THE Alliance | SRTR SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

Knowing is Half the Battle: Using SRTR Data to Monitor Transplant Program Performance

TODAY'S SPEAKER



Jon Snyder, PhD, MS

Director, SRTR

Director of Transplant Epidemiology,

HennepinHealthcare Research Institute

Tuesday, January 23, 2024, 2:00pm – 3:30pm ET



Performance Improvement: How to Handle MPSC Metrics for Transplant Programs

Thursday, January 25, 2024, 3:00pm – 4:00pm ET
11:00am – 12:00pm PT

Available Continuing Education Credits: 1 CEPTC Credit, 1 Nursing Contact Hour

SPEAKERS:



Lindsay Smith, RN, MSN
Transplant Quality Director
Vanderbilt Transplant Center



Kristina Wheeler
Program Consultant
THE Alliance

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Meet Our Moderator



John Gutowski MBA, MHA, FACHE
Executive Director, Transplant
uchealth

Meet Our Presenter



Jon Snyder

PHD, MS

Director, SRTR

Director of Transplant Epidemiology,

Hennepin Healthcare Research Institute

SRTR SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

HennepinHealthcare Research Institute

SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

Using SRTR Data to Monitor Transplant Program Performance

Jon Snyder, PhD
Director, Scientific Registry of Transplant Recipients
Director, Transplant Epidemiology
Chronic Disease Research Group
Hennepin Healthcare Research Institute

January 23, 2024

Disclosures

The views expressed do not necessarily reflect the official policies of the U.S. Department of Health and Human Services nor does mention of trade names, commercial practices, or organizations imply endorsement by the U.S. Government.

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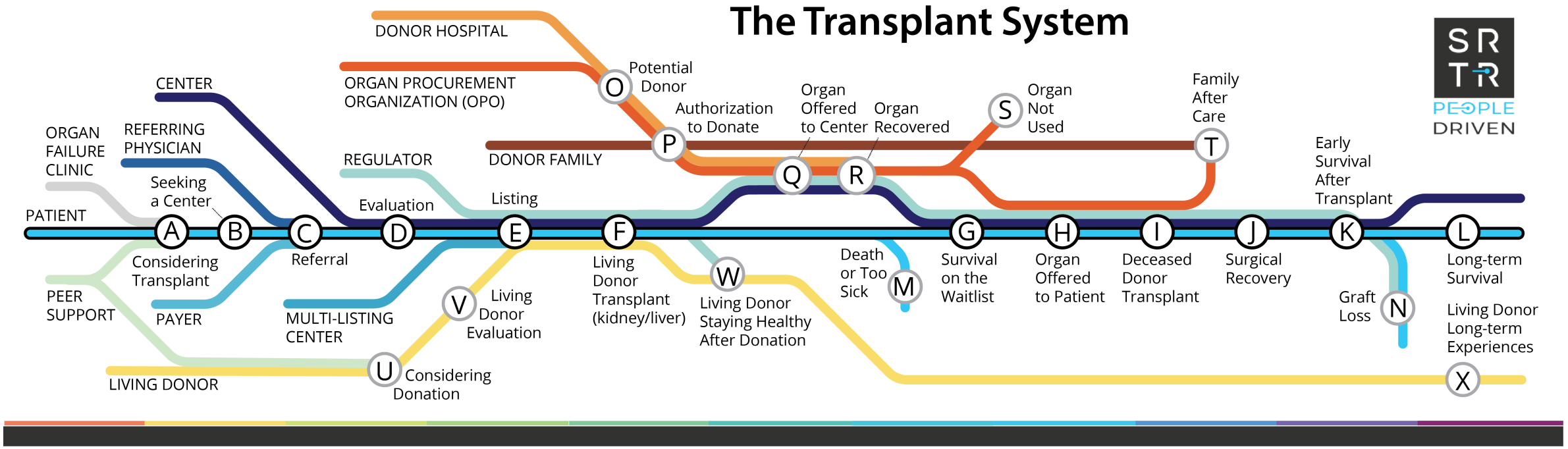
Presentation Goals

- Understand the 4 metrics the Membership and Professional Standards Committee is using to assess transplant program performance.
- Understand the triggers for MPSC review, i.e., flagging rules.
- Identify how to find and interpret the risk adjustment models used to adjust program performance metrics.
- Breakout Groups & Closing Discussion

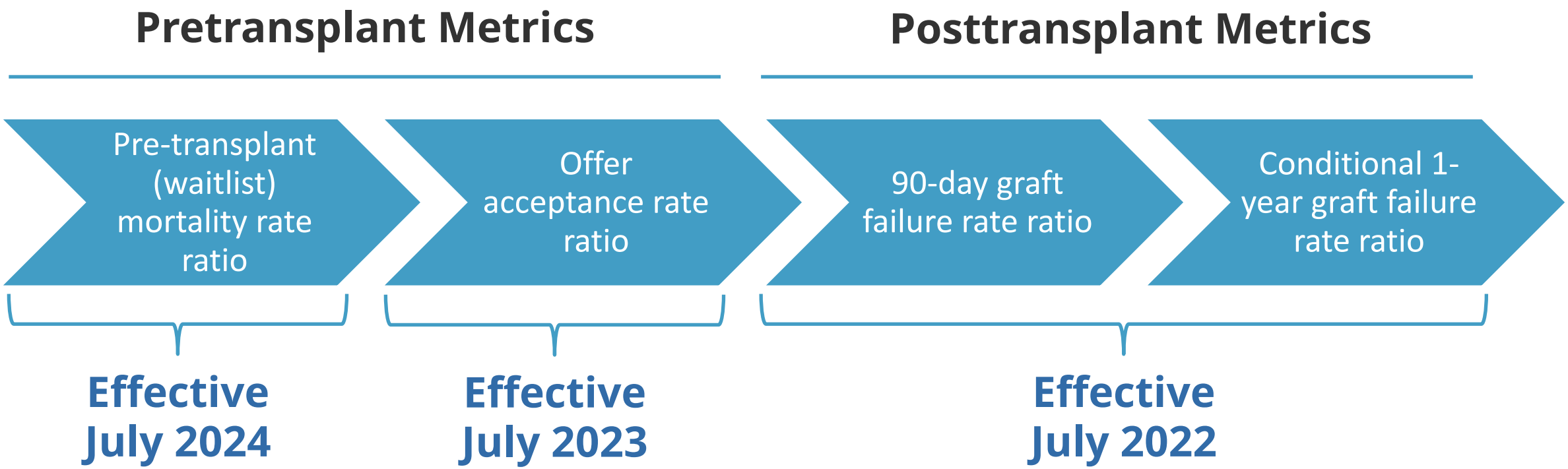
Breakout Group Poll

Group	SRTR Lead:
Offer Acceptance Evaluations and CUSUMs	Nick Wood, PhD Biostatistician
Pre-transplant mortality metric and expected survival workbooks	Grace Lyden, PhD Biostatistician
Post-transplant graft failure metric and expected survival workbooks and CUSUMs	Jon Miller, PhD Biostatistician
Understanding risk adjustment models and where to find information about the models	Jon Snyder, PhD Director, SRTR

The Transplant System Map



Four metrics being used by the OPTN's MPSC:



Qualities of Metrics Chosen by the MPSC

1. Measures aspects of care that are clearly within the authority of the OPTN
2. Measures aspects of care that the transplant program can impact
3. Has a clear desired outcome

SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

Pretransplant (waitlist) Mortality Rate Ratio

Pretransplant (Waitlist) Mortality



Question Being Addressed:

On days when a patient is not transplanted, are patients listed by this program more/less likely to die compared with similar patients nationally?

Pretransplant (Waitlist) Mortality Rate Ratio: Methodology

Compares Observed (O) deaths to expected (E) deaths from the time the patient is listed until they are transplanted.

O = Observed Deaths Between Listing and Transplant.

E = Expected Deaths Between Listing and Transplant.

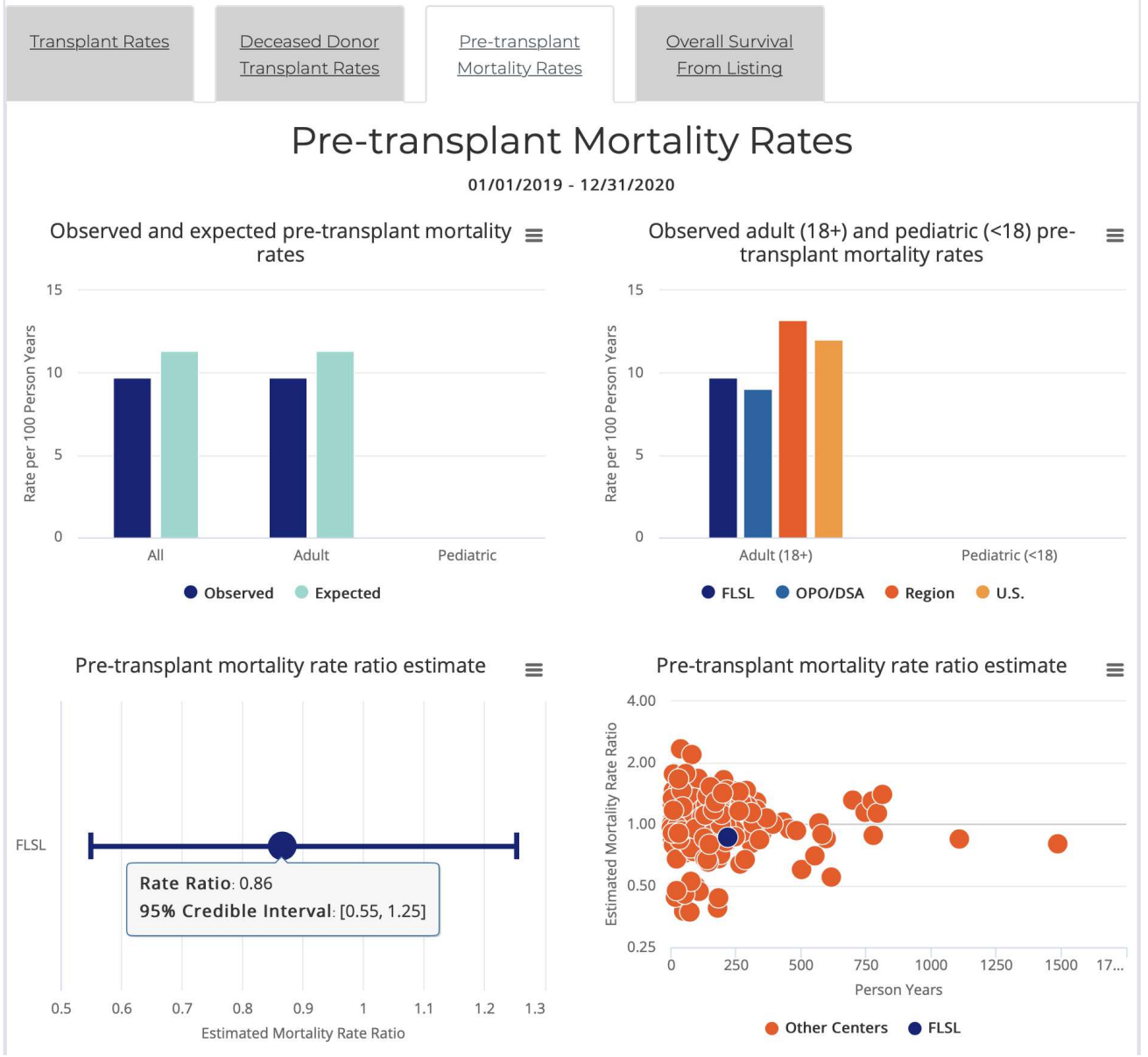
Waitlist Mortality Rate Ratio = (O+2)/(E+2).

Pretransplant (Waitlist) Mortality Rate Ratio: Methodology

Evaluation Window	2-year evaluation window
Days evaluated	Any day within the window from waitlisting until transplant.
Post-removal deaths	Deaths are evaluated post-removal unless transferred to another program. If a person is removed for reason of recovery (transplant no longer needed), deaths are evaluated for a maximum of 60 additional days.

SRTR Reporting

Pre-transplant mortality rates are reported with detail by adult and pediatric candidates (if applicable) and comparisons to outcomes within the donation service area (DSA), the OPTN region, and comparisons to all other programs.



Pretransplant Workbooks are Available to Perform Subgroup Analyses

Available on the SRTR Secure Site.

Programs can view evaluations within subgroups of choice. Example shown at right is by candidate age groups

Overall Waitlist Mortality Rate	
All candidates	
Number of Candidates	145
Observed Deaths (O)	9
Expected Deaths (E)	5.96
Overall Waitlist Mortality Rate Ratio	1.38
Candidate age: <40	
Number of Candidates	43
Observed Deaths (O)	2
Expected Deaths (E)	0.94
Overall Waitlist Mortality Rate Ratio	1.36
Candidate age: 40-<60	
Number of Candidates	46
Observed Deaths (O)	4
Expected Deaths (E)	2.01
Overall Waitlist Mortality Rate Ratio	1.5
Candidate age: ≥60	
Number of Candidates	55
Observed Deaths (O)	3
Expected Deaths (E)	3.01
Overall Waitlist Mortality Rate Ratio	1

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FIND & COMPARE TRANSPLANT PROGRAMS

Select Organ | Search by Postal Code or Program Name (optional) | SEARCH

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- Risk Adjustment Models
  - Posttransplant Outcomes
  - Waiting List
  - Offer Acceptance
  - Deceased Donor Yield
  - Mortality After Listing
- Kidney Transplant Decision Aid
- Liver Waiting List Calculator
- Acuity Circles Evaluation
- COVID-19 Evaluation

COV App

Includes a wide otive statistics.

COVID-19 APP

Model Elements | Model Coefficients | Model Element Plots | Baseline Hazard | Additional Info

Model Elements Table

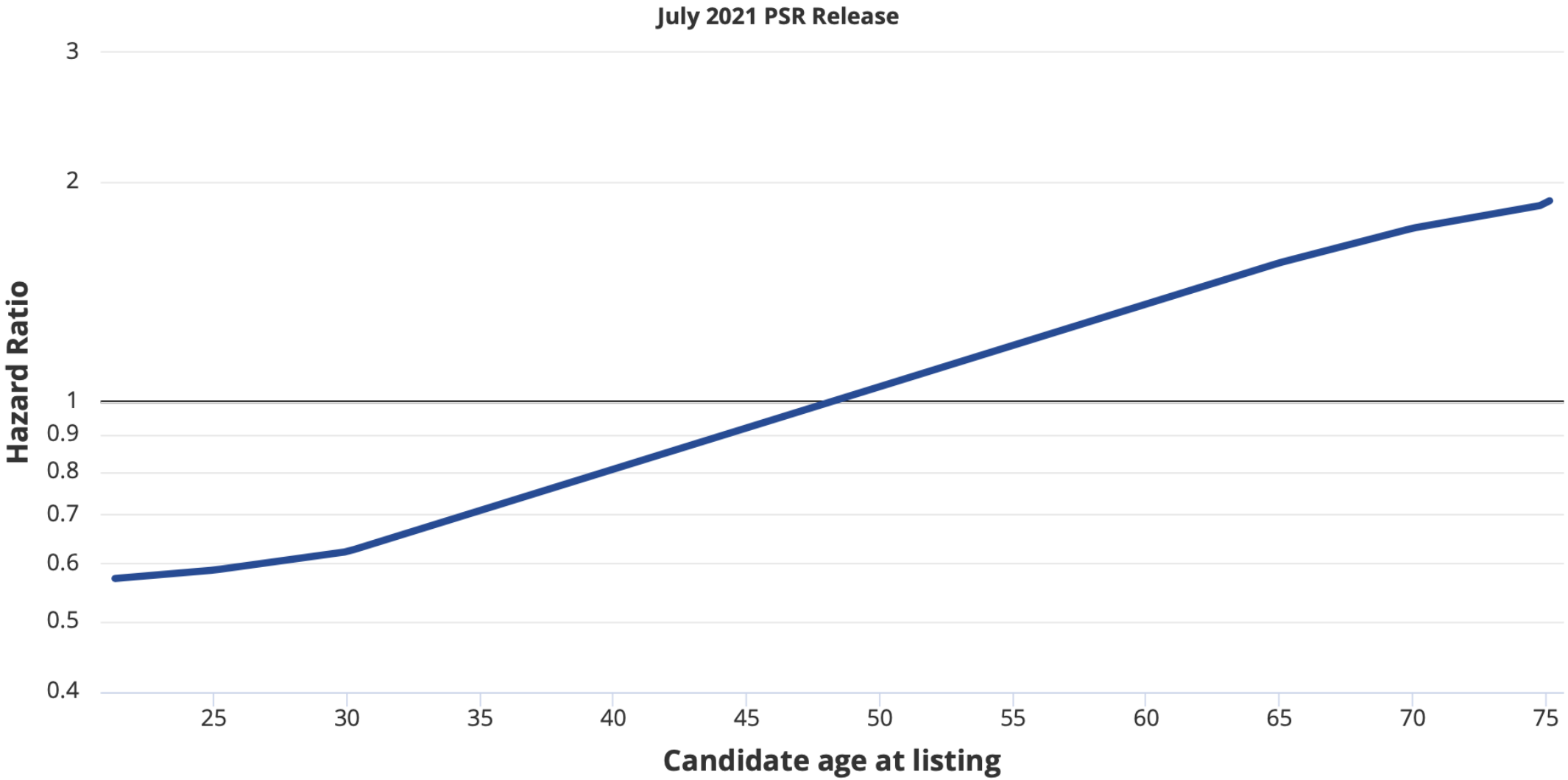
This table lists the elements included in the risk adjustment model and each element's data source. For additional information on the data sources, click the Additional Info tab.

Show 25 entries

Search:

Element	Source
Candidate age at listing	TCR
Candidate blood type	TCR
Candidate BMI	Calculated
Candidate diabetes type	TCR
Candidate education	TCR
Candidate sex	TCR
Candidate height	TCR
Candidate previous malignancy	TCR
Candidate PVD	TCR
Candidate primary insurance	TCR

Adult (18+) Kidney Pre-transplant Mortality Rate*



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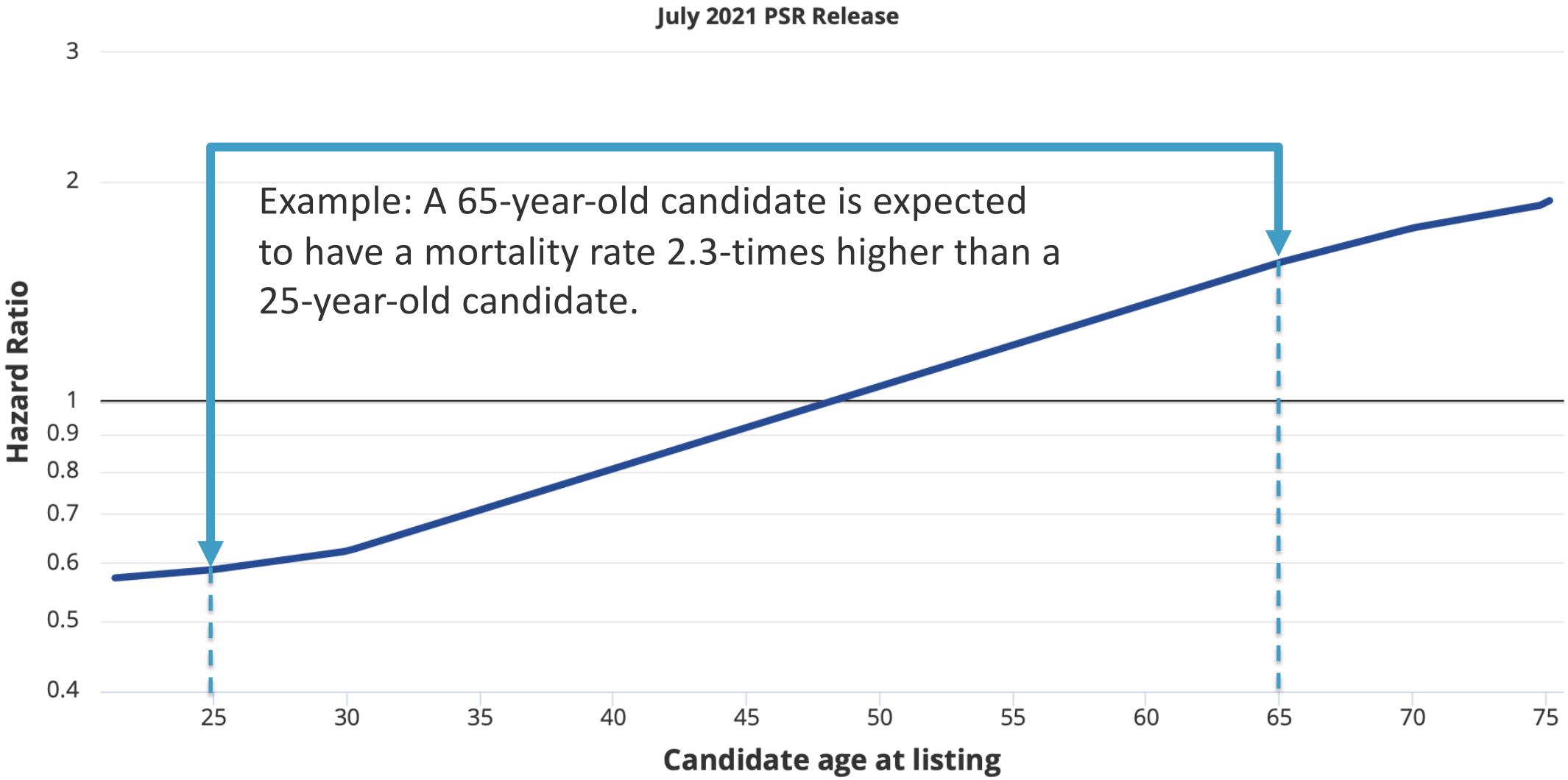

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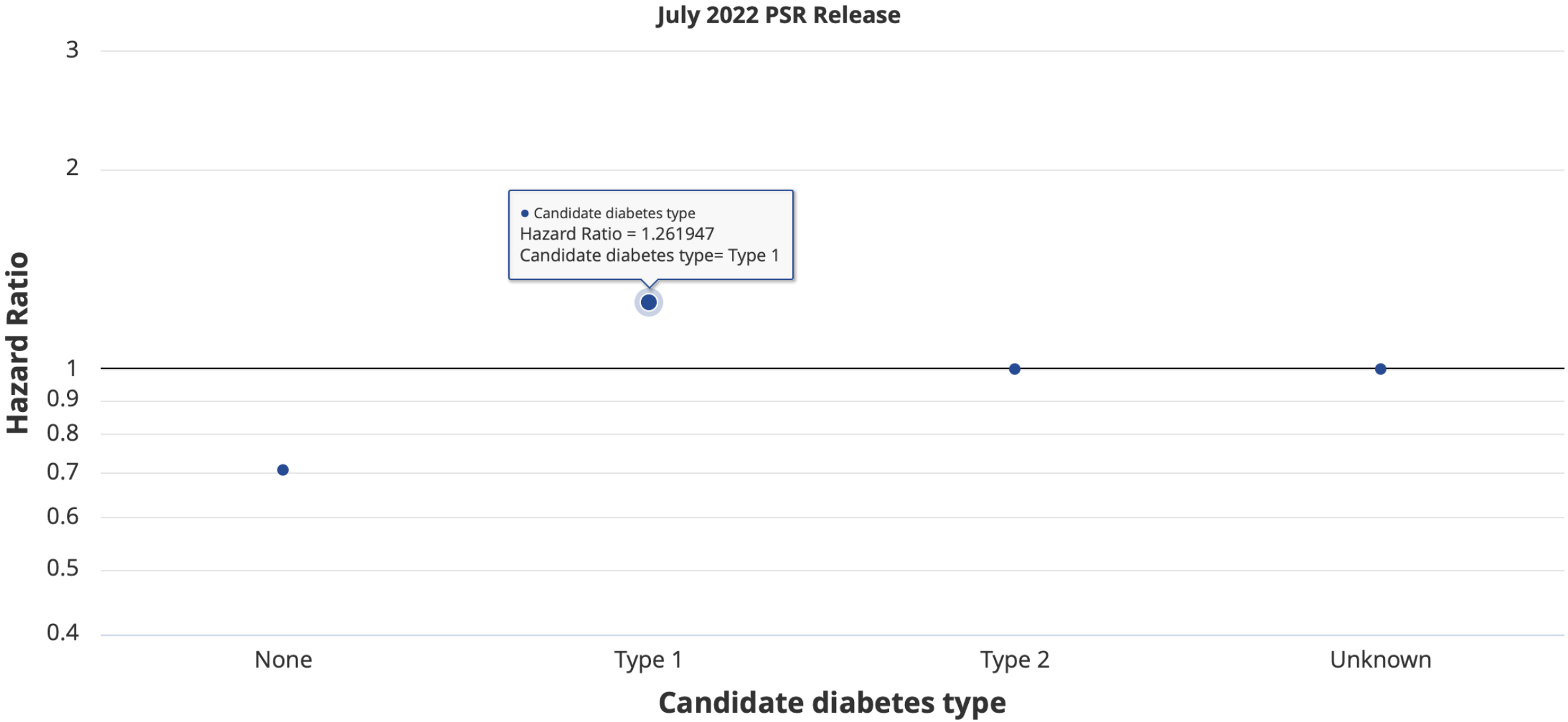

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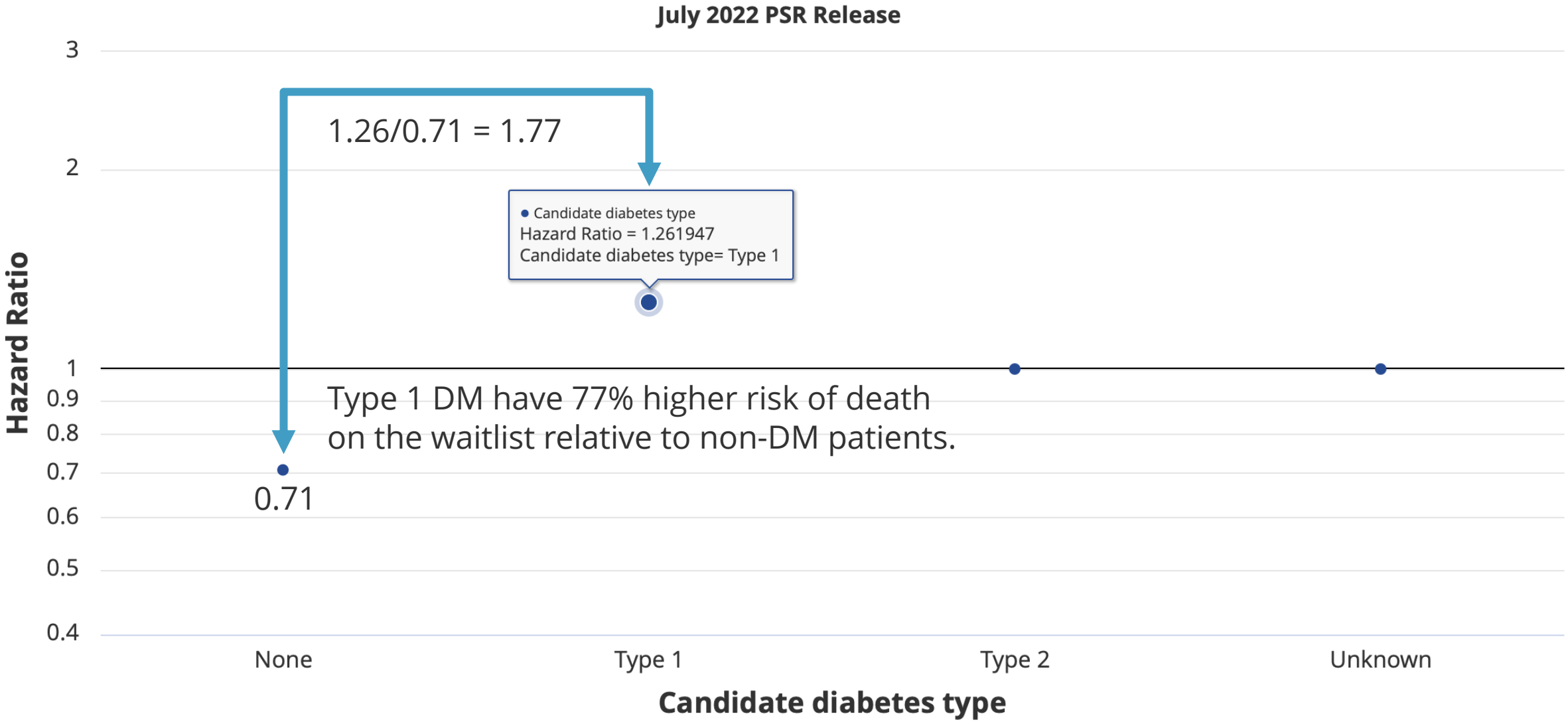


SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

Offer Acceptance Rate Ratio

Offer Acceptance Rate Ratio



Question Being Addressed:

Given the types of offers received to the specific candidates, does this program accept offers at a rate higher/lower than national experience for similar offers to similar candidates?

