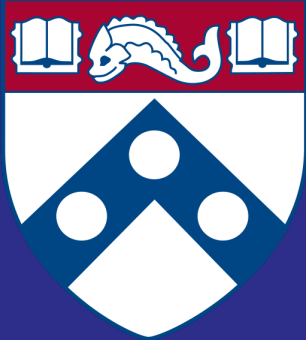


The Impact of Elimination of the Donor Service Area (DSA) on United States Lung Transplant Practices and Outcomes at High and Low Competition Centers

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INTRODUCTION

- On November 24, 2017, the DSA was removed as the primary geographic unit of lung transplant allocation in the United States.
- There are limited data on this change's impact on pre-transplant resource utilization or post-transplant outcomes.
- Objectives:**
 - To use the Scientific Registry of Transplant Recipients (SRTR) to evaluate the effect of DSA elimination on the use of pre-transplant mechanical ventilation and ECMO and post-transplant length of stay (LOS).
 - To assess whether outcomes differed as a function of competition by comparing high competition and low competition centers.

METHODS

- Retrospective cohort study of adult lung transplant recipients in SRTR in the year preceding (11/23/16 – 11/23/17) or following (11/25/17 – 11/25/17) elimination of the DSA.
- Pre- and post-change groups were described and compared using standard analytic tests.
- The Hernfindal-Hirschman Index (HHI), a measure of market competition based on geographic proximity and transplant volume, was calculated for all study transplant centers.
- Centers in the lowest and highest HHI groups by tertile were identified.
- A difference-in-differences analysis was performed to assess the relative effects of the policy change on low and high competition centers.

RESULTS

Table 1. Lung transplant demographics, characteristics and outcomes before and after the emergency action change.				
	All (n = 4771)	Pre-era (n = 2336)	Post-era (n = 2435)	P-value
Recipient demographics				
Age, years, median (IQR)	61 (53-66)	61 (53-66)	62 (53-67)	0.44
Female, n (%)	1933 (40.5)	966 (41.4)	967 (39.7)	0.25
Non-White, n (%)	610 (12.8)	308 (13.2)	302 (12.4)	0.42
Native lung disease, n (%)				
Group A – Obstructive	1402 (29.4)	723 (31.0)	679 (27.9)	0.02
Group B – Pulmonary Vascular	247 (5.2)	112 (4.8)	135 (5.5)	0.24
Group C – Immunodeficiency	509 (10.7)	253 (10.8)	256 (10.5)	0.72
Group D – Restrictive	2613 (54.77)	1248 (53.4)	1365 (56.1)	0.07
Pre-transplant FVC, median (IQR)	47 (37-61)	48 (37-61)	47 (37-60)	0.33
Mean pulmonary artery pressure, mean ± SD	27.7 ± 11.1	27.3 ± 10.7	28.1 ± 11.5	0.01
ECMO at transplant, n (%)	260 (5.5)	117 (5.0)	143 (5.9)	0.12 °
Ventilator dependent at transplant, n (%)	227 (4.8)	122 (5.2)	105 (4.3)	0.14
Pre-transplant dialysis, n (%)	25 (0.5)	8 (0.3)	17 (0.7)	0.09
Waitlist time, days, median (IQR)				
All recipients	48 (15-141)	53 (15-162)	44 (14-128)	0.001
Group A	84 (28-244)	99 (30-281)	70 (24-204)	0.006
Group D	35 (12-102)	35 (11-102.5)	36 (12-101)	0.36
Transplant Characteristics				
Bilateral transplant, n (%)	3557 (74.6)	1740 (74.5)	1817 (74.6)	0.92
Ischemic time, minutes, mean ± SD				
All transplants	325.5 ± 117.7	318.5 ± 113.2	332.2 ± 121.6	<0.0001
Bilateral lung transplants	344.8 ± 116.2	338.0 ± 110.0	351.4 ± 121.4	0.02
Single lung transplants	268.9 ± 103.2	261.8 ± 102.6	275.9 ± 103.5	0.0006
Transplant-Related Outcomes				
Length of stay, days, median (IQR)	18 (12-31)	17 (12-30)	19 (13-32)	0.01 °
>5 days mechanical ventilation, n (%)	1045 (21.9)	488 (20.9)	557 (22.9)	0.10
New post-transplant dialysis, n (%)	360 (7.6)	160 (6.9)	200 (8.2)	0.08
Tracheostomy, n (%)	157 (3.3)	72 (3.1)	85 (3.5)	0.43
Airway dehiscence, n (%)	71 (1.5)	33 (1.4)	38 (1.6)	0.67
Survival				
30 day mortality, n (%)	117 (2.5)	50 (2.1)	67 (2.8)	0.17
60 day mortality, n (%)	181 (3.8)	85 (3.6)	96 (3.9)	0.58
6 month mortality, n (%)	310 (6.5)	148 (6.3)	162 (6.7)	0.66

° Incidence rate ratios were used to compare usage of pre-transplant ECMO before and after DSA elimination. There was no difference in the incident rate of need for ECMO at transplant (IRR=1.16, 95% CI=0.09-1.49).

