OPTN/SRTR 2011 Annual Data Report: lung

ABSTRACT Lungs are allocated in part based on the Lung Allocation Score (LAS), which considers risk of death without transplant and posttransplant. Wait-list additions have been increasing steadily after an initial decline following LAS implementation. In 2011, the largest number of adult candidates were added to the waiting list in a single year since 1998; donation and transplant rates have been unable to keep pace with wait-list additions. Candidates aged 65 years or older have been added faster than candidates in other age groups. After an initial decline following LAS implementation, wait-list mortality increased to 15.7 per 100 wait-list years in 2011. Short- and long-term graft survival improved in 2011; 10-year graft failure fell to an all-time low. Since 1998, the number of new pediatric (aged 0-11 years) candidates added yearly to the waiting list has declined. In 2011, 19 pediatric lung transplants were performed, a transplant rate of 34.7 per 100 wait-list years. The percentage of patients hospitalized before transplant has not changed. Both graft and patient survival have continued to improve over the past decade. Posttransplant complications for pediatric lung transplant recipients, similar to complications for adult recipients, include hypertension, renal dysfunction, diabetes, bronchiolitis obliterans syndrome, and malignancy.

KEY WORDS End-stage lung diseases, Lung Allocation Score, lung transplant, transplant outcomes.

Everyone else's tomorrow was always more important to him than his own. We carry Joshua's memory forward by continuing to help others.

Monica, donor mother

Adult Lung Transplant

Introduction

As of June 30, 2011, more than 9,000 people in the US were living with a transplanted lung (Figure 5.5); lung transplant is increasingly used to extend lives and improve quality of life for patients with end-stage lung diseases. Lungs are allocated to US transplant candidates primarily on the basis of age, geography, blood type (ABO) compatibility, and the Lung Allocation Score (LAS). Implemented in 2005, the LAS is an attempt to identify the best candidates for transplant by estimating risk of death without transplant and post-transplant. The LAS is calculated for all candidates aged 12 years or older. To date, lungs are the only transplanted organs whose allocation scheme takes post-transplant survival into account. After implementation of the LAS, waiting time was no longer the primary consideration for access to a lung transplant; therefore, the LAS system reduced waiting times by effectively disincentivizing early listing as a way to accumulate waiting time. As a result, candidates currently listed on the waiting list are in more immediate need of transplant, compared with those in the pre-LAS era. Allocation trends identified in previous years continued in 2011, specifically in regard to increasing rates of transplant in older patients, especially candidates aged 65 years or older (Figure 1.3), and a preference for bilateral over single lung transplant (Figure 3.1). The median LAS at transplant continues to increase, rising from 36.6 in 2005 to 40.8 in 2011 (Figure 3.5).

The LAS applies to adolescents (aged 12 to 17 years) and candidates aged 18 years or older. As part of the development of the LAS, pulmonary diagnoses of candidates (aged 12 years or older) were categorized into four main groups based on survival probability and pathophysiology of the underlying disease. The four groups are: Group A, obstructive lung disease (e.g., chronic obstructive pulmonary disease/emphysema); Group B, pulmonary vascular disease (e.g., idiopathic pulmonary arterial hypertension); Group C, cystic fibrosis and immunodeficiency disorders; and Group D, restrictive lung disease (e.g., idiopathic pulmonary fibrosis and re-transplant). The LAS system is monitored and refined as needed to increase the accuracy of the parameters used to predict risk of death without transplant and post-transplant for these diagnostic groups. The first comprehensive adjustments to the LAS calculation are currently being evaluated. The proposed revised LAS will include the already approved bilirubin parameter. This will further improve survival predictability for all diagnostic groups, effects that will be particularly notable for candidates in Group B. The impact of changes to the LAS should be discernible over the next several years.

Waiting List Trends

Waiting list additions have been increasing steadily, after an initial decline immediately following implementation of the LAS system. In 2011, more than 2,200 new candidates were added to the waiting list; this was the largest number of lung transplant candidates added to the waiting list in a single year since at least 1998 (Figure 1.1). Year-end wait-list counts have also been increasing, indicating that donation and transplant rates have not been able to keep pace with the influx of new lung transplant candidates. The number of inactive candidates on the waiting list decreased markedly after implementation of the LAS, falling from an all-time high of 2,001 inactive wait-listed candidates in 2005 to 325 in 2011 (Figure 1.1). This steady decrease in inactive candidacy may indicate that candidates are being more appropriately chosen for the waiting list and those at risk of being designated as inactive because of advancing disease are undergoing transplant more efficiently.

Candidates aged 65 years or older continue to be added to the waiting list faster than candidates in other age groups. This trend has led to an increase in candidates aged 65 years or older, from 2.9% of the waiting list in 1998 to 24.4% in 2011. In contrast, the group of candidates aged 18 to 34 years has decreased from 18.6% of the waiting list in 1998 to 11.7% in

2011, and the group aged 35 to 49 years has decreased from a high of 28.6% in 2000 to just 14.0% in 2011. Since implementation of the LAS, the percentage of Group B candidates on the waiting list has decreased from 8.3% to 5.1%, while the percentage of Group D candidates has increased from 33.8% to 46.1% (Figure 1.2). Racial group, blood type, and sex distributions on the waiting list have remained stable over the past 10 years (Figure 1.2). The conversion from waiting list to transplant has increased for all candidates awaiting a lung transplant; however, that increase is most dramatically illustrated in candidates aged 65 years or older (Figure 1.3).

Only 5.2% of wait-listed patients originally listed for a lung transplant in 2008 remained on the waiting list 36 months later, and 76.0% had already received an organ (Figure 1.5). Overall median waiting time for a lung transplant is now 3.6 months, varying from 2.1 months for Group D patients to 9.7 months for Group B patients (Figure 1.6).

The proportion of wait-listed candidates undergoing lung transplant varies greatly by donation service area (DSA). The highest unadjusted rate of transplant was in a DSA in which 95.0% of the candidates wait-listed in 2010 underwent lung transplant within 1 year of listing. In 5 other DSAs, at least 80% of the candidates wait-listed in 2010 underwent lung transplant within 1 year. On average, 64.4% of lung transplant candidates underwent transplant within 1 year of listing (Figure 1.7).

Wait-list mortality demographics have changed substantially since implementation of the LAS. After the initial decline in mortality rates after the LAS went into effect, mortality rates are on the rise again and are now at 15.7 per 100 wait-list years (Figure 1.9). The LAS was originally implemented to minimize wait-list mortality while considering the probability of post-transplant survival. This methodology also de-emphasized time on the waiting list, effectively removing any incentive for early listing. As a result of the changing priorities in the new allocation model, candidates being listed for transplant have more advanced lung disease at listing than in previous years. It is possible that the listing of increasingly ill candidates and the higher proportion of candidates aged 65 years or older have resulted in increased wait-list mortality rates, measured in deaths per 100 years on the waiting list (Figure 1.9). As with transplant rates, wait-list mortality percentages vary notably by DSA. Mortality rates based on deaths within 90 days after listing vary from zero to 15% but can be dramatically affected by the raw number of transplant candidates listed at each center. The two DSAs with the lowest wait-list mortality rates nationwide had zero deaths within 90 days of listing, among patients first listed 2009-2010 (Figure 1.10).

Donation

Deceased donation rates for lungs have steadily increased over the past 10 years. While overall donation rates have increased, increases have been larger for certain demographic groups than for others. Specifically, from 2000 to 2010, rates among donors aged 15 to 34 years increased from 7.4 to 13.7 donations per 1,000 deaths; this age group continues to represent the largest source of lungs for transplant. Donation rate varies by race as well. The rate among Hispanic lung donors is almost twice the rate among white donors and is the highest donation rate of all racial groups. Donation rates among black donors also increased during 2000-2010 from 1.1 to 3.2 donations per 1,000 deaths, second only to the rate among Hispanic donors (Figure 2.1). Geographically, donation rates continue to vary by state. The District of Columbia, Delaware, Alaska, South Carolina, and Maryland had the highest deceased donor lung donation rates in the US in 2008-2010. Alaska, Maine, and Utah had the greatest increases in lung donation rates between 2005-2007 and 2008-2010 (Figure 2.2).

The number of lungs recovered and transplanted per deceased donor has been steadily increasing, from 0.24 lungs recovered per donor in 1998 to 0.41 lungs recovered per donor in 2011. Similarly, the rate of lungs transplanted per donor has

increased, from 0.23 in 1998 to 0.39 in 2011 (Figure 2.3). Cause of death leading to donation has been changing gradually over the past 10 years. While cerebrovascular or stroke deaths continue to compose approximately one-third of the deaths leading to lung donation, donations stemming from head trauma have been steadily declining, representing 44.7% of all deceased lung donors in 2011, compared with 58.0% in 1998 (Figure 2.8). At the same time, donations from anoxia have increased from 4.9% in 2002 to 16.9% in 2011.

Donation after circulatory death (DCD) is not yet a major contributor to lung transplant. Since 2008, lungs recovered from DCD donors have accounted for only 0.8% to 1.9% of lung transplants in the US, with most DCD lung transplants being performed in larger transplant centers (Figure 3.6).

Living donors have not been used widely since implementation of the LAS in 2005. Since then, only nine living lung transplants have been performed, and only two since 2008 (Figure 3.4). Living donor lung transplant was not widely performed before the LAS and largely has fallen out of favor, likely because the sickest wait-listed candidates gain access to transplant with their higher LAS.

Transplant

In 2011, 1,830 lung transplants were performed, the largest number of lung transplants ever in one year (Figure 3.1). Single and bilateral lung transplants accounted for 29.9% (548) and 70.1% (1,282) of the total number of transplants, respectively. The number of single lung transplants has remained relatively stable since the late 1990s, indicating that the increase in total lung transplants is due almost entirely to the preferential use of bilateral transplant. The number of bilateral transplants has almost tripled since 2000, from 460 to 1,282 (Figure 3.1). Re-transplant rates have also increased, compared with the year 2000; however, they have remained stable since LAS implementation, accounting for 3.8% of all transplants in 2011 (Figure 3.1).

Since 2001, older recipients, men, and Group D recipients have made up a larger proportion of patients undergoing transplant each year (Figure 3.2). In 2001, only 3.4% of the transplants in the US were performed in recipients aged 65 years or older. By 2011, recipients aged 65 years or older composed 26.6% of US lung recipients. During that same period, recipients aged 35 to 49 years decreased from 22.7% to 12.4%. Part of this shift reflects the aging of the US population. However, LAS policy priorities such as increased transplant access for patients who are at increased risk of mortality, such as those in Group D, who tend to be older, may be reinforcing this shift to older recipient age. The proportion of female lung transplant recipients has also markedly decreased. In 2001, female candidates received 53.5% of all lung transplants, but by 2011 women represented only 41.9% of lung transplant recipients. The trend appears stable over a number of years, with no obvious reason for the shift. However, part of this trend could be explained by the decline in female lung transplant candidates (Figure 1.2).

Lung transplant recipients are undergoing transplant with higher LAS scores. When the LAS system was implemented, the median LAS at transplant was 36.6; it has increased steadily to the highest median value of 40.8 in 2011 (Figure 3.5). The distribution of the LAS has also shifted. In 2006, immediately after implementation of the LAS system, 14.0% of the wait-list recipients had scores of 50 or more; however, by 2011, 29.2% of the recipients had scores of 50 or more at transplant (Figure 3.11). This trend most likely reflects the increased illness severity of candidates on the waiting list, given the other noted trends of increasing LAS in the transplant candidates (Figure 1.2) and increasing mortality rates among wait-listed candidates (Figure 1.9).

Lung transplant procedures performed in the US continue to be financed through multiple forms of insurance. Private insurance remains the primary source of funding for lung transplants. However, government funding has increased over the past

decade. This increase is almost entirely through the Medicare program, which funded transplants for 20.9% of recipients in 2000 and for 37.4% of recipients in 2011 (Figure 3.10). This trend is likely due to the increasing age of the lung transplant cohort.

Donor/Recipient Matching

In general, the closer the immunologic or HLA match between a donor and a recipient, the less likely it is that rejection will occur. Most lung transplant recipients have 0% panel reactive antibodies (PRA) at the time of transplant, though the overall percentage of 0% PRA recipients is decreasing over time. In 2011, 66.3% had 0% PRA (Figure 4.1). Since implementation of the LAS, the percentage of transplant patients with high numbers of HLA mismatches has increased. Indeed, the past decade has seen an apparent trend toward more liberally performing transplants for patients with higher PRA or HLA mismatches (Figures 4.1-4.5). It is unclear whether this is the result of changing practices at transplant centers or recent changes in methods that make the detection of circulating anti-HLA antibodies more sensitive.

In most transplants performed in 2007-2011, donor cytomegalovirus (CMV) status and recipient CMV status were matched or CMV-positive candidates received CMV-negative lungs (Figure 4.6). This practice decreases the chances of a CMV-negative recipient seroconverting to CMV and suffering its potential consequences such as CMV pneumonia or increased risk of developing bronchiolitis obliterans syndrome. However, 24.4% of lung transplants were from a CMV-positive donor to a CMV-negative recipient, which could increase the incidence of post-transplant CMV infection. Similarly, donors and recipients are often matched on the basis of Epstein-Barr virus (EBV) status; in 2007-2011, only 11.4% of lung transplants were from an EBV-positive donor to an EBV-negative recipient (Figure 4.7). However, this trend is explained by the much higher percentage of the lung transplant candidates being positive for EBV.

