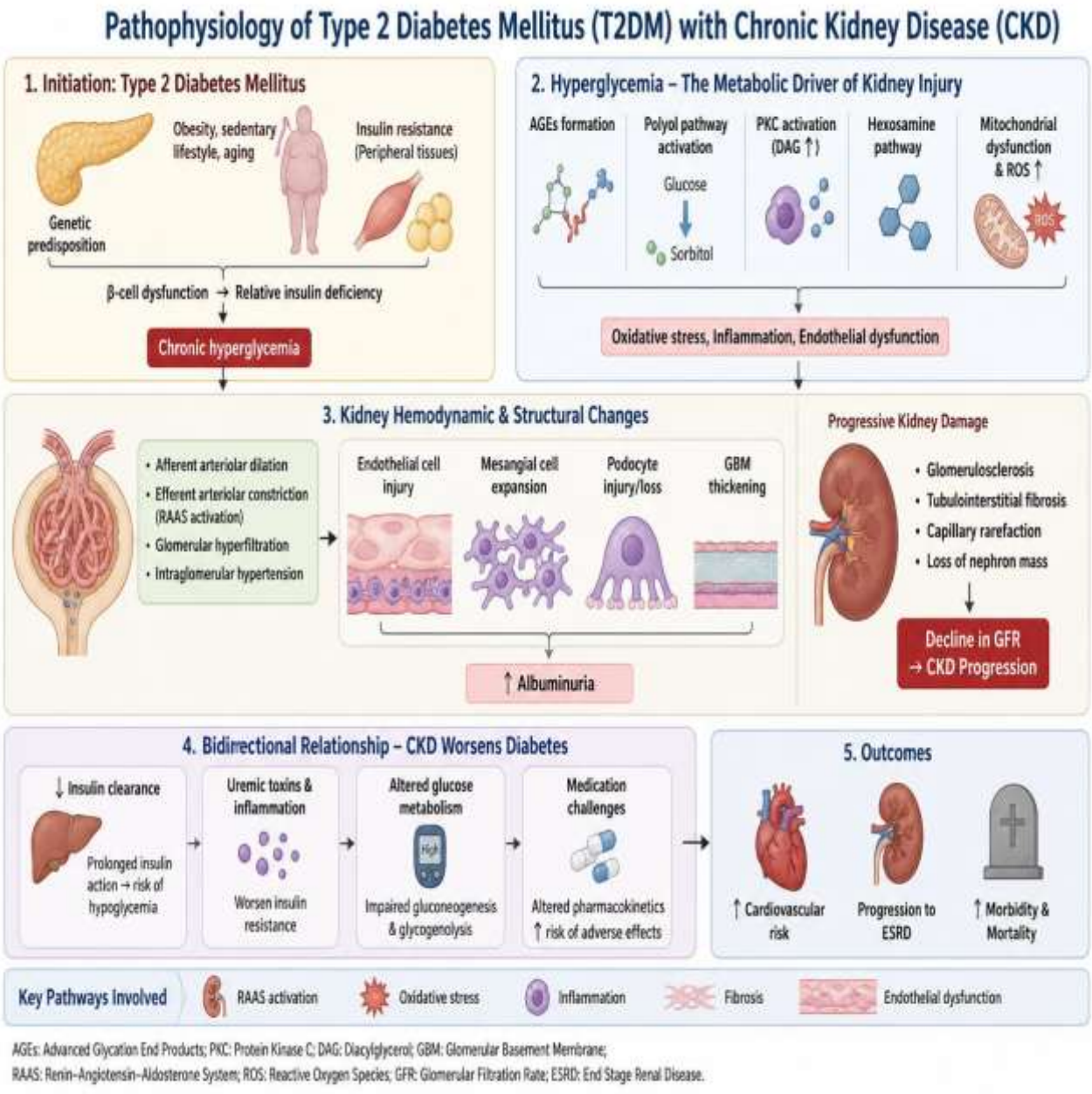
Type 2 diabetes mellitus is primarily characterized by insulin resistance and progressive β-cell dysfunction, leading to chronic hyperglycemia. Persistent hyperglycemia plays a central role in the development of chronic kidney disease by inducing metabolic and hemodynamic alterations in the kidney. Elevated glucose levels activate multiple damaging pathways, including the formation of advanced glycation end products (AGEs), activation of the polyol pathway, and increased protein kinase C activity, all of which contribute to oxidative stress and inflammation. These processes damage glomerular endothelial cells, mesangial cells, and podocytes, resulting in thickening of the glomerular basement membrane and mesangial expansion.[11]

