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Attrition and Delays in Kidney Transplant Evaluation Among People Living With HIV and End-Stage Renal Disease

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ABSTRACT

Introduction: People living with HIV (PLWH) have a higher incidence of end-stage renal disease (ESRD) than HIV-negative individuals and are less likely to receive a kidney transplant. We described attrition and delays across the transplant care continuum for PLWH with ESRD at the Medical University of South Carolina (MUSC) and explored factors associated with waitlisting.

Methods: Retrospective review of electronic health records of PLWH with ESRD who received care at MUSC or were referred for kidney transplantation between May 1, 2012 and December 31, 2023. Progression through the transplant continuum (referral, evaluation initiation, evaluation completion, waitlisting, and transplantation) was quantified. Multivariable time-to-event analyses was performed.

Results: Among 234 PLWH with ESRD, transplant referral occurred in 190 (80%), of whom 135 (71%) initiated evaluation, 75 (39%) completed evaluation, 62 (32%) were waitlisted, and 44 (23%) received a transplant. Among evaluation non-completers, outstanding testing (42%) and excessive comorbidities (15%) were the most common reasons. Median time from dialysis to referral was 510 days (IQR 139–1665), and median time from evaluation to waitlisting was 306 days (IQR 186–520). In multivariable Cox regression, peritoneal dialysis was associated with shorter time to waitlisting (HR 2.60; 95% CI 1.17–5.75; $p = 0.02$) and Black race trended towards longer time to waitlisting (HR 0.30; 95% CI 0.08–1.11; $p = 0.07$).

Conclusions: Although PLWH with ESRD at MUSC progressed through the transplant continuum, substantial delays were observed. Interventions to reduce structural and logistical barriers and streamline evaluation steps may improve timely access to kidney transplantation.

1 | Introduction

As people living with HIV (PLWH) are living longer due to effective antiretroviral therapy (ART), the spectrum of HIV-related complications has shifted from acute to chronic conditions. One such long-term complication is end-stage renal disease (ESRD). Currently, PLWH make up an estimated 0.5%–1.5% of the total ESRD population [1]. Compared to the general population, where ESRD incidence is 0.5 per 1000, the rate in PLWH is significantly higher, between 3 and 10 per 1000, and continues to rise as life expectancy improves [2]. Black individuals and males with HIV are disproportionately affected [3] as ESRD remains a major contributor to mortality in these populations.

The causes of ESRD in PLWH are multifactorial. HIV-associated nephropathy (HIVAN), historically a leading cause, has declined with the use of ART, as it is associated with uncontrolled viremia [4, 5]. However, certain ART medications are nephrotoxic [6], and PLWH remain at increased risk for chronic kidney disease due to comorbidities such as diabetes, hypertension, and hepatitis C virus (HCV) infection, contributing to the elevated ESRD risk in this population [7–9].

Treatment options for ESRD include dialysis and kidney transplantation, with transplantation offering superior outcomes, reduced mortality, and lower costs [5]. Yet, PLWH still face lower rates of waitlisting, longer wait times, and higher waitlist mortality compared with the general population [10–13]. Barriers such as incomplete transplant evaluation, substance use, and uncontrolled HIV have been reported, though much of the published literature is from large academic centers in the Northeast United States [13–15]. Given that the southeastern United States has the highest HIV prevalence, region-specific barriers may exist.

The HIV Organ Policy Equity (HOPE) Act has fundamentally changed the landscape of kidney transplantation for people with HIV by permitting the transplantation of organs from donors with HIV into recipients with HIV [16]. Since implementation of the HOPE Act, HIV-positive donor to HIV-positive recipient transplantation has been shown to be safe and effective, while simultaneously expanding the donor pool and reducing wait times for eligible recipients [17–19]. However, these advances can only benefit individuals who successfully navigate the transplant evaluation process and are ultimately placed on the transplant waitlist. Consequently, identifying barriers that delay or prevent progression through the transplant continuum is increasingly important to ensure that people with HIV can fully benefit from this expanded transplant opportunity.

The purpose of this study was to describe attrition and delays across the kidney transplant care continuum for PLWH evaluated at the Medical University of South Carolina (MUSC) and to explore patient and clinical factors associated with time to waitlisting. MUSC is one of only two transplant centers in the state. By identifying barriers within this population, we aim to inform targeted strategies to improve transplant access and outcomes for PLWH in South Carolina.

2 | Methods

2.1 | Study Population and Data Sources

We performed a retrospective review of electronic health records of PLWH and ESRD who either received care at MUSC Health Care System or were referred for kidney transplantation at MUSC between May 1, 2012, and December 31, 2023. Epic Slicer Dicer, a self-service reporting tool within the Epic electronic health record system, was utilized to identify persons at MUSC who are HIV positive, have ESRD, and did not die before initiating ESRD services. The medical record number for those who met the query criteria was requested. A chart review was performed to extract clinical and laboratory data. Patients were included if they were alive during the study time period, had confirmed HIV and ESRD (manually verified), had documentation of pursuit of a kidney transplant, had their kidney transplant evaluation performed at MUSC, and had sufficient medical record information about the transplant process. Preemptive transplant patients were excluded from time-to-event analyses anchored on dialysis initiation because a dialysis start date was not available. This study was approved by the MUSC Institutional Review Board.

