KIPA2022_01 Allocation Simulation Analysis Report Addendum

Analysis Report Addendum for the Data Request from the OPTN Kidney and Pancreas Continuous Distribution Workgroup

Date:

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Data Request ID:

KI2022_01_Addendum

1 Background

The OPTN Kidney and Pancreas Continuous Distribution Workgroup (the workgroup) is currently working on adopting the Continuous Distribution framework for kidney, pancreas, kidney-pancreas and pancreas islets allocation. At the April 29, 2022 workgroup meeting, the workgroup requested simulations for 4 different scenarios, plus current rules. Each model, a run of the Organ Allocation Simulation software, represents a different set of weights for each of the attributes that will define continuous distribution.

Following submission of the initial report, additional results were requested in December of 2022.

2 Request: Additional results for simulation runs for 4 continuous distribution scenarios

Additional results figures are requested from the OASIM simulation scenarios and the simulation of current rules described in the previous request: KIPA2022_01 Allocation Simulation Data Request.

The additional requested figures are included below and will be included for current allocation and the 4 continuous distribution scenarios for kidney and kidney-pancreas/pancreas, where appropriate:

1. Travel distance by KDPI

2. Distribution of distance broken out by
   - cPRA (0-.6, .6-.8, .8-.98, .98-.995, .995-.999 and .999-1.0)
   - Age groups
   - Race
3. 1-year and 10-year graft failure rates by DR mismatch
4. Median waiting time at the time of transplant overall and by:
   - Age
   - Gender
   - Race
   - Ethnicity
   - Rural/urban residence
   - OPTN region
   - cPRA (0-.6, .6-.8, .8-.98, .98-.995, .995-.999 and .999-1.0)
   - Blood type
   - EPTS

3 Analysis Metrics

Most of the outcome metrics reported in this addendum were previously reported in the initial KIPA2022_01 Allocation Simulation Report, including:

1. **Donor-recipient distance (organ travel distance)**
2. **Posttransplant graft failure**
3. **Transplant rate**

Median waiting time among transplant recipients is the only previously unreported outcome metric in this addendum report.

1. **Median waiting time**: Median waiting time is the median time from listing to transplant among patients transplanted in the simulation. As the median waiting time includes time the patients were waiting prior to the start of the simulation period, it is not directly comparable to the time at risk denominator from the transplant rate outcome metrics. The time at risk denominator from the transplant rate outcome metric includes time

contributed by patients that were transplanted *as well as* patients that were not transplanted in the simulations. For these reasons, there is not a simple direct comparison between previously reported transplant rates and median waiting time. For example, if continuous distribution scenarios show increased transplant rates among older candidates, this does not necessarily mean that waiting times among older transplant recipients will go down because the candidates chosen for transplant could, for example, be candidates that had more waiting time before they entered the simulation time period.

4 Simulated Results

All results presented in this report represent the mean or median value for a given metric across the 10 iterations; each metric is calculated at the scenario/iteration level and the mean across iterations is calculated to apply to the scenario; the minimum and maximum across iterations are also presented as error bars in figures and as a range in tables.

4.1 Kidney Additional Results

4.1.1 Organ Travel Distance by KDPI

Organ travel distance by KDPI shows the expected impact of the donor modifier in the 'High KDPI Efficiency' scenario that is intended to limit travel distance kidneys with KDPI > 85. While the KDPI <= 85 kidneys in the 'High KDPI Efficiency' scenario had travel distances that were similar to the 'Combined AHP' scenario, the KDPI > 85 kidneys in the 'High KDPI Efficiency' had substantially lower travel distances than in the 'Combined AHP' scenario.

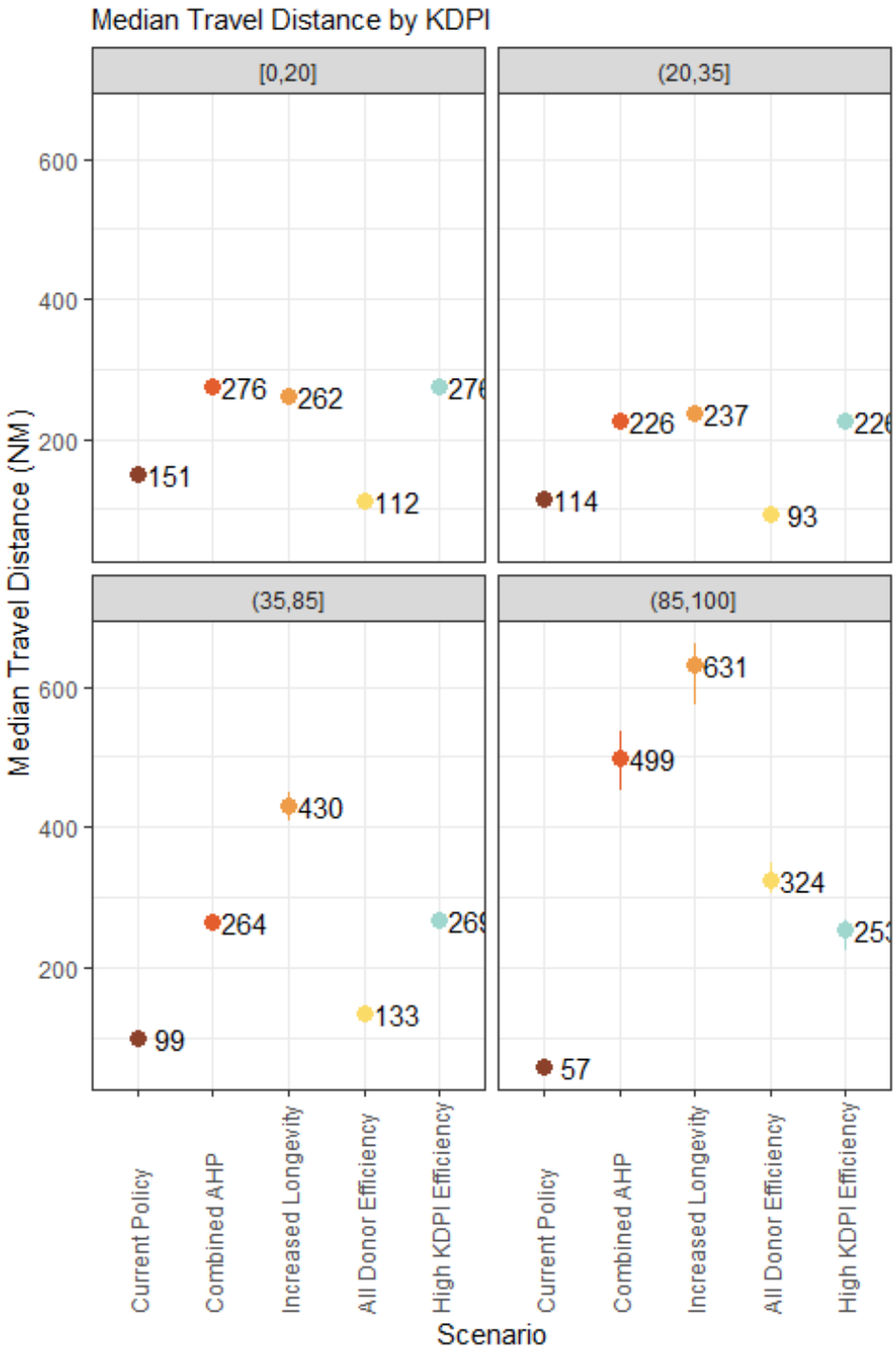

Figure 1: Travel distance is between the donor hospital and the transplant center, in nautical miles.

4.2 Kidney Additional Results

4.2.1 Organ Travel Distance Distribution by Subgroups

Organ travel distance among all candidate subgroups was lowest in the 'All Donor Efficiency' scenario. For most subgroups, the organ travel distance distribution in the 'All Donor Efficiency' scenario was similar to the simulation of 'Current Policy', with the exception of candidates with cPRA > 0.995. These highly sensitized candidates had longer travel distances in the simulation of 'Current Policy', and distances were substantially lower in the 'All Donor Efficiency' scenario.

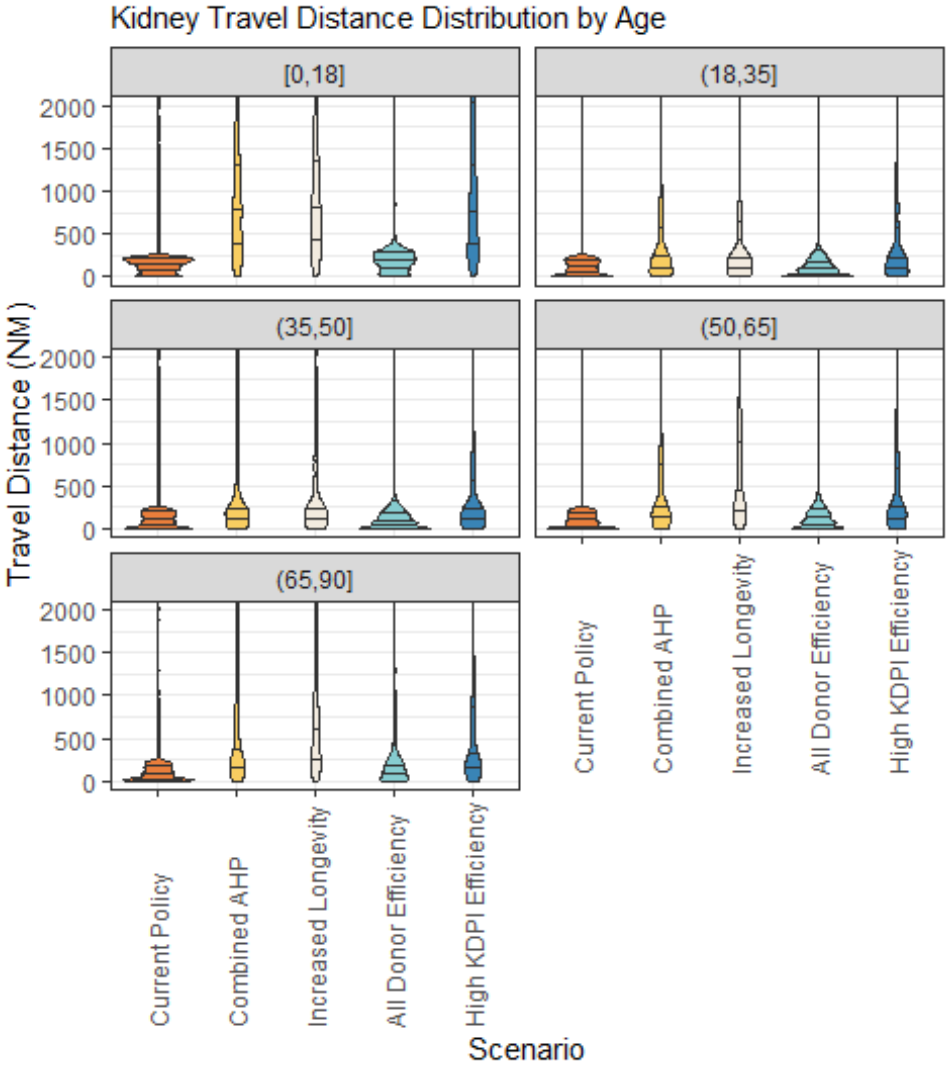

Figure 2: Distribution of travel distance. Travel distance is between the donor hospital and the transplant center, in nautical miles. Age is age in years of the recipient at time of transplant.

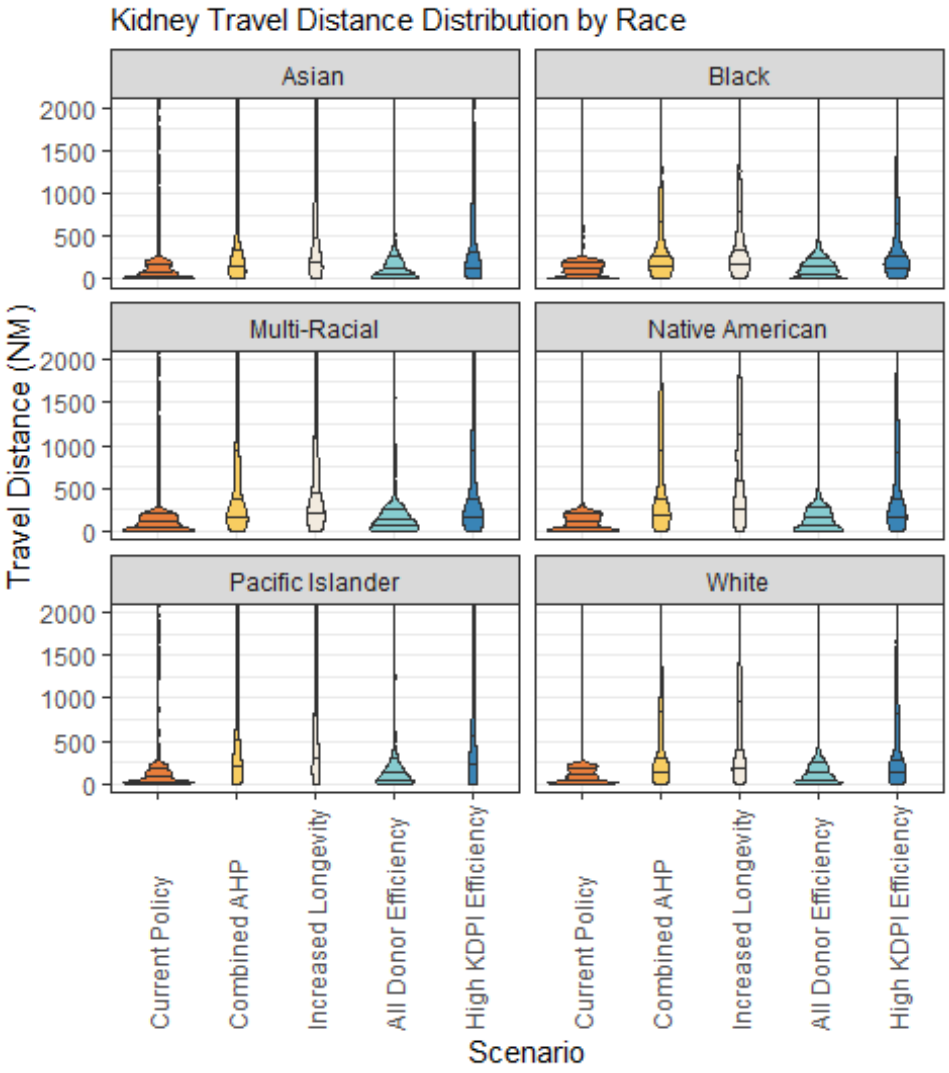

Figure 3: Distribution of travel distance. Travel distance is between the donor hospital and the transplant center, in nautical miles.