Offer Acceptance Rate Ratio: Methodology

Compares Observed (O) offer acceptances to expected (E) offer acceptances.

O = Observed Offer Acceptances

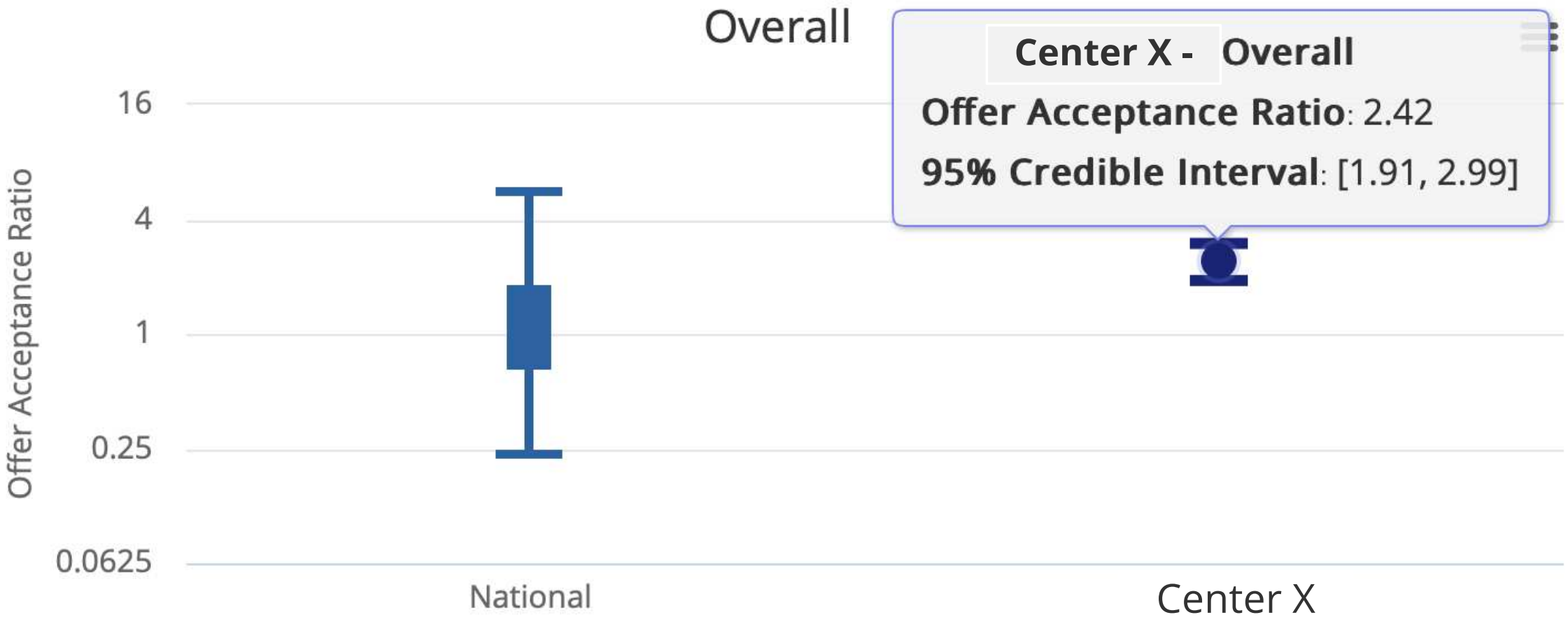
E = Expected Offer Acceptances

Offer Acceptance Rate Ratio = (O+2)/(E+2).

Offer Acceptance Rate Ratio: Methodology

Evaluation Window	1-year evaluation window
Offers that are NOT evaluated	1. Bypassed offers 2. Match run had no acceptances 3. Offer occurred after the organ was accepted 4. Duplicate offers across multiple match runs* 5. Offers to multi-organ candidates**
Notes	*Kidney allocation may offer candidates dual kidneys after the single kidney. In this situation, the second offer to the candidates is kept in the cohort. **Kidney-alone offers are included for KP candidates if the program indicated the patient will entertain kidney-alone offers.

Consider Offer Acceptance



SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

SECURE SITE

Subgroups Available

Donor Characteristics	History of Acceptance	Number of Offers	Number of Acceptances	Expected Acceptances	Offer Acceptance Ratio
Overall	Above Average	99	22	9.00	2.18
PHS Increased Infectious Risk	Above Average	31	9	2.00	2.75
Ejection Fraction (Less Than or Equal to 50)	Average	6	1	0.88	1.04
Donor Age (> 40)	Above Average	30	6	1.43	2.34
Over 50 Offers	Somewhat Above Average	17	3	0.60	1.92
Over 500 Miles Away	Above Average	30	7	1.86	2.33
Weekend	Above Average	24	5	1.31	2.12

SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

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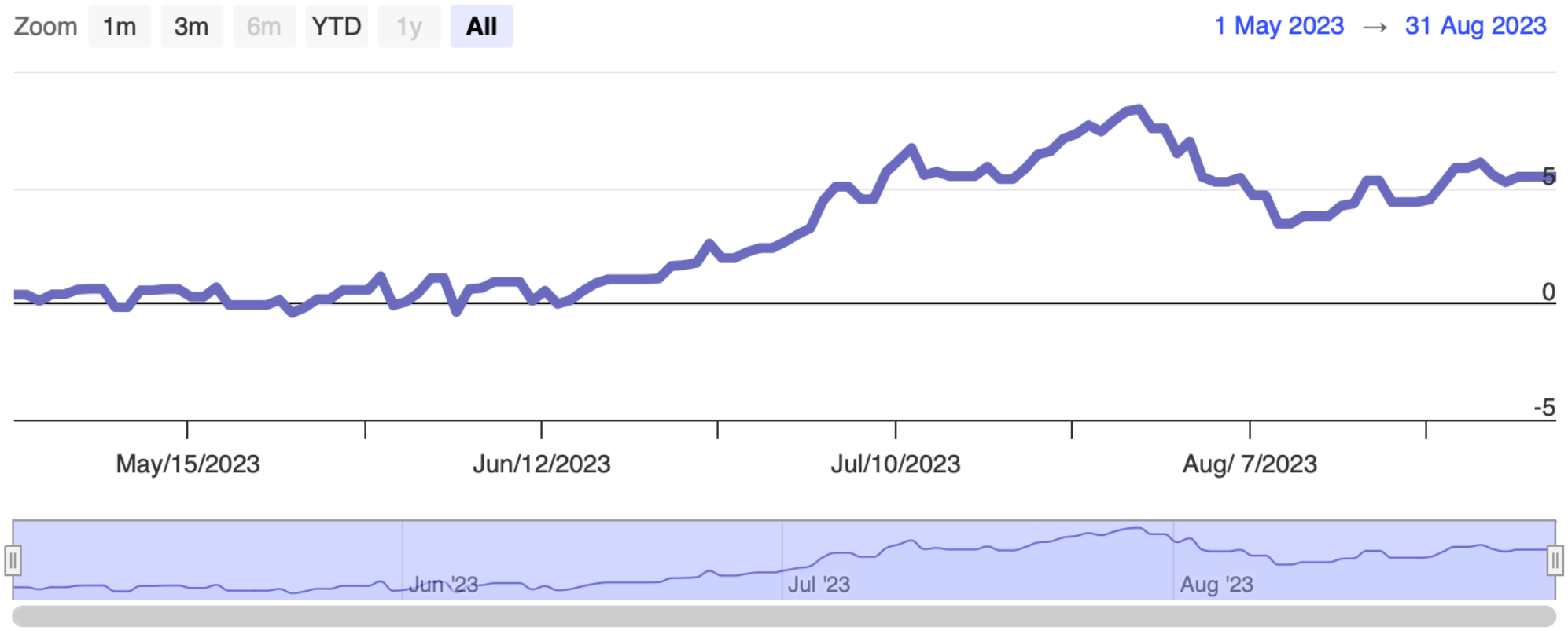
Subgroups for Kidney Offers

Across Subgroups

Subgroup	History of Acceptance	Number of Offers	Number of Acceptances	Expected Acceptances	Offer Acceptance Ratio
Overall	Somewhat Below Average	4718	37	42.52	0.88
KDRI < 1.05	Somewhat Above Average	549	19	15.28	1.22
1.05 <= KDRI < 1.75	Somewhat Below Average	3094	16	22.49	0.73
KDRI >= 1.75	Somewhat Below Average	1075	2	4.74	0.59
KDPI >= 60	Somewhat Below Average	2325	6	10.81	0.62
DCD	Somewhat Below Average	2592	9	13.58	0.71
Hard-to-Place (Offer Number > 100)	Below Average	3713	0	2.64	0.43
COVID Positive	Average	330	2	1.58	1.12
PHS Increased Infectious Risk	Somewhat Below Average	634	3	4.00	0.83
HCV+	Average	28	1	0.64	1.14
Weekend	Somewhat Below Average	908	7	10.48	0.72
Pediatric Candidates	Average	9	1	0.20	1.36
Adult Candidates	Somewhat Below Average	4709	36	42.32	0.86

Offer Acceptance CUSUMs



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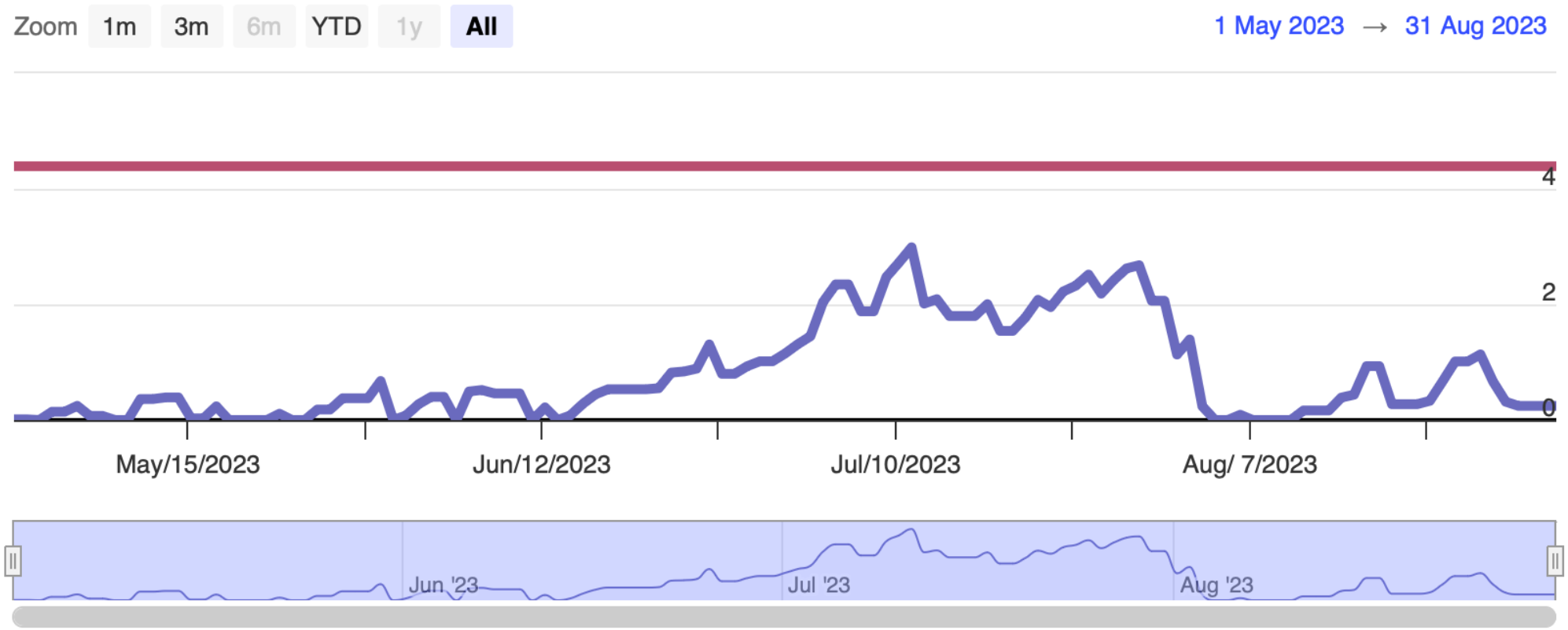

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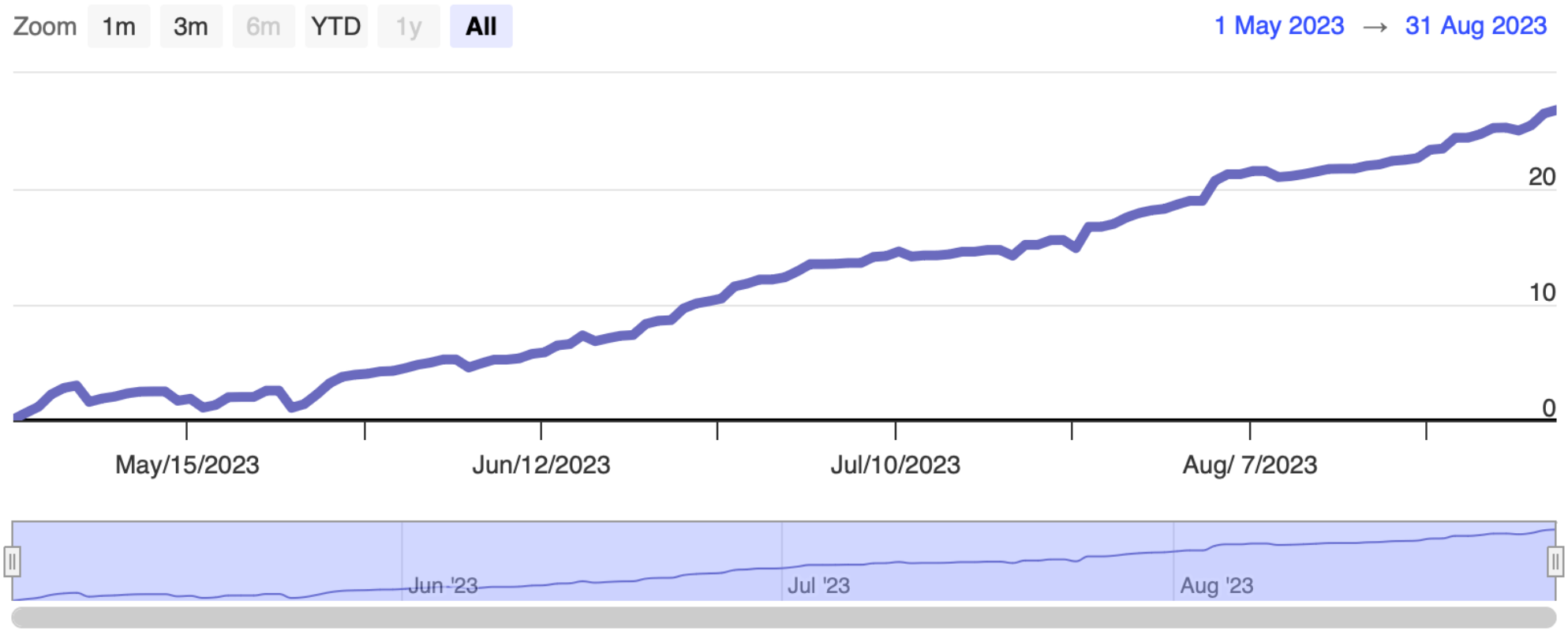

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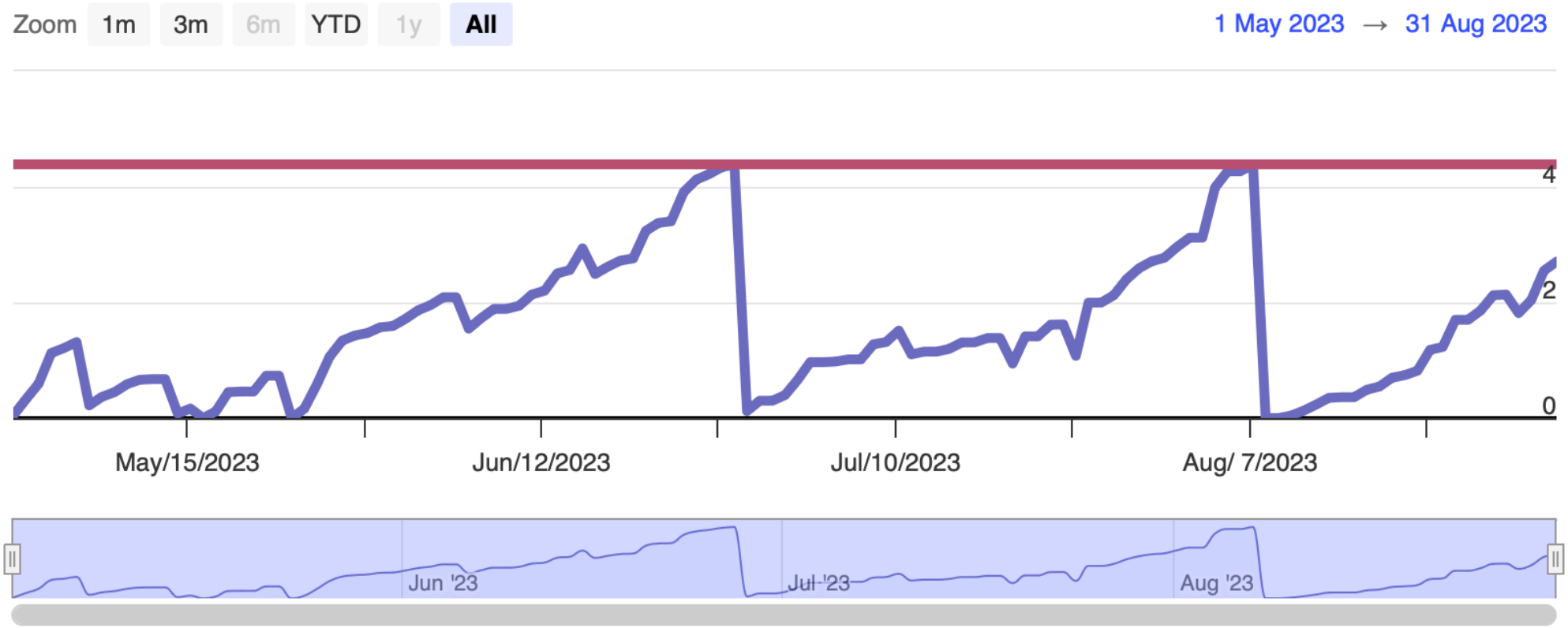

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Risk Adjustment Model: Offer Acceptance

Choose an organ of interest:

- ○ Kidney
- ◉ Liver
- ○ Heart
- ○ Lung
- ○ Pancreas
- ○ Kidney-Pancreas

Liver Model Strata

- ○ Pediatric Candidate
- ○ Adult Candidate - Donor < 40
- ◉ Adult Candidate - Donor ≥ 40

Element Type	Element
Candidate	Accept an incompatible blood type?
Candidate	Allocation MELD/PELD
Candidate	Ascites
Candidate	Candidate Age at Listing (Years)
Candidate	Candidate BMI
Candidate	Candidate Blood Type
Candidate	Candidate Gender
Candidate	Candidate Height (cm)
Candidate	Candidate Weight (kg)
Candidate	Diagnosis
Candidate	Dialysis in Prior Week
Candidate	Laboratory MELD/PELD
Candidate	Natural Log INR
Candidate	Natural Log of Albumin
Candidate	Natural Log of Bilirubin
Candidate	Status 1A
Candidate	Status 1B
Candidate and Donor	Center Number
Candidate and Donor	Center Rank
Candidate and Donor	Donor/Candidate Gender Mismatch
Candidate and Donor	Natural Log of Candidate:Donor Height Ratio
Candidate and Donor	Natural Log of Candidate:Donor Weight Ratio
Candidate and Donor	Natural Log of Distance (km) Between Candidate and Donor
Candidate and Donor	Offer Number
Donor	Arginine Vasopressin

Offer Acceptance

Offer Acceptance

Donor	BUN
Donor	Biopsy
Donor	Blood Infection
Donor	COVID Positive
Donor	Cause of Death
Donor	Cigarette Use > 20 Pack Years
Donor	Cocaine Use
Donor	DCD Downtime (Minutes)
Donor	Donation After Circulatory Death (DCD)
Donor	Donor Age (Months)
Donor	Donor BMI
Donor	Donor Blood Type
Donor	Donor Gender
Donor	Donor Height (cm)

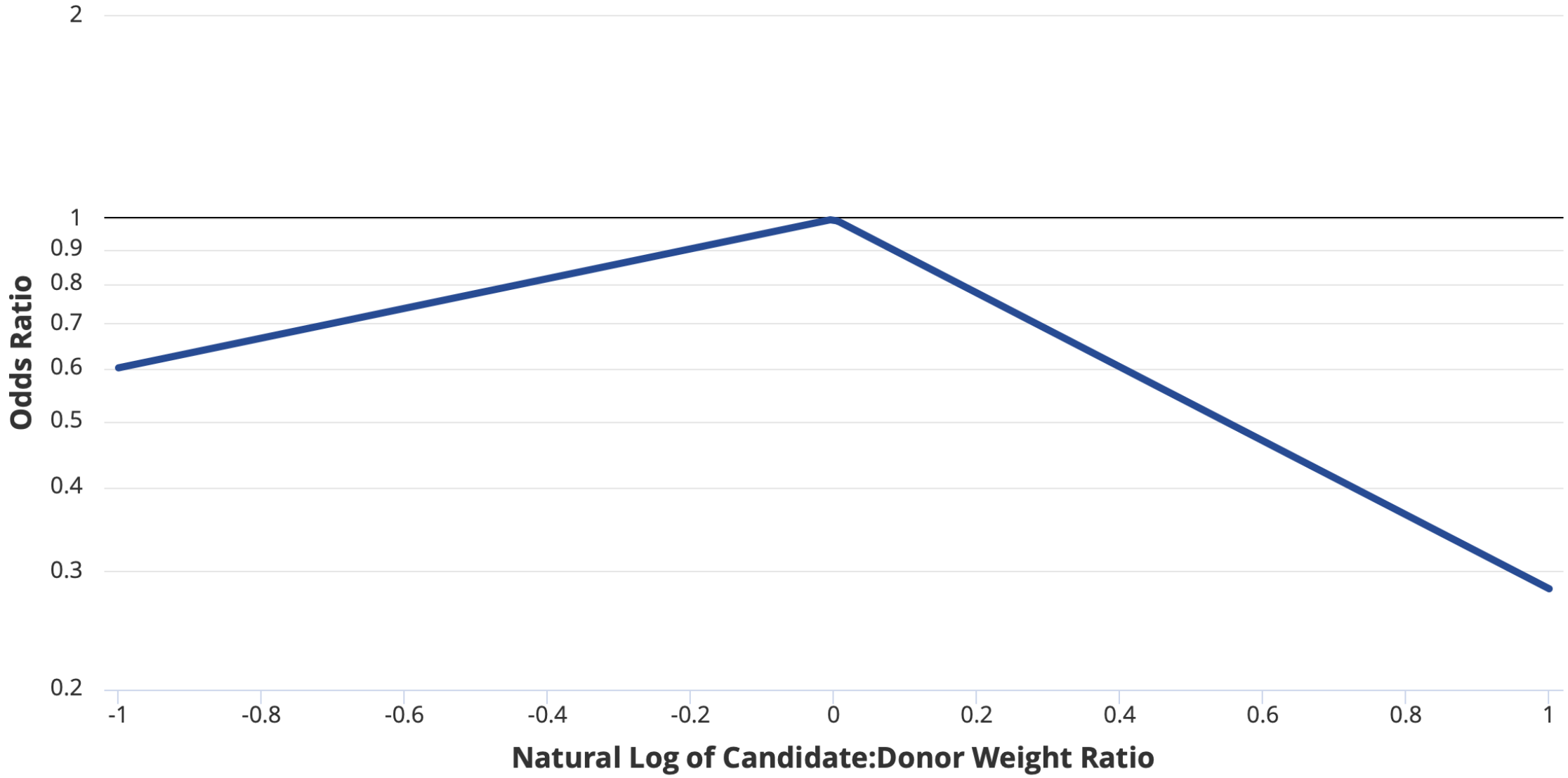
Donor	Donor History of Diabetes
Donor	Donor History of Hypertension
Donor	Donor Weight (kg)
Donor	HCV NAT Results
Donor	Heavy Alcohol Use (heavy= 2+ drinks/day)
Donor	Hematocrit
Donor	History of IV Drug Use
Donor	History of Previous MI
Donor	Liver Offer Type
Donor	Macro Fat

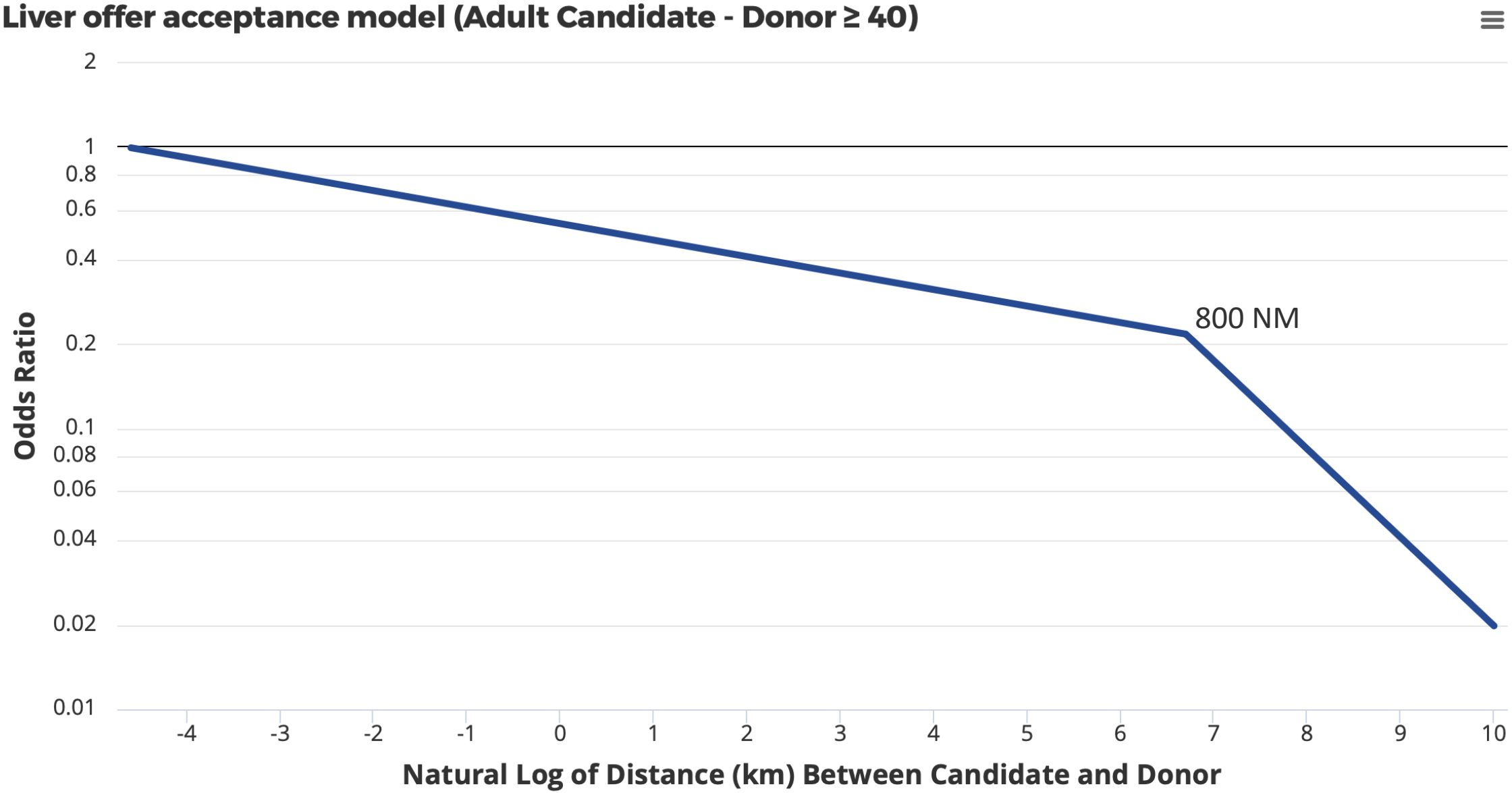
Element Type	Element
Donor	Mechanism of Death
Donor	Micro Fat
Donor	Other Drug Abuse
Donor	PHS Increased Infectious Risk
Donor	Peak INR
Donor	Peak Lipase
Donor	Peak SGOT
Donor	Peak SGPT
Donor	Peak Serum Amylase
Donor	Peak Serum Creatinine
Donor	Peak Serum Sodium
Donor	Previous Gastrointestinal Disease
Donor	Tattoos
Donor	Weekend Allocation (Match Run Submitted on Friday or Saturday)
Donor	toxscreen

