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waiting list .....	4
deceased donation .....	8
living donation .....	9
transplant .....	11
donor-recipient matching .....	14
outcomes .....	15
pediatric transplant .....	19
transplant center maps....	25

## OPTN/SRTR 2013 Annual Data Report:

# liver

**ABSTRACT** During 2013, 10,479 adult candidates were added to the liver transplant waiting list, compared with 10,185 in 2012; 5921 liver transplants were performed, and 211 of the transplanted organs were from living donors. As of December 31, 2013, 15,027 candidates were registered on the waiting list, including 12,407 in active status. The most significant change in allocation policy affecting liver waitlist trends in 2013 was the Share 35 policy, whereby organs from an entire region are available to candidates with model for end-stage liver disease scores of 35 or higher. Median waiting time for such candidates decreased dramatically, from 14.0 months in 2012 to 1.4 months in 2013, but the effect on waitlist mortality is unknown. The number of new active pediatric candidates added to the liver transplant waiting list increased to 693 in 2013. Transplant rates were highest for candidates aged younger than 1 year (275.6 per 100 waitlist years) and lowest for candidates aged 11 to 17 years (97.0 per 100 waitlist years). Five-year graft survival was 71.7% for recipients aged younger than 1 year, 74.9% for ages 1 to 5 years, 78.9% ages 6 to 10 years, and 77.4% for ages 11 to 17 years.

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**KEY WORDS** Liver transplant, model for end-stage liver disease, waiting list.

*We are still waiting for the call that they have a liver for our 9 year old daughter. We jump every time the phone rings.*

Robin, mother

## Adult Liver Transplant

### Introduction

In 2013, 5921 liver transplants were performed in adults; 5710 organs were from deceased donors and 211 were from living donors (Figure LI 4.5). In the US, 139 centers performed at least one adult liver transplant. As of December 31, 2013, 15,027 candidates were registered on the waiting list, including 12,407 in active status (Figure LI 1.3). Waitlist mortality remained a concern; 1767 patients died while waiting for a liver transplant and another 1223 were removed from the list due to being too sick to undergo transplant (Figure LI 1.7). Early data after implementation of the so-called Share 35 policy suggest that waiting time for patients with high model for end-stage liver disease (MELD) scores was reduced dramatically (Figure LI 1.9), although waitlist mortality did not change appreciably (Figure LI 1.10). As of June 30, 2013, more than 59,000 adults were living with a functioning liver graft (Figure LI 6.6).

### Waiting List

During 2013, 10,479 candidates were added to the liver transplant waiting list (Figure LI 1.7), compared with 10,185 in 2012. The number of active waitlist candidates on December 31, 2013, was 12,407, compared with 12,442 one year before (Figure LI 1.3). The number of candidates on the active list has remained stable over time (Figure LI 1.1).

The most significant change in allocation policy affecting liver waitlist trends in 2013 was the Share 35 policy, whereby organs from an entire region are available to candidates with MELD scores of 35 or higher. Median waiting time for candidates with MELD scores of 35 or higher decreased dramatically, from 14.0 months in 2012 to 1.4 months in 2013 (Figure LI 1.9). Waiting times for status 1A/1B candidates did not change appreciably. The extent to which the shortened waiting time for candidates with high MELD scores will translate to reduced waitlist mortality remains to be determined.

### Donation/Transplant

Over the past several years, deceased donation rates, rates of livers recovered for transplant and not transplanted, and use of donation after circulatory death (DCD) livers have not changed dramatically (Figures LI 2.1 to LI 2.5). Similarly, numbers of living donor transplants and donor outcomes after the procedure have remained stable (Figures LI 3.1 to LI 3.10).

Data on recipients show a continued trend toward older ages; 15.0% of all adult recipients in 2013 were aged 65 years or older (Figure LI 4.2). Hepatitis C virus (HCV) remained the most common single diagnosis, followed by malignancies, some of which likely also represent HCV (Figure LI 4.2).

Geographic disparity in the median MELD score and the gap between laboratory and allocation MELD scores at the time of transplant continued (Figures LI 4.8 and LI 4.9).

The proportion of multi-organ transplants, particularly simultaneous liver and kidney transplants, continued to increase; the proportion of simultaneous liver and kidney transplants rose from 6.7% in 2010 to 7.8% in 2012 and 8.1% in 2013 (Figure LI 4.5). Shorter waiting times for high MELD candidates may potentially reduce the need for these transplants by decreasing the frequency of prolonged hepatorenal syndrome and acute kidney injury; however, the observation period under the Share 35 rule in 2013 was not long enough to show an impact on the national trend.

### Outcomes

Despite progressive escalation in the severity of end-stage liver disease, graft survival trends are encouraging (Figures LI 6.1 and LI 6.2). Pretransplant disease severity affects immediate postoperative survival, but both 30- and 90-day graft survival for all deceased donor livers remained robust. Survival after living donor and DCD transplant also remained favorable (Figures LI 6.1 and LI 6.3). Regarding primary diagnosis, HCV recipients continued to experience the poorest graft survival, often related to recurrent hepatitis C (Figure LI 6.4). Hopefully, new antiviral agents introduced in late 2013 will reduce late graft failure, a trend that will be monitored closely. Overall, as of June 30, 2013, 59,500 liver transplant recipients were alive with a functioning graft, with many more pediatric recipients reaching adulthood each year (Figure LI 6.6).

## Pediatric Transplant

### Waiting List

In 2013, the number of new active candidates added to the pediatric liver transplant waiting list increased to 693; very few candidates were added as inactive (Figure LI 7.1). The number of prevalent candidates (on the list on December 31 of the given year) continued to decline, and most (66.9%) were listed as active. The age distribution of waitlist candidates has remained remarkably similar over the past decade. In 2013, 19.8% of candidates were aged younger than 1 year, 31.3% were aged 1 to 5 years, 14.1% were aged 6 to 10 years, and 34.8% were aged 11 to 17 years (Figure LI 7.2). White candidates represented the largest racial/ethnic group on the waiting list in 2013 (53.8%) followed by Hispanic (24.2%), black (13.7%), and Asian candidates (5.7%). Most (63.8%) candidates had been waiting for less than 1 year, 9.6% for 1 to less than 2 years, 9.2% for 2 to less than 4 years, and 17.4% for 4 or more years. In 2013, 25.1% of candidates were at status 1A/1B, 11.0% had MELD/pediatric end-stage liver disease

(PELD) scores of less than 15, 22.3% had MELD/PELD scores of 15 to 29, and 19.0% had MELD/PELD score of 30 or higher.

Comparing waitlist candidates from 2003 to 2013, a higher proportion were Hispanic in 2013 (17.0% vs. 22.3%), and a higher proportion waited for less than 1 year (31.1% vs. 42.4%) (Figure LI 7.3). Interestingly, the proportion of candidates awaiting retransplant decreased from 17.5% in 2003 to 7.7% in 2013. Among candidates removed from the waiting list in 2013, 70.4% received a deceased donor liver, 5.9% received a living donor liver, 4.8% died, 12.1% were removed from the list because their condition improved, and 2.1% were considered too sick to undergo transplant (Figure LI 7.4). Approximately 67% of candidates newly listed in 2010 underwent deceased donor transplant within 3 years, 9.0% underwent living donor transplant, 5.4% died, 11.9% were removed from the list, and 7.1% were still waiting (Figure LI 7.5). In 2013, the rate of deceased donor transplant among active pediatric candidates was 140.2 per 100 active waitlist years (Figure LI 7.6). Rates were highest for candidates aged younger than 1 year (275.6 per 100 active waitlist years) and lowest for candidates aged 11 years or older (97.0 per 100 active waitlist years). Of note, transplant rates have been steadily increasing for candidates aged younger than 1 year. Pretransplant mortality has decreased for all age groups, to 6.0 deaths per 100 waitlist years in 2012-2013 (Figure LI 7.7). The pretransplant mortality rate was highest for candidates aged younger than 1 year, at 26.4 deaths per 100 waitlist years in 2012-2013 (Figure LI 7.7).

### Transplant

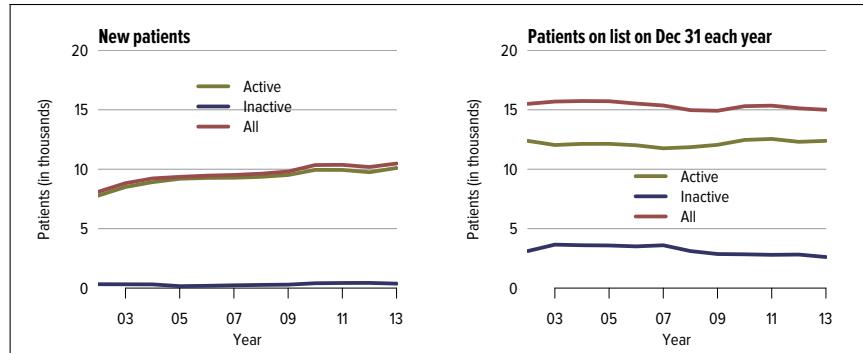
The number of deceased donor liver transplants peaked at 542 in 2008 and was 493 in 2013 (Figure LI 7.8). The number of living donor liver transplants decreased from a peak of 120 in 2000 to 41 in 2013 with most (70.7%) from closely related donors (Figure LI 7.9). Over the past decade of pediatric liver transplant, recipient age, sex, and racial/ethnic distributions have changed little (Figure LI 7.10). Cholestatic disease remained the leading cause of liver failure (45.6%). In 2011-2013, 9.2% of liver transplant recipients had undergone previous transplant, a decrease from almost 14% a decade earlier. Insurance coverage appears to be changing; the percentage of recipients with private insurance decreased from 53.3% to 44.3%, and Medicaid coverage increased. In 2011-2013, 38.5% of recipients waited less than 31 days for transplant, and 14.9% waited 31 to 60 days, similar to 2001-2003. Almost 60% of liver transplant recipients were not hospitalized before transplant. Regarding medical urgency status, 34.3% of recipients underwent transplant as status 1A/1B, and 15.2% had MELD/PELD scores of 35 or higher. The most common

scores at the time of transplant were 15 to 29 (25.0%). Types of liver transplant procedures in pediatric recipients changed little over the past decade; 64.0% of patients received a whole liver in 2011-2013, 19.7% received a partial liver, and 16.2% received a split liver. The proportion of living donors declined from 14.9% in 2001-2003 to 9.5% in 2011-2013. ABO-incompatible liver transplant occurred in 2.9% of recipients in 2011-2013, similar to the earlier era.

### Immunosuppression and Outcomes

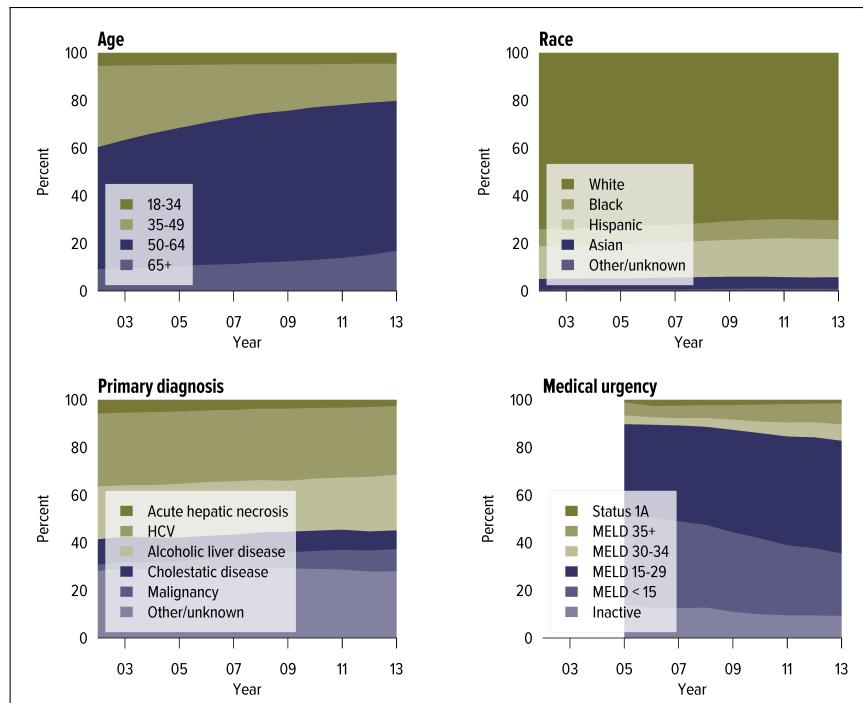
In 2013, 22.7% of pediatric liver recipients received interleukin-2 receptor antagonists for induction therapy, 12.3% received a T-cell depleting agent, and 66.0% reported no induction (Figure LI 7.12). The most commonly used initial immunosuppression agents included tacrolimus (96.2%), steroids (84.5%), and mycophenolate mofetil (38.0%). Use of mammalian target of rapamycin inhibitors at the time of transplant was minimal (1.6%), but increased to 5.1% at 1 year posttransplant. At 1 year posttransplant, 52.9% of recipients were receiving steroids. Graft survival continued to improve over the past decade among recipients of deceased donor and living donor livers. Graft survival was 92.3% at 30 days for deceased donor transplants performed in 2013, 89.3% at 1 year for transplants performed in 2012, 84.6% at 3 years for transplants performed in 2010, 78.1% at 5 years for transplants performed in 2008, and 68.4% at 10 years for transplants performed in 2003 (Figure LI 7.13). Graft survival was 98.5% at 30 days for living donor transplants performed in 2013, 93.1% at 1 year for transplants performed in 2011-2012, 85.4% at 3 years for transplants performed in 2009-2010, 85.7% at 5 years for transplants performed in 2007-2008, and 67.5% at 10 years for transplants performed in 2001-2002 (Figure LI 7.14). By age, 5-year graft survival was 71.7% for recipients aged younger than 1 year, 74.9% for ages 1 to 5 years, 78.9% ages 6 to 10 years, and 77.4% for ages 11 to 17 years (Figure LI 7.16). Five-year graft survival was lowest, 60.0%, for recipients with HCV as cause of disease. Five-year graft survival was 76.4% for recipients of a first liver transplant, compared with 64.5% for retransplant recipients. The incidence of acute rejection was remarkably similar for all age groups and lowest for recipients aged younger than 1 year. Of recipients in 2007 to 2011, approximately 18% experienced acute rejection by 6 months posttransplant, 27% to 31% by 12 months, and 29% to 39% by 24 months (Figure LI 7.15); 13.5% died within 5 years of transplant (Figure LI 7.17), and the leading cause of death was infection at 1 year and 5 years posttransplant. The incidence of posttransplant lymphoproliferative disorder was 4.6% at 5 years posttransplant for recipients who were negative for Epstein-Barr virus and 3.4% for those who were positive (Figure LI 7.11).

