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Original Research

AWAREness of Diagnosis and Treatment of Chronic Kidney Disease in Adults With Type 2 Diabetes (AWARE-CKD in T2D)

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Key Messages

- Past studies found low physician adherence to clinical guidelines for diabetes management in chronic kidney disease and poor patient awareness of their disease.
- Family physicians and endocrinologists were inadequately using urine albuminuria tests, delaying diagnosis and prompt attention to therapy for kidney disease.
- In this study's highly specialized endocrinology-led practice, one-half of the patient cohort was not aware of a kidney disease diagnosis.

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ABSTRACT

Objectives: Diabetes remains the leading contributor to the development of chronic kidney disease (CKD) and end-stage kidney disease, emphasizing the urgency of identifying barriers to early diagnosis and intervention. The primary objective of this study was to describe the awareness, values and preferences of physicians and patients with respect to managing CKD among patients with type 2 diabetes (T2D).
Methods: A cross-sectional survey was conducted among physicians and adult patients with T2D and CKD based on estimated glomerular filtration rate and urine albumin-to-creatinine ratio (uACR) measured within 1 year. Physicians were recruited from email networks across Canada, excluding Alberta, and patients were recruited from LMC Diabetes and Endocrinology clinics in Ontario and Quebec. Two separate surveys were developed by a steering committee. Survey responses from 160 physicians (60 general practitioners, 50 endocrinologists and 50 nephrologists) and 169 patients were analyzed descriptively.
Results: Gaps in physician care included insufficient use of uACR screening, limited knowledge or use of Kidney Disease Improving Global Outcomes (KDIGO) and KidneyWise resources and lower than expected prescription of recommended therapies. The patient data showed 51.5% of patients were unaware of a CKD diagnosis, and 75.6% of patients who received a prior CKD diagnosis would have preferred an earlier diagnosis.
Conclusions: The results highlight several opportunities for improving CKD in T2D management. More education and clarity are needed for physicians interpreting uACR levels that should prompt a referral to a nephrologist, and additional understanding of kidney risk progression is vital for patients.

Mots clés:
maladie rénale chronique
conscientisation des patients
conscientisation des médecins
préférences de traitement
diabète de type 2

RÉSUMÉ

Objectifs : Le fait que le diabète demeure la cause principale de l'apparition de l'insuffisance rénale chronique (IRC) et de l'insuffisance rénale terminale souligne l'urgence de déterminer les obstacles au

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diagnostic et aux interventions précoces. Le principal objectif de la présente étude était de décrire la conscientisation, les valeurs et les préférences des médecins et des patients quant à la prise en charge de l'IRC chez les patients atteints du diabète de type 2 (DT2).

Méthodes : Nous avons mené une enquête transversale auprès des médecins et des patients adultes atteints du DT2 et de l'IRC en fonction de la mesure du débit de filtration glomérulaire estimé et du calcul du rapport albuminurie:créatininurie (RAC) dans 1 année. Nous avons recruté les médecins à partir de réseaux de messagerie électronique du Canada, sauf de l'Alberta, et nous avons recruté les patients dans les cliniques LMC de l'Ontario et du Québec. Un comité directeur a élaboré 2 enquêtes distinctes. Les réponses de 160 médecins (60 omnipraticiens, 50 endocrinologues et 50 néphrologues) et de 169 patients aux enquêtes ont fait l'objet d'une analyse descriptive.

Résultats : Les lacunes dans les soins des médecins ont notamment été le recours insuffisant à l'évaluation du RAC, les connaissances ou l'utilisation limitées des ressources de KDIGO et de KidneyWise, et le nombre de prescriptions de traitements recommandés moindre que prévu. Les données sur les patients ont montré que 51,5 % des patients ignoraient le diagnostic de MRC, et que 75,6 % des patients qui avaient déjà reçu un diagnostic de MRC auraient souhaité recevoir ce diagnostic plus précocement.

Conclusions : Les résultats font ressortir plusieurs possibilités pour améliorer la MRC dans la prise en charge du DT2. Les médecins doivent recevoir davantage de formation et de précisions pour interpréter les concentrations du RAC afin d'accélérer l'aiguillage vers un néphrologue, et les patients doivent avoir une meilleure compréhension de la progression du risque de maladie rénale.

Introduction

Diabetes mellitus is the predominant risk factor for the development of chronic kidney disease (CKD) (1) and end-stage kidney disease (ESKD), with approximately 1 in 3 people developing diabetic kidney disease and associated complications (2,3). CKD and ESKD among people with diabetes contribute independently to an elevated risk of cardiovascular (CV) events, heart failure, higher hospitalization rates, reduced quality of life and premature death (4–7). The clinical emphasis of mitigating risk factors associated with CKD among people with type 2 diabetes (T2D) highlights the importance of early diagnosis and effective therapy for CV and kidney risk protection.

