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Novel Approaches to Organ Utilization and Allocation

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CUTTING EDGE OF TRANSPLANTATION

TRANSPLANT SUMMIT 2020
BALANCING EQUITY AND UTILITY IN THE FACE OF AN ORGAN SHORTAGE

Disclosure

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Learning Objectives

- Participants will be able to:
  - summarize characteristics of kidneys at high probability of delay or discard
  - identify utilization challenges related to delays in kidney allocation
  - compare alternatives to sequential kidney allocation including simultaneous offers, skipping candidates unlikely to accept, and open offers to centers

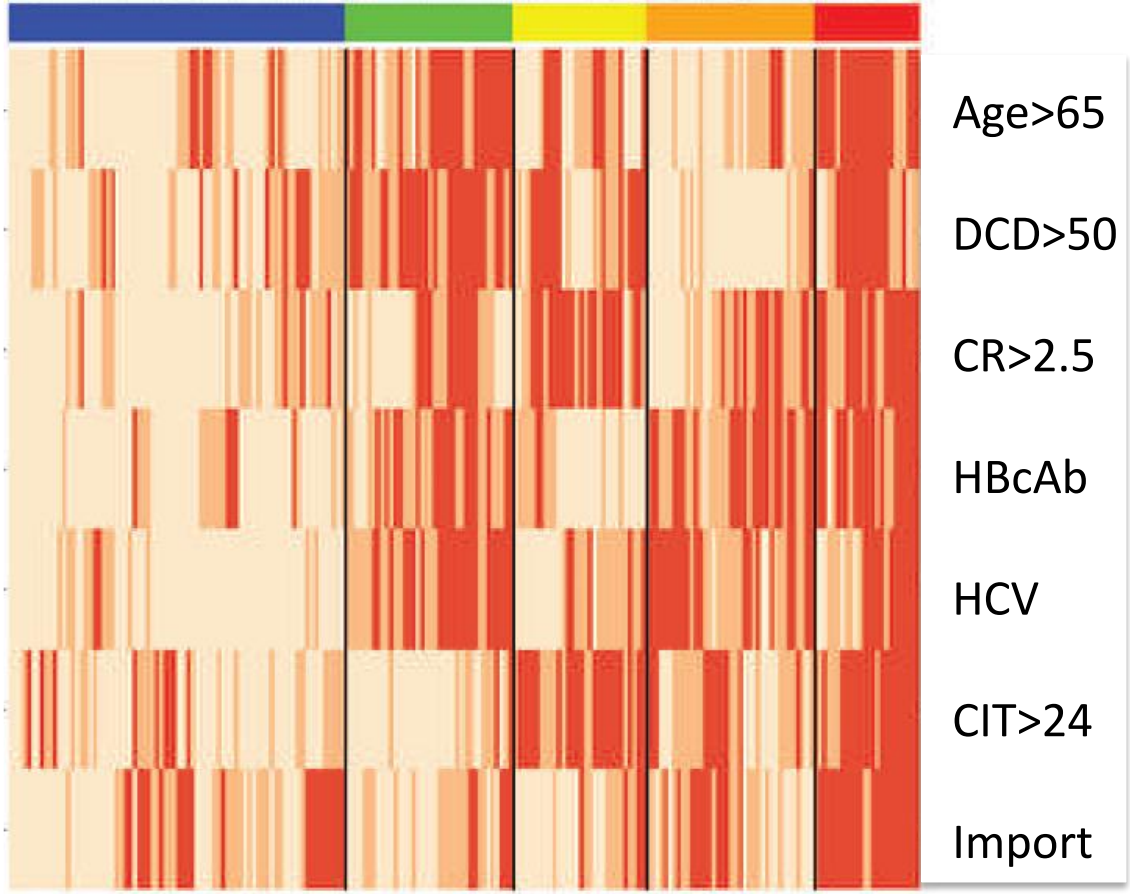
Discard and delay - Kidney

- Under new KAS, the kidney discard rate is almost **60% for KDPI > 85%** and approximately **20% overall** (Stewart et al. 2017)
- Every post-recovery kidney decline increases the CIT
- Long delays can cause usable organs of marginal quality to be eventually discarded (Massie et al. 2010)

Why are kidneys delayed and underutilized?

- Candidates near the top of the waiting list become more selective, so non-ideal kidneys must be offered until they reach candidates with lower priority, and making a large number of offers takes time
- Centers that are reluctant to take non-ideal kidneys are also reluctant to declare this fact by filtering out offers
- Centers delay placements when they are slow to decline offers; worse with larger numbers of centers in play for placing a kidney
- OPOs delay placements by making offers only post-recovery

The Aggressive Center Phenotype: Center-level patterns in the utilization of sub-optimal kidneys, Garonzik-Wang et al. AJT 12: 400-8, 2012



Characteristic	Blue	Green	Yellow	Orange	Red
Average Score	3.7	6.3	5.8	5.7	8.1
Wait-list Size	176	343	331	461	511
Organ Shortage Ratio	4.7	6.6	7.3	7.7	8.5
Wait time (yrs)	4.1	5.4	8.6	8.2	10

Center Type	1 Year Graft Survival	3 Year Graft Survival
Aggressive Centers	87.7%	75.1%
Non-Aggressive Centers	91.5%	81.7%

Reduce geographic disparity

- Center aggressiveness is related to kidney shortage: zero aggressive centers found in single-center OPOs, regions with more shortage have more aggressive centers
- DSAs and regions eliminated from kidney allocation; replaced with a 250 mile circle

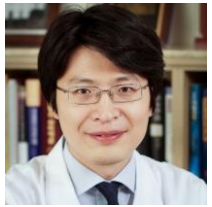
Center aggressiveness report cards

- Facilitate changes in practice by showing centers which types of non-ideal kidneys they are rejecting, and which other centers use those kidneys

Benefit calculators

- Show centers, at the point of offer, how much their particular candidate’s expected survival improves if they accept a particulary

Non-ideal kidneys (with higher KDPI) still give survival benefit

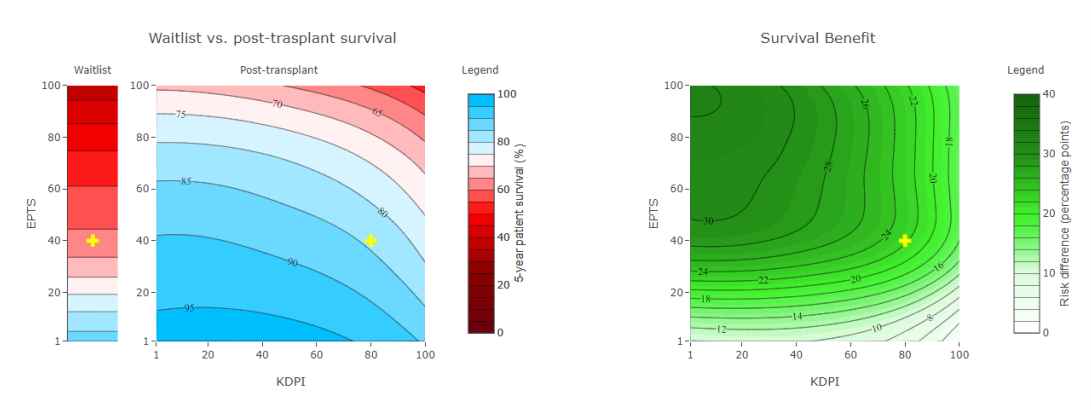


Survival Benefit Estimator

Please enter the candidate's Estimated Post-Transplant Survival (EPTS) and the kidney's Kidney Donor Profile Index (KDPI). Values are between 1 and 100.