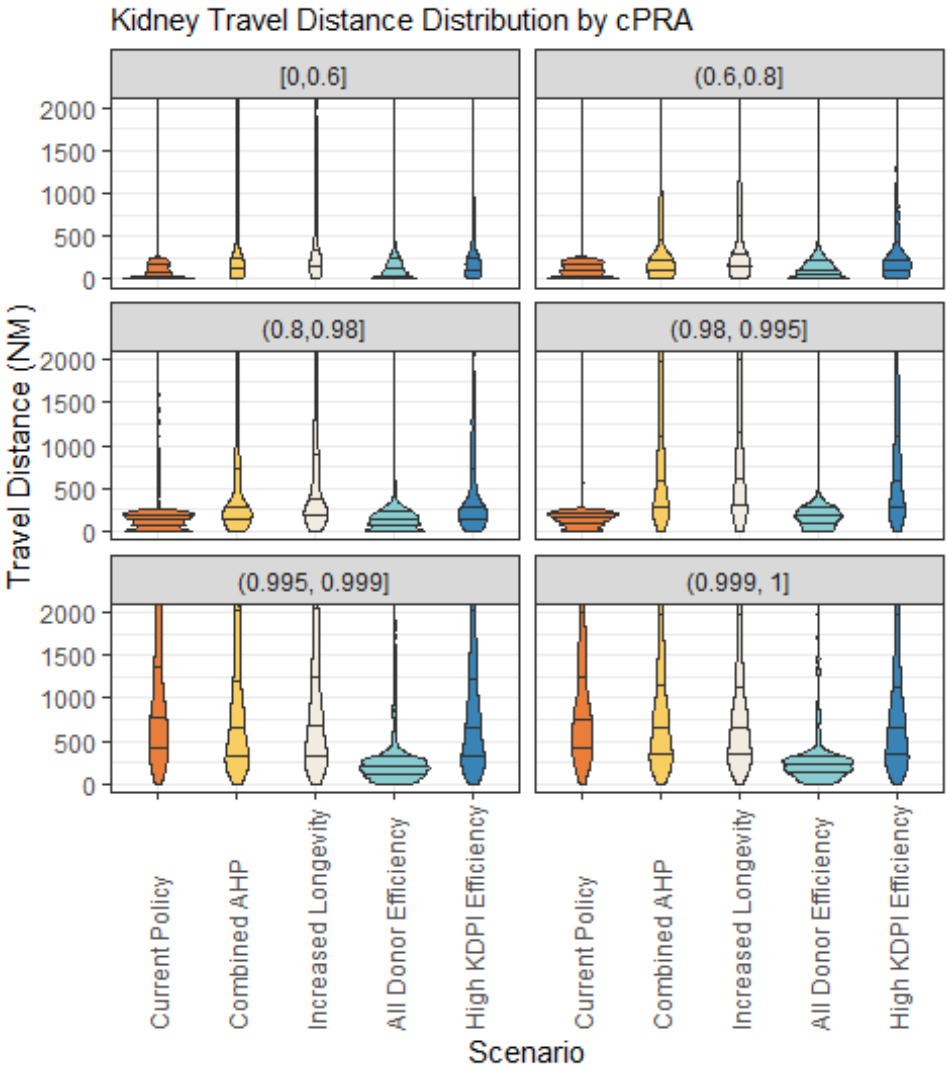

Figure 4: Distribution of travel distance. Travel distance is between the donor hospital and the transplant center, in nautical miles. CPRA at cohort start is the last value the candidate had prior to the simulation start or their value at listing.

4.2.2 Posttransplant Graft Failure by HLA-DR Mismatch

One-year and ten-year graft failure rates among kidney transplant recipients were higher for recipients with 1 or 2 HLA-DR mismatches under the continuous distribution scenarios compared to the simulation of 'Current Policy'.

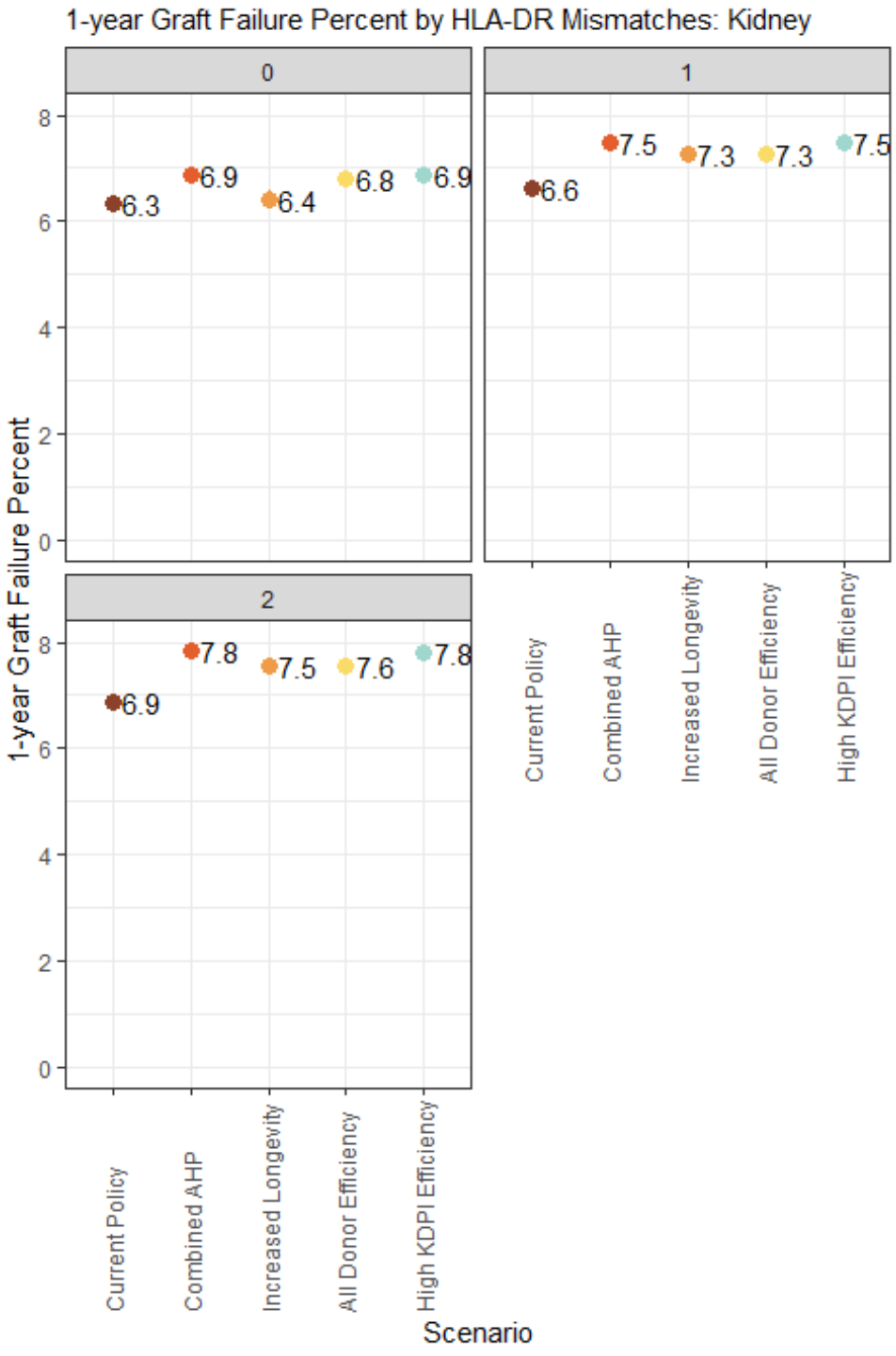

Figure 5: HLA-DR Mismatches. All cause graft failure.

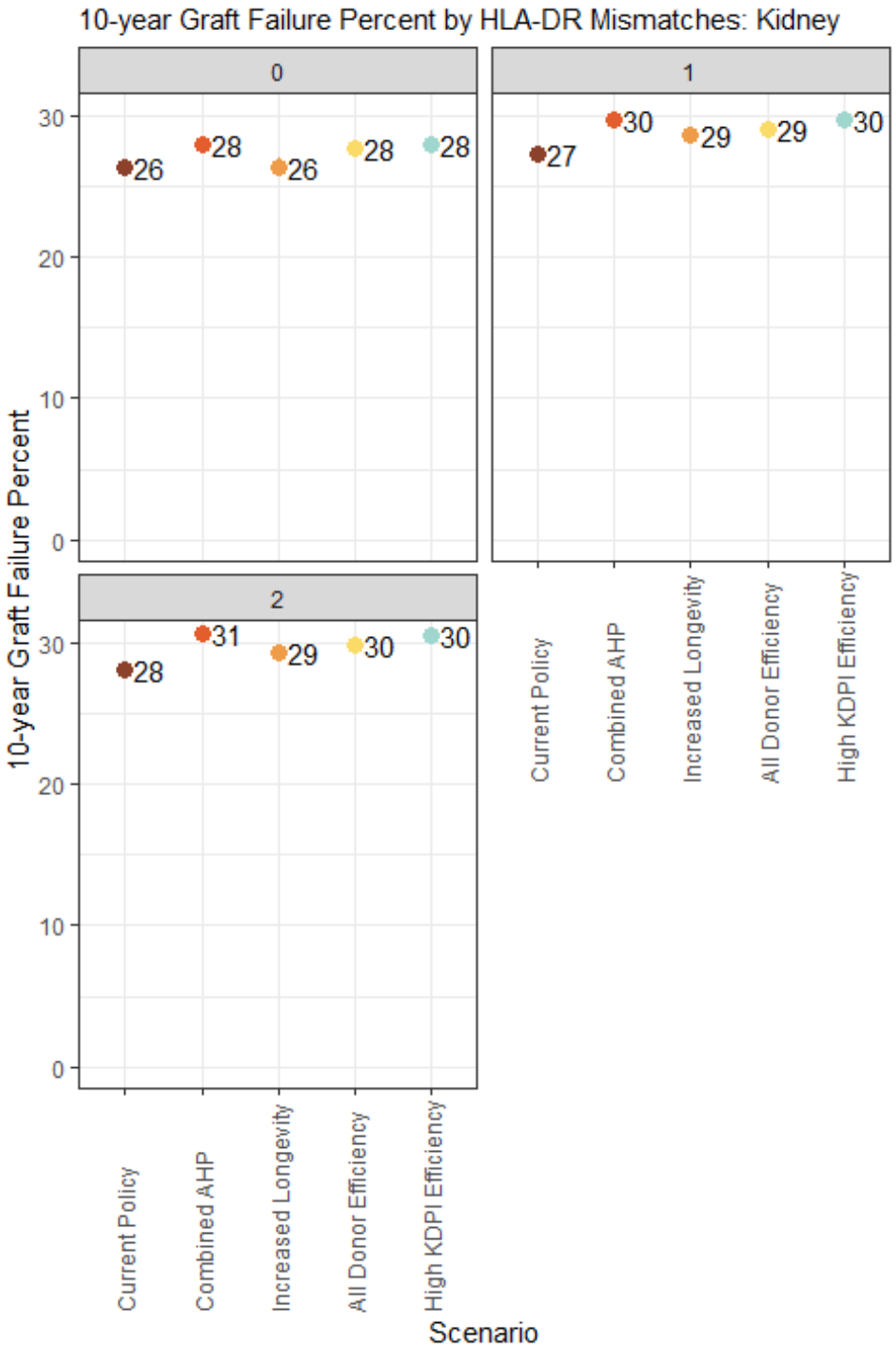

Figure 6: HLA-DR Mismatches. All cause graft failure.

4.2.3 Median Waiting Time among Transplant Recipients by Subgroups

Among many subgroups, median waiting time among transplant recipients was lowest for the 'Increased Longevity' scenario. For candidates aged 65 and older, all continuous distribution

scenarios showed notably lower median waiting time among patients that were transplanted than the simulation of 'Current Policy'. As described above, these lower median waiting times cannot be directly attributed to increased transplant rates in this age group and might instead reflect that the patients who were transplanted had shorter waiting times to begin with.

