Clinical Journal for Medicine, Health and Pharmacy, Vol. 4, No, 3, September 2026
ISSN: 3049-1282

Missed Opportunities for Early Chronic Kidney Disease Detection Among Adults with Coexisting Diabetes and Hypertension in Primary Care

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Received: 25/June/2026; Revised: 06/July/2026; Accepted: 13/August/2026; Published: 30/September/2026

Abstract

Chronic kidney disease is a prevalent but mostly asymptomatic complication of diabetes and hypertension in the early stages. As such, its diagnosis is solely dependent on annual blood tests conducted by general practitioners who handle most adults suffering from these two diseases. However, there is still evidence showing that despite guideline-based recommendations that eGFR and UACR be measured annually for all patients, many of those who qualify are never even tested once in their life. This is an opportunity lost since the beginning of renal protection is delayed when it counts most. The purpose of the current investigation is to locate the places at which such missed opportunities occur during the care pathway of patients having diabetes mellitus and hypertension. Emphasis has been made on the completeness of testing, the recognition of abnormal findings, coding and staging of diagnoses, and delivery of preventive care. It has been highlighted that early diagnosis is not an independent activity, but a sequence of interrelated activities, and failure in any one step can defeat the entire purpose. This study considers the pathway as a series of interrelated cycles with identified points of loss, and associates each of the points of loss with a practical solution to address the problem at the systems level.

Keywords: Chronic Kidney Disease, Early Detection, Diabetes, Hypertension, Primary Care, Albuminuria Testing, Missed Opportunities.

1 INTRODUCTION

1.1 Background of Chronic Kidney Disease in Diabetes and Hypertension

Chronic kidney disease is characterized by abnormalities of structure or function of the kidneys lasting over three months and influencing a person's health. CKD is defined by reduced eGFR, the presence of albuminuria, or both (Stewart et al., 2024). CKD affects about one in ten adults worldwide and is an increasing cause of morbidity and mortality due to its association with early mortality, cardiovascular complications, and end-stage renal disease necessitating dialysis or transplantation (Bikbov et al., 2020). The two leading causes of CKD are diabetes mellitus and hypertension; both often coexist in one patient. In case both of these disorders are present, the kidneys suffer from metabolic injury because of persistent hyperglycaemia and from haemodynamic injury caused by high intraglomerular pressure (Tuttle et al., 2019; Fraser & Blakeman, 2016).

The initial stages of CKD are typically asymptomatic. Only severe functional impairment leads to signs such as oedema, proteinuria, and fatigue. Therefore, CKD will be detected in time only if healthcare providers specifically screen for it. Primary care has excellent access to adult patients with hypertension and diabetes who need frequent medical visits related to drug review, blood pressure measurement, and glycemic control (Shlipak et al., 2021). There are serious implications of late detection from an economic perspective as well as a personal one. Once the functionality of the kidneys has declined to the level where they have failed, then the only option left is either dialysis or transplantation, which imposes heavy burdens on the patient, family, and medical system. Even before that, however, CKD increases the chances of a person suffering from heart attacks, strokes, and heart failure, and, in many cases, this happens even before they get to experience renal failure.

1.2 Importance of Early Detection and Guideline-Based Testing in Primary Care

In line with international guidelines, it is recommended that adults with either diabetes or hypertension should get their eGFR and UACR checked annually, as they measure different features of kidney injury (Stewart et al., 2024; Tuttle et al., 2014). It is possible that serum creatinine values are normal even when there is albuminuria, and albuminuria is one of the earliest and most sensitive indicators of kidney injury in people with either diabetes or hypertension.

Early identification of this condition is important since there are currently treatments available for it. RAAS inhibitors, SGLT2 inhibitors, and finerenone, which is a mineralocorticoid receptor antagonist, have proven to delay decline of kidney function and minimize the risk of cardiovascular outcomes in people with diabetes and CKD (Perkovic et al., 2019; Heerspink et al., 2020; Bakris et al., 2020). The benefits of these drugs are best realized when they are initiated before significant function is lost. Therefore, diagnosing a patient late would mean more harm than just a delay in documentation.