2.2 | Study Outcomes and Variables

This study examines two primary outcomes. One outcome was to describe the patterns and outcomes for each step of the transplant care continuum among PLWH at MUSC, stratified into: referred for kidney transplant, transplant evaluation initiated, transplant evaluation completed, waitlisted for transplant, and transplanted. The second outcome was to describe patient, clinical, and social characteristics associated with achieving waitlisting.

Patient and clinical characteristics were comprised of age at dialysis start, sex, race/ethnicity, marital status, education level, employment status, household income, attributed cause of ESRD, and comorbidities including hypertension, diabetes mellitus, coronary artery disease, congestive heart failure, peripheral vascular disease, obesity, history of psychiatric condition, history of HCV or hepatitis B virus (HBV) infection, history of tobacco use, and history of substance use. Psychiatric conditions were defined as any history of major depressive disorder, bipolar disorder, generalized anxiety disorder, post-traumatic stress disorder, and/or schizophrenia. Substance use encompassed current or former clinically relevant use of illicit drugs, marijuana, and/or alcohol. Tobacco use included current or former smokers. HIV management data included CD4 count and HIV viral load (VL) at the time of evaluation, antiretroviral medication class at the time of evaluation, and whether a change to the anti-retroviral therapy (ART) regimen was needed for transplant. For CD4 count and HIV VL, if multiple values were present, we used the value closest to evaluation start.

2.3 | Statistical Analysis

Descriptive statistics for patient demographic and clinical factors were performed. Categorical variables were summarized as frequencies with percentages, and continuous variables were reported as median with an interquartile range (IQR). To assess the effect of clinical and demographic factors on waitlisting, multivariable Cox proportional hazards models were used to evaluate the sub-distributional hazards of the outcome. The competing risk of death was accounted for by using conditional time-dependent weights. For multivariable patient-level analyses, covariates that were either significant in bivariable analyses or determined to be socially and clinically relevant to access to transplantation were included in multivariable-adjusted models. To support model stability, multivariable analyses were restricted to participants with complete covariate data for included variables. The proportional hazards assumption was tested using time-dependent variables and was met. All analyses were conducted in R (R version 4.0.1).

To evaluate temporal changes following implementation of the HOPE Act, we performed a prespecified secondary analysis stratifying participants according to transplant evaluation initiation on or before December 31, 2017 (pre-HOPE era) or on or after January 1, 2018 (post-HOPE era). January 1, 2018 was selected as the cutoff because it reflects the period after the initial implementation of HOPE Act protocols, when HIV-positive donor to HIV-positive recipient kidney transplantation had begun at multiple transplant centers nationwide. Waitlisting and transplant rates were compared using Fisher's exact tests, and time intervals across the transplant continuum were compared using the Wilcoxon rank-sum test.

3 | Results

3.1 | Study Population

The query performed in Epic Slicer Dicer identified 487 potential PLWH and ESRD. Of these, 243 patients did not have HIV, 7 patients did not have ESRD, and three patients did not have sufficient data for chart review. The remaining 234 patients were included in the analysis (Figure S1). Demographic and clinical data are presented in Table 1. Of the 234 patients included in the analysis, the median age at time of referral for kidney transplant was 48 years of age (IQR 36–56 years). The study cohort was male-dominant (70%), and the vast majority were of the Black race (93%). The majority of PLWH were single (58%), and education status was largely unknown (47%), though in those where education status was recorded, the most common was achieving a high school diploma (20%). Most of the cohort was on disability (52%), and of those with known household income per month, $1000–$1999 (17%) was the most common. HIV associated nephropathy (HIVAN) was the most common cause of ESRD in PLWH, although only 34% of patients received a kidney biopsy. The most common comorbidities were hypertension (92%), diabetes (35%), congestive heart failure (32%), and obesity (28%). Substance use was present in 18% of patients. The median CD4 count was 356 cells/mm^3 and 66% of patients had an undetectable VL. At pre-transplant infectious disease evaluation, 39% of patients were on a protease inhibitor regimen, and an ART change was needed to accommodate a kidney transplant in 28% of patients.

