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OPTN/SRTR 2011 Annual Data Report:

liver

ABSTRACT The current liver allocation system, introduced in 2002, decreased the importance of waiting time for allocation priorities; the number of active wait-listed candidates and median waiting times were immediately reduced. However, the total number of adult wait-listed candidates has increased since 2002, and median waiting time has increased since 2006. Pretransplant mortality rates have been stable, but the number of candidates withdrawn from the list as being too sick to undergo transplant nearly doubled between 2009 and 2011. Deceased donation rates have remained stable, with an increasing proportion of expanded criteria donors. Living donation has decreased over the past 10 years. Transplant outcomes remain robust, with continuously improving graft survival rates for deceased donor, living donor, and donation after circulatory death livers. Numbers of new and prevalent pediatric candidates on the waiting list have decreased. Pediatric pretransplant mortality has decreased, most dramatically for candidates aged less than 1 year. The transplant rate has increased since 2002, and is highest in candidates aged less than 1 year. Graft survival continues to improve for pediatric recipients of deceased donor and living donor livers. Incidence of acute rejections increases with time after transplant. Posttransplant lymphoproliferative disorder remains an important concern in pediatric recipients.

KEY WORDS Liver transplant, model for end-stage liver disease, pediatric end-stage liver disease, transplant outcomes.

*I am just so grateful for this
amazing gift I received.*

Halley, liver recipient

In 2011, 5,805 adult liver transplants were performed in the United States (Figure 4.1). These included transplant of 5,351 organs from donation after brain death donors, 266 from donation after circulatory death (DCD) donors, and 188 from living donors. Organs were procured across the country and transplanted at 131 transplant programs (from deceased organ donation chapter, Figure 1.3). For the organ recipients, these life-saving operations are expected to provide an unadjusted 1-year survival of 88.2% (data not shown). These extraordinary results are achieved by collaboration among transplant surgeons, physicians, and other health care providers, as well as organ procurement and allocation personnel. Conversely, during 2011, 2,456 patients died while on the waiting list, and 482 patients were removed from the list because they were too sick to undergo transplant (Figure 1.5).

Waiting List

The current allocation system, introduced in 2002, markedly decreased the importance of waiting time for liver allocation priorities. The number of active wait-listed liver transplant candidates was immediately reduced (Figure 1.1), as was the median waiting time (Figure 1.7). The proportion of wait-listed candidates who received an organ within 5 years of listing increased (Figure 1.9). Increasing proportions of candidates are older (Figure 1.2); the proportion of the largest age group, those aged 50 to 64 years, increased from 51.2% in 2001 to 63.7% in 2011. The proportion of male candidates increased gradually over time.

A gradually worsening donor shortage trend is recognizable. Since 2002, the total number of wait-listed candidates

gradually increased (Figure 1.1); most are listed as active. The median pre-transplant waiting time increased gradually but consistently since 2006 (Figure 1.7). The proportion of candidates with model for end-stage liver disease (MELD) scores greater than 15 also increased (Figures 1.2, 1.3). While pre-transplant mortality rates have been relatively stable since 2007 (Figure 1.10), the number of candidates withdrawn from the list because they were too sick to undergo transplant nearly doubled between 2009 (260) and 2011 (482; Figure 1.5). These data raise concern that wait-list mortality, which has decreased since the MELD-based allocation system was implemented, may increase again.

Geographic disparity in organ availability remains notable. The proportion of adults receiving deceased donor organs within 5 years of listing varied from less than 50% in some donation service areas (DSAs) to more than 80% in others (Figure 1.8). Similarly, mortality within 90 days of listing, regardless of transplant status, varied substantially by DSA; 90-day mortality varied more than 2-fold between DSAs with the lowest and highest mortality (Figure 1.12). As expected, the likelihood of undergoing transplant tended to be lower in DSAs with higher mortality. One possible approach to reducing wait-list mortality is to expand organ sharing among candidates at highest risk of death, as is currently done with status 1A and 1B patients. Based on analyses illustrated in Figure 1.11, showing that mortality for end-stage liver disease patients with the highest MELD scores (35 or higher) is nearly comparable to mortality for status 1A and 1B patients, a policy proposal for regional sharing of organs for those patients has recently been approved.

Transplant, Deceased and Living Donation

In the past several years, deceased donor liver donation rates have remained stable (Figure 2.1). In response to the donor shortage, transplant surgeons continue their efforts to increase the donor pool.

An increasing proportion of deceased donors are expanded criteria donors. The proportion of DCD organs has increased compared with the 1990s and remains at approximately 6% (Figures 2.7, 4.4). The proportion of organs donated after anoxic brain death increased more than 2-fold in the past decade, and the proportion of organs donated after death due to head trauma decreased (Figure 2.8).

Geographic inequality in deceased donor liver donation rates remains substantial (Figure 2.2). Variability between states with the highest and lowest donation rates is approximately 4-fold. This variability is accompanied by geographic differences in deceased donor transplant rates; by DSA, rates vary from 15.3 to 258.5 per 100 patient-years on the waiting list (Figure 4.6). Use of DCD donors varies widely by DSA, from 0% to 22.2% of transplants performed in 2009-2011 (Figure 4.5). Median MELD scores in adults receiving deceased donor livers ranged from 18.5 to 36.0; the national median MELD score is 27 (Figure 4.8).

The number of donations from living donors reached a plateau at about 250, about half the number of a decade ago (Figure 3.1). The relatively low number of living donor transplants performed in the US is substantially less than the numbers performed in countries such as Japan and Korea, a disparity possibly reflecting more access to deceased donors in the US than in many parts of Asia. The gradual decrease in the number of living donors in the US over the past 10 years

may be related to concerns about donor safety. Morbidity rates for living donors remain relatively low. Biliary complications in the first 6 weeks after donation are reported in less than 3% of living donors per year, except for 2007, when they were reported in 7.9% (Figure 3.8); most complications are reported as grade 1 or 2. Vascular complications in the first 6 weeks remain low, at less than 2% (Figure 3.9), and the frequency of reoperations in the first 6 weeks is low, at less than 4% (Figure 3.11).

Unfortunately, two donor deaths were reported in 2010 (Figure 3.12), and these deaths clearly affected the views of the transplant community regarding living donation. The number of left lobe transplants increased slightly (Figure 3.5). Since left lobe and left lateral lobe segment donation are generally regarded as safer for the donor (less volume of tissue taken), the slight increase in the number of these procedures compared with right lobe donation may reflect ongoing safety concerns in the transplant community. In general, living donor rates are higher in geographic areas with higher median MELD scores; the transplant community may be avoiding living donation unless the candidate has a MELD score less than 30.

Several important trends among liver transplant recipients are apparent. First, increasing proportions of recipients are older. Over the past decade, the proportion of recipients aged 50 years or older increased from 58.5% to 77.1%, and the proportion aged 35 to 49 years halved, from 35.1% to 16.9% from 2002 to 2011 (counts shown in Figure 4.2). Absolute numbers are small, but the proportion of recipients aged 65 years or older has gradually increased, from 7.6% in 2002 to 12.8% in 2011. The proportions of recipients with obesity and diabetes have also increased (Table 4.9). Second, liver transplant rates

in female candidates are increasingly recognized to be lower than rates in male counterparts. Several potential explanations may apply, and the gap may be narrowing in the past 2 to 3 years (Figure 4.3). Third, an upward trend remains for combined transplant. This is most notable for simultaneous liver-kidney transplant; these procedures increased more than 2-fold in the past decade (Figure 2.4). Simultaneous liver-kidney transplant remains a contentious topic, and the criteria for determining who is most appropriate for the procedure have not been established and adopted.

Outcomes

Although liver transplant is being performed in increasingly challenging circumstances (more older recipients with more comorbidity undergoing transplant with high MELD scores and suboptimal donor organs), transplant outcomes in the US remain robust. In survival models with minimal adjustment (age, sex, race), the graft failure rate has continuously improved (Figure 6.2). Improvement in graft outcomes has occurred in deceased donor, living donor, and DCD transplants (Figure 6.1). As of June 30, 2011, 62,469 liver transplant recipients in the US were alive with a functioning graft (Figure 6.7).

Several factors affect graft survival after liver transplant, including recipient age, primary cause of disease, and status and MELD score at the time of transplant (Figures 6.4, 6.5). These factors have been well described and have relatively modest impact on absolute graft survival rates.

Successful liver transplant results are in part attributable to appropriate use of immunosuppression. Initial immunosuppression for most recipients is tacrolimus and mycopheno-

late mofetil (MMF), commonly in conjunction with steroids (Figure 7.1). Induction therapy is used infrequently (Figure 7.2). By 1 year after transplant, most patients are no longer taking steroids and are taking tacrolimus with or without MMF (Figure 7.3). With these immunosuppressive regimens, acute rejection occurs in less than 20% of recipients during the first year (Figure 6.8).

Pediatric Transplant

WAITING LIST

The number of new active pediatric candidates added to the liver transplant waiting list decreased from a peak of 969 in 2001 to 704 in 2011; few candidates were added as inactive (Figure 8.1). In a similar trend, the number of prevalent candidates on the waiting list has decreased. Since 2008, prevalent candidates with active status outnumber those with inactive status. The wait-list age distribution has changed little over the past decade; in 2011, 49.2% of listed candidates were aged 6 years or younger (Figure 8.2). The proportion of Hispanic wait-listed candidates increased from 14.8% in 1998 to 24.0% in 2011. The number of wait-listed candidates waiting for a re-transplant decreased from 236 in 2001 to 76 in 2011 and represented 11.2% of wait-listed candidates (Figure 8.3). Among all wait-listed candidates in 2011, 8.2% of those aged 0 to 5 years were waiting for a re-transplant, as were 18.8% of those aged 6 to 10 years and 15.3% of those aged 11 to 17 years. Pre-transplant mortality has steadily declined for candidates wait-listed for a liver-alone transplant, from 14.3 deaths per 100 wait-list years in 1998-1999 to 6.2 in 2010-2011; the most dramatic decline was in the group aged less than 1 year, where pre-transplant mortality was halved (Figure 8.7).

TRANSPLANT

The number of deceased donor pediatric liver transplants peaked at 542 in 2008 and decreased to 477 in 2011. The number of living donor transplants decreased from a peak of 120 in 2000 to 59 in 2011 (Figure 8.8). The transplant rate has increased since 2002 to the current rate of 84.1 transplants per 100 patient-years on the waiting list (Figure 8.9). The transplant rate is highest for patients aged less than 1 year: 264 transplants per 100 patient-years on the waiting list. Over the past decade, the age, sex, and ethnic distributions of recipients have changed little (Figure 8.10). Cholestatic disease remains the leading cause of liver failure. More than 55% of patients who underwent transplant waited 60 days or fewer for transplant. Without taking into account exception scores provided by Organ Procurement and Transplantation Network (OPTN) policy, MELD/pediatric end-stage liver disease (PELD) scores at the time of transplant were 35 or higher for 14.7% of patients and less than 15 for 15.0%; the most common score range was 15 to 29. Most pediatric patients (63.6%) received a whole liver. The percentage of living donors declined from 19.4% during 1999-2001 to 10.6% during 2009-2011 (Figure 8.10). Use of DCD organs is rare in pediatric liver transplant, generally accounting for less than 1% (Figure 8.12).

IMMUNOSUPPRESSION AND OUTCOMES

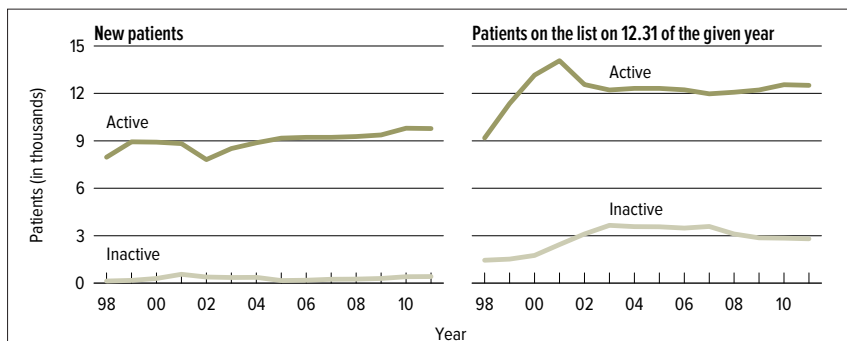
In 2011, tacrolimus was reported as part of the initial maintenance immunosuppressive medication regimen for 95.4% of pediatric liver transplant recipients and MMF for 40.1% (Figure 8.15). Steroid use was reported for 87.3% of recipients at the time of transplant, but for only 38.7% of 2010 recipients at 1 year after transplant. Mammalian target of rapamycin (mTOR)

inhibitors were reported for 1.4% of recipients at the time of transplant and for 5.3% at 1 year after transplant. In 2011, 68.8% of liver transplants were performed with no induction immunosuppression (Figure 8.15). Graft survival has continued to improve over the past decade for recipients of deceased donor and living donor livers. Graft failure was 10.1% at 6 months for deceased donor transplants performed in 2010, 14.4% at 1 year for transplants performed in 2009, 19.6% at 3 years for transplants performed in 2008, 25.0% at 5 years for transplants performed in 2006, and 35.8% at 10 years for transplants performed in 2001 (Figure 8.16). Incidence of acute rejection increases with time after transplant. For liver transplants performed in 2005-2010, acute rejection occurred for 20.0% by 6 months after transplant, 30.6% by 12 months, and 36.8% by 24 months (Figure 8.19). Post-transplant lymphoproliferative disorder (PTLD) is an important concern in pediatric transplantation. The highest risk for PTLD and Epstein-Barr virus (EBV) infection occurs in EBV-negative recipients. Incidence of PTLD was 6.2% at 5 years after transplant in EBV-negative recipients and 4.0% in EBV-positive recipients (Figure 8.14).