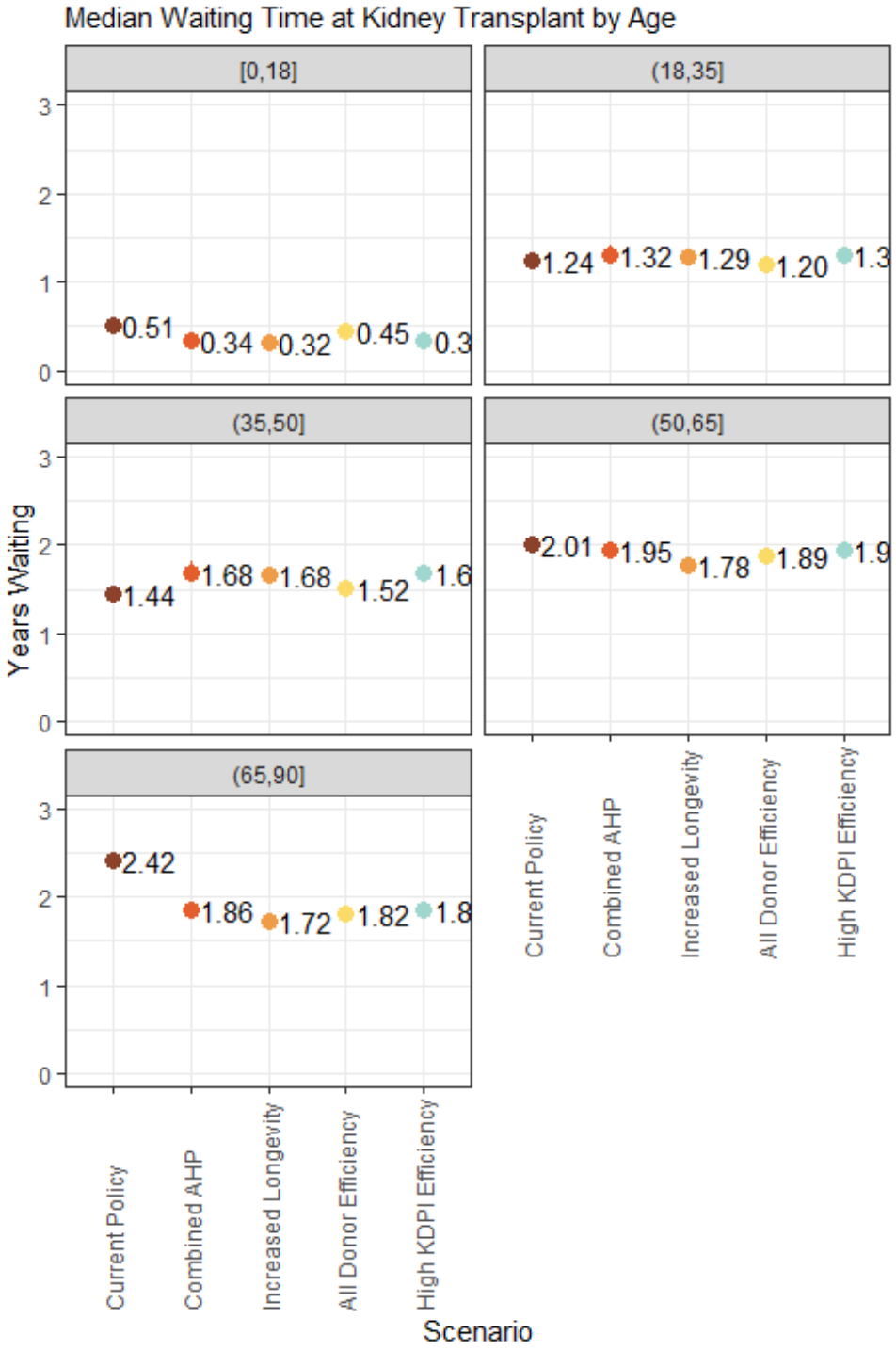

Figure 7: Median time in years from listing to kidney alone transplant among those transplanted. Age is age in years of the recipient at time of transplant.

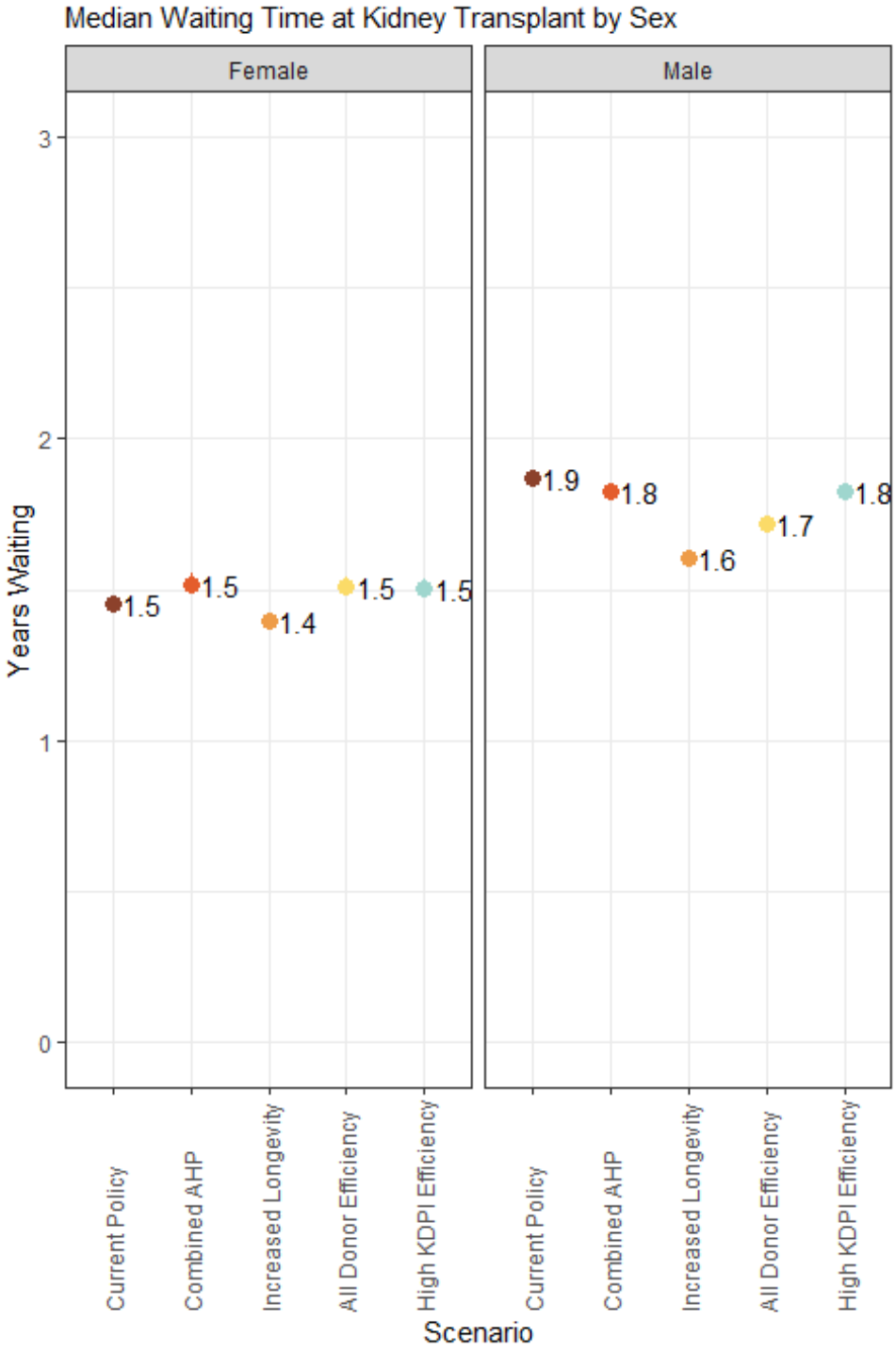

Figure 8: Median time in years from listing to kidney alone transplant among those transplanted

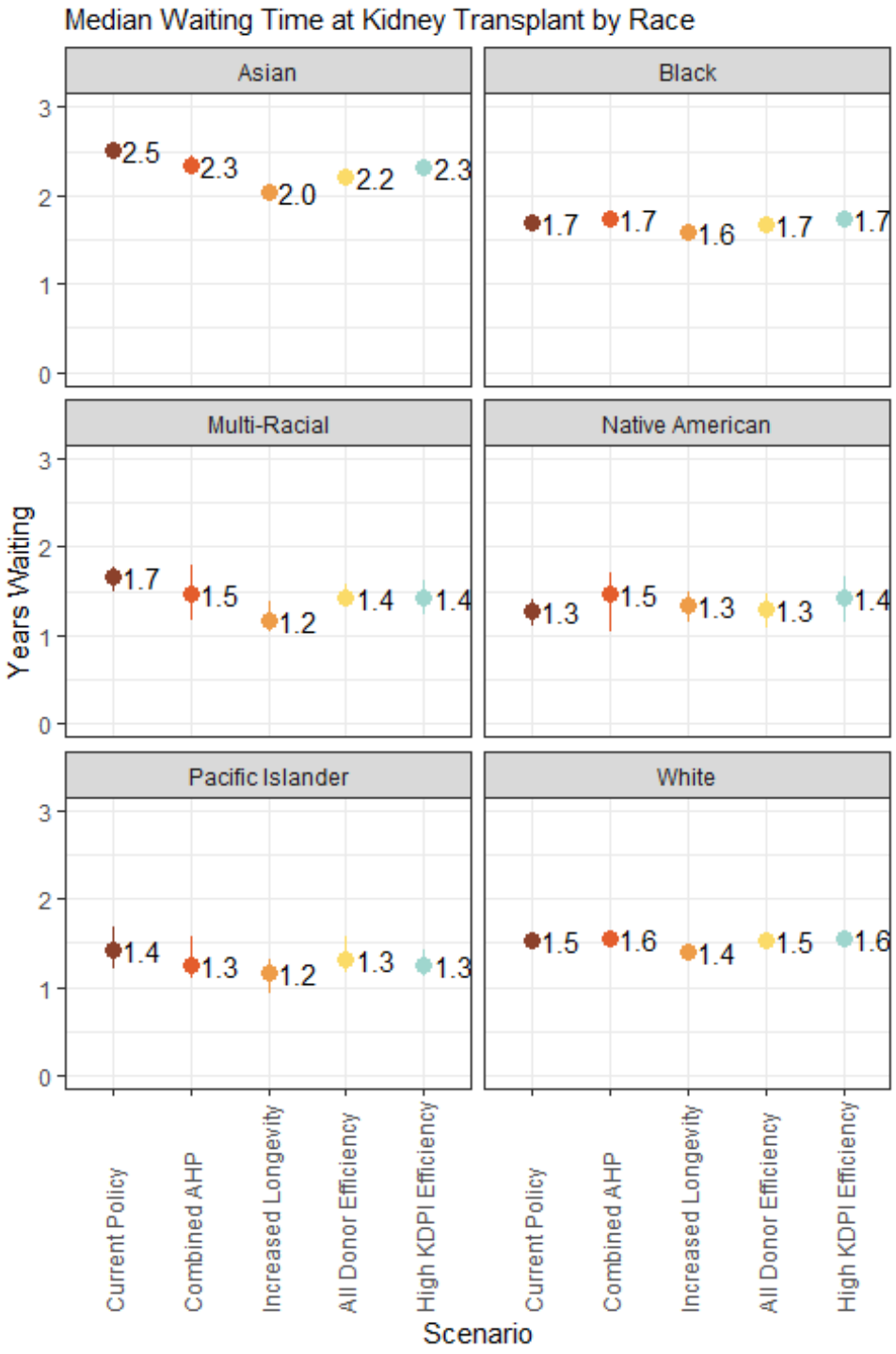

Figure 9: Median time in years from listing to kidney alone transplant among those transplanted

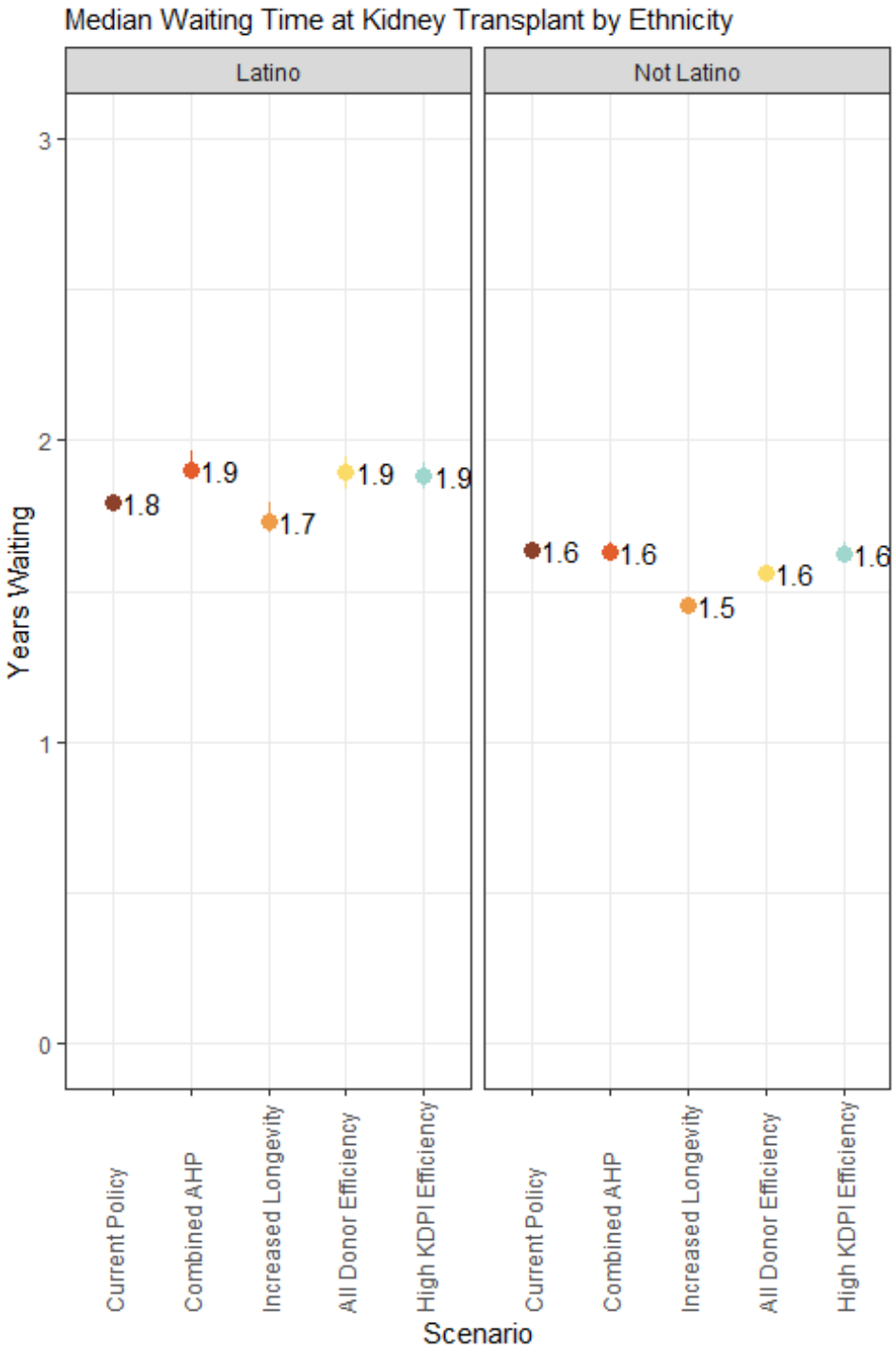

Figure 10: Median time in years from listing to kidney alone transplant among those transplanted