3.2 | Kidney Transplant Care Continuum and Patient Attrition

The transplant care continuum for this cohort is described in Figure 1. Out of the 234 patients included in the analysis, 190 (80%) were referred for transplant. Of those referred, 135 (71%) initiated the transplant evaluation and 75 (56% of those initiating) completed the evaluation. The majority of patients who completed the evaluation process were waitlisted for kidney transplant (83%), and 44 (59%) of those were transplanted. Reasons why patients did not complete the evaluation process are highlighted in Figure S2. Of the 60 patients who did not complete the evaluation process, 23 (38%) were deemed medially ineligible to proceed (either secondary to comorbidity burden, not meeting HIV criteria or concerns for non-compliance with dialysis or HIV treatment). Twenty-four patients (40%) had incomplete testing or outstand-

TABLE 1 | Baseline demographics of people living with HIV and end-stage renal disease.

Variables	*n* (%)[a]
Total *N*	234
Age at incident dialysis, median (IQR), years	48 (36–56)
Sex	
Male	164 (70)
Female	69 (30)
Race	
Black/African American	217 (93)
White	13 (6)
Other or multi-racial	4 (2)
Marital status[b]	
Married	55 (24)
Single	136 (58)
Divorced	17 (7)
Significant other, not married	4 (2)
Legally separated	11 (5)
Widowed	10 (4)
Education[b]	
Did not graduate high school	18 (8)
High school diploma	46 (20)
Trade school/Certificate program	4 (2)
Some college	24 (10)
Associate's degree	4 (2)
Bachelor's degree	17 (7)
Master's degree	8 (3)
Doctorate degree	0 (0.0)
Other	2 (1)
Unknown	110 (47)
Employment	
Disabled	121 (52)
Not employed	52 (22)
Employed part-time time	12 (5)
Employed full-time	31 (13)
Unknown	18 (8)
Household income per month[b]	
Less than $500	3 (1)
$500–$999	27 (12)
$1000–$1999	40 (17)
$2000–$2999	10 (4)
Greater than $3000	18 (8)
Unknown	134 (58)
Type of dialysis	
Hemodialysis	197 (86)
Peritoneal dialysis	33 (14)

(Continues)

TABLE 1 | (Continued)

Variables	*n* (%)[a]
Preemptive (never on dialysis)	4 (2)
Cause of ESRD[b]	
HIV-associated nephropathy	110 (47)
Hypertension	95 (41)
Diabetes	50 (22)
Focal segmental glomerulosclerosis	17 (7)
Polycystic kidney disease	2 (1)
Multifactorial, unspecified	5 (2)
Other	19 (8)
Unknown	29 (13)
Received kidney biopsy	
Yes	79 (34)
No	99 (42)
Unknown	56 (24)
Comorbidities	
Hypertension	216 (92)
Diabetes	81 (35)
Insulin-dependent	43 (56)
Coronary artery disease	56 (24)
Congestive heart failure	74 (32)
Peripheral vascular disease	32 (14)
Hepatitis C	25 (11)
Hepatitis B	18 (8)
Obesity	66 (28)
Median BMI (kg/m^2)	26.3 (22.2–30.8)
Tobacco use	49 (21)
Substance use	43 (18)
Other psychiatric conditions	57 (24)
HIV History[b]	
Median CD4 count (cells/mm^3)	356 (205–531)
HIV viral load (copies/mL)	
HIV VL = 0	157 (66)
HIV VL 1–200	29 (12)
HIV VL > 200	36 (15)
History of opportunistic infections	45 (24)
Protease based regimen	91 (39)
Integrase based regimen	170 (73)
Change in ART required for transplant	45 (28)
History of ART resistance	41 (23)
Follows at MUSC for HIV care	62 (27)

Abbreviations: ART, anti-retroviral therapy; BMI, body mass index; HIV, human immunodeficiency virus; MUSC, Medical University of South Carolina; VL, viral load.

[a]Percentages rounded up or down for simplicity.

[b]Variable has missing data and values may not add up to 100.0.

ing evaluations (e.g., echocardiography, cardiac catheterization, colonoscopy, consultations, or other required studies). Seven (12%) patients were actively undergoing the evaluation process at the end of the study period and five (9%) patients withdrew from the evaluation process.

The median duration between beginning dialysis and referral for kidney transplant was 553 days (IQR 140–1843), though 29 patients were referred pre-emptively (25 before dialysis initiation and 4 prior to any documented dialysis initiation) and were not included in the calculation. The median duration between referral to evaluation start was 114 days (IQR 49–337) (Table 2). The median length of time it took to complete the evaluation process was 223 days (IQR 119–414). Median time from evaluation start to waitlisting was 306 days (IQR 186–520) and from waitlisting to transplantation 152 days (IQR 33–542). Among participants who underwent kidney transplantation, the median time from referral to transplant was 968 days (IQR 537–1538).

