Canadian Society of Nephrology/ Société canadienne de néphrologie CSN/SCN

CANADIAN JOURNAL OF KIDNEY HEALTH AND DISEASE
Journal canadien de la santé et de la maladie rénale

Original Clinical Research Quantitative

Canadian Journal of Kidney Health and Disease
Volume 9: 1–9

DOI: 10.1177/20543581221118434
journals.sagepub.com/home/cjk
SAGE

Death and Dialysis Following Discharge From Chronic Kidney Disease Clinic: A Retrospective Cohort Study

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Abstract

Background: Multidisciplinary care is recommended for patients with advanced chronic kidney disease (CKD). A formalized, risk-based approach to CKD management is being adopted in some jurisdictions. In Ontario, Canada, the eligibility criteria for multidisciplinary CKD care funding were revised between 2016 and 2018 to a 2 year risk of kidney replacement therapy (KRT) greater than 10% calculated by the 4-variable Kidney Failure Risk Equation (KFRE). Implementation of the risk-based approach has led to the discharge of prevalent CKD patients.

Objective: The primary objective of this study was to determine the frequency of occurrence of death and KRT initiation in patients discharged from CKD clinic.

Design: Retrospective cohort study

Setting: Single center multidisciplinary CKD clinic in Ontario, Canada

Patients: Four hundred and twenty five patients seen at least once in 2013 at the multidisciplinary CKD clinic

Measurements: Outcomes included discharge status, death, re-referral and KRT initiation. Reasons for discharge were recorded.

Methods: Outcomes were extracted from available electronic medical records and the provincial death registry between the patient's initial clinic visit in 2013 and January 1, 2020. KFRE-2 scores were calculated using the 4-variable KFRE equation. The hazard rates of death and KRT after discharge due to stable eGFR/low KFRE were compared to patients who remained in the clinic.

Results: Of the 425 CKD patients, 69 (16%) and 19 (4%) were discharged to primary care and general nephrology, respectively. Of those discharged, 7 (8%) were re-referred to nephrology or CKD clinic, while only 2 (2%) discharged patients required subsequent KRT. The hazard of mortality was reduced after discharge from the clinic due to stable eGFR/low KFRE (adjusted HR = 0.45 [95% CI, 0.25-0.78, $P = .005$]).

Limitations: Single center, observational retrospective study design and unknown kidney function over time post discharge for most patients

Conclusions: Discharge of low risk patients from multidisciplinary CKD clinic appears feasible and safe, with fewer than 1 in 40 discharged patients subsequently initiated on KRT over the following 7 years.

Abrégé

Contexte: Des soins multidisciplinaires sont recommandés pour les patients atteints d'insuffisance rénale chronique (IRC) de stade avancé. Une approche officielle de gestion de l'IRC, axée sur le risque, est en cours d'adoption dans certaines juridictions. En Ontario, au Canada, les critères d'admissibilité pour le financement des soins multidisciplinaires d'IRC ont été révisés entre 2016 et 2018 en fonction d'un risque supérieur à 10 % d'amorcer une thérapie de remplacement rénal (TRR) dans les 2 ans (risque calculé par l'équation KFRE [Kidney Failure Risk Equation] à 4 variables). La mise en œuvre de cette approche fondée sur le risque a mené au congé des patients prévalents atteints d'IRC.

Objectif: L'objectif principal de cette étude était de déterminer la fréquence des décès et de l'amorce d'une TRR chez les patients ayant reçu leur congé de la clinique d'IRC.

Conception: Étude de cohorte rétrospective

Cadre: Une clinique multidisciplinaire d'IRC de l'Ontario (Canada)

Sujets: 425 patients vus au moins une fois en 2013 à la clinique multidisciplinaire d'IRC

