

Discussion of “Who Benefits from Higher Treatment Rates?”

by Stephen Kastoryano

Discussant: Yulong Wang

Lehigh University

Annual Health Econometrics Workshop

2026

The Allocation Problem

- Waitlists allocate scarce goods: organs, housing, schools, credit
- Causal evaluations try to hold selection fixed across treated and control
- But after a policy change, selection need not stay invariant
 - agents re-optimize; the *composition* of the treated shifts
- Then understanding selection matters as much as the treatment effect
- **Question:** when treatment supply expands, *who* benefits?

The U.S. Kidney Waitlist

- ~140,000 candidates in 2022, with ~40,000 added and ~25,000 transplanted each year
- Entry when kidney function falls below $\text{GFR} \leq 20$; OPTN's UNet ranks compatible candidates
- Pre-2014: tissue match, age, waiting time, geography. Post-2014: EPTS score, sensitized patients, less weight on time and distance
- Centers and patients may decline offers, with no penalty
- 25% of viable kidneys discarded in 2021 (France 9%, UK 10–12%)

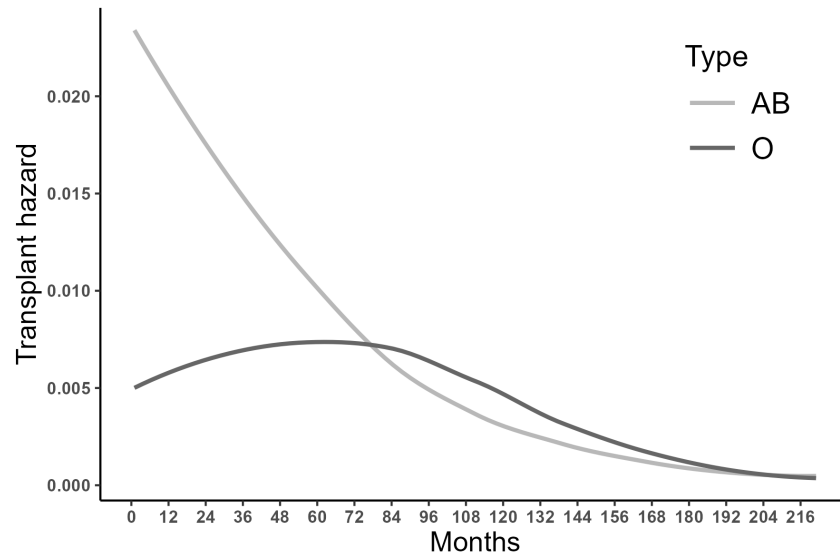
ABO Blood Type as a Regime

- AB is the universal recipient; O can only receive from an O donor
- Fixed at birth, and plausibly unrelated to mortality given X
- But it strongly shifts the *timing* and likelihood of offers
- Exactly what Abbring–van den Berg (2005) require: a randomized *regime*, not a randomized treatment
- Caveat: policy prioritizes B and O for identical-type kidneys

