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Changes in offer and acceptance patterns for pediatric kidney transplant candidates under the new Kidney Allocation System

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Abstract

Stakeholders have expressed concerns regarding decreased deceased donor kidney transplant (DDKT) rates for pediatric candidates under the Kidney Allocation System (KAS). To better understand what might be driving this, we studied Scientific Registry of Transplant Recipients kidney offer data for 3642 pediatric (age <18 years) kidney-only transplant candidates between December 31, 2012 to December 3, 2014 (pre-KAS) and December 4, 2014 to January 6, 2017 (post-KAS). We used negative binomial regression and multilevel logistic regression to compare offer and acceptance rates pre- and post-KAS. We stratified by donor age (<18, 18–34, and 35+ years) and KDPI (<35% and ≥35%) to reflect differing allocation prioritization pre-KAS and post-KAS. As might be expected from prioritization changes, post-KAS candidates were less likely to receive offers for donors 18–34 years old with KDPI ≥35% (adjusted incidence rate ratio [aIRR]: 0.18–0.21, $P < .001$), and more likely to receive offers for donors 18–34 years old and KDPI <35% (aIRR: 1.12–1.20, $P < .001$). However, offer acceptance practices also changed post-KAS: kidneys from donors 18–34 years old and KDPI <35% were 23% less likely to be accepted post-KAS (adjusted odds ratio: 0.61–0.77, $P = .03$). Using kidneys from donors 18–34 years old with KDPI <35% post-KAS to the same extent they were used pre-KAS might be an effective strategy to mitigate any decrease in DDKT rates for pediatric candidates.

Keywords

clinical research/practice; health services and outcomes research; kidney transplantation/nephrology; organ allocation; organ procurement and allocation; pediatrics; registry/registry analysis

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DISCLOSURE

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1 | INTRODUCTION

The Kidney Allocation System (KAS) implemented on December 4, 2014 was designed to better match deceased donor kidneys with the longest expected graft survival to patients expected to live the longest posttransplant (“longevity matching”).^{1,2} Under KAS, the way in which kidneys were allocated to pediatric candidates was changed, in part to keep a standardized allocation system based on the Kidney Donor Profile Index (KDPI). Prior to KAS, pediatric candidates were preferentially allocated donors ≥ 35 years old; under KAS, they are preferentially allocated organs from donors with a KDPI $< 35\%$.³ However, there have been several unintended changes for pediatric candidates under KAS.

One of these unintended changes has been a 21% decrease in deceased donor kidney transplant (DDKT) rates for candidates < 6 years old.⁴ Also, 2 studies have described a decrease in the number of pediatric recipients receiving organs from pediatric donors, with absolute decreases ranging from 3.3% to 11%.^{5,6} Furthermore, 1 study noted a 121-day increase in the amount of time recipients < 10 years old spent on the waitlist prior to transplant after KAS, and an absolute 6.7% increase in the percentage of recipients waiting longer than 1 year for transplant.⁶ However, the cause of these changes has yet to be established. One possibility is that KAS has directed organs that are well suited for pediatric candidates towards adult candidates, and thus pediatric candidates are no longer receiving the same high-quality offers they were before KAS. Alternatively, it may be that kidney acceptance practices have changed under KAS, and high-quality kidneys are being offered to pediatric candidates but not accepted. It would be useful to understand how any KAS-related changes in kidney offers or acceptance practices have contributed to these unintended consequences of KAS.

To better understand these observations, we studied how kidney offer and acceptance patterns have changed under KAS using national kidney offer data. Our goals were to (1) compare offers to pediatric candidates on the waitlist before and after KAS, (2) compare acceptance patterns before and after KAS, (3) determine how these offer and acceptance patterns varied across donor age and KDPI, and (4) determine whether KAS-related changes differentially impacted the youngest pediatric candidates (< 6 years old).