Mesures: L'état de santé au moment du congé, le décès, la réorientation du patient vers la clinique multidisciplinaire et l'initiation d'une TRR comptaient parmi les résultats d'intérêt. Les raisons du congé ont été enregistrées.
Méthodologie: Les résultats ont été extraits des dossiers médicaux électroniques disponibles et du registre provincial des décès entre la première visite à la clinique en 2013 et le 1er janvier 2020. Les scores KFRE-2 ont été calculés avec l'équation KFRE à 4 variables. Le taux d'incidence de décès et de TRR suivant un congé motivé par un DFGe stable ou un faible score KFRE a été comparé à celui des patients restés à la clinique.
Résultats: Des 425 patients inclus, 69 (16 %) avaient reçu leur congé en soins primaires et 19 (4 %) en néphrologie générale. Parmi les patients sortis, 7 (8 %) ont été réorientés vers une clinique de néphrologie ou d'IRC et seulement 2 (2 %) ont dû éventuellement amorcer une TRR. Un DFGe stable et un score KFRE faible ont contribué à réduire le taux de mortalité après le congé de la clinique (RR corrigé = 0,45 [IC à 95 %: 0,25-0,78; $P = 0,005$]).
Limites: Étude rétrospective observationnelle dans un seul center. La fonction rénale au fil du temps après le congé de l'hôpital était inconnue pour la plupart des patients.
Conclusion: Donner leur congé de la clinique multidisciplinaire d'IRC aux patients à faible risque apparaît possible et sûr; moins d'un patient sur 40 ayant dû amorcer une TRR dans les 7 années suivantes.

Keywords
chronic kidney disease, discharge, outcome, kidney replacement therapy, death

Received April 28, 2022. Accepted for publication July 6, 2022.

Introduction

Chronic kidney disease (CKD) is a worldwide health problem associated with adverse outcomes, including cardiovascular events, renal failure, hospitalizations, and premature death.[1] Historically, care for CKD has largely been guided by the serum creatinine (Cr) or Cr-based estimated glomerular filtration rate (eGFR).[2] However, at any eGFR level, there is a wide variability in the progression toward renal failure depending on other clinical characteristics.[3] Numerous clinical and laboratory-based risk scores have been derived to predict the risk of renal failure in patients with CKD.[4] It has been argued that integrating these tools into clinical practice enables a more rational allocation of limited health care resources to those with the greatest need for renal failure preparation and symptom management with the additional benefits of reassurance of low risk patients and avoidance of unnecessary anxiety and interventions.[5-8]

In 2011, predictive models called the Kidney Failure Risk Equations (KFREs) were developed to estimate the 2 and 5-year risks of kidney replacement therapy (KRT) in CKD patients.[9] The KFRE models incorporate four variables (age, sex, eGFR-EPI, and urine albumin-to-creatinine ratio [ACR]) or eight variables (age, sex, eGFR-EPI, ACR, serum calcium, phosphate, bicarbonate, and albumin).[9] The KFREs' performance has been validated in CKD patients in various settings, and implementation of KFRE at a policy level is gaining traction both within Canada and abroad.[10-15] In a large multinational meta-analysis, 2-year KRFE (KFRE-2) discriminative ability was excellent with a C-statistic of 0.9.[10] In its North American cohorts, KFRE-2 calibration was described as "adequate," with both underestimation and overestimation of risk depending on cohort.[10] In two recent studies in Canadian advanced CKD populations, the KFRE-2 C-statistic was 0.83, and a slight tendency to overestimate risk was observed in both.[11,14]

As recommended by KDIGO and others, in many highly resourced jurisdictions, patients with advanced CKD receive multidisciplinary kidney care.[8,16] Multidisciplinary kidney clinics aim to delay the progression of CKD, mitigate suboptimal initiation of KRT, and improve quality of life and survival.[8,16-21] Multidisciplinary CKD clinics are costly, and access should be considered in the context of limited health resources. In Ontario, Canada, the provincial renal health policy maker, the Ontario Renal Network (ORN), is responsible for the funding and delivery of kidney care. The ORN criteria for multidisciplinary CKD resources have evolved over the past decade.[19] In 2013, patients with an eGFR of less than 30 mL/min/1.73 m^2 were eligible. In 2016, KFRE-2 risk-based criteria were progressively implemented, and in April 2018, a KFRE-2 of greater than 10% or an eGFR of

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less than 15 mL/min/1.73 m^2 were established as cut-offs for access to multidisciplinary care resources.[19]

The use of risk-based assessment by clinicians before and after the funding policy changes has resulted in the discharge of prevalent CKD patients from multidisciplinary CKD clinics.[22] The outcomes of discharged patients are unknown. The lack of studies examining the impact of renal (and other) prediction models on clinical outcomes has been cited as a major limitation in assessing their utility and, consequently, a research priority.[23] The primary objective of this study was to determine the frequency of re-referral to nephrology, death, and need for KRT in patients discharged from multidisciplinary CKD care. We also compared KFRE scores at baseline and discharge, as well as outcomes of death and KRT, between discharged and non-discharged patients.

