



Interdisciplinary Care and Preparedness for Kidney Failure Management in a High-Risk Population

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Rationale & Objective: Interdisciplinary care may improve health outcomes in patients with chronic kidney disease (CKD). Few studies have evaluated this model of health care delivery in racial and ethnic minorities.

Study Design: Retrospective cohort study.

Setting & Participants: Incident end-stage kidney disease (ESKD) patients at Montefiore Medical Center from October 1, 2013, to October 31, 2019.

Exposure: Pre-ESKD interdisciplinary care.

Outcomes: Pre-ESKD transplant listing and optimal kidney replacement therapy (KRT) start (use of arteriovenous access at hemodialysis initiation, outpatient hemodialysis start, preemptive transplant, or peritoneal dialysis as the first modality).

Analytical Approach: We constructed multivariable logistic regression models adjusted for sociodemographic and clinical factors to determine the odds of transplant listing and optimal KRT start between interdisciplinary versus the usual care group.

Results: Of the 295 incident ESKD patients included in our study, 84 received interdisciplinary care and 211 received usual nephrology care. The

mean age was 59.9 years (standard deviation, 13.9 years), 47% were women, and 87% were African American or Hispanic. Baseline characteristics were similar between the groups, except that the interdisciplinary care group had a lower prevalence of hypertension (60% vs 75%). Compared with usual care, a higher proportion of patients in the interdisciplinary care group were listed for kidney transplant (44% vs 16%) and had an optimal KRT start (53% vs 44%). Receipt of interdisciplinary care was associated with a higher odds (OR, 5.73; 95% CI, 2.78-11.80; $P < 0.001$) of transplant listing compared with usual care after adjusting for important sociodemographic and clinical factors. The odds of an optimal KRT start also favored interdisciplinary care (OR, 1.60; 95% CI, 0.88-2.89; $P = 0.12$) but did not achieve statistical significance.

Limitations: The study was non-randomized and had a small sample size.

Conclusions: Interdisciplinary care is associated with better ESKD preparedness compared with usual nephrology care alone in racial and ethnic minorities. Larger studies are needed to determine the effectiveness of interdisciplinary care in patients with advanced CKD.

Complete author and article information provided before references.

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Chronic kidney disease (CKD) affects approximately 1 in 7 Americans, and African American and Hispanic individuals are disproportionately burdened.^{1,2} With the worsening severity of CKD, the risk of adverse events, including hospitalizations and deaths, increases in a step-wise fashion.³ Potentially modifiable factors, such as inadequate patient education and late or inconsistent CKD care, contribute to poor outcomes, especially among racial and ethnic minorities.⁴⁻⁶

The Centers for Medicare and Medicaid Services Kidney Care Choice initiatives have made improving health outcomes for patients with late-stage CKD a national priority in the United States.⁷ Despite decades of awareness regarding the importance of patient education and preparedness in improving health outcomes in CKD,⁸ national indicators demonstrate that pre-ESKD education and care may not be optimal for maximizing dialysis preparedness.² Interdisciplinary (or multidisciplinary) care has emerged as an alternative to traditional nephrology care to optimize patient education and improve health outcomes in CKD. Interdisciplinary care is a coordinated, patient-centered approach that integrates different disciplines to achieve

common management goals.⁹ The Kidney Disease Improving Global Outcomes (KDIGO) 2012 guidelines specify that interdisciplinary care in CKD should entail patient education regarding choices of kidney replacement modalities, timely vascular access planning, transplant, and nutritional counseling while considering ethical, psychological, and social issues that may be barriers to optimal patient education and care delivery.¹⁰ The interdisciplinary care team may comprise nephrologists (general and transplant nephrology), advanced practice providers (nurse practitioners or physician assistants), vascular access providers (vascular surgeons and interventional radiologists), providers to assist with advanced care planning and goals of care discussions (eg, palliative care specialists or geriatricians), pharmacists, registered dietitians, social workers, and patient navigators with community outreach. Interdisciplinary models in CKD care have been associated with improved health outcomes, including lower all-cause mortality, slower decline in kidney function, higher likelihood of arteriovenous access (AV) fistula or graft placement, and lower risk of hospitalization.¹¹⁻¹⁴ However, the vast majority of studies on interdisciplinary care were