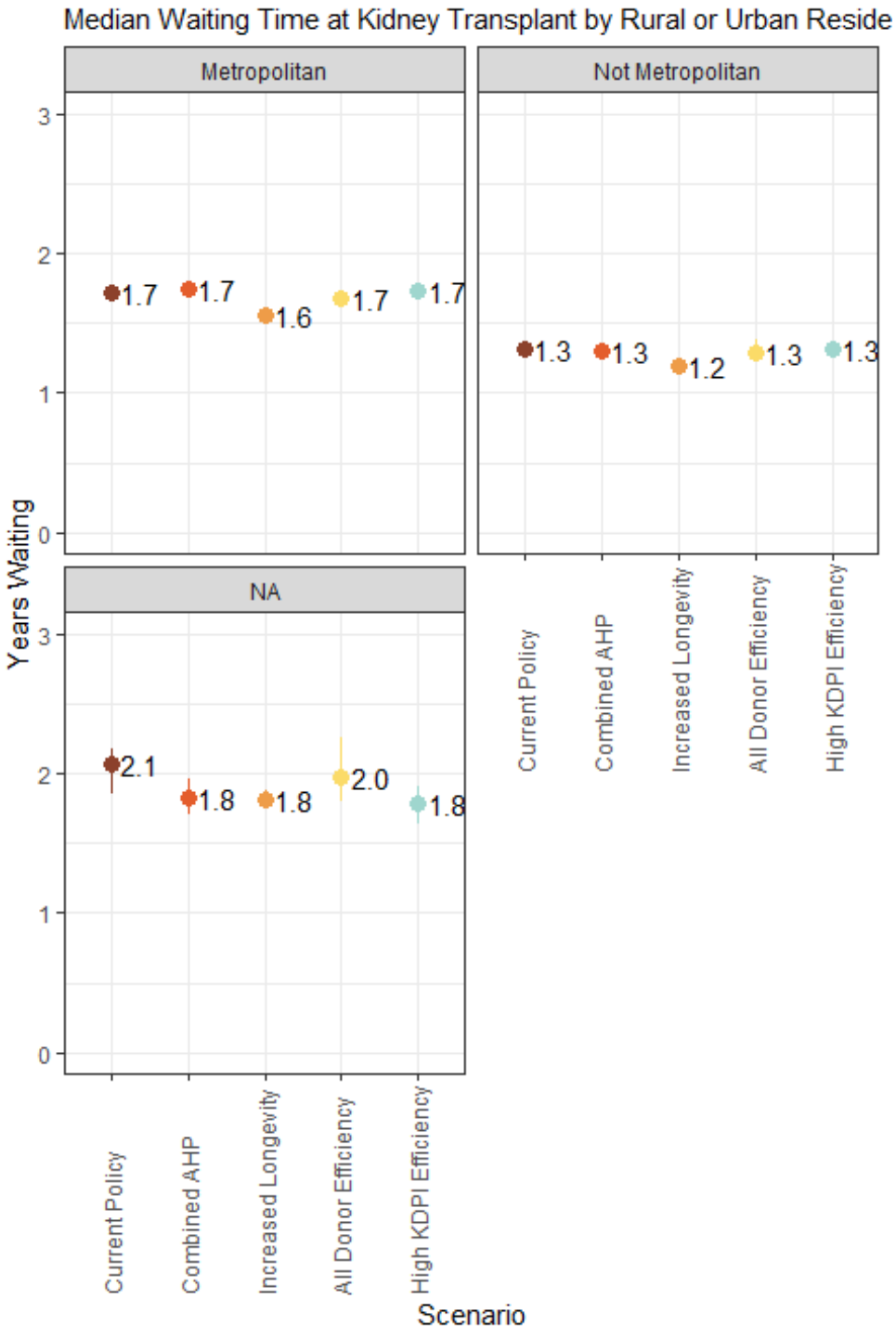

Figure 11: Median time in years from listing to kidney alone transplant among those transplanted

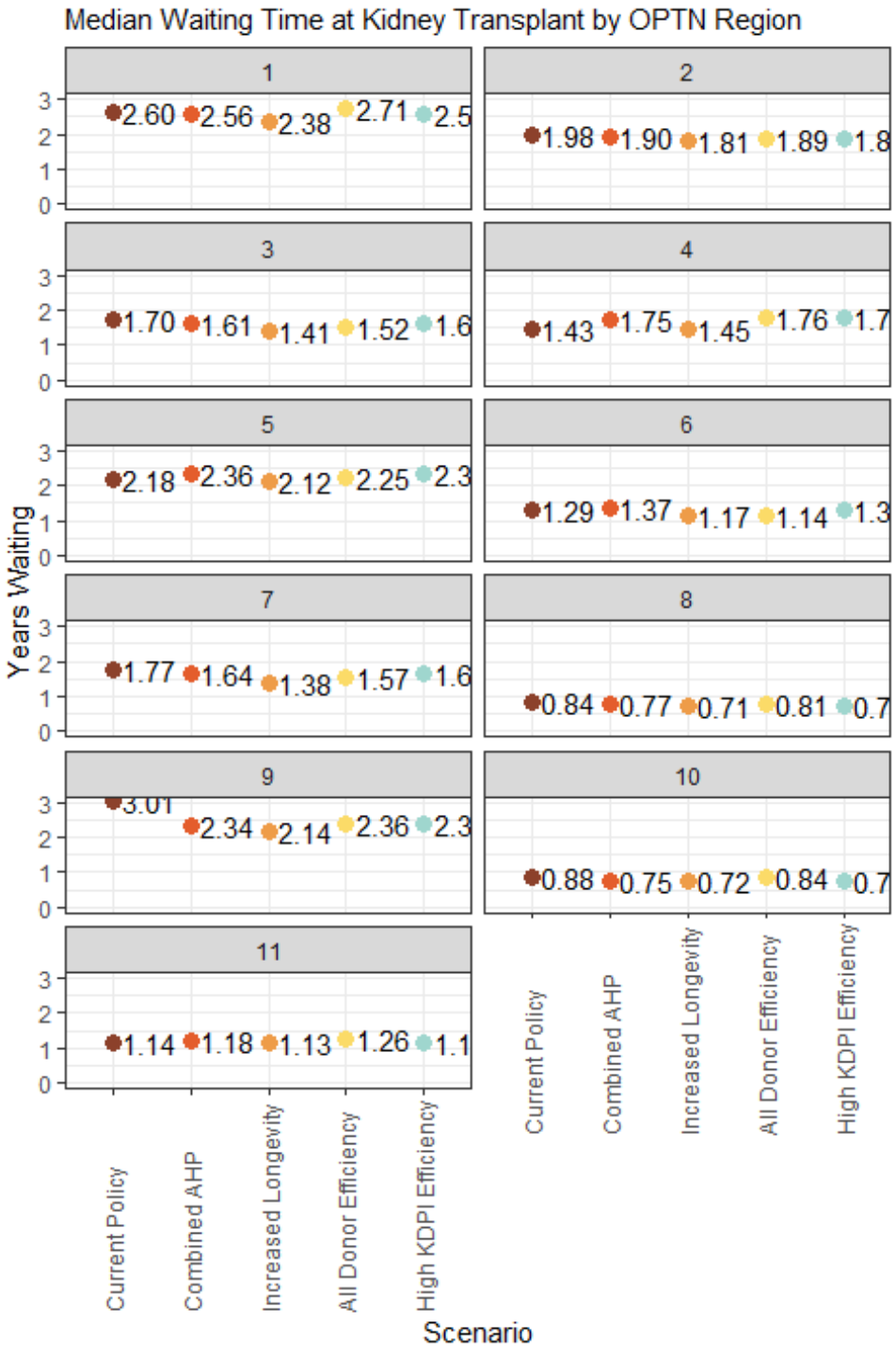

Figure 12: Median time in years from listing to kidney alone transplant among those transplanted

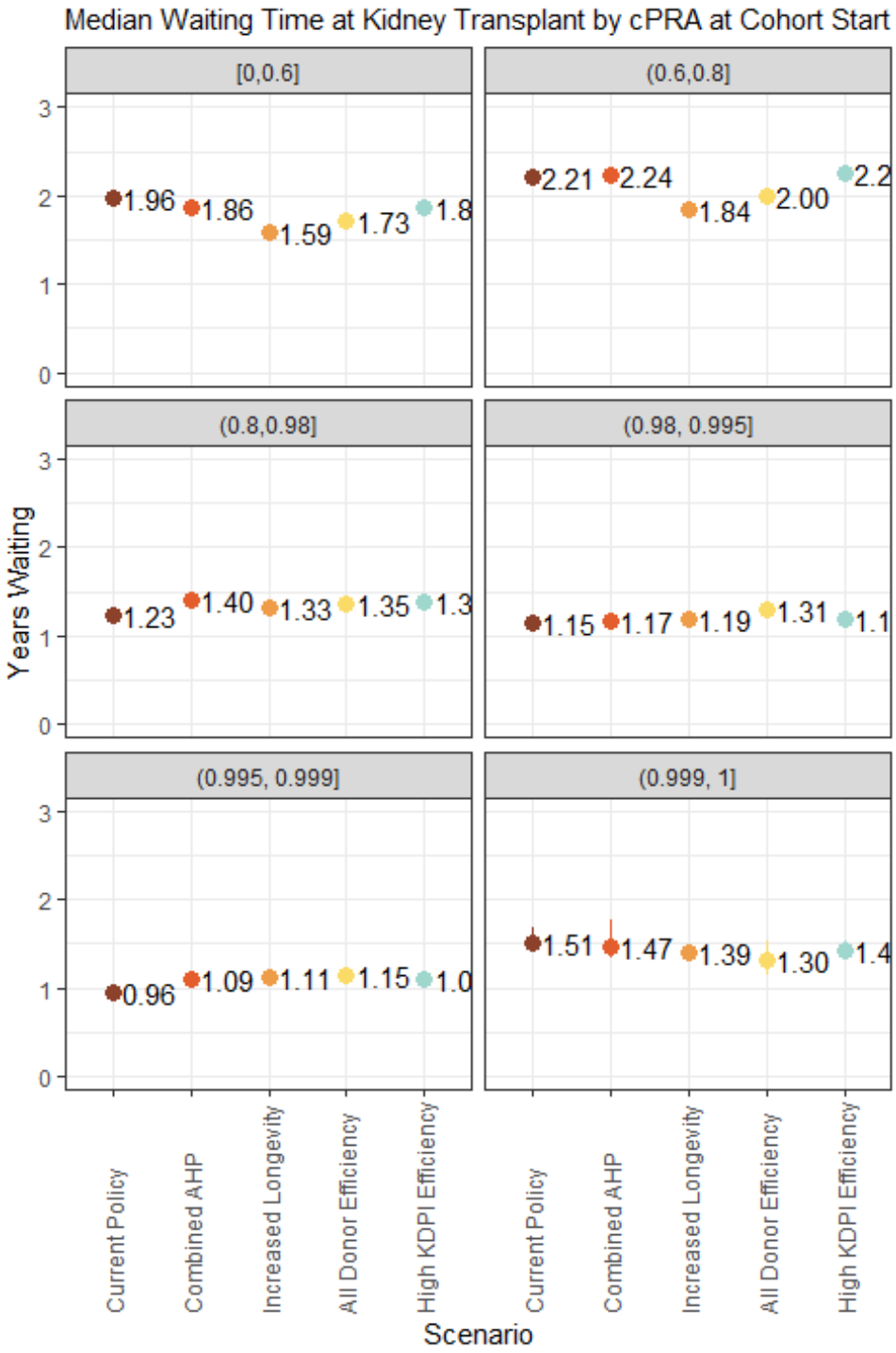

Figure 13: Median time in years from listing to kidney alone transplant among those transplanted. CPRA at cohort start is the last value the candidate had prior to the simulation start or their value at listing.

