Supplemental Online Content

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eMethods.

eTable 1. Spearman's rank correlation coefficients between donation metrics.

eTable 2. Consistency of top overall performers (2008-2017) in annual rankings by donation metric.

eFigure 1. Overall donation metrics from 2008-2017 by OPO.

eFigure 2. Year-to year variation in donation rates by OPO.

eFigure 3. Variation in yearly national donation rate ranking by OPO.

eFigure 4. Overall donor eligibility rates from 2008-2017 by OPO.

eFigure 5. Donor eligibility rate by organ.

eFigure 6. Year-to year variation in donor eligibility by OPO.

eFigure 7. Donation metrics by race.

eFigure 8. Donation metrics by sex.

eFigure 9. Donation metrics by age.

This supplemental material has been provided by the authors to give readers additional information about their work.

eMethods.

Data Sources

We excluded donation information from Puerto Rico, as we did not have access to the corresponding CDC mortality data.

CDC and UNOS data sources included date and location of death or donation, as well as individual age, sex, race, and cause of death. UNOS data also included a list of eligible deaths, which are deaths by persons who met a pre-defined list of medical criteria at their time of death.[11] Eligible deaths are reported to UNOS by individual OPOs and not all organ donors meet all eligibility criteria. An eligible donor was any donor that appeared in both the UNOS donation and UNOS eligible death datasets. NHANES data included obesity rates by age, sex, race, and geographic region.

Statistical Analysis

Significance levels for all tests were α=0.05. We performed all statistical analyses using R version 3.6.3.[15] We developed map figures using Tableau version 2019.2.[16] We calculated each of the donation metrics and the donor eligibility rate as an overall national measurement. We also calculated each metric by year, race, sex, age, cause of death, and OPO. We used Spearman's rank-order correlation to analyze the strength of correlation among donation metrics. We assessed OPO metric variation among OPOs as well as year-to-year variation within each OPO. We also assessed whether OPOs with the highest and lowest donation metrics performed consistently over time.

We used the number of total deaths within an OPO's service area as a proxy for the size/demand of an OPO, as OPO size may impact ability to efficiently consent and allocate donor organs. OPOs with 0-20,000 annual deaths were considered "small", those with 20,000-40,000 were considered "medium", and those with 40,000+ were considered "large". The distribution of annual death volume was multi-modal, and this categorization provided us with 3 sub-groups of similar sample size. We analyzed how OPO size corresponded to donation rates and the use of ineligible donors.

Beta Regression

Much of the discussion around differences in donation metrics assumes that there are inherent differences in potential donor populations among OPOs.[4] We performed a beta regression to describe the associations of donor characteristics with OPO donation metrics and the use of ineligible donors. We included donor race, sex, age, cause of death (COD), and body mass index (BMI), and OPO as covariates. Beta regression is a technique designed to model proportional data with values between 0 and 1.[17] We performed our analysis using the `betareg` package in R, with a logit link function.[18] We developed a distinct beta regression model for each of the three donation metrics and the donor eligibility rate. In beta regression, the value of a regression coefficient does not have a 1:1 relationship with the expected change in a donation metric. However, the relative size of a coefficient is indicative of the strength of association with a donation metric after controlling for other variables. We assessed parameter significance using likelihood ratio tests. We confirmed that multi-collinearity was not present among parameters using variance inflation factor (VIF) tests.

For our analysis, we separated individuals into two BMI categories based on established obesity cutoffs: 1) greater than or equal to 30 kg/m^2, and 2) less than 30 kg/m^2. Donor BMI was not available in all datasets. When missing, BMI was interpolated using obesity prevalence data by demographic subgroup from 2008-2016 NHANES.[19] Additionally, the CDC and OPTN datasets had distinct COD codes with no direct mapping between datasets. To include COD in our beta regression, we converted the CDC COD codes to match OPTN COD codes. We estimated CDC COD rates using OPTN COD codes by extrapolating death rates by demographic subgroup from OPTN data.

For some subgroups, donation rate metrics were above 1.0 because of either the use of ineligible donors or differences in reporting between datasets. To allow analysis of these rates using beta regression, the data for this donation rate were transformed using a min-max normalization. This normalization is a linear transformation which does not change the relationship between the response and the predictors. Significance levels for all tests were $\alpha=0.05$.

