

wait list 74
 deceased donation 77
 live donation 78
 transplant 80
 donor-recipient
 matching 83
 outcomes 84
 pediatric transplant 87
 Medicare data 92
 transplant center
 maps 95

OPTN/SRTR 2012 Annual Data Report:

liver

W. R. Kim^{1,2}, J. M. Smith^{1,3}, M. A. Skeans⁴, D. P. Schladt⁴, M. A. Schnitzler^{1,4}, E. B. Edwards^{5,6}, A. M. Harper^{5,6}, J. L. Wainright^{5,6}, J. J. Snyder^{7,8}, A. K. Israni^{9,10}, B. L. Kasiske^{9,11}

¹ Scientific Registry of Transplant Recipients, Minneapolis Medical Research Foundation, Minneapolis, MN

² Division of Gastroenterology and Hepatology, Mayo Clinic, Rochester, MN

³ Department of Pediatrics, University of Washington, Seattle, WA

⁴ Center for Outcomes Research, Saint Louis University School of Medicine, St. Louis, MO

⁵ Organ Procurement and Transplantation Network, Richmond, VA

⁶ United Network for Organ Sharing, Richmond, VA

⁷ Department of Epidemiology and Community Health, University of Minnesota, Minneapolis, MN

⁸ Department of Medicine, Hennepin County Medical Center, University of Minnesota, Minneapolis, MN

ABSTRACT Liver transplant in the US remains a successful life-saving procedure for patients with irreversible liver disease. In 2012, 6256 adult liver transplants were performed, and more than 65,000 people were living with a transplanted liver. The number of adults who registered on the liver transplant waiting list decreased for the first time since 2002; 10,143 candidates were added, compared with 10,359 in 2011. However, the median waiting time for active wait-listed adult candidates increased, as did the number of candidates removed from the list because they were too sick to undergo transplant. The overall deceased donor transplant rate decreased to 42.3 per 100 patient-years, and varied geographically from 18.9 to 228.0 per 100 patient-years. Graft survival continues to improve, especially for donation after circulatory death livers. The number of new active pediatric candidates added to the waiting list also decreased. Almost 75% of pediatric candidates listed in 2009 underwent transplant within 3 years; the 2012 rate of deceased donor transplants among active pediatric wait-listed candidates was 136 per 100 patient-years. Graft survival for deceased donor pediatric transplants was 92.8% at 30 days. Medicare paid for some or all of the care for more than 30% of liver transplants in 2010.

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

When I awoke from surgery three and a half days later, while still on life support I spoke my first words, "She was younger than I." My surgeon teared up, "And she has three children!" I have had normal liver functions for the past seven years thanks to my 44-year old donor.

Ronald, liver recipient

Adult Liver Transplant

INTRODUCTION

In 2012, 6256 liver transplants were performed in the United States (Figure 4.1). These included transplant of 5747 organs from donation after brain death (DBD) donors, 263 from donation after circulatory death (DCD) donors, and 246 from living donors. Organs were procured from across the country and transplanted at 132 transplant centers. For deceased donor recipients who underwent transplant in 2007, these life-saving operations yielded an unadjusted 5-year survival of 70.5% (Figure 6.4). Based on Medicare data, incorporated into the Annual Data Report for the first time this year, liver transplants cost an average of \$188,000 during the first year after transplant. More importantly, human costs were substantial; in 2012, 2187 patients died while on the waiting list, and 815 were removed from the list because they were too sick to undergo transplant (Figure 1.6). Ultimately, liver transplant in the US remains a successful life-saving procedure for patients with irreversible liver disease. As of June 30, 2012, more than 65,000 people were living with a liver transplant; 57,000 had undergone transplant as adults and 8700 as children (Figure 6.7).

WAITING LIST

During 2012, 10,143 candidates were added to the liver transplant waiting list (Figure 1.6), most with active status ($n = 9708$, 96%; Figure 1.1). This compares with 10,359 candidates added in 2011 and represents a decrease of 216 (2.1%), the first decrease in wait-list registrations since 2002. Similarly, the number of active wait-list candidates on December 31, 2012, was 12,427, compared with 12,635 one year before. Whether such decreases will continue remains to be seen, but if future data confirm a decreasing demand for liver transplant, it will represent a reversal of a trend that has persisted since liver transplant became recognized as an established procedure. A possible explanation of the decreases may be positive, such as successful treatment of viral hepatitis or better management of patients with advanced liver disease. Conversely, the explanation may be negative, such as aging patients with hepatitis C virus (HCV) infection being rejected from transplant candidacy, or increasing comorbidity in patients with end-stage liver disease or hepatocellular carcinoma (HCC)

related to increasing prevalence of obesity and related metabolic and cardiovascular complications.

Figure 1.2 shows further trends among liver transplant wait-list candidates. The proportion of older patients (aged 65 years or older) increased. Model for end-stage liver disease (MELD) scores at registration were most commonly between 6 (the lower bound) and 14, but the proportion of scores between 15 and 34 is growing steadily. The distribution of liver disease etiology remains unchanged, except for malignancy. This trend is a part of larger phenomena of increasing incidence of HCC and rapidly increasing numbers of liver transplant candidates and recipients with HCC exceptions (also see Figure 1.3). Figure 1.4 shows a similar trend with regard to HCC; deceased donor transplant rates among active adult candidates with HCC exceptions were nearly three times higher than rates among those without HCC exceptions. The overall transplant rate has been gradually declining since 2006; greater decline was seen in candidates with HCC exceptions and in candidates aged 18 to 34 years.

The decrease in transplant rates reflects the gradually worsening donor shortage. Despite the decline in wait-list registration, the median pretransplant waiting time among active wait-listed adult patients increased from 12.9 months in 2009 to 17.6 months in 2010 and to 18.5 months in 2011 (Figure 1.8). Pretransplant mortality rates decreased in 2012, for the first time in several years (Figure 1.10).

Among active adult wait-list candidates, the overall deceased donor transplant rate was 42 per 100 patient-years on the waiting list (Figure 1.4). However, geographic variability in transplant rates was considerable. Within the continental US, rates ranged from 18.9 per 100 patient-years on the waiting list to 228.0, more than a 10-fold difference (Figure 1.5). Median MELD scores at the time of transplant also varied widely by donation service area (DSA). Within the continental US, median MELD scores were 22 in several DSAs, and the highest MELD scores were in DSAs located in California and New York (Figure 4.9).

Similarly, the proportion of adults receiving deceased donor organs within 5 years of listing ranged from 30.5% in a DSA in New York to 86.1% in the Arkansas DSA (Figure 1.9). These differences are striking, and the solution to geographic disparity remains a challenge. There is an inverse correlation

between transplant rates and median MELD scores by DSA. Increasing donation represents the most ideal solution for the donor shortage; there is no clear correlation between the organ donation rate and the median MELD score at transplant (Figure 2.2).

DONATION

Figure 2.1 shows the trend in organ donation rates over time. Rates peaked in 2006 and have been decreasing since, despite modest increases from donors aged 15 to 34 and 35 to 44 years. Figure 2.5 shows that the proportion of donors who died of cerebral anoxia has been increasing. The proportion of DCD donors has been stable since 2005 (Figure 2.4).

The total number of living donor liver transplants has been stable since 2008 (Figure 3.1). However, right lobe donation increased slightly from 57.8% of total living donors in 2010 to 63.7% in 2012 (Figure 3.3). The most noticeable recent trend in living donor transplant is data that suggest worsening short-term outcomes for donors. The number of donors with biliary complications reported to OPTN more than doubled, from 6 cases (2.5%) in 2011 to 14 (6.4%) in 2012 (Figure 3.5). The number of vascular complications also increased, from just 1 case in 2010 and 2011 to 7 in 2012 (Figure 3.6). Complications other than biliary and vascular increased modestly (Figure 3.7). Donor rehospitalization within 6 weeks of organ donation increased from 7.8% to 9.7% between 2010 and 2011, and rehospitalization within 6 months increased from 8.6% to 11.4% (Figure 3.4). Conversely, the number of donors who required reoperation decreased and, most importantly, no donor deaths were reported in 2012.

TRANSPLANT

Data on recipients show a continued trend toward older ages. The number of recipients aged 65 years or older more than doubled, from 363 in 2002 to 835 in 2012 (Figure 4.2). The largest group of recipients, those aged 50 to 64 years, increased from 2433 in 2002 to 3623 in 2012. However, the most noticeable trend in recipient characteristics is the rapidly rising number and proportion of recipients with a primary diagnosis of malignancy; the number increased from 432 in 2002 to 1337 in 2012 (Figure 4.2). The most common diagnosis in recipients remains HCV, which likely contributes to the number of recipients with

malignancy as the primary diagnosis at transplant (Figure 4.2). In keeping with the trend in the general population toward increasing prevalence of obesity, the proportion of recipients with body mass index (BMI) 30 kg/m² or higher increased from 29.0% in 2002 to 35.4% in 2012 (Figure 4.7). Because many liver transplant candidates have ascites and fluid retention, high BMI does not necessarily indicate obesity. However, increasing prevalence of diabetes during the same time period (18.2% to 24.6%) suggests increasing obesity (Figure 4.7).

Nationwide, the median match MELD score for transplant in 2012 was 27 (Figure 4.9). However, geographic disparity in median MELD scores remains wide. In DSAs in the continental US, the lowest median MELD score was 21 and the highest 35. In eight DSAs, median MELD scores were 30 or higher in 2012. A substantial part of this variation is due to differences in lab MELD and match MELD scores by DSA. Score adjustments are common for HCC, and nationwide the median difference between lab and match MELD scores is 2 points, but it varies from 0 to 11 points (Figure 4.10). In DSAs with the highest median match MELD scores, the median difference between lab and match MELD scores was also largest. There is a consensus that the adjustment score for patients with HCC may still be too high, disadvantaging patients with severe end-stage liver disease without HCC. Work attempting to address the gap is underway.

The proportion of multi-organ transplants is increasing, a trend led by simultaneous liver and kidney (SLK) transplants. In 2012, 8.4% of all deceased donor transplants were multi-organ; of these, 92% were SLK transplants (Figure 4.3). The issue of increasing use of SLK transplants has been a topic of many discussions, debates, and publications. The trend is due to several factors, the most important of which is the worsening condition of liver transplant candidates with end-stage liver disease, leading to higher incidence of hepatorenal syndrome and other renal complications. Of note, the current allocation system, which takes into account renal function of liver candidates, may not be the only cause of the increase in SLK. Indeed, it is possible that, given the continued organ shortage and increasing severity of end-stage liver disease, patients with adequate renal function may be left with their liver disease progressing, potentially resulting in an even greater need for SLK transplant.

Tacrolimus-based immunosuppression after transplant was reported for most patients (Figure 4.8). Reported use of mycophenolate and to a lesser extent azathioprine increased, and reported use of steroids decreased (Figure 4.8). Use of mammalian target of rapamycin (mTOR) inhibitors at transplant was reported in approximately 3% of recipients, and within the first year after transplant in 9%. The proportion of liver recipients reported to be undergoing induction therapy, particularly with an interleukin-2 receptor antagonist, has been increasing (Figure 4.8). Some of these trends may be related to the small but significant proportion of patients undergoing SLK transplant.

OUTCOMES

Continued improvement in overall graft survival is encouraging (Figures 6.2 and 6.6). Figure 6.1 shows that 90-day graft survival for all deceased donor livers consistently improved in the past decade. Of note, DCD graft survival substantially improved over time. Living donor graft survival abruptly worsened, reversing the previous trend of consistent improvement (Figure 6.1). This, combined with less favorable donor outcomes discussed previously, may raise concerns about the practice of living donor liver transplant as a whole and may deserve closer scrutiny. Figure 6.5 shows the analysis of living donor transplant outcomes by subgroup.

In subgroup analyses, outcomes were poorest for older patients, patients with the highest MELD scores, and patients with HCV (Figure 6.4). DCD grafts survived less well than DBD grafts; the gap developed during the first year after transplant and continued over time. Survival of retransplant grafts was lower than survival of primary grafts, which is also well documented.

As of June 30, 2012, 56,900 adult liver transplant recipients were alive, a number that testifies to the success of the nationwide practice of liver transplant. This total number of liver recipients alive in 2012 was almost exactly twice the number alive 10 years before (28,500 in 2002).

Pediatric Transplant

WAITING LIST

The number of new active candidates added to the pediatric liver transplant waiting list has steadily decreased, and very

few have been added as inactive (Figure 7.1). A similar trend is the decreasing numbers of prevalent wait-listed patients (those on the list on December 31 of the given year), of whom most (60%) are listed as active. The age distribution of wait-listed candidates changed little over the past decade. In 2012, 22.5% of candidates were aged less than 1 year, 26.9% were aged 1 to 5 years, 15.3% were aged 6 to 10 years, and 35.4% were aged 11 to 17 years (Figure 7.2). Half of the wait-list candidates have been waiting for less than 1 year, 19.6% for 1 to less than 2 years, 11.7% for 2 to less than 4 years, and 18.9% for 4 or more years. In 2012, 13.1% of wait-list candidates ($n = 85$) had undergone a previous liver transplant (Figure 7.3). Of all wait-list candidates in 2012, 10.3% (43) of those aged less than 6 years, 20.5% (16) of those aged 6 to 10 years, and 17.0% (26) of those aged 11 to 17 years were waiting for retransplant (Figure 7.3). Among candidates removed from the waiting list in 2012, 66.0% received a deceased donor liver, 7.5% received a living donor liver, 5.2% died, 13.7% were removed from the list because their condition improved, and 2.4% were considered too sick to undergo transplant (Figure 7.4). Almost 75% of patients newly listed in 2009 underwent transplant within 3 years; 6.4% died, 11.9% were removed from the list, and 7.0% were still waiting (Figure 7.5). The rate of deceased donor transplant among active pediatric wait-list candidates was 136 per 100 patient-years on the waiting list. Rates were highest for candidates aged younger than 1 year (267 per 100 patient-years on the waiting list) and lowest for candidates aged 11 years or older (87 per 100 patient-years on the waiting list) (Figure 7.6). Of note, transplant rates have been steadily increasing for candidates aged younger than 1 year; for older candidates, rates began to plateau in 2005 for candidates aged 11 years or older and in 2009 for candidates aged 1-10 years. Pretransplant mortality has decreased for all age groups, to 5.8 deaths per 100 wait-list years in 2010-2012 (Figure 7.7). The pretransplant mortality rate is highest for candidates aged younger than 1 year, at 25.4 deaths per 100 wait-list years in 2010-2012 (Figure 7.7).

