A 5-Tier System for Categorizing Program-Specific Adjusted Transplant and Waitlist Mortality Rate Ratios

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Introduction

In the United States, the Scientific Registry of Transplant Recipients (SRTR) publishes public reports on transplant program performance every 6 months.

To provide healthcare consumers with accessible reports, SRTR categorizes transplant program performance into tiers.

SRTR traditionally used a 3-tier system based on the outcome of a statistical hypothesis test. The tiers were

- Better than expected
- As expected
- Worse than expected

However, statistical hypothesis testing is severely limited by its dependence on sample size. Within the context of publicly reported pretransplant metrics, we demonstrate the limitations of statistical hypothesis testing and propose alternative 5-tier systems.

Methods

Categorization of program outcomes should try to ensure that programs in the same tier have similar outcomes; otherwise, the public reporting fails to accurately convey the program's outcomes. However, ensuring that programs in the same tier have similar outcomes naturally increases the risk of better apparent outcomes due to random variation. Categorization systems must balance these conflicting issues.

Methods (Cont'd)

Categorizing program outcomes involves a tradeoff between better differentiation and higher misclassification rates. We therefore use two metrics to assess the performance of the 3-tier and 5-tier systems in each dimension:

- Within-Tier Sum of Squares: Lower values indicate that tiers are identifying more similar levels of performance.
- Correct Classification Rate: The simulated probability that a program in a given tier has a truly better transplant or waitlist mortality rate ratio than programs in a lower tier.

We used the updated pretransplant model building process with the cohort that would have been released in the January 2017 program-specific reports. The transplant and waitlist mortality outcomes at kidney programs were retrieved and categorized into the 3-tier system based on statistical hypothesis testing and the alternative 5-tier system.

The correct classification rate was simulated by sampling the number of expected events with replacement from adult kidney transplant programs. The true transplant and waitlist mortality rate ratios were randomly selected from a Gamma distribution with mean 1 and variance 1/8. We then estimated the probability that a program in, for example, tier 4 was truly better than a program in tier 2. The simulation was repeated 2,000 times to minimize the impact of randomly selecting transplant and waitlist mortality rate ratios, expected events, and observed events.

Results

Correct Classification Rate:

Probability that a program has a truly better transplant or waitlist mortality rate ratio

Transplant Rate

	Tier	5	4	3	2
5-Tier	4	96%	--	--	--
	3	97%	87 %	--	--
	2	99%	96 %	79%	--
	1	100%	99 %	94%	88%
3-Tier	2	--	--	89%	--
	1	--	--	100%	91%

Waitlist Mortality

	Tier	5	4	3	2
5-Tier	4	82%	--	--	--
	3	89%	65%	--	--
	2	98%	84%	71%	--
	1	100%	96%	91%	85%
3-Tier	2	--	--	89%	--
	1	--	--	100%	91%

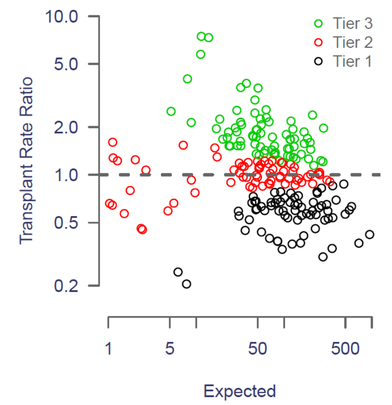
Within-Tier Sum of Squares:

Lower values indicate that the tiers identify similar outcomes

Metric	3-Tier	5-Tier
Transplant rate	23.6	9.9
Waitlist mortality	8.6	3.4

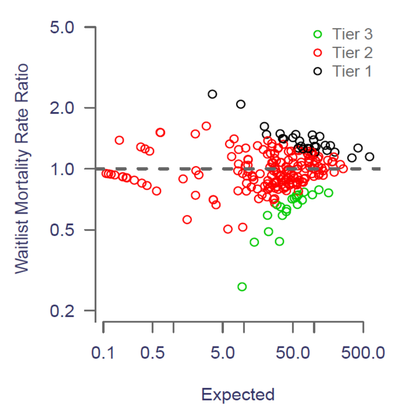
Transplant Rate Ratios

Statistical Hypothesis Test/3-Tier System

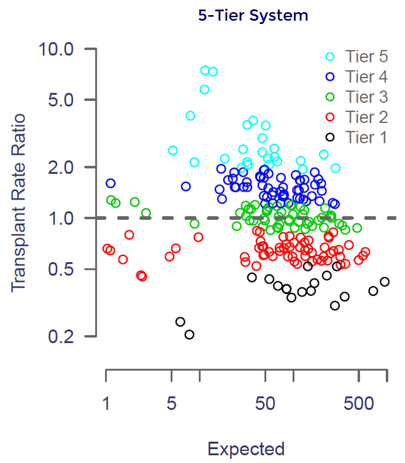


Waitlist Mortality Rate Ratios

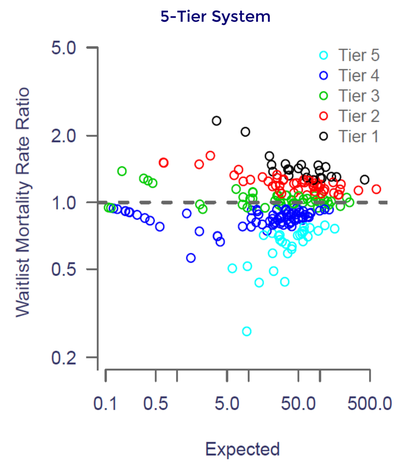
Statistical Hypothesis Test/3-Tier System



5-Tier System



5-Tier System



Conclusions

The 5-tier system improved differentiation (as demonstrated by the lower within-tier sum of squares), while maintaining a relatively high correct classification rate, especially for transplant rate evaluations. For example, the 3-tier system for transplant rate had a better classification rate than the 5-tier system for only 1-tier differences despite the substantially worse differentiation. Thus, the 5-tier system should provide more informative reporting of transplant and waitlist mortality rate ratios due to better differentiation and a relatively high correct classification rate.

References

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