2 | METHODS

2.1 | Data source

This study used data from the Scientific Registry of Transplant Recipients (SRTR) December 2018 public release. The SRTR data system includes data on all donor, wait-listed candidates, and transplant recipients in the United States, submitted by the members of the Organ Procurement and Transplantation Network (OPTN), and has been described elsewhere.⁷ The Health Resources and Services Administration, US Department of Health and Human Services provides oversight to the activities of the OPTN and SRTR contractors. This study was approved by the Johns Hopkins University Institutional Review Board.

2.2 | Study population

To characterize offer patterns on the waitlist, we studied 3642 pediatric kidney-only transplant candidates (listed at age <18 years) who were ever active on the waitlist in the 2 years before (pre-KAS: December 31, 2012 to December 3, 2014) and after KAS (post-KAS: December 4, 2014 to January 6, 2017). To characterize offer acceptance, we studied 3048 pediatric kidney transplant candidates who were ever offered a deceased donor kidney in the 2 years pre-KAS and post-KAS. Pediatric kidney transplant candidates who listed for liver transplantation during the study period were excluded (n = 116). Candidates who turned 18 while on the waitlist remained in our study, as they were still prioritized as pediatric candidates. We compared pediatric candidates actively listed pre- and post-KAS using χ^2 tests for categorical variables and Wilcoxon rank sum tests for continuous variables. Candidates actively listed pre- and post-KAS were included in both columns of Table 1 and contribute person-time to each era.

2.3 | Match-run data

Each time a deceased donor kidney becomes available, candidate and donor factors are input to generate an appropriate offer match-list, from which a kidney is offered to each candidate in turn based on the current allocation system and candidate priority. Match-run data include a record of all offers made for each kidney, and whether the offer was declined or accepted. We excluded bypassed offers (offers made outside the formal match list using a bypass code; for example, donor medical urgency requiring immediate organ placement) and offers made for kidneys that were never accepted by anyone (ie, discards). In addition, offers reported as accepted in the match-run data that did not have an associated transplant record were considered declines (n = 7), and offers reported as declines in the match-run data that did have an associated transplant record were considered acceptances (n = 95).

2.4 | Offer rate

We calculated the offer rate, defined as the total number of offers made to pediatric candidates per total active person-years on the waitlist, pre- and post-KAS for all offers and for offers across donor age and KDPI. We stratified by donor age (categorized as <18, 18-34, and 35+ years) and KDPI (<35% and ≥35%) to reflect differing allocation prioritization pre- vs post-KAS. To determine whether the offer rate per person-year changed post-KAS and to account for overdispersion of offer counts, we used negative binomial regression with offer rate as the dependent variable and actively waitlisted time post-KAS as the primary exposure.⁸⁻¹¹ We adjusted for candidate age, sex, race, primary diagnosis, time on dialysis, preemptive listing, and calculated panel-reactive antibody (cPRA, modeled as 0%, 1%-79%, and 80%+), and stratified by donor age (<18, 18-34, 35+ years old) and KDPI (<35% vs ≥35%).

2.5 | Offer acceptance

We calculated the percent of offers that were accepted pre- and post-KAS for all offers and for offers within each donor age and KDPI stratum. To determine whether offer acceptance changed post-KAS, we used multilevel logistic regression with offer acceptance as the dependent variable and offer made post-KAS as the primary exposure. We adjusted for

candidate age, sex, race, primary diagnosis, time on dialysis, preemptive listing, cPRA, and calendar time, and stratified by donor age (<18, 18-34, and 35+) and donor KDPI (<35% vs 35%). We used logistic regression to model the binary outcome of offer acceptance, and the multilevel framework with a random for transplant center allowed us to account for potential within-center clustering and between-center differences in acceptance practices.¹²

2.6 | Accepted and declined kidneys

To identify changes in the deceased donor kidneys that were accepted or declined post-KAS, we compared the clinical and demographic characteristics of accepted and declined deceased donors pre- and post-KAS using χ^2 tests for categorical variables and Wilcoxon rank sum tests for continuous nonparametric variables. Kidneys from the same donor were only included once in Tables 4 and 5.

