

Projection vs. reality: KPSAM and KAS

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Introduction

On December 4, 2014, the national kidney allocation system (KAS) was substantially revised. The decision to revise was based in part on results from the kidney-pancreas simulated allocation modeling (KPSAM) software, which projected changes in the demographics of transplant recipients and median posttransplant survival under the proposed system. Of interest to the transplant community is how well KPSAM predicted the impact of the new KAS.

Methods

We compared two simulated and two real cohorts under the former and new systems. Simulated results were based on 2010 waitlist and donor cohorts. The actual cohorts were from January 1, 2010-December 31, 2010 (pre-KAS), and December 4, 2014-December 3, 2015 (post-KAS).

Results

- Increases of 0.9% in black and 0.7% Hispanic candidates were projected; in reality, transplants increased by nearly 3% and 4% (Figure 1C).
- Likewise, increases of 0.3% and 2% in candidates with cPRA 99% and 100%, respectively, were projected; in reality, increases were 2.5% and 9% (data not shown).

Results, cont.

- The increase in sharing was also larger than predicted, nearly 11% versus the 2% predicted. This is likely related to the success of candidates with cPRA 100% and 99%, to whom organs are mandatorily shared before all other kidney-alone offers.
- Several changes were less robust than predicted. Transplants in ABO: B candidates decreased by 0.3% versus the increase of 5% expected, and in candidates aged 18-34 years 3% versus the 5% expected (Figure 1A, 1B).
- Distribution of waitlist deaths by age was generally well predicted. However, there has been an unexpected increase in waitlist deaths among candidates aged 35-49 (+3.5%), and an unexpected decrease among candidates aged ≥ 65 (-3.4%), data not shown. This may be due to a different case-mix being listed, since transplants at ages 35-49 have increased.
- Possible explanations for KPSAM's underprediction are a change in acceptance behavior under KAS, and an increase in the number of high-priority candidates on the waiting list since 2010 (see Table 1).

Figure 1. Distribution of actual and predicted transplants in 2010 and 1 year post-KAS (12/4/2014-12/3/2015), by blood type, age, race, and dialysis time at listing.