Outcomes

Early graft failure, defined as failure of the graft within the first 6 weeks after transplant, is frequently used as a measure of procedural and immunosuppressive medication effectiveness. In 2011, the incidence of early graft failure dropped to 5.3% among adult lung transplant recipients, indicating continued improvement in immunosuppressive medication management and surgical procedures and perhaps donor selection and management (Figure 5.1). Long-term graft survival has also improved; long-term graft failure at 10 years post-transplant declined to an all-time low in adult lung transplant recipients (Figure 5.2). Figure 5.3 shows 5-year graft survival according to LAS and diagnosis group for transplants performed in 2005-2006. There was a significant difference in graft survival based on LAS, with higher LAS associated with worse allograft survival (log-rank $P = 0.0021$). However, the effect of diagnosis group on graft survival did not reach statistical significance (log-rank $P = 0.0952$) (Figure 5.3).

Apart from graft failure, several complications can adversely affect the health of transplant recipients post-transplant. Diabetes, hypertension, and renal dysfunction are frequent complications of lung transplant that are presumed to stem from the long-term use of immunosuppressive medications (Figure 5.7). At 5 years post-transplant, nearly 50% of the recipients have renal dysfunction, nearly 50% have diabetes, and more than 60% have hypertension. Likewise, malignancy may occur with extended suppression of the immune system and is reported in 15.4% of lung recipient 5 years after transplant. Despite these obstacles, the overall survival rate and lifespan of lung transplant recipients continues to improve (Figure 5.2).

Figure 5.9 shows the variations in unadjusted recipient survival according to demographic and diagnosis groups, LAS, and procedure choice. One important observation in regard to post-transplant survival concerns recipients with an LAS of 50 to 100; these candidates, who are the sickest on the waiting list, are also those with the lowest survival rates at every time

point after transplant, starting from the immediate post-operative time to 5 years post-transplant. In addition, recipients who are aged 65 years or older had the most notable decrease in survival compared with the rest of the lung transplant recipient cohort. However, as noted earlier, these patients are experiencing increasingly higher transplant rates than those in other age categories. Finally, transplant procedure choice appears to affect survival. Survival is better for patients receiving a bilateral or right single lung transplant compared with those receiving a left single lung transplant. However, it is important to keep in mind that these registry data on single and bilateral lung transplant have not been adjusted for age, LAS, or diagnosis—variables that may mediate the noted survival differences.

Immunosuppression

Trends in immunosuppression among lung transplant recipients have remained stable over the past several years. Since 1998, use of tacrolimus as the primary calcineurin inhibitor has steadily increased. Today, it is used in nearly all lung transplant recipients. Mycophenolate is still the predominant antimetabolite used in lung transplant recipients. Steroid use is also virtually universal and extends from the immediate post-transplant period through at least 1 year post-transplant. Mammalian target of rapamycin (mTOR) inhibitors are used rarely, if at all, immediately after transplant. Use of induction agents after transplant is mixed; 55.7% of patients did not receive them in 2011. For patients who do receive an induction agent, interleukin-2 receptor antagonists (IL2-RA) are the primary agents chosen, with a minority of patients receiving a T-cell depleting agent (Figure 6.4).

Pediatric Lung Transplant

Waiting List Trends

Because the lung transplant allocation policy for adolescents (aged 12 to 17 years) is similar to that for adults, for this report we chose to limit the pediatric population to candidates and recipients aged 0 to 11 years.

Since 1998, the number of new candidates added each year to the pediatric lung transplant waiting list has consistently declined (Figure 7.1). And since 2005, the number of inactive candidates on December 31 of the year has surpassed the number of active candidates. This trend of not listing patients early for transplant and leaving candidates inactive on the waiting list is partly explained by the institution of the priority system for pediatric lung transplant. The age distribution of pediatric candidates on the lung transplant waiting list has also changed. Historically, most (> 70%) wait-list candidates were aged 6 years or older. Since 2005, the proportion of wait-listed candidates in this age group has decreased and the proportion of candidates aged younger than 1 year and aged 1 to 5 years has increased. By 2011, 13.0% of candidates were aged younger than 1 year, and 24.0% were aged 1 to 5 years (Figure 7.2). This shift in age reflects changes in the diagnoses for which lung transplant is indicated as well as earlier detection and more aggressive testing for diseases such as surfactant deficiencies. As seen in all pediatric transplantation, the ethnic distribution of wait-list candidates has changed, with increasing representation of Hispanic patients (Figure 7.2). In 2011, 38.8% of candidates removed from the waiting list were removed due to transplant, 26.5% due to death, 12.2% due to improved condition, and 6.1% due to being too sick to undergo transplant (Figure 7.3). Wait-list mortality rates declined from an all-time high of 28.3 per 100 wait-list years in the 1998-1999 cohort to 11.2 in 2002-2003, but have remained essentially unchanged since then; in 2010-2011 the wait-list mortality rate was 15.0 per 100 wait-list years (Figure 7.6) compared with 15.7 per 100 wait-list years for adults (Figure 1.9). The rates are 2-fold higher in patients aged younger than 6 years compared with patients aged 6 to 11 years: 25.1 per 100 wait-list years versus 10.7 per 100 wait-list years.

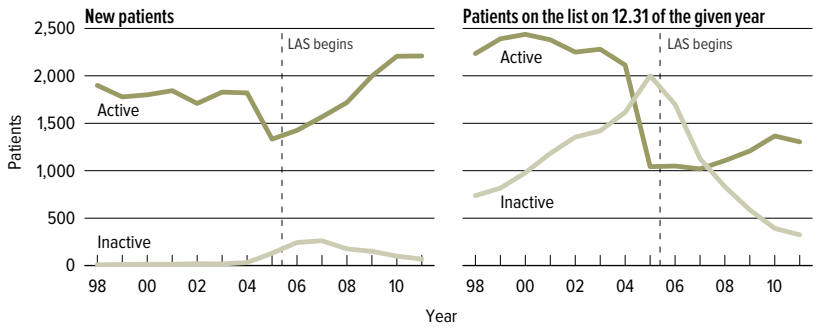
Transplant

In 2011, a total of 19 pediatric lung transplants were performed: 3 in recipients aged less than 1 year, 5 in recipients aged 1 to 5 years, and 11 in recipients aged 6 to 11 years (Figure 7.7). The transplant rate was 34.7 per 100 wait-list years (Figure 7.8). Over the past decade, the transplant rates in the context of the increasing proportion of wait-listed candidates aged 0 to 5 years appear to demonstrate a shift to providing transplants for younger candidates more quickly. These younger patients represent one-third to two-thirds of transplants per year (Figure 7.7), yet the rate of transplant for these patients is 2- to 3-fold higher than for patients aged 6 to 11 years (Figure 7.8). This shift may reflect the changing primary diagnosis of transplant recipients, with a decrease in the proportion of patients with cystic fibrosis and primary pulmonary hypertension and an increase in diagnoses such as bronchiolitis obliterans or early detection of surfactant deficiencies. Among pediatric lung transplant recipients in 2009-2011, 56.7% waited less than 3 months (Figure 7.9). The percentage of patients hospitalized before transplant has not changed (from approximately 50%), but more patients were using a ventilator in 2009-2011 compared with the earlier era. The procedure of choice was bilateral sequential transplant, which was performed in almost all patients (Figure 7.9). Medicaid coverage for pediatric lung transplant has increased, with a corresponding decrease in private insurance coverage (Figures 7.9, 7.10).

Immunosuppression and Outcomes

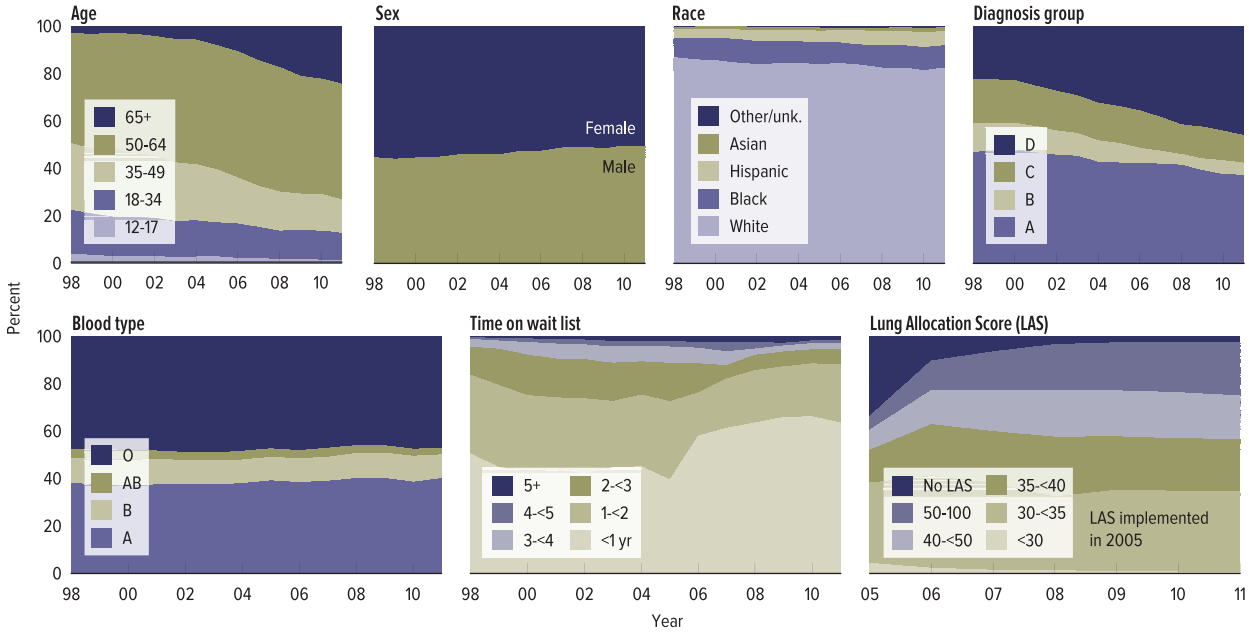
The immunosuppression used in pediatric lung transplant has changed notably. The trends in pediatric lung transplant immunosuppression are similar to those seen in adult lung transplant immunosuppression. Tacrolimus is increasingly used and is now the dominant calcineurin inhibitor. Likewise, the use of mycophenolate has increased and it is now the primary antimetabolite. In 2010-2011, all pediatric lung transplant recipients received tacrolimus as part of the initial maintenance immunosuppressive medication regimen, 97.4% received mycophenolate, and 94.9% received steroids (Figure 7.13). The past decade has seen a shift from no induction therapy to an increasing use of IL2-RA (Figure 7.13). Both graft and patient survival have continued to improve over the past decade. For transplants performed in 2008-2009, graft failure was 3.4% at 6 months, 13.6% at 1 year, and 19.8% at 3 years. For transplants performed in 2006-2007, 5-year graft failure was 51.4%, and for transplants performed in 2000-2001, 10-year failure was 68.6% (Figure 7.14). Among pediatric lung recipients who underwent transplant between 2005 and 2010, the incidence of acute rejection was 16.9% within 1 year and 27.7% within 2 years after transplant (Figure 7.16). Figure 7.15 shows the variations in 5-year recipient survival by age and race. At every time point after transplant, starting from the immediate post-operative time to 5 years post-transplant, the most notable difference in survival was for recipients aged younger than 1 year; these recipients had lower survival rates than every other age group, particularly recipients aged 6 to 11 years (Figure 7.15). Post-transplant complications for pediatric lung transplant recipients are similar to complications for adult recipients and include hypertension, renal dysfunction, diabetes, bronchiolitis obliterans syndrome, and malignancy (Figure 7.12). The highest incidence of post-transplant lymphoproliferative disorder (PTLD) occurred in EBV-negative recipients. Among these recipients, the post-transplant incidence of PTLD was 7.0% at 1 year, 8.3% at 3 years, and 20.3% at 5 years (Figure 7.11).

wait list



LU 1.1 Adult patients waiting for a lung transplant

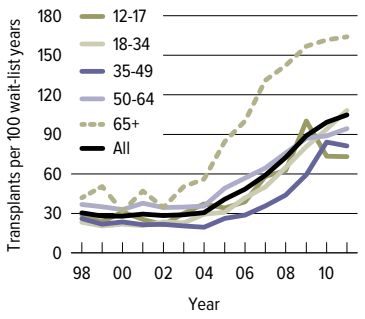
Patients waiting for a transplant. A "new patient" is one who first joins the list during the given year, without having listed in a previous year. However, if a patient has previously been on the list, has been removed for a transplant, and has relisted since that transplant, the patient is considered a "new patient." Patients concurrently listed at multiple centers are counted only once. Those with concurrent listings and active at any program are considered active; those inactive at all programs at which they are listed are considered inactive.