For patients with CKD and T2D, current clinical practice guidelines recommend a comprehensive strategy to reduce risks of kidney disease progression and CV disease, including glycemic monitoring and blood pressure optimization; treatment with angiotensin-converting enzyme inhibitors (ACEis) or angiotensin receptor blockers (ARBs) in patients with hypertension or albuminuria; treatment with lifestyle therapy for all patients; a sodium-glucose cotransporter-2 inhibitor (SGLT2i) and metformin for patients with T2D, CKD and an estimated glomerular filtration rate (eGFR) $\geq$30 mL/min per 1.73 m^2; and implementation of a self-management educational program (8–11). Despite recent updates to clinical practice guidelines, the overall uptake of these guidelines are likely suboptimal because adherence to Kidney Disease Improving Global Outcomes (KDIGO) 2012 guidelines in real-world nephrology practice settings was reported to be low (12). Substantial gaps in quality of CKD care in primary care practice have also been reported, with a high occurrence of uncontrolled hypertension, a low rate of kidney function and blood pressure monitoring, declined ACEi/ARB use over time and underused statins (13,14). Various factors could impact adherence to clinical practice guidelines, such as patient and physician awareness (familiarity with the medical condition and guideline recommendations), self-efficacy of physicians with following guidelines, patient values (relative importance of a health state) or patient and physician preference for or against an intervention (15–18). The considerable variation in quality of care across countries, physicians and practice settings (12–14) indicates a critical need for improvement.

Among adults with T2D, screening for CKD is important for early intervention. Screening for albuminuria and assessment of serum creatinine, converted to eGFR for CKD, is recommended at the time of diagnosis for adults (9). Despite these recommendations, there is evidence of inadequate patient awareness of CKD diagnosis among patients with and without diabetes in primary care settings (19–22), and among patients receiving publicly funded health care (undefined care setting) in Quebec, Canada (23). How these findings extend to patients with T2D cared for by physicians in an endocrinology-led practice is unclear. To our knowledge, no prior studies have reported on physician awareness, values and preferences for managing CKD in T2D across physician specialities, or patient awareness, values and preferences of patients with CKD and T2D followed in a specialty care practice. Therefore, the primary objective of this study was to describe the awareness, values and preferences of physicians (general practitioners [GPs], endocrinologists and nephrologists) and patients on managing CKD in T2D. Secondary objectives were to assess awareness of available CKD treatments and referral tools including KidneyWise (Ontario resource) (24), KDIGO guidelines (11) and Diabetes Canada guidelines (9), and communication between patients and physicians.

Methods

Study design

A cross-sectional survey study was conducted among physicians who treat patients with CKD and T2D, and among patients with CKD and T2D. The study protocol and physician and patient surveys were approved by an independent ethics committee, and all study participants provided informed consent. Eligible study participants were sent an email invitation to participate in the electronic survey platform, and the surveys were self-administered online. The invitation to participate consisted of a brief description of the study, an electronic link and password to access the survey, the informed consent form and a contact email for any questions. The recruitment process for the patient cohort was entirely separate from the patient's health care appointments with their endocrinologist. Eligible patients were identified using the LMC Diabetes Registry, subsequently described in more detail. Survey data were collected between June 15, 2020, and March 31, 2021. The study was conducted in compliance with the ethics principles of the Declaration of Helsinki and registered on ClinicalTrials.gov (NCT04498156).

Participants

Study participants included physicians and patients, recruited independently of each other. Physicians were recruited from

physician email networks. Eligible physicians included licensed GPs, endocrinologists and nephrologists currently providing care for patients with CKD in T2D. To minimize selection bias, inclusion of endocrinologists from LMC Diabetes and Endocrinology (LMC) clinics was capped at 50% of participating endocrinologists.

Patients were recruited from 12 of 13 endocrinology clinics affiliated with LMC (LMC clinics), which provided access to additional patient data from the LMC Diabetes Registry. The LMC Diabetes Registry holds the electronic medical records of >42,000 patients with diabetes in Canada's largest single-specialty group of 13 endocrinology clinics in Ontario, Quebec and Alberta. The one LMC clinic in Alberta was excluded from study recruitment because of research ethics board constraints, requiring additional funding and time for a separate local research ethics submission, which unfortunately did not fit the study's budget and timelines. Because of these restrictions for the province of Alberta, neither patients nor physicians could be recruited from Alberta.

Patients were included in the study if they were ≥18 years of age, had a diagnosis of T2D, had an eGFR <60 mL/min/1.73 m^2, or had an eGFR ≥60 mL/min/1.73 m^2 and urine albumin-to-creatinine ratio (uACR) ≥2 mg/mmol measured within the last year based on data from the LMC Diabetes Registry, and had no documented nondiabetic etiology for kidney disease. To supplement the patient survey responses, additional data were retrieved from the LMC Diabetes Registry to describe the patient cohort in more detail. The patient data included sociodemographic information, medical history, laboratory measurements within the last year and prescribed medications. eGFR measurements were used to describe CKD severity (mild: eGFR ≥60 mL/min/1.73 m^2 and uACR ≥2 mg/mmol; moderate: eGFR 30 to 59 mL/min/1.73 m^2; severe: eGFR ≤29 mL/min/1.73 m^2) for each patient. To access the additional patient data, patients enrolled in the study had to be part of the LMC Diabetes Registry; therefore, only patients in Ontario and Quebec were included, whereas the physician cohort included physicians across all provinces in Canada except for Alberta.

