

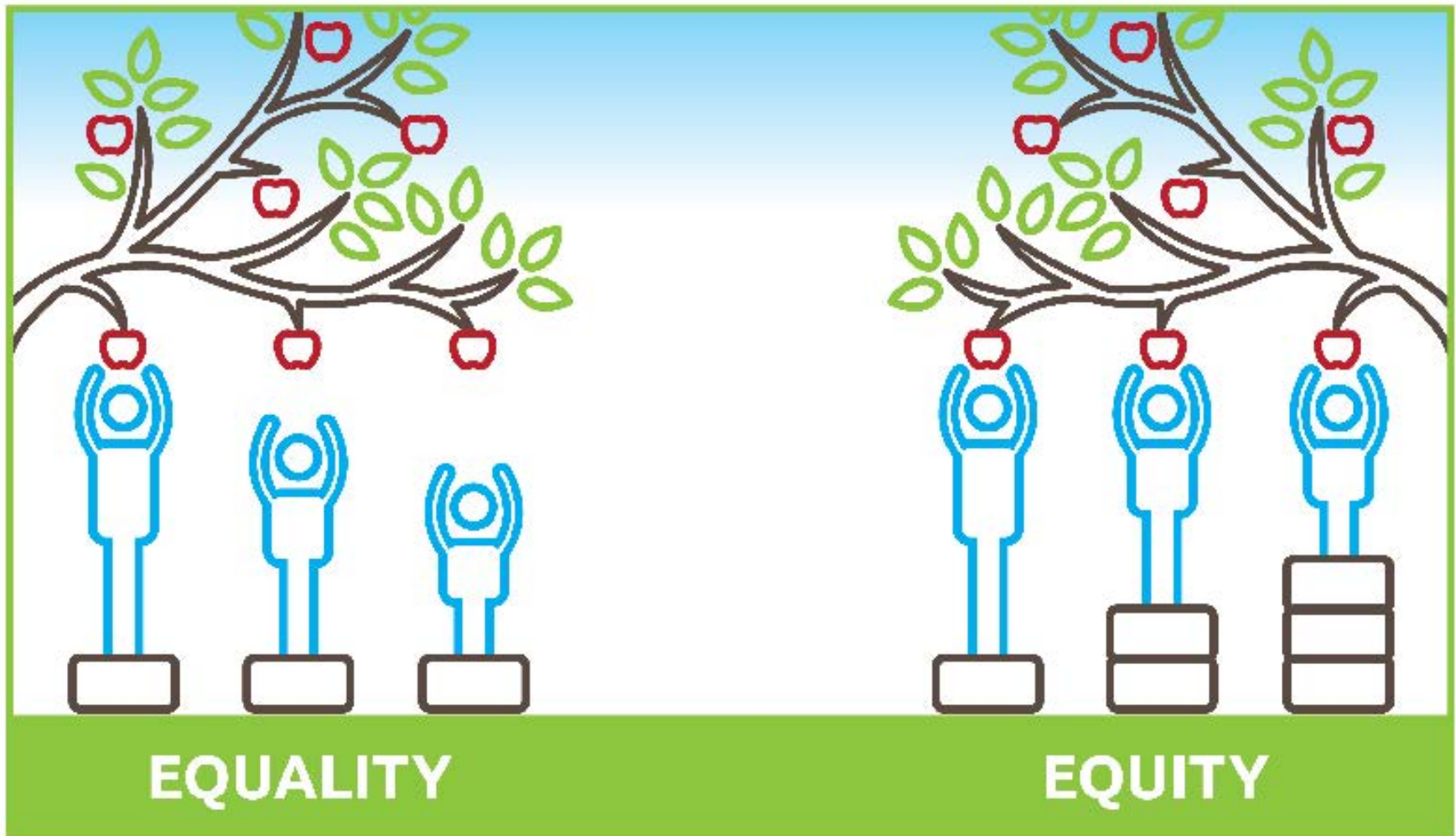


Organ Transplantation
Report on Equity in Access

Deceased Donor Kidney Allocation
August 21, 2017 (Quarterly Report)

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Report on Equity in Access

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Key Findings

This quarterly update reveals the following:

1. After decreasing with KAS, the level of disparity among waitlisted candidates in access to deceased donor kidneys has remained relatively stable during the subsequent 9 quarterly periods. The stability in this equity measure suggests that equity in access to deceased donor kidney transplants has remained consistently better than before KAS during the last 9 quarters (Figure 1 shown below and described further on page 10).