Candidate EPTS 40 **Kidney KDPI** 80 Estimate

Predicted 5-year survival if the candidate..	
Remains on waitlist, based on the candidate's EPTS	61.8 %
Receives this kidney, based on the candidate's EPTS and the offered kidney's KDPI	84.1 %
Survival benefit, based on the candidate's EPTS and the offered kidney's KDPI	+22.3 percentage points



The yellow marker indicates predicted 5-year survival for the candidate's EPTS and the offered kidney's KDPI.
To explore other combinations of EPTS and KDPI, enter new values or place your mouse pointer on the charts.

Save it from the trash: get it for free

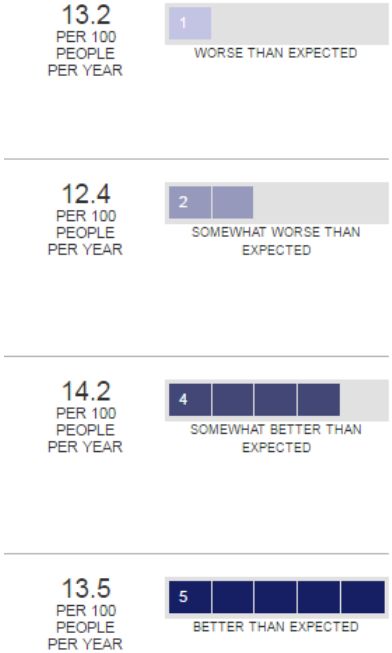
- If 12 centers refuse a kidney, and then your center takes it, outcomes are not tracked in program-specific reports
- Kidneys at highest risk of delay or discard also exempted from program-specific reports

Centers scared to take non-ideal kidneys

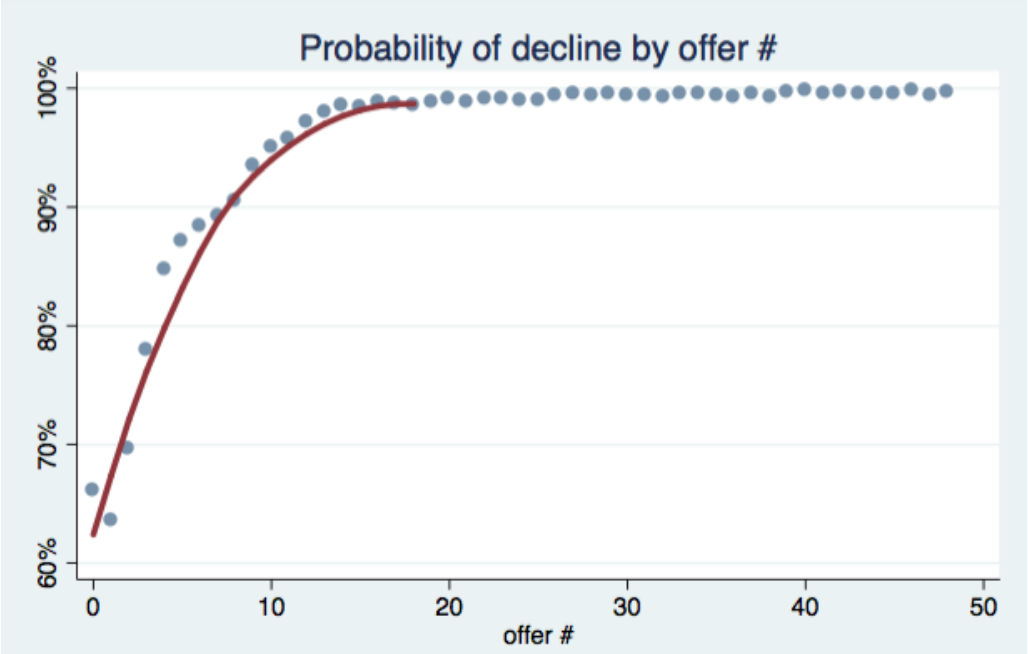
FIND & COMPARE TRANSPLANT PROGRAMS

Select Organ ▼

Search by Postal Code or Program Name (optional)



The more centers refuse an offer, the less likely the next center will accept it



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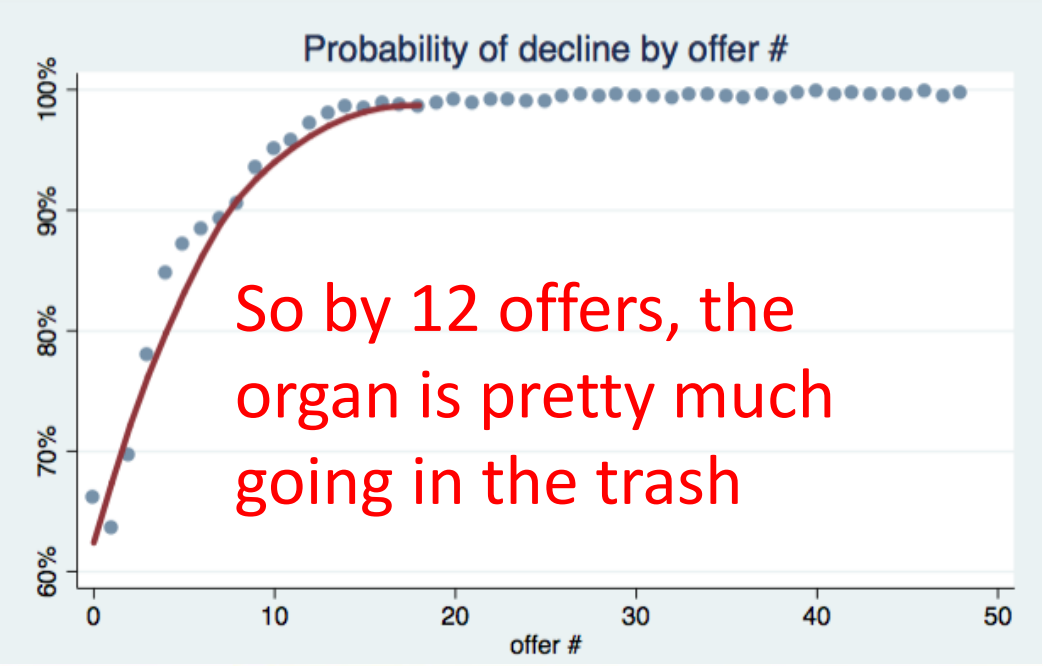
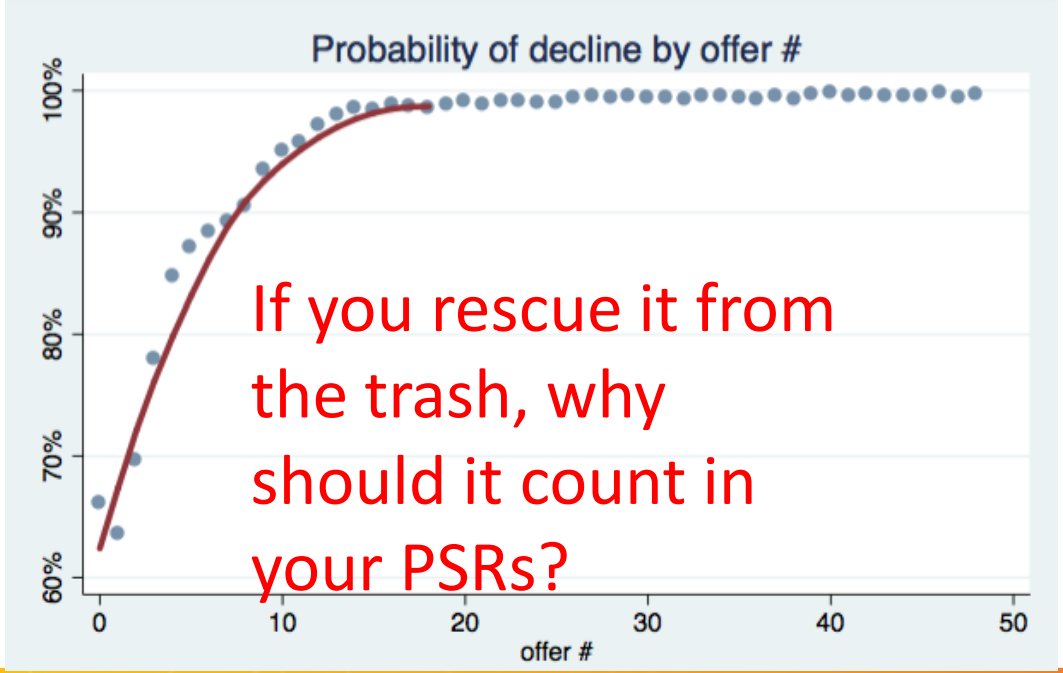