In addition, glomerular hyperfiltration and intraglomerular hypertension occur early in diabetic kidney disease due to altered renal hemodynamics and activation of the renin–angiotensin–aldosterone system (RAAS). This leads to progressive albuminuria and decline in glomerular filtration rate (GFR). Chronic inflammation and oxidative stress further perpetuate endothelial dysfunction, creating a cycle of kidney injury and fibrosis. Over time, these structural and functional changes result in diabetic nephropathy and eventual progression to end-stage renal disease (ESRD).

The relationship between T2DM and CKD is bidirectional. CKD itself worsens insulin resistance and alters glucose metabolism due to reduced insulin clearance and uremic toxin accumulation. Moreover, CKD modifies the pharmacokinetics of antidiabetic drugs, complicating glycemic control and increasing the risk of adverse effects. Together, these mechanisms create a complex cardio-renal-metabolic interaction that accelerates disease progression and increases morbidity and mortality in affected patient.[11]

Figure 1: Pathophysiology of Type 2 Diabetes Mellitus with Chronic Kidney Disease

RISK



FACTORS OF T2DM WITH CKD

Patients with Type 2 Diabetes Mellitus (T2DM) are at a significantly increased risk of developing Chronic Kidney Disease(CKD) due to both metabolic and hemodynamic abnormalities. Several non-modifiable risk factors contribute to CKD progression, including advanced age and longer duration of diabetes. Studies show that individuals aged ≥60 years and those with diabetes duration >10 years have a higher likelihood of reduced kidney function due to cumulative glycemic damage. [12]

Among modifiable risk factors, poor glycemic control plays a central role, as elevated HbA1c levels accelerate glomerular damage and albuminuria. Hypertension, particularly elevated systolic blood pressure, further contributes to renal injury by increasing intraglomerular pressure and promoting nephron loss. Lifestyle-related factors such as tobacco use and unhealthy dietary habits (e.g., high protein or non-vegetarian diet patterns in some populations) are also associated with worsening kidney outcomes. [12]

Additionally, the presence of comorbid conditions such as dyslipidemia, obesity, and cardiovascular disease increases the risk of CKD in diabetic patients. These conditions exacerbate endothelial dysfunction, oxidative stress, and inflammation, all of which contribute to the progression of diabetic nephropathy. Evidence from cross-sectional and observational studies also highlights albuminuria and reduced estimated glomerular filtration rate (eGFR) as both risk indicators and predictors of disease progression. [13]

Overall, the interplay between metabolic dysregulation, hypertension, lifestyle habits, and duration of diabetes determines the onset and progression of CKD in T2DM patients. Identifying and modifying these risk factors is essential to improve clinical outcomes and enhance medication adherence strategies in this population.

STAGES OF T2DM WITH CKD

Diabetic kidney disease (DKD), a major complication of type 2 diabetes mellitus, progresses through well-defined stages based on structural and functional changes in the kidneys, particularly albuminuria and glomerular filtration rate (GFR).

STAGE 1 (hyperfiltration stage) occurs at or near the diagnosis of diabetes and is characterized by increased GFR and renal hypertrophy due to metabolic and hemodynamic alterations. This stage is often asymptomatic and partially reversible with good glycemic control.