POLICY UPDATES

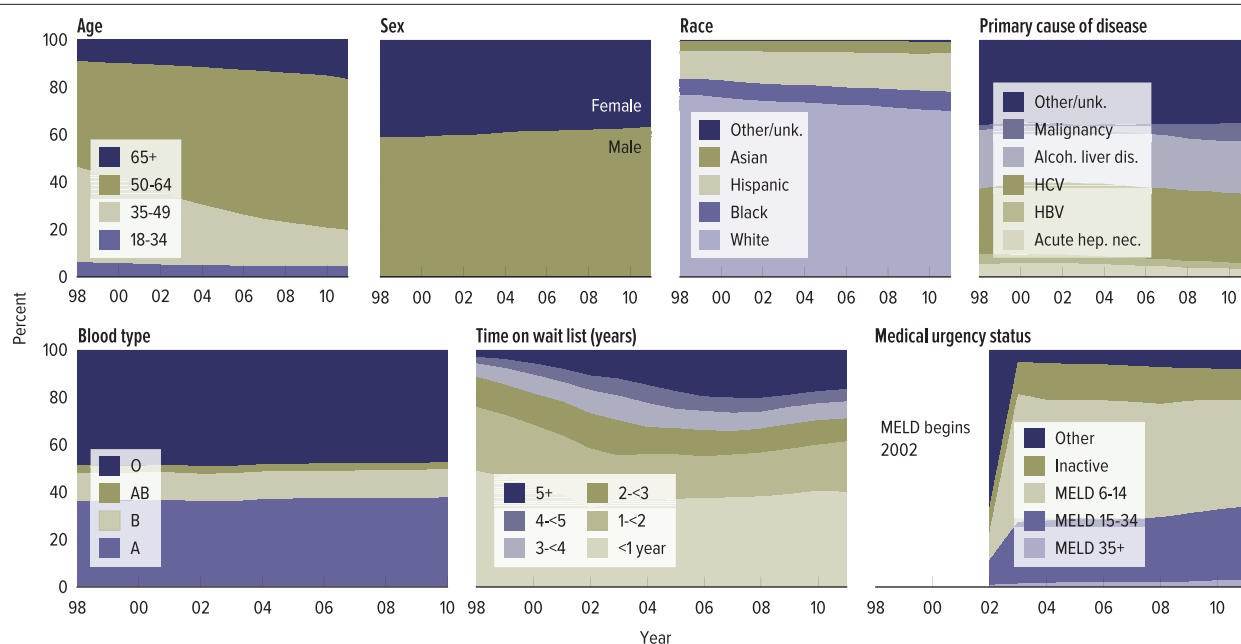
The OPTN Pediatric Transplantation and Liver and Intestinal Organ Transplantation Committees developed two proposals that were adopted by the OPTN Board of Directors in November 2011 and implemented on February 1, 2012: 1) to allow centers to seek permission to list all pediatric liver candidates with non-metastatic hepatoblastoma as status 1B, and 2) to eliminate the requirement that pediatric liver transplant candidates be in a hospital's intensive care unit to qualify as status 1A or 1B.

wait list



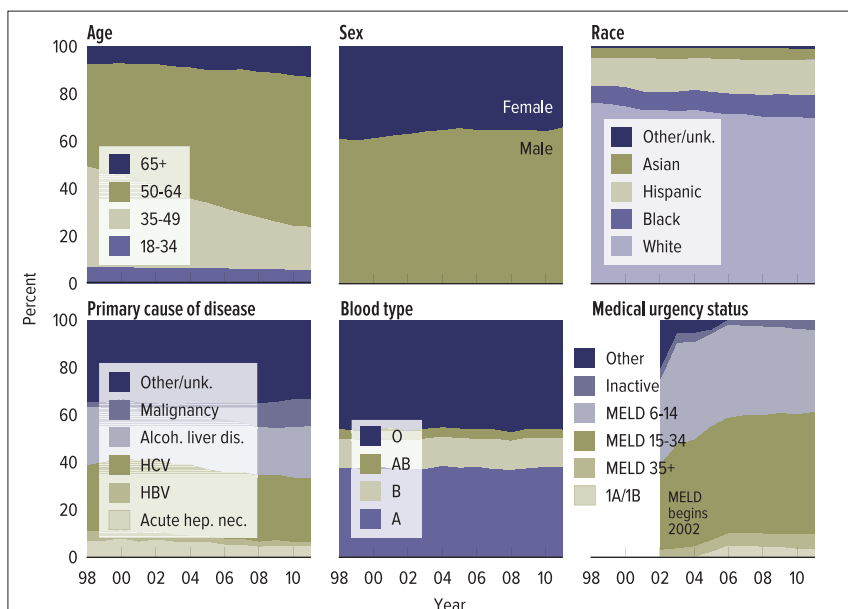
LI 1.1 Adult patients waiting for a liver transplant

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.



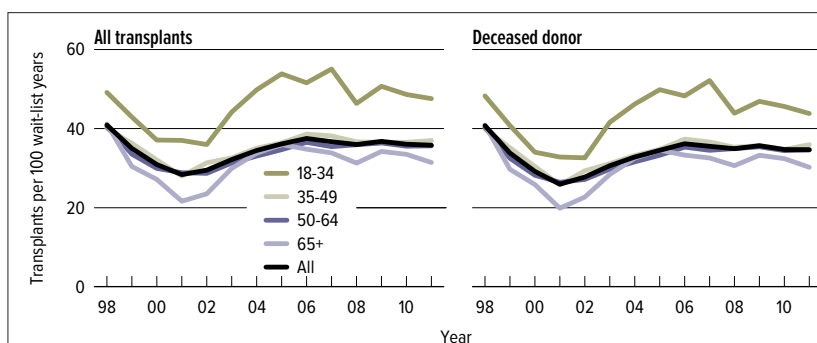
LI 1.2 Distribution of adult patients waiting for a liver transplant

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. Malignancy as primary cause of disease includes, but is not limited to hepatocellular carcinoma (HCC); for some patients with HCC, another condition may have been cited as the primary cause of liver failure.



LI 1.3 Distribution of adult patients newly listed for a liver transplant

A newly listed 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 newly listed patient. Patients concurrently listed at multiple centers are counted only once. Malignancy as primary cause of disease includes, but is not limited to hepatocellular carcinoma (HCC); for some patients with HCC, another condition may have been cited as the primary cause of liver failure.



LI 1.4 Liver transplant rates among adult waiting list candidates, by age

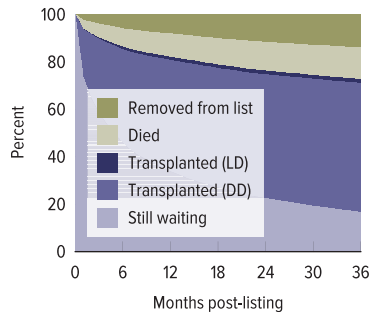
Patients waiting for a transplant; age as of January 1 of the given year. Yearly period-prevalent rates are computed as the number of all transplants/deceased donor transplants per 100 patient years of waiting time in the given year. All waiting time per patient per listing is counted, and all listings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

	2009	2010	2011
Patients at start of year	15,181	15,074	15,376
Patients added during year	9,674	10,210	10,212
Patients removed during year	9,761	9,890	10,258
Patients at end of year	15,094	15,394	15,330
Removal reason			
Deceased donor transplant	5,548	5,489	5,596
Living donor transplant	167	210	186
Patient died	2,315	2,458	2,456
Patient refused transplant	67	50	57
Improved, tx not needed	585	571	547
Too sick to transplant	260	329	482
Other	819	783	934

LI 1.5 Liver transplant waiting list activity among adult patients

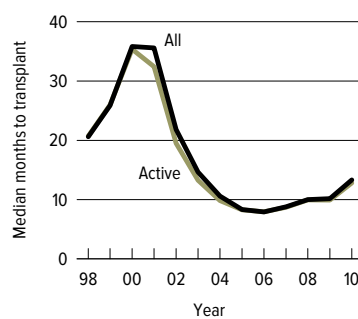
Patients with concurrent listings at more than one center are counted once, from the time of earliest listing to the time of latest removal. Patients listed, transplanted, and re-listed are counted more than once. Patients are not considered "on the list" on the day they are removed. Thus, patient counts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

wait list



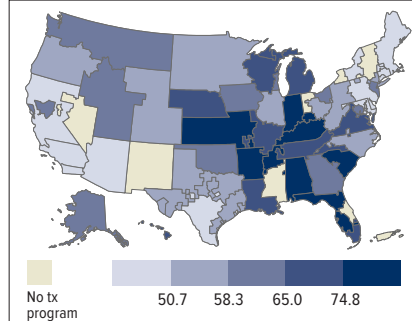
LI 1.6 Outcomes for adult patients waiting for a liver transplant among new listings in 2008

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.



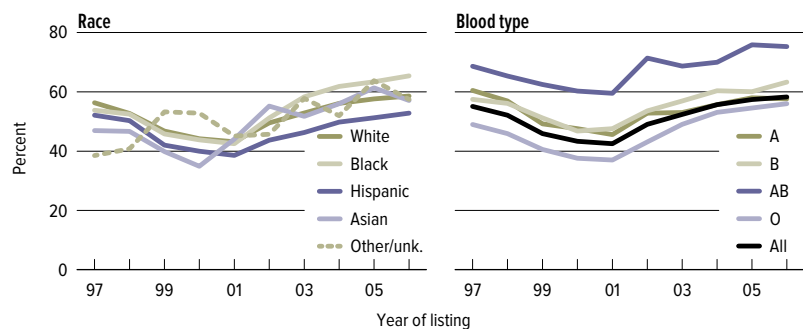
LI 1.7 Median months to liver transplant for wait-listed adult patients

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.



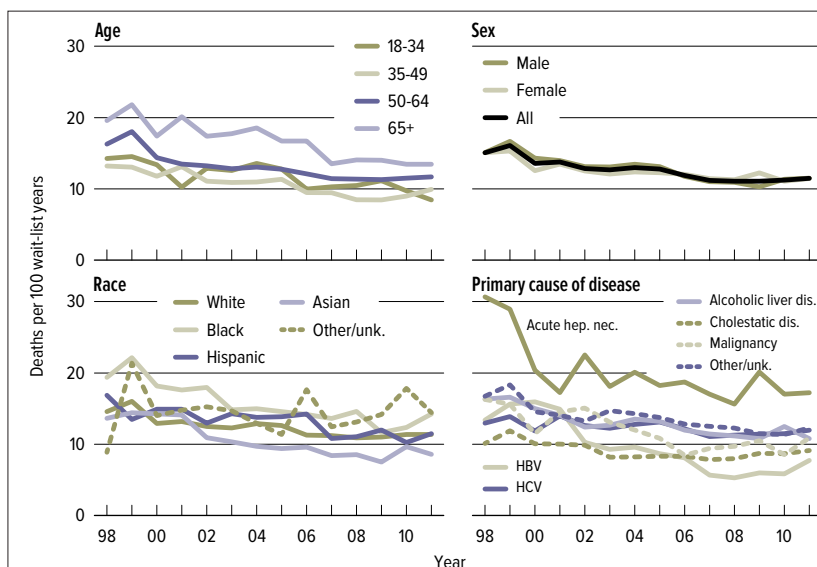
LI 1.8 Percent of adult wait-listed patients, 2006, who received a deceased donor liver transplant within five years, by DSA

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.



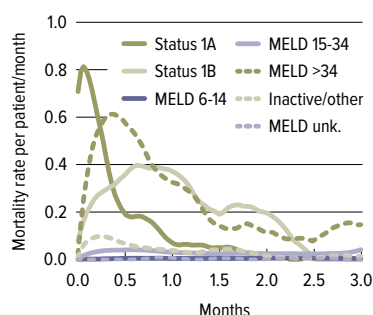
LI 1.9 Adult wait-listed patients who received a deceased donor liver transplant within five years

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.