LU 1.2 Distribution of adult patients (active) waiting for a lung transplant

Patients waiting for a transplant any time in the given year. Age determined on the earliest of listing date or December 31 of the given year. Concurrently listed patients are counted once. Patients first listed prior to LAS implementation may remain score-less after 2005 due to missing data among elements required to compute LAS.

wait list



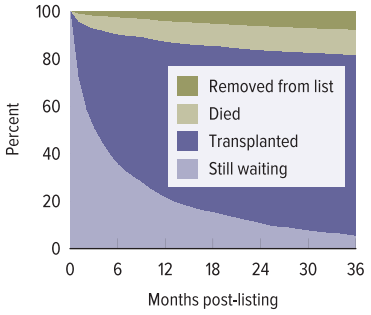
LU 1.3 Lung transplant rates among adult waiting list candidates, by age

Patients waiting for a transplant; age as of January 1 of the given year. Yearly period-prevalent rates computed as the number of deceased donor transplants per 100 patient years of waiting time in the given year. All waiting time per patient per listing is counted, and all listings that end in a transplant for the patient are considered transplant events.

	2009	2010	2011
Patients at start of year	1,937	1,798	1,753
Patients added during year	2,148	2,309	2,280
Patients removed during year	2,286	2,348	2,403
Patients at end of year	1,799	1,759	1,630
Removal reason			
Deceased donor transplant	1,630	1,744	1,798
Living donor transplant	1	0	1
Patient died	335	329	351
Patient refused transplant	4	5	11
Improved, tx not needed	140	160	69
Too sick to transplant	45	40	77
Other	131	70	96

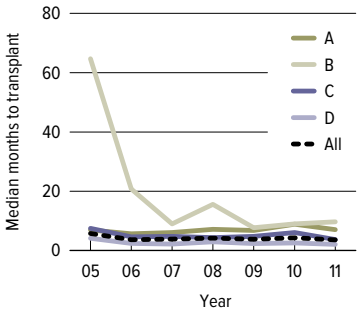
LU 1.4 Lung transplant waiting list activity among adult patients

Patients with concurrent listings at more than one center are counted once, from the time of earliest listing to the time of latest removal. Patients listed, transplanted, and re-listed are counted more than once. Patients are not considered "on the list" on the day they are removed. Thus, patient counts on January 1 may be different from patient counts on December 31 of the prior year.



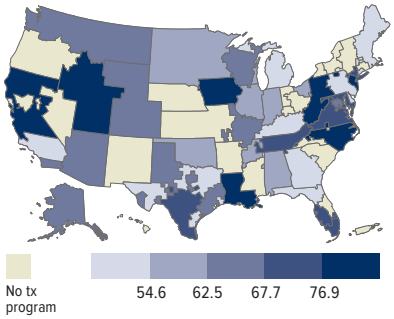
LU 1.5 Outcomes for adult patients waiting for a lung transplant among new listings in 2008

Patients waiting for a transplant and first listed in 2008. Patients with concurrent listings at more than one center are counted once, from the time of the earliest listing to the time of latest removal.



LU 1.6 Median months to lung transplant for wait-listed adult patients, by diagnosis group

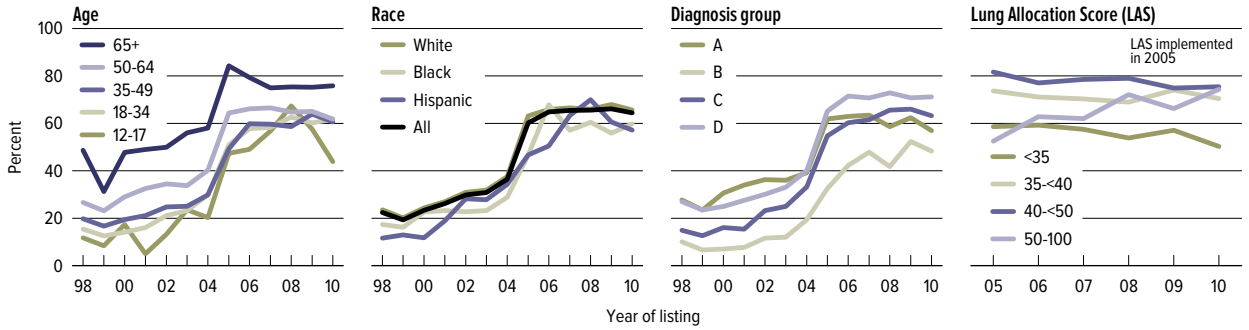
Patients waiting for a transplant, with observations censored at December 31, 2011; Kaplan-Meier method used to estimate time to transplant. If an estimate is not plotted for a certain year, 50% of the cohort listed in that year had not been transplanted at the censoring date. Only the first transplant is counted.



LU 1.7 Percent of adult wait-listed patients, 2010, who received a deceased donor lung transplant within one year, by DSA

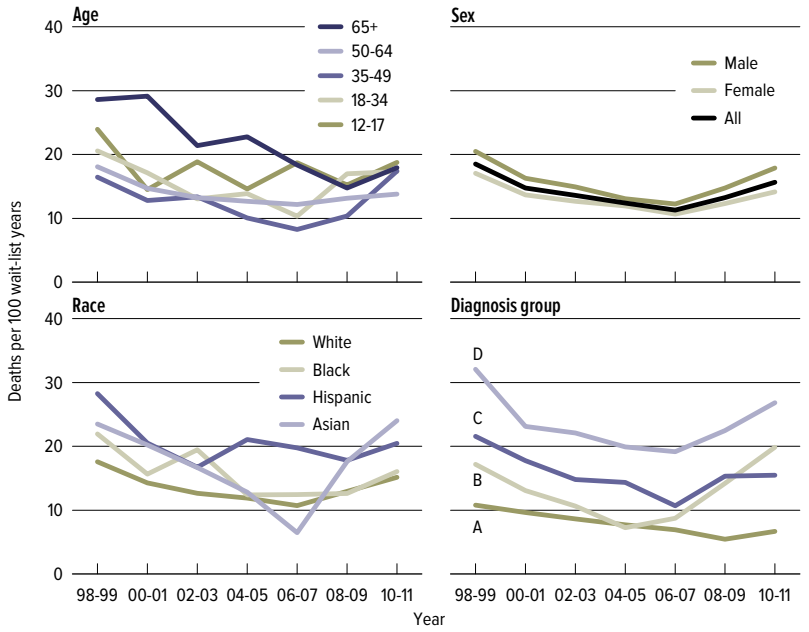
Patients with concurrent listings in a single DSA are counted once in that DSA, and those listed in multiple DSAs are counted separately per DSA.

wait list



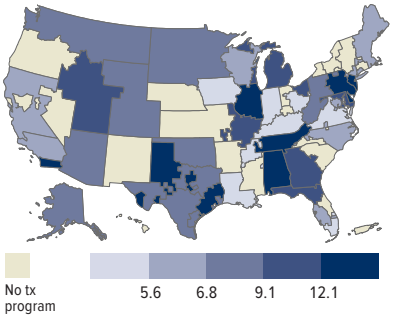
LU 1.8 Adult wait-listed patients who received a deceased donor lung transplant within one year

Patients with concurrent listings at more than one center are counted once, from the time of earliest listing to the time of latest removal. Patients listed, transplanted, and re-listed are counted more than once.



LU 1.9 Pre-transplant mortality rates among adult patients wait-listed for a lung transplant

Patients waiting for a transplant. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given 2-year interval. For rates shown by different characteristics, waiting time is calculated as the total waiting time in the interval for patients in that group. Only deaths that occur prior to removal from the waiting list are counted. Age is calculated on the latest of listing date or January 1 of the given interval. Other patient characteristics come from the OPTN Transplant Candidate Registration form.



LU 1.10 Mortality within 90 days of listing for lung transplant, by DSA, 2009–2010

Percent of adult patients who die within 90 days of first listing. Patients with concurrent listings in a single DSA are counted once in that DSA, and those listed in multiple DSAs are counted separately per DSA. All deaths occuring within 90 days of listing are counted, including deaths occuring after transplant or removal from the wait list.

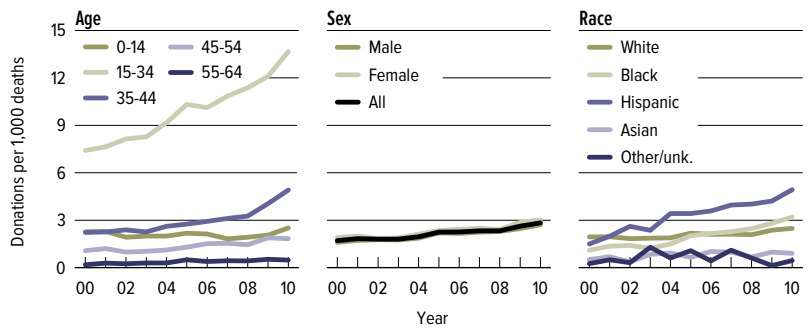
	Level	2001 N	2001 %	2006 N	2006 %	2011 N	2011 %
Age	12-17	107	3.0	62	2.3	30	1.8
	18-34	613	17.2	418	15.2	190	11.6
	35-49	1,080	30.2	726	26.4	261	16.0
	50-64	1,665	46.6	1,355	49.2	864	52.8
	65+	107	3.0	191	6.9	290	17.7
Sex	Female	2,053	57.5	1,653	60.1	973	59.5
	Male	1,519	42.5	1,099	39.9	662	40.5
Race	White	2,993	83.8	2,284	83.0	1,336	81.7
	Black	371	10.4	259	9.4	165	10.1
	Hispanic	150	4.2	148	5.4	101	6.2
	Asian	50	1.4	42	1.5	26	1.6
	Other/unk.	8	0.2	19	0.7	7	0.4
Diagnosis group	A	1,572	44.0	1,145	41.6	770	47.1
	B	530	14.8	405	14.7	113	6.9
	C	561	15.7	406	14.8	173	10.6
	D	796	22.3	731	26.6	579	35.4
	Other/unknown	113	3.2	65	2.4	0	0.0
Most recent lung allocation score (LAS)	<30	0	0.0	197	7.2	36	2.2
	30-<35	0	0.0	1,031	37.5	912	55.8
	35-<40	0	0.0	300	10.9	362	22.1
	40-<50	0	0.0	129	4.7	195	11.9
	50-100	0	0.0	61	2.2	103	6.3
	No LAS*	3,572	100.0	1,034	37.6	27	1.7
Blood type	A	1,326	37.1	1,042	37.9	632	38.7
	B	359	10.1	282	10.2	157	9.6
	AB	135	3.8	107	3.9	36	2.2
	O	1,752	49.0	1,321	48.0	810	49.5
Time on waiting list	<1 month	148	4.1	138	5.0	149	9.1
	1-<3 months	273	7.6	205	7.4	215	13.1
	3-<6 months	319	8.9	151	5.5	223	13.6
	6-<12 months	650	18.2	208	7.6	281	17.2
	1-<2 years	860	24.1	308	11.2	348	21.3
	2-<3 years	487	13.6	425	15.4	149	9.1
	3+ years	835	23.4	1,317	47.9	270	16.5
Status	Inactive	1,185	33.2	1,700	61.8	326	19.9
	Active	2,387	66.8	1,052	38.2	1,309	80.1
Transplant history	Listed for first transplant	3,456	96.8	2,656	96.5	1,557	95.2
	Listed for subseq. tx	116	3.2	96	3.5	78	4.8
Total		3,572	100.0	2,752	100.0	1,635	100.0

*In 2006, all but 17 patients with missing LAS were listed before May 4, 2005.
In 2011, only 1 patient was listed before May 4, 2005.

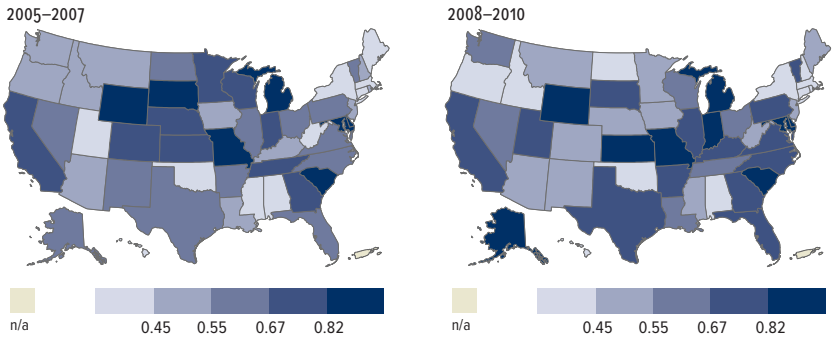
LU 1.11 Characteristics of adult patients on the lung transplant waiting list on December 31 of 2001, 2006, & 2011

Patients waiting for a transplant on December 31, 2001, December 31, 2006, and December 31, 2011, regardless of first listing date; active/inactive status is on this date, and multiple listings are not counted. Patients missing LAS in 2011 are all inactive.

deceased donation

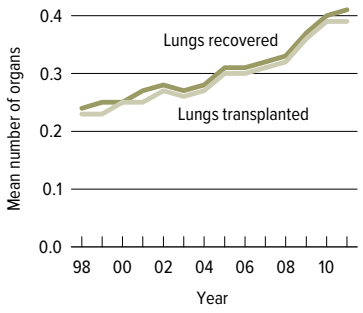


LU 2.1 Deceased donor lung donation rates
Numerator: Deceased donors age less than 65 whose organ(s) were recovered for transplant. Denominator: US deaths per year, age less than 65. (Death data available at http://www.cdc.gov/nchs/products/nvsr.htm.) Donors who donated two lungs are counted twice.



