



Multidisciplinary Chronic Kidney Disease Clinic Practices: A Scoping Review

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Abstract

Background: Multidisciplinary chronic kidney disease (CKD) clinics improve patient outcomes but their optimal design is unclear.

Objective: To perform a scoping review to identify and describe current practices (structure, function) associated with multidisciplinary CKD clinics.

Design: Scoping review.

Setting: Databases included Medline, EMBASE, Cochrane, and CINAHL.

Patients: Patients followed in multidisciplinary CKD clinics globally.

Measurements: Multidisciplinary CKD clinic composition, entry criteria, follow-up, and outcomes.

Methods: We systematically searched the literature to identify randomized controlled trials, non-randomized interventional studies, or observational studies of multidisciplinary CKD clinics defined by an outpatient setting where two or more allied health members (with or without a nephrologist) provided longitudinal care to 50 or more adult or pediatric patients with CKD. Included studies were from 2002 to present. Searches were completed on August 10, 2018. Title, abstracts, and full texts were screened independently by two reviewers with disagreements resolved by a third. We abstracted data from included studies to summarize multidisciplinary CKD clinic team composition, entry criteria, follow-up, and processes.

Results: 40 studies (8 randomized controlled trials and 32 non-randomized interventional studies or observational studies) involving 23 230 individuals receiving multidisciplinary CKD care in 12 countries were included. Thirty-eight focused on adults (27 with CKD, 10 incident dialysis patients, one conservative therapy) while two studies focused on adolescents or children with CKD. The multidisciplinary team included a mean of 4.6 (SD 1.5) members consisting of a nephrologist, nurse, dietician, social worker, and pharmacist in 97.4%, 86.8%, 84.2%, 57.9%, and 42.1% of studies respectively. Entry criteria to multidisciplinary CKD clinics ranged from glomerular filtration rates of 20 to 70 mL/min/1.73m² or CKD stages 1 to 5 without any proteinuria or risk equation-based criteria. Frequency of follow-up was variable by severity of kidney disease. Team member roles and standardized operating procedures were infrequently reported.

Limitations: Unstandardized definition of multidisciplinary CKD care, studies limited to CKD defined by glomerular filtration rate, and lack of representation from countries other than Canada, Taiwan, the United States, and the United Kingdom.

Conclusions: There is heterogeneity in multidisciplinary CKD team composition, entry criteria, follow-up, and processes with inadequate reporting of this complex intervention. Additional research is needed to determine the best model for multidisciplinary CKD clinics.

Trial registration: Not applicable.

Abrégé

Contexte: Les cliniques multidisciplinaires d'insuffisance rénale chronique (cliniques d'IRC) permettent d'améliorer les issues des patients, mais le modèle optimal demeure inconnu.

Objectifs: Procéder à un examen exploratoire pour répertorier et décrire les pratiques actuelles (structure, fonction) des cliniques d'IRC.

Type d'étude: Revue exploratoire.

Sources: Les bases de données Medline, EMBASE, Cochrane et CINAHL.

Sujets: Les patients suivis en cliniques d'IRC partout dans le monde.

Mesures: La composition de la clinique, les critères d'admission, le suivi et les résultats.



Méthodologie: Nous avons parcouru la littérature de façon systématique et répertorié les essais contrôlés à répartition aléatoire, les études interventionnelles non réparties aléatoirement ou les études observationnelles portant sur des cliniques d'IRC. Ces dernières étaient définies par un contexte de consultations externes où au moins deux fournisseurs de soins connexes (avec ou sans néphrologue) ont fourni des soins longitudinaux à au moins 50 patients, adultes ou enfants, atteints d'IRC. Les études incluses dataient de 2002 à aujourd'hui. La recherche s'est terminée le 10 août 2018. Deux réviseurs ont, de façon indépendante, passé en revue le titre, le résumé et l'article complet. Les désaccords ont été résolus par une tierce personne. La composition de l'équipe, les critères d'admission, le suivi et les processus de la clinique ont été déterminés à partir des données extraites des études retenues.

Résultats: Ont été retenues 40 études (8 essais contrôlés à répartition aléatoire et 32 études interventionnelles non aléatoires ou études observationnelles) touchant 23 230 individus recevant des soins multidisciplinaires en IRC dans 12 pays différents. Trente-huit études portaient sur des adultes (patients atteints d'IRC [$n=27$], patients dialysés incidents [$n=10$] et patients ayant un traitement conservateur [$n=1$]). Les deux autres portaient sur des adolescents ou des enfants atteints d'IRC. L'équipe multidisciplinaire comptait en moyenne 4,6 (écart-type: 1,5) membres, dont un néphrologue, une infirmière, un diététiste, un travailleur social et un pharmacien (97,4 %, 86,8 %, 84,2 %, 57,9 % et 42,1 % des études, respectivement). Les critères d'admission à la clinique consistaient en un débit de filtration glomérulaire de 20 à 70 ml/min/1,73 m², une IRC de stade I à 5 sans protéinurie ou des critères de risque fondés sur des équations. La fréquence des suivis variait selon la gravité de l'atteinte rénale. Les rôles des membres de l'équipe et les procédures opérationnelles standardisées étaient rarement discutés.