In a secondary analysis, 85 participants were referred for kidney transplantation before January 1, 2018, and 105 were referred on or after January 1, 2018 (Table S1). A significantly greater proportion of referred participants initiated transplant evaluation in the post-HOPE era (84.8% vs. 54.1%, $p < 0.001$). However, rates of evaluation completion (44.8% vs. 32.9%, $p = 0.103$), waitlisting (35.2% vs. 29.4%, $p = 0.438$), and kidney transplantation (23.8% vs. 23.5%, $p = 1.000$) were similar between eras. Although the time from dialysis initiation to transplant referral remained prolonged and did not differ significantly between eras (603 vs. 525 days, $p = 0.872$), the interval from referral to evaluation initiation was substantially shorter after 2018 (73 vs. 329 days, $p < 0.001$). Likewise, the time from referral to evaluation completion decreased significantly in the post-HOPE era (303 vs. 601 days, $p = 0.002$). In contrast, the duration of the evaluation process itself, measured from evaluation initiation to completion (232 vs. 187 days, $p = 0.575$), and the time from evaluation initiation to waitlisting (308 vs. 323 days, $p = 0.468$) were similar between eras. Among transplanted participants, the median time from referral to transplantation was significantly shorter after 2018 (699 vs. 1486 days, $p = 0.021$), whereas the interval from waitlisting to transplantation did not differ significantly between eras (132 vs. 380 days, $p = 0.152$).

3.3 | Multivariable-Adjusted Analyses

To ensure model stability, analyses were restricted to participants with complete data for all covariates included in the model, yielding a final analytic sample of 207 individuals. In multivariable Cox proportional hazards analysis evaluating time from incident dialysis to kidney transplant waitlisting (Table 3), peritoneal dialysis was associated with a significantly higher likelihood of waitlisting compared with hemodialysis (hazard ratio [HR], 2.60; 95% confidence interval [CI], 1.17–5.75). Black race was associated with a lower hazard of waitlisting compared with non-Black race, although this association did not reach statistical significance (HR, 0.30; 95% CI, 0.08–1.11). Age and sex were not significantly associated with time to waitlisting. Educational attainment and employment status were not independently associated with waitlisting after adjustment, including comparisons of individuals with a high school education or less or unknown education

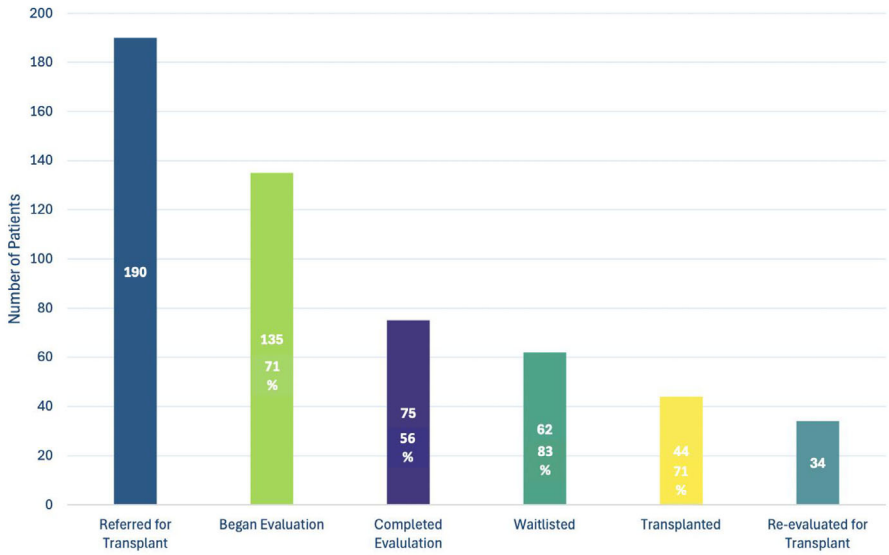

FIGURE 1 | Attrition of transplant steps among PLWH and ESRD.

TABLE 2 | Attrition of transplant steps with associated duration and identified barriers.

Variable	*n* (%)[a] or Median (IQR)
Referral and Evaluation initiation	
Time from dialysis initiation to referral, days	510 (139–1665)
Evaluated for kidney transplant?	
Yes	135 (57)
No	102 (43)
Time from dialysis initiation to evaluation, days	682 (236–2186)
Time from referral to evaluation initiation, days	114 (49–337)
Initial evaluation modality	
Virtual	51 (39)
In-person	80 (61)
Caregiver/social support available	
Yes	115 (91)
No	12 (9)
Transportation issues documented	10 (8)
Potential living donor identified	37 (29)
Calculated PRA, %	32 (11–72)
Evaluation completion	
Completed transplant evaluation?	
Yes	75 (56)
No	60 (44)
Time from referral to evaluation completion, days	386 (149–942)
Duration of evaluation (evaluation initiation → completion), days	223 (119–414)
Barriers to evaluation completion	
Medically ineligible to proceed with transplant evaluation	23 (38)
Did not meet HIV criteria	7 (12)
Too many comorbidities	10 (15)
Non-compliant	6 (10)
Evaluation ongoing	7 (12)
Patient withdrew voluntarily	5 (9)
Patient no-show/did not complete testing requirements	25 (42)
Other	10 (17)
Waitlisting	
Waitlisted for kidney transplant?	
Yes	62 (82)
No	14 (18)
Time from evaluation initiation to waitlisting, days	309 (186–520)
Ever deactivated from waitlist	23 (38)
Re-evaluated for transplant	34 (25)
Kidney transplant outcomes	
Received kidney transplant	44 (71)
Time from waitlisting to transplant, days	152 (33–542)
Time from referral to transplant, days	968 (537–1538)