Survey development

The surveys were developed by a steering committee, consisting of a GP (P.L.), endocrinologist (A.A.), nephrologist (A.S.), epidemiologists (L.C. and S.K.B.), Bayer representatives (A.C. and M.F.) and a patient representative with CKD and T2D. The surveys consisted of multiple choice, Likert-type and ranking questions. For physicians completing the survey, demographic information and clinical practice details were collected. The physician survey contained 5 patient case studies developed by the steering committee. Patient age; sex; T2D duration; glycated hemoglobin, eGFR and uACR measurements, and any medications were provided for each case study, representing patients at various stages of CKD progression based on eGFR and albuminuria in accordance with KDIGO categories (case 1: stage G2 A2; case 2: stage G3a A1; case 3: stage G3b A2; case 4: stage G4 A2; case 5: stage G5). However, the physicians completing the survey were not provided the corresponding stage of CKD diagnosis. In addition to the case studies, questions designed to assess values, preferences and factors that influence clinical management were built into the physician survey. These factors, as described by Cabana et al (15) and Espeland and Baerheim (25), consisted of the following: awareness, outcome expectancy (the expectation that performing a specific task will lead to a positive health impact), process expectancy (the expectation that following a specific task will lead to better process of care) and self-efficacy (the belief that one can actually perform a behaviour). The patient survey included questions to capture demographic information, including age bracket and sex, and questions to assess awareness of CKD, and values and preferences for management and treatment of CKD in T2D. Patient data on quality of life questions were also collected, and both of the physician and patient surveys included questions assessing patient-physician interactions.

Statistical analysis

The statistical analysis was explorative and descriptive in nature. The count (n) and proportion (%) of respondents endorsing each response option were reported. Demographic variables were summarized as count and percentage for categorical variables, and mean and standard deviation or median and first quartile and third quartile for continuous variables. Results were summarized separately for patients and physicians. Patient results were stratified by CKD severity (mild: eGFR ≥60 mL/min/1.73 m^2 and uACR ≥2 mg/mmol; moderate: eGFR 30 to 59 mL/min/1.73 m^2; severe: eGFR ≤29 mL/min/1.73 m^2), whereas physician results were stratified by specialty (GPs, endocrinologists and nephrologists). The statistical analysis was performed using R version 4.0.5 (R Foundation for Statistical Computing).

Results

The surveys were completed by 160 physicians and 170 patients. A total of 4,371 email invitations to participate were sent to Canadian GPs, endocrinologists and nephrologists, and 7,499 email invitations were sent to LMC patients. The response rate for physicians and patients was 3.6% (160 of 4,371) and 2.3% (170 of 7,499), respectively. The low response rate was due to having a capped number of surveys and not due to poor response to the email invitations to participate. Among physician respondents, 60 (37.5%) were GPs, 50 (31.3%) were endocrinologists and 50 (31.3%) were nephrologists. Of the 50 endocrinologists surveyed, 50% were LMC physicians and 50% were external to LMC. Physician characteristics and clinical practice details are presented in Table 1. In the patient group, data from one patient were excluded from the analysis because of immunoglobulin A nephropathy, which was indicated in the patient's medical history. Among the remaining 169 patient respondents, 85 (50.3%), 55 (32.5%) and 29 (17.2%) had mild, moderate and severe CKD, respectively, based on biochemical laboratory results measured within 1 year of the study start date.

Data retrieved from the LMC Diabetes Registry showed mean ± standard deviation for patient age and diabetes duration were 63.6±11.7 years of age and 16.2±8.7 years, respectively. Median glycated hemoglobin was 7.0% (interquartile range, 6.5 to 7.9). Obesity, defined as body mass index ≥30 kg/m^2, was found among 61.5% of the patients. ACEis/ARBs were prescribed in 123 patients (72.8%), and an SGLT2i was prescribed in 85 patients (60.3%) with an eGFR ≥30 mL/min/1.73 m^2 (n=141). Additional patient characteristics collected from the survey are presented in Table 2.

Self-reported physician diagnosis and management strategies (case study results)

For the diagnosis of CKD severity for case 3, describing a patient with stage G3b and A2 according to KDIGO eGFR and albuminuria categories, 8 physicians (5%) indicated mild CKD and 11 physicians (6.9%) indicated severe CKD, whereas most physicians (88.1%) identified the case as moderate CKD. According to the most recent KDIGO guidelines, the illustrated patient would be considered at very high risk for CKD progression (11). Of the nephrologists, 66% thought this patient should be treated by them, whereas 45% of GPs and 40% of endocrinologists indicated that a nephrologist should be the physician responsible for managing the patient. When GPs were asked about the likelihood of referring the patient to an endocrinologist or a nephrologist, 45% of GPs indicated they would probably or definitely refer the patient to an endocrinologist and 61.7% indicated they would probably or definitely refer the patient