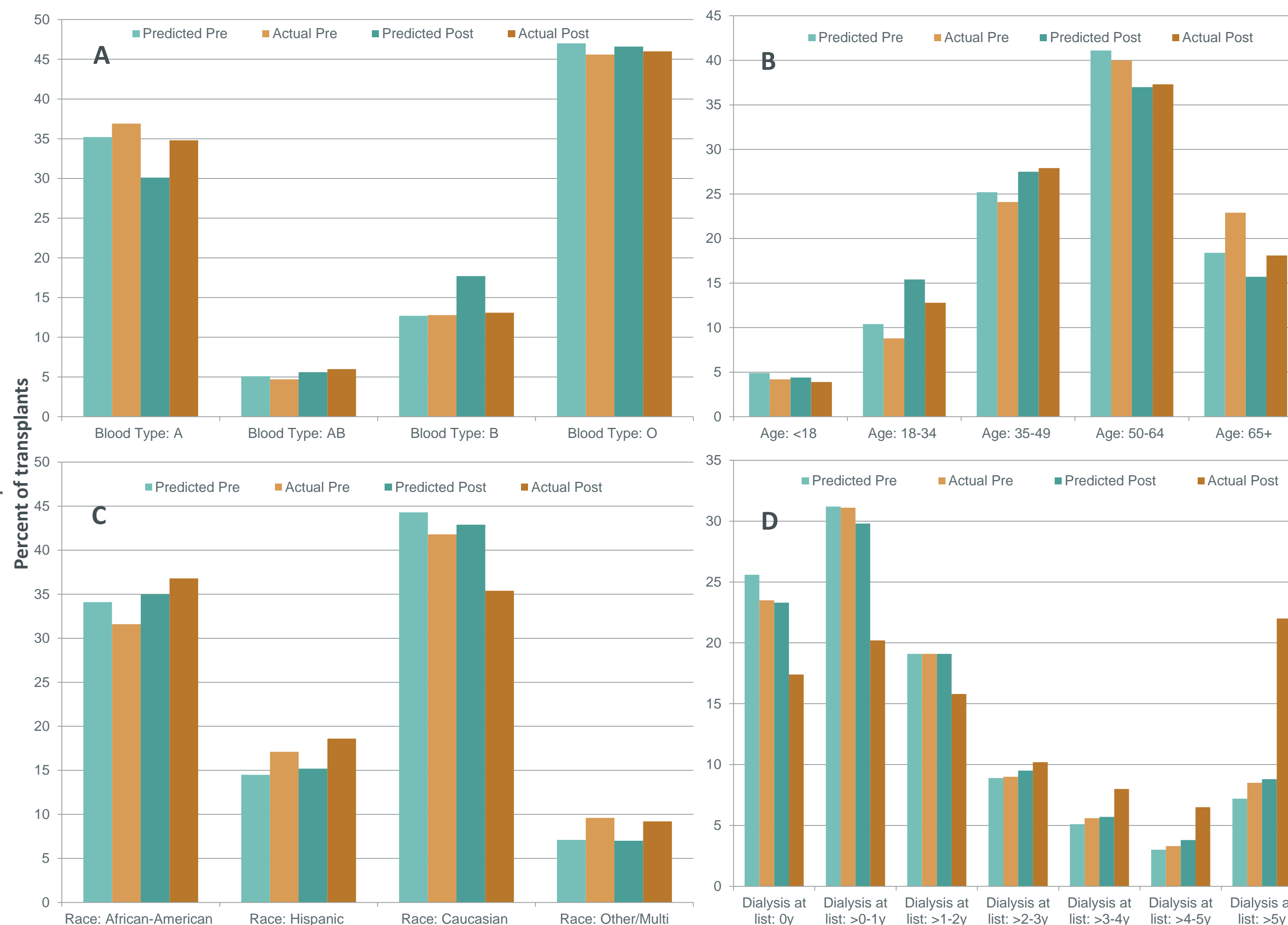


Table 1. Change in number of kidney-alone listings from 2010 to 2014

| cPRA | N 2010 | N 2014 | Change |
|------------------|--------|--------|--------|
| 0 | 73469 | 84498 | 11029 |
| 1-19 | 8560 | 11905 | 3345 |
| 20-69 | 15065 | 18437 | 3372 |
| 70-79 | 2686 | 3109 | 423 |
| 80-97 | 9768 | 9365 | -403 |
| 98 | 1512 | 1579 | 67 |
| 99 | 2768 | 2968 | 200 |
| 100 | 6828 | 9172 | 2344 |
| Dialysis at list | N 2010 | N 2014 | Change |
| 0y | 31811 | 41490 | 9679 |
| > 0-1 y | 38372 | 42201 | 3829 |
| > 1-2 y | 22281 | 24434 | 2153 |
| > 2-3 y | 10512 | 11793 | 1281 |
| > 3-4 y | 5912 | 6795 | 883 |
| > 4-5 y | 3637 | 4295 | 658 |
| > 5 y | 8131 | 10025 | 1894 |

Conclusions

- KPSAM accurately predicted the direction but not magnitude of most demographic changes.
- In particular, transplants by cPRA $\geq 99\%$ and dialysis time > 3 years at listing increased substantially beyond predicted values.
- To a lesser degree, transplants in black and Hispanic candidates increased beyond predicted values.
- Likely explanations for underprediction are an actual change in acceptance behavior under KAS and reliance on historic data.
- Although these high-priority candidates (cPRA 99%-100%, or dialysis time > 3 years) have not become relatively more common, i.e., in proportion to the rest of the waiting list, their absolute numbers have increased as the kidney waiting list has continued to grow (Table 1). Given a relatively constant supply of deceased-donor kidneys per year, an increase in the number of candidates with high priority in allocation (for example, +2344 candidates with cPRA 100%) seemingly caused a much larger "bolus effect" than KPSAM was able to predict.
- These results show that KPSAM can make useful predictions about the direction of large-scale changes in many outcomes of interest to the policy development community, despite limitations in modeling behavior changes.

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