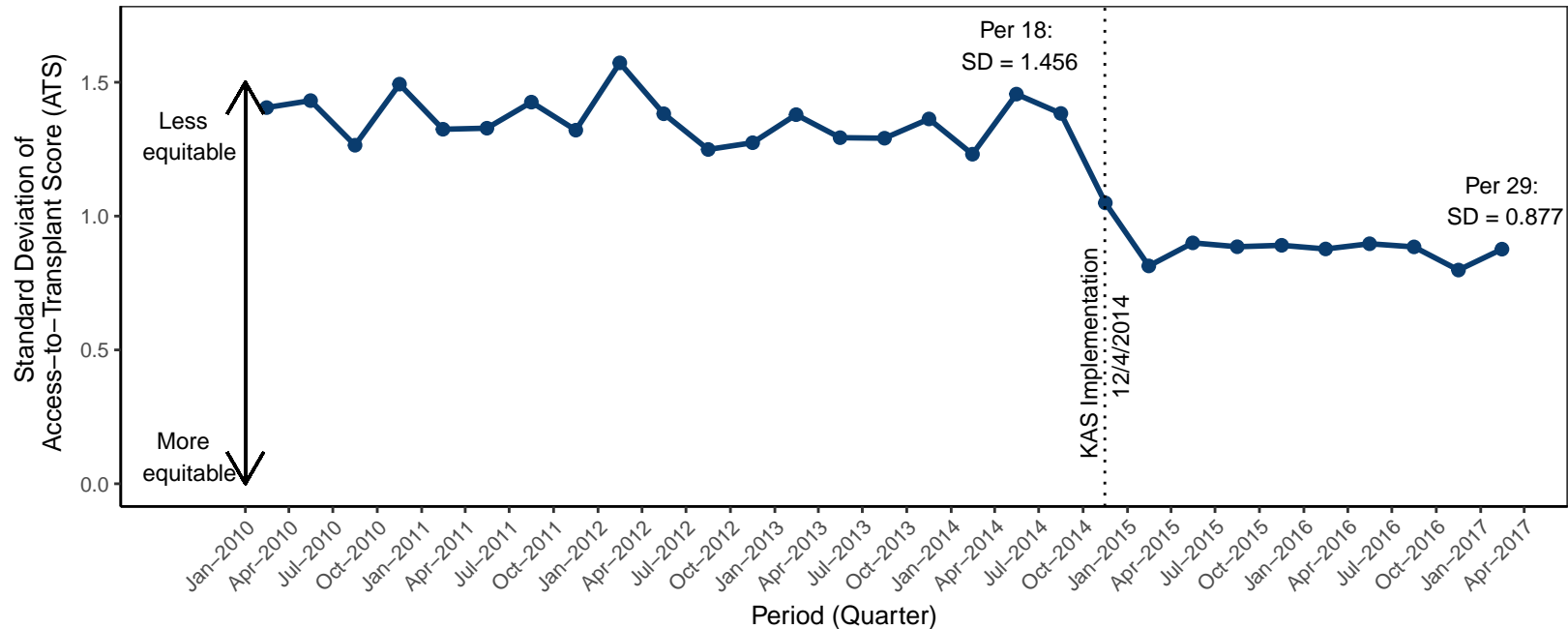


Figure 1: Tracking Variability in Access-to-Transplant Score (ATS) Among Waitlisted Kidney Candidates by Quarter (Jan 2010 - Mar 2017)

2. The candidate characteristic most associated with disparities in access, after adjusting for other factors, remains DSA of the transplant hospital, followed by candidate CPRA and candidate blood type (i.e., ABO). Disparities associated with other factors, such as candidate diagnosis, prior kidney transplant, insurance type (private vs. public), and candidate age, are relatively small (Figure 5).