° A competing risks model was used to compare length of stay before and after the elimination of the DSA. LOS was increased in the post-DSA era (sub-hazard ratio=0.93, 95% CI=0.88-0.98).

- In the post-DSA era, there was a 9 day decrease in median waitlist time; there was no difference in need for pre-transplant ECMO.
- Median LOS increased from 17 to 19 days in the post-DSA era; there was no difference in other outcomes, such as prolonged ventilation, new dialysis, or early survival.
- High competition centers saw an 18.5 minute increase in ischemic time compared to low competition centers but did not differentially increase single lung transplants or pre-transplant ECMO utilization.

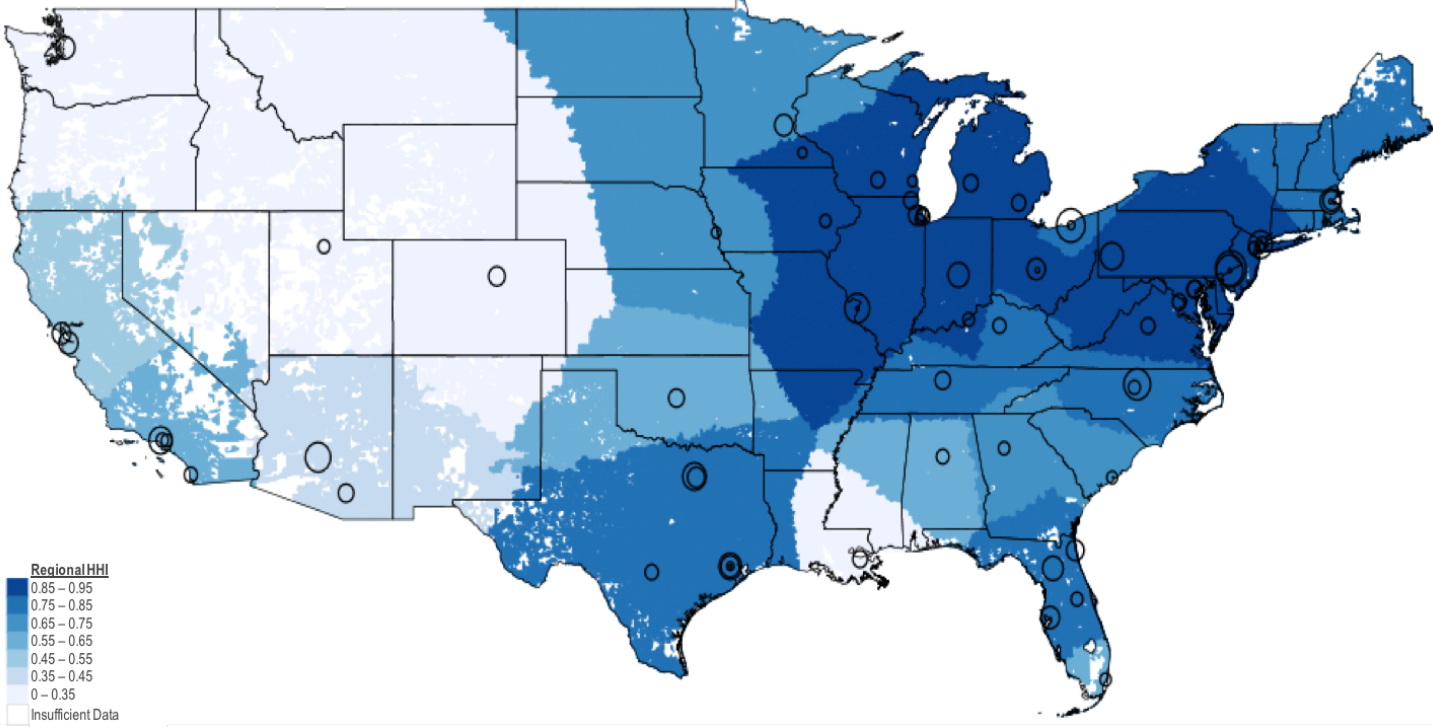


Figure 1: Transplant center competition in the United States as measured by the HHI, by Zip Code Tabulation Areas (ZCTA). ZCTAs are colored based on the HHI of the nearest transplant center by straight line distance. Centers active during the study period are depicted as circles with size proportional to the volume of transplants performed over the study period.