2.7 | Statistical analysis

Confidence intervals are reported as per the method of Louis and Zeger.¹³ A 2-sided α level of 0.05 was used to indicate statistical significance. All analyses were performed using Stata 15.

3 | RESULTS

3.1 | Pediatric candidates pre- and post-KAS

There were 2137 and 2095 pediatric candidates actively listed in the pre- and post-KAS eras. Characteristics of pediatric candidates on the kidney transplant waitlist remained largely unchanged between eras (Table 1); pre- and post-KAS median age at study entry was 13 (interquartile range 8-16, $P = .9$), 59.2% vs 58.1% were male ($P = .5$), 25.5% vs 22.9% were black/African American ($P = .1$), and 30.9% vs 29.6% were listed preemptively ($P = .4$).

3.2 | Offers pre- and post-KAS

In the 2 years pre-KAS, 8240 offers were made to active pediatric candidates. Pre-KAS, 24.5% of offers were from donors <18 years old, 68.6% from donors 18-34 years old, 6.9% from donors 35+ years old, and 69.9% from donors with KDPI < 35% (Figure 1A, left panel). In the 2 years post-KAS, 9953 offers were made to active pediatric candidates. Post-KAS, 11.6% were from donors <18 years old, 68.8% from donors 18-34 years old, 19.6% from donors 35+ years old, and 88.8% from donors with KDPI < 35% (Figure 1A, right panel). The percent of offers from donors <18 years old with KDPI < 35% decreased from 13.1% pre-KAS to 2.4% post-KAS (Figure 1).

3.3 | Offer rates per person-year pre- and post-KAS

Among actively listed pediatric candidates, 76.9% pre-KAS vs 82.8% post-KAS were ever offered a deceased donor kidney that was eventually accepted by someone ($P < .001$). More specifically, 25.4% vs 28.1% were ever offered a kidney from a donor <18 years old with KDPI < 35% ($P = .045$), 24.6% vs 8.0% were ever offered a kidney from a donor <18 years old with KDPI > 35% ($P < .001$), 62.9% vs 70.5% were ever offered a kidney from a donor 18-34 years old with KDPI < 35% ($P < .001$), 23.0% vs 8.9% were ever offered a

kidney from a donor 18-34 years old with KDPI $\geq 35\%$ ($P < .001$), 5.7% vs 32.2% were ever offered a kidney from a donor >35 years old with KDPI $< 35\%$ ($P < .001$), and 12.3% vs 18.8% were ever offered a kidney from a donor ≤ 35 years old with KDPI $\geq 35\%$.

Accounting for person-time, the crude offer rate overall increased from 7.5 offers per waitlist-year pre-KAS to 9.0 post-KAS ($P < .001$, Table 2). The crude offer rate for kidneys from donors <18 years old with KDPI $< 35\%$ remained similar at 0.81 pre-KAS and 0.82 post-KAS ($P = .2$), whereas the crude offer rate for kidneys from donors <18 years old with KDPI $\geq 35\%$ decreased from 0.95 to 0.22 ($P < .001$). After adjustment, the overall offer rate increased post-KAS by 13% (adjusted incidence rate ratio [aIRR]: 1.011.08_{1.15}, $P = .02$) (Table 2). However, the association between KAS and offer rates varied across donor age and KDPI. Offer rates for kidneys from donors <18 years old and KDPI $< 35\%$ did not significantly change (aIRR: 0.780.88_{1.00}, $P = .04$), whereas offer rates for those with KDPI $\geq 35\%$ decreased by 79% post-KAS (aIRR: 0.180.21_{0.25}, $P < .001$). Offer rates for kidneys from donors 18-34 years old and KDPI $< 35\%$ increased by 27% post-KAS (aIRR: 1.121.20_{1.29}, $P < .001$), whereas offer rates for those with KDPI $\geq 35\%$ decreased by 79% post-KAS (aIRR: 0.170.21_{0.25}, $P < .001$). Offer rates for kidneys from donors 35+ years old and KDPI $< 35\%$ increased substantially post-KAS (aIRR: 7.098.57_{10.37}, $P < .001$), as did offer rates for those with KDPI $\geq 35\%$ (aIRR: 1.211.43_{1.69}, $P < .001$).