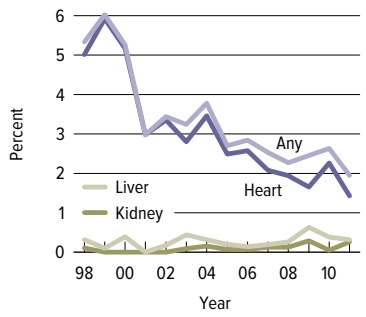
LU 2.2 Deceased donor lung donation rates (per 1,000 deaths), by state
Numerator: Deceased donors residing in the 50 states whose lung(s) were recovered for transplant in the given year range. Denominator: US deaths by state during the given year range (death data available at http://www.cdc.gov/nchs/products/nvsr.htm). Rates are calculated within ranges of years for more stable estimates. Donors who donated two lungs are counted twice.

deceased donation



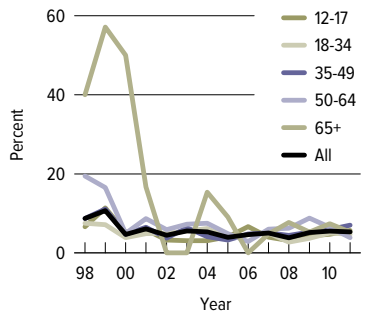
LU 2.3 Lungs recovered per donor & lungs transplanted per donor

Denominator: all deceased donors with at least one organ of any type recovered for transplant. Numerator for recovery rate: number of lungs recovered for transplant in the given year; lungs recovered for other purposes are not included. Numerator for transplant rate: all deceased donor lungs transplanted in given year.



LU 2.4 Deceased donor lungs transplanted with another organ

All patients receiving a deceased donor lung transplant. A transplant is considered multi-organ if any organ of a different type is transplanted at the same time. A multi-organ transplant may include more than two different organs in total; if so, each non-lung organ will be considered separately.



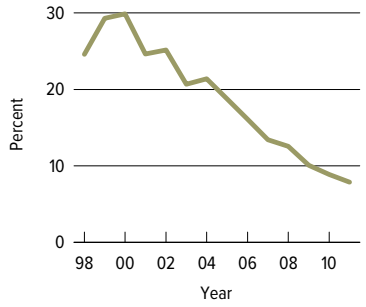
LU 2.5 Discard rates for lungs recovered for transplant

Percent of lungs discarded out of all lungs recovered for transplant. Lungs are counted individually.

Reasons for discard	Percent	N
Other, specify	29.0	31
Poor organ function	22.4	24
Anatomical abnormalities	19.6	21
Diseased organ	9.3	10
Organ trauma	6.5	7
Recipient determined to be unsuitable	5.6	6
Missing	1.9	2
Too old on pump	1.9	2
Vascular damage	1.9	2
Infection	0.9	1
Warm ischemic time too long	0.9	1

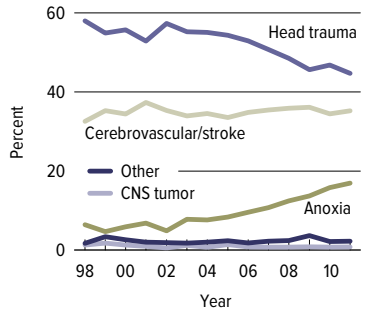
LU 2.6 Reasons for discards, 2011

Reasons for discard among lungs recovered for transplant but not transplanted in 2011.



LU 2.7 Lung donors with a smoking history of 20 pack-years or more

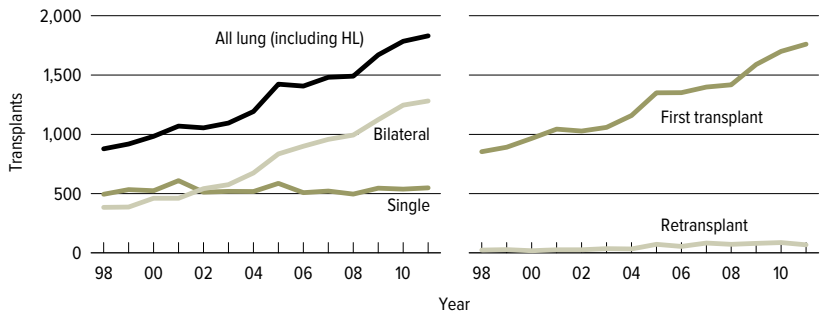
All deceased donors whose lung(s) were transplanted in the given year. Smoking history as reported to the OPTN.



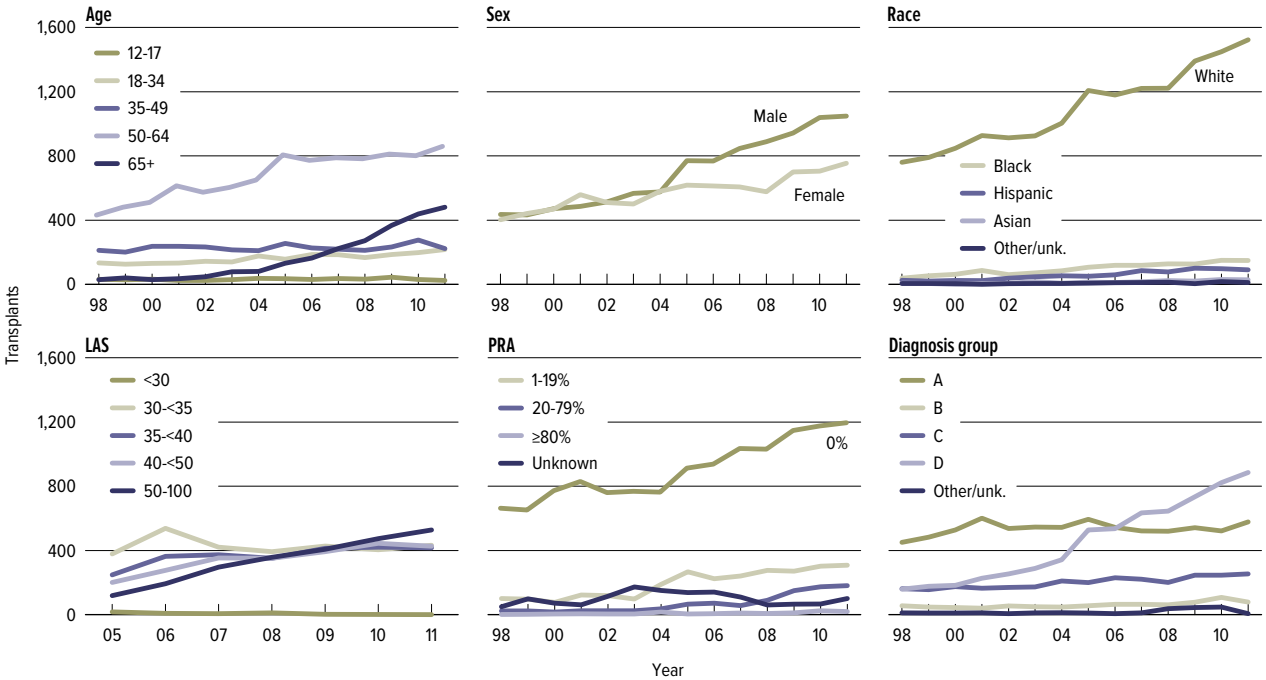
LU 2.8 Cause of death among deceased lung donors

Deceased donors whose lungs were transplanted. Donors who contributed more than one lung were counted once. CNS = central nervous system.

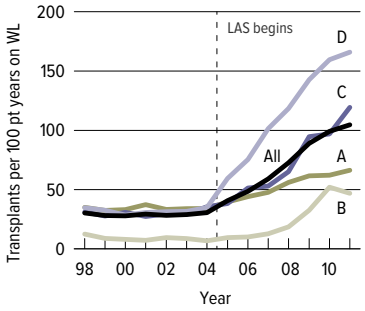
transplant



LU 3.1 Total adult lung transplants
Patients receiving a transplant. Retransplants are counted.

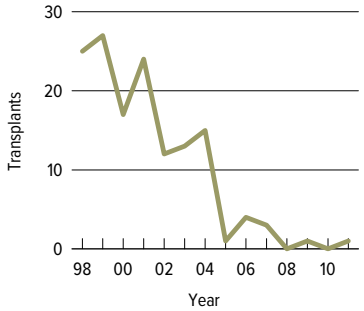


LU 3.2 Adult lung transplants
Patients receiving a transplant. Retransplants are counted.



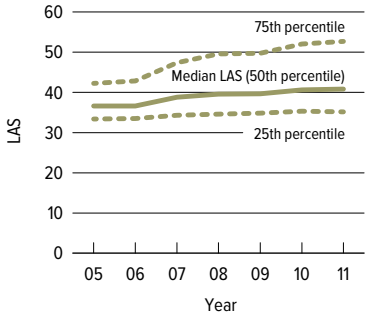
LU 3.3 Lung transplant rates in adult waiting list candidates, by diagnosis group

Patients waiting for a transplant. Rates are computed as the number of transplants per 100 patient-years of waiting time in the given year. All waiting time per patient per listing is counted, and all listings that end in a transplant for the patient are considered transplant events.



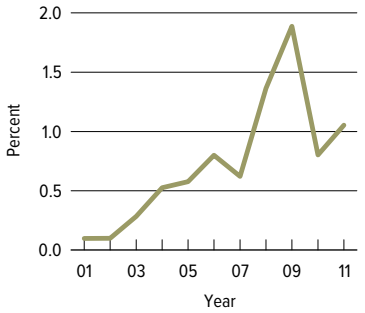
LU 3.4 Adult lung transplants from living donors

Living donor lung transplants.



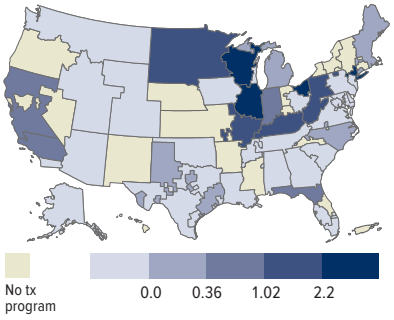
LU 3.5 Median LAS at transplant

Patients aged 12 years and older with all data required to compute LAS non-missing; last LAS prior to transplant.



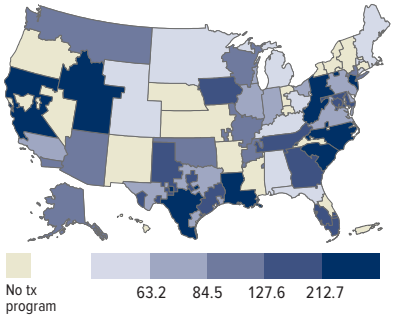
LU 3.6 Use of DCD lungs among adult lung transplant recipients

Percent of deceased donor transplants using a DCD donor.



LU 3.7 Percent of adult deceased donor lung transplants that are DCD, by DSA, 2005–2011

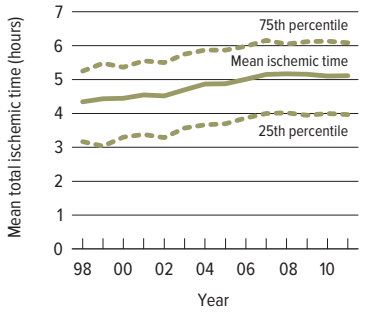
Percent of deceased donor transplants using a DCD donor, by DSA of the transplanting center.



LU 3.8 Deceased donor lung transplant rates per 100 patient years on the waiting list among adult candidates, by DSA, 2010–2011

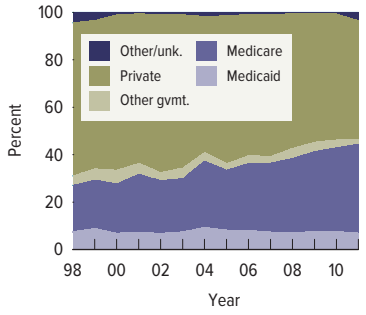
Transplant rates by DSA of the listing center, limited to those on the waiting list in 2010 and 2011; deceased donor transplants only. Maximum time per listing is two years.

transplant



LU 3.9 Total ischemia time for adult lung transplants

Patients receiving a transplant in the given year. Retransplants are included. Total ischemia time includes cold, warm and anastomotic time. For lung recipients with both lungs transplanted, the maximum of the ischemia time for the two lungs is used.



LU 3.10 Insurance coverage among adult lung transplant recipients at time of transplant

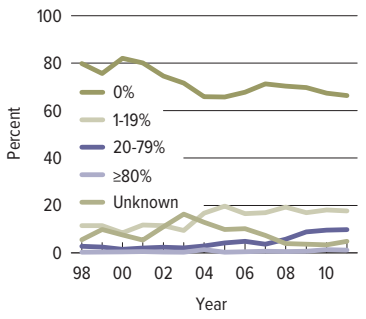
Patients receiving a transplant. Retransplants are counted.

