SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

Historical Priors for Bayesian Assessment of Transplant Program Performance

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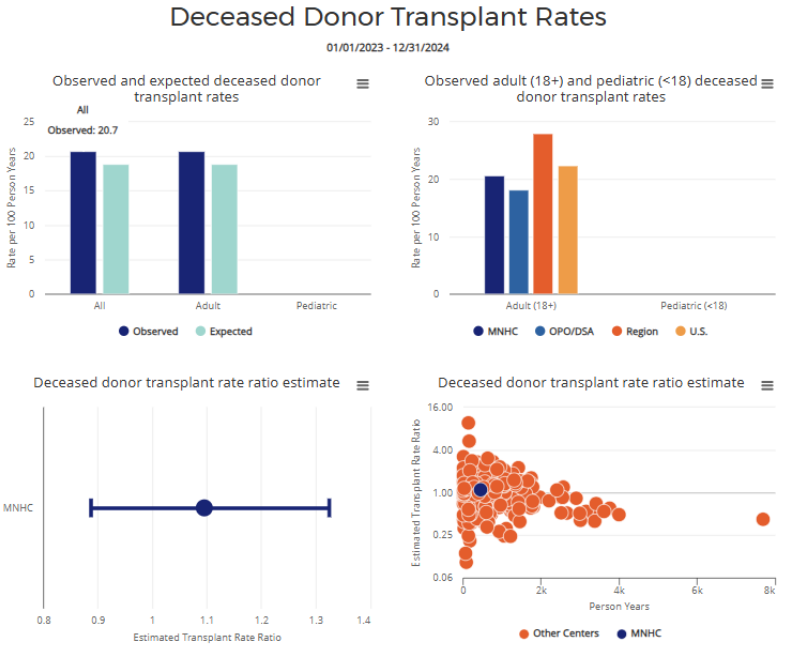
Background

- The Scientific Registry of Transplant Recipients (SRTR) publishes transplant program evaluations every 6 months

- Observed-to-Expected (O-to-E) ratios for:
  - Graft failures, pretransplant deaths, accepted offers, transplants, etc
  - “Expected” is derived from national risk-adjusted models



Background

- Bayesian methodology:
    - Prior for rate ratio: gamma(2,2)
        - Prior mean = 1 (as expected)
    - Posterior for rate ratio: gamma(O+2, E+2)
        - Posterior mean: (O+2) / (E+2)
        - Shrinks O/E ratio toward 1
- Posterior distribution → Tier assignment
    - (Tier 1 = worst, Tier 5 = best)