Limites: Les résultats sont limités par une définition non standardisée de « soins multidisciplinaires en IRC » et le manque de représentation de pays autres que le Canada, Taiwan, les États-Unis et le Royaume-Uni. De plus, les études retenues étaient limitées par une définition de l'IRC reposant sur le débit de filtration glomérulaire.

Conclusion: On observe une hétérogénéité dans la composition des équipes multidisciplinaires des cliniques d'IRC. Les critères d'admission, le suivi et les procédures sont également divergents, et les rapports sur cette intervention complexe sont inadéquats. D'autres études sont nécessaires pour définir le meilleur modèle de clinique multidisciplinaire en IRC.

Keywords

multidisciplinary, CKD, scoping review

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What was known before

The multidisciplinary chronic kidney disease (CKD) clinic literature has focused on a variety of outcomes and a subset of interventions deployed within the complex multifaceted nature of these clinics. The optimal structure and function of multidisciplinary CKD clinics is unknown. The description of multidisciplinary CKD clinic composition, entry criteria, processes, follow-up and outcomes have been incomplete.

What this adds

This scoping review describes current evidence available and outlines the structure and function of multidisciplinary CKD clinics reported in the literature. There is

significant heterogeneity in multidisciplinary CKD clinic team composition, entry criteria, follow-up and processes. The majority of studies incompletely reported clinic structure and function.

Introduction

Multidisciplinary chronic kidney disease (CKD) clinics are associated with improved patient outcomes when compared to traditional nephrology care delivery models.^{1,2} Studies of multidisciplinary CKD clinics have shown improvements in fistula rates,³ hospitalization,⁴ CKD progression,^{5,6} and mortality.^{3,7} Multidisciplinary CKD clinics also appear to be a cost-effective intervention.⁸ However, the literature dedicated

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to multidisciplinary CKD clinics does not typically fully report the nature of this complex intervention,⁹ which may involve a variety of components that may individually or collectively¹⁰ influence patient morbidity and mortality.

Multidisciplinary CKD clinic teams are typically composed of a nephrologist and various other allied health care members including nurses, dieticians, pharmacists, and social workers each with specific skill sets dedicated to preventing CKD progression, managing complications of CKD, and optimizing the transition to dialysis, transplant, or conservative therapy. There is increasing interest in the use of multidisciplinary CKD clinics as a means to improve outcomes and provide cost-effective care.^{8,11}

We performed a scoping review^{12,13} to identify and describe practices associated with multidisciplinary CKD clinics as an initiative of the Ontario Renal Network.¹⁴ Our objective was to (1) map and describe the current evidence available and (2) outline multidisciplinary CKD clinic practices (structure and function) to identify knowledge gaps and opportunities for further research in improving care to CKD patients.

Materials and Methods

Search Strategy

We performed a scoping review of the literature to identify studies reporting on the structure and function of multidisciplinary CKD clinics using the Arksey and O'Malley¹⁵ framework. Given that the definition of "multidisciplinary" is not standardized,^{1,2} we included any study where longitudinal care was provided to individuals with kidney disease in an outpatient setting by two or more team members (eg, nurse, nurse practitioner, dietician, pharmacist, nephrologist, social worker, other) thus capturing "multidisciplinary," "interprofessional," or "interdisciplinary" CKD teams. The search strategy was developed with the aid of a librarian experienced in both systematic and scoping reviews (J.C.) (Supplemental Figure 1). Searches were conducted in Medline, EMBASE, Cochrane, and CINAHL; the gray literature was not systematically searched. We included randomized controlled trials (RCTs) and non-randomized interventional or observational studies (prospective or retrospective) that included adult or pediatric CKD patients published from 2002 to the date of the search and excluded (1) non-English studies, (2) studies with less than 50 participants, and (3) studies focusing solely on educational or self-management interventions. Reference lists of included studies were searched to identify studies not captured in the electronic search strategy even if outside the publication date restrictions. Our initial search strategy included congestive heart failure, chronic obstructive pulmonary disease, and

diabetes mellitus populations as it was thought practices of multidisciplinary teams in these settings could be extrapolated to CKD. However, given the number of included CKD studies after screening, we later excluded all non-CKD studies at full text screening.