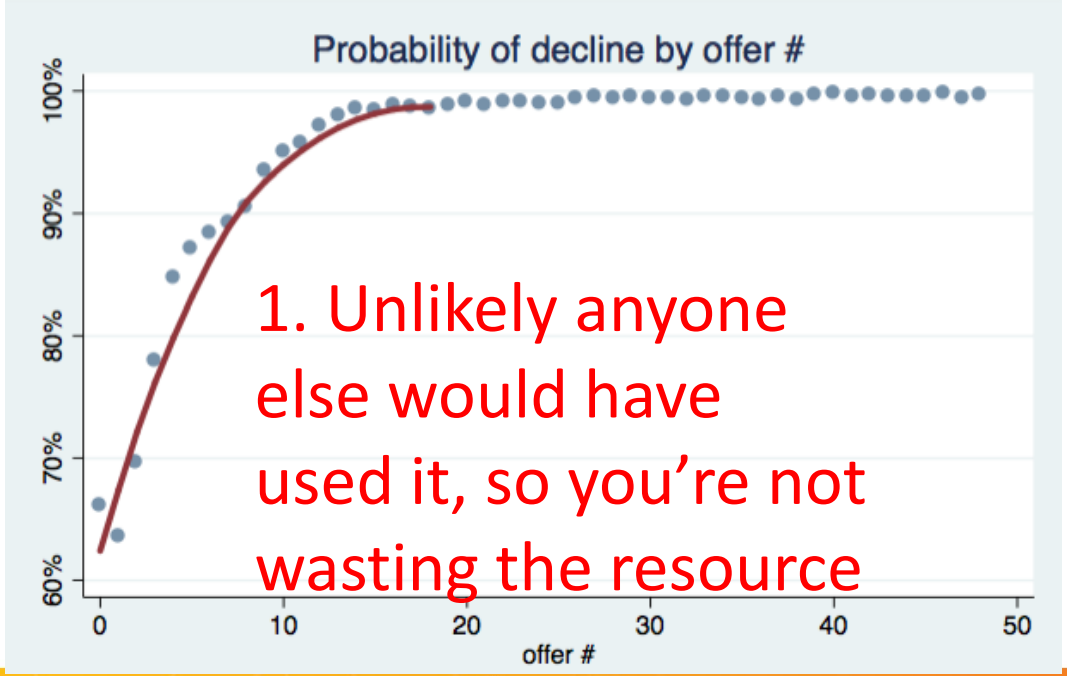
So by 12 offers, the organ is pretty much going in the trash

The more centers refuse an offer, the less likely the next center will accept it



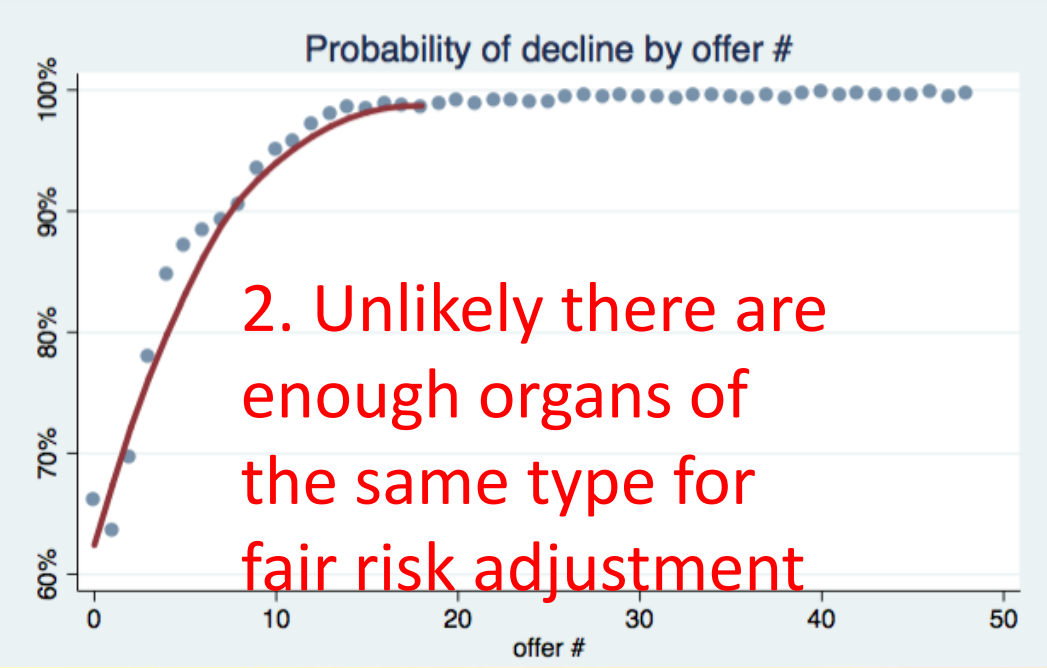
If you rescue it from the trash, why should it count in your PSRs?

The more centers refuse an offer, the less likely the next center will accept it



1. Unlikely anyone else would have used it, so you're not wasting the resource

The more centers refuse an offer, the less likely the next center will accept it



2. Unlikely there are enough organs of the same type for fair risk adjustment

Proposal

- If at least 12 centers declined the organ before you accepted it, it’s yours for free

But what if the offer went to you early:

We know which kidneys centers are scared to take

Improving Distribution Efficiency of Hard-to-Place Deceased Donor Kidneys: Predicting Probability of Discard or Delay

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Massie/Segev 2010 AJT

PODD score
(Probability of Discard or Delay)