Liver offer acceptance model (Adult Candidate - Donor ≥ 40)



Liver offer acceptance model (Adult Candidate - Donor ≥ 40)




Liver offer acceptance model (Adult Candidate - Donor ≥ 40)
Odds Ratio
2
1
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
800 NM
-4
-3
-2
-1
0
1
2
3
4
5
6
7
8
9
10
Natural Log of Distance (km) Between Candidate and Donor

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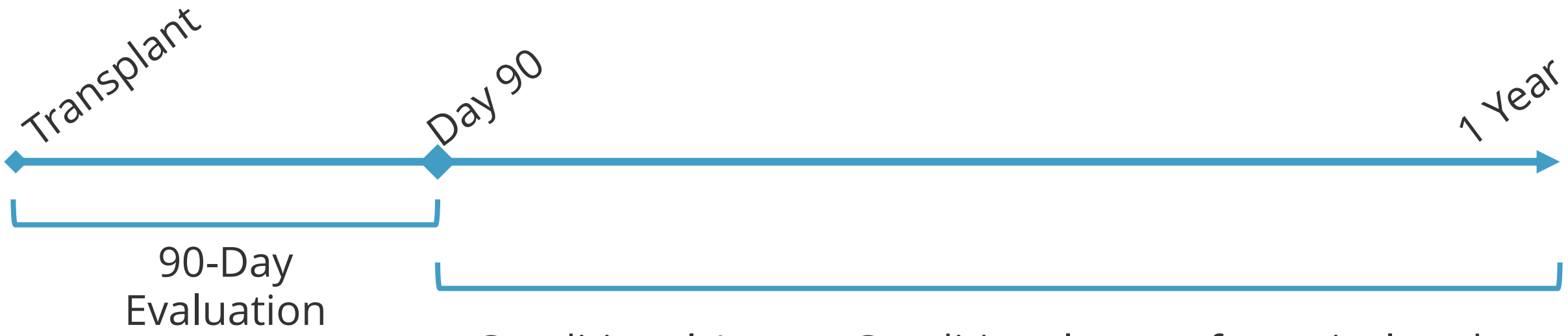
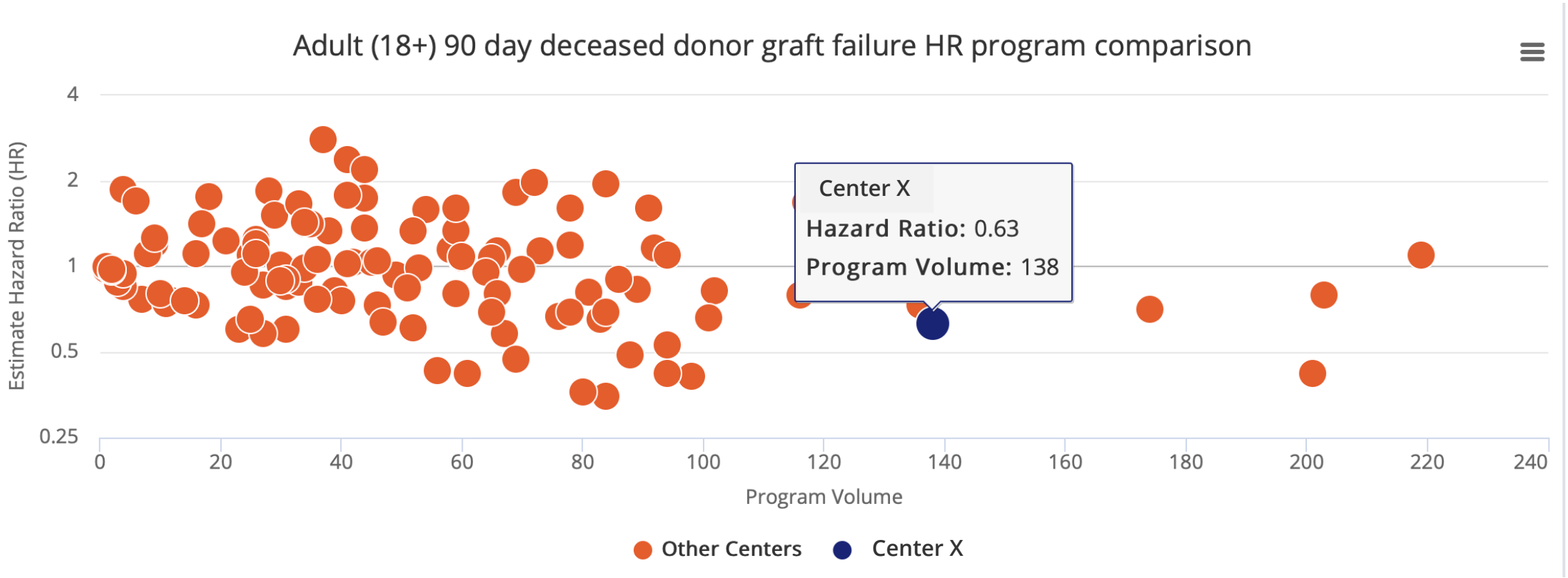
90-day and Conditional 1-Year Graft Survival

90-Day and Conditional 1-Year Graft Survival

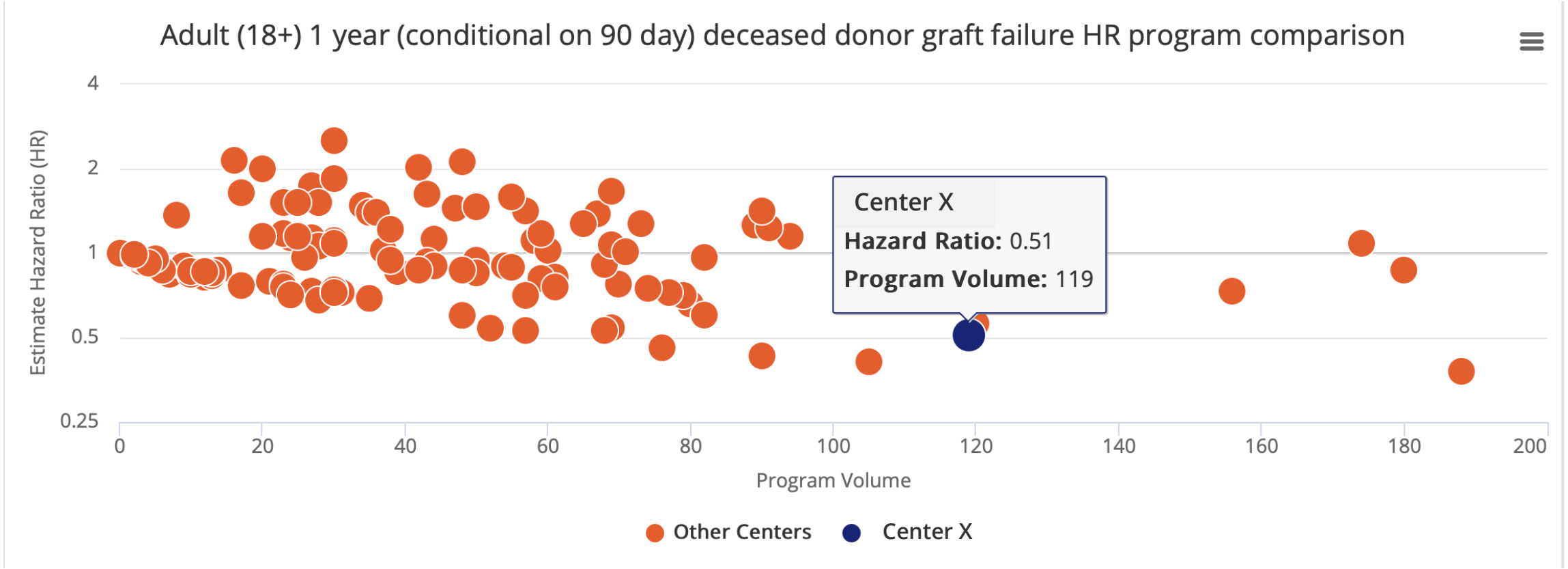


Conditional 1-year: Conditional on graft survival to day 90, evaluates graft survival from day 90 to 1-year.

90-day Heart Graft Failure Rate Ratios



Conditional 1-Year Heart Graft Failure Rate Ratios



Using Bayesian Assessments to Determine Performance Thresholds

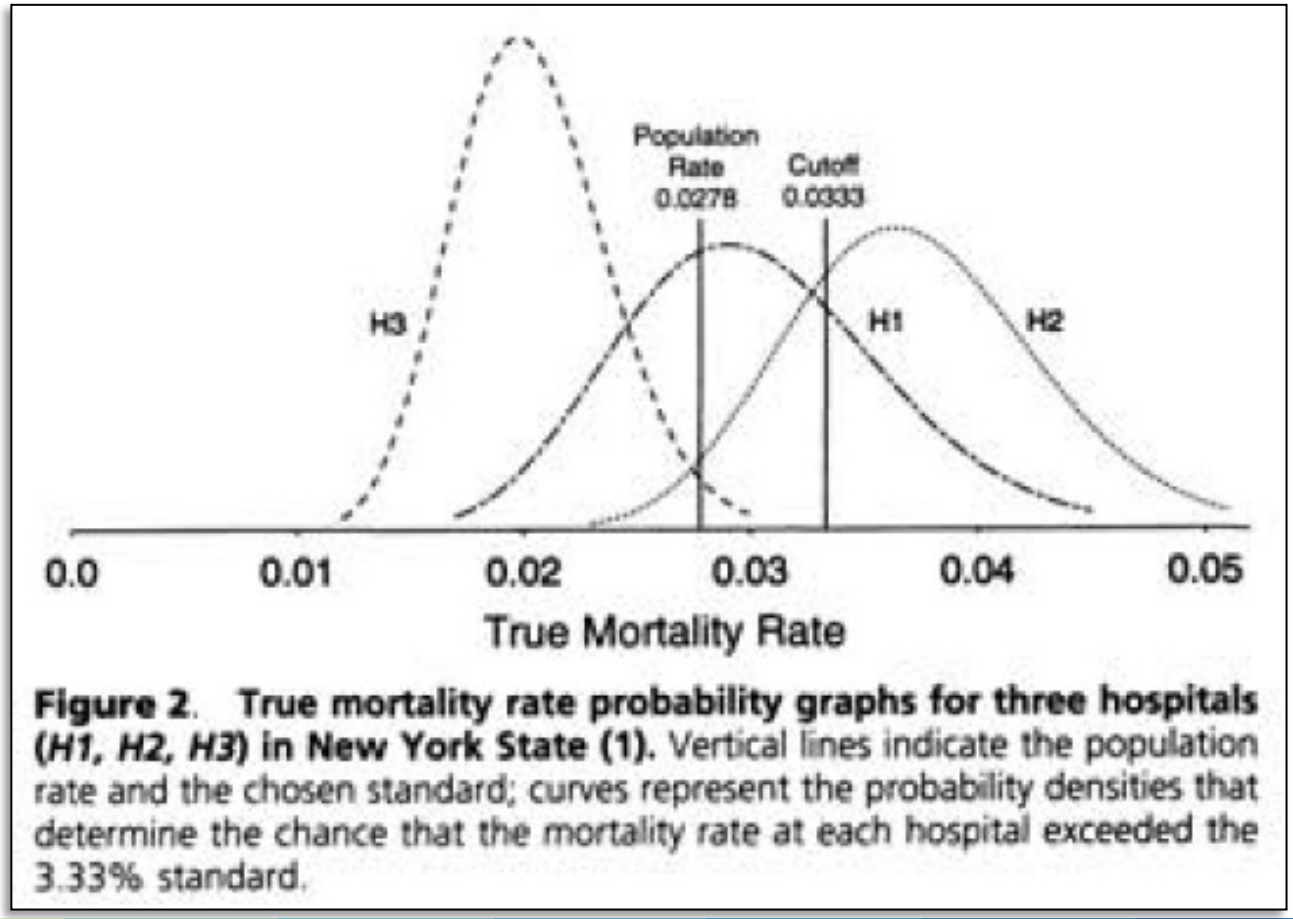


Figure 2. True mortality rate probability graphs for three hospitals (*H1, H2, H3*) in New York State (1). Vertical lines indicate the population rate and the chosen standard; curves represent the probability densities that determine the chance that the mortality rate at each hospital exceeded the 3.33% standard.

Bayesian models allow us to estimate the probability distribution for the performance of a particular program, which can be compared to identified thresholds or national norms

Christiansen CL, Morris CN. *Ann Intern Med*. 1997;127:764.

MPSC Screening Rules

A program will be reviewed for its waitlist mortality rate ratio if:

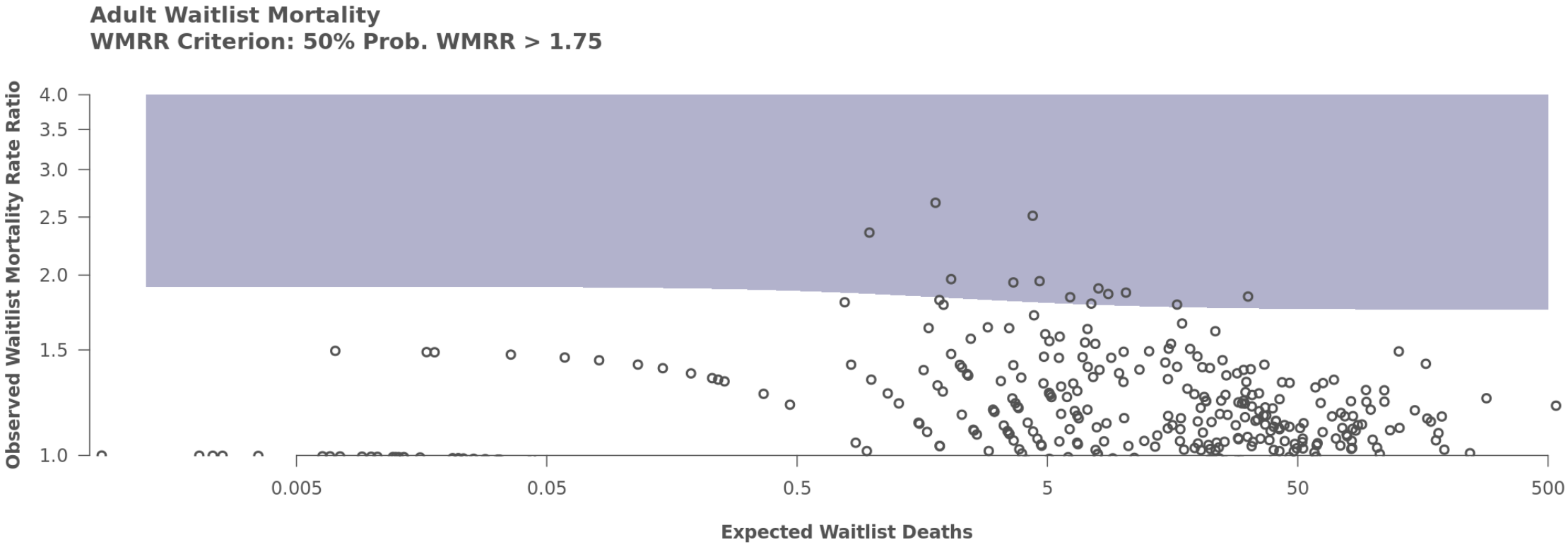
The probability is >50% that the program's waitlist mortality rate ratio is >1.75.

In other words, there is more than 50% probability that the program's mortality rate is at least 75% higher than expected.

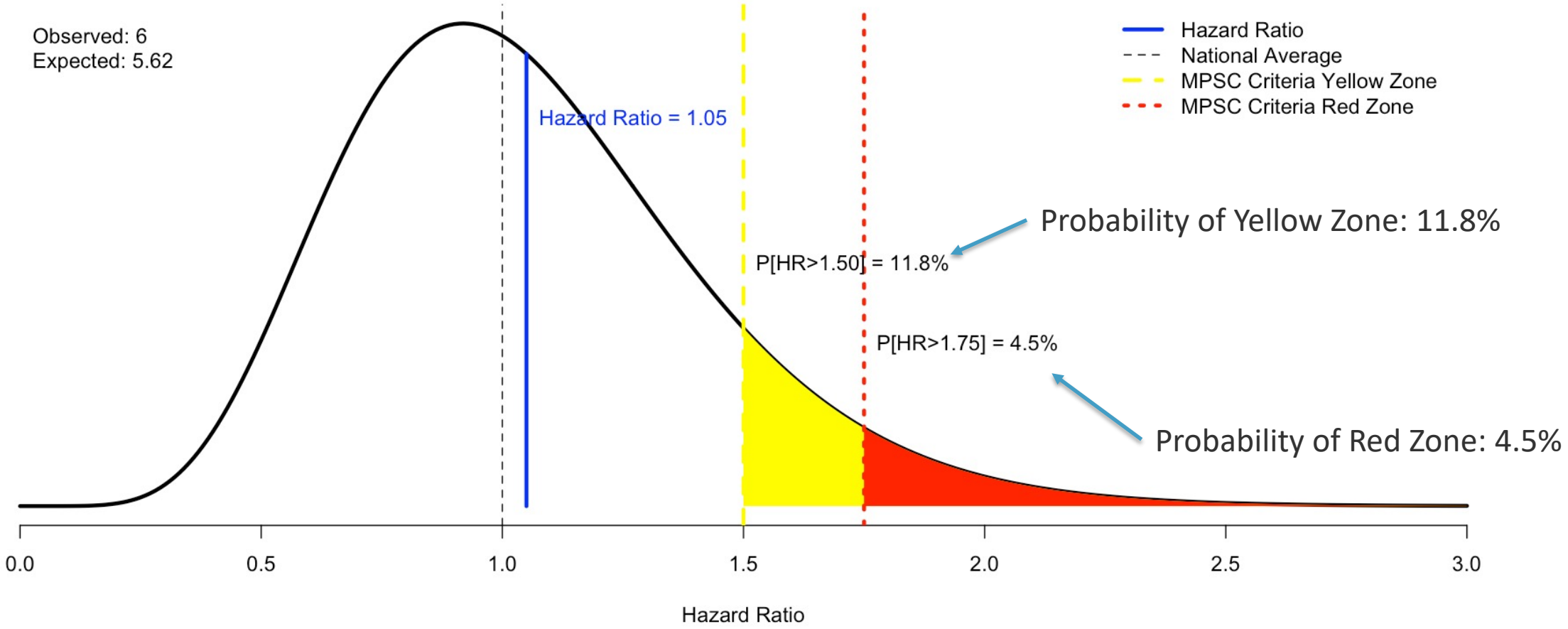
MPSC Screening Rules – Adult Evaluations

Performance Metric:	Red-Zone Boundary:	Probability of being above the Boundary:
Pretransplant Mortality Rate Ratio	>1.75	>50%
Offer Acceptance Rate Ratio	<0.30	>50%
90-Day Graft Failure Rate Ratio	>1.75	>50%
Conditional 1-year	>1.75	>50%

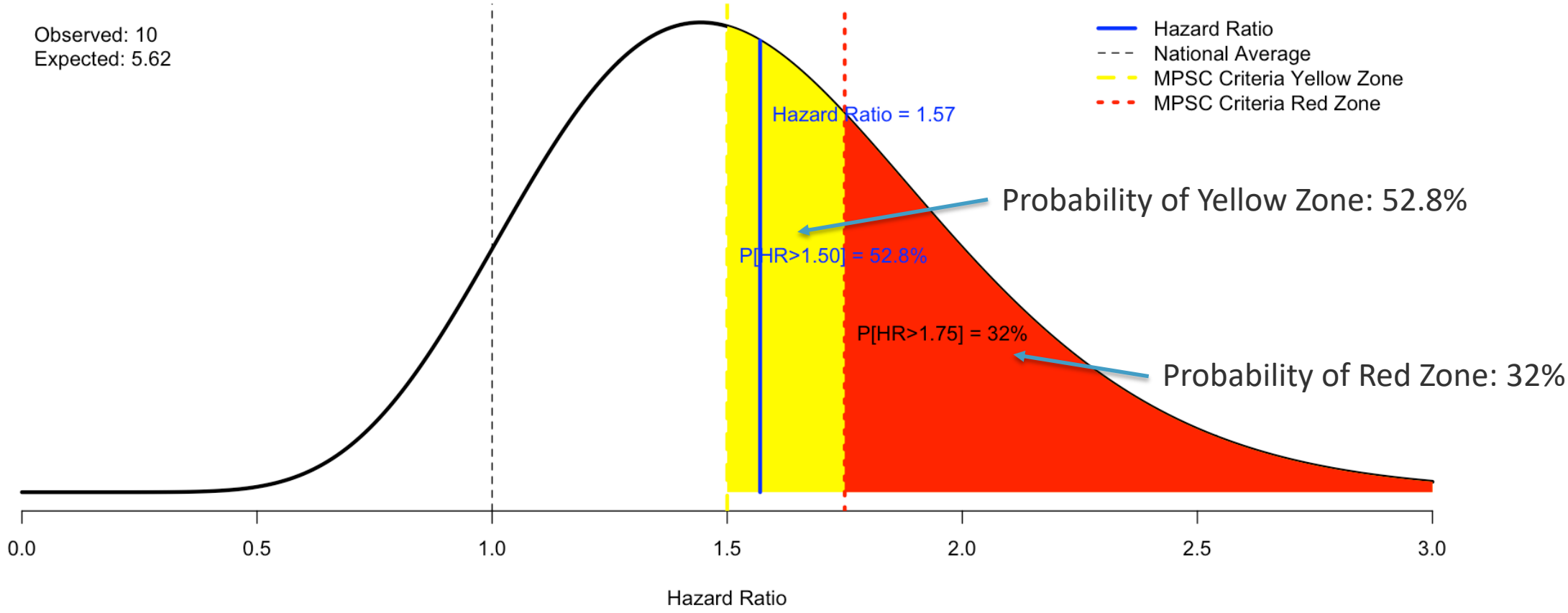
MPSC's Pretransplant Mortality Screening Rule Visualized



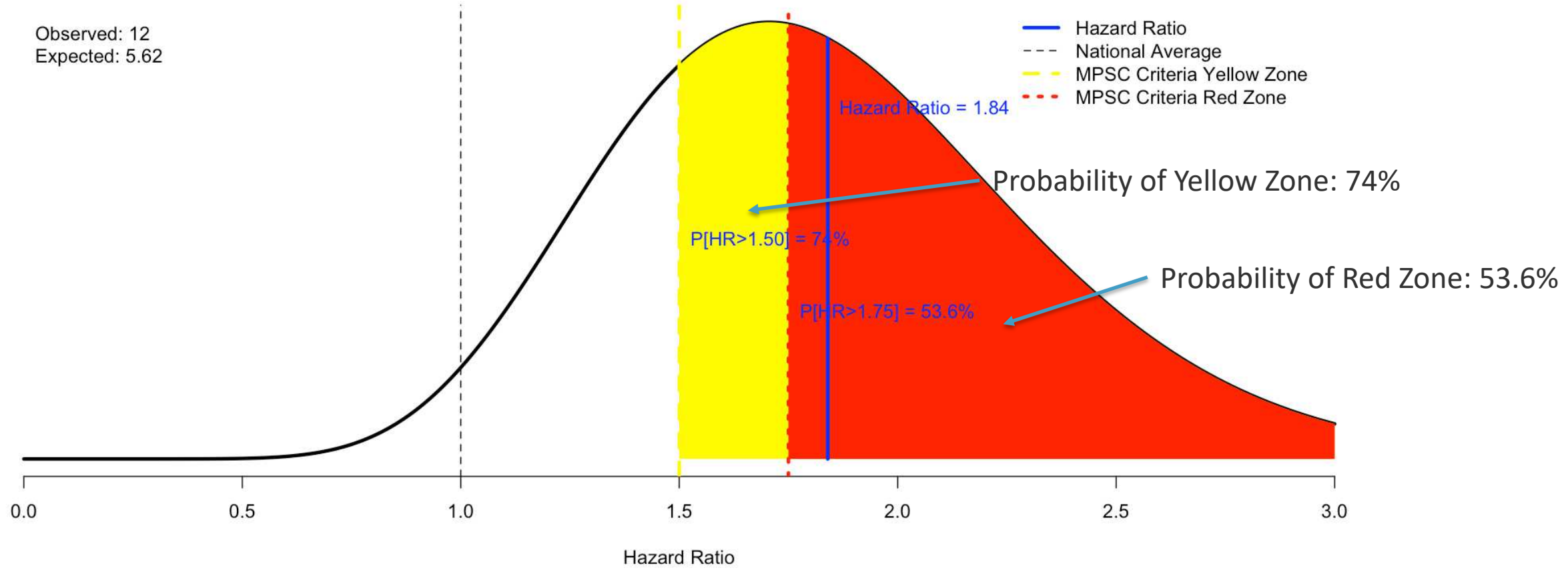
Visualizing this program's MPSC Evaluation



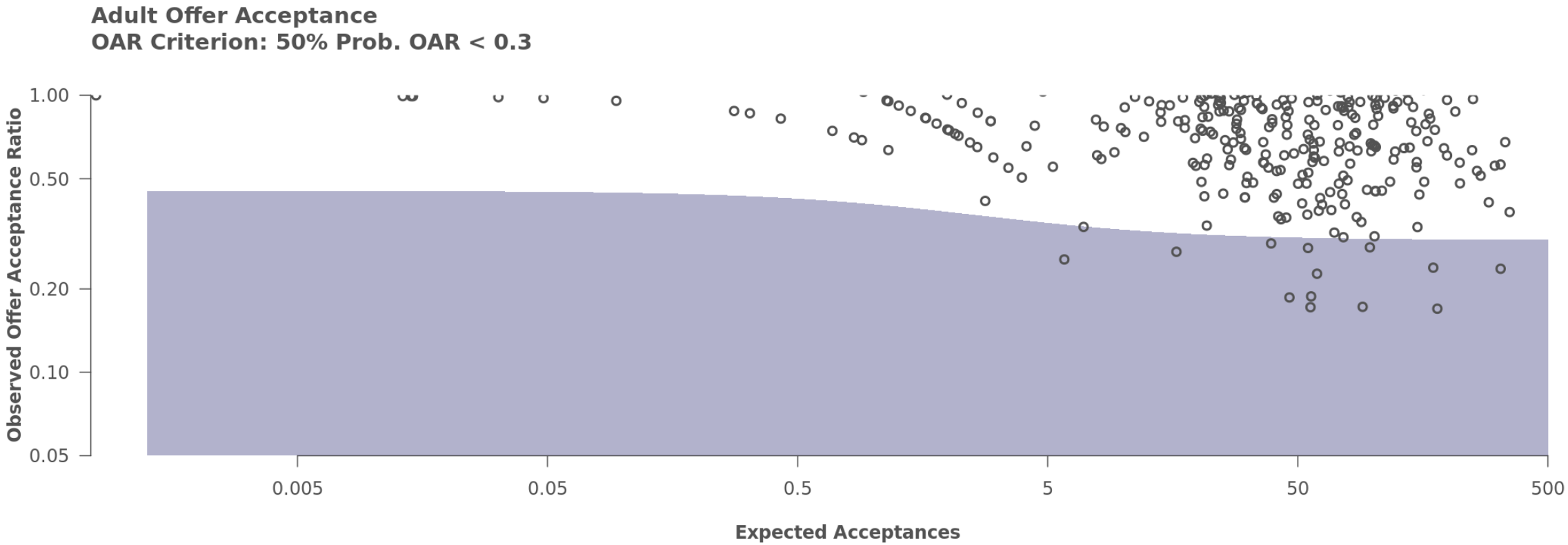
What if the program experienced 4 More Deaths (10 total)?