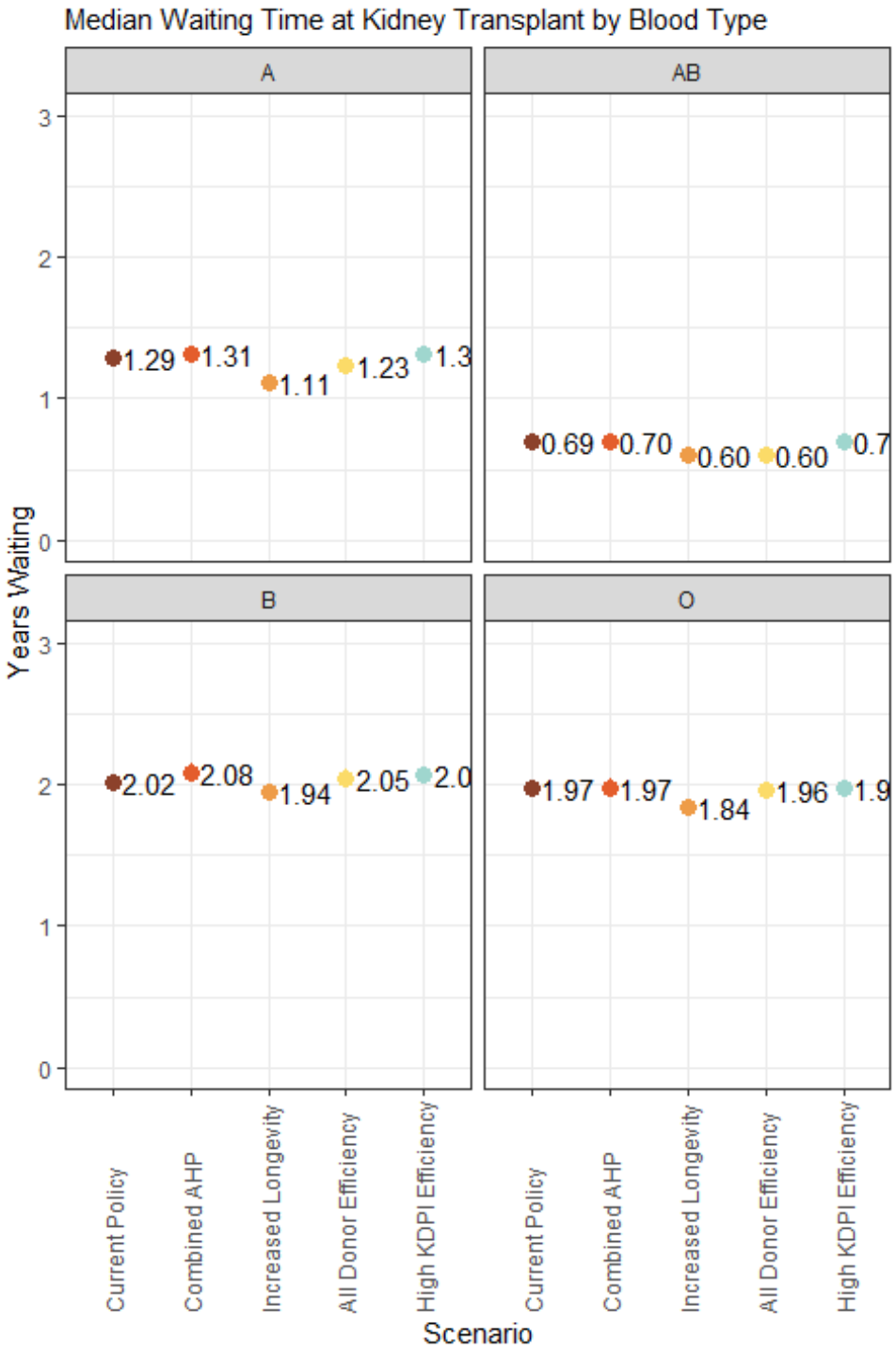

Figure 14: Median time in years from listing to kidney alone transplant among those transplanted

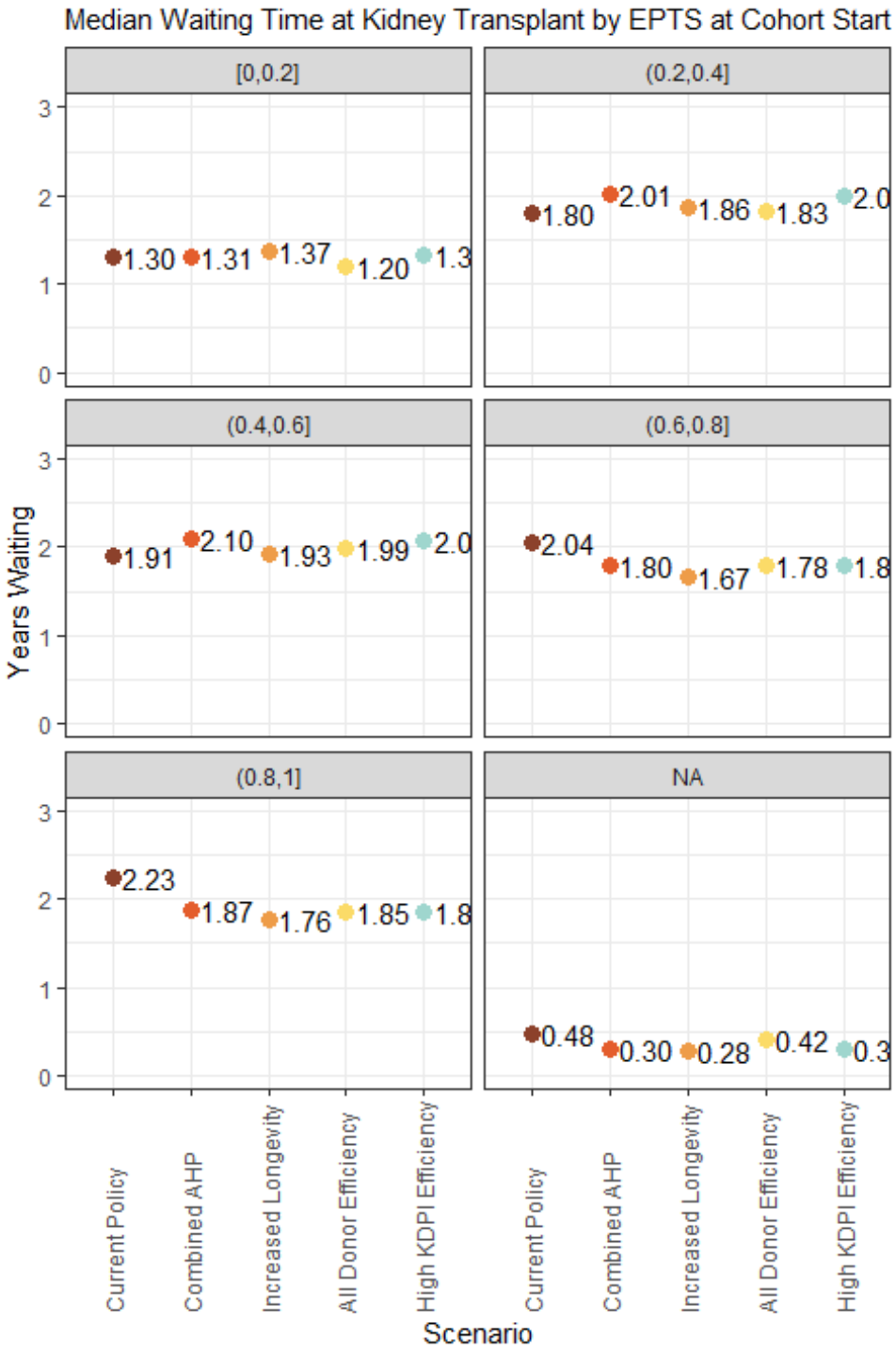

Figure 15: Median time in years from listing to kidney alone transplant among those transplanted. EPTS at cohort start is the last value the candidate had prior to the simulation start or their value at listing.

4.2.4 Transplant Rates by cPRA

This addendum presents transplant rates by cPRA with finer categorization for the 0.98 to 1, highly sensitized, candidates. The transplant rates for candidates with cPRA (0.8 to 0.98], (0.98 to 0.995] and (0.995 to 0.999] are notably higher than all other cPRA categories. Under the continuous distribution scenarios, transplant rates for the (0.995 to 0.999] cPRA candidates are notably lower than the simulation of 'Current Policy'. The transplant rates for the (0.999 to 1] cPRA candidates under the continuous distribution scenarios are lower than the simulation of current policy, particularly under the 'All Donor Efficiency' scenario. By contrast, for the candidates with cPRA (0.98 to 0.995] transplant rates are higher under all continuous distribution scenarios compared to the simulation of current policy except under the 'All Donor Efficiency' scenario.

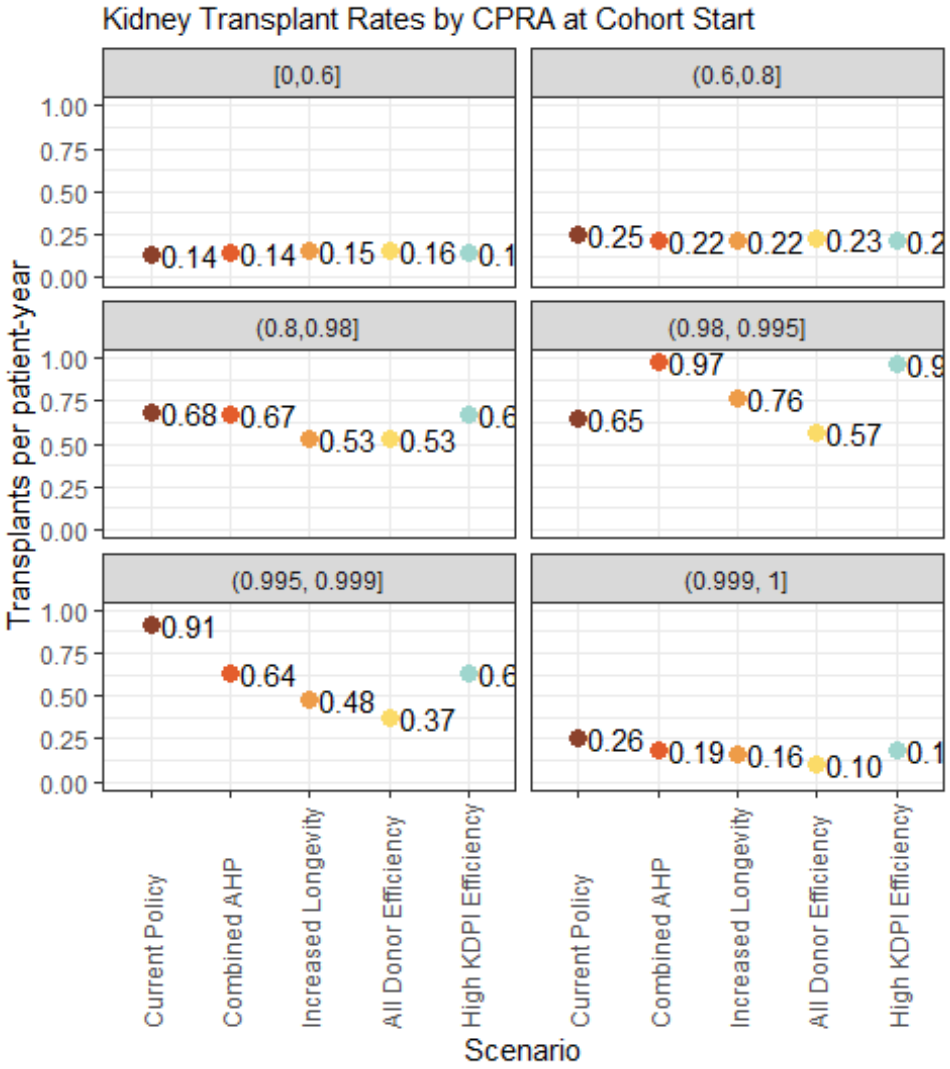

Figure 16: CPRA at cohort start is the last value the candidate had prior to the simulation start or their value at listing. Person-time is calculated in days for all candidates from the start of their simulation period (simulation start or listing) to transplant, waitlist removal, or simulation end.

4.3 Pancreas and Kidney-Pancreas Additional Results

4.3.1 Organ Travel Distance Distribution by Subgroups

Travel distance for pancreas and kidney-pancreas was generally shortest among subgroups under the 'All Donor Efficiency' scenario.