	Donors per Eligible Death	Eligible Donors per Eligible Death	Eligible Donors per Donor
Donors per Death	*ρ*: 0.15 CI: (-0.11, 0.40) p: 0.26	*ρ*: 0.04 CI: (-0.22, 0.30) p: 0.75	*ρ*: -0.19 CI: (-0.43, 0.08) p: 0.16
Donors per Eligible Death	-	**ρ: 0.65** **CI: (0.47, 0.78)** **p: <0.001**	**ρ: -0.87** **CI: (-0.92, -0.78)** **p: <0.001**
Eligible Donors per Eligible Death	-	-	*ρ*: -0.22 CI: (-0.45, 0.04) p: 0.10

eTable 1. Spearman's rank correlation coefficients between donation metrics. ρ: correlation parameter estimate, CI: 95% confidence interval, p: p-value. Bold values represent statistical significance with α=0.05.

	Donors per death	Donors per eligible death	Eligible donors per eligible death	Eligible donors per donor
% of occasions OPOs in the top quartile overall (2008-2017) were in top quartile of annual rankings	82.86%	68.57%	64.29%	67.14%
% of occasions OPOs in the bottom quartile overall (2008-2017) were in bottom quartile of annual rankings	74.29%	69.29%	65.00%	70.00%

eTable 2. Consistency of top overall performers (2008-2017) in annual rankings by donation metric

eFigure 1. Overall donation metrics from 2008-2017 by OPO. OPOs with the lowest relative value for each metric are colored orange in the corresponding map. Similarly, OPOs with the highest relative donation rate for each metric are colored blue. The color scale is linear between the minimum and maximum values for each donation metric, and the scales are independent between metrics.

eFigure 2. Year-to year variation in donation rates by OPO. OPOs are listed in descending order according to their median donors per eligible death rate over the study period.

eFigure 3. Variation in yearly national donation rate ranking by OPO. Box-and-whisker plots of year-to-year donation rate ranking by OPO. OPOs are listed in descending order according to their median donors per eligible death rate over the study period.

eFigure 4. Overall donor eligibility rates from 2008-2017 by OPO. OPOs with the lowest relative value for each metric are colored orange in the corresponding map. Similarly, OPOs with the highest relative donation rate for each metric are colored blue. The color scale is linear between the minimum and maximum values.

eFigure 5. Donor eligibility rate by organ. Box-and-whisker plots of the donor eligibility rate across OPOs by organ. The donor eligibility rate is calculated for each OPO for the entire 2008-2017 study period.

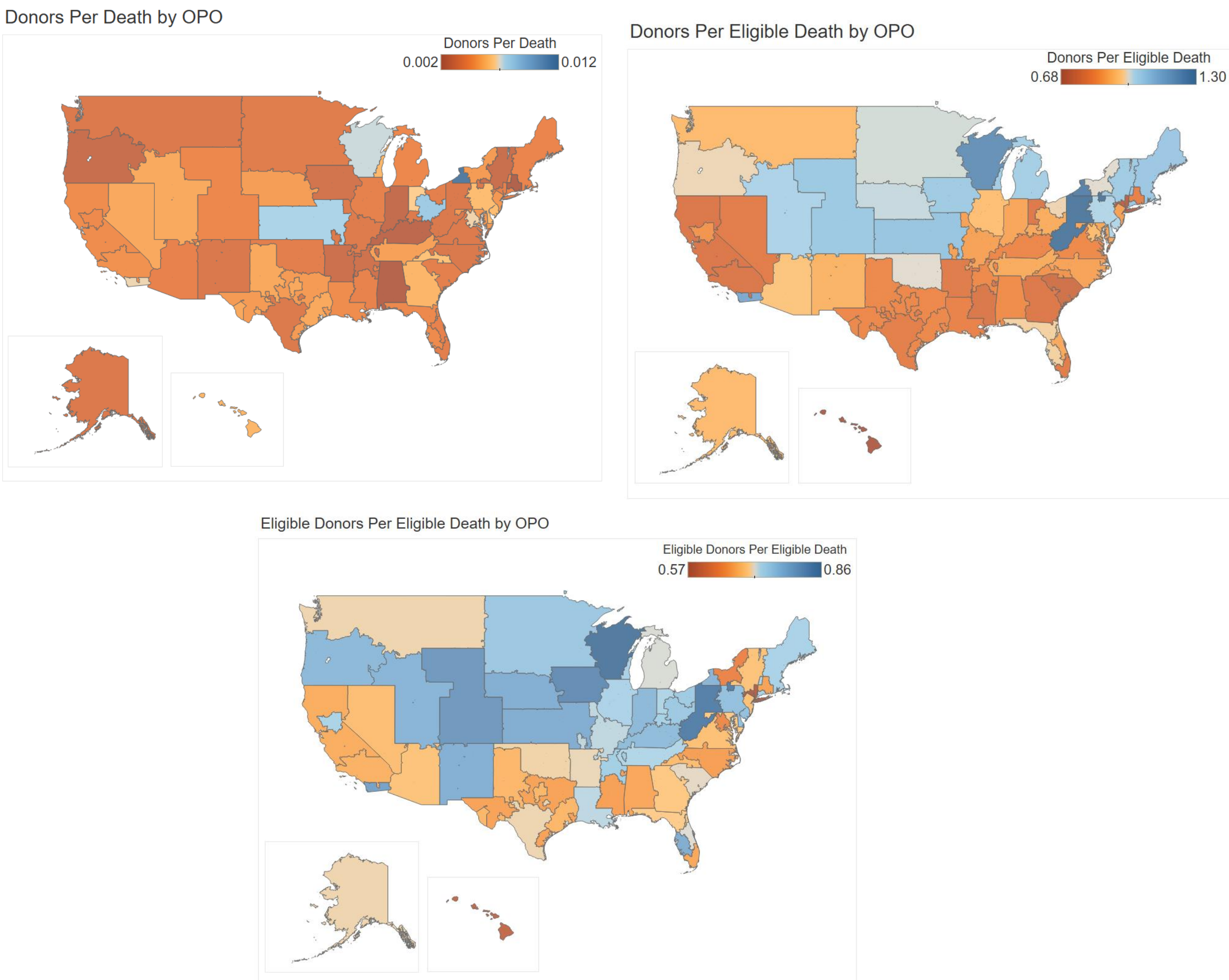
eFigure 6. Year-to year variation in donor eligibility by OPO. OPOs are listed in descending order according to their median donors per eligible death rate over the study period. Rank correlation tests found significant negative correlation between donors per eligible death and eligible donors per donor ($\alpha = 0.05$).