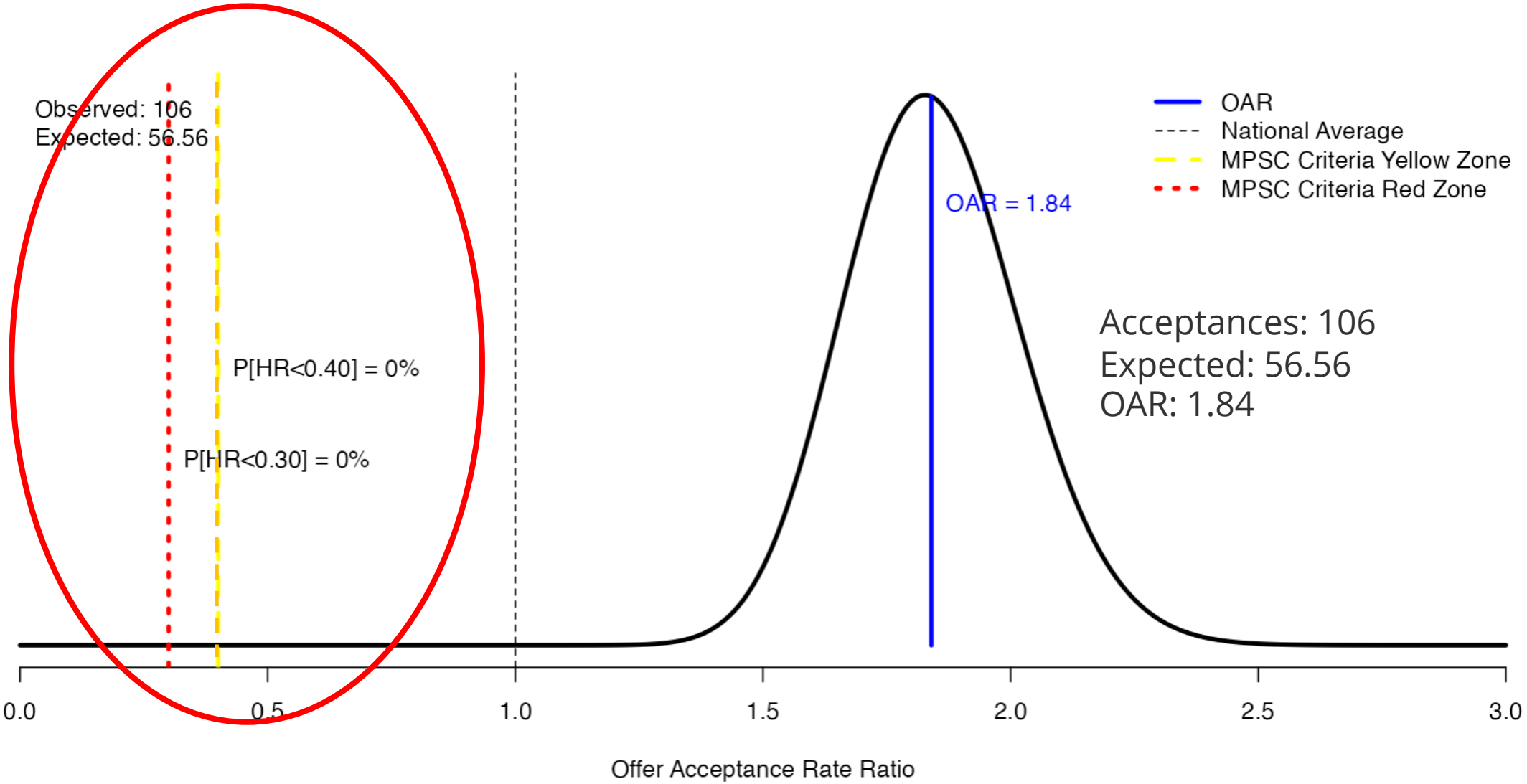
What if the program experienced 6 More Deaths (12 total)?



MPSC's Offer Acceptance Screening Rule Visualized



The MPSC Screening Algorithm



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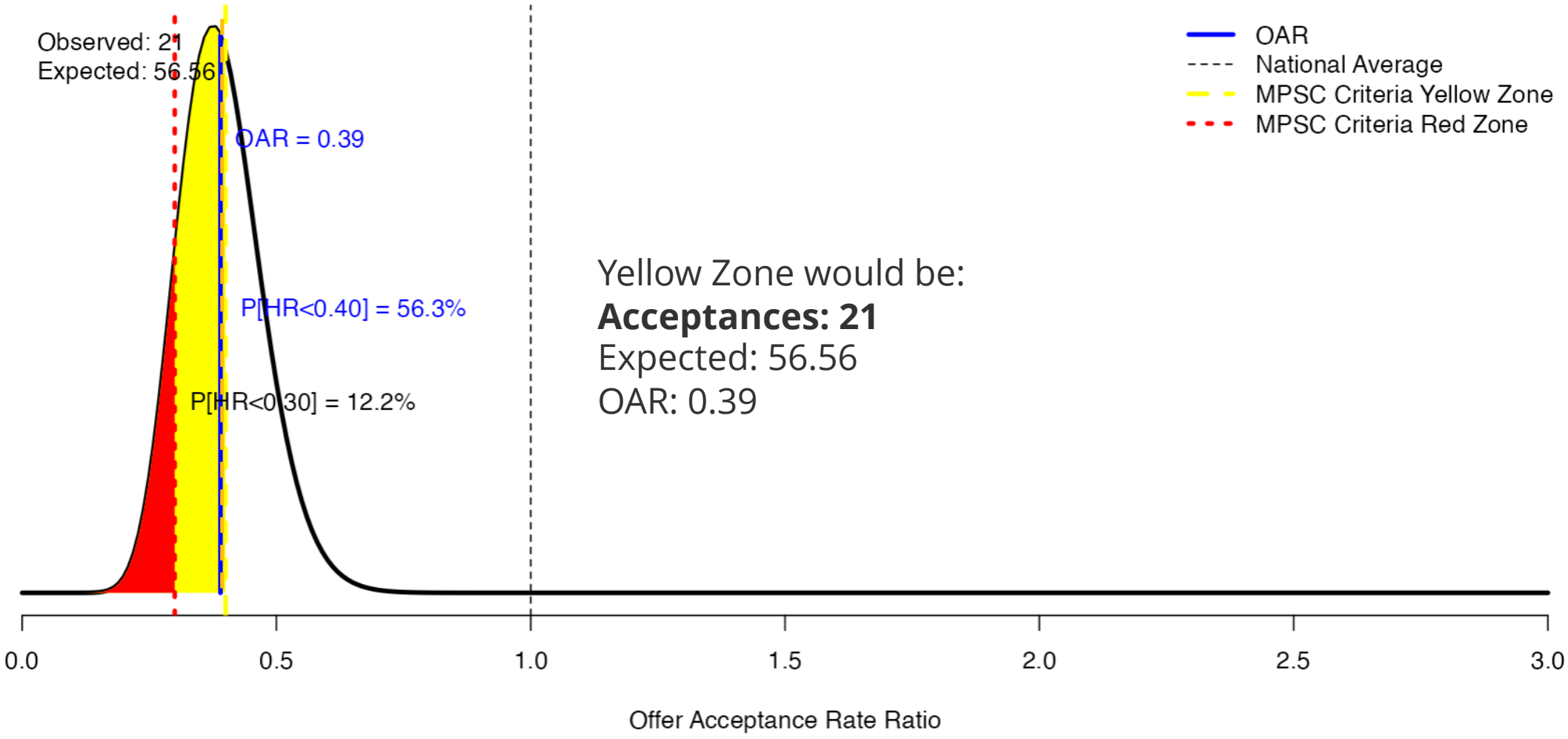
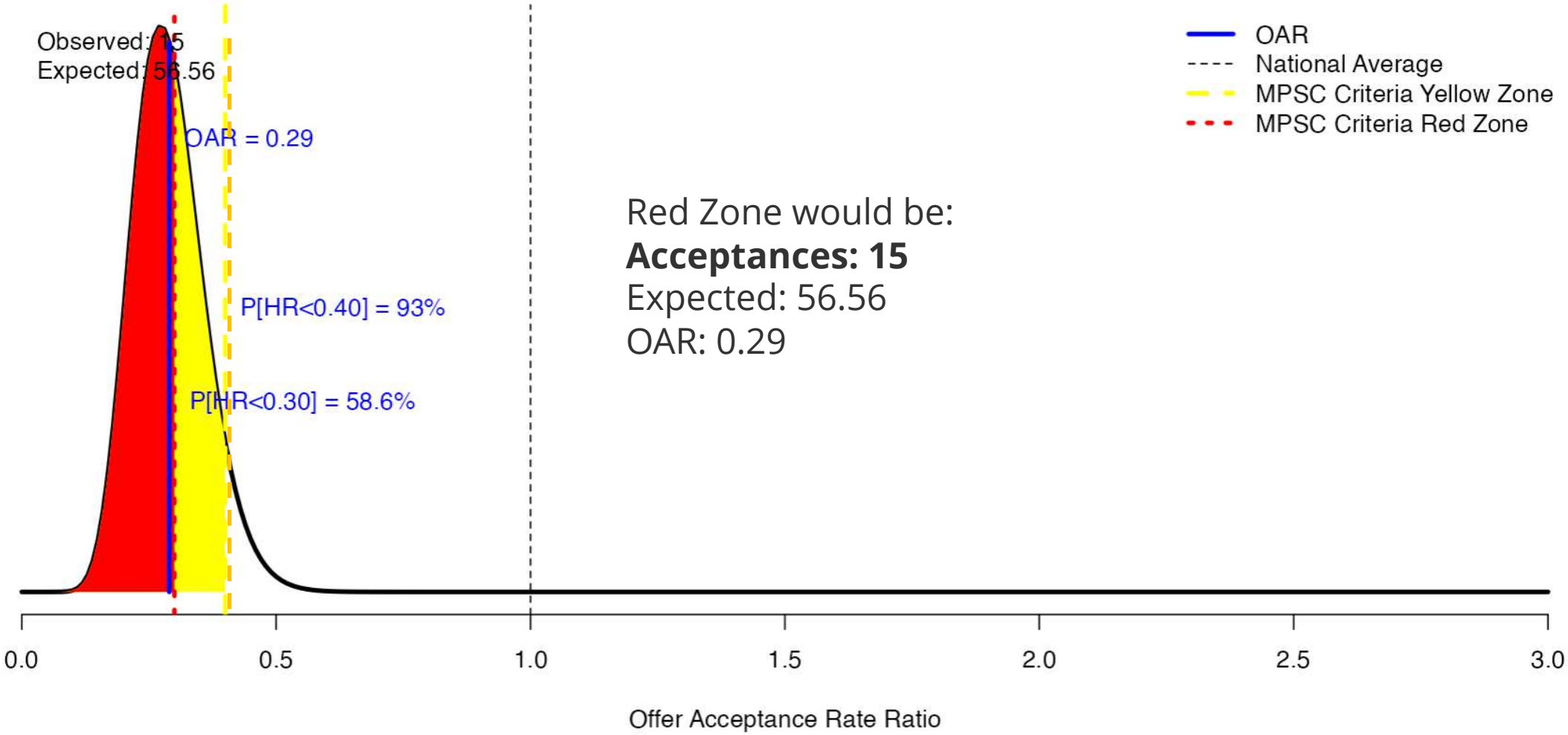


Yellow Zone would be:
Acceptances: 21
Expected: 56.56
OAR: 0.39

The MPSC Screening Algorithm



Red Zone would be:
Acceptances: 15
Expected: 56.56
OAR: 0.29

Breakout Group Leads



Nick Wood, PhD

Offer Acceptance



Grace Lyden, PhD

Pre-Transplant Mortality



Jon Miller, PhD

Posttransplant Outcomes



Jon Snyder, PhD

Risk Adjustment

SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

Thanks!

My email: Jon.Snyder@cdrg.org
General SRTR Help: SRTR@SRTR.org

Jon Snyder, PhD
Director, Scientific Registry of Transplant Recipients
Director, Transplant Epidemiology
Chronic Disease Research Group
Hennepin Healthcare Research Institute

January 23, 2024

SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

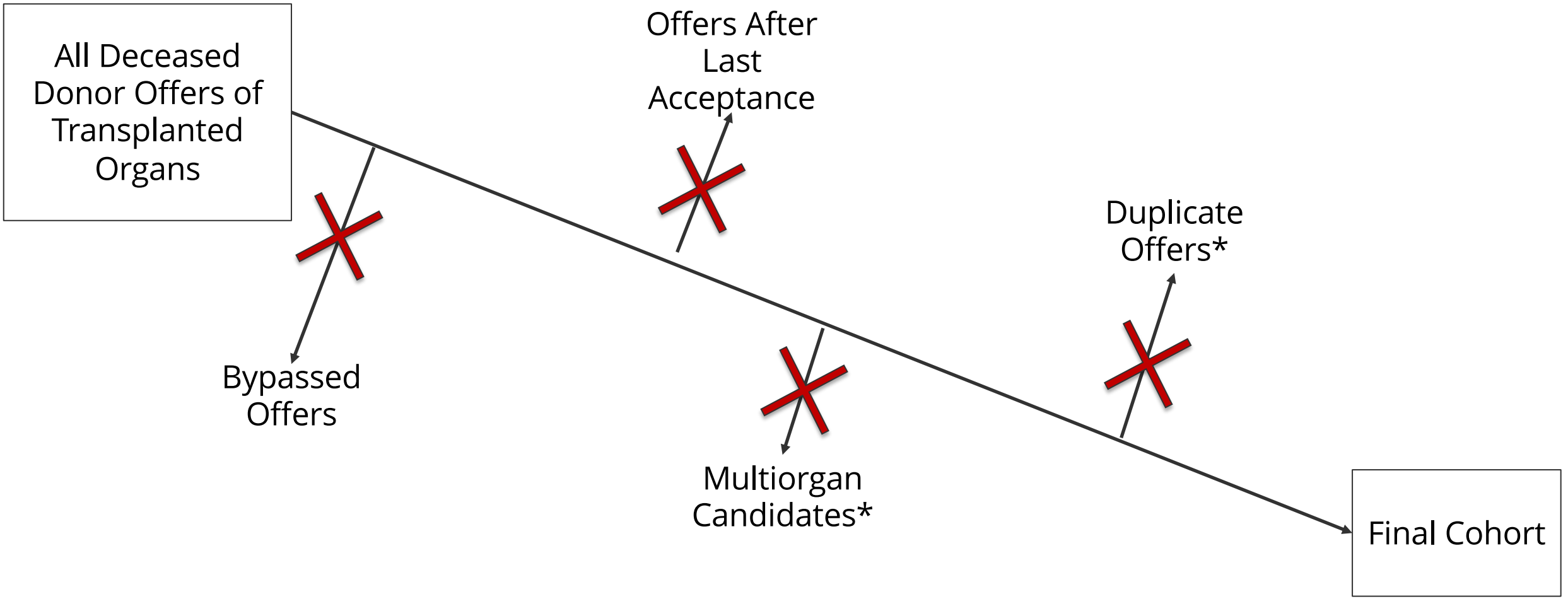
Breakout #1: Offer Acceptance Metrics and CUSUMs

Nicholas Wood, PhD
David Zaun, MS

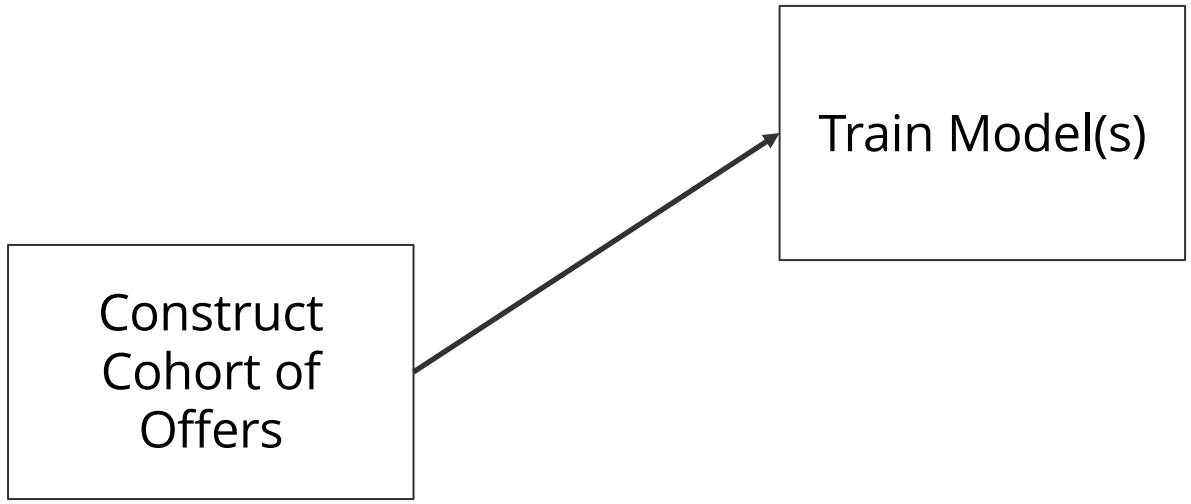
Offer Acceptance Overview

Construct Cohort of Offers

Which Offers?



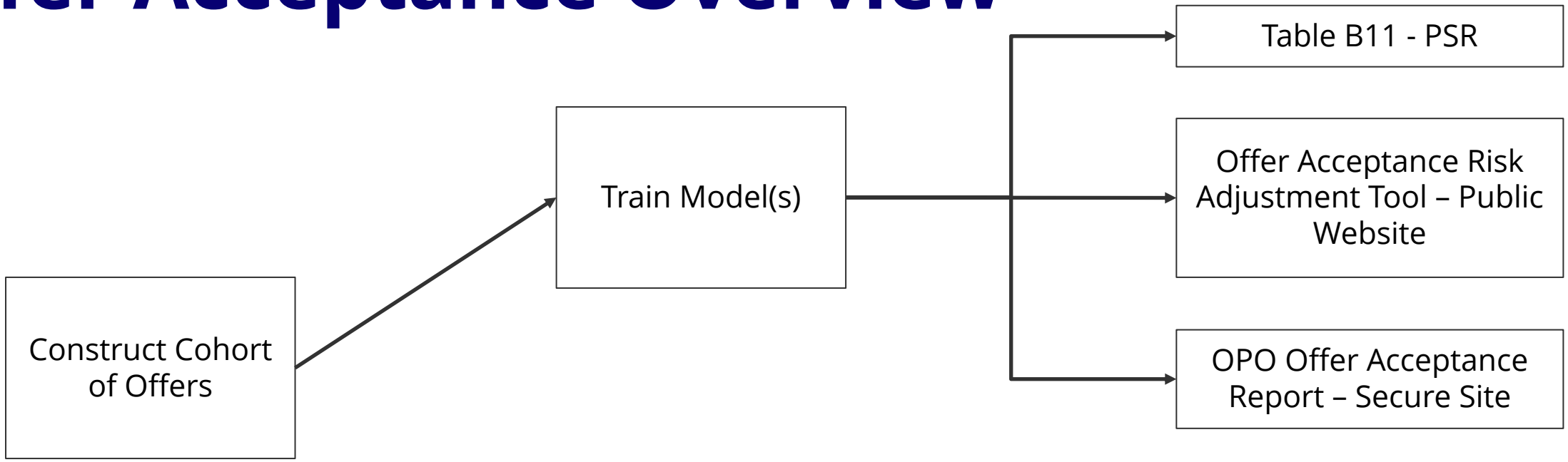
Offer Acceptance Overview



What Model?

- Logistic Regression
- Candidate Covariates (e.g., age, weight, diagnosis, etc.)
- Donor Covariates (e.g., KDRI, cause of death, etc.)
- Interactions (e.g., donor:candidate height ratio, HLA mismatches, distance, etc.)
- Output: Probability of Acceptance Based On “National Average Practice”

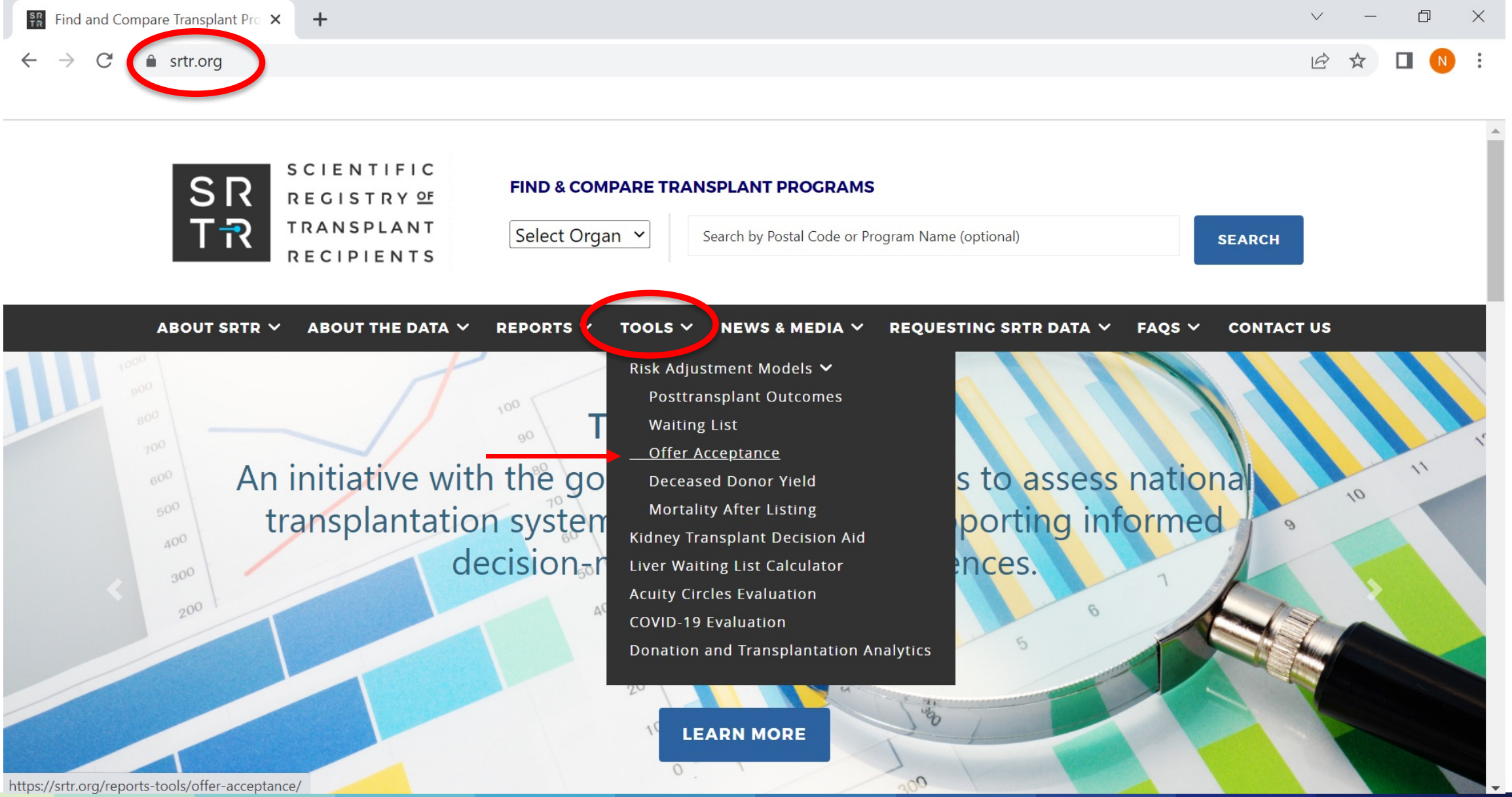
Offer Acceptance Overview



B. Waiting List Information

Table B11. Offer Acceptance Practices: 07/01/2021 - 06/30/2022

Offers Acceptance Characteristics	This Center	OPO/DSA	Region	U.S.
Overall				
Number of Offers	5,823	22,292	25,176	291,116
Number of Acceptances	67	511	581	7,600
Expected Acceptances	97.8	537.5	629.2	7,590.3
Offer Acceptance Ratio*	0.69	0.95	0.92	1.00
95% Credible Interval**	[0.54, 0.86]	--	--	--
PHS increased infectious risk				
Number of Offers	934	3,381	3,693	47,352
Number of Acceptances	12	87	99	1,412
Expected Acceptances	17.3	89.7	104.0	1,409.4
Offer Acceptance Ratio*	0.73	0.97	0.95	1.00
95% Credible Interval**	[0.40, 1.15]	--	--	--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Select Organ
Search by Postal Code or Program Name (optional)
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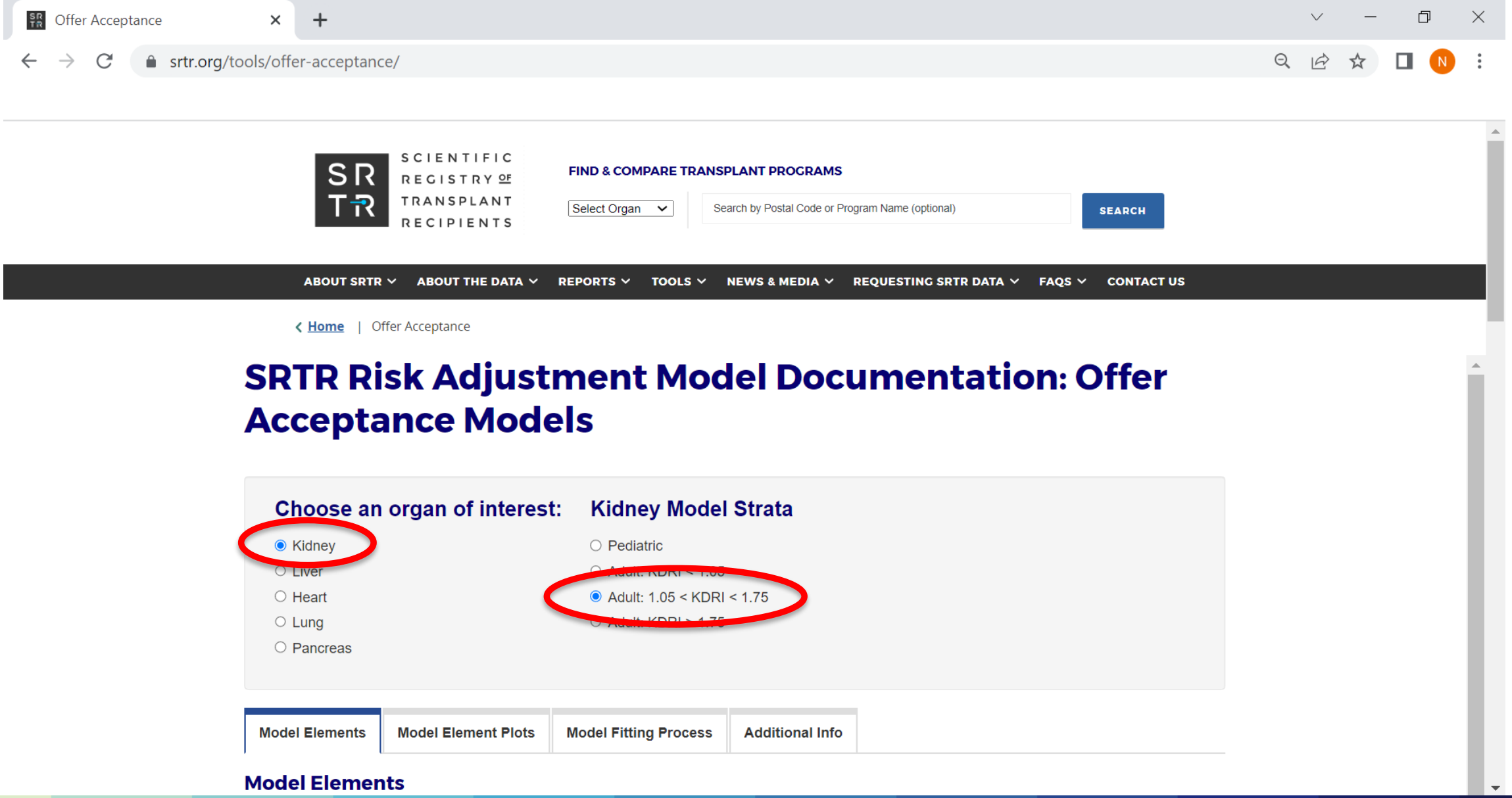
Offer Acceptance
Deceased Donor Yield
Mortality After Listing
Kidney Transplant Decision Aid
Liver Waiting List Calculator
Acuity Circles Evaluation
COVID-19 Evaluation
Donation and Transplantation Analytics
An initiative with the go
transplantation system
decision-
s to assess national
porting informed
nces.
LEARN MORE
https://srtr.org/reports-tools/offer-acceptance/