		2001		2006		2011	
	Level	N	%	N	%	N	%
Age	12-17	25	2.4	31	2.2	25	1.4
	18-34	133	12.7	186	13.5	217	12.0
	35-49	237	22.7	227	16.4	223	12.4
	50-64	614	58.8	773	56.0	859	47.6
	65+	36	3.4	164	11.9	480	26.6
Sex	Female	559	53.5	613	44.4	755	41.9
	Male	486	46.5	768	55.6	1,049	58.1
Race	White	927	88.7	1,180	85.4	1,524	84.5
	Black	87	8.3	119	8.6	149	8.3
	Hispanic	24	2.3	60	4.3	91	5.0
	Asian	6	0.6	12	0.9	28	1.6
Diagnosis group	A	601	57.5	544	39.4	578	32.0
	B	40	3.8	64	4.6	79	4.4
	C	165	15.8	230	16.7	254	14.1
	D	227	21.7	536	38.8	886	49.1
	Other/unknown	12	1.1	7	0.5	7	0.4
Lung allocation score (LAS)	<30	0	0	9	0.7	1	0.1
	30-<35	0	0	538	39.0	432	23.9
	35-<40	0	0	364	26.4	417	23.1
	40-<50	0	0	276	20.0	427	23.7
	50-100	0	0	193	14.0	527	29.2
Blood type	A	417	39.9	580	42.0	741	41.1
	B	137	13.1	140	10.1	192	10.6
	AB	44	4.2	46	3.3	59	3.3
	O	447	42.8	615	44.5	812	45.0
Time on waiting list	<1 month	75	7.2	438	31.7	626	34.7
	1 -<3 months	121	11.6	298	21.6	410	22.7
	3 -<6 months	144	13.8	190	13.8	288	16.0
	6 -<12 months	183	17.5	162	11.7	246	13.6
	1-<2 years	224	21.4	133	9.6	153	8.5
	2-<3 years	206	19.7	69	5.0	43	2.4
	3+ years	82	7.8	90	6.5	38	2.1
	Unknown	10	1.0	1	0.1	0	0.0
Pretransplant medical cond.	Hospitalized: ICU	29	2.8	104	7.5	182	10.1
	Hospitalized: not ICU	36	3.4	116	8.4	159	8.8
	Not hospitalized	979	93.7	1,161	84.1	1,403	77.8
	Unknown	1	0.1	0	0.0	60	3.3
On ventilator at transplant	No	1,017	97.3	1,318	95.4	1,670	92.6
	Yes	28	2.7	63	4.6	134	7.4
Procedure type	Lobe	24	2.3	5	0.4	3	0.2
	Single	585	56.0	503	36.4	545	30.2
	Bilateral	436	41.7	873	63.2	1,256	69.6
Donor type	Deceased	1,021	97.7	1,377	99.7	1,803	99.9
	Donation after brain death	1,020	97.6	1,366	98.9	1,784	98.9
	Donation after circulatory death	1	0.1	11	0.8	19	1.1
	Living	24	2.3	4	0.3	1	0.1
Prior solid organ tx		28	2.7	58	4.2	74	4.1
Primary payer	Private	654	62.6	822	59.5	905	50.2
	Medicare	258	24.7	390	28.2	675	37.4
	Other government	127	12.2	158	11.4	163	9.0
	Other	6	0.6	11	0.8	61	3.4
Total	All patients	1,045	100.0	1,381	100.0	1,804	100.0

LU 3.11 Characteristics of adult lung transplant recipients, 2001, 2006, & 2011

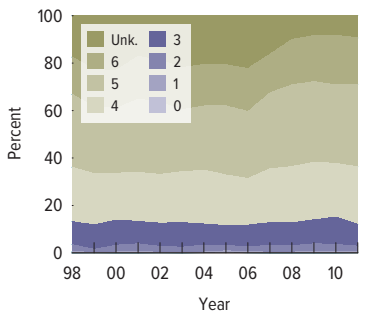
Patients receiving a transplant. Retransplants are counted.

donor-recipient matching



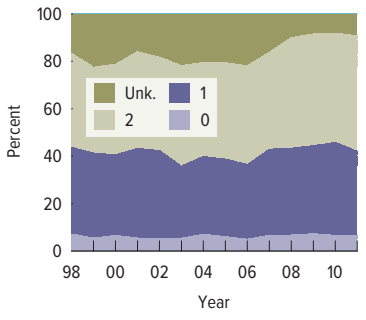
LU 4.1 PRA at time of lung transplant in adult recipients

PRA is the maximum of the most recent values recorded at the time of transplant. If "most recent PRA" is not provided, peak PRA is used.



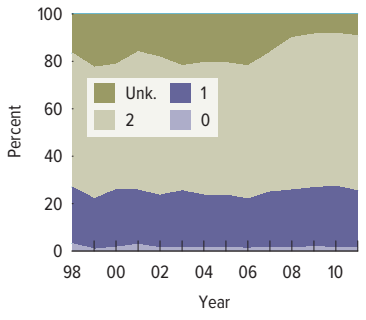
LU 4.2 Total HLA mismatches among adult lung transplant recipients

Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011.



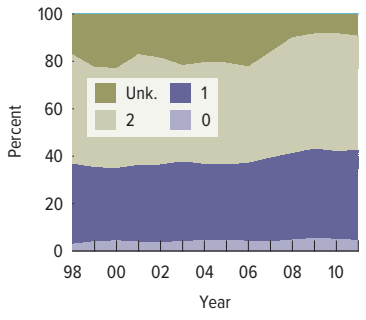
LU 4.3 HLA-A mismatches among adult lung transplant recipients

Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011.



LU 4.4 HLA-B mismatches among adult lung transplant recipients

Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011.



LU 4.5 HLA-DR mismatches among adult lung transplant recipients

Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011.

donor-recipient matching

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	15.6	24.4	0.2	40.2
Positive	18.8	35.3	0.2	54.3
Unknown	2.3	3.2	0.0	5.5
Total	36.7	62.9	0.4	100

LU 4.6 Adult lung donor-recipient cytomegalovirus (CMV) serology matching, 2007–2011

Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields are unknown, not done, or pending the person is considered to be "unknown" for that serology; otherwise, serology is assumed negative.

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	0.9	11.4	0.4	12.7
Positive	4.6	65.6	1.5	71.6
Unknown	0.9	14.2	0.6	15.7
Total	6.4	91.2	2.5	100

LU 4.7 Adult lung donor-recipient Epstein-Barr virus (EBV) serology matching, 2007–2011

Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields are unknown, not done, or pending the person is considered to be "unknown" for that serology; otherwise, serology is assumed negative.

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	78.6	1.8	0.1	80.5
Positive	3.3	0.2	0.0	3.5
Unknown	15.6	0.4	0.0	16.0
Total	97.5	2.3	0.1	100

LU 4.8 Adult lung donor-recipient hepatitis B core antibody (HBCAb) serology matching, 2007–2011

Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields are unknown, not done, or pending the person is considered to be "unknown" for that serology; otherwise, serology is assumed negative.

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	94.5	0.0	0.1	94.6
Positive	1.9	0.0	0.0	1.9
Unknown	3.5	0.0	0.0	3.5
Total	99.9	0.0	0.1	100

LU 4.9 Adult lung donor-recipient hepatitis B surface antigen (HBSAg) serology matching, 2007–2011

Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields are unknown, not done, or pending the person is considered to be "unknown" for that serology; otherwise, serology is assumed negative.

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	88.4	0.0	0.0	88.4
Positive	1.4	0.0	0.0	1.4
Unknown	10.2	0.0	0.0	10.2
Total	100.0	0.0	0.0	100

LU 4.10 Adult lung donor-recipient hepatitis C core antibody serology matching, 2007–2011

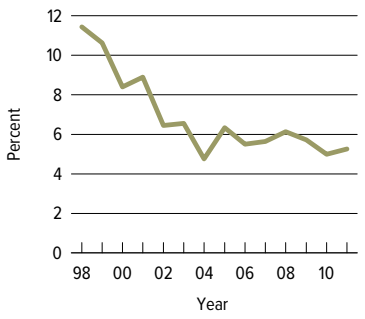
Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields are unknown, not done, or pending the person is considered to be "unknown" for that serology; otherwise, serology is assumed negative.

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	88.2	0.0	0.0	88.2
Positive	0.1	0.0	0.0	0.1
Unknown	11.7	0.0	0.0	11.7
Total	100.0	0.0	0.1	100

LU 4.11 Adult lung donor-recipient human immunodeficiency virus (HIV) serology matching, 2007–2011

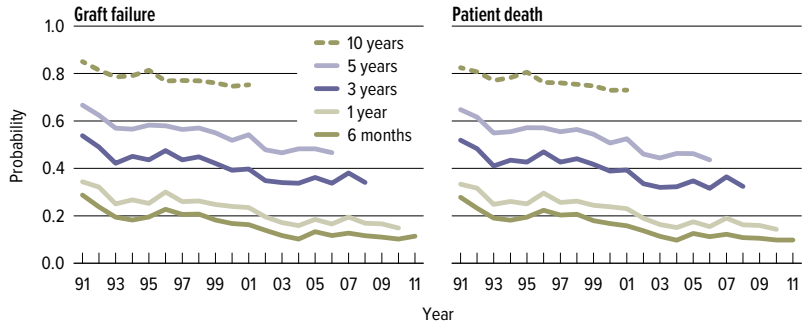
Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields are unknown, not done, or pending the person is considered to be "unknown" for that serology; otherwise, serology is assumed negative.

outcomes



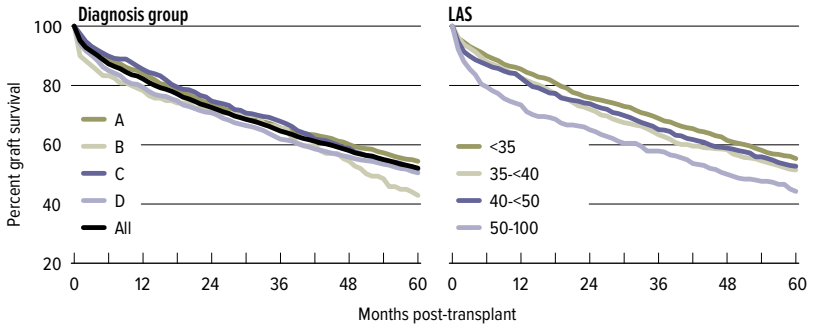
LU 5.1 Graft failure within the first 6 weeks after transplant among adult lung transplant recipients

All-cause graft failure is identified from multiple data sources, including the OPTN Transplant Recipient Registration, OPTN Transplant Recipient Follow-up, as well as death dates from the Social Security Administration.



LU 5.2 Graft failure & patient death among adult lung transplant recipients

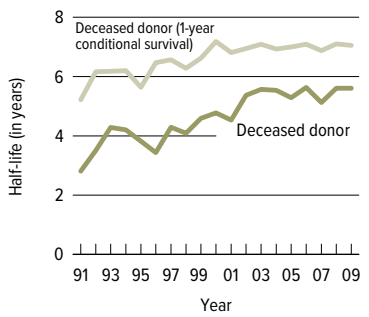
Cox proportional hazards models reporting probability, adjusting for age, sex, and race.



LU 5.3 Graft survival among adult lung transplant recipients transplanted in 2005–2006: deceased donors

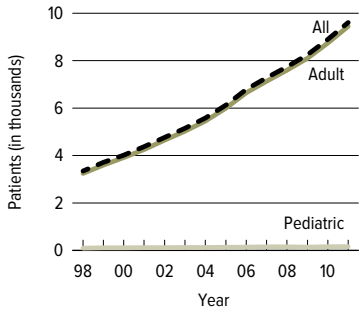
Graft survival estimated using unadjusted Kaplan-Meier methods.

outcomes



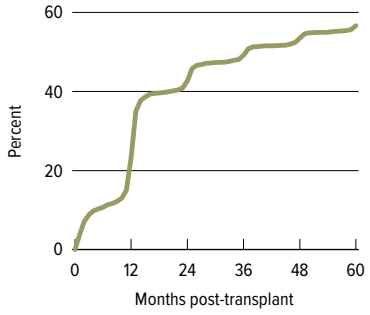
LU 5.4 Half-lives for adult lung transplant recipients

Estimated graft half-lives and conditional half-lives. Half-lives are interpreted as the estimated median survival of grafts from the time of transplant. Conditional half-lives are interpreted as the estimated median survival of grafts which survive the first year.



LU 5.5 Recipients alive & with a functioning lung transplant on June 30 of the year

Transplants before June 30 of the year that are still functioning. Patients are assumed alive with function unless a death or graft failure is recorded. A recipient can experience a graft failure and drop from the cohort, then be retransplanted and re-enter the cohort.



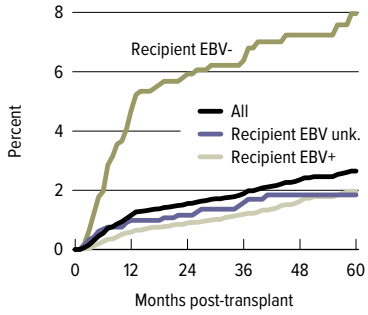
LU 5.6 Incidence of first acute rejection among adult patients receiving a lung transplant in 2005–2009

Acute rejection defined as a record of acute or hyperacute rejection, or a record of an anti-rejection drug being administered on either the Transplant Recipient Registration form or the Transplant Recipient Follow-up Form. Only the first rejection event is counted, and patients are followed for acute rejection only until graft failure, death, or loss to follow-up. Cumulative incidence, defined as the probability of acute rejection at any time prior to the given time, is estimated using Kaplan-Meier methods.