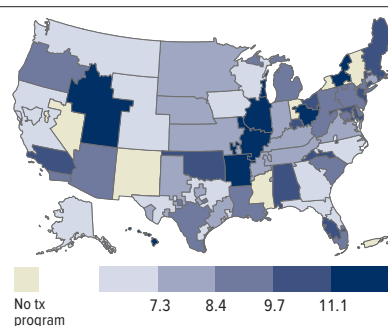
LI 1.10 Pre-transplant mortality rates among adult patients wait-listed for a liver transplant

Patients waiting for a transplant. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. For rates shown by different characteristics, waiting time is calculated as the total waiting time in the year 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 year. Other patient characteristics come from the OPTN Transplant Candidate Registration form.



LI 1.11 Mortality rates by medical urgency status, 2006-2011

Estimated hazard rate for death among patients waiting for liver transplant, stratified by medical urgency status at listing.



LI 1.12 Mortality within 90 days of listing for liver transplant, by DSA, 2009-2010

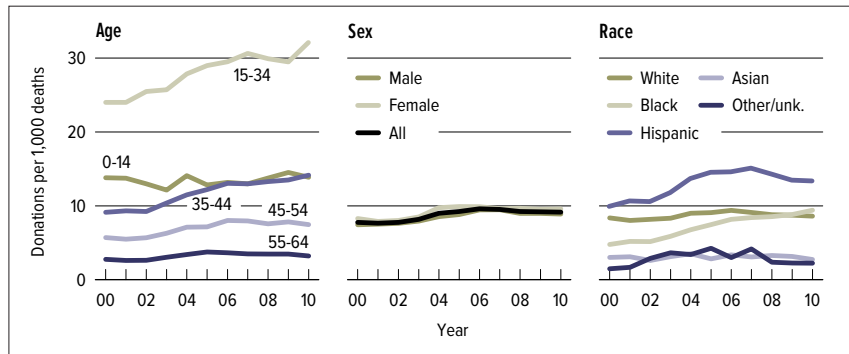
Percent of adult patients who die within 90 days of first listing. Patients with concurrent listings in a single DSA are counted once in that DSA, and those listed in multiple DSAs are counted separately per DSA. All deaths occurring within 90 days of listing are counted, including deaths occurring after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

	Level	2001		2011	
		N	%	N	%
Age	18-34	844	5.1	617	4.0
	35-49	5,575	33.7	2,389	15.6
	50-64	8,489	51.3	9,881	64.4
	65+	1,637	9.9	2,460	16.0
Sex	Male	9,584	57.9	9,583	62.4
	Female	6,961	42.1	5,764	37.6
Race	White	12,337	74.6	10,737	70.0
	Black	1,158	7.0	1,088	7.1
	Hispanic	2,224	13.4	2,609	17.0
	Asian	740	4.5	763	5.0
	Other/unk.	86	0.5	150	1.0
Primary cause of disease	Acute hep. nec.	815	4.9	394	2.6
	HBV	626	3.8	430	2.8
	HCV	5,020	30.3	4,615	30.1
	Alcoholic liver dis.	3,836	23.2	3,563	23.2
	Cholestatic disease	1,877	11.3	1,381	9.0
	Malignancy	354	2.1	915	6.0
	Other/unk.	4,017	24.3	4,049	26.4
Tx history	Listed for first tx	15,430	93.3	14,918	97.2
	Listed for subseq. tx	1,115	6.7	429	2.8
Blood type	A	5,868	35.5	5,845	38.1
	B	1,854	11.2	1,704	11.1
	AB	486	2.9	384	2.5
	O	8,337	50.4	7,414	48.3
Time on wait list	<1 year	6,191	37.4	5,521	36.0
	1-<2	3,700	22.4	2,756	18.0
	2-<3	2,419	14.6	1,655	10.8
	3-<4	1,523	9.2	1,308	8.5
	4-<5	1,057	6.4	953	6.2
	5+	1,655	10.0	3,154	20.6
Status	Active	14,094	85.2	12,537	81.7
	Inactive	2,451	14.8	2,810	18.3
Medical urgency status	1A/1B			2	0.0
	MELD 35+			57	0.4
	MELD 30-34			51	0.3
	MELD 25-29			164	1.1
	MELD 20-24			899	5.9
	MELD 15-19			2,631	17.1
	MELD 10-14			4,873	31.8
	MELD 6-9			2,706	17.6
	HCC T1			1	0.0
	HCC T2			748	4.9
	Other exceptions			405	2.6
	Inactive			2,810	18.3
Total		16,545	100.0	15,347	100.0

LI 1.13 Characteristics of adult patients on the liver transplant waiting list on December 31, 2001 & December 31, 2011

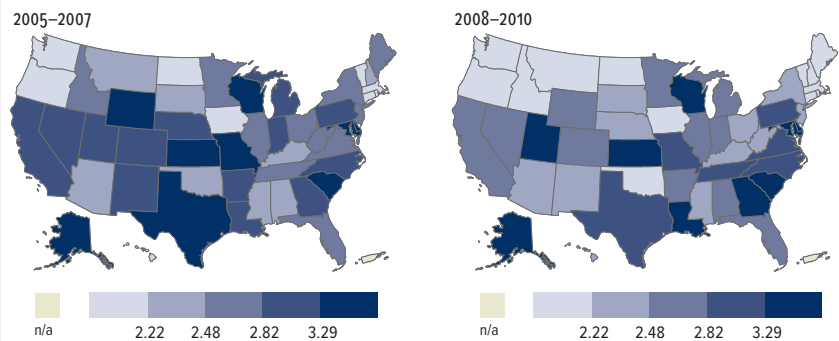
Patients waiting for a transplant on December 31, 2001 and December 31, 2011, regardless of first listing date; active/inactive status is on this date, and multiple listings are not counted.

deceased donation



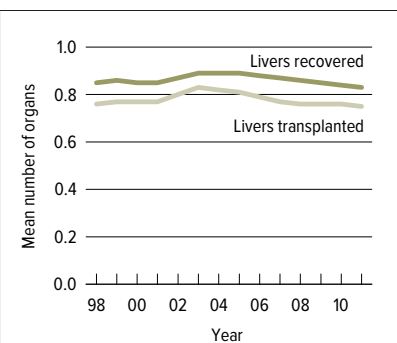
LI 2.1 Deceased donor liver donation rates

Numerator: Deceased donors age less than 65 whose liver was recovered for transplant. Denominator: US deaths per year, age less than 65. (Death data available at <http://www.cdc.gov/nchs/products/nvsr.htm>.)



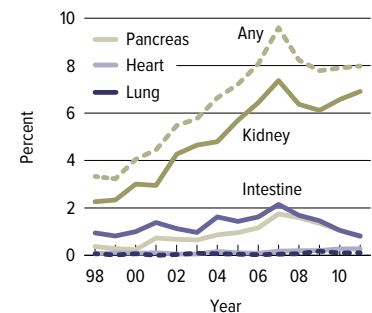
LI 2.2 Deceased donor liver donation rates (per 1,000 deaths), by state

Numerator: Deceased donors residing in the 50 states whose liver was 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.



LI 2.3 Livers recovered per donor & livers transplanted per donor

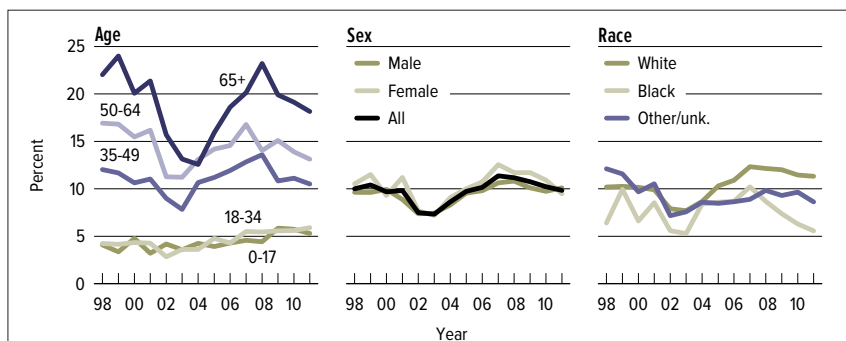
Denominator: all deceased donors with at least one organ of any type recovered for transplant. Numerator for recovery rate: number of livers recovered for transplant in the given year; livers recovered for other purposes are not included. Numerator for transplant rate: all deceased donor livers transplanted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



LI 2.4 Deceased donor livers transplanted with another organ

All patients receiving a deceased donor liver 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-liver organ will be considered separately.

deceased donation



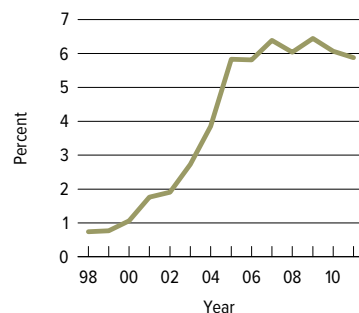
LI 2.5 Discard rates for livers recovered for transplant

Percent of livers discarded out of all livers recovered for transplant.

Reasons for discard	Percent	N
Biopsy findings	43.54	290
Other, specify	19.07	127
Anatomical abnormalities	7.36	49
Warm ischemic time too long	6.61	44
Diseased organ	6.01	40
Poor organ function	5.71	38
Recipient determined to be unsuitable	2.70	18
No recipient located - list exhausted	2.55	17
Organ trauma	1.80	12
Too old on ice	1.65	11
Vascular damage	1.50	10
Donor medical history	0.45	3
Organ not as described	0.45	3
Positive hepatitis	0.30	2
Infection	0.15	1
Missing	0.15	1

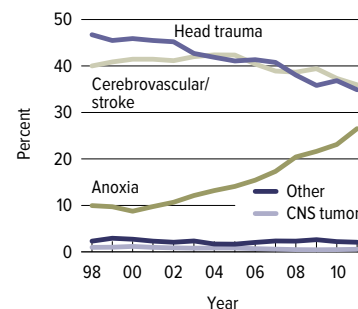
LI 2.6 Reasons for discards, 2011

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



LI 2.7 Liver donors who are DCD

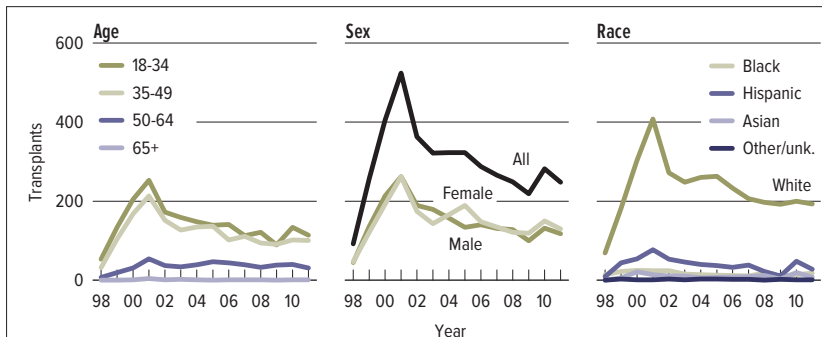
Deceased donors whose liver was recovered for transplant. DCD status is reported on the OPTN Deceased Donor Registration form.



LI 2.8 Cause of death among deceased liver donors

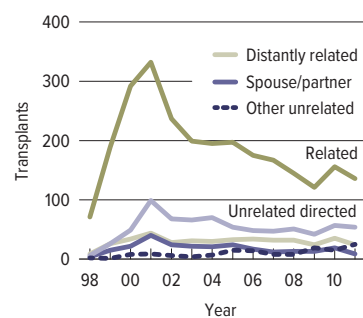
Deceased donors whose liver was transplanted. CNS = central nervous system.

live donation



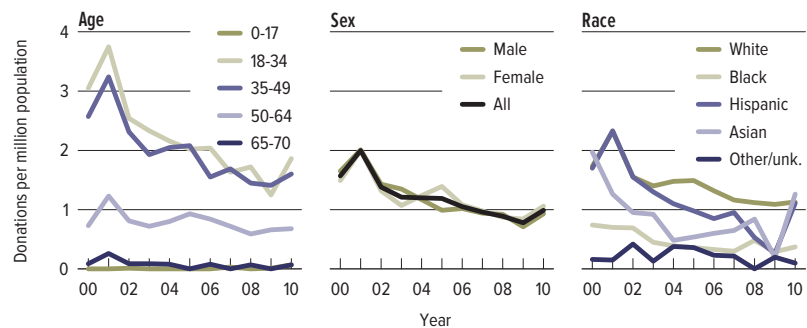
LI 3.1 Liver donations from living donors

Number of living donor donations; characteristics recorded on OPTN Living Donor Registration form.



