Increasing Equity in Kidney Transplantation:

Results of the Kidney Transplant Fast Track Study

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KEY POINTS

Question: Is Kidney Transplant Fast Track (KTFT) associated with a higher likelihood of waitlisting and kidney transplantation?

Findings: In this prospective comparative cohort trial of 1118 end-stage kidney disease (ESKD) patients and a historical control group of 1152 ESKD patients undergoing evaluation for kidney transplantation, KTFT patients were 40% more likely to be waitlisted and 21% more likely to be transplanted than historical controls. Unlike the historical control group, after KTFT, there were no significant race differences in kidney transplantation.

Meaning: KTFT was associated with a higher likelihood of waitlisting and kidney transplantation, and may help reduce race disparities.

ABSTRACT

Importance: Kidney transplantation (KT) is the optimal treatment for end-stage kidney disease (ESKD). The evaluation process for KT is lengthy, time consuming, and burdensome; racial and ethnic disparities persist.

Objective: To determine the potential advantage of Kidney Transplant Fast Track (KTFT) on likelihood of waitlisting, KT, and associated disparities, compared to standard care.

Design: Prospective comparative cohort trial with a prospective historical control (HC) comparison, with equal duration of follow-up. KTFT cohort study duration: 2015-2018, follow-up through 2022; HC cohort study duration: 2010-2014, follow-up through 2018.

Setting: Single urban transplant center

Participants: Adult, English-speaking, ESKD patients with no history of KT, scheduled KT evaluation appointment; KTFT sample: 1472 eligible, 1288 consented and completed baseline interview, 170 excluded for not attending evaluation appointment; HC sample: 1337 eligible, 1152 consented and completed baseline interview, none excluded.

Exposure: Streamlined, patient-centered, coordinated-care KT evaluation process.

Main Outcome(s) and Measure(s): Time to waitlisting for KT and receipt of KT

Results: KTFT participants (n=1118) were 37% (n=416) female, M(SD) age=57.2 (13.2); 22% (n=245) non-Hispanic Black, 71% (n=790) non-Hispanic White, and 7% (n=83) Other race and ethnicity. HC participants (n=1152) were 39% (n=447) female, M(SD) age=55.5 (13.2); 23% (n=267) non-Hispanic Black, 69% (n=789) non-Hispanic White, and 8% (n=96) Other. After adjusting for demographic and clinical factors, KTFT patients had a 40% greater chance of being placed on the active waitlist for KT compared to HCs (subdistribution hazard ratio, SHR=1.40, CI=1.24-1.59, $p<.001$). Among those who were waitlisted, KTFT patients had a 21% greater chance of receiving a KT than HCs (SHR=1.21, CI=1.04-1.41, p=.014). KTFT Black patients were 54% (SHR=1.54, CI=1.16-2.05, $p=.014$) and KTFT White patients were 38% (SHR=1.38, CI=1.20-1.60, $p<.001$) more likely to be waitlisted for KT than their respective HCs;

but no such difference was found for Other patients (SHR=1.28, CI=0.83-1.98, p=0.270). Black KTFT patients were 51% more likely to undergo KT than Black HCs (SHR=1.51, CI=1.06-2.17, *p*=0.023), but no significant differences were found for White (SHR=1.15, CI=0.96-1.37, p=0.127) or Other patients (SHR=1.23, CI=0.72-2.07, p=0.448).

Conclusions and Relevance: KTFT was significantly better than standard care for waitlisting and KT. KTFT may help reduce race disparities in KT.

INTRODUCTION

It is well established that kidney transplantation (KT) is the optimal treatment for end-stage kidney disease (ESKD). It reduces mortality, improves quality of life, and is less costly than dialysis.[1–5] Despite these advantages, there are well-documented barriers that prevent otherwise eligible patients from obtaining KT.[6,7] Research has shown significant disparities in ESKD and its treatment for members of vulnerable groups (e.g., minority race and ethnicity, low income), particularly Black patients. For example, although ESKD in Black patients is four times greater than in White patients, Black patients are less than half as likely to undergo KT.[8] Black race is associated with: (a) a longer time to complete evaluation for KT,[9] (b) lower likelihood of getting a KT,[10,11] (c) lower rates of pre-emptive listing for KT,[12–16] and, (d) lower rates of living versus deceased donor KT.[17,18]

A majority of patients who are referred for KT and begin the evaluation process do not make it through to receipt of transplant, in part because of the significant patient burden navigating the KT process following a referral.[19–23] The first step following referral is commencing KT evaluation, which traditionally requires an initial visit with the transplant team, followed by a battery of tests conducted by multiple specialists (e.g., blood work, cardiac checks, pap smear) and several follow-up visits before a patient's case can be presented to the transplant team for a decision about waitlisting the patient for KT.[24] The process is lengthy, time consuming and burdensome to the patient.[25] Despite some variation among centers, patients typically must complete testing on their own and ensure that results are forwarded to the transplant team. This process requires significant effort, oversight and follow-up by the patient, who may be feeling unwell. It can be daunting and confusing for many patients, especially those with low health literacy[26] or those who perceive or experience barriers within the healthcare system, contributing to long-standing racial/ethnic and socioeconomic disparities in KT waitlisting and receipt on a national level.[19,27–29]