PLAIN-LANGUAGE SUMMARY

Interdisciplinary (or multidisciplinary) care improves the health of patients with chronic kidney disease but has not been well studied in patients at the highest risk for poor health outcomes. In African American and Hispanic patients with newly diagnosed kidney failure, we evaluated an interdisciplinary care program that included nurse practitioner care coordination and compared it to usual care on patient preparedness, including early access to kidney transplant listing and an optimal dialysis start. We found that interdisciplinary compared with usual care was associated with better patient preparedness, particularly early access to transplant listing.

conducted outside of the United States, and very few studies have evaluated this model of health care delivery in racial and ethnic minorities, who are at the highest risk for poor health outcomes.¹¹ We conducted a retrospective study to evaluate the association of receipt of interdisciplinary care versus usual nephrology care with end-stage kidney disease (ESKD) preparedness among predominantly African American and Hispanic individuals with CKD. Our interdisciplinary care program utilizes evidence-based nurse practitioner (NP) care coordination, which has been previously shown to improve health outcomes in CKD.¹³ We evaluated the following measures of patient preparedness: (1) pre-ESKD kidney transplant listing and (2) optimal kidney replacement therapy (KRT) start (defined as the use of AV access at hemodialysis initiation, outpatient hemodialysis (HD) start, preemptive transplant, or peritoneal dialysis (PD) as the first modality). We hypothesized that the receipt of interdisciplinary care would be associated with better ESKD preparedness.

METHODS

We performed a retrospective cohort study comparing patients with incident ESKD who received nurse practitioner-led education and care coordination as part of our interdisciplinary care program to patients who received usual nephrology from October 1, 2013, to October 31, 2019. The study was approved by the institutional review board (IRB# 2017-8285) of the Albert Einstein College of Medicine/Montefiore Medical Center. Informed consent was waived by the IRB because this study used pre-existing and not prospectively collected data.

Study Setting and Participants

The outpatient nephrology practice (not including affiliate sites) at Montefiore Medical Center followed approximately 500 patients with CKD stage 4 or 5 in 2019. Approximately 15%-20% were enrolled in our interdisciplinary care program, also known as the Kidney Care

Program. Montefiore serves a predominately urban African American and Hispanic population in the Bronx, New York, an area that has a 30% higher incidence of ESKD than the US average.¹⁵ The Bronx is also one of the poorest urban counties in the country, with 30% of Bronx households living below the federal poverty level.¹⁶

We abstracted data and performed chart reviews on 577 adults (age ≥ 18 years) followed in Montefiore nephrology clinics with a new *International Classification of Diseases, Ninth and Tenth Revision* diagnosis of ESKD between October 1, 2013, and October 31, 2019 (Fig 1). We included patients with a confirmed diagnosis of incident ESKD by their nephrologist who were seen at least once in the 3 months preceding the diagnosis of ESKD. We removed duplicate records ($n = 18$) and excluded patients with prevalent ESKD ($n = 178$) and those who were not designated as having ESKD by their nephrologist ($n = 43$). From the usual care group, we excluded additional patients because they were not seen by nephrology within 3 months preceding their diagnosis of ESKD ($n = 43$) (Fig 1).

Description of the Kidney Care Program at Montefiore Medical Center

The Kidney Care Program was established in October 2012 and is supported by the Department of Medicine and Nephrology and Montefiore's Care Management Organization (CMO). The Montefiore CMO works with a network of more than 3,100 physicians and other providers who provide care to more than 225,000 individuals covered by a variety of private and government-sponsored health programs. Montefiore's CMO has a track record of demonstrating successful care coordination and developing innovative health care delivery models to serve the most