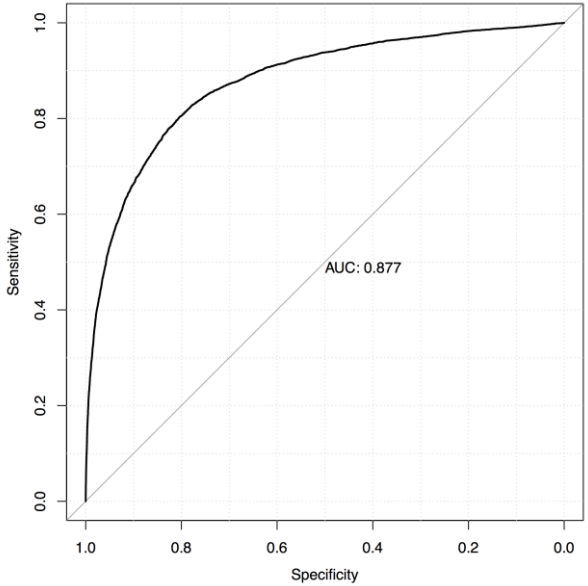
$$\text{odds} = \text{Exp}(-2.052 + 0.256 \times I[female] + 0.775 \times I[age > 40] \times [(age - 40)/10] + 0.345 \times I[bloodab] - 0.092 \times I[bmi] + 0.090 \times I[bmi > 23] \times [bmi - 23] + 0.352 \times I[cancer] + 0.105 \times I[smoking] + 0.409 \times I[hypertension] + 0.197 \times I[mi] + 0.322 \times I[diabetes] + 0.309 \times I[diabetes10y] + 0.335 \times I[insulin] + 1.000 \times I[dcd] + 0.049 \times I[cva] - 0.196 \times I[head] + 2.212 \times I[htlv] + 0.097 \times I[cmv] + 0.309 \times I[hbvcore] + 2.533 \times I[hbvcoresurface] + 1.922 \times I[hepc] + 0.250 \times I[cdc] - 0.515 \times I[pumped] + 1.321 \times I[scler20] + 1.123 \times I[creat])$$

$$\text{PODD} = \frac{odds}{1+odds}$$

Most high PODD kidneys don't get used

- PODD C statistic for predicting discard (prospective validation): **0.88**

- We <u>know</u> which kidneys centers don't want



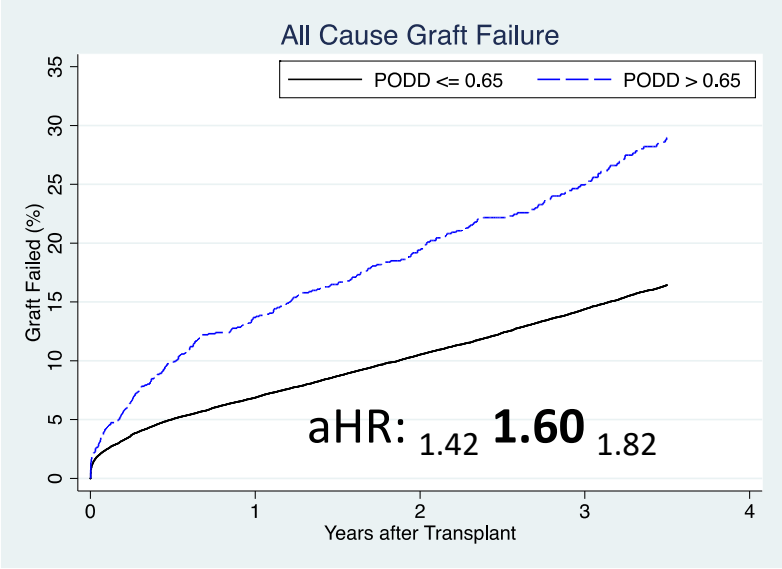
Save it from the trash: get it for free

- If at least 12 centers declined the organ before you accepted it, it's yours for free

- If you're one of the first 12 centers offered the kidney, and the PODD > 65%, it's yours for free

Are unwanted kidneys really that bad?

Center Type	1 Year Graft Survival	3 Year Graft Survival
Aggressive Centers	87.7%	75.1%
Non-Aggressive Centers	91.5%	81.7%



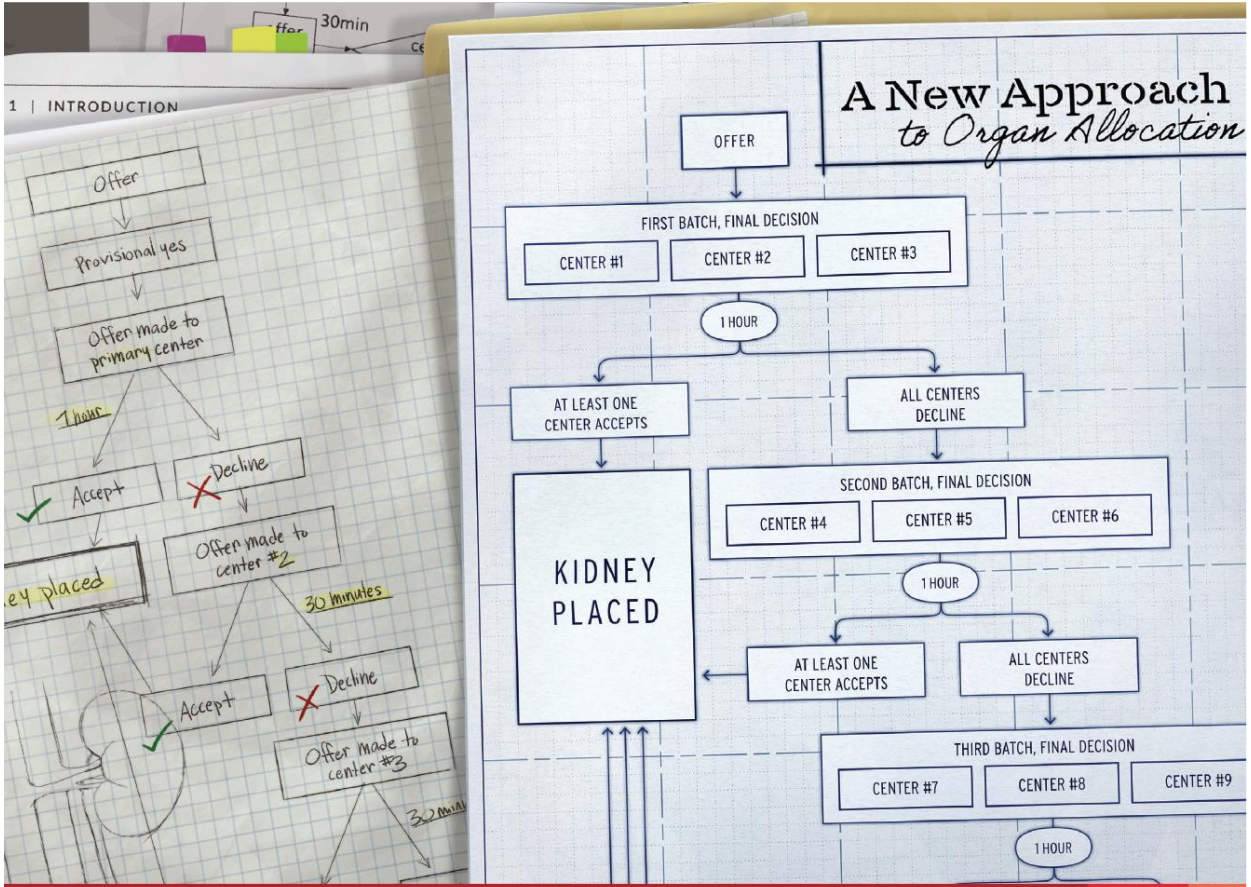
Are unwanted kidneys really that bad?

"I never thought it was such a bad little tree. It's not bad at all, really. Maybe it just needs a little love."

