United States Organ Transplantation

OPTN & SRTR ANNUAL DATA REPORT 2011

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Health Resouces and Services Administration
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Figure titles specify adult and pediatric populations; if not listed, figure includes patients of all ages. (For lung data, patients aged 12 and older are grouped with adults.) And unless otherwise indicated, data in all figures are for solitary organ transplants.

Each chapter contains (when relevant to the specific organ) the following sections:

- *wait list*
- *deceased donation*
- *live donation*
- *transplant*
- *donor-recipient matching*
- *outcomes*
- *immunosuppression*
- *pediatric transplant*
- *maps of transplant centers*

POPULATIONS REPORTED

Figure titles indicate adult or pediatric populations; if not specified, data include all patients of all ages.

With the exception of the "total transplants" figure in each organ-specific chapter (i.e., KI 4.1), and of pancreas figures which specify SPK and PAK transplants, all figures in these chapters are limited to patients on the waiting list for a single-organ transplant (i.e, not heart-lung, not kidney-pancreas).

AGE

Adult patients are defined as those 18 and older for all organs except lung; lung allocation policy treats patients 12 and older as adults. For wait-list figures, age is defined at time of listing unless otherwise specified.

RACE/ETHNICITY

Multi-racial patients are defined as other/unknown. When a given race group is not shown, it is included with other/unknown.

ECD KIDNEYS

Data on willingness to accept an ECD kidney are available from 2003.

PANCREAS DATA

Pancreas data encompass the three types of pancreas wait lists or transplants: simultaneous kidney-pancreas (SPK), pancreas after kidney (PAK), and pancreas-alone (PTA).

LUNG ALLOCATION SCORE

The lung allocation score (LAS) became available in 2005. Data by LAS are presented using the most recent LAS before December 31 of each year.

preface

This Annual Data Report of the US Organ Procurement and Transplantation Network (OPTN) and the Scientific Registry of Transplant Recipients (SRTR) is the 21st annual report and is based largely on data pertaining to the period 1998-2011. The previous report, OPTN/SRTR 2010 Annual Data Report, was based on data from the period 1998-2009. Thus, the current report contains two additional years of data, for 2010 and 2011, and therefore includes more recent data than the previous report. In addition, the title OPTN/SRTR 2011 Annual Data Report reflects the fact that the report covers the most recent complete year of transplants, those performed in 2011.

This publication was developed for the US Department of Health and Human Services, Health Resources and Services Administration, Healthcare Systems Bureau, Division of Transplantation, by the SRTR contractor, the Minneapolis Medical Research Foundation (MMRF), and the OPTN contractor, the United Network for Organ Sharing (UNOS), under contracts HHSH250201000018C and 234-2005-37011C, respectively.

As the SRTR contractor, MMRF, through its Chronic Disease Research Group (CDRG), determined which data to present, conducted the required analyses, created the figures and tables, drafted the text, and designed the document. As the OPTN contractor, UNOS reviewed the draft report, contributed to the content, and provided the glossary. This report is available at http://www.srtr.org/. Individual chapters, as well as the report as a whole, may be downloaded.

OVERVIEW AND HIGHLIGHTS

This Annual Data Report includes chapters on kidney, pancreas, liver, intestine, heart, and lung transplantation, a chapter on deceased donor organ donation, and an appendix. Also, new this year is a chapter on international transplant rate comparisons. The organ-specific chapters include sections describing the waiting list, deceased donor organ donation, living donor organ donation, transplant, donor-recipient matching, outcomes, immunosuppression, and pediatric transplant. When possible, similar data and formats are used for each chapter and section. However, this is not always possible because some data are not pertinent to all organs.

Graphical presentation of the data is emphasized: approximately 500 figures, tables, and maps are included in the various chapters. Graphics are downloadable from the SRTR website as slides. The data behind the graphics are downloadable from the SRTR website in a spreadsheet format. Numerous data tables are also provided on the site.

Maps in this report present data divided into quintiles. A sample map is provided on the next page.

In this example, approximately one-fifth of all data points have a value of 10.8 or above. Ranges include the number at the lower end of the range, and exclude that at the upper end (e.g., the second range here is 8.2 to < 9.2). To facilitate comparisons of maps for different periods, we commonly apply a single legend to each map in a series. In this case, the data in each individual map are not evenly distributed, and a map for a single year may not con-

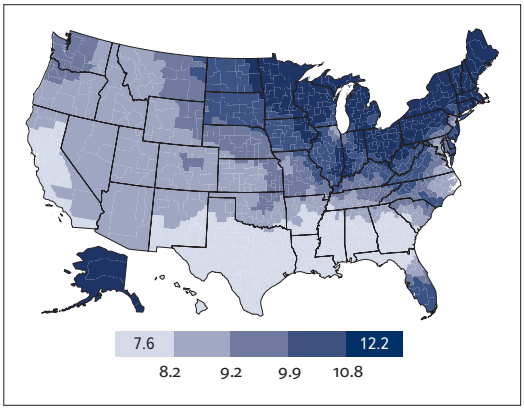
tain all listed ranges. Numbers in the first and last boxes indicate the mean values of data points in the highest and lowest quintiles, not the minimum and maximum of observed data.

Maps by donation service area (DSA) use DSA boundaries in effect at the end of 2011. Some DSAs include non-contiguous areas. If a DSA has no transplant program for a given organ, the DSA is not shaded on the map.

On the SRTR website, the Excel page for each map includes additional data. The map-specific mean is calculated using only the population included in the map; this does not usually match other data in the Annual Data Report, and should be quoted with caution. The overall mean includes all patients for whom data are available, whether or not their residency, transplant center, or DSA is known. We also include the number of patients excluded in the map-specific mean, and the total number of patients used in the calculation.

MILESTONE DATES IN THE PRODUCTION OF THIS REPORT

Data were cut: April 2012.
Data were analyzed: May 2012.



DATA REQUESTS TO THE SRTR

Simple data requests can be fulfilled with existing data, do not require additional programming or analyses, can generally be fulfilled quickly (i.e., in less than 4 hours), and do not require a data use agreement (DUA) or payment. Requests for a standard analysis file (SAF) or a simulated allocation model (SAM) require a DUA and payment. SRTR offers a student discount for researchers who qualify.

Data requests requiring linkages with other public or private data sources can often be accommodated. To protect the privacy of individuals in the transplant registry, SRTR will perform linkages and analyses that require use of personal identifiers; SRTR will release the resulting data as summary data or as individual data with encrypted identifiers. In exceptional circumstances, identifiers may be released to other government agencies or to investigators for linkage, but only after authorization by the SRTR Technical Advisory Committee and the SRTR Project Officer at HRSA. Data requests for additional SRTR programming will be considered depending on available resources and reviewed on a case-by-case basis by SRTR and the SRTR Project Officer at HRSA. Requesters must sign a DUA. An hourly rate will be assessed for time spent on the request; cost to fulfill the request is based solely on the programming time required. Data sets require payment in addition to payment for programming time.

WEBSITES

WWW.SRTR.ORG is a public website containing transplant program-specific reports, organ procurement organization (OPO)-specific reports, summary tables, archives of past reports, timelines for future reports, risk-adjustment models, methods, basic references for researchers who use SRTR data files, a link to the Annual Data Report and its supporting documentation and data tables, answers to frequently asked questions, and other information.

HTTPS://SECURESRTR.TRANSPLANT.HRSA.GOV is a secure website that provides access to the pre-

release program- and OPO-specific reports, survival spreadsheets, and other useful information. All individual authorized users from transplant programs and OPOs have their own unique logins for the secure site.

HTTP://UNOS.ORG is a public website containing information on donation and transplantation, data collection instruments, data reports, education materials for patients and transplant professionals, policy development, and other information. This website also links to the OPTN website.

HTTP://OPTN.TRANSPLANT.HRSA.GOV is a public website containing news, information, and resources about transplantation and donation, including transplant data reports; policy development; and related boards and committees. It also contains allocation calculators, a calendar of events, answers to frequently asked questions, and other information.

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SUGGESTED CITATIONS

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Or, provide the URL for the webpage cited and the access date: Organ Procurement and Transplantation Network (OPTN) and Scientific Registry of Transplant Recipients (SRTR). OPTN/SRTR 2011 Annual Data Report. Department of Health and Human Services, Health Resources and Services Administration, Healthcare Systems Bureau, Division of Transplantation; 2012. Available at [insert URL here]. Accessed [insert date here].

Abbreviated citation: OPTN/SRTR 2011 Annual Data Report. HHS/HRSA/HSB/DOT.

PUBLICATIONS BASED ON DATA IN THIS REPORT OR SUPPLIED ON REQUEST MUST INCLUDE A CITATION AND THE FOLLOWING STATEMENT

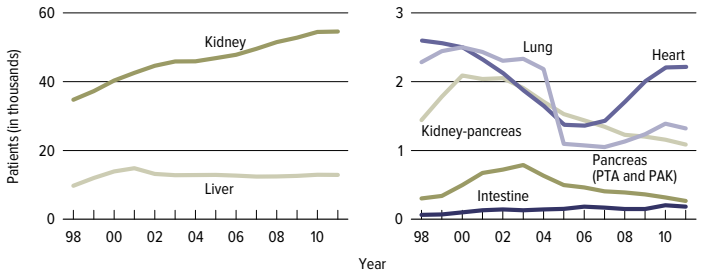
The data and analyses reported in the 2011 Annual Data Report of the Organ Procurement and Transplantation Network and the US Scientific Registry of Transplant Recipients have been supplied by the Minneapolis Medical Research Foundation and UNOS under contract with HHS/HRSA. The authors alone are responsible for reporting and interpreting these data; the views expressed herein are those of the authors and not necessarily those of the US Government.

introduction

As in previous years, a recurring theme in this year's Annual Data Report is the imbalance between the supply of organs and the number of patients who could benefit from transplant. Differences in supply and demand for different organs are highlighted below; also discussed are changes in waiting list activity, transplants performed, and organs recovered for transplant but discarded.

DECEASED DONOR TRANSPLANT WAITING LISTS

Separate waiting lists are maintained for each deceased donor organ that is allocated for transplant by the Organ Procurement and Transplantation Network (OPTN). The numbers of new patients listed for transplant every year differ by organ type. In making comparisons, it is important to remember that patients who need a kidney and, to a lesser extent, patients who need a liver may undergo living donor transplant and never appear on the deceased donor waiting list. However, some patients who ultimately undergo living donor transplant may have been listed on the deceased donor waiting list.



INT 1a Patients on the waiting list on December 31 of the year (active listings only)

All except PA: Patients waiting for a transplant on 12/31 of the given year. 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. PA only: Patients waiting for a transplant on 12/31 of the given year. Patients concurrently listed at multiple centers or on more than one list (pancreas-alone, kidney-pancreas) 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.

The kidney transplant waiting list is the largest by far (Figure 1a). On December 31, 2011, 54,599 active candidates were wait-listed for kidney transplant, 1,086 for simultaneous pancreas-kidney (SPK) transplant, 267 for pancreas transplant alone (PTA) or pancreas after kidney (PAK) transplant, 12,905 for liver transplant, 183 for intestine transplant, 2,208 for heart transplant, and 1,323 for lung transplant. Of note, in 2005, a new allocation system based on the Lung Allocation Score (LAS) was implemented in an attempt to allow sicker patients to undergo lung transplants more quickly. With implementation of this new system, many patients who would not undergo transplant were removed from the lung transplant waiting list, resulting in an abrupt decline in the number of candidates listed (Figure 1a). In addition, some patients are listed for multiple organs and appear on more than one waiting list.

The number of active (prevalent) candidates on the kidney transplant waiting list was virtually unchanged between December 31, 2010, and December 31, 2011; it increased by only 0.2%, from 54,505 to 54,599 (Figure 1a). Previously, the number of active candidates on the kidney transplant waiting list had increased every year, averaging a 2.7% per year increase over the past 5 years. The numbers of prevalent candidates on the waiting list at the end of the year declined in 2011 compared

with 2010 for SPK (-6.2%), PTA (-15.5%), and lung (-4.8%) transplants, but were unchanged for heart (0.0%) and liver (-0.2%) transplants.

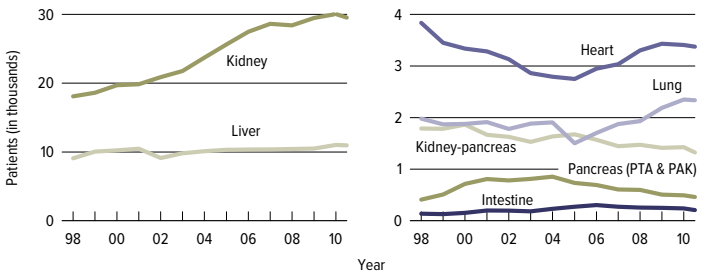
The number of new (active and inactive) candidates added to the deceased donor kidney waiting list declined 3.4% between 2010 and 2011 (Figure 1b). The annual numbers of candidates added to the waiting lists also declined for SPK (-14.7%), PTA (-12.8%), heart (-1.9%), and, to lesser extents, lung (-0.9%) and liver (-0.7%).

One can speculate that the small reduction in the demand for deceased donor kidney transplant may reflect the slowing rate of new end-stage kidney failure. Less clear is why the demand for pancreas transplant decreased so dramatically in the past few years. The new pancreas allocation system, in which pancreas allocation is virtually independent of kidney allocation, has been approved by the OPTN Board of Directors but has not yet been implemented. In the new allocation system, organ procurement organizations will no longer be able to give preference to candidates for simultaneous pancreas-kidney transplant or candidates for solitary pancreas transplant (pancreas after kidney or pancreas transplant alone). Instead, these two types of pancreas candidates will be given equal priority within locality, HLA mismatch status, calculated panel reactive antibody (CPRA) status, and waiting time.

ORGAN TRANSPLANTS

Between 2010 and 2011, the total number of kidney transplants performed in the US declined slightly (by 0.7%), from 17,726 to 17,604 (Figure 2). In fact, since 2007, when 17,496 transplants were performed, the number of kidney transplants performed annually has changed little. This is not due to a declining demand for kidneys, since many more candidates were active on the waiting list than underwent transplant. On December 31, 2011, for example, 54,599 candidates were wait-listed for kidney transplant, roughly 3-fold more than underwent transplant in 2011.

The number of pancreas transplants has declined markedly and progressively. Between 2010 and 2011, the total number of pancreas transplants (pancreas alone or combined with a kidney) performed in the US declined by 7.6%, from 1,137 to 1,051. Since the



INT 1b Patients added to the waiting list during the year (active & inactive at listing)

All except PA: 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. PA only: Patients waiting for a transplant. A "new patient" is one who first joins one of the three lists 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 or on more than one list 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.

peak of 1,454 pancreas transplants performed in 2004, numbers have declined annually. Reasons for this decline are unclear, but it is not due to fewer donors.

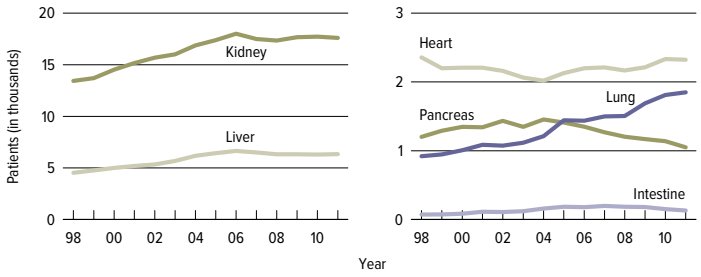
The number of liver transplants declined by 4.7%, from a peak of 6,651 in 2006 to 6,341 in 2011. This represents a decline of about 1% per year. The number of lung transplants increased slightly, by 2.1%, from 1,811 in 2011 to 1,849 in 2010. This continues an annual increase in lung transplants over the past decade of about 7% per year. The number of heart transplants changed little (a decline of 0.4%) between 2010 and 2011.

DISCARDS

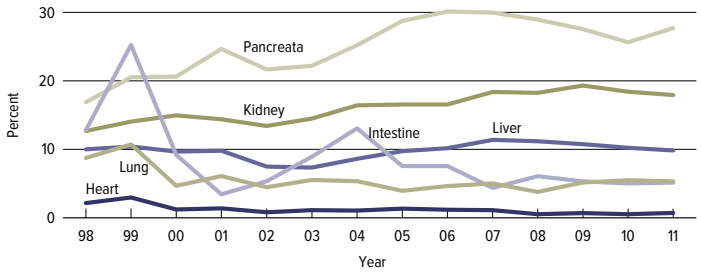
A general shortage of deceased donor organs for transplant continues. A frequently asked question is how often organs removed for transplant are subsequently discarded. The answer varies for different organs and different reasons (Figure 3). The discard rate is highest (25% to 30%) for pancreata. This is undoubtedly because the shortage of pancreata is not as critical as for other organs. Hence, patients and their physicians can wait for a high-quality pancreas. Since 2005, the annual percentage of discarded pancreata has changed little.

The least often discarded organ is the heart, followed by lung and liver. This is because these organs are seldom removed from a deceased donor unless a recipient has already been found. The discard rate for lungs is approximately 5%, and the rate for hearts is less than 1%. The liver discard rate is approximately 10%, and has changed little since 2005.

The discard rate for kidneys is about 18%, and has changed little in the past several years. The most common reason given for discarding a kidney that has been recovered for transplant is the biopsy result. This result may be a somewhat biased, since biopsies are more likely to be obtained when the donor kidney for some reason is suspected to be suboptimal. An argument can be made that biopsies, which have been shown to be poor predictors of graft outcomes, should be used less often.



INT 2 Transplants performed during the year (adult & pediatric combined)
Kidney: Patients receiving a kidney-alone or simultaneous kidney-pancreas transplant. Lung: Patients receiving a lung-alone or simultaneous heart-lung transplant. Other organs: Patients receiving a transplant. Retransplants are counted.



INT 3 Discard rates among organs recovered for transplant
Percent of organs discarded out of all organs recovered for transplant. Lungs and kidneys are counted individually.

SUMMARY

Overall, growth in the demand for some organs, such as kidneys, has lessened slightly, as reflected by slowing growth in the deceased donor kidney transplant waiting list. Nevertheless, there are far more candidates on the waiting list than there are available organs. Efforts to increase the supply of donors should continue. However, many organs that are recovered for transplant are not used. Thus, some relief of the organ shortage may be possible by focusing efforts on minimizing the number of discarded organs recovered for transplant.

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OPTN/SRTR 2011 Annual Data Report:

kidney

ABSTRACT A shortage of kidneys for transplant remains a major problem for patients with end-stage renal disease. The number of candidates on the waiting list continues to increase each year, while organ donation numbers remain flat. Thus, transplant rates for adult wait-listed candidates continue to decrease. However, pretransplant mortality rates also show a decreasing trend. Many kidneys recovered for transplant are discarded, and discard rates are increasing. Living donation rates have been essentially unchanged for the past decade, despite introduction of desensitization, non-directed donations, and kidney paired donation programs. For both living and deceased donor recipients, early posttransplant results have shown ongoing improvement, driven by decreases in rates of graft failure and return to dialysis. Immunosuppressive drug use has changed little, except for the Food and Drug Administration approval of belatacept in 2011, the first approval of a maintenance immunosuppressive drug in more than a decade. Pediatric kidney transplant candidates receive priority under the Share 35 policy. The number of pediatric transplants peaked in 2005, and decreased to a low of 760 in 2011. Graft survival and short-term renal function continue to improve for pediatric recipients. Posttransplant lymphoproliferative disorder is an important concern, occurring in about one-third of pediatric recipients.

KEY WORDS End-stage renal disease, kidney transplant, transplant outcomes, transplant waiting list.

This transplant impacted my life and the lives of my friends, family and community. I am especially grateful to be able to raise my son, to take him out of foster care and give him a good home and loving family.

Towana, kidney/pancreas recipient

Perhaps the most striking highlight of the 2010 and 2011 data is how little has changed. Organ donation numbers are relatively flat and the waiting list continues to grow. The shortage of kidneys remains a major problem for patients with end-stage renal disease (ESRD). Thus, there are attempts to increase the donor pool, and the kidney donor profile index (KDPI), which reflects the overall quality of deceased donor kidneys, continues to increase, especially for expanded criteria donors (ECD) (Figures 2.11, 2.12).

Adults

Waiting List

The number of kidney transplant candidates on the waiting list continues to increase each year (Figure 1.1). In 2003, a major change in Organ Procurement and Transplantation Network (OPTN) kidney allocation policy allowed candidates listed as inactive to accumulate points for waiting time. As a consequence of this change, and of the increasing time between wait-listing and transplant, many transplant centers now list candidates before evaluation is complete. The number of candidates who are inactive at any time within 7 days of wait-listing increased from 718 in 2003 to 9,628 in 2011. The most common reasons for inactive status among these candidates were incomplete candidate work-up (69.0%), insurance issues (9.5%), and candidate too sick (7.7%) (Figure 1.3). Importantly, however, the number of active candidates on the waiting list at the end of each year continued to increase, from 7,404 in 2003 to 32,501 in 2011 (Figure 1.1).

The wait-listed population continues to age. Since 1998, candidates aged 50 years or older represent an increasing proportion of wait-listed candidates (Figure 1.4). From a patient perspective, the steady annual trend of increased wait-listing of prevalent dialysis patients of all ages is encouraging (Figure 1.6).

Increases in the number of candidates on the waiting list and relatively flat organ donation rates have resulted in steady decreases in transplant rates for adult wait-listed candidates since 1998 (Figure 1.7). In 1998, the deceased donor transplant rate was 20.6 transplants per 100 wait-list years, compared with 11.4 transplants per 100 wait-list years in 2011. As a consequence, in the past 3 years, more than 20,000 wait-listed candidates have been removed from the waiting list because they died or became too sick to undergo transplant (Figure 1.8). A positive note is a steady trend toward decreasing pre-transplant mortality rates in wait-listed candidates (Figure 1.14). The percentage of wait-listed candidates who received a deceased donor kidney within 5 years of listing varies greatly by donation service area (DSA) (Figure 1.11); this observation is worthy of more detailed study. Notably, 30.5% of candidates with panel-reactive antibody (PRA) of 80% to 100% undergo transplant within 5 years, not greatly dissimilar to the 36.0% who undergo transplant with less than 1% PRA (Figure 1.12). This rate of transplant in candidates with PRA of 80% to 100% is due to the allocation priority points provided to these high-PRA candidates.

Donation

After several years with little change, the deceased donor kidney donation rate (per 1,000 deaths) has increased slightly (Figure 2.1). However, many kidneys recovered for transplant are discarded. The discard rate increased steadily from 12.7% in 2002 to 17.9% in 2011 (Figure 2.5). Figure 2.6 lists reasons for deceased donor organ discard after nephrectomy. Importantly, donor kidneys are discarded only after being offered locally, regionally, and nationally. Given the tremendous organ shortage, the continuing high rate of discard is of concern. Currently, each organ procurement organization (OPO) is responsible for notifying OPTN of the reason for discard. Yet different centers may turn down the same kidney offer for different reasons (e.g., patient too sick versus donor quality). A kidney that might not be accepted for one patient (e.g., new on the list, 0% PRA) might be accepted for another (100% PRA). Determining how many centers rejected a kidney before it was discarded will be important, as will determining whether kidneys discarded in one region have characteristics similar to kidneys used in another region.

In 2011, kidneys were not recovered from 734 (9.0%) donors from whom at least one organ was recovered for transplant (Figure 2.8). The major reasons for non-recovery of deceased donor kidneys at the time another organ was

recovered were poor organ function (44.3%), donor medical history (11.1%), other (9.3%), and organ refused by all national programs (6.6%) (Figure 2.9). The major reasons for discard after recovery were biopsy findings (37.3%), no recipient identified (16.6%), poor organ function (9.2%), anatomic abnormalities (7.1%), and other (17.5%) (Figure 2.6). The relatively high discard rate may be related to the steady increase in the KDPI. However, given the organ shortage, it would be beneficial to better understand how 16.6% of discarded kidneys were discarded because no recipient could be identified.

Although donation rates have not greatly changed, the percentage of transplants performed from donation after circulatory death (DCD) has steadily increased, from 1.4% in 1998 to 15.8% in 2011 (Figure 4.6). Percentages of DCDs vary widely by DSA, ranging from less than 5% to more than 30% (Figure 4.7). At the same time, there is considerable variation by DSA in kidney transplant rates per 100 patient-years on the waiting list (Figure 1.11). Of note, some centers with low DCD use have high deceased donor transplant rates (Figure 4.8). It would be interesting to determine if this is due to low listing rates, different donor management protocols, or other reasons.

Nationally, living donation rates have been essentially unchanged for the past decade (Figures 3.1, 3.3), despite introduction of desensitization, non-directed donations, and kidney paired donation programs. Although national rates are unchanged, since 2005 donation rates per million population have increased in some areas of the country and decreased by 5% to 10% in other areas (Figure 3.4). Comparison of living donation rates by state (Figure 3.4) with deceased donation rates by state (Figure 2.2) reveals interesting differences. Some states have high rates for both; others, low rates for both; still others, high rates for one and low rates for the other. Reasons for this variability should be studied.

The number of paired donation transplants increased steadily, from 2 in 2000 to 429 in 2011 (Figure 3.5). Hopefully, with the development of donor chain transplants, and with a national system for paired donation, the numbers will continue to grow.

Poor follow-up of living donors remains an important issue. At 12 months after donation, readmission data are unreported for 20.0% of donors (Figure 3.9), and estimated glomerular filtration rate (eGFR) is unknown for 49.7% of donors (Figure 3.7).

Transplants

Commensurate with the increasing age of candidates on the waiting list, the number of transplants performed annually in patients aged 50 years or older has steadily increased, and the number performed annually in patients aged 65 years or older tripled between 1998 and 2011 (Figure 4.2). Also of note, since 2006 the number of transplants performed in black, Hispanic, and Asian patients has increased, and the number performed in white patients has decreased (Figure 4.2). However, transplant rates (per 100 patient-years on the waiting list) have been steadily decreasing since 1998 (Figure 4.3).

Outcomes

The steady improvement in early post-transplant results is an exciting observation. Over the past 15 years, for both living and deceased donor transplant recipients, 90-day, 6-month, and 1-, 3-, and 5-year results have shown ongoing improvement (Figures 6.1, 6.3, 6.4). There is now a suggestion of improvement in 10-year results (Figures 6.3, 6.4), and, in the past decade, for both living and deceased donor transplants, half-life has improved by about 1 year (for grafts functioning beyond the first year) (Figure 6.7). This improvement has been driven by a decrease in the rate of graft failure and return to dialysis. Rates of death with graft function have not declined. As of June 30, 2011, 164,200 adults in the US were surviving with a functioning kidney graft, about twice as many as a decade earlier (Figure 6.8).

Of concern is the rate of post-transplant lymphoproliferative disorder (PTLD) in recipients who were negative for the Epstein-Barr virus (EBV) at the time of transplant (Figure 6.11). EBV status has been recognized as a risk factor for PTLD in children. However, by 5 years post-transplant, close to 2% of EBV-negative adults have developed PTLD. Rates are similar for patients receiving EBV-negative or EBV-positive donor organs.

Immunosuppressive Medication Use

The types and combination of types of immunosuppressive drugs used over the past few years have differed little. However, a highlight of 2011 was the first US Food and Drug Administration approval in more than a decade of a new maintenance immunosuppressive drug, belatacept. Although the drug was approved in June 2011, OPTN data submission forms were not changed to allow reporting of its use until fall 2011 (until then, the box marked "other" had to be checked). The 2012 report will provide the first annual snapshot of the clinical use of belatacept.

Children and Adolescents

Waiting List

On September 28, 2005, the kidney allocation system was modified to give priority to pediatric candidates ahead of adult candidates locally, regionally, and nationally for non-zero mismatch kidney offers from donors aged 35 years or younger (OPTN Policy 3.5.11.5.1). The intent of this modification, referred to as "Share 35," was to prioritize allocation of younger donor kidneys to address established goals of rapidly providing transplants to pediatric candidates with minimal impact on adult transplant rates. The effect of this policy on pediatric kidney transplant outcomes is an area of ongoing evaluation.

In 2011, almost half of new pediatric candidates added to the kidney transplant waiting list were listed as inactive. This number has continued to increase since the policy change in 2003 permitting waiting time to accrue while candidates are listed as inactive. Similarly, among prevalent pediatric wait-listed candidates, those listed as inactive outnumber those listed as active (Figure 8.1). Since 2007, the age distribution of pediatric candidates waiting for kidney transplant has changed (Figure 8.2). Candidates aged 11 to 17 years remain the most common pediatric age group listed (71.3%); however, candidates aged 1 to 5 years now represent the second-largest pediatric age group, having surpassed the group aged 6 to 10 years. The racial/ethnic distribution of wait-listed pediatric candidates has also changed. While the proportions of white and Asian candidates have remained relatively constant, the proportion of Hispanic candidates has increased and the proportion of black candidates has decreased. The etiology of ESRD has remained relatively constant; structural abnormalities are the most common cause in the youngest patients, and focal segmental glomerulosclerosis and glomerulonephritis increase in frequency with increasing age (Figure 8.3).

In 2011, 13.1% of candidates on the waiting list had undergone a previous kidney transplant (Figure 8.4). The number of children and adolescents on the waiting list who had undergone a previous transplant varied from 98 in 1998 to 141 in 2008 and 119 in 2011 (data not shown). Of all candidates on the waiting list in 2011, 4.3% of those aged 0 to 5 years, 14.7% of those aged 6 to 10 years, and 15.5% of those aged 11 to 17 years were waiting for re-transplant. Among patients undergoing transplant in 2008, within 1 year of listing, 45.7% underwent deceased donor transplant, 13.9% underwent living donor transplant, 38.0% were still waiting at the end of 2011 (Figure 8.6). In contrast to mortality among patients waiting for other organs, pre-transplant mortality among pediatric candidates waiting for kidney transplant is low, 1.5 per 100 wait-list years in 2011 (Figure 8.8).

Transplants

The number of pediatric kidney transplants peaked in 2005 at 899 and decreased to a low of 760 in 2011 (Figure 8.9). Re-transplant accounted for 9.1% of transplants performed in 2011 (Figure 8.10). The rate of deceased donor kidney transplants decreased from a peak of 60.2 per 100 wait-list years in 2006 to 44.4 per 100 wait-list years in 2011. The rate of living donor transplants increased from a nadir of 13.0 per 100 wait-list years in 2007 to 16.1 per 100 wait-list years in 2011 (Figure 8.11).

In the past decade, the proportion of pediatric patients undergoing preemptive kidney transplant has remained steady at about 25% (Figure 8.12). The number of HLA mismatches has increased, which may be partly attributable to implementation of the Share 35 deceased donor kidney allocation system.

Donation to pediatric recipients from related living donors has declined dramatically, by about 50%. Donation from "other" living donors has increased, possibly reflecting

increased participation in kidney paired donation (Figure 8.13). Use of DCD kidneys increased over time to 4.6% in 2011 (Figure 8.14). No ECD kidneys have been used in pediatric recipients since 2006. The mean KDPI in pediatric recipients in 2011 was 40% (Figure 8.15). The KDPI is a numerical measure that combines 10 donor characteristics to express the quality of a donor kidney relative to other donors. It is derived by first calculating the Kidney Donor Risk Index (KDRI) using donor characteristics only, and then mapping the values against a reference group to obtain percentiles. The reference group used here is all kidneys recovered for transplant in 2011. Higher values of KDPI indicate poorer donor quality. For example, a kidney donor with a KDPI of 90% has a higher KDRI (and therefore higher estimated risk of post-transplant graft failure) than 90% of the reference group. The KDPI is based on these donor characteristics: age, race/ethnicity, hypertension status, diabetes status, serum creatinine level, cause of death (cerebrovascular, cardiac, etc.), height, weight, DCD status, and hepatitis C status.

The age of deceased donor organs allocated to pediatric transplant recipients has changed over time, guided by changes in both clinical practice and allocation policy such as Share 35. Figure 8.16 shows the increase in deceased donor organs from donors aged younger than 35 years.

Outcomes

Graft survival (patient survival with a functioning graft) has continued to improve among pediatric recipients over the past decade. Graft failure for deceased donor transplants was 3.7% at 6 months and 5.3% at 1 year for transplants in 2009-2010, 15.3% at 3 years for transplants in 2007-2008, 29.1% at 5 years for transplants in 2005-2006, and 51.4% at 10 years for transplants in 2001-2002 (Figure 8.24). Corresponding graft failure for living donor transplants was 1.6% at 6 months and 2.7% at 1 year for transplants in 2009-2010, 8.4% at 3 years for transplants in 2007-2008, 18.1% at 5 years for transplants in 2005-2006, and 35.7% at 10 years for transplants in 2001-2002 (Figure 8.25). The rate of late graft failure is traditionally measured by the graft half-life conditional on 1-year survival, defined as the time to when half of grafts surviving at least 1 year are still functioning. For deceased donor transplants, the estimated 1-year conditional half-life was 11.9 years for transplants in 2011 (Figure 8.26). For living donor transplants, the estimated 1-year conditional half-life was 15.3 years for transplants in 2011.

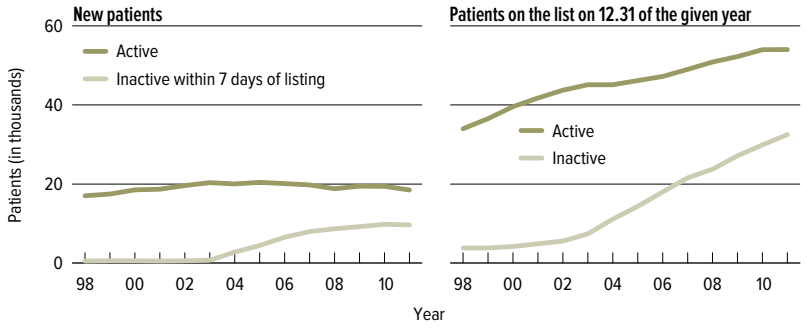
Short-term renal function, measured by eGFR, has improved substantially in pediatric recipients over the past decade. The proportion of patients with eGFR of 90 mL/min/1.73 m^2 or greater at discharge increased from 17.1% in 2000 to 33.9% in 2011, at 6 months post-transplant from 10.3% in 2000 to 25.7% in 2011, and at 1 year post-transplant from 6.7% in 2000 to 24.5% in 2010 (Figure 8.28). Almost 70% of patients in the 2011 cohort had eGFR of 60 mL/min/1.73 m^2 or greater at discharge, CKD stage 1-2.

PTLD is an important concern in pediatric transplantation. The highest risk for EBV infection and PTLD occurs for EBV-negative recipients of EBV-positive donor kidneys. This occurred in 32.5% of deceased donor recipients and 33.5% of living donor recipients (Figure 8.19). The incidence of PTLD among EBV-negative recipients was 4.5% at 5 years post-transplant, compared with 0.6% among EBV-positive recipients (Figure 8.21). Although PTLD is the most common type of malignancy in pediatric kidney transplant recipients, other types of malignancies are reported and they increase over time post-transplant (Figure 8.22).

Immunosuppressive Medication Use

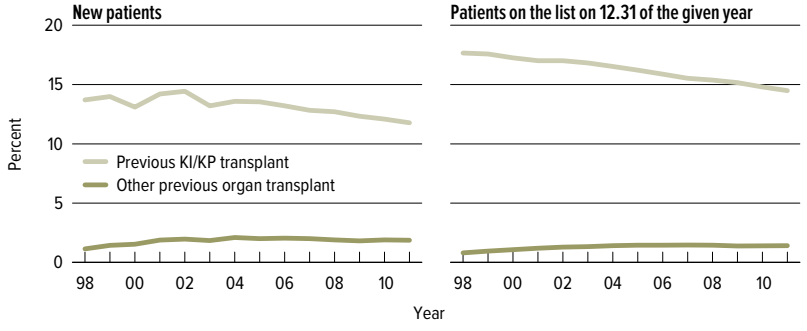
Trends in maintenance immunosuppressive medications used in children and adolescents are similar to trends for adults. In 2011, 94.0% of pediatric transplant recipients received tacrolimus as part of the initial maintenance immunosuppressive medication regimen, and 92.6% received mycophenolate mofetil (Figure 8.23). In 2010, corticosteroids were used in 62.1% of transplant recipients at the time of transplant and in 62.5% at 1 year post-transplant. Induction therapy has changed in pediatric kidney transplantation. Decreased availability of the interleukin-2 receptor antagonist daclizumab likely contributed to decreased utilization. There has been a corresponding increase in the proportion of patients receiving T-cell depleting agents or no induction therapy.

wait list



KI 1.1 Adult patients waiting for a kidney 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.



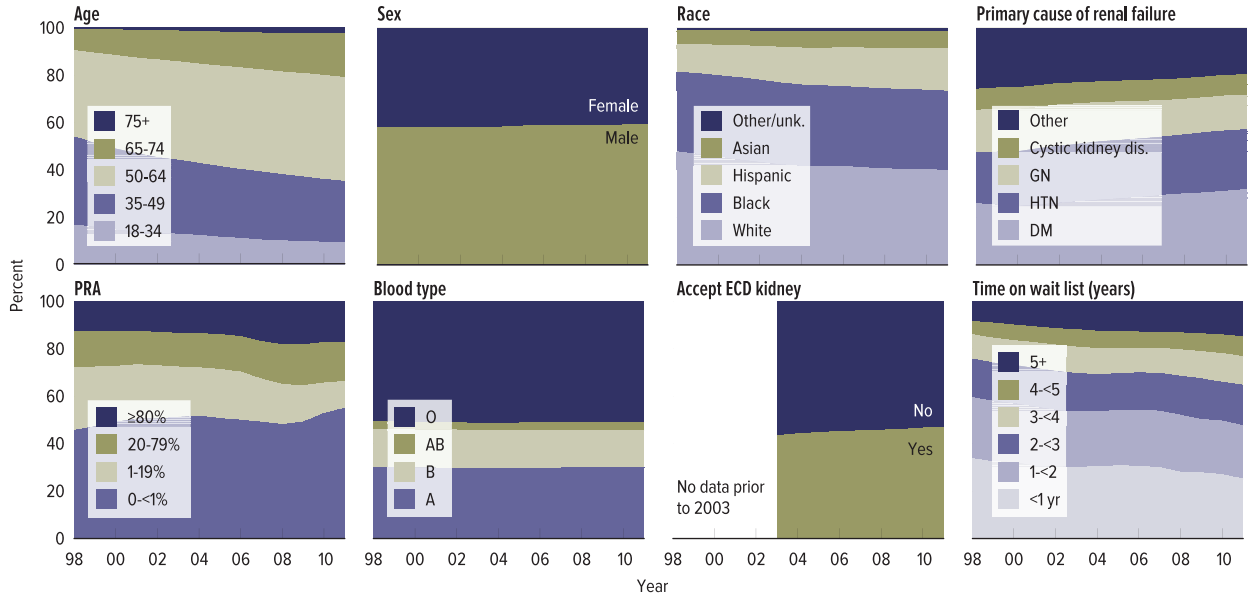
KI 1.2 Prior transplant status of adults waiting for a kidney transplant

Prior transplant status of patients waiting for a kidney transplant. Prior kidney transplant defined as kidney or kidney-pancreas transplant. Other solid organ transplant defined as all other organs beside kidney or kidney-pancreas. Prevalent patients as of December 31 of each year. Each patient is counted only once.

Reason for inactive status	Inactive w/i 7 days of listing N	%	Active at listing, inact. on 12.31 N	%
Candidate work-up incomplete	8,029	69.0	5,414	29.1
Insurance issues	1,107	9.5	1,698	9.1
Too sick	897	7.7	6,596	35.5
Weight inappropriate for tx	553	4.8	1,057	5.7
Too well	542	4.7	870	4.7
Candidate choice	302	2.6	1,026	5.5
Tx pending	107	0.9	55	0.3
Medical non-compliance	47	0.4	635	3.4
Inappropriate substance use	37	0.3	276	1.5
Candidate could not be contacted	12	0.1	431	2.3
Physician/surgeon unavailable	3	0.0	2	0.0
Unknown	2	0.0	535	2.9
Transplanted; removal pending data correction	1	0.0	-	0.0

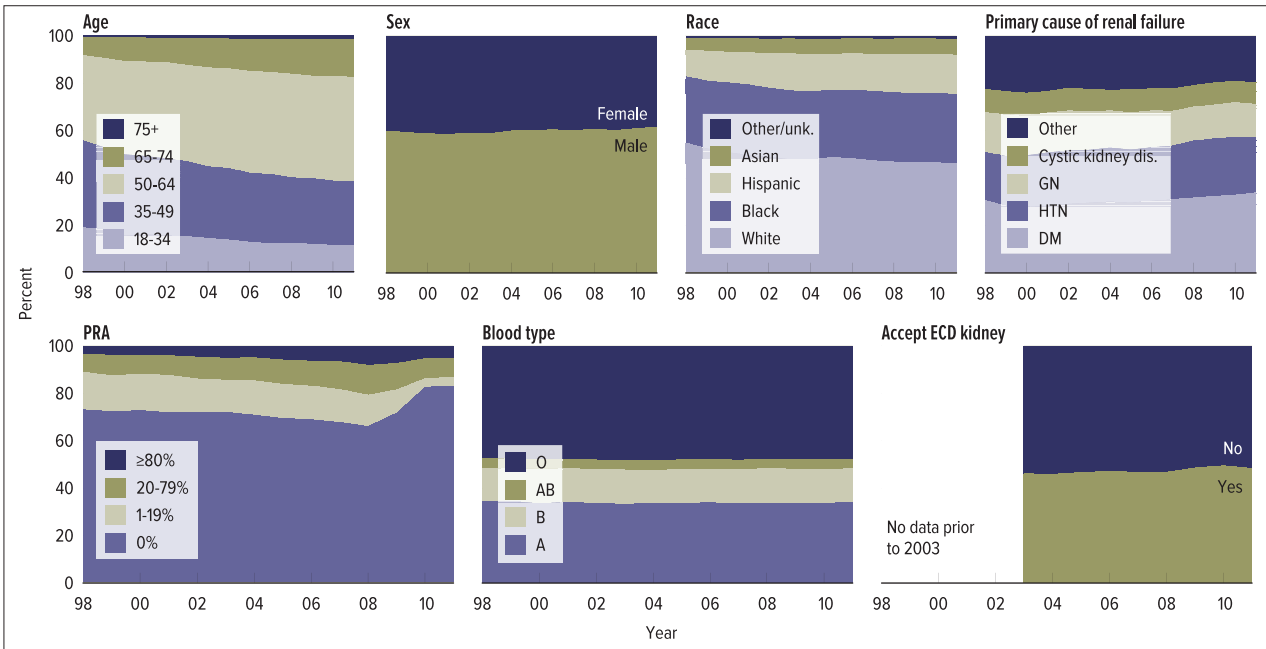
KI 1.3 Reasons for inactive status among kidney transplant listings, 2011

Reasons for inactive status of listings in 2011. Since patients can be concurrently listed at more than one center and have different reasons for going inactive at each center, each listing is counted separately.



KI 1.4 Distribution of adult patients waiting for a kidney 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.

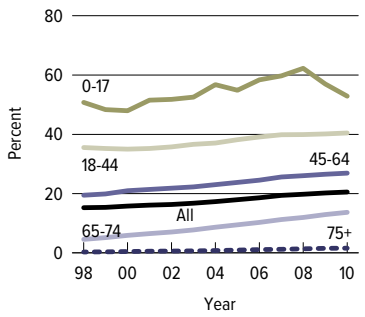


KI 1.5 Distribution of adult patients newly listed for a kidney transplant

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.

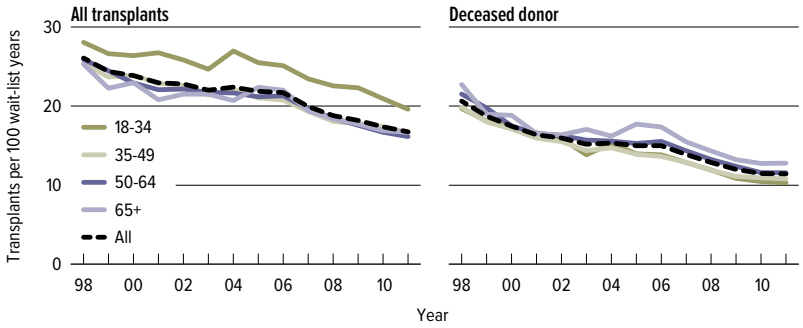
data behind the figures can be downloaded from our website, at www.srtr.org

wait list



KI 1.6 Prevalent dialysis patients wait-listed for a kidney transplant, by age

Prevalent dialysis patients, all ages, wait-listed for a kidney-alone transplant. Percentage calculated as the sum of wait-list patients divided by the sum of point prevalent dialysis patients on December 31 of each year (data from the United States Renal Data System).



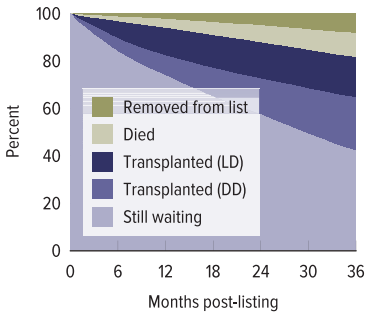
KI 1.7 Kidney transplant rates among adult waiting list candidates, by age

Patients waiting for a transplant; age as of January 1 of the given year. Yearly period prevalent rates for all transplants/deceased donor transplants 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	74,572	79,365	83,879
Patients added during year	28,645	29,216	28,131
Patients removed during year	23,820	24,662	25,463
Patients at end of year	79,397	83,919	86,547
Removal reason			
Deceased donor transplant	9,713	9,980	10,399
Living donor transplant	5,170	5,235	4,922
Tx (type not specified)	54	89	81
Patient died	5,181	5,172	5,139
Patient refused transplant	271	318	406
Improved, tx not needed	131	101	135
Too sick to transplant	1,358	1,467	1,903
Changed to kid.-pan. list	165	191	194
Other	1,777	2,109	2,284

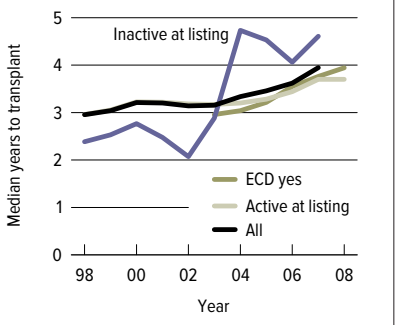
KI 1.8 Kidney transplant waiting list activity among adult patients

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.



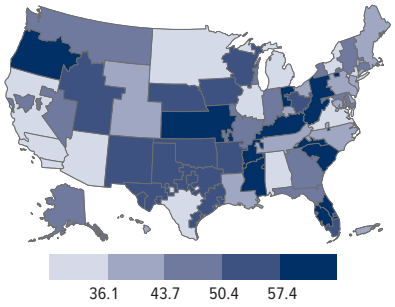
KI 1.9 Outcomes for adult patients waiting for a kidney transplant among new listings in 2008

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.



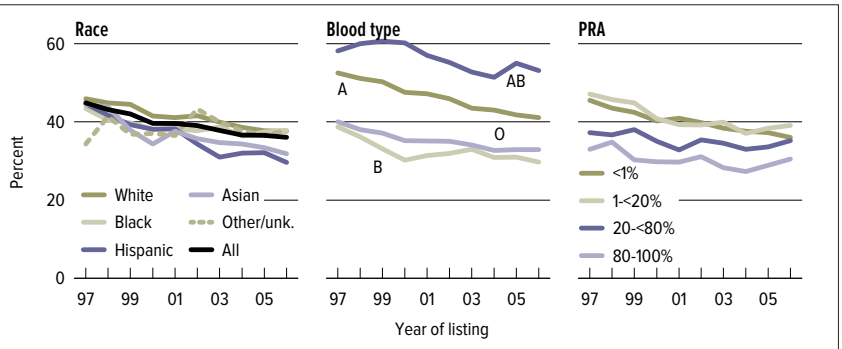
KI 1.10 Median years to kidney transplant for wait-listed adult patients

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.



KI 1.11 Percent of adult wait-listed patients, 2006, who received a deceased donor kidney transplant within five years, by DSA

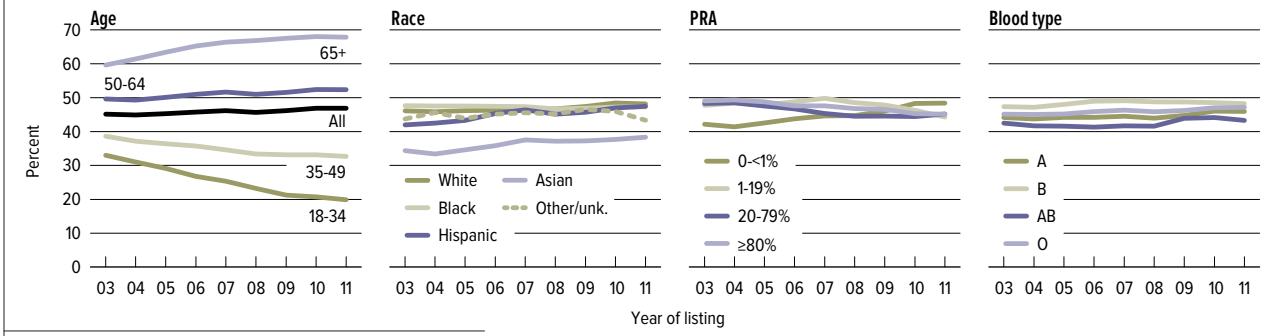
Patients with concurrent listings in a single DSA are counted once in that DSA, and those listed in multiple DSAs are counted separately per DSA.



KI 1.12 Adult wait-listed patients who received a deceased donor kidney transplant within five years

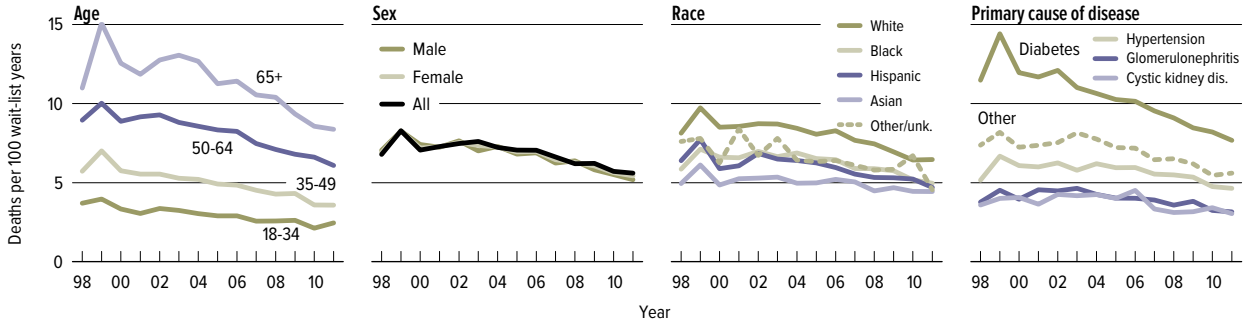
Patients with concurrent listings at more than one center are counted once, from the time of earliest listing to the time of latest removal. Patients listed, transplanted, and re-listed are counted more than once.

wait list



KI 1.13 Adult listings willing to accept an ECD kidney

Patients waiting for a kidney-alone transplant, 2003 (beginning of ECD program) to 2011. Patients are counted for each listing. Data by sex are not shown; percentages for men and women are similar to overall.



KI 1.14 Pre-transplant mortality rates among adult patients wait-listed for a kidney 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.

		2001		2011	
	Level	N	%	N	%
Age	18-44	16,021	34.3	21,461	24.8
	45-64	24,952	53.5	48,071	55.5
	65-74	5,210	11.2	15,148	17.5
	75+	466	1.0	1,868	2.2
Sex	Male	26,797	57.4	51,238	59.2
	Female	19,852	42.6	35,310	40.8
Race	White	19,130	41.0	32,695	37.8
	Black	17,230	36.9	29,731	34.4
	Hispanic	6,590	14.1	16,203	18.7
	Asian	3,078	6.6	6,737	7.8
	Other/unk.	621	1.3	1,182	1.4

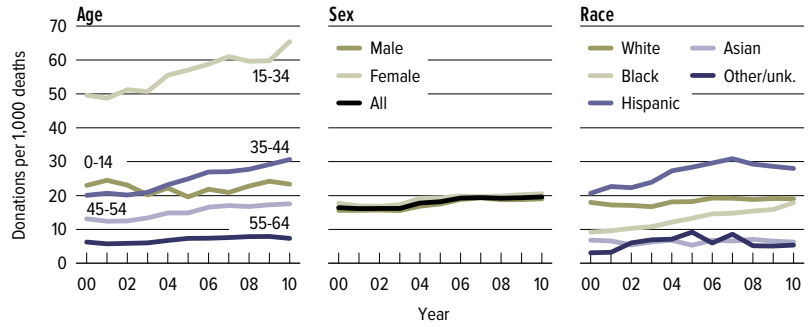
		2001		2011	
	Level	N	%	N	%
Primary cause dis.	DM	11,602	24.9	27,852	32.2
	HTN	11,596	24.9	22,203	25.7
	GN	8,183	17.5	12,550	14.5
	Cyst. kid	4,063	8.7	7,256	8.4
	Oth/unk	11,205	24.0	16,687	19.3
Tx history	List 1st tx	38,040	81.5	73,566	85.0
	List sub. tx	8,609	18.5	12,982	15.0
Blood type	A	13,013	27.9	25,068	29.0
	B	7,903	16.9	13,804	15.9
	AB	1,242	2.7	2,529	2.9
	O	24,491	52.5	45,147	52.2

		2001		2011	
	Level	N	%	N	%
PRA & CPRA	<20%	33,414	71.6	57,954	67.0
	≥20%	13,163	28.2	28,594	33.0
	Unknown	72	0.2	0.0	0.0
Time on list	<1 year	15,942	34.2	24,418	28.2
	1-<2	11,085	23.8	19,714	22.8
	2-<3	7,331	15.7	14,525	16.8
	3-<4	4,668	10.0	9,629	11.1
	4-<5	2,872	6.2	6,602	7.6
	5+	4,751	10.2	11,660	13.5
ECD kidney	Will not accept			46,418	53.6
	Will accept			40,130	46.4

KI 1.15 Characteristics of adult patients on the kidney transplant waiting list on December 31, 2001 & December 31, 2011

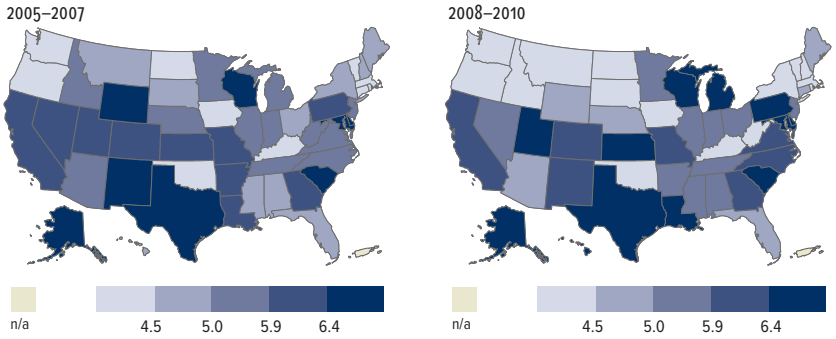
Patients waiting for a transplant on December 31, 2001 and December 31, 2011, regardless of first listing date; active/inactive status is on this date, and multiple listings are not counted.

deceased donation



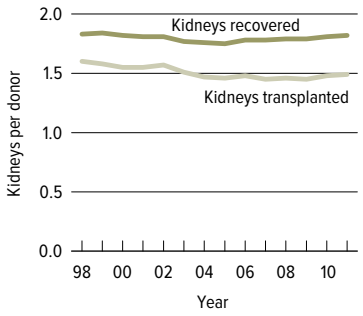
KI 2.1 Deceased donor kidney donation rates

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



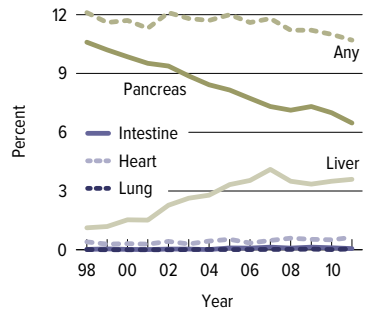
KI 2.2 Deceased donor kidney donation rates (per 1,000 deaths), by state

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



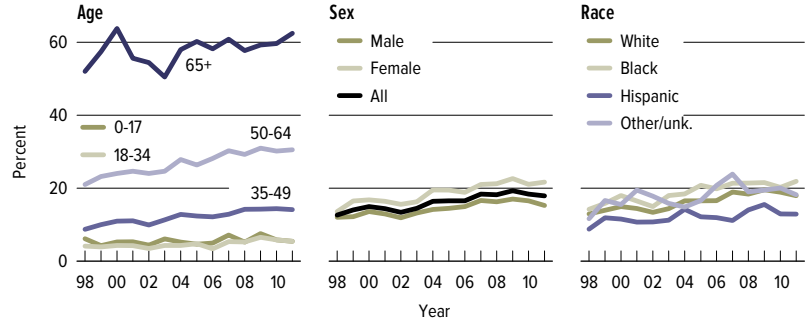
KI 2.3 Kidneys recovered per donor & kidneys transplanted per donor

Denom.: all deceased donors with at least one organ of any type recovered for tx. Numerator for recovery rate: number of kidneys recovered for tx in the given year; those recovered for other purposes are not included. Numerator for tx rate: all deceased donor kidneys tx'ed in given year.



KI 2.4 Deceased donor kidneys transplanted with another organ

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



KI 2.5 Discard rates for kidneys recovered for transplant

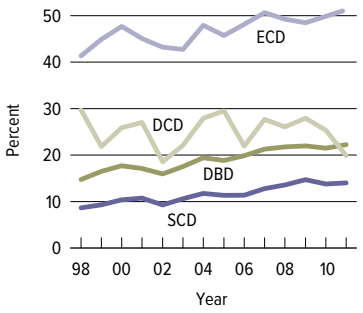
Percent of kidneys discarded out of all kidneys recovered for transplant. Kidneys are counted individually.

deceased donation

Reasons for discard	Percent	N
Biopsy findings	37.34	966
Other, specify	17.51	453
No recipient located - list exhausted	16.62	430
Poor organ function	9.24	239
Anatomical abnormalities	7.07	183
Diseased organ	3.48	90
Vascular damage	1.70	44
Organ trauma	1.24	32
Positive hepatitis	1.16	30
Too old on ice	1.08	28
Warm ischemic time too long	0.85	22
Too old on pump	0.70	18
Donor medical history	0.66	17
Recipient determined to be unsuitable	0.43	11
Organ not as described	0.27	7
Donor social history	0.23	6
Infection	0.19	5
Ureteral damage	0.15	4
Positive HIV	0.08	2

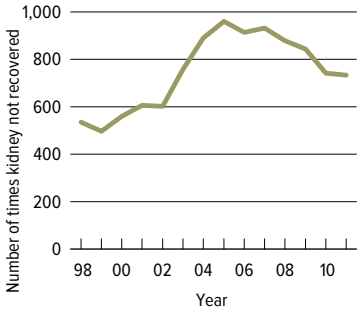
KI 2.6 Reasons for kidney discards among kidneys removed for transplant but not transplanted, 2011

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



KI 2.7 Discards by donor type

Percent of kidneys discarded out of all kidneys recovered for transplant, by SCD/ECD and DCD/DBD classification of donor. Each donor is counted once.



KI 2.8 Donors whose kidneys were not recovered

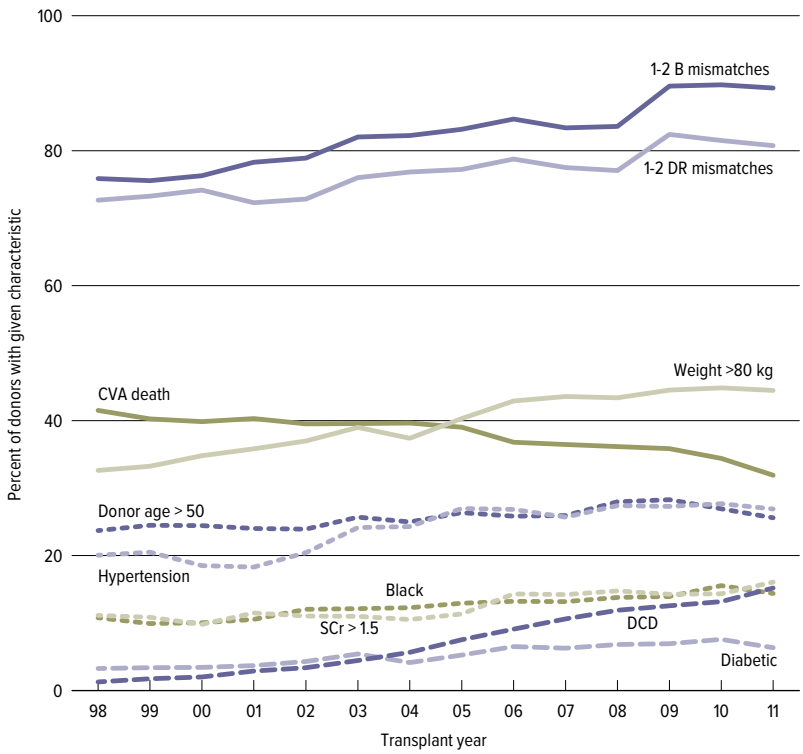
Donors whose kidney(s) were not recovered but at least one other organ was.

deceased donation

Reasons for non-recovery	Percent	N
Poor organ function	44.28	534
Donor medical history	11.11	134
Other specify	9.29	112
Organ refused by all national programs	6.63	80
Ruled out after evaluation in OR	4.64	56
Diseased organ	4.48	54
Acute/chronic renal failure	3.73	45
Emotional	3.23	39
No recipient located	2.74	33
Organ refused by all regional programs	2.65	32
Donor age	2.32	28
Donor quality	1.24	15
Positive hepatitis	1.16	14
Donor social history	0.83	10
Family conflict	0.50	6
Anatomical abnormalities	0.41	5
Medical examiner restricted	0.33	4
Hemodynamically unstable donor	0.17	2
Surgical damage in OR	0.08	1
Time constraints	0.08	1
Trauma to organ	0.08	1

KI 2.9 Reasons for kidneys not being recovered at the time of another organ's recovery

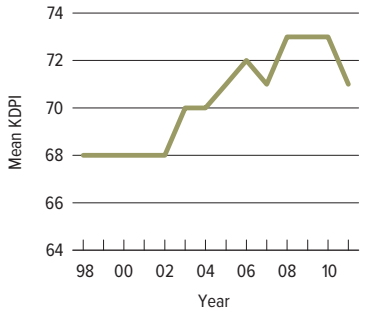
Reasons for non-recovery of kidney, in donors who had at least one other non-renal organ recovered for transplant, 2011. If the same reason was recorded for each kidney, it was only counted once.



KI 2.10 Major components of kidney donor risk index (KDRI) over time

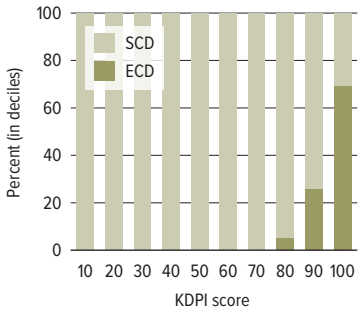
Patients receiving a kidney-only, deceased donor transplant. Donors with a missing value for height, weight, or creatinine are excluded. The components of KDRI are donor age, donor race, donor creatinine, donor cause of death, donor height, donor weight, donor history of hypertenion, donor history of diabetes, DCD donor, HCV+ donor, HLA-B and DR mismatches with recipient, cold ischemic time of organ, and transplant procedure type (*en bloc*, single, or double). The KDRI is used to calculate the Kidney Donor Profile Index (KDPI), which is the percentile of donors with each KDRI.

deceased donation



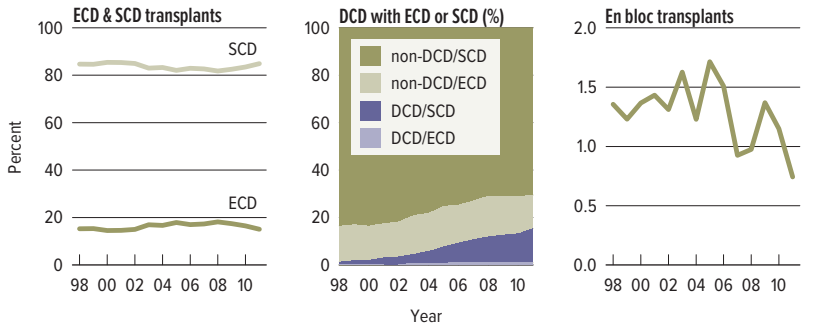
KI 2.11 Mean kidney donor profile index (KDPI)

Patients receiving a kidney-only, deceased-donor transplant. Donors with a missing value for height, weight, or creatinine are excluded. KDPI is based on donor factors only; the percentiles are derived by mapping to the 2011 population of kidneys recovered for transplant.



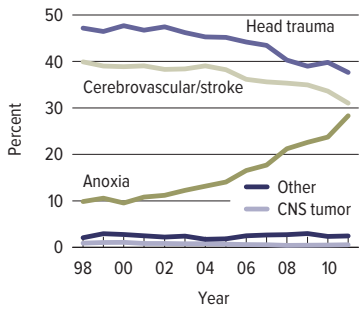
KI 2.12 Kidney donor profile index (KDPI) scores for ECD & SCD kidneys, 2010

All deceased donors whose kidney was transplanted in the given year, by SCD/ECD status. Each transplanted kidney is counted separately. Donors with a missing value for height, weight, or creatinine are excluded. KDPI is based on donor factors only; the percentiles are derived by mapping to the 2011 population of kidneys recovered for transplant.



KI 2.13 ECD, SCD, DCD, & en bloc kidney transplants

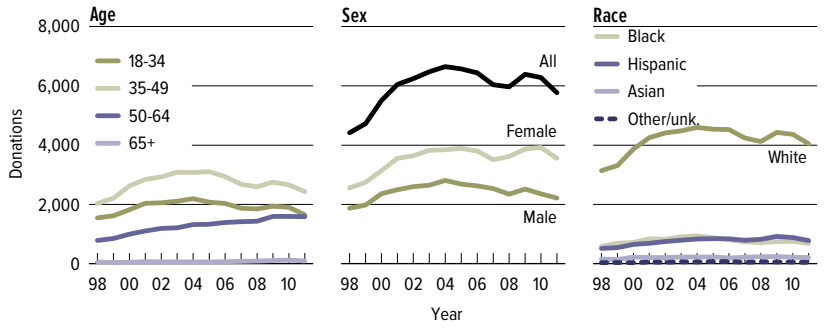
Deceased donor kidney-alone transplants.



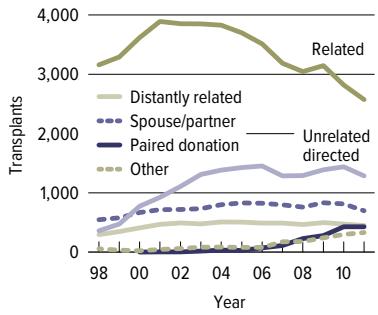
KI 2.14 Cause of death among deceased kidney donors

Deceased donors whose kidneys were transplanted. Donors who contributed more than one kidney are counted once. CNS = central nervous system.

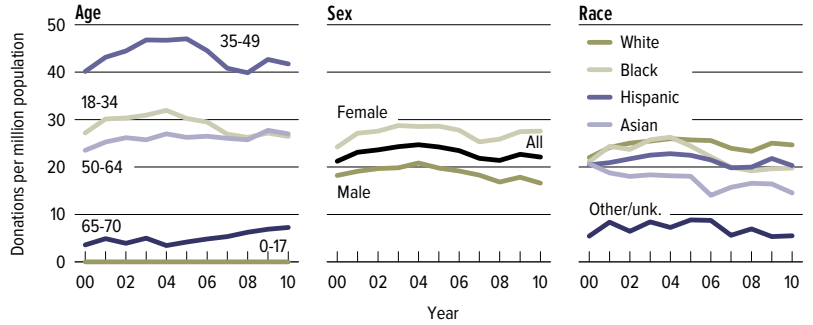
live donation



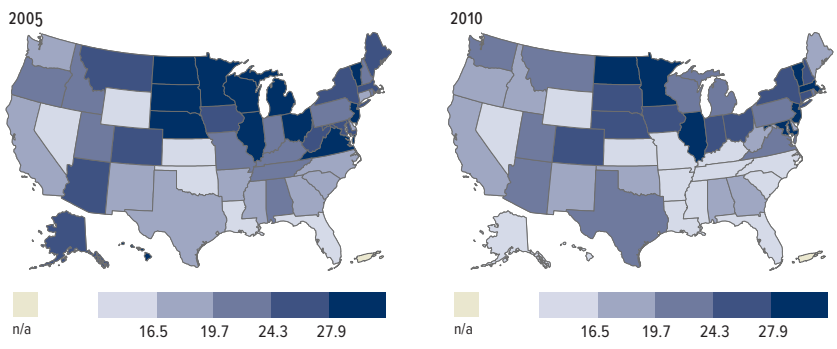
KI 3.1 Kidney donations from living donors
Number of living donor donations; characteristics recorded on OPTN Living Donor Registration form.



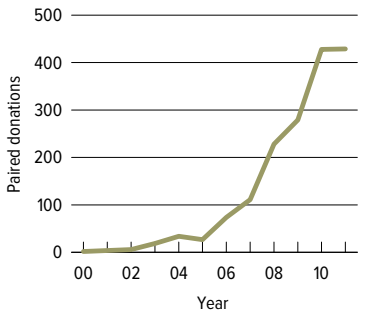
KI 3.2 Kidney transplants from living donors, by donor relation
Number of living donor donations; characteristics recorded on OPTN Living Donor Registration form.



KI 3.3 Living donor kidney donation rates
Number of living donors whose relevant organ 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).



KI 3.4 Living donor kidney donation rates (per million population), by state
Number of living donors residing in the 50 states whose kidney 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).



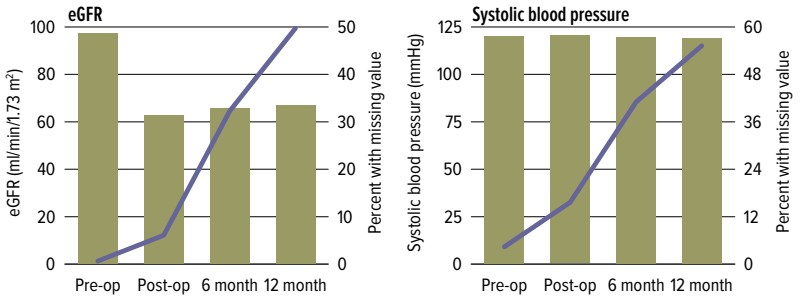
KI 3.5 Paired kidney donations
Counts include "domino" donation chains.

live donation

	Deceased donor		Living donor, not paired		Paired	
	N	%	N	%	N	%
PRA/CPRA						
0%	9,190	42.4	6,325	56.5	312	36.3
>0-9%	2,649	12.2	1,427	12.8	69	8.0
10-19%	1,368	6.3	711	6.4	56	6.5
20-29%	1,196	5.5	552	4.9	43	5.0
30-39%	726	3.4	311	2.8	23	2.7
40-49%	694	3.2	291	2.6	26	3.0
50-59%	703	3.2	257	2.3	36	4.2
60-69%	602	2.8	275	2.5	53	6.2
70-74%	298	1.4	133	1.2	18	2.1
75-79%	272	1.3	97	0.9	21	2.4
80-84%	671	3.1	113	1.0	30	3.5
85-89%	657	3.0	117	1.0	37	4.3
90-94%	770	3.6	118	1.1	44	5.1
95%	180	0.8	24	0.2	3	0.3
96%	214	1.0	28	0.3	8	0.9
97%	220	1.0	34	0.3	9	1.0
98%	305	1.4	50	0.4	16	1.9
99%	383	1.8	65	0.6	14	1.6
100%	561	2.6	105	0.9	40	4.7
Unk.	6	0.0	153	1.4	1	0.1
Blood type						
A	7,696	35.5	4,365	39.0	288	33.5
B	2,845	13.1	1,458	13.0	175	20.4
AB	1,179	5.4	420	3.8	45	5.2
O	9,945	45.9	4,943	44.2	351	40.9
Age						
0-17	919	4.2	571	5.1	14	1.6
18-34	2,008	9.3	2,043	18.3	130	15.1
35-49	5,376	24.8	3,237	28.9	284	33.1
50-64	9,137	42.2	3,906	34.9	324	37.7
65+	4,225	19.5	1,429	12.8	107	12.5

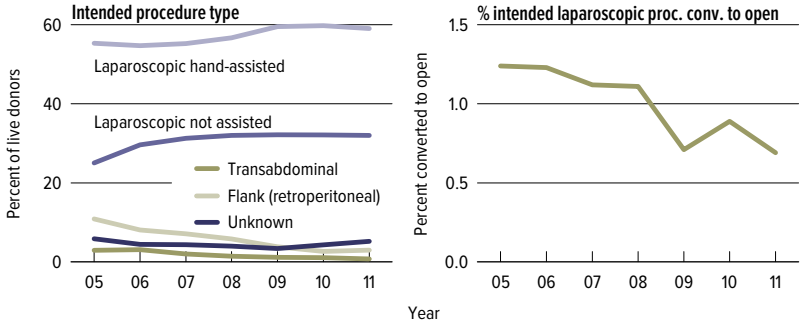
KI 3.6 Characteristics of kidney paired donation (KPD) & non-KPD recipients, 2000–2011 combined

Patients receiving kidney-alone transplants in 2010 and 2011. PRA is the maximum of computed and measured PRA.



KI 3.7 Mean pre- & post-operative eGFR & systolic blood pressure among kidney donors, 2009

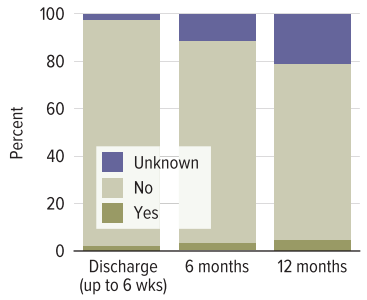
eGFR estimated by CKD-EPI formula. (Levey AS et al., Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI). A new equation to estimate glomerular filtration rate. Ann Intern Med., 2009 May 5; 150(9):604–12).



KI 3.8 Intended kidney transplant procedure type & percent of intended laparoscopic procedures converted to open, 2005–2010

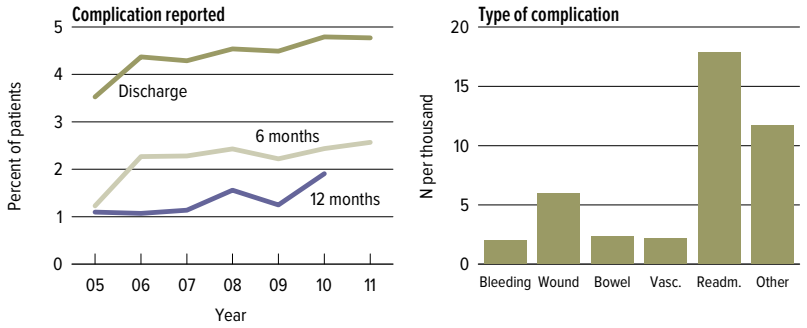
Data sparse prior to 2005.

live donation



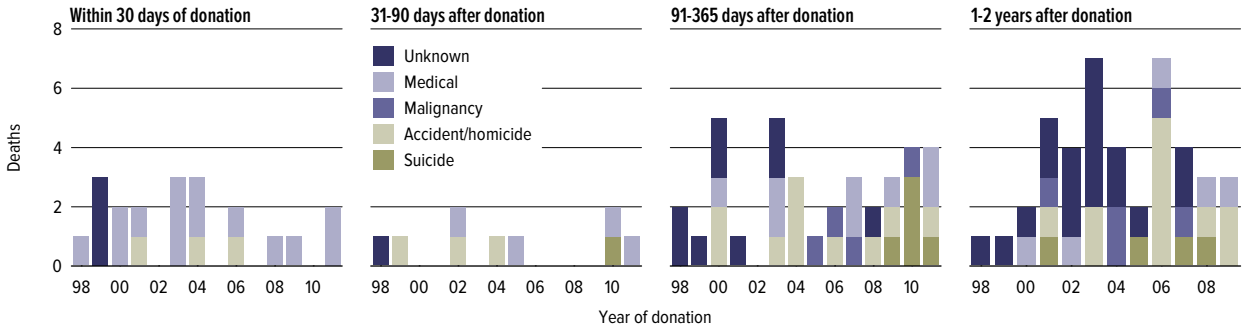
KI 3.9 Readmission to the hospital in the first year among live kidney donors, 2010

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.



KI 3.10 Kidney complications among live kidney donors

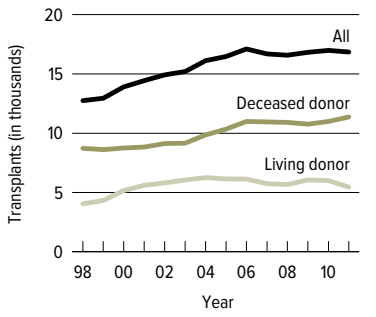
Complications reported on the Living Donor Registration and Living Donor Follow-up forms at each time point. Complications include readmission, re-operation, bleeding, wound healing, bowel obstruction, vascular complications, and other complications requiring intervention. Multiple complcations may be reported at any time point. Type of discharge complication is shown among all live donors, 2005–2011.



KI 3.11 Living kidney donor deaths

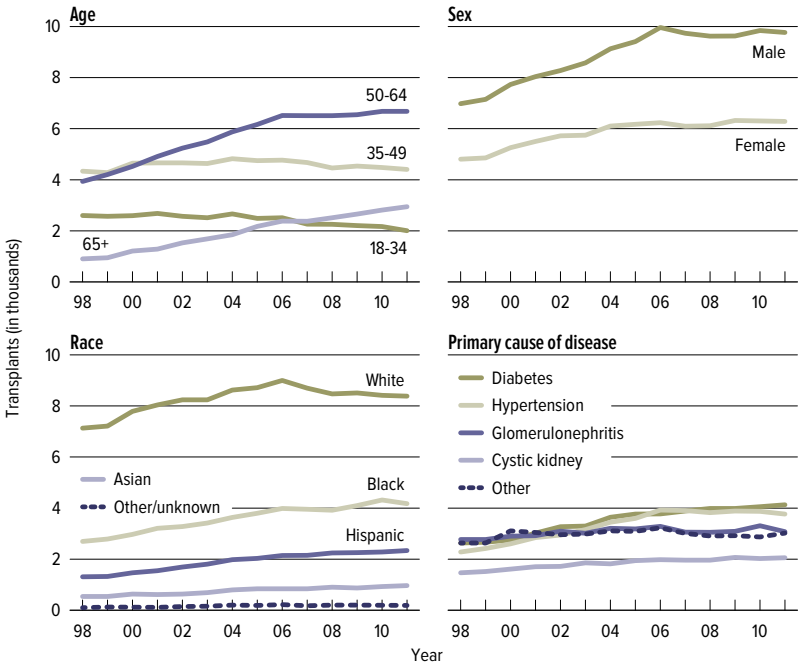
Living kidney donors. Deaths as reported to the OPTN or Social Security Administration. "Donation related" deaths are included in the "Medical" category.

transplant



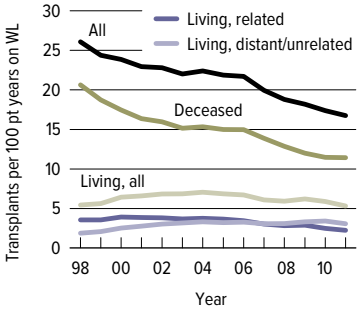
KI 4.1 Total adult kidney transplants (includes kidney-pancreas)

Patients receiving a kidney-alone or simultaneous kidney-pancreas transplant. Retransplants are counted.



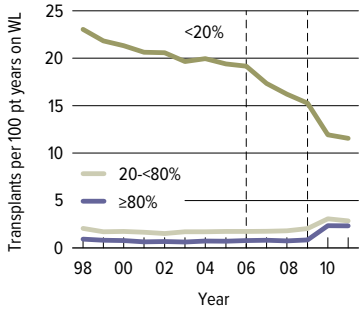
KI 4.2 Adult kidney transplants

Patients receiving a kidney-alone or simultaneous kidney-pancreas transplant. Retransplants are counted.



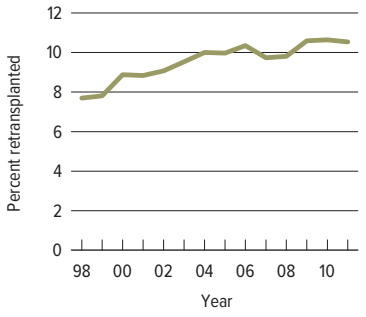
KI 4.3 Kidney transplant rates in adult waiting list candidates

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.



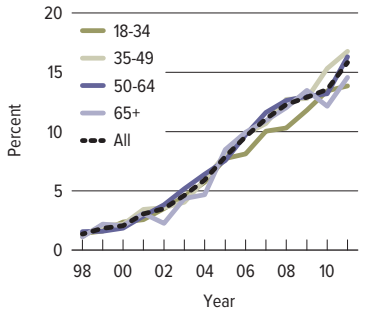
KI 4.4 Kidney transplant rates in adult waiting list candidates, by PRA/CPRA

Patients waiting for a transplant. Yearly period-prevalent rates for deceased donor transplants 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. PRA/CPRA at the latest of the listing date or Jan. 1 of a given year is used. The most recent PRA is used prior to 2007. If most recent PRA was not provided, peak PRA is reported. Between 2007 and 2009, PRA is used when it is available and CPRA otherwise, because PRA was used in allocation. After 2009, when CPRA started being used in allocation, CPRA is reported.



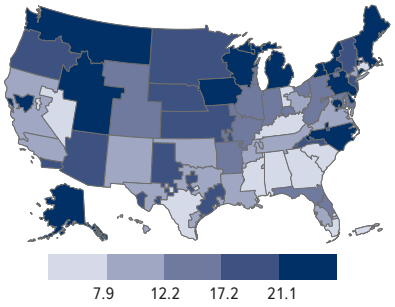
KI 4.5 Retransplants among adult kidney transplants

Patients receiving a kidney-alone retransplant in the given year.



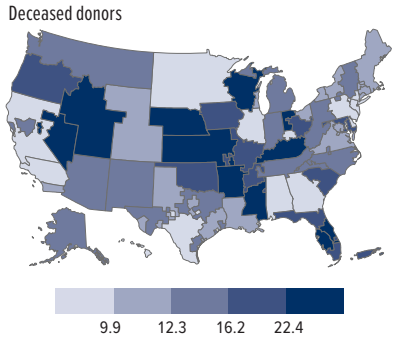
KI 4.6 Use of DCD kidneys among adult kidney-alone transplant recipients, by recipient age

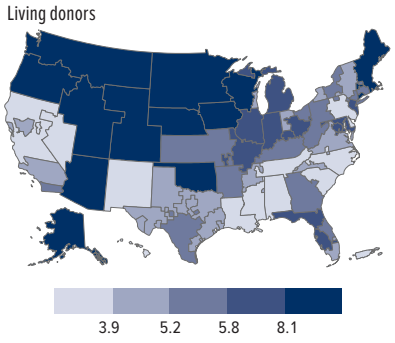
Percent of deceased donor transplants using a DCD donor.



KI 4.7 Percent of adult deceased donor kidney transplants that are DCD, by DSA, 2011

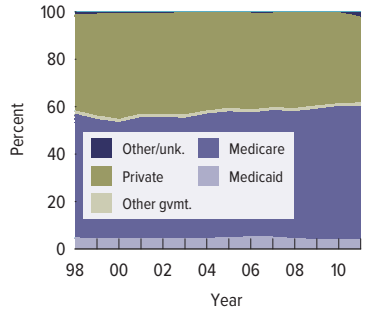
Percent of deceased donor transplants using a DCD donor, by DSA of the transplanting center.





KI 4.8 Kidney 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; includes deceased and living donor rates. Maximum time per person on the list is two years.



KI 4.9 Insurance coverage among adult kidney transplant recipients at time of transplant

Patients receiving a transplant. Retransplants are counted.

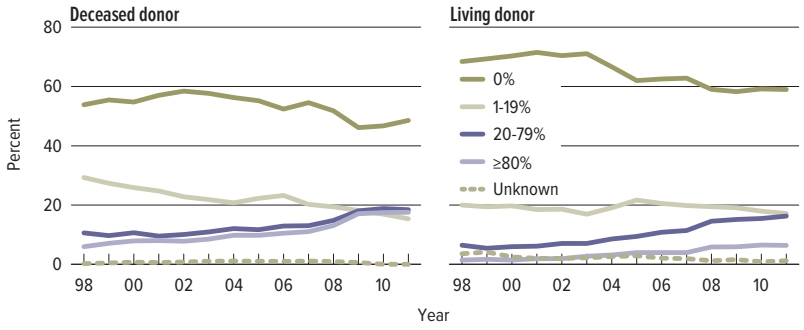
transplant

		2001						2011					
		All		Deceased		Living		All		Deceased		Living	
	Level	N	%	N	%	N	%	N	%	N	%	N	%
Age	18-34	2,685	19.8	1,246	15.7	1,439	25.7	2,012	12.5	1,003	9.5	1,009	18.5
	35-49	4,665	34.4	2,669	33.6	1,996	35.6	4,412	27.5	2,720	25.7	1,692	31.0
	50-64	4,913	36.3	3,124	39.3	1,789	31.9	6,683	41.6	4,669	44.1	2,014	36.8
	65+	1,287	9.5	903	11.4	384	6.8	2,948	18.4	2,197	20.7	751	13.7
Sex	Female	5,509	40.7	3,160	39.8	2,349	41.9	6,286	39.2	4,237	40.0	2,049	37.5
	Male	8,041	59.3	4,782	60.2	3,259	58.1	9,769	60.8	6,352	60.0	3,417	62.5
Race	White	8,042	59.4	4,216	53.1	3,826	68.2	8,388	52.2	4,720	44.6	3,668	67.1
	Black	3,216	23.7	2,351	29.6	865	15.4	4,174	26.0	3,408	32.2	766	14.0
	Hispanic	1,552	11.5	923	11.6	629	11.2	2,340	14.6	1,602	15.1	738	13.5
	Asian	622	4.6	390	4.9	232	4.1	965	6.0	716	6.8	249	4.6
	Other/unknown	118	0.9	62	0.8	56	1.0	188	1.2	143	1.4	45	0.8
Primary cause of disease	Diabetes	3,027	22.3	1,735	21.8	1,292	23.0	4,128	25.7	2,911	27.5	1,217	22.3
	Hypertension	2,842	21.0	1,961	24.7	881	15.7	3,771	23.5	2,747	25.9	1,024	18.7
	Glomerulonephritis	2,922	21.6	1,595	20.1	1,327	23.7	3,076	19.2	1,783	16.8	1,293	23.7
	Cystic kidney disease	1,709	12.6	953	12.0	756	13.5	2,057	12.8	1,189	11.2	868	15.9
	Other/unknown	3,050	22.5	1,698	21.4	1,352	24.1	3,023	18.8	1,959	18.5	1,064	19.5
Blood type	A	5,186	38.3	3,070	38.7	2,116	37.7	5,988	37.3	3,840	36.3	2,148	39.3
	B	1,660	12.3	959	12.1	701	12.5	2,070	12.9	1,364	12.9	706	12.9
	AB	634	4.7	435	5.5	199	3.5	803	5.0	581	5.5	222	4.1
	O	6,070	44.8	3,478	43.8	2,592	46.2	7,194	44.8	4,804	45.4	2,390	43.7
PRA/CPRA	<20%	10,845	80.0	5,999	75.5	4,846	86.4	10,384	64.7	6,378	60.2	4,006	73.3
	20%-<80%	1,596	11.8	1,093	13.8	503	9.0	3,202	19.9	2,207	20.8	995	18.2
	≥80%	995	7.3	827	10.4	168	3.0	2,393	14.9	2,001	18.9	392	7.2
	Unknown	114	0.8	23	0.3	91	1.6	76	0.5	3	0.0	73	1.3
History of renal	Preemptive transplant	1,594	11.8	404	5.1	1,190	21.2	2,314	14.4	821	7.8	1,493	27.3
replacement therapy	<1 year	2,423	17.9	717	9.0	1,706	30.4	1,866	11.6	654	6.2	1,212	22.2
	<3 years	4,244	31.3	2,647	33.3	1,597	28.5	3,812	23.7	2,434	23.0	1,378	25.2
	<5 years	2,266	16.7	1,855	23.4	411	7.3	3,011	18.8	2,607	24.6	404	7.4
	5+ years/unknown	3,023	22.3	2,319	29.2	704	12.6	5,052	31.5	4,073	38.5	979	17.9
Insurance	Private	5,735	42.3	2,510	31.6	3,225	57.5	5,816	36.2	2,716	25.6	3,100	56.7
	Medicare	6,878	50.8	4,912	61.8	1,966	35.1	8,997	56.0	6,996	66.1	2,001	36.6
	Other/unknown	937	6.9	520	6.5	417	7.4	1,242	7.7	877	8.3	365	6.7
HLA mismatches with donor	0	1,603	11.8	980	12.3	623	11.1	1,233	7.7	817	7.7	416	7.6
	1	804	5.9	423	5.3	381	6.8	327	2.0	97	0.9	230	4.2
	2	1,716	12.7	698	8.8	1,018	18.2	1,172	7.3	430	4.1	742	13.6
	3	3,090	22.8	1,514	19.1	1,576	28.1	2,750	17.1	1,435	13.6	1,315	24.1
	4	2,501	18.5	1,777	22.4	724	12.9	3,759	23.4	2,869	27.1	890	16.3
	5	2,416	17.8	1,616	20.3	800	14.3	4,363	27.2	3,288	31.1	1,075	19.7
	6	1,328	9.8	904	11.4	424	7.6	2,103	13.1	1,554	14.7	549	10.0
	Unk.	92	0.7	30	0.4	62	1.1	348	2.2	99	0.9	249	4.6
Kidney transplant history	First transplant	11,832	87.3	6,846	86.2	4,986	88.9	14,157	88.2	9,268	87.5	4,889	89.4
	Retransplant	1,718	12.7	1,096	13.8	622	11.1	1,898	11.8	1,321	12.5	577	10.6
Prior other organ tx		319	2.4	184	2.3	135	2.4	416	2.6	274	2.6	142	2.6
DCD status *	Non-DCD	.	.	7,700	97.0	.	.	.	.	8,912	84.2	.	.
	DCD	.	.	242	3.0	.	.	.	.	1,677	15.8	.	.
SCD/ECD status *	SCD	.	.	6,685	84.2	.	.	.	.	8,709	82.2	.	.
	ECD	.	.	1,257	15.8	.	.	.	.	1,880	17.8	.	.
Total		13,550	100.0	7,942	100.0	5,608	100.0	16,055	100.0	10,589	100.0	5,466	100.0

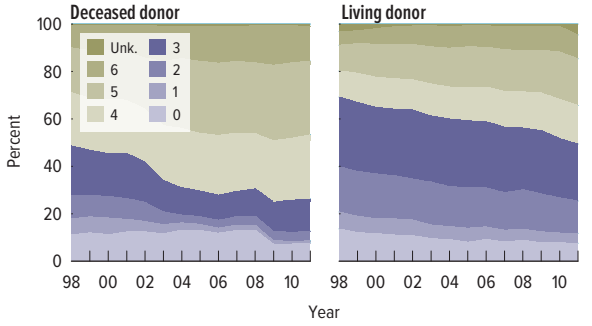
* for deceased donor transplant only

KI 4.10 Characteristics of adult kidney transplant recipients, 2001 & 2011
Patients receiving a transplant. Retransplants are counted.

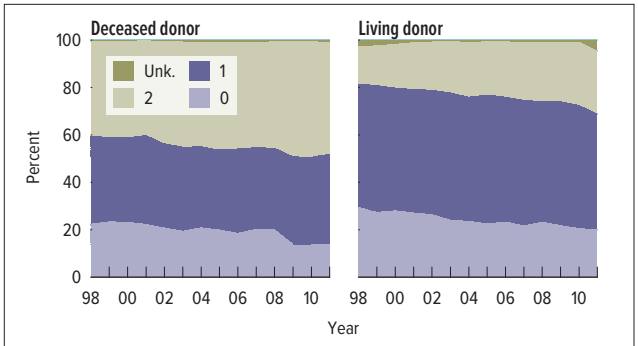
donor-recipient matching



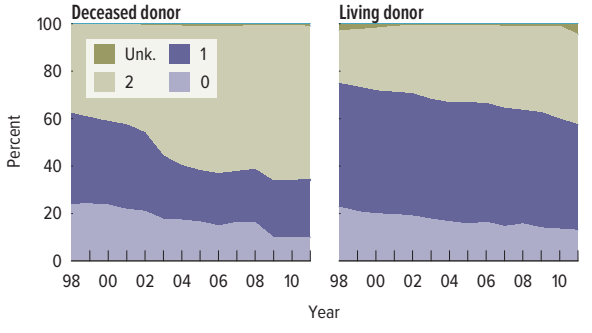
KI 5.1 PRA at time of kidney transplant in adult recipients
PRA is the maximum of the most recent values recorded at the time of transplant. If "most recent PRA" is not provided, peak PRA is used. CPRA is conditionally incorporated between December 1, 2007 – October 1, 2009 where, if CPRA is >0, the value is included but otherwise is not; from October 1, 2009, CPRA is included unconditionally.