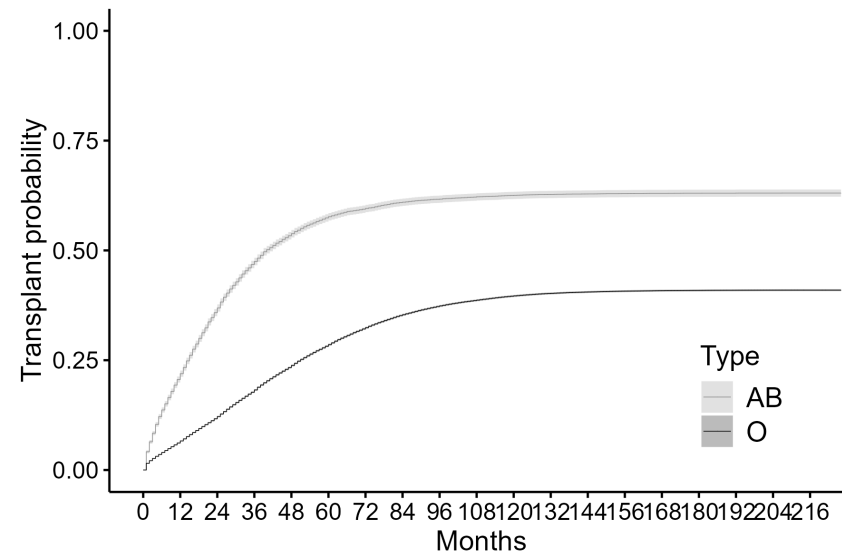
Data and Sample

- SRTR covers all candidates, donors and recipients; death dates come from Social Security records
- Entrants June 2002–Dec 2014; adults; first spell; kidney only
- Excludes living-donor recipients, cPRA > 0 , rare A1/A2 subtypes
- $N_O = 170,463$, $N_{AB} = 13,393$
- Covariates: age, diabetes, dialysis, prior transplant, sex, race, diagnosis

Facts I: Transplant Rates



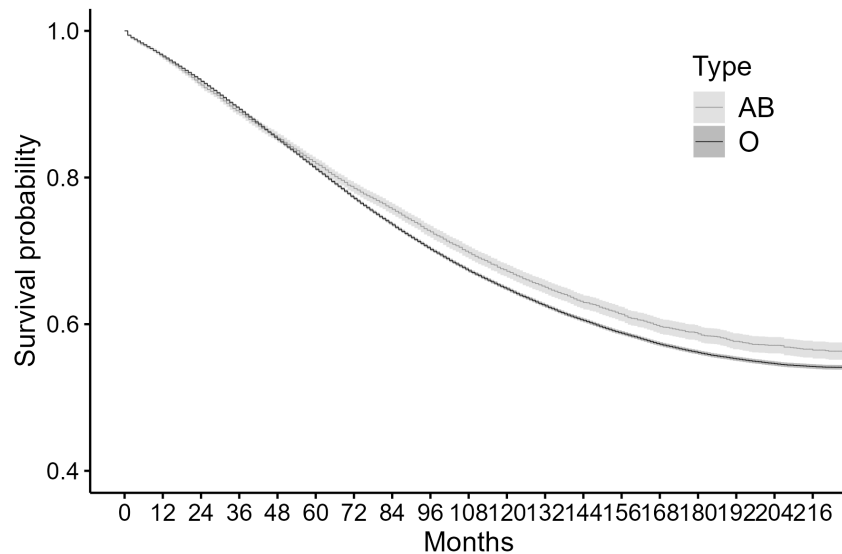
(a) Transplant hazard



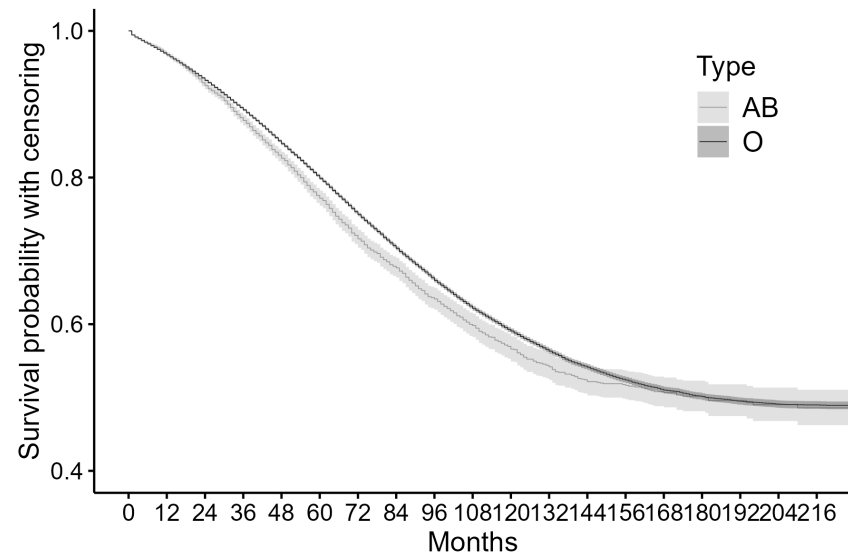
(b) Transplant probability

- AB hazard $\approx 2.5 \times$ O over five years; about half of AB are transplanted within five years

Facts II: The Puzzle



(c) Overall survival



(d) Pre-transplant survival

- Overall survival is nearly identical for five years – yet AB candidates die faster *before* transplant