Our previous work showed that demographic characteristics (e.g., race, age, education, income) and clinical factors (e.g., time on dialysis, BMI) predict the rate of KT evaluation completion.[28–30] Most efforts to reduce disparities in KT emphasize educating patients on dialysis who have not been referred for KT.[31–44] Although modestly successful,[32,34,37,45] patient education does not reduce the burden to the patient, nor does it eliminate external barriers to completing the evaluation process. Although changes to the national Kidney Allocation System (KAS) improved rates of KT for minority patients who were already waitlisted,[46] our own and others' data show that KAS has little influence on rate of KT for those who are not waitlisted,[28,46] or listed inactive.[47]

Instead, changing the demands of the KT evaluation process on the patient may significantly reduce KT disparities. By using the same urgent, healthcare system-facilitated approach to KT that exists for other end-organ transplantation,[8,48] we speculated that the time to complete evaluation might be reduced, resulting in a higher number of patients receiving KT more quickly due to less time for physical decline as they await testing appointments and delivery of results from their providers to the transplant team. Support for this approach comes from a retrospective analysis of KT recipients.[49] However, this work did not examine the effects of the intervention prospectively and there was no comparison group of patients who did not undergo the intervention.

After extensive discussion and review with administration, medical and surgical staff, nurse coordinators, and administrative support, the KT program at the University of Pittsburgh Medical Center, Starzl Transplantation Institute (UPMC STI) transplant center instituted a streamlined evaluation approach, that we dubbed Kidney Transplant Fast Track (KTFT) in December 2012.[50] KTFT has not been systematically compared with previous standard care procedures that existed in our center through November 2012. Thus, it presented us with a unique opportunity to prospectively examine and evaluate the effectiveness of such a systematic clinical change within a surgical setting. We leveraged the participant data from our previous

study,[28,29] and used them as historical controls for the patients undergoing the new KTFT evaluation process.[50] Our objective was to test whether a comprehensive, patient-centered, system-level fast-track KT evaluation was associated with a greater likelihood of KT waitlisting and KT, relative to standard care, and to determine whether KTFT would be especially helpful for Black and other non-White racial and ethnic minority patients.

METHODS

Study Design

The KTFT study sample came from a quasi-experimental trial (ClinicalTrials.gov identifier: NCT02342119) of patients who were scheduled for transplant evaluation at the UPMC STI, between May 2015 and June 2018 and followed via medical record through August 2022 (see Figure 1 for description of patient flow through the study). The historical control (HC) comparison sample came from a cohort study of patients who were scheduled for transplant evaluation at the UPMC STI between March 2010 and October 2012, and followed via medical record through August 2018 (see Ng et al.[28] and Wesselman et al.[29] for detail on the study protocol and patient flow).

To obtain demographic and clinical information, KTFT participants completed structured baseline interviews prior to their first KT evaluation clinic appointment. HC patients completed their baseline interview after attending their initial KT evaluation appointment. For both cohorts, we followed patient progress through transplant evaluation, waitlisting, and time to transplant via medical record review to obtain the outcome measures.

This study was approved by the Institutional Review Boards (IRB) at the University of Pittsburgh (PRO09060113) and the University of New Mexico (17–084), and a data use agreement was signed between the two institutions. The study was conducted in accordance with the Declaration of Helsinki and is consistent with the Principles of the Declaration of Istanbul as outlined in the ‘Declaration of Istanbul on Organ Trafficking and Transplant Tourism’.

Kidney Transplant Fast Track (KTFT) Intervention: Brief Overview

The KTFT intervention involves the completion of most or all testing on the same day that patients arrive for their first pre-transplant clinic appointment, rather than providing patients with a list of tests to be completed on their own with their referring physician. If patients are unable to complete all testing on the same day as their evaluation, a transplant clinic scheduler or nurse coordinator arranges appointment times and preparatory material for all remaining tests to be completed as soon as possible (see Bornemann et al.[50] for detailed information on the study protocol). The original protocol included an education intervention, but because we found no significant effect of the intervention[51] it is not discussed further.

Study Cohort

For both study samples, patient inclusion criteria were: 1) scheduled for a KT appointment; 2); English speaking; 3) 18 years or older; 4) no history of KT; and 5) not waitlisted for KT. During the KTFT recruitment timeframe, 1472 people were eligible for the study, 1288 consented and completed the baseline interview, but 170 patients were excluded for not attending their evaluation appointment. During the HC study recruitment timeframe, 1337 people were eligible for the study, and 1152 attended their evaluation, consented to participate, and completed the baseline interview (due to a difference in baseline interview timing).

Measures

Outcome Variables. Our main outcome variables were time to transplant waitlisting and, among waitlisted patients, time to kidney transplant.

Demographics and Clinical Characteristics at Transplant Evaluation. We assessed demographics (e.g., race and ethnicity, age, income, education) and clinical factors (e.g., dialysis, co-morbidities) via baseline interviews and medical record (EMR) review (Table 1). We calculated the Charlson Comorbidity Index score from EMR information.[52–54]

Statistical Analysis

We examined descriptive data across the two study cohorts (KTFT vs. HC) using standard tests for continuous and categorical variables. To visualize the probability of events,

we calculated and plotted adjusted cumulative incidence functions (CIFs) for time from evaluation inception to waitlisting and, among patients waitlisted, time to KT from waitlisting date.