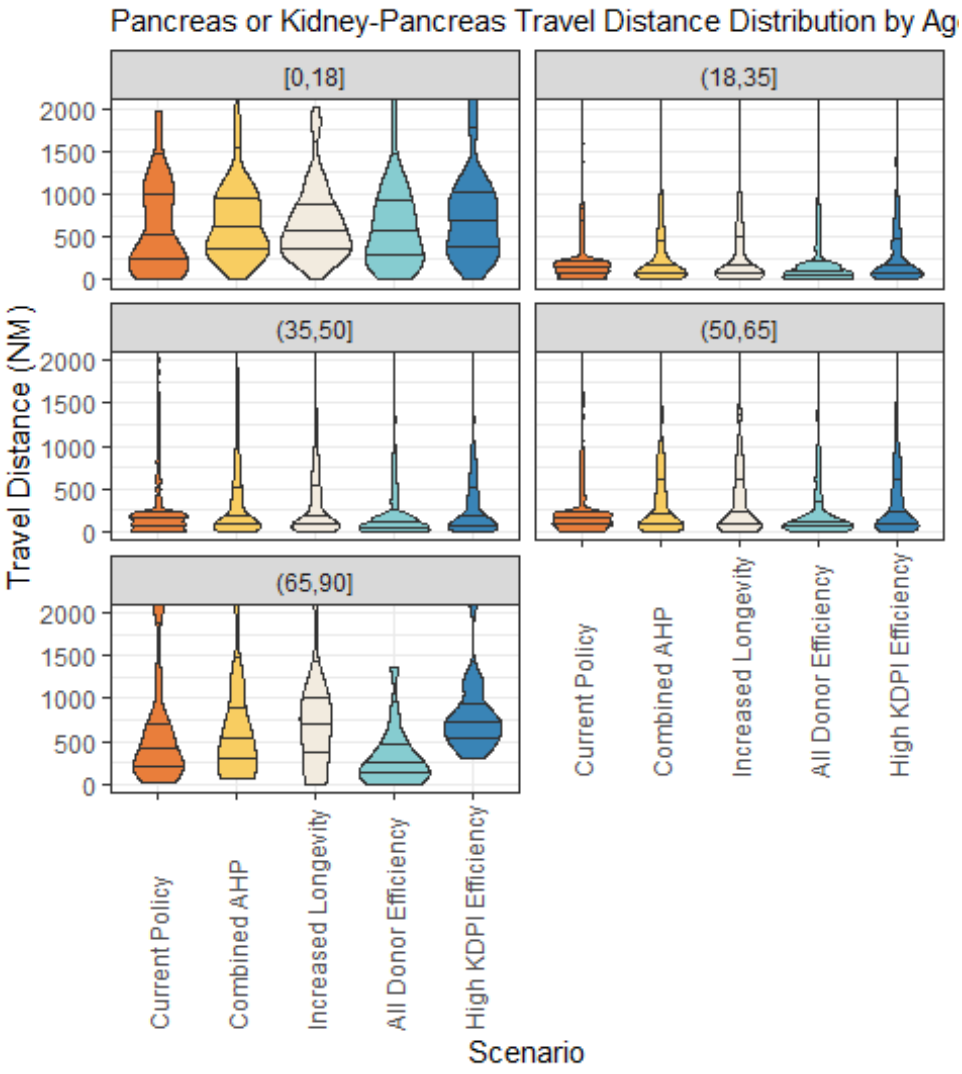

Figure 17: Distribution of travel distance. Travel distance is between the donor hospital and the transplant center, in nautical miles. Age is age in years of the recipient at time of transplant.

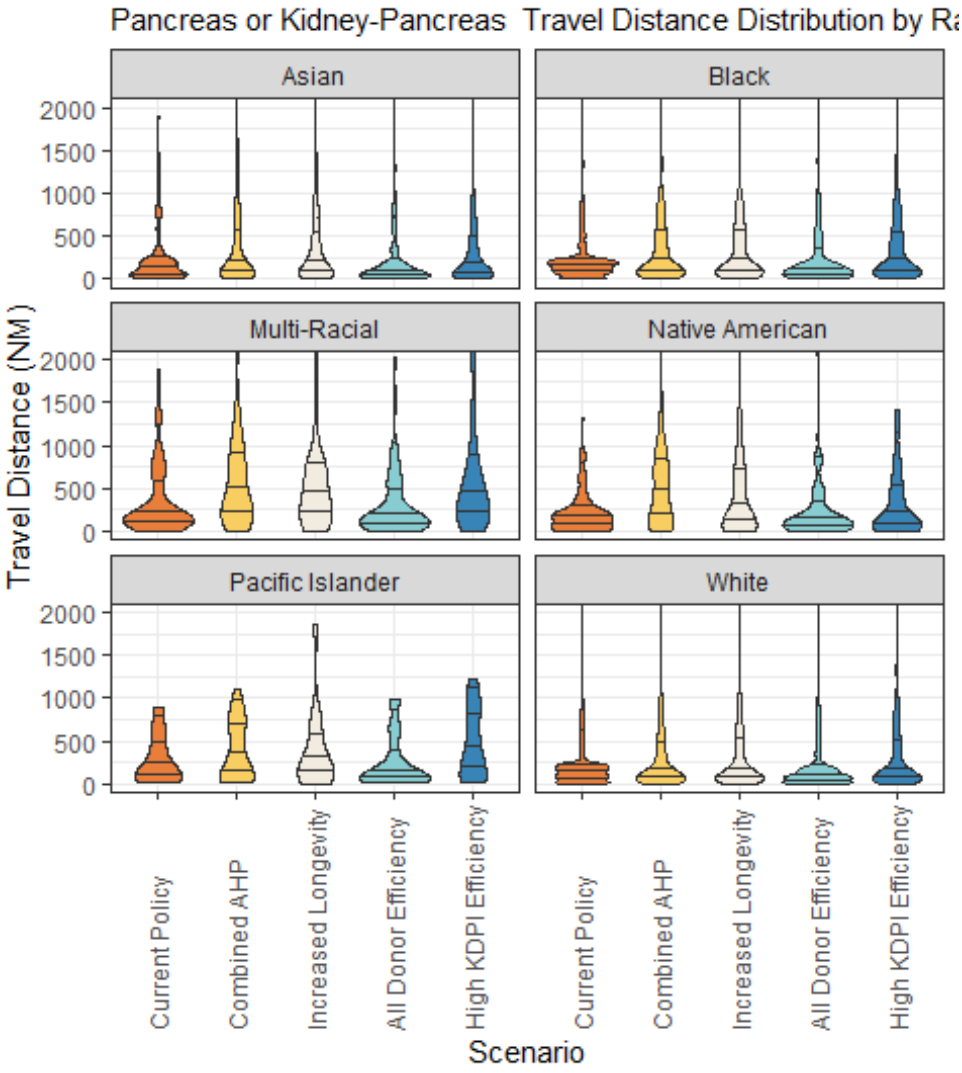

Figure 18: Distribution of travel distance. Travel distance is between the donor hospital and the transplant center, in nautical miles.

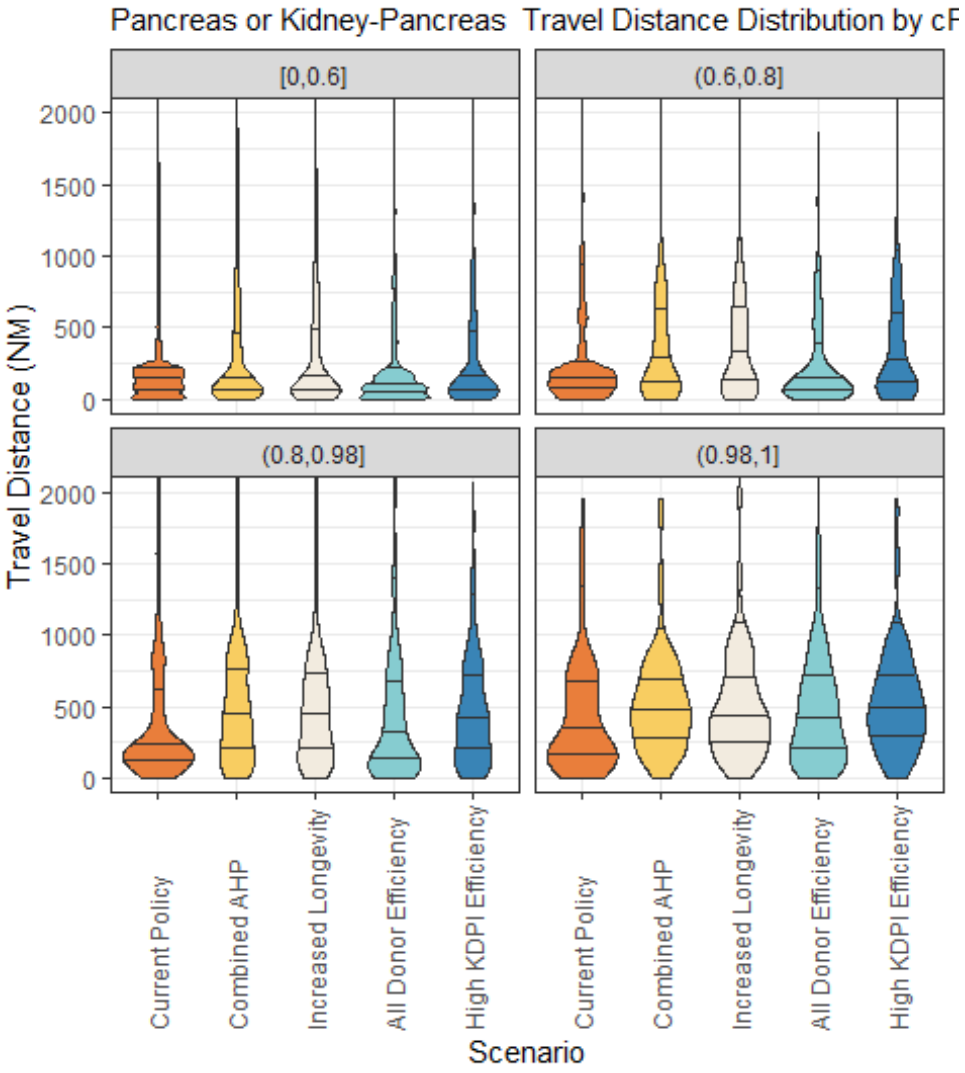

Figure 19: Distribution of travel distance. Travel distance is between the donor hospital and the transplant center, in nautical miles. CPRA at cohort start is the last value the candidate had prior to the simulation start or their value at listing.

4.3.2 Median Waiting Time among Transplant Recipients by Subgroups

Median waiting times among pancreas and kidney-pancreas transplant recipients did not show any notable differences under continuous distribution scenarios compared to the simulation of 'Current Policy'.

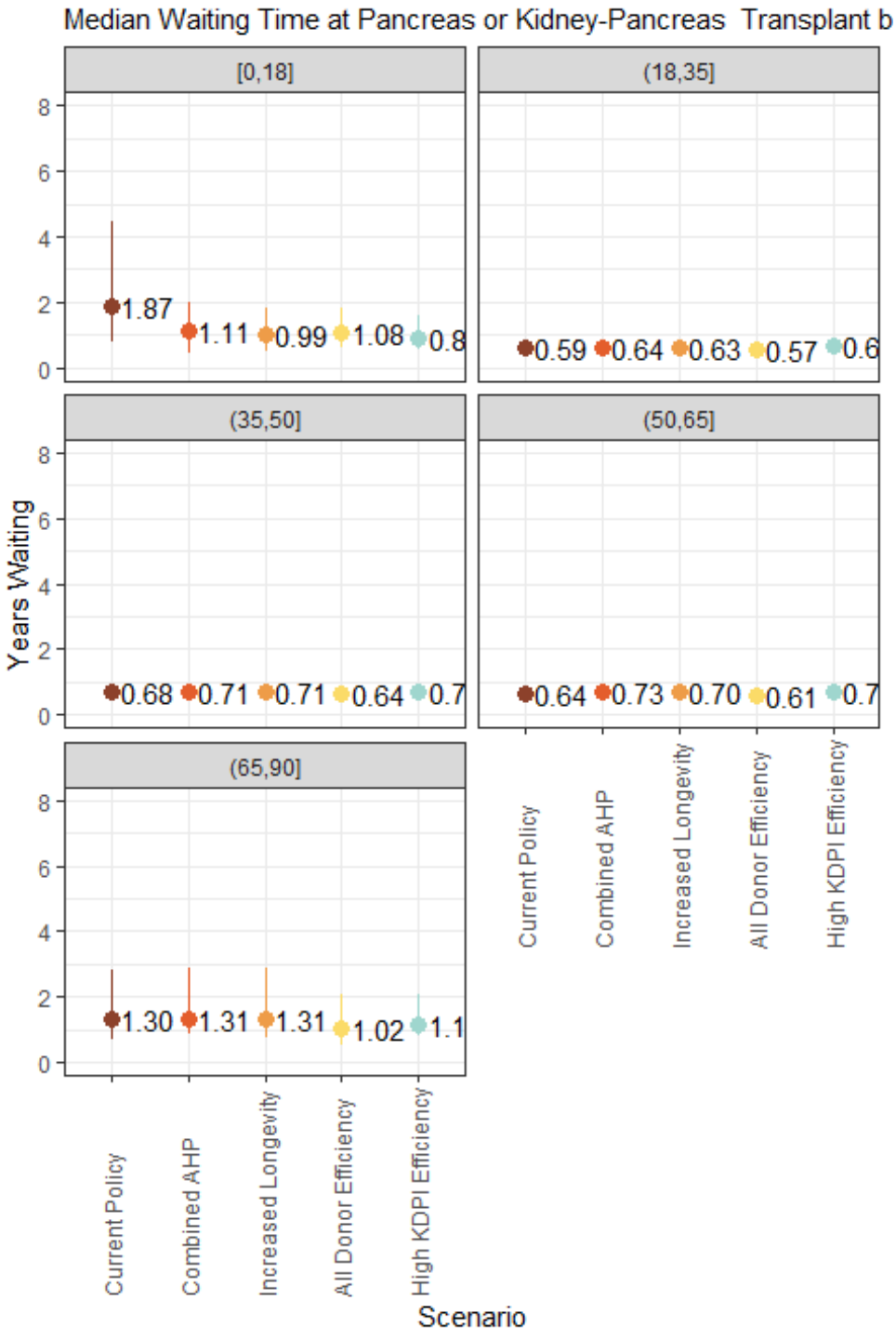

Figure 20: Median time in years from listing to pancreas or kidney-pancreas transplant among those transplanted. Age is age in years of the recipient at time of transplant.