Methods

A retrospective cohort study was performed on a point prevalent sample of patients with eGFR less than 30 mL/min/1.73 m^2 seen at least once in the multidisciplinary CKD clinic at Kingston General Hospital, Ontario, Canada in 2013. Ethics approval was obtained by the Health Sciences and Affiliated Teaching Hospitals Research Ethics Board (6004492). A chart review was performed to elucidate the etiology of CKD, smoking status, demographic characteristics, cardiovascular disease history (previous myocardial infarction, coronary revascularization, heart failure, or stroke), and diabetes mellitus status. Each patient's CKD-EPI, Cr-based equation (eGFR-EPI), 4-variable KFRE-2, and 5-year KFRE (KFRE-5) were calculated using data from the patient's first (index) visit to the CKD clinic in 2013.[24] Where ethnicity data was unavailable, eGFR and KFRE calculations were generated by imputing Caucasian race. For patients whose ACR levels were below the threshold of detection (n = 7), we imputed the lowest possible value (1.1 mg/mmol). We chose 2013 as the year for index visits as ACRs were systematically measured once for most patients that year as part of programmatic policy. Prior to the implementation of the KFRE funding criteria, it was neither common practice nor recommended to measure serial ACRs.[25]

Patients' courses from clinic visit in 2013 to January 1, 2020, including initiation of KRT, discharge from CKD clinic, and outpatient re-referral to nephrology, were extracted from available electronic medical records. Clinic letters on the date of discharge were reviewed to confirm the date and reason for discharge. Deaths prior to January 1, 2020 were ascertained through Ontario's Office of the Registrar General.[26] For discharged patients, KFRE scores were calculated at the time of discharge. Reasons for discharge were identified and categorized as due to stable eGFR/low KFRE, patient initiated for active palliation, desired eventual conservative care, relocation of household closer to other nephrology centers, or other patient preferences. Time from discharge to re-referral and the initiation of KRT were also determined.

Analysis

All continuous variables are described by quartiles due to the strong positive skew of several variables. We estimated the hazards ratio of KRT and death among patients with ongoing follow-up in the multidisciplinary CKD clinic and those discharged due to stable eGFR/low KFRE. We censored patients at the time of discharge for reasons other than stable eGFR/low KFRE or at the end of follow-up on January 1, 2020. We used Cox proportional hazards model with discharge due to stable eGFR/low KFRE as a time-dependent covariate to model the association between being discharged and KRT and mortality (separate models). We re-ran the models after adjusting for baseline age, sex, diabetes status, systolic blood pressure, active smoker, CVD and index visit KFRE-2 risk.[27] These covariates were chosen based on their availability and our a-priori belief that they could potentially confound the association between the outcome and the decision to discharge. All covariates were binary except age and KFRE-2 risk, which were modeled as continuous covariates. When modeling time to KRT, we considered death a competing risk, precluding the possibility of KRT.[28] A secondary analysis considered all discharges regardless of reason. Finally, we performed a sensitivity analysis which used modified Poisson regression with robust standard errors to model the incidence density of KRT and death in the time before and after CKD clinic discharge. The analysis was performed using SAS software version 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

Patient Characteristics

There were 771 patients who were seen at least once in the multidisciplinary CKD clinic during 2013. Of those patients, 643 had Cr and ACR data available. Four hundred twenty five of those patients had an eGFR of less than 30 mL/min/1.73 m^2 and were included in the study. Patient characteristics are shown in Table 1. The median (Q1,Q3) age was 74 (65,81) years. The leading causes of CKD were diabetes (45%), hypertension (27%), and glomerulonephritis (8%). There was a heavy burden of comorbid cardiovascular disease (54%) and diabetes (56%). Seventy three patients (17%) were active smokers. Of the 268 patients for whom race was available, 253 (94%) were white and 7 (3%) were indigenous.

Median eGFR (Q1,Q3) was 20 (16,24) mL/min/1.73 m^2, median ACR (Q1,Q3) 32 (5,125) mg/mmol and median (Q1,Q3) KFRE-2 and KFRE-5 were 16 (6,37%) and 42 (17,76%), respectively. Sixty two percent of patients had a KFRE-2 greater than or equal to 10%.

Table 1. Patient Characteristics at Index Visit (n = 425).