TRANSPLANT

The number of deceased donor liver transplants peaked at 542 in 2008 and decreased to 473 in 2012. The number of living donor liver transplants decreased from a peak of 120 in 2000 to

52 in 2012 (Figure 7.8). Approximately 10% of liver transplant recipients in 2012 had undergone previous transplant (Figure 7.9). In 2012, 10.1% of pediatric liver transplants were part of a multi-organ transplant: 5.5% pancreas, 5.5% intestine, and 4.2% kidney (Figure 7.10). DCD donors are rarely used in pediatric liver transplant, accounting for less than 1% in 2012 (Figure 7.12). Considering the past decade of pediatric liver transplant, age, sex, and ethnic distributions of recipients have changed little (Figure 7.13). Cholestatic disease remains the leading cause (46.9%) of liver failure. In 2010-2012, 38.4% of recipients waited less than 30 days for transplant, and 16.4% waited 31 to 60 days. Almost 60% of liver transplant recipients were not hospitalized before transplant. Considering medical urgency status, 15.4% of recipients underwent transplant as status 1A and 15.2% as status 1B; 13.8% had a MELD/pediatric end-stage liver disease (PELD) score of 35 or higher. The most common score at time of transplant was 15 to 29 (28%). Most pediatric patients (63.7%) received a whole liver; split liver transplants increased only slightly from 13.1% of transplants in 2002 to 16.1% in 2012. The proportion of living donors declined from 17.5% in 2000-2002 to 11% in 2010-2012. ABO-incompatible liver transplant occurred in 2.7% of recipients in 2010-2012, similar to the earlier era 2000-2002.

IMMUNOSUPPRESSION AND OUTCOMES

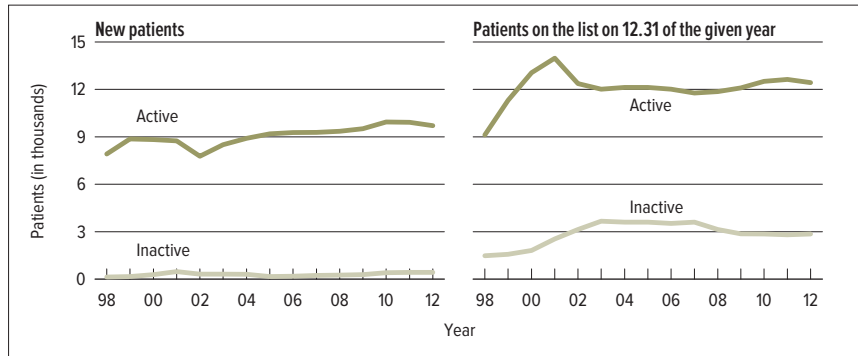
In 2012, 95.5% of pediatric liver transplant recipients were reported to received tacrolimus as part of their initial maintenance immunosuppressive medication regimen, 89.2% to receive steroids, 46.5% to receive mycophenolate, and 1.2% to receive mTOR inhibitors (Figure 7.15). At 1 year after transplant, 53.8% of recipients were receiving steroids and 5.6% mTOR inhibitors. In 2012, 70% of liver transplants were performed with no induction immunosuppression. Graft survival has continued to improve over the past decade among recipients of deceased donor and living donor liver transplants. Graft survival for deceased donor transplants performed in 2012 was 92.8% at 30 days; for transplants in 2011, 87.3% at 1 year; for transplants in 2009, 82.0% at 3 years; for transplants in 2007, 78.7% at 5 years; and for transplants in 2002, 67.4% at 10 years (Figure 7.16). In contrast to other organs, graft survival is remarkably similar in the various age groups (Figure 7.19). The incidence of acute rejection increases with time

after transplant. Among liver transplant recipients from 2006 to 2011, 18% experienced acute rejection by 6 months after transplant, 27% by 12 months, and 33% by 24 months (Figure 7.18). Posttransplant lymphoproliferative disorder (PTLD) is a significant concern in pediatric transplant. The highest risk for PTLD occurs in Epstein-Barr virus (EBV)-negative recipients. The incidence of PTLD was 4.7% at 5 years after transplant in EBV-negative recipients and 3.4% among EBV-positive recipients (Figure 7.14).

Economics

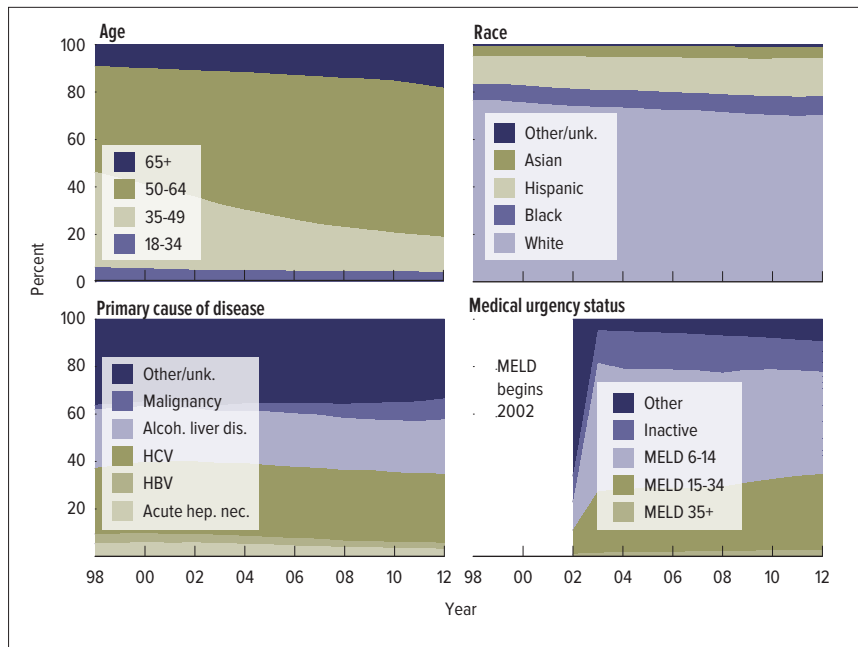
It may be surprising that Medicare is the largest single payer for liver transplant in the US, paying for some or all of the care for more than 30% of liver transplants in 2010 (Figure 8.1). Average reimbursement for liver recipients with primary Medicare coverage from transplant through 1 year after transplant was \$162,157 for Part A and \$25,447 for Part B (Figure 8.5), totaling \$187,604, approximately double the Medicare Parts A and B expenditure for a kidney transplant recipient (Figure 8.5, Kidney chapter) and approximately half the expenditure for a heart transplant recipient (Figure 7.5, Heart chapter). Rehospitalization is common after liver transplant; rates are relatively high in the first year (Figure 8.2) and drop by half in the second year (Figure 8.3). Primary causes of rehospitalization are dominated by surgical complications and infections in both the first and second years after transplant (Figure 8.4). Annual costs following the first year are dramatically smaller; Medicare Parts A and B costs average \$20,385 and \$10,240, respectively, during the second year (Figure 8.6), totaling \$30,625, and are expected to remain stable in later years. Additional costs not accounted for here include reimbursement to hospitals for the transplant portion of the Medicare Cost Report and Medicare Part D. Including estimates for these brings average Medicare cost to approximately \$250,000 in the first year after transplant and approximately \$35,000 in subsequent years, which is remarkably similar to total cost estimates for kidney and pancreas transplant. Liver transplant recipients account for 15% of all Medicare Parts A and B expenditures after solid organ transplant, \$597 million, or \$26,499 per patient in 2010 (Figure 8.7).

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.



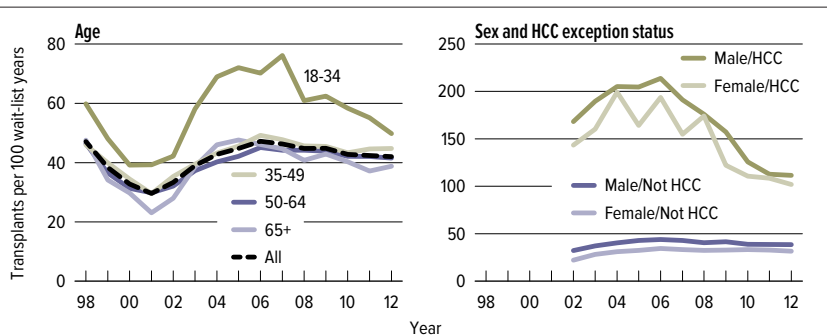
LI 1.2 Distribution of adult patients waiting for a liver transplant

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. Medical urgency status is the first known in the given year.

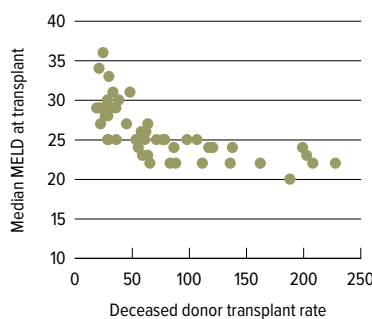
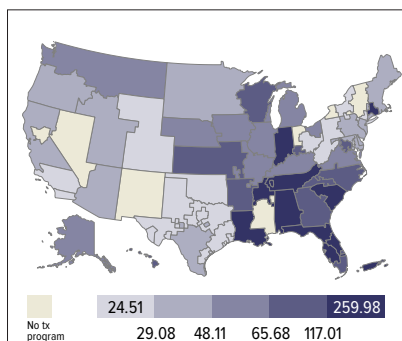
| | Level | 2002 | | 2012 | |
|------------------------|------------------------------------|---------------------|--------------|---------------|--------------|
| | | N | % | N | % |
| Age | 18-34 | 724 | 4.7 | 611 | 4.0 |
| | 35-49 | 4,817 | 31.0 | 2,248 | 14.7 |
| | 50-64 | 8,414 | 54.2 | 9,748 | 63.7 |
| | 65+ | 1,577 | 10.2 | 2,701 | 17.6 |
| Sex | Male | 8,986 | 57.9 | 9,485 | 62.0 |
| | Female | 6,546 | 42.1 | 5,823 | 38.0 |
| Race | White | 11,533 | 74.3 | 10,754 | 70.3 |
| | Black | 1,012 | 6.5 | 1,081 | 7.1 |
| | Hispanic | 2,207 | 14.2 | 2,593 | 16.9 |
| | Asian | 678 | 4.4 | 745 | 4.9 |
| | Other/unk. | 102 | 0.7 | 135 | 0.9 |
| | Primary cause of hep. nec. disease | Acute | 733 | 4.7 | 321 |
| HBV | | 572 | 3.7 | 427 | 2.8 |
| HCV | | 4,796 | 30.9 | 4,612 | 30.1 |
| Alcoholic liver dis. | | 3,519 | 22.7 | 3,657 | 23.9 |
| Cholestatic disease | | 1,784 | 11.5 | 1,307 | 8.5 |
| Malignancy | | 289 | 1.9 | 1,052 | 6.9 |
| Other/unk. | | 3,839 | 24.7 | 3,932 | 25.7 |
| Tx history | | Listed for first tx | 14,557 | 93.7 | 14,903 |
| | Listed for subseq. tx | 975 | 6.3 | 405 | 2.6 |
| Blood type | A | 5,510 | 35.5 | 5,771 | 37.7 |
| | B | 1,727 | 11.1 | 1,679 | 11.0 |
| | AB | 410 | 2.6 | 391 | 2.6 |
| | O | 7,885 | 50.8 | 7,467 | 48.8 |
| Time on wait list | <1 year | 4,632 | 29.8 | 5,565 | 36.4 |
| | 1-<2 | 3,577 | 23.0 | 2,818 | 18.4 |
| | 2-<3 | 2,571 | 16.6 | 1,809 | 11.8 |
| | 3-<4 | 1,762 | 11.3 | 1,171 | 7.6 |
| | 4-<5 | 1,082 | 7.0 | 936 | 6.1 |
| | 5+ | 1,908 | 12.3 | 3,009 | 19.7 |
| Status | Active | 12,395 | 79.8 | 12,442 | 81.3 |
| | Inactive | 3,137 | 20.2 | 2,866 | 18.7 |
| Medical urgency status | 1A/1B | - | 0.0 | 2 | 0.0 |
| | MELD 35+ | 29 | 0.2 | 61 | 0.4 |
| | MELD 30-34 | 35 | 0.2 | 67 | 0.4 |
| | MELD 25-29 | 95 | 0.6 | 168 | 1.1 |
| | MELD 20-24 | 550 | 3.5 | 943 | 6.2 |
| | MELD 15-19 | 2,183 | 14.1 | 2,611 | 17.2 |
| | MELD 10-14 | 5,154 | 33.2 | 4,687 | 30.9 |
| | MELD 6-9 | 4,002 | 25.8 | 2,505 | 16.5 |
| | HCC T1 | 72 | 0.5 | 2 | 0.0 |
| | HCC T2 | 184 | 1.2 | 793 | 5.2 |
| | Other exceptions | 74 | 0.5 | 447 | 3.0 |
| Inactive | 3,137 | 20.2 | 2,866 | 18.9 | |
| Total | | 15,532 | 100.0 | 15,308 | 100.0 |

LI 1.3 Characteristics of adult patients on the liver transplant waiting list on December 31, 2002 & December 31, 2012

Patients waiting for a transplant on December 31, 2002 and December 31, 2012, regardless of first listing date; active/inactive status is on this date, and multiple listings are not counted.