How Figure 1(d) Is Built

- Kaplan–Meier by blood type, without covariates; the event is death while on the waitlist
- **Censored at transplant:** someone transplanted in month 12 is in the denominator for months 1–12, then leaves. A death after transplant never enters the curve.
- Not dropped from the sample: dropping everyone *ever* transplanted would condition on the future
- With R_t alive and still waiting, d_t deaths among them:

$$\hat{S}(\tau) = \prod_{t \leq \tau} (1 - d_t/R_t)$$

Censoring: A Small Example

Ten AB candidates:

Month	At risk	Deaths	Transplanted	Factor
1	10	1	3	$1 - 1/10 = .90$
2	6	1	1	$1 - 1/6 = .83$
3	4	0	0	$1 - 0/4 = 1.00$
$\hat{S}(3) = .90 \times .83 \times 1.00 = .75$				

- Each factor is the sample analog of $p_t(z)$, so Figure 1(d) is β_τ estimated without covariates
- KM assumes the censored share the death risk of those who remain. If transplants ignored health, AB and O would coincide. They don't.

Reading 1(c) and 1(d) Together

- Blood type randomizes: AB and O start alike in health
- 1(b): AB transplanted far more often, yet 1(c) shows nearly identical overall survival for five years
- 1(d): AB candidates *still waiting* die faster, so the ones removed were the healthier ones
- AB = large healthy transplanted group + small sick waiting pool; for O it is the reverse
- Similar mixtures $\Rightarrow$ the extra transplants went to candidates who would have survived anyway

... framework

The Framework

- Enter the state at $t = 0$; regime $Z \in \{0, 1\}$ assigned at baseline
- Potential treatment time S^z ; potential death $T^{z,s}$; untreated $T^{z,\infty}$
- Observe (Z, S, T, X) when $T \geq S$
- Key assumption: $(\{T^{z,s}\}, \{S^z\}) \perp Z \mid X = x$
- Estimand, the pre-transplant survival gap:

$$\beta_\tau = \prod_{t=0}^{\tau} p_t(z') - \prod_{t=0}^{\tau} p_t(z)$$
$$p_t(z) = \Pr(T > t \mid S > t, T \geq t, X = x, Z = z)$$

Two Mechanisms Behind $\beta < 0$

- **M1** – regime effect on untreated survival:

$$E[T^{z'}, \infty] < E[T^z, \infty]$$

moral hazard, a causal effect, *not* selection

- **M2** – regime effect on treatment timing:

$$\partial \left[\Pr(S^{z'} \leq s|u) - \Pr(S^z \leq s|u) \right] / \partial u > 0$$

healthier candidates gain more from the high-rate regime

- Step 3 separates them: survival among the earliest treated

Estimation (1): Two Hazards

- Competing risks in continuous time:

$$\begin{aligned}\theta_t^T(x, z, s) &= \lambda_t^T(z, 1(s \leq t)) e^{x' \beta_T} \\ \theta_t^S(x, z) &= \lambda_t^S(z) e^{x' \beta_S}\end{aligned}$$

- Baselines piecewise constant on one-year intervals I_k :

$$\lambda_t^T(z, d) = \sum_k \lambda_k^T(z, d) 1\{t \in I_k\}$$

- Only the baselines vary with the regime: β_T and β_S are the same for AB and O candidates
- Only $\lambda^T(z, 0)$, the death hazard while waiting, enters β

Estimation (2): The Likelihood

- Observe $Y_i = \min(T_i, S_i, C_i)$, C_i end of follow-up; $\delta_i^T =$ died waiting, $\delta_i^S =$ transplanted

- With $\Lambda^T(y; z) = \int_0^y \lambda_u^T(z, 0) du$, and Λ^S alike, $L = L_T \times L_S$:

$$L_T = \prod_i \left[\lambda_{Y_i}^T(z_i, 0) e^{x_i' \beta_T} \right]^{\delta_i^T} \exp \left(-e^{x_i' \beta_T} \Lambda^T(Y_i; z_i) \right)$$

$$L_S = \prod_i \left[\lambda_{Y_i}^S(z_i) e^{x_i' \beta_S} \right]^{\delta_i^S} \exp \left(-e^{x_i' \beta_S} \Lambda^S(Y_i; z_i) \right)$$

- No shared parameters or frailty, so two separate PH fits: death with transplant censored, transplant with death censored

