United States Organ Transplantation

OPTN/SRTR 2023 Annual Data Report

US Department of Health and Human Services
Health Resources and Services Administration

DATA REPORT 2023

U.S. Department of Health and Human Services
HRSA
Health Resources and Services Administration

SRTR
SCIENTIFIC REGISTRY OF TRANSPLANT RECIPIENTS

OPTN/SRTR 2023 Annual Data Report: Preface

This Annual Data Report of the US Organ Procurement and Transplantation Network (OPTN) and the Scientific Registry of Transplant Recipients (SRTR) is the 33rd annual report and is based on data pertaining to the period 2012-2023. The title *OPTN/SRTR 2023 Annual Data Report* reflects the fact that the report covers the most recent complete year of transplants, those performed in 2023.

This publication was developed for the US Department of Health and Human Services, Health Resources and Services Administration, Health Systems Bureau, Division of Transplantation, by the SRTR contractor, Hennepin Healthcare Research Institute (HHRI), and the OPTN contractor, United Network for Organ Sharing (UNOS), under SRTR contract HHSH75R60220C00011 and OPTN contract HHSH250201900001C.

As the SRTR contractor, HHRI, through its Chronic Disease Research Group (CDRG), determined which data to present, conducted the required analyses, created the figures and tables, and drafted the text. As the OPTN contractor, UNOS reviewed the draft report and contributed to the content. This report is available at https://srtr.transplant.hrsa.gov/annualdatareports. Individual chapters may be downloaded.

1 Overview and Highlights

This Annual Data Report includes chapters on kidney, pancreas, liver, intestine, heart, and lung transplants, as well as a chapter on deceased organ donation. The organ-specific chapters include information on such topics as the waiting list, deceased donor organ donation, living donor organ donation, transplant, outcomes, and pediatric transplant. When possible, similar data and formats are used for each chapter. However, this is not always possible because some data are not pertinent to all organs.

Graphical presentation of the data is emphasized: more than 700 figures (including any maps) and tables are included in the chapters. They may be copied and pasted from the HTML files into slides.

Maps in this report present data divided into quintiles. Figure 1 is a sample map.

Maps by donation service area (DSA) use DSA boundaries in effect at the beginning of 2021, after the merger of LifeChoice Donor Services and New England Organ Bank.

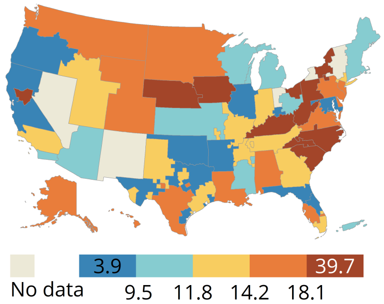

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Figure 1: Example map. In this example, about one-fifth of all data points have a value above 18.1. Ranges include the number at the lower end of the range and exclude that at the upper end (eg, the second range here is 9.5 to <11.8). Numbers in the first and last boxes are the minimum and maximum of observed data.

Some DSAs include noncontiguous areas. If a DSA has no transplant program for a given organ or no listings during the map's timeframe, it is labeled "No data" on the map and shaded accordingly.

2 Milestone Dates in the Production of This Report

Data were cut: June 2024.

Data were analyzed: July 2024.

3 Methods

cPRA

For recipients of kidney and pancreas transplants performed on January 1, 2010, or later, panel-reactive antibody (PRA) at the time of transplant is the calculated PRA (cPRA) value.

For recipients of heart transplants performed from January 1, 2010, through March 30, 2015, PRA at the time of transplant is the minimum value between the most recently recorded PRA and the peak PRA. For recipients of heart transplants performed on March 31, 2015, or later, the cPRA value was used at the time of transplant. If that value is missing, we use the peak cPRA value known at the time of transplant.

Heart status groups

Starting on October 18, 2018, adult candidates were allocated hearts based on status groups 1-6. Status 1 candidates have the highest waitlist mortality risk and status 6 the lowest. Before that date, candidates were allocated hearts based on status groups 1A (highest priority), 1B, and 2.

Incidence
Cumulative incidence of posttransplant outcomes (diabetes, posttransplant lymphoproliferative disorder, and acute rejection) are computed using survival methods.

Graft failure
Unless otherwise specified, “graft failure” refers to graft failure from any cause, including death and retransplant. For kidney failure, this also includes return to maintenance dialysis. “Graft survival” similarly refers to the absence of all-cause graft failure.

Patient survival
Posttransplant patient survival is not censored at graft failure. Thus, patient survival includes follow-up after graft failure, retransplant, and return to maintenance dialysis in the case of kidney recipients.

Transplant rates
Transplant rates include all waiting time (ie, active and inactive) in the interval described.

Pretransplant mortality
Pretransplant mortality rates include all waiting time, and patients are followed until the earliest date of transplant, death, transfer to another program, removal from the waiting list due to improved condition, or cohort censor date. Because we continue to follow candidates for death outcomes beyond removal (except removal due to improved condition), we do not include removal due to deteriorated condition as part of a combined outcome.

Rates by subgroup
When rates are shown by subgroup (ie, sex, race, or primary cause of disease), the numerator and denominator are computed exclusively within those groups. For example, for pretransplant mortality by race, the numerator for each race is the number of deaths in that 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 (eg, model for end-stage liver disease [MELD], PRA), it is assessed at the earliest of transplant, death, removal, or December 31 of the year, and a candidate contributes waiting time and outcome only at that level. For example, age is assessed only once a year; therefore, a candidate contributes all of his or her waiting time to a single age category in a given yearly rate calculation but may change age categories over

time. For example, a waitlisted candidate who was 34 years old on December 31, 2018, would be included in the 18- to 34-year age group in 2018, but if that candidate were still listed in 2020, he or she would be included in the 35- to 49-year age group.

Donor risk index

The kidney donor risk index (KDRI) and pancreas donor risk index (PDRI) are measures of donor quality based on donor factors.

KDRI[1] = Exp{-0.0194 × [if age < 18 yrs] × [age - 18 yrs] + 0.0128 × [age - 40 yrs] + 0.0107 × [if age > 50 yrs] × [age - 50 yrs] + 0.179 × [if African-American race] + 0.126 × [if hypertensive] + 0.130 × [if diabetic] + 0.220 × [serum creatinine - 1 mg/dL] - 0.209 × [if serum creatinine > 1.5 mg/dL] × [serum creatinine - 1.5 mg/dL] + 0.0881 × [if cause of death = cerebrovascular accident] - 0.0464 × [(height - 170 cm)/10] - 0.0199 × [if weight < 80 kg] × [(weight - 80 kg)/5] + 0.133 × [if DCD] + 0.240 × [if HCV+]}

PDRI[2] = Exp{-0.1379 × [if female] - 0.03446 × [if age < 20 yrs] × [age - 20 yrs] + 0.02615 × [age - 28 yrs] + 0.1949 × [if creatinine > 2.5 mg/dL] + 0.2395 × [if African-American] + 0.1571 × [if Asian] - 0.0009863 × [BMI - 24] + 0.03327 × [if BMI > 25] × [BMI - 25] - 0.006074 × [height - 173 cm] + 0.3317 × [if DCD] + 0.2102 × [if cause of death = cerebrovascular accident]}

[1]Rao PS, Schaubel DE, Guidinger MK, Andreoni KA, Wolfe RA, Merion RM, Port FK, Sung RS. A comprehensive risk quantification score for deceased donor kidneys: the kidney donor risk index. *Transplantation*. 2009;88(2):231-236. doi:10.1097/TP.0b013e3181ac620b

[2]Axelrod DA, Sung RS, Meyer KH, Wolfe RA, Kaufman DB. Systematic evaluation of pancreas allograft quality, outcomes and geographic variation in utilization. *Am J Transplant*. 2010;10:837-845. doi:10.1111/j.1600-6143.2009.02996.x

Complete versions of these indices also include transplant factors, but the donor-specific indices in this report are limited to donor-specific factors. Conversion of KDRI to a cumulative percentage scale (ie, KDPI) is done using the OPTN KDPI Mapping Tables. For donors with organs recovered January through May, the cohort 2 years prior was used to assign KDPI; for donors with organs recovered June through December, the cohort 1 year prior was used to assign KDPI. Kidneys recovered en bloc were counted once.

4 Notes

Population reported

Figure titles indicate adult or pediatric populations; if not specified, data include patients of all ages. In the past, lung data included patients aged 12 years or older with adults, and figure titles specified the age ranges. Since the 2019 report, we have classified all lung patients aged 18 years or older as adults and younger patients as pediatrics.

Unless otherwise specified, data in each organ-specific chapter include both isolated transplants and multiorgan transplants of the given type. For example, patients on the kidney transplant waiting list include those listed for an isolated kidney, kidney-pancreas, or any other organ combination that includes kidney.

Waitlist populations are no longer reported at the person level. If a patient is listed at more than one center, that patient is counted once per listing.

Age

Adult patients are defined as those aged 18 years or older for all organs. For waitlist figures, age is defined at the time of first listing, unless otherwise specified.

Race and ethnicity

Prior to September 14, 2023, race and ethnicity were jointly reported by the OPTN in candidate and donor registrations. Beginning on September 14, 2023, they are reported separately. For consistency across time, race and ethnicity are combined in this Annual Data Report. Unless otherwise indicated, in this report, White is defined as non-Hispanic White, and Hispanic is defined as Hispanic/Latino ethnicity with White race or no race reported. The Black, Asian, and Native American categories include persons reported as Hispanic. Asian is defined as Asian, Native Hawaiian, or other Pacific Islander. Native American is defined as American Indian or Alaska Native. When the Other category is shown, Other is defined as Native American, multiracial, or unreported race and ethnicity. The Other category was created to represent these groups when sample sizes are small.

Sex

As in previous years, the OPTN reports birth sex (not gender). Beginning on June 15, 2023, UNOS and the OPTN label the information as “birth sex” instead of “gender,” but the data definition has not changed. In the Annual Data Report, the term *sex* continues to be used.

Pancreas data

Pancreas data encompass the three types of pancreas waiting lists or transplants: simultaneous kidney-pancreas, pancreas after kidney, and pancreas transplant alone (ie, without kidney). Pancreata used for islet transplant are excluded.

MELD score
MELD scores shown in figures and tables are calculated MELD scores, not allocation MELD scores, unless otherwise specified.

Metropolitan and nonmetropolitan designation
Many data are displayed by the designation of a candidate's or recipient's permanent zip code as metropolitan or nonmetropolitan. We used rural-urban commuting area (RUCA) codes and defined metropolitan, micropolitan, small town, and rural areas. These were then collapsed into metropolitan areas, which include suburbs adjacent to major cities, and nonmetropolitan areas, which include cities, towns, and rural areas of fewer than 50,000 people.

5 Data Requests

Requests for data can be made to SRTR at http://www.srtr.org or to OPTN at http://optn.transplant.hrsa.gov.

6 Websites

http://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, links to current and past Annual Data Reports and their 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 prerelease 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.

http://unos.org is a public website containing information on donation and transplant, 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 transplant 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.

7 Contact Information

Research Inquiries
SRTR data requests: 877-970-7787 (toll free); srtr@srtr.org (email)

Media Inquiries
SRTR: 877-970-7787 (toll free); srtr@srtr.org (email)

Federal Program Inquiries
HHS/HRSA/HSB/DoT
5600 Fishers Lane
Parklawn Bldg, Eighth Floor West
Rockville, MD 20857
301-443-7577

8 Commonly Used Abbreviations in This Report

BMI: body mass index
CAKUT: congenital anomalies of the kidney and urinary tract
CAS: composite allocation score
CDC: Centers for Disease Control and Prevention
CDRG: Chronic Disease Research Group
CMV: cytomegalovirus
COVID-19: coronavirus disease 2019
cPRA: calculated panel-reactive antibody
CVA: cerebrovascular accident
DBD: donation after brain death
DCD: donation after circulatory death
DD: deceased donor
DDKT: deceased donor kidney transplant
DGF: delayed graft function
DoT: Division of Transplantation

DSA: donation service area
EBV: Epstein-Barr virus
ECD: expanded-criteria donor
ECMO: extracorporeal membrane oxygenation
eGFR: estimated glomerular filtration rate
FSGS: focal segmental glomerulosclerosis
HCC: hepatocellular carcinoma
HCV: hepatitis C virus
HHS: US Department of Health and Human Services
HIV: human immunodeficiency virus
HLA: human leukocyte antigen
HRSA: Health Resources and Services Administration
HSB: Health Systems Bureau
KAS: kidney allocation system
KDPI: kidney donor profile index
KDRI: kidney donor risk index
LAS: lung allocation score
LD: living donor
LDKT: living donor kidney transplant
LVAD: left ventricular assist device
MASH: metabolic dysfunction–associated steatohepatitis
MELD: model for end-stage liver disease
NRP: normothermic regional perfusion
OPO: organ procurement organization
OPTN: Organ Procurement and Transplantation Network
ORPD: organs recovered per donor
OTPD: organs transplanted per donor
PAK: pancreas-after-kidney (transplant)
PELD: pediatric end-stage liver disease
PDRI: pancreas donor risk index
PRA: panel-reactive antibody
PTA: pancreas transplant alone
PTLD: posttransplant lymphoproliferative disorder
RUCA: rural-urban commuting area
SCD: standard-criteria donor
SGS: short-gut syndrome
SPK: simultaneous pancreas-kidney (transplant)

SRTR: Scientific Registry of Transplant Recipients
UNOS: United Network for Organ Sharing
VAD: ventricular assist device

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This publication lists nonfederal resources in order to provide additional information to consumers. The views and content in these resources have not been formally approved by HHS or HRSA. Neither HHS nor HRSA endorses the products or services of the listed resources.

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OPTN/SRTR 2023 Annual Data Report: Introduction

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Abstract

The *OPTN/SRTR 2023 Annual Data Report* presents the status of the solid organ transplant system in the United States from 2012 through 2023. Organ-specific chapters are presented for kidney, pancreas, liver, intestine, heart, and lung transplant. Each organ-specific chapter is organized to present waitlist information, donor information (both deceased and living, as appropriate), transplant information, and patient outcomes. Data pertaining to pediatric patients are generally presented separately from the adult data; however, many chapters now have a Donation section, which includes data on adult and pediatric organ donation. The data presented in the Annual Data Report are descriptive in nature. In other words, most tables and figures present raw data without statistical adjustment for possible confounding or changes over time. Therefore, the reader should keep in mind the observational nature of the data when attempting to draw inferences before trying to ascribe a cause to any observed patterns or trends. This introduction provides a brief overview of trends in candidates on the waiting list, new additions to the waiting list, transplant activity, and posttransplant patient survival, with a focus on 2013-2023. More detailed descriptions can be found in the respective organ-specific chapters.

Keywords: Organ transplant, patient survival, waiting list

1 Trends in Kidney Transplant

In 2023, there were 144,842 adult and pediatric candidates on the kidney waiting list at some point (Figure INT 1), a 1.3% increase from 2022. This includes active and inactive candidates on the list at any time during the year. Over the past decade (2013-2023), the size of the waiting list peaked prior to the COVID-19 pandemic, with 146,637 candidates in

2019. The number of new candidates added to the kidney waiting list in 2023 rose to 47,838 (Figure INT 3), a 5.6% increase from 2022. A similar increase was seen in the previous year. Over the past decade, the highest number of new kidney candidates were added in 2023. The number of kidney transplants also increased to 28,142 in 2023, the highest number and a 7.0% increase from 2022 (Figure INT 5). Despite the growing number of kidney transplants, there is potential for an even higher number of kidney transplants to be performed, based on the increasing proportion of kidneys from deceased donors recovered for the purpose of transplant but ultimately not transplanted (ie, nonuse rate). In 2023, the nonuse of kidneys increased to 27.9%, from 26.6% in 2022 (Figure INT 7). These kidneys when recovered en bloc were counted once, whereas kidneys recovered separately were counted twice. With over a quarter of all deceased donor kidneys not used, this represents an opportunity for improved efficiency in the transplant system. Among kidney transplant recipients in 2016-2018, 1-year and 5-year patient survival were 97.4% and 86.6%, respectively (Figure INT 8). Of note, a record number of donation after circulatory death (DCD) kidneys were transplanted in 2023—representing 26.1% of all deceased donor kidney transplants (Figure INT 9).

2 Trends in Pancreas Transplant

Over the past decade, the demand for pancreas-alone transplant has continued to decline, as evidenced by a decrease in the number of candidates listed for pancreas-alone or pancreas-after-kidney transplant. The number of these candidates was down to 974 in 2022 and 1,024 in 2023, compared with 1,536 in 2013 (Figure INT 2), which is likely due to improvement in medical management of diabetes. In comparison, the number of candidates waiting for a combined kidney-pancreas transplant over the same period has increased slightly to 3,554 in 2023, a 6.3% increase from 3,344 in 2022 and up from 3,428 in 2013. Similar trends were seen in the number of new additions to the pancreas waiting list in 2023, with an increase to 323 for pancreas-alone or pancreas-after-kidney and an increase to 1,587 for kidney-pancreas, compared with 2022 (Figure INT 4). The total number of pancreas transplants performed in the United States was 915 in 2023, a slight decline from 918 in 2022 (Figure INT 6). The proportion of pancreases from deceased donors recovered for the purpose of transplant but not transplanted declined to 23.4%, a decrease from 28.7% in 2022. Among all organs, pancreas still has a high nonuse rate, second only to kidney in 2023 (Figure INT 7). Thus, there is potential for an even higher number of pancreas transplants to be performed. Among transplant recipients in 2016-2018, 1-year and 5-year patient survival were 96.0% and 88.3%, respectively (Figure INT 8).

3 Trends in Liver Transplant

Over the past decade, the demand for liver transplants has continued to decline, likely due to improvements in the treatment of hepatitis C. In 2023, the number of adult and pediatric liver transplant candidates on the waiting list rose slightly to 25,634, a 1.2% increase from 2022. However, compared with 2013, the total number of candidates remained low, from a peak of 28,484 in 2013 (Figure INT 1). There has been a smaller increase in new candidates added to the waiting list during the same time period. In 2023, there were 14,658 candidates added to the waiting list, a 7.8% increase from 2022 (Figure INT 3). The number of liver transplants rose to 10,659 in 2023, an 11.9% increase from 2022; this number has increased each year since 2013, when it was 6,455 (Figure INT 5). The proportion of livers from deceased donors recovered for the purpose of transplant but ultimately not transplanted decreased to 9.7% in 2023, from 9.9% in 2022 (Figure INT 7). Thus, there is potential for an even higher number of liver transplants to be done. Among transplant recipients in 2016-2018, 1-year and 5-year patient survival were 92.5% and 81.5%, respectively (Figure INT 8). Of note, a record number of DCD livers were transplanted in 2023—representing 15.9% of all deceased donor liver transplants (Figure INT 9).

4 Trends in Intestine Transplant

In 2023, there were 349 candidates on the intestine waiting list, a slight increase from 347 in 2022 (Figure INT 2). Of these 349 candidates, 135 were newly added to the intestine waiting list (Figure INT 4). The number of intestine transplants in 2023 was 95, a 15.8% increase from 2022 (Figure INT 6). However, the demand for intestine transplants has largely continued to decline over the past decade, likely due to improvements in medical management. Among intestine transplant recipients in 2016-2018, 1-year and 5-year survival were 81.1% and 62.2%, respectively (Figure INT 8). This represents the lowest 1-year patient survival among all solid organ transplants.

5 Trends in Heart Transplant

In 2023, there were 9,190 candidates on the heart waiting list, a 5.5% increase from 2022 (Figure INT 2). Of these candidates, 5,800 were newly added to the list in 2023, which represents a 12.6% annual increase since 2022 (Figure INT 4). The number of heart transplants performed in 2023 reached a record high of

4,599, a 10.5% increase over 2022 and up from 2,554 in 2013 (Figure INT 6). Among the cohort of heart transplant recipients in 2016-2018, 1-year and 5-year patient survival were 91.7% and 80.8%, respectively (Figure INT 8). Of note, a record number of DCD hearts were transplanted in 2023—representing 13.4% of all deceased donor heart transplants (Figure INT 9).

6 Trends in Lung Transplant

In 2023, there were 4,438 candidates on the lung waiting list, a 3.2% increase from 2022 (Figure INT 2). The year 2023 saw 3,427 new listings, a 6.8% increase from 2022 (Figure INT 4). The 3,080 lung transplants performed in 2023 was a record high and a 12.3% increase from 2022. This is a sign not only of continued recovery from the COVID-19 pandemic (the prepandemic number of lung transplants was 2,759 in 2019) but also of additional growth (Figure INT 6). Among the cohort of lung transplant recipients in 2016-2018, 1-year and 5-year survival were 89.0% and 60.1%, respectively. This represents the lowest 5-year patient survival among all solid organ transplants. Of note, a record number of DCD lungs were transplanted in 2023—representing 10.1% of all deceased donor lung transplants (Figure INT 9).

7 Summary

In 2023, the transplant community has continued to increase the use of DCD organs among kidney, liver, heart, and lung recipients, at record levels. As in the previous year, the transplant community set another record for the number of solid organ transplants performed in the country. Over the past decade (2013-2023), the number of kidney transplants increased by 59%; liver transplants, by 65%; heart transplants, by 80%; and lung transplants, by 58%. During the same period, there was a decline of 10% for pancreas transplant and of 13% for intestine transplants. Since 2013, the number of candidates on the waiting list increased for kidney, kidney-pancreas, heart, and lung transplants and decreased for liver, intestine, and pancreas-alone transplants. The last decade also saw an increase in the number of newly listed candidates for kidney, kidney-pancreas, liver, heart, and lung transplant and a decline in the number of newly listed candidates for intestine and pancreas-alone transplant. The growth in transplants overall was outpaced by the waitlist additions, thereby highlighting the continued supply-demand imbalance in solid organ transplantation. Since 2013, the growth in the number of organs recovered for the purpose of transplant but ultimately not transplanted for kidney, liver, heart, and lung—with intestine stabilizing and pancreas declining—represent an opportunity for improving efficiency in the system. Each organ-specific chapter and the chapter on deceased organ donation in this Annual Data Report present a more detailed look at the status of organ donation and transplantation in the United States.

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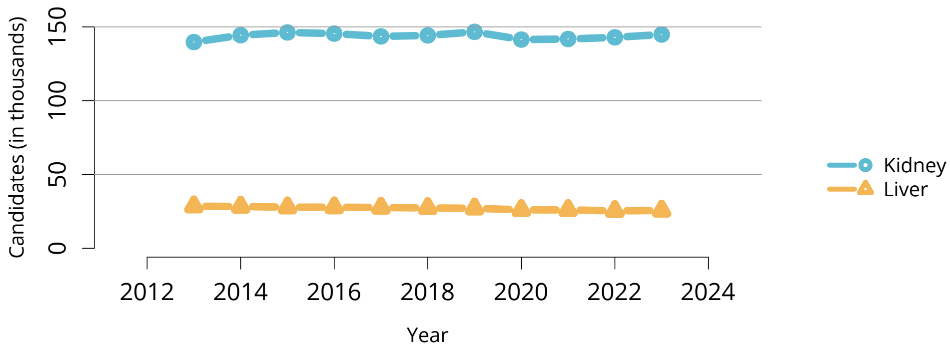

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Figure INT 1: All candidates on the kidney or liver waiting list. Candidates listed at multiple centers are counted once per listing. Includes active and inactive candidates on the list any time during the year.

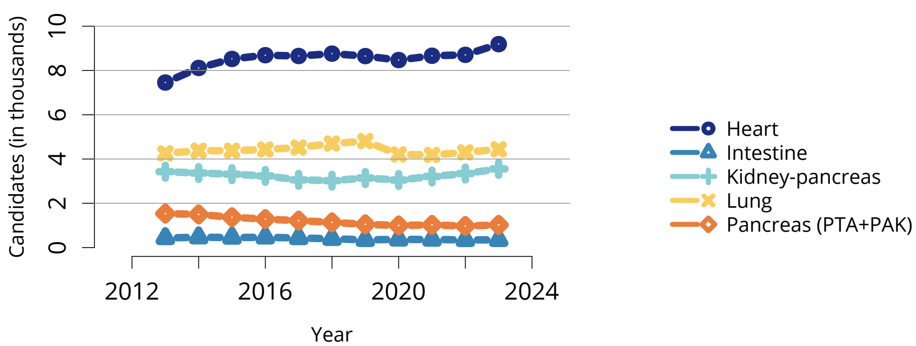

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Figure INT 2: All candidates on the waiting list for organs other than isolated kidney or liver. Candidates listed at multiple centers are counted once per listing. Includes active and inactive candidates on the list any time during the year. PAK, pancreas after kidney; PTA, pancreas transplant alone.

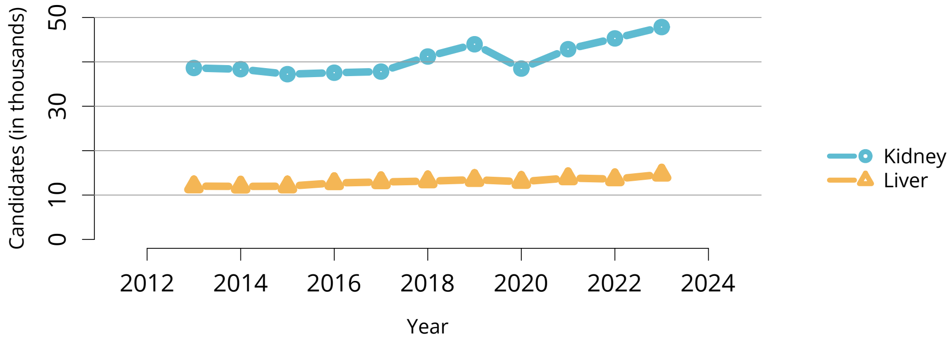

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Figure INT 3: New candidates added to the kidney or liver waiting list during the year. A new candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and subsequently relisted are considered new. Active and inactive patients are included.

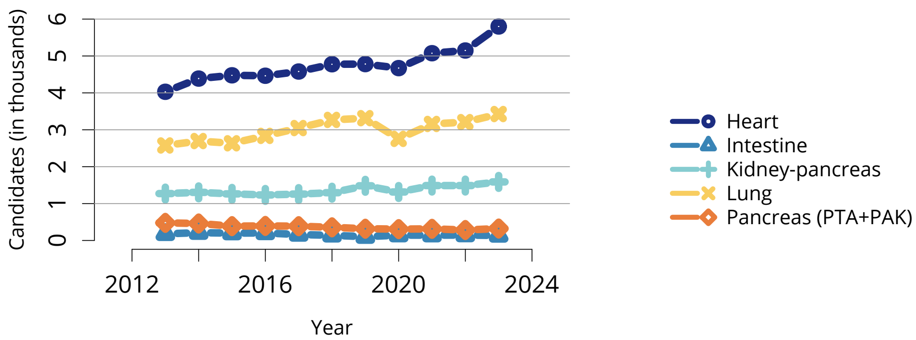

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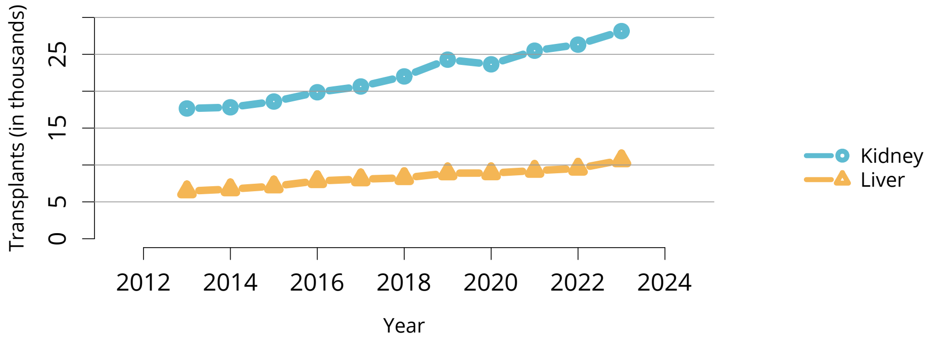
Figure INT 4: New candidates added to the waiting list during the year for organs other than isolated kidney or liver. A new candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and subsequently relisted are considered new. Active and inactive patients are included. PAK, pancreas after kidney; PTA, pancreas transplant alone.



OPTN/SRTR 2023 Annual Data Report

Figure INT 5: Total counts of kidney or liver transplants. Kidney: patients undergoing kidney or simultaneous pancreas-kidney transplant. Retransplants and multiorgan transplants are included.

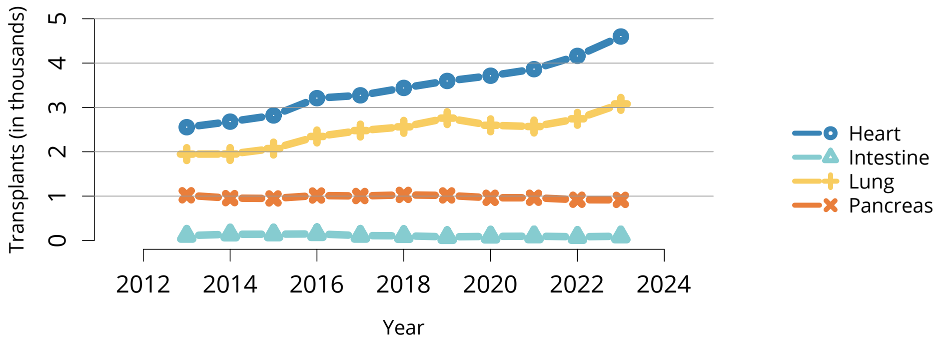


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Figure INT 6: Total counts of transplants for organs other than isolated kidney or liver. Pancreas: patients undergoing pancreas or simultaneous pancreas-kidney transplant. Heart: patients undergoing heart or heart-lung transplant. Lung: patients undergoing lung or heart-lung transplant. Retransplants and multiorgan transplants are included.

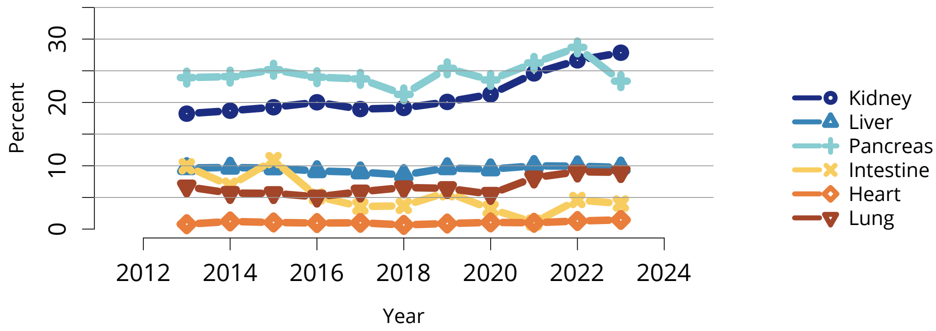

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Figure INT 7: Rates of organs recovered for transplant and not transplanted. Percentage of organs not transplanted out of all organs recovered for transplant. Kidneys and lungs recovered en bloc are counted once, and those recovered separately are counted twice.

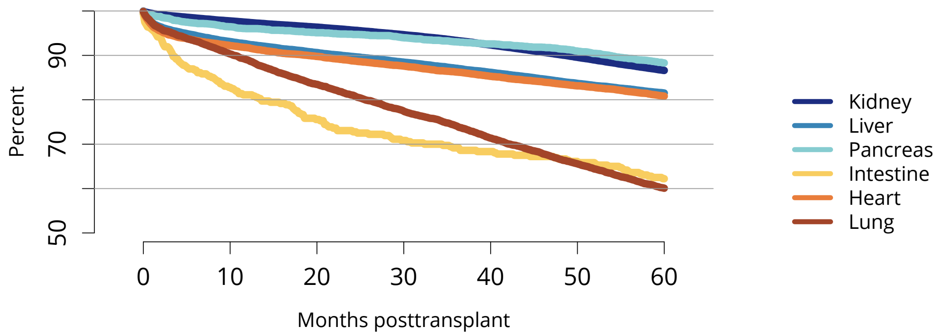

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Figure INT 8: Patient survival among all transplant recipients, 2016-2018, by organ. Patient survival estimated using unadjusted Kaplan-Meier methods. Similar overall survival rates for kidney and pancreas recipients and liver and heart recipients may obscure an organ's line on the graph.

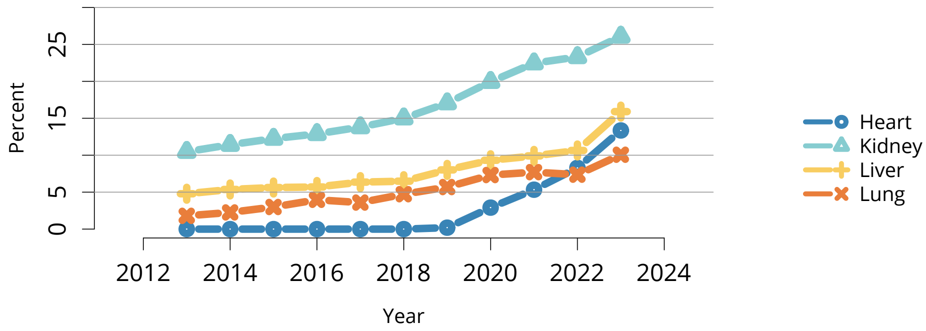

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Figure INT 9: Percent of DCD transplants by organ. All transplant recipients, including retransplant and multiorgan recipients. DCD, donation after circulatory death.

OPTN/SRTR 2023 Annual Data Report: Kidney

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Abstract

In 2023, the field of kidney transplantation faced both successes and challenges. A record 28,142 total kidney transplants were achieved in the United States, largely due to an increase in deceased donor kidney transplants (DDKTs). While the number of adult candidates listed for DDKT slightly increased, it remained below the level in 2019, with 11.4% of candidates waiting 5 years or more. Across racial and ethnic groups, Black adult candidates had the largest increase in DDKT rate in 2023, in parallel with the Organ Procurement and Transplantation Network policy to modify waiting time (implemented January 5, 2023). Following increases in death rates during the COVID-19 pandemic, pretransplant mortality declined in 2023 across various age, race and ethnicity, sex, and blood type categories, although mortality continued to vary substantially by donation service area. The rate of deceased donor kidneys that were recovered for transplant but not

transplanted (nonuse) increased to a notable high of 27.9%, from 26.6% in 2022, with even higher rates for biopsied kidneys (41.4%), those from donors aged 65 years or older (72.2%), and kidneys with a kidney donor profile index of 85% or higher (72.5%). In contrast, nonuse of kidneys recovered from hepatitis C virus nucleic acid test–positive donors declined to 27.2% in 2023, from 43.0% in 2017, likely reflecting more common use of protocols incorporating direct-acting antiviral therapy. Disparities in access to living donor kidney transplant (LDKT) persist and particularly affect non-White and publicly insured patients. Delayed graft function has risen over the past decade, but appears to have plateaued, at 26.1% overall for adult recipients in 2023. Five-year graft survival rates were 90.0% for LDKT compared with 82.2% for DDKT in recipients aged 18-34 years, and 80.2% for LDKT versus 66.1% for DDKT in those aged 65 years or older.
Keywords: Deceased donor transplant, kidney transplantation, living donor transplant, transplant access, transplant outcomes, waitlist outcomes

1 Introduction

Kidney transplantation offers eligible patients with end-stage kidney disease the best chance for long-term survival without dialysis and at the lowest cost to the health care system. In 2023, a record 28,142 total kidney transplants were done in the United States. However, there are ongoing challenges in improving transplant access, reducing disparities, and enhancing long-term allograft survival, along with efforts toward those goals. In recent years, there has been unprecedented focus on increasing access to kidney transplant, including introducing new payment models for transplant centers and referring providers, as well as regulatory and legislative measures aimed at increasing deceased donor organ procurement, promoting organ use, and removing barriers to living donation. As the effects of the COVID-19 pandemic diminish, attention is shifting toward modernizing the transplant system to enhance performance and efficiency and address racial disparities. Although the number of deceased donor kidney transplants (DDKTs) continues to rise, this progress is countered by increasing rates of kidney nonuse, longer cold ischemia times, and delayed graft function amid broader geographic organ sharing. The rate of living donor kidney transplants (LDKTs) remains low and is marked by sociodemographic disparities.

The Annual Data Report provides a comprehensive review of the current state of kidney transplantation in the United States, highlighting both achievements and concerning trends that require further scrutiny. It includes data on waiting lists for adult and pediatric kidney transplants, as well as information on deceased and living donations, transplant procedures, and outcomes.

2 Adult Kidney Transplant

2.1 Waiting List

The number of adult candidates added to the kidney waiting list increased to 46,661 in 2023, showing recovery from the COVID-19 pandemic–related decline to 37,401 in 2020 and surpassing the pre-pandemic peak of 42,933 in 2019 (Figure KI 1). The total number of adult candidates ever waiting for kidney transplant in 2023 (including those listed at multiple centers) rose slightly to 141,886, compared with 140,124 in 2022, but remained below the 144,058 candidates ever waiting in 2019 (Figure KI 2). There were 4,002 waitlist removals due to death in 2023, a significant decrease from 5,371 in 2021 during the COVID-19 pandemic. However, the 4,855 waitlist removals due to being too sick for transplant in 2023 reflect an ongoing increase from 4,059 in 2021. Removals for other reasons aside from transplant or clinical improvement were also higher in 2023 (Table KI 5). The trend of a gradual increase in the proportion of older candidates on the waiting list over the past decade continued. Candidates aged 50-64 years at listing remained the largest age group (42.3% of listed candidates) in 2023, while the proportion of candidates aged 65 years or older rose slightly to 26.7%. Candidates aged 18-24 years made up only 8.0% of the adult waiting list (Figure KI 3). The sex distribution of the waiting list remained unchanged: 61.9% of adult kidney candidates in 2023 were male (Figure KI 4). Since 2012, the proportions of Asian, Hispanic, and Multiracial candidates on the kidney waiting list have generally increased slightly, but the distributions have been relatively stable in recent years, with a slight ongoing decline in the proportion of White candidates (36.8% in 2023 versus 37.1% in 2022; Figure KI 5). The distribution of primary kidney failure diagnoses in 2023 remained stable, with diabetes (38.7%) and hypertension (20.1%) as the most common causes. The proportion of candidates with other/unknown causes of kidney failure showed a slight ongoing increase to 18.8% (Figure KI 6).

In 2023, the proportion of adult candidates on the waiting list with a waiting time of less than 1 year rose to 37.9%, up from 36.1% in 2022 and 34.2% in 2021. Meanwhile, 11.4% of candidates on the waiting list at some point in 2023 had been waiting for 5 years or longer, a proportion that has declined since 2017 (Figure KI 7). The proportion of waitlisted candidates with a high body mass index (BMI) also continued to increase slightly in 2023, with 19.3% having a BMI of 35 kg/m^2 or greater, while a stable 27.5% had a BMI of 30-<35 kg/m^2 (Figure KI 8). The proportion of candidates waitlisted before starting dialysis showed an ongoing, encouraging increase to 27.4% in 2023, although

14.9% of those waitlisted had been on dialysis for 6 or more years (Figure KI 9). The distribution of candidates across blood type groups remained stable in 2023, with 52.8% of waitlisted kidney candidates having blood type O (Figure KI 10). The proportion of candidates with a previous transplant was 10.8% in 2023, reflecting a gradual decline from 14.8% in 2012 (Figure KI 11).

In 2023, the proportion of adult candidates willing to accept a kidney with a high kidney donor profile index (KDPI) score declined slightly across all age groups, continuing a downward trend that began after the revised kidney allocation system (KAS) was implemented in December 2014. Willingness to accept high-KDPI kidneys was higher among older candidates, but only 48.4% of those aged 50-64 years and 63.3% of those aged 65 years or older were willing to accept them in 2023 (Figure KI 12). In contrast, the proportion of candidates willing to accept a kidney from a donor who is hepatitis C virus (HCV) antibody positive has continued to increase sharply, and even surpassed the unwilling proportion by reaching 51.0% in 2023 (Figure KI 13). This increase follows the availability of highly effective direct-acting antiviral agents and the growing experience in using these regimens to manage anticipated donor-derived infections.

Rates of DDKT among adult waitlist candidates continued to rise in 2023, following a low point in 2014 (Figure KI 14). Candidates aged 18-34 years have the highest transplant rates, but their rate did not increase in 2023. Increased DDKT rates were observed for those aged 35 years or older, with a notable increase for candidates aged 65 years or older, reaching the same rate as among candidates aged 35-49 years (Figure KI 15). DDKT rates rose across racial and ethnic groups, with Black candidates having the highest DDKT rate in 2023 at 26.1 transplants per 100 patient-years (Figure KI 16). This trend corresponds with changes in waiting time credit based on estimated glomerular filtration rate (eGFR) for Black candidates in the allocation policy. The DDKT rates also increased across primary diagnoses of kidney failure (Figure KI 17). Additionally, DDKT rates rose across all calculated panel-reactive antibody (cPRA) levels in 2023, with sharp increases among those with cPRA of 80%-<98%, reaching 34.3 transplants per 100 patient-years, and those with cPRA of 98%-100%, reaching 21.0 transplants per 100 patient-years (Figure KI 18). DDKT rates increased across all candidate blood type groups in 2023, peaking at 44.3 transplants per 100 patient-years for those with blood type AB (Figure KI 19). In 2023, DDKT rates increased for candidates with waiting times of less than 5 years, reaching a high of 19.5 transplants per 100 patient-years for those with 3-<5 years of waiting time and 28.4 transplants per 100 patient-years for those waiting less than 1 year (Figure KI 20). By sex, DDKT rates remained slightly higher in female candidates compared with male candidates in 2023, a trend since 2016 (Figure KI 21).

For adults newly waitlisted in 2018-2020, 29.9% were still waiting 3 years after listing; 30.8% had undergone DDKT, 13.5% had undergone LDKT, 6.8% had died, and 19.1% had been removed from the waiting list (Figure KI 22). The proportion of patients who underwent DDKT within 3 months rose to a high of 12.3% among those listed in 2022, while the percentage who underwent DDKT within 3 years also continued to rise, reaching 32.9% for those listed in 2020 (Figure KI 23). (Note that in deceased donor kidney allocation, match-run priority is primarily based on candidate duration of organ failure, which can include both time on the list and time on dialysis prior to listing. OPTN policy refers to this duration as "waiting time"; in the Annual Data Report, "waiting time" refers only to time since listing.)

Following increases in mortality rates during the COVID-19 pandemic, pretransplant mortality declined in 2023 to 5.0 deaths per 100 patient-years, compared with 6.2 deaths per 100 patient-years in 2021 (Figure KI 24), with decreases across race and ethnicity (Figure KI 26) and sex (Figure KI 27). Pretransplant mortality in 2023 was lowest in those aged 18-34 years and remained stable in that group while declining in older age groups (Figure KI 25). By blood type, pretransplant mortality was lowest in patients with blood type AB and remained stable in that group while declining among patients with other blood types (Figure KI 29). Pretransplant mortality declined in all diagnosis groups, and those with glomerulonephritis or cystic kidney disease continued to have the lowest mortality rates (Figure KI 28). Pretransplant mortality continued to vary substantially by donation service area, ranging from 2.0 to 7.3 deaths per 100 patient-years (Figure KI 30).

Death within 6 months of removal from the waiting list (for removal reasons other than transplant or death) declined in 2023 for adult candidates from a peak in 2020 (Figure KI 31). Considered by diagnosis group, mortality after waitlist removal declined slightly from 2022 to 2023 for those with diabetes, glomerulonephritis, or cystic kidney disease but increased slightly in those with hypertension and those with other/unknown causes of kidney failure (Figure KI 32). By age, death within 6 months of waitlist removal rose slightly among both younger and older adult candidates, while declining slightly in those aged 35-64 years (Figure KI 33). By race and ethnicity, death within 6 months of waitlist removal rose for Asian, Black, Native American, and slightly for White candidates but declined for Hispanic and Multiracial candidates (Figure KI 34). In 2023, death within 6 months of waitlist removal declined slightly among female candidates but increased among male candidates (Figure KI 35).

2.2 Transplants

The upward trajectory in total adult kidney transplants was modestly slowed by the COVID-19 pandemic in 2020, then continued to rise, reaching a high of 27,351 in 2023 (Figure KI 37). This trend was driven by growth in DDKT, which rose to a high of 21,303 in 2023 (Figure KI 38), predominantly from donors with KDPI of less than 85% (Figure KI 44). In 2023, the proportion of adult DDKT from donors classified as KDPI less than 20% showed a slight decrease, to 24.2%, while most DDKTs were from KDPI 35%-<85% donors (51.6%), and only 6.3% of DDKTs were from donors with KDPI of 85% or greater (Figure KI 44). Considered by recipient age, kidney transplant counts increased most in recipients aged 50-64 years and those aged 65 years or older (Figure KI 39). Adult kidney transplant counts rose across racial and ethnic groups, with the largest increase in Black patients (Figure KI 41). Growth in total kidney transplants in 2023 was similar by recipient sex (Figure KI 40). Kidney transplant counts increased across diagnosis groups in 2023, especially in patients with diabetic kidney failure, in parallel with larger representation of patients with diabetes on the waiting list (Figure KI 42). In 2023, most growth in adult kidney transplant occurred in patients without prior transplant (Figure KI 43). In 2023, 89.8% of DDKTs and 90.7% of LDKTs were performed in first-time recipients (Table KI 8).

Disparities in access to LDKT continued in 2023. While 31.0% of adult waitlisted candidates as of December 31, 2023, were Black (Table KI 1), Black patients made up only 11.8% of LDKT recipients, versus 36.6% of DDKT recipients, in 2023 (Table KI 6). White patients made up 35.7% of the waiting list in 2023 (Table KI 1) and constituted 33.8% of DDKT recipients and 61.0% of LDKT recipients (Table KI 6). Most LDKT recipients (54.1%) had private insurance at the time of transplant in 2023, compared with 27.3% of DDKT recipients; 61.7% of DDKT recipients were Medicare beneficiaries compared with 37.8% of LDKT recipients (Table KI 6). LDKT recipients tended to have less dialysis time and lower cPRA levels than DDKT recipients. In 2023, 33.0% of LDKT recipients underwent transplant without having had dialysis, compared with 13.9% of DDKT recipients (Table KI 7).

The proportion of adult DDKT recipients with peak cPRA levels of 98%-100% increased sharply after the 2014 KAS revision and then gradually declined, from 12.5% in 2015 to 6.1% in 2022, with a slight increase to 7.2% in 2023. Following the March 2021 KAS250 revision, there was an increase in the proportion of DDKT recipients with cPRA of 80%-<98%: in 2020, 7.0%; in 2021, 10.4%; then in 2023, a slight decline to 9.6% (Figure KI 49). By comparison, only 1.0% of LDKT recipients in 2023 had peak cPRA levels of 98%-100%, while most LDKT recipients (68.1%) had peak cPRA levels of <1% (Figure KI 50). Sensitization was more common among adult recipients of paired LDKT, with 2.3% having cPRA of 98%-100% and 8.0% having cPRA of 80%-<98% (Figure KI 51). By donor type, 23.9% of DDKTs and 42.0% of LDKTs were performed with three or fewer HLA mismatches, including zero HLA mismatches in less than 5% of both DDKTs and LDKTs (Figure KI 48).

Induction immunosuppression was used in 93.0% of adult kidney transplants in 2023, reflecting a small but continued increase in proportion since 2020 (Figure KI 45). This trend was driven by growing use of T-cell–depleting induction agents alone (75.2% of recipients), while 16.4% received interleukin-2 receptor antibodies (IL2Ab) alone and 1.5% were reported as receiving both agents (Figure KI 46). Most patients received tacrolimus and mycophenolate–based regimens during the initial transplant hospitalization period: 68.8% received triple therapy (tacrolimus, mycophenolate, and steroids) and 24.7% received tacrolimus and mycophenolate without reported steroid use (Figure KI 47).

2.3 Outcomes

Delayed graft function, defined as dialysis within the first 7 days posttransplant, has trended higher over the past decade, but appears to have plateaued, at 26.1% overall in 2023 in adults (Figure KI 52). The eGFR at 12 months, calculated using the 2021 race-free Chronic Kidney Disease–Epidemiology Collaboration creatinine-based equation, an early surrogate allograft outcome, was 45 mL/min/1.73 m^2 or higher for 64.9% of DDKT recipients in 2022, reflecting a slight downtrend from 67.8% in 2016 (Figure KI 65). Among LDKT recipients, 80.6% had 12-month eGFR of 45 mL/min/1.73 m^2 or higher in 2022, a slight decline from 82.6% in 2016 (Figure KI 66). Acute rejection rates continued to trend lower across age groups. For transplants performed in 2022, acute rejection by 1 year was highest in recipients aged 18-34 years at 8.0% and lowest in recipients aged 65 years or older at 5.1% (Figure KI 67). Acute rejection at 1 year occurred in 7.1% of those who received both IL2Ab and T-cell–depleting induction (Figure KI 68), likely in part reflecting regimen changes in patients with early complications. For other regimens, acute rejection at 1 year was reported in 5.7% of those who received IL2Ab induction alone, 6.0% who received T-cell–depleting induction alone, and 4.7% of those whose transplants were managed without induction. Posttransplant lymphoproliferative disorder was uncommon in adult kidney transplant recipients, reported in 1.9% and 0.5% of Epstein-Barr virus (EBV)–negative and EBV-positive recipients, respectively, at 5-years posttransplant (Figure KI 69).

Among adult DDKT recipients, 5-year graft survival was lowest among older (versus younger) recipients: 66.1% among recipients aged 65 years or older compared with 82.2% among recipients aged 18-34 years (Figure KI 53). Compared with graft survival among White recipients, 5-year DDKT graft survival was higher among Asian, Hispanic, and Multiracial recipients but lower among Black and Native American recipients (Figure KI 54). Graft survival was lower among male recipients (versus female recipients; Figure KI 55) and recipients with diabetes as the cause of kidney failure (versus other causes; Figure KI 56). Compared with recipients with BMI of 18.5-<25 kg/m^2 at transplant, 5-year graft survival showed a graded decline in those with higher BMI levels (Figure KI 60). Five-year DDKT graft survival was 62.9% for allografts with KDPI of 85% or greater, compared with 84.6%, 81.2%, and 74.8% for those with KDPI of <20%, KDPI 20%-<35%, and KDPI 35%-<85%, respectively (Figure KI 57). Five-year graft survival was only slightly lower for donation after circulatory death (DCD) transplants compared with donation after brain death transplants (75.8% versus 77.4%; Figure KI 58). Graft survival was lower after transplant of kidneys that underwent a procurement biopsy compared to kidneys transplanted without biopsy (73.1% versus 80.9%; Figure KI 59), although, given the high nonuse rate of biopsied kidneys (Figure KI 96) and the uncertain predictive value of biopsy beyond clinical factors, the utility of procurement biopsy in informing appropriate organ use is a topic of ongoing debate.[1]

Among adult LDKT recipients, 5-year graft survival was 80.2% in recipients aged 65 years or older, compared with 90.0% in recipients aged 18-34 years (Figure KI 61). Compared with graft survival in White recipients, 5-year LDKT graft survival was higher among Asian and Hispanic recipients and lower among Black, Multiracial, and Native American recipients (Figure KI 62). Five-year LDKT graft survival was lower in recipients with diabetic kidney failure compared with recipients with other disease causes (Figure KI 64), and similar in female and male recipients (Figure KI 63).

Trends in adult posttransplant patient survival generally paralleled the trends observed in kidney graft survival. Five years posttransplant, 70.1% of DDKT recipients and 81.9% of LDKT recipients aged 65 years or older were alive, compared with 95.7% and 97.9% of those aged 18-34 years, respectively (Figure KI 70 and Figure KI 76). Patient survival after DDKT was higher in female recipients than male recipients (Figure KI 72). Compared with patient survival among White recipients, 5-year patient survival after DDKT and LDKT were higher among Asian, Black, Hispanic, and Multiracial recipients, but lower among Native American recipients; however, across racial and ethnic groups, patient survival was higher after LKDT compared with DDKT (Figure KI 71 and Figure KI 78). Five-year patient survival was lowest among recipients with diabetes as the cause of kidney disease, at 76.8% for DDKT recipients and 85.8% for LDKT recipients (Figure KI 73 and Figure KI 77). Patient survival among DDKT recipients showed graded decline with donor KDPI score, from 91.2% in recipients of KDPI 0-<20% kidneys to 71.7% in recipients of kidneys with KDPI of 85% or greater (Figure KI 74). Patient survival was also lower in recipients of grafts that had undergone a procurement biopsy compared with recipients of grafts that were not biopsied (Figure KI 75).

3 Donation

3.1 Deceased Donation

The counts of deceased donors (adult and pediatric) from whom at least one kidney was recovered for transplant continued to rise in 2023 (Figure KI 79), particularly among donors aged 36 years or older (Figure KI 80). The proportion of deceased donors aged 35 years or younger declined to 31.1% in 2023, from 34.0% in 2022, whereas the proportion aged 50 years or older increased to 41.0% in 2023, from 37.9% in 2022 (Figure KI 82). The racial and ethnic distribution of deceased kidney donors remained largely unchanged over the past decade, with 66.7% White donors in 2023 (Figure KI 84), and the predominance of male deceased donors in 2023 (62.0%) was stable compared with 2022 (Figure KI 83). The counts of HCV antibody–positive deceased donors from whom kidneys were recovered was stable in 2023 (Figure KI 81), slowing the prior trend of more rapid increase over the past decade. In 2023, 4.8% of deceased kidney donors were HCV positive with a nucleic acid test (NAT+), a decline from a peak of 6.6% in 2020, while 5.2% were HCV positive with NAT-/Ab+, a slight increase from 4.9% in 2022 (Figure KI 85). The proportion of DCD kidney donors continued to rise, reaching 37.3% in 2023 (Figure KI 86). Among causes of death, the proportion of deceased kidney donors who died of anoxia continued to increase, to 49.5% in 2023 (Figure KI 87), in the context of the ongoing opioid epidemic.

Overall, in 2023, the proportion of deceased donor kidneys recovered for transplant and not transplanted (nonuse rate) continued to rise to a notable high of 27.9%, compared with 26.6% in 2022 and 18.7% in 2012 (Figure KI 88), in the context of the broader geographic organ distribution but also with substantial variation by donor characteristics. Nonuse rates were highest for kidneys recovered from donors aged 65 years or older, reaching 72.2% in 2023 (Figure KI 89). The nonuse rate was also higher for kidneys recovered from donors with diabetes (Figure KI 90), hypertension (Figure KI 93), or elevated BMI (with a graded increase for BMI level above 25 kg/m^2; Figure KI 94), compared with donors without each of these characteristics, respectively.

In 2023, nonuse was slightly higher for kidneys recovered from Black and Asian donors (30.2% and 30.0%, respectively) compared with White donors (28.4%), while nonuse was lower for kidneys recovered from Hispanic donors and those of Other race and ethnicity (Figure KI 92). Kidneys recovered for transplant that were biopsied continued to have increasing nonuse rates, up to 41.4% in 2023 (Figure KI 96). Kidney nonuse was similarly elevated at 43.8% among kidneys recovered from donors with serum creatinine of 1.5 mg/dL or higher (Figure KI 95).

Nonuse of kidneys recovered from HCV-positive donors with NAT-/Ab+ declined to 30.6% in 2023, from 49.5% in 2016, while nonuse of kidneys recovered from HCV-positive donors with NAT+ declined to 27.2% in 2023, from 43.0% in 2017 (Figure KI 98), contrasting with rising nonuse of kidneys recovered from HCV-negative donors with NAT-/Ab-. These data indicate that clinicians and patients are becoming more comfortable with the low transmission risk from NAT-/Ab+ organs,[2] and with treatment options following transplant from NAT+ donors. A *lower* proportion of kidneys from donors with risk factors for blood-borne disease transmission as defined by the US Public Health Service Guideline were not used than kidneys from donors without these risk factors in 2023 (21.4% versus 29.3%) (Figure KI 99), perhaps because kidneys with these risk factors are often from younger donors and otherwise of high quality with low KDPI scores. In 2023, the nonuse rate of kidneys with KDPI of 85% or greater reached a high of 72.5% (Figure KI 101). The impact on kidney nonuse of OPTN board-approved changes in KDPI to remove race and HCV status in 2024 will be evaluated in the coming years. In 2023, the nonuse rate of kidneys from DCD donors rose to 34.8% (Figure KI 100). Kidney nonuse also increased across donor causes of death and was highest at 41.7% for kidneys recovered from donors who died of cerebrovascular accident/stroke (Figure KI 97).

3.2 Living Donation

Following a recent peak in the number of living kidney donors at 6,856 in 2019, the number decreased to 5,226 in 2020 during the COVID-19 pandemic, and subsequently has trended upward to 6,226 in 2023 (Figure KI 102). In 2023, directed and distantly related (defined as a biological relation other than a parent, child, half sibling, or full sibling) living kidney donations declined compared with counts in 2022, while counts of paired kidney donation and living donations from spouses, relatives, and others were higher, with 20.6% from donor exchanges (Figure KI 102). As noted above, only a small proportion of individuals on the waiting list receives an LDKT each year, despite government initiatives to reduce financial barriers to living donation and to encourage early LDKT.[3]

In 2023, the proportion of living kidney donors aged 55 years or older rose slightly, while the proportion aged 39 years or younger declined slightly, with young adult living donors aged 18-29 years reaching a low of 12.6% (Figure KI 103). Living donors aged 40-54 years continued to make up the most common donor age group. In 2023, the proportion of female living kidney donors remained stably high, at 63.5% (Figure KI 104). The racial and ethnic composition of living donors in 2023 (68.7% White, 16.9% Hispanic, 7.2% Black, 5.2% Asian, 2.1% Other) was relatively stable compared with 2022 (Figure KI 105). Of note, this reflects a general decrease in the proportion of Black living donors, from 11.2% in 2013 (Figure KI 105). The proportion of living donors with BMI greater than 30 kg/m^2 was stable in 2023 (23.9%) compared with 2022 (23.6%) (Figure KI 107). Most living donation surgeries in 2023 were intended as laparoscopic hand-assisted (57.4%) or pure laparoscopic procedures (40.8%) (Figure KI 106).

4 Pediatric Kidney Transplant

4.1 Waiting List

In 2023, the number of pediatric candidates added to the kidney transplant waiting list reached its highest point at 1,177 (Figure KI 108). The number of prevalent pediatric candidates (listed before age 18 years) had a 34.4% increase: 2,956 in 2023 from 2,199 in 2012 (Figure KI 109). By age, candidates aged 12 years or older accounted for the largest proportion of those waiting, at 36.4%, compared with those aged 6-11 years (18.5%) and aged 0-5 years (15.4%) (Figure KI 110). In terms of race and ethnicity, White candidates accounted for the largest group (41.8%) on the kidney transplant waiting list, followed by Hispanic (28.6%), Black (18.5%), Asian (6.5%), Multiracial (3.0%), and Native American (1.0%) candidates (Figure KI 111). The proportion of Black candidates has decreased since 2013 (Table KI 11). Over the past decade, the distributions of age, sex, and geographic distance to transplant center have remained largely unchanged (Table KI 11). The proportion of candidates with congenital anomalies of the kidney and urinary tract as primary cause of disease has increased, while the proportions with glomerulonephritis and focal segmental glomerulosclerosis (FSGS) have decreased (Table KI 12). Most pediatric candidates waiting as of December 31, 2023, had a cPRA level less than 1% (65.3%), an increase since 2013, and there has been a decrease in the proportion of sensitized candidates with cPRA of 80% or greater, to 10.0% in 2023 (Table KI 12). The proportion of pediatric candidates waiting for retransplant decreased over the past decade: 17.2% in 2023 from 30.2% in 2013 (Table KI 13).

The distribution of waiting time among pediatric candidates on the kidney transplant waiting list (active and inactive) has remained similar over the past decade, with almost 50% of candidates waiting for less than 1 year (Figure KI 114). Looking at the cPRA levels of pediatric candidates on the waiting list in 2023, 65.5% of candidates had a cPRA of less than 1%, while the remainder were as follows: 10.3% (cPRA 1%-<20%), 15.1% (cPRA 20%-<80%), 3.9% (cPRA 80%-<98%), and 5.2% (cPRA 98%-100%) (Figure KI 115). In the past decade, there has been a 75.9% increase in the proportion of pediatric candidates on the waiting list who were not on dialysis, to 52.5% in 2023 from 29.8% in 2012 (Figure KI 117). Of the 1,079 candidates removed from the waiting list in 2023, 653 (60.5%) received a deceased donor kidney, 267 (24.7%) received a living donor kidney, 14 (1.3%) died, 10 (0.9%) were considered too sick to undergo transplant, and 5 (0.5%) were removed from the list because their condition improved (Table KI 14 and Table KI 15). Among patients newly listed in 2018-2020, 51.6% underwent DDKT within 3 years, 23.5% underwent LDKT, 16.7% were still waiting, 7.0% were removed from the list for other reasons, and 1.2% died (Figure KI 118). There has been a 16.1% decrease in the rate of DDKT among pediatric waitlist candidates in the past decade: 36.2 transplants per 100 patient-years in 2023 compared with 43.2 transplants per 100 patient-years in 2012 (Figure KI 119). In 2023, transplant rates were relatively similar for all pediatric age groups: 47.6, 47.3, and 43.9 transplants per 100 patient-years for age 0-5 years, age 6-11 years, and age 12-17 years, respectively, compared with 14.3 transplants per 100 patient-years among candidates who had turned age 18 by the start of the year (Figure KI 120). By race and ethnicity, the highest transplant rates were among Black (42.6 transplants per 100 patient-years), Other (includes Multiracial and Native American; 40.7 transplants per 100 patient-years), and Hispanic candidates (39.4 transplants per 100 patient-years), followed by Asian (34.1 transplants per 100 patient-years) and White candidates (30.8 transplants per 100 patient-years) (Figure KI 121). Transplant rates varied by cPRA, with the highest rates in 2023 among candidates with cPRA of less than 1% at 39.0 transplants per 100 patient-years. The priority for candidates with high immunologic sensitivity continued to result in higher transplant rates compared with historical rates. Candidates with cPRA of 80%-<98% had a 67.2% increase (32.7 transplants per 100 patient-years in 2023, from 19.6 in 2012) and those in the 98%-100% category had a 138.6% increase (14.0 transplants per 100 patient-years in 2023, from 5.9 in 2012) (Figure KI 122). Transplant rates varied by blood type; in 2023, the rate was 52.9 transplants per 100 patient -years among candidates with type AB, followed by 38.2, 34.4, and 30.4 transplants per 100 patient-years among candidates with type O, type A, and type B, respectively (Figure KI 123). Pretransplant mortality was at its lowest point in the past decade, at 1.0 deaths per 100 patient-years in 2023 (Figure KI 124).

4.2 Transplants

The total number of pediatric kidney transplants performed in 2023 increased to 791, from its lowest point of 705 in 2022 (Figure KI 129); 550 (69.5%) were DDKTs and 241 (30.5%) were LDKTs (Figure KI 130). The latter value of 241 represents a 16% decrease in the number of pediatric LDKTs over the past decade (from 287 in 2012), and it is notable that the distribution of the relationship of the living donor to the recipient has changed over time. The number of related living donors had a 37.1% decrease to 122 transplants in 2023 (from 194 in 2012), the unrelated directed category had a 75.9% increase to 51 transplants in 2023 (from 29 in 2012), and the paired donation category remains very low but did have an 83.3% increase to 22 transplants in 2023 (from 12 in 2012) (Figure KI 134). Of interest, children aged 12-17 years had the highest proportion of LDKT (45.2%), followed by those aged 0-5 years (30.3%) and 6-11 years (24.5%) (Figure KI 137). Looking at donor age, 59.9% of pediatric recipients received a kidney from a donor aged 18-35 years, followed by donor age 36-49 years (23.8%), donor age 12-17 years (11.4%), and donor age 6-11 years (3.2%). Only 1.8% of pediatric transplants were performed with a donor aged 0-5 years or 50 years or older (Figure KI 133). Preemptive (transplant before starting dialysis) pediatric DDKTs have steadily increased since 2016: 26.2% of pediatric DDKTs in 2023 versus 15.0% in 2016 (Figure KI 135), corresponding to the increase in preemptive listings (Figure KI 117).

In 2023, there were 33 programs performing only pediatric kidney transplants (here, meaning age 0-17 years and a small number up to age 21 years), 139 performing only adult transplants (18 years or older), 57 performing mixed transplants (in both adults and children of any age), and 4 functionally adult programs (performing 80% or more transplants in adults and the remainder in adolescents aged 15-17 years); compared with 2012, these values represent a 17.9% increase, a 15.8% increase, a 17.4% decrease, and a 73.3% decrease, respectively (Figure KI 138). For transplant center volume, 13.3% of transplants in recipients younger than 18 years were performed at programs with a volume of five or fewer pediatric transplants in 2023 (Figure KI 139). Almost half (49.7%) of all pediatric recipients who underwent transplant in 2023 were aged 12-17 years: 51.6% of pediatric DDKT recipients and 45.2% of pediatric LDKT recipients (Table KI 16). The racial and ethnic distributions were notably different for DDKT and LDKT recipients. For LDKT recipients, 66.4% were White, 17.8% were Hispanic, 7.5% were Black, 4.6% were Asian, and 2.9% were Multiracial. In contrast, for DDKT recipients, 35.5% were White, 30.7% were Hispanic, 22.7% were Black, 6.2% were Asian, 3.3% were Multiracial, and 1.3% were Native American (Table KI 16). Private insurance was more common among LDKT recipients (58.9%), and Medicare or Medicaid was more common among DDKT recipients (66.2%) (Table KI 16). Most DDKT recipients (96.9%) underwent transplant with a kidney from a donor with KDPI less than 35% (Table KI 18). Most DDKT recipients (81.9%) had four or more HLA mismatches compared with only 31.6% of LDKT recipients (Figure KI 143). Multiorgan transplant remained uncommon; 4.0% of pediatric candidates received multiorgan transplant in 2023, with kidney-liver transplant being the most common (Table KI 18).

The combination of a donor who was positive for cytomegalovirus and a pediatric recipient who was negative occurred in 37.1% of DDKTs in 2021-2023 (Table KI 19). The combination of a donor who was positive for EBV and a pediatric recipient who was negative occurred in 37.2% of DDKTs (Table KI 19).

4.3 Immunosuppressive Medication Use

Almost all (93.4%) pediatric kidney transplant recipients had some induction use reported in 2023 (Figure KI 140); 66.6% T-cell–depleting agent use only, 22.0% IL2Ab use only, and 4.8% a combination of IL2Ab and T-cell–depleting agent use (Figure KI 141). The most common immunosuppression regimens prescribed during the initial transplant hospitalization period were tacrolimus, a mycophenolate agent, and steroids in 55.9% of recipients, followed by tacrolimus and mycophenolate in 35.3% (Figure KI 142).

4.4 Outcomes

The rate of delayed graft function was 6.9% for pediatric DDKT recipients and 2.5% for pediatric LDKT recipients in 2023 and has been stable in both over the past decade (Figure KI 144 and Figure KI 145). Short-term kidney function, measured by eGFR, has also remained stable over the past decade. Proportions of LDKT and DDKT recipients from 2022 with eGFR of 60 mL/min/1.73 m^2 or higher at 12 months posttransplant were 69.0% and 66.3%, respectively (Figure KI 146 and Figure KI 147). Graft failure after DDKT in pediatric recipients was 2.8% at 6 months and 4.0% at 1 year for transplants in 2022, 7.7% at 3 years for transplants in 2020, 12.4% at 5 years for transplants in 2018, and 35.4% at 10 years for transplants in 2013 (Figure KI 148). Corresponding graft failure after LDKT was 3.0% at 6 months and 3.0% at 1 year for transplants in 2022, 5.0% at 3 years for transplants in 2020, 8.8% at 5 years for transplants in 2018, and 19.7% at 10 years for transplants in 2013 (Figure KI

149). For the cohort of recipients who underwent transplant in 2016-2018, 1-, 3-, and 5-year graft survival were 97.6%, 93.6%, and 86.9% for DDKT recipients and 99.1%, 96.4%, and 93.1% for LDKT recipients, respectively (Figure KI 150). Graft survival varied by age; the highest 5-year graft survival among pediatric DDKT recipients was in those aged 6-11 years (92.4%) and lowest among those aged 12-17 years (83.5%) (Figure KI 151). Of note, the adolescent group aged 12-17 years started off with the highest 1-year graft survival among all ages but this shifted at approximately 2 years posttransplant. Looking at graft survival by recipient diagnosis, 5-year graft survival ranged from 90.2% (congenital anomalies of the kidney and urinary tract) to 81.0% (FSGS) to 80.8% (glomerulonephritis) (Figure KI 152). For graft survival in DDKT recipients by KDPI, 5-year graft survival was similar for recipients of kidneys with KDPI of 0%-<20% (86.9%) and 20%-<35% (87.8%), with a small decrease among those with KDPI 35%-<85% (83.1%) (Figure KI 153). Graft outcomes varied by donor age; the lowest 5-year DDKT graft survival of 76.2% was among recipients of kidneys from donors aged 0-5 years (Figure KI 154). In the 2022 recipient cohort, the overall incidence of acute rejection within the first year ranged from 9.6% among patients aged 6-11 years and 9.7% among patients aged 12-17 years to 14.1% among patients aged 0-5 years (Figure KI 155). Incidence of posttransplant lymphoproliferative disorder among EBV-negative recipients from 2012-2018 was 4.2% at 5-years posttransplant, compared with 0.8% among EBV-positive recipients (Figure KI 157). Overall, 5-year patient survival among pediatric DDKT recipients in 2016-2018 was 97.3% (Figure KI 159), with little variability by recipient age: 96.5% (age 0-5 years), 97.5% (age 6-11 years), and 97.5% (age 12-17 years) (Figure KI 160). Patient survival in this cohort did not vary by etiology of kidney disease (Figure KI 161). Among pediatric LDKT recipients in 2016-2018, 5-year patient survival was 98.6% (Figure KI 162), again with little variability by age (Figure KI 163). Survival was slightly lower for LDKT recipients with FSGS (96.1%) compared with other diagnoses (Figure KI 164).

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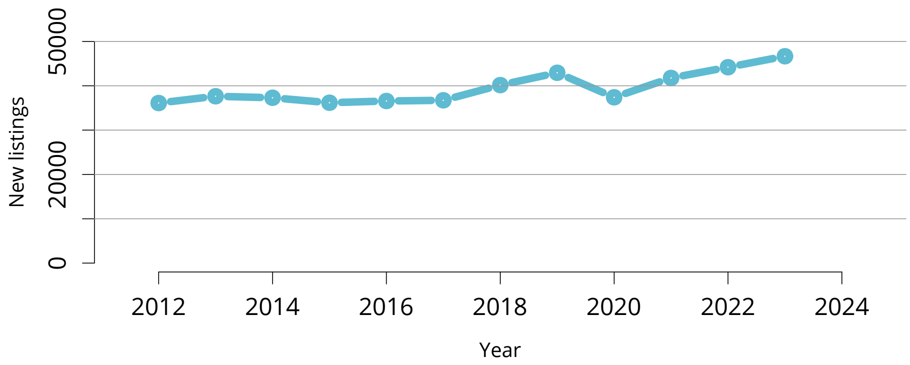
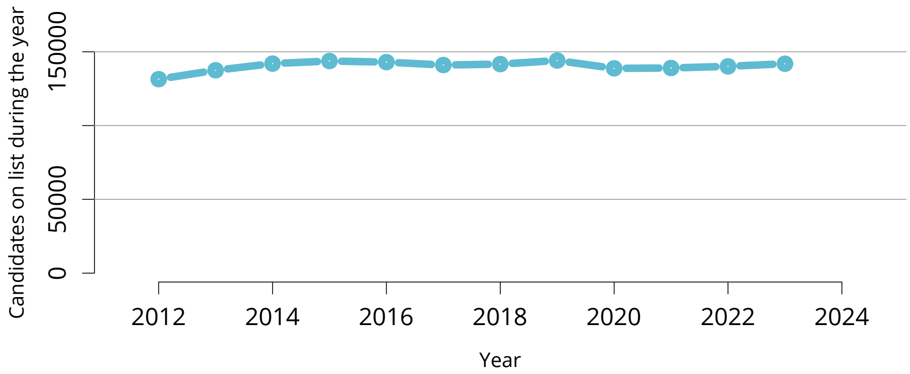


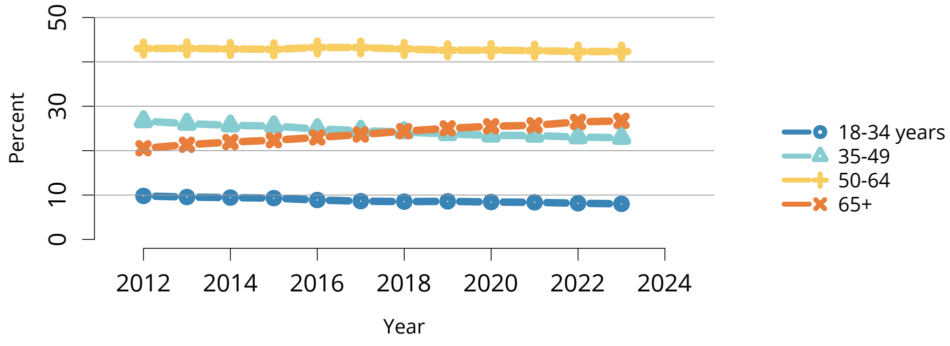
OPTN/SRTR 2023 Annual Data Report

Figure KI 1: New adult candidates added to the kidney transplant waiting list. A new candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and subsequently relisted are considered new. Active and inactive patients are included. Candidates listed at more than one center are counted once per listing. Includes kidney and kidney-pancreas listings.



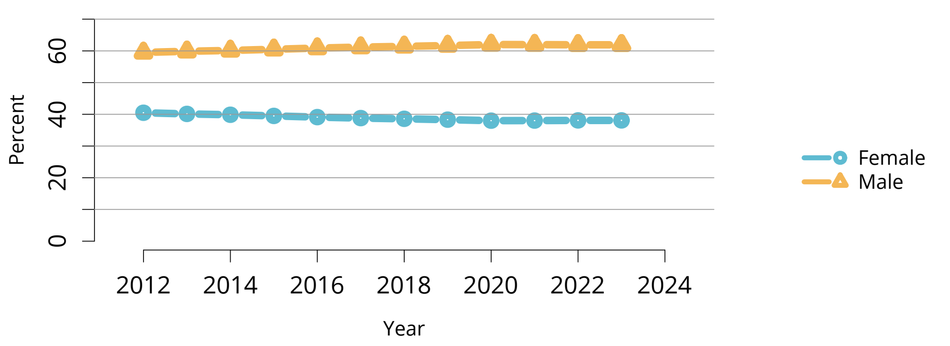
OPTN/SRTR 2023 Annual Data Report

Figure KI 2: All adult candidates on the kidney transplant waiting list. Adult candidates on the list at any time during the year. Candidates listed at more than one center are counted once per listing. Includes kidney and kidney-pancreas candidates.



OPTN/SRTR 2023 Annual Data Report

Figure KI 3: Distribution of adults waiting for kidney transplant by age. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included. Age is determined at the earliest of transplant, death, removal, or December 31 of the year.



OPTN/SRTR 2023 Annual Data Report

Figure KI 4: Distribution of adults waiting for kidney transplant by sex. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

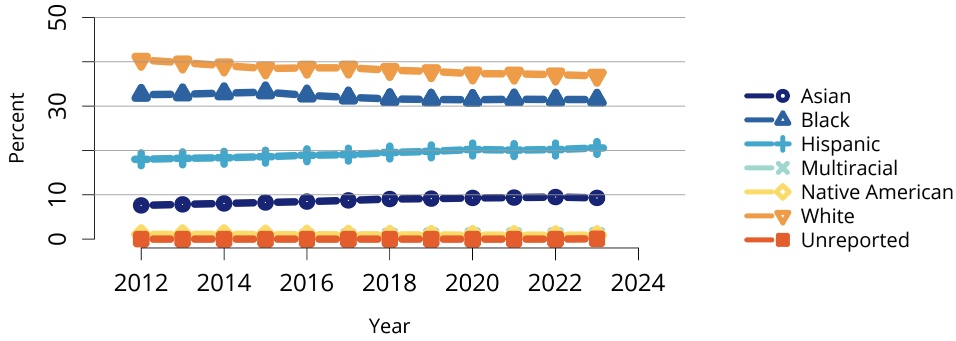


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Figure KI 5: Distribution of adults waiting for kidney transplant by race and ethnicity. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

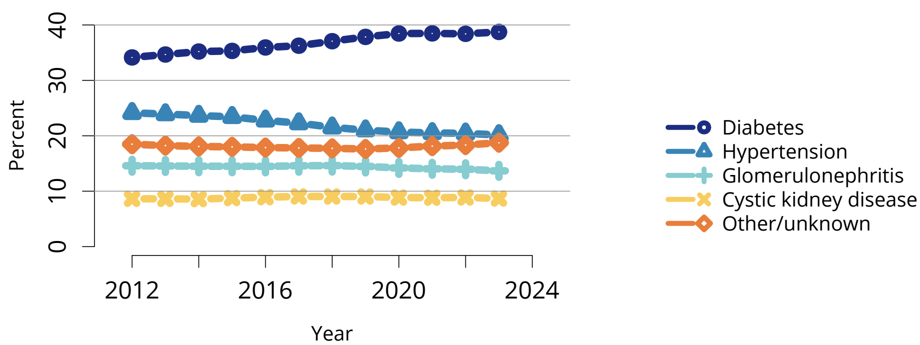

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Figure KI 6: Distribution of adults waiting for kidney transplant by diagnosis. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

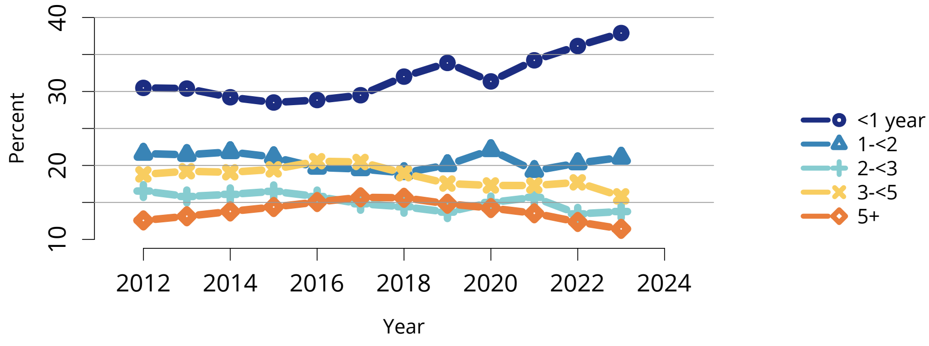

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Figure KI 7: Distribution of adults waiting for kidney transplant by waiting time (years). Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Time on the waiting list is determined at the earliest of transplant, death, removal, or December 31 of the year. Candidates listed in the given year are considered to have been listed less than 1 year. Active and inactive candidates are included.

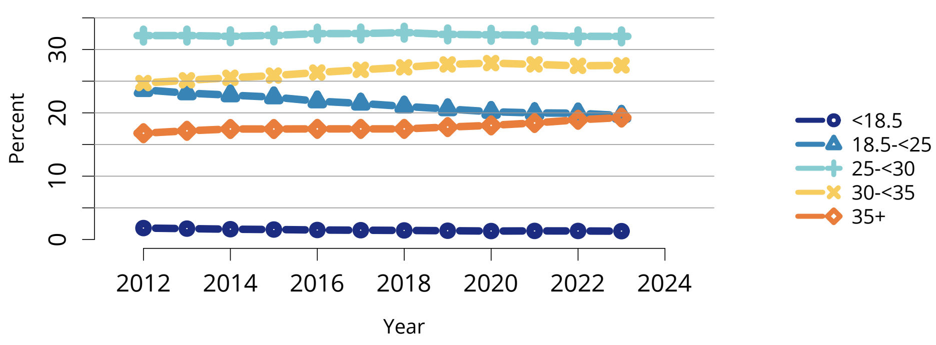

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Figure KI 8: Distribution of adults waiting for kidney transplant by BMI. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included. BMI, body mass index.

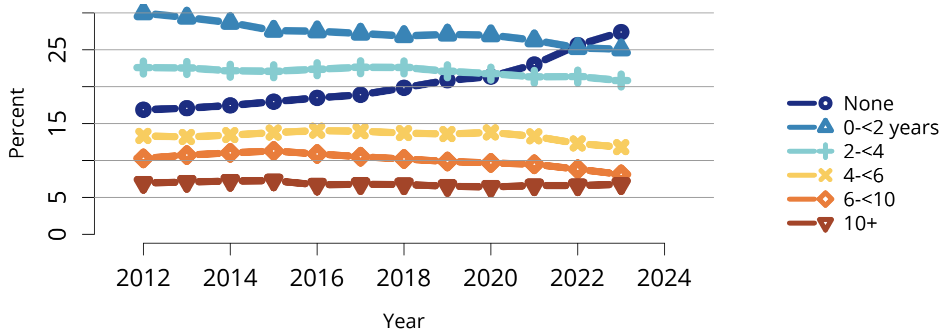

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Figure KI 9: Distribution of adults waiting for kidney transplant by years on dialysis. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Time on dialysis is computed as time from minimum of first end-stage renal disease service date or most recent graft failure to listing date or January 1 of the given year. Active and inactive candidates are included.

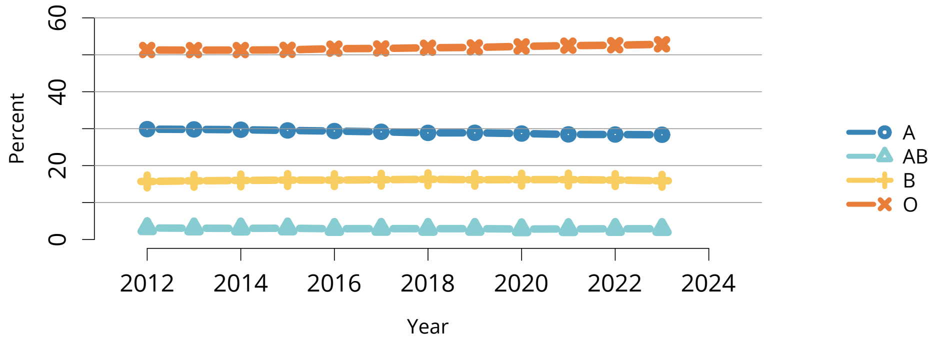

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Figure KI 10: Distribution of adults waiting for kidney transplant by blood type. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

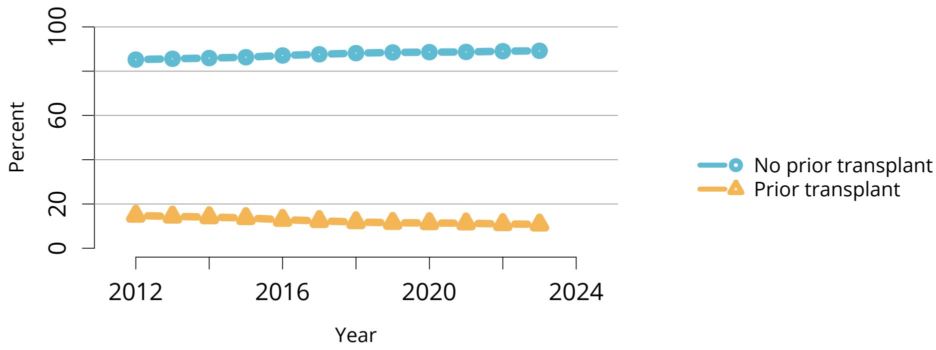

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Figure KI 11: Distribution of adults waiting for kidney transplant by prior transplant status. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

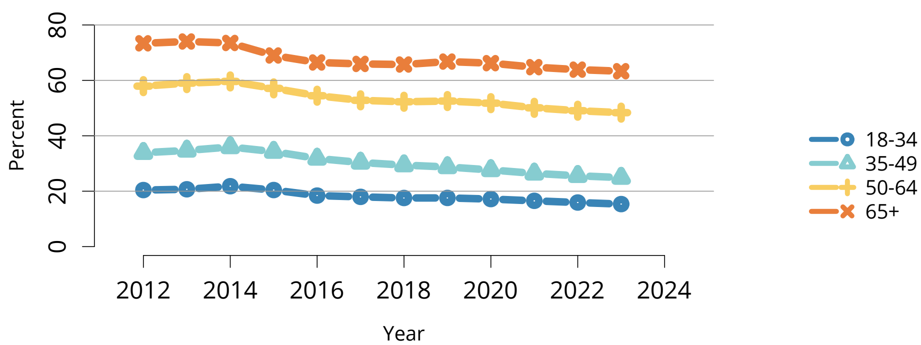

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Figure KI 12: Adults willing to accept a kidney designated ECD or KDPI >= 85% by age. Adults waiting for kidney transplant on December 31 of the given year. Candidates listed at more than one center are counted once per listing. Willingness to accept ECD kidney at time of listing or willingness to accept a local non-zero HLA mismatch KDPI >=85% kidney at the later of listing date or January 1 of the given year, beginning in 2014. ECD, expanded-criteria donor; KDPI, kidney donor profile index.

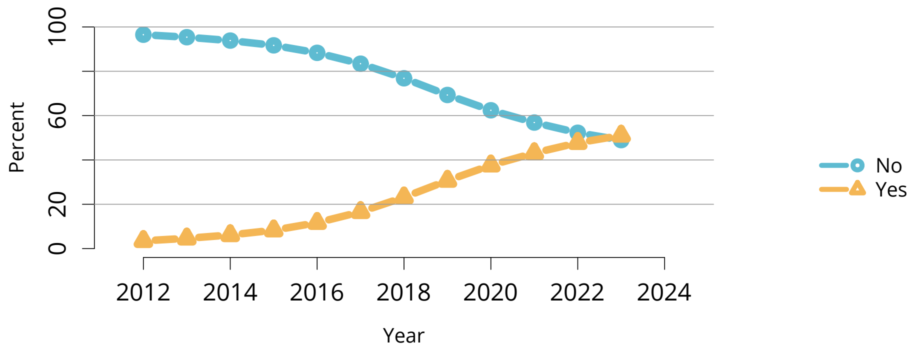

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Figure KI 13: Adults willing to accept kidney from HCV+ donor. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Willingness to accept HCV+ organ at time of listing. HCV, hepatitis C virus.

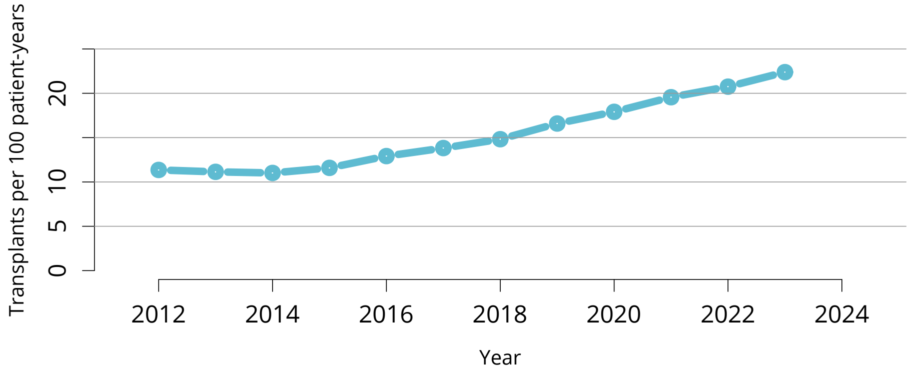

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Figure KI 14: Overall deceased donor kidney transplant rates among adult waitlist candidates. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

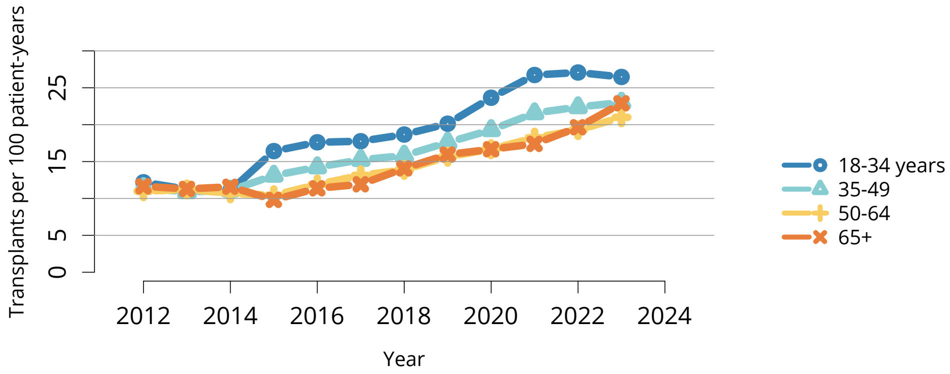

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Figure KI 15: Deceased donor kidney transplant rates among adult waitlist candidates by age. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year.

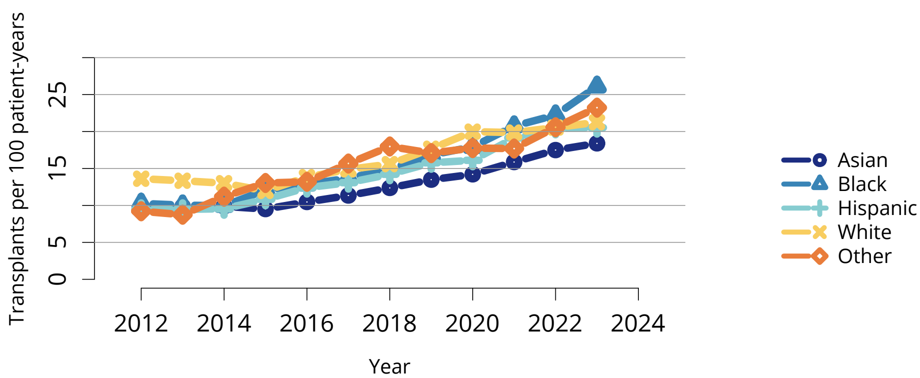

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Figure KI 16: Deceased donor kidney transplant rates among adult waitlist candidates by race and ethnicity. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

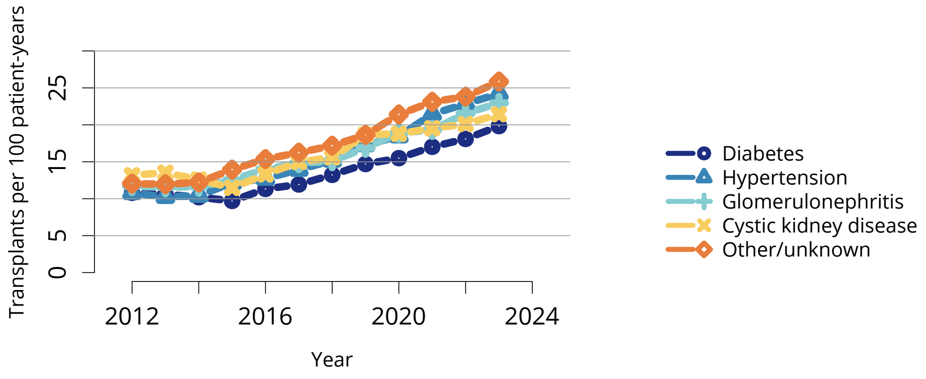

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Figure KI 17: Deceased donor kidney transplant rates among adult waitlist candidates by diagnosis. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

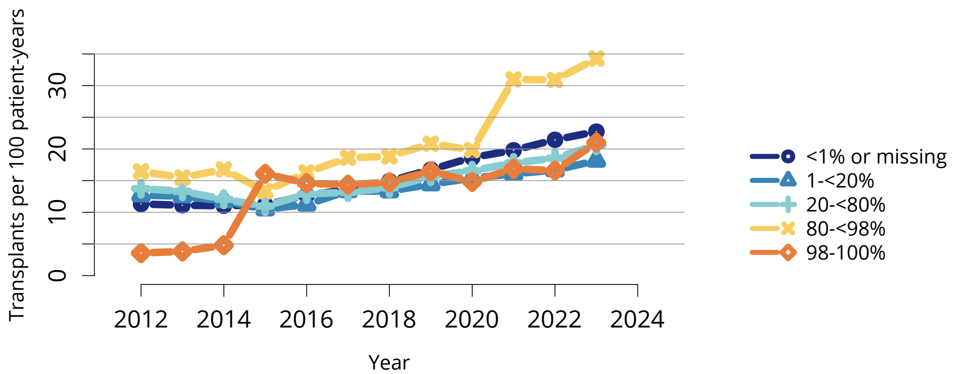

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Figure KI 18: Deceased donor kidney transplant rates among adult waitlist candidates by cPRA. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. cPRA is determined at the later of listing date or January 1 of the given year. Missing indicates no unacceptable antigens were reported. cPRA, calculated panel-reactive antibody.

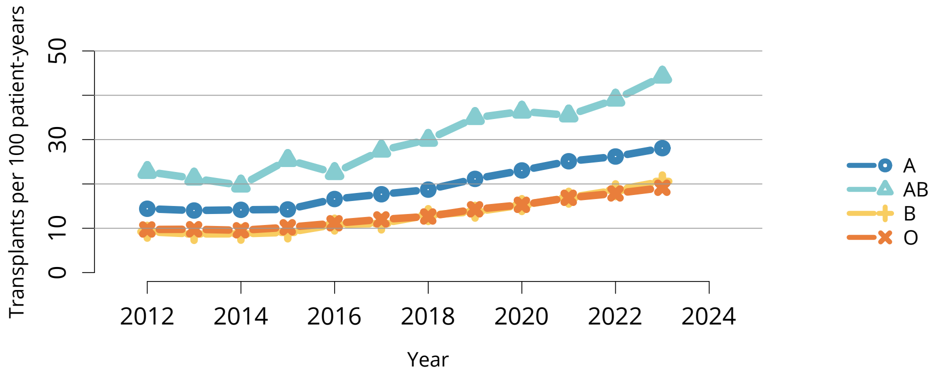

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Figure KI 19: Deceased donor kidney transplant rates among adult waitlist candidates by blood type. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

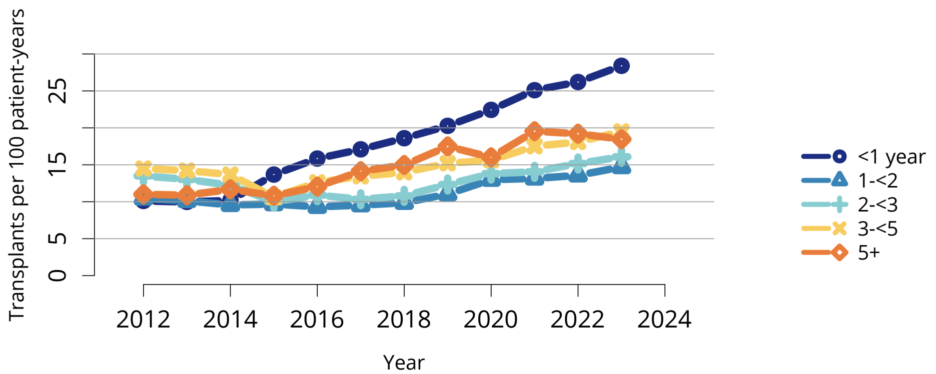

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Figure KI 20: Deceased donor kidney transplant rates among adult waitlist candidates by time on the waiting list. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

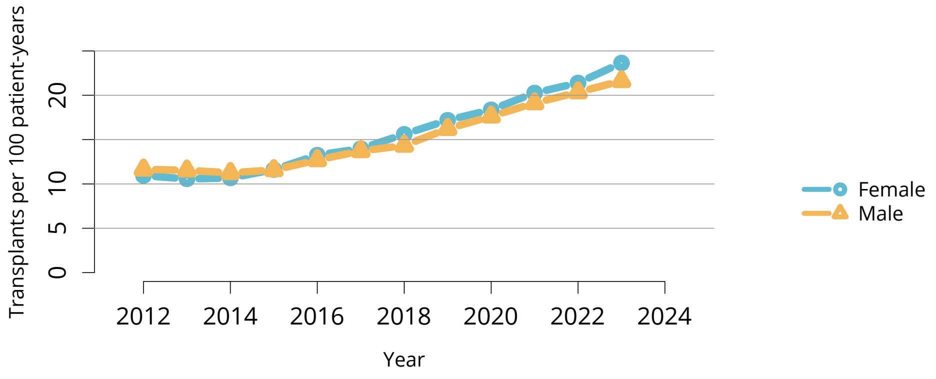

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Figure KI 21: Deceased donor kidney transplant rates among adult waitlist candidates by sex. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

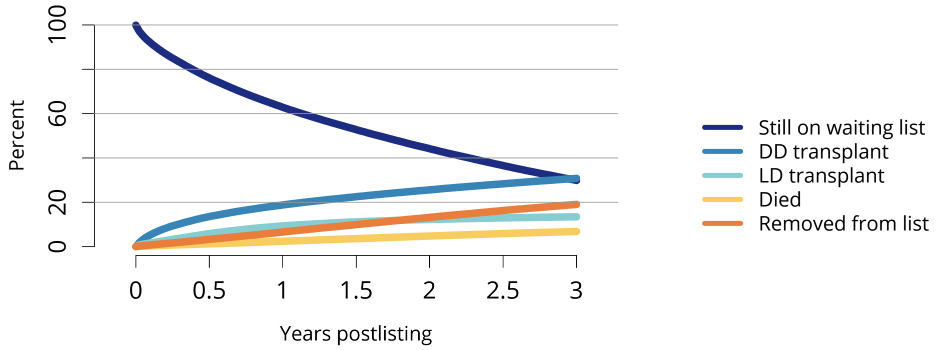

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Figure KI 22: Three-year outcomes for adults waiting for kidney transplant, new listings in 2018-2020. Candidates listed at more than one center are counted once per listing. Removed from list includes all reasons except transplant and death. DD, deceased donor; LD, living donor.

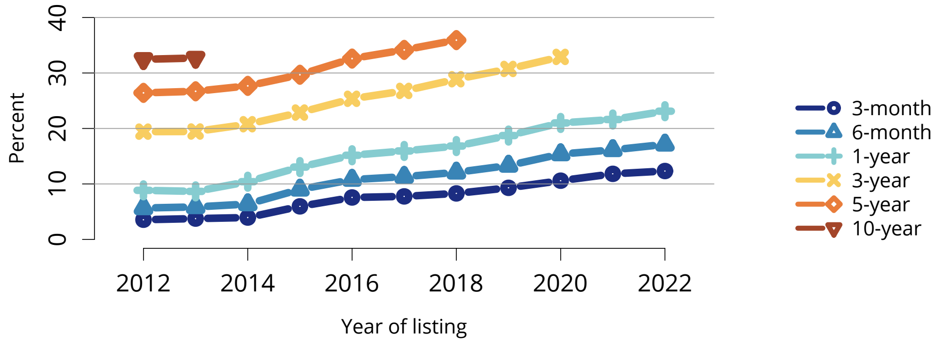

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Figure KI 23: Percentage of adults who underwent deceased donor kidney transplant within a given period of listing. Candidates listed at more than one center are counted once per listing.

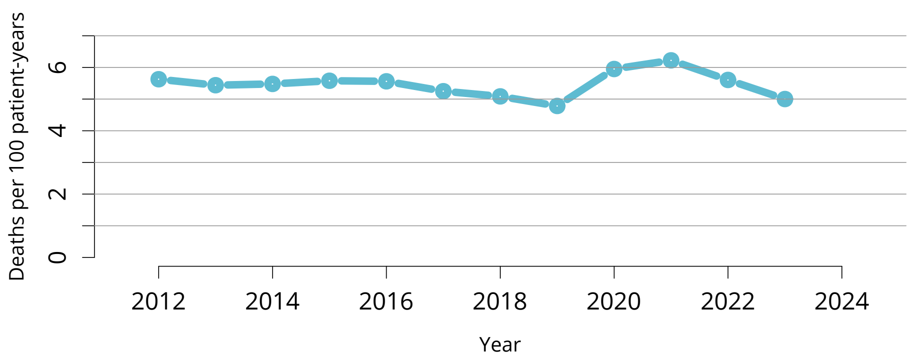

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Figure KI 24: Overall pretransplant mortality rates among adults waitlisted for kidney transplant. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

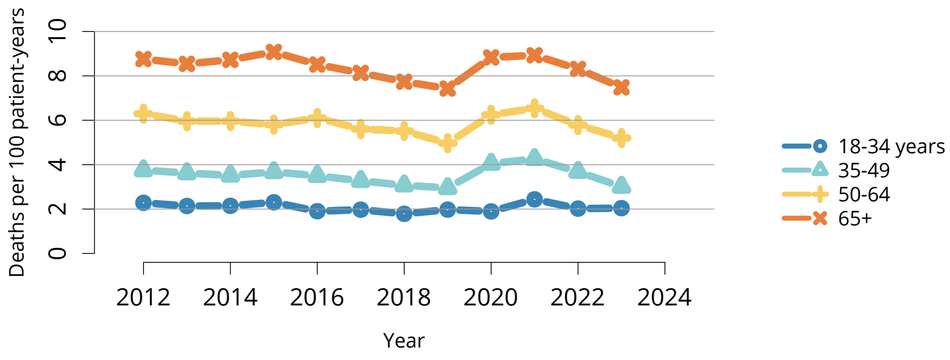

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Figure KI 25: Pretransplant mortality rates among adults waitlisted for kidney transplant by age. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year.

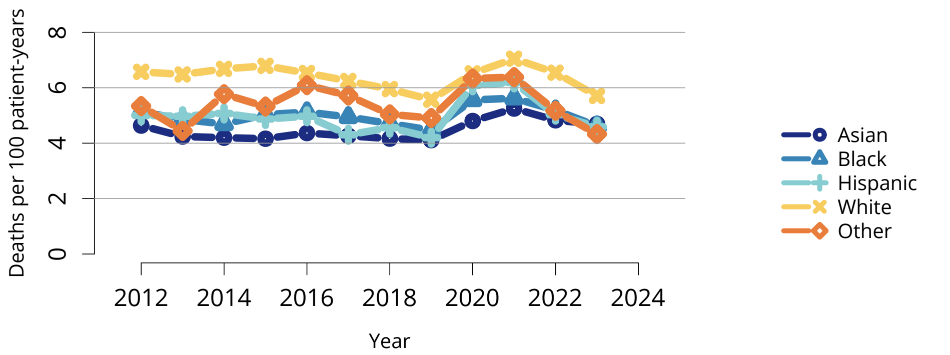

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Figure KI 26: Pretransplant mortality rates among adults waitlisted for kidney transplant by race and ethnicity. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

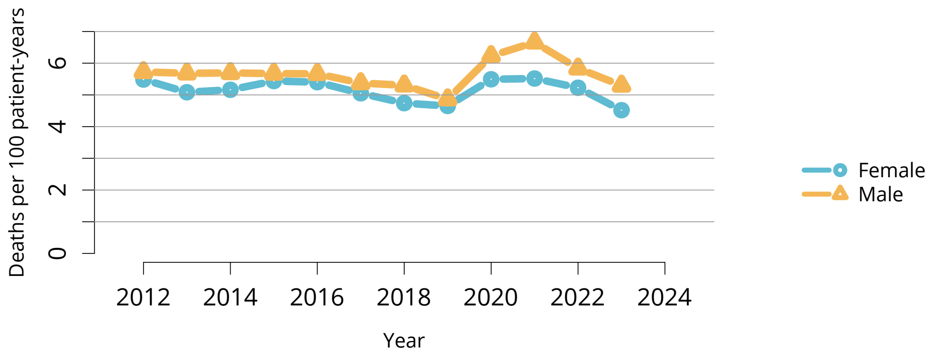

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Figure KI 27: Pretransplant mortality rates among adults waitlisted for kidney transplant by sex. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

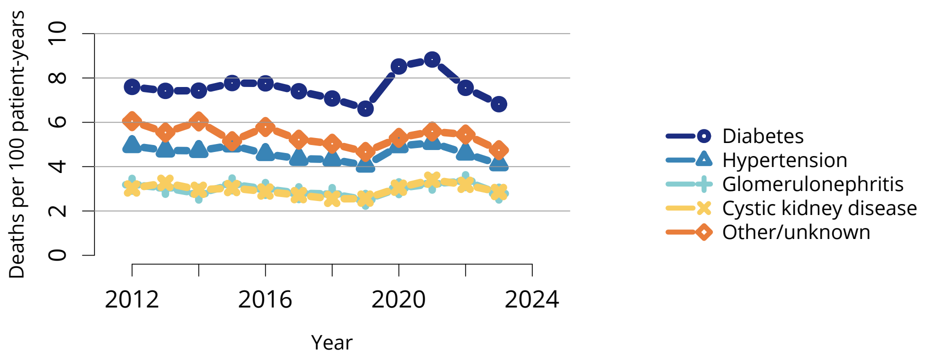

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Figure KI 28: Pretransplant mortality rates among adults waitlisted for kidney transplant by diagnosis. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

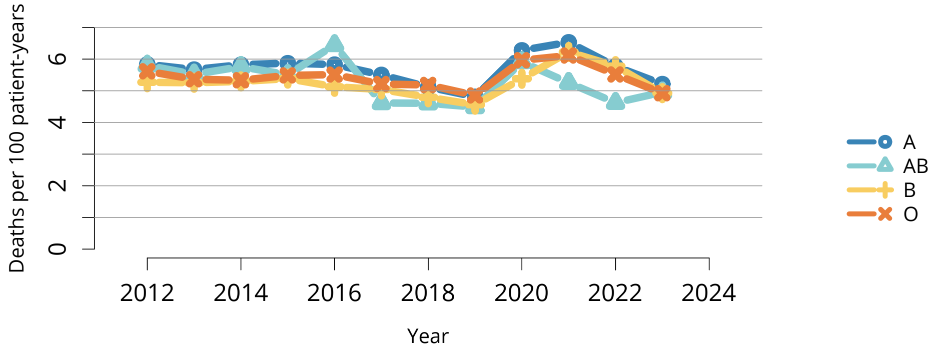

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Figure KI 29: Pretransplant mortality rates among adults waitlisted for kidney transplant by blood type. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

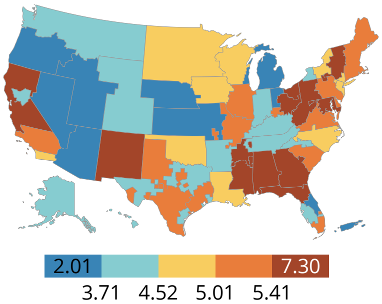

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Figure KI 30: Pretransplant mortality rates among adults waitlisted for kidney transplant in 2023 by DSA. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. DSA, donation service area.

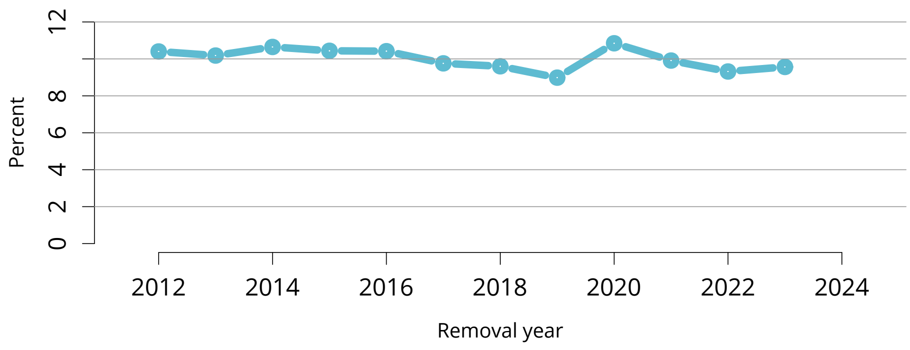

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Figure KI 31: Deaths within 6 months after removal among adult kidney waitlist candidates, overall. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list.

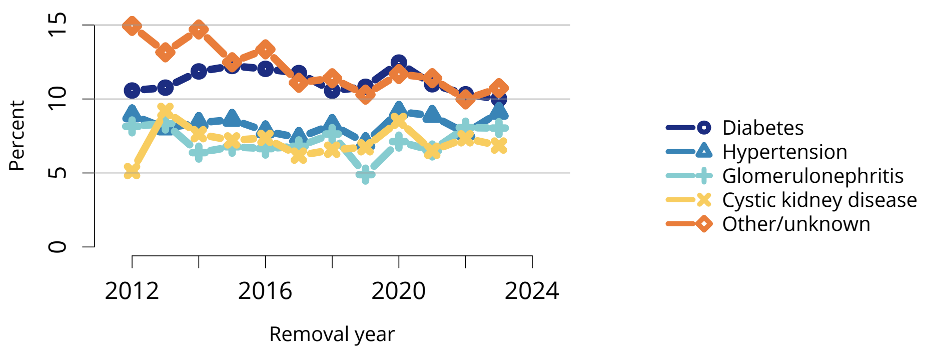

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Figure KI 32: Deaths within 6 months after removal among adult kidney waitlist candidates, by diagnosis group at removal. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list.

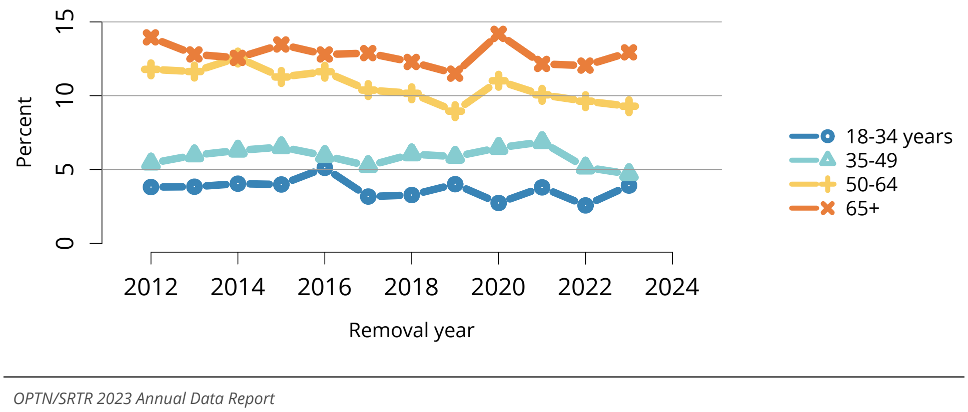

Figure KI 33: Deaths within 6 months after removal among adult kidney waitlist candidates, by age. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list. Age is determined at removal.

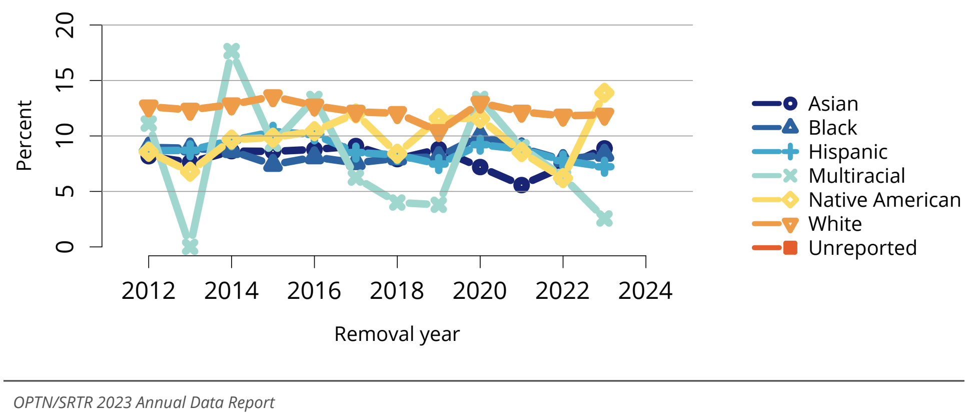

Figure KI 34: Deaths within 6 months after removal among adult kidney waitlist candidates, by race and ethnicity. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list.

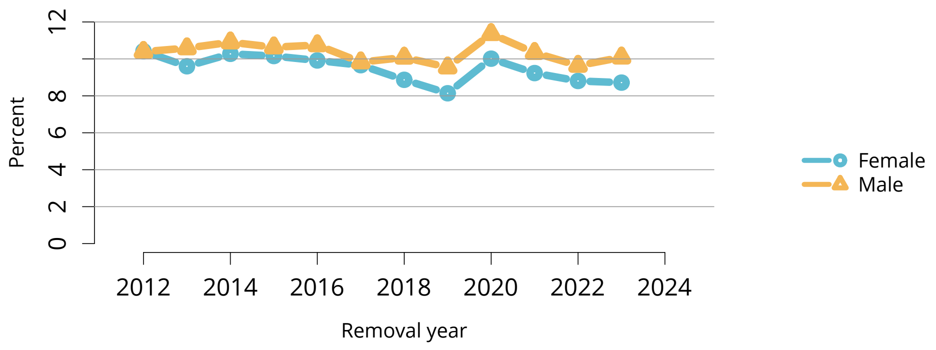

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Figure KI 35: Deaths within 6 months after removal among adult kidney waitlist candidates, by sex. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list.

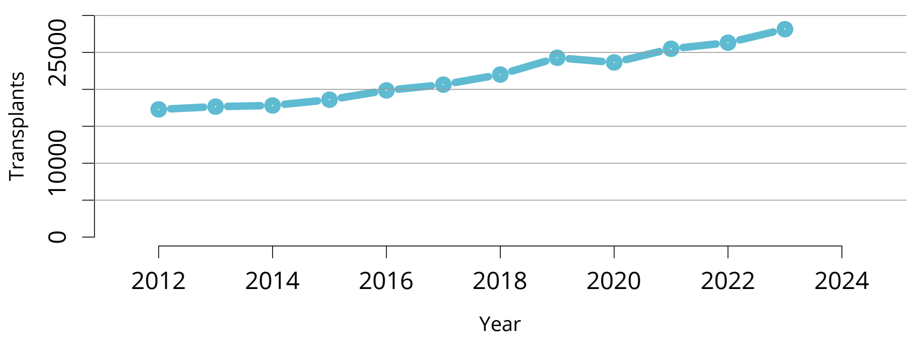

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Figure KI 36: Overall kidney transplants. All kidney transplant recipients, including adult and pediatric, retransplant, and multiorgan recipients.

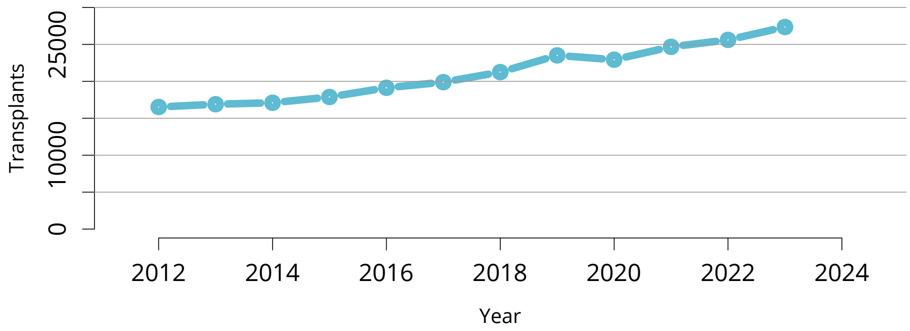

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Figure KI 37: Overall adult kidney transplants. All adult kidney transplant recipients, including retransplant and multiorgan recipients.

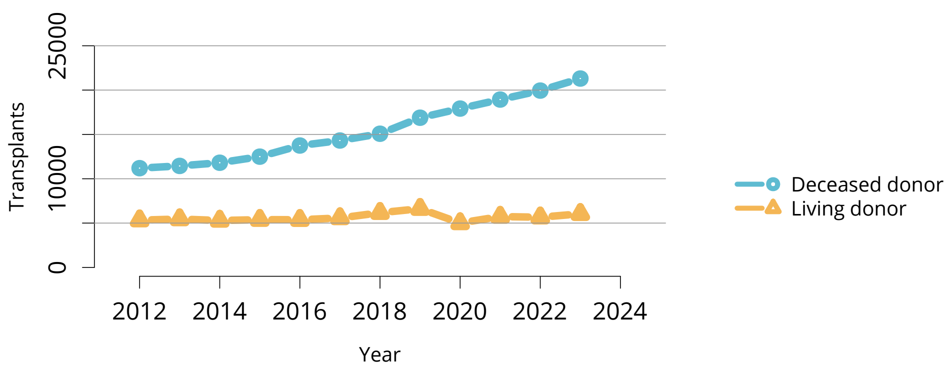

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Figure KI 38: Adult kidney transplants by donor type. Adult kidney transplant recipients, including retransplant and multiorgan recipients.

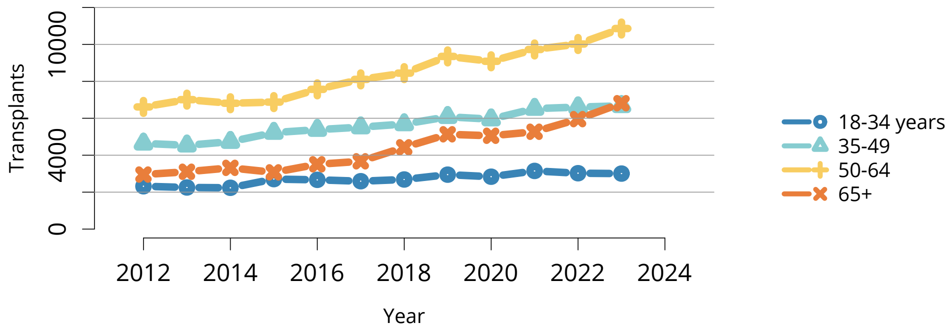

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Figure KI 39: Adult kidney transplants by age. Adult kidney transplant recipients, including retransplant and multiorgan recipients.

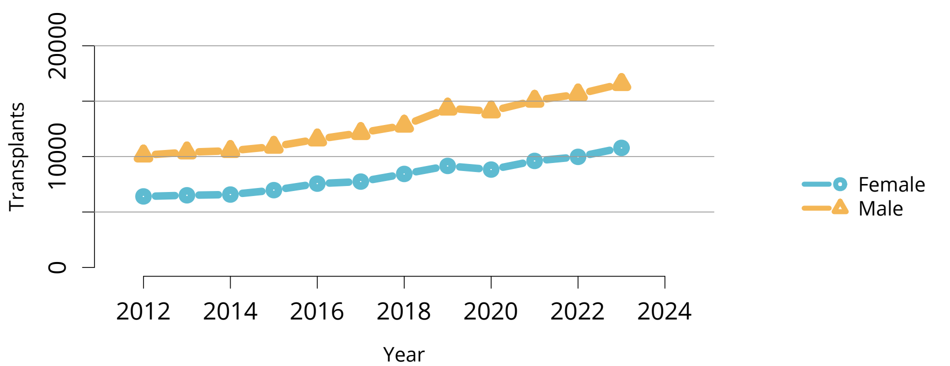

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Figure KI 40: Adult kidney transplants by sex. Adult kidney transplant recipients, including retransplant and multiorgan recipients.

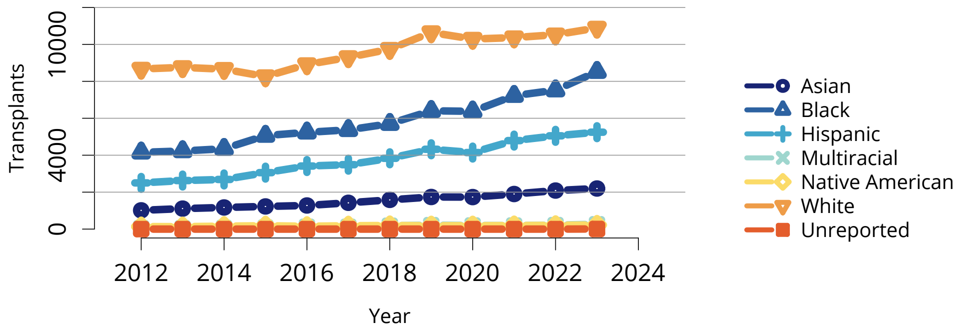

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Figure KI 41: Adult kidney transplants by race and ethnicity. Adult kidney transplant recipients, including retransplant and multiorgan recipients.

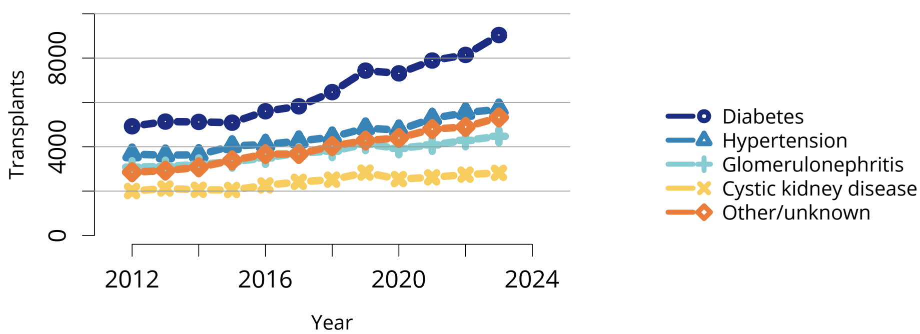

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Figure KI 42: Adult kidney transplants by diagnosis. Adult kidney transplant recipients, including retransplant and multiorgan recipients.

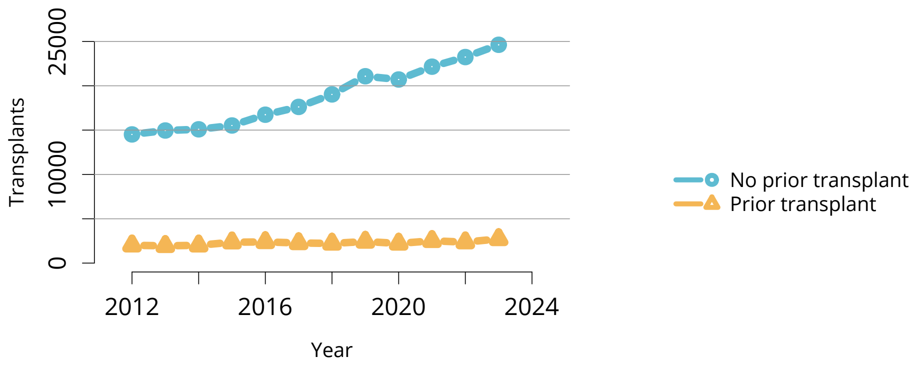

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Figure KI 43: Adult kidney transplants by prior transplant status. Adult kidney transplant recipients, including retransplant and multiorgan recipients.

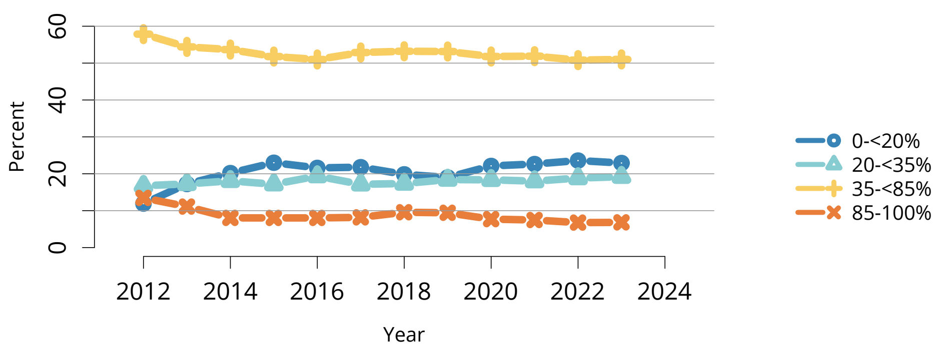

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Figure KI 44: Kidney transplants by KDPI. All adult recipients of deceased donor kidneys, including multiorgan transplant recipients. Conversion of kidney donor risk index to KDPI is done using the OPTN KDPI Mapping Tables. For donors recovered January through May, the cohort 2 years prior was used to assign KDPI; for donors recovered June through December, the cohort 1 year prior was used to assign KDPI. Kidneys recovered en bloc are counted once. KDPI, kidney donor profile index.

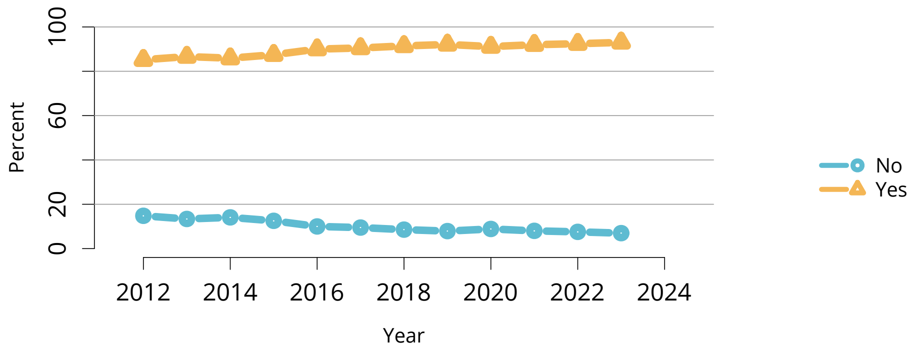

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Figure KI 45: Induction agent use in adult kidney transplant recipients. Immunosuppression at transplant reported to the OPTN.

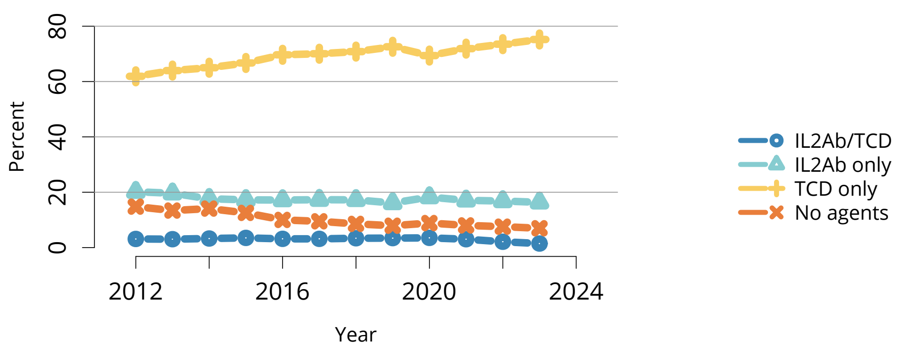

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Figure KI 46: Type of induction agent use in adult kidney transplant recipients. Immunosuppression at transplant reported to the OPTN. IL2Ab, interleukin-2 receptor antibody; TCD, T-cell depleting.

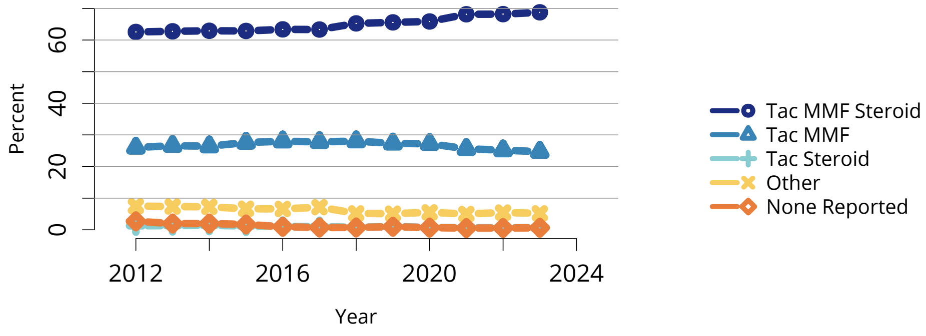

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Figure KI 47: Immunosuppression regimen use in adult kidney transplant recipients. Immunosuppression regimen at transplant reported to the OPTN. MMF, all mycophenolate agents; Tac, tacrolimus.

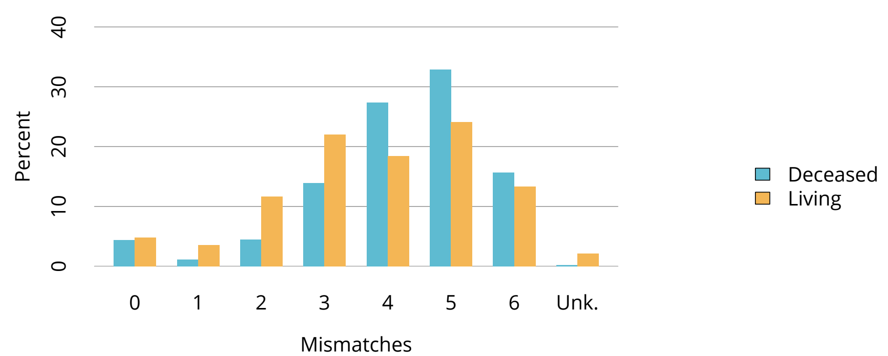

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Figure KI 48: Total HLA A, B, and DR mismatches among adult kidney transplant recipients, 2019-2023. Donor and recipient antigen matching is based on OPTN antigen values and split equivalences policy as of 2023. Unk, unknown.

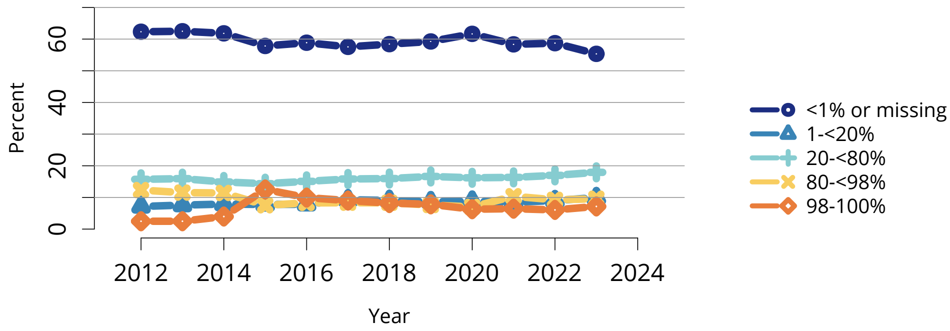

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Figure KI 49: Peak cPRA at time of kidney transplant in adult deceased donor recipients. Peak cPRA is used. Missing indicates no unacceptable antigens were reported. cPRA, calculated panel-reactive antibody.

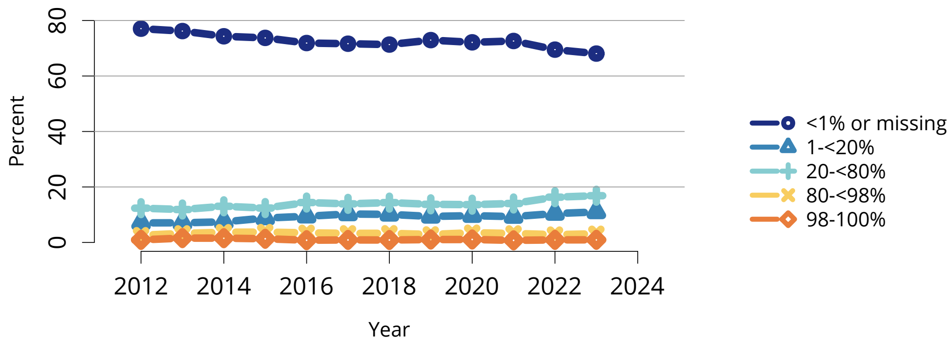

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Figure KI 50: Peak cPRA at time of kidney transplant in adult living donor recipients. Peak cPRA is used. Missing indicates no unacceptable antigens were reported. cPRA, calculated panel-reactive antibody.

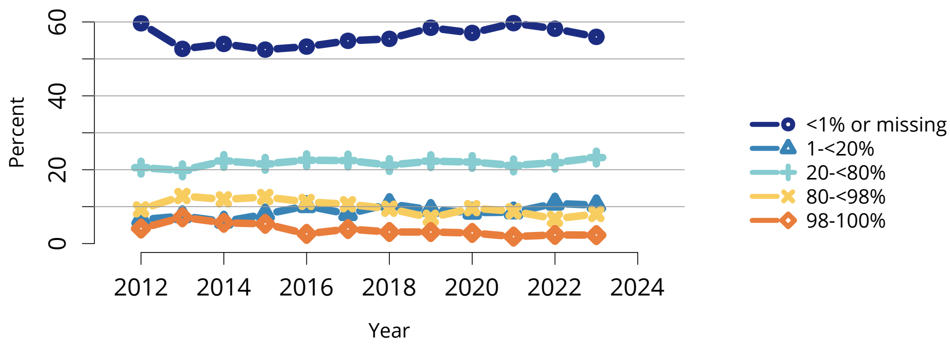

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Figure KI 51: Peak cPRA at time of kidney transplant in adult paired living donor recipients. Peak cPRA is used. Missing indicates no unacceptable antigens were reported. cPRA, calculated panel-reactive antibody.

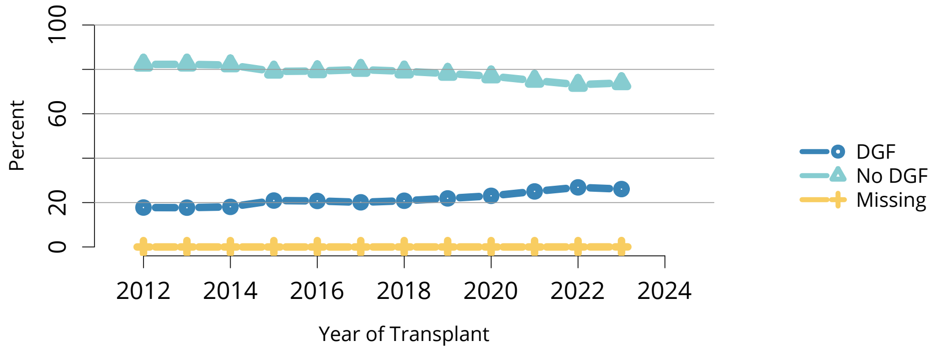

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Figure KI 52: Delayed graft function among adult kidney transplant recipients. All adult recipients of kidneys. Delayed graft function is defined as dialysis administered within the first 7 days posttransplant. DGF, delayed graft function.