		One-year events, 2008–10 tx		Five-year events, 2004–06 tx	
	Level	N	%	N	%
Bronchiolitis Obliterans syndrome (BOS)	Grade 3	36	0.8	356	9.7
	Grade 2	32	0.7	170	4.6
	Grade 1	85	1.9	279	7.6
	Grade OP	107	2.3	263	7.2
	Grade unk.	110	2.4	485	13.2
	No	3,746	82.2	1,972	53.9
	Unk.	441	9.7	136	3.7
Renal dysfunction	Yes	807	17.7	1,737	47.4
	No	3,492	76.6	1,836	50.2
	Unk.	258	5.7	88	2.4
Hypertension, drug-treated	Yes	1,570	34.5	2,319	63.3
	No	1,660	36.4	874	23.9
	Unk.	1,327	29.1	468	12.8
Diabetes	Yes	878	19.3	1,654	45.2
	No	3,412	74.9	1,914	52.3
	Unk.	267	5.9	93	2.5
Malignancy	Yes	159	3.5	563	15.4
	No	4,131	90.7	3,039	83.0
	Unk.	267	5.9	59	1.6
Re-hosp.	Yes	2,402	52.7	3,064	83.7
	No	1,814	39.8	483	13.2
	Unk.	341	7.5	114	3.1
Total		4,557	100.0	3,661	100.0

LU 5.7 Post-transplant events among adult lung transplant recipients

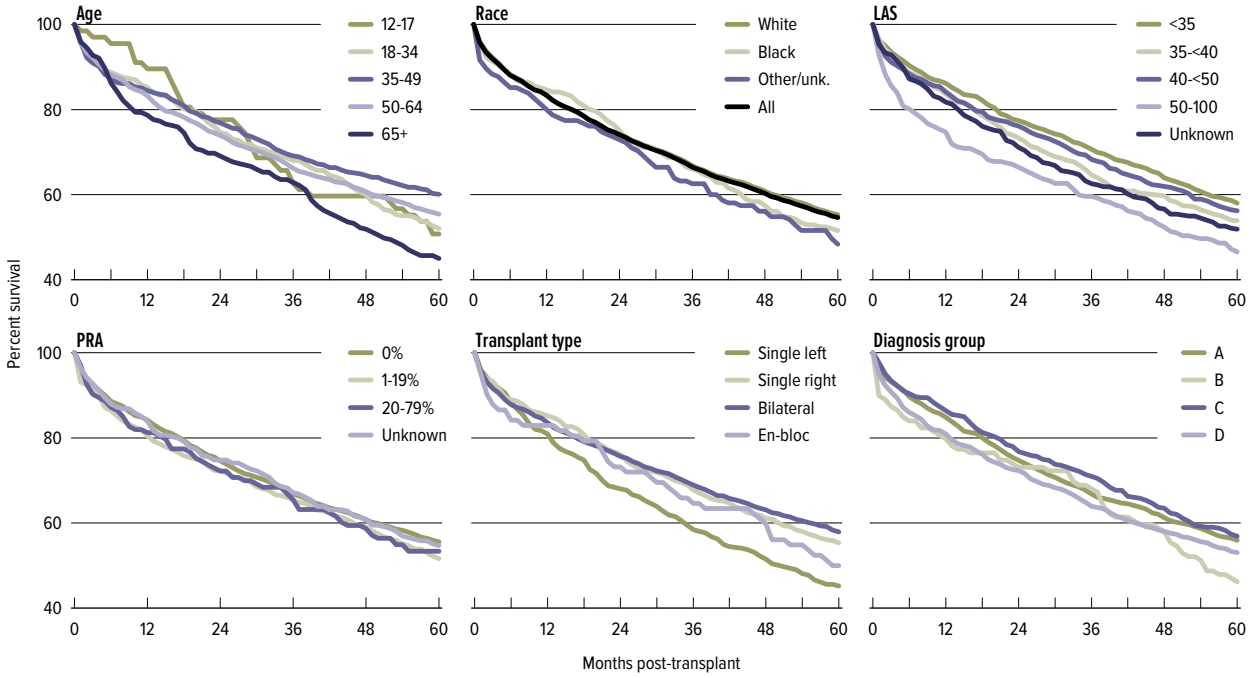
Post-transplant events are recorded on the Transplant Recipient Follw-up form. One-year events are reported for patients transplanted 2008–2010; five-year events are reported for those transplanted 2004–2006. Patients with more than one transplant are counted separately per transplant. Patients who did not survive the transplant hospitalization are excluded. For BOS, the most severe complication recorded for each transplant is counted.



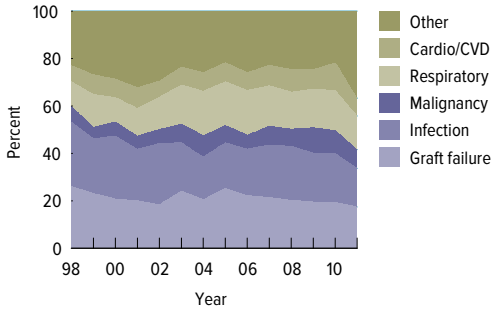
LU 5.8 Incidence of PTLD among adult patients receiving a lung transplant in 2005–2009, by recipient Epstein-Barr virus (EBV) status at transplant

The cumulative incidence, defined as the probability of post-transplant lymphoproliferative disorder (PTLD) being diagnosed between the time of transplant and the given time, is estimated using Kaplan-Meier methods. PTLD is identified as either a reported complication or cause of death on the Transplant Recipient Follow-up forms or on the Post-transplant Malignancy form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's Disease. Only the earliest date of PTLD diagnosis is considered, and patients are followed for PTLD until graft failure, death, or loss to follow-up. Patients are censored at graft failure because malignancies are not reliably reported after graft failure.

outcomes

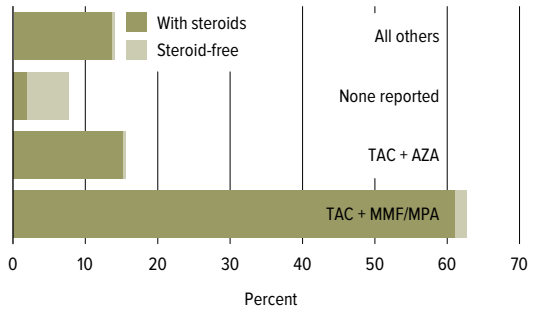


LU 5.9 Patient survival among adult lung transplant recipients, 2005–2006
Percent patient survival using unadjusted Kaplan-Meier methods. For patients with more than one transplant during the period, only their first transplant is considered. Data for PRA of 80-100% are not shown due to small N.



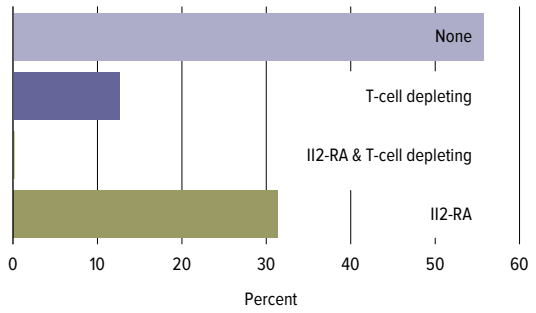
LU 5.10 Cause of death among adult lung transplant recipients
Patients who died in a given year are included regardless of when transplant was received. Primary cause of death is as reported by the OPTN from the Transplant Follow-up forms. Other causes of death include hemorrhage, trauma, non-compliance, unspecified other, unknown, etc.

immunosuppression



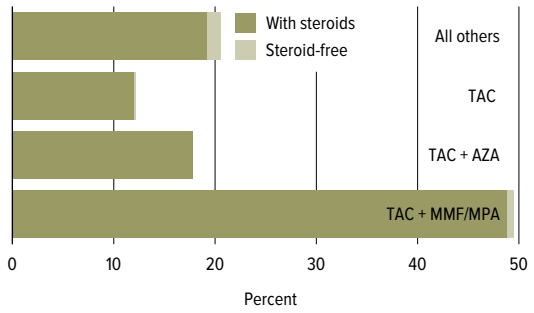
LU 6.1 Initial immunosuppression regimen in adult lung transplant recipients, 2011

Patients transplanted in 2011 and discharged with a functioning graft. Top three baseline immunosuppression regimens are given, plus the "all others" group. Regimens are defined by use of calcineurin inhibitors (TAC=Tacrolimus, Cyclo=Cyclosporine), anti-metabolites (AZA=Azathioprine, MMF/MPA=Mycophenolate), and mTOR inhibitors (mTOR). Data within each regimen are reported separately by steroid use.



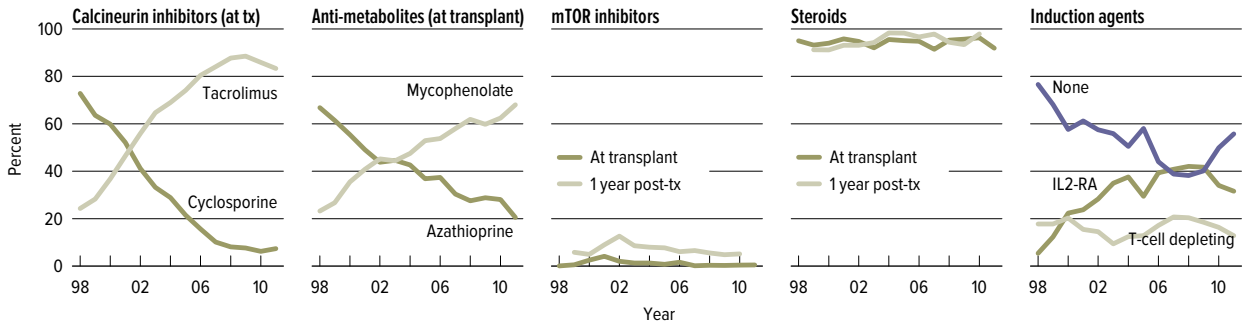
LU 6.2 Induction agents used at time of lung transplant, adult recipients, 2011

Patients transplanted in 2011 and discharged with a functioning graft.



LU 6.3 Immunosuppression at one year in adult lung transplant recipients, 2010

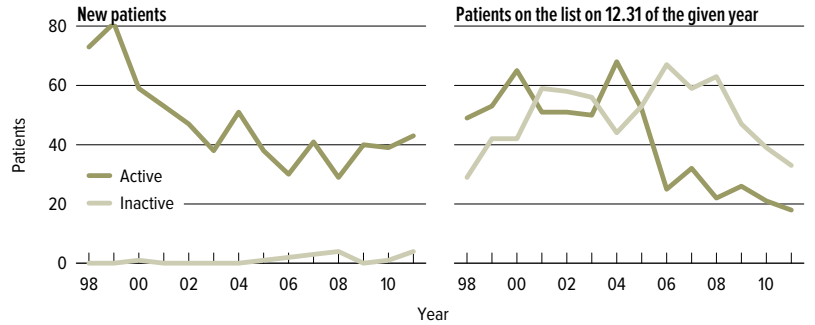
Patients transplanted in 2010 and remaining alive with graft function one year post-transplant. Top three one-year immunosuppression regimens are given, plus the "all others" group. Regimens are defined by use of calcineurin inhibitors (TAC=Tacrolimus, Cyclo=Cyclosporine), anti-metabolites (AZA=Azathioprine, MMF/MPA=Mycophenolate), and mTOR inhibitors (mTOR). Data within each regimen are reported separately by steroid use.



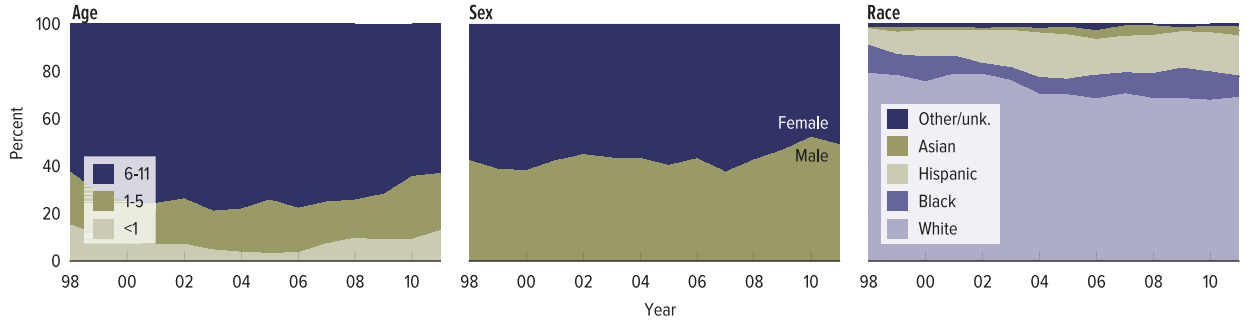
LU 6.4 Immunosuppression use in adult lung transplant recipients

One-year post-transplant data for mTOR inhibitors and steroids limited to patients alive with graft function one year post-transplant. One-year post-transplant data are not reported for 1998 transplant recipients, as follow-up data were very sparse.

pediatric transplant



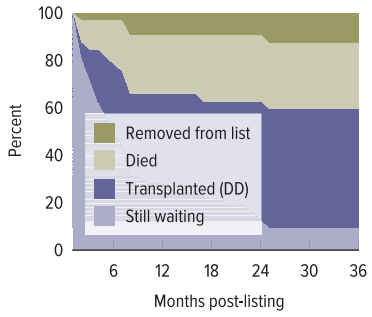
LU 7.1 Pediatric patients waiting for a lung transplant
Patients waiting for a transplant. A "new patient" is one who first joins the list during the given year, without having listed in a previous year. However, if a patient has previously been on the list, has been removed for a transplant, and has relisted since that transplant, the patient is considered a "new patient". Patients concurrently listed at multiple centers are counted only once. Those with concurrent listings and active at any program are considered active; those inactive at all programs at which they are listed are considered inactive.