Estimation (3): From Hazards to β

- Each factor of the estimand, for a candidate with x under z :

$$\Pr(T > t | T \geq t, S > t, x, z) = \exp\left(-e^{x'\beta_T} \int_{t-1}^t \lambda_u^T(z, 0) du\right)$$

- So the product telescopes:

$$\prod_{t \leq \tau} \Pr(T > t | T \geq t, S > t, x, z) = \exp\left(-e^{x'\beta_T} \Lambda^T(\tau; z)\right)$$

- Without covariates, $\hat{\lambda}_k^T(z, 0) = \text{deaths} / \text{person-time while waiting}$, which is why it tracks Kaplan–Meier

Estimation (4): Aggregation and Inference

- Average predicted survival over candidates:

$$\begin{aligned}\hat{S}(\tau; z) &= \sum_i \hat{w}_i(s) \exp\left(-e^{x'_i \hat{\beta}_T} \hat{\Lambda}^T(\tau; z)\right) \\ \hat{\beta}_\tau &= \hat{S}(\tau; z') - \hat{S}(\tau; z)\end{aligned}$$

- Weights: each candidate's predicted transplant density at s under AB,

$$\hat{w}_i(s) \propto \hat{\theta}_s^S(x_i, 1) \exp\left(-\int_0^s \hat{\theta}_u^S(x_i, 1) du\right)$$

- Standard errors: delta method on $(\hat{\lambda}, \hat{\beta})$
- Alternatives: nearest-neighbor matching gives similar results; ML methods struggle with competing risks and censoring

Estimation (5): What Drives the Sign

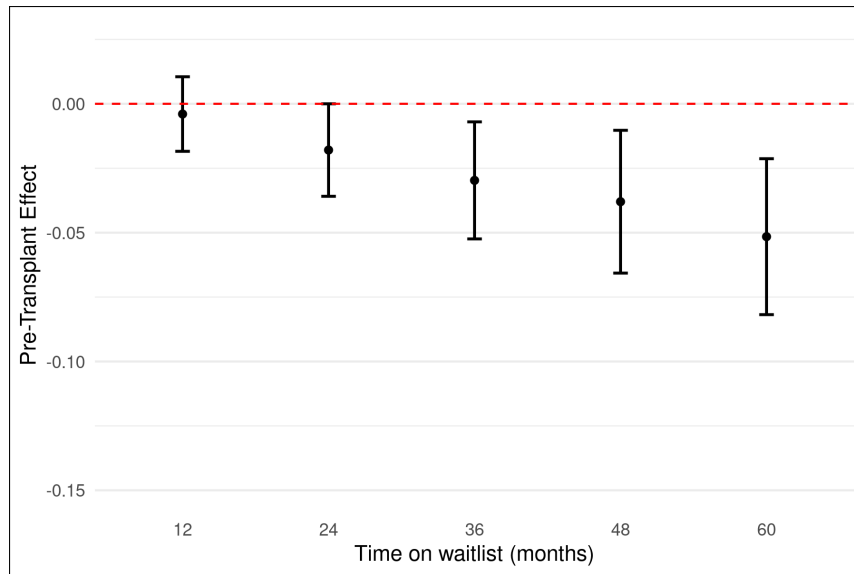
- β_T is common across regimes, so each candidate's term is negative exactly when