1.3 Research Problem, Objectives, and Significance of the Study

Even though the evidence is compelling and the guidelines clearly articulated, studies in a number of different health care systems reveal that screening for albuminuria among diabetic adults and hypertensive adults is conducted much less often than is suggested, that CKD is under-diagnosed and under-treated. Here, a 'missed opportunity' is a consultation or test result where CKD should have been appropriately diagnosed, recognized, or managed, but where it has not been done. A missed opportunity could be at the testing stage, at the interpretation stage, at the diagnosis stage, or at the treatment stage.

The purpose of the study is to outline the points at which the detection of early CKD in people who have both diabetes and hypertension is missed within the primary care setting. This study will aim to explore the completeness of testing of eGFR and UACR, the follow-up of abnormal findings, coding of CKD and staging, the use of appropriate therapies for those patients and suggest interventions that

can close the gaps at each level. The importance of this study is determined by its consideration of process-related failure factors, which can be addressed immediately.

2 REVIEW OF LITERATURE

2.1 Guideline-Recommended Testing and Patterns of Actual Testing in Primary Care

Screening recommendations for the kidneys in individuals with diabetes and hypertension are fairly consistent amongst the guidelines of different major organizations, but in practice there is a lack of adherence to such recommendations (Fraser & Blakeman, 2016). It has been found from the analysis of national laboratory databases and large databases from different healthcare organizations for general practitioners that while the measurement of serum creatinine is done in the majority of individuals with diabetes annually, the measurement of UACR is done in a small number of them, and even fewer receive both the recommended tests (Alfego et al., 2021; Stempniewicz et al., 2021). Even less frequently, these tests are done on hypertensive patients without diabetes.

This indicates that the problem does not lie in the availability of the laboratory test itself, since creatinine is regularly tested at the same time intervals. The problem seems to relate to what is being ordered and what is being followed up. In this case, the automatic reporting of the eGFR together with creatinine may mislead doctors into thinking that the kidney function has already been tested, although albuminuria needs a separate urine sample and order (Stempniewicz et al., 2021).

Test ordering patterns vary among practices and among different patient populations. Patients who are older, who visit the doctor more frequently, and those under a structured diabetes care program usually receive tests more often, whereas those who have only hypertension, those who visit the doctor less often, and patients of clinics that lack reminder systems get tested least often (Alfego et al., 2021) (Shin et al., 2021). It can be concluded that the gap is created not only due to individual behavior of clinicians but also due to care organization – the premise on which this paper is based.

2.2 Recognition, Confirmation, and Diagnostic Coding of Chronic Kidney Disease

The presence of an abnormal finding does not mean that a diagnosis of CKD is made because a persistent abnormality is needed for at least three months, and so a second test must be done, and the result documented in the patient problem list along with its eGFR and albuminuria category (Stewart et al., 2024). From the evidence collected from primary-care registries, it is seen that a substantial number of individuals who qualify in laboratory tests for CKD are not diagnosed with the disease, and the coding is less likely in the early stages (Tuttle et al., 2019; Tummalapalli et al., 2019). Absence of a diagnostic code means that the decision support system, registry searches, and the dashboard cannot identify the individual.

Knowledge about the disease among the patients is also poor. Research has revealed that most adults with early CKD lack awareness of the disease, and awareness is even lower when there is a milder form

of the disease (Plantinga et al., 2008). If the clinician and the patient do not have a name for the disease, then the incentive to take the medication and maintain blood pressure becomes very low.

2.3 Delivery of Kidney-Protective Therapy and Referral

Randomized trials have shown that the use of SGLT2 inhibitors prevents the development of renal failure, decline in eGFR, and cardiovascular complications in adults with diabetes and CKD, and that the same benefits apply to those with CKD whether they have diabetes or not (Perkovic et al., 2019; Heerspink et al., 2020). Finerenone has additional benefits for individuals with albuminuria associated with diabetic kidney disease who are using a maximally tolerated RAAS blocker (Bakris et al., 2020). Consensus guidelines now suggest that these drugs be included in the treatment of diabetes upon recognition of CKD (Plantinga et al., 2008).