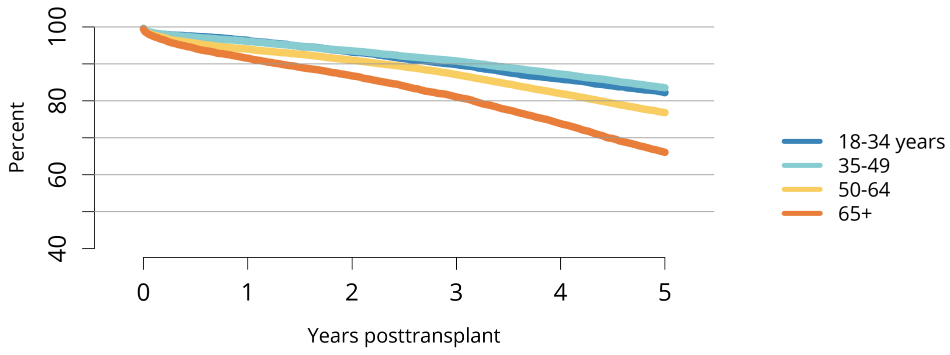

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Figure KI 53: Graft survival among adult deceased donor kidney transplant recipients, 2016-2018, by age. Graft survival estimated using unadjusted Kaplan-Meier methods.

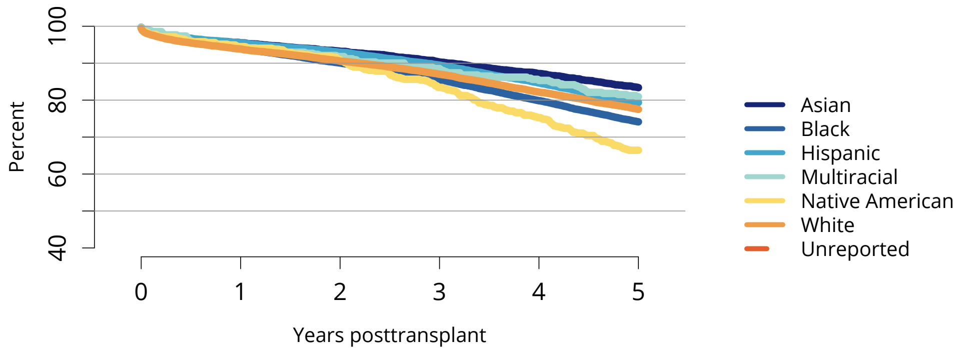

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Figure KI 54: Graft survival among adult deceased donor kidney transplant recipients, 2016-2018, by race and ethnicity. Graft survival estimated using unadjusted Kaplan-Meier methods.

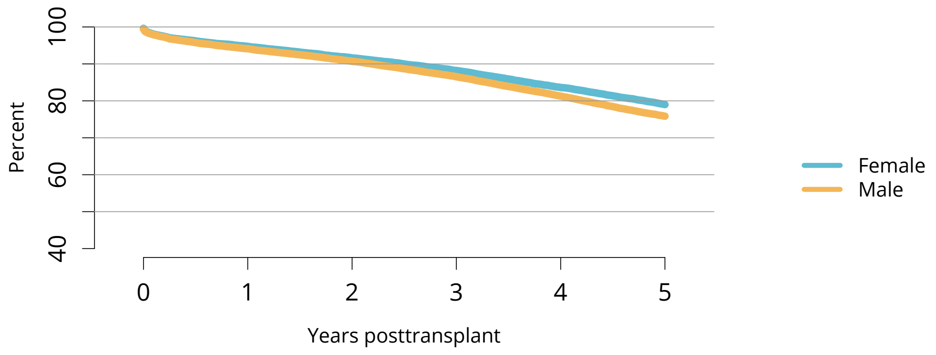

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Figure KI 55: Graft survival among adult deceased donor kidney transplant recipients, 2016-2018, by sex. Graft survival estimated using unadjusted Kaplan-Meier methods.

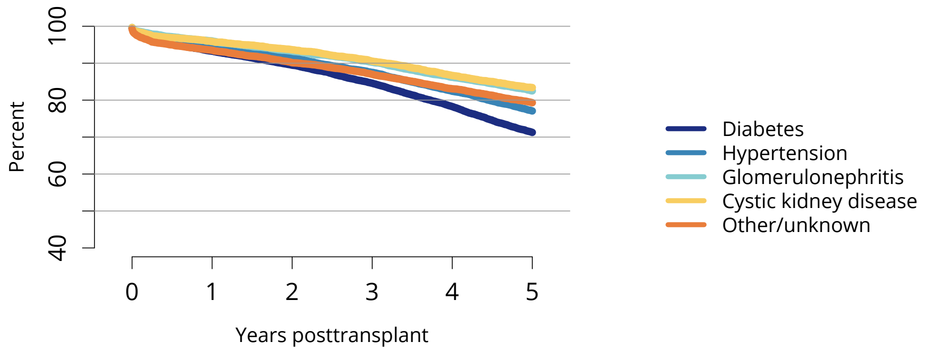

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Figure KI 56: Graft survival among adult deceased donor kidney transplant recipients, 2016-2018, by diagnosis. Graft survival estimated using unadjusted Kaplan-Meier methods.

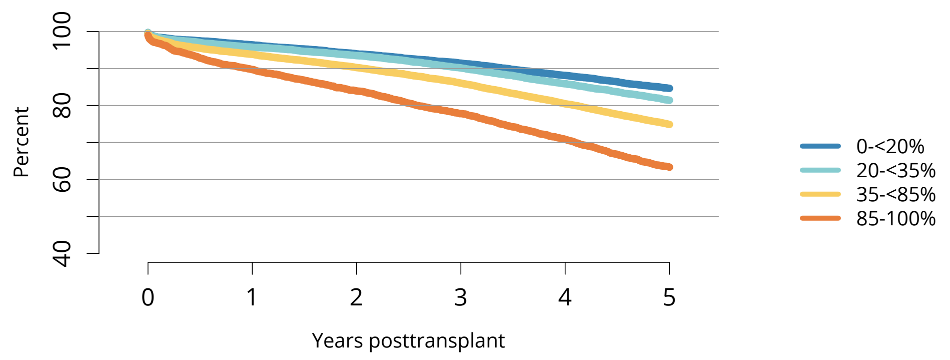

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Figure KI 57: Graft survival among adult deceased donor kidney transplant recipients, 2016-2018, by KDPI. Graft survival estimated using unadjusted Kaplan-Meier methods. Conversion of kidney donor risk index to KDPI is done using the OPTN KDPI Mapping Tables. For donors recovered January through May, the cohort 2 years prior was used to assign KDPI; for donors recovered June through December, the cohort 1 year prior was used to assign KDPI. KDPI, kidney donor profile index.

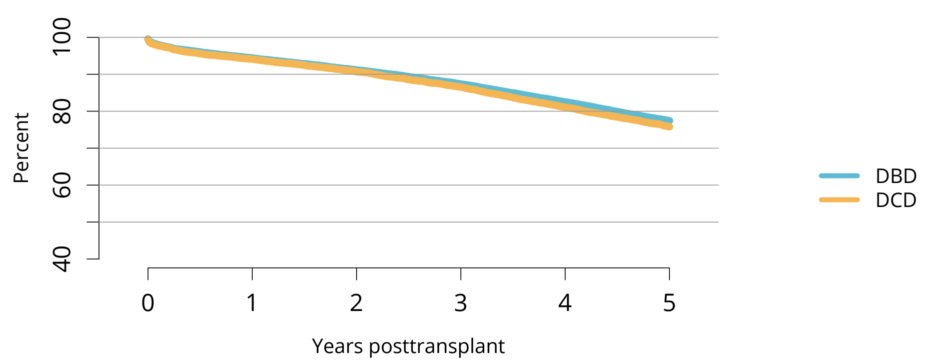

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Figure KI 58: Graft survival among adult deceased donor kidney transplant recipients, 2016-2018, by DCD status. Graft survival estimated using unadjusted Kaplan-Meier methods. DBD, donation after brain death; DCD, donation after circulatory death.

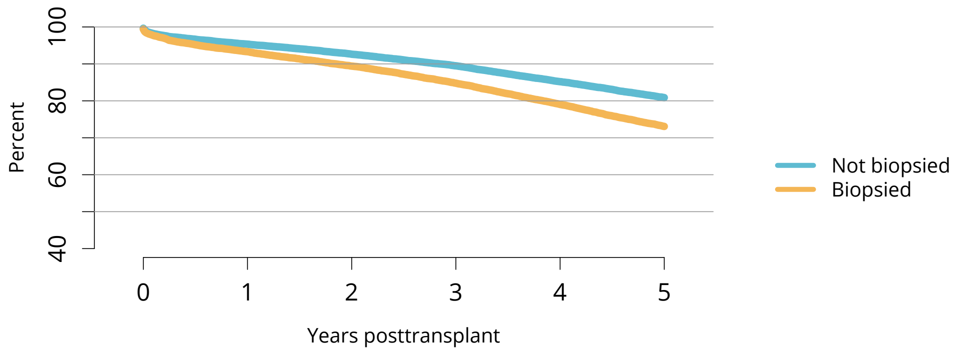

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Figure KI 59: Graft survival among adult deceased donor kidney transplant recipients, 2016-2018, by biopsy status. Graft survival estimated using unadjusted Kaplan-Meier methods. Kidneys are classified as biopsied if either of the donor's kidneys was biopsied.

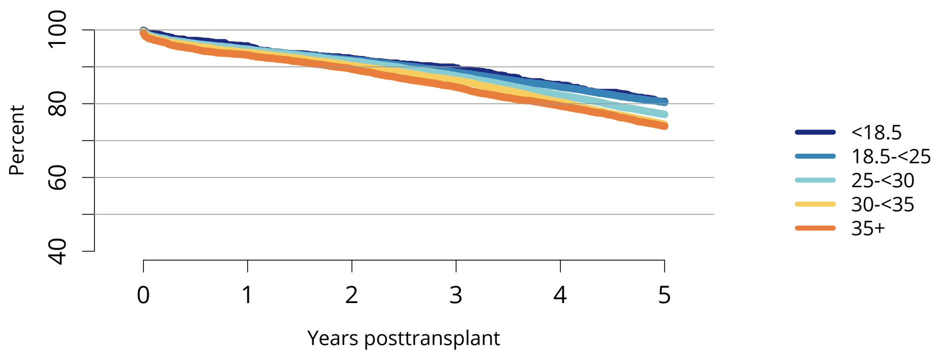

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Figure KI 60: Graft survival among adult deceased donor kidney transplant recipients, 2016-2018, by BMI. Graft survival estimated using unadjusted Kaplan-Meier methods. BMI, body mass index.

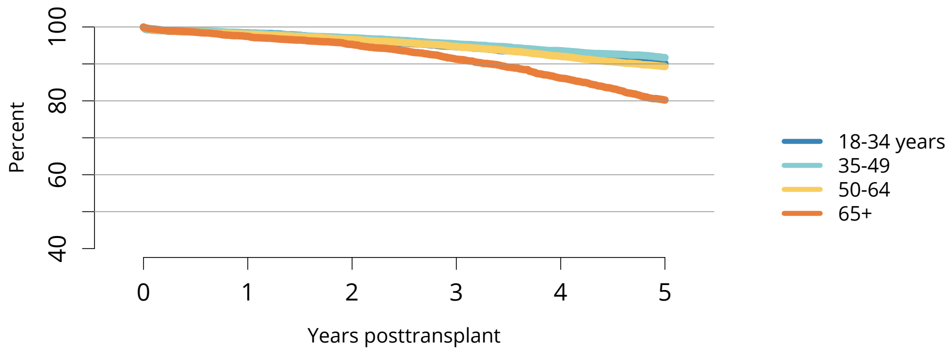

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Figure KI 61: Graft survival among adult living donor kidney transplant recipients, 2016-2018, by age. Graft survival estimated using unadjusted Kaplan-Meier methods.

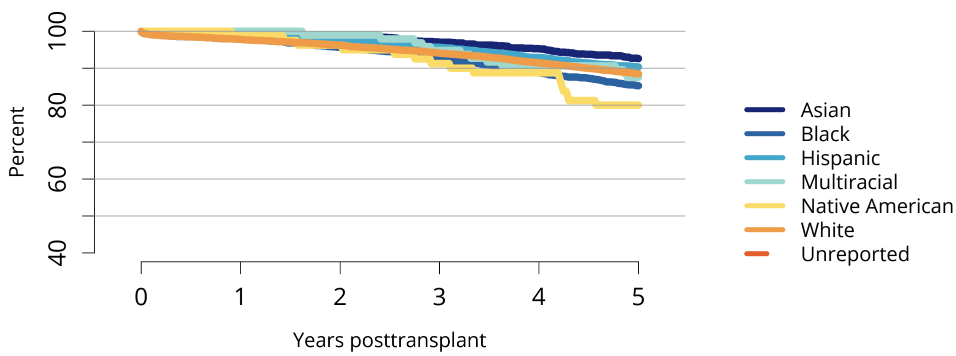

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Figure KI 62: Graft survival among adult living donor kidney transplant recipients, 2016-2018, by race and ethnicity. Graft survival estimated using unadjusted Kaplan-Meier methods.

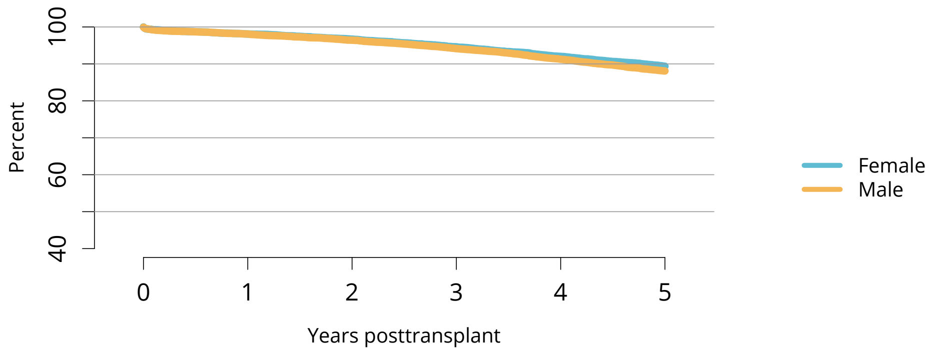

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Figure KI 63: Graft survival among adult living donor kidney transplant recipients, 2016-2018, by sex. Graft survival estimated using unadjusted Kaplan-Meier methods.

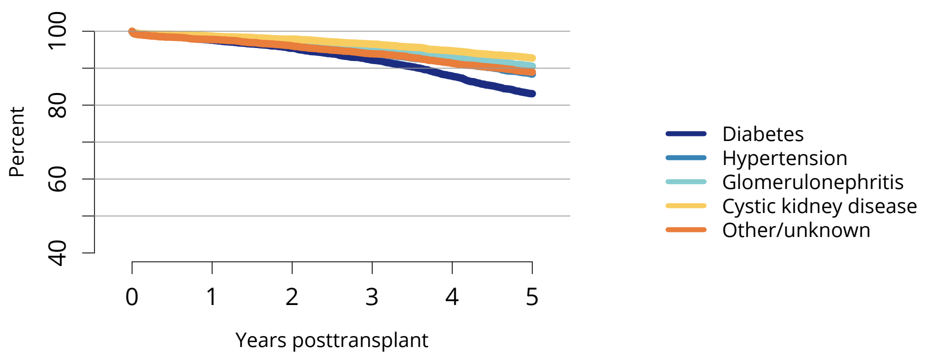

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Figure KI 64: Graft survival among adult living donor kidney transplant recipients, 2016-2018, by diagnosis. Graft survival estimated using unadjusted Kaplan-Meier methods.

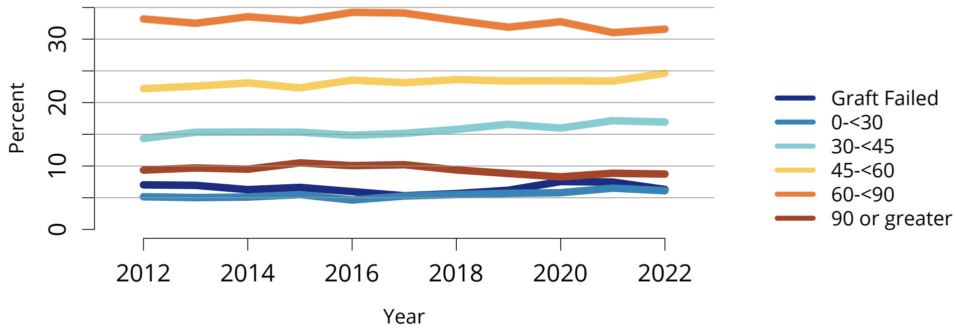

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Figure KI 65: Distribution of eGFR at 12 months posttransplant among adult deceased donor kidney transplant recipients. Glomerular filtration rate (mL/min/1.73 m^2) estimated using the race-free 2021 Chronic Kidney Disease–Epidemiology Collaboration equation, and computed by SRTR for patients alive with graft function at 12 months posttransplant. eGFR, estimated glomerular filtration rate.

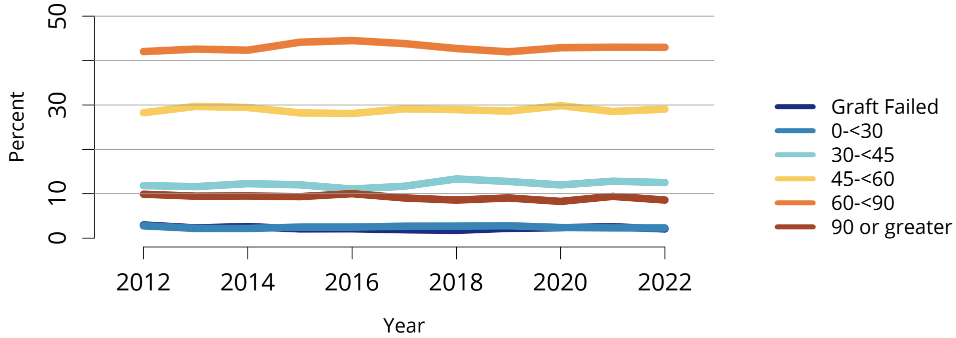

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Figure KI 66: Distribution of eGFR at 12 months posttransplant among adult living donor kidney transplant recipients. Glomerular filtration rate (mL/min/1.73 m^2) estimated using the race-free 2021 Chronic Kidney Disease–Epidemiology Collaboration equation, and computed by SRTR for patients alive with graft function at 12 months posttransplant. eGFR, estimated glomerular filtration rate.

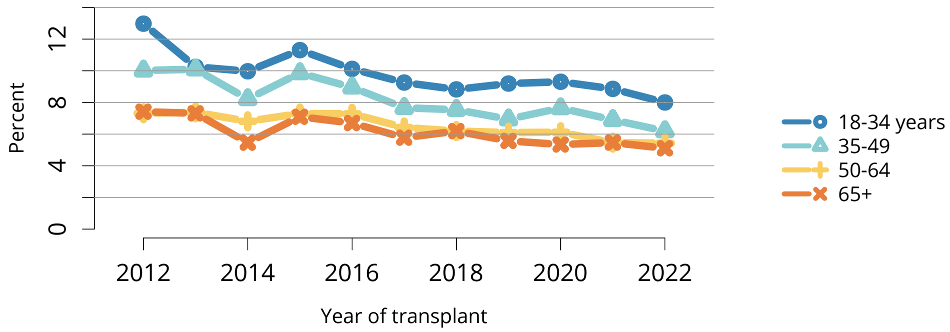

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Figure KI 67: Incidence of acute rejection by 1 year posttransplant among adult kidney transplant recipients by age. Only the first reported rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier method.

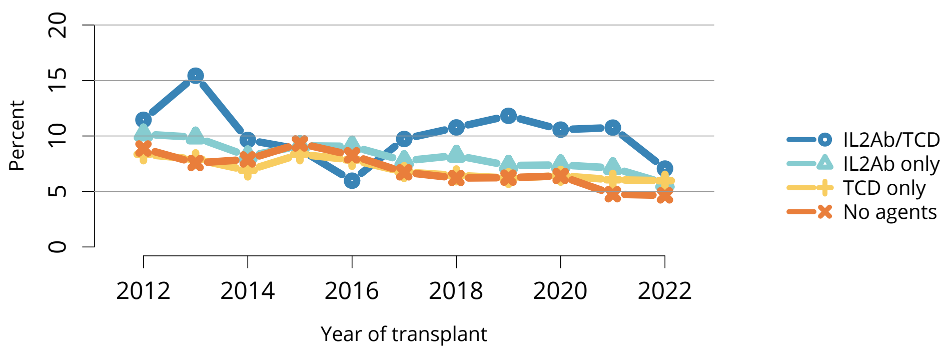

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Figure KI 68: Incidence of acute rejection by 1 year posttransplant among adult kidney transplant recipients by induction agent. Only the first reported rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier method. IL2Ab, interleukin-2 receptor antibody; TCD, T-cell depleting.

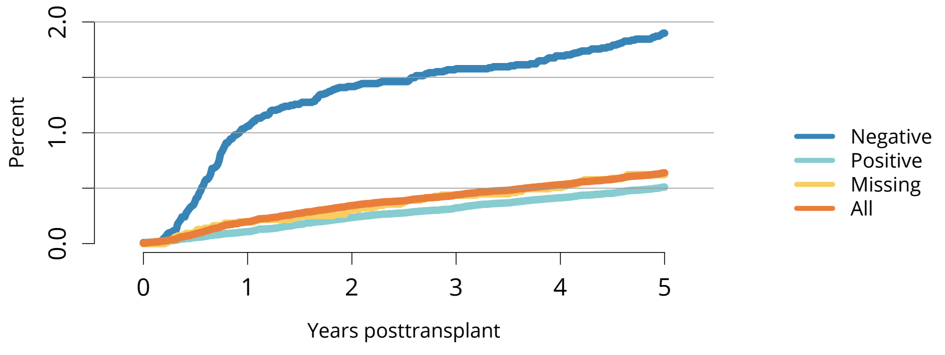

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Figure KI 69: Incidence of PTLD among adult kidney transplant recipients by recipient EBV status at transplant, 2012-2018. Cumulative incidence is estimated using the Kaplan-Meier method. PTLD is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus; PTLD, posttransplant lymphoproliferative disorder.

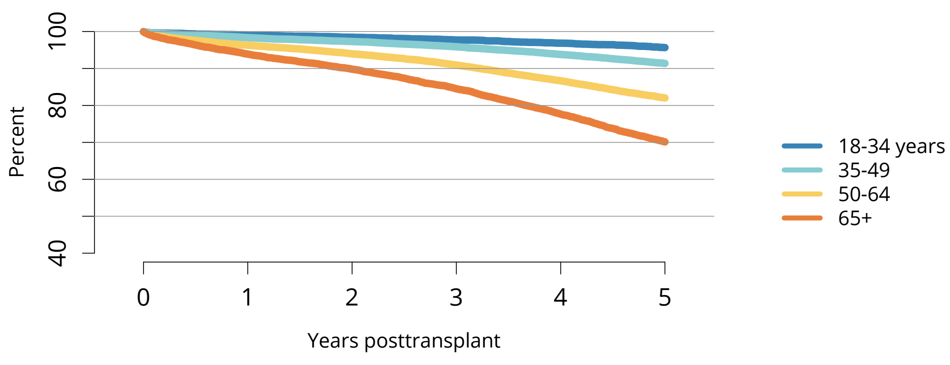

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Figure KI 70: Patient survival among adult deceased donor kidney transplant recipients, 2016-2018, by age. Patient survival estimated using unadjusted Kaplan-Meier methods.

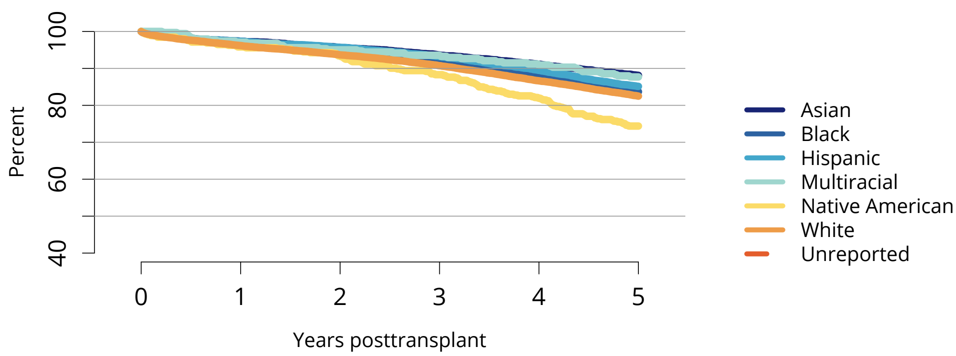

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Figure KI 71: Patient survival among adult deceased donor kidney transplant recipients, 2016-2018, by race and ethnicity. Patient survival estimated using unadjusted Kaplan-Meier methods.

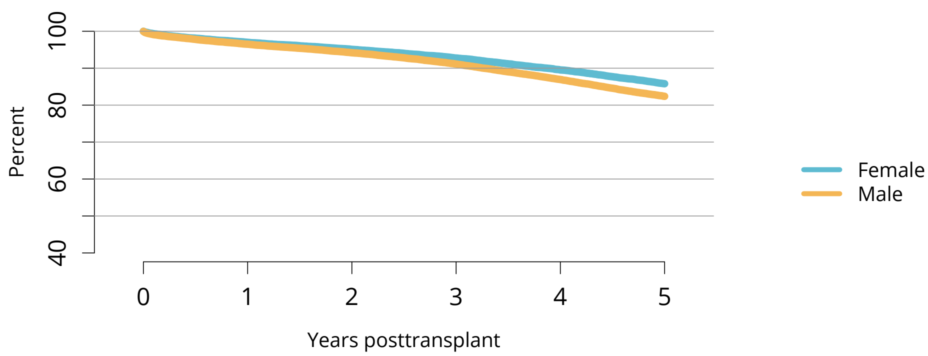

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Figure KI 72: Patient survival among adult deceased donor kidney transplant recipients, 2016-2018, by sex. Patient survival estimated using unadjusted Kaplan-Meier methods.

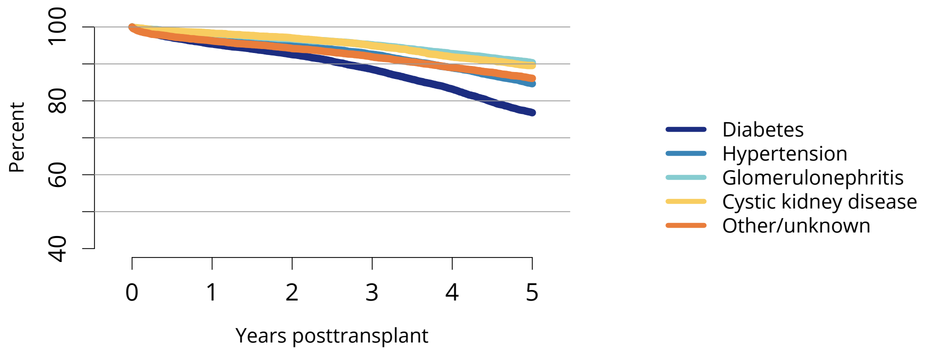

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Figure KI 73: Patient survival among adult deceased donor kidney transplant recipients, 2016-2018, by diagnosis. Patient survival estimated using unadjusted Kaplan-Meier methods.

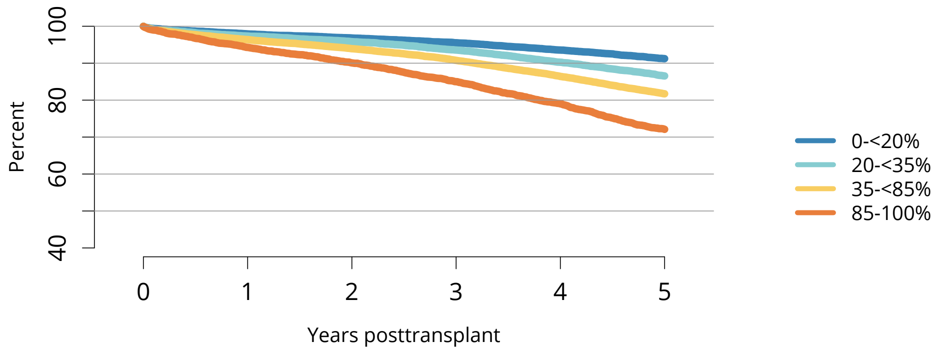

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Figure KI 74: Patient survival among adult deceased donor kidney transplant recipients, 2016-2018, by KDPI. Patient survival estimated using unadjusted Kaplan-Meier methods. Conversion of kidney donor risk index to KDPI is done using the OPTN KDPI Mapping Tables. For donors recovered January through May, the cohort 2 years prior was used to assign KDPI; for donors recovered June through December, the cohort 1 year prior was used to assign KDPI. KDPI, kidney donor profile index.

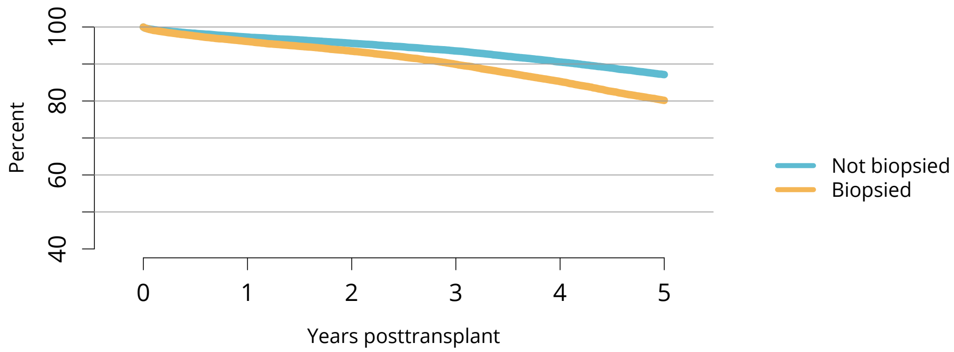

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Figure KI 75: Patient survival among adult deceased donor kidney transplant recipients, 2016-2018, by biopsy status. Patient survival estimated using unadjusted Kaplan-Meier methods. Kidneys are classified as biopsied if either of the donor's kidneys was biopsied.

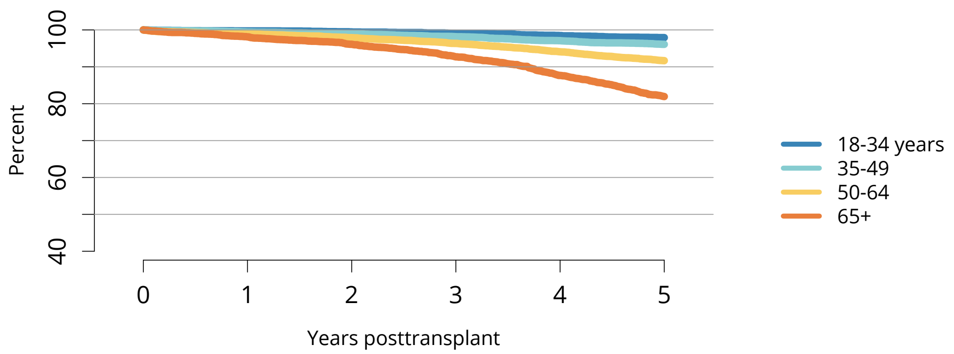

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Figure KI 76: Patient survival among adult living donor kidney transplant recipients, 2016-2018, by age. Patient survival estimated using unadjusted Kaplan-Meier methods.

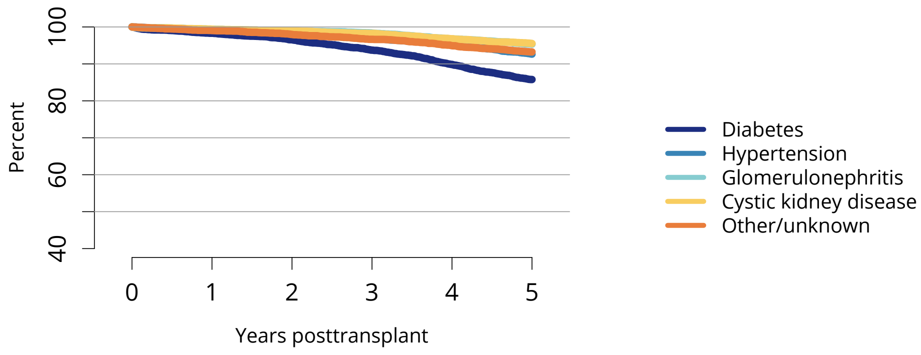

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Figure KI 77: Patient survival among adult living donor kidney transplant recipients, 2016-2018, by diagnosis. Patient survival estimated using unadjusted Kaplan-Meier methods.

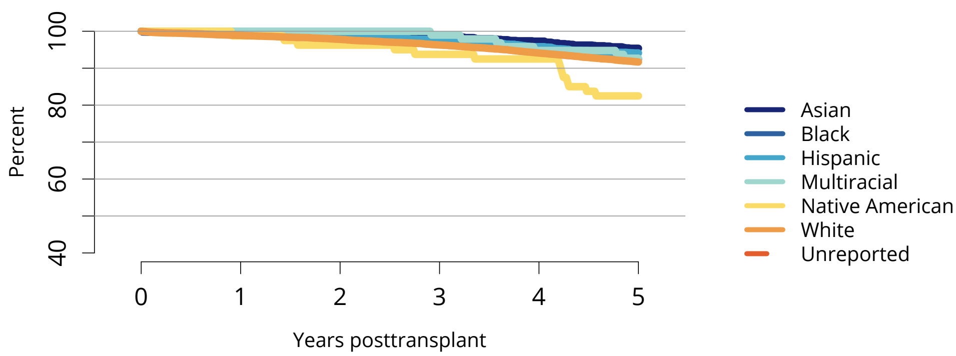

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Figure KI 78: Patient survival among adult living donor kidney transplant recipients, 2016-2018, by race and ethnicity. Patient survival estimated using unadjusted Kaplan-Meier methods.

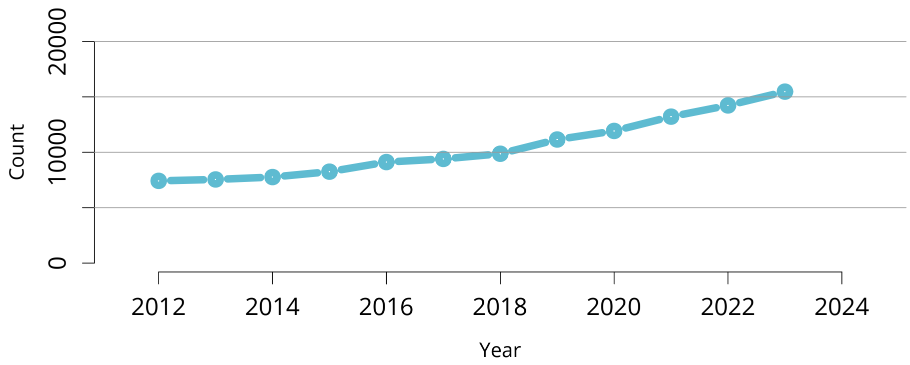

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Figure KI 79: Overall deceased kidney donor count. Count of deceased donors from whom at least one kidney was recovered for transplant.

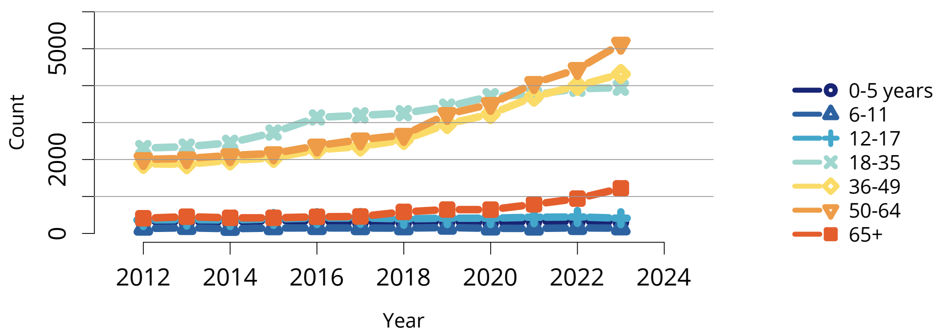

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Figure KI 80: Deceased kidney donor count by age. Count of deceased donors from whom at least one kidney was recovered for transplant.

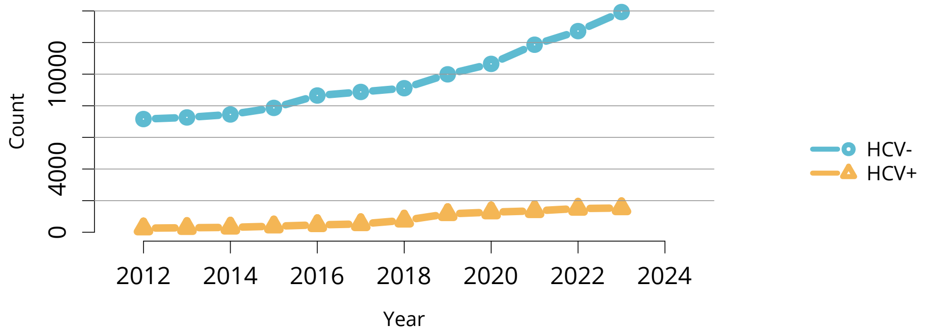

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Figure KI 81: Deceased kidney donor count by HCV status. Count of deceased donors from whom at least one kidney was recovered for transplant. Donor HCV status was based on an antibody test. HCV, hepatitis C virus.

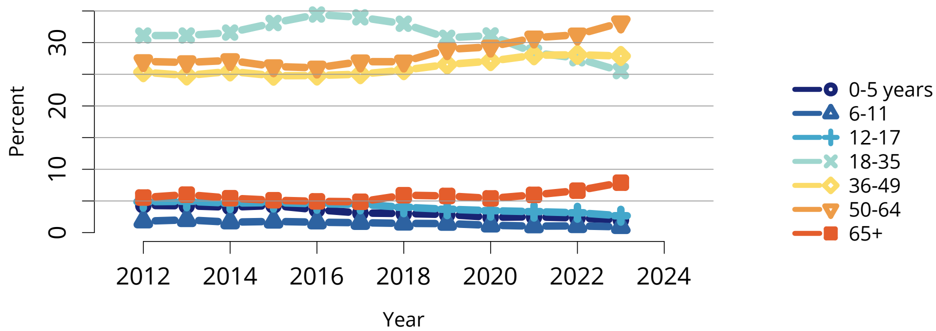

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Figure KI 82: Distribution of deceased kidney donors by age. Deceased donors from whom at least one kidney was recovered for transplant.

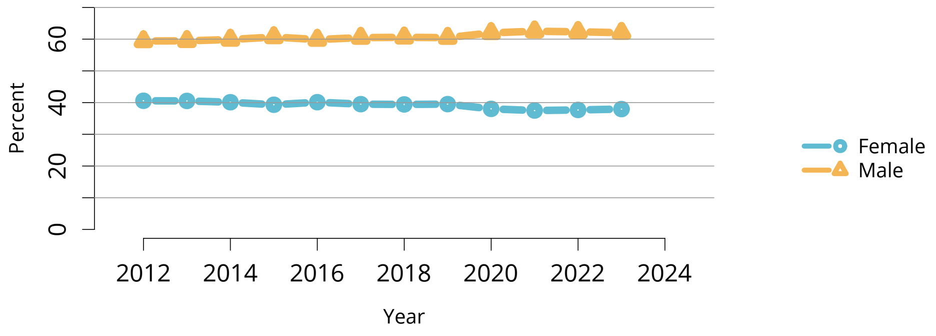

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Figure KI 83: Distribution of deceased kidney donors by sex. Deceased donors from whom at least one kidney was recovered for transplant.

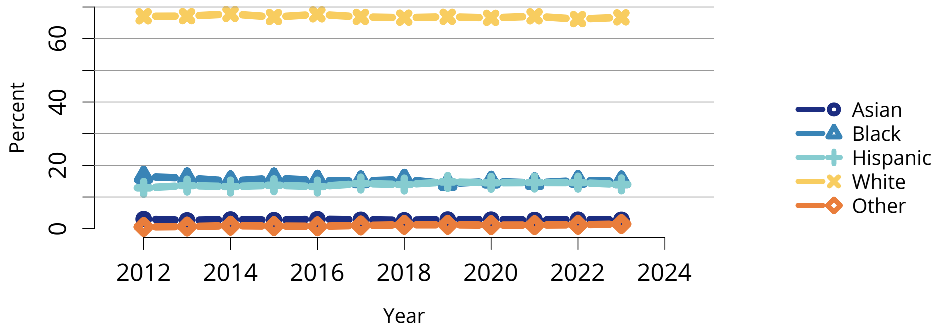

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Figure KI 84: Distribution of deceased kidney donors by race and ethnicity. Deceased donors from whom at least one kidney was recovered for transplant. The Other race category is composed of Native American and Multiracial categories.

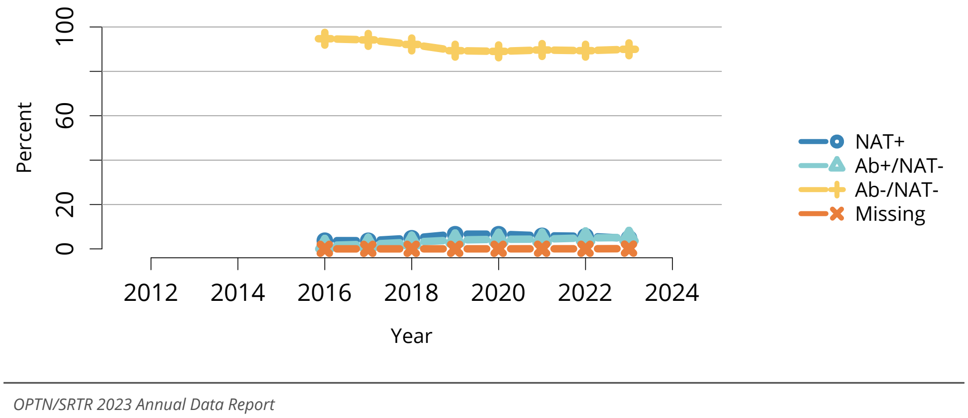

Figure KI 85: Distribution of deceased kidney donors by donor HCV status. Deceased donors from whom at least one kidney was recovered for transplant. Donor HCV status was based on NAT and antibody tests. Ab, antibody; HCV, hepatitis C virus; NAT, nucleic acid test.

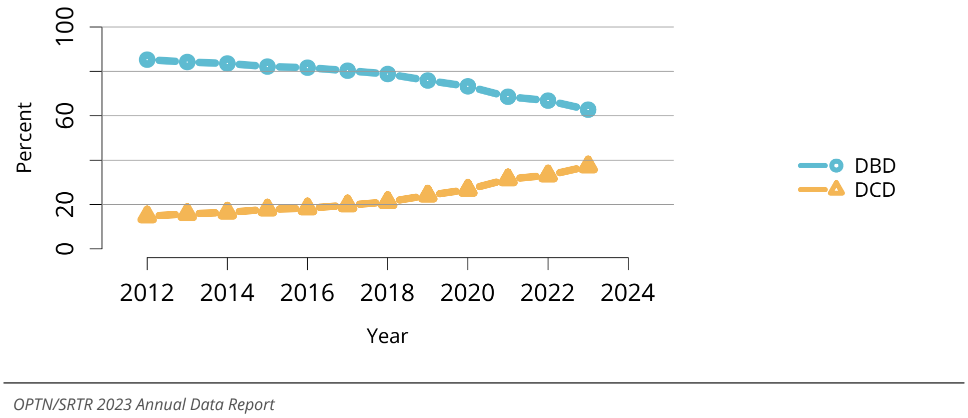

Figure KI 86: Distribution of deceased kidney donors by DCD status. Deceased donors whose kidneys were recovered for transplant. DBD, donation after brain death; DCD, donation after circulatory death.

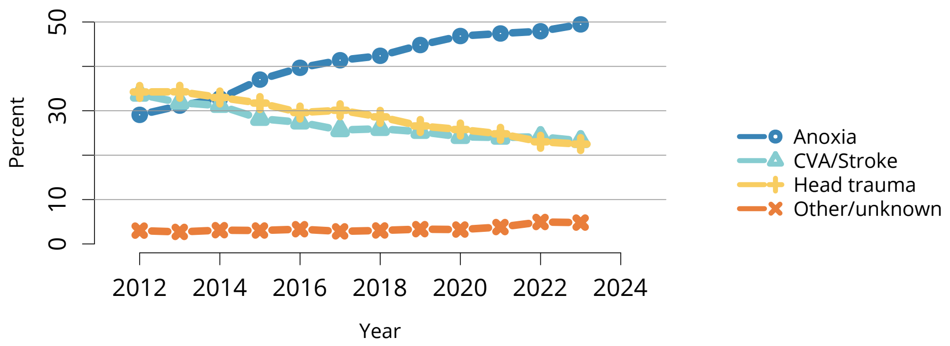

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Figure KI 87: Cause of death among deceased kidney donors. Deceased donors with at least one kidney recovered for transplant. Each donor is counted once. CVA, cerebrovascular accident.

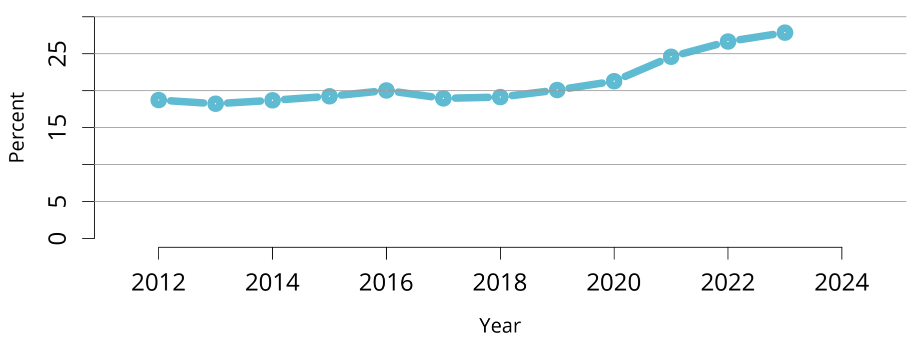

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Figure KI 88: Overall percent of kidneys recovered for transplant and not transplanted. Percentages of kidneys not transplanted out of all kidneys recovered for transplant.

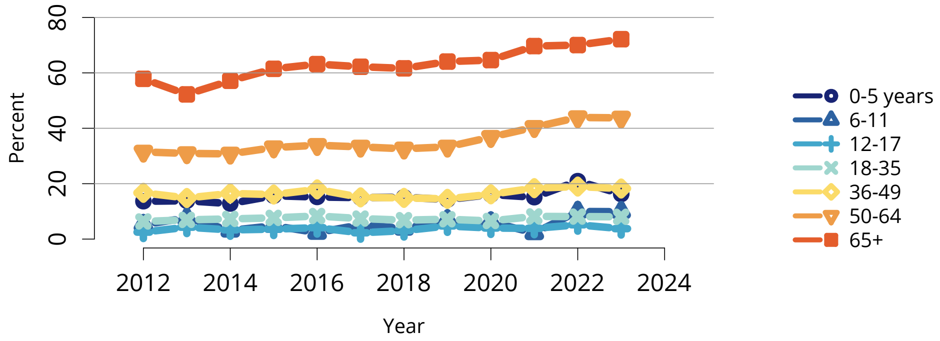

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Figure KI 89: Percent of kidneys recovered for transplant and not transplanted by donor age. Percentages of kidneys not transplanted out of all kidneys recovered for transplant.

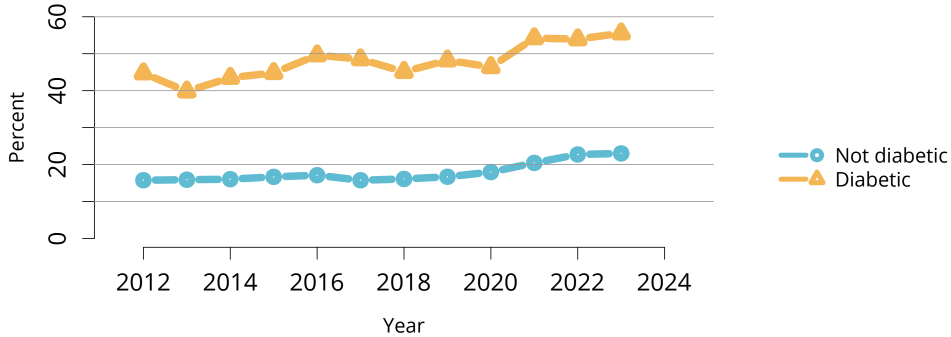

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Figure KI 90: Percent of kidneys recovered for transplant and not transplanted by donor diabetes status. Percentages of kidneys not transplanted out of all kidneys recovered for transplant.

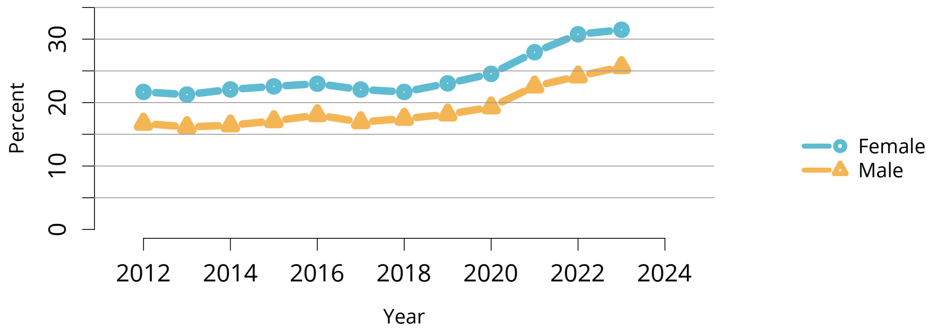

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Figure KI 91: Percent of kidneys recovered for transplant and not transplanted by donor sex. Percentages of kidneys not transplanted out of all kidneys recovered for transplant.

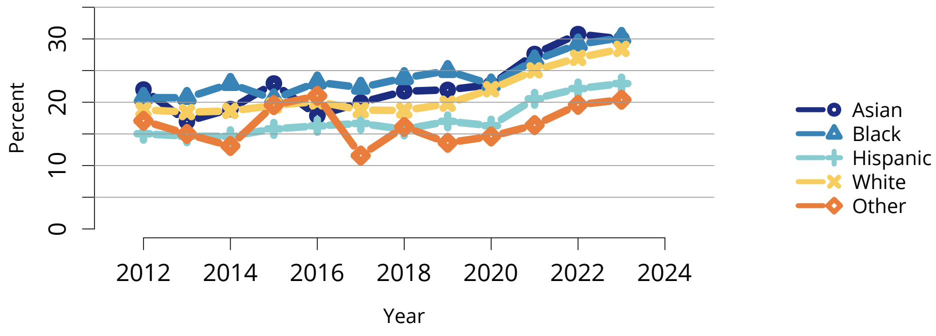

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Figure KI 92: Percent of kidneys recovered for transplant and not transplanted by donor race and ethnicity. Percentages of kidneys not transplanted out of all kidneys recovered for transplant. The Other race category is composed of Native American and Multiracial categories.

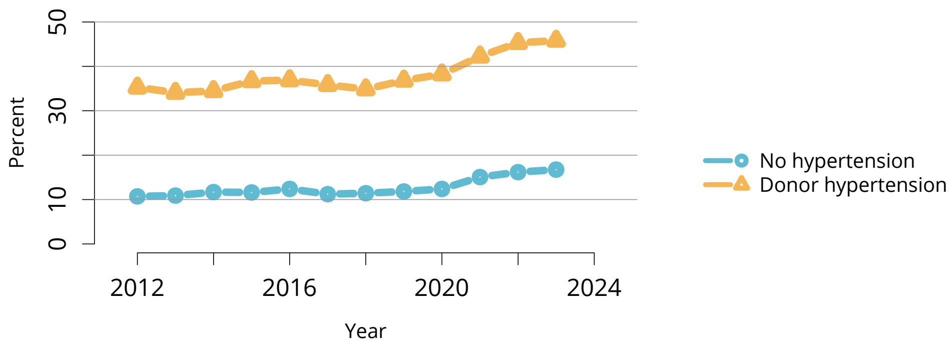

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Figure KI 93: Percent of kidneys recovered for transplant and not transplanted by donor hypertension status. Percentages of kidneys not transplanted out of all kidneys recovered for transplant.

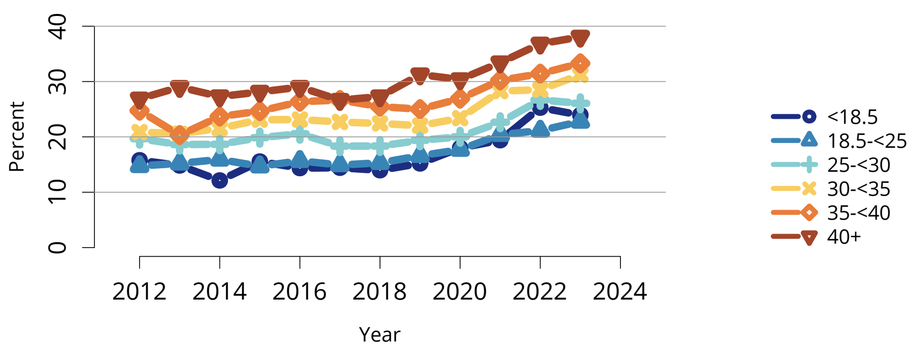

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Figure KI 94: Percent of kidneys recovered for transplant and not transplanted by donor BMI. Percentages of kidneys not transplanted out of all kidneys recovered for transplant. BMI, body mass index.

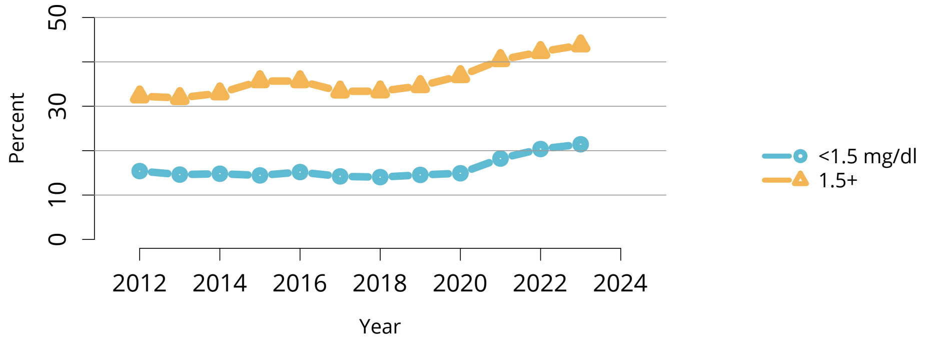

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Figure KI 95: Percent of kidneys recovered for transplant and not transplanted by donor terminal creatinine. Percentages of kidneys not transplanted out of all kidneys recovered for transplant.

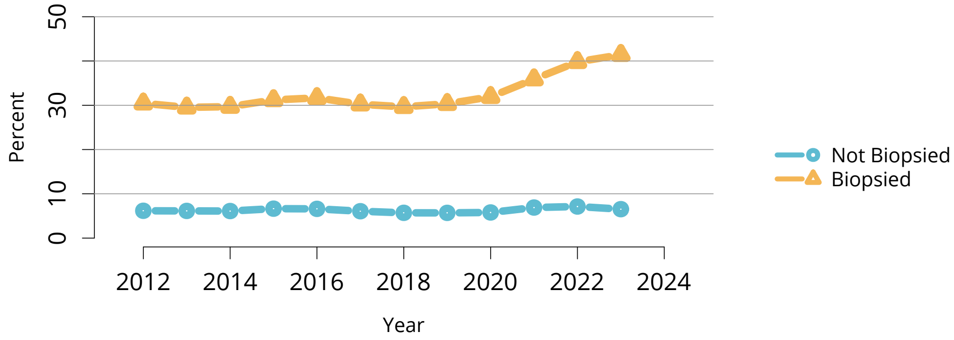

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Figure KI 96: Percent of kidneys recovered for transplant and not transplanted by donor biopsy status. Percentages of kidneys not transplanted out of all kidneys recovered for transplant. Kidneys are classified as biopsied if either of the donor's kidneys was biopsied.

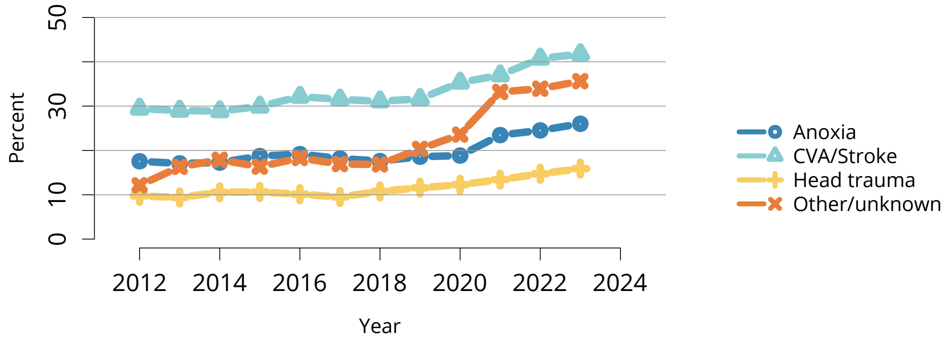

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Figure KI 97: Percent of kidneys recovered for transplant and not transplanted by donor cause of death. Percentages of kidneys not transplanted out of all kidneys recovered for transplant. CVA, cerebrovascular accident.

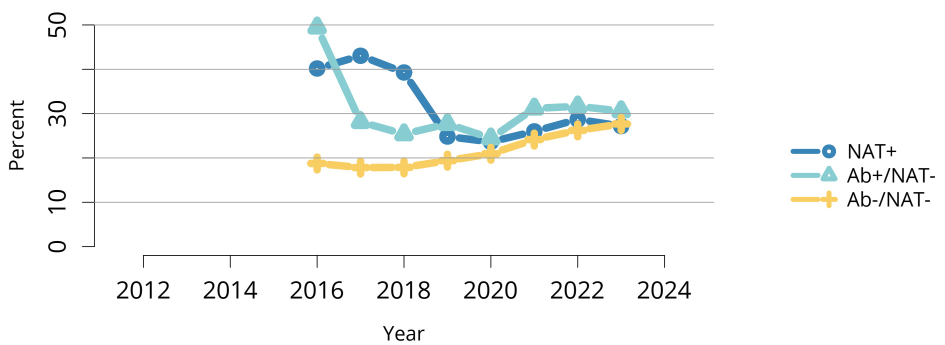

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Figure KI 98: Percent of kidneys recovered for transplant and not transplanted by donor HCV status. Percentages of kidneys not transplanted out of all kidneys recovered for transplant. Donor HCV status was based on NAT and antibody tests. Ab, antibody; HCV, hepatitis C virus; NAT, nucleic acid test.

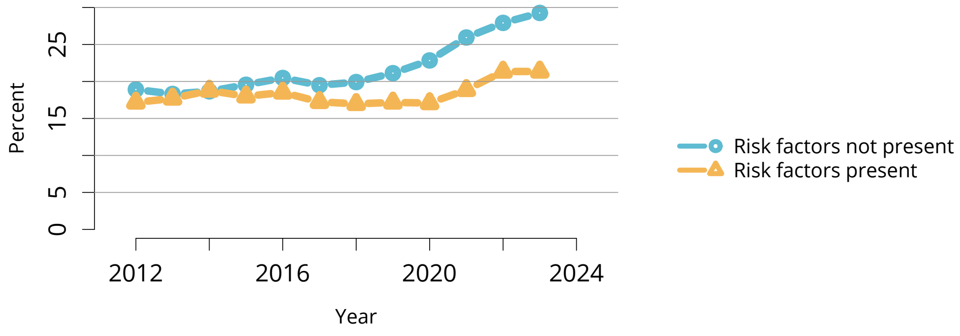

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Figure KI 99: Percent of kidneys recovered for transplant and not transplanted, by donor risk of disease transmission. Percentages of kidneys not transplanted out of all kidneys recovered for transplant. “Risk factors” refers to risk criteria for acute transmission of human immunodeficiency virus, hepatitis B virus, or hepatitis C virus from the US Public Health Service Guideline.

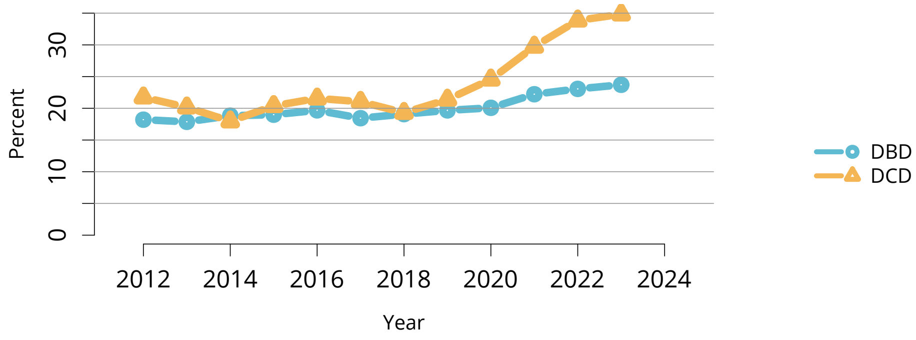

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Figure KI 100: Percent of kidneys recovered for transplant and not transplanted by DCD status. Percentages of kidneys not transplanted out of all kidneys recovered for transplant. DBD, donation after brain death; DCD, donation after circulatory death.

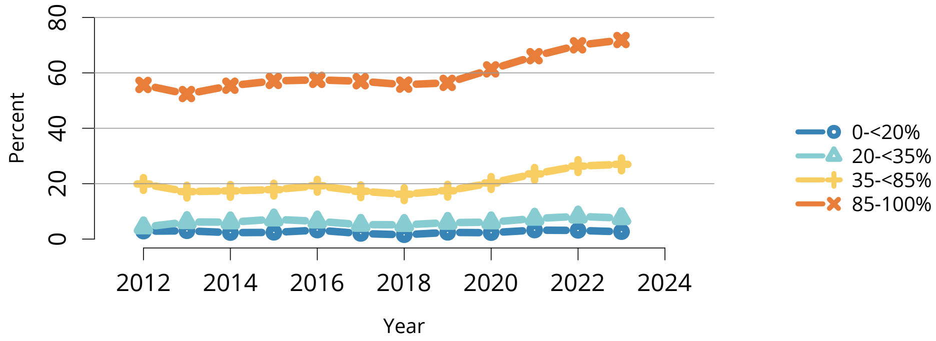

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Figure KI 101: Percent of kidneys recovered for transplant and not transplanted by KDPI. Percentages of kidneys not transplanted out of all kidneys recovered for transplant, by KDPI classification. Conversion of kidney donor risk index to KDPI is done using the OPTN KDPI Mapping Tables. For donors recovered January through May, the cohort 2 years prior was used to assign KDPI; for donors recovered June through December, the cohort 1 year prior was used to assign KDPI. KDPI, kidney donor profile index.

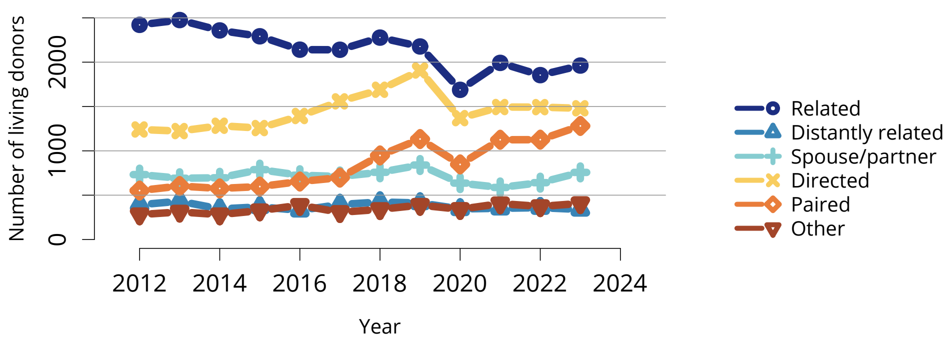

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Figure KI 102: Number of living kidney donors by donor relation. As reported on the OPTN Living Donor Registration Form.

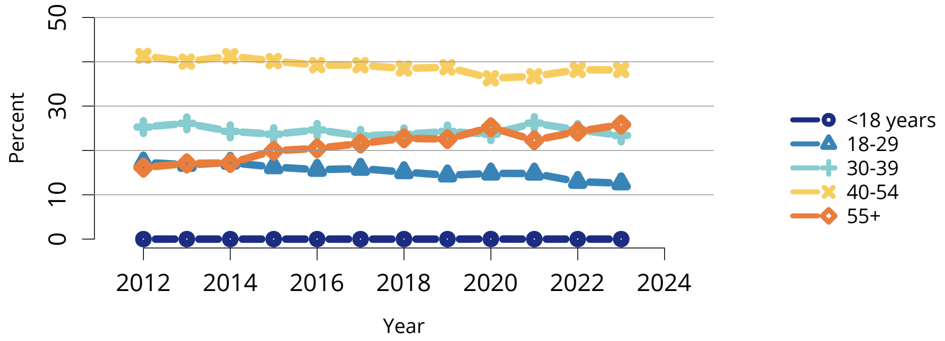

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Figure KI 103: Living kidney donors by age. As reported on the OPTN Living Donor Registration Form.

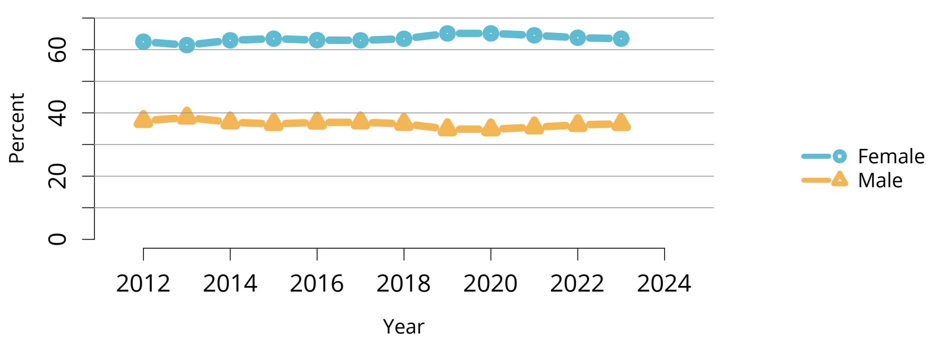

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Figure KI 104: Living kidney donors by sex. As reported on the OPTN Living Donor Registration Form.

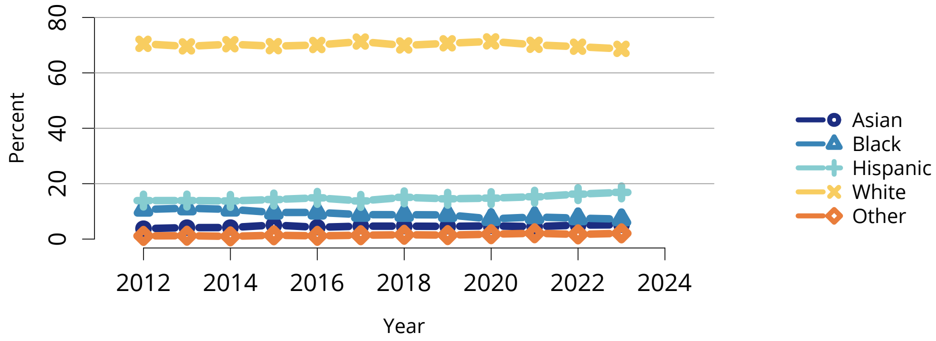

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Figure KI 105: Living kidney donors by race and ethnicity. As reported on the OPTN Living Donor Registration Form. The Other race category is composed of Native American and Multiracial categories.

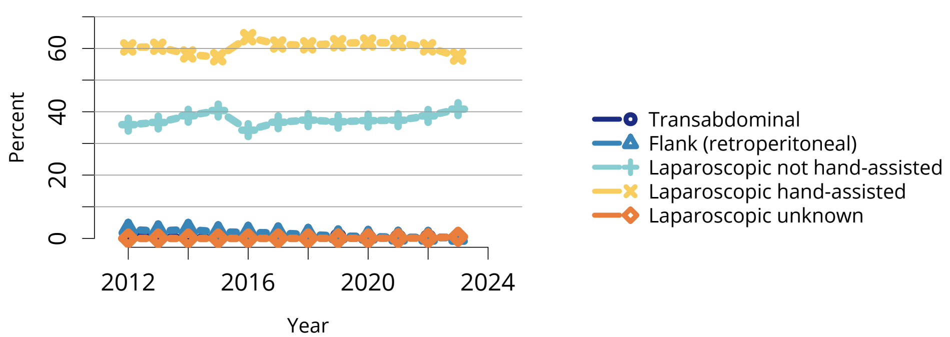

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Figure KI 106: Intended living kidney donor procedure type. As reported on the OPTN Living Donor Registration Form.

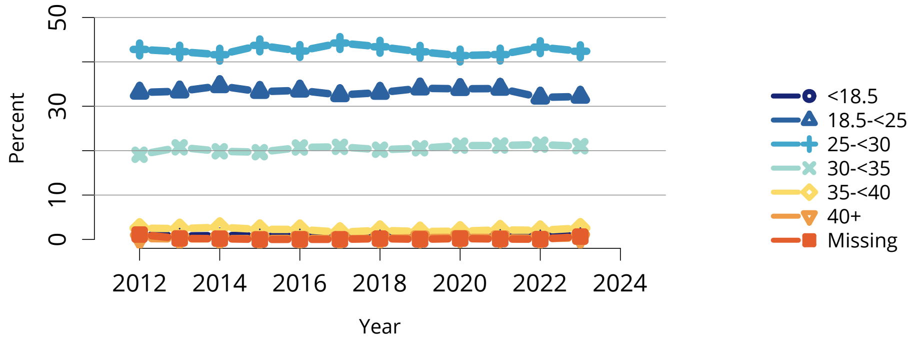

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Figure KI 107: BMI among living kidney donors. Donor height and weight reported on the OPTN Living Donor Registration Form. BMI, body mass index.

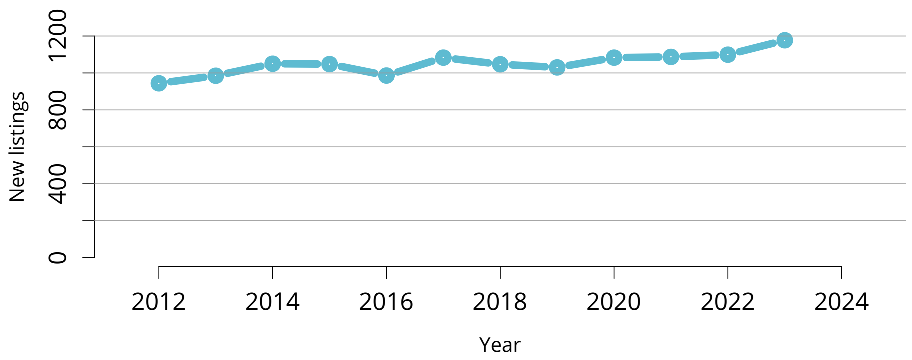

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Figure KI 108: New pediatric candidates added to the kidney transplant waiting list. A new candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and were subsequently relisted are considered new. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

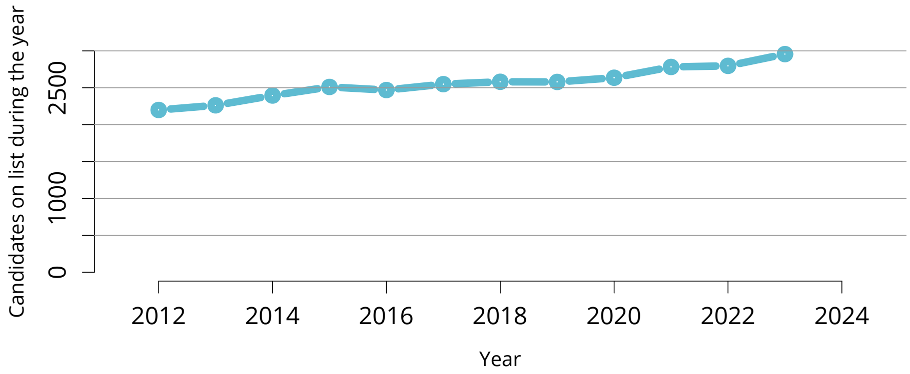

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Figure KI 109: All pediatric candidates on the kidney transplant waiting list. Candidates listed at more than one center are counted once per listing; age determined at first listing.

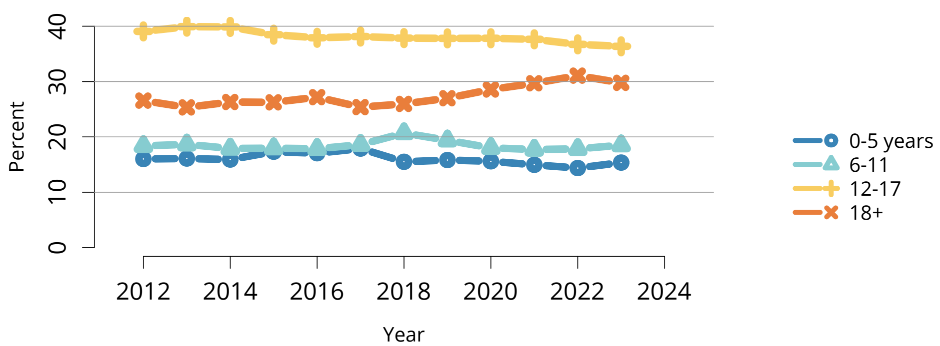

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Figure KI 110: Distribution of pediatric candidates waiting for kidney transplant by age. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included. Age is determined at the earliest of transplant, death, removal, or December 31 of the year. The 18+ category is for candidates who turned age 18 while waiting.

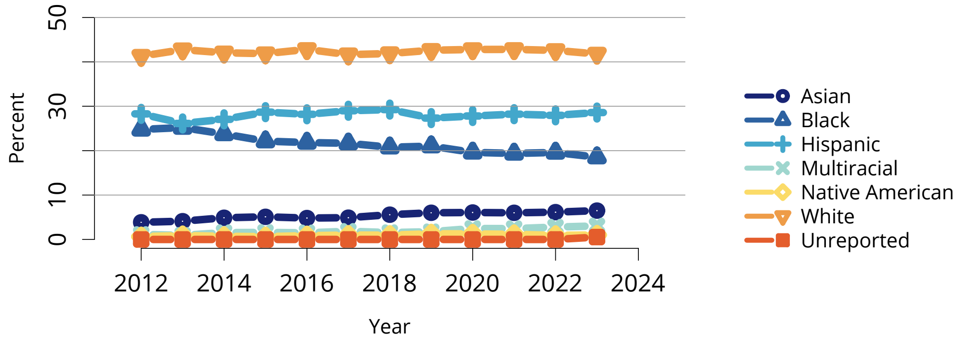

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Figure KI 111: Distribution of pediatric candidates waiting for kidney transplant by race and ethnicity. Candidates waiting for transplant any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included.

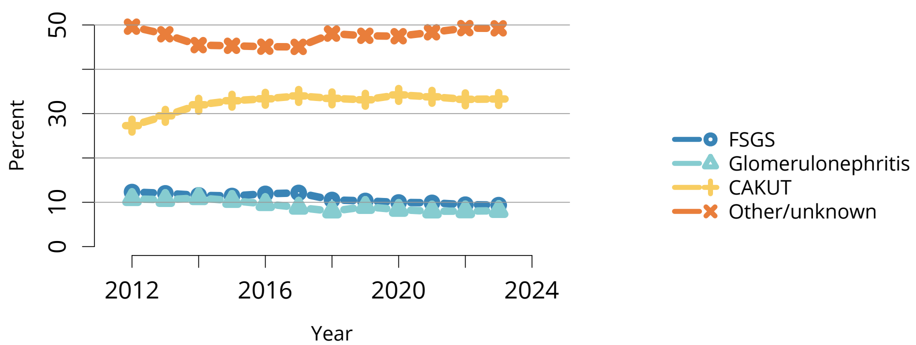

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Figure KI 112: Distribution of pediatric candidates waiting for kidney transplant by diagnosis. Candidates waiting for transplant any time in the given year. Candidates listed at more than one center are counted once per listing. Diagnosis categories follow North American Pediatric Renal Trials and Collaborative Studies recommendations. Active and inactive candidates are included. CAKUT, congenital anomalies of the kidney and urinary tract; FSGS, focal segmental glomerulosclerosis.

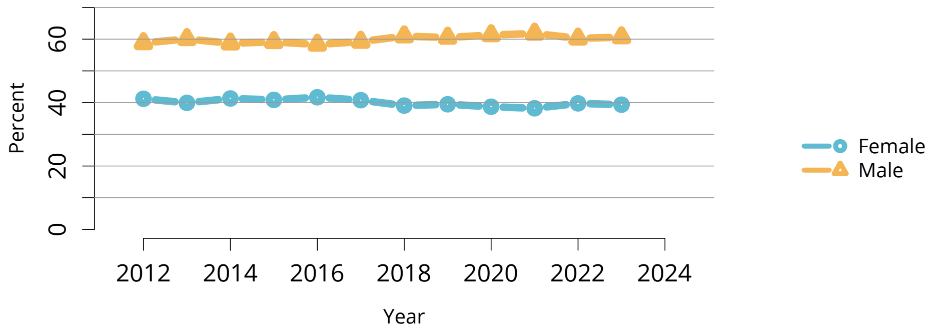

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Figure KI 113: Distribution of pediatric candidates waiting for kidney transplant by sex. Candidates waiting for transplant any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

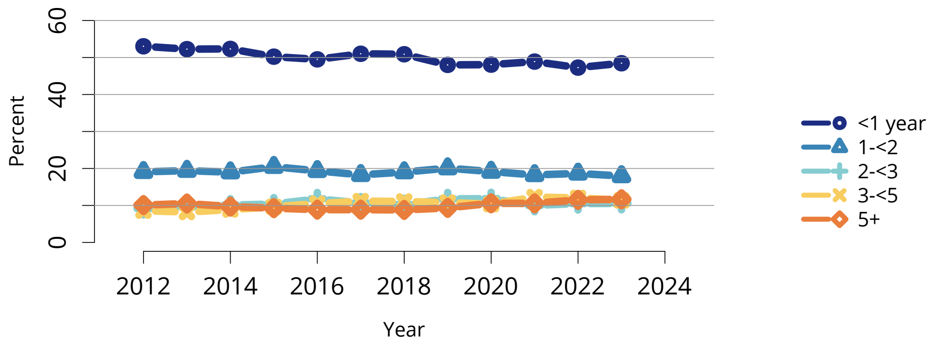

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Figure KI 114: Distribution of pediatric candidates waiting for kidney transplant by waiting time. Candidates waiting for transplant any time in the given year. Candidates listed at more than one center are counted once per listing. Time on the waiting list is determined at the earliest of transplant, death, removal, or December 31 of the year. Candidates listed in the given year are considered to have been listed less than 1 year. Active and inactive candidates are included.

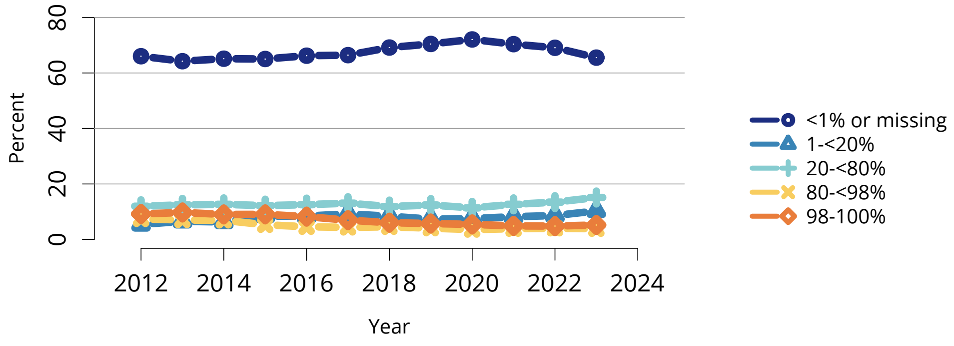

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Figure KI 115: Distribution of pediatric candidates waiting for kidney transplant by cPRA. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. cPRA is determined at the earliest of transplant, death, removal, or December 31 of the year. Missing indicates no unacceptable antigens were reported. Active and inactive candidates are included. cPRA, calculated panel-reactive antibody.

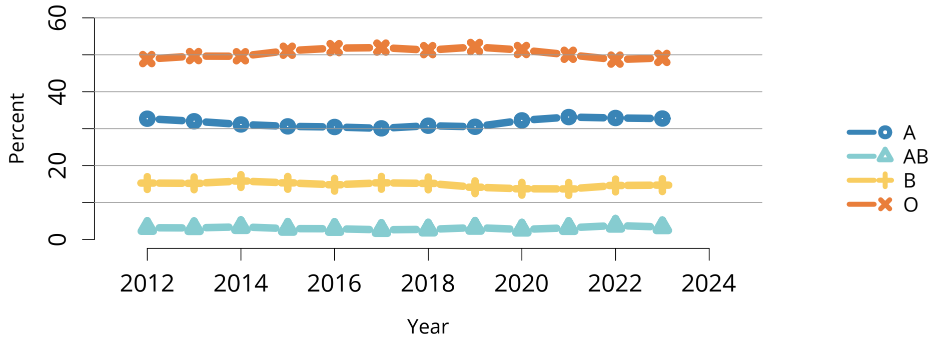

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Figure KI 116: Distribution of pediatric candidates waiting for kidney transplant by blood type. Candidates waiting for transplant any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

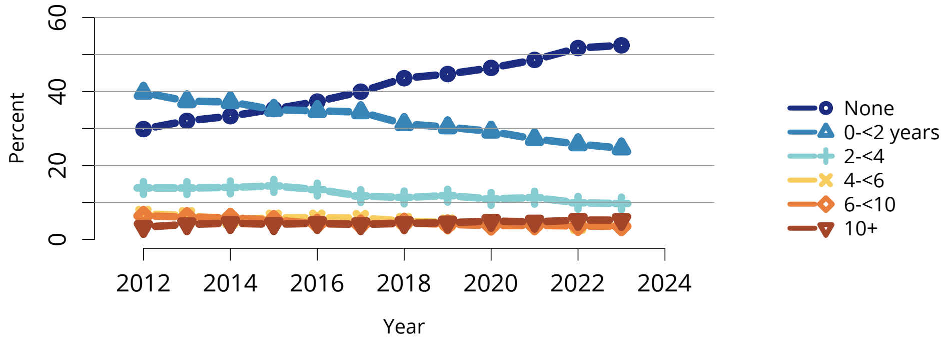

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Figure KI 117: Distribution of pediatric candidates waiting for kidney transplant by years on dialysis. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Time on dialysis is computed as time from minimum of first end-stage renal disease service date or most recent graft failure to listing date or January 1 of the given year. Active and inactive candidates are included.

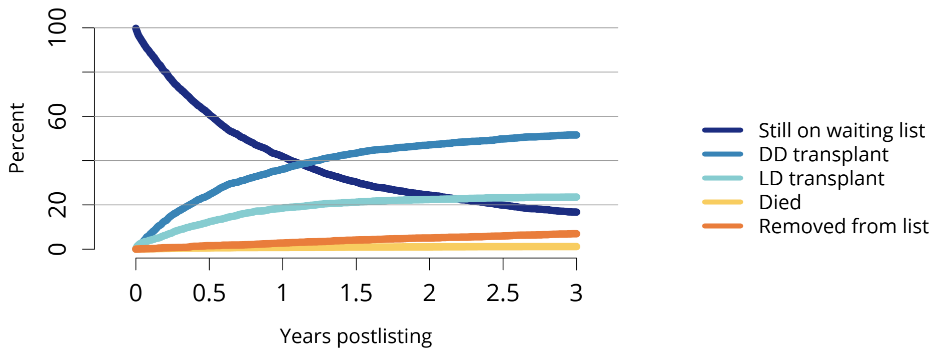

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Figure KI 118: Three-year outcomes for newly listed pediatric candidates waiting for kidney transplant, 2018-2020. Pediatric candidates who joined the waiting list in 2018-2020. Candidates listed at more than one center are counted once per listing. DD, deceased donor; LD, living donor.

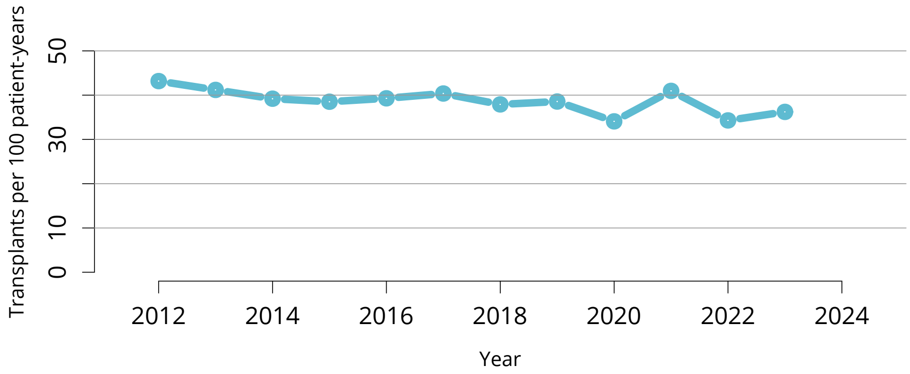

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Figure KI 119: Overall deceased donor kidney transplant rates among pediatric waitlist candidates. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

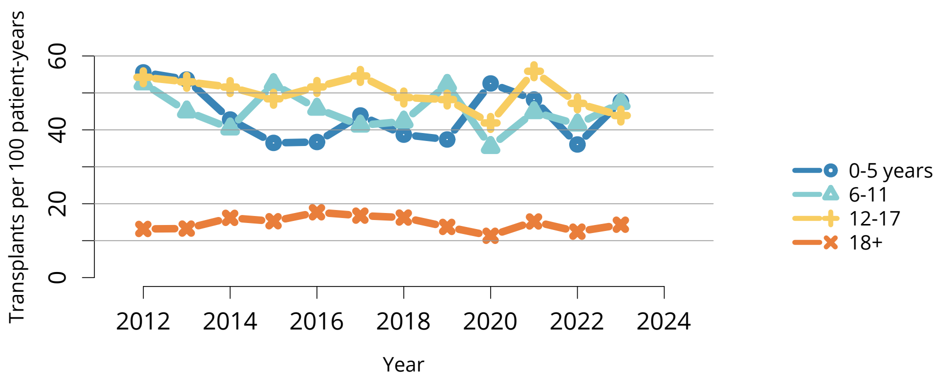

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Figure KI 120: Deceased donor kidney transplant rates among pediatric waitlist candidates by age. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year. The 18+ category is for candidates who turned age 18 while waiting.

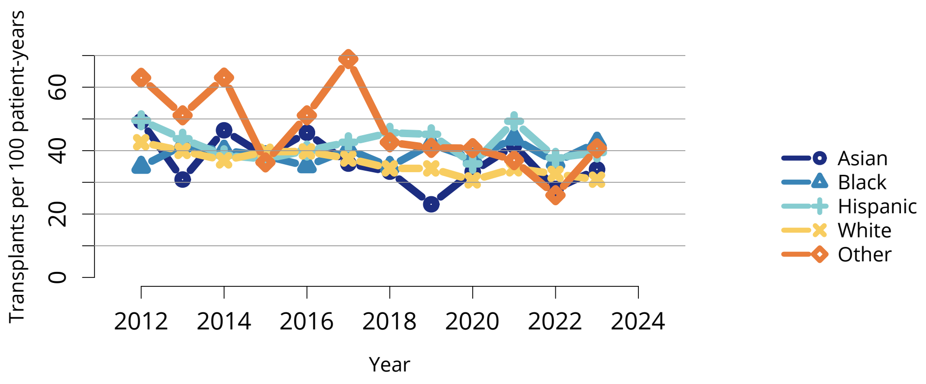

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Figure KI 121: Deceased donor kidney transplant rates among pediatric waitlist candidates by race and ethnicity. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

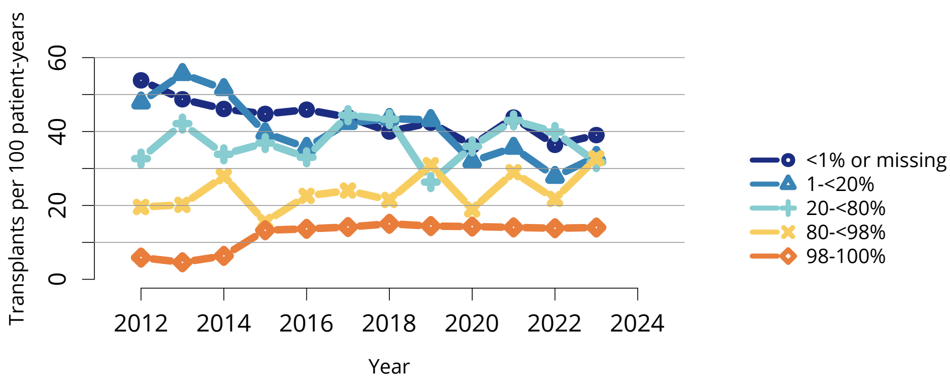

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Figure KI 122: Deceased donor kidney transplant rates among pediatric waitlist candidates by cPRA. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. cPRA is determined at the later of listing date or January 1 of the given year. Missing indicates no unacceptable antigens were reported. cPRA, calculated panel-reactive antibody.

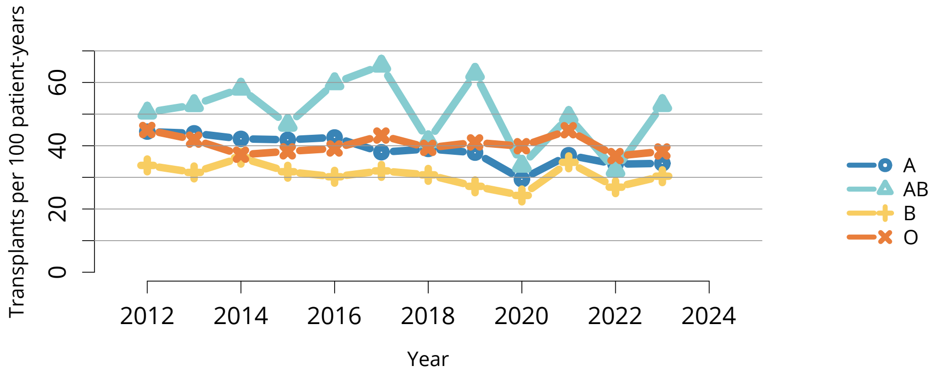

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Figure KI 123: Deceased donor kidney transplant rates among pediatric waitlist candidates by blood type. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

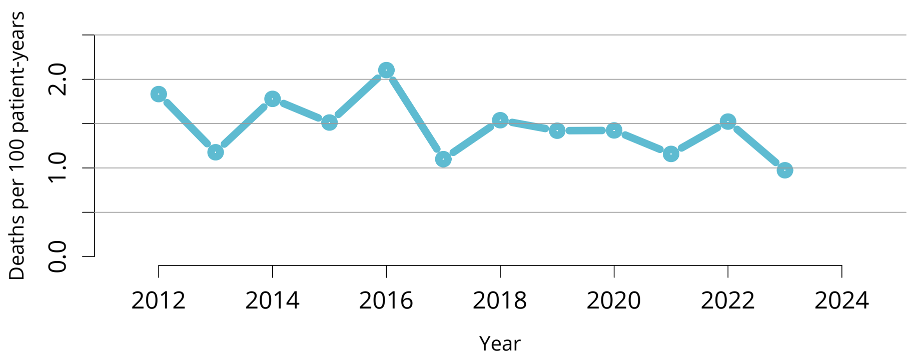

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Figure KI 124: Overall pretransplant mortality rates among pediatric candidates waitlisted for kidney. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

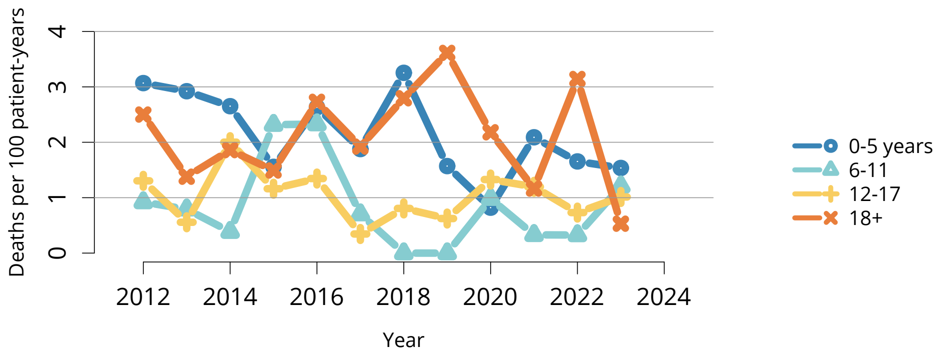

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Figure KI 125: Pretransplant mortality rates among pediatric candidates waitlisted for kidney transplant by age. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year. The 18+ category is for candidates who turned age 18 while waiting.

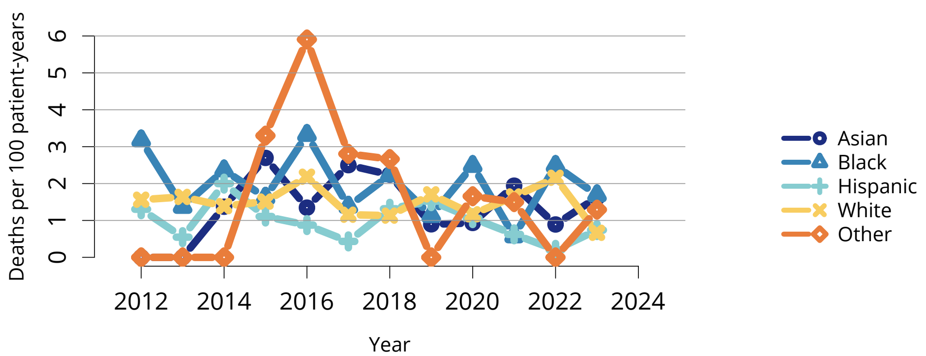

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Figure KI 126: Pretransplant mortality rates among pediatric candidates waitlisted for kidney transplant by race and ethnicity. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

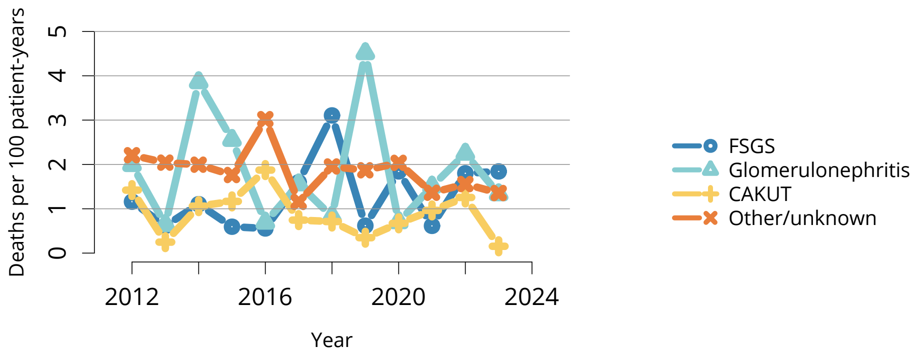

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Figure KI 127: Pretransplant mortality rates among pediatric candidates waitlisted for kidney transplant by diagnosis. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Diagnosis categories follow North American Pediatric Renal Trials and Collaborative Studies recommendations. Active and inactive candidates are included. CAKUT, congenital anomalies of the kidney and urinary tract; FSGS, focal segmental glomerulosclerosis.

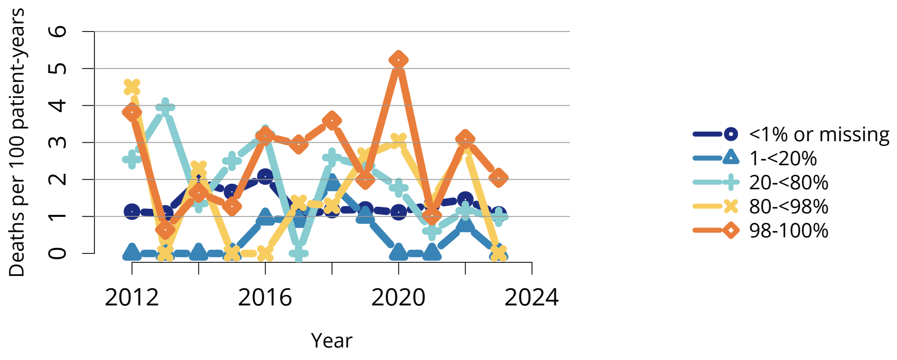

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Figure KI 128: Pretransplant mortality rates among pediatric candidates waitlisted for kidney transplant by cPRA. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. cPRA is determined at the later of listing date or January 1 of the given year. Missing indicates no unacceptable antigens were reported. cPRA, calculated panel-reactive antibody.

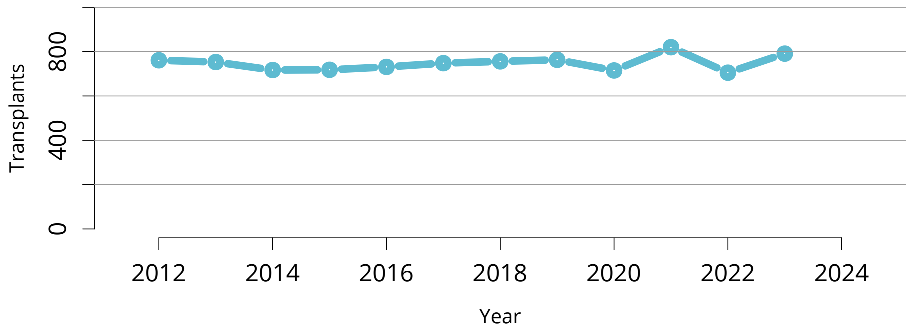

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Figure KI 129: Overall pediatric kidney transplants. All pediatric kidney transplant recipients, including retransplant and multiorgan recipients.

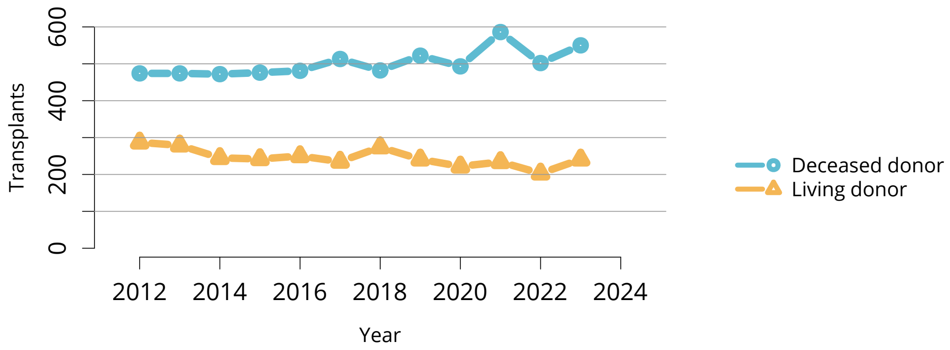

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Figure KI 130: Pediatric kidney transplants by donor type. All pediatric kidney transplant recipients, including retransplant and multiorgan recipients.

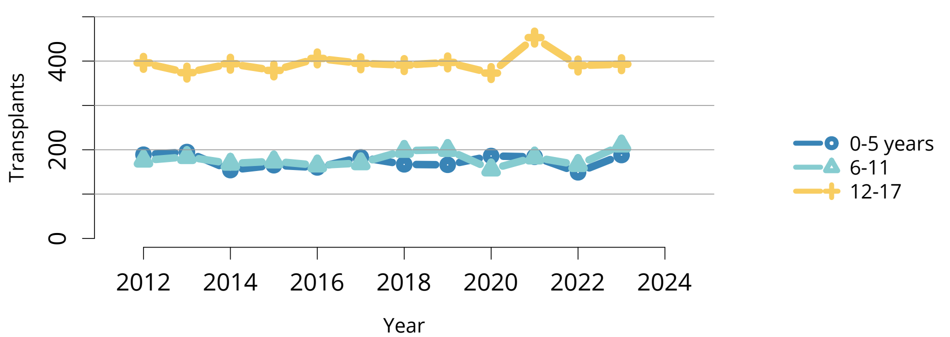

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Figure KI 131: Pediatric kidney transplants by recipient age. All pediatric kidney transplant recipients, including retransplant and multiorgan recipients.

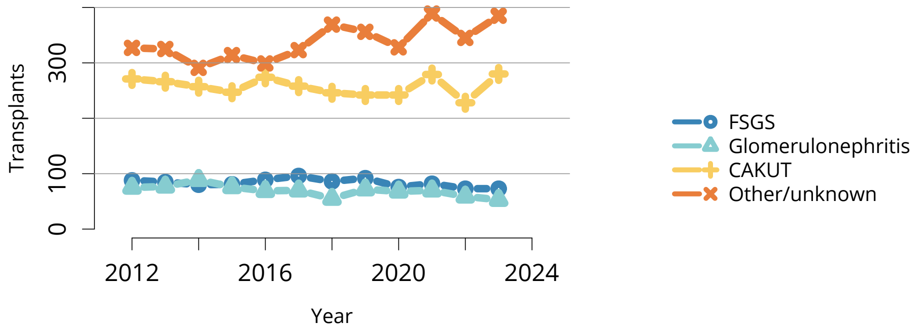

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Figure KI 132: Pediatric kidney transplants by diagnosis. All pediatric kidney transplant recipients, including retransplant, and multiorgan recipients. Diagnosis categories follow North American Pediatric Renal Trials and Collaborative Studies recommendations. Active and inactive candidates are included. CAKUT, congenital anomalies of the kidney and urinary tract; FSGS, focal segmental glomerulosclerosis.

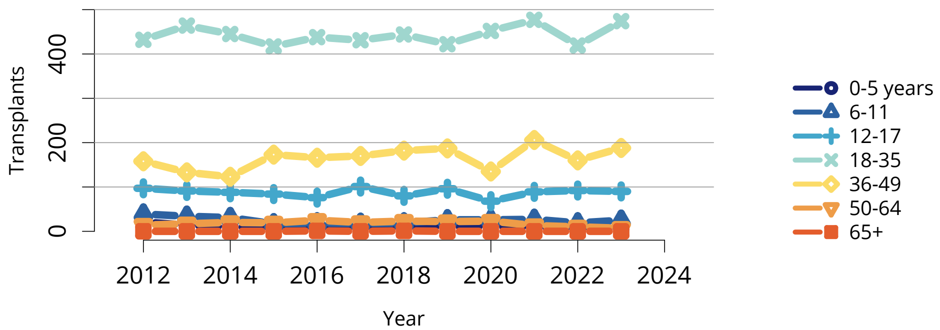

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Figure KI 133: Pediatric kidney transplants by donor age. All pediatric kidney transplant recipients, including retransplant and multiorgan recipients.

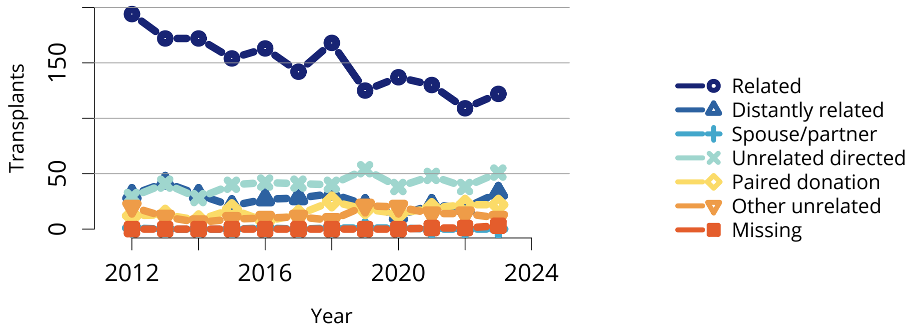

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Figure KI 134: Number of living donor pediatric kidney transplants by donor relation. As reported on the OPTN Living Donor Registration Form. All pediatric kidney transplant recipients, including retransplant, and multiorgan recipients.

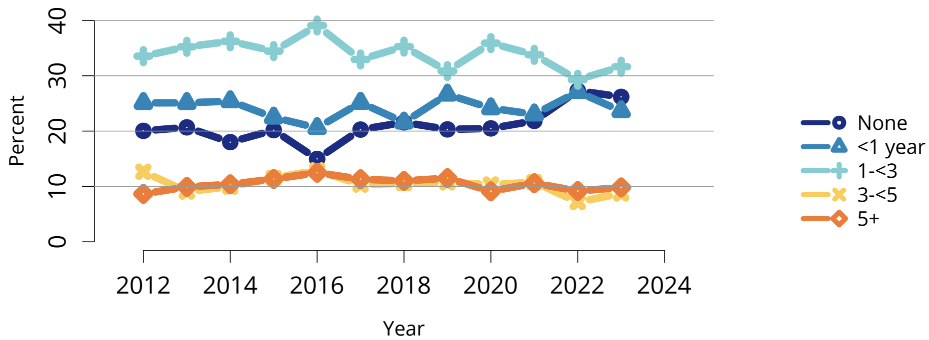

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Figure KI 135: Percent of pediatric deceased donor kidney transplants by years on dialysis. All pediatric recipients of deceased donor kidneys, including multiorgan transplant recipients. Time on dialysis is computed as time from minimum of first end-stage renal disease service date or most recent graft failure to transplant date.

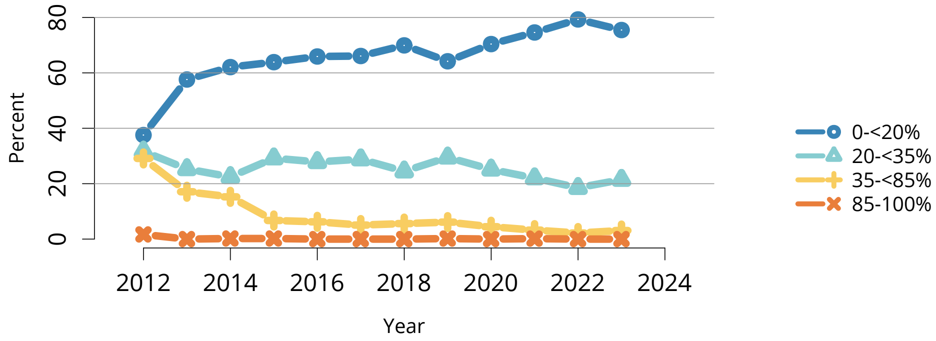

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Figure KI 136: Percent of pediatric kidney transplants by KDPI. All pediatric recipients of deceased donor kidneys, including multiorgan transplant recipients. Conversion of kidney donor risk index to KDPI is done using the OPTN KDPI Mapping Tables. For donors recovered January through May, the cohort 2 years prior was used to assign KDPI; for donors recovered June through December, the cohort 1 year prior was used to assign KDPI. Kidneys recovered en bloc are counted once. KDPI, kidney donor profile index.

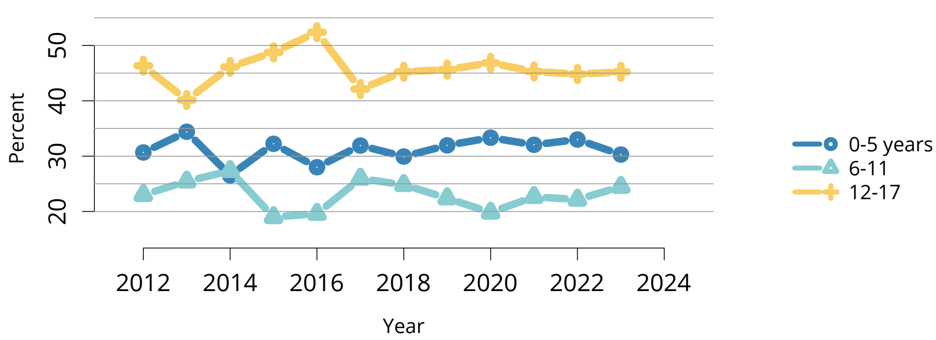

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Figure KI 137: Percent of pediatric kidney transplants from living donors by recipient age. All pediatric living kidney transplant recipients, including retransplant and multiorgan recipients.

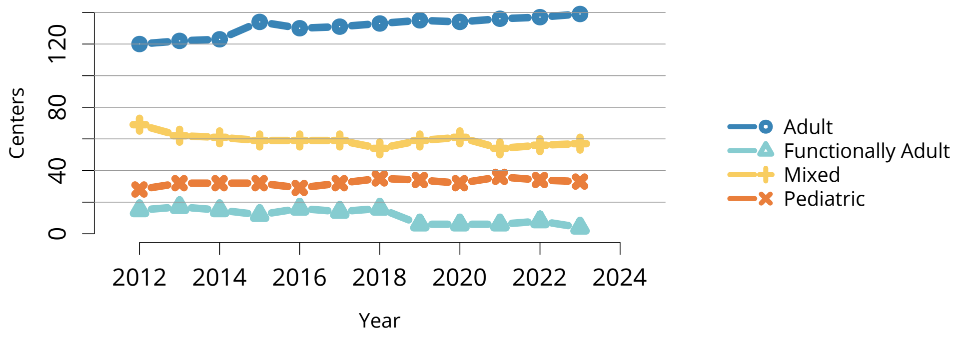

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Figure KI 138: Number of centers performing pediatric and adult kidney transplants by center age mix. Adult centers performed transplants only for recipients aged 18 years or older. Functionally adult centers performed transplants for 80% adults or more, and the remainder were children aged 15-17 years. Mixed included adults and children of any age groups. Pediatric centers performed transplants for recipients aged 0-17 years, and a small number of adults up to age 21 years.

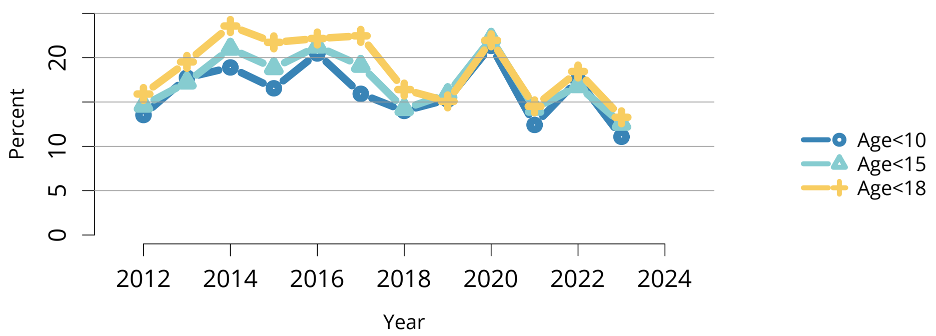

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Figure KI 139: Pediatric kidney recipients at programs that perform five or fewer pediatric transplants annually. Age groups are cumulative.

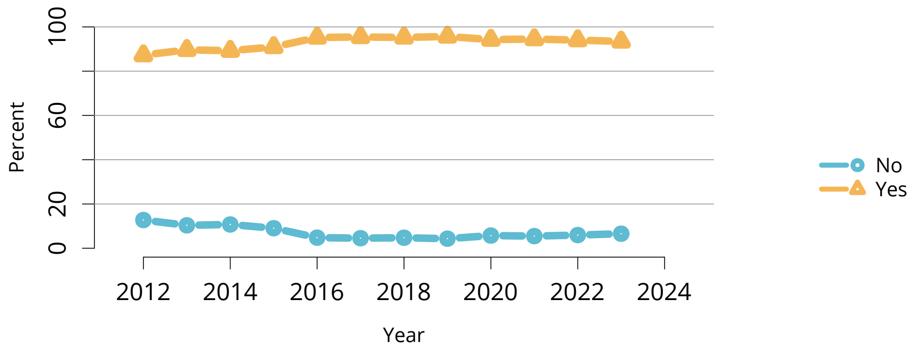

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Figure KI 140: Induction agent use in pediatric kidney transplant recipients. Immunosuppression at transplant reported to the OPTN.

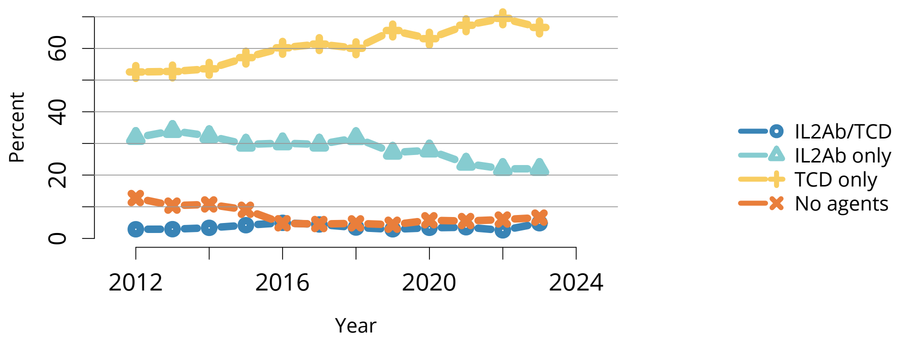

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Figure KI 141: Type of induction agent use in pediatric kidney transplant recipients. Immunosuppression at transplant reported to the OPTN. IL2Ab, interleukin-2 receptor antibody; TCD, T-cell depleting.

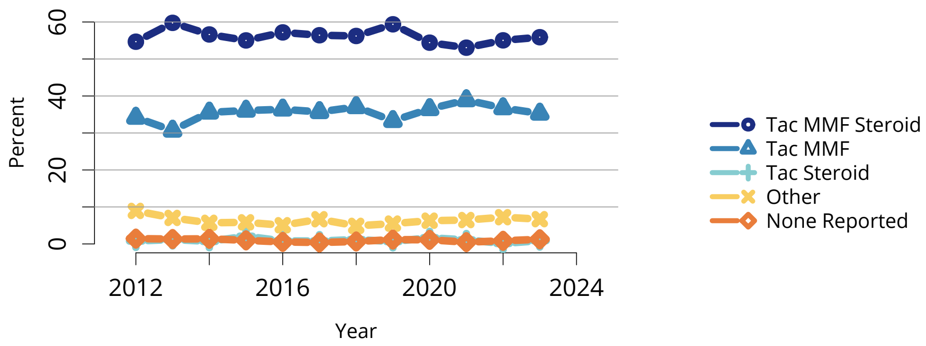

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Figure KI 142: Immunosuppression regimen use in pediatric kidney transplant recipients. Immunosuppression regimen at transplant reported to the OPTN. MMF, all mycophenolate agents; Tac, tacrolimus.

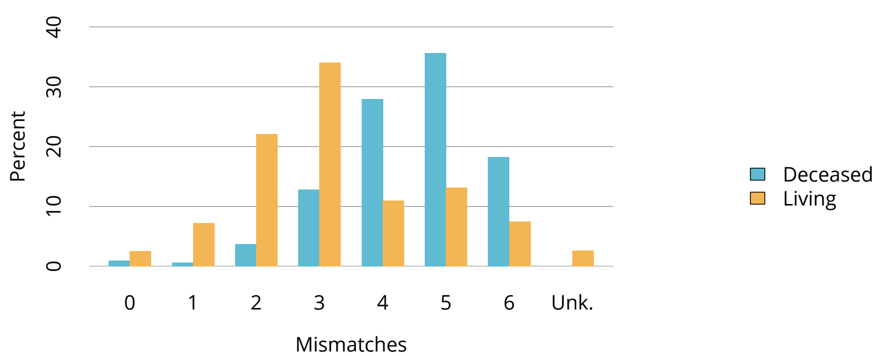

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Figure KI 143: Total HLA A, B, and DR mismatches among pediatric kidney transplant recipients, 2019-2023. Donor and recipient antigen matching is based on OPTN antigen values and split equivalences policy as of 2023. Unk, unknown.

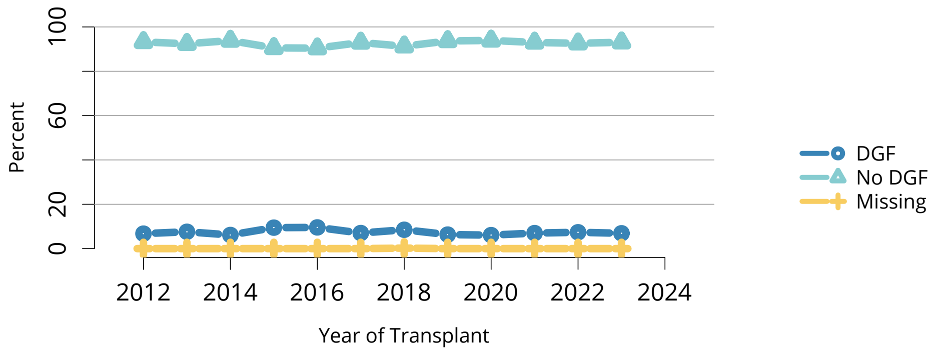

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Figure KI 144: Delayed graft function among pediatric deceased donor kidney transplant recipients. All pediatric recipients of deceased donor kidneys. Delayed graft function is defined as dialysis administered within the first 7 days posttransplant. DGF, delayed graft function.

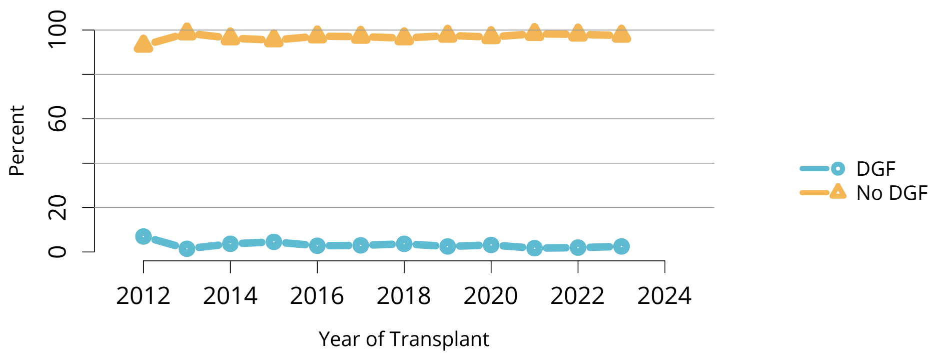

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Figure KI 145: Delayed graft function among pediatric living donor kidney transplant recipients. All pediatric recipients of living donor kidneys. Delayed graft function is defined as dialysis administered within the first 7 days posttransplant. DGF, delayed graft function.

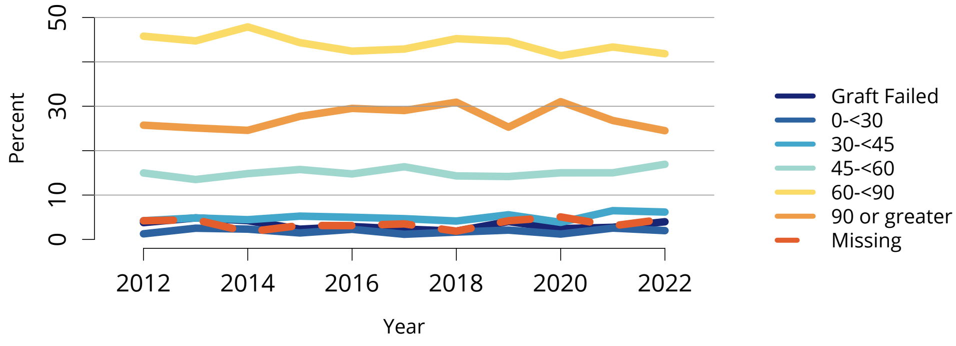

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Figure KI 146: Distribution of eGFR at 12 months posttransplant among pediatric deceased donor kidney transplant recipients. Glomerular filtration rate (mL/min/1.73 m^2) estimated using the bedside Schwartz equation, and computed by SRTR for patients alive with graft function at 12 months posttransplant. Equation: eGFR = 0.413*Height(cm)/Creatinine (mg/dL). eGFR, estimated glomerular filtration rate.

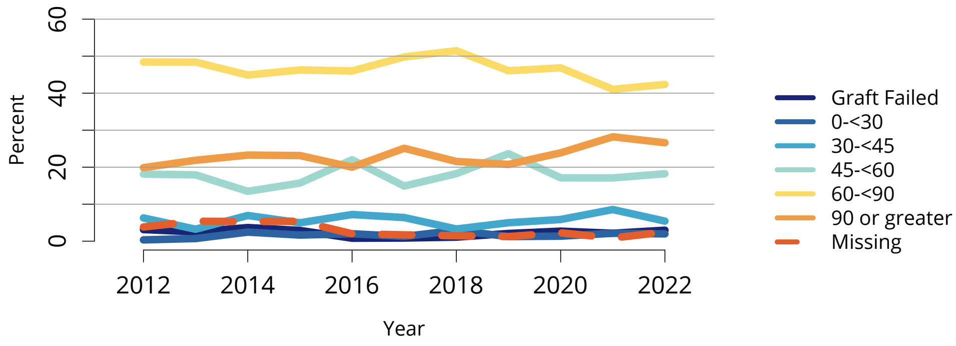

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Figure KI 147: Distribution of eGFR at 12 months posttransplant among pediatric living donor kidney transplant recipients. Glomerular filtration rate (mL/min/1.73 m^2) estimated using the bedside Schwartz equation, and computed by SRTR for patients alive with graft function at 12 months posttransplant. Equation: eGFR = 0.413*Height(cm)/Creatinine (mg/dL). eGFR, estimated glomerular filtration rate.

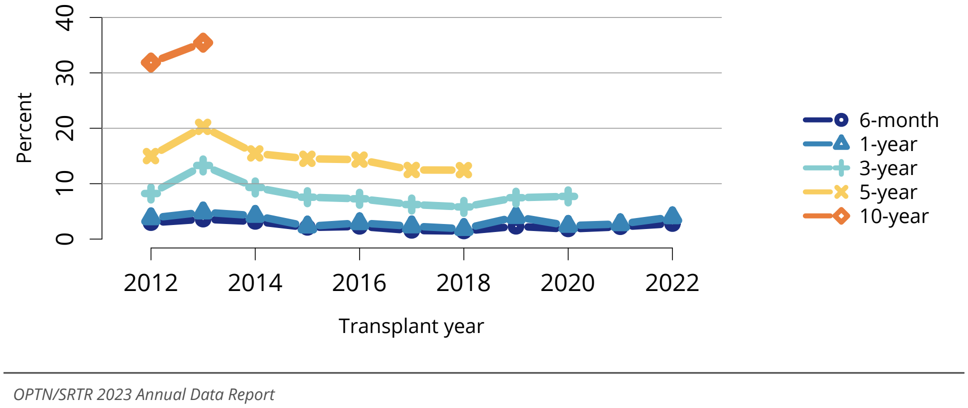

Figure KI 148: Graft failure among pediatric deceased donor kidney transplant recipients. All pediatric recipients of deceased donor kidneys, including multiorgan transplant recipients. Estimates are unadjusted, computed using Kaplan-Meier methods. Recipients are followed to the earliest of kidney graft failure; kidney retransplant; return to dialysis; death; or 6 months, 1, 3, 5, or 10 years posttransplant. All-cause graft failure is defined as any of the prior outcomes prior to 6 months, 1, 3, 5, or 10 years, respectively.

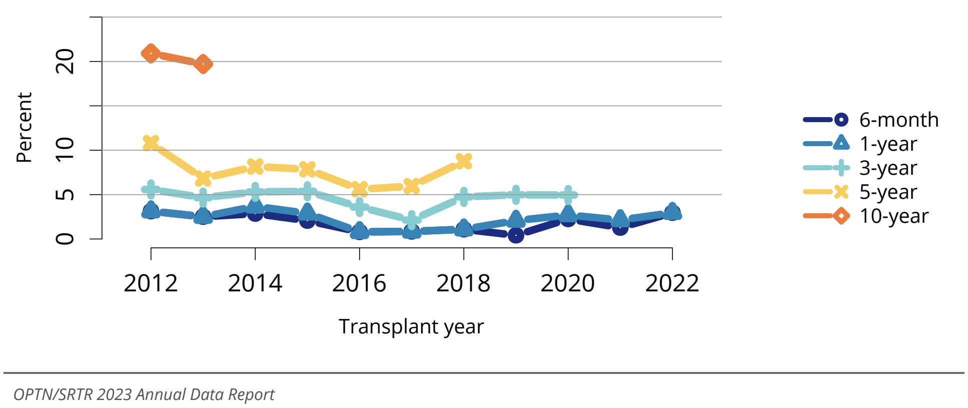

Figure KI 149: Graft failure among pediatric living donor kidney transplant recipients. All pediatric recipients of living donor kidneys, including multiorgan transplant recipients. Estimates are unadjusted, computed using Kaplan-Meier methods. Recipients are followed to the earliest of kidney graft failure; kidney retransplant; return to dialysis; death; or 6 months, 1, 3, 5, or 10 years posttransplant. All-cause graft failure is defined as any of the prior outcomes prior to 6 months, 1, 3, 5, or 10 years, respectively.

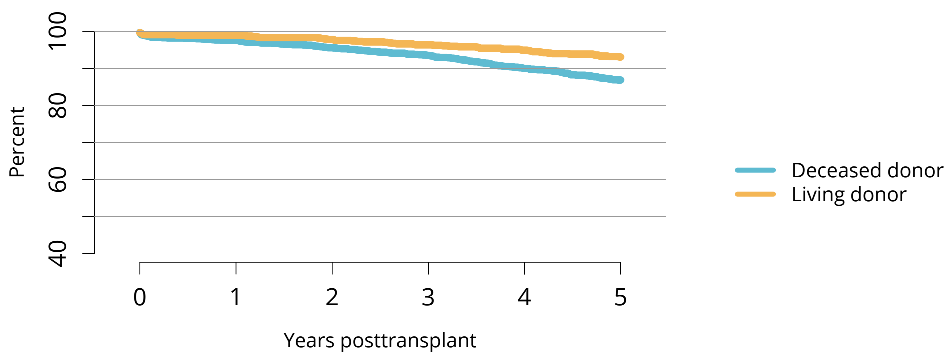

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Figure KI 150: Graft survival among pediatric kidney transplant recipients, 2016-2018, by donor type. Recipient survival estimated using unadjusted Kaplan-Meier methods.

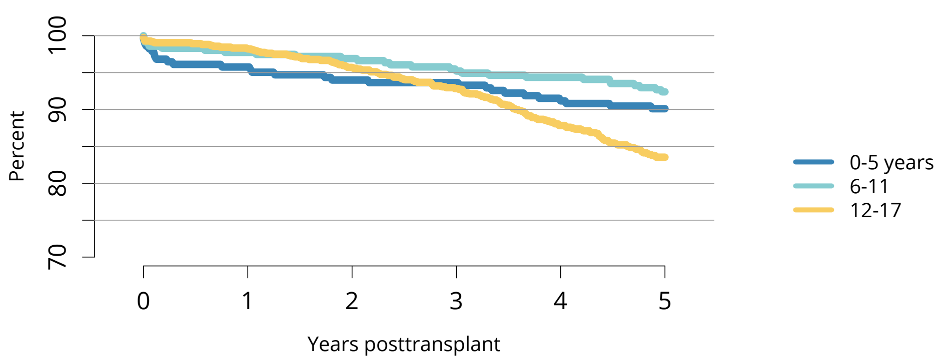

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Figure KI 151: Graft survival among pediatric deceased donor kidney transplant recipients, 2016-2018, by age. Recipient survival estimated using unadjusted Kaplan-Meier methods.

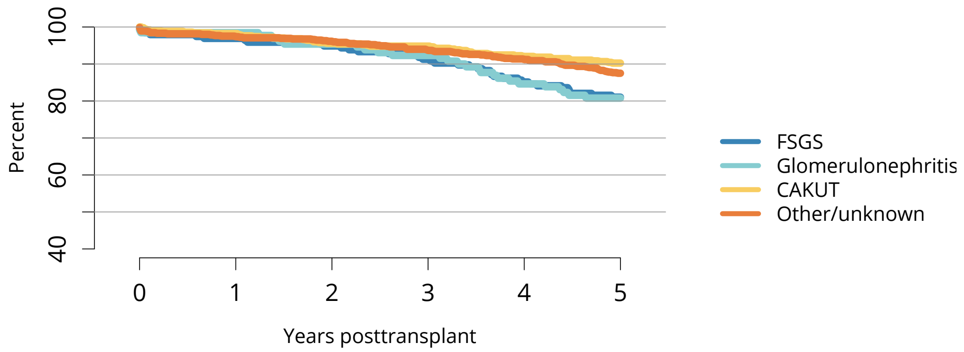

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Figure KI 152: Graft survival among pediatric deceased donor kidney transplant recipients, 2016-2018, by diagnosis. Recipient survival estimated using unadjusted Kaplan-Meier methods. Diagnosis categories follow North American Pediatric Renal Trials and Collaborative Studies recommendations. Active and inactive candidates are included. CAKUT, congenital anomalies of the kidney and urinary tract; FSGS, focal segmental glomerulosclerosis.

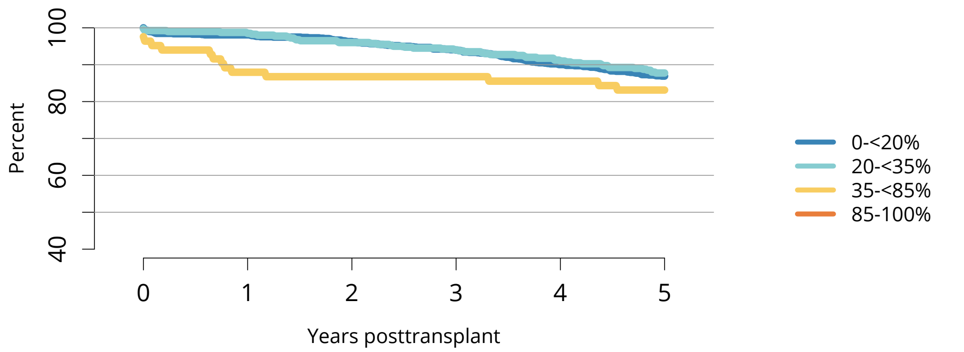

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Figure KI 153: Graft survival among pediatric deceased donor kidney transplant recipients, 2016-2018, by KDPI. Recipient survival estimated using unadjusted Kaplan-Meier methods. Conversion of kidney donor risk index to KDPI is done using the OPTN KDPI Mapping Tables. For donors recovered January through May, the cohort 2 years prior was used to assign KDPI; for donors recovered June through December, the cohort 1 year prior was used to assign KDPI. KDPI, kidney donor profile index.

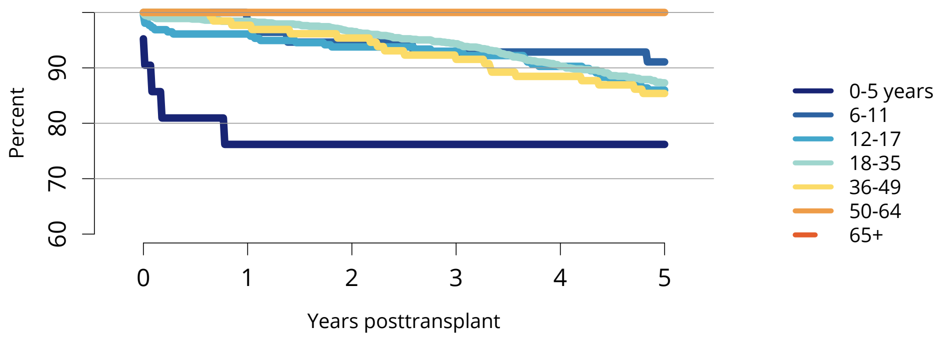

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Figure KI 154: Graft survival among pediatric deceased donor kidney transplant recipients, 2016-2018, by donor age. Recipient survival estimated using unadjusted Kaplan-Meier methods.

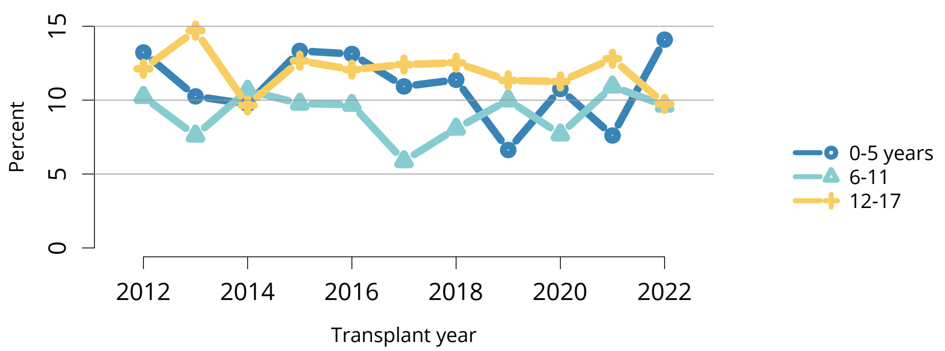

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Figure KI 155: Incidence of acute rejection by 1 year posttransplant among pediatric kidney transplant recipients by age. Only the first reported rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier method.