(Continues)

TABLE 2 | (Continued)

Variable	*n* (%)[a] or Median (IQR)
Transplant performed outside MUSC	6 (14)
Living donor transplant	3 (7)
Multi-organ transplant	2 (5)

Abbreviations: IQR, interquartile range; MUSC, Medical University of South Carolina; PRA, panel-reactive antibody.

[a]Percentages rounded up or down for simplicity.

relative to those with some college or higher education. Similarly, marital status was not associated with time to waitlisting. Clinical and psychosocial factors, including hepatitis B or C infection, obesity, substance use, other psychiatric conditions, and receipt of HIV care at MUSC, were not significantly associated with waitlisting in the adjusted model. Receipt of HIV care at MUSC was also not significantly associated with referral or evaluation initiation.

4 | Discussion

In this single-center retrospective study of PLWH and ESRD at MUSC, we found that once patients were referred, the majority initiated the transplant evaluation process, over half completed it, and 82% of those who completed the evaluation were ultimately waitlisted. These findings highlight that PLWH who are referred for a kidney transplant at MUSC appear to have strong potential to progress successfully to waitlisting and transplantation once engaged in the evaluation process. HIV-specific clinical factors, such as viremia or low CD4 count, rarely prevented patients from moving forward. Instead, the most common reason for failure to complete the transplant evaluation was outstanding required diagnostic testing or specialty consultations, or other center-specific evaluation requirements.

A key finding of this study is the higher-than-expected rate of evaluation completion and waitlisting. Compared with prior studies showing substantially lower waitlisting rates among PLWH who initiate evaluation [11, 12, 15], our cohort demonstrated more favorable outcomes at each step of the continuum. While some degree of selection bias may contribute, such as nephrologists referring only those perceived to be transplant candidates, the overall referral-to-transplant ratio does not suggest unusually restrictive practices. Instead, this may reflect evolving provider comfort with transplantation among PLWH, decreased stigma, greater familiarity with ART management around transplant, and possibly the HOPE Act enhancing interest in transplantation among PLWH. Importantly, these findings challenge the assumption that PLWH require fundamentally different evaluation pathways and instead suggest that with appropriate clinical coordination, their progression toward transplantation can exceed previously documented national patterns of only 12.7% of prevalent ESRD patients achieving waitlisting in 2020 [20].

An additional factor that may have contributed to the increased proportion of patients initiating transplant evaluation was the adoption of virtual transplant evaluation visits during the COVID-19 pandemic. At our center, virtual evaluations increased substantially after March 2020, likely reducing travel and logistical barriers associated with the initial evaluation process. Although our study was not designed to assess the independent impact of telehealth on transplant evaluation outcomes, the increased availability of virtual visits may have facilitated earlier engagement with the transplant program and contributed to the higher proportion of referred patients who initiated evaluation. Future studies are needed to determine whether virtual evaluation strategies improve access to kidney transplantation, particularly for historically underserved populations.

HIV-specific eligibility criteria were rarely the reason for evaluation failure, underscoring that other, less easily measured factors likely contribute to attrition. Only 12% of those who did not complete evaluation failed due to unmet HIV parameters. The most common barrier, failing to complete required testing, occurred in 40% of non-completers and reflects a pattern seen in broader transplant populations [13, 15]. This suggests that ineligibility due to medical comorbidity alone does not explain evaluation dropout. Psychosocial and socioeconomic factors are known to influence access to kidney transplantation, though our study did not identify independent associations between factors such as educational attainment, employment status, marital status, or other psychosocial variables and time to waitlisting. In addition, barriers such as financial limitation or health insurance coverage were not consistently documented in the medical record. However, many participants were disabled, had low income, or lacked consistent transportation, echoing findings from prior literature that social determinants of health influence transplant readiness and access [21]. To better understand the psychosocial and socioeconomic challenges faced by candidates in the evaluation process, qualitative data is needed. With such data, implementation-focused research can be used to identify actionable barriers and develop strategies such as patient navigation, enhanced care coordination, or targeted social support interventions to assist with evaluation completion rates.

When investigating how the HOPE Act may have influenced access to kidney transplant for PLWH, secondary analyses demonstrated significantly shorter times from referral to evaluation initiation and from referral to transplantation after implementation of the HOPE Act. These findings suggest that although barriers to early referral persist, progression through the transplant evaluation process has improved over time. During this period, our transplant center also implemented several multilevel initiatives to improve equitable access to transplantation, including dialysis center education, expansion of telehealth services, partnerships with community providers to facilitate completion of evaluation testing, and increased utilization of high-risk donor organs [24]. While the present study cannot determine the relative contribution of these initiatives, they likely reflect evolving institutional efforts to improve access to kidney transplantation.