3.4 | Offer acceptance pre- and post-KAS

Pre-KAS, 12.2% ($n = 1002$ transplants) of deceased donor kidneys offers were accepted vs 10.6% ($n = 1053$ transplants) post-KAS. Overall, this change was not statistically significant (adjusted odds ratio [aOR]: 0.760.95_{1.18}, $P = .6$); however, the percent of offers accepted pre- vs post-KAS varied by donor age and KDPI (Table 3). After adjustment, kidneys from donors <18 years old and KDPI $< 35\%$ were equally likely to be accepted post-KAS (aOR: 0.771.06_{1.45}, $P = .8$; absolute acceptance 21.8% pre-KAS vs 22.1% post-KAS), as were those with KDPI $\geq 35\%$ (aOR: 0.300.65_{1.40}, $P = .2$; absolute acceptance 5.4% pre-KAS vs 3.8% post-KAS). In contrast, kidneys from donors 18-34 years old and KDPI $< 35\%$ were 23% less likely to be accepted post-KAS (aOR: 0.610.77_{0.98}, $P = .03$; absolute acceptance 14.2% pre-KAS vs 10.4% post-KAS). Kidneys from donors 18-34 years old and KDPI $\geq 35\%$ were equally likely to be accepted post-KAS (aOR: 0.571.07_{2.01}, $P = .8$; absolute acceptance 5.9% pre-KAS vs 8.6% post-KAS). Kidneys from donors 35+ years old with KDPI $< 35\%$ were substantially more likely to be accepted post-KAS (aOR: 1.162.82_{6.87}, $P = .02$; absolute acceptance 4.4% pre-KAS vs 8.4% post-KAS), although those with KDPI $\geq 35\%$ were equally likely to be accepted post-KAS (aOR: 0.751.6_{3.74}, $P = .2$; absolute acceptance 2.3% pre-KAS vs 3.6% post-KAS).

3.5 | Accepted and declined kidney characteristics pre- and post-KAS

There were 1002 kidneys (878 donors) accepted by pediatric candidates pre-KAS, and 1053 kidneys (884 donors) accepted post-KAS. Compared to kidneys pre-KAS, those accepted post-KAS were less likely to be from donors <18 years old (26.2% pre-KAS vs 19.6% post-KAS, $P < .001$), and more likely to be at PHS increased infectious risk (8.0% pre-KAS vs 13.6% post-KAS, $P < .001$). Kidneys accepted pre-KAS and post-KAS had similar KDPI (median 13.0 pre-KAS vs 13.2 post-KAS, $P = .4$) (Figure 2, Table 4).

Pre-KAS, kidneys from 2296 donors were ever declined on behalf of pediatric candidates, and post-KAS 2421 were ever declined. Kidneys declined post-KAS were less likely to be from donors <18 years old (22.6% pre-KAS vs 12.1% post-KAS), and more likely to be Public Health Service increased infectious risk (23.4% pre-KAS vs 33.4% post-KAS, $P < .001$). Median KDPI of declined kidneys decreased from 25.6 pre-KAS to 20.6 post-KAS ($P < .001$) (Table 5).

