OPTN Lung Transplantation Committee

Descriptive Data Request

Lung Continuous Distribution
One Year Monitoring Report

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Executive Summary

Monitoring began upon implementation of continuous distribution on March 9, 2023. Based on the first year of data collection, compared to the pre policy era (March 09, 2022 - March 08, 2023), in the post policy era (March 09, 2023 - March 08, 2024):

Overall

- The transplant rate increased by 16% from 281 transplants per 100 patient years to 327 transplants per 100 patient years.
- The waiting list mortality rate decreased by 29% from 24 deaths or removals for too sick per 100 patient years to 17 deaths or removals for too sick per 100 patient years.

Continuous Distribution Attributes

- Compared to less medically urgent candidates, the most medically urgent candidates (those with at least 2.5 medical urgency points) had the highest rates of transplant, the highest rates of waiting list removals for death or too sick, and the shortest median waiting time for a transplant. The median travel distance from the donor hospital to transplant program was also greatest for the most medically urgent candidates.
- The transplant rate remained similar for pediatric candidates <12 years old, but increased slightly for pediatric candidates between 12 and 17 years old, though sample sizes were small.
- Blood type was evaluated for approximately 5.5 months in the Pre-CD era, the Post-CD era, and the Post-CD era after the ABO modification. Compared to the Pre-CD era, the transplant rate in the Post-CD era increased for candidates with blood types A, AB, and B and decreased slightly for candidates with blood type O. However, the transplant rate for candidates with blood type O increased from the Post-CD era to the Post-CD + ABO Modification era to a similar rate as the Pre-CD era.
- The transplant rate increased for candidates across all height groupings, except for the tallest grouping (adults greater than 177.7 cm tall).

Other Noteworthy Results

- Median distance from the donor hospital to transplant program increased for both DCD organs and non-DCD organs.
- The utilization rate remained around 17% in both policy eras.
- The median number of programs that received organ offers both before and after the final acceptor increased.
- The number of registrations with at least one submitted exception request increased from 169 to 307.
- Since the implementation of the ABO Modification in September 2023, the number of exception requests submitted each month decreased and then leveled off.
- The transplant rate increased slightly for lung/kidney and lung/liver patients.
- The median time to transplant increased for heart/lung patients.

Overall, it is still early post-implementation. Changes such as those to behavior or clinical practice may have an impact on the system. The implications of the policy change will continue to be monitored closely with annual reports to the OPTN Lung Transplantation Committee for the next two years.

Background/Purpose

On March 9, 2023 the lung allocation policy switched to a continuous distribution framework. Continuous distribution (CD) uses a composite allocation score to determine the preferential order of candidates on a match run when a medically suitable lung donor becomes available. This point-based system replaces the previous, classification-based system. Under the classification-based system, candidates were first arranged into ordered groups (e.g., "blood type identical, within 250 nautical miles of the donor hospital") and then, within each group, preferentially ordered by Lung Allocation Score (LAS). In contrast, continuous distribution does not use candidate groupings. All candidates are prioritized using a composite allocation score (CAS) that takes into account medical, biological, and other factors permitted by the Final Rule to determine preferential ordering on a match run. These attributes include:

- Medical urgency: a metric that captures the patient's predicted 1-year survival on the waiting list without a transplant (this measure was a component of LAS)
- Post-transplant survival: a metric that captures the patient's predicted 5-year survival were they to receive a transplant (a 1-year version of this measure was a component of LAS)
- Biological disadvantage: a measure of how disadvantaged a candidate is to receive a transplant based on aspects of their biology, including blood type, CPRA (calculated panel reactive antibody), and height
- Patient access: a measure that considers whether the candidate is pediatric or a prior living donor
- Efficiency: a measure that captures the efficiency of the transplant, in terms of both distance from the donor hospital to transplant center and logistical planning

Based on data from the three month monitoring report showing that the number of transplants declined in the first three months of CD for blood type O candidates, a policy change was implemented on September 27, 2023 which altered the blood type rating scale. This report will evaluate the impact of the modified blood type rating scale, in addition to the evaluation of lung CD as a whole.

In addition to the analyses included in this report, the OPTN Lung Policy Monitoring Dashboard has been developed to further assist with post-implementation monitoring. This dashboard displays counts of lung waiting list additions, removals for death or too sick, and transplants across policy eras and stratified by various patient criteria. It also includes information on lung donors, non-use rates, utilization rates, and match efficiency.

The purpose of this report is to provide early metrics summarizing the impact of the policy change. In an effort to provide data as soon as possible, this report was produced before the 90 day data lag allotted by OPTN policy has fully passed; therefore, data are subject to change. As more data accumulate over time, more extensive analyses will be performed. The OPTN will respond to further requests by the OPTN Lung Transplantation Committee.

Committee Request

Monitoring reports using pre vs. post comparisons will be presented to the Committee after approximately 3 months, 6 months and then annually for 3 years following the allocation change.

The Committee will consider overall waiting list deaths and post-transplant deaths, as well as variance in waiting list deaths, post-transplant deaths, and distance between donor and candidate transplant hospitals as key metrics to evaluate the effectiveness of the proposal.

Metrics to be evaluated include:

- Waiting List
    - Number of candidates ever waiting, additions, and removals
    - Distribution of WLAUC and PTAUC
    - Population characteristics such as CPRA, prior living donor, height, age group at time of listing, and diagnosis group
    - Number of candidates by OPTN region
    - Candidate waiting time by OPTN region
    - Numbers of patient deaths, overall and by diagnosis group, medical urgency score, post-transplant survival score, and OPTN region

- Overall waiting list mortality rate and transplant rate by diagnosis group, WLAUC and PTAUC groups, and OPTN region
    - Number of exception requests, overall and by diagnosis group
    - Number of multiorgan candidates
- Transplants
    - Number of recipients
    - Distribution of WLAUC and PTAUC
    - Population characteristics such as CPRA, prior living donor, height, age group at time of listing, and diagnosis group
    - Number of recipients by OPTN region
    - Patient post-transplant survival
    - Number of recipients transplanted with an exception request, overall and by diagnosis group
    - Distance between the donor hospital and transplant center
    - Distance between the donor hospital and transplant center by medical urgency group, post-transplant survival, and by composite allocation score group
    - Transplant rate changes by transplant program size (small, medium, large)
    - Distribution of ischemic time
    - Number of multiorgan recipients
- Utilization
    - Non-use rate by OPTN region and donation after circulatory death (DCD) vs. non-DCD
    - Utilization rate by OPTN region and DCD vs. non-DCD
    - Number & percentage of perfused lungs by OPTN region
    - Number & percentage of DCD lungs transplanted by OPTN region
    - Time from first electronic offer to cross clamp
    - Distribution of sequence number of the final acceptor

Analysis of post-transplant outcomes will be performed after sufficient follow-up data have accrued, which is dependent on submission of follow-up forms. The OPTN and SRTR contractors will work with the committee to define the specific analyses requested for ongoing monitoring for each update. The OPTN equity in access dashboard will also be used to evaluate the impact of this policy on transplant rates by various candidate attributes.

Methods

Data Sources:

Organ Procurement and Transplantation Network (OPTN) data were used for this analysis. The OPTN data system includes data on all donors, waitlisted candidates, and transplant recipients in the US, submitted by members of the OPTN. Continuous distribution was implemented on March 9, 2023. Unless otherwise stated, this report compares metrics for 1 year before and after the implementation date, with the pre era spanning March 09, 2022 to March 08, 2023 and the post era spanning March 09, 2023 to March 08, 2024. The only exception for these defined policy eras is in the blood type section. To evaluate the impact of CD implementation as well as the implementation of the blood type modification in September 2023, the data have been split into the following three eras (each 163 days long) for the blood type analysis: Blood Type Pre-CD (September 26, 2022 to March 08, 2023), Blood Type Post-CD (April 16, 2023 to September 26, 2023), and Blood Type Post-CD + ABO Modification (September 27, 2023 to March 08, 2024).

In an effort to provide data as soon as possible, this report was produced with OPTN data as of May 03, 2024 and before the 90 day data lag allotted by OPTN policy has fully passed. Data are subject to change due to future database submission or correction.

For continuous variables, medians and ranges were reported, and for categorical variables, counts and frequencies were reported. All analyses involving counts of waitlist additions, transplants, or removals for death or too sick stratified by a single variable have been omitted from this report and instead are available on the OPTN Lung Policy Monitoring Dashboard. For all rates, 95% confidence intervals were reported, as well as the number of unique patients on the waiting list that belonged to each grouping. Diagnosis groups utilized in this monitoring

report align with those outlined in OPTN lung allocation policy: A- obstructive lung disease, B- pulmonary vascular disease, C- cystic fibrosis and immunodeficiency disorder, and D- restrictive lung disease {OPTN Policies, https://optn.transplant.hrsa.gov/media/1200/optn_policies.pdf Accessed 4/25/2024}.

Waiting List

Cohort: For all analyses (except for within the blood type section) candidates added to the lung waiting list, removed from the waiting list, or ever waiting for a lung-alone transplant from March 09, 2022 through March 08, 2023 (pre) and March 09, 2023 through March 08, 2024 (post) were included. For the blood type analyses, candidates added to the lung waiting list, removed from the waiting list, or ever waiting for a lung-alone transplant from September 26, 2022 through March 08, 2023 (Blood Type: Pre-CD), April 16, 2023 through September 26, 2023 (Blood Type: Post-CD), and September 27, 2023 through March 08, 2024 (Blood Type: Post-CD + ABO Modification) were included. A separate analysis was conducted for candidates listed for a lung-multiorgan transplant, which included all candidates waiting for a lung and at least one other organ from March 09, 2022 through March 08, 2023 (pre) and March 09, 2023 through March 08, 2024 (post).

Analysis: All of the CAS attributes were calculated based on clinical data entered in the OPTN Waiting List. For all candidates on the waiting list, a CAS subscore was calculated. This subscore summed all the CAS attribute points except for the efficiency points (i.e., medical urgency points, post-transplant survival points, biological disadvantage points, and patient access points). Efficiency points are not known until the time a match is made and the distance between the donor hospital and transplant center is known. For this reason, all analyses in this section used the CAS subscore, rather than the final CAS.

For all CAS attributes (including medical urgency, post-transplant survival, and the CAS subscore), candidates have both a calculated and a match score; these differ when a candidate has an approved exception request, which causes the match score to be higher than the calculated score. For all analyses, the match scores (the same scores used for allocation) were used as reported at the time of removal from the waiting list.

Exceptions in each era were determined based on submissions to the National Lung Review Board. Under the previous allocation system (LAS), a single registration could only have one approved and active exception request at a time (although a registration could submit more than one request if the first request was denied). Under continuous distribution, using the CAS, a single registration can have multiple exception requests. Prior to CD implementation, centers could submit CAS exception requests through an interim process so that those requests, if approved, would be in place at the start of implementation. Twenty-six lung requests and one heart/lung request were submitted through this process and were not included in these analyses. Exceptions were analyzed at the registration level whenever possible (where one registration can have more than one exception request submitted and approved under CD). However, when the metric of interest depended on the outcome of a specific request submission (i.e., request approvals), analyses were performed at the form submission level.

Waiting list mortality rates are reported as the number of deaths or removals for too sick per 100 patient years. Patient years is a type of measurement that takes into account both the number of patients that experience an event and the amount of time they spend waiting for an event. For example, if 100 patients waited for one year that would amount to 100 patient years of data. Similarly, if 10 patients waited for 10 years that would also amount to 100 patient years of data. For a subject like transplant, time waiting is sometimes just as important as the event itself. For example, we are interested in the number of transplants or removals for death or too sick, but also interested in how long candidates waited during the study period. It is important to use this type of rate because the waiting list is dynamic and people are added and removed at different points in time. We set rates to per 100 patient years for ease in comparing rates across populations that might vary in size or duration of time waited. For this analysis, active and inactive waiting time were used for the patient years calculation. Since some candidates may spend several months or years on the waiting list, a candidate may contribute waiting time to both eras, but a death or removal for too sick is attributed only to the era in which it occurred. Waiting list mortality rates were calculated for the population as a whole, as well as for sub-populations based on a variety of different attributes. For time-varying attributes, such as medical urgency points and post-transplant survival points, a time-varying analysis was performed.

Transplant

Cohort: For all analyses (except for within the blood type section) recipients that received a lung-alone transplant

from March 09, 2022 through March 08, 2023 (pre) and March 09, 2023 through March 08, 2024 (post) were included. For the blood type analyses, recipients that received a lung-alone transplant from September 26, 2022 through March 08, 2023 (Blood Type: Pre-CD), April 16, 2023 through September 26, 2023 (Blood Type: Post-CD), and September 27, 2023 through March 08, 2024 (Blood Type: Post-CD + ABO Modification) were included. A separate analysis was conducted for lung-multiorgan transplants which included all recipients who received a lung and at least one other organ from March 09, 2022 through March 08, 2023 (pre) and March 09, 2023 through March 08, 2024 (post).

Analysis: For all analyses using CAS attributes, the match score at the time of transplant was used. Transplant rates are reported as the number of transplants per 100 patient years. This rate is calculated by dividing the number of all deceased donor lung transplants by the number of years patients spent waiting. For each policy era, active and inactive waiting time within the era analyzed were used for the patient years calculation. Since some candidates may spend several months or years on the waiting list, a candidate may contribute waiting time to both eras, but a transplant is attributed only to the era in which it occurred. Transplant rates were calculated for the population as a whole, as well as for sub-populations based on a variety of different attributes. For time-varying attributes, such as medical urgency points and post-transplant survival points, a time-varying analysis was performed.

Utilization

Cohort: All donors from which at least one organ was recovered for the purposes of transplantation from March 09, 2022 through March 08, 2023 (pre) and March 09, 2023 through March 08, 2024 (post) were included.

Analysis: The utilization rate is defined as the percent of lungs that are transplanted based on all possible lungs from every deceased donor with at least one organ recovered for the purpose of transplant; this assumes that each donor has two possible lungs for donation. The non-use rate is defined as the number of lungs recovered for the purpose of transplant but not transplanted out of all lungs recovered for transplant.

Median Waiting Time

Cohort: For all analyses (except for within the blood type section) all registrations added to the waiting list for a lung-alone transplant from March 09, 2022 through March 08, 2023 (pre) and March 09, 2023 through March 08, 2024 (post) were included. For the blood type analyses, all registrations added to the waiting list for a lung-alone transplant from September 26, 2022 through March 08, 2023 (Blood Type: Pre-CD), April 16, 2023 through September 26, 2023 (Blood Type: Post-CD), and September 27, 2023 through March 08, 2024 (Blood Type: Post-CD + ABO Modification) were included. A separate analysis was conducted for registrations listed for a lung-multiorgan transplant, which included all registrations added to the waiting list for a lung and at least one other organ from March 09, 2022 through March 08, 2023 (pre) and March 09, 2023 through March 08, 2024 (post).

Analysis: We calculated the median waiting time based on a variety of different attributes using a competing risk analysis. Because these analyses were run without the data lag, results may vary slightly as more data accrue.

Match run analysis

Cohort: All lung-alone match runs submitted from March 09, 2022 through March 08, 2023 (pre) and March 09, 2023 through March 08, 2024 (post) were included. For most analyses, only matches with an acceptance were included, and offers after the final acceptance were excluded. However, when counting the number of programs offered after the final acceptor, all offers up until the match was closed (which includes offers after the final acceptance) were included.

Analysis: We calculated descriptive metrics for the number of offers sent in the pre and post eras, as well as the sequence number of the final acceptor. We also calculated the cumulative percent of offers received for pediatric candidates up to each sequence number on the match run, using the following equation:

$$\frac{\text{Number of offers received by pediatric candidates up to sequence number i}}{\text{Number of offers sent to all candidates up to sequence number i}}$$

Results

For this report, the Results are broken into four main subsections:

- The **Overall** subsection focuses on general trends associated with the implementation of Continuous Distribution.
- The **Continuous Distribution Attributes** subsection evaluates trends associated with each of the individual attributes of Continuous Distribution in an effort to determine whether the specific goals of the policy are being met.
- The **Exceptions** subsection assesses the impact of Continuous Distribution on exception request submission and approval practices.
- The **Multiorgan** subsection evaluates trends in multiorgan listings and transplants under Continuous Distribution.

In addition to the analyses included in this report, the **OPTN Lung Policy Monitoring Dashboard** has been developed to further assist with post-implementation monitoring. The policy monitoring dashboard displays counts of lung waiting list additions, removals for death or too sick, and transplants across policy eras and stratified by various patient criteria. In addition, it includes information on lung donors, non-use rates, utilization rates, and match efficiency. The intent is that the dashboard will allow for near-continuous monitoring of any policy change by all members of the lung transplantation community. As a result, lung monitoring reports will shift to a key metrics framework, which are more concise and focus explicitly on evaluating the key metrics of a policy change. Charts from previous monitoring reports that are duplicative of the dynamic and interactive charts in the dashboard have been eliminated from this monitoring report to prevent redundancy.

Overall

The number of deaths or removals for too sick per 100 patient years on the waiting list decreased from 24.33 in the pre era to 17.29 in the post era.

Figure 1: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Era
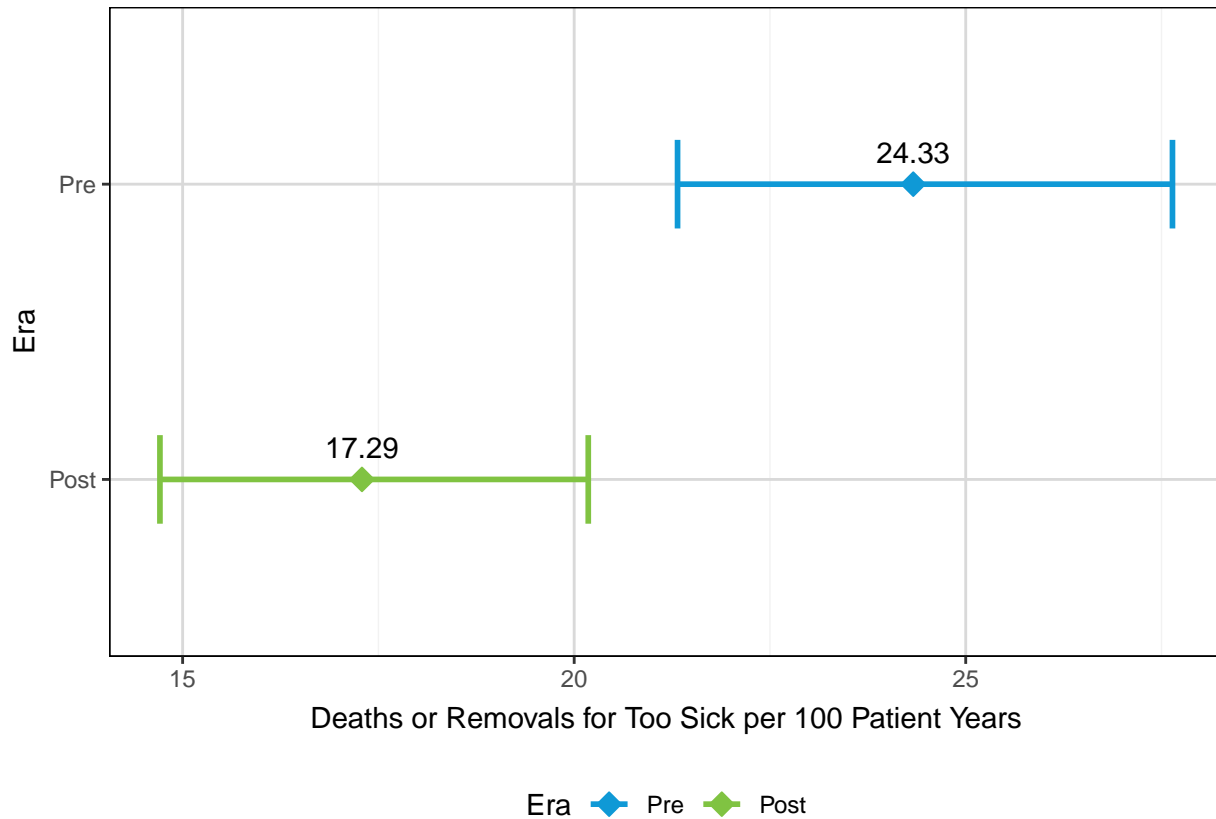

Table 1: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Era

Era	N Patients	Deaths or Removals for Too Sick per 100 Patient Years	95% Confidence Interval
Pre	3985	24.33	(21.32, 27.64)
Post	4180	17.29	(14.71, 20.18)

The number of transplants per 100 patient years on the waiting list increased from 280.69 in the pre era to 327.17 in the post era.

Figure 2: Lung Transplants per 100 Patient Years on the Waiting List by Era
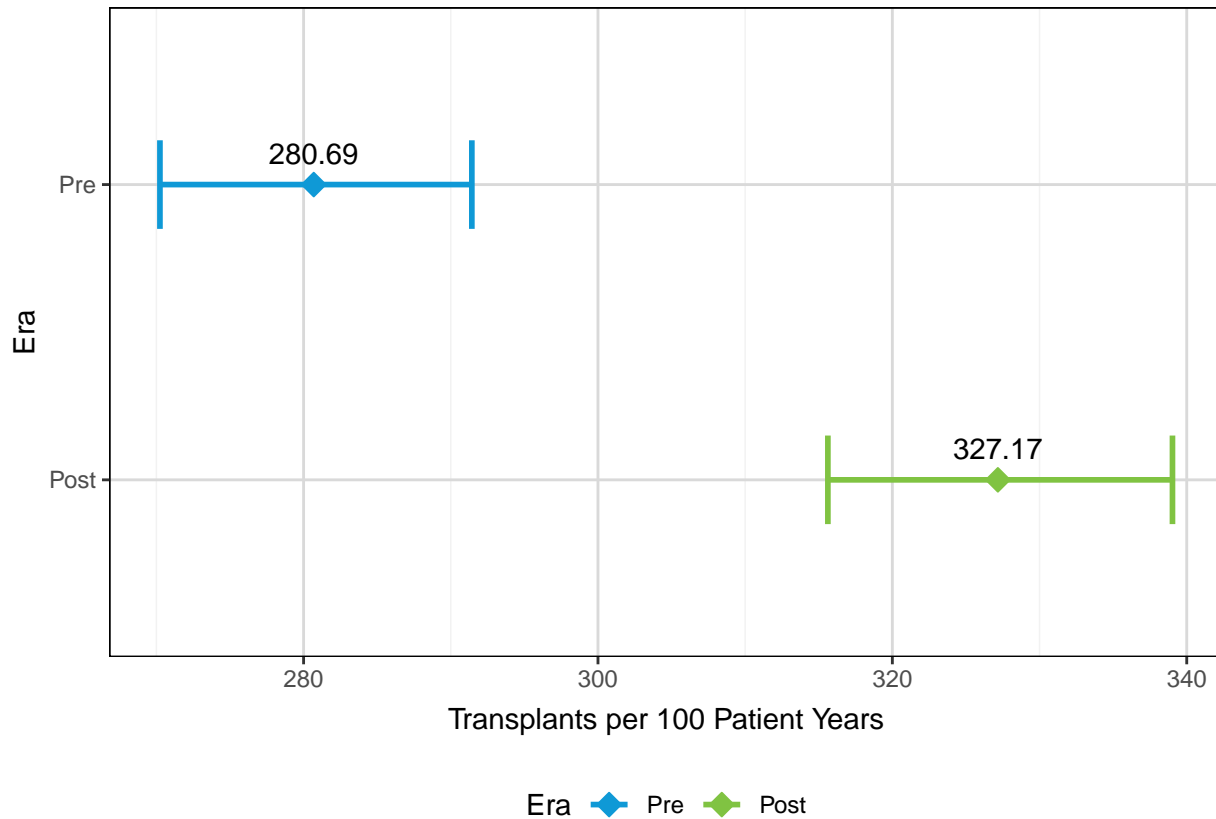

Table 2: Lung Transplants per 100 Patient Years on the Waiting List by Era

| Era	N Patients	Transplants per 100 Patient Years	95% Confidence Interval
Pre	3985	280.69	(270.24, 291.43)
Post	4180	327.17	(315.62, 339.03)

Continuous Distribution Attributes

This subsection evaluates trends associated with each of the individual attributes of Continuous Distribution in an effort to determine whether the specific goals of the policy are being met.

Medical Urgency

Medical Urgency Points were not calculated in the pre era; thus, all metrics in this section only include data from the post policy era (from March 09, 2023 to March 08, 2024). In addition, all analyses reflect patients' "match" medical urgency points, which include any approved exception requests and are the scores used in allocation. Finally, both rate analyses included in this section were run with time-varying data, meaning that they account for patients' changing medical urgency points during their tenure on the waiting list. As patients' medical urgency scores change, they will contribute waiting time to whichever grouping they fall into at any point in time, and an event (transplant or removal for death or too sick) will be attributed to whichever grouping they were in when the event occurred.

The number of deaths or removals for too sick per 100 patient years on the waiting list was greatest for the most medically urgent individuals (those with at least 2.5 medical urgency points).

Figure 3: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Time-Varying Medical Urgency Points in the Post Policy Era
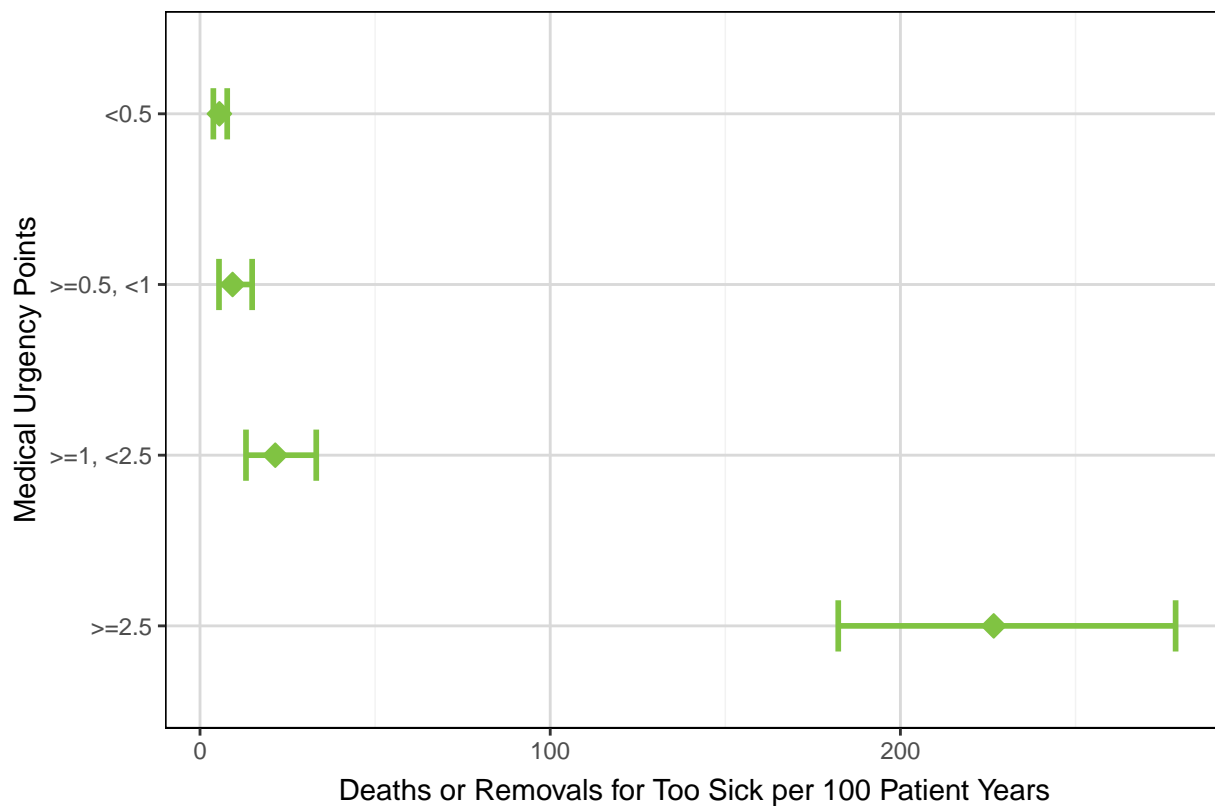
Rates were calculated using patients' time–varying medical urgency points.

Table 3: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Time-Varying Medical Urgency Points in the Post Policy Era

Medical Urgency Points	N Patients	Deaths or Removals for Too Sick per 100 Patient Years	95% Confidence Interval
<0.5	2483	5.53	(3.81, 7.77)
>=0.5, <1	1114	9.30	(5.42, 14.89)
>=1, <2.5	869	21.49	(13.13, 33.19)
>=2.5	1153	226.64	(182.25, 278.58)

[a] Rates were calculated using patients' time-varying medical urgency points.

The number of transplants per 100 patient years on the waiting list was greatest for the most medically urgent individuals (those with at least 2.5 medical urgency points).

Figure 4: Lung Transplants per 100 Patient Years on the Waiting List by Time-Varying Medical Urgency Points in the Post Policy Era

Rates were calculated using patients' time–varying medical urgency points.
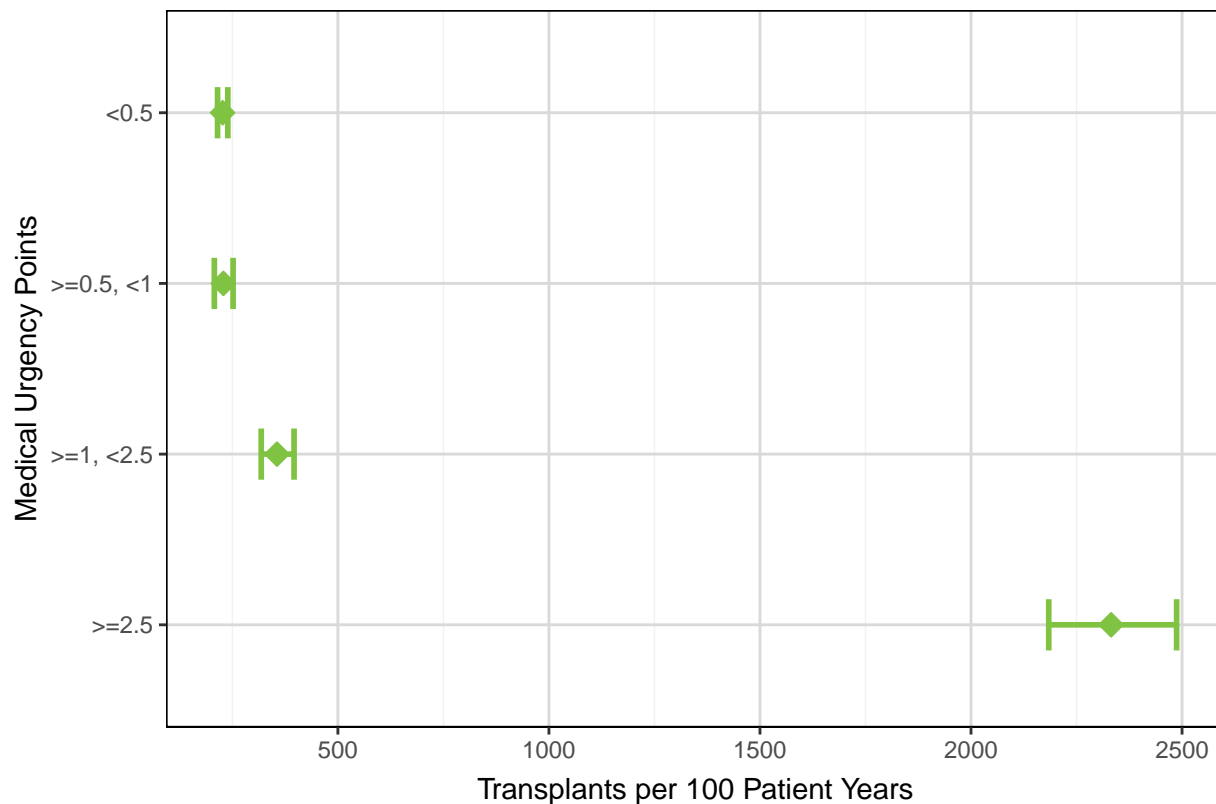
Table 4: Lung Transplants per 100 Patient Years on the Waiting List by Time-Varying Medical Urgency Points in the Post Policy Era

Medical Urgency Points	N Patients	Transplants per 100 Patient Years	95% Confidence Interval
<0.5	2483	226.78	(214.85, 239.19)
>=0.5, <1	1114	228.69	(207.29, 251.70)
>=1, <2.5	869	355.65	(318.37, 396.11)
>=2.5	1153	2331.92	(2184.12, 2487.08)

[a] Rates were calculated using patients' time-varying medical urgency points.

Median time to transplant was shortest for the most medically urgent candidates (candidates with at least 2.5 medical urgency points at the time of listing).