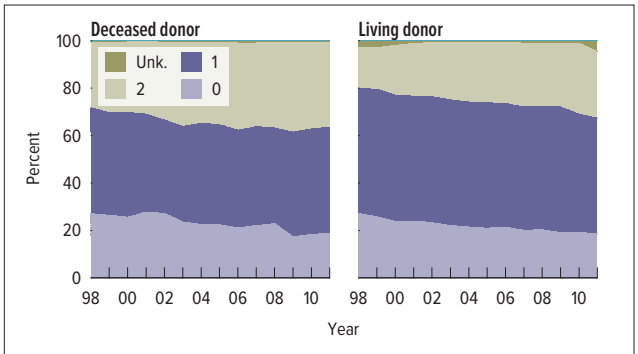
KI 5.2 Total HLA mismatches among adult kidney transplant recipients
Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011.



KI 5.3 HLA-A mismatches among adult kidney transplant recipients
Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011.



KI 5.4 HLA-B mismatches among adult kidney transplant recipients
Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011.



KI 5.5 HLA-DR mismatches among adult kidney transplant recipients
Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011.

donor-recipient matching

	DECEASED DONOR				LIVING DONOR			
RECIPIENT	Neg.	Pos.	Unk.	Total	Neg.	Pos.	Unk.	Total
Negative	11.9	17.8	0.1	29.8	21.8	15.3	3.0	40.1
Positive	23.8	43.6	0.2	67.6	19.6	33.5	4.2	57.3
Unknown	0.9	1.6	0.0	2.5	0.7	0.9	0.9	2.6
Total	36.6	63.0	0.4	100	42.1	49.7	8.1	100

KI 5.6 Adult kidney 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.

	DECEASED DONOR				LIVING DONOR			
RECIPIENT	Neg.	Pos.	Unk.	Total	Neg.	Pos.	Unk.	Total
Negative	0.7	10.6	0.5	11.8	1.9	7.0	3.0	11.9
Positive	3.8	60.2	1.7	65.7	4.5	51.5	9.6	65.6
Unknown	1.3	20.4	1.0	22.6	0.5	5.2	16.8	22.5
Total	5.7	91.2	3.1	100	6.9	63.8	29.4	100

KI 5.7 Adult kidney 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.

	DECEASED DONOR				LIVING DONOR			
RECIPIENT	Neg.	Pos.	Unk.	Total	Neg.	Pos.	Unk.	Total
Negative	72.6	2.9	0.1	75.6	66.9	1.5	10.6	79.0
Positive	7.7	0.9	0.0	8.6	3.3	0.4	0.8	4.5
Unknown	15.2	0.6	0.0	15.8	6.1	0.1	10.4	16.6
Total	95.5	4.4	0.1	100	76.3	2.0	21.8	100

KI 5.8 Adult kidney 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.

	DECEASED DONOR				LIVING DONOR			
RECIPIENT	Neg.	Pos.	Unk.	Total	Neg.	Pos.	Unk.	Total
Negative	93.0	0.0	0.2	93.2	82.9	0.0	11.2	94.1
Positive	2.6	0.0	0.0	2.6	1.4	0.0	0.2	1.5
Unknown	4.2	0.0	0.0	4.2	2.5	0.0	1.9	4.4
Total	99.8	0.0	0.2	100	86.8	0.0	13.3	100

KI 5.9 Adult kidney 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.

	DECEASED DONOR				LIVING DONOR			
RECIPIENT	Neg.	Pos.	Unk.	Total	Neg.	Pos.	Unk.	Total
Negative	87.7	0.3	0.0	88.0	82.9	0.1	8.8	91.8
Positive	4.7	2.2	0.0	6.8	2.6	0.0	0.2	2.9
Unknown	5.1	0.1	0.0	5.2	3.0	0.0	2.3	5.4
Total	97.4	2.6	0.0	100	88.5	0.1	11.4	100

KI 5.10 Adult kidney donor-recipient hepatitis C serology matching, 2007–2011

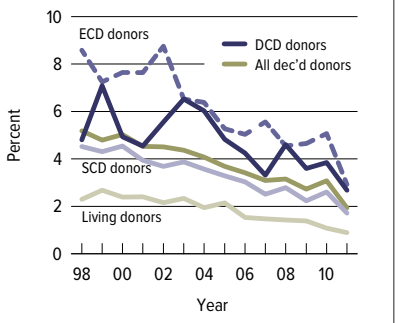
Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields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

	DECEASED DONOR				LIVING DONOR			
RECIPIENT	Neg.	Pos.	Unk.	Total	Neg.	Pos.	Unk.	Total
Negative	85.9	0.0	0.1	86.0	77.0	0.0	9.3	86.3
Positive	0.7	0.0	0.0	0.7	0.4	0.0	0.1	0.5
Unknown	13.3	0.0	0.0	13.3	3.1	0.0	10.0	13.1
Total	99.9	0.0	0.1	100	80.6	0.0	19.4	100

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

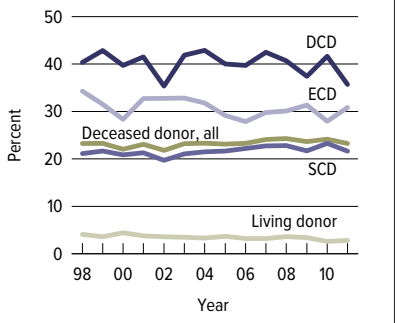
Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields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

outcomes



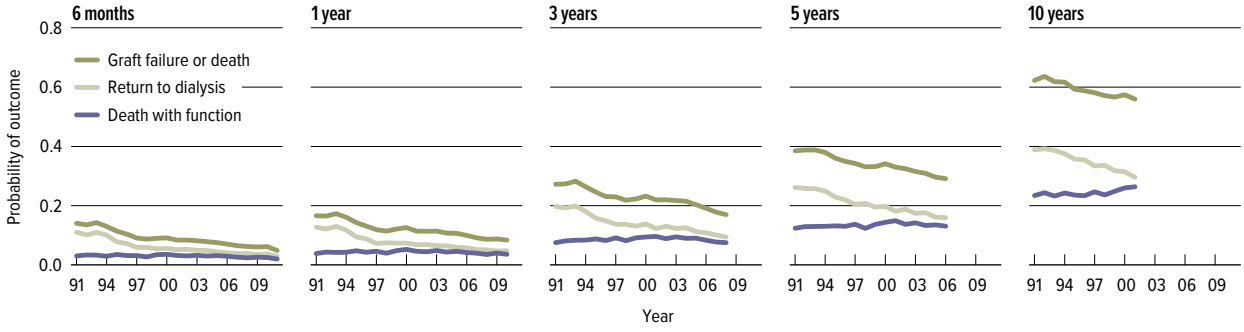
KI 6.1 Death-censored graft failure within 90 days among adult kidney transplant recipients

Retransplantation, graft failure, or return to dialysis within the first 90 days after transplant date. Graft failure due to death is not included. Graft failure dates are determined from multiple data sources, including the OPTN Transplant Recipient Registration, OPTN Transplant Recipient Follow-up.



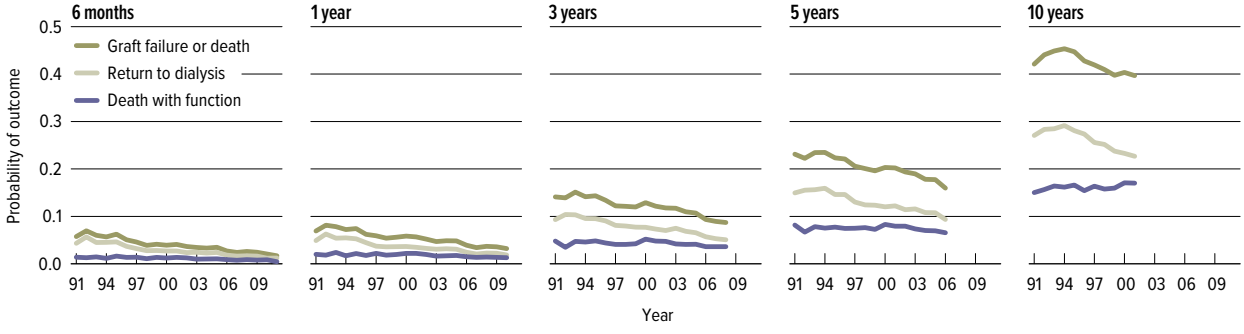
KI 6.2 Delayed graft function among adult kidney transplant recipients

Delayed graft function is defined as receiving dialysis within the first post-transplant week.



KI 6.3 Outcomes among adult kidney transplant recipients: deceased donor

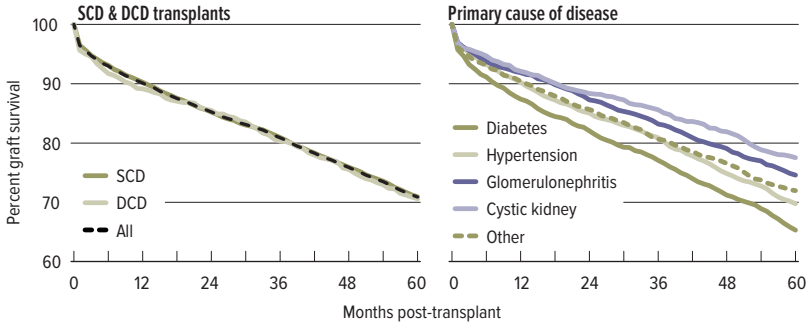
Data are reported as probablity of each outcome. Probabilities are unadjusted, computed using Kaplan-Meier competing risk methods. Death with function defined as no graft failure prior to death; return to dialysis defined as graft failure preceding death.



KI 6.4 Outcomes among adult kidney transplant recipients: living donor

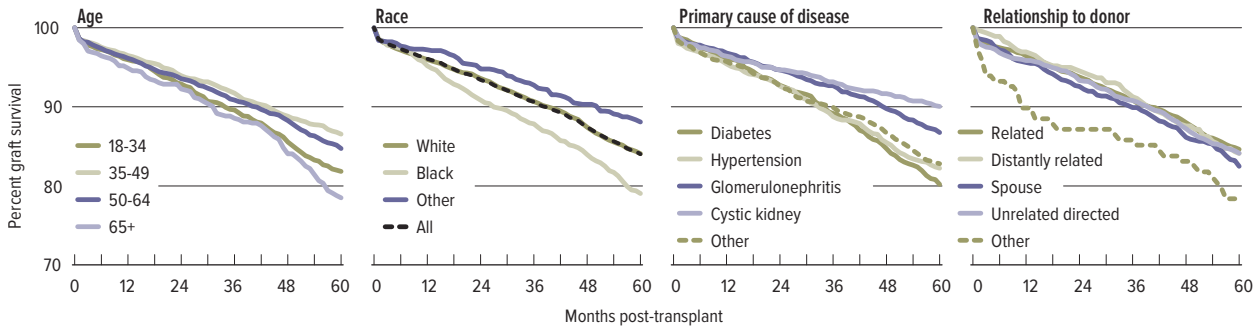
Data are reported as probablity of each outcome. Probabilities are unadjusted, computed using Kaplan-Meier competing risk methods. Death with function defined as no graft failure prior to death; return to dialysis defined as graft failure preceding death.

outcomes



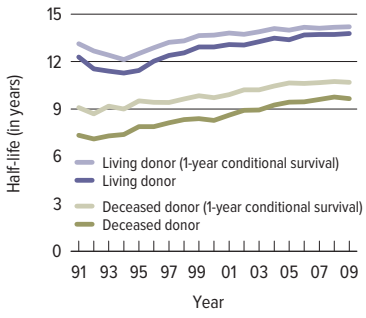
KI 6.5 Graft survival among adult kidney transplant recipients transplanted in 2006: deceased donors

Graft survival estimated using unadjusted Kaplan-Meier methods.



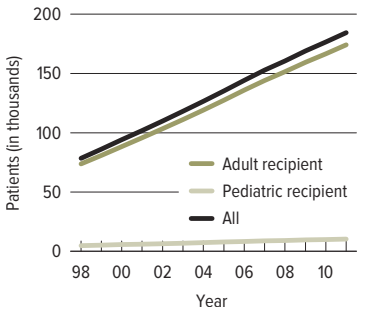
KI 6.6 Graft survival among adult kidney transplant recipients transplanted in 2006: living donors

Graft survival estimated using unadjusted Kaplan-Meier methods. The "other relationship" group includes non-biological, unrelated paired donations, non-directed (anonymous) donation, and non-biological, living/deceased donation.



KI 6.7 Half-lives for adult kidney transplant recipients

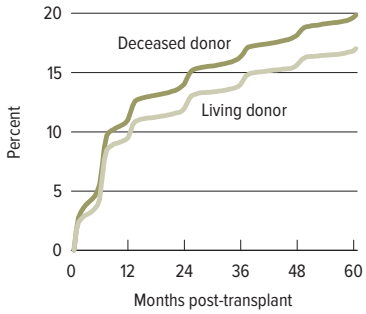
Estimated graft half-lives and conditional half-lives. Half-lives are interpreted as the estimated median survival of grafts from the time of transplant. Conditional half-lives are interpreted as the estimated median survival of grafts which survive the first year.



KI 6.8 Recipients alive & with a functioning kidney transplant on June 30 of the year

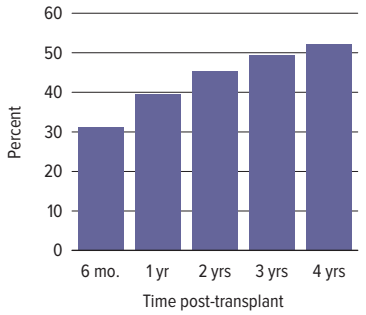
Transplants before June 30 of the year that are still functioning. Patients are assumed alive with function unless a death or graft failure is recorded. A recipient can experience a graft failure and drop from the cohort, then be retransplanted and re-enter the cohort.

outcomes



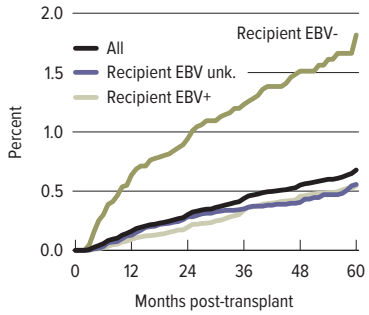
KI 6.9 Incidence of first acute rejection among adult patients receiving a kidney transplant in 2005–2009

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.



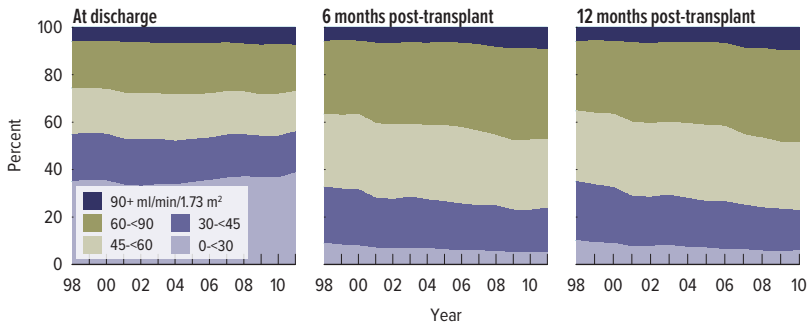
KI 6.10 Reported cumulative incidence of rehospitalizations among adult patients receiving a kidney transplant in 2006–2011

Cumulative incidence of rehosptalization 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.



KI 6.11 Incidence of PTLD among adult patients receiving a kidney transplant in 2005–2009, by recipient Epstein-Barr virus (EBV) status at transplant

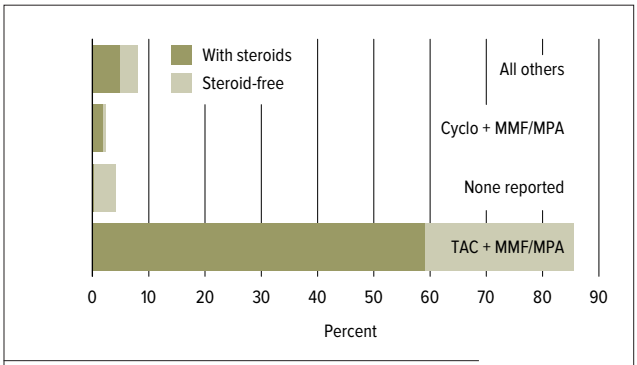
The cumulative incidence, defined as the probability of post-transplant lymphoproliferative disorder (PTLD) being diagnosed between the time of transplant and the given time, is estimated using Kaplan-Meier methods. PTLD is identified as either a reported complication or cause of death on the Transplant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



KI 6.12 Distribution of eGFR at discharge & at 6 & 12 months post-transplant among adult kidney transplant recipients

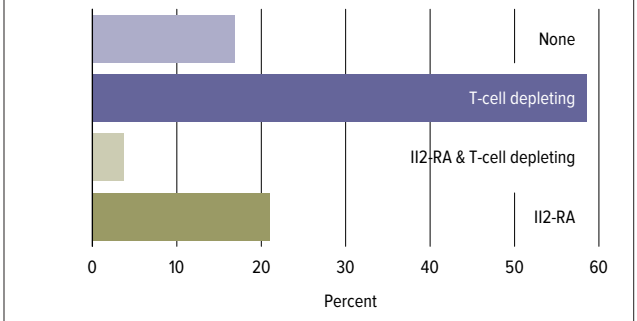
GFR estimated using CKD-EPI equation, and computed for patients alive with graft function at the given time point.

immunosuppression



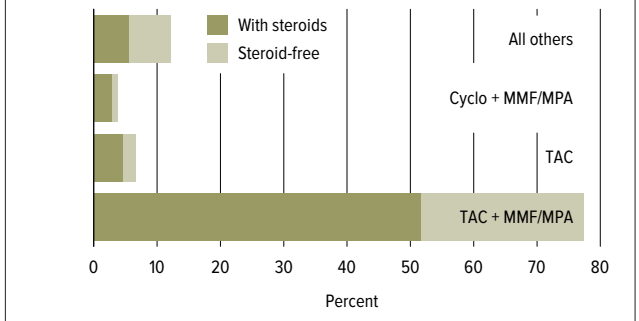
KI 7.1 Initial immunosuppression regimen in adult kidney transplant recipients, 2011

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



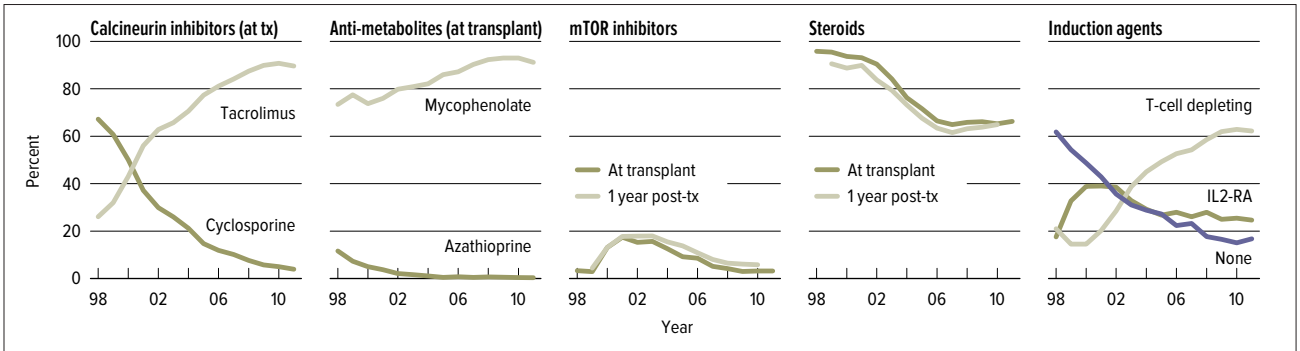
KI 7.2 Induction agents used at time of kidney transplant, adult recipients, 2011

Patients transplanted in 2011 and discharged with a functioning graft.



KI 7.3 Immunosuppression regimen at one year in adult kidney transplant recipients, 2010

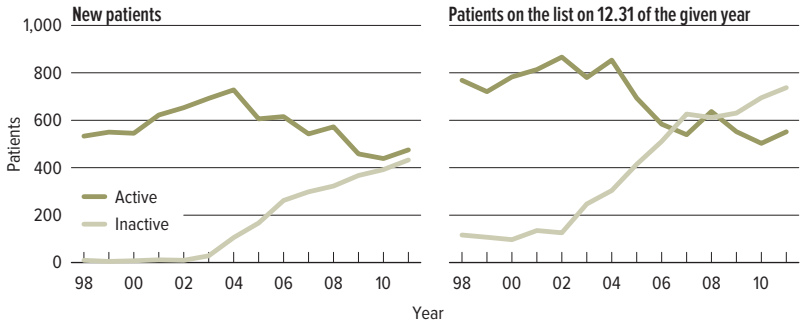
Patients transplanted in 2010 and remaining alive with graft function one year post-transplant. Top three one-year immunosuppression regimens are given, plus the "all others" group. Regimens are defined by use of calcineurin inhibitors (TAC=Tacrolimus, Cyclo=Cyclosporine), anti-metabolites (AZA=Azathioprine,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



KI 7.4 Immunosuppression use in adult kidney transplant recipients

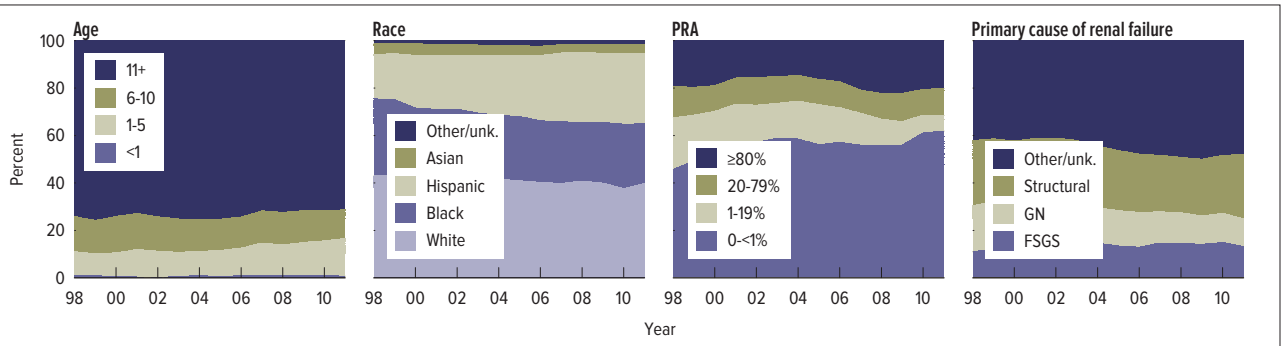
One-year post-transplant data for mTOR inhibitors and steroids limited to patients alive with graft function one year post-transplant. One-year post-transplant data are not reported for 1998 transplant recipients, as follow-up data were very sparse.

pediatric transplant



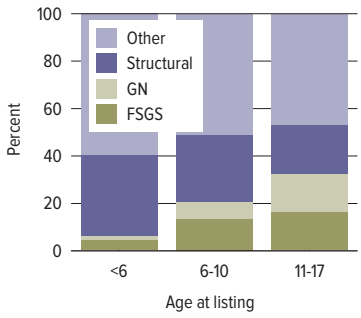
KI 8.1 Pediatric patients waiting for a kidney transplant

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.



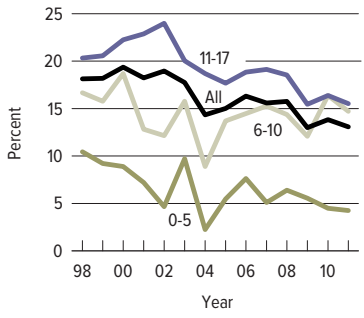
KI 8.2 Distribution of pediatric patients waiting for a kidney transplant

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. Primary cause of renal failure categorized according groups used by NAPRTCS. FSGS = focal segmental glomerulosclerosis. GN = glomerulonephritis.



KI 8.3 Primary cause of ESRD in pediatric patients waiting for kidney transplant, 2007–2011, by age

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. Age is computed at earliest listing date. FSGS = focal segmental glomerulosclerosis. GN = glomerulonephritis.



KI 8.4 Prior kidney transplant in pediatric patients waiting for a kidney transplant, by age

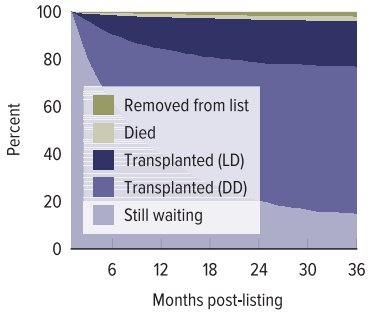
Prior transplant is obtained from the OPTN Transplant Candidate Registration form.

	2009	2010	2011
Patients at start of year	1,262	1,193	1,203
Patients added during year	823	831	909
Patients removed during year	891	821	824
Patients at end of year	1,194	1,203	1,288
Removal reason			
Deceased donor transplant	623	569	562
Living donor transplant	213	202	206
Tx (type not specified)	1	-	-
Patient died	21	27	16
Patient refused transplant	2	2	2
Improved, tx not needed	5	3	9
Too sick to transplant	2	1	1
Changed to kid.-pan. list	-	-	1
Other	24	17	27

KI 8.5 Kidney transplant waiting list activity among pediatric patients

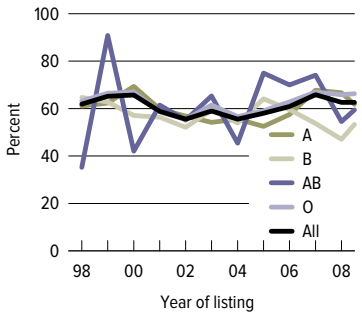
Patients with concurrent listings at more than one center are counted once, from the time of earliest listing to the time of latest removal. Patients listed, transplanted, and re-listed are counted more than once. Patients are not considered "on the list" on the day they are removed. Thus, patient counts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

pediatric transplant



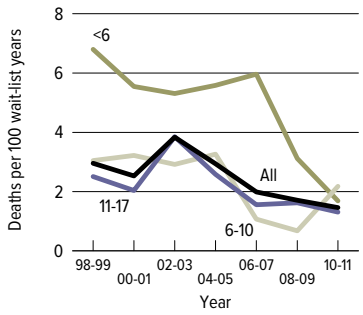
KI 8.6 Outcomes for pediatric patients waiting for a kidney transplant among new listings in 2008

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.



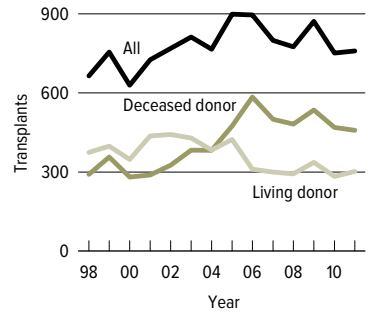
KI 8.7 Pediatric wait-listed patients who receive a deceased donor kidney transplant within three years, by blood type

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.



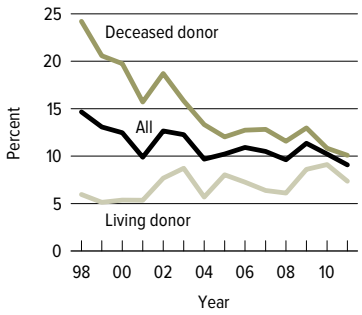
KI 8.8 Pre-transplant mortality rates among pediatric patients wait-listed for a kidney transplant, by age

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.



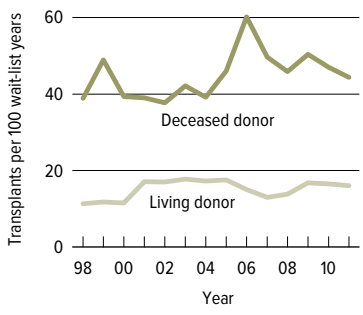
KI 8.9 Pediatric kidney transplants (includes kidney-pancreas), by donor type

Patients receiving a kidney-alone or simultaneous kidney-pancreas transplant, by kidney donor type.



KI 8.10 Percent of pediatric kidney transplants that are retransplants

Includes patients tranplanted after age 17, but listed at age 17 or younger. Retransplanted patients include only those with a prior kidney transplant.



KI 8.11 Kidney transplant rates in pediatric waiting list candidates

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.

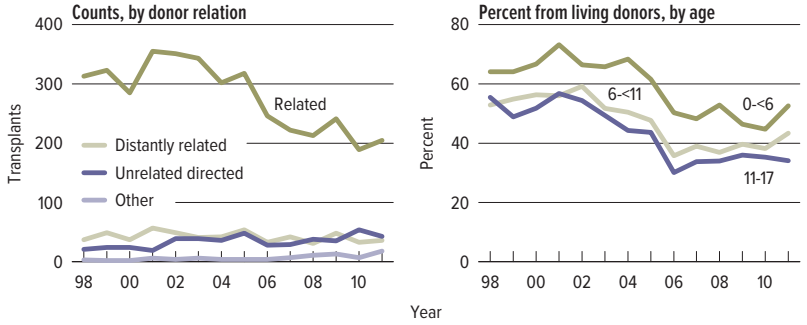
pediatric transplant

		1999–2001						2009–2011					
		All		Deceased		Living		All		Deceased		Living	
	Level	N	%	N	%	N	%	N	%	N	%	N	%
Age	<1	17	0.8	2	0.2	15	1.3	5	0.2	2	0.1	3	0.3
	1-5	396	18.8	129	14.0	267	22.6	510	21.5	266	18.4	244	26.5
	6-10	411	19.5	182	19.7	229	19.4	429	18.1	256	17.7	173	18.8
	11-17	1,282	60.9	610	66.1	672	56.8	1,427	60.2	925	63.8	502	54.4
Sex	Female	885	42.0	403	43.7	482	40.7	954	40.2	596	41.1	358	38.8
	Male	1,221	58.0	520	56.3	701	59.3	1,417	59.8	853	58.9	564	61.2
Race	White	1,250	59.4	431	46.7	819	69.2	1,193	50.3	574	39.6	619	67.1
	Black	391	18.6	249	27.0	142	12.0	438	18.5	350	24.2	88	9.5
	Hispanic	388	18.4	199	21.6	189	16.0	616	26.0	447	30.8	169	18.3
	Asian	55	2.6	30	3.3	25	2.1	87	3.7	56	3.9	31	3.4
	Other/unknown	22	1.0	14	1.5	8	0.7	37	1.6	22	1.5	15	1.6
Primary cause of disease	FSGS	227	10.8	134	14.5	93	7.9	299	12.6	205	14.1	94	10.2
	Glomerulonephritis	386	18.3	162	17.6	224	18.9	270	11.4	175	12.1	95	10.3
	Structural	741	35.2	319	34.6	422	35.7	724	30.5	422	29.1	302	32.8
	Other cause	752	35.7	308	33.4	444	37.5	1,078	45.5	647	44.7	431	46.7
Blood type	A	794	37.7	326	35.3	468	39.6	784	33.1	435	30.0	349	37.9
	B	259	12.3	112	12.1	147	12.4	281	11.9	168	11.6	113	12.3
	AB	79	3.8	30	3.3	49	4.1	75	3.2	48	3.3	27	2.9
	O	974	46.2	455	49.3	519	43.9	1,231	51.9	798	55.1	433	47.0
PRA/CPRA	<20%	1,838	87.3	793	85.9	1,045	88.3	1,908	80.5	1,160	80.1	748	81.1
	20-79%	125	5.9	72	7.8	53	4.5	300	12.7	205	14.1	95	10.3
	≥80%	57	2.7	51	5.5	6	0.5	120	5.1	84	5.8	36	3.9
	Unknown	86	4.1	7	0.8	79	6.7	43	1.8	0	0.0	43	4.7
History of renal replacement therapy	Preemptive tx	512	24.3	119	12.9	393	33.2	612	25.8	279	19.3	333	36.1
	<1 year	645	30.6	212	23.0	433	36.6	615	25.9	370	25.5	245	26.6
	<3 years	620	29.4	362	39.2	258	21.8	700	29.5	499	34.4	201	21.8
	<5 years	126	6.0	93	10.1	33	2.8	155	6.5	121	8.4	34	3.7
	5+ years	203	9.6	137	14.8	66	5.6	289	12.2	180	12.4	109	11.8
Insurance	Private	1,062	50.4	338	36.6	724	61.2	990	41.8	452	31.2	538	58.4
	Medicaid	426	20.2	240	26.0	186	15.7	537	22.6	386	26.6	151	16.4
	Medicare	533	25.3	306	33.2	227	19.2	657	27.7	478	33.0	179	19.4
	Other public	56	2.7	24	2.6	32	2.7	150	6.3	114	7.9	36	3.9
	Other	29	1.4	15	1.6	14	1.2	37	1.6	19	1.3	18	2.0
HLA mismatches with donor	0	97	4.6	42	4.6	55	4.6	55	2.3	28	1.9	27	2.9
	1	138	6.6	26	2.8	112	9.5	79	3.3	4	0.3	75	8.1
	2	421	20.0	44	4.8	377	31.9	284	12.0	24	1.7	260	28.2
	3	591	28.1	124	13.4	467	39.5	485	20.5	146	10.1	339	36.8
	4	323	15.3	259	28.1	64	5.4	450	19.0	380	26.2	70	7.6
	5	324	15.4	283	30.7	41	3.5	617	26.0	534	36.9	83	9.0
	6	167	7.9	134	14.5	33	2.8	374	15.8	332	22.9	42	4.6
	Unknown	45	2.1	11	1.2	34	2.9	27	1.1	1	0.1	26	2.8
Kidney transplant history	First transplant	1,894	89.9	770	83.4	1,124	95.0	2,169	91.5	1,318	91.0	851	92.3
	Retransplant	212	10.1	153	16.6	59	5.0	202	8.5	131	9.0	71	7.7
Prior solid organ tx		28	1.3	14	1.5	14	1.2	24	1.0	17	1.2	7	0.8
DCD status *	Non-DCD	919	99.6	919	99.6	0	0.0	1,370	94.5	1,370	94.5	0	0.0
	DCD	4	0.4	4	0.4	0	0.0	79	5.5	79	5.5	0	0.0
SCD/ECD status *	SCD	905	98.0	905	98.0	0	0.0	1,449	100.0	1,449	100.0	0	0.0
	ECD	18	2.0	18	2.0	0	0.0	0	0.0	0	0.0	0	0.0
All patients		2,106	100.0	923	100.0	1,183	100.0	2,371	100.0	1,449	100.0	922	100.0

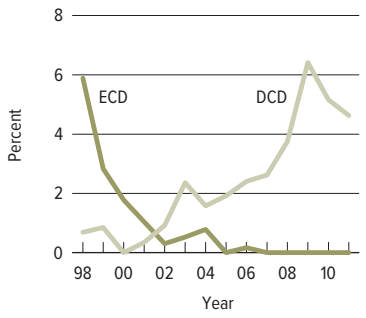
* for deceased donor transplant only

KI 8.12 Characteristics of pediatric kidney transplant recipients, 1999–2001 & 2009–2011
Patients receiving a transplant. Retransplants are counted. PCOD categories follow NAPRTCS recommendations.

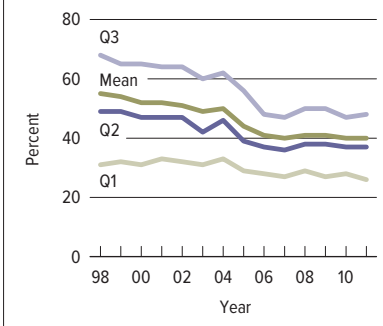
pediatric transplant



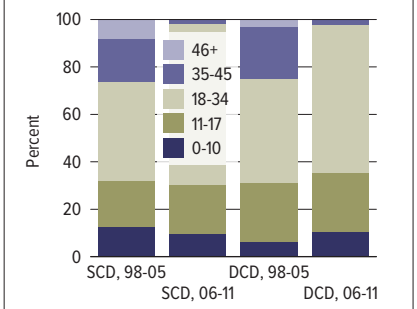
KI 8.13 Pediatric kidney transplants from living donors
Relationship of live donor to recipient is as indicated on the Living Donor Registration form.



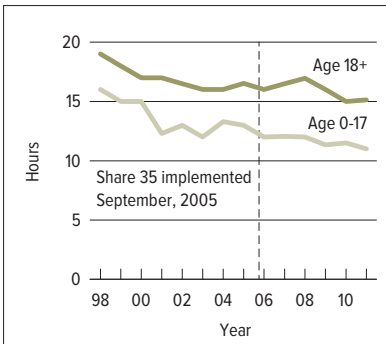
KI 8.14 Use of ECD or DCD donors in pediatric kidney transplant recipients
Patients receiving a DCD or ECD kidney transplant.



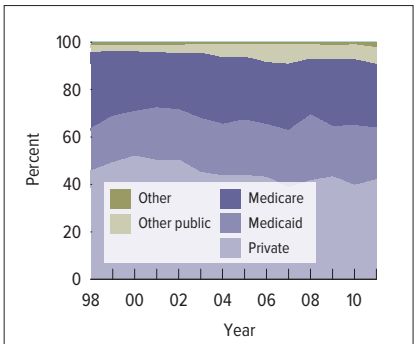
KI 8.15 Distribution of kidney donor profile index (KDPI) in pediatric recipients of deceased donor kidneys
Patients receiving a kidney-only, deceased-donor transplant. Those whose transplant organ was missing a value for height, weight, or creatinine are excluded. KDPI is based on donor factors only; the percentiles are derived by mapping to the 2011 population of kidneys recovered for transplant.



KI 8.16 Donor age among pediatric kidney transplant recipients, by kidney status, before & after Share 35
Patients receiving a deceased donor transplant. Share 35 began in September 2005. SCD: standard criteria donor kidneys; DCD: donations after cardiac death. Data for expanded criteria donor (ECD) kidneys are not shown; n=41 ECD kidneys in 1998–2005 and 1 ECD kidney in 2006–2011. Donors of ECD kidneys are age 50+.



KI 8.17 Median cold ischemia time in adult & pediatric transplant recipients
Patients receiving a deceased donor transplant. Share 35 began in September, 2005.



KI 8.18 Insurance coverage among pediatric kidney transplant recipients at time of transplant
Patients receiving a transplant in given year; reported primary insurance payor at time of transplant. Retransplants are counted.

pediatric transplant

	DECEASED DONOR				LIVING DONOR			
RECIPIENT	Neg.	Pos.	Unk.	Total	Neg.	Pos.	Unk.	Total
Negative	4.5	32.5	0.9	37.9	5.7	33.5	8.8	47.9
Positive	5.1	44.5	0.9	50.6	3.7	31.2	5.4	40.3
Unknown	1.2	10.0	0.5	11.6	1.0	6.0	4.8	11.8
Total	10.8	87.0	2.3	100	10.4	70.7	18.9	100

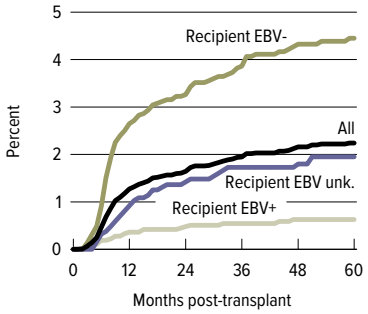
KI 8.19 Kidney donor-recipient Epstein-Barr virus (EBV) serology matching for pediatric transplant recipients, 2007–2011

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

	DECEASED DONOR				LIVING DONOR			
RECIPIENT	Neg.	Pos.	Unk.	Total	Neg.	Pos.	Unk.	Total
Negative	22.4	33.6	0.2	56.2	32.4	26.2	5.4	64.0
Positive	13.9	22.8	0.2	36.9	5.4	21.7	2.0	29.1
Unknown	2.6	4.2	0.0	6.8	2.2	2.8	1.9	6.8
Total	38.9	60.6	0.5	100	40.0	50.7	9.3	100

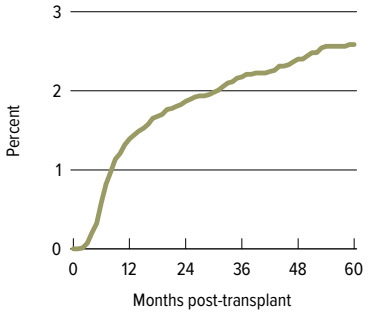
KI 8.20 Kidney donor-recipient cytomegalovirus (CMV) serology matching for pediatric transplant recipients, 2007–2011

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



KI 8.21 Incidence of PTLD among pediatric patients receiving a kidney transplant, 1999–2009

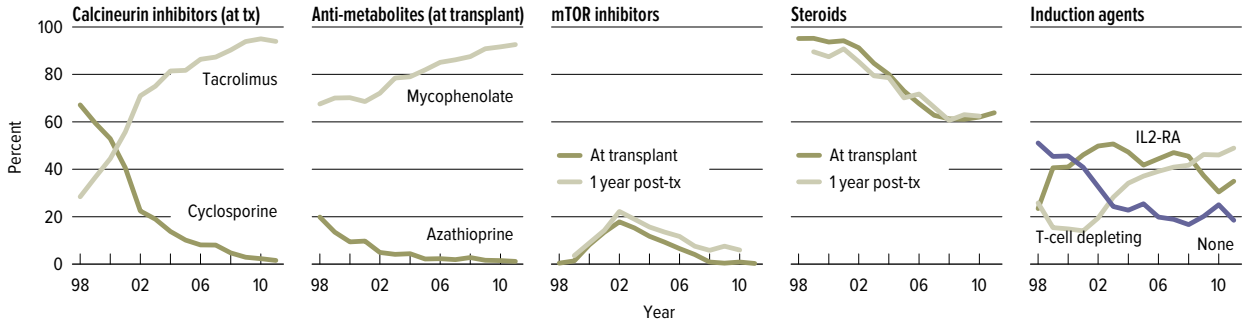
The cumulative incidence, defined as the probability of post-transplant lymphoproliferative disorder (PTLD) being diagnosed between the time of transplant and the given time, is estimated using Kaplan-Meier methods. PTLD is identified as either a reported complication or cause of death on the Transplant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



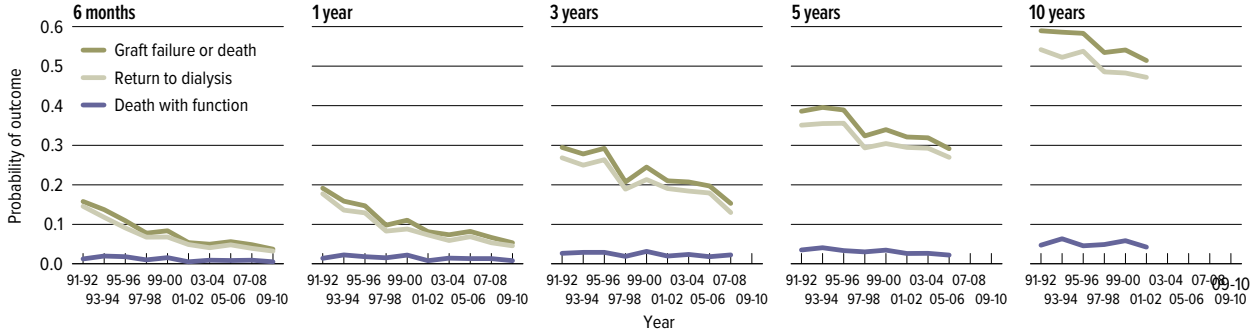
KI 8.22 Incidence of any malignancy in pediatric patients receiving a kidney transplant in 1999–2009

The cumulative incidence, defined as the probability of any malignancy being diagnosed between the time of transplant and the given time, is estimated using Kaplan-Meier methods. Malignancies are identified on the Malignancy forms or on the Transplant Recipient Follow-up forms. Causes of graft failure or causes of death attributed to a malignancy are included. Only the earliest date of diagnosis is included in the analysis, and patients are followed only until graft failure, death, or loss to follow-up. Patients are censored at graft failure because malignancies are not reliably reported after graft failure.

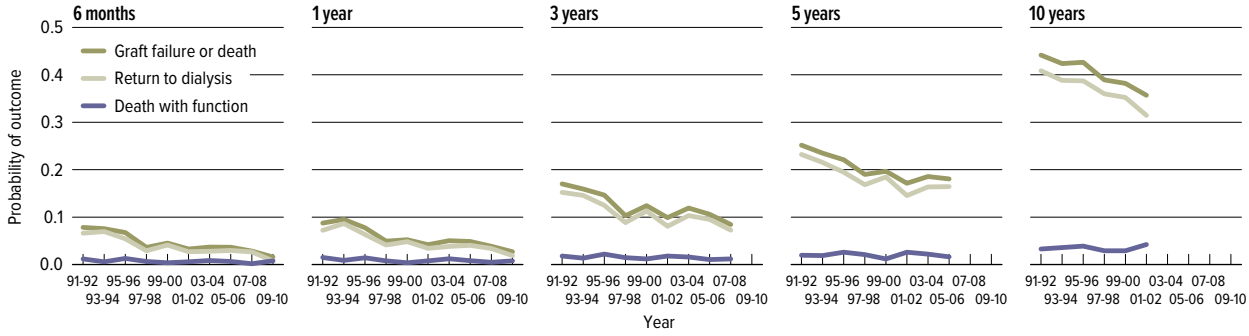
pediatric transplant



KI 8.23 Immunosuppression use in pediatric kidney 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.

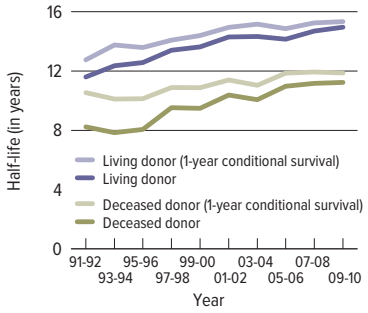


KI 8.24 Outcomes among pediatric kidney transplant recipients: deceased donor
Data are reported as probablity of each outcome. Probabilities are unadjusted, computed using Kaplan-Meier competing risk methods. Death with function defined as no graft failure prior to death; return to dialysis defined as graft failure preceding death.



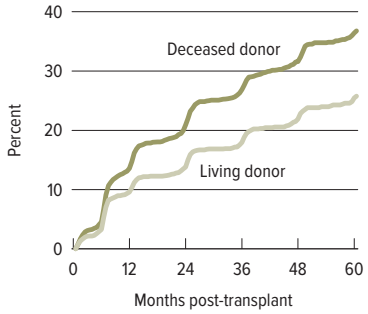
KI 8.25 Outcomes among pediatric kidney transplant recipients: living donor
Data are reported as probablity of each outcome. Probabilities are unadjusted, computed using Kaplan-Meier competing risk methods. Death with function defined as no graft failure prior to death; return to dialysis defined as graft failure preceding death.

pediatric transplant



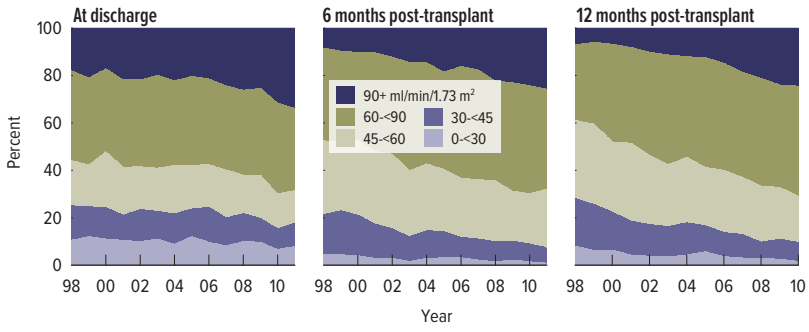
KI 8.26 Half-lives for pediatric kidney transplant recipients

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.



KI 8.27 Incidence of first acute rejection among pediatric patients receiving a kidney transplant in 2005–2010

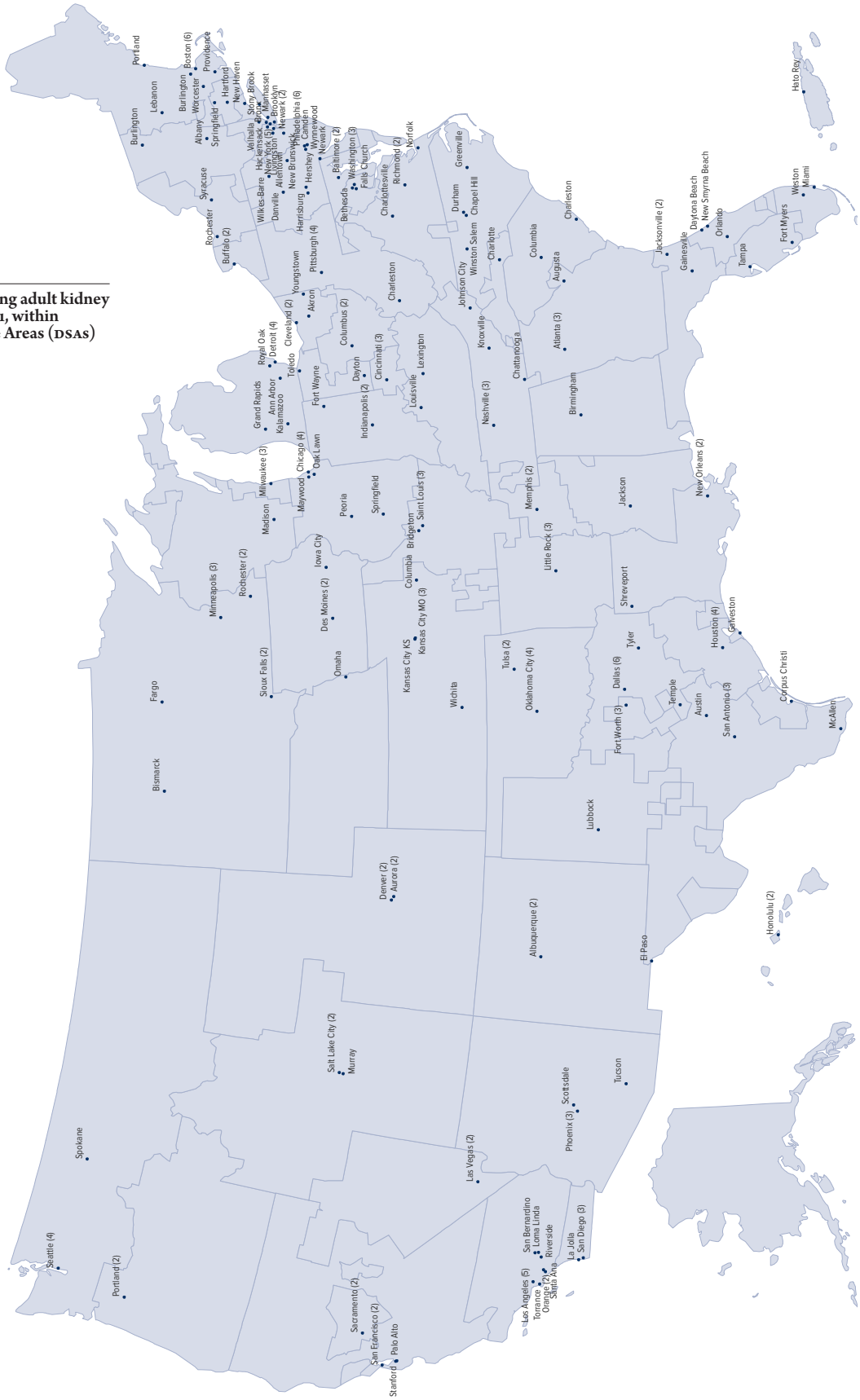
Acute rejection defined as a record of acute or hyperacute rejection, or a record of an anti-rejection drug being administered on either the Transplant Recipient Registration form or the Transplant Recipient Follow-up Form. Only the first rejection event is counted, and patients are followed for acute 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.



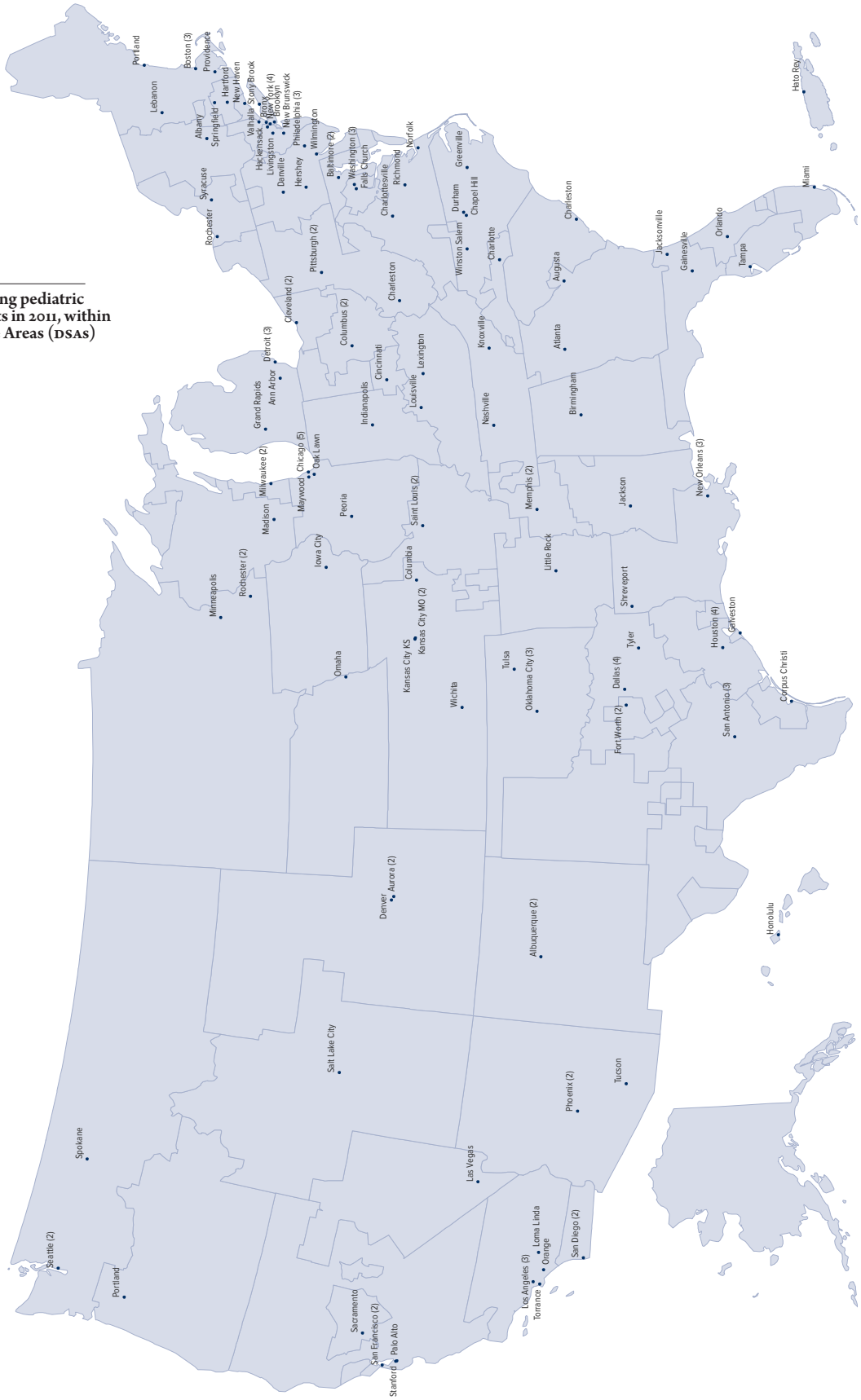
KI 8.28 Distribution of eGFR, at discharge & at 6 & 12 months post-transplant among pediatric kidney transplant recipients

GFR estimated using the bedside Schwartz equation, and computed for patients alive with graft function at the given time point.

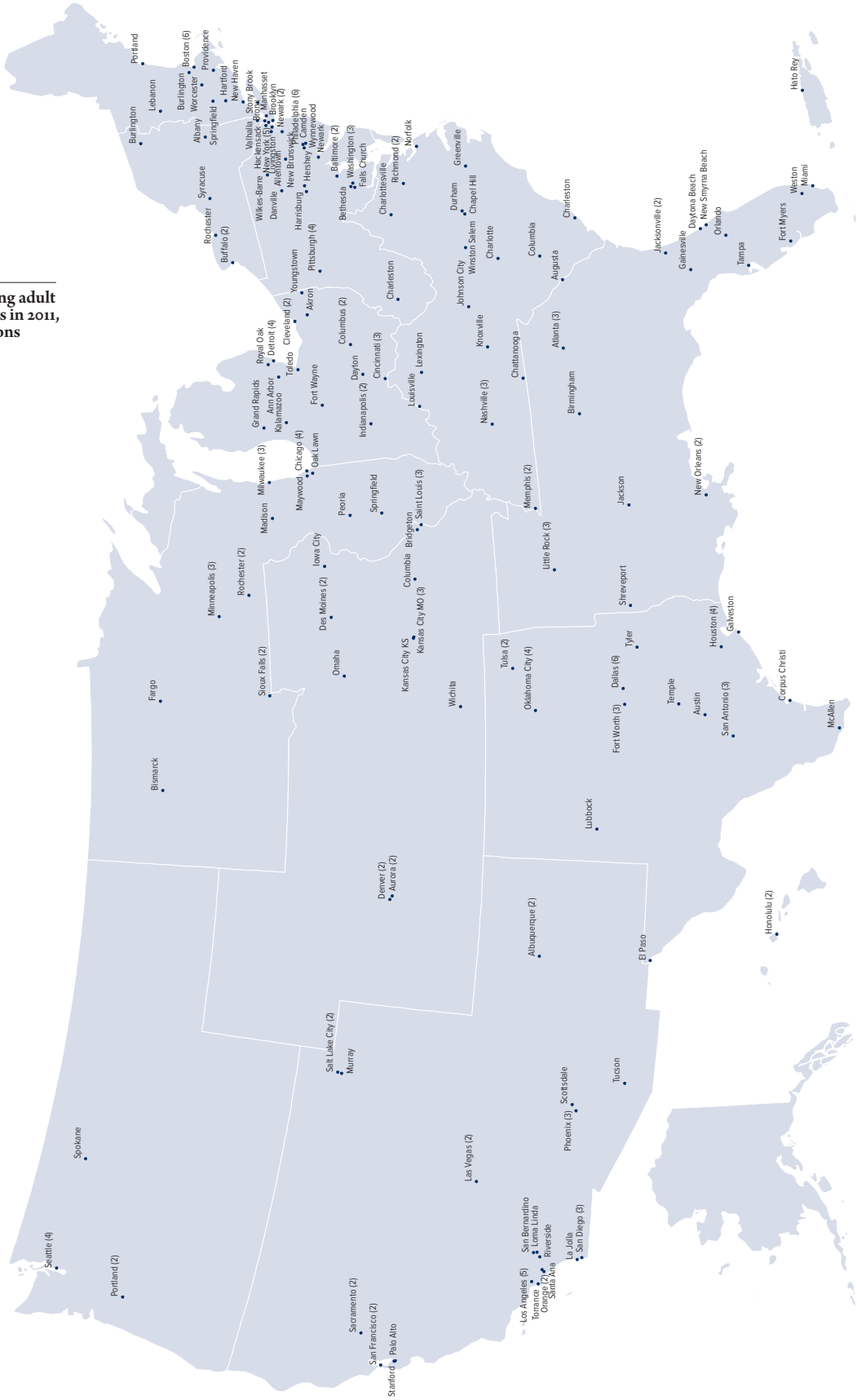
KI 9.1 Centers performing adult kidney transplants in 2011, within Donation Service Areas (DSAs)



KI 9.2 **Centers performing pediatric kidney transplants in 2011, within Donation Service Areas (DSAs)**



KI 9.3 Centers performing adult kidney transplants in 2011, within OPTN regions



wait list 52
donation 57
transplant 59
donor-recipient matching 62
outcomes 65
immunosuppression 69
transplant center maps 70

OPTN/SRTR 2011 Annual Data Report: pancreas

ABSTRACT Numbers of pancreas transplants have been decreasing over the past decade, but outcomes continue to improve for all types: simultaneous pancreas-kidney transplant, pancreas after kidney transplant (PAK), and pancreas transplant alone (PTA). The most notable decrease occurred for PAK transplants, possibly due in part to decreases in numbers of living donor kidney transplants. The number of new candidates on the pancreas transplant waiting list has decreased steadily since 2000; only 1005 active candidates were added in 2011. Transplant rates for all pancreas transplant types reached a low in 2011 of 34.9 transplants per 100 wait-list years. Deceased donation rates have also been decreasing since 2005, but use of donation after circulatory death has been gradually increasing. The discard rate in 2011 was 27.7%, and higher for pancreata recovered from older donors. Improved outcomes during the early posttransplant period largely reflect improved donor and recipient selection and improved technical strategies. Inconsistent definitions of graft failure across reporting centers creates an ongoing challenge in the interpretation of outcome data for pancreas transplants. Rates of posttransplant re-hospitalization are high, most occurring in the first 6 months. Rejection rates are highest for PTA recipients, who also experience higher incidence of posttransplant lymphoproliferative disorder.

KEY WORDS Diabetes mellitus, pancreas transplant, transplant outcomes, transplant waiting list.

A second chance in life is the greatest gift I'll ever receive. My donor – he still lives inside of me. His legacy lives on. And he's never forgotten.

Cherilyn, kidney/pancreas recipient

Introduction

Pancreas transplant remains a viable option for beta cell replacement in insulin-dependent diabetes mellitus, mostly type 1. Although the number of pancreas transplants has been decreasing in the past decade, outcomes continue to improve for all groups of pancreas transplant: simultaneous pancreas-kidney transplant (SPK) and solitary pancreas transplant (pancreas after kidney transplant [PAK] and pancreas transplant alone [PTA]). The improving outcomes are mainly due to improvements in immunosuppression, surgical technique, and donor-recipient selection.

The decrease in the number of pancreas transplants is partly attributable to improved insulin delivery systems, concerns about outcomes after solitary pancreas transplant (1), and potentially a renewed interest in islet transplant. Even though isolated reports suggest that 5-year islet transplant outcomes at a single center have matched pancreas transplant outcomes, the current consensus seems to be that pancreas transplant is superior to islet transplant in efficiency and durability. This view may change in the future, resulting in more islet transplants being performed.

The most notable decrease in pancreas transplants occurred in the PAK group. This could be partially due to a decrease in the number of living donor kidney transplants. Pancreas survival after PAK clearly lags behind pancreas survival in SPK, although the kidney survival benefit in PAK (usually performed with a living donor kidney) may offset this disadvantage.

The decrease in PAK transplants may be mitigated by changes in national policy when implemented by the Organ Procurement and Transplantation Network (OPTN). This national policy was approved by the OPTN Board of Directors in November 2010. A combined pancreas list for SPK and solitary pancreas transplant (PAK and PTA) will give equal priority to SPK and solitary pancreas candidates within locality, HLA mismatch, calculated panel reactive antibody (CPRA) division, and waiting time.

A detailed analysis of pancreas transplant trends over the past decade is presented in the following sections.

Waiting List

Over the past decade, the number of new candidates on the pancreas waiting list showed an increasing trend until 2000, after which it decreased steadily until 2011, when only 1,005 candidates joined the waiting list as active candidates (Figure 1.1). The proportion of older candidates (aged 50 to 64 years) has gradually increased, with a corresponding decrease in the proportion of younger candidates (aged 18 to 34 years) (Figure 1.2). The percentage of white candidates (67.4% in 2011) has decreased, with a corresponding increase in the percentage of black candidates (17.8% in 2011). The percentage of candidates reported to have type 2 diabetes has remained stable (8.0% in 2010 and 2011). The percentage of obese candidates (body mass index [BMI] > 30 kg/m^2) is gradually increasing, in keeping with national trends in the general population. Although relatively fewer candidates are on the waiting list, time on the waiting list has gradually increased over the past decade. Whether this is due to more restrictive acceptance criteria or the effect of redundancy on the waiting list is yet to be determined (Figure 1.2).

The distribution of newly listed candidates is similar to that of all candidates on waiting list (Figures 1.2, 1.3). With the introduction of the CPRA measure, the proportion of candidates with a CPRA of less than 1% has increased to approximately 80% in the past 2 years (Figure 1.3).

The transplant rates for all three pancreas transplant groups have decreased over the past few years, to an overall low in 2011 of 34.9 transplants per 100 wait-list years (PTA, 29.2 transplants per 100 wait-list years; SPK, 41.8; PAK, 16.7) (Figure 1.4).

In 2011, 106 living donor kidney transplants were performed in SPK wait-listed candidates, down from 143 in 2009 and 138 in 2010 (Figure 1.5). This is consistent with the overall decrease in living donor kidney transplants in 2011 (see kidney chapter).

Outcomes for candidates on the waiting list over a 3-year follow-up period (from the time of listing) are shown in Figure 1.6. Median time to transplant for active candidates in 2010 was 7.2 months for PTA, 12.3 months for SPK, and 10.1

months for PAK. This is shorter than the overall waiting time (for active and inactive candidates) shown in Figure 1.7, especially in the PAK group, where inactive candidates are on the list for a longer time.

The geographic variation by donation service area (DSA) in waiting times for SPK is similar to that for kidney transplant (Figure 1.11 in kidney chapter). Local organ procurement organization (OPO) practices allowing for SPK prioritization for kidney allocation play a role in this overall geographic variation. A universal SPK and PTA allocation policy approved by OPTN in November 2010 is pending implementation. In brief, the combined pancreas list will treat SPK, PAK, and PTA candidates equally. This may eliminate variation caused by geographic practices in allocation policy.

Donation

Deceased donor pancreas donation rates have been decreasing since 2005. In 2010, the overall rate reached a low for the past decade of 2.4 donors per 1,000 deaths (Figure 2.1). However, the donation rate for donors aged 15 to 34 years has remained unchanged in the past 5 years, at approximately 15 donors per 1,000 deaths. Unadjusted geographic heterogeneity in donation rates is substantial (Figure 2.2). Pancreas recovery rate per donor remains low. In 2011, pancreata were recovered from 19% of all organ donors but only 13% were transplanted (Figure 2.3). This includes donors of all age groups and with all comorbid conditions (such as diabetes), so the true denominator for suitable pancreas donors is presumably lower.

Approximately 79% of pancreata were part of a multi-visceral transplant in 2011, with 74% being kidney-pancreas transplants (Figure 2.4).

The overall discard rate for pancreata recovered was 27.7% in 2011; the highest rate (81.3%) was for pancreata recovered from donors aged 50 years or older (Figure 2.5). The pancreas donor risk index has been steadily decreasing over the past decade, with a notable part of the decrease attributable to shorter cold ischemia times (Figures 2.7, 2.8). Only donors whose pancreata were transplanted are considered in these calculations. The percentage of donation after circulatory death (DCD) donors has remained relatively steady in the past 7 years, at approximately 3.5% (Figure 2.9).

Anoxic brain injury as a cause of death has been steadily increasing, reaching a rate of 21.1% in 2011, with a corresponding decrease in head trauma to 61.3% (Figure 2.10).

Transplant

The number of pancreas transplants has decreased every year since 2004; 1,051 pancreas transplants were performed in 2011. The greatest percentage decrease has been for PAK, followed by SPK and PTA (Figure 3.1). The decrease in PAKs has become the focus of discussion at meetings of the OPTN Pancreas Transplantation Committee in recent years, with recognition that the decrease may be partly attributable to the decrease in living donor kidney donation rates. In addition, variation across OPOs that allows for preferential allocation of pancreata to SPK candidates may likely be a factor.

Looking at subgroups of transplant recipients, the decrease in transplant numbers is noted to be greatest in the most prevalent demographic groups. The greatest decreases have been among recipients aged 35 to 49 years, recipients of white race, recipients with a BMI of 18.5 to 24.9 kg/m^2, and recipients with type 1 diabetes (Figure 3.2).

Over the past decade, pancreas transplant rates for waitlisted candidates have steadily decreased (Figure 3.3). Use of DCD donors has been gradually increasing. In 2011, approximately 3.1% of transplants were from DCD donors, with the highest percentage in SPK (3.5%) and the lowest in PAK (0.9%) (Figure 3.5). Geographically, transplant rates and use of DCD donors varied widely (Figures 3.6, 3.7).

The characteristics of patients undergoing pancreas transplant in 2011 are summarized in Figure 3.8. Approximately 55% of all transplants were performed in patients aged 35 to 49 years. Women predominated in the PTA group, but not in SPK or PAK. Approximately 25% of PTAs were performed for causes other than diabetes or unknown. It is unclear whether this is due to missing data or whether PTAs are being performed in

substantial numbers for other reasons, such as surgical diabetes or disabling exocrine failure. In 2011, private insurance covered 66.7% of PTAs, 42.0% of SPKs, and 48.3% of PAKs. In contrast, Medicare covered only 22.5% of PTAs, but 49.3% of SPKs and 45.6% of PAKs. Re-transplants constituted 5.3% of all pancreas transplants, but 22.8% of PAK transplants.

Donor-Recipient Matching

The percentage of unsensitized recipients (0% PRA) has been decreasing gradually; 62.4% were unsensitized in 2011 (Figure 4.1).

HLA trends for pancreas transplants showed that the percentage of highly mismatched transplants (5 or 6 mismatches) has been increasing over the past few years across all groups (Figure 4.2). However, that trend changed in the PTA group in 2011, with an increase in better-matched patients (0 to 4 mismatches) compared with 2010. Whether better matching in this group is a one-time observation or the start of a trend remains to be seen.

Donor-recipient virology data were analyzed for 2007-2011. Overall, the virology results were similar to those reported for 2005-2009 in the OPTN/SRTR 2010 Annual Data Report; however, the percentage of donors positive for the Epstein-Barr virus (EBV) increased from 61.2% in 2005-2009 to 89.1% in 2007-2011. The percentage of high-risk transplants (D+/R-) was 14.0% (Figure 4.7).

Cytomegalovirus analysis showed that high-risk transplants (D+/R-) accounted for 27.8% of all transplants (Figure 4.6).

Donors positive for hepatitis B virus, hepatitis C virus, and human immunodeficiency virus (HIV) were extremely rare. Only 0.7% of donors were positive for hepatitis B core antibody compared with 3.2% of recipients; 3.2% of recipients were positive for hepatitis C virus, and 0.2% were positive for HIV (Figures 4.8, 4.10, 4.11).

Outcomes

Despite the decreasing number of pancreas transplants being performed nationally, the overall success for the procedure continues to improve in all three categories (Figure 5.1). Improvements during the early post-transplant period largely reflect improved donor and recipient selection, as well as improved technical strategies. The greatest improvement in graft survival within the first 6 weeks after transplant has been in the PTA category. Continued improvements in the technical strategies used with these patients can be attributed in part to a better understanding of anticoagulation strategies in a non-uremic state. The pancreas transplant community is in general consensus that anticoagulation strategies are essential during the perioperative periods in non-uremic recipients. Specific anticoagulation strategies continue to evolve and remain variable between centers. These strategies take into account the risk-to-benefit ratio of clotting (allograft thrombosis) versus bleeding but are not tracked in the OPTN and SRTR database.

An ongoing challenge in the interpretation of the outcome data for pancreas transplant results from the fact that the definition of what constitutes a graft failure is not consistent across reporting centers. Some centers report as a graft failure any return to the use of agents directed at managing hyperglycemia; other centers report a graft failure only when the recipient returns to pre-transplant levels for 24-hour insulin requirements. Although insulin independence is the gold standard by which most centers report graft failure, this definition needs to be standardized across all centers to allow accurate interpretation of graft survival data. Keeping this in mind, graft failure at 5 years for PTA and PAK is 40% to 50%, whereas the 5-year failure of the pancreas graft in SPK remains less than 20% (Figures 5.2, 5.3, 5.5). The better long-term results for SPK versus PAK and PTA undoubtedly represent the difficulty of detecting rejection in the absence of a simultaneously transplanted kidney. Detection of an early rejection episode is more likely in SPK, since an elevation in serum creatinine is a strong marker that will trigger a further work-up for rejection. In PAK and PTA, such a surrogate marker for pancreas rejection is unavailable. As a result, serum hyperglycemia is frequently the first warning for pancreas allograft rejection, and by that late time the function of the pancreas allograft has been irreversibly compromised.

The 5-year kidney graft survival rate for SPK recipients continues to improve. For SPK transplants performed in 2005, the adjusted 5-year kidney graft failure dropped below 20% and rose only slightly for transplants in 2006 (Figure 5.4). The excellent long-term results for kidneys transplanted simultaneously with a pancreas are in part related to the highly selected nature of SPK deceased donors. In addition, early rejection episodes in SPK recipients have decreased markedly in the past decade (Figure 5.1); for SPKs performed in 2005-2009, the incidence of rejection by the first 12 months is 16% (Figure 5.10). Kidney graft failure or death after a PAK transplant has steadily decreased. Five-year kidney graft failure after a pancreas transplant is less than 20% (Figure 5.6). Both kidney and pancreas graft failures are predictive of patient death after PAK. However, kidney graft failure is a stronger predictor for death; therefore, preservation of kidney function after PAK is critically important.

Patients with either type 1 or type 2 diabetes are candidates for pancreas transplant, but less than 10% of adult candidates waiting for a pancreas transplant are characterized as type 2. The characterization as type 1 or type 2 diabetes is reported by the institution, but no strict data requirements (i.e., detectability of c-peptide) are required for this classification. Despite this lack of strict definition, it is interesting that graft survival using unadjusted Kaplan-Meier methods shows no great differences at 5 years, with pancreas graft survival approximating 70% in both type 1 and type 2 diabetic recipients (Figure 5.7). Again, these data must be interpreted in the context that pancreas graft survival may be defined differently for type 1 versus type 2 diabetic recipients, and illustrates the need for universal definitions and standards for reporting pancreas allograft failure.

The challenges of pancreas transplant are reflected in the very high rates of re-hospitalization among adults who underwent a pancreas transplant in 2006-2011. Most of these hospitalizations occurred within the first 6 months after the transplant (Figure 5.11). Pancreas transplant is associated with higher incidences of rejection compared with kidney transplant, reflecting the relatively high immunogenicity of the pancreas allograft (Figure 6.9 in kidney chapter). Figure 5.10 shows that PTA recipients have the highest incidence of rejection. This relates in part to their healthier overall state and ability to mount a strong immune response as compared with the uremic recipients of SPK. The higher immunosuppression requirements associated with PTA are reflected in the markedly higher incidence of post-transplant lymphoproliferative disorder (PTLD) in this category of recipients (Figure 5.12). The incidence of PTLD is higher in all EBV-negative recipients; more than 6% of PTA recipients in this group were diagnosed with PTLD within 18 months of pancreas transplant.

Immunosuppression

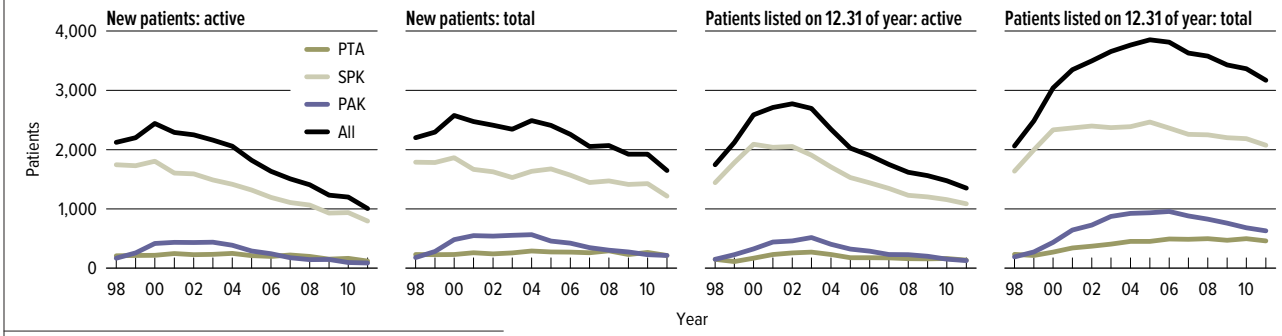
Pancreas allografts have always been regarded as highly immunogenic, perhaps related to the need to overcome both the alloimmune and autoimmune responses. Recognition of the high degree of immunogenicity is evidenced by the fact that T-cell depleting induction agents were used in more than 70% of pancreas transplants performed in 2011 (Figure 6.2). Despite the known toxicity of tacrolimus to beta cells, the combination of tacrolimus and mycophenolate mofetil (MMF) has become the heavily favored maintenance regimen (Figure 6.3).

The issue of steroid-free regimens remains controversial, although the data suggest that approximately 40% of pancreas transplant recipients are on regimens that avoid steroids. Despite the fact that mammalian target of rapamycin (MTOR) inhibitors were reported to have less toxicity to the kidney and beta cells, routine use of these agents in maintenance regimens was reported in less than 20% of pancreas transplants at discharge and 1 year after the transplant (Figure 6.4).

Reference

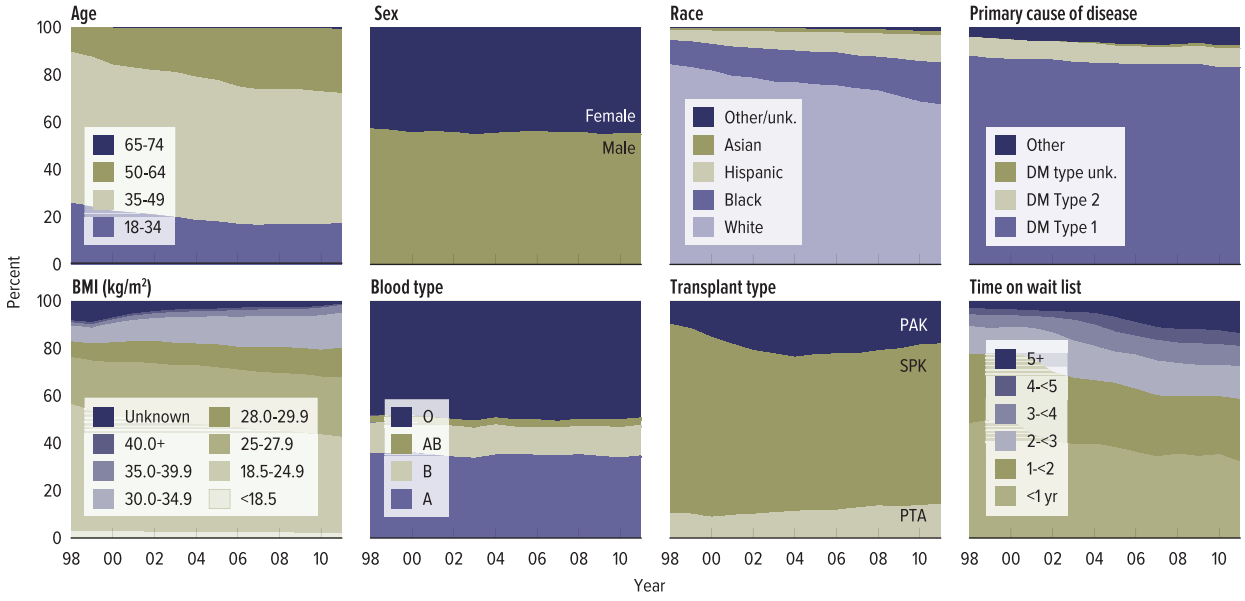
1. Venstrom J, McBride M, Rother K, Hirshberg B, Orchard T, Harlan D. Survival after pancreas transplantation in patients with diabetes and preserved kidney function. JAMA 2003; 290: 2817-2823.

wait list



PA 1.1 Adult patients waiting for a pancreas transplant

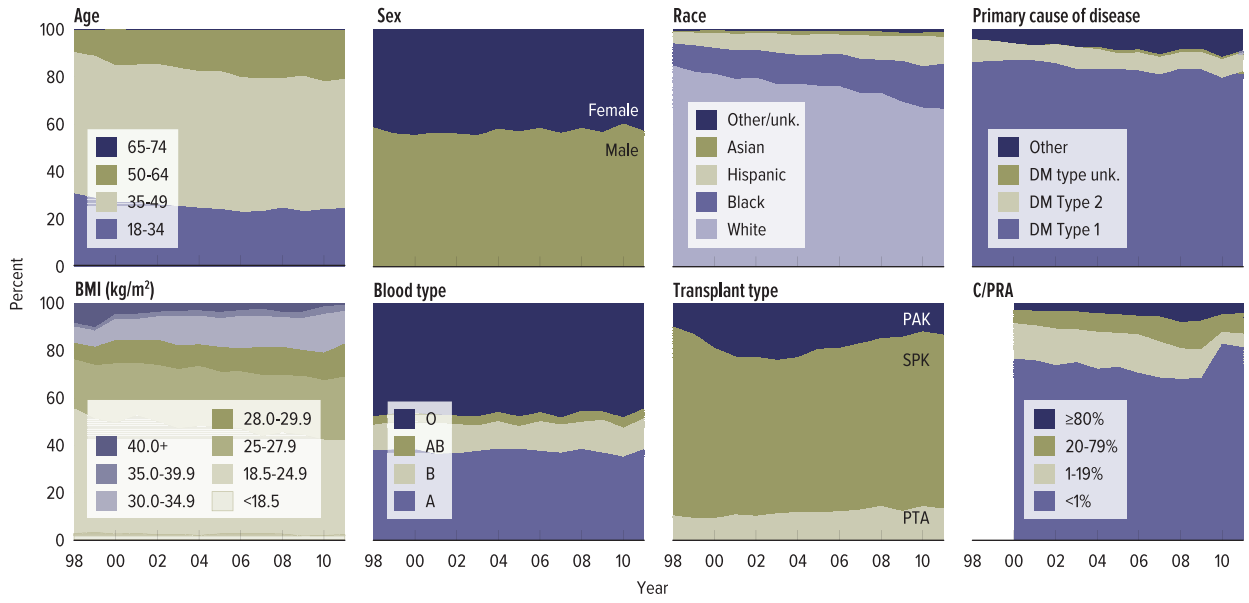
Patients waiting for a transplant. A "new patient" is one who first joins one of the three lists during the given year, without having listed in a previous year. However, if a patient has previously been on the list, has been removed for a transplant, and has relisted since that transplant, the patient is considered a "new patient." Patients concurrently listed at multiple centers or on more than one list 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.



PA 1.2 Distribution of adult patients waiting for a pancreas transplant

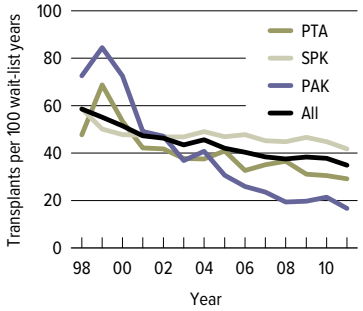
Patients waiting for a transplant any time in the given year. Age determined on the earliest of listing date or December 31 of the given year. Concurrently listed patients are counted once.

wait list



PA 1.3 Distribution of adult patients newly listed for a pancreas transplant

A newly listed patient is one who first joins one of the three lists 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 and/or on multiple lists are counted only once. C/PRA is the peak observed for that candidate during the listing.



PA 1.4 Pancreas transplant rates among adult waiting list candidates

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

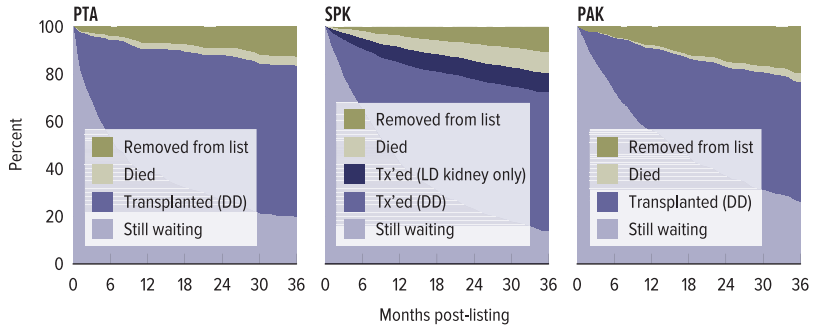
	PTA			SPK			PAK		
	2009	2010	2011	2009	2010	2011	2009	2010	2011
Patients at start of year	499	471	496	2,276	2,232	2,209	839	763	682
Patients added during year	232	267	212	1,391	1,385	1,179	273	225	216
Patients removed during year	260	241	245	1,434	1,405	1,312	349	306	267
Patients at end of year	471	497	463	2,233	2,212	2,076	763	682	631
Removal reason									
Deceased donor transplant	157	152	142	912	875	834	162	156	115
Living donor kidney transplant	-	-	-	143	138	106	-	-	-
Patient died	18	24	18	181	197	147	30	23	23
Patient refused transplant	18	5	23	11	11	10	24	15	25
Condition improved, tx not needed	7	2	9	14	12	13	5	3	4
Too sick to transplant	7	14	15	65	85	81	27	33	34
Changed to kidney-pancreas list	1	1	-	-	-	-	2	-	1
Other	52	43	38	108	87	121	99	76	65

PA 1.5 Pancreas 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.

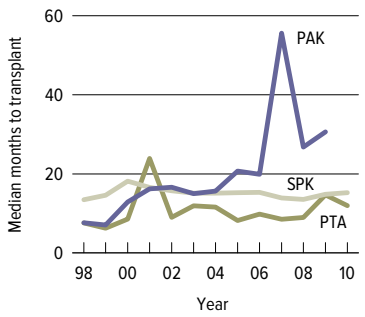
data behind the figures can be downloaded from our website, at www.srtr.org

wait list



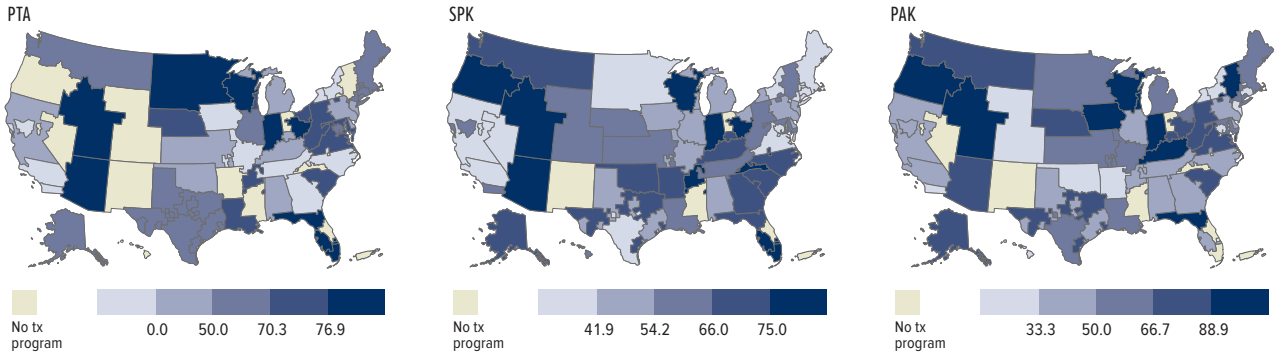
PA 1.6 Outcomes for adult patients waiting for a pancreas transplant among new listings in 2008

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.



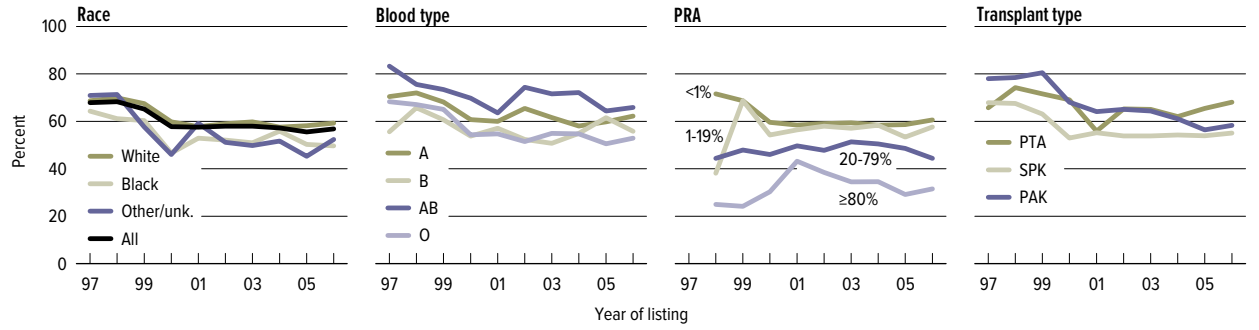
PA 1.7 Median months to pancreas transplant for wait-listed adult patients

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.



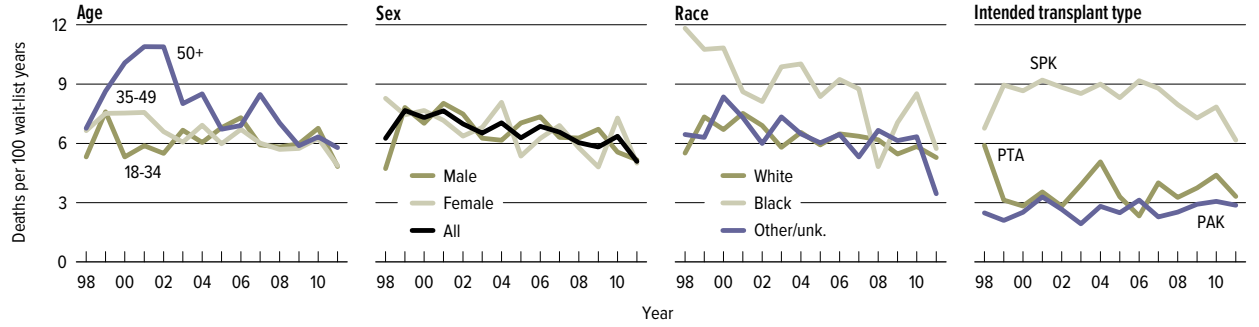
PA 1.8 Percent of adult wait-listed patients, 2006, who received a deceased donor pancreas transplant within five years, by DSA

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.



PA 1.9 Adult wait-listed patients who received a deceased donor pancreas 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.



PA 1.10 Pre-transplant mortality rates among adult patients wait-listed for a pancreas 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.

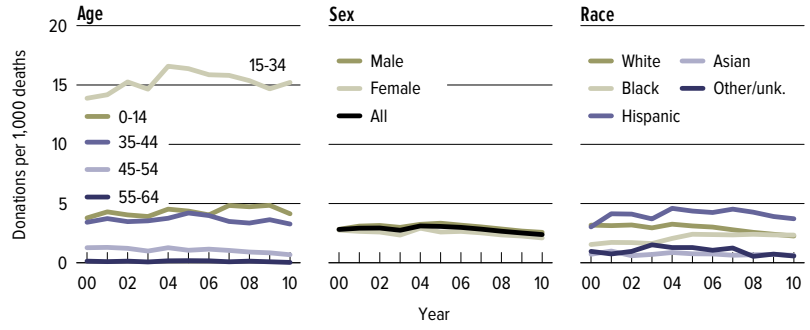
wait list

		2001						2011					
	Level	PTA N	%	SPK N	%	PAK N	%	PTA N	%	SPK N	%	PAK N	%
Age	18-34	81	23.7	548	22.8	126	19.0	89	19.2	397	19.1	62	9.8
	35-49	217	63.5	1469	61.0	420	63.4	221	47.7	1,224	59.0	365	57.8
	50-64	43	12.6	383	15.9	114	17.2	146	31.5	450	21.7	200	31.7
	65+	1	0.3	7	0.3	2	0.3	7	1.5	5	0.2	4	0.6
Sex	Male	148	43.3	1,356	56.3	388	58.6	190	41.0	1,168	56.3	354	56.1
	Female	194	56.7	1,051	43.7	274	41.4	273	59.0	908	43.7	277	43.9
Race	White	315	92.1	1,776	73.8	564	85.2	383	82.7	1,274	61.4	472	74.8
	Black	14	4.1	385	16.0	52	7.9	30	6.5	468	22.5	76	12.0
	Hispanic	12	3.5	197	8.2	36	5.4	40	8.6	261	12.6	70	11.1
	Asian	0	0.0	37	1.5	7	1.1	4	0.9	38	1.8	11	1.7
	Other/unknown	1	0.3	12	0.5	3	0.5	6	1.3	35	1.7	2	0.3
Primary cause	Diabetes Type 1	314	91.8	2,052	85.3	593	89.6	393	84.9	1,694	81.6	568	90.0
of disease	Diabetes Type 2	11	3.2	220	9.1	22	3.3	14	3.0	196	9.4	39	6.2
	Diabetes type unk.	0	0.0	1	0.0	2	0.3	1	0.2	27	1.3	13	2.1
	Other cause/unk.	17	5.0	134	5.6	45	6.8	55	11.9	159	7.7	11	1.7
Transplant	Listed/first tx	314	91.8	2,290	95.1	515	77.8	401	86.6	1,913	92.1	457	72.4
history	Listed/subseq. tx	28	8.2	117	4.9	147	22.2	62	13.4	163	7.9	174	27.6
Blood type	A	122	35.7	722	30.0	265	40.0	173	37.4	662	31.9	241	38.2
	B	43	12.6	344	14.3	76	11.5	50	10.8	297	14.3	68	10.8
	AB	6	1.8	54	2.2	24	3.6	9	1.9	52	2.5	23	3.6
	O	171	50.0	1,287	53.5	297	44.9	231	49.9	1,065	51.3	299	47.4
PRA	<1%	227	66.4	1,455	60.4	312	47.1	271	58.5	1,212	58.4	270	42.8
	1-<80%	95	27.8	741	30.8	296	44.7	104	22.5	519	25.0	247	39.1
	80-100%	20	5.8	209	8.7	46	6.9	88	19.0	345	16.6	114	18.1
Time on list	<1 year	169	49.4	1,143	47.5	372	56.2	140	30.2	832	40.1	167	26.5
	1-<2	64	18.7	717	29.8	173	26.1	86	18.6	505	24.3	96	15.2
	2-<3	35	10.2	279	11.6	49	7.4	54	11.7	267	12.9	85	13.5
	3-<4	24	7.0	112	4.7	17	2.6	41	8.9	158	7.6	65	10.3
	4-<5	17	5.0	68	2.8	8	1.2	24	5.2	103	5.0	57	9.0
	5+	33	9.6	88	3.7	43	6.5	118	25.5	211	10.2	161	25.5
BMI (kg/m^2)	<18.5	8	2.3	64	2.7	14	2.1	13	2.8	32	1.5	10	1.6
	18.5-24.9	187	54.7	1,153	47.9	293	44.3	192	41.5	836	40.3	241	38.2
	25.0-27.9	77	22.5	535	22.2	168	25.4	109	23.5	522	25.1	163	25.8
	28.0-29.9	20	5.8	217	9.0	58	8.8	52	11.2	252	12.1	87	13.8
	30.0-34.9	20	5.8	238	9.9	60	9.1	66	14.3	325	15.7	96	15.2
	35.0-39.9	5	1.5	55	2.3	13	2.0	19	4.1	71	3.4	20	3.2
	40.0+	4	1.2	20	0.8	6	0.9	3	0.6	17	0.8	2	0.3
	Unknown	21	6.1	125	5.2	50	7.6	9	1.9	21	1.0	12	1.9
Total		342	100.0	2,407	100.0	662	100.0	463	100.0	2,076	100.0	631	100.0

PA 1.11 Characteristics of adult patients on the pancreas transplant waiting list on December 31, 2001 & December 31, 2011

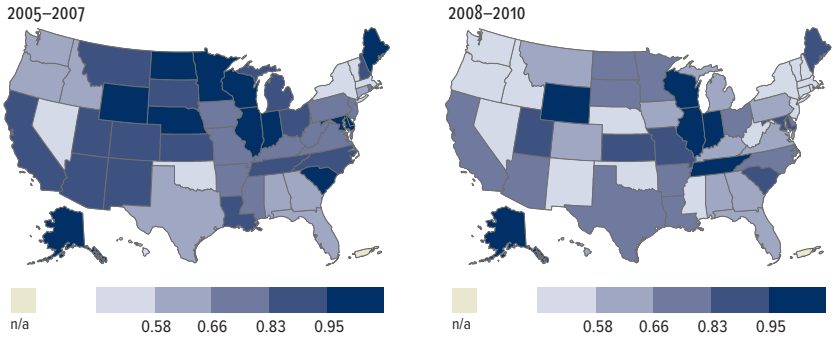
Patients waiting for a transplant on December 31, 2001 and December 31, 2011, regardless of first listing date; active/inactive status is on this date, and multiple listings are not counted.

donation



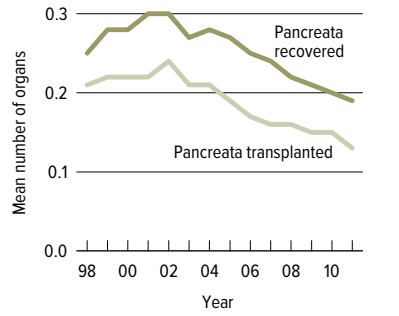
PA 2.1 Deceased donor pancreas donation rates

Numerator: Deceased donors age less than 65 whose pancreas 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.)