3.6 | Subgroup analysis among pediatric candidates 6 years old

Among candidates 6 years old, offer rates remained unchanged post-KAS (aIRR: $0.901.03_{1.17}$, $P = .7$). Similar to our main findings, changes in offer rate varied by donor age and KDPI. Offer rates of kidneys from donors <18 years old with KDPI < 35% remained largely unchanged (aIRR: $0.700.88_{1.10}$, $P = .3$) and those with KDPI 35% decreased (aIRR: $0.150.22_{0.68}$, $P < .001$). Offer rates of kidneys from donors 18-34 years old with KDPI < 35% remained unchanged (aIRR: $0.961.11_{1.29}$, $P = .2$), and those with KDPI 35% decreased (aIRR: $0.150.21_{0.29}$, $P < .001$). Offer rates for kidneys from donors 35+ years old with KDPI < 35% increased (aIRR: $6.579.98_{15.14}$, $P < .001$), and those with KDPI 35% increased (aIRR: $1.081.52_{2.12}$, $P = .02$). Overall acceptance of offers among candidates 6 years old decreased from 10.6% pre-KAS to 7.9% post-KAS (205 vs 185 acceptances), although this was not statistically significant (aOR: $0.450.73_{1.18}$, $P = .2$). Acceptance of kidneys from donors <18 years old with KDPI < 35% decreased from 17.0% to 15.9% (aOR: $0.400.81_{1.62}$, $P = .5$) and acceptance of those with KDPI 35% decreased from 7.0% to 0% (no calculable aOR). Acceptance of kidneys from donors 18-34 years old with KDPI < 35% decreased from 11.7% to 8.1% (aOR: $0.380.66_{1.12}$, $P = .1$), and acceptance of those with KDPI 35% remained unchanged from 5.7% to 5.9% post-KAS (aOR: $0.130.59_{2.67}$, $P = .5$). Finally, acceptance of kidneys from donors >35 years old with KDPI < 35% increased from 0% to 5.0% post-KAS (no calculable aOR), and acceptance of those with KDPI 35% increased from 0% to 2.2% post-KAS (no calculable aOR).

3.7 | Increased risk for disease transmission donors

To understand what might be driving the decreased acceptance among donors 18-34 years old with KDPI < 35%, we explored increased risk for disease transmission (IRD) donor acceptances pre- and post-KAS within this donor population. Among donors 18-34 years old with KDPI < 35%, 25.7% were labeled IRD pre-KAS and 35.7% were IRD post-KAS. The total number of offers to this group from IRD donors increased from 1484 pre-KAS to 2818 post-KAS, and the total number of offers from non-IRD donors increased from 3200 to 3822. Offer acceptance of IRD donors 18-34 years old with KDPI < 35% remained constant at 3.8% pre-KAS as 4.0% post-KAS ($P = .7$), while acceptance of non-IRD donors 18-34 years old with KDPI < 35% decreased from 19.0% pre-KAS to 15.2% post-KAS ($P < .001$).

4 | DISCUSSION

In this national study of kidney offers before and after KAS, we found that KAS significantly altered the types of kidneys being offered to pediatric DDKT candidates. The overall offer rate per person-year increased post-KAS by 13%, from 7.5 offers per person-year to 9.0 offers per person-year. The post-KAS changes in kidney offers were

consistent with what might be expected from prioritization changes: post-KAS candidates were 79% less likely to receive offers for kidneys from both donors <18 years old and 18-34 years old with KDPI $\geq$ 35%, and more likely to receive offers for donors 18-34 years old with KDPI < 35%. However, we also found that offer acceptance practices changed post-KAS. Notably, kidneys from donors 18-34 years old with KDPI < 35% were 23% less likely to be accepted post-KAS compared to pre-KAS, and kidneys from donors 35+ years old with KDPI < 35% were nearly 3-fold more likely to be accepted post-KAS. Our findings indicate that any changes in DDKT rates for pediatric candidates are likely the result of both policy change and transplant community acceptance practices.