This quarterly report contains an updated assessment of equity in kidney allocation as of August 21, 2017. The inaugural report, which covered the period January 2010 through March 2016, can be found here: https://optn.transplant.hrsa.gov/media/2159/equity_in_access_report_201705.pdf. The inaugural report highlights the impact of KAS on equity and elaborates on study limitations and methods.

Standard for Measuring Equity in Deceased Donor Organ Allocation

The OPTN pursues strategic goals of increasing the number of transplants; providing equity in access to transplants; improving outcomes for waitlisted patients, living donors, and transplant recipients; promoting living donor and transplant recipient safety; and promoting the efficient management of the OPTN.

The approach presented in this report measures equity in organ allocation by analyzing disparities in the expected time to deceased donor transplant among candidates on the waiting list. Disparities in timely access to transplantation attributable to the following factors are discounted when measuring the degree to which the system is equitable, since these factors are intentionally used by OPTN policy to increase transplant access for specific groups of patients: medical urgency, pediatric status, previously accumulated waiting time, prior organ donation in the U.S. or its territories (kidney), and net-benefit of transplantation (lung).

Conversely, disparities associated with other candidate factors, including the following, are not considered intentional or desirable and are not discounted when measuring the degree to which the system is equitable: ethnicity; age (among adults); age (among pediatrics); blood type; degree of immune sensitization; gender; cause of organ failure; socioeconomic factors such as income level, education, and insurance type (public or private); citizenship status; place of residence or place of listing.

A system with no undesirable disparities in access to transplantation may be unattainable. For example, for some candidates the pool of biologically compatible donors is so limited that equalizing their opportunities for transplant compared to other candidates may be an impossibility. Further, achieving perfect equity may be undesirable if it comes at the expense of other goals, such as optimizing organ utilization and improving recipient outcomes.

The intent of measuring and tracking equity is three-fold: (1) to gauge progress with respect to the OPTN's goal of providing equitable access to transplants, (2) to evaluate the impact on equity of previously implemented policy changes, (3) and to help the OPTN evaluate trade-offs between equity and other goals when considering the adoption of new policies.

This first report focuses exclusively on equity in access to deceased donor kidney transplants for waitlisted candidates. The feasibility of extending this methodology to the allocation of non-renal organs is being evaluated.

Measuring Equity in Access to Deceased Donor Kidney Transplants

What is an “Access-to-Transplant Score” (ATS)?

An Access-to-Transplant Score, or ATS, is a numerical measure developed to quantify the variability in expected waiting times for receiving a deceased donor kidney transplant among waitlisted patients. It is derived from a Cox proportional hazards regression model that takes into account fifteen patient characteristics such as blood type, CPRA, DSA of listing, age, ethnicity, and other factors considered to potentially impact a candidate’s time-to-transplant. The ATS is actually the (discounted) “xbeta” from from this statistical model, minus the average xbeta for all active candidates. The “xbeta” shifts the time-to-transplant curve higher or lower depending on candidate factors, as illustrated in **Figure 2** for five sample patients.