Figure 5: Median Time to Transplant (Days) by Medical Urgency Points at Listing in the Post Policy Era
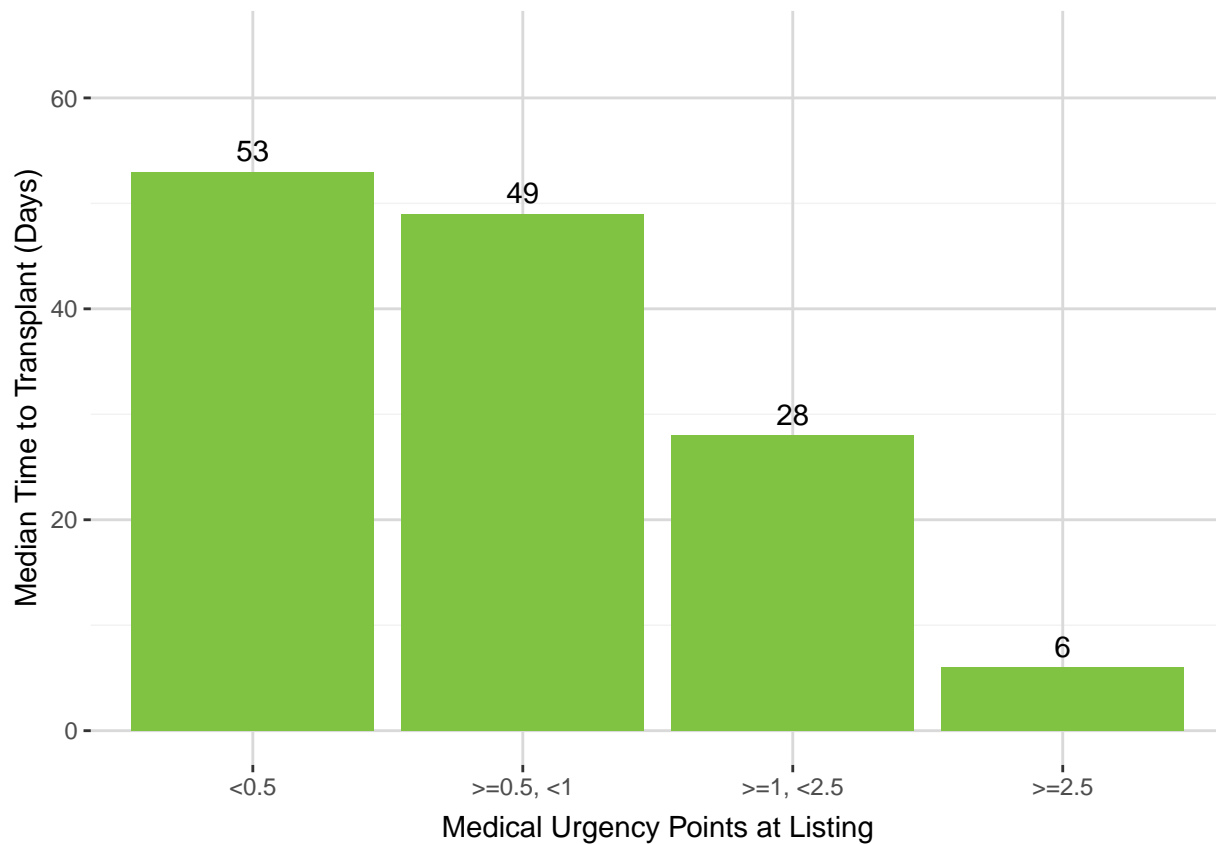

Table 5: Median Time to Transplant (Days) by Medical Urgency Points at Listing in the Post Policy Era

Medical Urgency Points at Listing	N Registrations	Median Time to Transplant (Days)
<0.5	1731	53
>=0.5, <1	635	49
>=1, <2.5	374	28
>=2.5	576	6

In the post era, median distance for the most medically urgent recipients (those with 2.5 or more medical urgency points at the time of transplant) was greater (526.5 NM) than the median distance for all other recipients. SRTR modeling indicated travel distances would increase for the most medically urgent recipients.

Figure 6: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program by Medical Urgency Points at Transplant in the Post Policy Era
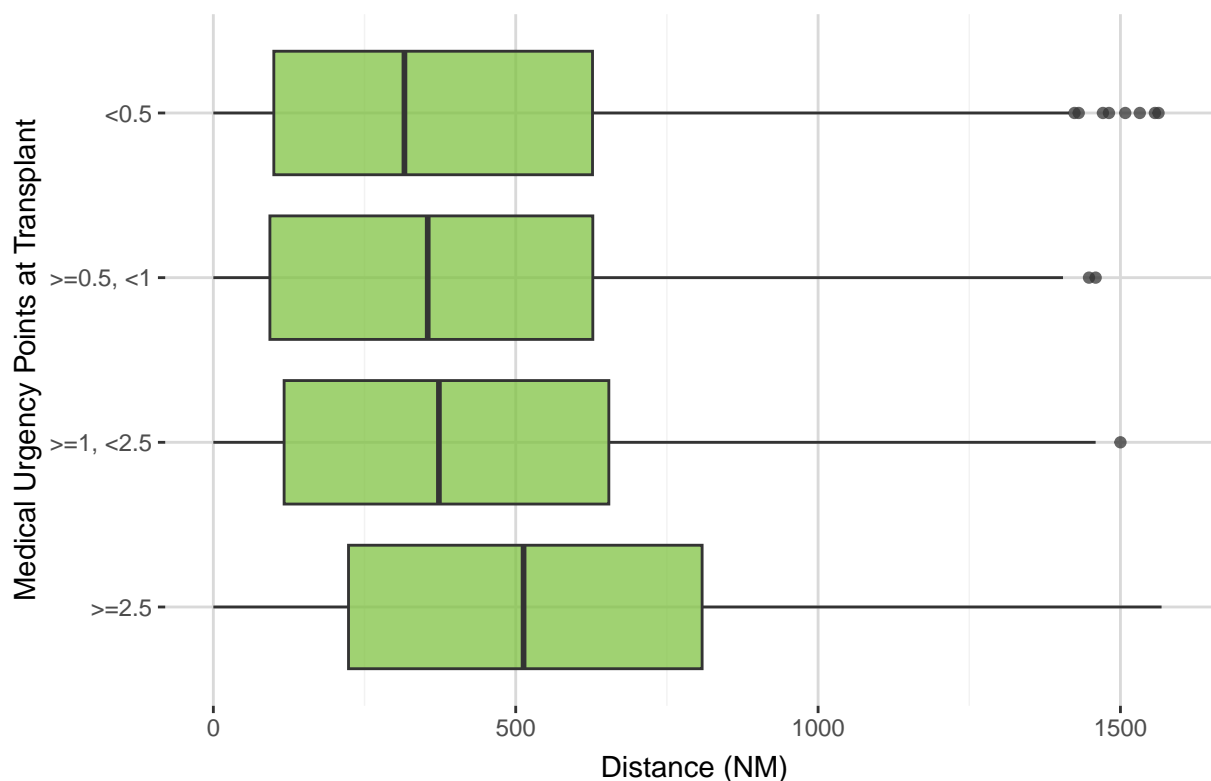
View is restricted to the 99th percentile of distance (1591 NM). There were 31 cases where lungs traveled further than this distance in the post policy era.

Table 6: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program by Medical Urgency Points at Transplant in the Post Policy Era

Medical Urgency Points at Transplant	N	N Missing	Min	25th Percentile	Median	Mean	75th Percentile	Max
<0.5	1309	0	0	100.0	318.0	409.66	631.00	2920
>=0.5, <1	405	0	0	97.0	362.0	430.32	648.00	2021
>=1, <2.5	357	0	0	122.0	375.0	430.61	664.00	2349
>=2.5	976	0	0	225.0	526.5	566.00	826.25	2244
Total	3047	0	0	152.5	385.0	464.94	710.50	2920

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Post-Transplant Survival

Post-Transplant Survival Points were not calculated in the pre era; thus, all metrics in this section only include data from the post policy era (from March 09, 2023 to March 08, 2024). In addition, all analyses reflect patients' "match" post-transplant survival points, which include any approved exception requests and are the scores used in allocation. Finally, both rate analyses included in this section were run with time-varying data, meaning that they account for patients' changing post-transplant survival points during their tenure on the waiting list. As patients' post-transplant survival scores change, they will contribute waiting time to whichever grouping they fall into at any point in time, and an event (transplant or removal for death or too sick) will be attributed to whichever grouping they were in when the event occurred.

The number of deaths or removals for too sick per 100 patient years on the waiting list was greatest for patients with <20 post-transplant survival points.

Figure 7: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Time-Varying Post-Transplant Survival Points in the Post Policy Era
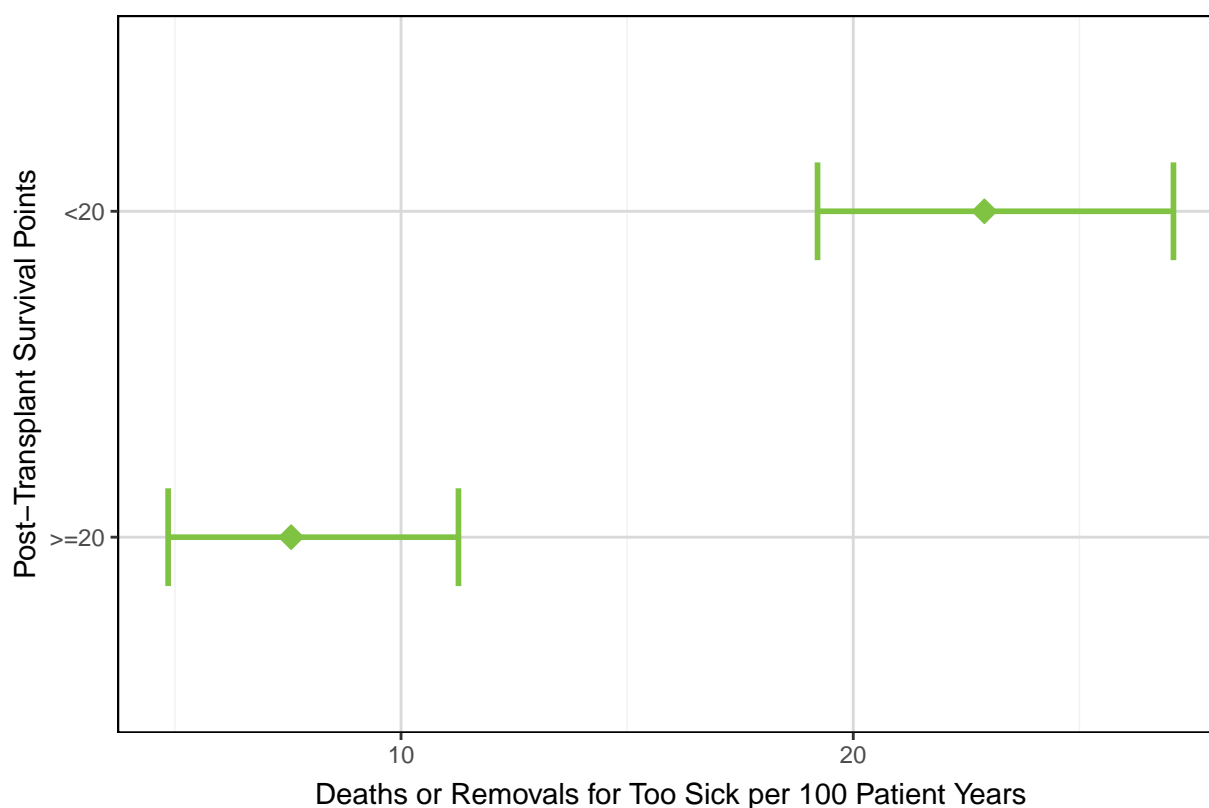
Rates were calculated using patients' time–varying post–transplant survival points.

Table 7: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Time-Varying Post-Transplant Survival Points in the Post Policy Era

Post-Transplant Survival Points	N Patients	Deaths or Removals for Too Sick per 100 Patient Years	95% Confidence Interval
<20	2958	22.90	(19.21, 27.08)
>=20	1711	7.57	(4.85, 11.27)

[a] Rates were calculated using patients' time-varying post-transplant survival points.

The number of transplants per 100 patient years on the waiting list was greatest for patients with 20 or more post-transplant survival points.

Figure 8: Lung Transplants per 100 Patient Years on the Waiting List by Time-Varying Post-Transplant Survival Points in the Post Policy Era
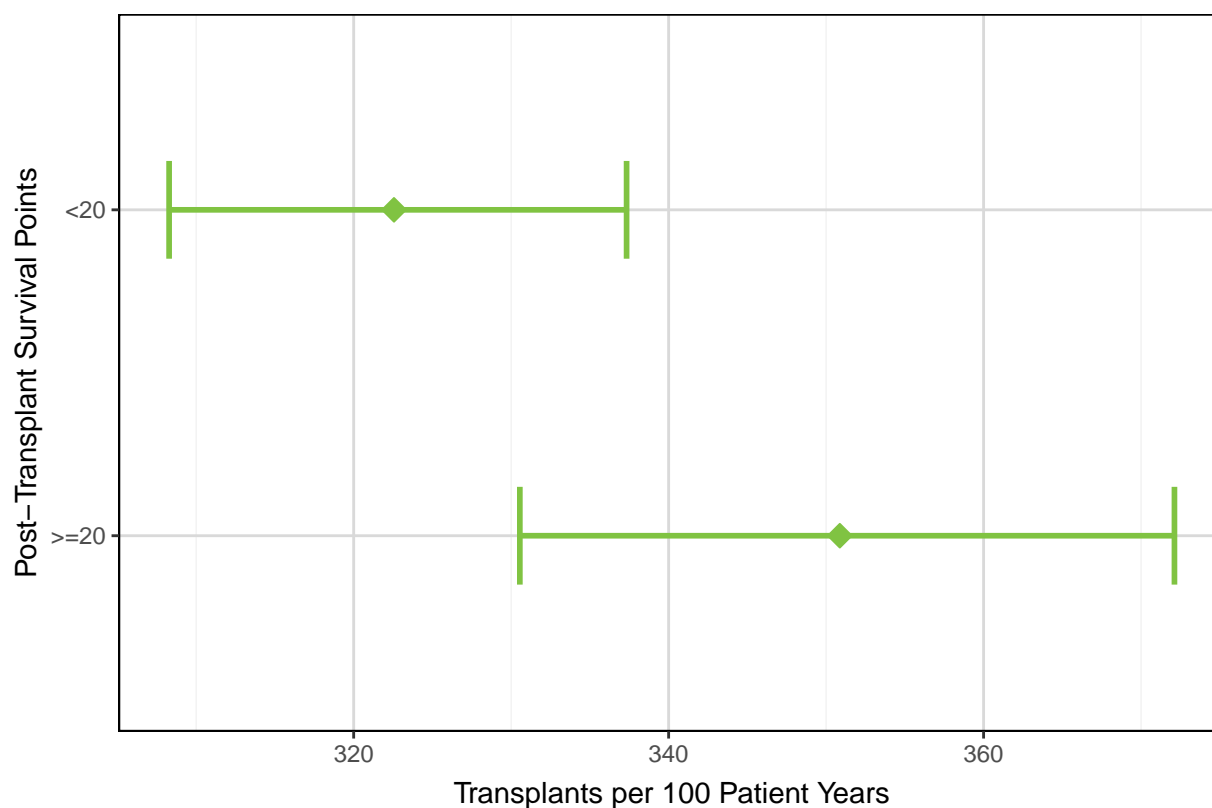
Rates were calculated using patients' time–varying post–transplant survival points.

Table 8: Lung Transplants per 100 Patient Years on the Waiting List by Time-Varying Post-Transplant Survival Points in the Post Policy Era

Post-Transplant Survival Points	N Patients	Transplants per 100 Patient Years	95% Confidence Interval
<20	2958	322.56	(308.28, 337.33)
>=20	1711	350.87	(330.55, 372.12)

[a] Rates were calculated using patients' time-varying post-transplant survival points.

Median time to transplant was slightly less for patients with $>= 20$ post-transplant survival points at the time of listing, compared to patients with <20 post-transplant survival points at listing.

Figure 9: Median Time to Transplant (Days) by Post-Transplant Survival Points at Listing in the Post Policy Era

Table 9: Median Time to Transplant (Days) by Post-Transplant Survival Points at Listing in the Post Policy Era

Post-Transplant Survival Points at Listing	N Registrations	Median Time to Transplant (Days)
<20	2192	37
$>=20$	1124	31

In the post era, median distance for patients with less than 20 post-transplant survival points (420.5 NM) was greater than the median distance for patients with 20 or more post-transplant survival points (347 NM).

Figure 10: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program by Post-Transplant Survival Points at Transplant in the Post Policy Era
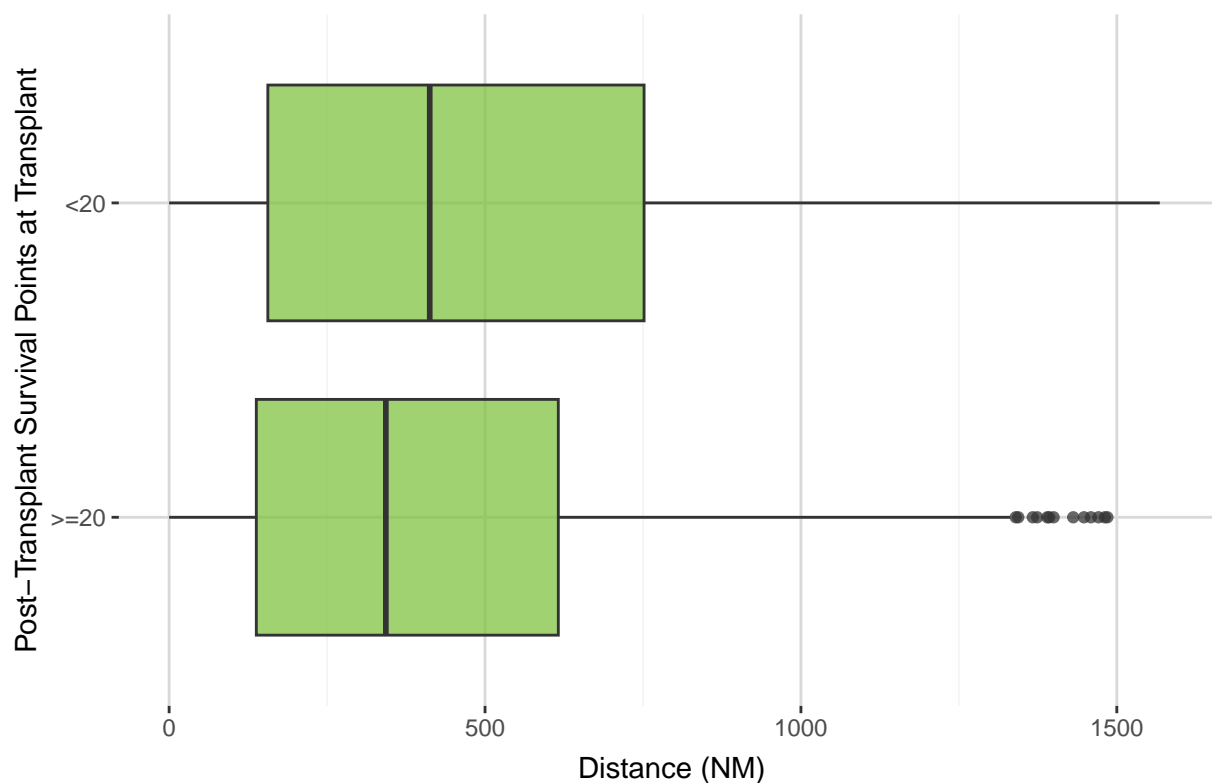
View is restricted to the 99th percentile of distance (1591 NM). There were 31 cases where lungs traveled further than this distance in the post policy era.

Table 10: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program by Post-Transplant Survival Points at Transplant in the Post Policy Era

Post-Transplant Survival Points at Transplant	N	N Missing	Min	25th Percentile	Median	Mean	75th Percentile	Max
<20	1912	0	0	158.0	420.5	491.25	761.0	2284
>=20	1135	0	0	139.0	347.0	420.62	626.0	2920
Total	3047	0	0	152.5	385.0	464.94	710.5	2920

Pediatric

Pediatric candidates are defined as those who are less than 18 years old at the time of listing; this includes individuals who turn 18 years old while on the waiting list. The sample sizes for pediatrics are currently too small to definitively determine implications of the policy change; however, below we describe trends we are observing so far. We will continue to monitor pediatrics in upcoming monitoring reports as more data become available.

Although sample sizes were small, the number of deaths or removals for too sick per 100 patient years on the waiting list was similar for pediatric candidates in the pre and post eras.

Figure 11: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Era and Pediatric Age Group
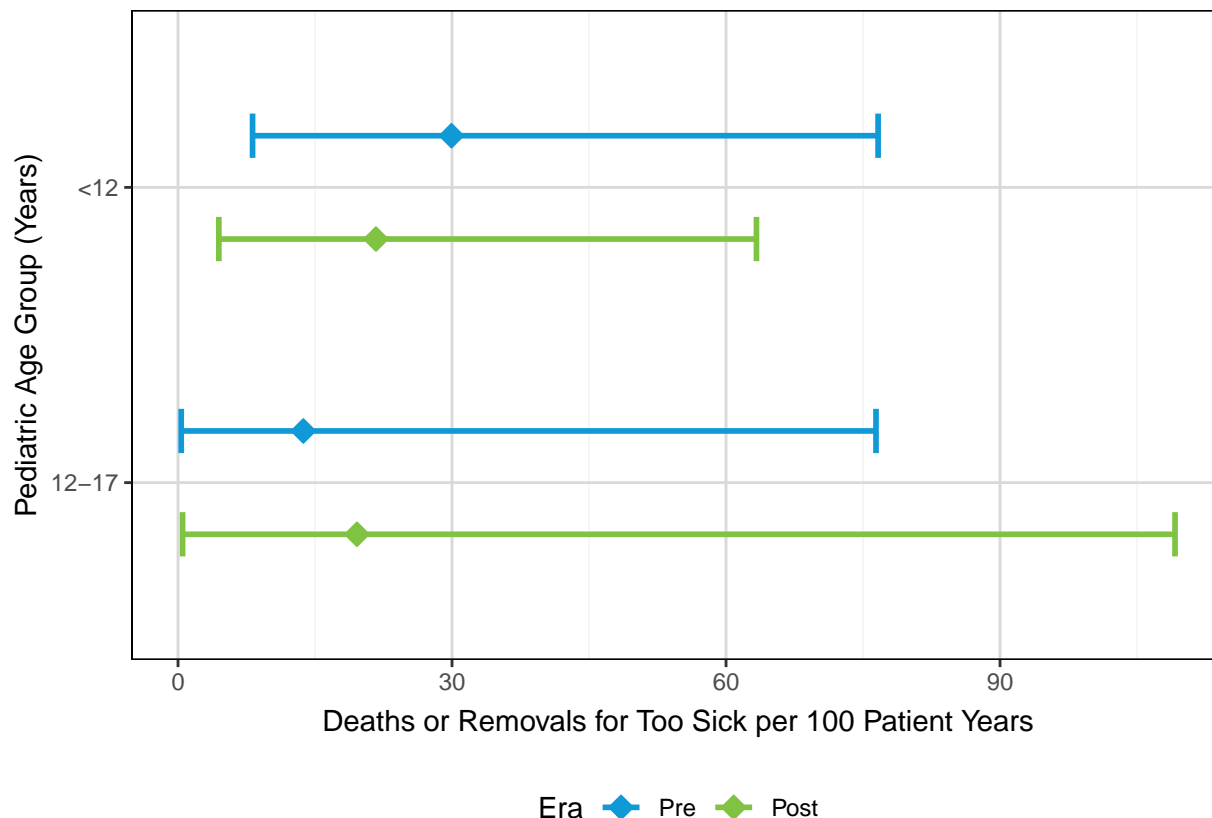
Table 11: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Era and Pediatric Age Group

Pediatric Age Group (Years)	Era	N Patients	Deaths or Removals for Too Sick per 100 Patient Years	95% Confidence Interval
<12	Pre	29	29.94	(8.16, 76.65)
	Post	32	21.67	(4.47, 63.33)
12-17	Pre	29	13.72	(0.35, 76.42)
	Post	26	19.59	(0.50, 109.16)

Although sample sizes were small, the number of lung transplants per 100 patient years increased slightly for pediatric candidates between 12-17 years in the post era. The number of transplants per 100 patient years for candidates <12 years remained similar across the policy eras.

Figure 12: Lung Transplants per 100 Patient Years on the Waiting List by Era and Pediatric Age Group
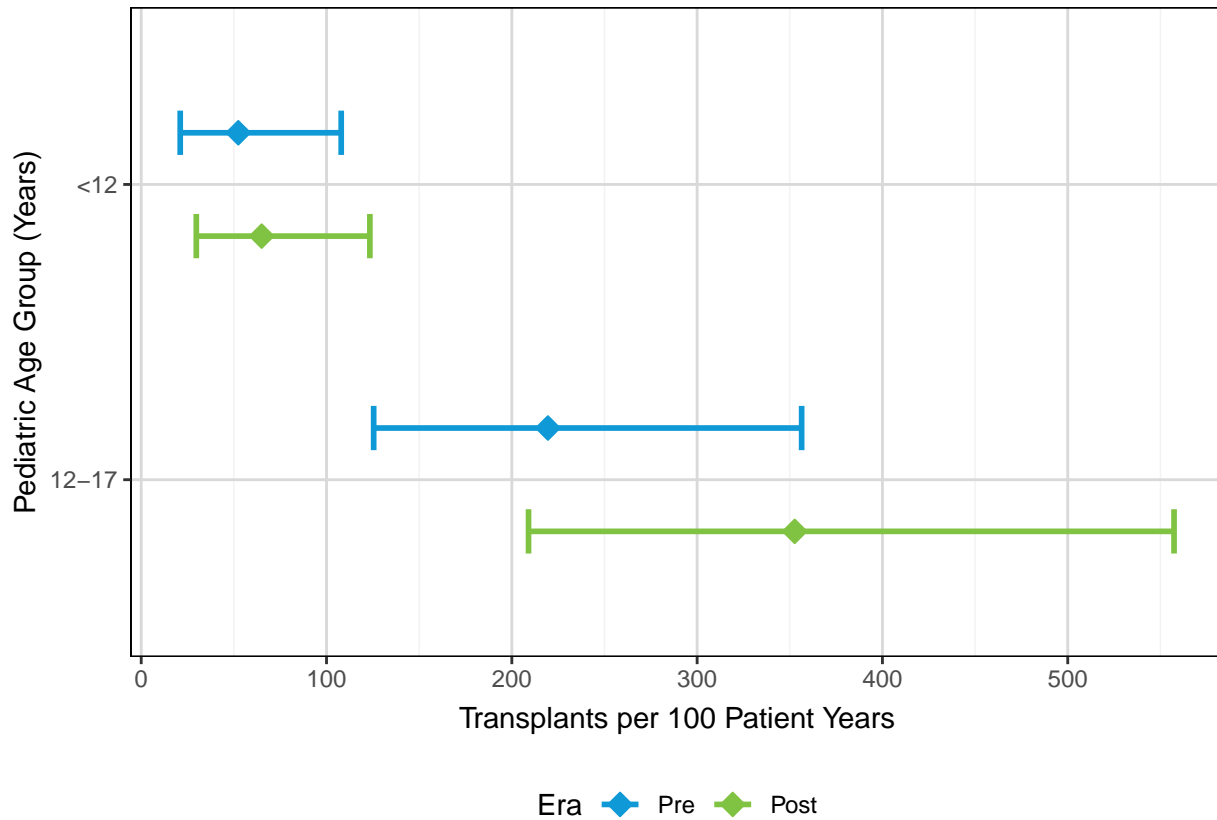
Table 12: Lung Transplants per 100 Patient Years on the Waiting List by Era and Pediatric Age Group

Pediatric Age Group (Years)	Era	N Patients	Transplants per 100 Patient Years	95% Confidence Interval
<12	Pre	29	52.39	(21.06, 107.94)
	Post	32	65.01	(29.73, 123.41)
12-17	Pre	29	219.47	(125.44, 356.40)
	Post	26	352.66	(209.01, 557.35)

In the post era, the number of pediatric lungs transplanted to adult recipients increased slightly and the number transplanted to pediatric recipients decreased slightly. In addition, more adult lungs were transplanted to pediatric recipients in the post era compared to the pre era.

Figure 13: Number of Lung Transplants by Era, Recipient Age Group, and Donor Age Group
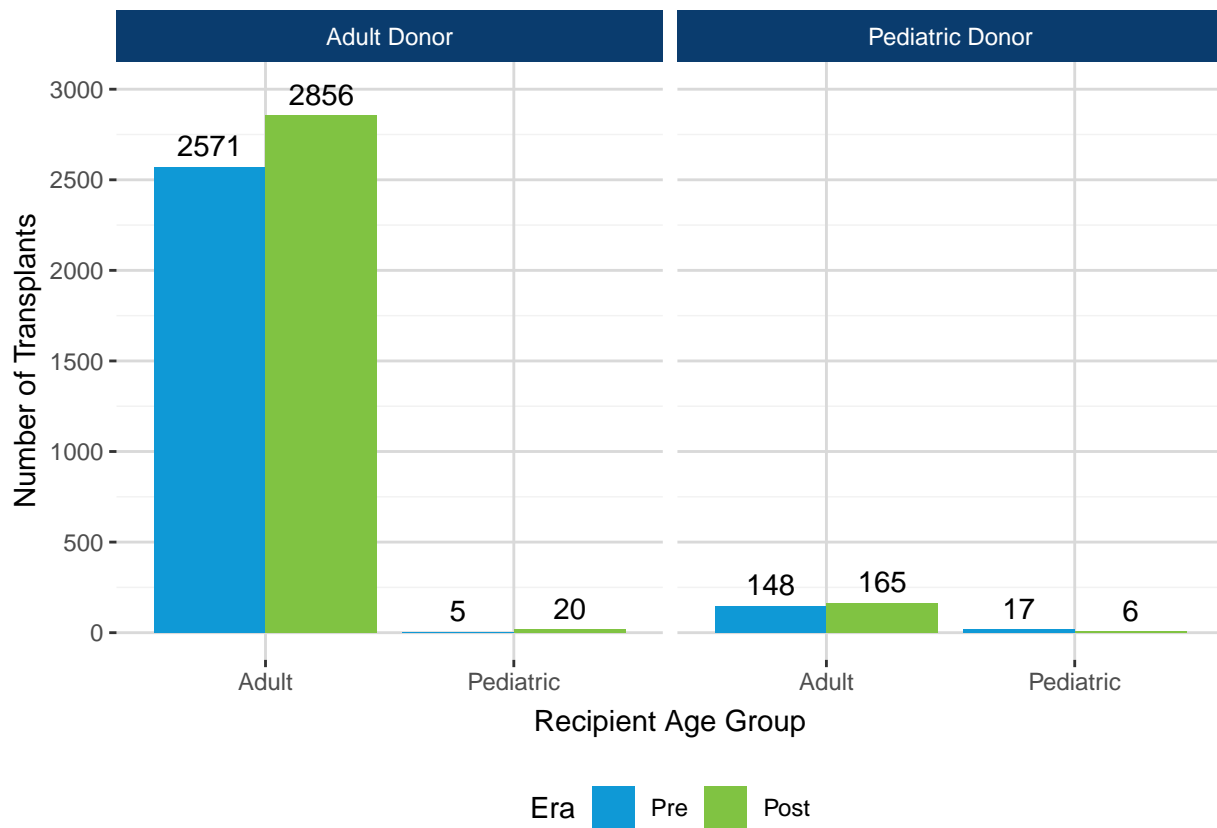
Table 13: Number of Lung Transplants by Era, Recipient Age Group, and Donor Age Group

Era	Recipient Age Group	Adult Donor	Pediatric Donor
Pre	Adult	2,571 (99.8%)	148 (89.7%)
	Pediatric	5 (0.2%)	17 (10.3%)
	Total	2,576 (100.0%)	165 (100.0%)
Post	Adult	2,856 (99.3%)	165 (96.5%)
	Pediatric	20 (0.7%)	6 (3.5%)
	Total	2,876 (100.0%)	171 (100.0%)

The following figure and table describe how pediatric candidates were ranked on the match run in the pre and post policy eras by depicting the cumulative percent of offers received by pediatric candidates at the top of the match run (from sequence numbers 1 to 30). In the post era, pediatric candidates had greater access to transplants and received the first offer on a match run 11% of the time, compared to the pre era where they received the first offer on a match run only 4% of the time.