Offer Acceptance
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SRTR Risk Adjustment Model Documentation: Offer Acceptance Models
Choose an organ of interest:
Kidney
Liver
Heart
Lung
Pancreas
Kidney Model Strata
Pediatric
Adult: 1.05 < KDRI < 1.75
Model Elements
Model Element Plots
Model Fitting Process
Additional Info
Model Elements

Offer Acceptance

srtr.org/tools/offer-acceptance/

Model Elements | Model Element Plots | Model Fitting Process | Additional Info

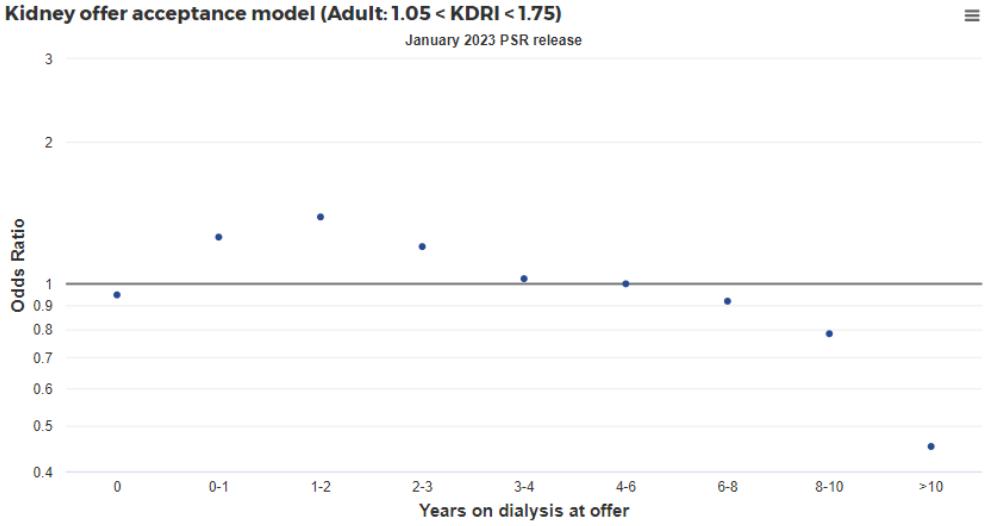
Model Element Plots

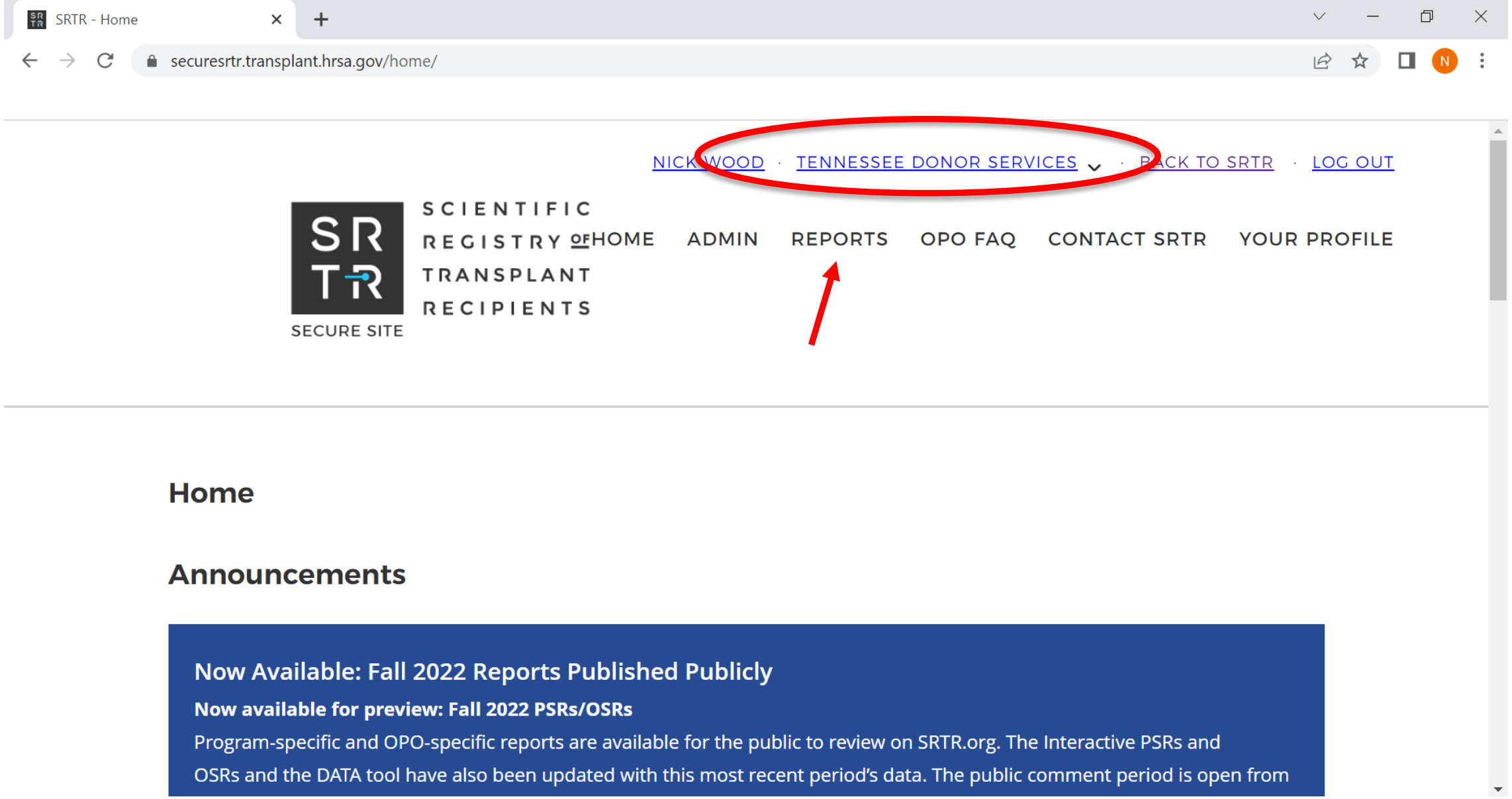
Here you can select a covariate from the model to see the relationship between the covariate and the likelihood of accepting a given offer. Importantly, the offer acceptance model is stratified by candidate age (pediatric/adult) and donor quality for adult candidates. This means that the figures depend on the selected strata. Additionally, the estimated effects for the offer acceptance model are accessible by clicking on the download button below.

DOWNLOAD .CSV FILE

Select a Covariate to Plot

Years on dialysis at offer

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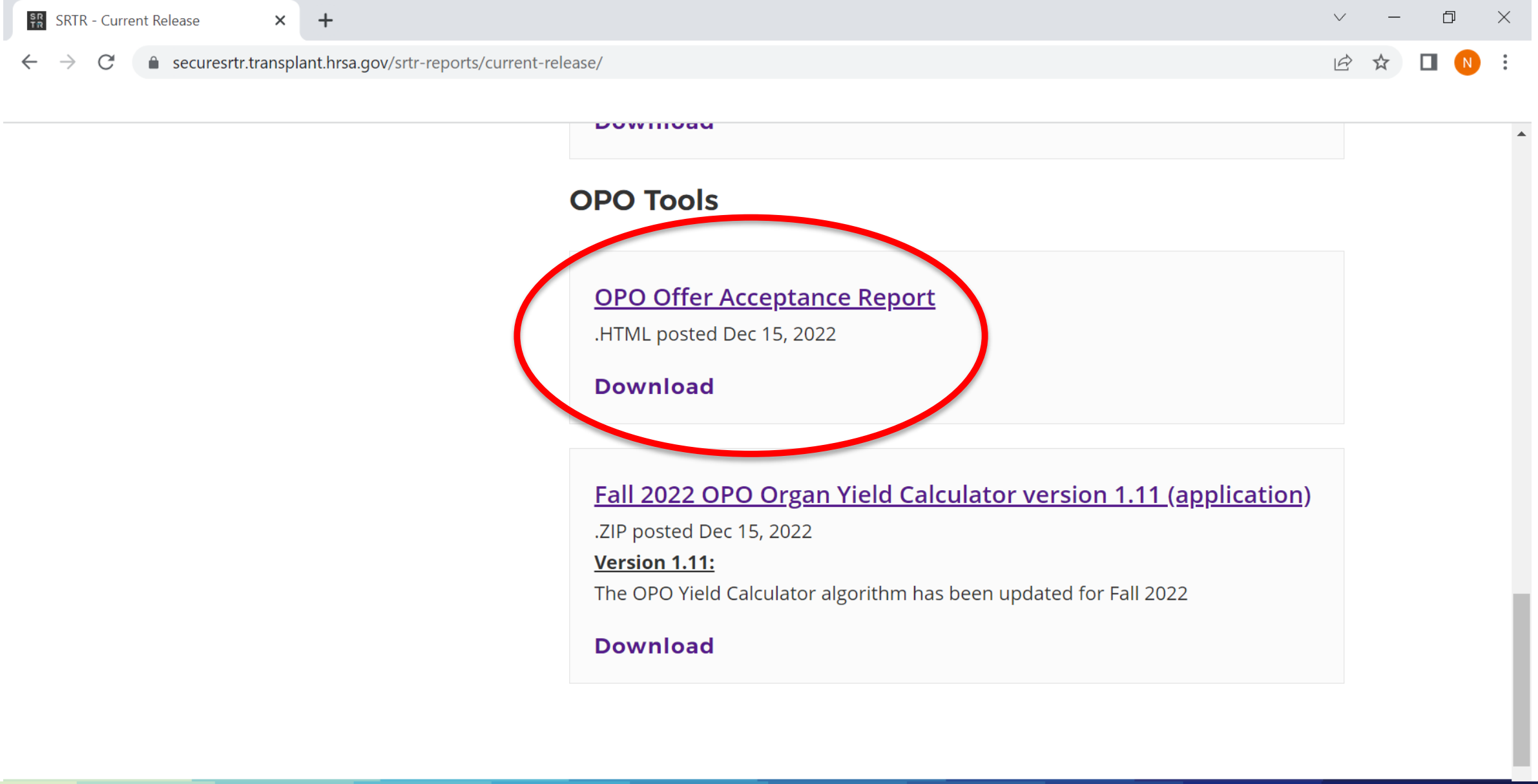
Now Available: Fall 2022 Reports Published Publicly
Now available for preview: Fall 2022 PSRs/OSRs
Program-specific and OPO-specific reports are available for the public to review on SRTR.org. The Interactive PSRs and
OSRs and the DATA tool have also been updated with this most recent period's data. The public comment period is open from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OPO Tools
OPO Offer Acceptance Report
.HTML posted Dec 15, 2022
Download
Fall 2022 OPO Organ Yield Calculator version 1.11 (application)
.ZIP posted Dec 15, 2022
Version 1.11:
The OPO Yield Calculator algorithm has been updated for Fall 2022
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SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

OPO Offer Acceptance Report

Data from:
December 15, 2022

Cohort Start:
7/1/2021

Cohort End:
6/31/2022

Feedback?:
SRTR@SRTR.org
1.877.970.SRTR (7787)
http://www.srtr.org/

The OPO Offer Acceptance Report identifies programs with above average offer acceptance for organs with hard-to-place characteristics. For each characteristic, transplant programs are placed into one of five tiers ranging from above average to below average acceptance. Programs with above average acceptance have a demonstrated history of accepting organs with the given characteristic at rates substantially higher than the national average. In contrast, programs with below average acceptance have a demonstrated history of substantially lower acceptance than the national average.

Characteristics of Kidney Offers

- High-KDPI kidneys (KDRI $\geq$ 1.75): High-KDPI kidneys are associated with worse posttransplant outcomes and are discarded at the highest rate across the spectrum of donor quality.
- PHS increased infectious risk: Requires transplant candidate's consent and is associated with a higher rate of discard after controlling for other factors, despite similar posttransplant outcomes.
- Donation after circulatory death (DCD): Common and well-known risk-factor for kidney discard.
- HCV positive: Strongly associated with discard, and many transplant programs perform no HCV positive transplants.
- Over 100 offers: A kidney is unlikely to be accepted after being offered 100 times, and a small proportion of transplant programs account for a large proportion of such acceptances.

Characteristics of Liver Offers

- PHS increased infectious risk: Requires transplant candidate's consent and is associated with a higher rate of discard after controlling for other factors, despite similar posttransplant outcomes.
- Donation after circulatory death (DCD): Common and well-known risk-factor for liver discard and associated with worse posttransplant outcomes.
- HCV positive: Strongly associated with liver discard.
- Over 50 offers: Offers of livers that have been declined 50 times.
- Over 500 miles: The transplant hospital is over 500 miles from the donor hospital.

OPO Offer Acceptance Report | About | Kidney | Liver | Heart | Lung | Kidney-Pancreas | Pancreas

High KDPI | PHS increased infectious risk | DCD | HCV positive | Over 100 offers

SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

OPO Offer Acceptance Report

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6/31/2022

Feedback?:
SRTR@SRTR.org
1.877.970.SRTR (7787)
http://www.srtr.org/

Show 50 entries

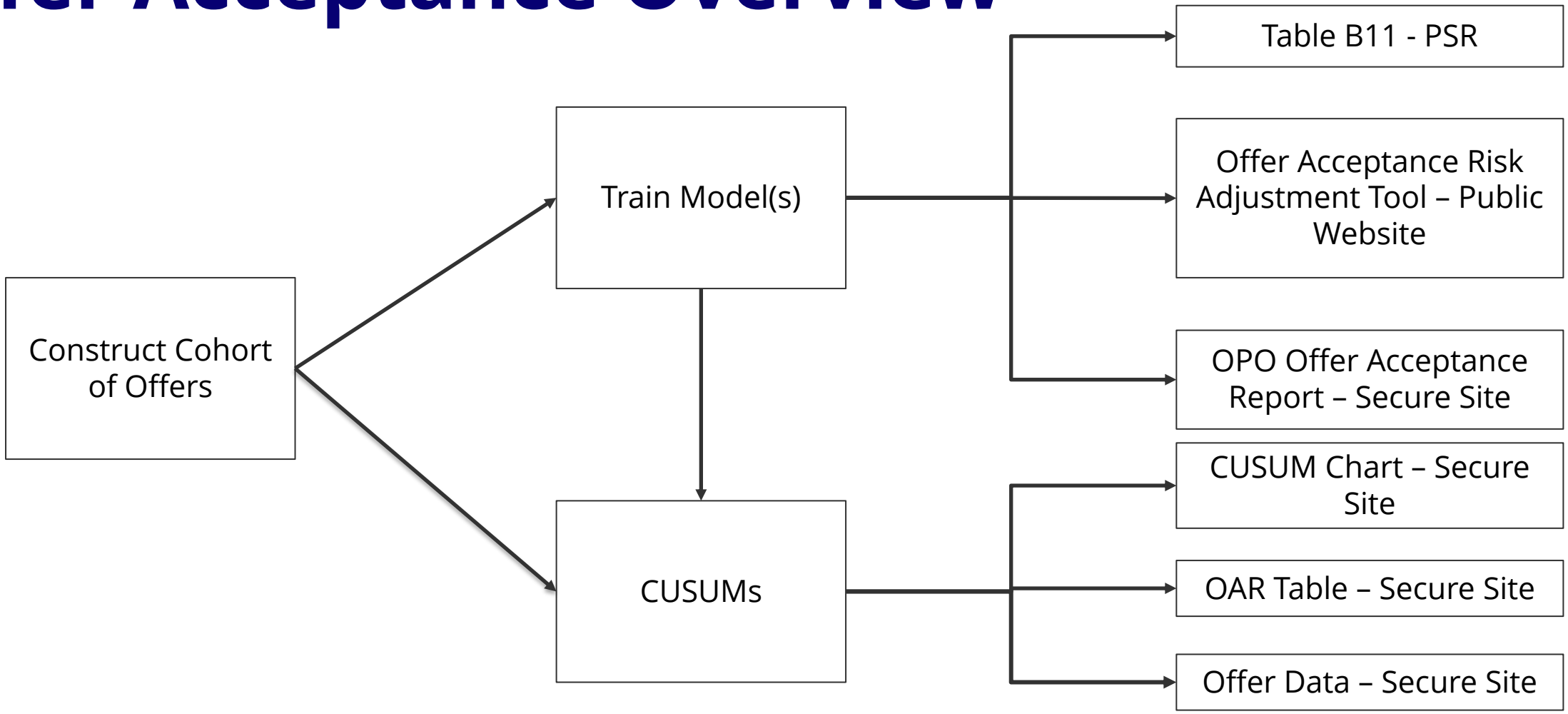
Search:

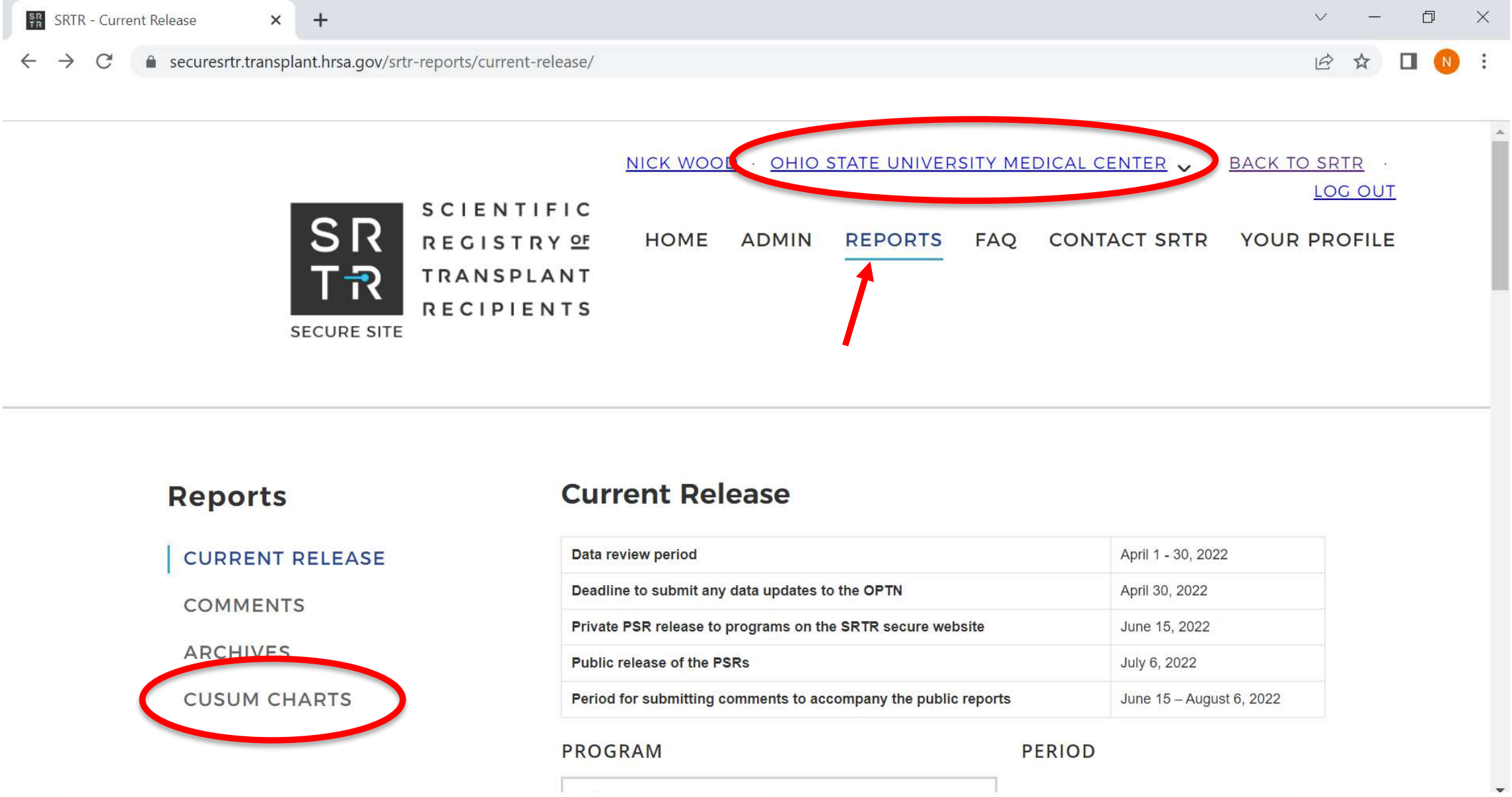
Program	History of Acceptance	Offers	Acceptances	Expected	Offer Acceptance Ratio
[redacted]	Above Average	1749	70	5.1	10.20
	Above Average	354	32	1.8	8.96
	Above Average	92	21	1.1	7.32
	Above Average	314	14	0.5	6.31
	Above Average	421	20	1.9	5.69
	Above Average	118	13	0.7	5.62
	Above Average	513	23	3.8	4.35
	Above Average	513	22	3.6	4.29
	Above Average	1567	16	2.3	4.18
	Above Average	684	18	2.8	4.15

Showing 1 to 50 of 236 entries

Previous 1 2 3 4 5 Next

Offer Acceptance Overview

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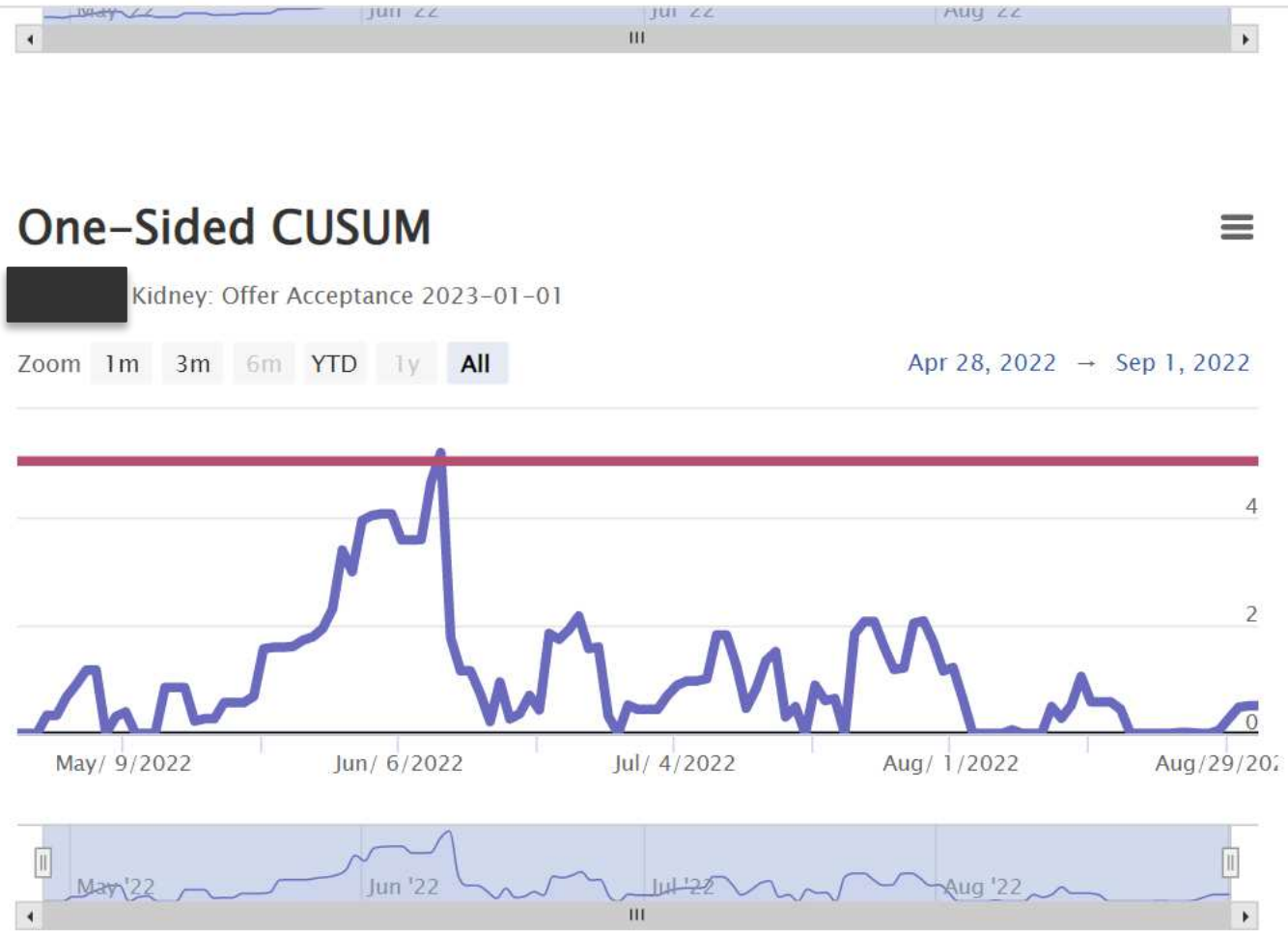
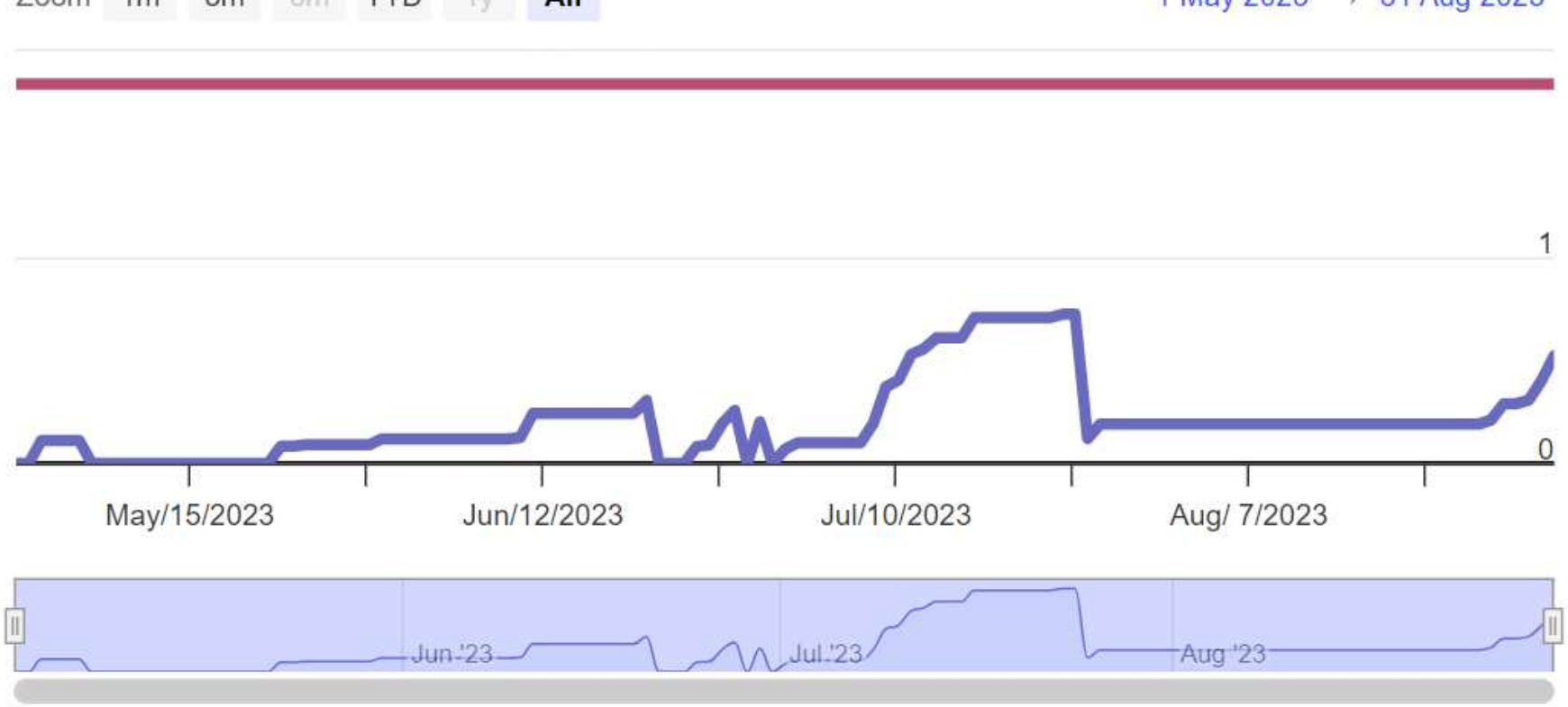
Current Release
Data review period | April 1 - 30, 2022
Deadline to submit any data updates to the OPTN | April 30, 2022
Private PSR release to programs on the SRTR secure website | June 15, 2022
Public release of the PSRs | July 6, 2022
Period for submitting comments to accompany the public reports | June 15 – August 6, 2022
PROGRAM
PERIOD