LI 1.4 Deceased donor liver transplant rates among active adult waiting list candidates
Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of active waiting time in a given year. Age is calculated on the first active listing date in a given year. HCC candidates are those with exception points granted in the given year.



LI 1.5 Deceased donor liver transplant rates per 100 patient years on the waiting list among active adult candidates, by DSA, 2011-2012

Transplant rates by DSA of the listing center, limited to those with active time on the waiting list in 2011 and 2012; deceased donor transplants only. Maximum time per listing is two years. 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.

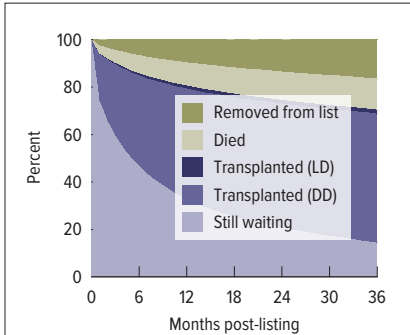
| | 2010 | 2011 | 2012 |
|------------------------------|--------|--------|--------|
| Patients at start of year | 14,956 | 15,360 | 15,428 |
| Patients added during year | 10,349 | 10,359 | 10,143 |
| Patients removed during year | 9,925 | 10,272 | 10,281 |
| Patients at end of year | 15,380 | 15,447 | 15,290 |

| Removal reason | 2010 | 2011 | 2012 |
|----------------------------|-------|-------|-------|
| Deceased donor transplant | 5,450 | 5,539 | 5,468 |
| Living donor transplant | 209 | 187 | 192 |
| Patient died | 2,458 | 2,506 | 2,187 |
| Patient refused transplant | 53 | 60 | 73 |
| Improved, tx not needed | 552 | 541 | 644 |
| Too sick to transplant | 362 | 482 | 815 |
| Other | 841 | 957 | 902 |

LI 1.6 Liver transplant waiting list activity among adult patients

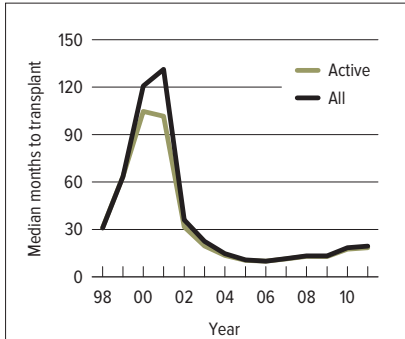
Patients with concurrent listings at more than one center are counted once, from the time of earliest listing to the time of latest removal. Patients listed, transplanted, and re-listed are counted more than once. Patients are not considered "on the list" on the day they are removed. Thus, patient counts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

wait list



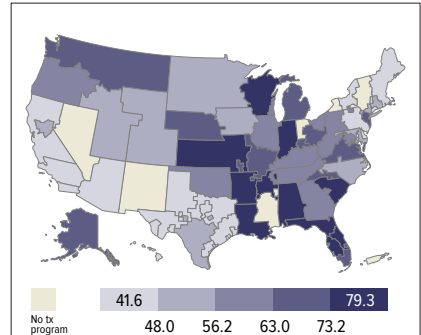
LI 1.7 Three-year outcomes for adult patients waiting for a liver transplant among new listings in 2009

Adult patients waiting for any liver transplant and first listed in 2009. 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.



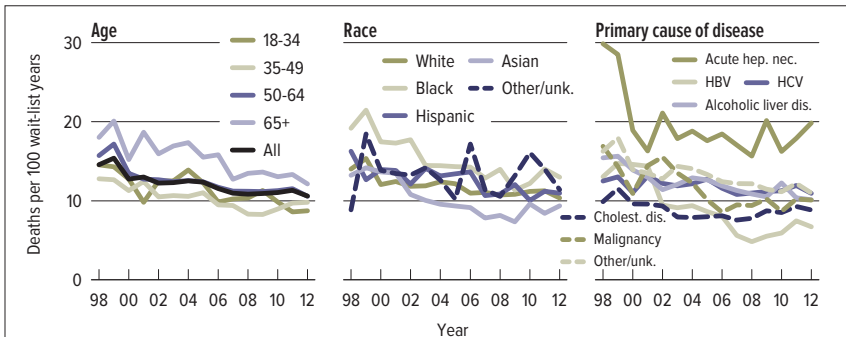
LI 1.8 Median months to liver transplant for wait-listed adult patients

Patients waiting for a transplant, with observations censored at December 31, 2012; Kaplan-Meier methods used to estimate time to transplant. If an estimate is not plotted, 50% of the cohort listed in that year had not been transplanted at the censoring date. Only the first transplant is counted.



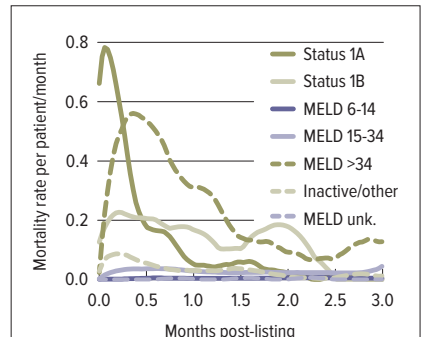
LI 1.9 Percent of adult wait-listed patients, 2007, who received a deceased donor liver transplant within five years, by DSA

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

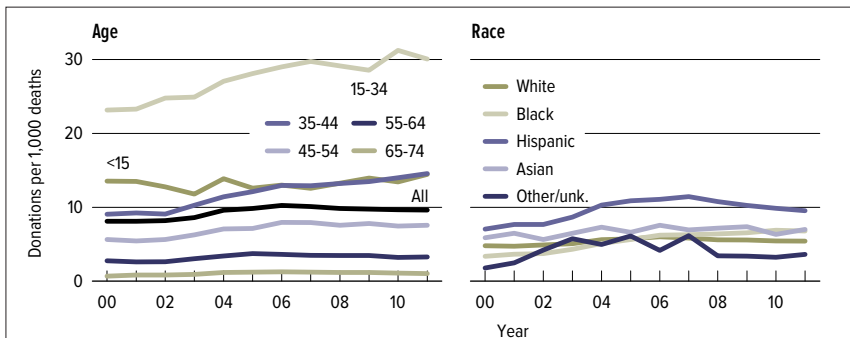
Patients waiting for a transplant. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. For rates shown by different characteristics, waiting time is calculated as the total waiting time in the year for patients in that group. Only deaths that 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, 2007-2012

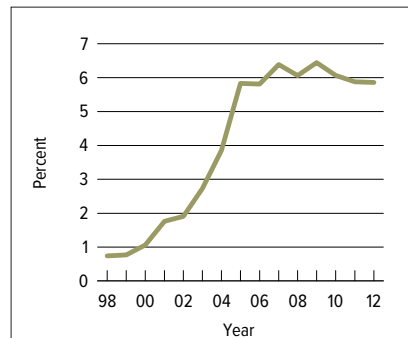
Estimated hazard rate for death among candidates waiting for a liver transplant by medical urgency status at listing. Epanechnikov kernel-smoothed estimators were used with a bandwidth of 0.5 for Status 1B candidates and 0.25 for all other status groups

deceased donation



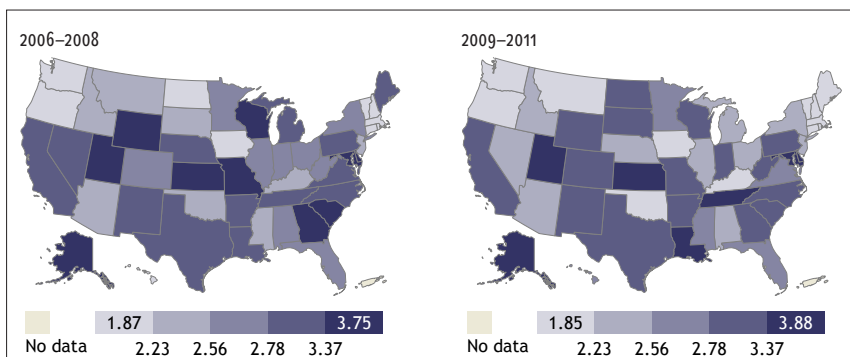
LI 2.1 Deceased donor liver donation rates

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



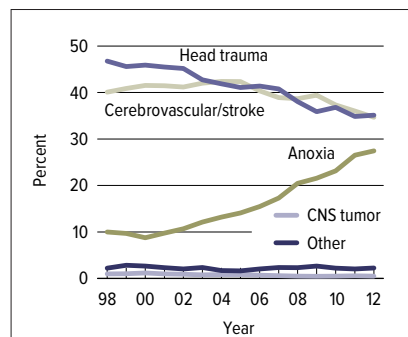
LI 2.4 Liver donors who are DCD

Deceased donors whose liver was recovered for transplant.



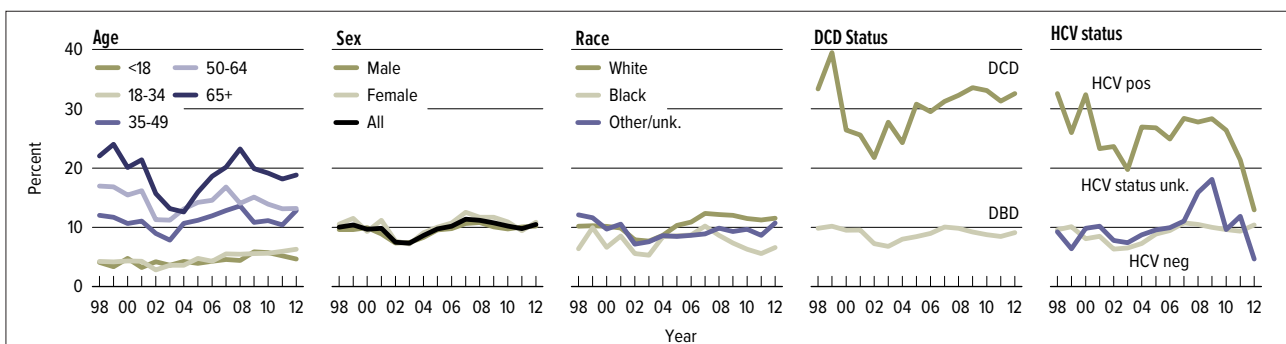
LI 2.2 Deceased donor liver donation rates (per 1,000 deaths), by state

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 2.5 Cause of death among deceased liver donors

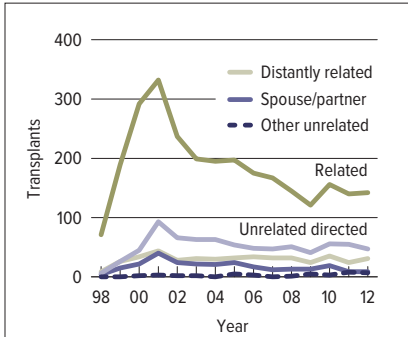
Deceased donors whose liver was transplanted. CNS = central nervous system.



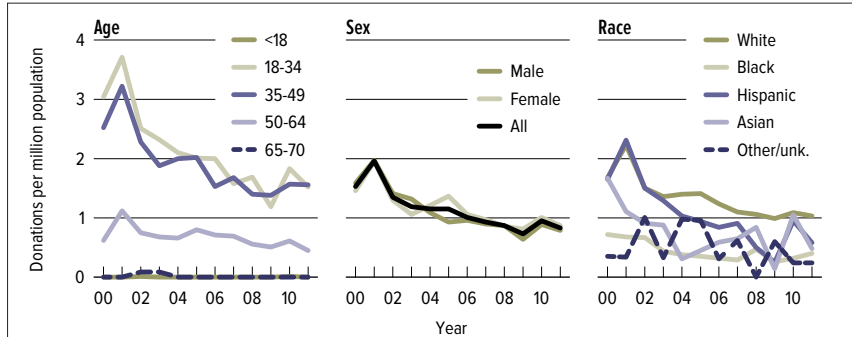
LI 2.3 Discard rates for livers recovered for transplant

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

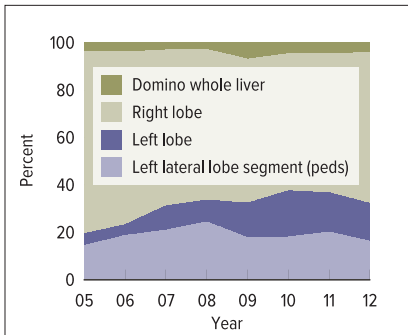
live donation



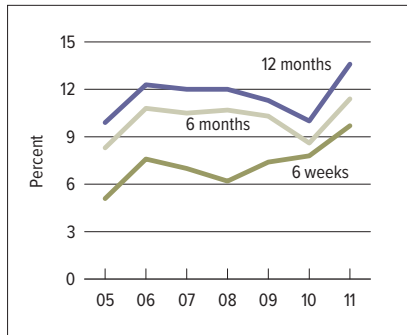
LI 3.1 Liver transplants from living donors, by donor relation
 Number of living donor donations, excluding domino liver; characteristics recorded on the OPTN Living Donor Registration form.



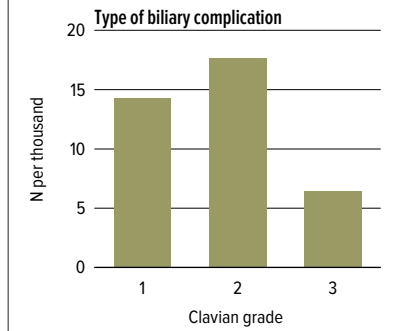
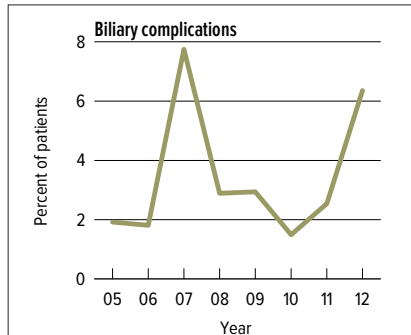
LI 3.2 Living donor liver donation rates
 Number of living donors whose liver was recovered for transplant each year. Denominator: US population age 70 and younger (population data downloaded from http://www.cdc.gov/nchs/nvss/bridged_race/data_documentation.htm#vintage2011).