$$\hat{\Lambda}^T(\tau; AB) > \hat{\Lambda}^T(\tau; O)$$

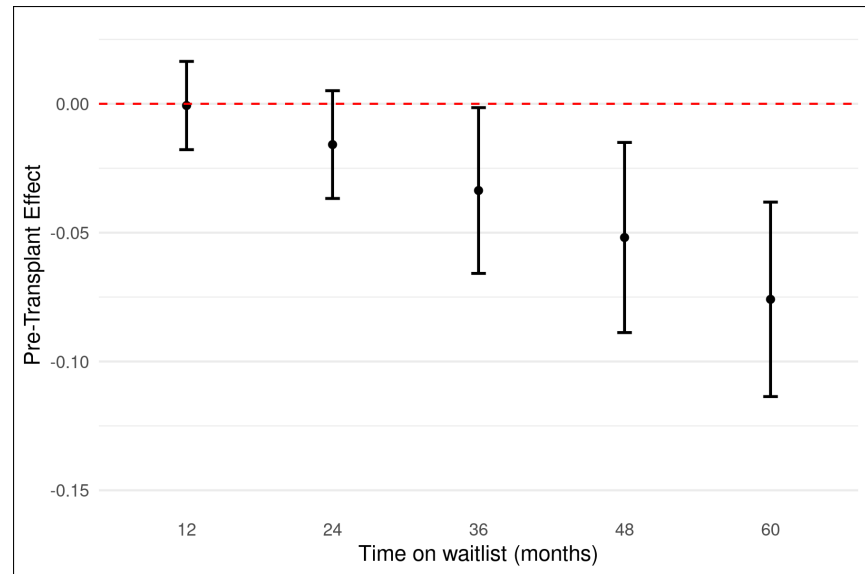
- So the sign of β is set by the gap in baseline cumulative death hazards among those still waiting
- Covariates change its magnitude, not its sign: through risk levels, the weights, and $\hat{\Lambda}^T$ when the waiting pools differ in covariates

... result

Result 1: The Pre-Transplant Gap Is Robust



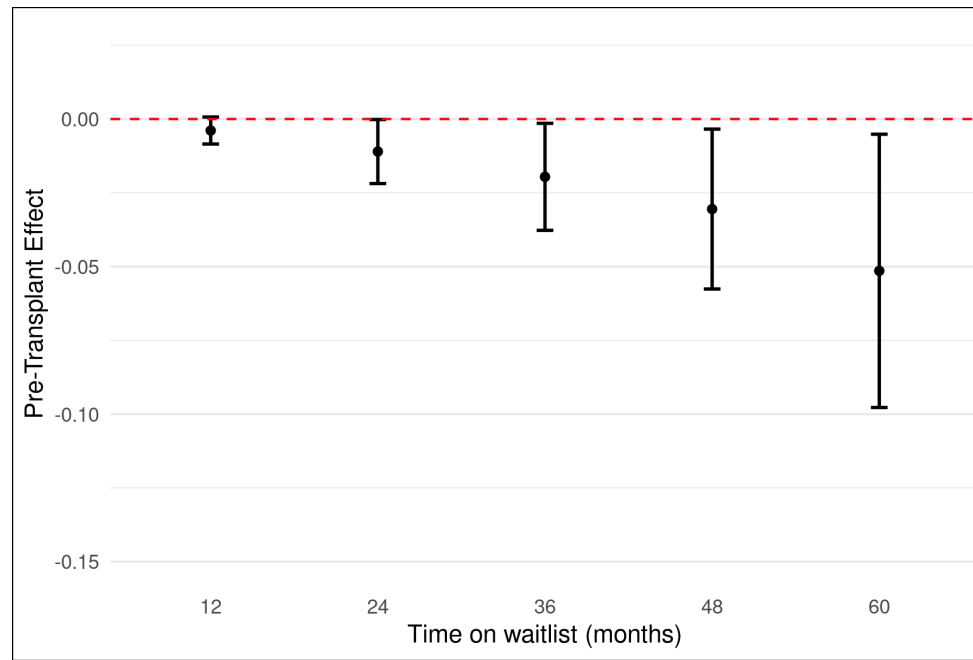
(a) No covariates



(b) All covariates

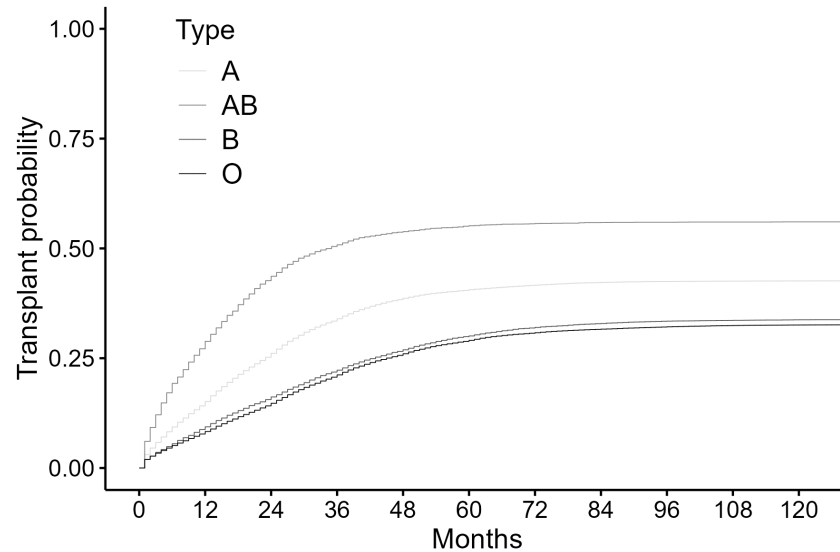
- Five-year gap: $\approx 5\text{pp}$ without covariates, $\approx 7.5\text{pp}$ with all covariates; the sign never changes