Study Selection

Two reviewers independently (D.C. and K.S.B.) screened the abstracts of all identified studies without title screening given its limited ability to exclude studies. Two reviewers (D.C. and L.P.) screened full texts, and discrepancies were resolved by the third reviewer (K.S.B.).

Data Extraction

The following information was independently abstracted for all included studies by two reviewers (D.C. and L.P.) using a standardized form and entered into a Microsoft Excel spreadsheet: author, year of publication, study design, number of centers, year the study took place, country, type of analysis, follow-up duration, number of patients receiving multidisciplinary CKD care (and comparator group if applicable), multidisciplinary team composition, clinic entry criteria, frequency of follow-up by kidney function, frequency of laboratory investigations by kidney function, any description of the specific roles of multidisciplinary team members, and any other specific practices related to care provision. We did not assess study quality given the focus of our scoping review.

Data Synthesis

Data were summarized quantitatively using descriptive statistics including means with standard deviations, medians with interquartile ranges, and frequencies or proportions when appropriate. A descriptive analysis of clinic processes was performed. All analyses were performed using STATA.¹⁶ We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping reviews checklist¹⁷ (Supplemental Figure 2).

Results

The search was conducted on August 10, 2018 resulting in 4296 citations. After duplicates were removed, a total of 2427 studies were screened, of which 47 met inclusion criteria. Of these studies, 40 were unique cohorts without duplicate data and were included in this scoping review (see Figure 1).

Of these 40 studies, 8 were RCTs and 32 were non-randomized or interventional observational studies involving a total of 23 230 individuals receiving multidisciplinary CKD care in 12 countries (Canada, $n = 12.5$; Taiwan, $n = 8$;