LI 3.3 Living donor liver transplant graft type
 As reported on the OPTN Living Donor Registration form.

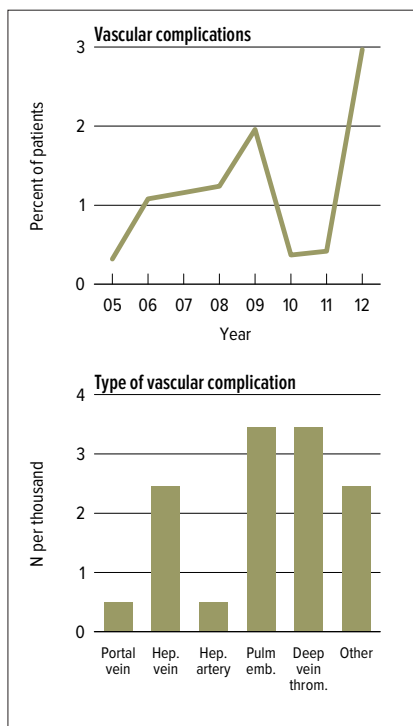


LI 3.4 Readmission to the hospital in the first 6 weeks, 6 months, and 1 year among living liver donors
 Cumulative readmission to the hospital. The six-week time point is recorded at the earliest of discharge or six weeks post-donation.



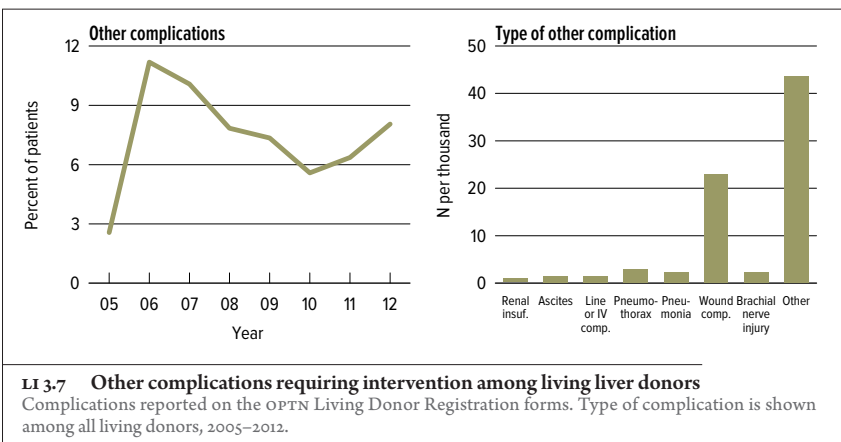
LI 3.5 Biliary complications among living liver donors
 Complications reported on the OPTN Living Donor Registration forms. Type of complication is shown among all living donors, 2005–2011.
 Clavian Grade 1: bilious JP drainage more than 10 days. Clavian Grade 2: interventional procedure (ERCP, PTC, percutaneous drainage, etc.). Clavian Grade 3: surgical intervention.

live donation



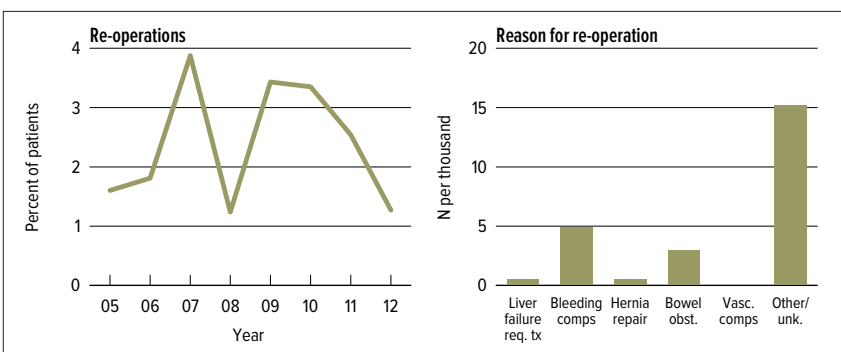
LI 3.6 Vascular complications requiring intervention among living liver donors

Complications reported on the OPTN Living Donor Registration forms. Type of complication is shown among all living donors, 2005–2012.



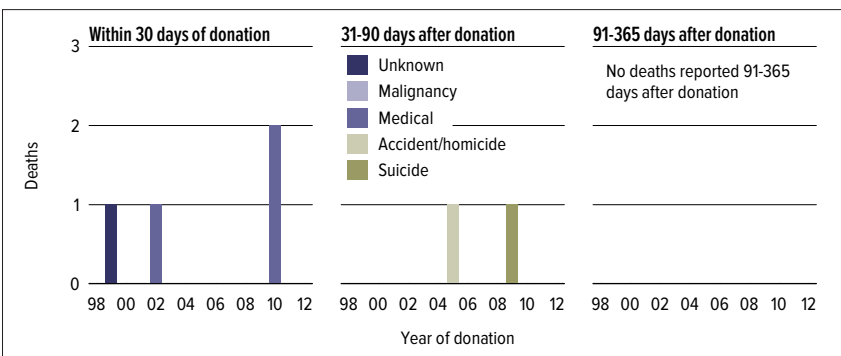
LI 3.7 Other complications requiring intervention among living liver donors

Complications reported on the OPTN Living Donor Registration forms. Type of complication is shown among all living donors, 2005–2012.



LI 3.8 Re-operation among living liver donors

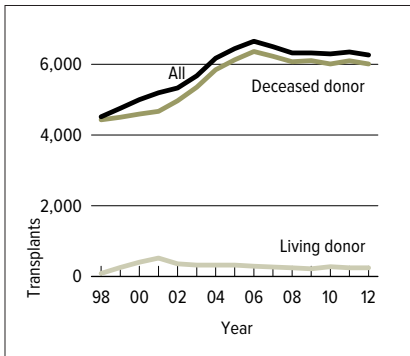
Complications reported on the OPTN Living Donor Registration forms. Type of complication is shown among all living donors, 2005–2012.



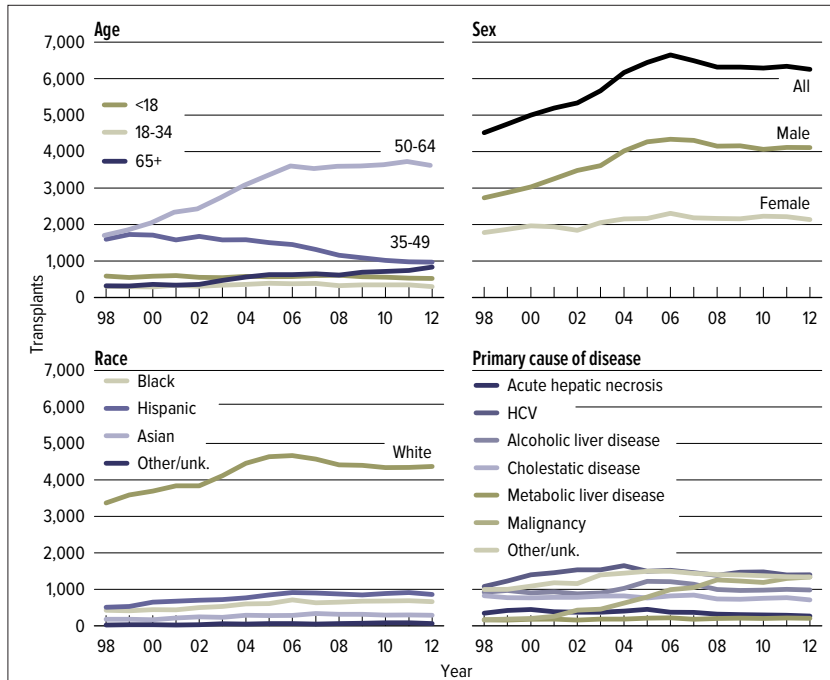
LI 3.9 Living liver donor deaths

Living liver donors; domino donors excluded. Deaths as reported to the OPTN or Social Security Administration. “Donation related” deaths are included in the “Medical” category.

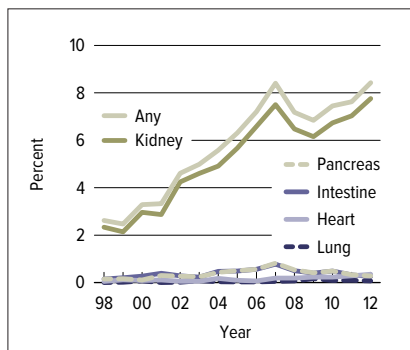
transplant



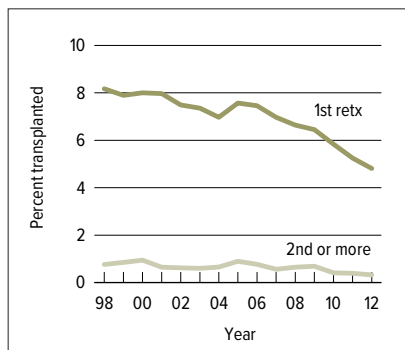
LI 4.1 Total liver transplants
Patients receiving a transplant, including multi-organ transplants and pediatrics. Retransplants are counted.



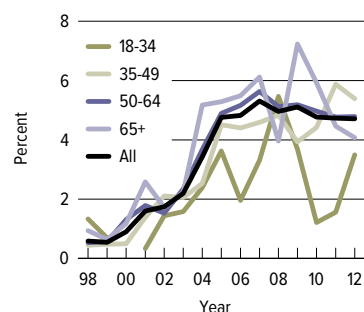
LI 4.2 Liver transplants
Patients receiving a transplant, including multi-organ transplants and pediatrics. Retransplants are counted.



LI 4.3 Liver transplants that were part of a multi-organ transplant
All adult patients receiving a deceased donor liver transplant with at least one additional organ. A multi-organ transplant may include more than two different organs in total; if so, each non-liver organ will be considered separately. Kidney transplants include living donor transplants.

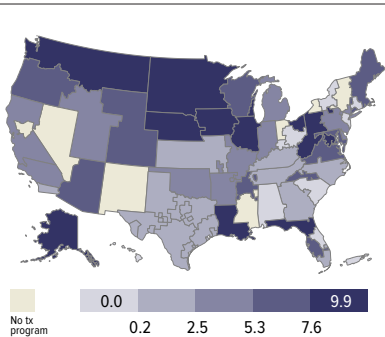


LI 4.4 Retransplants among adult liver transplant recipients
Patients receiving a liver retransplant (deceased or living donor) in the given year.



LI 4.5 Use of DCD livers among adult recipients, by recipient age

Percent of deceased donor transplants using a DCD donor. DCD = donation after circulatory death.



LI 4.6 Percent of adult, deceased donor liver transplants that are DCD, by DSA, 2010-2012

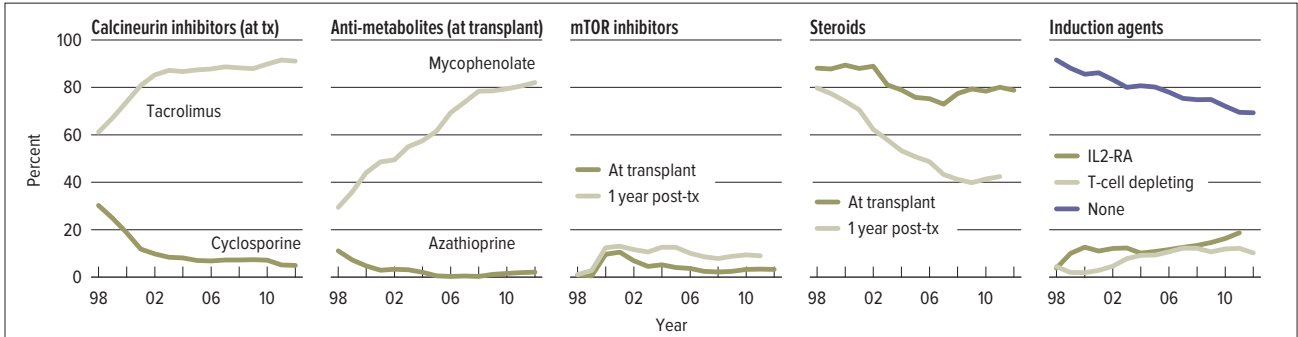
Percent of deceased-donor transplants using a DCD donor, by DSA of the transplanting center. Patients with concurrent listings in a single DSA are counted once in that DSA, and those listed in multiple DSAs are counted separately per DSA.