Figure 14: Cumulative Percent of Offers Received by Pediatric Candidates by Era and Sequence Number
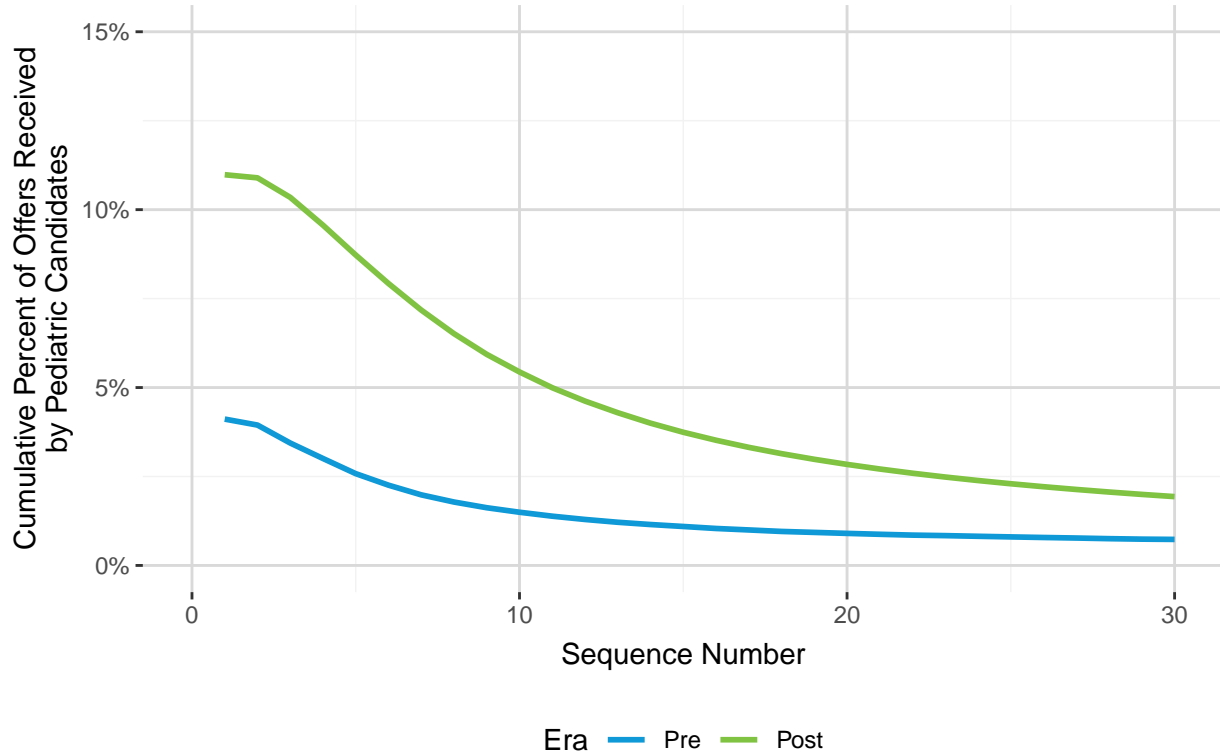
View is restricted to match run sequence numbers 1 through 30 to highlight differences at the top of the match run between the pre and post eras.

Table 14: Cumulative Percent of Offers Received by Pediatric Candidates by Era and Sequence Number

Sequence Number	Pre	Post
1	4.1138%	10.9818%
2	3.9459%	10.8942%
3	3.4405%	10.3451%
4	3.0058%	9.5640%
5	2.5802%	8.7245%
6	2.2559%	7.9238%
7	1.9842%	7.1772%
8	1.7822%	6.5139%
9	1.6224%	5.9324%
10	1.4957%	5.4384%
11	1.3843%	4.9952%
12	1.2924%	4.6195%
13	1.2138%	4.2923%
14	1.1499%	3.9987%
15	1.0954%	3.7432%
16	1.0389%	3.5190%
17	0.9980%	3.3189%
18	0.9559%	3.1419%
19	0.9289%	2.9830%
20	0.9015%	2.8401%
21	0.8755%	2.7101%
22	0.8524%	2.5922%
23	0.8380%	2.4848%
24	0.8195%	2.3864%
25	0.8026%	2.2960%
26	0.7859%	2.2125%
27	0.7705%	2.1353%
28	0.7526%	2.0636%
29	0.7391%	1.9969%
30	0.7316%	1.9346%

[a] Cumulative percent of offers received by pediatric candidates are only listed through match run sequence number 30 to highlight differences in pediatric offers at the top of the match run in the pre and post eras.

In the post policy era, median distance from the donor hospital to transplant program increased slightly for pediatric recipients from 333 NM to 360 NM, though sample sizes were small.

Figure 15: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program for Pediatric Recipients by Era
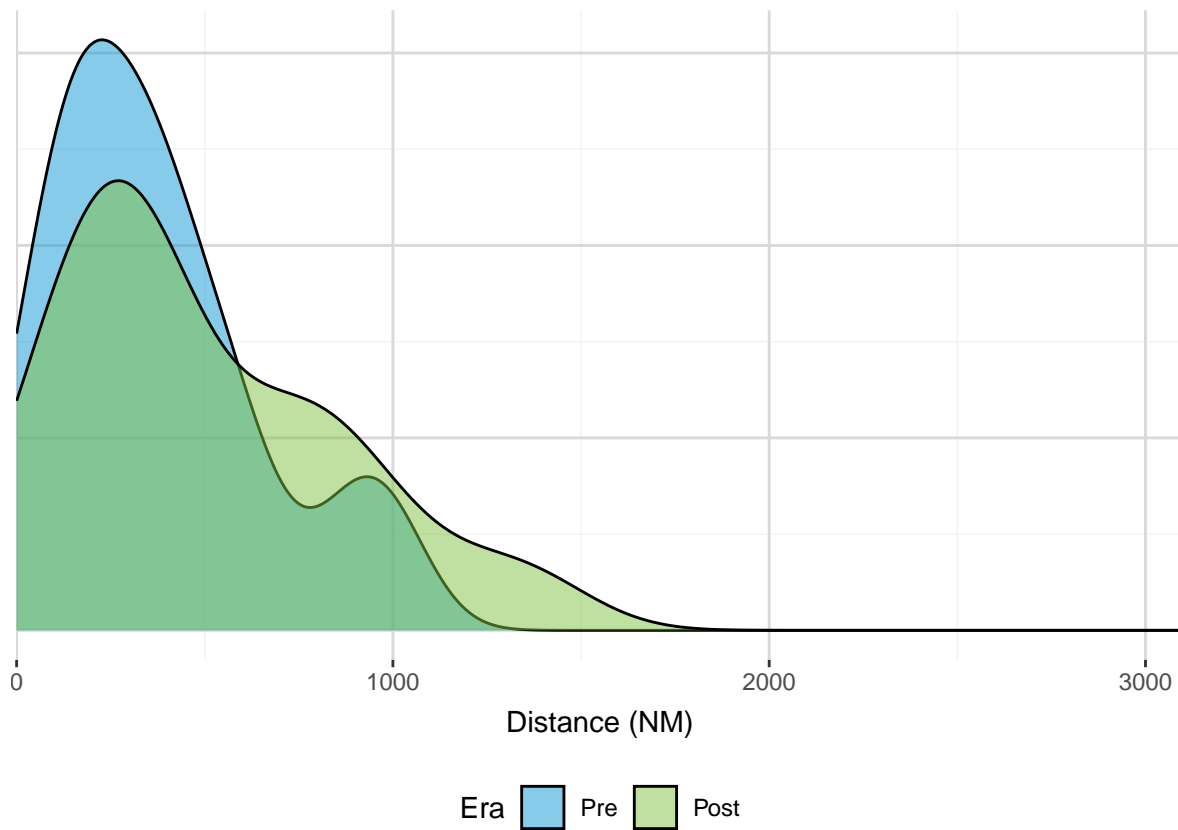
Table 15: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program for Pediatric Recipients by Era

Era	N	N Missing	Min	25th Percentile	Median	Mean	75th Percentile	Max
Pre	23	0	22	180.5	333	371.48	508.5	982
Post	27	0	3	230.5	360	491.70	747.0	1384

The pediatric lung utilization rate increased slightly for both DCD and non-DCD pediatric donors. The pediatric utilization rate is defined as the percent of pediatric lungs that are transplanted based on all possible lungs from every deceased pediatric donor with at least one organ recovered for the purpose of transplant; this definition assumes that each donor has two possible lungs for donation.

Figure 16: Pediatric Lung Donor Utilization Rates by Era and Donor Type
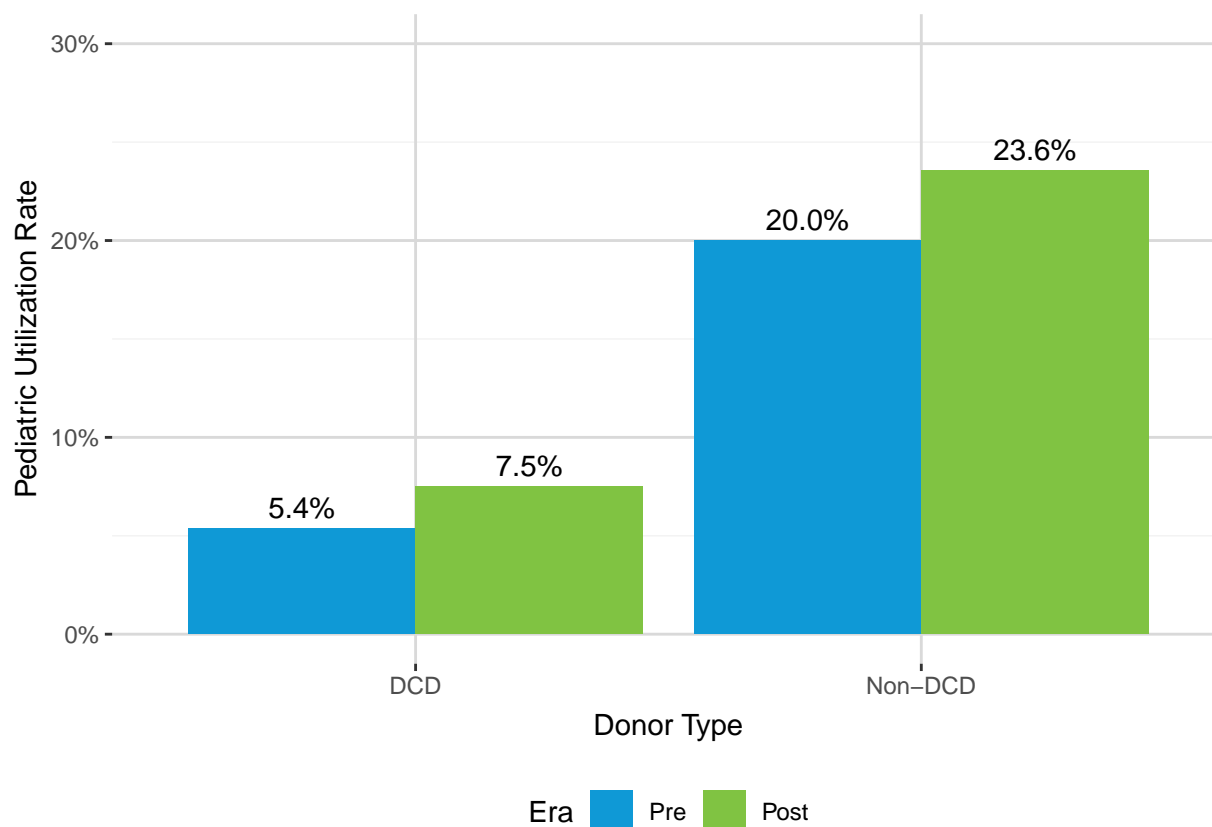
Table 16: Pediatric Lung Donor Utilization Rates by Era and Donor Type

DCD Status	Era	N Donors	N Lungs Transplanted	Pediatric Utilization Rate
DCD	Pre	223	24	5.4%
	Post	233	35	7.5%
Non-DCD	Pre	723	289	20.0%
	Post	626	295	23.6%
All Pediatric Donors	Pre	946	313	16.5%
	Post	859	330	19.2%

The pediatric lung non-use rate increased for both DCD and non-DCD donors in the post era. The pediatric non-use rate is defined as the number of pediatric lungs recovered for the purpose of transplant but not transplanted out of all pediatric lungs recovered for transplant.

Figure 17: Pediatric Lung Donor Non-Use Rates by Era and Donor Type

Table 17: Pediatric Lung Donor Non-Use Rates by Era and Donor Type

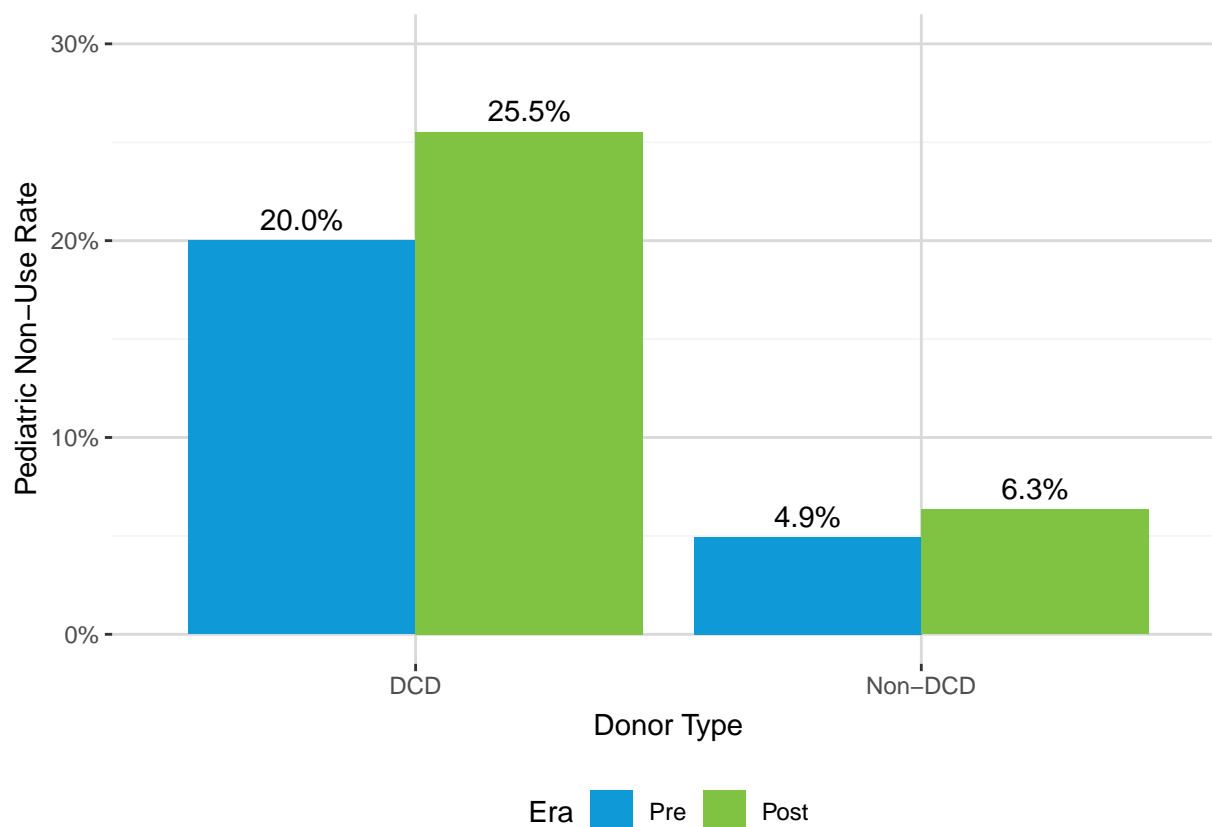| DCD Status	Era	N Lungs Recovered	N Lungs Transplanted	Pediatric Non-Use Rate
DCD	Pre	30	24	20.0%
	Post	47	35	25.5%
Non-DCD	Pre	304	289	4.9%
	Post	315	295	6.3%
All Pediatric Donors	Pre	334	313	6.3%
	Post	362	330	8.8%

Prior Living Donor

In the first year of Continuous Distribution there have been less than 10 prior living donors on the waiting list. To protect patient privacy, we cannot provide any additional information about these individuals. We will continue to monitor the prior living donor population and will include more information when it is available.

Blood Type

On September 27th, 2023 the OPTN Lung Transplantation Committee modified how blood type is incorporated into lung continuous distribution (CD) allocation to provide more proportional access to lung transplantation for candidates of all blood types and to improve access to lung transplantation for blood type O candidates. As a result of this change, this section of the report compares ~5.5 months of blood type data across three eras: before CD implementation (Blood Type: Pre-CD; September 26, 2022 - March 08, 2023), after CD implementation with the original blood type rating scale (Blood Type: Post-CD; April 16, 2023 - September 26, 2023), and after CD implementation with the modified blood type rating scale (Blood Type: Post-CD + ABO Mod; September 27, 2023 - March 08, 2024).

Compared to the Pre-CD era, the number of deaths or removals for too sick per 100 patient years remained similar or decreased slightly under the Post-CD + ABO Modification era for candidates with blood types A, B, and O. The number of deaths or removals for too sick per 100 patient years for blood type AB candidates had large confidence intervals due to the small sample size.

Figure 18: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Era and Candidate Blood Type
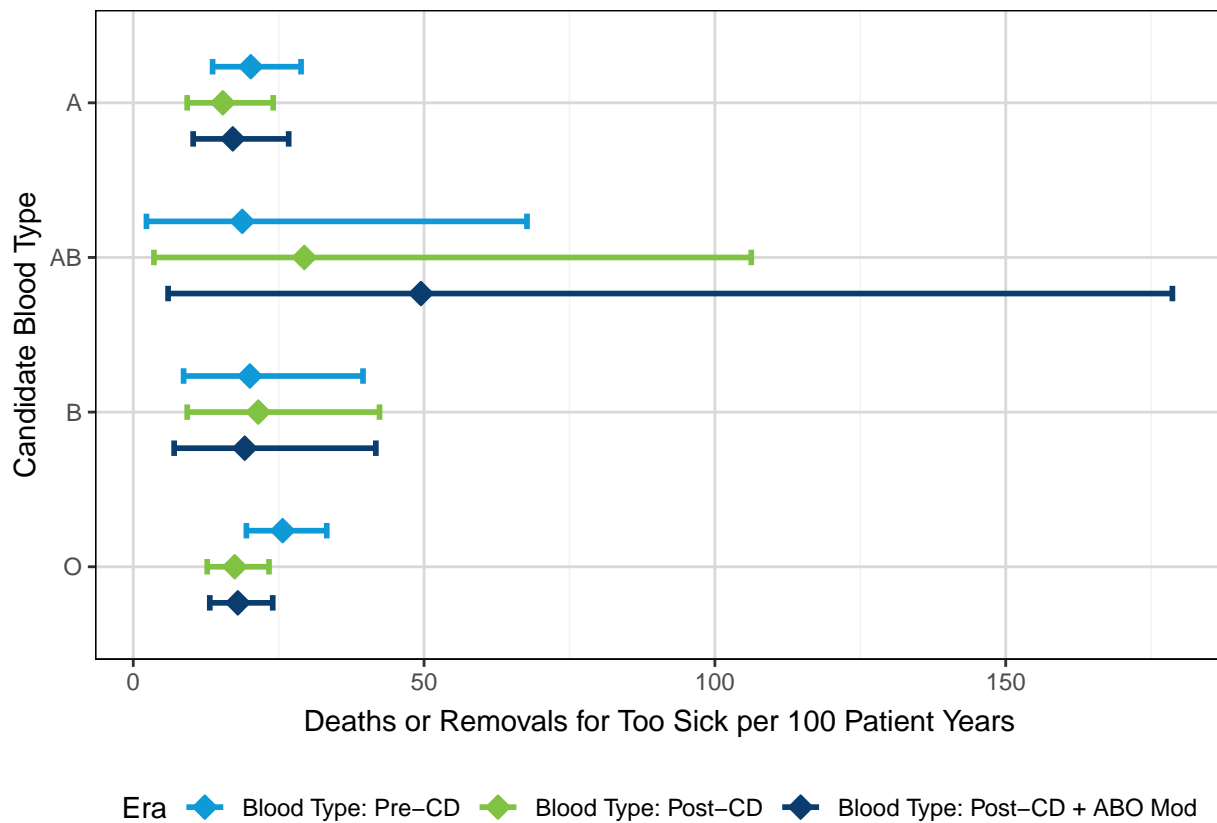
Table 18: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Era and Candidate Blood Type

Candidate Blood Type	Era	N Patients	Deaths or Removals for Too Sick per 100 Patient Years	95% Confidence Interval
A	Blood Type: Pre-CD	833	20.21	(13.64, 28.85)
	Blood Type: Post-CD	865	15.40	(9.27, 24.06)
	Blood Type: Post-CD + ABO Mod	786	17.11	(10.30, 26.72)
AB	Blood Type: Pre-CD	74	18.74	(2.27, 67.70)
	Blood Type: Post-CD	71	29.41	(3.56, 106.25)
	Blood Type: Post-CD + ABO Mod	57	49.46	(5.99, 178.66)
B	Blood Type: Pre-CD	256	20.05	(8.66, 39.50)
	Blood Type: Post-CD	276	21.49	(9.28, 42.34)
	Blood Type: Post-CD + ABO Mod	230	19.17	(7.03, 41.71)
O	Blood Type: Pre-CD	1137	25.68	(19.45, 33.27)
	Blood Type: Post-CD	1219	17.44	(12.72, 23.34)
	Blood Type: Post-CD + ABO Mod	1282	17.98	(13.16, 23.98)

Compared to the Pre-CD era, the transplant rate in the Post-CD era increased for candidates with blood types A, AB, and B and decreased slightly for candidates with blood type O. However, the transplant rate for candidates with blood type O increased from the Post-CD era to the Post-CD + ABO Modification era, to a similar rate as the Pre-CD era.

Figure 19: Lung Transplants per 100 Patient Years on the Waiting List by Era and Candidate Blood Type

Era ◆ Blood Type: Pre–CD ◆ Blood Type: Post–CD ◆ Blood Type: Post–CD + ABO Mod
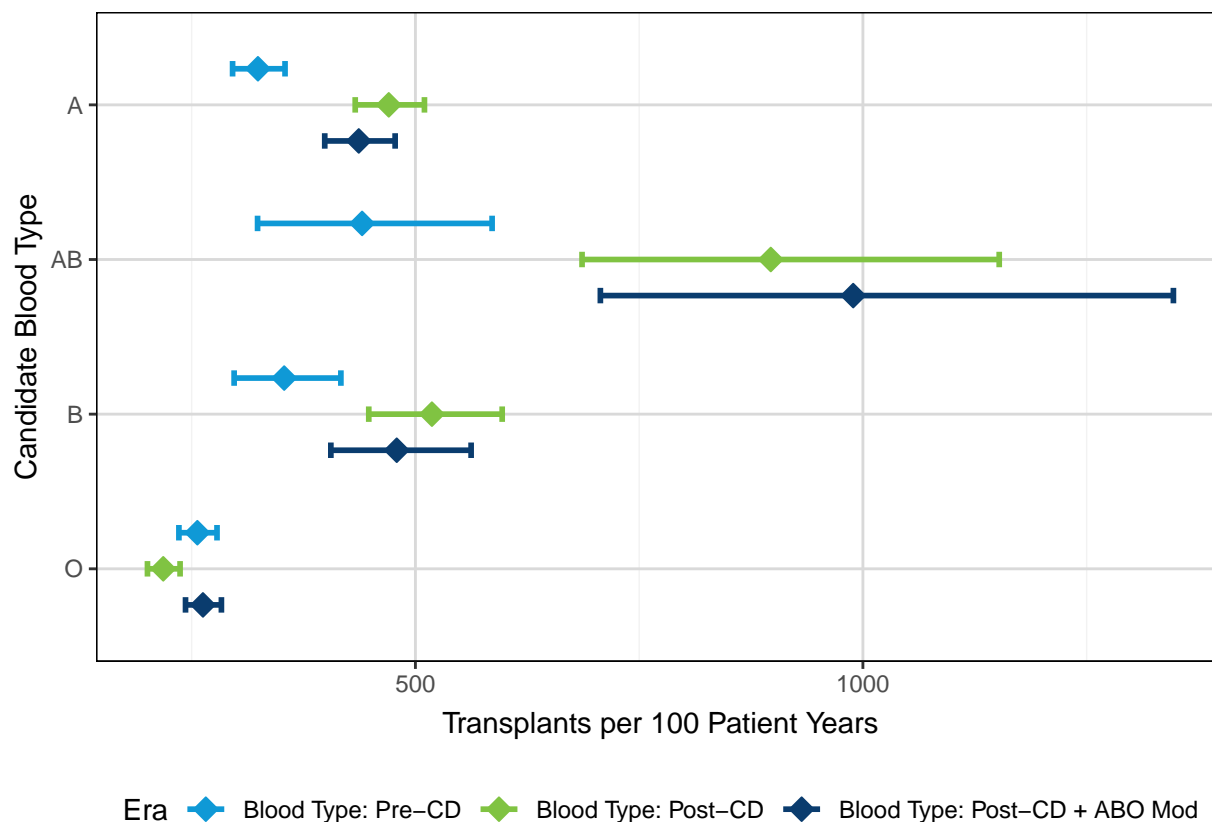
Table 19: Lung Transplants per 100 Patient Years on the Waiting List by Era and Candidate Blood Type

Candidate Blood Type	Era	N Patients	Transplants per 100 Patient Years	95% Confidence Interval
A	Blood Type: Pre-CD	833	324.03	(295.72, 354.33)
	Blood Type: Post-CD	865	470.23	(432.73, 510.10)
	Blood Type: Post-CD + ABO Mod	786	436.69	(398.68, 477.34)
AB	Blood Type: Pre-CD	74	440.44	(323.62, 585.69)
	Blood Type: Post-CD	71	897.06	(686.18, 1152.31)
	Blood Type: Post-CD + ABO Mod	57	989.16	(706.67, 1346.96)
B	Blood Type: Pre-CD	256	353.35	(297.43, 416.72)
	Blood Type: Post-CD	276	518.44	(447.87, 596.96)
	Blood Type: Post-CD + ABO Mod	230	479.13	(405.52, 562.23)
O	Blood Type: Pre-CD	1137	256.36	(235.72, 278.31)
	Blood Type: Post-CD	1219	218.24	(200.59, 237.04)
	Blood Type: Post-CD + ABO Mod	1282	262.60	(243.12, 283.23)

In the Post-CD era more blood type O donor lungs were transplanted to blood type A and B recipients compared to the Pre-CD era; however, after the ABO modification was implemented more blood type O donor lungs went to blood type O recipients.

Figure 20: Number of Lung Transplants by Era, Donor Blood Type, and Recipient Blood Type
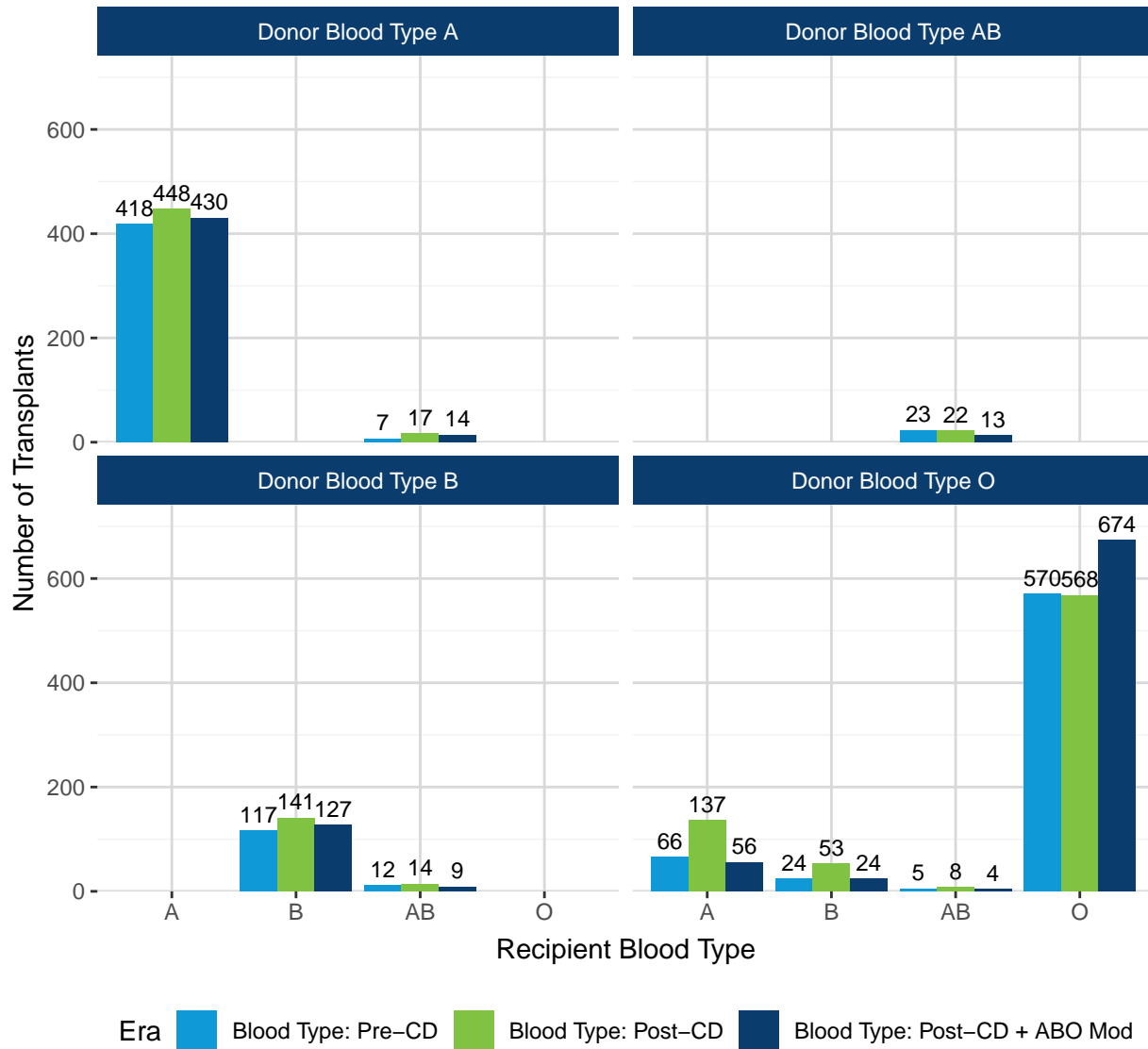
Table 20: Number of Lung Transplants by Era, Donor Blood Type, and Recipient Blood Type

Donor Blood Type	Recipient Blood Type	Era		
		Blood Type: Pre-CD	Blood Type: Post-CD	Blood Type: Post-CD + ABO Mod
A	A	418 (98.4%)	448 (96.3%)	430 (96.8%)
	AB	7 (1.6%)	17 (3.7%)	14 (3.2%)
	B	0 (0.0%)	0 (0.0%)	0 (0.0%)
	O	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Total	425 (100.0%)	465 (100.0%)	444 (100.0%)
AB	A	0 (0.0%)	0 (0.0%)	0 (0.0%)
	AB	23 (100.0%)	22 (100.0%)	13 (100.0%)
	B	0 (0.0%)	0 (0.0%)	0 (0.0%)
	O	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Total	23 (100.0%)	22 (100.0%)	13 (100.0%)
B	A	0 (0.0%)	0 (0.0%)	0 (0.0%)
	AB	12 (9.3%)	14 (9.0%)	9 (6.6%)
	B	117 (90.7%)	141 (91.0%)	127 (93.4%)
	O	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Total	129 (100.0%)	155 (100.0%)	136 (100.0%)
O	A	66 (9.9%)	137 (17.9%)	56 (7.4%)
	AB	5 (0.8%)	8 (1.0%)	4 (0.5%)
	B	24 (3.6%)	53 (6.9%)	24 (3.2%)
	O	570 (85.7%)	568 (74.2%)	674 (88.9%)
	Total	665 (100.0%)	766 (100.0%)	758 (100.0%)

Compared to the Pre-CD era, the median time to transplant decreased for candidates with blood types A, AB, and B in the Post-CD era; however, median waiting time increased slightly for candidates with blood types AB and B in the Post-CD + ABO Modification era. For candidates with blood type O, median time to transplant increased from the Pre-CD era to the Post-CD era and then decreased in the Post-CD + ABO Modification era. Despite the decrease in median waiting time in the ABO Modification era, candidates with blood type O have a slightly longer median waiting time than they did during the Pre-CD era and the longest median waiting time compared to candidates of other blood types.