Study Cohort Multivariable Analyses: We used time-to-event analyses (Fine-Gray competing risk models, with death as a competing event)[55,56] to examine the cumulative incidence of study outcomes across the study cohorts (KTFT, HC). A separate model was fit for each outcome. Our analyses controlled for demographic and clinical covariates that showed associations with 1 or more study outcomes (i.e., p-value <0.10, subdistribution hazard ratio [SHR] >2, or SHR <0.5).

Because our study design was not a randomized controlled trial, and our primary outcomes (waitlisting, KT) and competing risk events (e.g., death) may not be independent, methods such as Cox regression and competing risks are subject to potential bias in inference for causality (e.g., KTFT vs. HC). Instead, our analysis focused on estimating the probability of the outcomes and its comparison between KTFT and HC as well as comparisons across race and ethnicity groups. Therefore, because Fine-Gray competing risk models are designed for more accurate estimation of the cumulative incidence function (probability of primary and competing events over time), we chose the Fine-Gray competing risk models approach.[57–60]

Study Cohort by Race and Ethnicity Analyses: Because another important concern for our intervention was the potential influence of KTFT on racial and ethnic disparities in access to kidney transplantation, we examined whether unique combinations of study cohort and race and ethnicity predicted study outcomes. We cross-classified study cohort (KTFT or HC) by race and ethnicity (non-Hispanic Black, non-Hispanic White, Other), yielding 6 groups: KTFT Black, White, and Other; and HC Black, White, and Other patients. We completed these analyses for each of our key outcomes, adjusting for demographic and clinical factors.

RESULTS

Sample Description

The sample of 1118 KTFT participants was 22% (n=245) non-Hispanic Black (Black), 71% (n=790) non-Hispanic White (White), and 7% (n=83) Other race and ethnicity (Other, consisting mostly of individuals identifying as multiracial; see Table 1, footnote a). Similarly, the sample of 1152 HC participants was 23% (n=267) Black, 69% (n=789) White, and 8% (n=96) Other (also consisting mostly of multiracial individuals; see Table 1, footnote a). The KTFT and HC samples were similar across most demographics, except the KTFT cohort averaged 2 years older and a higher percentage relied exclusively on public insurance. On clinical characteristics, the KTFT cohort had a very modest but statistically significant higher mean BMI, a lower percentage of patients with <1 year of dialysis, but a greater percentage with 1-5 years of dialysis, and more potential donors. Table 1 also lists the numbers of patients experiencing study outcomes and reasons for censoring. We used these data in time-to-event analyses addressing study aims.

Comparison of Study Outcomes by Cohort

Likelihood of Waitlisting. Over a 7-year follow-up period, after adjusting for demographic (i.e., race, age, education, income, marital status, employment status, type of insurance) and clinical factors (i.e., kidney disease burden, Charlson Comorbidity, and dialysis duration), KTFT patients were 40% more likely to be placed on the active waitlist for KT than HCs (SHR=1.40, CI=1.24-1.59, p<.0001; Figure 2a and Table 2, first row).

Likelihood of Receiving a Transplant After Waitlisting. Among those who were on the active waitlist, after adjusting for demographic and clinical factors, KTFT patients were 21% more likely to get a kidney transplant than HCs (SHR=1.21, CI=1.04-1.41, p=0.014), Figure 2b and Table 2, first row.

Comparison of Study Outcomes by Cohort and Race

Likelihood of Waitlisting. KTFT Black patients were 54% more likely (SHR=1.54, CI=1.16-2.05, p=.003) and KTFT White patients were 38% more likely (SHR=1.38, CI=1.20-1.60, p<.001) to be waitlisted for KT than their respective HCs; but, there was no statistically

significant difference for the KTFT Other patients and their HCs (SHR=1.28, CI=0.83-1.98, *p*=0.270). We found no significant differences in likelihood of waitlisting between KTFT Black and White patients (SHR=0.79, CI=0.61-1.01, *p*=0.060) or between KTFT Other and White patients (SHR=0.77, CI=0.54-1.09, *p*=0.143). In contrast, HC Black patients were significantly less likely to be waitlisted than White patients, (SHR=0.71, CI=0.58-0.87, *p*=0.001), see Figure 3a and Table 2 for key comparisons and Supplemental Table 1 for all comparisons.

Likelihood of Receiving a Transplant After Waitlisting. Black KTFT patients were 51% more likely to receive a KT after waitlisting than Black HCs (SHR=1.51, CI=1.06-2.17, *p*=0.023). Results for KTFT White (SHR=1.15, CI=0.96-1.37, *p*=0.127) and for KTFT Other patients (SHR=1.23, CI=0.72-2.07, *p*=0.448) were not significantly different than their respective HCs. There was no significant KT differences between KTFT Black and White patients (SHR=1.05, CI= 0.79-1.40, *p*=0.715); in contrast, such differences between HC Black and White patients were more pronounced, though not reliably different (SHR=0.80, CI=0.60-1.07, *p*=0.130); Figure 3b and Table 2 for key comparisons and Supplemental Table 1 for all comparisons.