While KAS has led to increased transplant rates for the highly sensitized, racial minorities, and certain blood types in the adult population,^{9,14–16} reports of the impact of KAS on the pediatric population have been mixed.^{4–6,10} Notably, concern over decreased DDKT rates for certain pediatric candidates (particularly for candidates $\leq$ 6 years old) has led some to suggest that this is the direct result of KAS—that the policy is at fault—and that modifications to KAS should be considered.^{17,18} These concerns prompted us to analyze changes in offer and acceptance patterns for pediatric candidates after KAS, since changes in these patterns could plausibly lead to changes in DDKT rates. Our findings only partially support the position that KAS is responsible for any changes in DDKT rates. As might be expected from the policy change, post-KAS candidates were 79% less likely to receive offers for kidneys from both donors <18 years old and 18-34 years old with KDPI $\geq$ 35%, and more likely to receive offers for donors 18-34 years old and 35+ years old with KDPI < 35%. However, beyond the direct consequences of policy change (ie, changes in offer patterns), we also found evidence that the transplant community's behavior changed (ie, changes in acceptance patterns). Encouragingly, kidneys from donors 35+ years old with KDPI < 35% were nearly 3-fold more likely to be accepted post-KAS compared to pre-KAS, which might reflect an understanding that low KDPI kidneys (even from older donors) could possibly be used with great outcomes in pediatric recipients, although pediatric recipients were not included when creating the KDPI.¹⁹ However, kidneys from donors 18-34 years old with KDPI < 35% were 23% less likely to be accepted post-KAS, even after adjusting for donor and recipient characteristics. This might be a consequence of increased selectivity of these high-quality kidneys, since these kidneys were actually 20% more likely to be offered to post-KAS pediatric candidates. This acceptance decrease does not appear to be driven by IRD donors, as acceptance of these offers from IRD donors remained unchanged, albeit low, despite the reasonable safety profile reported thus far.^{20–22} Thus, policy change and transplant community behavior might both be contributing to any decrease in DDKT rates for pediatric candidates, and 1 potential mechanism to mitigate this might be to utilize kidneys from donors 18-34 years old with KDPI < 35% post-KAS to the same extent that they were being used pre-KAS.

One limitation of our study is that we were unable to determine the reasons that candidates declined a kidney. For example, candidates might decline a high-quality deceased donor kidney if they have a potential living donor in evaluation, and thus the decline does not reflect perceived kidney quality but rather the availability of a potentially better transplant. However, we do not expect rates of living donation to have changed substantially during the relatively short 4-year study period, and therefore this should not bias our results, since

the effect of this would be similar in both the pre-KAS and post-KAS era. Despite this limitation, we studied full national organ offer data, and so our findings reflect national practice.

In conclusion, the goal of our study was to determine whether reduced DDKT rates for certain pediatric candidates were due to changes in offers to pediatric candidates (ie, an effect of policy change) or to changes in acceptance practices (ie, an effect of transplant community behavior). We found evidence of both; while changes in offers largely mirrored what might be expected from KAS prioritization changes, the acceptance of kidneys from donors 18-34 years old with KDPI < 35% decreased, and acceptance of kidneys from donors 35+ years old with KDPI < 35% significantly increased, post- KAS, indicating that the transplant community's acceptance patterns have changed as well. Using these high-quality kidneys from donors 18-34 years old with KDPI < 35% post-KAS to the same extent they were used pre-KAS might be an effective strategy to mitigate any decrease in DDKT rates for pediatric DDKT candidates.

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DATA AVAILABILITY STATEMENT

The data are available from the Scientific Registry of Transplant Recipients.

Abbreviations:

aIRR	adjusted incidence rate ratio
aOR	adjusted odds ratio
DDKT	deceased donor kidney transplantation
IRD	increased risk for disease transmission
KAS	Kidney Allocation System
KDPI	Kidney Donor Profile Index
OPTN	Organ Procurement and Transplantation Network
SRTR	Scientific Registry of Transplant Recipients

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FIGURE 1.

A, Overall offers to pediatric candidates increased 13% post-KAS compared to pre-KAS, although this varied by donor age and KDPI stratum. Offer rates decreased for kidneys from donors <18 y old and donors 18-34 y old with a KDPI $\geq$ 35%. In contrast, offer rates increased for kidneys from donors 18-34 y old with KDPI < 35%, and for donors 35+ y old with any KDPI. B, Overall acceptance for pediatric candidates did not change post-KAS compared to pre-KAS, although this varied by donor and KDPI stratum. The likelihood of acceptance significantly decreased for kidneys from donors 18-34 y old with

KDPI < 35%, but actually increased for donors 35+ y old with KDPI < 35%. Black = donor <18 y old; blue = donor 18-34 y old; light blue = donor 35+ y old; red = accepted donor. Gray dashed lines delineate donor age and KDPI stratum. KAS, Kidney Allocation System; KDPI, Kidney Donor Profile Index [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

FIGURE 2.