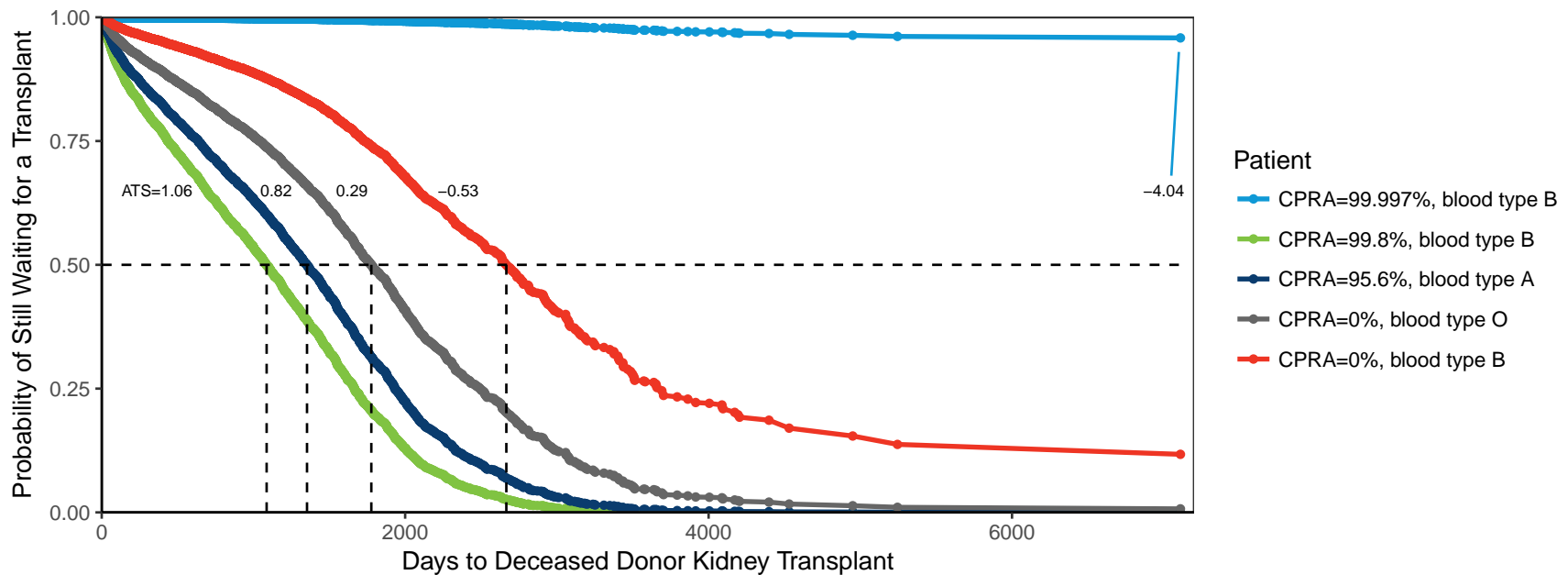


Figure 2: Time-to-Transplant Distribution for Five Sample Patients, Post-KAS (2016 Q1)

Current Variability among Active WL Candidates in the Timely Access to Deceased Donor Kidney Transplantation

Figure 3 shows the distribution of “Access to Transplant Scores” (ATS) for the 64,539 kidney registrations waiting in active status on January 01, 2017. The standard deviation of 0.877 summarizes the degree of variability among candidates in ATS. ATS is highlighted for three patients, revealing that the estimated median waiting times (MWT) for these patients vary from under 1 year to over 14 years. These differences are not due to pediatric priority, differences in previously accumulated waiting time, or other factors in OPTN policy that induce desired disparities in time-to-transplant. Rather, the disparities shown in Figure 2 are attributable to other factors, such as blood type, CPRA, and donor service area (DSA) of listing. These scores were estimated based on the allocation of deceased donor transplants during 1st quarter of 2017 (January 01 - March 31).