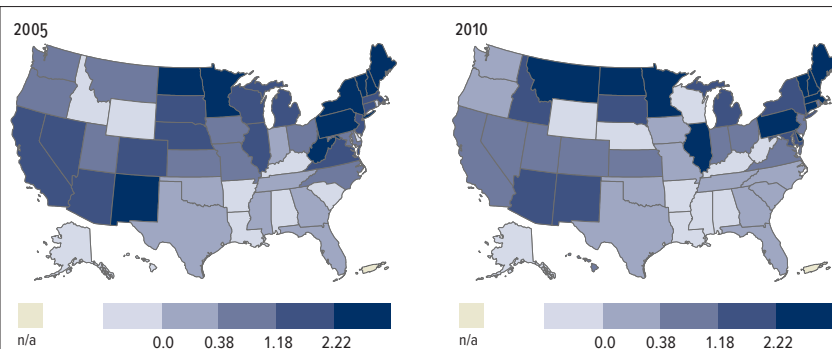
LI 3.2 Liver transplants from living donors, by donor relation

Number of living donor donations; characteristics recorded on OPTN Living Donor Registration form.



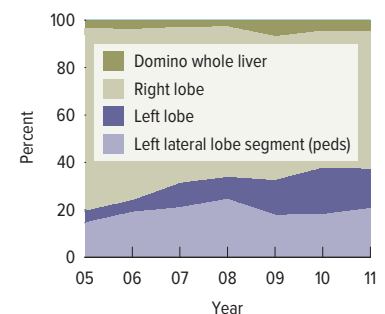
LI 3.3 Living donor liver donation rates

Number of living donors whose liver was recovered for transplant each year. Denominator: US population age 70 and younger (population data downloaded from <http://www.census.gov/popest/national/asrh/2009-nat-res.html>).



LI 3.4 Living donor liver donation rates (per million population), by state

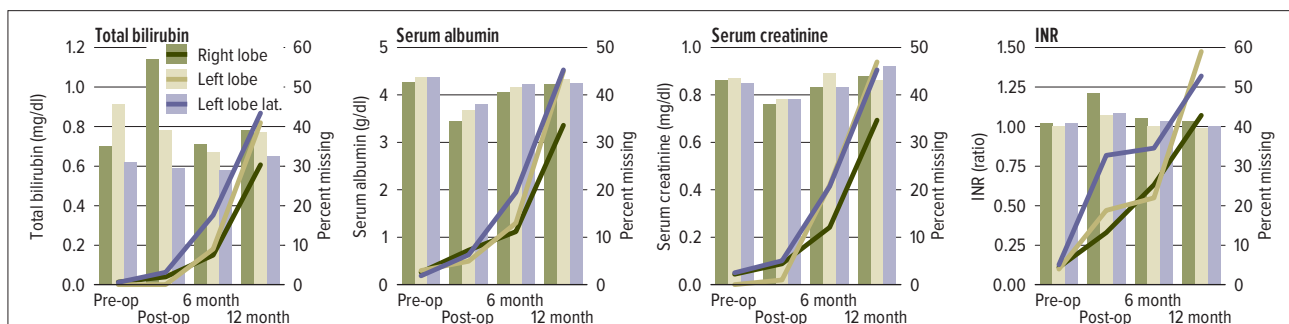
Number of living donors residing in the 50 states whose liver was recovered for transplant in the given year. Denominator: US population age 70 and younger (population data downloaded from http://www.cdc.gov/nchs/nvss/bridged_race/data_documentation.htm).



LI 3.5 Living donor liver transplant graft type

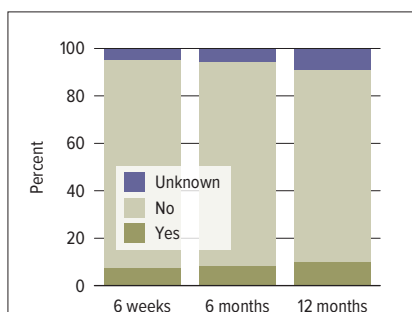
Living donors by graft type for each year. Denominator: total number of living liver donors for each year.

live donation



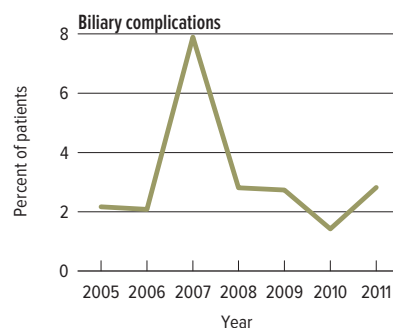
LI 3.6 Mean pre- & post-operative total bilirubin, serum albumin, serum creatinine, & INR among liver donors, 2008–2010

Pre- and post-recovery lab values as reported on the OPTN Living Donor Registration form. Six- and 12-month lab values as reported on the OPTN Living Donor Follow-up form.



LI 3.7 Readmission to the hospital in the first year among live liver donors, 2010

Cumulative readmission to the hospital. "Unknown" means that patient has been lost to follow-up as of this follow-up visit. The six-week time point is recorded at the earliest of discharge or six weeks post-donation.



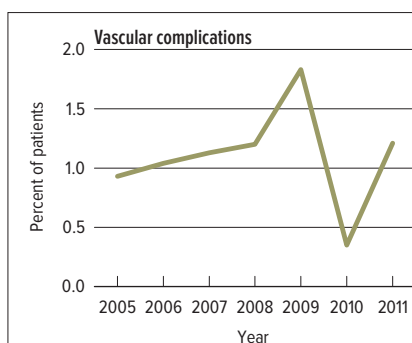
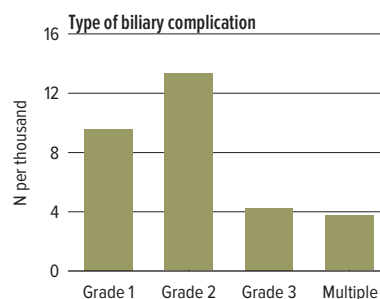
LI 3.8 Biliary complications among live liver donors

Complications reported on the OPTN Living Donor Registration forms. Type of complication is shown among all live donors, 2005–2011.

Grade 1: Bilious JP drainage more than 10 days

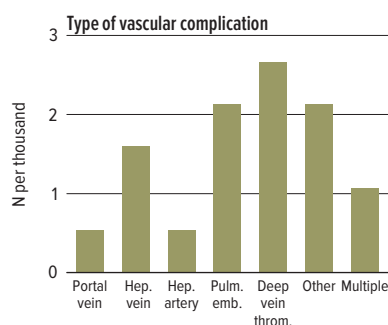
Grade 2: Interventional procedure (ERCP, PTC, percutaneous drainage, etc.)

Grade 3: Surgical intervention

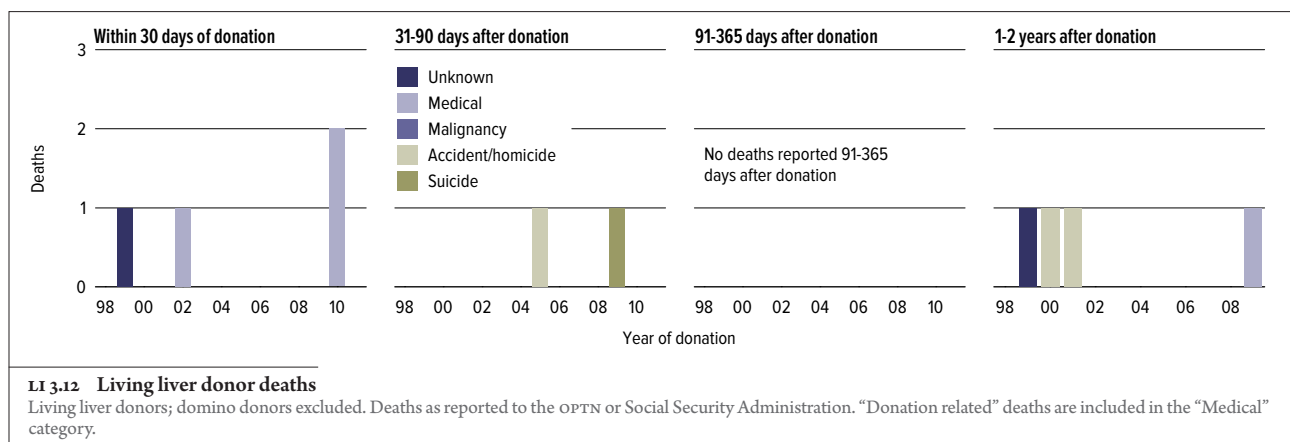
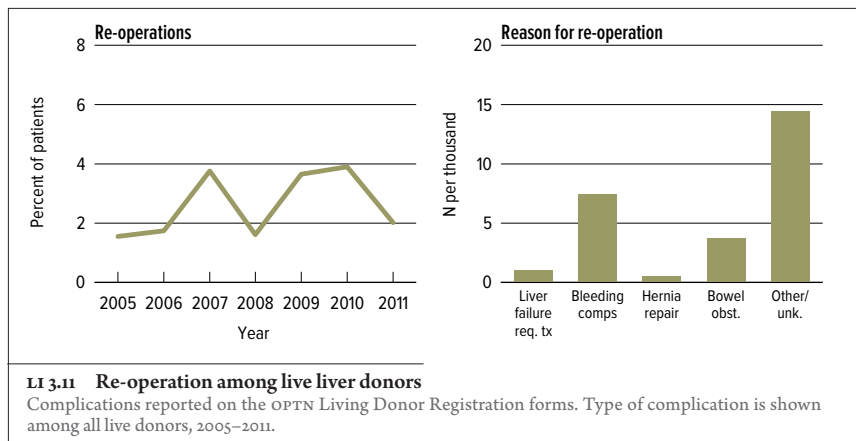
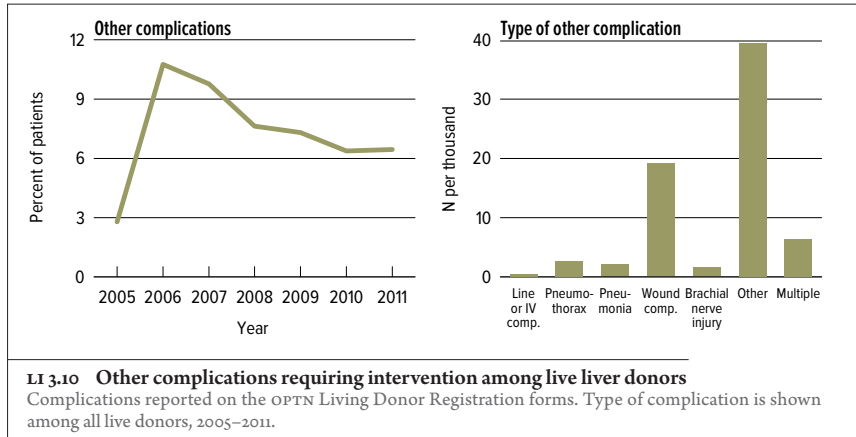


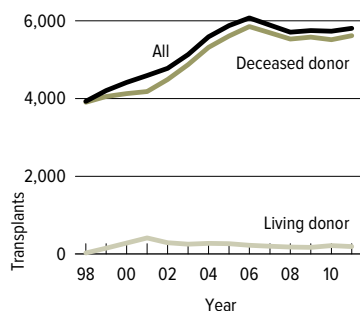
LI 3.9 Vascular complications requiring intervention among live liver donors

Complications reported on the OPTN Living Donor Registration forms. Type of complication is shown among all live donors, 2005–2011.