# waiting list



## LI 1.1 Adults waiting for liver transplant

A new patient is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and subsequently relisted are considered new. Candidates concurrently listed at multiple centers are counted once. Concurrently listed candidates who are active at any program are considered active; those who are inactive at all programs are considered inactive.



## LI 1.2 Distribution of adults waiting for liver transplant

Candidates waiting for transplant any time in the given year. Candidates listed concurrently at multiple centers are counted once. Age is determined at the later of listing date or January 1 of the given year. Time on the waiting list is determined at the earlier of December 31 or removal from the waiting list. Medical urgency status is the most severe during the year. Active and inactive patients are included. HBV, hepatitis B virus; HCV, hepatitis C virus.

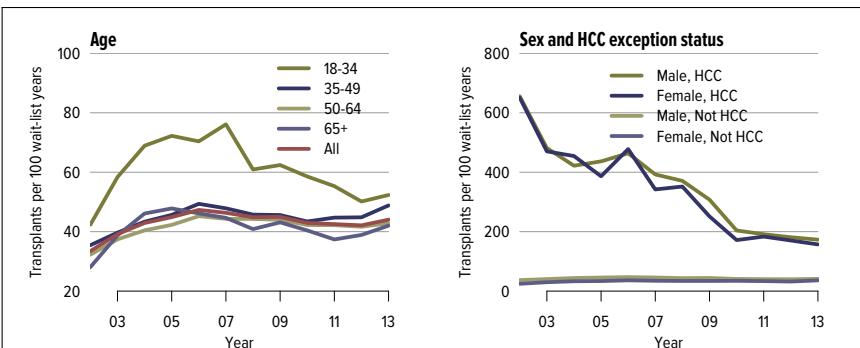
# Waiting list

		2003		2013	
		N	%	N	%
<b>Age</b>	18-34	671	4.3	616	4.1
	35-49	4,434	28.2	2,189	14.6
	50-64	8,949	57.0	9,361	62.3
	65+	1,659	10.6	2,861	19.0
<b>Sex</b>	Female	6,512	41.4	5,598	37.3
	Male	9,201	58.6	9,429	62.7
<b>Race</b>	White	11,561	73.6	10,498	69.9
	Black	1,045	6.7	1,084	7.2
	Hispanic	2,280	14.5	2,517	16.7
	Asian	739	4.7	779	5.2
	Other/unknown	88	0.6	149	1.0
<b>Citizenship</b>	US citizen	15,211	96.8	14,264	94.9
	Non-citizen resident	336	2.1	305	2.0
	Non-citizen non-resident	143	0.9	32	0.2
	Other/unknown	23	0.1	426	2.8
<b>Primary diagnosis</b>	Acute hepatic necrosis	713	4.5	277	1.8
	HCV	4,879	31.1	4,418	29.4
	Alcoholic liver disease	3,541	22.5	3,617	24.1
	Cholestatic disease	1,792	11.4	1,245	8.3
	Malignancy	321	2.0	1,165	7.8
	Other/unk.	4,467	28.4	4,305	28.6
<b>Liver tx history</b>	First transplant	14,723	93.7	14,636	97.4
	Retransplant	990	6.3	391	2.6
<b>Blood type</b>	A	5,636	35.9	5,813	38.7
	B	1,770	11.3	1,634	10.9
	AB	412	2.6	392	2.6
	O	7,895	50.2	7,188	47.8
<b>Waiting time</b>	<1 year	4,817	30.7	5,785	38.5
	1-< 2 years	2,796	17.8	2,696	17.9
	2-< 3 years	2,500	15.9	1,726	11.5
	3-< 4 years	1,896	12.1	1,202	8.0
	4-< 5 years	1,342	8.5	795	5.3
	5+ years	2,362	15.0	2,823	18.8
<b>Medical urgency</b>	Status 1/1A/1B	6	0.0	1	0.0
	MELD 35+	30	0.2	52	0.3
	MELD 30-34	66	0.4	257	1.7
	MELD 15-29	2,838	18.1	5,242	34.9
	MELD < 15	9,112	58.0	6,855	45.6
	Inactive	3,661	23.3	2,620	17.4
<b>HCC exception</b>	Yes	228	1.5	955	6.4
	No	15,485	98.5	14,072	93.6
<b>Multi-organ</b>	Liver alone	15,435	98.2	14,138	94.1
	Liver-kidney	244	1.6	811	5.4
	Liver-pancreas-intestine	14	0.1	33	0.2
	Liver-heart	6	0.0	32	0.2
	Other	14	0.1	13	0.1
<b>All candidates</b>		15,713	100.0	15,027	100.0

### LI 1.3 Characteristics of adults on the liver transplant waiting list on December 31, 2003, and December 31, 2013

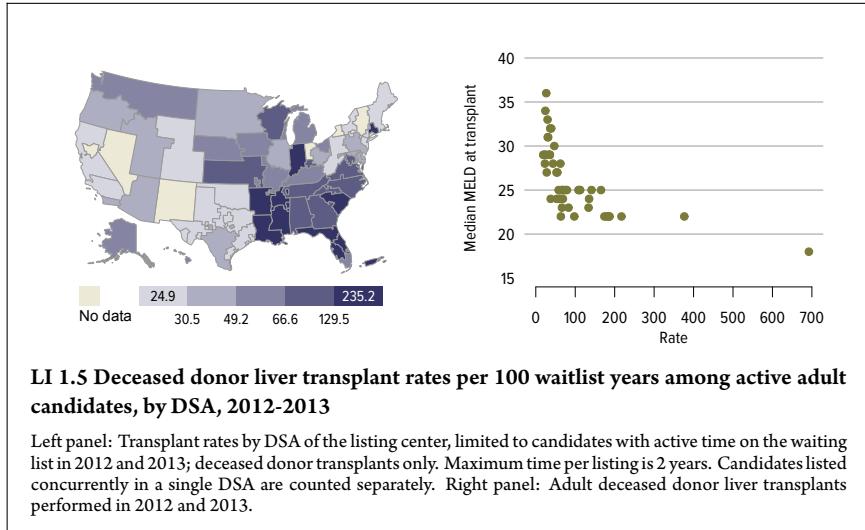
Patients waiting for transplant on December 31, 2003, and December 31, 2013, regardless of first listing date; active/inactive status is on this date, and multiple listings are not counted.

# waiting list



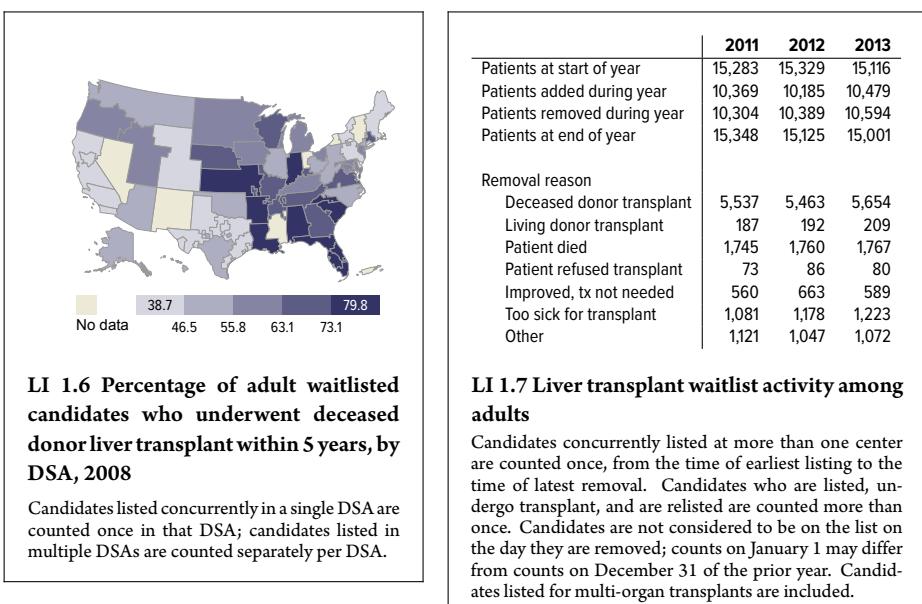
## LI 1.4 Deceased donor liver transplant rates among active adult waitlist candidates

Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of active waiting in a given year. Hepatocellular carcinoma (HCC) candidates have active Stage 2 exception points (per OPTN policy 9.3.G) in the given year.

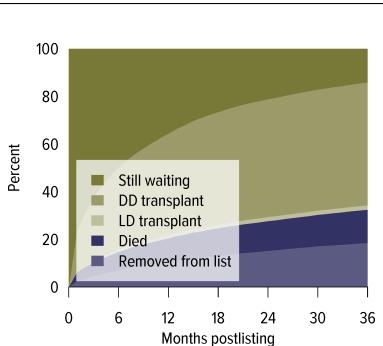


## LI 1.5 Deceased donor liver transplant rates per 100 waitlist years among active adult candidates, by DSA, 2012-2013

Left panel: Transplant rates by DSA of the listing center, limited to candidates with active time on the waiting list in 2012 and 2013; deceased donor transplants only. Maximum time per listing is 2 years. Candidates listed concurrently in a single DSA are counted separately. Right panel: Adult deceased donor liver transplants performed in 2012 and 2013.

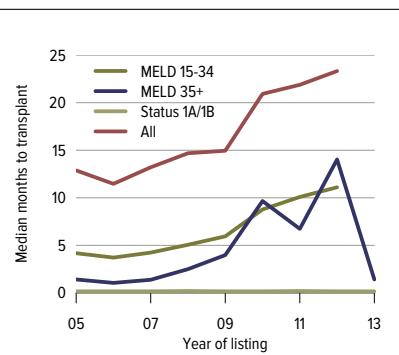


# Waiting list



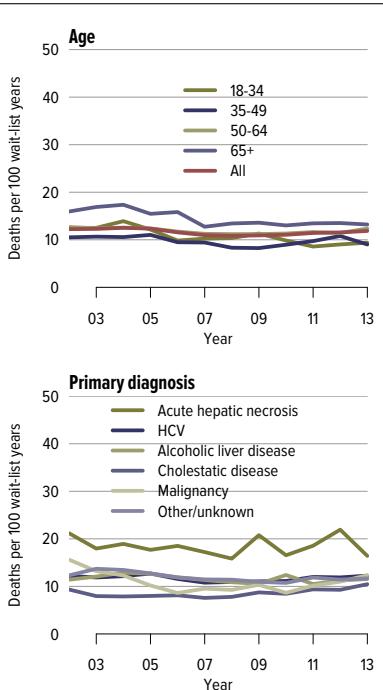
**LI 1.8 Three-year outcomes for adults waiting for liver transplant, new listings in 2010**

Adults waiting for any liver transplant and first listed in 2010. Candidates concurrently listed at more than one center are counted once, from the time of earliest listing to the time of latest removal. DD, deceased donor; LD, living donor.