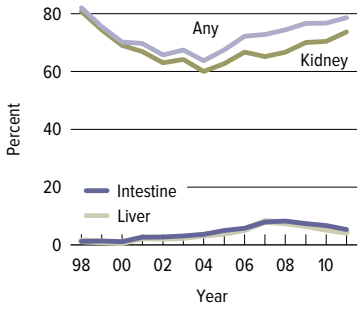
PA 2.2 Deceased donor pancreas donation rates (per 1,000 deaths), by state

Numerator: Deceased donors residing in the 50 states whose pancreas 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.



PA 2.3 Pancreata recovered per donor & pancreata transplanted per donor

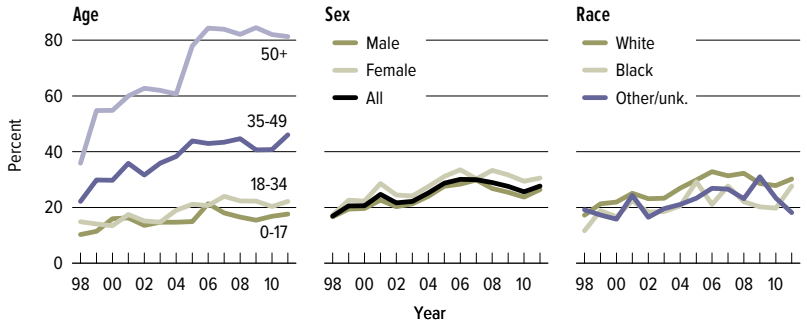
Denominator: all deceased donors with at least one organ of any type recovered for transplant. Numerator for recovery rate: number of pancreata recovered for transplant in the given year; pancreata recovered for other purposes are not included. Numerator for transplant rate: all deceased donor pancreata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



PA 2.4 Deceased donor pancreata transplanted with another organ

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

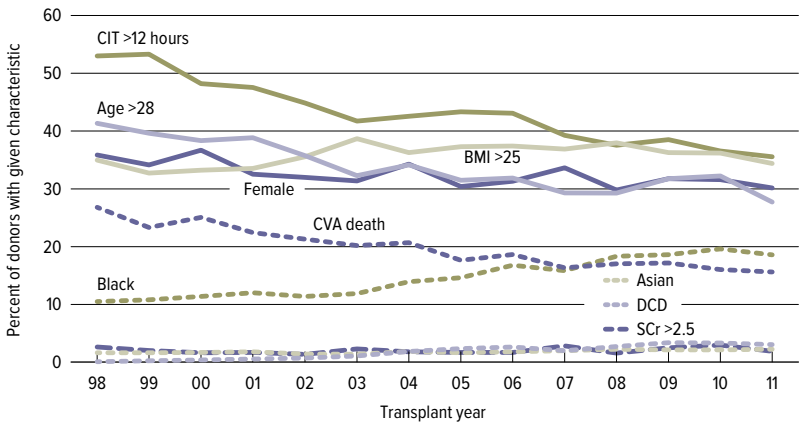
donation



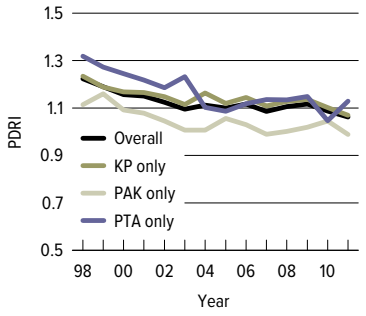
PA 2.5 Discard rates for pancreata recovered for transplant
Percent of pancreata discarded out of all pancreata recovered for transplant.

Reasons for discard	Percent	N
Other, specify	37.95	159
Anatomical abnormalities	18.38	77
No recipient located - list exhausted	10.74	45
Poor organ function	6.68	28
Diseased organ	6.21	26
Too old on ice	3.82	16
Organ trauma	3.10	13
Vascular damage	3.10	13
Recipient determined to be unsuitable	2.39	10
Donor medical history	2.15	9
Organ not as described	1.43	6
Warm ischemic time too long	1.43	6
Biopsy findings	1.19	5
Donor social history	0.72	3
Infection	0.24	1
Missing	0.24	1
Positive hepatitis	0.24	1

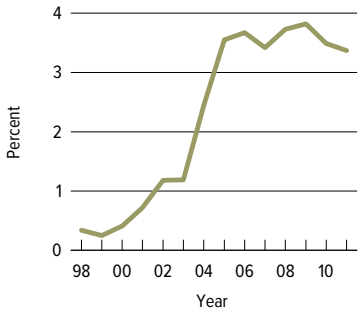
PA 2.6 Reasons for discards, 2011
Reasons for discard among pancreata recovered for transplant but not transplanted in 2011.



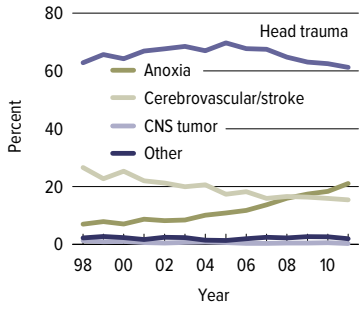
PA 2.7 Major components of pancreas donor risk index (PDRI) over time
Adult patients receiving a simultaneous kidney-pancreas or pancreas-alone deceased donor transplant. Components of the PDRI are donor age, race, sex, creatinine, cause of death, DCD, BMI, height, and cold ischemic time of pancreas.



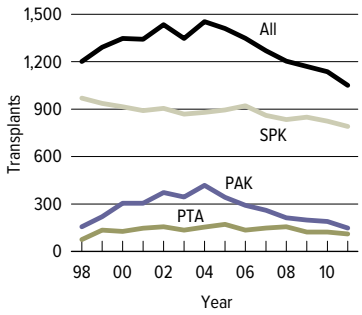
PA 2.8 Mean pancreas donor risk index (PDRI)
Adult patients receiving a simultaneous kidney-pancreas or pancreas-alone deceased donor transplant.



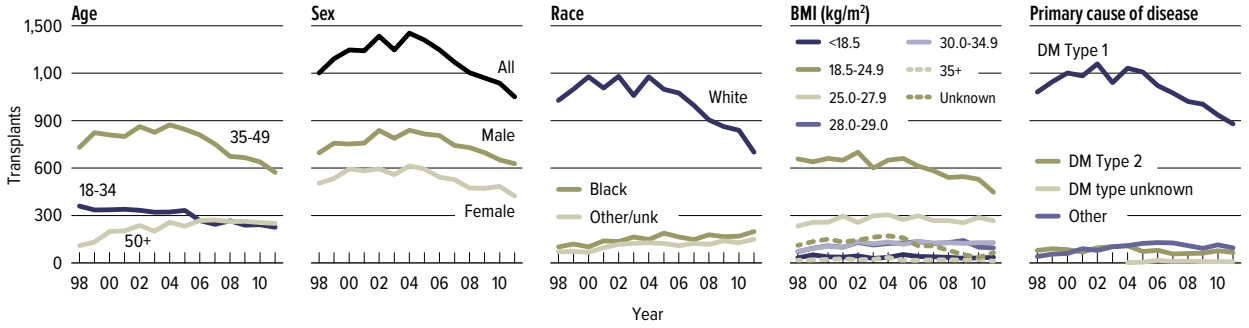
PA 2.9 Pancreas donors who are DCD
Deceased donors whose pancreas was recovered for transplant. DCD status is reported on the OPTN Deceased Donor Registration form.



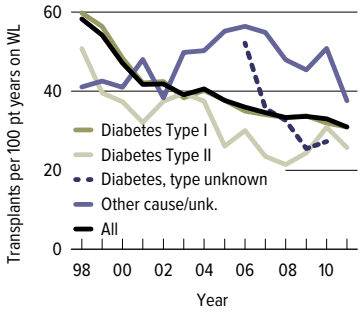
PA 2.10 Cause of death among deceased pancreas donors
Deceased donors whose pancreas was transplanted. CNS = central nervous system.



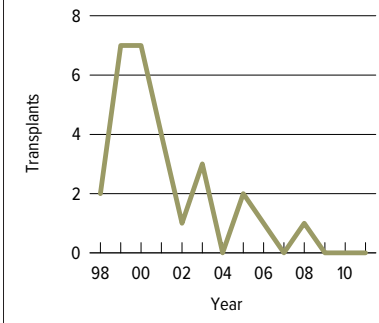
PA 3.1 Total adult pancreas transplants
Patients receiving a transplant. Retransplants are counted.



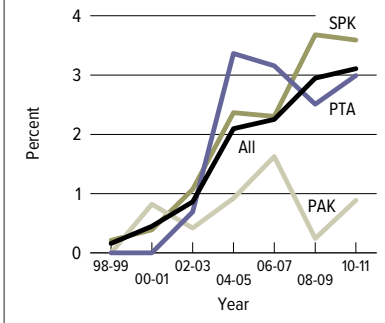
PA 3.2 Adult pancreas transplants
Patients receiving a transplant. Retransplants are counted.



PA 3.3 Pancreas 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. Yearly rates based on fewer than 10 transplants (for unknown diabetes type) are not shown.

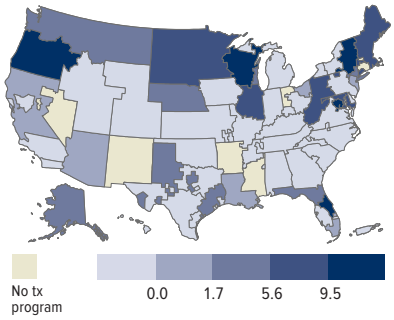


PA 3.4 Adult pancreas transplants from living donors
Living donor transplants.



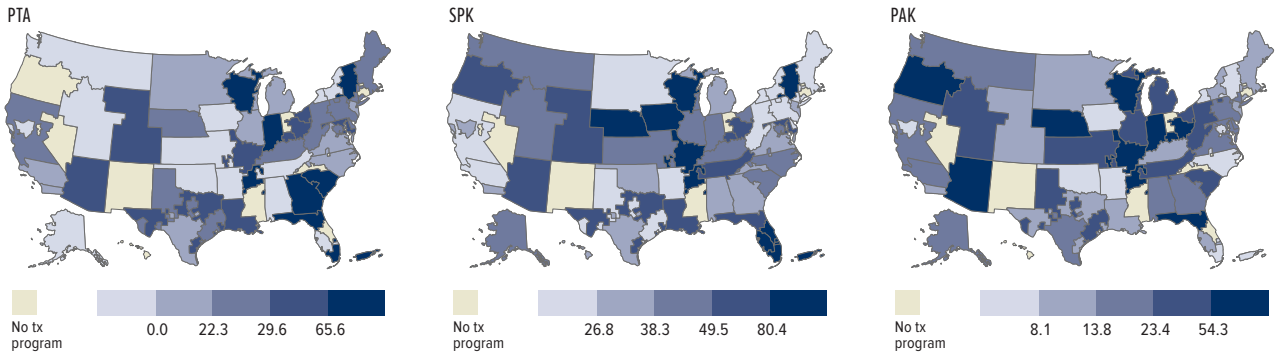
PA 3.5 Use of DCD pancreata among adult recipients, by transplant type
Percent of deceased donor transplants using a DCD donor.

transplant



PA 3.6 Percent of adult deceased donor pancreas transplants that are DCD, by DSA, 2009–2011

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

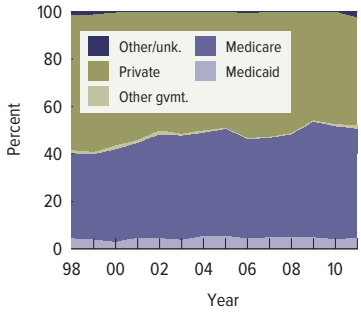


PA 3.7 Deceased donor pancreas transplant rates per 100 patient years on the waiting list among adult candidates, by DSA, 2010–2011

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.

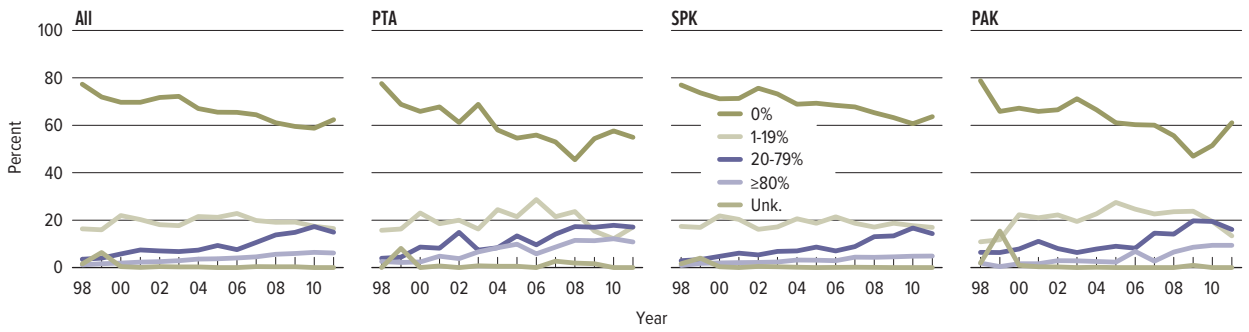
		All		PTA		SPK		PAK	
	Level	N	%	N	%	N	%	N	%
Age	18-34	226	21.5	23	20.7	169	21.4	34	22.8
	35-49	574	54.6	48	43.2	444	56.1	82	55.0
	50-64	249	23.7	39	35.1	177	22.4	33	22.1
	65+	2	0.2	1	0.9	1	0.1	0	0.0
Sex	Female	423	40.2	70	63.1	288	36.4	65	43.6
	Male	628	59.8	41	36.9	503	63.6	84	56.4
Race	White	702	66.8	99	89.2	499	63.1	104	69.8
	Black	199	18.9	3	2.7	179	22.6	17	11.4
	Hispanic	118	11.2	7	6.3	88	11.1	23	15.4
	Asian	17	1.6	1	0.9	14	1.8	2	1.3
	Other/unknown	15	1.4	1	0.9	11	1.4	3	2.0
Primary cause of disease	Diabetes Type 1	896	85.3	82	73.9	677	85.6	137	91.9
	Diabetes Type 2	64	6.1	1	0.9	54	6.8	9	6.0
	Diabetes type unk.	9	0.9	0	0.0	7	0.9	2	1.3
	Other cause/unk.	82	7.8	28	25.2	53	6.7	1	0.7
Blood type	A	378	36.0	48	43.2	270	34.1	60	40.3
	B	123	11.7	7	6.3	98	12.4	18	12.1
	AB	52	4.9	6	5.4	40	5.1	6	4.0
	O	498	47.4	50	45.0	383	48.4	65	43.6
BMI (kg/m^2)	<18.5	38	3.6	5	4.5	24	3.0	9	6.0
	18.5-24.9	478	45.5	46	41.4	368	46.5	64	43.0
	25.0-27.9	282	26.8	24	21.6	222	28.1	36	24.2
	28.0-29.9	105	10.0	15	13.5	68	8.6	22	14.8
	30.0-34.9	136	12.9	19	17.1	99	12.5	18	12.1
	35.0-39.9	10	1.0	2	1.8	8	1.0	0	0.0
	40.0+	2	0.2	0	0.0	2	0.3	0	0.0
	Unknown	.	0.0	0	0.0	0	0.0	0	0.0
Time on waiting list	<30 days	97	9.2	18	16.2	65	8.2	14	9.4
	31-60 days	88	8.4	20	18.0	55	7.0	13	8.7
	61-90 days	59	5.6	9	8.1	44	5.6	6	4.0
	3-<6 months	185	17.6	23	20.7	140	17.7	22	14.8
	6-<12 months	229	21.8	22	19.8	168	21.2	39	26.2
	1-<2 years	231	22.0	10	9.0	199	25.2	22	14.8
	2-<3 years	95	9.0	7	6.3	72	9.1	16	10.7
	3+ years	67	6.4	2	1.8	48	6.1	17	11.4
Insurance	Private	478	45.5	74	66.7	332	42.0	72	48.3
	Medicare	483	46.0	25	22.5	390	49.3	68	45.6
	Other government	63	6.0	7	6.3	49	6.2	7	4.7
	Other	27	2.6	5	4.5	20	2.5	2	1.3
Pancreas tx history	First transplant	995	94.7	104	93.7	776	98.1	115	77.2
	Retransplant	56	5.3	7	6.3	15	1.9	34	22.8
Total		1,051	100.0	111	100.0	791	100.0	149	100.0

PA 3.8 Characteristics of adult pancreas transplant recipients, 2011
Patients receiving a transplant. Retransplants are counted.

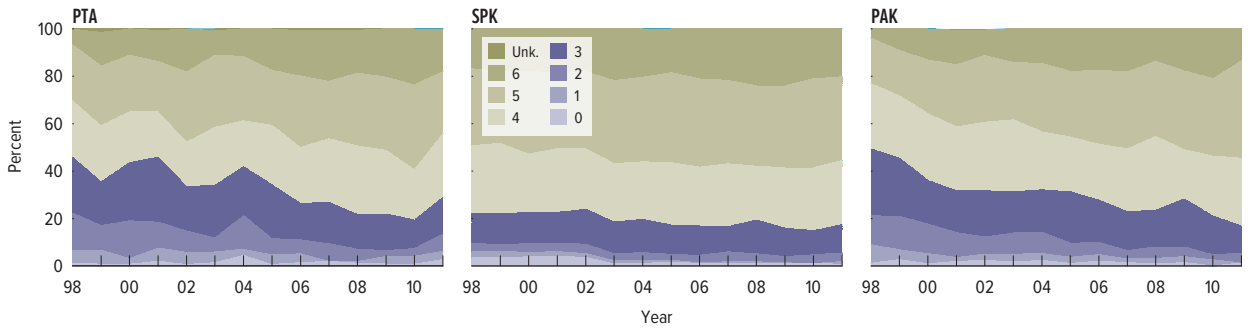


PA 3.9 Insurance coverage among adult pancreas transplant recipients at time of transplant
Patients receiving a transplant. Retransplants are counted.

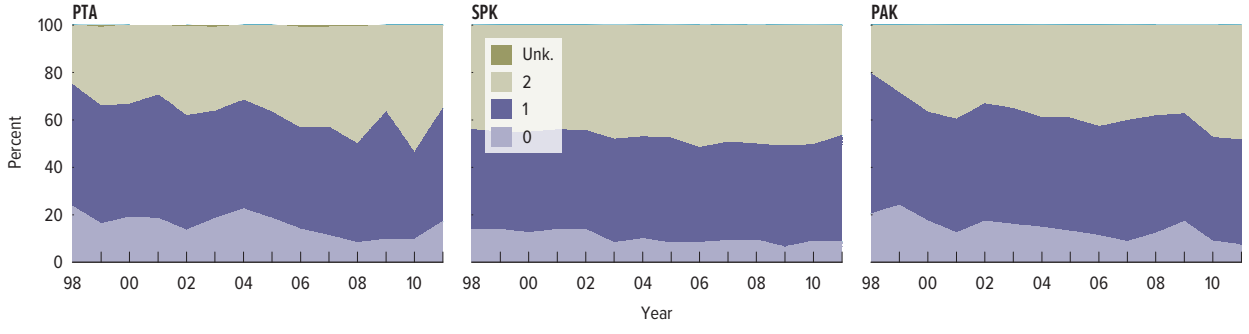
donor-recipient matching



PA 4.1 C/PRA at time of pancreas 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. CPRA is conditionally incorporated between December 1, 2007 – October 1, 2009 where, if CPRA is >0, the value is included but otherwise is not; from October 1, 2009, CPRA is included unconditionally.

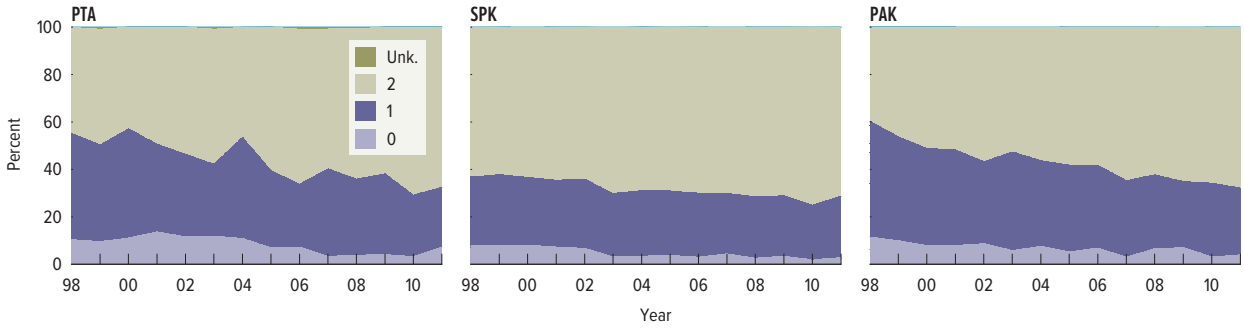


PA 4.2 Total HLA mismatches among adult pancreas transplant recipients
Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011.

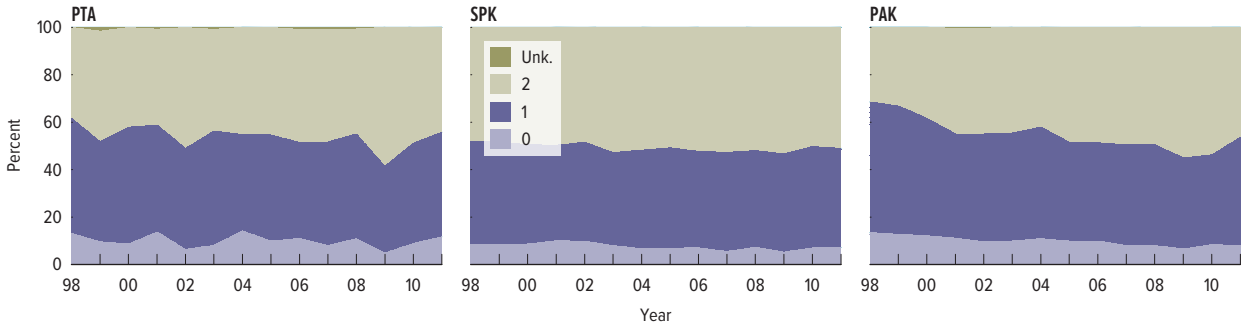


PA 4.3 HLA-A mismatches among adult pancreas transplant recipients
Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011.

donor-recipient matching



PA 4.4 HLA-B mismatches among adult pancreas transplant recipients
Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011.



PA 4.5 HLA-DR mismatches among adult pancreas transplant recipients
Donor and recipient antigen matching is based on the OPTN's antigen values and split equivalences policy as of 2011.

donor-recipient matching

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	19.3	27.8	0.2	47.3
Positive	19.1	29.9	0.2	49.2
Unknown	1.5	2.1	0.0	3.6
Total	39.8	59.8	0.4	100

PA 4.6 Adult pancreas donor-recipient cytomegalovirus (CMV) serology matching, 2007–2011

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

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	1.2	14.0	0.7	15.9
Positive	5.5	60.6	1.5	67.6
Unknown	1.1	14.4	0.9	16.4
Total	7.9	89.1	3.0	100

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

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

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	77.9	0.6	0.1	78.6
Positive	3.2	0.1	0.0	3.2
Unknown	18.1	0.1	0.0	18.2
Total	99.2	0.7	0.1	100

PA 4.8 Adult pancreas donor-recipient hepatitis B core antibody (HBcAb) serology matching, 2007–2011

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

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	92.3	0.0	0.2	92.5
Positive	1.4	0.0	0.0	1.4
Unknown	6.2	0.0	0.0	6.2
Total	99.8	0.0	0.2	100

PA 4.9 Adult pancreas donor-recipient hepatitis B surface antigen (HBsAg) serology matching, 2007–2011

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

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	90.1	0.0	0.0	90.1
Positive	3.2	0.0	0.0	3.2
Unknown	6.7	0.0	0.0	6.7
Total	100	0.0	0.0	100

PA 4.10 Adult pancreas donor-recipient hepatitis C serology matching, 2007–2011

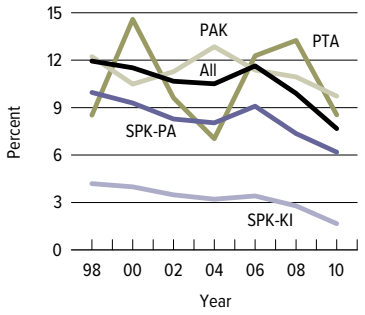
Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields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

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	84.5	0.0	0.1	84.6
Positive	0.2	0.0	0.0	0.2
Unknown	15.2	0.0	0.0	15.2
Total	99.9	0.0	0.1	100

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

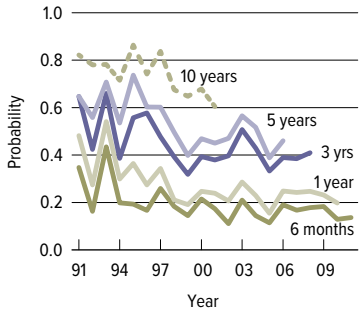
Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields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

outcomes



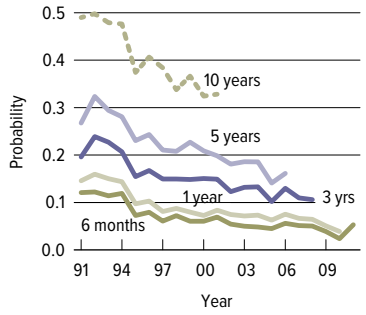
PA 5.1 Graft failure within the first 6 weeks after transplant among adult pancreas transplant recipients

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.



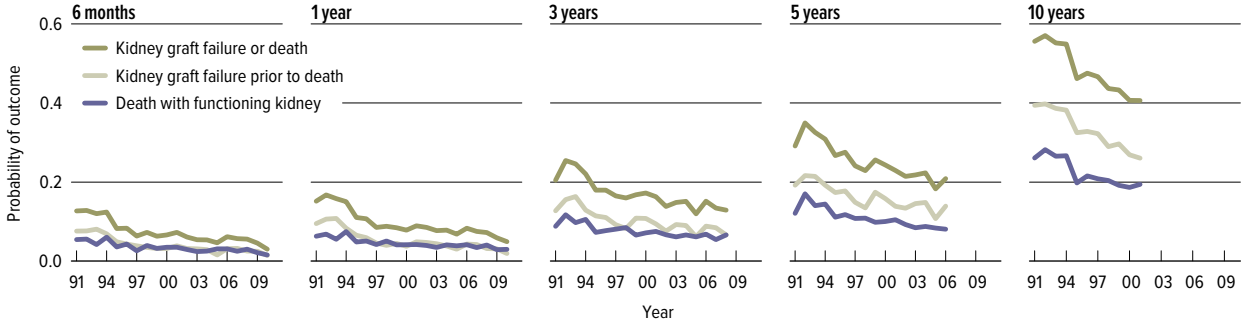
PA 5.2 Graft failure among adult PTA transplant recipients

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



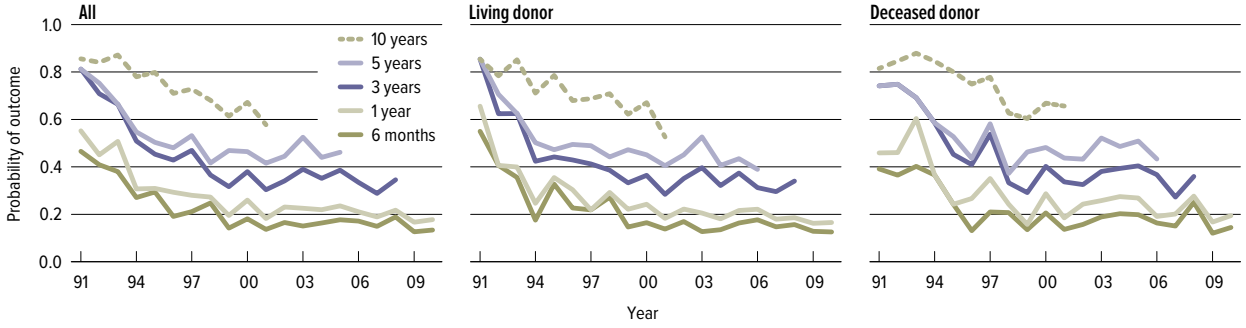
PA 5.3 Graft failure among adult SPK transplant recipients: pancreas outcomes

Cox proportional hazards models, adjusted for age, sex, and race. Simultaneous kidney-pancreas (SPK) transplant recipients are followed from date of transplant until the first of reported pancreas graft failure, pancreas retransplant, death, or loss-to-follow-up.



PA 5.4 Outcomes among adult SPK transplant recipients: kidney outcomes

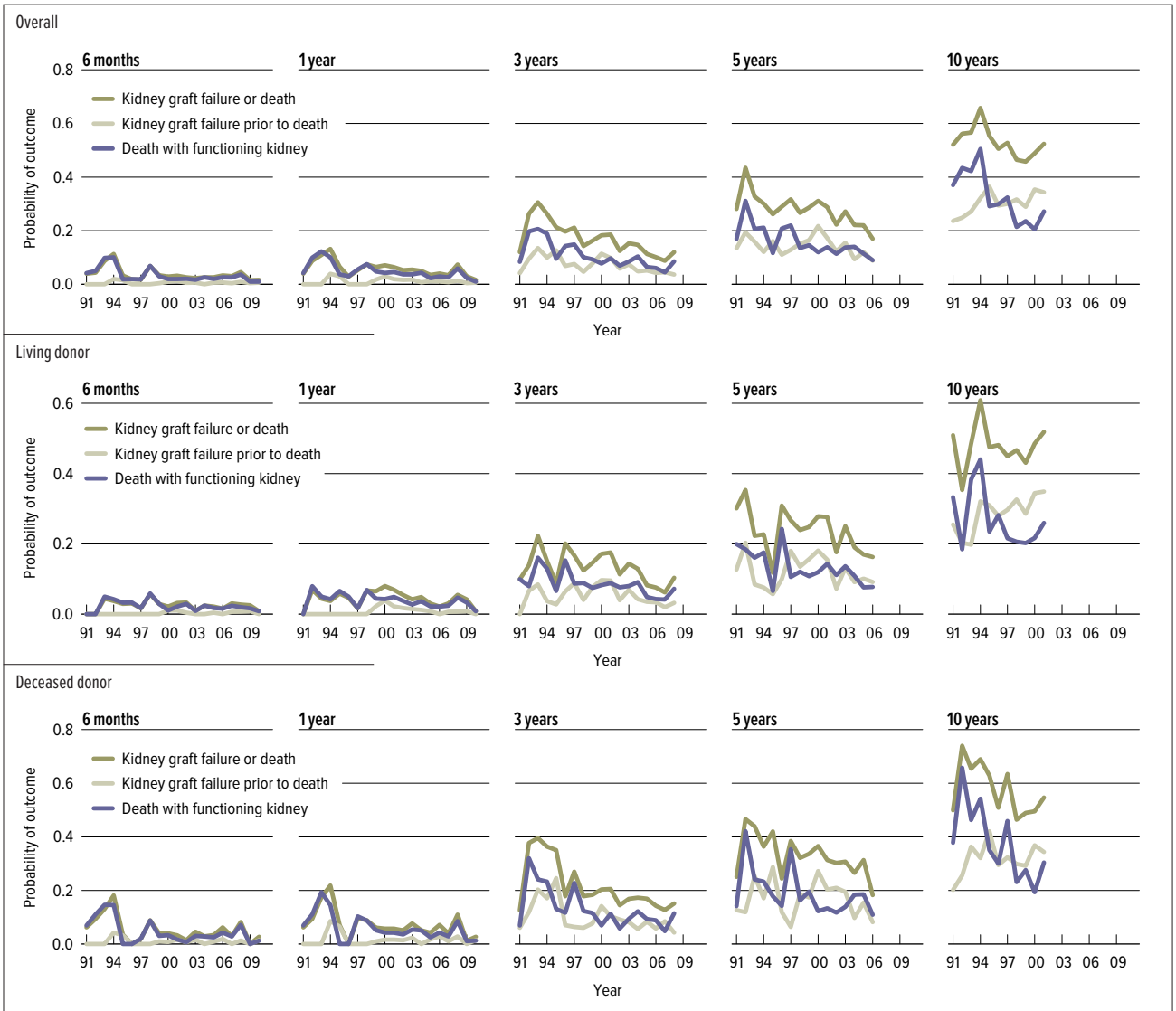
Cox proportional hazards models, adjusted for age, sex, and race. Simultaneous kidney-pancreas (SPK) transplant recipients are followed from date of transplant until the first of kidney graft failure, kidney retransplant, return to dialysis, death, or loss-to-follow-up.



PA 5.5 Pancreas graft failure among adult PAK transplant recipients by kidney donor type

Cox proportional hazards models, adjusted for age, sex, and race. Pancreas-after-kidney (PAK) transplant recipients are followed from date of transplant until the first of pancreas graft failure, pancreas retransplant, death, or loss-to-follow-up. Only PAK recipients with a record of a previous KI/KP transplant are included.

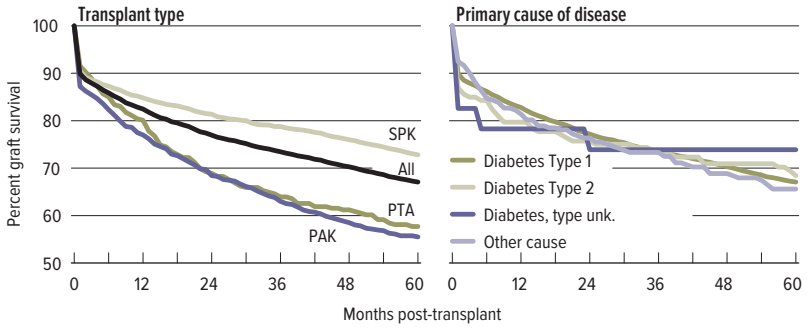
outcomes



PA 5.6 Outcomes among adult PAK transplant recipients: kidney outcomes (from time of pancreas transplant)

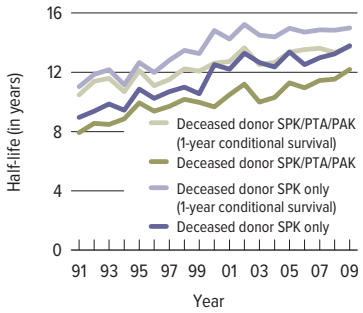
Cox proportional hazards models, adjusted for age, sex, and race. Pancreas-after-kidney (PAK) transplant recipients are followed from date of pancreas transplant until the first of kidney graft failure, kidney retransplant, return to dialysis, death, or loss-to-follow-up. Only PAK recipients with a record of a previous KI/KP transplant are included.

outcomes



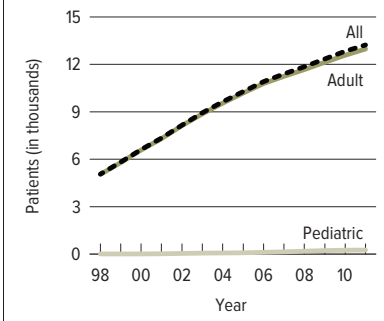
PA 5.7 Graft survival among adult pancreas transplant recipients transplanted in 2006: deceased donors

All-cause graft survival estimated using unadjusted Kaplan-Meier methods; pancreas outcomes only.



PA 5.8 Half-lives for adult pancreas transplant recipients

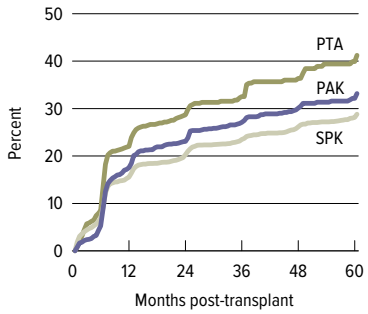
Estimated graft half-lives and conditional half-lives. Half-lives are interpreted as the estimated median survival of grafts from the time of transplant. Conditional half-lives are interpreted as the estimated median survival of grafts which survive the first year.



PA 5.9 Recipients alive & with a functioning pancreas transplant on June 30 of the year

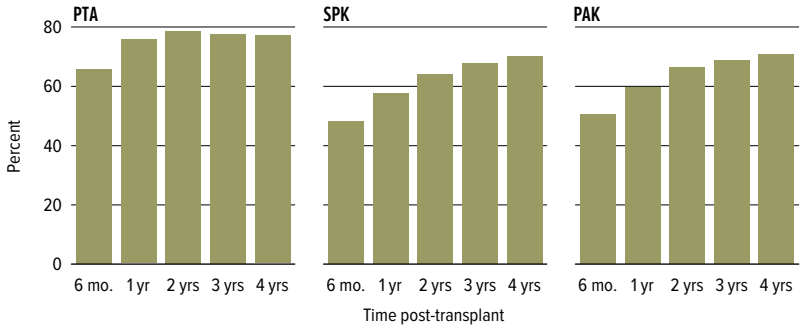
Transplants before June 30 of the year that are still functioning. Patients are assumed alive with function unless a death or graft failure is recorded. A recipient can experience a graft failure and drop from the cohort, then be retransplanted and re-enter the cohort.

outcomes



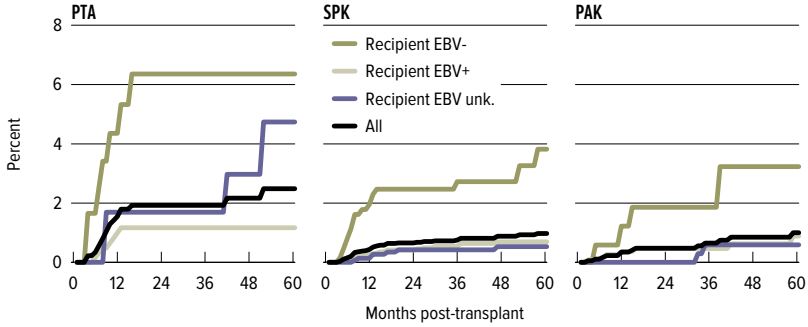
PA 5.10 Incidence of first acute rejection among adult patients receiving a pancreas transplant in 2005–2009

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. For simultaneous kidney-pancreas recipients, an acute rejection may be of the kidney or pancreas, and graft failure is the first of kidney or pancreas graft failure. Cumulative incidence, defined as the probability of acute rejection at any time prior to the given time, is estimated using Kaplan-Meier methods.



PA 5.11 Reported cumulative incidence of rehospitalizations among adult patients receiving a pancreas transplant in 2006–2011

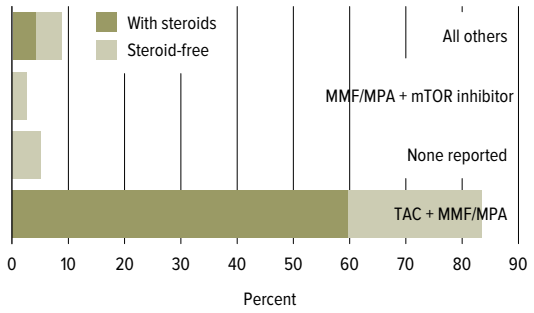
Cumulative incidence of rehosptalization post-transplant; hospitalization identified from the OPTN Transplant Recipient Follow-up form. Patients required to be alive with graft function at each time period, so denominators reduce over time.`



PA 5.12 Incidence of PTLD among adult patients receiving a pancreas transplant in 2003–2009, by recipient Epstein-Barr virus (EBV) status at transplant

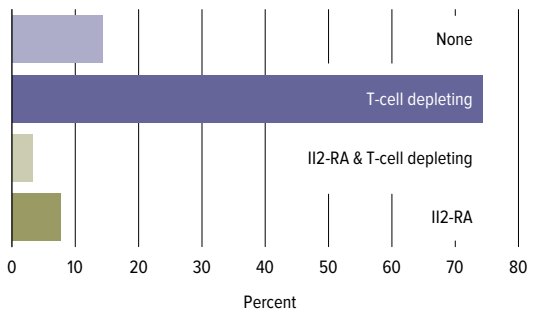
The cumulative incidence, defined as the probability of post-transplant lymphoproliferative disorder (PTLD) being diagnosed between the time of transplant and the given time, is estimated using Kaplan-Meier methods. PTLD is identified as either a reported complication or cause of death on the Transplant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

immunosuppression



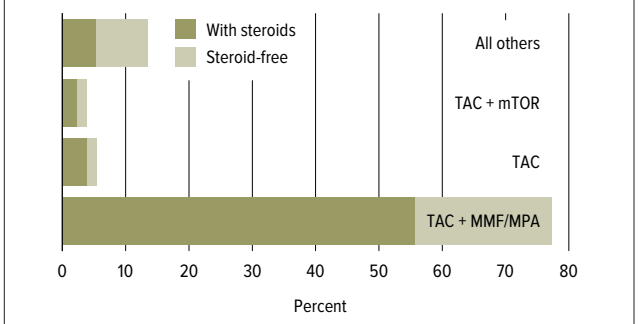
PA 6.1 Initial immunosuppression regimen in adult pancreas transplant recipients, 2011

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



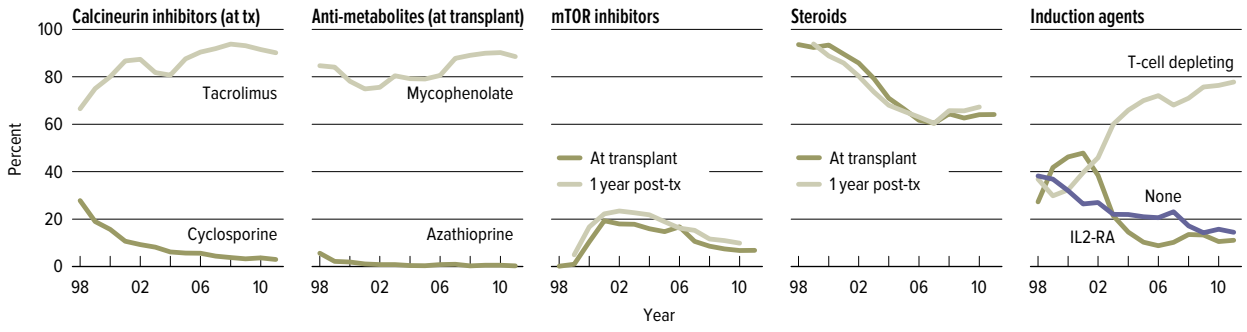
PA 6.2 Induction agents used at time of pancreas transplant, adult recipients, 2011

Patients transplanted in 2011 and discharged with a functioning graft.



PA 6.3 Immunosuppression regimen at one year in adult pancreas transplant recipients, 2010

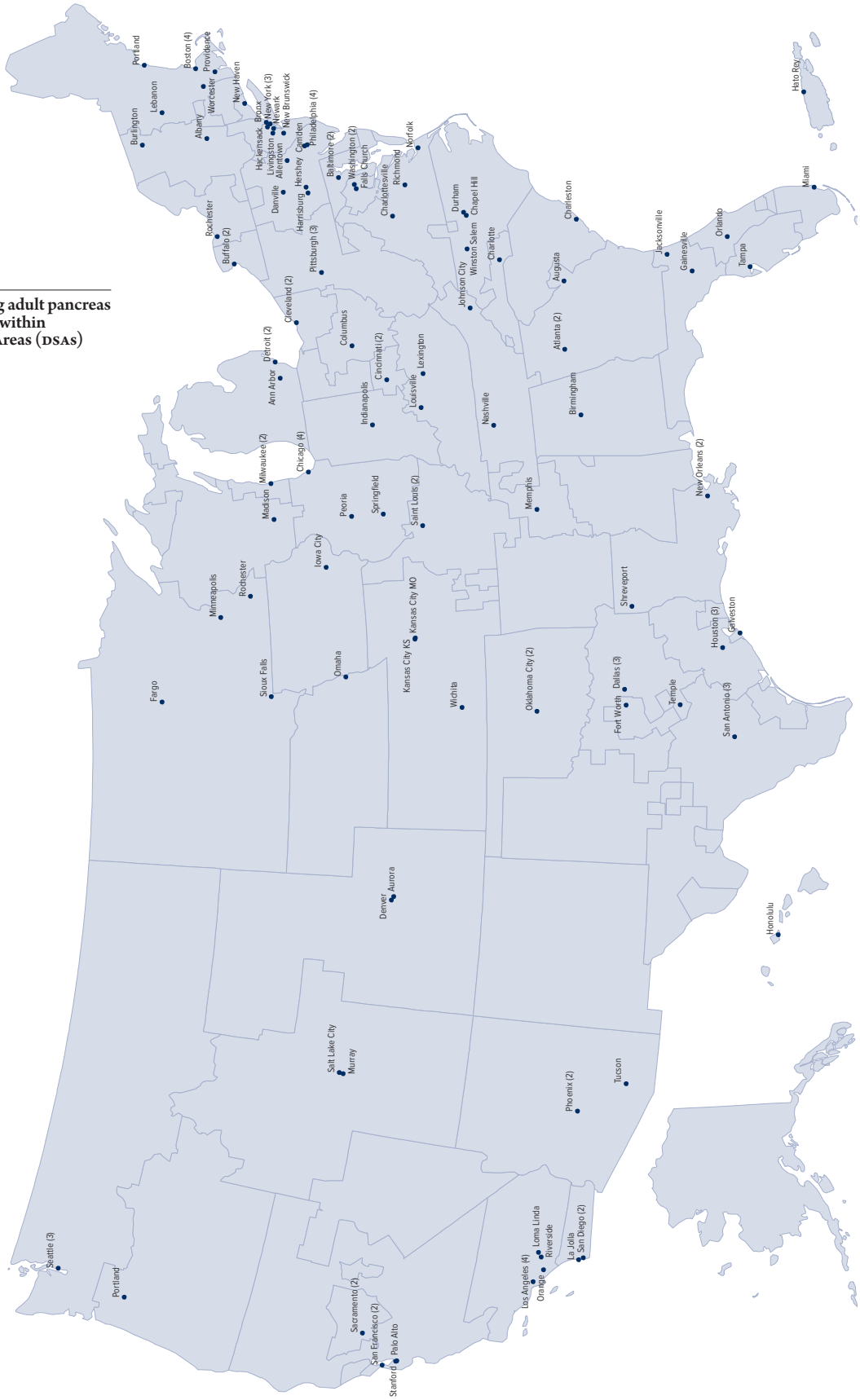
Patients transplanted in 2010 and remaining alive with graft function one year post-transplant. Top three one-year immunosuppression regimens are given, plus the "all others" group. Regimens are defined by use of calcineurin inhibitors (TAC=Tacrolimus, Cyclo=Cyclosporine), anti-metabolites (AZA=Azathioprine,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



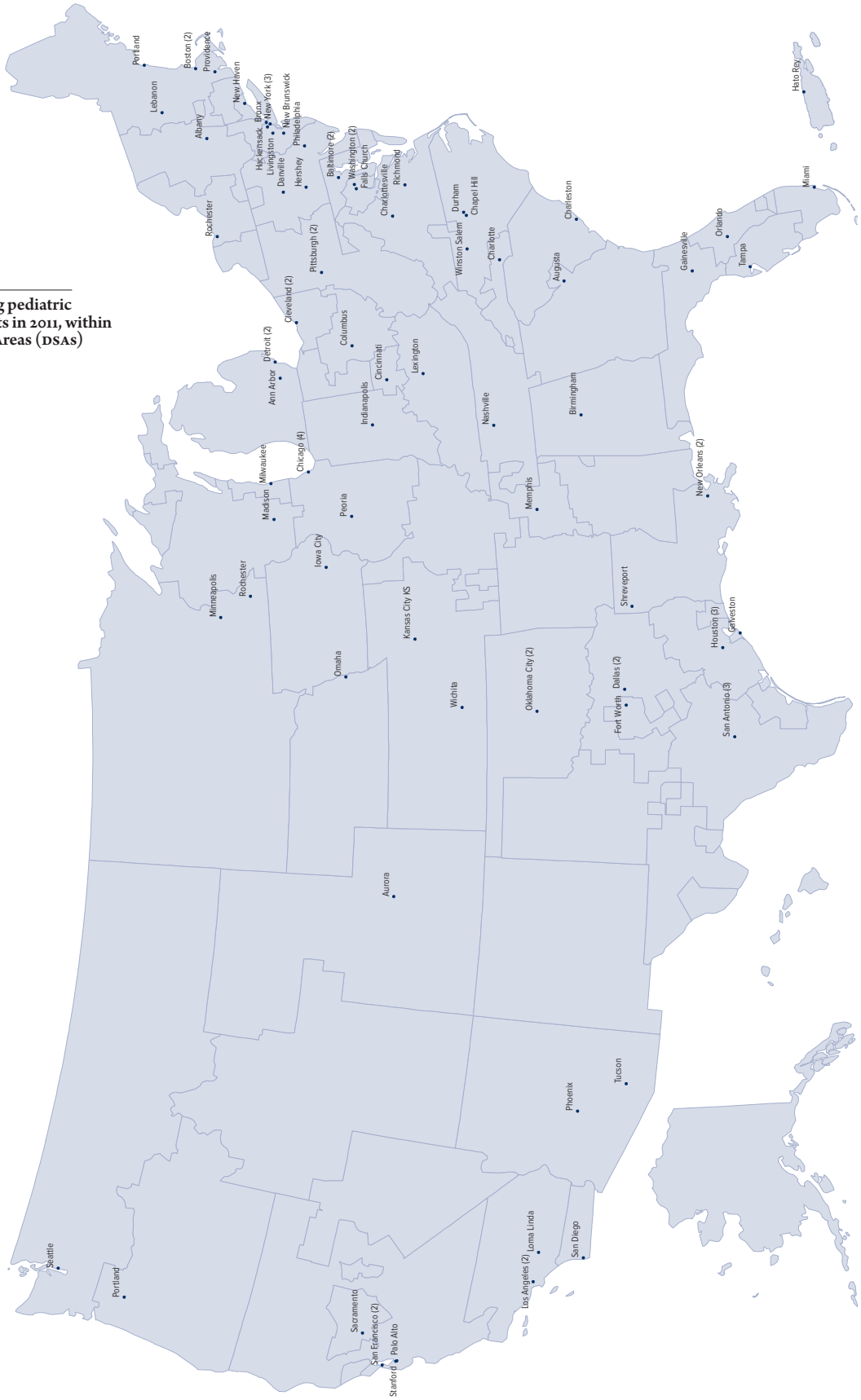
PA 6.4 Immunosuppression use in adult pancreas transplant recipients

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.

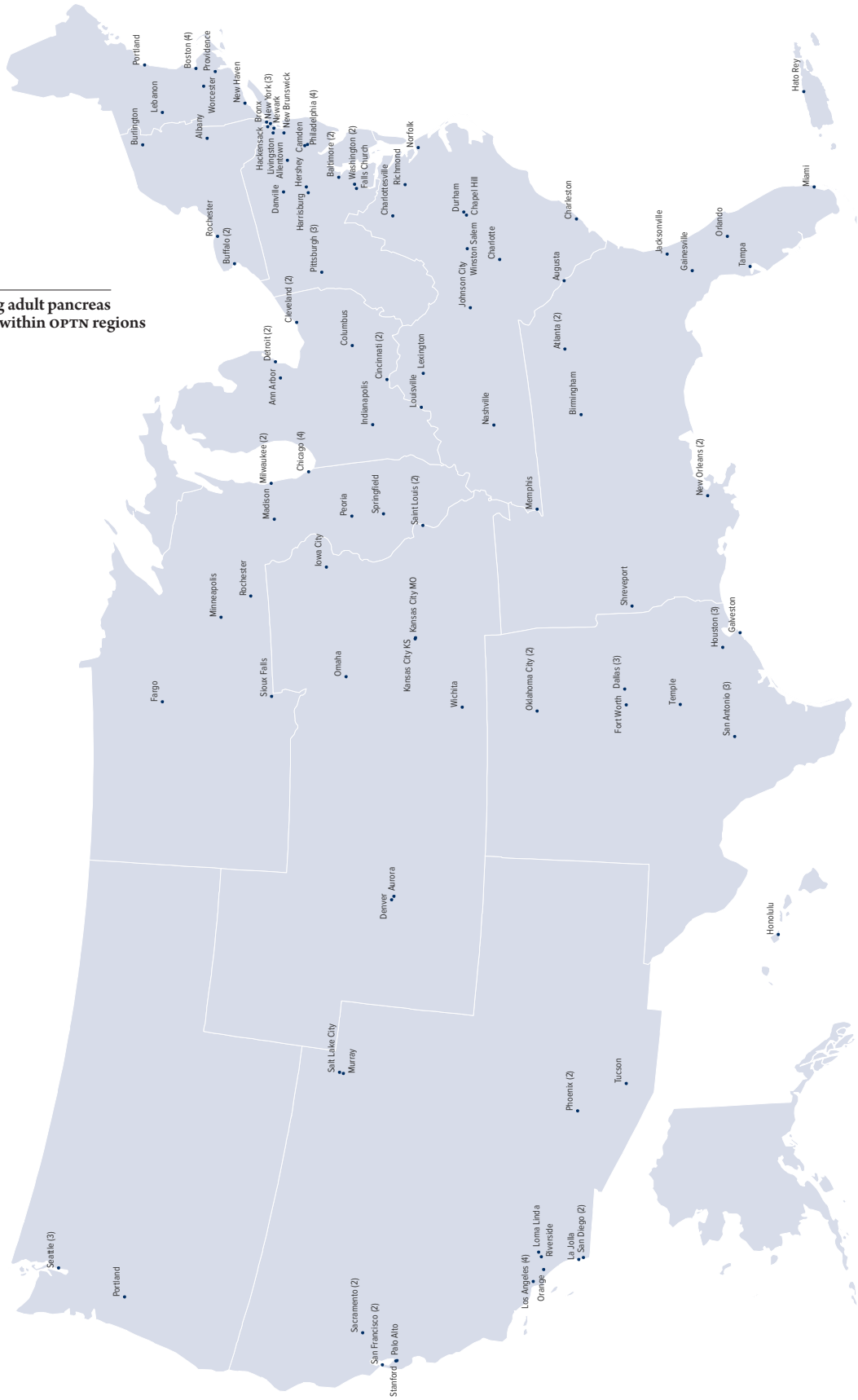
PA 7.1 Centers performing adult pancreas transplants in 2011, within Donation Service Areas (DSAs)



PA 7.2 Centers performing pediatric pancreas transplants in 2011, within Donation Service Areas (DSAs)



PA 7.3 Centers performing adult pancreas transplants in 2011, within OPTN regions



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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 mycophenolate 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 to10 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).

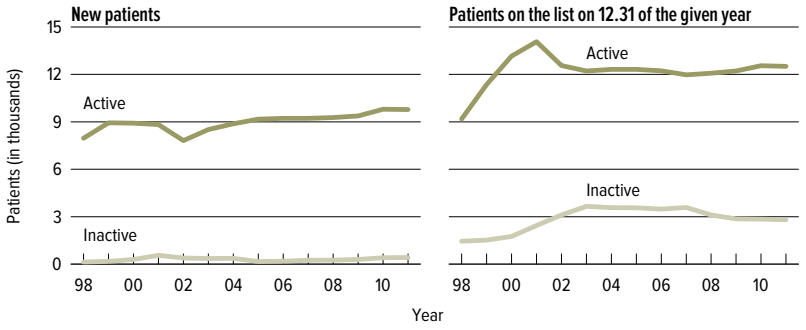
Immunosuppression and Outcomes

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

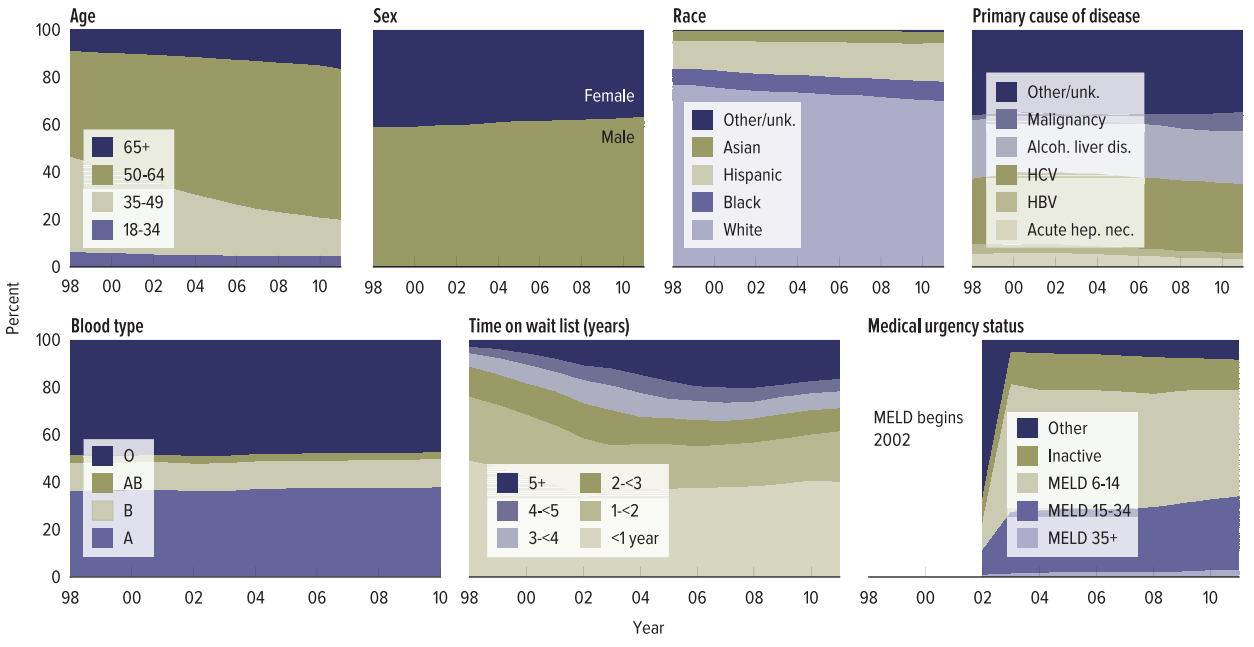
The OPTN Pediatric Transplantation and Liver and Intestinal Organ Transplantation Committees developed two proposals that were adopted by the OPTN Board of Directors in November 2011 and implemented on February 1, 2012: 1) to allow centers to seek permission to list all pediatric liver candidates with 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



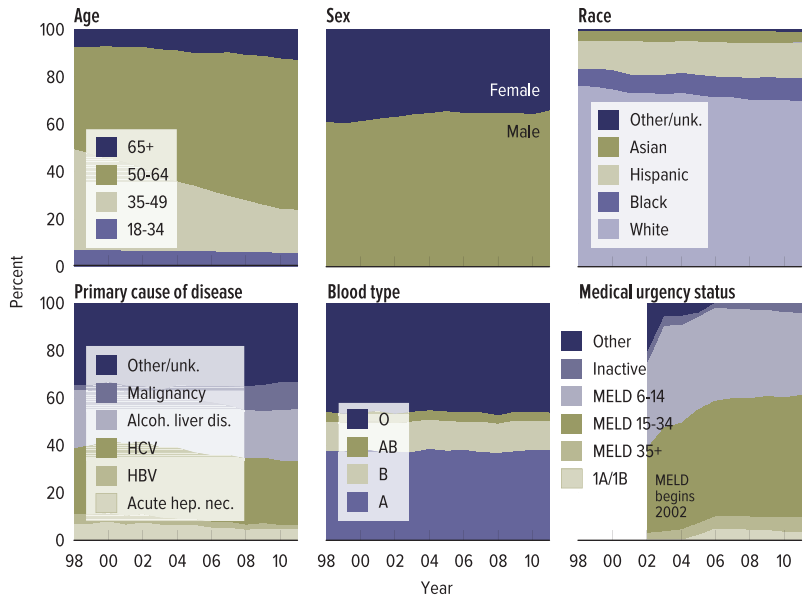
LI 1.1 Adult patients waiting for a liver transplant

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.



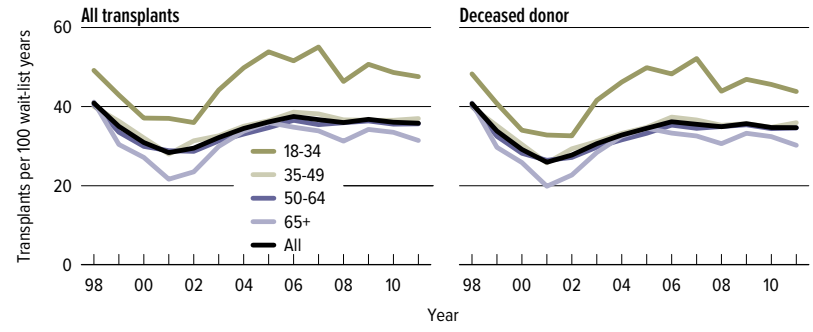
LI 1.2 Distribution of adult patients waiting for a liver transplant

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.

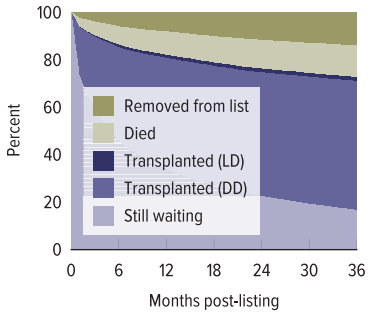
	2009	2010	2011
Patients at start of year	15,181	15,074	15,376
Patients added during year	9,674	10,210	10,212
Patients removed during year	9,761	9,890	10,258
Patients at end of year	15,094	15,394	15,330
Removal reason			
Deceased donor transplant	5,548	5,489	5,596
Living donor transplant	167	210	186
Patient 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.

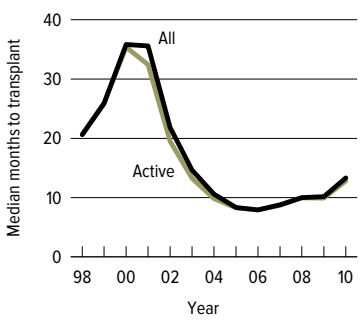
data behind the figures can be downloaded from our website, at www.srtr.org

wait list



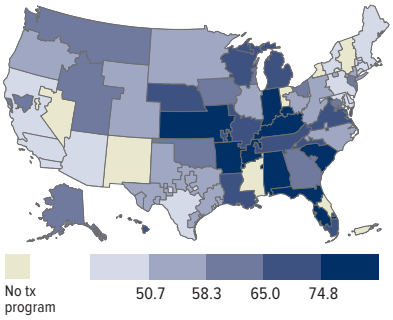
LI 1.6 Outcomes for adult patients waiting for a liver transplant among new listings in 2008

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.



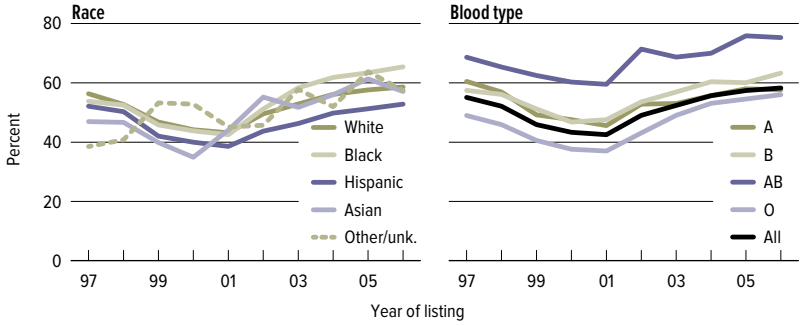
LI 1.7 Median months to liver transplant for wait-listed adult patients

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

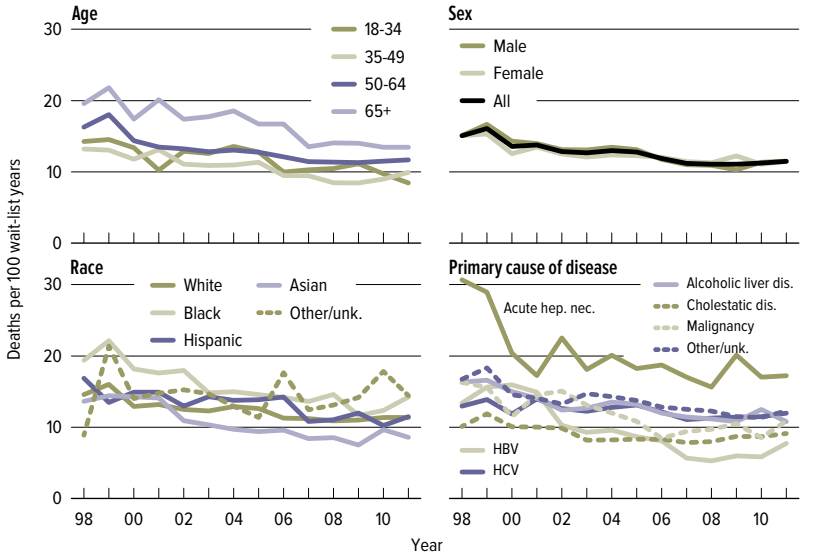
Patients with concurrent listings in a single DSA are counted once in that DSA, and those listed in multiple DSAs are counted separately per DSA.



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

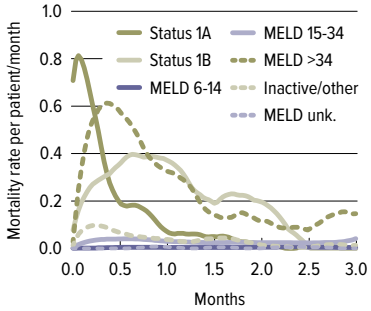
Patients with concurrent listings at more than one center are counted once, from the time of earliest listing to the time of latest removal. Patients listed, transplanted, and re-listed are counted more than once.

wait list



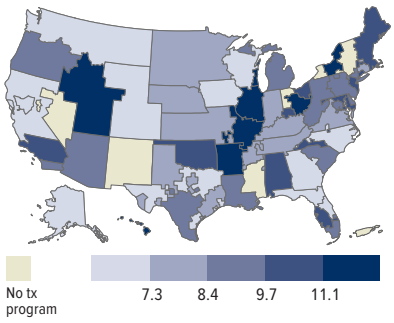
LI 1.10 Pre-transplant mortality rates among adult patients wait-listed for a liver transplant

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

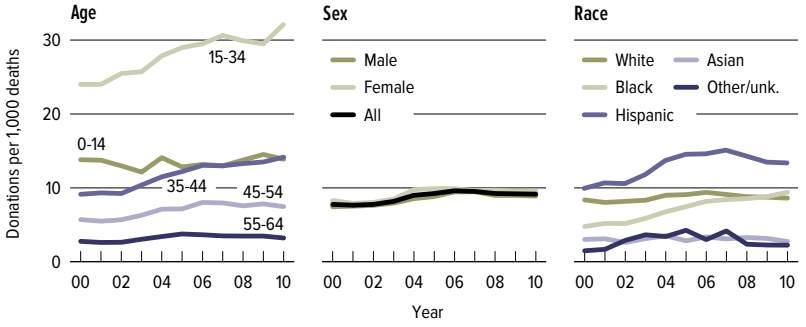
Percent of adult patients who die within 90 days of first listing. Patients with concurrent listings in a single DSA are counted once in that DSA, and those listed in multiple DSAs are counted separately per DSA. All deaths occuring within 90 days of listing are counted, including deaths occuring after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

		2001		2011	
	Level	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

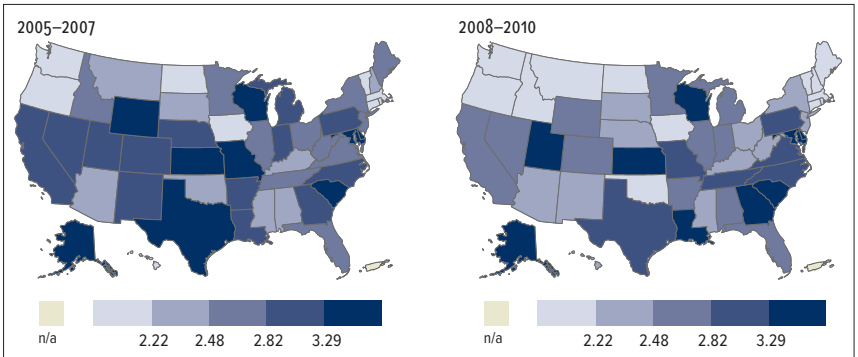
Patients waiting for a transplant on December 31, 2001 and December 31, 2011, regardless of first listing date; active/inactive status is on this date, and multiple listings are not counted.

deceased donation



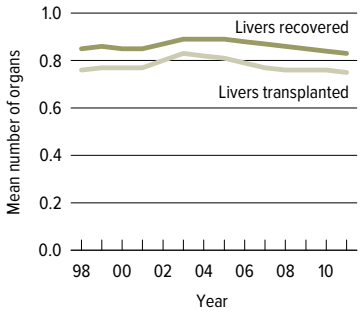
LI 2.1 Deceased donor liver donation rates

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.)



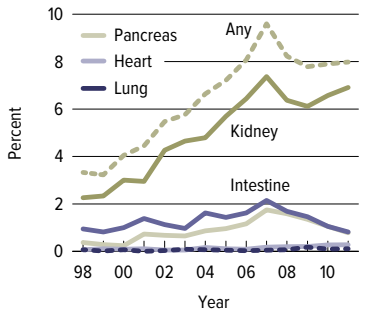
LI 2.2 Deceased donor liver donation rates (per 1,000 deaths), by state

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

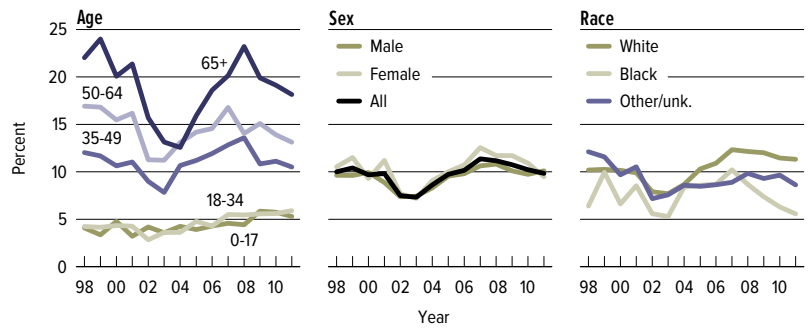
Denominator: all deceased donors with at least one organ of any type recovered for transplant. Numerator for recovery rate: number of livers recovered for transplant in the given year; livers recovered for other purposes are not included. Numerator for transplant rate: all deceased donor livers transplanted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

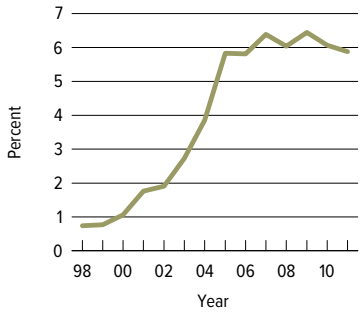
deceased donation



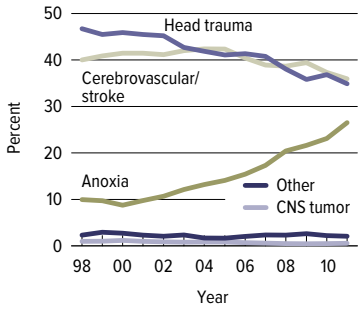
LI 2.5 Discard rates for livers recovered for transplant
Percent of livers discarded out of all livers recovered for transplant.

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.

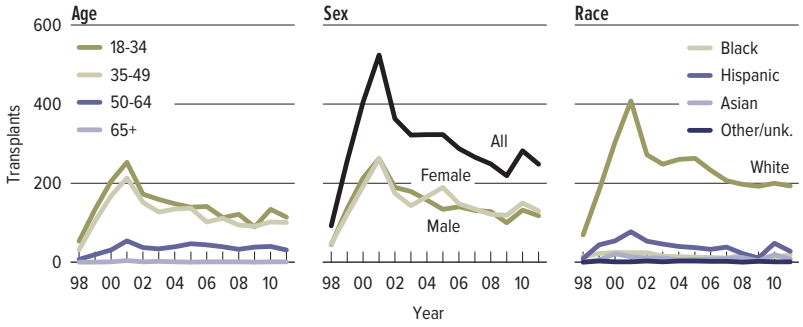


LI 2.7 Liver donors who are DCD
Deceased donors whose liver was recovered for transplant. DCD status is reported on the OPTN Deceased Donor Registration form.

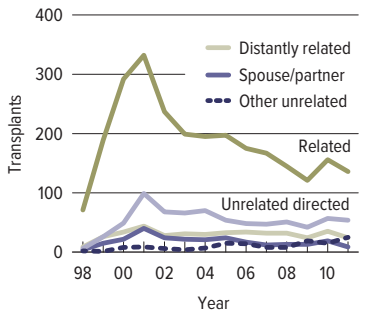


LI 2.8 Cause of death among deceased liver donors
Deceased donors whose liver was transplanted. CNS = central nervous system.

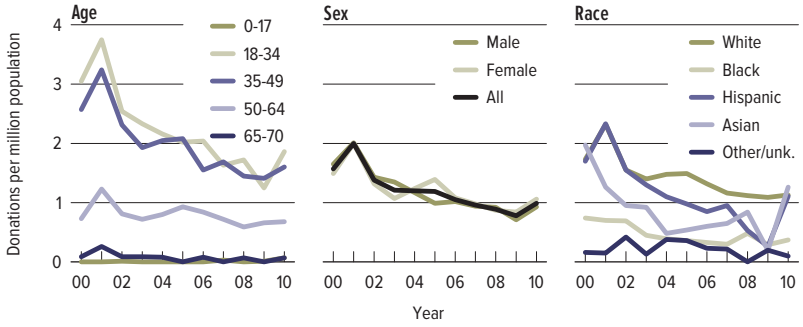
live donation



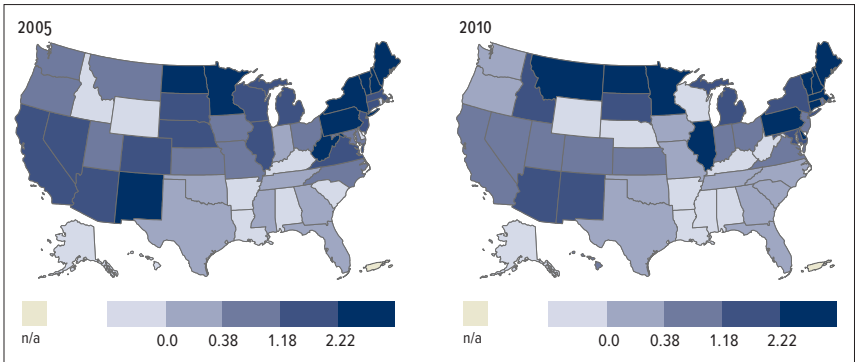
LI 3.1 Liver donations from living donors
Number of living donor donations; characteristics recorded on OPTN Living Donor Registration form.



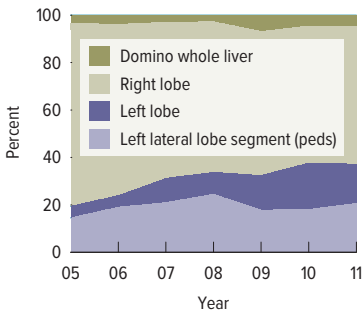
LI 3.2 Liver transplants from living donors, by donor relation
Number of living donor donations; characteristics recorded on OPTN Living Donor Registration form.



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).

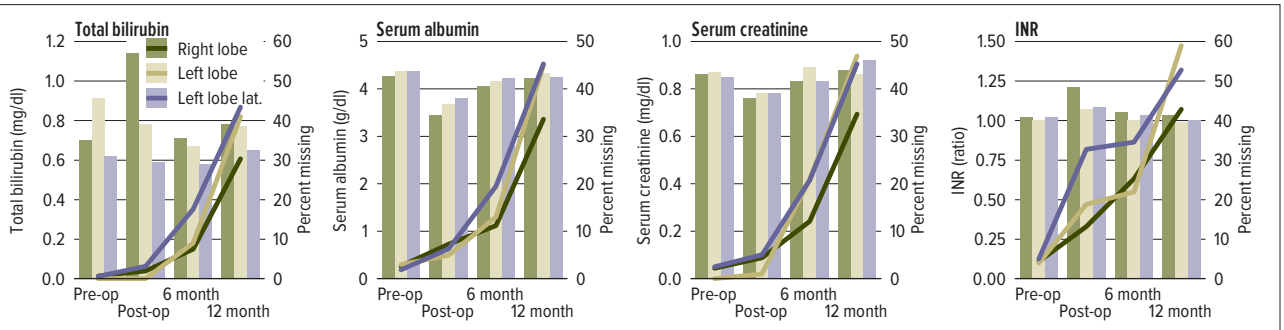


LI 3.4 Living donor liver donation rates (per million population), by state
Number of living donors residing in the 50 states whose liver was recovered for transplant in the given year. Denominator: US population age 70 and younger (population data downloaded from http://www.cdc.gov/nchs/nvss/bridged_race/data_documentation.htm).



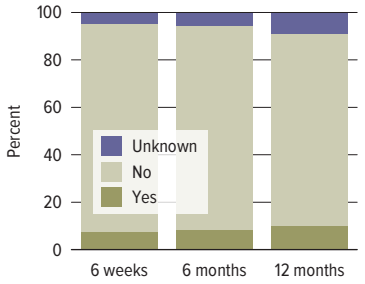
LI 3.5 Living donor liver transplant graft type
Living donors by graft type for each year. Denominator: total number of living liver donors for each year.

live donation



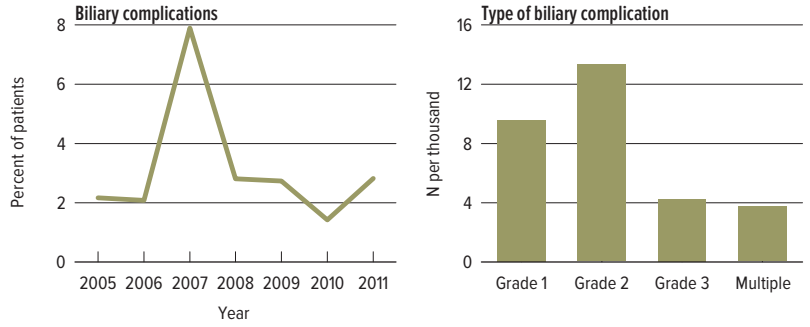
LI 3.6 Mean pre- & post-operative total bilirubin, serum albumin, serum creatinine, & INR among liver donors, 2008–2010

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.



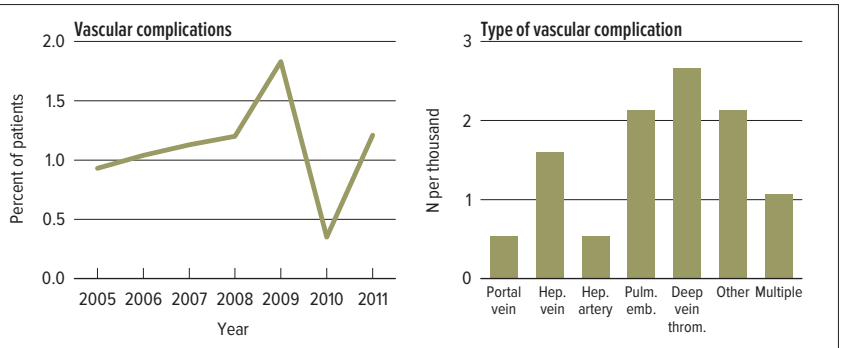
LI 3.7 Readmission to the hospital in the first year among live liver donors, 2010

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

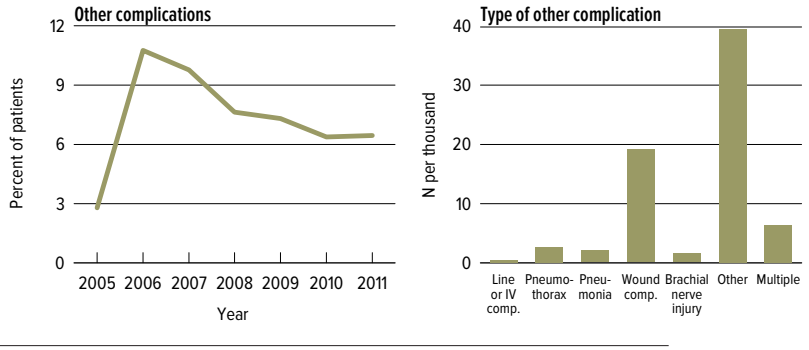
Complications reported on the OPTN Living Donor Registration forms. Type of complication is shown among all live donors, 2005–2011.
Grade 1: Bilious JP drainage more than 10 days
Grade 2: Interventional procedure (ERCP, PTC, percutaneous drainage, etc.)
Grade 3: Surgical intervention



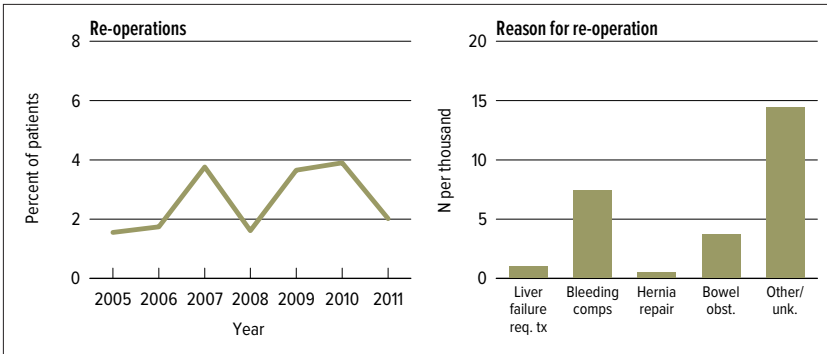
LI 3.9 Vascular complications requiring intervention among live liver donors

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

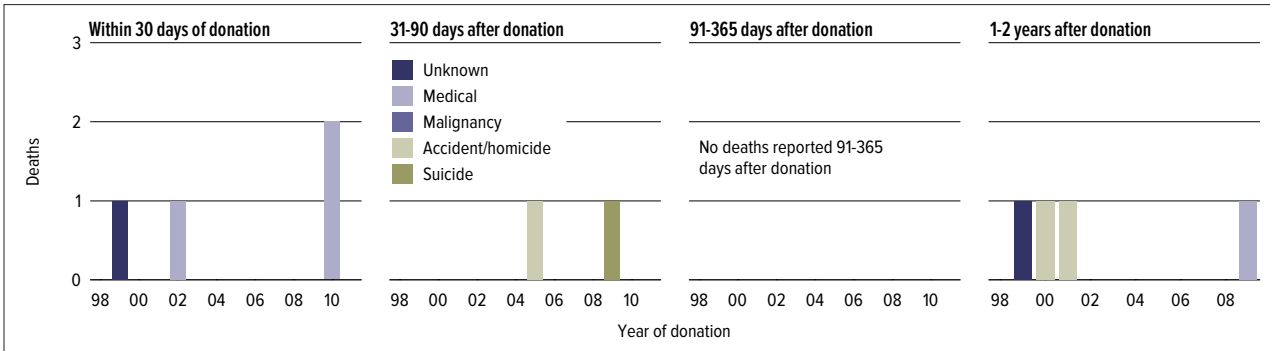
live donation



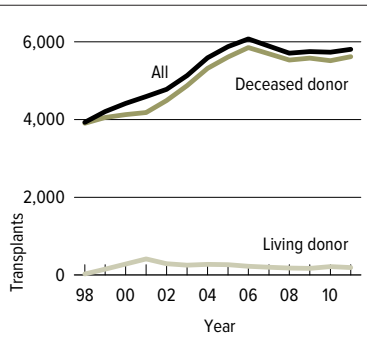
LI 3.10 Other complications requiring intervention among live liver donors
Complications reported on the OPTN Living Donor Registration forms. Type of complication is shown among all live donors, 2005–2011.



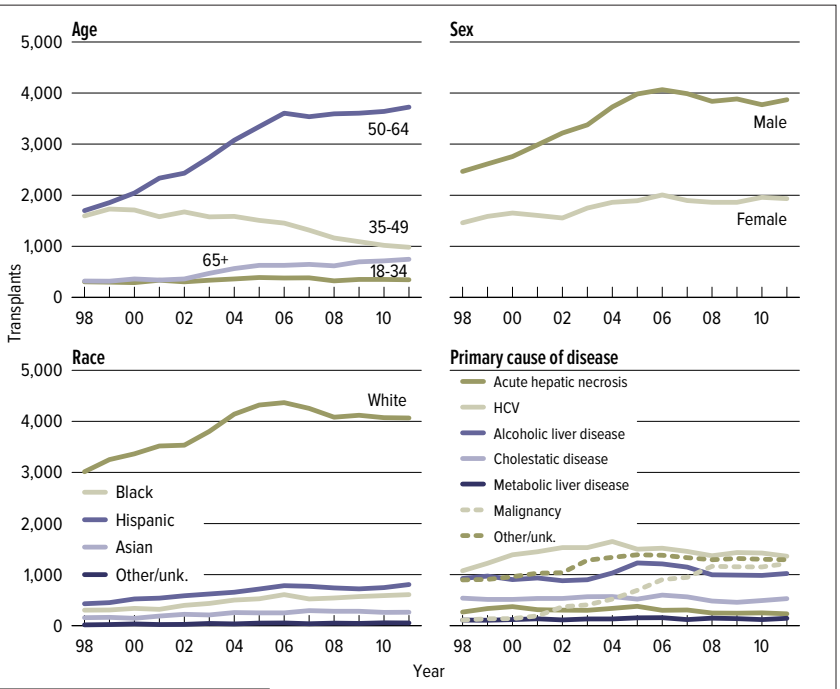
LI 3.11 Re-operation among live liver donors
Complications reported on the OPTN Living Donor Registration forms. Type of complication is shown among all live donors, 2005–2011.



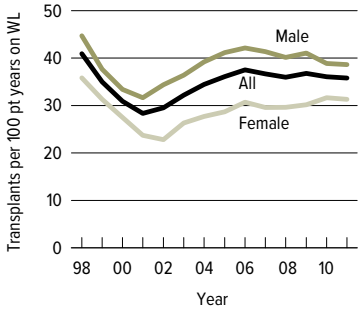
LI 3.12 Living liver donor deaths
Living liver donors; domino donors excluded. Deaths as reported to the OPTN or Social Security Administration. "Donation related" deaths are included in the "Medical" category.



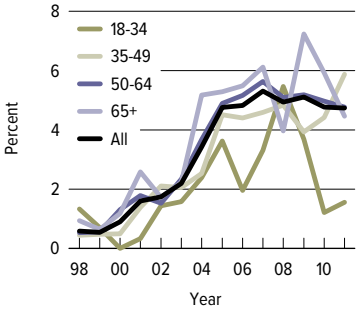
LI 4.1 Total adult liver transplants
Patients receiving a transplant. Retransplants are counted.



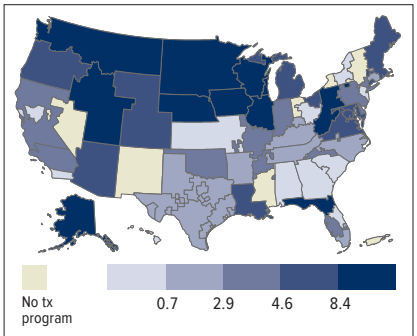
LI 4.2 Adult liver transplants
Patients receiving a transplant. Retransplants are counted.



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.

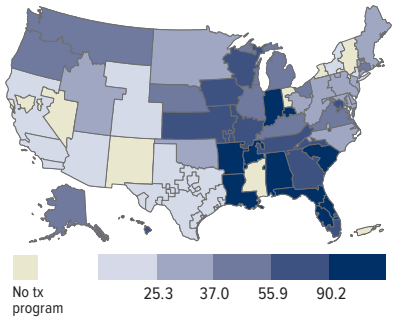


LI 4.4 Use of DCD livers among adult recipients, by recipient age
Percent of deceased donor transplants using a DCD donor.



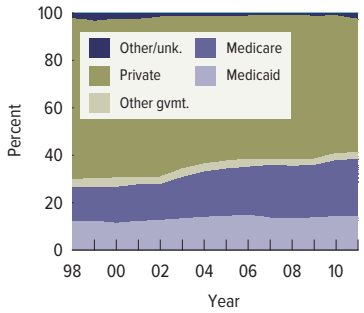
LI 4.5 Percent of adult, deceased donor liver transplants that are DCD, by DSA, 2009–2011
Percent of deceased donor transplants using a DCD donor, by DSA of the transplanting center.

transplant



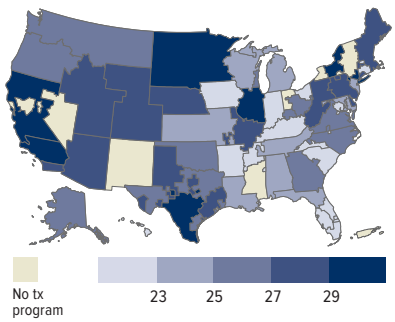
LI 4.6 Deceased donor liver transplant rates per 100 patient years on the waiting list among adult candidates, by DSA, 2010–2011

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

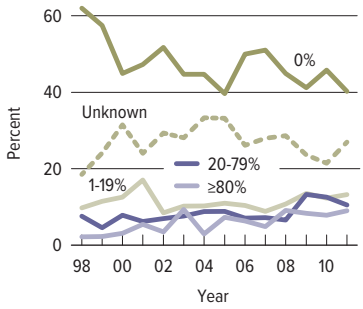
Deceased donor liver transplants; DSA of transplant center location. Patients with status 1A, 1B and inactive status excluded, and allocation MELD score used.

	Level	2001 N	2001 %	2011 N	2011 %
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
	Other/unknown			1	0.0
Primary payer	Private	3,049	66.4	3,264	56.2
	Medicaid	558	12.1	811	14.0
	Other	986	21.5	1,730	29.8
Procedure 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
Donor type	Deceased	4,181	91.0	5,617	96.8
	Living	412	9.0	188	3.2
Patient on life support	Yes	510	11.1	381	6.6
Previous abdominal surg.	Yes	1,776	38.7	2,362	40.7
Diabetes	Yes	872	19.0	1,436	24.7
Portal vein thrombosis	Yes	168	3.7	491	8.5
Incident tumor found at transplant	Yes	159	3.5	151	2.6
Spontaneous bacterial peritonitis (SBP)	Yes	395	8.6	440	7.6
Total		4,593	100.0	5,805	100.0

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

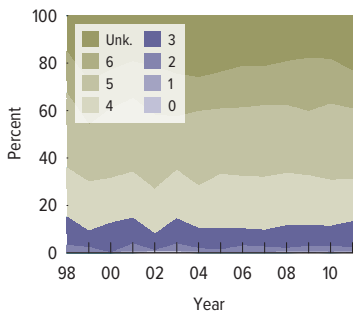
Patients receiving a transplant. Retransplants are counted.

donor-recipient matching



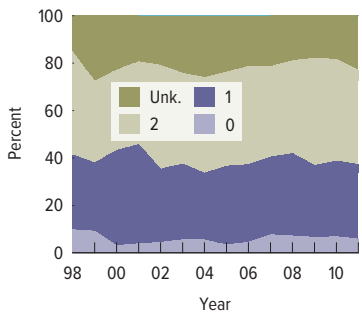
LI 5.1 PRA at time of liver-kidney transplant in adult recipients

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.



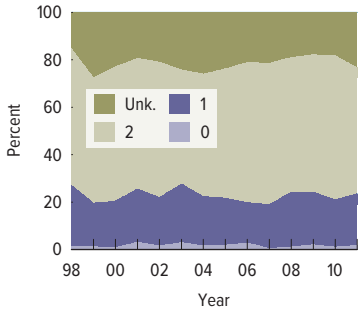
LI 5.2 Total HLA mismatches among adult liver-kidney transplant recipients

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.