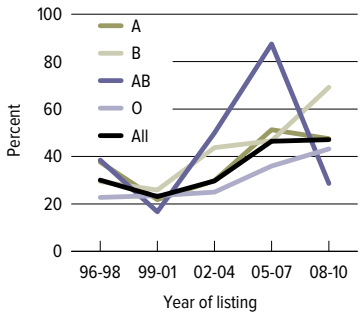
LU 7.2 Distribution of pediatric patients waiting for a lung transplant
Patients waiting for a transplant any time in the given year. Age determined on the lastest of listing date or January 1 of the given year. Concurrently listed patients are counted once.

	2009	2010	2011
Patients at start of year	86	73	60
Patients added during year	38	36	40
Patients removed during year	51	49	49
Patients at end of year	73	60	51
Removal reason			
Received a transplant	24	26	19
Patient died	8	11	13
improved, tx not needed	13	11	6
Too sick to transplant	1	0	3
Other	5	1	8

LU 7.3 Lung transplant waiting list activity among pediatric patients
Patients with concurrent listings at more than one center are counted once, from the time of earliest listing to the time of latest removal. Patients listed, transplanted, and re-listed are counted more than once. Patients are not considered "on the list" on the day they are removed. Thus, patient counts on Jan. 1 may be different from patient counts on Dec. 31 of the prior year.

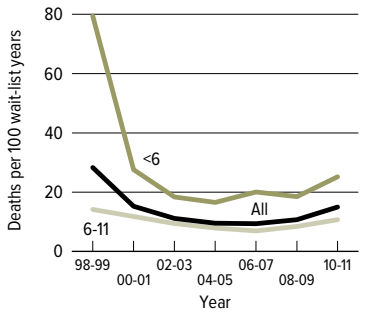


LU 7.4 Outcomes for pediatric patients waiting for a lung transplant among new listings in 2008
Patients waiting for a transplant and first listed in 2008. Patients with concurrent listings at more than one center are counted once, from the time of the earliest listing to the time of latest removal.



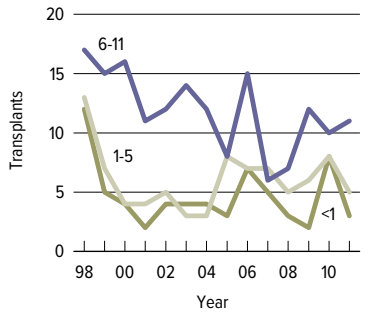
LU 7.5 Pediatric wait-listed patients who receive a deceased donor lung transplant within one year, by blood type
Patients with concurrent listings at more than one center are counted once, from the time of earliest listing to the time of latest removal. Patients listed, transplanted, and re-listed are counted more than once.

pediatric transplant



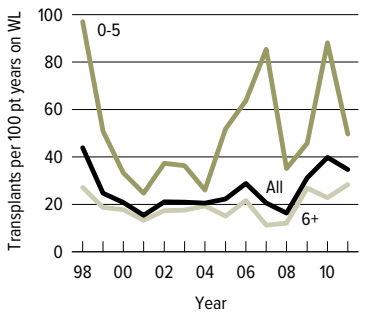
LU 7.6 Pre-transplant mortality rates among pediatric patients wait-listed for a lung transplant, by age

Patients waiting for a transplant. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given 2-year interval. Waiting time is calculated as the total waiting time per age group in the interval. Only deaths that occur prior to removal from the waiting list are counted. Age is calculated on the latest of listing date or January 1 of the given period.



LU 7.7 Pediatric lung transplants (including heart-lung), by age

Patients receiving a lung or heart-lung transplant.



LU 7.8 Lung transplant rates in pediatric waiting list patients, by age

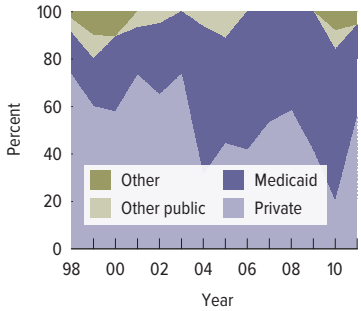
Patients waiting for transplant. Transplant rates are computed as the number of transplants per 100 patient-years of waiting time in the given 2-year interval. Patients with concurrent listings at multiple centers are counted once.

		1999-2001		2009-2011	
	Level	N	%	N	%
Age	<1	9	16.7	13	21.7
	1-5	9	16.7	17	28.3
	6-11	36	66.7	30	50.0
Sex	Female	37	68.5	28	46.7
	Male	17	31.5	32	53.3
Race	White	42	77.8	39	65.0
	Black	4	7.4	7	11.7
	Hispanic	7	13.0	11	18.3
	Asian	1	1.9	2	3.3
	Other/unk.	0	0.0	1	1.7
Primary diagnsosis	Cystic fibrosis	22	40.7	14	23.3
	Pulmonary hypertension	13	24.1	10	16.7
	Pulmonary fibrosis	4	7.4	9	15.0
	Other vascular	3	5.6	4	6.7
	All others	12	22.2	23	38.3
Transplant number	First	53	98.1	57	95.0
	Retransplant	1	1.9	3	5.0
Blood type	A	16	29.6	24	40.0
	B	9	16.7	11	18.3
	AB	1	1.9	3	5.0
	O	28	51.9	22	36.7
Time on waiting list	<1 month	13	24.1	13	21.7
	1 -<3 months	11	20.4	21	35.0
	3-<6 months	7	13.0	11	18.3
	6-<12 months	9	16.7	8	13.3
	1-<2 years	9	16.7	5	8.3
	2+ years	1	1.9	2	3.3
	Unknown	4	7.4	0	0.0
Pretransplant medical condition	Hospitalized: ICU	17	31.5	19	31.7
	Hospitalized: not ICU	8	14.8	10	16.7
	Not hospitalized	29	53.7	31	51.7
Patient on ventilator immediately pre-tx	No	43	79.6	39	65.0
	Yes	11	20.4	21	35.0
Procedure type	Bilateral sequential	41	75.9	57	95.0
	Bilateral en-bloc	5	9.3	3	5.0
	Unknown	8	14.8	0	0.0
Donor type	Deceased	46	85.2	60	100.0
	Living	8	14.8	0	0.0
Primary payer	Private	34	63.0	22	36.7
	Medicaid	13	24.1	33	55.0
	Other Public	3	5.6	2	3.3
	Unknown	4	7.4	3	5.0
All patients		54	100.0	60	100.0

LU 7.9 Characteristics of pediatric lung transplant recipients, 1999–2001 & 2009–2011

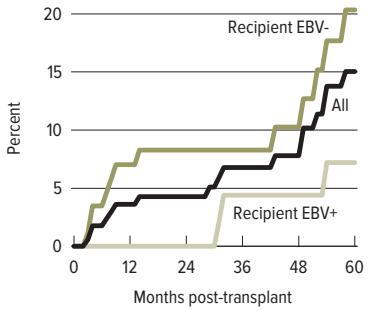
Patients receiving a transplant. Retransplants are counted.

pediatric transplant



LU 7.10 Insurance coverage among pediatric lung transplant recipients at time of transplant

Patients receiving a transplant in given year; reported primary insurance payor at time of transplant. Retransplants are counted.



LU 7.11 Incidence of PTLD among pediatric patients receiving a lung transplant, 1999–2009 , by recipient Epstein-Barr virus (EBV) status at transplant

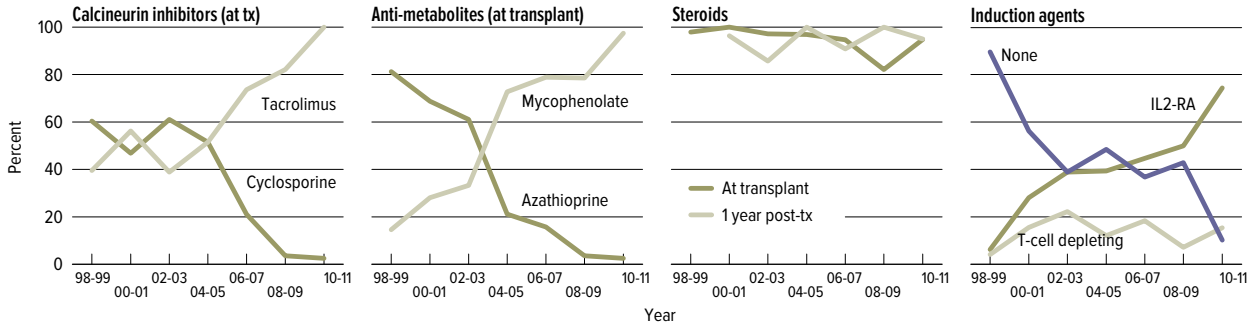
The cumulative incidence, defined as the probability of post-transplant lymphoproliferative disorder (PTLD) being diagnosed between the time of transplant and the given time, is estimated using Kaplan-Meier methods. PTLD is identified as either a reported complication or cause of death on the Transplant Recipient Follow-up forms or on the Post-transplant Malignancy form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's Disease. Only the earliest date of PTLD diagnosis is considered, and patients are followed for PTLD until graft failure, death, or loss to follow-up. Patients are censored at graft failure because malignancies are not reliably reported after graft failure.

		One-year events, 2007–10 tx		Five-year events, 2003–06 tx	
	Level	N	%	N	%
Bronchiolitis Obliterans syndrome (BOS)	Grade 3	1	1.6	4	6.0
	Grade 2	0	0.0	1	1.5
	Grade 1	0	0.0	2	3.0
	Grade OP	0	0.0	1	1.5
	Grade unk.	0	0.0	16	23.9
	No	55	85.9	43	64.2
	Unk.	8	12.5	0	0.0
Renal dysfunction	Yes	4	6.3	18	26.9
	No	56	87.5	49	73.1
	Unk.	4	6.3	0	0.0
Hypertension, drug-treated	Yes	21	32.8	37	55.2
	No	37	57.8	28	41.8
	Unk.	6	9.4	2	3.0
Diabetes	Yes	1	1.6	16	23.9
	No	59	92.2	51	76.1
	Unk.	4	6.3	0	0.0
Malignancy	Yes	1	1.6	5	7.5
	No	59	92.2	62	92.5
	Unk.	4	6.3	0	0.0
Re-hosp.	Yes	33	51.6	59	88.1
	No	28	43.8	8	11.9
	Unk.	3	4.7	0	0.0
Total		64	100.0	67	100.0

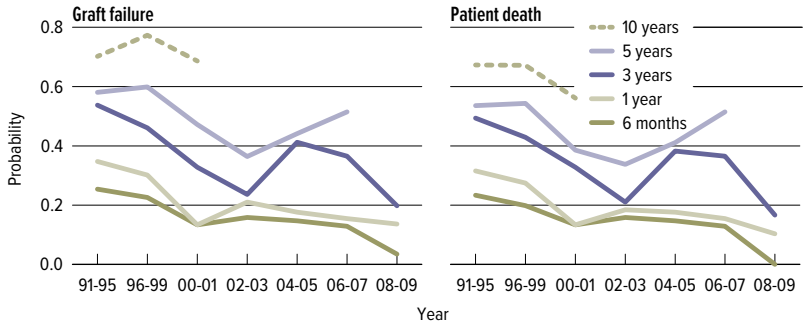
LU 7.12 Post-transplant events among pediatric lung transplant recipients

One-year events are reported for patients transplanted 2007–2010; five-year events are reported for those transplanted 2003–2006. Patients with more than one transplant are counted separately per transplant. Patients who did not survive the transplant hospitalization are excluded. For BOS, the most severe complication recorded for each transplant is counted.

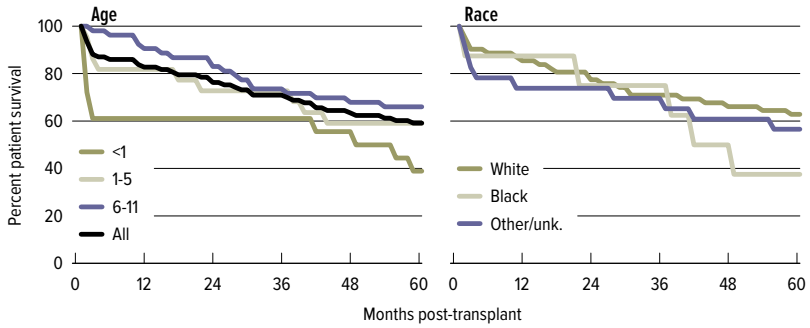
pediatric transplant



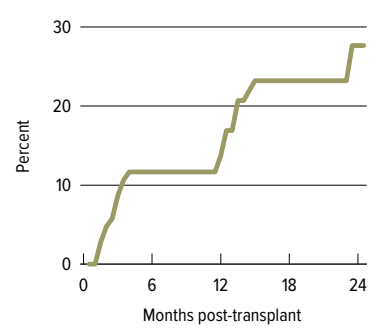
LU 7.13 Immunosuppression use among pediatric lung transplant recipients
One-year post-transplant data for steroids limited to patients alive with graft function one year post-transplant. One-year post-transplant data are not reported until 2000 due to sparse data.



