



## Overcoming challenges and bridging gaps in chronic kidney disease management in primary care

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### Abstract

Chronic Kidney Disease (CKD) poses significant challenges to primary care systems globally, hindering early detection, effective management, and prevention of disease progression. Key barriers include healthcare system limitations, knowledge gaps among providers, and patient-related factors. In many resource-limited settings, there is insufficient access to specialized care, diagnostic tools, and essential medications, which exacerbates the progression of CKD. Additionally, financial constraints prevent adequate care, while a lack of comprehensive CKD training for primary care providers leads to missed opportunities for early intervention. Patient adherence to lifestyle changes and medications is also influenced by socioeconomic factors, making disease management more complex. Emerging advancements in research, such as novel biomarkers, and technological innovations like telemedicine and wearable devices, offer promising solutions for improving CKD care. However, addressing these challenges requires systemic changes, including policy reforms, enhanced provider education, and better access to resources. The integration of CKD management into primary care could significantly reduce the burden on healthcare systems, improve patient outcomes, and enhance quality of life for those affected.

**Keywords:** Chronic Kidney Disease; Primary Care; Management; Healthcare System Limitations; Patient Adherence; Telemedicine; Wearable Devices

### 1. Introduction

Chronic Kidney Disease (CKD) is a growing global health challenge, with significant implications for both individuals and healthcare systems [1]. Early detection and management of CKD are essential to slowing disease progression, preventing complications, and improving patient outcomes [2]. However, despite the recognition of these needs, there are numerous barriers that hinder optimal care, particularly within primary care settings. These barriers encompass systemic issues, such as limitations in healthcare infrastructure and financial constraints, as well as gaps in provider knowledge and patient-related challenges [3]. Addressing these gaps is critical to ensuring that CKD patients receive timely, effective care that can slow disease progression and enhance quality of life [4]. This article will explore the key challenges in CKD management within primary care, focusing on healthcare system limitations, knowledge gaps among healthcare providers, and patient-related barriers. Additionally, we will highlight emerging innovations and potential policy changes that can improve CKD care in primary care settings and reduce the global burden of this disease.

### 2. Challenges and Gaps in Primary Care for CKD Management

Despite the growing recognition of the importance of early detection and management of Chronic Kidney Disease (CKD) in primary care, several challenges and gaps hinder optimal care. These include limitations within healthcare systems,

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knowledge gaps among healthcare providers, and patient-related barriers that complicate the effective management of CKD. Addressing these challenges is crucial to improving outcomes for CKD patients and reducing the burden of this condition on both individuals and healthcare systems. One of the primary challenges in CKD management within primary care is the limited access to specialized care, diagnostic tools, and medications, particularly in resource-limited settings.

The progression of CKD can be slowed through early detection and timely referral to nephrologists or kidney specialists. However, many primary care settings, especially in rural or low-income areas, face significant challenges in providing access to specialist care [5]. There may be a shortage of trained nephrologists, resulting in long waiting times for referrals or lack of referrals altogether. This lack of access can delay necessary interventions that could prevent or slow the progression of CKD to end-stage renal disease (ESRD), where dialysis or a kidney transplant becomes necessary. In many cases, patients are not referred to nephrologists until they have advanced CKD, reducing the effectiveness of management strategies and leading to worse outcomes.

Access to the diagnostic tools necessary for effective CKD screening, such as eGFR testing and urine albumin tests, may also be limited in some primary care settings. For instance, the availability of automated eGFR testing or urine albumin-to-creatinine ratio tests may be constrained by budget limitations, especially in low-income countries or underfunded healthcare systems. Furthermore, access to essential medications like angiotensin-converting enzyme inhibitors (ACE inhibitors), angiotensin receptor blockers (ARBs), and sodium-glucose cotransporter 2 inhibitors (SGLT2i) is often restricted by both financial constraints and healthcare policies, limiting the ability of primary care providers to manage CKD effectively [6].

