Web-based Supplementary Materials for "Estimating Individual-Level and Population-Level Causal Effects of Organ Transplantation Treatment Regimes" by Jeffrey A. Boatman and David M. Vock

1   Web Appendix A. Notation

$T^*(\infty)$: potential survival time from listing if a patient were to never receive a transplanted organ

$T^*(b, q)$: potential survival time from listing if a patient received an organ b days after listing with organ characteristics q

$\mathcal{Q}$: the set of all donor characteristics

$X^*(b)$ the covariates collected b days after listing for a random patient including whether or not the patient had been previously transplanted and had previously died prior to time b

L_i: calendar date the ith patient is listed for organ transplantation

$N_{ij}^*(t, q)$: indicator that patient died on the jth study day if she accepted an organ with characteristics q, t days after listing

$Y_{ij}^*(t, q)$: indicator that patient was at risk of death on the jth study day if she accepted an organ with characteristics q, t days after listing

$N_{ij}^*(\infty)$: indicator that patient died on the jth study day if she were to never receive a transplant

$Y_{ij}^*(\infty)$: indicator that patient was at risk of death on the jth study day if she were to never receive a transplant

g: a transplant regime dictating which organs should be avoided

$\mathcal{G}$: the set of all possible treatment regimes

$T_i^*(g, g')$: the time from listing a patient would live if she where to follow regime g and all other patients were to follow g'

$B^{(g,g')}$: time from listing until transplantation for a patient who follows regime g while all other patients follow regime g'

$Q^{(g,g')}$: vector of the transplanted organ characteristics for a patient who follows regime g while all other patients follow regime g'

$\mathcal{P}_i$: the set of potential outcomes for the ith patient

$f_{T^*(g,g')}(t)$: the density of $T^*(g, g')$

$f_{T^*(B,Q)|\overline{X}^*(b)}\{t|\overline{x}(b)\}$: the conditional density of $T^*(b, q)$

$\rho^{(g,g')}\{b, q|\overline{x}(b)\}$: the probability of receiving a transplant b days after listing with organ characteristics q given she is untransplanted $b-1$ days after listing with covariate history $\overline{x}(b)$ and the patient follows regime g while all others follow regime g'

$f_{T,Q|\overline{X}^*(t)}^{(g,g')}\{t, q|\overline{x}(t)\}$: the probability of receiving a transplant t days after listing with organ characteristics q if the patient follows regime g while all others follow regime g'

$f_{\overline{X}(b)}$: the density of $\overline{X}(b)$

T_i: the observed time from entering the waiting list until death

X_{ij}: the vector of covariates collected on the ith patient on the jth day

N_{ij}: indicator for whether patient died on the jth study day

Y_{ij}: indicator for whether patient was at risk for death on the jth study day

S_j: number of organs available on the jth study day

Q_{jk}: characteristics of the kth organ on the jth day

A_{ijk}: indicator for whether the patient was transplanted with the kth organ on the jth day

O_{ijk}: indicator for whether the patient was offered the kth organ on the jth day

E_{ijk}: the collection of all information on the ith subject at the time of the kth transplant on the jth day but excluding whether the ith patient actually receives the kth organ

$E_{\cdot jk}$: the collection of information on all subjects $i = 1, \ldots, n$ prior to assigning the kth organ on the jth study day

R_{ijk}: the rank of the ith patient on the waiting list for the kth organ on the jth day of the study

$D_{ijk}(g, E_{ijk})$: indicator for whether or not the kth organ on day j should be avoided under regime g based on the organ and patient characteristics

$\pi_{ijk}^{A(g)}(E_{ijk})$: the probability that the ith patient accepts the kth organ on the jth day if the patient is complying with or following regime g.

$\emptyset$: the transplant regime where patients make no changes to their propensity to accept or decline organs

$\pi_{ijk}^{A(\emptyset)}(E_{ijk})$: the probability that the ith patient accepts the kth organ on the jth day if the patient makes no changes to her organ acceptance policy.

$\pi_{ijk}^{O(g,g')}(E_{\cdot jk})$: the conditional probability the ith patient is offered the kth organ on day j given that she is following regime g and all other patients are following regime g'

$\pi_{ijk}^{(g,g')}(a_{ijk}, E_{\cdot jk})$: the probability that ith person receives and does not receive if $a_{ijk} = 1$ and $a_{ijk} = 0$, respectively, the kth available organ on the jth day given all information up until the time of assigning that organ, assuming the ith patient is following regime g and all other patients are following regime g'.