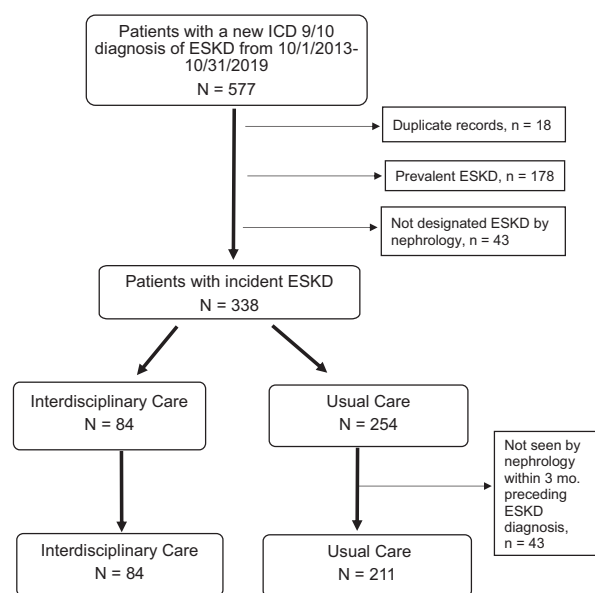


Figure 1. Study flowchart. Abbreviations: ESKD, end-stage kidney disease; ICD, *International Classification of Diseases*; mo, month.

vulnerable across multiple care settings in the Bronx. The Kidney Care Program uses a guideline-driven, evidence-based NP coordinated care model with a number of adjunct services, including comprehensive pharmacist medication review, dietitian support, and group CKD education classes. The program goals include: (1) optimizing patient and caregiver knowledge and self-management skills; (2) delaying progression of CKD; (3) educating patients and caregivers about CKD prognosis and treatment options, and ensuring treatments are in concert with patients' wishes; (4) managing the transition from earlier stages of CKD to kidney failure. Eligible patients (ie, those with CKD stage 4 or 5) are identified through data mining, and contacted by a CMO care coordinator for enrollment and an appointment with the NP. All patients must be seen by the NP for enrollment. Patients may also be referred to the program by their nephrologist, primary care provider, or a CMO case manager. While all patients with CKD stage 4 or 5 followed at Montefiore are eligible, enrollment is on a first-come, first-serve basis. The program is voluntary; eligible patients may decline enrollment or any of the program offerings. Figure 2 illustrates the different program offerings and the proportion of patients who typically receive each offering. The median number of visits with the NP is 2 per year (range, 1-4). While some offerings are standard for all enrolled patients (such as the medication review performed by a CMO pharmacist), others are coordinated by the NP with guidance from the patient's nephrologist (such as referral to a nutritionist, transplant or vascular surgery, or a palliative care specialist). Some program offerings, such as case management, are available only to the CMO population, whereas others, such as the group CKD education classes, are



Figure 2. Montefiore's Kidney Care Program offerings and proportion of patients who receive each offering. Proportion of patients in interdisciplinary care who receive each offering (*). Abbreviations: ESKD, end-stage kidney disease.

open to all Montefiore patients and their families. The NP meets monthly with the CMO team, including the program's medical director, to review the new patients enrolled, complex cases, and those patients who are transitioning to ESKD. Care coordination decisions are then communicated to the patient by the NP.

Data Collection

Data on age, sex, race, ethnicity, preferred language (English-dominant speaker or not), body mass index, and comorbid conditions (including a history of diabetes mellitus, hypertension, cardiovascular disease, obesity, dementia, and human immunodeficiency virus) were abstracted using Clinical Looking Glass, a patented software developed at Montefiore that efficiently integrates massive amounts of data from clinical and administrative datasets.¹⁷ The data in Clinical Looking Glass are captured through Montefiore's existing electronic medical records and combined centrally, where the data undergo standardized data checks and quality assurance. Comorbid conditions and Charlson Comorbidity Index scores were obtained from Clinical Looking Glass using *International Classification of Diseases, Ninth and Tenth Revision* codes.^{18,19} Chart reviews were done on the entire cohort obtained from Clinical Looking Glass to validate the diagnosis of incident ESKD and adjudicate all the outcomes of interest. Chart reviews were also performed on all included patients to obtain individual-level socioeconomic information (including insurance status and type and highest education level) and relevant laboratory data (including serum potassium, phosphorus, hemoglobin, intact parathyroid hormone, bicarbonate, albumin, and estimated glomerular filtration by Modification of Diet in Renal Disease Study equation,²⁰ the equation in use at the time in our clinical laboratory findings and reported to the clinicians). Laboratory data were obtained as close as possible to the initiation of KRT but no more than 30 days earlier.