Table 1
Physician characteristics

Characteristic	All physicians (n=160)	Physician subspecialty		
		GP (n=60)	Endocrinology (n=50)	Nephrology (n=50)
Sex				
Male	94 (58.8)	34 (56.7)	27 (54)	33 (66)
Female	64 (40)	24 (40)	23 (46)	17 (34)
Unspecified	2 (1.3)	2 (3.3)	0 (0)	0 (0)
Age, years				
18–44	85 (53.1)	41 (68.3)	25 (50)	19 (38)
45–64	66 (41.3)	15 (25)	21 (42)	30 (60)
65–74	8 (5)	4 (6.7)	3 (6)	1 (2)
≥75	1 (0.6)	0 (0)	1 (2)	0 (0)
Province				
Newfoundland	5 (3.1)	4 (6.7)	0 (0)	1 (2)
Nova Scotia	7 (4.4)	5 (8.3)	1 (2)	1 (2)
PEI	1 (0.7)	0 (0)	0 (0)	1 (2)
NB	8 (5)	6 (10)	1 (2)	1 (2)
Quebec	28 (17.5)	8 (13.3)	10 (20)	10 (20)
Ontario	76 (47.5)	21 (40.4)	31 (62)	24 (48)
Manitoba	15 (9.4)	6 (10)	1 (2)	8 (16)
Saskatchewan	9 (5.6)	7 (11.7)	1 (2)	1 (2)
BC	11 (6.9)	3 (5)	5 (10)	3 (6)
Years of practice				
≤2	9 (5.6)	0 (0)	6 (12)	3 (6)
3–5	23 (14.4)	13 (21.7)	6 (12)	4 (8)
6–10	42 (26.3)	21 (35)	14 (28)	7 (14)
11–15	31 (19.4)	9 (15)	6 (12)	16 (32)
16–20	19 (11.9)	2 (3.3)	5 (10)	12 (34)
>20	36 (22.5)	15 (25)	13 (26)	8 (16)
Practice setting, % time spent				
Academic	29±41.8	6.6±19	25±38.6	59.5±47
Community	15.8±29.6	14.1±24	4.1±14.9	29.5±39.7
Private practice	50.4±43.1	67.5±38.2	68.8±38.7	11.5±22.7
Other	6.0±18.4	13.2±27.1	0.9±3.9	2.4±10
T2D patient weekly caseload				
0–20	53 (33.1)	37 (61.7)	7 (14)	9 (18)
21–50	70 (43.8)	21 (35)	25 (50)	24 (48)
51–75	17 (10.6)	0 (0)	9 (18)	8 (16)
>75	20 (12.5)	2 (3.3)	9 (18)	9 (18)
T2D-CKD patient weekly caseload				
0–20	85 (53.1)	52 (86.7)	24 (48)	9 (18)
21–50	54 (33.8)	7 (11.7)	22 (44)	25 (50)
51–75	10 (6.3)	0 (0)	3 (6)	7 (14)
>75	11 (6.9)	1 (1.7)	1 (2)	9 (18)

BC, British Columbia; *CKD,* chronic kidney disease; *GP,* general practitioner; *NB,* New Brunswick; *PEI,* Prince Edward Island; *T2D,* type 2 diabetes.
Note: Values are n (%) or mean ± standard deviation.

to a nephrologist. When endocrinologists were asked about referrals, 46% said they would probably or definitely refer the patient to a nephrologist.

In response to "What type of medication would you prescribe for this patient?," the top 3 medications selected by the physicians for case 3 (stage G3b A2) were ACEi/ARB (94.4%), SGLT2i (82.5%) and glucagon-like peptide-1 receptor agonists (GLP-1 RA) (41.3%). These same therapies were selected as the top 3 medications for case 1 (stage G2 A2), with 85%, 79.3% and 20.6% of the physicians selecting ACEi/ARB, SGLT2i and GLP-1 RA as treatment options, respectively. For case 4 (stage G4 A2), responses for preferred medications were lower for ACEi/ARB (30.6%), SGLT2i (35.6%) and GLP-1 RA (36.9%) compared with case 3 (stage G3b A2). Finally, the top 3 most selected answers on preferred therapy for case 5 (stage G5) were none (30%), GLP-1 RA (16.9%) and ACEi/ARB (14.4%).

Physician screening, referrals and awareness of guidelines

When asked about CKD screening, 100% of physicians and 96.8% of physicians answered yes to routine use of eGFR and uACR, respectively. eGFR was monitored quarterly by 63.1% of physicians, semiannually by 27.5% and annually by 8.8%. uACR was monitored quarterly by 36.8% of physicians, semiannually by 32.3% and annually by 31%. The timing of CKD assessment with patients in relation to T2D diagnosis occurred for most physicians at diagnosis of T2D (58.1%), and before (12.5%) or after (16.5%) diagnosis of prediabetes.

