Simulated Tier Variability

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Disclosures

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I have no financial relationships to disclose within the past 12 months relevant to my presentation.

AND

My presentation does/do not include discussion of off-label or investigational use
I do/do not intend to reference unlabeled/unapproved uses of drugs or products in my presentation

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Background

The Scientific Registry of Transplant Recipients semi-annually assigns transplant programs to one of five performance tiers for 1-year graft survival in its program-specific reports (PSRs).

Concerns have been expressed about historical variability in tier assignment over time.
Historical Analyses

Spring 2017, fall 2014, and spring 2012 PSR reports for kidney programs were analyzed, providing up to three tier assignments for each program, and the intraclass correlation for the assigned tiers was 0.110.20.

Historical analyses, however, have two important limitations:

• They cannot separate random variation from changes to programs over time.

• They cannot compare the observed tier assignments to the correct tier assignments.
Simulation Study

To overcome these limitations, a simulation study was performed to assess the reliability of tier assignments when program effects are known and held constant.

Simulation parameters approximated the cohort of adult recipients of deceased donor kidneys in the January 2018 PSRs. One hundred PSR cohorts were simulated for 11,600 simulated programs (50 batches of 232) to produce 20 temporally independent tiers for each program.

Simulation studies have limitations, too! Reality is complicated, so simulations make simplifying assumptions. Although simulation design attempts to replicate the major features of reality, simulations aren’t perfectly realistic.
Results: Consistency

The intraclass correlation for the 20 independent tier assignments was $0.38 \pm 0.39 \pm 0.40$.

The intraclass correlations were $0.19 \pm 0.20 \pm 0.21$, $0.34 \pm 0.35 \pm 0.36$, and $0.56 \pm 0.57 \pm 0.58$ for programs with 0-3, 3-10, and >10 expected events, respectively.

So, there is substantially greater agreement in the simulated tiers than in the historical tiers.
Results: Agreement

A true tier was derived from the program effect for each simulated program.

The intraclass correlation between a single assigned tier and the true tier was 0.52, 0.54, and 0.55, overall.

The intraclass correlations between a single assigned tier and the true tier were 0.26, 0.29, 0.32, 0.55, 0.57, and 0.59, and 0.70, 0.72, and 0.74 for programs with 0-3, 3-10, and >10 expected events, respectively.

So, there is moderate agreement between the assigned tier and the true tier, especially for larger programs.
Results: Accuracy

The assigned tier matched the true tier 37.5% of the time.

The assigned tier matched the true tier 32.5%, 37.8%, and 44.4% of the time for programs with 0-3, 3-10, and >10 expected events, respectively.

The assigned tier was within one tier of the true tier 83.6% of the time, and 79.0%, 83.7%, and 90.0% of the time for programs with 0-3, 3-10, and >10 expected events, respectively.
Accuracy: True Tier = 1

All

Expected: (0,3]

Expected: (3,10]

Expected: 10+

True Tier: 1

Proportion

Tier

Proportion

Tier

Proportion

Tier

Proportion

Tier
Accuracy: True Tier = 2

- **All**: Proportion distribution across tiers 1 to 5.
- **Expected: (0,3]**: Proportion distribution across tiers 1 to 5.
- **Expected: (3,10]**: Proportion distribution across tiers 1 to 5.
- **Expected: 10+**: Proportion distribution across tiers 1 to 5.

*Scientific Registry of Transplant Recipients*
Accuracy: True Tier = 3

All

Expected: (0,3]

Expected: (3,10]

Expected: 10+

True Tier: 3

Tier: Proportion

1 2 3 4 5

Tier: Proportion

1 2 3 4 5

Tier: Proportion

1 2 3 4 5

Tier: Proportion

1 2 3 4 5

Scientific Registry of Transplant Recipients
Accuracy: True Tier = 4

**All**

<table>
<thead>
<tr>
<th>Tier</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion</td>
<td>0.0</td>
<td>0.2</td>
<td>0.4</td>
<td>0.6</td>
<td>0.8</td>
</tr>
</tbody>
</table>

**Expected: (0,3]**

<table>
<thead>
<tr>
<th>Tier</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion</td>
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<td>0.2</td>
<td>0.4</td>
<td>0.6</td>
<td>0.8</td>
</tr>
</tbody>
</table>

**Expected: (3,10]**

<table>
<thead>
<tr>
<th>Tier</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion</td>
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<td>0.2</td>
<td>0.4</td>
<td>0.6</td>
<td>0.8</td>
</tr>
</tbody>
</table>

**Expected: 10+**

<table>
<thead>
<tr>
<th>Tier</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion</td>
<td>0.0</td>
<td>0.2</td>
<td>0.4</td>
<td>0.6</td>
<td>0.8</td>
</tr>
</tbody>
</table>
Accuracy: True Tier = 5

- **All**
  - Tier: 1, 2, 3, 4, 5
  - Proportion: 0.2, 0.4, 0.6, 0.8

- **Expected: (0,3]**
  - Tier: 1, 2, 3, 4, 5
  - Proportion: 0.0, 0.2, 0.4, 0.6

- **Expected: (3,10]**
  - Tier: 1, 2, 3, 4, 5
  - Proportion: 0.0, 0.2, 0.4, 0.6

- **Expected: 10+**
  - Tier: 1, 2, 3, 4, 5
  - Proportion: 0.0, 0.2, 0.4, 0.6
Conclusions

• Consistency for simulated programs was substantially higher than historical consistency, which suggests that real-world programs change over time.
• Consistency is higher for larger programs and lower for smaller programs.
• Agreement between the assigned tier and the true tier is fairly high for large programs, but low for small programs.
• Tiers often differ from true tiers, but usually the difference is one tier or less.
• The more data are available for a given program, the more likely the assigned tier is correct, or close to correct.
Prediction: Assigned Tier = 1
Prediction: Assigned Tier = 2

Tier: 2

All

Expected: (0,3]

Expected: (3,10]

Expected: 10+

True Tier

True Tier

True Tier

True Tier
Prediction: Assigned Tier = 3
Prediction: Assigned Tier = 4

All: Proportion of True Tier assignments for all categories.

Expected: (0,3]: Proportion of True Tier assignments for the expected range.

Expected: (3,10]: Proportion of True Tier assignments for the expected range.

Expected: 10+: Proportion of True Tier assignments for the expected range.
Prediction: Assigned Tier = 5

Tier: 5

All

Expected: (0,3]

Expected: (3,10]

Expected: 10+