**LI 1.9 Median months to liver transplant for waitlisted adults, by medical urgency at listing**

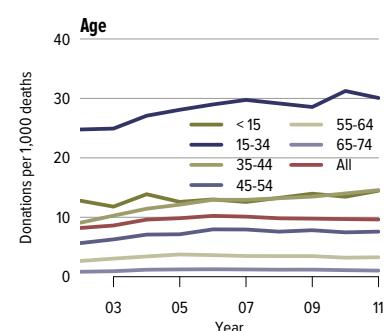
Observations censored at earliest of December 31, 2013, transfer to another center, or removal from waiting list due to improved condition; otherwise, candidates contribute waiting time until deceased donor transplant. Kaplan-Meier competing risks methods used to estimate time to transplant. Analysis performed per candidate not per listing. If an estimate is not plotted, 50% of the cohort listed in that year had not undergone transplant by the censoring date. Only the first transplant is counted.



**LI 1.10 Pretransplant mortality rates among adults waitlisted for liver transplant**

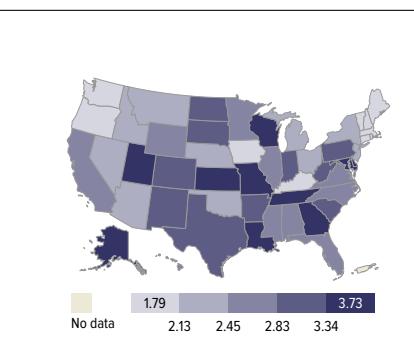
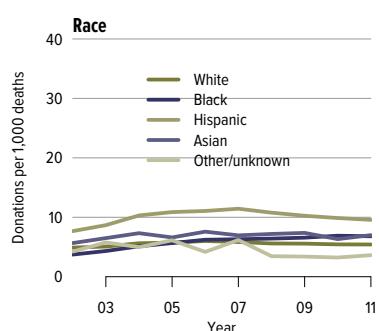
Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Patients concurrently listed at multiple centers are counted once. Deaths after removal from the waiting list are not counted. Rates by status are calculated as the number of transplants for a given status divided by total waiting time in the year at that status. Age is determined at the later of listing date or January 1 of the given year.

# deceased donation

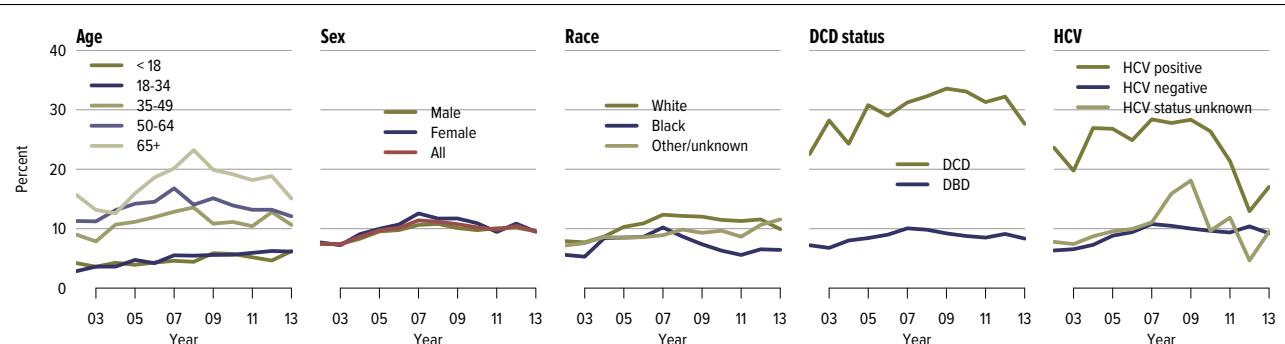


## LI 2.1 Deceased donor liver donation rates

Numerator: Deceased donors aged younger than 75 years with livers recovered for transplant. Denominator: US deaths per year, age younger than 75 years. Death data available only through 2011. (Death data available at <http://www.cdc.gov/nchs/products/nvsr.htm>)

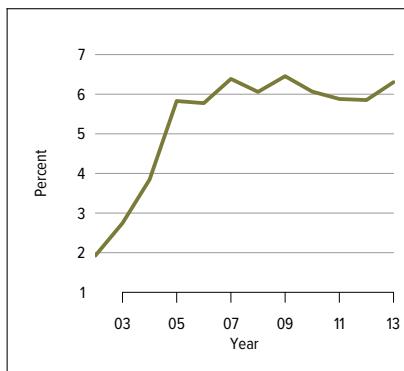


Numerator: Deceased donors residing in the 50 states whose livers were recovered for transplant from 2009 through 2011. Denominator: US deaths, all ages, by state from 2009 through 2011 (death data available at <http://www.cdc.gov/nchs/products/nvsr.htm>).



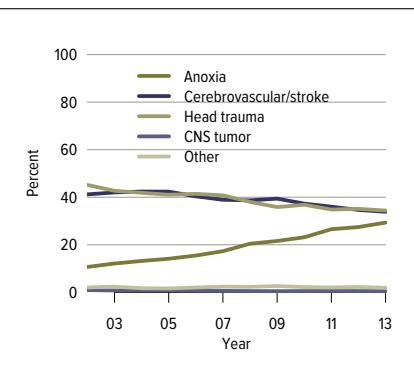
## LI 2.3 Rates of organs recovered for transplant and not transplanted

Percentages of livers not transplanted out of all livers recovered for transplant. HCV, hepatitis C virus.



## LI 2.4 DCD liver donors

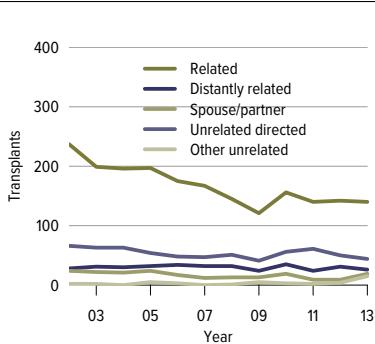
Deceased donors whose livers were recovered for transplant.



## LI 2.5 Cause of death among deceased liver donors

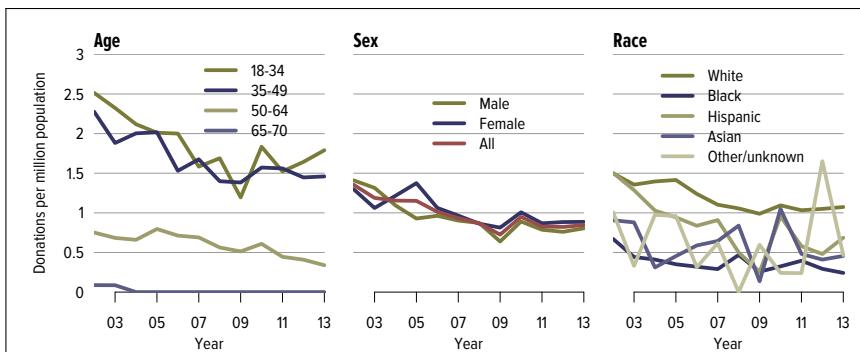
Deceased donors whose livers were transplanted. CNS, central nervous system.

# living donation



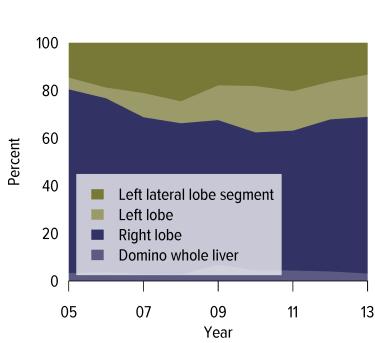
**LI 3.1 Liver transplants from living donors, by donor relation**

Numbers of living donor donations, excluding domino livers; characteristics recorded on the OPTN Living Donor Registration Form.



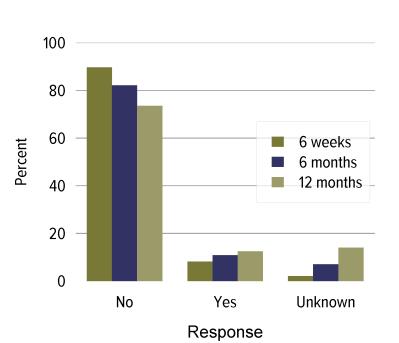
**LI 3.2 Living donor liver donation rates**

Number of living donors whose livers were recovered for transplant each year, excluding domino liver donors.  
Denominator: US population aged 70 years or younger (population data downloaded from [http://www.cdc.gov/nchs/nvss/bridged\\_race.htm](http://www.cdc.gov/nchs/nvss/bridged_race.htm))



**LI 3.3 Living donor liver transplant graft type**

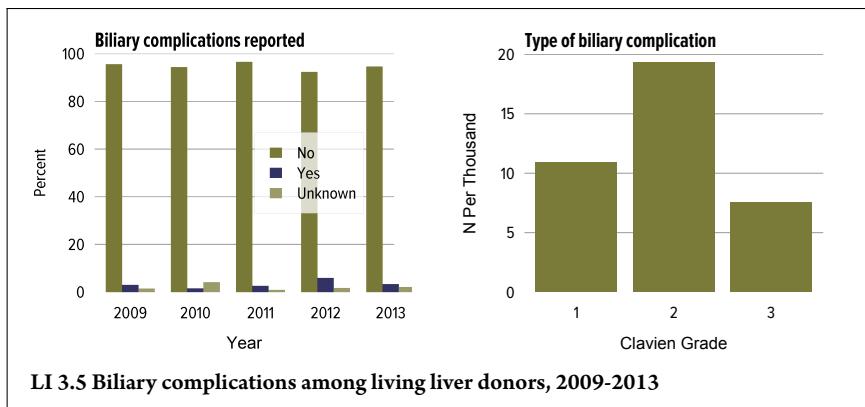
As reported on the OPTN Living Donor Registration Form.



**LI 3.4 Rehospitalization in the first 6 weeks, 6 months, and 1 year among living liver donors, 2008-2012**

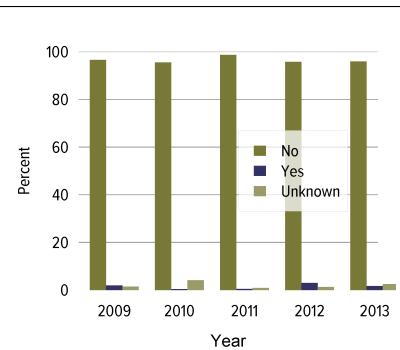
Cumulative hospital readmission. The 6-week time point is recorded at the earliest of discharge or 6 weeks after donation. Domino liver donors excluded.

# living donation



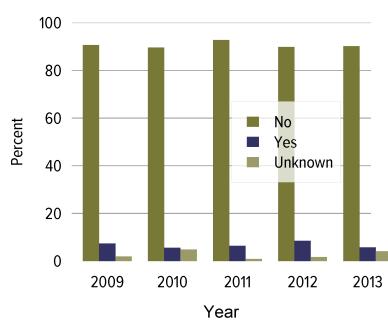
### LI 3.5 Biliary complications among living liver donors, 2009-2013

Complications reported on the OPTN Living Donor Registration Form. Type of complication is shown for all living donors, 2009-2013. Clavien Grade 1, bilious Jackson Pratt drainage more than 10 days; Clavien Grade 2, interventional procedure (endoscopic retrograde cholangiopancreatography, percutaneous transhepatic cholangiography, percutaneous drainage, etc.); Clavien Grade 3, surgical intervention. Domino liver donors excluded.



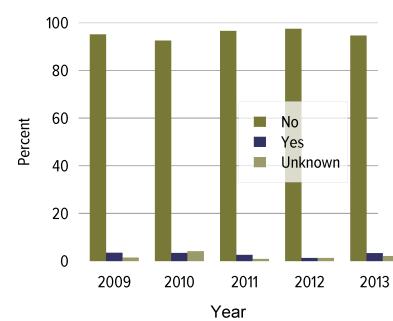
### LI 3.6 Vascular complications requiring intervention among living liver donors, 2009-2013

Complications reported on the OPTN Living Donor Registration Form. Domino liver donors excluded.



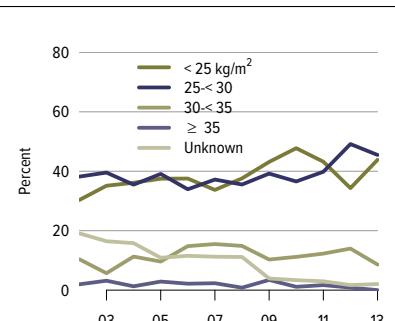
### LI 3.7 Other complications requiring intervention among living liver donors, 2009-2013

Complications reported on the OPTN Living Donor Registration Form. Domino liver donors excluded.



### LI 3.8 Re-operation among living liver donors, 2009-2013

Complications reported on the OPTN Living Donor Registration Form. Domino liver donors excluded.