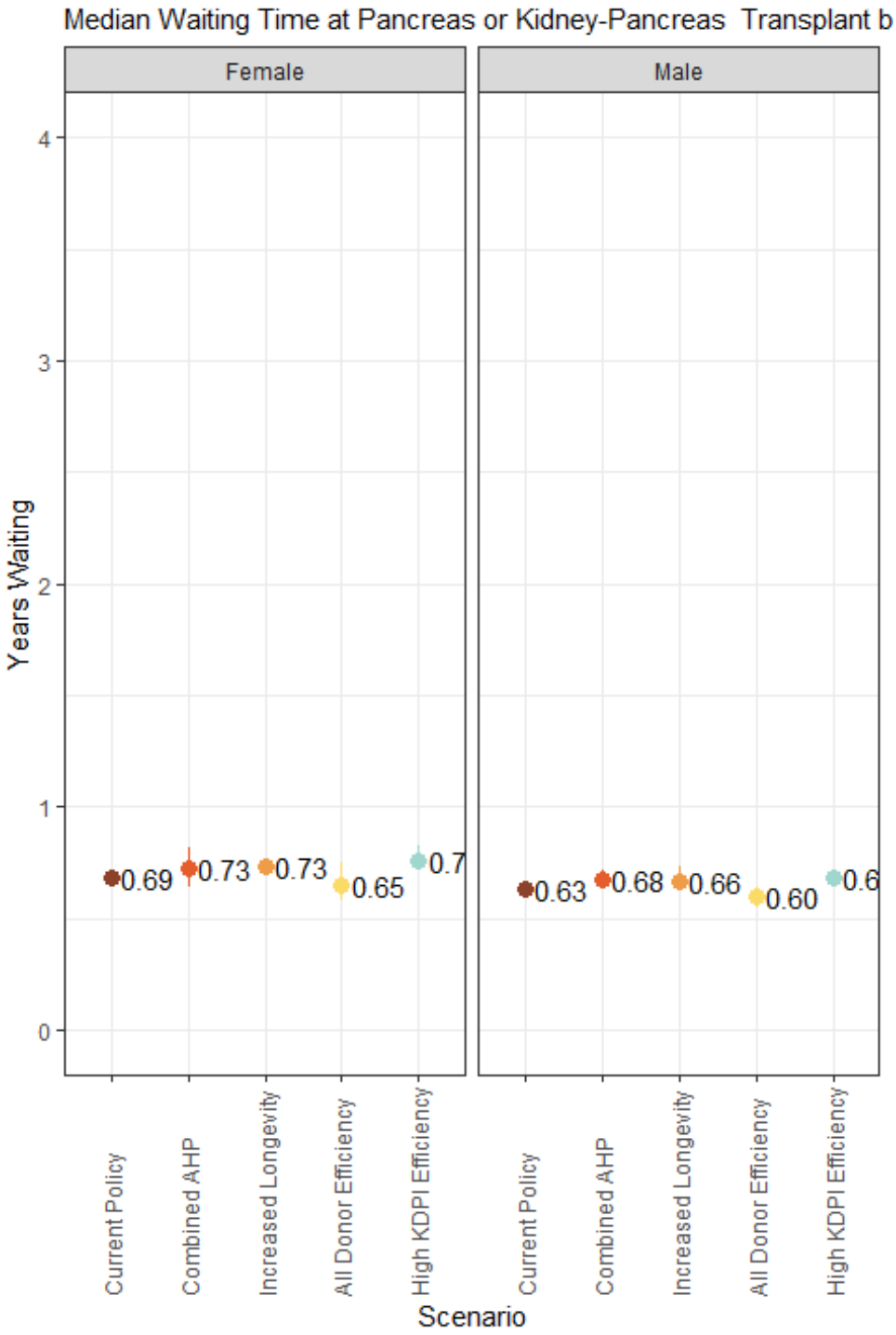

Figure 21: Median time in years from listing to pancreas or kidney-pancreas transplant among those transplanted

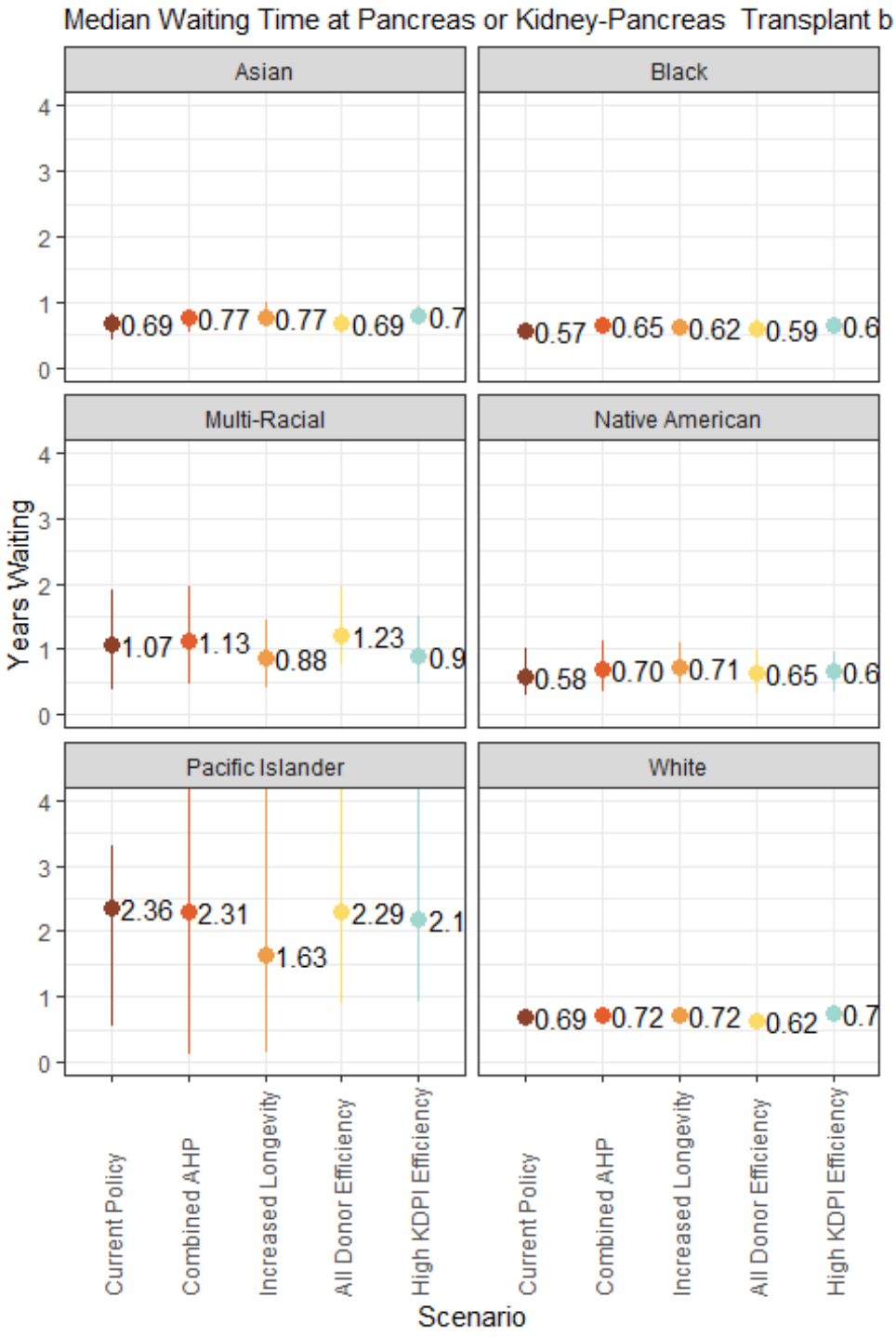

Figure 22: Median time in years from listing to pancreas or kidney-pancreas transplant among those transplanted

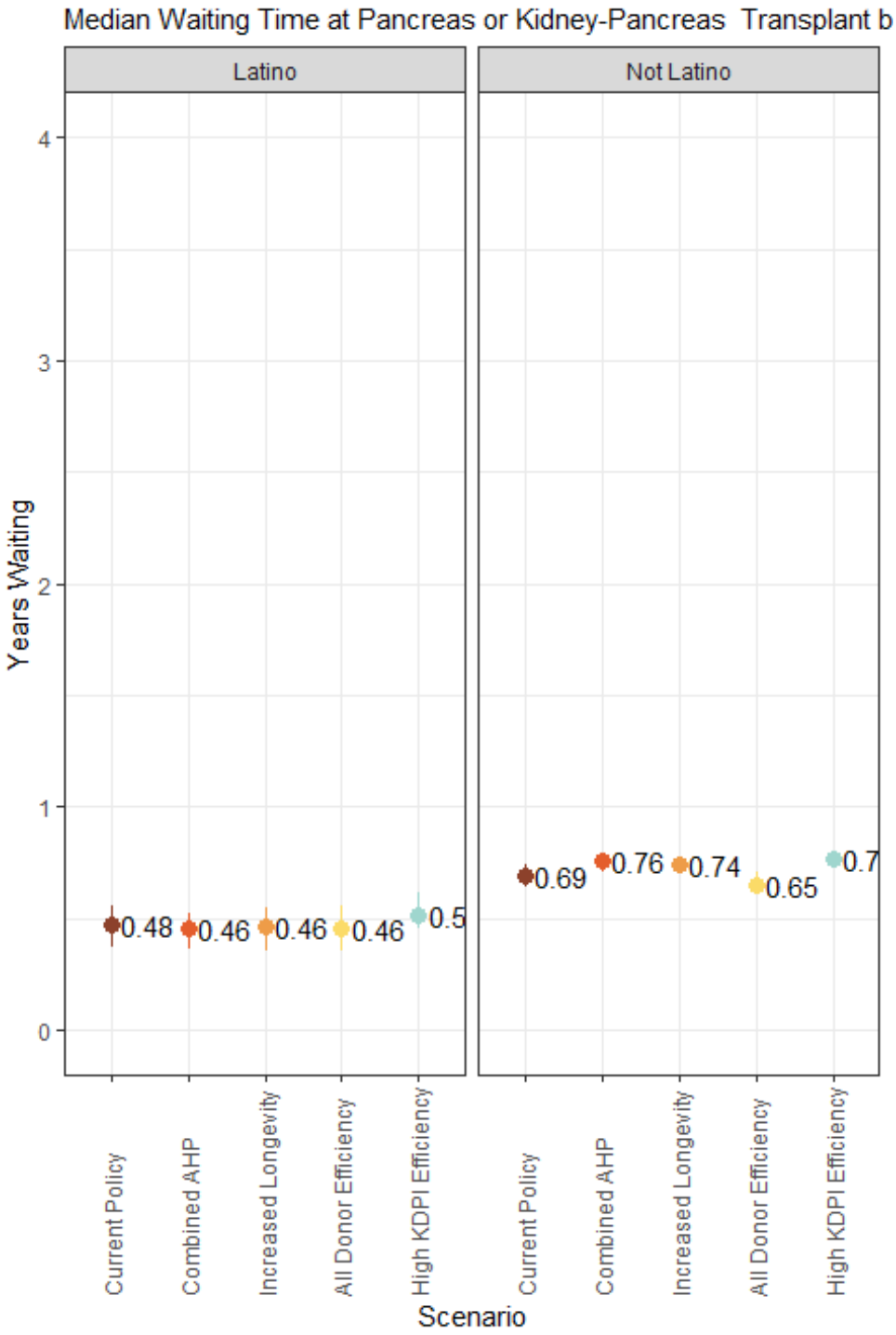

Figure 23: Median time in years from listing to pancreas or kidney-pancreas transplant among those transplanted

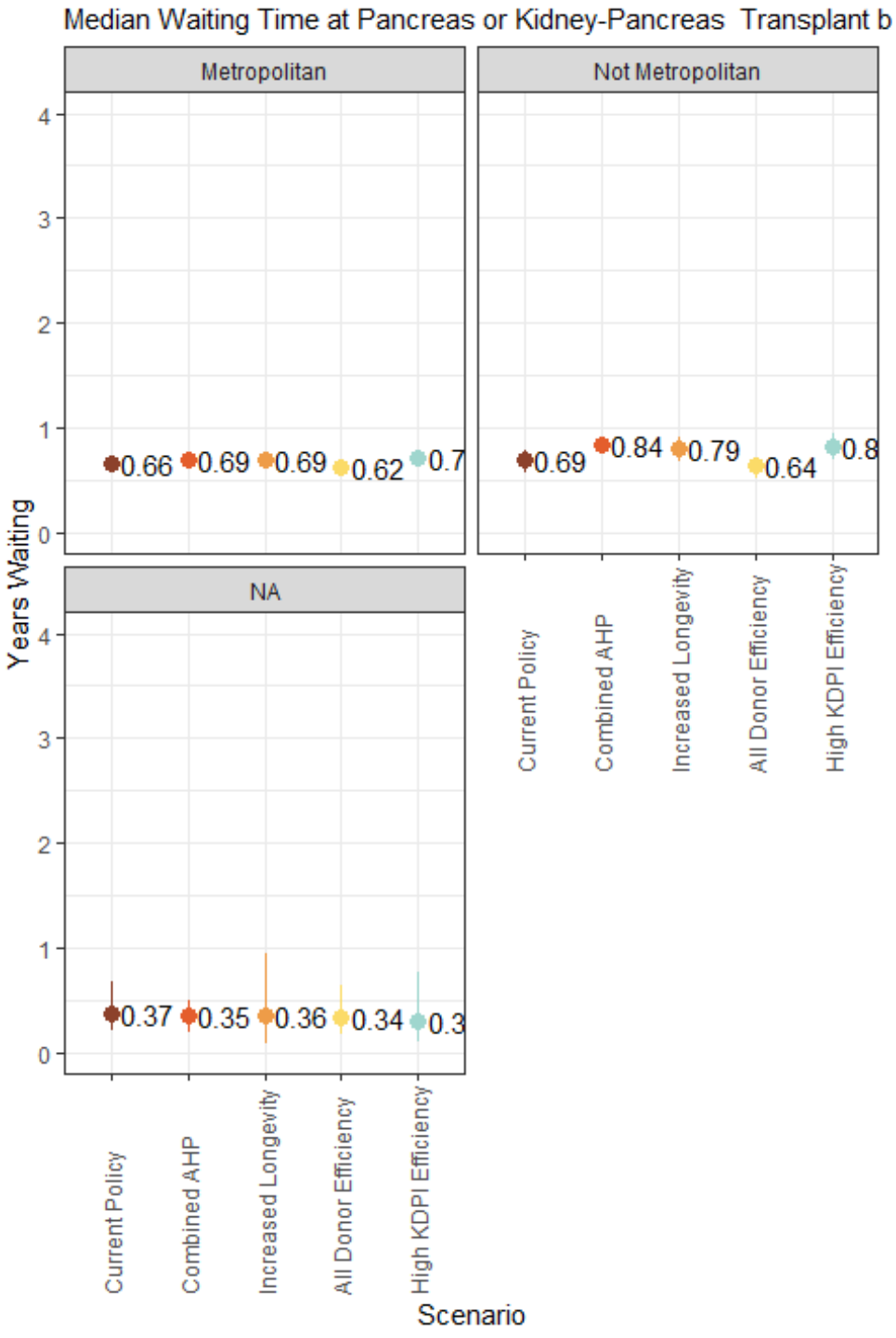

Figure 24: Median time in years from listing to pancreas or kidney-pancreas transplant among those transplanted