SRTR Secure Site
securesrtr.transplant.hrsa.gov/srtr-reports/cusum-charts/
SRTR Reports / CUSUM Charts
PERIOD
Jan 2023
PROGRAM
Kidney
TYPE
Offer Acceptance
[redacted] Kidney: Offer Acceptance
2023-01-01
Expected – Observed CUSUM
[redacted] Kidney: Offer Acceptance 2023-01-01
Zoom 1m 3m 6m YTD 1y All
Apr 28, 2022 → Sep 1, 2022
2
0
-2
-6
May/ 9/2022
Jun/ 6/2022
Jul/ 4/2022
Aug/ 1/2022
Aug/29/202
May '22
Jun '22
Jul '22
Aug '22


One-Sided CUSUM
[redacted] Kidney: Offer Acceptance 2023-01-01
Zoom 1m 3m 6m YTD 1y All
Apr 28, 2022 → Sep 1, 2022
4
2
0
May/ 9/2022
Jun/ 6/2022
Jul/ 4/2022
Aug/ 1/2022
May '22
Jun '22
Jul '22
Aug '22



Download Data (csv)

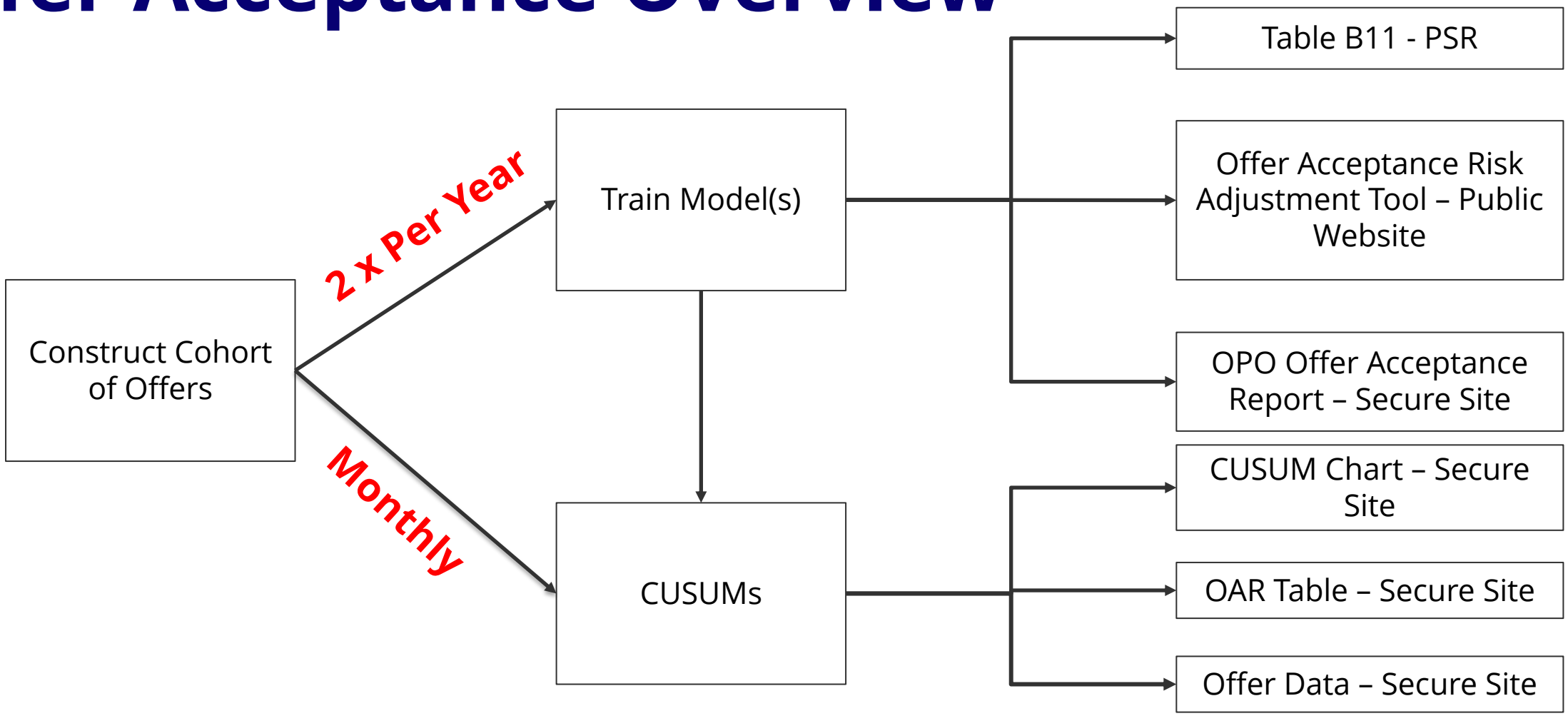
Expected	Offer Accepted
0.101445763	FALSE
0.033744838	FALSE
0.068818838	FALSE
0.017307891	FALSE
0.014652059	TRUE
0.023500225	FALSE
0.042442803	FALSE
0.040377078	TRUE
0.013885524	FALSE
0.061548938	FALSE
0.104811287	FALSE
0.057254084	FALSE
0.065176045	FALSE
0.053862053	FALSE
0.032785443	FALSE
0.059226165	TRUE
0.121141732	TRUE
0.137489182	FALSE
0.06189995	FALSE
0.049336125	FALSE
0.071606949	FALSE



Across donor characteristics

Donor Characteristics	History of Acceptance	Number of Offers	Number of Acceptances	Expected Acceptances	Offer Acceptance Ratio
Overall	Somewhat Below Average	5851	61	68.84	0.89
Low-KDRI	Somewhat Below Average	666	19	25.61	0.76
Medium-KDRI	Average	3402	38	35.55	1.07
High-KDRI	Somewhat Below Average	1783	4	7.68	0.62
DCD Donor	Somewhat Below Average	2126	13	19.44	0.70
PHS Increased Infectious Risk	Average	1027	14	15.49	0.91
HCV+	Below Average	292	5	10.71	0.55
Weekend	Average	1806	23	23.81	0.97

Offer Acceptance Overview



Questions?

SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

Pre-transplant mortality metric and pre-transplant expected workbooks

Grace Lyden, PhD

Who is included?

Candidates on waitlist during 2-year evaluation period

- **Jan 2024 PSR:** 07/01/2021 – 06/30/2023

Includes:

- Adults and pediatrics
- Multi-organ candidates
- Re-transplant candidates

What is being measured?

Pretransplant mortality

What is being measured?

Pretransplant mortality

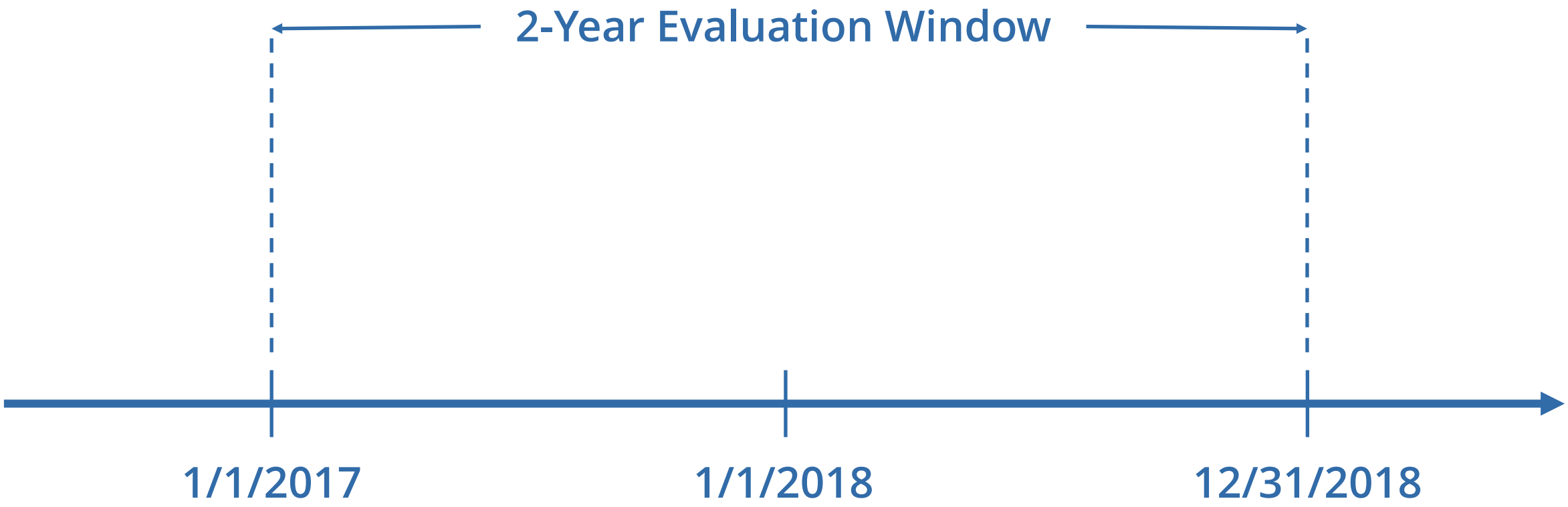
= Deaths before transplant

Which days are evaluated?

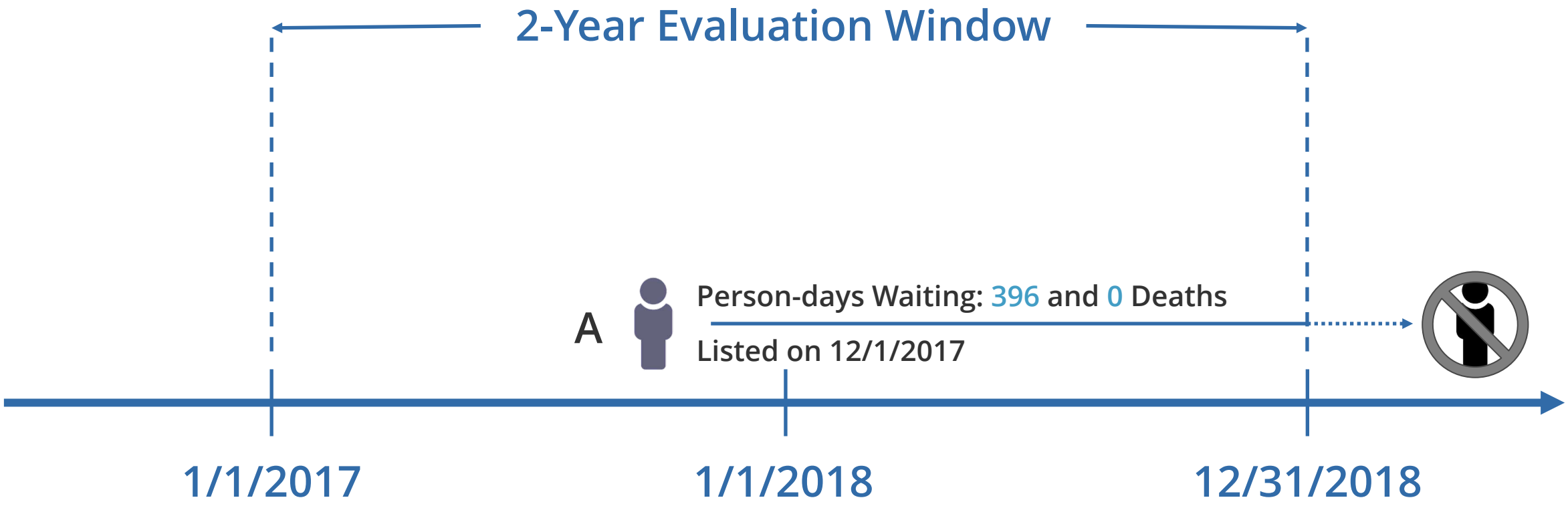
- Every day after waitlisting that is:
    1. In the two-year evaluation window AND
    2. Before transplant or transfer to another program OR
    3. Within 60 days of removal for recovery

- This means deaths are counted for candidates who have been removed from the waitlist
    - For reasons other than transplant or transfer
    - If removed for recovery, deaths count for 60 days after removal

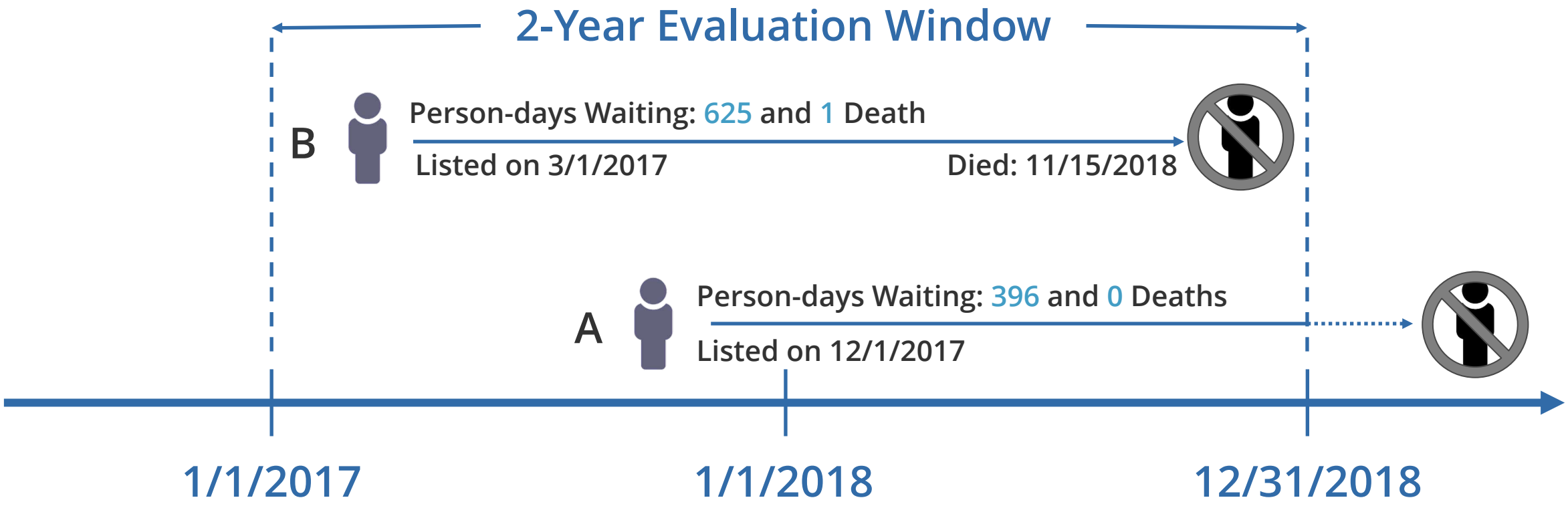
Pretransplant Mortality: Evaluation Period



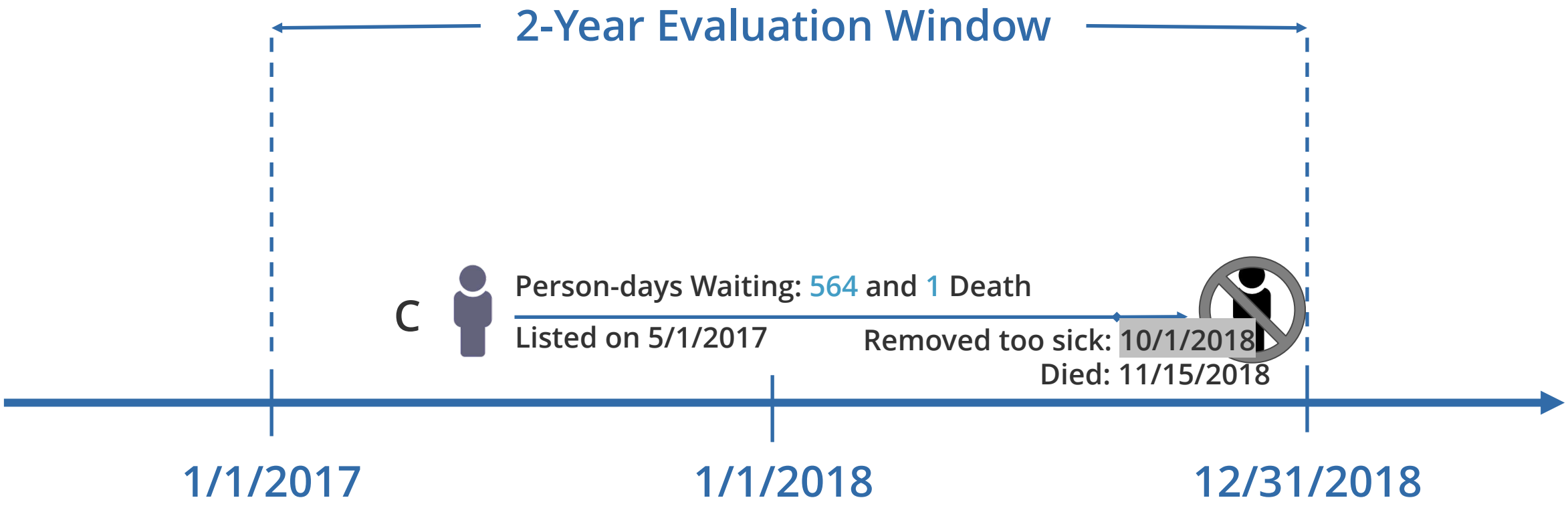
Pretransplant Mortality: Evaluation Period



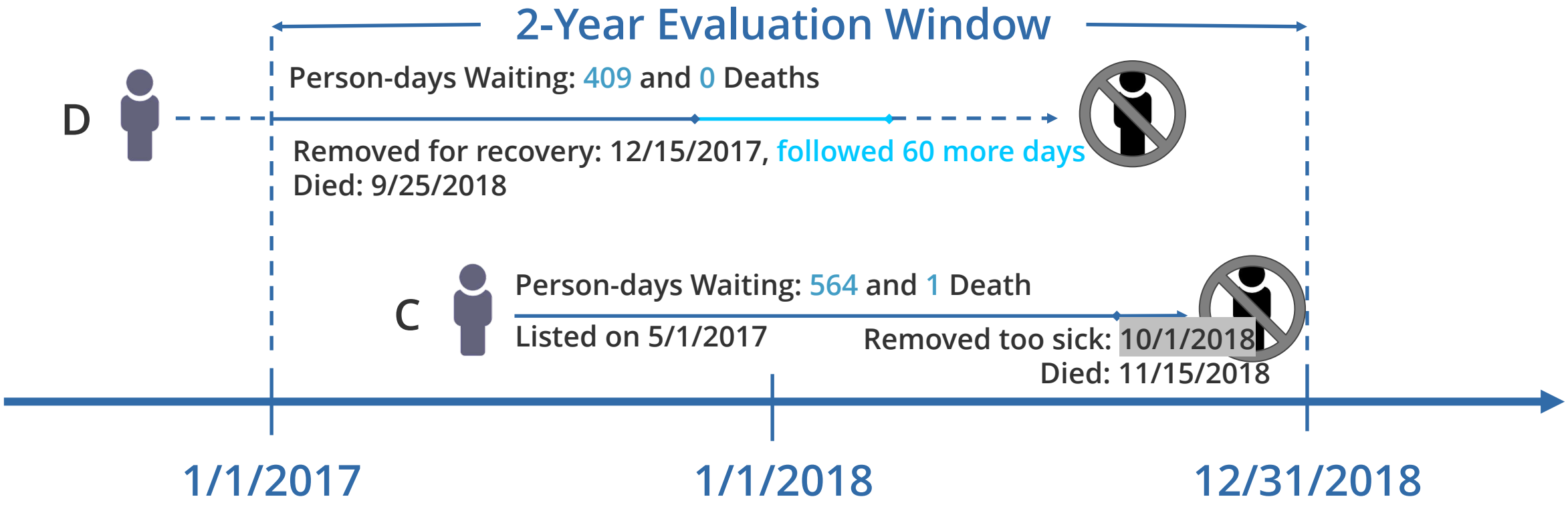
Pretransplant Mortality: Evaluation Period



Pretransplant Mortality: Evaluation Period



Pretransplant Mortality: Evaluation Period



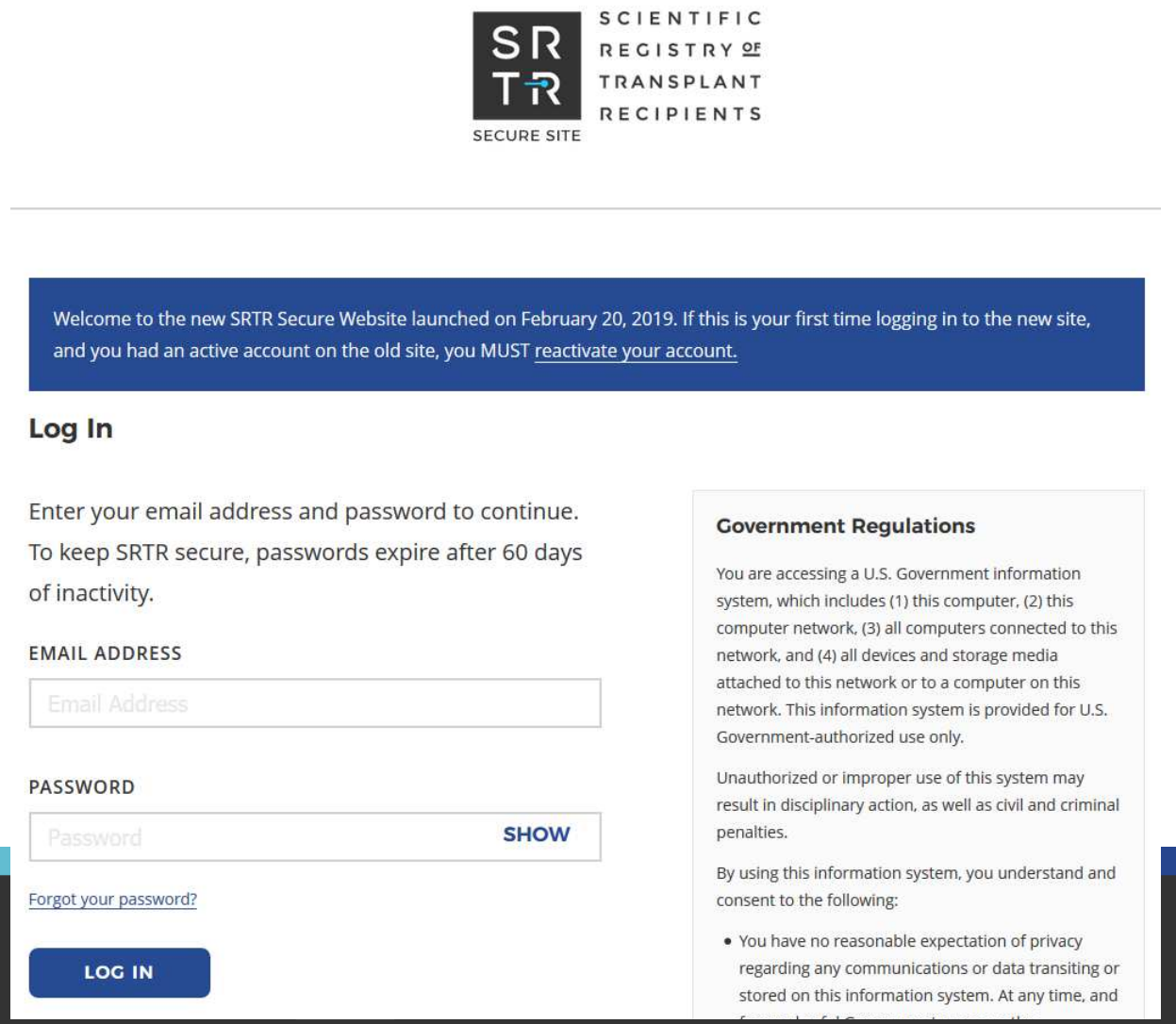
Tools to understand risk adjustment for pretransplant mortality

1. Waiting List tool on SRTR website
    - https://srtr.org/tools/waiting-list/

2. Pretransplant expected survival workbooks
    - Demo in this breakout session

Pretransplant expected workbooks

securesrtr.transplant.hrsa.gov



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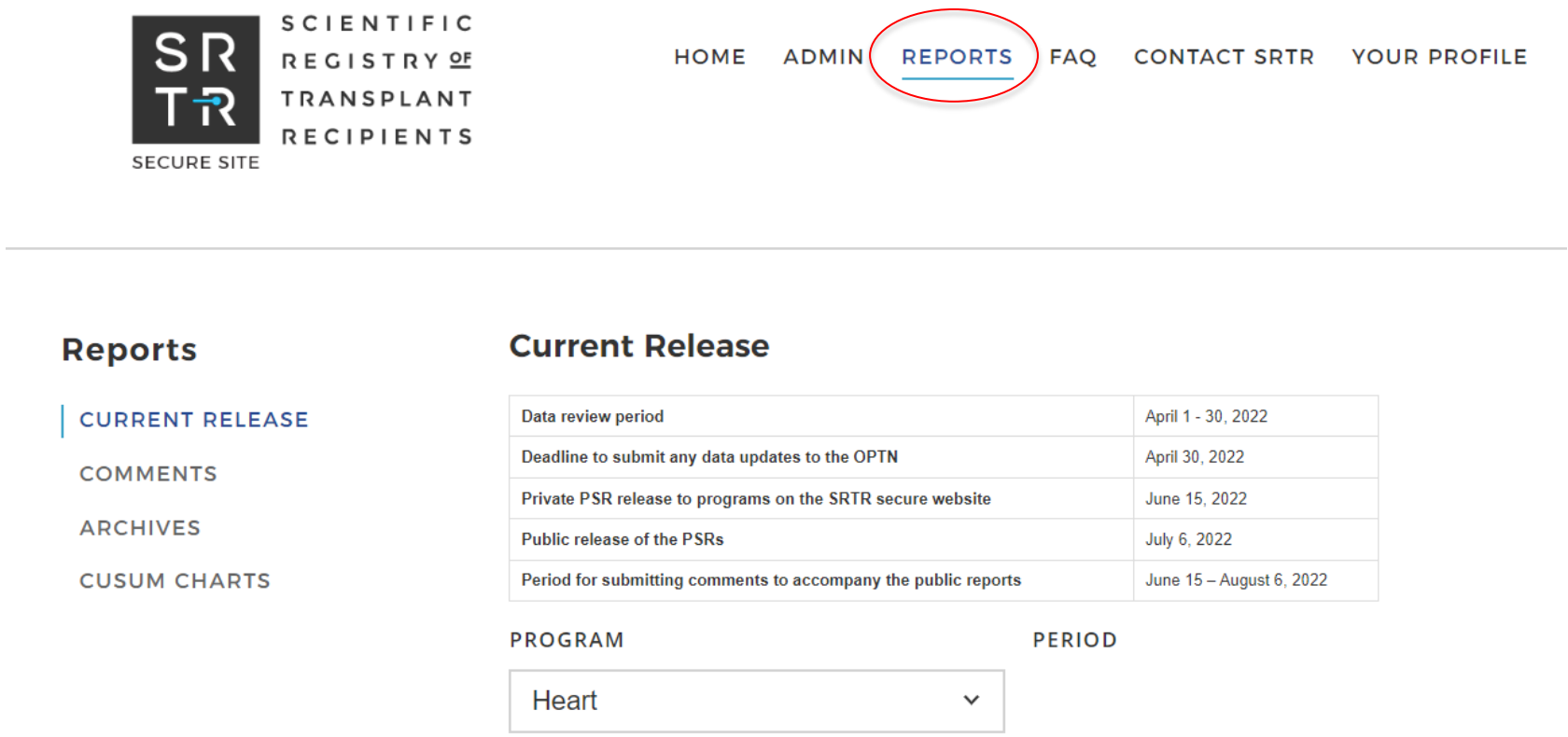

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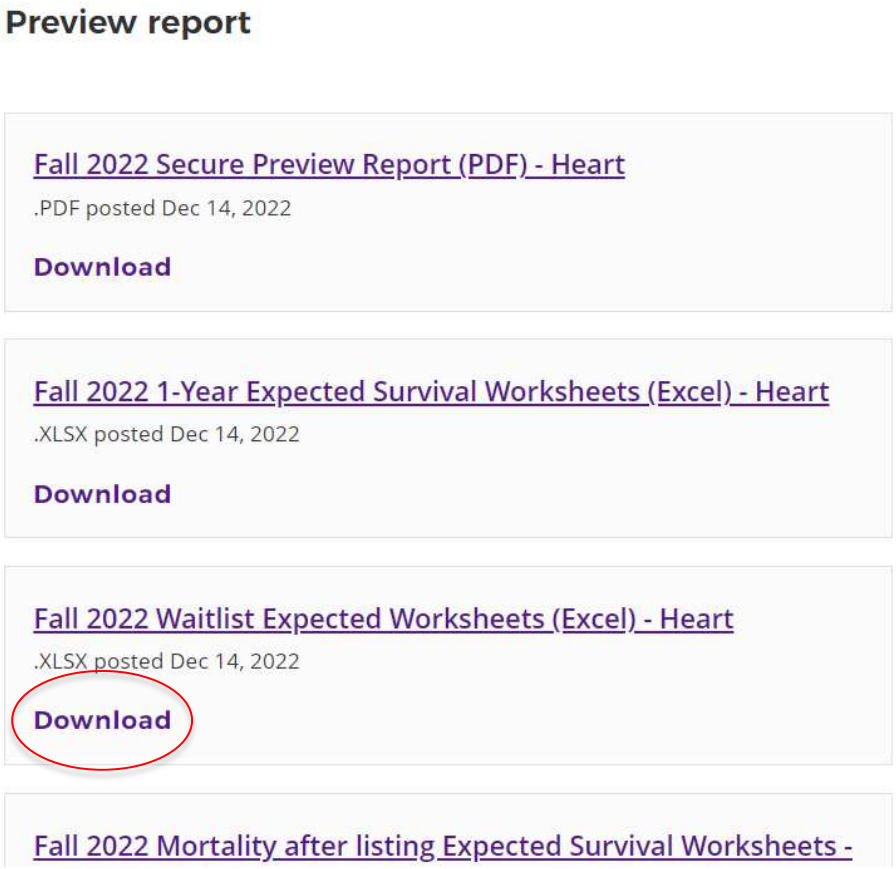


DEMO

Additional slides

MPSC Screening Rule

A program will be reviewed for its pretransplant mortality rate ratio if:

The probability is >50% that the program's pretransplant mortality rate ratio is >1.75.