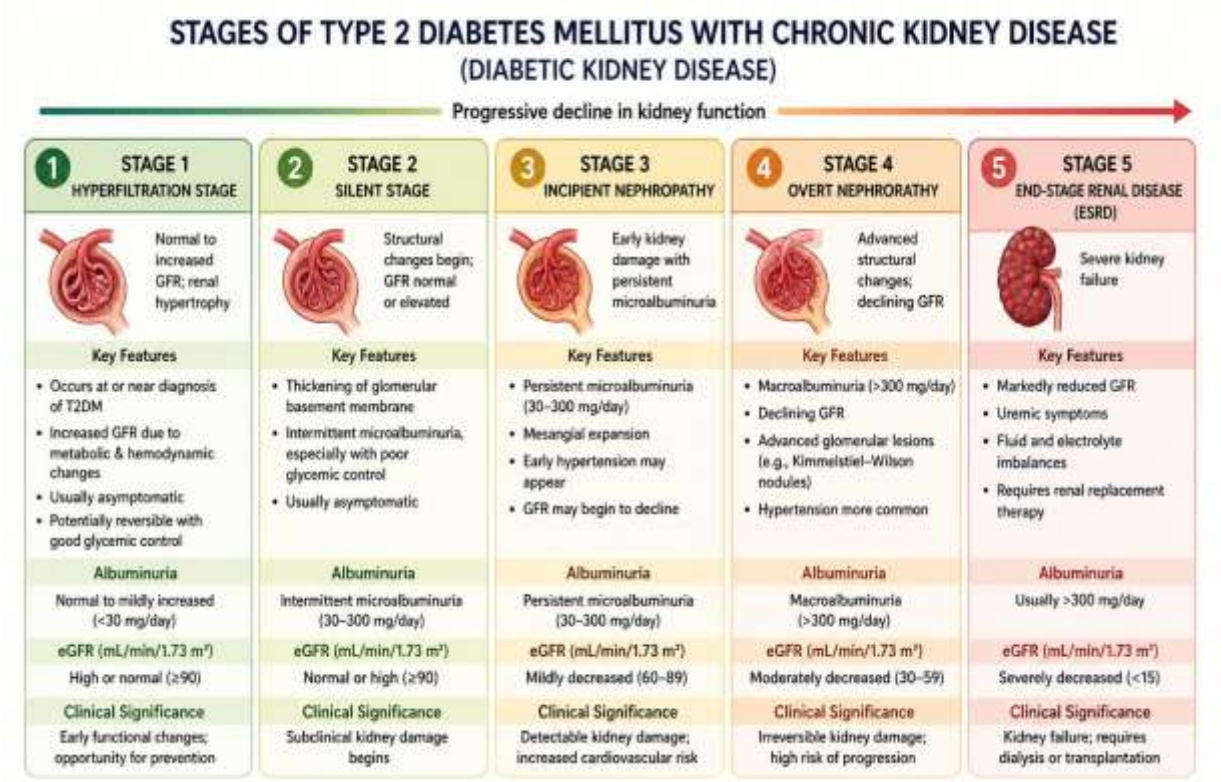
STAGE 2 (silent stage) subtle structural changes such as thickening of the glomerular basement membrane develop, while GFR may remain normal or elevated, and intermittent microalbuminuria may appear, especially during poor glycemic control.

STAGE 3 (incipient nephropathy) is marked by persistent microalbuminuria (30–300 mg/day), mesangial expansion, and early hypertension; this stage is clinically significant as it indicates the onset of detectable kidney damage and increased cardiovascular risk.

STAGE 4 (overt nephropathy) is characterized by macroalbuminuria (>300 mg/day), declining GFR, and more advanced glomerular lesions such as Kimmelstiel–Wilson nodules, reflecting irreversible renal damage.