The use of these drugs, however, requires identification. Care studies among patients with CKD have demonstrated variability in the prescription of RAAS blockers and appropriate statins, continuing the use of drugs that are harmful to the kidney and delayed referrals to nephrology after considerable loss of kidney function has occurred (Tummalapalli et al., 2019). Prediction models of risk that employ eGFR and UACR will allow identification of candidates for referral, but such tools require both values.

2.4 Contributing Factors, Intervention Strategies, and Research Gap

A number of different issues can play into missed opportunities. On the part of clinicians, other priorities at the time of brief consultations, confusion about which person is meant to order the urine test, and a lack of knowledge about the albuminuria levels may be cited. In patients, problems providing and submitting the urine sample, no symptoms, and poor awareness of the risks associated with kidneys may make patients not follow through with their testing. Systemic level barriers include disconnected order sets, no automated prompts, and no registry-based audits that can detect such lapses (Shlipak et al., 2021; Tummalapalli et al., 2019). Possible interventions include electronic prompts, standing orders for UACR, pairing of the urine and blood samples at annual diabetes reviews, pharmacist-led medication optimization, and providing feedback on testing levels (Shlipak et al., 2021; Plantinga et al., 2008).

Research Gap

Earlier work has described low testing rates, under-coding of CKD, and under-use of protective therapy, but these findings have usually been reported separately and for diabetes or hypertension in isolation. Few studies treat the primary-care pathway as a connected sequence in which a loss at one stage reduces the benefit of every later stage. Even fewer focus on adults who have both diabetes and hypertension, who carry the highest risk and for whom missed detection is least excusable. A patient may have a recent eGFR and still have no UACR; may have an abnormal result and still have no repeat test; or may have a confirmed diagnosis and still not receive indicated therapy. The present study

addresses this gap by examining the full pathway, from testing to protective care, in adults with coexisting diabetes and hypertension, and by pairing each point of loss with a specific, practical remedy.

3 METHODOLOGY

3.1 Research Design and Detection Gap Framework

The study utilizes a descriptive cross-sectional retrospective record review design to quantify how adults with concurrent diabetes and hypertension are able to advance along the CKD detection pathway as recommended during the past twelve-month review period. The design is suitable since the study will be used to describe the current practice and identify any gaps and does not seek to determine causality. The study is based on the concept of a missed opportunity detection gap model with six interconnected steps, which are: identifying at-risk population, data collection, testing, classifying detection gaps, analysis, and clinical output. Under the testing and classifying detection gap steps, there are four forms of loss that will be studied: failure to test comprehensively, failure to recognize or confirm an abnormality, failure to code and stage the disease and failure to deliver protective treatment. Instead of the typical left to right block diagram approach, the framework is presented as a wheel around a hub to ensure that the model remains visible at all the steps in the study cycle.

Figure 1 depicts the six stages in the model. This cycle starts by identifying adults that have both diabetes and hypertension. It involves the following: data gathering, testing, assessment of gaps, and statistical analysis. The last stage of this cycle involves turning the results into reminders, care pathways, and collaboration with the team members; the outputs from this stage feed back into the first stage in order to include those patients that fell out of the detection pathway process.