In other words, there is more than 50% probability that the program's mortality rate is at least 75% higher than expected.

Example: Mayo Arizona kidney program

O = 75

E = 77

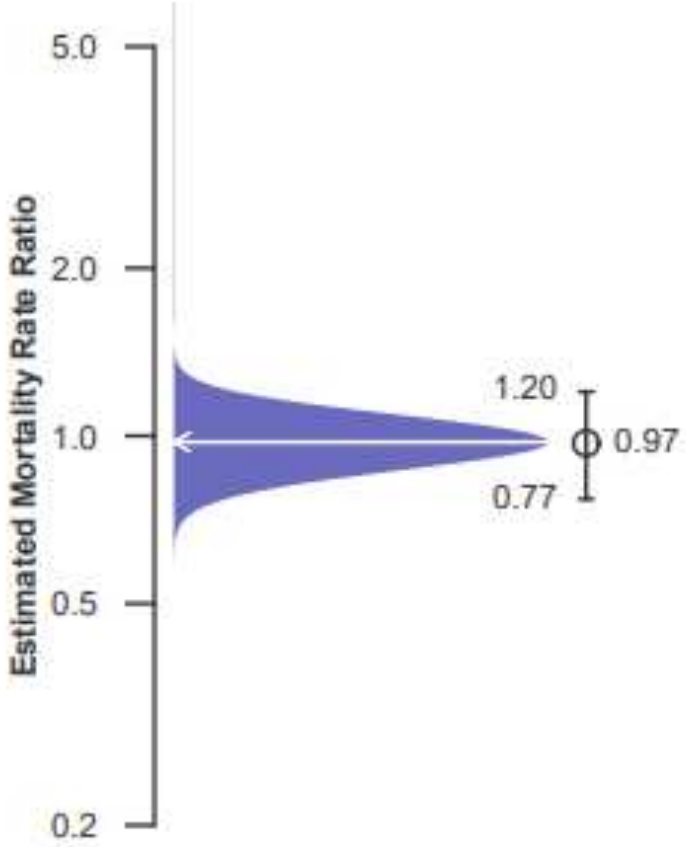
(O+2) / (E+2) = 77 / 79 = 0.97

Rate Ratio (RR) ~ gamma(O+2, E+2)

= gamma(77, 79)

This gamma distribution is also called **the posterior density, the distribution of likely values for the program's rate ratio, given the data we have.**

Figure B5. Pre-transplant mortality rate ratio estimate



Example: Mayo Arizona kidney program

O = 75

E = 77

(O+2) / (E+2) = 77 / 79 = 0.97

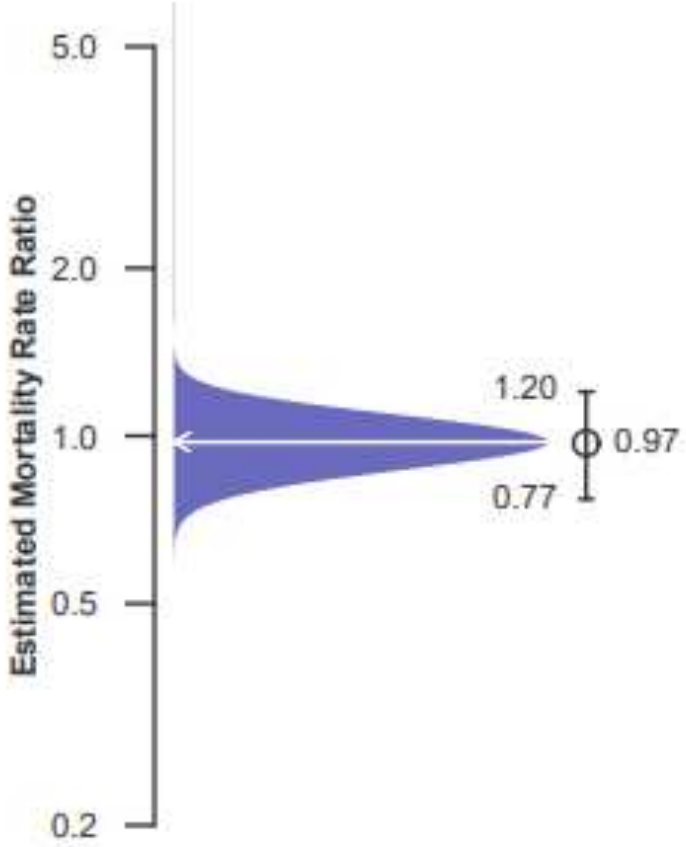
Rate Ratio (RR) ~ gamma(O+2, E+2)

= gamma(77, 79)

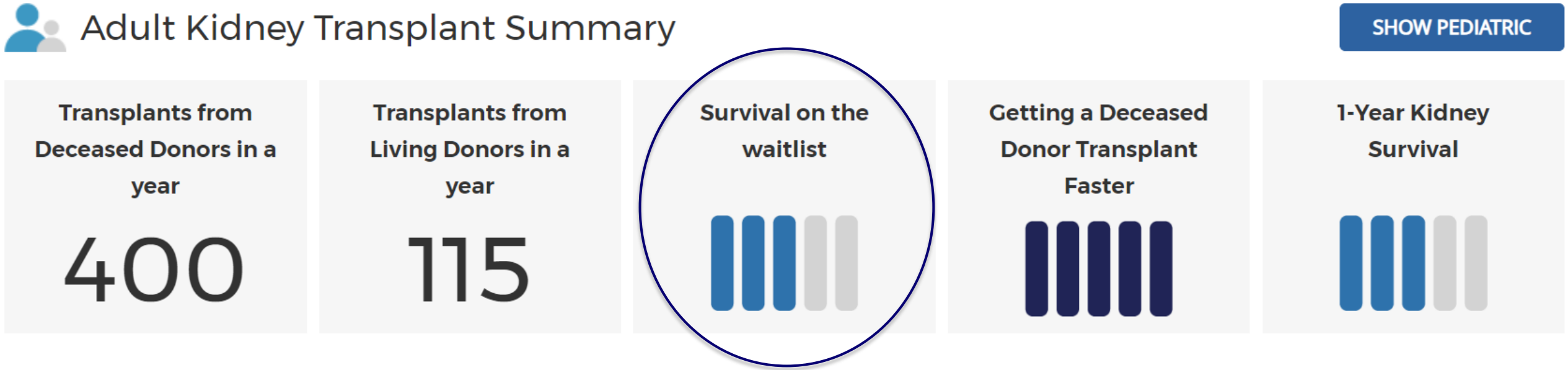
Pr(RR > 1.75) < 0.001 (using software)

Therefore – Not flagged by MPSC

Figure B5. Pre-transplant mortality rate ratio estimate



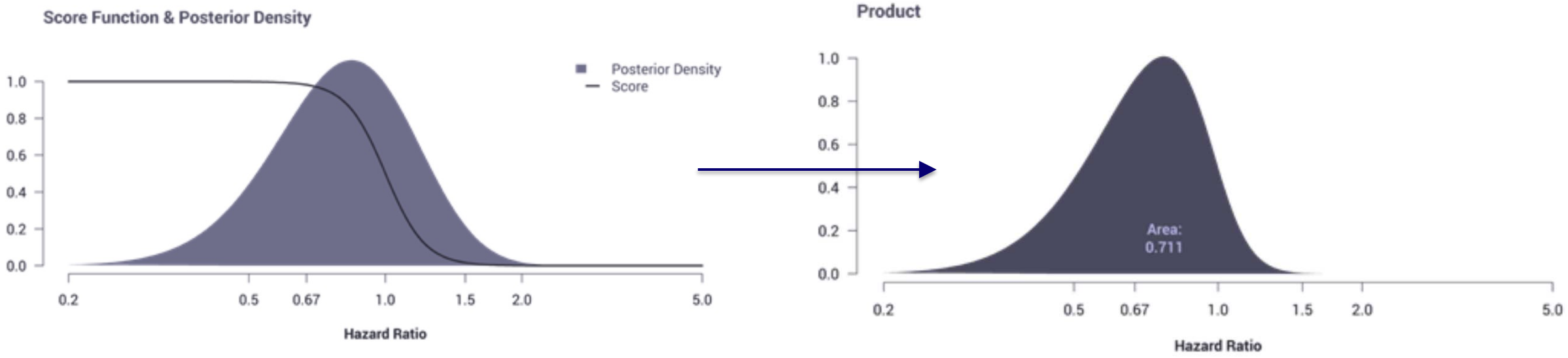
Example: Mayo Arizona kidney program



Calculating pretransplant mortality tier

1. Multiply posterior density by the score function: 1 / (1+x^10)

2. Calculate the area under this curve (ie, take the integral).



Calculating pretransplant mortality tier

3. Convert the score to a tier:

Score	Tier assignment
0 - <0.125	1
0.125 - <0.375	2
0.375 - <0.625	3
0.625 - <0.875	4

https://www.srtr.org/about-the-data/guide-to-using-the-srtr-website/txguidearticles/5-tier-outcome-assessment/

Example: Mayo Arizona kidney program

Mayo's score in Jan 2024: **0.56**

Score	Tier assignment
0 - <0.125	1
0.125 - <0.375	2
0.375 - <0.625	3
0.625 - <0.875	4

https://www.srtr.org/about-the-data/guide-to-using-the-srtr-website/txguidearticles/5-tier-outcome-assessment/

FAQ: If a candidate's medical status (e.g., diabetes, dialysis, MELD) changes after listing, does your risk adjustment account for that?

No. Even when we have this information (ie, the OPTN collects it and the center records it), we do not include it in the risk adjustment.

We do not adjust for post-listing risk factors in the pre-transplant models, because changes to medical status after listing could be affected by the care that a patient has received at the center. For example, a preemptive kidney candidate might have to go on dialysis if a center is not aggressive in accepting an offer for them. We are trying to measure the quality of care, so we would not adjust for this.

https://www.srtr.org/faqs/for-transplant-center-professionals/

PROGRAM SPECIFIC REPORTS (PSR) METHODOLOGY- WAITING LIST

Which patients are included when assessing a program's pretransplant mortality rate?

Are patients who are inactive for all or part of the 24-month period included in the calculation?

What happens when a candidate's condition deteriorates and he or she is removed from the waiting list?

How long will a patient be followed in the Program Specific Reports?

How does SRTR count patient time?

What is the formula for patient years?

How long will a death on the waiting list continue to appear on a program's report?

What is the formula for the waiting list transplant rate?

What is the formula for the pretransplant mortality rate?

What is the formula for the waiting list *expected* transplant rate?

What is the formula for the *expected* pretransplant mortality rate?

The waiting list models used to include one-year cohorts. It seems like it is two-year cohorts now?

Why aren't P-Values included anymore in the model documentation?

Are candidates listed for multi-organ transplants included in the transplant rate and pretransplant mortality calculations for each organ *separately?*

SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

Breakout #3: Post-transplant graft failure metric, expected survival workbooks, and CUSUMs

Jon Miller, PhD
Ryo Hirose, MD

CUSUMs

https://securesrtr.transplant.hrsa.gov/home/

Reports

- CURRENT RELEASE
- COMMENTS
- ARCHIVES
- CUSUM CHARTS

Current Release

Data review period	April 1 - 30, 2022
Deadline to submit any data updates to the OPTN	April 30, 2022
Private PSR release to programs on the SRTR secure website	June 15, 2022
Public release of the PSRs	July 6, 2022
Period for submitting comments to accompany the public reports	June 15 – August 6, 2022

PROGRAM PERIOD

Kidney

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Reports

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PROGRAM

Kidney

PERIOD

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PERIOD

Jan 2023

PROGRAM

Kidney

TYPE

Graft Survival

COHORT AGE

Adult

DONOR TYPE

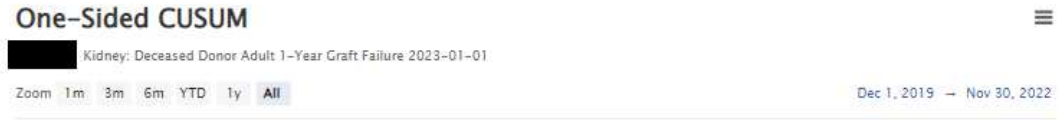
Deceased Donors

[redacted] Kidney: Deceased Donor Adult 1-Year Graft Failure

2023-01-01



Reliability: CUSUM less reliable after 2022-07-31



Reliability: CUSUM less reliable after 2022-07-31



Reliability: CUSUM less reliable after 2022-07-31

Download Data (csv)

Reliability: CUSUM less reliable after 2022-07-31



Reliability: CUSUM less reliable after 2022-07-31

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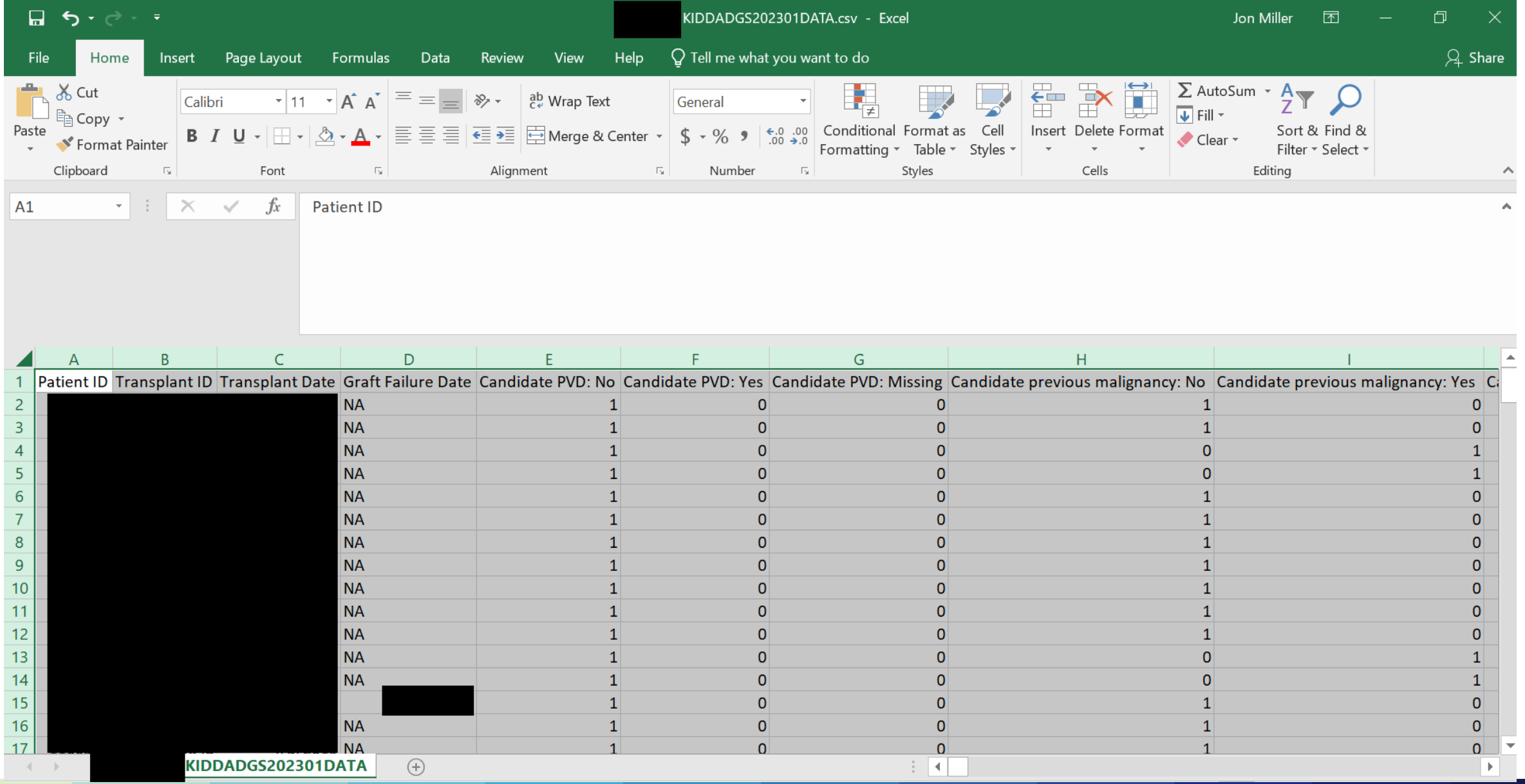

Patient ID	Transplant ID	Transplant Date	Graft Failure Date	Candidate PVD: No	Candidate PVD: Yes	Candidate PVD: Missing	Candidate previous malignancy: No	Candidate previous malignancy: Yes	C
[redacted]			NA	1	0	0	1	0	
			NA	1	0	0	1	0	
			NA	1	0	0	0	1	
			NA	1	0	0	0	1	
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			[redacted]	1	0	0	1	0	
			NA	1	0	0	1	0	
			NA	1	0	0	1	0	

Expected Survival Workbook

Reports

- CURRENT RELEASE
- COMMENTS
- ARCHIVES
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PROGRAM

Kidney

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SECURE SITE

Reports

CURRENT RELEASE
COMMENTS
ARCHIVES
CUSUM CHARTS

Current Release

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PROGRAM PERIOD

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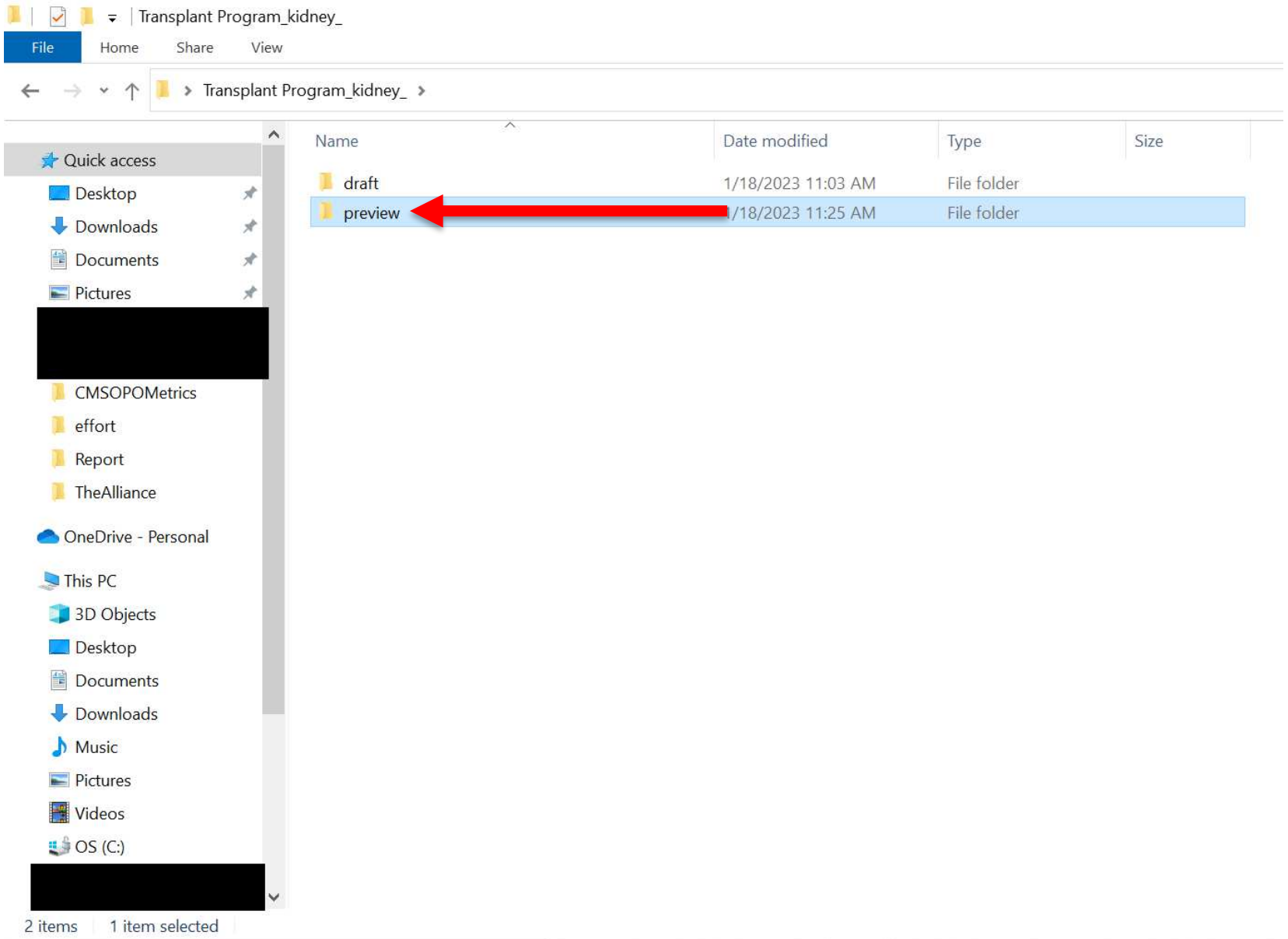
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File
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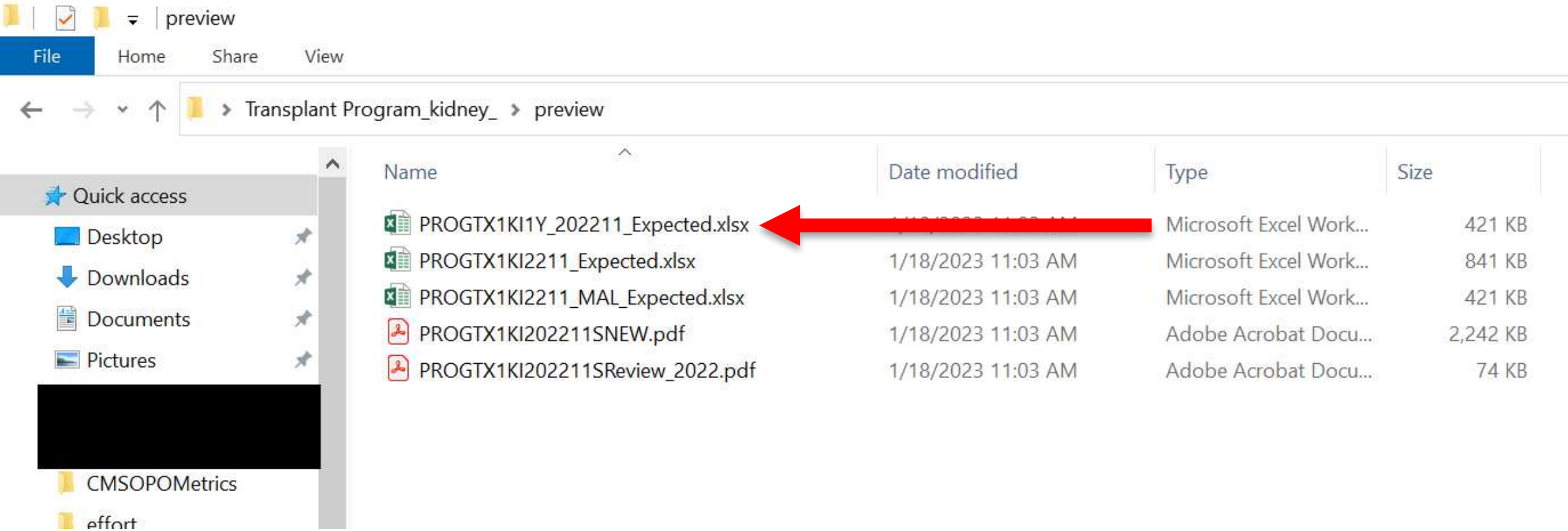
2 items
1 item selected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Quick access
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SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

Breakout #4: Risk Adjustment

Jon Snyder, PhD

How we build models…

Developing Statistical Models to Assess Transplant Outcomes Using National Registries: The Process in the United States

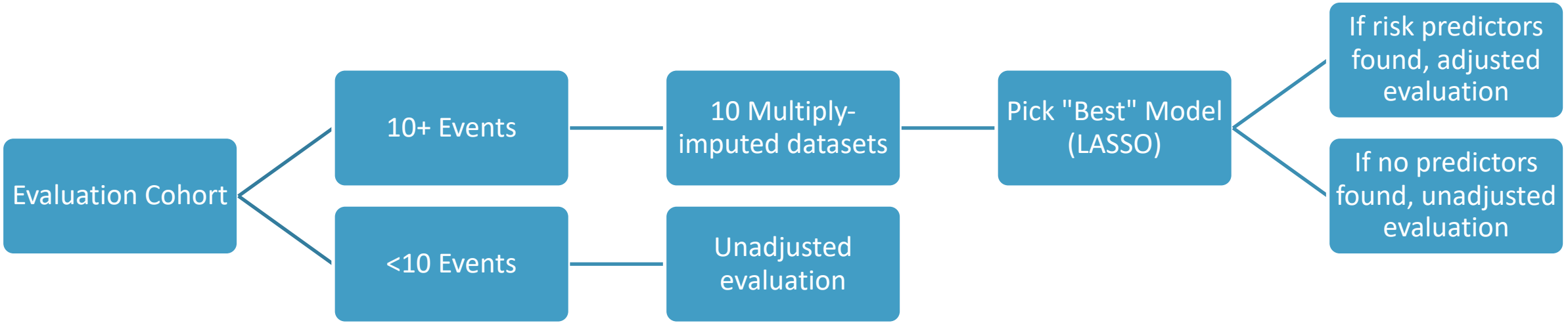
Jon J. Snyder, PhD, MS,[1,2] Nicholas Salkowski, PhD,[1] S. Joseph Kim, MD, PhD,[3] David Zaun, MS,[1] Hui Xiong, MS,[1] Ajay K. Israni, MD, MS,[1,2,4] and Bertram L. Kasiske, MD[1,4]

Abstract: Created by the US National Organ Transplant Act in 1984, the Scientific Registry of Transplant Recipients (SRTR) is obligated to publicly report data on transplant program and organ procurement organization performance in the United States. These reports include risk-adjusted assessments of graft and patient survival, and programs performing worse or better than expected are identified. The SRTR currently maintains 43 risk adjustment models for assessing posttransplant patient and graft survival and, in collaboration with the SRTR Technical Advisory Committee, has developed and implemented a new systematic process for model evaluation and revision. Patient cohorts for the risk adjustment models are identified, and single-organ and multiorgan transplants are defined, then each risk adjustment model is developed following a prespecified set of steps. Model performance is assessed, the model is refit to a more recent cohort before each evaluation cycle, and then it is applied to the evaluation cohort. The field of solid organ transplantation is unique in the breadth of the standardized data that are collected. These data allow for quality assessment across all transplant providers in the United States. A standardized process of risk model development using data from national registries may enhance the field.