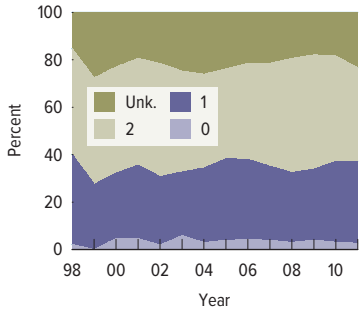
LI 5.3 HLA-A mismatches among adult liver-kidney transplant recipients

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

	DECEASED DONOR				LIVING DONOR			
RECIPIENT	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.

	DECEASED DONOR				LIVING DONOR			
RECIPIENT	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.

	DECEASED DONOR				LIVING DONOR			
RECIPIENT	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.

	DECEASED DONOR				LIVING DONOR			
RECIPIENT	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.

	DECEASED DONOR				LIVING DONOR			
RECIPIENT	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

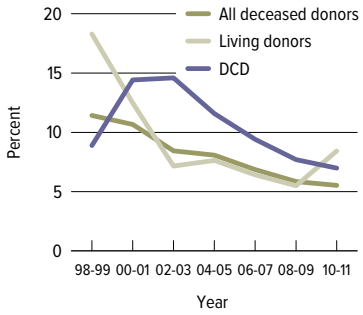
Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields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

	DECEASED DONOR				LIVING DONOR			
RECIPIENT	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

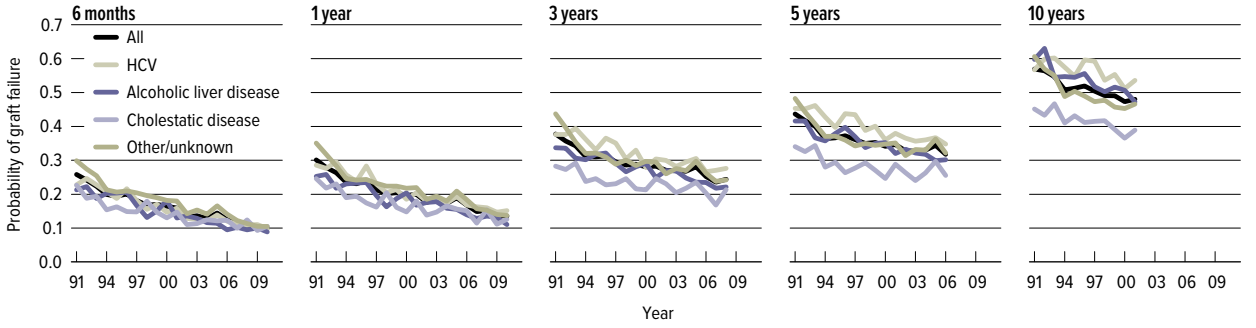
Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields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

outcomes



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

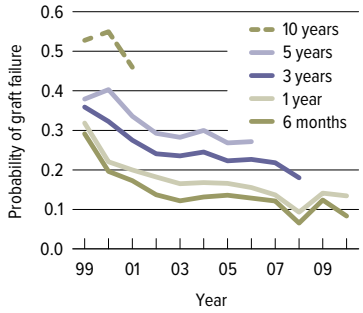
All-cause graft failure is identified from multiple data sources, including the OPTN Transplant Recipient Registration, OPTN Transplant Recipient Follow-up, as well as death dates from the Social Security Administration.



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

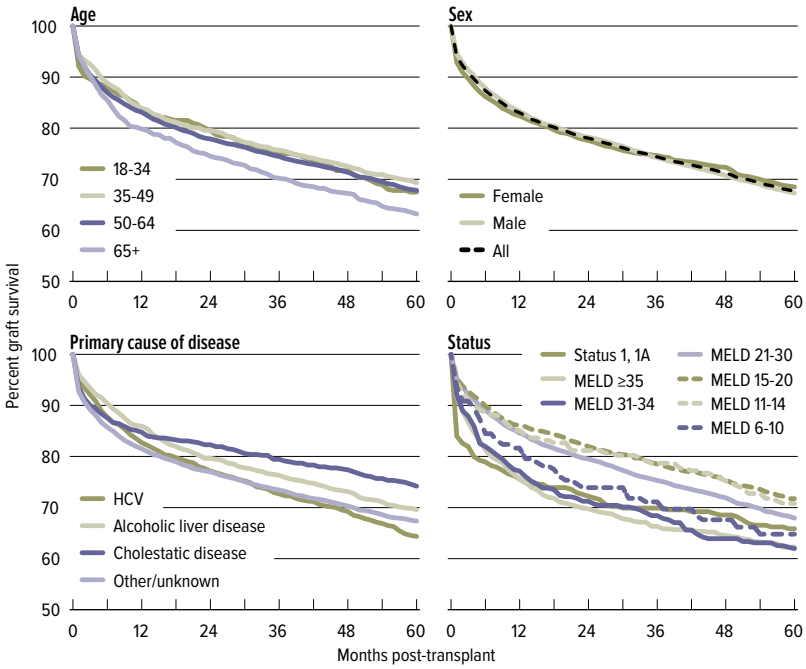
Cox proportional hazards models reporting probability, adjusting for age, sex, and race.

outcomes



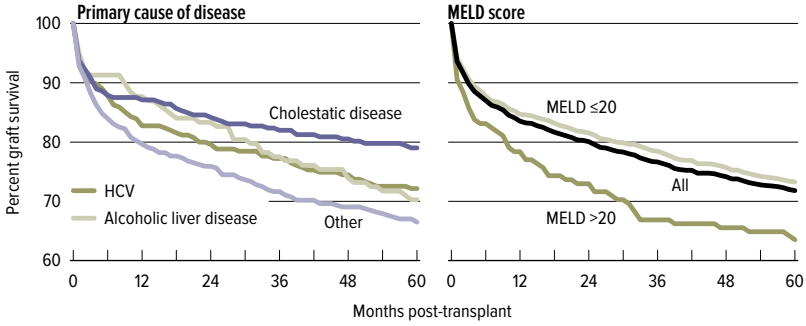
LI 6.3 Graft failure among adult liver transplant recipients: living donor

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



LI 6.4 Graft survival among adult liver transplant recipients transplanted in 2006: deceased donors

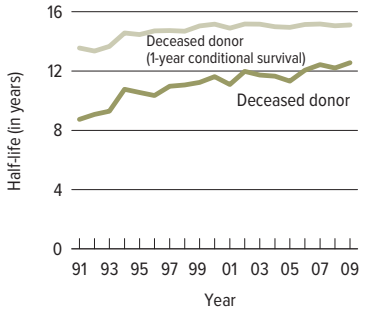
Graft survival estimated using unadjusted Kaplan-Meier methods.



LI 6.5 Graft survival among adult liver transplant recipients transplanted in 2003–2006: living donors

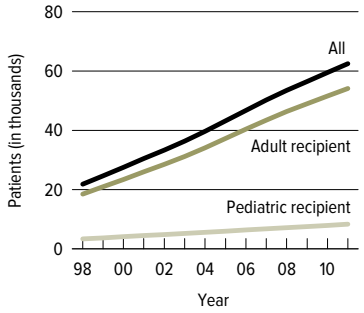
Graft survival estimatedl using unadjusted Kaplan-Meier methods. MELD >20 includes a small number of Status 1 or 1A patients.

outcomes



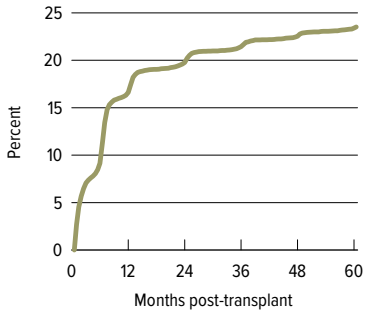
LI 6.6 Half-lives for adult deceased donor liver transplant recipients

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.



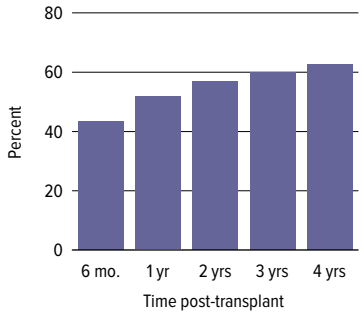
LI 6.7 Recipients alive & with a functioning liver transplant on June 30 of the year

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.



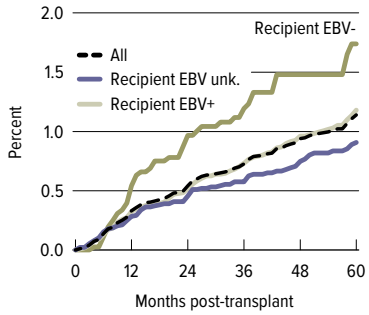
LI 6.8 Incidence of first acute rejection among adult patients receiving a liver transplant in 2005–2009

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

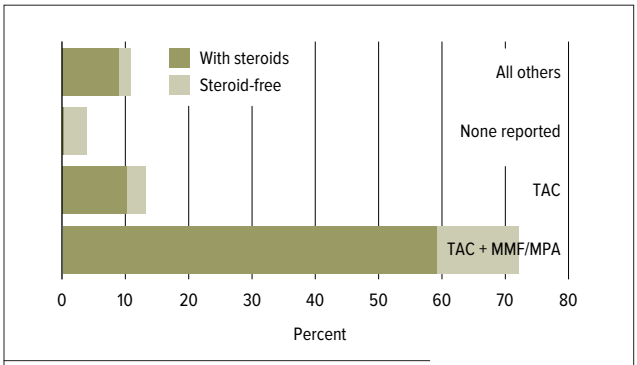
Cumulative incidence of rehosptalization post-transplant; hospitalization identified from the OPTN Transplant Recipient Follow-up form. Patients required to be alive with graft function at each time period, so denominators reduce over time.



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

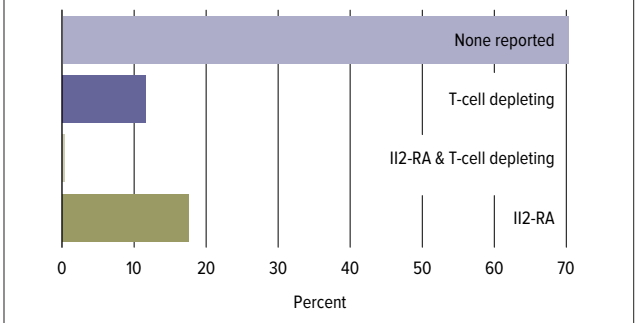
The cumulative incidence, defined as the probability of post-transplant lymphoproliferative disorder (PTLD) being diagnosed between the time of transplant and the given time, is estimated using Kaplan-Meier methods. PTLD is identified as either a reported complication or cause of death on the Transplant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

immunosuppression



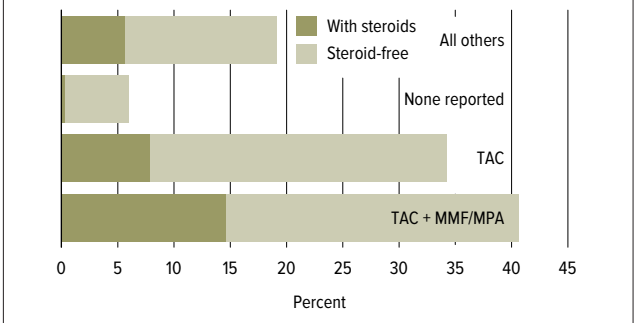
LI 7.1 Initial immunosuppression regimen in adult liver transplant recipients, 2011

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



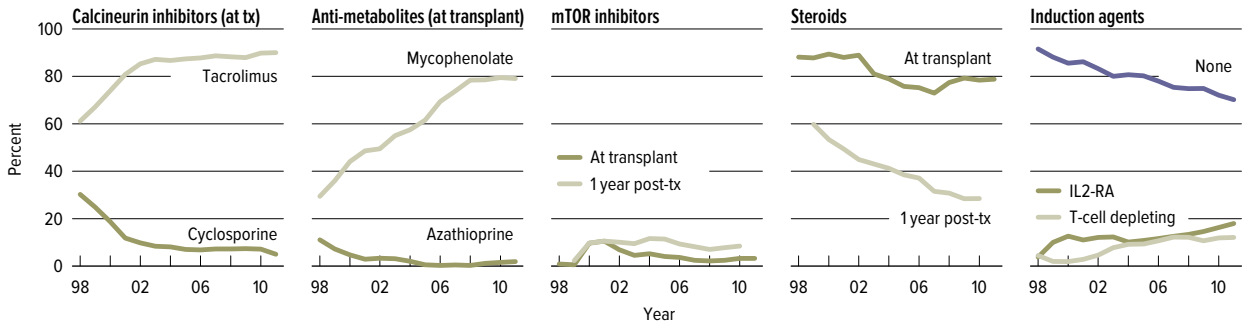
LI 7.2 Induction agents used at time of liver transplant, adult recipients, 2011

Patients transplanted in 2011 and discharged with a functioning graft.



LI 7.3 Immunosuppression regimen at one year in adult liver transplant recipients, 2010

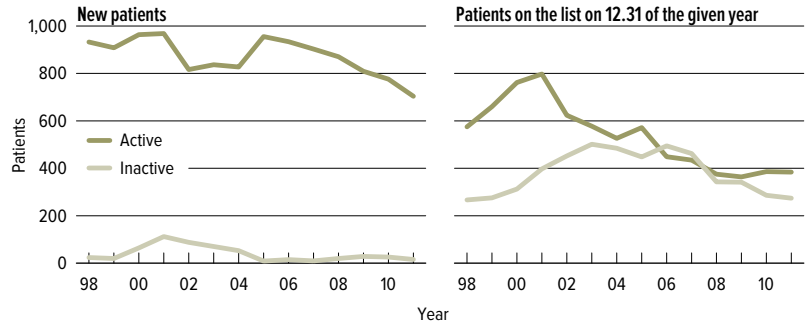
Patients transplanted in 2010 and remaining alive with graft function one year post-transplant. Top three one-year immunosuppression regimens are given, plus the "all others" group. Regimens are defined by use of calcineurin inhibitors (TAC=Tacrolimus, Cyclo=Cyclosporine), anti-metabolites (AZA=Azathioprine,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



LI 7.4 Immunosuppression use in adult liver transplant recipients

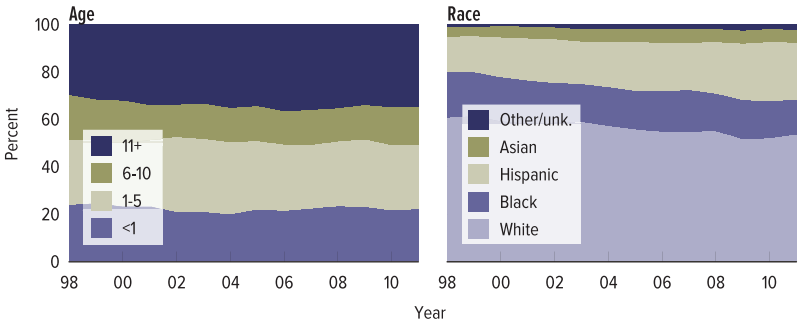
One-year post-transplant data for mTOR inhibitors and steroids limited to patients alive with graft function one year post-transplant. One-year post-transplant data are not reported for 1998 transplant recipients, as follow-up data were very sparse.

pediatric transplant



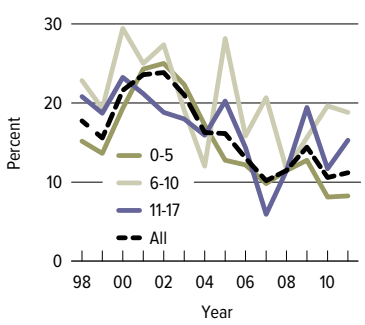
LI 8.1 Pediatric patients waiting for a liver transplant

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

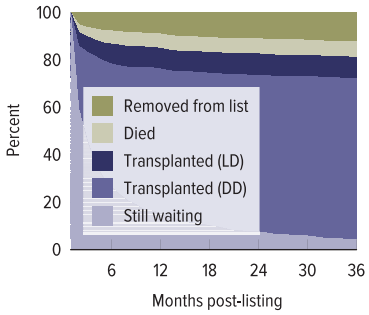
Prior transplant is obtained from the OPTN Transplant Candidate Registration form.

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

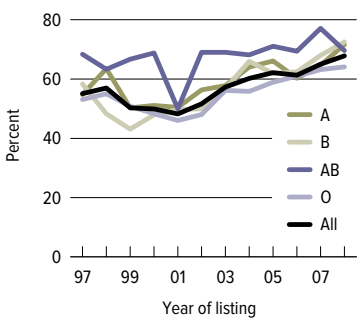
LI 8.4 Liver transplant waiting list activity among pediatric patients

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.



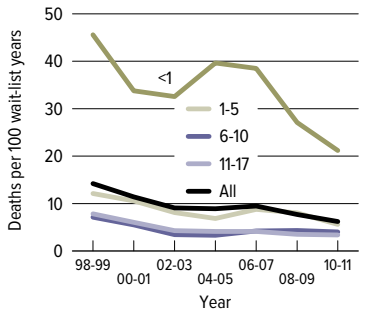
LI 8.5 Outcomes for pediatric patients waiting for a liver transplant among new listings in 2008

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.



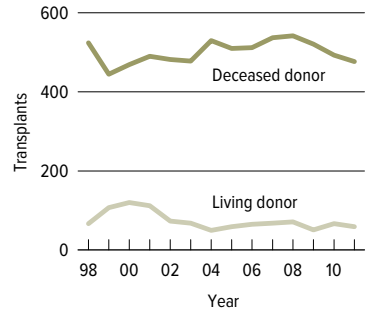
LI 8.6 Pediatric wait-listed patients who receive a deceased donor liver transplant within three years, by blood type

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.



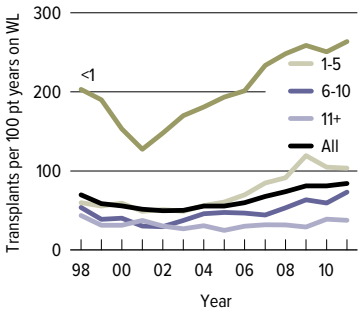
LI 8.7 Pre-transplant mortality rates among pediatric patients wait-listed for a liver transplant, by age

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

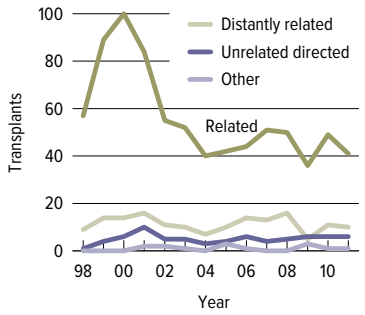
Patients waiting for transplant. Transplant rates are computed as the number of transplants per 100 patient-years of waiting time in the given year. Patients with concurrent listings at multiple centers are counted once.

pediatric transplant

		1999-2001		2009-2011	
	Level	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

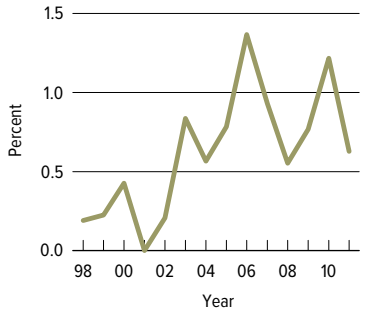
LI 8.10 Characteristics of pediatric liver transplant recipients, 1999–2001 & 2009–2011

Patients receiving a transplant. Retransplants are counted.



LI 8.11 Pediatric liver transplants from living donors

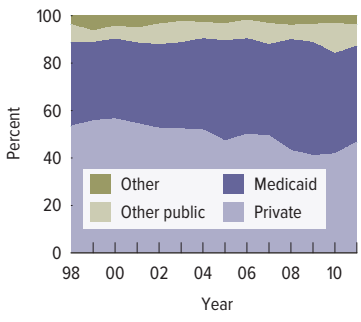
Relationship of live donor to recipient is as indicated on the Living Donor Registration form.



LI 8.12 Use of DCD donors in pediatric liver transplant recipients

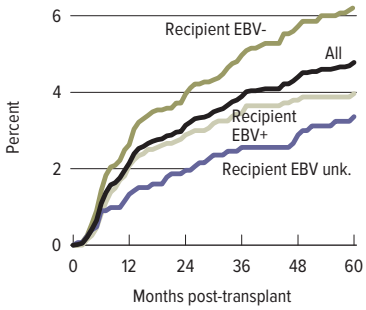
Patients receiving a DCD liver transplant.

pediatric transplant



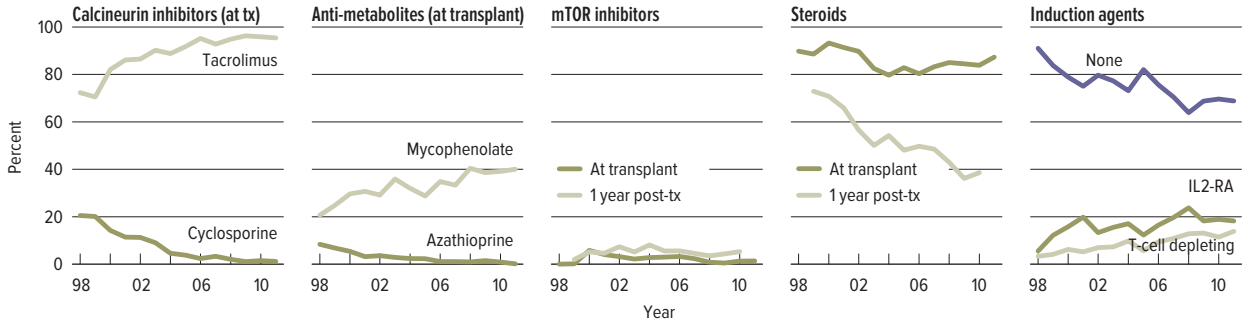
LI 8.13 Insurance coverage among pediatric liver transplant recipients at time of transplant

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

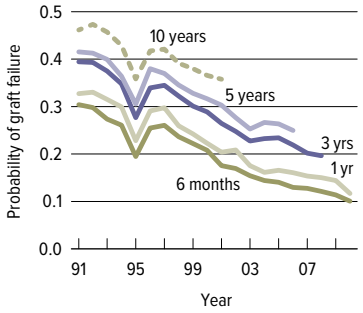
The cumulative incidence, defined as the probability of post-transplant lymphoproliferative disorder (PTLD) being diagnosed between the time of transplant and the given time, is estimated using Kaplan-Meier methods. PTLD is identified as either a reported complication or cause of death on the Transplant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

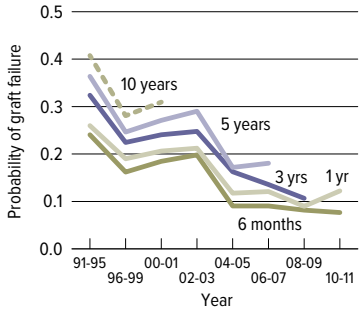
One-year post-transplant data for mTOR inhibitors and steroids limited to patients alive with graft function one year post-transplant. One-year post-transplant data are not reported for 1998 transplant recipients, as follow-up data were very sparse.

pediatric transplant



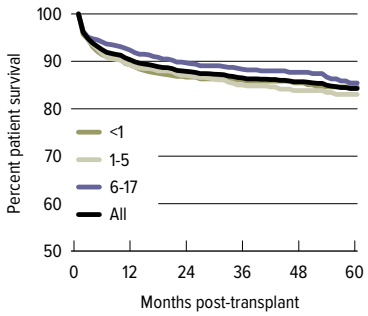
LI 8.16 Graft failure among pediatric liver transplant recipients: deceased donor

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



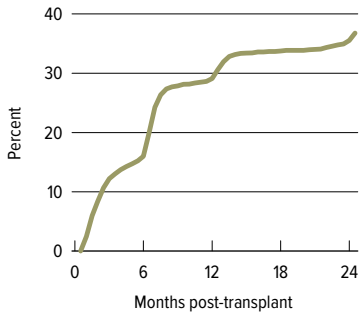
LI 8.17 Graft failure among pediatric liver transplant recipients: living donor

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

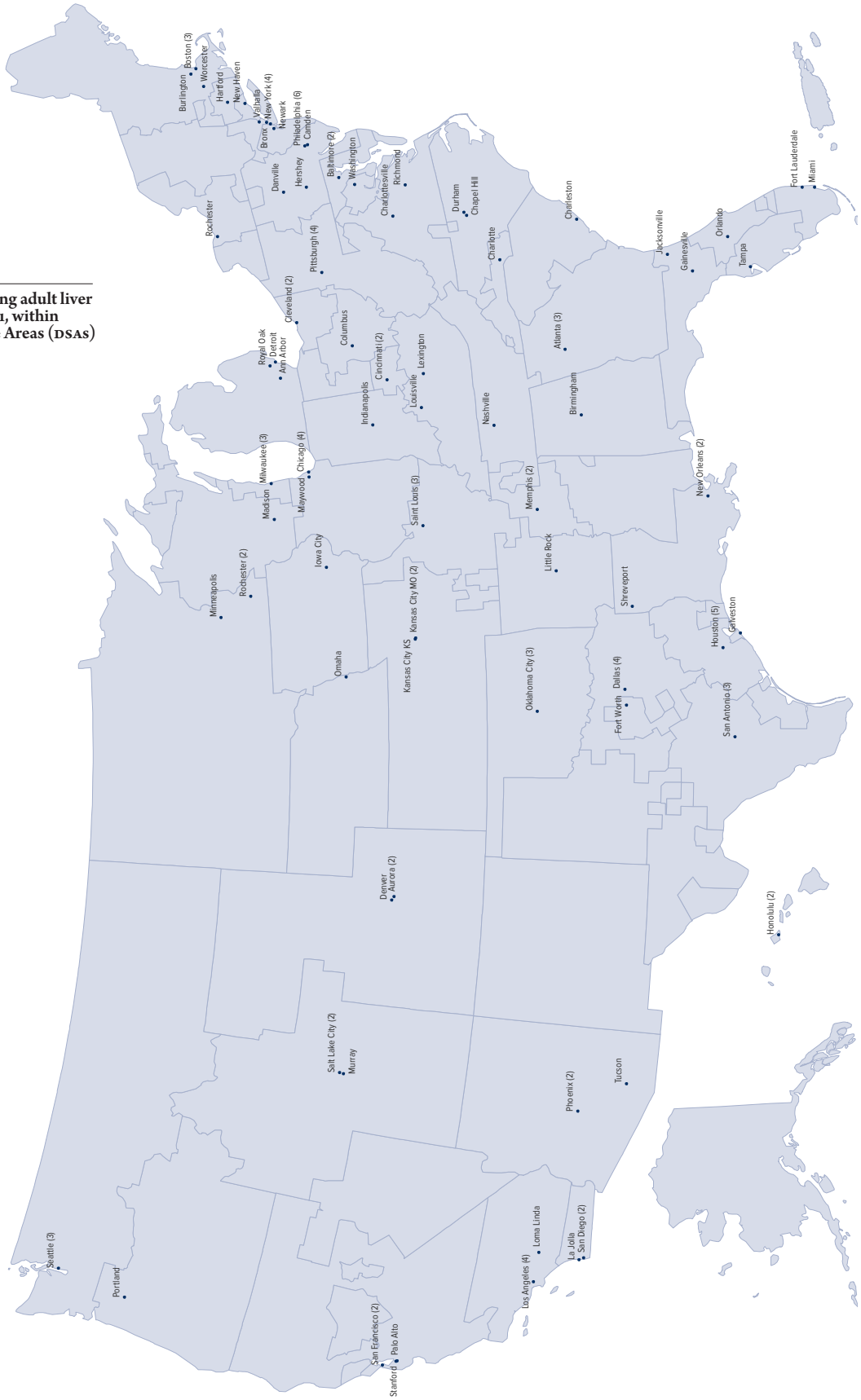
Percent patient survival using unadjusted Kaplan-Meier methods. For patients with more than one transplant during the period, only their first transplant is considered.



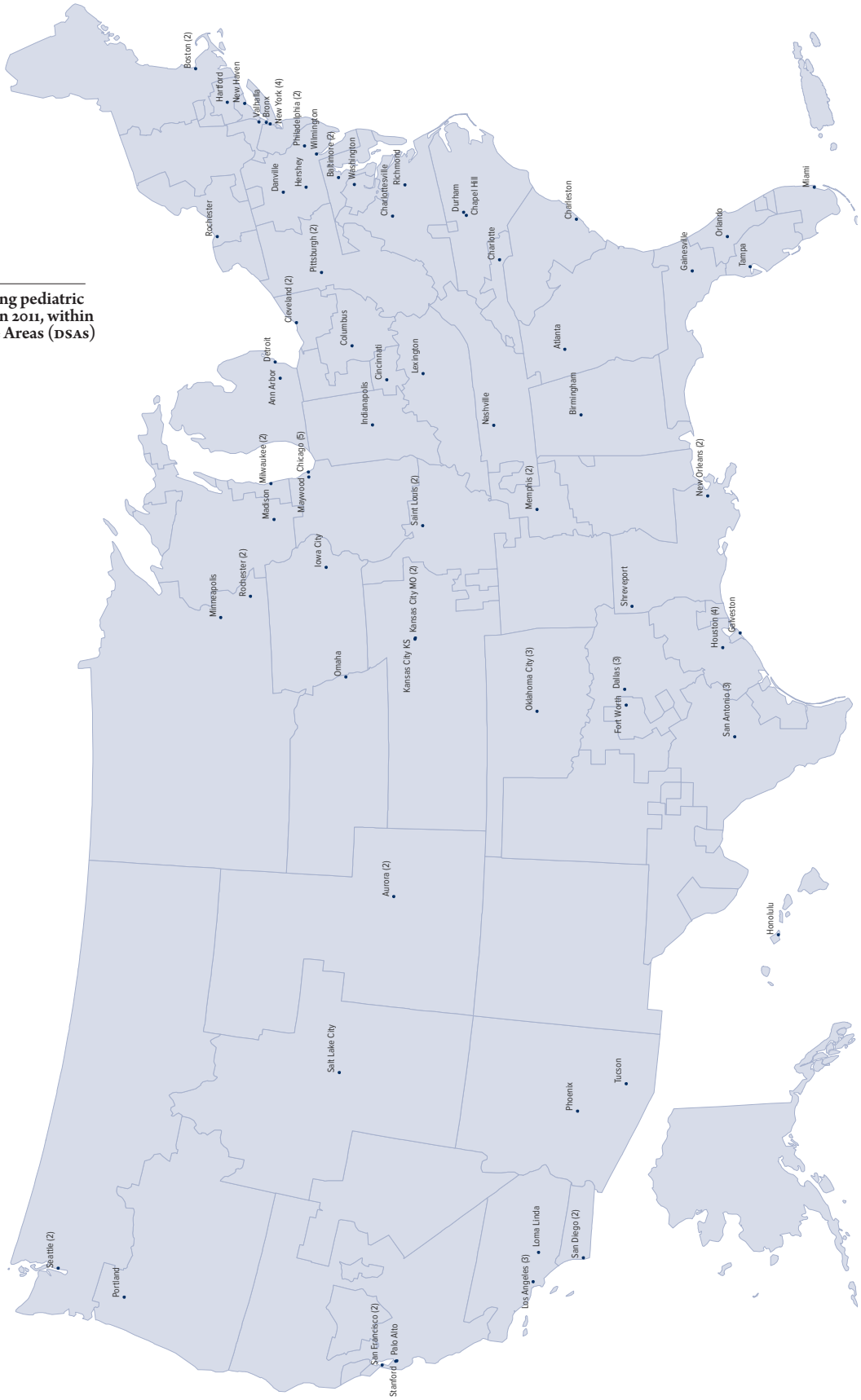
LI 8.19 Incidence of first acute rejection among pediatric patients receiving a liver transplant in 2005–2010

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.

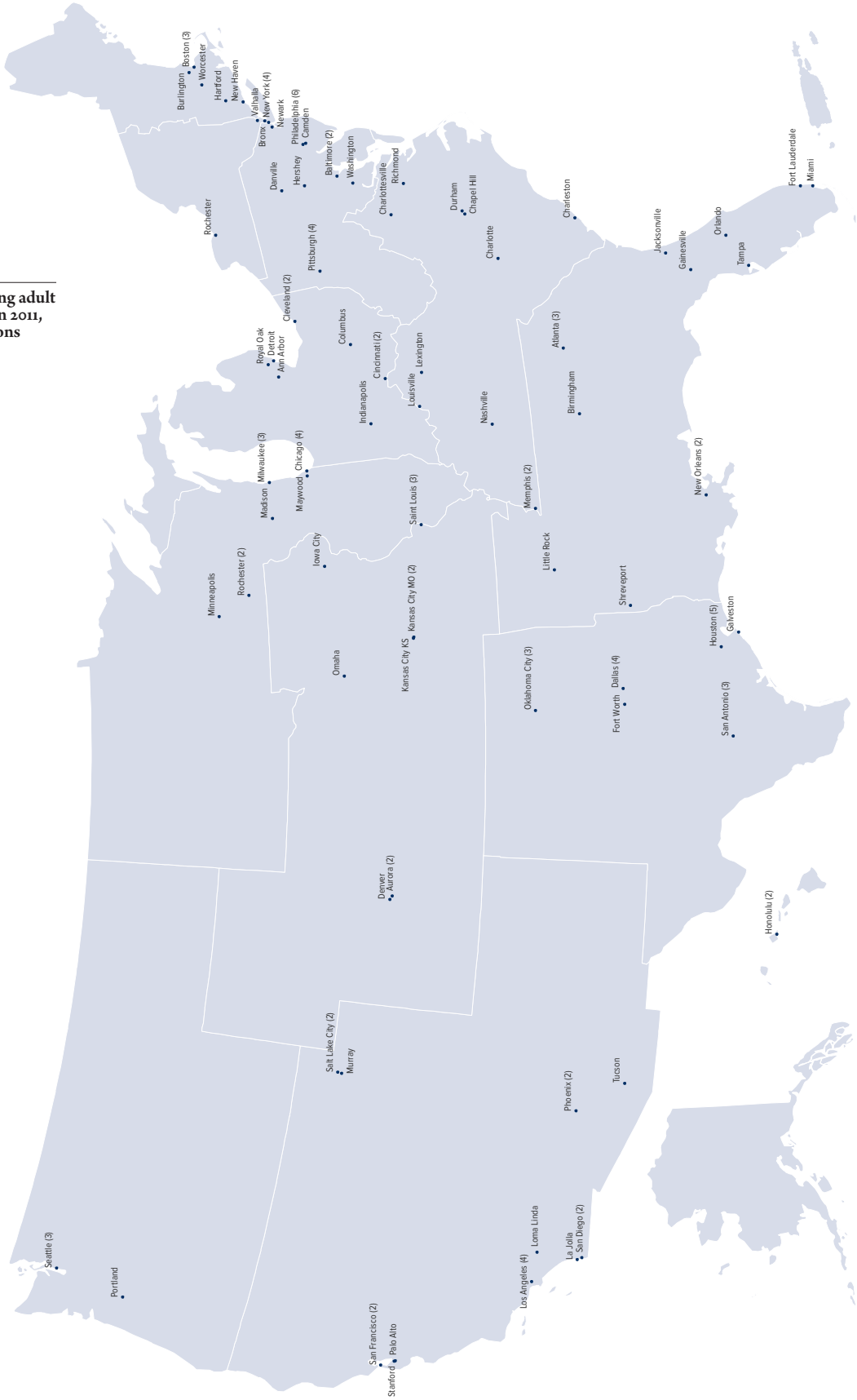
LI 9.1 Centers performing adult liver transplants in 2011, within Donation Service Areas (DSAs)



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



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OPTN/SRTR 2011 Annual Data Report:

intestine

ABSTRACT Since 2006, the number of new intestinal transplant candidates listed each year has declined, likely reflecting increased medical and surgical treatment for intestinal failure. Historically, intestinal transplant occurred primarily in the pediatric population; in 2011, 41% of prevalent candidates on the waiting list were aged 18 years or older. The most common etiology of intestinal failure remains short-gut syndrome, which encompasses several diagnoses. The proportion of candidates with high medical urgency status decreased and time on the waiting list increased in 2011. The overall rate of transplant decreased from a peak of 92.7 transplants per 100 wait-list years in 2005 to 49.2 in 2011. The number of intestines recovered and transplanted per donor has decreased since 2007, possibly due to fewer listed patients. Almost 50% of deceased donor intestines were transplanted with another organ in 2011. Historically, the most common organ transplanted with the intestine was the liver, but in 2011 it was the pancreas. Graft survival has continued to improve over the past decade, and the number of recipients alive with a functioning intestinal graft has steadily increased since 1998. Hospitalization is common, occurring in 84.8% of recipients by 6 months posttransplant and in almost all by 4 years.

KEY WORDS Intestinal failure, intestinal transplant, parenteral nutrition, transplant outcomes.

The donor who blessed our family is anonymous for now, but we will never stop thanking them and their family. In the midst of their mourning they cared enough to give us a precious gift. I hope they know because of their loving spirit a five-year-old is alive and well today.

recipient mother

Introduction

Treatment of intestinal failure has advanced in major ways in the past decade. Survival has improved, and morbidity associated with parenteral nutrition, including liver failure, has declined. Nevertheless, intestinal transplant still plays an important role in the treatment of intestinal failure. In the past 20 years, intestinal transplant has progressed from an experimental therapy to an accepted treatment for children and adults with intractable, life-threatening intestinal failure.

Intestinal transplants may be performed in isolation, with a liver transplant, or as part of a multi-visceral transplant including any combination of liver, stomach, pancreas, colon, spleen, and kidney. For patients receiving long-term parenteral nutrition therapy, awareness is growing that if consideration for intestinal transplant is delayed until development of end-stage liver disease, outcomes before and after transplant are worse than if referral occurs earlier when only intestinal transplant is needed.

Waiting List

Since 2006, the number of new candidates listed every year for intestinal transplant has decreased (Figure 1.1), likely reflecting increased medical and surgical treatments for patients with intestinal failure. Approximately one-third of prevalent candidates on the waiting list in 2011 were inactive. In 2011, 55.4% of candidates on the waiting list were diagnosed with congenital or other short-gut syndrome, 13.7% with necrotizing enterocolitis, 5.2% with pseudo-obstruction, 0.5% with enteropathies, and 25.3% with other or unknown diagnosis (Figure 1.2). Historically, intestinal transplant occurred primarily in the pediatric population, which is reflected in the age distribution of prevalent candidates on the waiting list. The most common age group was 0 to 5 years, constituting 41.2% of wait-listed candidates in 2011 (Figure 1.2). This is a decrease from a peak of 56.6% in 2000. The percentage of candidates aged 6 to 17 years increased from 13.3% in 2008 to 18.0% in 2011, possibly also reflecting improvements in intestinal failure management. Forty-one percent of prevalent candidates on the waiting list in 2011 were aged 18 years or older. However, the proportion of new additions to the waiting list aged 18 years or older increased dramatically, from 29.0% in 1998 to 58.9% in 2011 (Figure 1.3). Sex and ethnicity distributions of new listings for intestinal transplants have not changed, nor have cause of disease distributions. The most common etiology of intestinal failure remains short-gut syndrome, which encompasses a large group of diagnoses. Medical urgency (status 1) decreased from 84.1% of listings in 2002 to 69.1% in 2011 for new additions to the waiting list (Figure 1.3). For all candidates on the waiting list, time spent on the waiting list (Figure 1.2) increased. In 2011, 41.7% of candidates were wait-listed for less than 1 year, 25.1% for 1 to 2 years, and 33.2% for more than 2 years (Figure 1.2).

The overall rate of intestinal transplant declined from a peak of 92.7 transplants per 100 wait-list years in 2005 to 49.2 transplants per 100 wait-list years in 2011 (Figure 1.4).

In 2011, the most common reason for removal from the waiting list was deceased donor transplant (75.6%), followed by death (11.9%), improvement in condition (4.8%), and being too sick to undergo transplant (2.4%) (Figure 1.5). Pre-transplant mortality has decreased dramatically over time for all age groups, from 51.5 per 100 wait-list years in 1998-1999 to 6.7 per 100 wait-list years for candidates listed in 2010-2011 (Figure 1.9).

For candidates wait-listed in 2010, the median time to transplant was 14.9 months for those aged younger than 18 years and 2.8 months for those aged 18 years or older (Figure 1.7).

Donation

The highest rate of deceased donor intestine donations has been from donors aged younger than 15 years (Figure 2.1). The number of intestines recovered and transplanted per donor has decreased since 2007 (Figure 2.2), possibly due to a decrease in listed patients. Almost 50% of deceased donor intestines were transplanted with another organ

in 2011 (Figure 2.3). Historically, the most common organ transplanted with the intestine was the liver; this practice decreased substantially from a peak of 67.7% in 2007 to the current low of 39.1% in 2011. In 2011, pancreas was the most common organ transplanted with the intestine (Figure 2.3). The overall discard rate for donor intestines decreased from 12.8% in 1998 to 5.1% in 2011 (Figure 2.4).

Transplant

Numbers of both intestine-only and intestine-liver transplants have declined since 2009 (Figure 3.1). The rate of intestinal transplants peaked in 2005 at 92.6 transplants per 100 wait-list years and steadily declined to 49.2 transplants per 100 wait-list years in 2011 (Figure 3.4). By age, intestinal transplant recipients have changed substantially; adults now outnumber pediatric recipients (Figure 3.2). The decline in pediatric rates is likely attributable to improved medical and surgical care of intestinal failure patients. Approximately 25% of patients aged 6 to 17 years waiting for an intestinal transplant are waiting for a re-transplant (Figure 3.3). In 2011, 32.6% of intestinal transplant recipients had Medicaid as their primary insurance provider, and 44.2% had private insurance (Figure 3.5). Over the past decade, the primary cause of intestinal failure has changed little (Figure 3.6). The number of patients waiting longer than 1 year for an intestinal transplant has increased (6.2% in 2001 vs. 18.6% in 2011), reflecting the improved general health of this population and the decreased number who require liver transplant.

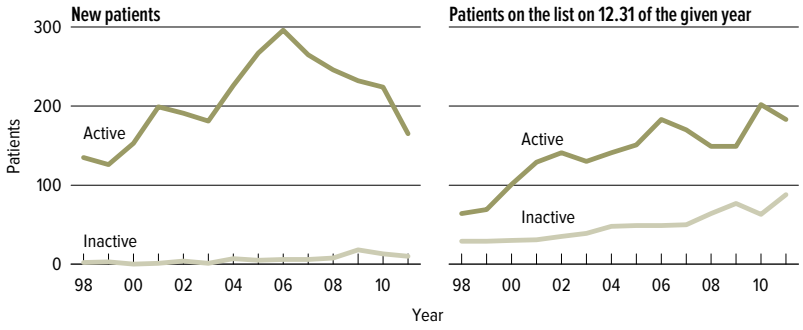
Outcomes

Graft survival has continued to improve over the past decade. Graft failure for deceased donor transplants in 2010-2011 was 16% at 6 months and 26% at 1 year; graft failure for transplants in 2008-2009 was 46% at 3 years, and for transplants in 2006-2007, 48% at 5 years (Figure 4.2). These numbers should be interpreted with caution, as they represent graft failure for two separate populations: recipients of liver-intestine transplants and of intestine-alone transplants. Outcomes are similar in adult and pediatric intestinal transplant recipients (Figure 4.3). The number of recipients alive with a functioning intestinal graft has steadily increased since 1998 (Figure 4.5). The incidence of first acute rejection increased over time post-transplant; 42.6% of all patients experienced rejection in the first 12 months (Figure 4.6). Hospitalization is very common among intestinal transplant recipients, occurring in 84.8% by 6 months post-transplant, and in almost all by 4 years post-transplant (Figure 4.7). For patients who underwent transplant in 2005-2009, the incidence of post-transplant lymphoproliferative disorder was 2.9% at 6 months, 5.3% at 1 year, 7.2% at 2 years, 8.2% at 3 years, and 10.2% at 5 years, with slightly higher rates in recipients negative for Epstein-Barr virus (Figure 4.8).

Immunosuppression

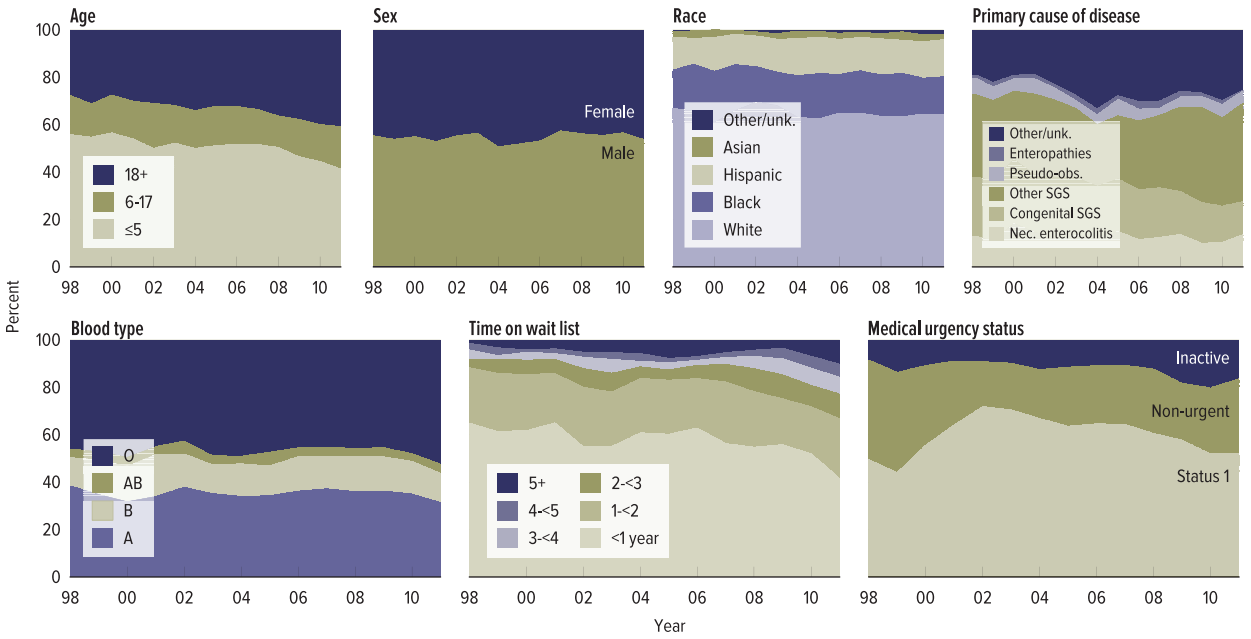
Among patients who underwent transplant in 2011, the most common initial immunosuppression regimen was tacrolimus and steroids (35.8%), followed by tacrolimus, mycophenolate (MMF/MPA), and steroids (18.7%); tacrolimus and MMF/MPA (15.4%); tacrolimus alone (13.8%); and tacrolimus, mammalian target of rapamycin (mTOR) inhibitor, and steroids (11.4%) (Figure 5.1). For induction therapy, 61.0% of patients received T-cell depleting agents, 12.2% received interleukin-2 receptor antagonists, and 22.0% received no induction (Figure 5.2). At 1 year post-transplant, the most common immunosuppression was tacrolimus alone (30.4%), followed by tacrolimus and steroids (28.6%); tacrolimus, MMF/MPA, and steroids (13.4%); and tacrolimus, mTOR inhibitor, and steroids (8.0%) (Figure 5.3). Over the past decade, tacrolimus has been the main calcineurin inhibitor, used in 96.7% of patients in 2011 (Figure 5.4). MMF/MPA use increased to 35.0% in 2011, while mTOR inhibitor use decreased from 37.7% in 2000 to 13.0% in 2011. Steroids were used in 66.7% of patients at the time of transplant and in 58.9% at 1 year post-transplant.

wait list



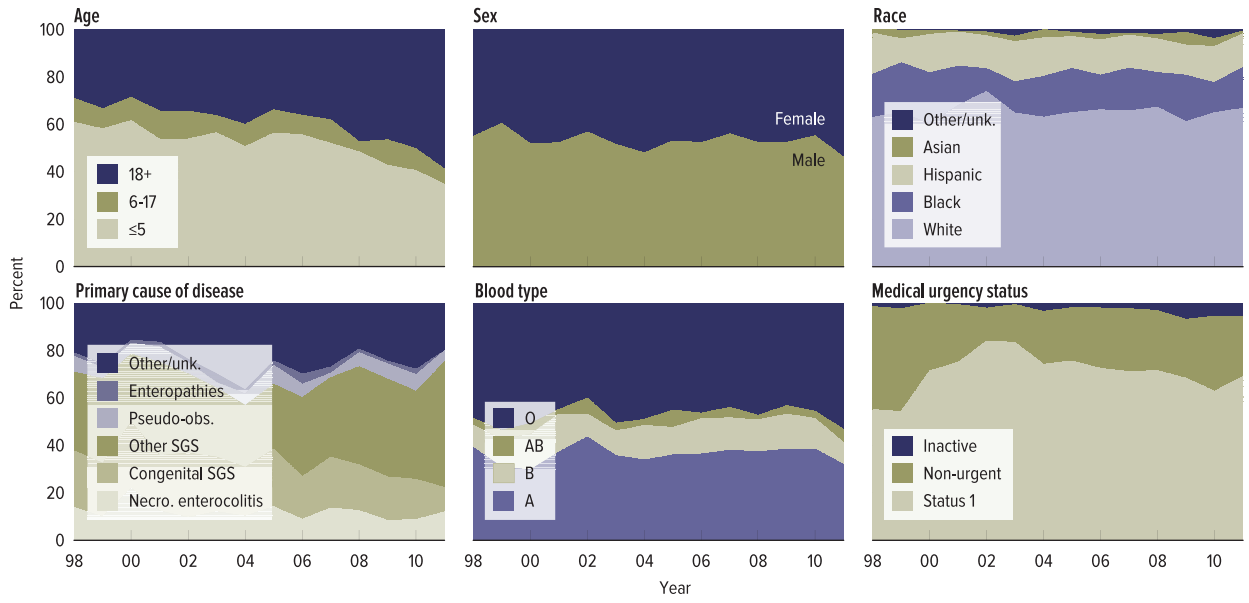
IN 1.1 Patients waiting for an intestinal transplant

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.



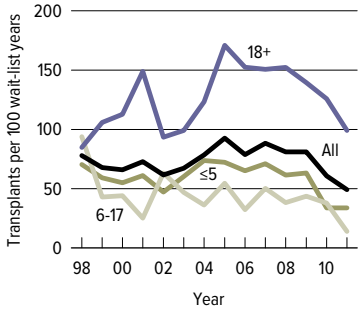
IN 1.2 Distribution of patients waiting for an intestinal transplant

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.



IN 1.3 Distribution of patients newly listed for an intestinal 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.



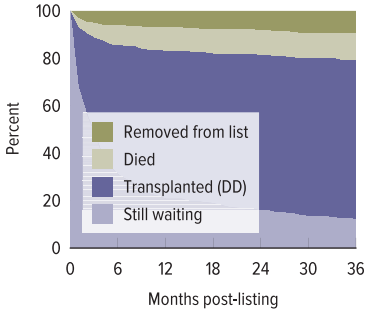
IN 1.4 Intestinal transplant rates among waiting list candidates, by age

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

	2009	2010	2011
Patients at start of year	213	226	264
Patients added during year	250	237	175
Pts removed during year	237	198	168
Patients at end of year	226	265	271
Removal reason			
Deceased donor transplant	178	149	127
Living donor transplant	1	1	-
Patient died	29	18	20
Patient refused transplant	1	0	2
Improved, tx not needed	17	21	8
Too sick to transplant	5	4	4
Other	6	5	7

IN 1.5 Intestinal transplant waiting list activity

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.

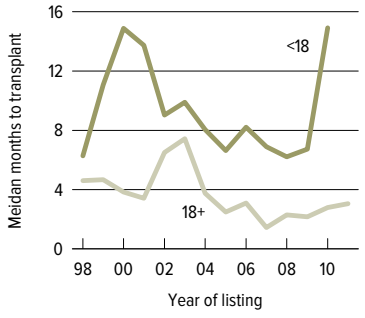


IN 1.6 Outcomes for patients waiting for an intestinal transplant among new listings in 2008

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.

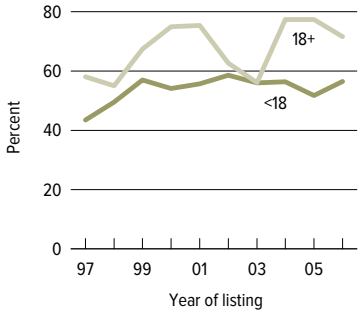
data behind the figures can be downloaded from our website, at www.srtr.org

wait list



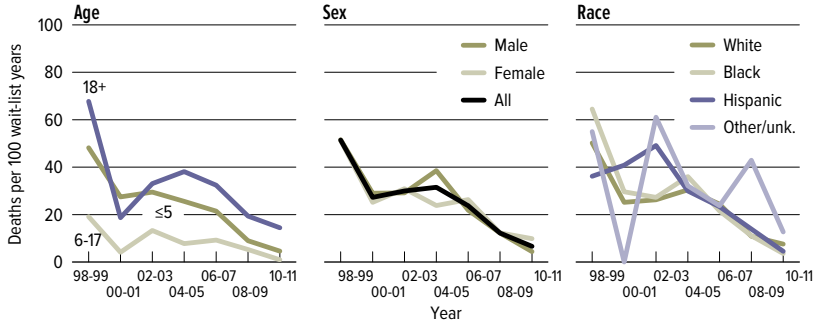
IN 1.7 Median months to intestinal transplant for wait-listed patients, by age

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.



IN 1.8 Wait-listed patients who received a deceased donor intestinal transplant within five years, by age

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.



IN 1.9 Pre-transplant mortality rates among patients wait-listed for an intestinal transplant

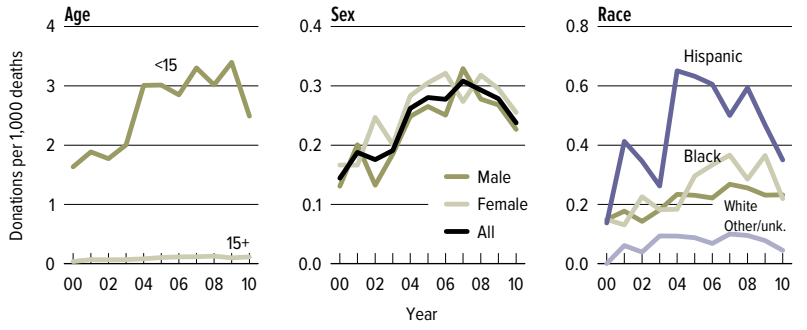
Patients waiting for a transplant. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given 2-year interval. For rates shown by different characteristics, waiting time is calculated as the total waiting time in the interval for patients in that group. Only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

		2001		2011	
	Level	N	%	N	%
Age	0-5	84	52.5	126	46.5
	6-17	40	25.0	66	24.4
	18-34	12	7.5	20	7.4
	35-49	15	9.4	30	11.1
	50-64	9	5.6	26	9.6
	65+	0	0.0	3	1.1
Sex	Female	85	53.1	156	57.6
	Male	75	46.9	115	42.4
Race	White	102	63.8	161	59.4
	Black	34	21.3	48	17.7
	Hispanic	20	12.5	50	18.5
	Asian	3	1.9	7	2.6
	Other/unk.	1	0.6	5	1.9
Primary cause of disease	Necrotizing enterocolitis	25	15.6	40	14.8
	Congenital SGS	38	23.8	45	16.6
	Other SGS	50	31.3	91	33.6
	Pseudo-obstruction	9	5.6	16	5.9
	Entero-pathies	2	1.3	1	0.4
	Other/unk.	36	22.5	78	28.8
Transplant history	Listed for for first tx	147	91.9	242	89.3
	Listed for subseq tx	13	8.1	29	10.7
Blood type	A	50	31.3	83	30.6
	B	31	19.4	42	15.5
	AB	6	3.8	10	3.7
	O	73	45.6	136	50.2
Time on wait list	<1 yr	85	53.1	86	31.7
	1-<2	27	16.9	60	22.1
	2-<3	18	11.3	35	12.9
	3-<4	9	5.6	27	10.0
	4-<5	6	3.8	20	7.4
	5+	15	9.4	43	15.9
Medical urgency status	Status 1	91	56.9	98	36.2
	Non-urgent	39	24.4	86	31.7
	Inactive	30	18.8	87	32.1
Total		160	100.0	271	100.0

IN 1.10 Characteristics of patients on the intestinal transplant waiting list on December 31, 2001 & December 31, 2011

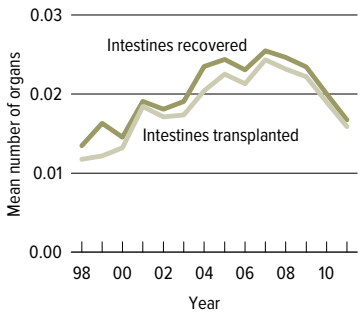
Patients waiting for a transplant on December 31, 2001 and December 31, 2011, regardless of first listing date; active/inactive status is on this date, and multiple listings are not counted.

deceased donation



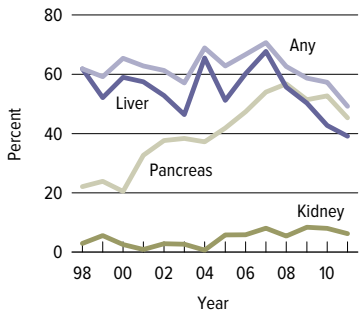
IN 2.1 Deceased donor intestinal donation rates

Numerator: Deceased donors age less than 65 whose intestine 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.)



IN 2.2 Intestines recovered per donor & intestines transplanted per donor

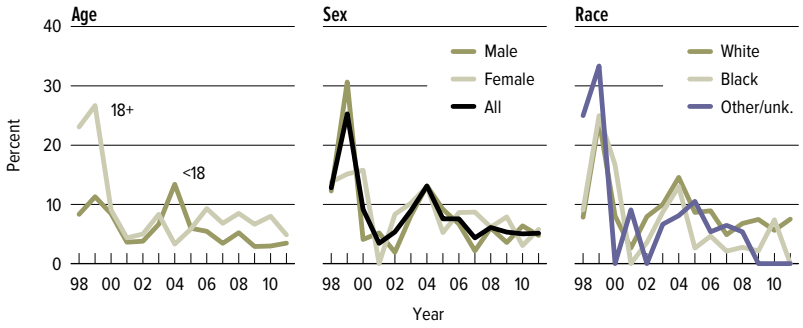
Denominator: all deceased donors with at least one organ of any type recovered for transplant. Numerator for recovery rate: number of intestines recovered for transplant in the given year; intestines recovered for other purposes are not included. Numerator for transplant rate: all deceased donor intestines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



IN 2.3 Deceased donor intestines transplanted with another organ

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

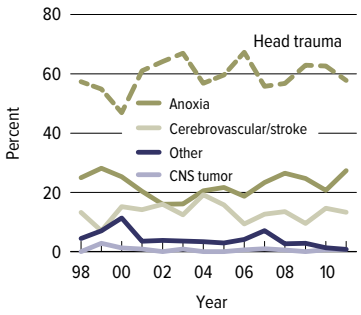
deceased donation



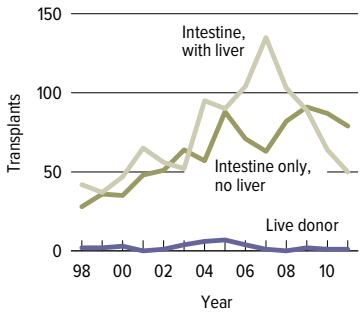
IN 2.4 Discard rates for intestines recovered for transplant
Percent of intestines discarded out of all intestines recovered for transplant.

Reasons for discard	Percent	N
Anatomical abnormalities	28.6	2
Diseased organ	28.6	2
Missing	14.3	1
Other, specify	14.3	1
Recipient determined to be unsuitable	14.3	1

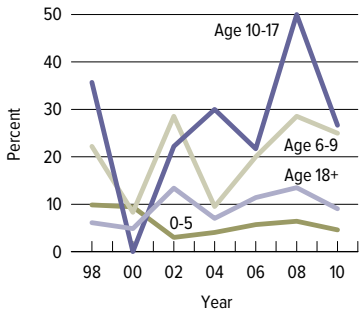
IN 2.5 Reasons for discards, 2011
Reasons for discard among intestines recovered for transplant but not transplanted in 2011.



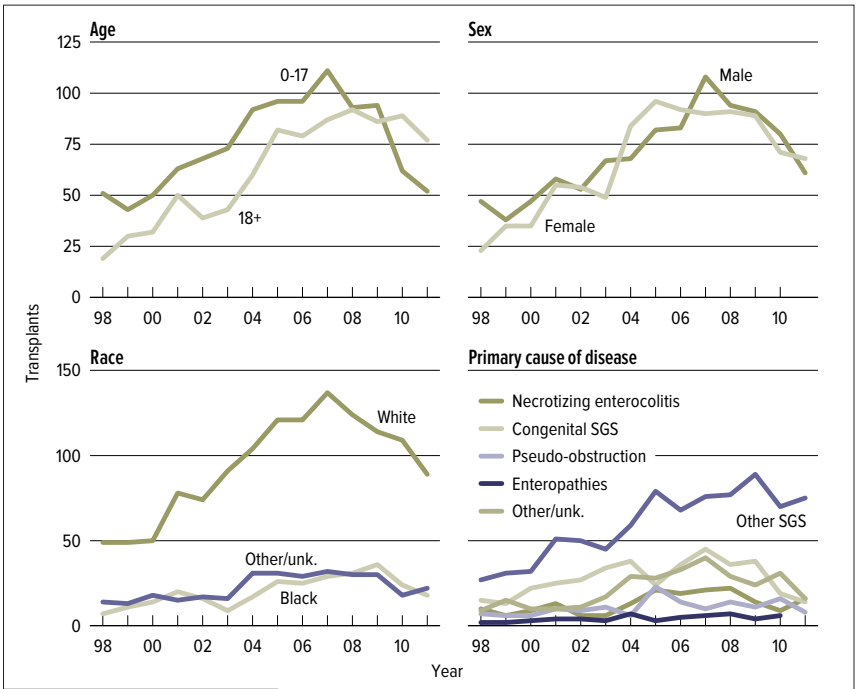
IN 2.6 Cause of death among deceased intestinal donors
Deceased donors whose intestine was transplanted. CNS = central nervous system.



IN 3.1 Total intestinal transplants
Patients receiving a transplant. Retransplants are counted.

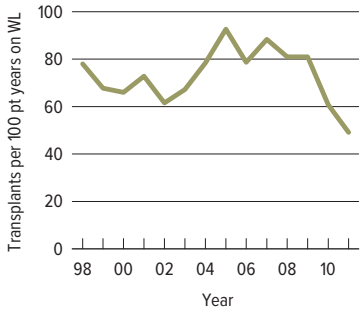


IN 3.3 Prior transplants in patients waiting for an intestinal transplant
Prior transplant of any organ is obtained from the OPTN Transplant Candidate Registration form.



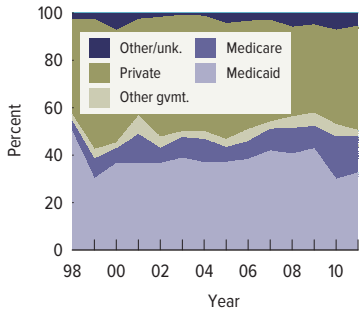
IN 3.2 Intestinal transplants
Patients receiving a transplant. Retransplants are counted.

transplant



IN 3.4 Intestinal transplant rates in 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.



IN 3.5 Insurance coverage among intestinal transplant recipients at time of transplant

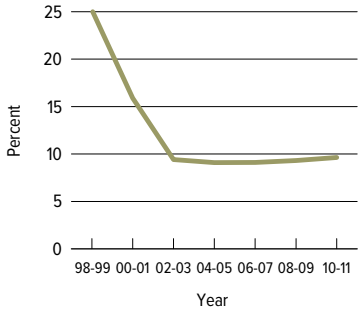
Patients receiving a transplant. Retransplants are counted.

		2001		2011	
	Level	N	%	N	%
Age	0-17	63	55.8	52	40.3
	18-34	14	12.4	23	17.8
	35-49	22	19.5	19	14.7
	50-64	13	11.5	33	25.6
	65+	1	0.9	2	1.6
Sex	Female	55	48.7	68	52.7
	Male	58	51.3	61	47.3
Race	White	78	69.0	89	69.0
	Black	20	17.7	18	14.0
	Hispanic	13	11.5	17	13.2
	Asian	2	1.8	4	3.1
	Other/unknown	0	0.0	1	0.8
Primary cause of disease	Necrotizing enterocolitis	13	11.5	16	12.4
	Congenital SGS	25	22.1	14	10.9
	Other SGS	51	45.1	75	58.1
	Pseudo-obstruction	10	8.8	8	6.2
	Enteropathies	4	3.5	0	0.0
	Other/unk	10	8.8	16	12.4
Blood type	A	41	36.3	41	31.8
	B	20	17.7	10	7.8
	AB	5	4.4	7	5.4
	O	47	41.6	71	55.0
Time on waiting list	<30 days	28	24.8	41	31.8
	31-60 days	15	13.3	15	11.6
	61-90 days	12	10.6	15	11.6
	3-<6 months	34	30.1	19	14.7
	6-<12 months	17	15.0	15	11.6
	1-<2 years	5	4.4	18	14.0
	2-<3 years	1	0.9	3	2.3
	3+ years	1	0.9	3	2.3
Medical condition	Hospitalized: ICU	14	12.4	10	7.8
	Hospitalized: not ICU	18	15.9	26	20.2
	Not hospitalized	81	71.7	92	71.3
	Unknown	0	0.0	1	0.8
Primary payer	Private	46	40.7	57	44.2
	Medicaid	41	36.3	42	32.6
	Other	26	23.0	30	23.3
Donor type	Deceased	113	100.0	128	99.2
	Living	0	0.0	1	0.8
Intestine transplant history	First transplant	106	93.8	118	91.5
	Retransplant	7	6.2	11	8.5
Patient on life support	Yes	5	4.4	12	9.3
Total		113	100.0	129	100.0

IN 3.6 Characteristics of intestinal transplant recipients, 2001 & 2011

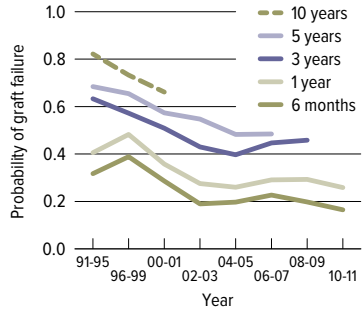
Patients receiving a transplant. Retransplants are counted.

outcomes



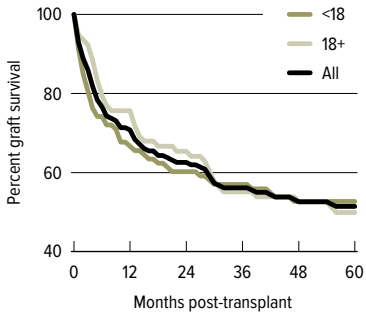
IN 4.1 Graft failure within the first 6 weeks among intestinal transplant recipients

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.



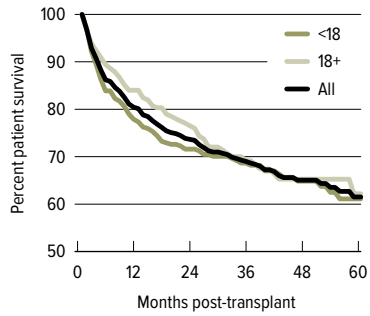
IN 4.2 Graft failure among intestinal transplant recipients: deceased donor

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



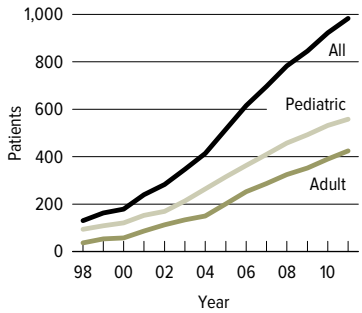
IN 4.3 Graft survival among intestinal transplant recipients transplanted in 2006, by age: deceased donors

Graft survival estimated using unadjusted Kaplan-Meier methods.



IN 4.4 Patient survival among intestinal transplant recipients, 2002–2006, by age: deceased donors

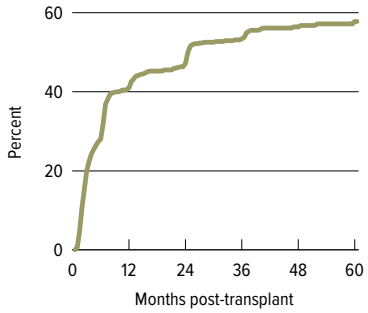
Percent patient survival using unadjusted Kaplan-Meier methods. For patients with more than one transplant during the period, only their first transplant is considered.



IN 4.5 Recipients alive & with a functioning intestinal transplant on June 30 of the year

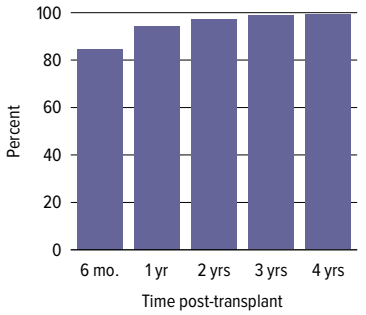
Transplants before June 30 of the year that are still functioning. Patients are assumed alive with function unless a death or graft failure is recorded. A recipient can experience a graft failure and drop from the cohort, then be retransplanted and re-enter the cohort.

outcomes



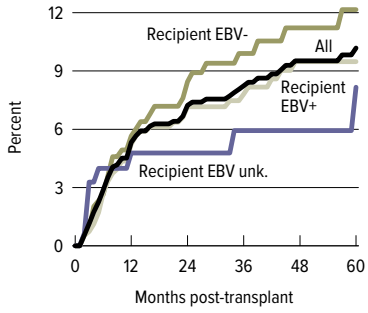
IN 4.6 Incidence of first acute rejection among patients receiving an intestinal transplant in 2005–2009

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.



IN 4.7 Reported cumulative incidence of rehospitalizations among patients receiving an intestinal transplant in 2006–2011

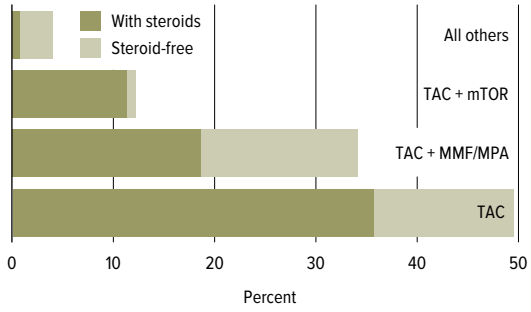
Cumulative incidence of rehosptalization post-transplant; hospitalization identified from the OPTN Transplant Recipient Follow-up form. Patients required to be alive with graft function at each time period, so denominators reduce over time.



IN 4.8 Incidence of PTLD among patients receiving an intestinal transplant in 2005–2009, by recipient Epstein-Barr virus (EBV) status at transplant

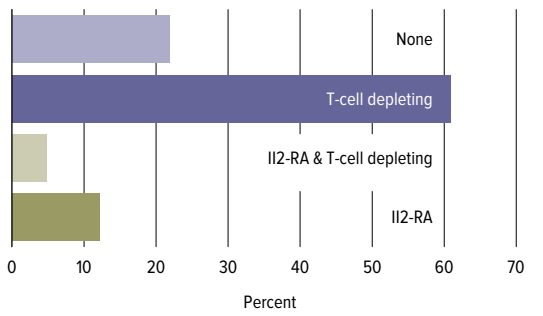
The cumulative incidence, defined as the probability of post-transplant lymphoproliferative disorder (PTLD) being diagnosed between the time of transplant and the given time, is estimated using Kaplan-Meier methods. PTLD is identified as either a reported complication or cause of death on the Transplant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

immunosuppression



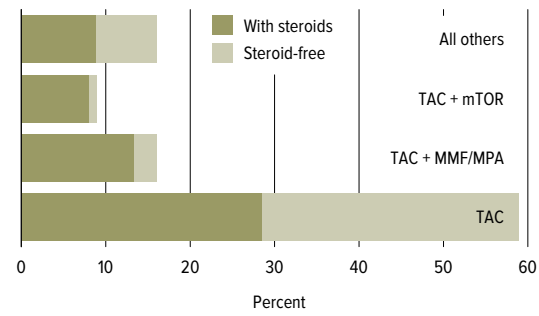
IN 5.1 Initial immunosuppression regimen in intestinal transplant recipients, 2011

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



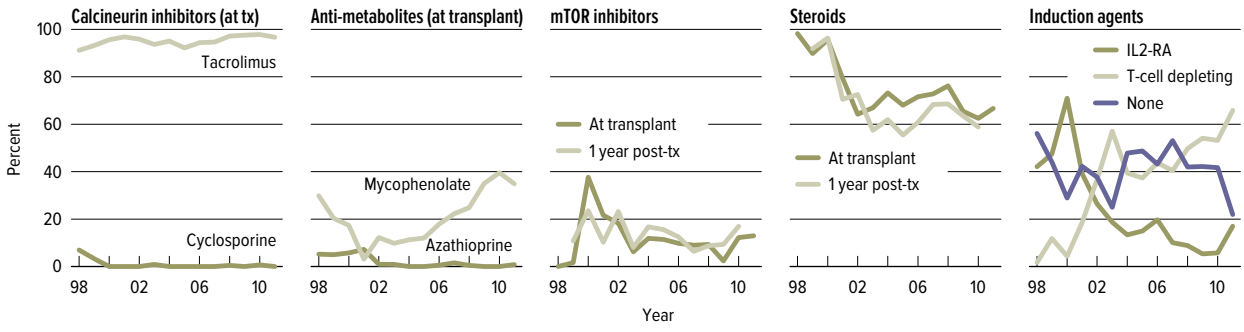
IN 5.2 Induction agents used at time of intestinal transplant, 2011

Patients transplanted in 2011 and discharged with a functioning graft.



IN 5.3 Immunosuppression regimen at one year in intestinal transplant recipients, 2010

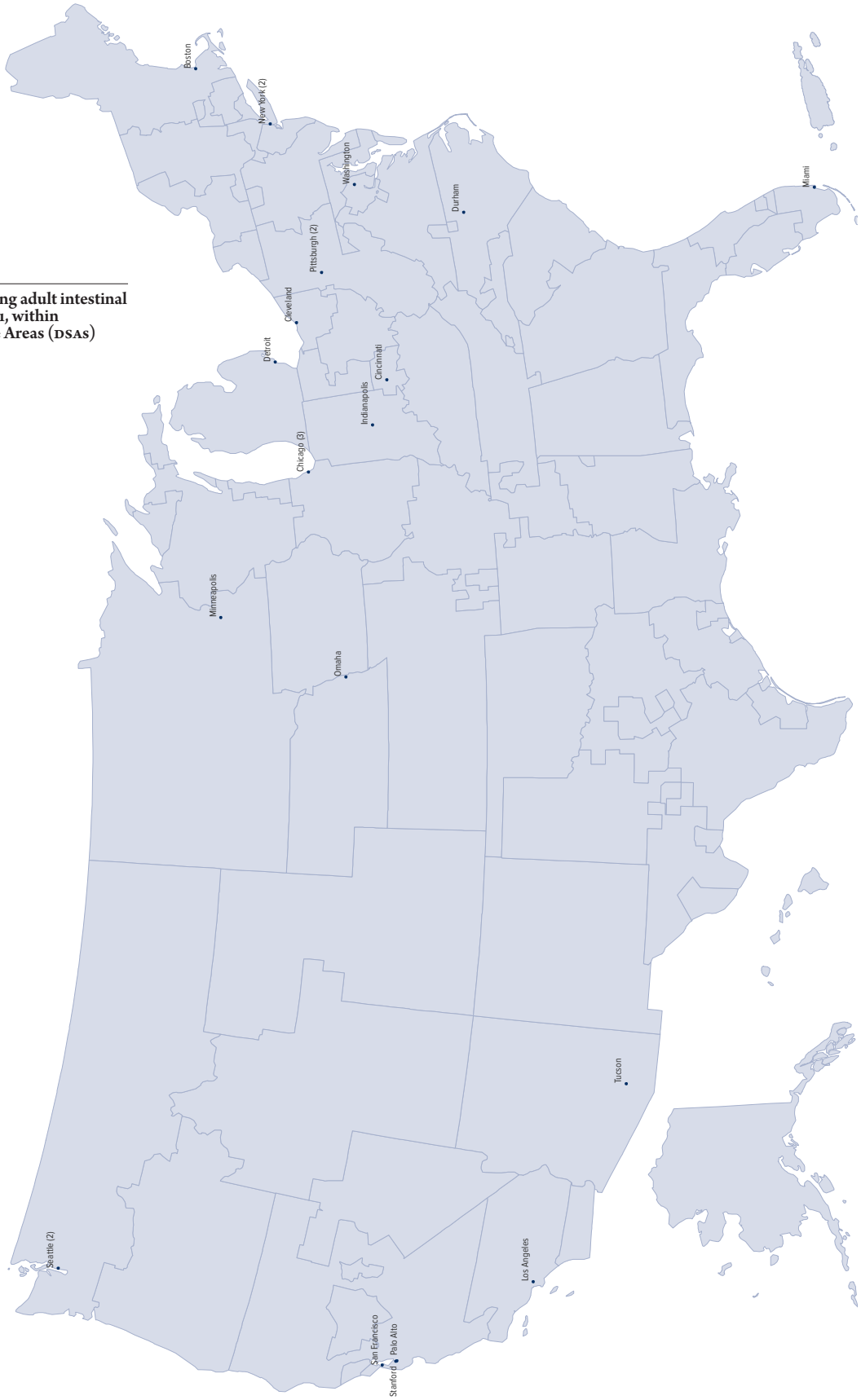
Patients transplanted in 2010 and remaining alive with graft function one year post-transplant. Top three one-year immunosuppression regimens are given, plus the "all others" group. Regimens are defined by use of calcineurin inhibitors (TAC=Tacrolimus, Cyclo=Cyclosporine), anti-metabolites (AZA=Azathioprine,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

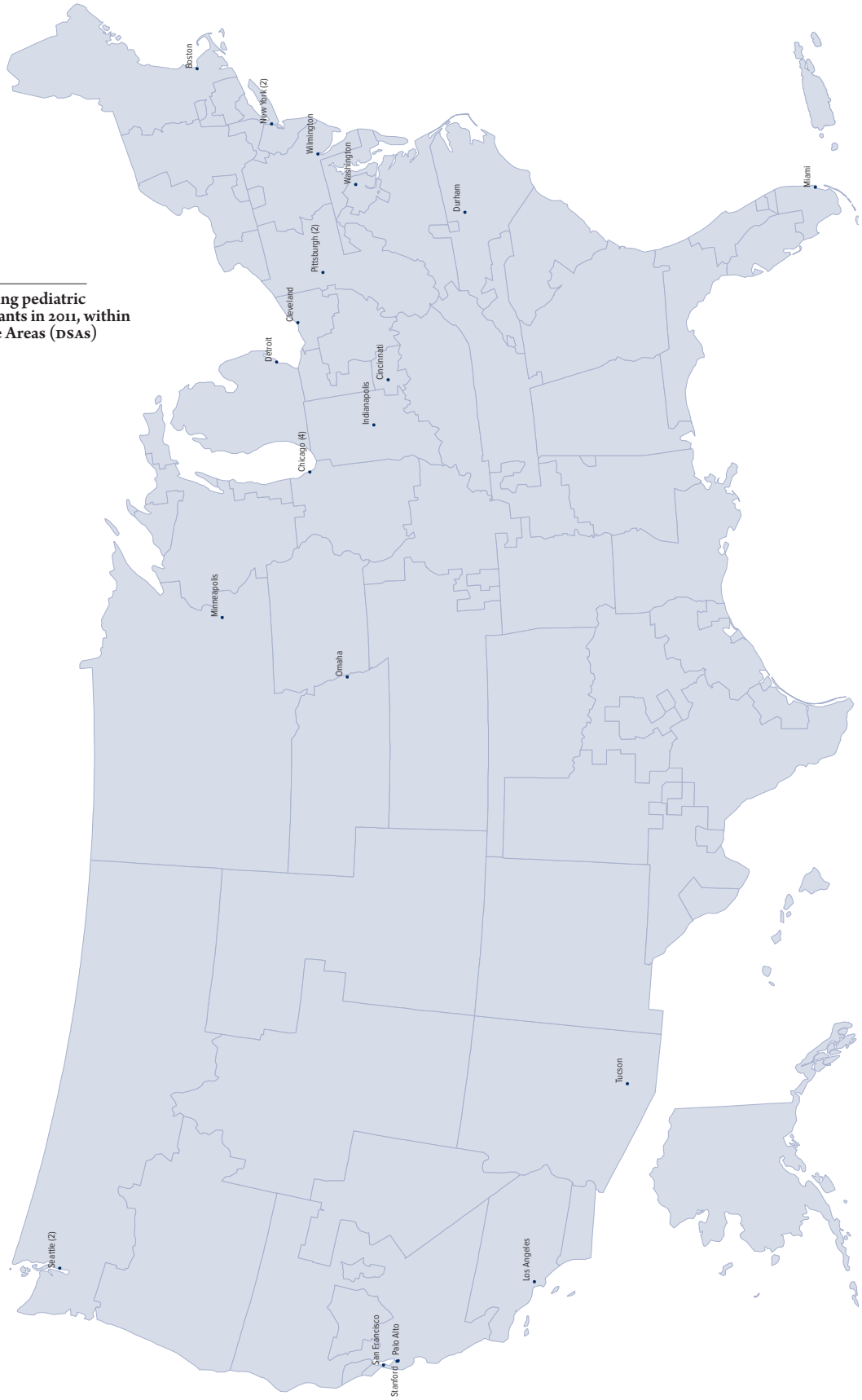


IN 5.4 Immunosuppression use in intestinal transplant recipients

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.

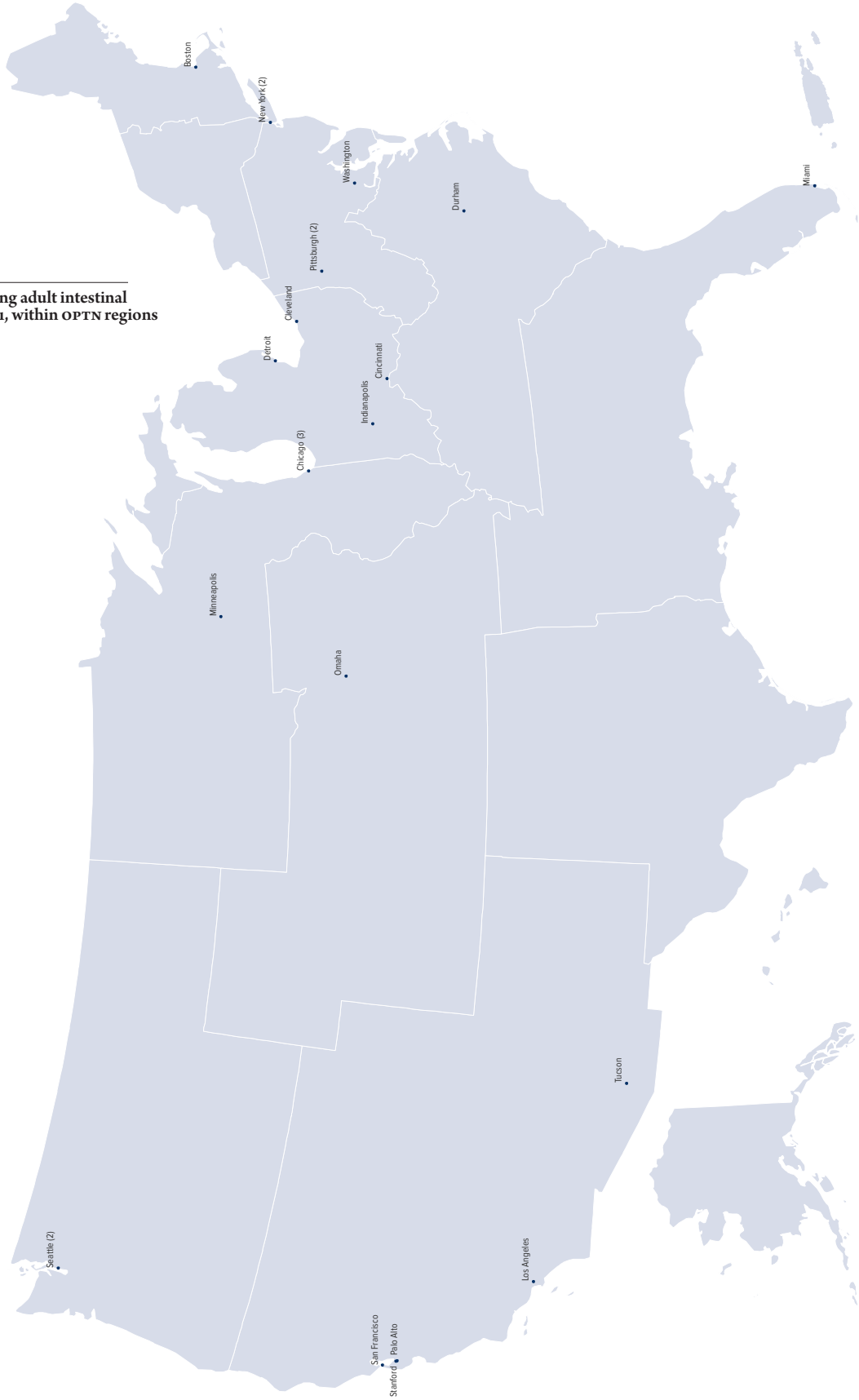
IN 6.1 Centers performing adult intestinal transplants in 2011, within Donation Service Areas (DSAs)





IN 6.2 Centers performing pediatric intestinal transplants in 2011, within Donation Service Areas (DSAs)

IN 6.3 Centers performing adult intestinal transplants in 2011, within OPTN regions



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pediatric transplant 142
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OPTN/SRTR 2011 Annual Data Report: heart

ABSTRACT Since 2005, the number of new active adult candidates on the heart transplant waiting list increased by 19.2%. The transplant rate peaked at 78.6 per 100 wait-list years in 2007, and declined to 67.8 in 2011. Wait-list mortality declined over the past decade, including among patients with a ventricular assist device at listing; in 2010 and 2011, the mortality rate for these patients was comparable to the rate for patients without a device. Median time to transplant was lowest for candidates listed in 2006-2007, and increased by 3.8 months for patients listed in 2010-2011. Graft survival has gradually improved over the past two decades, though acute rejection is common. Hospitalizations are frequent and increase in frequency over the life of the graft. In 2011, the rate of pediatric heart transplants was 124.6 per 100 patient-years on the waiting list; the highest rate was for patients aged less than 1 year. The pre-transplant mortality rate was also highest for patients aged less than 1 year. Short- and long-term graft survival has continued to improve. The effect on wait-list outcomes of a new pediatric heart allocation policy implemented in 2009 to reduce pediatric deaths on the waiting list cannot yet be determined.

KEY WORDS End-stage heart failure, heart transplant, transplant outcomes, ventricular assist device.

I want to do everything possible, because I don't want to waste any of the time I've been given. I am lucky, and I will do everything I can to make sure others get the same chance at life as I have been given. I tell everyone how important it is to be a donor. It really is about giving life.

Lacey, heart recipient

Introduction

Heart transplant has long been the best option for selected patients with end-stage heart failure. However, improvements in ventricular assist device (VAD) technology and increased experience with mechanical circulatory support have led to 1-year survival rates approaching those of heart transplant (1). The projected duration of current VADs is at least 5 years, and complications such as stroke and infection have declined substantially compared with complications related to older-generation devices. VADs bridge patients with end-stage heart failure safely to transplant and effectively treat heart failure. Thus, for many patients whose conditions are stable with a VAD, there is no urgency to proceed with listing for heart transplant. Durable devices have dramatically changed the way end-stage heart failure is managed and have resulted in shifts in post-transplant and wait-list trends.

Over the past decade, there have been minor fluctuations in the number of transplants performed per year, with a relatively consistent increase since 2004 (Figure 3.1). This increase in transplants has been mirrored by increases in donation rates, new listings, and transplant rates during the same period (Figures 1.1, 1.4, 2.1). This trend may be explained by policy changes that promote broader sharing. Substantial geographic variation in transplant rates still exists (Figure 3.4). Although geographic variations in donation rates may explain this trend, other factors may include regional donor use, access to the waiting list, geographic variations in listing practices, and death on the waiting list. Over the past decade, two major revisions to heart allocation policy have affected current trends: 1) in 2002, the policy regarding candidates with a VAD was changed to allow listing as status 1A for 30 days at any time after implant; 2) in 2006, the Organ Procurement and Transplantation Network (OPTN) implemented a broader sharing policy to preferentially allocate hearts to combined local and zone A status 1A and 1B candidates (2). In this report, when possible, we highlight trends that may have been influenced by these revisions.

Under the current allocation system, which was revised in 2002, all VAD patients, including those with complications as well as those who are stable, may accrue 30 days of status 1A time without a requirement for hospital admission. If patients with a VAD are not listed as status 1A, they can be listed indefinitely as status 1B. This revision, combined with the growing number of candidates with a VAD, has contributed to the increased proportion of status 1A and 1B registrations over the past decade and the decline in the proportion of status 2 registrations (Figures 1.2, 1.3, 1.12). Although candidates using intravenous inotropes can be listed as status 1A, the proportion of recipients receiving inotropes has declined over the past decade from 51% to 35%, presumably due to increased use of VADs in candidates who previously may have been prescribed inotropic therapy and the recognized survival benefit of VADs compared with inotropic therapy (3,4) (Figure 3.7). While these policies were developed during the early era of mechanical circulatory support, there have been substantial gains in VAD survival; thus the policies may need to be revised to reflect current clinical practice. Disease severity may vary widely among VAD patients. Variability in stability among VAD patients may contribute to differences in wait-list survival and possibly post-transplant survival. Currently, the OPTN Thoracic Organ Transplantation Committee is reassessing allocation policies in favor of a system that can better distinguish severity of illness among VAD patients. Furthermore, status 2 candidates are waiting longer due to changing trends in listing practices and the downstream effects of the broader sharing initiative. It remains to be seen whether longer waiting times will be detrimental to wait-list survival of status 2 candidates.

Adult Heart Transplant Waiting List Trends

New Listings, Wait-List Mortality, and Time to Transplant

Since 2004, the number of new active adult (aged 18 years or older at listing) candidates on the waiting list has increased by 19.2% (Figure 1.1). As expected, implementation of the broader geographic sharing policy and revision of the VAD policy have affected listing practices. Since 2006, the proportions of candidates who were first listed as status 1A and status 1B have increased by 5.4% and 7.3%, respectively, and the proportion initially listed as status 2 has declined by 11.7% (Figure 1.3).

The transplant rate peaked at 78.6 per 100 wait-list years in 2007 and has been declining since; in 2011, the rate was 67.8 per 100 wait-list years (Figure 1.4). Among candidates who were listed for transplant in 2008, 60.0% underwent transplant within 12 months of listing, 25.0% were still waiting at 12 months, and 9.5% had died. By 36 months, 69.7% had undergone transplant, 8.2% were still waiting, and 11.6% had died (Figure 1.6).

Wait-list mortality declined over the past decade, from 16.9 deaths per 100 wait-list years in 2001 to 11.6 per 100 wait-list years in 2011 (Figure 1.10). Trends were similar for men and women (data not shown), all age groups, all race categories, and all medical urgency status categories. In 2011, mortality by age was lowest for candidates aged 35 to 49 years; mortality was comparable for women and men (data not shown), and lowest for Asians. Wait-list mortality declined to approximately 10 deaths per 100 wait-list years for all diagnoses (Figure 1.10). Trends among candidates with a VAD at listing are notable. VAD survival has improved greatly. Historically, wait-list mortality has been substantially lower for candidates without a VAD than for candidates with a VAD; however, over the past decade, wait-list mortality improved dramatically among candidates with a VAD at listing, declining from 102.2 per 100 wait-list years in 2001 to 12.9 per 100 wait-list years in 2011. In 2010 and 2011, the mortality rate was comparable to the rate for candidates without a VAD at listing, a testament to improvements in VAD technology, experience, and application over the past 10 years (Figure 1.10). These data should be interpreted cautiously, however, as a marked proportion of candidates without a VAD received a VAD after listing; these candidates were included in the analysis as patients without a VAD at listing.

As expected with the broader sharing policy implemented in 2006, wait-list mortality declined substantially. Between 2006 and 2011, wait-list mortality for candidates listed as status 1A and 1B declined from 92.1 and 32.4 deaths per 100 wait-list years, respectively, to 36.9 and 11.0 deaths per 100 wait-list years. Wait-list mortality remains low for status 2 candidates, declining from 9.7 to 8.1 deaths per 100 wait-list years during this same time period (Figure 1.10). Mortality among candidates listed as inactive remained stable at 12.3 deaths per 100 wait-list years in 2011. Wait-list mortality remains highest for status 1A candidates compared with other medical urgency status categories.

Over the past decade, median time to transplant was lowest for candidates listed in 2006-2007, and has been increasing since. Overall, the duration of waiting time to transplant for candidates listed in 2010-2011 was 3.8 months longer than for the 2006-2007 cohort. In candidates listed as status 1A, median time to transplant increased from less than 1 month to 1.7 months. The trend was notable in candidates listed initially as status 1B and 2, for whom median waiting time increased by 3.5 months and 9.3 months, respectively (Figure 1.7). This trend does not, however, account for status upgrades or downgrades after listing. Median waiting time for candidates with a VAD at listing was 2.2 months less than for candidates without a VAD. Although waiting time also increased in recent years for candidates with a VAD, the magnitude was slightly less than for candidates without a VAD at listing, at 3.4 months compared with 4.4 months (Figure 1.7). As stated before, this analysis included candidates initially listed without a VAD who received a VAD after listing as candidates without a VAD at listing. The proportion of candidates listed in 2010 who underwent transplant within 1 year of listing varied widely by donation service area (DSA), from 27.1% to 81.0% (Figure 1.8). This variability may be due at least in part to differences among DSAs in listing practices and status changes after listing. Nationwide, the proportion of candidates undergoing transplant within 1 year of listing declined to 54.6% in recent years (Figure 1.9). Transplant within 1 year of listing was most likely for candidates with blood group AB and least likely for candidates with blood group O (Figure 1.9).