Distribution of donor age and KDPI of offered (solid lines) and accepted (dashed lines) kidneys pre- and post-KAS. The pre-KAS prioritization of donors less than 35 y old is evident in (A), while post-KAS prioritization of donors with KDPI < 35% is evident in (B). Despite changes in offers, accepted kidneys had similar distributions of donor age and KDPI pre- and post-KAS. KAS, Kidney Allocation System; KDPI, Kidney Donor Profile Index [Color figure can be viewed at wileyonlinelibrary.com]

TABLE 1

Characteristics of pediatric candidates active on the kidney transplant waitlist in the 2-y pre- and post-KAS

Factor	Pre-KAS (N = 2151)	Post-KAS (N = 2088)	P value
Age at entry, median (IQR)	13 (8, 16)	13 (8, 16)	.9
Age categories, %			
0-6 y	21.2	20.1	.6
7-12 y	23.2	24.5	
13-17 y	48.0	47.3	
>17 y	7.6	8.1	
Male sex	59.0	58.1	.5
Race, %			
White	47.1	48.7	.2
Black/African American	25.4	22.9	
Hispanic/Latino/Other	27.5	28.4	
Time on dialysis, median (IQR)	1.5 (0.6, 3.0)	1.5 (0.7, 3.0)	.9
Preemptive listing, %	31.2	29.6	.3
Calculated panel reactive antibody, med (IQR)	0 (0, 29.5)	0 (0, 23.6)	.8

Abbreviations: IQR, interquartile range; KAS, Kidney Allocation System.

TABLE 2

Crude offer rate per waitlist-year pre- and post-KAS and adjusted change in offer rate post-KAS among pediatric candidates who accumulated active time on the waitlist in the 2-y pre- and post-KAS

	Pre-KAS offer rate per waitlist-year ^a	Post-KAS offer rate per waitlist-year ^a	Change in offer rate post-KAS (aIRR) ^c	P value
All kidneys	7.48 (7.32-7.65) ^b	8.95 (8.78-9.13)	1.01 ^{1.08} _{1.15}	.02
Donor <18 y old; KDPI < 35%	0.81 (0.75-0.86)	0.82 (0.77-0.87)	0.78 ^{0.88} _{0.996}	.04
Donor <18 y old; KDPI ≥ 35%	0.95 (0.89-1.01)	0.22 (0.19-0.24)	0.18 ^{0.21} _{0.25}	<.001
Donor 18-34 y old; KDPI < 35%	4.25 (4.13-4.38)	5.97 (5.83-6.12)	1.12 ^{1.20} _{1.29}	<.001
Donor 18-34 y old; KDPI ≥ 35%	0.88 (0.83-0.94)	0.19 (0.17-0.22)	0.17 ^{0.21} _{0.25}	<.001
Donor 35 y old; KDPI < 35%	0.12 (0.10-0.15)	1.16 (1.10-1.23)	7.09 ^{8.57} _{10.37}	<.001
Donor 35 y old; KDPI ≥ 35%	0.39 (0.36-0.43)	0.59 (0.55-0.64)	1.21 ^{1.43} _{1.69}	<.001

Abbreviations: aIRR, adjusted incident rate ratio; cPRA, calculated panel-reactive antibody; KAS, Kidney Allocation System; KDPI, Kidney Donor Profile Index.

^aPre- and post-KAS offer rate per waitlist-year calculated as the total number of offers made to pediatric candidates of each kidney type divided by the accumulated active waitlist years of pediatric candidates.

^bInterpreted as actively listed pediatric candidates received a mean of 7.28 offers per waitlist year pre-KAS vs 8.95 offers per waitlist year post-KAS.