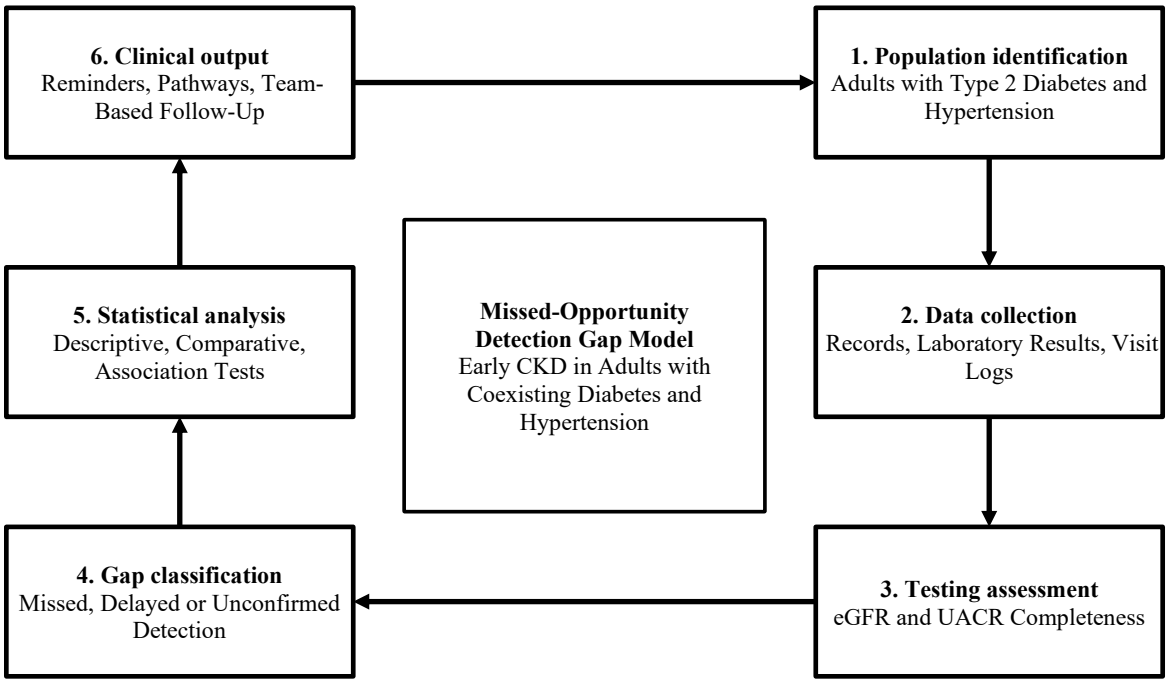


Figure 1: Circular Detection Gap Model for Early CKD Detection in Adults with Diabetes and Hypertension

3.2 Participant Selection and Primary-Care Cohort Profile

The study population will comprise of patients aged 18 years or more with an existing diagnosis of diabetes mellitus (type 1/2) and hypertension in their primary care record, and who have been with the practice for at least twelve months. Purposive sampling from the practice register is appropriate in this case since all the subjects included in the study will have had a chance to undergo screening in the look-back period. Subjects with a known diagnosis of CKD stages 4 and 5, dialysis treatment, kidney transplantation, pregnancy, or missing data in the look-back period will be excluded. Background information will be collected for each of the subjects in the form of age, sex, duration of diabetes, duration of hypertension, blood pressure and glycated haemoglobin readings, number of visits to the clinic, and practice details.

3.3 Detection-Pathway Assessment and Data Collection

Data will be collected from electronic health records, laboratory records, and prescription records through the use of the structured abstraction form. For testing, the abstraction form captures whether there was a measurement of serum creatinine with eGFR and UACR in the look-back period, whether there is a date for the measurement and whether spot urine dipstick test was conducted as an alternative to UACR. For recognition, the abstraction form captures whether there was an eGFR of less than 60 mL/min/1.73 m^2 and UACR of 30 mg/g or greater, and whether a repeat test was performed within the next three to four months. For diagnosis, the abstraction form captures whether CKD exists in the problem list, and whether the documentation of eGFR and albuminuria category exists. For management, the abstraction form captures whether there was a prescription of RAAS inhibitor, SGLT2 inhibitor and mineralocorticoid receptor antagonist where appropriate, and blood pressure and glycaemic targets, medication reviews, and nephrology referral in eligible patients.

Missed opportunities have been operationalised using rules that define them in relation to the stages they occur. In the testing stage, a patient would be considered to be a missed opportunity when there had been at least one visit in the look back period where the two tests were not conducted in the previous twelve months. In the recognition stage, a patient with an abnormal value without a repeat test done within four months will be considered as a missed opportunity. In the diagnosis stage, a patient with laboratory values meeting the CKD criteria on two different occasions within three months but with no diagnosis of CKD is considered to be a missed opportunity.