eFigure 7. Donation metrics by race. Each point represents the average donation rate for a given demographic by year, ranging from 2008-2017.

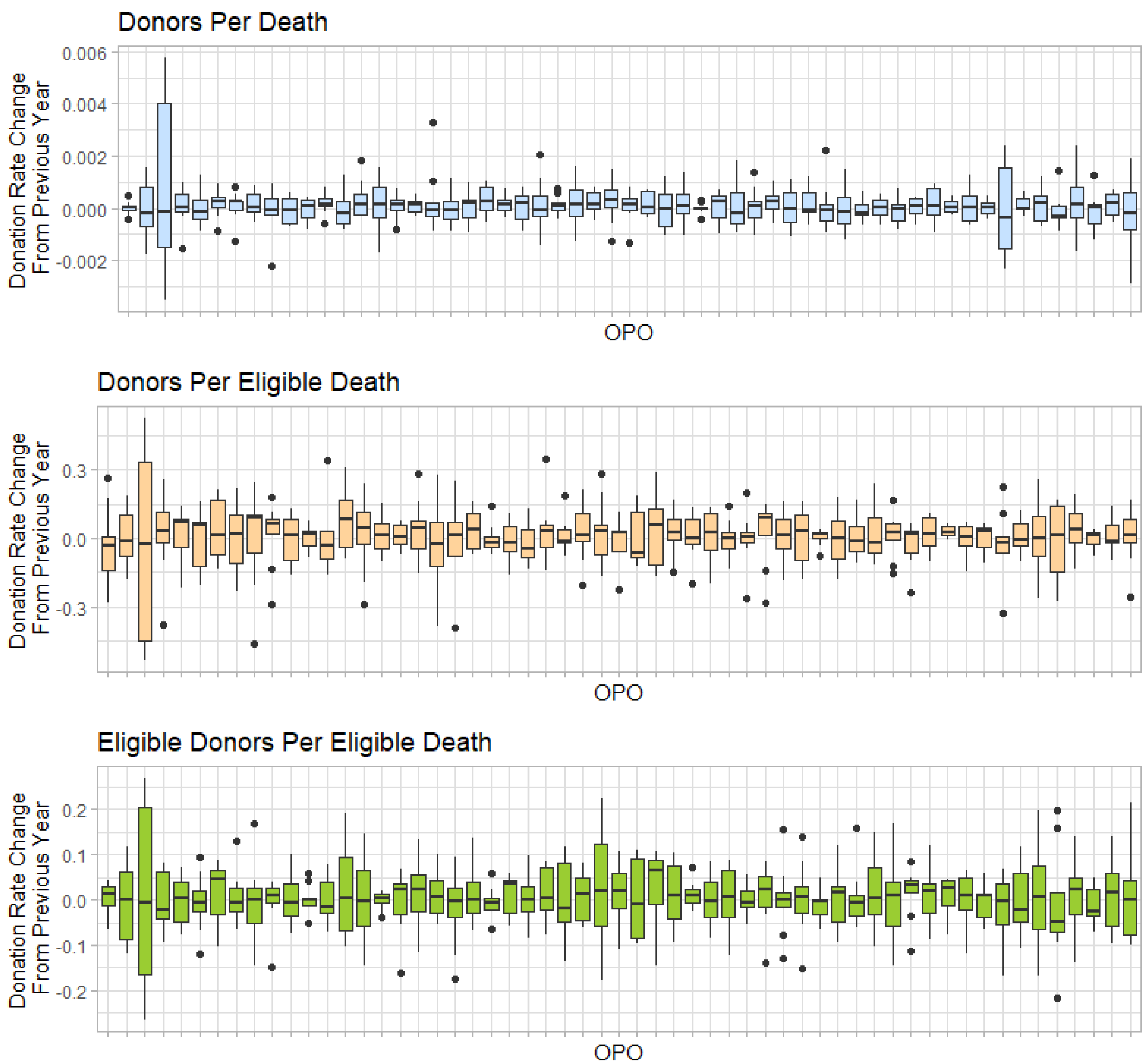
eFigure 8. Donation metrics by sex. *Acronyms: F: female; M: Male. Each point represents the average donation rate for a given demographic by year, ranging from 2008-2017.