STAGE 5 (end-stage renal disease, ESRD) represents severe kidney failure with markedly reduced GFR (<15 mL/min/1.73 m²), requiring renal replacement therapy such as dialysis or transplantation. These stages highlight a gradual but progressive decline in renal function over years, emphasizing the importance of early detection and medication adherence to slow disease progression in patients with T2DM and CKD.[14][15]

Figure 2: Stages of Type 2 Diabetes Mellitus with Chronic Kidney Disease



MEDICATION ADHERANCE IN PATIENT WITH TYPE2DM WITH CKD

Medication adherence in patients with type 2 diabetes mellitus (T2DM) with chronic kidney disease (CKD) is a critical determinant of disease progression, glycemic control, and prevention of complications. Medication adherence is defined as the extent to which a patient's behavior corresponds with prescribed therapeutic recommendations. In patients with T2DM and CKD, adherence is often challenging due to polypharmacy, complex dosing schedules, and the presence of multiple comorbidities such as hypertension and cardiovascular disease. Studies show that CKD patients may be prescribed more than 20 medications per day, increasing treatment burden and reducing adherence levels. [16]

Evidence suggests that medication non-adherence is common, with approximately 30–40% of patients with T2DM not adhering adequately to prescribed therapies, leading to poor glycemic control and worsening renal outcomes. [16]

In CKD populations, non-adherence is associated with increased risks of hospitalization, morbidity, and mortality. Factors contributing to poor adherence include low health literacy, financial constraints, complex regimens, adverse drug effects, and lack of patient education. Socioeconomic determinants such as income, education, and social support also significantly influence adherence behavior. [17]

In patients with both T2DM and CKD, adherence becomes even more crucial because pharmacotherapy aims not only to control blood glucose but also to slow kidney disease progression and manage complications like anemia, mineral bone disorders, and electrolyte imbalance. [16]

A hospital-based study in India reported that medication adherence varies significantly among T2DM patients with and without CKD, emphasizing the need for targeted interventions in this high-risk group. [18]

Improving medication adherence requires a multidisciplinary approach, including patient education, simplification of drug regimens, regular follow-up, and involvement of clinical pharmacists. Enhancing adherence can significantly improve therapeutic outcomes, reduce healthcare costs, and delay progression to end-stage renal disease.

ROLE OF PHARMACIST IN IMPROVING MEDICATION ADHERANCE (T2DM WITH CKD)

Clinical pharmacists play a crucial role in improving medication adherence among patients with type 2 diabetes mellitus (T2DM) and chronic kidney disease (CKD), where treatment regimens are often complex and lifelong. Pharmacists contribute through medication reconciliation, medication review, and identification of drug-related problems, ensuring that prescriptions are appropriate, safe, and simplified to enhance adherence. They provide patient-centered counselling and education about disease conditions, drug usage, side effects, and the importance of adherence, which improves patient understanding and motivation. Additionally, pharmacists monitor therapeutic outcomes, adjust dosages (especially important in CKD due to altered drug clearance), and prevent drug–drug interactions.

Pharmacist-led interventions such as motivational interviewing, adherence tools (pill organizers, reminders), and follow-up monitoring have been shown to significantly improve adherence rates and clinical outcomes. In patients with T2DM and CKD, pharmacists also assist in optimizing therapy (e.g., antihyperglycemics, antihypertensives, reno-protective drugs) and collaborate with physicians as part of a multidisciplinary team. Their involvement helps reduce medication errors, improve glycemic and renal outcomes, and enhance quality of life. Overall, integrating pharmacists into renal and diabetes care settings is essential for addressing barriers to adherence and achieving better long-term disease control. [19][20]