Characteristic	
Male, n (%)	234 (55)
Median age (Q1,Q3) years	74 (65,81)
Diabetes, n (%)	239 (56)
Cardiovascular disease history, n (%)	229 (54)
Smoker, n (%)	73 (17)
Race, n (%)	
Documented race	268
White	253 (94)
Aboriginal	7 (3)
Other	8 (3)
Kidney disease etiology, n (%)	
Diabetes	190 (45)
Hypertension	113 (27)
Glomerulonephritis	32 (8)
Obstructive uropathy	17 (4)
Polycystic kidney disease	12 (3)
Other	61 (14)
Median eGFR mL/min/1.73 m^2 (Q1,Q3)	20 (16,24)
eGFR 15-29 mL/min/1.73 m^2, n (%)	328 (77)
eGFR < 15 mL/min/1.73 m^2, n (%)	97 (23)
Median ACR (mg/mmol) (Q1,Q3)	32 (5,125)
A1 < 3 mg/mmol, n (%)	74 (17)
A2 3-30 mg/mmol, n (%)	133 (31)
A3 > 30 mg/mmol, n (%)	218 (51)
Median KFRE-2 (%) (Q1,Q3)	16 (6,37)
KFRE-2 ≥ 10%, n (%)	265 (62)
Median KFRE-5 (%) (Q1,Q3)	42 (17,76)

Note. eGFR = estimated glomerular filtration rate, ACR = albumin-creatinine ratio, KFRE-2 = 2-year kidney failure risk equation, KFRE-5 = 5-year kidney failure risk equation.

Patient Outcomes

The mean time to death or the end of follow-up was 4.4 years for people never discharged and 5.2 years for people discharged for any reason (Table 2). The difference between the two is due to differing death rates since follow-up for all patients was from the index visit in 2013 to January 1, 2020, unless intervening death.

Figure 1 shows patient outcomes. During the study period, 69 (16%) and 19 (4%) patients were discharged to primary care and general nephrology respectively. Of the remaining 337 patients, 43 (13%) remained active patients in the CKD clinic, 169 (50%) progressed to KRT, and 125 (37%) died without ever starting KRT. Of the 169 patients who started KRT, 77 (46%) died.

Of the 69 patients discharged to primary care, 30 (43%) remained alive, and 34 (50%) patients died without re-referral or KRT within our health region. Four patients were re-referred, one of whom initiated KRT. Reasons for re-referral included deteriorating renal function with worsening proteinuria and raising KFRE in 3 patients and management of CKD complications through a multidisciplinary approach in another patient. One additional patient, who subsequently died, required KRT acutely for acute kidney injury without prior outpatient re-referral to nephrology.

Of the 19 patients discharged to general nephrology clinics, 10 (53%) remained alive, and 6 (31%) were dead without re-referral to the CKD clinic or KRT initiation within our health region (South East Ontario). Three additional patients discharged from general nephrology were re-referred to the CKD clinic. Reasons for re-referral included deteriorating renal function for 2 patients and patient preference for management of CKD complications in another patient. No patients discharged from general nephrology started KRT within our health region. Of the 13 patients alive at study completion, 10 continued to be followed in our renal program while 3 had been referred to nephrology outside our health region and KRT initiation status for them is unknown.

For discharged patients, the year and reason for discharge are depicted in Figure 2. The majority of patients were discharged between 2015 and 2017 (70%), with only 3% discharged in the last 2 years of the study. The most commonly stated reason for discharge (60%) was stable eGFR (prior to 2016)/low KFRE (2016-2020), followed by patient preference without commitment to conservative care (n = 14), conservative kidney care (n = 10), active palliation (n = 6), and patient relocation (n = 5). No patients censored at time of discharge for active palliation or eventual conservative care initiated KRT during study time period.

Index Visit and Discharge KFRE Scores by Outcome

KFRE scores at index visit (2013) are displayed in Table 3. Non-discharged patients had higher median KFRE-2s at baseline (20%) as compared to all discharged patients (5%). Non-discharged patients who subsequently started KRT had a higher median KFRE-2 (37%) than those who did not start KRT or died (12%) and those that died without KRT (13%). KFRE scores at the time of discharge are displayed in Table 4. The median KFRE-2 at the time of discharge was 5%. Both patients who subsequently started KRT had a KFRE-2 of 6% at discharge compared to 5% for the 86 discharged patients who did not require KRT.

Re-referral/Kidney Replacement Therapy

The median time (Q1,Q3) between discharge from CKD and the re-referred visit (n = 7) was 657 (420 839) days. The median time between discharge and the initiation of KRT (n = 2) was 823 days. One of two discharged patients who started KRT did so in the setting of a concurrent acute illness and the development of acute kidney injury.