eFigure 9. Donation metrics by age. Each point represents the average donation rate for a given demographic by year, ranging from 2008-2017. Ages shown are in years.

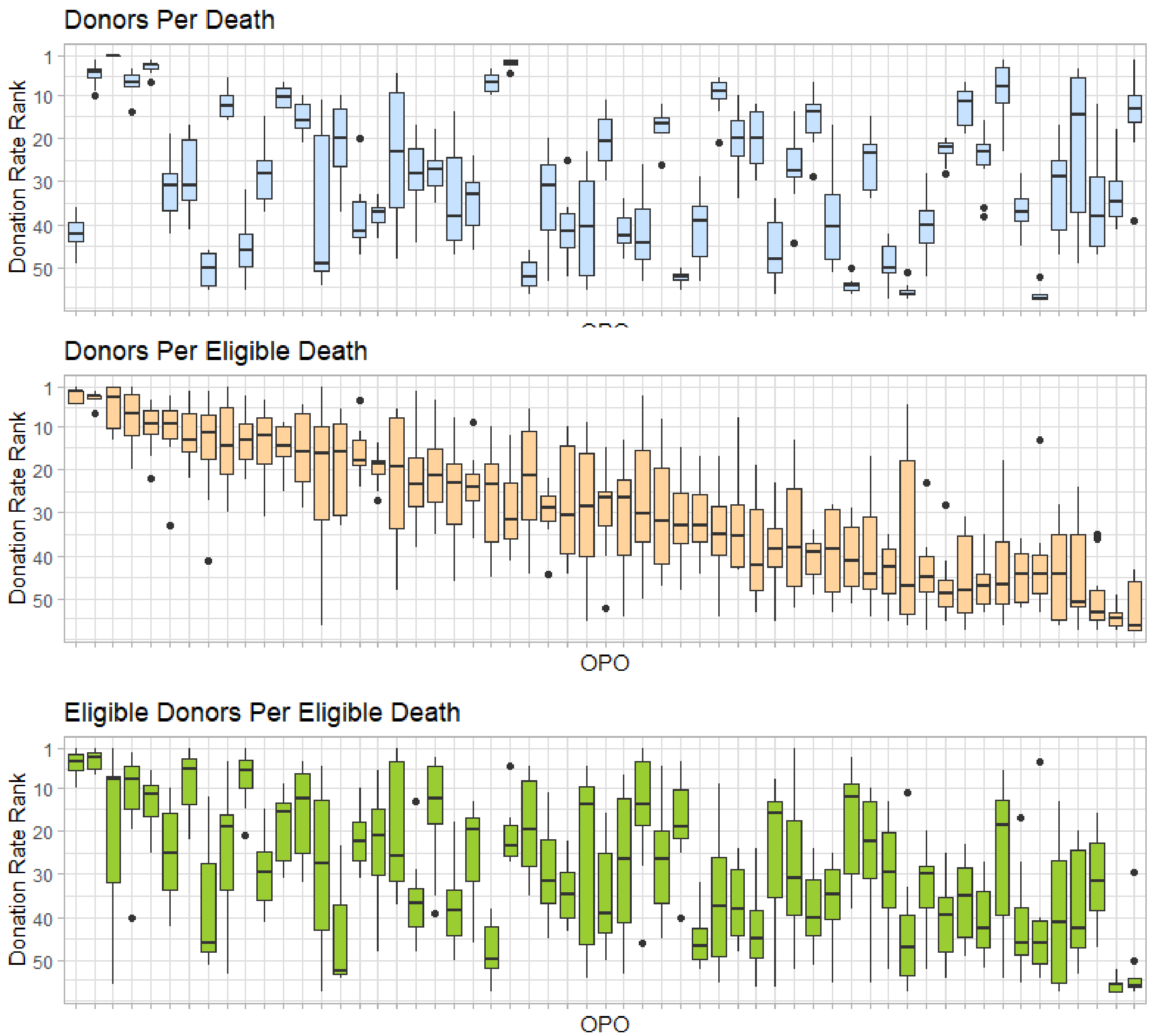
eFigure 1. Overall donation metrics from 2008-2017 by OPO.