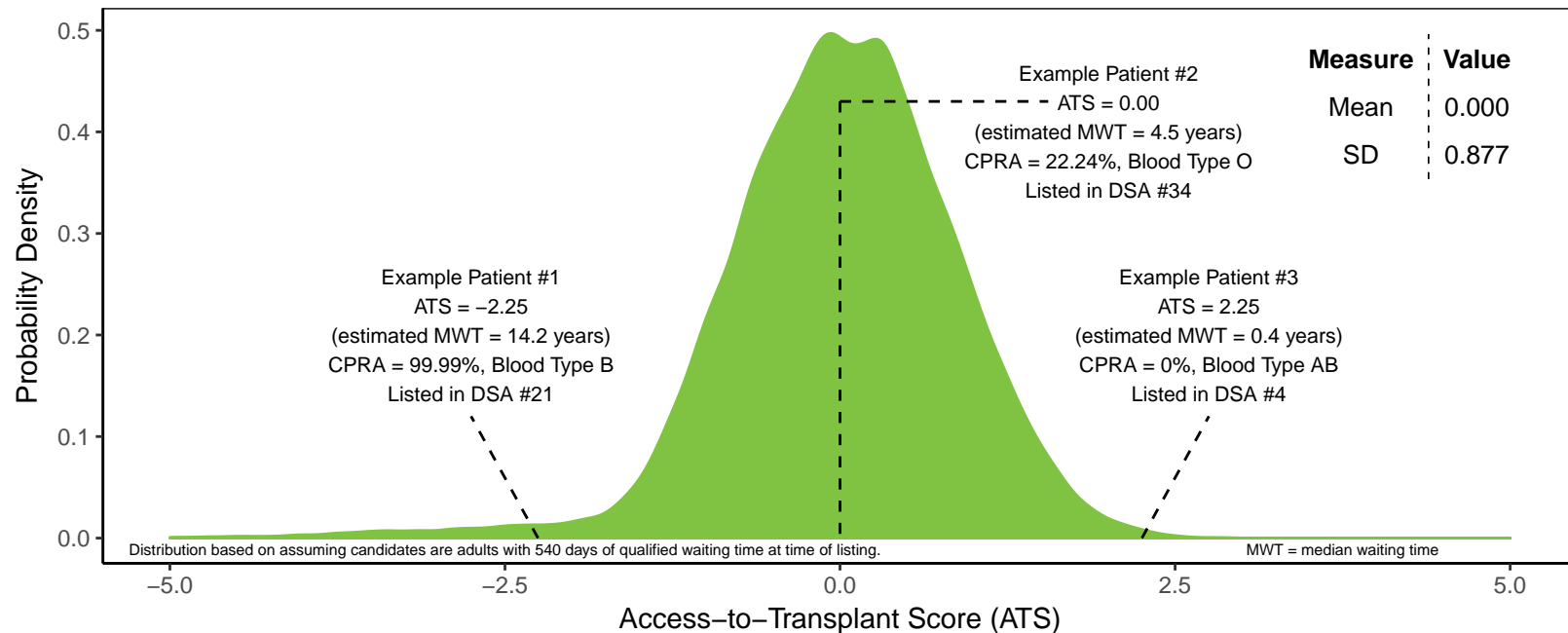


Figure 3: Variability in Access-to-Transplant Score (ATS) for Waitlisted Kidney Candidates, Post-KAS (2017 Q1)

Pre vs Post-KAS Variability in the Timely Access to Deceased Donor Kidney Transplantation

The blue distribution curve in **Figure 4** shows the variability in access to transplant among waitlisted kidney candidates pre-KAS (2nd quarter of 2014), with a standard deviation of 1.456. The post-KAS standard deviation of 0.877 represents a 40% decrease in variability in ATS scores compared to pre-KAS. Example patient #4, a very highly sensitized candidate, had an ATS of -2.70 pre-KAS. This candidate's ATS was still quite low but increased to -1.36 post-KAS. Percentiles (P10, P25, P75, P90) are shown for comparison.