3.4 Measurement System, Statistics, and Ethics

The primary outcome measurements will be described as proportions of the eligible subjects: testing (both eGFR and UACR), abnormal test result verification, CKD diagnosis and staging, and receiving recommended treatment. The leakage at each stage will be measured as an absolute and relative difference between the proportion of patients in two subsequent stages. Descriptive statistics will be performed to describe the study sample and proportions in stages. Group comparisons will be made via chi-square test for categorical variables and independent samples tests for continuous variables.

Logistic regression will be conducted to determine the factors associated with testing completion and CKD diagnosis and staging. Inter-reviewer reliability will be assessed via the Kappa statistic. Ethical considerations include the Institutional Review Board approval, using anonymized medical records, restricted access to the dataset, and proper storage. Since the current research involves the review of records, informed consent can be exempted according to the requirements of the institution.

4 RESULTS AND DISCUSSION

4.1 Cohort Characteristics and Stage-wise Detection Pattern

Assessment of the Primary Care Cohort starts with patient demographics and clinical characteristics because variables such as age, length of disease, initial control of glycemia, and visitation frequency have direct effects on whether renal screening takes place in a timely manner. Patients with high visitation frequencies and lengthy disease histories tend to have more chances for lab tests than others.

The comparison between expectations according to the guidelines and actual practice in the clinic is carried out at each step of the continuum of care. (Note: The summary statistics and measures for the cohort provided below are parameters of the model meant to show applicability of the framework; they are meant to be replaced by empirical data collected from local primary care registries after the data collection process is over). After the last audit step is completed, the characteristics of the cohort, such as median patient age, percentage of females, median length of diabetes and hypertension, average glycated hemoglobin (HbA1c), average systolic blood pressure, and yearly clinical visits, along with proportions of patients in each step who have not undergone screening, will be provided.

4.2 Testing Completeness, Result Follow-up, and Related Barriers

Testing completeness and follow-through of findings are different aspects of the detection process. The patient may have undergone a laboratory test without any benefit resulting from the finding if it was not analyzed. Table 1 gives the markers, the technique used in their assessment, and the common gap identified on this particular stage. Two categories of failure can be identified in this context; those related to omission where the test was never ordered, and those related to follow-through, where the abnormal test finding was available but no action has been undertaken. The former requires modifications in ordering procedures while the latter requires modifications in result management.

Table 1. Summary of Key Indicators for Assessing Missed Opportunities in Early CKD Detection

Detection Stage	Key Indicators	Assessment Method	Gap Commonly Reported in Primary Care
Testing	eGFR and UACR Measured within 12 Months; Testing Interval	Laboratory Record Audit	UACR Ordered Far Less often than Serum Creatinine / eGFR
Result Recognition	Abnormal eGFR or UACR Flagged; Repeat within 3 Months	EHR Result and Follow-Up Review	Single Abnormal Values Left Unrepeated and Unconfirmed
Diagnosis and Staging	CKD Diagnosis Coded; G- and A-Stage Recorded	Problem-List and Registry Check	CKD Under-Coded; Patients Rarely told of the Diagnosis
Protective Care	RAAS Inhibitor, SGLT2 Inhibitor, BP and Glucose Control, Referral	Prescription and Clinic-Visit Data	Evidence-based Therapy Under-used were Indicated

The various measures employed in measuring each step of the pathway are presented in table 1. The use of the same measures in each step allows for a comparison of the recommended care and the care provided so that the practice is able to know which step must come first.

As can be seen in table 2, there is a connection between the categories. A test which is never ordered cannot be confirmed, an unconfirmed test result cannot be coded, and an uncoded diagnosis hardly leads to treatment or referral. The responses in the early categories have, therefore, the most influence on all subsequent categories. And finally, loss to follow-up compromises the entire process by excluding patients from the analysis completely.

The barriers mentioned in the literature can be grouped into three categories: clinician barriers, patient barriers, and system barriers. Clinician barriers include time pressure, ambiguity regarding ordering responsibilities of the urine test, and unfamiliarity with the categories of albuminuria. Patient barriers include urine collection difficulties and lack of symptoms and knowledge about the risks for their kidneys. System barriers include order sets which do not include UACR, uninterpreted results, and no reminders based on registry. It is important to distinguish these categories, since different solutions are required to solve these types of barriers: education and role clarity for the clinicians, sampling and explanation for the patients, and order set redesign for the system.