Comparison of KRT Between Discharged (Stable eGFR/Low KFRE) and Non-Discharged Patients

Of the 337 patients that were not discharged, 169 (50%) started KRT compared to 2 (4%) of the 53 patients discharged due to

Table 2. Events and Follow-up Time per Person.

	Events	Total person years follow-up	Incidence per person (%)	Mean years follow-up per person
Not discharged (n = 337)				
KRT	169	957	50.1	2.8
Death	202	1480	59.9	4.4
Discharged for any reason (n = 88)				
KRT	2	458	2.3	5.2
Death	41	459	46.6	5.2
Discharged due to stable eGFR/low KFRE (n = 53)				
KRT	2	397	3.8	7.5
Death	15	398	28.3	7.5

Note. KRT = kidney replacement therapy; eGFR = estimated glomerular filtration rate; KFRE = kidney failure risk equation.

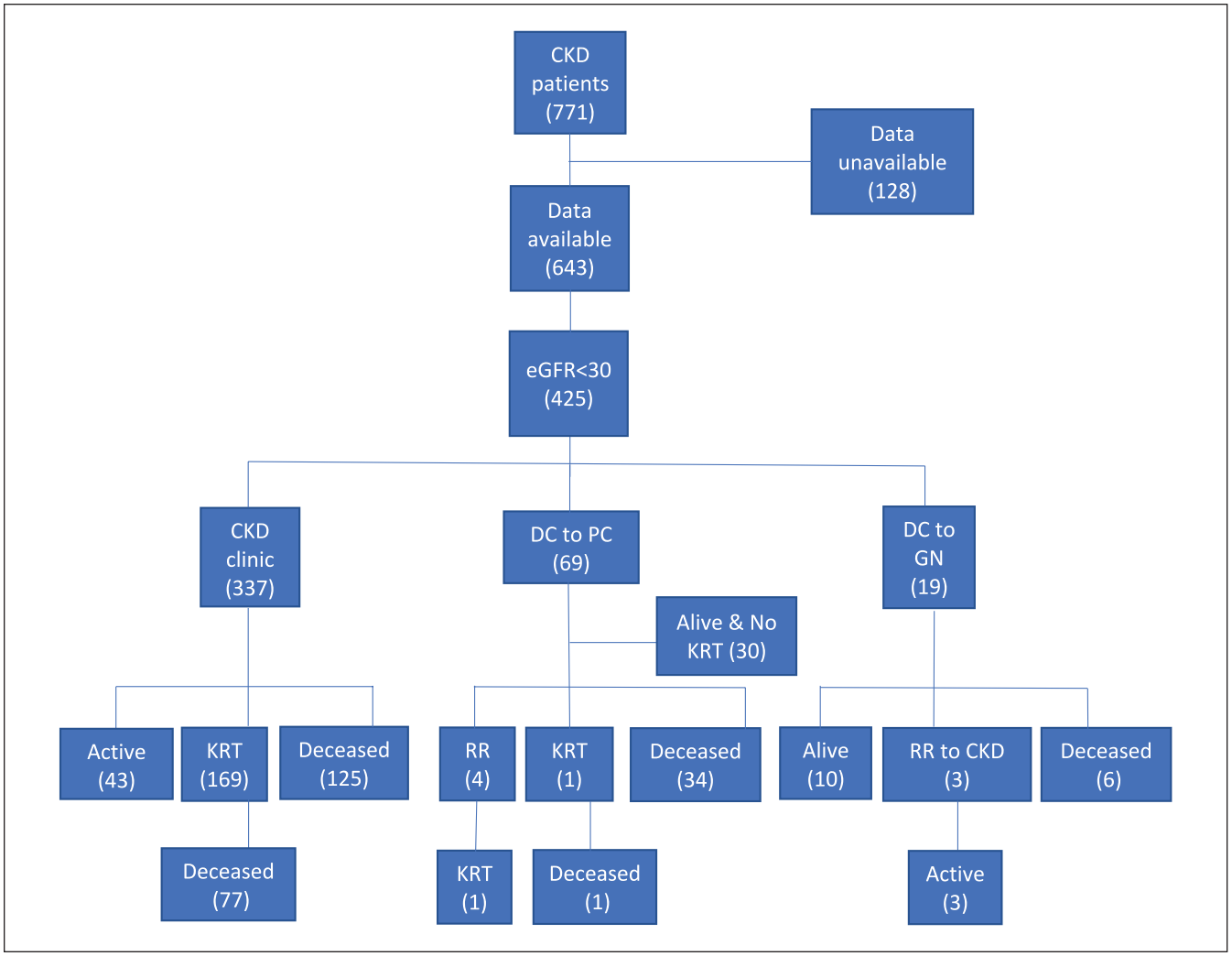