GPs and endocrinologists answered questions on what eGFR and uACR levels they would typically refer their patients with T2D and CKD to a nephrologist. For eGFR, most GPs (56.7%) and endocrinologists (74%) indicated eGFR <30 mL/min/1.73 m^2, whereas some GPs (35%) and endocrinologists (24%) indicated eGFR <45 mL/min/1.73 m^2. On the other hand, 8%, 62% and 30% of the nephrologists indicated that patients with T2D and CKD are typically referred to them with eGFR <30 mL/min/1.73 m^2, eGFR <45 mL/min/1.73 m^2 and eGFR <60 mL/min/1.73 m^2, respectively. For uACR levels that would typically lead to a nephrology referral, most GPs selected uACR >20 mg/mmol (53.3%), followed by uACR >60 mg/mmol (18.3%). Most endocrinologists selected uACR >60 mg/mmol (52%), followed by uACR >20 mg/mmol (34%). A small proportion of physicians would refer their patients with uACR >3.5 mg/mmol (6.7% of GPs and 15% of endocrinologists) or indicated that they do not consider uACR (11.8% of GPs and 10% of endocrinologists). Nephrologists indicated the typical uACR levels that patients were typically referred to them were at uACR >2 mg/mmol (2%), uACR >3.5 mg/mmol (22%), uACR >20 mg/mmol (48%) and uACR

Table 2
Patient characteristics

Characteristic	All patients (n=169)	CKD severity		
		Mild (G1/G2) (n=85)	Moderate (G3a/G3b) (n=55)	Severe (G4/G5) (n=29)
CKD severity		85 (50.3)	55 (32.5)	29 (17.2)
Sex				
Male	114 (67.5)	57 (67.1)	38 (69.1)	19 (65.5)
Female	55 (32.5)	28 (32.9)	17 (30.9)	10 (34.5)
Age, years				
18–44	13 (7.7)	11 (12.9)	2 (3.6)	0 (0)
45–64	72 (42.6)	44 (51.8)	18 (32.7)	10 (34.5)
65–74	56 (33.1)	26 (30.6)	21 (38.2)	9 (31)
≥75	28 (16.6)	4 (4.7)	14 (25.5)	10 (34.5)
Province				
Quebec	41 (24.3)	25 (29.4)	14 (25.5)	2 (6.9)
Ontario	128 (75.7)	60 (70.6)	41 (74.5)	27 (93.1)
Years since T2D diagnosis				
<1	0 (0)	0 (0)	0 (0)	0 (0)
1–2	7 (4.1)	5 (5.9)	2 (3.6)	0 (0)
3–5	8 (4.7)	7 (8.2)	1 (1.8)	0 (0)
6–10	30 (17.8)	19 (22.4)	8 (14.5)	3 (10.3)
>10	124 (73.4)	54 (63.5)	44 (80)	26 (89.7)
Time of CKD diagnosis in relation to T2D				
No diagnosis of CKD	87 (51.5)	61 (71.8)	25 (45.5)	1 (3.4)
Before diagnosis of T2D	9 (5.3)	1 (1.2)	3 (5.5)	5 (17.2)
At time of T2D diagnosis	11 (6.5)	5 (5.9)	3 (5.5)	3 (10.3)
1–2 years after T2D diagnosis	7 (4.1)	4 (4.7)	2 (3.6)	1 (3.4)
3–5 years after T2D diagnosis	12 (7.1)	3 (3.5)	6 (10.9)	3 (10.3)
6–10 years after T2D diagnosis	17 (10.1)	6 (7.1)	5 (9.1)	6 (20.7)
>10 years after T2D diagnosis	26 (15.4)	5 (5.9)	11 (20)	10 (34.5)

CKD, chronic kidney disease; *T2D,* type 2 diabetes.
Note: Values are n (%).

>60 mg/mmol (18%), whereas 10% of nephrologists responded "uACR often not considered." Considering resources used for determining kidney risk in their patients, physician respondents used Diabetes Canada guidelines for CKD (69.4%), KDIGO guidelines (35.6%), KidneyWise (14.4%) or other resources (10%). Of physicians, 9.4% did not use any resource. More GPs (78.3%) and endocrinologists (82%), but fewer nephrologists (46%), used the Diabetes Canada guidelines for CKD, whereas more nephrologists (74%) than GPs (8.3%) and endocrinologists (3%) used the KDIGO guidelines. Similarly, more nephrologists (22%), and fewer GPs (16.7%) and endocrinologists (4%), used KidneyWise as a resource.

Physician values and preferences on available therapies

All physician groups ranked prevention of kidney disease risk as the number one reason for prescribing an ACEi/ARB, followed by treatment for hypertension and prevention of CV events. GPs ranked glucose lowering, prevention of CV events and prevention of kidney disease risk as the top 3 reasons for prescribing an SGLT2i. Endocrinologists ranked the same conditions in their top 3 reasons, but the prevention of kidney disease risk was ranked first, followed by glucose lowering and prevention of CV events. Nephrologists, on the other hand, ranked prevention of kidney disease risk, prevention of CV events and prevention of hospitalization for heart failure as the top 3 reasons for prescribing an SGLT2i. GPs, endocrinologists and nephrologists ranked treatment of hypertension as the primary reason for prescribing mineralocorticoid receptor antagonists. Prevention of CV events and prevention of hospitalizations for heart failure were reported as the second and third ranked reasons for prescribing mineralocorticoid receptor antagonists.