Outcomes of Interests

We evaluated the following measures of patient preparedness for ESKD: (1) kidney transplant listing before dialysis initiation; (2) optimal KRT start (defined as the use of AV access at hemodialysis initiation, outpatient HD start, preemptive transplant, or PD as the first modality). We also reported on the patients with incident ESKD who opted to do non-dialysis conservative kidney management instead of KRT. These patients were designated to have incident ESKD (CKD stage 5 with symptoms of uremia) by their nephrologist and would have been initiated on KRT if in line with the patient's (or health care proxy's) expressed wishes.

Statistical Analysis

Descriptive statistics were used to compare the participant baseline characteristics. χ^2 or Fisher exact tests were used to compare proportions and t tests or Wilcoxon signed

rank tests to compare normally and non-normally distributed data, respectively. For all missing data, we performed multiple imputations ($m = 20$ imputations) based on the assumption that the data were missing at random.²¹ Data on education and body mass index were missing in 31% and 28% of patients, respectively. The rest of the covariates were complete or had less than 5% missing data. We constructed multivariable logistic regression models, which were adjusted for sociodemographic and clinical factors in a stepwise fashion to determine the odds of transplant listing and optimal KRT start between interdisciplinary care versus the usual group. For the optimal KRT start outcome, we excluded the 3 patients who opted for non-dialysis kidney management but performed a sensitivity analysis in which they were included as an optimal start. The final logistic regression models were adjusted for age, sex, race or ethnicity, preferred language, comorbid conditions, body mass index, Charlson Comorbidity Index scores, laboratory data, education, and insurance. In sensitivity analyses, we compared the final models with and without imputation for missing data. In another sensitivity analysis, we removed the Charlson Comorbidity Index scores from the final models, given the possibility of collinearity with the individual comorbid conditions that make up the index. A P value <0.05 was considered statistically significant. All statistical analyses were done using Stata MP, version 17.0 (Stata Corp).

RESULTS

Over the study period, we performed chart reviews on 577 patients with a diagnosis of ESKD seen at Montefiore Nephrology Outpatient Clinics. After exclusions, we included 295 patients who had incident ESKD; 84 received interdisciplinary care and 211 received usual nephrology care (Fig 1). There were no significant differences in the sociodemographic characteristics of patients exposed to interdisciplinary care compared with the usual care group (Table 1). The mean age was 59.9 years (standard deviation [SD] 13.9), 47% were women, and 87% were African American or Hispanic (Table 1). The majority of patients (76%) were English-dominant speakers. Twenty-six patients (9%) were uninsured, and 55 (26%) had less than high school education. The prevalence of comorbid conditions was similar between the groups, except that the interdisciplinary care group had a lower prevalence of hypertension compared with those who received usual care (60% vs 75%; $P = 0.009$). The median body mass index was 29.2 (interquartile range [IQR], 25.2-34.2) and similar between the 2 groups. The median hemoglobin was slightly lower (8.2 vs 8.7 mg/dL; $P = 0.08$), and the potassium was slightly higher (4.8 vs 4.5 mEq/L; $P = 0.04$) in the interdisciplinary care compared with the usual care group. There were no differences in the other laboratory data between the 2 groups; the median estimated glomerular filtration rate at KRT initiation was 7 mL/min/1.73 m² (IQR, 5-10), phosphorus levels were 5.6 mg/dL

(IQR, 4.6-6.6), bicarbonate levels were 20 mEq/L (IQR, 16-22), albumin levels were 3.6 g/dL (IQR, 3.1-3.9), and intact parathyroid hormone levels were 310 pg/mL (IQR, 179-475) (Table 1).