| Level | 2002 | | 2012 | | |
|--|----------------------------|-------|-------|-------|-------|
| | N | % | N | % | |
| Age | 18-34 | 306 | 6.4 | 303 | 5.3 |
| | 35-49 | 1,675 | 35.1 | 970 | 16.9 |
| | 50-64 | 2,433 | 50.9 | 3,623 | 63.2 |
| | 65+ | 363 | 7.6 | 835 | 14.6 |
| Sex | Female | 1,556 | 32.6 | 1,862 | 32.5 |
| | Male | 3,221 | 67.4 | 3,869 | 67.5 |
| Race | White | 3,536 | 74.0 | 4,088 | 71.3 |
| | Black | 400 | 8.4 | 576 | 10.1 |
| | Hispanic | 589 | 12.3 | 752 | 13.1 |
| | Asian | 225 | 4.7 | 260 | 4.5 |
| | Other/unknown | 27 | 0.6 | 55 | 1.0 |
| Primary cause of disease | Acute hepatic necrosis | 307 | 6.4 | 210 | 3.7 |
| | HCV | 1,531 | 32.0 | 1,402 | 24.5 |
| | Alcoholic liver disease | 883 | 18.5 | 986 | 17.2 |
| | Cholestatic disease | 535 | 11.2 | 458 | 8.0 |
| | Metabolic liver disease | 114 | 2.4 | 135 | 2.4 |
| | Malignancy | 369 | 7.7 | 1,281 | 22.4 |
| | All others | 1,038 | 21.7 | 1,259 | 22.0 |
| Blood type | A | 1,895 | 39.7 | 2,155 | 37.6 |
| | B | 610 | 12.8 | 796 | 13.9 |
| | AB | 262 | 5.5 | 277 | 4.8 |
| | O | 2,010 | 42.1 | 2,503 | 43.7 |
| Time on waiting list | <30 days | 1,308 | 27.4 | 1,723 | 30.1 |
| | 31-60 days | 508 | 10.6 | 577 | 10.1 |
| | 61-90 days | 334 | 7.0 | 394 | 6.9 |
| | 3-<6 months | 694 | 14.5 | 899 | 15.7 |
| | 6-<12 months | 786 | 16.5 | 906 | 15.8 |
| | 1-<2 years | 680 | 14.2 | 706 | 12.3 |
| | 2-<3 years | 265 | 5.5 | 213 | 3.7 |
| | 3+ years | 195 | 4.1 | 313 | 5.5 |
| | Missing/unknown | 7 | 0.1 | 0 | 0.0 |
| BMI | <18.5 | 120 | 2.5 | 115 | 2.0 |
| | 18.5-24.9 | 1,537 | 32.2 | 1,656 | 28.9 |
| | 25.0-29.9 | 1,694 | 35.5 | 1,928 | 33.6 |
| | 30.0-34.9 | 941 | 19.7 | 1,299 | 22.7 |
| | 35.0-39.9 | 321 | 6.7 | 525 | 9.2 |
| | 40.0+ | 121 | 2.5 | 206 | 3.6 |
| Medical condition | Unknown | 43 | 0.9 | 2 | 0.0 |
| | Hospitalized: ICU | 619 | 13.0 | 723 | 12.6 |
| Medical urgency status before transplant | Hospitalized: not ICU | 722 | 15.1 | 1,074 | 18.7 |
| | Not hospitalized | 3,436 | 71.9 | 3,879 | 67.7 |
| | Unknown | 0 | 0.0 | 55 | 1.0 |
| | Status 1A/1B | 296 | 6.2 | 192 | 3.4 |
| Primary payer | MELD 35-40 | 334 | 7.0 | 1,028 | 17.9 |
| | MELD 30-34 | 365 | 7.6 | 920 | 16.1 |
| | MELD 15-29 | 2,431 | 50.9 | 3,421 | 59.7 |
| | MELD 6-14 | 610 | 12.8 | 169 | 2.9 |
| | Other/unknown | 741 | 15.5 | 1 | 0.0 |
| Procedure type | Private | 3,220 | 67.4 | 3,179 | 55.5 |
| | Medicaid | 603 | 12.6 | 718 | 12.5 |
| | Other | 954 | 20.0 | 1,834 | 32.0 |
| Donor type | Whole liver | 4,414 | 92.4 | 5,474 | 95.5 |
| | Partial liver, rmdr not tx | 290 | 6.1 | 189 | 3.3 |
| | Split liver | 73 | 1.5 | 68 | 1.2 |
| Patient on life support | Deceased | 4,487 | 93.9 | 5,537 | 96.6 |
| | Living | 290 | 6.1 | 194 | 3.4 |
| Diabetes | Yes | 364 | 7.6 | 403 | 7.0 |
| Previous abdominal surg. | Yes | 1,740 | 36.4 | 2,484 | 43.3 |
| Portal vein thrombosis | Yes | 870 | 18.2 | 1,412 | 24.6 |
| Incident tumor found at transplant | Yes | 132 | 2.8 | 570 | 9.9 |
| Spontaneous bacterial peritonitis (SBP) | Yes | 223 | 4.7 | 198 | 3.5 |
| Total | | 4,777 | 100.0 | 5,731 | 100.0 |

LI 4.7 Characteristics of adult liver transplant recipients, 2002 & 2012

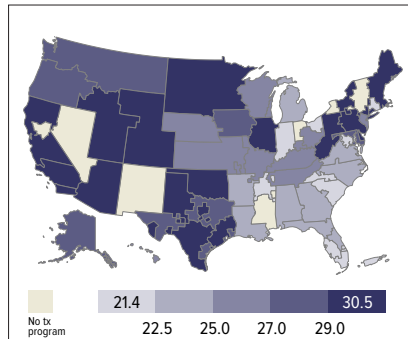
Patients receiving a transplant. Retransplants are counted.

transplant



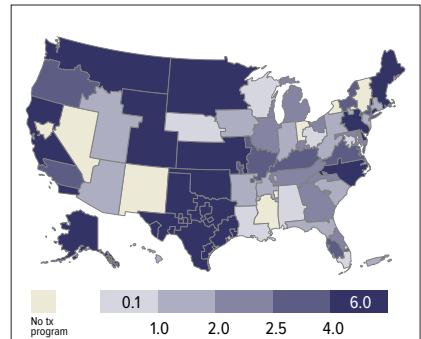
LI 4.8 Immunosuppression use in adult liver transplant recipients

One-year post-transplant data limited to patients alive with graft function one year post-transplant. Mycophenolate group includes mycophenolate mofetil and mycophenolate sodium.



LI 4.9 Median MELD score for adult, deceased donor liver transplants, by DSA, 2012

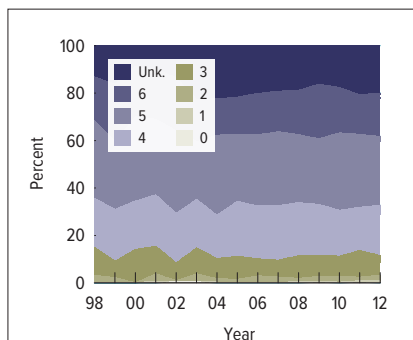
Deceased donor liver transplants; DSA of transplant center location. Patients with status 1A, 1B and inactive status excluded, and allocation MELD score used. Patients with concurrent listings in a single DSA are counted once in that DSA, and those listed in multiple DSAs are counted separately per DSA.



LI 4.10 Difference in lab MELD & allocation MELD among liver transplant recipients, 2012

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

donor–recipient matching



LI 5.1 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 2012. Limited to liver-kidney transplants only.

| RECIPIENT | DECEASED DONOR | | | | LIVING DONOR | | | |
|-----------|----------------|------|------|-------|--------------|------|------|-------|
| | Neg. | Pos. | Unk. | Total | Neg. | Pos. | Unk. | Total |
| Negative | 11.3 | 19.6 | 0.1 | 31.1 | 31.2 | 12.0 | 3.9 | 47.2 |
| Positive | 22.3 | 43.3 | 0.1 | 65.8 | 23.7 | 22.4 | 3.8 | 49.8 |
| Unknown | 1.0 | 2.2 | 0.0 | 3.2 | 1.6 | 1.2 | 0.3 | 3.0 |
| Total | 34.6 | 65.1 | 0.2 | 100 | 56.5 | 35.6 | 8.0 | 100 |

LI 5.2 Adult liver donor-recipient cytomegalovirus (CMV) serology matching, 2008–2012

Adult transplant cohort from 2008–2012. 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 | 0.6 | 10.5 | 0.1 | 11.2 | 1.0 | 8.8 | 1.2 | 11.0 |
| Positive | 2.8 | 58.9 | 0.1 | 61.9 | 3.9 | 51.9 | 11.8 | 67.6 |
| Unknown | 1.1 | 25.7 | 0.1 | 26.9 | 1.6 | 8.5 | 11.4 | 21.4 |
| Total | 4.6 | 95.1 | 0.3 | 100 | 6.5 | 69.1 | 24.3 | 100 |

LI 5.3 Adult liver donor-recipient Epstein-Barr virus (EBV) serology matching, 2008–2012

Adult transplant cohort from 2008–2012. 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 | 68.7 | 2.9 | 0.0 | 71.6 | 70.5 | 1.4 | 7.7 | 79.6 |
| Positive | 18.7 | 2.0 | 0.0 | 20.7 | 11.8 | 0.7 | 1.3 | 13.7 |
| Unknown | 7.5 | 0.3 | 0.0 | 7.8 | 2.9 | 0.0 | 3.8 | 6.7 |
| Total | 94.8 | 5.1 | 0.1 | 100 | 85.1 | 2.1 | 12.8 | 100 |

LI 5.4 Adult liver donor-recipient hepatitis B core antibody (HBCAB) serology matching, 2008–2012

Adult transplant cohort from 2008–2012. 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 | 90.8 | 0.0 | 0.1 | 90.9 | 83.3 | 0.0 | 7.5 | 90.7 |
| Positive | 4.8 | 0.0 | 0.0 | 4.8 | 2.4 | 0.0 | 0.3 | 2.6 |
| Unknown | 4.3 | 0.0 | 0.0 | 4.3 | 5.5 | 0.0 | 1.2 | 6.7 |
| Total | 99.9 | 0.0 | 0.1 | 100 | 91.1 | 0.0 | 8.9 | 100 |

LI 5.5 Adult liver donor-recipient hepatitis B surface antigen (HBsAg) serology matching, 2008–2012

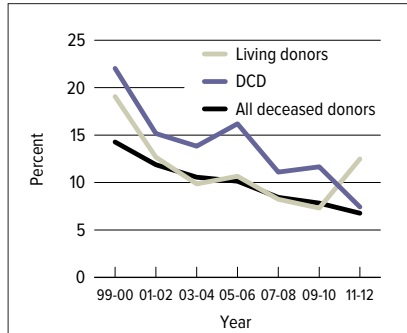
Adult transplant cohort from 2008–2012. Donor serology is reported on the OPTN donor registration forms; recipient serology is reported on the OPTN recipient registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields 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 | 52.9 | 0.1 | 0.0 | 53.0 | 58.8 | 0.4 | 6.5 | 65.8 |
| Positive | 39.6 | 3.2 | 0.0 | 42.8 | 26.7 | 0.3 | 2.7 | 29.7 |
| Unknown | 4.0 | 0.1 | 0.0 | 4.2 | 2.7 | 0.0 | 1.8 | 4.6 |
| Total | 96.6 | 3.4 | 0.0 | 100 | 88.2 | 0.7 | 11.1 | 100 |

LI 5.6 Adult liver donor-recipient hepatitis C serology matching, 2008–2012

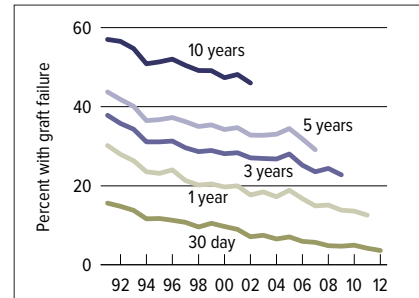
Adult transplant cohort from 2008–2012. Donor serology is reported on the OPTN donor registration forms; recipient serology is reported on the OPTN recipient registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields are unknown, not done, or pending, the person is considered to be “unknown” for that serology; otherwise, serology is assumed negative.

outcomes



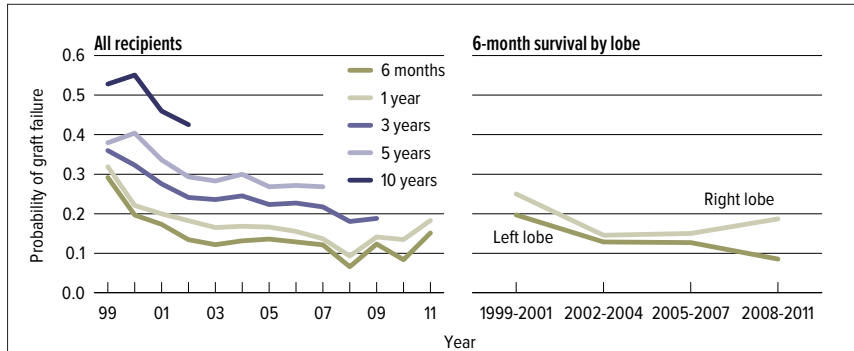
LI 6.1 Graft failure within the first 90 days after transplant among adult liver transplant recipients

All-cause graft failure is identified from multiple data sources, including the OPTN Transplant Recipient Registration form, OPTN Transplant Recipient Follow-up form, as well as death dates from the Social Security Administration. Transplants through September 30, 2012 are included to allow for sufficient follow-up.