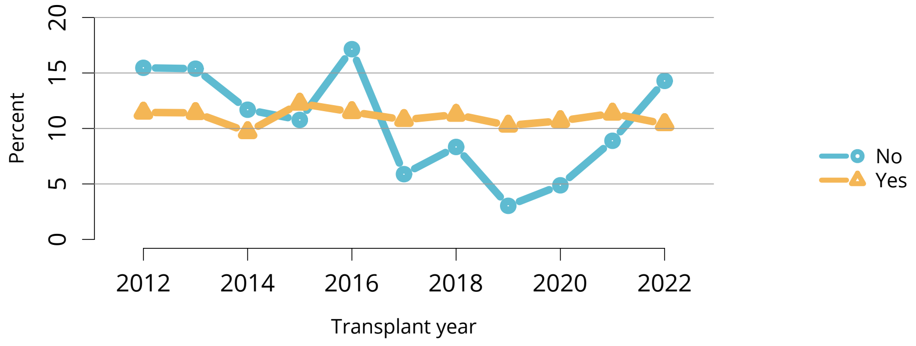

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Figure KI 156: Incidence of acute rejection by 1 year posttransplant among pediatric kidney transplant recipients by induction agent use. Only the first reported rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier method. Immunosuppression at transplant reported to the OPTN.

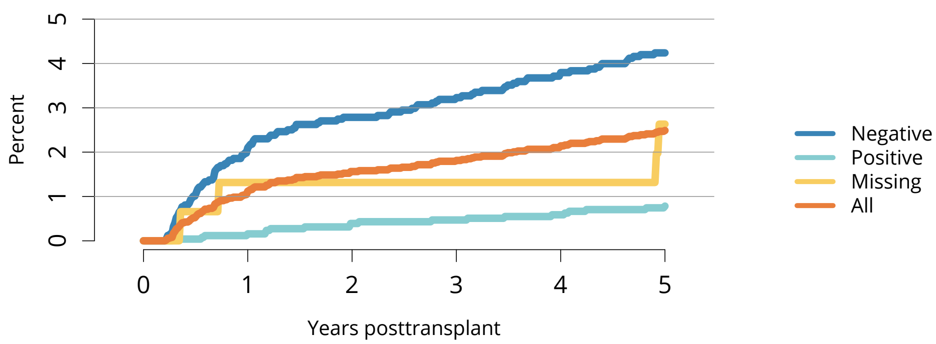

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Figure KI 157: Incidence of PTLD among pediatric kidney transplant recipients by recipient EBV status at transplant, 2012-2018. Cumulative incidence is estimated using the Kaplan-Meier method. PTLD is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or on the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus; PTLD, posttransplant lymphoproliferative disorder.

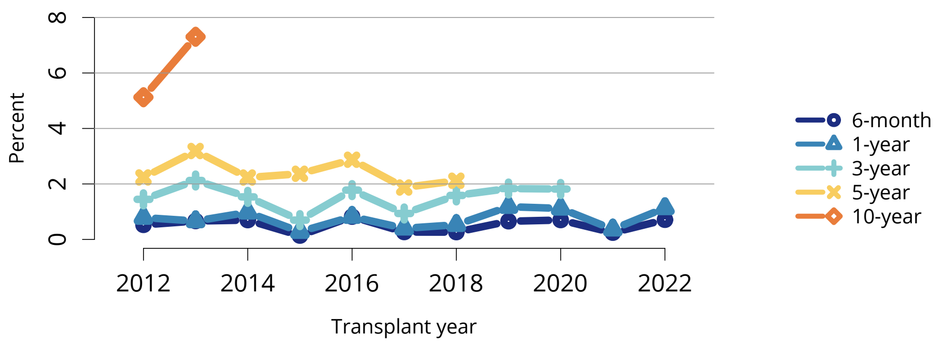

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Figure KI 158: Patient death among pediatric kidney transplant recipients. All pediatric recipients of deceased donor kidneys, including multiorgan transplant recipients. Estimates are unadjusted, computed using Kaplan-Meier methods.

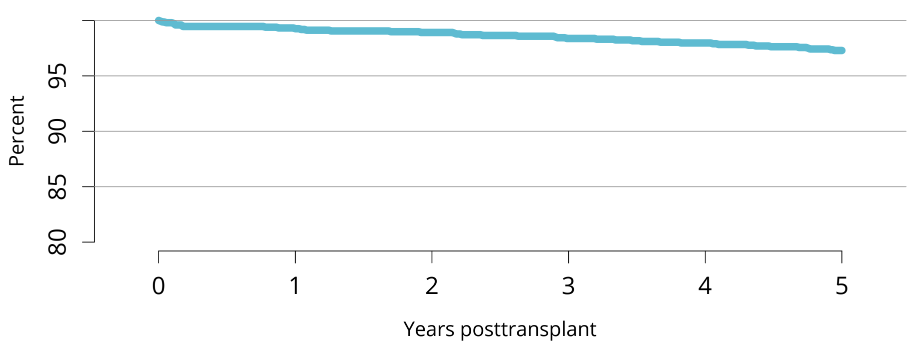

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Figure KI 159: Overall patient survival among pediatric deceased donor kidney transplant recipients, 2016-2018. Recipient survival estimated using unadjusted Kaplan-Meier methods.

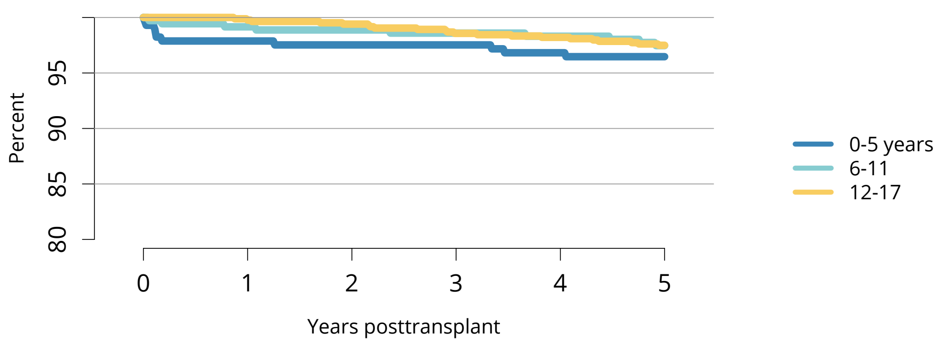

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Figure KI 160: Patient survival among pediatric deceased donor kidney transplant recipients, 2016-2018, by recipient age. Recipient survival estimated using unadjusted Kaplan-Meier methods.

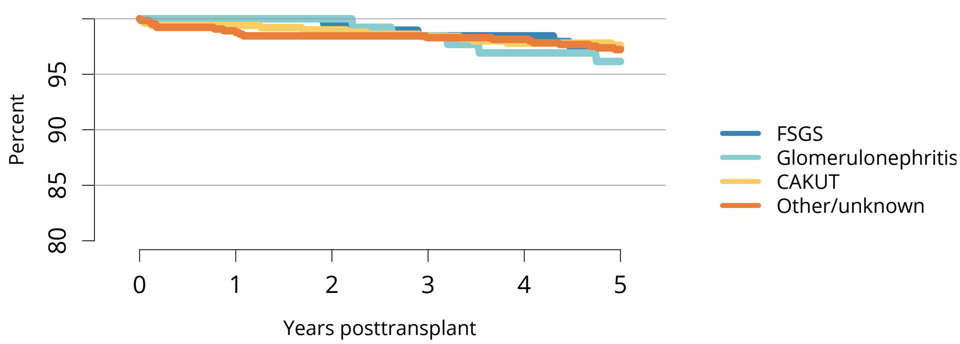

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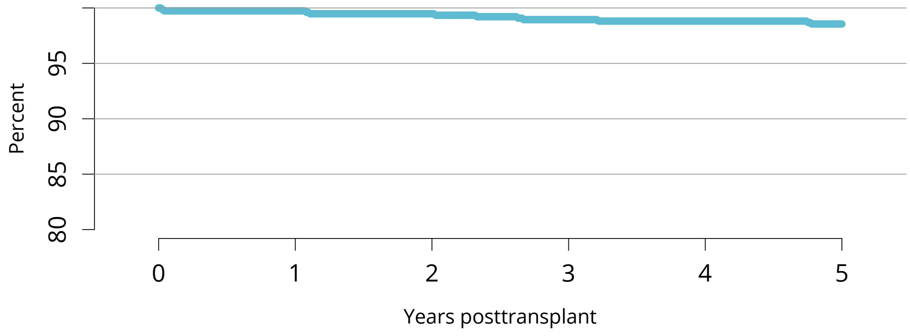
Figure KI 161: Patient survival among pediatric deceased donor kidney transplant recipients, 2016-2018, by diagnosis. Recipient survival estimated using unadjusted Kaplan-Meier methods. Diagnosis categories follow North American Pediatric Renal Trials and Collaborative Studies recommendations. CAKUT, congenital anomalies of the kidney and urinary tract; FSGS, focal segmental glomerulosclerosis.



OPTN/SRTR 2023 Annual Data Report

Figure KI 162: Overall patient survival among pediatric living donor kidney transplant recipients, 2016-2018. Recipient survival estimated using unadjusted Kaplan-Meier methods.

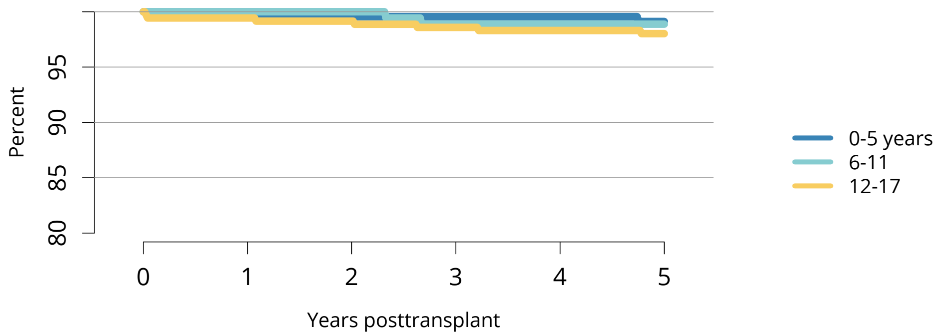


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Figure KI 163: Patient survival among pediatric living donor kidney transplant recipients, 2016-2018, by recipient age. Recipient survival estimated using unadjusted Kaplan-Meier methods.

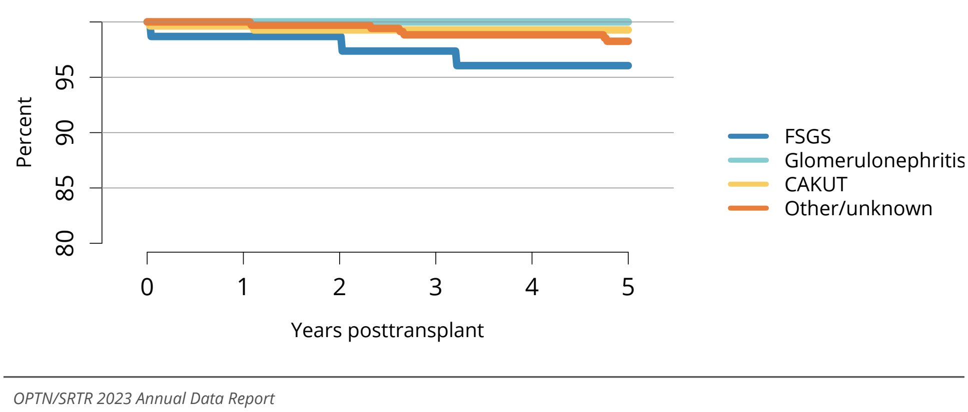

Figure KI 164: Patient survival among pediatric living donor kidney transplant recipients, 2016-2018, by diagnosis. Recipient survival estimated using unadjusted Kaplan-Meier methods. Diagnosis categories follow North American Pediatric Renal Trials and Collaborative Studies recommendations. CAKUT, congenital anomalies of the kidney and urinary tract; FSGS, focal segmental glomerulosclerosis.

Table KI 1: Demographic characteristics of adults on the kidney transplant waiting list on December 31, 2013, December 31, 2018, and December 31, 2023. Candidates waiting for transplant on December 31 of the given year, regardless of first listing date. Distance is computed from candidate's home zip code to the transplant center. Age is determined on December 31 of the year.

	2013		2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Age (years)						
18-34 years	9946	9.5	8317	8.2	7321	7.7
35-49	27820	26.6	24604	24.3	22050	23.3
50-64	45401	43.4	44226	43.7	41010	43.3
65+	21548	20.6	24019	23.7	24420	25.8
Sex						
Female	42358	40.5	38793	38.3	35848	37.8
Male	62357	59.5	62373	61.7	58953	62.2
Race and ethnicity						
Asian	8515	8.1	9717	9.6	9322	9.8
Black	35757	34.1	32912	32.5	29344	31
Hispanic	19739	18.9	20401	20.2	20484	21.6
Multiracial	448	0.4	776	0.8	879	0.9
Native American	1175	1.1	964	1	862	0.9
White	39081	37.3	36396	36	33816	35.7
Unreported	0	0	0	0	94	0.1
Miles between candidate and center						
<50 miles	69570	66.4	66997	66.2	62499	65.9
50-<100	15497	14.8	15539	15.4	14862	15.7
100-<150	7517	7.2	7069	7	6586	6.9
150-<250	6941	6.6	6444	6.4	5585	5.9
250+	4468	4.3	4628	4.6	4738	5
Missing	722	0.7	489	0.5	531	0.6
All candidates						
All candidates	104715	100	101166	100	94801	100

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Table KI 2: Clinical characteristics of adults on the kidney transplant waiting list on December 31, 2013, December 31, 2018, and December 31, 2023. Candidates waiting for transplant on December 31 of the given year, regardless of first listing date. Diabetes status based on diagnosis and comorbid conditions. Missing cPRA indicates no unacceptable antigens were reported. cPRA, calculated panel-reactive antibody.

	2013		2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Diagnosis						
Diabetes	36385	34.7	38060	37.6	37205	39.2
Hypertension	25699	24.5	21971	21.7	19218	20.3
Glomerulonephritis	15239	14.6	14753	14.6	12709	13.4
Cystic kidney disease	8704	8.3	8957	8.9	8205	8.7
Other/unknown	18687	17.8	17424	17.2	17464	18.4
NA	1	0	1	0	0	0
Blood type						
A	29989	28.6	27731	27.4	25343	26.7
AB	2877	2.7	2596	2.6	2288	2.4
B	17120	16.3	16915	16.7	15292	16.1
O	54729	52.3	53924	53.3	51878	54.7
cPRA						
<1% or missing	64808	61.9	62394	61.7	56463	59.6
1-<20%	7821	7.5	9615	9.5	9986	10.5
20-<80%	15337	14.6	16479	16.3	18068	19.1
80-<98%	6970	6.7	5917	5.8	4611	4.9
98-100%	9779	9.3	6761	6.7	5673	6
All candidates						
All candidates	104715	100	101166	100	94801	100

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Table KI 3: Listing characteristics of adults on the kidney transplant waiting list on December 31, 2013, December 31, 2018, and December 31, 2023. Candidates waiting for transplant on December 31 of the given year, regardless of first listing date.

	2013		2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Waiting time (years)						
<1 year	32215	30.8	31575	31.2	34136	36
1-<2	23341	22.3	20369	20.1	21407	22.6
2-<3	16530	15.8	15301	15.1	13912	14.7
3-<5	19386	18.5	18962	18.7	14858	15.7
5+	13243	12.6	14959	14.8	10488	11.1
Previous transplant						
No prior transplant	89153	85.1	88928	87.9	84428	89.1
Prior transplant	15562	14.9	12238	12.1	10373	10.9
All candidates						
All candidates	104715	100	101166	100	94801	100

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Table KI 4: Kidney transplant waitlist activity among adults. Candidates listed at more than one center are counted once per listing. Candidates who are listed, undergo transplant, and are relisted are counted more than once. Candidates are not considered to be on the list on the day they are removed; counts on January 1 may differ from counts on December 31 of the prior year. Candidates listed for multiorgan transplants are included.

Waiting list state	**2021**	**2022**	**2023**
Waiting list state			
Patients at start of year	97244	95940	95225
Patients added during year	41766	44184	46661
Patients removed during year	43061	44894	47085
Patients at end of year	95949	95230	94801

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Table KI 5: Removal reason among adult kidney transplant candidates. Removal reason as reported to the OPTN. Candidates with death dates that precede removal dates are assumed to have died waiting.

Removal reason	2021	2022	2023
Removal reason			
Deceased donor transplant	18829	19854	21200
Living donor transplant	5714	5634	6022
Transplant outside US	39	58	75
Patient died	5371	4717	4002
Patient refused transplant	282	296	294
Improved, transplant not needed	217	269	329
Too sick for transplant	4059	4503	4855
Other	8280	9327	10049
Changed to kidney-pancreas list	242	219	239
Still on waiting list	28	17	20

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Table KI 6: Demographic characteristics of adult kidney transplant recipients, 2023. Kidney transplant recipients, including retransplant recipients. Distance is computed from recipient's home zip code to the transplant center.

	Deceased		Living		All	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Recipient age (years)						
18-34 years	2067	9.7	939	15.5	3006	11
35-49	5086	23.9	1585	26.2	6671	24.4
50-64	8631	40.5	2228	36.8	10859	39.7
65+	5519	25.9	1296	21.4	6815	24.9
Sex						
Female	8538	40.1	2247	37.2	10785	39.4
Male	12765	59.9	3801	62.8	16566	60.6
Race and ethnicity						
Asian	1735	8.1	463	7.7	2198	8
Black	7806	36.6	716	11.8	8522	31.2
Hispanic	4164	19.5	1083	17.9	5247	19.2
Multiracial	203	1	60	1	263	1
Native American	189	0.9	35	0.6	224	0.8
White	7200	33.8	3690	61	10890	39.8
Unreported	6	0	1	0	7	0
Insurance						
Private	5826	27.3	3271	54.1	9097	33.3
Medicare	13139	61.7	2289	37.8	15428	56.4
Medicaid	1687	7.9	346	5.7	2033	7.4
Other/unknown	651	3.1	142	2.3	793	2.9
Miles between recipient and center						
<50 miles	14140	66.4	3900	64.5	18040	66
50-<100	3349	15.7	923	15.3	4272	15.6
100-<150	1447	6.8	416	6.9	1863	6.8
150-<250	1034	4.9	325	5.4	1359	5
250+	1160	5.4	412	6.8	1572	5.7
Missing	173	0.8	72	1.2	245	0.9
All recipients						
All recipients	21303	100	6048	100	27351	100

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Table KI 7: Clinical characteristics of adult kidney transplant recipients, 2023. Kidney transplant recipients, including retransplant recipients. Missing cPRA indicates no unacceptable antigens were reported. cPRA, calculated panel-reactive antibody.

	Deceased		Living		All	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Diagnosis						
Diabetes	7421	34.8	1619	26.8	9040	33.1
Hypertension	4770	22.4	924	15.3	5694	20.8
Glomerulonephritis	3102	14.6	1370	22.7	4472	16.4
Cystic kidney disease	1869	8.8	954	15.8	2823	10.3
Other/unknown	4141	19.4	1181	19.5	5322	19.5
Blood type						
A	7149	33.6	2303	38.1	9452	34.6
AB	1041	4.9	280	4.6	1321	4.8
B	3176	14.9	846	14	4022	14.7
O	9937	46.6	2619	43.3	12556	45.9
Years of dialysis						
None	2955	13.9	1994	33	4949	18.1
<1 year	2132	10	1287	21.3	3419	12.5
1-<3	4837	22.7	1606	26.6	6443	23.6
3-<5	4124	19.4	468	7.7	4592	16.8
5+	7255	34.1	693	11.5	7948	29.1
cPRA						
<1% or missing	11791	55.3	4117	68.1	15908	58.2
1-<20%	2122	10	665	11	2787	10.2
20-<80%	3820	17.9	1019	16.8	4839	17.7
80-<98%	2044	9.6	189	3.1	2233	8.2
98-100%	1526	7.2	58	1	1584	5.8
All recipients						
All recipients	21303	100	6048	100	27351	100

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Table KI 8: Transplant characteristics of adult kidney transplant recipients, 2023. Kidney transplant recipients, including retransplant recipients. DCD status and KDPI scores apply to deceased donor transplants only. DBD, donation after brain death; DCD, donation after circulatory death; KDPI, kidney donor profile index.

	Deceased		Living		All	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Waiting time (years)						
<1 day	5	0	16	0.3	21	0.1
1 day-<1 year	11105	52.1	3861	63.8	14966	54.7
1-<3	5221	24.5	1728	28.6	6949	25.4
3-<5	2960	13.9	343	5.7	3303	12.1
5+	2012	9.4	100	1.7	2112	7.7
KDPI						
0-<20%	4883	22.9	0	0	4883	17.9
20-<35%	4092	19.2	0	0	4092	15
35-<85%	10865	51	0	0	10865	39.7
85-100%	1456	6.8	0	0	1456	5.3
Missing	7	0	6048	100	6055	22.1
Donation after circulatory death						
DBD	13988	65.7	0	0	13988	51.1
DCD	7315	34.3	0	0	7315	26.7
Living donor	0	0	6048	100	6048	22.1
Previous transplant for recipients						
No prior transplant	19136	89.8	5487	90.7	24623	90
Prior transplant	2167	10.2	561	9.3	2728	10
Organs transplanted						
Kidney only	19244	90.3	6047	100	25291	92.5
Kidney-pancreas	809	3.8	0	0	809	3
Kidney-liver	797	3.7	0	0	797	2.9
Heart-kidney	421	2	0	0	421	1.5
Kidney-lung	21	0.1	0	0	21	0.1
Intestine-pancreas-liver-kidney	1	0	0	0	1	0
Other	10	0	1	0	11	0
All recipients						
All recipients	21303	100	6048	100	27351	100

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Table KI 9: Adult deceased donor kidney donor-recipient serology matching, 2021-2023. Donor serology is reported on the OPTN Donor Registration Form and recipient serology on the OPTN Transplant Recipient Registration Form. There may be multiple fields per serology. Any evidence for a positive serology is treated as positive for that serology. Donor HCV NAT data are shown by recipient HCV antibody status. CMV, cytomegalovirus; EBV, Epstein-Barr virus; HBsAg, hepatitis B surface antigen; HCV, hepatitis C virus; NAT, nucleic acid test; unk, unknown.

Donor	Recipient	CMV	EBV	HBsAg	HCV antibody	HCV NAT
Donor						
D-	R-	12.66	0.45	96.36	84.55	88.85
D-	R+	24.94	7.01	1.38	3.03	3.25
D-	R unk	0.68	0.34	2.01	2.18	2.28
D+	R-	18.18	4.73	0.18	9.45	5.13
D+	R+	41.41	83.45	0.01	0.56	0.33
D+	R unk	1.03	3.8	0.01	0.23	0.13
D unk	R-	0.31	0.01	0.06	0	0.03
D unk	R+	0.77	0.2	0	0	0
D unk	R unk	0.02	0.01	0	0	0

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Table KI 10: Adult living donor kidney donor-recipient serology matching, 2021-2023. Donor serology is reported on the OPTN Donor Registration Form and recipient serology on the OPTN Transplant Recipient Registration Form. There may be multiple fields per serology. Any evidence for a positive serology is treated as positive for that serology. Donor HCV NAT data are shown by recipient HCV antibody status. CMV, cytomegalovirus; EBV, Epstein-Barr virus; HBsAg, hepatitis B surface antigen; HCV, hepatitis C virus; NAT, nucleic acid test; unk, unknown.

Donor	Recipient	CMV	EBV	HBsAg	HCV antibody	HCV NAT
Donor						
D-	R-	23.76	0.96	92.29	91.04	84.46
D-	R+	21.14	7.94	0.92	1.59	1.48
D-	R unk	0.7	0.22	3.62	3.9	3.3
D+	R-	16.72	5.58	0.49	0.74	0.09
D+	R+	31.63	79.83	0.01	0.03	0.01
D+	R unk	0.71	2.81	0	0.01	0.01
D unk	R-	2.19	0.18	2.17	2.13	9.37
D unk	R+	2.61	1.88	0.03	0.05	0.18
D unk	R unk	0.54	0.6	0.48	0.5	1.12

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Table KI 11: Demographic characteristics of pediatric candidates on the kidney transplant waiting list on December 31, 2013, December 31, 2018, and December 31, 2023. Candidates younger than 18 years at listing waiting for transplant on December 31 of the given year, regardless of first listing date. Age is determined on December 31 of the year. The 18+ category is for candidates who turned age 18 while waiting. Distance is computed from candidate's home zip code to the transplant center.

	2013		2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Age (years)						
0-5 years	183	13.6	216	13.9	254	13.5
6-11	237	17.6	315	20.3	318	16.9
12-17	495	36.8	548	35.4	648	34.5
18+	430	32	470	30.3	657	35
Sex						
Female	519	38.6	598	38.6	730	38.9
Male	826	61.4	951	61.4	1147	61.1
Race and ethnicity						
Asian	66	4.9	97	6.3	127	6.8
Black	354	26.3	350	22.6	346	18.4
Hispanic	360	26.8	446	28.8	549	29.2
Multiracial	16	1.2	24	1.5	57	3
Native American	9	0.7	20	1.3	20	1.1
White	540	40.1	612	39.5	766	40.8
Unreported	0	0	0	0	12	0.6
Miles between candidate and center						
<50 miles	875	65.1	1031	66.6	1212	64.6
50-<100	219	16.3	209	13.5	295	15.7
100-<150	107	8	112	7.2	143	7.6
150-<250	84	6.2	113	7.3	124	6.6
250+	47	3.5	77	5	95	5.1
Missing	13	1	7	0.5	8	0.4
All candidates						
All candidates	1345	100	1549	100	1877	100

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Table KI 12: Clinical characteristics of pediatric candidates on the kidney transplant waiting list on December 31, 2013, December 31, 2018, and December 31, 2023. Candidates younger than 18 years at listing waiting for transplant on December 31 of the given year, regardless of first listing date. Missing cPRA indicates no unacceptable antigens were reported. CAKUT, congenital anomalies of the kidney and urinary tract; cPRA, calculated panel-reactive antibody; FSGS, focal segmental glomerulosclerosis.

	2013		2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Pediatric diagnosis						
FSGS	170	12.6	151	9.7	166	8.8
Glomerulonephritis	144	10.7	129	8.3	151	8
CAKUT	426	31.7	553	35.7	647	34.5
Other/unknown	604	44.9	716	46.2	912	48.6
NA	1	0.1	0	0	1	0.1
Blood type						
A	411	30.6	467	30.1	592	31.5
AB	41	3	44	2.8	55	2.9
B	228	17	245	15.8	291	15.5
O	665	49.4	793	51.2	939	50
cPRA						
<1% or missing	809	60.1	1058	68.3	1226	65.3
1-<20%	77	5.7	108	7	186	9.9
20-<80%	166	12.3	182	11.7	277	14.8
80-<98%	104	7.7	86	5.6	75	4
98-100%	189	14.1	115	7.4	113	6
All candidates						
All candidates	1345	100	1549	100	1877	100

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Table KI 13: Listing characteristics of pediatric candidates on the kidney transplant waiting list on December 31, 2013, December 31, 2018, and December 31, 2023. Candidates younger than 18 years at listing waiting for transplant on December 31 of the given year, regardless of first listing date.

	2013		2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Waiting time (years)						
<1 year	602	44.8	656	42.3	756	40.3
1-<2	266	19.8	328	21.2	349	18.6
2-<3	146	10.9	190	12.3	215	11.5
3-<5	145	10.8	199	12.8	255	13.6
5+	186	13.8	176	11.4	302	16.1
Previous transplant						
No prior transplant	939	69.8	1240	80.1	1554	82.8
Prior transplant	406	30.2	309	19.9	323	17.2
All candidates						
All candidates	1345	100	1549	100	1877	100

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Table KI 14: Kidney transplant waitlist activity among pediatric candidates. Candidates who are listed, undergo transplant, and are relisted are counted more than once. Candidates are not considered to be on the list on the day they are removed; counts on January 1 may differ from counts on December 31 of the prior year. Candidates listed for multiorgan transplants are included.

Waiting list state	2021	2022	2023
Waiting list state			
Patients at start of year	1695	1698	1779
Patients added during year	1087	1099	1177
Patients removed during year	1084	1018	1079
Patients at end of year	1698	1779	1877

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Table KI 15: Removal reason among pediatric kidney transplant candidates. Removal reason as reported to the OPTN. Candidates with death dates that precede removal dates are assumed to have died waiting.

Removal reason	2021	2022	2023
Removal reason			
Deceased donor transplant	692	591	653
Living donor transplant	257	230	267
Patient died	20	24	14
Patient refused transplant	6	5	3
Improved, transplant not needed	4	9	5
Too sick for transplant	9	13	10
Other	96	146	127

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Table KI 16: Demographic characteristics of pediatric kidney transplant recipients, 2023. Pediatric kidney transplant recipients, including retransplant recipients. Distance is computed from recipient's home zip code to the transplant center.

	Deceased		Living		All	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Recipient age (years)						
0-5 years	115	20.9	73	30.3	188	23.8
6-11	151	27.5	59	24.5	210	26.5
12-17	284	51.6	109	45.2	393	49.7
Sex						
Female	225	40.9	93	38.6	318	40.2
Male	325	59.1	148	61.4	473	59.8
Race and ethnicity						
Asian	34	6.2	11	4.6	45	5.7
Black	125	22.7	18	7.5	143	18.1
Hispanic	169	30.7	43	17.8	212	26.8
Multiracial	18	3.3	7	2.9	25	3.2
Native American	7	1.3	0	0	7	0.9
White	195	35.5	160	66.4	355	44.9
Unreported	2	0.4	2	0.8	4	0.5
Insurance						
Private	142	25.8	142	58.9	284	35.9
Medicare	120	21.8	23	9.5	143	18.1
Medicaid	244	44.4	66	27.4	310	39.2
Other/unknown	44	8	10	4.1	54	6.8
Miles between recipient and center						
<50 miles	334	60.7	154	63.9	488	61.7
50-<100	100	18.2	37	15.4	137	17.3
100-<150	38	6.9	17	7.1	55	7
150-<250	40	7.3	23	9.5	63	8
250+	33	6	10	4.1	43	5.4
Missing	5	0.9	0	0	5	0.6
All recipients						
All recipients	550	100	241	100	791	100

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Table KI 17: Clinical characteristics of pediatric kidney transplant recipients, 2023. Pediatric kidney transplant recipients, including retransplant recipients. Diagnosis categories follow North American Pediatric Renal Trials and Collaborative Studies recommendations. Missing cPRA indicates no unacceptable antigens were reported. CAKUT, congenital anomalies of the kidney and urinary tract; cPRA, calculated panel-reactive antibody; FSGS, focal segmental glomerulosclerosis.

	Deceased		Living		All	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Diagnosis						
FSGS	55	10	18	7.5	73	9.2
Glomerulonephritis	39	7.1	14	5.8	53	6.7
CAKUT	183	33.3	97	40.2	280	35.4
Other/unknown	273	49.6	112	46.5	385	48.7
Blood type						
A	164	29.8	114	47.3	278	35.1
AB	23	4.2	11	4.6	34	4.3
B	66	12	30	12.4	96	12.1
O	297	54	86	35.7	383	48.4
Years of dialysis						
None	144	26.2	74	30.7	218	27.6
<1 year	130	23.6	73	30.3	203	25.7
1-<3	174	31.6	66	27.4	240	30.3
3-<5	48	8.7	13	5.4	61	7.7
5+	54	9.8	15	6.2	69	8.7
cPRA						
<1% or missing	367	66.7	162	67.2	529	66.9
1-<20%	58	10.5	34	14.1	92	11.6
20-<80%	93	16.9	37	15.4	130	16.4
80-<98%	22	4	5	2.1	27	3.4
98-100%	10	1.8	3	1.2	13	1.6
All recipients						
All recipients	550	100	241	100	791	100

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Table KI 18: Transplant characteristics of pediatric kidney transplant recipients, 2023. Pediatric kidney transplant recipients, including retransplant recipients. DCD status and KDPI scores apply to deceased donor transplants only. DBD, donation after brain death; DCD, donation after circulatory death; DGF, delayed graft function; KDPI, kidney donor profile index.

	Deceased		Living		All	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Waiting time (years)						
<1 day	0	0	3	1.2	3	0.4
1 day-<1 year	394	71.6	190	78.8	584	73.8
1-<3	129	23.5	43	17.8	172	21.7
3-<5	22	4	5	2.1	27	3.4
5+	5	0.9	0	0	5	0.6
KDPI						
0-<20%	415	75.5	0	0	415	52.5
20-<35%	118	21.5	0	0	118	14.9
35-<85%	17	3.1	0	0	17	2.1
Missing	0	0	241	100	241	30.5
Donation after circulatory death						
DBD	528	96	0	0	528	66.8
DCD	22	4	0	0	22	2.8
Living donor	0	0	241	100	241	30.5
Previous transplant for recipients						
No prior transplant	502	91.3	227	94.2	729	92.2
Prior transplant	48	8.7	14	5.8	62	7.8
Organs transplanted						
Kidney only	518	94.2	241	100	759	96
Kidney-liver	28	5.1	0	0	28	3.5
Heart-kidney	2	0.4	0	0	2	0.3
Intestine-pancreas-liver-kidney	2	0.4	0	0	2	0.3
All recipients						
All recipients	550	100	241	100	791	100

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Table KI 19: Pediatric deceased donor kidney donor-recipient serology matching, 2021-2023. Donor serology is reported on the OPTN Donor Registration Form and recipient serology on the OPTN Transplant Recipient Registration Form. There may be multiple fields per serology. Any evidence for a positive serology is treated as positive for that serology. CMV, cytomegalovirus; EBV, Epstein-Barr virus; unk, unknown.

Donor	Recipient	CMV	EBV
Donor			
D-	R-	27.35	7.08
D-	R+	12.94	6.53
D-	R unk	1.4	0.18
D+	R-	37.12	37.24
D+	R+	18.68	46.09
D+	R unk	1.22	2.38
D unk	R-	0.79	0.18
D unk	R+	0.49	0.24
D unk	R unk	0	0.06

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Table KI 20: Pediatric living donor kidney donor-recipient serology matching, 2021-2023. Donor serology is reported on the OPTN Donor Registration Form and recipient serology on the OPTN Transplant Recipient Registration Form. There may be multiple fields per serology. Any evidence for a positive serology is treated as positive for that serology. CMV, cytomegalovirus; EBV, Epstein-Barr virus; unk, unknown.

Donor	Recipient	CMV	EBV
Donor			
D-	R-	35.99	6.49
D-	R+	9.59	2.36
D-	R unk	0.88	0
D+	R-	31.56	57.08
D+	R+	16.22	31.56
D+	R unk	1.47	1.77
D unk	R-	3.1	0.15
D unk	R+	0.88	0.29
D unk	R unk	0.29	0.29

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OPTN/SRTR 2023 Annual Data Report: Pancreas

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Abstract

The overall number of pancreas transplants in the United States remained relatively unchanged in 2023 at 915 transplants, compared with 918 transplants in 2022. The number of pancreas-after-kidney transplants continued to decline and reached the lowest level in the past decade: 36 transplants in 2023. The proportion of pancreas recipients with type 2 diabetes increased to 25.4% in 2023 from 22.5% in 2022, comparable to the proportion of candidates with type 2 diabetes on the waiting list increasing to 25.2% in 2023 compared with 23.4% in 2022. The number of adult additions to the pancreas waiting list increased in 2023 to 1,876 compared with 1,736 in 2022. The proportion of candidates on the waiting list who are older, obese, or have type 2 diabetes has been increasing. The number of pancreas donors decreased in 2023 compared with 2022; however, the nonuse rate also decreased during the same period. The distribution of volume across transplant centers was relatively unchanged in 2023, with only 5% of centers performing more than 30 transplants a year. Outcomes of pancreas transplants were relatively stable from 2020 to 2022, with 1-year pancreas graft survival rates in adults of

90.8% in simultaneous pancreas-kidney transplant, 87.5% in pancreas transplant alone, and 84.4% in pancreas-after-kidney transplant for transplants performed in 2022. Kidney 1-year graft survival in simultaneous pancreas-kidney transplant was excellent at 96.2% for transplants in 2022.
Keywords: Pancreas transplant, transplant outcomes, waitlist outcomes

1 Introduction

As part of its effort to develop a continuous distribution system for pancreas allocation in the United States since the previous Annual Data Report, the Organ Procurement and Transplantation Network (OPTN) Board of Directors has asked the kidney and pancreas committees to prioritize the utilization of organs in the new allocation system. Consequently, the Pancreas Transplantation Committee has submitted a request to the Scientific Registry of Transplant Recipients (SRTR) to update the Organ Allocation Simulation (OASim) software model to determine whether simulation can answer questions related to organ nonuse. At the time of this writing, this work is ongoing at SRTR.

The Pancreas Committee is also working on developing medical urgency criteria for pancreas candidates. Subject matter experts in the area have appeared before the Committee to help with specific criteria for hypoglycemia unawareness being included as an attribute for medical urgency. In addition, it was proposed that a Pancreas Review Board (yet to be formed) will serve as the determining body for medical urgency of pancreas candidates.

Another agenda item before the Pancreas Committee is implementation of measures to improve efficiency in the procurement and utilization of pancreata. The committee intends to release a guidance document to include best practices and guidance on procurement of pancreata.

To summarize, most of the initiatives in pancreas transplant allocation and policy over the past year were aimed at improving utilization while developing a system of continuous distribution.

2 Waiting List

The number of new adult candidates added to the waiting list in 2023 increased for simultaneous pancreas-kidney (SPK) transplant (1,585 in 2023 versus 1,485 in 2022) and pancreas-after-kidney (PAK) transplant (111 in 2023 versus 71 in 2022), whereas it remained unchanged in pancreas transplant alone (PTA) (180 in both 2022 and 2023) (Figure PA 1). Of note, the number of new listings in SPK is the highest over the past decade. This may suggest a delayed postpandemic recovery in additions to the waiting list for pancreas transplant and should be monitored over the next couple of years.

Increases were seen in prevalent adult listings for SPK (3,549 in 2023 versus 3,339 in 2022), PAK (370 in 2023 versus 355 in 2022), and PTA (564 in 2023 versus 541 in 2022) (Figure PA 2).

The age distribution of adult candidates on the waiting list was largely unchanged in 2023 compared with 2022. However, as noted in prior reports, the proportion of older candidates (age 55 years or older) has increased over the past decade: 14.8% in 2023 compared with 12.1% in 2012 (Figure PA 3). This is consistent with an increasing proportion of candidates with type 2 diabetes on the waiting list.

The sex distribution of adult candidates on the waiting list was unchanged from prior years, with an overall male preponderance in 2023: 53.7% male and 46.3% female (Figure PA 4). Of note, there was a female preponderance on the waiting list for PTA (53.2% female and 46.8% male at the end of 2023) (Table PA 1), as has been the case historically.

Over the past decade, there has been an increase in the proportion of adult candidates on the waiting list who were Asian, Black, and Hispanic, with a corresponding decrease in candidates who were White. In 2023, 46.5% were White, 29.2% were Black, 17.5% were Hispanic, and 4.8% were Asian, compared with 2012, when the percentages were 67.4%, 18.5%, 11.2%, and 1.8%, respectively. Again, this is likely due to the impact of type 2 diabetes on the waiting list (Figure PA 5).

The proportion of adult candidates with type 2 diabetes on the waiting list has continued to increase steadily over the past decade since the pancreas allocation system was implemented in 2014. There has been a 204.5% increase in the type 2 diabetes diagnosis category: 25.2% in 2023 compared with 8.3% in 2012. Correspondingly, the type 1 diabetes category has had a 19.6% decline: 66.9% in 2023 compared with 83.3% in 2012 (Figure PA 6). With the increasing proportion of candidates with type 2 diabetes on the list, there has been a concurrent increase in the proportion of candidates who are obese. In 2023, 23.7% of candidates had a body mass index (BMI) of 30 or greater, compared with 18.7% in 2012 (Figure PA 8).

The distribution of candidates by waiting time has not appreciably changed since 2020, with about half of adult pancreas transplant candidates (50.4%) in 2023 having waiting times of 1 year or longer (Figure PA 7). The distribution of adult candidates by blood type has not changed dramatically year over year; however, over the past decade, there has been a trend toward a higher proportion of candidates with blood type B (16.4% in 2023 versus 13.1% in 2012) with a corresponding decrease in candidates with blood type O (47.6% in 2023 versus 50.2% in 2012) (Figure PA 9).

When looking at the waiting list by intended transplant category for adults, SPK continued to increasingly dominate (79.2% in 2023) followed by PTA (12.6%) and PAK (8.3%). Of note, the PAK listings have decreased by about 50% over the past decade (Figure PA 10).

The proportion of retransplant candidates has been steadily decreasing over the past decade (6.3% in 2023 versus 15.4% in 2012) (Figure PA 11). This is partly attributable to the decrease in PAK listings (Figure PA 2), where retransplant listings are the highest (22.2%) (Table PA 3).

While new listings have increased in the past 5 years, there has not been an increase in transplant rates. Transplant rates for adults decreased to 35.4 transplants per 100 patient-years in 2023, from 44.8 in 2019 (Figure PA 12). This may be due to centers being more selective with donors and avoidance of risk. There were no clear trends in transplant rates by diabetes type (Figure PA 13). By blood type, there was a spike in the transplant rate for blood type AB in 2023 to 55.9 transplants per 100 patient years. However, this is a very small proportion of the overall population and is likely not significant (Figure PA 14). The decrease in transplant rates has been across all pancreas transplant categories (SPK, PAK, and PTA) over the past 5 years (Figure PA 15).

For outcome on the waiting list, 46.3% of adult SPK candidates received a deceased donor transplant at 1 year (Figure PA 18), compared with 35.6% of PTA candidates (Figure PA 17) and only 22.6% of PAK candidates (Figure PA 16). This disparity extended to 3 years, when 60.6% of SPK candidates had received a deceased donor transplant compared with 45.9% of PTA candidates and 34% of PAK candidates. The long waiting times for solitary pancreas transplant, especially PAK, is concerning and may have an unintended consequence of making PAK that starts with a living donor kidney a less attractive option for candidates who have a living donor.

Waitlist mortality among adults has shown a favorable trend over the past decade: 4.6 deaths per 100 patient-years in 2023 compared with 5.6 in 2014 (Figure PA 19). Mortality spiked at the beginning of the COVID-19 pandemic to 6.2 deaths per 100 patient-years in 2020 but has since decreased in the postpandemic era. This may be due to a combination of better list management and selective listing practices. Mortality for candidates aged 55 years or older declined sharply to 4.9 deaths per 100 patient-years in 2023, compared with 8.9 in 2022, but this is likely due to the small numbers in this age group and not significant (Figure PA 20). There were no notable trends in mortality by race and ethnicity (Figure PA 21). Differences by sex were notable in that the waitlist mortality for female candidates has been consistently decreasing since the COVID-19 pandemic began in 2020, whereas the trend is not as consistent for male candidates (Figure PA 22). Since 2020, SPK candidates have shown a consistent decrease in waitlist mortality (5.3 deaths per 100 patient-years in 2023 versus 7.1 in 2020), while the trends for PAK and PTA candidates were less consistent, presumably due to small numbers (Figure PA 23). Pretransplant mortality rates by donation service area show wide variability (range in 2023: 0-21.2 deaths per 100 patient-years), but this is probably skewed by small numbers in some donation service areas (Figure PA 24).

Deaths within 6 months after removal from the waiting list (for reasons other than transplant) among adult candidates declined substantially from 8.0% in 2022 to 3.4% in 2023 (Figure PA 25)—the lowest level in a decade after steadily increasing from 2019 to 2022 (presumably affected by COVID-19). The decrease in deaths within 6 months of removal from the waiting list was uniform across all age groups (Figure PA 26) and across all transplant types, except PAK where the numbers were small (Figure PA 27).

Regarding access to a transplant center, note that only 4.6% of SPK candidates in 2023 lived 250 miles or farther from their transplant center whereas 17.4% of PTA candidates did (Table PA 1). Solitary pancreas transplants are performed at selected centers, and access may involve traveling long distances.

3 Donations

The number of deceased donors whose pancreas was recovered for transplant decreased to 1,194 in 2023 compared with 1,286 in 2022 (Figure PA 28). However, the number of pancreas transplants did not change appreciably during that time (915 in 2023 and 918 in 2022) (Figure PA 41), suggesting that the nonuse rate for pancreata decreased in 2023. There is a continuing preference for using pancreata from young donors, with 70.9% of donors in 2023 under age 30 (Figure PA 29). Male preponderance among pancreas donors continued in 2023: 69.9% male and 30.1% female (Figure PA 30). White donors continued to constitute the majority in 2023, at 60.9% (Figure PA 31), while White individuals received 42.5% of the transplants (Figure PA 45). The proportion of Black (20.7% in 2023) and Hispanic (16% in 2023) donors remained largely unchanged in the past few years. Donors of lower weight (<20 kg, usually pediatric) also remained uncommon, at 1.3% of donors in 2023 (Figure PA 33). Donors with higher BMI (30 or greater) or with lower BMI (<18.5) remained less common in 2023: 7.9% and 7.8%, respectively (Figure PA 32).

Head trauma continued to be the leading cause of death among donors and had an uptick to 50.7% in 2023 (versus 47.0% in 2022). Meanwhile, anoxia, which has been steadily increasing for over a decade with increasing drug-related deaths, showed a small decrease as a cause of donor death for the first time in many years. It is to be hoped that this is the start of a positive trend of decreasing drug-related mortality in the United States (Figure PA 34). Regarding pancreata recovered with the intent for transplant, the nonuse rate was 23.4% in 2023 compared with 28.7% in 2022. This was a substantial decrease in nonuse after the rate had been increasing since 2020 (Figure PA 35) and one that it is hoped will continue. Nonuse rates decreased for younger donors (age <40 years), whereas they increased among older donors (40 years or older), reinforcing the previously noted preference for pancreata from younger donors (Figure PA 36). Of interest, the decrease in nonuse in 2023 was only observed for male donors (21.4% in 2023 versus 29.2% in 2022) while the nonuse rate for female donors was unchanged (27.9% in 2023 versus 27.6% in 2022) (Figure PA 37). Nonuse rates showed no significant trends by race and ethnicity, although Asian donor nonuse rates showed a decrease while the Other category (Native American and Multiracial) increased; these groups are a very small percentage of the overall population (Figure PA 38). Nonuse rates generally increase as the donor BMI increases. For 2023, once BMI was at 30-<35, the nonuse rate climbed to 39.8%, and for BMI of 35-<40, the nonuse rate was greater than 80%; no donors had a BMI of 40 or greater (Figure PA 39). Nonuse rates were not notably different based on disease transmission risk categories, with 22.8% nonuse for donors with risk factors not present and 23.4% nonuse for donors with risk factors present in 2023 (Figure PA 40).

4 Transplants

The overall number of pancreas transplants of all types (SPK, PTA, PAK) was 915 in 2023, reflecting a 12.3% decrease since 2012 (Figure PA 41). There has not been a rebound in any of the type categories following the COVID-19 era, with the most significant decreases in PAK transplants (Figure PA 42). In addition, this was the only category of pancreas transplants that decreased further from the numbers reported in 2022, and has decreased by 70.2% from 121 PAK transplants in 2012 to only 36 in 2023.

The number of pancreas transplants performed in 2023 for recipients younger than 18 years rebounded to 23, from 14 done in 2022 (Figure PA 43). Of interest, the number of pancreas transplants performed at the other end of the age spectrum (55 years and older) also increased, with 124 performed in 2023 compared with 109 in 2022. This was also the only age category that has increased from the number of pancreas transplants performed in 2012. The increase in the number of pancreas recipients aged 55 years or older correlates with the increase in the number of pancreas transplants performed in people with type 2 diabetes. The ratio of pancreas transplants performed in male versus female patients remained relatively unchanged over the past decade, with more male than female recipients (Figure PA 44). The overall number of pancreas transplants in White recipients continued to trend downward, in contrast with other racial and ethnic categories (Figure PA 45). Compared with 2012, the number of pancreas transplants increased in Asian recipients by 370% (47 transplants in 2023 from 10 in 2012), in Black recipients by 58.5% (298 transplants in 2023 from 188 in 2012), and in Hispanic recipients by 42.9% (170 transplants in 2023 from 119 in 2012). The increases in the number of transplants performed in Asian, Black, and Hispanic recipients correlated with the ongoing increases in the number of pancreas transplants being performed for type 2 diabetes (Figure PA 46). The number of pancreas transplants performed in recipients with type 1 diabetes decreased over the past decade by 32% (607 transplants in 2023 from 893 in 2012), whereas the number performed in recipients with type 2 diabetes increased by 236% (232 transplants in 2023 from 69 in 2012).

The use of lymphodepleting induction therapy continued to increase, and 89.0% of adult pancreas transplants performed in 2023 used T-cell–depleting induction only (Figure PA 47). This represents a 14% increase over the past decade. During the same period, the number of pancreas transplants using only interleukin-2 receptor antibodies for induction therapy decreased to 1.5% in 2023, from 8.9% in 2012. Of interest, for 6.8% of pancreas transplants performed in 2023, no induction agent use was reported. Maintenance immunosuppression using tacrolimus and a mycophenolate agent has become the dominant regimen and was used in 95.3% of pancreas transplant recipients in 2023 (Figure PA 48). In 2023, 29.9% of pancreas transplants were maintained on steroid-free regimens, compared with 65.4% on maintenance with triple therapy including tacrolimus, mycophenolate, and steroids. Unsensitized recipients and recipients with calculated panel-reactive antibody of less than 20% constituted 72.2%, 84.8%, and 79.5% of the pancreas transplants for PAK, PTA, and SPK, respectively, in 2023 (Figure PA 49, Figure PA 50, and Figure PA 51). In 2023, most pancreas transplants (41.2%) were performed at centers performing 10 or fewer pancreas transplants, while 26.6% of pancreas transplants were performed at medium-volume centers (11-24 transplants per year) and 32.2% were performed at large-volume centers (25 or more transplants per year) (Figure PA 53).

5 Outcomes

The outcome data in 2023 reflect the fourth year that the Annual Data Report includes the criteria for defining pancreas graft failure if any of the following occurred: 1) a recipient's transplanted pancreas is removed; 2) a recipient reregisters for a pancreas transplant; 3) a recipient registers for an islet transplant after undergoing a pancreas transplant; 4) a recipient dies; or 5) a recipient's total insulin use is greater or equal to 0.5 units/kg/day for 90 consecutive days (OPTN Policy 1.2: definitions). The incidence of pancreas graft failure in the first 90 days is generally attributed to technical losses. There was an increase in graft failure in the first 90 days in adults in the PAK category to 16.1% in 2023 (from 6.7% in 2022), whereas the incidence was relatively unchanged following PTA at 9.5% (from 9.4% in 2022) and was lower following SPK at 6.4% (from 7.1% in 2022) (Figure PA 54). Pancreas graft failure within the first year posttransplant has been and remained relatively low since this was first tracked in 2020, and for transplants done in 2022 the 1-year pancreas graft failure rates were 15.6%, 12.5%, and 9.2% following PAK, PTA, and SPK, respectively (Figure PA 55).

The 1-, 5-, and 10-year unadjusted kidney graft failure rates in adults following SPK remained low at 3.8% for transplants performed in 2022, 15.2% for transplants performed in 2018, and 34.4% for transplants performed in 2013, respectively (Figure PA 56). The good long-term kidney function can be attributed, in part, to normalization of hemoglobin A_{1C} and lack of kidney disease from diabetic nephropathy following successful pancreas transplant. In addition, the high quality of the donor kidneys (low kidney donor profile index) that are used in SPK contributes to the excellent long-term function following SPK. The merits of normalizing hemoglobin A_{1C} and prevention of diabetic nephropathy are evident with the low 10-year death-censored kidney graft failure rate of 18.7% for SPKs performed in 2013 (Figure PA 57). Similarly, the 10-year death-censored kidney graft failure rate (from the time of pancreas transplant) was 18.5% for pancreas after deceased donor kidney transplants in 2013 and 2014 (Figure PA 59) and 13.7% for pancreas after living donor kidney transplants in 2013 and 2014 (Figure PA 61), which also reflects the beneficial metabolic aspects of successful pancreas transplant in terms of preventing recurrent diabetic nephropathy.

The incidence of acute rejection by 1-year posttransplant for pancreas transplant recipients remains low, and inversely correlates with age. The 1-year rejection rates, reporting only the first reported rejection event, were 10.4%, 8.4%, and 6.4% for recipients aged 18-34 years, 35-49 years, and 50-64 years, respectively (Figure PA 63). The consistency of immunosuppressive regimens following pancreas transplant, with lymphodepletion induction and maintenance including tacrolimus and mycophenolate used in over 90% of pancreas transplants (Figure PA 47 and Figure PA 48), has resulted in the steady reduction of reported rejection rates over the past decade in these age groups (Figure PA 63 and Figure PA 64).

The cumulative incidence of post-transplant lymphoproliferative disorder (PTLD) following pancreas transplant has been a concern based on the more aggressive immunosuppressive regimens that have historically been used to suppress both the alloimmune and autoimmune responses. Despite these concerns, the cumulative incidence of PTLD has remained consistently low, although higher incidence was noted in Epstein-Barr virus (EBV)–negative recipients following pancreas transplant compared with EBV-positive recipients. The 5-year cumulative incidence of PTLD following PAK in adults was 1.1% in EBV-positive compared with 1.6% in EBV-negative recipients (Figure PA 65), and after SPK was 0.7% in EBV-positive and 1.1 % in EBV-negative recipients (Figure PA 67). There was a much higher impact of EBV status in the PTA recipients, with a 5-year cumulative incidence of PTLD of 0.7% in EBV-positive recipients and 4.5% in EBV-negative recipients (Figure PA 66).

The more aggressive immunosuppressive regimens associated with low rejection rates following pancreas transplant have not resulted in higher mortality over the past decade. Although allograft survival was recently defined and allograft success rates are in their fourth year following the new definitions, mortality rates after pancreas transplant have always been accurately monitored by the OPTN. The rates of recipient death at 1 year, 5 years, and 10 years have decreased in every category of pancreas transplant. Mortality at 1 year has decreased from 4.5%, 4.9%, and 4.9% for transplants in 2003 and 2004 to 1.3%, 4.2%, and 2.7% for transplants in 2021 and 2022 following PAK, PTA, and SPK, respectively (Figure PA 68). Mortality at 5 years has decreased from 16.6%, 11.2%, and 13.0% for transplants in 2003 and 2004 to 9.1%, 7.8%, and 9.3% for transplants in 2017 and 2018 following PAK, PTA, and SPK, respectively (Figure PA 69). Longer term mortality at 10 years has decreased from 32.0%, 22.0%, and 26.4% for transplants in 2003 and 2004 to 29.6%, 15.9%, and 21.8% for transplants in 2013 and 2014 following PAK, PTA, and SPK, respectively (Figure PA 70).

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This report is available at https://srtr.transplant.hrsa.gov/annualdatareports. Individual chapters may be downloaded.

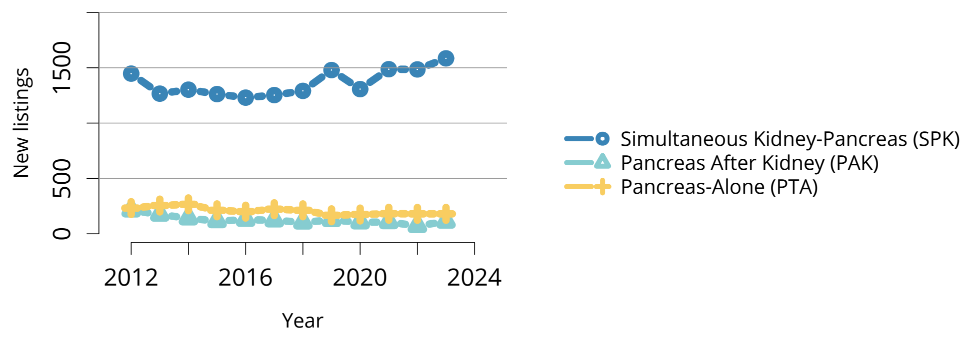

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Figure PA 1: New adult candidates added to the pancreas transplant waiting list. A new candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and subsequently relisted are considered new.

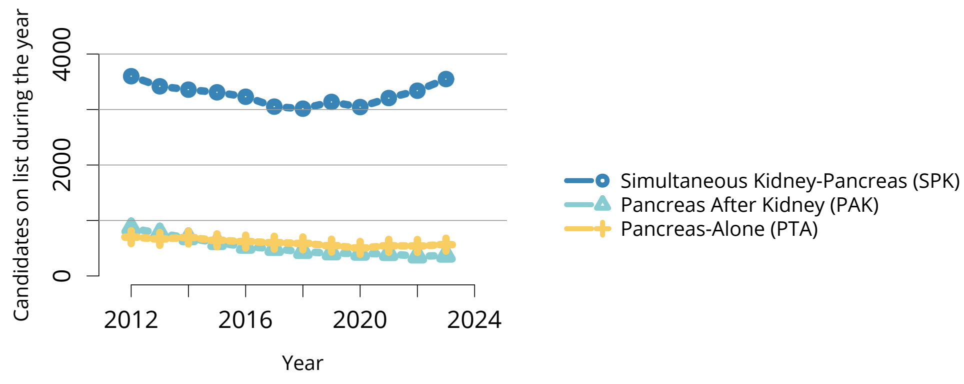

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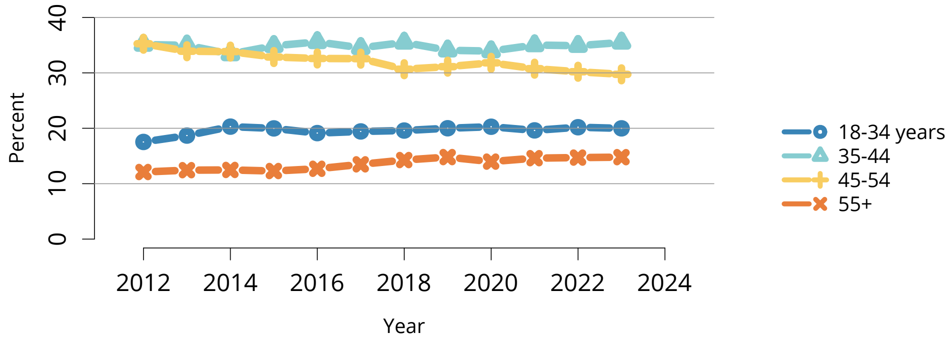
Figure PA 2: All adult candidates on the pancreas transplant waiting list. Adult candidates on the list at any time during the year. Candidates listed at more than one center are counted once per listing.



OPTN/SRTR 2023 Annual Data Report

Figure PA 3: Distribution of adults waiting for pancreas transplant by age. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included. Age is determined at the earliest of transplant, death, removal, or December 31 of the year.

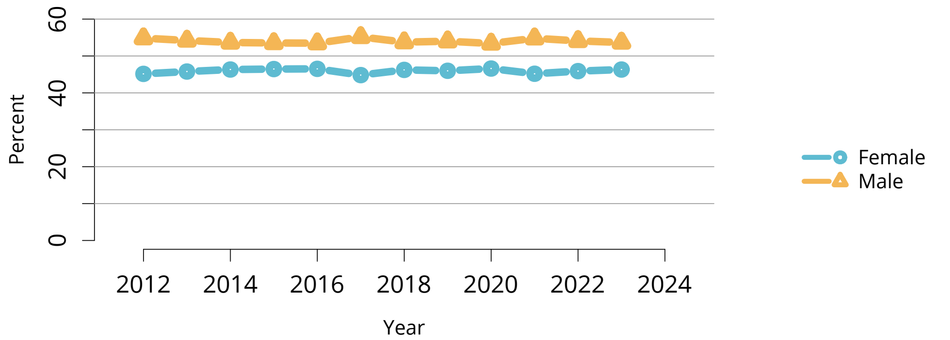


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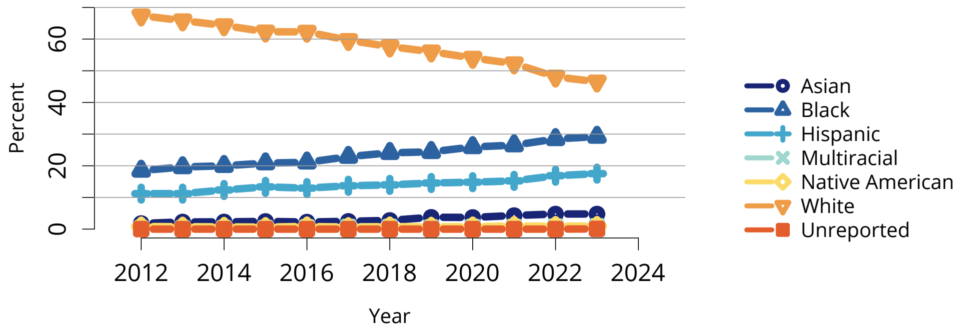
Figure PA 4: Distribution of adults waiting for pancreas transplant by sex. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.



OPTN/SRTR 2023 Annual Data Report

Figure PA 5: Distribution of adults waiting for pancreas transplant by race and ethnicity. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

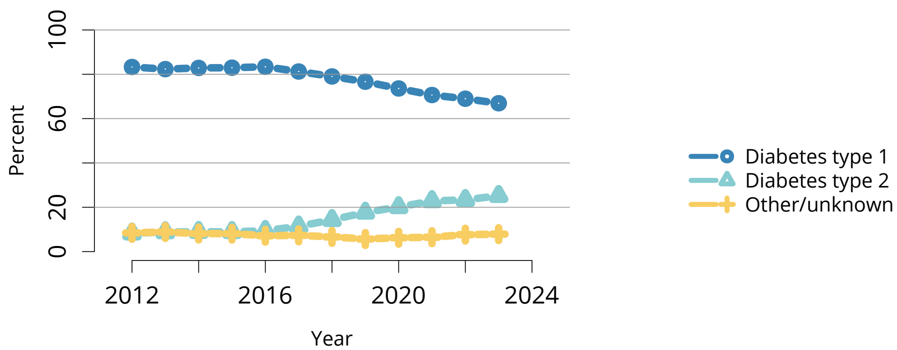


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Figure PA 6: Distribution of adults waiting for pancreas transplant by diagnosis. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

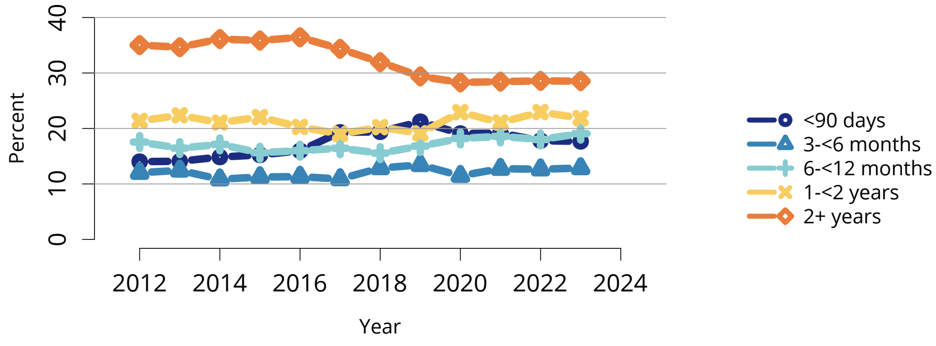

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Figure PA 7: Distribution of adults waiting for pancreas transplant by waiting time. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Time on the waiting list is determined at the earliest of transplant, death, removal, or December 31 of the year. Active and inactive candidates are included.

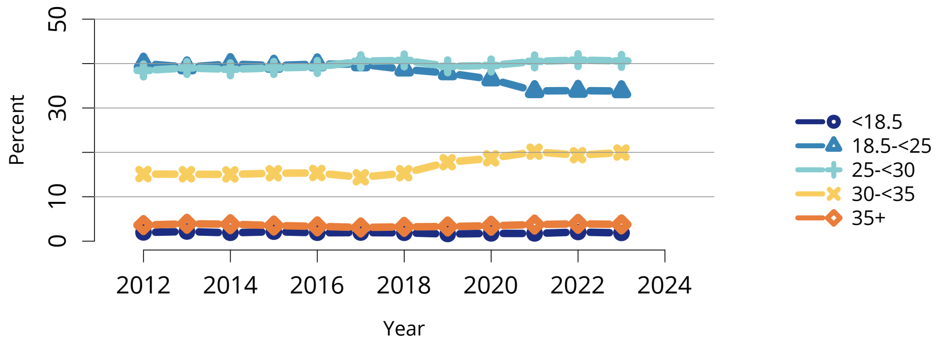

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Figure PA 8: Distribution of adults waiting for pancreas transplant by BMI. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included. BMI, body mass index.

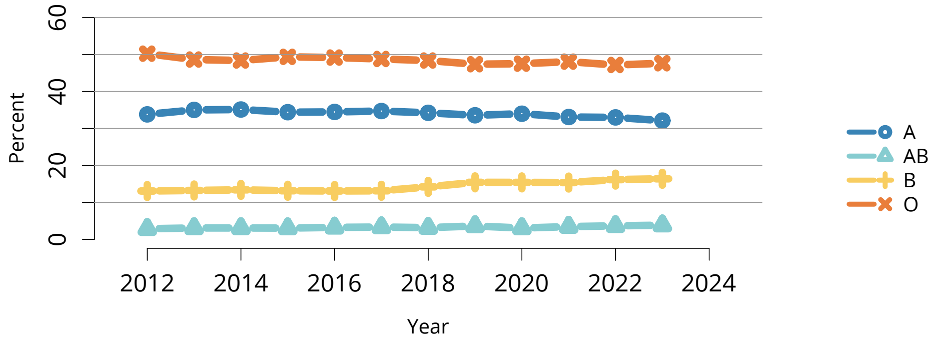

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Figure PA 9: Distribution of adults waiting for pancreas transplant by blood type. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

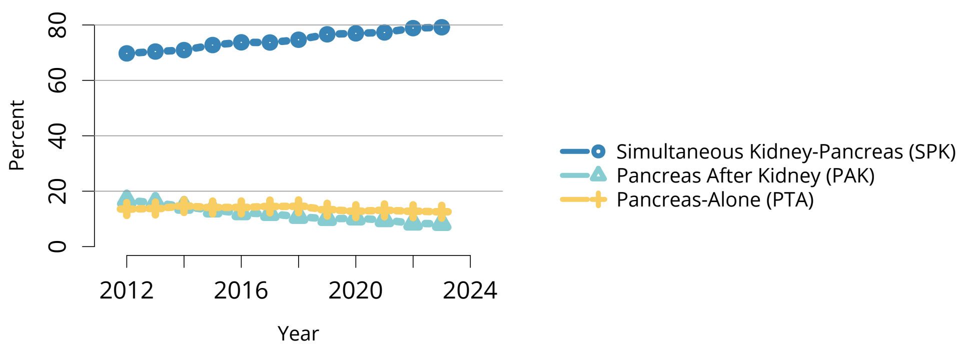

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Figure PA 10: Distribution of adults waiting for pancreas transplant by intended transplant type. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

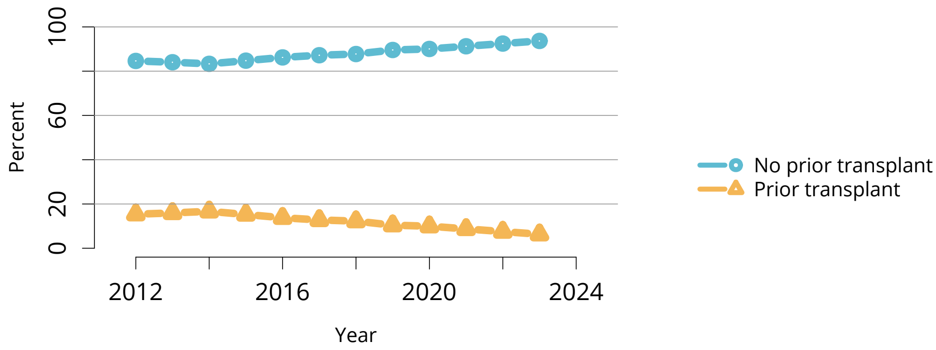

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Figure PA 11: Distribution of adults waiting for pancreas transplant by prior transplant status. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

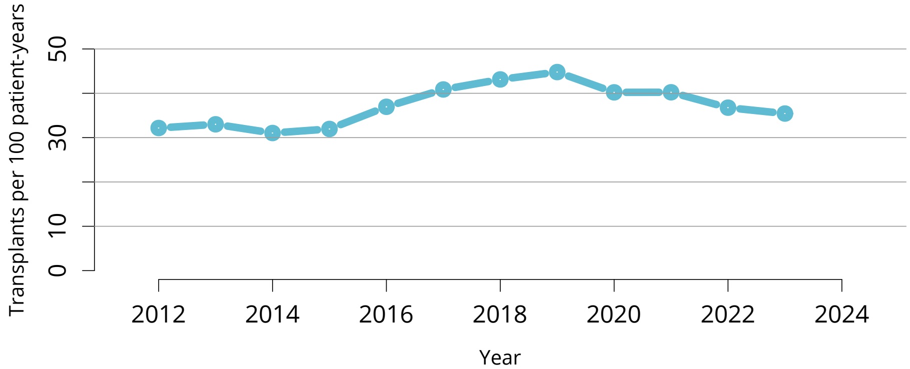

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Figure PA 12: Overall deceased donor pancreas transplant rates among adult waitlist candidates. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

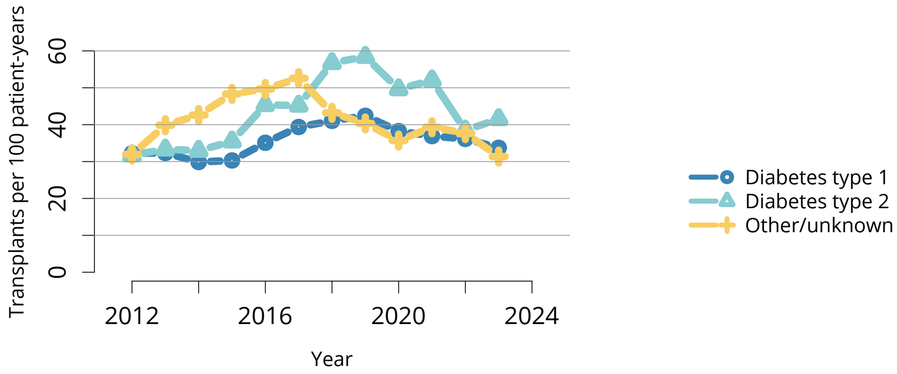

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Figure PA 13: Deceased donor pancreas transplant rates among adult waitlist candidates by diagnosis. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

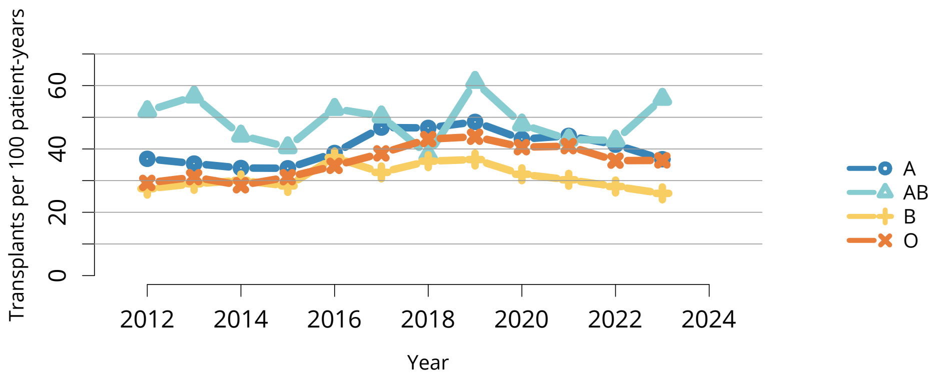

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Figure PA 14: Deceased donor pancreas transplant rates among adult waitlist candidates by blood type. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

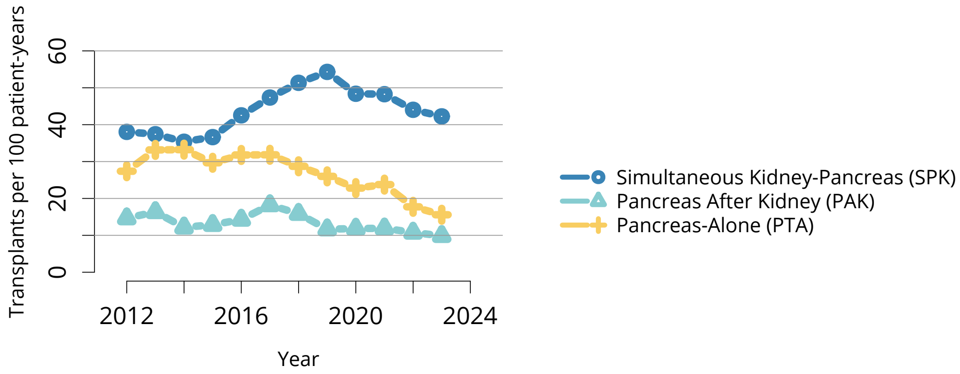

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Figure PA 15: Deceased donor pancreas transplant rates among adult waitlist candidates by intended transplant type. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

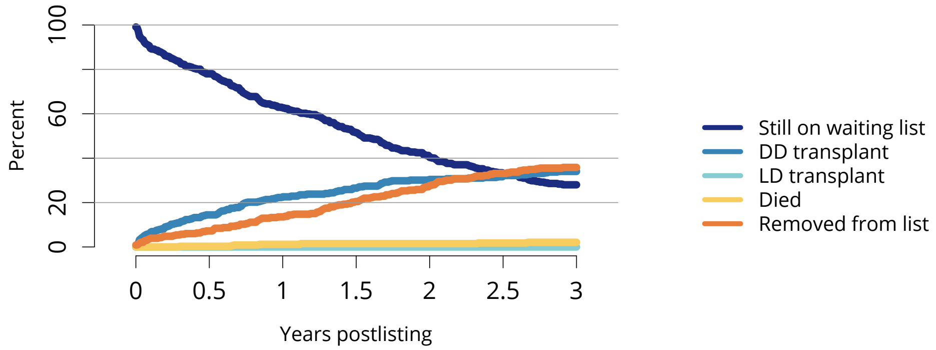

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Figure PA 16: Three-year outcomes for adults waiting for pancreas after kidney transplant, new listings in 2018-2020. Candidates listed at more than one center are counted once per listing. Removed from list includes all reasons except transplant and death. DD, deceased donor; LD, living donor.

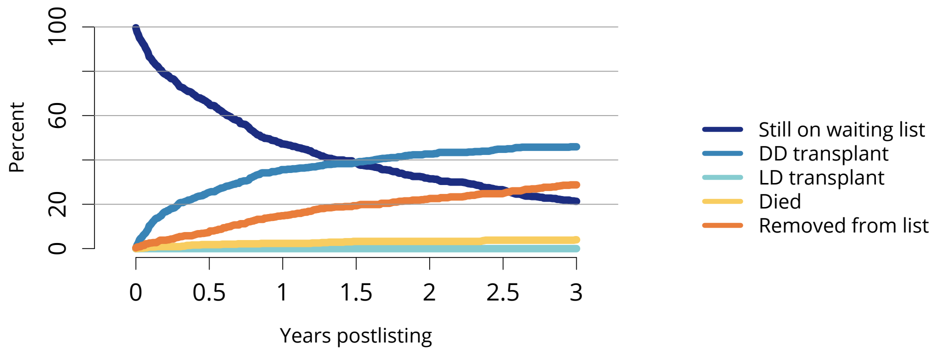

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Figure PA 17: Three-year outcomes for adults waiting for pancreas transplant alone, new listings in 2018-2020. Candidates listed at more than one center are counted once per listing. Removed from list includes all reasons except transplant and death. DD, deceased donor; LD, living donor.

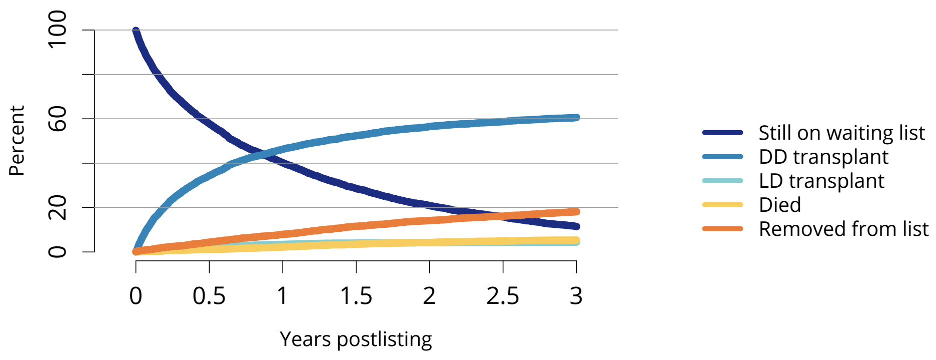

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Figure PA 18: Three-year outcomes for adults waiting for simultaneous pancreas-kidney transplant, new listings in 2018-2020. Candidates listed at more than one center are counted once per listing. Removed from list includes all reasons except transplant and death. DD, deceased donor; LD, living donor.

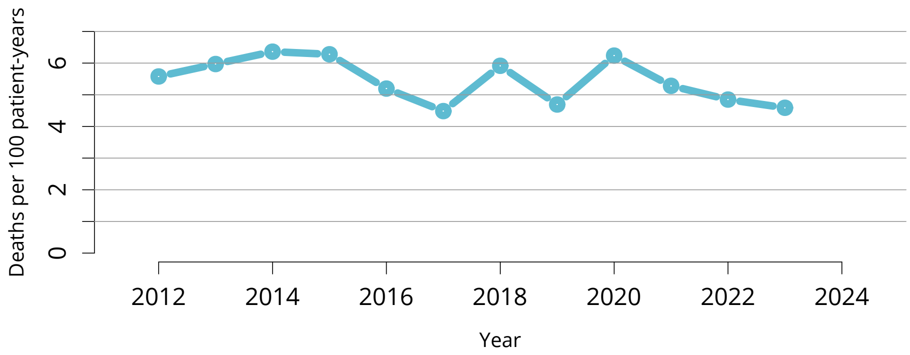

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Figure PA 19: Overall pretransplant mortality rates among adults waitlisted for pancreas transplant. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

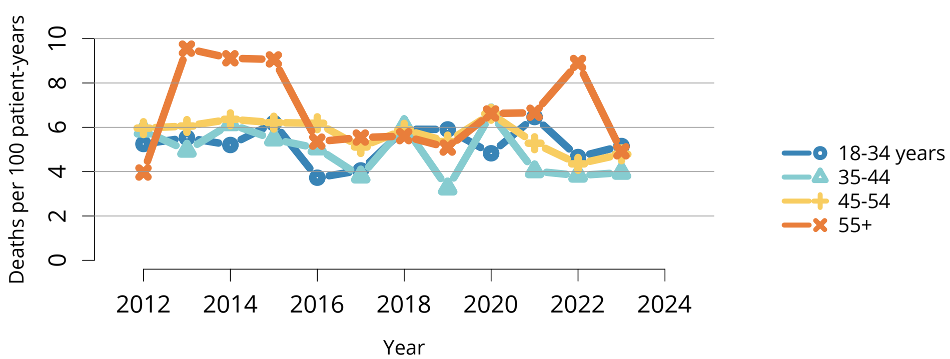

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Figure PA 20: Pretransplant mortality rates among adults waitlisted for pancreas transplant by age. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year.

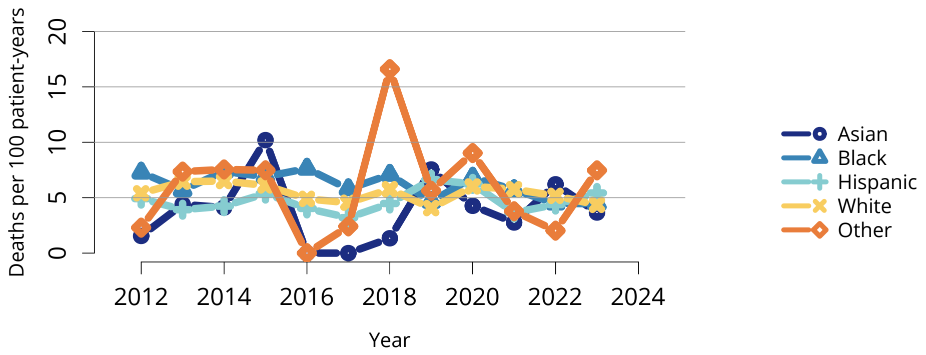

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Figure PA 21: Pretransplant mortality rates among adults waitlisted for pancreas transplant by race and ethnicity. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

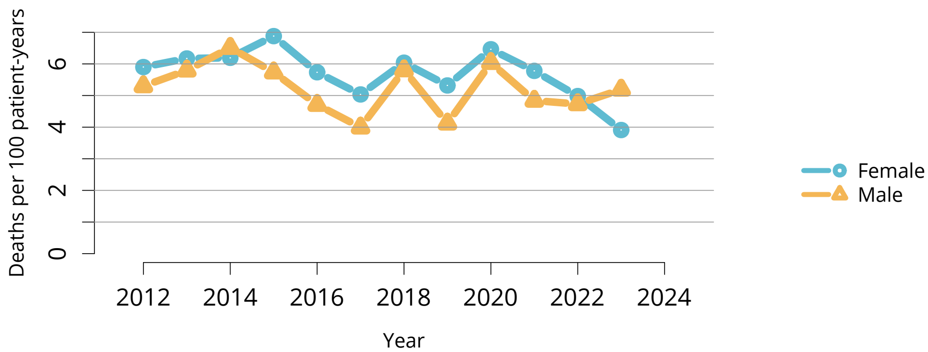

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Figure PA 22: Pretransplant mortality rates among adults waitlisted for pancreas transplant by sex. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

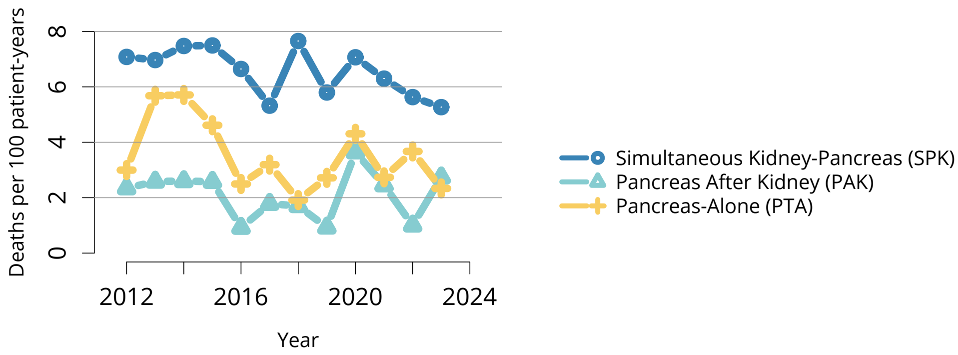

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Figure PA 23: Pretransplant mortality rates among adults waitlisted for pancreas transplant by intended transplant type. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

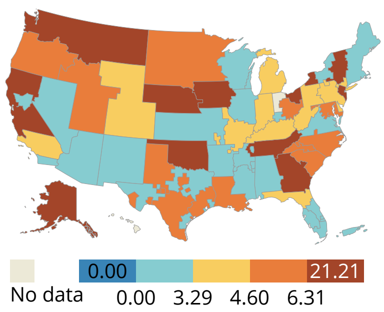

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Figure PA 24: Pretransplant mortality rates among adults waitlisted for pancreas transplant in 2023 by DSA. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. DSA, donation service area.

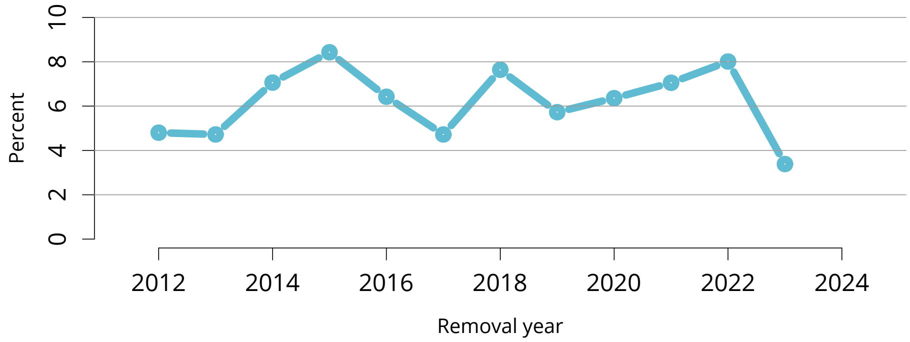

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Figure PA 25: Deaths within 6 months after removal among adult pancreas waitlist candidates, overall. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list.

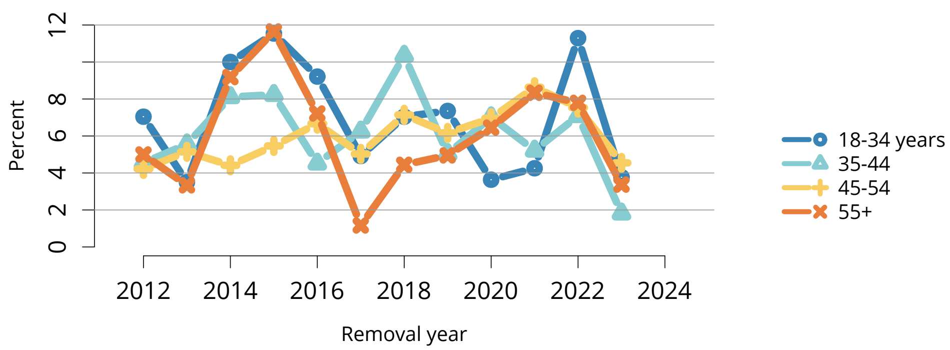

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Figure PA 26: Deaths within 6 months after removal among adult pancreas waitlist candidates, by age. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list. Age is determined at removal.

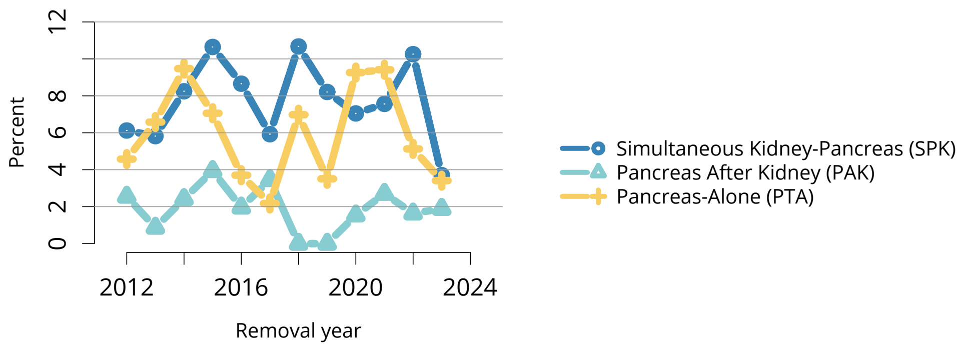

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Figure PA 27: Deaths within 6 months after removal among adult pancreas waitlist candidates, by intended transplant type. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list.

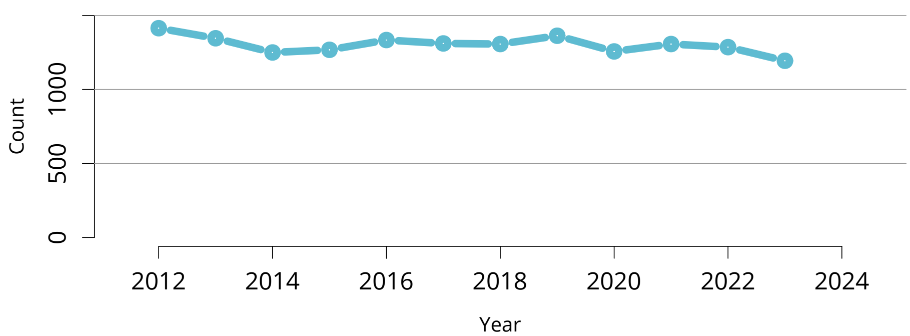

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Figure PA 28: Overall deceased pancreas donor count. Count of deceased donors whose pancreata were recovered for transplant. Pancreata recovered for islet transplant are excluded.

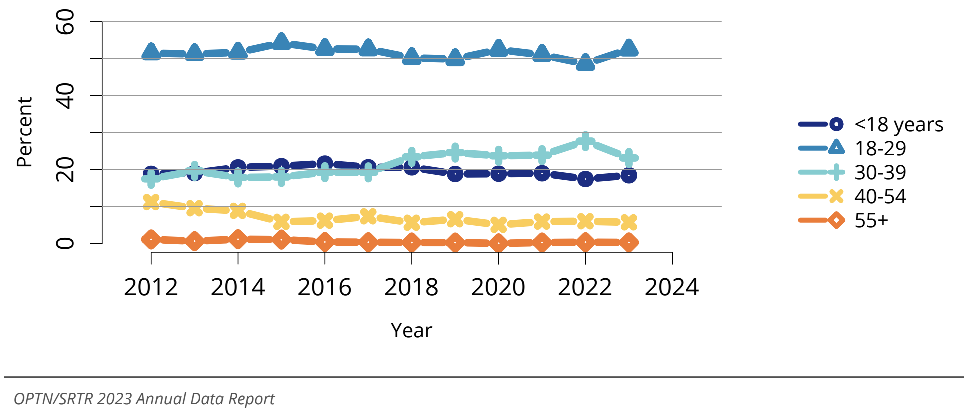

Figure PA 29: Distribution of deceased pancreas donors by age. Deceased donors whose pancreata were recovered for transplant. Pancreata recovered for islet transplant are excluded.

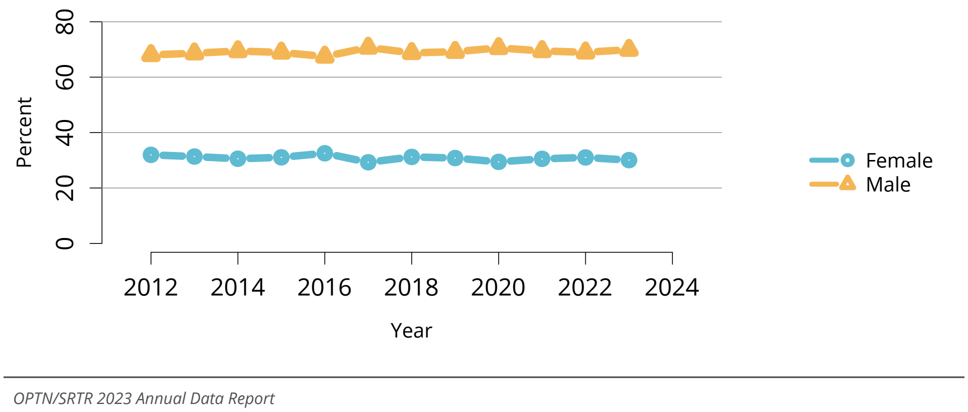

Figure PA 30: Distribution of deceased pancreas donors by sex. Deceased donors whose pancreata were recovered for transplant. Pancreata recovered for islet transplant are excluded.

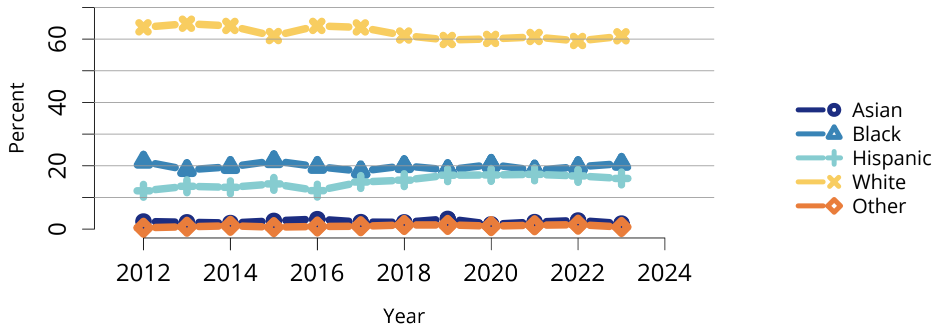

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Figure PA 31: Distribution of deceased pancreas donors by race and ethnicity. Deceased donors whose pancreata were recovered for transplant. Pancreata recovered for islet transplant are excluded. The Other race category is composed of Native American and Multiracial categories.

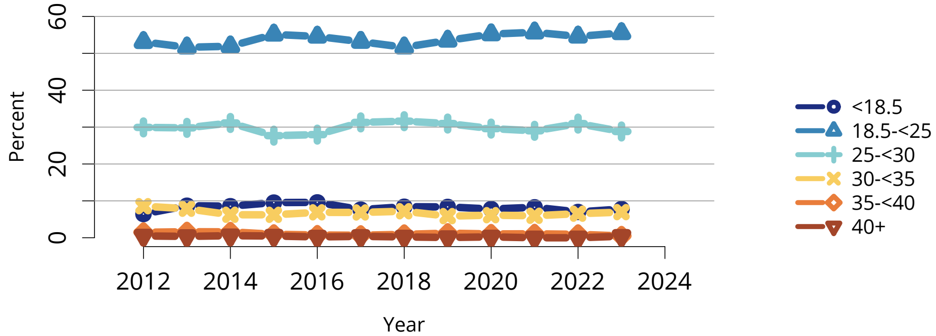

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Figure PA 32: Distribution of deceased pancreas donors by donor BMI. Deceased donors whose pancreata were recovered for transplant. Pancreata recovered for islet transplant are excluded. BMI, body mass index.

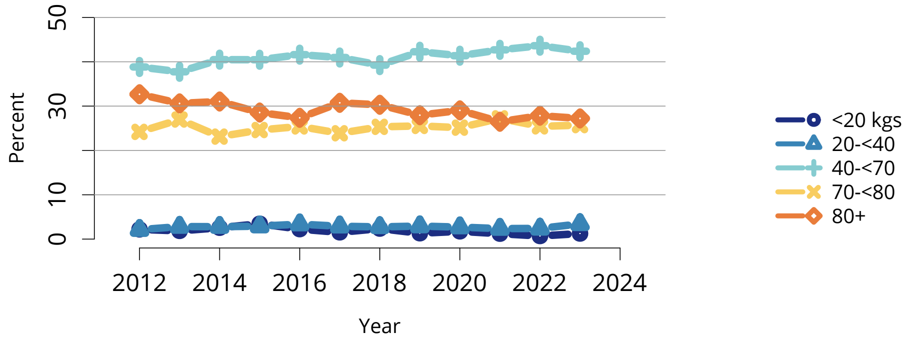

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Figure PA 33: Distribution of deceased pancreas donors by weight. Deceased donors whose pancreata were recovered for transplant.

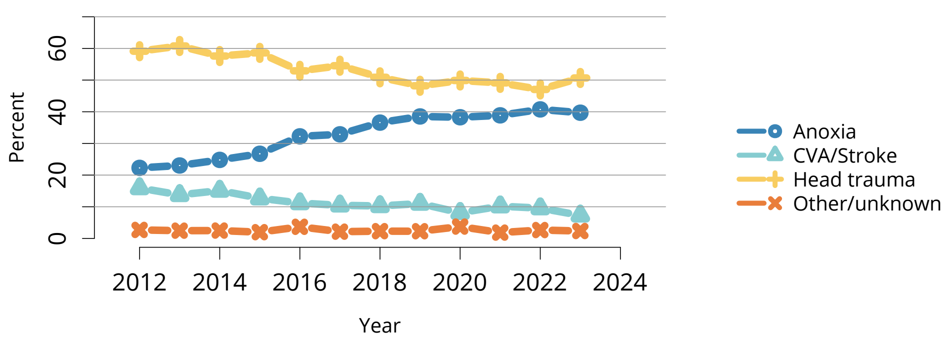

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Figure PA 34: Cause of death among deceased pancreas donors. Donors whose pancreata were recovered for transplant. CVA, cerebrovascular accident.

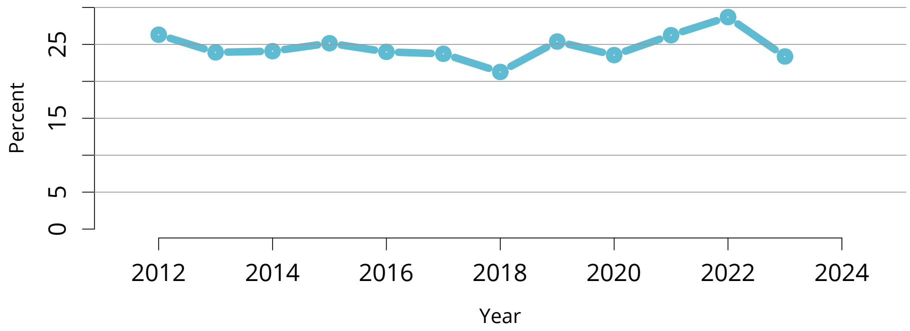

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Figure PA 35: Overall rates of pancreata recovered for transplant and not transplanted. Percentages of pancreata not transplanted out of all pancreata recovered for transplant. Pancreata recovered for islet transplant are excluded.

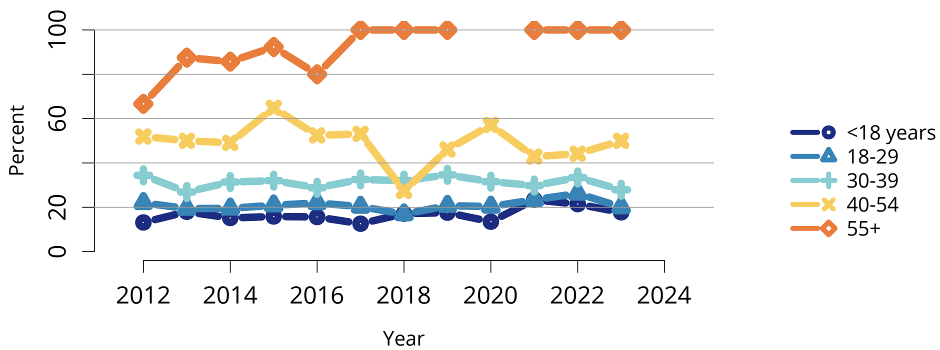

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Figure PA 36: Rates of pancreata recovered for transplant and not transplanted by donor age. Percentages of pancreata not transplanted out of all pancreata recovered for transplant. Pancreata recovered for islet transplant are excluded. Missing dots indicate no pancreata were recovered from donors in the age category in the year.

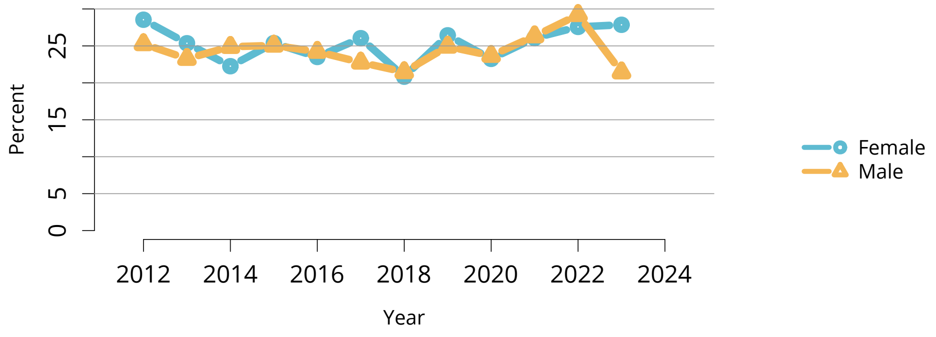

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Figure PA 37: Rates of pancreata recovered for transplant and not transplanted by donor sex. Percentages of pancreata not transplanted out of all pancreata recovered for transplant. Pancreata recovered for islet transplant are excluded.

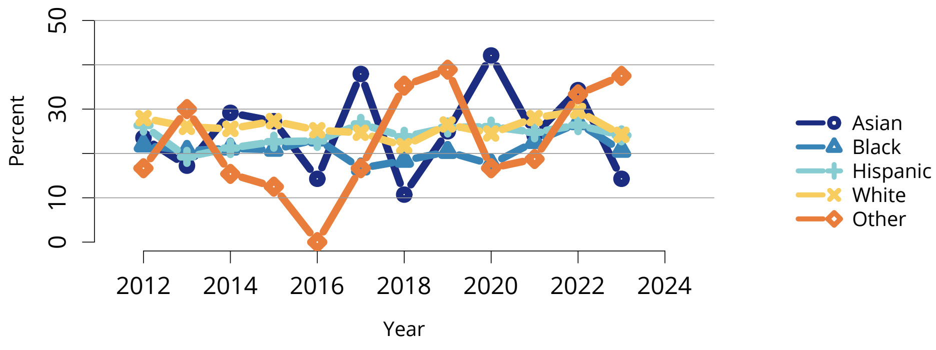

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Figure PA 38: Rates of pancreata recovered for transplant and not transplanted by donor race and ethnicity. Percentages of pancreata not transplanted out of all pancreata recovered for transplant. Pancreata recovered for islet transplant are excluded. The Other race category is composed of Native American and Multiracial categories.

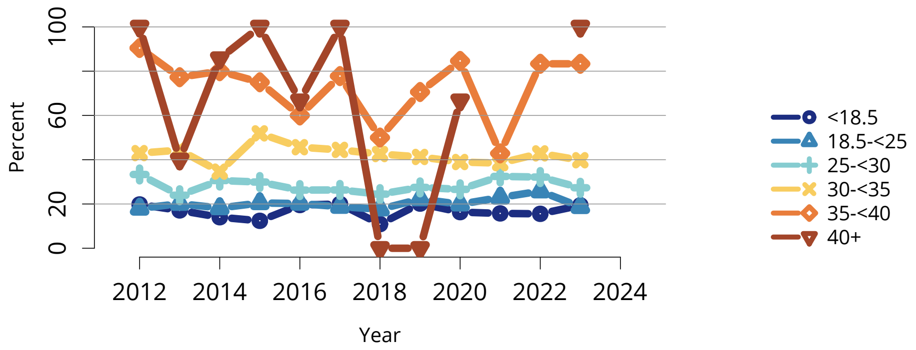

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Figure PA 39: Rates of pancreata recovered for transplant and not transplanted by donor BMI. Percentages of pancreata not transplanted out of all pancreata recovered for transplant. Pancreata recovered for islet transplant are excluded. Missing dots indicate no pancreata were recovered from donors in the BMI category in the year. BMI, body mass index.

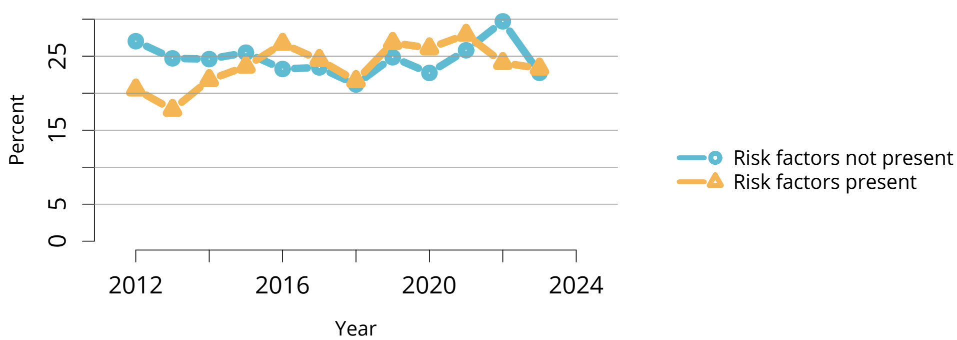

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Figure PA 40: Rates of pancreata recovered for transplant and not transplanted, by donor risk of disease transmission. Percentages of pancreata not transplanted out of all pancreata recovered for transplant. Pancreata recovered for islet transplant are excluded. "Risk factors" refers to risk criteria for acute transmission of human immunodeficiency virus, hepatitis B virus, or hepatitis C virus from the US Public Health Service Guideline.

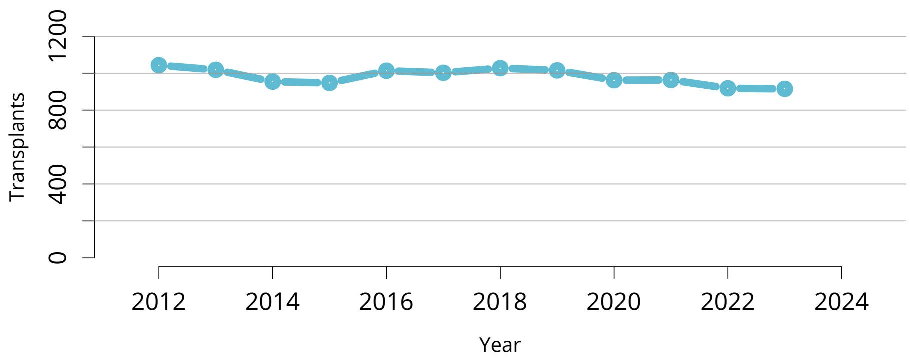

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Figure PA 41: Overall pancreas transplants. All pancreas transplant recipients, including adult and pediatric, retransplant, and multiorgan recipients.

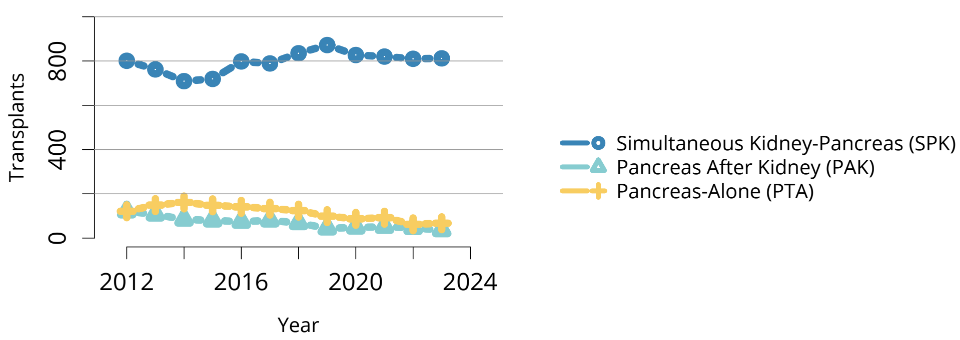

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Figure PA 42: Total pancreas transplants by pancreas transplant type. All pancreas transplant recipients, including adult and pediatric, retransplant, and multiorgan recipients.

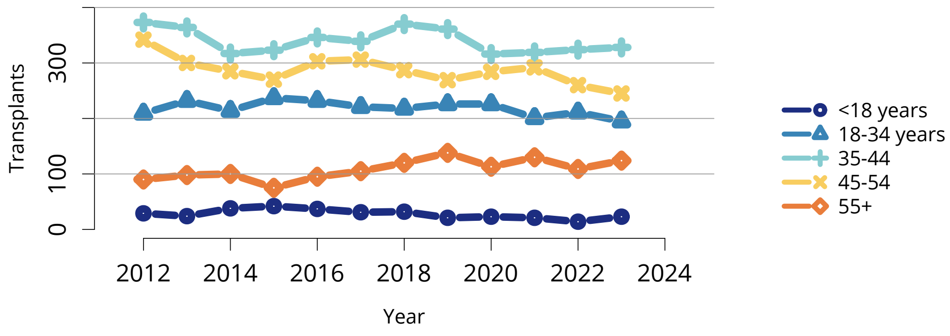

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Figure PA 43: Total pancreas transplants by age. All pancreas transplant recipients, including adult and pediatric, retransplant, and multiorgan recipients.

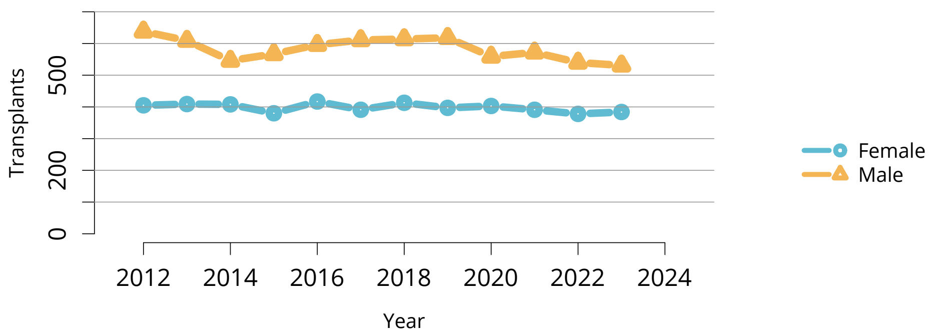

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Figure PA 44: Total pancreas transplants by sex. All pancreas transplant recipients, including adult and pediatric, retransplant, and multiorgan recipients.

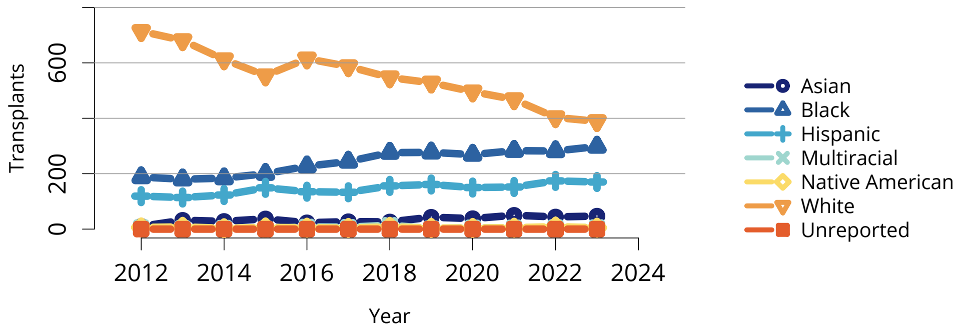

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Figure PA 45: Total pancreas transplants by race and ethnicity. All pancreas transplant recipients, including adult and pediatric, retransplant, and multiorgan recipients.

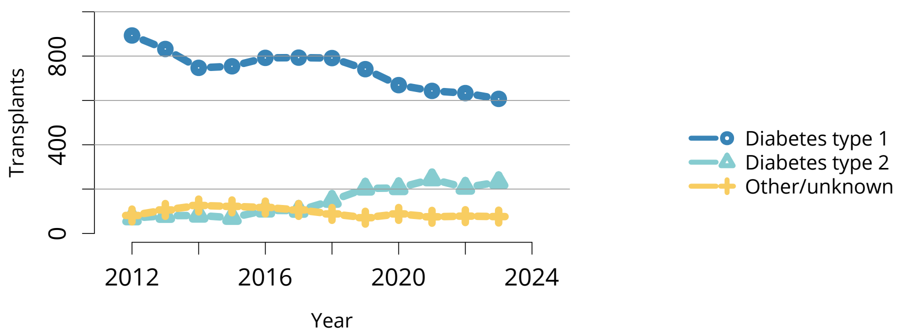

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Figure PA 46: Total pancreas transplants by diagnosis. All pancreas transplant recipients, including adult and pediatric, retransplant, and multiorgan recipients.

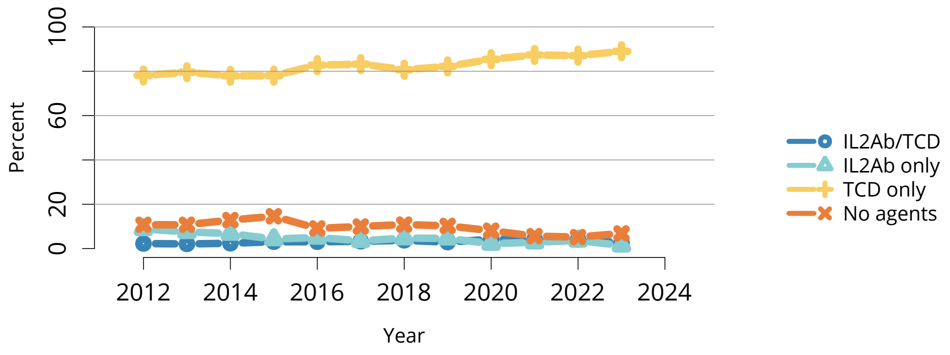

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Figure PA 47: Induction agent use in adult pancreas transplant recipients. Immunosuppression at transplant reported to the OPTN. IL2Ab, interleukin-2 receptor antibody; TCD, T-cell depleting.

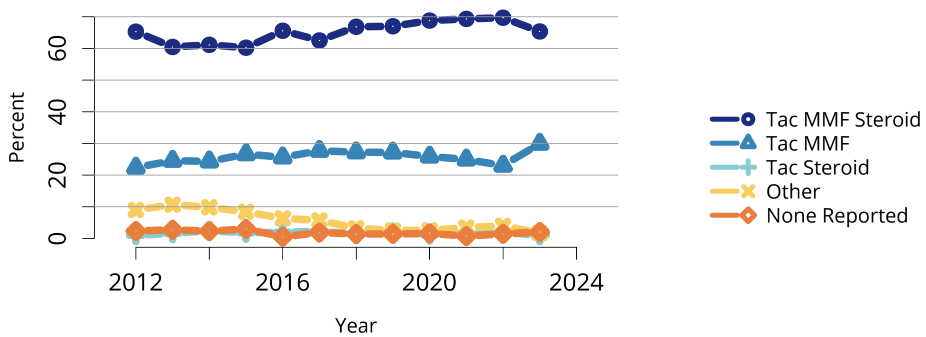

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Figure PA 48: Immunosuppression regimen use in adult pancreas transplant recipients. Immunosuppression regimen at transplant reported to the OPTN. MMF, all mycophenolate agents; Tac, tacrolimus.

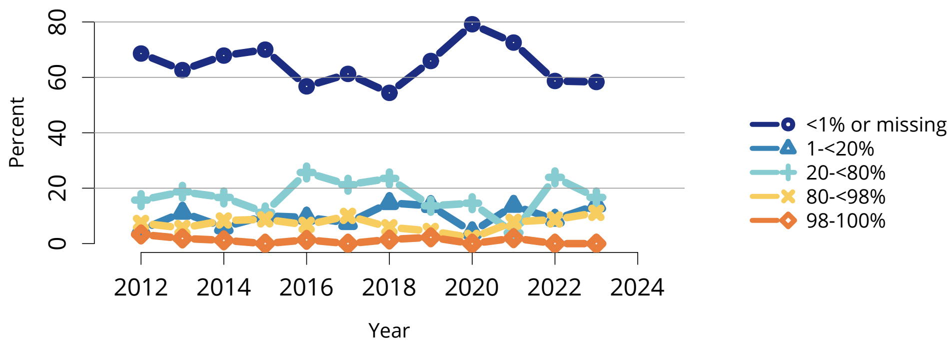

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Figure PA 49: CPRA in adult recipients of pancreas after kidney transplant. Peak cPRA is used. Missing indicates no unacceptable antigens were reported. cPRA, calculated panel-reactive antibody.

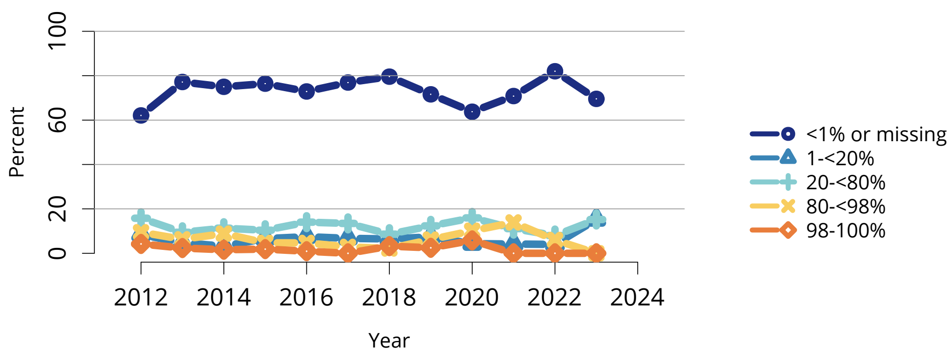

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Figure PA 50: CPRA in adult recipients of pancreas transplant alone. Peak cPRA is used. Missing indicates no unacceptable antigens were reported. cPRA, calculated panel-reactive antibody.

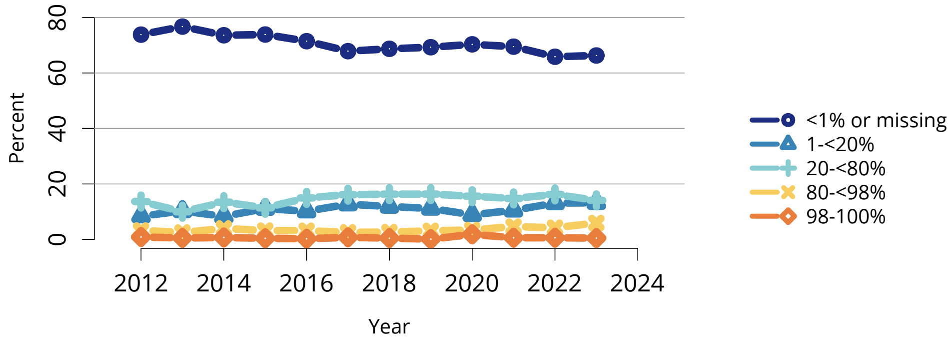

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Figure PA 51: CPRA in adult recipients of simultaneous pancreas-kidney transplant. Peak cPRA is used. Missing indicates no unacceptable antigens were reported. cPRA, calculated panel-reactive antibody.

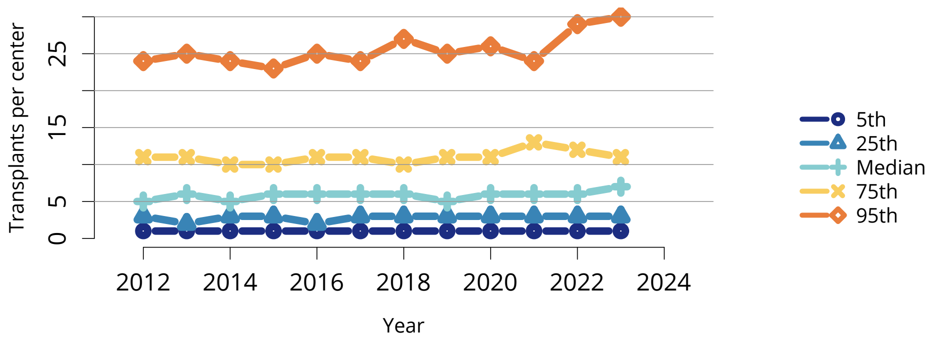

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Figure PA 52: Annual adult pancreas transplant center volumes by percentile. Annual volume data are limited to recipients aged 18 years or older.

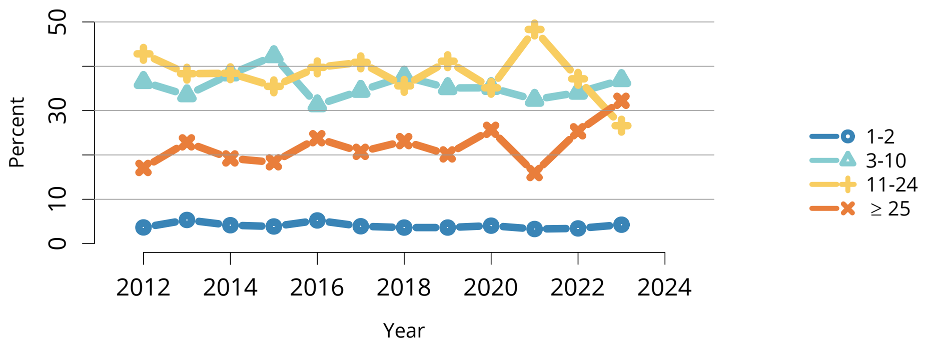

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Figure PA 53: Distribution of adult pancreas transplants by annual center volume. Based on annual volume data among recipients aged 18 years or older.

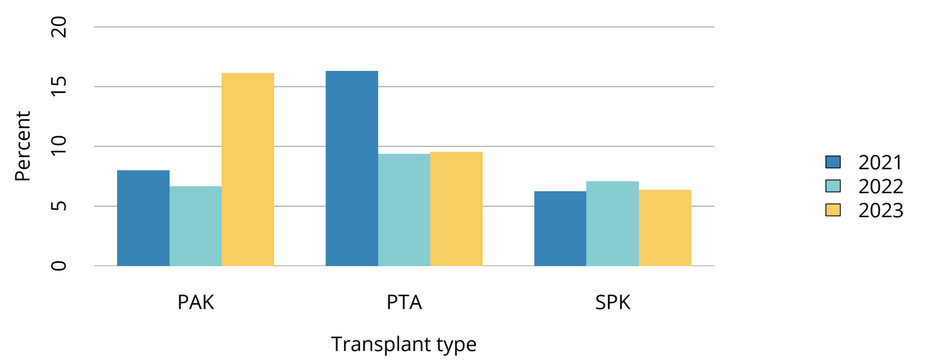

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Figure PA 54: Pancreas graft failure within the first 90 days posttransplant among adult pancreas transplant recipients. All-cause graft failure is identified from multiple data sources, including the OPTN Transplant Recipient Registration Form, the OPTN Transplant Recipient Follow-up Form, and death dates from the Social Security Administration. Transplants after September 30, 2023, are excluded due to insufficient follow-up. Nonrenal multivisceral transplants are excluded. PAK, pancreas after kidney; PTA, pancreas transplant alone; SPK, simultaneous pancreas-kidney.

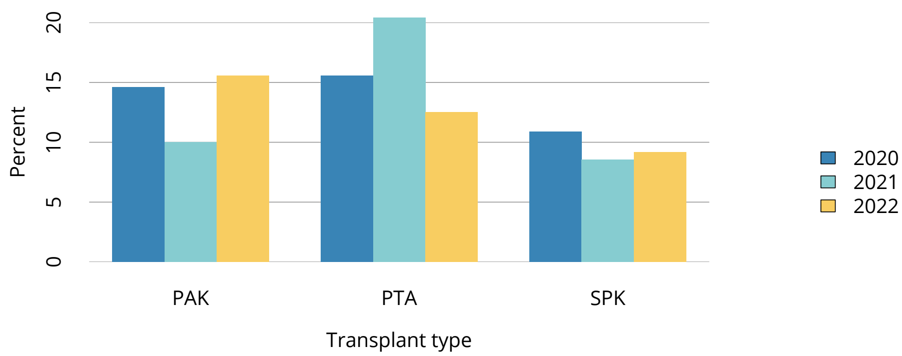

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Figure PA 55: Pancreas graft failure within the first year posttransplant among adult pancreas transplant recipients. All-cause graft failure is identified from multiple data sources, including the OPTN Transplant Recipient Registration Form, the OPTN Transplant Recipient Follow-up Form, and death dates from the Social Security Administration. Nonrenal multivisceral transplants are excluded. PAK, pancreas after kidney; PTA, pancreas transplant alone; SPK, simultaneous pancreas-kidney.

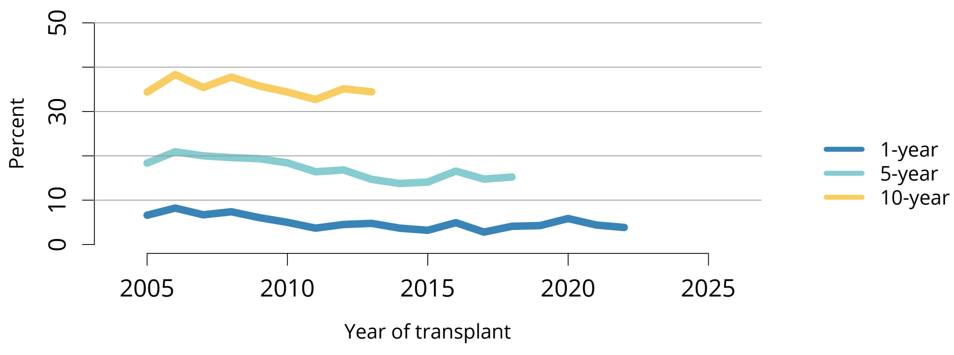

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Figure PA 56: Kidney graft failure among adult SPK transplant recipients. Estimates are unadjusted, computed using Kaplan-Meier methods. SPK transplant recipients are followed from date of transplant to the earliest of kidney graft failure; kidney retransplant; return to dialysis; death; or 1, 5, or 10 years posttransplant. All-cause graft failure is defined as any of the above outcomes prior to 1, 5, or 10 years, respectively. Nonrenal multivisceral transplants are excluded. SPK, simultaneous pancreas-kidney.

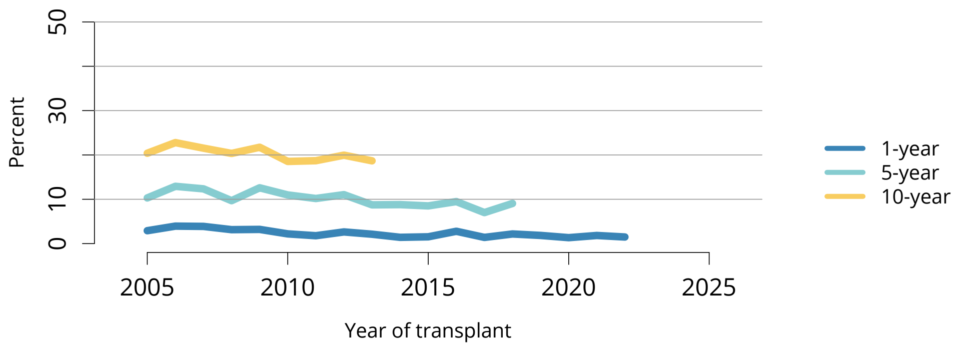

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Figure PA 57: Death censored kidney graft failure among adult SPK transplant recipients. Estimates are unadjusted, computed using Kaplan-Meier competing risk methods. SPK transplant recipients are followed from date of transplant to the earliest of kidney graft failure; kidney retransplant; return to dialysis; death; or 1, 5, or 10 years posttransplant. Death-censored graft failure is defined as return to dialysis, reported graft failure, or kidney retransplant. Nonrenal multivisceral transplants are excluded. SPK, simultaneous pancreas-kidney.

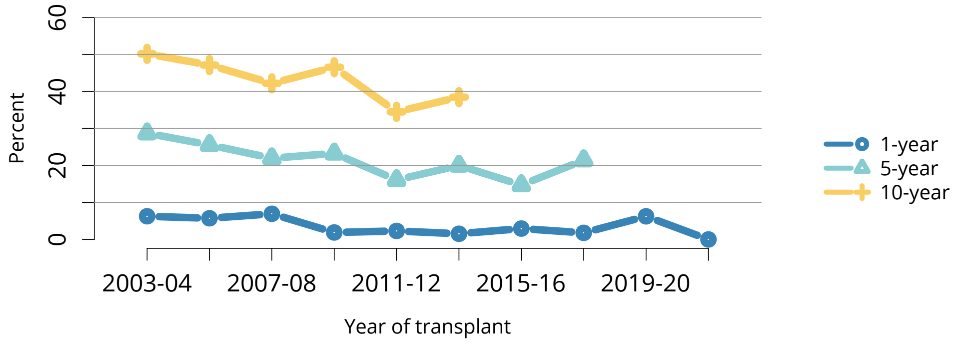

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Figure PA 58: Kidney graft failure among adult PAK transplant recipients with a deceased donor kidney (from time of pancreas transplant). Estimates are unadjusted, computed using Kaplan-Meier methods. PAK transplant recipients who previously underwent deceased donor kidney transplant are followed from the date of pancreas transplant to the earliest of kidney graft failure; kidney retransplant; return to dialysis; death; or 1, 5, or 10 years posttransplant. Only PAK recipients with an OPTN record of previous kidney or kidney-pancreas transplant are included. Multivisceral transplants are excluded. All-cause graft failure is defined as any of the above outcomes prior to 1, 5, or 10 years, respectively. All time points are 2-year periods. PAK, pancreas after kidney.

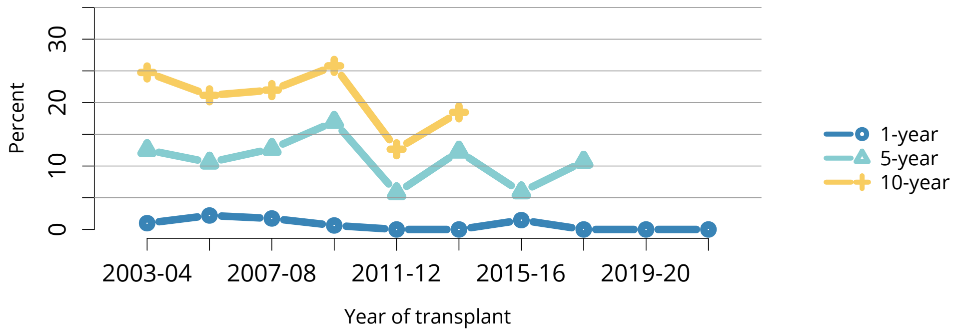

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Figure PA 59: Death-censored kidney graft failure among adult PAK transplant recipients with a deceased donor kidney (from time of pancreas transplant). Estimates are unadjusted, computed using Kaplan-Meier competing risk methods. PAK transplant recipients who previously underwent deceased donor kidney transplant are followed from the date of pancreas transplant to the earliest of kidney graft failure; kidney retransplant; return to dialysis; death; or 1, 5, or 10 years posttransplant. Only PAK recipients with an OPTN record of previous kidney or kidney-pancreas transplant are included. Multivisceral transplants are excluded. Death-censored graft failure is defined as return to dialysis, reported graft failure, or kidney retransplant. All time points are 2-year periods. PAK, pancreas after kidney.

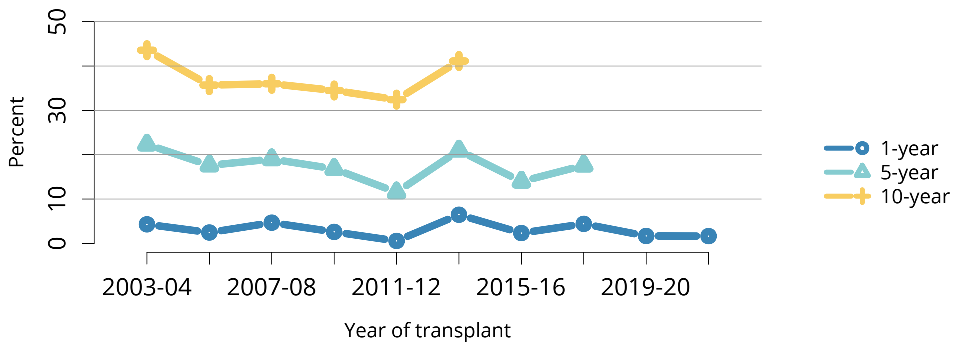

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Figure PA 60: Kidney graft failure among adult PAK transplant recipients with a living donor kidney (from time of pancreas transplant). Estimates are unadjusted, computed using Kaplan-Meier methods. PAK transplant recipients who previously underwent living donor kidney transplant are followed from date of pancreas transplant to the earliest of kidney graft failure; kidney retransplant; return to dialysis; death; or 1, 5, or 10 years posttransplant. Only PAK recipients with an OPTN record of a previous living kidney donor transplant are included. Multivisceral transplants are excluded. All-cause graft failure is defined as any of the above outcomes prior to 1, 5, or 10 years, respectively. All time points are 2-year periods. PAK, pancreas after kidney.

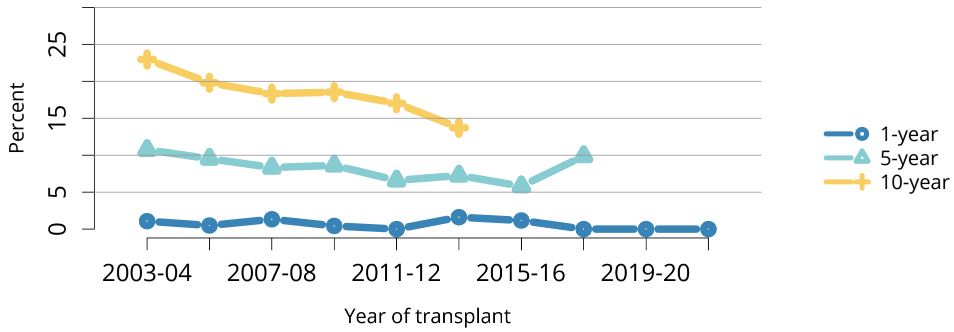

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Figure PA 61: Death-censored kidney graft failure among adult PAK transplant recipients with a living donor kidney (from time of pancreas transplant). Estimates are unadjusted, computed using Kaplan-Meier competing risk methods. PAK transplant recipients who previously underwent living donor kidney transplant are followed from date of pancreas transplant to the earliest of kidney graft failure; kidney retransplant; return to dialysis; death; or 1, 5, or 10 years posttransplant. Only PAK recipients with an OPTN record of a previous living kidney donor transplant are included. Multivisceral transplants are excluded. Death-censored graft failure is defined as return to dialysis, reported graft failure, or kidney retransplant. All time points are 2-year periods. PAK, pancreas after kidney.

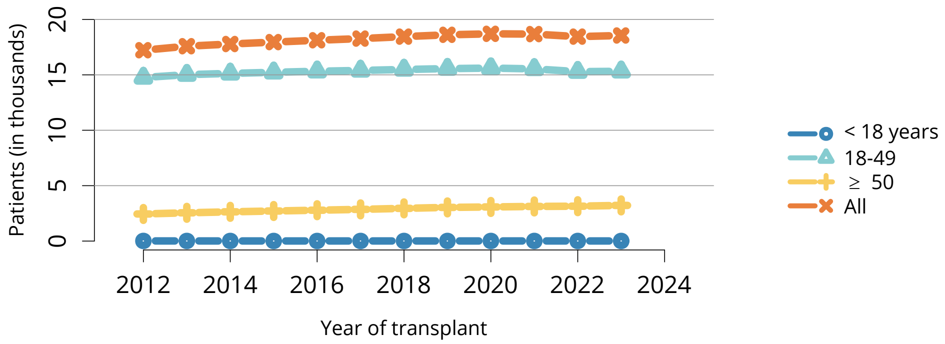

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Figure PA 62: Recipients alive after pancreas transplant on June 30 of the year, by age at transplant. Recipients are not censored at reported graft failure since the uniform definition of graft failure was not in effect until 2018. However, a recipient may experience a reported graft failure and be removed from the cohort, undergo retransplant, and re-enter the cohort.