Patient awareness and preferences on CKD diagnosis

Among patient respondents, 87 (51.5%) reported not receiving a CKD diagnosis. When broken down by severity, 71.8% of patients with mild CKD, 45.5% of patients with moderate CKD and 3.4% of patients with severe CKD were unaware of their CKD. Of those who received a CKD diagnosis, 75.0%, 73.3% and 78.6% of patients with mild, moderate and severe CKD, respectively, would have preferred to receive a CKD diagnosis earlier. Kidney health was part of regular discussions with their physician for 63.9% of patients, with an increasing percentage for patients indicating regular discussions with CKD progression (mild CKD: 58%; moderate CKD: 64%; severe CKD: 83%). More patients with severe CKD discussed kidney health with a nephrologist (75.9%) than patients with mild CKD (11.8%) and moderate CKD (21.8%). Among the 82 patients who received a CKD diagnosis, the risk of progression to dialysis or transplantation was shared with 39 (47.6%) of them. Patients with mild or moderate CKD were more likely to not receive information on risk progression than those with severe CKD (mild CKD: 75%; moderate CKD: 56.7%; severe CKD: 28.6%).

Physician and patient values or preferences when considering new medications

When prescribing new medications, a large proportion of physicians thought the following were important (rating of 4 or 5 out of a 5-point scale): efficacy in reducing CV outcomes (94.4%), efficacy in reducing kidney outcomes (95.6%), effectiveness in glycated hemoglobin lowering (83.7%) and effectiveness in reducing microalbuminuria (80.1%). Other factors that were extremely important to >50% of physicians included that it improves quality of life and has strong clinical trial data, whereas 45% of physicians thought lower cost of medication was extremely important.

A large proportion of patients valued prevention of CV events (90%) and prevention of kidney disease progression (87.9%). Other factors that were extremely important to >50% of patients included the following: it is recommended by my doctor, it alleviates disease symptoms and it improves quality of life. In contrast with the physicians, only 25.4% and 26% of patients thought that low cost of medication and strong clinical trial data, respectively, were extremely important. A summary of physician and patient

Table 3
Importance of factors when considering new medications

Variable	All physicians (n=160)					All patients (n=169)				
	1 Not at all important	2	3	4	5 Extremely important	1 Not at all important	2	3	4	5 Extremely important
Once daily dosing	0 (0)	10 (6.3)	25 (25.6)	72 (45)	53 (33.1)	N/A	N/A	N/A	N/A	N/A
Available in combination (physician survey)/ reduced pill burden (patient survey)	17 (10.6)	30 (18.8)	49 (30.6)	48 (30)	16 (10)	20 (11.8)	16 (9.5)	39 (23.1)	40 (23.7)	54 (32)
Lower cost of medication	4 (2.5)	5 (3.1)	28 (17.5)	51 (31.9)	72 (45)	36 (21.3)	31 (18.3)	31 (18.3)	28 (16.6)	43 (25.4)
Availability of private drug coverage	2 (1.3)	18 (11.3)	29 (18.1)	46 (28.8)	65 (40.6)	N/A	N/A	N/A	N/A	N/A
Availability of public drug coverage/provincial formulary reimbursement	1 (0.6)	2 (1.3)	4 (2.5)	4 (23.8)	115 (71.8)	N/A	N/A	N/A	N/A	N/A
Efficacy in reducing cardiovascular outcomes (physician survey)/prevention of cardiovascular events (patient survey)	0 (0)	0 (0)	9 (5.6)	43 (26.9)	108 (67.5)	3 (1.8)	1 (0.6)	13 (7.7)	38 (22.5)	114 (67.5)
Efficacy in reducing kidney outcomes (physician survey)/prevention of kidney disease progression (patient survey)	0 (0)	2 (1.3)	5 (3.1)	40 (25)	113 (70.6)	2 (1.2)	3 (1.8)	15 (8.9)	43 (25.4)	106 (62.7)
Effectiveness in A1C lowering	2 (1.3)	7 (4.4)	17 (10.6)	49 (30.6)	85 (53.1)	N/A	N/A	N/A	N/A	N/A
Effectiveness in reducing microalbuminuria	2 (1.3)	8 (5)	22 (13.8)	66 (41.3)	62 (38.8)	N/A	N/A	N/A	N/A	N/A
It is recommended by clinical practice guidelines (physician survey)/it is recommended by my doctor (patient survey)	0 (0)	6 (3.8)	20 (12.5)	68 (42.5)	66 (41.3)	2 (1.2)	4 (2.4)	18 (10.7)	50 (29.6)	95 (56.2)
It is recommended by my pharmacist	N/A	N/A	N/A	N/A	N/A	23 (13.6)	25 (14.8)	51 (30.2)	40 (23.7)	30 (17.8)
Alleviates disease symptoms	0 (0)	5 (3.1)	23 (14.4)	76 (47.5)	56 (35)	4 (2.4)	4 (2.4)	19 (11.2)	54 (32)	88 (52.1)
Improves quality of life	0 (0)	1 (0.6)	15 (9.4)	56 (35)	88 (55)	4 (2.4)	1 (0.6)	8 (4.7)	34 (20.1)	122 (72.2)
Low potential to cause adverse effects	0 (0)	1 (0.6)	12 (7.5)	71 (44.4)	76 (47.5)	5 (3)	12 (7.1)	31 (18.3)	46 (27.2)	75 (44.4)
It can be taken orally	1 (0.6)	10 (6.3)	28 (17.5)	69 (43.1)	52 (32.5)	15 (8.9)	14 (8.3)	38 (22.5)	43 (25.4)	59 (34.9)
Easy to follow dosing schedule	1 (0.6)	3 (1.9)	22 (13.8)	69 (43.1)	65 (40.6)	11 (6.5)	7 (4.1)	28 (16.6)	51 (30.2)	72 (42.6)
It is easy to get information about the medication online	21 (13.1)	34 (21.3)	70 (43.8)	23 (14.4)	12 (7.5)	15 (8.9)	16 (9.5)	30 (17.8)	48 (28.4)	60 (35.5)
There is a 1-800 number that patients can call to get access to information about the medication	47 (29.4)	44 (27.5)	52 (32.5)	13 (8.1)	4 (2.5)	35 (20.7)	25 (14.8)	46 (27.2)	28 (16.6)	35 (20.7)
It has a patient support program that provides access to medical staff	23 (14.4)	47 (29.4)	60 (37.5)	23 (14.4)	7 (4.4)	22 (13)	19 (11.2)	55 (32.5)	32 (18.9)	41 (24.3)
It has strong clinical trial data	1 (0.6)	0 (0)	5 (3.1)	45 (28.1)	109 (68.1)	15 (8.9)	12 (7.1)	49 (29)	49 (29)	44 (26)
It has been in use for decades	18 (11.3)	34 (21.3)	58 (36.5)	40 (25)	10 (6.3)	9 (5.3)	30 (17.8)	51 (30.2)	47 (27.8)	32 (18.9)