(*Transplantation* 2016;100: 288–294)

Note: The process has evolved slightly from this publication and is continuing to evolve! The basic idea stands.

The process, in brief…



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Select Organ | Search by Postal Code or Program Name (optional) | SEARCH

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- Risk Adjustment Models
  - Posttransplant Outcomes
  - Waiting List
  - Offer Acceptance
  - Deceased Donor Yield
  - Mortality After Listing
- Kidney Transplant Decision Aid
- Liver Waiting List Calculator
- Acuity Circles Evaluation
- COVID-19 Evaluation

COV App

Includes a wide otive statistics.

COVID-19 APP

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Risk Adjustment Model: Offer Acceptance

Choose an organ of interest:

- ○ Kidney
- ◉ Liver
- ○ Heart
- ○ Lung
- ○ Pancreas
- ○ Kidney-Pancreas

Liver Model Strata

- ○ Pediatric Candidate
- ○ Adult Candidate - Donor < 40
- ◉ Adult Candidate - Donor ≥ 40

Element Type	Element
Candidate	Accept an incompatible blood type?
Candidate	Allocation MELD/PELD
Candidate	Ascites
Candidate	Candidate Age at Listing (Years)
Candidate	Candidate BMI
Candidate	Candidate Blood Type
Candidate	Candidate Gender
Candidate	Candidate Height (cm)
Candidate	Candidate Weight (kg)
Candidate	Diagnosis
Candidate	Dialysis in Prior Week
Candidate	Laboratory MELD/PELD
Candidate	Natural Log INR
Candidate	Natural Log of Albumin
Candidate	Natural Log of Bilirubin
Candidate	Status 1A
Candidate	Status 1B
Candidate and Donor	Center Number
Candidate and Donor	Center Rank
Candidate and Donor	Donor/Candidate Gender Mismatch
Candidate and Donor	Natural Log of Candidate:Donor Height Ratio
Candidate and Donor	Natural Log of Candidate:Donor Weight Ratio
Candidate and Donor	Natural Log of Distance (km) Between Candidate and Donor
Candidate and Donor	Offer Number
Donor	Arginine Vasopressin

Offer Acceptance

Offer Acceptance

Donor	BUN
Donor	Biopsy
Donor	Blood Infection
Donor	COVID Positive
Donor	Cause of Death
Donor	Cigarette Use > 20 Pack Years
Donor	Cocaine Use
Donor	DCD Downtime (Minutes)
Donor	Donation After Circulatory Death (DCD)
Donor	Donor Age (Months)
Donor	Donor BMI
Donor	Donor Blood Type
Donor	Donor Gender
Donor	Donor Height (cm)

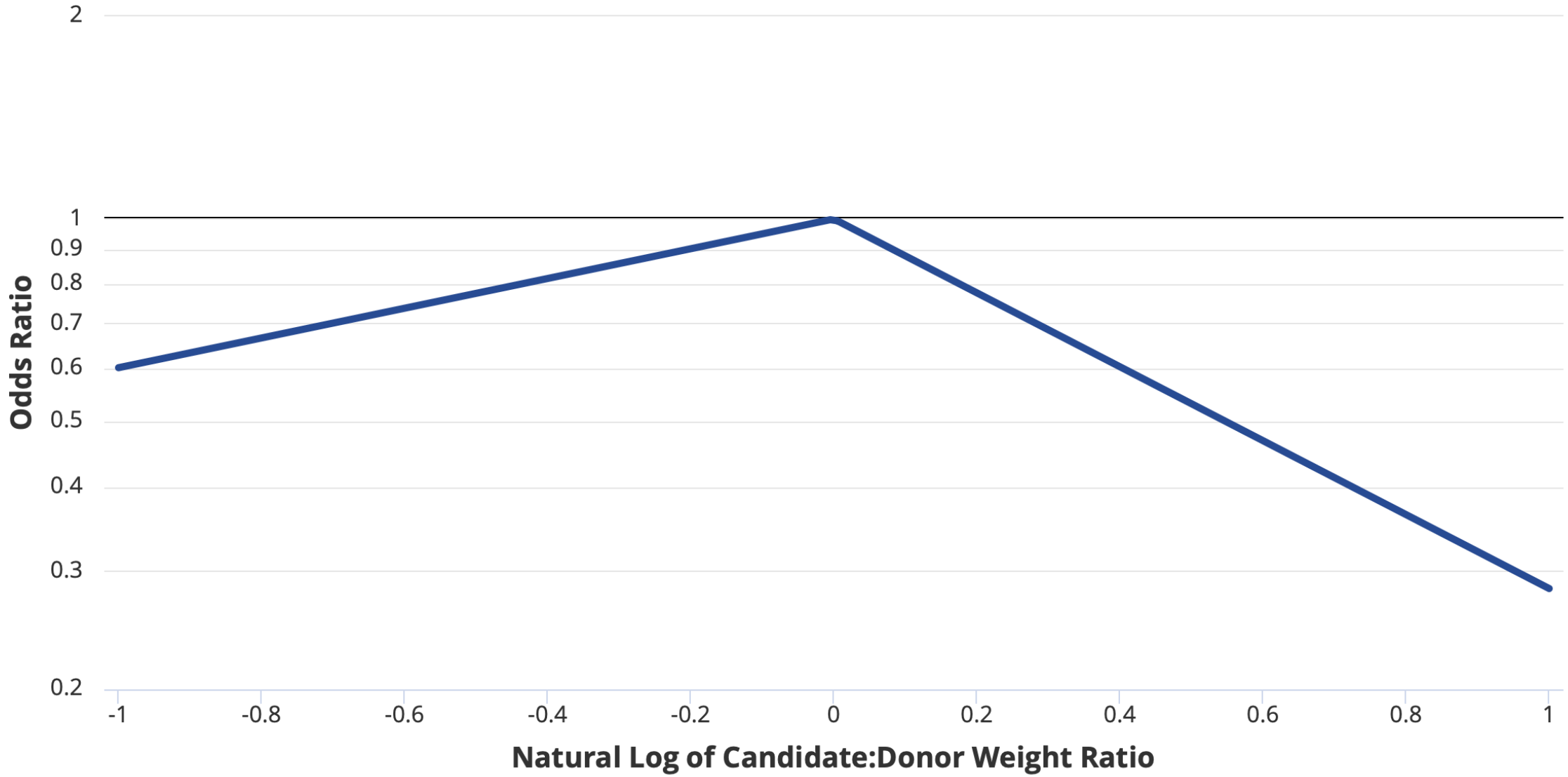
Donor	Donor History of Diabetes
Donor	Donor History of Hypertension
Donor	Donor Weight (kg)
Donor	HCV NAT Results
Donor	Heavy Alcohol Use (heavy= 2+ drinks/day)
Donor	Hematocrit
Donor	History of IV Drug Use
Donor	History of Previous MI
Donor	Liver Offer Type
Donor	Macro Fat

Element Type	Element
Donor	Mechanism of Death
Donor	Micro Fat
Donor	Other Drug Abuse
Donor	PHS Increased Infectious Risk
Donor	Peak INR
Donor	Peak Lipase
Donor	Peak SGOT
Donor	Peak SGPT
Donor	Peak Serum Amylase
Donor	Peak Serum Creatinine
Donor	Peak Serum Sodium
Donor	Previous Gastrointestinal Disease
Donor	Tattoos
Donor	Weekend Allocation (Match Run Submitted on Friday or Saturday)
Donor	toxscreen

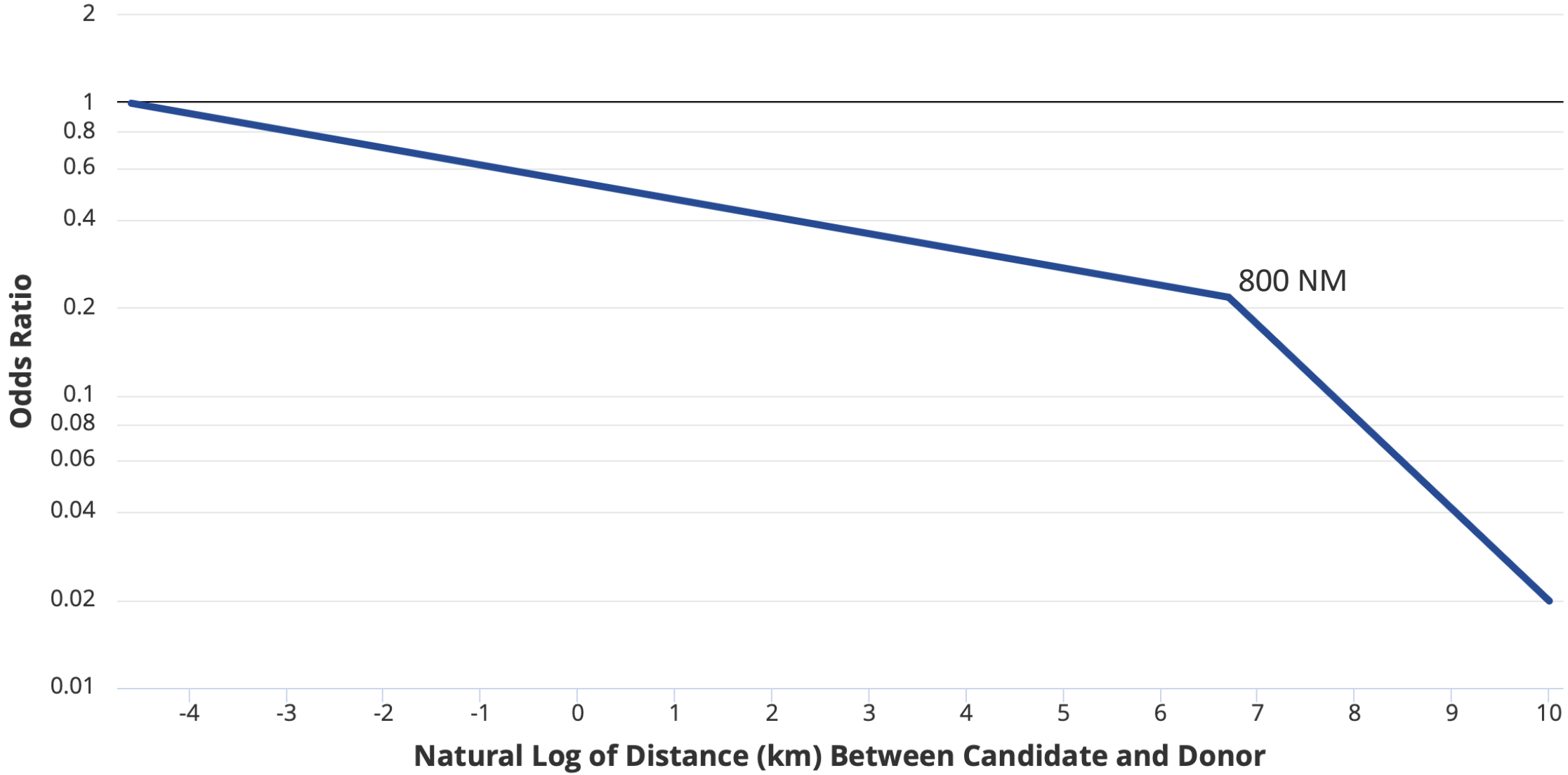
Liver offer acceptance model (Adult Candidate - Donor ≥ 40)



Liver offer acceptance model (Adult Candidate - Donor ≥ 40)



Liver offer acceptance model (Adult Candidate - Donor ≥ 40)



Choose a transplant type:

- ○ Heart
- ○ Intestine
- ◉ Kidney
- ○ Liver
- ○ Lung

Choose an outcome:

- ◉ Graft Survival
- ○ Patient Survival

Choose an age group:

- ◉ Adult (18+)
- ○ Pediatric (<18)

Choose a donor type:

- ◉ Deceased Donor
- ○ Living Donor

Choose a time frame:

- ◉ First-Year Outcomes
- ○ Three-Year Outcomes

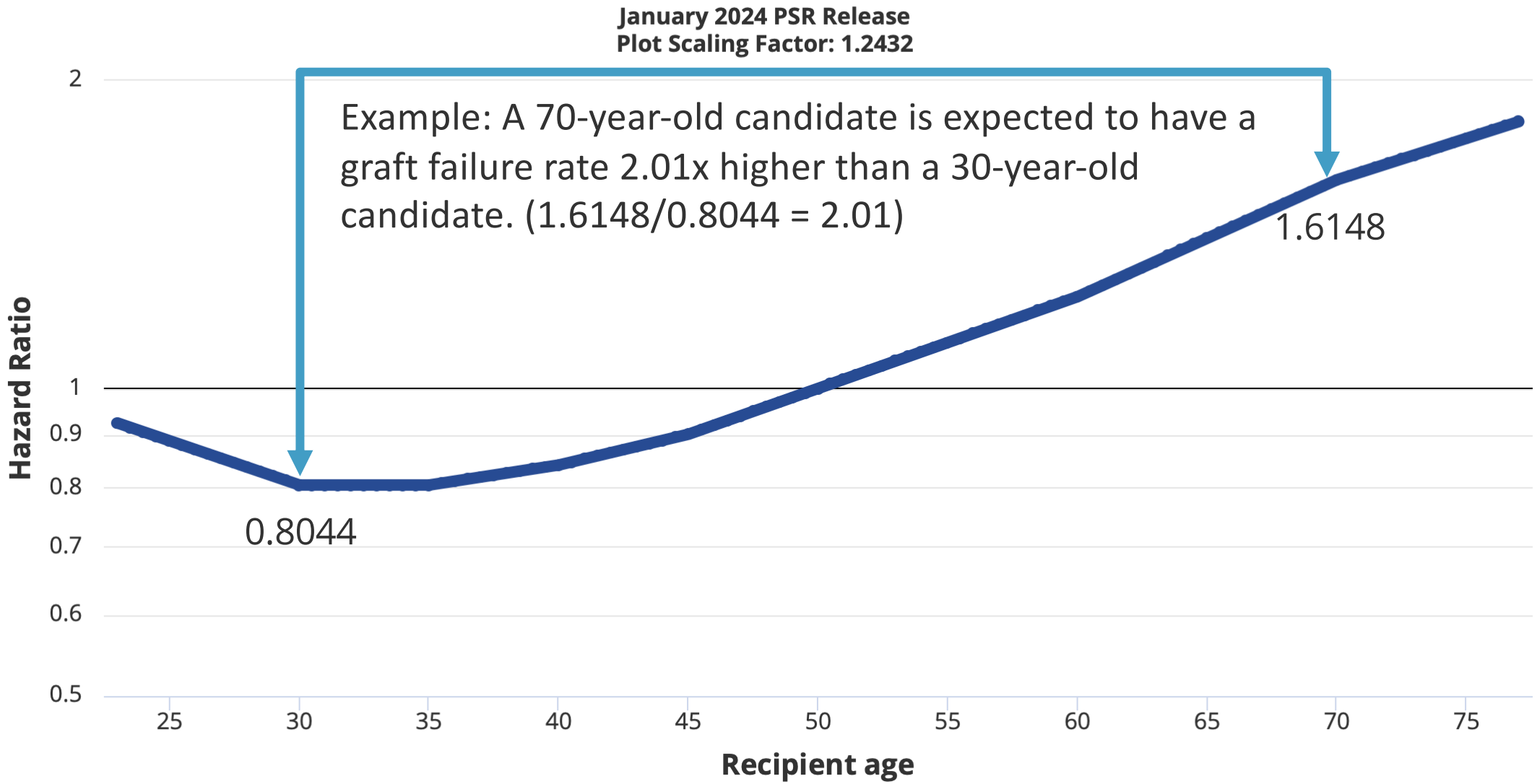
Model Elements | **Model Coefficients** | **Model Element Plots** | **Baseline Cumulative Hazard** | **Other Elements**

Posttransplant Outcomes

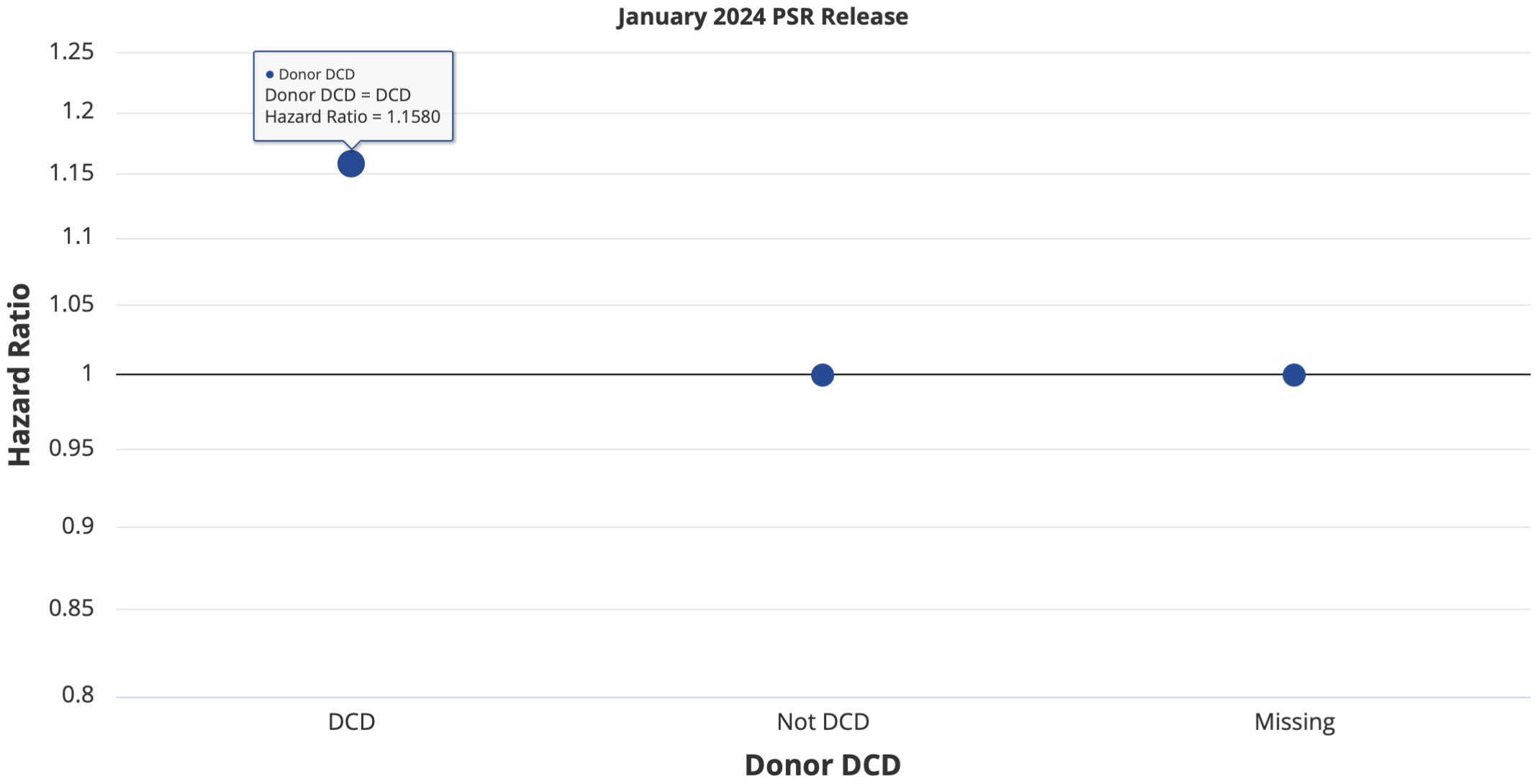
Additional info

Model Elements

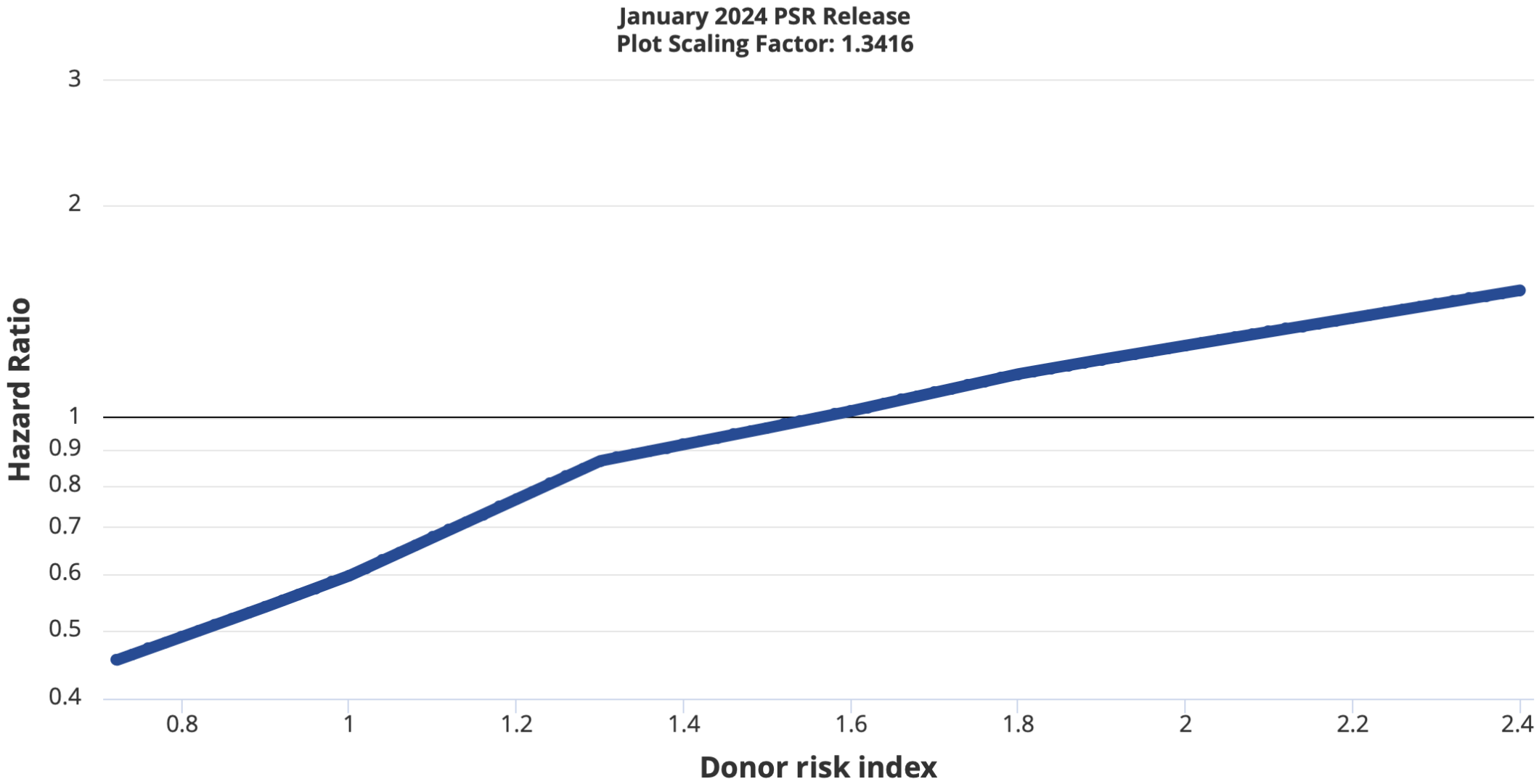
Adult (18+) Recipient Deceased-Donor 1-Year Kidney Graft Survival



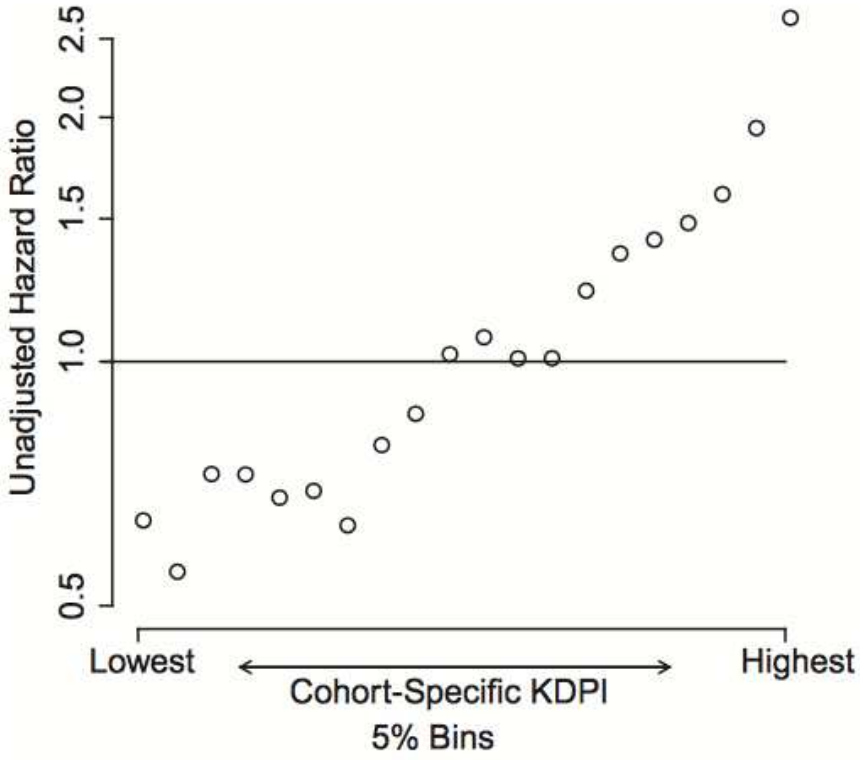
Adult (18+) Recipient Deceased-Donor 1-Year Kidney Graft Survival

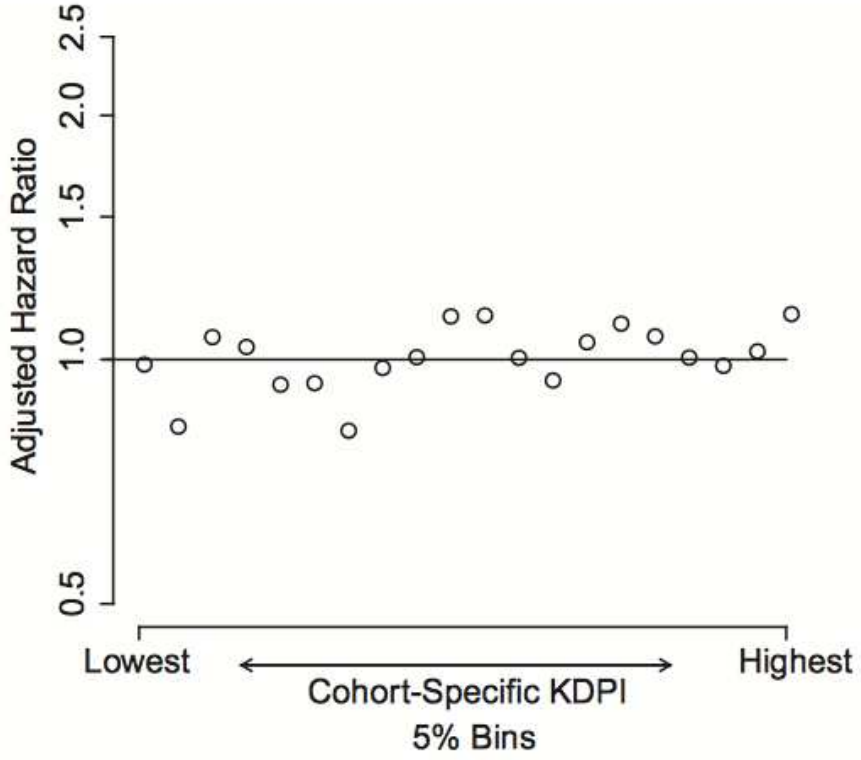


Adult (18+) Recipient Deceased-Donor 1-Year Kidney Graft Survival



Q: How well to the models account for measured risk?





Snyder, et al. Effects of High-Risk Kidneys on Scientific Registry of Transplant Recipients Program Quality Reports. Am J Transplant 2016;16:2646-53.

A Special Thanks to Our Presenter



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Director of Transplant Epidemiology,

Hennepin Healthcare Research Institute

SRTR SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

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