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*Review*

# Importance of Early Diagnosis of Chronic Kidney Disease: An Updated Review

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## ABSTRACT

Chronic kidney disease (CKD) is an insidious progressive condition affecting millions worldwide, characterized by gradual loss of kidney function and associated with high morbidity and mortality. Late diagnosis often leads to cardiovascular and metabolic complications and the need for renal replacement therapies, implicating high economic costs and deterioration in quality of life. The importance of early diagnosis lies in the opportunity to intervene in early stages, slowing disease progression through strict control of risk factors such as hypertension, diabetes mellitus, dyslipidemia and lifestyle habits. Furthermore, early detection allows implementation of non-pharmacological measures and use of renoprotective therapeutic strategies including renin-angiotensin-aldosterone system inhibitors and new agents such as SGLT2 inhibitors. Periodic monitoring of estimated glomerular filtration rate (eGFR) and albuminuria forms the basis of screening, especially in at-risk populations. Population studies demonstrate that early-stage interventions can reduce the risk of progression to advanced stages by up to 50% and decrease adverse complications such as cardiovascular disease. Thus, early diagnosis of CKD proves to be an essential strategy to optimize clinical outcomes, reduce costs and improve patient quality of life, reinforcing the need for public health policies that promote screening and educational programs.

**Keywords:** Chronic kidney disease; Early diagnosis; Glomerular filtration; Albuminuria; SGLT2 inhibitors

## Introduction

Chronic kidney disease (CKD) is defined as the persistent loss of kidney function for a period equal to or greater than three months, characterized by structural or functional alterations in the kidneys that compromise systemic homeostasis[1,2]. The global prevalence of CKD has increased in recent decades, estimated at over 10% of the world population presenting some degree of renal impairment. In Brazil, epidemiological studies indicate a rising incidence, particularly among individuals with risk factors such as systemic arterial hypertension and type 2 diabetes mellitus. This condition imposes a huge burden on the healthcare system given the need for renal replacement therapies such as dialysis and transplantation, as well as the increase in adverse outcomes including cardiovascular disease and premature mortality. CKD progression is often silent, clinically manifesting only in advanced stages when eGFR falls below 30 mL/min/1.73 m² or in the presence of significant albuminuria (> 300 mg/24 h)[3].

At this stage, therapeutic options become more limited and the risk of hospitalizations, cardiovascular events and

metabolic complications rises considerably. In this context, early diagnosis emerges as a key strategy to halt or slow disease course through recognition of subclinical signs and adoption of targeted interventions. Numerous studies show that early identification of abnormalities in eGFR and albuminuria enables effective interventions[4,5]. Use of angiotensin-converting enzyme inhibitors (ACEi) and angiotensin receptor blockers (ARBs) has been shown to reduce glomerular loss progression and minimize proteinuria. More recently, sodium-glucose cotransporter type 2 (SGLT2) inhibitors and glucagon-like peptide-1 receptor agonists (GLP-1 RAs) have emerged as promising in CKD management, showing renal and cardiovascular benefits independent of glycemia. However, to maximize these benefits, it is essential that diagnosis occur at early stages when renal reserves still allow positive response to pharmacological and non-pharmacological interventions[6]. In addition to therapeutic advances, public health policies aimed at population screening in risk groups such as hypertensive, diabetic, obese individuals and those with family history of CKD are imperative.

International guidelines recommend annual assessment of eGFR and urinary albumin-to-creatinine ratio in these patients. Emerging biomarkers such as cystatin C and microRNAs have potential to increase early diagnosis sensitivity, although they still require further clinical validation[7]. Moreover, patient education plays a central role by promoting lifestyle changes, treatment adherence and comorbidity self-management. Targeted educational programs have demonstrated improvement in blood pressure and glycemic control, factors directly related to CKD progression. In this scenario, it becomes clear that early diagnosis of CKD constitutes a fundamental pillar of contemporary nephrology, integrating diagnostic advances[8,9], therapeutic strategies and population strategies that together aim to reduce morbidity and mortality and preserve renal function over time.

## Objectives

This article aims to critically review the available scientific evidence on the importance of early diagnosis of chronic kidney disease (CKD), highlighting its relevance in reducing the progression of renal dysfunction, associated cardiovascular and metabolic complications, as well as optimizing the use of Reno protective therapies.

## Materials and Methods

In this review, a bibliographic search was conducted on PubMed, Scopus and the Latin American and Caribbean Health Sciences Literature (LILACS) databases to identify relevant studies published.

## Discussion

Early detection of chronic kidney disease (CKD) plays a central role in preventing renal and cardiovascular complications and optimizing healthcare resources[10]. Population studies show that by identifying subclinical alterations in eGFR and albuminuria, it is possible to institute interventions that significantly slow disease progression. For example, use of renin-angiotensin-aldosterone system blockers at early stages can reduce annual eGFR decline by up to 30% compared to treatment started late in advanced stage. This renoprotective effect results from attenuation of glomerular hypertension and reduction of proteinuria, both critical factors in CKD evolution. In addition to pharmacological management, intervention on modifiable risk factors proves effective in containing renal progression. Strict blood pressure control, with a target below 130/80 mmHg for patients with persistent albuminuria, reduces the risk of adverse renal events by approximately 25%.