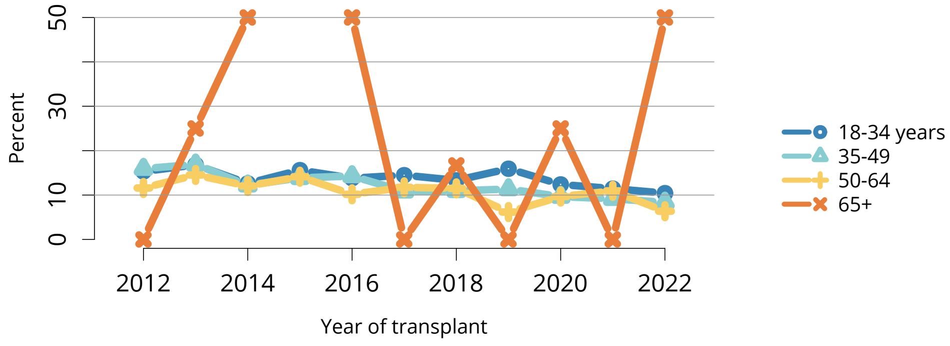

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Figure PA 63: Incidence of acute rejection by 1 year posttransplant among adult pancreas transplant recipients by age. Only the first reported rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier method. Missing dots indicate no pancreata were transplanted in patients in the age category in the year.

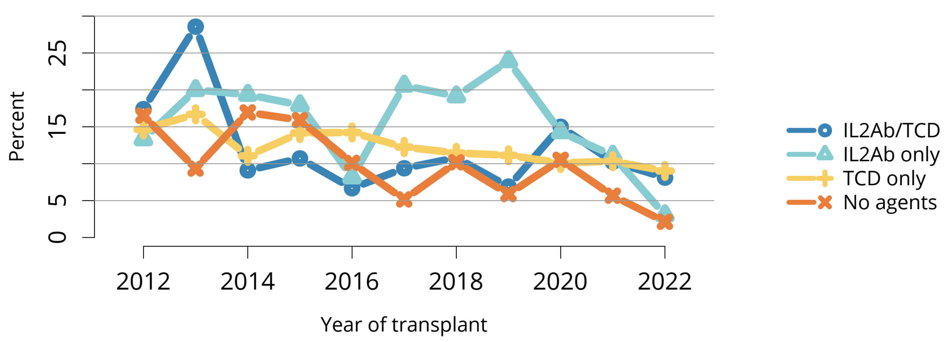

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Figure PA 64: Incidence of acute rejection by 1 year posttransplant among adult pancreas transplant recipients by induction agent. Only the first reported rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier method. IL2Ab, interleukin-2 receptor antibody; TCD, T-cell depleting.

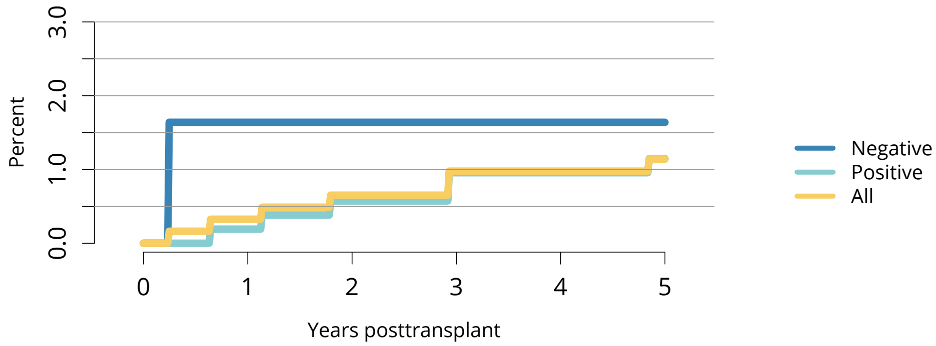

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Figure PA 65: Incidence of PTLD among adult recipients of pancreas after kidney transplant by recipient EBV status at transplant, 2012-2018. Cumulative incidence is estimated using the Kaplan-Meier method. PTLD is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus; PTLD, posttransplant lymphoproliferative disorder.

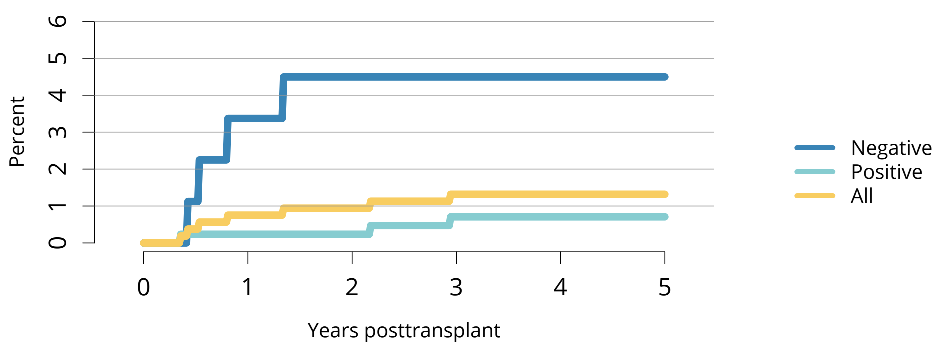

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Figure PA 66: Incidence of PTLD among adult recipients of pancreas transplant alone by recipient EBV status at transplant, 2012-2018. Cumulative incidence is estimated using the Kaplan-Meier method. PTLD is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus; PTLD, posttransplant lymphoproliferative disorder.

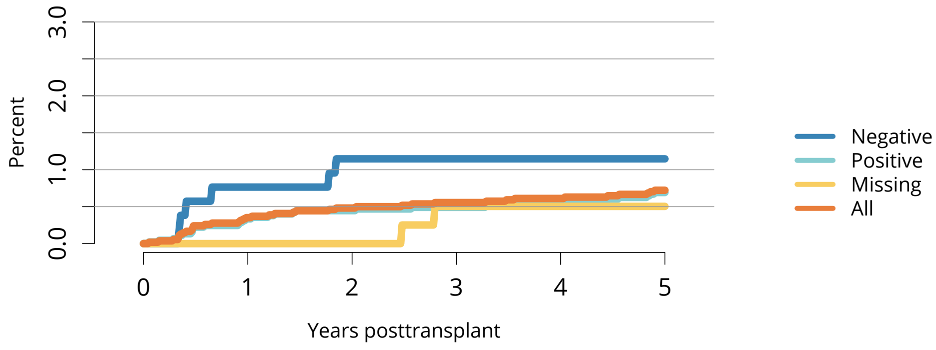

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Figure PA 67: Incidence of PTLD among adult recipients of simultaneous pancreas-kidney transplant by recipient EBV status at transplant, 2012-2018. Cumulative incidence is estimated using the Kaplan-Meier method. PTLD is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus; PTLD, posttransplant lymphoproliferative disorder.

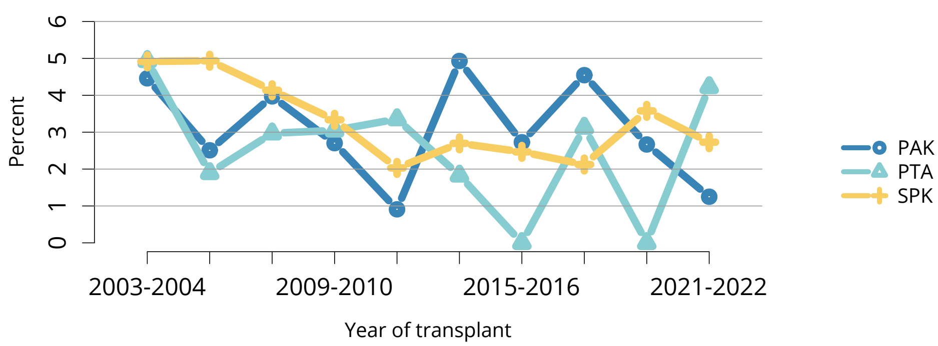

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Figure PA 68: Patient death at 1 year among adult pancreas transplant recipients. Outcomes are computed using unadjusted Kaplan-Meier methods. Transplant recipients are followed from date of transplant to the earlier of death or 1 year posttransplant. Only first pancreas transplant is considered. PAK recipients without a record of previous kidney or kidney-pancreas transplant are reclassified as PTA. All time points are 2-year periods. PAK, pancreas after kidney; PTA, pancreas transplant alone; SPK, simultaneous pancreas-kidney.

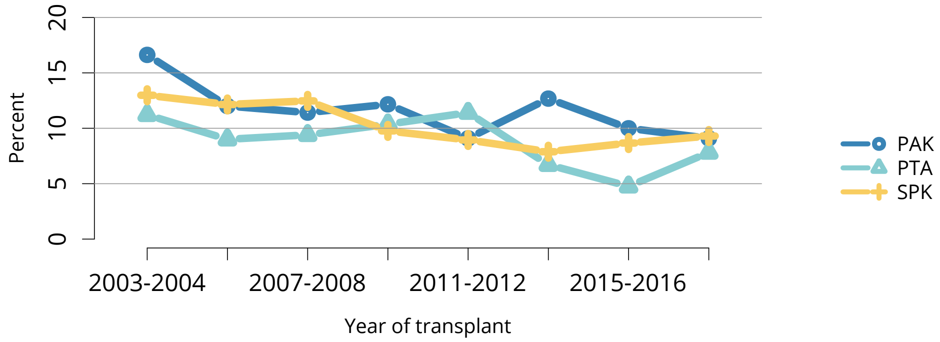

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Figure PA 69: Patient death at 5 years among adult pancreas transplant recipients. Outcomes are computed using unadjusted Kaplan-Meier methods. Transplant recipients are followed from date of transplant to the earlier of death or 5 years posttransplant. Only first pancreas transplant is considered. PAK recipients without a record of previous kidney or kidney-pancreas transplant are reclassified as PTA. All time points are 2-year periods. PAK, pancreas after kidney; PTA, pancreas transplant alone; SPK, simultaneous pancreas-kidney.

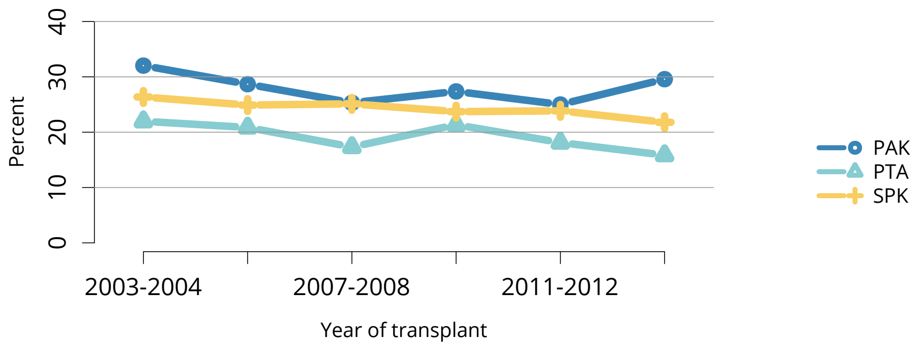

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Figure PA 70: Patient death at 10 years among adult pancreas transplant recipients. Outcomes are computed using unadjusted Kaplan-Meier methods. Transplant recipients are followed from date of transplant to the earlier of death or 10 years posttransplant. Only first pancreas transplant is considered. PAK recipients without a record of previous kidney or kidney-pancreas transplant are reclassified as PTA. All time points are 2-year periods. PAK, pancreas after kidney; PTA, pancreas transplant alone; SPK, simultaneous pancreas-kidney.

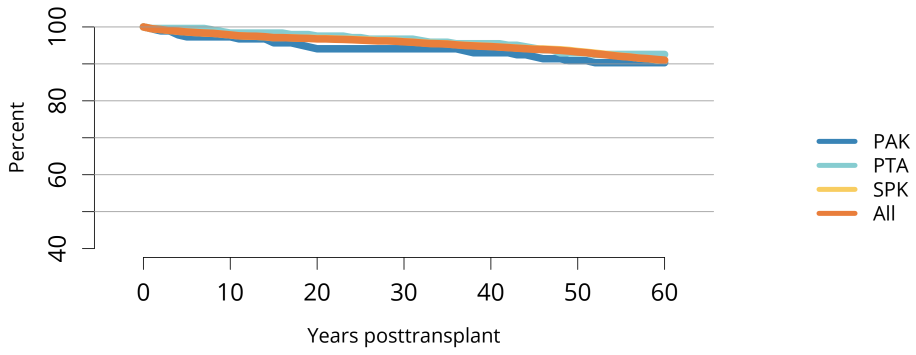

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Figure PA 71: Patient survival among adult deceased donor pancreas transplant recipients, 2016-2018, by transplant type. Patient survival estimated using unadjusted Kaplan-Meier methods. Multivisceral transplants are excluded. PAK, pancreas after kidney; PTA, pancreas transplant alone; SPK, simultaneous pancreas-kidney.

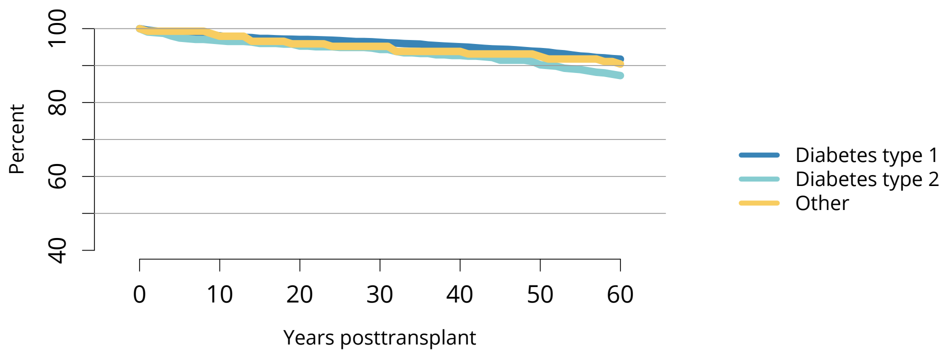

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Figure PA 72: Patient survival among adult deceased donor pancreas transplant recipients, 2016-2018, by diagnosis. Patient survival estimated using unadjusted Kaplan-Meier methods. Multivisceral transplants are excluded.

Table PA 1: Demographic characteristics of adults on the pancreas transplant waiting list on December 31, 2023. Candidates waiting for transplant on December 31, 2023, regardless of first listing date. Distance is computed from candidate's home zip code to the transplant center. PAK, pancreas after kidney; PTA, pancreas transplant alone; SPK, simultaneous pancreas-kidney.

	PAK		PTA		SPK		All	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Age (years)								
18-34 years	22	8.4	92	24.6	444	21.6	558	20.8
35-44	94	36	118	31.6	755	36.8	967	36
45-54	98	37.5	114	30.5	578	28.2	790	29.4
55+	47	18	50	13.4	275	13.4	372	13.8
Sex								
Female	118	45.2	199	53.2	957	46.6	1274	47.4
Male	143	54.8	175	46.8	1095	53.4	1413	52.6
Race and ethnicity								
Asian	11	4.2	10	2.7	115	5.6	136	5.1
Black	63	24.1	63	16.8	624	30.4	750	27.9
Hispanic	51	19.5	50	13.4	366	17.8	467	17.4
Multiracial	1	0.4	2	0.5	27	1.3	30	1.1
Native American	4	1.5	2	0.5	24	1.2	30	1.1
White	131	50.2	246	65.8	894	43.6	1271	47.3
Unreported	0	0	1	0.3	2	0.1	3	0.1
Body mass index								
<18.5	4	1.5	17	4.5	30	1.5	51	1.9
18.5-<25	86	33	137	36.6	668	32.6	891	33.2
25-<30	100	38.3	141	37.7	853	41.6	1094	40.7
30-<35	57	21.8	62	16.6	410	20	529	19.7
35+	14	5.4	17	4.5	91	4.4	122	4.5
Miles between candidate and center								
<50 miles	166	63.6	198	52.9	1263	61.5	1627	60.6
50-<100	46	17.6	48	12.8	359	17.5	453	16.9
100-<150	21	8	27	7.2	170	8.3	218	8.1
150-<250	13	5	33	8.8	145	7.1	191	7.1
250+	14	5.4	65	17.4	94	4.6	173	6.4
Missing	1	0.4	3	0.8	21	1	25	0.9
All candidates								
All candidates	261	100	374	100	2052	100	2687	100

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Table PA 2: Clinical characteristics of adults on the pancreas transplant waiting list on December 31, 2023. Candidates waiting for transplant on December 31, 2023, regardless of first listing date. PAK, pancreas after kidney; PTA, pancreas transplant alone; SPK, simultaneous pancreas-kidney.

	PAK		PTA		SPK		All	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Diagnosis								
Diabetes type 1	186	71.3	269	71.9	1379	67.2	1834	68.3
Diabetes type 2	65	24.9	29	7.8	539	26.3	633	23.6
Other/unknown	10	3.8	76	20.3	134	6.5	220	8.2
Blood type								
A	88	33.7	144	38.5	605	29.5	837	31.1
AB	16	6.1	14	3.7	55	2.7	85	3.2
B	37	14.2	52	13.9	382	18.6	471	17.5
O	120	46	164	43.9	1010	49.2	1294	48.2
All candidates								
All candidates	261	100	374	100	2052	100	2687	100

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Table PA 3: Listing characteristics of adults on the pancreas transplant waiting list on December 31, 2023. Candidates waiting for transplant on December 31, 2023, regardless of first listing date. PAK, pancreas after kidney; PTA, pancreas transplant alone; SPK, simultaneous pancreas-kidney.

	PAK		PTA		SPK		All	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Waiting time								
<90 days	24	9.2	44	11.8	311	15.2	379	14.1
3-<6 months	35	13.4	45	12	300	14.6	380	14.1
6-<12 months	33	12.6	57	15.2	438	21.3	528	19.7
1-<2 years	35	13.4	79	21.1	492	24	606	22.6
2+ years	134	51.3	149	39.8	511	24.9	794	29.5
Previous transplant								
No prior transplant	203	77.8	338	90.4	1963	95.7	2504	93.2
Prior transplant	58	22.2	36	9.6	89	4.3	183	6.8
All candidates								
All candidates	261	100	374	100	2052	100	2687	100

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Table PA 4: Transplant waitlist activity among adults waiting for a pancreas after kidney transplant. Candidates listed at more than one center are counted once per listing. Candidates who are listed, undergo transplant, and are relisted are counted more than once. Candidates are not considered to be on the list on the day they are removed; counts on January 1 may differ from counts on December 31 of the prior year. Candidates listed for multiorgan transplants are included.

Waiting list state	2021	2022	2023
Waiting list state			
Patients at start of year	293	284	259
Patients added during year	106	71	111
Patients removed during year	115	96	109
Patients at end of year	284	259	261

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Table PA 5: Transplant waitlist activity among adults waiting for a pancreas transplant alone. Candidates listed at more than one center are counted once per listing. Candidates who are listed, undergo transplant, and are relisted are counted more than once. Candidates are not considered to be on the list on the day they are removed; counts on January 1 may differ from counts on December 31 of the prior year. Candidates listed for multiorgan transplants are included.

Waiting list state	2021	2022	2023
Waiting list state			
Patients at start of year	362	361	384
Patients added during year	181	180	180
Patients removed during year	182	157	190
Patients at end of year	361	384	374

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Table PA 6: Transplant waitlist activity among adults waiting for a simultaneous pancreas-kidney transplant. Candidates listed at more than one center are counted once per listing. Candidates who are listed, undergo transplant, and are relisted are counted more than once. Candidates are not considered to be on the list on the day they are removed; counts on January 1 may differ from counts on December 31 of the prior year. Candidates listed for multiorgan transplants are included.

Waiting list state	2021	2022	2023
Waiting list state			
Patients at start of year	1720	1854	1964
Patients added during year	1487	1485	1585
Patients removed during year	1352	1375	1497
Patients at end of year	1855	1964	2052

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Table PA 7: Removal reason among adults waiting for pancreas after kidney transplant. Removal reason as reported to the OPTN. Candidates with death dates that precede removal dates are assumed to have died waiting.

Removal reason	2021	2022	2023
Removal reason			
Deceased donor transplant	34	29	25
Patient died	6	3	8
Patient refused transplant	4	3	7
Improved, transplant not needed	2	1	1
Too sick for transplant	11	16	14
Other	54	44	52
Changed to kidney-pancreas list	3	0	2
Still on waiting list	1	0	0

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Table PA 8: Removal reason among adults waiting for pancreas transplant alone. Removal reason as reported to the OPTN. Candidates with death dates that precede removal dates are assumed to have died waiting.

Removal reason	2021	2022	2023
Removal reason			
Deceased donor transplant	86	66	57
Patient died	7	11	7
Patient refused transplant	5	3	8
Improved, transplant not needed	7	2	9
Too sick for transplant	13	18	16
Other	56	49	84
Changed to kidney-pancreas list	8	8	9

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Table PA 9: Removal reason among adults waiting for simultaneous pancreas-kidney transplant. Removal reason as reported to the OPTN. Candidates with death dates that precede removal dates are assumed to have died waiting.

Removal reason	2021	2022	2023
Removal reason			
Deceased donor transplant	858	852	851
Living donor transplant	75	53	86
Transplant outside US	2	1	2
Patient died	100	89	95
Patient refused transplant	6	6	9
Improved, transplant not needed	7	12	14
Too sick for transplant	73	80	112
Other	231	280	328
Still on waiting list	0	2	0

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Table PA 10: Demographic characteristics of adult pancreas transplant recipients, 2023. Pancreas transplant recipients, including retransplant recipients. Distance is computed from recipient's home zip code to the transplant center. PAK, pancreas after kidney; PTA, pancreas transplant alone; SPK, simultaneous pancreas-kidney.

	PAK		PTA		SPK		All	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Recipient age (years)								
18-34 years	6	16.7	11	23.9	178	22	195	21.9
35-49	21	58.3	15	32.6	422	52.1	458	51.3
50-64	9	25	19	41.3	203	25.1	231	25.9
65+	0	0	1	2.2	7	0.9	8	0.9
Sex								
Female	16	44.4	25	54.3	331	40.9	372	41.7
Male	20	55.6	21	45.7	479	59.1	520	58.3
Race and ethnicity								
Asian	2	5.6	2	4.3	40	4.9	44	4.9
Black	8	22.2	3	6.5	282	34.8	293	32.8
Hispanic	1	2.8	3	6.5	162	20	166	18.6
Multiracial	1	2.8	0	0	5	0.6	6	0.7
Native American	0	0	0	0	5	0.6	5	0.6
White	24	66.7	38	82.6	316	39	378	42.4
Body mass index								
<18.5	0	0	4	8.7	18	2.2	22	2.5
18.5-<25	15	41.7	19	41.3	326	40.2	360	40.4
25-<30	13	36.1	19	41.3	320	39.5	352	39.5
30-<35	7	19.4	4	8.7	121	14.9	132	14.8
35+	0	0	0	0	13	1.6	13	1.5
Missing	1	2.8	0	0	12	1.5	13	1.5
Insurance								
Private	15	41.7	37	80.4	299	36.9	351	39.3
Medicare	15	41.7	4	8.7	382	47.2	401	45
Medicaid	4	11.1	4	8.7	108	13.3	116	13
Other/unknown	2	5.6	1	2.2	21	2.6	24	2.7
Miles between recipient and center								
<50 miles	20	55.6	20	43.5	490	60.5	530	59.4
50-<100	5	13.9	6	13	144	17.8	155	17.4
100-<150	7	19.4	4	8.7	75	9.3	86	9.6
150-<250	1	2.8	5	10.9	46	5.7	52	5.8
250+	1	2.8	10	21.7	39	4.8	50	5.6
Missing	2	5.6	1	2.2	16	2	19	2.1
All recipients								
All recipients	36	100	46	100	810	100	892	100

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Table PA 11: Clinical characteristics of adult pancreas transplant recipients, 2023. Pancreas transplant recipients, including retransplant recipients. PAK, pancreas after kidney; PTA, pancreas transplant alone; SPK, simultaneous pancreas-kidney.

	PAK		PTA		SPK		All	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Diagnosis								
Diabetes type 1	30	83.3	22	47.8	553	68.3	605	67.8
Diabetes type 2	5	13.9	1	2.2	226	27.9	232	26
Other/unknown	1	2.8	23	50	31	3.8	55	6.2
Blood type								
A	12	33.3	18	39.1	262	32.3	292	32.7
AB	3	8.3	4	8.7	41	5.1	48	5.4
B	3	8.3	7	15.2	99	12.2	109	12.2
O	18	50	17	37	408	50.4	443	49.7
All recipients								
All recipients	36	100	46	100	810	100	892	100

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Table PA 12: Transplant characteristics of adult pancreas transplant recipients, 2023. Pancreas transplant recipients, including retransplant recipients. PAK, pancreas after kidney; PTA, pancreas transplant alone; SPK, simultaneous pancreas-kidney.

	PAK		PTA		SPK		All	
Characteristic	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**
Waiting time								
1-<90 days	2	5.6	12	26.1	297	36.7	311	34.9
3-<6 months	3	8.3	4	8.7	118	14.6	125	14
6-<12 months	5	13.9	14	30.4	149	18.4	168	18.8
1-<2 years	8	22.2	7	15.2	131	16.2	146	16.4
2+ years	18	50	9	19.6	115	14.2	142	15.9
Previous transplant for recipients								
No prior transplant	29	80.6	44	95.7	800	98.8	873	97.9
Prior transplant	7	19.4	2	4.3	10	1.2	19	2.1
All recipients								
All recipients	36	100	46	100	810	100	892	100

OPTN/SRTR 2023 Annual Data Report

OPTN/SRTR 2023 Annual Data Report: Liver

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Abstract

The number of liver transplants performed in 2023 in the United States reached another record high, totaling 10,659 overall, of which 10,125 (95.0%) were in adult recipients and 534 (5.0%) were in pediatric recipients. This growth was driven by increased recovery of livers from older donors and donation after circulatory death (DCD) donors—likely related to the wider availability of machine perfusion technologies. The overall nonuse rate, or percent of livers recovered for transplant and not transplanted, was 9.7%, a decrease from the preceding years, and 16.7% of transplant recipients accepted DCD livers. There was also growth in living donation, representing 5.7% of adult transplants and 14.6% of pediatric transplants. In July 2023, the model for end-stage liver disease (MELD) 3.0 and pediatric end-stage liver disease (PELD)–creatinine scoring systems were updated from MELD-sodium and PELD, respectively, and criteria for status 1B qualification for pediatric candidates were updated. A major goal of MELD 3.0 was to address the sex

disparity in deceased donor transplant rates. In 2023, the gap in deceased donor liver transplant rates between sexes narrowed, although the rate remained higher for adult male candidates compared with female candidates, and pretransplant mortality rates were higher among adult female candidates compared with male candidates. Alcohol-associated liver disease and metabolic dysfunction–associated steatohepatitis remained the leading indications for liver transplant.
Keywords: Liver transplantation, liver donation, outcomes, waiting list

1 Introduction

As we survey the totality of the 2023 liver transplant data, we observe macro trends that may reflect the impact of recent developments in liver transplantation on pretransplant and posttransplant outcomes. Before we delve into detailed data in the body of the report, we would like to highlight three areas that may be noteworthy.

First, since the first approval by the US Food and Drug Administration in 2021, machine perfusion devices have had substantial impact on the practice and outcome of liver transplantation. Compared with the traditional cold storage method, the technology enhances organ viability, reduces the risk of ischemic injury, and allows real-time functional assessment of the graft. Its largest impact has been seen in donation after circulatory death (DCD) graft, leading to a substantial expansion of donor pools. In this year's report, we note that removals from the waiting list for transplant among adult liver transplant candidates in the United States outpaced the number of new registrations, leaving fewer patients remaining on the list at the end of 2023. Waiting times are shorter, and there are more recipients with model for end-stage liver disease (MELD) scores of 14 or lower at the time of transplant and fewer in the higher MELD categories. The data indicate that this is not because of reduced waitlist registration, as the number of patients newly added to the list actually increased.

Second, the MELD score has been used to prioritize patients on the liver transplant waiting list since 2002. The latest version of the score, MELD 3.0, incorporates new variables including female sex and serum albumin and updates the coefficients for serum creatinine, international normalized ratio, bilirubin, and sodium. Although the pretransplant mortality rate for liver transplant candidates decreased with MELD-based organ allocation, women had experienced lower transplant rates and higher waitlist mortality. MELD 3.0 was adopted for policy implementation in July 2023. In this report, concurrent with implementation of MELD 3.0, we begin to see that the disparity in transplant rates between sexes has decreased, foretelling an encouraging impact of the new system.

The third trend, seen on a longer time scale compared with the other two, is simultaneous liver-kidney (SLK) transplant. As recognized by the inclusion of serum creatinine in the MELD score, renal dysfunction represents a vitally important extrahepatic manifestation of end-stage liver disease. In addition to having a significant impact on pretransplant mortality, renal impairment at the time of transplant also affects posttransplant outcomes, which justifies SLK in some of the liver transplant recipients. To achieve equitable use of renal allografts between kidney and liver transplant candidates, standardized medical criteria for SLK transplant were established in 2017. At the same time, a “safety net” mechanism was put in place, so that a kidney graft would be preferentially allocated in the event the renal function does not recover soon after liver transplant. In this 2023 data report, the proportion of adult SLK transplants of total liver transplants has decreased, and the number of new kidney registrations and the number of kidney transplants in adults with a previous history of liver transplant have increased since implementation of the safety net policy in 2017. The net effect may be the more judicious use of kidney allografts in patients with end-stage liver disease and improved organ utility.

2 Adult Liver Transplant

2.1 Waiting List

In 2023, there were a total of 24,492 adult liver candidates ever waiting in the United States, with a record 13,954 candidates newly added to the waiting list, an 8.5% increase over the previous year (Figure LI 1 and Figure LI 2). By the end of the year, 14,747 were removed from the list—64.5% for deceased donor liver transplant, 3.9% for living donor liver transplant, 6.4% for death, 6.6% for being too sick, 7.5% for improved condition, and 11.1% for other reasons—and 9,745 were left waiting (Table LI 4 and Table LI 5), a 7.5% decrease from the end of 2022. Compared with previous years, a greater proportion of patients were removed for transplant, and a smaller proportion were removed for death or being too sick for transplant.

Overall, adult candidates in 2023 were younger than in previous years: 6.3% were aged 18-34 years, 20.1% aged 35-49 years, 46.7% aged 50-64 years, and 26.9% aged 65 years or older (Figure LI 3). In terms of sex distribution, female candidates made up an increasing proportion of the waiting list, although still there were more male than female candidates being listed (60.6% and 39.4%, respectively) (Figure LI 4). The racial and ethnic composition was relatively unchanged: 67.8% White, 19.0% Hispanic, 6.5% Black, 4.5% Asian, 1.2% Native American, 0.6%

Multiracial, and 0.3% unreported (Figure LI 5).

The most common primary diagnosis among adult waitlist candidates was alcohol-associated liver disease, with 34.9% categorized as alcohol-associated cirrhosis and 4.1% as alcohol-associated hepatitis—increases from 22.8% and 0.1% in 2013, respectively (Figure LI 6). In August 2022, the diagnosis for "alcoholic cirrhosis" was updated to "alcohol-associated cirrhosis without acute alcohol-associated hepatitis," and the diagnosis of "alcoholic hepatitis" was updated to "acute alcohol-associated hepatitis with or without cirrhosis." Accordingly, the prevalence of waitlisting for alcohol-associated hepatitis increased from 1.7% in 2021, to 2.1% in 2022, to the 4.1% in 2023, likely related to not only practice changes but also the updated nomenclature. In 2023, 20.4% of registrations had metabolic dysfunction–associated steatohepatitis (MASH) as the primary indication for waitlisting, an increase from 9.6% in 2013. Other specified diagnoses were less common, including hepatocellular carcinoma (HCC) (10.3%), cholestatic liver disease (7.2%), hepatitis C (6.2%), and acute liver failure (1.6%).

Most adult liver transplant candidates in 2023 were overweight by body mass index (BMI); there were 1.6% with BMI of <18.5 kg/m^2, 23.0% with BMI of 18.5-<25 kg/m^2, 33.8% with BMI of 25-<30 kg/m^2, 23.7% with BMI of 30-<35 kg/m^2, and 17.3% with BMI of 35 kg/m^2 or greater (Figure LI 8). The most common blood type was O (48.4%), followed by type A (38.0%), type B (10.6%), and type AB (3.1%) (Figure LI 9), mirroring the distribution of the general US population. Similar to previous years, 3.2% of candidates had a history of prior transplant (Figure LI 10).

2.2 Waitlist Outcomes

The overall deceased donor liver transplant rate for adults increased to 94.7 transplants per 100 patient-years in 2023, from 36.1 transplants per 100 patient-years in 2013 (Figure LI 11). This increase occurred across all age and racial and ethnic groups (Figure LI 12 and Figure LI 13). Candidates aged 18-34 years and 35-49 years continued to have higher deceased donor transplant rates than older candidates. White and Black candidates had higher deceased donor transplant rates than Asian or Hispanic candidates. The deceased donor liver transplant rate for patients with blood type AB (254.6 transplants per 100 patient-years) was nearly twice more than that for patients with blood type B and three times more than that for patients with blood types A or O (Figure LI 14).

Deceased donor transplant rates for adult candidates with and without HCC exception points have been similar since 2020, after many years of greater transplant access for patients with HCC and a series of policy changes lengthening their waiting time and decreasing their waitlist priority (Figure LI 15).

In July 2023, MELD 3.0 replaced MELD-sodium (MELD-Na) to represent medical urgency in the liver transplant waiting list, which was intended to address, in part, the sex disparity in deceased donor transplant rates. In 2023, with the second half of the year reflecting the policy change, the gap in adult deceased donor liver transplant rates between sexes had already started to narrow, although the rate was still higher for male candidates compared with female candidates (96.9 versus 91.4 transplants per 100 patient-years) (Figure LI 16).

Among adult candidates newly listed in 2018-2020, only 7.0% remained on the waiting list after 3 years, 58.3% received a deceased donor liver transplant, 3.3% received a living donor liver transplant, 8.6% died, and 22.8% were removed from the list for other reasons (Figure LI 17). Of candidates listed in 2022, 41.7% underwent deceased donor liver transplant within 3 months; 48.4%, within 6 months; and 58.2%, within 1 year—all increases compared with previous years (Figure LI 18). The 1-year probability of deceased donor liver transplant increased to 58.2% from 40.6% 10 years prior.

The pretransplant mortality rate among adult waitlist candidates has decreased from 16.9 to 12.9 deaths per 100 patient-years over the past decade and has been overall stable in the past several years (Figure LI 19). In 2023, female candidates still had higher pretransplant mortality rates compared with male candidates (13.9 versus 12.2 deaths per 100 patient-years); MELD 3.0 was in effect for only the latter half of the year, and height- or body size–based disparities may still have contributed (Figure LI 22). By etiology, higher pretransplant mortality rates were observed among those with alcohol-associated hepatitis (29.4 deaths per 100 patient-years), acute liver failure (21.5 deaths per 100 patient-years), and MASH (16.5 deaths per 100 patient-years) (Figure LI 23). Despite the noted allocation policy changes that have lengthened waiting time and lowered waitlist priority for patients with HCC exception points, pretransplant mortality rates remained lower for patients with an HCC exception compared to those without (11.2 versus 13.1 deaths per 100 patient-years) (Figure LI 25). Pretransplant mortality rates still varied widely across the 51 active donation service areas, with a median of 13.1 deaths per 100 patient-years (interquartile range, 10.2-17.2) and ranging from 3.9 to 39.7 deaths per 100 patient-years (Figure LI 26).

Among adults removed from the liver transplant waiting list for reasons other than transplant or death, 14.3% died within 6 months after removal (Figure LI 27). The risk of death within 6 months after removal was higher among those with MELD scores greater than 25 and patients aged 65 years or older (Figure LI 28 and Figure LI 29).

2.3 Transplants

In 2023, there were 10,125 adult liver transplant recipients, another all-time high, representing a 71% increase in the past decade (Figure LI 33). Both deceased and living donation increased, with 9,545 deceased donor and 580 living donor liver transplants performed (Figure LI 34).

Alcohol-associated liver disease continued to be the most common indication for adult liver transplant, with 41.1% of recipients having a primary diagnosis of alcohol-associated liver disease (34.6% alcohol-associated cirrhosis and 6.5% alcohol-associated hepatitis), followed by MASH at 20.3%. Other specified etiologies included HCC (10.4%), hepatitis C virus (HCV) (4.2%), cholestatic liver disease (7.4%), and acute liver failure (2.0%) (Figure LI 38 and Table LI 7). Only 14.6% of patients underwent transplant with HCC MELD exception points, a decrease from 26.4% in 2013. By urgency status, 2.1% underwent transplant as status 1A, 9.7% with an allocation MELD score of 40 or greater, 10.8% with a MELD of 35-39, 26.8% with a MELD of 25-34, 30.9% with a MELD of 15-24, and 19.5% with a MELD of 14 or lower. Compared with 2013, there were more recipients in the lowest urgency category (MELD 14 or lower) and fewer in the higher urgency categories (MELD 25 or higher). Waiting times were also shorter: 63.8% of transplant recipients waited less than 90 days, 10.8% waited 3-<6 months, 13.6% waited 6-<12 months, 7.2% waited 1-<2 years, and 4.5% waited 2 years or longer (Table LI 8).

The proportion of female adult liver transplant recipients has increased: 38.8% in 2023 compared with 34.1% in 2013 (Figure LI 36). In 2023, 69.8% of liver transplant recipients were White, 17.5% Hispanic, 6.6% Black, 4.1% Asian, 0.6% Multiracial, and 0.4% unreported (Figure LI 37). With the decline in hepatitis C and the rise in alcohol-associated liver disease and MASH, the age composition of the waiting list has also shifted, with a higher proportion of recipients aged 35-49 years (23.3% in 2023 versus 16.5% in 2013) and 65 years or older (22.4% versus 16.3%), and fewer aged 50-64 years (46.8% versus 61.6%) (Table LI 6). There were more recipients in the highest BMI categories: BMI of 35 kg/m^2 or greater, 15.5% in 2023 versus 13.0% in 2013; BMI of 30-<35 kg/m^2, 22.4% in 2023 versus 21.5% in 2013. Only 3.4% of recipients had a history of previous transplant in 2023, compared with 5.0% in 2013 (Figure LI 40 and Table LI 8).

Most adult liver transplants were covered by private insurance (50.9%), followed by Medicare (26.0%) and Medicaid (19.0%). Based on the rural-urban commuting area designation of their home zip code, 82.8% of recipients lived in metropolitan areas; 56.7% lived less than 50 miles from the transplant center, 17.6% within 50-<100 miles, 9.2% within 100-<150 miles, 7.8% within 150-<250 miles, and 7.9% 250 miles or farther (Table LI 6).

Recipients of livers procured from DCD made up 16.7% of adult liver transplants in 2023, a marked increase from preceding years (11.3% in 2022 and 5.2% in 2013), likely related to the wider availability of machine perfusion technologies (Figure LI 39). Only 91 adults received split deceased donor livers (0.9% of adult transplants in 2023 versus 1.2% in 2013) (Table LI 8).

In 2023, there were 804 adult recipients of SLK transplants, representing 7.9% of total liver transplants, a decrease from 9.6% in 2017 when standardized medical eligibility criteria were introduced (Figure LI 41). By far, patients who received SLK transplant were listed via the chronic kidney disease criteria (89.7%) rather than acute kidney injury (9.5%) or metabolic disease (0.2%) criteria (Figure LI 42).

Regarding immunosuppression, induction therapy was used in 30.3% of adult liver transplants, most often with interleukin-2 receptor antibody alone (24.6%) rather than T-cell–depleting agent alone (5.6%) (Figure LI 46 and Figure LI 47). Most liver transplant recipients were maintained on a combination of tacrolimus, a mycophenolate agent, and steroids (66.6%); the remainder used tacrolimus and mycophenolate (18.7%), tacrolimus and steroids (4.4%), or another regimen (10.3%) (Figure LI 48).

2.4 Outcomes

Graft failure was reported in 6.3% at 6 months and 7.9% at 1 year for adult deceased donor liver transplant recipients in 2022, 15.8% at 3 years for those who received transplant in 2020, 20.7% at 5 years for those who received transplant in 2018, and 36.7% at 10 years for those who received transplant in 2013 (Figure LI 49). Overall patient outcomes followed a similar pattern, with mortality of 5.0% at 6 months, 6.5% at 1 year, 14.0% at 3 years, 19.0% at 5 years, and 34.6% at 10 years (Figure LI 51). Over the past decade, 1-year graft failure and patient mortality have decreased; these values were 7.9% and 6.5%, respectively, for patients who underwent transplant in 2022, compared with 11.6% and 10.0%, respectively, for patients who underwent transplant in 2012.

Among adult recipients of deceased donor liver transplant in 2016-2018, 5-year graft survival was 75.0% among those aged 65 years or older, 79.3% for those aged 50-64 years, 82.2% for those aged 35-49 years, and 80.8% for those aged 18-34 years. Patient survival followed a similar pattern (Figure LI 52 and Figure LI 68). Lower graft and patient survival were observed in Black or Other race compared with White, Hispanic, or Asian recipients (Figure LI 53 and Figure LI 69); in male recipients compared with female recipients (Figure LI 54 and Figure LI 70); in those with HCC and MASH diagnoses compared with other etiologies (Figure LI 55 and Figure LI 71); and in those with MELD scores of 40 or greater compared with other MELD categories (39 or lower) (Figure LI 56 and Figure LI 72). In all of these groups, however, 5-year graft survival still exceeded 74.1% and patient survival exceeded 75.1%. The 5-year graft survival rate for DCD livers was 75.6%, compared with 79.2% for recipients of donation after brain death (DBD) livers (Figure LI 57). Liver transplant recipients with HCC MELD exception had a 5-year graft survival rate of 77.6% compared with 79.3% in those without (Figure LI 58).

Graft outcomes among adult living donor liver transplant recipients were: 5.8% graft failure at 6 months, 6.6% at 1 year, 13.6% at 3 years, 21.2% at 5 years, and 40.8% at 10 years (Figure LI 50). The 5-year graft survival among living donor liver transplant recipients was highest for cholestatic liver disease (85.8%) and MASH (83.9%) compared with other etiologies (Figure LI 63). Older recipients (aged 65 years or older) had worse outcomes, with 5-year patient survival of 76.6%, compared with 82.5%, 88.4%, and 94.2% for ages 50-64 years, 35-49 years, and 18-34 years, respectively (Figure LI 73).

Among liver recipients who underwent transplant in 2022, the incidence of reported acute rejection by 1-year posttransplant was higher among younger adult patients (20.2% for age 18-34 years) and lower among older patients (7.9% for age 65 years or older) (Figure LI 65). Among adult liver transplant recipients in 2012-2018, the 5-year incidence of reported posttransplant lymphoproliferative disorder was 1.0% in those with positive Epstein-Barr virus (EBV) status at transplant and 2.0% in those with negative EBV status at transplant (Figure LI 67).

In 2023, there were 734 new adult registrations for kidney transplant with a previous history of liver transplant (Figure LI 43). The most common primary diagnosis for kidney transplant waitlisting among liver transplant recipients was hepatorenal syndrome (31.1%), followed by Other/unknown (20.2%), diabetes (17.7%), and calcineurin nephrotoxicity (16.6%) (Figure LI 44). Hepatorenal syndrome as the primary diagnosis for kidney transplant increased notably after implementation of the SLK eligibility criteria, as did safety net listings (i.e., waitlisting 60-<365 days after liver transplant), which accounted for 327 (44.6%) new registrations (Figure LI 43). There were 418 kidney transplants in recipients with a previous history of liver transplant, which increased from 274 since implementation of the safety net policy in 2017 (Figure LI 45).

3 Donation

In 2023, there were 10,967 deceased donors whose livers were recovered for transplant in the United States, another record high (Figure LI 77). This was driven by an increase in older donors (40 years or older), whereas the number of younger donors (pediatric [younger than 18 years] and adults aged 18-29 years) remained relatively stable (Figure LI 78). Only 5.8% of donors were younger than 18 years, 17.1% were aged 18-29 years, 20.3% were aged 30-39 years, 29.5% were aged 40-54 years, and 27.3% were aged 55 years or older (Figure LI 80). The sex distribution of donors was similar to that in previous years at 61.3% male and 38.7% female (Figure LI 81), as were racial and ethnic categories: 62.3% White, 18.3% Black, 14.9% Hispanic, 3.0% Asian, and 1.5% Other (Figure LI 82). Although the absolute number of HCV-positive donors by antibody testing increased, the overall proportion decreased, representing 8.8% of deceased liver donors in 2023 (Figure LI 79); by both antibody and nucleic acid test (NAT), 91.1% of donor livers were HCV negative (Ab-/NAT-), 4.7% were HCV positive with Ab+ and NAT-, and 4.1% were HCV positive with NAT+ (Figure LI 83). The most common cause of death among liver donors remained anoxia (49.0%), followed by cerebrovascular accident/stroke (24.4%), head trauma (23.8%), and Other/unknown (2.7%) (Figure LI 86).

In recent years, the proportion of DCD livers recovered for transplant has increased markedly, representing 20.1% of deceased donor livers in 2023, an increase from 14.1% in 2022, 9.0% in 2018, and 6.3% in 2013 (Figure LI 84); this increase reflects the promise of machine perfusion technologies to reduce the risk of ischemic injury and improve organ viability. There are also more donor livers undergoing liver biopsy (46.9%): 37.1% reported <11% macrovesicular steatosis, 7.0% had 11%-<31%, and 2.8% had 31% or greater (Figure LI 85).

The overall nonuse rate, or percent of livers recovered for transplant and not transplanted, was 9.7% in 2023, a slight decrease from the preceding years (Figure LI 87). Livers from older donors were less likely to be used (12.4% for donors aged 55 years or older versus 3.2% for donors younger than 18 years) (Figure LI 88). Livers from HCV NAT+ donors were more likely to be recovered and not transplanted (14.6%), while livers from HCV Ab+/NAT- donors were used at similar rates as those from HCV Ab-/NAT- donors (9.2% and 9.5%, respectively) (Figure LI 92). Livers with risk factors present by US Public Health Service criteria were not less likely to be used than those without this designation (Figure LI 93). DCD livers remained over three times more likely than DBD livers to be unused in 2023, although the nonuse rate for both DCD and DBD livers has decreased compared with years prior (22.8% in 2023 versus 30.0% in 2019 for DCD; 6.5% in 2023 versus 7.1% in 2019 for DBD) (Figure LI 94). Livers with macrovesicular steatosis were also more likely to be unused (48.7% for livers with 31% fat or greater, 18.2% for livers with 11%-<31% fat, and 10.1% for livers with <11% fat versus 6.4% for livers without liver biopsy values reported) (Figure LI 95).

There were 659 living donors in 2023, an all-time high—driven by an increase in directed (26.3%) or Other donor-relation donors (15.2%), while the number of donor livers from related persons or spouses/partners remained stable (Figure LI 96). A small but growing number of living donor liver transplants (49 [7.5%]) were performed as a paired donation. Living donors were somewhat older than in previous years, with 7.3% aged 55 years or older, 35.8% aged 40-54 years, 36.7% aged 30-39 years, 20.0% aged 18-29 years, and 0.2% younger than 18 years (Figure LI 97). Living donors were more likely to be female than male (59.2% versus 40.8%) and more likely to be White than all other races and ethnicities combined (76.8% versus 23.2%) (Figure LI 98 and Figure LI 99).

Living donors most often donated the right lobe (80.7%), an increasing trend; 1.1% of living liver donations were recorded as whole domino (Figure LI 100).

4 Pediatric Liver Transplant

4.1 Waiting List

In 2023, there were 1,142 pediatric liver candidates listed at any time during the year in the United States, with 438 on the list at the start of the year and 704 candidates newly added (Figure LI 102, Figure LI 103, and Table LI 12). Over the course of the year, 738 patients were removed (63.7% for deceased donor liver transplant, 10.7% for living donor liver transplant, 3.7% for death, 1.8% for being too sick, 13.0% for improved condition, and 7.2% for a reason of Other), leaving 404 candidates still waiting, an 8% decrease from 2022 (Table LI 12 and Table LI 13).

Among pediatric candidates, the largest age category was 1-5 years (35.3%), followed by 12-17 years (21.3%) and younger than 1 year (18.4%) (Figure LI 104). Compared with 10 years ago, there were more liver transplant candidates in the younger age groups and fewer adolescents (12 years or older). In terms of race and ethnicity, most candidates were White (45.9%), followed by Hispanic (24.8%), Black (17.5%), Asian (6.0%), Multiracial (4.1%), Native American (1.1%), and unreported (0.7%) (Figure LI 105).

Among pediatric candidates who had been listed in 2018-2020, 66.9% received deceased donor liver transplant, 9.8% received living donor liver transplant, 3.2% died, 16.0% were removed from the list, and 4.1% were still waiting (Figure LI 107).

Overall deceased donor liver transplant rates for pediatric candidates remained stable in 2023 at 110.9 transplants per 100 patient-years, which had increased slightly after the allocation policy change in 2020 that prioritized pediatric donors for pediatric recipients (Figure LI 108). Deceased donor liver transplant rates were higher for age younger than 1 year compared with other pediatric age categories (Figure LI 109) and for the White, Black, and Other racial and ethnic categories compared with the Hispanic and Asian categories (Figure LI 110).

The overall pretransplant mortality rate for pediatric candidates in 2023 was 6.7 deaths per 100 patient-years, which has increased from a nadir of 4.9 deaths per 100 patients-years in 2020 (Figure LI 111). Despite the higher deceased donor liver transplant rate, the highest pretransplant mortality was still among the age category of younger than 1 year (18.6 deaths per 100 patient-years; Figure LI 112) and among the Black and Other racial and ethnic categories compared with Hispanic, White, and Asian (Figure LI 113).

4.2 Transplants

In 2023, there were 534 pediatric liver transplants, including retransplant and multiorgan recipients, a relatively stable number compared with previous years (Figure LI 114). The proportion of living donation has increased, to 14.6% in 2023 from 7.7% in 2013 (Figure LI 115).

Among all pediatric liver transplant recipients, 24.9% were aged younger than 1 year, 37.6% were aged 1-5 years, 16.9% were aged 6-11 years, and 20.6% were aged 12-17 years (Figure LI 116 and Table LI 14). The most common diagnosis among these liver transplant recipients was biliary atresia (37.5%), followed by Other/unknown etiologies (24.3%), metabolic disease (14.8%), hepatoblastoma (8.1%), acute liver failure (8.1%), and other cholestatic disease (7.3%) (Table LI 15). Similar to adult liver transplant, the proportion of pediatric recipients with a history of prior transplant decreased: 4.5% in 2023 compared with 8.8% in 2013 (Table LI 16).

In terms of medical urgency, 9.7% of pediatric liver transplant recipients underwent transplant as status 1A; 22.3%, as status 1B; 1.7%, with MELD or PELD score of 40 or greater; 1.1%, with MELD/PELD of 35-39; 6.7%, with MELD/PELD of 25-34; 16.9%, with MELD/PELD of 15-24; and 41.2%, with MELD/PELD of 14 or lower (Table LI 15). In July 2023, criteria for status 1B qualification were updated, along with PELD updating to PELD-creatinine, but this has not yet resulted in any detectable changes in the medical urgency status. Among pediatric liver transplant recipients in 2023, 65.4% had waited fewer than 90 days, 16.7% waited for 3-<6 months, 10.5% waited for 6-<12 months, 5.1% waited for 1-<2 years, and 2.4% waited for 2 or more years (Table LI 16). Overall, waiting times were shorter than in 2013. The proportion of ABO-incompatible pediatric transplants increased: 4.3% in 2023 compared with 3.6% in 2013. No pediatric patients received a liver from a DCD donor in 2023. Most received whole liver (58.4%), followed by partial liver (21.7%) and split liver (19.9%), which represents a modest increase in split liver acceptance since 2021 (Figure LI 117).

The most common insurance among pediatric liver transplant recipients in 2023 was Medicaid (50.7%), followed by private insurance (37.8%). Based on the recipient's reported zip code, 82.5% lived in metropolitan areas; 45.1% lived less than 50 miles from the transplant center, 16.7% within 50-<100 miles, 12.2% within 100-<150 miles, 11.4% within 150-<250 miles, and 12.9% were 250 miles or farther (Table LI 14).

Induction agent use was reported in 40.4% of pediatric liver transplant recipients in 2023 (Figure LI 118), more commonly interleukin-2 receptor antibody than T-cell depleting agent (Figure LI 119). The most common immunosuppression regimens were combination tacrolimus, mycophenolate, and steroids (39.0%) or combination tacrolimus and steroids (36.9%) (Figure LI 120).

4.3 Outcomes

Short-term graft failure rates among pediatric deceased donor liver transplant recipients increased in 2022 (9.1% at 6 months and 10.7% at 1 year) compared with previous years (Figure LI 121). Longer-term graft failure rates were similar: 10.6% at 3 years for transplants in 2020, 12.2% at 5 years for transplants in 2018, and 23.1% at 10 years for transplants in 2013. Mirroring the graft outcomes, short-term patient mortality worsened (7.6% at 6 months, 8.9% at 1 year, and 9.8% at 3 years) compared with previous years (Figure LI 129). Longer-term outcomes were stable or improved, with a patient mortality rate of 7.6% at 5 years for transplants in 2018 and 13.9% at 10 years for transplants in 2013.

Among pediatric deceased donor liver transplant recipients in 2016-2018, overall 5-year graft survival was 86.3% and patient survival was 90.3% (Figure LI 126, Figure LI 130, and Figure LI 133). Five-year graft survival was highest among those with metabolic disease (95.5%), biliary atresia (90.9%), or other cholestatic disease (87.6%) and was lowest among those with a diagnosis of hepatoblastoma (78.8%) or Other/unknown etiology (75.0%) (Figure LI 124).

Outcomes among pediatric living donor liver transplant recipients were superior to those among deceased donor recipients, with graft failure rates of 5.7% at 6 months, 5.7% at 1 year, 7.6% at 3 years, 9.7% at 5 years, and 17.1% at 10 years (Figure LI 122); overall 5-year patient survival was 94.9% (Figure LI 126 and Figure LI 133).

The incidence of acute rejection by 1-year posttransplant for pediatric liver transplant recipients was 19.3% for those younger than 1 year, 25.9% for ages 1-5 years, 22.9% for ages 6-11 years, and

15.6% for ages 12-17 years (Figure LI 127), rates that are higher than those observed in adult recipients. The overall 5-year incidence of posttransplant lymphoproliferative disorder for pediatric recipients who underwent transplant in 2012-2018 was 4.4%: 5.2% among those with EBV-negative status and 3.1% among those with EBV-positive status at the time of transplant (Figure LI 128).

Support, Copyright, and Citation Information

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This report is available at https://srtr.transplant.hrsa.gov/annualdatareports. Individual chapters may be downloaded.

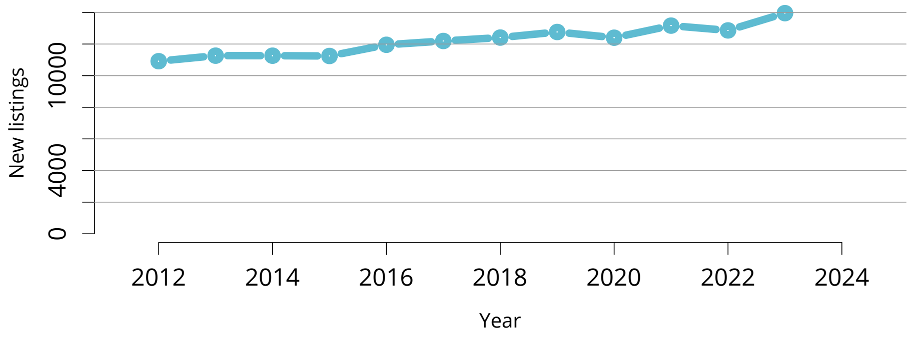

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Figure LI 1: New adult candidates added to the liver transplant waiting list. A new candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and subsequently relisted are considered new. Active and inactive patients are included.

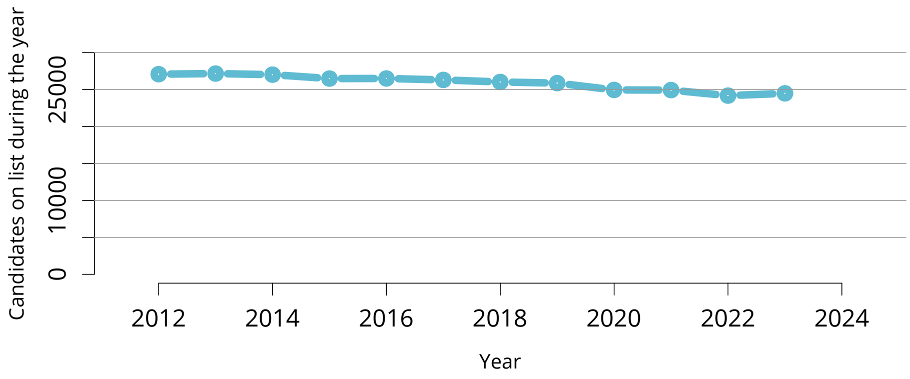

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Figure LI 2: All adult candidates on the liver transplant waiting list. Adult candidates on the list at any time during the year. Candidates listed at more than one center are counted once per listing.

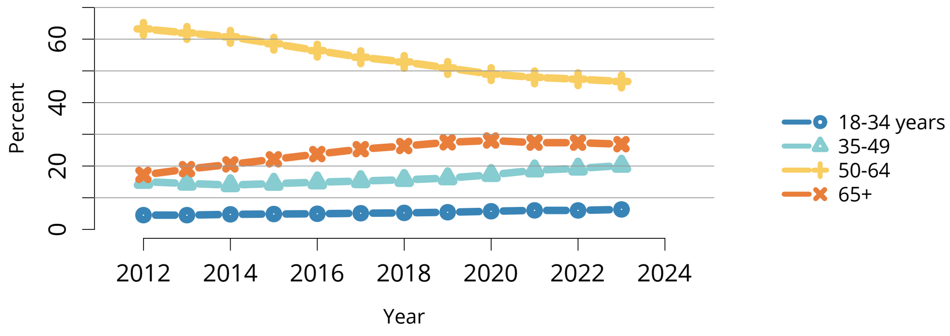

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Figure LI 3: Distribution of adults waiting for liver transplant by age. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included. Age is determined at the earliest of transplant, death, removal, or December 31 of the year.

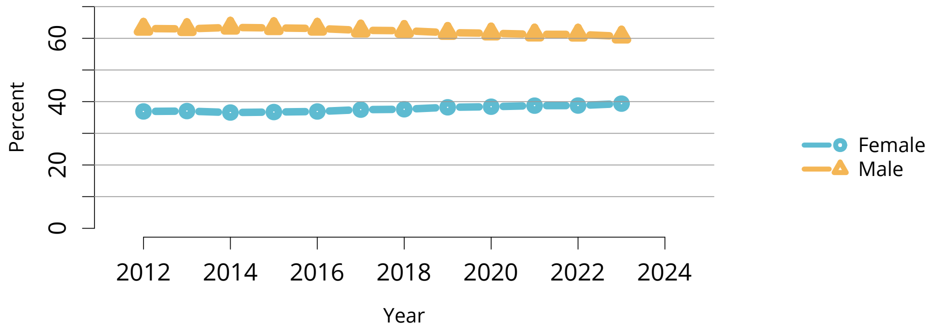

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Figure LI 4: Distribution of adults waiting for liver transplant by sex. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

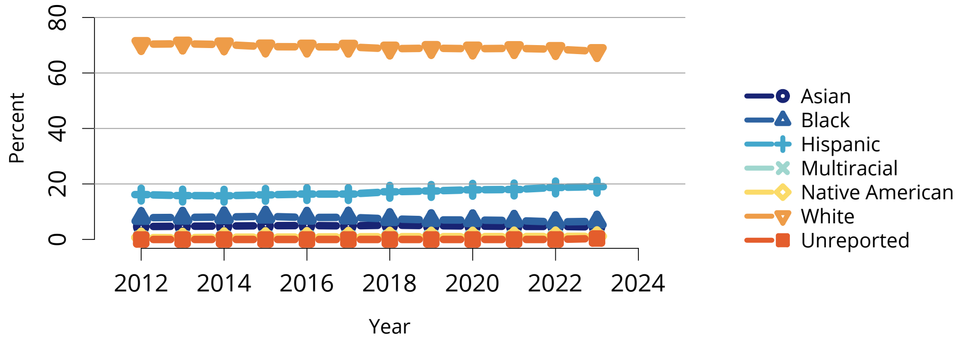

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Figure LI 5: Distribution of adults waiting for liver transplant by race and ethnicity. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

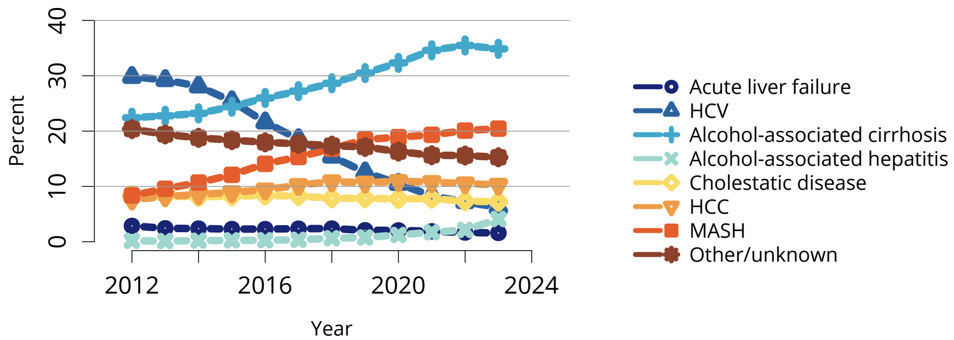

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Figure LI 6: Distribution of adults waiting for liver transplant by diagnosis. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included. HCC, hepatocellular carcinoma; HCV, hepatitis C virus; MASH, metabolic dysfunction–associated steatohepatitis.

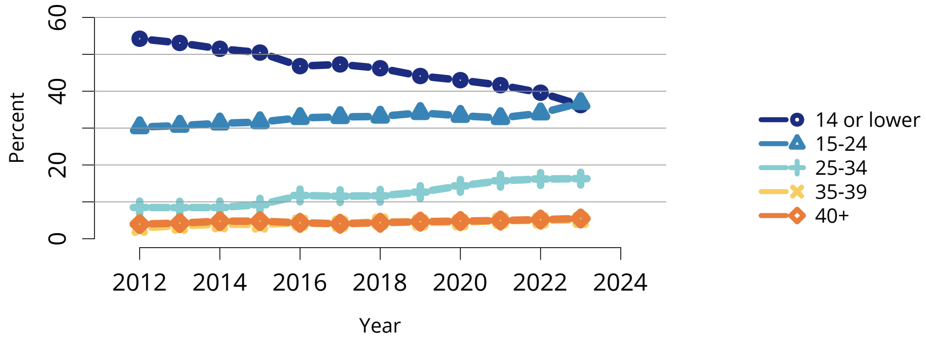

Figure LI 7: Distribution of adults waiting for liver transplant by last laboratory MELD score in the year. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included. MELD, model for end-stage liver disease.

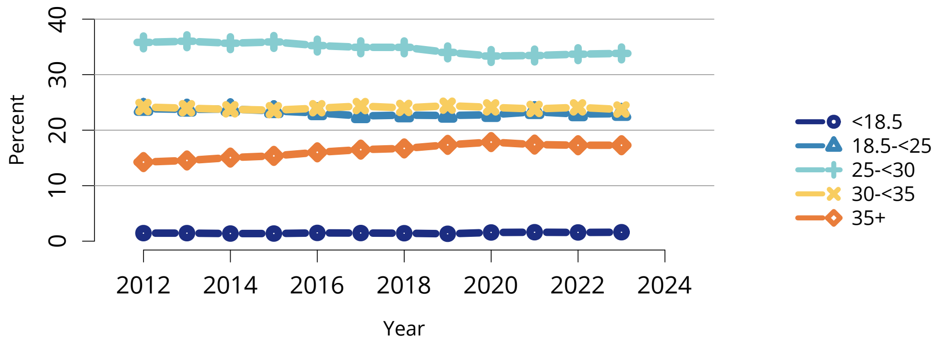

Figure LI 8: Distribution of adults waiting for liver transplant by BMI. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included. BMI, body mass index.

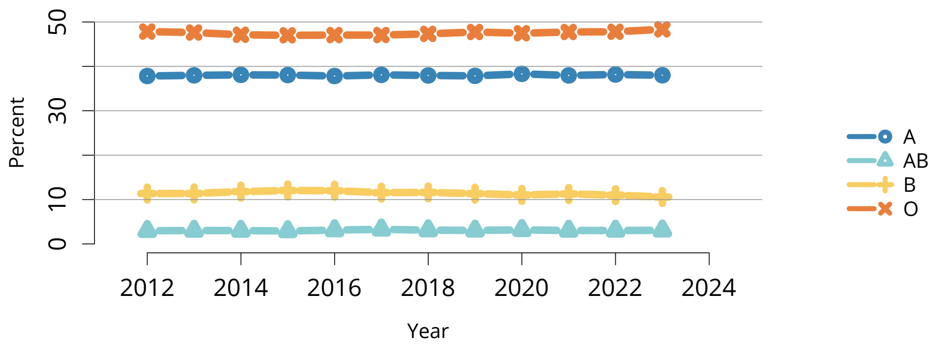

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Figure LI 9: Distribution of adults waiting for liver transplant by blood type. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

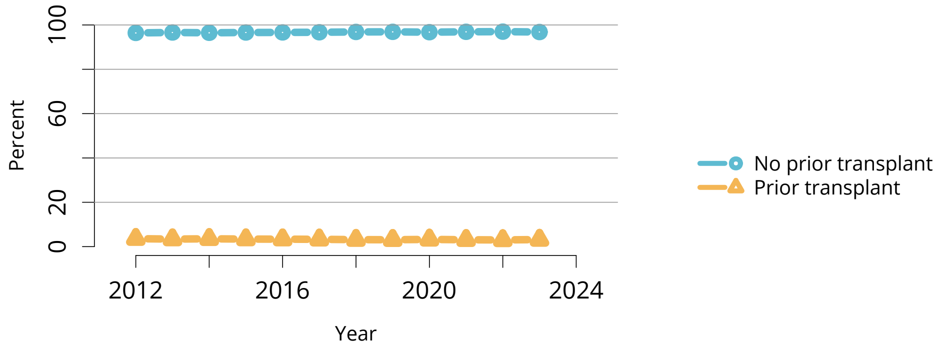

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Figure LI 10: Distribution of adults waiting for liver transplant by prior transplant status. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

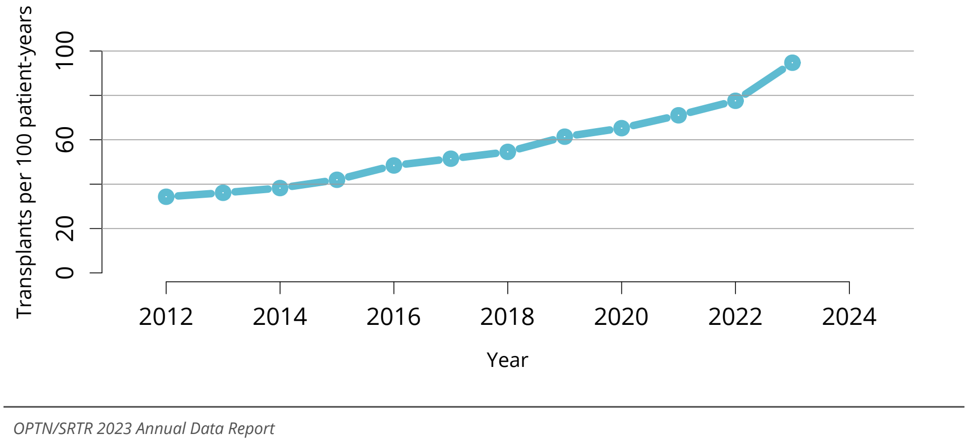

Figure LI 11: Overall deceased donor liver transplant rates among adult waitlist candidates. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

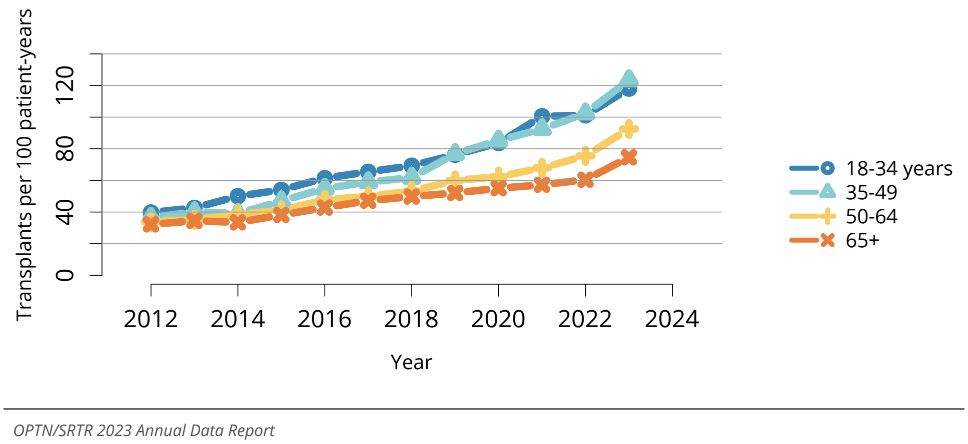

Figure LI 12: Deceased donor liver transplant rates among adult waitlist candidates by age. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year.

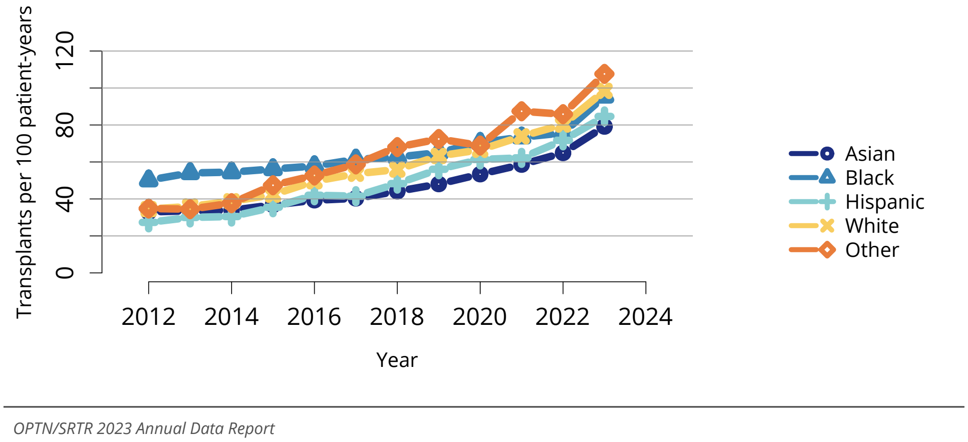

Figure LI 13: Deceased donor liver transplant rates among adult waitlist candidates by race and ethnicity. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

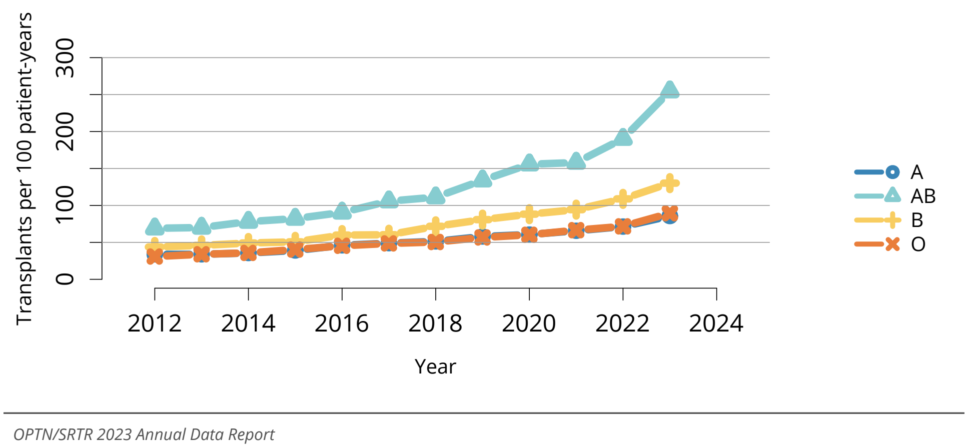

Figure LI 14: Deceased donor liver transplant rates among adult waitlist candidates by blood type. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

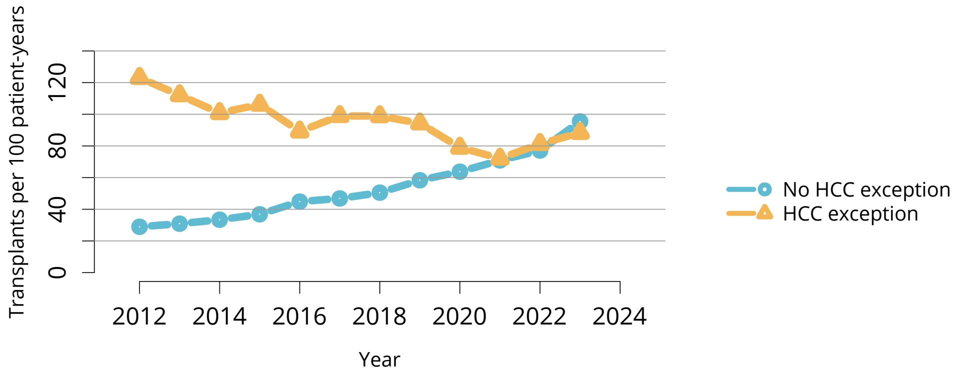

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Figure LI 15: Deceased donor liver transplant rates among adult waitlist candidates by HCC exception status. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. HCC is determined at the later of listing date or January 1 of the year. HCC, hepatocellular carcinoma.

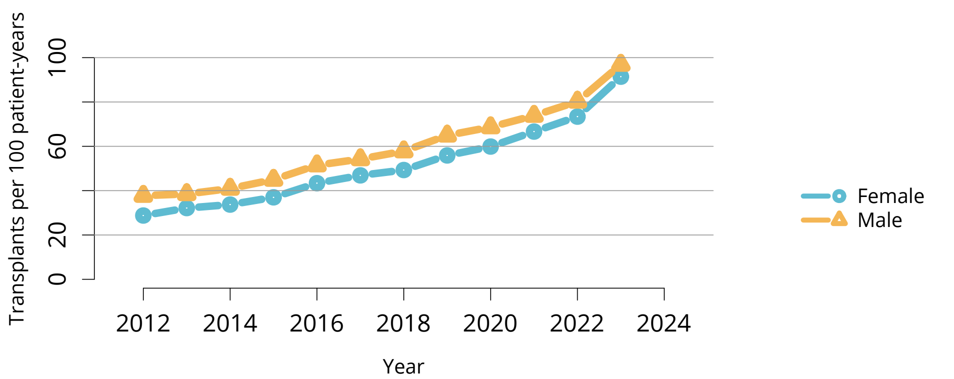

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Figure LI 16: Deceased donor liver transplant rates among adult waitlist candidates by sex. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

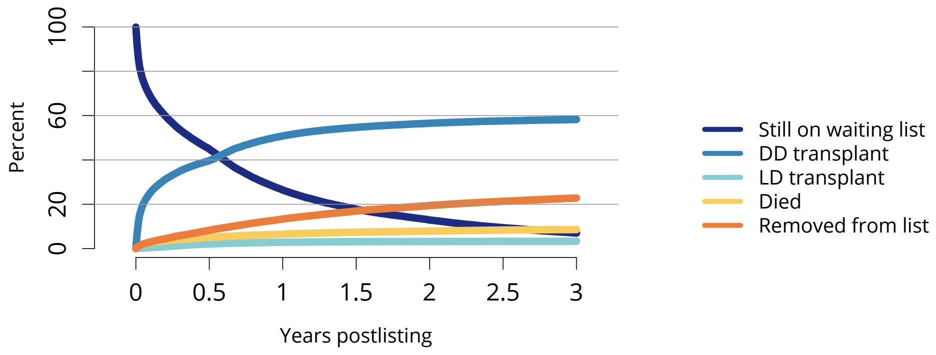

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Figure LI 17: Three-year outcomes for adults waiting for liver transplant, new listings in 2018-2020. Candidates listed at more than one center are counted once per listing. Removed from list includes all reasons except transplant and death. DD, deceased donor; LD, living donor.

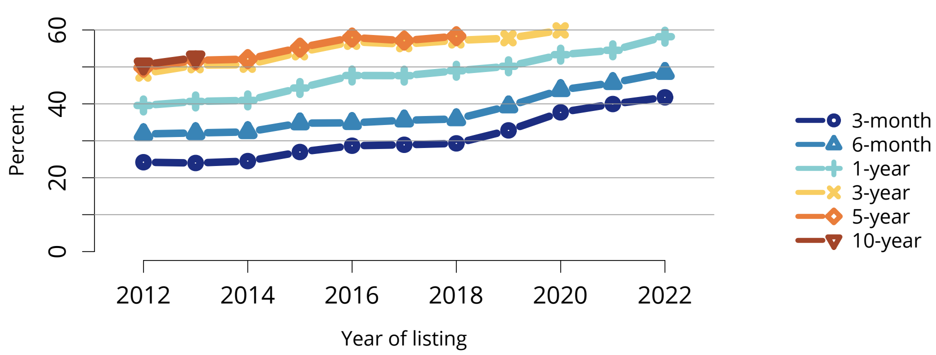

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Figure LI 18: Percentage of adults who underwent deceased donor liver transplant within a given period of listing. Candidates listed at more than one center are counted once per listing.

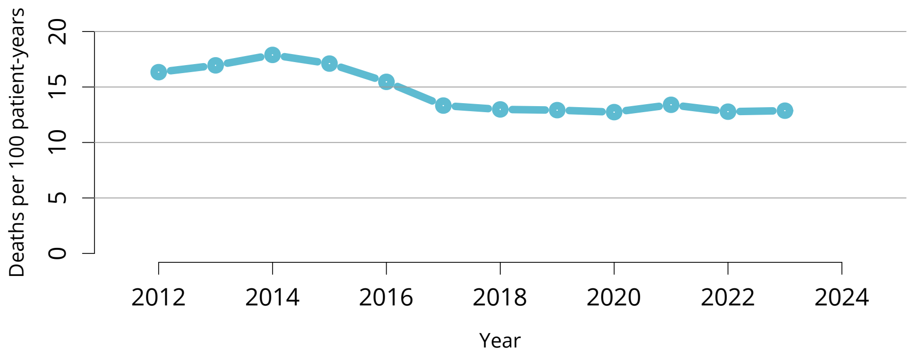

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Figure LI 19: Overall pretransplant mortality rates among adults waitlisted for liver transplant. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

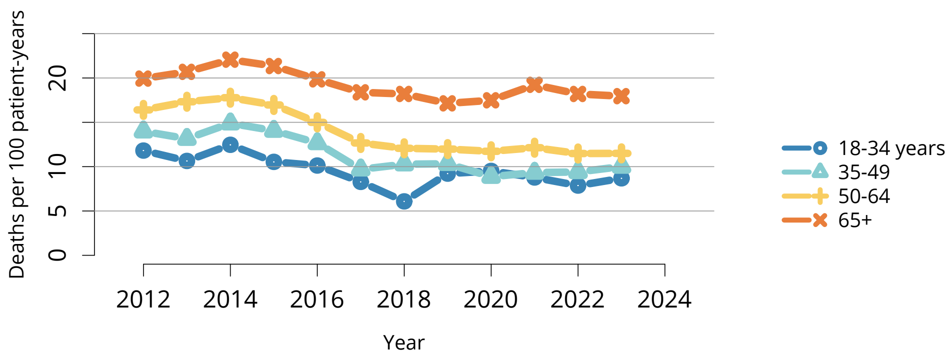

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Figure LI 20: Pretransplant mortality rates among adults waitlisted for liver transplant by age. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year.

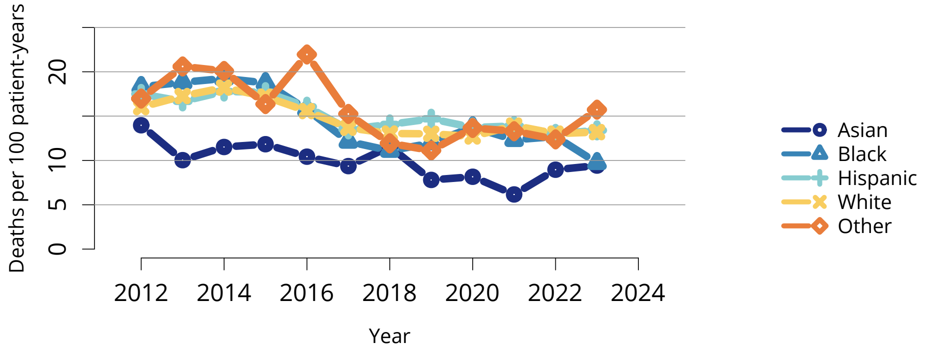

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Figure LI 21: Pretransplant mortality rates among adults waitlisted for liver transplant by race and ethnicity. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

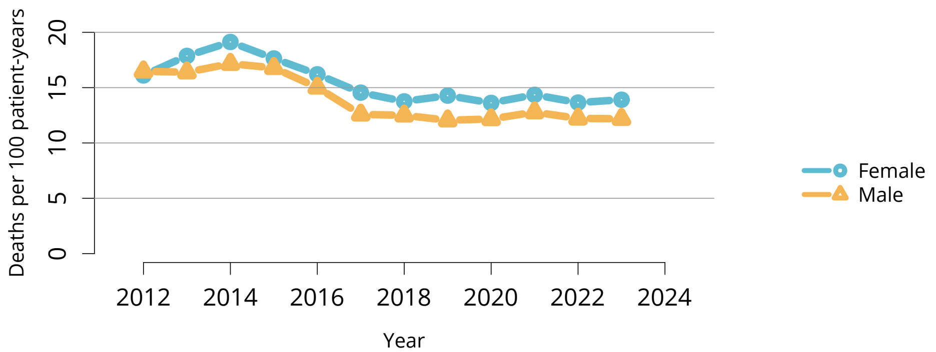

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Figure LI 22: Pretransplant mortality rates among adults waitlisted for liver transplant by sex. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

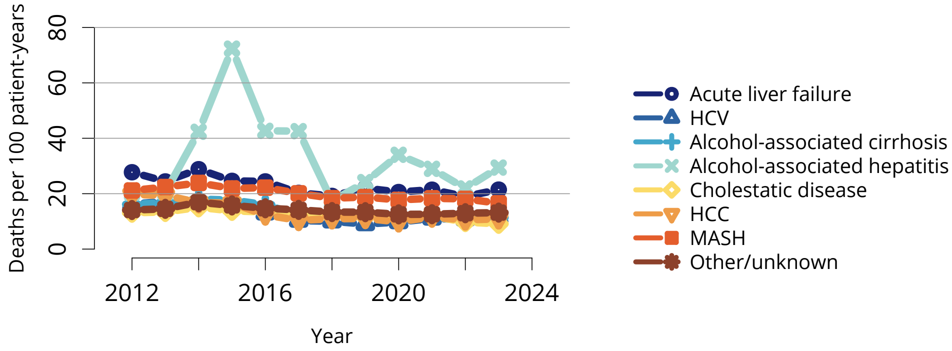

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Figure LI 23: Pretransplant mortality rates among adults waitlisted for liver transplant by diagnosis. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. HCC, hepatocellular carcinoma; HCV, hepatitis C virus; MASH, metabolic dysfunction–associated steatohepatitis.

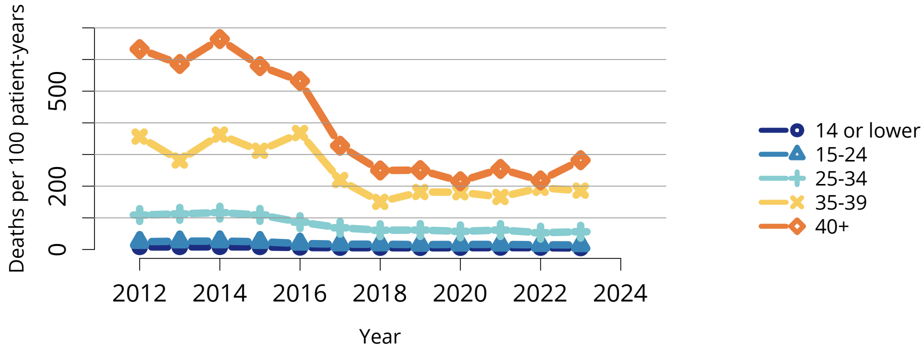

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Figure LI 24: Pretransplant mortality rates among adults waitlisted for liver transplant by first laboratory MELD score in the year. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Medical urgency is determined at the later of listing date or January 1 of the year. MELD, model for end-stage liver disease.

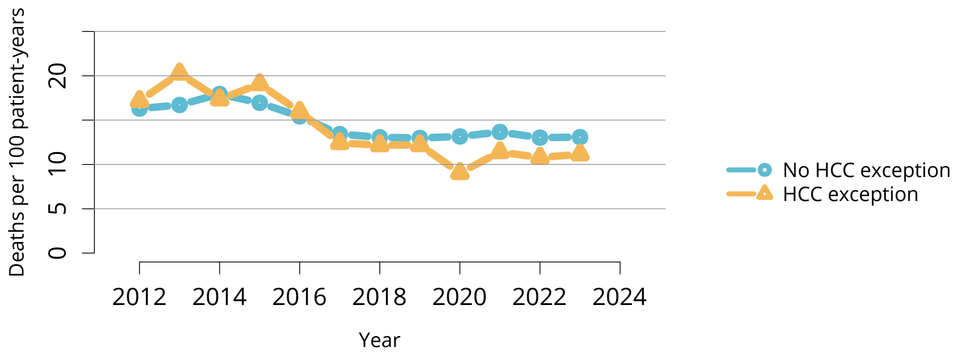

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Figure LI 25: Pretransplant mortality rates among adults waitlisted for liver by HCC exception status. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. HCC is determined at the later of listing date or January 1 of the year. HCC, hepatocellular carcinoma.

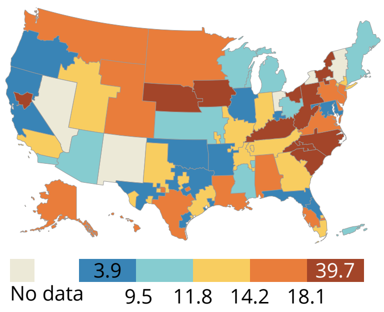

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Figure LI 26: Pretransplant mortality rates among adults waitlisted for liver transplant in 2023 by DSA. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. DSA, donation service area.

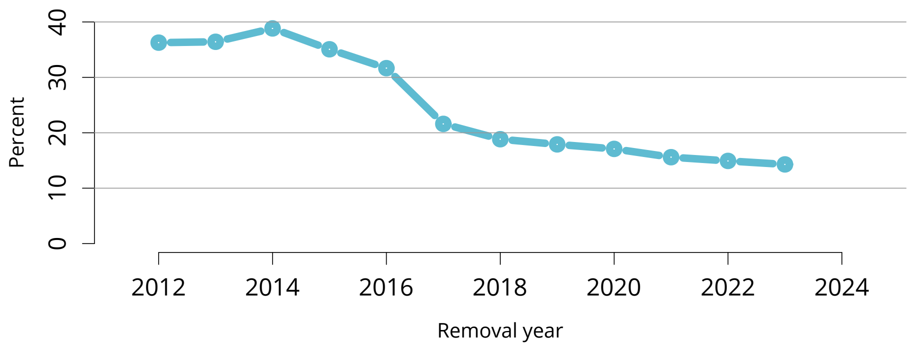

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Figure LI 27: Deaths within 6 months after removal among adult liver waitlist candidates, overall. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list.

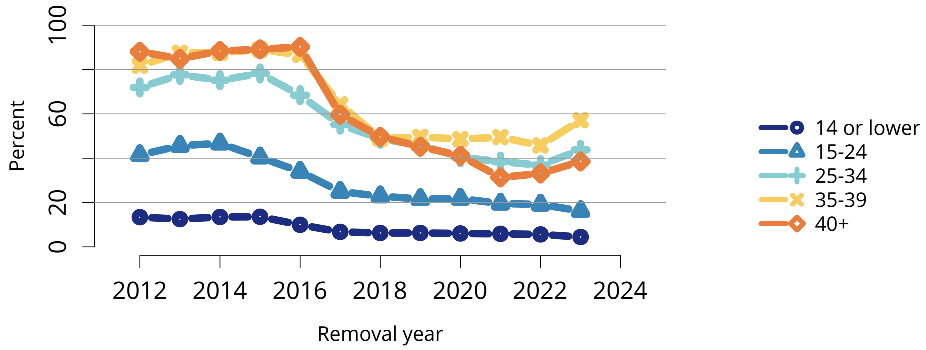

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Figure LI 28: Deaths within 6 months after removal among adult liver waitlist candidates, by laboratory MELD score at removal. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list. MELD, model for end-stage liver disease.

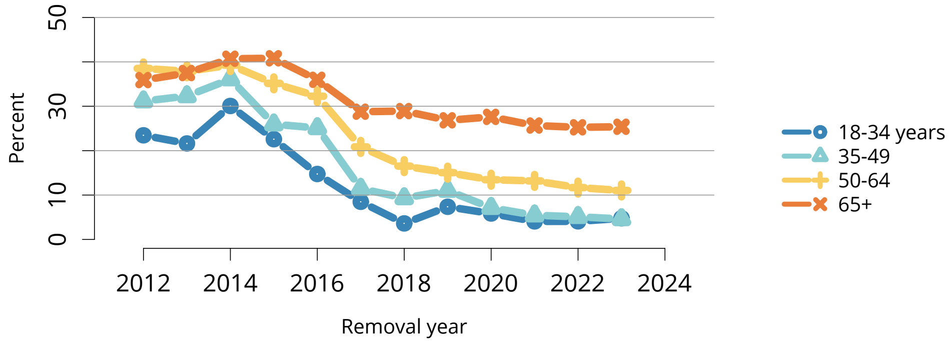

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Figure LI 29: Deaths within 6 months after removal among adult liver waitlist candidates, by age. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list. Age is determined at removal.

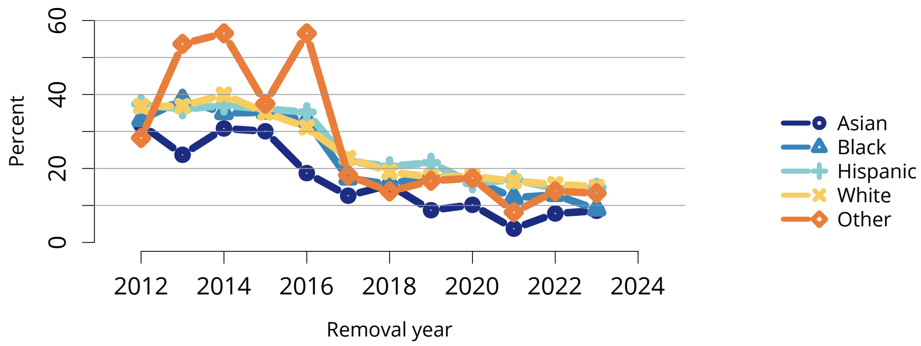

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Figure LI 30: Deaths within 6 months after removal among adult liver waitlist candidates, by race and ethnicity. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list. The Other race category is composed of Native American and Multiracial categories.

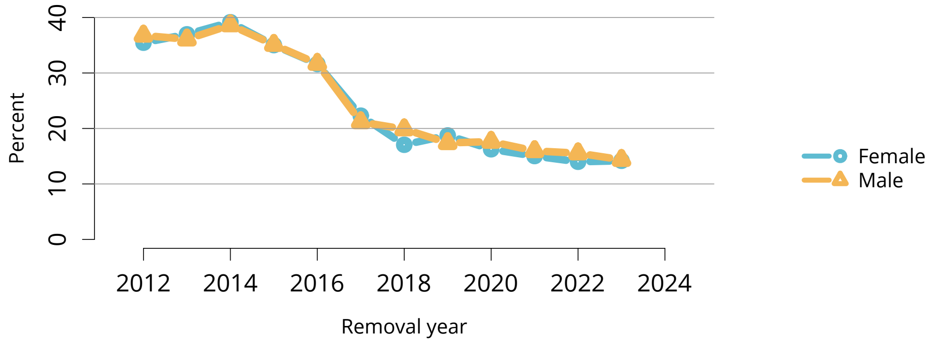

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Figure LI 31: Deaths within 6 months after removal among adult liver waitlist candidates, by sex. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list.

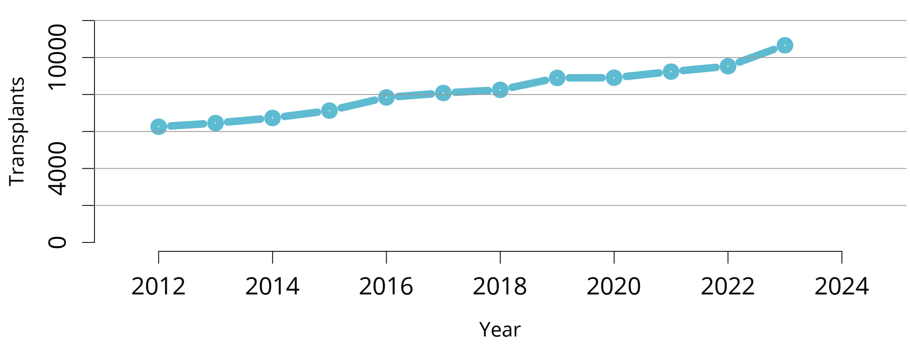

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Figure LI 32: Overall liver transplants. All liver transplant recipients, including adult and pediatric, re-transplant, and multiorgan recipients.

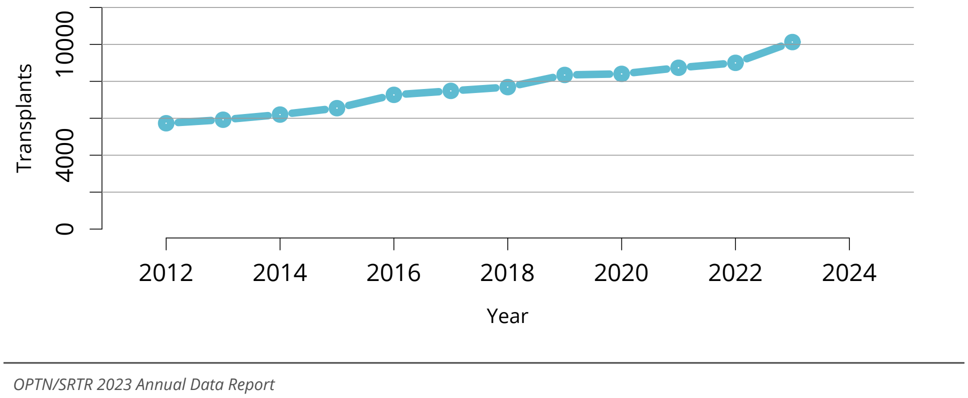

Figure LI 33: Overall adult liver transplants. All adult liver transplant recipients, including retransplant and multiorgan recipients.

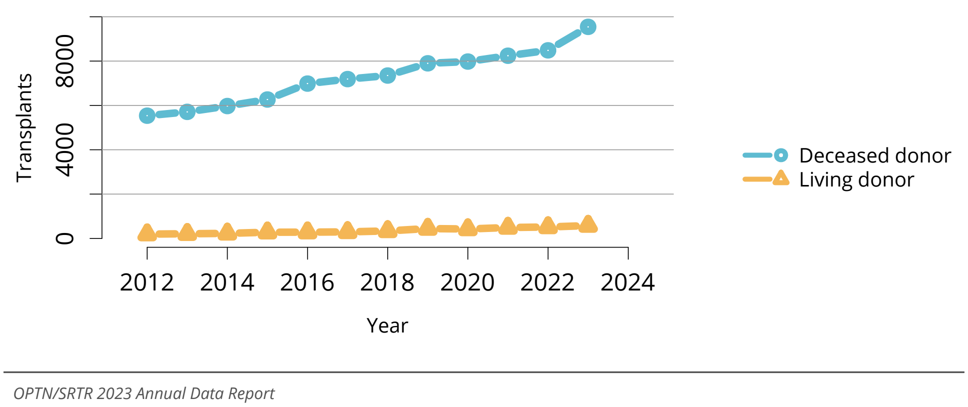

Figure LI 34: Adult liver transplants by donor type. Adult liver transplant recipients, including retransplant and multiorgan recipients.

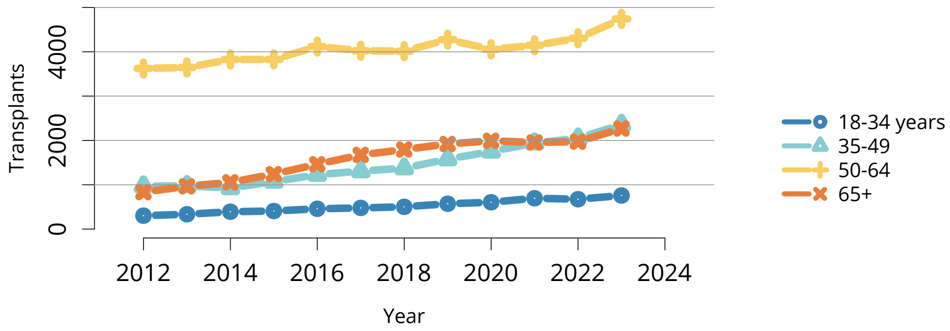

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Figure LI 35: Adult liver transplants by age. Adult liver transplant recipients, including retransplant and multiorgan recipients.

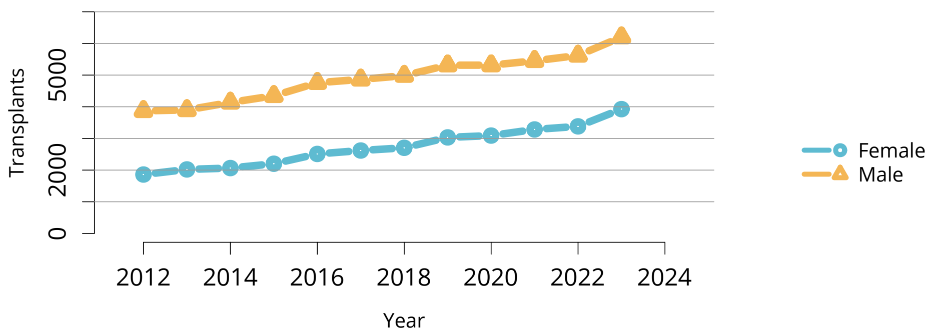

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Figure LI 36: Adult liver transplants by sex. Adult liver transplant recipients, including retransplant and multiorgan recipients.

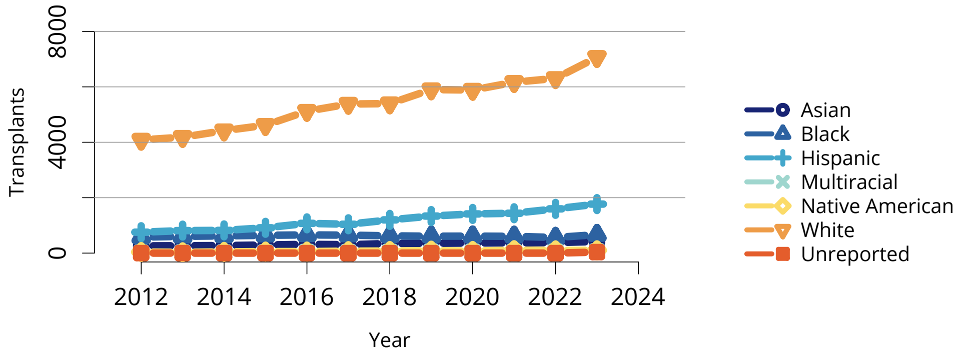

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Figure LI 37: Adult liver transplants by race and ethnicity. Adult liver transplant recipients, including retransplant and multiorgan recipients.

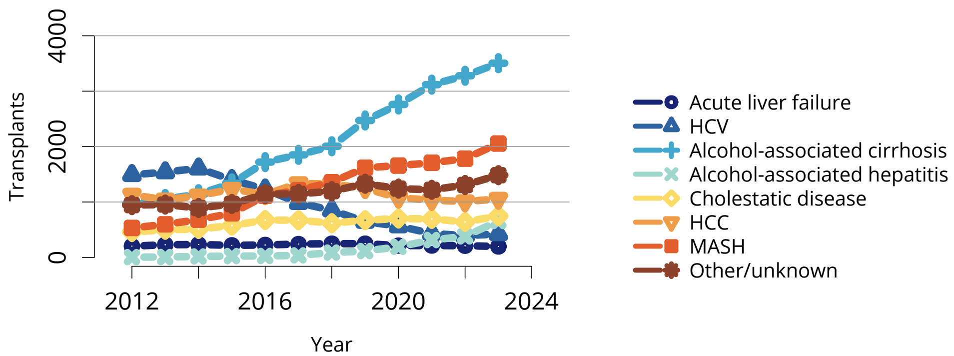

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Figure LI 38: Adult liver transplants by diagnosis. Adult liver transplant recipients, including retransplant and multiorgan recipients. HCC, hepatocellular carcinoma; HCV, hepatitis C virus; MASH, metabolic dysfunction–associated steatohepatitis.

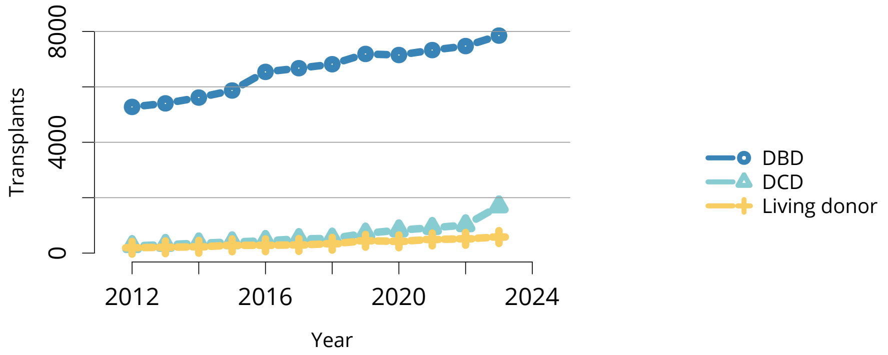

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Figure LI 39: Adult liver transplants by DCD status. Adult liver transplant recipients, including retransplant and multiorgan recipients. DBD, donation after brain death; DCD, donation after circulatory death.

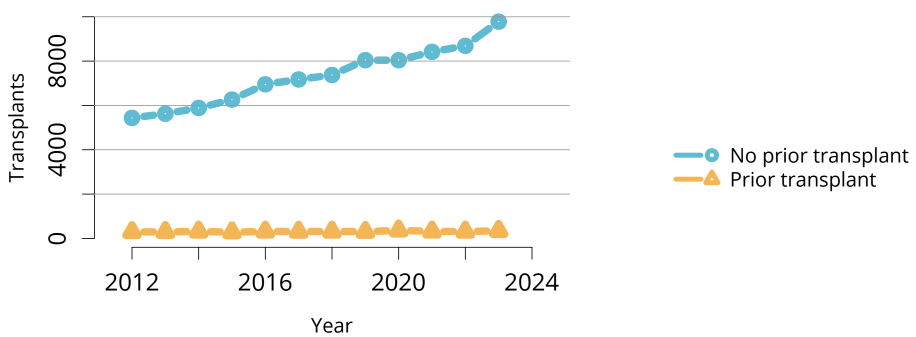

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Figure LI 40: Adult liver transplants by prior transplant status. Adult liver transplant recipients, including retransplant and multiorgan recipients.

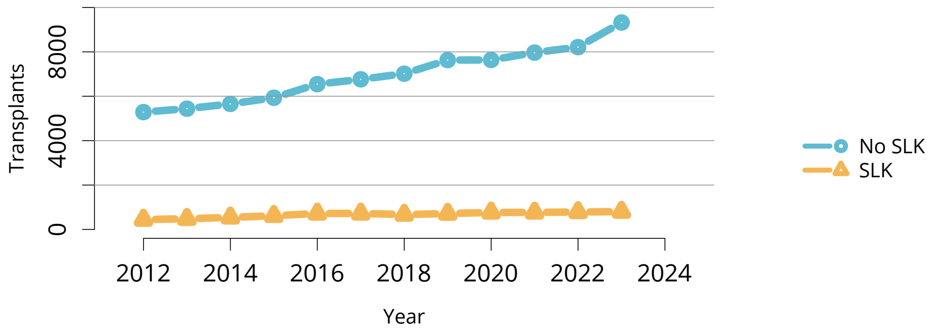

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Figure LI 41: Adult liver transplants by SLK. Adult liver transplant recipients, including retransplant and multiorgan recipients. SLK transplants are in recipients with a liver and kidney transplant from the same donor. SLK, simultaneous liver-kidney.

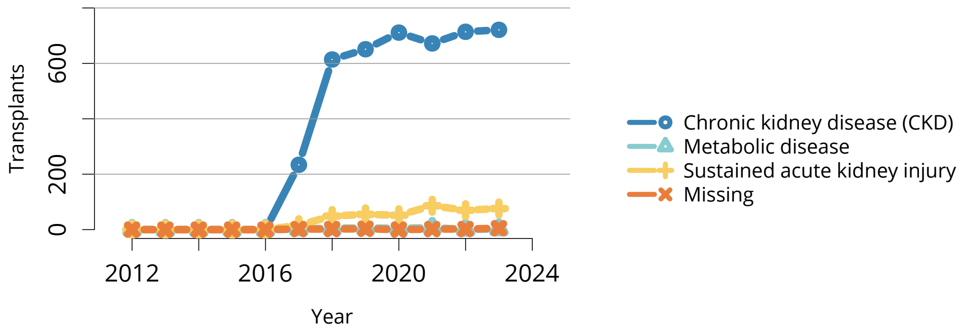

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Figure LI 42: Adult SLK transplants by SLK diagnosis. Adult SLK transplant recipients, including retransplant and multiorgan recipients. SLK transplants are in recipients with a liver and kidney transplant from the same donor. SLK, simultaneous liver-kidney.

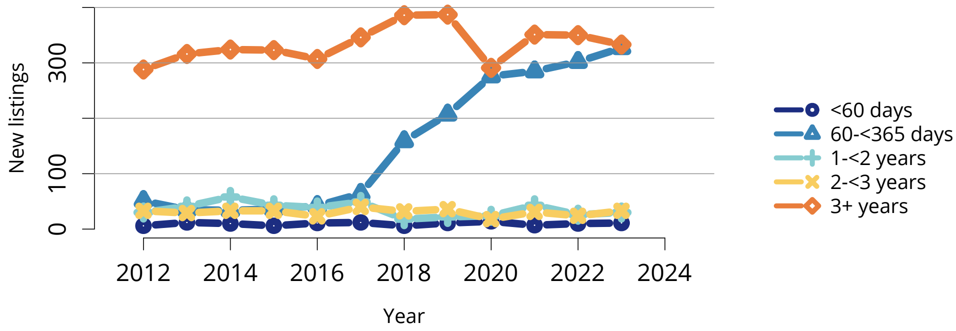

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Figure LI 43: New adult candidates added to the kidney transplant waiting list after liver transplant by time to kidney listing from liver transplant. A new candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and subsequently relisted are considered new. Active and inactive patients are included.

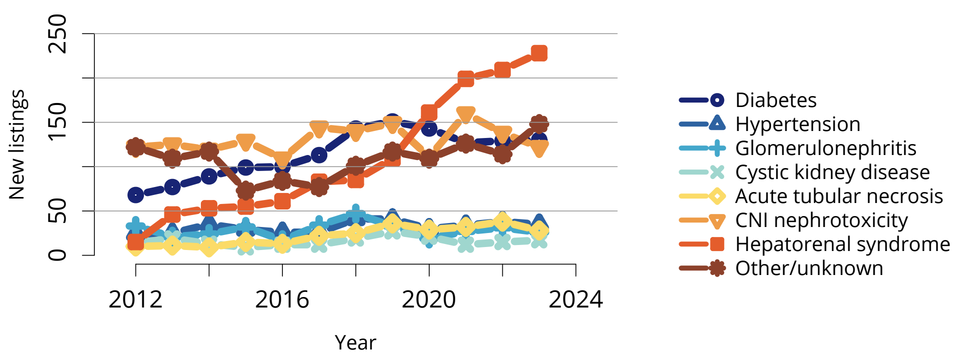

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Figure LI 44: New adult candidates added to the kidney transplant waiting list after liver transplant by diagnosis. A new candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and subsequently relisted are considered new. Active and inactive patients are included. CNI, calcineurin inhibitor.

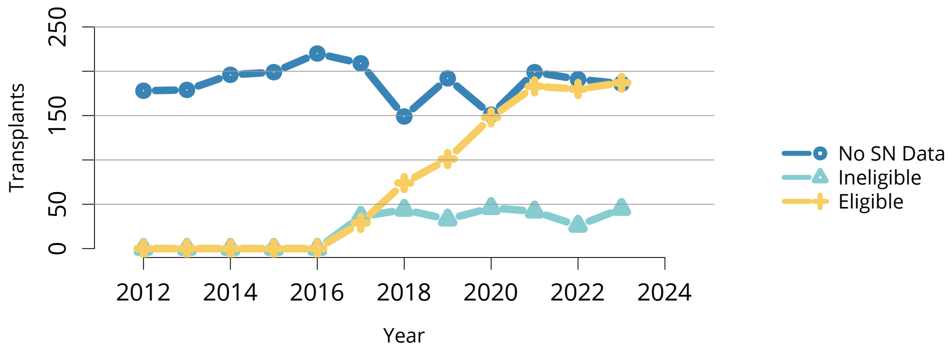

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Figure LI 45: Adult kidney transplants by SLK safety net eligibility. Adult kidney transplant recipients, including retransplant and multiorgan recipients. SLK transplants are in recipients with a liver and kidney transplant from the same donor. SLK, simultaneous liver-kidney; SN, safety net.

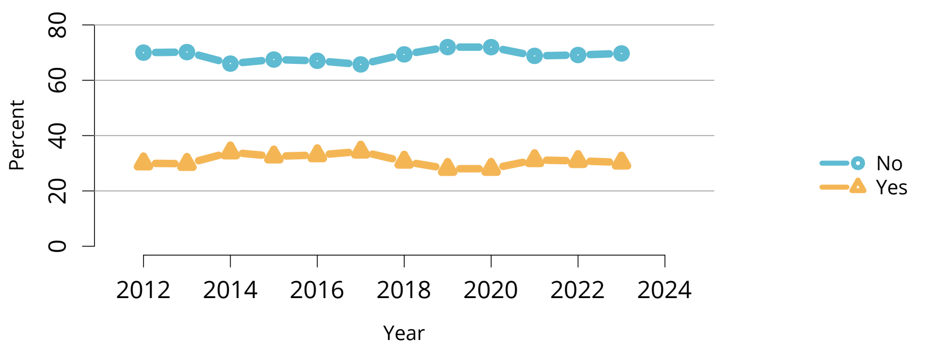

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Figure LI 46: Induction agent use in adult liver transplant recipients. Immunosuppression at transplant reported to the OPTN.

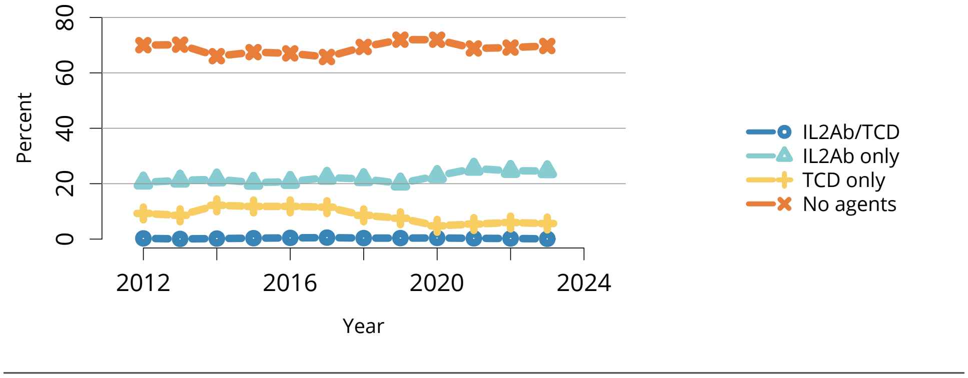

Figure LI 47: Type of induction agent use in adult liver transplant recipients. Immunosuppression at transplant reported to the OPTN. IL2Ab, interleukin-2 receptor antibody; TCD, T-cell depleting.

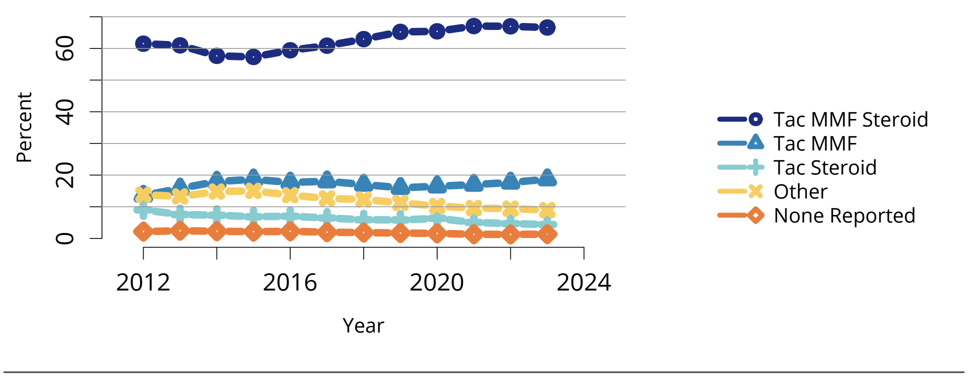

Figure LI 48: Immunosuppression regimen use in adult liver transplant recipients. Immunosuppression regimen at transplant reported to the OPTN. MMF, all mycophenolate agents; Tac, tacrolimus.

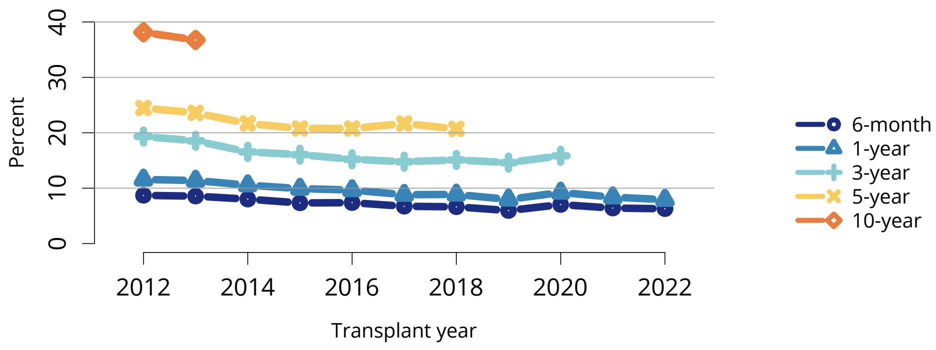

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Figure LI 49: Graft failure among adult deceased donor liver transplant recipients. All adult recipients of deceased donor livers, including multiorgan transplant recipients.

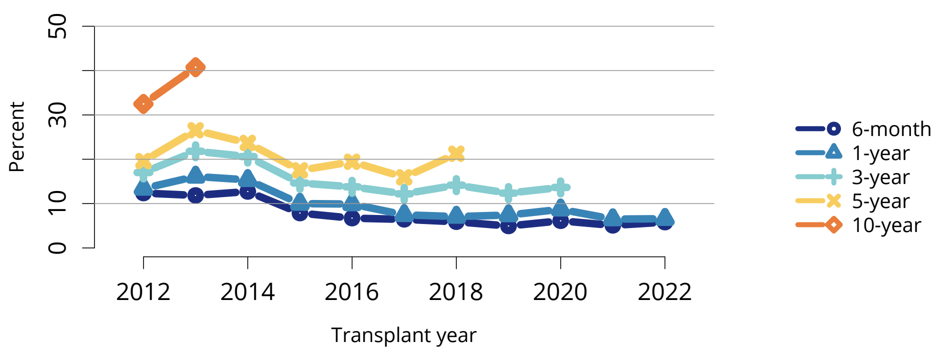

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Figure LI 50: Graft failure among adult living donor liver transplant recipients. All adult recipients of living donor livers, including multiorgan transplant recipients.

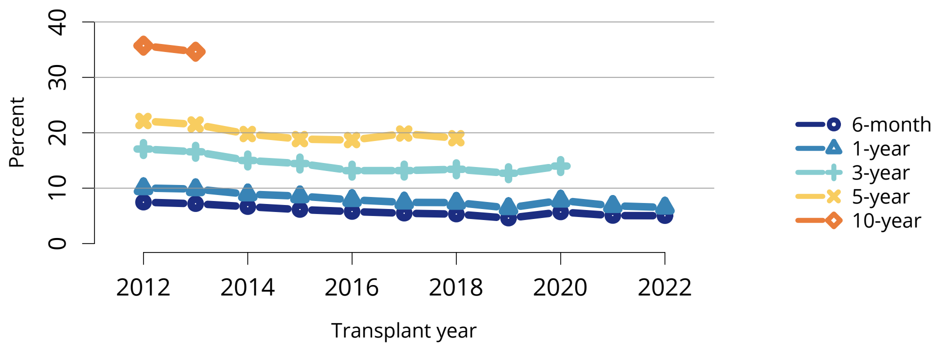

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Figure LI 51: Patient death among adult liver transplant recipients. All adult recipients of deceased donor livers, including multiorgan transplant recipients.

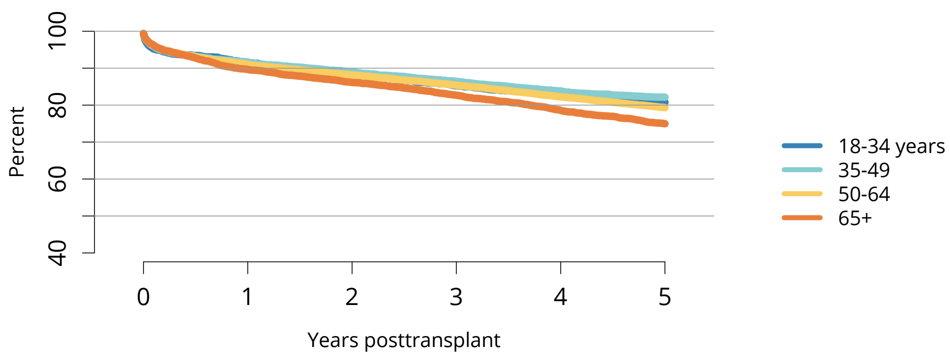

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Figure LI 52: Graft survival among adult deceased donor liver transplant recipients, 2016-2018, by age. Graft survival estimated using unadjusted Kaplan-Meier methods.

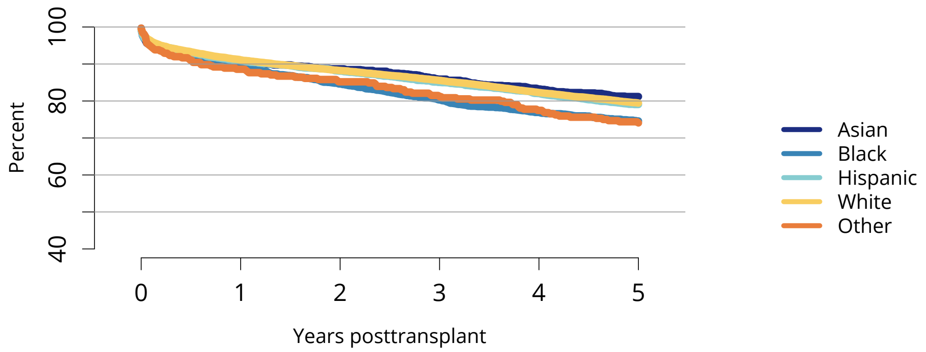

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Figure LI 53: Graft survival among adult deceased donor liver transplant recipients, 2016-2018, by race and ethnicity. Graft survival estimated using unadjusted Kaplan-Meier methods. The Other race category is composed of Native American and Multiracial categories.

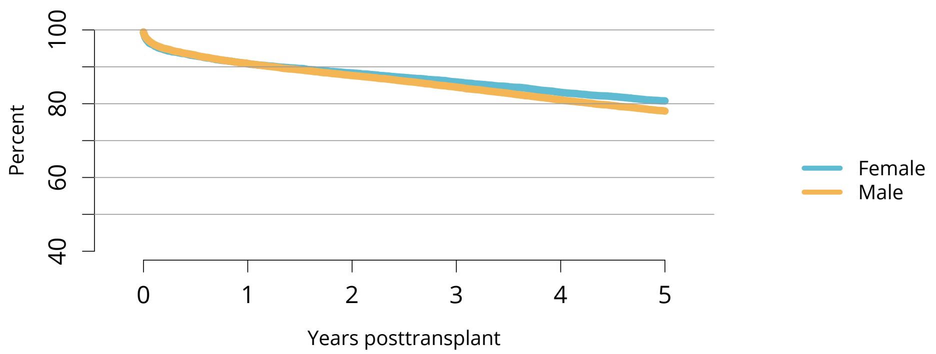

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Figure LI 54: Graft survival among adult deceased donor liver transplant recipients, 2016-2018, by sex. Graft survival estimated using unadjusted Kaplan-Meier methods.

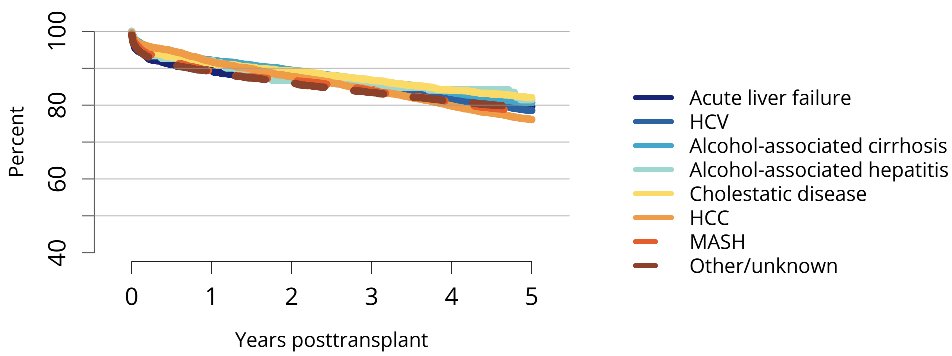

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Figure LI 55: Graft survival among adult deceased donor liver transplant recipients, 2016-2018, by diagnosis. Graft survival estimated using unadjusted Kaplan-Meier methods. HCC, hepatocellular carcinoma; HCV, hepatitis C virus; MASH, metabolic dysfunction–associated steatohepatitis.

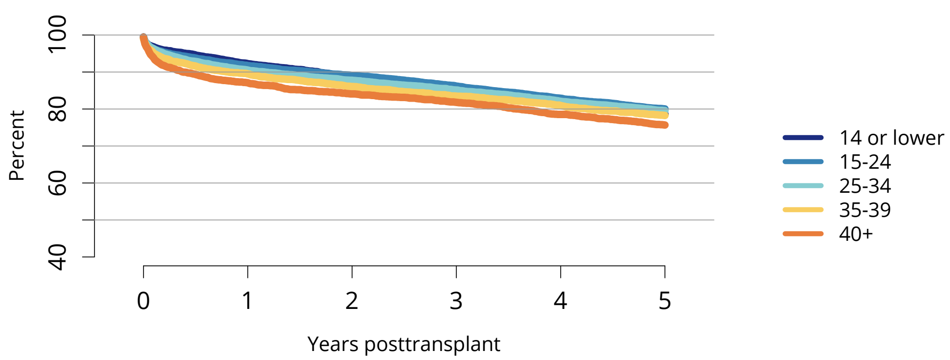

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Figure LI 56: Graft survival among adult deceased donor liver transplant recipients, 2016-2018, by laboratory MELD score. Graft survival estimated using unadjusted Kaplan-Meier methods. MELD, model for end-stage liver disease.

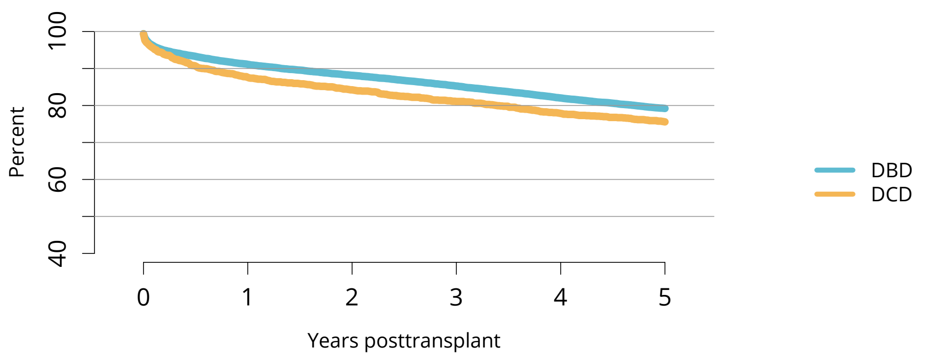

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Figure LI 57: Graft survival among adult deceased donor liver transplant recipients, 2016-2018, by DCD status. Graft survival estimated using unadjusted Kaplan-Meier methods. DBD, donation after brain death; DCD, donation after circulatory death.

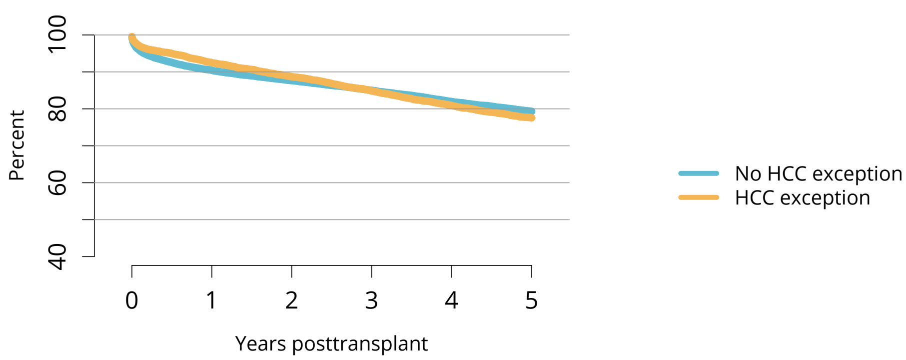

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Figure LI 58: Graft survival among adult deceased donor liver transplant recipients, 2016-2018, by HCC status. Graft survival estimated using unadjusted Kaplan-Meier methods. HCC, hepatocellular carcinoma.

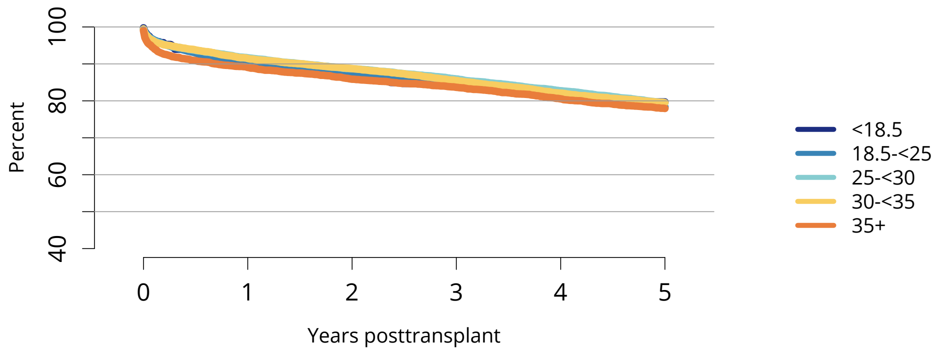

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Figure LI 59: Graft survival among adult deceased donor liver transplant recipients, 2016-2018, by BMI. Graft survival estimated using unadjusted Kaplan-Meier methods. BMI, body mass index.

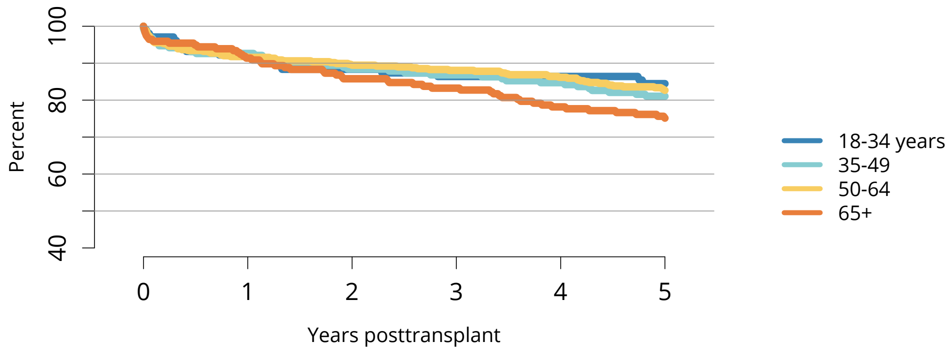

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Figure LI 60: Graft survival among adult living donor liver transplant recipients, 2016-2018, by age. Graft survival estimated using unadjusted Kaplan-Meier methods.

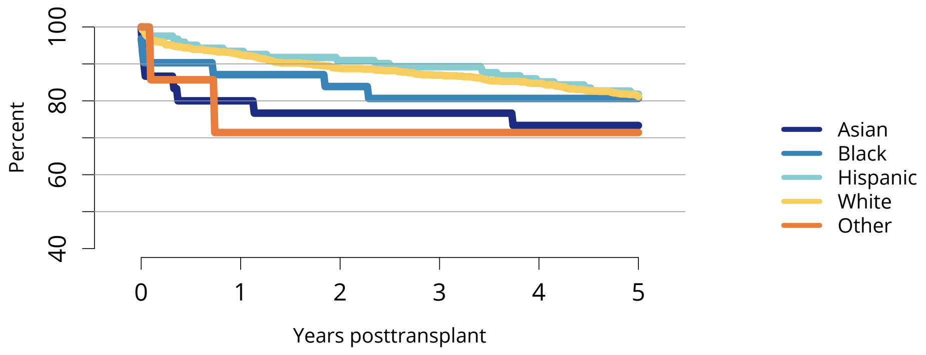

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Figure LI 61: Graft survival among adult living donor liver transplant recipients, 2016-2018, by race and ethnicity. Graft survival estimated using unadjusted Kaplan-Meier methods. The Other race category is composed of Native American and Multiracial categories.

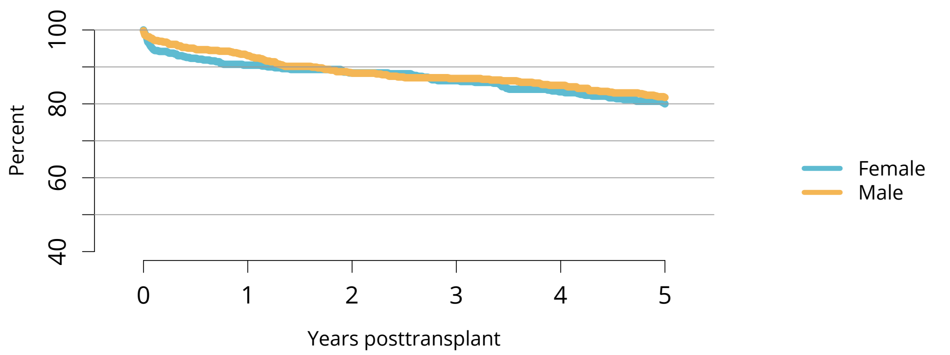

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Figure LI 62: Graft survival among adult living donor liver transplant recipients, 2016-2018, by sex. Graft survival estimated using unadjusted Kaplan-Meier methods.

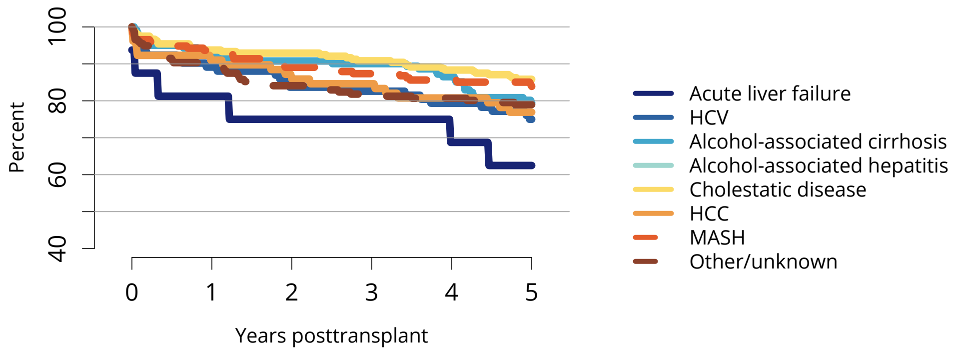

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Figure LI 63: Graft survival among adult living donor liver transplant recipients, 2016-2018, by diagnosis. Graft survival estimated using unadjusted Kaplan-Meier methods. HCC, hepatocellular carcinoma; HCV, hepatitis C virus; MASH, metabolic dysfunction–associated steatohepatitis.