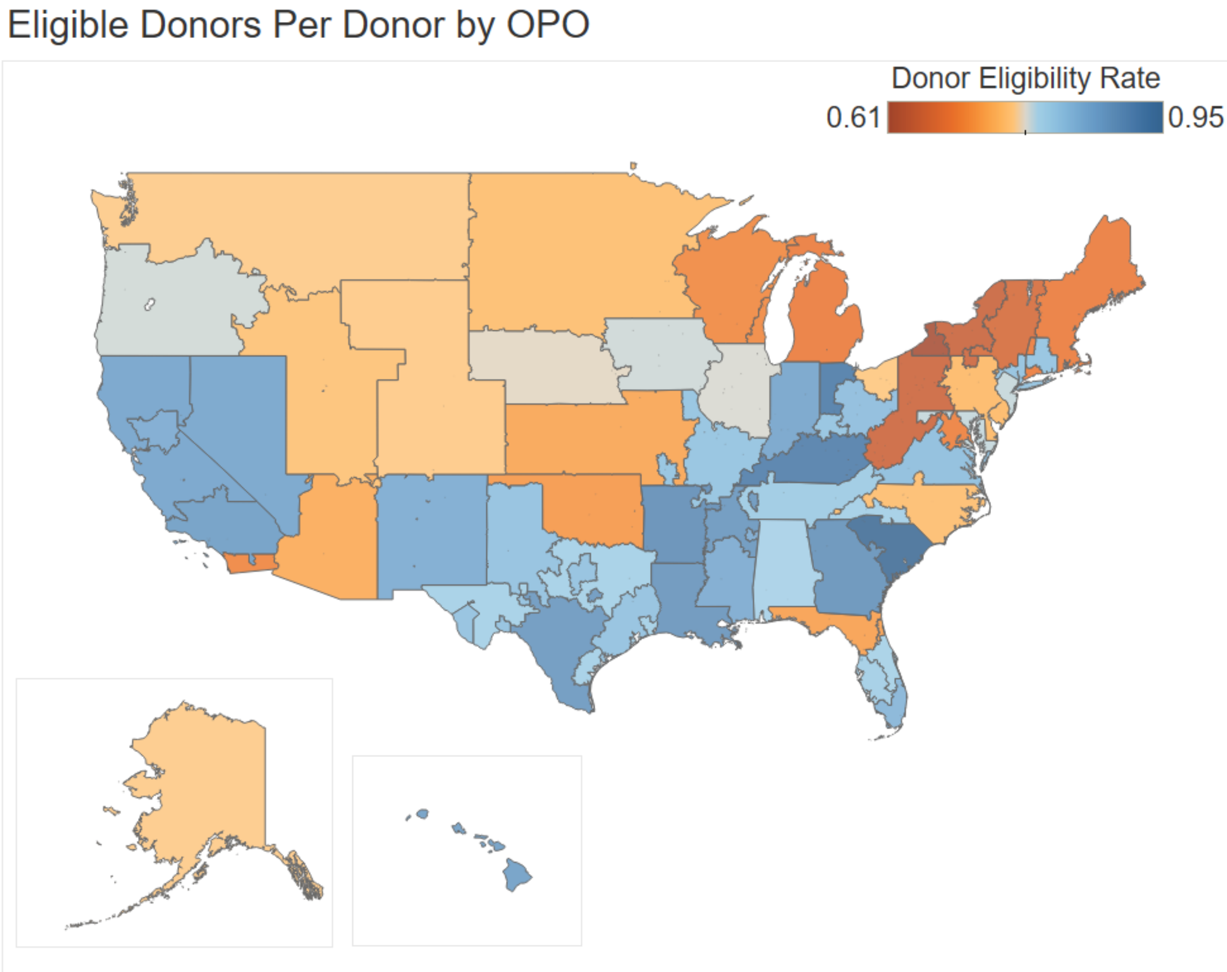
eFigure 2. Year-to year variation in donation rates by OPO.