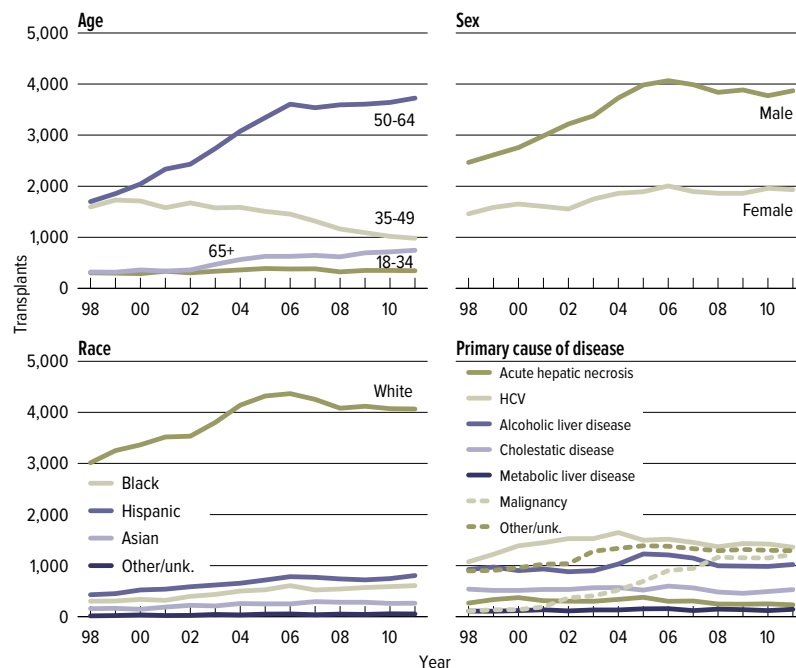
live donation





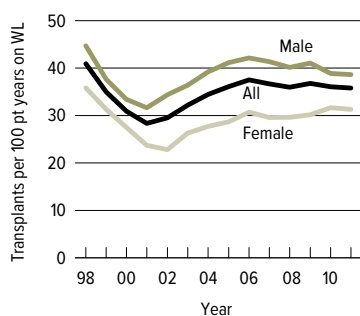
LI 4.1 Total adult liver transplants

Patients receiving a transplant. Retransplants are counted.



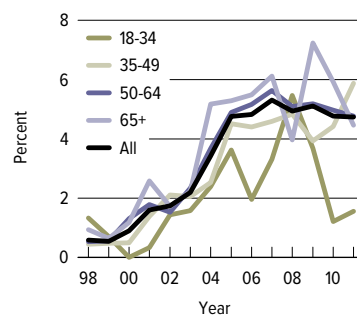
LI 4.2 Adult liver transplants

Patients receiving a transplant. Retransplants are counted.



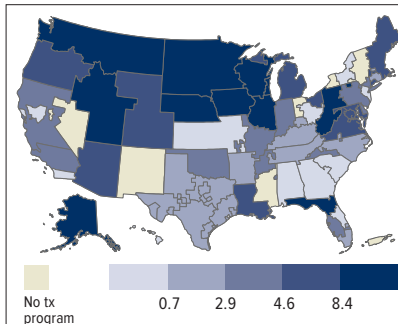
LI 4.3 Liver transplant rates in adult waiting list candidates

Patients waiting for a transplant. 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.



LI 4.4 Use of DCD livers among adult recipients, by recipient age

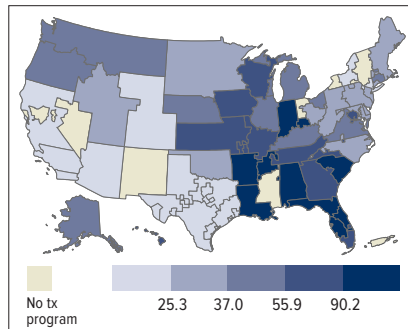
Percent of deceased donor transplants using a DCD donor.



LI 4.5 Percent of adult, deceased donor liver transplants that are DCD, by DSA, 2009-2011

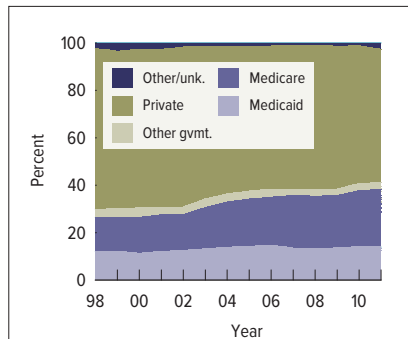
Percent of deceased donor transplants using a DCD donor, by DSA of the transplanting center.

transplant



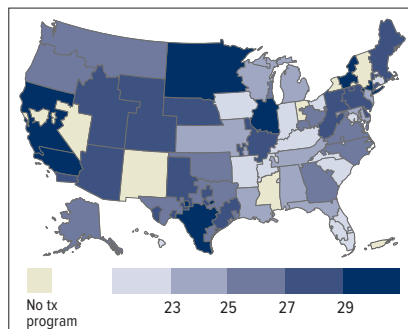
LI 4.6 Deceased donor liver transplant rates per 100 patient years on the waiting list among adult candidates, by DSA, 2010-2011

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.



LI 4.7 Insurance coverage among adult liver transplant recipients at time of transplant

Patients receiving a transplant. Retransplants are counted.



LI 4.8 Median MELD score for adult deceased donor liver transplants, by DSA, 2011

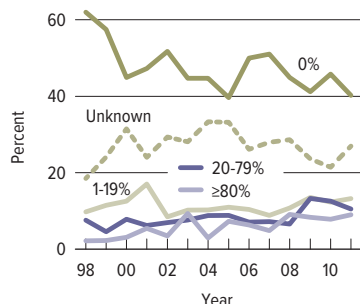
Deceased donor liver transplants; DSA of transplant center location. Patients with status 1A, 1B and inactive status excluded, and allocation MELD score used.

		2001		2011	
Level		N	%	N	%
Age	18-34	337	7.3	349	6.0
	35-49	1,579	34.4	983	16.9
	50-64	2,338	50.9	3,728	64.2
	65+	339	7.4	745	12.8
Sex	Female	1,608	35.0	1,935	33.3
	Male	2,985	65.0	3,870	66.7
Race	White	3,521	76.7	4,069	70.1
	Black	320	7.0	610	10.5
	Hispanic	538	11.7	808	13.9
	Asian	191	4.2	264	4.5
	Other/unknown	23	0.5	54	0.9
Primary cause of disease	Acute hepatic necrosis	314	6.8	234	4.0
	HCV	1,450	31.6	1,364	23.5
	Alcoholic liver disease	935	20.4	1,024	17.6
	Cholestatic disease	535	11.6	531	9.1
	Metabolic liver disease	136	3.0	143	2.5
	Malignancy	194	4.2	1,216	20.9
	All others	1,029	22.4	1,293	22.3
Blood type	A	1,938	42.2	2,138	36.8
	B	587	12.8	778	13.4
	AB	228	5.0	304	5.2
	O	1,840	40.1	2,585	44.5
Time on waiting list	<30 days	948	20.6	1,773	30.5
	31-60 days	370	8.1	604	10.4
	61-90 days	318	6.9	442	7.6
	3-6 months	660	14.4	902	15.5
	6-12 months	872	19.0	914	15.7
	1-2 years	841	18.3	703	12.1
	2-3 years	323	7.0	173	3.0
	3+ years	239	5.2	294	5.1
	Missing/unknown	22	0.5	0	0.0
BMI	<18.5	132	2.9	94	1.6
	18.5-24.9	1,456	31.7	1,700	29.3
	25.0-29.9	1,575	34.3	2,012	34.7
	30.0-34.9	846	18.4	1,214	20.9
	35.0-39.9	327	7.1	551	9.5
	40.0+	163	3.5	232	4.0
	Unknown	94	2.0	2	0.0
Medical condition	Hospitalized: ICU	1,115	24.3	744	12.8
	Hospitalized: not ICU	671	14.6	1,131	19.5
	Not hospitalized	2,807	61.1	3,843	66.2
	Unknown	0	0.0	87	1.5
Medical urgency status before transplant	Status 1A/1B			215	3.7
	MELD 35-40			1,067	18.4
	MELD 30-34			915	15.8
	MELD 15-29			3,423	59.0
	MELD 6-14			184	3.2
Primary payer	Other/unknown			1	0.0
	Private	3,049	66.4	3,264	56.2
Procedure type	Medicaid	558	12.1	811	14.0
	Other	986	21.5	1,730	29.8
Donor type	Whole liver	4,110	89.5	5,558	95.7
	Partial liver, rmdr not tx	404	8.8	183	3.2
	Split liver	79	1.7	64	1.1
Patient on life support	Deceased	4,181	91.0	5,617	96.8
	Living	412	9.0	188	3.2
Previous abdominal surg.	Yes	510	11.1	381	6.6
	No	1,776	38.7	2,362	40.7
Diabetes	Yes	872	19.0	1,436	24.7
	No	168	3.7	491	8.5
Portal vein thrombosis	Yes	159	3.5	151	2.6
	No	395	8.6	440	7.6
Incident tumor found at transplant	Yes	395	8.6	440	7.6
	No	4,593	100.0	5,805	100.0
Spontaneous bacterial peritonitis (SBP)					
Total		4,593	100.0	5,805	100.0

LI 4.9 Characteristics of adult liver transplant recipients, 2001 & 2011

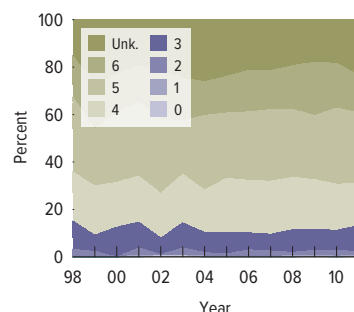
Patients receiving a transplant. Retransplants are counted.

donor-recipient matching



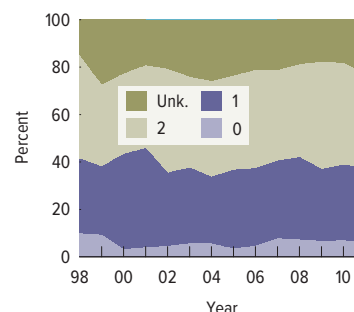
LI 5.1 PRA at time of liver-kidney transplant in adult recipients

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. Limited to liver-kidney transplants only.



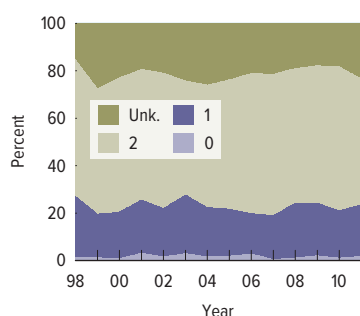
LI 5.2 Total HLA mismatches among adult liver-kidney transplant recipients

Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011. Limited to liver-kidney transplants only.



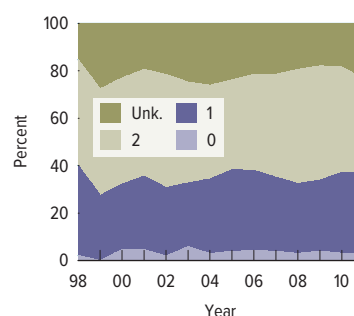
LI 5.3 HLA-A mismatches among adult liver-kidney transplant recipients

Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011. Limited to liver-kidney transplants only.



LI 5.4 HLA-B mismatches among adult liver-kidney transplant recipients

Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011. Limited to liver-kidney transplants only.



LI 5.5 HLA-DR mismatches among adult liver-kidney transplant recipients

Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011. Limited to liver-kidney transplants only.

donor-recipient matching

RECIPIENT	DECEASED DONOR				LIVING DONOR			
	Neg.	Pos.	Unk.	Total	Neg.	Pos.	Unk.	Total
Negative	11.0	19.4	0.1	30.5	29.9	11.7	4.3	45.9
Positive	22.0	42.6	0.3	64.9	23.5	22.8	4.5	50.8
Unknown	1.5	3.1	0.0	4.7	1.7	0.7	0.7	3.2
Total	34.5	65.1	0.4	100	55.1	35.2	9.6	100

LI 5.6 Adult liver 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.

RECIPIENT	DECEASED DONOR				LIVING DONOR			
	Neg.	Pos.	Unk.	Total	Neg.	Pos.	Unk.	Total
Negative	0.7	11.1	0.7	12.5	1.4	7.4	2.2	11.0
Positive	2.9	53.5	1.4	57.8	3.0	46.7	12.7	62.4
Unknown	1.3	27.4	1.1	29.7	1.8	11.3	13.6	26.7
Total	4.8	92.0	3.2	100	6.1	65.4	28.5	100

LI 5.7 Adult liver 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.

RECIPIENT	DECEASED DONOR				LIVING DONOR			
	Neg.	Pos.	Unk.	Total	Neg.	Pos.	Unk.	Total
Negative	66.3	2.8	0.0	69.1	67.4	1.7	8.6	77.6
Positive	19.1	2.1	0.0	21.2	12.6	0.6	1.6	14.8
Unknown	9.3	0.4	0.0	9.6	3.0	0.0	4.7	7.6
Total	94.7	5.2	0.1	100	83.0	2.3	14.8	100

LI 5.8 Adult liver 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.

RECIPIENT	DECEASED DONOR				LIVING DONOR			
	Neg.	Pos.	Unk.	Total	Neg.	Pos.	Unk.	Total
Negative	88.6	0.0	0.1	88.7	81.6	0.0	7.6	89.2
Positive	5.4	0.0	0.0	5.4	2.8	0.0	0.2	3.0
Unknown	5.8	0.0	0.0	5.8	4.2	0.0	3.6	7.8
Total	99.8	0.0	0.2	100	88.6	0.0	11.4	100

LI 5.9 Adult liver 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.