Result 1: After the 2014 Reform

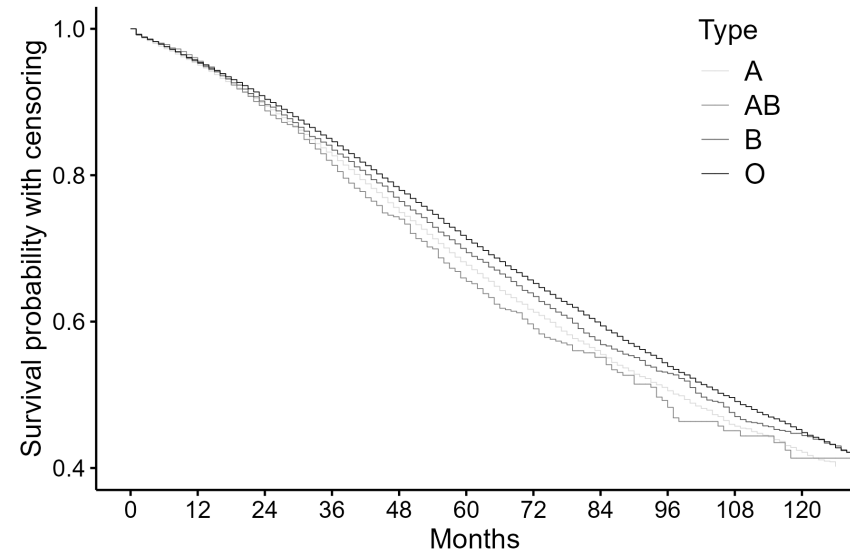


- Entrants after 2015, all covariates: $\approx 2\text{pp}$ lower at year 3, $\approx 5\text{pp}$ at year 5
- Smaller sample and wider bands, but the same pattern under the 2014 allocation system

