Beyond Geography: Novel Ideas and Challenges in Organ Allocation

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Disclosure

I have no disclosures relevant to this talk.

Other disclosures:

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Learning Objectives

• To understand currently available data on use of risk scores for donor heart allocation.

• To become familiar with strategies for allocating higher-risk donor hearts.

• To describe strategies to improve organ allocation, including use of artificial intelligence and other novel technologies.
Risk Scores for Heart Transplant Allocation

Donor risk scores

• **Donor Risk Index** (4 variables: donor age, BUN/Cr ratio, race mismatch, ischemic time)

• **Eurotransplant Heart Donor Score** (12 variables)
Recipient risk scores

- **IMPACT**: 12 variables

- **CARRS score** (CVA, albumin, Re-HTx, renal dysfunction, sternotomies)


Schulze PC, Circ Heart Failure, 2013
Risk Scores for Heart Transplant Allocation

Donor and recipient risk scores

- **Hong KN**: 3 donor, 8 recipient, and 2 transplant-related variables

- **Singh TP**: 1 donor, 6 recipient, and 1 transplant-related variable

Hong KN, Ann Thorac Surg, 2011

Singh TP, Circulation HF, 2012
### Risk Scores for Heart Transplant Allocation

**Donor and recipient risk scores: SRTR**

#### Model Coefficients

This table shows the coefficients for each level of the risk adjusters included in the model. These coefficients are from a Cox proportional hazards model. To better understand the relationship between each element and modeled risk, click on the 'Model Element Plots' tab. To download a CSV file of the model, click the button above.

Note: the list of predictors may include indicators for multiorgan transplant types. The SRTR is building new models so that multiorgan transplants can be included in future risk-adjusted outcomes, although they are not currently included in the data presented in the program-specific reports.

**Download CSV File**

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<thead>
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<th>Element</th>
<th>Level</th>
<th>Coefficient</th>
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<tr>
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<td>Candidate Diabetes Type</td>
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<td>Type Other/Unknown</td>
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</table>
Risk Scores for Heart Transplant Allocation

Problems with current risk scores

• Focus solely on post-transplant survival, not on waitlist mortality

• Use of registries with few donor variables (and of questionable quality)

• Can only examine outcomes of donor hearts *that were used for transplant* (so we don’t know potential outcomes of hearts that were not used)
Donor Predictors of Recipient Outcomes

We can accurately model which donor hearts are likely to be *accepted* for transplant, but these predictors say nothing about how the recipient will fare post-transplant.

Khush K, Circ Heart Failure, 2013
Donor Utilization Score

- Used ISHLT Registry to examine heart donors in Europe (2000-2018, N=27,631) and used the California Random Forest Model to determine which donor hearts *would* and *would not* have been accepted for transplant in the US.
- Calculated a **Donor Utilization Score (DUS)**: likelihood that the heart would have been accepted in the US (0-1.0)
- Donors with low DUS
  - Older
  - Stroke as cause of death
  - Lower LVEF
  - Hypertension
  - Shorter

Yas Moayedi, MD
Donor Utilization Score

Donor age and DUS

Donor cause of death and DUS

Moayedi Y, manuscript submitted for publication
Donor Utilization Score

- 2/3 of donor hearts accepted for European recipients would have been discarded in the US
- The DUS predicts short-term post-transplant mortality: higher mortality for recipients of hearts with DUS<0.4

- US centers can safely increase donor heart utilization by accepting hearts with DUS>0.4
  - Estimated 400 additional donor hearts per year
  - Reduce waitlist times
  - Reduce waitlist mortality
Donor Heart Study

• 5 (now 6) -year prospective study to establish evidence-based guidelines for donor heart evaluation and acceptance for transplantation
• Funded by National Institutes of Health (National Heart, Lung, and Blood Institute)

Principal Investigator
Kiran Khush, MD, MAS (Stanford University)

Co-Investigators
Darren Malinoski, MD (OHSU/Portland VA)
Jonathan Zaroff, MD (Kaiser Division of Research)
Participating OPOs
**DHS: Study Aims**

**Aim 1:** To identify clinical correlates of cardiac function in potential heart donors
- Standardized data collection on cardiac assays
  - Electrocardiogram (ECG)
  - Echocardiogram (TTE)
  - Troponin-I
  - B-type natriuretic peptide (BNP, nt-proBNP)

**Aim 2:** To prospectively collect detailed data on reasons for donor heart non-acceptance

**Aim 3:** To develop clinical tools to assist transplant centers with real-time decisions regarding donor heart acceptance
DHS: Enrollment to-date

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<th>OPO</th>
<th>Eligible</th>
<th>Enrolled</th>
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<td>269</td>
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<td>Donor Network West</td>
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<td>LifeChoice</td>
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<td>97</td>
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<td>LifeLink Georgia</td>
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<td>559</td>
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<tr>
<td>Gift of Hope IL</td>
<td>830</td>
<td>584</td>
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<td>New England Organ Bank</td>
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<tr>
<td>Gift of Life MI</td>
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<td>533</td>
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<td>LifeGift Texas</td>
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<td>693</td>
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<tr>
<td>Total</td>
<td>5646</td>
<td>4104</td>
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**Enrollment vs. Time**

- Donor Network West
- Donor Network of Arizona
- LifeChoice
- LifeLink GA
- Gift of Hope IL
- New England Donor Services
- Gift of Life Michigan
- LifeGift TX

**Date of Second Note of Brain Death**

Heart Allocation Score

• Balances risk of waitlist mortality with post-transplant mortality
• Our practice has changed so much in the past few years (temporary and durable MCSD)
• Need to identify, collect, and analyze data for key variables
• “Moving target” as the allocation system evolves
Transplant Center Considerations

Should we allocate “hard to place organs” to centers that are more likely to accept them?