Figure 21: Median Time to Transplant (Days) by Era and Recipient Blood Type
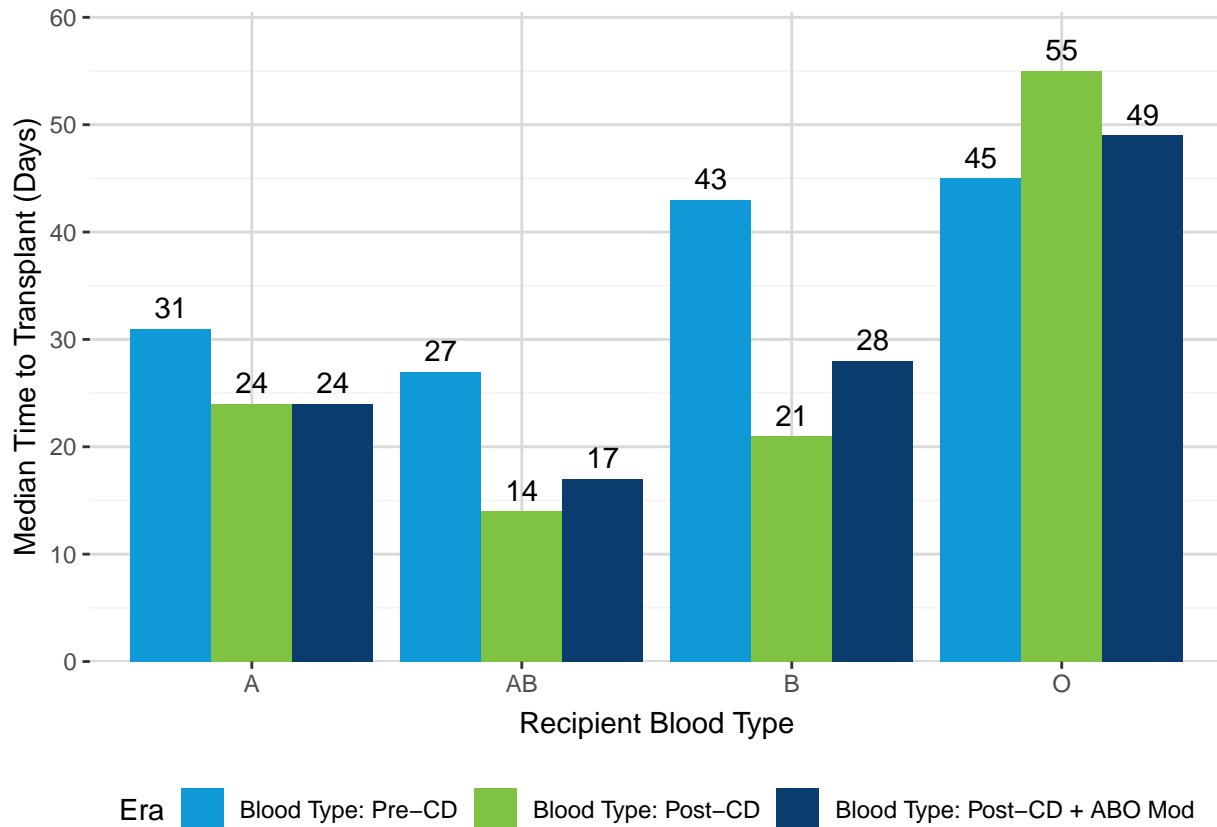
Table 21: Median Time to Transplant (Days) by Era and Recipient Blood Type

Recipient Blood Type	Era	N Registrations	Median Time to Transplant (Days)
A	Blood Type: Pre-CD	501	31
	Blood Type: Post-CD	567	24
	Blood Type: Post-CD + ABO Mod	548	24
AB	Blood Type: Pre-CD	51	27
	Blood Type: Post-CD	54	14
	Blood Type: Post-CD + ABO Mod	50	17
B	Blood Type: Pre-CD	167	43
	Blood Type: Post-CD	181	21
	Blood Type: Post-CD + ABO Mod	163	28
O	Blood Type: Pre-CD	626	45
	Blood Type: Post-CD	706	55
	Blood Type: Post-CD + ABO Mod	716	49

Median distance from the donor hospital to transplant program increased across all blood types from the Pre-CD era to the Post-CD era, and again from the Post-CD era to the Post-CD + ABO Modification era.

Figure 22: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program by Era and Recipient Blood Type
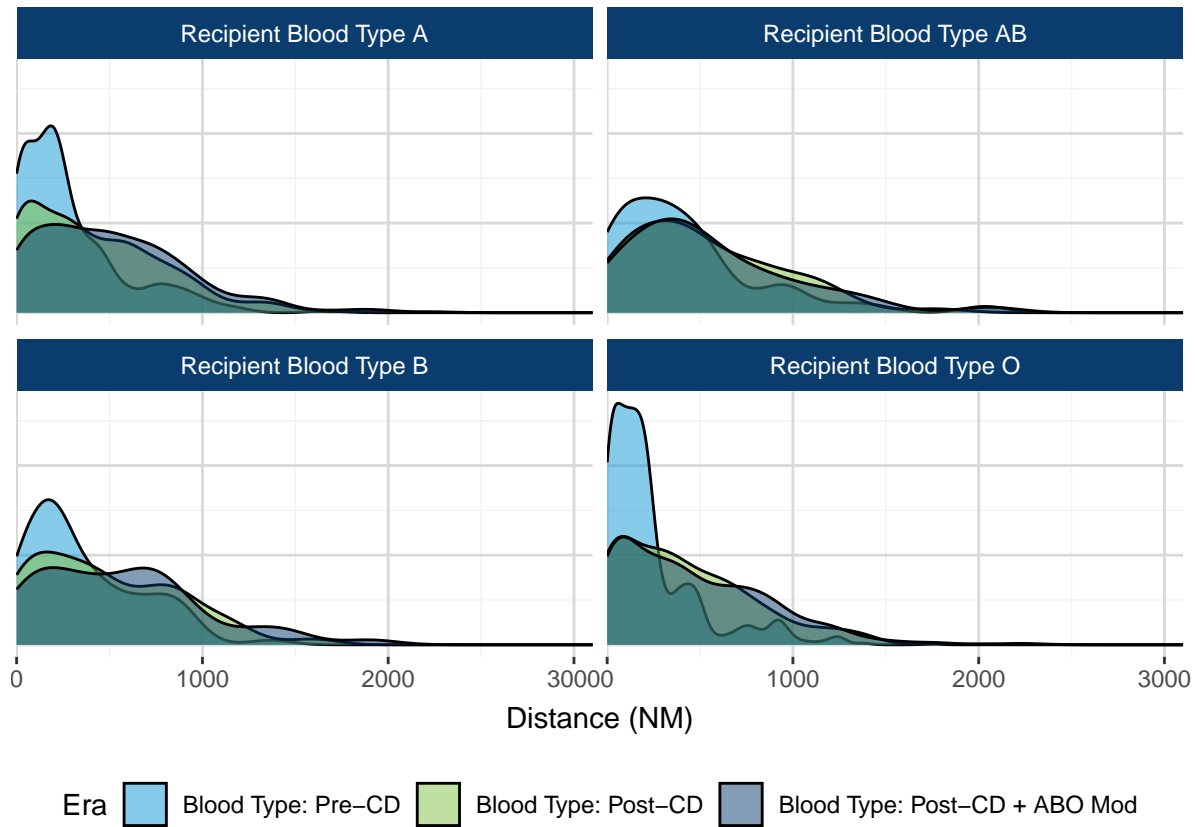
Table 22: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program by Era and Recipient Blood Type

Recipient Blood Type	Era	N	N Missing	Min	25th Percentile	Median	Mean	75th Percentile	Max
A	Blood Type: Pre-CD	484	0	0	79.75	204.5	289.08	400.00	1777
	Blood Type: Post-CD	585	0	0	120.00	349.0	430.28	660.00	2205
	Blood Type: Post-CD + ABO Mod	486	0	0	212.25	464.5	519.60	755.50	2284
AB	Blood Type: Pre-CD	47	0	1	134.50	325.0	424.06	527.00	2036
	Blood Type: Post-CD	61	0	9	223.00	433.0	528.90	787.00	1769
	Blood Type: Post-CD + ABO Mod	40	0	4	234.50	444.0	554.10	750.25	2058
B	Blood Type: Pre-CD	141	0	0	141.00	264.0	361.72	556.00	1410
	Blood Type: Post-CD	194	0	0	175.00	425.5	490.65	781.75	1652
	Blood Type: Post-CD + ABO Mod	151	0	0	210.00	514.0	566.34	794.00	1957
O	Blood Type: Pre-CD	570	0	0	68.00	158.0	239.86	291.25	1743
	Blood Type: Post-CD	568	0	0	126.75	354.0	434.66	649.25	2244
	Blood Type: Post-CD + ABO Mod	674	0	0	129.00	377.5	463.32	724.00	2349
Total	Blood Type: Pre-CD	1242	0	0	78.00	197.0	279.85	393.75	2036
	Blood Type: Post-CD	1408	0	0	137.75	368.5	444.64	681.25	2244
	Blood Type: Post-CD + ABO Mod	1351	0	0	170.50	424.0	497.77	750.50	2349

Medical urgency points are not available for candidates that were transplanted in the Pre-CD era. Compared to the Post-CD era, median medical urgency points at transplant increased slightly for blood type AB, B, and O recipients in the Post-CD + ABO Modification era. However, for blood type O the mean medical urgency points at transplant decreased from 4.85 in the Post-CD era to 4.59 in the Post-CD + ABO Modification era.

Figure 23: Distribution of Medical Urgency Points at Transplant by Era and Recipient Blood Type
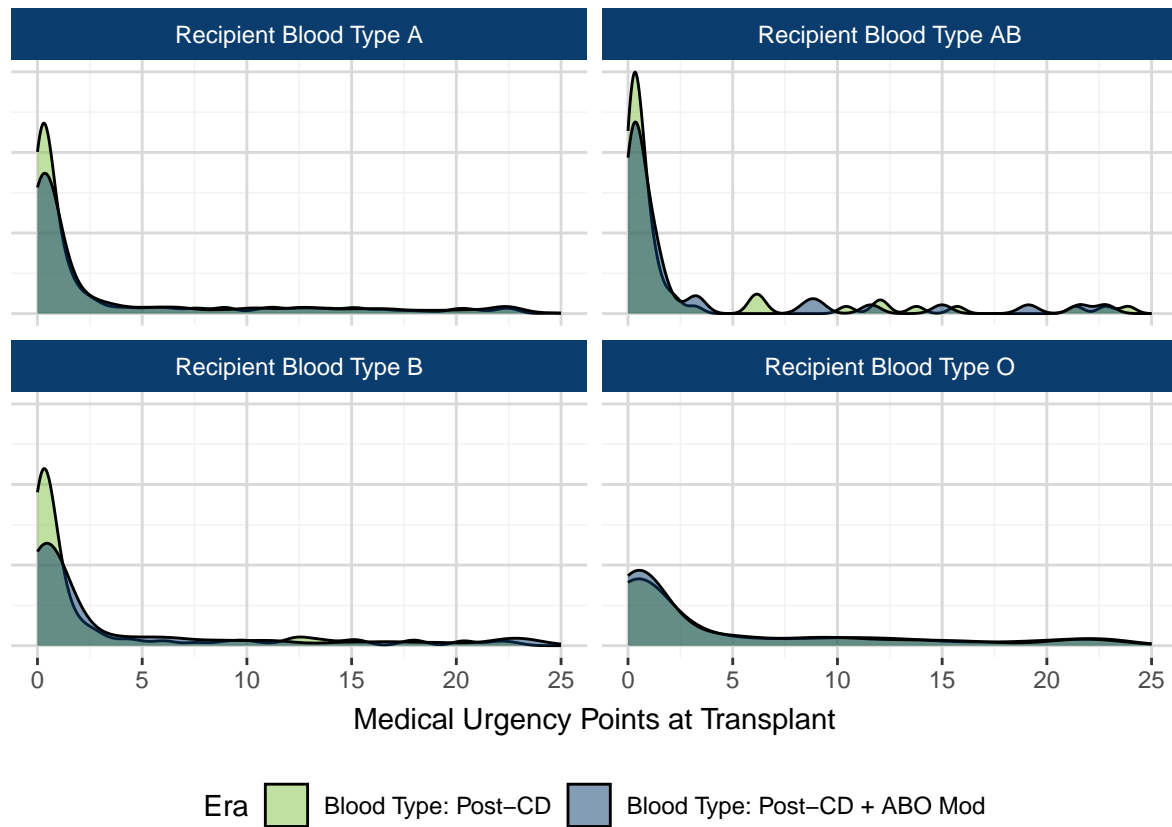
Table 23: Distribution of Medical Urgency Points at Transplant by Era and Recipient Blood Type

Recipient Blood Type	Era	N	N Missing	Min	25th Percentile	Median	Mean	75th Percentile	Max
A	Blood Type: Post-CD	585	0	0.01	0.18	0.56	3.43	2.63	24.75
	Blood Type: Post-CD + ABO Mod	486	0	0.02	0.18	0.55	3.77	3.70	24.10
AB	Blood Type: Post-CD	61	0	0.04	0.23	0.55	2.97	1.48	23.88
	Blood Type: Post-CD + ABO Mod	40	0	0.02	0.21	0.60	3.30	1.64	22.80
B	Blood Type: Post-CD	194	0	0.00	0.18	0.54	3.20	2.43	22.80
	Blood Type: Post-CD + ABO Mod	151	0	0.04	0.23	0.62	3.92	4.31	24.10
O	Blood Type: Post-CD	568	0	0.01	0.23	0.86	4.85	7.84	23.75
	Blood Type: Post-CD + ABO Mod	674	0	0.01	0.27	0.94	4.59	7.14	25.00
Total	Blood Type: Post-CD	1408	0	0.00	0.20	0.64	3.95	4.34	24.75
	Blood Type: Post-CD + ABO Mod	1351	0	0.01	0.23	0.71	4.18	5.36	25.00

CAS scores are not available for candidates that were transplanted in the Pre-CD era. The following results describe candidates' CAS scores at transplant, minus the points the candidates received based on their blood type. In both the Post-CD and Post-CD + ABO Modification eras blood type O recipients had the highest median CAS scores at transplant (excluding the blood type points from their score).

Figure 24: Distribution of CAS at Transplant Excluding Blood Type Points by Era and Recipient Blood Type
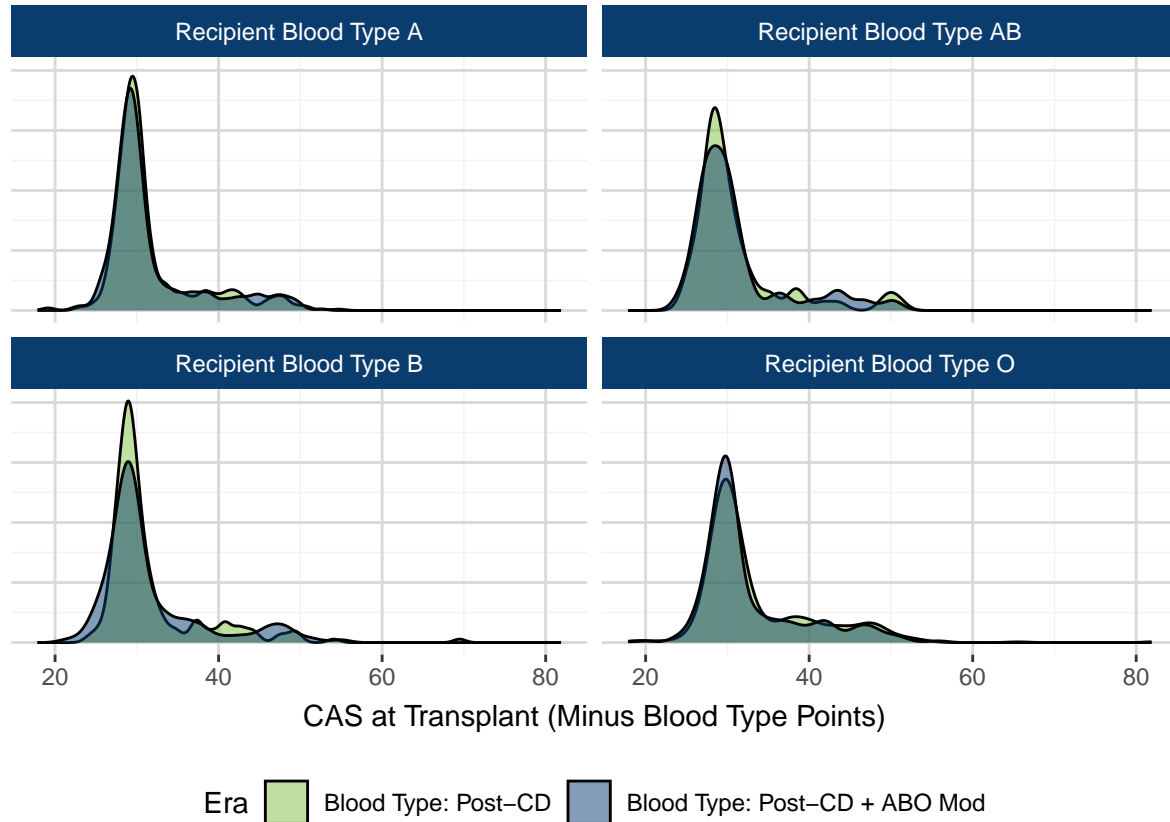
Table 24: Distribution of CAS at Transplant Excluding Blood Type Points by Era and Recipient Blood Type

Recipient Blood Type	Era	N	N Missing	Min	25th Percentile	Median	Mean	75th Percentile	Max
A	Blood Type: Post-CD	585	0	22.60	28.66	29.90	31.76	31.93	52.72
	Blood Type: Post-CD + ABO Mod	486	0	19.00	28.42	29.64	31.78	32.36	54.76
AB	Blood Type: Post-CD	61	0	25.11	27.97	28.92	31.00	31.44	51.05
	Blood Type: Post-CD + ABO Mod	40	0	24.58	27.42	29.55	31.08	31.22	50.17
B	Blood Type: Post-CD	194	0	24.06	28.47	29.39	31.58	31.57	69.48
	Blood Type: Post-CD + ABO Mod	151	0	21.53	28.04	29.36	31.60	32.70	54.91
O	Blood Type: Post-CD	568	0	18.41	29.25	30.68	33.37	36.41	65.58
	Blood Type: Post-CD + ABO Mod	674	0	17.85	28.95	30.32	32.72	34.40	81.88
Total	Blood Type: Post-CD	1408	0	18.41	28.78	30.08	32.35	33.18	69.48
	Blood Type: Post-CD + ABO Mod	1351	0	17.85	28.59	29.93	32.21	33.28	81.88

CPRA

CPRA was not a component of lung allocation prior to the implementation of continuous distribution and was not calculated for lung candidates before January 26th, 2023 (*see news item*). Because CPRA data are unavailable for a majority of the pre policy era, this section only includes data for the post policy era (from March 09, 2023 to March 08, 2024). In the post policy era CPRA remains under reported and is missing not at random and should be interpreted accordingly. All data reported in this section reflect the most recent CPRA that is available for a patient in the OPTN Waiting List.

In the post policy era, the number of deaths or removals for too sick per 100 patient years was similar across all CPRA groupings. The confidence intervals are large for the CPRA 98+ group due to the small sample size.

Figure 25: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by CPRA in the Post Policy Era
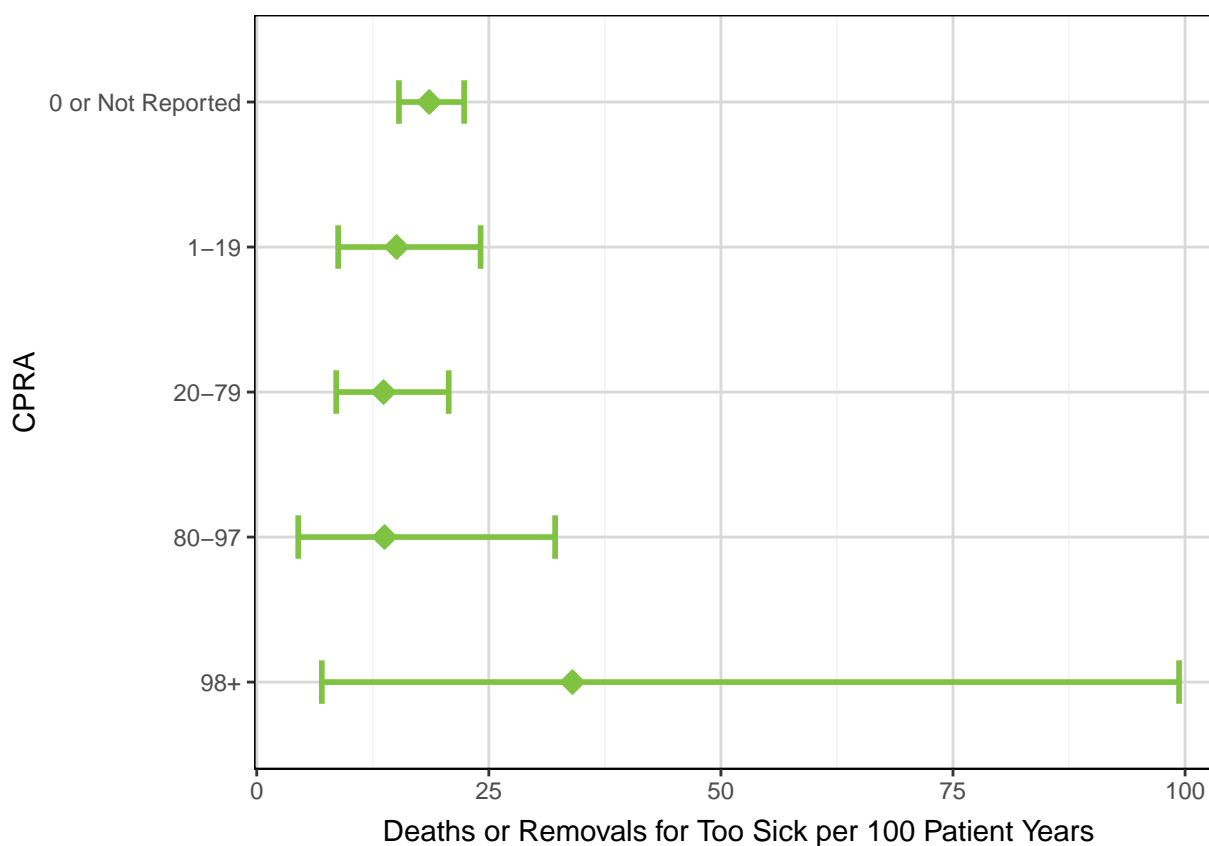
Table 25: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by CPRA in the Post Policy Era

CPRA	N Patients	Deaths or Removals for Too Sick per 100 Patient Years	95% Confidence Interval
0 or Not Reported	3042	18.58	(15.32, 22.34)
1-19	456	15.06	(8.77, 24.11)
20-79	576	13.66	(8.56, 20.68)
80-97	95	13.77	(4.47, 32.14)
98+	21	34.00	(7.01, 99.35)

In the post policy era, the number of transplants per 100 patient years was highest for individuals with no unacceptable antigens entered in the OPTN Waiting List.

Figure 26: Lung Transplants per 100 Patient Years on the Waiting List by CPRA in the Post Policy Era
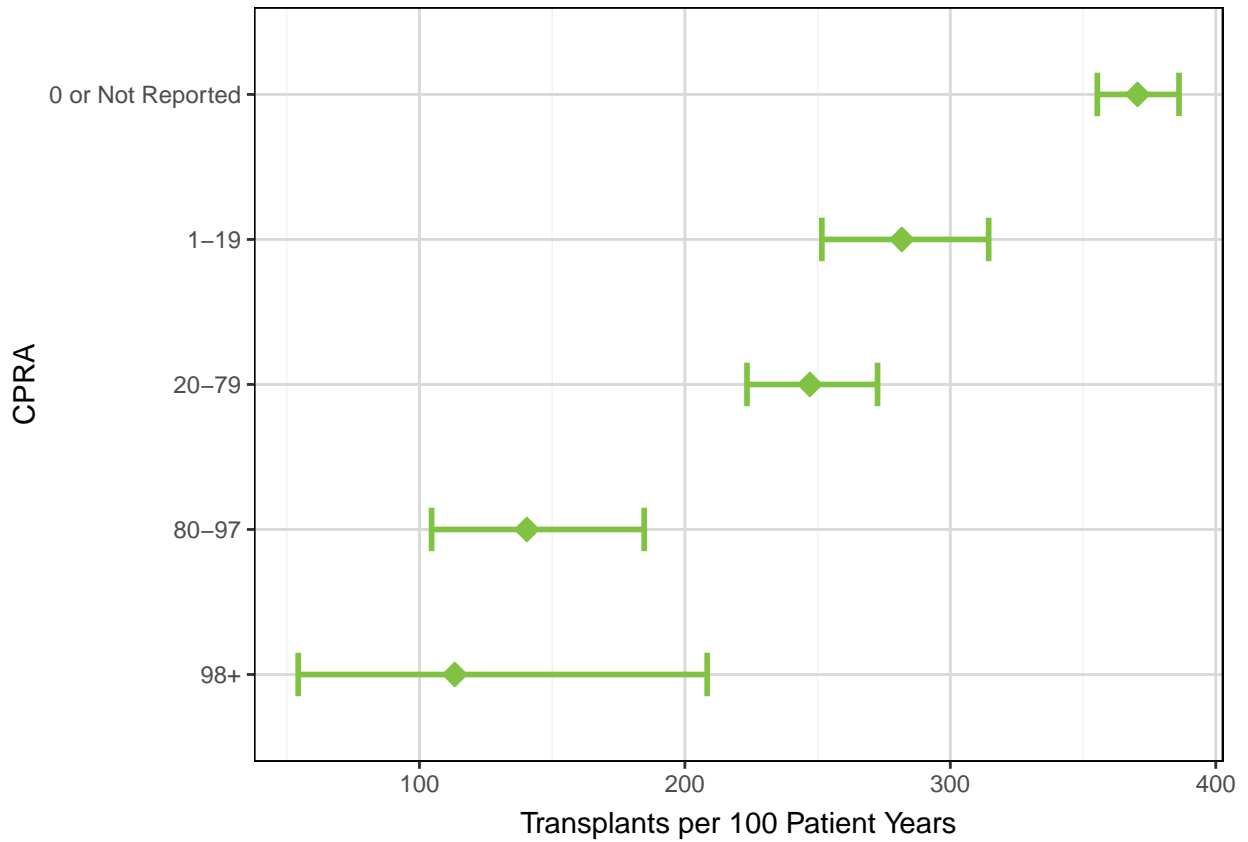
Table 26: Lung Transplants per 100 Patient Years on the Waiting List by CPRA in the Post Policy Era

CPRA	N Patients	Transplants per 100 Patient Years	95% Confidence Interval
0 or Not Reported	3042	370.52	(355.38, 386.15)
1-19	456	281.72	(251.60, 314.44)
20-79	576	247.08	(223.40, 272.59)
80-97	95	140.46	(104.58, 184.68)
98+	21	113.32	(54.34, 208.40)

In the post policy era, median time to transplant was longest for the most sensitized candidates. For this analysis, candidates in the 80-97 and 98+ groups were combined because of the small sample size.

Figure 27: Median Time to Transplant (Days) by CPRA in the Post Policy Era
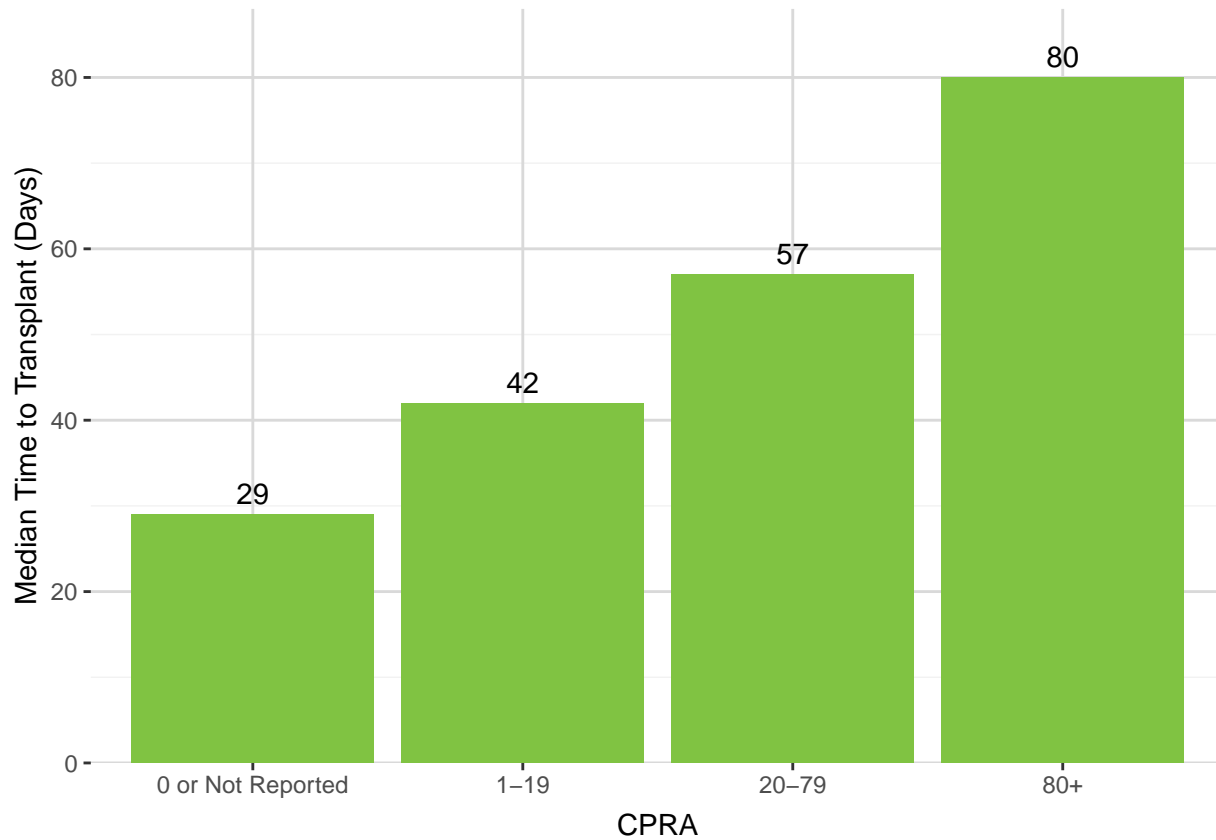
Table 27: Median Time to Transplant (Days) by CPRA in the Post Policy Era

CPRA	N Registrations	Median Time to Transplant (Days)
0 or Not Reported	2470	29
1-19	367	42
20-79	419	57
80+	60	80

In the post policy era, median distance was greatest for the most sensitized candidates.

Figure 28: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program by CPRA in the Post Policy Era
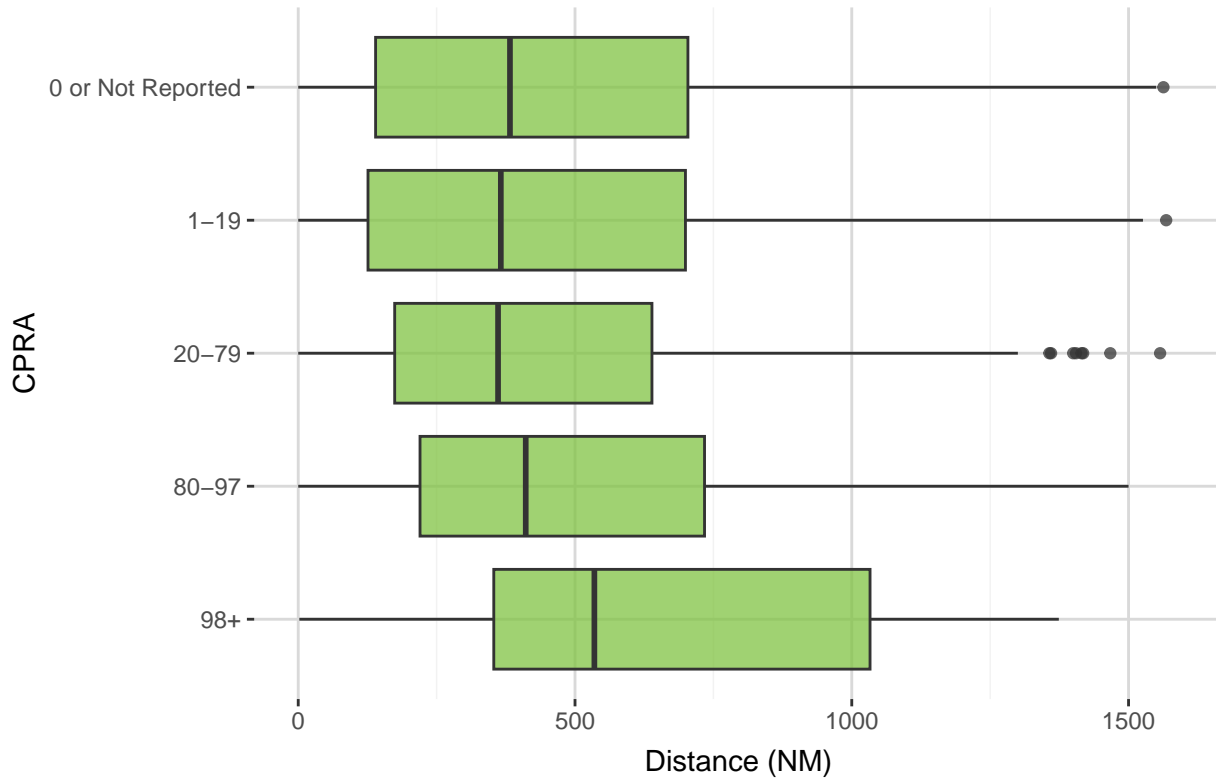
View is restricted to the 99th percentile of distance (1591 NM). There were 31 cases where lungs traveled further than this distance in the post policy era.

Table 28: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program by CPRA in the Post Policy Era

CPRA	N	N Missing	Min	25th Percentile	Median	Mean	75th Percentile	Max
0 or Not Reported	2184	0	0	142.0	389.5	463.43	712.25	2920
1-19	352	0	0	127.0	373.0	459.03	728.25	2349
20-79	405	0	0	175.0	362.0	446.52	659.00	2244
80-97	79	0	0	220.0	419.0	543.70	800.50	2227
98+	27	0	2	368.5	543.0	710.04	1063.50	2058
Total	3047	0	0	152.5	385.0	464.94	710.50	2920

Height

In all height analyses, pediatric candidates are grouped separately from adult candidates. Although points for height are assigned in the same manner for pediatric and adult candidates, we report the results this way to closely monitor how short adults are impacted by Continuous Distribution, and to not conflate their data with that of pediatrics, who tend to be shorter and also receive pediatric allocation points.

The number of deaths or removals for too sick per 100 patient years decreased in the post policy era for all adult height groups except for those between 165 and 170.1 cm tall (where rates remained similar). In the post policy era, the number of deaths or removals for too sick per 100 patient years was similar across all height groupings.