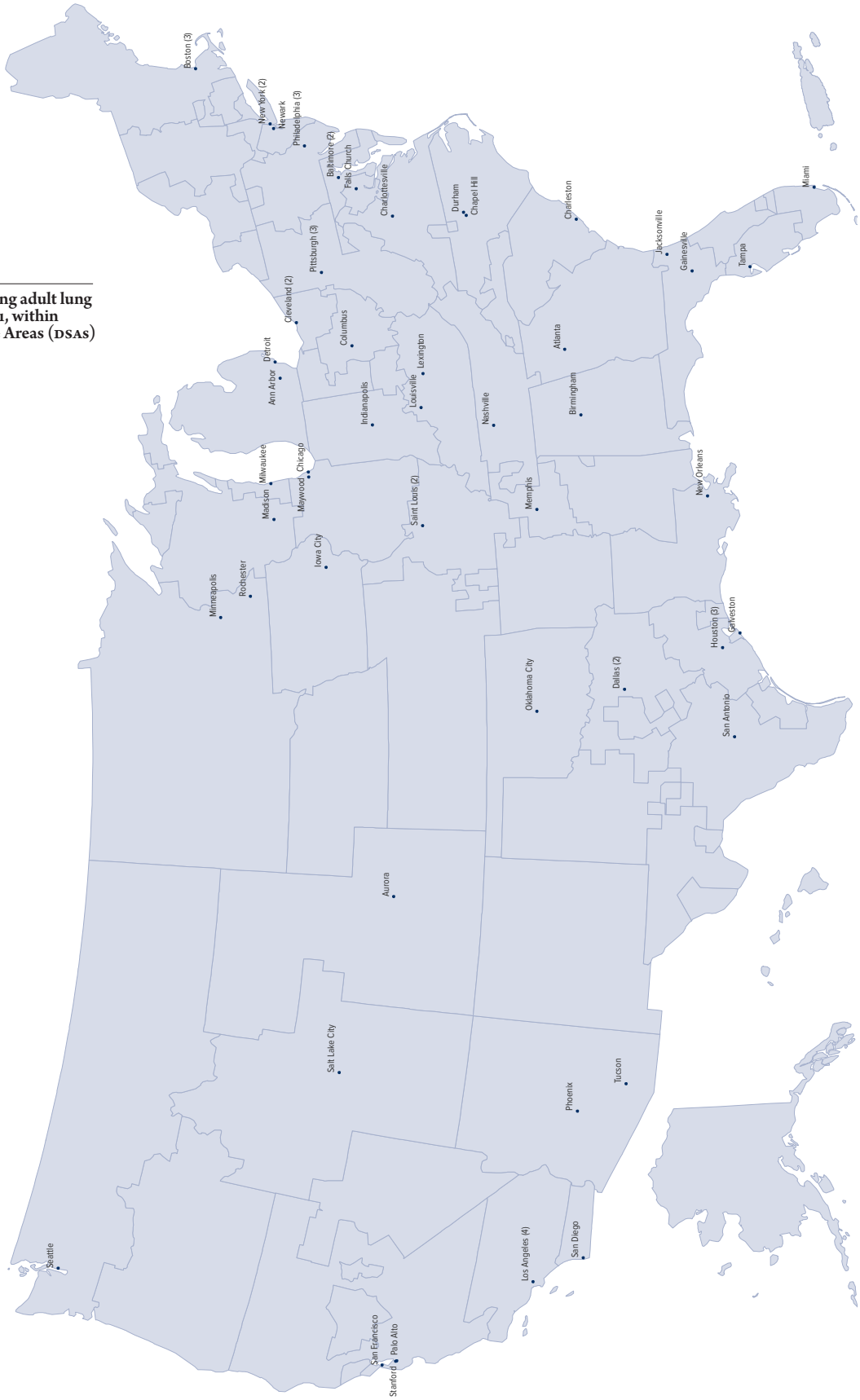
LU 7.14 Graft failure & patient death among pediatric lung transplant recipients
Cox proportional hazards model reporting probability, adjusting for age, sex, and race.



LU 7.15 Survival among pediatric lung transplant recipients, 2002–2006
Percent patient survival using unadjusted Kaplan-Meier methods. For patients with more than one transplant during the period, only their first transplant is considered.

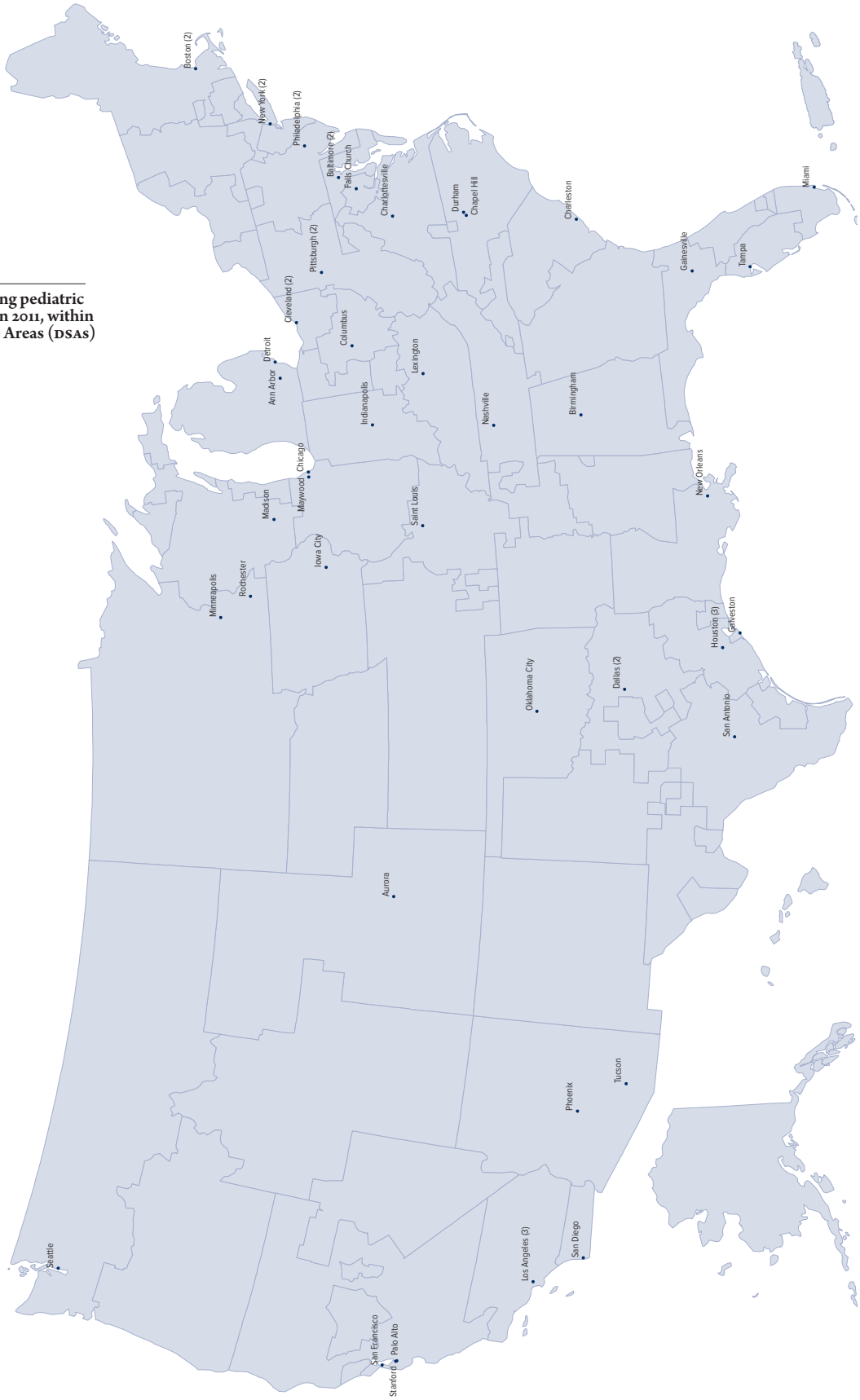


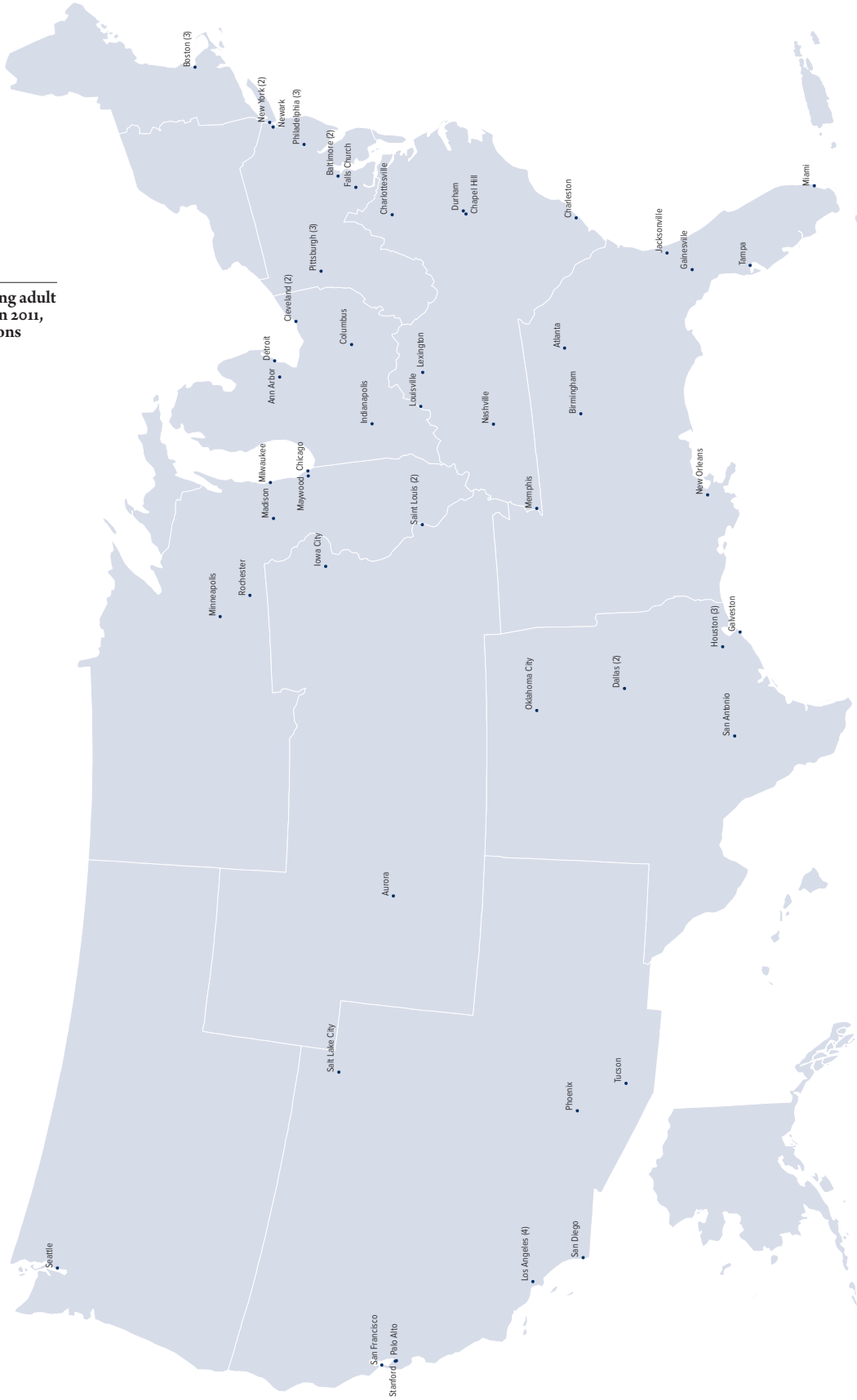
LU 7.16 Incidence of first acute rejection among pediatric patients receiving a lung transplant in 2005–2010
Acute rejection defined as a record of acute or hyperacute rejection, or a record of an anti-rejection drug being administered on either the Transplant Recipient Registration form or the Transplant Recipient Follow-up Form. Only the first rejection event is counted, and patients are followed for acute rejection only until graft failure, death, or loss to follow-up. Cumulative incidence, defined as the probability of acute rejection at any time prior to the given time, is estimated using Kaplan-Meier methods.



LU 8.1 Centers performing adult lung transplants in 2011, within Donation Service Areas (DSAs)

LU 8.2 Centers performing pediatric lung transplants in 2011, within Donation Service Areas (DSAs)





LU 8.3 Centers performing adult lung transplants in 2011, within OPTN regions