COMPLICATIONS OF TYPE 2 DM WITH CKD

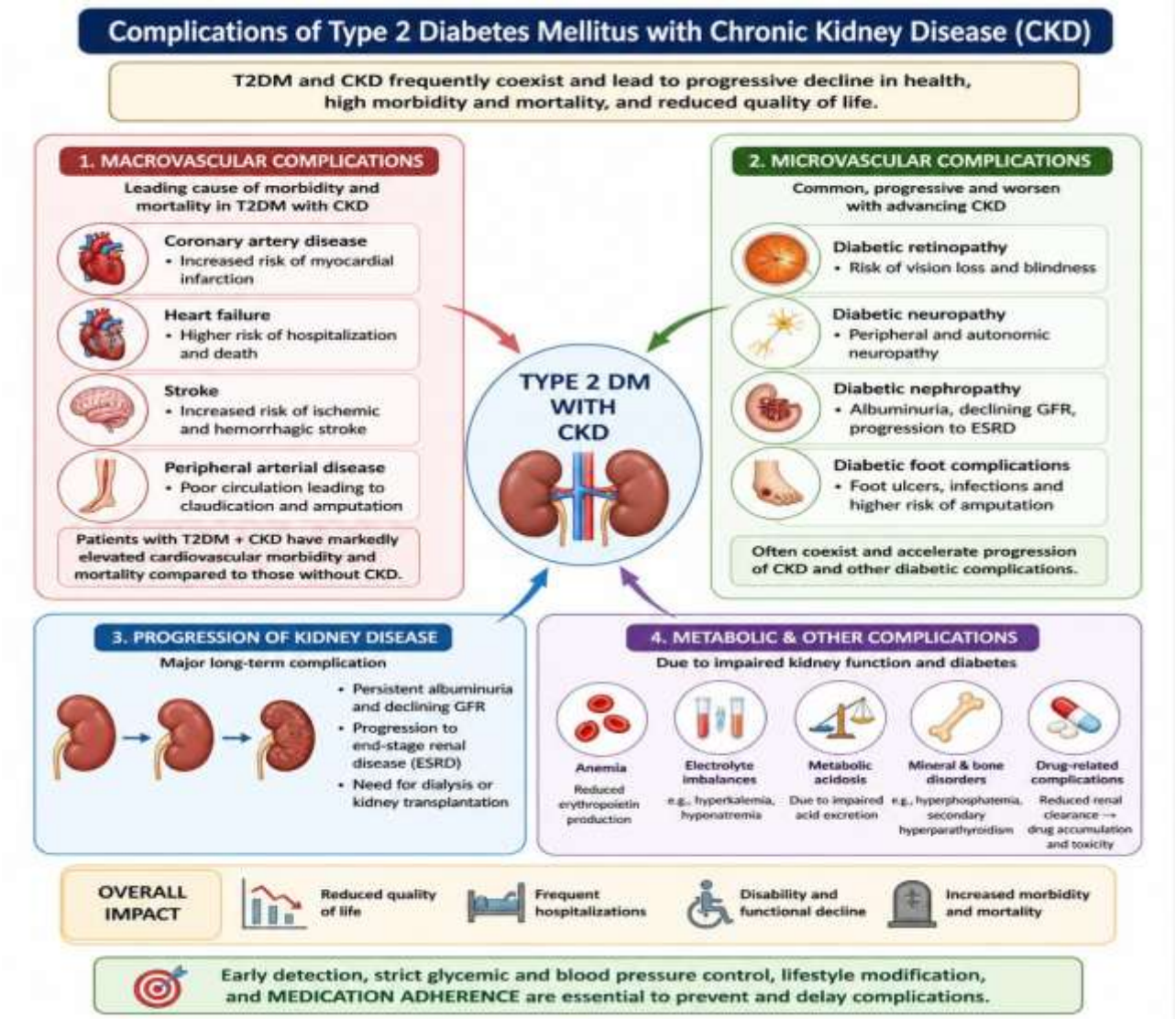
Patients with T2DM and CKD are at a significantly increased risk of both microvascular and macrovascular complications, leading to high morbidity and mortality. One of the major complications is progression to end-stage renal disease (ESRD), where declining glomerular filtration rate (GFR) and persistent albuminuria result in the need for dialysis or kidney transplantation. Additionally, CKD in diabetes is strongly associated with cardiovascular complications such as coronary artery disease, heart failure, stroke, and peripheral arterial disease, which are the leading causes of death in these patients. Studies indicate that patients with T2DM and CKD have a markedly elevated risk of cardiovascular morbidity and mortality compared to those without kidney involvement. [21]

Microvascular complications are also common, including diabetic retinopathy, neuropathy, and nephropathy, which often coexist and worsen with advancing CKD stages. Neuropathy and peripheral vascular disease increase the risk of diabetic foot ulcers and amputations, especially due to poor wound healing and reduced blood supply. [22]

Furthermore, CKD contributes to metabolic complications such as anemia, electrolyte imbalances (e.g., hyperkalemia), metabolic acidosis, and mineral and bone disorders due to impaired kidney function. Patients may also experience drug-related complications, as reduced renal clearance increases the risk of drug accumulation and adverse effects, directly impacting medication adherence.