Figure 1. Outcomes of study patients including discharge to primary care or general nephrology, re-referral, initiation of kidney replacement therapy, and death.
Note. DC = discharge; PC = primary care; GN = general nephrology; RR = re-referral; KRT = kidney replacement therapy.

stable eGFR/low KFRE. Counting death as a competing risk and KRT discharge as a time-dependent covariate, the unadjusted subdistribution hazard ratio in people discharged was 0.14 (95% CI, 0.03 to 0.54, $P = .005$) compared to those

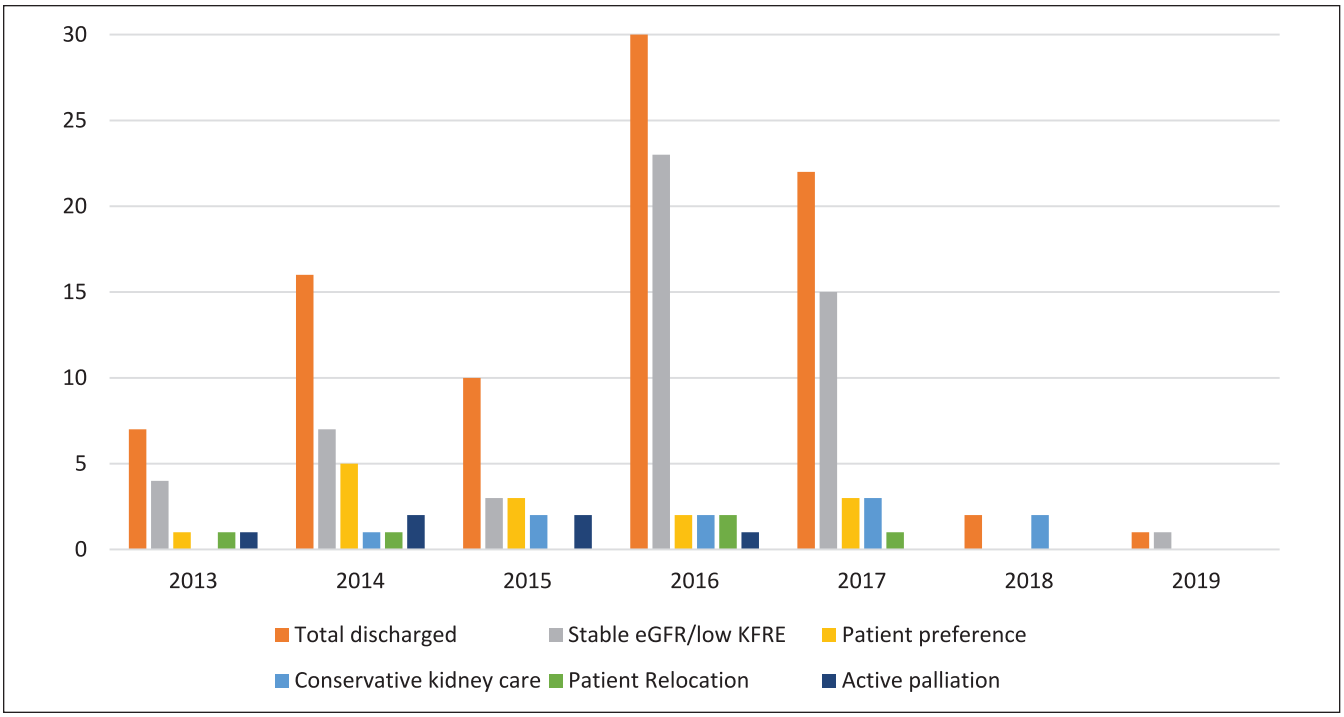

Figure 2. Number of discharged patients from CKD clinic by year and reason.
Note. CKD = chronic kidney disease; eGFR = estimated Glomerular Filtration Rate; KFRE = kidney failure risk equation.

Table 3. Median (Q1,Q3) KFRE-2 at index visit (2013) for patient subgroups by outcome.