Table 2. Lung transplant demographics, characteristics and outcomes at low competition and high competition centers before and after the emergency action change.							
Variable	Low Competition			High Competition			Coefficient, P-value*
	Pre-era (n = 765)	Post-era (n = 809)	P-value	Pre-era (n = 680)	Post-era (n = 762)	P-value	
Recipient Demographics							
Age, years, median (IQR)	61 (53-67)	62 (53-67)	0.35	62 (54-67)	62 (55-67)	0.95	-0.65, 0.49
Female, n (%)	297 (38.8)	335 (41.4)	0.30	293 (43.1)	279 (36.6)	0.01	0.68, 0.009
Non-White, n (%)	93 (12.2)	85 (10.5)	0.30	94 (13.8)	101 (13.3)	0.75	1.13, 0.58
Native lung disease, n (%)							
Group A – Obstructive	202 (26.4)	220 (27.2)	0.72	245 (36.0)	223 (29.3)	0.006	0.71, 0.03
Group B – Pulmonary Vascular	28 (3.7)	39 (4.8)	0.25	39 (5.7)	45 (5.9)	0.89	0.77, 0.44
Group C – Immunodeficiency	87 (11.4)	85 (10.5)	0.58	65 (9.6)	77 (10.1)	0.73	1.16, 0.54
Group D – Restrictive	448 (58.6)	465 (57.5)	0.66	331 (48.7)	417 (54.7)	0.02	1.32, 0.06
Pre-transplant FVC, median (IQR)	45.5 (36-59)	48 (38-61)	0.07	51 (39-63)	47 (37-60)	0.002	-4.45, 0.001
Mean pulmonary artery pressure, mean ± SD	27.0 ± 10.4	27.1 ± 11.0	0.52	28.2 ± 10.6	28.7 ± 11.7	0.92	0.41, 0.61
ECMO at transplant, n (%)							
Ventilator dependent at transplant, n (%)	41 (5.4)	59 (7.3)	0.07 *	37 (5.4)	40 (5.3)	0.40 *	0.68, 0.22
Pre-transplant dialysis, n (%)	4 (0.5)	9 (1.1)	0.20	3 (0.4)	3 (0.4)	0.89	0.71, 0.30
Waitlist time, days, median (IQR)							
All recipients	38 (11-134)	35 (12-103)	0.02	56 (15-164)	51 (15-138)	0.003	-9.19, 0.61
Group A	77 (21-260)	51.5 (18-145)	0.03	103 (36-281)	75 (26-214)	0.01	1.64, 0.97
Group D	27.5 (8-89)	25 (11-81)	0.23	33 (10-100)	44 (13-117)	0.50	9.07, 0.59
Transplant Characteristics							
Bilateral transplant, n (%)	609 (79.6)	662 (81.8)	0.26	449 (66.0)	484 (63.5)	0.32	0.78, 0.13
Ischemic time, mean ± SD							
All transplants	324.6 ± 106.7	321.1 ± 122.3	0.55	333.5 ± 128.1	348.2 ± 125.0	0.03	18.18, 0.04
Bilateral lung transplants	340.7 ± 103.8	335.2 ± 124.8	0.40	369.3 ± 122.2	382.8 ± 121.7	0.09	19.00, 0.06
Single lung transplants	261.7 ± 94.0	257.5 ± 84.5	0.69	264.4 ± 109.8	287.4 ± 106.3	0.02	27.14, 0.07
Transplant-Related Outcomes							
Length of stay, days, median (IQR)	17 (12-29)	18 (12-29)	0.89 *	18 (12-33)	19 (14-34)	0.34 *	2.52, 0.32
>5 days mechanical ventilation, n (%)	158 (20.7)	167 (20.6)	0.99	170 (25.0)	194 (25.5)	0.84	1.03, 0.88
New post-transplant dialysis, n (%)	54 (7.1)	59 (7.3)	0.86	55 (8.1)	71 (9.3)	0.41	1.12, 0.68
Tracheostomy, n (%)	33 (4.3)	47 (5.8)	0.18	22 (3.2)	22 (2.9)	0.70	0.63, 0.24
Airway dehiscence, n (%)	11 (1.4)	8 (1.0)	0.42	17 (2.5)	13 (1.7)	0.30	1.06, 0.92
Survival							
30 day mortality, n (%)	13 (1.7)	16 (2.0)	0.68	17 (2.5)	25 (3.3)	0.38	1.13, 0.80
60 day mortality, n (%)	24 (3.1)	29 (3.6)	0.62	31 (4.6)	34 (4.5)	0.93	0.85, 0.67
6 month mortality, n (%)	49 (6.4)	52 (6.4)	0.99	50 (7.4)	51 (6.7)	0.63	0.90, 0.71

* Coefficient and p-value for difference-in-difference comparison of low competition and high competition centers

* Incidence rate ratios were used to compare usage of pre-transplant ECMO before and after DSA elimination. There was no difference in the incidence rate of need for ECMO at transplant at low competition centers (IRR = 1.34, 95% CI = 0.89 – 2.05) or at high competition centers (IRR = 0.94, 95% CI = 0.59 – 1.51).

* A competing risks model was used to compare length of stay before and after the elimination of the DSA. No difference was found in post-DSA LOS at low competition centers (sub-hazard ratio=0.99, 95% CI = 0.89 – 1.09) or high competition centers (sub-hazard ratio=0.95, 95% CI = 0.86 – 1.05).

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CONCLUSIONS

- Elimination of the DSA was associated with increased post-transplant LOS but no significant differences in pre-transplant ECMO or other post-transplant outcomes.
- Effects were largely similar at low and high competition centers.

DISCLOSURES

- The authors have no relevant financial relationships to disclose.