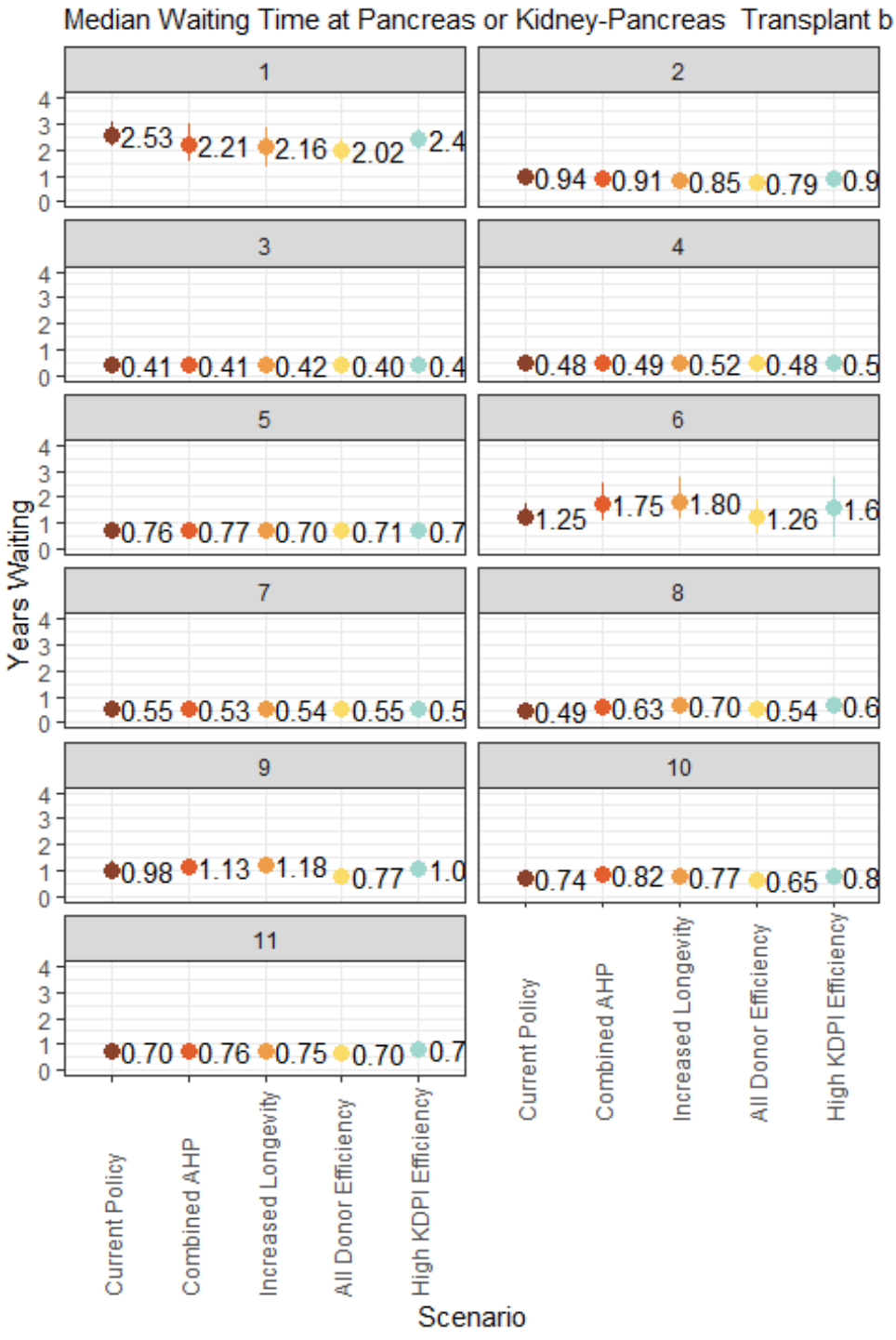

Figure 25: Median time in years from listing to pancreas or kidney-pancreas transplant among those transplanted

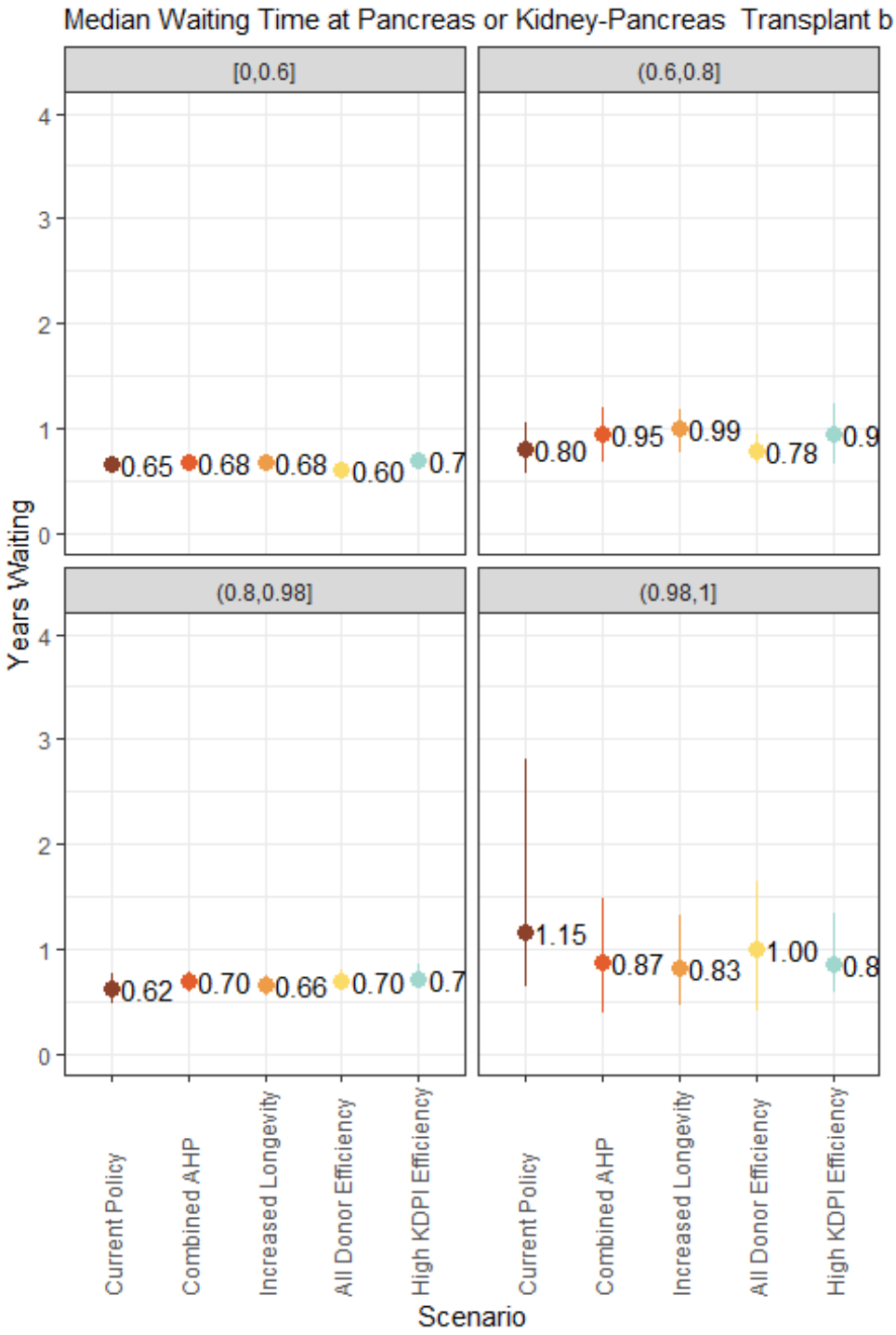

Figure 26: Median time in years from listing to pancreas or kidney-pancreas transplant among those transplanted. CPRA at cohort start is the last value the candidate had prior to the simulation start or their value at listing.

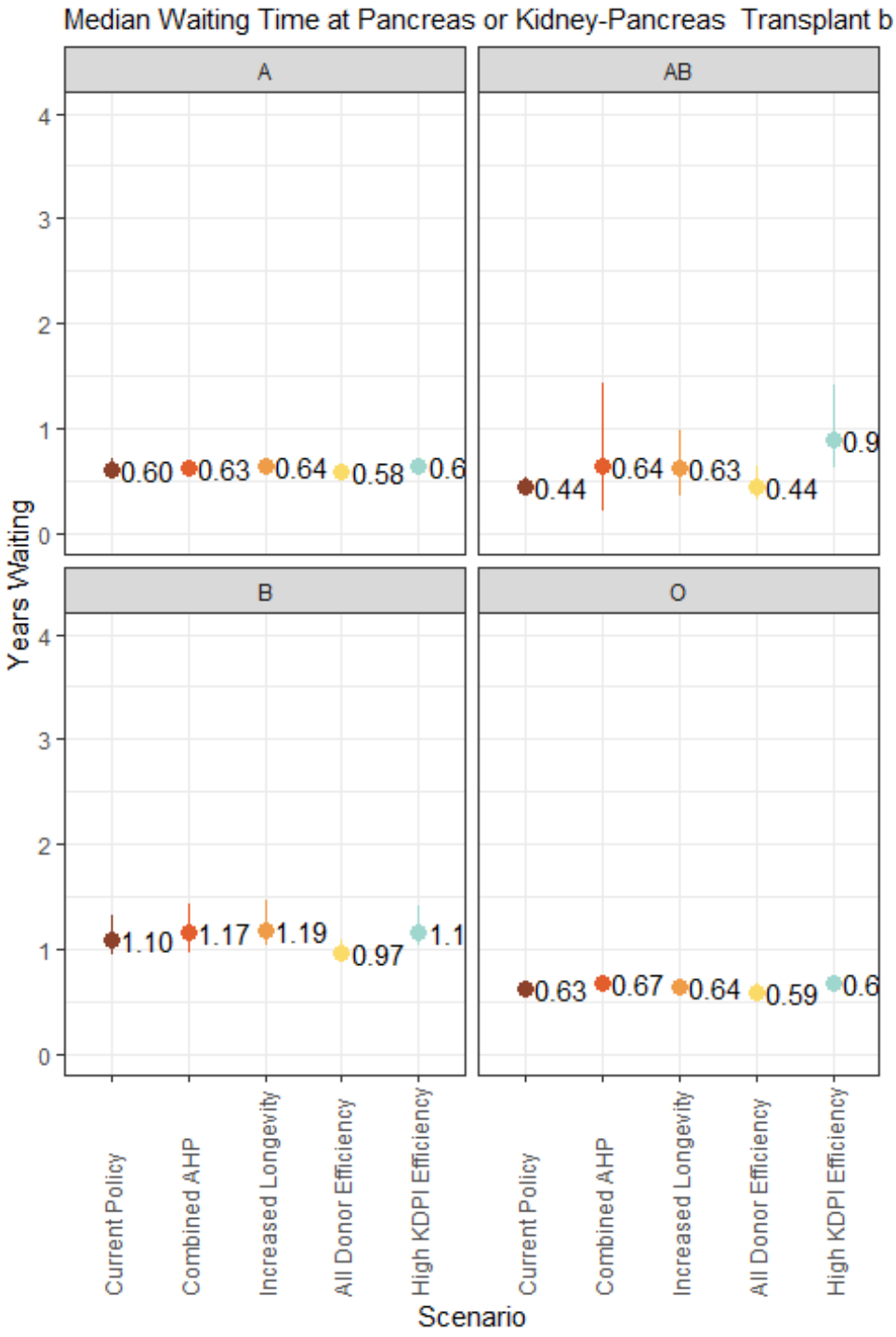

Figure 27: Median time in years from listing to pancreas or kidney-pancreas transplant among those transplanted

5 Interpretation

The SRTR interpretation of results are possible explanations for some notable results. These interpretations are not directly observable from results but present mechanisms that could explain the results.

1. In general, organs had to travel farther to reach the highly sensitized recipients (Figure 4). The All Donor Efficiency scenario, however, kept almost all travel to <500 nautical miles for even the most highly sensitized (cPRA > 0.98). The tradeoff for less travel in this scenario was a lower transplant rate for cPRA > 0.98, relative to other CD scenarios (Figure 15). That is, highly sensitized patients were made to wait until a match was available within (approximately) a 500 nautical-mile range, for All Donor Efficiency.

2. The increased graft failure rates predicted among 1 and 2 HLA-DR mismatch kidney recipients under all continuous distribution scenarios may represent the lower priority that these candidates receive compared to 0 HLA-DR mismatch candidates. It is possible that the decreased priority for candidates with HLA-DR mismatches means that candidates that are unlikely to have a 0 DR mismatch offer are accepting higher KDPI kidneys or kidneys otherwise associated with increased risk of graft failure.