- Median donor sequence number varies across the country, likely reflecting transplant-center practices, local competition, OPO performance, etc.

Khush K, Am J Transplant, 2019
Transplant Center Considerations

Should we allocate “hard to place organs” to centers that are more likely to accept them?

• Donor sequence number is not predictive of post-transplant survival

• This approach would expedite organ placement to aggressive centers, but may not achieve optional D-R matching

Baran D, Circulation Heart Failure, 2019
Transplant Center Volume: Is Bigger Better?

Should heart transplantation be performed primarily at higher volume centers?

- Inferior survival at low volume centers (<10.5 transplants/year)
- Particularly true for high risk donors and recipients

Transplant Center Volume: Is Bigger Better?

Should heart transplantation be performed primarily at higher volume centers?

Change the Playing Field

Should we incentivize centers to accept higher-risk donor hearts?

• Modify the metrics by which transplant centers are evaluated
• Changes to hospital reimbursement systems
• Publicly available data on donor heart acceptance
• Education campaigns on benefits of accepting higher risk organs
• Shared decision making with patients
Change the Playing Field

SRTR: Publicly available data on donor heart acceptance

Table B10. Offer Acceptance Practices: 07/01/2018 - 08/30/2019

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<thead>
<tr>
<th>Offers Acceptance Characteristics</th>
<th>This Center</th>
<th>OPO/DSA</th>
<th>Region</th>
<th>U.S.</th>
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<tbody>
<tr>
<td>Overall</td>
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<tr>
<td>Number of Offers</td>
<td>216</td>
<td>671</td>
<td>3,402</td>
<td>45,104</td>
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<tr>
<td>Number of Acceptances</td>
<td>61</td>
<td>199</td>
<td>528</td>
<td>3,219</td>
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<td>Expected Acceptances</td>
<td>229</td>
<td>75.9</td>
<td>309.2</td>
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<td>PHS increased infectious risk</td>
<td>2.53</td>
<td>1.43</td>
<td>1.32</td>
<td>1.00</td>
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<tr>
<td>Ejection fraction &lt; 60</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Number of Offers</td>
<td>68</td>
<td>228</td>
<td>1,153</td>
<td>13,883</td>
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<tr>
<td>Number of Acceptances</td>
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<td>29</td>
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<td>Expected Acceptances</td>
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<tr>
<td>Donor Age &gt;= 40</td>
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<td>Number of Offers</td>
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<td>164</td>
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<td>Number of Acceptances</td>
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<td>Donor more than 560 miles away</td>
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<td>Number of Offers</td>
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<td>Number of Acceptances</td>
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<td>Expected Acceptances</td>
<td>3.14</td>
<td>2.30</td>
<td>1.49</td>
<td>1.01</td>
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Figure B1. Offer acceptance: Overall
Figure B2. Offer acceptance: PHS increased infectious risk
Figure B3. Offer acceptance: Ejection fraction < 60
Figure B4. Offer acceptance: Donor age >= 40
Figure B5. Offer acceptance: Donor more than 560 miles away
Change the Playing Field

SRTR: Publicly available data on donor heart acceptance
New Strategies for Organ Offers

UNOS projects to increase organ utilization

1. **Kidney accelerated placement project**: Allows difficult-to-place kidneys to reach patients at hospitals that have previously accepted and transplanted medically similar kidneys, potentially minimizing cold ischemic time.
New Strategies for Organ Offers

2. Better offer screening:
   • Offer a “filters tool” that will allow transplant centers to filter out donor offers they do not want to receive by creating custom-designed, multi-criteria filters
   • Centers can select model-derived filters generated by UNOS based on offer refusal patterns
New Strategies for Organ Offers

3. **Improved donor image sharing**: Gives universal access to high-quality medical imaging during the organ offer process
New Strategies for Organ Offers

4. Collaborative Innovation and Improvement Network:
   • UNOS performance improvement specialists worked on-site with centers to improve performance (waitlist management, organ offer and acceptance, care coordination) in real time
   • 90-day cycles
   • Teams worked collaboratively with other centers
   • Centers encouraged to develop tools that best fit their programs
New Strategies for Organ Offers

5. **OPO Benchmark Reports**: Enables OPOs to compare themselves to other similar OPOs to evaluate performance measures.

6. **Organ Utilization Tool**: Visually illustrates the characteristics and outcomes of organs turned down by local centers that were transplanted elsewhere.
New Strategies for Organ Offers

7. **Center Acceptance and Refusal Evaluation (CARE) tool**: Transplant centers can see the outcomes for organ offers they accept as well as those they refuse.
New Strategies for Organ Offers

8. **UNOS Labs**: Experimental incubator that brings together data, technology, and industry expertise to improve the allocation and transplantation system.

E.g. Use of artificial intelligence to simultaneously account for donor and candidate characteristics, as well as transplant center acceptance practices, to more “intelligently” offer organs, and offer them faster.
Summary: Novel Approaches to Improve Allocation

• Use risk scores to improve donor heart utilization (Donor Utilization Score)
• Heart allocation score
• Preferential “higher risk” organ allocation to more aggressive centers
• Reduce the number of transplant centers (favoring higher volume)?
• Incentivizing centers to accept higher risk donor hearts
• Partnering with UNOS to develop new technologies to improve the allocation process
Thank you