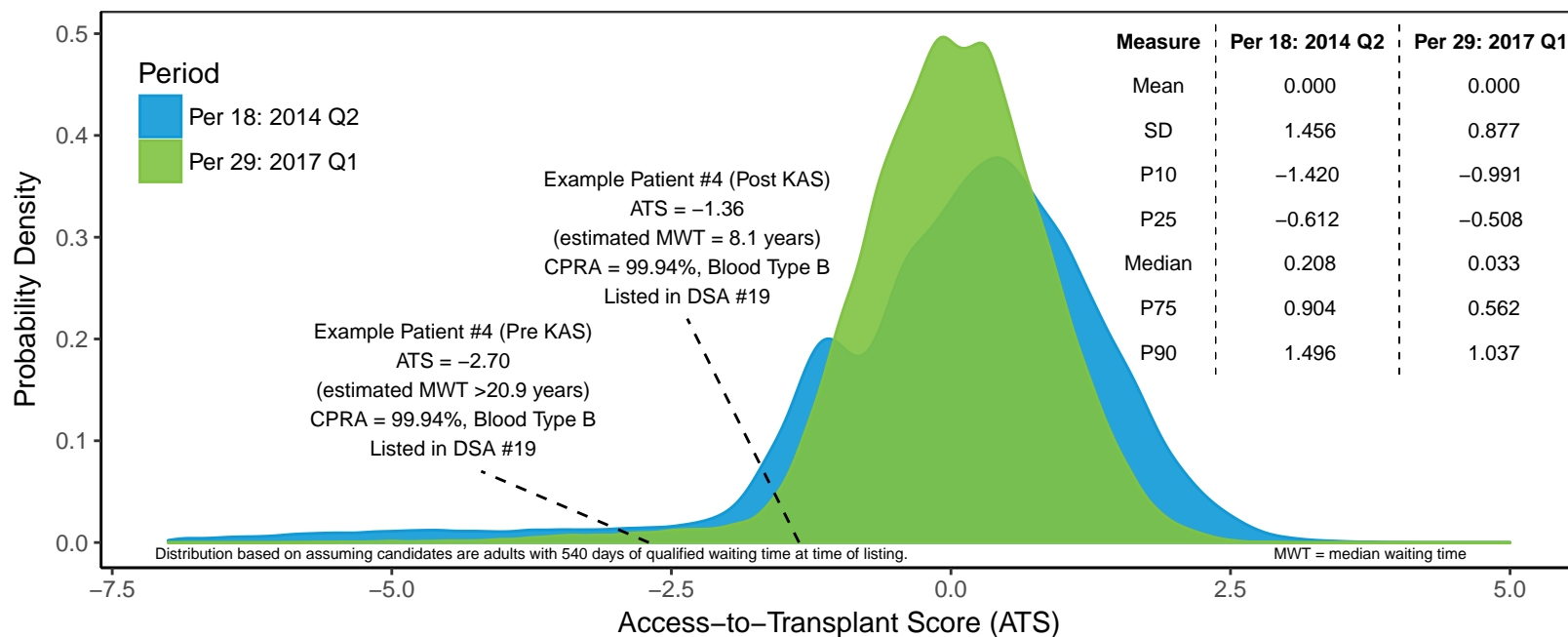


Figure 4: Variability in Access-to-Transplant Score (ATS) for Waitlisted Kidney Candidates, Pre (2014 Q2) vs. Post-KAS (2017 Q1)

“Period 29” is a 3-month (Jan 01, 2017 - Mar 31, 2017) post-KAS period, while “Period 18” is a 3-month (Apr 01, 2014 - Jun 30, 2014) pre-KAS period chosen for comparison. A complete list of all 29 period start and end dates is included in Appendix I.

Tracking Variability in Transplant Access over Time (Jan 01, 2010 - Mar 31, 2017)

Figure 1 shows quarterly measurements of the variability in ATS scores, as captured by the standard deviation of scores for all active candidates on the waiting list. Twenty five quarters are shown, starting with January 01, 2010 - March 31, 2010 (Period 1) and extending through January 01, 2017 - March 31, 2017 (Period 29). A complete list of all 29 period start and end dates is included in Appendix I. Prior to implementation of the new Kidney Allocation System (KAS) on December 4, 2014, the standard deviation ranged from 1.23 to 1.57 and averaged 1.36. Post-KAS, the standard deviation ranged from 0.80 to 0.90 and averaged 0.87, a drop of 36% compared to pre-KAS. (Note that the standard deviation of 1.05 for period 20 - Oct 01, 2014 through Dec 31, 2014 - reflects approximately two pre-KAS months together with one post-KAS month.)

These results suggest that KAS improved equity in access to deceased donor kidney transplants by substantially reducing the variability in the expected time-to-transplant among waitlisted patients. During the five years prior to KAS, the variability in ATS scores remained relatively stable. After decreasing concurrent with KAS, the standard deviation has remained relatively consistent through March 31, 2017.

Measuring Equity in Access by Candidate Characteristics

Identifying Candidate Characteristics Most Associated with Disparities in Access to Transplantation

In **Figure 5**, the standard deviation of risk-adjusted ATS scores for the most recent period (29: Jan 01, 2017 - Mar 31, 2017) are shown for ten candidate characteristics (factors). Risk-adjusted scores isolate the degree to which each factor is associated with candidates' time-to-transplant, *assuming all other factors are equal*. For example, the risk-adjusted standard deviation associated with CPRA means that all other factors, such as blood type, donor service area (DSA), age, etc., are assumed to be the same, such that only the variation attributable to differences in CPRA is included.