Outcomes

Of the 295 patients included in our study, 71 (24%) were listed for a kidney transplant and 138 (47%) had an optimal KRT start. Compared with the usual care group, patients exposed to interdisciplinary care were more likely to be listed (44% vs 16%; $P < 0.001$). A higher proportion of patients in the interdisciplinary group compared with usual care had an optimal KRT start (53% vs 44%; $P = 0.14$).

Over 90% of patients ($n = 269$) did HD as their first modality, and none were home HD. Among these patients, a higher proportion in the interdisciplinary care versus usual care group used an AV access at first HD (45% vs 37%; $P = 0.20$) and had an outpatient HD start (25% vs 15%; $P = 0.07$). Although 144 (53%) patients had an AV access in place, only 105 (39%) used the AV access at their first HD. Among the patients who used an AV access at their first HD, 23 had grafts and 82 had fistulas.

Sixteen people (5%) had PD as the first modality, 6 (7%) in the interdisciplinary care group and 10 (5%) in the usual care group. Seven people (2%) received a pre-emptive kidney transplant during the study period, 3 (4%) in the interdisciplinary care group and 4 (2%) in the usual care group. Three people opted to do non-dialysis conservative kidney management, 2 in the interdisciplinary care group and 1 in the usual care group. Their ages range from 82-90 years, and all had significant comorbid conditions (including a history of dementia, stroke, or severe congestive heart failure). All 3 were transitioned to hospice care for their ESKD.

In the fully adjusted multivariable logistic regression model, receipt of interdisciplinary care was associated with a higher odds (odds ratio [OR], 5.73; 95% confidence interval [CI], 2.78-11.80; $P < 0.001$) of kidney transplant listing compared with usual care alone (Table 2). In the fully adjusted model, the odds ratio for optimal KRT start (OR, 1.60; 95% CI, 0.88-2.89; $P = 0.12$) also favored interdisciplinary care but did not achieve statistical significance (Table 2). When we included the 3 patients who opted for non-dialysis conservative kidney management as an optimal start, the OR was 1.70 (95% CI, 0.95-3.07; $P = 0.07$). The ORs in the final models with and without imputation for missing data were similar. Similarly, removing the Charlson Comorbidity Index scores from the multivariable logistic regression models did not significantly change the OR estimates (Table 2).

DISCUSSION

In this retrospective cohort study of predominantly racial and ethnic minorities with incident ESKD, receipt of interdisciplinary care was associated with 5-fold higher

Table 1. Sociodemographic and Clinical Characteristics of Incident End-Stage Kidney Disease Patients (N = 295) at Montefiore Medical Center From October 1, 2013, to October 31, 2019

Characteristic	All N = 295	Interdisciplinary Care N = 84	Usual Care N = 211	P Value
Age, y	59.9 ± 13.9	61.9 ± 13.4	59.1 ± 14.1	0.12
Female	136 (47)	43 (51)	93 (44)	0.27
Race/ethnicity				0.70
Non-Hispanic African American	112 (38)	35 (42)	77 (37)	
Non-Hispanic White	10 (3)	4 (5)	6 (3)	
Hispanic	143 (49)	38 (45)	105 (50)	
Asian	6 (2)	2 (2)	4 (2)	
Unknown/other	24 (8)	5 (6)	19 (9)	
English-dominant speaker	225 (76)	70 (83)	155 (73)	0.07
Uninsured	26 (9)	4 (5)	22 (10)	0.12
Less than HS education ^a	55 (26)	20 (27)	35 (25)	0.78
BMI, kg/m ^{2b}	29.2 [25.5-34.2]	28.4 [23.2-33.4]	29.4 [26.5-34.2]	0.27
Comorbid conditions				
Diabetes mellitus	111 (38)	29 (34)	82 (38)	0.48
Hypertension	208 (71)	50 (60)	158 (75)	0.009
Congestive heart failure	74 (25)	21 (25)	53 (25)	0.98
Myocardial infarction	16 (5)	3 (4)	13 (6)	0.37
Cerebrovascular disease	12 (4)	2 (2)	10 (5)	0.85
Obesity (BMI >30 kg/m ^{2b})	86 (42)	25 (40)	61 (43)	0.60
Dementia	4 (1)	2 (2)	2 (1)	0.33
HIV	6 (2)	1 (1)	5 (2)	0.51
Charlson Comorbidity Index score	3 [2-7]	3 [2-7]	3 [2-7]	0.96
Laboratory data				
eGFR, mL/min/1.73 m ^{2c,d}	7 [5-10]	8 [6-10]	7 [5-9]	0.21
Serum phosphorus, mg/dL ^d	5.6 [4.6-6.6]	5.6 [4.5-6.6]	5.6 [4.7-6.6]	0.53
Serum potassium, mEq/L	4.6 [4.2-5.1]	4.8 [4.4-5.1]	4.5 [4.1-5.1]	0.04
Serum bicarbonate, mEq/L	20 [16-22]	20 [17-21]	20 [16-23]	0.72
Serum albumin, g/dL ^e	3.6 [3.1-3.9]	3.5 [3.2-3.9]	3.6 [3.0-3.9]	0.52
Hemoglobin, g/dL ^f	8.5 [7.6-9.5]	8.2 [7.4-9.2]	8.7 [7.6-9.6]	0.08
Intact PTH, pg/mL ^g	310 [179-475]	279 [151-470]	327 [184-481]	0.20

