

Estimating Waiting Time for Deceased Donor Renal Transplantation in the Era of New Kidney Allocation System

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ABSTRACT

Background. On December 4, 2014, a new deceased donor kidney allocation system (KAS) was implemented. The KAS was designed to improve organ equity and graft-recipient longevity matching. However, estimated wait-time to deceased donor transplantation is difficult to predict post-KAS.

Methods. Using the Kidney-Pancreas Simulated Allocation Model software (KPSAM), a program that the Organ Procurement and Transplant Network uses to assess policy proposals, we compared the kidney allocations of both the new (post-KAS) and old policies (pre-KAS) (10 iterations for each group; total N = 204,148) and estimated wait-time based on blood type, duration of dialysis exposure, and calculated panel-reactive antibody (CPRA).

Results. The simulations revealed that estimated median (25th and 75th percentile) waiting time in transplanted recipients decreased from 2.3 (1.2, 3.8) years in the old allocation to 1.8 (0.8, 3.4) years in the new allocation system. The rate of transplantations performed within the first year of wait-listing increased from 20.7% to 31.3%. The KPSAM resulted in more transplantations in recipients with more than 5 years of dialysis exposure (26.5% to 37.4%), longevity matching (12.2% to 17.5%), blood group B (12.6% to 17.2%), and high CPRA $\geq 98\%$ (1.9% to 4.3%) in post-KAS compared with pre-KAS simulations.

Conclusions. Based on the KPSAM results, it was projected that post-KAS wait-time in transplanted recipients might decrease approximately 6 months (22%) across all CPRA categories. It might be related to the KAS awarding waiting time points for prelisting dialysis time and priority points awarded based on CPRA (bolus effect).

A new kidney allocation system (KAS) for deceased donor kidney transplantation (DDRT) was recently implemented after a greater than 20-year interval [1]. Major changes under KAS included the following: (1) giving priority points to highly sensitized patients; (2) starting wait-list time from listing or dialysis initiation date, whichever comes first; (3) allowing A2B/A2 kidneys to blood group B recipients; (4) introducing the organ and patient ranking system into the organ allocation process via Kidney Donor Profile Index (KDPI) and Estimated Post Transplant Survival (EPTS) [2]. Goals of KAS were to improve equity by increasing access to transplantation in highly sensitized patients, racial/ethnic minorities, candidates with blood type B, and graft-recipient longevity matching (aiming to match

younger patients with EPTS score <20% with higher quality kidneys with KDPI score <20% to reduce retransplantation and death with functioning graft).

The Organ Procurement and Transplant Network (OPTN) uses the Kidney-Pancreas Simulated Allocation Model software (KPSAM) to evaluate its planned policy changes [3]. Developed by the Scientific Registry of Transplant Recipients (SRTR), KPSAM can use allocation

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Table 1. Demographics of the Old and New Allocation Simulations and the Percent Change (Excluding Pediatric and Kidney-Pancreas Transplantations)

	Old Allocation Simulation (Pre-KAS), N = 102,071	New Allocation Simulation (Post-KAS), N = 102,077	Relative Change (%)
Median waiting list time (25 th , 75 th percentile), y	2.3 (1.2, 3.8)	1.8 (0.8, 3.4)	
Transplantation within first y of waiting list (%)	20.7	31.3	50.1
Median age (IQR), y	55 (45–63)	52 (41–62)	
Age, y (%)			
18–24	2	3.2	60
25–34	8	11.5	43.8
35–64	70.4	68.9	–2.1
≥65	19.6	16.4	–15.5
Female (%)	39.5	39.2	–0.8
Blood type (%)			
A	35.7	31.4	–12
B	12.6	17.2	36.5
O	46.5	46	–0.5
AB	5.2	5.4	3.9
Race/ethnicity (%)			
White	45	39.5	–12.3
African American	34.4	38.7	12.5
Hispanic	13.4	14.5	8.2
Other	7.2	7.2	0
Time on dialysis, y (%)			
Pre-emptive	11.1	7.3	–34.2
<1	7.6	6	–21.1
1–3	28.7	23.6	–17.7
3–5	26.2	25.7	–2
>5	26.5	37.4	41.1
HLA zero mismatch transplantation (%)	8	4.5	–43.8
Primary cause of disease			
Diabetes, age <50	4.7	4.3	–8.5
Diabetes, age ≥50	20.5	18.5	–9.8
Hypertension	26.6	28.9	8.6
Glomerular	22	23.1	5
Polycystic	8.7	6.9	–20.7
Renovascular	0.2	0.2	0
Other	17.3	18.1	4.6
Estimated post-transplantation survival 0–20% longevity-matching recipients	12.2	17.5	43.4

rules and incorporate random variability to determine how a chain of organs would be allocated to transplantation candidates. The results of the KPSAM simulations were used to propose the KAS [4]. Little is known about estimated wait-time to DDRT. In this study our purpose was to analyze and report the predicted wait times in transplant recipients that will likely be impacted by the new allocation policy based on their ABO blood type, years on dialysis, calculated panel-reactive antibody (CPRA) score, and longevity matching.

MATERIALS AND METHODS

This study used data from the SRTR. 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 OPTN. The Health Resources and Services Administration

(HRSA), U.S. Department of Health and Human Services provides oversight to the activities of the OPTN and SRTR contractors [3].

The KPSAM simulation uses one of the two input definitions corresponding to the old and the new allocation policy using actual deceased donor, wait list, and recipient data from January 1, 2010 to December 31, 2010, provided by the OPTN. It randomly generates a list of organ arrival and compatible candidates list, simulates organ acceptance behavior, and calculates number of transplants and organ discards given specific allocation rules. The KPSAM runs were simulated to complete a full year of transplants, with 10 iterations (each time randomly permuting the order of donor arrival and candidate's acceptance) of each policy on the simulation software to gather a good spread of data. It was assumed that 70% of the candidates with blood type B had low anti-A antibody titers and, therefore, could accept kidneys from donors with an A2 or A2B blood type that comprise 20% of blood type A or AB in white, African American, and Hispanic donors.

We analyzed and reported median (25th and 75th percentile) wait time with respect to CPRA scores, blood type, and years on dialysis

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