### LI 3.9 BMI among living liver donors

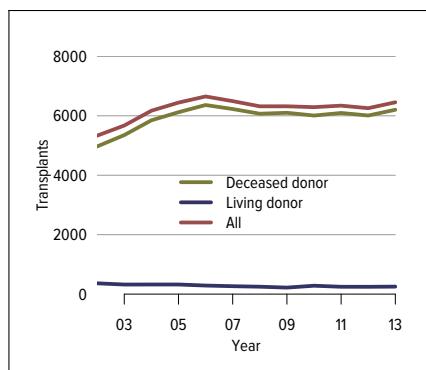
Donor height and weight reported on the OPTN Living Donor Registration Form. Domino liver donors excluded.

Cause	Days after donation		
	0-30	31-90	91-365
Suicide	0	1	0
Accident/homicide	0	0	0
Medical	2	0	0
Cancer	0	0	0
Unknown	0	0	0

### LI 3.10 Living liver donor deaths, 2009-2013

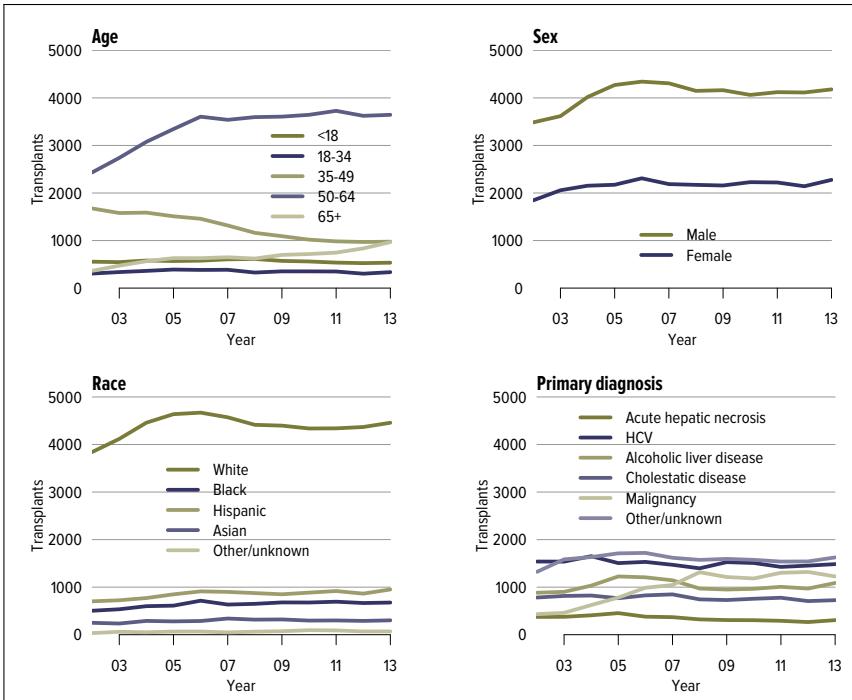
Living liver donors, excluding domino livers. Deaths as reported to OPTN or the Social Security Administration. Donation-related deaths are included in the Medical category.

# transplant



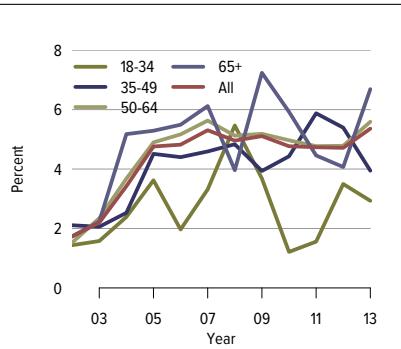
#### LI 4.1 Total liver transplants

All liver transplant recipients, including adult and pediatric, retransplant, and multi-organ recipients.



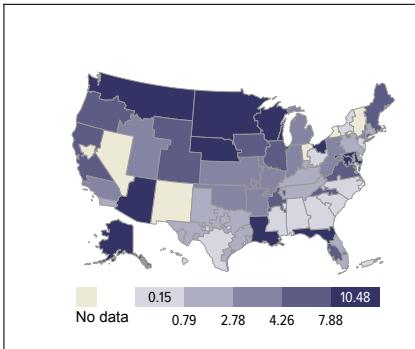
#### LI 4.2 Liver transplants

All liver transplant recipients, including adult and pediatric, retransplant, and multi-organ recipients. HCV, hepatitis C virus.



#### LI 4.3 Use of DCD livers among adult recipients, by recipient age

Percentages of deceased donor liver transplants from DCD donors.



#### LI 4.4 Percentage of adult DCD liver transplants by DSA, 2011-2013

Percentage of deceased donor liver transplants from DCD donors, by DSA of the transplanting center.

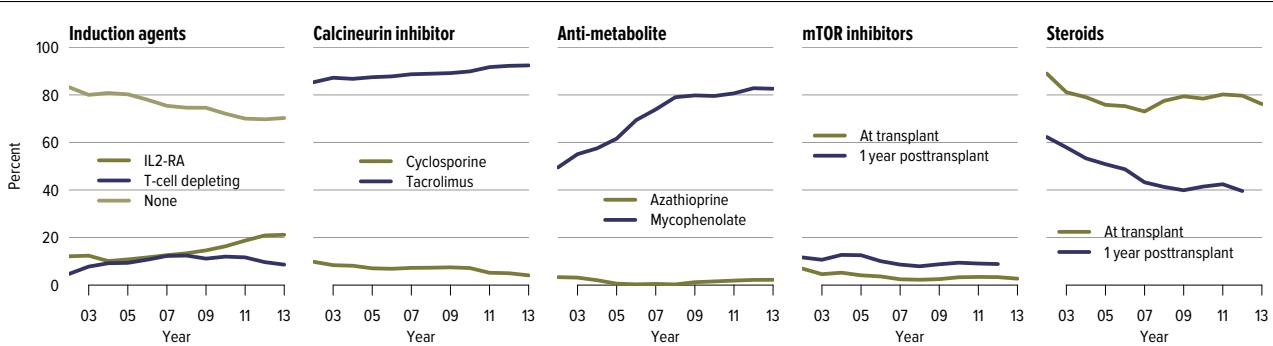
# transplant

	2003		2013	
	N	%	N	%
<b>Age</b>				
18-34	337	6.6	335	5.7
35-49	1,579	30.8	976	16.5
50-64	2,739	53.4	3,644	61.5
65+	472	9.2	966	16.3
<b>Sex</b>				
Female	1,749	34.1	2,020	34.1
Male	3,378	65.9	3,901	65.9
<b>Race</b>				
White	3,806	74.2	4,187	70.7
Black	439	8.6	604	10.2
Hispanic	622	12.1	809	13.7
Asian	212	4.1	267	4.5
Other/unknown	48	0.9	54	0.9
<b>Primary diagnosis</b>				
Acute hepatic necrosis	303	5.9	233	3.9
HCV	1,531	29.9	1,482	25.0
Alcoholic liver disease	901	17.6	1,088	18.4
Cholestatic disease	568	11.1	494	8.3
Malignancy	408	8.0	1,150	19.4
Other/unknown	1,416	27.6	1,474	24.9
<b>Blood type</b>				
A	1,917	37.4	2,140	36.1
B	706	13.8	801	13.5
AB	263	5.1	287	4.8
O	2,241	43.7	2,693	45.5
<b>Waiting time</b>				
< 31 days	1,757	34.3	1,777	30.0
31-60 days	616	12.0	595	10.0
61-90 days	368	7.2	396	6.7
3-6 months	675	13.2	969	16.4
6-12 months	584	11.4	930	15.7
1-2 years	539	10.5	771	13.0
2-3 years	279	5.4	208	3.5
3+ years	303	5.9	273	4.6
Unknown	6	0.1	2	0.0
<b>BMI (kg/m<sup>2</sup>)</b>				
< 18.5	111	2.2	126	2.1
18.5-25	1,619	31.6	1,678	28.3
25-28	1,216	23.7	1,335	22.5
28-30	626	12.2	733	12.4
30-35	1,000	19.5	1,279	21.6
35+	536	10.5	770	13.0
Unknown	19	0.4	0	0.0
<b>Medical condition</b>				
Hospitalized: ICU	613	12.0	851	14.4
Hospitalized: not ICU	748	14.6	1,204	20.3
Not hospitalized	3,766	73.5	3,819	64.5
Unknown	0	0.0	47	0.8
<b>Medical urgency</b>				
Status 1/IA	306	6.0	196	3.3
MELD 35+	476	9.3	1,357	22.9
MELD 30-34	527	10.3	894	15.1
MELD 15-29	3,026	59.0	3,303	55.8
MELD < 15	780	15.2	168	2.8
Other/unknown	12	0.2	3	0.1
<b>Insurance</b>				
Private	3,297	64.3	3,196	54.0
Medicare	893	17.4	1,655	28.0
Medicaid	679	13.2	767	13.0
Other/unknown	258	5.0	303	5.1
<b>Procedure type</b>				
Whole liver	4,788	93.4	5,645	95.3
Partial liver	251	4.9	204	3.4
Split liver	88	1.7	72	1.2
<b>Multi-organ transplant</b>				
Liver only	4,871	95.0	5,390	91.0
Liver-kidney	235	4.6	477	8.1
Other	21	0.4	54	0.9
<b>Donor type</b>				
Deceased	4,873	95.0	5,710	96.4
Living	254	5.0	211	3.6
<b>On life support</b>				
Diabetes	390	7.6	440	7.4
Portal vein thrombosis	1,013	19.8	1,494	25.2
Incident tumor found at tx	181	3.5	592	10.0
All recipients	197	3.8	164	2.8
All recipients	5,127	100.0	5,921	100.0

#### LI 4.5 Characteristics of adult liver transplant recipients, 2003 and 2013

Adult liver transplant recipients, including retransplants.

# transplant



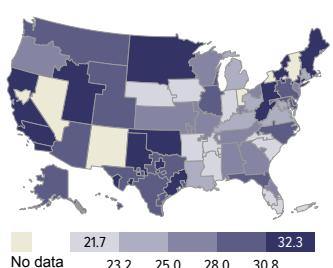
**LI 4.6 Immunosuppression in adult liver transplant recipients**

One-year posttransplant data are limited to patients alive with graft function at 1 year posttransplant. Mycophenolate includes mycophenolate mofetil and mycophenolate sodium. IL2-RA, interleukin-2 receptor antagonist; mTOR, mammalian target of rapamycin.

Medication	% 1yr post-tx	Medication	% 2-3yr post-tx
Sulfamethoxazole-Trimethoprim	45.7	Oxycodone	53.8
Mycophenolate	43.5	Hydrocodone	41.6
Oxycodone	39.2	Mycophenolate	35.9
Prednisone	36.7	Prednisone	32.8
Valganciclovir	31.8	Amlodipine Besylate	30.2
Hydrocodone	29.2	Amoxicillin	25.3
Furosemide	28.3	omeprazole	25.3
Ursodiol	24.2	Metoprolol Tartrate	22.4
Metoprolol Tartrate	21.9	Sulfamethoxazole-Trimethoprim	20.8
omeprazole	20.8	Furosemide	20.5
Amlodipine Besylate	20.7	Ursodiol	18.4
Magnesium Oxide	19.4	Zolpidem Tartrate	17.8
Nystatin	19.0	Azithromycin	17.6
Amoxicillin	17.1	Ciprofloxacin	17.5

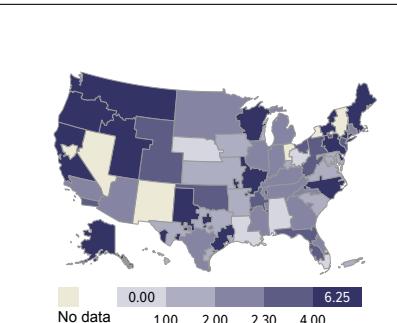
**LI 4.7 Top 15 medications filled by adult liver transplant recipients, 2009**

Adult liver transplant recipients, 2009, who were matched to the IMS Health pharmacy claims database and had at least one medication filled during year 1 or year 2 or 3 posttransplant.



**LI 4.8 Median MELD scores for adult deceased donor liver recipients, by DSA, 2013**

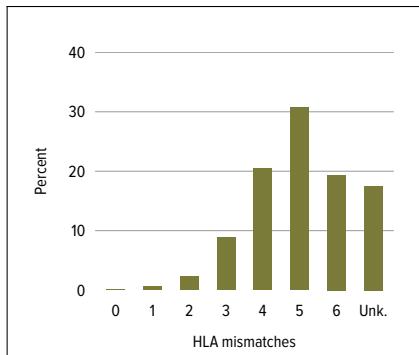
Deceased donor liver transplants. DSA of transplant center location. Status 1A and 1B and inactive status excluded; allocation MELD score used.



**LI 4.9 Differences in lab MELD and allocation MELD scores among liver transplant recipients, 2013**

Deceased donor liver transplants. DSA of transplant center location. Status 1A and 1B and inactive status excluded.