RECIPIENT	DECEASED DONOR				LIVING DONOR			
	Neg.	Pos.	Unk.	Total	Neg.	Pos.	Unk.	Total
Negative	51.7	0.1	0.0	51.8	58.1	0.2	5.9	64.2
Positive	39.0	2.8	0.0	41.8	25.2	0.2	3.2	28.6
Unknown	6.1	0.3	0.0	6.4	3.4	0.0	3.8	7.2
Total	96.8	3.2	0.0	100	86.7	0.4	12.9	100

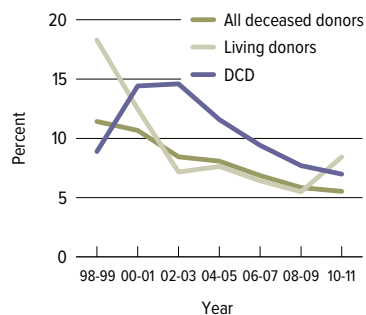
LI 5.10 Adult liver donor-recipient hepatitis C serology matching, 2007–2011

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.

RECIPIENT	DECEASED DONOR				LIVING DONOR			
	Neg.	Pos.	Unk.	Total	Neg.	Pos.	Unk.	Total
Negative	87.6	0.0	0.0	87.6	74.6	0.0	7.7	82.3
Positive	0.6	0.0	0.0	0.6	0.2	0.0	0.1	0.3
Unknown	11.8	0.0	0.0	11.8	5.5	0.0	11.9	17.4
Total	100	0.0	0.1	100	80.3	0.0	19.7	100

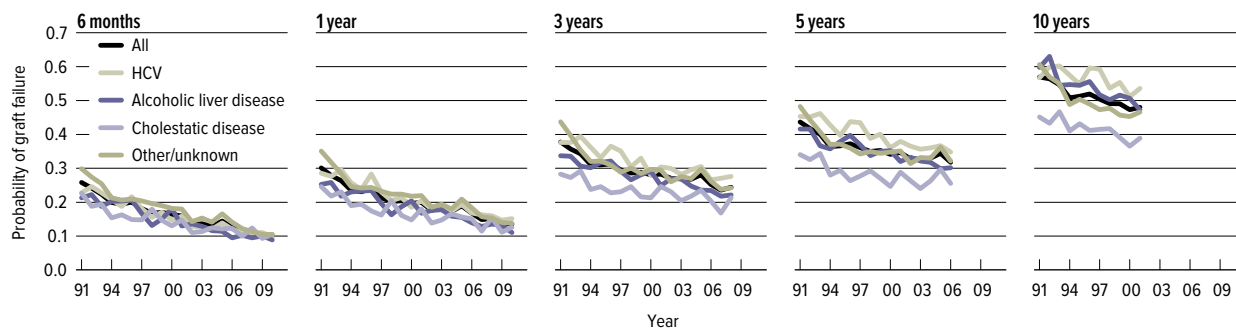
LI 5.11 Adult liver donor-recipient human immunodeficiency virus (HIV) serology matching, 2007–2011

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.



LI 6.1 Graft failure within the first 6 weeks after transplant among adult liver transplant recipients

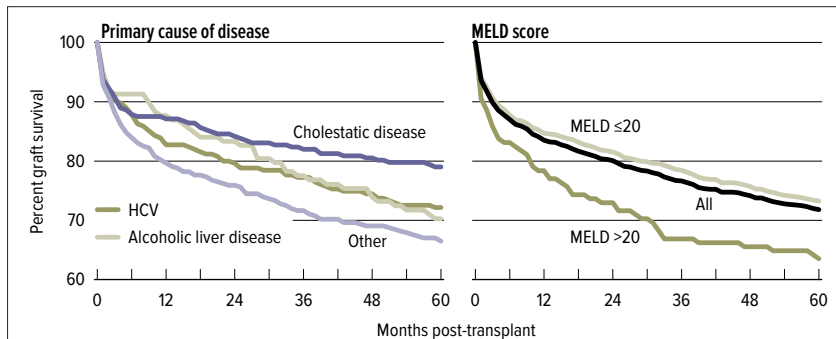
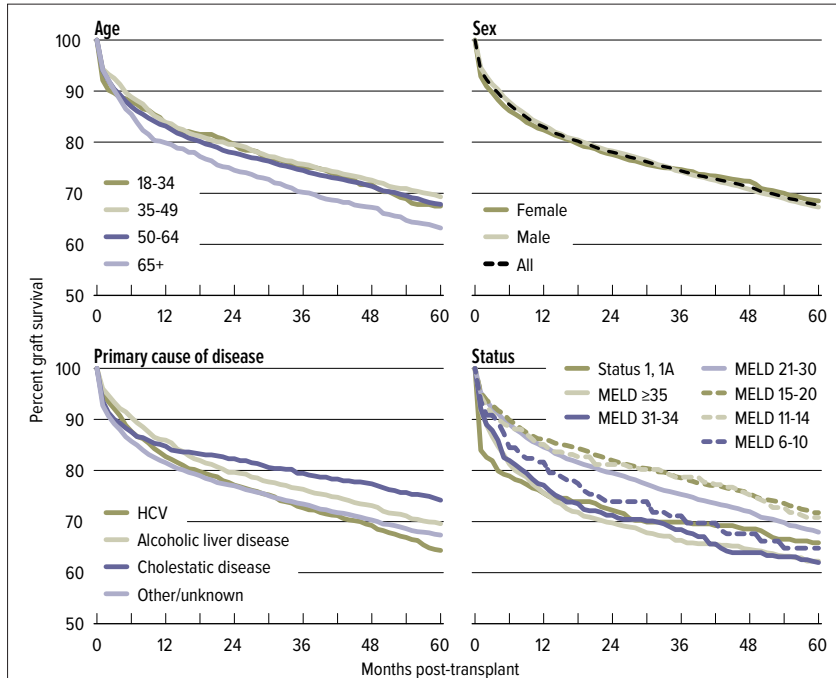
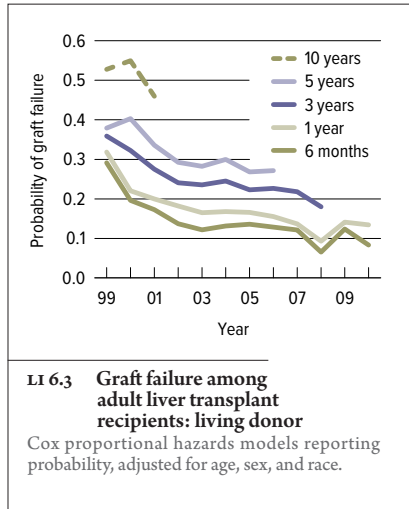
All-cause graft failure is identified from multiple data sources, including the OPTN Transplant Recipient Registration, OPTN Transplant Recipient Follow-up, as well as death dates from the Social Security Administration.

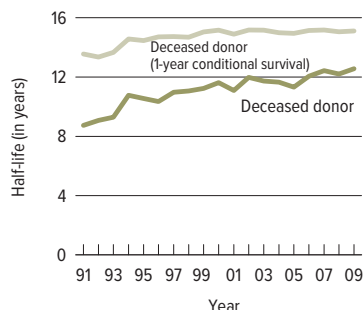


LI 6.2 Graft failure among adult liver transplant recipients, by diagnosis: deceased donor

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

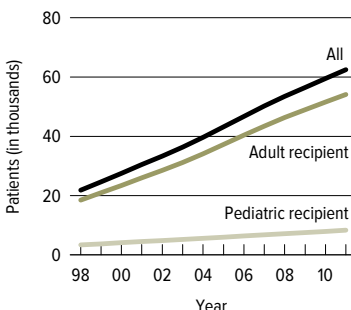
outcomes





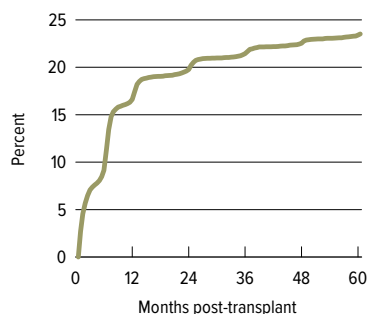
LI 6.6 Half-lives for adult deceased donor liver transplant recipients

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.



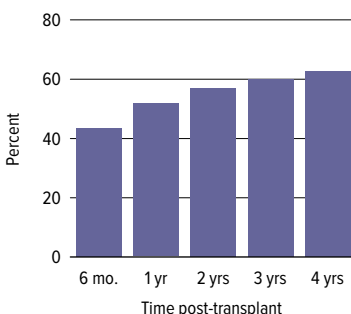
LI 6.7 Recipients alive & with a functioning liver transplant on June 30 of the year

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.



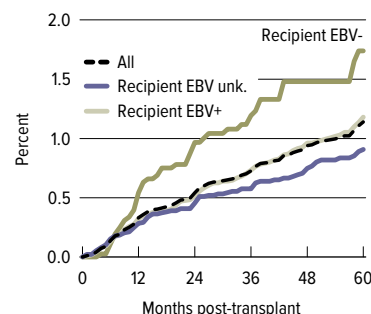
LI 6.8 Incidence of first acute rejection among adult patients receiving a liver transplant in 2005-2009

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.



LI 6.9 Reported cumulative incidence of rehospitalizations among adult patients receiving a liver transplant in 2006-2011

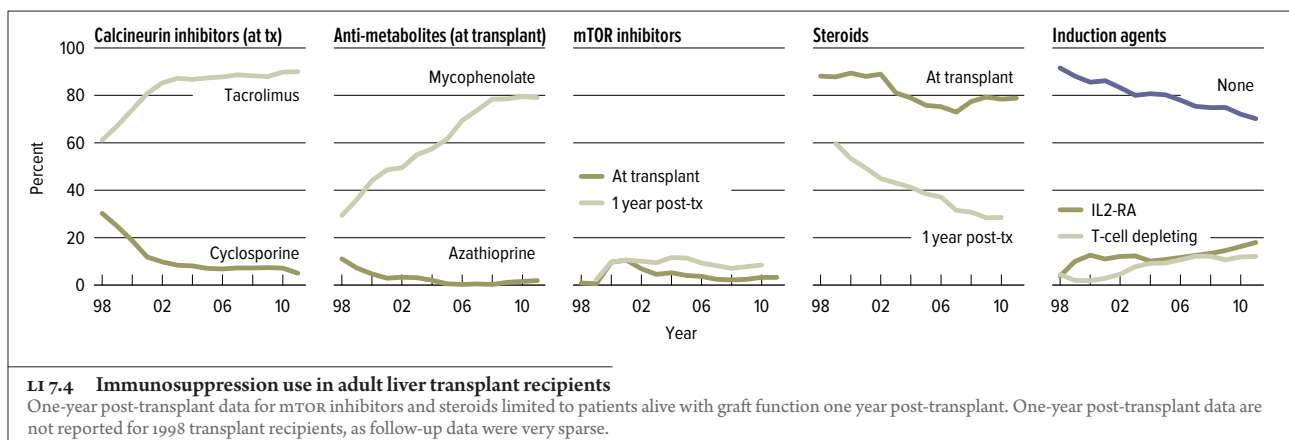
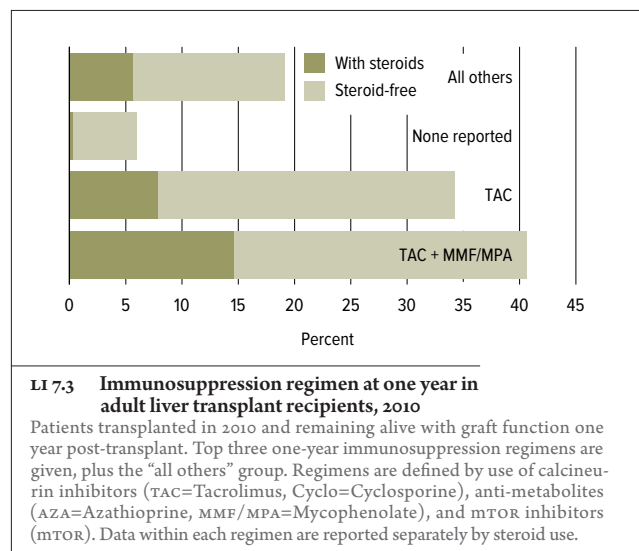
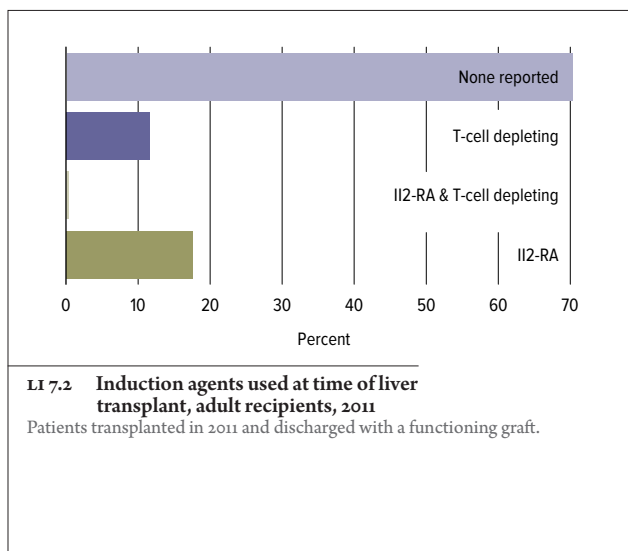
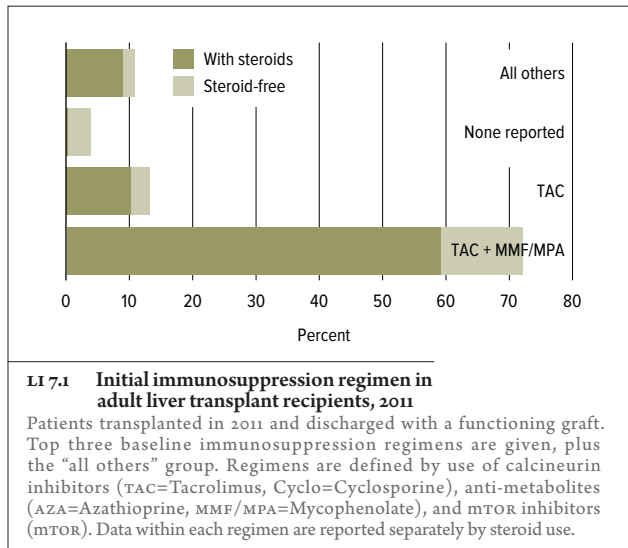
Cumulative incidence of rehospitalization post-transplant; hospitalization identified from the OPTN Transplant Recipient Follow-up form. Patients required to be alive with graft function at each time period, so denominators reduce over time.



