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Random forests improve prediction of deceased donor kidney transplant outcomes when compared with KDRI

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Abstract:

Background: Kidney transplantation is a cost-effective treatment for end-stage renal failure patients that provides a significant survival benefit and improves their quality of life compared to other forms of renal replacement. The predominant method used for donor kidney quality assessment is the Cox regression-based, piecewise linear kidney donor risk index (KDRI). A machine learning method (random forest) was compared to KDRI for predicting graft failure at 12, 24, and 36 months after transplantation.

Material and Methods: Random forest was trained and evaluated with the same deceased donor kidney transplant data (n=70242) initially used to develop KDRI (1995-2005) and included four readily available recipient variables from the estimated post-transplant survival score.

Results: When comparing type II error rates of 10%, random forests predicted an additional 2,148 successful grafts at 36 months after transplant (126%) than KDRI. Many high-KDRI kidneys, at risk for discard, were correctly predicted for successful transplantation with random forests. Random forest performed significantly better than KDRI for graft Kaplan-Meier survival analysis from 0-240 months (log-rank test $p<0.00$).

Conclusion: Machine learning methods can provide a significant improvement over KDRI for the assessment of kidney offers. This work lays the foundation for the use of machine learning methodologies in transplantation and describes the steps to measure, analyze, and validate future models.