In addition to diagnostic and treatment limitations, financial constraints present a significant barrier to CKD management in many regions. In low- and middle-income countries, the high costs associated with CKD care, including medications, regular monitoring, and specialist referrals, place a burden on both healthcare systems and patients [7]. These constraints can lead to underdiagnosis and undertreatment, contributing to the poor outcomes often seen in CKD patients in these settings. Moreover, healthcare providers in resource-limited settings may prioritize other urgent health issues, which can result in CKD being overlooked, despite its long-term consequences.

### **2.1. Knowledge Gaps**

Another significant challenge in primary care for CKD management is the knowledge gap among healthcare providers. While CKD is a prevalent and potentially preventable condition, there remains a lack of comprehensive training in CKD screening and management among primary care providers. Primary care providers (PCPs) are often the first point of contact for patients with risk factors for CKD, yet many do not receive sufficient training on how to screen for the disease, identify at-risk patients, or manage early stages of CKD effectively. A study conducted by Saran et al. (2023) highlighted that only about 40% of PCPs routinely screen patients at risk for CKD using recommended tests like eGFR and urine albumin-to-creatinine ratio [8]. This knowledge gap is partly due to limited inclusion of CKD education in medical curricula, with many providers receiving minimal training on kidney disease management. As a result, there may be a lack of awareness regarding the significance of early detection and treatment, leading to missed opportunities for intervention.

Moreover, there is also a lack of training regarding the latest pharmacological treatments for CKD, such as SGLT2 inhibitors and novel approaches to managing comorbidities like hypertension and diabetes. As clinical guidelines evolve and new therapeutic options become available, primary care providers must remain up-to-date with the latest evidence to provide optimal care.

### **2.2. Patient-Related Barriers**

Beyond systemic and educational barriers, patient-related factors also play a significant role in the successful management of CKD. These factors include adherence to lifestyle changes, medication regimens, and socioeconomic issues that affect access to healthcare. Adherence to prescribed lifestyle changes, such as dietary modifications, exercise, and smoking cessation, is a key factor in managing CKD. However, many patients struggle with making and maintaining these changes. Lifestyle modifications, such as reducing sodium intake, increasing physical activity, or losing weight, may be difficult for patients due to social, cultural, and personal factors. For instance, in low-income communities, access to healthy food options, safe places for physical activity, and smoking cessation programs may be limited. This makes it challenging for patients to comply with recommended changes, which could slow the progression of CKD.

Similarly, adherence to prescribed medications, such as ACE inhibitors or SGLT2 inhibitors, can be problematic due to factors like cost, side effects, and lack of understanding about the importance of these treatments. A study by Yilmaz et

al. (2022) found that medication non-adherence was a significant predictor of CKD progression, with cost and forgetfulness being the most commonly cited reasons for non-adherence among patients [9]. Primary care providers must not only prescribe medications but also engage in active discussions with patients about the importance of consistent medication use, potential side effects, and the benefits of treatment.

Socioeconomic status significantly influences a patient's ability to access healthcare services, including CKD screenings, medications, and specialist care. Low-income patients are less likely to have insurance coverage, making healthcare services less affordable. Additionally, transportation issues, time constraints due to work, and social support deficits may prevent patients from attending regular check-ups or specialist appointments. These barriers contribute to delayed diagnoses, poor disease management, and, ultimately, worsened kidney outcomes. Patients in lower socioeconomic groups are also more likely to suffer from comorbid conditions such as diabetes, hypertension, and obesity, which further increase their risk of CKD. Without access to affordable medications and preventive care, managing these risk factors becomes more difficult, creating a vicious cycle that exacerbates kidney disease.

Several challenges and gaps exist in the primary care management of CKD, which hinder the effective detection, treatment, and prevention of the disease. Healthcare system limitations, including restricted access to specialized care and medications, as well as financial constraints, present substantial barriers to optimal CKD management, especially in resource-limited settings. Knowledge gaps among healthcare providers regarding CKD screening and management further contribute to missed opportunities for early intervention. Finally, patient-related factors, such as poor adherence to lifestyle changes and medications, and socioeconomic barriers to accessing healthcare, complicate the management of CKD. To address these challenges, concerted efforts are needed at both the policy and clinical levels to improve CKD awareness, education, access to resources, and patient engagement in care.