Candidate Characteristics

Since 2001, the proportion of candidates aged 18 to 34 years increased from 8.8% to 10.7%, and the proportion of those aged 65 years or older increased from 12.5% to 19.2%. While candidates aged 50 to 64 years compose the largest proportion

of heart transplant candidates, 49.5% in 2011, the size of this age group has declined in recent years (Figure 1.2). Over the past decade, the proportion of women increased by 4.2%. The proportions of ethnic minorities also increased; most notably, the proportion of black candidates increased substantially, from 13.8% to 21.2% between 2001 and 2011 (Figure 1.2). This increase may in part reflect the disproportionate and earlier occurrence of heart failure in black patients (5). The proportion of candidates with cardiomyopathy surpassed the proportion with coronary artery disease in 2003, and the proportion with congenital heart disease increased to 3.9% in 2011. In 2011, a smaller proportion of candidates (14.4%) waiting for heart transplant spent 3 or more years on the waiting list, compared with 2001 (23.2%). Listing practices, that is, centers electing to list candidates only when they qualify at a higher urgency status, may be partially responsible for shorter waits. Finally, the proportions of status 1A and 1B candidates on the waiting list have grown remarkably from 2001 to 2011, increasing from 9.6% to 14.1% for status 1A and from 17.2% to 35.0% for status 1B (Figure 1.2). These trends may be a consequence of increased use of VADs and of centers listing only candidates who qualify for higher urgency statuses. The increasing proportions of candidates awaiting heart transplant at a higher urgency status suggest increased morbidity among candidates, although the impact of VAD availability cannot be discounted. A comparison of candidates on the waiting list on December 31, 2001, and December 31, 2011, reveals similar trends (Figure 1.12).

Donation

The rate of heart donation among people aged less than 65 years has not changed substantially over the past decade; in 2010 this rate was 3.6 per 1,000 patient deaths. Donation rates since 2000 increased by approximately 20% in groups aged 0 to 14, 15 to 34, and 35 to 44 years, and declined by 23.0% and 40.0% in groups aged 45 to 54 and 55 to 64 years, respectively (Figure 2.1). Donation rates among blacks and Hispanics increased (Figure 2.1). Donors aged 18 to 34 years have consistently composed the greatest proportion of heart donors, and in 2011 represented 48.6% (Figure 2.7). The proportion of hearts recovered per organ donor declined from 0.37 in 2001 to 0.28 in 2004 and has since plateaued (Figure 2.3). The proportion of recovered hearts that are discarded has been declining over the past decade, and in 2011 ranged from 0.2% (1 heart) among heart donors aged 0 to 17 years to 1.8% (3 hearts) among heart donors aged 50 to 64 years (Figure 2.5). For the 17 recovered hearts discarded in 2011, the most common reason for discard was other (47.1%), followed by anatomical abnormalities (17.6%) (Figure 2.6). The most common cause of death among donors is head trauma (52.8%). For heart transplant donors, the prevalence of head trauma as a cause of death is slowly declining over time while the prevalence of anoxia is increasing (Figure 2.8).

Adult Heart Transplant

Trends in Transplant Rates

Overall, the number of adult heart transplants performed was stable between 2000 and 2011 (1,926 and 1,949, respectively). However, in 2004, this number reached a nadir of 1,724 (Figure 3.1). The transplant rate peaked in 2007 and has since declined for all status codes except status 1A (Figure 3.3). The anticipated effect of the broader sharing policy was more rapid transplants in status 1A and 1B candidates. Although the transplant rate for candidates listed at status 1A increased to 315 per 100 patient-years in 2011, the rate declined for status 1B candidates, from 267 to 103 transplants per 100 patient-years between 2007 and 2011. As expected, the transplant rate for status 2 candidates also declined, from 59 to 35 transplants per 100 patient-years. Among candidates with a VAD at the time of listing, the transplant rate decreased from 203 to 99 transplants per 100 patient-years between 2007 and 2011 (Figure 3.3). Despite this dramatic decline, candidates with a VAD continue to undergo transplant at higher rates than candidates without a VAD at listing, in part due to shorter waiting times. Candidates who received a VAD after listing are not accounted for in this analysis; these candidates were included in the analysis as patients without a VAD at listing; therefore, caution is warranted in interpretation.

Geographic trends in transplant rates are highly variable due to variations in center listing practices, donor availability

and perhaps DSA practices (Figure 3.4). Transplant rates varied from 0 to more than 200 transplants per 100 patient-years.

Trends in life support, including respiratory support and circulatory support, are also changing. Since 2001, the proportions of recipients who received intravenous inotropes immediately before transplant decreased from 51.1% to 35.1%. Since 2004, the proportion of recipients who received a left-VAD before transplant more than doubled, from 16.0% to 35.4% in 2011. Intra-aortic balloon pump use and ventilator use have been stable, as has right-VAD use (Figure 3.7).

Recipient Characteristics

The mean age of adult heart transplant recipients is 50.9 years and has not changed appreciably over the past decade (Figure 3.5); however, an increasing number of recipients are aged 65 years or older. Increasing proportions of recipients are female, are members of ethnic minorities, have cardiomyopathy, and have a VAD at the time of transplant (Figures 3.2, 3.9). Sensitization of heart transplant candidates remains a challenge and has increased since 2007. Increased use of VADs, evolving diagnostic methods to detect and quantify anti-HLA antibody, and increasing use of virtual cross-match, which may help increase access of sensitized candidates to heart transplant, have contributed to the growing number of sensitized candidates (Figure 4.1).

Transplant Outcomes

Aside from minor fluctuations, the overall adjusted probability of short-term graft failure (6 months and 1 year, adjusted for age, sex, and race) has been declining over the past decade, and in general is low, 0.07 at 6 months and 0.09 at 1 year for patients who underwent transplant in 2010. In addition, graft failure at 3, 5, and 10 years post-transplant has steadily declined (Figure 5.1). Early graft failure, within the first 6 weeks post-transplant, has declined, and occurred in only 4.9% of heart transplant recipients in 2011 (Figure 5.2). Overall, 5-year graft survival was 74.9%, and was similar among all status codes and disease groups (Figure 5.3). The greatest decline in graft survival occurred within the first 12 months post-transplant, when survival decreased by 12.7% (Figure 5.3). Graft survival has gradually improved over the past two decades. In recipients who underwent transplant in 2009 and had a functioning graft at 1 year, the predicted half-life, conditional on 1 year of survival, was 14.0 years (Figure 5.4). The number of heart transplant survivors is increasing; in 2011, 21,457 adult recipients were alive with a functioning graft, compared with 16,259 in 2001 (Figure 5.5). Among patients who underwent transplant between 2005 and 2006, 5-year survival was reduced in blacks compared with whites (68.2% vs. 77.9%); in recipients aged 18 to 34 years compared with those aged 35 to 49, 50 to 64, and 65 years or older (69.9%, 77.4%, 76.3%, and 73.9%, respectively); and in recipients with a non-durable VAD compared with those without a VAD and those with a durable VAD (54.9%, 76.6%, and 73.5%, respectively) (Figure 5.9). Only 51 recipients were included in the non-durable VAD category. Recipients with biventricular assist devices involving both durable and non-durable VADs were included in the durable category: 6 patients had a Heartmate XVE combined with a non-durable device. Among recipients in whom the cause of death post-transplant is known, cardiovascular disease remains the most common primary cause (Figure 5.10).

Post-Transplant Morbidity

Acute rejection during the first year post-transplant is common, occurring in 24.5% of recipients who underwent transplant 2005-2009. By 5 years post-transplant, 50.9% of recipients had at least one episode of rejection (Figure 5.6). Hospitalizations are frequent during the first year, occurring in 39.3% of recipients who underwent transplant 2006-2011, and continue to increase over the life of the graft; within 4 years post-transplant, 65.3% of recipients have been hospitalized (Figure 5.7). Post-transplant lymphoproliferative disorder (PTLD) is relatively infrequent in adults and is closely linked to Epstein-Barr virus (EBV) status (Figure 5.8).

Summary

This year's report highlights several successes, including notable improvements in wait-list survival and in patient and

graft survival. The broader sharing policy and increased VAD use have contributed to these successes but have introduced new challenges regarding allocation of donor hearts. Median time to transplant is increasing, particularly among status 2 candidates. Numbers of candidates listed as status 2 are declining; the appropriateness of performing transplants in status 2 candidates is even being questioned (6). Transplant rates are declining for status 1B and status 2 candidates. To continue allocating hearts to the highest urgency candidates, the allocation policy will need to further distinguish severity of illness between status 1A and status 1B candidates. Revisions to the heart allocation policy are currently being considered; these revisions are anticipated to further define VAD complications to ensure that criteria used for justification of medical urgency are more uniform. Finally, wide geographic variations persist in donation rates, transplant rates, and wait-list mortality. While these analyses are currently not adjusted for medical urgency, which may contribute to the perceived variations, the causes of these disparate trends warrant further investigation to assess equitable access to donor hearts around the country.

Pediatric Heart Transplant

Pediatric Waiting List Trends

Since 1998, the number of new pediatric candidates added to the heart transplant waiting list has increased slightly, and few candidates have been added as inactive. The number of prevalent wait-list candidates remained stable between 250 and just over 300 in the past decade. Historically, more candidates were listed as inactive than as active, but in a shift since 2008, 57.1% of candidates are now listed as active (Figure 7.1). The age distribution changed over the past 3 years; the percentage of wait-listed candidates aged 11 to 17 years increased, with a corresponding decrease in the percentage aged less than 1 year (Figure 7.2). Eight percent of candidates on the waiting list in 2010-2011 were waiting for a re-transplant. Among all candidates on the list, 2.3% of those aged 0 to 5 years were waiting for a re-transplant, as were 15.8% of those aged 6 to 10 years and 14.7% of those aged 11 to 17 years (Figure 7.3). Of candidates newly listed in 2008, 70.2% underwent transplant within 3 years; 14.7% died, 11.8% were removed from the list, and 3.3% were still waiting (Figure 7.5). Pre-transplant mortality decreased for all age groups. The pre-transplant mortality rate was highest for candidates aged less than 1 year, at 49 deaths per 100 wait-list years in 2010-2011 (Figure 7.7).

Pediatric Transplant

The number of pediatric heart transplants performed each year increased from 274 in 1998 to 375 in 2011 (Figure 7.8). In 2011, the rate of pediatric heart transplant was 124.6 per 100 patient-years on the waiting list; the highest rate was for recipients aged less than 1 year, at 271.3 transplants per 100 patient-years on the waiting list (Figure 7.9). Over the past decade, congenital defects remain the most common primary cause of disease, affecting 43.4% of recipients in 2009-2011 (Figure 7.10). The percentage of patients who underwent transplant as status 1A increased from 62.2% in 1999-2001 to 87.1% in 2009-2011. This increase may reflect the policy implemented in 2009 that prioritized pediatric candidates awaiting heart transplant as status 1A in the combined local DSA and zone A as the first unit of allocation. This policy also preferentially allocates all pediatric hearts to pediatric recipients, a change from the previous policy, which prioritized adolescent donor hearts for pediatric candidates. VAD use increased from only 7.6% of pediatric transplant recipients in 1999-2001 to 18.3% in 2009-2011. Development of the Berlin Heart, a VAD for pediatric patients; the HeartMate II, a left VAD smaller than its predecessor; and other newer-generation devices allowed expansion of durable and non-durable support to pediatric candidates.

Pediatric Immunosuppression and Outcomes

Substantial changes in maintenance immunosuppression have occurred. Tacrolimus use increased from 23.8% in 1998 to 83.2% in 2011. Mycophenolate mofetil use increased from 33.2% in 1998 to 90.0% in 2011. In 2010, mammalian target of rapamycin inhibitors were used in 1.4% of patients at the time of transplant and in 7.2% at 1 year post-transplant. Steroids were used in 75.2% of patients at the time of transplant in 2010,

and use decreased to 36.1% at 1 year (Figure 7.13). In 2011, no induction immunosuppression was used in 32.0% of recipients, T cell depleting agents were used in 48.0%, and interleukin-2 receptor antagonists were used in 25.7% (Figure 7.13).

Graft survival, both long-term and short-term, has continued to improve. Graft survival for heart transplants performed in 2005 was 87.5% at 6 months, 84.6% at 1 year, and 72.1% at 5 years (Figure 7.14). Graft survival for heart transplants performed in 2010 was 92.7% at 6 months and 91.2% at 1 year. The rate of late graft failure is traditionally measured by the graft half-life conditional on 1-year survival, defined as the time to when half of grafts surviving at least 1 year are still functioning. For heart transplants performed in 2009-2010, the 1-year conditional graft half-life was 17.4 years (Figure 7.15). Incidence of first acute rejection increased over time post-transplant; 24.4% of patients experienced rejection in the first 12 months and 38.2% by 24 months post-transplant (Figure 7.16). The highest risk for EBV infection and PTLD occurred in EBV-negative recipients. Incidence of PTLD was 8.4% at 5 years post-transplant among EBV-negative recipients and 2.7% among EBV-positive recipients (Figure 7.12).

Policy Updates

In 2009, a new pediatric heart allocation sequence was implemented that preferentially allocates pediatric hearts to status 1A pediatric candidates in a combined allocation unit composing the local DSA and zone A before local adult status 1A candidates and status 1B pediatric candidates; compared with the previous policy, which prioritized local status 1A pediatric candidates, the new policy prioritizes both local and zone A status 1A pediatric candidates. The ultimate goal of this policy is to reduce pediatric deaths on the waiting list and to expedite allocation of pediatric hearts to pediatric candidates at highest risk of wait-list mortality. Although it is too early to determine the effect of this policy on wait-list outcomes, during 2010-2011, wait-list mortality appeared to decline among pediatric candidates in all age categories compared with 2008-2009 (Figure 7.7). Future OPTN/SRTR data reports will focus on the impact of these allocation policy changes.

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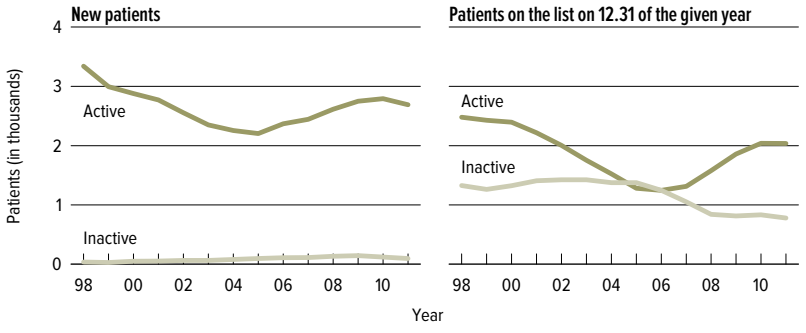
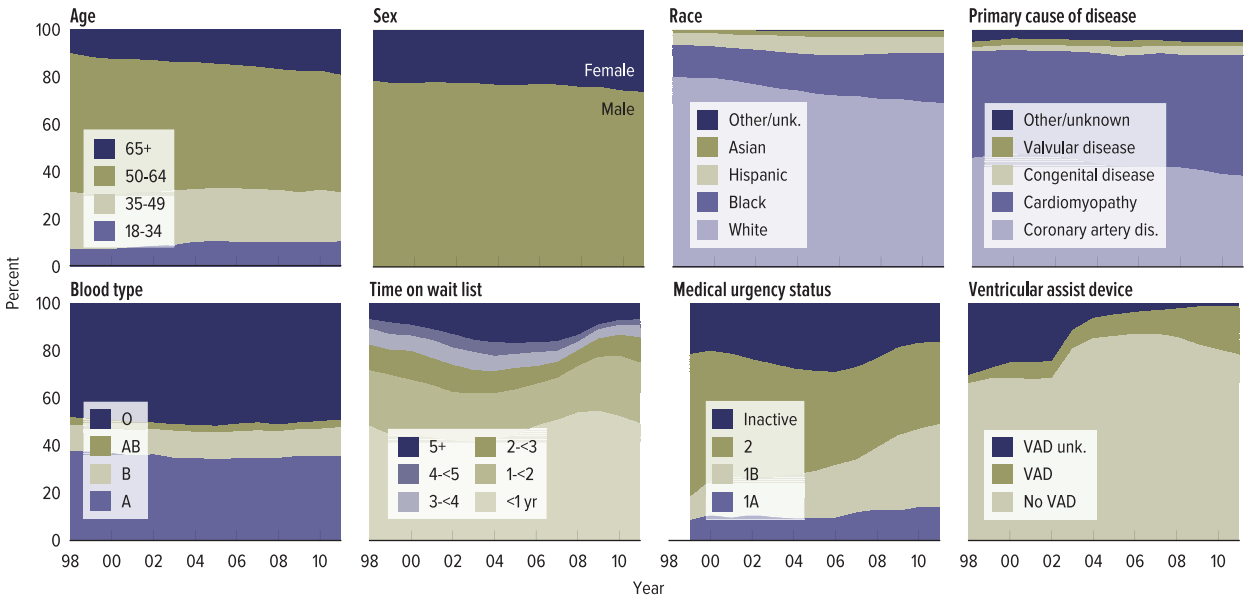
wait list



HR 1.1 Adult patients waiting for a heart transplant

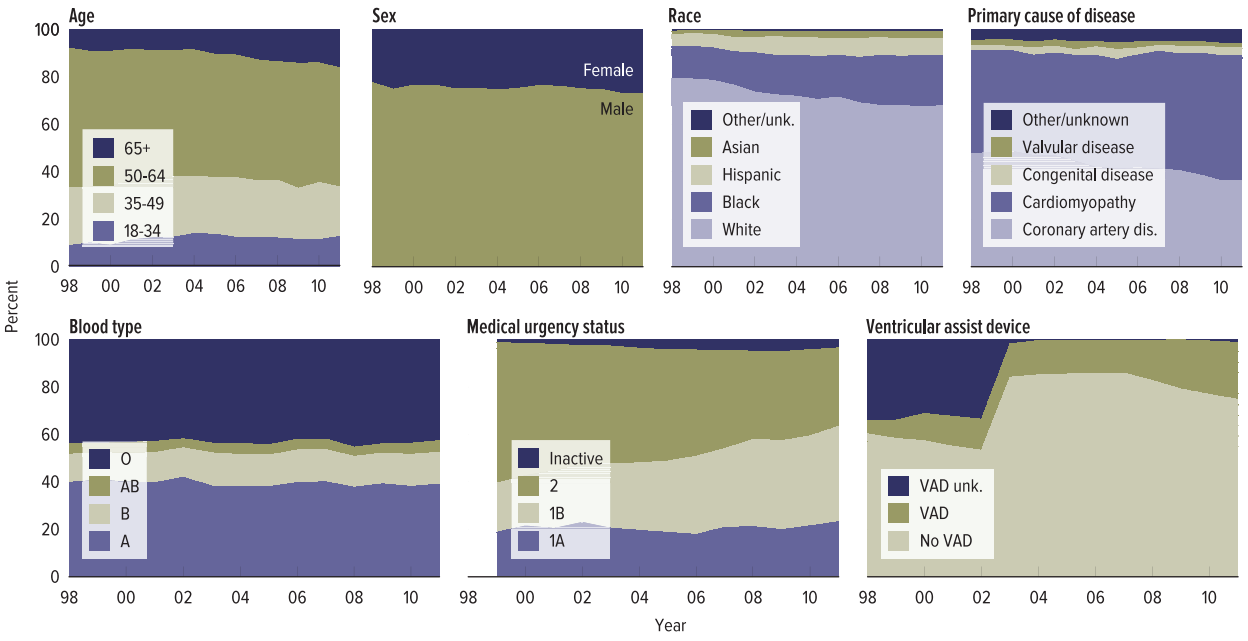
Patients waiting for a transplant. A "new patient" is one who first joins the list during the given year, without having listed in a previous year. However, if a patient has previously been on the list, has been removed for a transplant, and has relisted since that transplant, the patient is considered 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.



HR 1.2 Distribution of adult patients waiting for a heart transplant

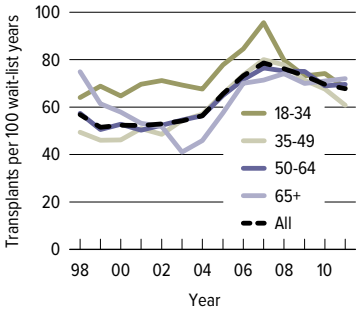
Patients waiting for a transplant any time in the given year. Age determined on the earliest of listing date or December 31 of the given year. Concurrently listed patients are counted once. Ventricular assist device information comes from the OPTN Transplant Candidate Registration form at the time of listing, and includes LVAD, RVAD, TAH, and LVAD + RVAD. Medical urgency status is the earliest available per year for each patient.

wait list



HR 1.3 Distribution of adult patients newly listed for a heart 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. Ventricular assist device information comes from the OPTN Transplant Candidate Registration form at the time of listing, and includes LVAD, RVAD, TAH, and LVAD + RVAD.



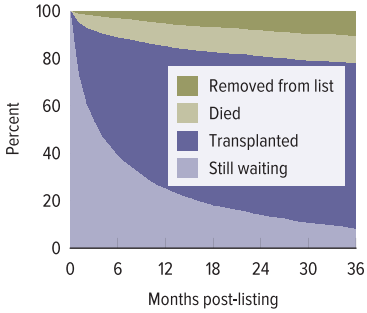
HR 1.4 Heart transplant rates among adult waiting list candidates, by age

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

	2009	2010	2011
Patients at start of year	2,409	2,668	2,867
Patients added during year	2,890	2,916	2,783
Patients removed during year	2,625	2,710	2,837
Patients at end of year	2,674	2,874	2,813
Removal reason			
Deceased donor transplant	1,840	1,965	1,931
Patient died	435	400	441
Patient refused transplant	14	12	18
Improved, tx not needed	193	164	166
Too sick to transplant	55	61	92
Other	88	108	189

HR 1.5 Heart 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.

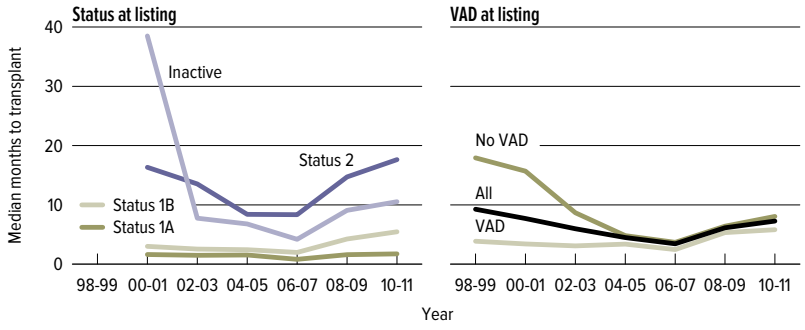


HR 1.6 Outcomes for adult patients waiting for a heart transplant among new listings in 2008

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.

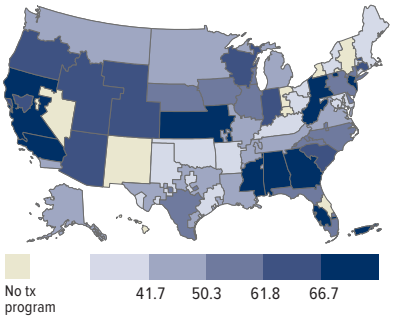
data behind the figures can be downloaded from our website, at www.srtr.org

wait list



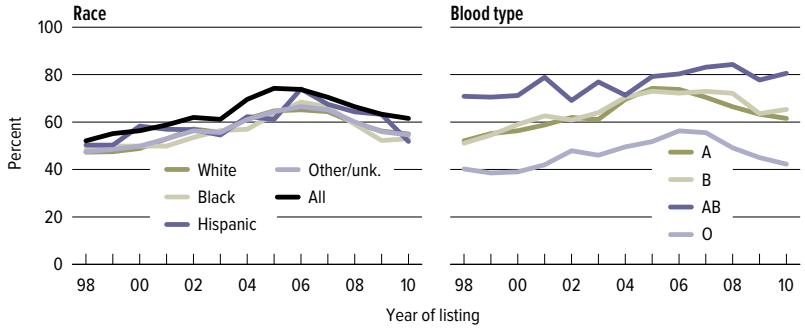
HR 1.7 Median months to heart transplant for wait-listed adult patients

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.



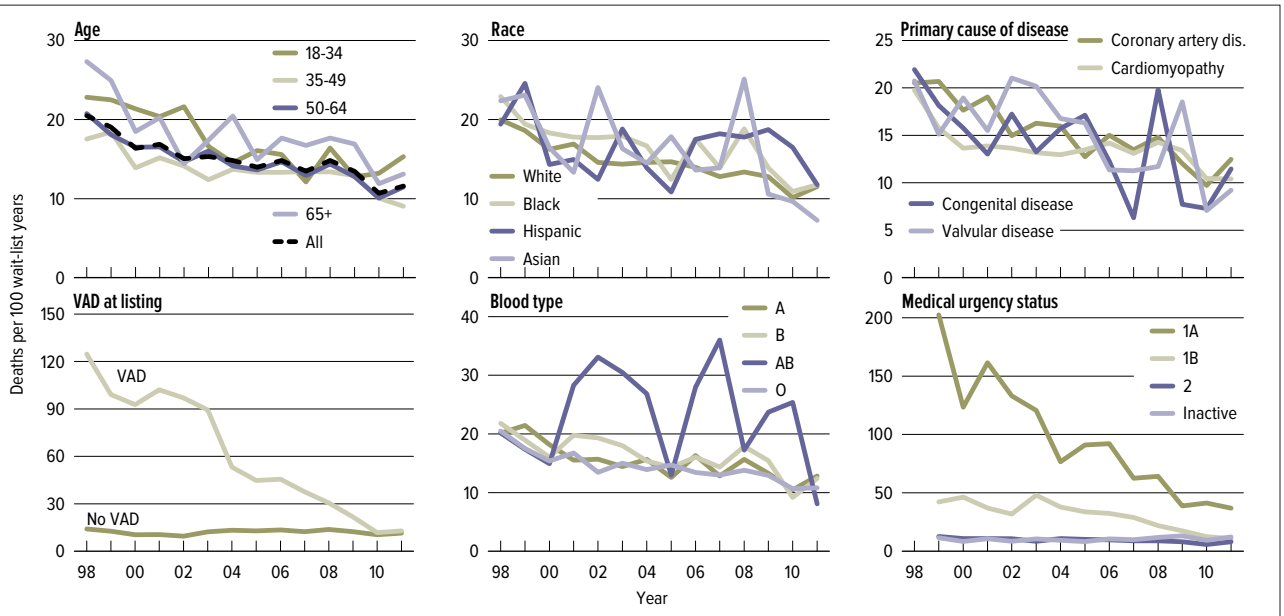
HR 1.8 Percent of adult wait-listed patients, 2010, who received a deceased donor heart transplant within one year, by DSA

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



HR 1.9 Adult wait-listed patients who received a deceased donor heart transplant within one year

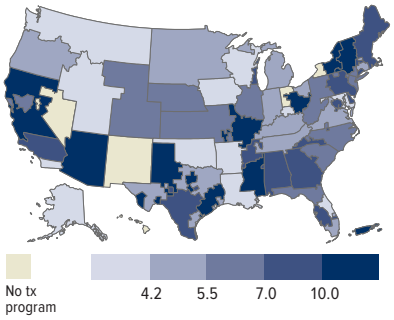
Patients with concurrent listings at more than one center are counted once, from the time of earliest listing to the time of latest removal. Patients listed, transplanted, and re-listed are counted more than once.



HR 1.10 Pre-transplant mortality rates among adult patients wait-listed for a heart 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. Medical urgency status is the earliest known status in the given year.

wait list



HR 1.11 Mortality within 90 days of listing for heart transplant, by DSA, 2009–2010

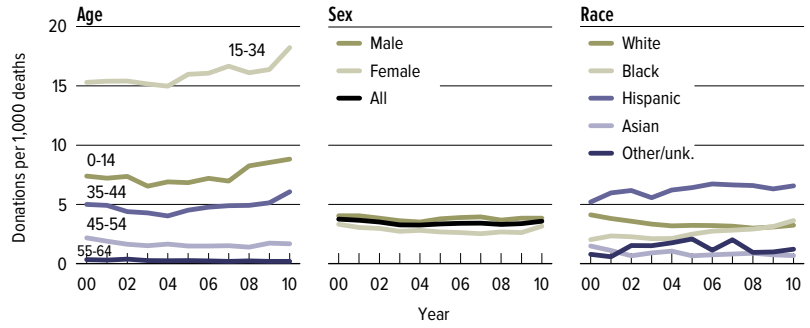
Patients with concurrent listings in a single DSA are counted once in that DSA, and those listed in multiple DSAs are counted separately per DSA. Deaths occuring within 90 days, but after transplant or removal from the waiting list, are included.

		2001		2011	
	Level	N	%	N	%
Age	18-34	270	7.4	305	10.8
	35-49	859	23.7	632	22.4
	50-64	2,081	57.3	1,401	49.7
	65+	421	11.6	481	17.1
Sex	Female	759	20.9	705	25.0
	Male	2,872	79.1	2,114	75.0
Race	White	2,863	78.9	1,952	69.2
	Black	489	13.5	602	21.4
	Hispanic	206	5.7	178	6.3
	Asian	60	1.7	61	2.2
	Other/unknown	13	0.4	26	0.9
Primary cause of disease	Cor. artery disease	1,680	46.3	1,079	38.3
	Cardiomyopathy	1,634	45.0	1,414	50.2
	Congenital disease	87	2.4	126	4.5
	Valvular disease	85	2.3	53	1.9
	Other/unknown	145	4.0	147	5.2
Transplant history	Listed/first transplant	3,532	97.3	2,706	96.0
	Listed/subseq. transplant	99	2.7	113	4.0
Blood type	A	1,164	32.1	906	32.1
	B	348	9.6	301	10.7
	AB	67	1.9	60	2.1
	O	2,052	56.5	1,552	55.1
Time on wait list	<1 year	1,282	35.3	1,387	49.2
	1-<2	722	19.9	626	22.2
	2-<3	457	12.6	323	11.5
	3-<4	356	9.8	166	5.9
	4-<5	237	6.5	71	2.5
	5+	577	15.9	246	8.7
Medical urgency status	1A	83	2.3	203	7.2
	1B	315	8.8	901	32.0
	2	1,759	49.4	936	33.2
	Inactive	1,405	39.4	779	27.6
Total		3,631	100.0	2,819	100.0

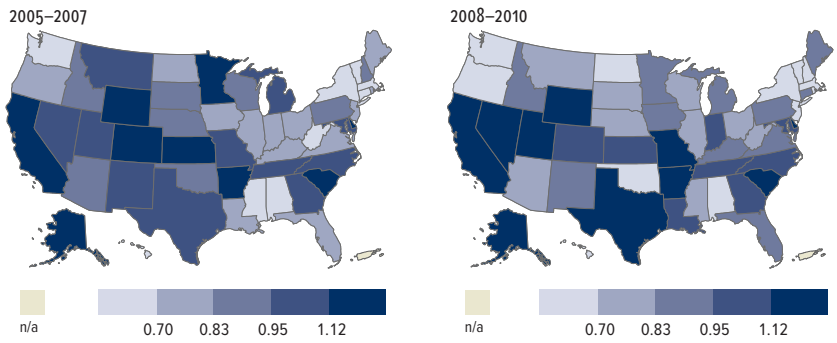
HR 1.12 Characteristics of adult patients on the heart transplant waiting list on December 31, 2001 & December 31, 2011

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.

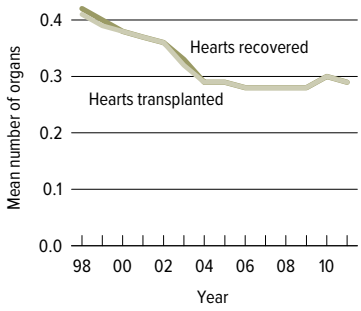
deceased donation



HR 2.1 Deceased donor heart donation rates
Numerator: Deceased donors age less than 65 whose organ(s) were recovered for transplant. Denominator: US deaths per year, age less than 65. (Death data available at http://www.cdc.gov/nchs/products/nvsr.htm.)

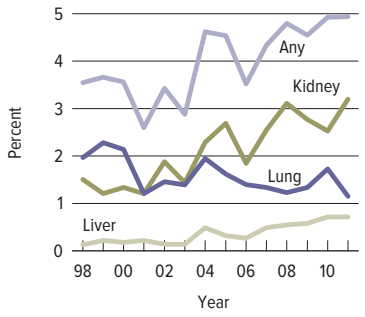


HR 2.2 Deceased donor heart donation rates (per 1,000 deaths), by state
Numerator: Deceased donors residing in the 50 states whose heart was recovered for transplant in the given year range. Denominator: US deaths by state during the given year range (death data available at http://www.cdc.gov/nchs/products/nvsr.htm).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



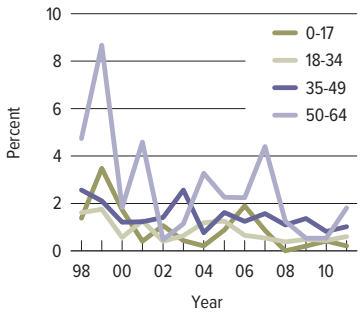
HR 2.3 Hearts recovered per donor & hearts transplanted per donor
Denominator: all deceased donors with at least one organ of any type recovered for transplant. Numerator for recovery rate: number of hearts recovered for transplant in the given year; hearts recovered for other purposes are not included. Numerator for transplant rate: all deceased donor hearts transplanted in given year.

deceased donation



HR 2.4 Deceased donor hearts transplanted with another organ

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



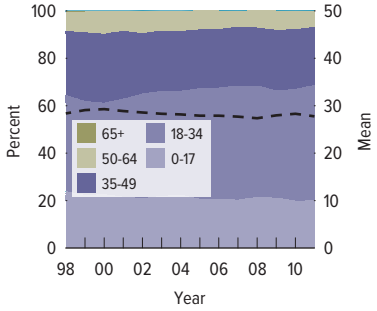
HR 2.5 Discard rates for hearts recovered for transplant, by age

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

Reasons for discard	Percent	N
Other, specify	47.06	8
Anatomical abnormalities	17.65	3
Diseased organ	5.88	1
Donor medical history	5.88	1
Missing	5.88	1
Organ trauma	5.88	1
Poor organ function	5.88	1
Too old on ice	5.88	1

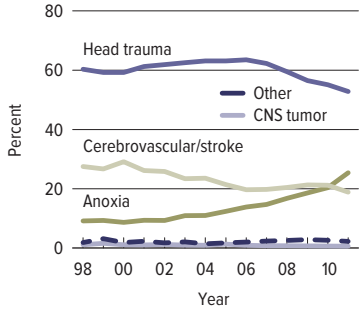
HR 2.6 Reasons for discards, 2011

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



HR 2.7 Heart donor age

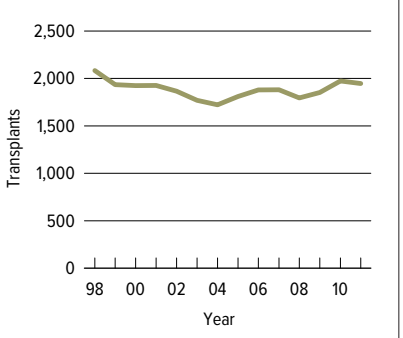
Transplanted hearts from US donors; age calculated at date of donation.



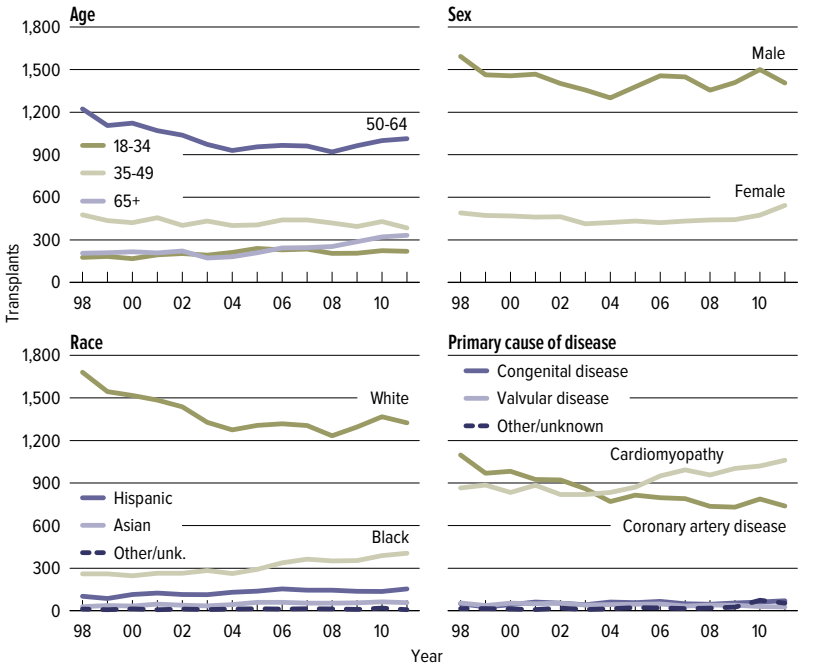
HR 2.8 Cause of death among deceased heart donors

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

transplant

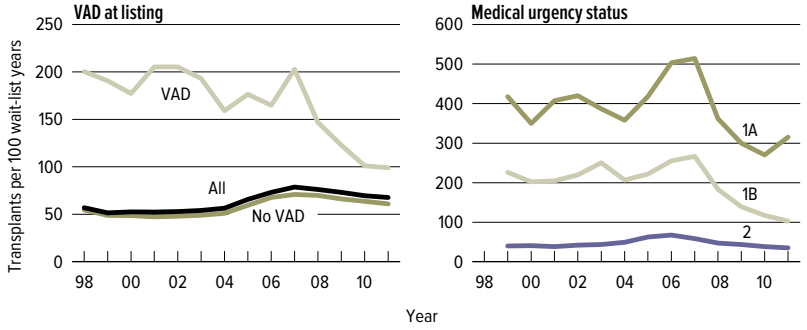


HR 3.1 Total adult heart transplants
Patients receiving a transplant. Retransplants are counted.



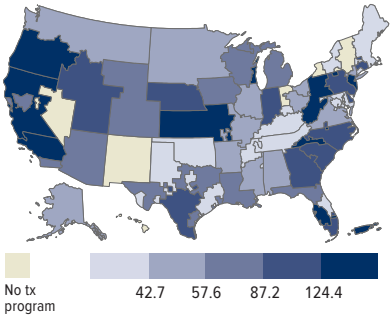
HR 3.2 Adult heart transplants
Patients receiving a transplant. Retransplants are counted.

transplant



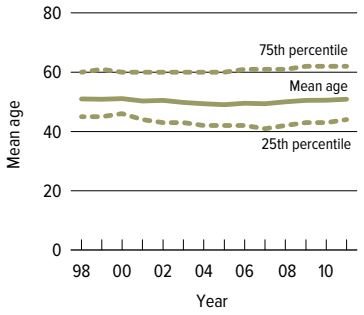
HR 3.3 Heart transplant rates in adult waiting list candidates

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. For rates by VAD and status, waiting time is calculated as the total waiting time in the given year for patients in each VAD/status group. All waiting time per patient per listing is counted, and all listings that end in a transplant for the patient are considered transplant events. Medical urgency status is updated each year, using the earliest known status in the given year.



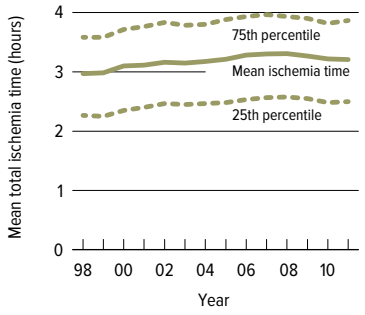
HR 3.4 Deceased donor heart transplant rates per 100 patient years on the waiting list among adult candidates, by DSA, 2010–2011

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.



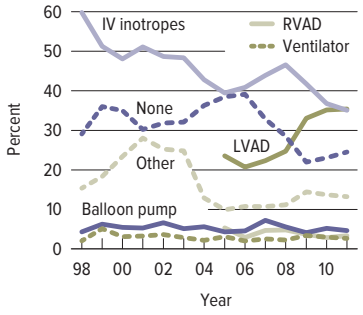
HR 3.5 Age at transplant for adult heart recipients

Patients receiving a transplant in the given year. Retransplants are included.



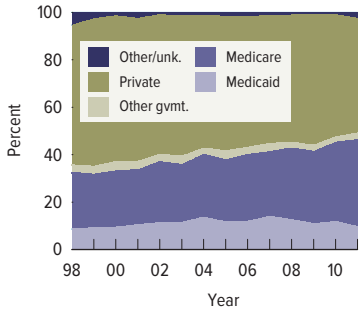
HR 3.6 Total ischemia time for adult heart transplants

Patients receiving a transplant in the given year. Retransplants are included. Total ischemia time includes cold, warm, and anastomotic time.



HR 3.7 Adult heart recipients on circulatory support prior to transplant

Patients may have more than one type of circulatory support. The "other" category includes types of circulatory support found in less than 2% of patients each year: total artificial heart, ECMO, inhaled NO, prostaglandins, and others.



HR 3.8 Insurance coverage among adult heart transplant recipients at time of transplant

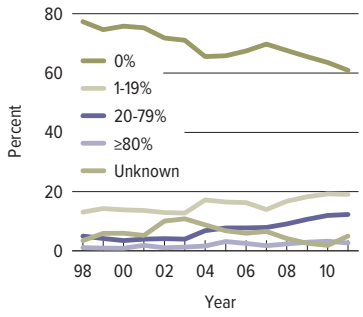
Patients receiving a transplant. Retransplants are counted.

	Level	2001 N	2001 %	2011 N	2011 %
Age	18-34	194	10.1	220	11.3
	35-49	457	23.7	384	19.7
	50-64	1,070	55.5	1,013	52.0
	65+	208	10.8	332	17.0
Sex	Female	461	23.9	544	27.9
	Male	1,468	76.1	1,405	72.1
Race	White	1,485	77.0	1,324	67.9
	Black	264	13.7	406	20.8
	Hispanic	125	6.5	154	7.9
	Asian	47	2.4	57	2.9
	Other/unk.	8	0.4	8	0.4
Primary cause of disease	Coronary artery dis.	925	48.0	738	37.9
	Cardiomyopathy	884	45.8	1,060	54.4
	Congenital disease	61	3.2	71	3.6
	Valvular disease	50	2.6	27	1.4
	Other/unknown	9	0.5	53	2.7
Transplant history	First	1,876	97.3	1,869	95.9
	Subsequent	53	2.7	80	4.1
Blood type	A	842	43.6	792	40.6
	B	261	13.5	276	14.2
	AB	118	6.1	105	5.4
	O	708	36.7	776	39.8
Primary payor	Private	1,160	60.1	941	48.3
	Medicaid	204	10.6	191	9.8
	Medicare	447	23.2	714	36.6
	Other government	70	3.6	55	2.8
	Other/unknown	48	2.5	48	2.5
Time on wait list	<30 days	485	25.1	531	27.2
	31-60 days	241	12.5	238	12.2
	61-90 days	195	10.1	199	10.2
	3-<6 months	325	16.8	304	15.6
	6-<12 months	299	15.5	323	16.6
	1-<2 years	228	11.8	232	11.9
	2-<3 years	82	4.3	73	3.7
	3+ years	74	3.8	49	2.5
Medical urgency status	1A	676	35.0	1,097	56.3
	1B	766	39.7	728	37.4
	2	486	25.2	124	6.4
	Other	1	0.1	0	0.0
Reported history of cigarette smoking at listing	No	n/a	n/a	1,044	53.6
	Yes	n/a	n/a	898	46.1
	Unknown	n/a	n/a	7	0.4
VAD status	No VAD	63	3	1,116	57.3
	VAD	513	27	819	42.0
	Unknown	1,353	70	14	0.7
Total		1,929	100.0	1,949	100.0

HR 3.9 Characteristics of adult heart transplant recipients, 2001 & 2011

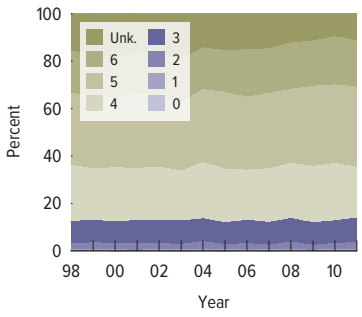
Patients receiving a transplant. Retransplants are counted. Ventricular assist device information comes from the OPTN Transplant Recipient Registration form and includes LVAD, RVAD, TAH, and LVAD + RVAD. Smoking history and VAD status were not collected on the TRR form in 2001.

donor-recipient matching



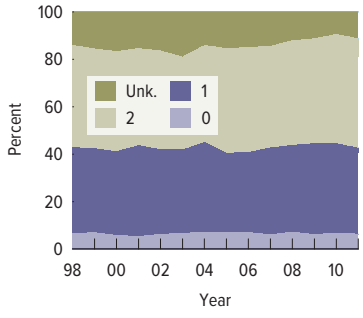
HR 4.1 PRA at time of heart transplant in adult recipients

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.



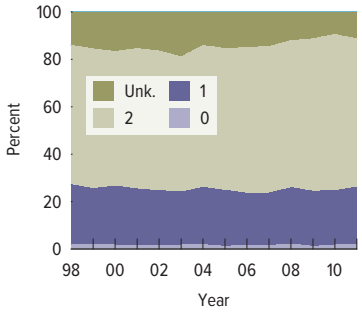
HR 4.2 Total HLA mismatches among adult heart transplant recipients

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



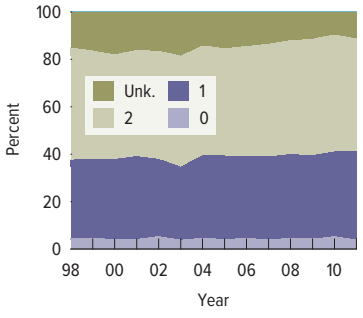
HR 4.3 HLA-A mismatches among adult heart transplant recipients

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



HR 4.4 HLA-B mismatches among adult heart transplant recipients

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



HR 4.5 HLA-DR mismatches among adult heart transplant recipients

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

donor-recipient matching

RECIPIENT	DONOR Negative	Positive	Unknown	Total
Negative	14.1	22.6	0.1	36.8
Positive	22.2	36.8	0.2	59.2
Unknown	1.7	2.4	0.0	4.1
Total	38.0	61.8	0.3	100

HR 4.6 Adult heart 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	DONOR Negative	Positive	Unknown	Total
Negative	0.9	13.0	0.4	14.4
Positive	3.9	60.6	1.7	66.2
Unknown	0.9	17.9	0.7	19.5
Total	5.7	91.5	2.8	100

HR 4.7 Adult heart 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	DONOR Negative	Positive	Unknown	Total
Negative	82.8	1.7	0.1	84.6
Positive	4.2	0.2	0.0	4.4
Unknown	10.9	0.1	0.0	11.0
Total	97.9	2.0	0.1	100

HR 4.8 Adult heart 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	DONOR Negative	Positive	Unknown	Total
Negative	94.7	0.0	0.1	94.8
Positive	1.7	0.0	0.0	1.7
Unknown	3.5	0.0	0.0	3.5
Total	99.9	0.0	0.1	100

HR 4.9 Adult heart 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	DONOR Negative	Positive	Unknown	Total
Negative	91.2	0.0	0.0	91.2
Positive	1.9	0.0	0.0	2.0
Unknown	6.8	0.0	0.0	6.8
Total	99.9	0.1	0.0	100

HR 4.10 Adult heart donor-recipient hepatitis C serology matching, 2007–2011

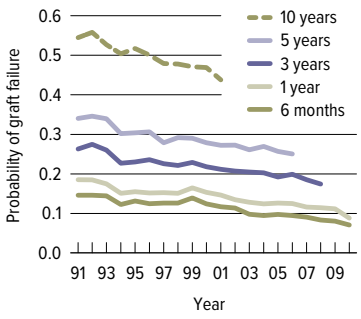
Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields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

RECIPIENT	DONOR Negative	Positive	Unknown	Total
Negative	92.0	0.0	0.1	92.1
Positive	0.2	0.0	0.0	0.2
Unknown	7.7	0.0	0.0	7.7
Total	99.9	0.0	0.1	100

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

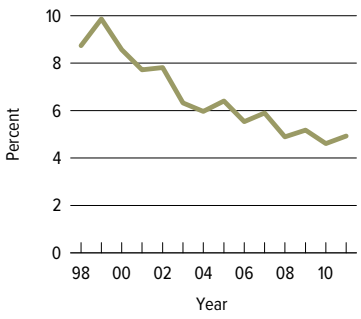
Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields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

outcomes



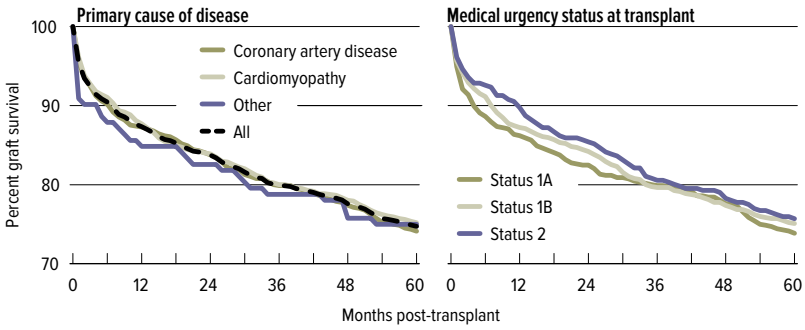
HR 5.1 Graft failure among adult heart transplant recipients

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



HR 5.2 Graft failure within the first 6 weeks after transplant among adult heart transplant recipients

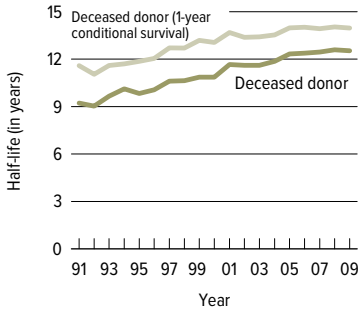
All-cause graft failure is identified from multiple data sources, including the OPTN Transplant Recipient Registration, OPTN Transplant Recipient Follow-up, as well as death dates from the Social Security Administration.



HR 5.3 Graft survival among adult heart transplant recipients transplanted in 2006

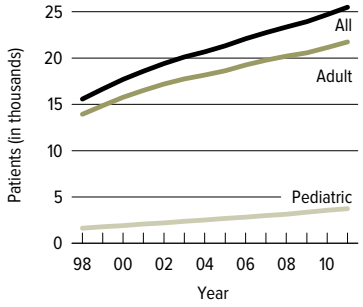
Graft survival estimated using unadjusted Kaplan-Meier methods.

outcomes



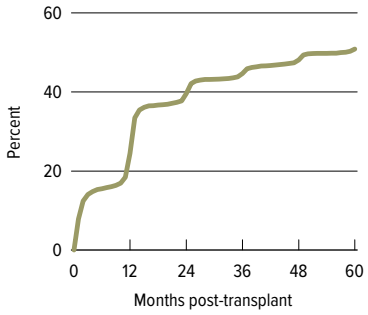
HR 5.4 Half-lives for adult heart transplant recipients

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.



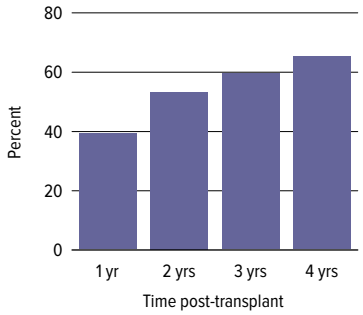
HR 5.5 Recipients alive & with a functioning heart transplant on June 30 of the year

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.



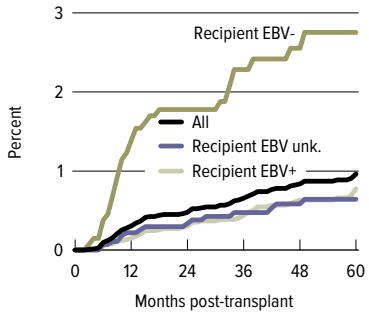
HR 5.6 Incidence of first acute rejection among adult patients receiving a heart transplant in 2005–2009

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.



HR 5.7 Reported cumulative incidence of rehospitalizations among adult patients receiving a heart transplant in 2006–2011

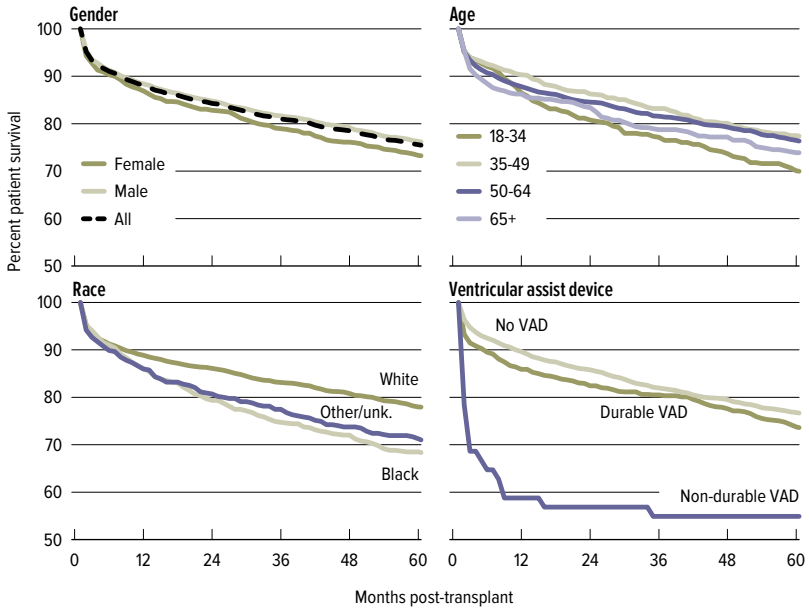
Cumulative incidence of rehosptalization post-transplant; hospitalization identified from the OPTN Transplant Recipient Follow-up form. Patients required to be alive with graft function at each time period, so denominators reduce over time.



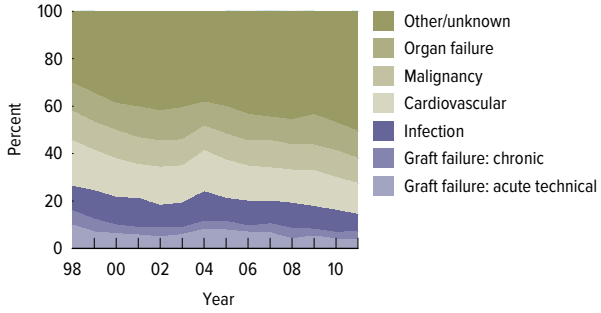
HR 5.8 Incidence of PTLD among adult patients receiving a heart transplant in 2005–2009, by recipient Epstein-Barr virus (EBV) status at transplant

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

outcomes

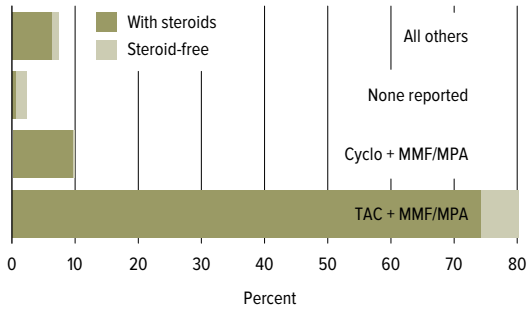


HR 5.9 Patient survival among adult heart transplant recipients, 2005–2006
Percent patient survival using unadjusted Kaplan-Meier methods. For patients with more than one transplant during the period, only their first transplant is considered. VAD status for each patient comes from time of transplant. Patients with both durable and non-durable VADs are included in the durable group.



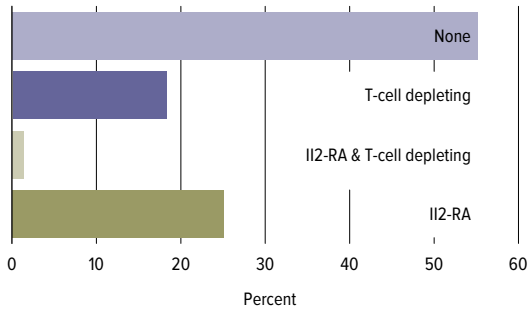
HR 5.10 Cause of death among adult heart transplant recipients
Patients who died in a given year are included regardless of when transplant was received. Primary cause of death is as reported by the OPTN from the Transplant Follow-up forms. Other causes of death include hemorrhage, trauma, non-compliance,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

immunosuppression



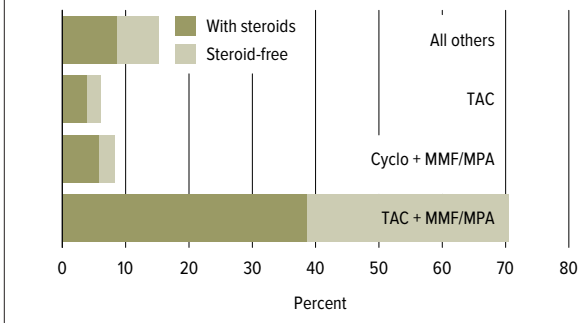
HR 6.1 Initial immunosuppression regimen in adult heart transplant recipients, 2011

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



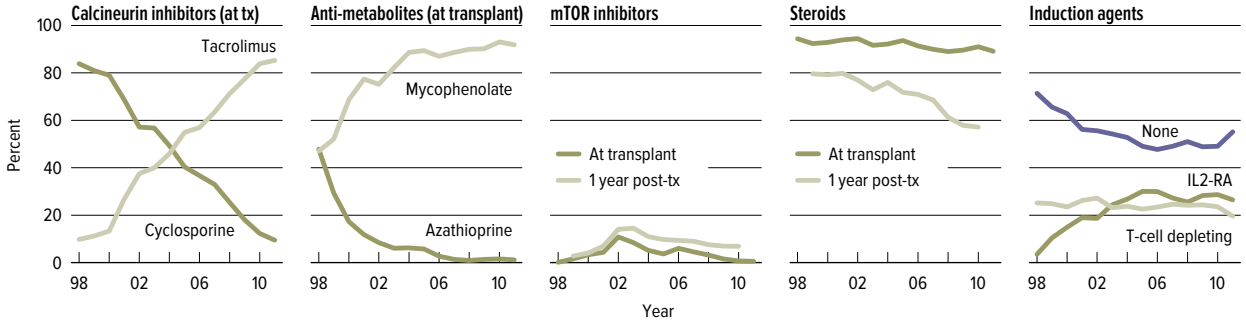
HR 6.2 Induction agents used at time of heart transplant, adult recipients, 2011

Patients transplanted in 2011 and discharged with a functioning graft.



HR 6.3 Immunosuppression at one year in adult heart transplant recipients, 2010

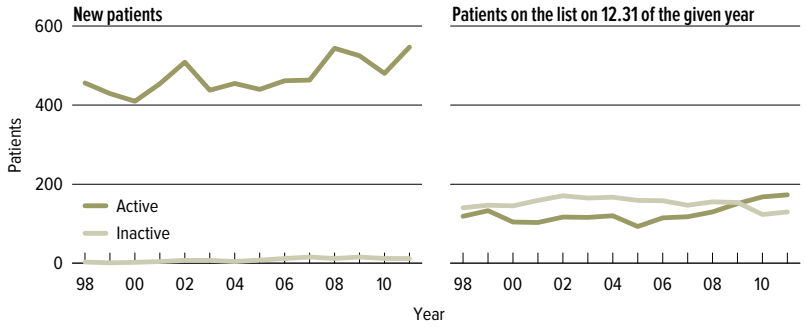
Patients transplanted in 2010 and remaining alive with graft function one year post-transplant. Top three one-year immunosuppression regimens are given, plus the "all others" group. Regimens are defined by use of calcineurin inhibitors (TAC=Tacrolimus, Cyclo=Cyclosporine), anti-metabolites (AZA=Azathioprine,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



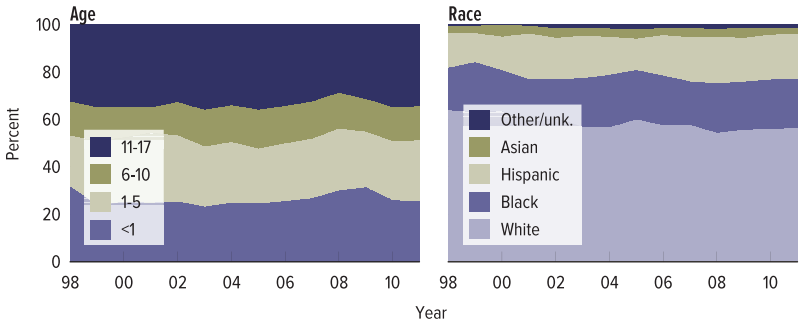
HR 6.4 Immunosuppression use in adult heart transplant recipients

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.

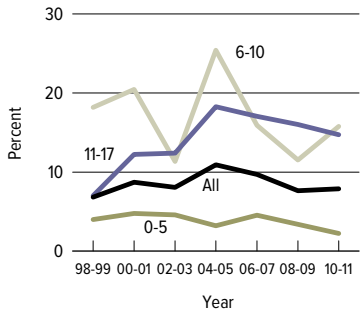
pediatric transplant



HR 7.1 Pediatric patients waiting for a heart 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.



HR 7.2 Distribution of pediatric patients waiting for a heart 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.



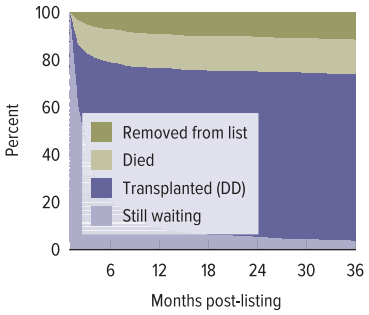
HR 7.3 Prior heart transplant in pediatric patients waiting for a heart transplant, by age
Prior transplant is obtained from the OPTN Transplant Candidate Registration form.

pediatric transplant

	2009	2010	2011
Patients at start of year	287	304	293
Patients added during year	537	487	544
Pts removed during year	518	497	536
Patients at end of year	306	294	301
Removal reason			
Received a transplant	365	364	384
Patient died	82	65	69
Patient refused transplant	1	1	0
Improved, tx not needed	47	43	47
Too sick to transplant	19	19	23
Other	4	5	13

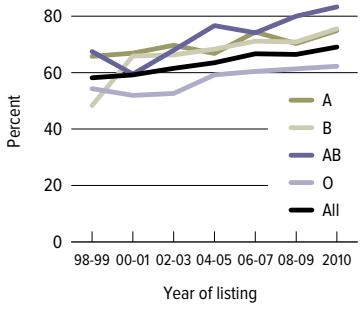
HR 7.4 Heart transplant waiting list activity among pediatric patients

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.



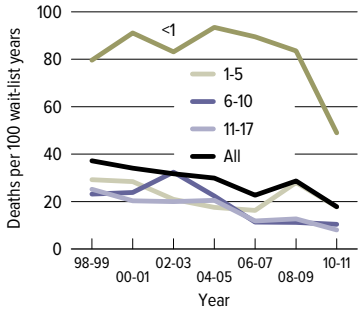
HR 7.5 Outcomes for pediatric patients waiting for a heart transplant among new listings in 2008

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.



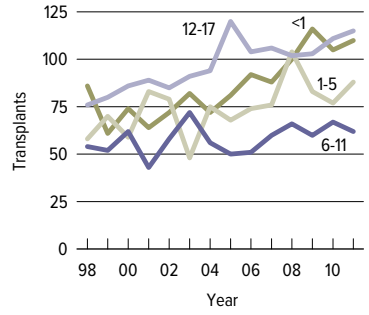
HR 7.6 Pediatric wait-listed patients who receive a deceased donor heart transplant within one year, by blood type

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



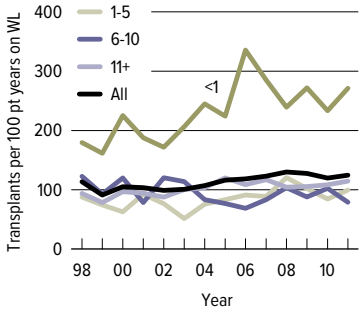
HR 7.7 Pre-transplant mortality rates among pediatric patients wait-listed for a heart transplant, by age

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.



HR 7.8 Pediatric heart transplants (including heart-lung), by age

Patients receiving a heart or heart-lung transplant.



HR 7.9 Heart transplant rates in pediatric waiting list candidates, by age

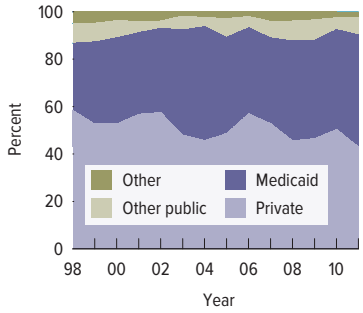
Patients waiting for transplant. Transplant rates are computed as the number of transplants per 100 patient-years of waiting time in the given year. Patients with concurrent listings at multiple centers are counted once.

pediatric transplant

		1999-2001		2009-2011	
	Level	N	%	N	%
Age	<1	197	24.7	331	30.3
	1-5	206	25.8	246	22.5
	6-10	111	13.9	147	13.5
	11-17	284	35.6	367	33.6
Sex	Female	349	43.7	511	46.8
	Male	449	56.3	580	53.2
Race	White	492	61.7	595	54.5
	Black	157	19.7	225	20.6
	Hispanic	111	13.9	195	17.9
	Asian	33	4.1	54	4.9
	Other/unk.	5	0.6	22	2.0
Primary cause of disease	Congenital defect	332	41.6	473	43.4
	Dilated myopathy: idiopathic	264	33.1	320	29.3
	Restrictive myopathy: idiopathic	42	5.3	47	4.3
	Dilated myopathy: myocarditis	15	1.9	49	4.5
	All others	145	18.2	202	18.5
Transplant history	First transplant	739	92.6	1018	93.3
	Subsequent	59	7.4	73	6.7
Blood type	A	310	38.8	403	36.9
	B	91	11.4	150	13.7
	AB	37	4.6	55	5.0
	O	360	45.1	483	44.3
Primary payer	Private	432	54.1	509	46.7
	Medicaid	280	35.1	476	43.6
	Other public	53	6.6	76	7.0
	Other	33	4.1	30	2.7
Time on wait list	<30 days	349	43.7	407	37.3
	31-60 days	144	18.0	228	20.9
	61-90 days	83	10.4	128	11.7
	3-<6 months	107	13.4	190	17.4
	6-<12 months	75	9.4	100	9.2
	1-<2 years	29	3.6	29	2.7
	2-<3 years	9	1.1	2	0.2
	3+ years	2	0.3	7	0.6
Status	1A	496	62.2	950	87.1
	1B	136	17.0	78	7.1
	2	155	19.4	63	5.8
	Unknown	11	1.4	0	0.0
Patient on VAD	No	30	3.8	889	81.5
	Yes	61	7.6	200	18.3
	Unknown	707	88.6	2	0.2
All patients		798	100.0	1091	100.0

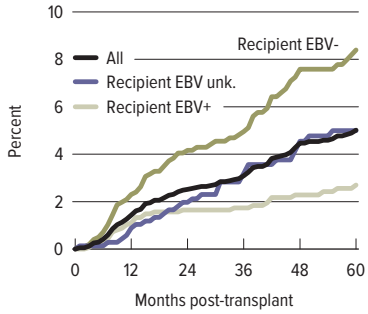
HR 7.10 Characteristics of pediatric heart transplant patients, 1999–2001 & 2009–2011

Patients receiving a transplant. Retransplants are counted.



HR 7.11 Insurance coverage among pediatric heart transplant recipients at time of transplant

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



HR 7.12 Incidence of PTLD among pediatric patients receiving a heart transplant, 1999–2009, by recipient Epstein-Barr virus (EBV) status at transplant

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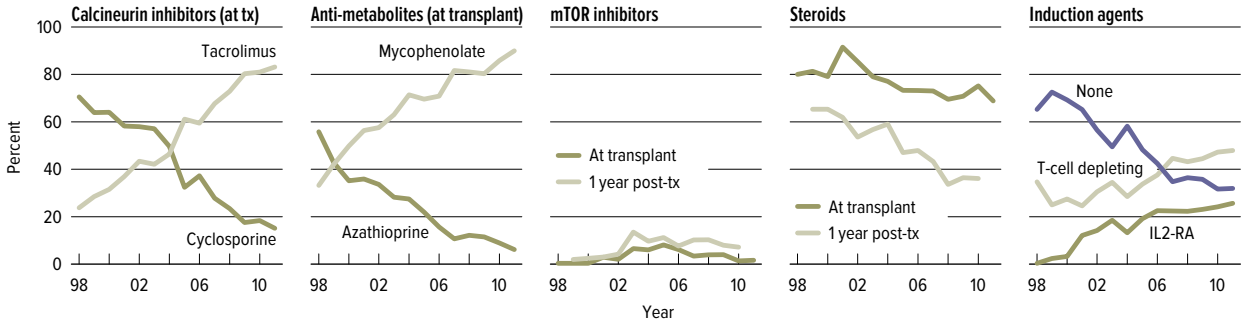
pediatric transplant



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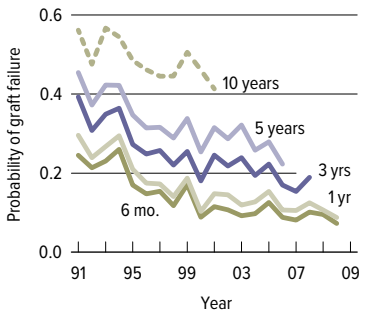
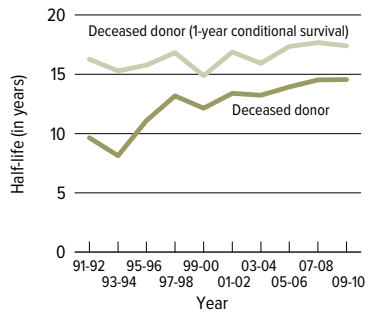


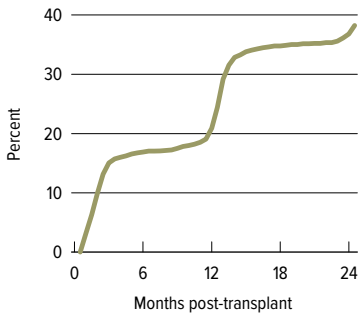
HR 7.14 Graft failure among pediatric heart transplant recipients

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



HR 7.15 Half-lives for pediatric heart 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.



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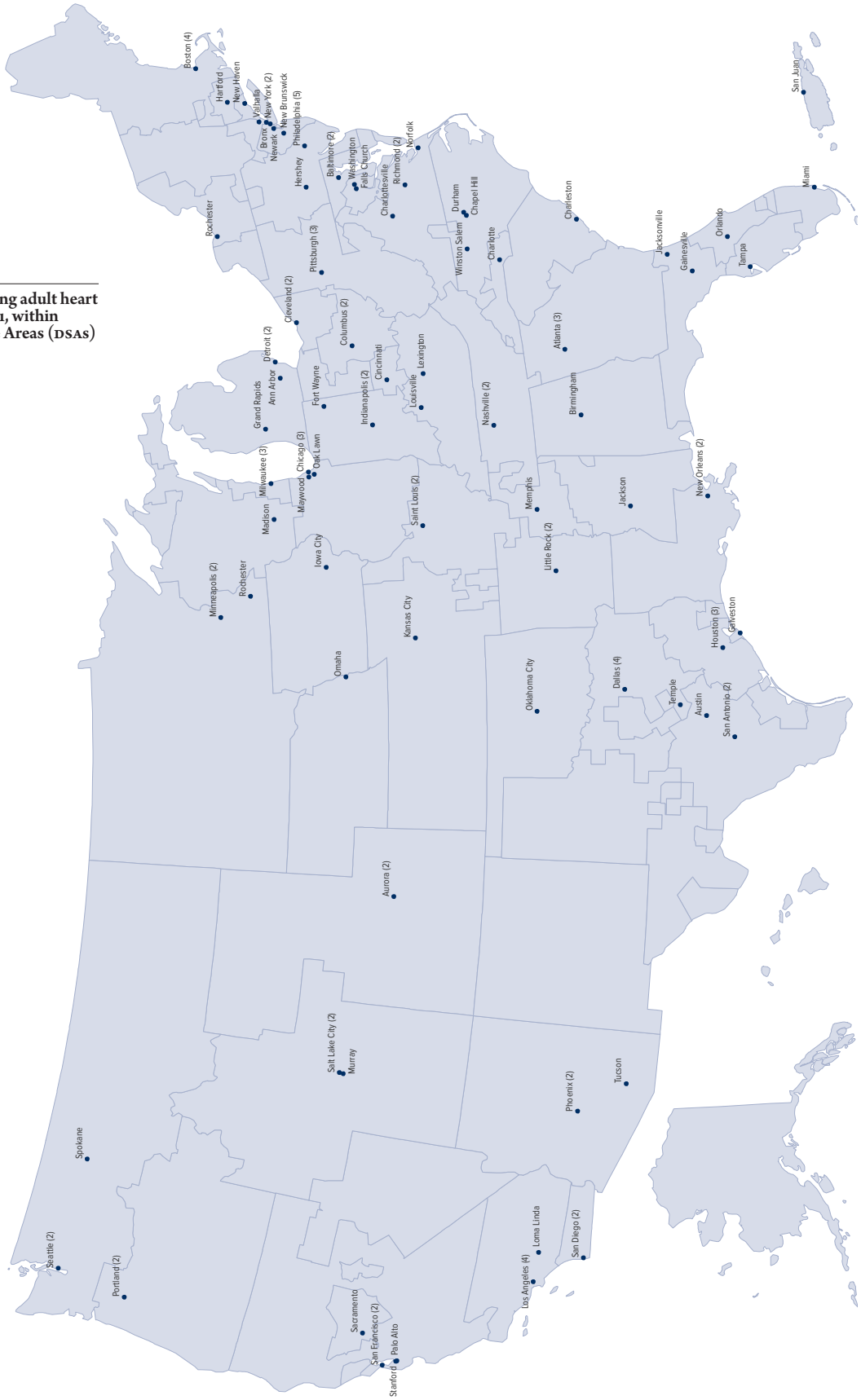
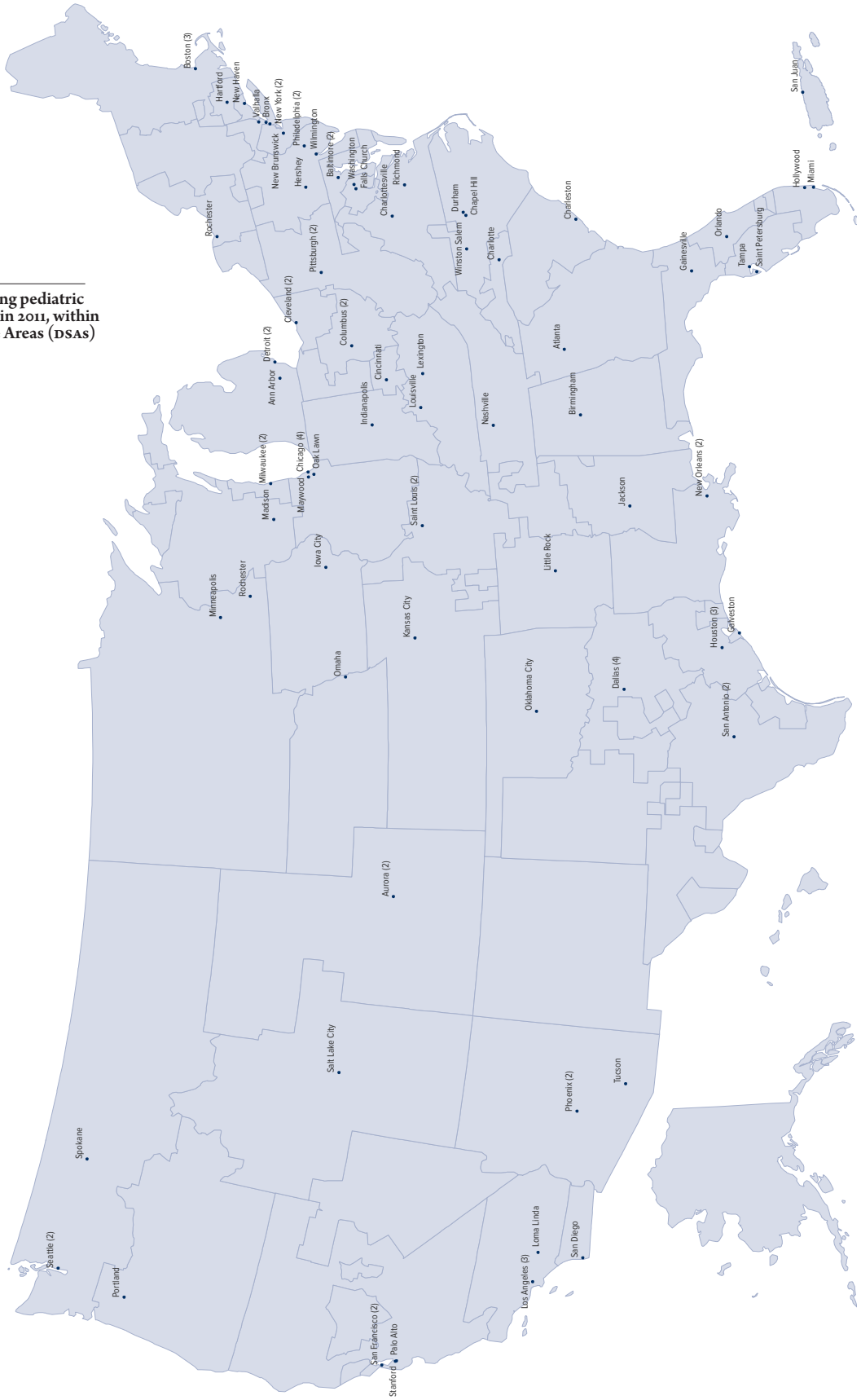
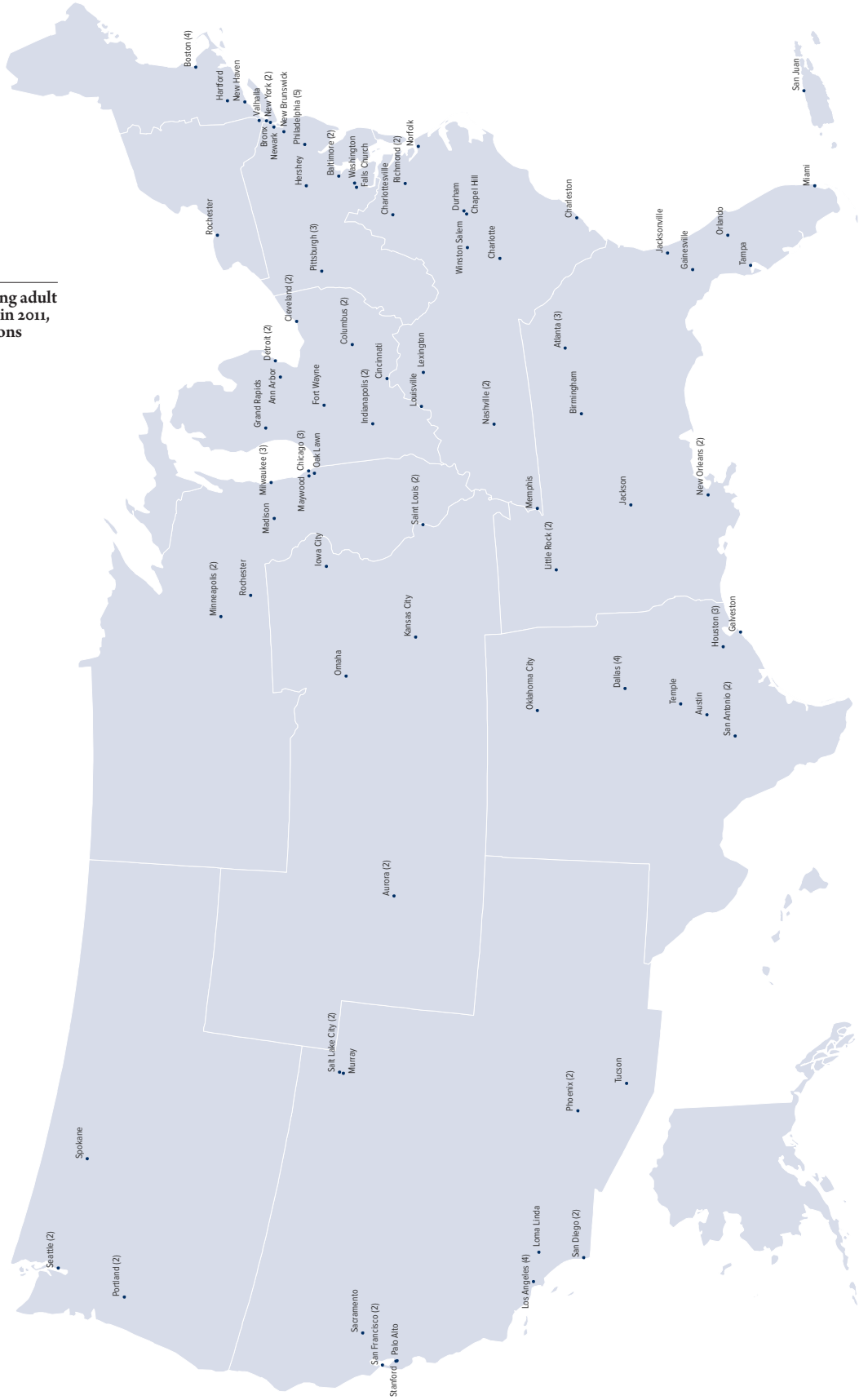
HR 8.1 Centers performing adult heart transplants in 2011, within Donation Service Areas (DSAs)



HR 8.2 Centers performing pediatric heart transplants in 2011, within Donation Service Areas (DSAs)



HR 8.3 Centers performing adult heart transplants in 2011, within OPTN regions



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transplant 162
donor-recipient matching 165
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immunosuppression 170
pediatric transplant 171
transplant center maps 175

OPTN/SRTR 2011 Annual Data Report: lung

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

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

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

Monica, donor mother

Adult Lung Transplant

Introduction

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

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

Waiting List Trends

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

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

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

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

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

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

Donation

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

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

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

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

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

Transplant

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

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

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

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

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

Donor/Recipient Matching

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

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

Outcomes

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

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

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

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

Immunosuppression

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

Pediatric Lung Transplant

Waiting List Trends

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

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

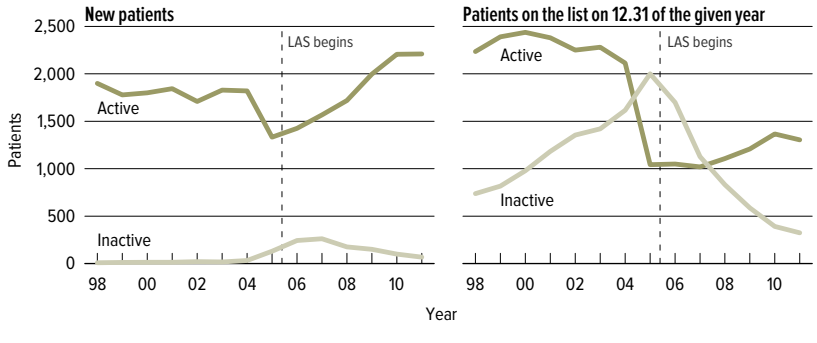
Transplant

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

Immunosuppression and Outcomes

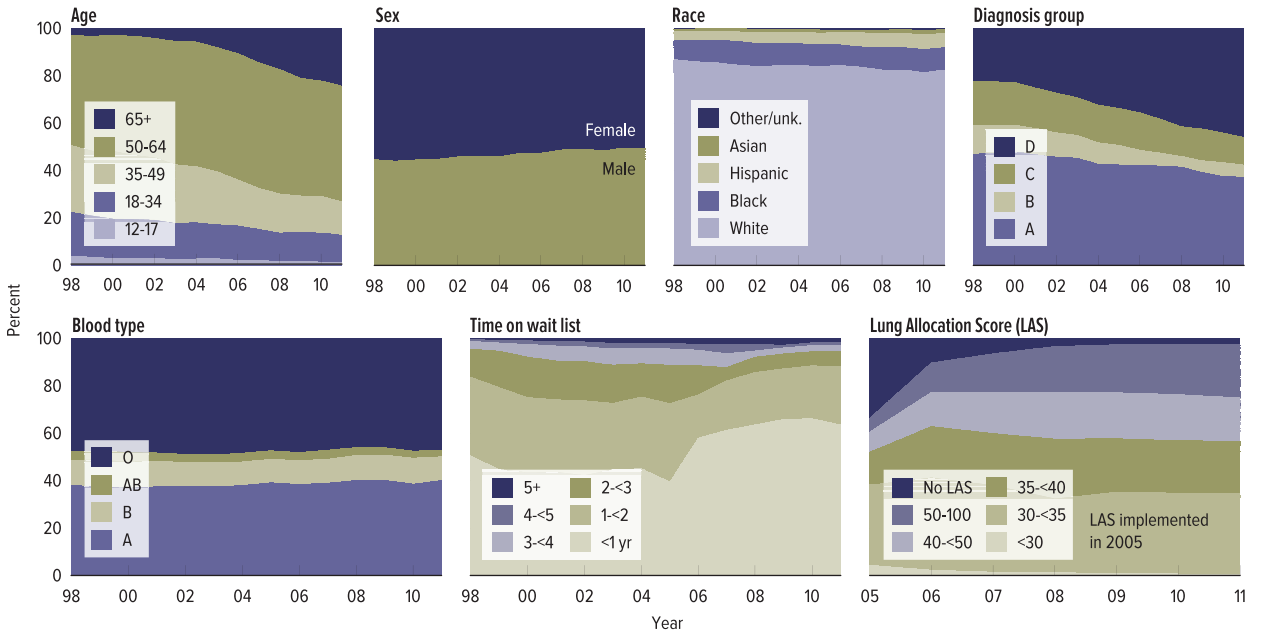
The immunosuppression used in pediatric lung transplant has changed notably. The trends in pediatric lung transplant immunosuppression are similar to those seen in adult lung transplant immunosuppression. Tacrolimus is increasingly used and is now the dominant calcineurin inhibitor. Likewise, the use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

wait list



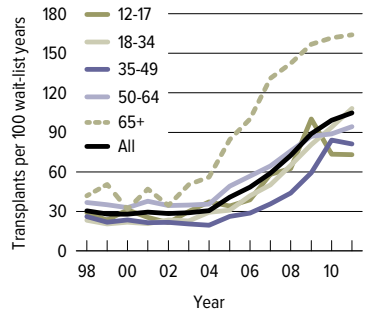
LU 1.1 Adult patients waiting for a lung transplant

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



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

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



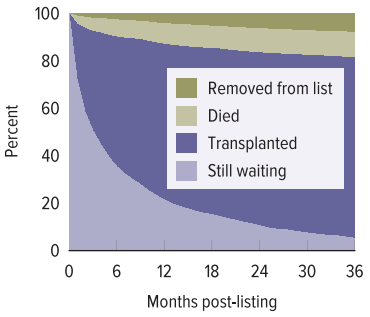
LU 1.3 Lung transplant rates among adult waiting list candidates, by age

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

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

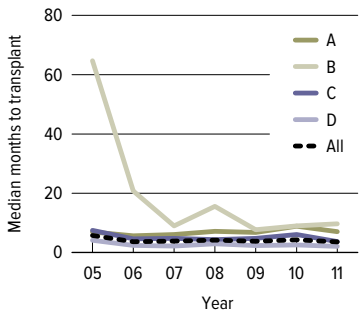
LU 1.4 Lung transplant waiting list activity among adult patients

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



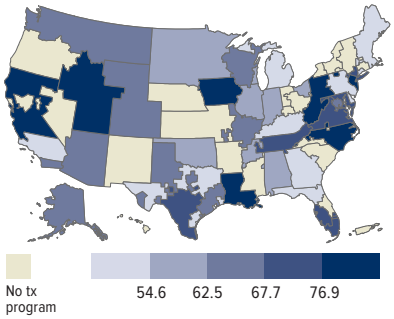
LU 1.5 Outcomes for adult patients waiting for a lung transplant among new listings in 2008

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



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

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

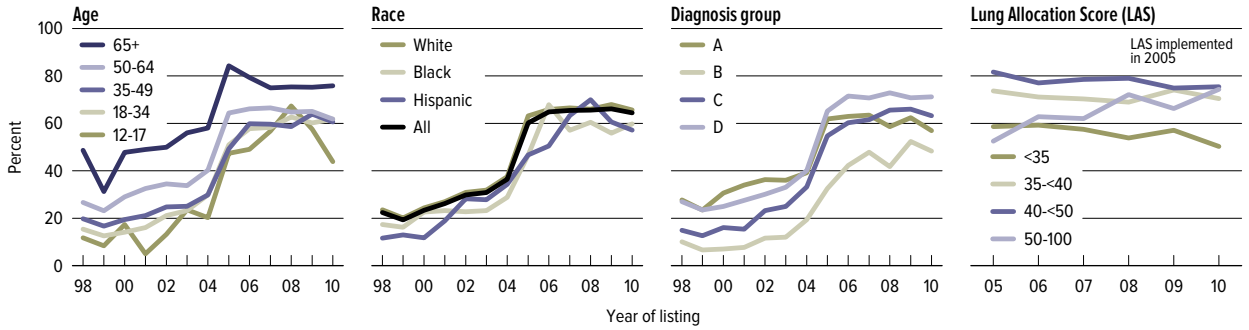


LU 1.7 Percent of adult wait-listed patients, 2010, who received a deceased donor lung transplant within one year, by DSA

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

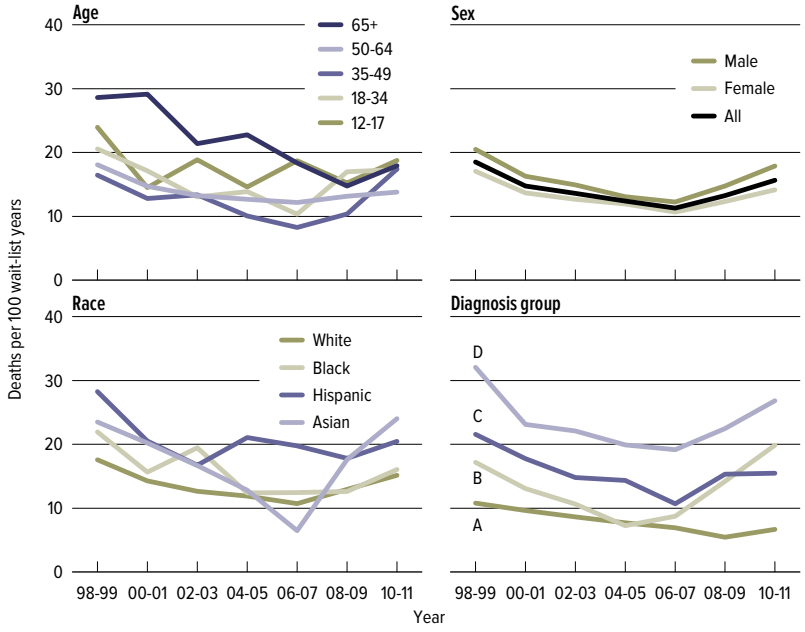
data behind the figures can be downloaded from our website, at www.srtr.org

wait list



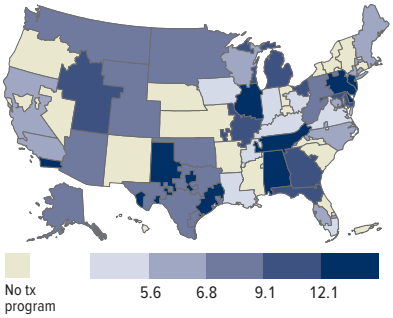
LU 1.8 Adult wait-listed patients who received a deceased donor lung transplant within one year

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



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

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



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

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

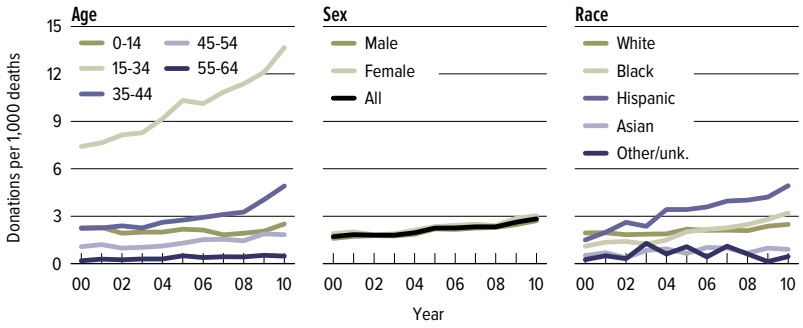
	Level	2001 N	2001 %	2006 N	2006 %	2011 N	2011 %
Age	12-17	107	3.0	62	2.3	30	1.8
	18-34	613	17.2	418	15.2	190	11.6
	35-49	1,080	30.2	726	26.4	261	16.0
	50-64	1,665	46.6	1,355	49.2	864	52.8
	65+	107	3.0	191	6.9	290	17.7
Sex	Female	2,053	57.5	1,653	60.1	973	59.5
	Male	1,519	42.5	1,099	39.9	662	40.5
Race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

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

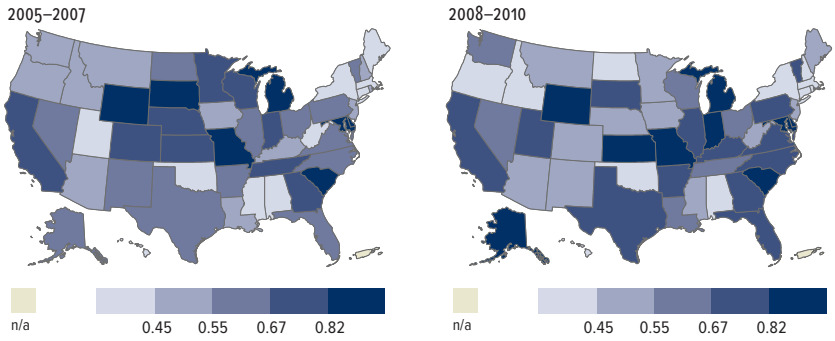
LU 1.11 Characteristics of adult patients on the lung transplant waiting list on December 31 of 2001, 2006, & 2011

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

deceased donation

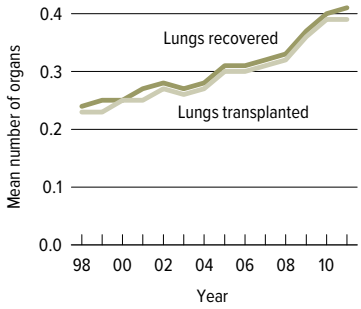


LU 2.1 Deceased donor lung donation rates
Numerator: Deceased donors age less than 65 whose organ(s) were recovered for transplant. Denominator: US deaths per year, age less than 65. (Death data available at http://www.cdc.gov/nchs/products/nvsr.htm.) Donors who donated two lungs are counted twice.



