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Detection of chronic kidney disease in non-nephrology practices: An important focus for intervention

Educational initiatives are needed to ensure more cardiologists, endocrinologists, and internal medicine specialists screen their high-risk patients for decreased kidney function.

ABSTRACT:

Background: **Chronic kidney disease (CKD) is a significant public health concern. It is not known whether non-nephrology speciality physicians test for CKD in patients who are at increased risk.**

Methods: **An audit of six representative academic and nonacademic non-nephrology specialty practices in Vancouver, BC, was performed. The primary outcome of interest was evidence of testing for CKD (serum creatinine and/or urine microalbumin) in high-risk populations (patients with diabetes, hypertension, or cardiovascular disease or age greater than 50 years).**

Results: **260 patient charts were reviewed: 91% of patients had at least one risk factor for CKD. Diabetes was present in 36%, hypertension in 46%, cardiovascular disease in 34%, and 85% were older than 50 years. Serum creatinine was measured in 76% of patients and urine microalbumin in 21%. Multivariate models showed that serum creatinine testing was associated with presence of cardiovascular disease, number of visits, and being seen by specific physicians. Measurement of urine microalbumin was associated with presence of diabetes, number of visits, and being seen by one specific physician. A glomerular filtration rate (GFR) less than 60 mL/min/1.73 m² was noted in 28% of patients. Of those with GFR less than 30 mL/min/1.73 m², none were referred to a nephrologist.**

Conclusions: **Risk factors for CKD are common in patients referred to certain specialty practices. Testing for CKD varies according to patient characteristics and individual physician profiles. When CKD testing is performed, almost 30% of patients are found to have impaired GFR. These data suggest that there may be value in targeting subspecialist internists for educational interventions.**

Background

Chronic kidney disease (CKD) is a major public health problem, with increasing incidence and prevalence, poor outcomes, and high costs.[1-3] Long-term adverse outcomes associated with CKD include kidney failure, complications of impaired kidney function and, more commonly, an increased risk for cardiovascular disease and death.[4] There is increasing evidence in support of evaluation and management strategies, many of which have been synthesized into evidence-based clinical practice guidelines.[5,6] However, care for patients with kidney disease is suboptimal at present and many patients experience

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kidney failure or end-stage renal disease without previously having seen a nephrologist—a state of affairs that has a tremendous impact on costs and outcomes for these patients.[7-10] Improving patient outcomes requires implementing the recommended management strategies, beginning with testing and diagnosis.

Patients with diabetes or hypertension and patients older than 60 years are at increased risk for kidney disease and are often seen by non-nephrology specialists for other concerns. Given the high proportion of high-risk patients in certain specialty practices (cardiology, endocrinology, and internal medicine), physicians in these practices would be an important focus for educational interventions. It is not known whether specialty physicians are appropriately testing for the presence of CKD. In order to assess the current practice patterns for testing of kidney disease, we undertook an audit of non-nephrology specialty practices in Vancouver, BC.

Results

Six of the eleven physicians we approached agreed to participate in the study. The physician and practice characteristics of the participants were as follows: two females and four males; one physician had been in practice for less than 5 years, two had been in practice for 5 to 10 years, and three had been in practice for more than 10 years. Three of the practices were community-based office practices, and three were university-affiliated, hospital-based clinics. The practices varied in size from 600 to 5000 patients and the percentage of new patients seen per week ranged from 35% to 60%. In terms of size and new patient visits, these practice characteristics are similar to the majority of practices in the Lower Mainland area of British Columbia. There were no differences in demographics between those physicians who did and those who did not agree to participate.

Methods

A chart review of 260 patients in six specialty practices was performed. The six physicians included two endocrinologists, one cardiologist, and three general internists. The office charts of all patients who were seen in these practices during the last 2 weeks of November 2001, which predated the educational session, were reviewed. All unique practice and patient identifiers were deleted so that analyses could be performed without reference to these and confidentiality of all involved could be maintained.