Patient group (N)	KFRE-2, %
All (425)	16 (6,37)
Non-discharged (337)	20 (8,43)
Non-discharged, active CKD (43)	12 (5,18)
Non-discharged, KRT (169)	37 (16,60)
Non-discharged, no KRT and deceased (125)	13 (6,27)
Discharged (88)	5 (3,11)
Discharged, KRT (2)	3 (3,3)
Discharged, no KRT (86)	5 (3,12)
Discharged, no KRT and deceased (40)	7 (5,26)

Note. CKD = chronic kidney disease, KRT = kidney replacement therapy; KFRE-2 = 2-year kidney failure risk equation.

remaining in the clinic. After adjustment for age, sex, diabetes, smoking status, CVD, systolic blood pressure, and KFRE-2, the subdistribution hazard ratio was 0.27 (0.07-1.10, $P = .068$). Table 5 provides further details including comparisons to discharges for any reason.

Comparison of Death Between Discharged (Stable eGFR/Low KFRE) and Non-Discharged Patients

The overall mortality in patients not discharged was 60% compared to 28% in those discharged for stable eGFR/low KFRE. Patients censored at the time of discharge had a 71% mortality rate. The unadjusted hazard ratio of death for people discharged for stable eGFR/low KFRE compared to non-discharged was 0.61 (0.35-1.04, $P = .069$), while the adjusted hazard ratio was 0.45 (0.25-0.78, $P = .005$). Table 5 provides more details including incidence density per person time.

Discussion

This study reveals that 1 in 5 prevalent CKD patients followed at a single center in Ontario, Canada in 2013 were discharged from multidisciplinary CKD clinic over the 7 subsequent years, with stable eGFR/low KFRE being the most commonly cited reason for discharge. Importantly, the outcomes for discharged patients were overall very favorable, with most not requiring any further or escalating nephrology intervention. Six percent of patients discharged to primary care were re-referred to outpatient nephrology after a median 657 days and only 2 (3%) initiated KRT, one being for acute kidney injury in the setting of inter-current illnesses rather than for progression of CKD. Death rates were high in CKD patients, with 60% of all patients deceased by the study's end. Patient death was lower in patients discharged for stable eGFR/low KFRE compared to those who remained in the CKD clinic, although statistical significance was only reached by the Cox proportional hazards model after adjustment for covariates. We are unaware of other studies that have examined outcomes in patients with CKD discharged from multidisciplinary CKD clinics.

Table 4. Median (Q1,Q3) KFRE-2 at time of discharge for patient subgroups by outcome.

Patient group (N)	KFRE-2,%
Total discharged (88)	5 (2,13)
Discharged, KRT (2)	6 (6,6)
Discharged, no KRT (86)	5 (2,14)
Discharged, no KRT and deceased (40)	7 (3,32)
Total discharged to primary care (69)	6 (2,17)
Discharged to primary care, no further nephrology care (64)	6 (2,19)
Discharged to primary care and re-referred (4)	5 (3,7)
Discharged to primary care and KRT (2)	6 (6,6)
Discharged to primary care, re-referred and KRT (1)	6
Discharged to primary care, not re-referred and KRT (1)	6
Total discharged to general nephrology (19)	5 (3,7)
Discharged to general nephrology, no KRT or CKD re- referral (16)	4 (2,7)
Discharged to general nephrology and CKD re-referral (3)	5 (5,13)
Discharged to general nephrology and KRT (0)	N/A

Note. CKD = chronic kidney disease; KRT = kidney replacement therapy; KFRE-2 = 2-year kidney failure risk equation.

Table 5. Relative Risks and Hazard Rates Before and after Discharge.

Outcome	Events	Person years	Events per 100 person years	Unadjusted RR	Adjusted RR	Unadjusted HR	Adjusted HR
Before discharge for any reason (n = 425)							
KRT	169	1188	14.2 (12.3-16.5)	Ref.	Ref.	Ref.	Ref.
Death	202	1712	11.8 (10.4-13.5)	Ref.	Ref.	Ref.	Ref.
After discharge for any reason (n = 88)							
KRT	2	226	0.9 (0.2-3.5)	**0.06 (0.02-0.24)**	**0.13 (0.03-0.55)**	**0.08 (0.02-0.31)**	**0.11 (0.03-0.46)**
Death	41	227	18.1 (13.0-25.2)	**1.53 (1.07-2.19)**	1.37 (0.93-2.03)	1.32 (0.93-1.89)	1.05 (0.71-1.54)
After discharge for stable eGFR/low KFRE (n = 53)							
KRT	2	165	1.2 (0.3-4.8)	**0.09 (0.02-0.34)**	**0.21 (0.05-0.85)**	**0.14 (0.03-0.54)**	0.27 (0.07-1.10)
Death	15	166	9.0 (5.4-15.1)	0.76 (0.54-1.30)	0.66 (0.37-1.18)	0.61 (0.35-1.04)	**0.45 (0.25-0.78)**