Figure 29: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Era and Height
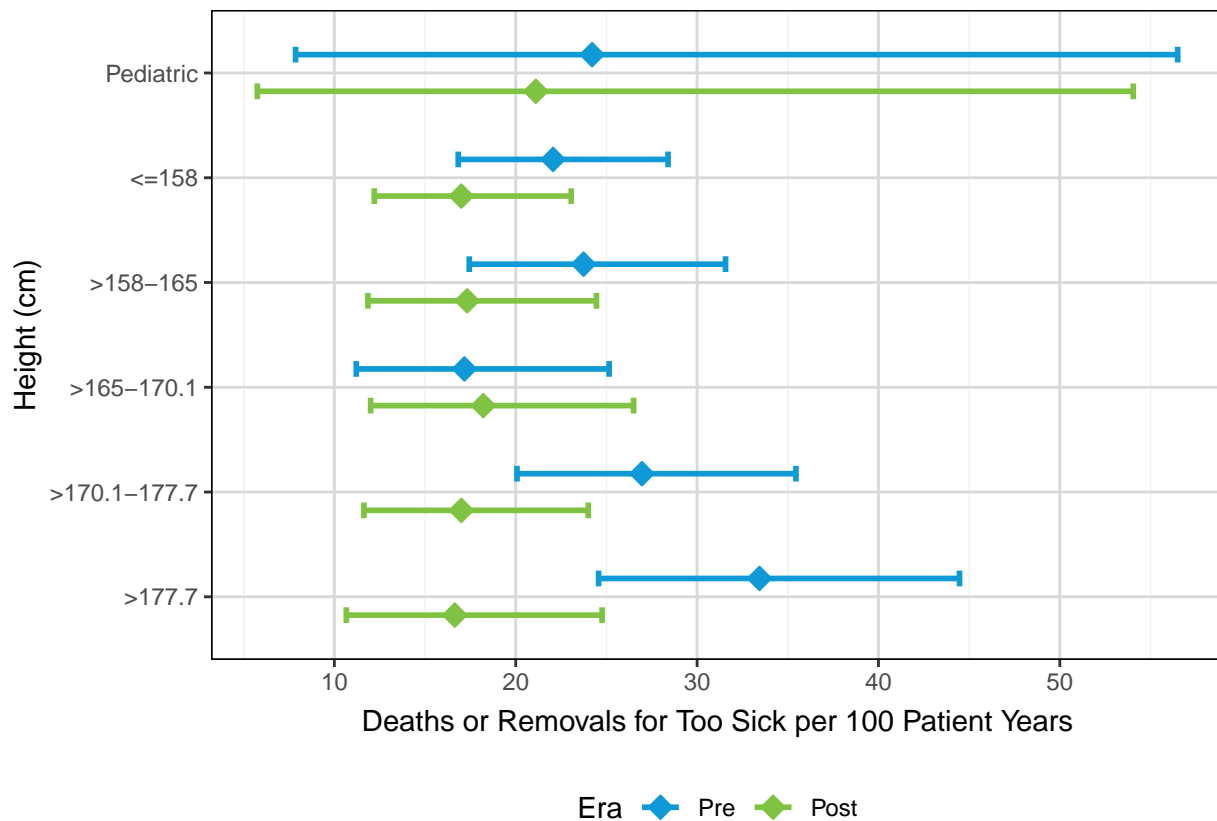
Table 29: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Era and Height

Height (cm)	Era	N Patients	Deaths or Removals for Too Sick per 100 Patient Years	95% Confidence Interval
Pediatric	Pre	58	24.21	(7.86, 56.50)
	Post	58	21.11	(5.75, 54.05)
<=158	Pre	754	22.06	(16.83, 28.40)
	Post	801	17.00	(12.20, 23.06)
>158-165	Pre	673	23.74	(17.44, 31.57)
	Post	737	17.32	(11.85, 24.45)
>165-170.1	Pre	609	17.17	(11.21, 25.15)
	Post	684	18.21	(12.00, 26.50)
>170.1-177.7	Pre	952	26.96	(20.07, 35.45)
	Post	976	17.00	(11.63, 24.00)
>177.7	Pre	948	33.44	(24.57, 44.47)
	Post	931	16.64	(10.66, 24.76)

The number of lung transplants per 100 patient years increased in the post policy era for all pediatric and adult height groups except for adults greater than 177.7 cm tall.

Figure 30: Lung Transplants per 100 Patient Years on the Waiting List by Era and Height
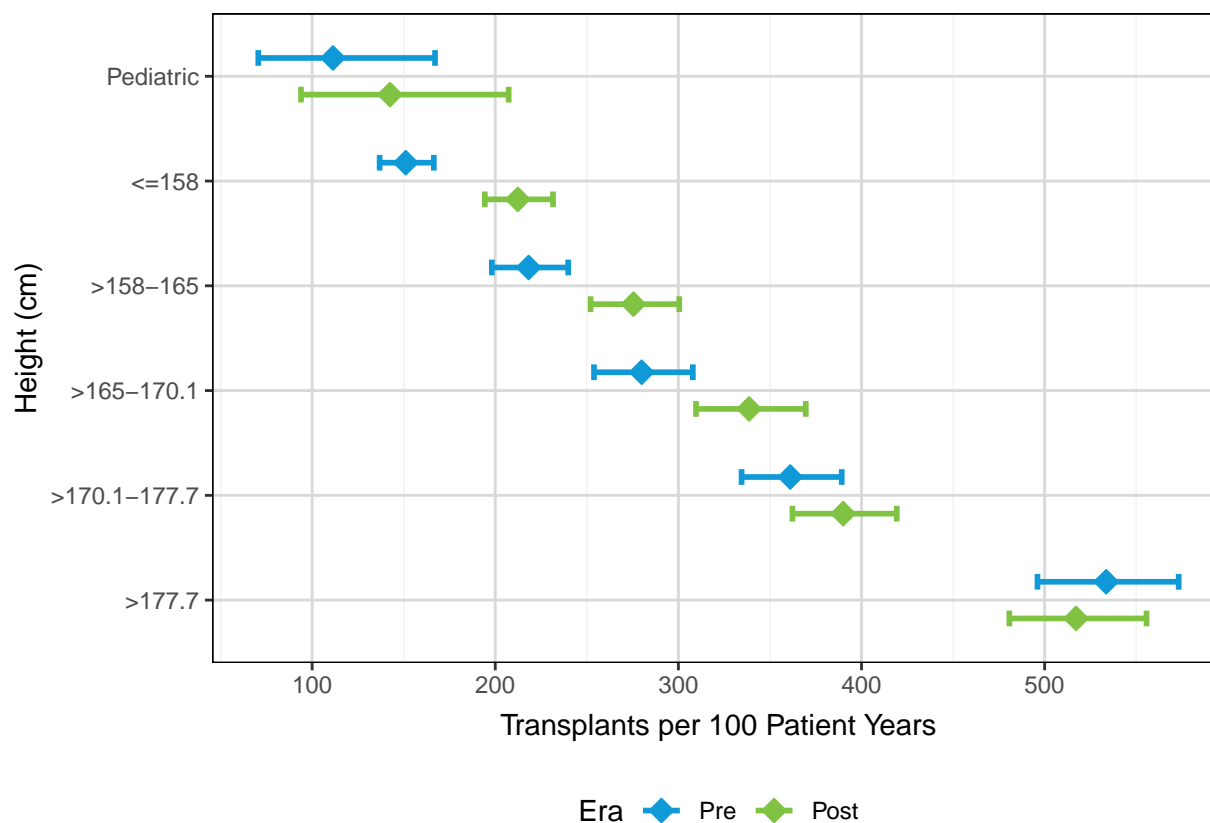
Table 30: Lung Transplants per 100 Patient Years on the Waiting List by Era and Height

Height (cm)	Era	N Patients	Transplants per 100 Patient Years	95% Confidence Interval
Pediatric	Pre	58	111.37	(70.60, 167.11)
	Post	58	142.50	(93.91, 207.32)
<=158	Pre	754	151.12	(136.86, 166.46)
	Post	801	212.31	(194.32, 231.53)
>158-165	Pre	673	218.22	(198.13, 239.81)
	Post	737	275.48	(252.06, 300.48)
>165-170.1	Pre	609	279.94	(253.92, 307.89)
	Post	684	338.61	(309.63, 369.56)
>170.1-177.7	Pre	952	361.08	(334.50, 389.20)
	Post	976	389.98	(362.28, 419.25)
>177.7	Pre	948	533.60	(496.09, 573.20)
	Post	931	517.16	(480.71, 555.64)

In the post policy era, median time to transplant decreased or remained similar for pediatric candidates and adult candidates of all heights.

Figure 31: Median Time to Transplant (Days) by Era and Height
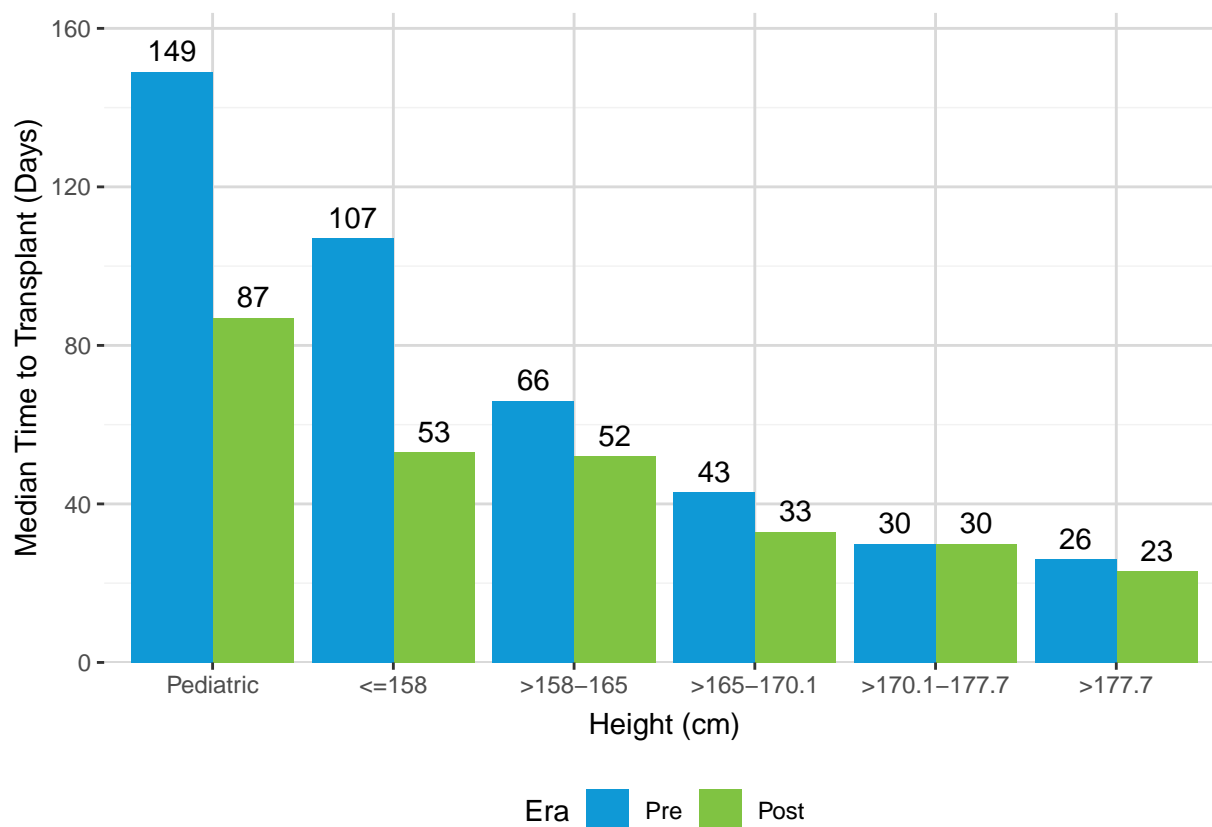
Table 31: Median Time to Transplant (Days) by Era and Height

Height (cm)	Era	N Registrations	Median Time to Transplant (Days)
Pediatric	Pre	42	149
	Post	33	87
<=158	Pre	496	107
	Post	550	53
>158-165	Pre	480	66
	Post	570	52
>165-170.1	Pre	474	43
	Post	553	33
>170.1-177.7	Pre	765	30
	Post	801	30
>177.7	Pre	790	26
	Post	809	23

In the post era, median distance from the donor hospital to transplant program increased for pediatric recipients and adult recipients of all heights.

Figure 32: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program by Era and Height
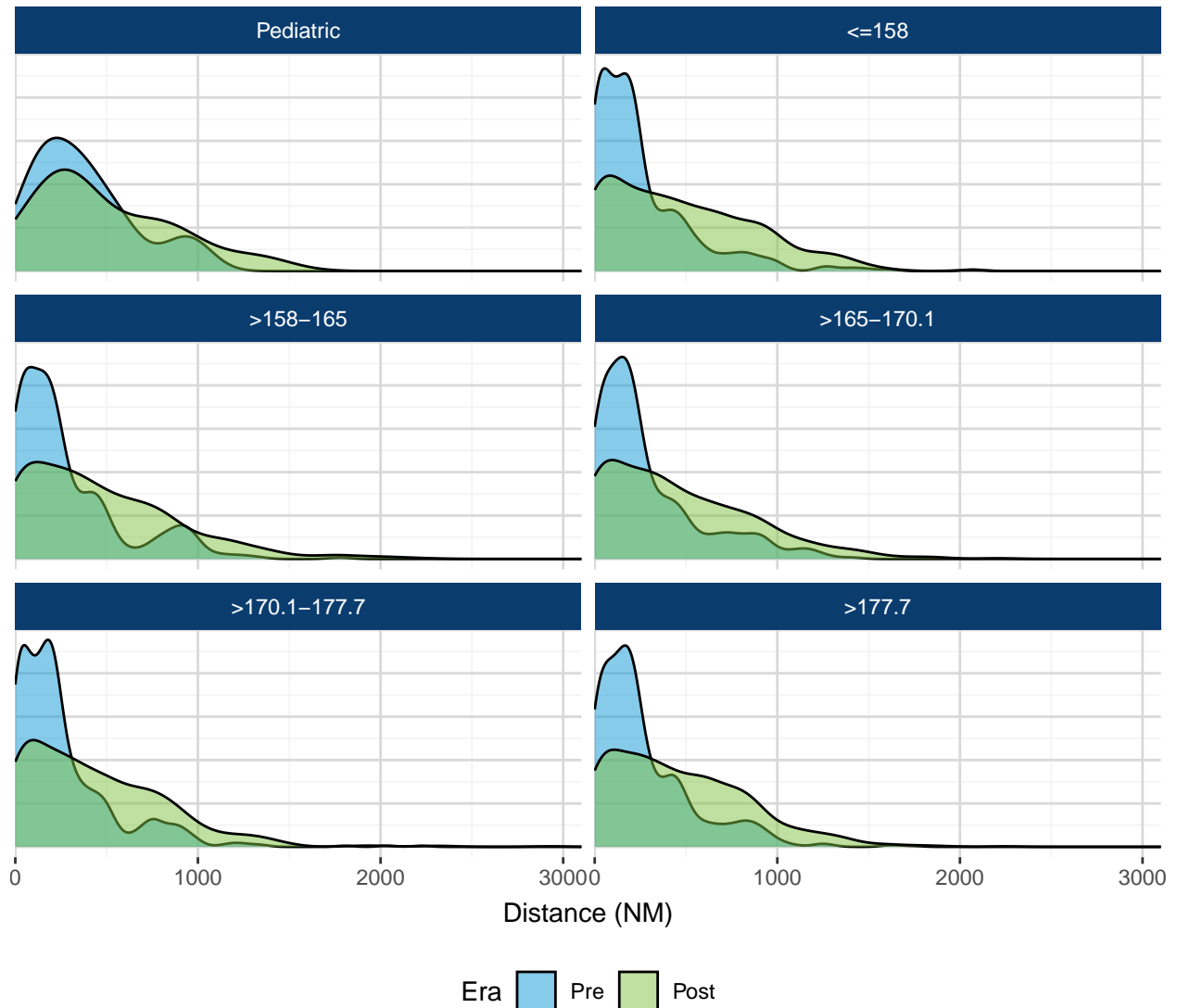
Table 32: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program by Era and Height

Height (cm)	Era	N	N Missing	Min	25th Percentile	Median	Mean	75th Percentile	Max
Pediatric	Pre	23	0	22	180.50	333.0	371.48	508.50	982
	Post	27	0	3	230.50	360.0	491.70	747.00	1384
<=158	Pre	416	0	0	62.75	180.0	254.94	343.75	2069
	Post	514	0	0	140.50	410.5	481.14	737.75	2055
>158-165	Pre	425	0	0	70.00	190.0	276.29	393.00	1777
	Post	513	0	0	153.00	376.0	474.42	707.00	2227
>165-170.1	Pre	422	0	0	88.00	192.0	284.81	390.00	1410
	Post	496	0	0	139.75	372.0	461.27	709.50	2205
>170.1-177.7	Pre	673	0	0	72.00	189.0	259.30	333.00	2225
	Post	717	0	0	140.00	365.0	444.12	681.00	2920
>177.7	Pre	782	0	0	85.25	197.5	269.52	393.75	1743
	Post	780	0	0	163.75	406.0	468.57	712.75	2244
Total	Pre	2741	0	0	77.00	192.0	269.06	378.00	2225
	Post	3047	0	0	152.50	385.0	464.94	710.50	2920

Efficiency

Transplants
In the post policy era the number of transplants per 100 patient years decreased slightly for small transplant hospitals (those who perform $<= 2$ lung transplants per month), increased slightly for medium transplant hospitals (those who perform >2-4 lung transplants per month), and increased for large transplant hospitals (those who perform >4 lung transplants per month).

Figure 33: Lung Transplants per 100 Patient Years on the Waiting List by Era and Transplant Program Size
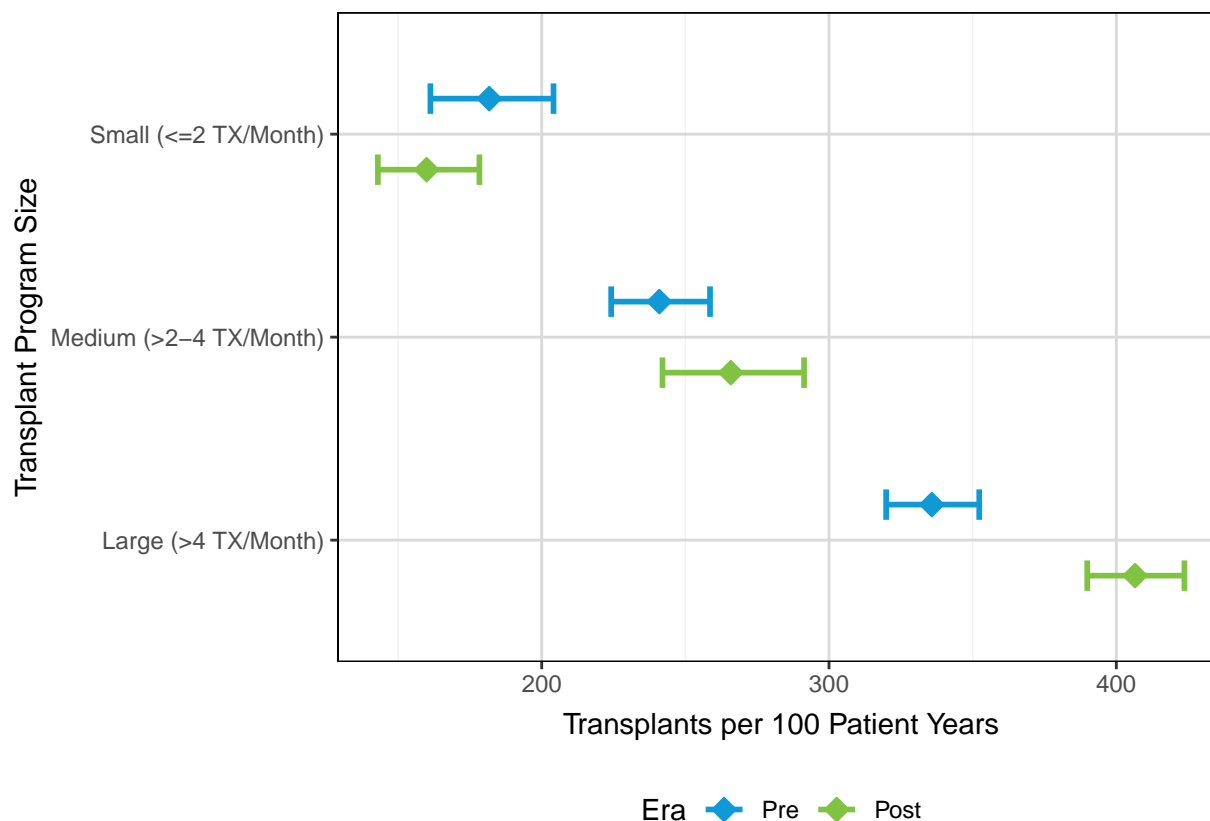
Table 33: Lung Transplants per 100 Patient Years on the Waiting List by Era and Transplant Program Size

Transplant Program Size	Era	N Patients	Transplants per 100 Patient Years	95% Confidence Interval
Small ($<=2$ TX/Month)	Pre	521	181.73	(161.25, 204.11)
	Post	586	159.93	(142.98, 178.32)
Medium (>2-4 TX/Month)	Pre	1189	240.92	(224.18, 258.58)
	Post	683	265.82	(242.03, 291.31)
Large (>4 TX/Month)	Pre	2297	335.79	(319.88, 352.29)
	Post	2931	406.53	(389.89, 423.70)

In the post era, there was an increase in the number of bilateral sequential lung procedures performed. The occurrence of other procedure types decreased slightly in the post era.

Figure 34: Number of Lung Transplants by Era and Procedure Type
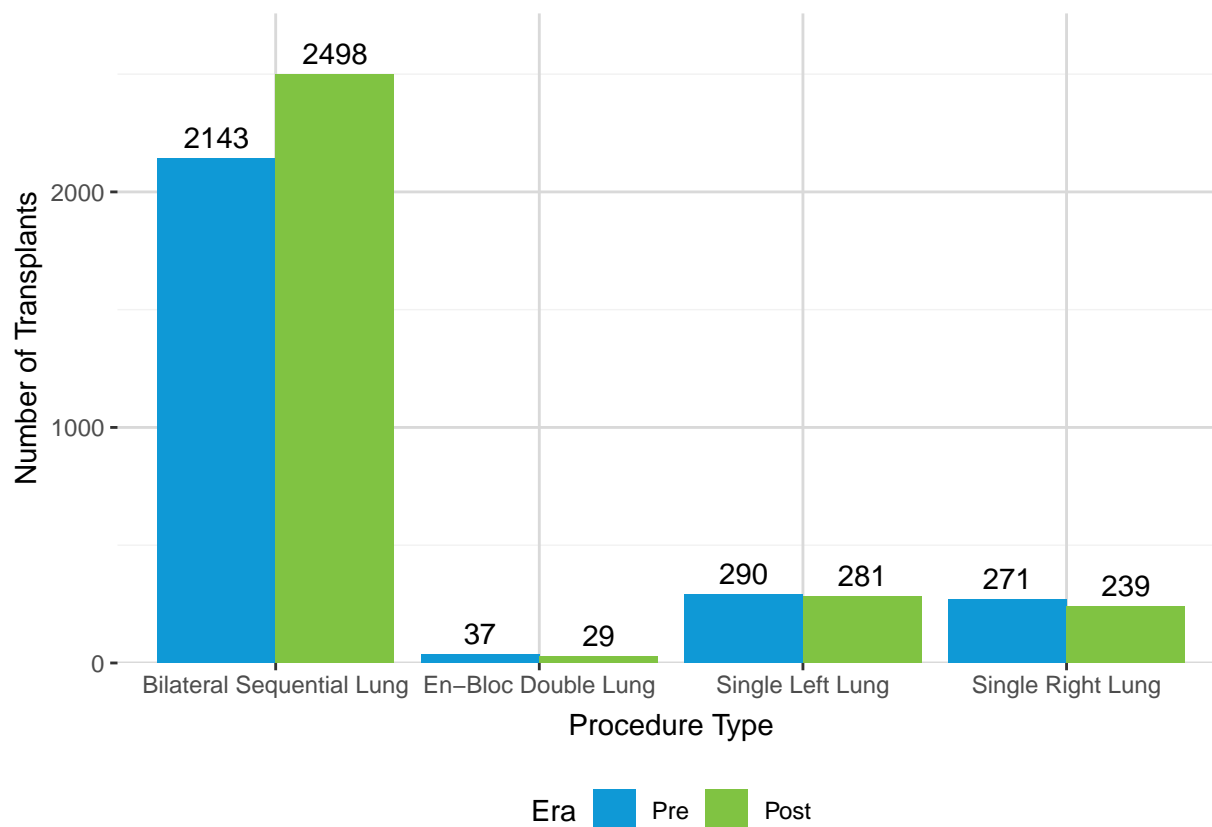
Table 34: Number of Lung Transplants by Era and Procedure Type

Procedure Type	Pre	Post
Bilateral Sequential Lung	2,143 (78.2%)	2,498 (82.0%)
En-Bloc Double Lung	37 (1.3%)	29 (1.0%)
Single Left Lung	290 (10.6%)	281 (9.2%)
Single Right Lung	271 (9.9%)	239 (7.8%)
Total	2,741 (100.0%)	3,047 (100.0%)

The percent of machine perfused lungs increased or remained similar in the post era in 7 OPTN regions and decreased in the remaining 4 OPTN regions.

Figure 35: Percent of Machine Perfused Lungs by Era and OPTN Region Out of All Lungs Recovered for Transplant
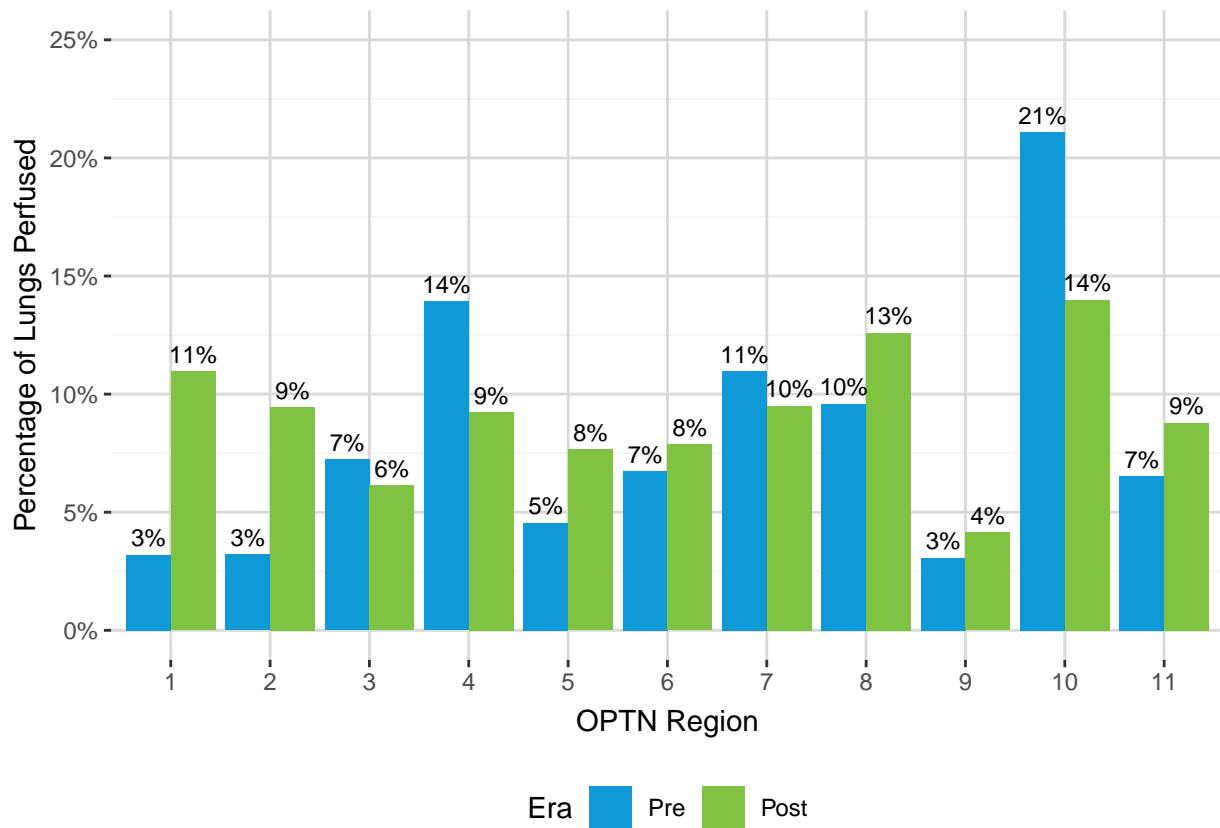
Table 35: Percent of Machine Perfused Lungs by Era and OPTN Region Out of All Lungs Recovered for Transplant

OPTN Region	Era	N Lungs Recovered	N Lungs Perfused	Percent Lungs Perfused
1	Pre	125	4	3.2%
	Post	146	16	11.0%
2	Pre	468	15	3.2%
	Post	487	46	9.4%
3	Pre	899	65	7.2%
	Post	1012	62	6.1%
4	Pre	783	109	13.9%
	Post	834	77	9.2%
5	Pre	836	38	4.5%
	Post	1005	77	7.7%
6	Pre	193	13	6.7%
	Post	305	24	7.9%
7	Pre	465	51	11.0%
	Post	484	46	9.5%
8	Pre	469	45	9.6%
	Post	540	68	12.6%
9	Pre	228	7	3.1%
	Post	290	12	4.1%
10	Pre	569	120	21.1%
	Post	679	95	14.0%
11	Pre	628	41	6.5%
	Post	683	60	8.8%
All Regions	Pre	5663	508	9.0%
	Post	6465	583	9.0%

In the post policy era, median distance from the donor hospital to transplant program increased for both DCD organs and non-DCD organs.

Figure 36: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program by Era and Donor Type
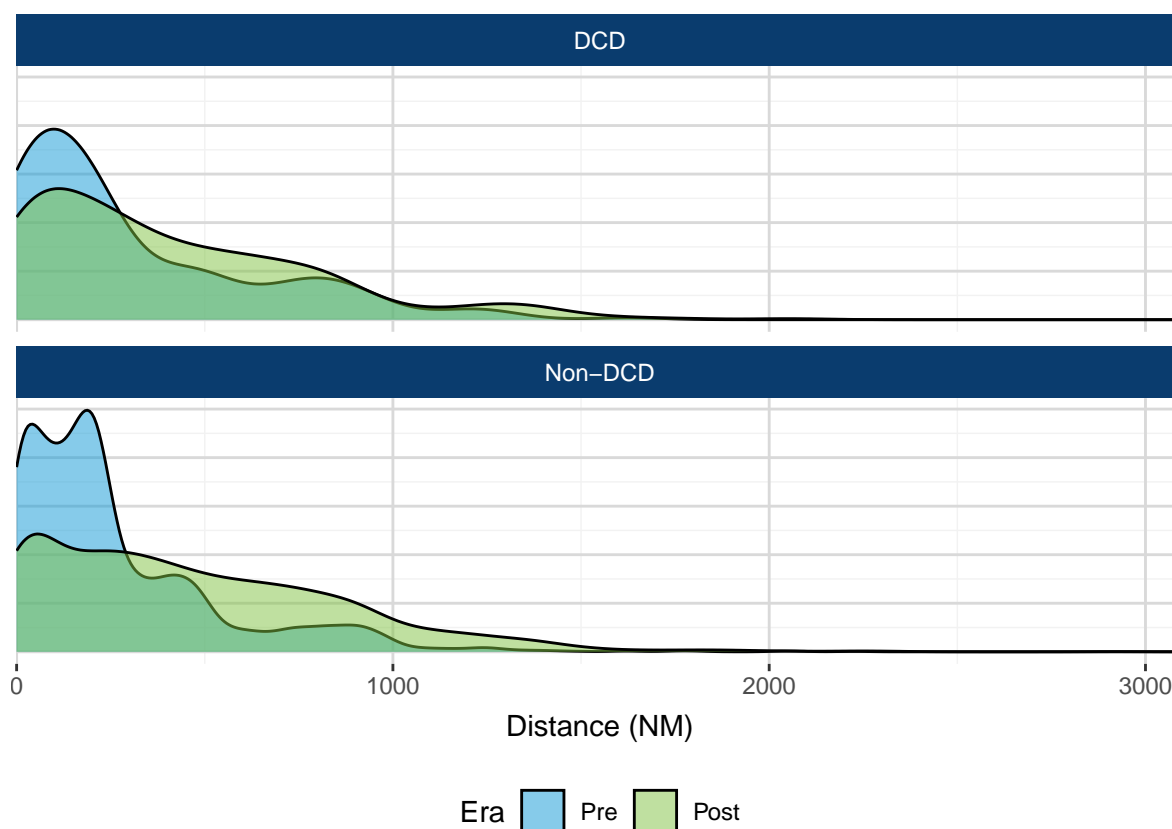
Table 36: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program by Era and Donor Type

Donor Type	Era	N	N Missing	Min	25th Percentile	Median	Mean	75th Percentile	Max
DCD	Pre	206	0	0	52.25	176.5	304.76	467.50	1624
	Post	360	0	0	99.50	309.5	414.77	632.25	2055
Non-DCD	Pre	2535	0	0	78.00	192.0	266.15	370.00	2225
	Post	2687	0	0	155.50	397.0	471.66	718.50	2920
Total	Pre	2741	0	0	77.00	192.0	269.06	378.00	2225
	Post	3047	0	0	152.50	385.0	464.94	710.50	2920

Utilization Rate

Utilization rate is defined as the percent of lungs that are transplanted based on all possible lungs from every deceased donor with at least one organ recovered for the purpose of transplant; this definition assumes that each donor has two possible lungs for donation.