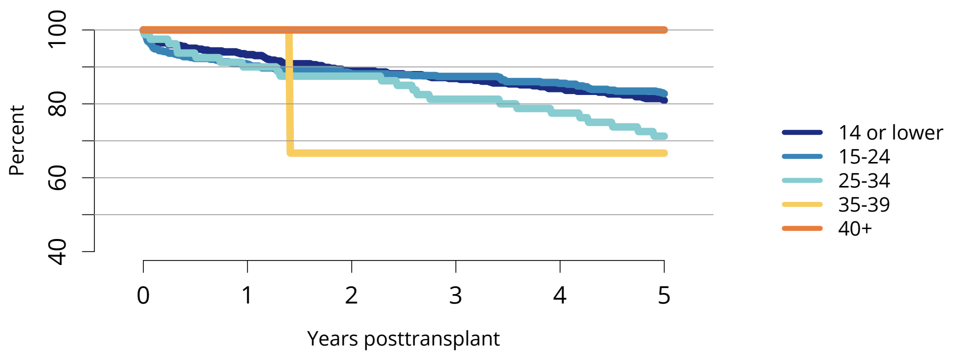

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Figure LI 64: Graft survival among adult living donor liver transplant recipients, 2016-2018, by laboratory MELD score. Graft survival estimated using unadjusted Kaplan-Meier methods. MELD, model for end-stage liver disease.

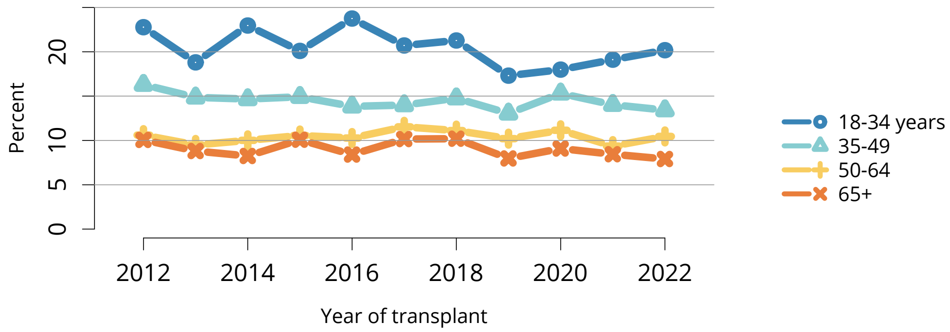

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Figure LI 65: Incidence of acute rejection by 1 year posttransplant among adult liver transplant recipients by age. Only the first reported rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier method.

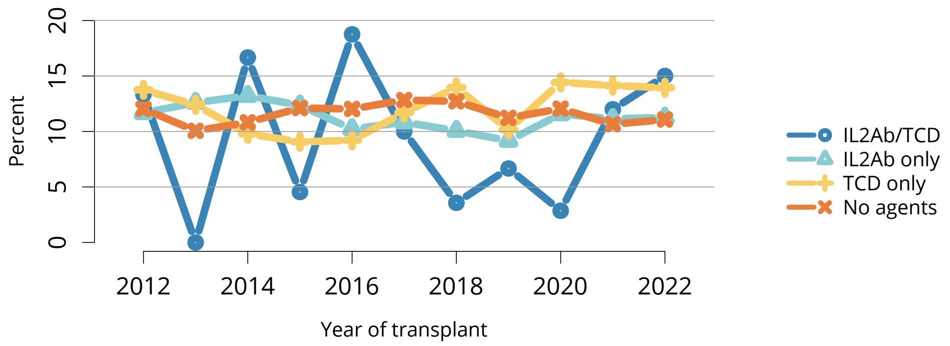

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Figure LI 66: Incidence of acute rejection by 1 year posttransplant among adult liver transplant recipients by induction agent. Only the first reported rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier method. IL2Ab, interleukin-2 receptor antibody; TCD, T-cell depleting.

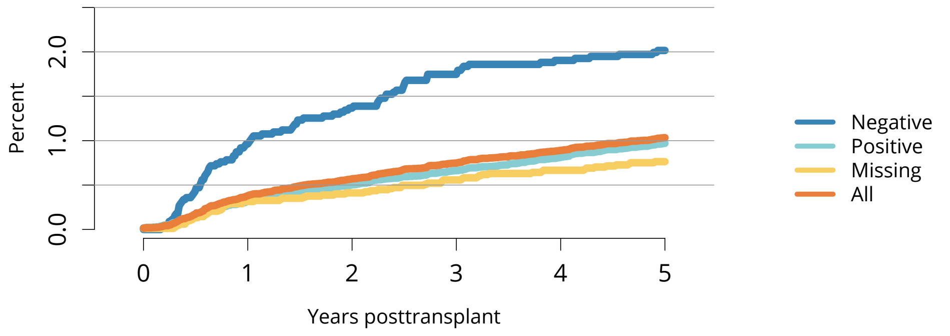

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Figure LI 67: Incidence of PTLD among adult liver transplant recipients by recipient EBV status at transplant, 2012-2018. Cumulative incidence is estimated using the Kaplan-Meier method. PTLD is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus; PTLD, posttransplant lymphoproliferative disorder.

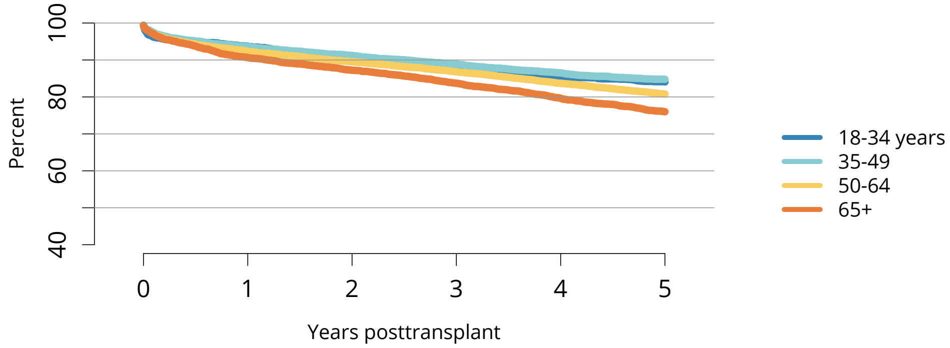

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Figure LI 68: Patient survival among adult deceased donor liver transplant recipients, 2016-2018, by age. Patient survival estimated using unadjusted Kaplan-Meier methods.

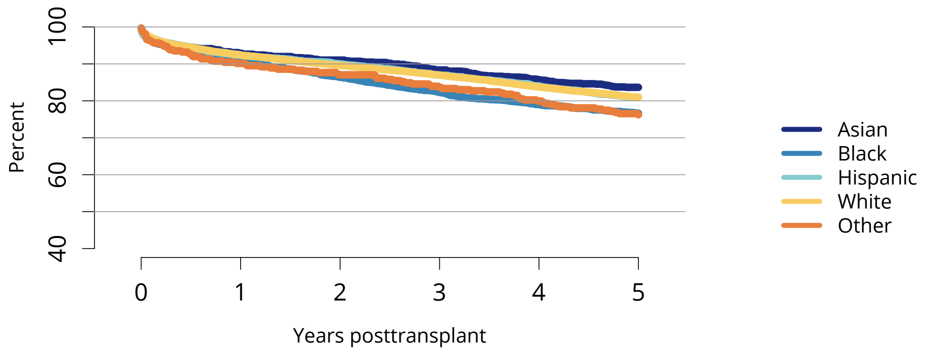

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Figure LI 69: Patient survival among adult deceased donor liver transplant recipients, 2016-2018, by race and ethnicity. Patient survival estimated using unadjusted Kaplan-Meier methods. The Other race category is composed of Native American and Multiracial categories.

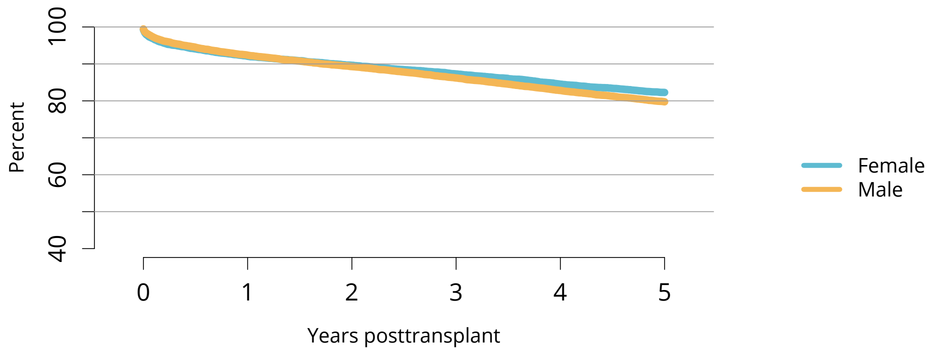

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Figure LI 70: Patient survival among adult deceased donor liver transplant recipients, 2016-2018, by sex. Patient survival estimated using unadjusted Kaplan-Meier methods.

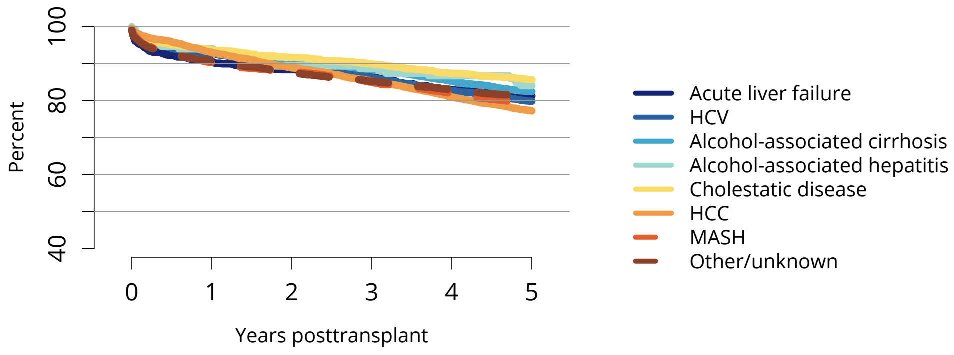

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Figure LI 71: Patient survival among adult deceased donor liver transplant recipients, 2016-2018, by diagnosis. Patient survival estimated using unadjusted Kaplan-Meier methods. HCC, hepatocellular carcinoma; HCV, hepatitis C virus; MASH, metabolic dysfunction–associated steatohepatitis.

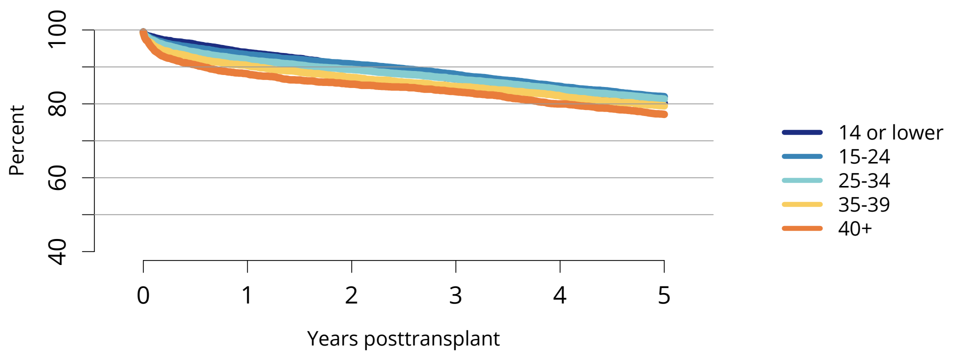

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Figure LI 72: Patient survival among adult deceased donor liver transplant recipients, 2016-2018, by laboratory MELD score. Patient survival estimated using unadjusted Kaplan-Meier methods. MELD, model for end-stage liver disease.

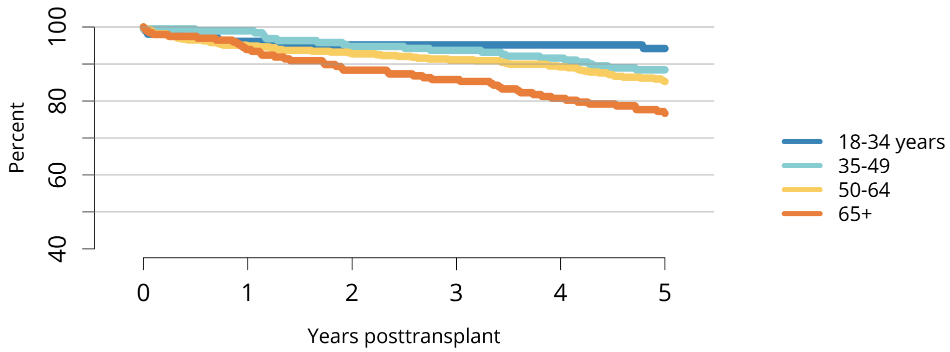

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Figure LI 73: Patient survival among adult living donor liver transplant recipients, 2016-2018, by age. Patient survival estimated using unadjusted Kaplan-Meier methods.

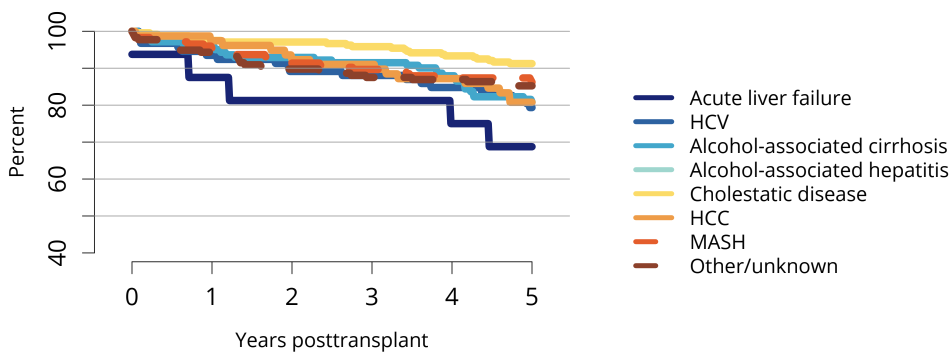

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Figure LI 74: Patient survival among adult living donor liver transplant recipients, 2016-2018, by diagnosis. Patient survival estimated using unadjusted Kaplan-Meier methods. HCC, hepatocellular carcinoma; HCV, hepatitis C virus; MASH, metabolic dysfunction–associated steatohepatitis.

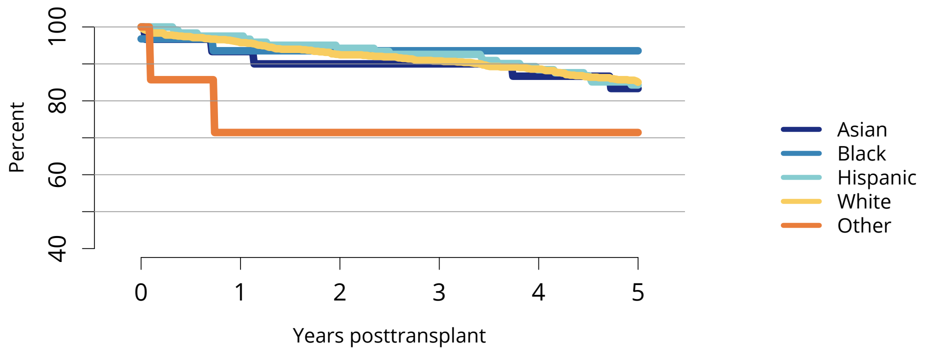

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Figure LI 75: Patient survival among adult living donor liver transplant recipients, 2016-2018, by race and ethnicity. Patient survival estimated using unadjusted Kaplan-Meier methods. The Other race category is composed of Native American and Multiracial categories.

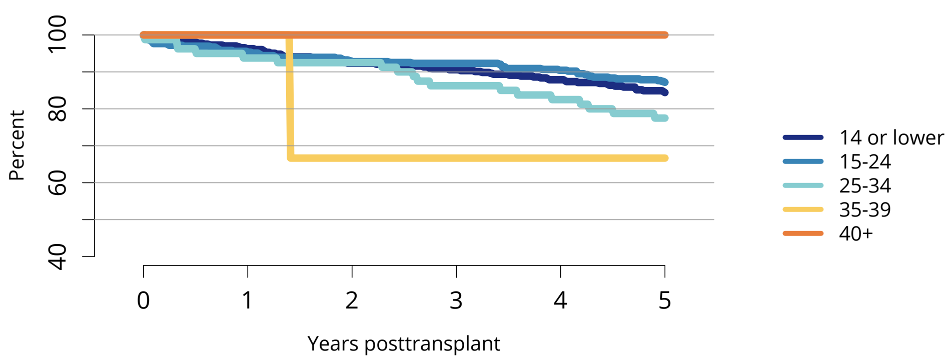

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Figure LI 76: Patient survival among adult living donor liver transplant recipients, 2016-2018, by laboratory MELD score. Patient survival estimated using unadjusted Kaplan-Meier methods. MELD, model for end-stage liver disease.

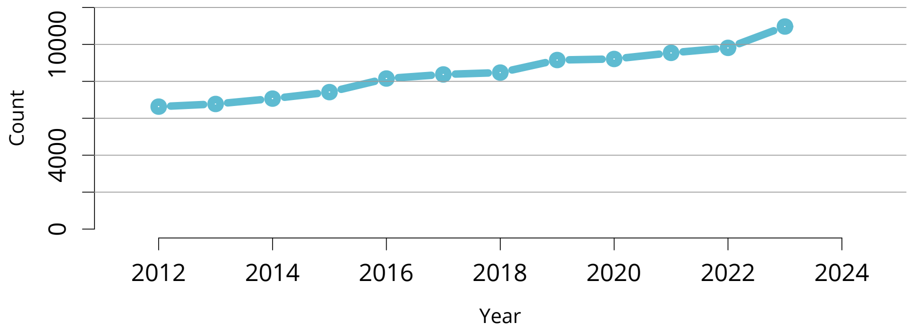

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Figure LI 77: Overall deceased liver donor count. Count of deceased donors whose livers were recovered for transplant.

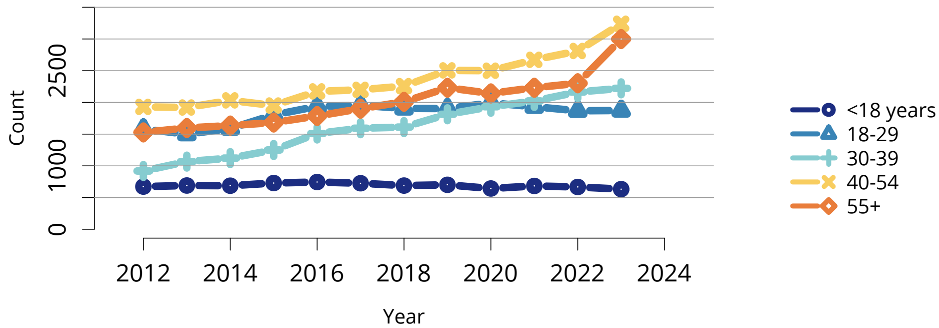

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Figure LI 78: Deceased liver donor count by age. Count of deceased donors whose livers were recovered for transplant.

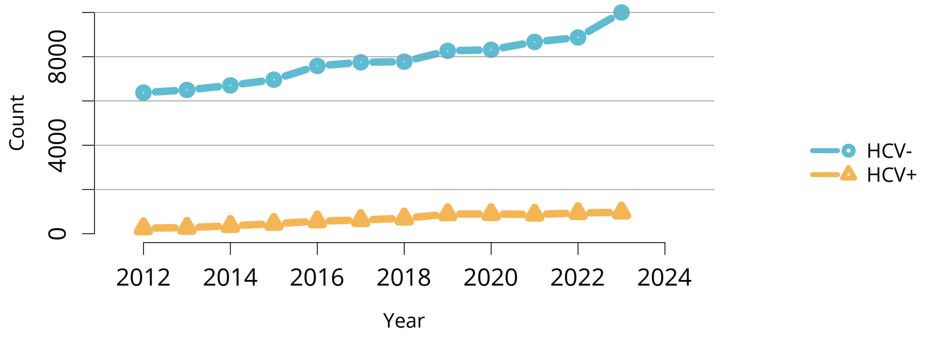

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Figure LI 79: Deceased liver donor count by HCV status. Count of deceased donors whose livers were recovered for transplant. Donor HCV status was based on an antibody test. HCV, hepatitis C virus.

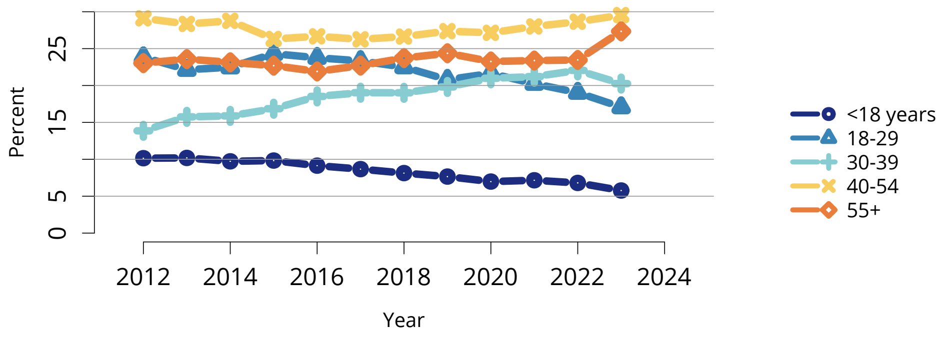

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Figure LI 80: Distribution of deceased liver donors by age. Deceased donors whose livers were recovered for transplant.

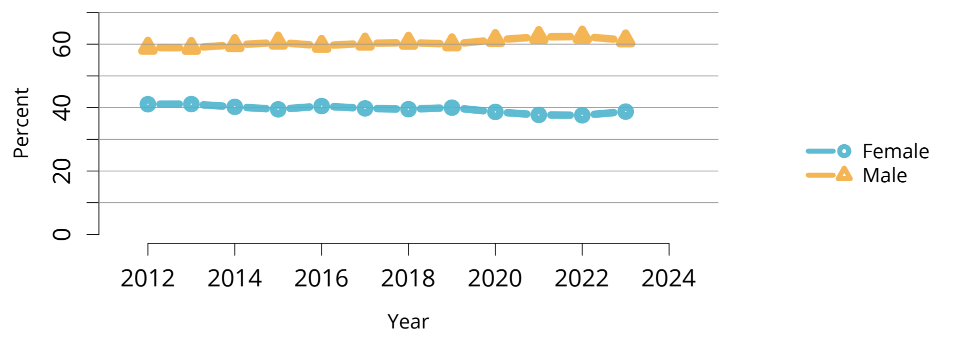

Figure LI 81: Distribution of deceased liver donors by sex. Deceased donors whose livers were recovered for transplant.

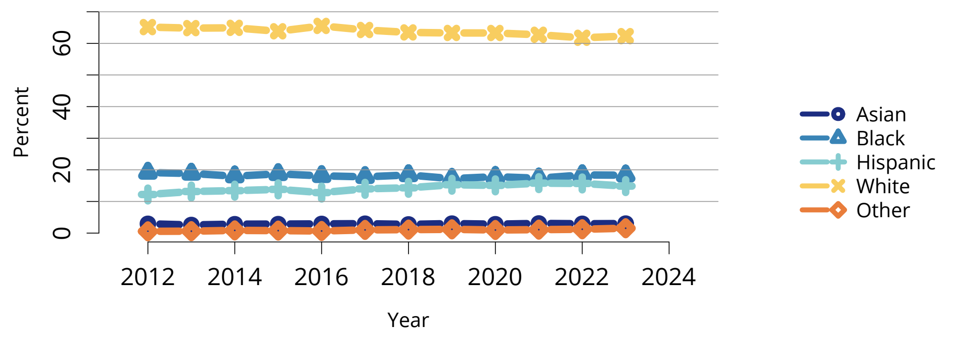

Figure LI 82: Distribution of deceased liver donors by race and ethnicity. Deceased donors whose livers were recovered for transplant. The Other race category is composed of Native American and Multiracial categories.

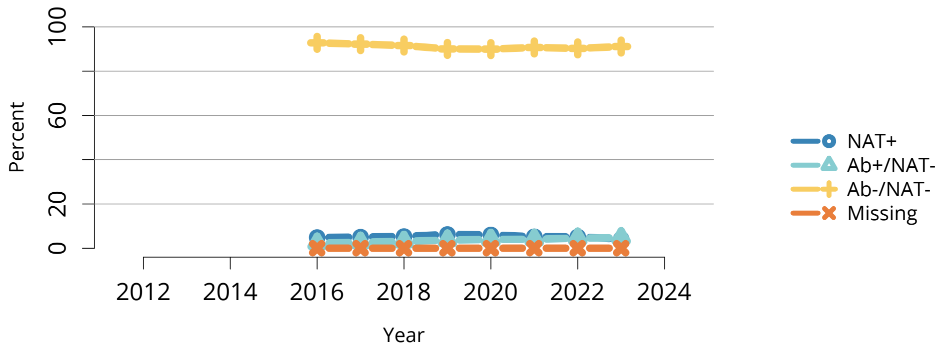

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Figure LI 83: Distribution of deceased liver donors by donor HCV status. Deceased donors whose livers were recovered for transplant. Donor HCV status was based on NAT and antibody tests. Ab, antibody; HCV, hepatitis C virus; NAT, nucleic acid test.

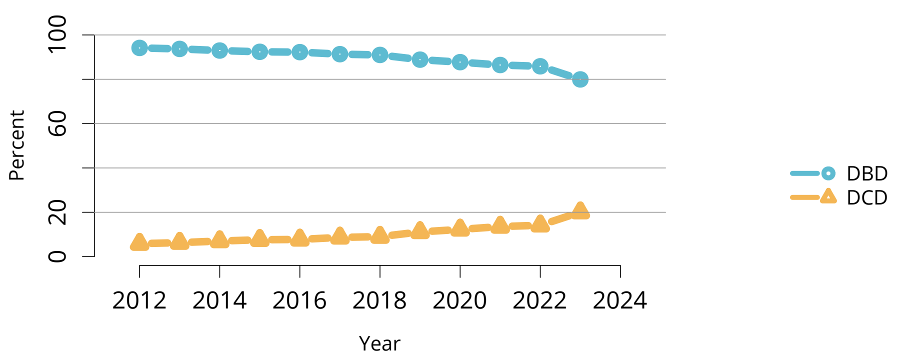

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Figure LI 84: Distribution of deceased liver donors by DCD status. Deceased donors whose livers were recovered for transplant. DBD, donation after brain death; DCD, donation after circulatory death.

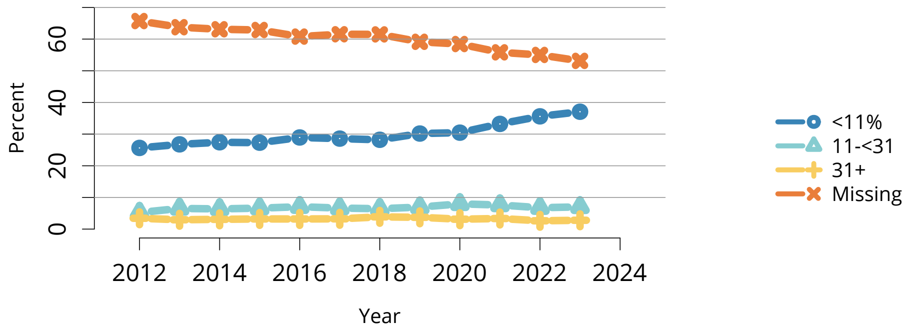

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Figure LI 85: Distribution of deceased liver donors by macrovesicular fat. Deceased donors whose livers were recovered for transplant.

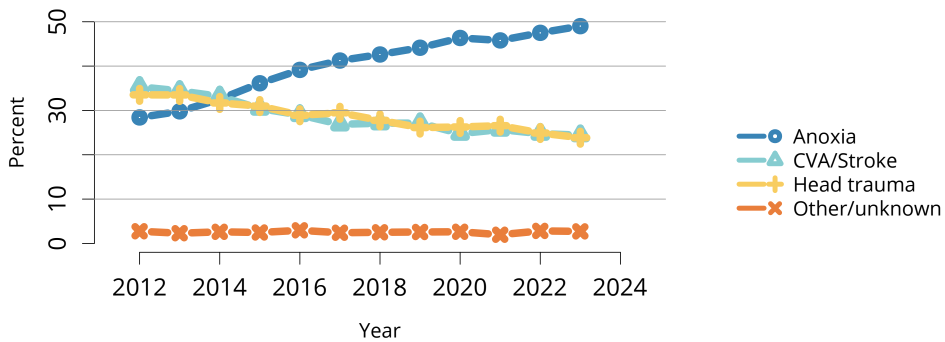

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Figure LI 86: Cause of death among deceased liver donors. Deceased donors with a liver recovered for the purposes of transplant. CVA, cerebrovascular accident.

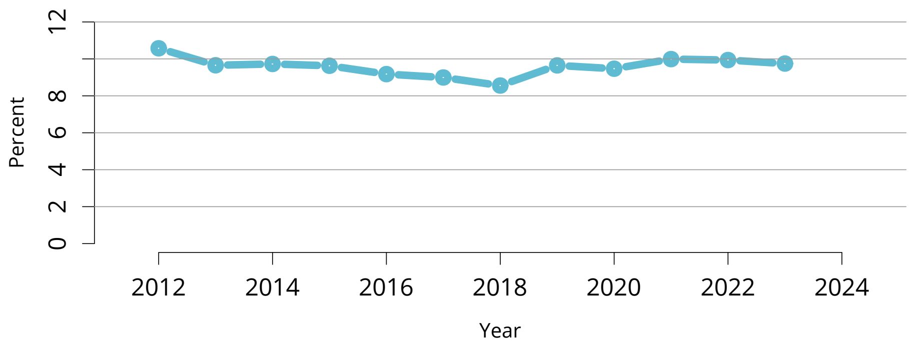

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Figure LI 87: Overall percent of livers recovered for transplant and not transplanted. Percentages of livers not transplanted out of all livers recovered for transplant.

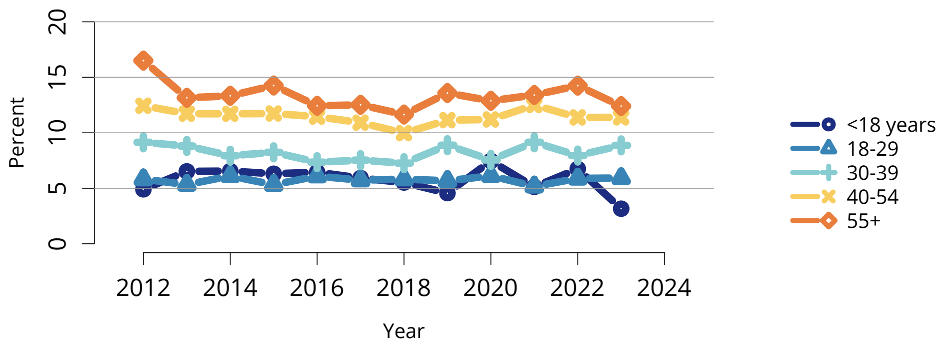

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Figure LI 88: Percent of livers recovered for transplant and not transplanted by donor age. Percentages of livers not transplanted out of all livers recovered for transplant.

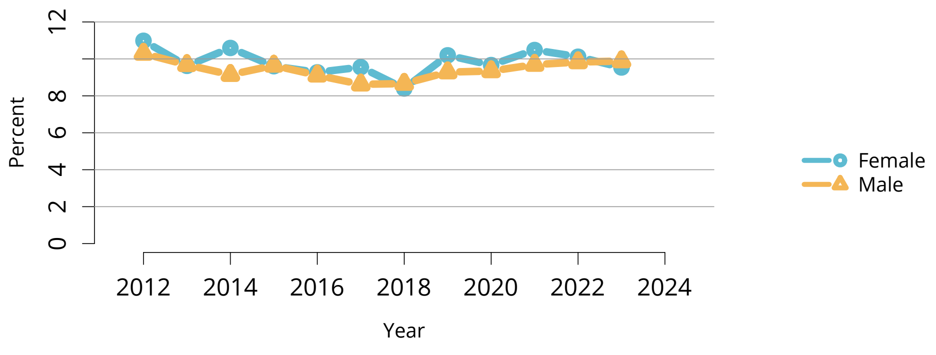

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Figure LI 89: Percent of livers recovered for transplant and not transplanted by donor sex. Percentages of livers not transplanted out of all livers recovered for transplant.

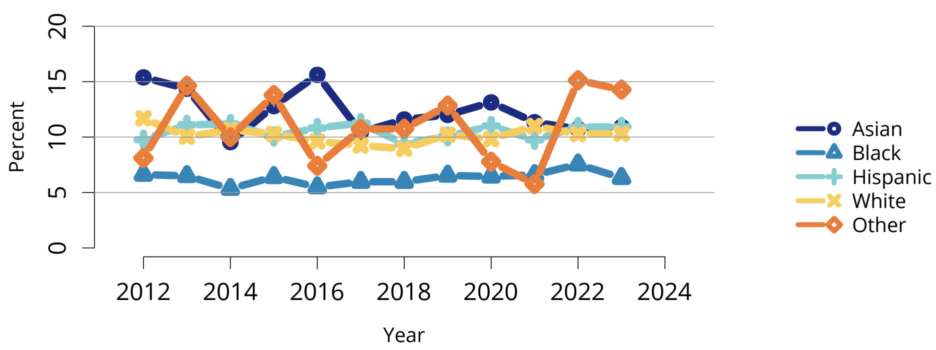

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Figure LI 90: Percent of livers recovered for transplant and not transplanted by donor race and ethnicity. Percentages of livers not transplanted out of all livers recovered for transplant. The Other race category is composed of Native American and Multiracial categories.

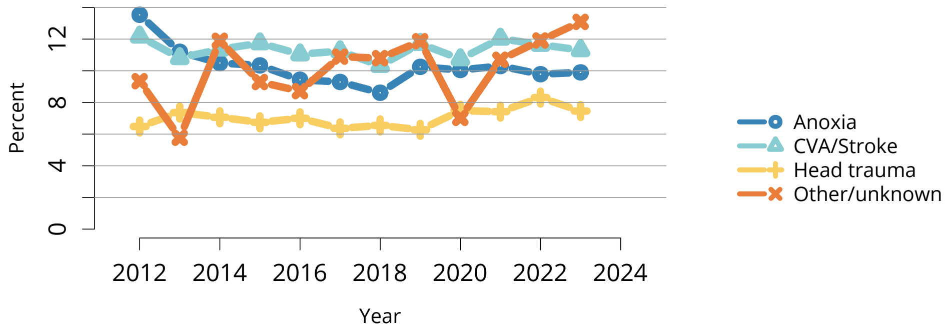

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Figure LI 91: Percent of livers recovered for transplant and not transplanted by donor cause of death. Percentages of livers not transplanted out of all livers recovered for transplant. CVA, cerebrovascular accident.

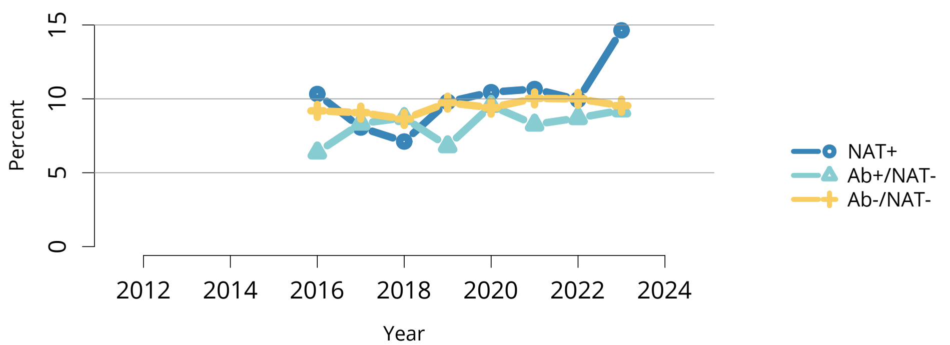

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Figure LI 92: Percent of livers recovered for transplant and not transplanted by donor HCV status. Percentages of livers not transplanted out of all livers recovered for transplant. Donor HCV status was based on NAT and antibody tests. Ab, antibody; HCV, hepatitis C virus; NAT, nucleic acid test.

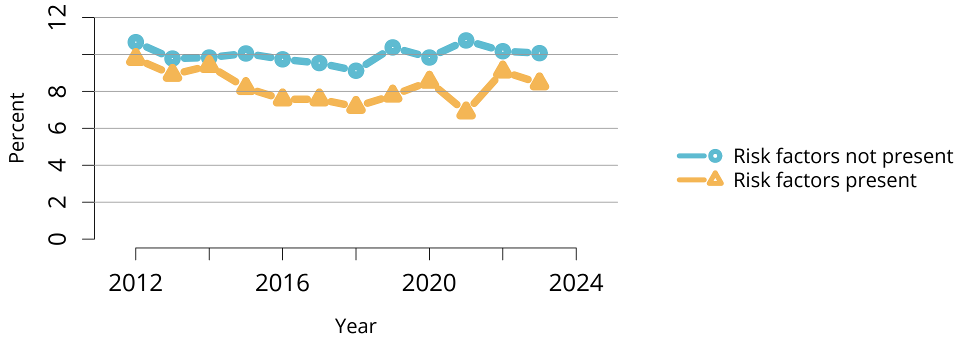

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Figure LI 93: Percent of livers recovered for transplant and not transplanted, by donor risk of disease transmission. Percentages of livers not transplanted out of all livers recovered for transplant. "Risk factors" refers to risk criteria for acute transmission of human immunodeficiency virus, hepatitis B virus, or hepatitis C virus from the US Public Health Service Guideline.

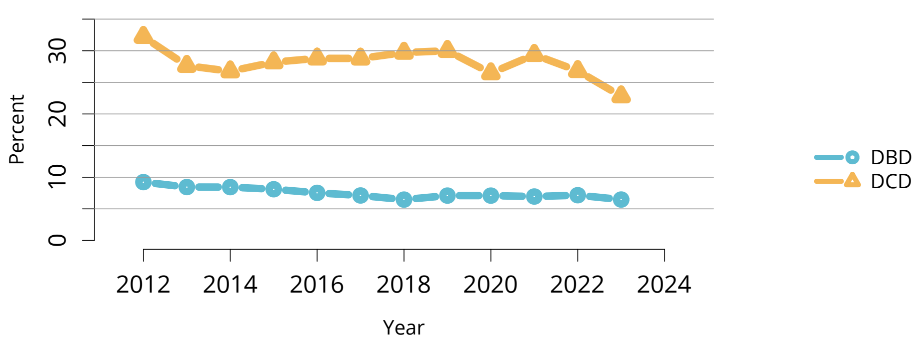

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Figure LI 94: Percent of livers recovered for transplant and not transplanted by DCD status. Percentages of livers not transplanted out of all livers recovered for transplant. DBD, donation after brain death; DCD, donation after circulatory death.

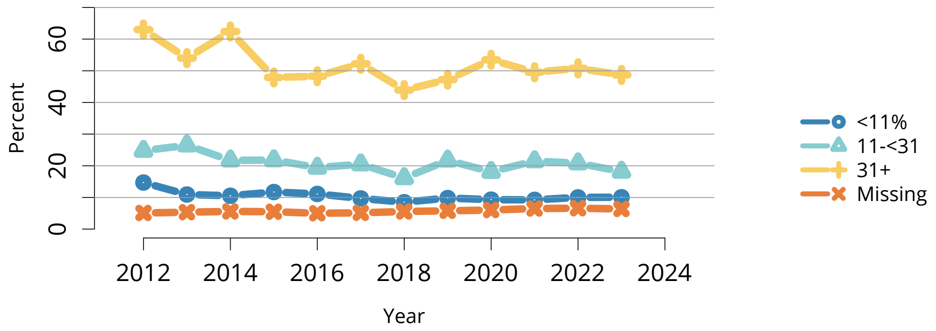

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Figure LI 95: Percent of livers recovered for transplant and not transplanted by macrovesicular fat. Percentages of livers not transplanted out of all livers recovered for transplant.

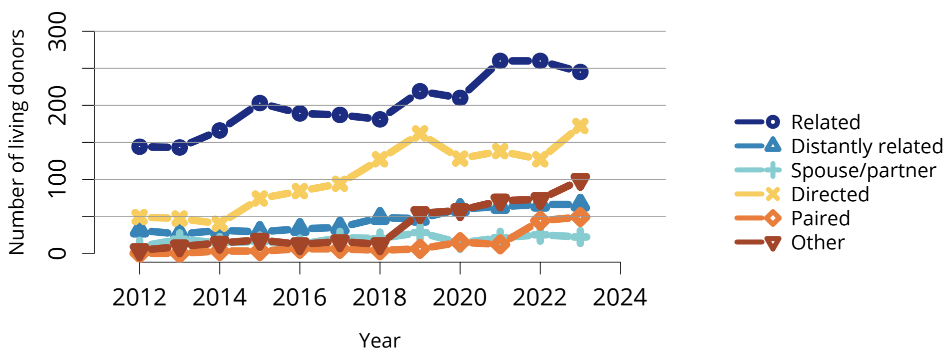

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Figure LI 96: Number of living liver donors by donor relation. Numbers of living donor donations, excluding domino livers, as reported on the OPTN Living Donor Registration Form.

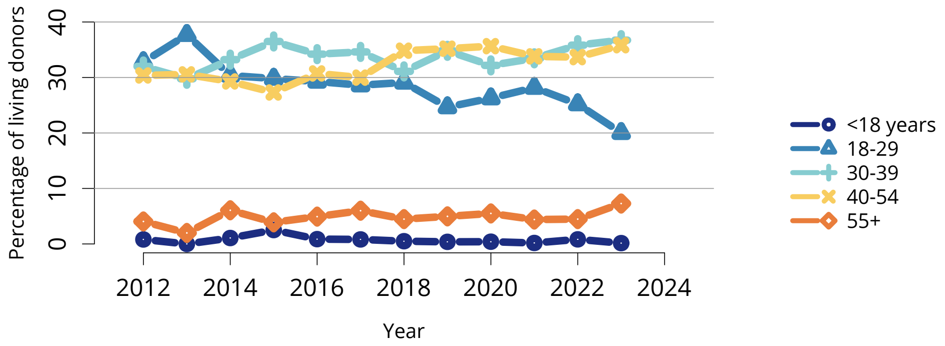

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Figure LI 97: Living liver donors by age. As reported on the OPTN Living Donor Registration Form. Domino liver donors excluded.

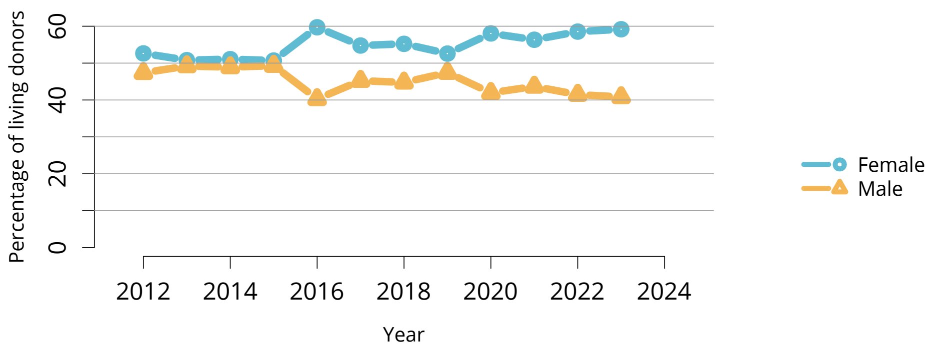

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Figure LI 98: Living liver donors by sex. As reported on the OPTN Living Donor Registration Form. Domino liver donors excluded.

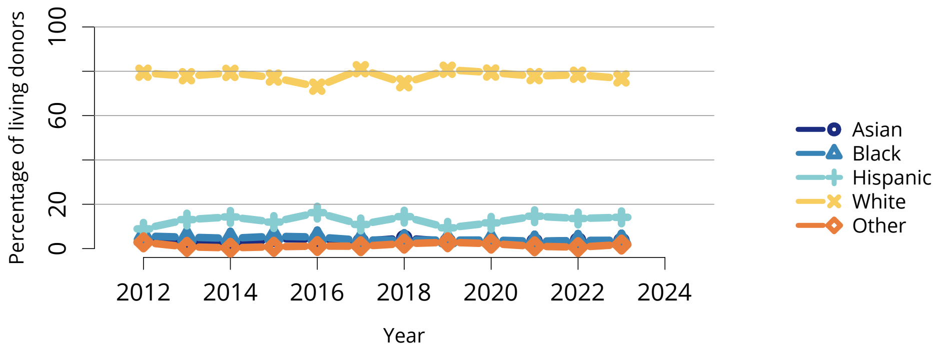

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Figure LI 99: Living liver donors by race and ethnicity. As reported on the OPTN Living Donor Registration Form. Domino liver donors excluded. The Other race category is composed of Native American and Multiracial categories.

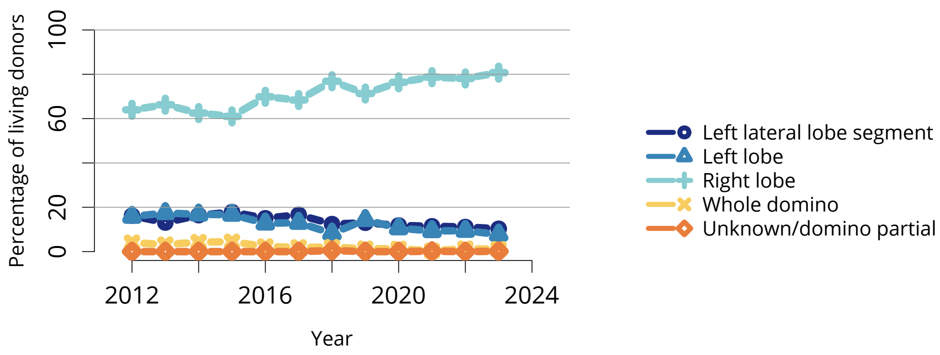

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Figure LI 100: Living donor liver transplant graft type. As reported on the OPTN Living Donor Registration Form.

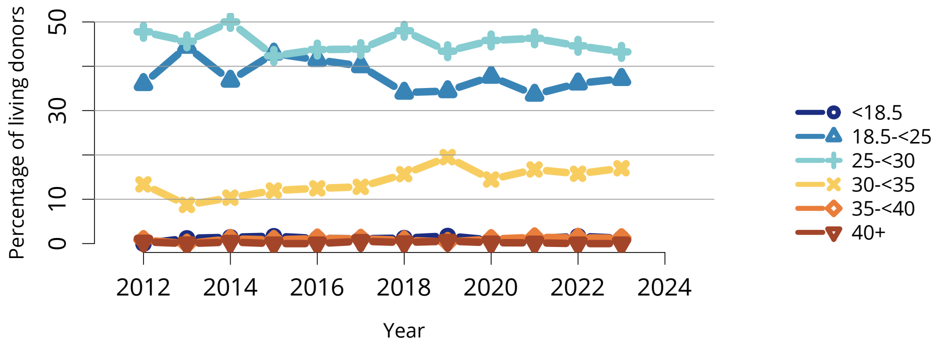

Figure LI 101: BMI among living liver donors. Donor height and weight reported on the OPTN Living Donor Registration Form. Domino liver donors excluded. BMI, body mass index.

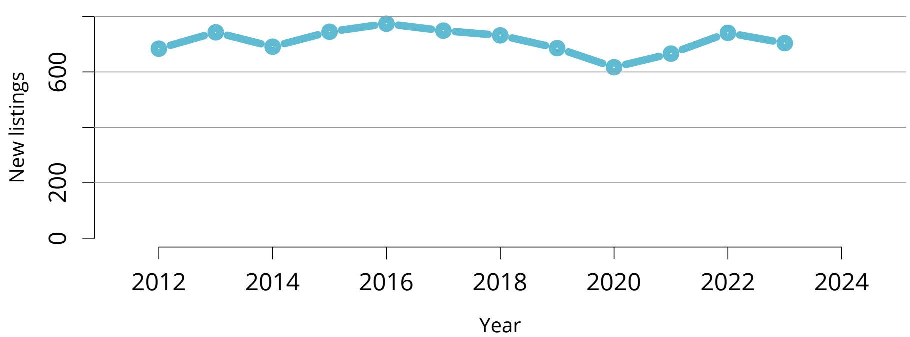

Figure LI 102: New pediatric candidates added to the liver transplant waiting list. A new candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and were subsequently relisted are considered new. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

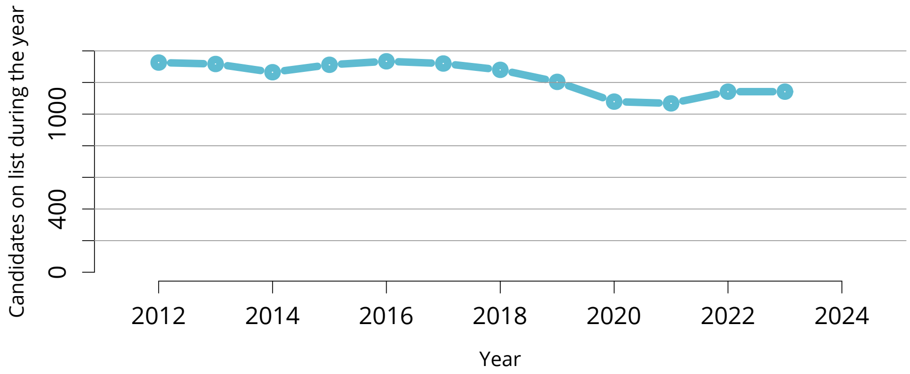

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Figure LI 103: All pediatric candidates on the liver transplant waiting list. Pediatric candidates listed at any time during the year. Candidates listed at more than one center are counted once per listing.

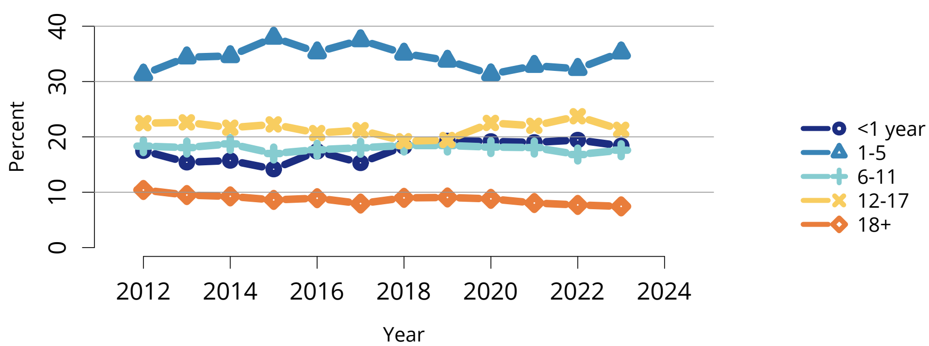

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Figure LI 104: Distribution of pediatric candidates waiting for liver transplant by age. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included. Age is determined at the earliest of transplant, death, removal, or December 31 of the year. The 18+ category is for candidates who turned age 18 while waiting.

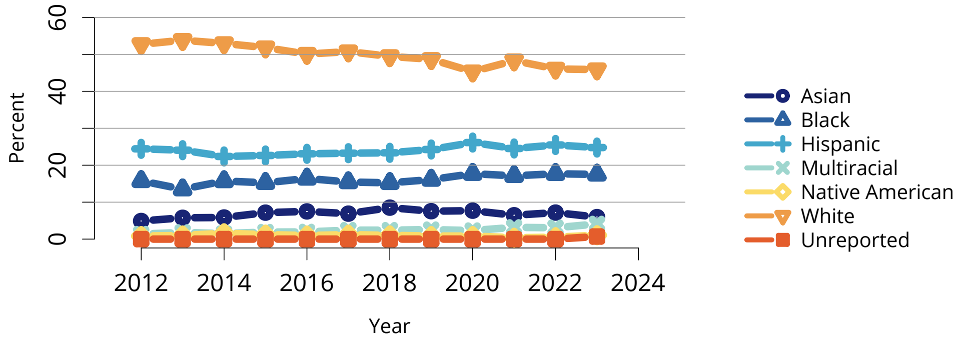

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Figure LI 105: Distribution of pediatric candidates waiting for liver transplant by race and ethnicity. Candidates waiting for transplant any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included.

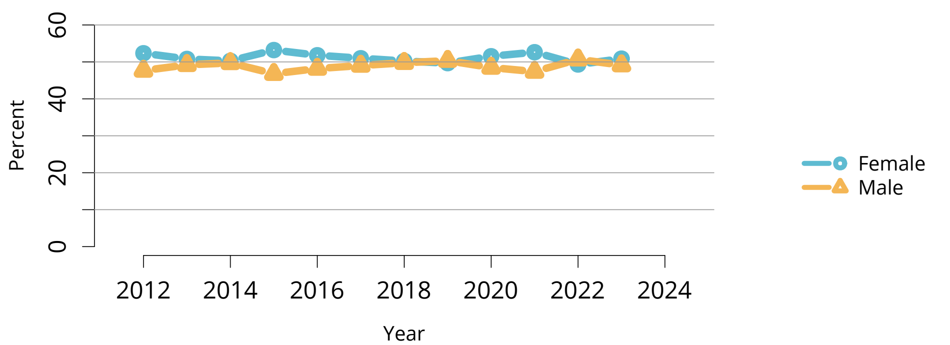

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Figure LI 106: Distribution of pediatric candidates waiting for liver transplant by sex. Candidates waiting for transplant any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

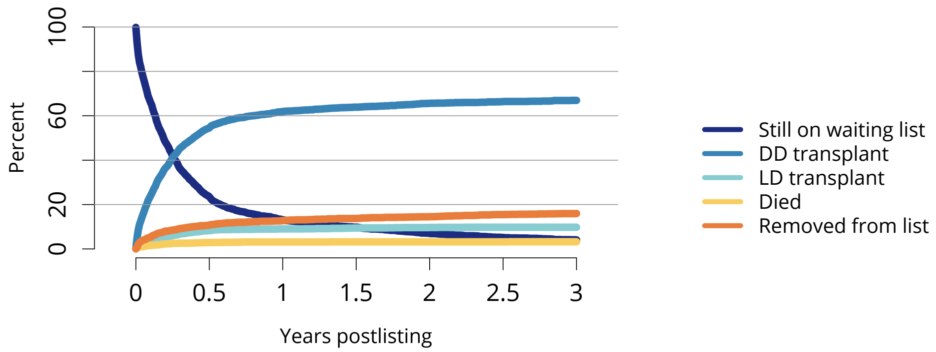

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Figure LI 107: Three-year outcomes for newly listed pediatric candidates waiting for liver transplant, 2018-2020. Pediatric candidates who joined the waiting list in 2018-2020. Candidates listed at more than one center are counted once per listing. DD, deceased donor; LD, living donor.

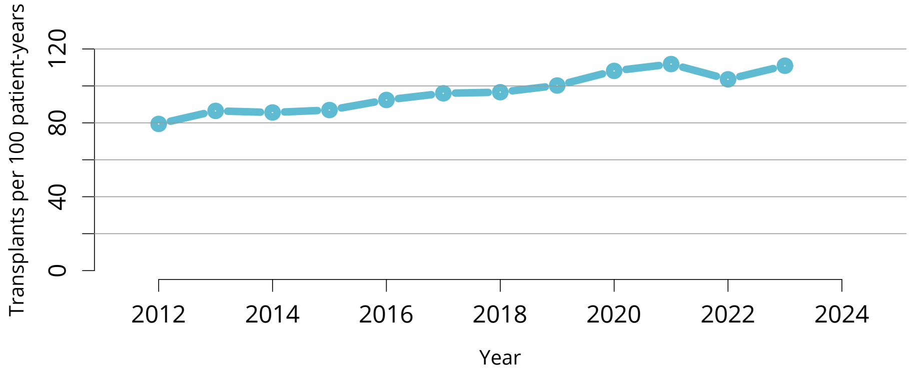

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Figure LI 108: Overall deceased donor liver transplant rates among pediatric waitlist candidates. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

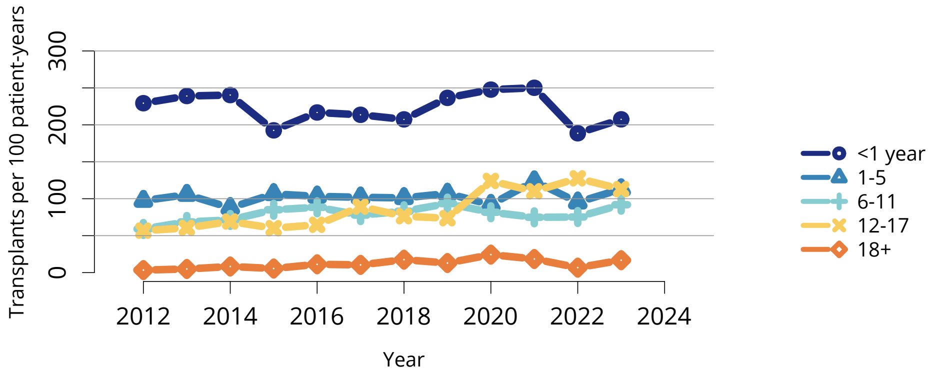

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Figure LI 109: Deceased donor liver transplant rates among pediatric waitlist candidates by age. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year. The 18+ category is for candidates who turned age 18 while waiting.

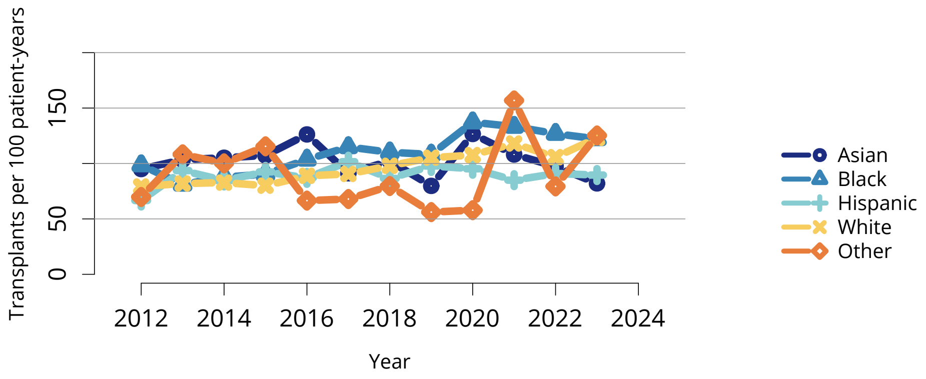

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Figure LI 110: Deceased donor liver transplant rates among pediatric waitlist candidates by race and ethnicity. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

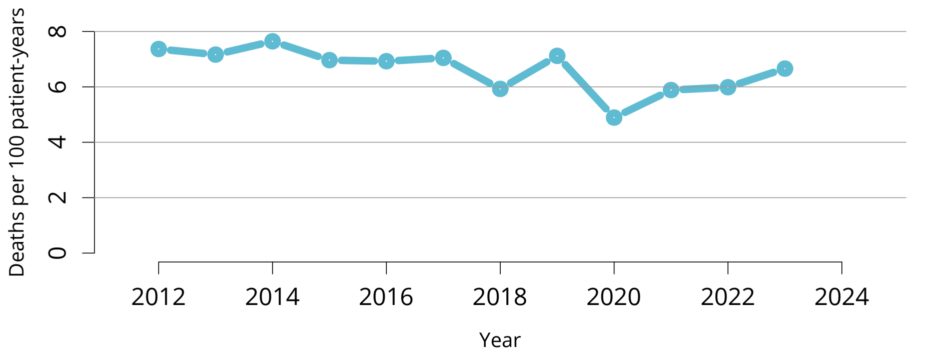

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Figure LI 111: Overall pretransplant mortality rates among pediatric candidates waitlisted for liver. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

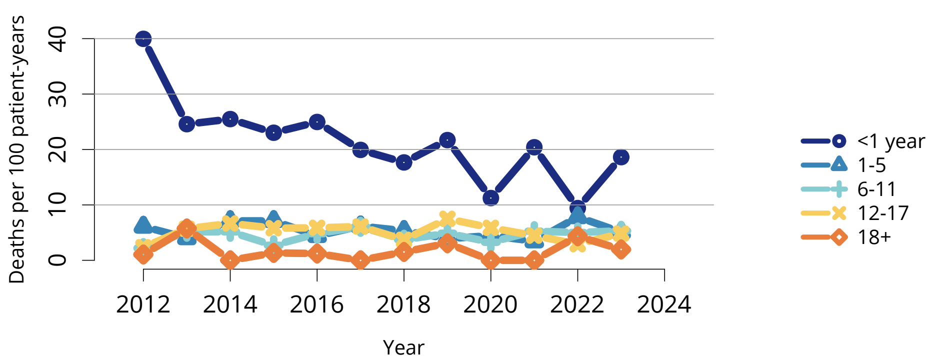

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Figure LI 112: Pretransplant mortality rates among pediatric candidates waitlisted for liver transplant by age. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year. The 18+ category is for candidates who turned age 18 while waiting.

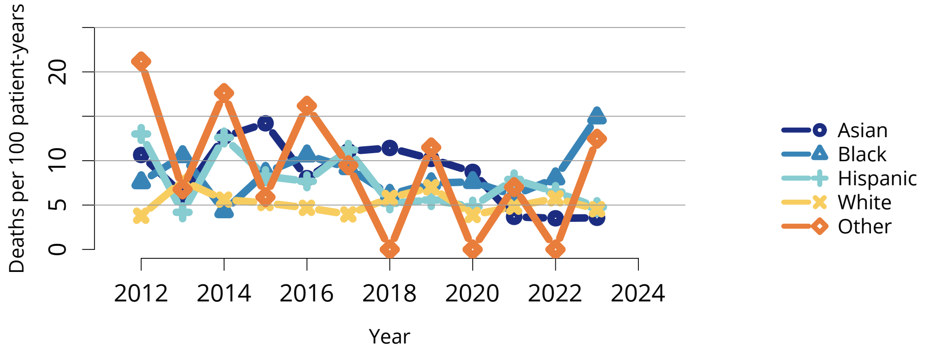

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Figure LI 113: Pretransplant mortality rates among pediatric candidates waitlisted for liver transplant by race and ethnicity. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

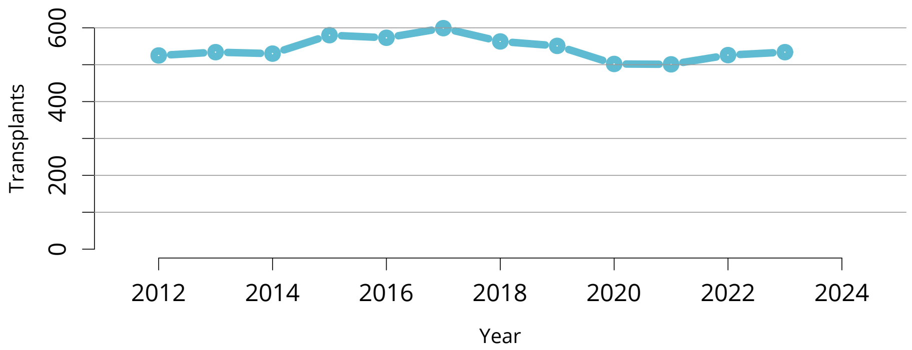

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Figure LI 114: Overall pediatric liver transplants. All pediatric liver transplant recipients, including retransplant and multiorgan recipients.

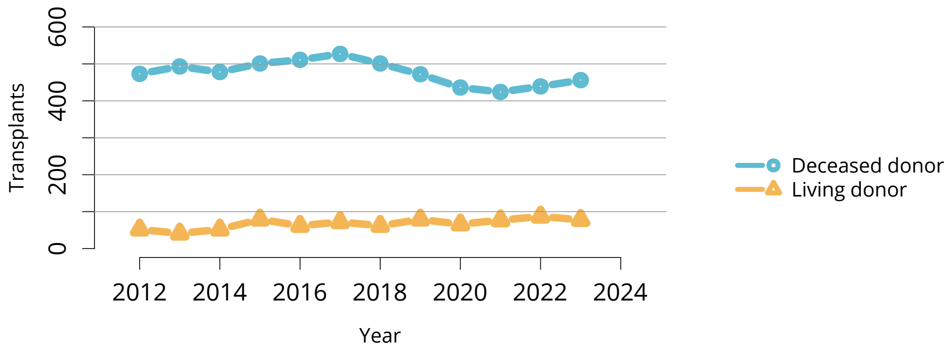

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Figure LI 115: Pediatric liver transplants by donor type. All pediatric liver transplant recipients, including retransplant and multiorgan recipients.

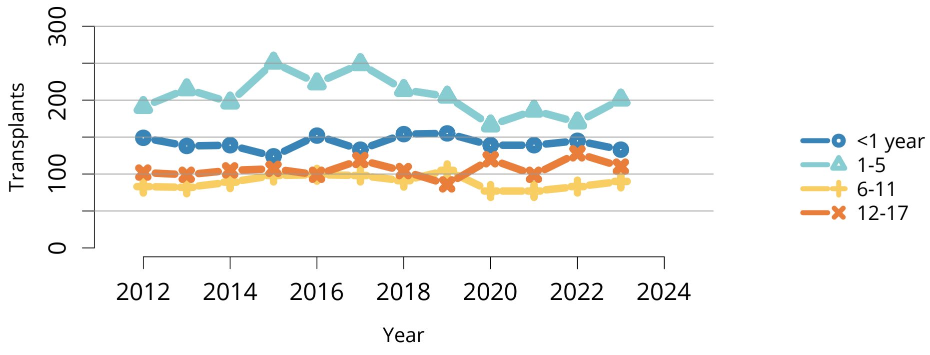

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Figure LI 116: Pediatric liver transplants by recipient age. All pediatric liver transplant recipients, including retransplant and multiorgan recipients.

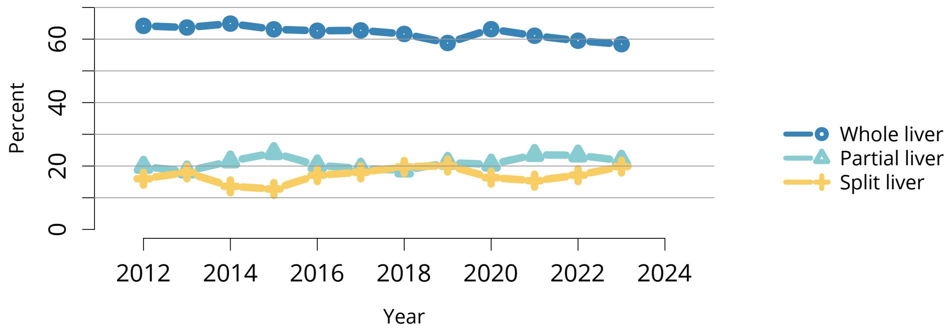

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Figure LI 117: Split or partial liver transplants in children. Percent of transplants from a split liver.

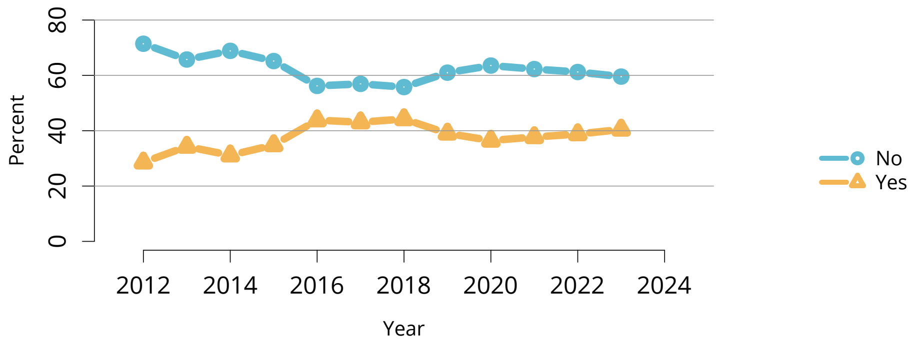

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Figure LI 118: Induction agent use in pediatric liver transplant recipients. Immunosuppression at transplant reported to the OPTN.

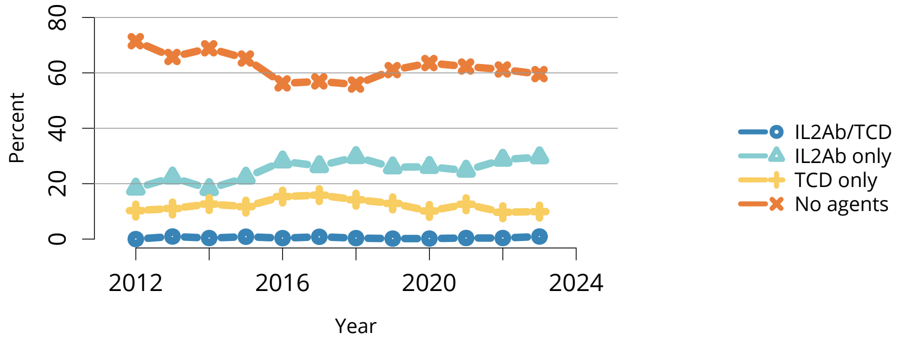

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Figure LI 119: Type of induction agent use in pediatric liver transplant recipients. Immunosuppression at transplant reported to the OPTN. IL2Ab, interleukin-2 receptor antibody; TCD, T-cell depleting.

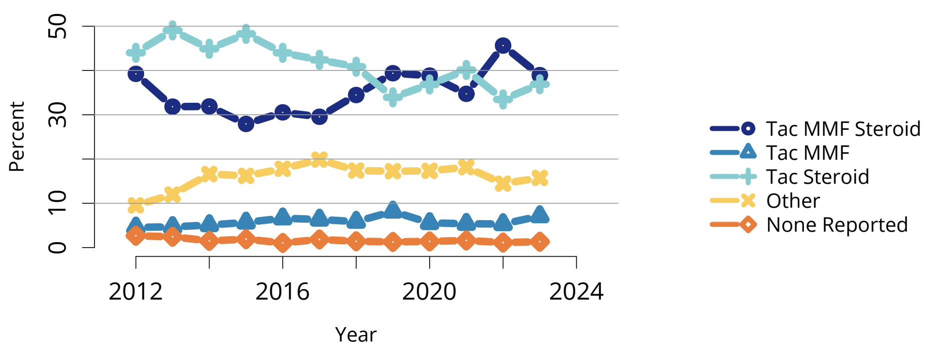

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Figure LI 120: Immunosuppression regimen use in pediatric liver transplant recipients. Immunosuppression regimen at transplant reported to the OPTN. MMF, all mycophenolate agents; Tac, tacrolimus.

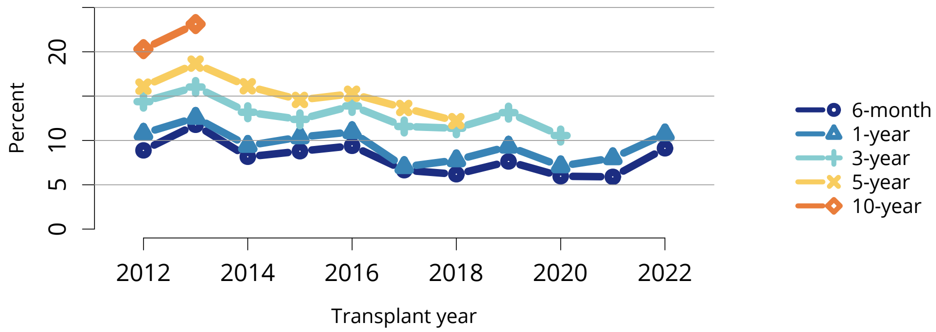

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Figure LI 121: Graft failure among pediatric deceased donor liver transplant recipients. All pediatric recipients of deceased donor livers, including multiorgan transplant recipients. Estimates are unadjusted, computed using Kaplan-Meier methods. Recipients are followed to the earliest of retransplant; death; or 6 months, 1, 3, 5, or 10 years posttransplant. All-cause graft failure is defined as any of the prior outcomes prior to 6 months, 1, 3, 5, or 10 years, respectively.

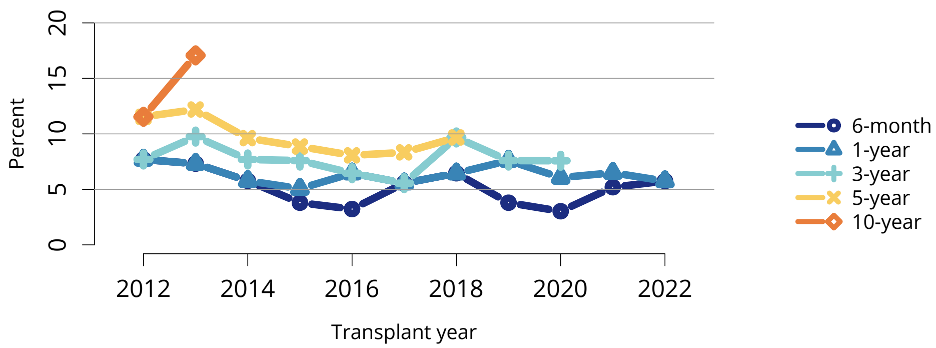

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Figure LI 122: Graft failure among pediatric living donor liver transplant recipients. All pediatric recipients of living donor livers, including multiorgan transplant recipients. Estimates are unadjusted, computed using Kaplan-Meier methods. Recipients are followed to the earliest of retransplant; death; or 6 months, 1, 3, 5, or 10 years posttransplant. All-cause graft failure is defined as any of the prior outcomes prior to 6 months, 1, 3, 5, or 10 years, respectively.

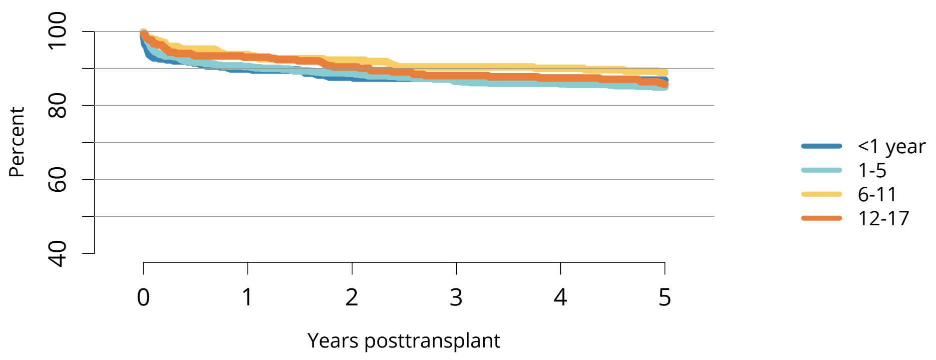

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Figure LI 123: Graft survival among pediatric deceased donor liver transplant recipients, 2016-2018, by age. Recipient survival estimated using unadjusted Kaplan-Meier methods.

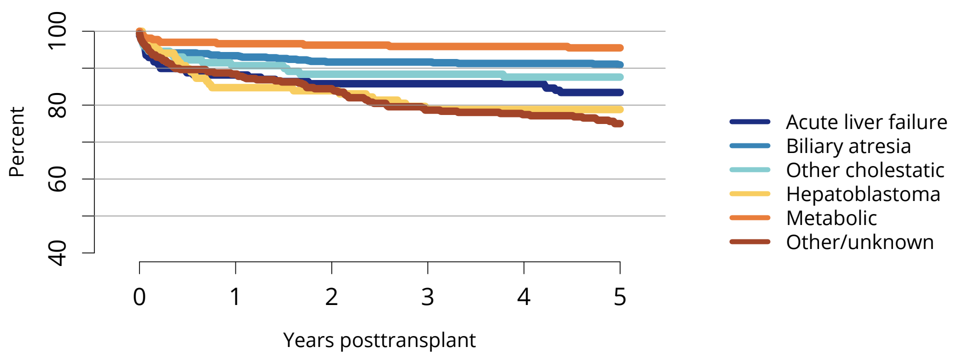

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Figure LI 124: Graft survival among pediatric deceased donor liver transplant recipients, 2016-2018, by diagnosis. Graft survival estimated using unadjusted Kaplan-Meier methods.

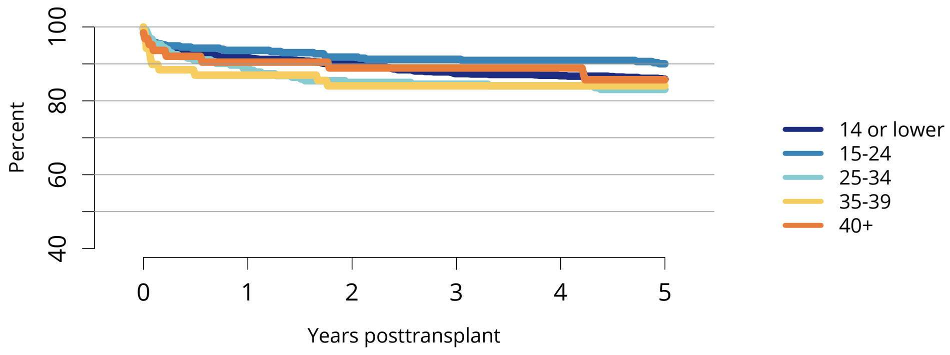

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Figure LI 125: Graft survival among pediatric deceased donor liver transplant recipients, 2016-2018, by laboratory MELD or PELD score. Graft survival estimated using unadjusted Kaplan-Meier methods. Pediatric candidates aged 12-17 years can be assigned MELD or PELD scores. MELD, model for end-stage liver disease; PELD, pediatric end-stage liver disease.

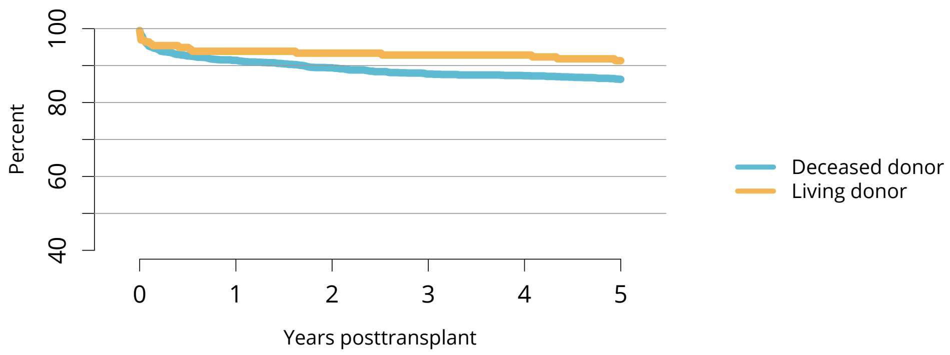

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Figure LI 126: Graft survival among pediatric liver transplant recipients, 2016-2018, by donor type. Recipient survival estimated using unadjusted Kaplan-Meier methods.

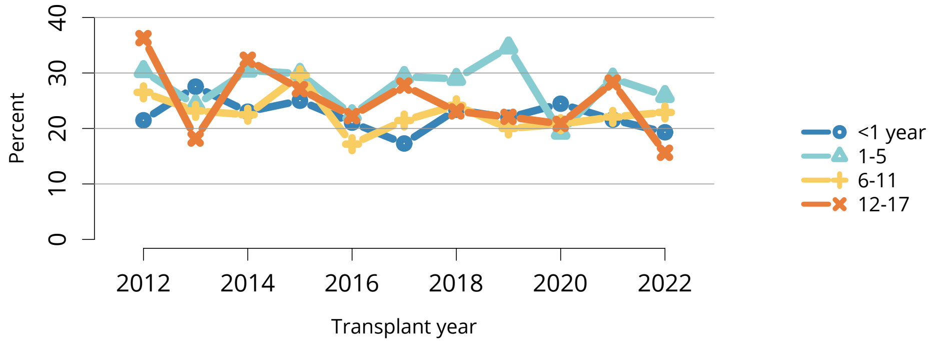

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Figure LI 127: Incidence of acute rejection by 1 year posttransplant among pediatric liver transplant recipients by age. Only the first reported rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier method.

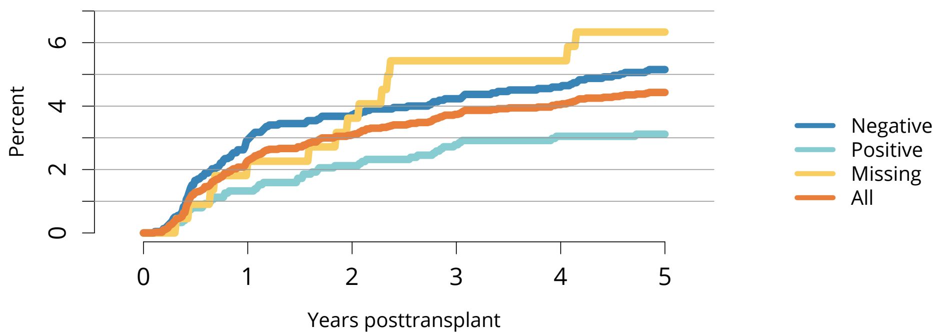

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Figure LI 128: Incidence of PTLD among pediatric liver transplant recipients by recipient EBV status at transplant, 2012-2018. Cumulative incidence is estimated using the Kaplan-Meier method. PTLD is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or on the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus; PTLD, posttransplant lymphoproliferative disorder.

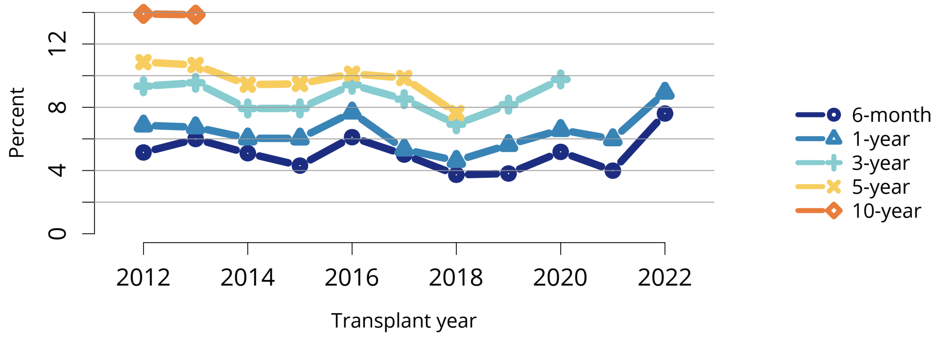

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Figure LI 129: Patient death among pediatric liver transplant recipients. All pediatric recipients of deceased donor livers, including multiorgan transplant recipients. Estimates are unadjusted, computed using Kaplan-Meier methods.

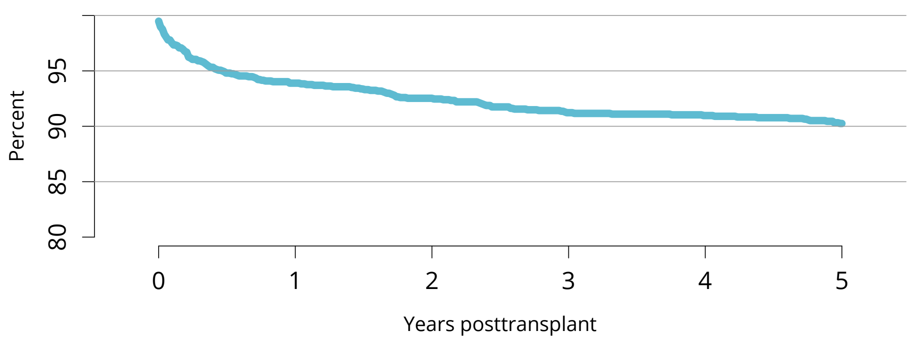

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Figure LI 130: Overall patient survival among pediatric deceased donor liver transplant recipients, 2016-2018. Recipient survival estimated using unadjusted Kaplan-Meier methods.

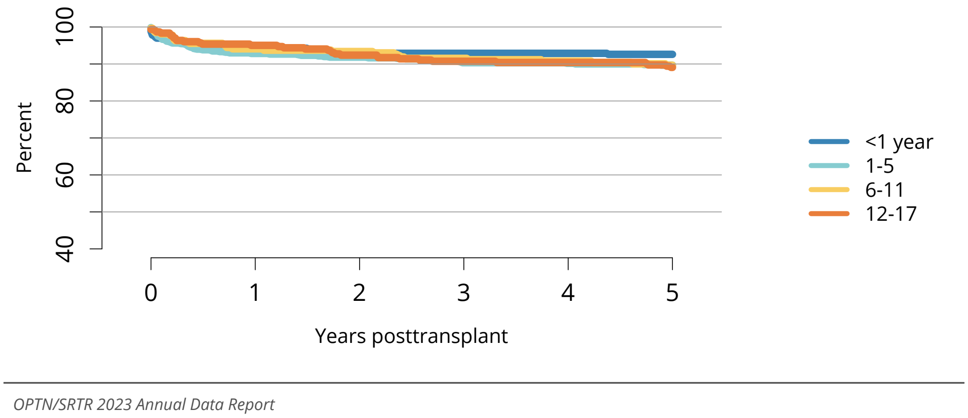

Figure LI 131: Patient survival among pediatric deceased donor liver transplant recipients, 2016-2018, by recipient age. Recipient survival estimated using unadjusted Kaplan-Meier methods.

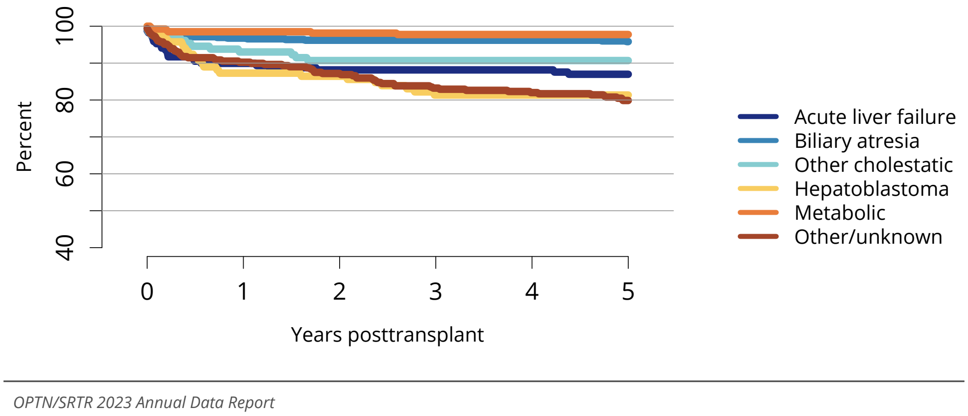

Figure LI 132: Patient survival among pediatric deceased donor liver transplant recipients, 2016-2018, by diagnosis. Recipient survival estimated using unadjusted Kaplan-Meier methods.

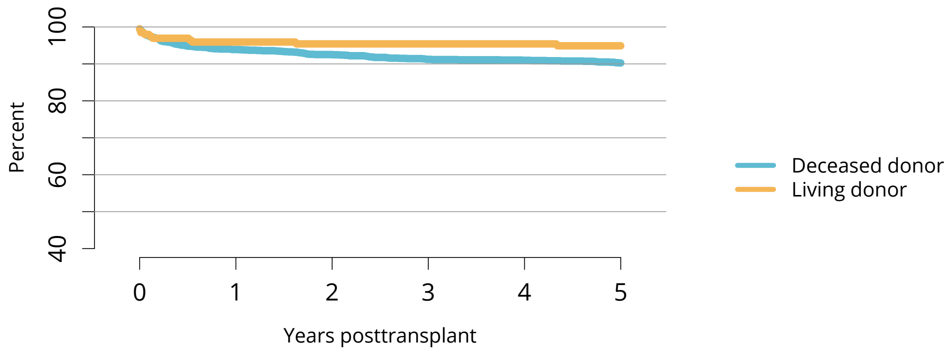

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Figure LI 133: Patient survival among pediatric liver transplant recipients, 2016-2018, by donor type. Recipient survival estimated using unadjusted Kaplan-Meier methods.

Table LI 1: Demographic characteristics of adults on the liver transplant waiting list on December 31, 2013, and December 31, 2023. Candidates waiting for transplant on December 31 of the given year, regardless of first listing date. Distance is computed from candidate's home zip code to the transplant center. Age is determined on December 31 of the year.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Age (years)				
18-34 years	681	4.3	542	5.6
35-49	2286	14.5	1763	18.1
50-64	9821	62.3	4649	47.7
65+	2973	18.9	2791	28.6
Sex				
Female	5885	37.3	3878	39.8
Male	9876	62.7	5867	60.2
Race and ethnicity				
Asian	797	5.1	482	4.9
Black	1114	7.1	670	6.9
Hispanic	2619	16.6	2004	20.6
Multiracial	44	0.3	56	0.6
Native American	111	0.7	117	1.2
White	11076	70.3	6381	65.5
Unreported	0	0	35	0.4
Geography				
Metropolitan	13253	84.1	8163	83.8
Nonmetropolitan	2349	14.9	1459	15
Missing	159	1	123	1.3
Miles between candidate and center				
<50 miles	9133	57.9	5480	56.2
50-<100	2564	16.3	1821	18.7
100-<150	1358	8.6	903	9.3
150-<250	1309	8.3	757	7.8
250+	1272	8.1	693	7.1
Missing	125	0.8	91	0.9
All candidates				
All candidates	15761	100	9745	100

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Table LI 2: Clinical characteristics of adults on the liver transplant waiting list on December 31, 2013, and December 31, 2023. Candidates waiting for transplant on December 31 of the given year, regardless of first listing date. HCC, hepatocellular carcinoma; HCV, hepatitis C virus; MASH, metabolic dysfunction–associated steatohepatitis.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Diagnosis				
Acute liver failure	273	1.7	105	1.1
HCV	4668	29.6	746	7.7
Alcohol-associated cirrhosis	3725	23.6	3290	33.8
Alcohol-associated hepatitis	19	0.1	201	2.1
Cholestatic disease	1360	8.6	785	8.1
HCC	1059	6.7	1068	11
MASH	1489	9.4	2067	21.2
Other/unknown	3168	20.1	1483	15.2
Blood type				
A	6106	38.7	3855	39.6
AB	403	2.6	158	1.6
B	1698	10.8	872	8.9
O	7554	47.9	4860	49.9
Urgency status				
14 or lower	7259	46.1	3961	40.6
15-24	4305	27.3	3228	33.1
25-34	1378	8.7	232	2.4
35-39	37	0.2	21	0.2
40+	14	0.1	7	0.1
Status 1A	2	0	2	0
Inactive	2759	17.5	2294	23.5
Missing	7	0	0	0
HCC status for liver candidates				
No HCC exception	14165	89.9	8193	84.1
HCC exception	1589	10.1	1552	15.9
Missing	7	0	0	0
All candidates				
All candidates	15761	100	9745	100

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Table LI 3: Listing characteristics of adults on the liver transplant waiting list on December 31, 2013, and December 31, 2023. Candidates waiting for transplant on December 31 of the given year, regardless of first listing date.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Previous transplant				
No prior transplant	15348	97.4	9476	97.2
Prior transplant	413	2.6	269	2.8
Waiting time				
<90 days	2100	13.3	2077	21.3
3-<6 months	1717	10.9	1428	14.7
6-<12 months	2331	14.8	1719	17.6
1-<2 years	2810	17.8	1727	17.7
2+ years	6803	43.2	2794	28.7
All candidates				
All candidates	15761	100	9745	100

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Table LI 4: Liver transplant waitlist activity among adults. Candidates listed at more than one center are counted once per listing. Candidates who are listed, undergo transplant, and are relisted are counted more than once. Candidates are not considered to be on the list on the day they are removed; counts on January 1 may differ from counts on December 31 of the prior year. Candidates listed for multiorgan transplants are included.

Waiting list state	**2021**	**2022**	**2023**
Waiting list state			
Patients at start of year	11768	11322	10538
Patients added during year	13165	12862	13954
Patients removed during year	13611	13645	14747
Patients at end of year	11322	10539	9745

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Table LI 5: Removal reason among adult liver transplant candidates. Removal reason as reported to the OPTN. Candidates with death dates that precede removal dates are assumed to have died waiting.

Removal reason	2021	2022	2023
Removal reason			
Deceased donor transplant	8213	8462	9516
Living donor transplant	492	515	579
Transplant outside US	1	2	2
Patient died	1154	1040	943
Patient refused transplant	135	118	146
Improved, transplant not needed	1051	983	1101
Too sick for transplant	1177	1091	973
Other	1388	1434	1487

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Table LI 6: Demographic characteristics of adult liver transplant recipients, 2013 and 2023. Liver transplant recipients, including retransplant recipients. Distance is computed from recipient's home zip code to the transplant center.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Recipient age (years)				
18-34 years	335	5.7	758	7.5
35-49	976	16.5	2358	23.3
50-64	3645	61.6	4741	46.8
65+	965	16.3	2268	22.4
Sex				
Female	2021	34.1	3925	38.8
Male	3900	65.9	6200	61.2
Race and ethnicity				
Asian	266	4.5	418	4.1
Black	605	10.2	667	6.6
Hispanic	812	13.7	1769	17.5
Multiracial	25	0.4	65	0.6
Native American	29	0.5	101	1
White	4184	70.7	7068	69.8
Unreported	0	0	37	0.4
Body mass index				
<18.5	124	2.1	165	1.6
18.5-<25	1685	28.5	2633	26
25-<30	2053	34.7	3336	32.9
30-<35	1273	21.5	2266	22.4
35+	768	13	1571	15.5
Missing	18	0.3	154	1.5
Insurance				
Private	3201	54.1	5151	50.9
Medicare	1686	28.5	2629	26
Medicaid	774	13.1	1924	19
Other/unknown	260	4.4	421	4.2
Geography				
Metropolitan	4874	82.3	8380	82.8
Nonmetropolitan	927	15.7	1621	16
Missing	120	2	124	1.2
Miles between recipient and center				
<50 miles	3311	55.9	5736	56.7
50-<100	984	16.6	1779	17.6
100-<150	539	9.1	927	9.2
150-<250	468	7.9	793	7.8
250+	551	9.3	804	7.9
Missing	68	1.1	86	0.8
All recipients				
All recipients	5921	100	10125	100

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Table LI 7: Clinical characteristics of adult liver transplant recipients, 2013 and 2023. Liver transplant recipients, including retransplant recipients. HCC, hepatocellular carcinoma; HCV, hepatitis C virus; MASH, metabolic dysfunction–associated steatohepatitis.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Diagnosis				
Acute liver failure	229	3.9	198	2
HCV	1540	26	423	4.2
Alcohol-associated cirrhosis	1054	17.8	3505	34.6
Alcohol-associated hepatitis	7	0.1	658	6.5
Cholestatic disease	499	8.4	747	7.4
HCC	1041	17.6	1055	10.4
MASH	597	10.1	2055	20.3
Other/unknown	954	16.1	1484	14.7
Blood type				
A	2140	36.1	3661	36.2
AB	287	4.8	478	4.7
B	801	13.5	1267	12.5
O	2693	45.5	4719	46.6
Urgency status at transplant				
14 or lower	168	2.8	1970	19.5
15-24	1753	29.6	3131	30.9
25-34	2444	41.3	2714	26.8
35-39	662	11.2	1094	10.8
40+	695	11.7	985	9.7
Status 1B	1	0	4	0
Status 1A	195	3.3	215	2.1
Inactive	1	0	12	0.1
Missing	2	0	0	0
HCC status for liver recipients				
No HCC exception	4357	73.6	8647	85.4
HCC exception	1562	26.4	1478	14.6
Missing	2	0	0	0
All recipients				
All recipients	5921	100	10125	100

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Table LI 8: Transplant characteristics of adult liver transplant recipients, 2013 and 2023. Liver transplant recipients, including retransplant recipients. DBD, donation after brain death; DCD, donation after circulatory death.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Waiting time				
<1 day	12	0.2	12	0.1
1-<90 days	2734	46.2	6450	63.7
3-<6 months	992	16.8	1097	10.8
6-<12 months	925	15.6	1382	13.6
1-<2 years	773	13.1	728	7.2
2+ years	483	8.2	456	4.5
Missing	2	0	0	0
Donor type				
Deceased donor	5710	96.4	9545	94.3
Living donor	211	3.6	580	5.7
Split versus whole liver transplant				
Whole liver	5645	95.3	9458	93.4
Partial liver	204	3.4	576	5.7
Split liver	72	1.2	91	0.9
Donation after circulatory death				
DBD	5404	91.3	7850	77.5
DCD	306	5.2	1695	16.7
Living donor	211	3.6	580	5.7
Previous transplant for recipients				
No prior transplant	5626	95	9780	96.6
Prior transplant	295	5	345	3.4
All recipients				
All recipients	5921	100	10125	100

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Table LI 9: Demographic characteristics of pediatric candidates on the liver transplant waiting list on December 31, 2013, and December 31, 2023. Candidates younger than 18 years at listing waiting for transplant on December 31 of the given year, regardless of first listing date. Age is determined on December 31 of the year. The 18+ category is for candidates who turned age 18 while waiting. Distance is computed from candidate's home zip code to the transplant center.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Age (years)				
<1 year	38	6.6	43	10.6
1-5	178	31	139	34.4
6-11	120	20.9	84	20.8
12-17	148	25.8	89	22
18+	90	15.7	49	12.1
Sex				
Female	291	50.7	200	49.5
Male	283	49.3	204	50.5
Race and ethnicity				
Asian	23	4	29	7.2
Black	85	14.8	54	13.4
Hispanic	127	22.1	124	30.7
Multiracial	11	1.9	18	4.5
Native American	7	1.2	3	0.7
White	321	55.9	172	42.6
Unreported	0	0	4	1
Geography				
Metropolitan	481	83.8	353	87.4
Nonmetropolitan	77	13.4	44	10.9
Missing	16	2.8	7	1.7
Miles between candidate and center				
<50 miles	292	50.9	203	50.2
50-<100	80	13.9	73	18.1
100-<150	55	9.6	28	6.9
150-<250	58	10.1	39	9.7
250+	77	13.4	55	13.6
Missing	12	2.1	6	1.5
All candidates				
All candidates	574	100	404	100

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Table LI 10: Clinical characteristics of pediatric candidates on the liver transplant waiting list on December 31, 2013, and December 31, 2023. Candidates younger than 18 years at listing waiting for transplant on December 31 of the given year, regardless of first listing date. For urgency status, pediatric candidates aged 12-17 years can be assigned model for end-stage liver disease (MELD) or pediatric end-stage liver disease (PELD) scores. HCC, hepatocellular carcinoma.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Pediatric diagnosis				
Acute liver failure	29	5.1	13	3.2
Biliary atresia	177	30.8	146	36.1
Other cholestatic	52	9.1	35	8.7
Hepatoblastoma	7	1.2	6	1.5
Metabolic	76	13.2	43	10.6
Other/unknown	233	40.6	161	39.9
Blood type				
A	167	29.1	113	28
AB	17	3	6	1.5
B	78	13.6	52	12.9
O	312	54.4	233	57.7
Urgency status				
14 or lower	161	28	125	30.9
15-24	81	14.1	55	13.6
25-34	76	13.2	33	8.2
35-39	13	2.3	5	1.2
40+	32	5.6	4	1
Status 1B	12	2.1	26	6.4
Status 1A	1	0.2	2	0.5
Inactive	196	34.1	154	38.1
Missing	2	0.3	0	0
HCC status for liver candidates				
No HCC exception	569	99.1	403	99.8
HCC exception	3	0.5	1	0.2
Missing	2	0.3	0	0
All candidates				
All candidates	574	100	404	100

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Table LI 11: Listing characteristics of pediatric candidates on the liver transplant waiting list on December 31, 2013, and December 31, 2023. Candidates younger than 18 years at listing waiting for transplant on December 31 of the given year, regardless of first listing date.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Previous transplant				
No prior transplant	526	91.6	378	93.6
Prior transplant	48	8.4	26	6.4
Waiting time				
<90 days	100	17.4	99	24.5
3-<6 months	79	13.8	54	13.4
6-<12 months	79	13.8	56	13.9
1-<2 years	77	13.4	73	18.1
2+ years	239	41.6	122	30.2
All candidates				
All candidates	574	100	404	100

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Table LI 12: Liver transplant waitlist activity among pediatric candidates. Candidates who are listed, undergo transplant, and are relisted are counted more than once. Candidates are not considered to be on the list on the day they are removed; counts on January 1 may differ from counts on December 31 of the prior year. Candidates listed for multiorgan transplants are included.

Waiting list state	2021	2022	2023
Waiting list state			
Patients at start of year	402	401	438
Patients added during year	666	741	704
Patients removed during year	667	704	738
Patients at end of year	401	438	404

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Table LI 13: Removal reason among pediatric liver transplant candidates. Removal reason as reported to the OPTN. Candidates with death dates that precede removal dates are assumed to have died waiting.

Removal reason	2021	2022	2023
Removal reason			
Deceased donor transplant	435	450	470
Living donor transplant	77	88	79
Transplant outside US	1	0	1
Patient died	20	20	27
Patient refused transplant	5	2	3
Improved, transplant not needed	85	79	96
Too sick for transplant	16	30	13
Other	28	35	49

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Table LI 14: Demographic characteristics of pediatric liver transplant recipients, 2013 and 2023. Pediatric liver transplant recipients, including retransplant recipients. Distance is computed from recipient's home zip code to the transplant center.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Recipient age (years)				
<1 year	138	25.8	133	24.9
1-5	215	40.3	201	37.6
6-11	82	15.4	90	16.9
12-17	99	18.5	110	20.6
Sex				
Female	256	47.9	275	51.5
Male	278	52.1	259	48.5
Race and ethnicity				
Asian	35	6.6	30	5.6
Black	71	13.3	105	19.7
Hispanic	142	26.6	114	21.3
Multiracial	10	1.9	19	3.6
Native American	6	1.1	7	1.3
White	270	50.6	256	47.9
Unreported	0	0	3	0.6
Insurance				
Private	219	41	202	37.8
Medicare	6	1.1	4	0.7
Medicaid	234	43.8	271	50.7
Other/unknown	75	14	57	10.7
Geography				
Metropolitan	441	82.6	441	82.6
Nonmetropolitan	75	14	83	15.5
Missing	18	3.4	10	1.9
Miles between recipient and center				
<50 miles	238	44.6	241	45.1
50-<100	77	14.4	89	16.7
100-<150	55	10.3	65	12.2
150-<250	70	13.1	61	11.4
250+	80	15	69	12.9
Missing	14	2.6	9	1.7
All recipients				
All recipients	534	100	534	100

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Table LI 15: Clinical characteristics of pediatric liver transplant recipients, 2013 and 2023. Pediatric liver transplant recipients, including retransplant recipients. For urgency status, pediatric candidates aged 12-17 years can be assigned model for end-stage liver disease (MELD) or pediatric end-stage liver disease (PELD) scores. HCC, hepatocellular carcinoma.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Diagnosis				
Acute liver failure	74	13.9	43	8.1
Biliary atresia	178	33.3	200	37.5
Other cholestatic	54	10.1	39	7.3
Hepatoblastoma	42	7.9	43	8.1
Metabolic	88	16.5	79	14.8
Other/unknown	98	18.4	130	24.3
Blood type				
A	191	35.8	189	35.4
AB	22	4.1	27	5.1
B	72	13.5	74	13.9
O	249	46.6	244	45.7
Urgency status at transplant				
14 or lower	53	9.9	220	41.2
15-24	75	14	90	16.9
25-34	107	20	36	6.7
35-39	32	6	6	1.1
40+	56	10.5	9	1.7
Status 1B	119	22.3	119	22.3
Status 1A	92	17.2	52	9.7
Inactive	0	0	2	0.4
HCC status for liver recipients				
No HCC exception	528	98.9	532	99.6
HCC exception	6	1.1	2	0.4
All recipients				
All recipients	534	100	534	100

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Table LI 16: Transplant characteristics of pediatric liver transplant recipients, 2013 and 2023. Pediatric liver transplant recipients, including retransplant recipients. DBD, donation after brain death; DCD, donation after circulatory death.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Waiting time				
<1 day	2	0.4	0	0
1-<90 days	334	62.5	349	65.4
3-<6 months	94	17.6	89	16.7
6-<12 months	58	10.9	56	10.5
1-<2 years	27	5.1	27	5.1
2+ years	19	3.6	13	2.4
ABO-Incompatible transplant				
Compatible/Identical	515	96.4	511	95.7
Incompatible	19	3.6	23	4.3
Donor type				
Deceased donor	493	92.3	456	85.4
Living donor	41	7.7	78	14.6
Split versus whole liver transplant				
Whole liver	340	63.7	312	58.4
Partial liver	98	18.4	116	21.7
Split liver	96	18	106	19.9
Donation after circulatory death				
DBD	490	91.8	456	85.4
DCD	3	0.6	0	0
Living donor	41	7.7	78	14.6
Previous transplant for recipients				
No prior transplant	487	91.2	510	95.5
Prior transplant	47	8.8	24	4.5
All recipients				
All recipients	534	100	534	100

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OPTN/SRTR 2023 Annual Data Report: Intestine

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Abstract

Intestine transplant can have significant health and quality-of-life benefits for those who require it. Despite its infrequent use, intestine transplant remains a mainstay of treating those with complications from long-term parenteral nutrition due to intestinal failure, as well as salvage therapy for those with a significant abdominal catastrophe. In 2023, there were 135 candidates added to the intestine transplant waiting list. Those awaiting intestine-without-liver transplant have low mortality on the waiting list, with no reported deaths in 2023. However, 8 patients died awaiting intestine-with-liver transplant, and the estimated 3-year mortality for those listed exceeds 10.0%. A total of 95 intestine transplants were performed in 2023, with only 33 performed in the pediatric age range. However, 18 of 34 recipients of intestine-with-liver transplant were in the pediatric age range. Immunosuppression for intestine transplants most commonly included an induction agent followed by maintenance with a combination of medications that included tacrolimus. In the recipients of intestine-without-liver transplants, 1- and 5-year graft survival were 78.3% and 46.5% in adult and 76.1% and 52.2% in pediatric recipients,

respectively. In the recipients of intestine-with-liver transplants, 1- and 5-year graft survival were 57.8% and 45.6% in adult and 81.1% and 60.0% in pediatric recipients, respectively. Acute rejection episodes occurred for approximately 20.0% of patients within the first year. The 5-year cumulative incidence of posttransplant lymphoproliferative disorder was higher in those with an intestine-without-liver transplant (11.5%) compared with those who also received a liver (2.5%). Rates of intestine transplant have remained stable for the past several years, with increasing need in the adult population. Future reports may reflect whether children who have avoided intestine transplant with the recent advances in intestinal rehabilitation ultimately require the procedure in adulthood.
Keywords: Intestinal failure, intestine transplant, intestine-liver transplant, outcomes, pediatric, waiting list.

1 Introduction

The intestine remains an infrequently transplanted organ. Despite the significant decrease in the number of intestine transplants over the past 2 decades, more recently the number of annual intestine transplants has plateaued over the past 5 years. This has been accompanied by a rise in the use of intestine transplant in adults, with a sustained shift to a greater proportion of transplants being performed in adults rather than children. However, a substantial proportion of intestine-with-liver transplants continue to be required in pediatric patients. The overall decrease in intestine transplant has been largely attributed to the advancement of multidisciplinary intestinal rehabilitation teams, but the persistent need for intestine-with-liver transplants in pediatrics is concerning. In the coming years, recent changes to the priority given to candidates for intestine-with-liver transplant may lead to more frequent combined transplant in adult patients in need.

While the need for intestine transplant may be reduced overall, the burden of disease for those requiring intestine transplant remained high in 2023. This is best evidenced by a total of 18 patients being removed from the waiting list for death or being too sick for transplant, up from 16 in the previous year. Thus, there continues to be a need to improve access to intestine transplant for the most vulnerable patients.

Although early posttransplant graft and patient survival remained higher in those receiving intestine-without-liver transplants, long-term survival continued to be supported by liver inclusion, with nearly identical 5-year graft survival values despite worse early posttransplant graft survival in these recipients. This trend was particularly striking in pediatrics, where both 1- and 5-year graft survival were greater in those also receiving a liver. Despite this, patient survival continued to be lower in recipients of intestine with liver, outlining the complexity involved in the care of these patients. These trends may also highlight the notable heterogeneity in diagnosis requiring transplant, including the striking number of recipients with an underlying diagnosis of venous or mesenteric thrombosis or abdominal tumors in 2023.

The demographic distributions of recipients in 2023 seem to mirror those of the national population. However, donor characteristics reflect a greater-than-expected number of Black donors, out of proportion to the population. Further data will be required to see whether this trend continues. Once again, high rates of posttransplant lymphoproliferative disorder (PTLD) were seen in this population, especially in those who received intestine-without-liver transplant. The lower rate of PTLD in liver-inclusive transplants warrants further exploration.

In this chapter, information on the waiting list, transplants, and outcomes in the United States is presented for intestine-without-liver transplants and combined intestine-liver transplants. Data for both types include multivisceral transplants distinguished by inclusion or exclusion of liver. Of note, this report contains data spanning the duration of the COVID-19 pandemic, with few effects seen on intestine trends over time.

2 Waiting List

Waitlist additions decreased slightly to a total of 135 new additions in 2023 (down from 146 in 2022 and 143 in 2021). For the second consecutive year, intestine-without-liver listing exceeded liver-inclusive listing, with 73 new additions to the intestine-without-liver waiting list (Figure IN 1). The total number of intestine candidates listed at any time during the year remained steady, with 167 listed for without liver and 182 listed for with liver (Figure IN 2). Over 60.0% of those waiting for intestine transplant overall were aged 18 years or older, continuing the trend of more adult candidates since 2021 (Figure IN 3). In terms of sex distribution, 48.1% of candidates were female (Figure IN 4). The racial and ethnic distribution of candidates has not changed much over time; note a new classification of “unreported” has been added to the figure (Figure IN 5). In 2023, candidates were 57.9% White, 18.1% Black, 17.8% Hispanic, 4.9% Asian, and less than 1.0% each of Multiracial, Native American, and unreported. Short-gut syndrome (SGS) remained the most common diagnosis, encompassing necrotizing enterocolitis (8.0%), congenital SGS (13.2%), and noncongenital SGS (Figure IN 6). The 79 candidates listed as “Other/unknown” included write-in diagnoses of 10 individuals with Hirschsprung disease, 27 with portal venous/mesenteric thrombosis, 11 with tumors, 8 with other forms of SGS, and 15 with a primary dysmotility disorder (Table IN 2). Candidates most commonly waited over 2 years prior to transplant, on both the intestine-without-liver and intestine-with-liver lists (Figure IN 7). Whereas the proportion of candidates waiting the longest for combined intestine-with-liver transplant remained at approximately 39.6% (Figure IN 8), the proportion of candidates waiting 2 years or longer for intestine-without-liver transplant has fallen from a peak of over 50.0% in 2019 year by year to the lowest level of 27.5% in 2023 (Figure IN 7). For candidates who remained on the list at the end of 2023, 39.6% of those awaiting intestine without liver and 46.1% of those awaiting intestine with liver had waited more than 2 years for transplant (Table IN 3).

Candidates for intestine transplant without and with liver were similar in terms of age and race and ethnicity (Table IN 1). There was a slight male predominance in those awaiting intestine-with-liver transplant. More than 85.0% of candidates on both waiting lists came from metropolitan areas, which reflects the distribution of population across the United States. Candidates frequently lived 250 miles or more from the transplant center in which they were listed, including 34.4% and 25.2% of those awaiting intestine transplant without and with liver, respectively. Distribution of diagnoses and blood types were similar between those on both waiting lists (Table IN 2). Less than 20.0% of candidates awaiting intestine transplant, both without and with liver, had had a previous transplant (Table IN 3).

Among adult candidates, there have been approximately equal numbers awaiting intestine transplant without or with liver across the past decade, with slightly more (54.5%) requiring intestine without liver in 2023 (Figure IN 9). Among pediatric candidates, over 60.0% of candidates in 2023 required intestine with liver, a percentage that has continued to increase since 2019 (Figure IN 10).

Rates of intestine transplant have remained relatively stable over time, considering the fluctuations expected with such a small number of transplants occurring each year. In 2023, adult candidates on the waiting list underwent transplant at a rate of 53.2 transplants per 100 patient-years (Figure IN 11) and pediatric candidates underwent transplant at a rate of 36.8 transplants per 100 patient-years (Figure IN 12). When examining these transplant rates by candidate age, similar variation from year to year can be observed. However, the transplant rate for individuals aged 65 years and older on the waiting list had consistently been greater than that for other adult age groups from 2019 to 2022, but in 2023 the highest rate was in those aged 50-64 years (Figure IN 13). A similar pattern is seen for pediatric candidates; those younger than 1 year had the highest transplant rate from 2016 to 2022, but in 2023 the highest rate was in those aged 1-5 years (Figure IN 14). Transplant rates have fluctuated by race and ethnicity, although Hispanic candidates seem to have consistently undergone transplant at lower rates since 2016 compared with their non-Hispanic White counterparts (Figure IN 15). Since 2021, candidates with liver colisting have undergone transplant at lower rates, ranging from 27.2-33.2 transplants per 100 patient-years compared with 57.2-60.3 transplants per 100 patient-years in those without liver colisting (Figure IN 16).

There were 138 candidates removed from the waiting list during 2023 (Table IN 4). While 95 of these removals were for deceased donor transplants, 8 candidates on the intestine-with-liver list died while awaiting transplant. An additional 10 candidates, 6 of whom were on the intestine-with-liver list, were removed for being too sick to receive a transplant (Table IN 5).

Three-year outcomes for those who were listed in 2018-2020 for intestine without liver show that 69.6% received a transplant, 4.1% died, 14.6% were removed from the waiting list for other reasons, and 11.7% remained on the waiting list (Figure IN 17). Over that same timeframe, for those listed for intestine with liver, 62.8% received a transplant, 10.2% died, 14.0% were removed from the waiting list for other reasons, and 13.0% remained on the waiting list (Figure IN 18). Mortality rates for candidates on the waiting list have shown large fluctuations by race and ethnicity given the small number of events from year to year (Figure IN 19). Mortality rates seem similar between male and female candidates, again with the caveat of small numbers (Figure IN 20). Those listed for intestine with liver have higher pretransplant mortality, with the 2023 mortality rate being 8.2 deaths per 100 patient-years; the mortality rate for those listed for intestine without liver dropped to 1.0 death per 100 patient-years (Figure IN 21). In adult intestine candidates in 2023, the mortality rates were 1.7 and 8.5 deaths per 100 patient-years for those without and with liver colisting, respectively (Figure IN 22). Pediatric candidates had a similar higher mortality rate for those with liver colisting, at 8.0 deaths per 100 patient-years. There were no pediatric deaths among candidates awaiting intestine transplant without liver in 2023 (Figure IN 23).

3 Donation

The overall number of intestines recovered from deceased donors increased slightly from 87 in 2022 to 99 in 2023 (Figure IN 24). By age, 55 intestine donors (55.6%) in 2023 were younger than 18 years (Figure IN 25 and Figure IN 26), a consistent pattern since 2012, which is reflective of the relatively greater proportion of pediatric candidates in intestine compared with other organs. For example, as shown in the Liver chapter in the previous report, only 6.8% of liver donors in 2022 were younger than 18 years. The percentage of female donors has been trending down since 2020, hitting a nadir of 26.3% of all intestine donors in 2023 (Figure IN 27). The distribution of donors by race and ethnicity in 2023 included 55.6% White, 28.3% Black, 14.1% Hispanic, and 1.0% Asian (Figure IN 28). It is notable that Black individuals made up 18.1% of candidates (Figure IN 5) but 28.3% of donors. The percent of intestines recovered for transplant and not transplanted has remained below 6.0% since 2016 (Figure IN 29). This rate was 4.0% in 2023, down from 4.6% in 2022. A greater percentage of female donors, 7.7%, compared with male donors, 2.7%, had intestines recovered but not transplanted in 2023 (Figure IN 30). Head trauma remained the most common cause of death in intestine donors, accounting for 49.5% in 2023 (Figure IN 31).

4 Transplant

From the 99 intestines recovered for transplant, 95 intestine transplants were performed in 2023, an increase from the 82 performed in 2022 (Figure IN 32). Of the 62 adult intestine transplants in 2023, 16 included a liver, a proportion that continued to decrease over the past few years (Figure IN 33). Of the 33 pediatric intestine transplants, 18 included a liver (Figure IN 34). Of the 95 recipients of intestine transplants, 46 were female (Figure IN 35). The recipient racial and ethnic distribution was as follows: 58.9% White, 17.9% Black, 14.7% Hispanic, 7.4% Asian, and 1.1% Native American (Figure IN 36). This is, again, notable for Black individuals making up 17.9% of recipients but 28.3% of donors in 2023.

In Table IN 6, the demographic characteristics of recipients of intestine without liver are compared with those of recipients of intestine with liver in 2023. The pediatric age range accounted for 24.6% of intestine-without-liver transplants, but a much greater percentage of intestine-with-liver transplants occurred in this age group (52.9%). This is similarly reflected in the higher proportion of recipients with Medicaid insurance among those who received an intestine-with-liver transplant.

The underlying diagnosis of those receiving intestine transplants in 2023 included 46 with noncongenital SGS, 5 with necrotizing enterocolitis, 7 with congenital SGS, and 9 with pseudo-obstruction (Figure IN 37). Most of those with noncongenital SGS (38 recipients) received an intestine-without-liver transplant (Table IN 7). The 28 recipients listed as “Other/unknown” diagnosis included 4 individuals with Hirschsprung disease, 5 with thrombosis, 4 with tumors, 2 with polyposis syndromes, 2 with congenital enteropathy, 6 with a primary dysmotility disorder, and 1 with hepatitis C; for the remainder, no diagnosis was assigned (Table IN 7).

Table IN 8 shows transplant characteristics of those who received an intestine without liver versus with liver in 2023. Most recipients of intestine-without-liver transplant had waited less than 1 year (78.7%), and 20.6% of recipients of intestine-with-liver transplant waited 2 or more years. In a new figure this year, candidates who had received a previous transplant were examined. Eight (8.4%) recipients had received a previous transplant in 2023, a percentage that continued to decrease since a peak of 18.3% of transplants performed in 2017 (Figure IN 38).

5 Immunosuppression

Use of induction agents has increased over time, reaching a new peak in 2023 at 87.4% of all intestine transplants (Figure IN 39). For maintenance immunosuppression, tacrolimus remained the preferred agent, although in 2023 more recipients were placed on a regimen including tacrolimus, steroids, and a mycophenolate agent compared with tacrolimus and steroids alone. The greatest proportion of recipients reported an alternate maintenance immunosuppression plan (Figure IN 40).

6 Outcomes

Graft failure among intestine transplant recipients has remained stable over time. In the most recent cohorts, the graft failure rate for recipients of intestine without liver was 12.2% at 6 months, 14.6% at 1 year, 32.4% at 3 years, 55.3% at 5 years, and 70.7% at 10 years (Figure IN 41). The graft failure rate for recipients of intestine with liver was 36.8% at 6 months, 47.4% at 1 year, 45.0% at 3 years, 58.6% at 5 years, and 65.6% at 10 years (Figure IN 42). This reflects the theorized immunoprotective support that the liver provides to long-term graft function, despite high rates of early graft failure likely due to a more fragile clinical condition at the time of transplant. Specifically examining adult transplants in 2016-2018, those receiving an intestine without liver had graft survival of 78.3% at 1 year and 46.5% at 5 years, while those receiving an intestine with liver had graft survival of 57.8% at 1 year and 45.6% at 5 years (Figure IN 43). Among the analogous pediatric transplant recipients in 2016-2018, graft survival for intestine without liver was 76.1% at 1 year and 52.2% at 5 years and graft survival for intestine with liver was 81.1% at 1 year and 60.0% at 5 years (Figure IN 44). Those coming from nonmetropolitan areas in the entire 2016-2018 transplant cohort had slightly better graft survival than those coming from metropolitan areas, although the number of recipients from nonmetropolitan areas was quite small (Figure IN 45).

Rejection is frequently reported in the first posttransplant year, and approximately 20.0% of adult and pediatric recipients had acute rejection in the latest data. These most recent rejection rates are lower than those generally seen over the preceding decade (Figure IN 46).

In intestine transplant, PTLD has been frequently reported as a complication, perhaps due to the need for higher levels of immunosuppression compared with for other solid organ transplants and the higher proportion of pediatric recipients, who are more likely to be naive to Epstein-Barr virus (EBV) at the time of transplant. Five-year cumulative incidence of PTLD was 6.2% in those who received an intestine without liver (Figure IN 47) and 2.5% in those who received an intestine with liver (Figure IN 48). Among only those negative to EBV at transplant, 5-year cumulative incidence of PTLD was 11.5% in those who received an intestine without liver and 2.5% in those who received an intestine with liver.

Among adult recipients who underwent transplant in 2016-2018, those who received an intestine without liver had an overall survival of 89.8% at 1 year and 62.5% at 5 years. Those who received an intestine with liver had an overall survival of 62.2% at 1 year and 50.0% at 5 years (Figure IN 49). Among pediatric recipients who underwent transplant in 2016-2018, those who received an intestine without liver had an overall survival of 91.3% at 1 year and 78.3% at 5 years. Those who received an intestine with liver had an overall survival of 82.1% at 1 year and 65.3% at 5 years (Figure IN 50).

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This report is available at https://srtr.transplant.hrsa.gov/annualdatareports. Individual chapters may be downloaded.

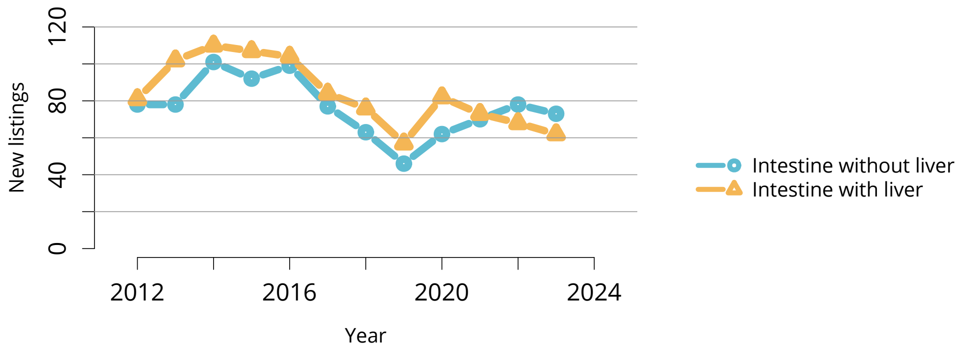

Figure IN 1: New candidates added to the intestine transplant waiting list by liver colisting. A new candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and subsequently relisted are considered new. Active and inactive patients are included. Candidates listed at more than one center are counted once per listing. New intestine-liver candidates are those listed for both organs on the same day.

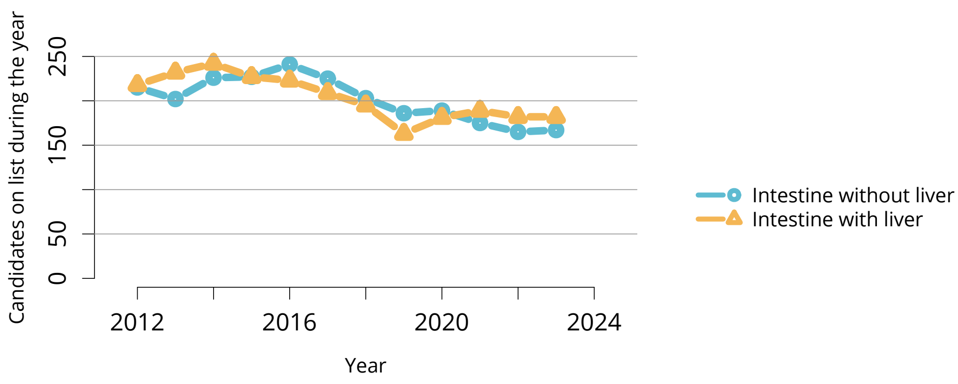

Figure IN 2: All candidates on the intestine transplant waiting list by liver colisting. Candidates on the list at any time during the year. Candidates listed at more than one center are counted once per listing.

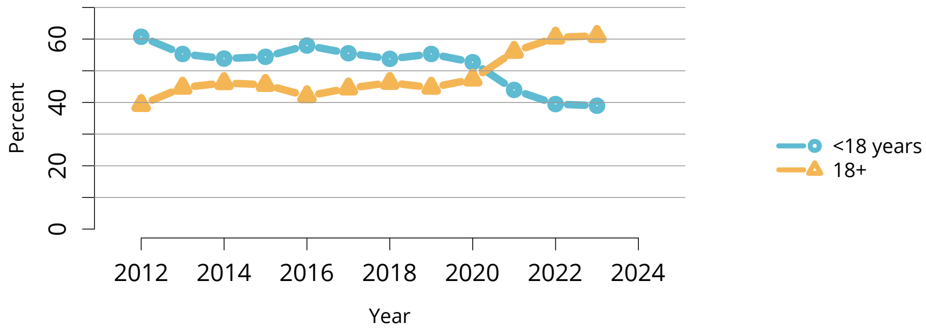

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Figure IN 3: Distribution of candidates waiting for intestine transplant by age. Candidates waiting for transplant at any time in the given year. Active and inactive candidates are included. Candidates listed at more than one center are counted once per listing. Age is determined at the earliest of transplant, death, removal, or December 31 of the year.

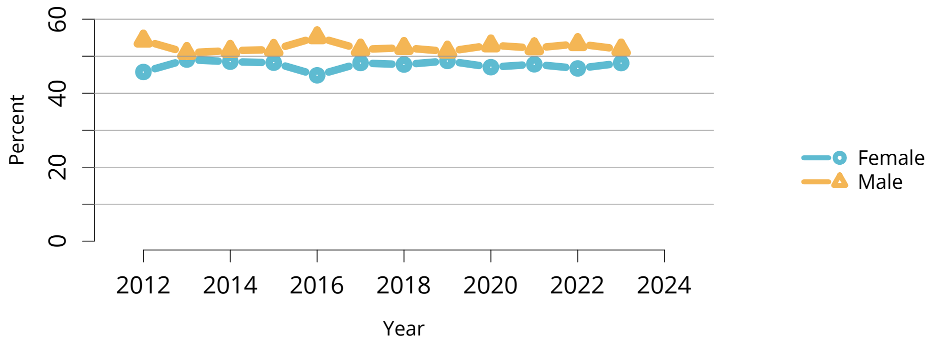

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Figure IN 4: Distribution of candidates waiting for intestine transplant by sex. Candidates waiting for transplant at any time in the given year. Active and inactive patients are included. Candidates listed at more than one center are counted once per listing.

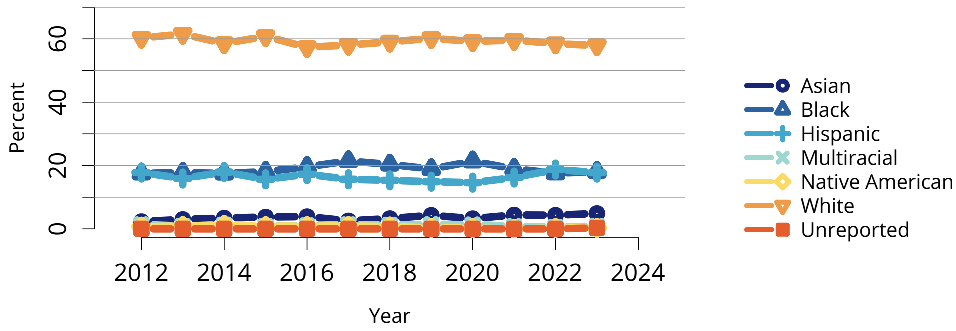

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Figure IN 5: Distribution of candidates waiting for intestine transplant by race and ethnicity. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

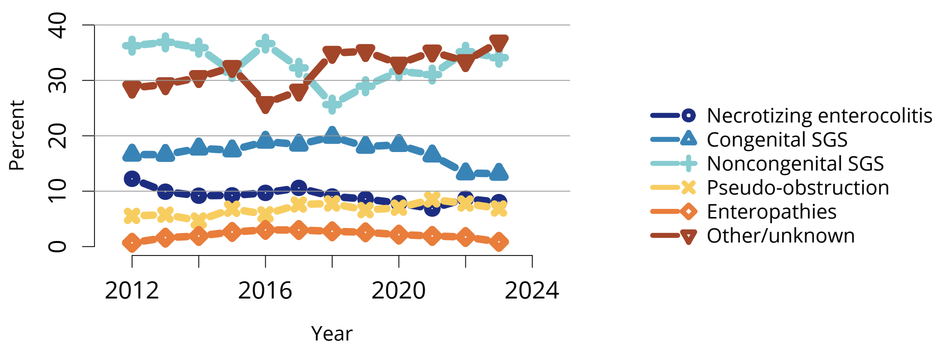

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Figure IN 6: Distribution of candidates waiting for intestine transplant by diagnosis. Candidates waiting for transplant at any time in the given year. Active and inactive patients are included. Candidates listed at more than one center are counted once per listing. SGS, short-gut syndrome.

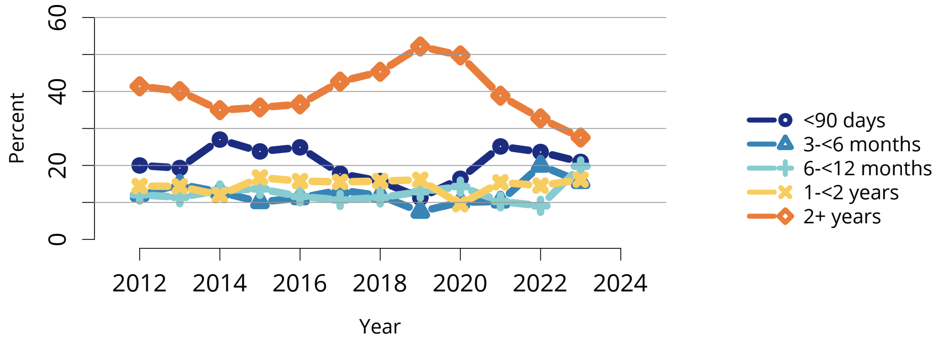

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Figure IN 7: Distribution of candidates waiting for intestine transplant without liver by waiting time. Candidates waiting for transplant at any time in the given year. Time on the waiting list is determined at the earliest of transplant, death, removal, or December 31 of the year. Active and inactive candidates are included. Candidates listed at more than one center are counted once per listing.

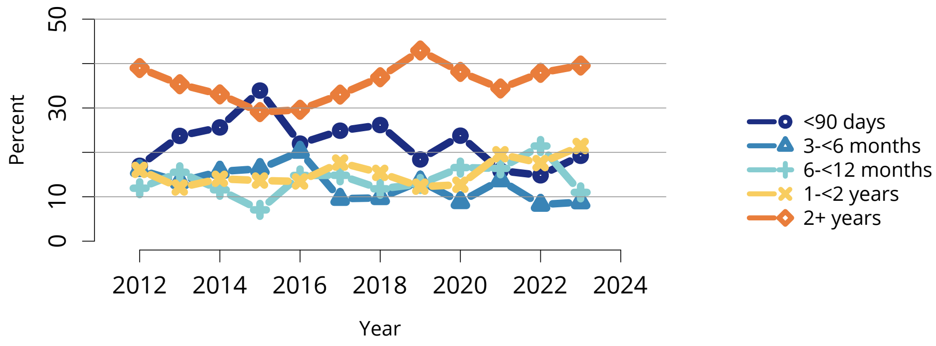

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Figure IN 8: Distribution of candidates waiting for intestine transplant with liver by waiting time. Candidates waiting for transplant at any time in the given year. Time on the waiting list is determined at the earliest of transplant, death, removal, or December 31 of the year. Active and inactive candidates are included. Candidates listed at more than one center are counted once per listing.

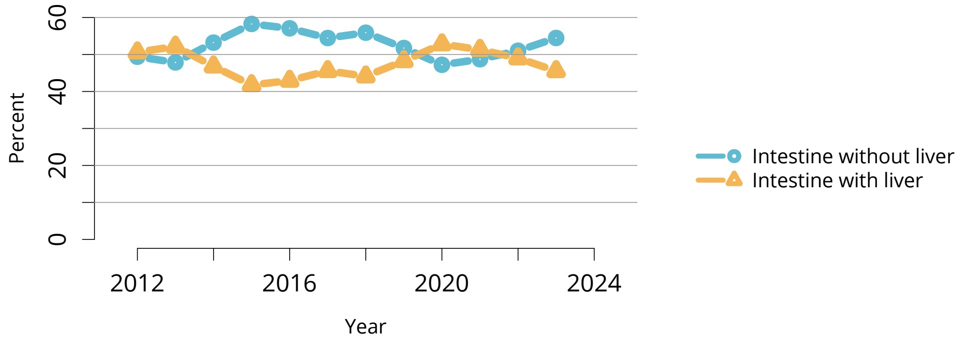

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Figure IN 9: Distribution of adult candidates waiting for intestine transplant by liver colisting. Adult candidates waiting for transplant at any time in the given year. Intestine-liver candidates were dually listed on at least one day during the year. Active and inactive patients are included. Candidates listed at more than one center are counted once per listing.