DISCUSSION

Our healthcare system-level changes in the clinical approach to KT evaluation created a naturalistic, pre/post experiment of the KTFT. Inspired by results from our previous descriptive work at the Veteran's Affairs,[61] and others' retrospective findings,[49] we sought to test the advantage of using a comprehensive, patient-centered, system-level fast-track KT evaluation process for ESKD patients over standard care on the likelihood of KT waitlisting, and increasing KT rates. We believe our study is superior to secondary-data analysis using SRTR data to compare centers because our approach examined the effects of the intervention prospectively and because our comparison group came from the same center allowing for the control of factors such as utilizing virtually the same clinical team, hospital policies, and geographic region of patients served.

Over a 7-year follow-up period, results showed that our center-based healthcare system-level intervention, Kidney Transplant Fast Track (KTFT), increased the likelihood of waitlisting and KT. KTFT patients had a 40% greater chance of being placed on the active waitlist for KT and a 21% greater chance of undergoing KT than historical controls. Notably, these advantages were found after controlling for sociodemographic and medical factors, indicating that our intervention was successful regardless of patients' varying social determinants of health such as income or education level. These findings are particularly important because they are a substantial departure from previous interventions focused on patient education, which neither alleviates the logistical burden for patients nor significantly improves waitlisting and KT outcomes.[34,37,40,62] We believe that the KTFT intervention removes the burden from patients and instead focuses on what the healthcare system can do for all patients regardless of their social determinants of health.

Another important study finding was the effect of KTFT on racial and ethnic disparities in access to kidney transplantation. Our results demonstrated that KTFT may have contributed to significant improvement in likelihood of waitlisting and KT for Black patients. Black patients in the KTFT cohort were 54% more likely to be waitlisted for KT, and 51% more likely to undergo KT, compared to Black historical control patients. Moreover, our conclusions are buffered by the finding that there were no significant differences in waitlisting and KT between KTFT Black and White patients, yet such differences were either significantly different (vis a vis, waitlisting) or more pronounced (vis a vis, KT) among their historical controls. *To our knowledge, ours is the first study to demonstrate such a remarkable reduction in KT disparities for Black and White patients.* Although we didn't find similar significant differences for Other race and ethnicity patients, we suspect that this result occurred because the group sizes were not sufficiently large and the patients were more heterogenous compared to the patients in the Black and White patient study groups.

Limitations

Despite our significant findings, it is important to note that our study has limitations because it was not a randomized-controlled trial (RCT). As such there might have been other temporal changes that occurred after the HC recruitment period or during the KTFT period that may possibly contaminate the effect of KTFT (e.g., national Medicare policy changes, transplant center-specific policy changes). Given the intuitive systemwide benefits of KTFT to all patients, conducting a randomized controlled trial may have raised ethical concerns of depriving clinical benefits to some patients. As an alternative, we conducted this longitudinal cohort study with a historical control group. Given the complex nature of transplant centers and organizational settings, we argue that the pragmatic trial approach[63] that we used in the current study improves the value of our research for decision making in clinical and health policy, which is the ultimate goal of this research.

Also, our study was limited to one transplant center. Although a single site, UPMC STI is one of the largest of the 42 transplant centers in UNOS Region Two,[64] making it an ideal location to test this intervention. It is, however, very well-resourced, and the majority of patients is well-insured either via private or public insurance. Thus, although our multivariable modeling accounted for individual, patient-level differences in income and insurance status, future research should determine whether KTFT can succeed in a variety of health care settings. For example, it would be important to test KTFT in modest health care settings (e.g., state-funded, safety-net hospitals) with limited operational funds, serving a patient population that is predominantly under- or uninsured.

Conclusion

Although a seemingly intuitive solution to enabling more patients to complete the evaluation process and be added to the waitlist, to our knowledge, only a few transplant centers use a healthcare systems-facilitated approach like KTFT to complete the transplant evaluation process.[49,65] Indeed, as noted by Schold et al., “[D]espite wide recognition, policy reforms, and extensive research, rates of waitlisting following ESKD onset did not seem to improve in more

than two decades and were consistently reduced among vulnerable populations. Improving access to transplantation may require more substantial interventions."[7] An important contribution of our study was to answer this call for a more substantial intervention. In addition, our intervention may have contributed to significantly reducing KT disparities. To the extent possible, we believe that KTFT should be implemented as standard of care across all transplant centers. We hope that clinicians and providers at various healthcare systems can use the results of our work to build an evidence base for implementing a similar approach in their respective transplant centers, and encourage appropriate insurance and Medicare reimbursement to enable institutions across the income spectrum (regardless of profit status) to implement the appropriate healthcare system changes.

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Author contributions: Drs. Larissa Myaskovsky and Mary Amanda Dew had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Dr. Myaskovsky is the first author, Dr. Dew is the senior author

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FIGURE LEGENDS

Figure 1. Kidney transplant candidates included and excluded from KTFT study cohort

Figure 2. Cumulative incidence of waitlisting (A) and, among those waitlisted, cumulative incidence of transplant (B), adjusted for demographics and medical factors

Figure 3. Cumulative incidence of waitlisting (A) and, among those waitlisted, cumulative incidence of transplant (B) in 6 study groups defined by race and ethnicity in combination with study cohort, adjusted for demographics and medical factors

TABLES

Table 1. Demographics, medical characteristics, and outcome comparisons of study cohorts