In diabetic patients, intensive glycemic control targeting an HbA1c near 7% reduces diabetic nephropathy incidence by up to 40%[11]. Moreover, lifestyle changes such as low-sodium diet, regular physical activity and smoking cessation are associated with improvements in renal function and long-term cardiovascular profile, elements intrinsically related to CKD outcomes. More recently, SGLT2 inhibitors and GLP-1 receptor agonists have expanded the therapeutic arsenal in nephrology. Randomized clinical trials show that empagliflozin and dapagliflozin reduce by about 35% the composite risk of progressive eGFR decline, need for renal replacement therapy or death from renal or cardiovascular causes. These drugs act not only in glycemic control but also on renal hemodynamic mechanisms by reducing glomerular hyperfiltration and mitigating interstitial inflammatory processes, justifying their early indication even in non-diabetic patients with moderate CKD.

From an economic perspective, early diagnosis and appropriate treatment have substantial implications in cost reduction. Cost-effectiveness models indicate that screening programs in risk populations spend about US$ 500 per patient diagnosed early, while annual cost of dialysis is around US$ 80 000 per patient. Thus, each dollar invested in early diagnosis and management returns multiple times in terms of public health and quality of life, besides relieving the burden on healthcare systems. However, logistical and structural barriers hinder universal implementation of screening programs. In remote regions and low-income communities, access to laboratories equipped for serum creatinine and albuminuria measurement is limited[12]. Pilot point-of-care (POC) testing projects demonstrate technical feasibility for albuminuria measurement in easily collected urine samples, with sensitivity above 85% compared to standard laboratory method. Integration of these technologies with telemedicine strategies can expand reach, allowing primary care professionals to remotely monitor high-risk patients and adjust conduct more promptly.

Patient and primary care professional education also constitutes a fundamental pillar. Training programs for family physicians in early CKD management improve adherence to screening guidelines and appropriate use of renoprotective medications, reflecting in higher case detection and lower disease progression[13]. For patients, educational actions aimed at understanding CKD risks, self-care importance and treatment adherence demonstrate significant improvement in blood pressure and glycemic control indicators, resulting in less eGFR decline. Finally, incorporation of artificial intelligence (AI) and big data analysis tools in nephrology practice offers promising perspectives[14]. Machine learning algorithms capable of integrating demographic, laboratory and clinical history variables can stratify CKD progression risk with accuracy above 90% in multicenter cohorts. This stratification allows efficient resource allocation, prioritizing interventions in patients with higher benefit probability and paving the way for precision medicine in nephrology. In sum, early diagnosis of CKD transcends mere recording of altered laboratory values: it represents a paradigm shift that combines screening, pharmacological and

non-pharmacological intervention, education and emerging technologies[15]. Consolidation of robust public policies and multidisciplinary integration involving nephrologists, general practitioners, nutritionists, health educators and software engineers are indispensable for the fullest realization of clinical and economic benefits.

## Conclusion

Early diagnosis of chronic kidney disease (CKD) is an indispensable strategy to alter the natural course of the disease, minimizing progression to end-stage renal failure and reducing associated complications. Detection at early stages not only allows timely implementation of Reno protective therapies such as renin-angiotensin-aldosterone system inhibitors and SGLT2 inhibitors but also the implementation of non-pharmacological interventions including strict blood pressure control, intensive glycemic management, promotion of healthy habits and adequate nutritional support. These measures, when executed in an integrated manner, have been shown to reduce the need for renal replacement therapy by up to 50% and prolong dialysis-free survival by more than five years in at-risk populations. From a public health perspective, adoption of screening programs in susceptible groups such as hypertensive, diabetic, obese and individuals with family history of CKD can mean billions in healthcare savings.

Cost-effectiveness of such initiatives is widely proven: every real invested in early diagnosis returns multiplied by reductions in hospitalizations, dialysis procedures and cardiovascular complications. Furthermore, patients' quality of life significantly improves as early interventions that delay CKD progression preserve functional autonomy and reduce symptoms such as fatigue, edema and electrolyte disturbances. However, to achieve these benefits in practice, structural and educational challenges must be overcome. Expansion of POC testing for albuminuria and creatinine alongside telemedicine platforms can provide coverage to geographically dispersed populations. Ongoing training of primary healthcare professionals through courses and simplified guidelines ensures greater adherence to screening and initial management recommendations.

Finally, active patient engagement through health education programs promoting self-management is crucial to maintain treatment adherence and lifestyle changes. Technological innovations such as emerging biomarkers (cystatin C, microRNAs) and AI models for risk prediction open new frontiers to enhance early diagnosis sensitivity and specificity. Precision nephrology grounded in genomic and phenotypic data promises to identify patient subgroups with optimized responses to specific Reno protective therapies, maximizing benefits and minimizing adverse effects. In conclusion, early diagnosis of CKD represents a milestone in contemporary nephrology, uniting diagnostic, therapeutic, educational and technological advances. Consolidation of public policies favoring risk population screening, strengthening primary care, adoption of new technologies and patient empowerment are key elements to transform the CKD landscape. Prioritizing early detection not only preserves renal function but also reduces healthcare costs and improves quality of life, consolidating a proactive and integrated approach that meets current and future population needs.

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