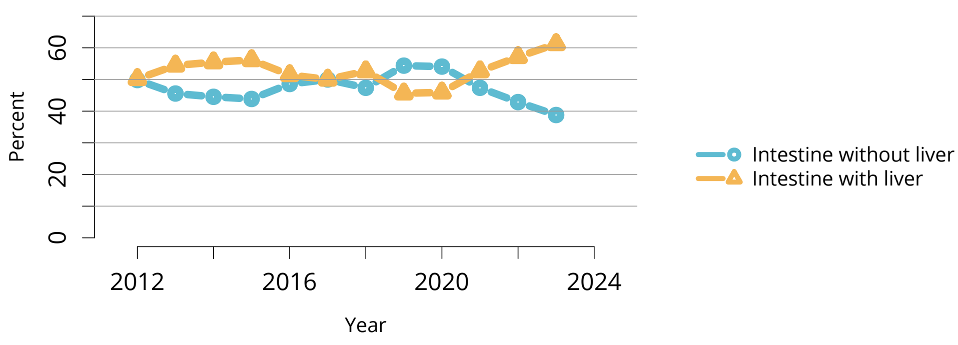

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Figure IN 10: Distribution of pediatric candidates waiting for intestine transplant by liver colisting. Pediatric candidates waiting for transplant at any time in the given year. Intestine-liver candidates were dually listed on at least one day during the year. Active and inactive patients are included. Candidates listed at more than one center are counted once per listing.

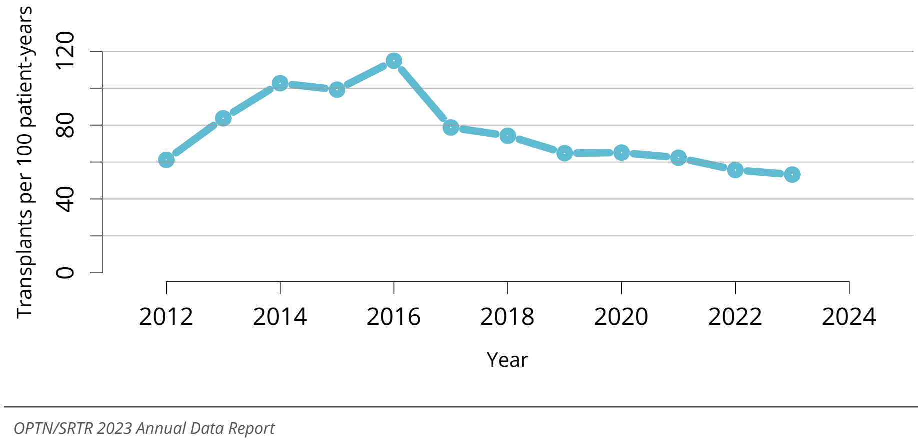

Figure IN 11: Overall donor intestine transplant rates among adult waitlist candidates. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

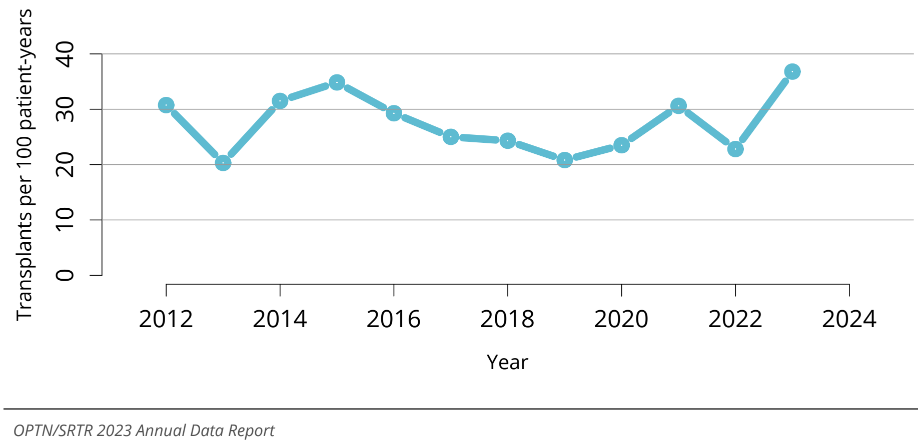

Figure IN 12: Overall donor intestine transplant rates among pediatric waitlist candidates. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

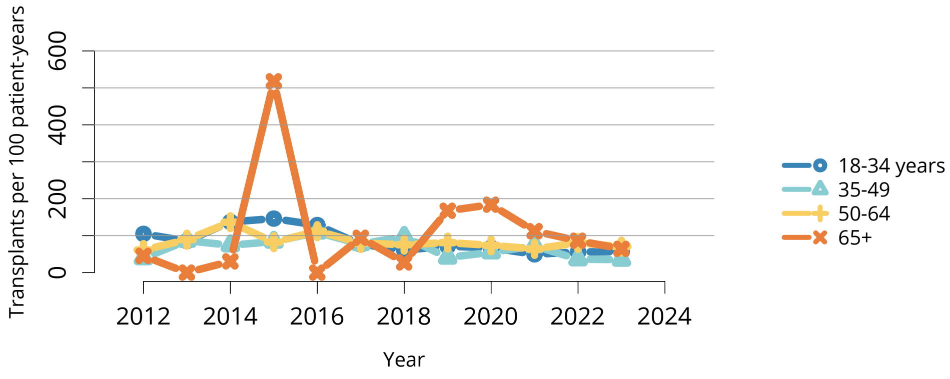

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Figure IN 13: Deceased donor intestine transplant rates among adult waitlist candidates by age. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year.

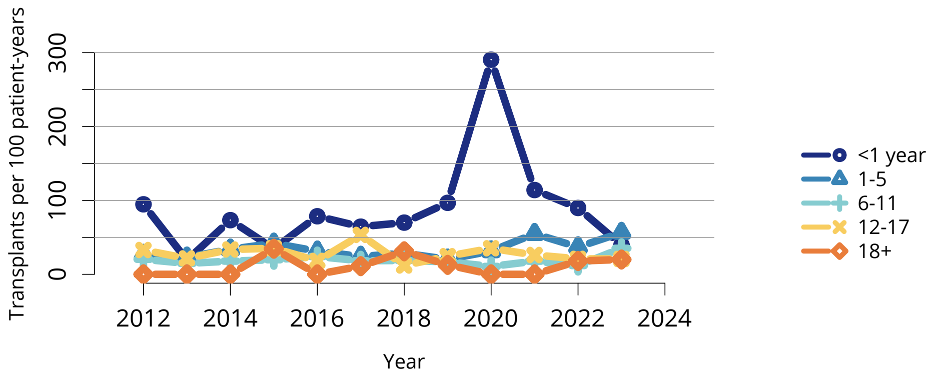

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Figure IN 14: Deceased donor intestine transplant rates among pediatric waitlist candidates by age. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year.

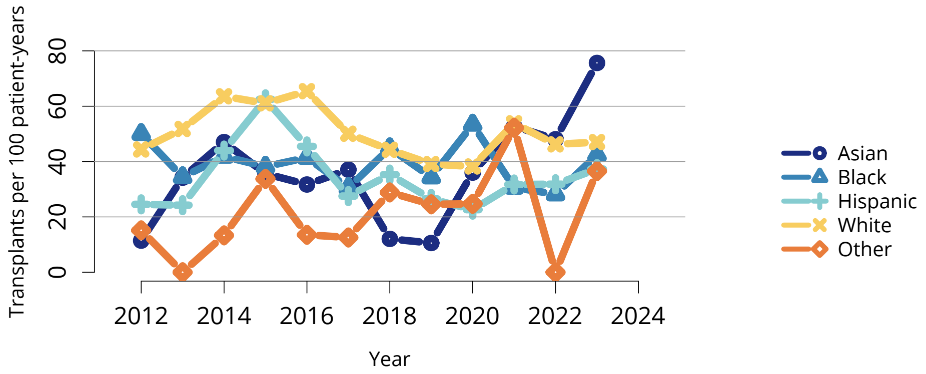

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Figure IN 15: Deceased donor intestine transplant rates among waitlist candidates by race and ethnicity. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

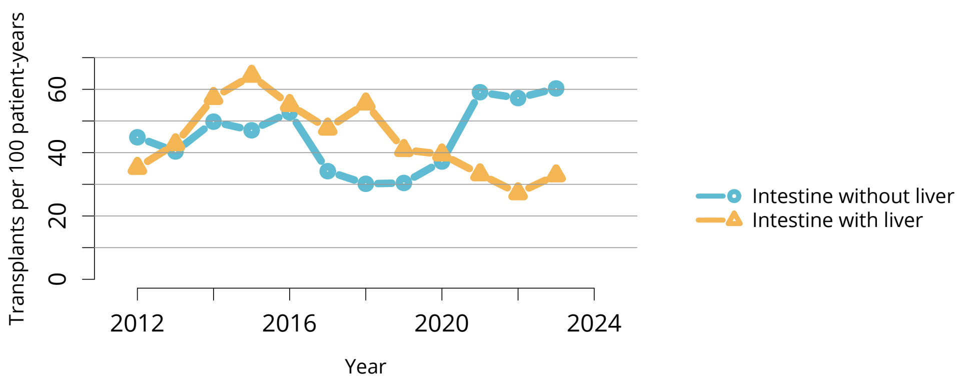

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Figure IN 16: Deceased donor intestine transplant rates among waitlisted candidates by liver colisting. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. Intestine-liver colisting is determined at the time of listing.

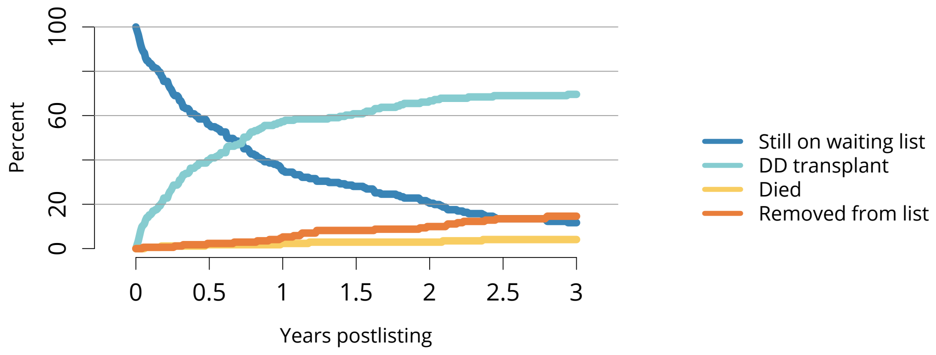

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Figure IN 17: Three-year outcomes for candidates waiting for intestine transplant without liver, new listings in 2018-2020. Candidates listed at more than one center are counted once per listing. Removed from list includes all reasons except transplant and death. DD, deceased donor.

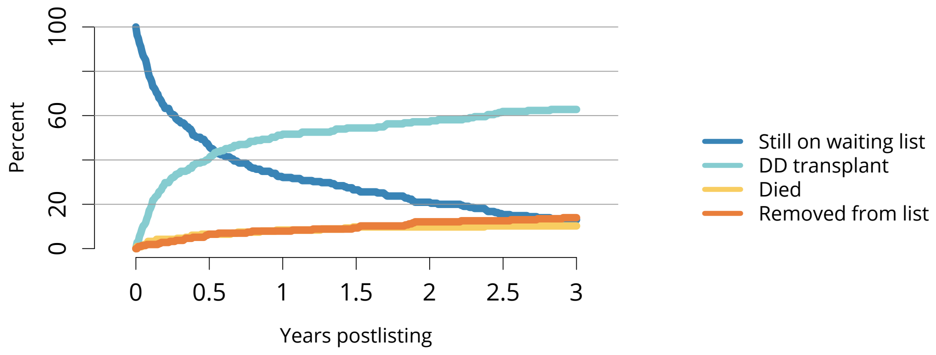

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Figure IN 18: Three-year outcomes for candidates waiting for intestine transplant with liver, new listings in 2018-2020. Candidates listed at more than one center are counted once per listing. Removed from list includes all reasons except transplant and death. DD, deceased donor.

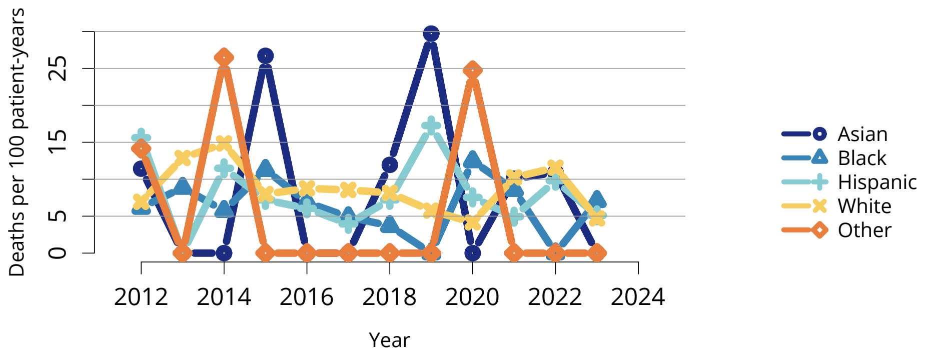

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Figure IN 19: Pretransplant mortality rates among candidates waitlisted for intestine transplant by race and ethnicity. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Candidates listed at more than one center are counted once per listing. The Other race category is composed of Native American and Multiracial categories.

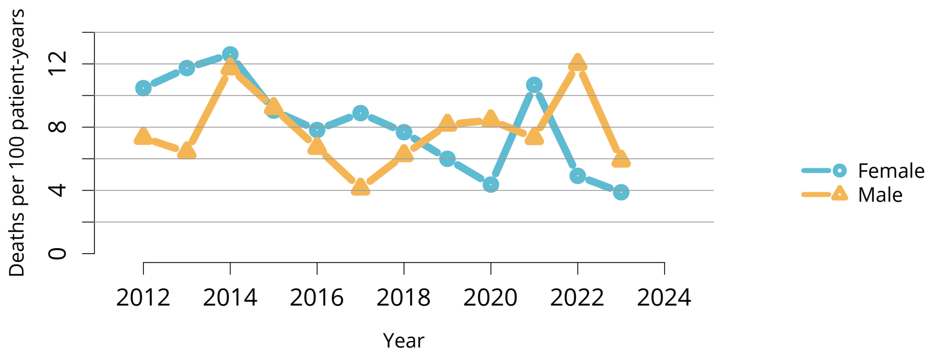

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Figure IN 20: Pretransplant mortality rates among candidates waitlisted for intestine transplant by sex. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Candidates listed at more than one center are counted once per listing.

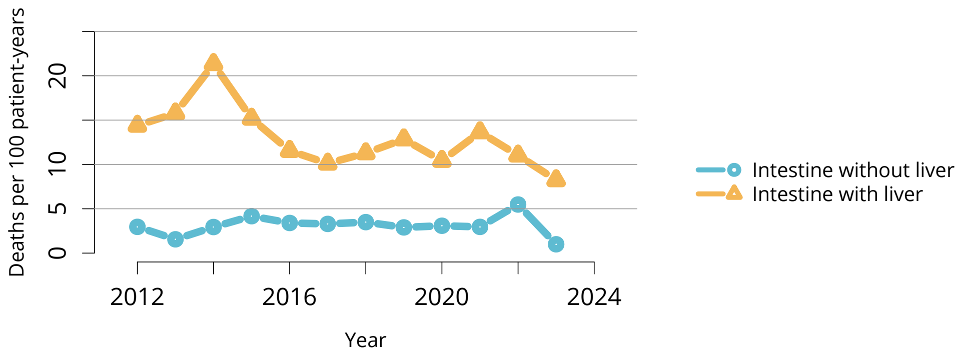

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Figure IN 21: Pretransplant mortality rates among candidates waitlisted for intestine transplant by liver colisting. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Candidates listed at more than one center are counted once per listing. Intestine-liver colisting is determined at the later of listing date or January 1 of the year.

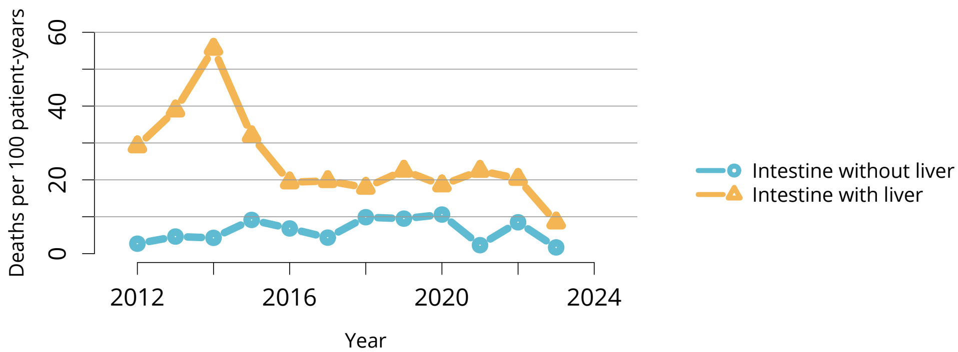

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Figure IN 22: Pretransplant mortality rates among adult candidates waitlisted for intestine transplant by liver colisting. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Candidates listed at more than one center are counted once per listing. Intestine-liver colisting is determined at the later of listing date or January 1 of the year.

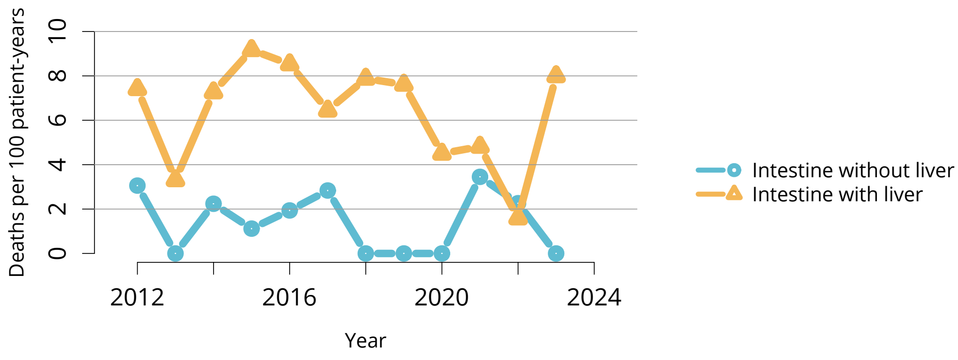

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Figure IN 23: Pretransplant mortality rates among pediatric candidates waitlisted for intestine transplant by liver colisting. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Candidates listed at more than one center are counted once per listing. Intestine-liver colisting is determined at the later of listing date or January 1 of the year.

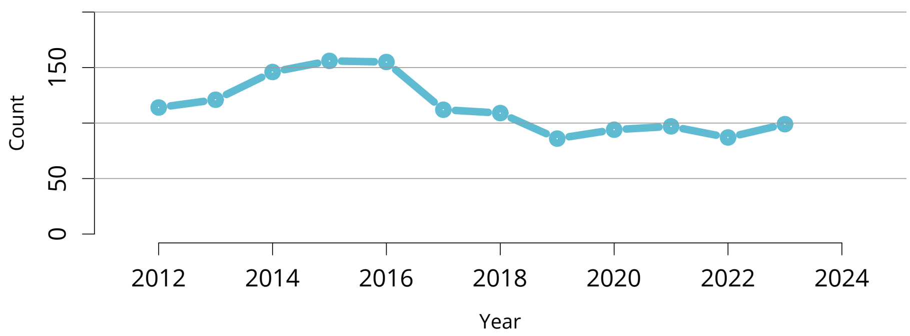

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Figure IN 24: Overall deceased intestine donor count. Count of deceased donors whose intestines were recovered for transplant.

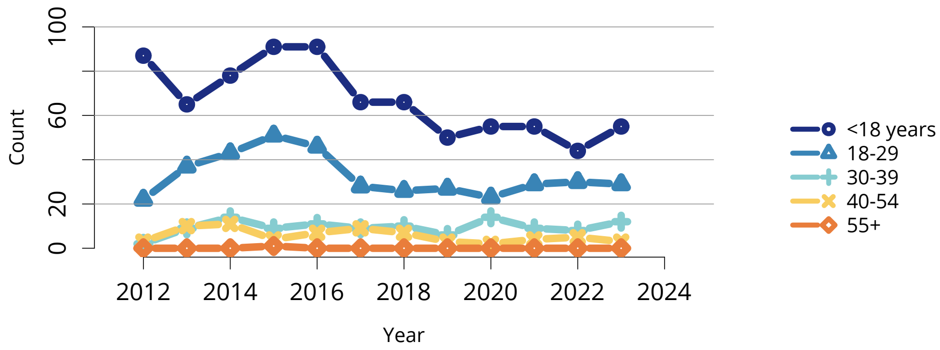

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Figure IN 25: Deceased intestine donor count by age. Count of deceased donors whose intestines were recovered for transplant.

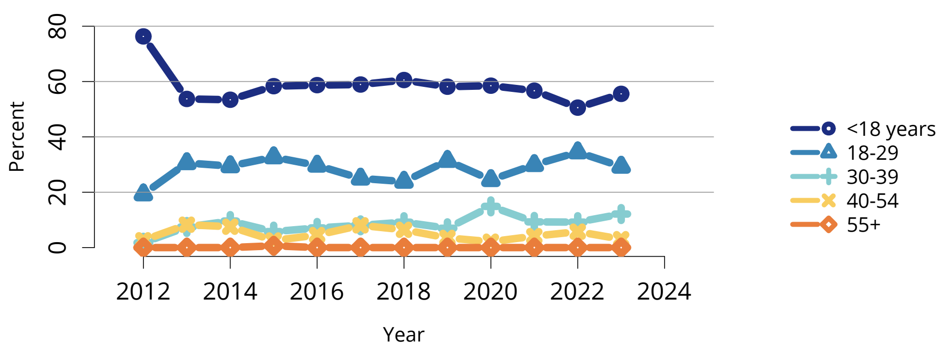

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Figure IN 26: Distribution of deceased intestine donors by age. Deceased donors whose intestines were recovered for transplant.

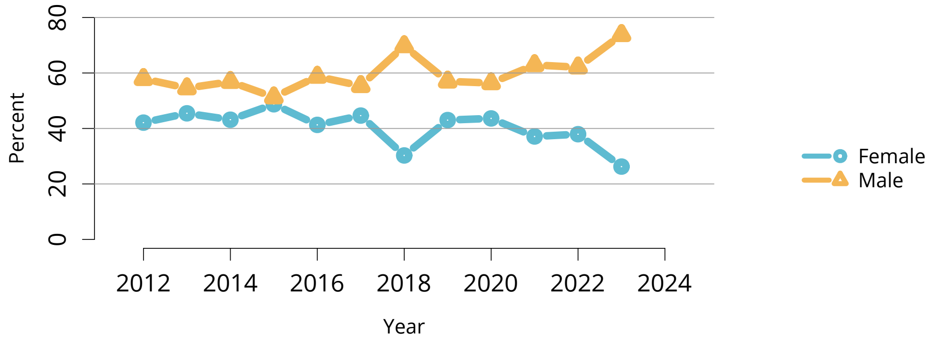

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Figure IN 27: Distribution of deceased intestine donors by sex. Deceased donors whose intestines were recovered for transplant.

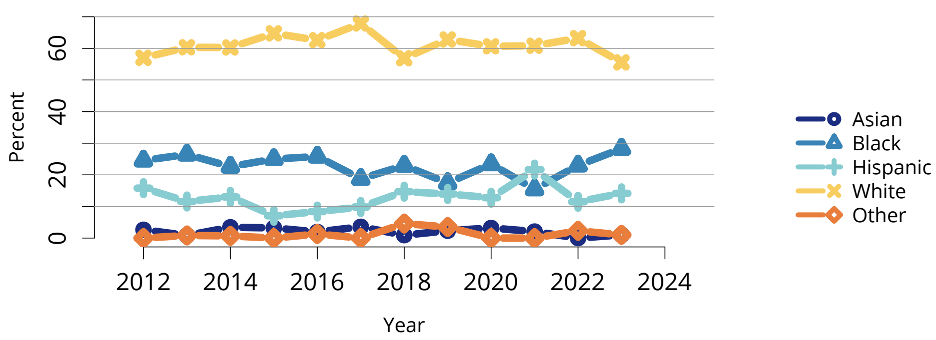

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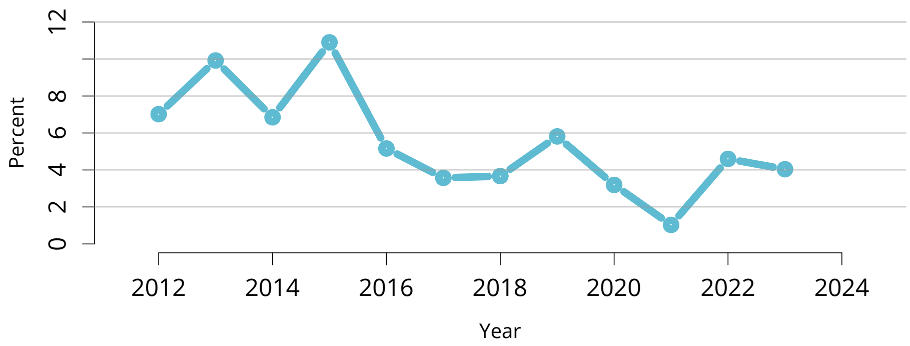
Figure IN 28: Distribution of deceased intestine donors by race and ethnicity. Deceased donors whose intestines were recovered for transplant. The Other race category is composed of Native American and Multiracial categories.



OPTN/SRTR 2023 Annual Data Report

Figure IN 29: Overall percent of intestines recovered for transplant and not transplanted. Percentages of intestines not transplanted out of all intestines recovered for transplant.

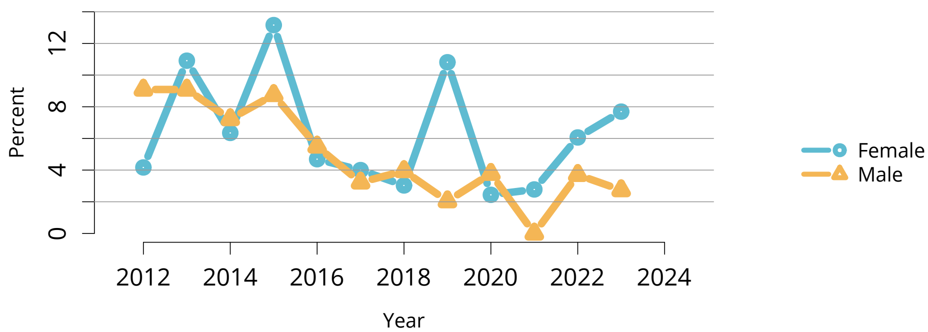


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Figure IN 30: Percent of intestines recovered for transplant and not transplanted by donor sex. Percentages of intestines not transplanted out of all intestines recovered for transplant.

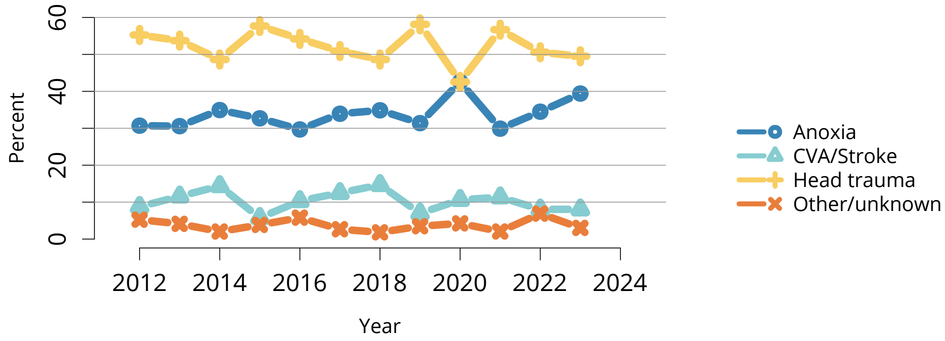

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Figure IN 31: Cause of death among deceased intestine donors. Deceased donors whose intestines were transplanted. CVA, cerebrovascular accident.

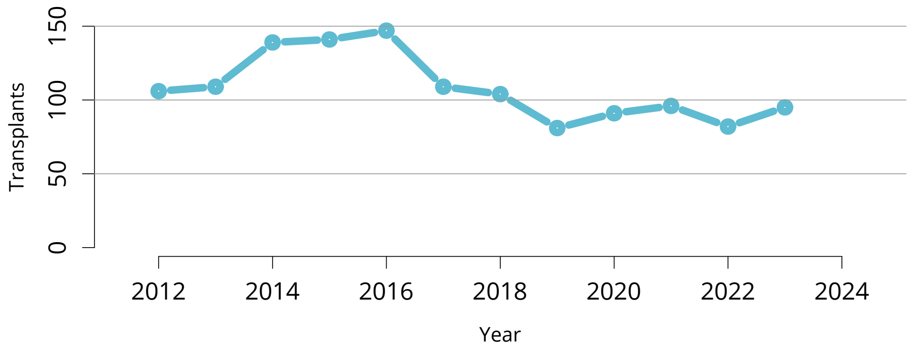

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Figure IN 32: Overall intestine transplants. All intestine transplant recipients, including adult and pediatric, retransplant, and multiorgan recipients.

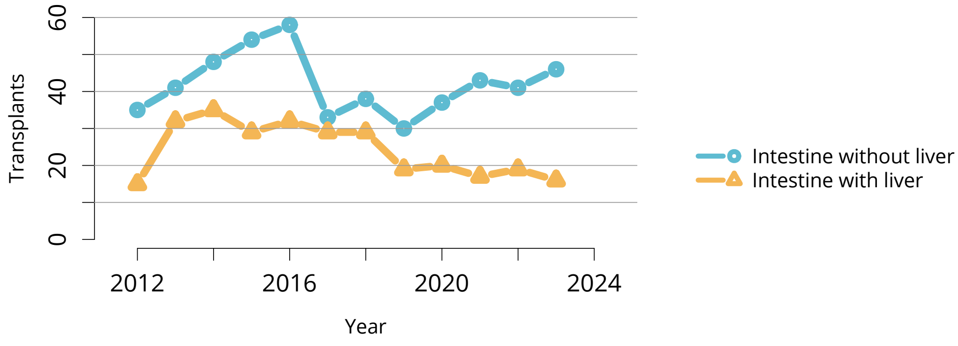

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Figure IN 33: Adult intestine transplants by transplant type. Adult intestine transplant recipients, including retransplant and multiorgan recipients.

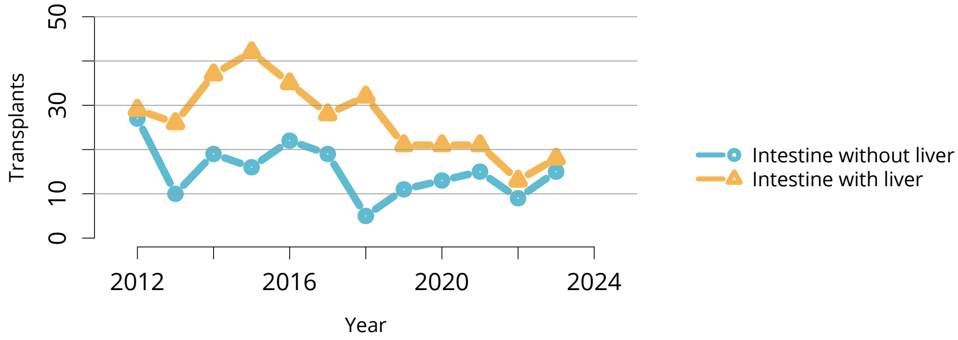

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Figure IN 34: Pediatric intestine transplants by transplant type. Pediatric intestine transplant recipients, including retransplant and multiorgan recipients.

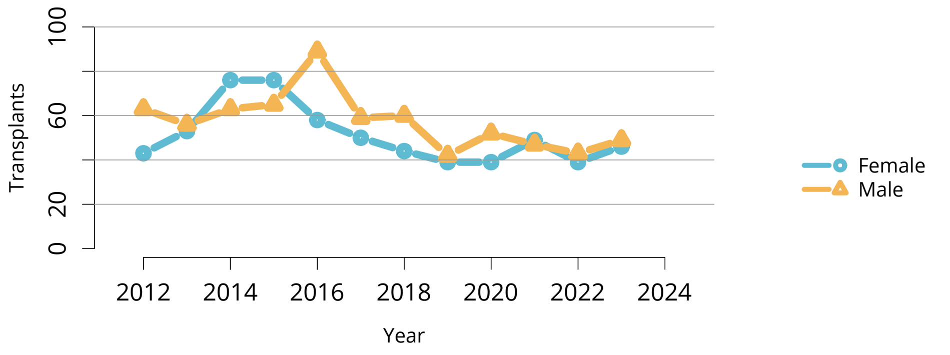

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Figure IN 35: Total intestine transplants by sex. All intestine transplant recipients, including adult and pediatric, retransplant, and multiorgan recipients.

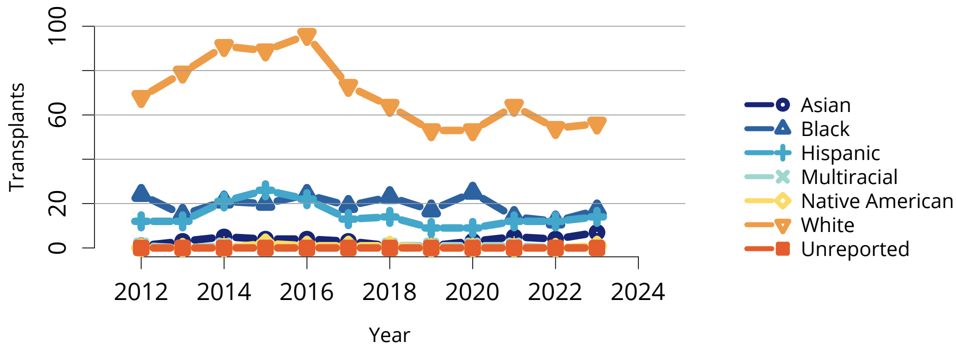

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Figure IN 36: Total intestine transplants by race and ethnicity. All intestine transplant recipients, including adult and pediatric, retransplant, and multiorgan recipients.

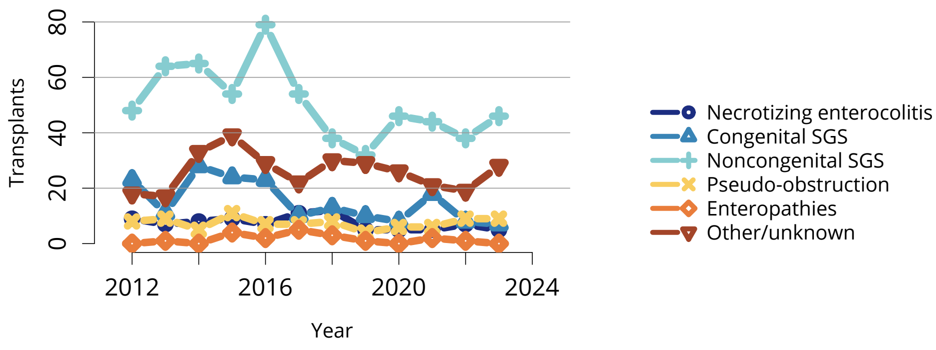

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Figure IN 37: Total intestine transplants by diagnosis. All intestine transplant recipients, including adult and pediatric, retransplant, and multiorgan recipients. SGS, short-gut syndrome.

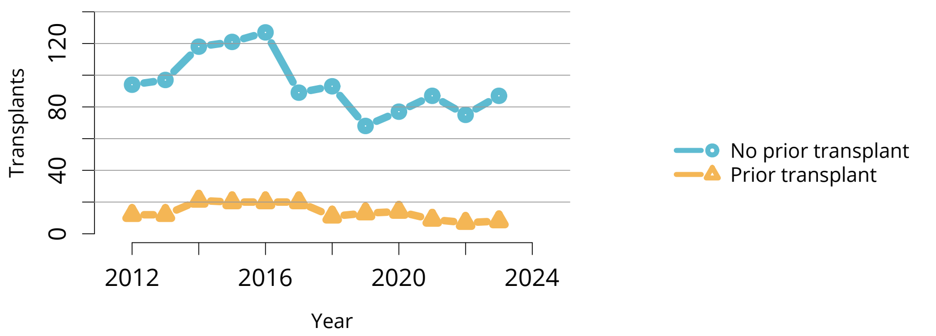

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Figure IN 38: Total intestine transplants by prior transplant status. All intestine transplant recipients, including adult and pediatric, retransplant, and multiorgan recipients.

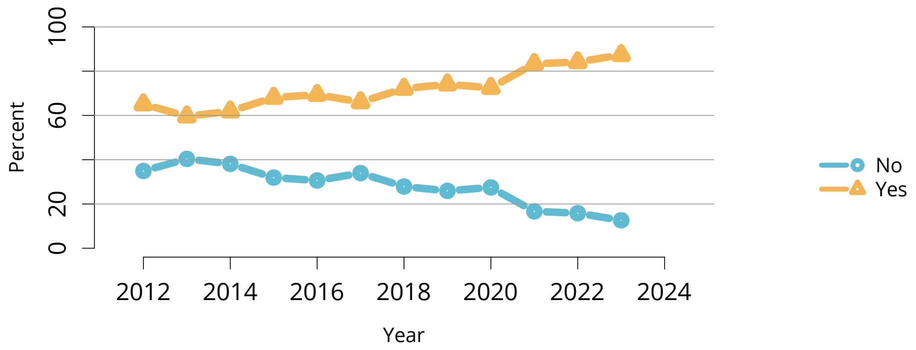

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Figure IN 39: Induction agent use in intestine transplant recipients. Immunosuppression at transplant reported to the OPTN.

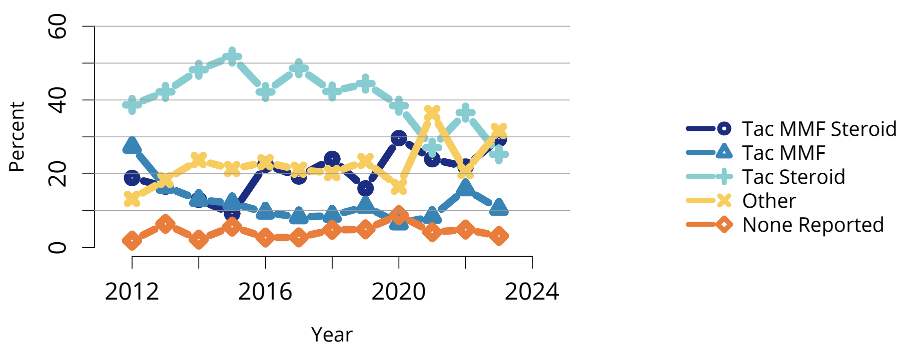

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Figure IN 40: Distribution of immunosuppression regimen use in intestine transplant recipients. Immunosuppression regimen at transplant reported to the OPTN. MMF, all mycophenolate agents; Tac, tacrolimus.

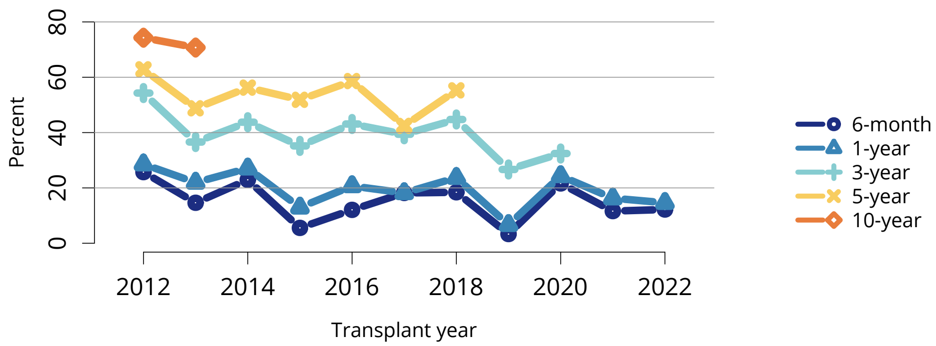

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Figure IN 41: Graft failure among transplant recipients of intestine without liver. All recipients of deceased donor intestines, including multiorgan transplant recipients.

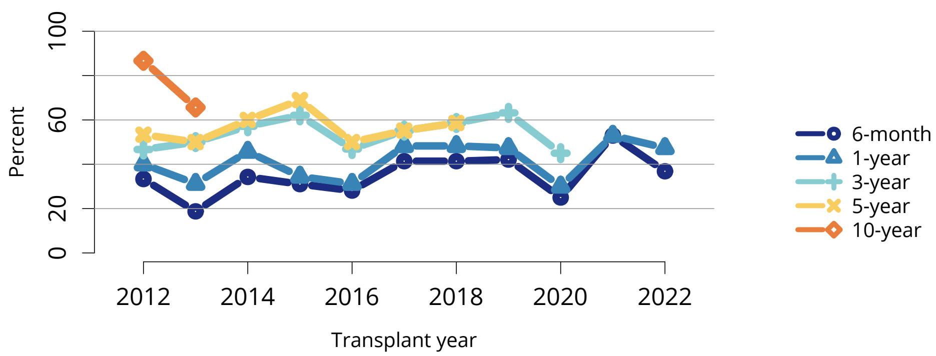

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Figure IN 42: Graft failure among transplant recipients of intestine with liver. All recipients of deceased donor intestines, including multiorgan transplant recipients.

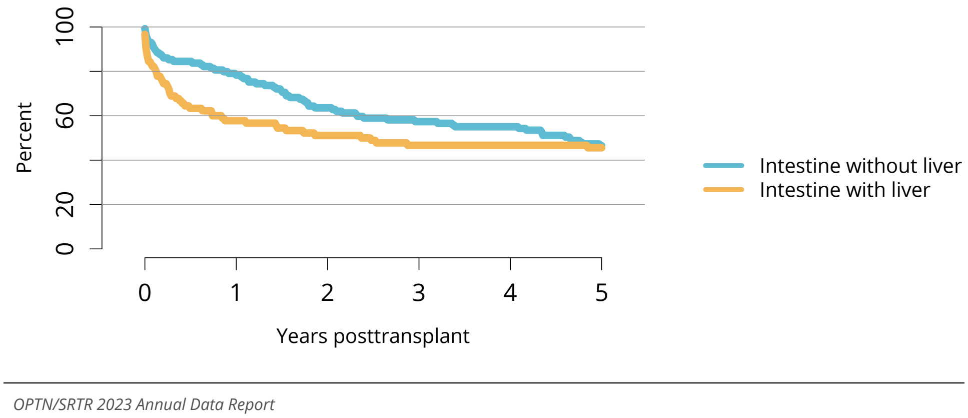

Figure IN 43: Graft survival among deceased donor adult intestine transplant recipients, 2016-2018, by transplant type. Intestine graft survival estimated using unadjusted Kaplan-Meier methods.

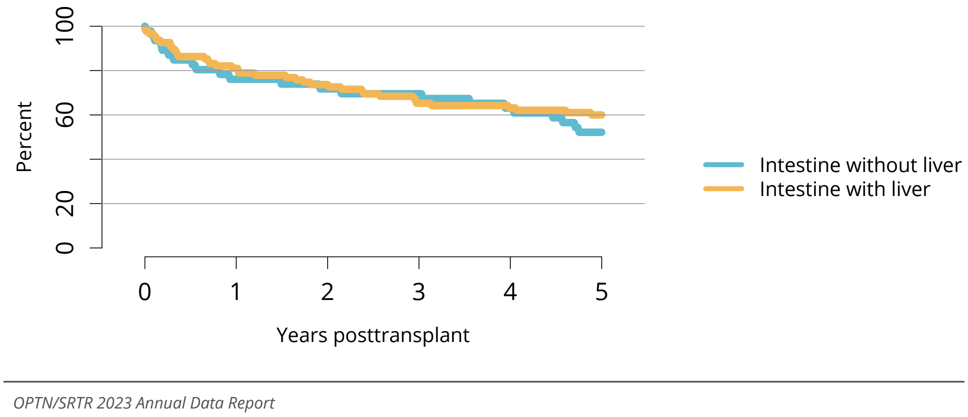

Figure IN 44: Graft survival among deceased donor pediatric intestine transplant recipients, 2016-2018, by transplant type. Intestine graft survival estimated using unadjusted Kaplan-Meier methods.

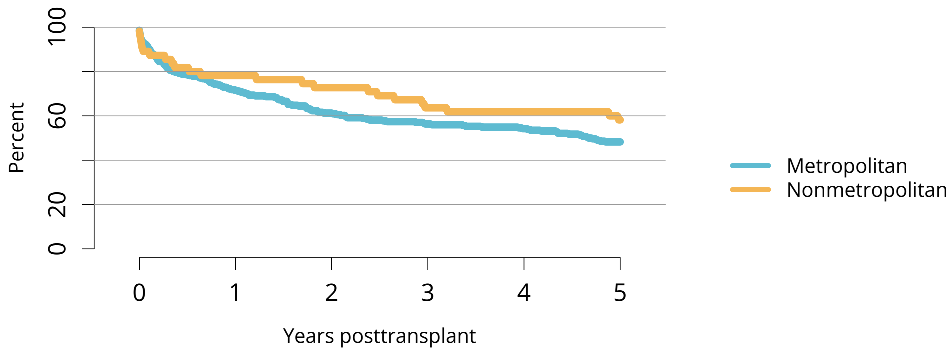

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Figure IN 45: Graft survival among deceased donor intestine transplant recipients, 2016-2018, by metropolitan versus nonmetropolitan recipient residence. Graft survival estimated using unadjusted Kaplan-Meier methods.

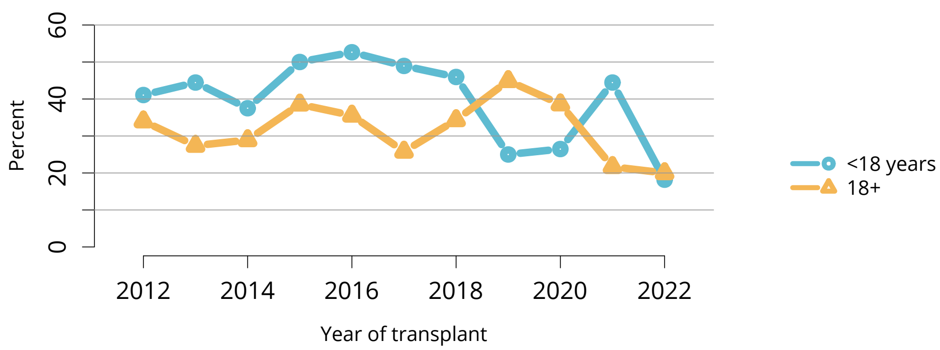

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Figure IN 46: Incidence of acute rejection by 1 year posttransplant among intestine transplant recipients by age. Only the first reported rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier method.

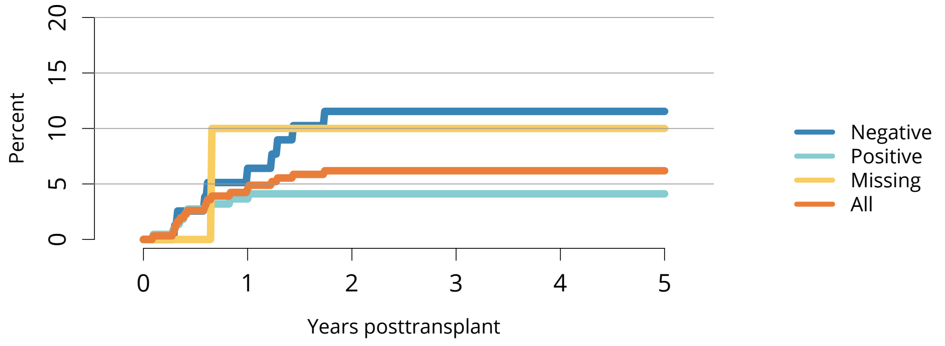

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Figure IN 47: Incidence of PTLD among recipients of intestine transplant without liver by recipient EBV status at transplant, 2012-2018. Cumulative incidence is estimated using the Kaplan-Meier method. PTLD is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus; PTLD, posttransplant lymphoproliferative disorder.

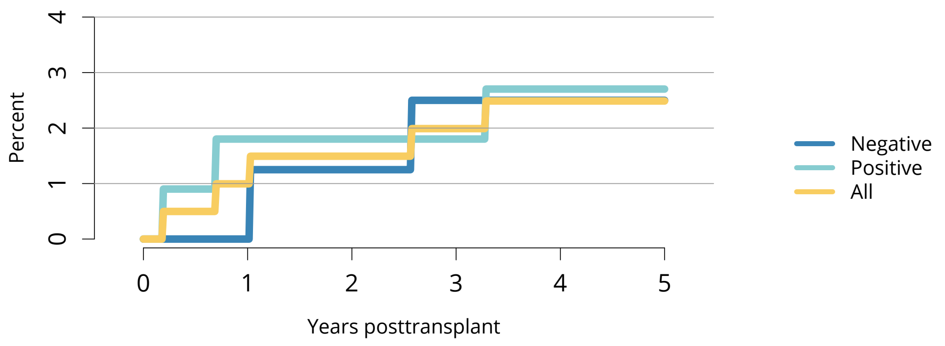

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Figure IN 48: Incidence of PTLD among recipients of intestine transplant with liver by recipient EBV status at transplant, 2012-2018. Cumulative incidence is estimated using the Kaplan-Meier method. PTLD is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus; PTLD, posttransplant lymphoproliferative disorder.

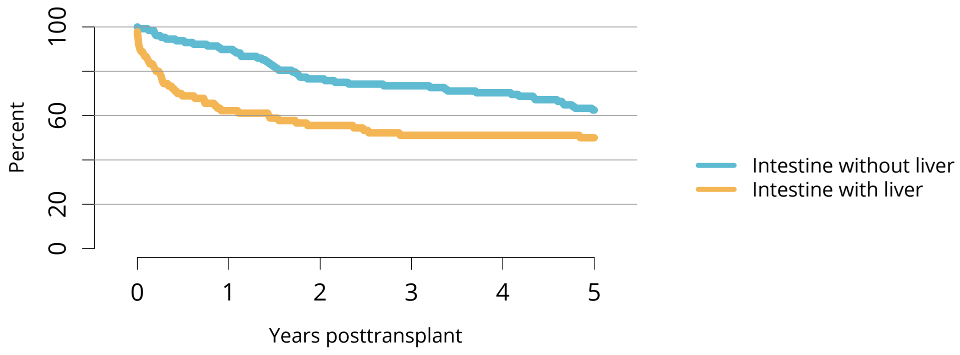

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Figure IN 49: Patient survival among deceased donor adult intestine transplant recipients, 2016-2018, by transplant type. Patient survival estimated using unadjusted Kaplan-Meier methods.

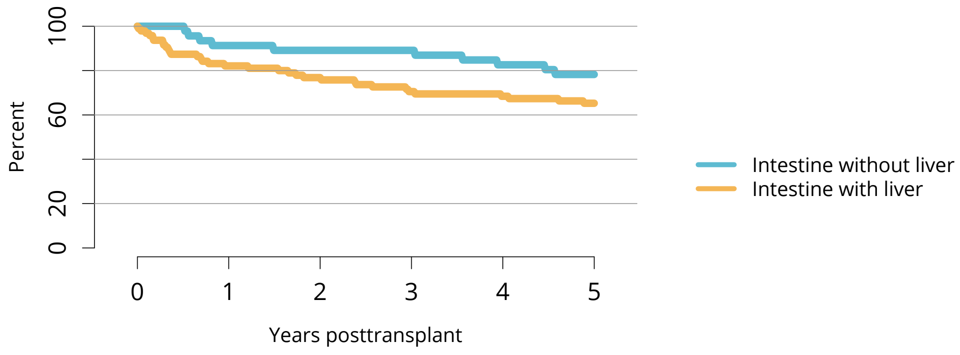

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Figure IN 50: Patient survival among deceased donor pediatric intestine transplant recipients, 2016-2018, by transplant type. Patient survival estimated using unadjusted Kaplan-Meier methods.

Table IN 1: Demographic characteristics of candidates on the intestine transplant waiting list on December 31, 2023. Candidates waiting for intestines without and with liver on December 31, 2023, regardless of first listing date. Distance is computed from candidate's home zip code to the transplant center. IN, intestine; LI, liver.

	IN		IN-LI	
Characteristic	**N**	**Percent**	**N**	**Percent**
Age (years)				
<18 years	38	39.6	49	42.6
18-34	17	17.7	25	21.7
35-49	28	29.2	20	17.4
50-64	12	12.5	21	18.3
65+	1	1	0	0
Sex				
Female	51	53.1	47	40.9
Male	45	46.9	68	59.1
Race and ethnicity				
Asian	6	6.2	3	2.6
Black	16	16.7	19	16.5
Hispanic	19	19.8	23	20
Multiracial	2	2.1	1	0.9
White	53	55.2	69	60
Geography				
Metropolitan	83	86.5	101	87.8
Nonmetropolitan	10	10.4	9	7.8
Missing	3	3.1	5	4.3
Miles between candidate and center				
<50 miles	29	30.2	42	36.5
50-<100	9	9.4	13	11.3
100-<150	7	7.3	8	7
150-<250	15	15.6	18	15.7
250+	33	34.4	29	25.2
Missing	3	3.1	5	4.3
All candidates				
All candidates	96	100	115	100

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Table IN 2: Clinical characteristics of candidates on the intestine transplant waiting list on December 31, 2023. Candidates waiting for intestines without and with liver on December 31, 2023, regardless of first listing date. The Other/unknown diagnosis category is composed of Hirschsprung disease, portal venous/mesenteric thrombosis, tumors, other forms of SGS, and primary dysmotility disorder categories. IN, intestine; LI, liver; SGS, short-gut syndrome.

	IN		IN-LI	
Characteristic	**N**	**Percent**	**N**	**Percent**
Diagnosis				
Necrotizing enterocolitis	9	9.4	10	8.7
Congenital SGS	15	15.6	18	15.7
Noncongenital SGS	33	34.4	31	27
Pseudo-obstruction	9	9.4	4	3.5
Enteropathies	1	1	2	1.7
Other/unknown	29	30.2	50	43.5
Blood type				
A	35	36.5	39	33.9
AB	5	5.2	5	4.3
B	14	14.6	17	14.8
O	42	43.8	54	47
All candidates				
All candidates	96	100	115	100

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Table IN 3: Listing characteristics of candidates on the intestine transplant waiting list on December 31, 2023. Candidates waiting for intestines without and with liver on December 31, 2023, regardless of first listing date. IN, intestine; LI, liver.

	IN		IN-LI	
Characteristic	**N**	**Percent**	**N**	**Percent**
Waiting time				
<90 days	13	13.5	15	13
3-<6 months	11	11.5	10	8.7
6-<12 months	16	16.7	12	10.4
1-<2 years	18	18.8	25	21.7
2+ years	38	39.6	53	46.1
Previous transplant				
No prior transplant	84	87.5	96	83.5
Prior transplant	12	12.5	19	16.5
All candidates				
All candidates	96	100	115	100

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Table IN 4: Intestine transplant waitlist activity, 2023. Candidates listed at more than one center are counted once per listing. Candidates who are listed, undergo transplant, and are relisted are counted more than once. Candidates are not considered to be on the list on the day they are removed; counts on January 1 may differ from counts on December 31 of the prior year. Candidates listed for multiorgan transplants are included. IN, intestine; LI, liver.

Waiting list state	IN	IN-LI
Waiting list state		
Patients at start of year	94	120
Patients added during year	73	62
Patients removed during year	71	67
Patients at end of year	96	115

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Table IN 5: Removal reason among intestine transplant candidates, 2023. Removal reason as reported to the OPTN. Candidates with death dates that precede removal dates are assumed to have died waiting. IN, intestine; LI, liver.

Removal reason	IN	IN-LI
Removal reason		
Deceased donor transplant	58	37
Patient died	0	8
Patient refused transplant	3	2
Improved, transplant not needed	2	7
Too sick for transplant	4	6
Other	4	7

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Table IN 6: Demographic characteristics of intestine transplant recipients, 2023. Intestine transplant recipients, including retransplant recipients. Distance is computed from recipient's home zip code to the transplant center. IN, intestine; LI, liver.

	IN		IN-LI	
Characteristic	**N**	**Percent**	**N**	**Percent**
Recipient age (years)				
<18 years	15	24.6	18	52.9
18-34	18	29.5	6	17.6
35-49	13	21.3	0	0
50-64	14	23	10	29.4
65+	1	1.6	0	0
Sex				
Female	28	45.9	18	52.9
Male	33	54.1	16	47.1
Race and ethnicity				
Asian	4	6.6	3	8.8
Black	12	19.7	5	14.7
Hispanic	7	11.5	7	20.6
Native American	1	1.6	0	0
White	37	60.7	19	55.9
Insurance				
Private	29	47.5	14	41.2
Medicare	9	14.8	4	11.8
Medicaid	14	23	13	38.2
Other/unknown	9	14.8	3	8.8
Geography				
Metropolitan	47	77	32	94.1
Nonmetropolitan	9	14.8	1	2.9
Missing	5	8.2	1	2.9
Miles between recipient and center				
<50 miles	26	42.6	16	47.1
50-<100	3	4.9	0	0
100-<150	4	6.6	4	11.8
150-<250	8	13.1	3	8.8
250+	15	24.6	10	29.4
Missing	5	8.2	1	2.9
All recipients				
All recipients	61	100	34	100

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Table IN 7: Clinical characteristics of intestine transplant recipients, 2023. Intestine transplant recipients, including retransplant recipients. The Other/unknown diagnosis category is composed of Hirschsprung disease, thrombosis, tumors, polyposis syndrome, congenital enteropathy, primary dysmotility disorder, hepatitis C, and unknown categories. IN, intestine; LI, liver; SGS, short-gut syndrome.

	IN		IN-LI	
Characteristic	**N**	**Percent**	**N**	**Percent**
Diagnosis				
Necrotizing enterocolitis	1	1.6	4	11.8
Congenital SGS	3	4.9	4	11.8
Noncongenital SGS	38	62.3	8	23.5
Pseudo-obstruction	6	9.8	3	8.8
Other/unknown	13	21.3	15	44.1
Blood type				
A	27	44.3	10	29.4
AB	2	3.3	1	2.9
B	5	8.2	9	26.5
O	27	44.3	14	41.2
All recipients				
All recipients	61	100	34	100

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Table IN 8: Transplant characteristics of intestine transplant recipients, 2023. Intestine transplant recipients, including retransplant recipients. IN, intestine; LI, liver.

	IN		IN-LI	
Characteristic	**N**	**Percent**	**N**	**Percent**
Waiting time				
1-<90 days	21	34.4	14	41.2
3-<6 months	13	21.3	3	8.8
6-<12 months	14	23	4	11.8
1-<2 years	9	14.8	6	17.6
2+ years	4	6.6	7	20.6
Donor type				
Deceased donor	61	100	34	100
Previous transplant for recipients				
No prior transplant	57	93.4	30	88.2
Prior transplant	4	6.6	4	11.8
All recipients				
All recipients	61	100	34	100

OPTN/SRTR 2023 Annual Data Report

OPTN/SRTR 2023 Annual Data Report: Heart

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Abstract

Despite unintended consequences and ongoing need for revision, the 2018 adult heart transplant policy revision continues to have a favorable impact as evidenced by increased transplant rates, decreased waitlist mortality, and more rapid transplant in higher acuity patients. In 2023, the total number of heart transplants in the United States increased 101.1% since 2012, reaching a record 4,599, of which 4,092 were performed in adults. Between 2022 and 2023 alone, 424 more adult heart transplants were performed, the largest annual increase this decade. Concurrently, the prevalence of heart donors after circulatory death increased to 14.0% in 2023. Candidates listed at adult statuses 1 and 2 underwent transplant more quickly (2,225.8 and 1,088.1 transplants per 100 patient-years, respectively). In 2023, adult waitlist mortality reached a low: 8.5 deaths per 100 patient-years. Multiorgan transplants (heart-liver and heart-kidney) in adults continue to increase, achieving comparable survival to that of heart transplant alone. Adults with congenital heart disease had the lowest pretransplant mortality of all diagnoses but also the lowest posttransplant survival, 76.1% at 5 years, emphasizing the need for

consensus on best practices. In pediatric heart transplant, heart transplants increased 36.3% and new listings increased 34.0%, but the transplant rate decreased 14.9% resulting in increased waiting times. High-urgency listings increased, with 83.6% of heart transplants performed for status 1A. Pediatric waitlist mortality has declined 53.4% since 2012, but remains substantial: 11.7 deaths per 100 patient-years. In 2023, 5-year posttransplant survival was 80.3% in adult recipients and 84.4% in pediatric recipients.
Keywords: Allocation, donor, heart failure, heart transplant, left ventricular assist device, mechanical circulatory support, outcomes

1 Introduction

Heart transplant affords eligible patients with end-stage heart disease the best opportunity for long-term survival. Yet, pretransplant risk stratification, the growing use of temporary mechanical circulatory support (MCS), disparities in access and outcomes, access management, growing medical complexity in the face of regulatory oversight, and rising costs of transplant remain challenges for the transplantation community. Fontan failure is one of the most common indications for heart transplant in adults with congenital heart disease and presents a unique challenge for heart transplant programs. Due to improvements in management and, subsequently, survival, the number of patients with Fontan circulation is growing; however, it is anticipated that one-third of these patients will either die or require heart transplant within 35 years of Fontan surgery.[1,2] Heart transplant programs plagued with constantly balancing candidate risk with programmatic oversight are universally challenged by treating these patients, raising the question of whether, similar to multiorgan transplant, consideration could be given to excluding Fontan patients from performance metrics. Risk stratification of heart transplant candidates remains suboptimal for both adult and pediatric settings. The pediatric heart transplant allocation system remains 3-tiered, and as seen under the prior adult policy, waiting times and waitlist mortality are increasing and more patients are being added to higher acuity status. The continuous distribution allocation policy is in development and is anticipated to allow more fluidity in prioritization and enhanced risk stratification. Multiorgan transplant continues to increase, and in September 2023, a policy to establish eligibility criteria and safety net for heart-kidney allocation and for heart-liver allocation was approved by the Organ Procurement and Transplantation Network (OPTN); however, it is too early to assess the impact of this policy.

The Annual Data Report provides an overview of the state of heart transplantation in the United States, including positive trends and trends that warrant further investigation and monitoring. Data on US adult and pediatric heart transplant waiting lists, donation, transplants, and outcomes are provided. Of note, the Impella 5.5 device was added to the OPTN computer system in August 2023. Thus, in the current report, Impella 5.5 is captured as "Other" or in some cases in the left ventricular assist device (LVAD) category. It is anticipated that future iterations of the Annual Data Report will be able to provide more granularity regarding temporary MCS.

2 Adult Heart Transplant

2.1 Waitlist Trends

There has been increasing turnover on the adult heart transplant waiting list. Since 2021, the number of patients awaiting heart transplant at the beginning and end of the year has declined, despite more additions to the list than ever; this is primarily due to transplants, because removals for death or "Other" reasons have declined while removals for improvement, being too ill, or patient declining have remained stable (Table HR 5 and Table HR 6). The number of candidates being added to the waiting list each year has gradually increased over the past decade, by 60.6% since 2012 (Figure HR 1). In 2020, there was a decrease in new additions to the waiting list, most likely due to the pandemic; however, since then, the number of new additions has increased by 1,064 (26.6%). Between 2013 and 2023, the number of candidates awaiting transplant on December 31 of a given year has decreased 15.2%. There have been no significant shifts in distribution by candidate age group or sex, but the prevalences of cardiomyopathy, congenital heart disease, and ventricular assist device (VAD) use have increased (Table HR 1 and Table HR 2). In addition, the proportion of non-White candidates on the waiting list has increased since 2012, with the greatest increase, 92.9%, occurring in the Native American category—although only 0.54% of candidates in 2023 were Native American (Figure HR 5). In 2023 and 2012, the proportions of White candidates were 56.2% and 68.0% and the proportions of Black candidates were 27.8% and 21.2%, respectively. Among candidates who had been awaiting transplant at any time in the given year, the proportion with waiting time of less than 90 days has increased since 2012, with the steepest increase occurring since 2018. In 2023, 50.5% of candidates had been on the list less than 90 days compared with 30.7% in 2012 and 32.2% in 2018 (increases of 64.5% and 56.8%, respectively). As a result, the proportion of candidates who had been listed for longer periods decreased. In 2023, there were fewer candidates on the list for 2 years or more: 16.5% in 2023 versus 20.7% in 2012 (Figure HR 7).

Duration on the waiting list takes into account candidates who underwent transplant, died, were removed for other reasons, or were still waiting. The shift to more candidates on the list for a shorter duration may be partially explained by the increase in transplant rates among high-urgency candidates and also by the increase in the number of additions to the list (Figure HR 7).

The behavioral changes that accompanied the 2018 policy revision are having a greater impact, with increasing listings at adult status 2. From 2019 through 2021, approximately one-third of candidates were listed at adult status 4. However, from 2021 through 2023, adult status 2 candidates (typically candidates with temporary MCS) increased while adult status 4 candidates declined, as centers began to favor temporary MCS over durable MCS to improve access to transplant; in 2023, adult status 2 candidates constituted 30.7% (Figure HR 9). During 2019-2023, the proportion of adult status 1 candidates, those typically on extracorporeal membrane oxygenation (ECMO), increased: 7.8% in 2023 versus 4.2% in 2019. The proportion of adult status 3 candidates declined: 7.6% in 2023 versus 11.7% in 2019. The increase in ECMO, intra-aortic balloon pump, and Impella use after the policy revision has been well described,[3] and while there was a surge in the number of patients who had ECMO at transplant following the policy change, the increased use of intra-aortic balloon pump and Impella resulted in more adult status 2 candidates[4,5] (Figure HR 9). Candidates listed at high-urgency status, adult statuses 1-3, accounted for 46.2% of all listings in 2023, a 28.0% increase since 2019. Trends by donor service area demonstrated that in 2023, most donation service areas listed approximately 7%-8% of candidates at adult status 1 and approximately 30% at adult status 2 (Table HR 4). Notable outliers included the following: region 8 listed 4.8% and 41.7% at adult statuses 1 and 2, respectively; region 11 listed 10.4% at adult status 1; and region 10 listed 22.1% at adult status 2.

2.2 Heart Transplant Rates

Since 2012, the overall heart transplant rate for adults increased 106.1%: 140.8 transplants per 100 patient-years in 2023 compared with 68.3 transplants per 100 patient-years in 2012. The heart transplant rate has increased 57.3% since 2019, the first year after the allocation policy revision in 2018 (Figure HR 13). All age groups had increases in transplant rates, although transplant rate tends to be highest in candidates aged 65 years or older; for those in this age group, it was 162.0 transplants per 100 patient-years in 2023 (Figure HR 14). There were similar increases in transplant rate for candidates of all races and ethnicities and diagnoses. The rate of transplant in Asian candidates far exceeded that in all of the other racial and ethnic categories: 216.9 transplants per 100 patient-years, with the Other category being second highest at 177.8 transplants per 100 patient-years. Despite increasing 97.7% since 2012, the transplant rate in Black candidates has tended to be the lowest of the racial and ethnic categories and remained so: 122.2 transplants per 100 patient-years in 2023 (Figure HR 15).

Among the diagnoses in adult candidates, the greatest change in transplant rate occurred in those with valvular heart disease: 175.5 transplants per 100 patient-years in 2023 compared with 48.9 transplants per 100 patient-years in 2012, a 258.9% increase. Candidates with congenital heart disease had a steep increase in transplant rate, particularly following the policy change, to 99.3 transplants per 100 patient-years in 2023. Yet, candidates with congenital heart disease have not had transplant rates comparable to those of the other diagnoses, and this was the lowest transplant rate of all diagnoses in 2023. The second-lowest transplant rate in 2023 occurred in candidates with coronary artery disease: 133.9 transplants per 100 patient-years (Figure HR 16). As expected, the transplant rates among adult statuses 1 and 2 were higher (2,225.8 and 1,088.1 transplants per 100 patient-years, respectively) than those of other statuses. Since 2019, there was an increase in transplant rate for all statuses except adult status 2, which declined by 7.0% (Figure HR 20).

Among adult patients listed in 2020, 74.0% underwent transplant by 3 years, a 9.0% increase since 2012 (Figure HR 24). Among those newly listed in 2020, by 3 years, 4.3% had died, 15.7% were removed for other causes, and 6.0% were still waiting (Figure HR 23). Since 2012, more patients have undergone transplant earlier after listing. The proportion of patients undergoing transplant within 3 months and within 1 year has steadily increased. Among patients listed in 2022, 58.3% underwent transplant within 3 months and 71.4% within 1 year, compared with 31.7% and 53.1%, respectively, in 2012 (Figure HR 24). In 2023, the lowest transplant rates occurred among candidates listed at adult statuses 4-6, inactive candidates, candidates with congenital heart disease, adults listed under pediatric status, and candidates with blood type O—all of which had transplant rates of less than 100 transplants per 100 patient-years (Figure HR 16, Figure HR 17, and Figure HR 20).

2.3 Pretransplant Mortality

In general, pretransplant mortality in adults waitlisted for heart transplant has decreased substantially since 2012. Overall pretransplant mortality reached a low of 8.5 deaths per 100 patient-years in 2023 despite a slight increase in 2020 (Figure HR 25). The pretransplant mortality rate declined for all racial and ethnic categories, although in 2023 it remained slightly higher for Asian and Hispanic candidates (10.5 deaths per 100 patient-years and 10.8 deaths per 100 patient-years, respectively) and was lowest for Black candidates (7.9 deaths per 100 patient-years). There have been fluctuations in mortality rates among all the racial and ethnic categories, but there were two outliers over the past decade: in 2015, the pretransplant mortality for Asian candidates was 20.1 deaths per 100 patient-years, and in 2017, it was 40.9 deaths per 100 patient-years for candidates classified as Other race and ethnicity (Figure HR 27). Among the diagnosis categories, pretransplant mortality was lowest among adult candidates with congenital heart disease in 2023 at 3.1 deaths per 100 patient-years, a remarkable decline from 17.1 deaths per 100 patient-years in 2012 (Figure HR 29), possibly due to the increasing consensus regarding a multidisciplinary approach to management and earlier referral to adult teams for heart failure.[6, 7, 8]

Compared with 2019, pretransplant mortality rates decreased for candidates in all active status groups except adult status 1, in which pretransplant mortality increased from 114.7 deaths per 100 patient-years in 2019 to 129.1 deaths per 100 patient-years in 2023, following a peak of 149.1 deaths per 100 patient-years in 2022. In 2023, candidates listed at adult status 6 continued to have the lowest pretransplant mortality rate: 3.0 deaths per 100 patient-years. Candidates listed at adult status 4 had the second-lowest pretransplant mortality: 5.3 deaths per 100 patient-years (Figure HR 32). The intent of the 2018 heart allocation policy revision was partially to improve risk stratification based on pretransplant mortality; however, pretransplant mortality of adult status 5 candidates exceeds that of adult status 4 candidates, and in some years, including 2023, that of adult status 3 candidates. Candidates listed at adult status 5 are those requiring multiorgan transplant. Although most multiorgan candidates are listed for heart-kidney, there are growing numbers of heart-liver and heart-lung candidates as well as candidates for triple-organ transplant; this has created heterogeneity in the complexity, which may exceed that of some patients with an LVAD, some patients with congenital heart disease, and some patients with restrictive cardiomyopathy, hypertrophic cardiomyopathy, and amyloid cardiomyopathy (adult status 4), and which may be on par with candidates listed for LVAD complications (adult status 3) (Figure HR 32). Pretransplant mortality ranged from 0 to 42.16 deaths per 100 patient-years between donation service areas (Figure HR 33), and the median was 8.1 deaths per 100 patient-years.

The pandemic resulted in increased mortality among patients with illnesses other than COVID-19.[9] Some transplant centers restricted heart transplants to the most urgent patients during the pandemic. Despite this, there was only a slight increase in the overall pretransplant mortality rate, from 8.7 deaths per

100 patient-years in 2019 to 9.0 deaths per 100 patient-years in 2020. More pronounced increases were seen in Asian, Black, and Hispanic candidates (Figure HR 27), in candidates residing in nonmetropolitan areas (Figure HR 30), and in candidates listed at adult statuses 1, 3, and 6 (Figure HR 32). Of note, pretransplant mortality for candidates listed as adult status 1 increased from 114.7 to 136.2 deaths per 100 patient-years between 2019 and 2020. In 2021, the year after the declaration of the national emergency for the pandemic, there was a steep decline in pretransplant mortality for adult status 1 candidates to 81.2 deaths per 100 patient-years, a change not seen in the other status groups and which cannot be explained by changes in transplant rate alone (Figure HR 32). In inactive candidates, pretransplant mortality was lower in 2020 (10.8 deaths per 100 patient-years) compared with 2019 (12.2 deaths per 100 patient-years).

Adult deaths within 6 months of removal from the transplant waiting list reached a nadir in 2021, and in 2023 the rate was 13.0 deaths per 100 patient-years, representing a 57.8% decrease from 2012 (Figure HR 34). In 2023, death within 6 months of removal occurred least in age group 18-34 years and most in age group 65 years or older: 3.7 deaths per 100 patient-years and 15.8 deaths per 100 patient-years, respectively. Although there was a decline in death after removal in all age groups, it was most notable in age group 18-34 years, decreasing 86.5% since 2012 (Figure HR 35). Asian candidates had deaths within 6 months of removal in excess of other racial and ethnic categories in 2023, at 26.1 deaths per 100 patient-years (Figure HR 36). There have been fluctuations in the occurrences of death within 6 months of removal for all status categories, but in 2023, the occurrence of death after removal remained high for candidates listed at adult statuses 1 and 2, at 27.8 deaths per 100 patient-years and 25.8 deaths per 100 patient-years, respectively. This is not surprising given the relative acuity of these patients.

2.4 Heart Transplant Trends

In 2023, there were 4,092 adult heart transplants performed. Adult heart transplant volume continues to increase, and in 2023, the largest annual increase of the past decade occurred. From 2022 to 2023, there were an additional 424 adult heart transplants performed in the United States. A similar increase, 405, was seen between 2015 and 2016 (Figure HR 39). The third-greatest increase, 295 transplants, occurred from 2021 to 2022. From 2012 to 2023, heart transplants increased by an average of 187 each year (median change, 126). Although transplant volume growth may be partially explained by more candidates being listed at a higher status, an increase in donors (Figure HR 63) and the promise of donation after circulatory death (DCD) may also be responsible. It has been projected that widespread use of DCD heart transplant could increase the donor pool by 30%.[10] Between 2020 and 2023, the percentage of DCD hearts recovered for transplant surged from 3.4% to 14.0% (Figure HR 69), which seems to indicate a substantial increase in heart transplants performed using DCD hearts, but some of these may have been unused. In 2017 and 2018, there were no DCD heart transplants performed, as no DCD hearts were recovered for transplant.

Transplants performed in age groups 65 years or older and 18-34 years increased 132.8% and 115.8%, respectively, from 2012 to 2023 (Figure HR 40). There have been notable increases in transplants in all racial and ethnic categories, although transplants in the Multiracial, Native American, and unreported groups remained relatively low. In 2023, there were 32 transplants performed in Native American patients, 17 in Multiracial patients, and 12 in patients in the unreported category (Figure HR 42). Racial and ethnic disparities in the use of advanced heart failure therapies have been well described.[11,12] Trends in transplant volume are promising. In 2023, there were 1,046 (25.6%) transplants performed in Black patients, a 161.5% increase from 400 transplants in 2012. Similar increases were seen in Hispanic and Asian recipients (Figure HR 42).

Despite growing numbers of transplants for all diagnoses in adults since 2012, the number of transplants performed for valvular heart disease has changed little since 2014; in 2023, only 38 transplants were performed for valvular heart disease (Figure HR 43). Since 2019, transplants have increased for all urgency status categories except adult status 3. In 2023, most transplants, 2,224 (54.3%), were performed in adult status 2 candidates (Figure HR 44). In general, patients with an LVAD and congenital heart disease are listed as adult status 4, and there has been increasing concern regarding excessive waiting times for adult status 4 candidates. The number of transplants for candidates listed at adult status 4 peaked at 737 in 2020 but has declined since then; in 2023, 580 (14.2%) transplants were performed in adult status 4. In 2023, the fewest transplants, 62, were performed in patients listed at adult status 5. Only 1.5% of candidates were listed at adult status 5 in 2023, which may be a result of centers listing candidates who require dual-organ transplant at higher statuses.

In 2023, multiorgan transplants constituted 13.5% of heart transplants in adults compared with 6.0% in 2012 (Figure HR 45). Heart-kidney transplants increased the most during this period: 421 transplants in 2023 versus 76 in 2012. Heart-lung transplants continued to increase, but they were less than 2% of all heart transplants and were 9.6% of all multiorgan transplants in 2023; only

53 adult heart-lung transplants were performed in the United States in 2023. The number of heart-liver transplants has surpassed heart-lung transplants; 70 adult heart-liver transplants were performed in 2023.

In 2023, the typical adult heart transplant recipient was male, aged 50-64 years, White (but more likely to be non-White than a decade ago), blood type O, without a VAD, calculated panel-reactive antibody (cPRA) < 1%, and adult status 2 at transplant. The typical recipient in 2023 had private insurance, resided in a metropolitan area, and was within 50 miles of the transplant center. While 45.9% of recipients had private insurance, 34.9% had Medicare and 14.7% had Medicaid (Table HR 8 and Table HR 9).

The use of induction therapy has fluctuated but tends to be more common than no induction over the past decade, with interleukin-2 agents most used (Figure HR 46 and Figure HR 47). Triple therapy with tacrolimus, a mycophenolate agent, and steroid was the most common immunosuppression regimen reported prior to discharge (Figure HR 48).

2.5 Posttransplant Survival and Morbidity

Trends in adult posttransplant mortality have been favorable. Although transplant mortality has fluctuated, since 2012, there has been an overall decline in posttransplant mortality at 6 months and at 1, 3, and 5 years (Figure HR 49). Six-month and 1- and 3-year mortality were lowest for patients who underwent transplant in 2018. There was a transient increase in posttransplant mortality for patients who underwent transplant in 2019, which exceeded that of the year prior to the new policy; however, for patients who underwent transplant in 2022, 6-month and 1-year posttransplant mortality were slightly lower (7.0% and 8.4%, respectively) than prepandemic and lower than the year prior to the policy revision. Three-year mortality among patients who underwent transplant in 2020 was 16.0%.

Among adult patients who underwent transplant in 2016-2018, the 5-year survival was 80.3%. Overall 1-year and 3-year patient survival were 91.5% and 85.9%, respectively (Figure HR 50). Older patients tended to have early decrements in survival compared with recipients aged 18-49 years; patients 65 years or older had the greatest decline in survival during the first year to 89.3%, while survival in the other age groups declined by less than 10% and remained greater than 90% at year 1. By 5 years, survival in patients 65 years or older was 77.3% compared with greater than 80% in other age groups (Figure HR 51). Patient survival was best in those aged 18-34 years through year 1, after which it was similar to that in age groups 35-49 and 50-64 years. Relatively early decline in patient survival was noted in Hispanic recipients compared with other racial and ethnic categories between 2-3 months posttransplant and declined to 91.7% at 6 months. By year 1, survival was slightly lower in Hispanic recipients, 90.3%, and highest in Black recipients, 92.4%. During year 2, Black and Asian patients had a similar decline (Figure HR 52). At year 5, survival was lowest in Black and Hispanic recipients, 77.2% and 77.3%, and highest in White recipients, 81.7%.

Adults with prior congenital heart disease who received a heart in 2016-2018 tended to have the lowest survival at all time points compared to recipients with other diagnoses, with a decrease in survival of greater than 10% within the first 3 months. At 1 year, survival in recipients with prior congenital heart disease was 86.0%, while survival ranged from 89.9% to 92.6% in the other diagnosis categories. This trajectory in survival persisted for congenital heart disease, with survival declining to 76.1% at 5 years. Patients with prior coronary artery disease had the second-lowest survival at 5 years, 77.2%. Survival at 5 years was greater than 80% for cardiomyopathy, valvular, and Other/unknown (Figure HR 53). Recipients who had a VAD tended to have slightly lower patient survival compared with recipients without a VAD: at 5 years, 79.3% and 81.2%, respectively (Figure HR 55).

Posttransplant patient survival by status (2018 heart revision categories) was analyzed for patients who received a heart in 2020-2021. Posttransplant survival tended to be similar between recipients who were adult statuses 2-4 and 6; however, there was an early and pronounced decrement in survival in recipients who were adult status 5 (Figure HR 57). Survival in recipients who were adult status 5 decreased within the first month of transplant; although initially at 100%, survival had declined to 87.5% by 3 months. Adult status 5 transplants were a small proportion, at only 80 transplants performed during this period (Figure HR 44). A similar, but less pronounced, trend was noted in recipients who were adult status 1, with a decline in survival seen within the first 3 months of transplant. At 1 year, survival was 83.8% in adult status 5, 87.1% in adult status 1, and greater than 90% in the other groups. Two-year survival was only 75.0% in adult status 5 recipients, 84.3% in adult status 1, and 86% or greater in the other status groups. Adult status 2 and adult status 6 recipients tended to have the best survival. Although higher posttransplant mortality may not be unexpected in adult status 1 recipients due to their acuity prior to transplant, the reason for higher mortality in adult status 5 recipients is not immediately obvious; however, it may be explained by multiorgan failure and longer waiting time for transplant. Adult status 5 recipients tend to have higher waitlist mortality, which may be an indication of medical acuity.

Heart-kidney and heart-liver transplant recipients who underwent transplant in 2016-2018 tended to have similar outcomes over 5 years, with heart-liver having the best patient survival at 5 years: 82.1%. In addition, patient survival for heart-kidney and heart-liver recipients was similar to that for heart-alone recipients in this cohort. Recipients in the “Other multiorgan” category, of which there were only 9, had the worst early survival, declining to 66.7% during the first year and remaining at 66.7% at 5 years; however, survival in heart-lung transplant recipients remained the lowest of all multiorgan categories, at 86.6% at 1 year and 64.2% at 5 years (Figure HR 59). Patients with cPRA of 98%-100% who received a heart in 2016-2018 had worse survival compared with other cPRA groups (Figure HR 60).

3 Donation

Deceased heart donors reached a peak in 2023 at 4,664 (adult and pediatric), a 90.3% increase since 2012 (Figure HR 63). There was a notable increase in donors aged 30-39 years (1,525 in 2023 compared with 456 in 2012); this group now constitutes the majority of donors, surpassing those aged 18-29 years (Figure HR 64 and Figure HR 65). Many programs have developed DCD programs and accept hearts from donors who are hepatitis C virus (HCV) positive to broaden access to transplant. Since 2016, the proportion of donors who were HCV positive, by antibody and nucleic acid test as NAT+ or NAT-/Ab+, has increased: for NAT+, 5.0% in 2023 versus 0.4% in 2016; for NAT-/Ab+, 4.9% in 2023 versus 0.2% in 2016 (Figure HR 68). Since 2019, there has been a steady and persistent increase in DCD: 14.0% of hearts donors in 2023 compared with 0.22% in 2019 (Figure HR 69). The proportion of hearts recovered for transplant and not transplanted (nonuse) reached a nadir of 0.7% in 2018, from 1.2% in 2012. There has been a subsequent increase in heart nonuse to 1.5% in 2023 (Figure HR 71). Nonuse rates have fluctuated in several categories, but notable trends include a 57.4% decrease in unused organs in the donor age group of 55 years or older: 1.6% in 2023 compared with 3.8% in 2012 (Figure HR 72). Nonuse amongst donors with hypertension decreased to 1.2% in 2023 while nonuse increased in donors without hypertension (Figure HR 75). Nonuse rates tend to be high in donors with body mass index (BMI) of 40 or higher; nonuse of hearts from these donors was 3.3% in 2023 (Figure HR 76). Nonuse of hearts from donors with head trauma increased to 1.6% in 2023 (Figure HR 77).

4 Pediatric Heart Transplant

4.1 Waitlist Trends

In 2023, the number of new pediatric candidates added to the waiting list reached its highest point at 737, up 34.0% from 2012 (Figure HR 79). There were a total of 1,248 prevalent candidates aged 17 years or younger, which represents a 44.6% increase from 2012 (Figure HR 80). The largest pediatric age groups on the waiting list in 2023 were 1-5 years (26.1%) and 12-17 years (25.6%), followed by 6-11 years (21.2%) and younger than 1 year (21.1%) (Figure HR 81). Half of pediatric heart transplant candidates were White (50.2%), 21.6% were Hispanic, 19.6% were Black, 3.4% were Asian, 0.6% were Native American, and 0.8% had unreported race and ethnicity (Figure HR 82). Congenital defects continued to be the leading and increasingly common diagnosis among pediatric heart transplant candidates, at 61.5% in 2023, which is a 35.2% increase since 2012 (Figure HR 83). Just over half (52.0%) of pediatric heart transplant candidates lived less than 50 miles from the transplant center (Table HR 11). The proportion of candidates listed with a VAD increased to 13.6% in 2023, from 5.1% in 2013 (Table HR 12). Among the 733 pediatric candidates for heart transplant removed from the waiting list in 2023 (Table HR 14), 531 (72.4%) were removed due to undergoing transplant, 62 (8.5%) died, 59 (8.0%) were removed due to improved condition, and 28 (3.8%) were considered too sick to undergo transplant (Table HR 15).

The proportion of pediatric heart transplant candidates on the waiting list less than 90 days continued its general decline over the past decade: 34.4% in 2023 compared with 46.9% in 2012, which represents a 26.7% decrease. The proportion of candidates waiting 3-<6 months had a 46.1% increase: 20.6% in 2023 versus 14.1% in 2012 (Figure HR 85). Half (50.7%) of pediatric candidates were listed at status 1A in 2023, followed by 18.4% at status 1B and 9.5% status 2 (Figure HR 86). Just over 70% of pediatric candidates newly listed in 2018-2020 underwent transplant within 3 years, 14.7% were removed from the list, 9.1% died, and 4.7% were still waiting (Figure HR 87).

In 2023, the heart transplant rate among pediatric candidates decreased to its lowest rate in the past decade, 99.7 transplants per 100 patient-years, which is a 14.9% decrease from 117.1 transplants per 100 patient-years in 2012 (Figure HR 88). Transplant rates in 2023 varied by age, with the highest rates for candidates aged 12-17 years (183.5 transplants per 100 patient-years) and younger than 1 year (129.5 transplants per 100 patient-years), followed by 6-11 years (66.3 transplants per 100 patient-years) and 1-5 years (62.8 transplants per 100 patient-years). Since 2012, transplant rates in candidates younger than 1 year decreased by 50.2%; in those aged 1-5 years, decreased by 32.6%; in those aged 6-11 years, decreased by 26.6%; and in those aged 12-17 years, increased by 42.1% (Figure HR 89). Transplant rates in 2023 were similar across racial and ethnic categories among pediatric waitlist candidates (Figure HR 90).

Overall pretransplant mortality in pediatric candidates waitlisted for heart transplant was 11.7 deaths per 100 patient-years in 2023, which is a 53.4% decline from 25.1 deaths per 100 patient-years in 2012 (Figure HR 92). Pretransplant mortality rates varied by age, with the highest 2023 rate in candidates younger than 1 year, at 29.5 deaths per 100 patient-years, followed by those aged 1-5 years, 6-11 years, and 12-17 years at 11.1, 5.8, and 5.8 deaths per 100 patient-years, respectively (Figure HR 93). By race and ethnicity, 2023 pretransplant mortality rates among Asian, Hispanic, Black, and White candidates were 21.8, 13.7, 12.3, and 10.1 deaths per 100 patient-years, respectively (Figure HR 94). By diagnosis, pretransplant mortality in 2023 was highest among those with congenital defects at 13.4 deaths per 100 patient-years (Figure HR 95). By medical urgency, pretransplant mortality in 2023 was highest for candidates listed at status 1A (25.7 deaths per 100 patient-years), followed by status 1B (7.7 deaths per 100 patient-years) and status 2 (2.3 deaths per 100 patient-years) among active statuses (Figure HR 96).

4.2 Trends in Heart Transplant

The number of pediatric heart transplants performed increased to 507 in 2023, a 36.3% increase from 2012 (Figure HR 98). There were 202 (39.8%) heart transplants performed in recipients aged 12-17 years, 118 (23.3%) in recipients younger than 1 year, 94 (18.5%) in recipients aged 6-11 years, and 91 (17.9%) in recipients aged 1-5 years (Figure HR 99). The 202 transplants in recipients aged 12-17 years is a 96.1% increase from 2012. Over the past decade, the proportion of transplant recipients aged 12-17 years has also increased, to 39.8% in 2023 compared with 33.3% in 2013, whereas the proportion aged younger than 1 year decreased, to 23.3% in 2023 compared with 28.5% in 2013 (Table HR 17). Looking at 2023 pediatric heart transplant counts by race and ethnicity, there were 268 transplants in White recipients, 99 in Hispanic recipients, 98 in Black recipients, 19 in Asian recipients, 18 in Multiracial recipients, and 4 in Native American recipients (Figure HR 101). Congenital defects as the primary cause of disease increased over the past decade: 56.8% of pediatric heart transplant recipients in 2023 compared with 43.1% in 2013 (Table HR 18). The proportion who underwent transplant at status 1A declined (83.6% in 2023 versus 92.0% in 2013), whereas the proportion who underwent transplant at status 1B increased (14.2% in 2023 versus 5.8% in 2013) and the proportion at status 2 stayed stable (Table HR 18). There has been a shift in the waiting time over the past decade, with fewer recipients who underwent transplant with 1-<90 days waiting time and more with 3-<6 months and 6-<12 months of waiting time (Table

HR 19). The proportion of pediatric heart transplant recipients with a VAD at transplant has increased: 42.0% in 2023 versus 26.5% in 2013 (Table HR 18). The proportion of ABO-incompatible transplants has also increased: 7.5% in 2023 versus 4.1% in 2013 (Table HR 19).

With some shifts over the years, induction therapy use has increased since 2012, to 86.6% of pediatric heart transplant recipients in 2023 (Figure HR 104); 77.0% reported T-cell–depleting therapy alone, 8.5% interleukin-2 receptor antibody only, 1.2% both, and 13.4% no induction agents (Figure HR 105). In 2023, the initial immunosuppression regimen used in pediatric heart transplant recipients was tacrolimus and a mycophenolate agent (44.8%), followed by tacrolimus, mycophenolate, and steroids (42.2%), and other combinations (11.0%) (Figure HR 106).

4.3 Posttransplant Survival and Morbidity

Among pediatric heart transplant recipients in 2022, the incidence of acute rejection in the first year posttransplant was 18.8% in recipients aged 12-17 years, 15.4% in those aged 6-11 years, 14.4% in those aged 1-5 years, and 8.8% in those younger than 1 year (Figure HR 107). Among pediatric heart transplant recipients in 2012-2018, the overall incidence of posttransplant lymphoproliferative disorder was 5.4% at 5 years; the incidence was 6.9% among recipients who were Epstein-Barr virus negative and 3.9% among recipients who were Epstein-Barr virus positive (Figure HR 108).

Recipient death occurred in 6.9% of patients at 6-months posttransplant and in 8.3% at 1-year posttransplant among pediatric heart transplants performed in 2022, in 11.6% at 3 years for transplants performed in 2020, in 17.1% at 5 years for transplants performed in 2018, and in 25.8% at 10 years for transplants performed in 2013 (Figure HR 109). Overall, 1-, 3-, and 5-year patient survival rates were 93.3%, 88.2%, and 84.4%, respectively, among recipients who underwent transplant in 2016-2018 (Figure HR 110). By age, 5-year patient survival was 82.8% for recipients younger than 1 year, 82.6% for those aged 1-5 years, 88.1% for those aged 6-11 years, and 85.0% for those aged 12-17 years among recipients who underwent transplant in 2016-2018 (Figure HR 111). By race and ethnicity, 5-year patient survival ranged from 86.7% among Asian recipients to 86.3% among White recipients, 82.5% among Hispanic recipients, and 81.5% among Black recipients (Figure HR 112). By etiology of disease, 5-year patient survival was lowest among children with congenital defects at 80.2% and highest for children with myocarditis at 93.5% (Figure HR 113). By urgency status, the 5-year patient survival for pediatric recipients was 83.5% for status 1A, 88.5% for status 1B, and 82.9% for status 2 (Figure HR 114).

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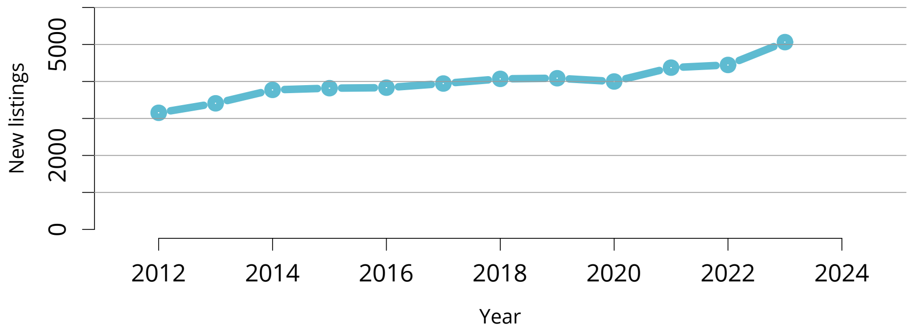

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Figure HR 1: New adult candidates added to the heart transplant waiting list. A new adult candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and subsequently relisted are considered new. Active and inactive patients are included.

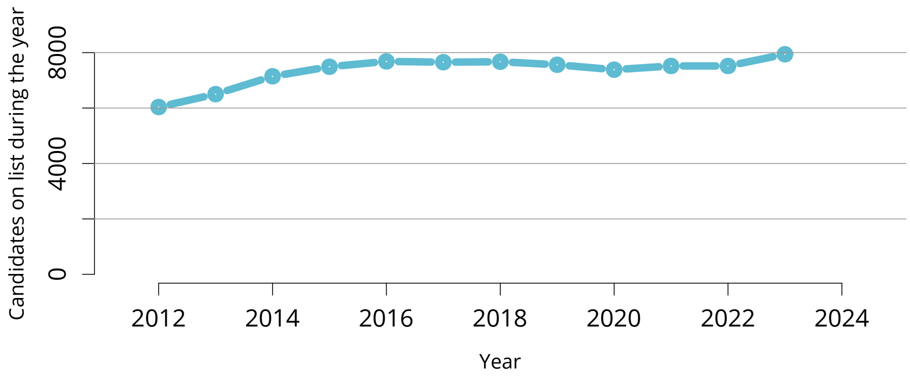

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Figure HR 2: All adult candidates on the heart transplant waiting list. Adult candidates on the list at any time during the year. Candidates listed at more than one center are counted once per listing.

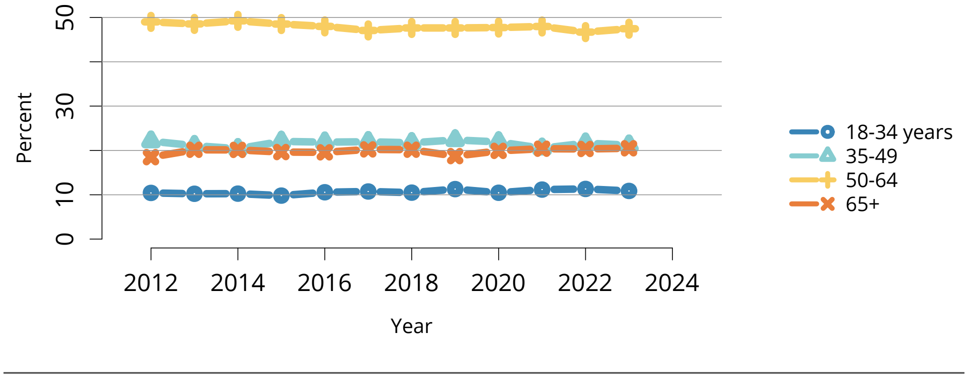

Figure HR 3: Distribution of adults waiting for heart transplant by age. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included. Age is determined at the earliest of transplant, death, removal, or December 31 of the year.

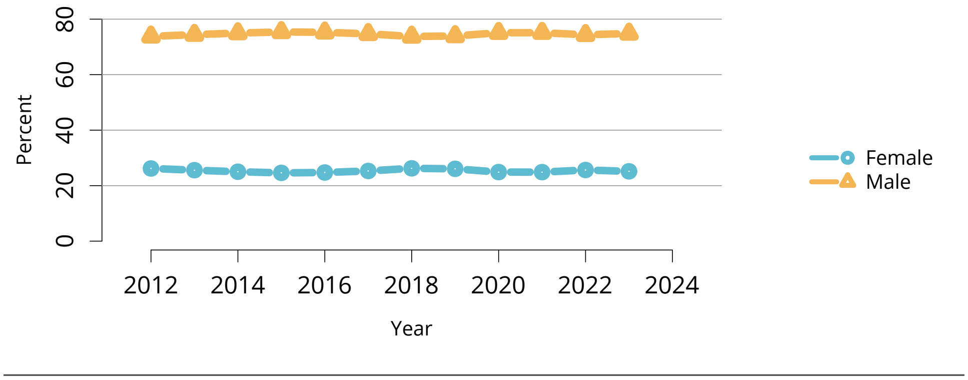

Figure HR 4: Distribution of adults waiting for heart transplant by sex. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

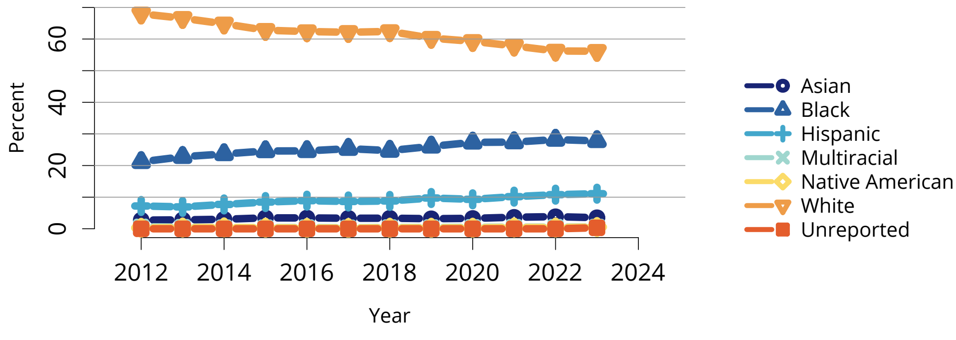

Figure HR 5: Distribution of adults waiting for heart transplant by race and ethnicity. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

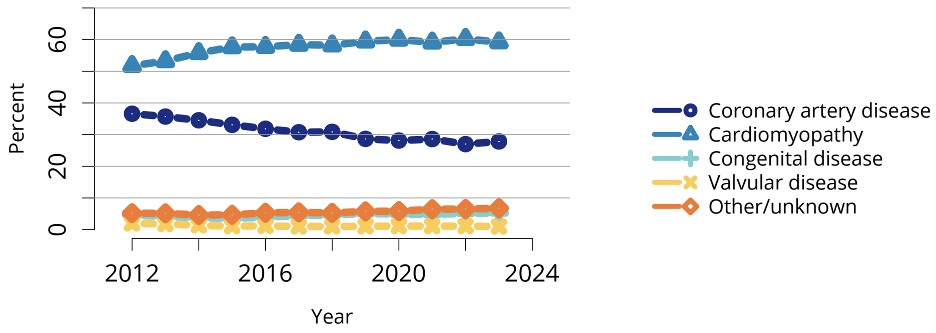

Figure HR 6: Distribution of adults waiting for heart transplant by diagnosis. Candidates waiting for transplant at any time in the given year. Active and inactive patients are included. Candidates listed at more than one center are counted once per listing.

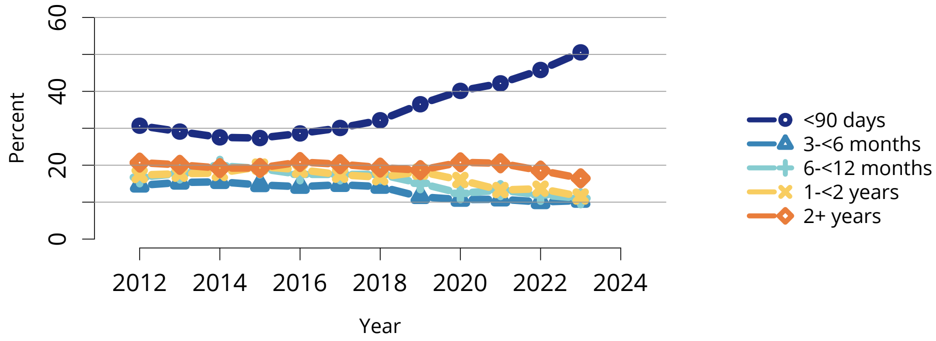

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Figure HR 7: Distribution of adults waiting for heart transplant by waiting time. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Time on the waiting list is determined at the earliest of transplant, death, removal, or December 31 of the year. Active and inactive candidates are included.

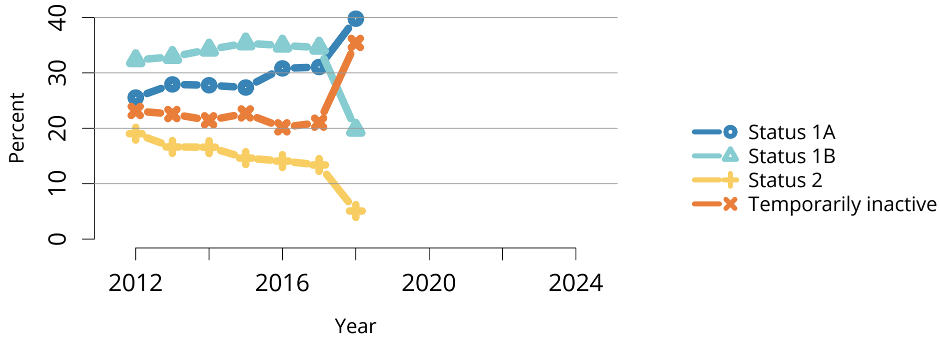

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Figure HR 8: Distribution of adults waiting for heart transplant by former medical urgency groups through October 17, 2018. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included. The October 2018 OPTN heart allocation policy update changed the status groups. Medical urgency for 2017 and earlier is determined at the earliest of transplant, death, removal, or December 31 of the year. For 2018 medical urgency statuses, statuses 1A, 1B, and 2 were determined at the earliest of transplant, death, or removal. For candidates who stayed active on the waiting list on or after October 18, 2018, and for candidates who were newly waitlisted on or after that date, their statuses are shown in Figure HR 9. Inactive statuses with new listings on or after October 18, 2018, are excluded here in Figure HR 8.

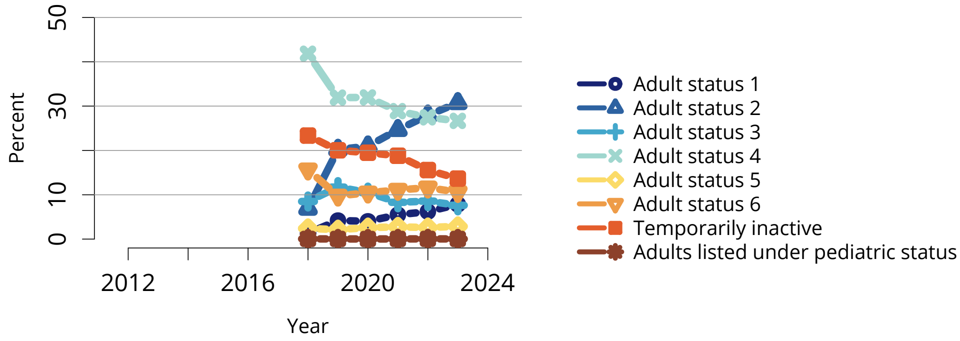

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Figure HR 9: Distribution of adults waiting for heart transplant by new medical urgency groups, October 18, 2018, through 2023. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included. The October 2018 OPTN heart allocation policy update changed the status groups. Medical urgency is determined at the earliest of transplant, death, removal, or December 31 of the year. For 2018 medical urgency statuses, adult statuses 1-6 and inactive status contain new listings on or after October 18, 2018, or existing listings from before the policy change.

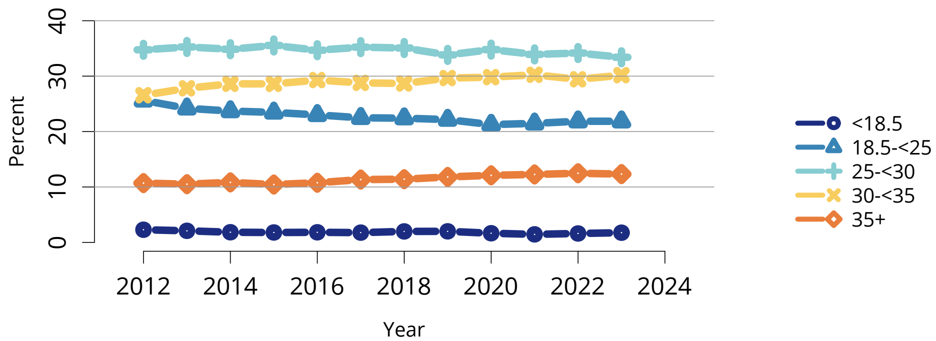

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Figure HR 10: Distribution of adults waiting for heart transplant by BMI. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included. BMI, body mass index.

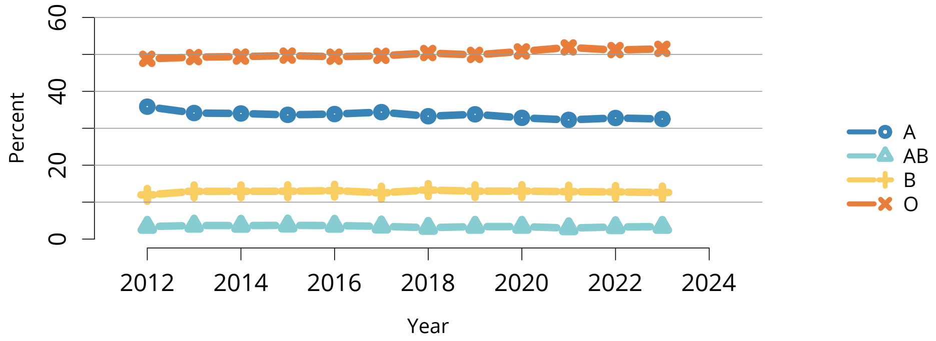

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Figure HR 11: Distribution of adults waiting for heart transplant by blood type. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

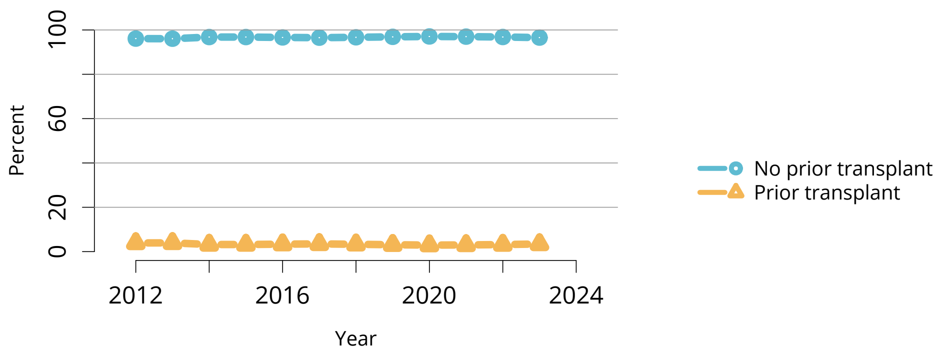

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Figure HR 12: Distribution of adults waiting for heart transplant by prior transplant status. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

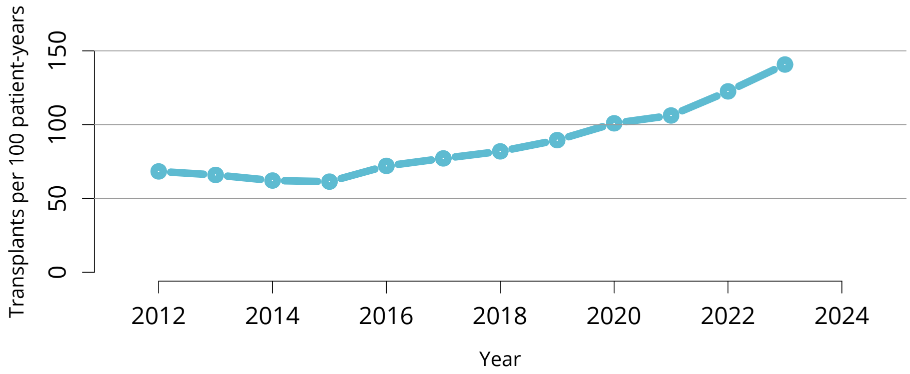

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Figure HR 13: Overall deceased donor heart transplant rates among adult waitlist candidates. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

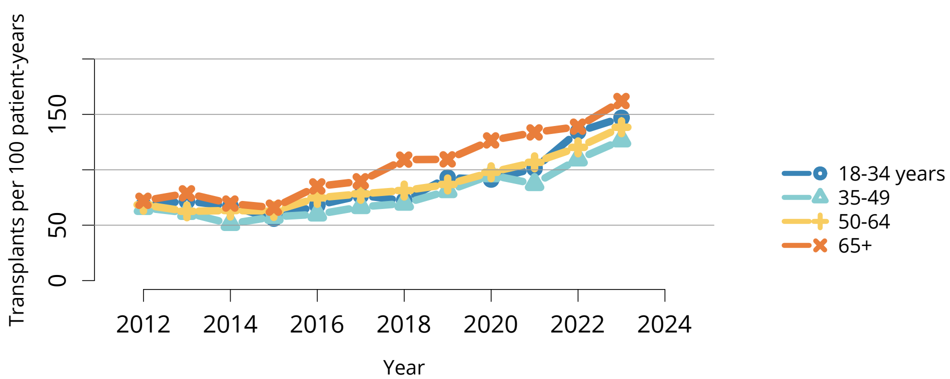

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Figure HR 14: Deceased donor heart transplant rates among adult waitlist candidates by age. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year.

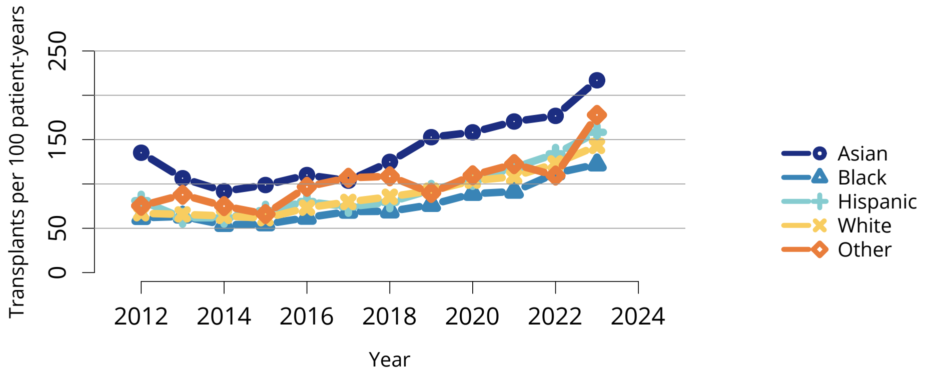

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Figure HR 15: Deceased donor heart transplant rates among adult waitlist candidates by race and ethnicity. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

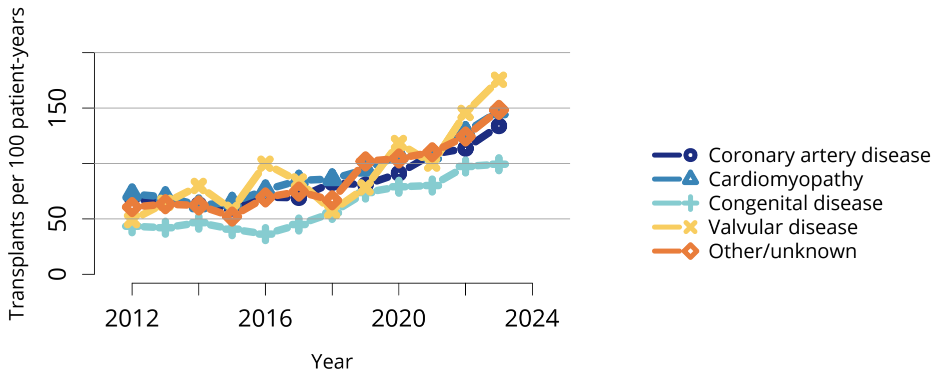

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Figure HR 16: Deceased donor heart transplant rates among adult waitlist candidates by diagnosis. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

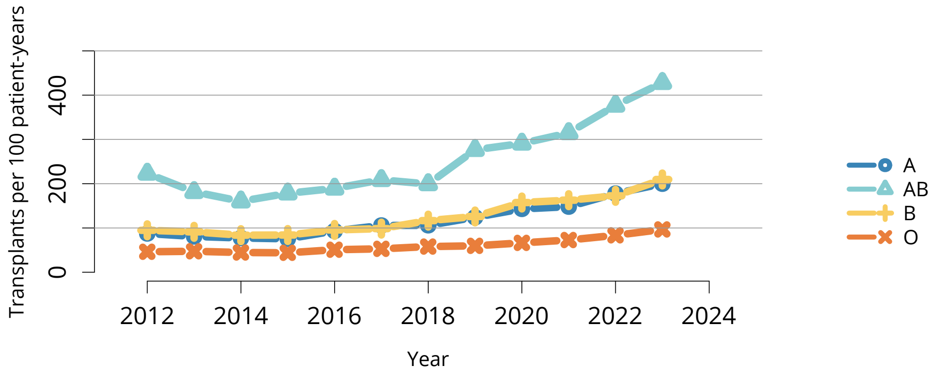

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Figure HR 17: Deceased donor heart transplant rates among adult waitlist candidates by blood type. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

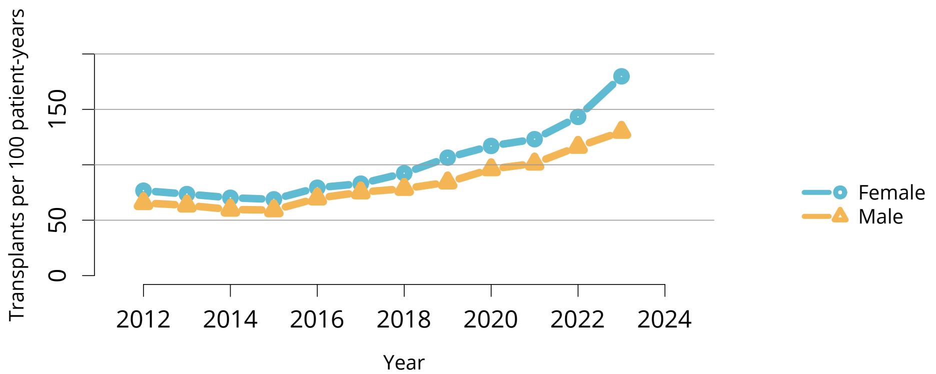

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Figure HR 18: Deceased donor heart transplant rates among adult waitlist candidates by sex. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

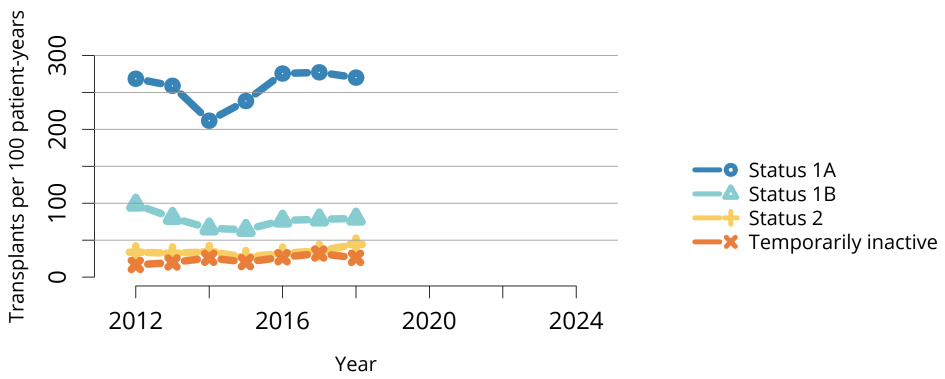

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Figure HR 19: Deceased donor heart transplant rates among adult waitlist candidates by former medical urgency groups through October 17, 2018. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. The October 2018 OPTN heart allocation policy update changed the status groups. Medical urgency is determined at the later of listing date or January 1 of the given year. For new listings on or after October 18, 2018, and for candidates who were newly waitlisted on or after that date, their medical urgency statuses are shown in Figure HR 20. Inactive statuses with new listings on or after October 18, 2018, are excluded here in Figure HR 19.

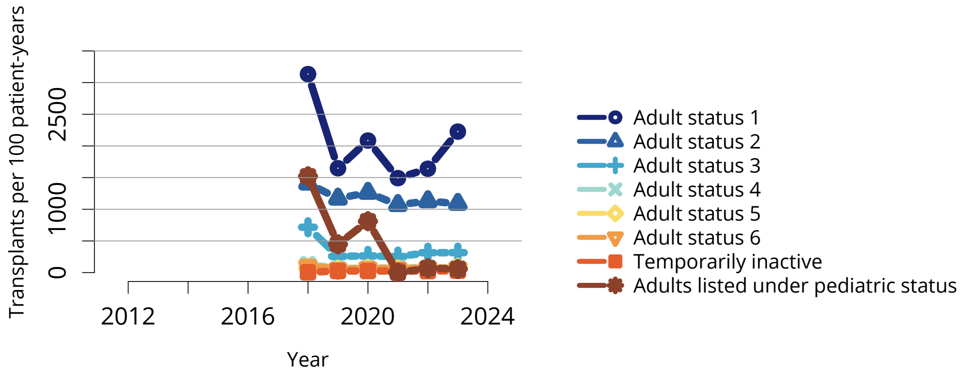

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Figure HR 20: Deceased donor heart transplant rates among adult waitlist candidates by new medical urgency groups, October 18, 2018, through 2023. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. The October 2018 OPTN heart allocation policy update changed the status groups. Medical urgency is determined at the later of listing date or January 1 of the given year. For 2018 medical urgency statuses, adult statuses 1-6 and inactive status contain new listings on or after October 18, 2018.

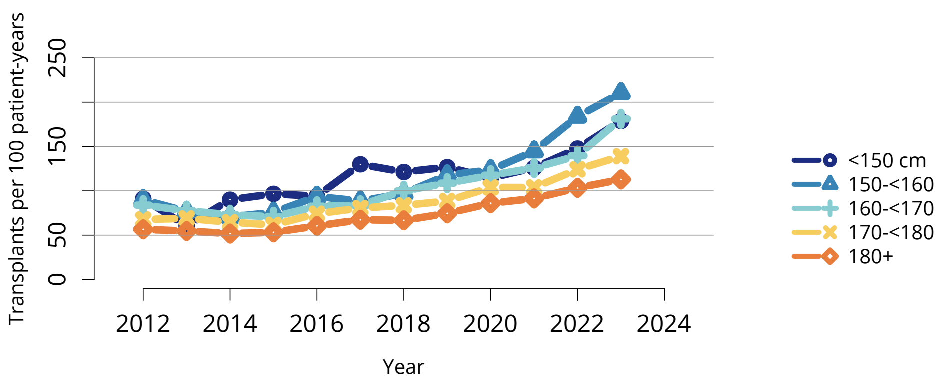

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Figure HR 21: Deceased donor heart transplant rates among adult waitlist candidates by height. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

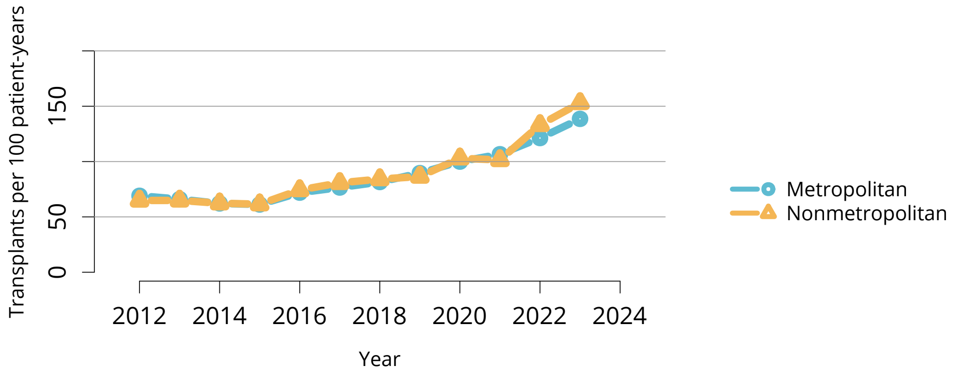

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Figure HR 22: Deceased donor heart transplant rates among adult waitlist candidates by metropolitan versus nonmetropolitan residence. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. Urban/rural determination is made using the RUCA (rural-urban commuting area) designation of the candidate's permanent zip code.

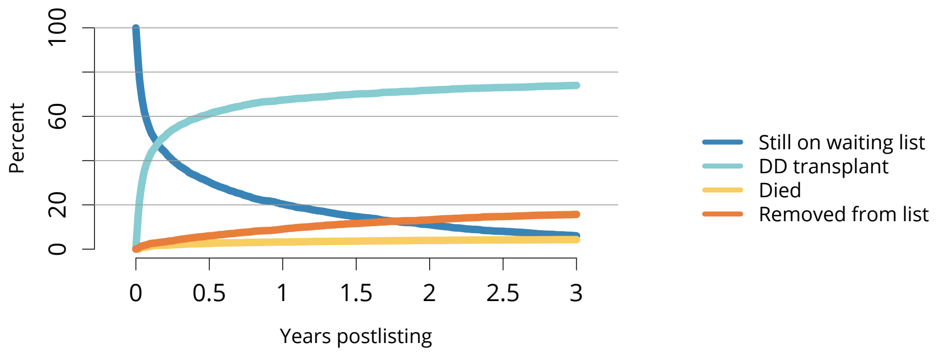

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Figure HR 23: Three-year outcomes for adults waiting for heart transplant, new listings in 2020. Candidates listed at more than one center are counted once per listing. Removed from list includes all reasons except transplant and death. DD, deceased donor.

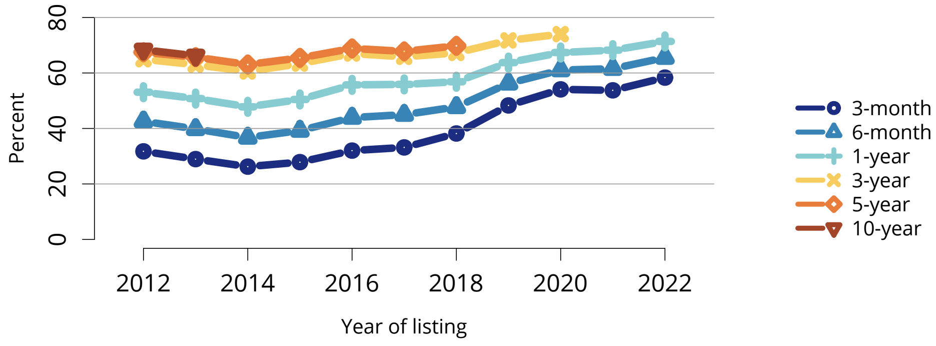

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Figure HR 24: Percentage of adults who underwent deceased donor heart transplant within a given period of listing. Candidates listed at more than one center are counted once per listing.

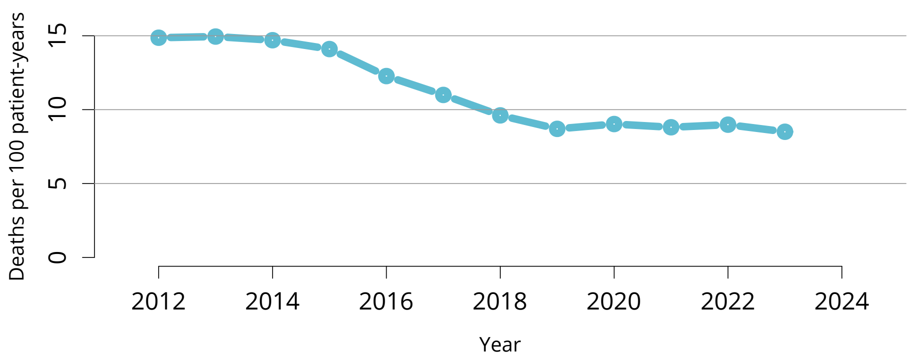

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Figure HR 25: Overall pretransplant mortality rates among adults waitlisted for heart transplant. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

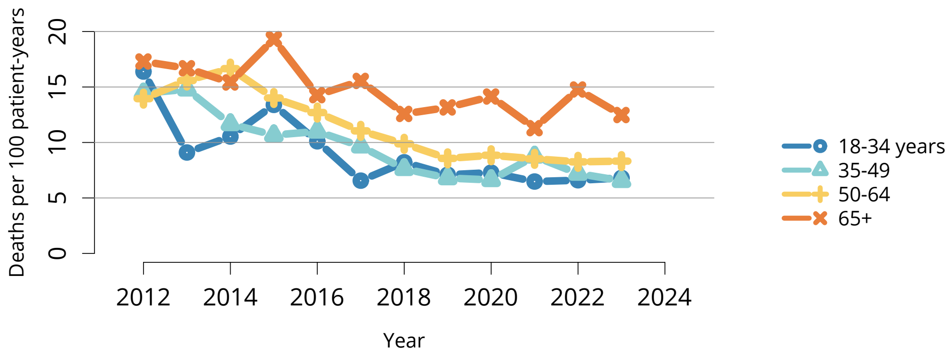

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Figure HR 26: Pretransplant mortality rates among adults waitlisted for heart transplant by age. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year.

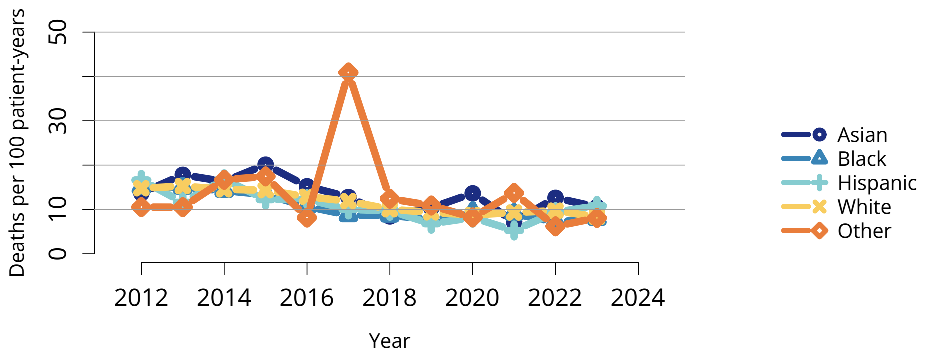

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Figure HR 27: Pretransplant mortality rates among adults waitlisted for heart transplant by race and ethnicity. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

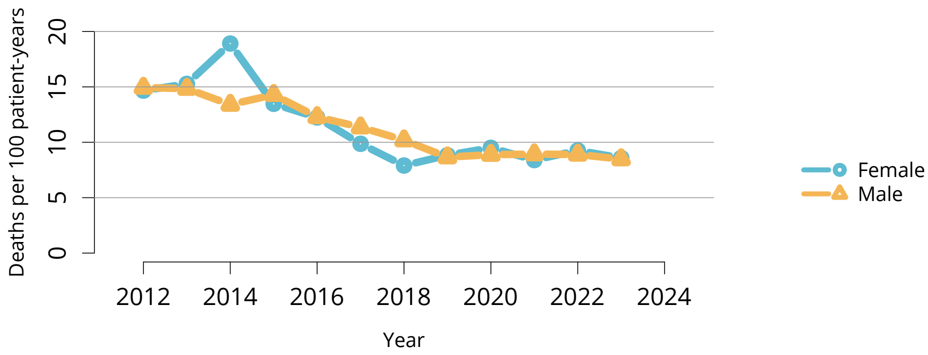

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Figure HR 28: Pretransplant mortality rates among adults waitlisted for heart transplant by sex. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

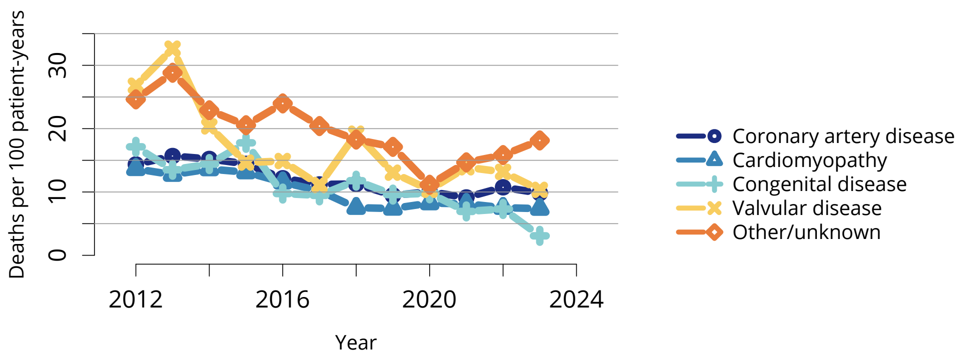

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Figure HR 29: Pretransplant mortality rates among adults waitlisted for heart transplant by diagnosis. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

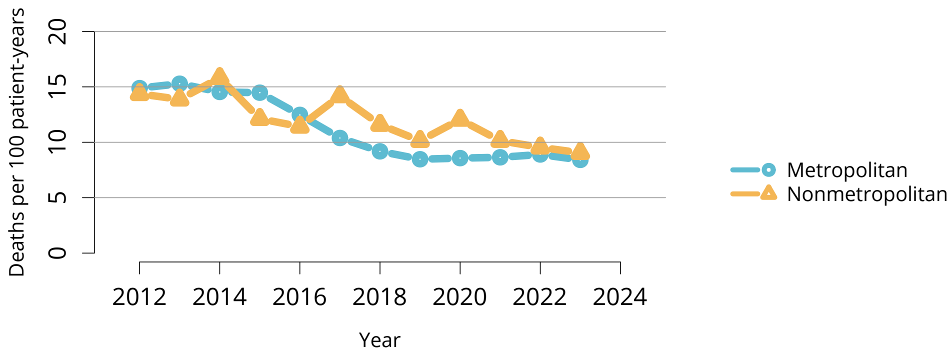

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Figure HR 30: Pretransplant mortality rates among adults waitlisted for heart transplant by metropolitan versus nonmetropolitan residence. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Urban/rural determination is made using the RUCA (rural-urban commuting area) designation of the candidate's permanent zip code.

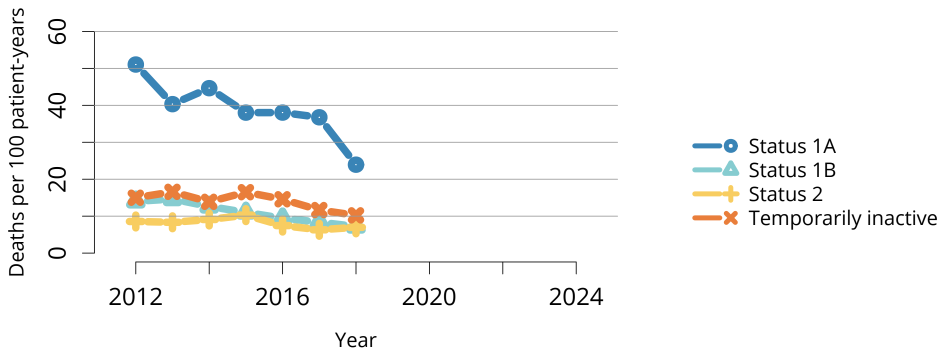

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Figure HR 31: Pretransplant mortality rates among adults waitlisted for heart transplant by former medical urgency groups through October 17, 2018. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Medical urgency is determined at the later of listing date or January 1 of the given year. The October 2018 OPTN heart allocation policy update changed the status groups. For 2018 medical urgency statuses, new listings on or after October 18, 2018, are not shown in this figure.

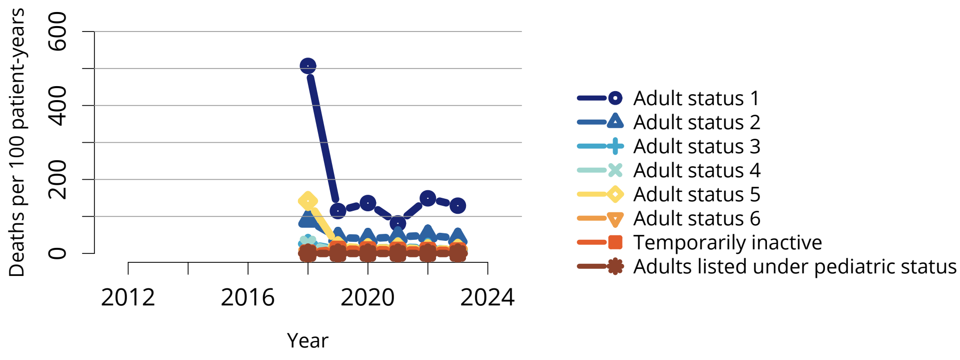

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Figure HR 32: Pretransplant mortality rates among adults waitlisted for heart transplant by new medical urgency groups, October 18, 2018, through 2023. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Medical urgency is determined at the later of listing date or January 1 of the given year. The October 2018 OPTN heart allocation policy update changed the status groups. For 2018 medical urgency statuses, adult statuses 1-6 and inactive status contain new listings on or after October 18, 2018.

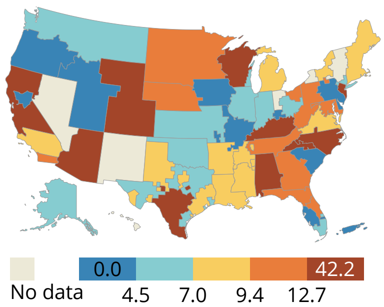

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Figure HR 33: Pretransplant mortality rates among adults waitlisted for heart transplant in 2023 by DSA. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. DSA, donation service area.