Utilization rates increased slightly for both DCD and non-DCD donors in the post policy era.

Figure 37: Donor Utilization Rates by Era and Donor Type
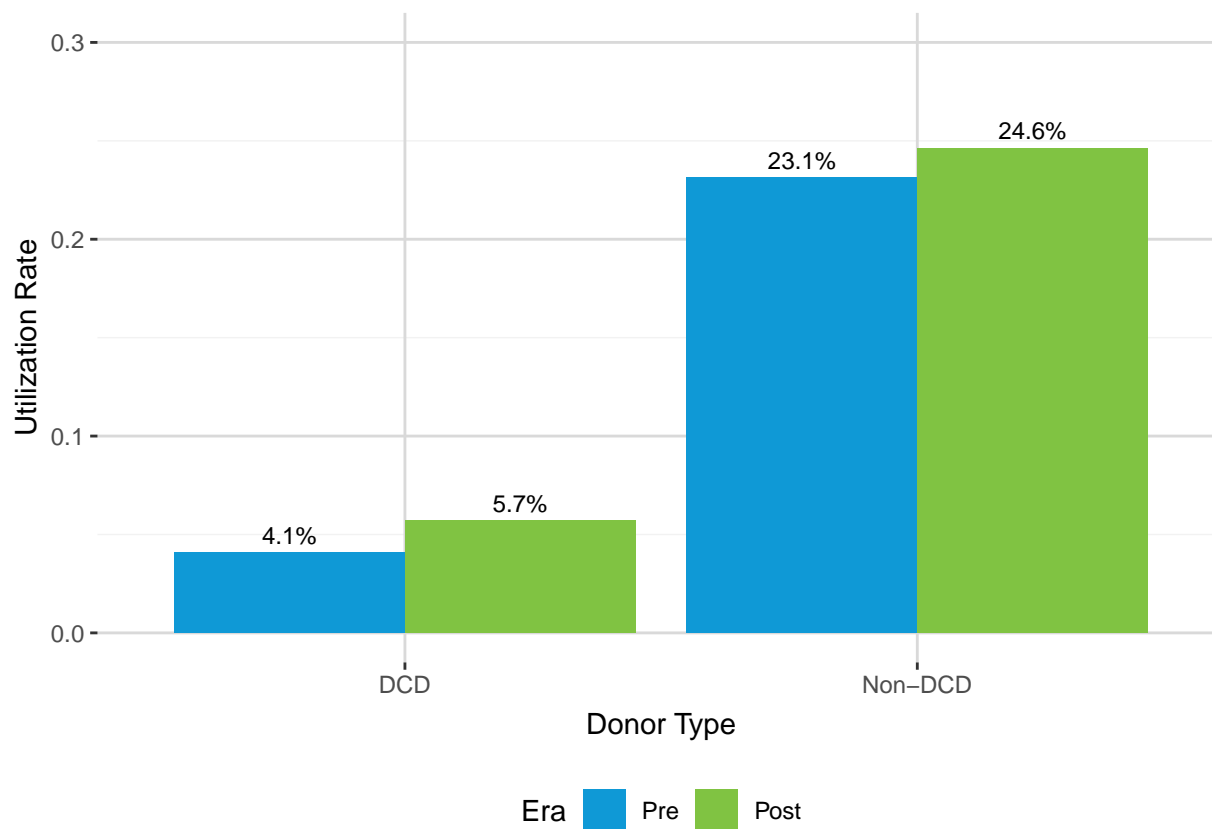
Table 37: Donor Utilization Rates by Era and Donor Type

DCD Status	Era	N Donor Lungs	N Lungs Transplanted	Utilization Rate
DCD	Pre	4905	401	4.1%
	Post	6264	716	5.7%
Non-DCD	Pre	10287	4758	23.1%
	Post	10384	5116	24.6%
All Donors	Pre	15192	5159	17.0%
	Post	16648	5832	17.5%

The utilization rate per month varied widely. In the last year of LAS the utilization rate per month varied from 13.8% to 19.5%. The monthly utilization rates in the first year of continuous distribution were within the range of utilization rates per month under LAS.

Figure 38: Donor Utilization Rates Per Month
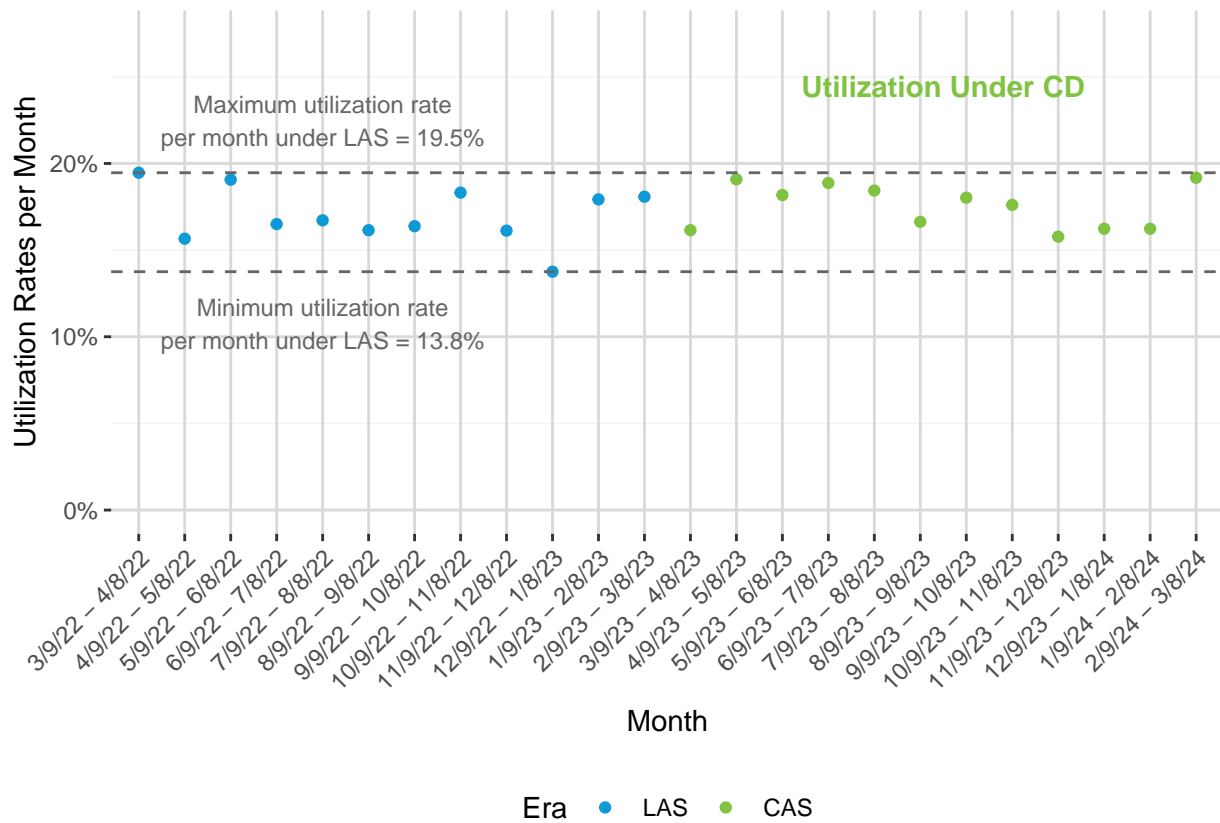
Table 38: Donor Utilization Rates Per Month

Policy Era	Month	N Donor Lungs	N Lungs Transplanted	Utilization Rate
LAS	3/9/22 - 4/8/22	1233	480	19.5%
	4/9/22 - 5/8/22	1226	384	15.7%
	5/9/22 - 6/8/22	1201	458	19.1%
	6/9/22 - 7/8/22	1224	404	16.5%
	7/9/22 - 8/8/22	1286	430	16.7%
	8/9/22 - 9/8/22	1254	405	16.1%
	9/9/22 - 10/8/22	1233	404	16.4%
	10/9/22 - 11/8/22	1332	488	18.3%
	11/9/22 - 12/8/22	1321	426	16.1%
	12/9/22 - 1/8/23	1385	381	13.8%
	1/9/23 - 2/8/23	1297	465	17.9%
	2/9/23 - 3/8/23	1200	434	18.1%
CAS	3/9/23 - 4/8/23	1393	450	16.2%
	4/9/23 - 5/8/23	1378	526	19.1%
	5/9/23 - 6/8/23	1466	533	18.2%
	6/9/23 - 7/8/23	1330	502	18.9%
	7/9/23 - 8/8/23	1383	510	18.4%
	8/9/23 - 9/8/23	1359	452	16.6%
	9/9/23 - 10/8/23	1337	482	18.0%
	10/9/23 - 11/8/23	1363	480	17.6%
	11/9/23 - 12/8/23	1344	424	15.8%
	12/9/23 - 1/8/24	1500	487	16.2%
	1/9/24 - 2/8/24	1460	474	16.2%
	2/9/24 - 3/8/24	1335	512	19.2%

Non-Use Rate
Non-use rate is defined as the number of lungs recovered for the purpose of transplant but not transplanted out of all lungs recovered for transplant.

Non-use rates decreased slightly for DCD donors and remained similar for non-DCD donors.

Figure 39: Donor Non-Use Rates by Era and Donor Type
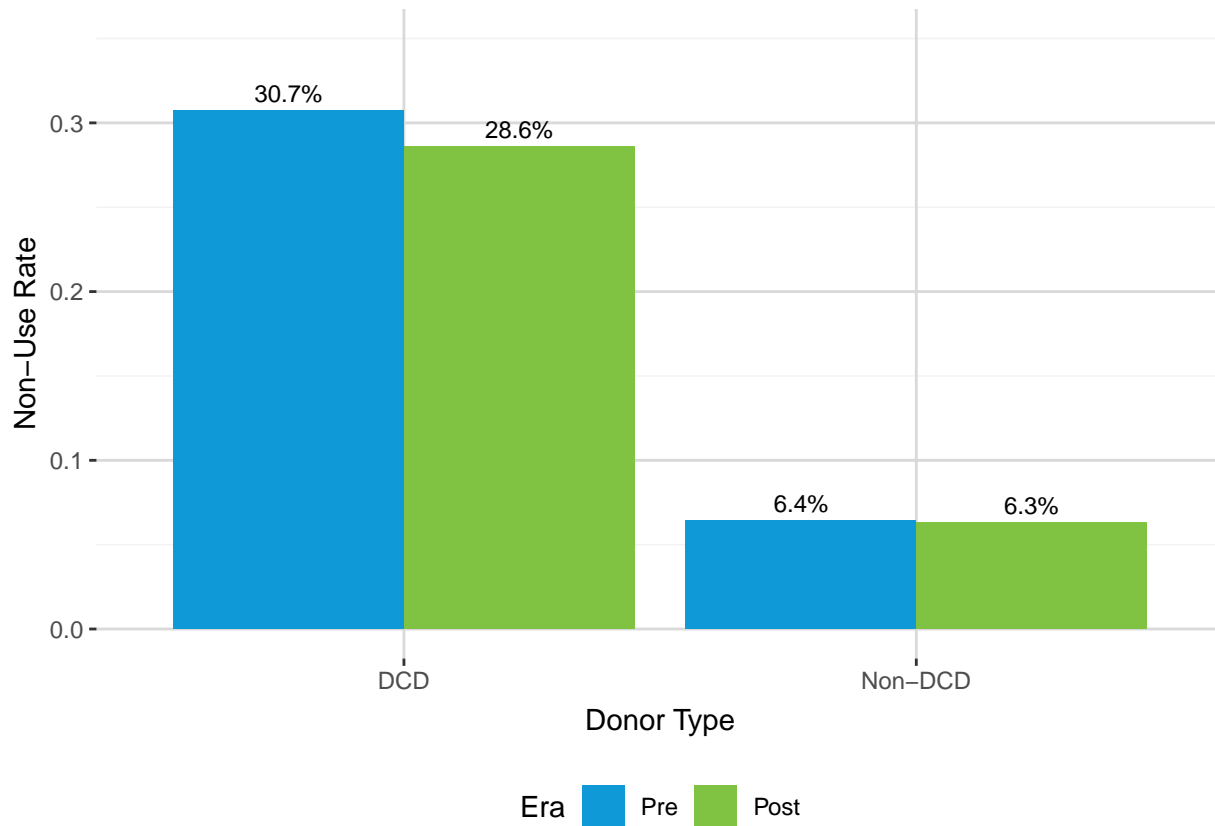
Table 39: Donor Non-Use Rates by Era and Donor Type

DCD Status	Era	N Lungs Recovered	N Lungs Transplanted	Non-Use Rate
DCD	Pre	579	401	30.7%
	Post	1003	716	28.6%
Non-DCD	Pre	5084	4758	6.4%
	Post	5462	5116	6.3%
All Donors	Pre	5663	5159	8.9%
	Post	6465	5832	9.8%

The non-use rates per month varied widely. In the last year of LAS the non-use rate per month varied from 7.0% to 10.7%. The monthly non-use rates in the first year of continuous distribution was more variable and ranged from 5.7% to 13.4%.

Figure 40: Donor Non-Use Rates Per Month
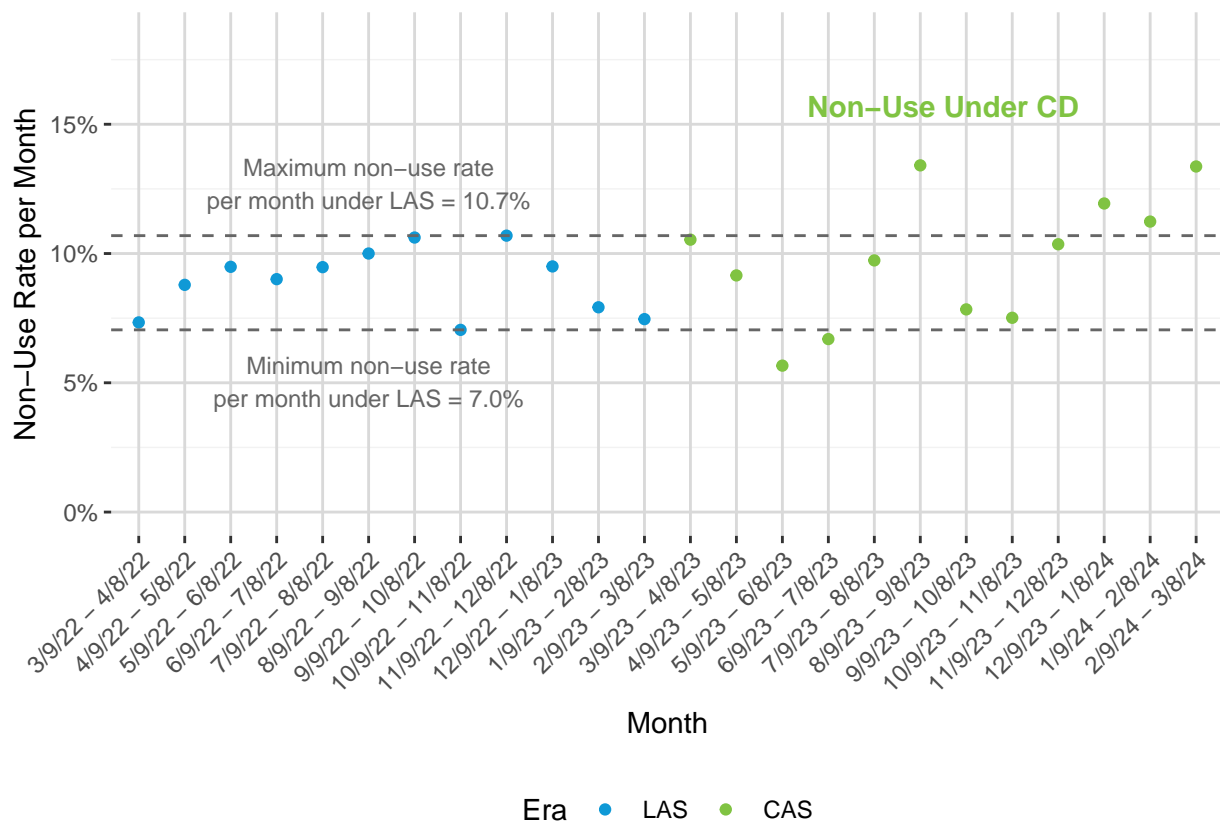
Table 40: Donor Non-Use Rate Per Month

Era	Month	N Lungs Recovered	N Lungs Transplanted	Non-Use Rate
LAS	3/9/22 - 4/8/22	518	480	7.3%
	4/9/22 - 5/8/22	421	384	8.8%
	5/9/22 - 6/8/22	506	458	9.5%
	6/9/22 - 7/8/22	444	404	9.0%
	7/9/22 - 8/8/22	475	430	9.5%
	8/9/22 - 9/8/22	450	405	10.0%
	9/9/22 - 10/8/22	452	404	10.6%
	10/9/22 - 11/8/22	525	488	7.0%
	11/9/22 - 12/8/22	477	426	10.7%
	12/9/22 - 1/8/23	421	381	9.5%
	1/9/23 - 2/8/23	505	465	7.9%
	2/9/23 - 3/8/23	469	434	7.5%
CAS	3/9/23 - 4/8/23	503	450	10.5%
	4/9/23 - 5/8/23	579	526	9.2%
	5/9/23 - 6/8/23	565	533	5.7%
	6/9/23 - 7/8/23	538	502	6.7%
	7/9/23 - 8/8/23	565	510	9.7%
	8/9/23 - 9/8/23	522	452	13.4%
	9/9/23 - 10/8/23	523	482	7.8%
	10/9/23 - 11/8/23	519	480	7.5%
	11/9/23 - 12/8/23	473	424	10.4%
	12/9/23 - 1/8/24	553	487	11.9%
	1/9/24 - 2/8/24	534	474	11.2%
	2/9/24 - 3/8/24	591	512	13.4%

Match Run Efficiency

In the post era, more programs received organ offers on a match run. The median number of unique programs offered up to the final acceptor increased from 4 to 10.

Figure 41: Distribution of the Number of Unique Programs Offered Up To the Final Acceptor on Lung Match Run by Era

Table 41: Distribution of the Number of Unique Programs Offered Up To the Final Acceptor on Lung Match Run by Era

Era	N	N Missing	Min	25th Percentile	Median	Mean	75th Percentile	Max
Pre	2949	0	1	2	4	6.77	8	59
Post	3211	0	1	4	10	13.95	20	63

In the post era, more programs received their first organ offers after the final acceptance. The median number of programs that received their first organ offer after the sequence number of the final acceptor increased from 7 to 11.

Figure 42: Distribution of the Number of Unique Programs Offered Only After the Final Acceptor on Lung Match Run by Era

Number of Programs Offered Only After Final Acceptor

Era ▯ Pre ▯ Post

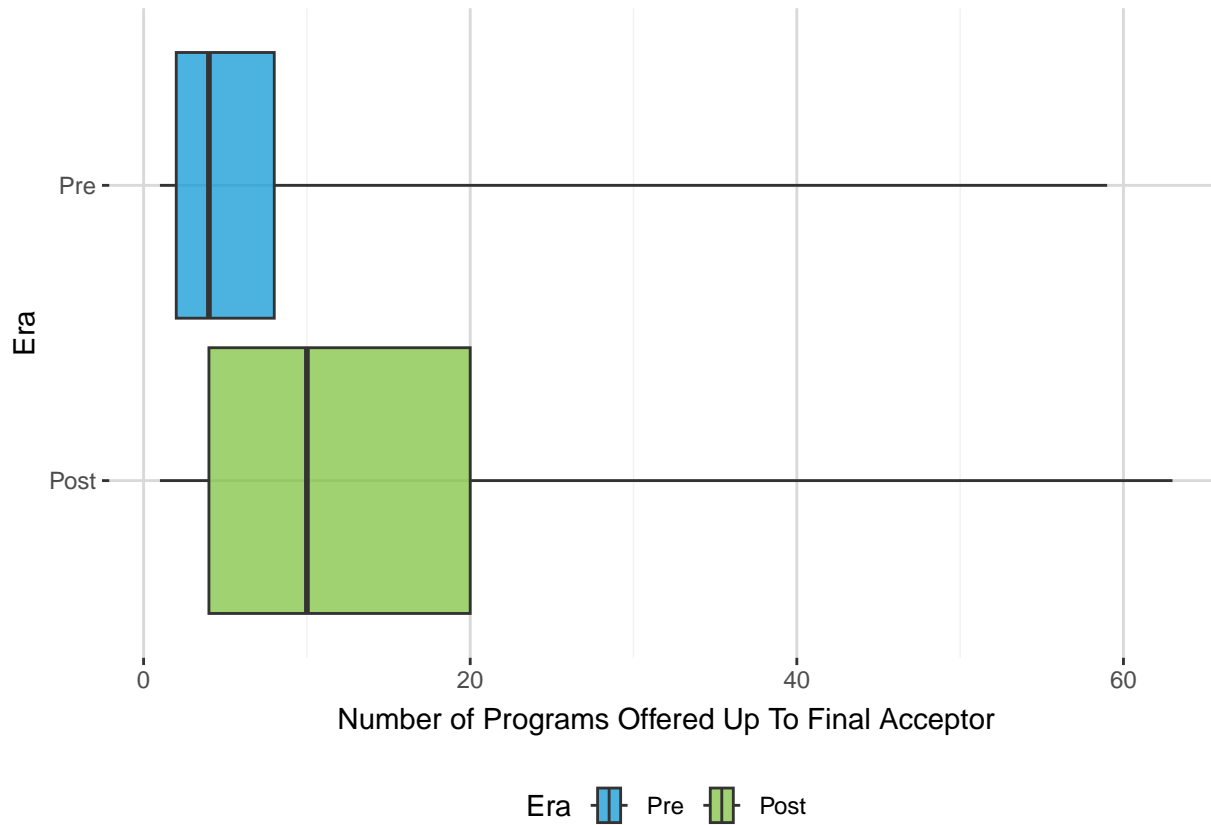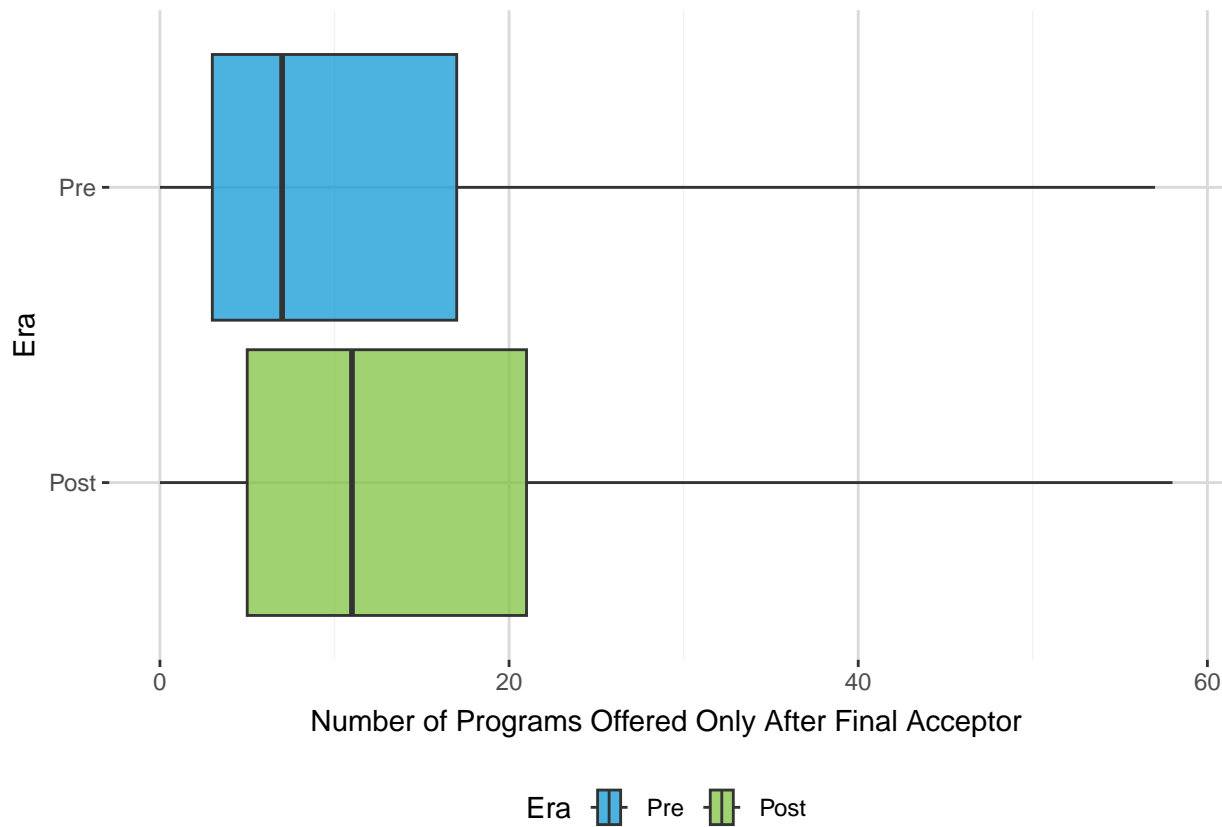**Table 42: Distribution of the Number of Unique Programs Offered Only After the Final Acceptor on Lung Match Run by Era**

Era	N	N Missing	Min	25th Percentile	Median	Mean	75th Percentile	Max
Pre	2949	0	0	3	7	11.82	17	57
Post	3211	0	0	5	11	14.03	21	58

Exceptions

The National Lung Review Board experienced a large increase in the quantity of exception forms submitted. This trend may be a bolus effect and may stabilize over time. The number of exceptions submitted will be included in future monitoring. Under LAS, a single registration could only have one exception request associated with it. Under continuous distribution (CD), a single registration can have multiple exception requests, provided the exception requests are under different goals.

Prior to implementation, programs could submit CAS exception requests through an interim process so that those requests, if approved, would be in place at the start of implementation. 26 requests were submitted through this process and were not included in the below charts. In the charts below, all LAS requests were submitted prior to lung CD implementation and all CAS requests were submitted after CD implementation.

The figure and table below show the number of registrations with exception requests submitted by era and diagnosis group. Multiple exception requests can be submitted for a single registration. For all diagnosis groups there were more registrations with submitted exception requests in the post policy era compared to the pre policy era.

Figure 43: Number of Lung Registrations with at Least One Exception Request Form Submitted by Era and Diagnosis Group

Table 43: Number of Lung Registrations with at Least One Exception Request Form Submitted by Era and Diagnosis Group
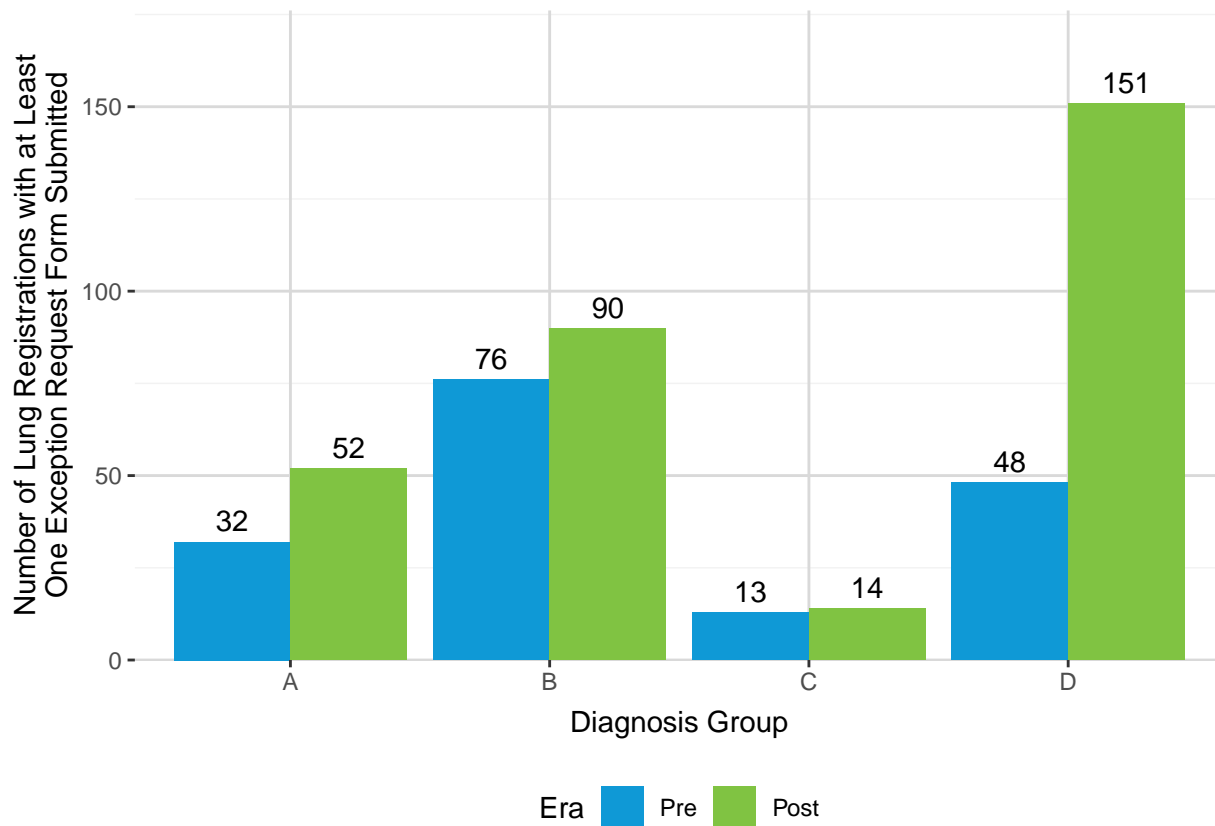
Diagnosis Group	Pre	Post
A	32 (18.9%)	52 (16.9%)
B	76 (45.0%)	90 (29.3%)
C	13 (7.7%)	14 (4.6%)
D	48 (28.4%)	151 (49.2%)
Total	169 (100.0%)	307 (100.0%)

The following figures and tables examine data at the exception form level.

The majority of exception requests were submitted for the medical urgency goal in the post policy era.

Figure 44: Number of Lung Exception Request Forms Submitted by Exception Status and Goal in the Post Policy Era
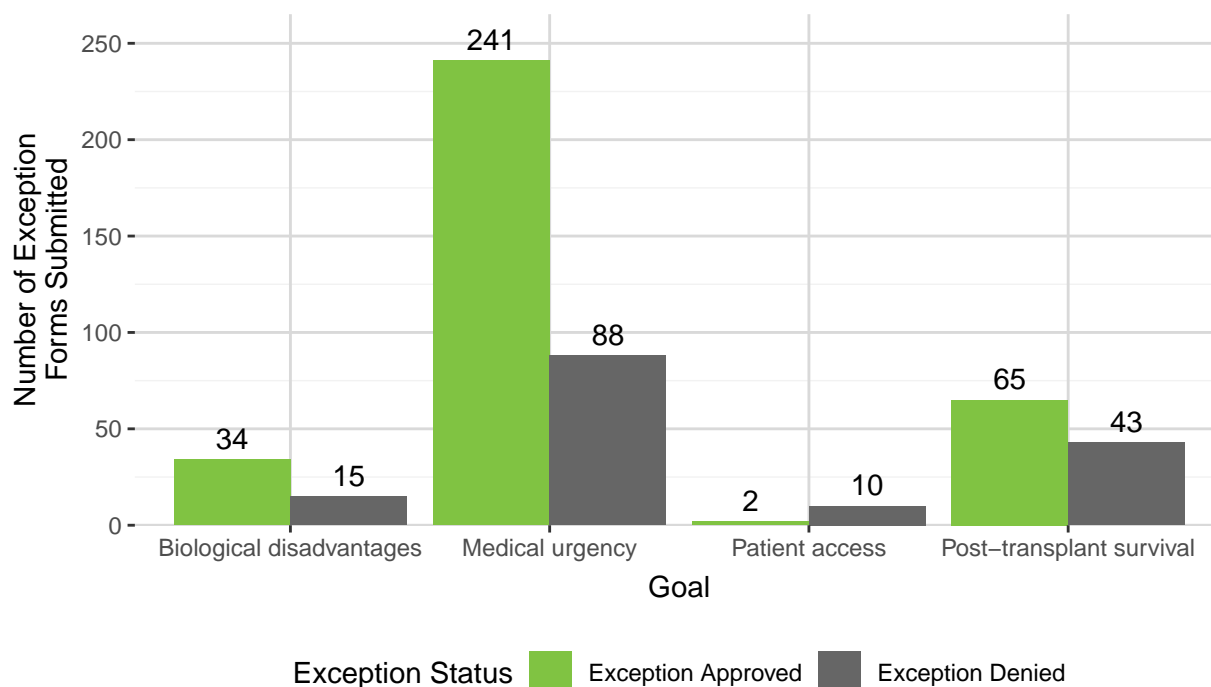
This chart does not include the 26 exceptions that were submitted to the National Lung Review Board prior to the implementation of Lung Continuous Distribution on 3/9/23. Under LAS, a single registration could only have one exception but under CD, a single registration can have multiple exceptions. Results include exceptions for multiorgan candidates but exclude exceptions on heart/lung (HL) registrations. Exceptions submitted on the lung registration of a HL candidate are included.