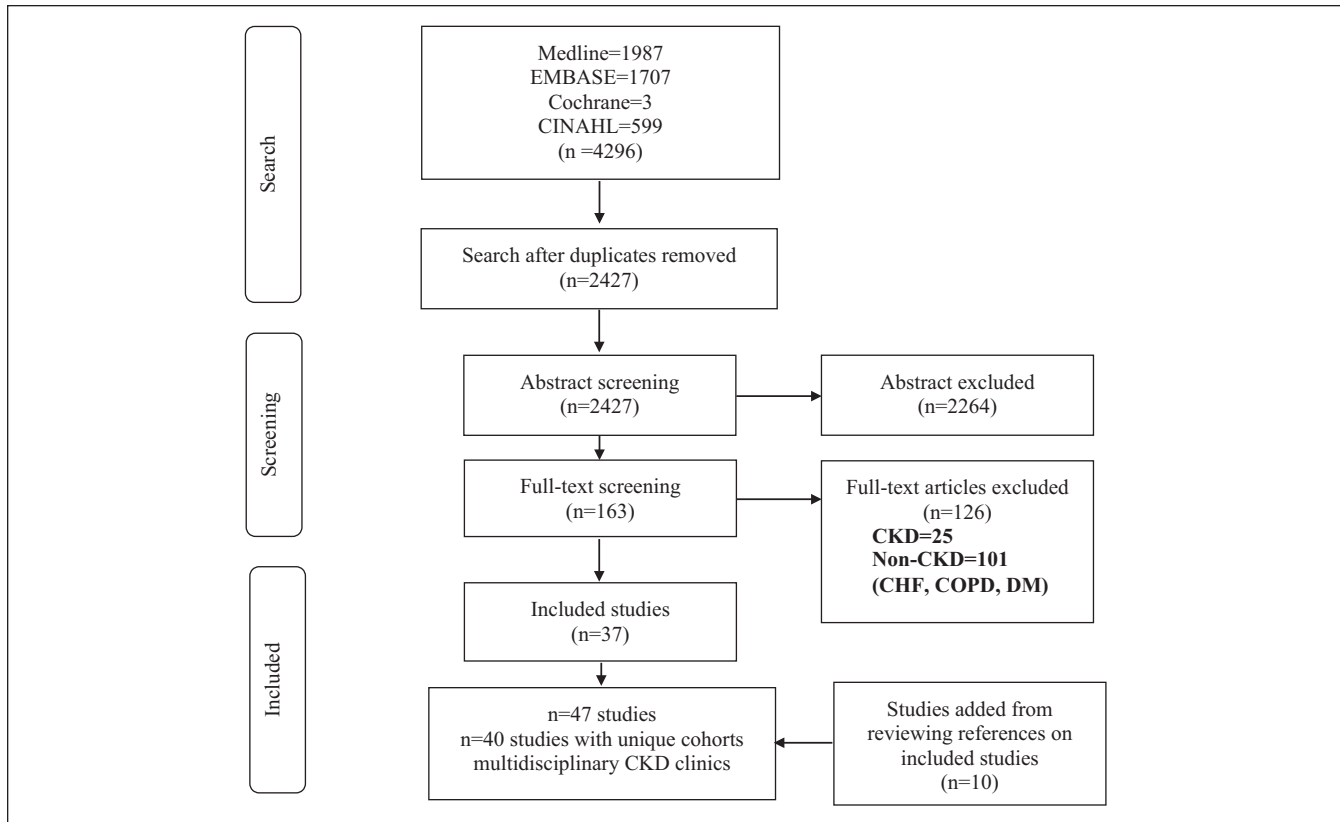


Figure 1. Flow diagram.

Note. CKD = chronic kidney disease; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; DM = diabetes mellitus.

United States, n = 8; United Kingdom, n = 3; Brazil, n = 2; Australia, n = 1; China, n = 1; France, n = 1; Italy, n = 1.5; Netherlands, n = 1; Singapore, n = 1; and Thailand, n = 1). Thirty-eight studies focused on adults (27 with CKD, 10 retrospective cohorts of incident dialysis patients, one conservative therapy) while two studies focused on adolescents or children with CKD. Ten studies were descriptive in nature, often describing the multidisciplinary CKD cohort longitudinally or before and after referral or change in clinic structure, and 28 studies compared multidisciplinary CKD clinics and standard care which was either nephrology or primary care based (two of which did not report the multidisciplinary CKD clinic in detail). The included studies reported a wide range of outcome measures including eGFR (estimated glomerular filtration rate), proteinuria, and other kidney endpoints (dialysis initiation, home modalities, vascular access, pre-emptive transplant), blood pressure, anemia parameters (hemoglobin, hematocrit, iron indices), mineral bone disorder parameters (calcium, phosphate, parathyroid hormone), bicarbonate, cardiovascular events, quality of life, health care utilization, costs, and mortality. Study outcomes are summarized in Tables 1 and 2, and have been previously reported^{1,2} with detailed information available in Supplemental Tables 1 and 2.

Multidisciplinary Team Composition

The multidisciplinary team ranged in size from two to seven members (mean = 4.6, SD = 1.5) (see Figure 2) in the 38 studies that reported team composition. The team members included a nephrologist, nurse, dietitian, social worker, and pharmacist in 97.4%, 86.8%, 84.2%, 57.9%, and 42.1% of studies respectively. Other members included a surgeon (n = 4), nurse practitioner (n = 3), counselor or personal support volunteer (n = 3), manager or coordinator (n = 2), diabetes educator (n = 2), psychologist (n = 1), exercise physiologist (n = 1), telehealth care technician (n = 1), clinic data manager (n = 1), complementary therapy practitioner (n = 1), occupational therapist (n = 1), physical therapist (n = 1), endocrinologist (n = 1), and other physician (n = 1).

Kidney Function Entry Criteria

Twenty-five of 40 studies (62.5%) reported formal entry criteria to multidisciplinary CKD clinics related to kidney function. The eGFR entry criteria ranged from eGFRs of 20 to 70 mL/min/1.73 m² and CKD stage entry criteria ranged from CKD stages 1 to 5. However, the majority of studies

Table 1. Summary of Randomized Controlled Trials' Multidisciplinary Teams and Outcomes (n = 8).

References ^a	Country	Multidisciplinary team members										Outcomes				
		Physician	Nurse	Dietician	Pharmacist	Social worker	GFR or ESRD	BP	Anemia	BMD	Acidosis	QOL	Mortality			
Harris et al ¹	United States	Green	Green	Green	Red	Green	Green	Yellow	Black	Black	Black	Black	Black	Black		
Barrett et al ²	Canada	Green	Green	Red	Red	Red	Green	Yellow	Black	Black	Black	Black	Black	Black		
Hopkins et al ³		Green	Green	Red	Red	Red	Green	Yellow	Black	Black	Black	Black	Black	Black		
CanPREVENT		Green	Green	Red	Red	Red	Green	Yellow	Black	Black	Black	Black	Black	Black		
van Zuilen et al ⁴	Netherlands	Green	Green	Red	Red	Red	Green	Yellow	Black	Black	Black	Black	Black	Black		
Peeters et al ⁵		Green	Green	Red	Red	Red	Green	Yellow	Black	Black	Black	Black	Black	Black		
MASTERPLAN		Green	Green	Red	Red	Red	Green	Yellow	Black	Black	Black	Black	Black	Black		
Howden et al ⁶	Australia	Green	Green	Red	Red	Red	Green	Yellow	Black	Black	Black	Black	Black	Black		
Howden et al ⁷		Green	Green	Red	Red	Red	Green	Yellow	Black	Black	Black	Black	Black	Black		
LANDMARK 3		Green	Green	Red	Red	Red	Green	Yellow	Black	Black	Black	Black	Black	Black		
Ishani et al ⁸	United States	Green	Green	Red	Red	Red	Green	Yellow	Black	Black	Black	Black	Black	Black		
Fishbane et al ⁹	United States	Green	Green	Red	Red	Red	Green	Yellow	Black	Black	Black	Black	Black	Black		
Fogelfeld et al ¹⁰	United States	Green	Green	Red	Red	Red	Green	Yellow	Black	Black	Black	Black	Black	Black		
Jiamjarinyapon et al ¹¹	Thailand	Green	Green	Red	Red	Red	Green	Yellow	Black	Black	Black	Black	Black	Black		

