Waste Not, Want Not: An Analysis of Discarded Organs
Darren Stewart, M.S.
Sr. Research Scientist
United Network for Organ Sharing (UNOS)

Disclosures

I have no financial relationships to disclose relevant to my presentation

AND

My presentation does not include discussion of off-label or investigational drugs

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Learning Objectives

1. To describe trends in organ utilization
2. To identify factors associated with long-term and post-KAS kidney discard rate trends
3. To discuss the relative sizes of differential sources of potential missed opportunities for transplantation

Waste Not, Want Not

Deceased donor

A *decedent from which at least one solid organ was recovered for the purpose of transplantation.*

Deceased kidney donor

A *deceased donor from which at least one kidney was recovered for transplantation.*

Waste Not, Want Not

Organ “discard” definition

*An organ recovered for the purpose of transplantation but not transplanted.*
Deceased donor organ transplantation is no longer stagnant

Waste Not, Want Not

https://optn.transplant.hrsa.gov/

Still, the vast supply-to-demand gap remains

Waste Not, Want Not

https://dambreaker.wordpress.com/2013/03/17/the-cliffs-of-insanity/

118,895 patients waiting

33,608 transplants in 2016

If none of the transplant-quality kidneys discarded under current practice was "wasted" but all were instead transplanted, would the 100,000 patients on the kidney waiting list no longer be in want? (Yes, No)
Kidney Discard Rate Trend

Waste Not, Want Not

How many of the ~3,000 annually discarded kidneys should have been discarded?

How many were “transplantable” and represent missed opportunities?

Filtering Analysis of Kidneys Discarded in 2012

Source: ATC Symposium 2013
Stewart, Rosendale, Delmonico
Filtering Analysis of Kidneys Discarded in 2012

Source: ATC Symposium 2013
Stewart, Rosendale, Delmonico

2,759 discarded kidneys

Filter Step

OPO discard reasons
Exclude 529 medical rule outs
(inherent defects, per OPO)
Exclude 79 due to recovery/surgical damage
Exclude 210 due to defects, disease, surgical damage, etc.

OPO discard reasons
2,230

TXC offer refusal reasons
2,151

OPO discard reasons
1,941

TXC offer refusal reasons
1,413

TIEDI® DDR form

1,110 remaining discards

Exclude 299 with KDRI > 2.25

TIEDI® DDR form

Very low function/quality

Exclude 4 HbSag+

About 800 (30%) of the kidneys were discarded due to inherent defects or damage.
1,110 Discards by KDRI and eGFR

<table>
<thead>
<tr>
<th>eGFR</th>
<th>40-60</th>
<th>60-80</th>
<th>80-100</th>
<th>100-120</th>
<th>120+</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>KDRI (KDPI approx)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.00-2.25 (90-95%)</td>
<td>82</td>
<td>34</td>
<td>42</td>
<td>30</td>
<td>4</td>
<td>192</td>
</tr>
<tr>
<td>1.75-2.00 (82-90%)</td>
<td>71</td>
<td>66</td>
<td>60</td>
<td>21</td>
<td>14</td>
<td>232</td>
</tr>
<tr>
<td>1.50-1.75 (70-85%)</td>
<td>86</td>
<td>56</td>
<td>71</td>
<td>56</td>
<td>39</td>
<td>306</td>
</tr>
<tr>
<td>1.25-1.50 (50-70%)</td>
<td>53</td>
<td>50</td>
<td>43</td>
<td>70</td>
<td>12</td>
<td>226</td>
</tr>
<tr>
<td>&lt;=1.25 (&lt;50%)</td>
<td>70</td>
<td>37</td>
<td>18</td>
<td>88</td>
<td>46</td>
<td>156</td>
</tr>
<tr>
<td>All</td>
<td>312</td>
<td>245</td>
<td>229</td>
<td>217</td>
<td>109</td>
<td>1,110</td>
</tr>
</tbody>
</table>

633 kidneys with eGFR>40, KDRI<2.25 (“Group B”)

477 kidneys with eGFR>80, KDRI<2.00 (“Group A”)

Descriptions of Group A & B Discards

<table>
<thead>
<tr>
<th>Group A (eGFR&gt;80, KDRI&lt;2.0)</th>
<th>Group B (eGFR&gt;40, KDRI&lt;2.25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (kidneys)</td>
<td>477</td>
</tr>
<tr>
<td>Mean terminal creatinine</td>
<td>0.70</td>
</tr>
<tr>
<td>Mean eGFR (CKD-EPI formula)</td>
<td>111.9</td>
</tr>
<tr>
<td>DCD</td>
<td>33.1%</td>
</tr>
<tr>
<td>ECD</td>
<td>21.6%</td>
</tr>
<tr>
<td>Glomerulosclerosis &gt; 20%</td>
<td>20.1%</td>
</tr>
<tr>
<td>CDC/PHS High Risk Donor</td>
<td>21.0%</td>
</tr>
<tr>
<td>HCV+</td>
<td>20.3%</td>
</tr>
</tbody>
</table>

72% had at most one of these risk factors

Most of these kidneys (especially Group A) had good estimated function and no more than one risk factor.

Candidates expected to “benefit” from a high KDPI kidney

Candidates predicted to benefit from high KDPI transplantation were on match run for nearly all 1,110 kidneys.
Filtering Analysis Conclusions

- 500 to 1000 kidneys ostensibly of transplant quality were discarded in 2012.
- At least 25% of discarded kidneys
- Significant unrealized transplant potential exists among discarded kidneys

Waste Not, Want Not

Why did the kidney discard rate rise from about 5% in the late 80's to nearly 20% by 2009?