# donor-recipient matching



## LI 5.1 Total HLA A, B, and DR mismatches among adult deceased donor liver-kidney transplant recipients

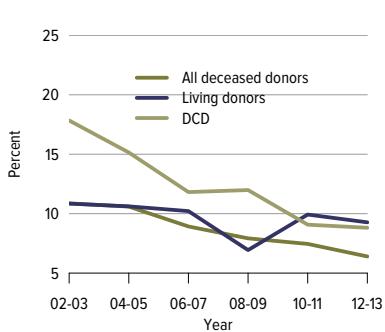
Donor and recipient antigen matching is based on OPTN antigen values and split equivalences policy as of 2013. Limited to deceased donor liver-kidney transplants only.

Donor	Recipient -			Recipient +			Recipient unk.			
	D-	D+	D unk.	D-	D+	D unk.	D-	D+	D unk.	
<b>CMV</b>	Deceased	11.5	19.5	0.1	22.5	43.6	0.2	0.8	1.7	0.0
	Living	29.0	12.6	4.0	24.3	24.3	3.2	1.3	11	0.2
<b>EBV</b>	Deceased	0.6	11.0	0.1	2.9	59.5	0.1	1.1	24.7	0.1
	Living	1.4	9.4	1.0	4.9	51.8	9.8	2.3	8.5	10.8
<b>HB core</b>	Deceased	69.5	2.9	0.0	18.7	1.9	0.0	6.7	0.2	0.0
	Living	70.3	1.2	7.1	11.6	0.7	1.4	4.5	0.0	3.2
<b>HB surface antigen</b>	Deceased	91.2	0.0	0.1	4.8	0.0	0.0	3.9	0.0	0.0
	Living	82.5	0.0	7.3	2.4	0.0	0.3	6.2	0.0	1.3
<b>HCV</b>	Deceased	53.6	0.1	0.0	39.2	3.3	0.0	3.6	0.1	0.0
	Living	59.3	0.3	5.2	27.5	0.1	2.2	3.8	0.0	1.6
<b>HIV</b>	Deceased	91.7	0.0	0.0	0.5	0.0	0.0	7.8	0.0	0.0
	Living	78.0	0.0	7.7	0.3	0.0	0.1	6.4	0.0	7.6

## LI 5.2 Adult liver donor-recipient serology matching, 2009-2013

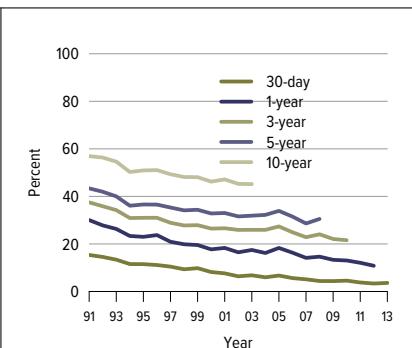
Donor serology is reported on the OPTN Donor Registration Form and recipient serology on the OPTN Transplant Recipient Registration Form. Any evidence for a positive serology indicates positive for that serology. If all fields are unknown, incomplete, or pending, the person is categorized as "unknown" for that serology; otherwise, serology is assumed negative. CMV, cytomegalovirus; EBV, Epstein-Barr virus; HB, hepatitis B; HCV, hepatitis C virus; HIV, human immunodeficiency virus.

# outcomes



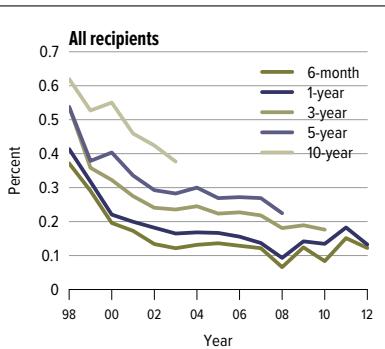
**LI 6.1 Graft failure within the first 90 days posttransplant among adult liver transplant recipients**

All-cause graft failure is identified from multiple data sources, including the OPTN Transplant Recipient Registration Form, the OPTN Transplant Recipient Follow-up Form, and death dates from the Social Security Administration. Transplants after September 30, 2013, are excluded due to insufficient follow-up.



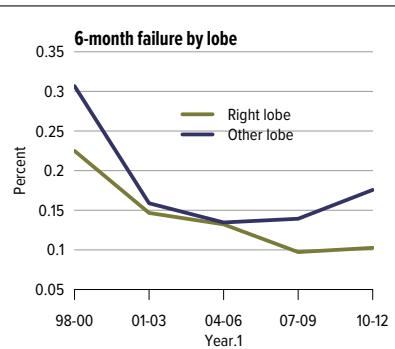
**LI 6.2 Graft failure among adult liver transplant recipients: deceased donor**

All adult recipients of deceased donor livers, including multi-organ transplants. Patients are followed until the earliest of retransplant, death, or December 31, 2013. Estimates computed with Cox proportional hazards models adjusted for age, sex, and race.

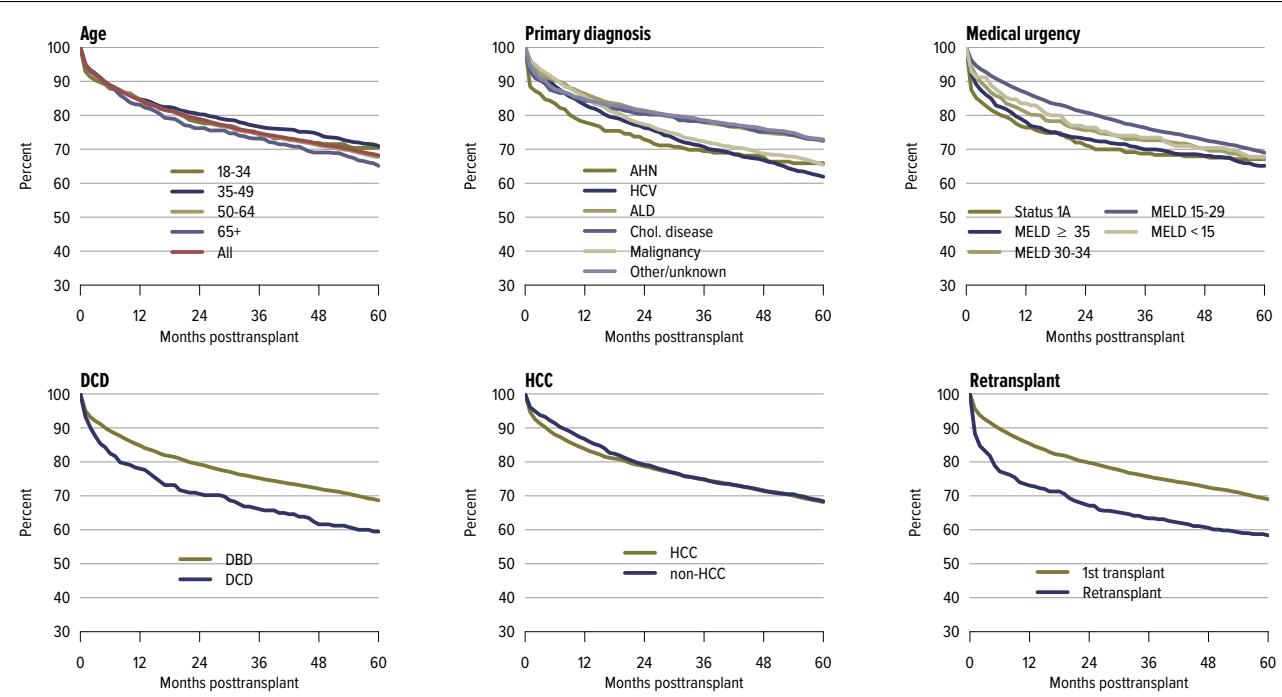


**LI 6.3 Graft failure among adult liver transplant recipients: living donor**

All adult recipients of living donor livers, including multi-organ transplants. Patients are followed until the earliest of retransplant, death, or December 31, 2013. Estimates computed with Cox proportional hazards models adjusted for age, sex, and race.

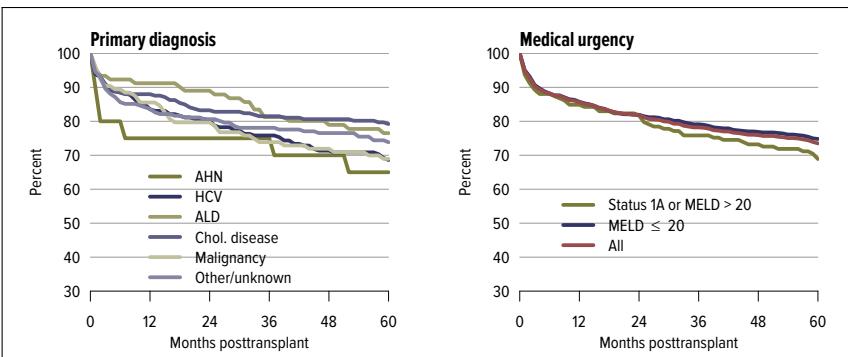


# outcomes



## LI 6.4 Graft survival among adult liver transplant recipients, 2008: deceased donors

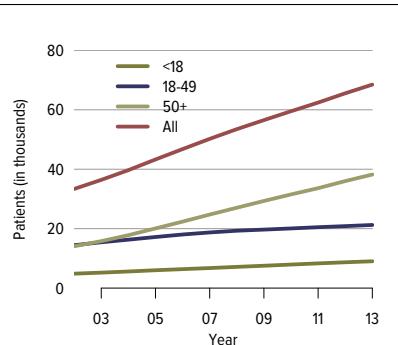
Graft survival estimated using unadjusted Kaplan-Meier methods. Hepatocellular carcinoma (HCC) is stage T2. AHN, acute hepatic necrosis; ALD, alcoholic liver disease; Chol. disease, cholestatic disease.



## LI 6.5 Graft survival among adult liver transplant recipients, 2008: living donors

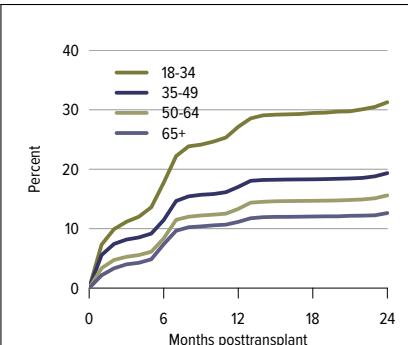
Graft survival estimated using unadjusted Kaplan-Meier methods. AHN, acute hepatic necrosis; ALD, alcoholic liver disease; Chol. disease, cholestatic disease.

# outcomes



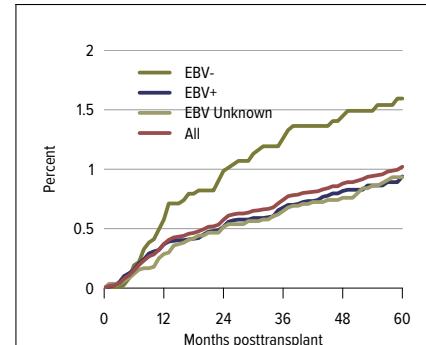
**LI 6.6 Recipients alive with a functioning liver graft on June 30 of the year, by age at transplant**

Recipients are assumed to be alive with function unless a death or graft failure is recorded. A recipient may experience a graft failure and be removed from the cohort, undergo retransplant, and re-enter the cohort.



**LI 6.7 Incidence of first acute rejection among adult liver transplant recipients, by age, 2007-2011**

Acute rejection is defined as a record of acute or hyperacute rejection, or a record on the OPTN Transplant Recipient Registration or Transplant Recipient Follow-up Form of an anti-rejection drug being administered. Only the first rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier competing risk method.



**LI 6.8 Incidence of PTLD among adult liver transplant recipients, by recipient EBV status at transplant, 2007-2011**

Cumulative incidence is estimated using the Kaplan-Meier competing risk method. Posttransplant lymphoproliferative disorder (PTLD) is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus.