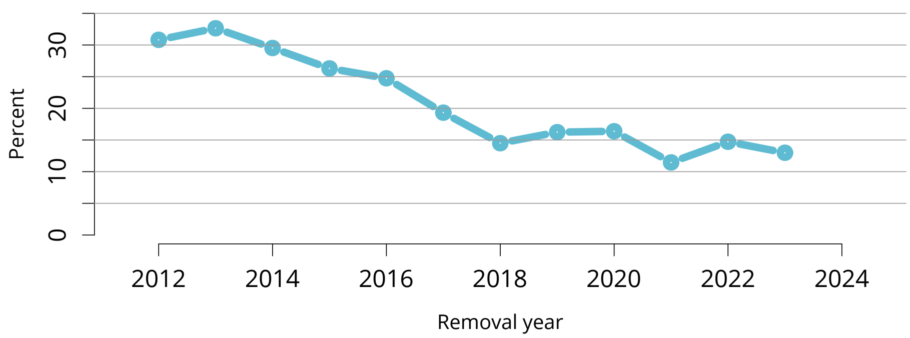

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Figure HR 34: Deaths within 6 months after removal among adult heart waitlist candidates, overall. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list.

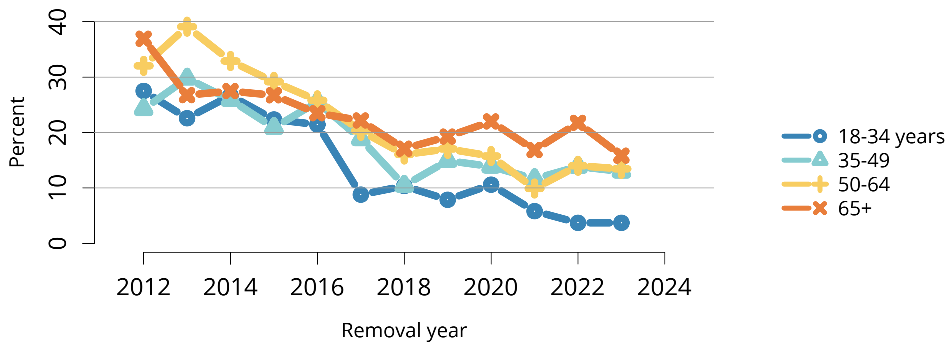

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Figure HR 35: Deaths within 6 months after removal among adult heart waitlist candidates, by age. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list. Age is determined at removal.

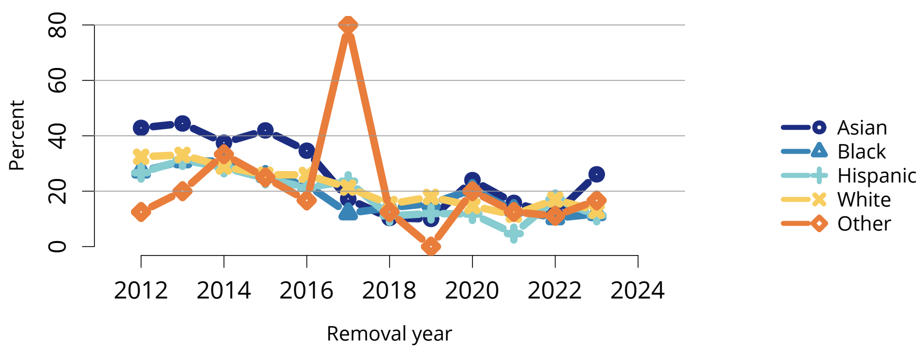

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Figure HR 36: Deaths within 6 months after removal among adult heart waitlist candidates, by race and ethnicity. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list. The Other race category is composed of Native American and Multiracial categories.

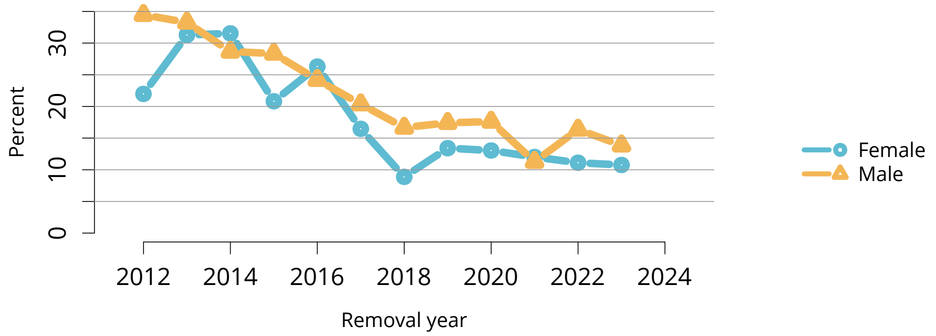

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Figure HR 37: Deaths within 6 months after removal among adult heart waitlist candidates, by sex. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list.

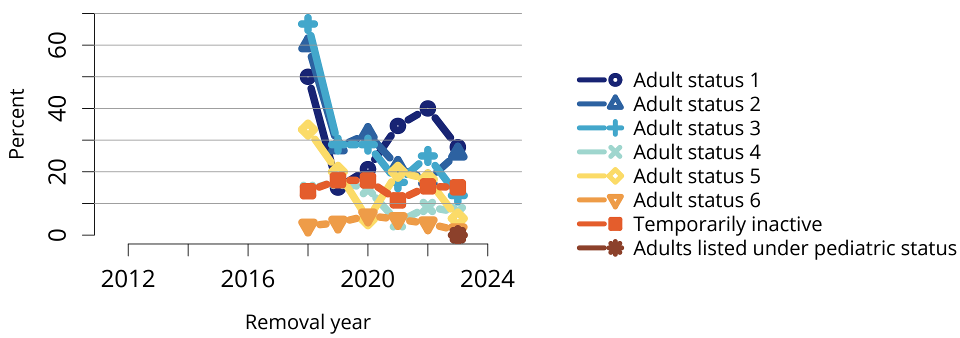

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Figure HR 38: Deaths within 6 months after removal among adult heart waitlist candidates, by status at removal. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list. The October 2018 OPTN heart allocation policy update changed the status groups. The adult statuses listed are for October 18, 2018, and onward. Medical urgency is determined at the earliest of transplant, death, removal, or December 31 of the year.

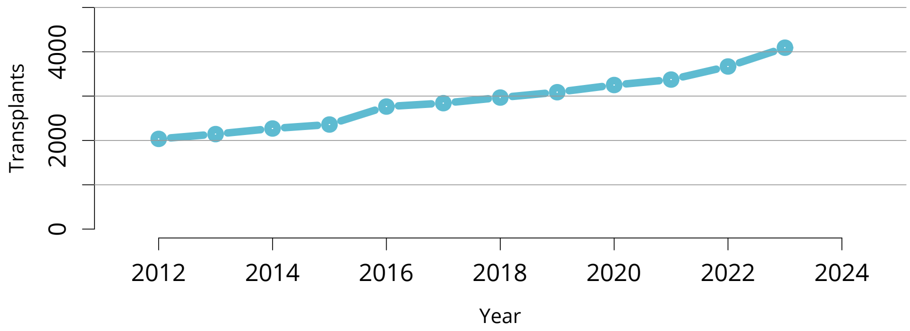

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Figure HR 39: Overall adult heart transplants. All adult heart transplant recipients, including retransplant and multiorgan recipients.

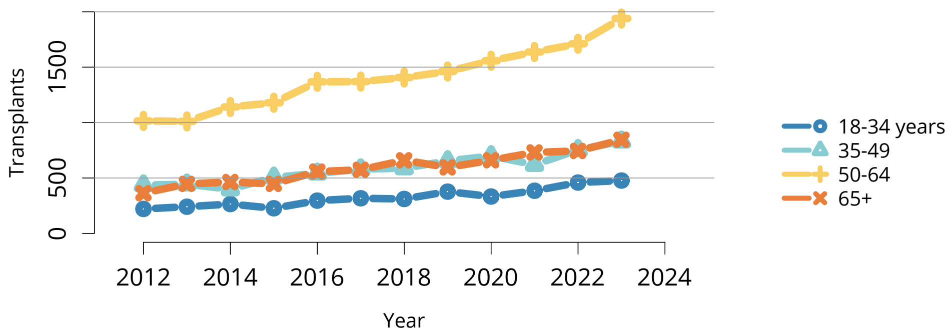

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Figure HR 40: Adult heart transplants by age. All adult heart transplant recipients, including retransplant and multiorgan recipients.

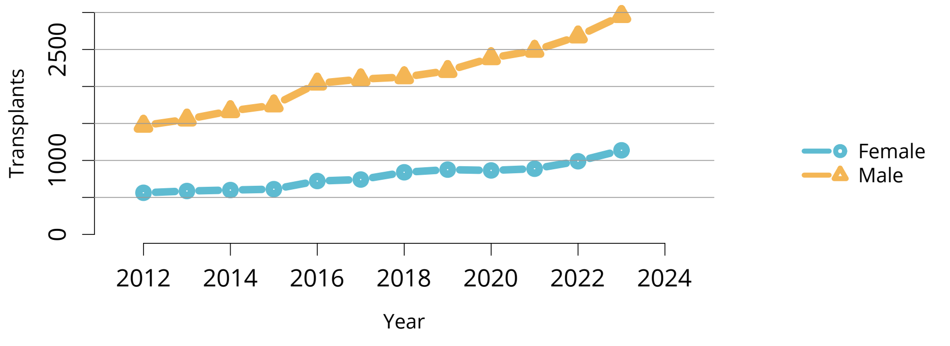

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Figure HR 41: Adult heart transplants by sex. All adult heart transplant recipients, including retransplant and multiorgan recipients.

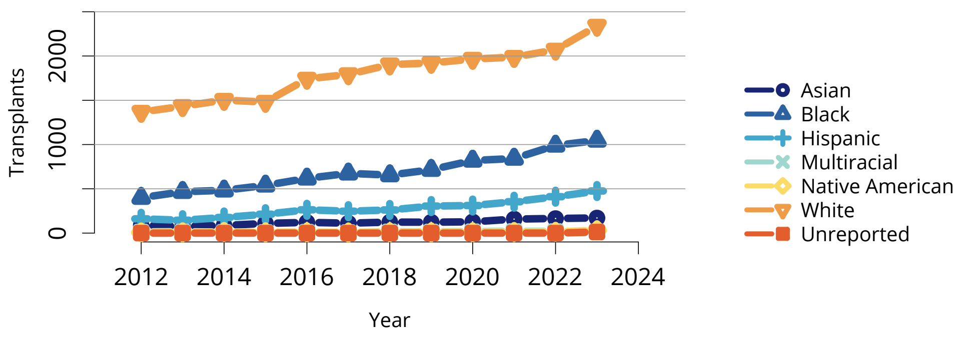

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Figure HR 42: Adult heart transplants by race and ethnicity. All adult heart transplant recipients, including retransplant and multiorgan recipients.

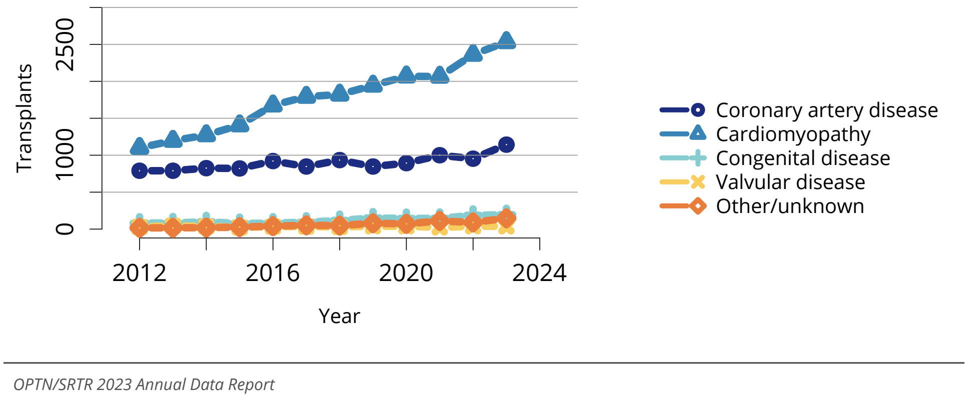

Figure HR 43: Adult heart transplants by diagnosis. All adult heart transplant recipients, including retransplant and multiorgan recipients.

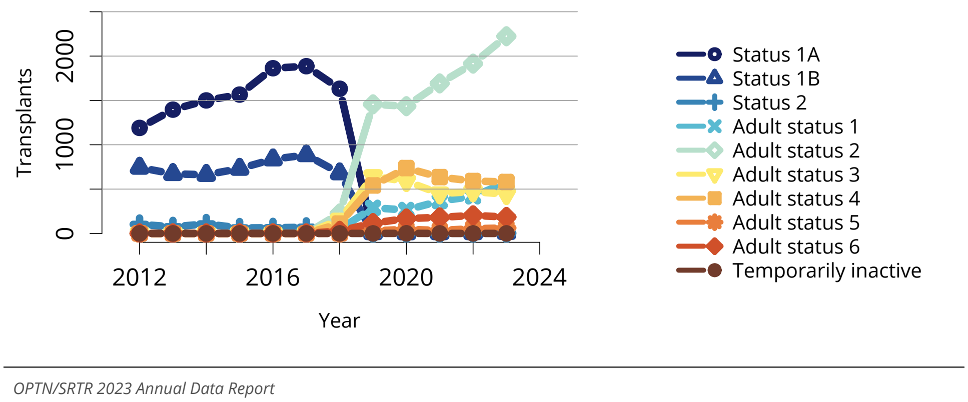

Figure HR 44: Adult heart transplants by medical urgency. All adult heart transplant recipients, including retransplant and multiorgan recipients. The October 2018 OPTN heart allocation policy update changed the status groups. The statuses 1A, 1B, and 2 listed first are through October 17, 2018, the last day before the policy update; the adult statuses listed are for October 18, 2018, and onward.

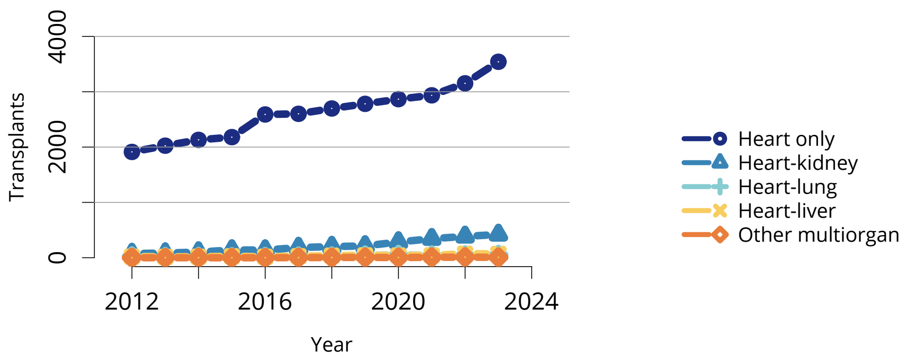

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Figure HR 45: Adult heart transplants by multiorgan transplant type. All adult heart transplant recipients, including retransplant and multiorgan recipients.

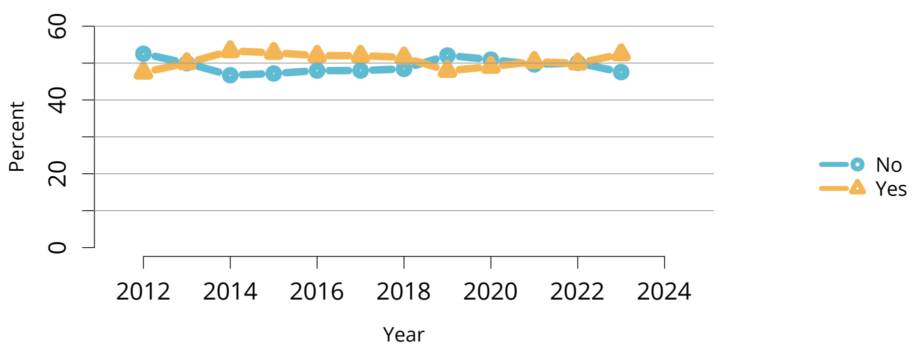

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Figure HR 46: Induction agent use in adult heart transplant recipients. Immunosuppression at transplant reported to the OPTN.

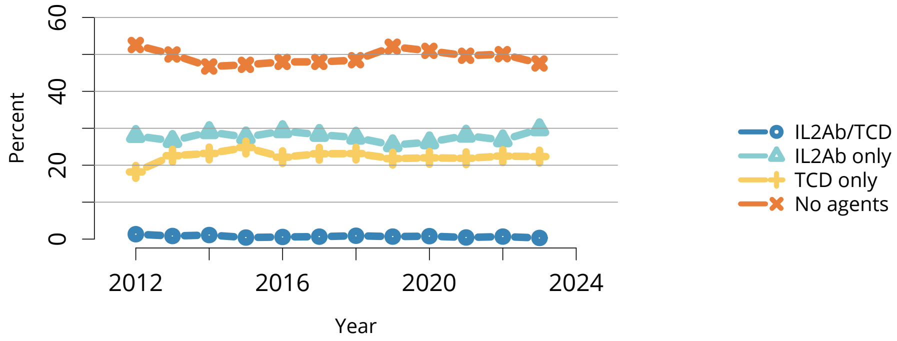

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Figure HR 47: Type of induction agent use in adult heart transplant recipients. Immunosuppression at transplant reported to the OPTN. IL2Ab, interleukin-2 receptor antibody; TCD, T-cell depleting.

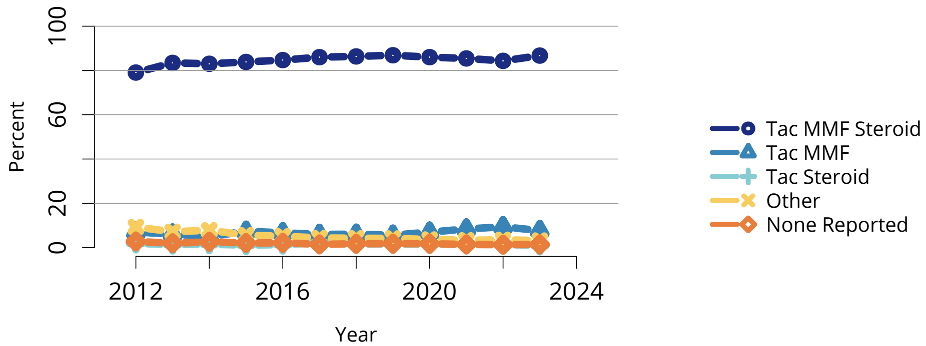

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Figure HR 48: Immunosuppression regimen use in adult heart transplant recipients. Immunosuppression regimen at transplant reported to the OPTN. MMF, all mycophenolate agents; Tac, tacrolimus.

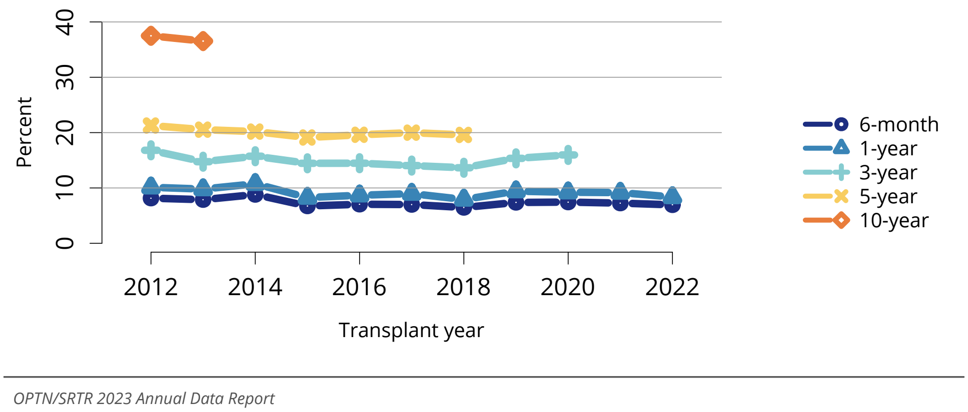

Figure HR 49: Patient death among adult heart transplant recipients. All adult recipients of deceased donor hearts, including multiorgan transplant recipients.

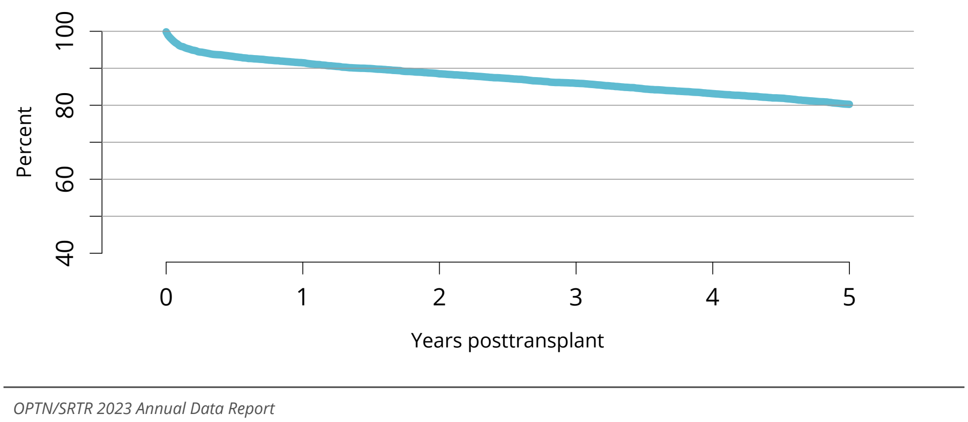

Figure HR 50: Patient survival among adult heart transplant recipients, 2016-2018. Patient survival estimated using unadjusted Kaplan-Meier methods.

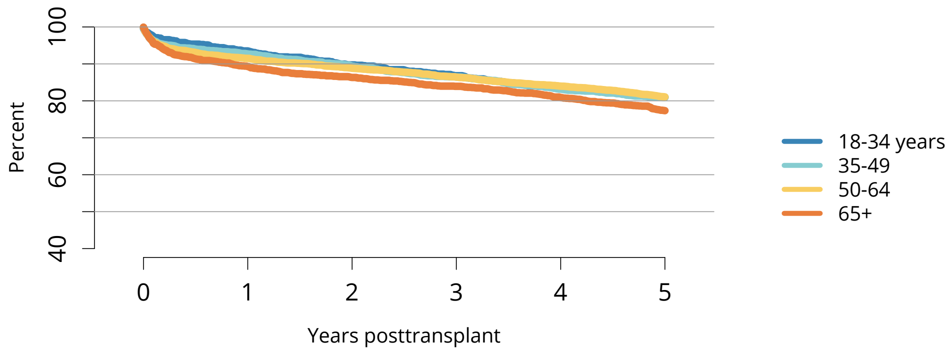

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Figure HR 51: Patient survival among adult heart transplant recipients, 2016-2018, by age. Patient survival estimated using unadjusted Kaplan-Meier methods.

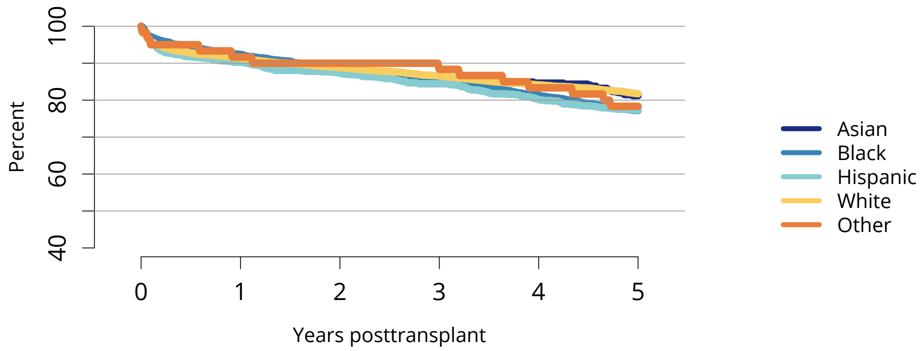

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Figure HR 52: Patient survival among adult heart transplant recipients, 2016-2018, by race and ethnicity. Patient survival estimated using unadjusted Kaplan-Meier methods. The Other race category is composed of Native American and Multiracial categories.

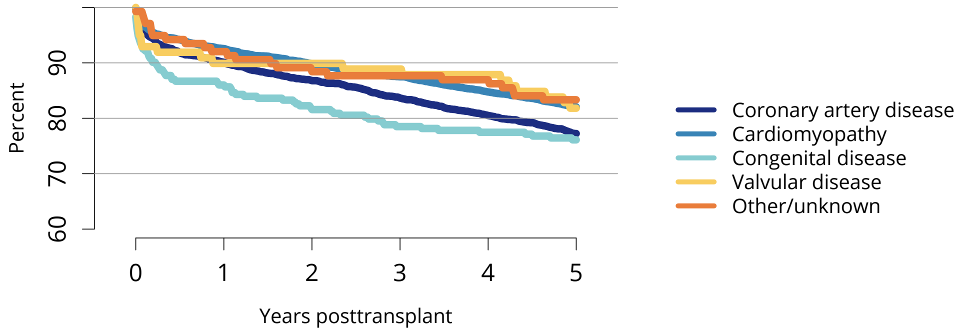

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Figure HR 53: Patient survival among adult heart transplant recipients, 2016-2018, by diagnosis group. Patient survival estimated using unadjusted Kaplan-Meier methods.

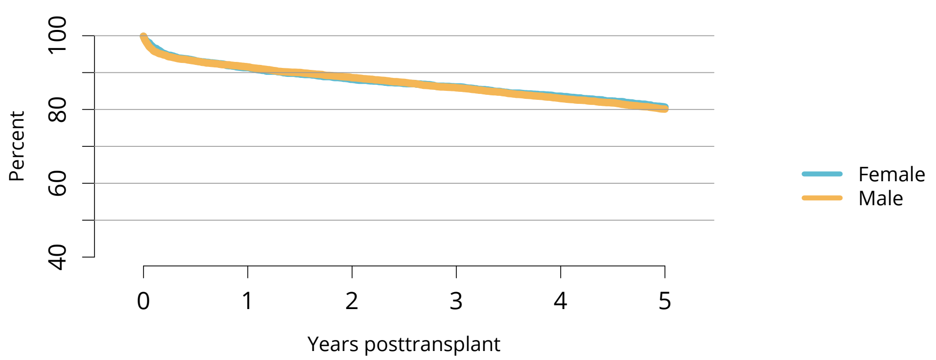

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Figure HR 54: Patient survival among adult heart transplant recipients, 2016-2018, by sex. Patient survival estimated using unadjusted Kaplan-Meier methods.

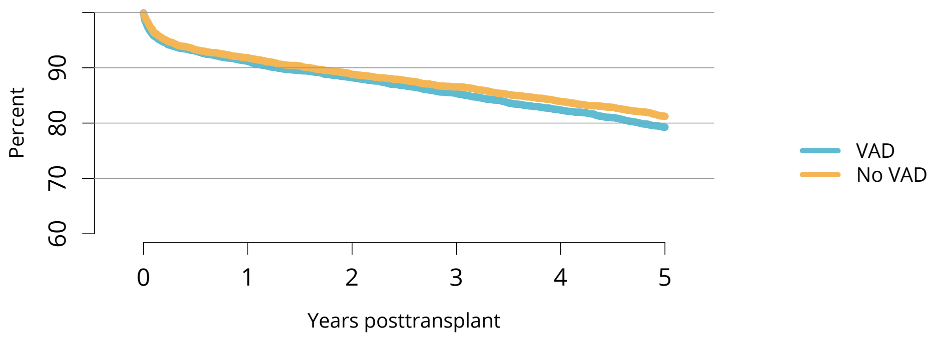

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Figure HR 55: Patient survival among adult heart transplant recipients, 2016-2018, by VAD status. Patient survival estimated using unadjusted Kaplan-Meier methods. VAD status at time of transplant. VAD, ventricular assist device.

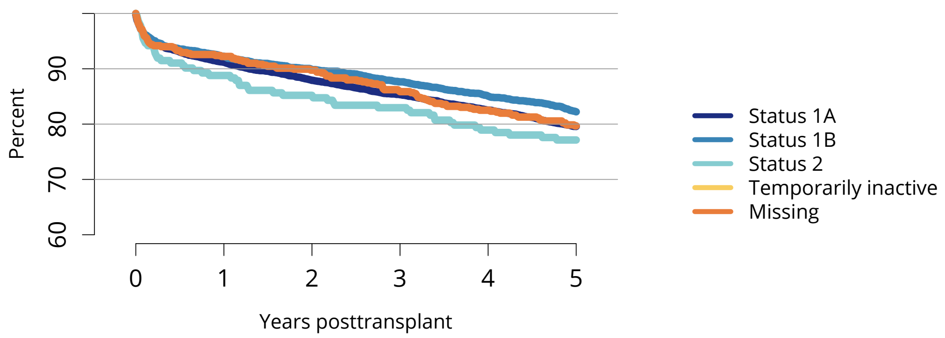

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Figure HR 56: Patient survival among adult heart transplant recipients, 2016-2018, by former medical urgency. Patient survival estimated using unadjusted Kaplan-Meier methods.

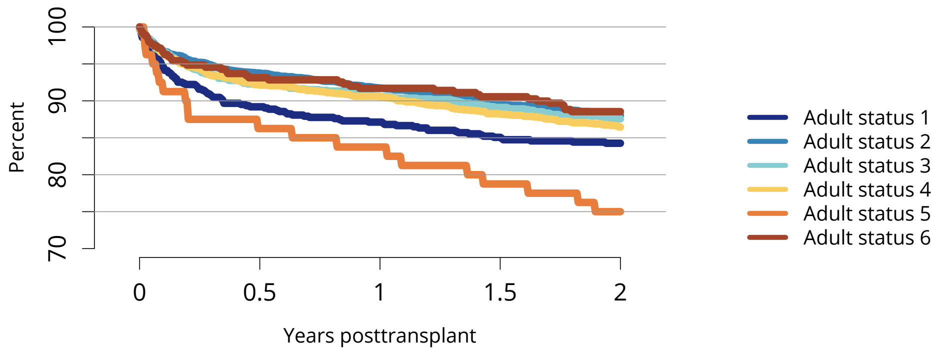

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Figure HR 57: Patient survival among adult heart transplant recipients, 2020-2021, by new medical urgency. Patient survival estimated using unadjusted Kaplan-Meier methods.

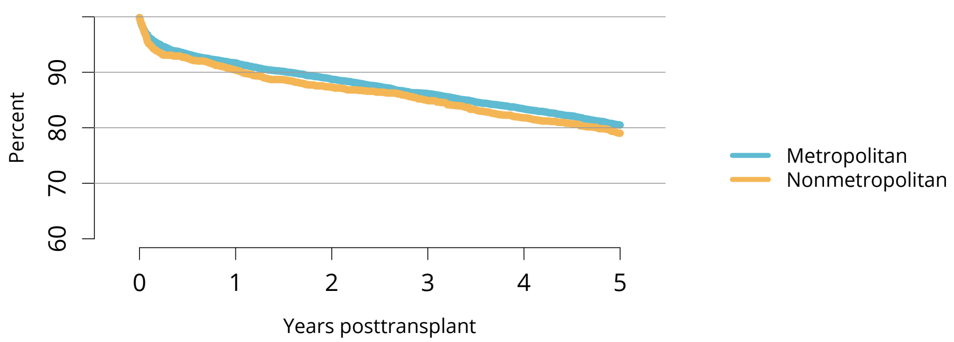

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Figure HR 58: Patient survival among adult heart transplant recipients, 2016-2018, by metropolitan versus nonmetropolitan recipient residence. Patient survival estimated using unadjusted Kaplan-Meier methods.

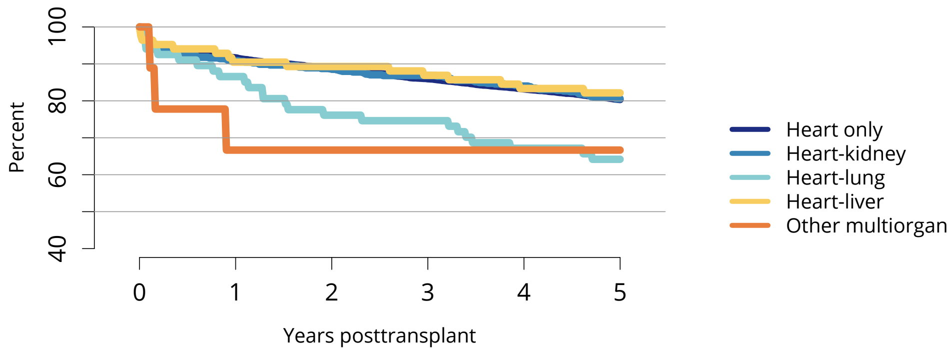

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Figure HR 59: Patient survival among adult heart transplant recipients, 2016-2018, by multiorgan transplant type. Patient survival estimated using unadjusted Kaplan-Meier methods.

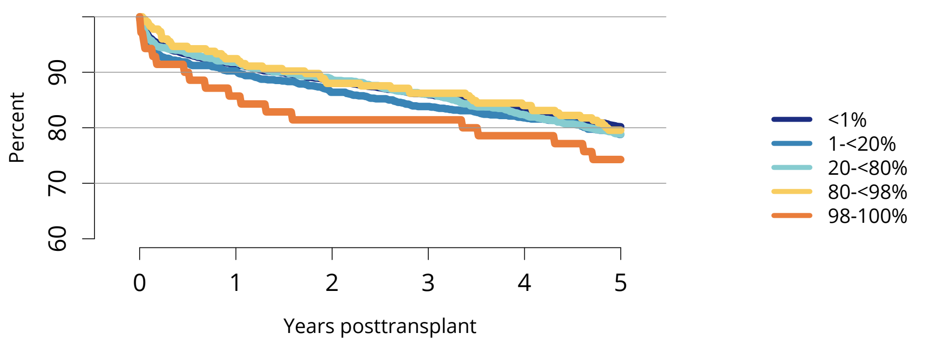

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Figure HR 60: Patient survival among adult heart transplant recipients, 2016-2018, by cPRA. Patient survival estimated using unadjusted Kaplan-Meier methods. Peak cPRA is used. cPRA, calculated panel-reactive antibody.

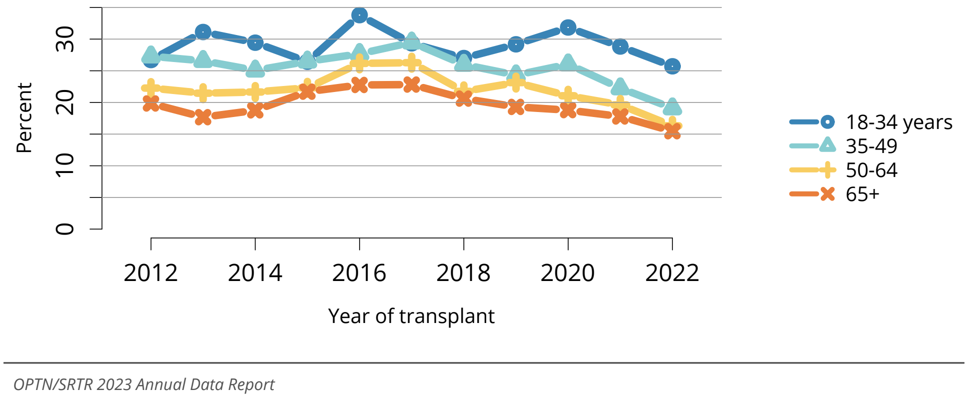

Figure HR 61: Incidence of acute rejection by 1 year posttransplant among adult heart transplant recipients by age. Only the first reported rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier method.

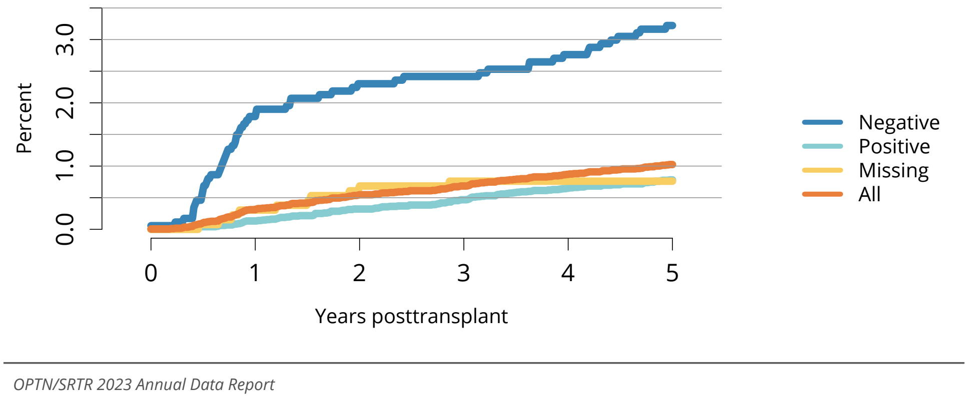

Figure HR 62: Incidence of PTLD among adult heart transplant recipients by recipient EBV status at transplant, 2012-2018. Cumulative incidence is estimated using the Kaplan-Meier method. PTLD is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus; PTLD, posttransplant lymphoproliferative disorder.

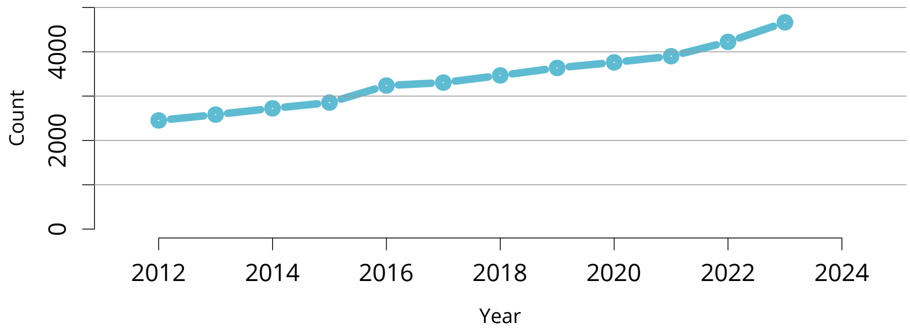

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Figure HR 63: Overall deceased heart donor count. Count of deceased donors whose hearts were recovered for transplant.

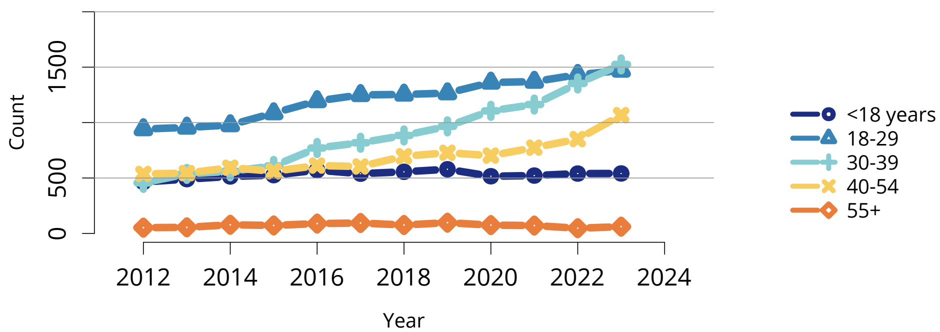

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Figure HR 64: Deceased heart donor count by age. Count of deceased donors whose hearts were recovered for transplant.

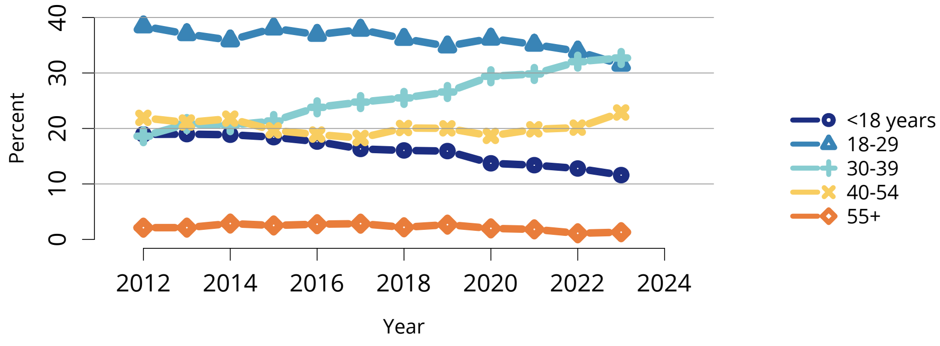

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Figure HR 65: Distribution of deceased heart donors by age. Deceased donors whose hearts were recovered for transplant.

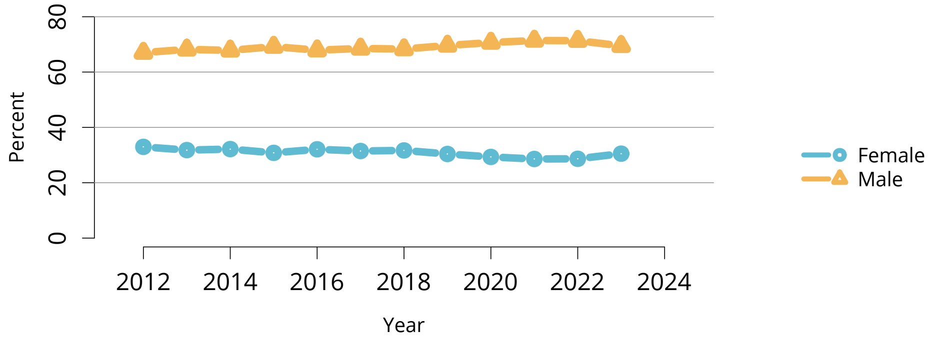

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Figure HR 66: Distribution of deceased heart donors by sex. Deceased donors whose hearts were recovered for transplant.

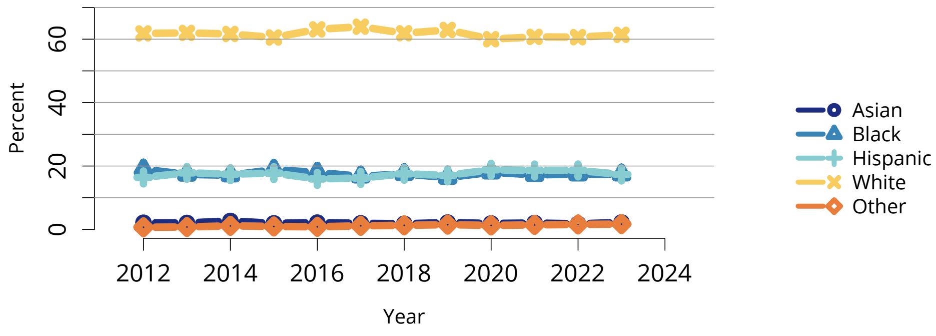

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Figure HR 67: Distribution of deceased heart donors by race and ethnicity. Deceased donors whose hearts were recovered for transplant. The Other race category is composed of Native American and Multiracial categories.

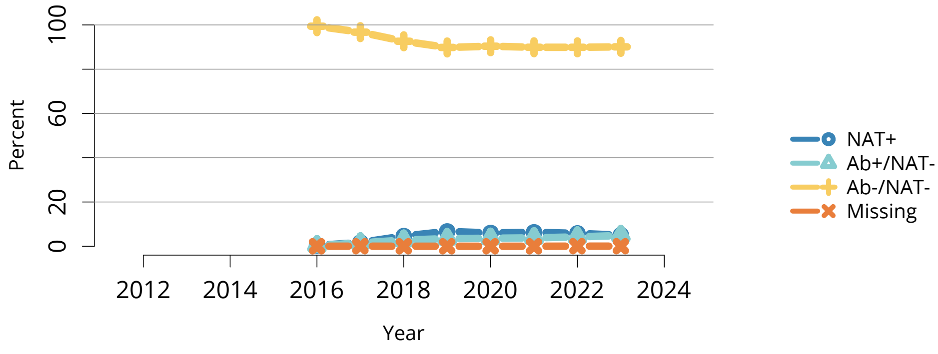

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Figure HR 68: Distribution of deceased heart donors by donor HCV status. Deceased donors whose hearts were recovered for transplant. Donor HCV status was based on NAT and antibody tests. Ab, antibody; HCV, hepatitis C virus; NAT, nucleic acid test.

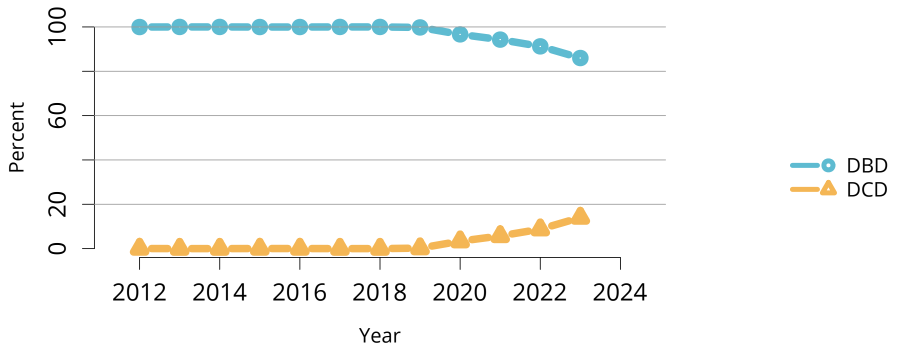

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Figure HR 69: Distribution of deceased heart donors by DCD status. Deceased donors whose hearts were recovered for transplant. DBD, donation after brain death; DCD, donation after circulatory death.

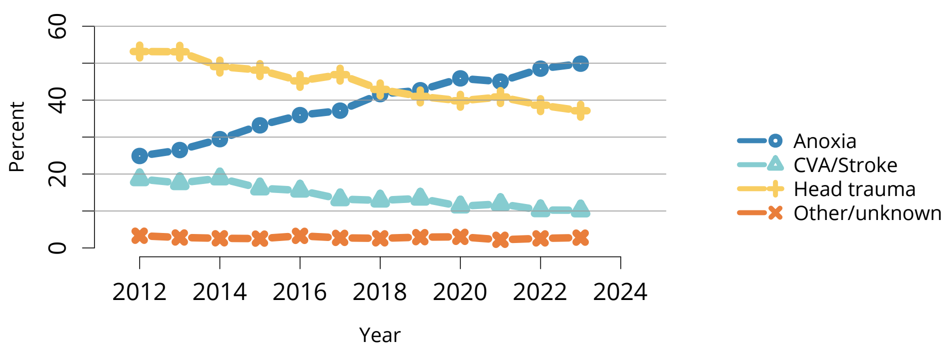

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Figure HR 70: Cause of death among deceased heart donors. Deceased donors with a heart recovered for the purposes of transplant. CVA, cerebrovascular accident.

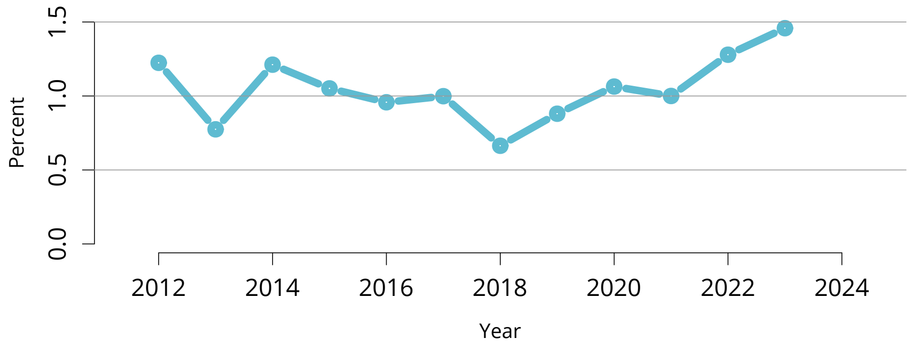

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Figure HR 71: Overall percent of hearts recovered for transplant and not transplanted. Percentages of hearts not transplanted out of all hearts recovered for transplant.

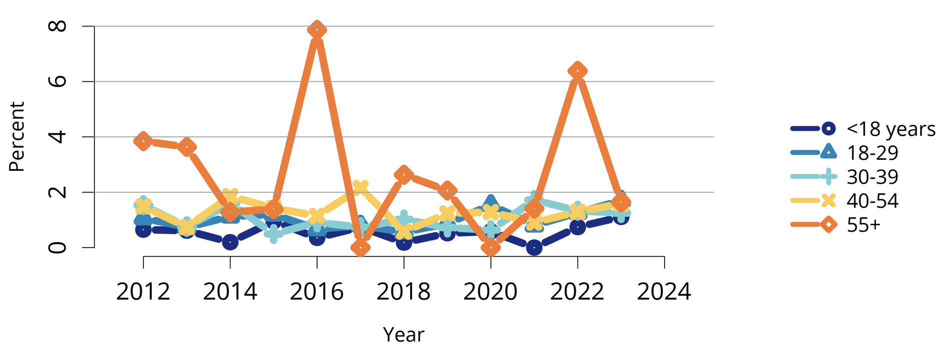

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Figure HR 72: Percent of hearts recovered for transplant and not transplanted by donor age. Percentages of hearts not transplanted out of all hearts recovered for transplant.

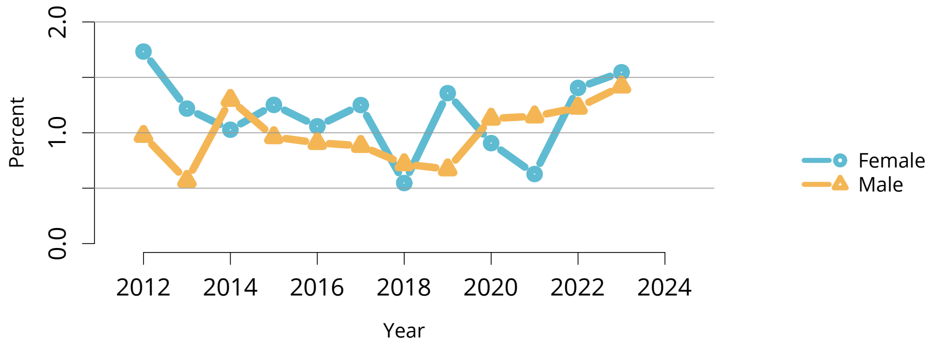

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Figure HR 73: Percent of hearts recovered for transplant and not transplanted by donor sex. Percentages of hearts not transplanted out of all hearts recovered for transplant.

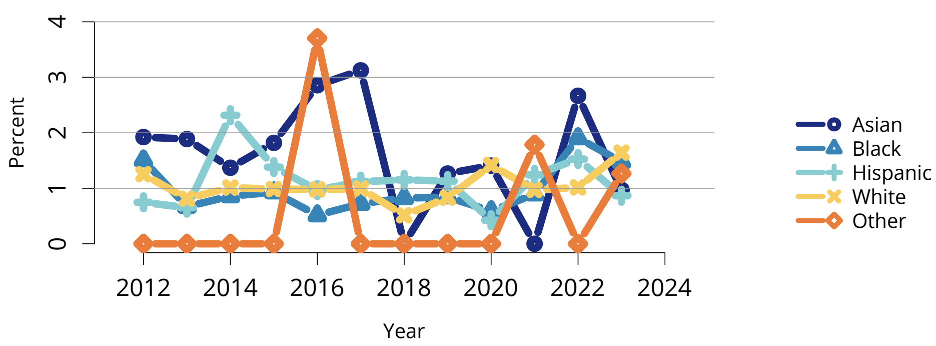

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Figure HR 74: Percent of hearts recovered for transplant and not transplanted by donor race and ethnicity. Percentages of hearts not transplanted out of all hearts recovered for transplant. The Other race category is composed of Native American and Multiracial categories.

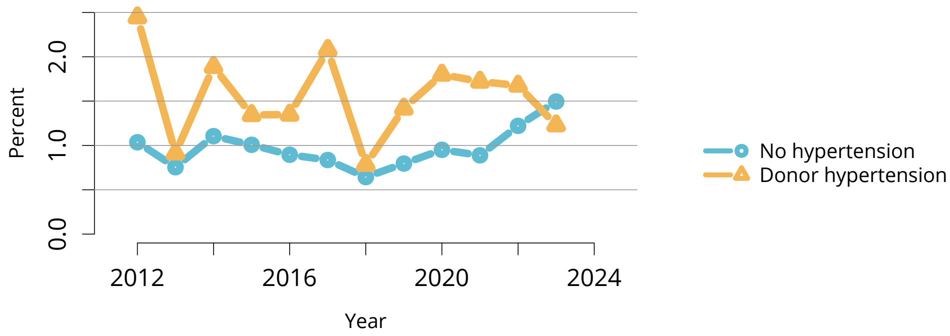

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Figure HR 75: Percent of hearts recovered for transplant and not transplanted by donor hypertension status. Percentages of hearts not transplanted out of all hearts recovered for transplant.

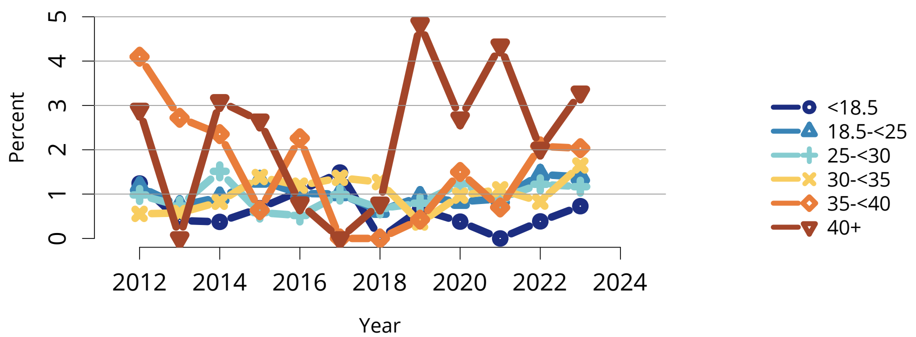

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Figure HR 76: Percent of hearts recovered for transplant and not transplanted by donor BMI. Percentages of hearts not transplanted out of all hearts recovered for transplant. BMI, body mass index.

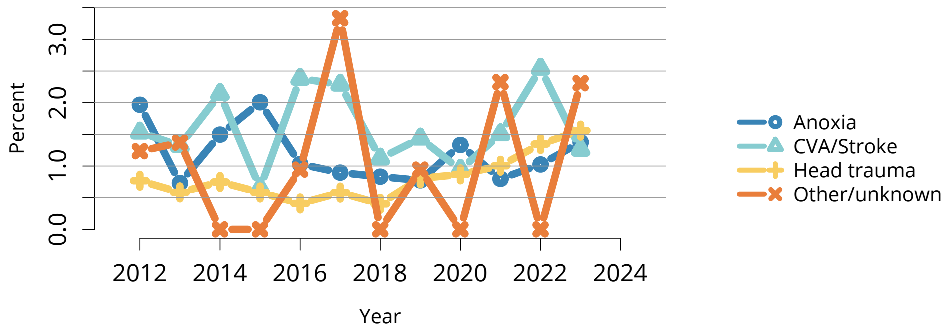

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Figure HR 77: Percent of hearts recovered for transplant and not transplanted by donor cause of death. Percentages of hearts not transplanted out of all hearts recovered for transplant. CVA, cerebrovascular accident.

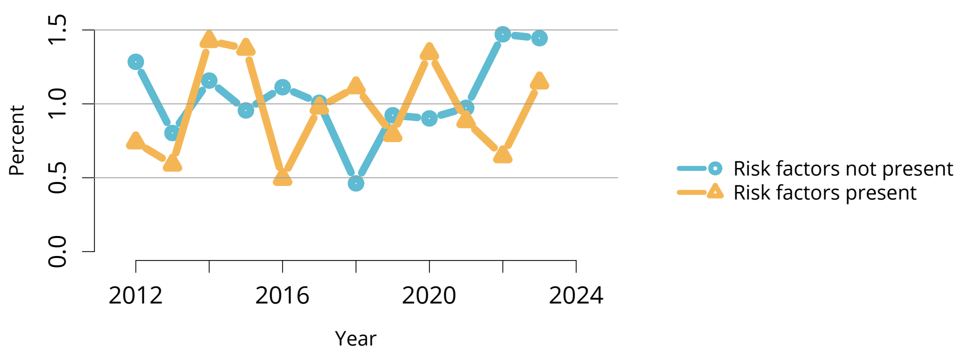

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Figure HR 78: Percent of hearts recovered for transplant and not transplanted, by donor risk of disease transmission. Percentages of hearts not transplanted out of all hearts recovered for transplant. “Risk factors” refers to risk criteria for acute transmission of human immunodeficiency virus, hepatitis B virus, or hepatitis C virus from the US Public Health Service Guideline.

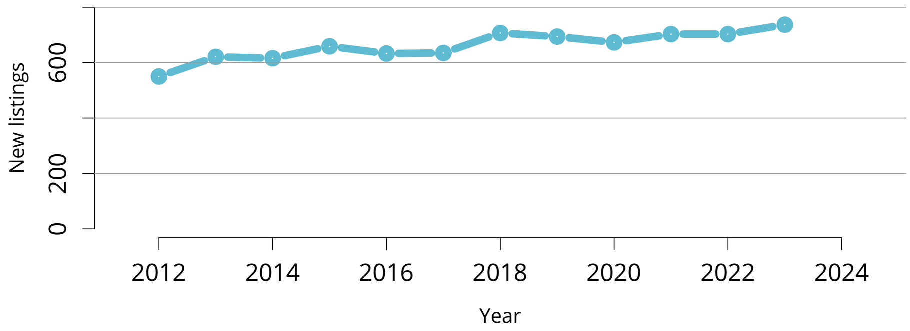

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Figure HR 79: New pediatric candidates added to the heart transplant waiting list. A new candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and were subsequently relisted are considered new. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

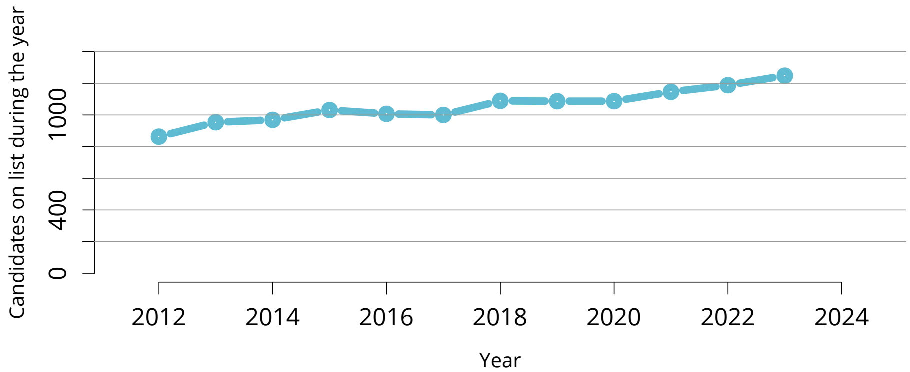

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Figure HR 80: All pediatric candidates on the heart transplant waiting list. Pediatric candidates listed at any time during the year. Candidates listed at more than one center are counted once per listing.

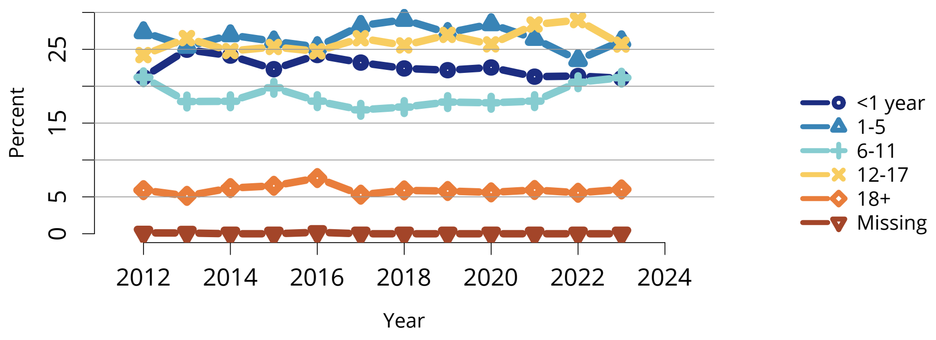

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Figure HR 81: Distribution of pediatric candidates waiting for heart transplant by age. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included. Age is determined at the earliest of transplant, death, removal, or December 31 of the year. The 18+ category is for candidates who turned age 18 while waiting.

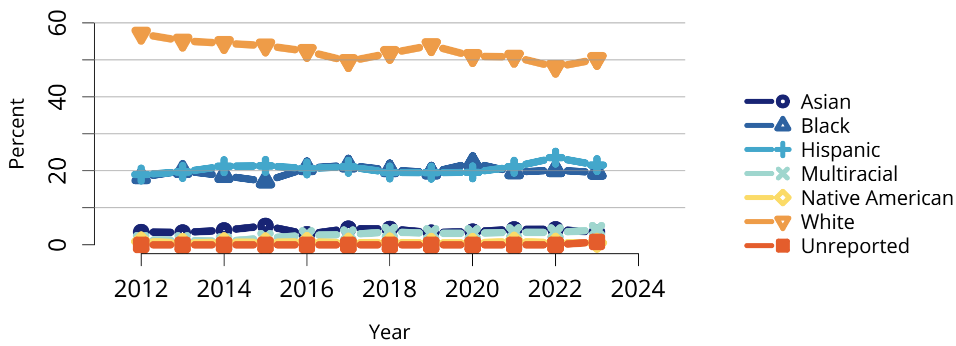

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Figure HR 82: Distribution of pediatric candidates waiting for heart transplant by race and ethnicity. Candidates waiting for transplant any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included.

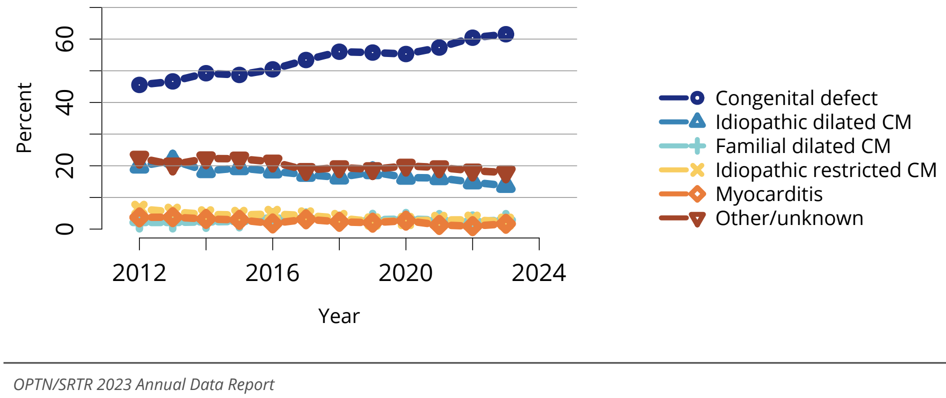

Figure HR 83: Distribution of pediatric candidates waiting for heart transplant by diagnosis. Candidates waiting for transplant any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included. CM, cardiomyopathy.

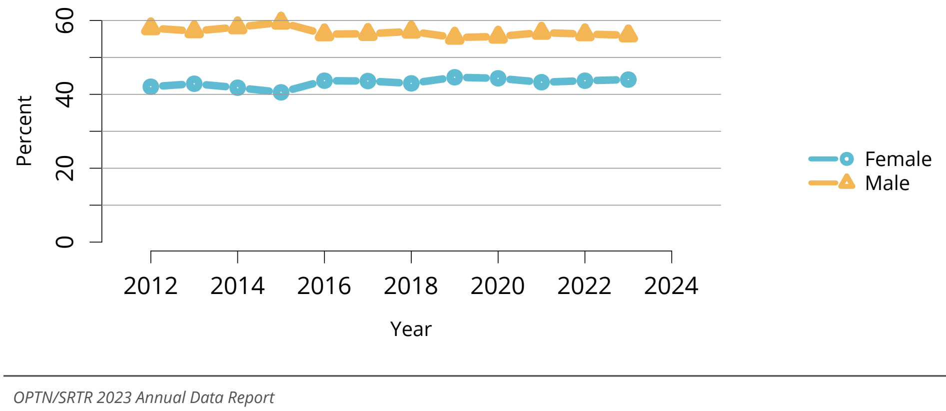

Figure HR 84: Distribution of pediatric candidates waiting for heart transplant by sex. Candidates waiting for transplant any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

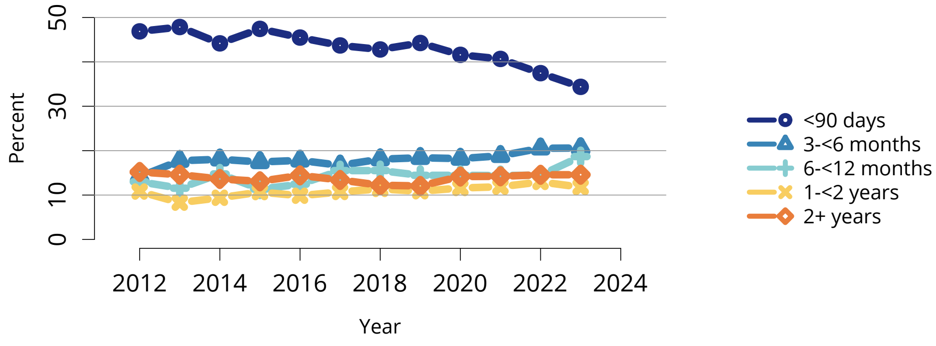

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Figure HR 85: Distribution of pediatric candidates waiting for heart transplant by waiting time. Candidates waiting for transplant any time in the given year. Candidates listed at more than one center are counted once per listing. Time on the waiting list is determined at the earliest of transplant, death, removal, or December 31 of the year. Active and inactive candidates are included.

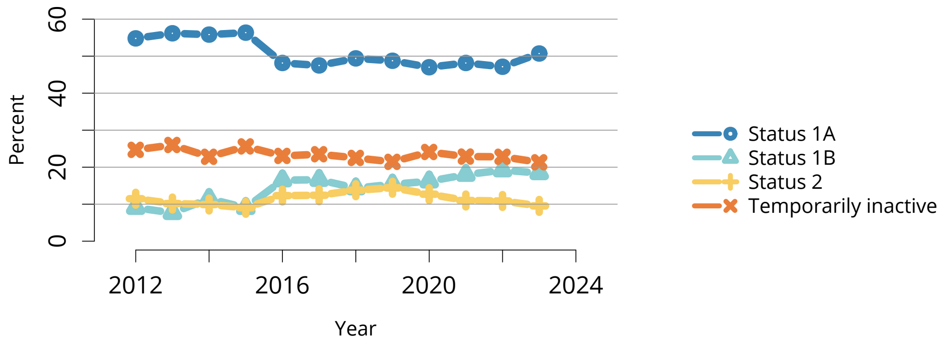

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Figure HR 86: Distribution of pediatric candidates waiting for heart transplant by medical urgency. Candidates waiting for transplant any time in the given year. Candidates listed at more than one center are counted once per listing. Medical urgency is determined at the earliest of transplant, death, removal, or December 31 of the year. Active and inactive patients are included.

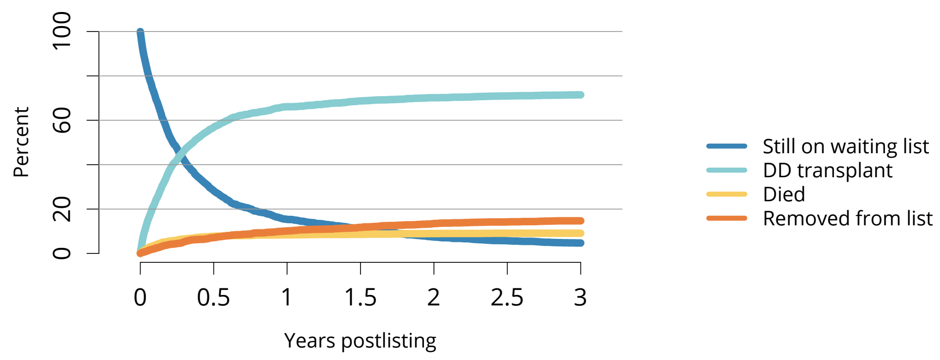

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Figure HR 87: Three-year outcomes for newly listed pediatric candidates waiting for heart transplant, 2018-2020. Pediatric candidates who joined the waiting list in 2018-2020. Pediatric candidates listed at more than one center are counted once per listing. Removed from list includes all reasons except transplant and death. DD, deceased donor.

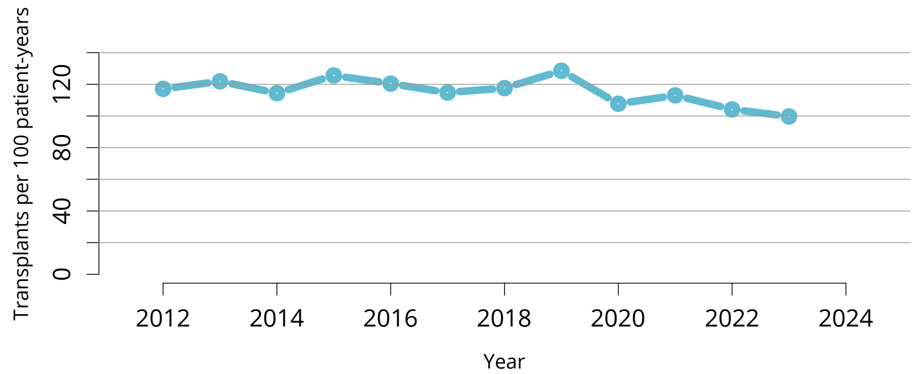

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Figure HR 88: Overall deceased donor heart transplant rates among pediatric waitlist candidates. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

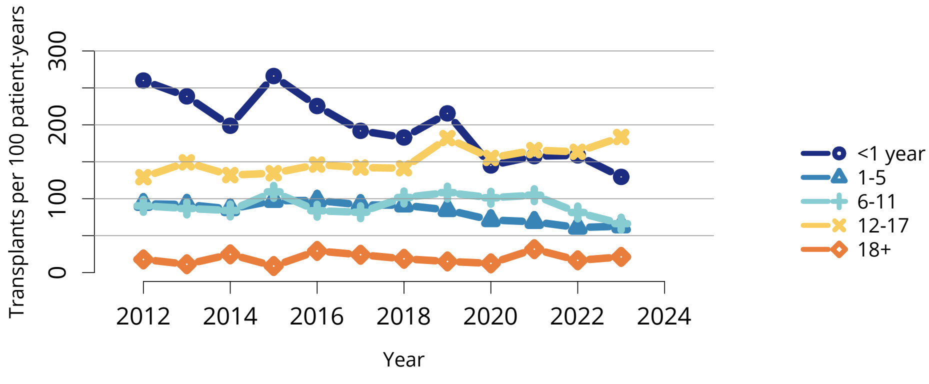

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Figure HR 89: Deceased donor heart transplant rates among pediatric waitlist candidates by age. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year. The 18+ category is for candidates who turned age 18 while waiting.

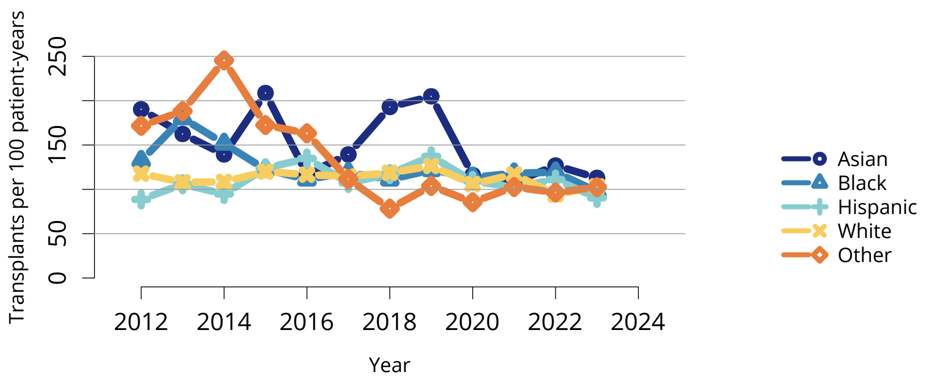

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Figure HR 90: Deceased donor heart transplant rates among pediatric waitlist candidates by race and ethnicity. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

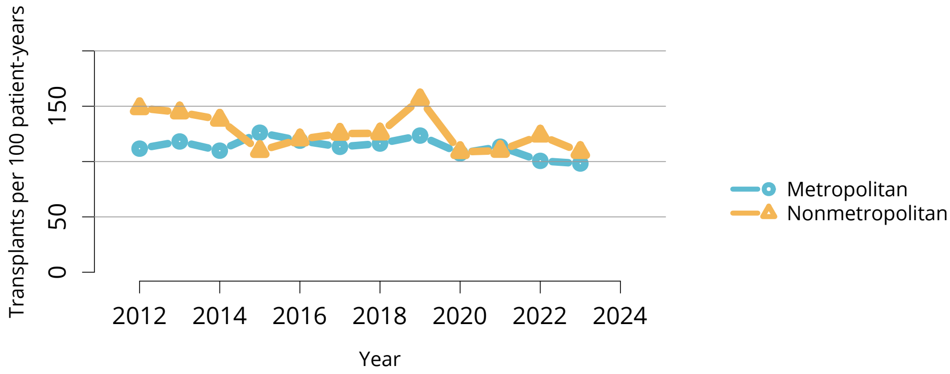

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Figure HR 91: Deceased donor heart transplant rates among pediatric waitlist candidates by metropolitan versus nonmetropolitan residence. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

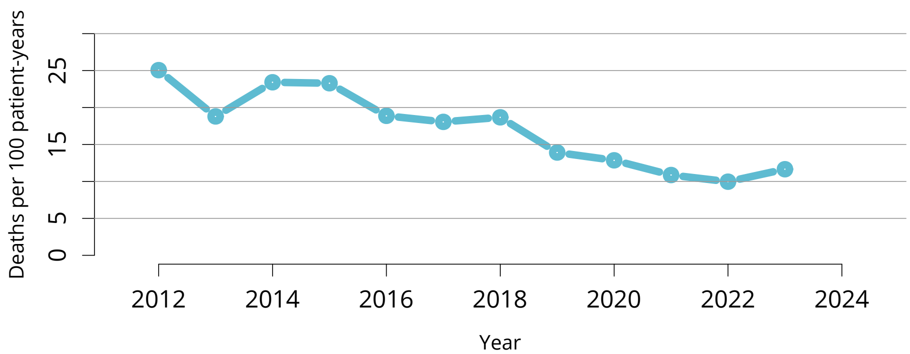

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Figure HR 92: Overall pretransplant mortality rates among pediatric candidates waitlisted for heart. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

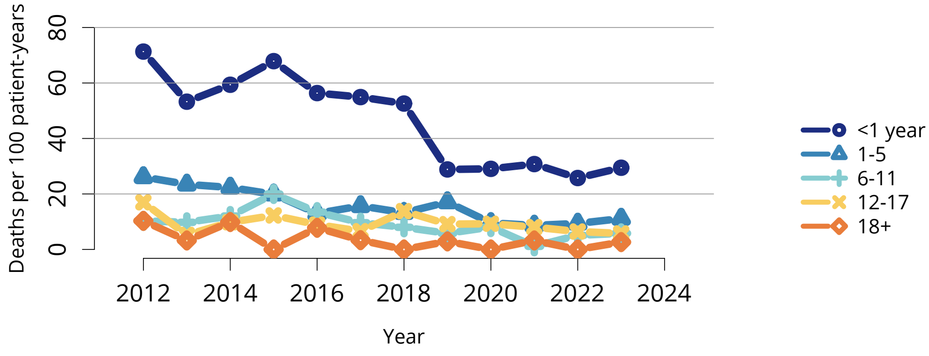

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Figure HR 93: Pretransplant mortality rates among pediatric candidates waitlisted for heart transplant by age. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year. The 18+ category is for candidates who turned age 18 while waiting.

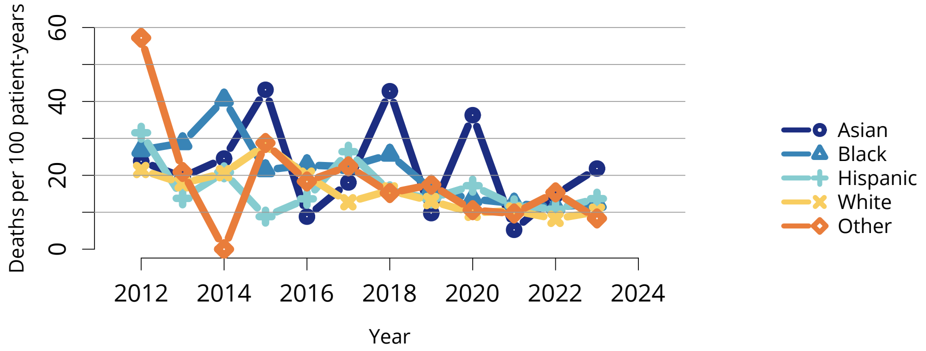

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Figure HR 94: Pretransplant mortality rates among pediatric candidates waitlisted for heart transplant by race and ethnicity. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

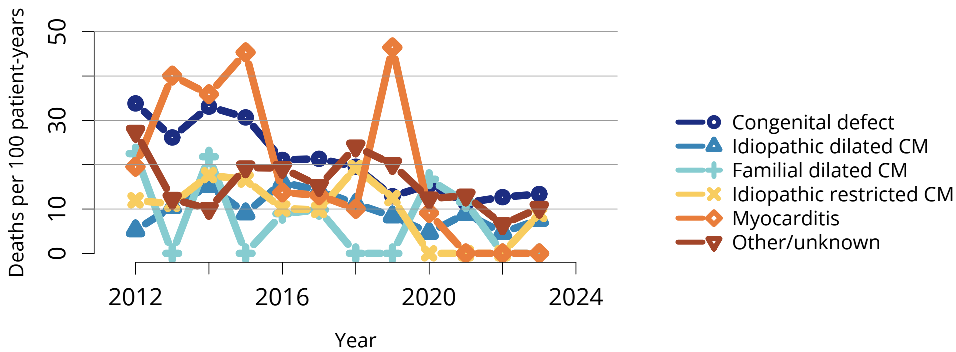

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Figure HR 95: Pretransplant mortality rates among pediatric candidates waitlisted for heart transplant by diagnosis. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. CM, cardiomyopathy.

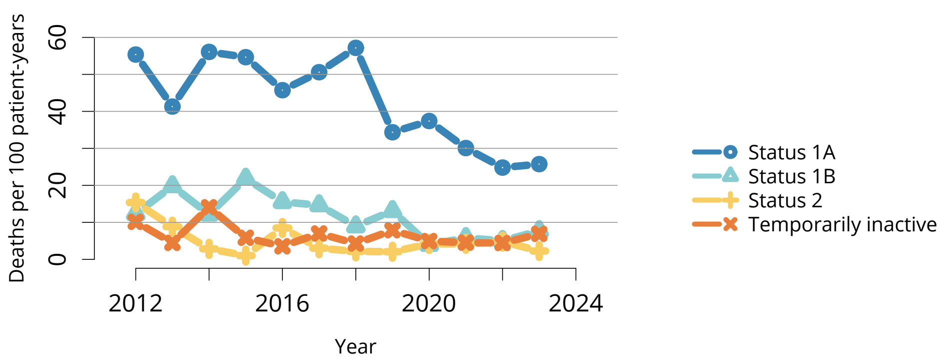

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Figure HR 96: Pretransplant mortality rates among pediatric candidates waitlisted for heart transplant by medical urgency. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Medical urgency is determined at the later of listing date or January 1 of the given year.

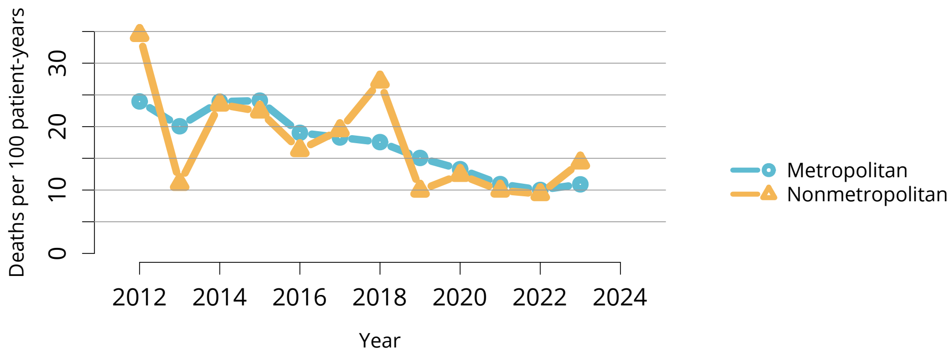

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Figure HR 97: Pretransplant mortality rates among pediatric candidates waitlisted for heart transplant by metropolitan versus nonmetropolitan residence. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Urban/rural determination is made using the RUCA (rural-urban commuting area) designation of the candidate's permanent zip code.

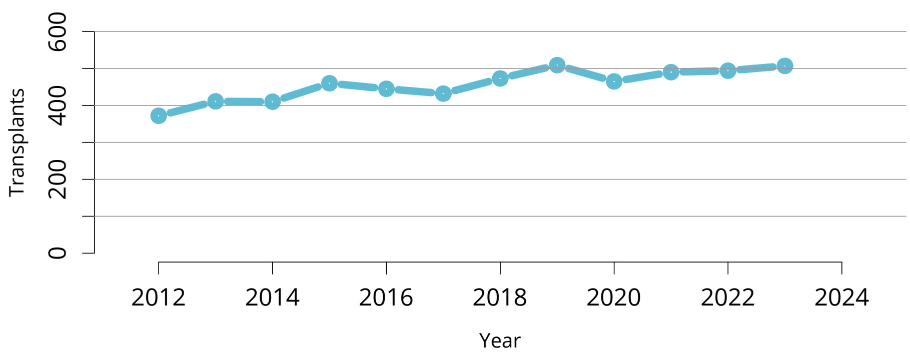

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Figure HR 98: Overall pediatric heart transplants. All pediatric heart transplant recipients, including retransplant and multiorgan recipients.

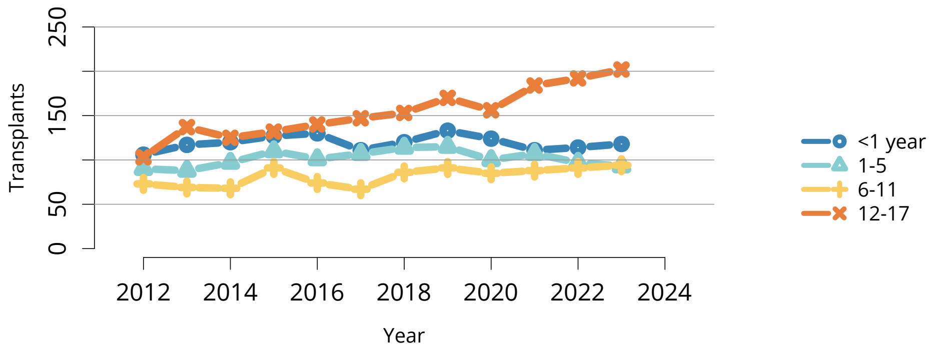

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Figure HR 99: Pediatric heart transplants by recipient age. All pediatric heart transplant recipients, including retransplant and multiorgan recipients.

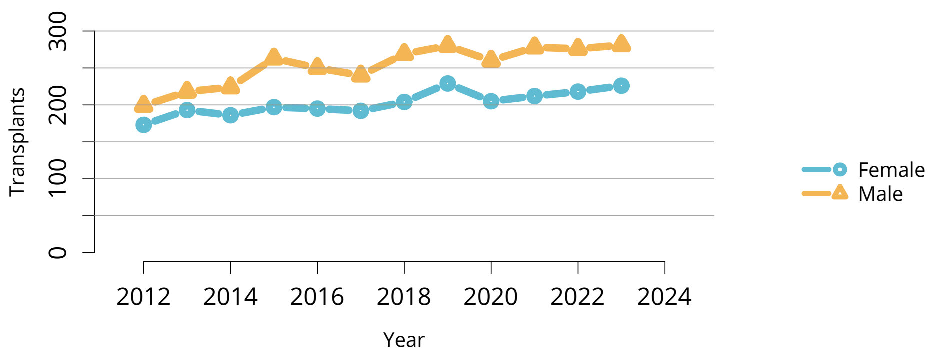

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Figure HR 100: Pediatric heart transplants by sex. All pediatric heart transplant recipients, including retransplant and multiorgan recipients.

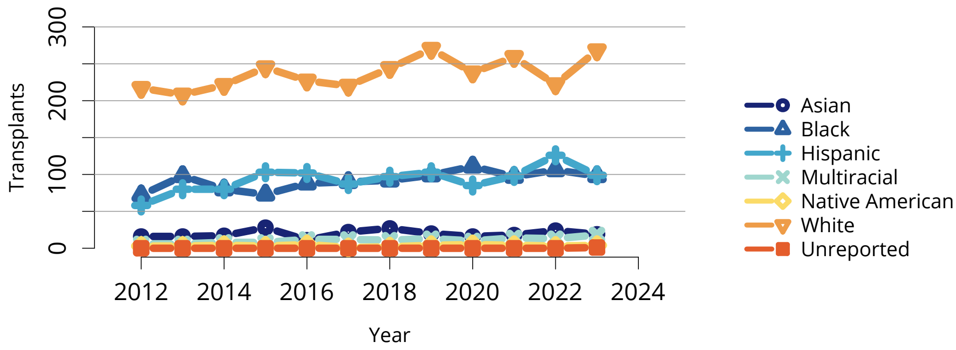

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Figure HR 101: Pediatric heart transplants by race and ethnicity. All pediatric heart transplant recipients, including retransplant and multiorgan recipients.

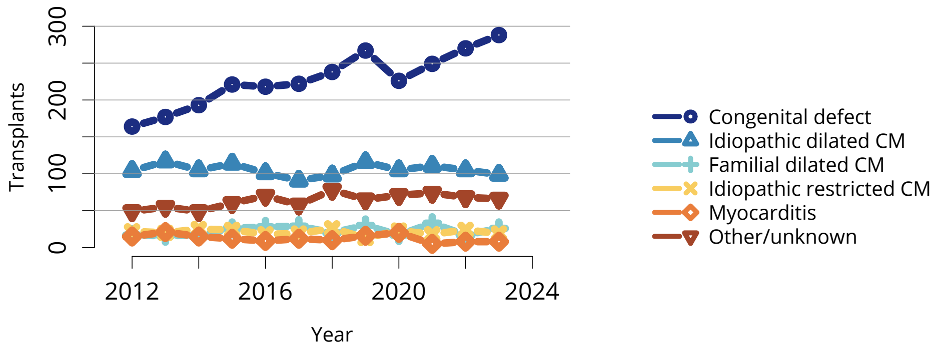

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Figure HR 102: Pediatric heart transplants by diagnosis. All pediatric heart transplant recipients, including retransplant and multiorgan recipients. CM, cardiomyopathy.

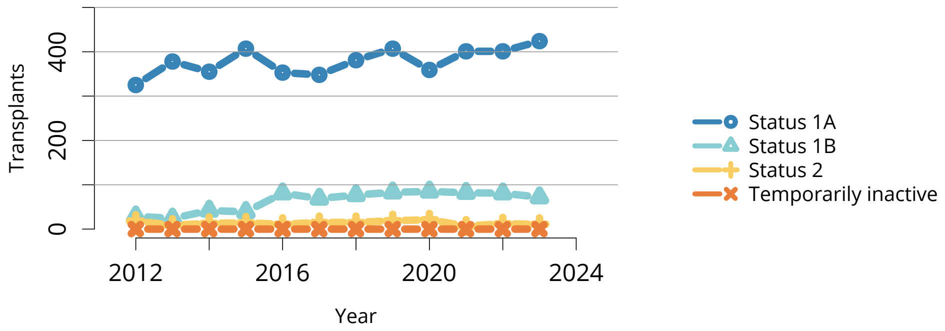

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Figure HR 103: Pediatric heart transplants by medical urgency. All pediatric heart transplant recipients, including retransplant and multiorgan recipients.

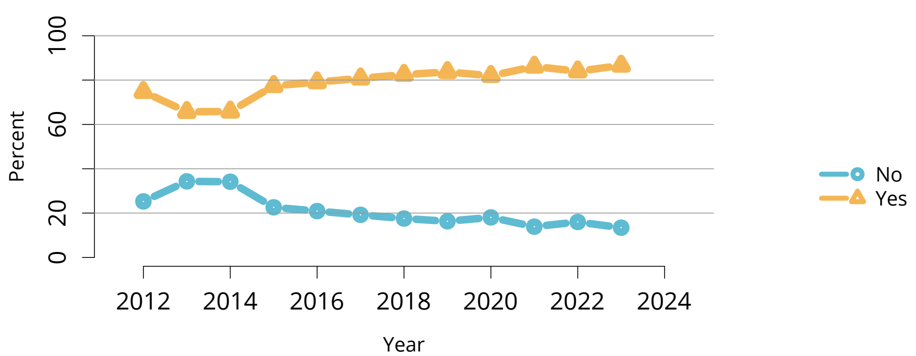

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Figure HR 104: Induction agent use in pediatric heart transplant recipients. Immunosuppression at transplant reported to the OPTN.

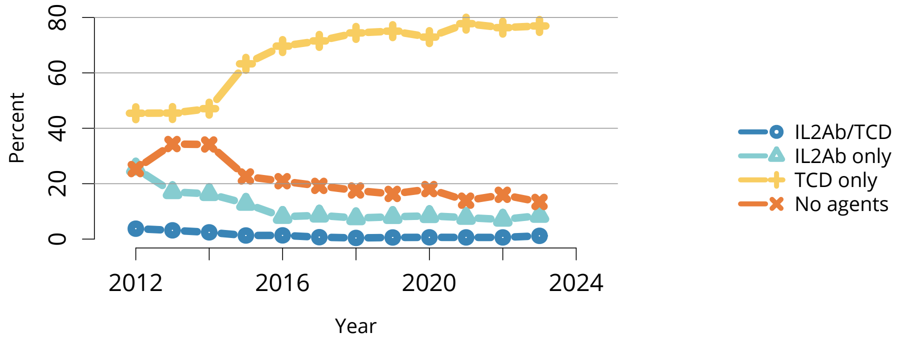

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Figure HR 105: Type of induction agent use in pediatric heart transplant recipients. Immunosuppression at transplant reported to the OPTN. IL2Ab, interleukin-2 receptor antibody; TCD, T-cell depleting.

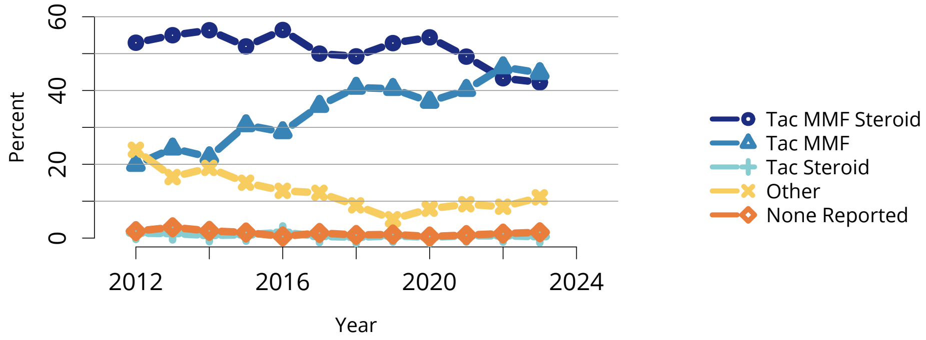

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Figure HR 106: Immunosuppression regimen use in pediatric heart transplant recipients. Immunosuppression regimen at transplant reported to the OPTN. MMF, all mycophenolate agents; Tac, tacrolimus.

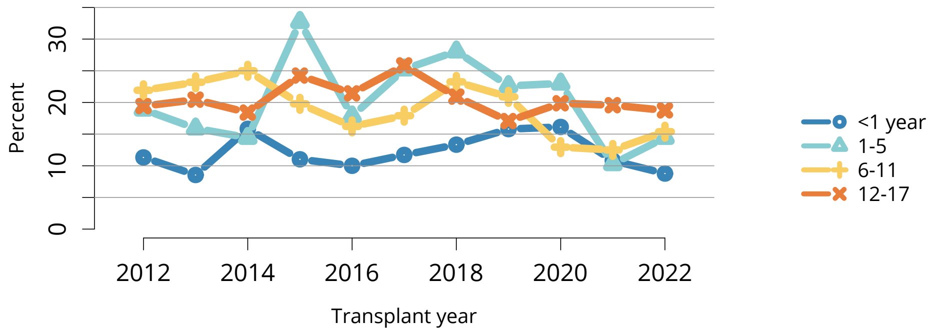

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Figure HR 107: Incidence of acute rejection by 1 year posttransplant among pediatric heart transplant recipients by age. Only the first reported rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier method.

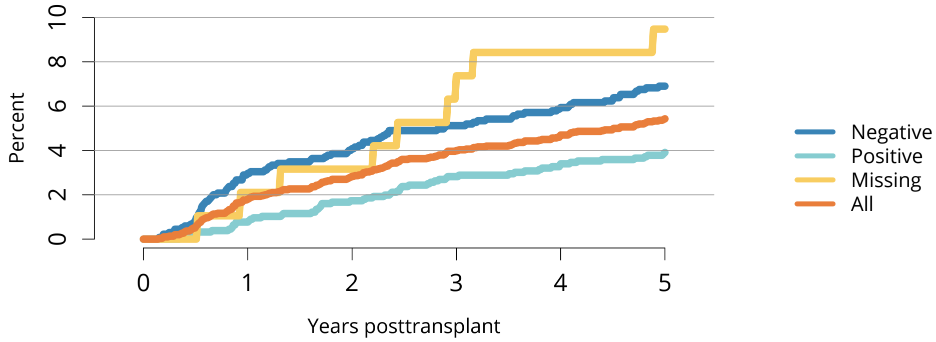

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Figure HR 108: Incidence of PTLD among pediatric heart transplant recipients by recipient EBV status at transplant, 2012-2018. Cumulative incidence is estimated using the Kaplan-Meier method. PTLD is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or on the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus; PTLD, posttransplant lymphoproliferative disorder.

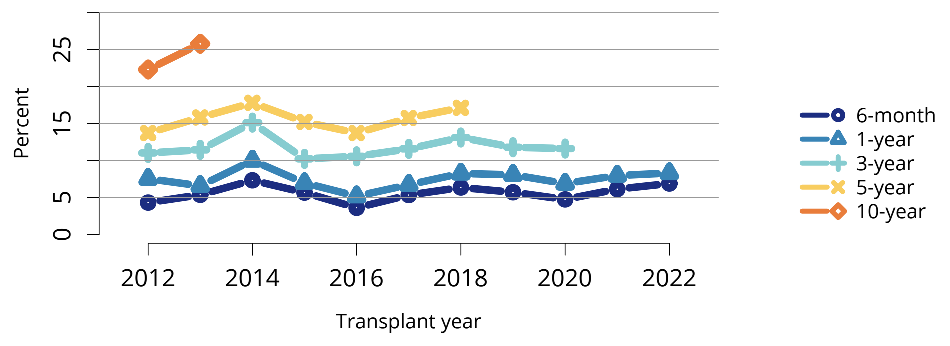

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Figure HR 109: Patient death among pediatric heart transplant recipients. All pediatric recipients of deceased donor hearts, including multiorgan transplant recipients. Estimates are unadjusted, computed using Kaplan-Meier methods.

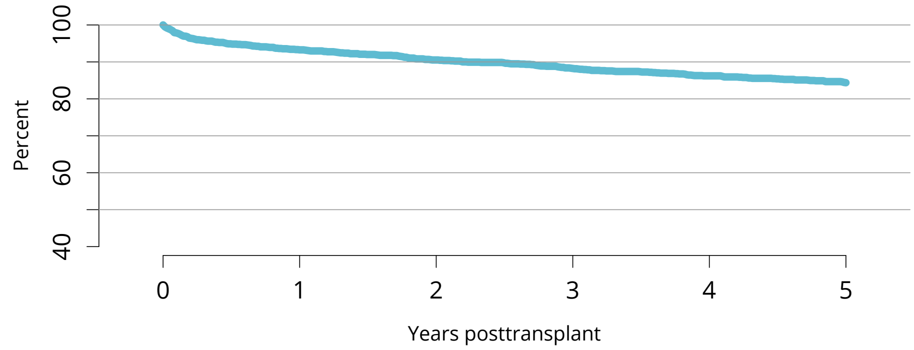

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Figure HR 110: Overall patient survival among pediatric deceased donor heart transplant recipients, 2016-2018. Recipient survival estimated using unadjusted Kaplan-Meier methods.

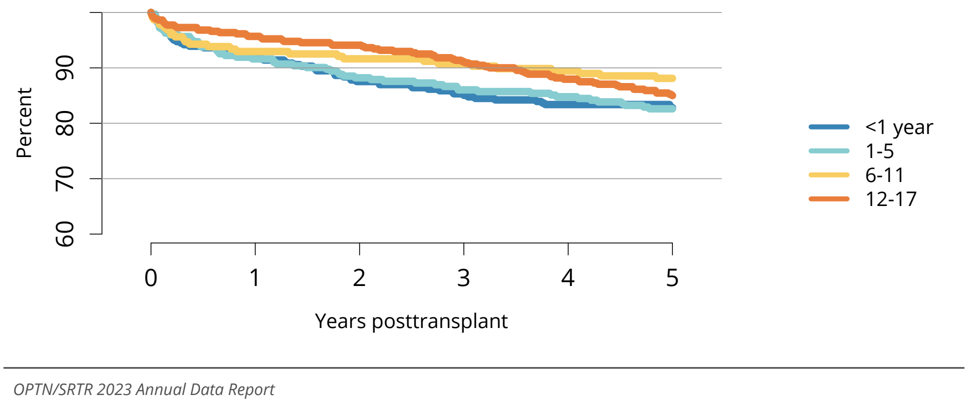

Figure HR 111: Patient survival among pediatric deceased donor heart transplant recipients, 2016-2018, by recipient age. Recipient survival estimated using unadjusted Kaplan-Meier methods.

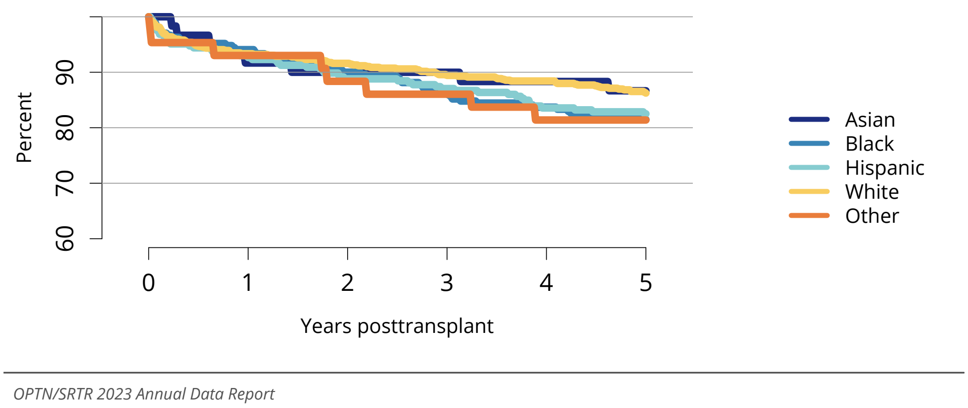

Figure HR 112: Patient survival among pediatric deceased donor heart transplant recipients, 2016-2018, by race and ethnicity. Recipient survival estimated using unadjusted Kaplan-Meier methods. The Other race category is composed of Native American and Multiracial categories.

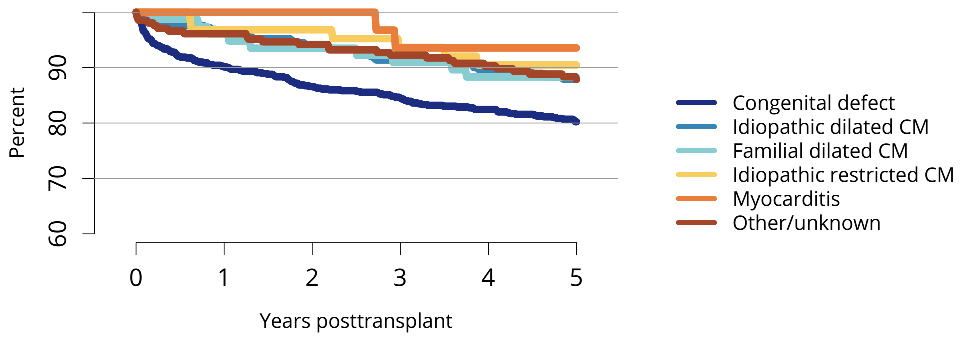

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Figure HR 113: Patient survival among pediatric deceased donor heart transplant recipients, 2016-2018, by diagnosis. Recipient survival estimated using unadjusted Kaplan-Meier methods.

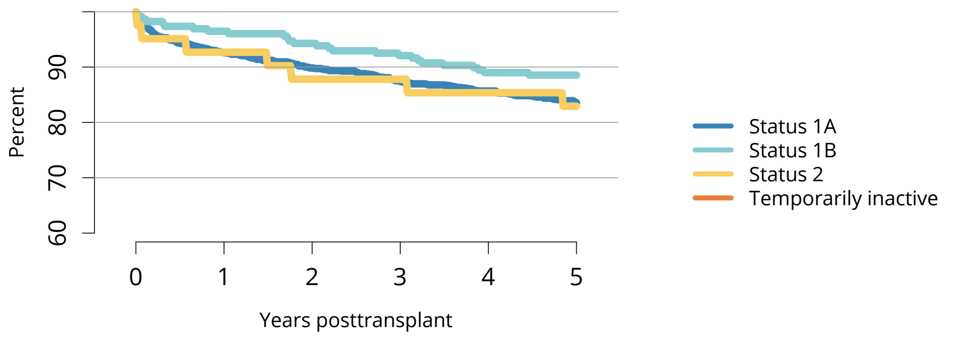

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Figure HR 114: Patient survival among pediatric deceased donor heart transplant recipients, 2016-2018, by medical urgency. Recipient survival estimated using unadjusted Kaplan-Meier methods.

Table HR 1: Demographic characteristics of adults on the heart transplant waiting list on December 31, 2013, and December 31, 2023. Candidates waiting for transplant on December 31 of the given year, regardless of first listing date. Distance is computed from candidate's home zip code to the transplant center. Age is determined on December 31 of the year.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Age (years)				
18-34 years	350	10.4	302	10.6
35-49	720	21.3	634	22.2
50-64	1681	49.8	1397	48.8
65+	623	18.5	529	18.5
Sex				
Female	798	23.7	586	20.5
Male	2576	76.3	2276	79.5
Race and ethnicity				
Asian	83	2.5	70	2.4
Black	790	23.4	875	30.6
Hispanic	244	7.2	306	10.7
Multiracial	15	0.4	19	0.7
Native American	13	0.4	10	0.3
White	2229	66.1	1571	54.9
Unreported	0	0	11	0.4
Geography				
Metropolitan	2812	83.3	2426	84.8
Nonmetropolitan	531	15.7	403	14.1
Missing	31	0.9	33	1.2
Miles between candidate and center				
<50 miles	1999	59.2	1692	59.1
50-<100	541	16	475	16.6
100-<150	324	9.6	268	9.4
150-<250	271	8	233	8.1
250+	215	6.4	166	5.8
Missing	24	0.7	28	1
All candidates				
All candidates	3374	100	2862	100

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Table HR 2: Clinical characteristics of adults on the heart transplant waiting list on December 31, 2013, and December 31, 2023. Candidates waiting for transplant on December 31 of the given year, regardless of first listing date. VAD, ventricular assist device.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Diagnosis				
Coronary artery disease	1198	35.5	813	28.4
Cardiomyopathy	1810	53.6	1661	58
Congenital disease	159	4.7	187	6.5
Valvular disease	47	1.4	20	0.7
Other/unknown	160	4.7	181	6.3
Blood type				
A	1073	31.8	763	26.7
AB	78	2.3	43	1.5
B	394	11.7	266	9.3
O	1829	54.2	1790	62.5
VAD status at listing				
No VAD	2449	72.6	1799	62.9
VAD	908	26.9	1062	37.1
Missing	17	0.5	1	0
Urgency status for heart candidates				
Status 1A	325	9.6	0	0
Status 1B	1328	39.4	0	0
Status 2	908	26.9	0	0
Adult status 1	0	0	19	0.7
Adult status 2	0	0	158	5.5
Adult status 3	0	0	140	4.9
Adult status 4	0	0	1403	49
Adult status 5	0	0	128	4.5
Adult status 6	0	0	551	19.3
Temporarily inactive	813	24.1	463	16.2
All candidates				
All candidates	3374	100	2862	100

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Table HR 3: Listing characteristics of adults on the heart transplant waiting list on December 31, 2013, and December 31, 2023. Candidates waiting for transplant on December 31 of the given year, regardless of first listing date.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Previous transplant				
No prior transplant	3256	96.5	2763	96.5
Prior transplant	118	3.5	99	3.5
Waiting time				
<90 days	625	18.5	621	21.7
3-<6 months	513	15.2	362	12.6
6-<12 months	663	19.7	479	16.7
1-<2 years	683	20.2	559	19.5
2+ years	890	26.4	841	29.4
All candidates				
All candidates	3374	100	2862	100

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Table HR 4: Medical urgency statuses 1 and 2 of adults on the heart transplant waiting list by OPTN region during 2022 and 2023. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included. Urgency status is determined at the earliest of transplant, death, removal, or December 31 of the year.

	2022		2023	
OPTN Region	**N**	**Percent**	**N**	**Percent**
Region 1				
Adult status 1	30	6.6	32	7.2
Adult status 2	93	20.5	130	29.3
Region 2				
Adult status 1	51	7.4	56	7.9
Adult status 2	175	25.3	221	31.2
Region 3				
Adult status 1	55	5.9	90	8.7
Adult status 2	276	29.8	350	33.9
Region 4				
Adult status 1	33	4.3	42	5.4
Adult status 2	205	27	219	28.1
Region 5				
Adult status 1	69	6.7	104	8.8
Adult status 2	345	33.5	365	31
Region 6				
Adult status 1	11	5.1	16	8
Adult status 2	53	24.5	52	26
Region 7				
Adult status 1	31	4.8	51	7.2
Adult status 2	195	30	229	32.4
Region 8				
Adult status 1	29	7.1	19	4.8
Adult status 2	130	31.7	164	41.7
Region 9				
Adult status 1	45	6.1	51	7.3
Adult status 2	216	29.5	231	33.1
Region 10				
Adult status 1	41	5.8	52	6.9
Adult status 2	144	20.5	168	22.1
Region 11				
Adult status 1	71	7.5	109	10.4
Adult status 2	268	28.3	311	29.8

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Table HR 5: Heart transplant waitlist activity among adults. Candidates listed at more than one center are counted once per listing. Candidates who are listed, undergo transplant, and are relisted are counted more than once. Candidates are not considered to be on the list on the day they are removed; counts on January 1 may differ from counts on December 31 of the prior year. Candidates listed for multiorgan transplants are included.

Waiting list state	2021	2022	2023
Waiting list state			
Patients at start of year	3146	3073	2879
Patients added during year	4373	4446	5063
Patients removed during year	4446	4640	5080
Patients at end of year	3073	2879	2862

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Table HR 6: Removal reason among adult heart transplant candidates. Removal reason as reported to the OPTN. Candidates with death dates that precede removal dates are assumed to have died waiting.

Removal reason	2021	2022	2023
Removal reason			
Deceased donor transplant	3355	3652	4068
Transplant outside US	0	1	0
Patient died	210	172	154
Patient refused transplant	23	20	20
Improved, transplant not needed	198	157	194
Too sick for transplant	252	212	249
Other	408	425	395
Still on waiting list	0	1	0

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Table HR 7: Adult heart transplant recipients on life support before transplant. Patients may have more than one type of life support. Circulatory support: left ventricular assist device, right ventricular assist device, total artificial heart, extracorporeal membrane oxygenation, and intra-aortic balloon pump.

	2020		2023	
Life support type	**N**	**Percent**	**N**	**Percent**
Life support type				
Any life support	2593	79.8	3129	76.5
Left ventricular assist device	1101	33.9	1523	37.2
Intravenous inotropes	1283	39.5	1648	40.3
Intra-aortic balloon pump	871	26.8	868	21.2
Right ventricular assist device	68	2.1	88	2.2
Extra corporeal membrane oxygenation	180	5.5	323	7.9
Total artificial heart	6	0.2	10	0.2
Ventilator	70	2.2	110	2.7
Inhaled nitric oxide	17	0.5	34	0.8
Prostaglandins	1	0	6	0.1

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Table HR 8: Demographic characteristics of adult heart transplant recipients, 2013 and 2023. Heart transplant recipients, including retransplant recipients. Distance is computed from recipient's home zip code to the transplant center.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Recipient age (years)				
18-34 years	241	11.2	477	11.7
35-49	444	20.7	831	20.3
50-64	1011	47.2	1939	47.4
65+	447	20.9	845	20.7
Sex				
Female	587	27.4	1137	27.8
Male	1556	72.6	2955	72.2
Race and ethnicity				
Asian	75	3.5	171	4.2
Black	467	21.8	1046	25.6
Hispanic	145	6.8	475	11.6
Multiracial	16	0.7	17	0.4
Native American	8	0.4	32	0.8
White	1432	66.8	2339	57.2
Unreported	0	0	12	0.3
Insurance				
Private	1037	48.4	1878	45.9
Medicare	772	36	1427	34.9
Medicaid	258	12	600	14.7
Other/unknown	76	3.5	187	4.6
Geography				
Metropolitan	1805	84.2	3418	83.5
Nonmetropolitan	317	14.8	601	14.7
Missing	21	1	73	1.8
Miles between recipient and center				
<50 miles	1316	61.4	2410	58.9
50-<100	359	16.8	669	16.3
100-<150	193	9	349	8.5
150-<250	151	7	322	7.9
250+	106	4.9	275	6.7
Missing	18	0.8	67	1.6
All recipients				
All recipients	2143	100	4092	100

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Table HR 9: Clinical characteristics of adult heart transplant recipients, 2013 and 2023. Heart transplant recipients, including retransplant recipients. VAD information is from the OPTN Transplant Recipient Registration Form and includes left VAD, right VAD, total artificial heart, and left + right VAD. Collection of cPRA began March 31, 2015. Prior to that, PRA class I and II values were used. Missing/temporarily inactive urgency statuses are regarded as listing errors since they should not have received a transplant. cPRA, calculated panel-reactive antibody; VAD, ventricular assist device.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Diagnosis				
Coronary artery disease	790	36.9	1143	27.9
Cardiomyopathy	1197	55.9	2533	61.9
Congenital disease	84	3.9	195	4.8
Valvular disease	45	2.1	38	0.9
Other/unknown	17	0.8	146	3.6
NA	10	0.5	37	0.9
Blood type				
A	843	39.3	1536	37.5
AB	132	6.2	204	5
B	325	15.2	609	14.9
O	843	39.3	1743	42.6
VAD at transplant				
VAD	1037	48.4	1651	40.3
No VAD	1106	51.6	2437	59.6
Missing	0	0	4	0.1
cPRA				
<1%	1114	52	1814	44.3
1-<20%	436	20.3	461	11.3
20-<80%	354	16.5	502	12.3
80-<98%	89	4.2	87	2.1
98-100%	37	1.7	45	1.1
Missing	113	5.3	1183	28.9
Urgency status for heart recipients				
Status 1A	1396	65.1	15	0.4
Status 1B	672	31.4	8	0.2
Status 2	75	3.5	2	0
Adult status 1	0	0	574	14
Adult status 2	0	0	2224	54.3
Adult status 3	0	0	442	10.8
Adult status 4	0	0	580	14.2
Adult status 5	0	0	62	1.5
Adult status 6	0	0	185	4.5
All recipients				
All recipients	2143	100	4092	100

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Table HR 10: Transplant characteristics of adult heart transplant recipients, 2013 and 2023. Heart transplant recipients, including retransplant recipients. DBD, donation after brain death; DCD, donation after circulatory death.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Waiting time				
<1 day	0	0	1	0
1-<90 days	985	46	3069	75
3-<6 months	377	17.6	372	9.1
6-<12 months	357	16.7	270	6.6
1-<2 years	298	13.9	186	4.5
2+ years	126	5.9	194	4.7
Previous transplant for recipients				
No prior transplant	2063	96.3	3970	97
Prior transplant	80	3.7	122	3
Donation after circulatory death				
DBD	2143	100	3488	85.2
DCD	0	0	604	14.8
Transplant type				
Heart only	2025	94.5	3541	86.5
Heart-kidney	85	4	421	10.3
Heart-lung	16	0.7	53	1.3
Heart-liver	16	0.7	70	1.7
Other multiorgan	1	0	7	0.2
All recipients				
All recipients	2143	100	4092	100

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Table HR 11: Demographic characteristics of pediatric candidates on the heart transplant waiting list on December 31, 2013, and December 31, 2023. Candidates younger than 18 years at listing waiting for transplant on December 31 of the given year, regardless of first listing date. Age is determined on December 31 of the year. The 18+ category is for candidates who turned age 18 while waiting. Distance is computed from candidate's home zip code to the transplant center.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Age (years)				
<1 year	62	17.6	71	13.8
1-5	101	28.6	158	30.7
6-11	72	20.4	147	28.5
12-17	91	25.8	98	19
18+	27	7.6	41	8
Sex				
Female	139	39.4	226	43.9
Male	214	60.6	289	56.1
Race and ethnicity				
Asian	11	3.1	16	3.1
Black	54	15.3	107	20.8
Hispanic	74	21	118	22.9
Multiracial	4	1.1	22	4.3
Native American	2	0.6	3	0.6
White	208	58.9	241	46.8
Unreported	0	0	8	1.6
Geography				
Metropolitan	294	83.3	422	81.9
Nonmetropolitan	52	14.7	87	16.9
Missing	7	2	6	1.2
Miles between candidate and center				
<50 miles	164	46.5	268	52
50-<100	77	21.8	91	17.7
100-<150	40	11.3	54	10.5
150-<250	31	8.8	61	11.8
250+	34	9.6	37	7.2
Missing	7	2	4	0.8
All candidates				
All candidates	353	100	515	100

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Table HR 12: Clinical characteristics of pediatric candidates on the heart transplant waiting list on December 31, 2013, and December 31, 2023. CM, cardiomyopathy; VAD, ventricular assist device.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Pediatric diagnosis				
Congenital defect	165	46.7	333	64.7
Idiopathic dilated CM	69	19.5	63	12.2
Familial dilated CM	3	0.8	7	1.4
Idiopathic restricted CM	21	5.9	10	1.9
Myocarditis	8	2.3	11	2.1
Other/unknown	87	24.6	91	17.7
Blood type				
A	107	30.3	136	26.4
AB	7	2	11	2.1
B	35	9.9	61	11.8
O	204	57.8	307	59.6
VAD status at listing				
No VAD	328	92.9	443	86
VAD	18	5.1	70	13.6
Missing	7	2	2	0.4
Urgency status for heart candidates				
Status 1A	105	29.7	143	27.8
Status 1B	44	12.5	135	26.2
Status 2	82	23.2	99	19.2
Temporarily inactive	122	34.6	138	26.8
All candidates				
All candidates	353	100	515	100

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Table HR 13: Listing characteristics of pediatric candidates on the heart transplant waiting list on December 31, 2013, and December 31, 2023. Candidates younger than 18 years at listing waiting for transplant on December 31 of the given year, regardless of first listing date.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Previous transplant				
No prior transplant	326	92.4	491	95.3
Prior transplant	27	7.6	24	4.7
Waiting time				
<90 days	118	33.4	133	25.8
3-<6 months	53	15	75	14.6
6-<12 months	39	11	87	16.9
1-<2 years	43	12.2	85	16.5
2+ years	100	28.3	135	26.2
All candidates				
All candidates	353	100	515	100

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Table HR 14: Heart transplant waitlist activity among pediatric candidates. Candidates who are listed, undergo transplant, and are relisted are counted more than once. Candidates are not considered to be on the list on the day they are removed; counts on January 1 may differ from counts on December 31 of the prior year. Candidates listed for multiorgan transplants are included.

Waiting list state	2021	2022	2023
Waiting list state			
Patients at start of year	443	485	511
Patients added during year	703	703	737
Patients removed during year	661	677	733
Patients at end of year	485	511	515

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Table HR 15: Removal reason among pediatric heart transplant candidates. Removal reason as reported to the OPTN. Candidates with death dates that precede removal dates are assumed to have died waiting.

Removal reason	2021	2022	2023
Removal reason			
Deceased donor transplant	505	509	531
Patient died	46	48	62
Patient refused transplant	3	2	2
Improved, transplant not needed	40	52	59
Too sick for transplant	33	35	28
Other	34	31	51

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Table HR 16: Pediatric heart transplant recipients on life support before transplant. Patients may have more than one type of life support. Circulatory support: left ventricular assist device, right ventricular assist device, total artificial heart, extracorporeal membrane oxygenation, and intra-aortic balloon pump.

	2018		2023	
Life support type	**N**	**Percent**	**N**	**Percent**
Life support type				
Any life support	352	74.4	346	68.2
Left ventricular assist device	141	29.8	194	38.3
Intravenous inotropes	226	47.8	185	36.5
Intra-aortic balloon pump	0	0	0	0
Right ventricular assist device	27	5.7	36	7.1
Extra corporeal membrane oxygenation	16	3.4	13	2.6
Total artificial heart	3	0.6	0	0
Ventilator	62	13.1	44	8.7
Inhaled nitric oxide	8	1.7	5	1
Prostaglandins	10	2.1	7	1.4

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Table HR 17: Demographic characteristics of pediatric heart transplant recipients, 2013 and 2023. Pediatric heart transplant recipients, including retransplant recipients. Distance is computed from recipient's home zip code to the transplant center.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Recipient age (years)				
<1 year	117	28.5	118	23.3
1-5	88	21.4	93	18.3
6-11	69	16.8	94	18.5
12-17	137	33.3	202	39.8
Sex				
Female	193	47	226	44.6
Male	218	53	281	55.4
Race and ethnicity				
Asian	16	3.9	19	3.7
Black	98	23.8	98	19.3
Hispanic	80	19.5	99	19.5
Multiracial	6	1.5	18	3.6
Native American	3	0.7	4	0.8
White	208	50.6	268	52.9
Unreported	0	0	1	0.2
Insurance				
Private	174	42.3	225	44.4
Medicare	0	0	2	0.4
Medicaid	195	47.4	235	46.4
Other/unknown	42	10.2	45	8.9
Geography				
Metropolitan	334	81.3	411	81.1
Nonmetropolitan	70	17	88	17.4
Missing	7	1.7	8	1.6
Miles between recipient and center				
<50 miles	205	49.9	247	48.7
50-<100	71	17.3	100	19.7
100-<150	45	10.9	65	12.8
150-<250	47	11.4	58	11.4
250+	36	8.8	30	5.9
Missing	7	1.7	7	1.4
All recipients				
All recipients	411	100	507	100

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Table HR 18: Clinical characteristics of pediatric heart transplant recipients, 2013 and 2023. Pediatric heart transplant recipients, including retransplant recipients. cPRA began March 31, 2015. Prior to that, measured PRA values were used. CM, cardiomyopathy; cPRA, calculated panel-reactive antibody; VAD, ventricular assist device.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Diagnosis				
Congenital defect	177	43.1	288	56.8
Idiopathic dilated CM	117	28.5	99	19.5
Familial dilated CM	16	3.9	26	5.1
Idiopathic restricted CM	20	4.9	19	3.7
Myocarditis	21	5.1	8	1.6
Other/unknown	55	13.4	66	13
NA	5	1.2	1	0.2
Blood type				
A	150	36.5	172	33.9
AB	9	2.2	21	4.1
B	52	12.7	83	16.4
O	200	48.7	231	45.6
VAD at transplant				
VAD	109	26.5	213	42
No VAD	302	73.5	293	57.8
Missing	0	0	1	0.2
cPRA				
<1%	186	45.3	241	47.5
1-<20%	60	14.6	65	12.8
20-<80%	78	19	67	13.2
80-<98%	24	5.8	16	3.2
98-100%	12	2.9	11	2.2
Missing	51	12.4	107	21.1
Urgency status for heart recipients				
Status 1A	378	92	424	83.6
Status 1B	24	5.8	72	14.2
Status 2	9	2.2	11	2.2
All recipients				
All recipients	411	100	507	100

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Table HR 19: Transplant characteristics of pediatric heart transplant recipients, 2013 and 2023. Pediatric heart transplant recipients, including retransplant recipients. DBD, donation after brain death; DCD, donation after circulatory death.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Waiting time				
<1 day	1	0.2	0	0
1-<90 days	254	61.8	226	44.6
3-<6 months	83	20.2	134	26.4
6-<12 months	50	12.2	102	20.1
1-<2 years	17	4.1	31	6.1
2+ years	6	1.5	14	2.8
ABO-Incompatible transplant				
Compatible/Identical	394	95.9	469	92.5
Incompatible	17	4.1	38	7.5
Previous transplant for recipients				
No prior transplant	392	95.4	492	97
Prior transplant	19	4.6	15	3
Donation after circulatory death				
DBD	411	100	497	98
DCD	0	0	10	2
Transplant type				
Heart only	404	98.3	501	98.8
Heart-kidney	0	0	2	0.4
Heart-lung	7	1.7	1	0.2
Heart-liver	0	0	3	0.6
All recipients				
All recipients	411	100	507	100

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OPTN/SRTR 2023 Annual Data Report: Lung

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Abstract

The year 2023 marked a year of major transition for the lung transplant community in the United States, as it became the first to adopt the continuous distribution system for organ allocation. Starting on March 9, 2023, the composite allocation score (CAS) was used to rank candidates for access to a lung transplant. Shortly after the adoption of this CAS system, it was amended to better represent the biological disadvantage of candidates with blood type O for accessing a donor organ. Despite the challenges of implementing major changes to the system, the year 2023 marked many successes and milestones in US lung transplantation. A total of 3,049 adult lung transplants were performed, representing the most transplants performed in any single year. Transplant rates continued their increase over time and reached an all-time high of 307.6 transplants per 100 patient-years for adults on the waiting list. By 1 year after listing, 81.2% of adult candidates underwent a deceased donor lung transplant, with 62.6% of them having waited 3 months or less. Adult waitlist mortality rates decreased to their lowest at 13.3 deaths per 100 patient-years, meeting one of the major goals of the organ allocation systems:

to decrease waitlist mortality. Survival after lung transplant remained stable over the past decade with 88.5% of adults who underwent transplant in 2022 surviving to 1 year compared with 87.2% of adults who underwent transplant in 2013.

Keywords: Composite allocation score, end-stage lung disease, lung transplantation, transplant outcomes

1 Introduction

In 2023, there were 3,049 adult and 31 pediatric lung transplants performed in the United States, continuing the trend of increasing lung transplants every year. The annual number of new candidates added to the waiting list also increased, with 3,385 adult and 42 pediatric candidates added. Adult waitlist mortality rates have decreased 27.1% over the past decade to 13.3 deaths per 100 patient-years, meeting one of the major goals of the organ allocation systems: to decrease waitlist mortality.

Lung transplantation in the United States underwent fundamental changes during this year. On March 9, 2023, lung was the first organ allocation system to adopt the continuous distribution framework, replacing the previous lung allocation score (LAS) system that had been in effect for nearly 18 years prior. The lung composite allocation score (CAS) was created to capture all considerations in the system-level allocation of a donor lung to a candidate. The CAS is used to prioritize adult and pediatric lung transplant candidates for an organ allocation based on their estimated 1-year waitlist mortality; 5-year posttransplant survival; biology that includes blood type, height, and calculated panel-reactive antibody (cPRA); pediatric status; prior living donor status; and placement efficiency. Shortly after the CAS was implemented, an unexpected decline in transplant rates for blood type O candidates was observed, likely due to the removal of the LAS system's prioritization of blood type O candidates for lungs from blood type O donors. The CAS blood type point distribution was modified effective September 27, 2023. Therefore, this 2023 report encompasses three distinct periods: January 1 – March 8, pre–continuous distribution with LAS still used; March 9 – September 26, continuous distribution with CAS used to rank candidates; and September 27 – December 31, continuous distribution with CAS plus ABO modification used. For calculations of medical urgency and posttransplant survival, adult candidates are categorized into four main diagnostic groups by shared diagnostic criteria or disease behavior into group A, obstructive lung disease; group B, pulmonary vascular disease; group C, cystic fibrosis and other immunodeficiency disorders; and group D, restrictive lung disease.

The Adult Lung Transplant section in

this report includes information on all lung transplant candidates and recipients aged 18 years or older at the time of placement on the waiting list. The Pediatric Lung Transplant section includes information on all lung transplant candidates and recipients younger than 18 years at the time of placement on the waiting list. Reports from 2019 and earlier separated adult and pediatric sections at the age of 12 years, but this was changed in 2020 to align with international reporting. This chapter includes data on all lung and multiorgan lung transplant recipients in the United States.

2 Adult Lung Transplant

2.1 Waiting List

2.1.1 Characteristics of waitlist candidates

In 2023, there were 3,385 new adult candidates added to the lung transplant waiting list, which represents the highest number of new listings in any single year and an increase of 37.4% over the past decade (Figure LU 1). There were 4,365 candidates on the list at any time during the year (Figure LU 2). Adults aged 50-64 years represented the largest group at 44.1% of the candidates, and the proportion of adults aged 65 years or older continued to grow, reaching 38.3% of the waitlisted population (Figure LU 3). Overall, the distribution remained stable by sex, with male candidates representing 53.4% of the waiting list (Figure LU 4). Although White candidates remained the majority, the proportion of individuals of minority race and ethnicity have increased over time. Hispanic candidates made up 14.1% of the waiting list in 2023, a 117.2% increase since 2013; Black candidates made up 11.1% of the list in 2023, a 16.3% increase since 2013 (Figure LU 5). Waitlist trends by diagnosis group remained consistent. At the extremes, candidates in group D continued to represent the majority (67.9%) of the waiting list, and the proportion of candidates in group C continued its decline noted since 2019, representing a mere 2.0% of the list in 2023—a trend attributed to the therapeutic efficacy and widespread use of highly effective modulator therapy. The proportion of candidates in group A was 21.5%, representing a 37.1% decrease over the past decade, and group B made up 8.5% of the waiting list (Figure LU 6).

The CAS incorporates in its calculation biological factors that affect a lung candidate's likelihood of finding a suitable donor match, including blood type, height, and cPRA. In 2023, individuals with blood type O continued to make up the highest proportion of the list at 48.9% of the waitlist population, followed by type A (36.6%), type B (11.4%), and type AB (3.2%) (Figure LU 10). The distribution of height categories remained largely stable over the past decade. At the extremes of height, adults < 150 cm (59 in) constituted 3.5% of the waiting list and those 180 cm (70 in) or taller, 16.1% (Figure LU 9). The implication of candidates' height on transplant access varies depending on whether a candidate is listed for a single or bilateral lung transplant, and on their diagnosis group, with candidates in group A generally requiring donors taller than the candidate and candidates in group D requiring shorter donors.

One of the key contributors to a candidate's final CAS is their estimated waitlist mortality over the next year without a transplant, which is reported as waitlist area under the curve (WLAUC; range, 0-365 days). This value has been calculated for all candidates since the implementation of LAS in 2005 and was used to derive the LAS, which largely reflected the risk of waitlist mortality. Until this year, the Annual Data Report only reported the final LAS value for ease of understanding. However, because the CAS incorporates multiple attributes in its calculation, starting with this report, the WLAUC values will be reported for candidates to represent the medical urgency status of those awaiting transplant. The WLAUC values are also shown in accompanying figures for longitudinal comparison of trends. In 2023, the proportion of transplant candidates whose estimated medical urgency over the next year was expressed by WLAUC of <210 days was 23.0%; of 210-<300 days, 16.9%; of 300-<335 days, 24.2%; and of 335 or more days, 36.0% (Figure LU 12).

In 2023, lung transplant candidates primarily lived in metropolitan areas, with only 13.4% residing in a nonmetropolitan region. While over half of candidates lived within 50 miles of their transplant center, 8.5% traveled 250 miles or more to their center (Table LU 1).

2.1.2 Outcomes of waitlist candidates

Deceased donor lung transplant rates continued their increase over time for adult candidates: 307.6 transplants per 100 patient-years for those on the waiting list in 2023 compared with 114.74 transplants per 100 patient-years in 2013 (Figure LU 13). By 1 year after listing, 81.2% of individuals underwent a deceased donor lung transplant, an increase of 24.4% over the past decade (Figure LU 20). Most of the candidates (65.0%) on the waiting list in 2023 waited less than 90 days for a lung transplant, 13.0% waited 3-<6 months, 11.1% waited 6-<12 months, and only 10.9% waited 1 year or longer (Figure LU 7).

Transplant rates have increased for all age categories of candidates over the past decade, but between 2022 and 2023, they plateaued for those aged 65 years or older. Candidates aged 65 years or older still had the highest transplant rate at 336.9 transplants per 100 patient-years (Figure LU 14). In terms of race and ethnicity, transplant rates were the lowest for Black candidates at 208.3 transplants per 100 patient-years compared with the highest rates of 465.6 and 328.4 transplants per 100 patient-years for candidates in the Other and White categories, respectively (Figure LU 15). Of note, the Other racial and ethnic category is composed of Multiracial, Native American, and unreported race candidates, who constituted 1.6% of candidates (Figure LU 5), leading to unstable estimates for reporting. Transplant rates have increased for candidates in all diagnosis groups over the past decade, with candidates in group D having the highest transplant rates, at 361.8 transplants per 100 patient-years (Figure LU 16). Transplant rates have diverged by blood type over the past decade, with candidates of blood type AB having the highest transplant rates and those with type O the lowest (Figure LU 17). The tallest candidates still had the highest transplant rates in 2023, and transplant rates were lower for candidates of shorter heights (Figure LU 18).

Adult candidate mortality rates have had a 27.1% decrease over the past decade, to 13.3 deaths per 100 patient-years in 2023 (Figure LU 21). Pretransplant mortality converged for age groups over time across a relatively narrow range of 11.6 to 17.1 deaths per 100 patient-years (Figure LU 22). There was a small variation in pretransplant mortality by race and ethnicity, although the rate decreased in all categories between the years 2022 and 2023, especially for Black and Hispanic candidates. The observed highest pretransplant mortality for Asian candidates in 2023 may reflect the smaller population sample size yielding unstable estimates (Figure LU 5 and Figure LU 23). Male candidates have historically had higher pretransplant mortality rates, which remained the case in 2023, but the rates for male and female candidates converged at 14.3 and 12.5 deaths per 100 patient-years, respectively (Figure LU 24). For the first time in the past decade, the pretransplant mortality rate for candidates in diagnosis group B exceeded that for candidates in group D. Group B candidates had the highest mortality rate at 23.5 deaths per 100 patient-years, and Group C reached a landmark statistic of zero deaths (Figure LU 25). Pretransplant mortality rates were the highest for candidates with blood type AB, followed by those with types B, O, and A; however, note that these rates are expressed as a function of the time candidates spent waiting (Figure LU 27). Candidates with blood type AB also had the highest transplant rate in 2023 (Figure LU 17), which suggests that both trends likely reflect the small proportion of these candidates on the list (Figure LU 10). Pretransplant mortality rates converged for candidates of all heights except those in the shortest height category of <150 cm, who had the highest rate at 23.3 deaths per 100 patient-years (Figure LU 28). Of those removed from the waiting list, 23.5% died within 6 months of waitlist removal (Figure LU 29), with the highest rates for candidates in diagnosis group D (Figure LU 30), those aged 65 years or older (Figure LU 31), and Hispanic candidates (Figure LU 32).

2.2 Transplant

2.2.1 Characteristics of transplant recipients

In 2023, a total of 3,049 adult lung transplants were performed (Figure LU 35), representing an increase of 327 from the year prior and the most transplants performed in any single year. The preferred lung transplant procedure continued to be bilateral, at 83.6% of all transplants (Figure LU 36). The number of transplants remained relatively stable for individuals aged 18-49 years but continued its dramatic increase for those aged 50 years or older, and was especially notable for those aged 50-64 years (Figure LU 37). Annually more transplants have occurred in male compared with female patients; however, this gap narrowed in 2023, with 1,724 male and 1,325 female transplant recipients (Figure LU 38). Since 2013, the number of transplants increased across all racial and ethnic categories, with transplants in Hispanic, Asian, and Black recipients increasing by 283.2% (n = 433 in 2023), 431.6% (n = 101 in 2023), and 79.4% (n = 296 in 2023), respectively (Figure LU 39). With more transplants performed each year over the past decade, candidates in diagnosis groups A, B, and D also had increases in transplants, with recipients in these groups representing 20.0%, 6.3%, and 71.8% of adult lung transplants in 2023, respectively. Group C recipients represented only 1.8% of the population (Figure LU 40). Of the 3,049 adult lung transplants performed in 2023, 96 (3.1%) transplants were part of multiorgan transplants, including 53 heart-lung, 22 liver-lung, and 21 kidney-lung transplants (Table LU 8).

The proportion of transplant recipients whose estimated waitlist mortality over the next year was expressed by WLAUC of <210 days was 27.7%; of 210-<300 days, 17.3%; of 300-<335 days, 22.7%; and of 335 or more days, 32.3% (Figure LU 41). When compared with prior years over the past decade, the greatest increases in proportions of transplants were observed for the sickest (those with WLAUC of <210 days) and the least sick (those with WLAUC of 335 or more days).