Despite the higher-than-expected rate of evaluation completion, substantial delays were observed across every step of the transplant continuum, which represents an important missed opportunity for earlier transplantation. The median time from dialysis initiation to referral exceeded 16 months, and further

TABLE 3 | Multivariable-adjusted Cox regression model for the relationship between demographic, social, and clinical variables with waitlisting.

Variable	aHR	Lower 95 CI	Upper 95 CI	*p*-Value	Reference category
Age	0.99	0.96	1.02	0.37	
Peritoneal dialysis	2.60	1.17	5.75	**0.02**	Hemodialysis
High school or less education	0.84	0.45	1.59	0.60	Some college
Employed	1.92	0.71	5.22	0.20	Not employed
Disabled	1.20	0.50	2.90	0.68	Not employed
Hepatitis B	0.44	0.10	1.90	0.27	
Hepatitis C	0.70	0.16	3.11	0.64	
Receives HIV care at MUSC	0.87	0.43	1.73	0.69	
Not married	0.85	0.41	1.79	0.67	Married
Obesity	1.20	0.56	2.58	0.64	
Psychiatric conditions	0.95	0.47	1.89	0.88	
Black race	0.30	0.08	1.11	0.07	Non-Black race
Male gender	0.70	0.34	1.44	0.34	Female gender
Substance use	1.17	0.49	2.78	0.73	

Note: To support model stability, multivariable analyses were restricted to participants with complete covariate data for included variables. Around 207 observations included in the model.

Abbreviations: aHR, adjusted hazard ratio; CI, confidence interval; MUSC, Medical University of South Carolina.

delays occurred between evaluation start to evaluation completion, waitlisting, and eventual transplantation. These prolonged time intervals are especially concerning, given the known survival benefits of earlier transplantation and the potential for worsening comorbidity burden during extended dialysis exposure [22, 23]. Efforts to streamline the referral processes, reduce scheduling bottlenecks, and proactively support pre-transplant testing completion could meaningfully improve access for PLWH.

The findings from the adjusted multivariable Cox proportional hazards model highlight dialysis modality and race as key signals meriting further mechanistic and implementation-focused investigation. Dialysis modality emerged as the strongest factor associated with waitlisting, with individuals receiving peritoneal dialysis experiencing significantly faster progression to waitlisting compared with those receiving hemodialysis. In the literature, pre-transplant peritoneal dialysis has been associated with lower risk of delayed graft function and graft loss [25, 26]. Another possible explanation for the higher likelihood of transplantation among peritoneal dialysis patients is that the flexibility afforded by peritoneal dialysis may facilitate completion of the numerous appointments and diagnostic studies required for transplant evaluation. Our study did not capture process-level metrics, such as appointment scheduling or completion rates, though warrants further study. Although Black race was associated with a lower hazard of waitlisting in the adjusted analysis, this finding did not reach statistical significance. Given that more than 90% of our cohort identified as Black, our study was underpowered to definitively evaluate the impact of race on transplant evaluation completion and waitlisting. Nonetheless, this finding is consistent with the literature of persistent racial disparities in access to kidney transplantation [27–29]. Socioeconomic indicators, including education level, employment status, and marital status, were not independently associated with time to waitlisting after adjustment for clinical and care-related factors, although point estimates suggested potential trends that warrant further investigation. Notably, receipt of HIV care at MUSC was not independently associated with evaluation start or waitlisting in the adjusted model, suggesting that differences in access may be driven more by upstream system-level factors than by HIV specialty care engagement alone.

This study has several limitations. As a single-center retrospective analysis, generalizability may be limited. Another limitation of the present study is the absence of an internal comparator cohort without HIV, which precludes determination of whether the observed delays are unique to PLWH or reflect broader transplant access challenges within our center or region. Our inclusion criteria required there to be enough data within medical record system for extraction. As such, our cohort may represent a select subgroup of patients that were highly engaged in care and may overestimate progression compared with the broader ESRD population. In addition, qualitative factors such as stigma, transportation barriers, financial strain, impact of dialysis modality on timeliness of visit completion, or perceived readiness for transplant were not captured in the electronic record and therefore could not be measured. Nonetheless, the study has notable strengths, including a large cohort in the southeastern United States that expands across a decade, detailed characterization of the full transplant continuum, and the ability to quantify where attrition and barriers occurred.