Table 44: Number of Lung Exception Request Forms Submitted by Exception Status and Goal in the Post Policy Era

Goal	Exception Approved	Exception Denied
Biological disadvantages	34 (9.9%)	15 (9.6%)
Medical urgency	241 (70.5%)	88 (56.4%)
Patient access	2 (0.6%)	10 (6.4%)
Post-transplant survival	65 (19.0%)	43 (27.6%)
Total	342 (100.0%)	156 (100.0%)

[a] This table does not include the 26 exceptions that were submitted to the National Lung Review Board prior to the implementation of Lung Continuous Distribution on 3/9/23.
[b] Under LAS, a single registration could only have one exception but under CD, a single registration can have multiple exceptions.
[c] Results include exceptions for multiorgan candidates but exclude exceptions on heart/lung (HL) registrations. Exceptions submitted on the lung registration of a HL candidate are included.

A large number of exception requests were submitted at the start of continuous distribution and immediately before the ABO Modification in September 2023. The number of forms submitted per month has leveled out since the implementation of the ABO Modification.

Figure 45: Number of Lung Exception Request Forms Submitted by Month of Submission and Goal in the Post Policy Era
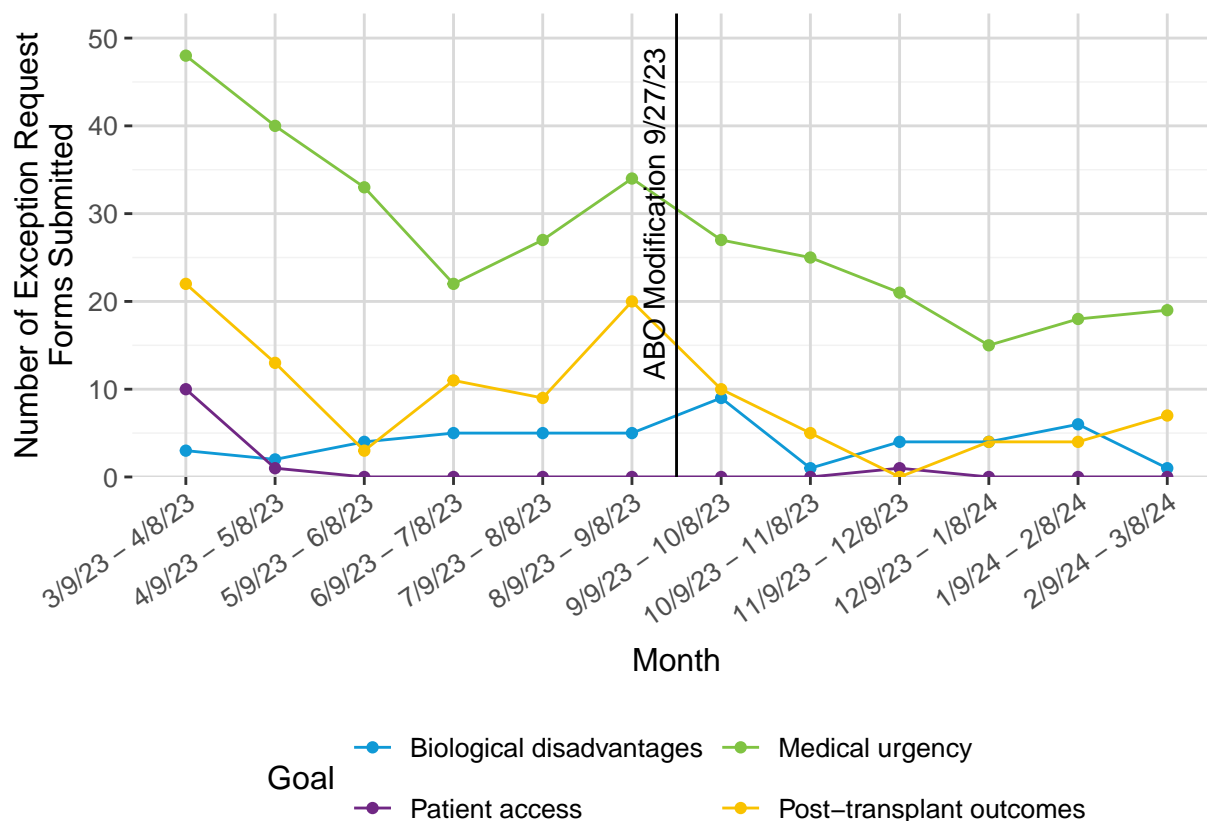
Table 45: Number of Lung Exception Request Forms Submitted by Month of Submission and Goal in the Post Policy Era

Month	Biological Disadvantages	Medical Urgency	Patient Access	Post-Transplant Outcomes	Total
3/9/23 - 4/8/23	3 (3.6%)	48 (57.8%)	10 (12.0%)	22 (26.5%)	83 (100.0%)
4/9/23 - 5/8/23	2 (3.6%)	40 (71.4%)	1 (1.8%)	13 (23.2%)	56 (100.0%)
5/9/23 - 6/8/23	4 (10.0%)	33 (82.5%)	0 (0.0%)	3 (7.5%)	40 (100.0%)
6/9/23 - 7/8/23	5 (13.2%)	22 (57.9%)	0 (0.0%)	11 (28.9%)	38 (100.0%)
7/9/23 - 8/8/23	5 (12.2%)	27 (65.9%)	0 (0.0%)	9 (22.0%)	41 (100.0%)
8/9/23 - 9/8/23	5 (8.5%)	34 (57.6%)	0 (0.0%)	20 (33.9%)	59 (100.0%)
9/9/23 - 10/8/23	9 (19.6%)	27 (58.7%)	0 (0.0%)	10 (21.7%)	46 (100.0%)
10/9/23 - 11/8/23	1 (3.2%)	25 (80.6%)	0 (0.0%)	5 (16.1%)	31 (100.0%)
11/9/23 - 12/8/23	4 (15.4%)	21 (80.8%)	1 (3.8%)	0 (0.0%)	26 (100.0%)
12/9/23 - 1/8/24	4 (17.4%)	15 (65.2%)	0 (0.0%)	4 (17.4%)	23 (100.0%)
1/9/24 - 2/8/24	6 (21.4%)	18 (64.3%)	0 (0.0%)	4 (14.3%)	28 (100.0%)
2/9/24 - 3/8/24	1 (3.7%)	19 (70.4%)	0 (0.0%)	7 (25.9%)	27 (100.0%)

The ratio of exception request forms submitted per number of candidates waiting varied slightly by center size, with higher volume centers having a slightly lower ratio, on average.

Figure 46: Ratio of Lung Exception Requests Submitted per Number of Candidates Ever Waiting by Center Size in the Post Policy Era
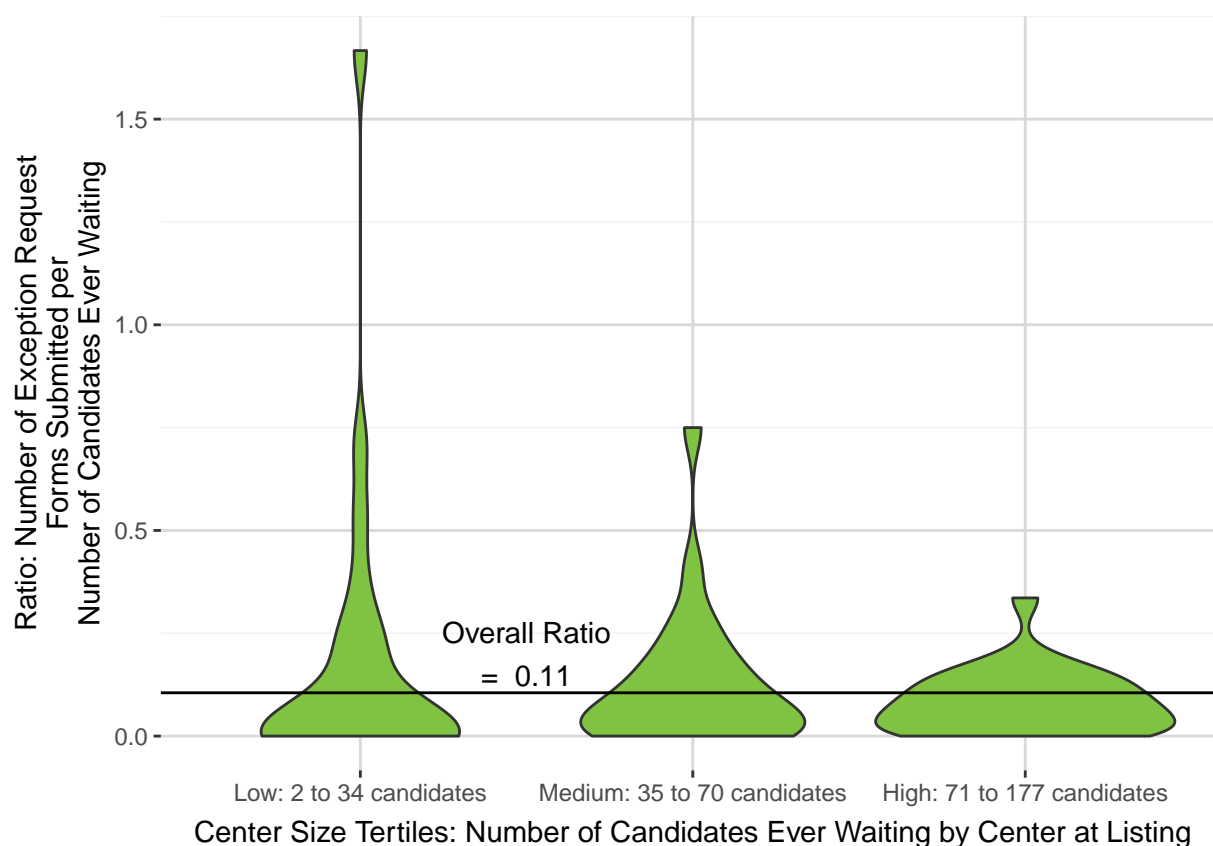
Table 46: Ratio of Lung Exception Requests Submitted per Number of Candidates Ever Waiting by Center Size in the Post Policy Era

Center Size Tertiles: Number of Candidates Ever Waiting by Center at Listing	N Ever Waiting	N Exception Forms Submitted	Ratio: Number of Exception Request Forms Submitted per Number of Candidates Ever Waiting
Low: 2 to 34 candidates	390	64	0.1641
Medium: 35 to 70 candidates	1236	156	0.1262
High: 71 to 177 candidates	2562	221	0.0863
Total	4188	441	0.1053

More candidates in diagnosis group B were removed from the waiting list for death or too sick with an approved exception request in the post era compared to the pre era.

Figure 47: Number of Waiting List Candidates Removed for Death or Too Sick by Era, Diagnosis Group, and Exception Status

Table 47: Number of Waiting List Candidates Removed for Death or Too Sick by Era, Diagnosis Group, and Exception Status

Diagnosis Group	Era	Exception Approved	No Exception	Exception Denied	Total
A	Pre	2 (5.3%)	36 (94.7%)	0 (0.0%)	38 (100.0%)
	Post	0 (0.0%)	23 (100.0%)	0 (0.0%)	23 (100.0%)
B	Pre	2 (15.4%)	11 (84.6%)	0 (0.0%)	13 (100.0%)
	Post	5 (31.2%)	11 (68.8%)	0 (0.0%)	16 (100.0%)
C	Pre	1 (50.0%)	1 (50.0%)	0 (0.0%)	2 (100.0%)
	Post	0 (0.0%)	1 (100.0%)	0 (0.0%)	1 (100.0%)
D	Pre	4 (2.2%)	176 (96.7%)	2 (1.1%)	182 (100.0%)
	Post	4 (3.4%)	113 (95.0%)	2 (1.7%)	119 (100.0%)

In the post policy era, two candidates that were removed from the waiting list for death or too sick to transplant had denied exception requests.

Figure 48: Number of Waiting List Candidates Removed for Death or Too Sick by Medical Urgency Points and Exception Status in the Post Policy Era
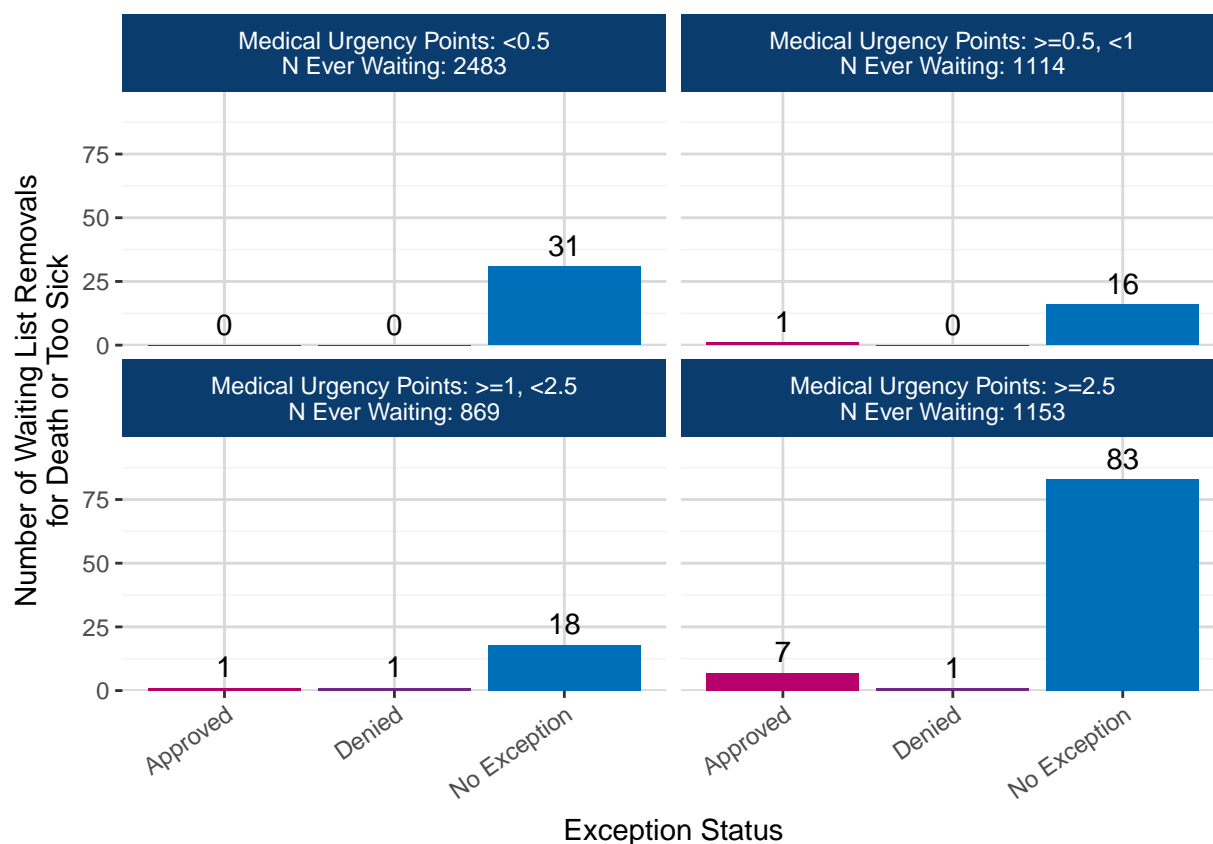
Table 48: Number of Waiting List Candidates Removed for Death or Too Sick by Medical Urgency Points and Exception Status in the Post Policy Era

Medical Urgency Points	Exception Goal	Exception Status		
		No Exception	Approved	Denied
<0.5	Not Applicable - No Exception Submitted	31	0	0
>=0.5, <1	Medical urgency	0	1	0
	Not Applicable - No Exception Submitted	16	0	0
>=1, <2.5	Medical urgency	0	1	1
	Not Applicable - No Exception Submitted	18	0	0
>=2.5	Medical urgency	0	6	1
	Post-transplant outcomes	0	1	0
	Not Applicable - No Exception Submitted	83	0	0

Multiorgan

The sample sizes for lung-multiorgan candidates and recipients are currently too small to definitively determine implications of the policy change; however, below we describe trends we are observing so far.

The number of deaths or removals for too sick per 100 patient years decreased slightly for heart/lung and lung/liver candidates in the post era and increased slightly for lung/kidney candidates, though sample sizes were small. No rate estimate is provided for lung/multiple organ candidates in the post era because there were less than 10 candidates waiting in this group.

Figure 49: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Era and Multiorgan Type
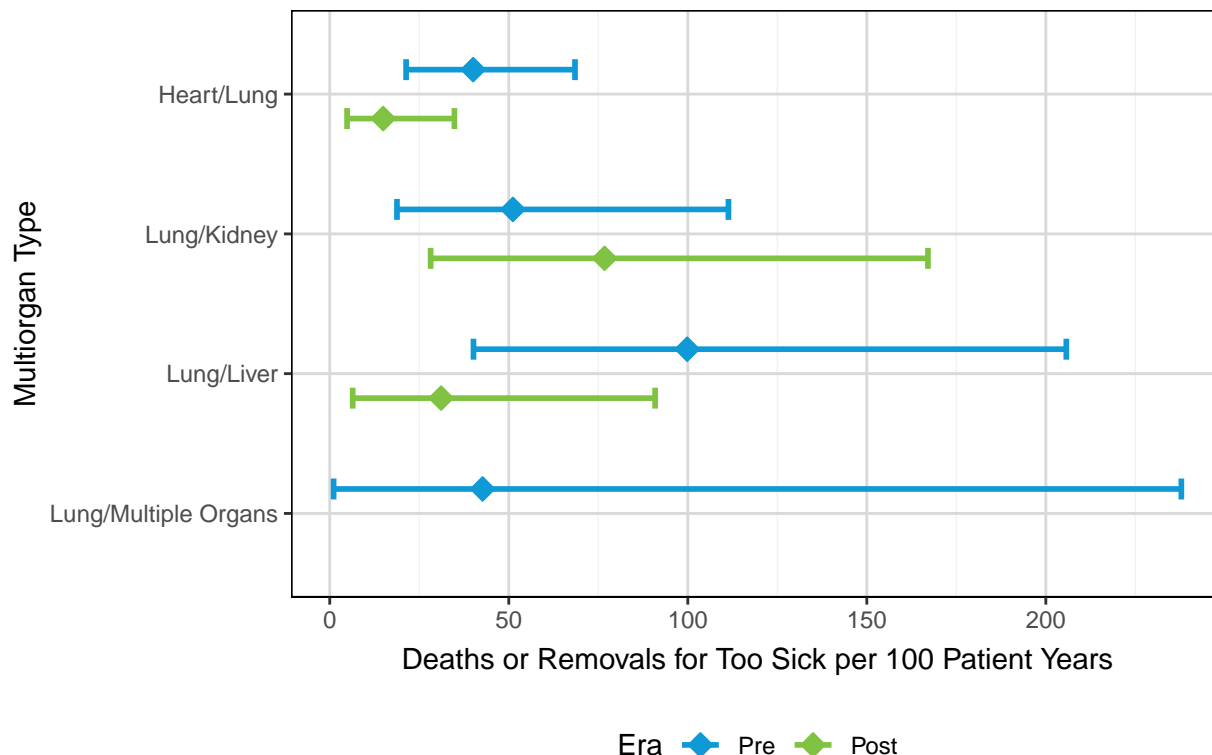
No rate estimate is provided for Lung/Multiple Organ candidates in the post era because there were less than 10 candidates waiting in this group.

Table 49: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Era and Multiorgan Type

Multiorgan Type	Era	N Patients	Deaths or Removals for Too Sick per 100 Patient Years	95% Confidence Interval
Heart/Lung	Pre	108	40.06	(21.33, 68.50)
	Post	100	14.92	(4.84, 34.82)
Lung/Kidney	Pre	48	51.16	(18.77, 111.35)
	Post	37	76.76	(28.17, 167.08)
Lung/Liver	Pre	30	99.84	(40.14, 205.72)
	Post	40	31.1	(6.41, 90.88)
Lung/Multiple Organs	Pre	10	42.69	(1.08, 237.85)
	Post	<10	–	–

In the post policy era the transplant rate increased slightly for lung/kidney and lung/liver candidates and remained similar for heart/lung candidates, though sample sizes were small. No rate estimate is provided for lung/multiple organ candidates in the post era because there were less than 10 candidates waiting in this group.

Figure 50: Lung-Multiorgan Transplants per 100 Patient Years on the Waiting List by Era and Multiorgan Type
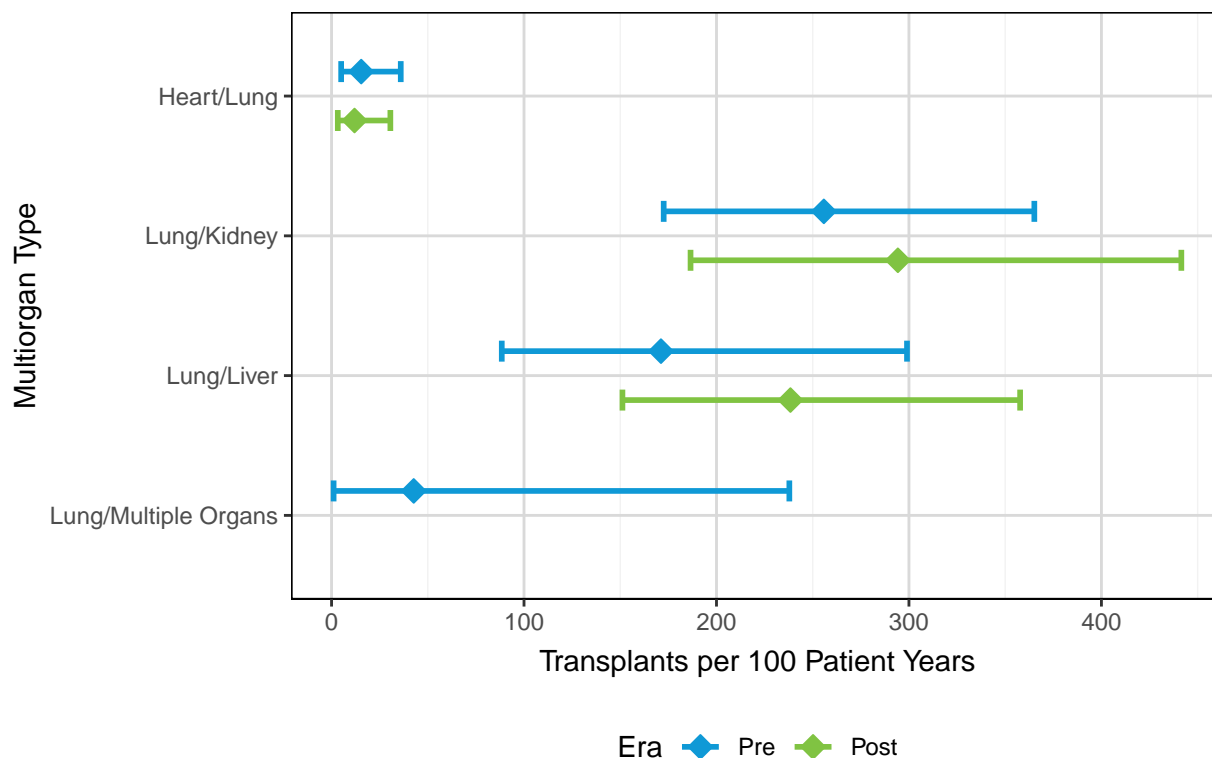
No rate estimate is provided for Lung/Multiple Organ candidates in the post era because there were less than 10 candidates waiting in this group.

Table 50: Lung-Multiorgan Transplants per 100 Patient Years on the Waiting List by Era and Multiorgan Type

Multiorgan Type	Era	N Patients	Transplants per 100 Patient Years	95% Confidence Interval
Heart/Lung	Pre	108	15.41	(5.00, 35.96)
	Post	100	11.94	(3.25, 30.56)
Lung/Kidney	Pre	48	255.78	(172.57, 365.14)
	Post	37	294.25	(186.53, 441.52)
Lung/Liver	Pre	30	171.16	(88.44, 298.98)
	Post	40	238.43	(151.14, 357.76)
Lung/Multiple Organs	Pre	10	42.69	(1.08, 237.85)
	Post	<10	–	–

Median time to transplant decreased in the post era for both lung/kidney and lung/liver candidates and increased for heart/lung candidates, though sample sizes were small. Median time to transplant is not provided for lung/multiple organ candidates because there were less than 10 registrations added to the waiting list in both the pre and post eras.

Figure 51: Median Time to Transplant (Days) by Era and Multiorgan Type
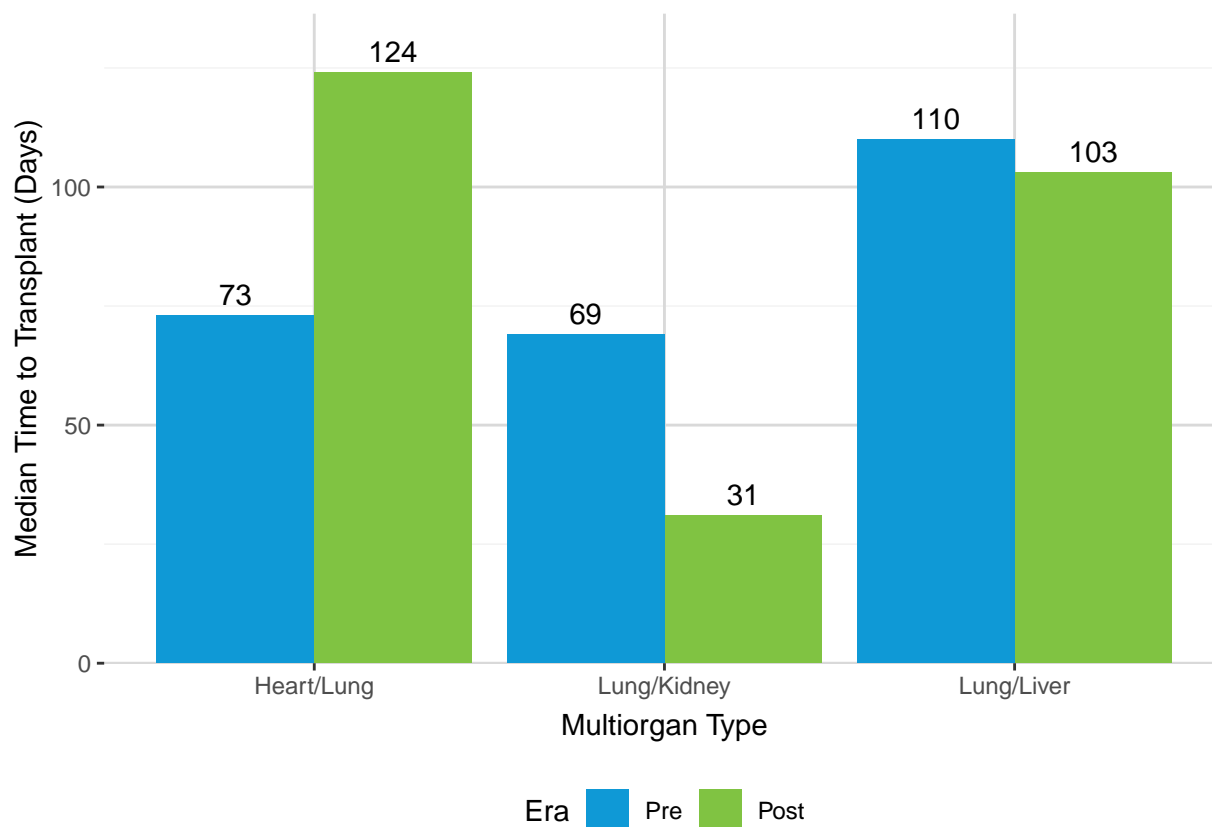
Table 51: Median Time to Transplant (Days) by Era and Multiorgan Type

Multiorgan Type	Era	N Registrations	Median Time to Transplant (Days)
Heart/Lung	Pre	81	73
	Post	76	124
Lung/Kidney	Pre	34	69
	Post	26	31
Lung/Liver	Pre	20	110
	Post	32	103

Compared to the pre era, median distance increased for all multiorgan types in the post era. Lung/multiple organ transplants were excluded from this analysis due to small sample sizes.

Figure 52: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program by Era and Multiorgan Type

Distance (NM)

Era Pre Post
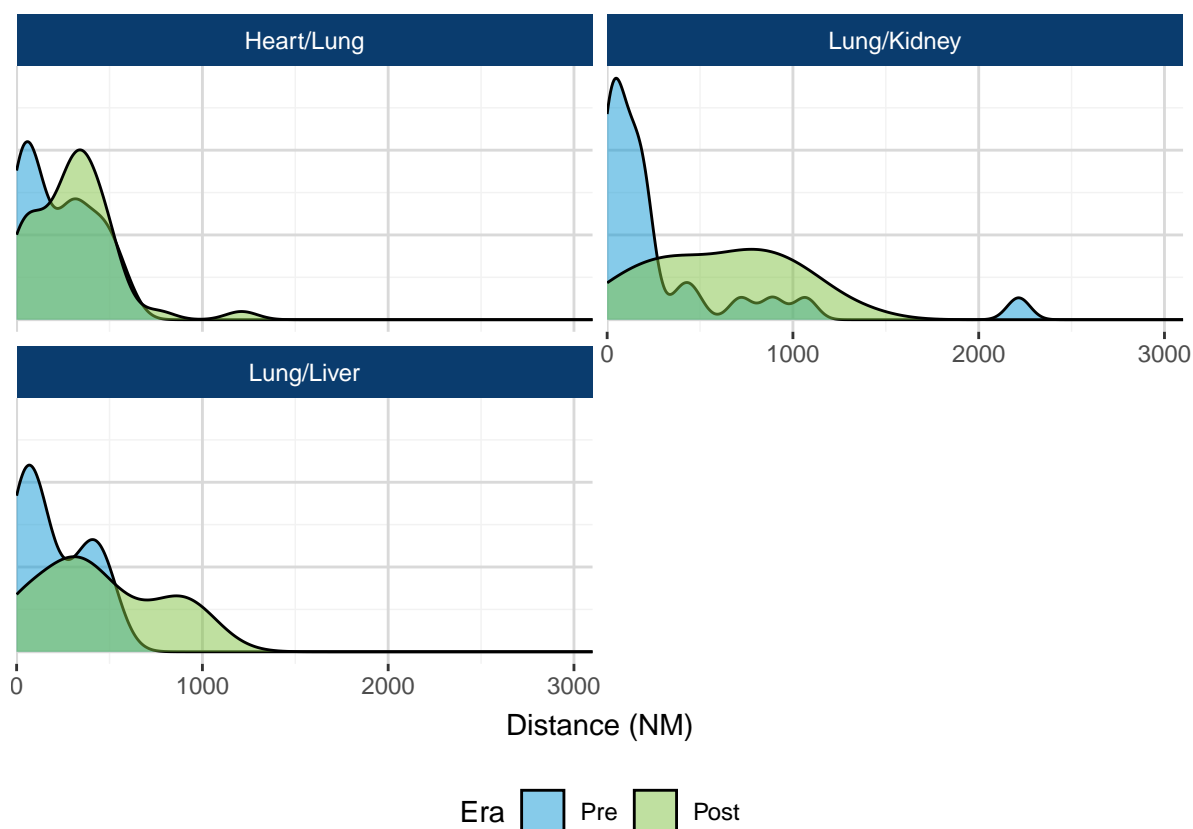
Table 52: Distribution of Distance (in Nautical Miles) from Donor Hospital to Transplant Program by Era and Multiorgan Type

Multiorgan Type	Era	N	N Missing	Min	25th Percentile	Median	Mean	75th Percentile	Max
Heart/Lung	Pre	55	0	0	62.5	218.0	230.20	376.00	602
	Post	49	0	0	133.0	303.0	302.69	406.00	1211
Lung/Kidney	Pre	25	0	0	29.0	122.0	298.40	204.00	2215
	Post	21	0	0	306.0	713.0	610.38	924.00	1341
Lung/Liver	Pre	12	0	3	66.0	107.5	199.83	382.75	473
	Post	23	0	6	241.5	366.0	444.09	723.50	1039
Total	Pre	92	0	0	59.0	155.5	244.77	378.75	2215
	Post	93	0	0	197.0	351.0	407.14	517.00	1341

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The median sequence number increased for both lung/kidney and lung/liver recipients. Heart/lungs are pulled by the heart match run and were therefore excluded from this analysis. Lung/multiple organ transplants were also excluded from this analysis due to small sample sizes.