Note. For multidisciplinary team members: green = yes, red = no, and black = not reported. For outcomes (one or more parameter or target): green = improved, yellow = no significant difference, red = worsened, and black = not reported. GFR = glomerular filtration rate (estimated GFR, creatinine); ESRD = end-stage renal disease (initiation of hemodialysis, peritoneal dialysis, kidney transplant); BP = blood pressure (systolic or diastolic, mean arterial blood pressure), anemia (hemoglobin, hematocrit); MBD = mineral bone disorder (calcium, phosphate, parathyroid hormone), acidosis (bicarbonate); QOL = quality of life

^aReferences available in the supplement material.

Table 2. Summary of Non-Randomized Interventional and Observational Studies' Multidisciplinary Teams and Outcomes (n = 32).

References ^a	Country	Physician	Nurse	Dietician	Pharmacist	Social worker	GFR or ESRD	BP	Anemia	BMD	Acidosis	QOL	Mortality
Levin et al ¹²	Canada	Green	Green	Green	Red	Green	Black	Black	Green	Green	Black	Black	Green
Ravani et al ¹³	Italy	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black
Goldstein et al ¹⁴	Canada	Black	Black	Black	Red	Black	Black	Black	Black	Black	Black	Black	Black
Curtis et al ¹⁵	Canada	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black
Thamayooran et al ¹⁷	Italy	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Hemmelgarn et al ¹⁸	Canada	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Lee et al ¹⁹	Canada	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Murtagh et al ²⁰	United States	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Wong et al ²¹	United Kingdom	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Friedman et al ²²	United Kingdom	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Soares et al ²³	Canada	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Soares et al ²⁴	Brazil	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Soares et al ²⁵	Brazil	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Soares et al ²⁵	Brazil	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Cerqueira et al ²⁶	Brazil	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Silva et al ²⁷	Brazil	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Zhang et al ²⁸	China	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Zhang et al ²⁹	China	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Zhang et al ²⁹	China	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Collister et al ³⁰	Canada	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Collister et al ³⁰	Canada	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Fenton et al ³¹	United Kingdom	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Wei et al ³²	Taiwan	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Bayliss et al ³³	United States	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Dixon et al ³⁴	United States	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Ajarmeh et al ³⁵	United States	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Lim et al ³⁶	Canada	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Lim et al ³⁶	Singapore	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Luciano et al ³⁷	Singapore	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Chen et al ³⁸	Brazil	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Chen et al ³⁸	Brazil	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Lei et al ³⁹	Taiwan	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Lei et al ³⁹	Taiwan	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Lin et al ⁴⁰	Taiwan	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Lin et al ⁴⁰	Taiwan	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Rognant et al ⁴¹	France	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Chen et al ⁴²	Taiwan	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Brown et al ⁴³	Taiwan	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Chen et al ⁴⁴	Canada	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Chen et al ⁴⁴	Canada	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Tsai et al ⁴⁵	Taiwan	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Tsai et al ⁴⁵	Taiwan	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Sood et al ⁴⁶	Taiwan	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Sood et al ⁴⁶	Taiwan	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Lin et al ⁴⁷	Canada	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Lin et al ⁴⁷	Canada	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Rinfret et al ⁴⁸	Taiwan	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Rinfret et al ⁴⁸	Taiwan	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black
Rinfret et al ⁴⁸	Canada	Green	Green	Green	Red	Green	Black	Black	Black	Black	Black	Black	Black

Note. For multidisciplinary team members: green = yes, red = no, and black = not reported. For outcomes (one or more parameter or target): green = improved, yellow = no significant difference, red = worsened, and black = not reported. GFR = glomerular filtration rate (estimated GFR, creatinine); ESRD = end-stage renal disease (initiation of hemodialysis, peritoneal dialysis, kidney transplant); BP = blood pressure (systolic or diastolic, mean arterial blood pressure), anemia (hemoglobin, hematocrit); MBD = mineral bone disorder (calcium, phosphate, parathyroid hormone), acidosis (bicarbonate); QOL = quality of life

^aReferences available in the supplemental material.