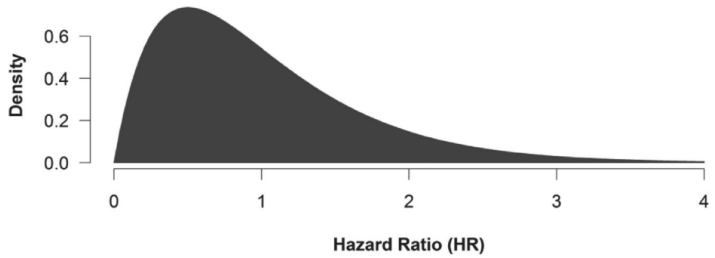


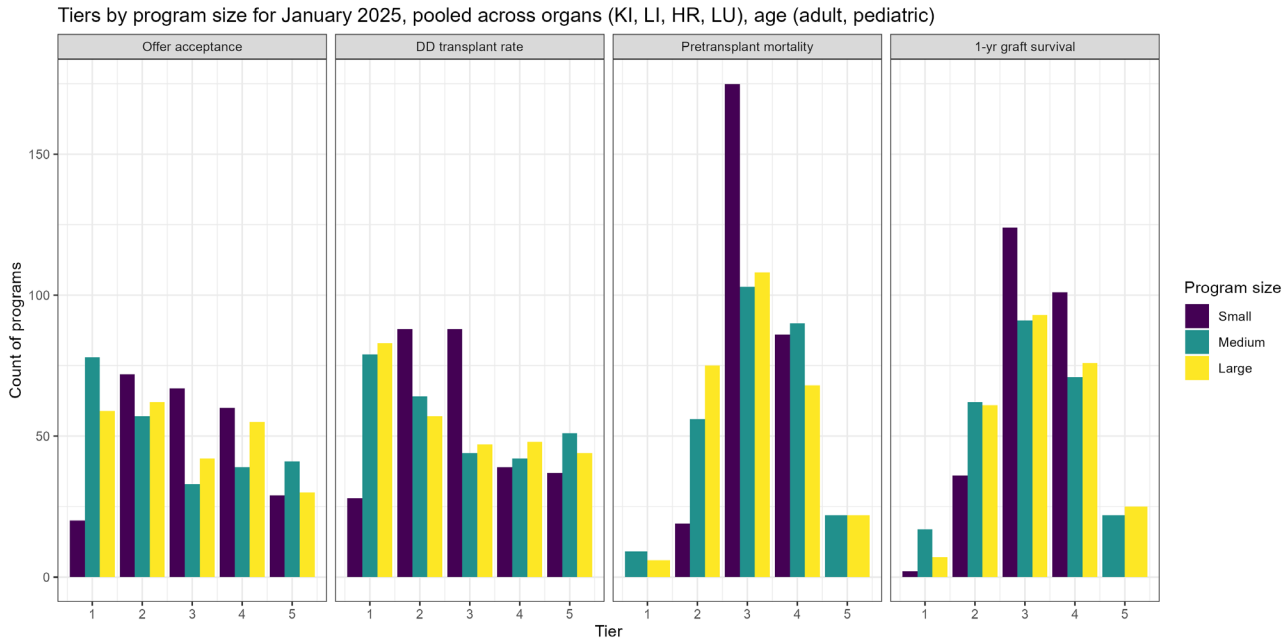
Figure 3: Gamma prior with mean of 1.0 and variance of 0.5 (SD = 0.71). The hazard ratio for each program is on the x-axis. A hazard ratio of 1 indicates a program that is performing exactly as expected and a hazard ratio of 2 a program with twice as many events as expected. The y-axis (labeled ''Density'') shows how frequent we believe this hazard ratio to be across all programs.

Motivation: Small Programs

- Gamma(2,2) prior pulls programs toward a mean of 1 (performing as expected)
    - Small programs have fewer observed data to pull their evaluations away from 1

→ More difficult for small programs to achieve the top tier

Motivation: Small Programs



Methods: Historical Priors

Define O_{past} and E_{past}:

O_{past} : Observed count of events from most recent nonoverlapping cycle

E_{past} : Expected count of events from most recent nonoverlapping cycle

Proposed Methodology:

Prior is an average of gamma(2,2) and gamma($O_{past} + 2, E_{past} + 2$):

$$\text{gamma}(\frac{O_{past}}{2} + 2, \frac{E_{past}}{2} + 2)$$

Posterior is therefore:

$$\text{gamma}(0 + \frac{O_{past}}{2} + 2, E + \frac{E_{past}}{2} + 2)$$

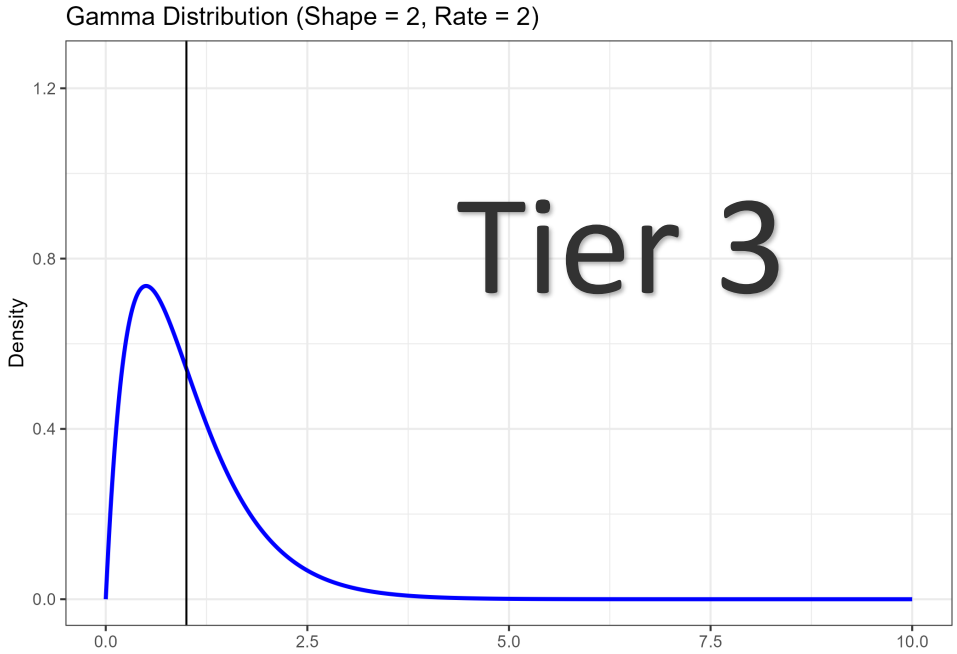
Example

- This is a trajectory of offer acceptance evaluations for a small adult heart program:

Cycle	Date range	Observed offers accepted	Expected offers accepted	Published SRTR tier rating (1-5)
July 2023	January 2022–December 2022	9	3.6	5
January 2024	July 2022–June 2023	14	7.4	4
July 2024	January 2023–December 2023	14	7.5	4
January 2025	July 2023–June 2024	10	5.6	4

Example: Current Methodology

Prior: gamma(2,2)



Example: Current Methodology

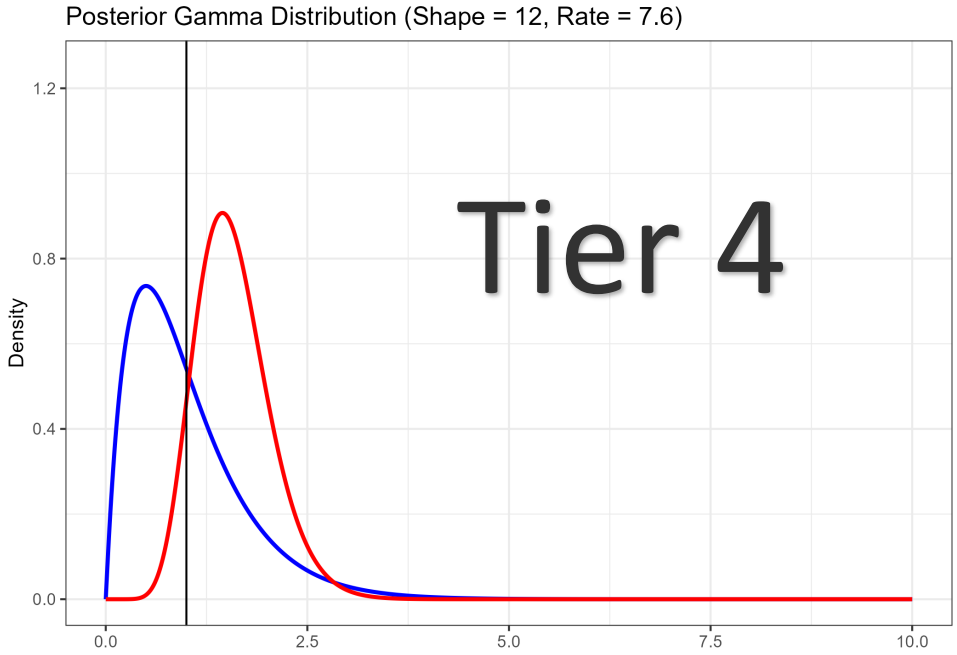
Prior: gamma(2,2)

Observed: 10

Expected: 5.6

→

Posterior: gamma(10+2, 5.6+2)