We need to direct them to the right recipients (and the right centers)

Accelerating kidney allocation: simultaneously expiring offers

- OPTN policy uses **sequential** expiration of offers
  - After a center becomes primary, when all higher-priority candidates have declined, then clock starts for that center to answer
  - In December 2017 these time limits were shortened to 1 hour/30 minutes, but still offers expire sequentially
- We propose to make **simultaneously expiring kidney offers in batches** to multiple centers, for kidneys offered at **regional** and **national** allocation levels
  - All centers in the batch must reply within 1 hour



WILEY

Tx NETWORK
Transplant Peer Review Network

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Accelerating allocation: Simulation

- Simulation based on Kidney-Pancreas Simulated Allocation Model (KPSAM) by SRTR
- Kidney is considered as discarded after **20h** of placement
- We assumed that one hour delay decreased acceptance by **5%**
  - There are no national data available about timing of offers, nor about incidence of post-recovery offers
  - OPTN does not report the time that a center received an offer, how long each center took to enter a final accept or decline decision, and do not even accurately reflect how many centers evaluated each organ offered
- We report the trade off between decreasing delay/discard and increasing offer screening burden with more centers per batch

Batch	Ranking match list	Center
First	Candidate 1	A
	Candidate 2	A
	Candidate 3	B
	Candidate 4	A
	Candidate 5	C
	Candidate 6	B
Second	Candidate 7	D
	Candidate 8	E
	Candidate 9	C
	Candidate 10	F
	Candidate 11	A
	Candidate 12	E
	Candidate 13	G
	Candidate 14	A

Example of simultaneous offer batches

Batching scenarios

Three scenarios of batching offers:

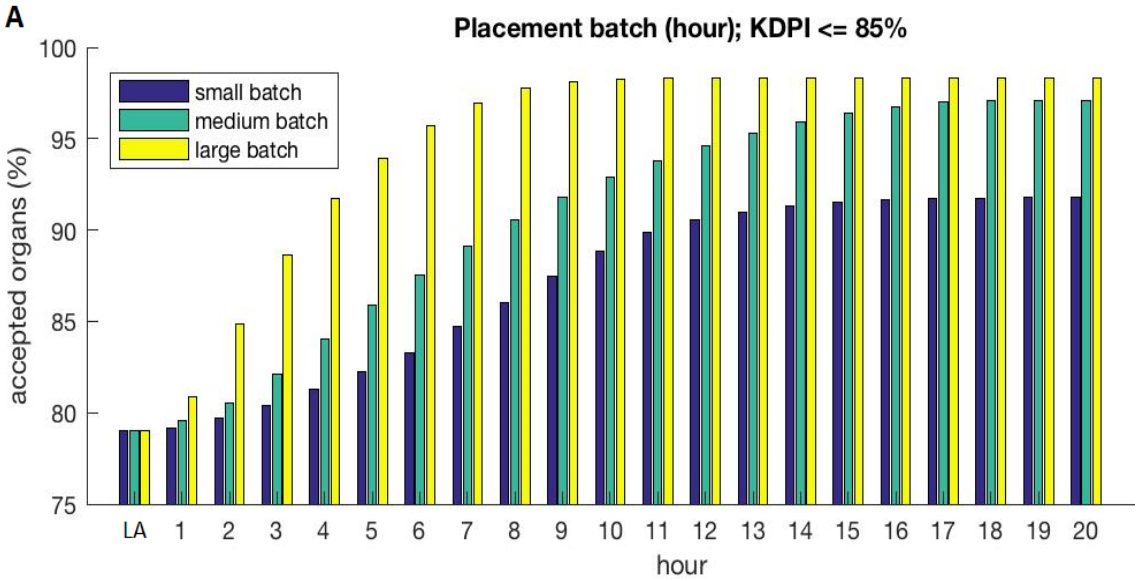
1. small batch size:
   2 centers regionally and **5** centers nationally
2. medium batch size:
   5 centers regionally and **10** centers nationally
3. large batch size:
   10 centers regionally and **20** centers nationally

Kidneys accepted; small versus large batches

- Additional 480 high DRI kidneys (KDRI > 85) placed
  - 1257 (65%) placed with small batches
  - 1737 (89%) accepted with large batches

- Additional 717 other kidneys (KDRI < 85) placed
  - 10,085 (92%) accepted with small batches
  - 10,802 (98%) accepted with large batches

Estimated placement time and discard of organs with KDPI <= 85%



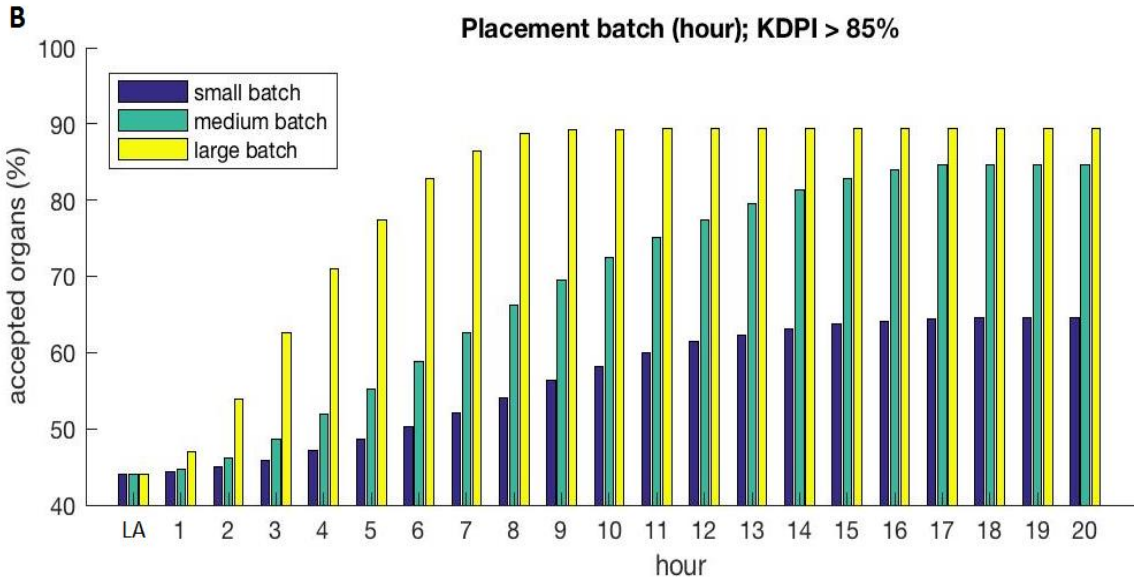
Acceptance rate

batch size	discard
Small	92%
Mid	97%
Large	98%

Placement time (first 10h)

batch size	within 10h
Small	89%
Medium	93%
Large	98%

Estimated placement time and discard of organs with KDPI > 85%



Acceptance rate

batch size	discard
Small	65%
Mid	85%
Large	89%

Placement time (first 10h)

batch size	within 10h
Small	58%
Medium	73%
Large	89%

Surgeon's workload: counting offers

- Making simultaneous offers to more centers per batch would increase surgeons' workload
- Early DonorNet was criticized for "***waking people up in the middle of the night six times a night for an [organ] that was never going to come to them***"
- We quantify the average weekly number of non-local offers per center in our simulation

Offers per week

	All kidneys		
	Regional	National	Total
Small batch	3.2	6.9	10.1
Medium-size batch	3.2	10.8	14.1
Large batch	3.3	13.5	16.8

Centers that opt out

- The only way for centers to opt out of simultaneous offering is to decline all non-local offers
- Our results show that both high- and low- DRI kidneys should be offered in simultaneous batches

Simultaneous offers

- Simultaneously expiring offers rescued 1197 kidneys from discard
- Simultaneously expiring offers decreased cold ischemia time; about 10% more low-DRI and 50% more high-DRI kidneys were placed in fewer than 10 hours
- Rescuing these kidneys means OPOs will make more offers and centers will screen more offers; about 60% increase in number of national offers screened

Skip non-aggressive centers

- Skipping: kidneys identified as non-ideal or at risk of discard or delay would be offered only to “aggressive” centers that have demonstrated willingness to accept such kidneys, which means skipping all candidates at non-aggressive centers
- Adjustment mechanism: what if a center wishes to change its aggressiveness?