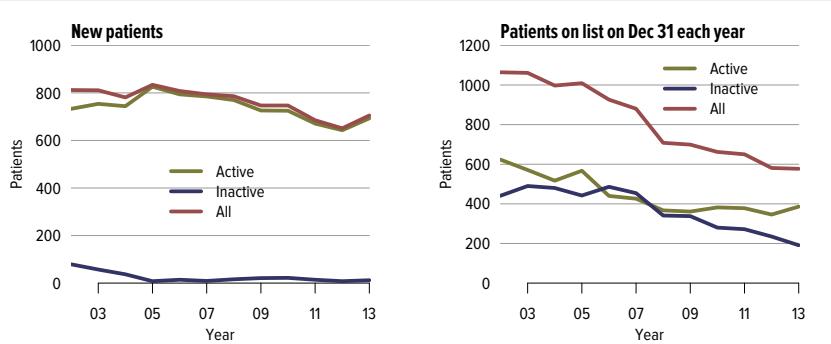
# outcomes

Cancer site	Observed	Rate per 100,000 PY	Lower CI	Upper CI
Lip	4	4.7	1.3	12.1
Mouth, tongue, other oral cavity and pharynx	33	39.0	26.8	54.8
Salivary gland	4	4.7	1.3	12.1
Nasopharynx	2	2.4	0.3	8.5
Oropharynx including tonsil	26	30.7	20.1	45.0
Esophagus	15	17.7	9.9	29.2
Stomach	15	17.7	9.9	29.2
Small intestine	5	5.9	1.9	13.8
Colorectum	64	75.7	58.3	96.6
Anus, anal canal and anorectum	13	15.4	8.2	26.3
Liver	32	37.8	25.9	53.4
Other biliary	5	5.9	1.9	13.8
Pancreas	21	24.8	15.4	37.9
Larynx	13	15.4	8.2	26.3
Lung and bronchus	137	162.0	136.0	191.5
Soft tissue including heart	10	11.8	5.7	21.7
Melanoma of the skin	48	56.8	41.9	75.3
Other non-epithelial skin	13	15.4	8.2	26.3
Breast	58	188.3	143.0	243.5
Cervix uteri	7	22.6	9.1	46.6
Corpus uteri	6	19.4	7.1	42.2
Ovary	4	12.9	3.5	33.1
Vagina and other female genital organs	7	22.6	9.1	46.6
Vulva	12	38.8	20.1	67.8
Prostate	107	200.2	164.1	242.0
Testis	3	5.6	1.2	16.3
Penis and other male genital organs	6	11.2	4.1	24.3
Urinary bladder, ureter, and other urinary organs	22	26.0	16.3	39.4
Kidney	36	42.5	29.8	58.9
Eye and orbit	8	9.4	4.1	18.6
Brain, cranial nerves, and other nervous system	14	16.5	9.0	27.7
Thyroid	16	18.9	10.8	30.7
Hodgkin lymphoma	6	7.1	2.6	15.4
Non-Hodgkin lymphoma	159	188.4	160.2	220.0
Myeloma	17	20.1	11.7	32.1
Acute lymphocytic leukemia	5	5.9	1.9	13.8
Chronic lymphocytic leukemia	1	1.2	0.0	6.6
Acute myeloid leukemia	10	11.8	5.7	21.7
Acute monocytic leukemia	1	1.2	0.0	6.6
Chronic myeloid leukemia	4	4.7	1.3	12.1
Mesothelioma	1	1.2	0.0	6.6
Kaposi sarcoma	13	15.4	8.2	26.3
Miscellaneous	91	107.6	86.6	132.1
Tumors with poorly specified morphology	39	46.1	32.8	63.0

#### LI 6.9 Posttransplant cancer among liver transplant recipients, 2000-2009

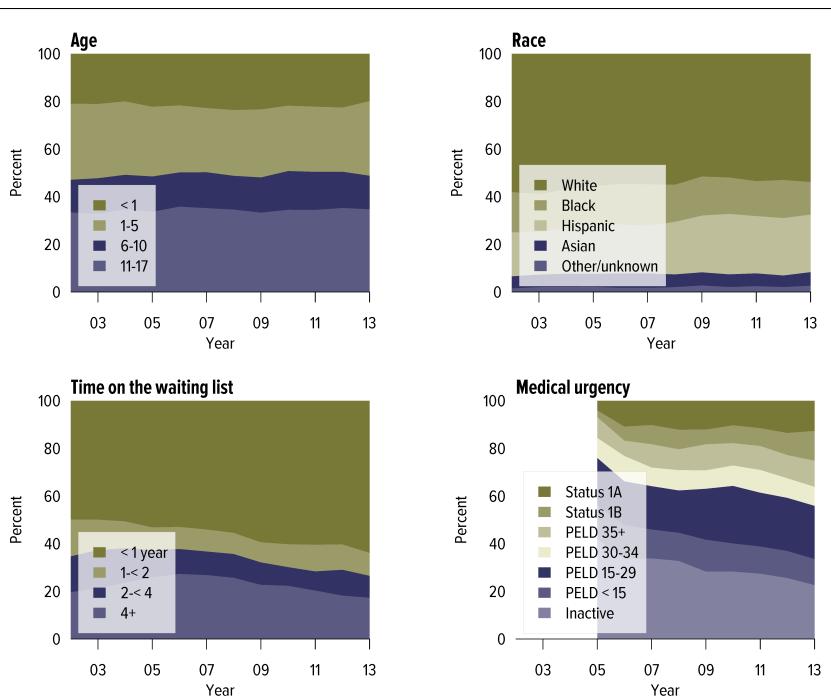
Reported cancer data linked to OPTN data from California, Colorado, Connecticut, Georgia, Hawaii, Illinois, Iowa, Michigan, New Jersey, New York, North Carolina, Texas, Florida, and Utah state cancer registries. Reported cancers are counted once per type per person posttransplant. Denominator: person-years posttransplant for residents of the above states who underwent transplant 2000-2009. Sex-specific denominators are used to compute rates for sex-specific cancers.

# pediatric transplant



## LI 7.1 Pediatric candidates waiting for liver transplant

A new patient is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and were subsequently relisted are considered new. Candidates concurrently listed at multiple centers are counted once. Concurrently listed candidates who are active at any program are considered active; those who are inactive at all programs are considered inactive.



## LI 7.2 Distribution of pediatric candidates waiting for liver transplant

Candidates waiting for transplant any time in the given year. Candidates listed concurrently at multiple centers are counted once. Age is determined at the later of listing date or January 1 of the given year. Pediatric candidates aged 12 to 17 years can be assigned MELD or PELD scores. Time on the waiting list is determined at the earlier of December 31 or removal from the waiting list. Medical urgency status is the most severe during the year. Active and inactive patients are included.

# pediatric transplant

	2003		2013		
	N	%	N	%	
<b>Age</b>					
< 1	79	7.4	36	6.2	
1-5	357	33.5	178	30.5	
6-10	167	15.7	101	17.3	
11-17	288	27.0	160	27.4	
18+	174	16.3	108	18.5	
<b>Sex</b>	Female	560	52.6	296	50.8
	Male	505	47.4	287	49.2
<b>Race</b>	White	639	60.0	331	56.8
	Black	161	15.1	83	14.2
	Hispanic	181	17.0	130	22.3
	Asian	62	5.8	22	3.8
	Other/unknown	22	2.1	17	2.9
<b>Citizenship</b>	US citizen	1,003	94.2	557	95.5
	Non-citizen resident	19	1.8	4	0.7
	Non-citizen non-resident	29	2.7	6	1.0
	Other/unknown	14	1.3	16	2.7
<b>Liver tx history</b>	First transplant	879	82.5	538	92.3
	Retransplant	186	17.5	45	7.7
<b>Blood type</b>	A	332	31.2	171	29.3
	B	140	13.1	77	13.2
	AB	29	2.7	17	2.9
	O	564	53.0	318	54.5
<b>Waiting time</b>	< 1 year	331	31.1	247	42.4
	1-2 years	158	14.8	76	13.0
	2-3 years	132	12.4	49	8.4
	3-4 years	98	9.2	43	7.4
	4-5 years	77	7.2	35	6.0
	5+ years	269	25.3	133	22.8
<b>Medical urgency</b>	Status 1/1A/1B	26	2.4	12	2.1
	MELD 35+	17	1.6	45	7.7
	MELD 30-34	14	1.3	39	6.7
	MELD 15-29	88	8.3	121	20.8
	MELD < 15	428	40.2	174	29.8
	Inactive	492	46.2	192	32.9
<b>Multi-organ</b>	Liver alone	972	91.3	497	85.2
	Liver-kidney	10	0.9	14	2.4
	Liver-pancreas-intestine	6	0.6	59	10.1
	Liver-heart	2	0.2	1	0.2
	Other	75	7.0	12	2.1
<b>All candidates</b>		1,065	100.0	583	100.0

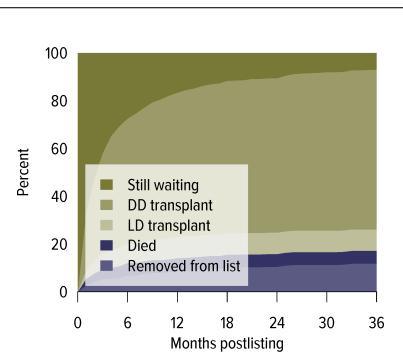
### LI 7.3 Characteristics of pediatric candidates on the liver transplant waiting list on December 31, 2003, and December 31, 2013

Candidates waiting for transplant on December 31, 2003, and December 31, 2013, regardless of first listing date; active/inactive status is on this date, and multiple listings are not counted. Pediatric candidates aged 12 to 17 years can be assigned MELD or PELD scores.

	2011	2012	2013
Patients at start of year	661	650	581
Patients added during year	685	651	705
Patients removed during year	696	720	709
Patients at end of year	650	581	577
Removal reason			
Deceased donor transplant	479	475	499
Living donor transplant	59	53	42
Patient died	28	35	34
Patient refused transplant	1	5	1
Improved, tx not needed	78	97	86
Too sick for transplant	18	19	15
Other	33	36	32

### LI 7.4 Liver transplant waitlist activity among pediatric candidates

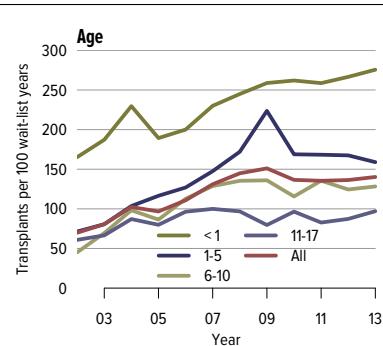
Candidates concurrently listed at more than one center are counted once, from the time of earliest listing to the time of latest removal. Candidates who are listed, undergo transplant, and are relisted are counted more than once. Candidates are not considered to be on the list on the day they are removed; counts on January 1 may differ from counts on December 31 of the prior year. Candidates listed for multi-organ transplants are included.



### LI 7.5 Three-year outcomes for pediatric candidates waiting for liver transplant among new listings, 2010

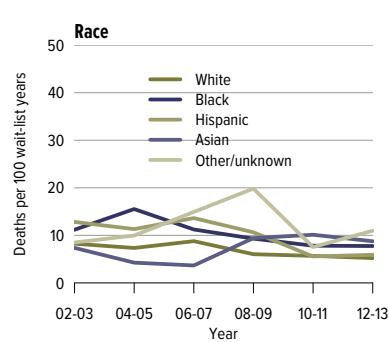
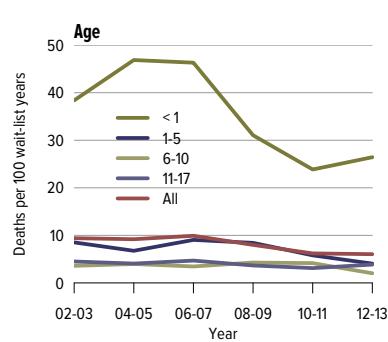
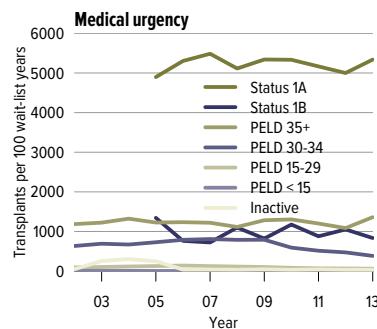
Candidates waiting for any liver transplant and first listed in 2010. Candidates concurrently listed at more than one center are counted once, from the time of earliest listing to the time of latest removal. DD, deceased donor; LD, living donor.

# pediatric transplant



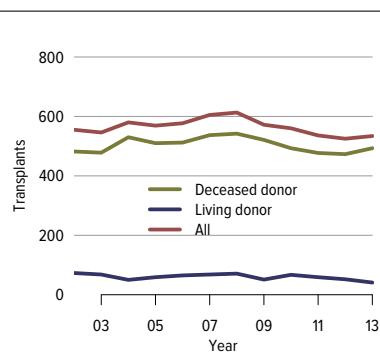
**LI 7.6 Deceased donor liver transplant rates among active pediatric waitlist candidates**

Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of active waiting in a given year. Age is calculated on the first active listing date in a given year. Pediatric candidates aged 12 to 17 years can be assigned MELD or PELD scores.



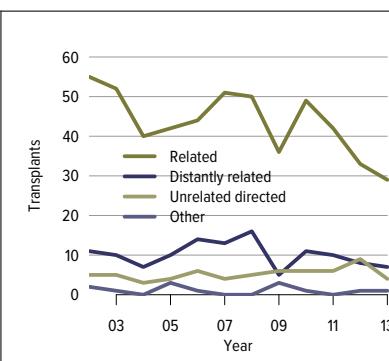
**LI 7.7 Pretransplant mortality rates among pediatric liver transplant candidates, by age**

Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Candidates concurrently listed at multiple centers are counted once. Deaths after removal from the waiting list are not counted. Age is calculated on the later of listing date or January 1 of the given year.