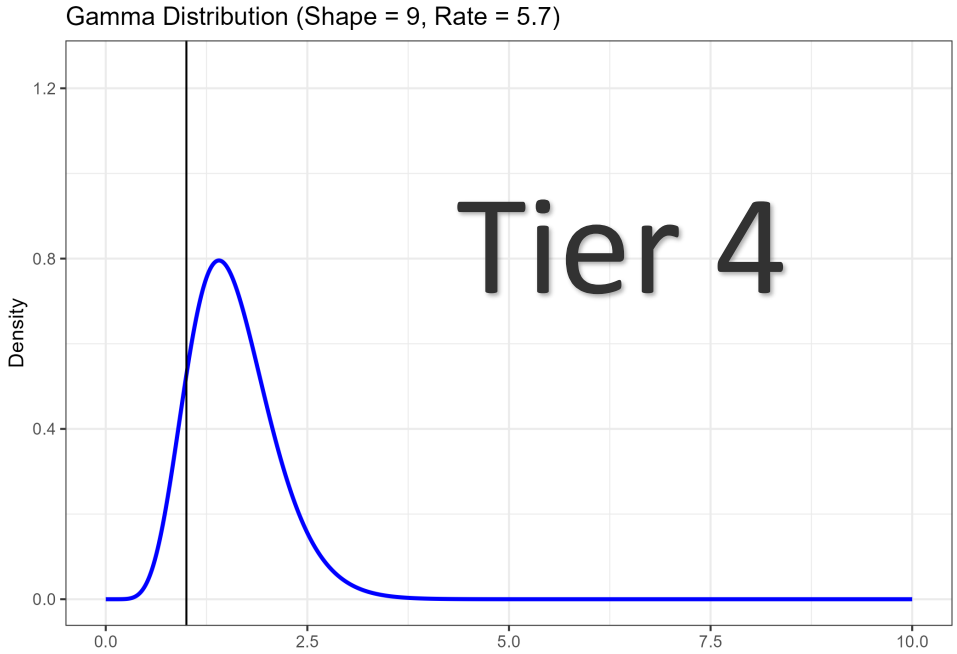


Example: Historical Priors

In January 2024 cycle:

- Observed: 14
- Expected: 7.4

Prior: gamma(14/2 + 2, 7.4/2 + 2)
= gamma(9, 5.7)



Example: Historical Priors

In January 2024 cycle:

- Observed: 14
- Expected: 7.4

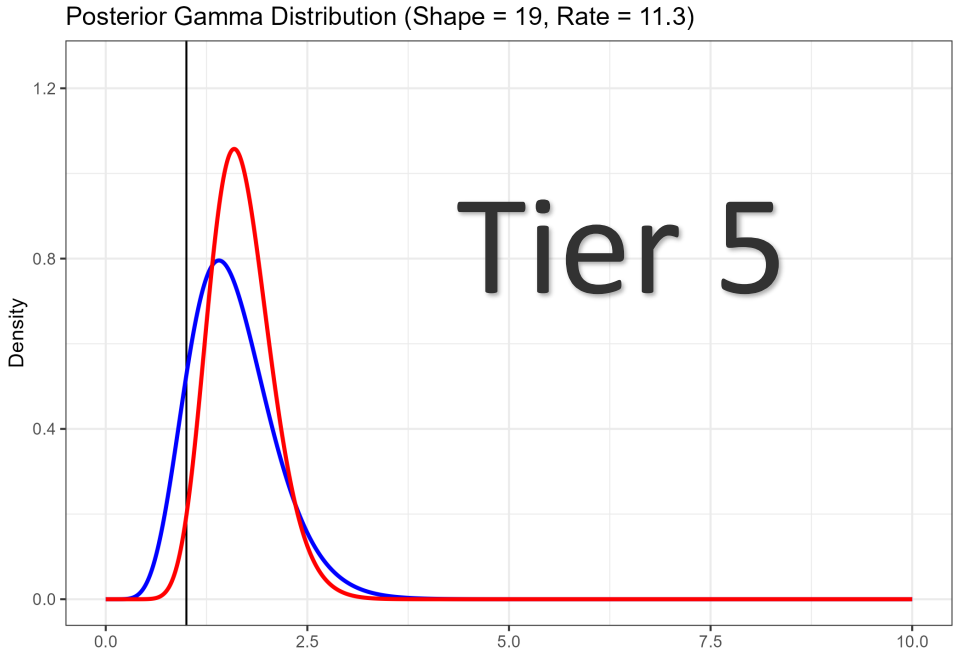
Prior: gamma(9, 5.7)