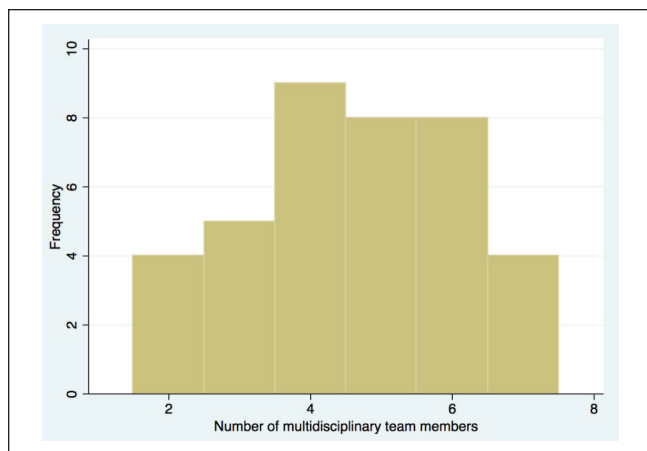


Figure 2. Multidisciplinary CKD team composition (n = 38 studies).

Note. CKD = chronic kidney disease.

included only stages 3-5 CKD and in the 22 of 40 studies (55.0%) who reported baseline eGFR, it ranged from 12.0 to 58.8 mL/min/1.73m². Baseline proteinuria was reported in 11 of 40 studies (27.5%). No study had formal entry criteria based on the degree of proteinuria or the kidney failure risk equation (KFRE).¹⁸ RCTs generally included patients with stage 3-4 CKD except for one study⁴ whose eligibility criteria included eGFR < 30 mL/min/1.73m². Non-randomized interventional and observational studies generally included patients with stage 3-5 CKD except for four cohorts that included patients with less advanced forms of CKD.¹⁹⁻²²

Follow-up Care

Twenty-one of 40 studies (52.5%) reported the frequency of follow-up. Follow-up frequency varied by CKD stage; for CKD stages 3, 4, and 5, the follow-up frequency was 3.88 (SD = 2.57; 16 studies), 2.82 (SD = 1.25; 19 studies), and 2.04 (SD = 1.07; 16 studies) months, respectively (see Figure 3). Frequency of laboratory testing was reported in 11 of 40 studies (27.5%).

Processes

Patient management focused on blood pressure, proteinuria, anemia, mineral bone disorder, dyslipidemia, cardiovascular risk reduction, diabetes, dietary restriction (sodium, potassium, phosphate), lifestyle interventions (physical activity, weight loss, smoking cessation), vascular access, medication reconciliation, adherence, nephrotoxin avoidance, depression, preventative care, and addressing social determinants of health and barriers to care (see Supplemental Tables 1 and 2). However, specific team member tasks and standardized operating procedures were only reported in 9/40 studies (22.5%). Twenty-five (62.5%) studies included education

and five (12.5%) studies included self-management as interventions with nurses primarily responsible for their delivery. Clinic throughput time was reported in 4 out of 40 studies (10.0%) studies and was 15 minutes,²³ 30-40 minutes,²⁴ 30-45 minutes²⁵ and 1 hour, per practitioner.²⁶

Discussion

In this scoping review, we identified 40 studies including 23 230 patients receiving multidisciplinary CKD care in 12 countries. Our findings show that there is heterogeneity in multidisciplinary team structure, entry criteria, follow-up, and processes. This has previously been shown with multidisciplinary CKD structure and function across Canada in a survey of renal programs.²⁷ This is presumably related to the variability in patient, physician, and health-care delivery factors across countries and continents including the epidemiology of CKD, attitudes of care providers and stakeholders²⁸ (eg, beliefs in the benefits and cost-effectiveness of multidisciplinary CKD care, ability and willingness of renal programs to manage this challenging patient population), and health-care system organization (eg, the primary care-nephrology interface,²⁹ resource allocation, remuneration practices). The typical multidisciplinary CKD team included a nephrologist, nurse, dietician, and either a social worker or pharmacist with occasionally other allied health members from a variety of backgrounds. RCTs focused on novel interventions applied in a multidisciplinary setting such as nurse-led clinics,³⁰⁻³² exercise,³² telemonitoring,³³ and self-management⁴ while non-randomized interventional and observational studies mostly focused on traditional CKD-related care processes. Entry criteria into multidisciplinary CKD clinics were poorly reported but patients typically had an eGFR less than 60 mL/min/1.73m² without consideration of proteinuria or overall risk of progression to end-stage renal disease (ESRD). We did not identify any studies in settings other than CKD defined solely by GFR including stones, glomerulonephritis, polycystic kidney disease, or transplant. Follow-up intensity varied by CKD staging and management involved risk factor modification, the treatment of CKD-related complications in addition to education, adherence, psychosocial care, and the transition to renal replacement therapy. Patient satisfaction was not an outcome in any study.