Clinical variables

Information was abstracted from each patient's office chart. The following demographic and clinical information was collected: age; sex; history of diabetes, hypertension, and cardiovascular disease; number of visits to the physician; drug therapies being used at the time of a visit; and blood pressure measured and recorded at any visit. The following laboratory measurements were also collected: serum hemoglobin, serum creatinine, total serum calcium, serum phosphate, 24-hour urine collections for creatinine clearance and protein, and urine microalbumin or protein in urine from spot collection. The estimated glomerular filtration rate (eGFR) was calculated using the Modification of Diet in Renal Disease (MDRD) equation: $GFR = 186 \times (\text{serum creatinine})^{-1.154} \times (\text{age}^{-0.203}) \times (1.212 \text{ if black}) \times (0.742 \text{ if female})$.[11,12] Creatinine was measured in micromoles per litre (μmol/L) and patients were assumed not to be black.

Outcome variables

The primary outcome was the proportion of patients who were tested for kidney disease with serum creatinine or with urine microalbumin on at least one occasion in a 12-month period. Secondary outcomes included the prevalence of impaired GFR and management of patients with CKD. Impaired GFR was stratified according to the following values: GFR ≥ 60mL/min/1.73 m^2, GFR ≥ 30–59 mL/min/1.73 m^2, GFR ≥ 15–29 mL/min/1.73 m^2, and GFR <15 mL/min/1.73 m^2.[13] Indicators of appropriate care for patients with CKD included the mean level of achieved blood pressure, the proportion of patients on an angiotensin-converting enzyme (ACE) inhibitor or angiotension receptor blocker, and referral to a nephrologist for patients with GFR < 30 mL/min.

Table 1. Clinical characteristics of study cohort.

Variable	n (%)
	N = 260
Demographics	
Age (median)	65 (23)
Female	159 (61)
Risk factors	
Diabetes	85 (33)
Hypertension	118 (45)
Cardiovascular disease	80 (31)
Age >50	199 (77)
Number of risk factors	
0	23 (9)
1	78 (30)
2	85 (33)
3	63 (24)
4	11 (4)
Follow-up history, median (range)	2 (3)

Statistical analyses

Descriptive statistics were presented as frequencies or means with standard deviation or median with interquartile range, depending on the underlying distribution. Variables were compared using the *t*-test, Wilcoxon rank sum test, or chi-square test, where appro-

Table 2. Frequency of testing for chronic kidney disease with serum creatinine or urine microalbumin.

	Total (N = 260)	Serum creatinine			Urine microalbumin		
	n (%)	Tested	Not tested	*P* value	Tested	Not tested	*P* value
n (%)		192 (74)	68 (26)		57 (22%)	204 (78%)	
Demographics							
Age, median (interquartile range)	65 (23)	64 (54–75)	58 (45–67)	<0.01	63 (44–70)	69 (57–75)	<0.01
Female	157 (60)	112 (58)	47 (69)	0.15	35 (61)	124 (61)	0.93
Risk factors							
Diabetes	85 (33)	65 (34)	20 (29)	0.51	50 (88)	35 (17)	<0.01
Hypertension	117 (46)	98 (51)	20 (29)	<0.01	25 (44)	93 (46)	0.79
Cardiovascular disease	80 (31)	72 (38)	8 (12)	<0.01	12 (21)	68 (34)	0.07
Age >50	199 (77)	156 (80)	43 (64)	<0.01	39 (68)	160 (79)	0.10
Number of risk factors							
0	23 (9)	10 (5)	13 (19)	<0.01	0 (0)	23 (11)	<0.01
1	77 (30)	48 (25)	30 (44)		18 (32)	60 (30)	
2	85 (33)	71 (37)	14 (21)		13 (23)	72 (35)	
3	63 (24)	53 (28)	10 (15)		21 (37)	42 (21)	
4	11 (4)	10 (5)	1 (1)		5 (9)	6 (3)	
Number of visits, median (range)	2 (3)	2 (1–5)	2 (1–2)	<0.01	3 (2–11)	2 (1–3)	<0.01
1	82 (32)	50 (26)	32 (47)	<0.01	8 (14)	74 (36)	<0.01
2	74 (28)	53 (28)	21 (31)		17 (30)	57 (28)	
>2	104 (40)	89 (46)	15 (22)		32 (56)	72 (35)	

priate. Univariate analyses examined the relationship between demographic, clinical, or physician practice variables and each outcome. Multivariate models using generalized estimating equations were then used to generate estimates of standard errors given clustering of patients within physician practices. Variable selection for regression models was performed using backward elimination.