Observed: 10

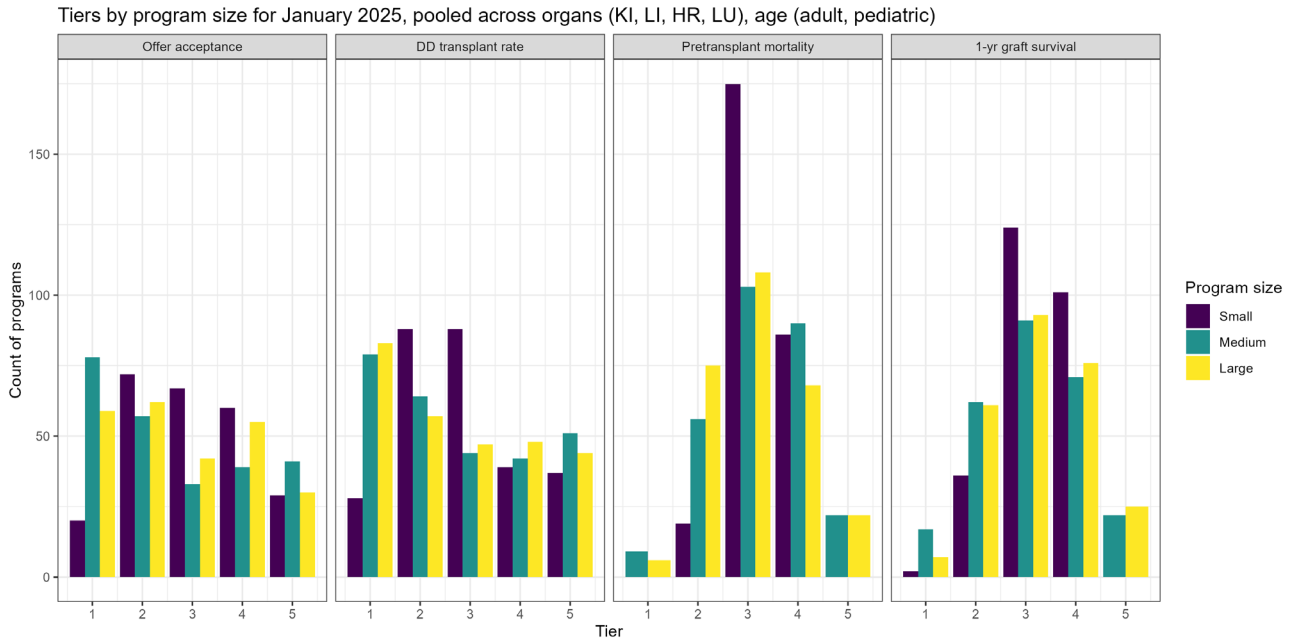
Expected: 5.6

→

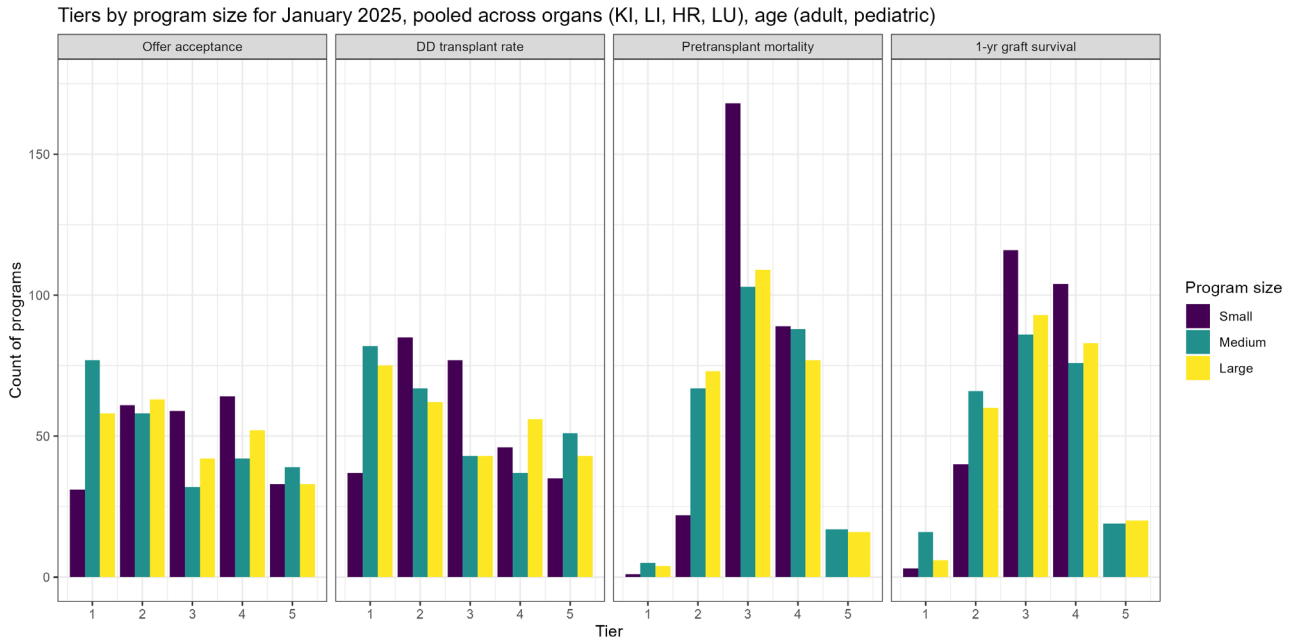
Posterior: gamma(10+9, 5.6+5.7)



January 2025 Tiers



January 2025 Tiers with Historical Priors



Simulation Results

Strengths of historical priors

- Tiers more stable over time, especially if program performance is constant over time; programs do not “bounce” around tiers from cycle to cycle
- More likely to assign Tier 5 to a small program that performs consistently well over time
- More likely to flag a small program that consistently performs poorly

Weaknesses of historical priors

- Less likely to flag a small program that *recently* got worse (ie, historical performance was better than current performance)
- Less likely to assign Tier 5 to a small program that *recently* improved (ie, cannot jump into Tier 5)

Debatable whether these are weaknesses or strengths!