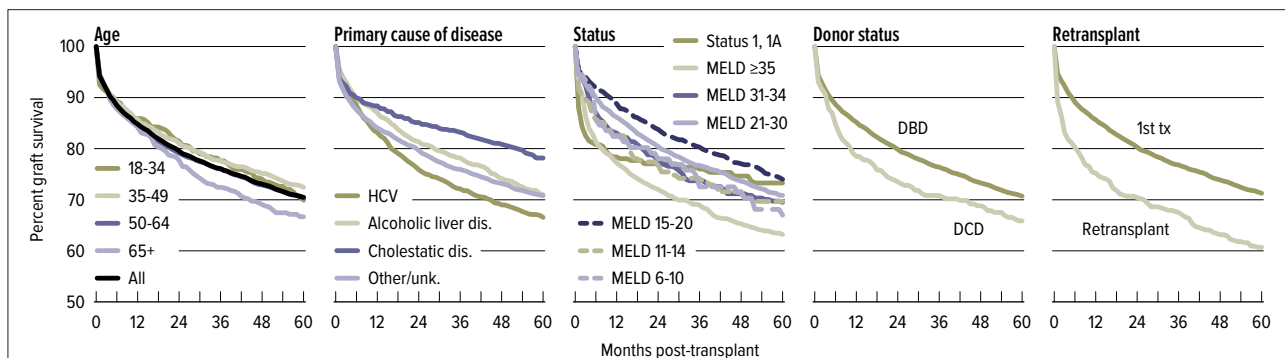
LI 6.2 Graft failure among adult liver transplant recipients: deceased donor

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

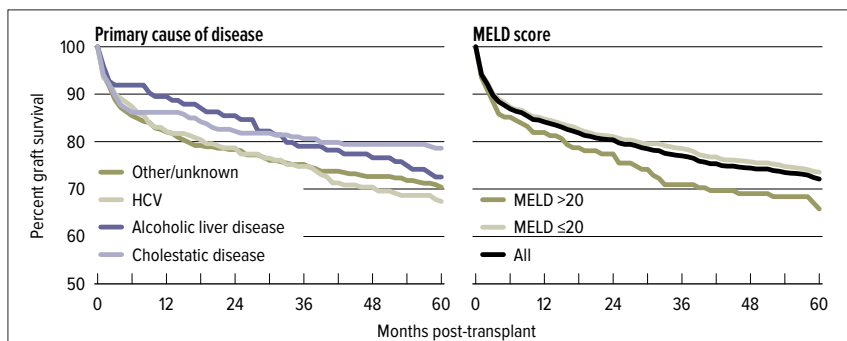


LI 6.3 Graft failure among adult liver transplant recipients: living donor

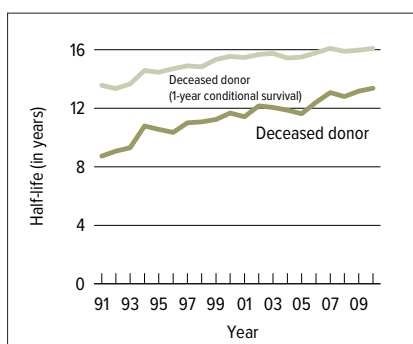
Cox proportional hazards models reporting probability, adjusting for age, sex, and race.



LI 6.4 Graft survival among adult liver transplant recipients transplanted in 2007: deceased donors
 Graft survival estimated using unadjusted Kaplan-Meier methods.

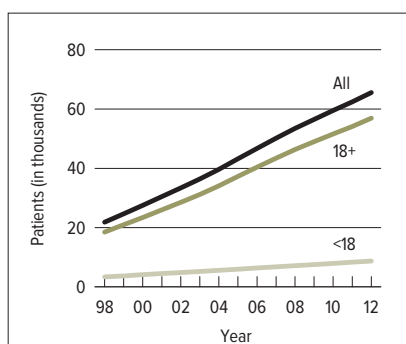


LI 6.5 Graft survival among adult liver transplant recipients transplanted in 2003-2007: living donors
 Graft survival estimated using unadjusted Kaplan-Meier methods.



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

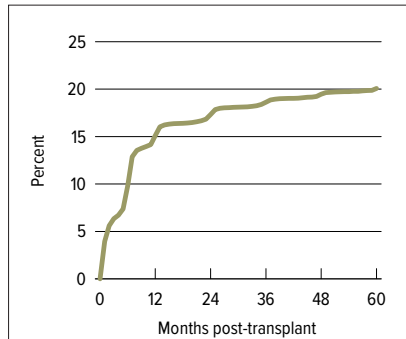
The half-life for a transplant cohort (e.g. 2009 liver transplants) is the time point in follow-up at which 50% of the transplanted grafts have failed. A conditional half-life for a transplant cohort is the same calculation but limited to those who survive with function at least 1 year post-transplant.



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

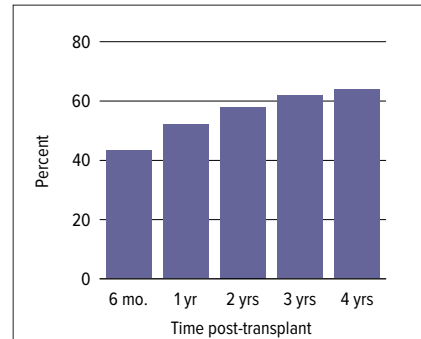
Transplants before June 30 of the year that are still functioning. Patients are assumed alive with function unless a death or graft failure is recorded. A recipient can experience a graft failure and drop from the cohort, then be retransplanted and re-enter the cohort. Age cut is based on age at transplant.

outcomes



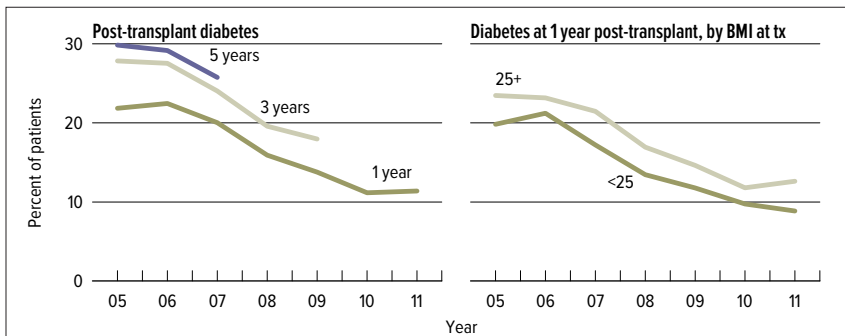
LI 6.8 Incidence of first acute rejection among adult patients receiving a liver transplant in 2006–2010

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. Cumulative incidence is estimated using Kaplan-Meier competing risk methods.



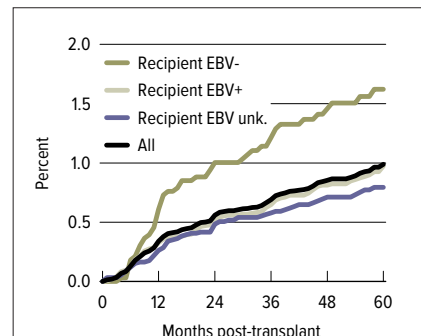
LI 6.9 Reported cumulative incidence of rehospitalizations among adult patients receiving a liver transplant in 2007–2012

Cumulative rate of rehospitalization; 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 Post-transplant diabetes among liver transplant recipients

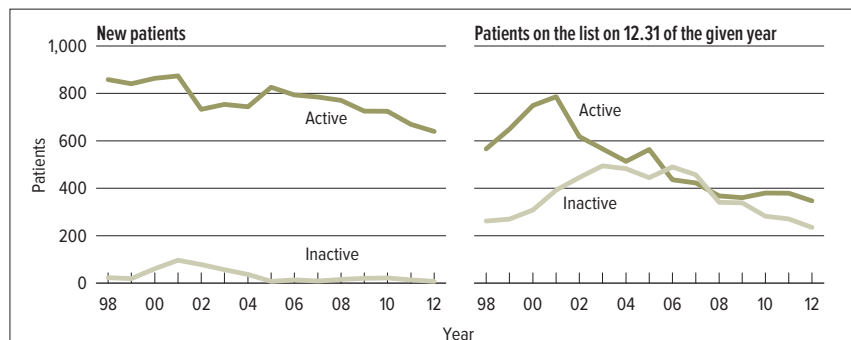
Percentage of adult deceased liver recipients who develop diabetes post-transplant out of patients who are diabetes free at transplant.



LI 6.11 Incidence of PTLD among adult patients receiving a liver transplant in 2006–2010, by recipient Epstein-Barr virus (EBV) status at transplant

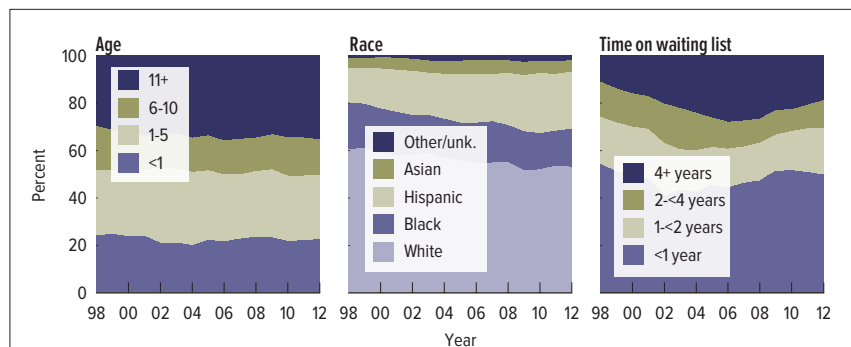
The cumulative incidence, is estimated using Kaplan-Meier competing risks methods. PTLD is identified as either a reported complication or cause of death on the Transplant Recipient Follow-up form or on the Post-transplant Malignancy form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's Disease. Only the earliest date of PTLD diagnosis is considered.

pediatric transplant



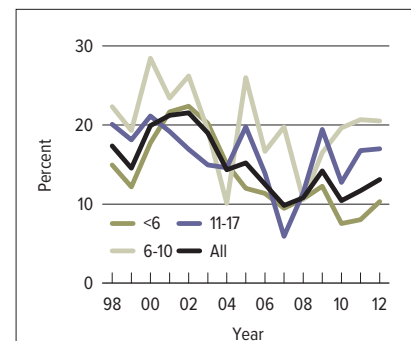
LI 7.1 Pediatric patients waiting for a liver transplant

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 7.2 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 7.3 Prior liver transplant in pediatric patients waiting for a liver transplant, by age

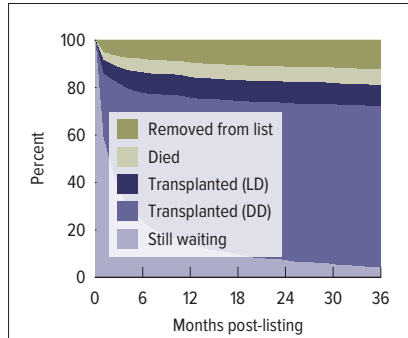
Prior transplant is obtained from the OPTN Transplant Candidate Registration form.

pediatric transplant

| | 2010 | 2011 | 2012 |
|------------------------------|------|------|------|
| Patients at start of year | 701 | 666 | 655 |
| Patients added during year | 747 | 684 | 648 |
| Patients removed during year | 781 | 696 | 718 |
| Patients at end of year | 667 | 654 | 585 |
| Removal reason | | | |
| Deceased donor transplant | 498 | 479 | 474 |
| Living donor transplant | 66 | 60 | 54 |
| Patient died | 63 | 33 | 37 |
| Patient refused transplant | 2 | 1 | 5 |
| Improved, tx not needed | 105 | 77 | 98 |
| Too sick to transplant | 12 | 12 | 17 |
| Other | 35 | 34 | 33 |

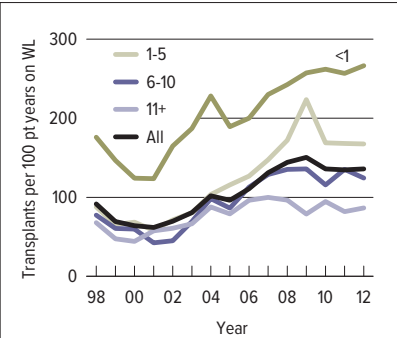
LI 7.4 Liver transplant waiting list activity among pediatric patients

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 January 1 may be different from patient counts on December 31 of the prior year. Patients listed for multi-organ transplants are included.



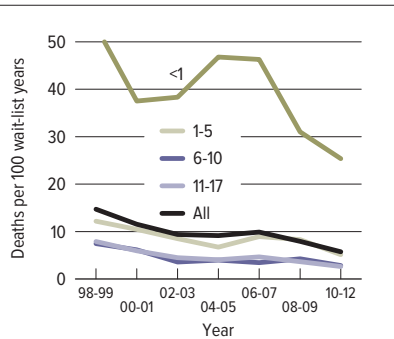
LI 7.5 Three-year outcomes for pediatric patients waiting for a liver transplant among new listings in 2009

Patients waiting for a transplant and first listed in 2009. 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.



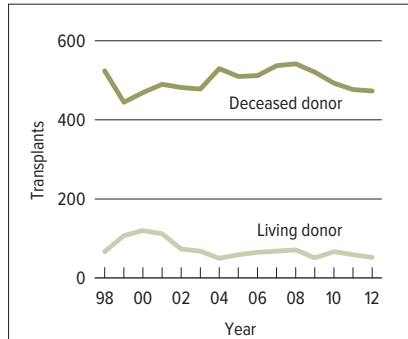
LI 7.6 Liver transplant rates among active pediatric waiting list candidates, by age

Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of active waiting time in the given year. Age is calculated on the first active listing date in a given year.



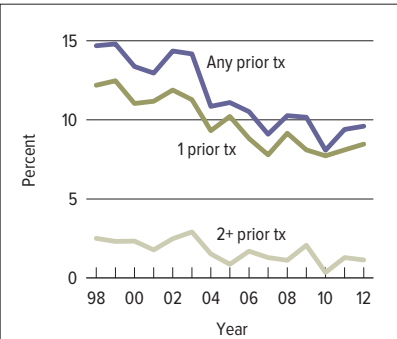
LI 7.7 Pre-transplant mortality rates among pediatric patients wait-listed for a liver transplant, by age

Patients waiting for a transplant. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given 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.



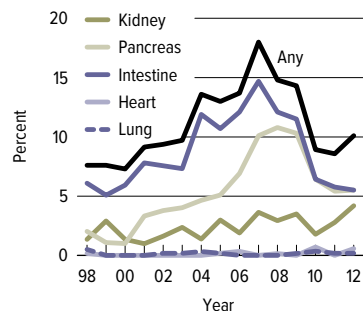
LI 7.8 Pediatric liver transplants, by donor type

Patients receiving a liver transplant.



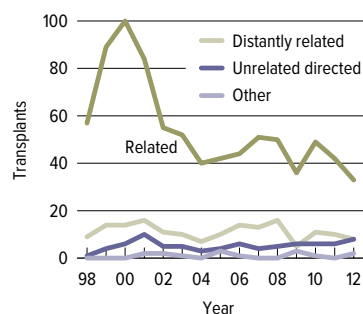
LI 7.9 Retransplants among pediatric liver transplant recipients

Includes patients transplanted after age 17, but listed at age 17 or younger. Retransplanted patients include only those with a prior transplant of the same type.