Characteristics	Cohort		Group Comparison	
	Kidney Transplant Fast Track (KTFT) (n=1118)	Historical Control (HC) (n=1152)	Test statistic	*p*
Demographic				
Race and ethnicity, n (%)			χ^2=1.38	0.501
Non-Hispanic White	790 (70.7)	789 (68.5)		
Non-Hispanic Black	245 (21.9)	267 (23.2)		
Other[a]	83 (7.4)	96 (8.3)		
Sex (female), n (%)	416 (37.2)	447 (38.8)	χ^2=0.59	0.444
Age (in year), mean (SD)	**57.2 (13.2)**	**55.5 (13.2)**	**t=3.06**	**0.002**
Education (<=high school), n (%)	519 (46.5)	551 (47.8)	χ^2=0.42	0.515
Household income (< US $50,000), n (%)	778 (72.3)	809 (74.2)	χ^2=0.94	0.332
Insurance status, n (%)			**χ^2=9.79**	**0.008**
Private only	204 (18.3)	233 (20.2)		
Public only	483 (43.2)	424 (36.8)		
Public and private	430 (38.5)	495 (43.0)		
Employment Status (employed), n (%)	270 (24.2)	293 (25.5)	χ^2=0.54	0.464
Marital status (not married), n (%)	582 (52.1)	564 (49.0)	χ^2=2.24	0.134
Clinical				
BMI, mean (SD)	**30.5 (6.8)**	**29.5 (6.2)**	**t=3.43**	**<0.001**
Charlson Comorbidity index, mean (SD)	4.3 (1.7)	4.2 (1.7)	t=1.29	0.198
Type of dialysis, n (%)			<0.0001[d]	0.130
None	415 (37.2)	397 (36.4)		
Hemodialysis	572 (51.3)	573 (52.5)		
Peritoneal dialysis	128 (11.5)	116 (10.6)		
Both	0 (0.0)	5 (0.5)		
Dialysis duration in years, n (%)			**χ^2=10.06**	**0.018**
0 years	392 (35.1)	395 (34.3)		
<1 year	429 (38.4)	504 (43.8)		
1-5 years	236 (21.1)	192 (16.7)		
>5 years	61 (5.5)	61 (5.3)		
Kidney disease burden (range: 1-5), median (IQR)	4.0 (3.0,4.7)	4.0 (3.0,4.7)	t=1.35	0.178

Characteristics	Cohort		Group Comparison	
	Kidney Transplant Fast Track (KTFT) (n=1118)	**Historical Control (HC) (n=1152)**	**Test statistic**	***p***
No. of potential donors, median (IQR)	**4.4 (3.4, 5.8)**	**4.2 (3.4,5.4)**	**t=2.48**	**0.013**
Days from evaluation to any waitlisting status, median (IQR)	**172 (56 - 385)**	**421 (160 - 926)**	**z=-16.35**	**<0.0001**
Days from waitlisting to any transplant status, median (IQR)	**728 (268, 1273)**	**849 (269, 1445)**	**z=-2.25**	**0.025**
Study Outcomes by end of follow- up, n (%)	**KTFT (n=1108)[b]**	**Historical Control (HC) (n=1152)**		
Outcome 1: Active Waitlisted	525 (46.9)	652 (56.6)	--	--
Competing risk: Death	172 (15.4)	328 (28.5)		
Censored: Alive, not waitlisted	411 (36.8)	172 (14.9)		
Case closed, incomplete evaluation	171 (15.3)	118 (10.2)		
Team declined patient for waitlisting	226 (20.2)	30 (2.6)		
Patient choice to withdraw from process	14 (1.3)	24 (2.1)		
	KTFT (n=524)[c]	**Historical Control (HC) (n=652)**		
Outcome 2: If waitlisted, Received Transplant	329 (62.7)	396 (60.7)	--	--
Competing risk: Death	53 (10.1)	141 (21.6)		
Censored: Alive on waitlist, no transplant	142 (27.1)	115 (17.6)		
Team declined patient for transplant	89 (17.0)	0 (0)		
Patient choice to withdraw from process	8 (1.5)	24 (3.7)		
Patient on waitlist at the end of study	43 (8.2)	34 (5.2)		
Incomplete evaluation	2 (0.4)	57 (8.7)		

Note: Missing values: KTFT: n=42 for household income; n=10 for BMI, Charlson Comorbidity index, and days from evaluation to any waitlisting status; n=3 for dialysis type; n=1 for sex, age, education, insurance, employment status, marital status, burden of KD, and Days from waitlisting to any transplant status; HC: n=61 for household income and dialysis type; n=4 for age; n=3 for employment.

[a] Other race and ethnicity, KTFT: 7 Asian; 25 Hispanic/Latino; 38 Mixed; 1 Native Hawaiian/Pacific Islander; 7 Other-not specified; HC: 13 Asian; 21 Hispanic/Latino; 54 Mixed; 8 Native American

[b] KTFT missing = 10; HC = 0

[c] KTFT missing = 1; HC = 0

[d] Table probability (test statistic) for Fisher's Exact Test

552 Table 2. Group comparison waitlisting and kidney transplantation outcomes, multivariable (competing risk) analysis and resulting
553 subdistribution hazard ratios