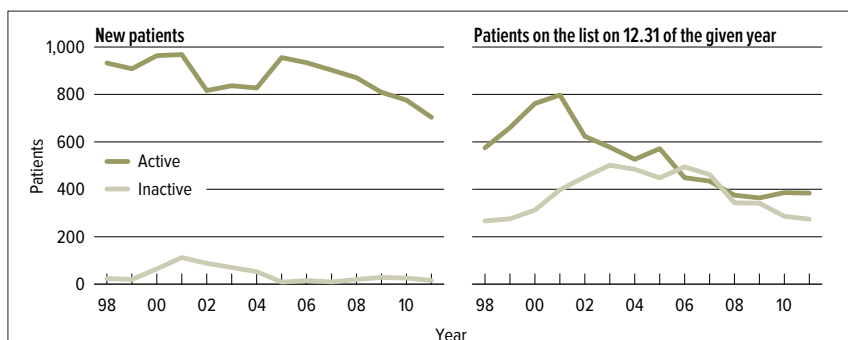
LI 6.10 Incidence of PTLTD among adult patients receiving a liver transplant in 2005-2009, by recipient Epstein-Barr virus (EBV) status at transplant

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. PTLTD 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 PTLTD, monomorphic PTLTD, or Hodgkin's Disease. Only the earliest date of PTLTD diagnosis is considered, and patients are followed for PTLTD until graft failure, death, or loss to follow-up. Patients are censored at graft failure because malignancies are not reliably reported after graft failure.

immunosuppression

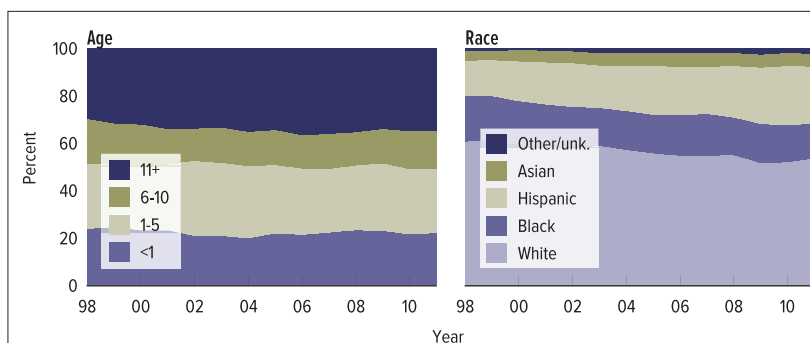


pediatric transplant



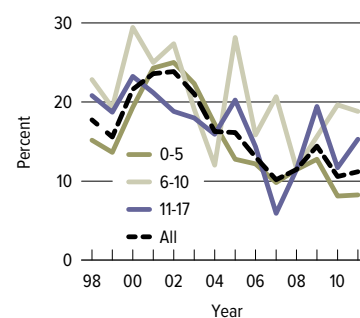
LI 8.1 Pediatric patients waiting for a liver transplant

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.



LI 8.2 Distribution of pediatric patients waiting for a liver 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.



LI 8.3 Prior liver transplant in pediatric patients waiting for a liver transplant, by age

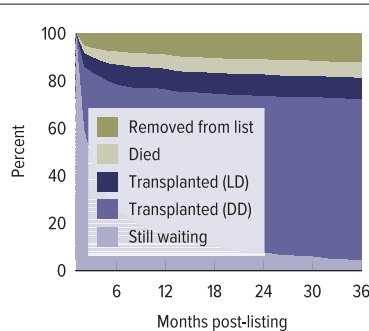
Prior transplant is obtained from the OPTN Transplant Candidate Registration form.

pediatric transplant

	2009	2010	2011
Patients at start of year	735	720	680
Patients added during year	749	747	679
Patients removed during year	763	786	701
Patients at end of year	721	681	658
Removal reason			
Deceased donor transplant	535	504	487
Living donor transplant	51	69	61
Patient died	61	60	31
Patient refused transplant	2	2	1
Improved, tx not needed	88	105	78
Too sick to transplant	7	12	12
Other	19	34	31

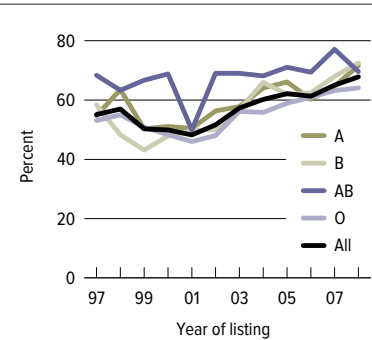
LI 8.4 Liver transplant waiting list activity among pediatric patients

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.



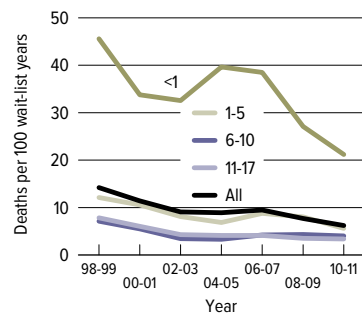
LI 8.5 Outcomes for pediatric patients waiting for a liver transplant among new listings in 2008

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.



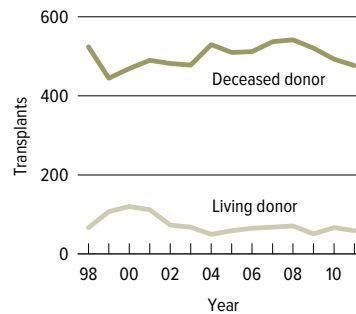
LI 8.6 Pediatric wait-listed patients who receive a deceased donor liver transplant within three years, by blood type

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.



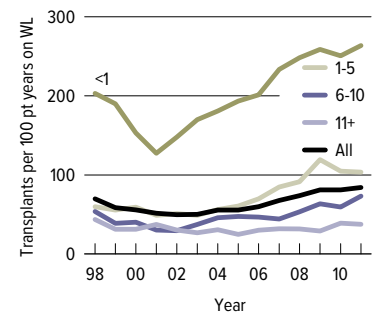
LI 8.7 Pre-transplant mortality rates among pediatric patients wait-listed for a liver transplant, by age

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.



LI 8.8 Pediatric liver transplants, by donor type

Patients receiving a liver transplant.



LI 8.9 Liver transplant rates in pediatric waiting list patients, by age

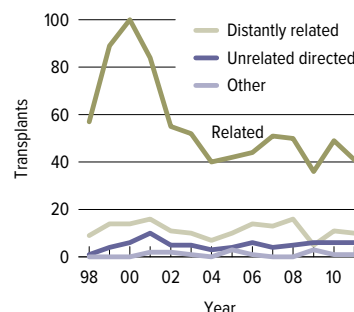
Patients waiting for transplant. Transplant rates are computed as the number of transplants per 100 patient-years of waiting time in the given year. Patients with concurrent listings at multiple centers are counted once.

pediatric transplant

	Level	1999-2001		2009-2011	
		N	%	N	%
Age	<1	531	30.5	481	28.8
	1-5	582	33.4	631	37.8
	6-10	235	13.5	241	14.4
	11-17	395	22.7	315	18.9
Sex	Female	933	53.5	849	50.9
	Male	810	46.5	819	49.1
Race	White	987	56.6	858	51.4
	Black	326	18.7	281	16.8
	Hispanic	346	19.9	373	22.4
	Asian	71	4.1	112	6.7
	Other/unknown	13	0.7	44	2.6
Primary cause of disease	Acute hepatic necrosis	238	13.7	176	10.6
	HCV	25	1.4	4	0.2
	Cholestatic disease	760	43.6	779	46.7
	Metabolic liver disease	165	9.5	223	13.4
	Malignancy	180	10.3	235	14.1
	All others	375	21.5	251	15.0
Transplant history	First transplant	1,498	85.9	1,514	90.8
	Retransplant	245	14.1	154	9.2
Blood type	A	616	35.3	553	33.2
	B	235	13.5	229	13.7
	AB	58	3.3	61	3.7
	O	834	47.8	825	49.5
Primary payer	Private	970	55.7	719	43.1
	Medicaid	584	33.5	727	43.6
	Other public	98	5.6	164	9.8
	Other	91	5.2	58	3.5
Time on wait list	<30 days	614	35.2	653	39.1
	31-60 days	208	11.9	276	16.5
	61-90 days	171	9.8	160	9.6
	3-<6 months	278	15.9	267	16.0
	6-<12 months	237	13.6	169	10.1
	1-<2 years	112	6.4	96	5.8
	2-<3 years	28	1.6	23	1.4
	3+ years	43	2.5	22	1.3
	No listing date	52	3.0	2	0.1
Medical condition	Hospitalized: ICU	573	32.9	383	23.0
	Hospitalized: not ICU	276	15.8	288	17.3
	Not hospitalized	893	51.2	995	59.7
	Missing/Unknown	1	0.1	2	0.1
Medical urgency status	1A			241	14.4
	1B			217	13.0
	MELD/PELD 35+			246	14.7
	MELD/PELD 30-34			222	13.3
	MELD/PELD 15-29			488	29.3
	MELD/PELD < 15			251	15.0
	Other/unknown			3	0.2
Procedure type	Whole liver	1055	60.5	1,061	63.6
	Partial liver, rest not tx	467	26.8	326	19.5
	Split liver	221	12.7	281	16.8
	Unknown	0	0.0	0	0.0
Donor type	Deceased	1,404	80.6	1,491	89.4
	Living	339	19.4	177	10.6
Previous abdom. surgery	Yes	874	50.1	941	56.4
Portal vein thrombosis	Yes	51	2.9	74	4.4
Incident. tumor found at tx	Yes	8	0.5	7	0.4
Spon. bac. peritonitis (SBP)	Yes	55	3.2	36	2.2
All patients		1,743	100.0	1,668	100.0

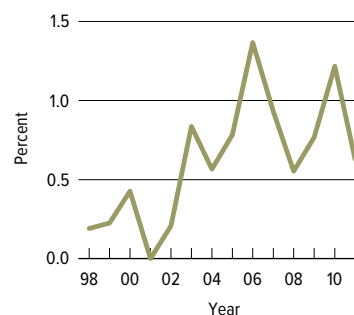
LI 8.10 Characteristics of pediatric liver transplant recipients, 1999-2001 & 2009-2011

Patients receiving a transplant. Retransplants are counted.



LI 8.11 Pediatric liver transplants from living donors

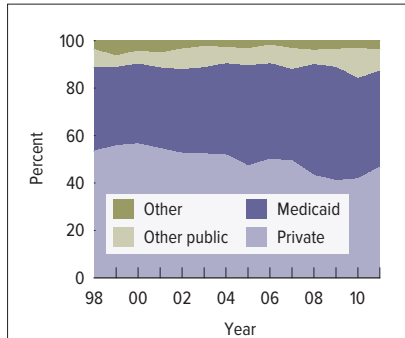
Relationship of live donor to recipient is as indicated on the Living Donor Registration form.