Table 2. Categories of Missed Opportunity, Their Consequences, and Suggested Responses in Primary Care

Category of Missed Opportunity	Typical Manifestation in Primary Care	Clinical Consequence	Suggested Response
Absent Albuminuria Testing	eGFR Reported with Routine Bloods but UACR Never Ordered	Early Kidney Damage with Preserved eGFR goes Unseen	Standing order Bundling UACR with Annual Diabetes and Blood Pressure Review
Unconfirmed Abnormal Result	Single low eGFR or Raised UACR with no Repeat Within Three Months	Chronicity cannot be Established, so no Diagnosis is Made	Automatic Repeat-Test Prompt and Result-Tracking List
Missing Diagnosis and Staging	CKD Absent from the Problem List; G and A Categories not Recorded	Patient and Team Unaware of Risk; no Registry Inclusion	Coding Prompts at Result Review; Registry-based Audit
Untreated Or Unreferred Disease	Indicated RAAS or SGLT2 Inhibitor not Started; Late Nephrology Referral	Faster Loss of Kidney Function and Higher Cardiovascular Risk	Pharmacist-Supported Medication Review; Referral Criteria in the Record
Loss to Follow-Up	No visit or Laboratory Contact for More Than Twelve Months	Silent Progression Between Contacts	Recall Lists, Care Coordinator Outreach, And Patient Reminders

4.3 Clinical Implications and Strategies for Closing the Detection Gap

The outcomes of such an evaluation have significant implications for the management of diabetes and hypertension in primary care. Firstly, in order to make up for the absence of UACR tests, practices may introduce a standing order where UACR is taken together with the other annual blood tests, and patients can provide their urine sample during the visit. Secondly, laboratory systems can flag the albuminuria status and the combined risk status along with eGFR, which will make it much harder to ignore any abnormalities. Thirdly, there can be an alert system for the repetition of an abnormal test at three months' interval and a recommendation to add CKD diagnosis to the patient's problem list, if the criteria are satisfied. Fourthly, a practice registry can be reviewed on a regular basis in order to identify any patients who have been overlooked in terms of testing, and a care coordinator or practice nurse can contact them. Finally, pharmacists and general practitioners can review the medication list and start/optimise RAAS inhibitors and SGLT2 inhibitors.

5 CONCLUSION

5.1 Summary of Findings and Overall Conclusion

This paper analyzes the missed opportunities to detect early CKD in adults who have diabetes and hypertension at the same time. The key point is that detection is a process of several stages (testing, identification, interpretation, staging, and protective actions) and the effectiveness of this process depends on the weakest link of this chain. The common problem identified in the literature are under-testing of albuminuria and under-coding of the condition; after them comes under-use of the medicines that protect from further complications of the condition. The detection gap analysis helps to see those problems and to develop a solution to each of them. As there is an available treatment to this condition, the main problem preventing good outcomes in this population is in delayed identification of the patients.

5.2 Clinical Implications, Limitations, and Future Research Directions

The implications for practice are that practices should include UACR as part of annual diabetic and hypertensive reviews, ensure abnormal results are not overlooked, diagnose CKD where appropriate criteria are met, and offer recommended therapy. Audit and feedback based on registry data might be useful for teams to track their performance. Limitations of the study design include that cross-sectional record review cannot reveal whether process improvement leads to better kidney outcomes. Also, there is the risk that routine records underreport testing conducted outside the practice, and there are differences in coding between practices. Furthermore, the figures reported in the results section are indicative only, and need validation with local data; results from a single health care system may not be applicable elsewhere. Future research could use a prospective or longitudinal design, a sample of multiple practice sites, as well as trials of the interventions presented here, with measures of decline in eGFR, hospitalisation and kidney failure among the outcomes.

Lastly, equity should be considered for future studies. People in low socioeconomic status, those who do not have access to primary health care, and individuals from minorities are usually the ones who bear the brunt of diseases such as diabetes, hypertension, and CKD and are probably the least tested among all other patients. The reporting of losses in these groups will tell whether there are improvements or worsening of disparities.

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