	Waitlisted for Transplant [a] SHR (CI), *p*	**Received Transplant [b] SHR (CI), *p***
Cohort (KTFT vs. HC) [c]	**1.40 (1.24, 1.59), *p*<0.001**	**1.21 (1.04, 1.41), *p*=0.014**
Cohort by race and ethnicity groups – key comparisons [d]		
Black KTFT – Black HC	**1.54 (1.16, 2.05), *p*=0.003**	**1.51 (1.06, 2.17), *p*=0.023**
White KTFT – White HC	**1.38 (1.20, 1.60), *p*<0.001**	1.15 (0.96, 1.37), *p*=0.127
Other KTFT – Other HC	1.28 (0.83, 1.98), *p*=0.270	1.23 (0.72, 2.07), *p*=0.448
Black KTFT – White KTFT	0.79 (0.61, 1.01), *p*=0.060	1.05 (0.79, 1.40), *p*=0.715
White KTFT – Other KTFT	0.77 (0.54, 1.09), *p*=0.143	0.82 (0.53, 1.29), *p*=0.404
Black HC – White HC	**0.71 (0.58, 0.87), *p*=0.001**	0.80 (0.60, 1.07), *p*=0.130
Covariates		
Age, years	**0.98 (0.98, 0.99), p<0.001**	**0.98 (0.97, 0.99), *p*<0.001**
Education (≤ high school)	0.92 (0.81, 1.04), *p*=0.169	**0.80 (0.68, 0.94), *p*=0.006**
Income (≤ $50,000)	**0.79 (0.68, 0.92), *p*=0.002**	**0.76 (0.63, 0.91), *p*=0.003**
Marital Status (married/partnered)	**1.21 (1.06, 1.39), *p*=0.005**	--
Employed (yes)	**1.26 (1.08, 1.46), *p*=0.003**	1.12 (0.94, 1.34), *p*=0.208
Insurance		
Public	Reference	Reference
Private	**1.60 (1.33, 1.93), *p*<0.001**	1.24 (0.99, 1.55), *p*=0.063
Both (private + public)	**1.47 (1.25, 1.74), *p*<0.001**	1.14 (0.91, 1.42), *p*=0.253
Kidney disease burden	0.95 (0.90, 1.01), *p*=0.087	--
Charlson Comorbidity Index	**0.87 (0.84, 0.91), *p*<0.001**	**0.93 (0.88, 0.97), *p*=0.003**
Dialysis duration		

	Waitlisted for Transplant [a] SHR (CI), *p*	Received Transplant [b] SHR (CI), *p*
No dialysis	Reference	Reference
< 1year	**0.63 (0.54, 0.73), *p*<0.001**	**0.78 (0.65, 0.92), *p*=0.005**
1-5 years	**0.68 (0.57, 0.83), *p*<0.001**	**1.33 (1.06, 1.66), *p*=0.013**
> 5 years	**0.61 (0.45, 0.83), *p*=0.002**	1.12 (0.71, 1.78), *p*=0.628
BMI	--	**0.98 (0.97, 0.99), *p*=0.006**
Network of potential donors	--	1.03 (0.99, 1.08), *p*=0.178

Note:
[a] BMI and network of potential donors did not meet criteria in univariable selection and were therefore excluded from the Waitlist model.
[b] Marital status and KD burden did not meet criteria in univariable selection and were therefore excluded from KT model.
[c] Number of events included in the analyses – Waitlisting: Active waitlisting=1130, competing risk=469, censored=555; Transplantation: KT=689, competing risk=190, censored=250.
[d] see Supplemental Table 1 for all cohort by race group comparisons

Figure 1. Kidney transplant candidates included and excluded from KTFT study cohort