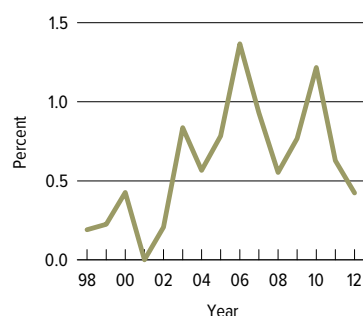
LI 7.10 Pediatric liver transplants that were part of a multi-organ transplant

Patients receiving a deceased donor liver transplant with at least one additional organ. A multi-organ transplant may include more than two different organs in total; if so, each non-liver organ will be considered separately.



LI 7.11 Pediatric liver transplants from living donors

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



LI 7.12 Use of DCD donors in pediatric liver transplant recipients

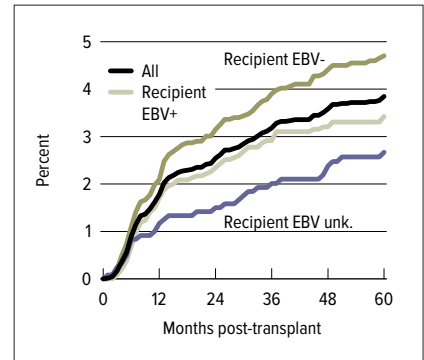
Patients receiving a DCD liver transplant.

| Level | 2000–2002 | | 2010–2012 | | |
|------------------------------|----------------------------|-------------------|-----------|-------|-------|
| | N | % | N | % | |
| Age | <1 | 497 | 28.5 | 462 | 28.5 |
| | 1-5 | 621 | 35.6 | 587 | 36.2 |
| | 6-10 | 214 | 12.3 | 228 | 14.1 |
| | 11-17 | 414 | 23.7 | 344 | 21.2 |
| Sex | Female | 938 | 53.7 | 833 | 51.4 |
| | Male | 808 | 46.3 | 788 | 48.6 |
| Race | White | 954 | 54.6 | 858 | 52.9 |
| | Black | 324 | 18.6 | 267 | 16.5 |
| | Hispanic | 378 | 21.6 | 356 | 22.0 |
| | Asian | 79 | 4.5 | 103 | 6.4 |
| | Other/unknown | 11 | 0.6 | 37 | 2.3 |
| Primary cause of disease | Acute hepatic necrosis | 215 | 12.3 | 182 | 11.2 |
| | HCV | 30 | 1.7 | 4 | 0.2 |
| | Cholestatic disease | 749 | 42.9 | 761 | 46.9 |
| | Metabolic liver disease | 155 | 8.9 | 224 | 13.8 |
| | Malignancy | 192 | 11.0 | 211 | 13.0 |
| | All others | 405 | 23.2 | 239 | 14.7 |
| | Transplant history | First transplant | 1,505 | 86.2 | 1,476 |
| Retransplant | 241 | 13.8 | 145 | 8.9 | |
| Blood type | A | 603 | 34.5 | 530 | 32.7 |
| | B | 252 | 14.4 | 215 | 13.3 |
| | AB | 65 | 3.7 | 72 | 4.4 |
| | O | 826 | 47.3 | 804 | 49.6 |
| Primary payer | Private | 954 | 54.6 | 718 | 44.3 |
| | Medicaid | 598 | 34.2 | 688 | 42.4 |
| | Other public | 119 | 6.8 | 160 | 9.9 |
| | Other | 75 | 4.3 | 55 | 3.4 |
| Time on wait list | <30 days | 601 | 34.4 | 622 | 38.4 |
| | 31-60 days | 221 | 12.7 | 266 | 16.4 |
| | 61-90 days | 172 | 9.9 | 149 | 9.2 |
| | 3-<6 months | 270 | 15.5 | 266 | 16.4 |
| | 6-<12 months | 241 | 13.8 | 178 | 11.0 |
| | 1-<2 years | 125 | 7.2 | 91 | 5.6 |
| | 2-<3 years | 34 | 1.9 | 26 | 1.6 |
| | 3+ years | 42 | 2.4 | 22 | 1.4 |
| | No listing date | 40 | 2.3 | 1 | 0.1 |
| | Medical condition | Hospitalized: ICU | 568 | 32.5 | 365 |
| Hospitalized: not ICU | | 268 | 15.3 | 296 | 18.3 |
| Not hospitalized | | 910 | 52.1 | 959 | 59.2 |
| Missing/Unknown | | 0 | 0.0 | 1 | 0.1 |
| Medical urgency status | 1A | . | . | 249 | 15.4 |
| | 1B | . | . | 247 | 15.2 |
| | MELD/PELD 35+ | . | . | 223 | 13.8 |
| | MELD/PELD 30-34 | . | . | 216 | 13.3 |
| | MELD/PELD 15-29 | . | . | 454 | 28.0 |
| | MELD/PELD < 15 | . | . | 229 | 14.1 |
| Other/unknown | . | . | 3 | 0.2 | |
| Procedure type | Whole liver | 1062 | 60.8 | 1,032 | 63.7 |
| | Partial liver, rest not tx | 455 | 26.1 | 328 | 20.2 |
| | Split liver | 229 | 13.1 | 261 | 16.1 |
| | Unknown | 0 | 0.0 | 0 | 0.0 |
| Donor type | Deceased | 1,441 | 82.5 | 1,443 | 89.0 |
| | Living | 305 | 17.5 | 178 | 11.0 |
| Previous abdom. surgery | Yes | 872 | 49.9 | 878 | 54.2 |
| Portal vein thrombosis | Yes | 64 | 3.7 | 84 | 5.2 |
| Incident. tumor found at tx | Yes | 8 | 0.5 | 8 | 0.5 |
| Spon. bac. peritonitis (SBP) | Yes | 52 | 3.0 | 34 | 2.1 |
| ABO | Compatible or identical | 1,701 | 97.4 | 1,577 | 97.3 |
| | Incompatible | 45 | 2.6 | 44 | 2.7 |
| All patients | | 1,746 | 100.0 | 1,621 | 100.0 |

LI 7.13 Characteristics of pediatric liver transplant recipients, 2000–2002 & 2010–2012

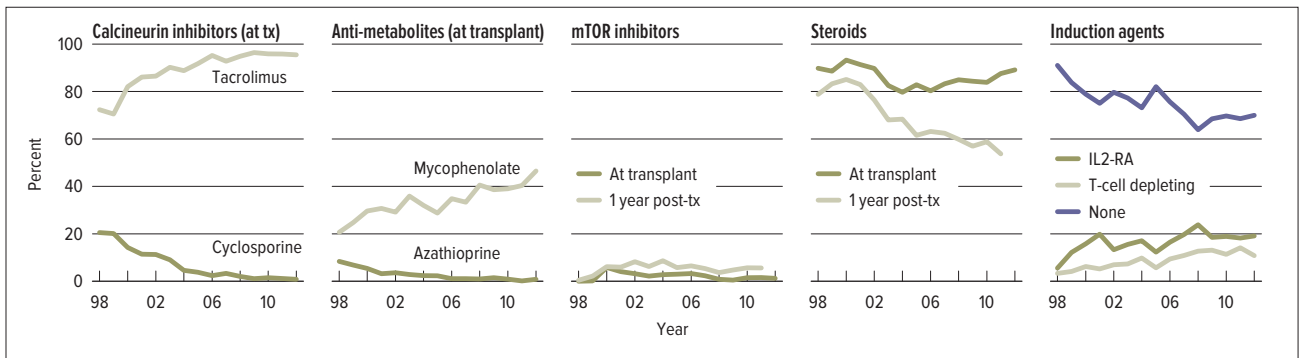
Patients receiving a transplant. Retransplants are counted. MELD / PELD began in 2002.

pediatric transplant



LI 7.14 Incidence of PTLD among pediatric patients receiving a liver transplant, 2000–2010, by recipient Epstein-Barr virus (EBV) status at transplant

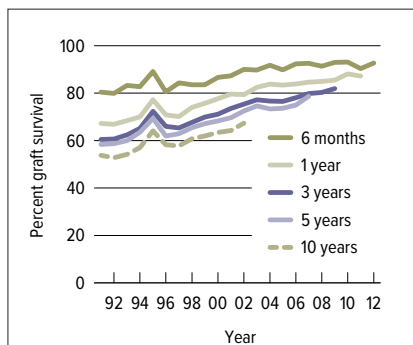
The cumulative incidence is estimated using Kaplan-Meier competing risks methods. PTLD is identified as either a reported complication or cause of death on the Transplant Recipient Follow-up form or on the Post-transplant Malignancy form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's Disease. Only the earliest date of PTLD diagnosis is considered.



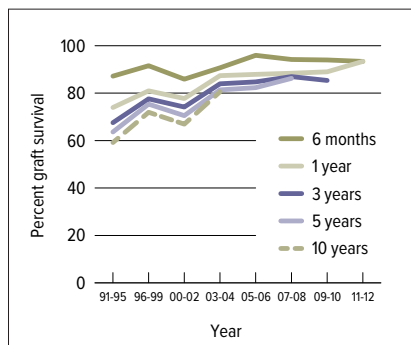
LI 7.15 Immunosuppression use in pediatric liver transplant recipients

One-year post-transplant data limited to patients alive with graft function one year post-transplant. Mycophenolate group includes mycophenolate mofetil and mycophenolate sodium.

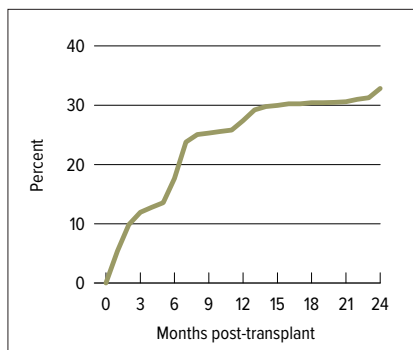
pediatric transplant



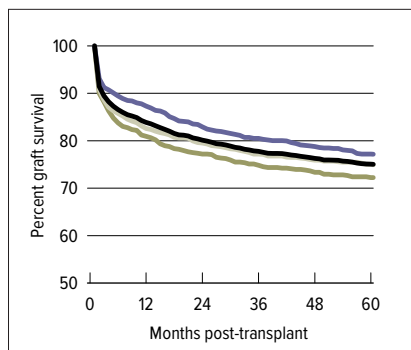
LI 7.16 Graft survival among pediatric liver transplant recipients: deceased donor
 Estimates computed with Cox proportional hazards model, adjusted for age, sex, and race.



LI 7.17 Graft survival among pediatric liver transplant recipients: living donor
 Estimates computed with Cox proportional hazards model adjusted for age, sex, and race.

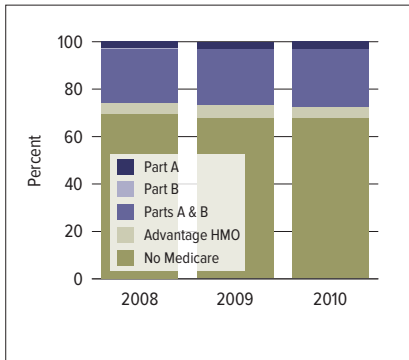


LI 7.18 Incidence of first acute rejection among pediatric patients receiving a liver transplant in 2006–2011
 Acute rejection defined as a record of acute or hyperacute rejection, or a record of an anti-rejection drug being administered on either the Transplant Recipient Registration form or the Transplant Recipient Follow-up form. Only the first rejection event is counted. Cumulative incidence, defined as the probability of acute rejection at any time prior to the given time, is estimated using Kaplan-Meier competing risk methods.



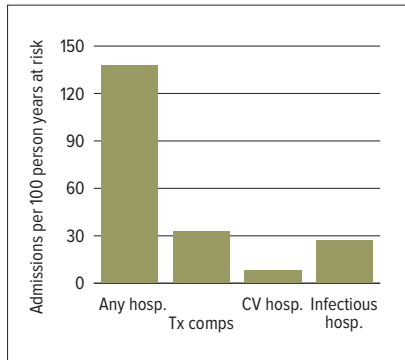
LI 7.19 Graft survival among pediatric liver transplant recipients transplanted in 2003–2007: deceased donors
 Graft survival estimated using unadjusted Kaplan-Meier methods.

Medicare data



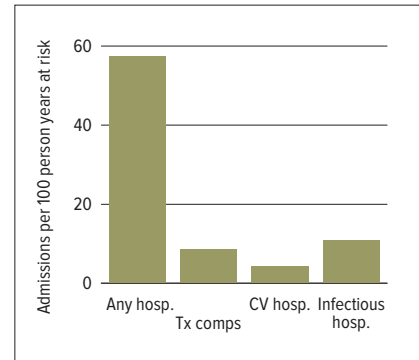
LI 8.1 Medicare coverage among liver transplant recipients

Coverage at the time of transplant as identified by the Medicare Beneficiary Annual Summary supplied by CMS.



LI 8.2 Rehospitization rates among liver transplant recipients in the first post-transplant year

Transplant recipients, 2008, with Medicare as the primary payer at transplant. Rehospitizations and reasons for rehospitization determined from Medicare claims. First year rates are based on rehospitizations occurring from initial discharge to one year later.