Open offers

- Open offers: a kidney is offered to a center for any candidate on their waitlist, which means skipping every candidate listed at any other center

Novel approaches: utilization and allocation

- Center aggressiveness report cards
- Benefit calculators
- Save it from the trash: get it for free
- Reduce geographic disparity
- Simultaneously expiring offers
- Skip non-aggressive centers
- Open offers

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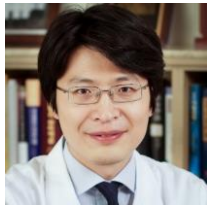
Non-ideal kidneys (with higher KDPI) still give survival benefit



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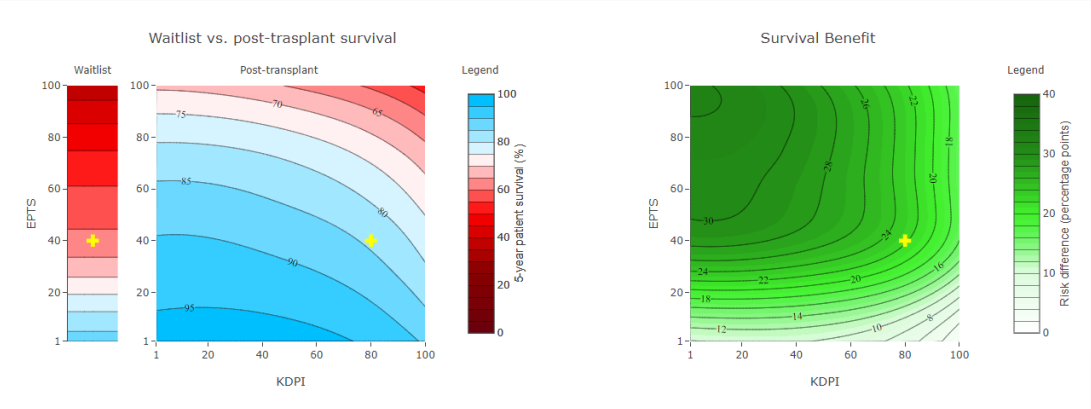

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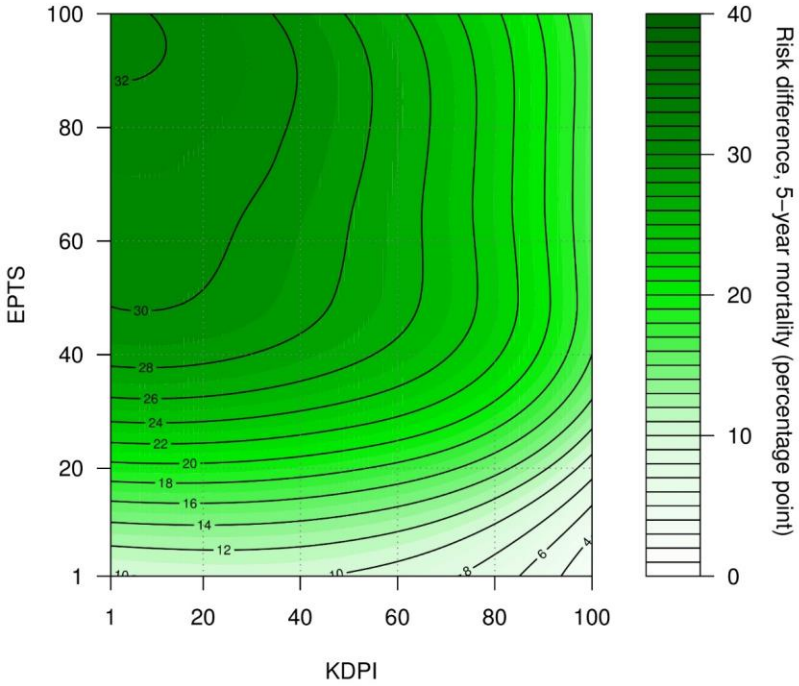
EPTS
KDPI
Risk difference, 5–year mortality (percentage point)
100
80
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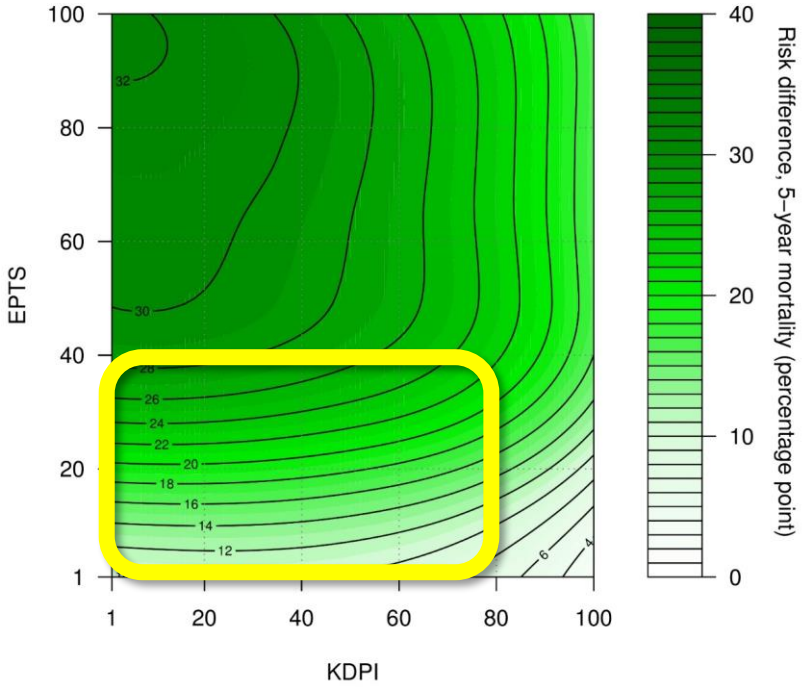
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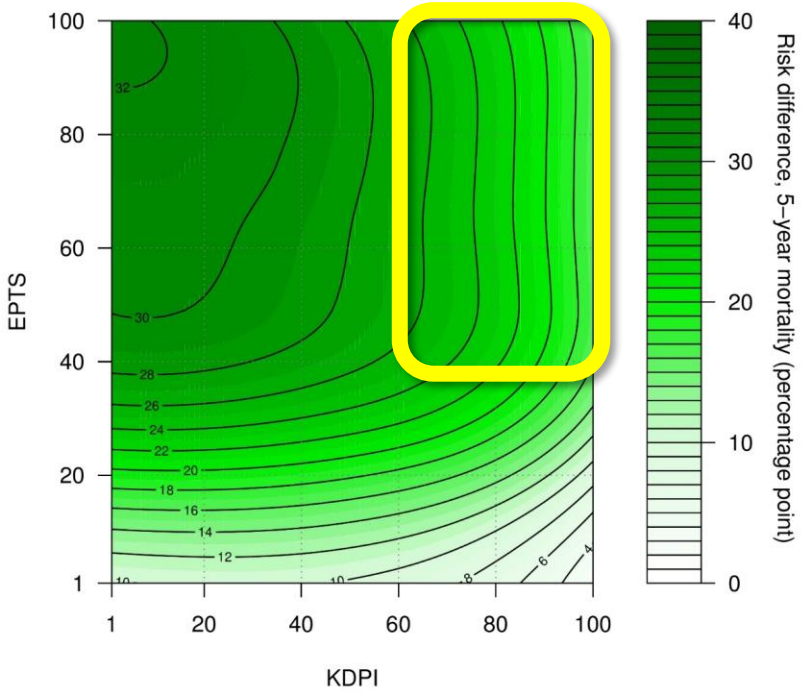
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Infectious-Risk Donors