**LI 7.8 Pediatric liver transplants, by donor type**

Recipients of liver transplant.



**LI 7.9 Pediatric liver transplants from living donors**

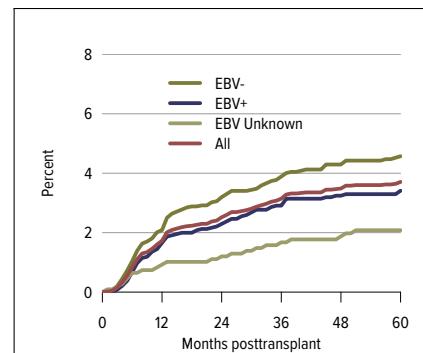
Relationship of living donor to recipient is as indicated on the OPTN Living Donor Registration Form.

# pediatric transplant

		2001-2003		2011-2013	
		N	%	N	%
<b>Age</b>	< 1	480	28.2	438	27.5
	1-5	615	36.1	602	37.7
	6-10	195	11.5	214	13.4
	11-17	413	24.3	341	21.4
<b>Sex</b>	Female	932	54.7	823	51.6
	Male	771	45.3	772	48.4
<b>Race</b>	White	934	54.8	845	53.0
	Black	317	18.6	248	15.5
	Hispanic	354	20.8	359	22.5
	Asian	75	4.4	102	6.4
	Other/unknown	23	1.4	41	2.6
<b>Primary diagnosis</b>	Acute hepatic necrosis	213	12.5	199	12.5
	HCV	26	1.5	4	0.3
	Cholestatic disease	740	43.5	727	45.6
	Malignancy	183	10.7	214	13.4
	Other/unknown	541	31.8	451	28.3
<b>Liver tx history</b>	First transplant	1,467	86.1	1,449	90.8
	Retransplant	236	13.9	146	9.2
<b>Blood type</b>	A	611	35.9	534	33.5
	B	239	14.0	214	13.4
	AB	62	3.6	77	4.8
	O	791	46.4	770	48.3
<b>Insurance</b>	Private	907	53.3	706	44.3
	Medicare	34	2.0	13	0.8
	Medicaid	598	35.1	683	42.8
	Other government	101	5.9	142	8.9
	Other/unknown	63	3.7	51	3.2
<b>Waiting time</b>	< 31 days	617	36.2	614	38.5
	31-60 days	220	12.9	238	14.9
	61-90 days	158	9.3	147	9.2
	3-6 months	262	15.4	270	16.9
	6-12 months	235	13.8	182	11.4
	1-2 years	118	6.9	92	5.8
	2-3 years	32	1.9	25	1.6
	3+ years	41	2.4	27	1.7
	Unknown	20	1.2	0	0.0
<b>Medical condition</b>	Hospitalized: ICU	534	31.4	379	23.8
	Hospitalized: not ICU	290	17.0	281	17.6
	Not hospitalized	879	51.6	934	58.6
	Unknown	0	0.0	1	0.1
<b>Medical urgency</b>	Status 1/A/1B	693	40.7	547	34.3
	MELD 35+	82	4.8	242	15.2
	MELD 30-34	38	2.2	206	12.9
	MELD 15-29	217	12.7	398	25.0
	MELD < 15	269	15.8	202	12.7
	Other/unknown	404	23.7	0	0.0
<b>Procedure type</b>	Whole liver	1,059	62.2	1,021	64.0
	Partial liver	400	23.5	315	19.7
	Split liver	244	14.3	259	16.2
<b>Donor type</b>	Deceased	1,450	85.1	1,443	90.5
	Living	253	14.9	152	9.5
<b>Previous abdominal surgery</b>		866	50.9	834	52.3
<b>Portal vein thrombosis</b>		80	4.7	83	5.2
<b>Incident tumor found at tx</b>		6	0.4	4	0.3
<b>Spontaneous bacterial peritonitis</b>		51	3.0	32	2.0
<b>ABO compatibility</b>	Comp./iden.	1,673	98.2	1,549	97.1
	Incompatible	30	1.8	46	2.9
<b>All recipients</b>		1,703	100.0	1,595	100.0

### LI 7.10 Characteristics of pediatric liver transplant recipients, 2001-2003 and 2011-2013

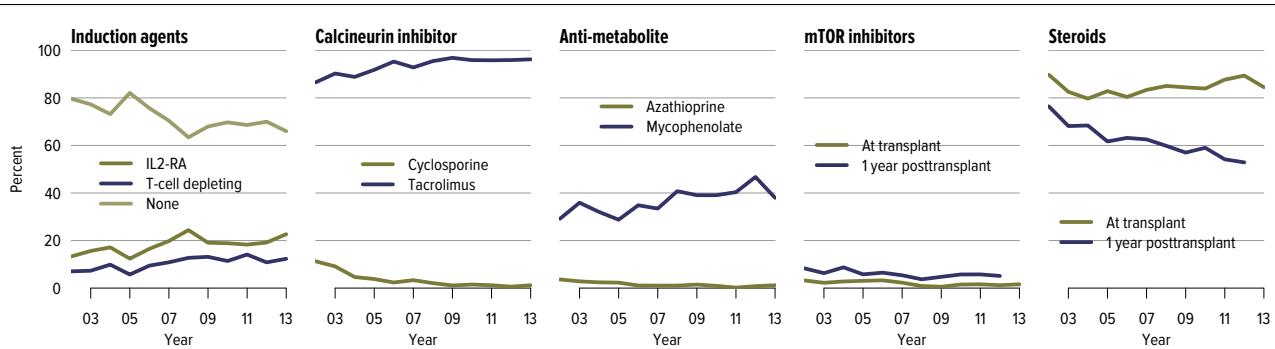
Liver transplant recipients, including retransplants. As MELD/PELD scoring began in 2002, the 2001-2003 cohort includes many recipients of unknown status. Pediatric candidates aged 12 to 17 years can be assigned MELD or PELD scores. HCV, hepatitis C virus.



### LI 7.11 Incidence of PTLD among pediatric liver transplant recipients, by recipient EBV status at transplant, 2001-2011

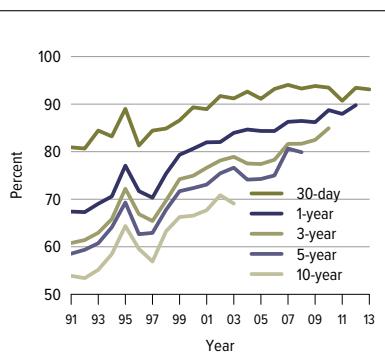
Cumulative incidence is estimated using the Kaplan-Meier competing risk method. Posttransplant lymphoproliferative disorder (PTLD) is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or on the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus.

# pediatric transplant



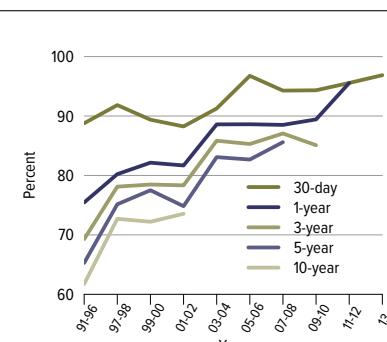
**LI 7.12 Immunosuppression in pediatric liver transplant recipients**

One-year posttransplant data are limited to patients alive with graft function at 1 year posttransplant. Mycophenolate includes mycophenolate mofetil and mycophenolate sodium. IL2-RA, interleukin-2 receptor antagonist; mTor, mammalian target of rapamycin.



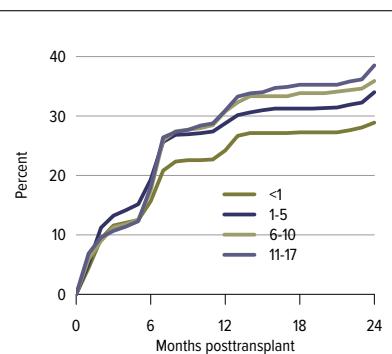
**LI 7.13 Graft survival among pediatric liver transplant recipients: deceased donor**

All pediatric recipients of deceased donor livers, including multi-organ transplants. Patients are followed until the earliest of retransplant, death, or December 31, 2013. Estimates computed with Cox proportional hazards models reporting, adjusted for age, sex, and race.



**LI 7.14 Graft survival among pediatric liver transplant recipients: living donor**

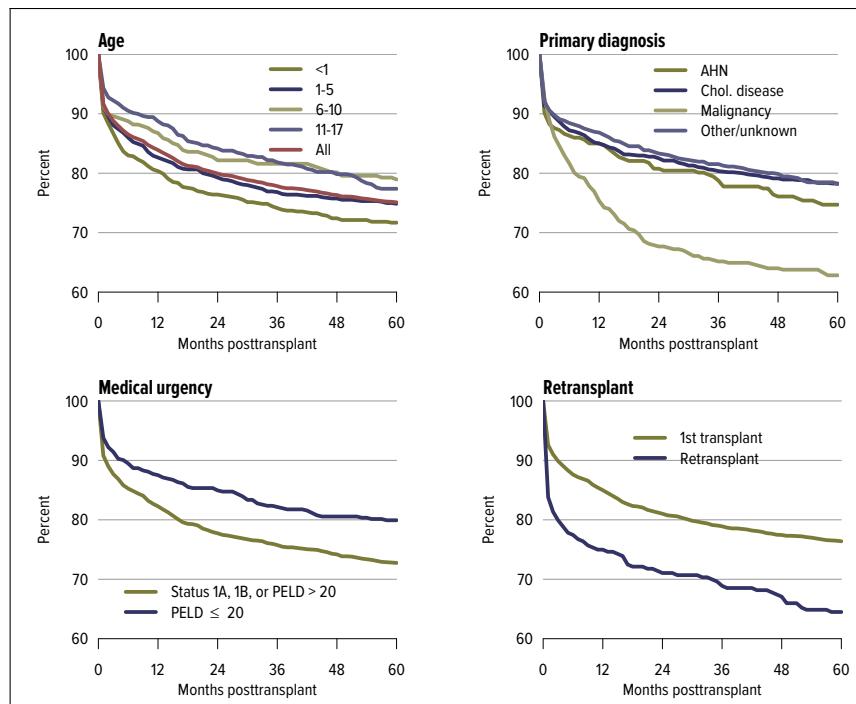
All pediatric recipients of living donor livers, including multi-organ transplants. Patients are followed until the earliest of retransplant, death, or December 31, 2013. Estimates computed with Cox proportional hazards models reporting, adjusted for age, sex, and race.



**LI 7.15 Incidence of first acute rejection among pediatric liver transplant recipients, by age, 2007-2011**

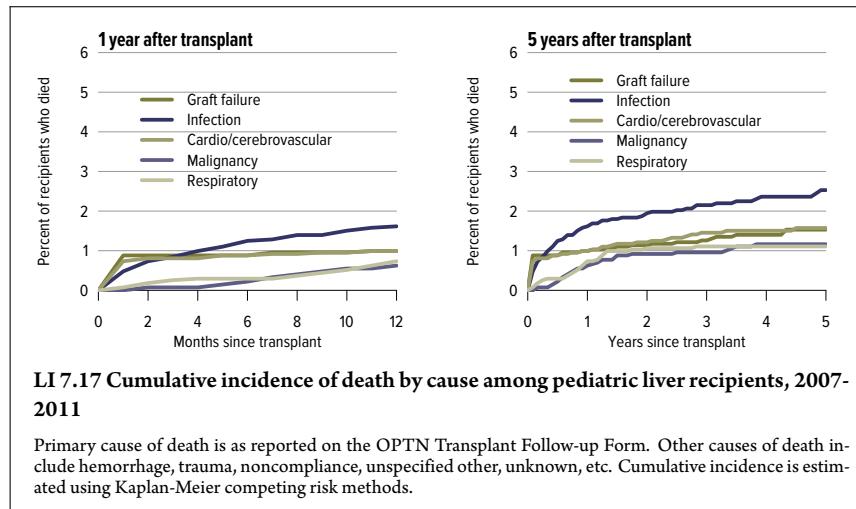
Acute rejection is defined as a record of acute or hyperacute rejection, or a record on the OPTN Transplant Recipient Registration Form or Transplant Recipient Follow-up Form of an anti-rejection drug being administered. Only the first rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier competing risk method.