Conclusions

Use of historical priors would:

- Increase precision (more informative prior)
- Shift smaller transplant programs toward outer tiers based on past performance
- Align more closely with Bayesian principles
- Perhaps enable smaller programs to achieve the top tier

Community input and Membership and Professional Standards Committee (MPSC) feedback will be essential to determine:

- Is it appropriate for historical data (from a program's most recent nonoverlapping cycle) to influence the program's current evaluations and tier ratings?

CDRG

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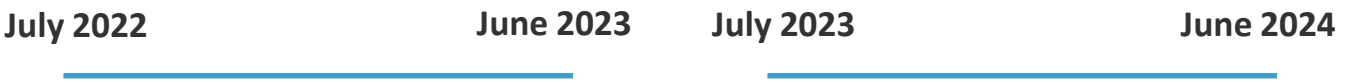
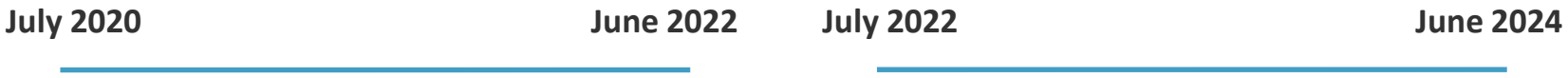
Nonoverlapping cycles, for January 2025

- Offer acceptance: 1-year cohorts



- Transplant rate and pretransplant mortality: 2-year cohorts



- 1-year graft survival: 2.5-year cohorts