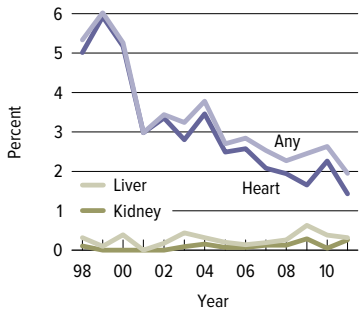
LU 2.2 Deceased donor lung donation rates (per 1,000 deaths), by state
Numerator: Deceased donors residing in the 50 states whose lung(s) were recovered for transplant in the given year range. Denominator: US deaths by state during the given year range (death data available at http://www.cdc.gov/nchs/products/nvsr.htm).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

deceased donation



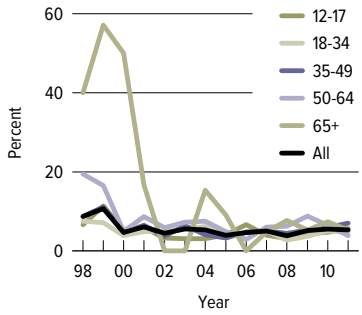
LU 2.3 Lungs recovered per donor & lungs transplanted per donor

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



LU 2.4 Deceased donor lungs transplanted with another organ

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



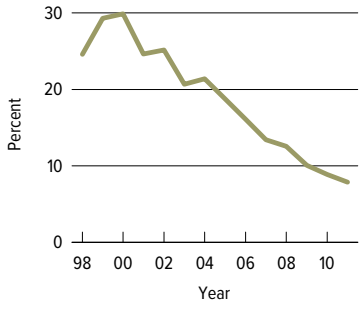
LU 2.5 Discard rates for lungs recovered for transplant

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

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

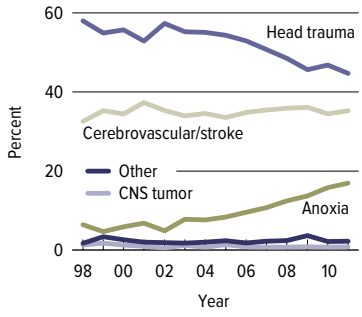
LU 2.6 Reasons for discards, 2011

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



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

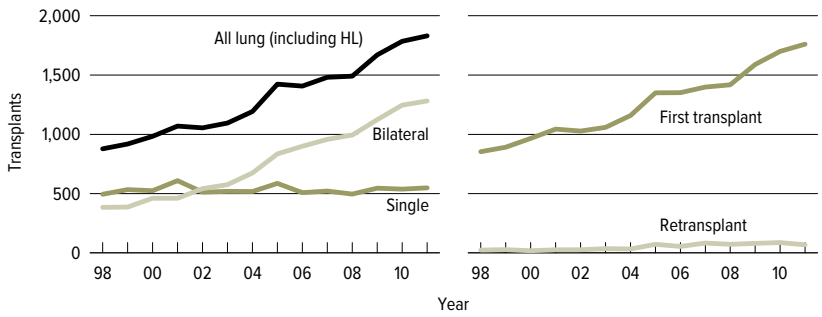
All deceased donors whose lung(s) were transplanted in the given year. Smoking history as reported to the OPTN.



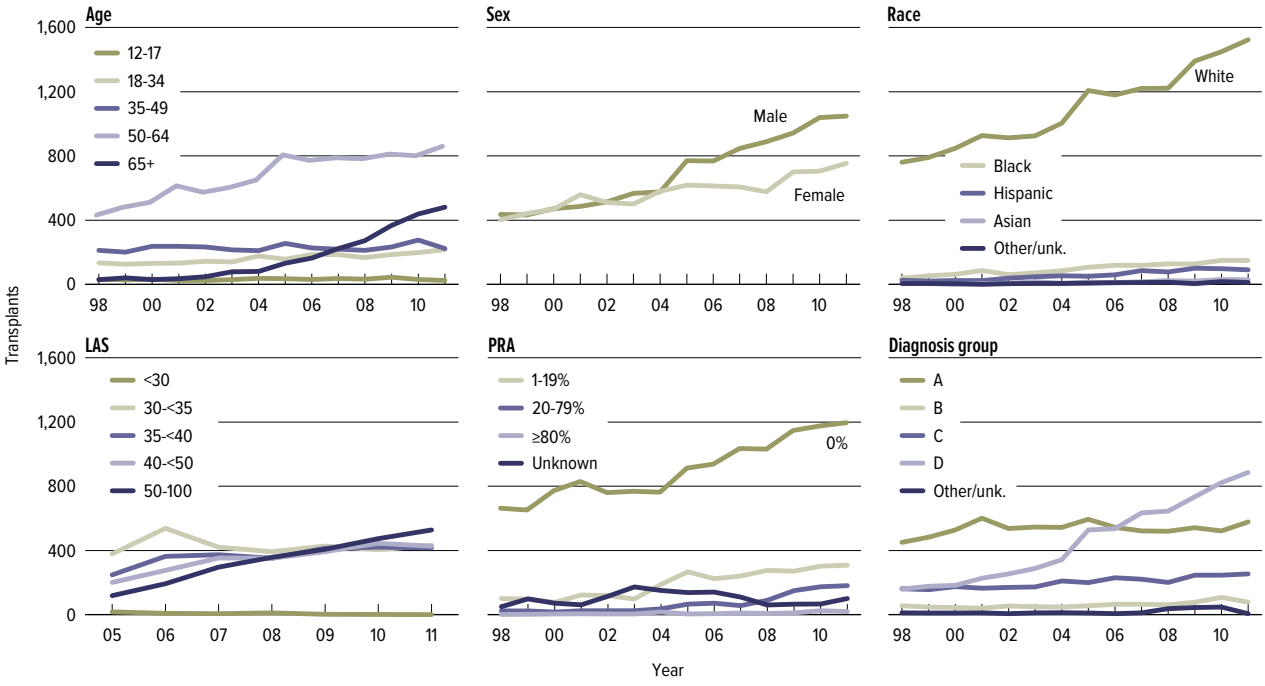
LU 2.8 Cause of death among deceased lung donors

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

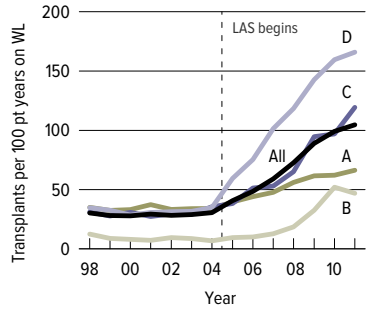
transplant



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

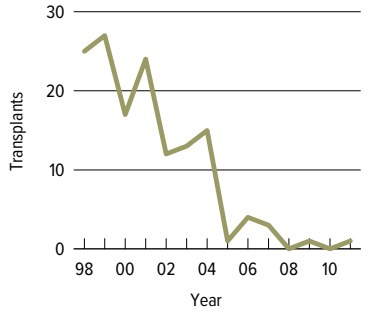


LU 3.2 Adult lung transplants
Patients receiving a transplant. Retransplants are counted.



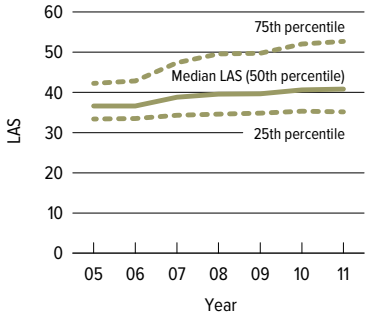
LU 3.3 Lung transplant rates in adult waiting list candidates, by diagnosis group

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



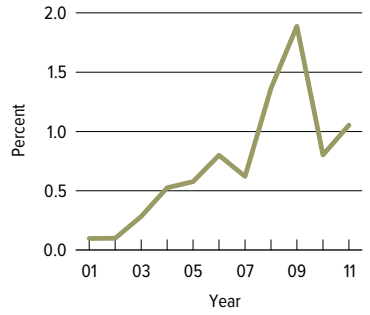
LU 3.4 Adult lung transplants from living donors

Living donor lung transplants.



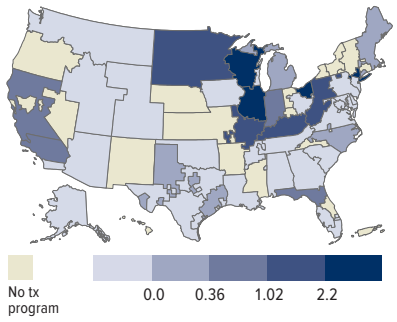
LU 3.5 Median LAS at transplant

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



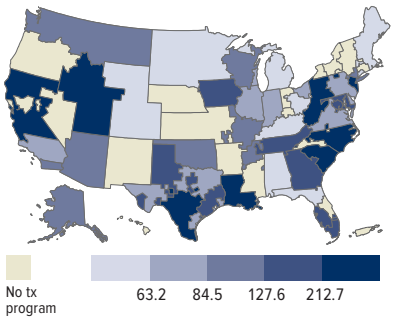
LU 3.6 Use of DCD lungs among adult lung transplant recipients

Percent of deceased donor transplants using a DCD donor.



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

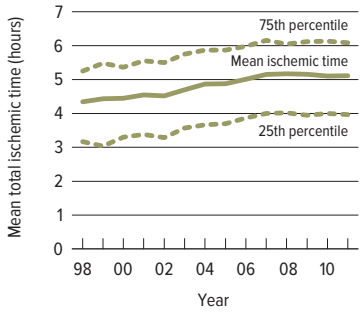
Percent of deceased donor transplants using a DCD donor, by DSA of the transplanting center.



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

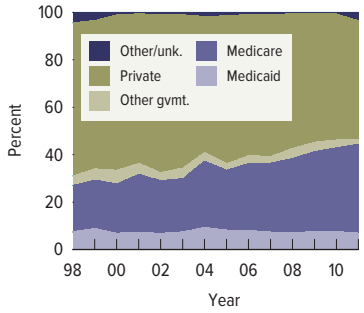
Transplant rates by DSA of the listing center, limited to those on the waiting list in 2010 and 2011; deceased donor transplants only. Maximum time per listing is two years.

transplant



LU 3.9 Total ischemia time for adult lung transplants

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



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

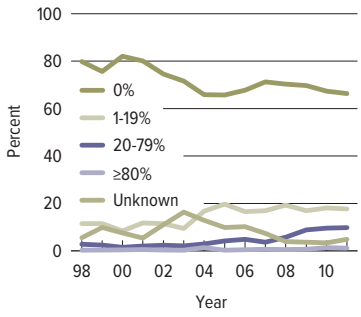
Patients receiving a transplant. Retransplants are counted.

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

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

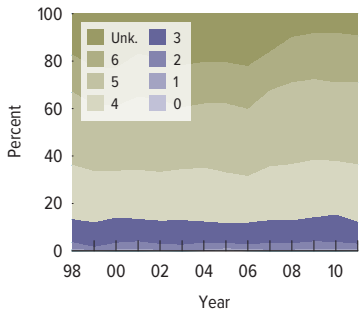
Patients receiving a transplant. Retransplants are counted.

donor-recipient matching



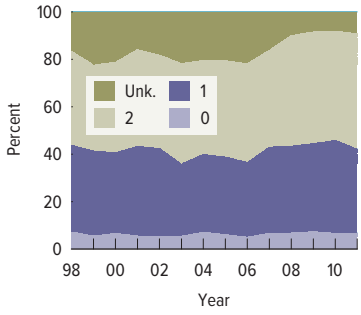
LU 4.1 PRA at time of lung transplant in adult recipients

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



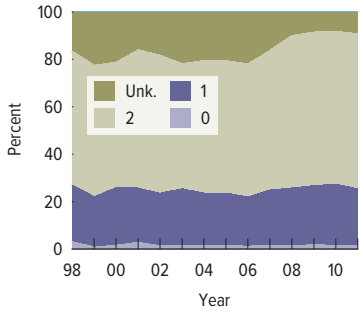
LU 4.2 Total HLA mismatches among adult lung transplant recipients

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



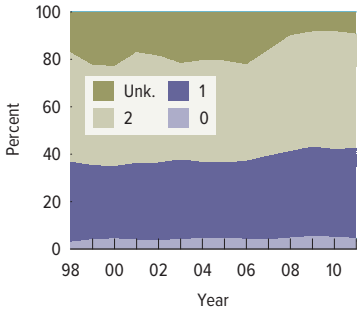
LU 4.3 HLA-A mismatches among adult lung transplant recipients

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



LU 4.4 HLA-B mismatches among adult lung transplant recipients

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



LU 4.5 HLA-DR mismatches among adult lung transplant recipients

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

donor-recipient matching

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

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

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

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

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

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

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

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

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

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

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

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

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

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

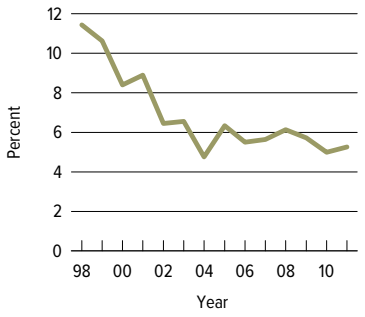
Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields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

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

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

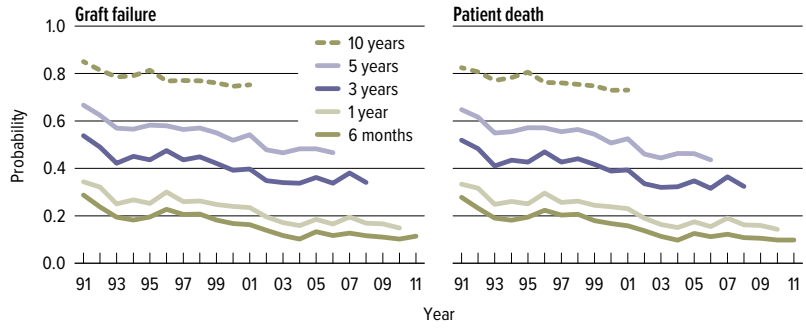
Adult transplant cohort from 2007–2011. Donor serology is reported on the OPTN Donor Registration forms; recipient serology is reported on the OPTN Recipient Registration forms. Any evidence for a positive serology is taken to indicate that the person is positive for the given serology; if all fields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

outcomes



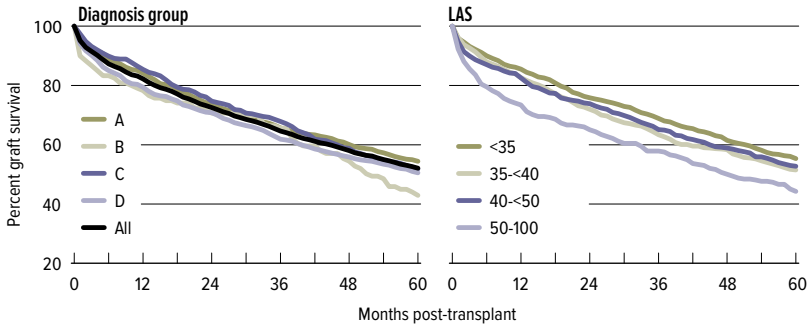
LU 5.1 Graft failure within the first 6 weeks after transplant among adult lung transplant recipients

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



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

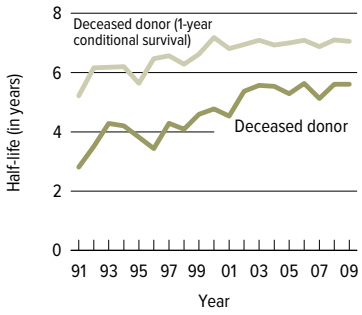
Cox proportional hazards models reporting probability, adjusting for age, sex, and race.



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

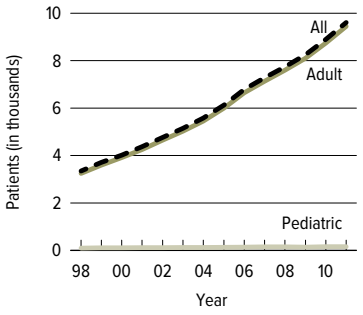
Graft survival estimated using unadjusted Kaplan-Meier methods.

outcomes



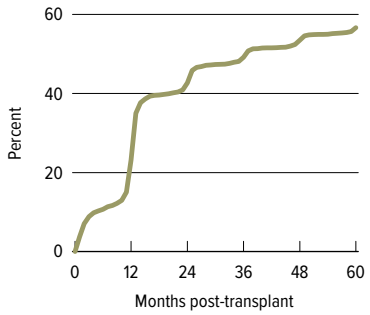
LU 5.4 Half-lives for adult lung transplant recipients

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



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

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



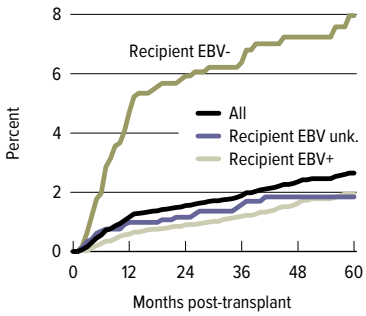
LU 5.6 Incidence of first acute rejection among adult patients receiving a lung transplant in 2005–2009

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

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

LU 5.7 Post-transplant events among adult lung transplant recipients

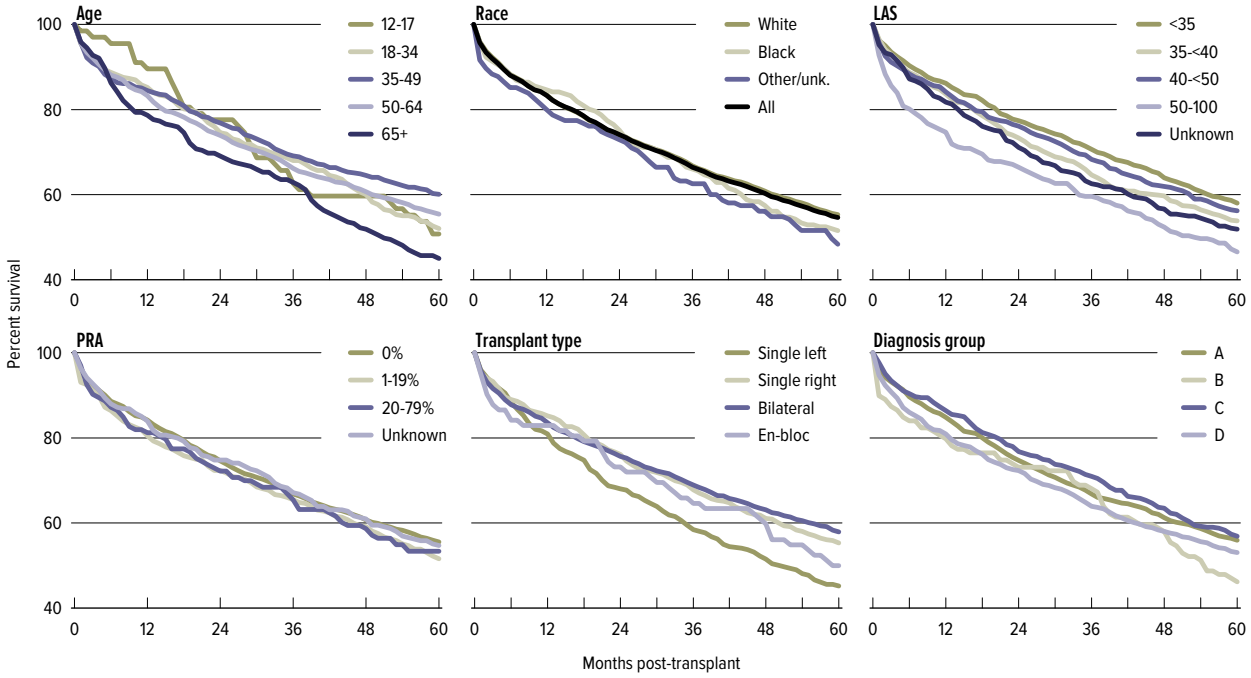
Post-transplant events are recorded on the Transplant Recipient Follw-up form. One-year events are reported for patients transplanted 2008–2010; five-year events are reported for those transplanted 2004–2006. Patients with more than one transplant are counted separately per transplant. Patients who did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



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

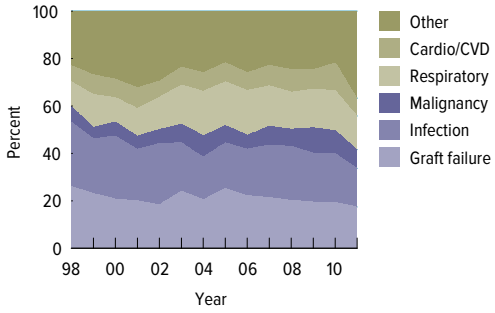
The cumulative incidence, defined as the probability of post-transplant lymphoproliferative disorder (PTLD) being diagnosed between the time of transplant and the given time, is estimated using Kaplan-Meier methods. PTLD is identified as either a reported complication or cause of death on the Transplant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

outcomes



LU 5.9 Patient survival among adult lung transplant recipients, 2005–2006

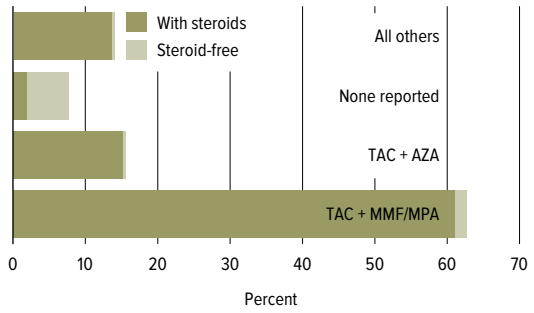
Percent patient survival using unadjusted Kaplan-Meier methods. For patients with more than one transplant during the period, only their first transplant is considered. Data for PRA of 80-100% are not shown due to small N.



LU 5.10 Cause of death among adult lung transplant recipients

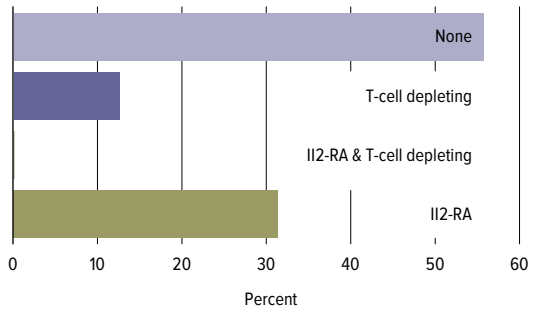
Patients who died in a given year are included regardless of when transplant was received. Primary cause of death is as reported by the OPTN from the Transplant Follow-up forms. Other causes of death include hemorrhage, trauma, non-compliance, unspecified other, unknown, etc.

immunosuppression



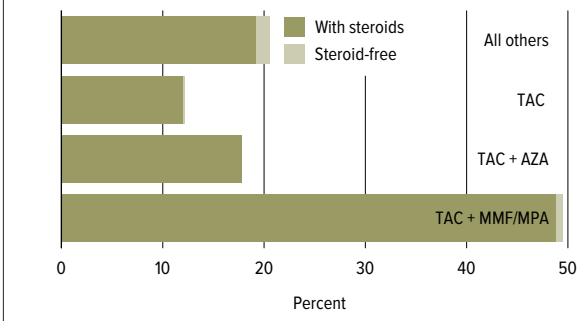
LU 6.1 Initial immunosuppression regimen in adult lung transplant recipients, 2011

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



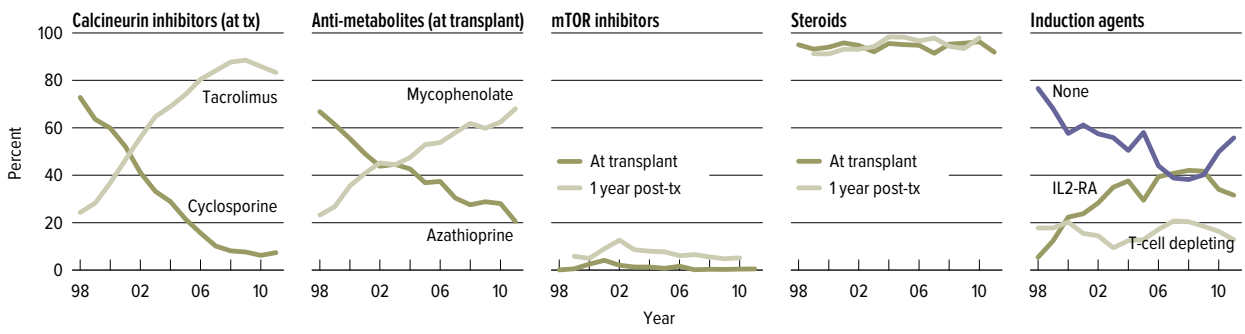
LU 6.2 Induction agents used at time of lung transplant, adult recipients, 2011

Patients transplanted in 2011 and discharged with a functioning graft.



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

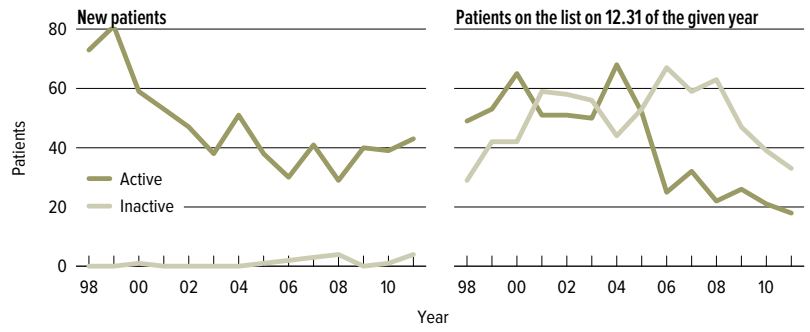
Patients transplanted in 2010 and remaining alive with graft function one year post-transplant. Top three one-year immunosuppression regimens are given, plus the "all others" group. Regimens are defined by use of calcineurin inhibitors (TAC=Tacrolimus, Cyclo=Cyclosporine), anti-metabolites (AZA=Azathioprine,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



LU 6.4 Immunosuppression use in adult lung transplant recipients

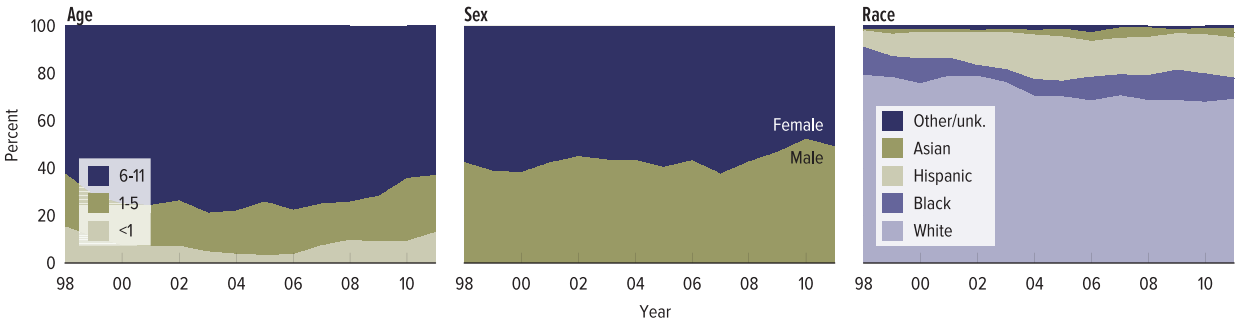
One-year post-transplant data for mTOR inhibitors and steroids limited to patients alive with graft function one year post-transplant. One-year post-transplant data are not reported for 1998 transplant recipients, as follow-up data were very sparse.

pediatric transplant



LU 7.1 Pediatric patients waiting for a lung transplant

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



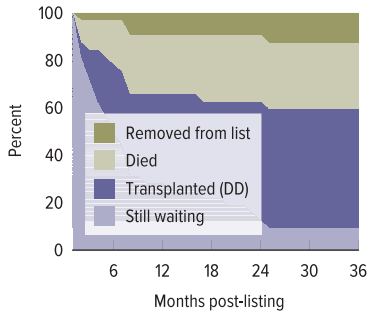
LU 7.2 Distribution of pediatric patients waiting for a lung transplant

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

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

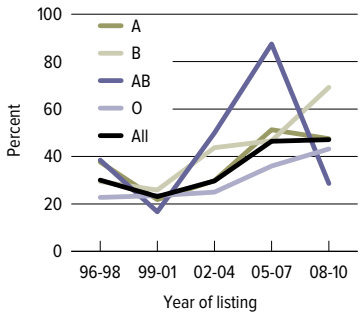
LU 7.3 Lung transplant waiting list activity among pediatric patients

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



LU 7.4 Outcomes for pediatric patients waiting for a lung transplant among new listings in 2008

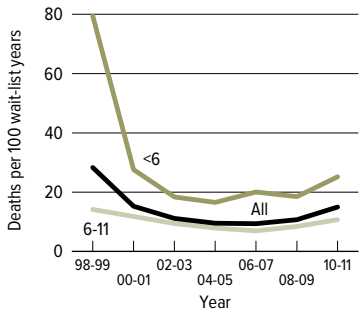
Patients waiting for a transplant and first listed in 2008. Patients with concurrent listings at more than one center are counted once, from the time of the earliest listing to the time of latest removal.



LU 7.5 Pediatric wait-listed patients who receive a deceased donor lung transplant within one year, by blood type

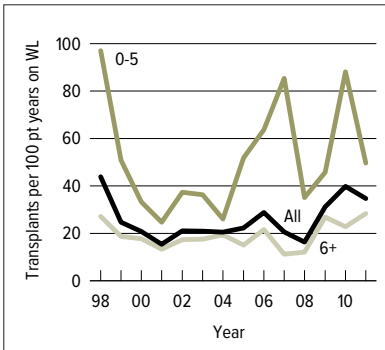
Patients with concurrent listings at more than one center are counted once, from the time of earliest listing to the time of latest removal. Patients listed, transplanted, and re-listed are counted more than once.

pediatric transplant



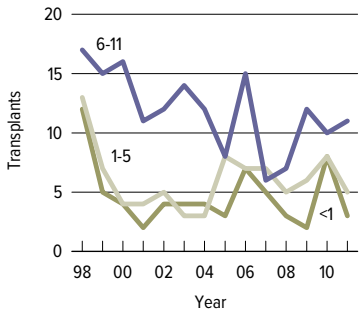
LU 7.6 Pre-transplant mortality rates among pediatric patients wait-listed for a lung transplant, by age

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



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

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



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

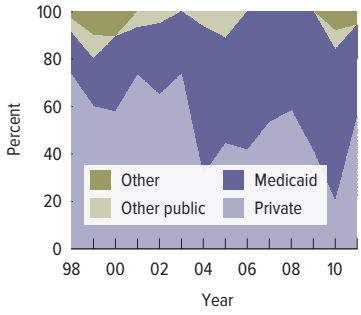
Patients receiving a lung or heart-lung transplant.

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

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

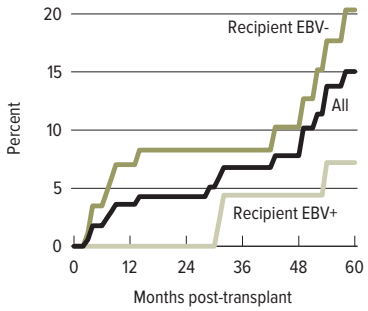
Patients receiving a transplant. Retransplants are counted.

pediatric transplant



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

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



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

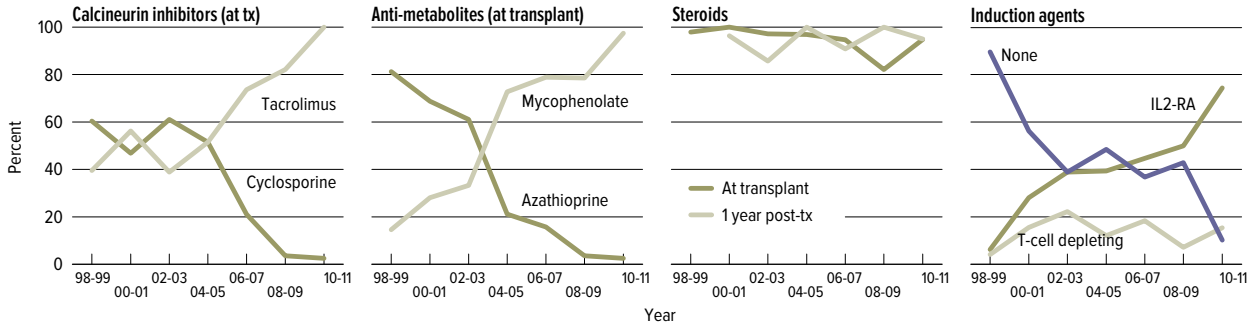
The cumulative incidence, defined as the probability of post-transplant lymphoproliferative disorder (PTLD) being diagnosed between the time of transplant and the given time, is estimated using Kaplan-Meier methods. PTLD is identified as either a reported complication or cause of death on the Transplant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

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

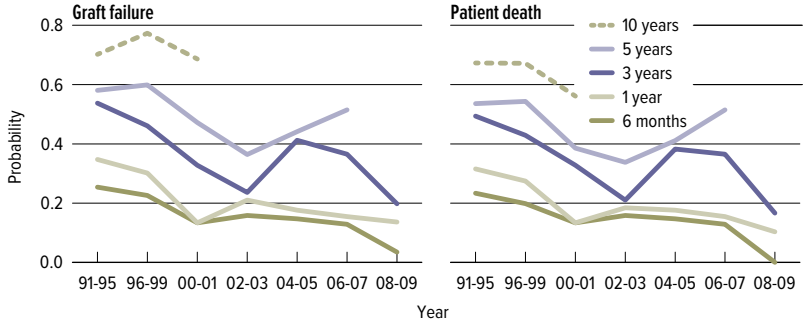
LU 7.12 Post-transplant events among pediatric lung transplant recipients

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

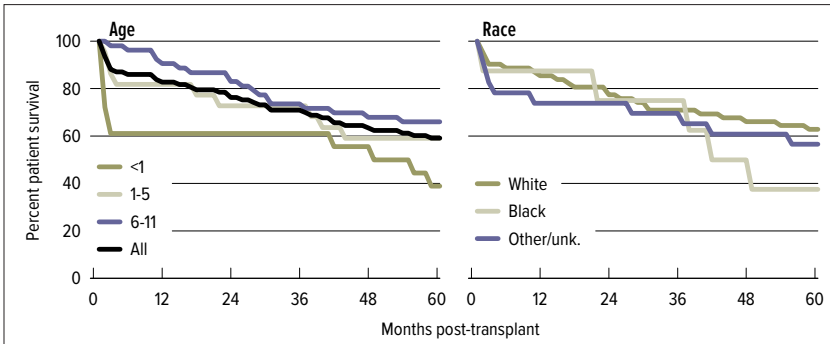
pediatric transplant



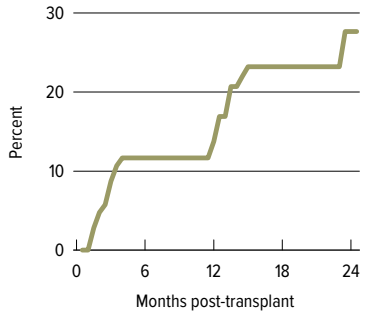
LU 7.13 Immunosuppression use among pediatric lung transplant recipients
One-year post-transplant data for steroids limited to patients alive with graft function one year post-transplant. One-year post-transplant data are not reported until 2000 due to sparse data.



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

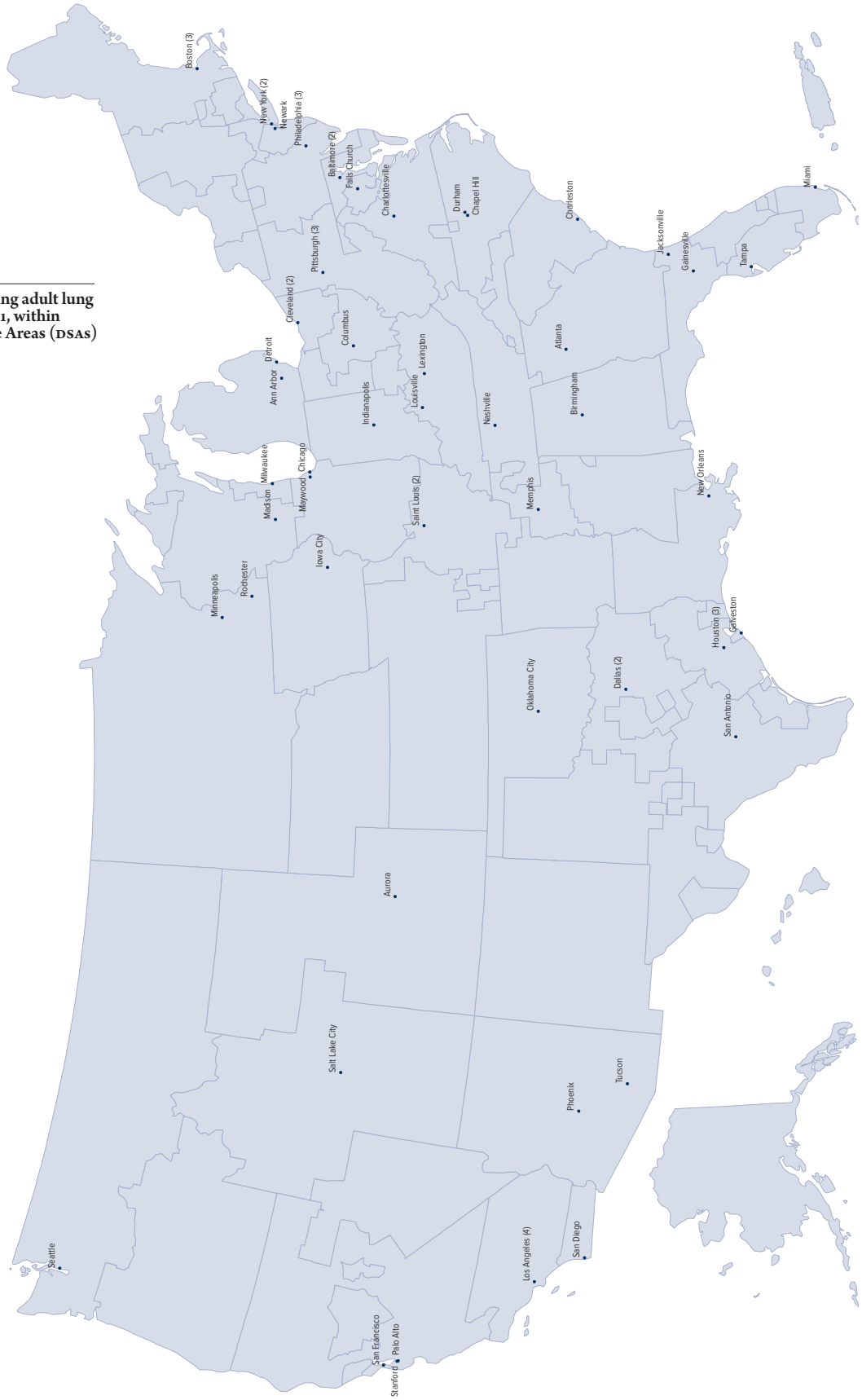


LU 7.15 Survival among pediatric lung transplant recipients, 2002–2006
Percent patient survival using unadjusted Kaplan-Meier methods. For patients with more than one transplant during the period, only their first transplant is considered.

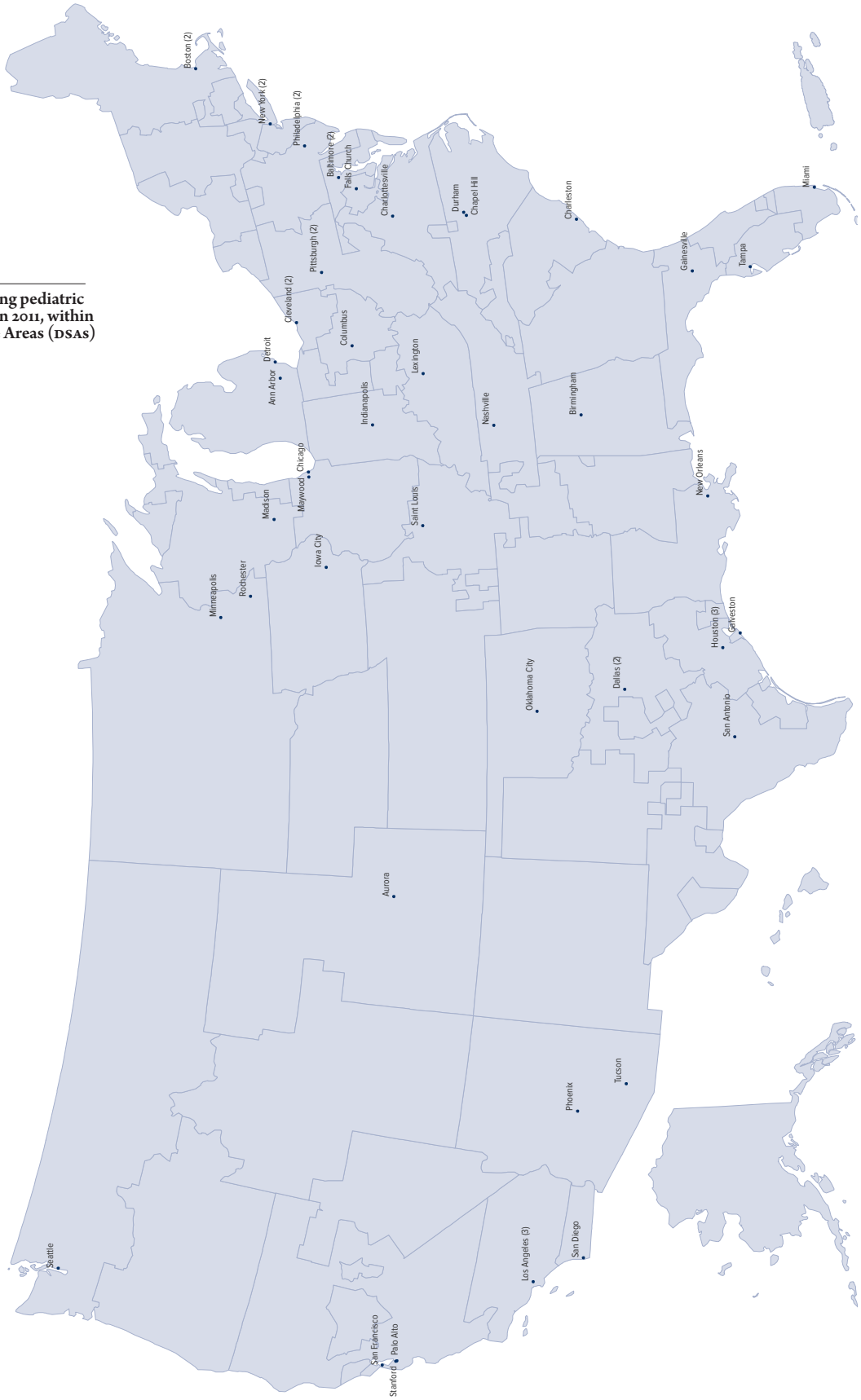


LU 7.16 Incidence of first acute rejection among pediatric patients receiving a lung transplant in 2005–2010
Acute rejection defined as a record of acute or hyperacute rejection, or a record of an anti-rejection drug being administered on either the Transplant Recipient Registration form or the Transplant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

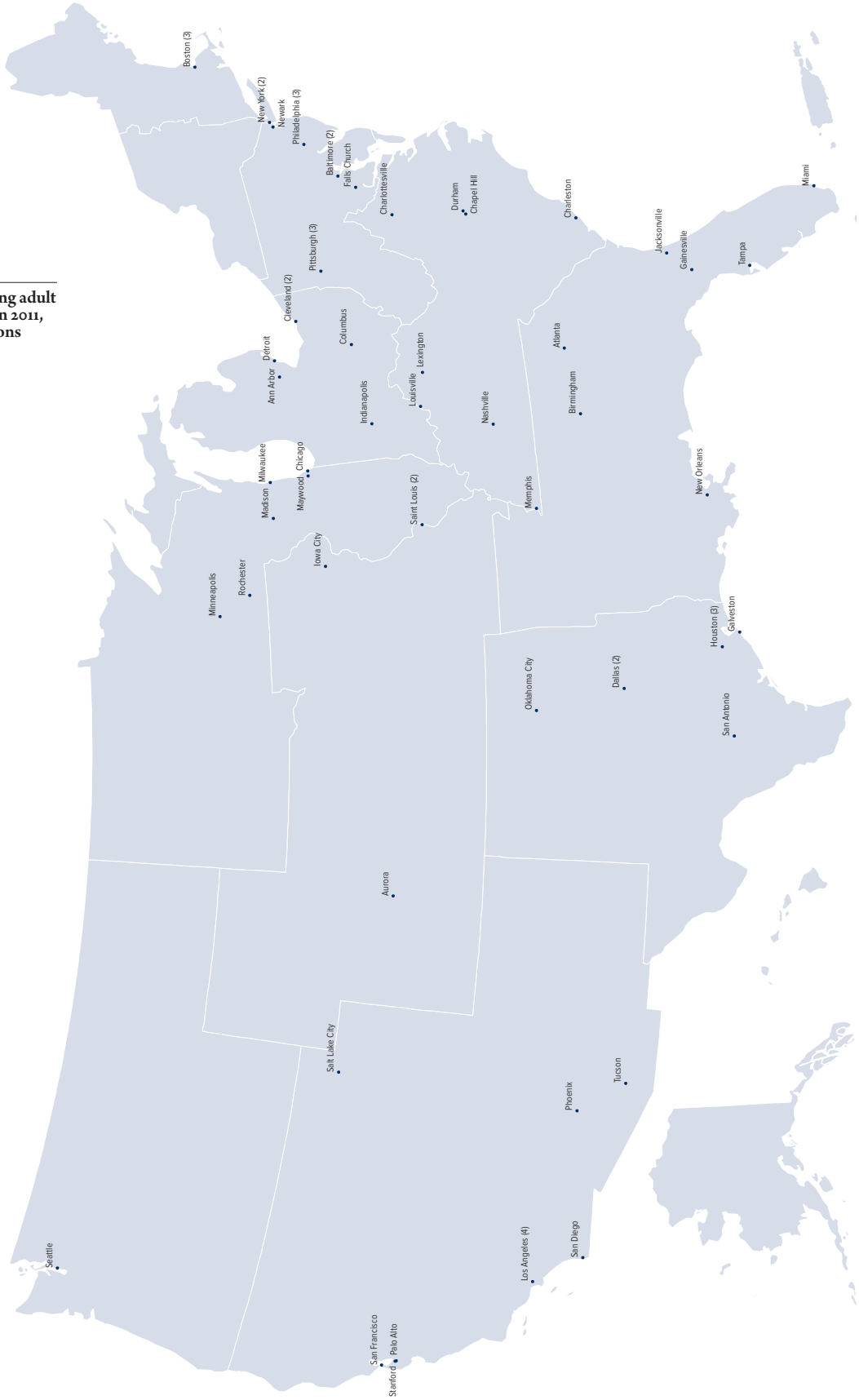
LU 8.1 Centers performing adult lung transplants in 2011, within Donation Service Areas (DSAs)



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



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



organ-specific donation rates 184
organs recovered per donor 187
organs transplanted per donor 189
organ discards | expanded criteria donors 191
donations after cardiac death | waiting time 192
organ use 193

OPTN/SRTR 2011 Annual Data Report:

deceased organ donation

ABSTRACT In 2011, the number of eligible deaths (death of a patient aged 70 years or younger who is legally declared brain dead and does not exhibit any excluding factors) was 9023, a slight decrease from 2010; 72.9 eligible donors per 100 eligible deaths were converted to organ donors. The unadjusted donation rate varied by donation service area (DSA), as did the number of transplant programs. The observed/expected organ yield ratio for all organs varied by DSA from 0.89 to 1.13. The total number of organs recovered divided by the number of donors was 3.54, slightly lower than in 2010; this value varied by DSA from 2.91 to 4.19. The number of organs transplanted per donor was 3.07, varying by DSA from 2.28 to 3.37. The discard rate for all organs combined was 0.13 per recovered organ, a value that varied substantially by DSA and by organ type. Reasons for not procuring or for discarding organs varied by organ type. Numbers of intestines, hearts, and lungs procured for transplant but not used are smaller than numbers of kidneys, pancreata, and livers because intestines, hearts, and lungs are recovered only after a transplant center has accepted the organ for transplant.

KEY WORDS Donation rate, eligible death, organ procurement organization, organ yield.

When I heard there would be five families impacted by Kim's organ donation, that was phenomenal. It was a moment of healing and beginning.

Kimberly, donor aunt

For organ donation, there are new metrics to calculate organ yield for all deceased donors, along with existing metrics such as donation rate, transplant rate, and rate of organs discarded. This chapter describes these metrics and compares them across the 58 donation service areas (DSAs).

Eligible Deaths

For reporting purposes, an eligible death is defined as the death of a patient aged 70 years or younger who is legally declared brain dead according to hospital policy and does not exhibit any of the list of exclusions listed in OPTN policy (Figure 1.1). The number of eligible deaths, as reported by organ procurement organizations (OPOs) to the Organ Procurement and Transplantation Network (OPTN), was 9,023 in 2011, a slight decrease from 9,035 in 2010. The estimated number of potential eligible deaths varies across the country, according to a recent study by Sheehy et al. using data from the National Center for Health Statistics (1). In 2007, these deaths represented 4.8% of all in-hospital deaths. The reasons for this variation in potential eligible deaths are not fully understood; regional variation in neurologic deaths could explain part of this variation (1).

Donation/Conversion Rate

The donation rate is calculated as the number of eligible donors per 100 eligible deaths. In 2011, 72.9 eligible donors per 100 eligible deaths were converted to organ donors (Figure 1.1). This overall 2011 rate was higher than the 2009 rate (69.4 per 100 eligible deaths) and the 2010 rate (71.7 per 100 eligible deaths). The donation rate for kidneys was higher than for livers; both of these rates were higher than the rates for thoracic organs and pancreata. Heart donation rates were higher than lung donation rates (lung donation refers to 1 or 2 lungs recovered). The unadjusted donation rate varied by DSA (Figure 1.2). The number of transplant programs in each DSA also varied substantially (Table 1.3).

Organ Yield

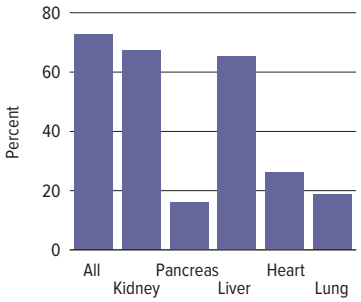
In June 2011, the OPTN Board of Directors approved use of the observed-versus-expected organs transplanted, or yield, metric. This adjusted analysis suggests opportunities to share best practices from DSAs with higher-than-expected organ-specific yields, to improve the overall yield across the country. The aggregate and organ-specific yield metrics based on 2-year cohorts for each OPO are publicly available on the Scientific Registry of Transplant Recipients website (2) and are reviewed biannually by the OPTN Membership and Professional Standards Committee. This metric compares the number of organs actually transplanted (observed) with the number of organs that would be expected to be transplanted, based on the national experience with similar donors (expected). The metric is expressed as the ratio of observed/expected organs transplanted. A ratio of less than 1 indicates that fewer organs were transplanted than would be expected, based on the national models for that particular organ. A ratio of greater than 1 indicates that more organs were transplanted than would be expected. Yields for all organs together (aggregate) are shown in Figure 1.4. In 2011, the observed/expected yield ratio for total organs varied across the DSAs from 0.89 to 1.13 (Figure 1.4). The observed/expected yield ratio for kidneys varied from 0.81 to 1.19 (Figure 1.5); for pancreata, from 0.10 to 2.26 (Figure 1.6); and for livers, from

0.83 to 1.19 (Figure 1.7). The range of observed/expected yield ratio for intestines was widest compared with all other organs, from 0 to 5.36 (Figure 1.8). The observed/expected yield ratio for hearts ranged from 0 to 1.28 (Figure 1.9), and for lungs, from 0.51 to 1.82 (Figure 1.10).

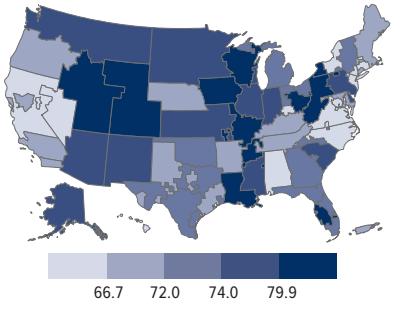
Organs Recovered per Donor

The total number of organs recovered divided by the number of donors was 3.54 in 2011, slightly lower than the 3.58 organs recovered per donor in 2010. Since 2000, this value has ranged from 3.48 to 3.62 (Figure 2.1). In 2011 the number varied substantially by DSA, ranging from 2.91 to 4.19 (Figures 2.2, 2.3). The number of kidneys recovered per donor ranged from 1.62 to 2.00; pancreata, from 0.07 to 0.31; and livers, from 0.64 to 0.95. The number of intestines recovered per donor ranged from 0.0 to 0.11; hearts, from 0.0 to 0.42; and lungs, from 0.13 to 0.76 (Figure 2.2). Of note, organs recovered per donor represents an unadjusted analysis. The value is not adjusted for mix of donor types recovered in the OPO, that is, standard criteria donors (SCD), expanded criteria donors (ECD), and donation after circulatory death (DCD) donors.

As expected, the number of organs recovered per donor from SCDs was higher than those from ECDs and DCD donors (Figure 2.4). In 2011, more kid-



DOD 1.1 **Overall & organ-specific donation rates per eligible deaths, 2011**



DOD 1.2 **Overall donation rates (per 100 eligible deaths), by DSA, 2011**

Donation rate is the number of deceased donors meeting eligibility criteria per 100 eligible deaths. Organ-specific rates represent the number of donors of each organ type meeting eligibility criteria per 100 eligible deaths. An eligible death is any hospital-reported death or imminent death that is evaluated and meets organ donor eligibility requirements: age 70 or younger, death by neurological criteria (based on the American Academy of Neurology Practice parameter for determining brain death), and without any of the following indications: tuberculosis, human immunodeficiency virus infection with specified conditions, Creutzfeldt-Jacob Disease, herpetic septicemia, rabies, reactive hepatitis B surface antigen, any retrovirus infection, active malignant neoplasms (except primary CNS tumors and skin cancers), Hodgkin's disease, multiple myeloma, leukemia, miscellaneous carcinomas, aplastic anemia, agranulocytosis, fungal and viral encephalitis, gangrene of bowel, extreme immaturity, or positive serological or viral culture findings for HIV.

neys were recovered per donor from DCD donors than from SCDs and ECDs: 1.98, 1.86, and 1.61, respectively (Figure 2.5). In contrast, for all other organs, more were recovered per donor from SCDs than from DCD donors. This pattern also occurred in 2010. Similarly, more organs were recovered per donor from SCDs than from ECDs, except for livers. Similar numbers of livers were recovered per donor from SCDs and from ECDs (Figure 2.6).

Organs Transplanted per Donor

The number of organs transplanted per donor was 3.07 in 2011, slightly lower than the 3.10 in 2010 (Figure 3.1). Since 2000, this value has ranged from 3.00 to 3.24. While the overall number of organs transplanted per donor in 2011 was similar to that in 2010 (Figure 3.1), the number varied substantially by DSA, ranging from 2.28 to 3.73 (Figures 3.2, 3.3). Of note, organs transplanted per donor represents an unadjusted analysis. The value is not adjusted for mix of SCD, ECD, and DCD donor types. As expected, the number of organs transplanted per donor from SCDs was higher than the numbers for ECDs and DCD donors (Figure 3.4). In 2011, more kidneys were transplanted per donor from DCD donors than from SCDs and ECDs: 1.73, 1.67, and 0.88, respectively (Figure 3.5). In contrast, for all other organs, the number of organs transplanted per donor from SCDs was higher than the numbers for ECDs and DCD donors (Figure 3.6).

Discard Rate

The number of organs discarded is calculated by subtracting the number of organs transplanted from the number of organs recovered for the purpose of transplantation. The discard rate is then calculated by dividing the number of organs discarded by the number of organs recovered for the purpose of transplantation. The discard rate for all organs combined was 0.13 per recovered organ, unchanged from 2010 (Figure 4.1). Organ-specific discard rates were similar to those in 2010. Discard rates varied substantially by DSA (Figure 4.2) and by organ type; discard rates were highest for pancreata and kidneys and lowest for hearts (Figure 4.2).

In 2011, use of kidneys, pancreata, livers, and lungs from ECDs varied by DSA. To quantify ECD use, the number of ECD organs transplanted is divided by the number of all organs (SCD+ECD+DCD) transplanted. This calculation was done for each organ type (kidney, pancreas, liver, and lung). The largest variation occurred for livers; ECDs represented 0% to 44% of all organs transplanted by DSAs (Figure 5.1). Waiting times for deceased donor transplants in 2011 varied across the country (Figure 7.1). Waiting times were longest for kidney transplants. Longer waiting times may be an impetus for the use of ECD organs. Of note, the waiting times are only for candidates who received a transplant. The waiting times do not account for candidates who did not receive a transplant.

Organ disposition data were reviewed to improve understanding of the reasons for organ discard or for not procuring an organ. In 2011, at least one organ was procured for the purpose of transplant from 8,128 donors (Figure 8.1). Of the 16,256 kidneys from these donors, 5,800 left, 5,741 right, and 298 *en bloc* kidneys were transplanted. This represents 75% of all kidneys, after counting each *en bloc* kidney as two kidneys transplanted. Reasons donor kidneys were not used are listed in Figure 8.1. The most common reason for not procuring a kidney was poor organ function. There were 1,233 left kidneys,

1,294 right kidneys, and 60 *en bloc* kidneys that were recovered but not transplanted. The most common reason for not transplanting a procured left or right kidney was "biopsy findings." The most common reason for not transplanting procured *en bloc* kidneys was "no recipient located, list exhausted," followed closely by "biopsy findings." From the 8,128 donors, only 1,093 pancreas allografts (13.4%) were transplanted; another 419 were recovered for the purpose of transplant and not used for transplant (Figure 8.2). From the 8,128 donors, only 6,031 liver allografts (74.2%) were transplanted; another 655 allografts were recovered but not transplanted (Figure 8.3). The most common reason for not transplanting recovered livers was "biopsy findings." The most common reason for not procuring a liver was "ruled out after evaluation in the operating room." For the remaining organs (intestine, heart, and lung), the numbers procured for transplant and not used were smaller, since the surgical procurement team in these cases is usually the same as the transplant team. Thus these organs would be recovered only after a transplant center has accepted the organ for transplantation (Figures 8.4, 8.5, 8.6).

References

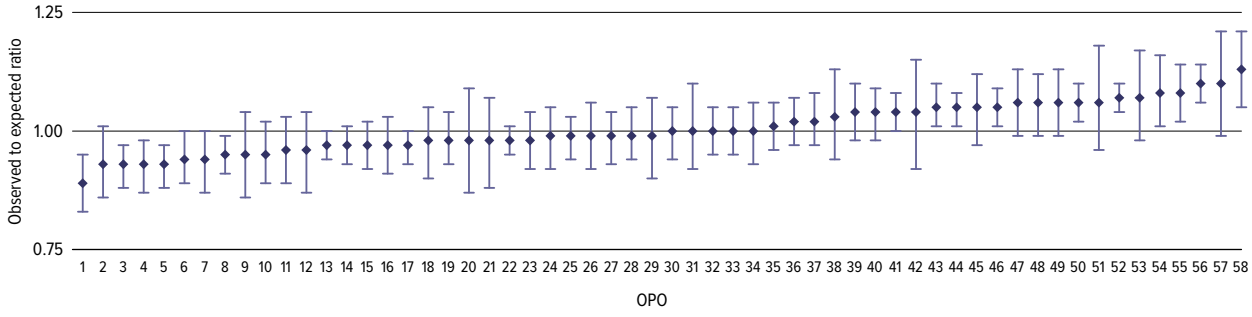
1. Sheehy E, O'Connor KJ, Luskin RS, Howard RJ, Cornell D, Finn J, Mone T, Selck FW, Delmonico FL. Investigating geographic variation in mortality in the context of organ donation. Am J Transplant 2012; 12: 1599-1602.

2. Scientific Registry of Transplant Recipients. OPO-specific reports. 2012. Available at http://www.srtr.org/opo/Default.aspx. Accessed July 10, 2012.

organ-specific donation rates

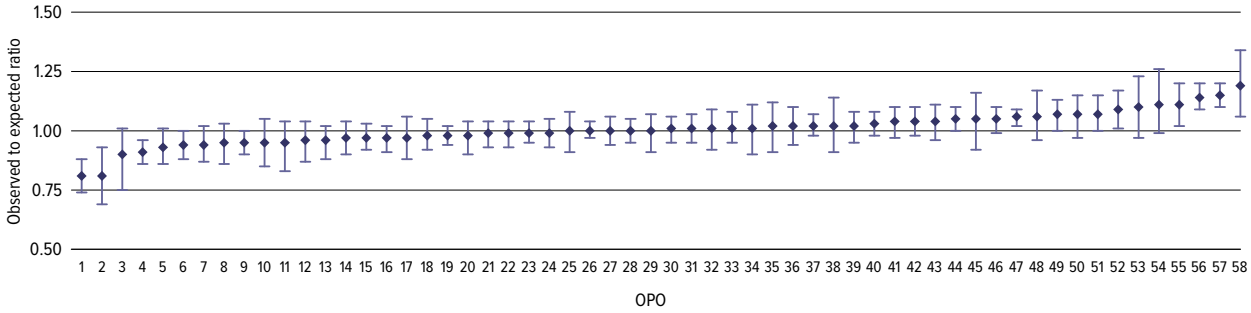
	Number of transplant programs in the country that transplanted at least one organ from the OPO						Number of transplant programs within the OPO service area					
DSA/OPO	KI	PA	LI	IN	HR	LU	KI	PA	LI	IN	HR	LU
ALOB	20	3	14	1	15	7	1	1	1		1	1
AROR	27	1	13	2	13	11	3		1		2	
AZOB	41	5	15	1	18	5	4	3	3	1	4	2
CADN	43	11	17	2	18	11	4	3	4	2	3	3
CAGS	21	5	13	1	7	7	2	1			1	
CAOP	55	13	18	6	20	12	11	6	5	1	5	3
CASD	22	5	8		9	4	4	3	3		2	1
CORS	26	3	12		18	9	4	2	3		2	1
CTOP	12	5	7	1	6	5	2		1		1	
DCTC	15	5	11	2	9	7	5	3	1	1	2	1
FLFH	20	6	9	1	13	8	2	1	1			
FLMP	23	6	11	3	14	9	1	1	2	1	2	1
FLUF	37	7	13	1	17	10	2	2	2		2	2
FLWC	30	6	18	4	13	8	2	1	1		2	1
GALL	37	9	23	4	27	13	4	3	3		3	1
HIOP	22	3	5			2	1	1	1			
IAOP	18	3	7	2	7	3	4	1	1		1	1
ILIP	43	8	13	3	22	14	8	6	6		6	2
INOP	32	1	7	2	21	6	3	1	1	1	3	1
KYDA	34	5	16	3	12	3	3	2	2		3	2
LAOP	37	11	12	2	18	14	4	3	3		2	1
MAOB	44	8	9	2	11	7	12	8	6	1	5	3
MDPC	18	2	8		13	9	2	2	2		2	2
MIOP	42	11	10	4	28	18	7	3	3	1	4	2
MNOP	48	4	13	2	13	9	9	4	3	1	3	2
MOMA	26	7	18	2	9	8	4	2	4		3	2
MSOP	28	7	20	1	15	8	1				1	
MWOB	37	11	17	3	22	22	6	2	3		1	
NCCM	16	4	12	1	7	10	1	1	1		1	
NCNC	34	6	16	1	18	7	4	3	2	1	3	2
NEOR	9	3	7		5	7	1	1	1	1	1	
NJTO	26	8	16		8	6	4	4	1		2	1
NMOP	13	3	11		10	4	2					
NVLV	25	4	17		12	4	1					
NYAP	13	4	7		8	3	2	2				
NYFL	12	1	8		7	4	2	1	1		1	
NYRT	43	6	10		13	4	10	4	6	2	4	1
NYWN	15	4	8		8	3	2	1				
OHLB	31	5	7	2	14	6	2	2	2	1	2	2
OHLC	12	6	6	1	7	9	2					
OHLP	13	2	10	2	19	8	2	1	1		2	1
OHOV	18	5	7	2	9	6	3	1	2	1	1	
OKOP	25	2	12	1	14	6	6	2	2		1	1
ORUO	20	4	10	1	12	3	3	1	2		2	
PADV	69	14	26	2	26	11	16	9	10		7	2
PATF	22	3	16	2	16	6	5	3	4	2	3	2
PRLL	20	3	14	2	4	6	1	1			1	
SCOP	33	6	19	4	24	16	1	1	1		1	1
TNDS	39	9	16	1	27	14	7	2	1		2	1
TNMS	24	6	7	2	19	10	2	1	2		1	1
TXGC	48	8	15	2	16	9	7	4	6		3	3
TXSA	29	4	8	3	9	3	5	2	3		2	1
TXSB	45	12	17	1	18	8	11	4	5		6	3
UTOP	23	7	11	1	11	9	3	2	3		3	1
VATB	25	6	21	2	19	11	4	2	2		4	1
WALC	33	6	11	1	8	2	5	3	3	1	3	1
WIDN	14	4	12		8	4	3	2	3		3	1
WIUW	19	3	12	3	12	5	1	1	1		1	1

DOD 1.3 Transplant program summary, 2011
Organ specific transplant programs are defined based on one or more transplants of that organ type within 2011.



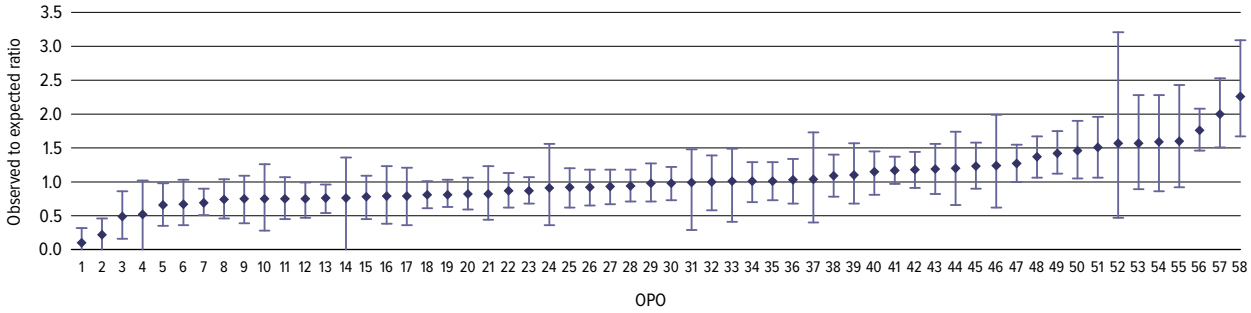
DOD 1.4 Donor yield: observed to expected ratio (O/E), 2011: all organs
Donor yield provides a measure of organs transplanted per donor. Expected yield is estimated from statistical models. These models take into account various characteristics that are not under the control of the OPOs. For variables used, see figures for the individual organs (Figures 1.5–10).

organ-specific donation rates



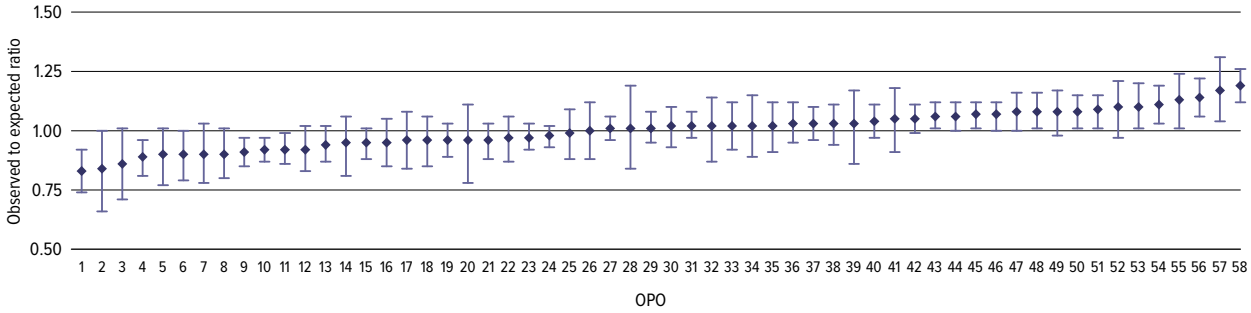
DOD 1.5 Donor yield: observed to expected ratio (O/E), 2011: kidney

Donor yield provides a measure of organs transplanted per donor. Expected yield is estimated from statistical models. These models take into account various characteristics that are not under the control of the OPOs. Variables used in the model: age, gender, blood type, cause of death, circumstances of death, mechanism of death, clinical infection present, cigarette use, cocaine use, heavy alcohol consumption, CDC high risk donor, history of diabetes, insulin dependence, history of hypertension, history of cancer, DCD, cardiac arrest after brain death, hepatitis B surface antigen, hepatitis B core antibody, hepatitis C antibody, serum creatinine, organ recovered outside the contiguous 48 states?



DOD 1.6 Donor yield: observed to expected ratio (O/E), 2011: pancreas

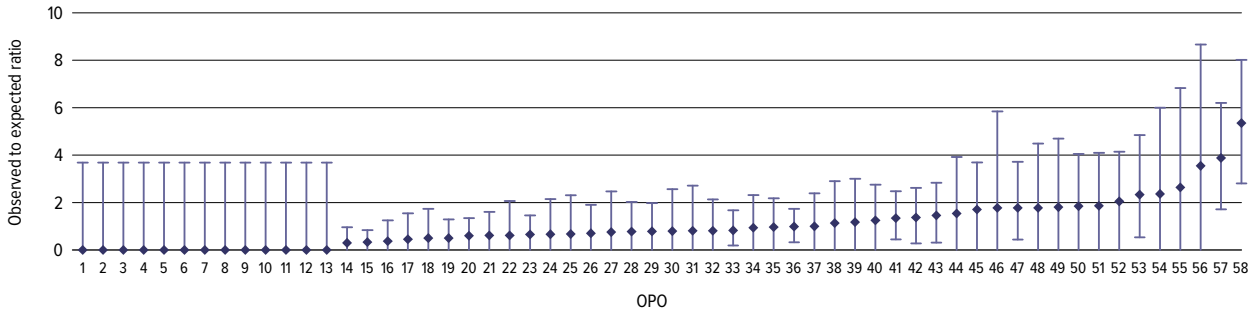
Donor yield provides a measure of organs transplanted per donor. Expected yield is estimated from statistical models. These models take into account various characteristics that are not under the control of the OPOs. Variables used in the model: age, BMI, race/ethnicity, blood type, cause of death, circumstances of death, mechanism of death, cocaine use, heavy alcohol consumption, CDC high risk donor, history of diabetes, insulin dependence, history of hypertension, history of cancer, DCD, lung pO_2 terminal value, hepatitis B surface antigen, hepatitis B core antibody, hepatitis C antibody, serum creatinine, organ recovered outside the contiguous 48 states?



DOD 1.7 Donor yield: observed to expected ratio (O/E), 2011: liver

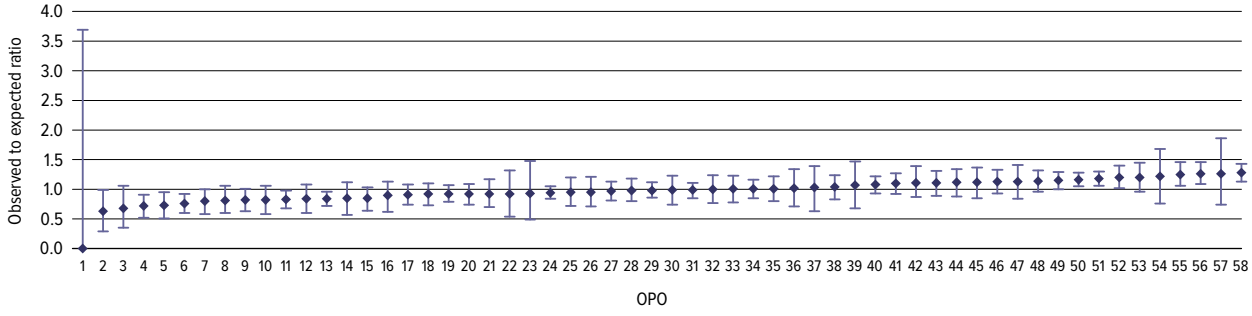
Donor yield provides a measure of organs transplanted per donor. Expected yield is estimated from statistical models. These models take into account various characteristics that are not under the control of the OPOs. Variables used in the model: age, BMI, race/ethnicity, blood type, cause of death, circumstances of death, clinical infection present, cigarette use, cocaine use, other drug use, heavy alcohol consumption, CDC high risk donor, history of diabetes, insulin dependence, DCD, DCD controlled, cardiac arrest after brain death, lung pO_2 terminal value, hepatitis B surface antigen, hepatitis B core antibody, hepatitis C antibody, organ recovered outside the contiguous 48 states?

organ-specific donation rates



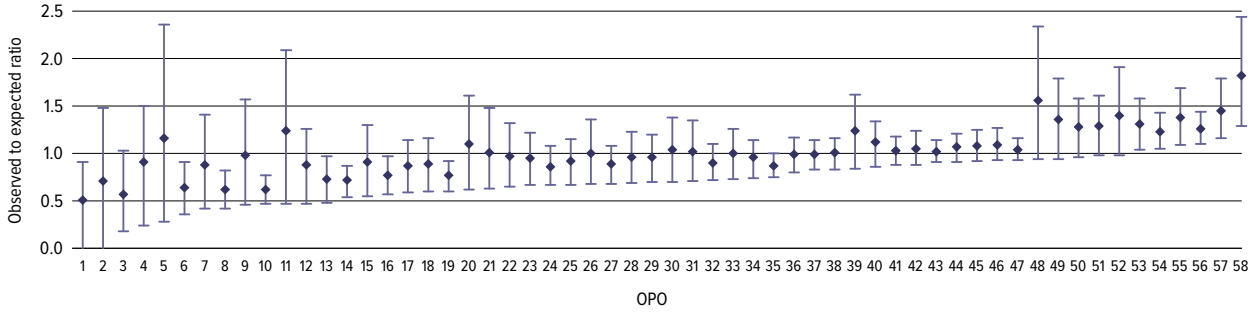
DOD 1.8 Donor yield: observed to expected ratio (O/E), 2011: intestine

Donor yield provides a measure of organs transplanted per donor. Expected yield is estimated from statistical models. These models take into account various characteristics that are not under the control of the OPOs. Variables used in the model: history of diabetes, insulin dependence, DCD, hepatitis B surface antigen.



DOD 1.9 Donor yield: observed to expected ratio (O/E), 2011: heart

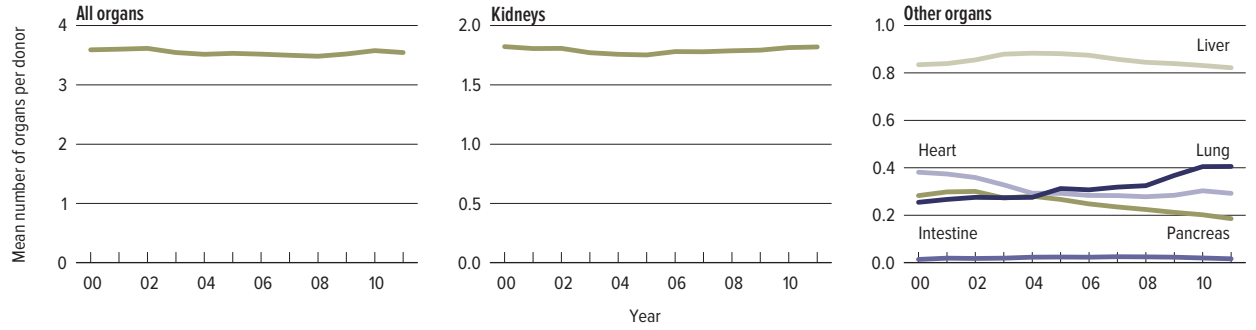
Donor yield provides a measure of organs transplanted per donor. Expected yield is estimated from statistical models. These models take into account various characteristics that are not under the control of the OPOs. Variables used in the model: age, BMI, gender, race/ethnicity, blood type, cause of death, mechanism of death, clinical infection present, cigarette use, cocaine use, other drug use, CDC high risk donor, history of diabetes, history of hypertension, DCD, cardiac arrest after brain death, lung pO_2 terminal value, hepatitis B surface antigen, hepatitis B core antibody, hepatitis C antibody, serum creatinine, organ recovered outside the contiguous 48 states?



DOD 1.10 Donor yield: observed to expected ratio (O/E), 2011: lung

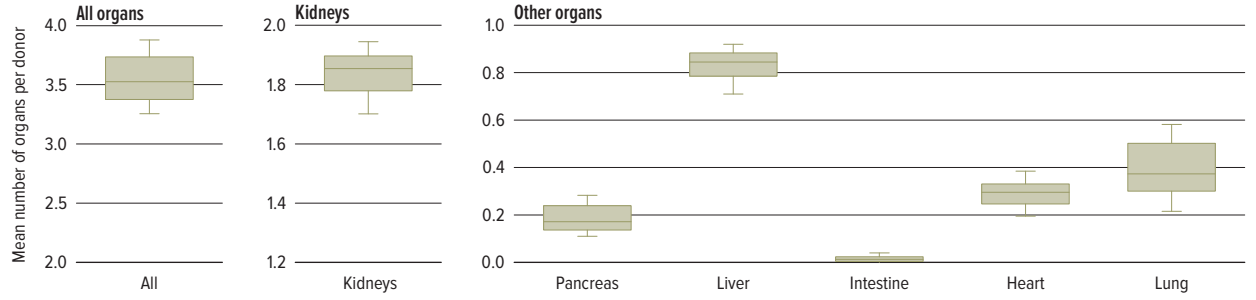
Donor yield provides a measure of organs transplanted per donor. Expected yield is estimated from statistical models. These models take into account various characteristics that are not under the control of the OPOs. Variables used in the model: age, BMI, gender, race/ethnicity, blood type, cause of death, circumstances of death, mechanism of death, clinical infection present, cigarette use, cocaine use, other drug use, CDC high risk donor, insulin dependence, history of cancer, DCD, cardiac arrest after brain death, lung pO_2 terminal value, hepatitis B surface antigen, hepatitis B core antibody, hepatitis C antibody, serum creatinine, organ recovered outside the contiguous 48 states?

organs recovered per donor



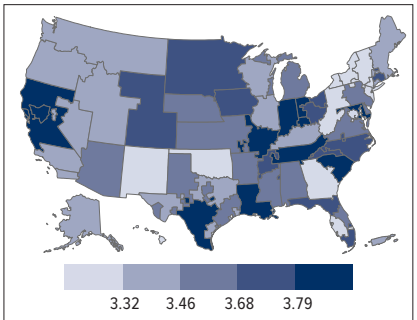
DOD 2.1 Organs recovered per donor (ORPD)

Organs recovered per donor is the average number of organs recovered per donor, calculated as the sum of recovered organs and by organ type, i.e., in the case of kidneys recovered, up to two kidneys can be recovered from an individual donor, while only one heart can be recovered from each donor.



DOD 2.2 Organs recovered per donor (ORPD), by DSA, 2011

Organs recovered per donor is the average number of organs recovered per donor, calculated as the sum of recovered organs and by organ type, i.e., in the case of kidneys recovered, up to two kidneys can be recovered from an individual donor, while only one heart can be recovered from each donor. Means of DSA-level means are shown.

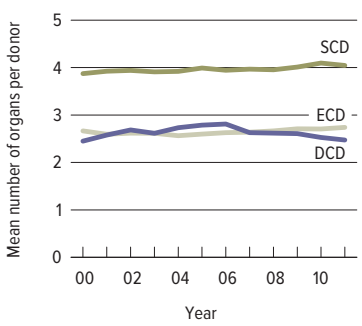


DOD 2.3 Organs recovered per donor (ORPD), by DSA, 2011

Organs recovered per donor is the average number of organs recovered per donor, calculated as the sum of recovered organs, i.e., in the case of kidneys recovered, up to two kidneys can be recovered from an individual donor, while only one heart can be recovered from each donor.

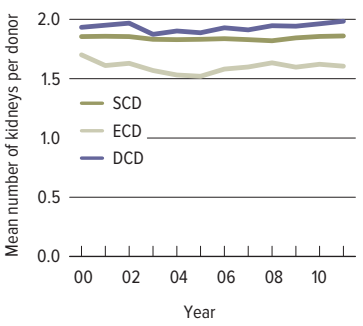
data behind the figures can be downloaded from our website, at www.srtr.org

organs recovered per donor



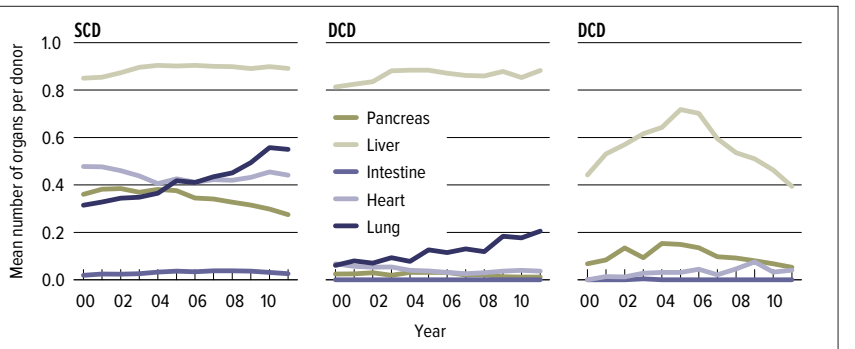
DOD 2.4 Organs recovered per donor (ORPD), by SCD, DCD, & ECD status

Organs recovered per donor is the average number of organs recovered per donor, calculated as the sum of recovered organs, i.e., in the case of kidneys recovered, up to two kidneys can be recovered from an individual donor, while only one heart can be recovered from each donor.



DOD 2.5 Kidneys recovered per donor (ORPD), by SCD, DCD, & ECD status

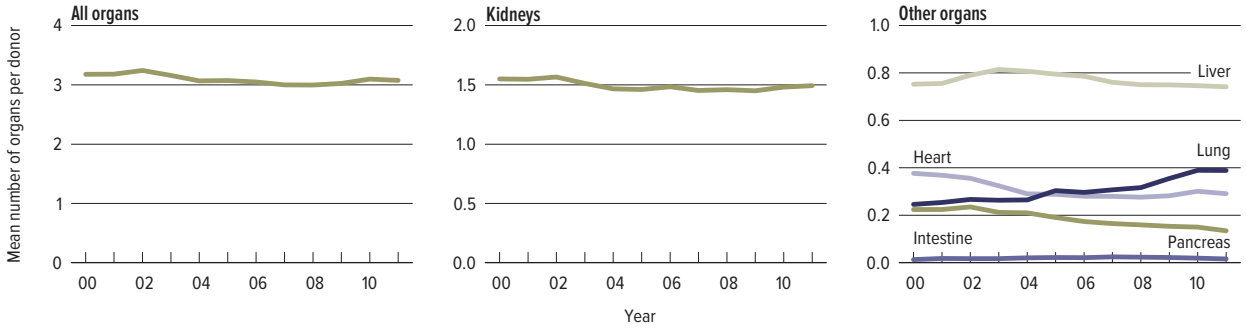
Kidneys recovered per donor is calculated as the sum of recovered kidneys; up to two kidneys can be recovered from an individual donor.



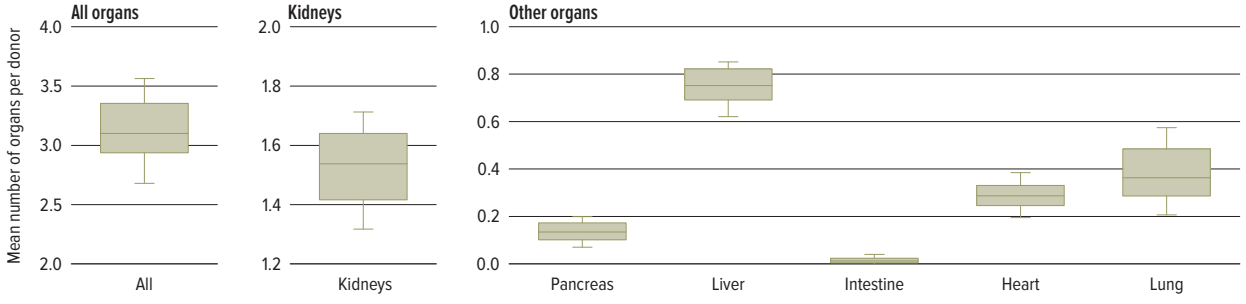
DOD 2.6 Other organs recovered per donor (ORPD), by SCD, DCD, & ECD status

Organs recovered per donor is the average number of organs recovered per donor, calculated as the sum of recovered organs and by organ type, i.e., in the case of kidneys recovered, up to two kidneys can be recovered from an individual donor, while only one heart can be recovered from each donor.

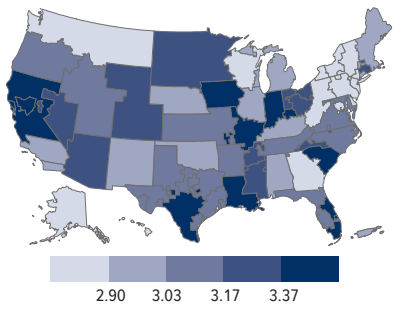
organs transplanted per donor



DOD 3.1 Organs transplanted per donor (OTPD)
Organs transplanted per donor is the average number of organs transplanted per donor. Organs divided into segments (liver, lung, pancreas, intestine) may account for more than one transplant, so the number transplanted may exceed the number recovered. Based on a count of recovered organs that are transplanted, which differs from the number of transplant operations.

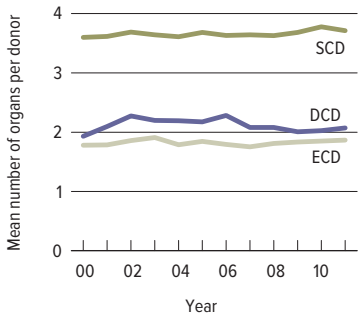


DOD 3.2 Organs transplanted per donor (OTPD), by DSA, 2011
Organs transplanted per donor is the average number of organs transplanted per donor. Organs divided into segments (liver, lung, pancreas, intestine) may account for more than one transplant, so the number transplanted may exceed the number recovered. Based on a count of recovered organs that are transplanted, which differs from the number of transplant operations. Means of DSA-level means are shown.



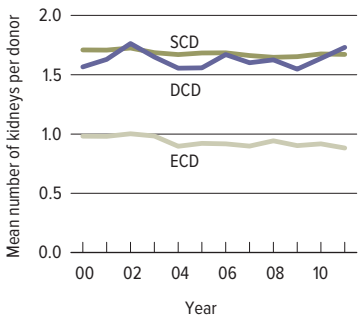
DOD 3.3 Organs transplanted per donor (OTPD), by DSA, 2011
Organs transplanted per donor is the average number of organs transplanted per donor. Organs divided into segments (liver, lung, pancreas, intestine) may account for more than one transplant, so the number transplanted may exceed the number recovered. Based on a count of recovered organs that are transplanted, which differs from the number of transplant operations.

organs transplanted per donor



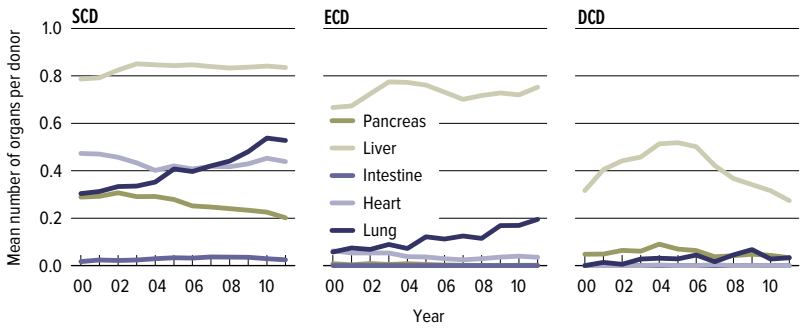
DOD 3.4 Organs transplanted per donor (OTPD), by SCD, DCD, & ECD status

Organs transplanted per donor is the average number of organs transplanted per donor. Organs divided into segments (liver, lung, pancreas, intestine) may account for more than one transplant, so the number transplanted may exceed the number recovered. Based on a count of recovered organs that are transplanted, which differs from the number of transplant operations.



DOD 3.5 Kidneys transplanted per donor (OTPD), by SCD, DCD, & ECD status

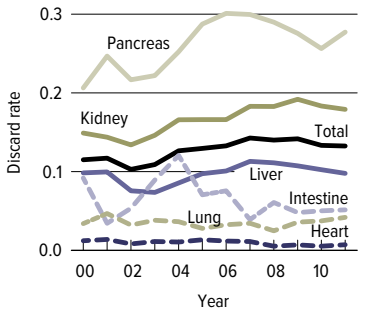
Kidneys transplanted per donor is the average number of kidneys transplanted per donor. Based on a count of recovered kidneys that are transplanted, which differs from the number of transplant operations.



DOD 3.6 Other organs transplanted per donor (ORPD), by SCD, DCD, & ECD status

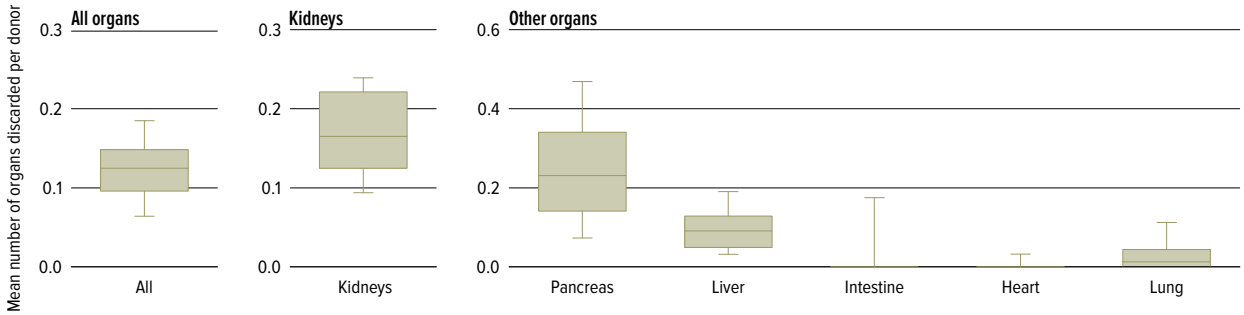
Organs transplanted per donor is the average number of organs transplanted per donor. Organs divided into segments (liver, lung, pancreas, intestine) may account for more than one transplant, so the number transplanted may exceed the number recovered. Based on a count of recovered organs that are transplanted, which differs from the number of transplant operations.

organ discards | expanded criteria donors



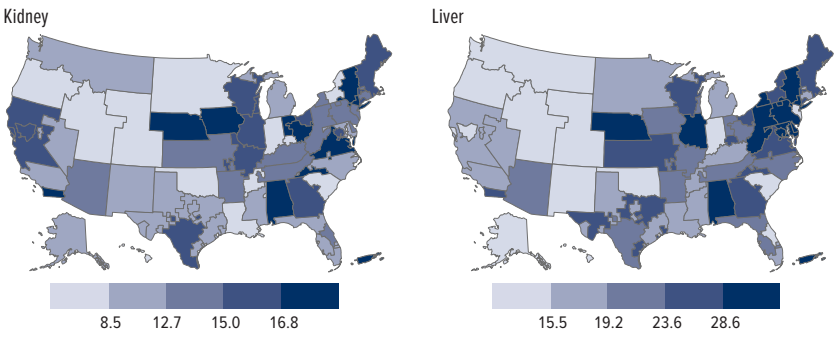
DOD 4.1 Organ discard rates for organs recovered for transplantation

Organ discard rate is calculated as the difference between the number of organs recovered and the number of organs transplanted, divided by the number of organs recovered.