Note: Values for categorical variables are given as count (proportion); values for continuous variables are given as mean ± standard deviation for normally distributed variables or median [interquartile range] for skewed variables.

Abbreviations: BMI, body mass index; eGFR, estimated glomerular filtration rate; ESA, erythropoietin stimulating agent; HIV, human immunodeficiency virus; HS, high school; PTH, parathyroid hormone.

^a83 (28%) people were missing data in education; 10 (12%) in the interdisciplinary care group and 73 (35%) in the usual care group.

^b92 (31%) people were missing data on BMI; 21 (25%) in interdisciplinary care group and 71 (34%) in the usual care group.

^ceGFR reported by the Modification of Diet in Renal Disease Study equation.²⁰ Complete data available except for the following laboratory data in the usual care group.

^d1 person was missing eGFR, phosphorus.

^e2 people were missing albumin.

^f3 people were missing hemoglobin.

^g13 people were missing data intact PTH.

odds of being listed for transplant before developing ESKD. The OR of an optimal KRT start also favored interdisciplinary care but was not statistically significant. In our study, the number of patients who chose PD, opted for non-dialysis conservative kidney management, or received preemptive transplants were very small.

In observational studies, interdisciplinary (or multidisciplinary) care models have been associated with greater ESKD preparedness compared with traditional health care delivery models in adults and children with CKD.^{11,22} Our study builds on prior work by focusing on the association of interdisciplinary care with health outcomes in racial and ethnic minorities with CKD, a population that few studies have addressed. The health inequities affecting African

American individuals and other minority groups are particularly evident in kidney transplantation. Greater than 50% of patients awaiting kidney transplants in the United States are ethnic minorities, with African American persons constituting >30% of those on the waiting list.² Furthermore, racial and ethnic minorities wait significantly longer on the waiting list.^{2,3} Patients with CKD can be listed for transplant when their estimated glomerular filtration rate is <21 mL/min/1.73 m². Therefore, the preparation of patients for kidney transplants should ideally begin as soon as progressive CKD is recognized, along with efforts to prevent and delay CKD progression, particularly in vulnerable populations. However, there are limited data on the effectiveness of interdisciplinary care models in

Table 2. Association of Receipt of Interdisciplinary Care (n = 84) vs Usual Care Alone (n = 211) With End-Stage Kidney Disease Preparedness in Incident patients in the Bronx, New York