LI 8.12 Use of DCD donors in pediatric liver transplant recipients

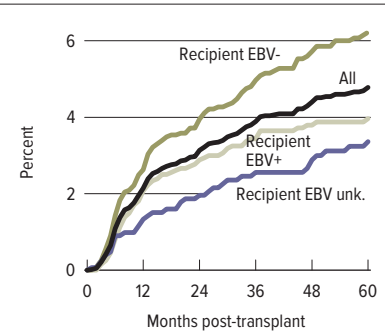
Patients receiving a DCD liver transplant.

pediatric transplant



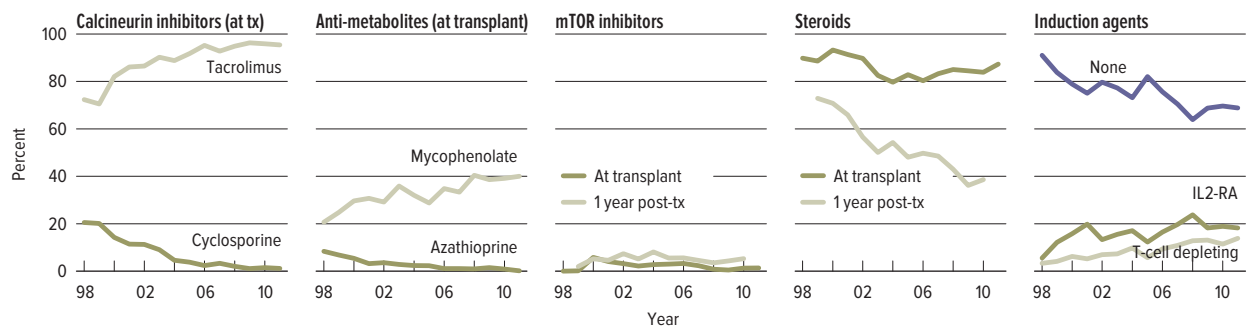
LI 8.13 Insurance coverage among pediatric liver transplant recipients at time of transplant

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



LI 8.14 Incidence of PTLD among pediatric patients receiving a liver transplant, 1999–2009, by recipient Epstein-Barr virus (EBV) status at transplant

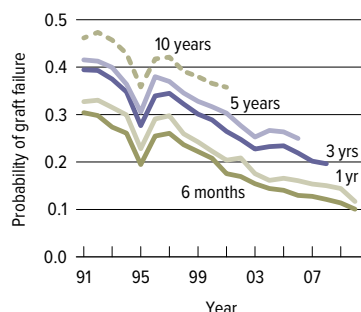
The cumulative incidence, defined as the probability of post-transplant lymphoproliferative disorder (PTLD) being diagnosed between the time of transplant and the given time, is estimated using Kaplan-Meier methods. PTLD is identified as either a reported complication or cause of death on the Transplant 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.



LI 8.15 Immunosuppression use in pediatric liver transplant recipients

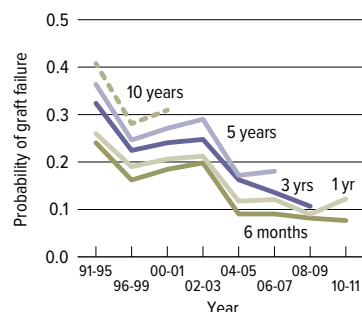
One-year post-transplant data for mTOR inhibitors and steroids limited to patients alive with graft function one year post-transplant. One-year post-transplant data are not reported for 1998 transplant recipients, as follow-up data were very sparse.

pediatric transplant



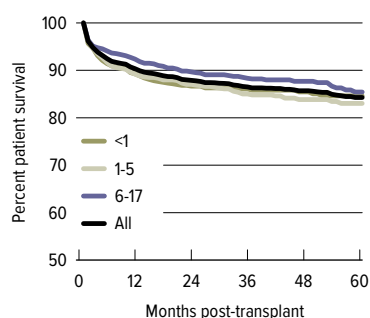
LI 8.16 Graft failure among pediatric liver transplant recipients: deceased donor

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



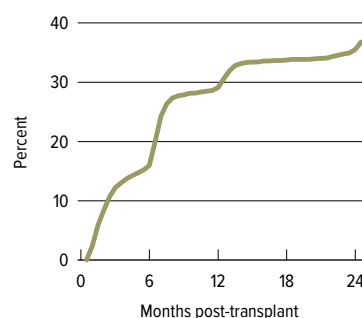
LI 8.17 Graft failure among pediatric liver transplant recipients: living donor

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



LI 8.18 Survival among pediatric liver transplant recipients, 2002-2006, by age

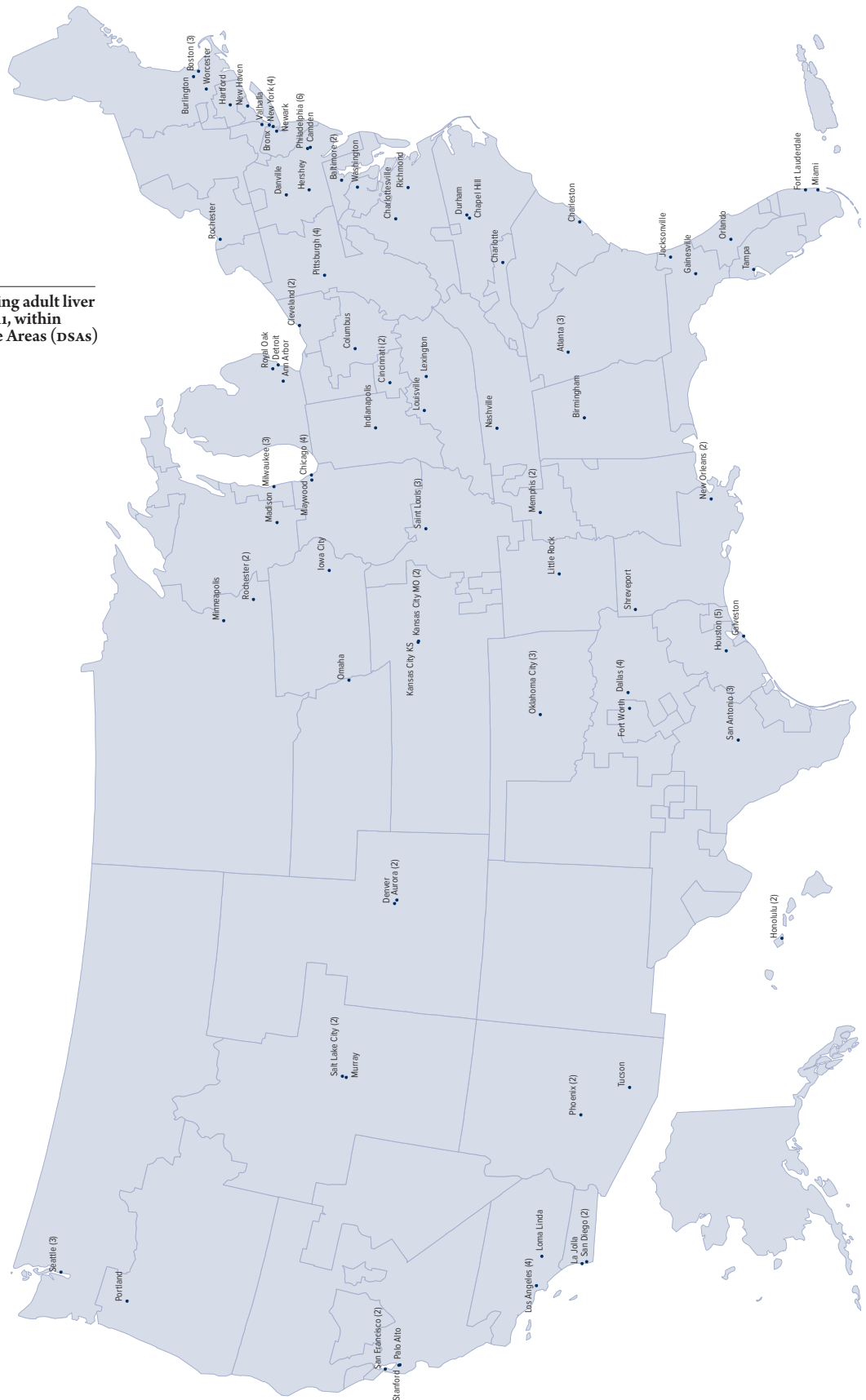
Percent patient survival using unadjusted Kaplan-Meier methods. For patients with more than one transplant during the period, only their first transplant is considered.



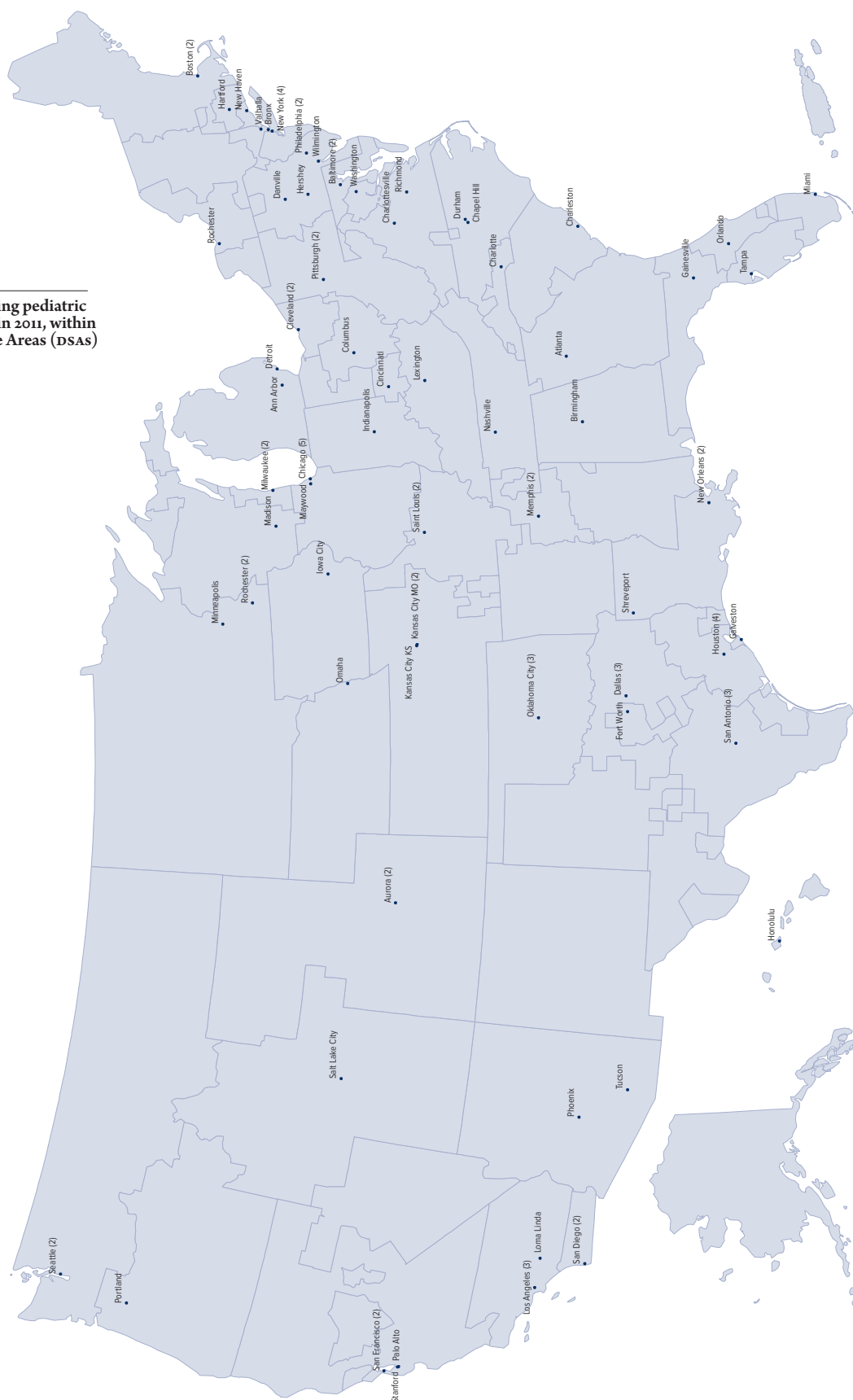
LI 8.19 Incidence of first acute rejection among pediatric patients receiving a liver transplant in 2005-2010

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.

LI 9.1 Centers performing adult liver transplants in 2011, within Donation Service Areas (DSAs)



LI 9.2 Centers performing pediatric liver transplants in 2011, within Donation Service Areas (DSAs)



LI 9.3 Centers performing adult liver transplants in 2011, within OPTN regions