LI 8.3 Rehospitization rates among liver transplant recipients in the second post-transplant year

Transplant recipients, 2008, with Medicare as the primary payer at transplant. Rehospitizations and reasons for rehospitization determined from Medicare claims. Second year rates are based on hospitalizations occurring from initial discharge+1 year to initial discharge+2 years.

| Year 1 Cause of hospitalization | Percent of hospitalizations | Year 2 Cause of hospitalization | Percent of hospitalizations |
|---|-----------------------------|-----------------------------------|-----------------------------|
| Transplant complication | 28.1 | Transplant complication | 18.1 |
| Other | 13.0 | Gastro-intestinal | 11.5 |
| Other infection | 11.6 | Other | 9.9 |
| Gastro-intestinal | 9.1 | Other infection | 8.8 |
| Genito-urinary and breast | 4.8 | Genito-urinary and breast | 7.3 |
| Immune and Hhematologic | 4.2 | Skin and musculoskeletal | 4.5 |
| Electrolyte, acid-vase & volume depletion | 3.7 | Respiratory infection | 4.0 |
| Bacteremia, viremia and septicemia | 3.4 | Immune and hematologic | 4.0 |
| Respiratory infection | 3.2 | Metabolic, endocrine, nutritional | 3.8 |
| Metabolic, endocrine, nutritional | 2.8 | Bacteremia, viremia & septicemia | 3.5 |

LI 8.4 Top ten causes of rehospitization among liver recipients transplanted in 2008 with Medicare primary coverage

Transplant recipients, 2008, with Medicare as the primary payer at transplant. Reasons for rehospitization determined from Medicare claims, denominator for percentages includes only those re-hospitalized.

| | # patients | Total costs | | PPPY costs | |
|--------------------------|------------|-------------|------------|------------|--------|
| | | Part A | Part B | Part A | Part B |
| All patients | 2,226 | 321,013,987 | 50,376,613 | 162,157 | 25,447 |
| Age | | | | | |
| 0-11 | * | * | * | * | * |
| 12-17 | * | * | * | * | * |
| 18-34 | 59 | 8,525,181 | 1,329,656 | 158,098 | 24,658 |
| 35-49 | 306 | 45,367,415 | 7,230,266 | 170,079 | 27,106 |
| 50-64 | 1,163 | 165,706,546 | 25,690,236 | 158,519 | 24,576 |
| 65+ | 693 | 100,539,999 | 15,997,704 | 164,664 | 26,201 |
| Sex | | | | | |
| Male | 1,467 | 205,927,523 | 32,595,328 | 158,441 | 25,079 |
| Female | 759 | 115,086,464 | 17,781,286 | 169,260 | 26,151 |
| Race | | | | | |
| White | 1,537 | 216,645,202 | 34,462,220 | 158,953 | 25,285 |
| Black | 234 | 36,707,952 | 5,284,950 | 176,625 | 25,429 |
| Hispanic | 333 | 48,107,530 | 7,756,420 | 161,175 | 25,986 |
| Asian/Pac. Isl. | 100 | 16,651,937 | 2,376,311 | 184,695 | 26,357 |
| Other/unlk. | 22 | 2,901,366 | 496,712 | 143,399 | 24,550 |
| Primary cause of disease | | | | | |
| Acute hep. nec. | 62 | 11,881,080 | 1,471,088 | 220,995 | 27,363 |
| HBV | 51 | 7,076,348 | 1,014,221 | 159,220 | 22,820 |
| HCV | 661 | 99,707,480 | 15,142,500 | 173,839 | 26,401 |
| Alco. liver disease | 386 | 53,006,877 | 8,406,637 | 151,912 | 24,093 |
| Malignancy | 287 | 35,765,011 | 6,070,074 | 135,309 | 22,965 |
| Cholestatic dis. | 195 | 29,024,359 | 4,507,489 | 170,591 | 26,493 |
| Other/unlk. | 584 | 84,552,832 | 13,764,604 | 161,209 | 26,244 |

LI 8.5 Total and per-person per-year (PPPY) Medicare costs (\$) among liver transplant recipients in the first post-transplant year

Costs among recipients transplanted in 2008 and 2009 who had Medicare as the primary payer at the time of transplant. First year costs include the transplant hospitalization. Costs incurred after a transplant failure are excluded. Values for cells with 9 or fewer patients are suppressed.

| | # patients | Total costs | | PPPY costs | |
|--------------------------|------------|-------------|-----------|------------|--------|
| | | Part A | Part B | Part A | Part B |
| All patients | 901 | 17,601,901 | 8,841,674 | 20,385 | 10,240 |
| Age | | | | | |
| 0-11 | * | * | * | * | * |
| 12-17 | * | * | * | * | * |
| 18-34 | 22 | 159,996 | 161,552 | 7,411 | 7,483 |
| 35-49 | 127 | 2,023,578 | 1,248,482 | 16,385 | 10,109 |
| 50-64 | 483 | 10,579,258 | 4,902,490 | 22,806 | 10,569 |
| 65+ | 267 | 4,793,386 | 2,514,049 | 18,985 | 9,957 |
| Sex | | | | | |
| Male | 585 | 10,718,295 | 5,587,032 | 19,193 | 10,005 |
| Female | 316 | 6,883,606 | 3,254,642 | 22,568 | 10,670 |
| Race | | | | | |
| White | 634 | 12,469,845 | 6,308,993 | 20,650 | 10,447 |
| Black | 82 | 2,242,840 | 837,614 | 28,049 | 10,475 |
| Hispanic | 134 | 2,211,934 | 1,351,120 | 16,728 | 10,218 |
| Asian/Pac. Isl. | 41 | 639,102 | 294,756 | 17,108 | 7,890 |
| Other/unlk. | 10 | 38,179 | 49,192 | 3,807 | 4,906 |
| Primary cause of disease | | | | | |
| Acute hep. nec. | 28 | 375,950 | 202,251 | 13,787 | 7,417 |
| HBV | 19 | 238,143 | 121,625 | 12,500 | 6,384 |
| HCV | 247 | 5,946,784 | 2,468,917 | 25,393 | 10,542 |
| Alco. liver disease | 174 | 2,849,612 | 1,615,970 | 16,882 | 9,573 |
| Malignancy | 110 | 2,022,833 | 1,050,306 | 19,851 | 10,307 |
| Cholestatic dis. | 80 | 1,679,529 | 863,743 | 21,812 | 11,217 |
| Other/unlk. | 243 | 4,489,051 | 2,518,861 | 19,082 | 10,707 |

LI 8.6 Total and per-person per-year (PPPY) Medicare costs (\$) among liver transplant recipients in the second post-transplant year

Costs among recipients transplanted in 2008 who had Medicare as the primary payer at the time of transplant. The second post-transplant year runs from 366 to 730 days after transplant. Costs incurred after a transplant failure are excluded. Values for cells with 9 or fewer patients are suppressed.

Medicare data

| Total costs | | 2008 total costs | | | 2009 total costs | | | 2010 total costs | | |
|---------------------------|------------------------|------------------|-------------|-------------|------------------|-------------|-------------|------------------|-------------|-------------|
| | | # patients | Part A | Part B | # patients | Part A | Part B | # patients | Part A | Part B |
| All patients | | 21,211 | 391,716,094 | 106,411,609 | 22,865 | 426,160,552 | 137,055,352 | 24,365 | 453,906,521 | 143,195,584 |
| Age | 0-11 | 75 | 2,219,698 | 473,923 | 77 | 2,220,116 | 503,599 | 88 | 2,494,070 | 652,442 |
| | 12-17 | 59 | 1,602,803 | 378,525 | 64 | 1,288,962 | 402,352 | 69 | 670,922 | 326,394 |
| | 18-34 | 864 | 15,373,334 | 3,881,979 | 907 | 16,512,642 | 5,045,785 | 955 | 18,611,775 | 5,325,707 |
| | 35-49 | 5,614 | 86,191,262 | 24,454,700 | 5,744 | 97,964,453 | 30,870,301 | 5,938 | 97,832,440 | 30,817,207 |
| | 50-64 | 11,661 | 210,685,697 | 57,157,300 | 12,818 | 220,515,882 | 72,296,815 | 13,837 | 243,154,740 | 76,799,362 |
| | 65+ | 2,938 | 75,643,300 | 20,065,181 | 3,255 | 87,658,497 | 27,936,500 | 3,478 | 91,142,574 | 29,274,472 |
| Sex | Male | 13,660 | 246,772,183 | 66,277,504 | 14,807 | 270,658,553 | 85,321,176 | 15,789 | 287,182,529 | 89,741,437 |
| | Female | 7,551 | 144,943,911 | 40,134,105 | 8,058 | 155,501,999 | 51,734,176 | 8,576 | 166,723,992 | 53,454,147 |
| Race | White | 16,304 | 283,825,238 | 80,185,940 | 17,424 | 302,009,851 | 101,716,758 | 18,477 | 327,816,618 | 106,467,904 |
| | Black | 1,546 | 39,026,215 | 8,109,682 | 1,730 | 42,987,954 | 10,884,473 | 1,900 | 48,131,500 | 12,100,417 |
| | Hispanic | 2,480 | 51,038,045 | 13,659,474 | 2,720 | 58,651,882 | 18,474,960 | 2,915 | 57,094,919 | 18,594,032 |
| | Asian/Pacific Islander | 736 | 14,844,170 | 3,652,742 | 831 | 20,031,072 | 5,113,957 | 877 | 16,696,382 | 4,860,874 |
| | Other/unlk. | 145 | 2,982,427 | 803,772 | 160 | 2,479,793 | 865,205 | 196 | 4,167,102 | 1,172,357 |
| Primary cause of disease | Acute hep. nec. | 948 | 18,375,230 | 4,303,138 | 1,004 | 17,455,776 | 5,568,307 | 1,060 | 18,822,755 | 5,464,659 |
| | HBV | 622 | 10,170,925 | 2,612,558 | 664 | 12,157,520 | 3,500,814 | 697 | 10,097,232 | 3,376,485 |
| | HCV | 5,376 | 106,105,213 | 26,646,476 | 5,850 | 115,329,702 | 35,247,138 | 6,247 | 124,237,312 | 36,273,427 |
| | Alco. liver disease | 4,202 | 73,552,556 | 19,683,136 | 4,486 | 75,302,460 | 24,282,247 | 4,729 | 83,225,747 | 25,362,360 |
| | Malignancy | 975 | 24,529,998 | 5,751,010 | 1,288 | 30,197,857 | 8,749,112 | 1,518 | 33,901,209 | 10,034,446 |
| | Cholestatic dis. | 2,507 | 36,188,606 | 11,717,986 | 2,674 | 41,442,763 | 15,296,468 | 2,851 | 40,984,258 | 15,443,301 |
| Other/Unk. | 6,581 | 122,793,566 | 35,697,306 | 6,899 | 134,274,474 | 44,411,267 | 7,263 | 142,638,009 | 47,240,907 | |
| Per person per year costs | | 2008 PPPY costs | | | 2009 PPPY costs | | | 2010 PPPY costs | | |
| All patients | | 21,211 | 19,940 | 5,417 | 22,865 | 20,194 | 6,495 | 24,365 | 20,106 | 6,343 |
| Age | 0-11 | 75 | 30,796 | 6,575 | 77 | 30,439 | 6,905 | 88 | 29,015 | 7,590 |
| | 12-17 | 59 | 29,879 | 7,056 | 64 | 21,330 | 6,658 | 69 | 10,098 | 4,912 |
| | 18-34 | 864 | 18,837 | 4,757 | 907 | 19,395 | 5,927 | 955 | 20,664 | 5,913 |
| | 35-49 | 5,614 | 16,326 | 4,632 | 5,744 | 18,077 | 5,696 | 5,938 | 17,402 | 5,481 |
| | 50-64 | 11,661 | 19,481 | 5,285 | 12,818 | 18,585 | 6,093 | 13,837 | 18,898 | 5,969 |
| | 65+ | 2,938 | 28,990 | 7,690 | 3,255 | 30,934 | 9,859 | 3,478 | 30,039 | 9,648 |
| Sex | Male | 13,660 | 19,539 | 5,248 | 14,807 | 19,871 | 6,264 | 15,789 | 19,648 | 6,140 |
| | Female | 7,551 | 20,661 | 5,721 | 8,058 | 20,784 | 6,915 | 8,576 | 20,947 | 6,716 |
| Race | White | 16,304 | 18,742 | 5,295 | 17,424 | 18,753 | 6,316 | 18,477 | 19,106 | 6,205 |
| | Black | 1,546 | 27,897 | 5,797 | 1,730 | 27,486 | 6,959 | 1,900 | 27,884 | 7,010 |
| | Hispanic | 2,480 | 22,364 | 5,985 | 2,720 | 23,352 | 7,356 | 2,915 | 21,139 | 6,884 |
| | Asian/Pacific Islander | 736 | 21,598 | 5,315 | 831 | 25,921 | 6,618 | 877 | 20,511 | 5,971 |
| | Other/unlk. | 145 | 22,361 | 6,026 | 160 | 16,602 | 5,792 | 196 | 23,563 | 6,629 |
| Primary cause of disease | Acute hep. nec. | 948 | 20,507 | 4,802 | 1,004 | 18,452 | 5,886 | 1,060 | 18,902 | 5,488 |
| | HBV | 622 | 17,234 | 4,427 | 664 | 19,402 | 5,587 | 697 | 15,086 | 5,045 |
| | HCV | 5,376 | 21,514 | 5,403 | 5,850 | 21,521 | 6,577 | 6,247 | 21,702 | 6,336 |
| | Alco. liver disease | 4,202 | 18,790 | 5,028 | 4,486 | 18,106 | 5,838 | 4,729 | 18,895 | 5,758 |
| | Malignancy | 975 | 29,344 | 6,880 | 1,288 | 27,046 | 7,836 | 1,518 | 25,356 | 7,505 |
| | Cholestatic dis. | 2,507 | 15,300 | 4,954 | 2,674 | 16,440 | 6,068 | 2,851 | 15,179 | 5,720 |
| Other/Unk. | 6,581 | 20,093 | 5,841 | 6,899 | 21,063 | 6,967 | 7,263 | 21,149 | 7,004 | |

LI 8.7 Total calendar-year Medicare costs (\$) spent on liver transplant recipients, 2008, 2009, & 2010

Costs paid by Medicare in each calendar year among recipients alive with graft function in the given year, regardless of Medicare eligibility at the time of transplant. Costs incurred after transplant failure are excluded.