Outcomes	Odds Ratio	95% CI	P Value
Listed for transplant			
Model A (includes demographics)	4.96	2.67-9.24	<0.001
Model B (includes comorbid conditions and laboratory data)	6.10	2.99-12.48	<0.001
Model C (fully adjusted)	5.73	2.78-11.80	<0.001
Model D (fully adjusted without multiple imputation)	5.36	1.81-15.81	<0.001
Model E (excludes Charlson Comorbidity Index score)	5.10	2.54-10.17	<0.001
Optimal kidney replacement therapy start ^a			
Model A (includes demographics)	1.50	0.88-2.54	0.13
Model B (includes comorbid conditions and laboratory data)	1.62	0.90-2.91	0.11
Model C (fully adjusted)	1.60	0.88-2.89	0.12
Model D (fully adjusted without multiple imputation)	1.62	0.78-3.40	0.20
Model E (excludes Charlson Comorbidity Index score)	1.61	0.90-2.89	0.11
Model F (includes non-dialysis conservative kidney management)	1.70	0.95-3.07	0.07

Note: Model A: Multivariable logistic regression model adjusted for age, sex, race or ethnicity, preferred language; Model B: Model A + additional adjustment for comorbid conditions (hypertension, diabetes mellitus, hypertension, cardiovascular disease, dementia, human immunodeficiency virus), Charlson Comorbidity Index scores, and laboratory data (serum potassium, serum phosphorus, hemoglobin, bicarbonate, albumin, and estimated glomerular filtration by Modification of Diet in Renal Disease Study equation); Model C (fully adjusted): Model B + additional adjustment for education and insurance; Model D: Model C without imputation for missing covariate data; Model E: Model C excluding Charlson Comorbidity Index scores; Model F (fully adjusted) includes the 3 patients who opted for non-dialysis conservative kidney management.

^aOptimal kidney replacement therapy start (defined as the use of arteriovenous access at hemodialysis initiation, outpatient hemodialysis start, preemptive transplant, or peritoneal dialysis as the first modality). For optimal kidney replacement therapy start outcome, all model except F excludes the 3 patients who opted for non-dialysis conservative kidney management.

improving transplant listing and preemptive transplant rates. In our study, we found that exposure to interdisciplinary care was statistically significantly associated with being listed for kidney transplants among incident ESKD patients. These findings are consistent with those in the Comprehensive Dialysis Study, a large national cohort study in the United States, in which early kidney transplant discussion was associated with a 3-fold higher odds of preemptive transplant listing and appeared to reduce barriers to preemptive transplant listing among African American individuals.²⁴ In a smaller single-center prospective study conducted in Germany, the implementation of an interdisciplinary team increased the number of living donor transplantations in the program.²⁵

Other important measures of ESKD preparedness that are associated with superior health outcomes and are cost-effective include the use of permanent AV access at HD initiation and outpatient dialysis initiation.²⁶⁻²⁹ The vast majority of patients (80%) in the United States are still initiating HD with a central venous catheter.³⁰ African American and Hispanic patients are also more likely to “crash” into dialysis (ie, have an unplanned dialysis start and initiate dialysis with a central venous catheter).^{31,32} Early referral to nephrology and pre-ESKD education have been shown to be important for permanent AV access placement in ESKD.^{6,33,34} However, even among patients with established nephrology care, the use of AV access at

first start is still not optimal² and suggests that traditional health care delivery models of care may not be adequate. One reason for this may be that general nephrologists have competing responsibilities and may have limited time and resources to provide the optimal pre-ESKD education and care coordination necessary for timely AV access placement. For this reason, an interdisciplinary care approach may be more advantageous over usual care nephrology care alone. In observational studies performed in the United States, Taiwan, and Canada, patients exposed to interdisciplinary care had significantly more AV fistulas placed.³⁵⁻³⁸ Lee et al³⁵ found that a higher proportion of patients in a multidisciplinary care CKD clinic had a functioning permanent vascular access in place at the time of starting HD compared with those who received usual nephrology care (62% vs 19%). Similarly, Wei et al³⁶ observed that patients who received interdisciplinary care were more likely to initiate dialysis with permanent vascular access (51% vs 29%) and had fewer hospitalizations (41% vs 19%) compared with those who received usual nephrology care. Yeoh et al³⁷ also found that patients exposed to a multidisciplinary care CKD program were far less likely to initiate HD with a central venous catheter (4% vs 37%). A study done in Canada, which included a prospective and retrospective cohort, found that patients exposed to interdisciplinary care were more likely to have a permanent AV access before initiation and less likely to