### **2.3. Future Directions in CKD Risk Factor Management**

As the global prevalence of Chronic Kidney Disease (CKD) continues to rise, the field of CKD management is experiencing significant innovations. Emerging research, technological advancements, and policy implications are shaping the future of CKD risk factor management, especially in primary care settings. These developments offer promising opportunities to enhance early detection, improve patient outcomes, and reduce the overall burden of CKD on healthcare systems. Recent studies have identified new risk factors and biomarkers that could improve the accuracy of CKD screening and risk prediction. For instance, researchers are exploring the role of genetic and epigenetic factors in the development of CKD, as well as potential biomarkers that could help identify individuals at risk before clinical symptoms appear. According to a study by Xu et al. (2023), novel biomarkers such as serum levels of certain microRNAs and circulating extracellular vesicles are being investigated for their ability to detect early kidney damage and predict disease progression [10]. These biomarkers could complement traditional screening tools, providing more personalized and precise risk assessments for patients in primary care settings.

Additionally, the integration of omics technologies, including genomics and proteomics, holds great promise for enhancing CKD risk stratification. By analyzing large datasets and identifying complex interactions between genes, proteins, and environmental factors, researchers are uncovering previously unknown pathways involved in kidney disease. As these findings are translated into clinical practice, they may enable primary care providers to better predict which patients are most likely to develop CKD and tailor interventions accordingly.

#### *2.3.1. Technological Advancements*

Telemedicine has emerged as a valuable tool in the management of CKD, particularly in remote or underserved areas where access to nephrologists and healthcare facilities may be limited. Telemedicine allows for regular virtual consultations, enabling healthcare providers to monitor patients' kidney health, review lab results, and adjust treatment plans without the need for in-person visits. Studies have shown that telemedicine-based interventions can improve the management of chronic diseases, including CKD, by increasing patient adherence to treatment and enhancing care coordination [11]. In primary care, telemedicine can be integrated with routine screening protocols, ensuring that high-risk patients receive continuous monitoring and timely interventions.

Wearable devices represent another innovative development in CKD management. These devices, which can monitor various physiological parameters such as blood pressure, heart rate, and even biomarkers related to kidney function, provide real-time data that can be used to assess disease progression. For example, wearable sensors that measure blood pressure and albuminuria have shown potential in detecting early signs of CKD exacerbations and improving patient outcomes through early intervention. These devices can be particularly useful in primary care settings where continuous monitoring may not be feasible with traditional methods.

To fully realize the potential of emerging technologies and research in CKD management, strong policy frameworks are needed. Recommendations for improving CKD care in primary care settings include enhancing education and training for primary care providers on the latest advancements in CKD screening, diagnosis, and management. Ensuring that primary care professionals are equipped with the knowledge to integrate new biomarkers, diagnostic tools, and treatment protocols into routine practice is critical to improving early detection and outcomes for CKD patients. On a larger scale, national and international health policies must prioritize CKD prevention and management. Initiatives like the World Health Organization's (WHO) Global Kidney Health initiative have been instrumental in raising awareness about CKD and advocating for policies that promote early detection, preventive care, and equitable access to treatment. National governments should consider adopting universal screening programs for at-risk populations, funding research into novel therapies, and addressing the social determinants of health that contribute to CKD risk.

Moreover, policies that support the integration of digital health technologies, such as telemedicine and wearable devices, into routine primary care practice can help improve access to care, particularly in low-resource settings [12]. By establishing reimbursement models for telehealth consultations and remote monitoring, healthcare systems can encourage the adoption of these technologies, improving the efficiency and effectiveness of CKD management. The future of CKD risk factor management in primary care is promising, with emerging research, technological advancements, and supportive policies offering new opportunities for early detection and intervention. By identifying novel risk factors, leveraging new screening tools, and incorporating telemedicine and wearable devices into routine practice, primary care providers will be better equipped to manage CKD and improve patient outcomes. Additionally, addressing policy gaps and ensuring equitable access to CKD care will be crucial in reducing the global burden of this disease. Continued investment in research and innovation, coupled with systemic changes in healthcare policy, will be vital in transforming CKD care in primary care settings.