^cChange in offer rate associated with KAS determined using negative binomial regression with adjustment for candidate age, sex, race, weight, primary diagnosis, time on dialysis, preemptive listing, and cPRA.

Crude offer acceptance and adjusted relative change in offer acceptance post-KAS among pediatric candidates who were ever offered a deceased donor kidney in the 2-y pre- and post-KAS

TABLE 3

	Pre-KAS acceptance, % (N transplants)	Post-KAS acceptance, % (N transplants)	Change post-KAS (aOR) ^a	P value
All offers	12.2% (1002)	10.6% (1053)	0.760.95 _{1.18}	.6
Donor <18 y old; KDPI < 35%	21.8% (206)	22.1% (201)	0.771.06 _{1.45}	.8
Donor <18 y old; KDPI 35%	5.4% (58)	3.8% (9)	0.300.65 _{1.40}	.2
Donor 18-34 y old;	14.2% (665)	10.4% (693)	0.610.77 _{0.98}	.03
KDPI < 35%				
Donor 18-34 y old;	5.9% (57)	8.6% (18)	0.571.07 _{2.01}	.8
KDPI 35%				
Donor 35 y old; KDPI < 35%	4.4% (6)	8.4% (108)	1.162.82 _{6.87}	.02
Donor 35 y old; KDPI 35%	2.3% (10)	3.6% (24)	0.751.68 _{3.74}	.2

Abbreviations: aOR, adjusted odds ratio; cPRA, calculated panel-reactive antibody; KAS, Kidney Allocation System; KDPI, Kidney Donor Profile Index.

^aChange post-KAS estimated using multilevel logistic regression adjusted for candidate age, sex, race, preemptive listing, dialysis time, cPRA, indication for transplant, and secular trends.

TABLE 4

Characteristics of deceased donor kidneys ever accepted by pediatric candidates pre- and post-KAS

For all candidates	Pre-KAS (N = 878)	Post-KAS (N = 884)	P value
Donor age, median (IQR)	22 (17, 28)	23 (19, 30)	<.001
Donor age, categories			
<18 y old	26.2%	19.6%	<.001
18-24 y old	36.6%	36.9%	
25-34 y old	35.4%	30.3%	
35-50 y old	1.8%	12.7%	
>50 y old	0.0%	0.6%	
KDPI, median % (IQR)	13.0 (6.1, 25.2)	13.2 (6.1, 22.8)	.4
IRD	8.0%	13.6%	<.001
DCD	5.5%	4.4%	.2
Donor cause of death			
Anoxia	25.2%	26.6%	.3
Stroke	10.2%	8.6%	
Head trauma	61.9%	63.1%	
Tumor/other	2.7%	17%	

Abbreviations: DCD, donation after cardiac death; IQR, interquartile range; IRD, increased risk for disease transmission; KAS, Kidney Allocation System; KDPI, Kidney Donor Allocation System.

TABLE 5

Characteristics of deceased donor kidneys ever declined by pediatric candidates pre- and post-KAS

For all candidates	Pre-KAS (N = 2296)	Post-KAS (N = 2421)	P value
Donor age, median (IQR)	25 (18, 31)	27 (21, 35)	<.001
Donor age, categories			
<18 y old	22.6%	12.1%	<.001
18-24 y old	27.4%	29.2%	
25-35 y old	35.8%	32.7%	
36-50 y old	10.8%	21.6%	
>50 y old	3.5%	4.4%	
KDPI, median % (IQR)	25.6 (11.7, 45.2)	20.6 (11.0, 31.5)	<.001
IRD	23.4%	33.4%	<.001
DCD	14.1%	13.1%	.3
Donor cause of death			
Anoxia	38.5%	42.2%	.06
Stroke	12.5%	10.9%	
Head trauma	45.3%	43.2%	
Tumor/other	3.7%	3.6%	

Abbreviations: DCD, donation after cardiac death; IQR, interquartile range; IRD, increased risk for disease transmission; KAS, Kidney Allocation System; KDPI, Kidney Donor Profile Index.