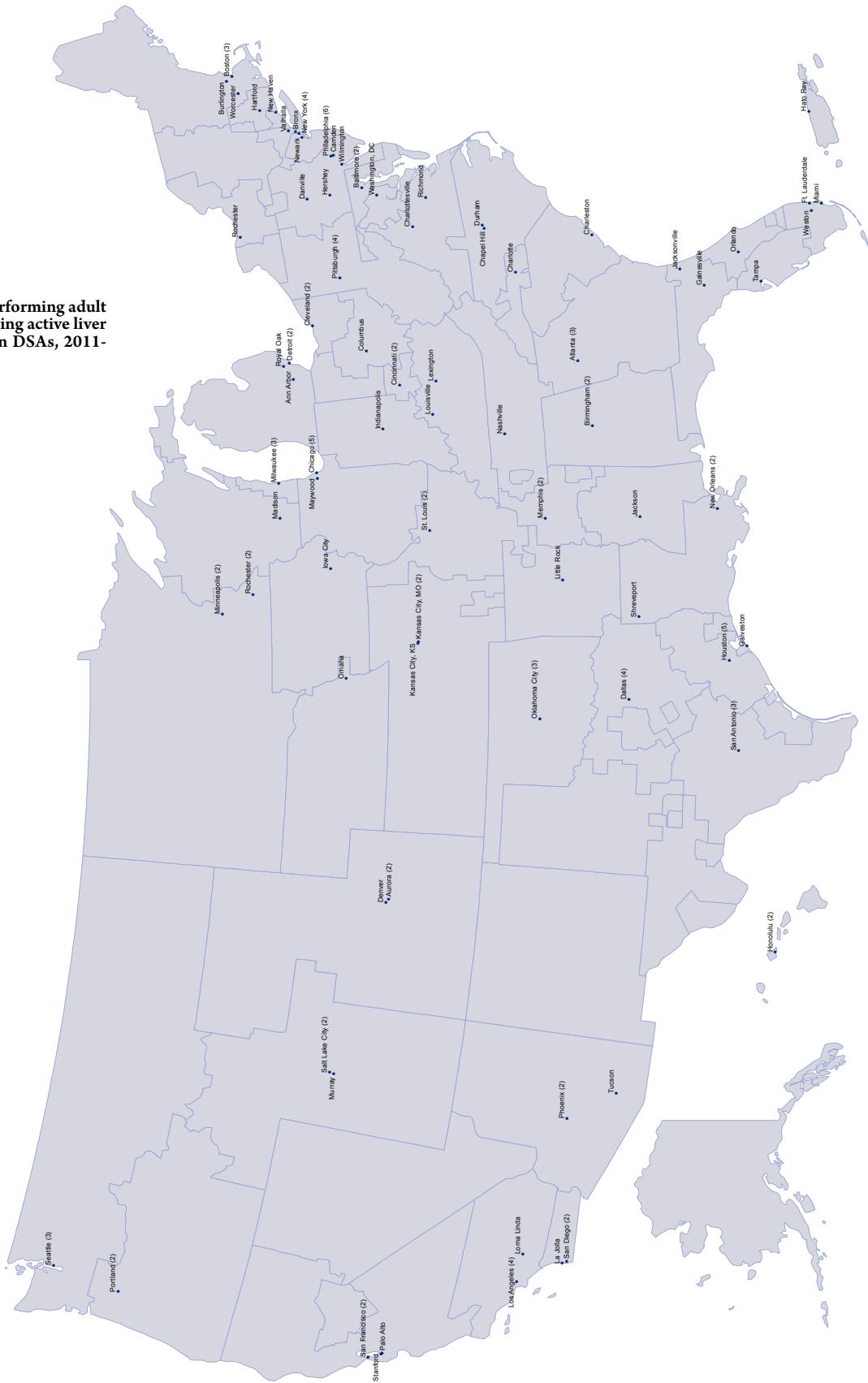
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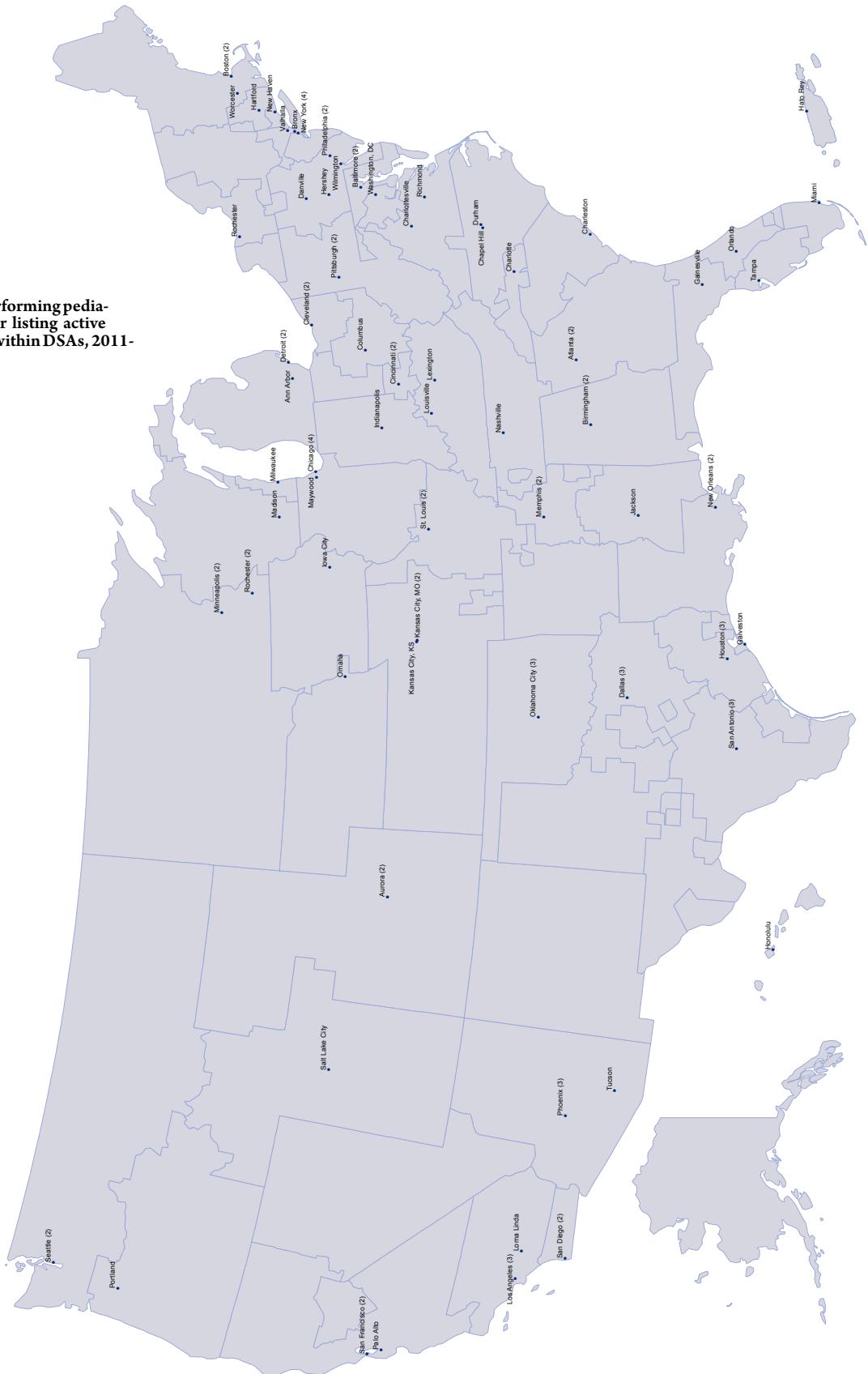
**LI 7.16 Graft survival among pediatric liver transplant recipients: deceased donors, 2004-2008**

Graft survival estimated using unadjusted Kaplan-Meier methods. Pediatric candidates aged 12 to 17 years can be assigned MELD or PELD scores. AHN, acute hepatic necrosis; Chol. disease, cholestatic disease; HCV, hepatitis C virus.





data behind the figures can be downloaded from our website, at [srtr.transplant.hrsa.gov](http://srtr.transplant.hrsa.gov)



# List of Figures/Tables

## **waiting list**

- LI 1.1** Adults waiting for liver transplant
- LI 1.2** Distribution of adults waiting for liver transplant
- LI 1.3** Characteristics of adults on the liver transplant waiting list on December 31, 2003, and December 31, 2013
- LI 1.4** Deceased donor liver transplant rates among active adult waitlist candidates
- LI 1.5** Deceased donor liver transplant rates per 100 waitlist years among active adult candidates, by DSA, 2012-2013
- LI 1.6** Percentage of adult waitlisted candidates who underwent deceased donor liver transplant within 5 years, by DSA, 2008
- LI 1.7** Liver transplant waitlist activity among adults
- LI 1.8** Three-year outcomes for adults waiting for liver transplant, new listings in 2010
- LI 1.9** Median months to liver transplant for waitlisted adults, by medical urgency at listing
- LI 1.10** Pretransplant mortality rates among adults waitlisted for liver transplant

## **deceased donation**

- LI 2.1** Deceased donor liver donation rates
- LI 2.2** Deceased donor liver donation rates (per 1000 deaths), by state, 2009-2011
- LI 2.3** Rates of organs recovered for transplant and not transplanted
- LI 2.4** DCD liver donors
- LI 2.5** Cause of death among deceased liver donors

## **living donation**

- LI 3.1** Liver transplants from living donors, by donor relation
- LI 3.2** Living donor liver donation rates
- LI 3.3** Living donor liver transplant graft type
- LI 3.4** Rehospitalization in the first 6 weeks, 6 months, and 1 year among living liver donors, 2008-2012
- LI 3.5** Biliary complications among living liver donors, 2009-2013
- LI 3.6** Vascular complications requiring intervention among living liver donors, 2009-2013
- LI 3.7** Other complications requiring intervention among living liver donors, 2009-2013
- LI 3.8** Re-operation among living liver donors, 2009-2013
- LI 3.9** BMI among living liver donors
- LI 3.10** Living liver donor deaths, 2009-2013

## **transplant**

- LI 4.1** Total liver transplants
- LI 4.2** Liver transplants
- LI 4.3** Use of DCD livers among adult recipients, by recipient age
- LI 4.4** Percentage of adult DCD liver transplants by DSA, 2011-2013
- LI 4.5** Characteristics of adult liver transplant recipients, 2003 and 2013
- LI 4.6** Immunosuppression in adult liver transplant recipients
- LI 4.7** Top 15 medications filled by adult liver transplant recipients, 2009
- LI 4.8** Median MELD scores for adult deceased donor liver recipients, by DSA, 2013
- LI 4.9** Differences in lab MELD and allocation MELD scores among liver transplant recipients, 2013

## **donor-recipient matching**

- LI 5.1** Total HLA A, B, and DR mismatches among adult deceased donor liver-kidney transplant recipients
- LI 5.2** Adult liver donor-recipient serology matching, 2009-2013

**outcomes**

- LI 6.1** Graft failure within the first 90 days posttransplant among adult liver transplant recipients
- LI 6.2** Graft failure among adult liver transplant recipients: deceased donor
- LI 6.3** Graft failure among adult liver transplant recipients: living donor
- LI 6.4** Graft survival among adult liver transplant recipients, 2008: deceased donors
- LI 6.5** Graft survival among adult liver transplant recipients, 2008: living donors
- LI 6.6** Recipients alive with a functioning liver graft on June 30 of the year, by age at transplant
- LI 6.7** Incidence of first acute rejection among adult liver transplant recipients, by age, 2007-2011
- LI 6.8** Incidence of PTLD among adult liver transplant recipients, by recipient EBV status at transplant, 2007-2011
- LI 6.9** Posttransplant cancer among liver transplant recipients, 2000-2009

**pediatric transplant**

- LI 7.1** Pediatric candidates waiting for liver transplant
- LI 7.2** Distribution of pediatric candidates waiting for liver transplant
- LI 7.3** Characteristics of pediatric candidates on the liver transplant waiting list on December 31, 2003, and December 31, 2013
- LI 7.4** Liver transplant waitlist activity among pediatric candidates
- LI 7.5** Three-year outcomes for pediatric candidates waiting for liver transplant among new listings, 2010
- LI 7.6** Deceased donor liver transplant rates among active pediatric waitlist candidates
- LI 7.7** Pretransplant mortality rates among pediatric liver transplant candidates, by age
- LI 7.8** Pediatric liver transplants, by donor type
- LI 7.9** Pediatric liver transplants from living donors
- LI 7.10** Characteristics of pediatric liver transplant recipients, 2001-2003 and 2011-2013
- LI 7.11** Incidence of PTLD among pediatric liver transplant recipients, by recipient EBV status at transplant, 2001-2011
- LI 7.12** Immunosuppression in pediatric liver transplant recipients
- LI 7.13** Graft survival among pediatric liver transplant recipients: deceased donor
- LI 7.14** Graft survival among pediatric liver transplant recipients: living donor
- LI 7.15** Incidence of first acute rejection among pediatric liver transplant recipients, by age, 2007-2011
- LI 7.16** Graft survival among pediatric liver transplant recipients: deceased donors, 2004-2008
- LI 7.17** Cumulative incidence of death by cause among pediatric liver recipients, 2007-2011

**transplant center maps**

- LI 8.1** Centers performing adult transplants or listing active liver candidates, within DSAs, 2011-2013
- LI 8.2** Centers performing pediatric transplants or listing active liver candidates, within DSAs, 2011-2013