The risk factors for CKD in primary care settings are multifaceted, encompassing demographic factors, medical history, lifestyle choices, and genetic predisposition. **Demographic factors** such as age, gender, and ethnicity significantly influence the likelihood of CKD development, with older age and certain ethnic groups (e.g., African Americans and Hispanic populations) being at higher risk. **Medical history** plays a critical role, with hypertension, diabetes, cardiovascular disease, and obesity being the most prominent risk factors associated with CKD. Early detection and appropriate management of these conditions can substantially reduce the risk of CKD progression. **Lifestyle factors**, including poor diet, smoking, and physical inactivity, also contribute to CKD risk [13]. Primary care providers must be vigilant in addressing these modifiable risk factors, as lifestyle interventions are a key aspect of preventing or managing CKD. Additionally, **genetic factors** and **family history** of kidney disease further increase the risk of CKD, underscoring the need for personalized risk assessments in high-risk populations.

The importance of **screening and early detection** cannot be overstated. Routine testing for kidney function, such as measuring eGFR and urine albumin, is essential for identifying at-risk individuals and intervening before the disease progresses to later stages. Despite the availability of effective screening tools, barriers to early detection remain, including lack of awareness, financial constraints, and inadequate provider training in some primary care settings. Addressing these gaps through education and resource allocation is essential for improving CKD outcomes.

### *2.3.2. Call to Action for Primary Care Providers*

Primary care providers (PCPs) play a crucial role in the early identification and management of CKD. It is imperative for PCPs to maintain a high level of awareness regarding the risk factors and clinical signs of CKD, as well as the latest screening guidelines [14]. By routinely screening at-risk populations and implementing early interventions, primary care providers can slow the progression of CKD and reduce the need for costly and intensive treatments such as dialysis. Proactive management strategies, including control of hypertension, diabetes, and lifestyle modification, should be integrated into routine care for high-risk patients. Additionally, PCPs should be equipped with the knowledge and tools necessary for timely referral to nephrologists when specialized care is required.

The integration of CKD management into primary care holds significant potential for improving public health outcomes. By focusing on early detection, timely interventions, and proactive management of risk factors, the overall progression of CKD can be slowed, reducing the number of patients who ultimately require dialysis or kidney transplants. Addressing CKD at the primary care level can also result in substantial **cost savings** by reducing hospitalizations, the need for expensive treatments, and the long-term burden on healthcare systems. Furthermore, improved CKD management can significantly enhance the **quality of life** for patients, minimizing complications such as cardiovascular disease, reduced mobility, and kidney failure. Early intervention not only prevents the progression of CKD but also reduces the associated comorbidities, leading to better overall health outcomes and lower mortality rates.

### 3. Conclusion

In conclusion, CKD presents a growing challenge to global health, with significant implications for both individuals and healthcare systems. The primary care sector plays a critical role in early detection, risk factor management, and slowing disease progression. However, several barriers hinder effective CKD management, including limited access to specialized care, knowledge gaps among healthcare providers, and patient-related challenges such as adherence issues and socioeconomic constraints. Overcoming these obstacles requires a multifaceted approach, combining healthcare system improvements, enhanced provider education, and patient engagement strategies. Emerging innovations, such as telemedicine, wearable devices, and the identification of novel biomarkers, offer promising tools for improving CKD management in primary care settings. Additionally, policy reforms that prioritize CKD prevention and equitable access to care are essential to reducing the global burden of the disease. By fostering a more proactive and integrated approach to CKD in primary care, we can enhance patient outcomes, reduce healthcare costs, and ultimately mitigate the long-term impact of CKD on individuals and healthcare systems worldwide. A collective effort from healthcare professionals, policymakers, and patients is crucial in addressing the challenges of CKD and ensuring better management of this increasingly prevalent condition.

### Compliance with ethical standards

#### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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