DOD 4.2 Variation in organ discard rates, by DSA, 2011

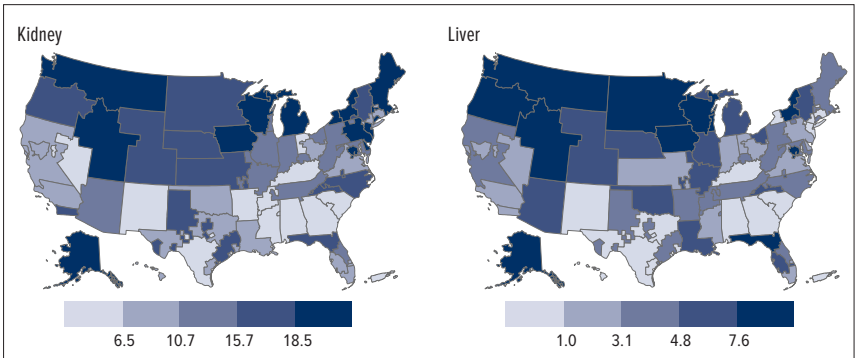
Organ discard rate is calculated as the difference between the number of organs recovered and the number of organs transplanted, divided by the number of organs recovered.



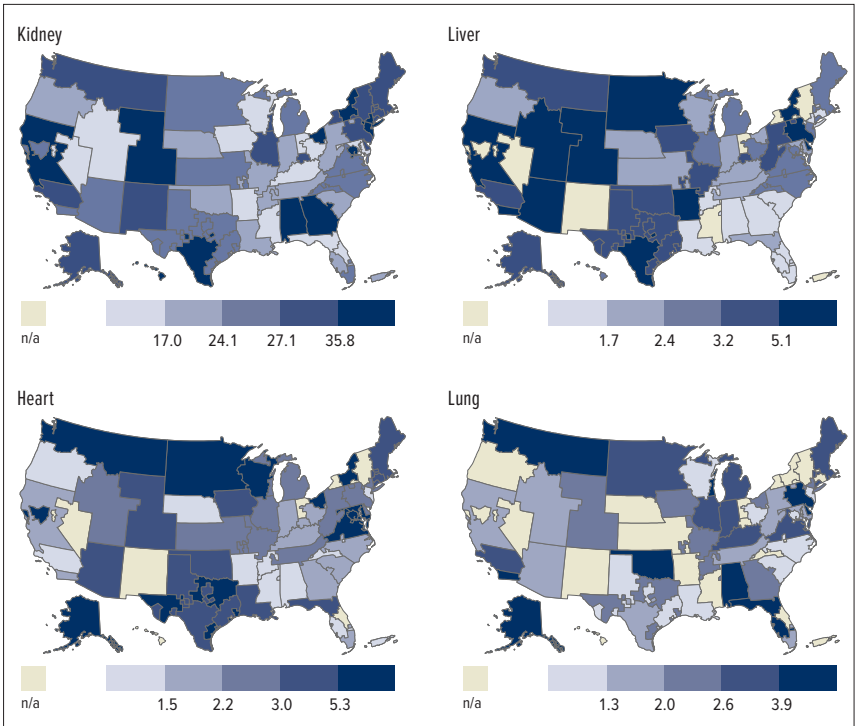
DOD 5.1 Variation in the use of ECD donors for patients transplanted in 2011, by DSA

Per DSA, the percent of transplants from ECD donors.

donations after cardiac death | waiting time



DOD 6.1 Variation in the use of DCD donors for patients transplanted in 2011, by DSA
Per DSA, the percent of transplants from DCD donors.



DOD 7.1 Variation in waiting time (months) for patients receiving a deceased donor transplant in 2011, by DSA
Median time to transplant for those on the waiting list and with a transplant in 2010. Time to transplant is calculated as the time (in months) after a candidate is placed on the transplant wait list.

Kidney

2011: 8128 donors (16256 kidneys)

Reported by left/right: 7667 donors (94%)

Left

- Consent not requested 46 (0.6%)
  - Donor age (12)
  - Acute/ chronic renal failure (20)
  - Donor quality (7)
  - Other (7)
- Consent not obtained 29 (0.4%)
  - Emotional (18)
  - Family conflict (3)
  - Other (8)
- Recovered, not for tx 27 (0.4%)
  - Recovered for research (27)
- Tx'ed 5800 (75.7%)
  - Locally (4716)
  - Shared (1084)
- Recovered for tx but not tx'd 1233 (16.1%)
  - Discarded locally (812)
  - Shared & discarded (252)
  - Submitted for research (169)
    - Too old on pump (8)
    - Too old on ice (13)
    - Vascular damage (24)
    - Ureteral damage (2)
    - Donor medical history (6)
    - Donor social history (3)
    - Positive HIV (1)
    - Positive hepatitis (11)
    - Warm ischemia time too long (9)
    - Organ trauma (15)
    - Organ not as described (2)
    - Biopsy findings (482)
    - Recipient determined to be unsuitable for transplant in OR (5)
    - Poor organ function (109)
    - Infection (2)
    - Diseased organ (41)
    - Anatomical abnormalities (92)
    - No recipient located, list exhausted (200)
    - Other (208)
- Organ not recovered 532 (6.9%)
  - Poor organ function (257)
  - Positive hepatitis (7)
  - Diseased organ (28)
  - Anatomical abnormalities (14)
  - No recipient located (16)
  - Donor medical history (67)
  - Donor social history (5)
  - Surgical damage in OR (1)
  - Organ refused by all regional programs (16)
  - Organ refused by all national programs (36)
  - Ruled out after evaluation in OR (35)
  - Hemodynamically unstable donor (1)
  - Trauma to organ (3)
  - Medical examiner restricted (2)
  - Other (44)

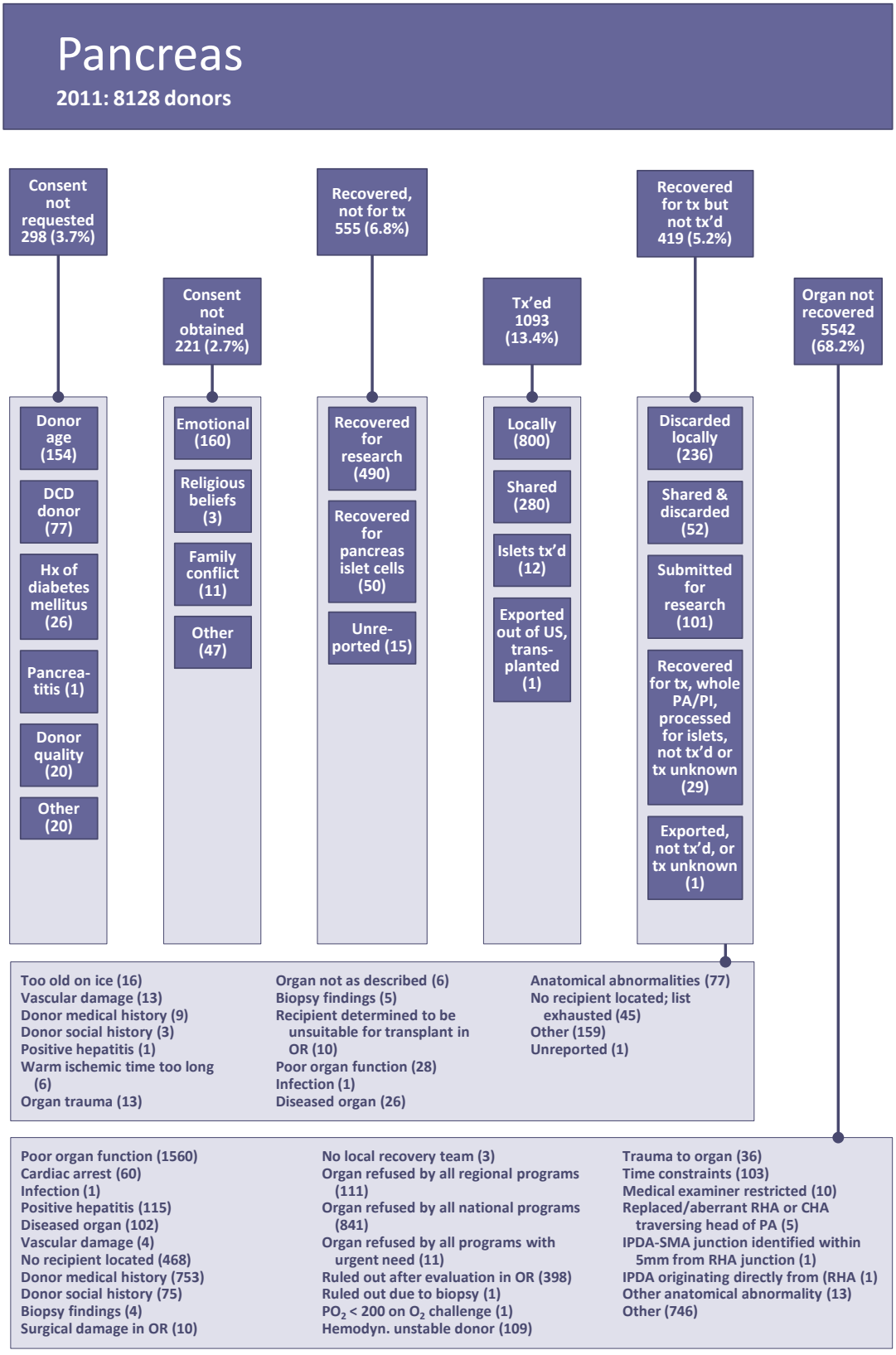
Right

- Consent not requested 46 (0.6%)
  - Donor age (12)
  - Acute/ chronic renal failure (20)
  - Donor quality (7)
  - Other (7)
- Consent not obtained 29 (0.4%)
  - Emotional (18)
  - Family conflict (3)
  - Other (8)
- Recovered, not for tx 34 (0.4%)
  - Recovered for research (34)
- Tx'ed 5741 (74.9%)
  - Locally (4472)
  - Shared (1269)
- Recovered for tx but not tx'd 1294 (16.9%)
  - Discarded locally (860)
  - Shared & discarded (252)
  - Submitted for research (171)
    - Too old on pump (10)
    - Too old on ice (14)
    - Vascular damage (20)
    - Ureteral damage (1)
    - Donor medical history (11)
    - Donor social history (3)
    - Positive HIV (1)
    - Positive hepatitis (19)
    - Warm ischemia time too long (13)
    - Organ trauma (17)
    - Organ not as described (3)
    - Biopsy findings (470)
    - Recipient determined to be unsuitable for transplant in OR (5)
    - Poor organ function (122)
    - Infection (2)
    - Diseased organ (48)
    - Anatomical abnormalities (87)
    - No recipient located, list exhausted (215)
    - Other (233)
- Organ not recovered 523 (6.8%)
  - Poor organ function (252)
  - Positive hepatitis (7)
  - Diseased organ (28)
  - Anatomical abnormalities (8)
  - No recipient located (16)
  - Donor medical history (68)
  - Donor social history (7)
  - Surgical damage in OR (1)
  - Organ refused by all regional programs (16)
  - Organ refused by all national programs (36)
  - Ruled out after evaluation in OR (31)
  - Hemodynamically unstable donor (1)
  - Trauma to organ (7)
  - Medical examiner restricted (3)
  - Other (42)

Reported en bloc: 461 donors (6%)

- Consent not requested 10 (2.2%)
  - Donor age (4)
  - Acute/ chronic renal failure (5)
  - Donor quality (1)
  - Other (0)
- Consent not obtained 5 (1.1%)
  - Emotional (3)
  - Family conflict (0%)
  - Other (2)
- Recovered, not for tx 18 (3.9%)
  - Recovered for research (18)
- Tx'ed 298 (64.8%)
  - Locally (180)
  - Shared (118)
- Recovered for tx but not tx'd 60 (13%)
  - Discarded locally (36)
  - Shared & discarded (14)
  - Submitted for research (10)
    - Too old on ice (1)
    - Ureteral damage (1)
    - Organ not as described (2)
    - Biopsy findings (14)
    - Recipient determined to be unsuitable for transplant in OR (1)
    - Poor organ function (8)
    - Infection (1)
    - Diseased organ (1)
    - Anatomical abnormalities (4)
    - No recipient located, list exhausted (15)
    - Other (12)
- Organ not recovered 69 (15%)
  - Poor organ function (33)
  - Diseased organ (2)
  - Anatomical abnormalities (1)
  - No recipient located (3)
  - Donor medical history (10)
  - Organ refused by all national programs (9)
  - Ruled out after evaluation in OR (3)
  - Trauma to organ (1)
  - Time constraints (1)
  - Medical examiner restricted (0%)
  - Other (6)

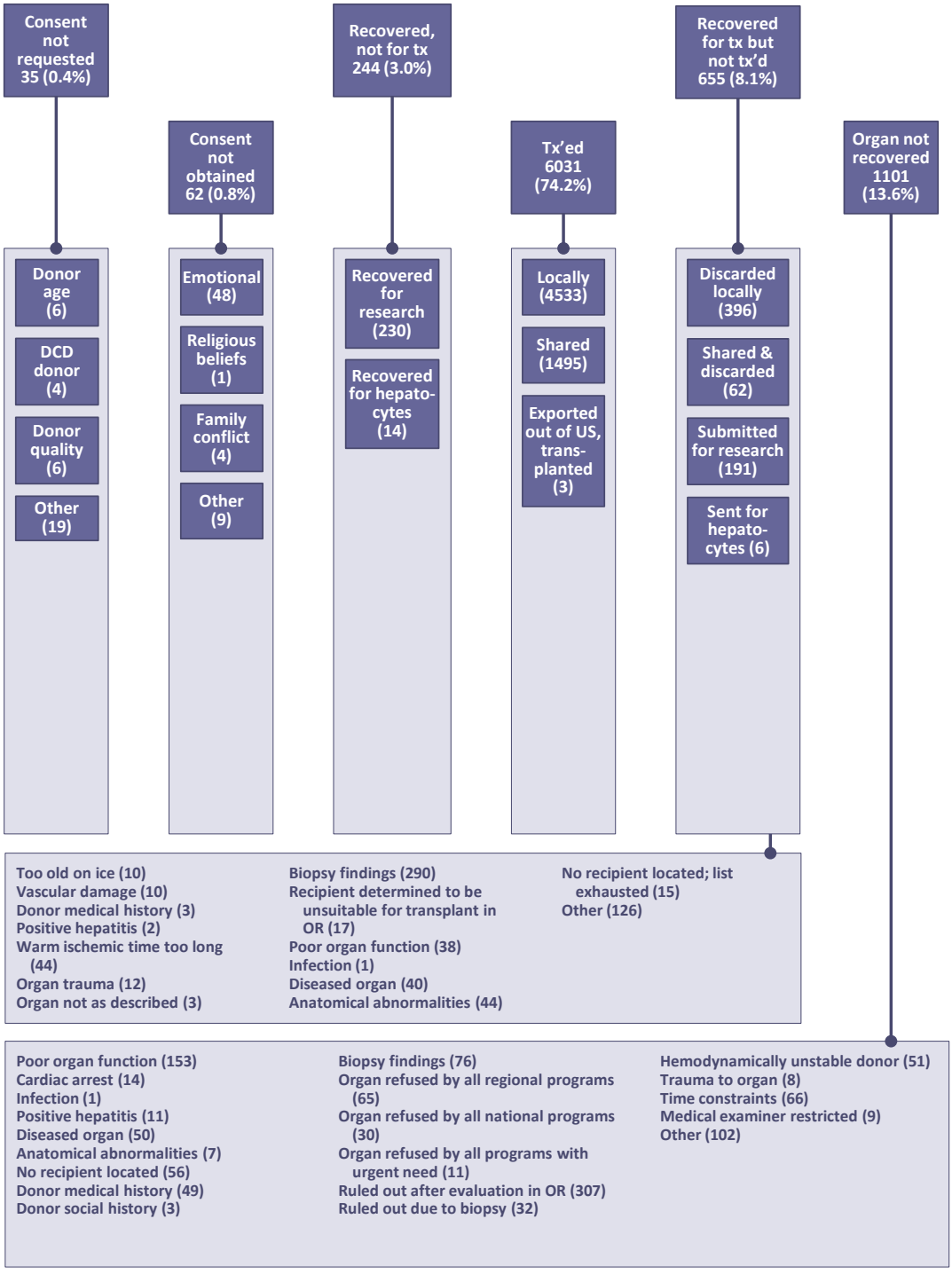
DOD 8.2 organ use: pancreas



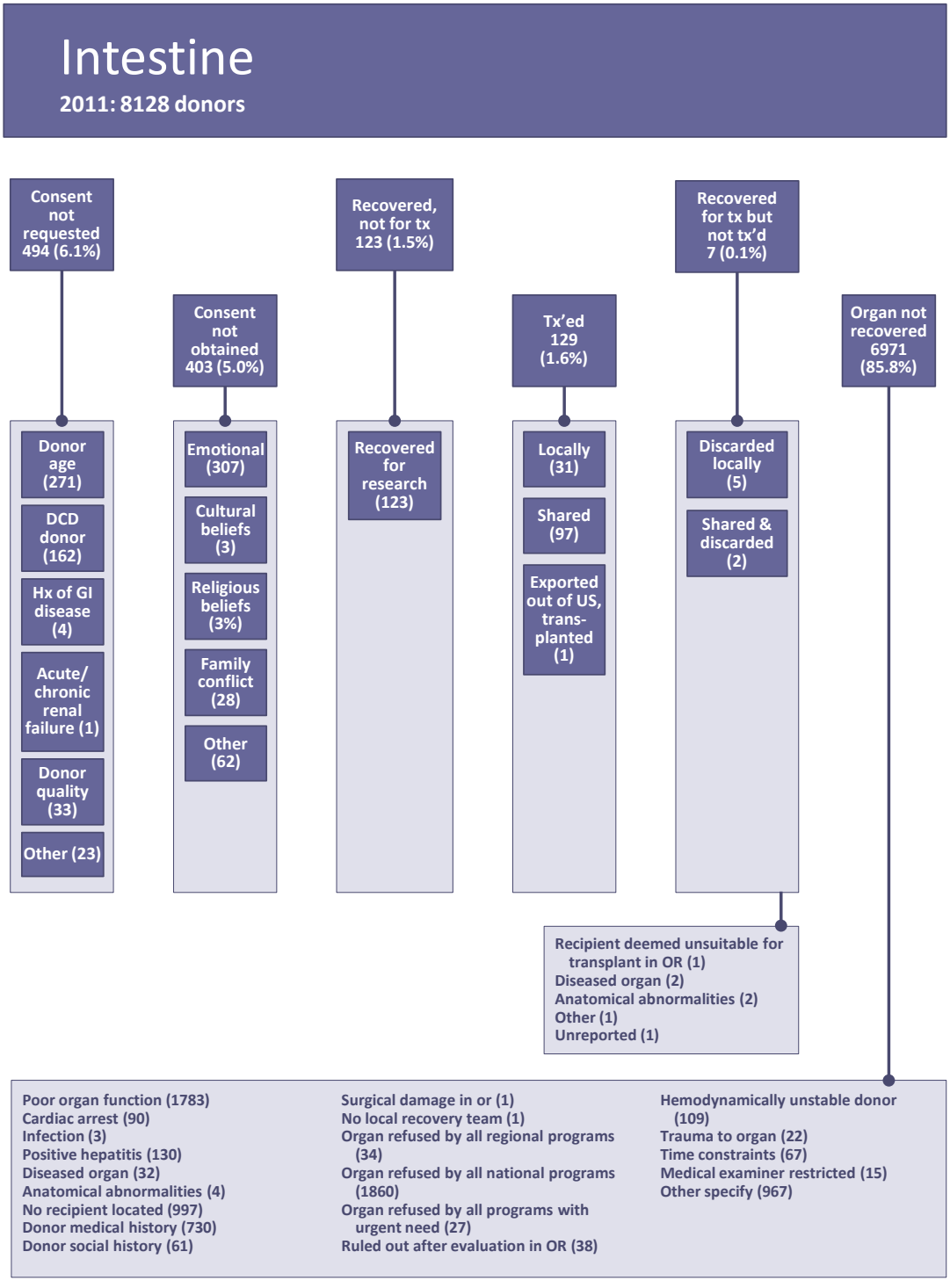
DOD 8.3 organ use: liver

Liver

2011: 8128 donors



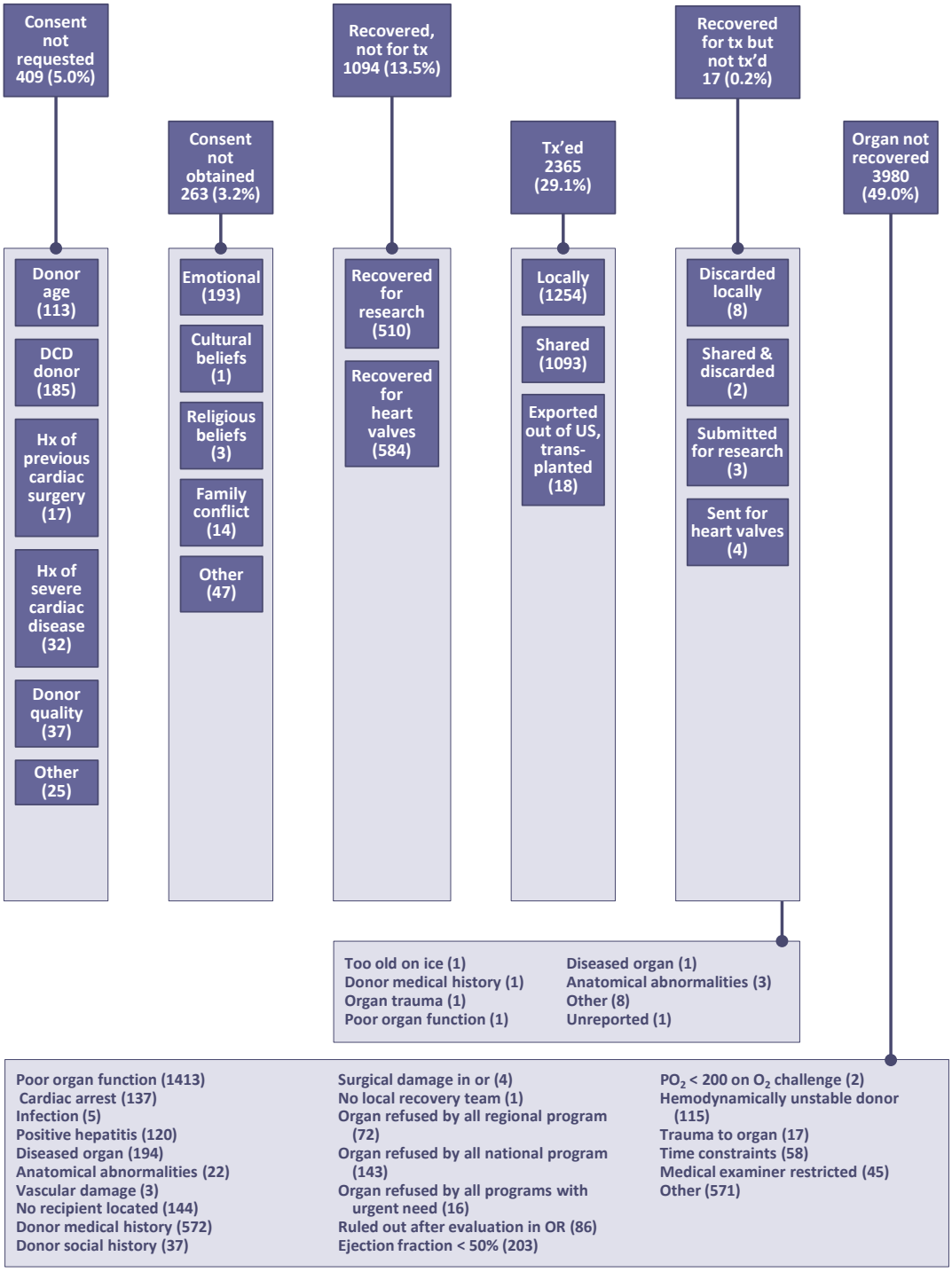
DOD 8.4 organ use: intestine



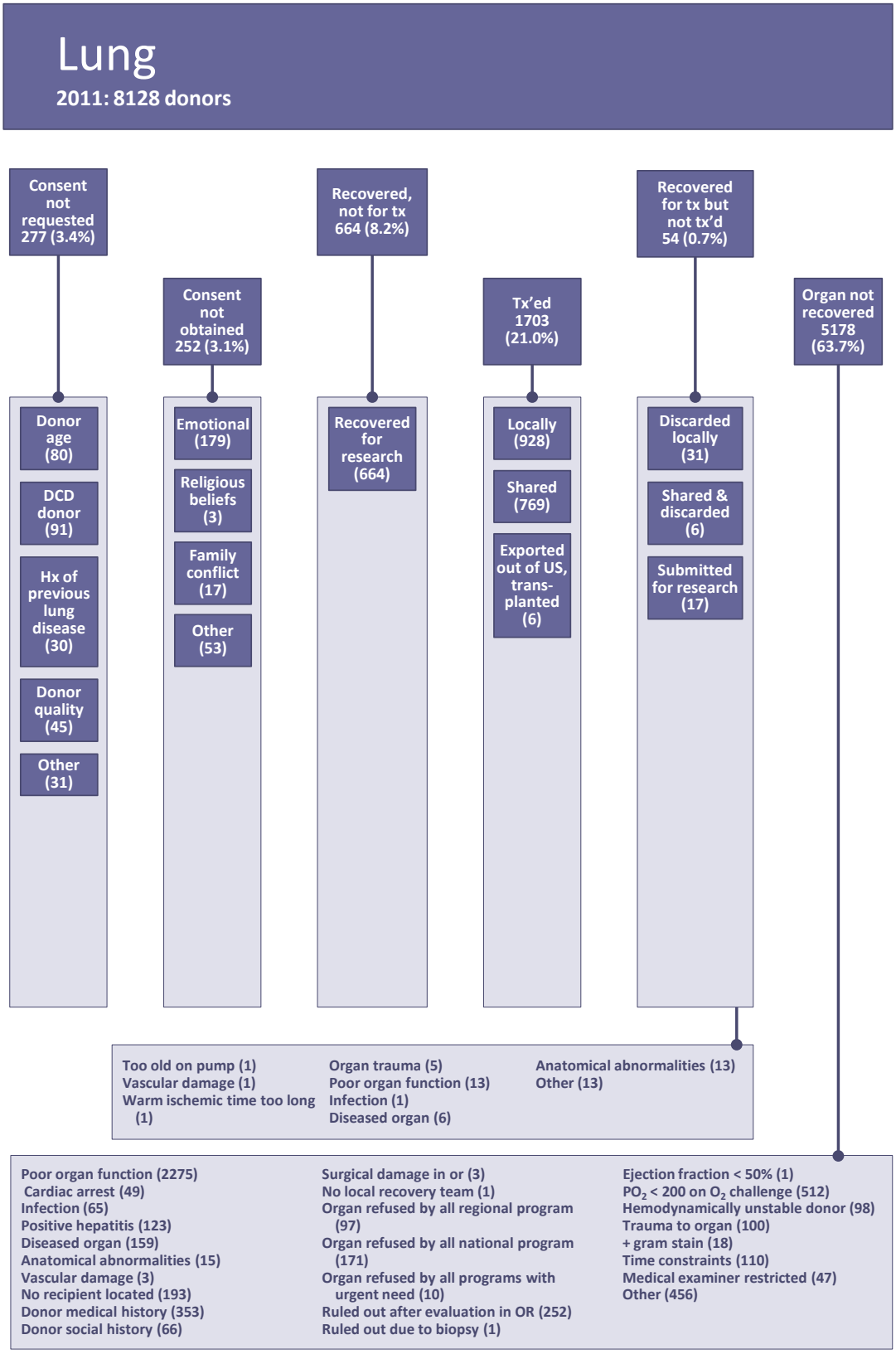
DOD 8.5 organ use: heart

Heart

2011: 8128 donors



DOD 8.6 organ use: lung



map: kidney transplants 202
map: pancreas transplants 204
map: liver transplants 206
map: heart transplants 208
map: lung transplants 210
kidney transplants 212
pancreas transplants 215
liver transplants 217
intestinal transplants 220
heart transplants 222
lung transplants 224

OPTN/SRTR 2011 Annual Data Report:

international data

ABSTRACT For the first time, OPTN/SRTR has undertaken to publish global transplant rates as part of its Annual Data Report. Understanding why rates vary from country to country may lead to a better understanding of how to improve access to transplant everywhere. Availability of information varies substantially from country to country, and how complete and accurate the data are is difficult to ascertain. For Canada, Malaysia, and the United Kingdom, data were supplied at SRTR request from well-known registries. For many other countries, SRTR was unable to obtain information, and data from the World Health Organization's Global Observatory on Donation and Transplantation were used. Transplant counts and rates vary substantially around the world, likely due to 1) differences in rates of end-organ diseases, 2) economic differences in the ability to provide transplants or other end-organ disease treatment, 3) cultural differences that might support or hinder organ donation and transplant, and 4) reporting differences.

KEY WORDS End-stage organ disease, international transplant counts, international transplant data, international transplant rates.

Life is totally different. You know, it's easy to get in a comfortable rut and not notice the clock ticking. Then, suddenly, you realize your time may run out. My new life has given me an opportunity to try new things. I don't need to be entertained anymore – there's ample entertainment in everyday things.

Dave, liver recipient

Introduction

This year, for the first time, OPTN/SRTR has undertaken to publish global transplant rates as part of its Annual Data Report.

For many reasons, comparing transplant rates between countries may be beneficial. In particular, understanding why rates differ from country to country may lead to a better understanding of how to improve access to transplants everywhere. Simply put, if one country has a successful transplant system, then other countries can learn from its techniques and approaches, thus improving transplantation around the world.

An example of how international comparisons can lead to knowledge acquisition is the story of deceased donor kidney transplant in Spain (1,2). For several years, Spain's higher rate of deceased donor transplants, in relation to most comparable countries, has been recognized. This has led to efforts to better understand the Spanish system and to study how successful features of the Spanish system can be adopted by other countries.

The availability of information on organ transplant rates varies substantially from country to country, and how complete and accurate the data are in each case is often difficult to know. Nevertheless, we have attempted to provide the best information currently available.

Methods

We contacted several registries and individual countries and asked them to share information on the number of transplants performed in their country or countries, excluding transplants in individuals from their countries that may have been performed elsewhere.

We used OPTN data for transplant counts in the United States. For Canada, Malaysia, and the United Kingdom, we used data supplied at our request from well-established registries. For many other countries, we have so far been unable to obtain information; in these cases, we used data from the World Health Organization's Global Observatory on Donation and Transplantation (3,4). These data have been collected by La Organización Nacional de Trasplantes (ONT), which operates under the auspices of the Spanish Ministry of Health. The ONT collects data annually using a survey instrument, and reports both transplant numbers and rates in the per million population unit. The ONT transplant rates per million population are calculated using data from the United Nations Population Fund report.

In this chapter, we report transplant counts by individual organs. Counts for the more common multi-organ transplants are included in the counts for individual organs as follows:

- Kidney: transplants reported as kidney plus those reported as kidney-pancreas
- Pancreas: transplants reported as pancreas plus those reported as kidney-pancreas
- Heart: transplants reported as heart plus those reported as heart-lung
- Lung: transplants reported as lung plus those reported as heart-lung

We report our findings as both counts and rates per million population. We recognize that the per million population unit may not always be the best measure of transplant rates. In comparing transplant rates between countries, obvious differences that may affect those rates should be accounted for. However, examining differences in raw numbers and rates per million population is a place to start. These observed differences suggest that it may be useful to collect additional information worldwide.

Results and Discussion

Transplant counts and rates vary substantially between countries around the world. Reasons for this variability likely include: 1) differences in the rates of end-organ disease, 2) economic differences in the ability to provide transplants or other treatments for end-organ disease, 3) cultural differences that might support or hinder organ donation and transplant, and 4) reporting of transplants.

Country-to-country variability in the underlying incidence of end-organ disease can be expected to affect the organ transplant rates. For example, the US has one of the highest rates of end-stage renal disease (ESRD) in the world. In the US in 2009, the incidence of ESRD was 371 per million population (5). Therefore, it should not be surprising that the US also has one of the highest rates of kidney transplant in the world (Figure 2.1). However, other factors undoubtedly play a role in determining transplant rates. The incidence of ESRD in Norway in 2009 was 116 per million population, or approximately

one-third the incidence in the US. Nevertheless, in 2010, rates of kidney transplant were similar in Norway and the US: 59.2 versus 57.5 per million population, respectively (Figure 2.2).

Socioeconomic factors likely play a role in access to transplant worldwide. For example, in 2010 there was a strong correlation between the Human Development Index (HDI) and the rate of deceased and living donor kidney transplant among World Health Organization member states (6). The HDI is a composite score that includes life expectancy, adult literacy, school enrollment, and gross domestic product. Similarly, rates of liver transplant are lower in countries with lower HDIs (4). Cultural differences may influence transplant rates as well. For example, Japan has a very high HDI, but lower rates of kidney transplant compared with countries with similar HDIs. The thoroughness of transplant reporting could also vary by country; unfortunately, this is difficult to assess, with such varied systems used from county to country to collect these data.

Worldwide, use of living kidney donors varies widely (Figures 2.5, 2.6). Among countries with active kidney transplant programs in 2009-2010, defined by at least 50 transplants in those 2 years, the proportions of kidney transplants from living donors varied from less than 10% in Chile, Columbia, Croatia, Cuba, Czech Republic, Estonia, Finland, France, Italy, Poland, Portugal, Slovakia, and Uruguay, to more than 75% in Algeria, India, Iran, Japan, Kenya, Kuwait, Lebanon, Mexico, Nepal, Nigeria, Pakistan, Philippines, Sudan, Syria, Tunisia, and Turkey. In the US, where the most kidney transplants are performed, more than 35% are from living donors.

From 2006-2010, overall rates of kidney transplant changed little in most countries (Figure 2.2). Countries where rates increased by more than 10% per year include Croatia, Estonia, Paraguay, Thailand, Tunisia, and Turkey. On the other hand, kidney transplant rates in El Salvador, Japan, and the Philippines declined by more than 10% per year over the same period. Pancreas transplants declined by 10% or more per year in Croatia, Italy, and New Zealand from 2006-2010. Except for increases of more than 10% in Argentina, Ireland, and Sweden, pancreas transplant rates changed little in most other countries (Figure 3.2).

Rates of liver transplant increased by more than 20% per year from 2006-2010 in several countries, including Croatia, Iran, Lithuania, Romania, Slovenia, Thailand, and Turkey, and declined in very few countries (Figure 4.2). In the past 5 years, lung transplant rates have remained stable, and increased by more than 10% per year only in countries that had 2006 rates of less than 0.2 transplants per million population (Figure 7.2). Heart transplant rates increased by more than 10% per year in Croatia, Slovakia, and Slovenia; however, heart transplant rates changed little in most other countries (Figure 6.2). Few countries are performing intestinal transplants; in 2010, countries performing more than one intestinal transplant included Argentina (7 transplants), Canada (3), Columbia (6), France (9), Germany (10), Iran (4), Italy (6) Japan (4), Spain (5), Turkey (3), the United Kingdom (18), and the US (151). Countries reporting one intestinal transplant in 2010 were Australia, Finland, India, Luxembourg, and Switzerland (Figure 5.4).

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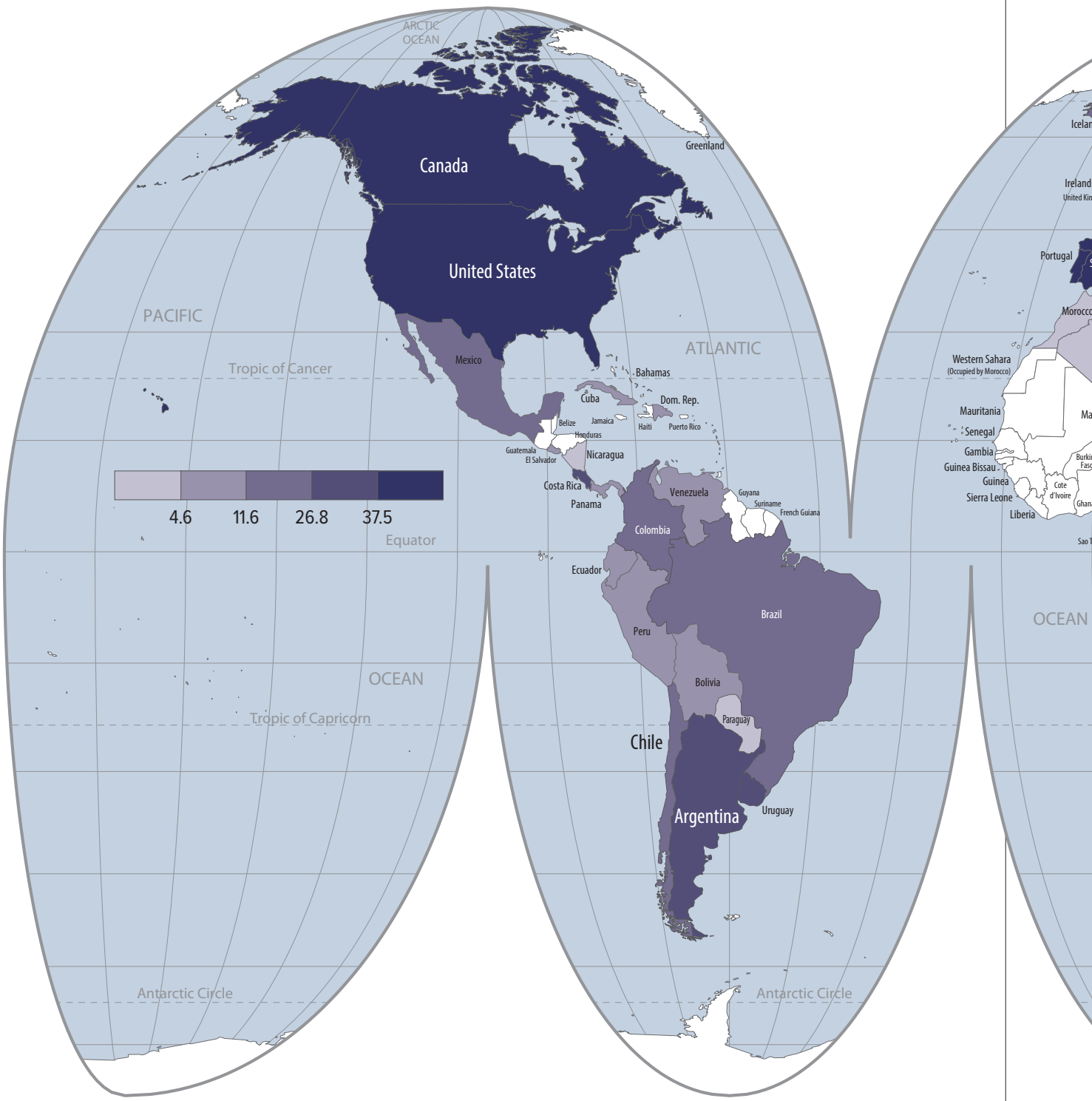
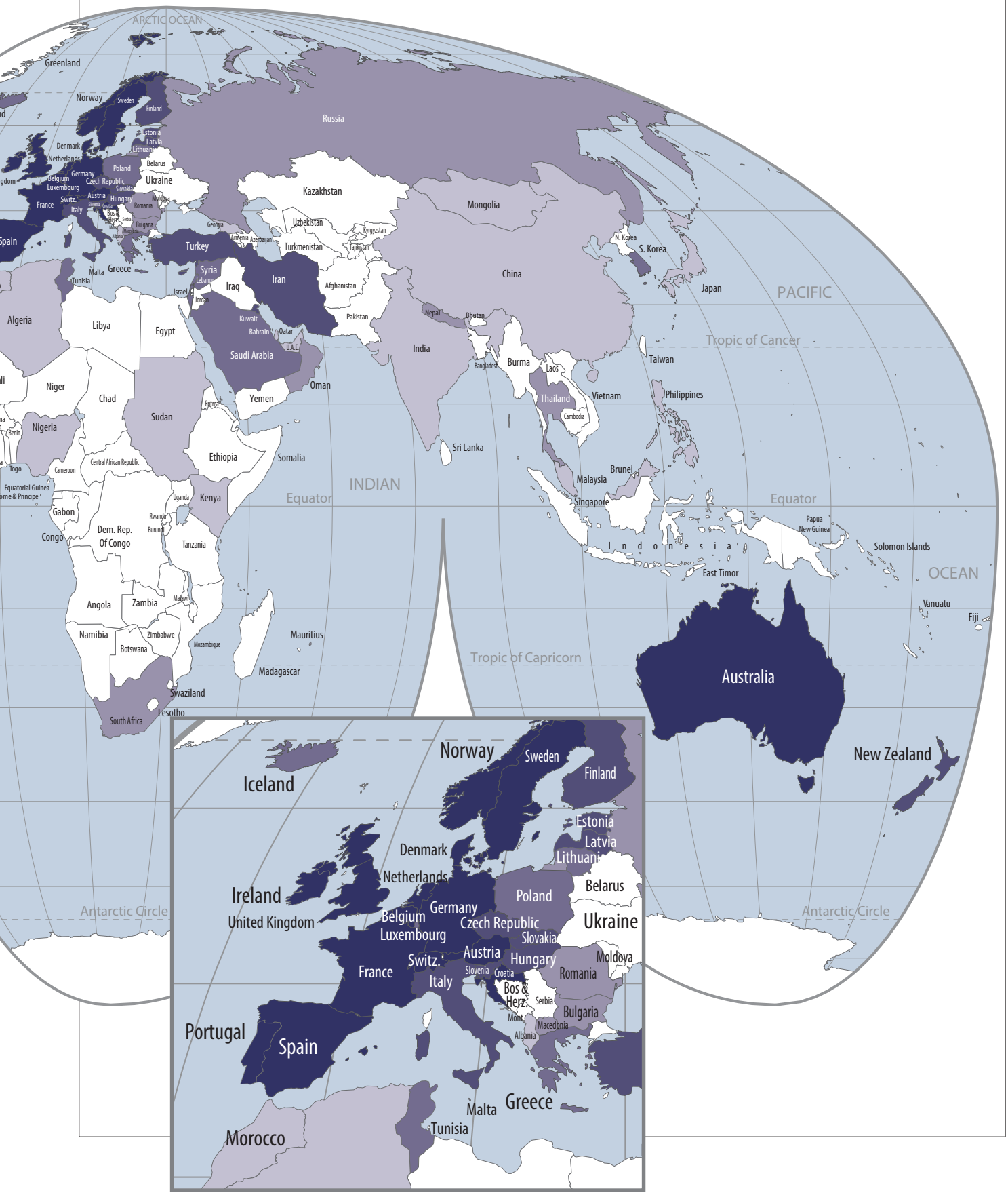
global map: kidney transplants

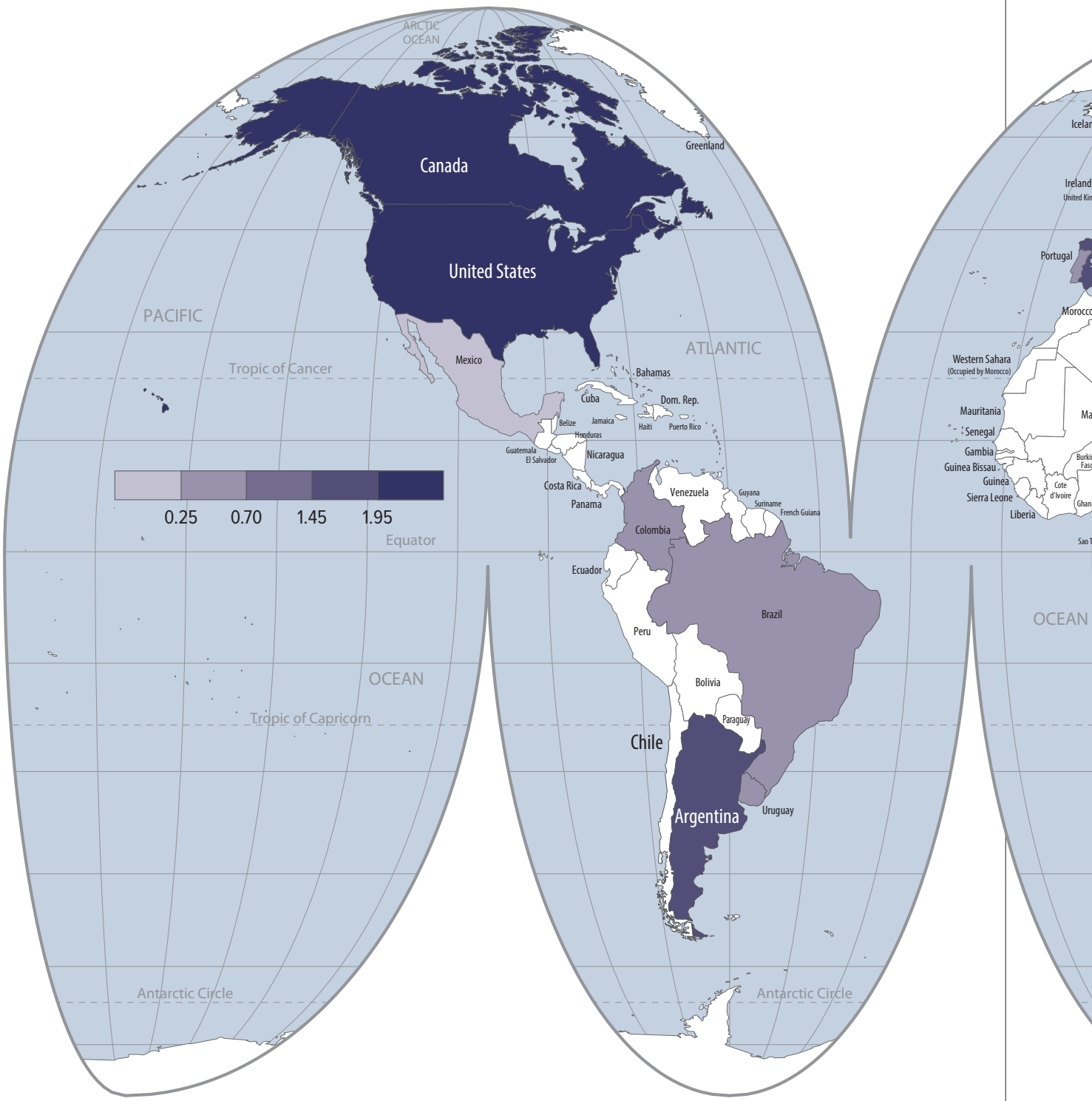


INTL 1.1 Kidney transplant rates per million population, by country, 2010

Numerator for kidney transplant rate includes kidney-alone and kidney-pancreas transplants.

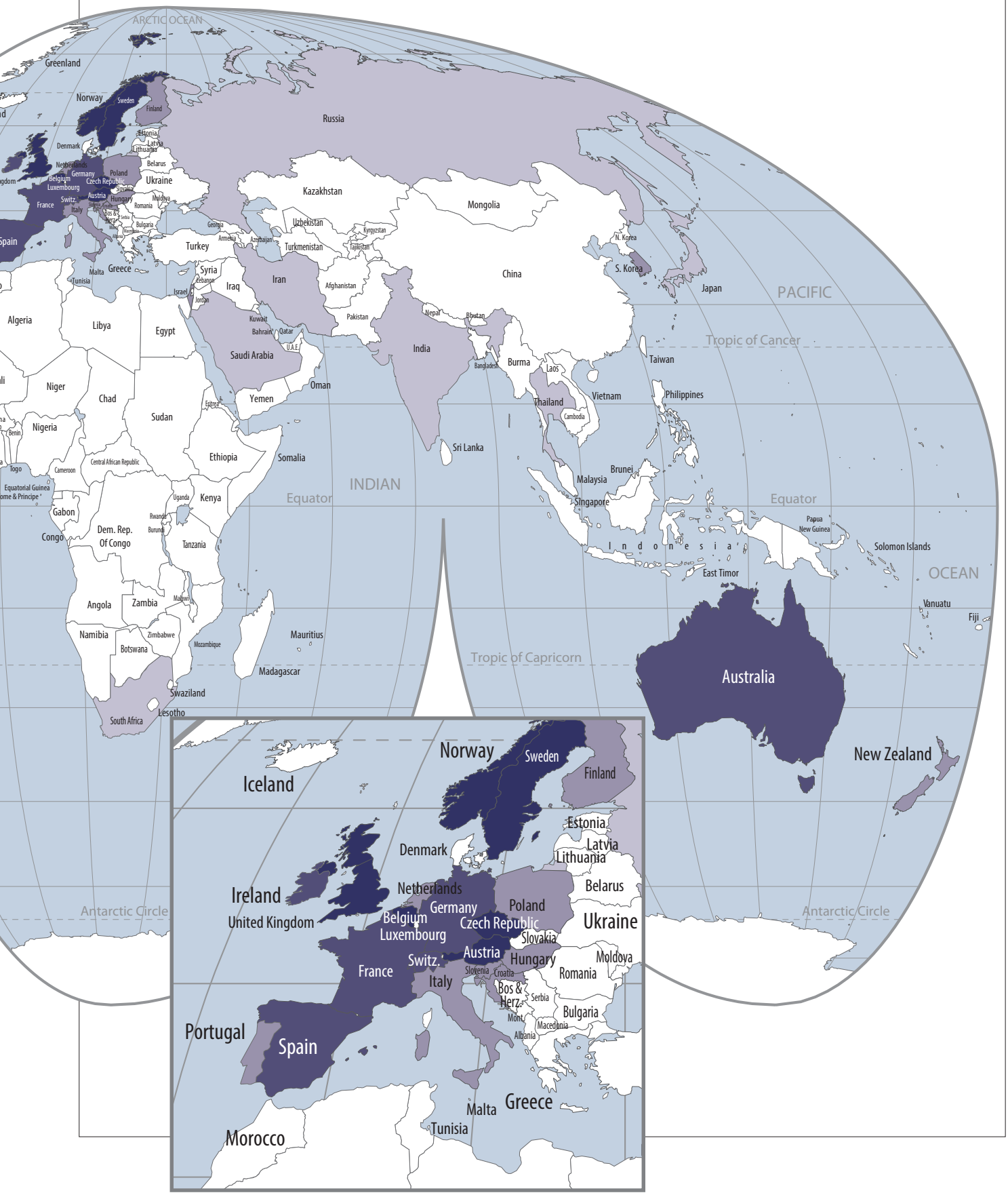

ARCTIC OCEAN
Greenland
Norway
Sweden
Finland
Russia
Estonia
Latvia
Lithuania
Denmark
Netherlands
Poland
Belarus
Ukraine
Belgium
Luxembourg
Germany
Czech Republic
Slovakia
France
Switz.
Austria
Hungary
Moldova
Romania
Italy
Slovenia
Croatia
Bos & Herz.
Serbia
Mont.
Bulgaria
Macedonia
Albania
Spain
Portugal
Turkey
Greece
Malta
Tunisia
Morocco
Algeria
Libya
Egypt
Syria
Lebanon
Israel
Jordan
Iraq
Iran
Kuwait
Bahrain
Qatar
U.A.E.
Saudi Arabia
Oman
Yemen
Kazakhstan
Uzbekistan
Turkmenistan
Kyrgyzstan
Tajikistan
Afghanistan
Pakistan
Mongolia
China
N. Korea
S. Korea
Japan
India
Nepal
Bhutan
Bangladesh
Burma
Laos
Thailand
Cambodia
Vietnam
Taiwan
Philippines
Sri Lanka
Brunei
Malaysia
Singapore
Indonesia
Papua New Guinea
East Timor
Solomon Islands
Vanuatu
Fiji
Australia
New Zealand
PACIFIC
OCEAN
INDIAN
Tropic of Cancer
Equator
Tropic of Capricorn
Antarctic Circle
Niger
Chad
Sudan
Nigeria
Benin
Togo
Cameroon
Central African Republic
Equatorial Guinea
Gabon
Congo
Dem. Rep. Of Congo
Uganda
Rwanda
Burundi
Kenya
Ethiopia
Somalia
Tanzania
Angola
Zambia
Malawi
Zimbabwe
Namibia
Botswana
Mozambique
Mauritius
Madagascar
Swaziland
Lesotho
South Africa
Iceland
Ireland
United Kingdom

global map: pancreas transplants



INTL 1.2 Pancreas transplant rates per million population, by country, 2010

Numerator for pancreas transplant rate includes pancreas-alone and kidney-pancreas transplants.


ARCTIC OCEAN
Greenland
Norway
Sweden
Finland
Russia
Estonia
Latvia
Lithuania
Denmark
Netherlands
Belarus
Belgium
Germany
Poland
Czech Republic
Ukraine
Luxembourg
Slovakia
Austria
Hungary
Moldova
France
Switz.
Italy
Romania
Bos & Herz.
Serbia
Bulgaria
Spain
Georgia
Armenia
Azerbaijan
Uzbekistan
Kyrgyzstan
Tajikistan
Turkmenistan
Turkey
Kazakhstan
Mongolia
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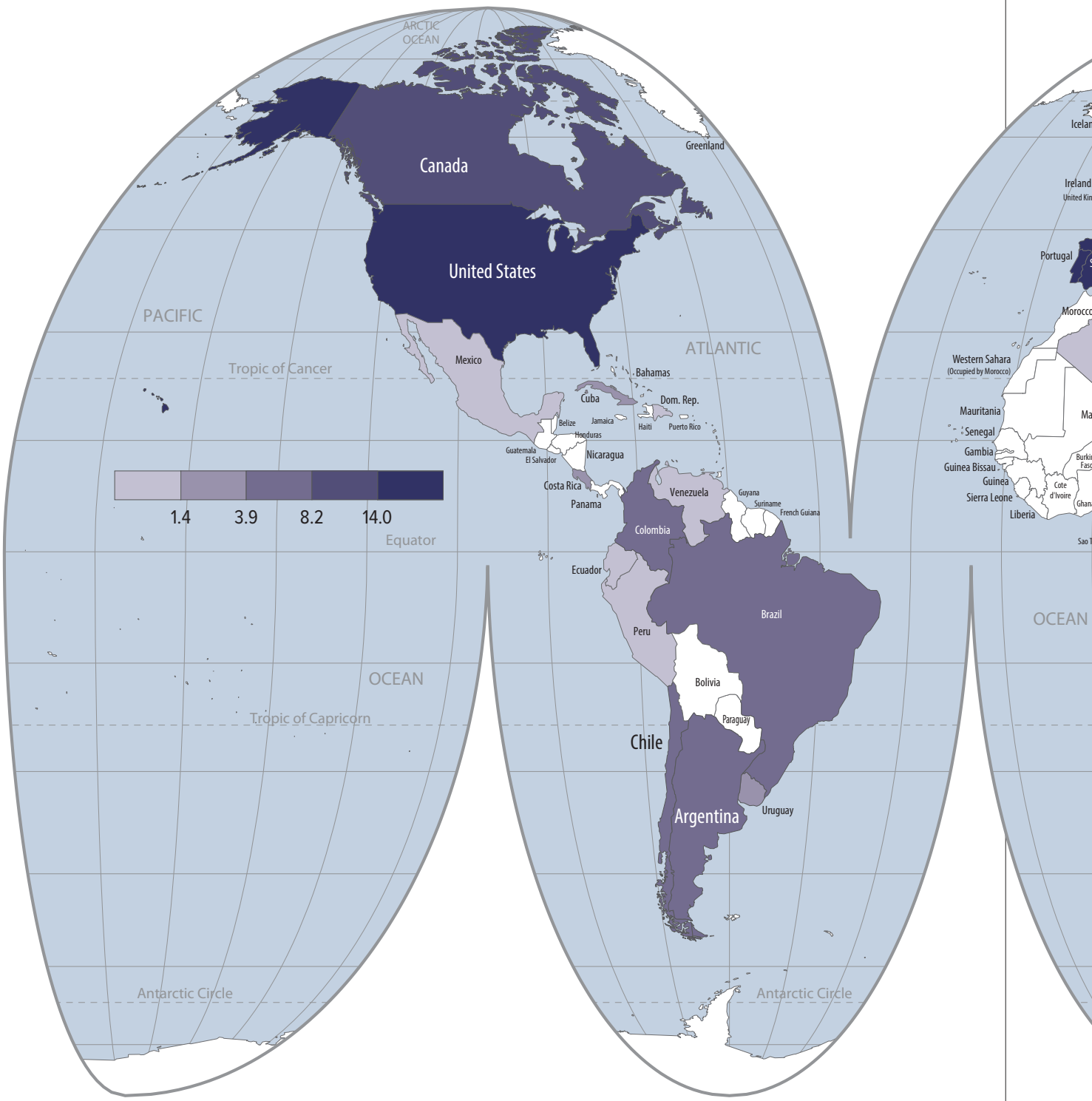
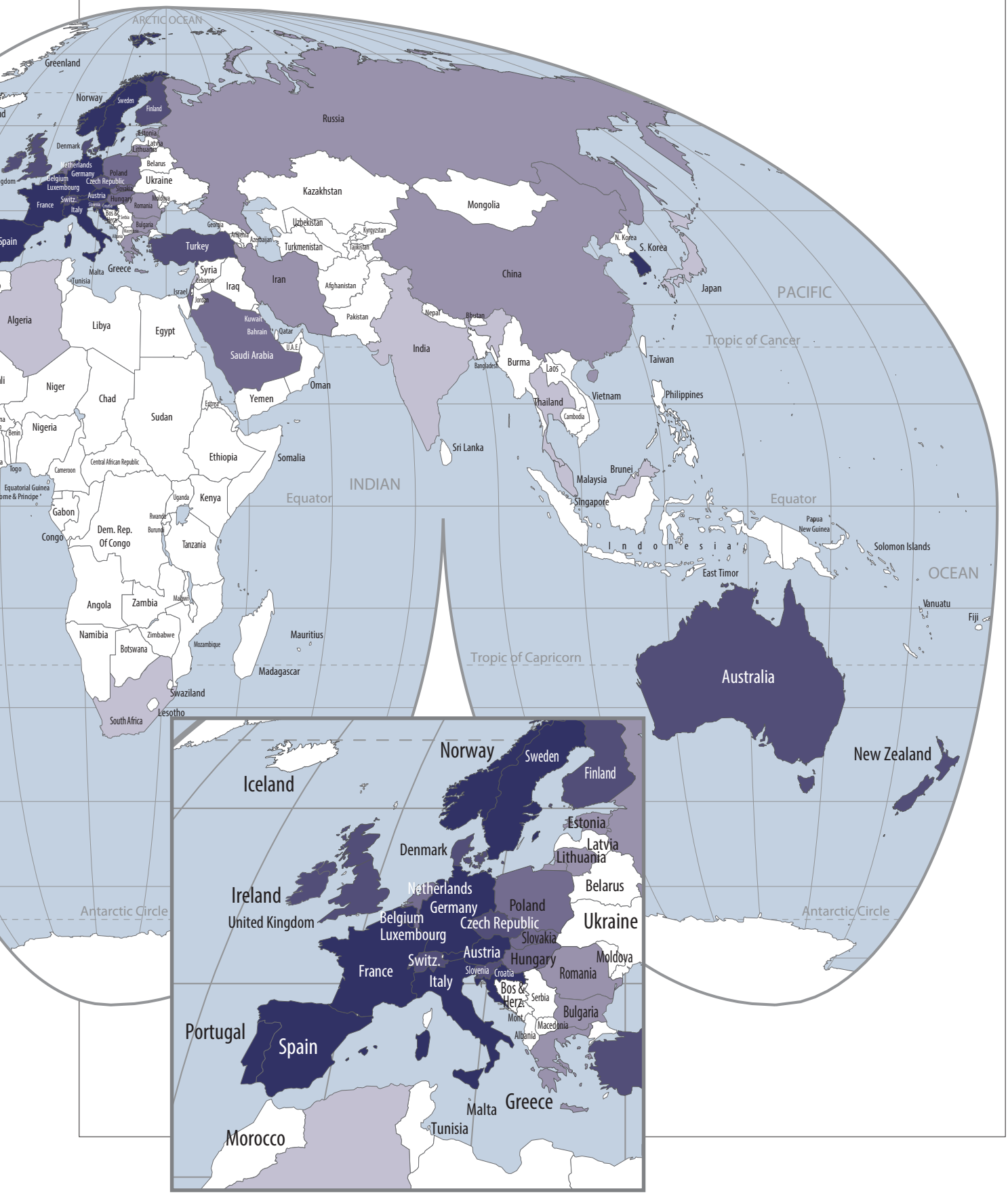
global map: liver transplants



INTL 1.3 **Liver transplant rates per million population, by country, 2010**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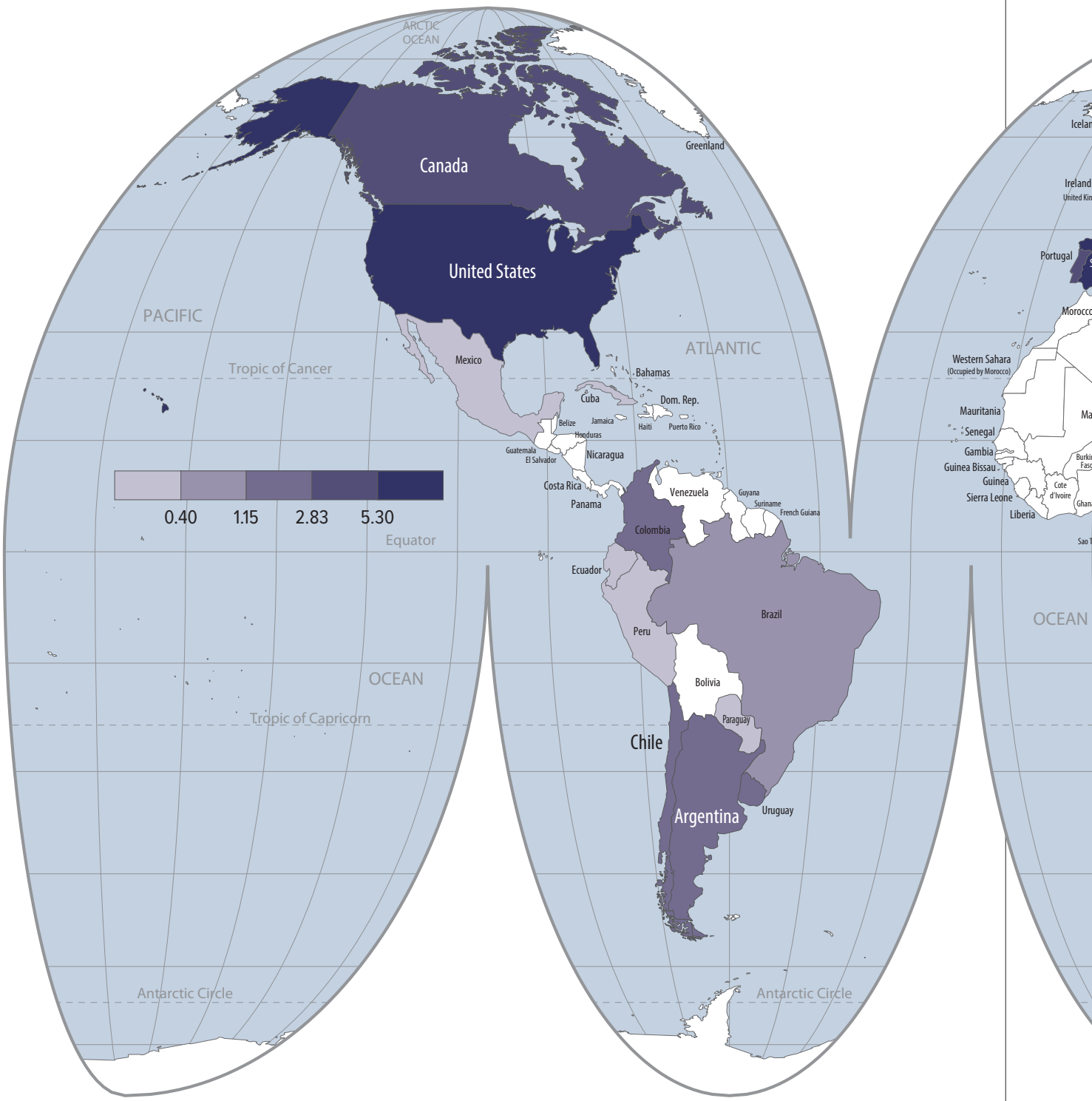
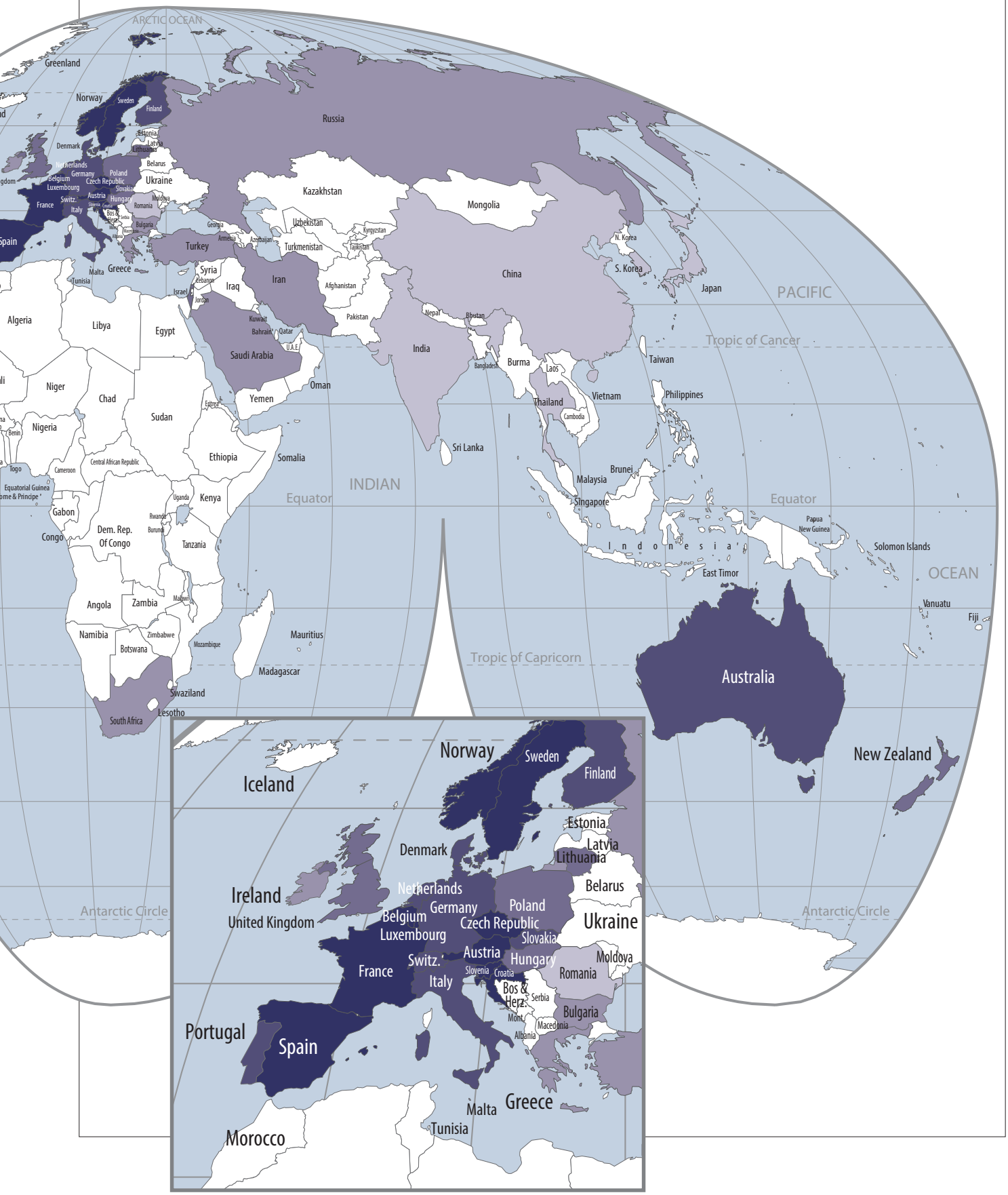
Antarctic Circle

global map: heart transplants



INTL 1.4 Heart transplant rates per million population, by country, 2010

Numerator for heart transplant rate includes heart-alone and heart-lung transplants.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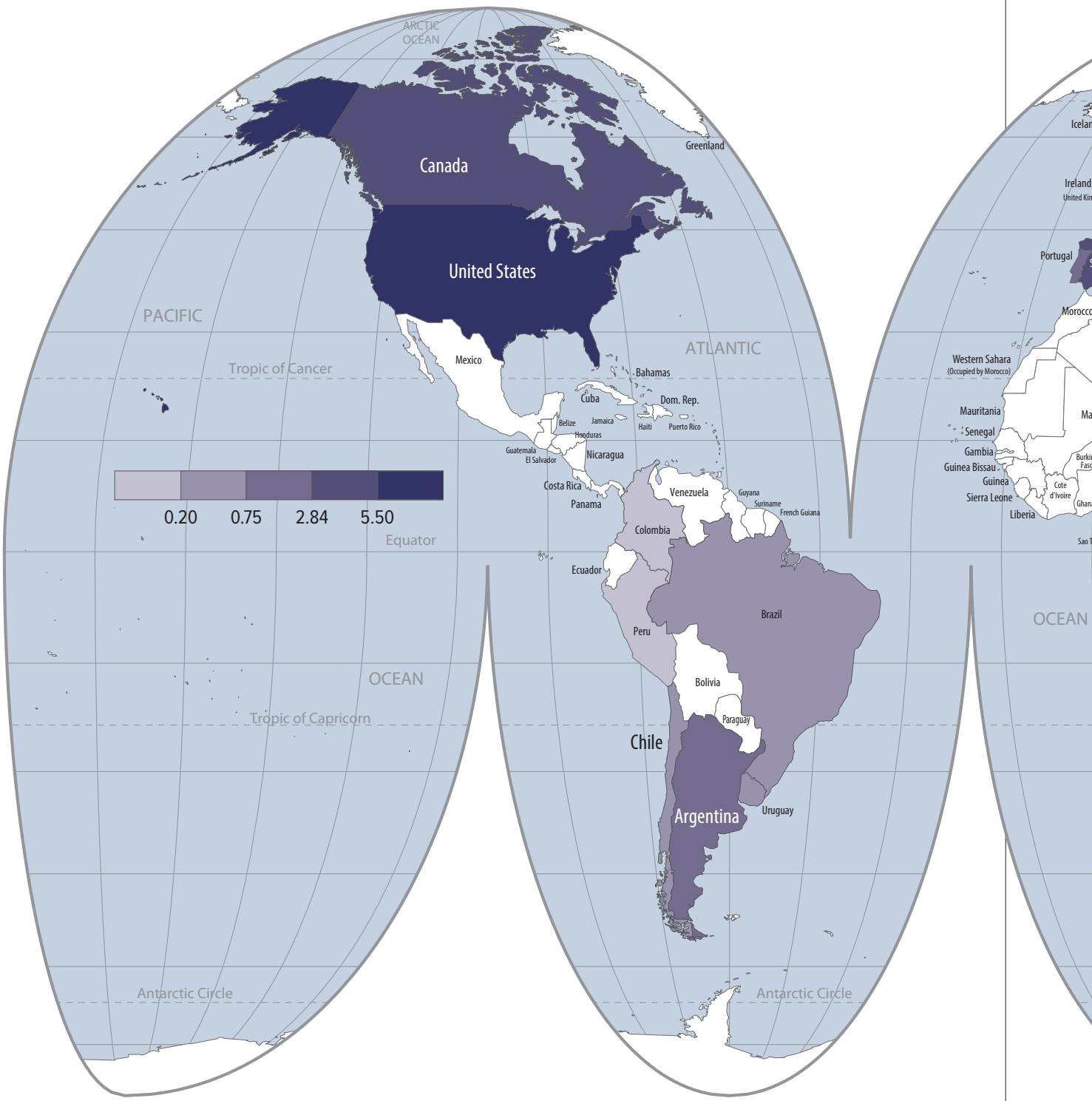
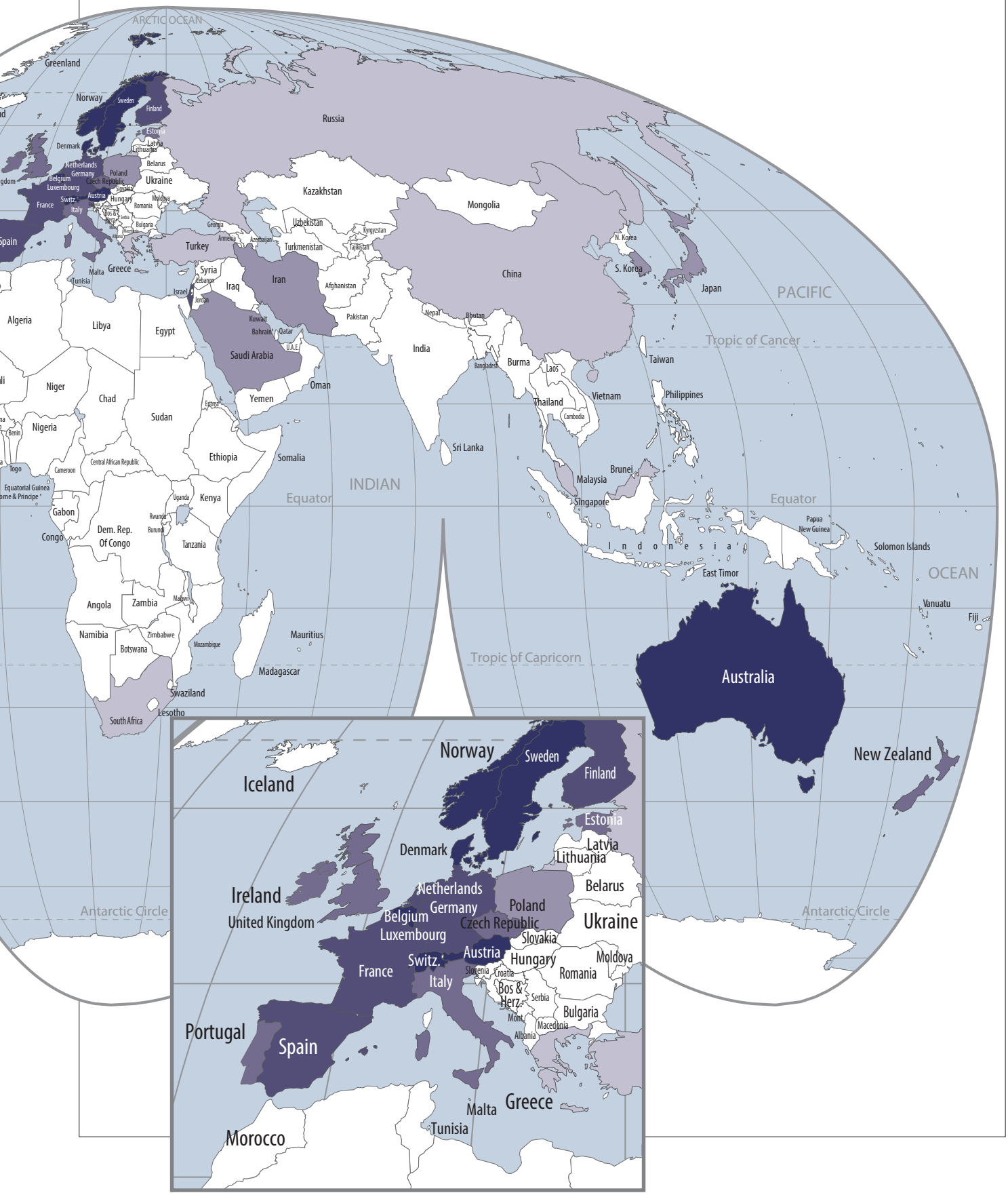
global map: lung transplants



INTL 1.5 Lung transplant rates per million population, by country, 2010

Numerator for lung transplant rate includes lung-alone and heart-lung transplants.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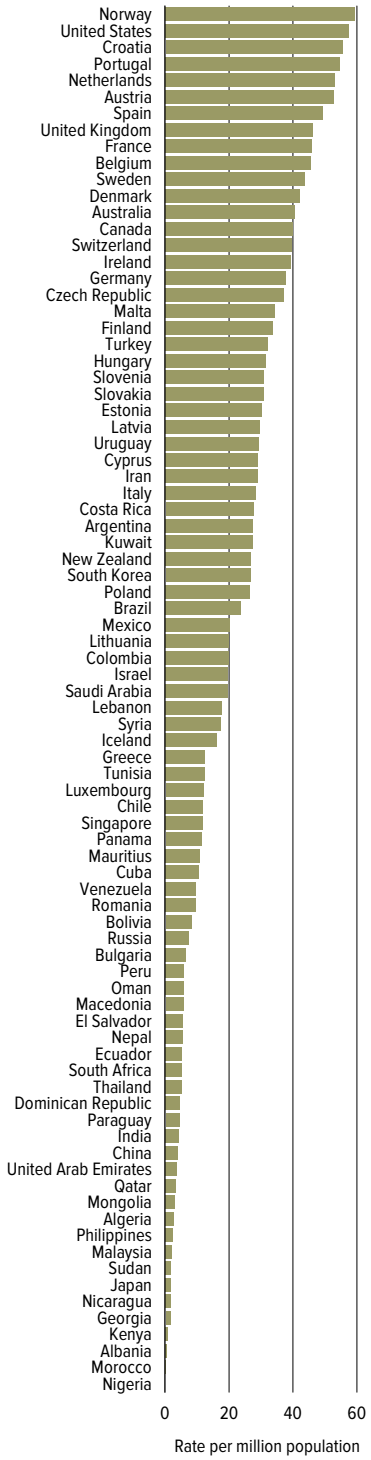
Morocco
Antarctic Circle
Antarctic Circle

kidney transplants



INTL 2.1 Kidney transplant rates by country, 2010

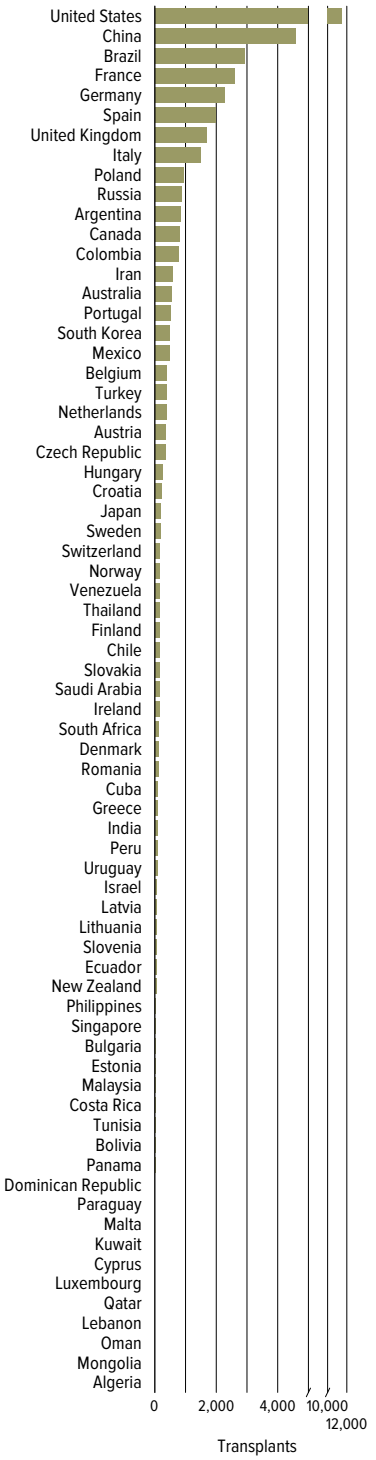
Numerator for kidney transplant rate includes kidney-alone and kidney-pancreas transplants.

	2006	2007	2008	2009	2010
Albania	.	.	.	.	0.67
Algeria	.	.	3.32	3.07	2.83
Argentina	22.19	23.35	25.62	27.33	27.57
Armenia	4.70	.	2.70	.	.
Australia	32.90	38.84	38.46	37.91	40.62
Austria	55.90	50.98	47.77	56.52	52.84
Bahrain	2.03	.	.	.	.
Bangladesh	.	.	0.19	.	.
Belgium	48.75	48.79	48.35	46.96	45.57
Bhutan	.	0.00	0.00	0.00	0.00
Bolivia	.	7.64	8.23	4.81	8.24
Brazil	18.05	16.95	19.42	21.34	23.61
Brunei	.	.	0.00	.	.
Bulgaria	4.60	3.69	2.62	4.44	6.71
Burma/ Myanmar	.	0.73	.	0.04	.
Cameroon	.	.	0.00	0.00	.
Canada	40.05	41.02	40.44	39.42	39.93
Chile	18.51	14.05	12.52	12.05	11.94
China	4.98	4.81	4.63	.	4.17
Colombia	14.53	17.98	16.46	19.58	19.91
Costa Rica	.	8.77	.	29.18	27.68
Croatia	30.70	15.36	38.29	40.76	55.50
Cuba	10.82	14.87	13.02	12.06	10.54
Cyprus	44.62	51.48	54.37	32.27	29.02
Czech Republic	40.74	40.67	34.93	39.07	37.25
Denmark	32.66	31.27	35.74	42.00	42.06
Dominican Republic	5.27	6.26	10.67	6.19	4.58
Ecuador	9.63	3.61	.	3.98	5.34
Egypt	.	.	15.53	.	.
El Salvador	13.90	6.35	4.83	.	5.62
Estonia	14.35	39.52	43.59	40.79	30.21
Ethiopia	.	.	0.00	0.00	0.00
Fiji	.	.	0.00	0.00	.
Finland	40.14	33.03	28.60	34.28	33.68
France	43.28	47.02	46.18	44.94	45.93
Georgia	1.93	.	1.51	1.73	1.74
Germany	35.27	36.76	35.02	35.13	37.74
Ghana	.	.	0.04	0.04	0.00
Greece	19.37	17.56	22.29	14.25	12.56
Guatemala	6.50	10.84	6.54	5.20	.
Honduras	.	0.53	.	.	.
Hungary	32.15	28.60	26.35	28.28	31.62
Iceland	26.72	23.18	16.43	22.82	16.19
India	.	.	4.91	4.02	4.26
Indonesia	.	2.06	2.08	.	.
Iran	25.48	25.79	25.67	28.18	28.96
Ireland	34.81	34.16	34.97	39.30	39.37
Israel	23.59	19.03	21.51	23.36	19.85
Italy	31.13	29.22	28.34	30.50	28.33
Ivory Coast	.	.	0.00	.	.
Japan	8.96	9.64	9.45	10.33	1.82
Jordan	.	1.67	30.98	.	.
Kenya	0.61	0.70	0.60	0.63	0.91
Kuwait	41.87	31.15	31.65	30.13	27.53
Kyrgyzstan	.	.	0.00	0.00	.
Latvia	32.97	32.30	24.49	31.37	29.76
Lebanon	.	20.54	.	18.30	17.94
Libya	9.13	8.27	8.89	8.86	.
Lithuania	16.73	25.73	15.43	24.75	20.03
Luxembourg	18.97	24.99	6.17	4.07	12.06
Macedonia	.	.	.	.	5.79
Malaysia	1.89	2.57	2.08	2.52	2.16
Maldives	.	.	0.00	0.00	0.00
Mali	.	.	0.00	.	.
Malta	.	.	0.00	29.62	34.42
Mauritius	.	.	.	15.57	10.82
Mexico	17.99	19.24	20.56	20.53	20.38
Moldova	.	.	0.00	0.00	0.00
Mongolia	.	.	.	0.66	3.24
Morocco	.	.	.	.	0.32
Nepal	.	.	0.75	0.56	5.53
Netherlands	41.18	51.92	47.23	50.03	53.16
New Zealand	23.47	30.01	29.95	29.19	26.81
Nicaragua	.	.	.	0.00	1.78
Nigeria	0.14	0.09	0.23	0.19	0.16
Norway	47.50	59.21	61.79	66.09	59.24
Oman	5.46	3.93	5.26	7.91	6.07
Pakistan	13.62	.	4.34	4.71	.
Panama	.	9.51	7.25	12.80	11.44
Paraguay	1.99	.	4.35	8.90	4.55
Peru	.	.	.	5.55	6.08
Philippines	7.48	12.17	6.96	5.22	2.57
Poland	23.82	18.04	21.56	20.92	26.47
Portugal	38.56	47.17	50.01	57.34	54.68
Qatar	.	.	.	2.55	3.49
Romania	9.30	10.09	10.29	8.90	9.65
Russia	.	3.73	.	.	7.58
Saudi Arabia	15.45	15.63	15.85	15.20	19.70
Senegal	.	.	0.00	.	.
Singapore	18.03	15.97	26.16	13.70	11.87
Slovakia	25.55	38.37	30.43	31.48	30.89
Slovenia	23.88	15.43	25.90	22.94	30.95
South Africa	4.65	4.32	4.53	5.97	5.29
South Korea	19.85	19.42	23.77	24.53	26.73
Spain	50.44	50.41	50.49	52.06	49.37
Sri Lanka	.	.	14.49	.	.
Sudan	1.88	1.60	1.63	2.64	1.98
Sweden	41.15	43.07	46.32	45.59	43.64
Switzerland	37.61	34.55	39.70	39.45	39.75
Syria	.	17.04	12.15	15.62	17.34
Tajikistan	.	.	0.00	0.41	.
Thailand	1.76	2.53	5.16	4.72	5.29
Tunisia	6.92	8.72	12.31	.	12.54
Turkey	12.83	17.56	21.97	30.75	32.16
United Arab Emirates	.	.	.	.	3.82
United Kingdom	36.26	39.41	42.96	44.50	46.11
United States	60.34	58.02	57.03	57.60	57.50
Uruguay	45.24	31.72	38.64	40.99	29.38
Uzbekistan	.	.	0.00	.	.
Venezuela	10.57	13.26	10.52	9.55	9.66
Vietnam	0.05	0.02	.	.	.

INTL 2.2 Kidney transplant rates per million population, by year & country

Numerator for kidney transplant rate includes kidney-alone and kidney-pancreas transplants

kidney transplants



INTL 2.3 Kidney transplant counts by country, 2010: deceased donor
Includes counts of kidney-pancreas transplants.

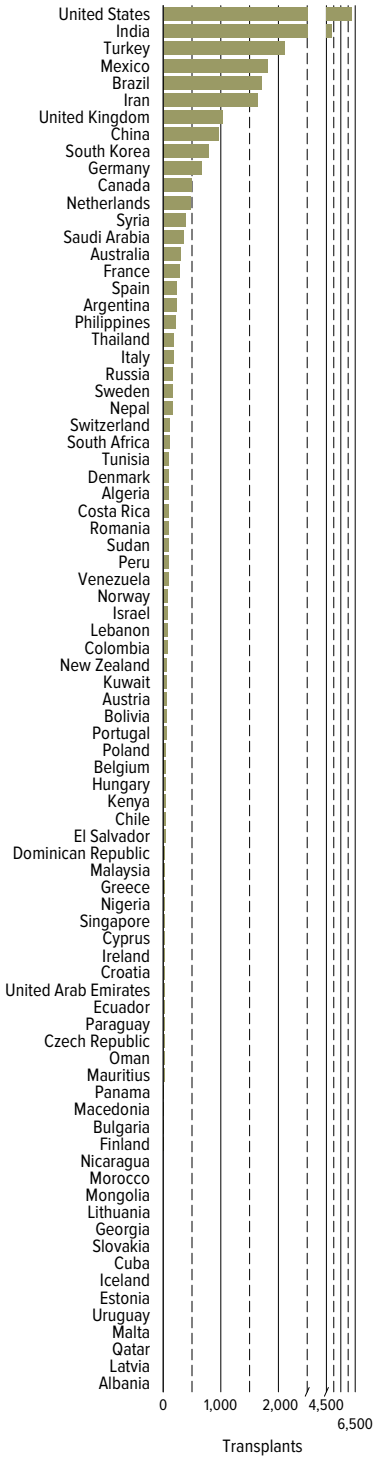
	2006	2007	2008	2009	2010
Albania	.	.	.	.	0
Algeria	.	.	.	0	2
Argentina	662	714	753	839	846
Armenia	.	.	.	.	.
Australia	368	342	424	446	548
Austria	374	336	303	363	348
Bahrain	2	.	.	.	.
Bangladesh	.	.	.	.	.
Belgium	445	449	442	428	404
Bhutan	.	0	0	0	0
Bolivia	.	23	38	31	30
Brazil	1,520	1,883	2,033	2,524	2,946
Brunei	.	.	0	.	.
Bulgaria	30	11	8	17	36
Burma/ Myanmar	.	0	.	0	.
Cameroon	.	.	0	0	.
Canada	767	819	801	814	805
Chile	263	228	206	199	163
China	5,900	4,500	3,500	.	4,577
Colombia	534	695	641	777	798
Costa Rica	.	18	.	46	32
Croatia	106	66	149	156	224
Cuba	111	150	136	130	111
Cyprus	8	18	24	15	8
Czech Republic	362	360	305	346	347
Denmark	120	115	122	141	130
Dominican Republic	0	1	7	17	16
Ecuador	.	10	.	33	60
Egypt	.	.	.	.	.
El Salvador	18	.	0	.	.
Estonia	18	47	54	49	35
Ethiopia	.	.	0	0	0
Fiji	.	.	0	0	.
Finland	207	168	141	174	164
France	2,484	2,676	2,663	2,603	2,609
Georgia	0	.	0	0	.
Germany	2,254	2,340	2,188	2,172	2,272
Ghana	.	.	.	0	0
Greece	144	101	186	116	108
Guatemala	6	36	14	12	.
Honduras	.	.	.	.	.
Hungary	296	265	235	250	265
Iceland	0	.	.	0	.
India	.	.	100	150	100
Indonesia	.	0	0	.	.
Iran	243	311	381	401	592
Ireland	142	141	136	154	151
Israel	99	59	86	93	65
Italy	1,665	1,585	1,533	1,650	1,512
Ivory Coast	.	.	0	.	.
Japan	197	187	210	189	209
Jordan	.	0	0	.	.
Kenya	.	0	0	0	0
Kuwait	28	23	26	8	10
Kyrgyzstan	.	.	0	0	.

	2006	2007	2008	2009	2010
Latvia	75	72	53	64	64
Lebanon	.	.	.	0	4
Libya	0	0	0	0	.
Lithuania	54	83	46	75	63
Luxembourg	9	12	3	2	6
Macedonia	.	.	.	.	0
Malaysia	26	27	24	35	34
Maldives	.	.	0	0	0
Mali	.	.	0	.	.
Malta	.	.	.	6	11
Mauritius	.	.	.	.	0
Mexico	505	526	562	495	484
Moldova	.	.	0	0	0
Mongolia	.	.	.	1	2
Morocco	.	.	.	.	0
Nepal	.	.	0	0	0
Netherlands	378	464	352	397	394
New Zealand	41	65	53	54	52
Nicaragua	.	.	.	0	0
Nigeria	.	0	0	0	0
Norway	132	174	180	188	180
Oman	0	0	0	0	2
Pakistan	0	.	0	0	.
Panama	.	22	12	26	26
Paraguay	2	.	6	19	11
Peru	.	.	.	158	91
Philippines	37	29	30	65	48
Poland	899	652	790	762	949
Portugal	358	446	475	531	522
Qatar	.	.	.	2	4
Romania	39	70	115	83	124
Russia	.	527	.	.	867
Saudi Arabia	151	122	166	111	156
Senegal	.	.	0	.	.
Singapore	56	46	46	41	36
Slovakia	110	195	145	153	162
Slovenia	48	30	52	43	61
South Africa	132	124	127	140	135
South Korea	263	280	481	488	491
Spain	2,055	2,074	2,073	2,093	1,985
Sri Lanka	.	.	.	.	.
Sudan	0	0	0	0	0
Sweden	234	256	283	229	202
Switzerland	159	162	170	189	180
Syria	.	0	0	0	0
Tajikistan	.	.	.	0	.
Thailand	114	164	149	155	166
Tunisia	7	14	28	.	30
Turkey	257	399	414	431	395
United Arab Emirates	.	.	.	.	.
United Kingdom	1,397	1,414	1,562	1,617	1,698
United States	11,583	11,455	11,390	11,296	11,450
Uruguay	134	96	114	123	90
Uzbekistan	.	.	0	.	.
Venezuela	118	186	178	169	179
Vietnam	0	0	.	.	.

INTL 2.4 Kidney transplant counts by year & country: deceased donor
Includes counts of kidney-pancreas transplants.

data behind the figures can be downloaded from our website, at www.srtr.org

kidney transplants

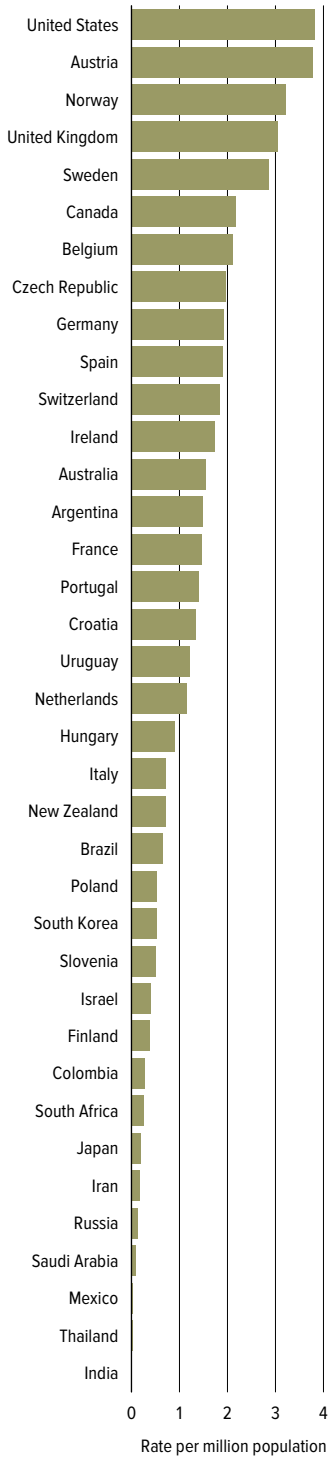


INTL 2.5 Kidney transplant counts by country, 2010: living donor
Includes counts of kidney-pancreas transplants.