- US Opioid epidemic: almost 30% of donors are IRD
- Discard rates 2x higher for IRDs than non-IRD counterparts
- Seems wasteful to discard these: there should be *someone* on the list who would benefit

ORIGINAL ARTICLE

AJT

Turn down for what? Patient outcomes associated with declining increased infectious risk kidneys

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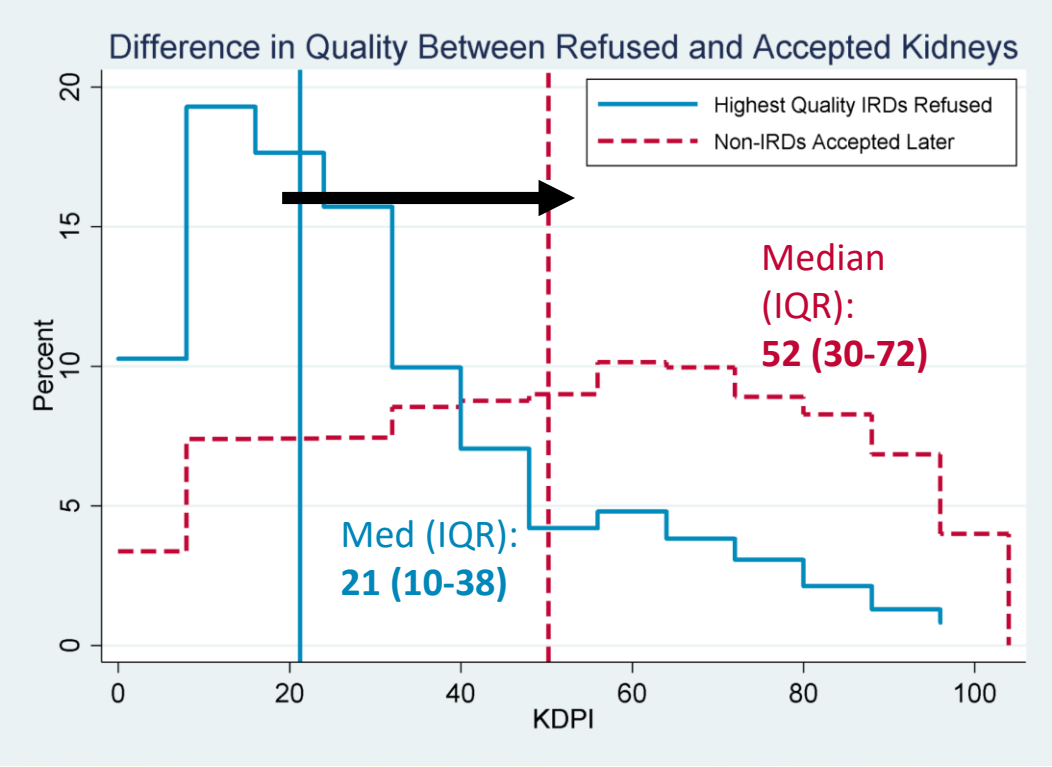
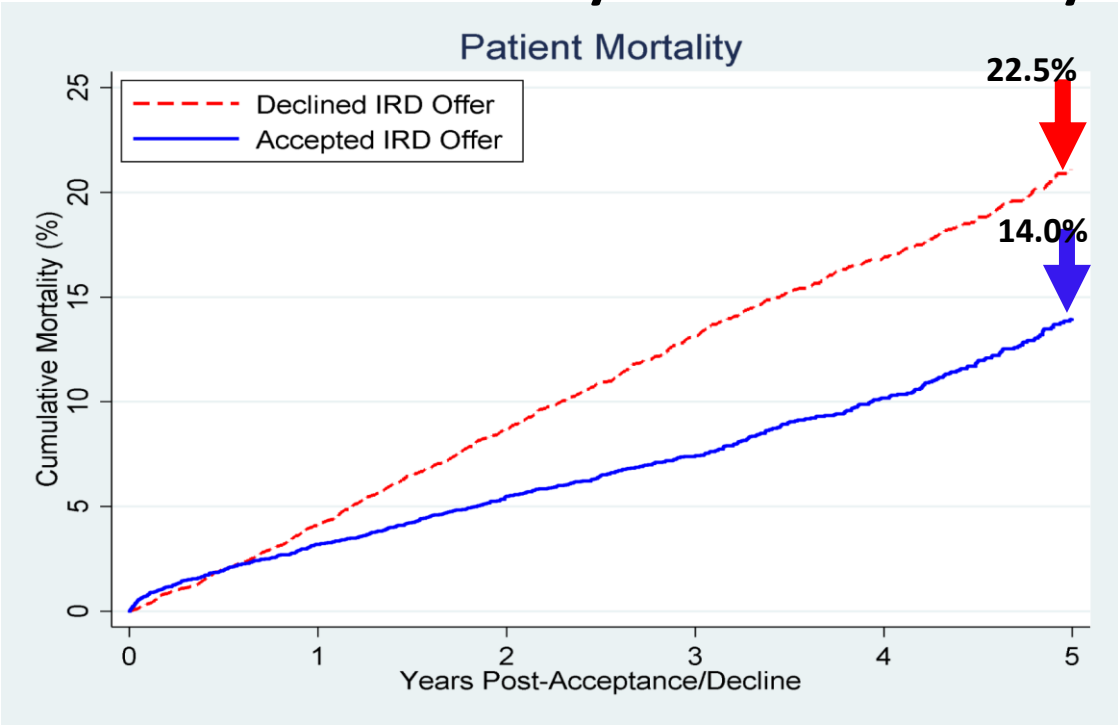
Funding information
National Institute of Diabetes and Digestive and Kidney Diseases, Grant/Award Number: K24DK101828, F30DK095545, K01DK101677 and F32DK109662; American

Infectious risk donors are higher-quality



Patients accepting infectious risk donors were less likely to die in 5 years



American Journal of Transplantation 2013; 13: 1227–1234
Wiley Periodicals Inc.

doi: 10.1002/ajt.12206

Identifying Appropriate Recipients for CDC Infectious Risk Donor Kidneys

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donors; NAT, nucleic acid testing; OPTN, Organ Procurement and Transplantation Network; PHS, Public Health Service; PRA, panel reactive antibody; SRTR, Scientific Registry of Program Recipients; T2D, time to death after transplantation with a non-IRD kidney; W2D, time to death from the waitlist; W2T, time to transplant from the waitlist