Results

The six physicians participating in the study saw a total of 260 patients during the observation period. **Table 1** shows the clinical characteristics of the patient cohort. A substantial proportion (91%) of patients seen in these specialty practices had at least one risk factor and 61% had more than one risk factor. Age greater than 50 years was the sole risk factor in 16% of patients; 32% of patients were seen for the first time during the observation period, and 40% had been seen more than twice by the specialist.

Testing for kidney disease

Overall, 74% of patients had at least one measurement of serum creatinine documented in their charts. **Table 2** shows the clinical characteristics of patients who were tested compared with those who were not tested for kidney disease. In patients who had at least one risk factor, 77% had a measurement of serum creatinine, 24% had a measurement of urine microalbumin, and testing for both was performed in 20%. Five patients had documentation for urine microalbumin but not for serum creatinine.

Multivariable models using generalized estimating equations that adjust for the clustering of patients within practices showed that independent predictors for testing of serum creatinine (**Table 3**) were older age, the presence of cardiovascular disease, having been seen more than one

Table 3. Predictors of serum creatinine testing.

	Odds ratio	95% CI
Risk		
Age	1.03	1.00–1.05
Hypertension	1.82	0.91–3.62
Cardiovascular disease	2.80	1.11–7.09
Physician*		
1	0.96	0.81–1.13
2	0.35	0.22–0.57
3	0.49	0.41–0.58
4	0.55	0.33–0.93
5	0.92	0.59–1.44
Number of visits (>1 vs 1)	3.36	1.64–6.85

*Compared to Physician Number 6

time by the physician, and being seen by specific physicians. Independent predictors for testing of urine microalbumin (**Table 4**) were the presence of diabetes and being seen by one specific physician—one of the two participating endocrinologists.

Prevalence of CKD

The median serum creatinine for the cohort was 81 µmol/L (range 67–104) and the mean estimated GFR was 76±26 mL/min/1.73 m^2. Older patients and patients with hypertension, cardiovascular disease, and a greater number of risk factors had significantly lower GFR values (P<0.01) (see **Figure**). **Table 5** shows the prevalence of impaired GFR stratified according to the National Kidney Foundation Kidney Disease Outcomes Quality Initiative (K/DOQI) staging system. A GFR of less than 30 mL/min/1.73 m^2 was noted in six patients (3%).

Discordance between serum creatinine and GFR values (i.e., normal serum creatinine with a GFR that is calculated at less than 60 mL/min/1.73 m^2) was noted in 36% of the cohort. The prevalence of this discordance was similar in all patients, regardless of age.

Management of blood pressure and referral to nephrology

Blood pressure was documented in the charts of 97% of patients. The mean blood pressure was 136±23/78±11. ACE inhibitors or angiotension receptor blockers were used in approximately 50% of patients. Older patients and patients with diabetes, hypertension, cardiovascular disease, and more severe impairment of kidney function were more likely to be prescribed one of these medications.

Of the cohort, seven patients had been referred to nephrologists. Of those, two had Stage 2 disease and five had Stage 3 disease. None of the patients with GFR <30 mL/min/1.73 m^2 had been referred at the time of chart review.

Conclusions

Our examination of unselected high-risk patients in six representative urban non-nephrology specialty practices showed that 91% of patients had at least one risk factor for CKD, and at least 50% had two risk factors for CKD. Of those patients with risk factors, 76% had at least one measurement of serum creatinine and only 24% had a measurement for urine microalbumin. Importantly, of those tested, 28% had a GFR < 60 mL/min/1.73 m^2.

Serum creatinine

The K/DOQI guidelines define CKD as reduced GFR or kidney damage that is present for 3 months or longer.[13] Current recommendations include regular testing for CKD in people at increased risk for CKD or with cardiovascular disease,[6,14,15] with measurement of serum creatinine to estimate the GFR.[6] Three-quarters of patients in this study had a measurement of serum creatinine at least once over the follow-up period. This rate of testing is higher than the 53% of patients with hypertension or diabetes who were tested in primary care practices in the United Kingdom over a 24-month interval. This rate is also higher than assessments of testing for serum creatinine in other populations,[16] and in the 40% of patients older than 50 years or with diabetes, hypertension, or cardiovascular disease in the British Columbia general population tested over a 24-month interval (personal communication, Dr H. Platt, Resource Utilization Branch, MOH BC), and in the 30% of patients older than 60 with diabetes or hypertension tested in a US regional commercial laboratory.[17]

Table 4. Predictors of urine microalbumin testing.