	2006	2007	2008	2009	2010
Albania	.	.	.	.	2
Algeria	.	.	112	105	96
Argentina	188	153	207	212	236
Armenia	14	.	8	.	.
Australia	273	268	352	324	293
Austria	57	62	58	69	59
Bahrain	.	.	.	.	.
Bangladesh	.	.	28	.	.
Belgium	41	42	45	49	49
Bhutan	.	0	0	0	0
Bolivia	.	49	41	16	52
Brazil	1,763	1,287	1,747	1,717	1,714
Brunei	.	.	0	.	.
Bulgaria	4	16	11	15	12
Burma/ Myanmar	.	38	.	2	.
Cameroon	.	.	0	0	.
Canada	487	483	478	458	493
Chile	35	.	.	.	37
China	600	1,800	2,600	.	963
Colombia	74	63	64	70	70
Costa Rica	.	20	.	84	93
Croatia	20	0	9	14	20
Cuba	8	16	8	4	6
Cyprus	38	36	34	20	24
Czech Republic	33	34	29	27	17
Denmark	58	56	74	90	102
Dominican Republic	49	58	95	43	29
Ecuador	134	41	.	25	19
Egypt	.	.	1,200	.	.
El Salvador	65	38	29	.	34
Estonia	1	5	3	4	4
Ethiopia	.	.	0	0	0
Fiji	.	.	0	0	.
Finland	3	5	9	6	11
France	247	235	222	223	283
Georgia	9	.	7	8	8
Germany	522	567	565	600	665
Ghana	.	.	1	1	0
Greece	63	87	51	34	27
Guatemala	75	102	71	57	.
Honduras	.	4	.	.	.
Hungary	14	17	24	24	42
Iceland	8	7	5	7	5
India	.	.	5,500	4,500	4,900
Indonesia	.	484	494	.	.
Iran	1,615	1,600	1,545	1,740	1,636
Ireland	4	5	10	18	23
Israel	54	68	56	69	78
Italy	117	99	123	136	182
Ivory Coast	.	.	0	.	.
Japan	939	1,037	991	1,123	.
Jordan	.	10	190	.	.
Kenya	22	26	23	25	37
Kuwait	69	51	50	67	60
Kyrgyzstan	.	.	0	0	.
Latvia	.	1	1	6	2
Lebanon	.	80	.	75	70
Libya	54	50	55	56	.
Lithuania	6	9	5	9	8
Luxembourg	.	0	0	0	0
Macedonia	.	.	.	.	12
Malaysia	24	42	33	35	27
Maldives	.	.	0	0	0
Mali	.	.	0	.	.
Malta	.	.	0	6	3
Mauritius	.	.	.	20	14
Mexico	1,426	1,561	1,698	1,785	1,806
Moldova	.	.	0	0	0
Mongolia	.	.	.	1	8
Morocco	.	.	.	.	10
Nepal	.	.	21	16	160
Netherlands	274	360	411	417	473
New Zealand	49	58	68	67	60
Nicaragua	.	.	.	0	10
Nigeria	20	14	35	30	26
Norway	80	86	98	104	83
Oman	15	11	15	23	16
Pakistan	2,348	.	775	855	.
Panama	.	9	12	17	13
Paraguay	10	.	21	37	18
Peru	.	.	.	.	85
Philippines	653	1,117	639	446	209
Poland	18	22	20	23	50
Portugal	38	37	49	64	51
Qatar	.	.	.	2	2
Romania	165	152	112	113	88
Russia	.	0	.	.	170
Saudi Arabia	220	260	228	272	349
Senegal	.	.	0	.	.
Singapore	29	31	83	28	25
Slovakia	29	14	21	19	7
Slovenia	0	1	0	1	0
South Africa	91	85	90	142	113
South Korea	672	648	650	687	796
Spain	102	137	156	235	240
Sri Lanka	.	.	300	.	.
Sudan	74	65	68	113	87
Sweden	131	123	136	164	168
Switzerland	117	99	116	102	114
Syria	.	349	259	340	385
Tajikistan	.	.	0	3	.
Thailand	.	.	189	156	185
Tunisia	63	75	99	.	102
Turkey	685	911	1,248	1,931	2,107
United Arab Emirates	.	.	.	.	19
United Kingdom	671	804	924	983	1,026
United States	6,435	6,043	5,968	6,388	6,277
Uruguay	8	6	7	7	3
Uzbekistan	.	.	0	.	.
Venezuela	153	159	100	87	84
Vietnam	4	2	.	.	.

INTL 2.6 Kidney transplant counts by year & country: living donor
Includes counts of kidney-pancreas transplants.

pancreas transplants

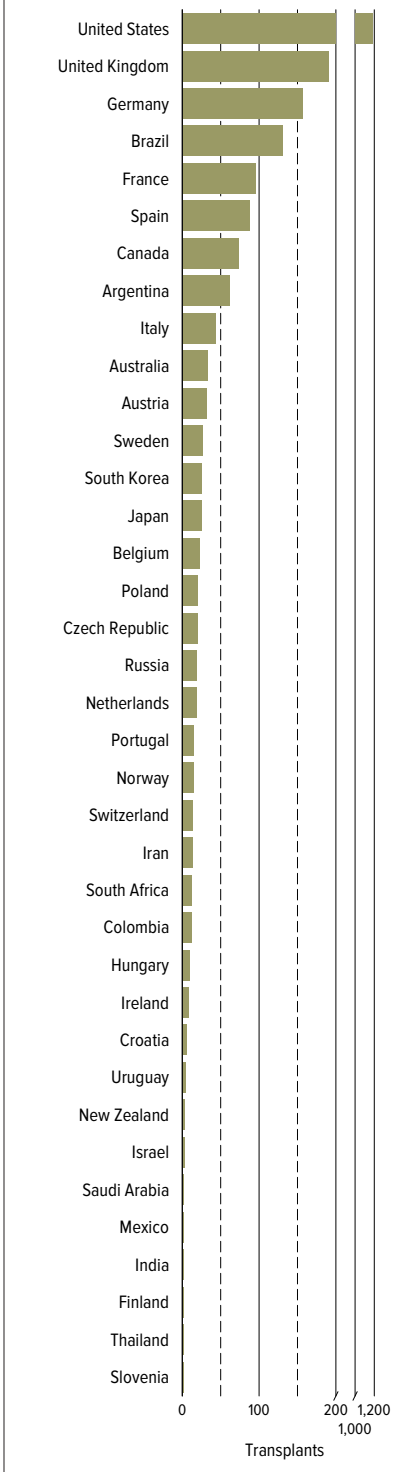


INTL 3.1 Pancreas transplant rates by country, 2010
Numerator for pancreas transplant rate includes pancreas-alone and kidney-pancreas transplants.

	2006	2007	2008	2009	2010
Albania	.	.	.	.	0.00
Algeria	.	.	.	0.00	0.00
Argentina	0.73	1.75	2.10	1.71	1.48
Australia	1.66	11.90	1.52	1.74	1.53
Austria	4.76	3.05	4.14	4.02	3.77
Bahrain	0.00	.	.	.	.
Bangladesh	.	.	0.00	.	.
Belgium	2.31	1.73	1.73	2.40	2.11
Bhutan	.	0.00	.	0.00	0.00
Brazil	0.90	0.92	0.16	.	0.65
Bulgaria	.	0.00	0.00	0.00	0.00
Burma/ Myanmar	.	0.00	.	.	.
Cameroon	.	.	0.00	0.00	.
Canada	2.76	2.22	2.56	2.09	2.16
Chile	0.06	0.06	.	0.06	.
Colombia	0.07	0.19	0.12	0.23	0.27
Costa Rica	.	.	.	0.00	0.00
Croatia	2.89	0.67	3.12	2.90	1.34
Cuba	0.18	.	0.09	.	.
Czech Republic	2.44	2.64	2.54	2.74	1.96
Denmark	0.00	.	.	0.00	.
El Salvador	.	.	0.00	.	.
Ethiopia	.	.	0.00	0.00	0.00
Fiji	.	.	.	0.00	.
Finland	.	.	.	0.00	0.38
France	1.42	1.48	1.26	1.32	1.47
Georgia	.	.	0.00	0.00	.
Germany	1.70	1.64	1.63	1.36	1.92
Ghana	.	.	.	0.00	0.00
Greece	.	.	0.19	0.28	.
Hungary	1.29	0.50	0.50	0.90	0.90
Iceland	.	.	.	0.00	.
India	.	.	.	.	0.00
Indonesia	.	0.00	0.00	.	.
Iran	0.10	0.42	0.17	0.21	0.17
Ireland	0.93	1.13	2.66	1.97	1.73
Israel	1.60	1.14	1.55	0.97	0.41
Italy	1.47	1.29	0.98	1.16	0.71
Ivory Coast	.	.	0.00	.	.
Japan	0.07	0.09	0.08	0.06	0.20
Jordan	.	.	0.00	.	.
Kenya	.	0.00	0.00	0.00	0.00
Kuwait	0.00	.	0.41	0.00	0.00
Kyrgyzstan	.	.	.	0.00	.
Latvia	.	0.00	0.45	0.00	0.00
Lebanon	.	.	.	0.00	0.00
Libya	.	0.00	0.00	0.00	.
Lithuania	.	.	1.12	1.13	0.00
Luxembourg	.	.	0.00	.	0.00
Macedonia	.	.	.	.	0.00
Malaysia	0.00	0.00	0.00	0.00	0.00
Maldives	.	.	.	0.00	0.00
Malta	.	.	.	0.00	0.00
Mauritius	.	.	.	.	0.00
Mexico	0.02	0.04	0.01	0.03	0.02
Moldova	.	.	0.00	0.00	0.00
Mongolia	.	.	.	.	0.00
Morocco	.	.	.	.	0.00
Nepal	.	.	0.00	0.00	0.00
Netherlands	1.41	1.71	0.85	1.21	1.15
New Zealand	1.47	0.24	0.96	0.48	0.71
Nicaragua	.	.	.	0.00	0.00
Nigeria	.	0.00	0.00	0.00	0.00
Norway	2.17	3.03	2.15	3.43	3.21
Oman	0.00	.	0.00	0.00	0.00
Pakistan	0.00	.	0.00	0.00	.
Paraguay	.	.	0.00	.	.
Peru	.	.	.	0.04	.
Philippines	.	.	.	.	0.00
Poland	0.96	0.55	0.52	0.52	0.52
Portugal	1.23	1.79	1.31	1.87	1.40
Qatar	.	.	.	0.00	0.00
Romania	0.09	0.05	0.00	0.00	0.00
Russia	.	.	.	.	0.14
Saudi Arabia	0.08	0.04	0.04	0.16	0.08
Senegal	.	.	0.00	.	.
Singapore	.	0.00	.	.	.
Slovakia	0.00	0.00	0.00	0.00	0.00
Slovenia	.	.	.	1.00	0.50
South Africa	0.19	0.21	0.08	0.22	0.24
South Korea	0.60	0.37	0.46	0.45	0.51
Spain	2.03	1.62	2.27	2.10	1.89
Sudan	0.00	0.00	0.00	0.00	0.00
Sweden	0.67	1.11	.	2.21	2.87
Switzerland	1.33	.	2.24	1.32	1.84
Syria	.	0.00	0.00	0.00	0.00
Thailand	0.00	0.02	0.00	0.00	0.02
Tunisia	0.00	0.00	0.00	.	0.00
Turkey	0.10	0.12	0.13	0.23	.
United Kingdom	2.68	4.03	3.50	3.34	3.05
United States	4.66	4.42	4.18	4.00	3.82
Uruguay	1.83	0.61	1.83	1.52	1.21
Venezuela	.	.	0.00	0.00	0.00
Vietnam	0.00	0.00	.	.	.

INTL 3.2 Pancreas transplant rates per million population, by year & country
Numerator for pancreas transplant rate includes pancreas-alone and kidney-pancreas transplants.

pancreas transplants



INTL 3.3 Pancreas transplant counts by country, 2010
Includes counts of kidney-pancreas transplants.

	2006	2007	2008	2009	2010
Albania	.	.	.	.	0
Algeria	.	.	.	0	0
Argentina	29	70	85	70	61
Australia	34	247	32	37	33
Austria	39	25	34	33	31
Bahrain	0	.	.	.	.
Bangladesh	.	.	0	.	.
Belgium	24	18	18	25	22
Bhutan	.	0	.	0	0
Brazil	173	178	32	.	131
Bulgaria	.	0	0	0	0
Burma/ Myanmar	.	0	.	.	.
Cameroon	.	.	0	0	.
Canada	90	73	85	70	73
Chile	1	1	.	1	.
Colombia	3	8	5	10	12
Costa Rica	.	.	.	0	0
Croatia	13	3	14	13	6
Cuba	2	.	1	.	.
Czech Republic	25	27	26	28	20
Denmark	0	.	.	0	.
El Salvador	.	.	0	.	.
Ethiopia	.	.	0	0	0
Fiji	.	.	.	0	.
Finland	.	.	.	0	2
France	90	94	81	85	95
Georgia	.	.	0	0	.
Germany	140	135	134	111	157
Ghana	.	.	.	0	0
Greece	.	.	2	3	.
Hungary	13	5	5	9	9
Iceland	.	.	.	0	.
India	.	.	.	.	2
Indonesia	.	0	0	.	.
Iran	7	31	13	16	13
Ireland	4	5	12	9	8
Israel	11	8	11	7	3
Italy	87	77	59	70	43
Ivory Coast	.	.	0	.	.
Japan	9	12	10	7	25
Jordan	.	.	0	.	.
Kenya	.	0	0	0	0
Kuwait	0	.	1	0	0
Kyrgyzstan	.	.	.	0	.
Latvia	.	0	1	0	0
Lebanon	.	.	.	0	0
Libya	.	0	0	0	.
Lithuania	.	.	4	4	0
Luxembourg	.	.	0	.	0
Macedonia	.	.	.	.	0
Malaysia	0	0	0	0	0
Maldives	.	.	.	0	0
Malta	.	.	.	0	0
Mauritius	.	.	.	.	0
Mexico	2	4	1	3	2
Moldova	.	.	0	0	0
Mongolia	.	.	.	.	0
Morocco	.	.	.	.	0
Nepal	.	.	0	0	0
Netherlands	23	28	14	20	19
New Zealand	6	1	4	2	3
Nicaragua	.	.	.	0	0
Nigeria	.	0	0	0	0
Norway	10	14	10	16	15
Oman	0	.	0	0	0
Pakistan	0	.	0	0	.
Paraguay	.	.	0	.	.
Peru	.	.	.	1	.
Philippines	.	.	.	.	0
Poland	37	21	20	20	20
Portugal	13	19	14	20	15
Qatar	.	.	.	0	0
Romania	2	1	0	0	0
Russia	.	.	.	.	19
Saudi Arabia	2	1	1	4	2
Senegal	.	.	0	.	.
Singapore	.	0	.	.	.
Slovakia	0	0	0	0	0
Slovenia	.	.	.	2	1
South Africa	9	10	4	11	12
South Korea	29	18	22	22	25
Spain	90	73	104	97	88
Sudan	0	0	0	0	0
Sweden	6	10	.	20	26
Switzerland	10	.	17	10	14
Syria	.	0	0	0	0
Thailand	0	1	0	0	1
Tunisia	0	0	0	.	0
Turkey	7	9	10	18	.
United Kingdom	163	247	216	207	190
United States	1,390	1,332	1,271	1,229	1,177
Uruguay	6	2	6	5	4
Venezuela	.	.	0	0	0
Vietnam	0	0	.	.	.

INTL 3.4 Pancreas transplant counts by year & country
Includes counts of kidney-pancreas transplants.

liver transplants

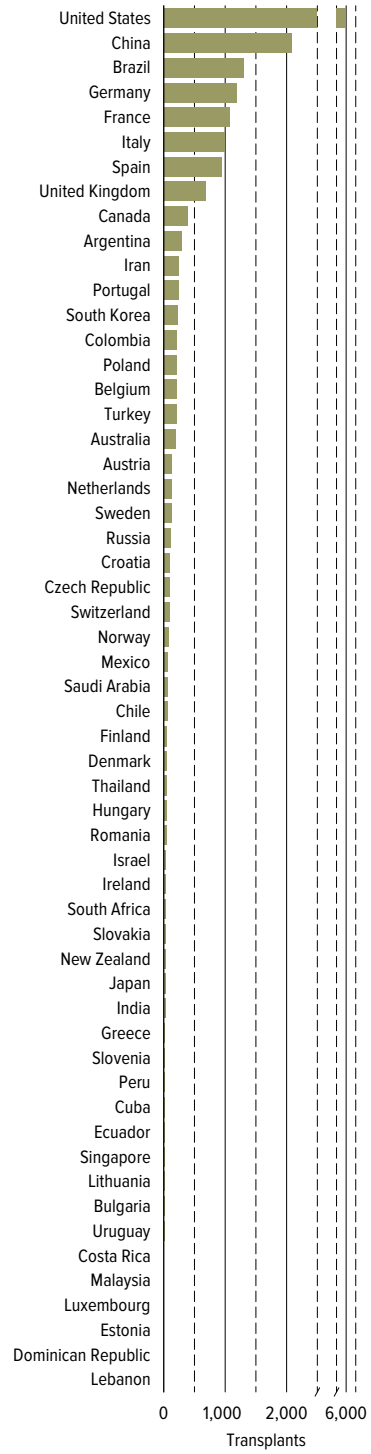
INTL 4.1 **Liver transplant rates by country, 2010**

	2006	2007	2008	2009	2010
Albania	.	.	.	.	0.00
Algeria	.	.	0.09	0.15	0.17
Argentina	5.96	6.69	6.92	6.48	7.79
Australia	8.00	7.28	9.28	8.80	9.67
Austria	16.97	14.51	14.14	18.64	17.17
Bahrain	0.00	.	.	.	.
Bangladesh	.	.	0.00	.	.
Belgium	22.74	25.69	22.11	23.53	23.31
Bhutan	.	0.00	.	0.00	0.00
Brazil	5.33	5.04	5.36	6.02	6.98
Bulgaria	1.35	0.96	1.24	1.80	2.10
Burma/ Myanmar	.	0.02	.	0.02	.
Cameroon	.	.	0.00	0.00	.
Canada	14.33	14.63	13.64	13.53	13.42
Chile	5.33	4.60	4.50	4.16	4.00
China	1.88	1.53	1.51	.	1.61
Colombia	4.04	4.53	4.59	5.61	4.98
Costa Rica	.	.	.	3.59	1.77
Croatia	10.90	5.12	14.47	13.81	23.40
Cuba	2.59	3.50	2.52	2.25	1.98
Czech Republic	9.67	11.24	9.49	9.99	10.00
Denmark	6.61	7.86	8.02	7.27	8.52
Dominican Republic	.	.	0.11	0.21	0.31
Ecuador	.	.	.	0.07	1.22
El Salvador	.	.	0.00	.	.
Estonia	.	1.52	1.53	3.08	2.32
Ethiopia	.	.	0.00	0.00	0.00
Fiji	.	.	.	0.00	.
Finland	10.13	10.12	8.96	9.14	9.52
France	16.38	16.66	15.78	16.25	16.86
Georgia	.	1.94	0.00	0.00	.
Germany	12.91	14.06	12.50	14.41	15.70
Ghana	.	.	.	0.00	0.00
Greece	2.53	2.99	5.41	3.07	2.33
Hungary	4.68	4.09	3.59	4.00	4.30
Iceland	.	.	.	0.00	.
India	.	.	0.22	0.39	0.26
Indonesia	.	0.00	0.01	.	.
Iran	1.48	2.19	2.47	2.66	3.89
Ireland	.	13.35	12.84	13.97	8.22
Israel	8.45	6.15	7.87	7.05	6.26
Italy	18.96	17.93	16.89	17.80	16.69
Ivory Coast	.	.	0.00	.	.
Japan	3.99	3.47	3.73	3.69	0.24
Jordan	.	0.00	3.26	.	.
Kenya	.	0.00	0.00	0.00	0.00
Kuwait	0.00	.	0.41	0.00	0.00
Kyrgyzstan	.	.	.	0.00	.
Latvia	.	0.00	0.00	0.00	0.00

	2006	2007	2008	2009	2010
Lebanon	.	.	.	0.00	0.24
Libya	1.69	0.99	0.32	0.00	.
Lithuania	0.84	2.52	1.68	1.97	3.67
Luxembourg	.	0.00	0.00	0.00	6.03
Macedonia	.	.	.	.	0.00
Malaysia	0.30	0.26	0.18	0.22	0.14
Maldives	.	.	0.00	0.00	0.00
Mali	.	.	0.00	.	.
Malta	.	.	.	22.21	0.00
Mauritius	.	.	.	.	0.00
Mexico	0.96	0.91	0.87	0.71	0.71
Moldova	.	.	0.00	0.00	0.00
Mongolia	.	.	.	.	0.00
Morocco	.	.	.	.	0.00
Nepal	.	.	0.00	0.00	0.00
Netherlands	6.01	9.11	7.98	8.01	8.15
New Zealand	6.85	8.23	5.75	9.73	8.47
Nicaragua	.	.	.	0.00	0.00
Nigeria	0.00	0.00	0.00	0.00	0.00
Norway	13.45	15.56	17.01	17.60	19.03
Oman	0.00	.	0.00	0.00	0.00
Pakistan	0.00	.	0.00	0.00	.
Paraguay	.	.	0.00	.	.
Peru	.	.	.	0.45	0.76
Philippines	0.02	0.02	.	.	0.00
Poland	5.19	5.09	6.36	6.13	6.16
Portugal	21.22	24.90	25.66	23.81	22.82
Qatar	.	.	.	0.00	0.00
Romania	0.90	1.72	1.95	1.45	2.32
Russia	.	0.00	.	.	1.50
Saudi Arabia	3.57	3.80	3.89	4.30	3.96
Senegal	.	.	0.00	.	.
Singapore	2.55	3.32	10.14	4.96	5.06
Slovakia	0.00	0.00	2.20	4.39	6.03
Slovenia	3.98	4.98	10.96	8.97	11.48
South Africa	0.46	0.74	0.59	0.75	0.73
South Korea	14.09	15.38	19.68	20.99	21.71
Spain	23.65	24.60	24.13	23.74	20.88
Sudan	0.00	0.00	0.00	0.00	0.00
Sweden	14.09	15.06	16.14	16.12	15.10
Switzerland	12.49	11.52	10.95	13.41	13.12
Syria	.	0.00	0.00	0.00	0.00
Tajikistan	.	.	0.00	.	.
Thailand	0.37	0.48	0.76	0.83	0.95
Tunisia	0.49	0.39	0.39	.	0.00
Turkey	4.33	6.46	7.94	7.72	8.93
United Kingdom	10.62	10.51	11.66	11.05	11.42
United States	22.27	21.53	20.76	20.59	20.41
Uruguay	.	1.22	0.91	3.04	3.64
Venezuela	0.23	0.38	0.38	0.45	0.29
Vietnam	0.07	0.07	.	.	.

INTL 4.2 **Liver transplant rates per million population, by year & country**

liver transplants

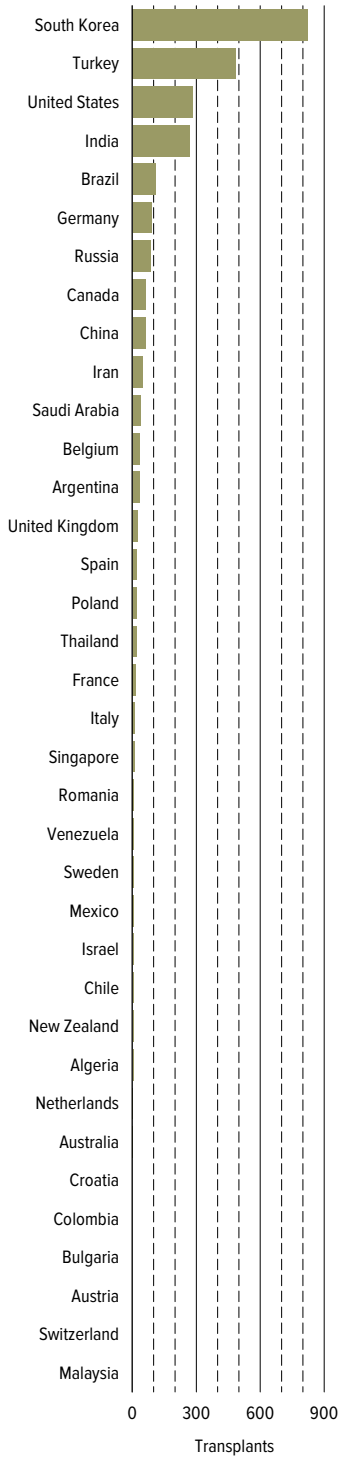


INTL 4.3 Liver transplant counts by country, 2010: deceased donor

	2006	2007	2008	2009	2010
Albania	.	.	.	.	0
Algeria	.	.	.	0	0
Argentina	236	247	247	245	289
Australia	161	147	192	185	204
Austria	137	116	112	146	139
Bahrain	0	.	.	.	.
Bangladesh	.	.	0	.	.
Belgium	218	241	217	222	210
Bhutan	.	0	.	0	0
Brazil	1,020	864	1,053	1,197	1,295
Bulgaria	9	6	5	9	13
Burma/ Myanmar	.	1	.	.	.
Cameroon	.	.	0	0	.
Canada	401	411	385	396	389
Chile	86	75	74	69	60
China	2,400	1,550	1,500	.	2,082
Colombia	170	193	198	237	218
Costa Rica	.	.	.	15	8
Croatia	45	23	64	60	103
Cuba	29	39	28	23	22
Czech Republic	98	115	97	102	102
Denmark	36	43	44	40	47
Dominican Republic	.	.	1	2	3
Ecuador	.	.	.	1	18
El Salvador	.	.	0	.	.
Estonia	.	2	2	4	3
Ethiopia	.	.	0	0	0
Fiji	.	.	.	0	.
Finland	53	53	47	48	50
France	1,001	1,043	1,001	1,035	1,075
Georgia	.	.	0	0	.
Germany	980	1,096	971	1,119	1,192
Ghana	.	.	.	0	0
Greece	27	32	58	33	25
Hungary	45	40	36	40	43
Iceland	.	.	.	0	.
India	.	.	40	50	30
Indonesia	.	0	0	.	.
Iran	97	148	147	168	251
Ireland	.	59	58	64	38
Israel	53	37	54	47	39
Italy	1,091	1,041	996	1,061	1,002
Ivory Coast	.	.	0	.	.
Japan	5	10	13	7	30
Jordan	.	0	0	.	.
Kenya	.	0	0	0	0
Kuwait	0	.	1	0	0
Kyrgyzstan	.	.	.	0	.
Latvia	.	0	0	0	0
Lebanon	.	.	.	0	1
Libya	0	0	0	0	.
Lithuania	3	8	6	7	13
Luxembourg	.	0	0	0	3
Macedonia	.	.	.	.	0
Malaysia	4	4	4	6	3
Maldives	.	.	0	0	0
Mali	.	.	0	.	.
Malta	.	.	.	9	0
Mauritius	.	.	.	.	0
Mexico	92	87	88	73	72
Moldova	.	.	0	0	0
Mongolia	.	.	.	.	0
Morocco	.	.	.	.	0
Nepal	.	.	0	0	0
Netherlands	94	147	129	129	131
New Zealand	24	30	17	33	30
Nicaragua	.	.	.	0	0
Nigeria	.	0	0	0	0
Norway	62	72	79	82	89
Oman	0	.	0	0	0
Pakistan	0	.	0	0	.
Paraguay	.	.	0	.	.
Peru	.	.	.	9	22
Philippines	2	2	.	.	0
Poland	180	178	224	214	217
Portugal	223	263	269	254	245
Qatar	.	.	.	0	0
Romania	17	31	35	29	42
Russia	.	0	.	.	121
Saudi Arabia	49	54	59	51	62
Senegal	.	.	0	.	.
Singapore	7	12	17	17	15
Slovakia	0	0	12	24	33
Slovenia	8	10	22	18	23
South Africa	22	36	29	37	36
South Korea	118	122	227	236	232
Spain	1,033	1,087	1,080	1,070	951
Sudan	0	0	0	0	0
Sweden	121	132	140	144	129
Switzerland	86	79	71	95	99
Syria	.	0	0	0	0
Tajikistan	.	.	0	.	.
Thailand	24	27	45	55	44
Tunisia	2	3	4	.	0
Turkey	114	209	212	229	209
United Kingdom	634	627	683	660	688
United States	6,363	6,228	6,070	6,101	6,009
Uruguay	.	3	3	10	12
Venezuela	6	4	2	0	0
Vietnam	0	0	.	.	.

INTL 4.4 Liver transplant counts by year & country: deceased donor

liver transplants



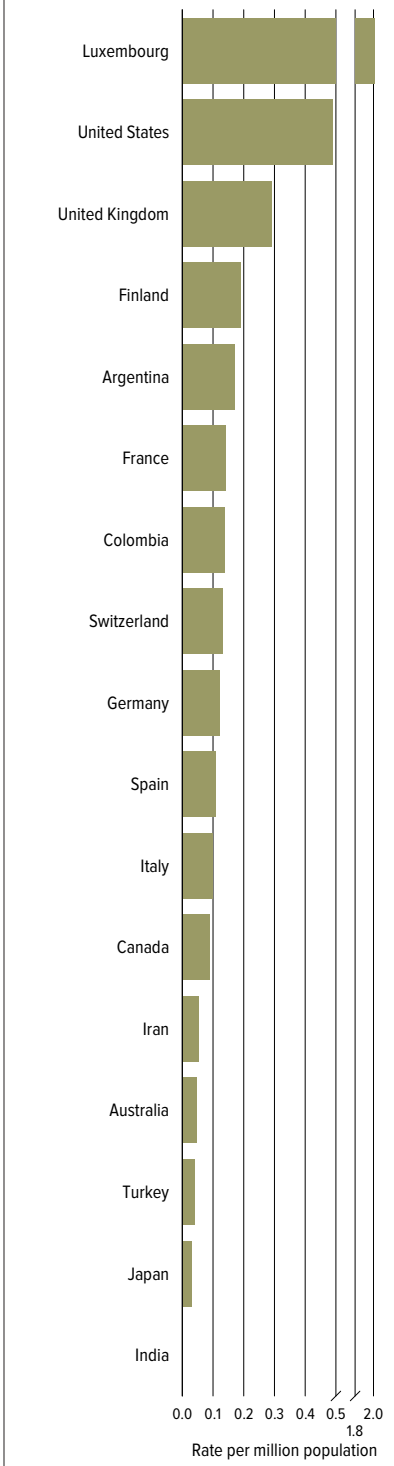
INTL 4.5 Liver transplant counts by country, 2010: living donor

	2006	2007	2008	2009	2010
Albania	.	.	.	.	0
Algeria	.	.	3	5	6
Argentina	.	21	33	20	33
Australia	3	4	3	2	4
Austria	2	3	4	7	2
Bahrain	0	.	.	.	.
Bangladesh	.	.	0	.	.
Belgium	18	26	13	23	33
Bhutan	.	0	.	0	0
Brazil	.	114	.	.	109
Bulgaria	1	1	4	4	2
Burma/ Myanmar	.	0	.	1	.
Cameroon	.	.	0	0	.
Canada	67	71	68	57	64
Chile	.	.	.	.	7
China	50	450	490	.	62
Colombia	.	.	.	8	2
Costa Rica	.	.	.	1	0
Croatia	4	0	1	2	2
Cuba	.	.	.	2	.
Czech Republic	1	.	0	0	0
Denmark	0	0	0	0	0
Dominican Republic	.	.	.	0	.
Ecuador	.	.	.	.	.
El Salvador	.	.	0	.	.
Estonia	.	.	.	.	.
Ethiopia	.	.	0	0	0
Fiji	.	.	.	0	.
Finland	.	.	0	0	0
France	36	18	10	12	17
Georgia	.	9	0	0	.
Germany	83	60	55	60	90
Ghana	.	.	.	0	0
Greece	.	.	0	.	0
Hungary	2	1	0	0	0
Iceland	.	.	.	0	.
India	.	.	210	400	270
Indonesia	.	1	2	.	.
Iran	11	14	38	34	48
Ireland	.	0	.	.	0
Israel	5	6	2	4	7
Italy	33	28	19	15	12
Ivory Coast	.	.	0	.	.
Japan	505	433	464	464	.
Jordan	.	.	20	.	.
Kenya	.	0	0	0	0
Kuwait	0	.	0	0	0
Kyrgyzstan	.	.	.	0	.
Latvia	.	0	0	0	0

	2006	2007	2008	2009	2010
Lebanon	.	.	.	0	.
Libya	10	6	2	0	.
Lithuania	.	1	.	.	0
Luxembourg	.	0	0	0	0
Macedonia	.	.	.	.	0
Malaysia	4	3	1	0	1
Maldives	.	.	0	0	0
Mali	.	.	0	.	.
Malta	.	.	.	.	0
Mauritius	.	.	.	.	0
Mexico	11	12	8	6	8
Moldova	.	.	0	0	0
Mongolia	.	.	.	.	0
Morocco	.	.	.	.	0
Nepal	.	.	0	0	0
Netherlands	4	2	2	3	4
New Zealand	4	4	7	8	6
Nicaragua	.	.	.	0	0
Nigeria	0	0	0	0	0
Norway	.	0	0	0	.
Oman	0	.	0	0	0
Pakistan	0	.	0	0	.
Paraguay	.	.	0	.	.
Peru	.	.	.	4	.
Philippines	.	.	.	.	0
Poland	20	18	21	22	20
Portugal	2	2	5	1	0
Qatar	.	.	.	0	0
Romania	3	7	8	3	9
Russia	.	0	.	.	88
Saudi Arabia	37	39	38	58	40
Senegal	.	.	0	.	.
Singapore	5	4	33	8	11
Slovakia	0	0	0	.	0
Slovenia	.	0	0	0	0
South Africa	.	.	0	0	0
South Korea	560	620	725	782	824
Spain	18	25	28	29	20
Sudan	0	0	0	0	0
Sweden	6	4	6	2	8
Switzerland	8	8	12	7	1
Syria	.	0	0	0	0
Tajikistan	.	.	.	.	.
Thailand	.	4	5	0	19
Tunisia	3	1	0	.	0
Turkey	205	274	390	364	486
United Kingdom	12	17	36	25	24
United States	288	266	249	219	282
Uruguay	.	1	.	0	0
Venezuela	.	6	8	12	8
Vietnam	6	6	.	.	.

INTL 4.6 Liver transplant counts by year & country: living donor

intestinal transplants

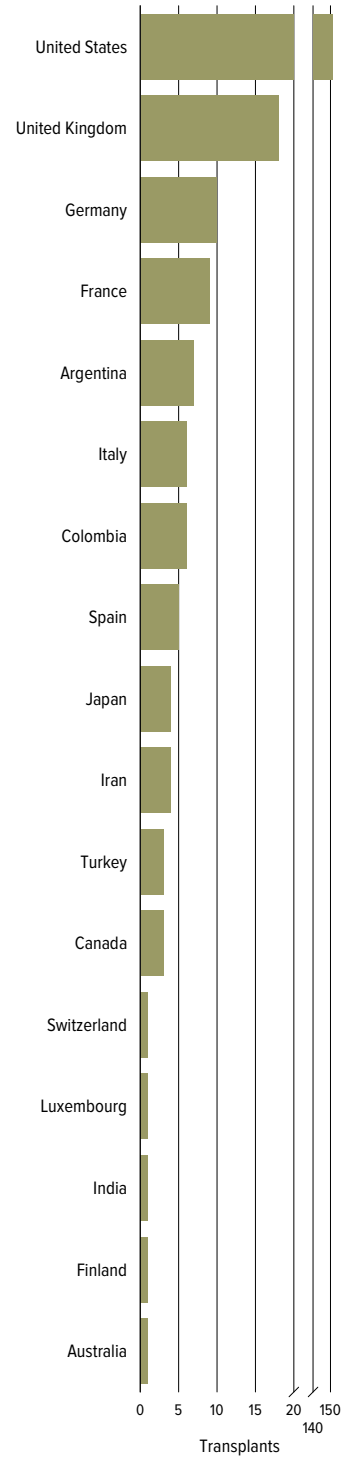


INTL 5.1 Intestinal transplant rates by country, 2010

	2006	2007	2008	2009	2010
Albania	.	.	.	.	0.00
Algeria	.	.	.	0.00	0.00
Argentina	.	0.15	0.20	0.07	0.17
Australia	0.00	.	.	.	0.05
Austria	0.00	.	.	.	.
Bahrain	0.00	.	.	.	.
Bangladesh	.	.	0.00	.	.
Belgium	0.00	.	.	.	.
Bhutan	.	0.00	.	0.00	0.00
Bulgaria	.	0.00	0.00	0.00	0.00
Burma/ Myanmar	.	0.00	.	.	.
Cameroon	.	.	0.00	0.00	.
Canada	0.21	0.12	0.12	0.09	0.09
Colombia	.	.	.	0.00	0.14
Costa Rica	.	.	.	0.00	0.00
Croatia	0.00	.	.	.	.
Czech Republic	0.00	0.00	0.00	0.00	0.00
Denmark	0.00	.	.	.	.
El Salvador	.	.	0.00	.	.
Ethiopia	.	.	0.00	0.00	0.00
Fiji	.	.	.	0.00	.
Finland	.	.	.	.	0.19
France	0.13	0.09	0.20	0.11	0.14
Georgia	.	.	0.00	0.00	.
Germany	0.01	.	.	0.10	0.12
Ghana	.	.	.	0.00	0.00
Greece	.	.	0.00	.	.
Iceland	.	.	.	0.00	.
India	.	.	.	.	0.00
Indonesia	.	.	0.00	.	.
Iran	0.00	0.00	0.00	0.00	0.05
Ireland	.	0.00	0.00	0.00	0.00
Israel	0.00	.	0.14	.	.
Italy	0.07	0.03	0.05	0.07	0.10
Ivory Coast	.	.	0.00	.	.
Japan	0.00	0.02	0.01	0.01	0.03
Kenya	.	0.00	0.00	0.00	0.00
Kuwait	0.00	.	0.00	0.00	0.00
Kyrgyzstan	.	.	.	0.00	.
Latvia	.	0.00	0.00	0.00	0.00
Lebanon	.	.	.	0.00	0.00
Libya	.	0.00	0.00	0.00	.
Lithuania	.	.	.	.	0.00
Luxembourg	.	.	0.00	.	2.01
Macedonia	.	.	.	.	0.00
Malaysia	0.00	0.00	0.00	0.00	0.00
Maldives	.	.	.	0.00	0.00
Malta	.	.	.	0.00	0.00
Mauritius	.	.	.	.	0.00
Mexico	.	.	.	0.00	0.00
Moldova	.	.	0.00	0.00	0.00
Mongolia	.	.	.	.	0.00
Morocco	.	.	.	.	0.00
Nepal	.	.	.	0.00	0.00
Netherlands	0.00	.	.	0.06	.
New Zealand	0.00	.	.	.	.
Nicaragua	.	.	.	0.00	0.00
Nigeria	.	0.00	0.00	0.00	0.00
Oman	0.00	.	0.00	0.00	0.00
Pakistan	0.00	.	0.00	0.00	.
Paraguay	.	.	0.16	.	.
Philippines	.	.	.	.	0.00
Poland	0.00	0.00	0.00	0.00	0.00
Portugal	0.00	0.00	0.00	0.00	0.00
Qatar	.	.	.	0.00	0.00
Romania	0.00	0.00	0.00	0.00	0.00
Saudi Arabia	0.00	0.00	0.00	0.00	0.00
Senegal	.	.	0.00	.	.
Singapore	.	0.00	.	.	.
Slovakia	0.00	0.00	0.00	0.00	0.00
South Africa	0.00	0.00	0.00	0.00	0.00
Spain	0.29	0.11	0.31	0.24	0.11
Sudan	0.00	0.00	0.00	0.00	0.00
Sweden	0.00	.	.	.	.
Switzerland	.	.	0.13	0.00	0.13
Syria	.	0.00	0.00	0.00	0.00
Thailand	0.00	.	0.00	0.00	0.00
Tunisia	.	.	0.00	.	0.00
Turkey	.	0.00	0.04	0.01	0.04
United Kingdom	0.07	.	0.23	0.36	0.29
United States	0.59	0.66	0.61	0.59	0.49
Uruguay	.	.	.	0.00	0.00
Venezuela	.	.	0.00	0.00	0.00
Vietnam	0.12	0.14	.	.	.

INTL 5.2 Intestinal transplant rates per million population, by year & country

intestinal transplants

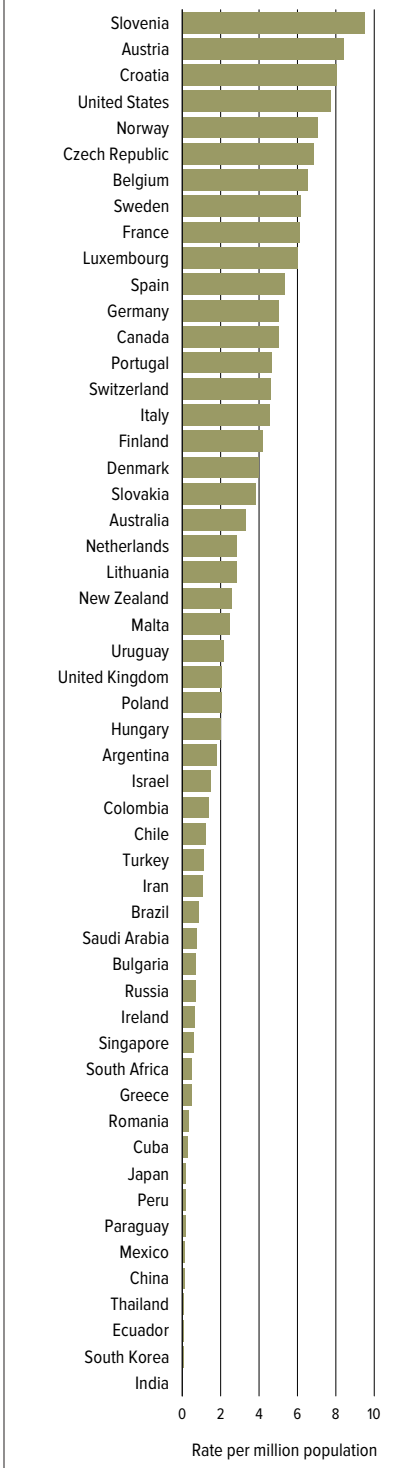


INTL 5.3 Intestinal transplant counts by country, 2010

	2006	2007	2008	2009	2010
Albania	.	.	.	.	0
Algeria	.	.	.	0	0
Argentina	.	6	8	3	7
Australia	0	.	.	.	1
Austria	0	.	.	.	.
Bahrain	0	.	.	.	.
Bangladesh	.	.	0	.	.
Belgium	0	.	.	.	.
Bhutan	.	0	.	0	0
Bulgaria	.	0	0	0	0
Burma/ Myanmar	.	0	.	.	.
Cameroon	.	.	0	0	.
Canada	7	4	4	3	3
Colombia	.	.	.	0	6
Costa Rica	.	.	.	0	0
Croatia	0	.	.	.	.
Czech Republic	0	0	0	0	0
Denmark	0	.	.	.	.
El Salvador	.	.	0	.	.
Ethiopia	.	.	0	0	0
Fiji	.	.	.	0	.
Finland	.	.	.	.	1
France	8	6	13	7	9
Georgia	.	.	0	0	.
Germany	1	.	.	8	10
Ghana	.	.	.	0	0
Greece	.	.	0	.	.
Iceland	.	.	.	0	.
India	.	.	.	.	1
Indonesia	.	.	0	.	.
Iran	0	0	0	0	4
Ireland	.	0	0	0	0
Israel	0	.	1	.	.
Italy	4	2	3	4	6
Ivory Coast	.	.	0	.	.
Japan	0	2	1	1	4
Kenya	.	0	0	0	0
Kuwait	0	.	0	0	0
Kyrgyzstan	.	.	.	0	.
Latvia	.	0	0	0	0
Lebanon	.	.	.	0	0
Libya	.	0	0	0	.
Lithuania	.	.	.	.	0
Luxembourg	.	.	0	.	1
Macedonia	.	.	.	.	0
Malaysia	0	0	0	0	0
Maldives	.	.	.	0	0
Malta	.	.	.	0	0
Mauritius	.	.	.	.	0
Mexico	.	.	.	0	0
Moldova	.	.	0	0	0
Mongolia	.	.	.	.	0
Morocco	.	.	.	.	0
Nepal	.	.	.	0	0
Netherlands	0	.	.	1	.
New Zealand	0	.	.	.	.
Nicaragua	.	.	.	0	0
Nigeria	.	0	0	0	0
Oman	0	.	0	0	0
Pakistan	0	.	0	0	.
Paraguay	.	.	1	.	.
Philippines	.	.	.	.	0
Poland	0	0	0	0	0
Portugal	0	0	0	0	0
Qatar	.	.	.	0	0
Romania	0	0	0	0	0
Saudi Arabia	0	0	0	0	0
Senegal	.	.	0	.	.
Singapore	.	0	.	.	.
Slovakia	0	0	0	0	0
South Africa	0	0	0	0	0
Spain	13	5	14	11	5
Sudan	0	0	0	0	0
Sweden	0	.	.	.	.
Switzerland	.	.	1	0	1
Syria	.	0	0	0	0
Thailand	0	.	0	0	0
Tunisia	.	.	0	.	0
Turkey	.	0	3	1	3
United Kingdom	4	.	14	22	18
United States	175	198	185	180	151
Uruguay	.	.	.	0	0
Venezuela	.	.	0	0	0
Vietnam	10	12	.	.	.

INTL 5.4 Intestinal transplant counts by year & country

heart transplants



INTL 6.1 Heart transplant rates by country, 2010
Numerator for heart transplant rate includes heart-alone and heart-lung transplants.

	2006	2007	2008	2009	2010
Albania	.	.	.	.	0.00
Algeria	.	.	0.00	0.00	0.00
Argentina	2.10	2.10	2.54	2.37	1.79
Australia	4.00	3.28	4.28	2.96	3.30
Austria	7.32	6.95	7.92	9.01	8.40
Bahrain	0.00	.	.	.	.
Bangladesh	.	.	0.00	.	.
Belgium	7.80	7.31	7.31	6.63	6.52
Bhutan	.	0.00	.	0.00	0.00
Brazil	0.72	0.82	1.02	1.01	0.83
Bulgaria	0.41	0.41	0.41	0.69	0.70
Burma/ Myanmar	.	0.00	.	.	.
Cameroon	.	.	0.00	0.00	.
Canada	5.63	5.07	5.06	5.14	5.01
Chile	1.24	0.98	1.16	1.08	1.19
China	.	.	0.10	.	0.11
Colombia	1.38	1.41	1.92	1.35	1.36
Costa Rica	.	0.23	.	0.67	0.00
Croatia	3.12	1.34	4.45	4.46	8.02
Cuba	0.27	0.63	0.27	0.27	0.27
Czech Republic	5.57	6.84	5.77	7.83	6.86
Denmark	5.14	5.30	3.65	4.91	3.99
Ecuador	.	.	.	0.07	0.07
El Salvador	.	.	0.00	.	.
Estonia	.	.	.	.	0.00
Ethiopia	.	.	0.00	0.00	0.00
Fiji	.	.	.	0.00	.
Finland	3.63	4.96	4.00	2.48	4.19
France	6.35	6.38	6.21	6.23	6.08
Georgia	.	.	0.00	0.00	.
Germany	5.30	5.23	4.89	4.63	5.01
Ghana	.	.	.	0.00	0.00
Greece	0.66	0.47	1.49	0.75	0.47
Hungary	2.19	2.19	2.20	2.40	2.00
Iceland	.	.	.	0.00	.
India	.	.	0.00	0.00	0.01
Indonesia	.	0.00	0.00	.	.
Iran	0.25	0.50	0.69	0.62	1.07
Ireland	.	1.58	0.89	2.40	0.65
Israel	3.50	2.58	2.95	2.63	1.50
Italy	5.80	5.23	5.46	5.89	4.56
Ivory Coast	.	.	0.00	.	.
Japan	0.08	0.08	0.09	0.06	0.18
Jordan	.	0.00	0.00	.	.
Kenya	.	0.00	0.00	0.00	0.00
Kuwait	0.00	.	0.00	0.00	0.00
Kyrgyzstan	.	.	.	0.00	.
Latvia	0.88	1.33	0.00	0.45	0.00
Lebanon	.	.	.	0.00	0.00
Libya	0.00	0.00	0.00	0.00	.
Lithuania	2.79	4.48	1.40	2.53	2.82
Luxembourg	.	.	0.00	.	6.03
Macedonia	.	.	.	.	0.00
Malaysia	0.04	0.11	0.00	0.04	0.00
Maldives	.	.	0.00	0.00	0.00
Malta	.	.	.	2.47	2.46
Mauritius	.	.	.	.	0.00
Mexico	0.12	0.14	0.13	0.15	0.13
Moldova	.	.	0.00	0.00	0.00
Mongolia	.	.	.	.	0.00
Morocco	.	.	.	.	0.00
Nepal	.	.	0.00	0.00	0.00
Netherlands	2.45	3.30	2.01	2.30	2.84
New Zealand	2.20	2.90	2.40	2.61	2.59
Nicaragua	.	.	.	0.00	0.00
Nigeria	.	0.00	0.00	0.00	0.00
Norway	6.94	8.00	9.04	5.79	7.06
Oman	0.00	.	0.00	0.00	0.00
Pakistan	0.00	.	0.00	0.00	.
Paraguay	.	.	0.16	0.16	0.16
Peru	.	.	.	.	0.17
Philippines	.	.	.	.	0.00
Poland	2.52	1.66	1.58	1.85	2.05
Portugal	3.58	4.79	3.93	4.39	4.66
Qatar	.	.	.	0.00	0.00
Romania	0.32	0.41	0.27	0.45	0.32
Russia	.	.	.	.	0.70
Saudi Arabia	0.54	0.49	0.76	0.59	0.74
Senegal	.	.	0.00	.	.
Singapore	1.27	0.83	0.61	0.99	0.58
Slovakia	1.84	4.04	4.77	4.21	3.84
Slovenia	3.48	5.48	2.99	8.97	9.49
South Africa	0.44	0.54	0.47	0.53	0.51
South Korea	0.02	0.02	0.04	0.00	0.04
Spain	6.32	5.38	6.45	5.94	5.31
Sudan	0.00	0.00	0.00	0.00	0.00
Sweden	4.44	5.09	5.09	6.29	6.17
Switzerland	3.59	3.84	3.83	3.95	4.59
Syria	.	0.00	0.00	0.00	0.00
Thailand	0.08	0.09	0.09	0.14	0.08
Tunisia	0.00	0.00	0.00	.	0.00
Turkey	0.61	0.86	0.69	0.72	1.11
United Kingdom	2.68	2.38	2.14	2.27	2.07
United States	7.45	7.43	7.20	7.30	7.70
Uruguay	2.14	1.53	3.35	2.13	2.12
Venezuela	.	.	0.00	0.00	0.00
Vietnam	0.00	0.00	.	.	.

INTL 6.2 Heart transplant rates per million population, by year & country
Numerator for heart transplant rate includes heart-alone and heart-lung transplants.

heart transplants

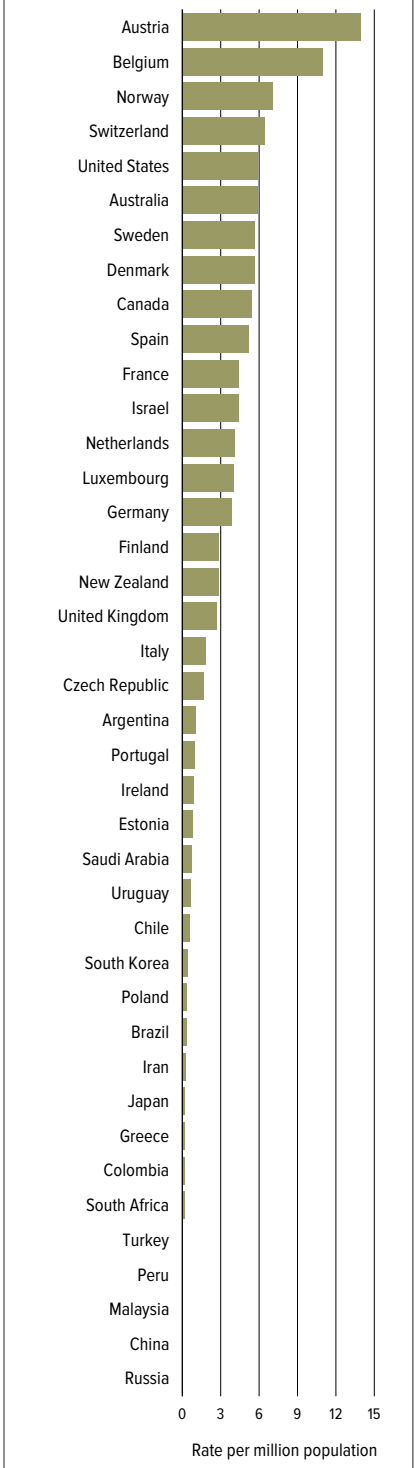
INTL 6.3 Heart transplant counts by country, 2010
Includes counts of heart-lung transplants.

	2006	2007	2008	2009	2010
Albania	.	.	.	.	0
Algeria	.	.	0	0	0
Argentina	83	84	103	97	74
Australia	82	68	90	63	71
Austria	60	57	65	74	69
Bahrain	0	.	.	.	.
Bangladesh	.	.	0	.	.
Belgium	81	76	76	69	68
Bhutan	.	0	.	0	0
Brazil	138	159	200	200	167
Bulgaria	3	3	3	5	5
Burma/ Myanmar	.	0	.	.	.
Cameroon	.	.	0	0	.
Canada	184	167	168	172	169
Chile	20	16	19	18	20
China	.	.	130	.	147
Colombia	58	60	83	59	60
Costa Rica	.	1	.	3	0
Croatia	14	6	20	20	36
Cuba	3	7	3	3	3
Czech Republic	57	70	59	80	70
Denmark	28	29	20	27	22
Ecuador	.	.	.	1	1
El Salvador	.	.	0	.	.
Estonia	.	.	.	.	0
Ethiopia	.	.	0	0	0
Fiji	.	.	.	0	.
Finland	19	26	21	13	22
France	402	406	398	401	394
Georgia	.	.	0	0	.
Germany	436	430	401	379	409
Ghana	.	.	.	0	0
Greece	7	5	16	8	5
Hungary	22	22	22	24	20
Iceland	.	.	.	0	.
India	.	.	5	5	10
Indonesia	.	0	0	.	.
Iran	18	37	52	47	82
Ireland	.	7	4	11	3
Israel	24	18	21	19	11
Italy	344	312	328	356	277
Ivory Coast	.	.	0	.	.
Japan	10	10	11	8	23
Jordan	.	0	0	.	.
Kenya	.	0	0	0	0
Kuwait	0	.	0	0	0
Kyrgyzstan	.	.	.	0	.
Latvia	2	3	0	1	0

	2006	2007	2008	2009	2010
Lebanon	.	.	.	0	0
Libya	0	0	0	0	.
Lithuania	10	16	5	9	10
Luxembourg	.	.	0	.	3
Macedonia	.	.	.	.	0
Malaysia	1	3	0	1	0
Maldives	.	.	0	0	0
Malta	.	.	.	1	1
Mauritius	.	.	.	.	0
Mexico	13	15	14	17	15
Moldova	.	.	0	0	0
Mongolia	.	.	.	.	0
Morocco	.	.	.	.	0
Nepal	.	.	0	0	0
Netherlands	40	54	33	38	47
New Zealand	9	12	10	11	11
Nicaragua	.	.	.	0	0
Nigeria	.	0	0	0	0
Norway	32	37	42	27	33
Oman	0	.	0	0	0
Pakistan	0	.	0	0	.
Paraguay	.	.	1	1	1
Peru	.	.	.	.	5
Philippines	.	.	.	.	0
Poland	97	64	61	71	79
Portugal	38	51	42	47	50
Qatar	.	.	.	0	0
Romania	7	9	6	10	7
Russia	.	.	.	.	97
Saudi Arabia	13	12	19	15	19
Senegal	.	.	0	.	.
Singapore	6	4	3	5	3
Slovakia	10	22	26	23	21
Slovenia	7	11	6	18	19
South Africa	21	26	23	26	25
South Korea	1	1	2	0	2
Spain	281	243	296	275	247
Sudan	0	0	0	0	0
Sweden	40	46	46	57	56
Switzerland	27	29	29	30	35
Syria	.	0	0	0	0
Thailand	5	6	6	9	5
Tunisia	0	0	0	.	0
Turkey	45	64	52	55	86
United Kingdom	163	146	132	141	129
United States	2,224	2,240	2,190	2,241	2,374
Uruguay	7	5	11	7	7
Venezuela	.	.	0	0	0
Vietnam	0	0	.	.	.

INTL 6.4 Heart transplant counts by year & country
Includes counts of heart-lung transplants.

lung transplants

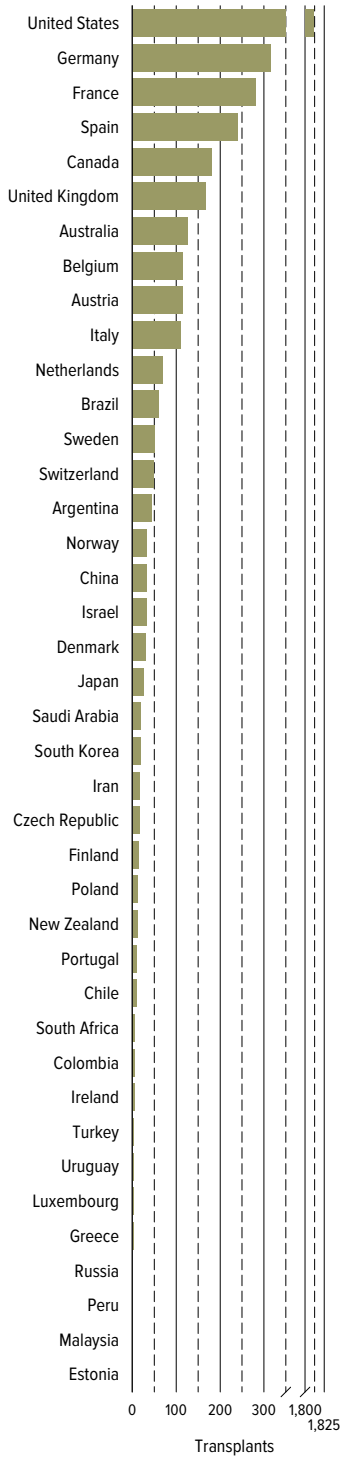


INTL 7.1 Lung transplant rates by country, 2010
Numerator for lung transplant rate includes lung-alone and heart-lung transplants.

	2006	2007	2008	2009	2010
Albania	.	.	.	.	0.00
Algeria	.	.	.	0.00	0.00
Argentina	.	0.62	0.87	0.83	1.06
Australia	5.08	4.10	5.71	5.46	5.86
Austria	12.82	10.00	14.87	13.40	13.88
Bahrain	0.00	.	.	.	.
Bangladesh	.	.	0.00	.	.
Belgium	8.77	9.14	7.98	8.74	10.94
Bhutan	.	0.00	.	0.00	0.00
Brazil	.	.	0.27	0.14	0.30
Bulgaria	.	0.00	0.00	0.00	0.00
Burma/ Myanmar	.	0.00	.	.	.
Cameroon	.	.	0.00	0.00	.
Canada	5.33	5.68	4.19	5.73	5.39
Chile	.	.	0.55	.	0.54
China	.	.	0.03	.	0.03
Colombia	.	.	0.33	0.16	0.14
Costa Rica	.	.	.	0.00	0.00
Croatia	0.00	.	.	.	.
Czech Republic	1.47	1.27	1.96	2.15	1.67
Denmark	6.05	6.04	3.28	5.27	5.62
El Salvador	.	.	0.00	.	.
Estonia	.	.	.	.	0.77
Ethiopia	.	.	0.00	0.00	0.00
Fiji	.	.	.	0.00	.
Finland	2.87	3.63	2.29	2.67	2.85
France	3.57	3.82	3.65	4.24	4.35
Georgia	.	.	0.00	0.00	.
Germany	3.36	3.67	3.52	3.52	3.85
Ghana	.	.	.	0.00	0.00
Greece	0.00	0.00	0.28	0.28	0.19
Hungary	.	.	.	.	0.00
Iceland	.	.	.	0.00	.
India	.	.	.	.	0.00
Indonesia	.	0.00	0.00	.	.
Iran	0.10	0.04	0.15	0.09	0.22
Ireland	.	.	0.89	1.09	0.87
Israel	6.55	5.15	7.31	6.77	4.35
Italy	1.55	1.90	1.60	1.87	1.83
Ivory Coast	.	.	0.00	.	.
Japan	0.05	0.07	0.11	0.09	0.20
Jordan	.	0.00	0.00	.	.
Kenya	.	0.00	0.00	0.00	0.00
Kuwait	0.00	.	0.00	0.00	0.00
Kyrgyzstan	.	.	.	0.00	.
Latvia	.	0.00	0.00	0.00	0.00
Lebanon	.	.	.	0.00	0.00
Libya	.	0.00	0.00	0.00	.
Lithuania	.	0.28	0.56	1.13	0.00
Luxembourg	.	.	0.00	.	4.02
Macedonia	.	.	.	.	0.00
Malaysia	0.00	0.00	0.00	0.00	0.04
Maldives	.	.	.	0.00	0.00
Malta	.	.	.	0.00	0.00
Mauritius	.	.	.	.	0.00
Mexico	.	0.02	0.01	0.01	0.00
Moldova	.	.	0.00	0.00	0.00
Mongolia	.	.	.	.	0.00
Morocco	.	.	.	.	0.00
Nepal	.	.	0.00	0.00	0.00
Netherlands	3.43	4.10	3.47	4.18	4.10
New Zealand	3.18	3.15	3.36	3.80	2.82
Nicaragua	.	.	.	0.00	0.00
Nigeria	.	0.00	0.00	0.00	0.00
Norway	7.59	6.48	7.11	5.15	7.06
Oman	0.00	.	0.00	0.00	0.00
Pakistan	0.00	.	0.00	0.00	.
Paraguay	.	.	0.00	.	.
Peru	.	.	.	.	0.04
Philippines	.	.	.	.	0.00
Poland	0.18	0.18	0.29	0.26	0.31
Portugal	.	0.38	0.38	1.03	0.93
Qatar	.	.	.	0.00	0.00
Romania	0.00	0.00	0.00	0.00	0.00
Russia	.	.	.	.	0.01
Saudi Arabia	0.08	0.00	0.04	0.16	0.74
Senegal	.	.	0.00	.	.
Singapore	0.21	0.21	0.41	0.00	0.00
Slovakia	0.00	0.00	0.00	0.00	0.00
South Africa	0.10	0.15	0.18	0.16	0.12
South Korea	0.06	0.19	0.19	0.17	0.37
Spain	3.96	4.14	4.27	4.75	5.14
Sudan	0.00	0.00	0.00	0.00	0.00
Sweden	5.55	4.76	5.86	5.74	5.62
Switzerland	4.79	.	5.28	5.13	6.43
Syria	.	0.00	0.00	0.00	0.00
Thailand	0.00	0.03	0.02	0.02	0.00
Tunisia	0.00	0.00	0.00	.	0.00
Turkey	.	0.03	0.03	0.09	0.04
United Kingdom	2.04	2.09	2.34	2.45	2.68
United States	4.81	4.98	4.95	5.51	5.87
Uruguay	.	0.92	1.22	0.00	0.61
Venezuela	.	.	0.00	0.00	0.00
Vietnam	0.00	0.00	.	.	.

INTL 7.2 Lung transplant rates per million population, by year & country
Numerator for lung transplant rate includes lung-alone and heart-lung transplants.

lung transplants



INTL 7.3 Lung transplant counts by country, 2010
Includes counts of heart-lung transplants.

	2006	2007	2008	2009	2010
Albania	.	.	.	.	0
Algeria	.	.	.	0	0
Argentina	.	25	35	34	44
Australia	104	85	120	116	126
Austria	105	82	122	110	114
Bahrain	0	.	.	.	.
Bangladesh	.	.	0	.	.
Belgium	91	95	83	91	114
Bhutan	.	0	.	0	0
Brazil	.	.	53	28	60
Bulgaria	.	0	0	0	0
Burma/ Myanmar	.	0	.	.	.
Cameroon	.	.	0	0	.
Canada	174	187	139	192	182
Chile	.	.	9	.	9
China	.	.	35	.	33
Colombia	.	.	14	7	6
Costa Rica	.	.	.	0	0
Croatia	0	.	.	.	.
Czech Republic	15	13	20	22	17
Denmark	33	33	18	29	31
El Salvador	.	.	0	.	.
Estonia	.	.	.	.	1
Ethiopia	.	.	0	0	0
Fiji	.	.	.	0	.
Finland	15	19	12	14	15
France	226	243	234	273	282
Georgia	.	.	0	0	.
Germany	277	302	289	288	314
Ghana	.	.	.	0	0
Greece	0	0	3	3	2
Hungary	.	.	.	.	0
Iceland	.	.	.	0	.
India	.	.	.	.	0
Indonesia	.	0	0	.	.
Iran	7	3	11	7	17
Ireland	.	.	4	5	4
Israel	45	36	52	49	32
Italy	92	113	96	113	111
Ivory Coast	.	.	0	.	.
Japan	6	9	14	11	25
Jordan	.	0	0	.	.
Kenya	.	0	0	0	0
Kuwait	0	.	0	0	0
Kyrgyzstan	.	.	.	0	.
Latvia	.	0	0	0	0
Lebanon	.	.	.	0	0
Libya	.	0	0	0	.
Lithuania	.	1	2	4	0
Luxembourg	.	.	0	.	2
Macedonia	.	.	.	.	0
Malaysia	0	0	0	0	1
Maldives	.	.	.	0	0
Malta	.	.	.	0	0
Mauritius	.	.	.	.	0
Mexico	.	2	1	1	0
Moldova	.	.	0	0	0
Mongolia	.	.	.	.	0
Morocco	.	.	.	.	0
Nepal	.	.	0	0	0
Netherlands	56	67	57	69	68
New Zealand	13	13	14	16	12
Nicaragua	.	.	.	0	0
Nigeria	.	0	0	0	0
Norway	35	30	33	24	33
Oman	0	.	0	0	0
Pakistan	0	.	0	0	.
Paraguay	.	.	0	.	.
Peru	.	.	.	.	1
Philippines	.	.	.	.	0
Poland	7	7	11	10	12
Portugal	.	4	4	11	10
Qatar	.	.	.	0	0
Romania	0	0	0	0	0
Russia	.	.	.	.	1
Saudi Arabia	2	0	1	4	19
Senegal	.	.	0	.	.
Singapore	1	1	2	0	0
Slovakia	0	0	0	0	0
South Africa	5	7	9	8	6
South Korea	3	9	9	8	18
Spain	176	187	196	220	239
Sudan	0	0	0	0	0
Sweden	50	43	53	52	51
Switzerland	36	.	40	39	49
Syria	.	0	0	0	0
Thailand	0	2	1	1	0
Tunisia	0	0	0	.	0
Turkey	.	2	2	7	3
United Kingdom	124	128	144	152	167
United States	1,437	1,502	1,505	1,690	1,811
Uruguay	.	3	4	0	2
Venezuela	.	.	0	0	0
Vietnam	0	0	.	.	.

INTL 7.4 Lung transplant counts by year & country
Includes counts of heart-lung transplants.

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Prior to Matthew's death, he had discussed organ donation with us and had put the sticker on his license. This made our decision to proceed with organ donation much easier. We are very proud of Matthew for the life that he lived and the gift he gave at his death.

Kim, donor mother

methods

PRA and CPRA

For kidney and pancreas transplant recipients prior to December 2007, PRA at the time of transplant is the value of the most recently recorded PRA. If that value is missing, we use the peak PRA value known at the time of transplant. In 2004, the OPTN Recipient Histocompatibility form changed the PRA collection method from overall PRA to Class I and Class II PRA. From 2004 through 2007, we use the maximum of the Class I and Class II values. From December 2007 through October 2009, we incorporate Calculated PRA (CPRA) if the value is greater than zero. In this time frame, we use the maximum of measured PRA and CPRA. From October 2009 to present, we use the maximum of CPRA, measured PRA, and allocation PRA. A similar approach is used for PRA and CPRA among kidney and pancreas candidates.

For liver, intestine, heart, and lung transplant recipients, PRA at the time of transplant is the value of the most recently recorded PRA. If that value is missing, we use the peak PRA value known the time of transplant. In 2004, the OPTN Recipient Histocompatibility form changed the PRA collection method from overall PRA to Class I and Class II PRA. In these years, we use the maximum of the Class I and Class II values.

Graft failure

Unless otherwise specified, "graft failure" refers to graft failure due to any cause, including death and re-transplantation. For kidney failure, this also includes return to maintenance dialysis. "Graft survival" similarly refers to the absence of all-cause graft failure.

Half-life

Graft half-life and conditional half-life estimates were computed using a "period" method, which is different from the method previously used. In the past, conditional half-life estimates relied on the rarely-true assumption of constant hazard after the first post-transplant year, and extrapolated the survival curve to its half-life based on that early hazard. The "period" method constructs a survival curve until the half-life differently. If the half-life of a cohort in a given year is observed, then the survival curve is constructed using the Kaplan-Meier method based on the observed data of this cohort.

Otherwise, we construct the survival curve using the data from the cohort for the observed part and "borrow" data from earlier cohorts for the rest. For example, the 2007 half-life estimate for kidney graft survival is based on observed and borrowed data. For patients transplanted in 2007, we have observed 4-year survival data through 2011. We extrapolate this 4 year survival curve to its half-life by using the observed 5th year failure rate of the 2006 cohort as the 5th year failure rate of 2007 cohort, the 6th year failure rate of 2005 cohort as the 6th year failure rate of 2007 cohort, and so on. Conditional half-life estimates are similarly computed, but limited to patients with one year of graft survival.

ALIVE WITH FUNCTION

For a given year and organ type, counts of recipients alive with function include all recipients of that organ, transplanted prior to June 30 of the given year and with no evidence of graft loss or death. Multi-organ recipients are counted once per organ. A heart-lung recipient, for example, is included in the counts of heart recipients and of lung recipients alive with function. A kidney-alone recipient who is transplanted in January, 2000, and who loses graft function in November, 2010, is counted as alive with function every year from 2000 through 2010. Recipients who are lost to follow-up are assumed alive with a functioning graft until evidence, usually a death date, contradicts this assumption.

RATES BY SUBGROUP

When rates are shown by subgroup (i.e., sex, race, primary cause of disease), numerator and denominator are computed exclusively within those groups. For example, for pre-transplant mortality by race group, the numerator for each race group is the number of deaths in that race group during the interval described. The denominator is the total waiting time within each race group in that same time interval. When a characteristic is subject to change over time (i.e. age, PRA), the subgroup variable is updated to use the first known value in a given interval, unless otherwise noted. For example, a wait-list candidate who is 34 on January 1, 2001, will be included in the 18-34 age group in 2001, but if still listed in 2003, that patient will be included in the 35-49 age group.

glossary

Acute rejection The host recognizes the graft as foreign and mounts an immunological attack on the graft tissues. Most acute rejections occur in the first year.

Allocation The process of determining how organs are distributed. Allocation includes the system of policies and guidelines, which ensure that organs are distributed in an equitable, ethical and medically sound manner.

Allocation analysis Review of the allocation of an organ to determine whether the allocation policies were followed. The analysis is performed by the OPTN contractor through the peer review process of the OPTN Membership and Professional Standards Committee.

Allograft An organ or tissue that is transplanted from one person to another of the same species: i.e. human-to-human. Example: a transplanted kidney.

Anti-rejection drugs (immunosuppressive drugs) Drugs that are used to prevent and/or treat rejection of a transplanted organ.

Antibody A protein molecule produced by the immune system in response to a foreign body, such as virus or a transplanted organ. Since antibodies fight the transplanted organ and try to reject it, recipients are required to take anti-rejection (immunosuppressive) drugs.

Antigen An antigen is any substance that causes your immune system to produce antibodies against it. An antigen may be a foreign substance from the environment such as chemicals, bacteria, viruses, pollen, or foreign tissues. An antigen may also be formed within the body, as with bacterial toxins.

Biopsy A tissue sample from the body, removed and examined under a microscope to diagnose for disease, determine organ rejection, or assess donated organs or tissues.

Blood vessels The veins, arteries and capillaries through which blood flows in the body. Certain blood vessels can be donated and transplanted.

Brain death Irreversible cessation of cerebral and brain stem function; characterized by absence of electrical activity in the brain, blood flow to the brain, and brain function as determined by clinical assessment of responses. A brain dead person is dead, although his or her cardiopulmonary functioning may be artificially maintained for some time.

Candidate A person registered on the organ transplant waiting list. When an organ is offered on behalf of the candidate, he or she is then referred to as a Potential Transplant Recipient (PTR).

Cardiac Having to do with, or referring to, the heart.

Cardiac death Death defined as the irreversible cessation of circulatory and respiratory functions. Death is declared in accordance with hospital policy and applicable state and local statues or regulation.

Chronic Developing slowly and lasting for a long time, possibly the rest of a person's life. For example: chronic kidney failure.

Chronic Disease Research Group (CDRG) A division of Minnesota Medical Research Foundation (MMRF). MMRF is the nonprofit research subsidiary of Hennepin Faculty Associates, the academic medical group that staffs Hennepin County Medical Center, a teaching hospital in Minneapolis, Minnesota. The CDRG conducts research primarily focused in the areas of chronic kidney disease and organ transplantation. The MMRF-CDRG is responsible for the administration of the Scientific Registry of Transplant Recipients (SRTR).

Chronic rejection Slow, continuous immunological attack of the host immune system on the transplanted organ usually resulting in progressive loss of organ function.

Cirrhosis A disease of the liver in which normal, healthy tissue is replaced with nonfunctioning fibrous scar tissue and healthy, functioning liver cells are lost; usually occurs when there is a lack of adequate nutrition, an infection or damage caused by alcohol abuse.

Committees The OPTN currently maintains approximately 20 standing committees, a fluctuating number of ad hoc committees (established by the President to address a specific issue as it arises), subcommittees and joint subcommittees (created and maintained by standing committees). Committees are comprised of professionals, at least one Patient/Public representative, Minority Affairs Committee Representative, Pediatric Committee Representative, and one or more SRTR representatives. Permanent Standing Committees also include representatives form each of the 11 Regions. HRSA's OPTN Project Officer and Director of DoT, or their designees, serve as ex-officio non-voting members of all committees. Each committee is provided administrative, policy, analytic, clinical and technical support by one or more committee liaisons from the UNOS staff.

Corticosteroid A synthetic hormone used to reduce the body's normal immune reaction to infection and foreign tissue, such as a transplanted organ. Prednisone is a corticosteroid.

Criteria (medical criteria) A set of clinical or biologic standards or conditions that must be met.

Cyclosporine A drug used to prevent rejection of the transplanted organ by suppressing the body's defense system. Considered an immunosuppressant.

Deceased donor An individual from whom at least one solid organ is recovered or the purpose of transplantation after suffering brain death or cardiac death.

Deceased donor transplant The transplant of an organ from a deceased donor.

Department of Health and Human Services (DHHS or HHS) The department of the federal government responsible for health-related programs and issues.

Dialysis A mechanical process designed to partially perform kidney functions, including correcting the balance of fluids and chemicals in the body and removing wastes. See Hemodialysis and Peritoneal Dialysis.

Diastolic blood pressure The bottom number in the blood pressure measurement (80 in a blood presure of 120/80), indicating the pressure in the arteries when the heart is at rest.

Division of Transplantation (DoT) DoT is the office within HHS/HRSA whose principal responsibilities include the oversight of management of the Organ Procurement and Transplantation Network (OPTN), the Scientific Registry of Transplant Recipients (SRTR) and the National Marrow Donar Program (NMDP) contracts; public education to increase organ and tissue donation; and technical assistance to organ procurement organizations (OPOS).

Domino transplant A procedure in which an organ is removed from one transplant candidate and immediately transplanted into a second patient, with the first patient receiving a new organ from a deceased donor.

Donate Life America Formerly the Coalition on Donation, Donate Life America is a national not-for-profit alliance of local affiliates and corporate partners that have joined forces to inspire all people to Donate Life through organ, eye and tissue donation. At the core of the organization's education efforts are the ongoing qualitative and quantitative research of public attitudes about organ and tissue donation and the development and dissemination of effective, motivating public service campaigns. Distributed at the national and community level, these multimedia campaigns effectively communicate two core messages: Transplants give people their life back, and here is how you can help. Founded by the transplant community in 1992, the Coalition publishes brochures, program kits and other materials; provides technical assistance, training, information and referral services; and coordinates the National Campaign for Organ and Tissue Donation. It is comprised of national organizational members and local coalitions across the U.S. that coordinate donation related activities at the local level. Volunteer advertising agencies work with the Coalition and its committees to develop targeted mass media campaigns.

Donation Service Area (DSA) The geographic area designated by CMS that is served by one organ procurement organization (OPO), one or more transplant centers, and one or more donor hospitals. Formerly referred to as Local Service Area or OPO Service Area.

Donor Someone from whom at least one organ or tissue is recovered for the purpose of transplantation. A deceased donor is a patient who has been declared dead using either brain death or cardiac death criteria, from whom at least onevascularized solid organ is recovered for the purpose of organ transplantation. A living donor is one who donates an organ or segment of an organ for the intent of transplantation.

Donor registries Available 24 hours a day, seven days a week, online registries provide authorized professionals access to a confidential database of registered organ donors, allowing easy and quick confirmation of an individual's consent to organ donation. All registries are voluntary and some are affiliated with the local motor vehicle bureau, while others are independently operated or OPO-based.

End-stage organ disease A disease that leads to the permanent failure of an organ.

Ethnicity For OPTN data purposes, the use of categories such as white, black or African-American, Hispanic, Asian, American Indian/Alaskan Native, Pacific Islander, multiracial.

Expanded criteria donor (ECD) kidney A kidney donated for transplantation from any brain dead donor over the age of 60 years; or from a donor over the age of 50 years with two of the following: a history of hypertension, the most recent serum creatinine greater than or equal to 1.5 mg/dl, or death resulting from a cerebral vascular accident (stroke). This definition applies to the allocation of deceased donor kidneys.

Functional status A way to measure the effects that lung disease may have on a person's ability to perform routine daily tasks. Functional status is used in the Lung Allocation Score.

Glomerular filtration rate (GFR) A measure used to determine kidney function, the GFR indicates the kidney's ability to filter and remove waste products.

Graft A transplanted organ or tissue.

Graft survival The length of time an organ functions successfully after being transplanted.

Hemodialysis A treatment for kidney failure where the patient's blood is passed through a filtering membrane to remove excess fluid and wastes.

Hepatic Having to do with, or referring to, the liver.

Hepatitis A viral infection or non-specific inflammation of the liver that can lead to liver failure. Hepatitis C is the leading cause of liver failure that leads to transplantation.

High blood pressure See hypertension.

Histocompatibility The examination of human leukocyte antigens (HLA) in a patient, often referred to as "tissue typing" or "genetic matching." Tissue typing is routinely performed for all donors and recipients in kidney and pancreas transplantation to help match the donor with the most suitable recipients to help decrease the likelihood of rejecting the transplanted organ. See Human Leukocyte Antigen System (HLA System).

Human immunodeficiency virus (HIV) A virus which destroys cells in the immune system, which makes it difficult for the body to fight off infections; toxins, or poisons; and diseases. HIV causes AIDS, a late stage of the virus characterized by serious infections, malignancies, and neurologic dysfunctions.

Hypertension High blood pressure. Occurs when the force of the blood pushing against the walls of the blood vessels is higher than normal because the blood vessels have either become less elastic or have gotten smaller. Hypertension causes the heart to pump harder to move blood through the body. It can cause kidney failure and heart disease if not treated.

Immune response The body's natural defense against foreign objects or organisms, such as bacteria, viruses or transplanted organs or tissue.

Immune system The organs, tissues, cells and cell products in your body that work to find and neutralize foreign substances including bacteria, viruses and transplanted organs.

Immunosuppression Prevention or inhibition of the immune system to respond to foreign substances in the body. Medications often used to prevent a recipient's immune system from rejecting a transplanted organ or tissue include prednisone, methylprednisolone, azathioprine, mycophenolate mofetil, cyclosporine, tacrolimus, and sirolimus, among others.

Immunosuppressive Relating to the weakening or reducing of your immune system's responses to foreign material; immunosuppressive drugs reduce your immune system's ability to reject a transplanted organ.

Induction therapy Medications given for a short finite period in the perioperative period for the purpose of preventing acute rejection. Though the drugs may be continued after discharge for the first 30 days after transplant, it will not be used long-term for immunosuppressive maintenance.

Infection A condition that occurs when a foreign substance, such as bacteria, enters your body, causing your immune system to fight the intruder. All transplant recipients can get infections more easily because their immune systems are suppressed. It is more difficult for them to recover from infection (such as urinary tract infections, colds and the flu).

Inflammation The swelling, heat and redness produced when the body is injured or infected.

International normalized ratio (INR) A measure of a patient's coagulation (clotting) system. INR is used in the MELD and PELD calculations.

Kidneys A pair of organs that remove wastes from the body through the production of urine. All of the blood in the body passes through the kidneys about 20 times every hour. Kidneys can be donated from living and deceased donors and transplanted into patients with kidney failure.

Leukocyte A white blood cell.

Liver The largest organ in the body, made up of a spongy mass of wedge-shaped lobes. The liver secretes bile, which aids in digestion, helps process proteins, carbohydrates, and fats, and stores substances like vitamins. It also removes wastes from the blood. A living donor can give part of their liver, after which the liver will regenerate itself in both the donor and recipient.

Match The compatibility between the donor and the recipient. The more appropriate the match, the greater the chance of a successful transplant.

Medicaid A partnership between the Federal government and the individual states to share the cost of providing medical coverage for recipients of welfare programs and allowing states to provide the same coverage to low-income workers not eligible for welfare. Programs vary greatly from state to state.

Medicare The program of the Federal government that provides hospital and medical insurance, through social security taxes, to people age 65 and over, those who have permanent kidney failure and certain people with disabilities.

Multiple listing Being on the waiting list for the same organ at more than one transplant center.

National Organ Transplant Act (NOTA) The National Organ Transplant Act (1984 Public Law 98-507), approved October 19, 1984 and amended in 1988 and 1990, outlawed the sale of human organs and provided for the establishment of the Task Force on Organ Transplantation; authorized the Secretary of HHS to make grants for the planning, establishment, and initial operation of qualified OPOs; and established the formation of the Organ Procurement and Transplantation Network (OPTN) and Scientific Registry of Transplant Recipients (SRTR).

New York Heart Association Functional Classification (NYHA) An assessment of a patient's heart failure based on the severity of symptoms. Range is Class I-IV.

Noncompliance 1) Failure of patients to follow the instructions of the medical team, 2) Failure of OPTN members to adhere to the policies and bylaws of the OPTN.

Organ A part of the body made up of tissues and cells that enable it to perform a particular function. Transplantable organs are the heart, liver, lungs, kidneys, pancreas and intestines.

Organ donation To give an organ or a part of an organ to be transplanted into another person. Organ donation can occur with a deceased donor, who can give kidneys, pancreas, liver, lungs, heart, intestinal organs, and with a live donor, who can give a kidney, or a portion of the liver, lung, or intestine.

Organ preservation Methods used to preserve organs while they are out of the body, between procurement from a donor and transplantation into a recipient.

Organ procurement The removal or retrieval of organs from a donor for transplantation.

Organ Procurement and Transplantation Network (OPTN) In 1987, Congress passed the National Organ Transplant Act that mandated the establishment of the OPTN and Scientific Registry of Transplant Recipients. The purpose of the OPTN is to improve the effectiveness of the nation's organ procurement, donation and transplantation system by increasing the availability of and access to donor organs for patients with end-stage organ failure. The Act stipulated that the Network be a non-profit, private sector entity comprised of all U.S. transplant centers, organ procurement organizations and histocompatibility laboratories. These members along with professional and voluntary healthcare organizations and the representatives of the general public are governed by a Board of Directors which reports to the Division of Transplantation, HRSA and ultimately HHS. UNOS holds the OPTN contract.

Organ Procurement Organization (OPO) An organization designated by the Centers for Medicare and Medicaid Services (CMS) and responsible for the procurement of organs for transplantation and the promotion of organ donation. OPOs serve as the vital link between the donor and recipient and are responsible for the identification of donors, and the retrieval, preservation and transportation of organs for transplantation. They are also involved in data folow-up regarding deceased organ donors. As a resource to the community OPOs engage in public educationon the critical need for organ donation. See also Donation Service Area (DSA).

Pancreas Irregularly shaped gland that lies behind the stomach and secretes pancreatic enzymes into the small intestines to aid in

the digestion of proteins, carbohydrates and fats. Islet cells within the pancreas secrete glucagon, which regulates blood sugar levels and insulin, which lowers blood sugar levels. If the pancreas fails, the individual becomes diabetic, and may need to take insulin. The pancreas can be donated and transplanted.

Panel reactive antibody (PRA) The percent PRA value is a measure of a patient's level of sensitization to HLA antigens. It is the percentage of cells from a panel of blood donors against which a potential recipient's serum reacts. The PRA reflects the percentage of the general population that a potential recipient makes antibodies (is sensitized) against. For example, a patient with a PRA of 80 percent will be incompatible with 80 percent of potential donors. Kidney patients with a high PRA are given priority on the waiting list. The higher the PRA, the more sensitized a patient is to the general donor pool, and thus the more difficult it is to find a suitable donor. A patient may become sensitized as a result of pregnancy, a blood transfusion, or a previous transplant.

PCO_2 A blood gas test is performed to measure the amount of CO_2 in the blood. When the lung's ability to exchange oxygen and CO_2 becomes impaired, the PCO_2 level may become increased. The candidate's current PCO_2 and change in PCO_2 are both considered in the lung allocation score calculation to reflect worsening PCO2 values. PCO_2 is used in the Lung Allocation Score.

Peritoneal dialysis A treatment technique for kidney failure that uses the patient's own body tissues inside of the (abdominal cavity to act as a filter. The intestines lie in the abdominal cavity, the space between the abdominal wall and the spine. A plastic tube called a "dialysis catheter" is placed through the abdominal wall into the abdominal cavity. A special fluid is then flushed into the abdominal cavity and washes around the intestines. The lining (peritoneum) of the abdominal cavity and of intra-abdominal organs act as a filter between this fluid and the blood stream. By using different types of solutions, waste products and excess water can be removed from the body through this process.

Plasmapheresis A process in which plasma is removed from blood and the remaining components, mostly red blood cells, are returned to the donor. The process may be used in transplantation to remove pre-formed antibodies.

Procurement The surgical procedure of removing an organ from a donor. Also referred to as recovery.

Pulmonary Having to do with, or referring to, the lungs.

Race See ethnicity.

Recipient A person who receives a transplant.

Recovery (organ) The surgical procedure of removing an organ from a donor.

Rejection A phenomenon that occurs when a recipient's immune system attacks a transplanted organ, tissue, or cell. Immunosuppressive drugs help prevent or treat rejection.

Renal Having to do with, or referring to, the kidneys.

Required request Hospitals must tell the families of suitable donors that their loved one's organs and tissues can be used for transplant. This law is expected to increase the number of donated organs and tissues for transplantation by giving more people the opportunity to donate.

Retransplantation Due to rejection or failure of a transplanted organ, some patients receive another transplant.

Retrieval The surgical procedure of organ recovery. Also referred to as procurement.

Risk pools State-created, nonprofit associations that do not require tax dollars for operational purposes. The risk pools are a temporary stopping place for individuals who are denied health insurance for medical reasons. Risk pools often help individuals who, because of their physical condition, are unable to purchase health insurance at any price.

Scientific Registry of Transplant Recipients (SRTR) As called for by the National Organ Transplant Act (NOTA), the purpose of the SRTR is to provide ongoing evaluation of clinical data about donors, transplant candidates, and recipients, as well as patient and graft survival rates. With oversight and funding from the DoT, the SRTR is currently administered by the Chronic Disease Research Group (CDRG) of the Minneapolis Medical Research Foundation (MMRF).

Sensitization Transplant candidates are "sensitized" if their immune system makes antibodies against a general donor pool. Sensitization usually occurs as a consequence of pregnancy, blood transfusions, or previous transplantation. The degree of sensitization is measured by panel reactive antibody (PRA). Highly sensitized patients are less likely to match with available donors and more likely to reject an organ than unsensitized patients.

Status An indication of the degree of medical urgency for patients awaiting heart or liver transplants. Examples: status 1A, status 1B, or status 2.

Steroids Naturally occurring hormones in the body that help control important body functions. Synthetic or man-made steroids can be used to suppress the immune system.

Survival rates Survival rates indicate the percentage of patients that are alive and the grafts (organs) that are still functioning after a certain amount of time. Survival rates are used in developing OPTN policy.

Systolic blood pressure The top number in the blood pressure (the 120 in a blood pressure of 120/80) measures the maximum pressure exerted on the vessel wall when the heart contracts.

Tissue An organization of a great many similar cells that perform a special function. Examples of tissues that can be transplanted are blood, bones, bone marrow, corneas, heart valves, ligaments, saphenous veins, and tendons.

Tissue typing A blood test that helps evaluate how closely the tissues of the donor match those of the recipient.

Uniform Determination of Death Act (UDDA) The 1981 Uniform Determination of Death Act is a model statute defining "brain death." Versions of this Act have been adopted in 39 states and the District of Columbia. The act states that an individual who has sustained either (a) irreversible cessation of circulatory or respiratory functions or (b) irreversible cessation of all functions of the entire brain, including the brain stem, is dead. A determination of death must be made in accordance with accepted medical standards.

United Network for Organ Sharing (UNOS) The private, nonprofit membership organization that coordinates the nation's transplant system through HRSA's OPTN contract. As OPTN contractor, UNOS is responsible for meeting all contract requirements. As contractor since the first OPTN contract award in 1986, UNOS has established and continually strives to improve tools, systems and quality processes that support OPTN contract objectives and requirements. These include:

- Managing the national organ transplant waiting list
- Collecting, managing and reporting of sensitive clinical data in a secure, fail-safe environment
- Facilitating an open, inclusive forum for development and continuous refinement of evidence-based policies and standards
- Member and policy performance assessment to ensure equitable, safe treatment of candidates and recipients
- Increasing donation and making the most of every organ that is donated through professional education, outcomes research, patient services and resources and public and professional education
- Continuously improving the care, quality of life and outcomes of organ transplant candidates and recipients

Varices (esophageal) Enlarged and swollen veins at the bottom of the esophagus, near the stomach. A common condition caused by increased venous pressure in the liver. These veins can ulcerate and bleed.

Vascular Referring to blood vessels and circulation.

Ventilator A machine that "breathes" for a patient when the patient is not able to breathe properly.

Virus A group of tiny organisms capable of growing and copying themselves while living within cells of the body.

Warm ischemic time (WIT) If the donor is a DCD donor, the warm ischemic time is the time from:

1. the time of Agonal Phase onset (from the time of cardiac arrest when the systolic pressure meets the following conditions for greater than five (5) minutes) to the time when core cooling is initiated. Agonal Phase onset:
   a. Newborn up to 28 days, with a systolic blood pressure less than 60 mmHg, OR
   b. b. 29 days up to 12 months, with a systolic blood pressure less than 70 mmHg, OR
   c. 1 year up to 10 years, with a systolic blood pressure less than 70 mmHg, plus 2 times the age of the patient in years, not to exceed 79 mmHg, OR
   d. 11 years or older, with a systolic blood pressure less than 80 mmHg, OR when the oxygen saturation is less than 80% at any age,
- The calculated time using the serial data to be collected beginning with the agonal phase and ending with the initiation of core cooling.

Xenograft An organ or tissue procured from a different species for transplantation into a human.

Glossary adapted from transplantliving.org, a UNOS website.

abbreviations

BMI	body mass index
BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
CDRG	Chronic Disease Research Group
CMV	cytomegalovirus
COPD	chronic obstructive pulmonary disease
CPRA	calculated panel reactive antibody
CSA	cyclosporine A
CSM	cyclosporine microemulsion
DCD	donation after cardiac death/donation after circulatory death
DD	deceased donor
DHHS	Department of Health and Human Services
DM	diabetes
DOT	Division of Transplantation
DSA	Donation Service Area
EBV	Epstein-Barr virus
ECD	expanded criteria donor kidney
ESRD	end-stage renal disease
eGFR	estimated glomerular filtration rate
GN	glomerulonephritis
HIV	human immunodeficiency virus
HLA	human leukocyte antigen
HMO	health maintenance organization
HTN	hypertension
INR	international normalized ratio
KDRI	kidney donor risk index
LAS	lung allocation score
LD	living donor
LVAD	left ventricular assist device
MTOR	mammalian target of rapamycin
NOTA	National Organ Transplant Act
NYHA	New York Heart Association Functional Classification
OPO	Organ Procurement Organization
OPTN	Organ Procurement and Transplantation Network
PAK	pancreas after kidney transplant
PPO	preferred provider organization
PRA	panel reactive antibody
PTA	pancreas transplant alone
PTLD	post-transplant lymphoproliferative disorder
RRT	renal replacement therapy
RVAD	right ventricular assist device
SCD	standard criteria donor
SPK	simultaneous pancreas-kidney transplant
SRTR	Scientific Registry of Transplant Recipients
STAC	SRTR Scientific and Technical Advisory Committee
TAH	total artificial heart
TCR	transplant candidate registration
TRR	transplant recipient registation
UDDA	Uniform Determination of Death Act
UNOS	United Network for Organ Sharing
USRDS	United States Renal Data System
VAD	ventricular assist device
WIT	warm ischemia time