have an urgent dialysis start.³⁸ In our study, the use of AV access at first HD was 2-fold higher in the interdisciplinary care group compared with national estimates.² While the use of AV access was also higher in the interdisciplinary care compared with the usual care group, in the adjusted models, the odds ratio was not statistically significant. This may be in part because of the small sample size. In our study, the use of an AV access at first HD in the usual care group was also higher than national estimates² and that of the usual care groups of similar studies.^{35,36} This is likely in part because of our inclusion of only patients with established nephrology care. This could also be reflective of changes in our nephrology practice, which may have resulted either directly or indirectly from establishing an interdisciplinary care program. For example, the creation of our interdisciplinary care program likely reinforced the importance of ESKD preparedness in our general nephrology practice. In an earlier observational study conducted at Montefiore from 2011 to 2013, only 27% of patients who developed ESKD used an AV access at HD initiation.³⁴

In our study, only 5% of patients opted to receive PD and none opted to do home HD. In the United States, home modalities are underutilized, especially among racial and ethnic minorities.³⁹ In a prospective study done in Canada, patients who received interdisciplinary care were more likely to choose PD.³⁸ However, a subsequent meta-analysis found that interdisciplinary care models did not increase the likelihood of choosing PD.¹²

Our study has limitations. As is the case with all observational studies, the patients were not randomly assigned to the different groups, and therefore it is subject to selection bias. The patients who enrolled in the interdisciplinary care program may be more motivated or become more engaged in their care through additional interactions with the NP or interdisciplinary care team, and therefore more likely to be adherent with visits for transplant evaluation or access placement. They may also feel more supported during the transition to ESKD. We did not have formal measures of patient satisfaction or engagement, so we were unable to explore these as potential explanatory factors for the differences observed between the groups. While the socio-demographic characteristics were similar between the groups, and we were able to adjust for a number of important clinical covariates, we could not exclude the possibility of residual confounding. Another limitation of our study was the small number of patients who received interdisciplinary care compared with those who received usual nephrology care, which limited the power to detect significant differences. We were also unable to assess whether certain aspects of our interdisciplinary program were more beneficial than others because of the small sample size. Lastly, this was a single-center study, and generalizability to other health systems may be limited.

Notwithstanding these limitations, our study has a number of strengths. Our study evaluated a health care delivery model in CKD that has been understudied in racial and ethnic minorities, who are disproportionately

susceptible to poor health outcomes. We also evaluated important outcomes (including vascular access use, early access to transplant listing, and outpatient dialysis starts), which are associated with better survival, quality of life, and cost-effective care. By focusing on outcomes in predominantly racial and ethnic minorities, we also sought to highlight interdisciplinary care as a health care delivery approach that could potentially advance efforts to achieve more equitable care in CKD.

In summary, an interdisciplinary care health care delivery model (such as Montefiore's Kidney Care Program) was associated with better ESKD preparedness, particularly early access to transplant listing, among predominantly racial and ethnic minorities with CKD. Our study also highlighted the need for more optimal education surrounding living donor transplants and home modalities (such as PD and home HD) because very few patients received a preemptive transplant and the vast majority of patients received in-center HD. An interdisciplinary care approach may be superior to usual nephrology care alone among racial and ethnic minorities with advanced CKD; however, larger, prospective, multicenter studies are needed to determine the effectiveness of interdisciplinary care models on ESKD preparedness. The potential role of the interdisciplinary care team in facilitating non-dialysis conservative kidney management for appropriate patients also warrants further study. While our current article focused on outcomes related to ESKD preparedness, an interdisciplinary approach to CKD care is likely to have other important benefits, such as slowing CKD progression and improving overall patient well-being, which should be evaluated in future studies. Future studies should also evaluate the cost-effectiveness of interdisciplinary care models in CKD care.

ARTICLE INFORMATION

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