	Odds ratio	95% CI
Diabetes	29.20	10.23–83.40
Physician*		
1	1.39	1.23–1.56
2	8.45	7.72–9.25
3	1.44	1.30–1.58
4	1.57	1.27–1.79
5	4.51	3.70–5.51
Number of visits (>1 vs 1)	4.78	1.87–12.21

*Compared to Physician Number 6

Table 5. Prevalence of impaired GFR in patients who had at least one risk factor (N = 260).

GFR*	n (%)
>60	138 (72)
30-60	46 (24)
15-30	6 (3)
<15	2 (1)

*Glomerular filtration rate, measured in mL/min/1.73 m^2

The higher rate of testing documented in the current study may signify an appropriate greater sensitivity to kidney disease by non-nephrology specialists and internal medicine subspecialists. Despite the relatively high rate of testing in this audit, measurement of serum creatinine was not universal for all high-risk patients. Given the importance of serum creatinine as a test for CKD as well as for medication selection and dose adjustment, together with its widespread availability and low cost, optimal care for these high-risk patients would require documenting the measurement of serum creatinine in all of their charts.

Urine microalbumin

Only 20% of the patient cohort and 50% of patients with diabetes had urine microalbumin checked. These results are consistent with estimates

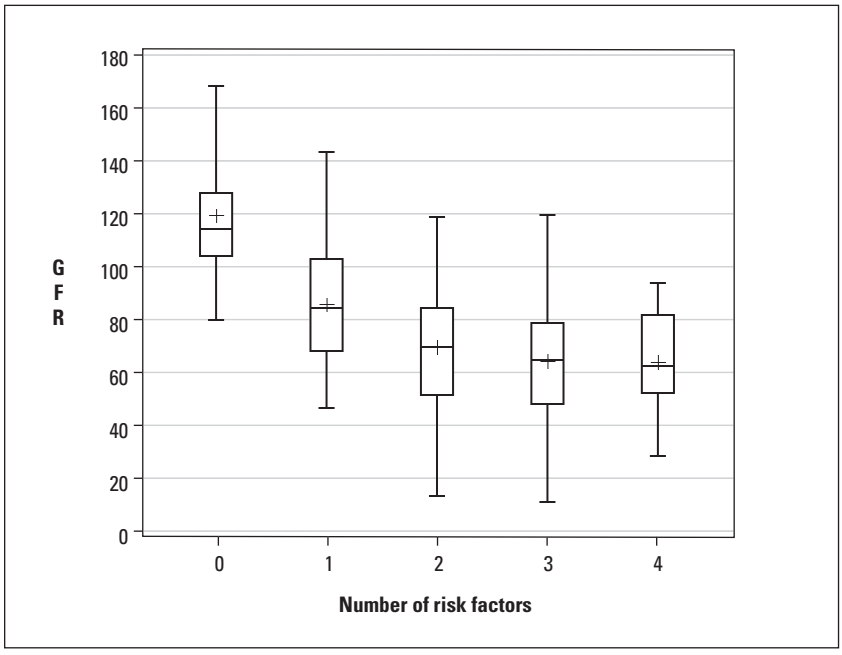

Figure. Mean glomerular filtration rate according to the number of risk factors.

The median levels of serum creatinine for the groups were 57 µmol/mL (range 54–65) for no risk factors, 71 µmol/mL (range 63–89) for one risk factor, 85 µmol/mL (range 75–105) for two risk factors, 89 µmol/mL (range 70–115) for three risk factors, and 100 µmol/mL (range 80–113) for four risk factors. Chronic kidney disease is defined as a GFR <60 mL/min/1.73 m^2.

of primary care physicians in the United States and reports of general practitioners' practices in British Columbia, where 37% and 27%, respectively, checked for urine microalbumin in their patients with diabetes.[18,19]