Figure 5 suggests that though equity has improved with KAS, the remaining disparities in timely access to transplantation are largely attributable to three factors: DSA of the transplant hospital, candidate CPRA, and candidate blood type (i.e., ABO). All else equal, the disparity associated with candidate diagnosis was fourth largest. The disparity associated with prior kidney transplant was fifth largest, though relatively small. The remaining five candidate factors - insurance type (private vs. public), candidate age, ethnicity, education level, and gender - were found to contribute very little to differences in candidate ATS scores.

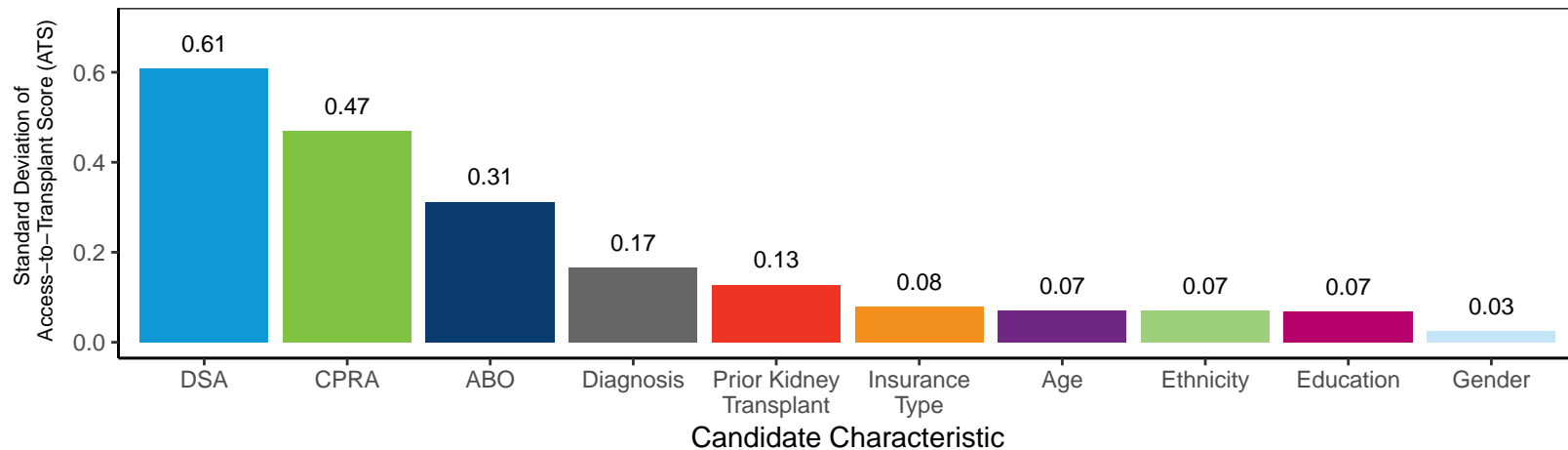


Figure 5: Variability in Access-to-Transplant Score (ATS) by Candidate Characteristic, "All Else Equal" Post-KAS: 2017 Q1

Appendix I: Period Start and End Dates

This analysis quantified disparities in time to receiving a deceased donor transplant in 29 different quarters. Periods 1-29 are identified below.

Period	Start Date	End Date	Period	Start Date	End Date
1	01/01/2010	03/31/2010	16	10/01/2013	12/31/2013
2	04/01/2010	06/30/2010	17	01/01/2014	03/31/2014
3	07/01/2010	09/30/2010	18	04/01/2014	06/30/2014
4	10/01/2010	12/31/2010	19	07/01/2014	09/30/2014
5	01/01/2011	03/31/2011	20	10/01/2014	12/31/2014
6	04/01/2011	06/30/2011	21	01/01/2015	03/31/2015
7	07/01/2011	09/30/2011	22	04/01/2015	06/30/2015
8	10/01/2011	12/31/2011	23	07/01/2015	09/30/2015
9	01/01/2012	03/31/2012	24	10/01/2015	12/31/2015
10	04/01/2012	06/30/2012	25	01/01/2016	03/31/2016
11	07/01/2012	09/30/2012	26	04/01/2016	06/30/2016
12	10/01/2012	12/31/2012	27	07/01/2016	09/30/2016
13	01/01/2013	03/31/2013	28	10/01/2016	12/31/2016
14	04/01/2013	06/30/2013	29	01/01/2017	03/31/2017
15	07/01/2013	09/30/2013			