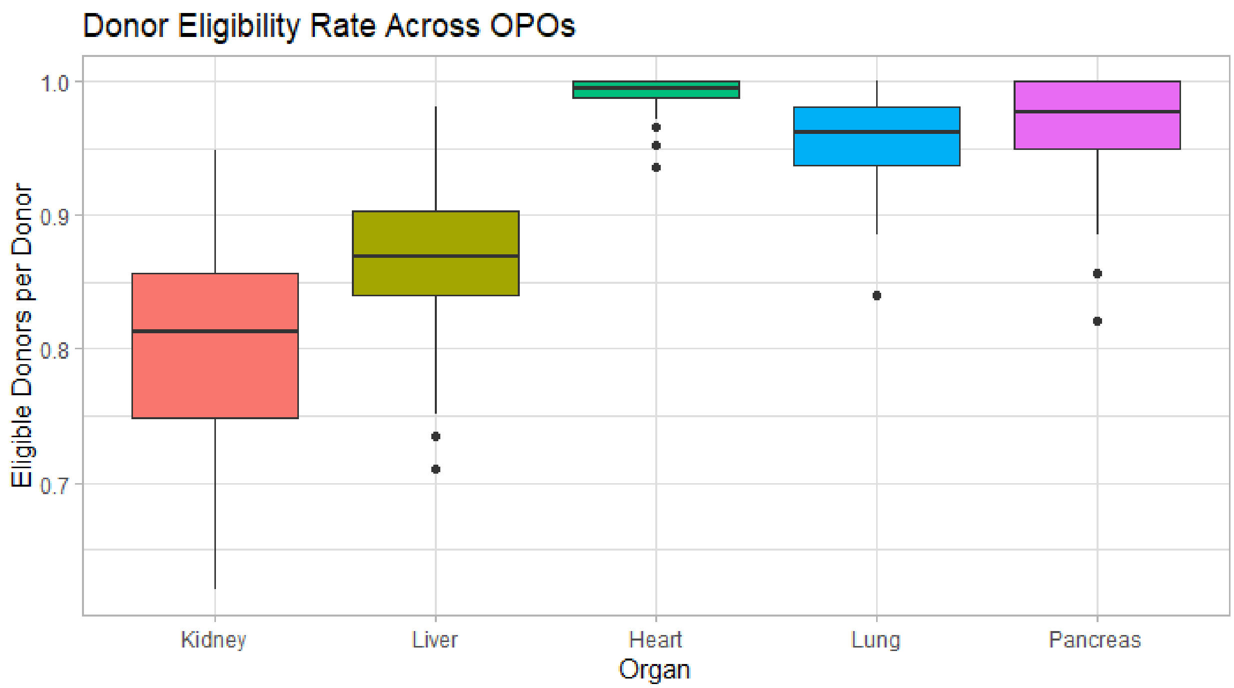
eFigure 3. Variation in yearly national donation rate ranking by OPO.