A1C, glycated hemoglobin; *N/A,* not applicable.
Notes: Values are n (%). If N/A, the question was not part of the physician or patient survey.

considerations for new medications is provided in Table 3. Additional data about patient quality of life were collected; however, the results were outside the focus of this paper.

Discussion

The physician and patient survey findings on awareness, values and preferences reveal important areas of CKD in T2D management that require attention. Upon review of the study results, gaps in physician care included the demand for earlier CKD diagnosis and intervention, insufficient use of uACR screening, limited knowledge or use of KDIGO and KidneyWise resources, and lower than expected prescription of ACEi/ARB therapy for CKD in T2D. The prominent findings from the patient data presented that at least one-half of the patients with CKD and T2D were unaware of a CKD diagnosis, and three-quarters of patients, who received a prior CKD diagnosis, would have preferred an earlier diagnosis. When prescribing or taking new medications, physicians and patients rated many of the same factors as important or extremely important (e.g. prevention of CV events, prevention of kidney disease progression, alleviates disease symptoms and improves quality of life). A few differences between the physician and patient data were ratings of importance on low medication costs and clinical trial data, where more physicians and fewer patients indicated each variable as extremely important. The results on the physicians' perceptions of their patients and the patients' perceptions on the importance of medication costs suggest the need for open communication between providers and patients; however, further analyses are still required validating the means to do so clinically and the impact on health outcomes and patient satisfaction. The difference in the importance placed on clinical trial data between patients and physicians could suggest the need for knowledge translation to patients, and similarly its impact clinically in future studies. Overall, the survey data further established the need to improve quality of care for CKD in T2D and offered unique insight on physician and patient awareness.

Several previous publications have reported barriers related to CKD detection and management. Perceived barriers identified by primary care physicians in caring for patients with CKD included limited recognition or knowledge about CKD, lack of awareness of guidelines or useful algorithms for CKD care, difficulty with managing CKD risk factors and the physician's belief that they are unable to improve CKD (26). In a recent systematic review, fear of diagnosing CKD and dissatisfaction with CKD guidelines were also outlined as barriers for managing CKD among primary care physicians (27). An earlier observational study also reported urine CKD testing was underused in primary care, thereby resulting in the underdiagnosis of CKD (28). Knowledge gaps in CKD management previously identified among internal medicine residents included unfamiliarity with CKD stages, clinical markers and risk factors for CKD and risk for CV disease among patients with CKD (29). The gaps in CKD care inferred from this study are aligned with previous data, highlighting CKD screening, timing of nephrology referrals and therapies prescribed as patient care areas that could be improved. In this study, almost one-half of the GPs and endocrinologists typically referred patients to a nephrologist at uACR >20 mg/mmol; however, about one-third waited until uACR was >60 mg/mmol, and approximately 12% of physicians stated they do not consider uACR. The latter is especially concerning because it suggests a lack of appropriate training and/or awareness of current guidelines for CKD in T2D management.