The different rates for the assessment of urine microalbumin and serum creatinine in patients with different risk factors are consistent, given the divergent recommendations for kidney disease testing in different disease-specific guidelines. The Joint National Committee guidelines for hypertension recommend testing kidney function with only serum creatinine,[20] whereas the American Diabetes Association and Canadian Diabetes Association did not, until recently, recommend testing for kidney disease with anything other than urine microalbumin.[21] While this has now changed, at the time of our study the new guidelines were not in effect. The Joint National Committee, American Diabetes Association, and Canadian Diabetes Association guidelines are inconsistent with the K/DOQI guidelines for CKD, which recommend testing for both estimated GFR and urine microalbumin for high-risk populations. In our cohort, over 30% of patients had at least two risk factors. It is possible that inconsistencies between the CKD, hypertension, and diabetes guidelines lead to physician uncertainty regarding the correct course of action for individual patients. If we are to effectively translate guidelines into clinical practice, we recommend consistency between the disease-specific guidelines.

Physician variations

Our study also demonstrated that specific physicians were more likely to test for CKD than others, even after we adjusted for patient characteristics and despite proximity to each other. This finding is consistent with previous reports demonstrating variations in individual physician practices.[22,23] We are not able to establish whether this variation is related to deficiencies in physician knowledge, disagreement with the guidelines, presumption that another physician is ordering the tests, constraints on a physician's ability to order the test, or patient-related factors. Given the ease of ordering serum creatinine, we would not expect structural barriers or patient compliance with testing recommendations to be significant impediments. Whatever the reason, we must consider these variations when developing educational initiatives directed at the unique needs of individual physicians.[24]

Education needed

We documented a 25% prevalence of moderately or severely decreased kidney function (GFR <60 mL/min/1.73 m^2) in those patients sent for serum creatinine testing. This prevalence is substantially higher than the 5% estimated from population-based surveys in the United States[25] and highlights the potential importance of education for internal medicine specialists who see patients at increased risk for CKD frequently.

In those patients who had GFR <60 mL/min/1.73m^2, 36% had normal values for serum creatinine, a figure consistent with reports in other populations and settings.[17,25-28] It is unlikely that these patients have been recognized as having kidney disease. This supports recommendations by the National Kidney Foundation, the National Kidney Disease Education Program of the US National Institutes of Health, and the American Society of Nephrology, and it also supports

the recent initiative by the British Columbia Ministry of Health to have clinical laboratories report GFR estimates whenever a serum creatinineis is ordered.[14,29]

The focus of this study was not to define the management of CKD by these physicians, yet it is interesting to note that despite severely decreased GFR (<30 mL/min/1.73 m^2), few patients were referred to a nephrologist.

A substantial number of patients with easily identifiable risk factors do not receive testing for kidney function. Among those tested, a substantial proportion had significantly impaired kidney function.

Study limitations

This study has several limitations. First, the physician and patient samples are smaller. We only describe the practices of six physicians in three specialities in an urban area and cannot comment on the impact of specific speciality training or geographical location in determining the variations in care. Nonetheless, the physicians do represent a spectrum of clinical practice. As well, the results are consistent with a similar survey of international speciality practices.[30] Moreover, these results likely represent a best-case scenario, given the volunteer nature of participation. Second, we cannot determine physicians' propensity to test specific individuals as we did not conduct interviews with individual physicians. Third, we cannot differentiate tests or processes of care that were *not performed* from those that were *not recorded* in the medical record. However, all physicians in our study used paper medical charts exclusively. So, it is reasonable to assume that all information that the physicians had available would be contained within the charts.

Summary

The results of our study show that a substantial number of patients with easily identifiable risk factors do not receive testing for kidney function. Among those tested, a substantial proportion had significantly impaired kidney function. This demonstrates that despite recommendations for screening by the National Kidney Foundation, Joint National Committee, American Diabetes Association, and Canadian Diabetes Association, there is a gap between guidelines and clinical practice. At this time, most educational strategies regarding CKD are targeted at general practitioners. Given the prevalence of CKD in the specialty practices discussed here, it may be important to refocus educational programs for physicians caring for the high-risk patients seen in these practices. Ideally, a more central role for non-nephrology internal medicine specialists needs to be assumed in the early detection and preliminary management of kidney disease.

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Competing interests

None declared.

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