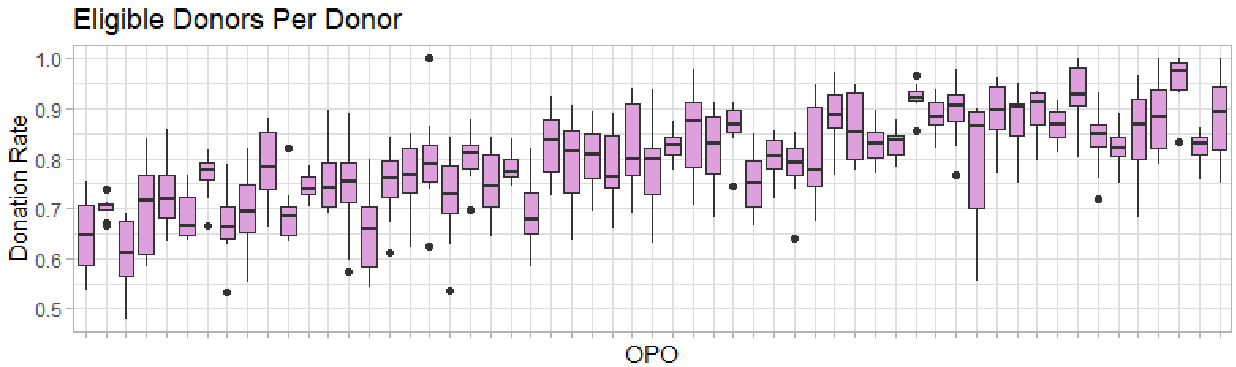
eFigure 4. Overall donor eligibility rates from 2008-2017 by OPO.



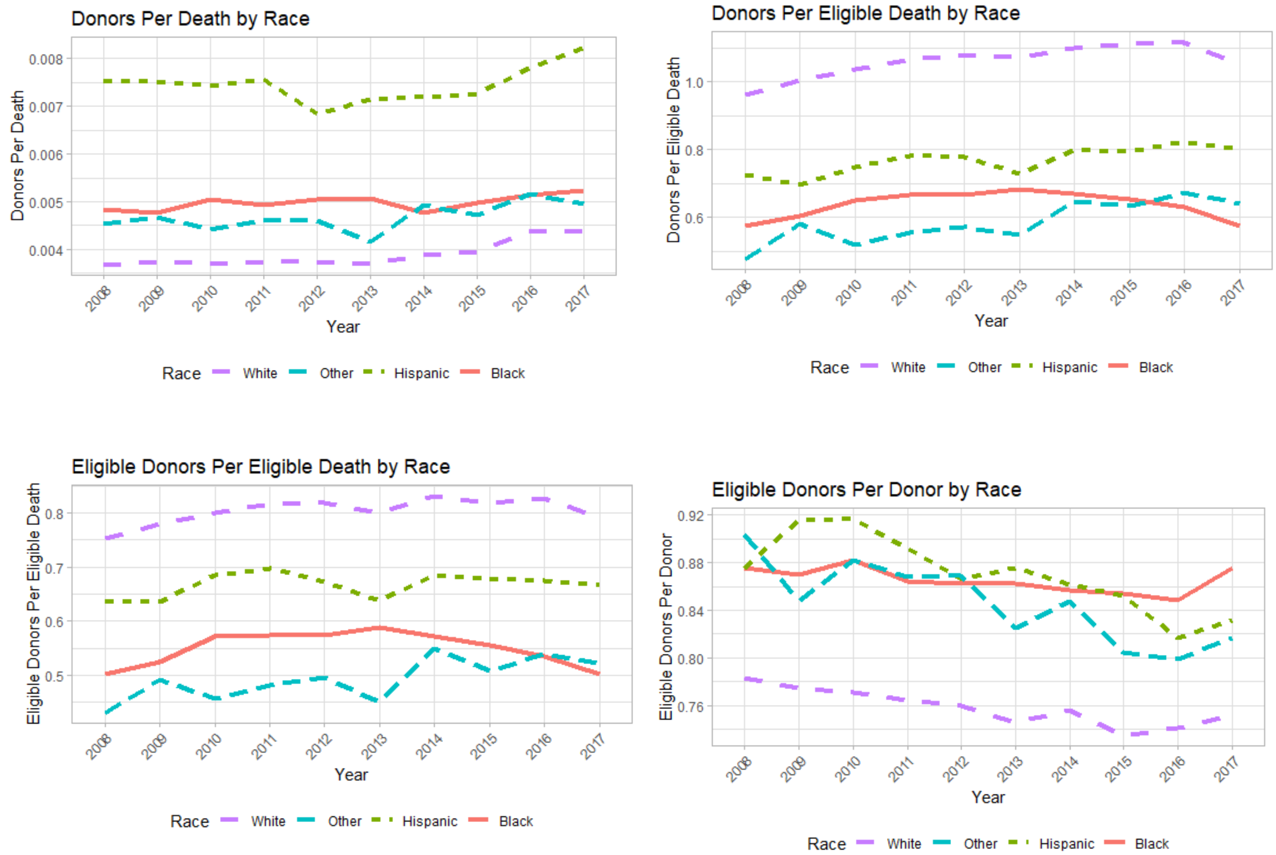
eFigure 5. Donor eligibility rate by organ.



