Envisioning the Future

Opportunities for Improving

Organ Allocation Models

Nikhil Agarwal (MIT and NBER)

Organ Allocation: A bird's eye view

- A matching problem between patients and deceased donors

- System

  – Prioritization rules

  – Patient/surgeon decisions

- Outcomes

  – Who gets what, discards

  – Life-year benefits

What changes with policy?

- A matching problem between patients and deceased donors

- System

  - Prioritization rules ← Direct effects. Focus of committee

  - Patient/surgeon decisions

- Outcomes

  - Who gets what, discards ← Predictions. Focus of SAMs.

  - Life-year benefits

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What changes with policy?

- A matching problem between patients and deceased donors

- System

    – Prioritization rules

    – Patient/surgeon decisions ← Indirect effect (i) due to incentives

- Outcomes

    – Who gets what, discards ← Indirect effects influence predictions

    – Life-year benefits

        ← Indirect effects (ii) if decisions and outcomes are correlated

Team

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Indirect Effect (i): Why Might Decisions Change?

|	All Donors		Local Donors Only		Non-Local Donors	
	pre-KAS	post-KAS	pre-KAS	post-KAS	pre-KAS	post-KAS
Number of Donors Per Year	1407.5	2197.1	183.5	203.4	1224.0	1993.7
Number of Transplants per Year	467.3	524.6	230.3	241.7	237.0	282.9
Characteristics of All Donors						
Donor Age	48.4	46.9	43.8	42.4	49.1	47.4
KDPI	55.0	55.7	50.1	49.2	55.8	56.4
Cardiac Death Donor (DCD)	12.6%	19.2%	9.7%	18.0%	13.1%	19.3%
Expanded Criteria Donor (ECD)	45.6%	39.8%	31.1%	23.6%	47.8%	41.4%
Characteristics of Transplanted Donors						
Donor Age	43.2	40.3	41.0	40.7	44.8	40.0
KDPI	59.3	53.2	53.3	50.6	63.8	54.8
Cardiac Death Donor (DCD)	8.8%	15.9%	9.7%	18.1%	8.1%	14.5%
Expanded Criteria Donor (ECD)	29.5%	18.6%	23.8%	17.8%	33.7%	19.2%

- Agarwal, Ashlagi, Somaini, Waldinger (2018) shows that option sets affect patient/surgeon decision-making

How to model decisions in SAMs?

(Agarwal, Ashlagi, Rees, Somaini, Waldinger, 2021)

- An approach for incorporating decision changes:

    – Patient/surgeon accepts an offer for a kidney if

    Benefits from transplantation > Benefits from waiting

    – Benefits from waiting depends on the likely future offers

- Dynamic SAM estimates benefits using this equation

    – Simulations estimate the change in benefit of waiting

- Thus, it allows for choice to depend on the priority rules!

    – See also Ata, Friedewald, Cem Randa (2020)

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Indirect Effect (ii): Outcomes and decisions
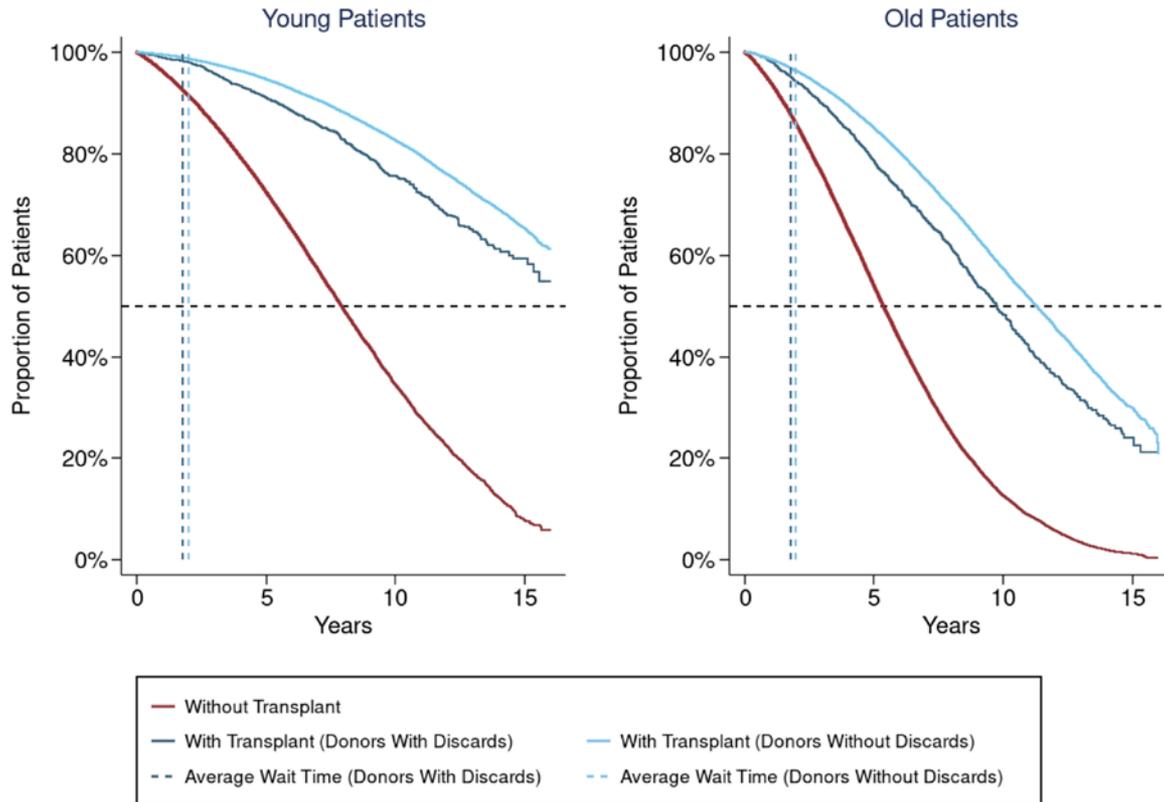
- Decisions and outcomes are not independent

  – Unmeasured patient condition
  (e.g. dialysis tolerance)

  – Unmeasured donor quality

- Controlling for what we observe is not sufficient

- Selection bias!

Correcting for Selection Bias

(Agarwal, Hodgson and Somaini, 2021)

- Gold-Standard experimental evidence:

  - Random assignment of kidneys to patients

  - Not possible!

- Second-best approach: Using a natural experiment.

  - Identical patients receive different transplants because:

    - Different offers due to timing
    - They make different decisions due to local organ scarcity

- Corrected life-years from transplantation (avg. 7.98 → 8.64 yrs)

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More Room for Improvement

- Real world is messier than simulations

- Policy changes can affect a number of things. Examples:

  – Patients registering on the list

  – Organ recovery ← OPO incentives

  – Offer processing speed (can affect cold ischemic time)

- Simulations are imperfect

  – But, they are our best guide in a complicated world

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