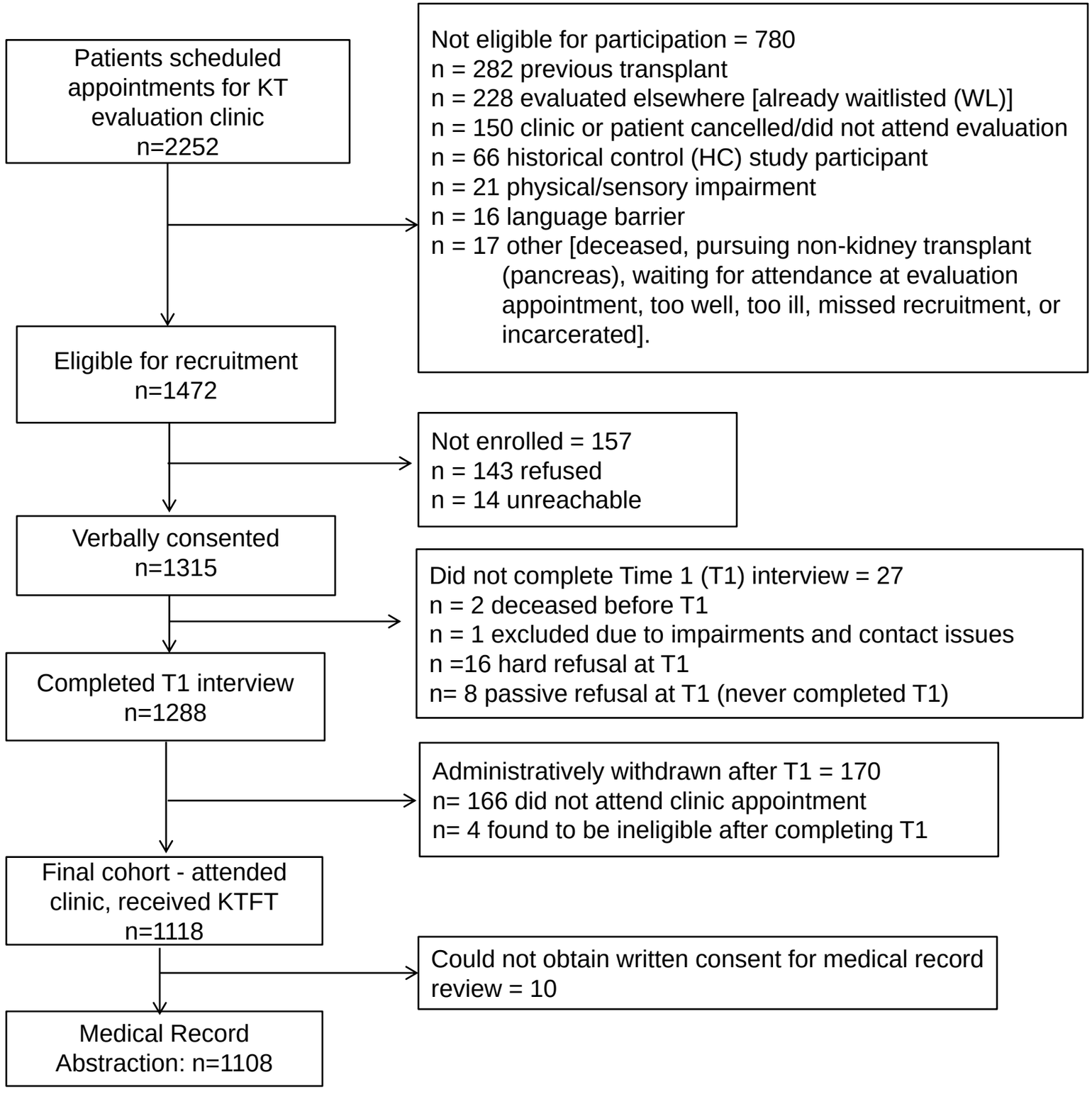

Figure 2. Cumulative incidence of waitlisting (A) and, among those waitlisted, cumulative incidence of transplant (B), adjusted for demographics and medical factors

A.