This scoping review was designed to identify current practices without attempting to determine specific factors causal or associated with improved patient outcomes. It is not clear what specific elements of multidisciplinary CKD clinics are responsible for their associations with improved patient outcomes (eg, education,³⁴ adherence,³⁵ self-management,³⁶ dietary interventions,³⁷ pharmacists,³⁸ vascular access planning³⁹). However, it is likely a combination of these factors that are mutually beneficial to patients given their prevalence in the provision of multidisciplinary CKD care but whether this includes other interventions less commonly associated with multidisciplinary CKD care such as

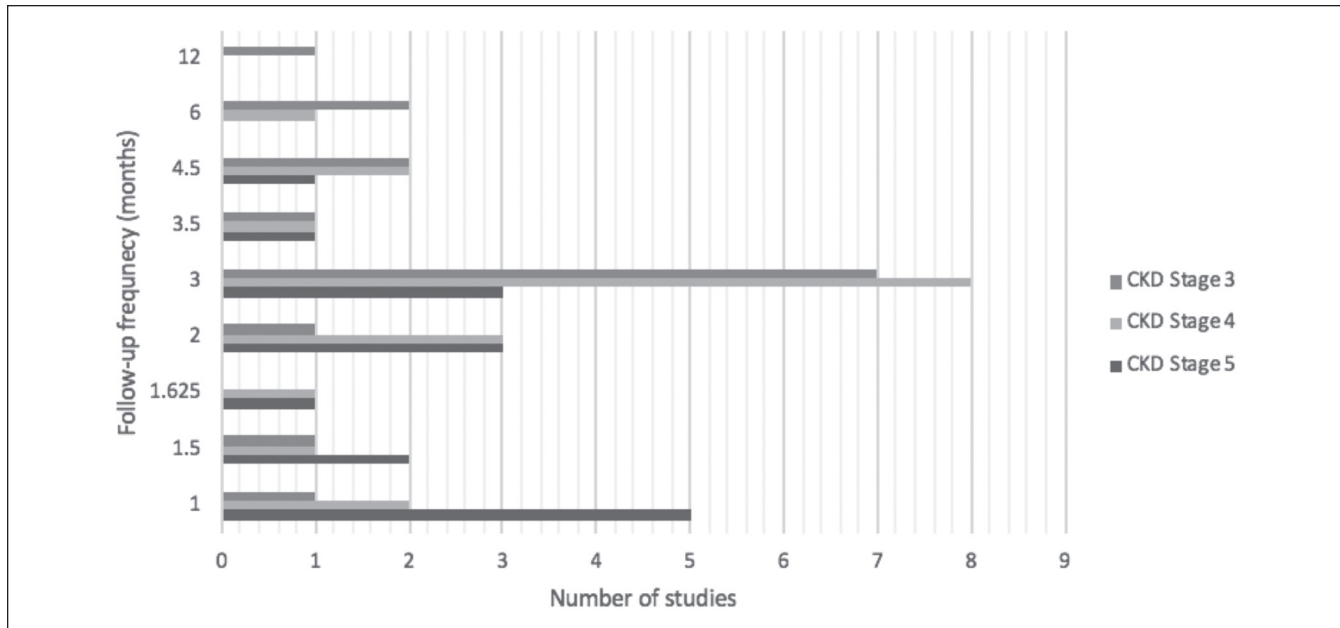


Figure 3. Follow-up frequency by CKD stages 3, 4, and 5.

Note. Follow-up frequency reported in months with ranges substituted with means, for example, = 1.625 months = 6 weeks-3 months, 1.5 months = 1-2 months, 2 months = 1-3 months, 3.5 months = 2-4 months, and 4.5 months = 3-6 months. CKD = chronic kidney disease.

exercise⁴⁰ or psychosocial support⁴¹ is unknown. Future research examining these specific interventions in the context of multidisciplinary CKD clinics is necessary in order to provide an evidence-based framework for the interventions implemented in these clinics. This could be accomplished by meta-regression using study-level covariates for clinic elements for specific outcomes or through the performance of RCTs dedicated to specific interventions in the setting of multidisciplinary CKD clinics. In the interim, the decision by renal programs on what to prioritize as components of multidisciplinary CKD care needs to be tailored to their patient populations while considering their relative benefits, availability, and costs.