Many GPs and endocrinologists may not be aware of the KidneyWise Clinical Toolkit available across Ontario or KDIGO guidelines as resources for CKD in T2D management and/or do not apply the recommendations in their clinical practice, as found in this study. Even though more nephrologists surveyed in this study used the KDIGO guidelines as a resource, the uptake and adherence to the KDIGO guidelines is undesirably low, as previously described for the KDIGO 2012 guidelines across nephrology practice settings (12), and in primary care practice (13). Stengel et al (12) reported poor adherence to the KDIGO guidelines for the evaluation of albuminuria and the prescription of ACEis/ARBs. Both the underutilization of albuminuria screening and ACEi/ARB for treatment among physicians are well aligned with the findings of the current study. Moreover, SGLT2is were prescribed among approximately 60% of patients with an eGFR $\geq$30 mL/min/1.73m^2 in the study, suggesting SGLT2is remain potentially underused among patients with CKD and T2D, especially considering recent clinical trial data (30,31). Hence, up-to-date teaching and review of clinical practice guidelines aligning GPs, endocrinologists and nephrologists on the recommended care path and therapies for CKD in T2D is warranted.

The data showing that a large proportion of patients were unaware of CKD in the current study are supported by previous literature (19–23). Most of these prior studies were conducted in primary care settings, and our data extend the results to people living with T2D with an expectantly higher risk of CKD complications within an endocrinology specialty care setting. About one-third of patients surveyed did not have regular discussions with their physician about their kidney health. Additionally, the risk of dialysis was only consistently shared when patients had severe CKD, suggesting a need for more patient education. Therefore, there is considerable room for improvements in enhancing patient understanding and patient-physician communication about kidney risk progression.

The findings of this study are in agreement with the expectations and clinical experience of the study's steering committee. Notable discussion points from the steering committee's post-evaluation meeting included the following: 1) kidney risk prevention should start with the GP with early awareness and diagnosis of kidney disease to prompt attention to therapy and follow-up at the primary care level, and nephrology referral where indicated according to guidelines; 2) as the landscape of treatment options for CKD in T2D continues to evolve, now is an opportune time to simplify practice guidelines and encourage the use of recommended therapies, such as ACEis/ARBs, SGLT2is and emerging therapies (e.g. finerenone, a new selective nonsteroidal mineralocorticoid receptor antagonist recently approved by the Food and Drug Administration), and consider earlier intervention, preferably before eGFR <30 mL/min/1.73 m^2 and/or uACR $\geq$20 mg/mmol; and 3) patient awareness and understanding of CKD diagnosis and risk of CKD progression remains a major gap in patient care that has not been effectively addressed. The patient representative on the steering committee also shared the desire for earlier CKD diagnosis, ideally at points of care when steps could be taken to slow CKD progression, and also had experienced urine tests not being done with GPs.

This study should be interpreted in light of a few limitations. The surveys were developed by a steering committee to capture in-depth data on physician and patient awareness, values and preferences; however, the use of newly developed surveys and not previously validated questions could be a potential limitation. There were no previously validated physician or patient surveys to our knowledge that would provide the same level of comprehensive data. The patient survey was conducted with patients followed in an endocrinology-led practice in Ontario or Quebec, and the results may not be generalizable to patients followed in a hospital or primary care setting, or to patients treated in other provinces or territories. The exclusion of physicians from Alberta because of research ethics board constraints also could impact the generalizability of findings to physicians in Alberta and outside of

Canada. A potential educational bias attributed to the study design and use of electronic surveys in the study could also affect the generalizability of results to participants with language barriers or poor digital literacy, and individuals without readily available access to Internet services. Additionally, social desirability bias could have led some respondents to report more favourable attitudes and behaviours than those actually held. Finally, CKD severity was determined using eGFR measured at a single time point to define the patient subgroups based on CKD severity; therefore, it is possible that the number of patients with mild CKD who were unaware of their CKD could be slightly overreported, if the diagnosis had not yet been confirmed with follow-up eGFR and/or uACR measurements.

Despite these limitations, the survey study was strengthened by its multidisciplinary, representative sample population. Among patient respondents, the distribution of CKD severity and province of residence was representative of the patient profile at LMC. Among physicians, the survey captured a representative cross-section of physicians across most of the country. Furthermore, the physician subgroups were representative of those involved in the management of CKD in T2D across the disease spectrum.

Conclusion

The study underlines several opportunities for improvement in the management of CKD in T2D based on physician and patient awareness, values and preferences. Referring patients with T2D and CKD to nephrologists by GPs and endocrinologists could be considered earlier to prevent kidney disease progression and complications. More education and greater clarity are needed for physicians interpreting uACR levels that should prompt a referral to a nephrologist. Further awareness and understanding of kidney risk progression is vital for patients. This study further supports a suboptimal application of clinical practice guidelines and therapies for CKD in T2D, namely ACEi/ARB and SGLT2i use, especially with worsening CKD. Better awareness of available tools and resources to help evaluate the risk of kidney disease progression is still needed. When considering new medications on the horizon, effectively preventing CV events and kidney disease complications, alleviating associated symptoms and improving quality of life were all highly valued and preferred by both physicians and patients.

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