$\overline{\pi}_{ij}^{(g,g')}(\overline{a}_{ij}, \overline{E}_{jS_j})$: the probability that the ith patient has her treatment history through study day j given that she is following regime g and all other patients follow regime g'

$S_r(g, g')$: the survival probability r days after entering the waiting list for following regime g while all other patients follow regime g'

$\lambda_t(g, g')$: the discrete-time hazard of death t days after entering the waiting list for a randomly selected patient if she were to following regime g and all other patients followed regime g'

λ_t^{PT}: the post-transplantation discrete-time hazard of death t days after transplantation

Web Table 1: Lung Quality Model Coefficient Estimates and 95% Confidence Intervals

Coefficient	Estimate	95% C.I.
Patient Age	-0.029	(-0.041, -0.017)
Patient Age$'$	0.041	(0.026, 0.056)
Patient Age$''$	-0.320	(-0.566, -0.073)
Donor Age	0.000	(-0.017, 0.017)
Donor Age$'$	-0.045	(-0.143, 0.052)
Donor Age$''$	0.098	(-0.069, 0.265)
LAS	0.049	(0.015, 0.084)
LAS$'$	-0.985	(-1.846, -0.124)
LAS$''$	1.565	(0.175, 2.954)
I(Donor Diabetes = Y)	0.257	(0.103, 0.411)
I(Disease Group = B)	0.204	(-0.020, 0.427)
I(Disease Group = C)	-0.219	(-0.433, -0.006)
I(Disease Group = D)	-0.126	(-0.253, 0.000)
I(Single-Lung Transplant)	0.115	(0.023, 0.207)
I(Patient on Life Support)	0.441	(0.278, 0.604)
I(Donor Race = other)	-0.199	(-0.323, -0.074)
I(Donor Race = white)	-0.269	(-0.368, -0.170)
Patient-Donor Height Difference	-0.003	(-0.017, 0.011)
Patient-Donor Height Difference$'$	-0.024	(-0.073, 0.026)
Patient-Donor Height Difference$''$	0.104	(-0.071, 0.280)
Patient BMI	0.012	(0.002, 0.022)

Coefficient estimates from the Cox proportional hazards model used to estimate donor quality. Coefficients for the restricted cubic spline bases are indicated by $'$ and $''$.

Web Table 2: Coefficients and 95% Confidence Intervals from Logistic Regression Model For Accepting a Transplantation.

Coefficient	Estimate	95%C.I.
Intercept	0.649	(-0.190, 1.488)
Current Age	-0.025	(-0.034, -0.017)
Current Age$'$	0.055	(0.043, 0.067)
Current Age$''$	-0.469	(-0.583, -0.355)
LAS	0.029	(0.006, 0.052)
LAS$'$	-0.046	(-0.426, 0.334)
LAS$''$	0.062	(-0.587, 0.711)
Days on Waiting List	-0.008	(-0.009, -0.007)
Days on Waiting List$'$	0.149	(0.118, 0.179)
Days on Waiting List$''$	-0.211	(-0.255, -0.167)
Disease Group = B	-0.967	(-1.099, -0.834)
Disease Group = C	-0.289	(-0.414, -0.164)
Disease Group = D	-0.614	(-0.686, -0.542)
Height Difference	0.103	(0.096, 0.111)
Height Difference$'$	-0.317	(-0.338, -0.295)
Height Difference$''$	0.863	(0.749, 0.976)
I(Donor Smoker $\geq$ 20 pack-years)	-0.227	(-0.302, -0.151)
I(Donor Age > 50)	-1.669	(-2.378, -0.961)
Current Age $\cdot$ I(Donor Age > 50)	0.028	(0.007, 0.048)
Current Age' $\cdot$ I(Donor Age > 50)	-0.002	(-0.034, 0.029)
Current Age" $\cdot$ I(Donor Age > 50)	0.015	(-0.266, 0.295)

Coefficient estimates from the logistic model used to estimate the probability of accepting an offered organ. Coefficients for the restricted cubic spline bases are indicated by $'$ and $''$.