Appendix II: Donor Service Area Identification Key

Encrypted DSA	The Donor Service Area (DSA) served by:	Encrypted DSA	The Donor Service Area (DSA) served by:
1	NYWN-OP1: Upstate New York Transplant Services Inc	30	CTOP-OP1: LifeChoice Donor Services
2	OHLC-OP1: Life Connection of Ohio	31	MSOP-OP1: Mississippi Organ Recovery Agency
3	NEOR-OP1: Nebraska Organ Recovery System	32	KYDA-OP1: Kentucky Organ Donor Affiliates
4	MWOB-OP1: Midwest Transplant Network	33	DCTC-OP1: Washington Regional Transplant Community
5	AROR-OP1: Arkansas Regional Organ Recovery Agency	34	MAOB-OP1: New England Organ Bank
6	IAOP-OP1: Iowa Donor Network	35	TXSB-OP1: Southwest Transplant Alliance
7	FLWC-OP1: LifeLink of Florida	36	MNOP-OP1: LifeSource Upper Midwest Organ Procurement Organization
8	NYAP-OP1: Center for Donation and Transplant	37	NYFL-IO1: Finger Lakes Donor Recovery Network
9	FLFH-IO1: TransLife	38	INOP-OP1: Indiana Donor Network
10	WIUW-IO1: UW Health Organ and Tissue Donation	39	TNDS-OP1: Tennessee Donor Services
11	AZOB-OP1: Donor Network of Arizona	40	PADV-OP1: Gift of Life Donor Program
12	OKOP-OP1: LifeShare Transplant Donor Services of Oklahoma	41	PRLI-OP1: LifeLink of Puerto Rico
13	UTOP-OP1: Intermountain Donor Services	42	NJTO-OP1: New Jersey Organ and Tissue Sharing Network OPO
14	WALC-OP1: LifeCenter Northwest	43	TXGC-OP1: LifeGift Organ Donation Center
15	MOMA-OP1: Mid-America Transplant Services	44	CORS-OP1: Donor Alliance
16	NVLV-OP1: Nevada Donor Network	45	MDPC-OP1: The Living Legacy Foundation of Maryland
17	OHLP-OP1: Lifeline of Ohio	46	OHLB-OP1: Lifebanc
18	NCCM-IO1: LifeShare of the Carolinas	47	ILIP-OP1: Gift of Hope Organ & Tissue Donor Network
19	CAGS-OP1: Sierra Donor Services	48	TNMS-OP1: Mid-South Transplant Foundation
20	NMOP-OP1: New Mexico Donor Services	49	NYRT-OP1: LiveOnNY
21	NCNC-OP1: Carolina Donor Services	50	WIDN-OP1: Wisconsin Donor Network
22	VATB-OP1: LifeNet Health	51	CADN-OP1: Donor Network West
23	ORUO-IO1: Pacific Northwest Transplant Bank	52	TXSA-OP1: Texas Organ Sharing Alliance
24	SCOP-OP1: We Are Sharing Hope SC	53	ALOB-OP1: Alabama Organ Center
25	MIOP-OP1: Gift of Life Michigan	54	HIOP-OP1: Legacy of Life Hawaii
26	FLUF-IO1: LifeQuest Organ Recovery Services	55	LAOP-OP1: Louisiana Organ Procurement Agency
27	OHOV-OP1: LifeCenter Organ Donor Network	56	CAOP-OP1: OneLegacy
28	PATF-OP1: Center for Organ Recovery and Education	57	GALL-OP1: LifeLink of Georgia
29	FLMP-OP1: Life Alliance Organ Recovery Agency	58	CASD-IO1: Lifesharing - A Donate Life Organization