Note. RRs are estimated by modified Poisson regression with robust standard errors, HRs are estimated by Cox Proportional hazards model with time-dependent variable for discharge status. The HR for death is the subdistribution hazard ratio where death is a competing risk precluding KRT. Adjusted models control for age, sex, diabetes, smoking status, history of cardiovascular disease, systolic blood pressure, and 2-year KFRE risk. RR and HRs in bold are statistically significant at a two-sided alpha = 0.05 without correction for multiplicity. KRT = kidney replacement therapy, RR = relative risk; HR = hazard ratio.

The low re-referral rate and KRT initiation post discharge suggests that both the primary care providers and patients were comfortable with the discharge plan and that non-palliative discharged patients remained stable over the course of the study time period. Discharge to primary care versus general nephrology was non-prescriptive and based on nephrologist practice and patient preference. Provincial privacy rules preclude the use of online laboratory data repositories for research purposes, so we were unable to access kidney function post discharge. Discharge instructions for primary care physicians are not standardized either provincially or locally but usually include a suggested laboratory monitoring plan along with re-referral criteria, which are nephrologist dependent. Interestingly, none of the patients discharged for active palliation or eventual conservative care were re-referred to nephrology or started KRT, suggesting continued commitment to their treatment plan.

The study time period overlaps with the formal adoption of a risk-based approach to CKD patient care and changes in CKD clinic funding eligibility criteria, which evolved from an absolute eGFR level of 30 mL/min/1.73 m^2 to one based on eGFR ($<$15 mL/min/1.73 m^2) and the KFRE-2 prediction model (2 year risk of KRT $>$ 10%). While the overall indirect health care system cost calculations are beyond the scope of this study, it has been estimated that over 6 million Canadian dollars in direct costs are being saved annually by these changes to the provincial funding model.[7]

The purpose of multidisciplinary CKD clinics is not only limited to prevention of GFR decline and KRT preparation but also includes cardiovascular risk factor modification, nutritional and psychosocial support, and medication rationalization amongst others, and focusing eligibility on KRT risk may be overly restrictive.[8,22] Whether multidisciplinary care beneficially impacts outcomes related to these

therapeutic interventions in low-risk patients has not been studied. We recommend that consideration be given to resource availability, multi-dimensional patient needs, and patient preference when assessing the potential benefits of multidisciplinary CKD care. Many primary care health teams also provide multidisciplinary services which may be more easily accessible to patients in their home communities and may be preferred by patients and their care providers.

Strengths of this study include the examination of crucial outcomes of death and KRT, the long follow-up (7 years), the low potential loss to follow-up as there is only 1 KRT program in the whole health region, and the use of provincial death records to ascertain death. Of the patients discharged due to relocation, only 1 moved outside of the province of Ontario such that our death data is robust.

Limitations of the study include its retrospective design and unknown kidney function over time post discharge for most due to provincial privacy legislation. Seventeen percent of patients seen at the CKD clinic at least once in 2013 did not have an ACR available and thus were not included in the analysis, although this small number should not affect results significantly. Patients discharged to primary care may have moved from our health region and subsequently been referred to CKD clinics or have initiated KRT in other regions without our knowledge. As can be seen by some wide confidence intervals, the small number of events post discharge has resulted in poor precision for some estimates. In addition, the results of this study may not be generalizable to different populations or health care systems. Finally, and most importantly, while the low re-referral and KRT rates among patients discharged is reassuring, the causal effect of CKD discharge on outcomes cannot be reliably assessed by this observational study design.

Conclusions

Discharge from multidisciplinary CKD clinic is safe and feasible for low-risk patients, with few requiring re-referral or KRT post discharge. Further research is needed to determine the causal effect of discharge on patient outcomes and establish the optimal KFRE (or other prediction tools) criteria upon which to base important CKD management decisions.

Acknowledgments

Frances MacLeod, the Office of the Registrar General of Ontario, and David Bruce.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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