Result 2: Dose–Response Across ABO



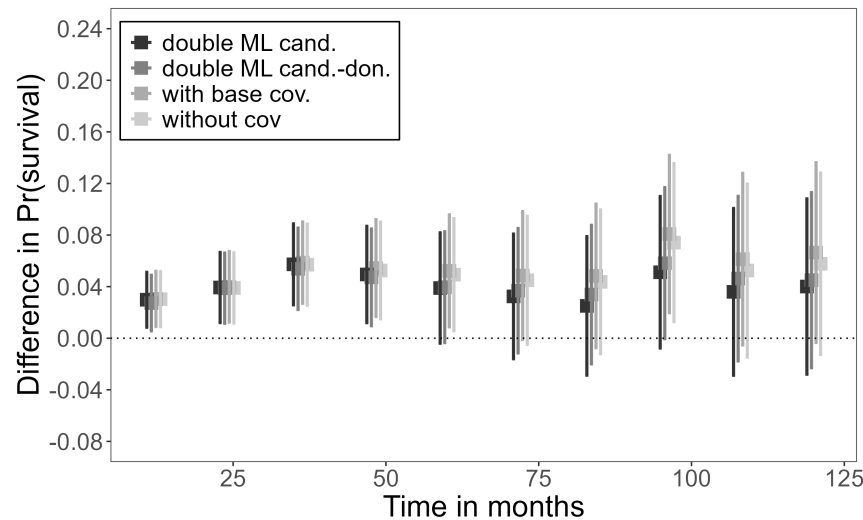
(a) Transplant probability



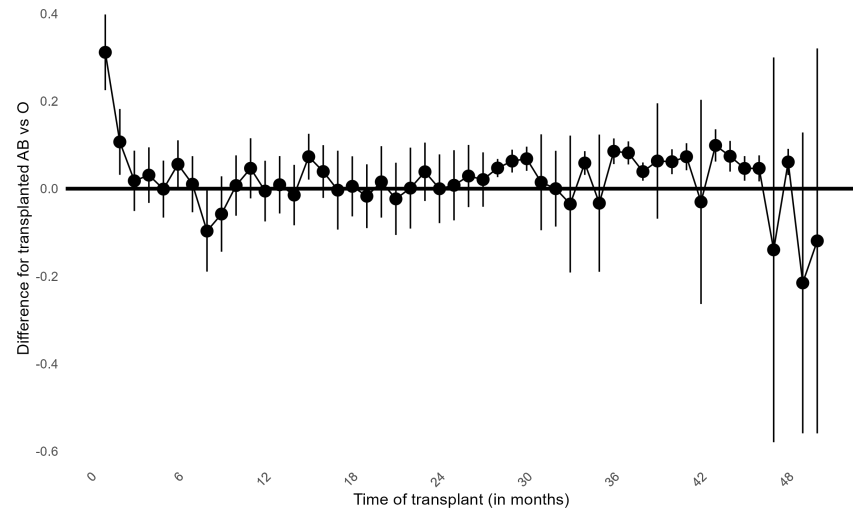
(b) Pre-transplant survival

- Pre-transplant survival mirrors the transplant-rate ordering. As the paper notes, this fits either mechanism: it argues against biology, not for selection specifically