Figure 53: Distribution of the Sequence Number of Lung-Multiorgan Recipients on the Lung Match Run by Era and Multiorgan Type

Sequence Number of Recipient

Era ▢ Pre ▢ Post
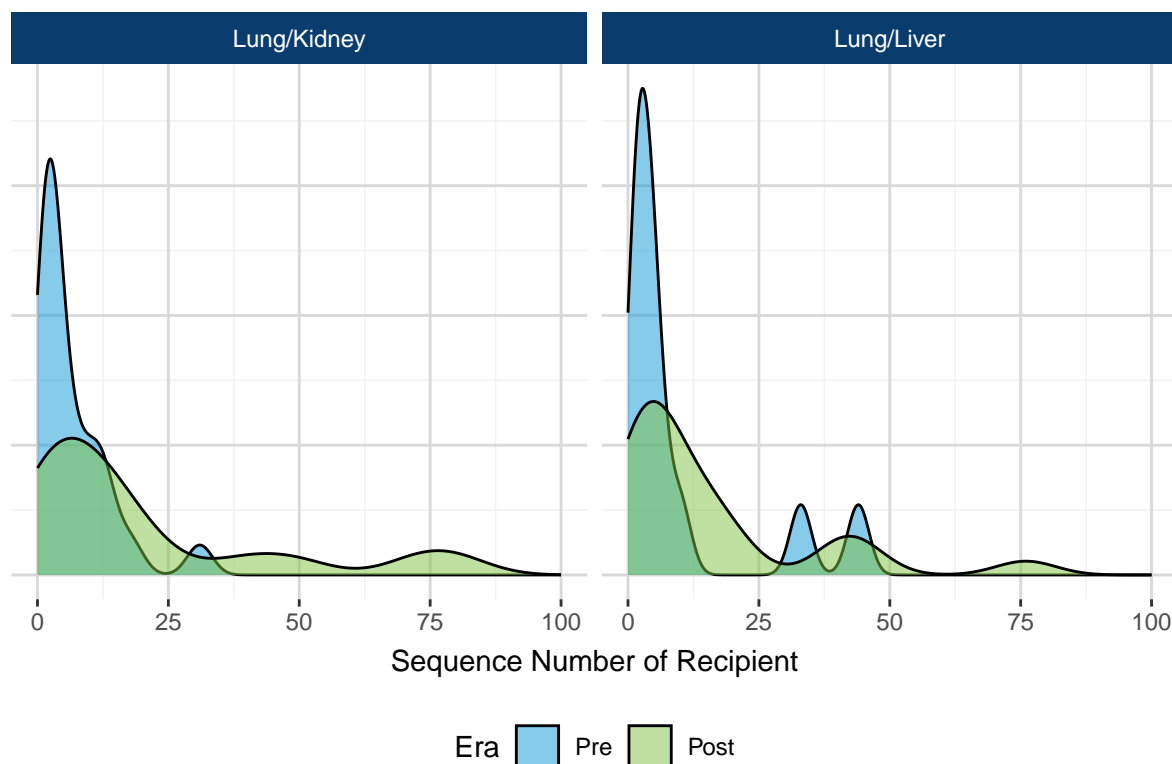
View is restricted to sequence number 100. There was one instance where the sequence number for a lung/kidney recipient in the post era was greater than 100.

Table 53: Distribution of the Sequence Number of Lung-Multiorgan Recipients on the Lung Match Run by Era and Multiorgan Type

Multiorgan Type	Era	N	N Missing	Min	25th Percentile	Median	Mean	75th Percentile	Max
Lung/Kidney	Pre	25	1	1	2.0	3.5	6.50	8.75	31
	Post	21	2	1	3.0	12.0	47.74	30.50	550
Lung/Liver	Pre	12	0	1	2.0	4.0	9.58	7.00	44
	Post	23	1	1	2.5	8.5	15.32	18.25	76

Appendix

The sections above describe how continuous distribution performed within the attributes incorporated into the lung CAS. However, equity across various patient demographics is also of concern to the Lung Committee and broader lung transplantation community. The following section examines continuous distribution's impact across patient age groups, diagnosis groups, birth sex, race/ethnicity groups, and OPTN regions.

Deaths or removals for too sick per 100 patient years on the waiting list did not significantly increase for any age group, diagnosis group, birth sex, race/ethnicity, or OPTN region (**Figure 54**, **Table 54**). Likewise, the number of transplants per 100 patients years on the waiting list did not significantly decrease for any age group, diagnosis group, birth sex, race/ethnicity, or OPTN region, with the exception of candidates ages 65 years and older (**Figure 55**, **Table 55**). The decrease in transplant rates for candidates 65 years and older may be due to the increased priority in 5-year post-transplant survival in the lung CAS compared to the previous allocation system.

Distance from the donor hospital to transplant center increased across all age groups, diagnosis groups, birth sex, race/ethnicity groups, and OPTN regions, except for recipients between 12-17 years of age, where the distance remained similar (**Figure 56**, **Table 56**). Median time to transplant decreased or remained the same for all age groups, diagnosis groups, birth sex, race/ethnicity groups, and OPTN regions, with the exception of candidates ages 65 years and older (whose median time to transplant increased by 6 days) and candidates in OPTN region 10 (whose median time to transplant increased by 5 days; **Figure 57**, **Table 57**).

Note: In all figures and tables, NH stands for "Non-Hispanic".

Figure 54: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Era and Patient Characteristic

Deaths or Removals for Too Sick per 100 Patient Years

Era ●— Pre ●— Post
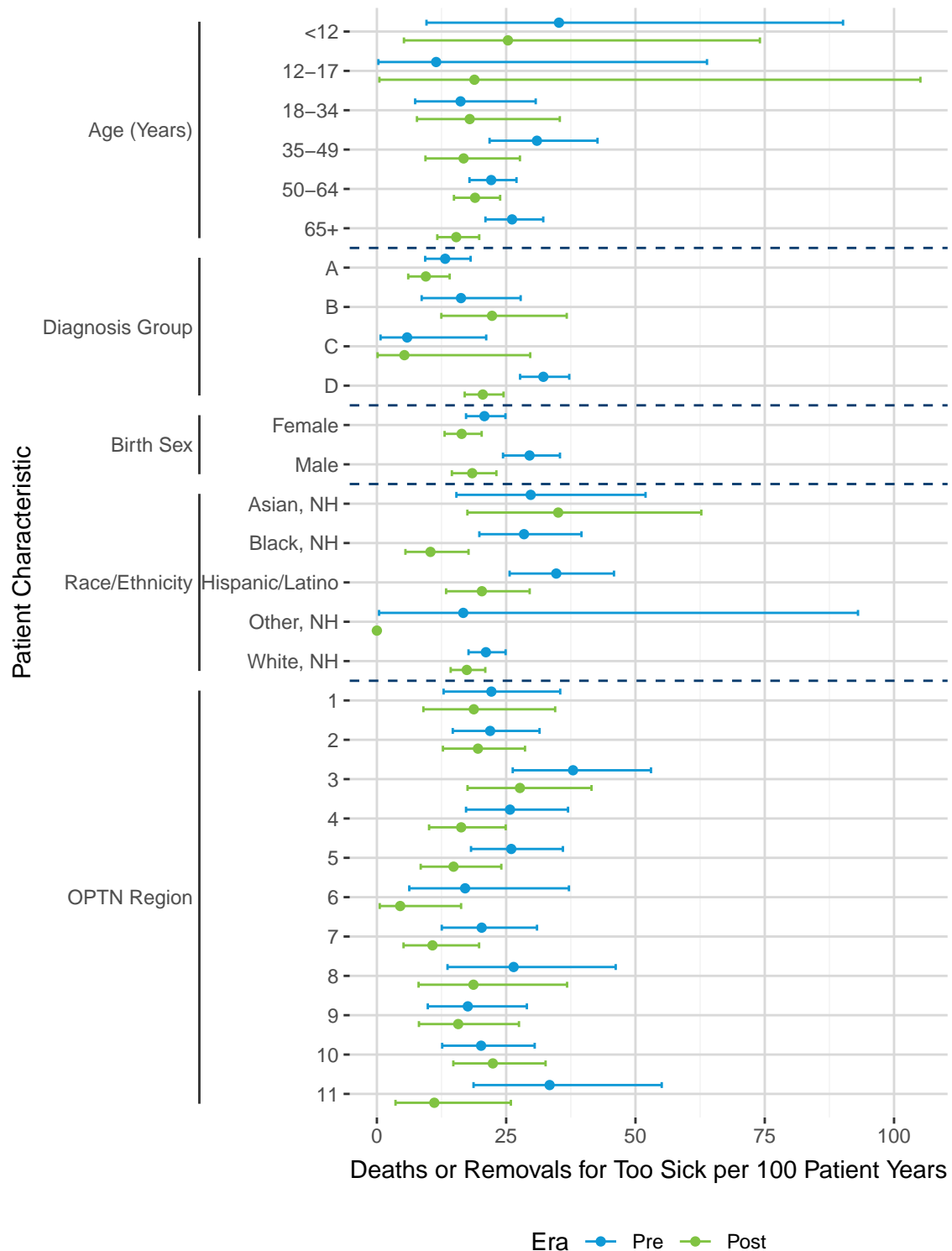
Table 54: Deaths or Removals for Too Sick per 100 Patient Years on the Waiting List by Era and Patient Characteristic

Patient Characteristic	Level	Era	Deaths or Removals for Too Sick Per 100 Patient Years	95% Confidence Interval
Age (Years)	<12	Pre	35.21	(9.59, 90.14)
		Post	25.34	(5.23, 74.06)
	12-17	Pre	11.46	(0.29, 63.83)
		Post	18.86	(0.48, 105.10)
	18-34	Pre	16.18	(7.40, 30.71)
		Post	17.95	(7.75, 35.37)
	35-49	Pre	30.95	(21.79, 42.66)
		Post	16.77	(9.39, 27.66)
	50-64	Pre	22.10	(17.90, 26.99)
		Post	18.98	(14.90, 23.83)
	65+	Pre	26.14	(20.99, 32.17)
		Post	15.34	(11.68, 19.79)
Diagnosis Group	A	Pre	13.20	(9.34, 18.12)
		Post	9.46	(6.06, 14.07)
	B	Pre	16.26	(8.66, 27.80)
		Post	22.26	(12.46, 36.71)
	C	Pre	5.85	(0.71, 21.14)
		Post	5.32	(0.13, 29.65)
	D	Pre	32.19	(27.69, 37.20)
		Post	20.48	(16.98, 24.49)
Birth Sex	Female	Pre	20.79	(17.24, 24.86)
		Post	16.39	(13.09, 20.26)
	Male	Pre	29.52	(24.39, 35.40)
		Post	18.43	(14.50, 23.11)
Race/Ethnicity	Asian, NH	Pre	29.74	(15.37, 51.95)
		Post	35.06	(17.50, 62.73)
	Black, NH	Pre	28.45	(19.81, 39.56)
		Post	10.36	(5.52, 17.72)
	Hispanic/Latino	Pre	34.68	(25.66, 45.85)
		Post	20.30	(13.38, 29.54)
	Other, NH	Pre	16.70	(0.42, 93.03)
		Post	0.00	−
	White, NH	Pre	21.08	(17.72, 24.89)
		Post	17.38	(14.27, 20.96)
		Pre	22.14	(12.90, 35.45)

(continued)

Patient Characteristic	Level	Era	Deaths or Removals for Too Sick Per 100 Patient Years	95% Confidence Interval
OPTN Region	1	Post	18.74	(8.99, 34.47)
	2	Pre	21.90	(14.67, 31.45)
		Post	19.54	(12.77, 28.64)
	3	Pre	37.93	(26.27, 53.00)
		Post	27.66	(17.53, 41.50)
	4	Pre	25.74	(17.24, 36.96)
		Post	16.30	(10.09, 24.91)
	5	Pre	25.98	(18.20, 35.97)
		Post	14.82	(8.47, 24.06)
	6	Pre	17.06	(6.26, 37.14)
		Post	4.51	(0.55, 16.28)
	7	Pre	20.26	(12.54, 30.96)
		Post	10.75	(5.15, 19.76)
	8	Pre	26.44	(13.66, 46.18)
		Post	18.67	(8.06, 36.78)
	9	Pre	17.58	(9.84, 29.00)
		Post	15.72	(8.13, 27.47)
	10	Pre	20.15	(12.63, 30.51)
		Post	22.42	(14.78, 32.62)
	11	Pre	33.40	(18.69, 55.08)
		Post	11.10	(3.60, 25.91)

Figure 55: Lung Transplants per 100 Patient Years on the Waiting List by Era and Patient Characteristic
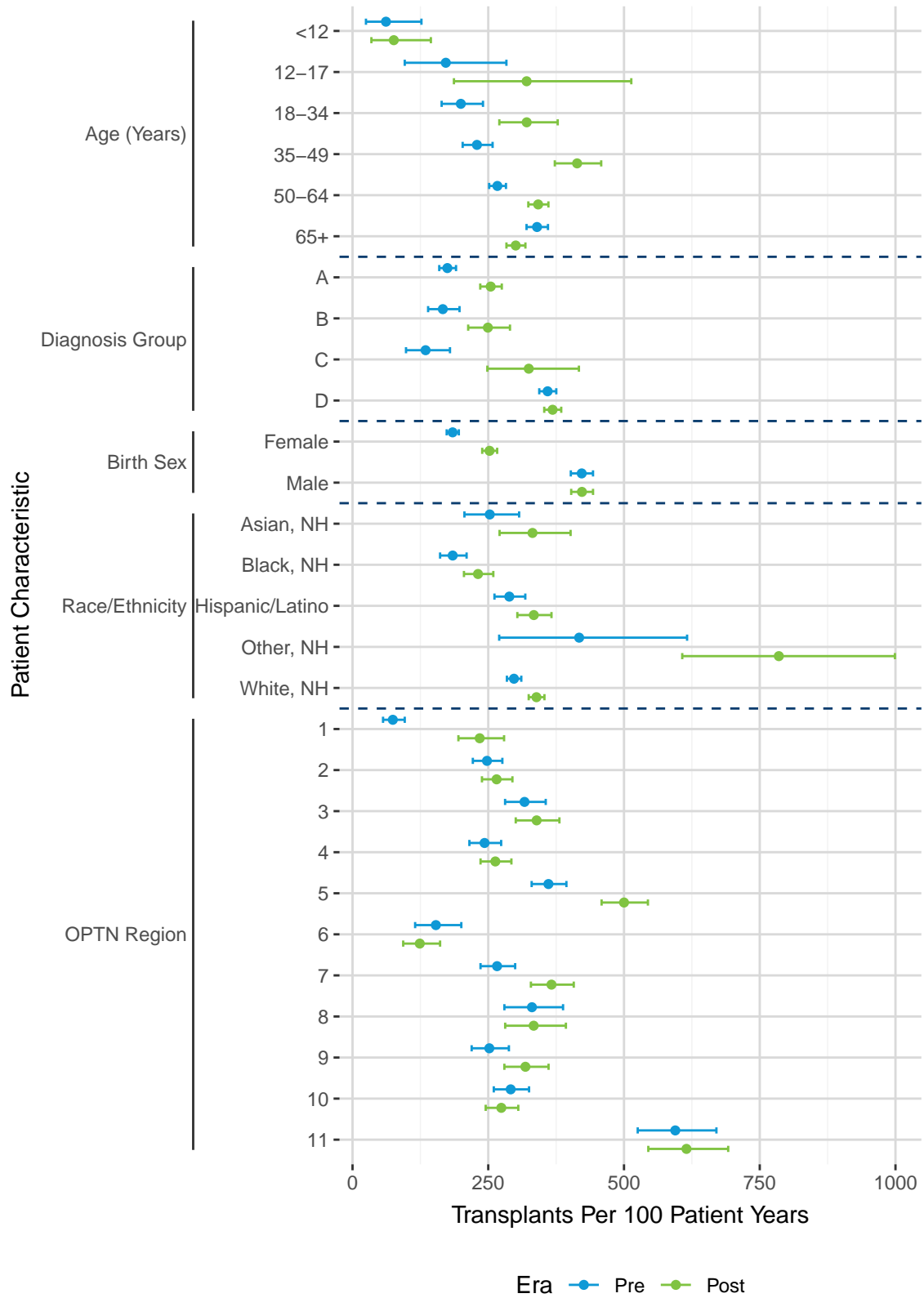
Table 55: Lung Transplants per 100 Patient Years on the Waiting List by Era and Patient Characteristic

Patient Characteristic	Level	Era	Transplants Per 100 Patient Years	95% Confidence Interval
Age (Years)	<12	Pre	61.61	(24.77, 126.94)
		Post	76.02	(34.76, 144.32)
	12-17	Pre	171.85	(96.18, 283.43)
		Post	320.67	(186.80, 513.43)
	18-34	Pre	199.52	(164.14, 240.28)
		Post	320.82	(270.40, 377.93)
	35-49	Pre	229.19	(202.85, 257.99)
		Post	413.65	(372.57, 458.03)
	50-64	Pre	266.83	(251.69, 282.64)
		Post	341.92	(323.81, 360.78)
	65+	Pre	339.81	(320.51, 359.97)
		Post	300.58	(283.50, 318.42)
Diagnosis Group	A	Pre	174.71	(159.77, 190.66)
		Post	254.51	(235.26, 274.91)
	B	Pre	166.31	(139.25, 197.09)
		Post	249.31	(213.03, 289.99)
	C	Pre	134.59	(98.54, 179.52)
		Post	324.61	(248.30, 416.98)
	D	Pre	359.34	(343.92, 375.26)
		Post	368.50	(353.12, 384.38)
Birth Sex	Female	Pre	184.36	(173.45, 195.78)
		Post	252.37	(238.88, 266.42)
	Male	Pre	422.14	(402.07, 442.95)
		Post	422.52	(402.78, 442.98)
Race/Ethnicity	Asian, NH	Pre	252.78	(206.11, 306.86)
		Post	331.47	(270.84, 401.63)
	Black, NH	Pre	184.49	(161.27, 210.11)
		Post	231.12	(205.28, 259.31)
	Hispanic/Latino	Pre	288.80	(261.45, 318.23)
		Post	333.90	(303.56, 366.45)
	Other, NH	Pre	417.43	(270.14, 616.21)
		Post	785.20	(607.28, 998.97)
	White, NH	Pre	297.36	(284.34, 310.82)
		Post	338.76	(324.51, 353.47)
	1	Pre	74.23	(56.22, 96.18)
		Post	234.27	(195.01, 279.13)

(continued)

Patient Characteristic	Level	Era	Transplants Per 100 Patient Years	95% Confidence Interval
OPTN Region	2	Pre	247.67	(221.59, 275.97)
		Post	265.35	(238.39, 294.52)
	3	Pre	316.80	(281.02, 355.87)
		Post	339.09	(300.66, 381.06)
	4	Pre	243.18	(215.24, 273.74)
		Post	263.05	(235.79, 292.60)
	5	Pre	360.86	(329.92, 393.92)
		Post	500.04	(458.75, 544.05)
	6	Pre	153.55	(115.35, 200.35)
		Post	123.90	(93.34, 161.28)
	7	Pre	266.23	(235.75, 299.57)
		Post	366.44	(328.57, 407.47)
	8	Pre	330.46	(279.69, 387.77)
		Post	333.64	(281.20, 393.03)
	9	Pre	251.99	(219.43, 288.02)
		Post	318.43	(279.65, 361.08)
	10	Pre	291.32	(260.18, 325.16)
		Post	274.06	(245.28, 305.28)
	11	Pre	594.46	(525.28, 670.20)
		Post	615.07	(544.76, 691.93)

Figure 56: Distance (in Nautical Miles) from Donor Hospital to Transplant Center by Era and Patient Characteristic
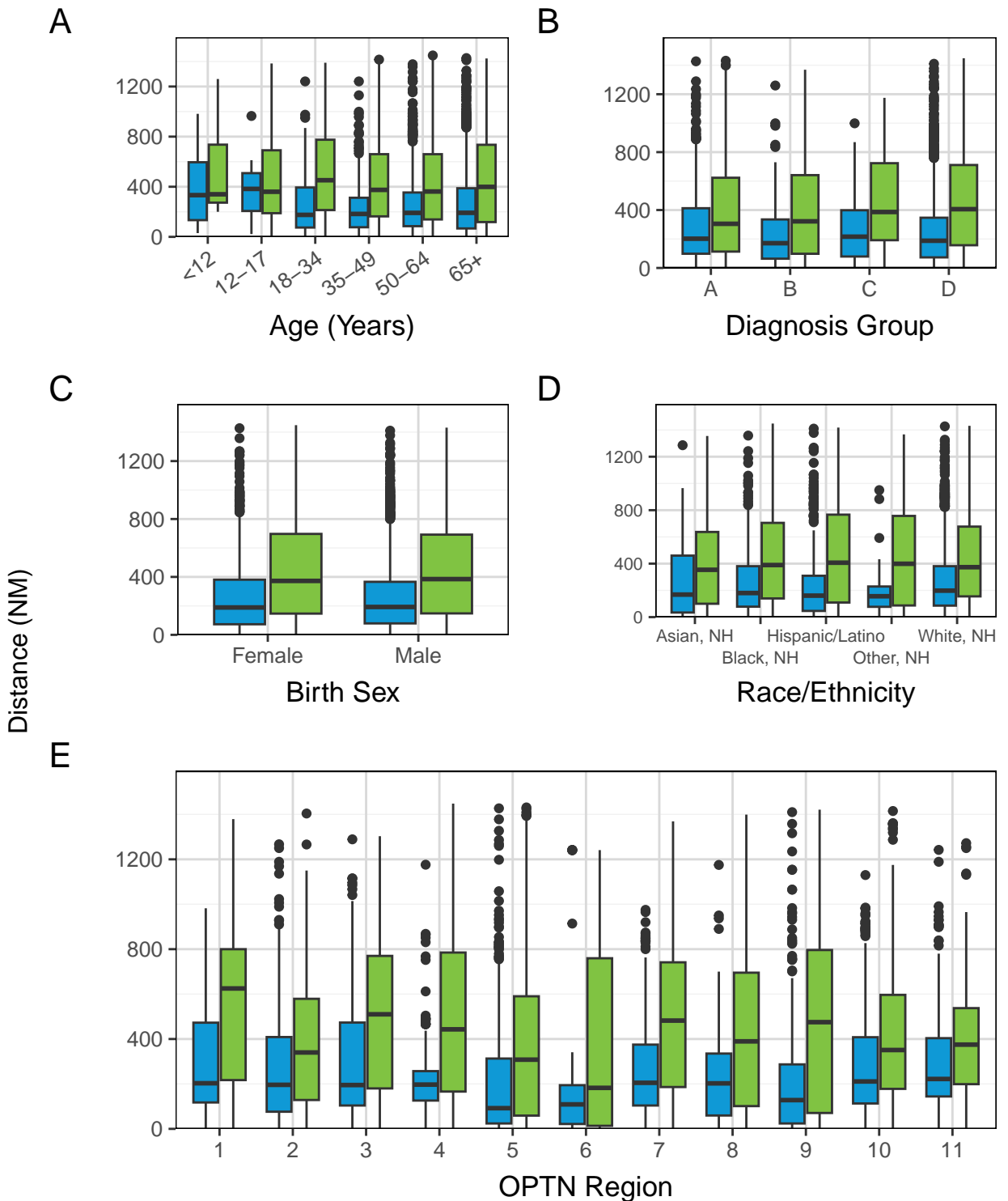
View is restricted to the 99th percentile of distance (1449 NM). There were 58 cases where lungs traveled further than this distance.

Era — Pre — Post

Table 56: Distance (in Nautical Miles) from Donor Hospital to Transplant Center by Era and Patient Characteristic

Category	Level	Era	N	Min	25th Percentile	Median	Mean	75th Percentile	Max
Age (Years)	<12	Pre	7	30	133.50	333.0	400.43	595.50	982
		Post	9	200	273.00	340.0	526.78	736.00	1260
	12-17	Pre	15	22	206.50	383.0	372.47	508.50	965
		Post	17	3	189.00	360.0	452.65	691.00	1384
	18-34	Pre	112	0	74.50	175.5	252.29	394.00	1241
		Post	144	0	214.50	458.5	518.73	784.75	1511
	35-49	Pre	280	0	78.25	185.5	247.86	318.75	2036
		Post	373	0	167.00	389.0	472.23	687.00	2349
	50-64	Pre	1165	0	86.00	192.0	262.93	359.00	2069
		Post	1339	0	140.00	365.0	442.42	673.50	2920
	65+	Pre	1162	0	67.25	192.5	279.79	392.75	2225
		Post	1165	0	124.00	406.0	481.54	760.00	2284
Diagnosis Group	A	Pre	504	0	98.75	202.0	298.53	413.75	1624
		Post	647	0	120.00	307.0	423.89	643.50	2920
	B	Pre	137	0	64.00	171.0	230.11	335.00	1260
		Post	171	0	98.00	323.0	425.85	651.00	2349
	C	Pre	47	0	79.00	216.0	270.40	398.50	999
		Post	61	6	194.00	413.0	483.61	734.00	2054
	D	Pre	2053	0	73.00	189.0	264.39	359.00	2225
		Post	2168	0	158.00	410.5	479.75	728.00	2244
Birth Sex	Female	Pre	1073	0	73.00	189.0	267.07	382.00	2225
		Post	1316	0	152.75	378.5	469.11	712.00	2349
	Male	Pre	1668	0	79.00	193.5	270.33	371.25	2069
		Post	1731	0	153.00	392.0	461.77	707.00	2920
Race/Ethnicity	Asian, NH	Pre	103	0	35.50	174.0	284.57	462.00	2069
		Post	104	0	106.00	381.0	474.01	698.25	2058
	Black, NH	Pre	230	0	78.25	180.0	277.02	385.50	1624
		Post	291	0	145.00	413.0	478.13	733.00	1652
	Hispanic/Latino	Pre	409	0	47.00	162.0	245.71	310.00	1491
		Post	447	0	109.00	418.0	479.27	780.00	2205
	Other, NH	Pre	25	0	77.00	156.0	227.92	229.00	950
		Post	67	0	93.50	412.0	513.73	774.00	1848
	White, NH	Pre	1974	0	86.00	198.0	272.68	383.00	2225
		Post	2138	0	157.00	379.0	458.18	690.00	2920
		Pre	57	0	119.00	207.0	334.93	481.00	1613

(continued)

Category	Level	Era	N	Min	25th Percentile	Median	Mean	75th Percentile	Max
OPTN Region	1	Post	126	0	226.00	630.5	632.83	855.75	2920
	2	Pre	330	0	76.25	196.0	274.63	408.75	1267
		Post	355	0	128.50	340.0	396.08	579.00	1404
	3	Pre	286	0	104.50	197.5	352.86	494.25	1803
		Post	282	0	181.00	513.0	521.71	790.75	2021
	4	Pre	277	0	126.00	197.0	208.21	257.00	1176
		Post	340	0	166.00	454.0	514.14	793.50	1736
	5	Pre	501	0	24.00	92.0	218.97	313.00	2069
		Post	543	0	64.50	314.0	411.18	610.50	2244
	6	Pre	54	1	21.75	109.0	214.50	194.50	1241
		Post	55	3	14.00	216.0	423.76	782.50	2349
	7	Pre	282	0	104.00	205.0	266.28	375.00	975
		Post	345	0	189.00	488.0	499.34	743.00	1471
	8	Pre	150	0	59.50	202.5	232.25	335.25	1175
		Post	143	0	109.50	391.0	452.45	696.50	1481
	9	Pre	218	0	24.75	131.0	261.50	349.25	2225
		Post	246	0	73.50	479.0	495.91	799.25	1885
	10	Pre	318	0	114.00	211.5	304.60	408.75	1777
		Post	333	0	183.00	353.0	445.48	626.00	1866
	11	Pre	268	0	148.75	222.0	313.72	409.25	2036
		Post	279	0	205.50	379.0	431.89	562.00	2054

The median time to transplant could not be calculated for candidates less than 12 years old at listing in the pre policy era because less than 50% of these candidates had been transplanted at the time of this report's production.

Figure 57: Median Time to Transplant (Days) by Era and Patient Characteristic
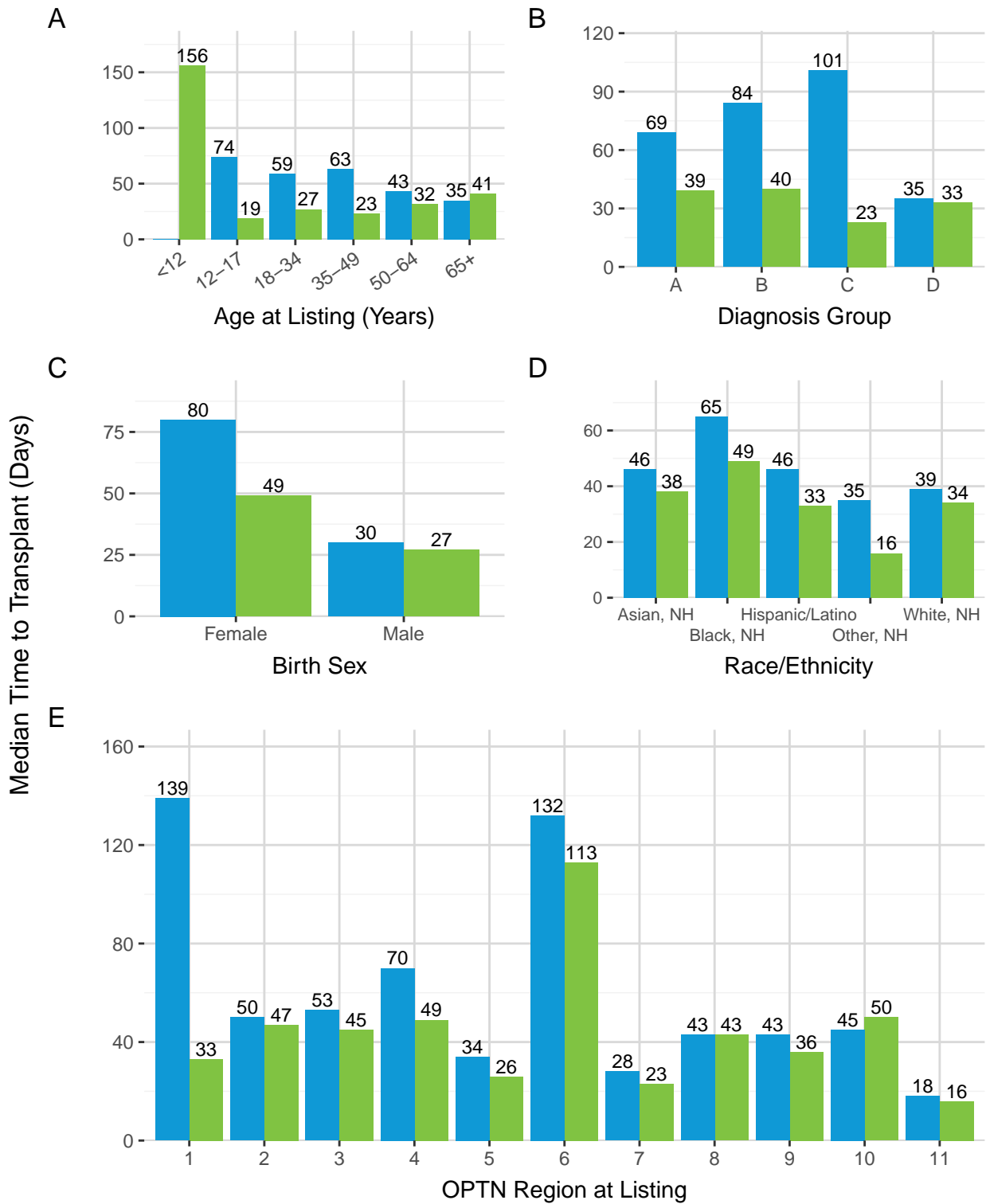
Table 57: Median Time to Transplant (Days) by Era and Patient Characteristic

Category	Level	Era	N Additions	Median Time to Transplant (Days)
Age at Listing (Years)	<12	Pre	19	–
		Post	15	156
	12-17	Pre	23	74
		Post	18	19
	18-34	Pre	136	59
		Post	142	27
	35-49	Pre	340	63
		Post	347	23
	50-64	Pre	1311	43
		Post	1464	32
	65+	Pre	1218	35
		Post	1330	41
Diagnosis Group	A	Pre	543	69
		Post	697	39
	B	Pre	157	84
		Post	172	40
	C	Pre	62	101
		Post	49	23
	D	Pre	2285	35
		Post	2398	33
Birth Sex	Female	Pre	1233	80
		Post	1408	49
	Male	Pre	1814	30
		Post	1908	27
Race/Ethnicity	Asian, NH	Pre	122	46
		Post	111	38
	Black, NH	Pre	279	65
		Post	318	49
	Hispanic/Latino	Pre	439	46
		Post	496	33
	Other, NH	Pre	25	35
		Post	81	16
	White, NH	Pre	2182	39
		Post	2310	34
	1	Pre	69	139
		Post	116	33

(continued)

Category	Level	Era	N Additions	Median Time to Transplant (Days)
OPTN Region at Listing	2	Pre	377	50
		Post	408	47
	3	Pre	334	53
		Post	306	45
	4	Pre	324	70
		Post	386	49
	5	Pre	517	34
		Post	575	26
	6	Pre	70	132
		Post	72	113
	7	Pre	300	28
		Post	348	23
	8	Pre	152	43
		Post	160	43
	9	Pre	235	43
		Post	269	36
	10	Pre	372	45
		Post	398	50
	11	Pre	297	18
		Post	278	16