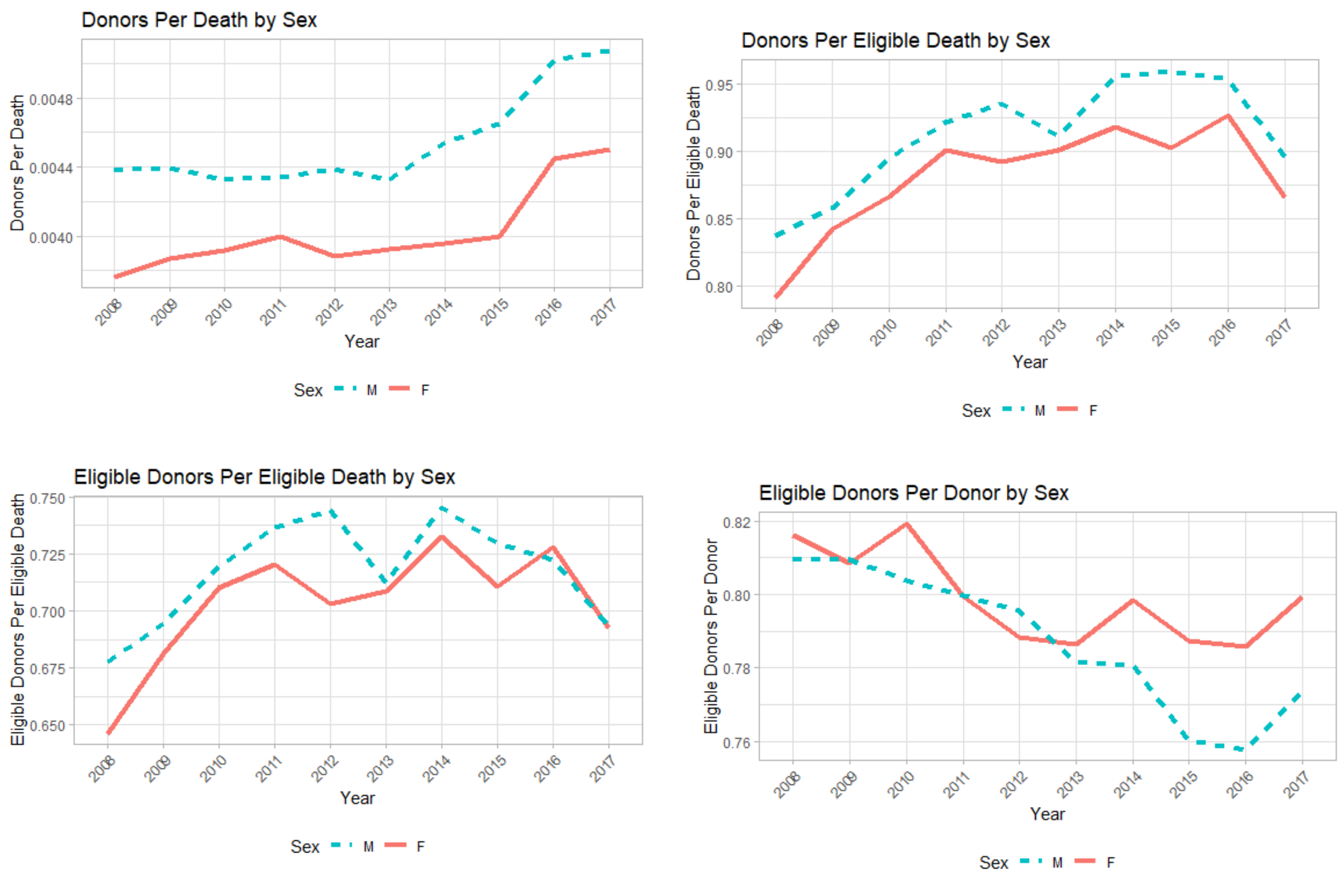
eFigure 6. Year-to year variation in donor eligibility by OPO.



eFigure 7. Donation metrics by race.



eFigure 8. Donation metrics by sex.



eFigure 9. Donation metrics by age.