Result 3: Selection Appears in the First Months



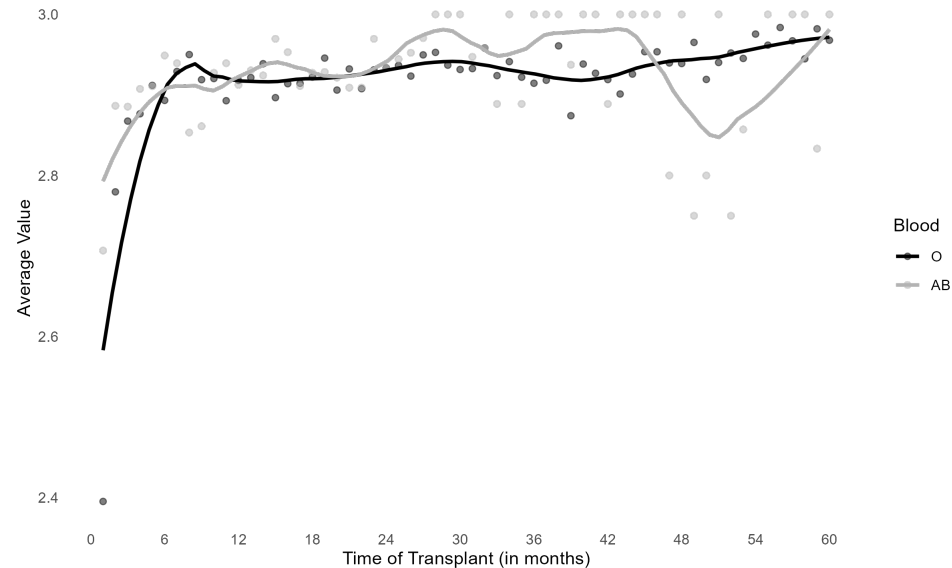
(a) Survival, treated mths 1–3



(b) Functional ability, AB vs O

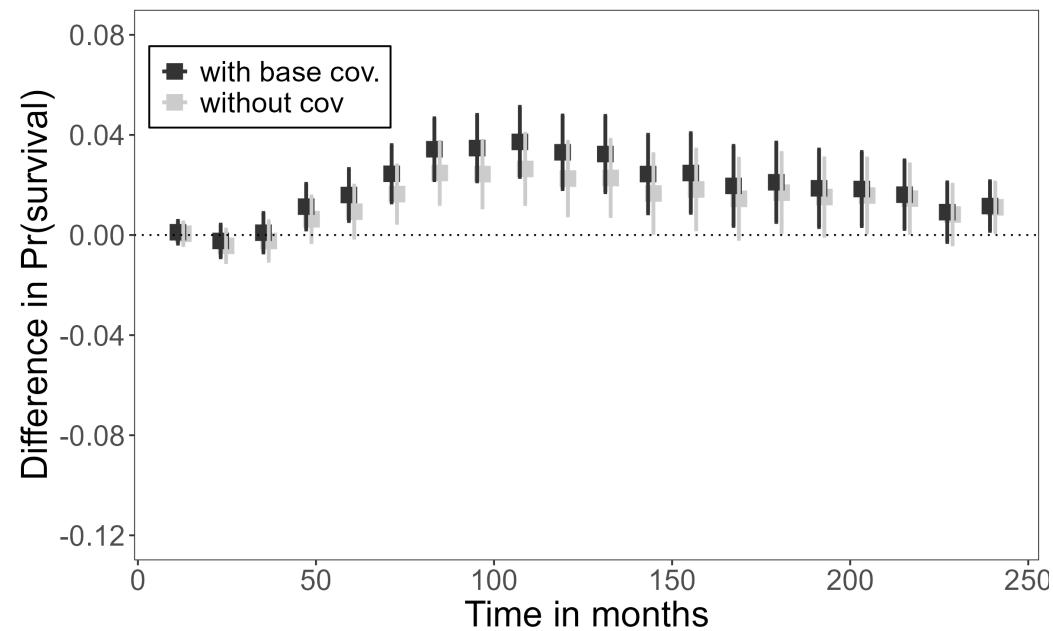
- Recipients in months 1–3: AB survive 3–6pp more for 4–5 years, robust to donor and match controls
- AB recipients' functional ability is 0.3 higher (1–3 scale) in month 1; the gap is gone by month 3

Result 3: No Top-Down Exhaustion



- Functional ability at transplant: both regimes converge near 2.9 by month 6, then stay flat
- Later recipients are also younger, with more HLA mismatches (Figs. 4e–4f)

Result 4: Overall Survival



- AB survives $\approx 3.5\text{pp}$ more at years 7–9, still $\approx 2\text{pp}$ at year 12
- Paper: $+1\%$ transplant rate $\Rightarrow +0.04\%$ survival at 7 yrs

Mechanism and Policy

- Centers the likely actors: low-health transplants cost more, and until July 2023 centers were graded only on 1-year post-transplant survival
- Feedback loop: reluctant centers $\Rightarrow$ OPOs recover fewer of the marginal kidneys in the first place
- The candidate story needs beliefs formed instantly, then abandoned after three months
- 2023–24 reforms add offer-acceptance and waitlist-mortality metrics – which may move selection to waitlist *entry*

... questions

Who Is Left Out of the Sample?

- Living-donor recipients are excluded; AB can accept any living donor, O only an O donor

	O	A	B	AB
Share of White sample	50.5%	35.6%	10.6%	3.4%
White Americans (approx.)	45%	40%	11%	4%
Ratio	1.12	0.89	0.96	0.85
Compatible donors	45%	85%	56%	100%

- The more compatible the type, the more under-represented it is
- The paper notes the exclusion “may be endogenous to blood type”

Scale or Skew?

Two identical bowls of 100 fruits, half good. Both pickers take 2 good for every 1 bad; only the amount differs.

	O picker	AB picker
Fruit taken	30	55
Left: good / bad	30 / 40	13 / 32
Share good among leftovers	43%	30%
Leftovers' survival (good .9, bad .5)	.671	.618

- AB's leftovers are worse by 5pp, the paper's headline, though AB is no pickier
- Leftovers are what Figure 1(d) measures. Only *who is picked* separates scale from skew: Step 3, months 1–3

Distortion or Design?

- EPTS (since 2014): the best 20% of candidates get priority for the best 20% of kidneys
- Center report cards (until July 2023): 1-year post-transplant survival
- Both reward transplanting healthier candidates; β measures what that costs on the waitlist
- The gap predates EPTS, but the center metric also predates the reform
- Possible reply: centers select on health beyond the risk adjustment, which games the metric

Three Questions

1. **Living donors.** AB can take a kidney from any living donor, so excluding living-donor recipients removes more healthy AB candidates. How much of the gap survives if living donation is treated as a third competing risk?
2. **Scale or skew?** Transplanting more candidates under the *same* selection rule already leaves a sicker AB pool. Beyond Step 3, what shows higher rates change *who* gets a kidney?
3. **Distortion or design?** Center metrics (until 2023) and EPTS (since 2014) both reward post-transplant survival. Is the gap a distortion, or the price of that objective?

Thanks!