In conclusion, PLWH referred for kidney transplantation at MUSC demonstrated strong progression through the evaluation process and high rates of waitlisting once evaluation was completed. HIV-specific clinical factors were not independently associated with progression through the kidney transplant evaluation process. Instead, our findings suggest that transplant access is influenced by a complex interplay of clinical, structural, and healthcare system factors. Significant delays across all

stages of the transplant continuum highlight opportunities for interventions aimed at earlier referral, streamlined evaluation, and improved patient support. Future studies should incorporate more granular process-level metrics and patient-reported data to identify specific barriers contributing to transplant evaluation attrition among PLWH and to compare these barriers with those experienced by individuals without HIV. Improved understanding of where and why attrition occurs across the transplant continuum will inform targeted, patient-centered strategies to reduce disparities and promote equitable access to kidney transplantation for PLWH.

Author Contributions

Scott Curry: formal analysis, data curation. **Dhriti Shah**: data curation. **Jillian Catalano**: writing – original draft, data curation. **Kyle M. Crawford**: data curation, writing – original draft. **Courtney E. Harris**: writing – review and editing. **Alexandra G. Mills**: data curation. **Drew Charles**: writing – review and editing. **Ruth O. Adekunle**: conceptualization, writing – original draft, visualization, writing – review and editing, project administration, data curation, supervision. **Yosra Alkabab**: writing – review and editing.

References

1. S. M. Boyle, D. H. Lee, and C. M. Wyatt, "HIV in the Dialysis Population: Current Issues and Future Directions," *Seminars in Dialysis* 30, no. 5 (2017): 430–437, https://doi.org/10.1111/sdi.12615.

2. G. M. Lucas, S. H. Mehta, and M. G. Atta, "End-Stage Renal Disease and Chronic Kidney Disease in a Cohort of African-American HIV-Infected and At-Risk HIV-Seronegative Participants Followed Between 1988 and 2004," *Aids* 21, no. 18 (2007): 2435–2443, https://doi.org/10.1097/QAD.0b013e32827038ad.

3. G. M. Lucas, B. Lau, M. G. Atta, D. M. Fine, J. Keruly, and R. D. Moore, "Chronic Kidney Disease Incidence, and Progression to End-Stage Renal Disease, in HIV-Infected Individuals: A Tale of Two Races," *Journal of Infectious Diseases* 197, no. 11 (2008): 1548–1557, https://doi.org/10.1086/587994.

4. L. Ryom, O. Kirk, and J. D. Lundgren, "Advanced Chronic Kidney Disease, End-Stage Renal Disease and Renal Death Among HIV-Positive Individuals in Europe," *HIV Medicine* 14, no. 8 (2013): 503–508, https://doi.org/10.1111/hiv.12038.

5. T. S. Ahuja, J. Grady, and S. Khan, "Changing Trends in the Survival of Dialysis Patients With Human Immunodeficiency Virus in the United States," *Journal of the American Society of Nephrology* 13, no. 7 (2002): 1889–1893, https://doi.org/10.1097/01.asn.0000019773.43765.bf.

6. R. Kalyesubula and M. A. Perazella, "Nephrotoxicity of HAART," *AIDS Research and Treatment* 2011, no. 1 (2011): 562790, https://doi.org/10.1155/2011/562790.

7. S. Naicker, S. Rahmania, and J. B. Kopp, "HIV and Chronic Kidney Disease," *Clinical Nephrology* 83, no. S1 (2015): S32–S38, https://doi.org/10.5414/CNP83S032.

8. C. M. Wyatt, J. A. Winston, and C. D. Malvestutto, "Chronic Kidney Disease in HIV Infection: An Urban Epidemic," *Aids* 21, no. 15 (2007): 2101–2103, https://doi.org/10.1097/QAD.0b013e3282ef1bb4.

9. A. G. Abraham, K. N. Althoff, and Y. Jing, "End-Stage Renal Disease Among HIV-Infected Adults in North America," *Clinical Infectious Diseases* 60, no. 6 (2015): 941–949, https://doi.org/10.1093/cid/ciu919.

10. G. E. Malat, S. M. Boyle, and R. M. Jindal, "Kidney Transplantation in HIV-Positive Patients: A Single-Center, 16-Year Experience," *American Journal of Kidney Diseases* 73, no. 1 (2019): 112–118, https://doi.org/10.1053/j.ajkd.2018.02.352.

11. J. E. Locke, S. Mehta, and D. Sawinski, "Access to Kidney Transplantation Among HIV-Infected Waitlist Candidates," *Clinical Journal of the American Society of Nephrology* 12, no. 3 (2017): 467–475, https://doi.org/10.2215/CJN.07460716.

12. R. O. Adekunle, R. Zhang, Z. Wang, R. E. Patzer, and A. K. Mehta, "Early Steps to Kidney Transplantation Among Persons With HIV and End-Stage Renal Disease in ESRD Network 6," *Transplant Infectious Disease* 24, no. 1 (2022): e13767, https://doi.org/10.1111/tid.13767.