It is also unclear which patients are most likely to benefit from being followed in multidisciplinary CKD clinics. A recent meta-analysis did show that the risk reduction in mortality was isolated to those multidisciplinary CKD clinics which had staff beyond a nephrologist and a nurse and primarily to patients with more advanced CKD.² In this scoping review, entry criteria were all GFR based and did not consider proteinuria overall risk of progression to ESRD (eg, using the KFRE) which has been previously used to triage nephrology referrals⁴² but not entry into multidisciplinary CKD clinics. Recently, renal programs in Alberta have adopted a risk-based approach to CKD care and have incorporated the KFRE into multidisciplinary clinic entry. Future research in this area is needed and could involve a cluster RCT as well as a planned pre/post intervention study⁴³ of implementing KFRE referral strategies while considering clinical outcomes, costs, and patient-reported experience measures.

Follow-up care was frequently qualified as being individualized based on patient factors such as GFR, GFR trajectory, the achievement of clinical targets, or financial factors such as reimbursement policies. Which strategy is the best for patients while considering costs in addition to the role of telemedicine and shared care by primary care physicians, nephrologists, and other subspecialists (eg, endocrinologists, cardiologists, vascular medicine) separately or in combined clinics as part of follow-up is yet to be determined.

The strengths of this scoping review include its broad eligibility criteria (any multidisciplinary setting where 2 or more health-care professionals provided care in an outpatient setting to individuals with kidney disease) and its detailed focus on multidisciplinary CKD structure and function. Previous systematic reviews and meta-analyses in this area focused only on the association of multidisciplinary CKD clinics with improved outcomes but did not examine in detail their overall designs.^{1,2} However, our study has some limitations. The definition of multidisciplinary CKD care is not standardized in the literature and not all studies meeting our definition for inclusion were necessarily captured by the search strategy. Only one study included a conservative therapy setting where it has been previously recommended should be delivered by a multiprofessional team,⁴⁴ but it is acknowledged that care in non-dialytic advanced CKD clinics may substantially differ depending on patient and provider values and preferences. Whether multidisciplinary teams are beneficial in these settings and how they are best structured remains uncertain. Qualitative studies were not included in this scoping review given its focus on multidisciplinary CKD clinic processes but

offer important stakeholder perspectives⁴⁵ regarding program implementation and evaluation.⁴⁶ The majority of studies were from Canada, Taiwan, the United States, and the United Kingdom, and thus multidisciplinary CKD practices outside of these countries are not well represented. In particular, multidisciplinary CKD clinics from low-income and middle-income countries⁴⁷ were absent other than Brazil^{21,48} and Thailand⁶ where specific challenges may exist including affordability, lack of access to routine laboratory measurements, a greater reliance on primary care and allied health workers as well as variable access to renal replacement therapy. Finally, there is the limitation inherent to scoping review methodology. Scoping reviews are undertaken to summarize the evidence landscape of a clinical question where the quality and quantity of evidence is uncertain. Although this scoping review lacks the specificity and quantitative nature of a meta-analysis, we feel that it is the most appropriate design to describe experiences with multidisciplinary CKD clinics and highlight opportunities for further research.

The aim of this scoping review was to summarize the current evidence available with regard to the design of multidisciplinary CKD clinics and to identify gaps in the literature to guide future research. We found that there is heterogeneity in multidisciplinary CKD clinic composition, entry criteria, follow-up, and processes. It remains unclear which specific aspects of multidisciplinary CKD care are responsible for improved patient outcomes, what patients benefit from being followed longitudinally in these clinics, how to best follow patients over time, and what best improves patient and caregiver experiences. Additional research is needed to determine their optimal structure and function.

Ethics Approval and Consent to Participate

Ethics approval and Consent to Participate was not required for this publication.

Consent for Publication

All authors have given their consent for publication of this article.

Availability of Data and Materials

Data and methods are not available for this article.

Author Contributions

Each co-author's contribution is as follows: conception or design (J.C.), or analysis and interpretation of data (L.P., M.D., A.M., M.B., A.L.), or both (D.C., K.S.B.); drafting the article or revising it (D.C., L.P., J.C., M.D., A.M., M.B., A.L., K.S.B.); providing intellectual content of critical importance to the work described (D.C., L.P., J.C., M.D., A.M., M.B., A.L., K.S.B.); and final approval of the version to be published (D.C., L.P., J.C., M.D., A.M., M.B., A.L., K.S.B.).


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Supplemental Material

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