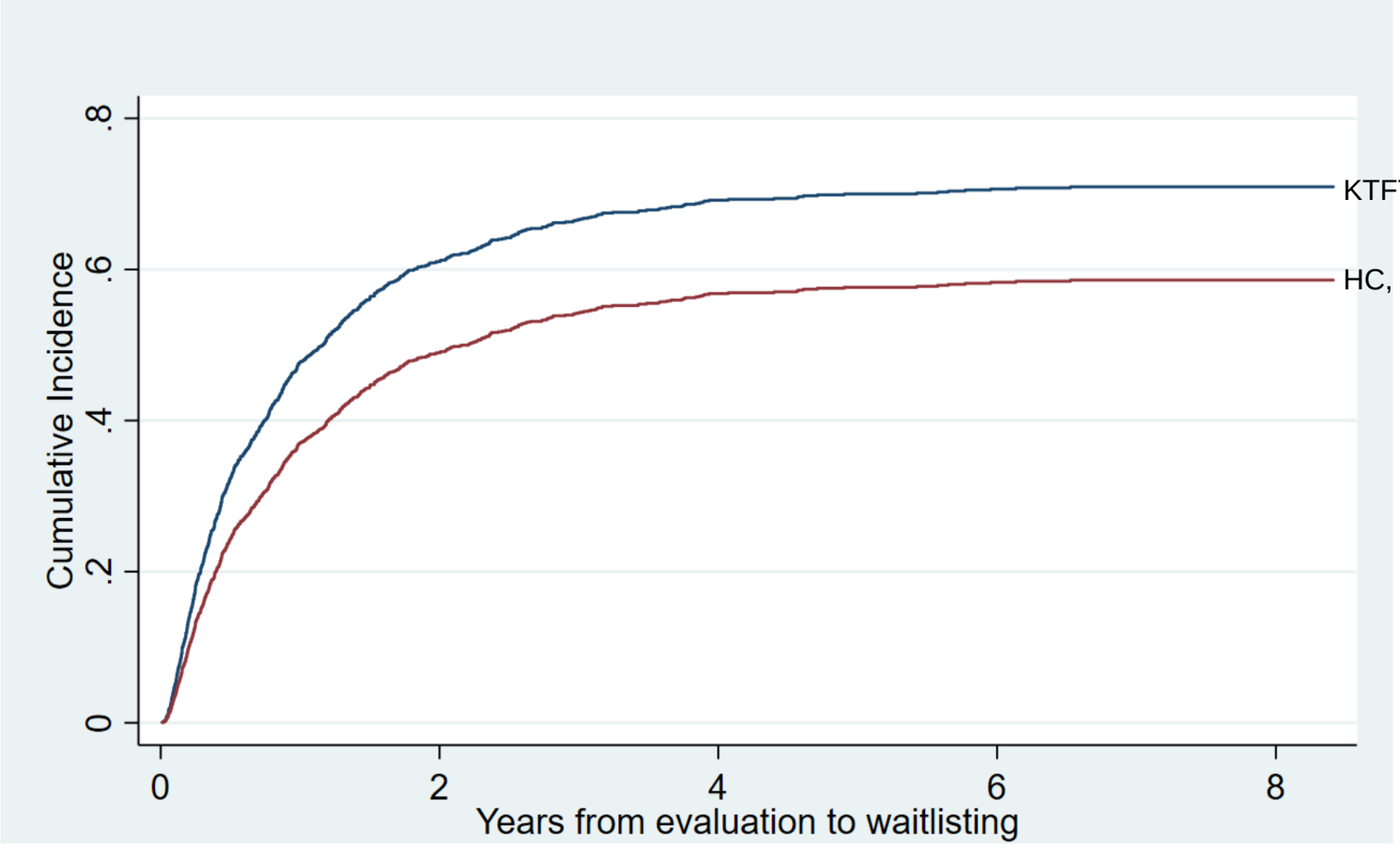

Figure 2. Cumulative incidence of waitlisting (A) and, among those waitlisted, cumulative incidence of and transplant (B), adjusted for demographics and medical factors

B.

Figure 3. Cumulative incidence of waitlisting (A) and, among those waitlisted, cumulative incidence of transplant (B) in 6 study groups defined by race/ethnicity in combination with study cohort, adjusted for demographics and medical factors

A.

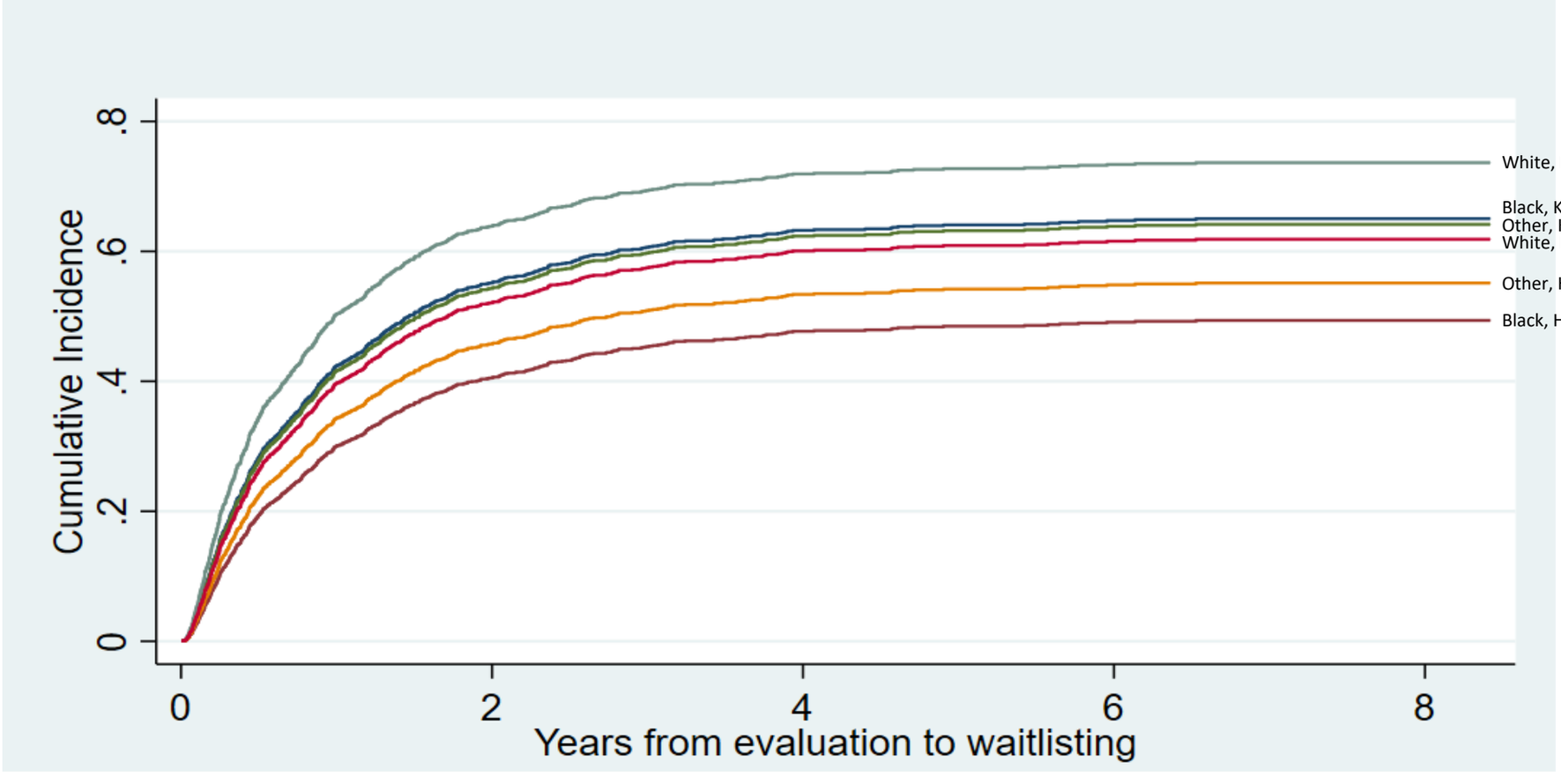

Figure 3. Cumulative incidence of waitlisting (A) and, among those waitlisted, cumulative incidence of transplant (B) in 6 study groups defined by race/ethnicity in combination with study cohort, adjusted for demographics and medical factors

B.