Overall, the coexistence of T2DM and CKD creates a complex clinical condition characterized by multisystem complications, including renal failure, cardiovascular disease, metabolic disturbances, and reduced quality of life, emphasizing the importance of early detection, strict glycemic control, and adherence to therapy.

Figure 3: Complications of Type 2 Diabetes Mellitus with Chronic Kidney Disease



IMPACT OF MEDICATION ADHERANCE

1. Medication adherence plays a crucial role in determining clinical outcomes in patients with type 2 diabetes mellitus (T2DM) with chronic kidney disease (CKD). Adequate adherence to prescribed antidiabetic, antihypertensive, and renoprotective therapies has been consistently associated with better glycemic control, slower progression of kidney damage, and reduced risk of cardiovascular complications. Studies show that patients who adhere to their medications maintain improved parameters such as HbA1c, blood pressure, and lipid levels, which are key factors in preventing CKD progression and associated morbidity. Conversely, poor adherence leads to suboptimal therapeutic effects, resulting in faster decline in glomerular filtration rate (GFR), increased albuminuria, and higher likelihood of requiring renal replacement therapy such as dialysis. [23]

2. Furthermore, non-adherence significantly increases the risk of adverse clinical outcomes, including cardiovascular events and mortality. Evidence from cohort studies in patients with T2DM indicates that non-adherence to cardiometabolic medications is linked with worse kidney outcomes (e.g., accelerated CKD progression) and higher incidence of cardiovascular complications such as myocardial infarction and stroke. [24]

3. In addition, adherence enhances the effectiveness of newer therapies like SGLT2 inhibitors and GLP-1 receptor agonists, which are known to provide renal and cardiovascular protection when taken consistently. [24]

4. Overall, medication adherence directly impacts disease progression, quality of life, hospitalization rates, and survival in T2DM patients with CKD. Improving adherence through patient education, regular monitoring, and pharmacist-led interventions is therefore essential to optimize therapeutic outcomes and reduce healthcare burden.

CONCLUTION

Medication adherence is a critical determinant of clinical outcomes in patients with type 2 diabetes mellitus (T2DM) complicated by chronic kidney disease (CKD). Poor adherence is highly prevalent in this population due to factors such as polypharmacy, complex dosing regimens, adverse drug effects, financial burden, and limited patient awareness. Suboptimal adherence contributes to poor glycemic control, accelerated progression of kidney disease, increased risk of cardiovascular complications, and higher rates of hospitalization and mortality. Conversely, improved adherence is associated with better disease control, slowed CKD progression, and enhanced quality of life. Multidisciplinary interventions-particularly involving clinical pharmacists, patient education, medication simplification, and regular follow-up play a pivotal role in improving adherence. Therefore, assessing and addressing medication adherence should be an integral component of the management strategy for patients with T2DM and CKD to optimize therapeutic outcomes and reduce healthcare burden.