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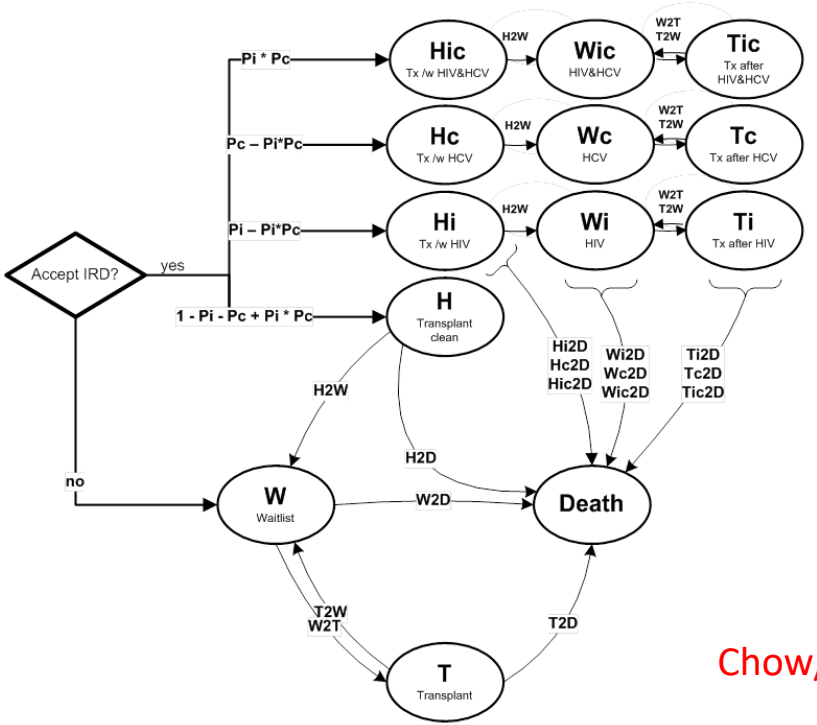
Background

Should candidate accept an IRD kidney? Markov Decision Process Model



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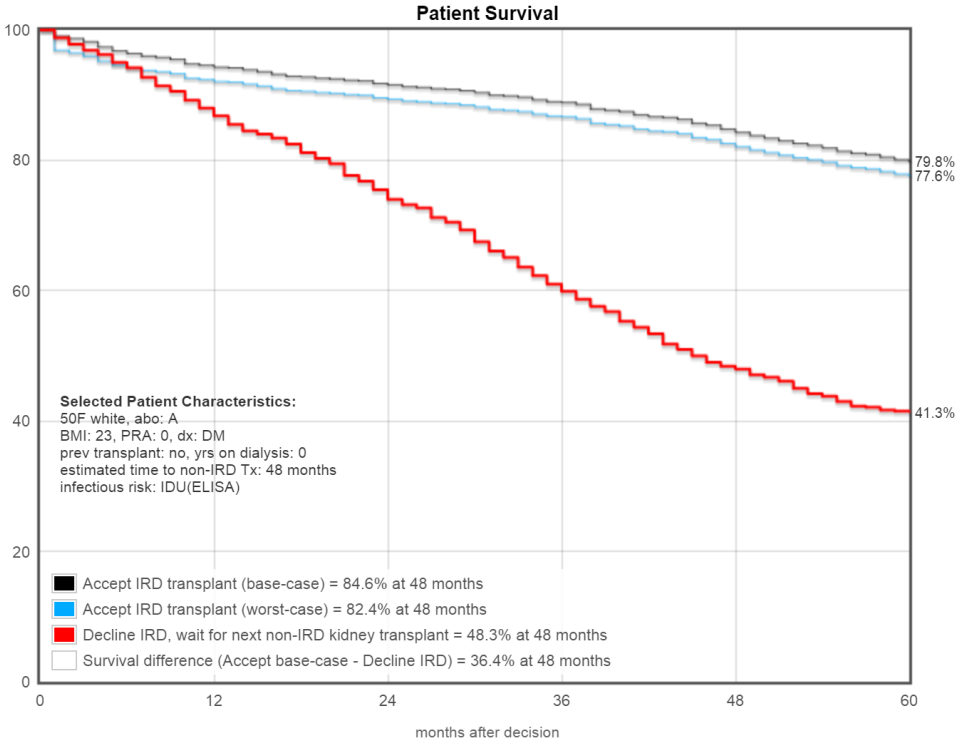
Johns Hopkins IRD Kidney Transplant Calculator



base-case estimate: mortality risk (if seroconverted) increased by 4.12% HIV, 3.42% HCV per year
worst-case estimate: mortality risk (if seroconverted) equivalent to immediate (100% chance) death

Recipient Characteristics:

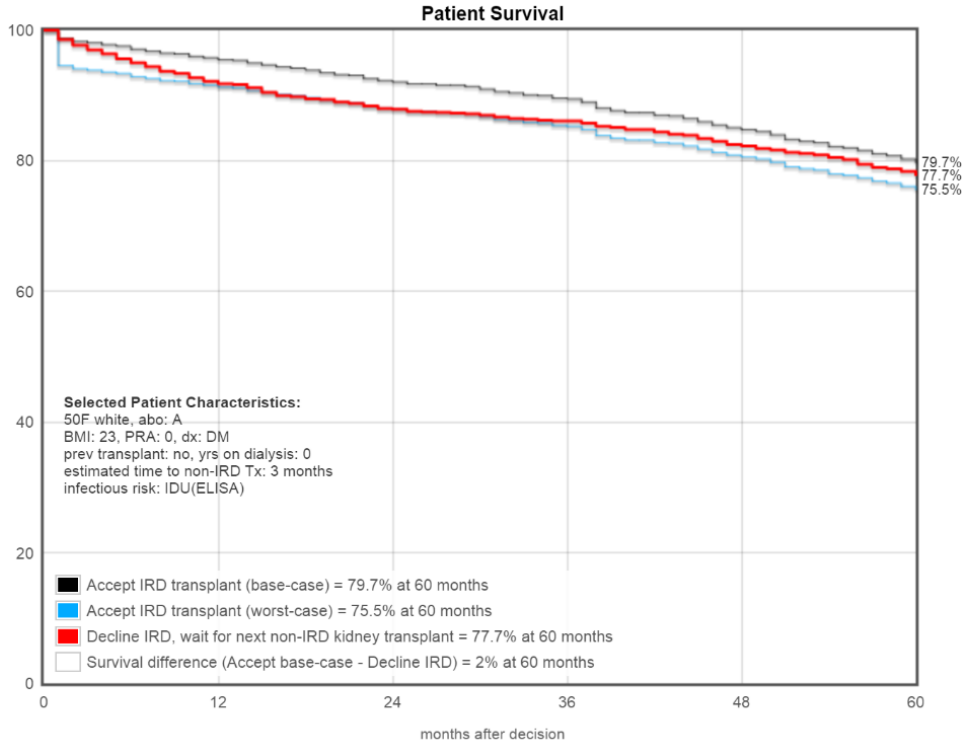
Age: (20-75)	50
Gender:	female
ABO:	Type A
Ethnicity:	White
BMI: (19-39)	23
PRA: (0-100)	0
Renal failure diagnosis:	diabetes mellitus
Previous transplant:	no
Years on waitlist:	0
Estimated time remaining until non-IRD transplant *:	48 months

* This is time in addition to the time the patient may have already waited. eg: if a patient has spent 1 year on the waitlist, and the estimated time remaining until a non-IRD transplant is 18 months, the patient is expected to have waited 30 months since listing, before a non-IRD transplant.

Donor Characteristics:

Infectious Risk Behavior:	Intravenous drug users
Serology Testing Used:	ELISA

Johns Hopkins IRD Kidney Transplant Calculator



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Age: (20-75)	50
Gender:	female
ABO:	Type A
Ethnicity:	White
BMI: (19-39)	23
PRA: (0-100)	0
Renal failure diagnosis:	diabetes mellitus
Previous transplant:	no
Years on waitlist:	0
Estimated time remaining until non-IRD transplant *:	3 months

* This is time in addition to the time the patient may have already waited. eg: if a patient has spent 1 year on the waitlist, and the estimated time remaining until a non-IRD transplant is 18 months, the patient is expected to have waited 30 months since listing, before a non-IRD transplant.

Donor Characteristics:

Infectious Risk Behavior:	Intravenous drug users
Serology Testing Used:	ELISA