Kidney Discard Rate Trend
Long-run increasing trend in median age, BMI, and KDRI among recovered kidney donors.

**Waste Not, Want Not**

What percentage of the long term, increasing discard rate trend can be explained by the recovery of an increasingly older, comorbid, and lower quality donor pool?

A. 0%

B. 1-25%

C. 26-50%

D. 51-75%

E. 75-100%

*Interactive polling question*

Long-run increasing trend in median age, BMI, and KDRI among recovered kidney donors.

**Waste Not, Want Not – 10 Year Trend (1999-2009)**

Long-run increasing trend in median age, BMI, and KDRI among recovered kidney donors.
Trend Analysis Conclusions

- Most (>80%) of the long-run increasing discard rate trend can be explained by changes in donor factors (including biopsy, pump)
- A statistically significant, residual increase in the discard rate was found, suggesting:
  1. Transplant center (or patient) risk aversion may have increased over time
  2. Allocation efficiency may have declined
- Increase in biopsies contributed to the discard rate rise
- Increase in pumping prevented the discard rate from rising further
Kidney Discard Rate Trend

- Pre-KAS (Jan 1, 2010 - Dec 3, 2014)
  - 18.9%
- Post-KAS (Dec 4, 2014 - Mar 31, 2016)
  - 19.2%

Statistically significant rise in discard rates post KAS.

Kidney Discard Rate: Pre (~5 years) vs. Post KAS (16 months)

- P-value=0.003
- RR=1.08
- OR=1.10

Trends in kidney pumping (KDPI>85% kidneys)

- Pre-KAS: 38.4%
- Post-KAS: 27.4%

Sharp drop in pumping KDPI>85% kidneys after KAS.
KAS Impact on Kidney Discards - Key Findings

- Discard rate has risen about 10% after KAS
  - Not explained by changes in donor KDPI
  - Poorer biopsy findings appear to have played a role
  - Practice changes – less pumping for KDPI>85% kidneys – appear to have played a role

Waste Not, Want Not – Liver Discard Rate

In contrast to kidneys, liver discard rate has remained relatively low and stable over time.
Deceased Donor Potential Study (DDPS) “Filter”

Exclusion:
- TB, viral meningitis, rabies, malignant neoplasms, amyloidosis, etc.

Inclusion:
- Intracerebral hemorrhage, head injury, anoxia, etc.

(1.5% of deaths)

Due to data limitations, filter estimate likely reflects an “upper bound” on donation potential.

Deceased Donor Potential Study: Organ-Specific Estimates*

<table>
<thead>
<tr>
<th>Estimate Type</th>
<th>Potential Donors (“cell 2”, Age&lt;25, Severity Score&lt;14)</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-organ specific (age≤75)</td>
<td>35,282</td>
<td>-N/A</td>
</tr>
<tr>
<td>Kidney-specific (no renal failure, age≤69)</td>
<td>28,996</td>
<td>-24.3%</td>
</tr>
<tr>
<td>Lung-specific (no chronic pulmonary disease, age≤65)</td>
<td>24,601</td>
<td>-35.8%</td>
</tr>
<tr>
<td>Heart-specific (no CHF or pulmonary disorder, age≤60)</td>
<td>18,184</td>
<td>-52.5%</td>
</tr>
</tbody>
</table>

*Based on Nationwide Inpatient Sample (NIS) from 2010

A significant portion of the estimated donor potential would not be viable for kidney, lung, or heart donation.

Deceased Donor Kidney Sources

Non-recovered kidneys among donors (n=1,780)

Per DDPS: Kidneys from non-donors (n=possibly as many as 20,000 x 2 = 40,000)

Greatest potential to close the gap is likely from today’s non-donors
Reducing discards and identifying new donation opportunities could help reduce the gap.

Bridging the Gap (kidney)

~100,000 kidney patients waiting

Perhaps 1,000 additional transplants from discards

19,061 transplants in 2016

DDPS suggests even more opportunities for additional transplants from current non-donors

Opportunities to further narrow the gap exist among discarded organs & donation potential unrealized under current practice.

Waste Not, Want Not – Conclusion

Opportunities to further narrow the gap exist among discarded organs & donation potential unrealized under current practice.

Waste Not, Want Not - Solutions

- Improve allocation
- Share OPO best practices
- Reduce transplant center & OPO risk aversion
- Improve the transplant reimbursement model
- Recondition marginal organs
- Increase living donation
Post-test question
Numerically, the greatest opportunity to narrow the kidney transplant supply to demand gap exists among which group?
A. Recovered but discarded kidneys
B. Non-recovered kidneys from deceased donors
C. Non-recovered kidneys from non-donors
Waste Not, Want Not

Did the discard rate reach 20% for the first time in 2016 due to a shift in donor quality?

(no, KDRI distribution largely unchanged. Slightly lower KDRI distribution among donors, actually, likely due to slight declining trend in donor ages due to opioid epidemic.)

Graft Survival & Discard Rates by KDPI – Is There a Disconnect?

Gradual decline in graft survival, yet steep increase in kidney discard rate.

Source: Stewart, et al, ATC 2013

Reasons for Kidney Discards by KDPI

Most high KDPI discards not due to anatomy or trauma.