REFERANCE

1.Improving medication adherence in type 2 diabetes: strategies for better clinical and economic outcomes.
2.Prescribing of diabetes medications to people with Type 2 Diabetes and chronic kidney disease: a national cross-sectional study, published:18 February 2019, volume 20, article number 29 (2019).
3. DeFronzo RA, Reeves WB, Awad AS. Pathophysiology of diabetic kidney disease: impact of SGLT2 inhibitors. Nature Reviews Nephrology. 2021; 17:319–334.
4. Fenta ET, Eshetu HB, Kebede N, et al. Prevalence and predictors of chronic kidney disease among type 2 diabetic patients worldwide: systematic review and meta-analysis. Diabetology & Metabolic Syndrome. 2023; 15:245.
5. Fenta ET, Eshetu HB, Kebede N, Bogale EK, Zewdie A, Kassie TD, et al. Prevalence and predictors of chronic kidney disease among type 2 diabetic patients worldwide: a systematic review and meta-analysis. Diabetol Metab Syndr. 2023; 15:245.
6. Varma PP, et al. Prevalence and risk factors of chronic kidney disease in type 2 diabetes mellitus patients in India: findings from the CITE study. BMC Nephrology.
7. Thomas MC, Cooper ME, Zimmet P. Changing epidemiology of type 2 diabetes mellitus and associated chronic kidney disease. Nature Review Nephrology. 2016;12(2):73–81.
8. Medication adherence among patients with type 2 diabetes mellitus in India: a systematic review and meta-analysis.
9. Nieuwlaat R, Wilczynski N, Navarro T, Hobson N, Jeffery R, Keepanasseril A, et al. Interventions for enhancing medication adherence. Clin Kidney J. 2018;11(4):513–52.
10. Chung H, Crowe CL, Kong SX, Singh R, Farej R, Elliott J, et al. Treatment adherence and outcomes in patients with type 2 diabetes mellitus and chronic kidney disease.
11.The pathophysiology and vascular complications of Diabetes in Chronic Kidney Disease: A Comprehensive Review.
12.Risk factors associated with Indian type 2 diabetes patients with chronic kidney disease (CITE study), BMC nephology, (2025)26:245.
13.Prevalance and risk factors of chronic kidney disease among type 2 Diabetes patients, Scientific Reports (2020)10:6205.
14. Mora-Fernandez C, Domínguez-Pimentel V, Muros de Fuentes M, Gorriz JL, Martínez-Castelao A, Navarro-González JF. Diabetic kidney disease: from physiology to therapeutics. Clin J Am Soc Nephrol. 2014;9(7):1177–1189.
15. Weir MR, Agarwal R, Rossing P, Usman MS, Khan MS, Butler J, et al. Chronic Kidney Disease and type 2 diabetes. American Diabetes Association Clinical Compendia. Arlington (VA): American Diabetes Association; 2021 Jun.
16.Trine Mecha Nielsen, Metha Frojk, Bo Feldt Rasmussen, Thordis Thomsen. Adherence to medication in patients with chronic kidney disease. Clinical Kidney Journal, volume 11, August 2018, Page 513-527.
17. Krass I, Schieback P, Dhippayom T. Socioeconomic factors associated with poor medication adherence in patients with type 2 diabetes mellitus. Eur J Clin Pharmacology. 2023;79(5):685–695.
18.Thomas V Paul, Vathsala Sadan, Anandha Ruby Jacob. A study to asses medication adherence among type 2 diabetes mellitus patients with and without chronic kidney disease attending the out-patient department, tertiary care hospital, vellore.

19. Pharmacist-Led Interventions for Medication Adherence in Patients with CKD. Calleja L, Glass BD, Cairns A, Taylor S. Pharmacy, 2023.
20. Type 2 Diabetes and CKD: Role of Pharmacists in Improving Outcomes. Published in PMC review article, 2024.
21. Eneyew Talie Fenta, Habitu Birhan Eshetu, Natnael kebede. Prevalence and predictors of chronic kidney disease among type2 diabetic patients worldwide. Diabetology and metabolic Syndrome (2023) 15:245.
22. Roy Raoul Felipe, MD. SAT- 135 Risk factors for foot problems among patients with type 2 Diabetes and Chronic Kidney Disease. Journal of Endocrine Society, volume 3.
23. Mayuree Tangkiatkumjai et al. Clin Exp Nephrol. 2017 Jun. Association between medication adherence and clinical outcomes in patients with chronic kidney disease.
24. Denicolo S, et al. Non- adherence to cardiometabolic medication and kidney/cardiovascular outcomes in T2DM. Diabetologia (2024)67:1283-1294.