13. D. H. Lee, S. M. Boyle, and G. E. Malat, "Barriers to Listing for HIV-Infected Patients Being Evaluated for Kidney Transplantation," *Transplant Infectious Disease* 19, no. 6 (2017): e12777, https://doi.org/10.1111/tid.12777.

14. S. M. Boyle, K. Fehr, and C. Deering, "Barriers to Kidney Transplant Evaluation in HIV-Positive Patients With Advanced Kidney Disease: A Single-Center Study," *Transplant Infectious Disease* 22, no. 2 (2020): e13253, https://doi.org/10.1111/tid.13253.

15. D. Sawinski, C. M. Wyatt, and L. Casagrande, "Factors Associated With Failure to List HIV-Positive Kidney Transplant Candidates," *American Journal of Transplantation* 9, no. 6 (2009): 1467–1471, https://doi.org/10.1111/j.1600-6143.2009.02637.x.

16. "HOPE Act," HRSA, accessed July 27, 2026, https://www.hrsa.gov/optn/professionals/resources/hope-act.

17. C. M. Durand, W. Zhang, and D. M. Brown, "A Prospective Multicenter Pilot Study of HIV-Positive Deceased Donor to HIV-Positive Recipient Kidney Transplantation: HOPE in Action," *American Journal of Transplantation* 21, no. 5 (2021): 1754–1764, https://doi.org/10.1111/ajt.16205.

18. C. M. Durand, A. Massie, and S. Florman, "Safety of Kidney Transplantation From Donors With HIV," *New England Journal of Medicine* 391, no. 15 (2024): 1390–1401, https://doi.org/10.1056/NEJMoa2403733.

19. J. D. Motter, S. Hussain, and D. M. Brown, "Wait Time Advantage for Transplant Candidates With HIV Who Accept Kidneys from Donors with HIV Under the HOPE Act," *Transplantation* 108, no. 3 (2024): 759–767, https://doi.org/10.1097/TP.0000000000004857.

20. "2025 Annual Data Report," USRDS, accessed June 29, 2024, https://usrds-adr.niddk.nih.gov/.

21. H. Wesselman, C. G. Ford, and Y. Leyva, "Social Determinants of Health and Race Disparities in Kidney Transplant," *Clinical Journal of the American Society of Nephrology* 16, no. 2 (2021): 262–274, https://doi.org/10.2215/CJN.04860420.

22. S. D. S. Fraser, P. J. Roderick, and C. R. May, "The Burden of Comorbidity in People With Chronic Kidney Disease Stage 3: A Cohort Study," *BMC Nephrology* 16 (2015): 193, https://doi.org/10.1186/s12882-015-0189-z.

23. S. Strohmaier, C. Wallisch, and M. Kammer, "Survival Benefit of First Single-Organ Deceased Donor Kidney Transplantation Compared with Long-Term Dialysis Across Ages in Transplant-Eligible Patients with Kidney Failure," *JAMA Network Open* 5, no. 10 (2022): e2234971, https://doi.org/10.1001/jamanetworkopen.2022.34971.

24. D. J. Taber, Z. Su, and M. Gebregziabher, "Multilevel Intervention to Improve Racial Equity in Access to Kidney Transplant," *Journal of the American College of Surgeons* 236, no. 4 (2023): 721–727, https://doi.org/10.1097/XCS.0000000000000542.

25. T. Ngamvichchukorn, C. Ruengorn, and K. Noppakun, "Association Between Pretransplant Dialysis Modality and Kidney Transplant Outcomes," *JAMA Network Open* 5, no. 10 (2022): e2237580, https://doi.org/10.1001/jamanetworkopen.2022.37580.

26. M. Tang, T. Li, and H. Liu, "A Comparison of Transplant Outcomes in Peritoneal and Hemodialysis Patients: A Meta-Analysis," *Blood Purification* 42, no. 2 (2016): 170–176, https://doi.org/10.1159/000446272.

27. A. Suah and M. R. Saunders, "Racial Disparities in Living Donor Kidney Transplantation—How Can We Bridge the Gap?," *JAMA Network Open* 6, no. 12 (2023): e2347808, https://doi.org/10.1001/jamanetworkopen.2023.47808.

28. R. E. Patzer, "Bridging Racial Disparities in Access to Kidney Transplantation in the United States," *Journal of the American Society of Nephrology* 35, no. 7 (2024): 959–961, https://doi.org/10.1681/ASN.0000000000000366.

29. B. A. Shelton, D. J. Becker, P. A. MacLennan, B. Sen, H. Budhwani, and J. E. Locke, "Racial Disparities in Access to the Kidney Transplant Waitlist Among People With Human Immunodeficiency Virus," *AIDS Patient Care and STDs* 37, no. 8 (2023): 394–402, https://doi.org/10.1089/apc.2023.0037.

Supporting Information

Additional supporting information can be found online in the Supporting Information section.

Supporting Information file 1: tid70304-sup-0001-SuppMat.docx

Supporting Information file 2:Visual Abstract