Finally, the highly selected population of lung transplant candidates has an exceptionally high rate of health insurance, ensuring coverage for the significant expenses related to lung transplant. In 2023, most (55.2%) lung transplant recipients had public insurance (46.1% Medicare, 9.1% Medicaid) while 40.5% had private insurance (Table LU 6).

2.2.2 Outcomes of transplant recipients

The use of induction agents has increased over time, with use in 86.5% of adult lung transplant recipients in 2023 (Figure LU 43). Among adult lung transplant recipients, 82.1% received interleukin-2 receptor antibody (IL2Ab) agents and 3.5% received T-cell–depleting agents (Figure LU 44). Triple-drug therapy remained the mainstay of immunosuppression with tacrolimus, a mycophenolate agent, and a steroid used in 86.7% of lung transplant recipients (Figure LU 45). Survival trends after lung transplant remained stable over the past decade, with 88.5% of recipients in 2022 surviving to 1 year, 71.3% of recipients in 2020 surviving to 3 years, 59.7% of recipients in 2018 surviving to 5 years, and 31.8% of recipients in 2013 surviving to 10 years (Figure LU 46). For those who underwent transplant in 2016-2018, 1-year patient survival was 89.0%, 3-year patient survival was 74.3%, and 5-year patient survival was 60.1% (Figure LU 47). At 5 years, 68.5% of recipients aged 35-49 years remained alive, followed by 64.9% aged 18-34 years, 62.4% aged 50-64 years, and 52.6% aged 65 years or older (Figure LU 48). Patient survival was similar across sex (Figure LU 52) and racial and ethnic groups (Figure LU 49). Transplant recipients in diagnosis group C had the highest unadjusted 5-year patient survival at 70.7%, compared with 57.8% to 61.9% across the other diagnosis groups (Figure LU 51).

The incidence of acute rejection in the first year after transplant remained the highest for lung transplant recipients aged 18-34 years, at 16.3% (Figure LU 53). For transplant recipients who were Epstein-Barr virus (EBV) negative, the incidence of posttransplant lymphoproliferative disorder (PTLD) was 8.0% by 5 years after transplant, while the incidence was lower at 1.3% for those who were EBV positive (Figure LU 55).

3 Donation

In 2023, there were 3,276 deceased donors with at least one lung recovered—a substantial increase from 1,896 deceased donors in 2013 (Figure LU 56). In terms of age, 82.2% of deceased donors were aged 18-54 years, followed by 11.9% aged 55 years or older and 5.9% younger than 18 years (Figure LU 57). For sex distribution, 60.4% were male donors (Figure LU 58). The largest proportion of donors by race and ethnicity was 59.7% White, followed by 18.0% Hispanic and 17.7% Black (Figure LU 59). The proportion of donation after circulatory death (DCD) donors continued its steady increase observed over the past decade, reaching 13.5% in 2023 from 2.3% in 2013 (Figure LU 60). In 2023, 9.0% of lungs recovered for transplant were ultimately not transplanted (Figure LU 61). This nonuse rate was highest for donors who were aged 55 years or older (Figure LU 62) and male (Figure LU 63). Nonuse rates were similar across donor cause of death (Figure LU 65) and Public Health Service Guideline risk factor status (Figure LU 66). The most common donor cause of death among deceased lung donors was anoxia, followed by head trauma and cerebrovascular accident/stroke (Figure LU 67).

4 Pediatric Lung Transplant

4.1 Waiting List

4.1.1 Characteristics of waitlist candidates

In 2023, there were 73 pediatric candidates on the lung waiting list (Figure LU 69), with 42 new candidates added during the year (Figure LU 68). The waiting list was made up of 49.1% candidates aged 12-17 years, 30.1% aged 6-11 years, 15.1% aged 1-5 years, 2.7% younger than 1 year, and 2.7% aged 18 years or older (turned 18 while waiting) (Figure LU 70). The waitlist composition by race and ethnicity included 56.2% White, 19.2% Hispanic, 13.7% Black, 9.6% Asian, and 1.4% candidates in the Other category (Figure LU 71). For distribution by sex, 53.4% of candidates were female (Figure LU 72). Candidates with blood type A made up 60% of the waiting list; type B, 25%; and type O, 15% (Table LU 10).

4.1.2 Outcomes of waitlist candidates

Regarding time on the waiting list, 37.0% of pediatric candidates were on the list for less than 90 days while 30.1% of candidates waited 1 year or more (Figure LU 73). Of candidates on the waiting list on December 31, 2023, 10.0% had waited less than 90 days; 20.0%, 3-<6 months; 15.0%, 6-<12 months; 35.0%, 1-<2 years; and 20.0%, 2 years or more (Table LU 11). Most candidates who underwent transplant did so by 1 year after listing, whereas by 3 years after listing 24.8% were removed from the waiting list and 12.4% died (Figure LU 74). The deceased donor lung transplant rate increased to 112.9 transplants per 100 patient-years in 2023, from 76.8 transplants per 100 patient-years in 2022 (Figure LU 75). Transplant rates were highest for candidates younger than 1 year, followed by those aged 12-17 years, 6-11 years, and 1-5 years (Figure LU 76). Although transplant rates by race and ethnicity are shown (Figure LU 77), it is difficult to interpret trends for transplant access by race and ethnicity in the pediatric population because the numbers are small in each category (Figure LU 69 and Figure LU 71). For distance to transplant center, 30.0% of pediatric candidates resided 250 miles or farther from their center; 15.0% resided in a nonmetropolitan area (Table LU 9).

The pediatric pretransplant mortality rate has increased to 33.3 deaths per

100 patient-years in 2023, from its lowest point in the past decade of 17.5 in 2021 (Figure LU 78). Pretransplant mortality was highest in 2023 for children younger than 1 year, at 128.1 deaths per 100 patient-years (Figure LU 79), although the trends may not be meaningful because the numbers are small in each category (Figure LU 69 and Figure LU 70). In 2023, nine pediatric candidates died on the waiting list, eight were removed due to having improved, and one was removed for being too sick for transplant (Table LU 13).

4.2 Transplant

4.2.1 Characteristics of transplant recipients

In 2023, there were 31 pediatric lung transplants performed (Figure LU 80): 20 recipients aged 12-17 years, 8 aged 6-11 years, 2 younger than 1 year, and 1 aged 1-5 years (Table LU 14 and Figure LU 81). By race and ethnicity, 19 recipients were White; 6, Black; 4, Hispanic; 1, Asian; and 1, Multiracial. Most of the recipients had private insurance (n = 15), followed by Medicaid (9) and Medicare (2). One candidate was supported with mechanical ventilation, 4 with extracorporeal membrane oxygenation (ECMO), and 4 with mechanical ventilation and ECMO (Table LU 15). For cause of lung disease, most pediatric transplant recipients were in the other/unknown diagnosis category (n = 17), followed by pulmonary hypertension (7), pulmonary fibrosis (4), and cystic fibrosis (3); the cystic fibrosis group has continued to decrease over the past few years. Retransplants accounted for 6.5% of pediatric lung transplants, while heart-lung transplants accounted for 3.2% (Table LU 16).

4.2.2 Outcomes of transplant recipients

Most pediatric lung transplant recipients (87.1%) received induction therapy (Figure LU 82), with 48.4% receiving T-cell–depleting agents and 38.7% receiving IL2Ab agents (Figure LU 83). Most transplant recipients were maintained on a regimen of tacrolimus, a mycophenolate agent, and a steroid, but the proportion of recipients who were maintained on tacrolimus and mycophenolate only increased to 19.4% (Figure LU 84). Although it remained a relatively uncommon occurrence, PTLD was higher at 5 years for EBV-negative recipients at 7.1% than for EBV-positive recipients at 1.3% (Figure LU 85). Slight variations in survival occurred, likely due to small sample sizes. Among transplant recipients in 2022, 81.0% of recipients survived to 1 year; of recipients in 2020, 63.9% survived to 3 years; of recipients in 2018, 57.5% survived to 5 years; and of recipients in 2013, 33.3% survived to 10 years (Figure LU 86). For those who underwent transplant in 2016-2018, 58.1% of pediatric lung transplant recipients survived to 5 years (Figure LU 87).

Support, Copyright, and Citation Information

This publication was produced for the U.S. Department of Health and Human Services (HHS), Health Resources and Services Administration (HRSA), by Hennepin Healthcare Research Institute (HHRI) and the United Network for Organ Sharing (UNOS) under contracts HHSH75R60220C00011 and HHSH250201900001C, respectively. Dr. Israni was supported in part by AHRQ R01HS028829.

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This report is available at https://srtr.transplant.hrsa.gov/annualdatareports. Individual chapters may be downloaded.

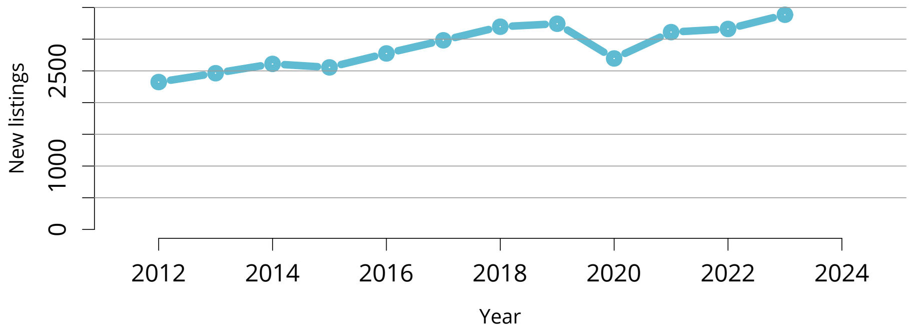

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Figure LU 1: New adult candidates added to the lung transplant waiting list. A new adult candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and subsequently relisted are considered new. Active and inactive patients are included.

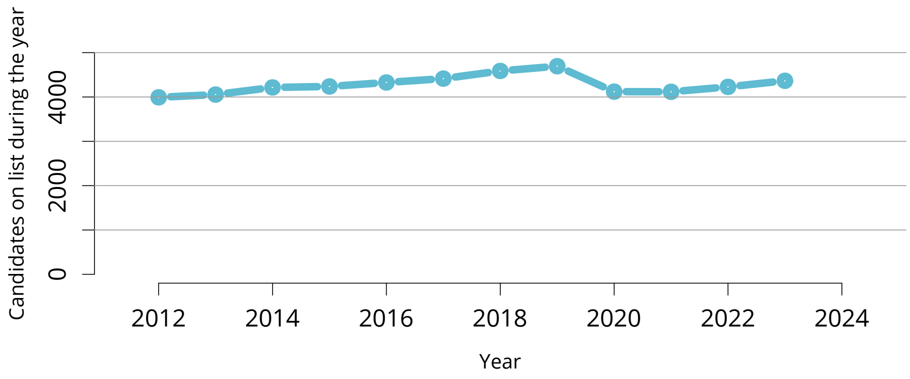

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Figure LU 2: All adult candidates on the lung transplant waiting list. Adult candidates on the list at any time during the year. Candidates listed at more than one center are counted once per listing.

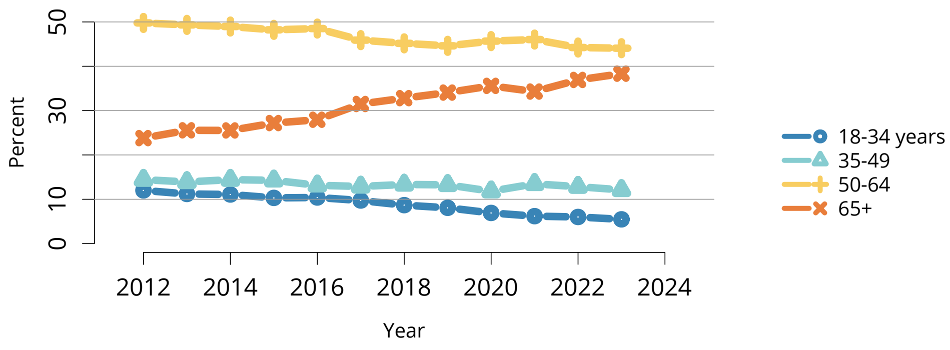

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Figure LU 3: Distribution of adults waiting for lung transplant by age. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included. Age is determined at the earliest of transplant, death, removal, or December 31 of the year.

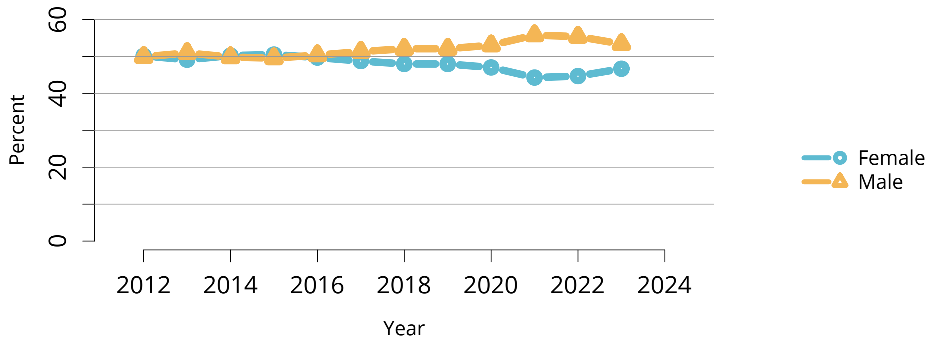

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Figure LU 4: Distribution of adults waiting for lung transplant by sex. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

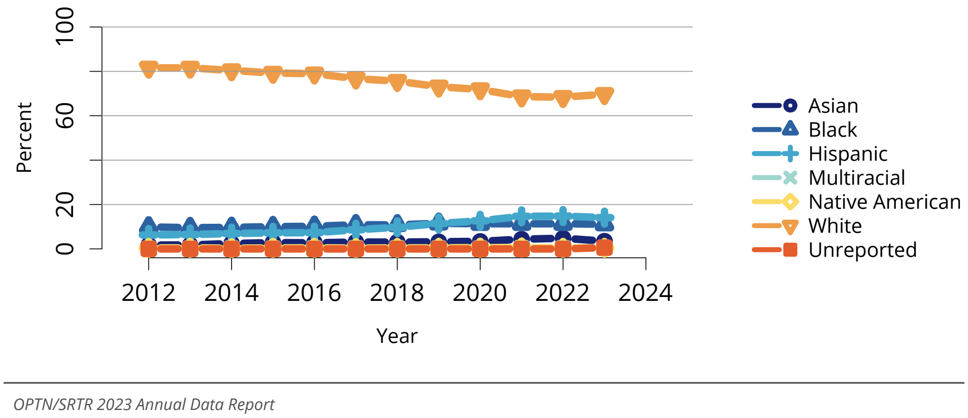

Figure LU 5: Distribution of adults waiting for lung transplant by race and ethnicity. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

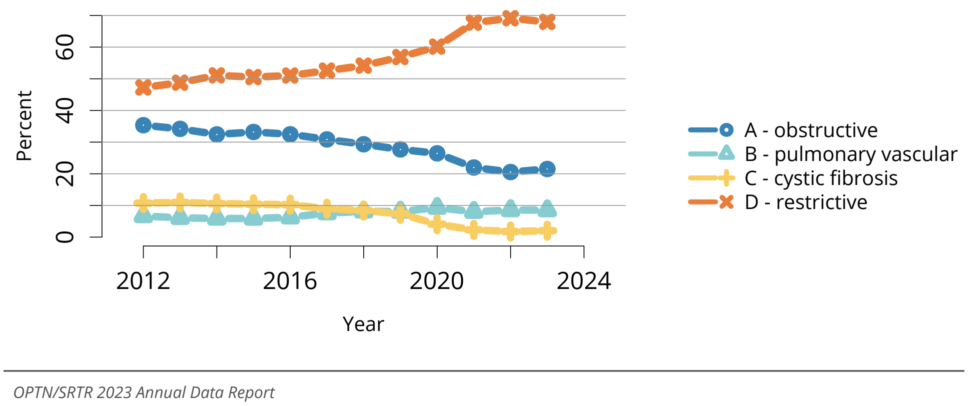

Figure LU 6: Distribution of adults waiting for lung transplant by diagnosis group. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

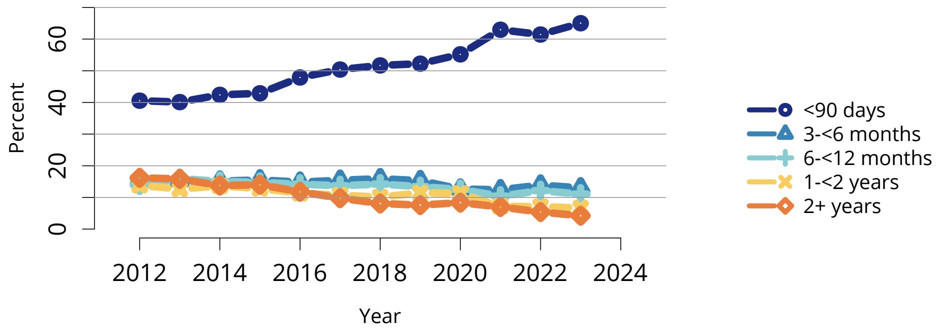

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Figure LU 7: Distribution of adults waiting for lung transplant by waiting time. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Time on the waiting list is determined at the earliest of transplant, death, removal, or December 31 of the year. Active and inactive candidates are included.

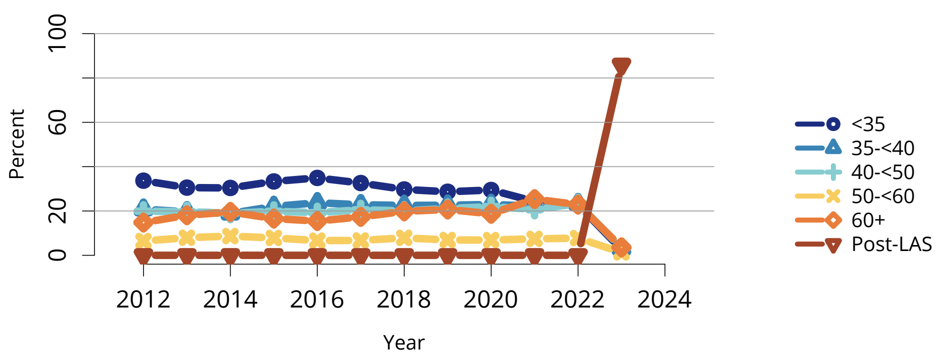

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Figure LU 8: Distribution of adult candidates waiting for lung transplant by LAS. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. LAS is determined at the earliest of transplant, death, removal, December 31 of the year, or March 8, 2023. Post-LAS is March 9, 2023, and later. LAS, lung allocation score.

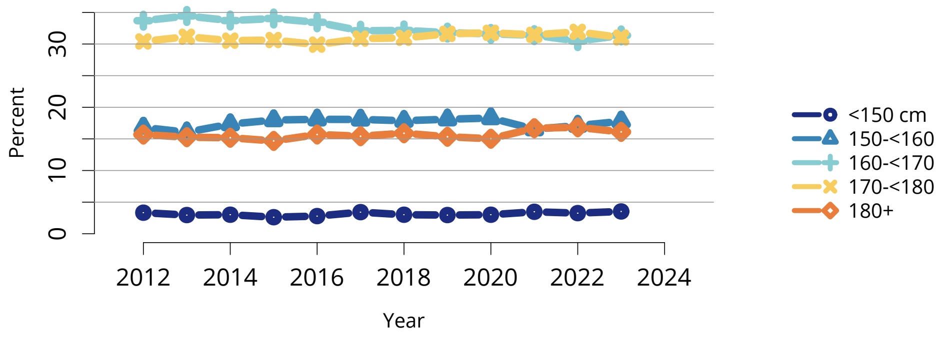

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Figure LU 9: Distribution of adult candidates waiting for lung transplant by height. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

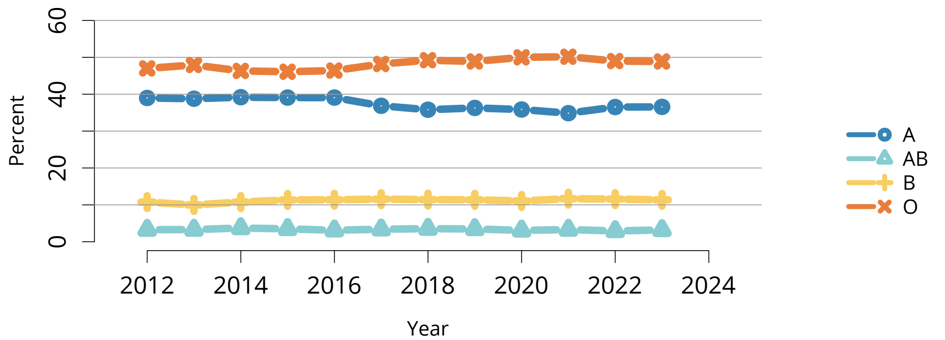

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Figure LU 10: Distribution of adults waiting for lung transplant by blood type. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

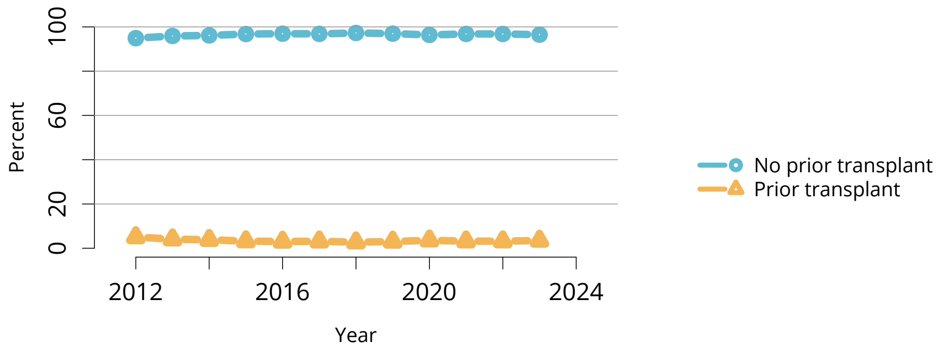

Figure LU 11: Distribution of adults waiting for lung transplant by prior transplant status. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

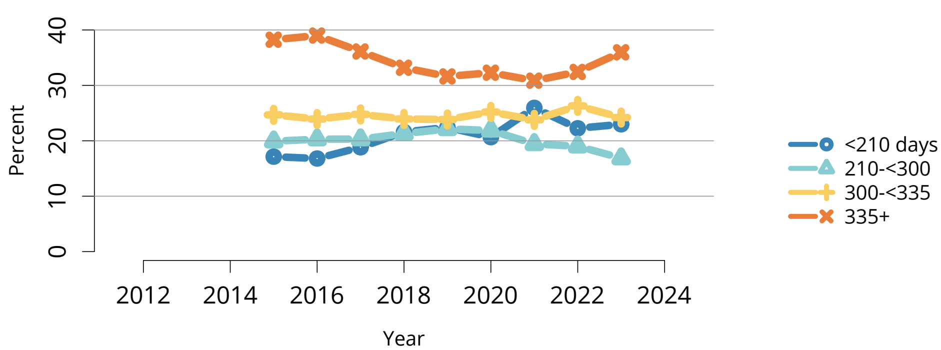

Figure LU 12: Distribution of adults waiting for lung transplant by WLAUC. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included. WLAUC is determined at the earliest of transplant, death, removal, or December 31 of the year. The 2015 WLAUC values are for February 19, 2015, through December 31, 2015. WLAUC, waitlist area under the curve.

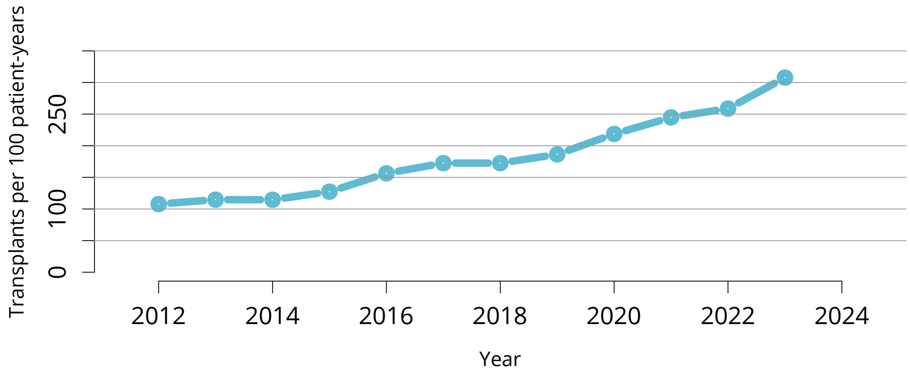

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Figure LU 13: Overall deceased donor lung transplant rates among adult waitlist candidates. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

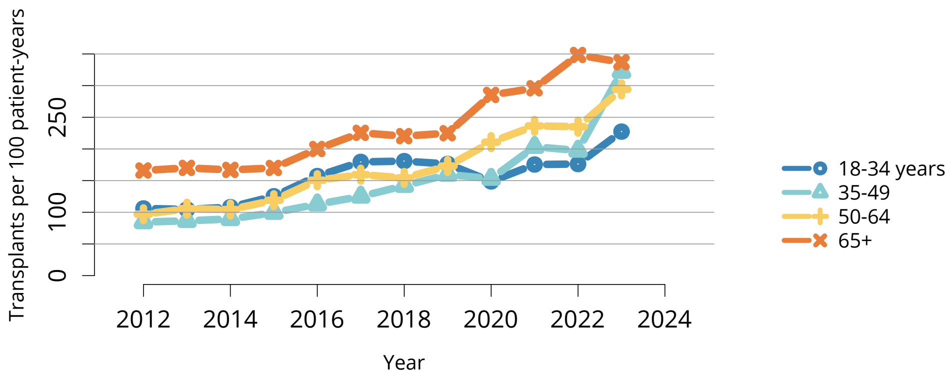

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Figure LU 14: Deceased donor lung transplant rates among adult waitlist candidates by age. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year.

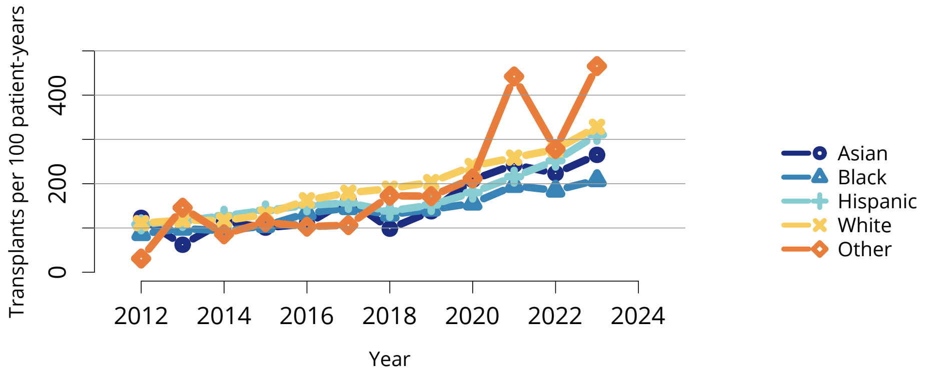

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Figure LU 15: Deceased donor lung transplant rates among adult waitlist candidates by race and ethnicity. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

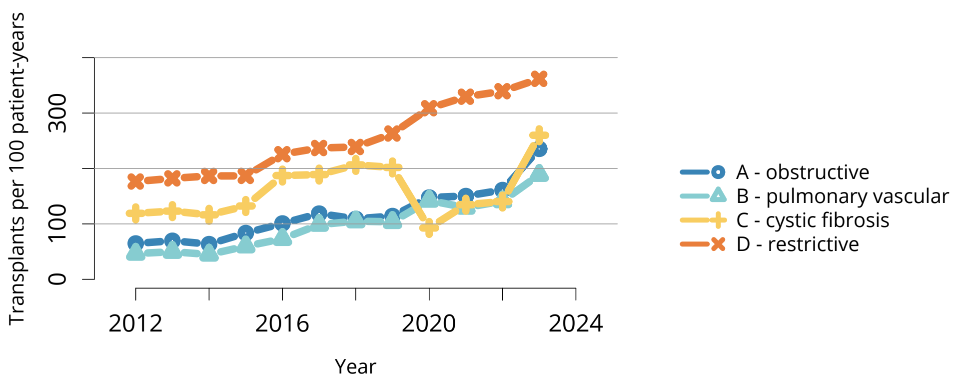

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Figure LU 16: Deceased donor lung transplant rates among adult waitlist candidates by diagnosis group. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

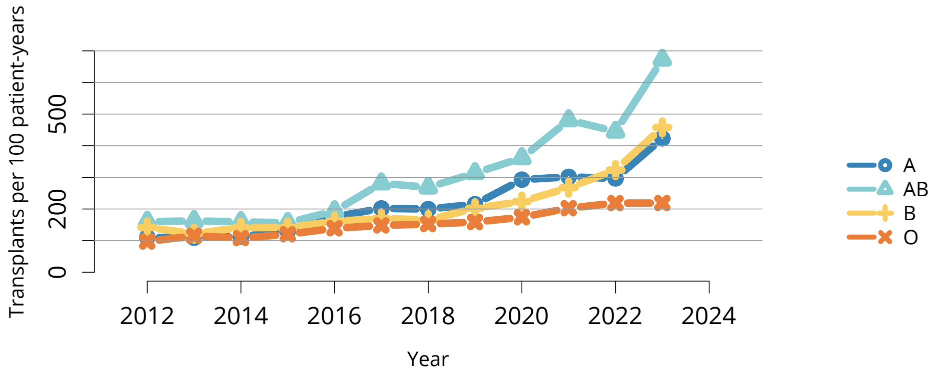

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Figure LU 17: Deceased donor lung transplant rates among adult waitlist candidates by blood type. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

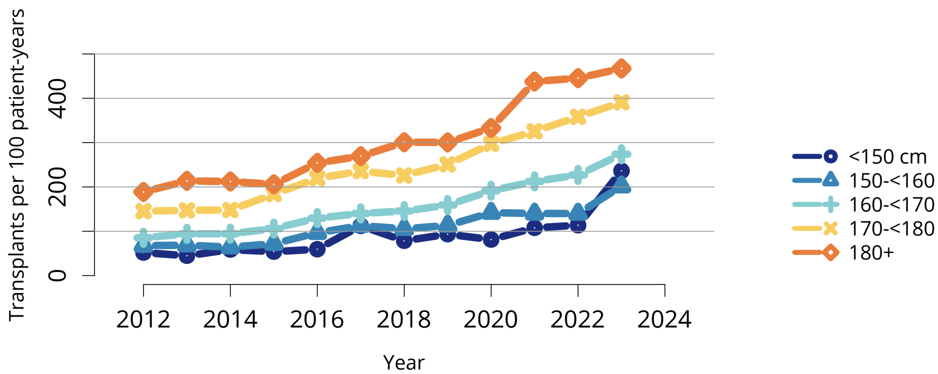

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Figure LU 18: Deceased donor lung transplant rates among adult waitlist candidates by height. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

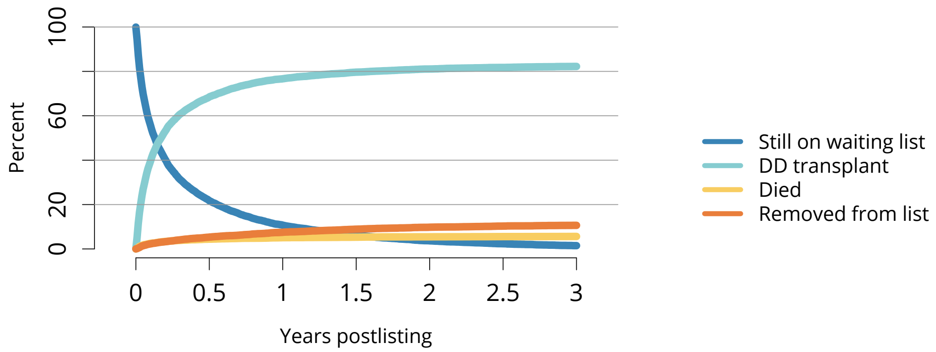

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Figure LU 19: Three-year outcomes for adults waiting for lung transplant, new listings in 2018-2020. Candidates listed at more than one center are counted once per listing. Removed from list includes all reasons except transplant and death. DD, deceased donor.

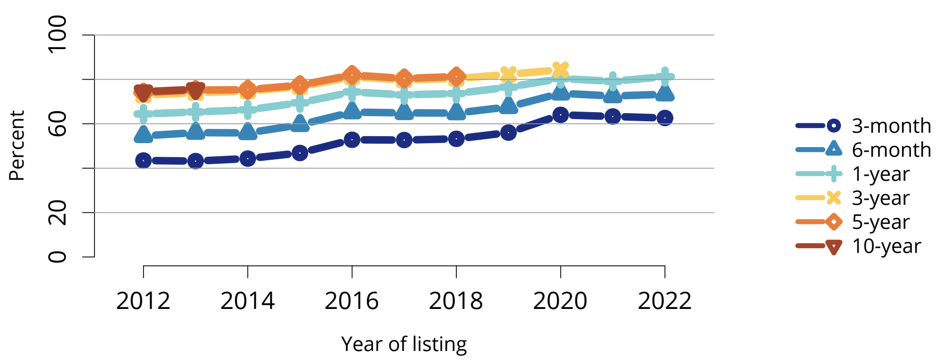

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Figure LU 20: Percentage of adults who underwent deceased donor lung transplant within a given period of listing. Candidates listed at more than one center are counted once per listing.

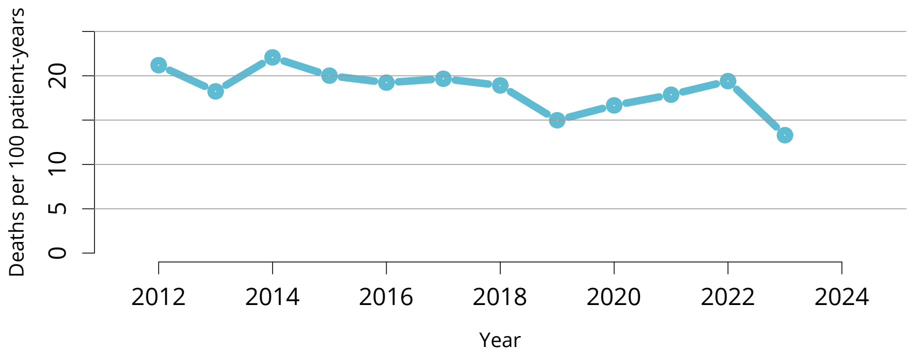

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Figure LU 21: Overall pretransplant mortality rates among adults waitlisted for lung transplant. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

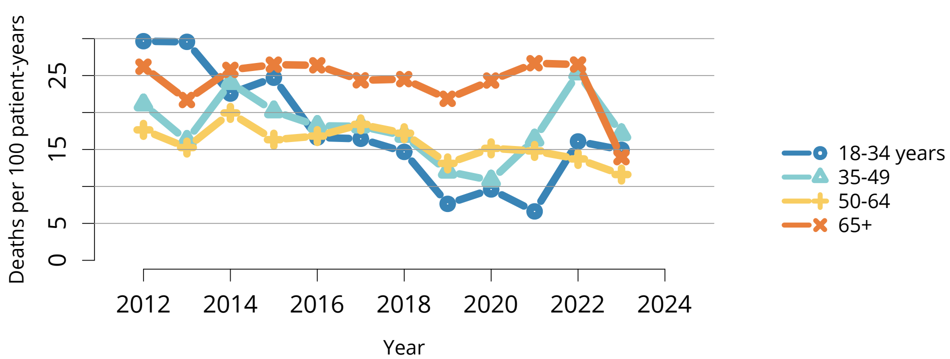

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Figure LU 22: Pretransplant mortality rates among adults waitlisted for lung transplant by age. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year.

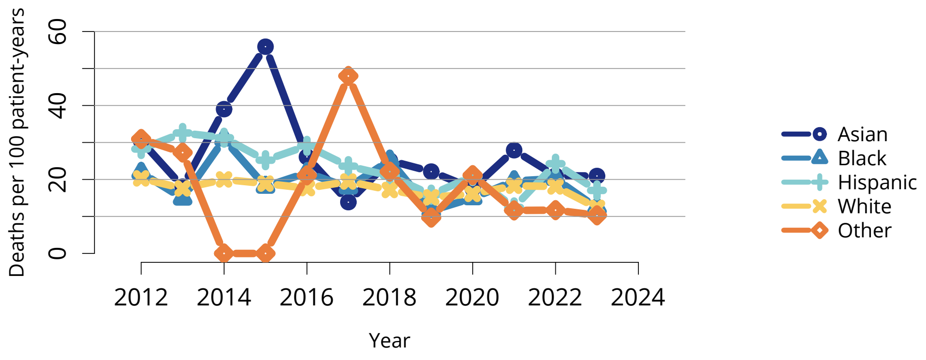

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Figure LU 23: Pretransplant mortality rates among adults waitlisted for lung transplant by race and ethnicity. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

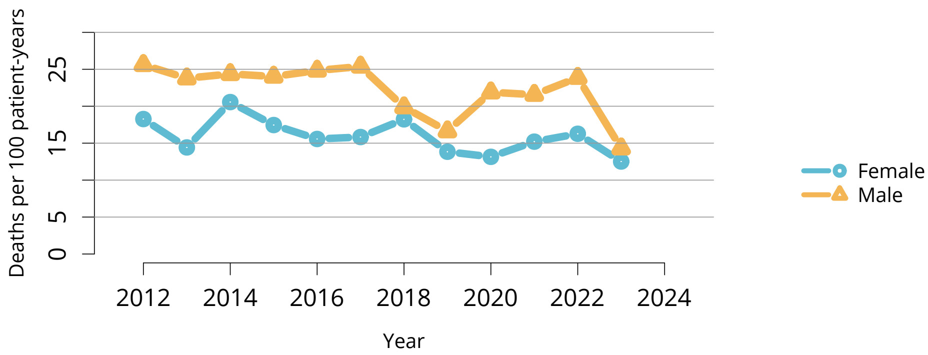

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Figure LU 24: Pretransplant mortality rates among adults waitlisted for lung transplant by sex. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

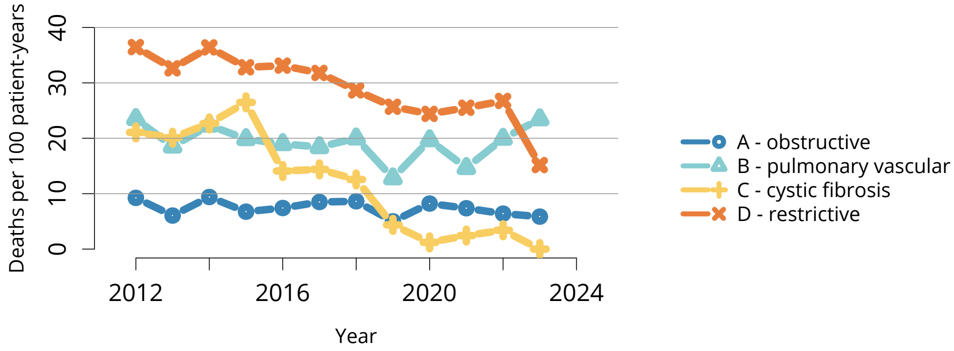

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Figure LU 25: Pretransplant mortality rates among adults waitlisted for lung transplant by diagnosis group. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

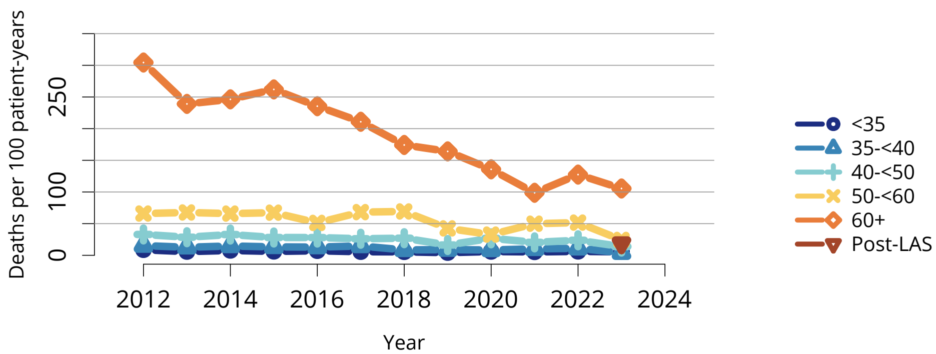

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Figure LU 26: Pretransplant mortality rates among adults waitlisted for lung transplant by LAS. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. LAS is determined at the later of listing date or January 1 of the given year, if listed March 8, 2023, or earlier. Post-LAS is March 9, 2023, and later. LAS, lung allocation score.

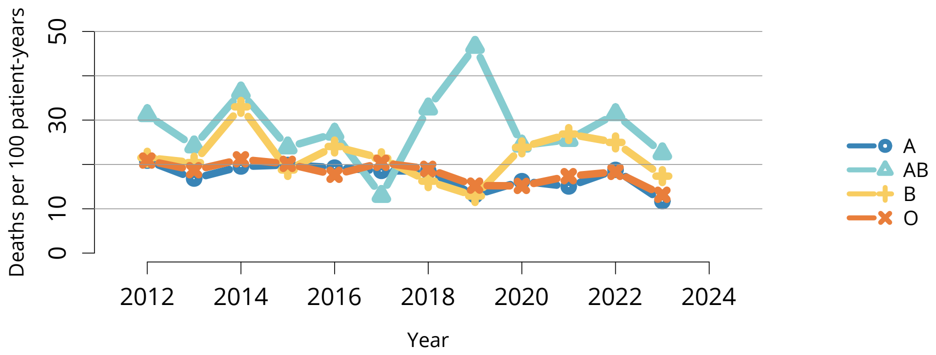

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Figure LU 27: Pretransplant mortality rates among adults waitlisted for lung transplant by blood type. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

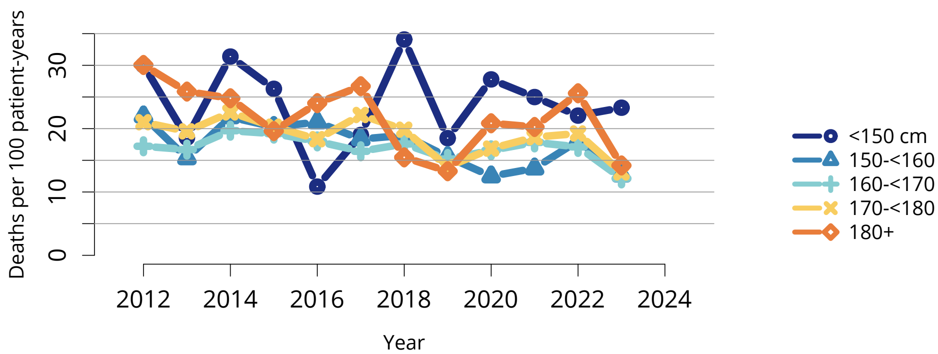

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Figure LU 28: Pretransplant mortality rates among adults waitlisted for lung transplant by height. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

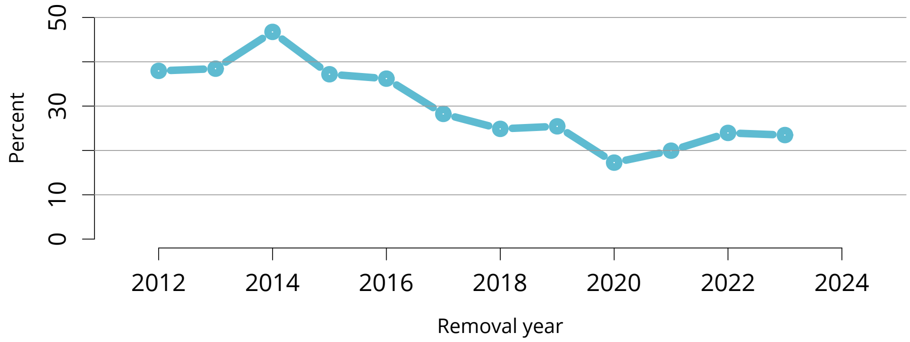

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Figure LU 29: Deaths within 6 months after removal among adult lung waitlist candidates, overall. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list.

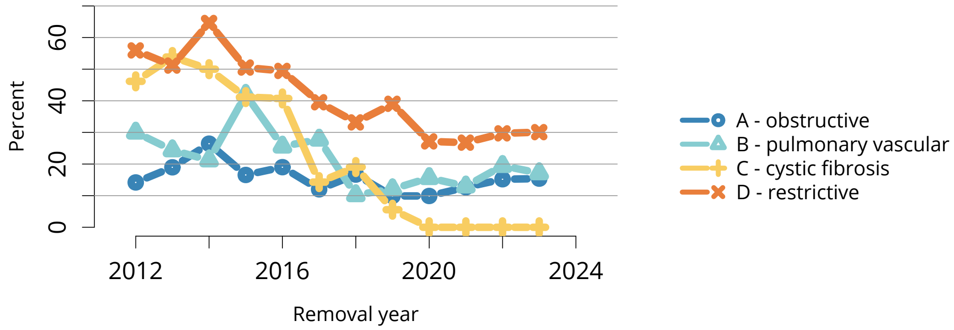

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Figure LU 30: Deaths within 6 months after removal among adult lung waitlist candidates, by diagnosis group. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list.

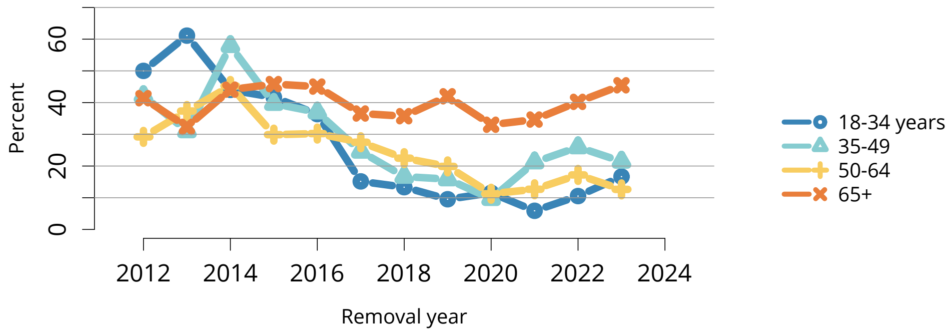

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Figure LU 31: Deaths within 6 months after removal among adult lung waitlist candidates, by age. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list. Age is determined at removal.

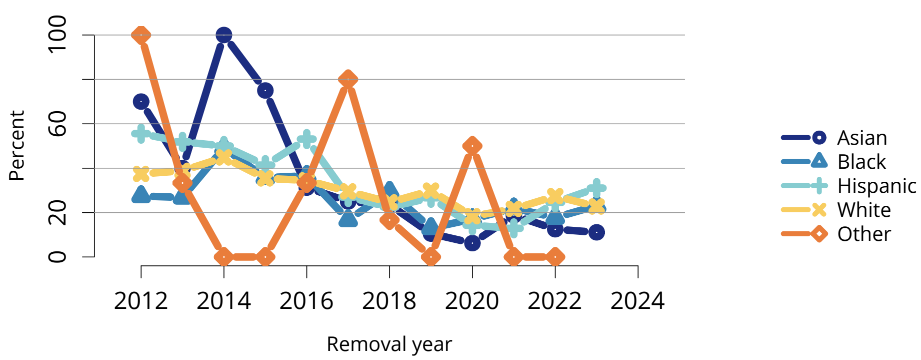

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Figure LU 32: Deaths within 6 months after removal among adult lung waitlist candidates, by race and ethnicity. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list. The Other race category is composed of Native American and Multiracial categories.

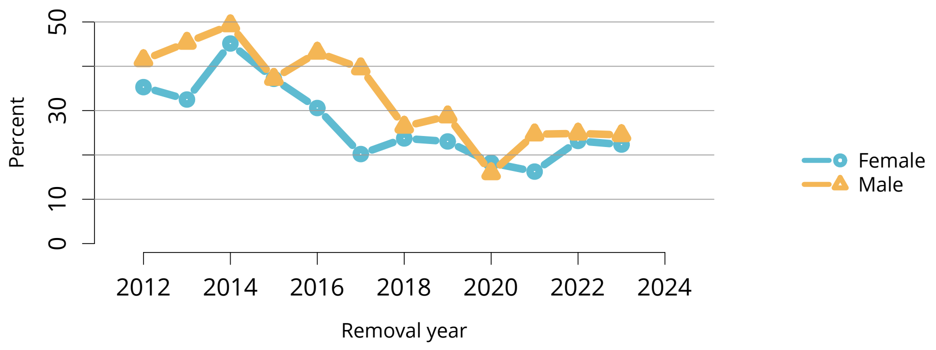

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Figure LU 33: Deaths within 6 months after removal among adult lung waitlist candidates, by sex. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list.

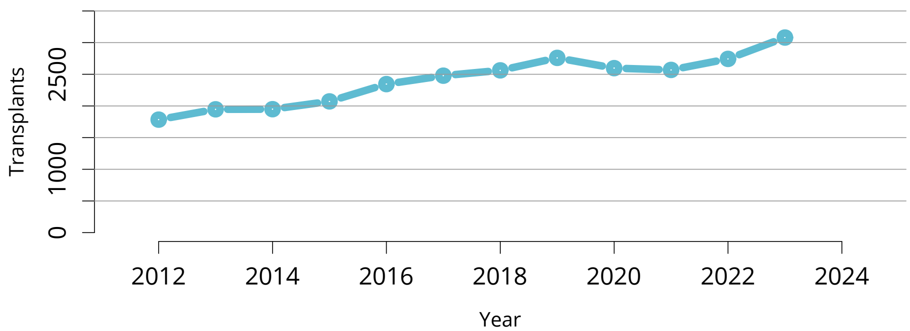

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Figure LU 34: Overall lung transplants. All lung transplant recipients, including adult and pediatric, re-transplant, and multiorgan recipients.

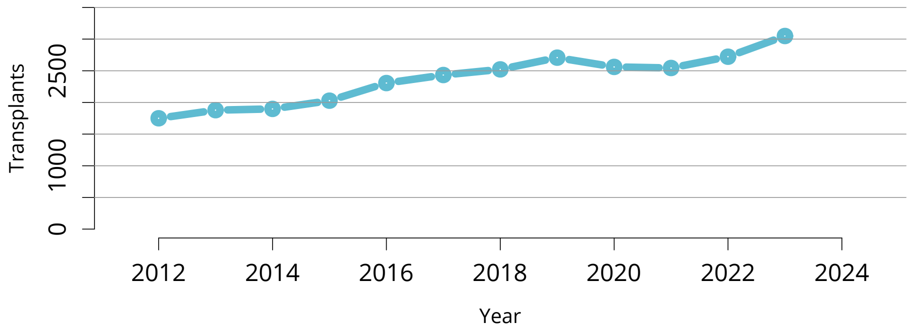

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Figure LU 35: Overall adult lung transplants. All adult lung transplant recipients, including retransplant and multiorgan recipients.

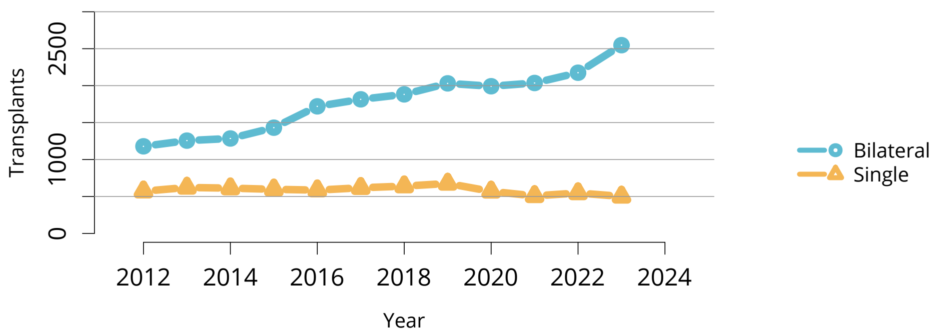

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Figure LU 36: Adult lung transplants by procedure type. Adult lung transplant recipients, including retransplant and multiorgan recipients.

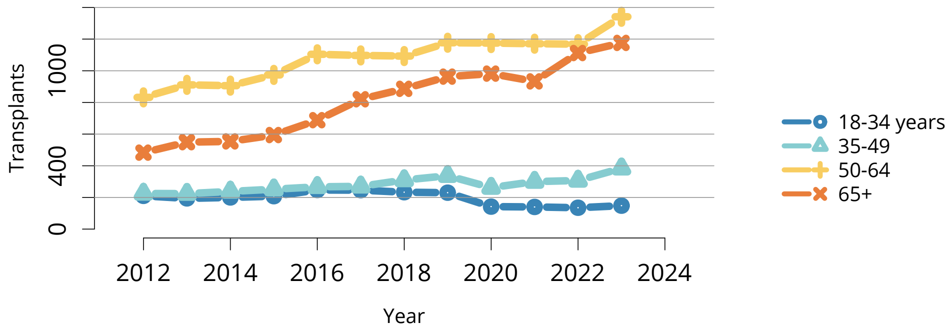

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Figure LU 37: Adult lung transplants by age. Adult lung transplant recipients, including retransplant and multiorgan recipients.

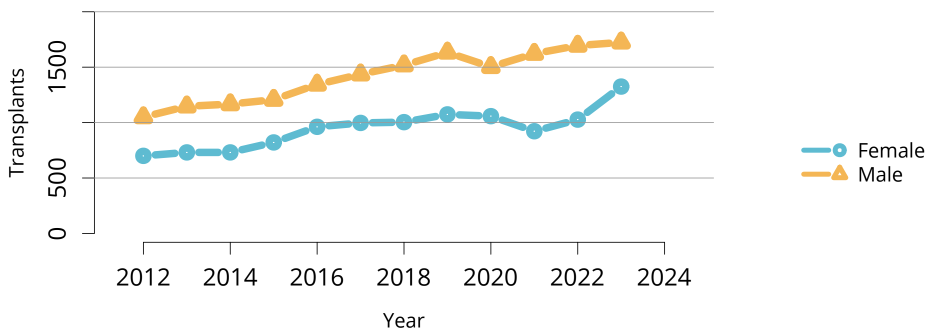

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Figure LU 38: Adult lung transplants by sex. Adult lung transplant recipients, including retransplant and multiorgan recipients.

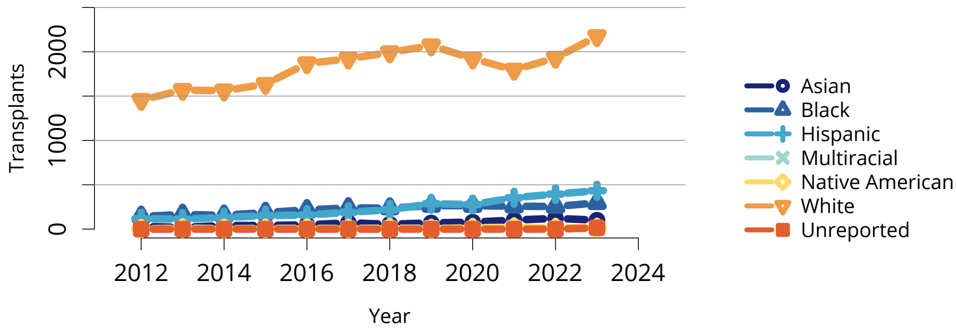

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Figure LU 39: Adult lung transplants by race and ethnicity. Adult lung transplant recipients, including retransplant and multiorgan recipients.

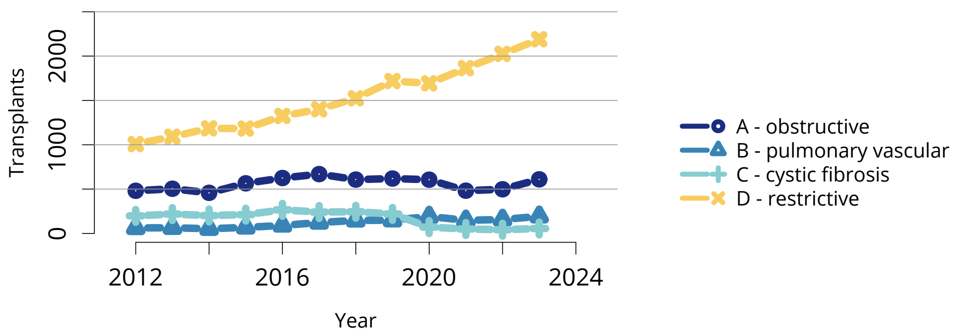

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Figure LU 40: Adult lung transplants by diagnosis group. Adult lung transplant recipients, including retransplant and multiorgan recipients.

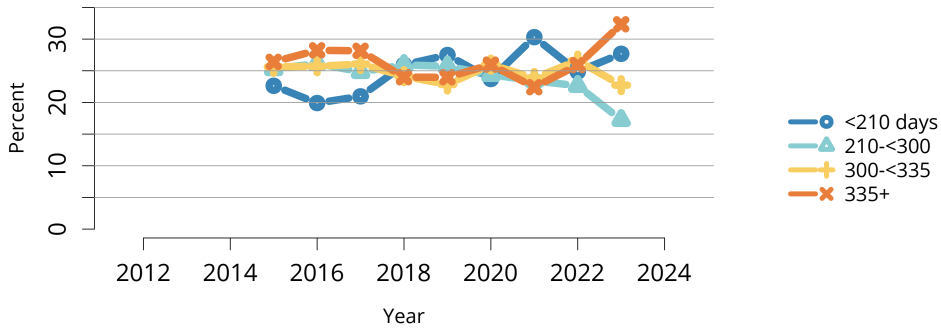

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Figure LU 41: Adult lung transplants by WLAUC at transplant. Adult lung transplant recipients, including retransplant and multiorgan recipients. The 2015 WLAUC values are for February 19, 2015, through December 31, 2015. WLAUC, waitlist area under the curve.

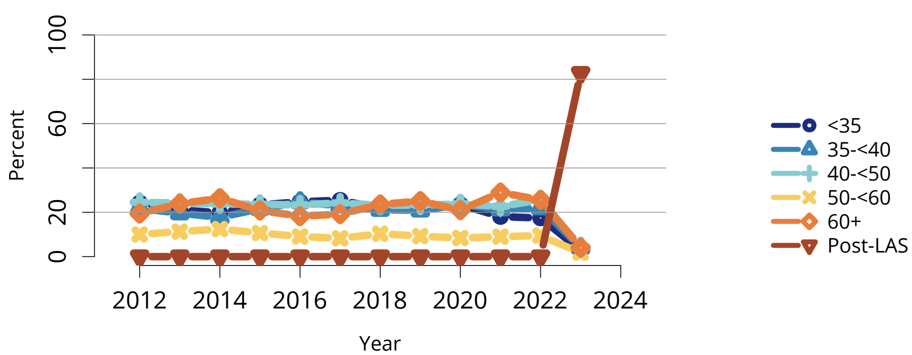

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Figure LU 42: Adult lung transplants by LAS. Adult lung transplant recipients, including retransplant and multiorgan recipients. LAS ended on March 8, 2023; post-LAS is March 9, 2023, and later. LAS, lung allocation score.

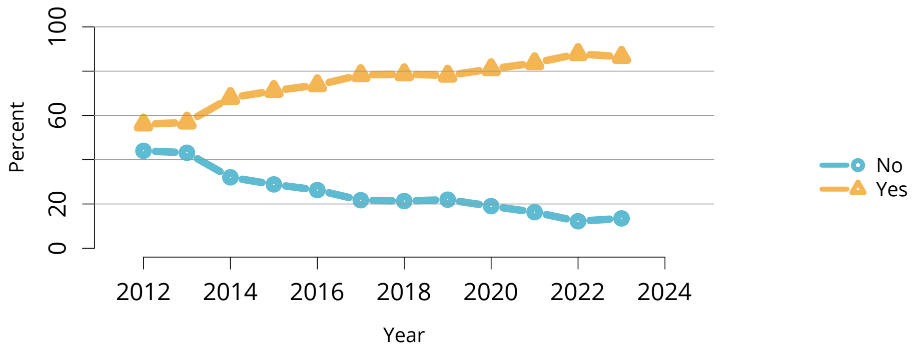

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Figure LU 43: Induction agent use in adult lung transplant recipients. Immunosuppression at transplant reported to the OPTN.

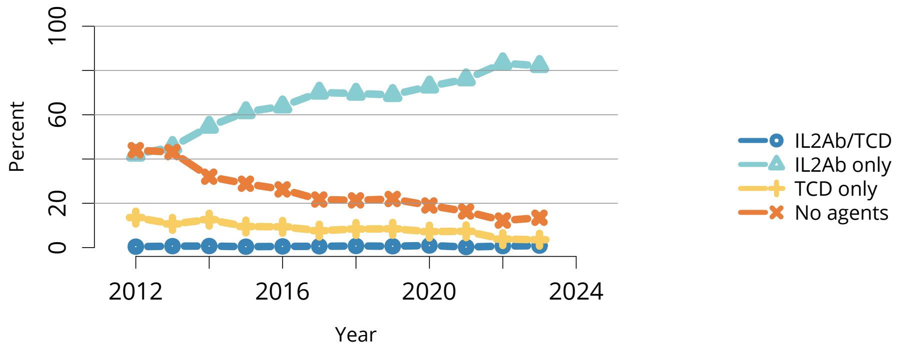

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Figure LU 44: Type of induction agent use in adult lung transplant recipients. Immunosuppression at transplant reported to the OPTN. IL2Ab, interleukin-2 receptor antibody; TCD, T-cell depleting.

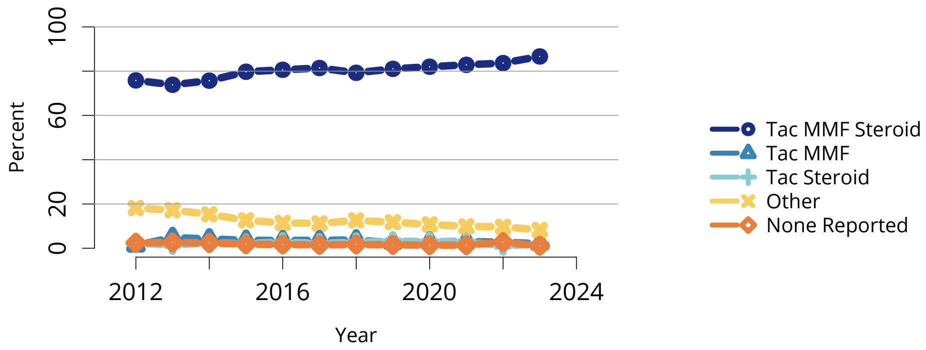

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Figure LU 45: Immunosuppression regimen use in adult lung transplant recipients. Immunosuppression regimen at transplant reported to the OPTN. MMF, all mycophenolate agents; Tac, tacrolimus.

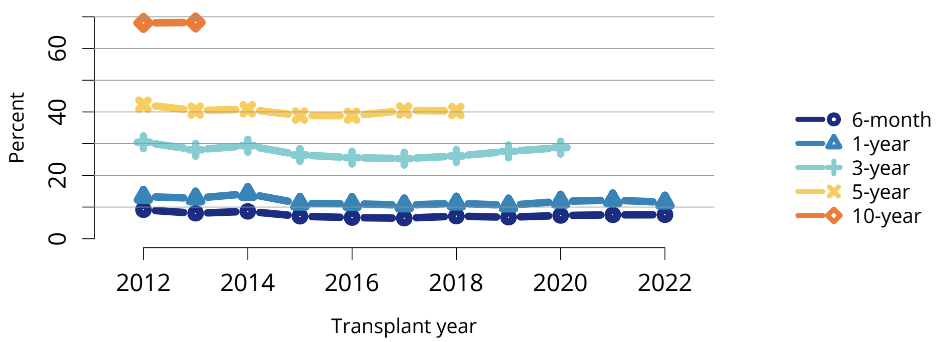

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Figure LU 46: Patient death among adult lung transplant recipients. All adult recipients of deceased donor lungs, including multiorgan transplant recipients.

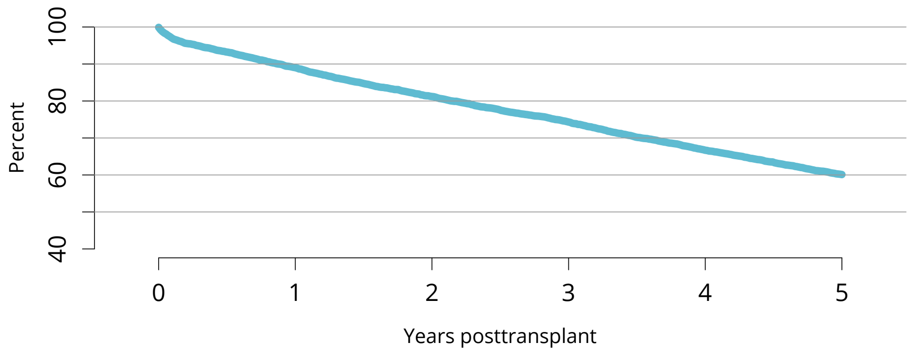

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Figure LU 47: Patient survival among adult lung transplant recipients, 2016-2018. Patient survival estimated using unadjusted Kaplan-Meier methods.

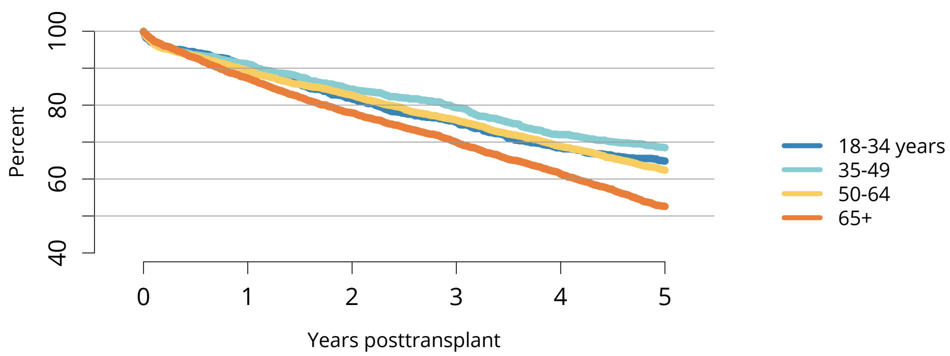

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Figure LU 48: Patient survival among adult lung transplant recipients, 2016-2018, by age. Patient survival estimated using unadjusted Kaplan-Meier methods.

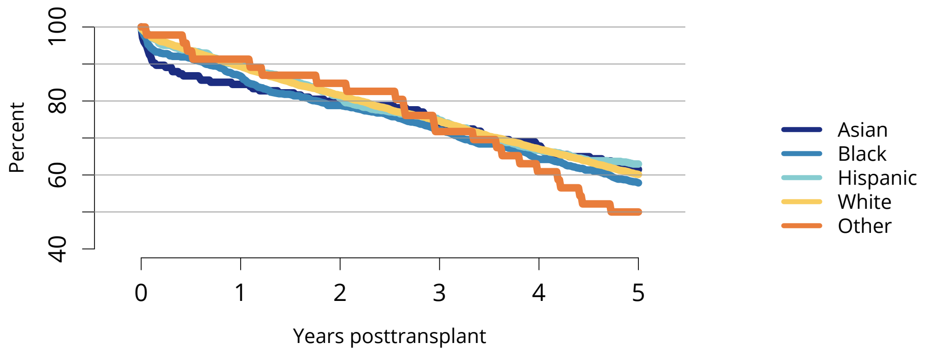

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Figure LU 49: Patient survival among adult lung transplant recipients, 2016-2018, by race and ethnicity. Patient survival estimated using unadjusted Kaplan-Meier methods. The Other race category is composed of Native American and Multiracial categories.

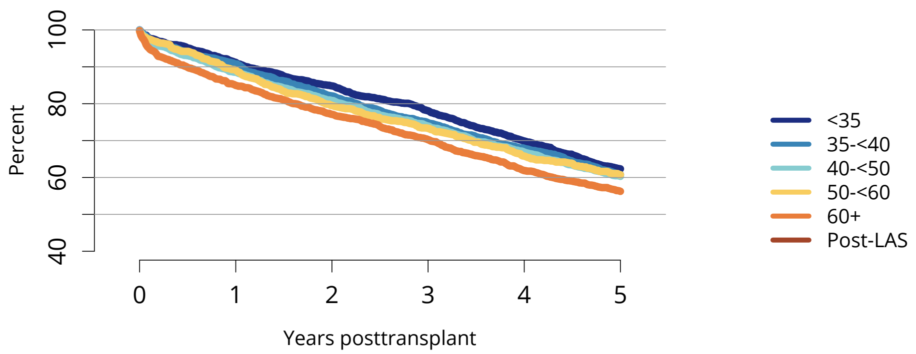

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Figure LU 50: Patient survival among adult lung transplant recipients, 2016-2018, by LAS. Patient survival estimated using unadjusted Kaplan-Meier methods. LAS ended on March 8, 2023; post-LAS is March 9, 2023, and later. LAS, lung allocation score.

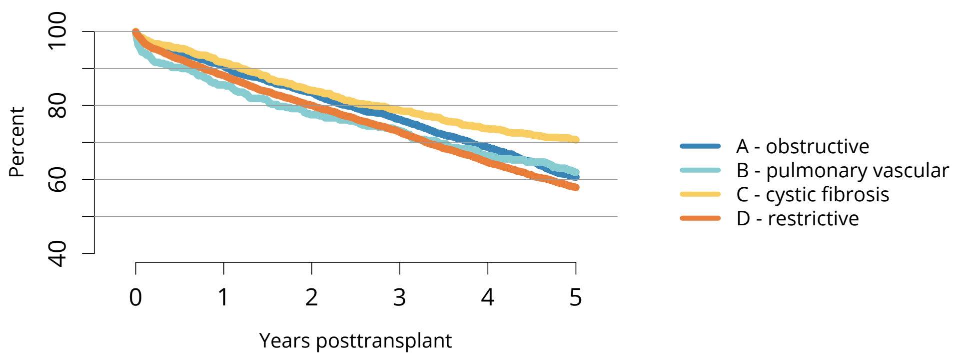

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Figure LU 51: Patient survival among adult lung transplant recipients, 2016-2018, by diagnosis group. Patient survival estimated using unadjusted Kaplan-Meier methods.

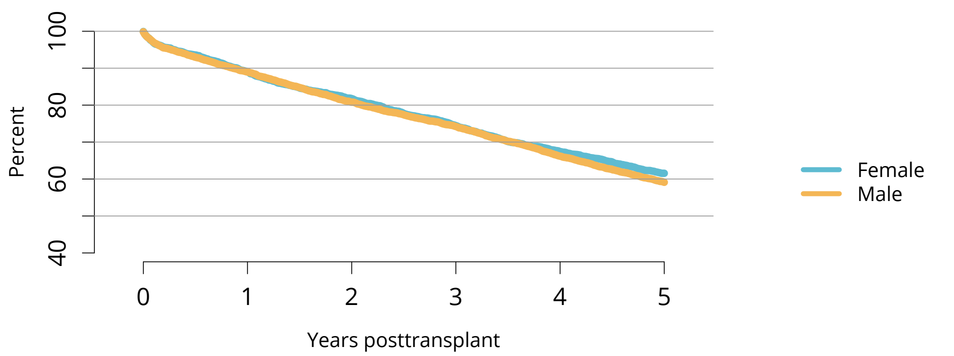

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Figure LU 52: Patient survival among adult lung transplant recipients, 2016-2018, by sex. Patient survival estimated using unadjusted Kaplan-Meier methods.

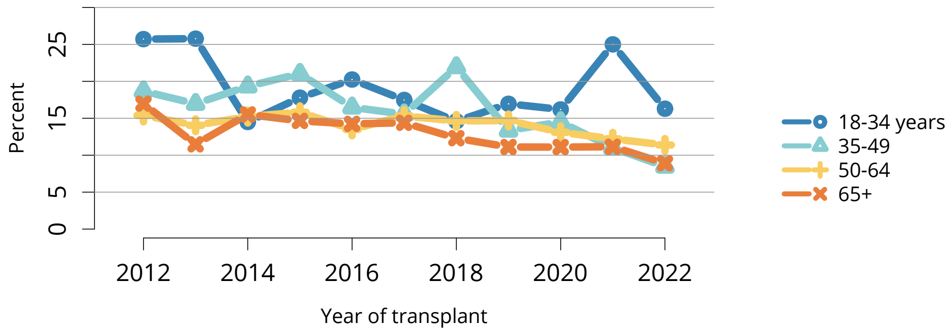

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Figure LU 53: Incidence of acute rejection by 1 year posttransplant among adult lung transplant recipients by age. Only the first reported rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier method.

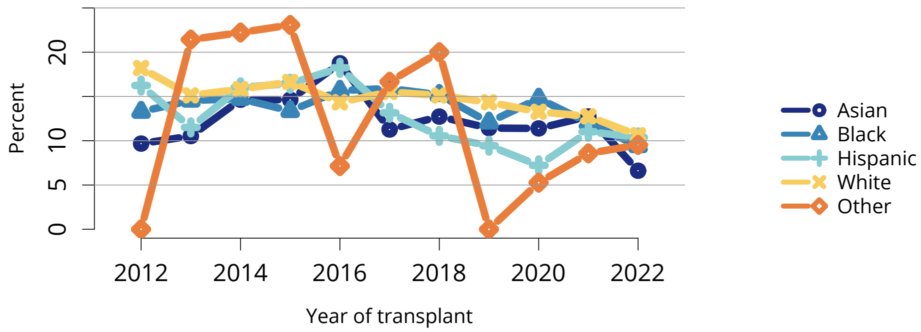

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Figure LU 54: Incidence of acute rejection by 1 year posttransplant among adult lung transplant recipients by race and ethnicity. Only the first reported rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier method. The Other race category is composed of Native American and Multiracial categories.

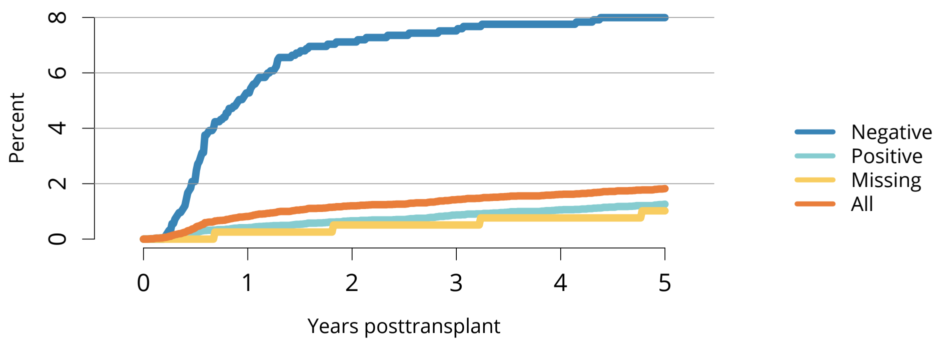

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Figure LU 55: Incidence of PTLD among adult lung transplant recipients by recipient EBV status at transplant, 2012-2018. Cumulative incidence is estimated using the Kaplan-Meier method. PTLD is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus; PTLD, posttransplant lymphoproliferative disorder.

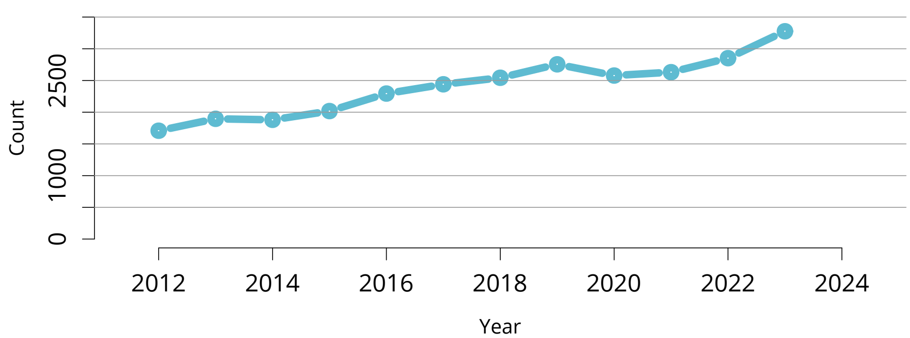

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Figure LU 56: Overall deceased lung donor count. Count of deceased donors with at least one lung recovered. Donors are counted once, regardless of the number of lungs recovered.

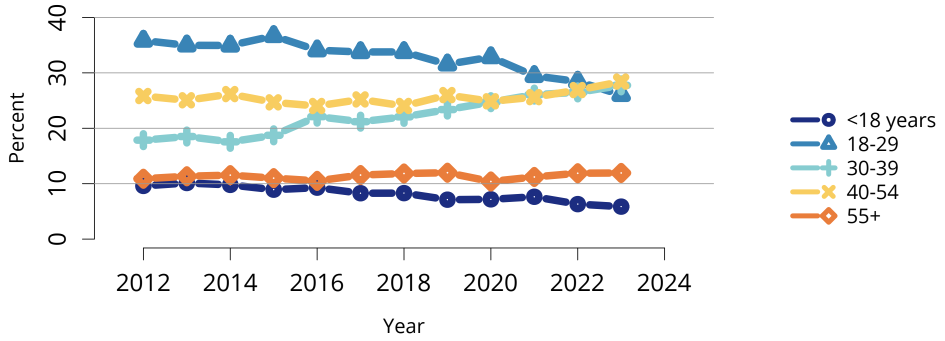

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Figure LU 57: Distribution of deceased lung donors by age. Deceased donors whose lungs were recovered for transplant. Donors are counted once, regardless of the number of lungs recovered.

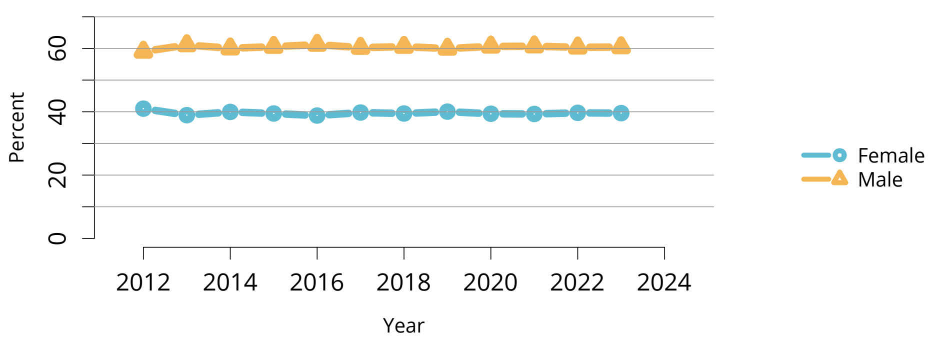

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Figure LU 58: Distribution of deceased lung donors by sex. Deceased donors whose lungs were recovered for transplant. Donors are counted once, regardless of the number of lungs recovered.

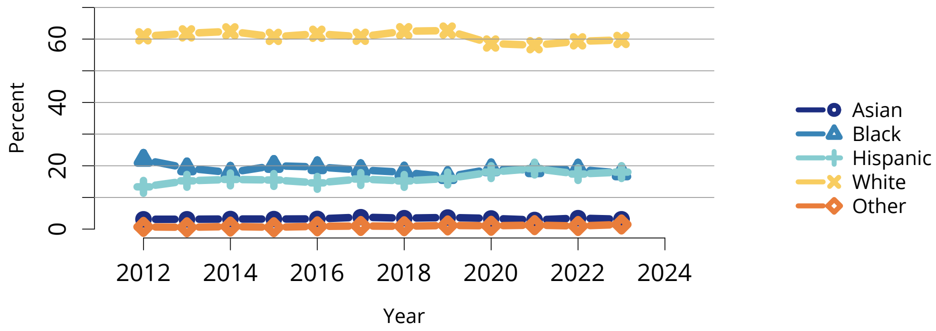

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Figure LU 59: Distribution of deceased lung donors by race and ethnicity. Deceased donors whose lungs were recovered for transplant. Donors are counted once, regardless of the number of lungs recovered. The Other race category is composed of Native American and Multiracial categories.

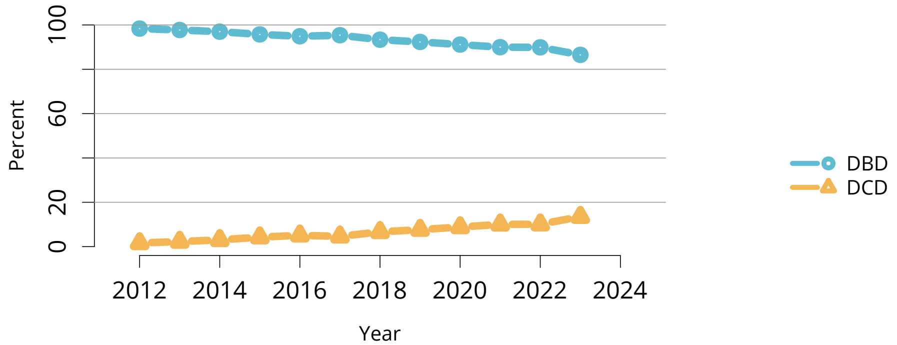

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Figure LU 60: Distribution of deceased lung donors by DCD status. Deceased donors whose lungs were recovered for transplant. DBD, donation after brain death; DCD, donation after circulatory death.

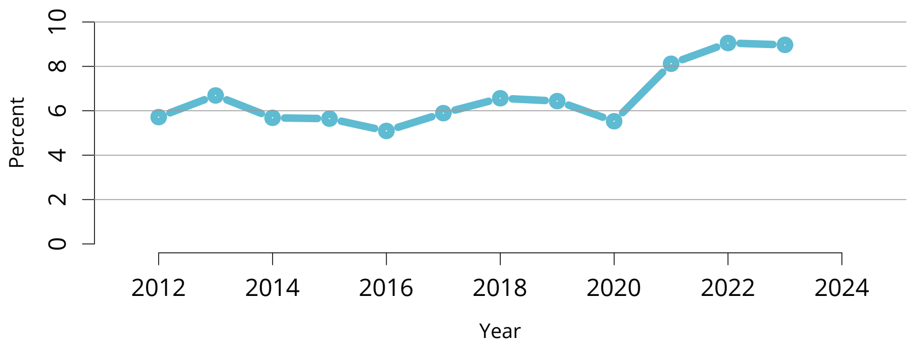

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Figure LU 61: Overall percent of lungs recovered for transplant and not transplanted. Percentages of lungs not transplanted out of all lungs recovered for transplant.

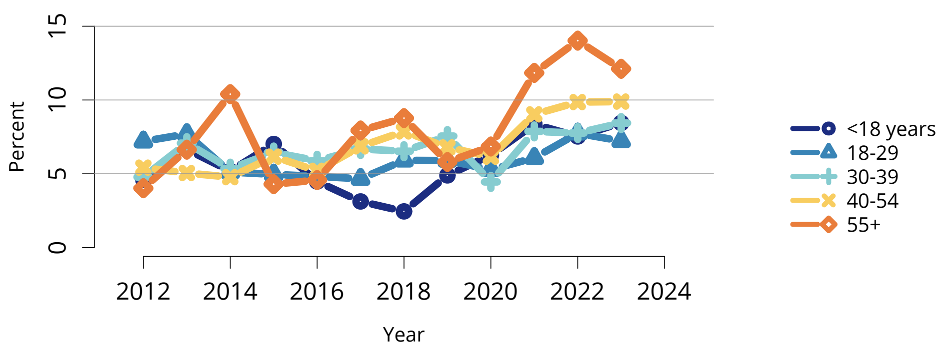

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Figure LU 62: Percent of lungs recovered for transplant and not transplanted by donor age. Percentages of lungs not transplanted out of all lungs recovered for transplant.

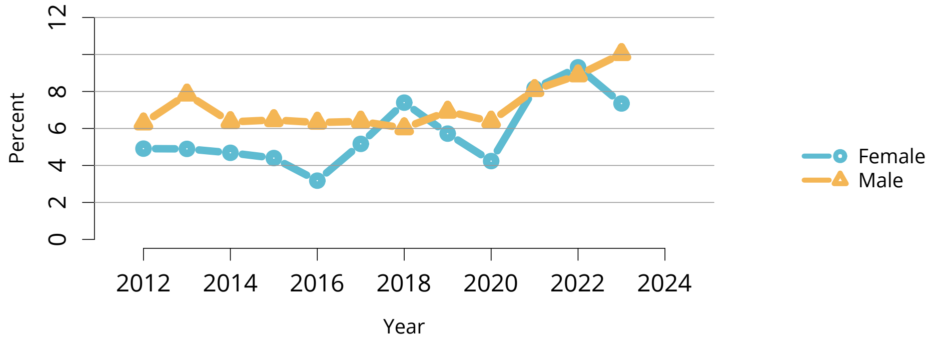

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Figure LU 63: Percent of lungs recovered for transplant and not transplanted by donor sex. Percentages of lungs not transplanted out of all lungs recovered for transplant.

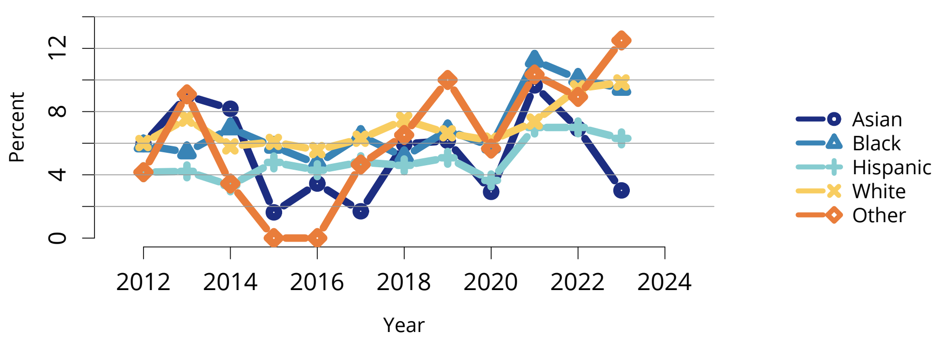

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Figure LU 64: Percent of lungs recovered for transplant and not transplanted by donor race and ethnicity. Percentages of lungs not transplanted out of all lungs recovered for transplant. The Other race category is composed of Native American and Multiracial categories.

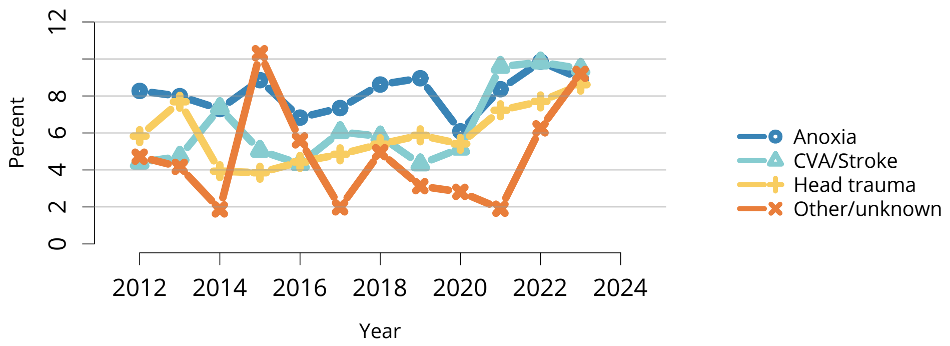

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Figure LU 65: Percent of lungs recovered for transplant and not transplanted by donor cause of death. Percentages of lungs not transplanted out of all lungs recovered for transplant. CVA, cerebrovascular accident.

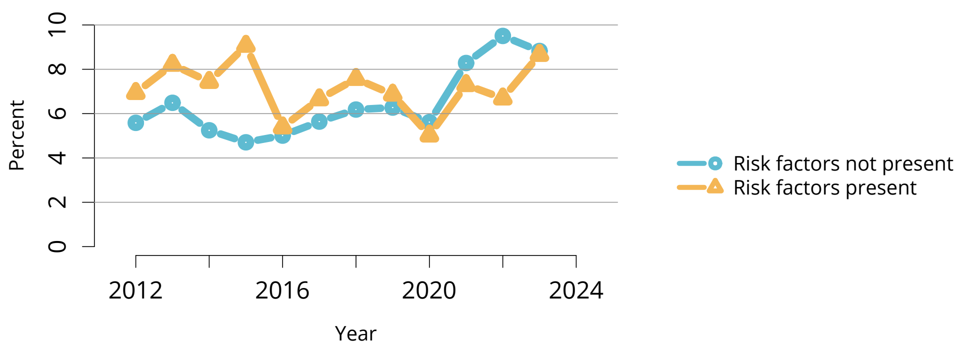

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Figure LU 66: Percent of lungs recovered for transplant and not transplanted, by donor risk of disease transmission. Percentages of lungs not transplanted out of all lungs recovered for transplant. “Risk factors” refers to risk criteria for acute transmission of human immunodeficiency virus, hepatitis B virus, or hepatitis C virus from the US Public Health Service Guideline.

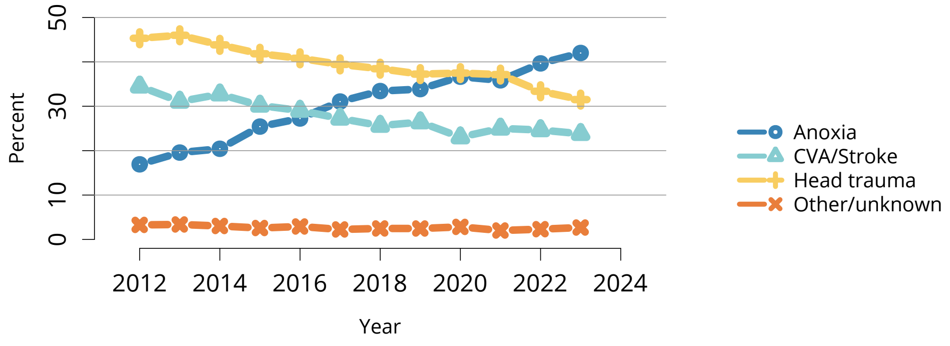

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Figure LU 67: Cause of death among deceased lung donors. Deceased donors with at least one lung recovered for the purposes of transplant. CVA, cerebrovascular accident.

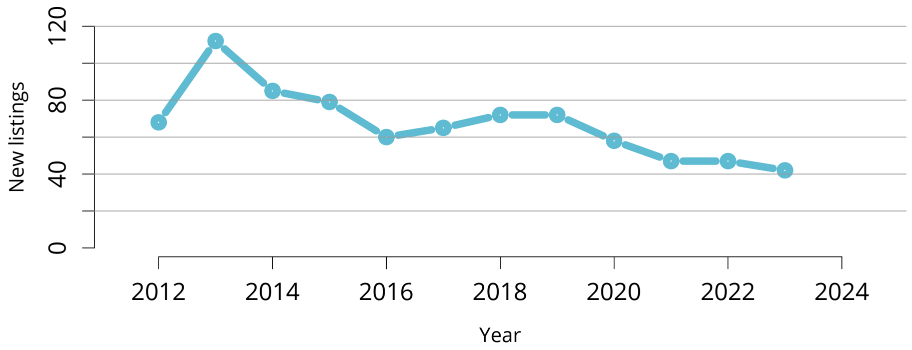

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Figure LU 68: New pediatric candidates added to the lung transplant waiting list. A new candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and were subsequently relisted are considered new. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

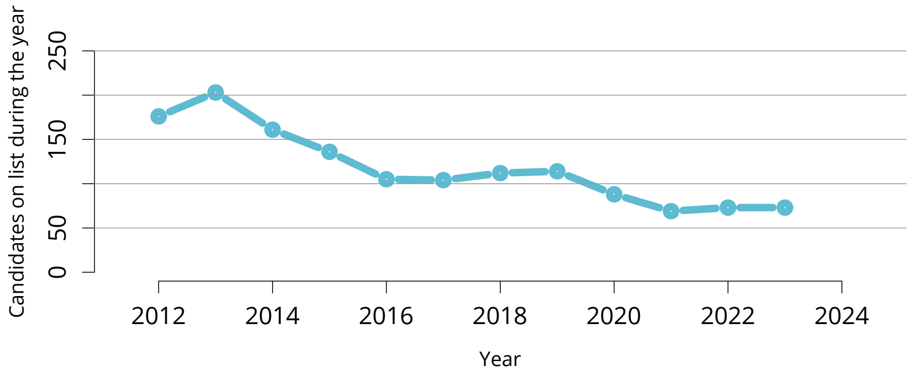

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Figure LU 69: All pediatric candidates on the lung transplant waiting list. Pediatric candidates listed at any time during the year. Candidates listed at more than one center are counted once per listing.

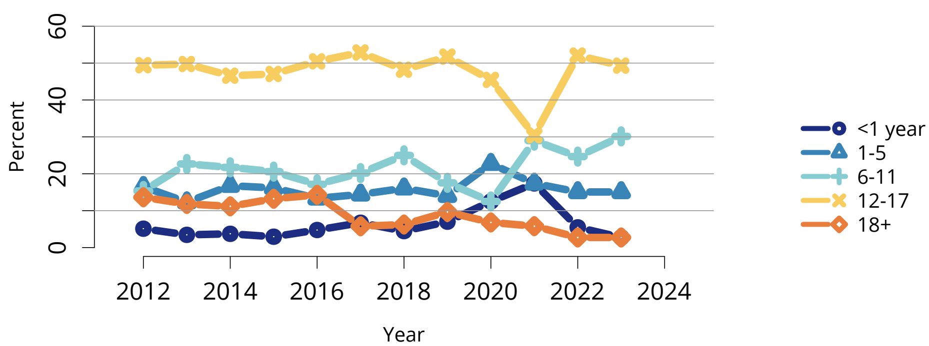

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Figure LU 70: Distribution of pediatric candidates waiting for lung transplant by age. Candidates waiting for transplant at any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included. Age is determined at the earliest of transplant, death, removal, or December 31 of the year. The 18+ category is for candidates who turned age 18 while waiting.

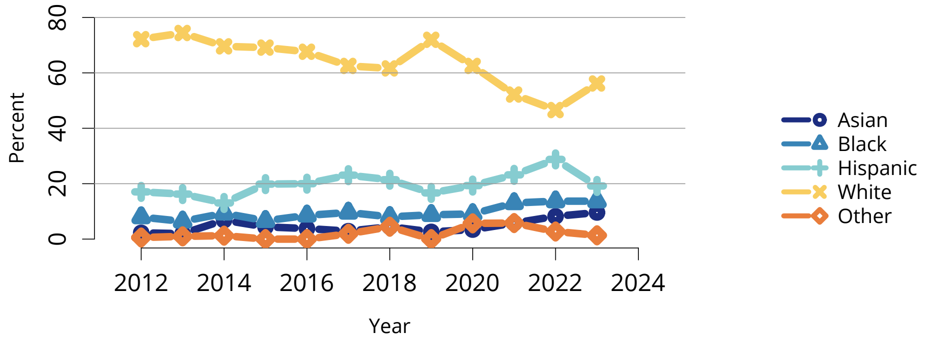

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Figure LU 71: Distribution of pediatric candidates waiting for lung transplant by race and ethnicity. Candidates waiting for transplant any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive candidates are included. The Other race category is composed of Native American and Multiracial categories.

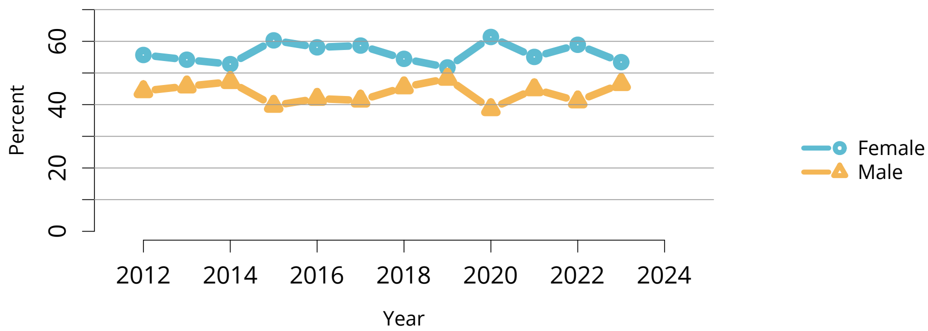

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Figure LU 72: Distribution of pediatric candidates waiting for lung transplant by sex. Candidates waiting for transplant any time in the given year. Candidates listed at more than one center are counted once per listing. Active and inactive patients are included.

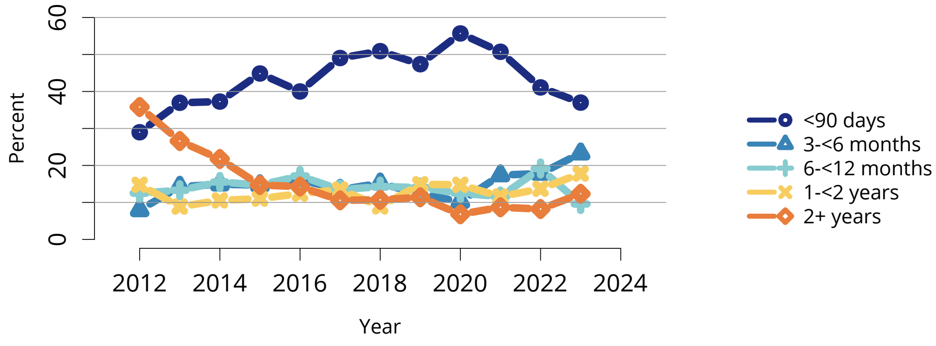

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Figure LU 73: Distribution of pediatric candidates waiting for lung transplant by waiting time. Candidates waiting for transplant any time in the given year. Candidates listed at more than one center are counted once per listing. Time on the waiting list is determined at the earliest of transplant, death, removal, or December 31 of the year. Active and inactive candidates are included.

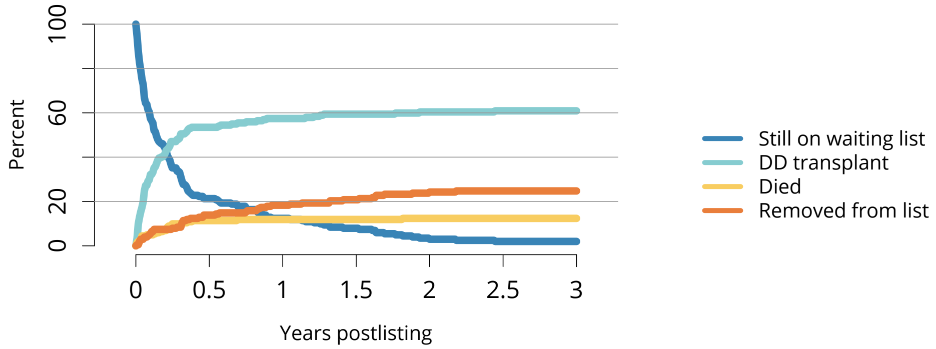

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Figure LU 74: Three-year outcomes for newly listed pediatric candidates waiting for lung transplant, 2018-2020. Pediatric candidates who joined the waiting list in 2018-2020. Pediatric candidates listed at more than one center are counted once per listing. Removed from list includes all reasons except transplant and death. DD, deceased donor.

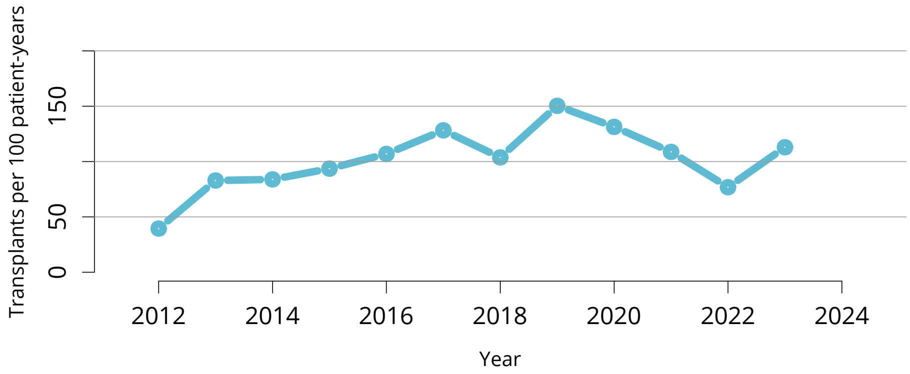

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Figure LU 75: Overall deceased donor lung transplant rates among pediatric waitlist candidates. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately.

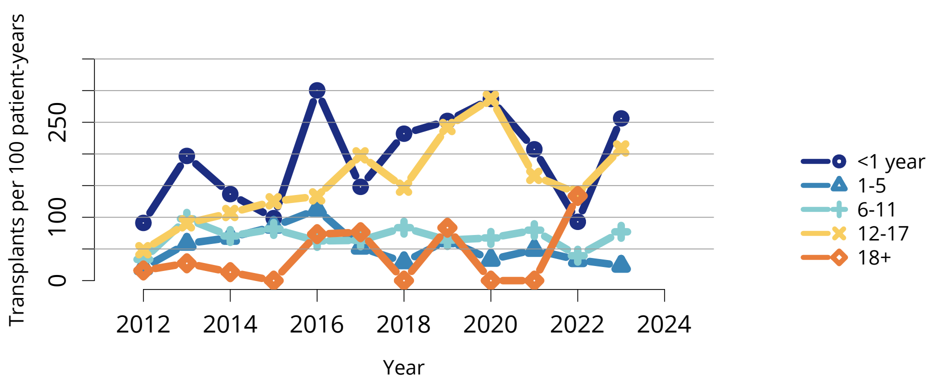

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Figure LU 76: Deceased donor lung transplant rates among pediatric waitlist candidates by age. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year. The 18+ category is for candidates who turned age 18 while waiting.

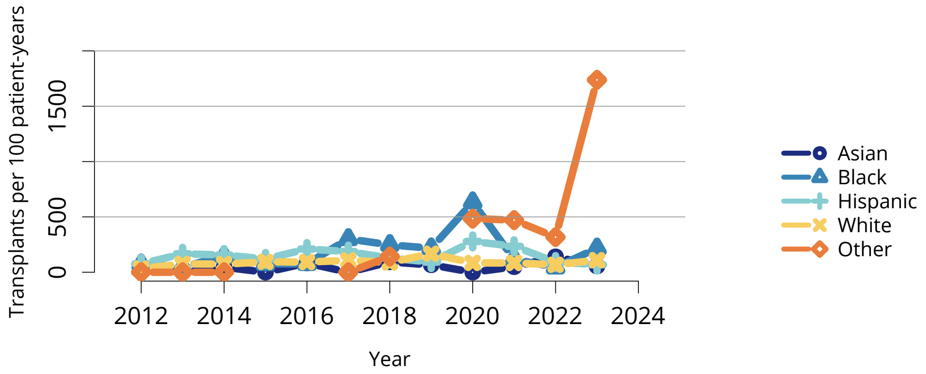

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Figure LU 77: Deceased donor lung transplant rates among pediatric waitlist candidates by race and ethnicity. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of waiting time in a given year. Individual listings are counted separately. The Other race category is composed of Native American and Multiracial categories.

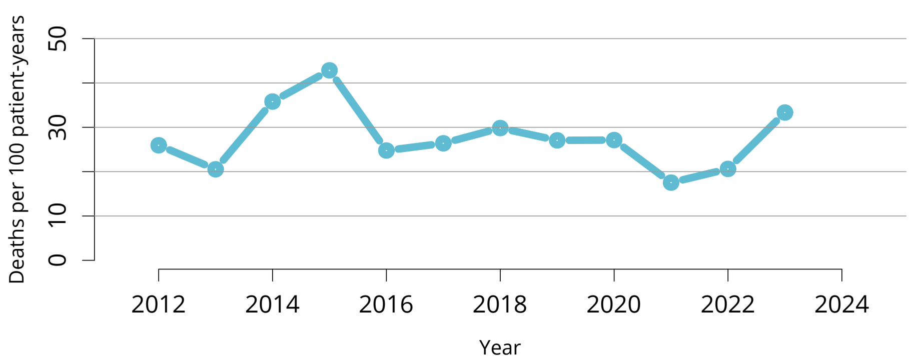

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Figure LU 78: Overall pretransplant mortality rates among pediatric candidates waitlisted for lung. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately.

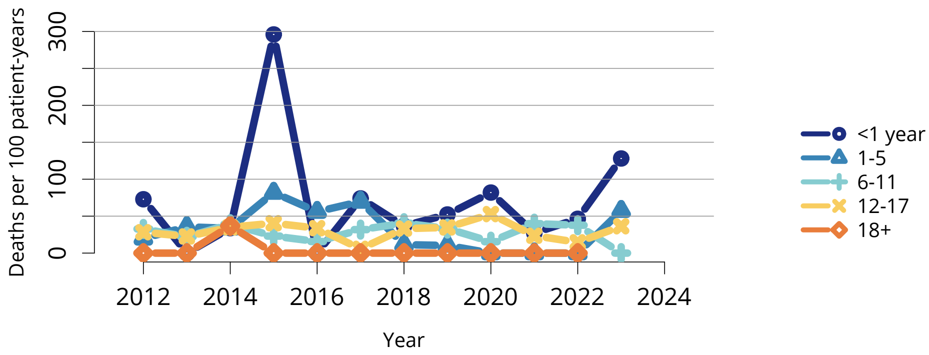

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Figure LU 79: Pretransplant mortality rates among pediatric candidates waitlisted for lung transplant by age. Mortality rates are computed as the number of deaths per 100 patient-years of waiting time in the given year. Waiting time is censored at transplant, death, transfer to another program, removal because of improved condition, or end of cohort. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year. The 18+ category is for candidates who turned age 18 while waiting.

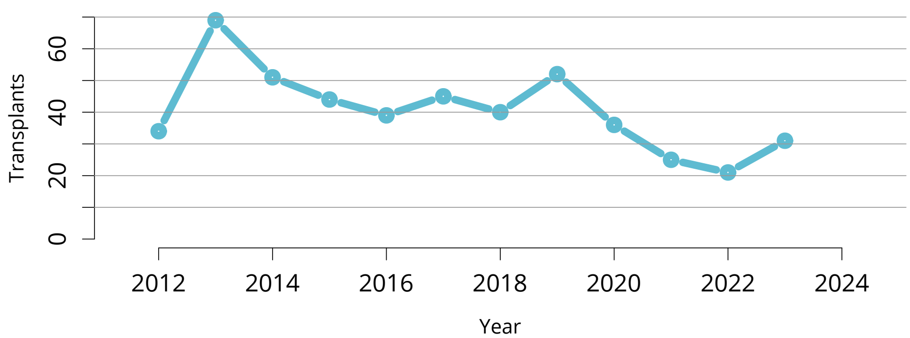

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Figure LU 80: Overall pediatric lung transplants. All pediatric lung transplant recipients, including re-transplant and multiorgan recipients.

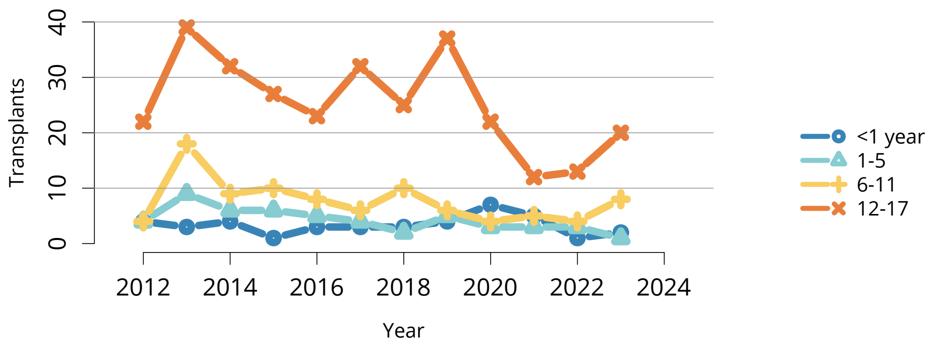

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Figure LU 81: Pediatric lung transplants by recipient age. All pediatric lung transplant recipients, including retransplant and multiorgan recipients.

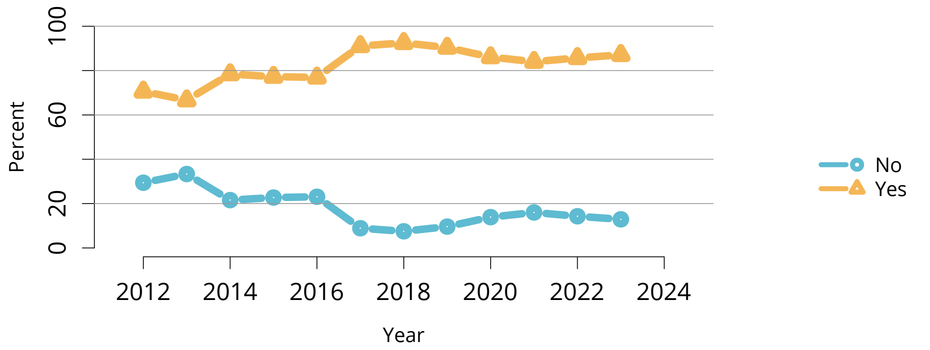

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Figure LU 82: Induction agent use in pediatric lung transplant recipients. Immunosuppression at transplant reported to the OPTN.

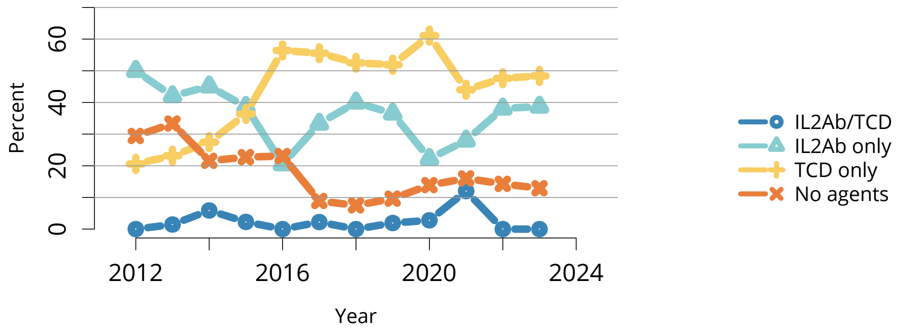

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Figure LU 83: Type of induction agent use in pediatric lung transplant recipients. Immunosuppression at transplant reported to the OPTN. IL2Ab, interleukin-2 receptor antibody; TCD, T-cell depleting.

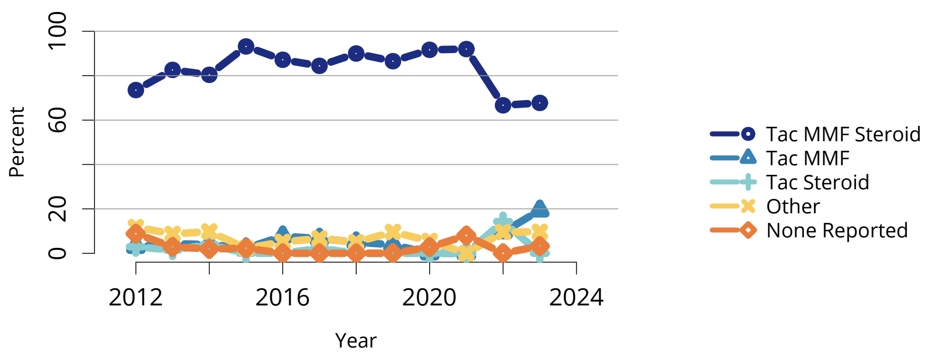

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Figure LU 84: Immunosuppression regimen use in pediatric lung transplant recipients. Immunosuppression regimen at transplant reported to the OPTN. MMF, all mycophenolate agents; Tac, tacrolimus.

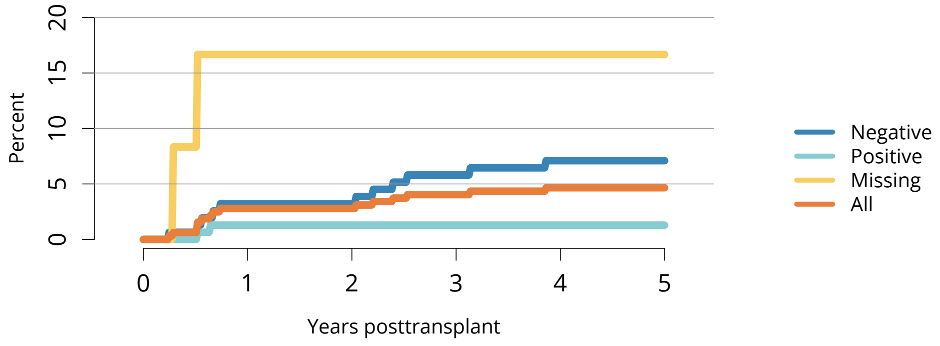

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Figure LU 85: Incidence of PTLD among pediatric lung transplant recipients by recipient EBV status at transplant, 2012-2018. Cumulative incidence is estimated using the Kaplan-Meier method. PTLD is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or on the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin's disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus; PTLD, posttransplant lymphoproliferative disorder.

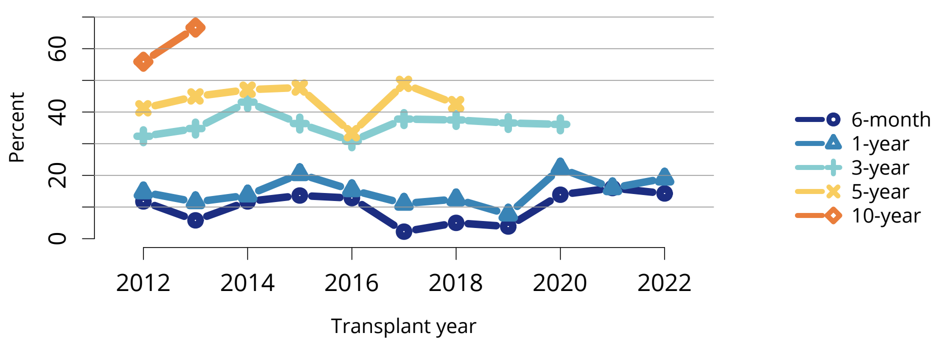

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Figure LU 86: Patient death among pediatric lung transplant recipients. All pediatric recipients of deceased donor lungs, including multiorgan transplant recipients. Estimates are unadjusted, computed using Kaplan-Meier methods.

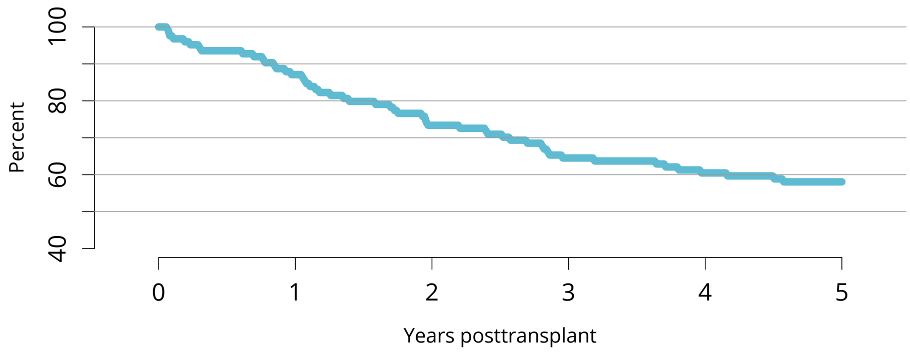

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Figure LU 87: Overall patient survival among pediatric deceased donor lung transplant recipients, 2016-2018. Recipient survival estimated using unadjusted Kaplan-Meier methods.

Table LU 1: Demographic characteristics of adults on the lung transplant waiting list on December 31, 2018, and December 31, 2023. Candidates waiting for transplant on December 31 of the given year, regardless of first listing date. Distance is computed from candidate's home zip code to the transplant center. Age is determined on December 31 of the year.

	2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Age (years)				
18-34 years	115	7.9	55	5.9
35-49	213	14.7	92	9.9
50-64	696	48	402	43.1
65+	427	29.4	384	41.2
Sex				
Female	850	58.6	509	54.6
Male	601	41.4	424	45.4
Race and ethnicity				
Asian	56	3.9	29	3.1
Black	170	11.7	141	15.1
Hispanic	162	11.2	126	13.5
Multiracial	4	0.3	8	0.9
Native American	4	0.3	4	0.4
White	1055	72.7	615	65.9
Unreported	0	0	10	1.1
Geography				
Metropolitan	1221	84.1	800	85.7
Nonmetropolitan	224	15.4	125	13.4
Missing	6	0.4	8	0.9
Miles between candidate and center				
<50 miles	770	53.1	500	53.6
50-<100	253	17.4	165	17.7
100-<150	138	9.5	88	9.4
150-<250	149	10.3	93	10
250+	135	9.3	79	8.5
Missing	6	0.4	8	0.9
All candidates				
All candidates	1451	100	933	100

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Table LU 2: Clinical characteristics of adults on the lung transplant waiting list on December 31, 2018, and December 31, 2023. Candidates waiting for transplant on December 31 of the given year, regardless of first listing date. LAS ended on March 8, 2023; post-LAS is March 9, 2023, and later. LAS was not reported for 2023 because the composite allocation score was used for allocation. ECMO, extracorporeal membrane oxygenation; LAS, lung allocation score; vent, ventilation; WLAUC, waitlist area under the curve.

	2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Diagnosis group				
A - obstructive	579	39.9	250	26.8
B - pulmonary vascular	144	9.9	97	10.4
C - cystic fibrosis	106	7.3	20	2.1
D - restrictive	622	42.9	566	60.7
Height at listing (cm)				
<150 cm	54	3.7	30	3.2
150-<160	343	23.6	218	23.4
160-<170	506	34.9	320	34.3
170-<180	375	25.8	241	25.8
180+	172	11.9	123	13.2
Missing	1	0.1	1	0.1
Blood type				
A	508	35	250	26.8
AB	27	1.9	7	0.8
B	163	11.2	64	6.9
O	753	51.9	612	65.6
WLAUC at waiting				
<210 days	72	5	35	3.8
210-<300	224	15.4	149	16
300-<335	417	28.7	300	32.2
335+	738	50.9	449	48.1
LAS at waiting				
<35	640	44.1	0	0
35-<40	438	30.2	0	0
40-<50	255	17.6	0	0
50-<60	56	3.9	0	0
60+	62	4.3	0	0
Post-LAS	0	0	933	100
All candidates				
All candidates	1451	100	933	100

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Table LU 3: Listing characteristics of adults on the lung transplant waiting list on December 31, 2018, and December 31, 2023. Candidates waiting for transplant on December 31 of the given year, regardless of first listing date.

	2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Previous transplant				
No prior transplant	1421	97.9	897	96.1
Prior transplant	30	2.1	36	3.9
Waiting time				
<90 days	433	29.8	361	38.7
3-<6 months	250	17.2	158	16.9
6-<12 months	306	21.1	201	21.5
1-<2 years	247	17	121	13
2+ years	215	14.8	92	9.9
All candidates				
All candidates	1451	100	933	100

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Table LU 4: Lung transplant waitlist activity among adults. Candidates listed at more than one center are counted once per listing. Candidates who are listed, undergo transplant, and are relisted are counted more than once. Candidates are not considered to be on the list on the day they are removed; counts on January 1 may differ from counts on December 31 of the prior year. Candidates listed for multiorgan transplants are included.

Waiting list state	**2021**	**2022**	**2023**
Waiting list state			
Patients at start of year	1006	1067	980
Patients added during year	3111	3161	3385
Patients removed during year	3050	3248	3432
Patients at end of year	1067	980	933

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Table LU 5: Removal reason among adult lung transplant candidates. Removal reason as reported to the OPTN. Candidates with death dates that precede removal dates are assumed to have died waiting.

Removal reason	2021	2022	2023
Removal reason			
Deceased donor transplant	2542	2721	3048
Patient died	132	142	85
Patient refused transplant	5	10	12
Improved, transplant not needed	52	44	40
Too sick for transplant	154	151	91
Other	165	180	156

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Table LU 6: Demographic characteristics of adult lung transplant recipients, 2018 and 2023. Lung transplant recipients, including retransplant recipients. Distance is computed from recipient's home zip code to the transplant center.

	2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Recipient age (years)				
18-34 years	233	9.2	148	4.9
35-49	310	12.3	384	12.6
50-64	1093	43.3	1341	44
65+	886	35.1	1176	38.6
Sex				
Female	1004	39.8	1325	43.5
Male	1518	60.2	1724	56.5
Race and ethnicity				
Asian	55	2.2	101	3.3
Black	237	9.4	296	9.7
Hispanic	218	8.6	433	14.2
Multiracial	8	0.3	15	0.5
Native American	12	0.5	16	0.5
White	1992	79	2174	71.3
Unreported	0	0	14	0.5
Insurance				
Private	1048	41.6	1235	40.5
Medicare	1170	46.4	1406	46.1
Medicaid	216	8.6	278	9.1
Other/unknown	88	3.5	130	4.3
Geography				
Metropolitan	2162	85.7	2500	82
Nonmetropolitan	324	12.8	493	16.2
Missing	36	1.4	56	1.8
Miles between recipient and center				
<50 miles	1301	51.6	1507	49.4
50-<100	433	17.2	570	18.7
100-<150	267	10.6	312	10.2
150-<250	252	10	313	10.3
250+	234	9.3	292	9.6
Missing	35	1.4	55	1.8
All recipients				
All recipients	2522	100	3049	100

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Table LU 7: Clinical characteristics of adult lung transplant recipients, 2018 and 2023. Lung transplant recipients, including retransplant recipients. LAS ended on March 8, 2023; post-LAS is March 9, 2023, and later. CAS started on March 9, 2023. CAS, continuous allocation score; ECMO, extracorporeal membrane oxygenation; LAS, lung allocation score; vent, ventilation; WLAUC, waitlist area under the curve.

	2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Diagnosis group				
A - obstructive	607	24.1	610	20
B - pulmonary vascular	147	5.8	193	6.3
C - cystic fibrosis	244	9.7	56	1.8
D - restrictive	1524	60.4	2190	71.8
Height at transplant (cm)				
<150 cm	49	1.9	102	3.3
150-<160	351	13.9	471	15.4
160-<170	754	29.9	910	29.8
170-<180	870	34.5	1005	33
180+	498	19.7	550	18
Missing	0	0	11	0.4
Blood type				
A	947	37.5	1234	40.5
AB	111	4.4	122	4
B	283	11.2	387	12.7
O	1181	46.8	1306	42.8
WLAUC at transplant				
<210 days	654	25.9	844	27.7
210-<300	654	25.9	526	17.3
300-<335	609	24.1	693	22.7
335+	605	24	986	32.3
LAS at transplant				
<35	550	21.8	90	3
35-<40	534	21.2	125	4.1
40-<50	584	23.2	136	4.5
50-<60	260	10.3	53	1.7
60+	594	23.6	122	4
Post-LAS	0	0	2523	82.7
CAS at transplant				
Pre-CAS	2522	100	526	17.3
<29	0	0	506	16.6
29-<31	0	0	737	24.2
31-<36	0	0	635	20.8
36+	0	0	572	18.8
Missing	0	0	73	2.4
Vent/ECMO at transplant				
Vent+ECMO	80	3.2	94	3.1
Vent only	42	1.7	36	1.2
ECMO only	83	3.3	111	3.6
Neither	2317	91.9	2808	92.1
All recipients				
All recipients	2522	100	3049	100

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Table LU 8: Transplant characteristics of adult lung transplant recipients, 2018 and 2023. Lung transplant recipients, including retransplant recipients. DBD, donation after brain death; DCD, donation after circulatory death.

	2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Waiting time				
<1 day	0	0	2	0.1
1-<90 days	1684	66.8	2281	74.8
3-<6 months	404	16	361	11.8
6-<12 months	243	9.6	233	7.6
1-<2 years	132	5.2	125	4.1
2+ years	59	2.3	47	1.5
Bilateral versus single lung transplant				
Bilateral	1882	74.6	2548	83.6
Single	640	25.4	501	16.4
Donation after circulatory death				
DBD	2402	95.2	2739	89.8
DCD	120	4.8	310	10.2
Previous transplant for recipients				
No prior transplant	2456	97.4	2950	96.8
Prior transplant	66	2.6	99	3.2
Transplant type				
Lung only	2471	98	2953	96.9
Heart-lung	25	1	53	1.7
Liver-lung	14	0.6	22	0.7
Kidney-lung	9	0.4	21	0.7
Other multiorgan	3	0.1	0	0
All recipients				
All recipients	2522	100	3049	100

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Table LU 9: Demographic characteristics of pediatric candidates on the lung transplant waiting list on December 31, 2018, and December 31, 2023. Candidates younger than 18 years at listing waiting for transplant on December 31 of the given year, regardless of first listing date. Age is determined on December 31 of the year. The 18+ category is for candidates who turned age 18 while waiting. Distance is computed from candidate's home zip code to the transplant center.

	2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Age (years)				
1-5	10	23.8	1	5
6-11	11	26.2	9	45
12-17	16	38.1	9	45
18+	5	11.9	1	5
Sex				
Female	18	42.9	5	25
Male	24	57.1	15	75
Race and ethnicity				
Asian	0	0	1	5
Black	2	4.8	2	10
Hispanic	8	19	5	25
White	32	76.2	12	60
Geography				
Metropolitan	31	73.8	16	80
Nonmetropolitan	9	21.4	3	15
Missing	2	4.8	1	5
Miles between candidate and center				
<50 miles	15	35.7	3	15
50-<100	2	4.8	3	15
100-<150	4	9.5	6	30
150-<250	8	19	1	5
250+	11	26.2	6	30
Missing	2	4.8	1	5
All candidates				
All candidates	42	100	20	100

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Table LU 10: Clinical characteristics of pediatric candidates on the lung transplant waiting list on December 31, 2018, and December 31, 2023. Candidates younger than 18 years at listing waiting for transplant on December 31 of the given year, regardless of first listing date. WLAUC, waitlist area under the curve.

	2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Diagnosis				
Cystic fibrosis	15	35.7	0	0
Pulmonary hypertension	7	16.7	6	30
Pulmonary fibrosis	2	4.8	0	0
Other vascular	2	4.8	1	5
Other/unknown	16	38.1	13	65
Height at listing (cm)				
<70 cm	2	4.8	0	0
70-<90	3	7.1	3	15
90-<110	7	16.7	0	0
110-<130	12	28.6	7	35
130+	18	42.9	10	50
Blood type				
A	13	31	12	60
AB	5	11.9	0	0
B	1	2.4	5	25
O	23	54.8	3	15
WLAUC at waiting				
<210 days	1	2.4	0	0
210-<300	2	4.8	0	0
300-<335	9	21.4	1	5
335+	30	71.4	19	95
All candidates				
All candidates	42	100	20	100

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Table LU 11: Listing characteristics of pediatric candidates on the lung transplant waiting list on December 31, 2018, and December 31, 2023. Candidates younger than 18 years at listing waiting for transplant on December 31 of the given year, regardless of first listing date.

	2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Previous transplant				
No prior transplant	40	95.2	19	95
Prior transplant	2	4.8	1	5
Waiting time				
<90 days	13	31	2	10
3-<6 months	4	9.5	4	20
6-<12 months	6	14.3	3	15
1-<2 years	8	19	7	35
2+ years	11	26.2	4	20
All candidates				
All candidates	42	100	20	100

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Table LU 12: Lung transplant waitlist activity among pediatric candidates. Candidates who are listed, undergo transplant, and are relisted are counted more than once. Candidates are not considered to be on the list on the day they are removed; counts on January 1 may differ from counts on December 31 of the prior year. Candidates listed for multiorgan transplants are included.

Waiting list state	2021	2022	2023
Waiting list state			
Patients at start of year	22	26	31
Patients added during year	47	47	42
Patients removed during year	43	42	53
Patients at end of year	26	31	20

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Table LU 13: Removal reason among pediatric lung transplant candidates. Removal reason as reported to the OPTN. Candidates with death dates that precede removal dates are assumed to have died waiting.

Removal reason	2021	2022	2023
Removal reason			
Deceased donor transplant	25	22	32
Patient died	3	7	9
Patient refused transplant	0	1	1
Improved, transplant not needed	5	0	8
Too sick for transplant	6	2	1
Other	4	10	2

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Table LU 14: Demographic characteristics of pediatric lung transplant recipients, 2018 and 2023. Pediatric lung transplant recipients, including retransplant recipients. Distance is computed from recipient's home zip code to the transplant center.

	2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Recipient age (years)				
<1 year	3	7.5	2	6.5
1-5	2	5	1	3.2
6-11	10	25	8	25.8
12-17	25	62.5	20	64.5
Sex				
Female	26	65	15	48.4
Male	14	35	16	51.6
Race and ethnicity				
Asian	1	2.5	1	3.2
Black	4	10	6	19.4
Hispanic	8	20	4	12.9
Multiracial	2	5	1	3.2
White	25	62.5	19	61.3
Insurance				
Private	15	37.5	15	48.4
Medicare	0	0	2	6.5
Medicaid	23	57.5	9	29
Other/unknown	2	5	5	16.1
Geography				
Metropolitan	34	85	24	77.4
Nonmetropolitan	5	12.5	6	19.4
Missing	1	2.5	1	3.2
Miles between recipient and center				
<50 miles	14	35	8	25.8
50-<100	3	7.5	5	16.1
100-<150	2	5	3	9.7
150-<250	10	25	4	12.9
250+	10	25	10	32.3
Missing	1	2.5	1	3.2
All recipients				
All recipients	40	100	31	100

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Table LU 15: Clinical characteristics of pediatric lung transplant recipients, 2018 and 2023. Pediatric lung transplant recipients, including retransplant recipients. Pediatric priority was reported in 2010 and later. LAS ended on March 8, 2023; post-LAS is March 9, 2023, and later. CAS started on March 9, 2023. CAS, continuous allocation score; ECMO, extracorporeal membrane oxygenation; LAS, lung allocation score; vent, ventilation; WLAUC, waitlist area under the curve.

	2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Diagnosis				
Cystic fibrosis	20	50	3	9.7
Pulmonary hypertension	5	12.5	7	22.6
Pulmonary fibrosis	1	2.5	4	12.9
Other vascular	1	2.5	0	0
Other/unknown	13	32.5	17	54.8
Height at transplant (cm)				
<70 cm	3	7.5	3	9.7
70-<90	1	2.5	0	0
90-<110	2	5	0	0
110-<130	3	7.5	3	9.7
130+	31	77.5	25	80.6
Blood type				
A	13	32.5	11	35.5
AB	2	5	2	6.5
B	4	10	5	16.1
O	21	52.5	13	41.9
WLAUC at transplant				
<210 days	6	15	7	22.6
210-<300	7	17.5	1	3.2
300-<335	8	20	0	0
335+	19	47.5	23	74.2
LAS at transplant				
<35	7	17.5	2	6.5
35-<40	9	22.5	0	0
40-<50	3	7.5	0	0
50-<60	3	7.5	0	0
60+	3	7.5	3	9.7
Not applicable (age <12 y)	15	37.5	2	6.5
Post-LAS	0	0	24	77.4
CAS at transplant				
Pre-CAS	40	100	7	22.6
36+	0	0	22	71
Missing	0	0	2	6.5
Vent/ECMO at transplant				
Vent+ECMO	2	5	4	12.9
Vent only	3	7.5	1	3.2
ECMO only	3	7.5	4	12.9
Neither	32	80	22	71
All recipients				
All recipients	40	100	31	100

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Table LU 16: Transplant characteristics of pediatric lung transplant recipients, 2018 and 2023. Pediatric lung transplant recipients, including retransplant recipients.

	2018		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Waiting time				
1-<90 days	27	67.5	19	61.3
3-<6 months	5	12.5	9	29
6-<12 months	7	17.5	2	6.5
1-<2 years	1	2.5	1	3.2
Bilateral versus single lung transplant				
Bilateral	40	100	30	96.8
Single	0	0	1	3.2
Previous transplant for recipients				
No prior transplant	40	100	29	93.5
Prior transplant	0	0	2	6.5
Transplant type				
Lung only	35	87.5	30	96.8
Heart-lung	5	12.5	1	3.2
All recipients				
All recipients	40	100	31	100

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OPTN/SRTR 2023 Annual Data Report: Deceased Organ Donation

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Abstract

The Annual Data Report is created using data from the Scientific Registry of Transplant Recipients (SRTR) to calculate variables such as organs recovered per donor, organs transplanted per donor, and organs recovered for transplant but not transplanted (ie, nonuse). SRTR uses data collected by the Organ Procurement and Transplantation Network. In 2023, there were 16,335 deceased donors, a 9.6% increase from 14,904 in 2022 and continuing the trend of increasing donors over the past decade. Donor characteristics have changed compared with 2013, with more donors with drug intoxication and cardiovascular mechanisms of death. In contrast, gunshot wound, blunt injury, and stroke have decreased as mechanisms of death in 2023 compared with 2013. The number of organs transplanted increased to 40,588 in 2023 (from 37,316 in 2022), including 10,818 left kidneys, 10,659 right kidneys, 372 en bloc kidneys, 917 pancreata, 9,910 livers, 95 intestines, 4,596 hearts, and 3,016 lungs. Compared with 2022, transplants of all organs increased. In 2023, 4,038 left kidneys, 4,220 right kidneys, 160 en block kidneys, 279 pancreata, 1,056 livers, 4 intestines, 68 hearts, and 260 lungs were not used. This nonuse of organs represents an opportunity to increase the number of transplants.

Keywords: Organ donors, organ nonuse, organs recovered, organs transplanted

1 Introduction

This chapter reports data collected by the Organ Procurement and Transplantation Network to describe deceased donor characteristics over the past decade and deceased donor metrics, as well as data on organ disposition in 2023. The donor metrics include organs recovered per donor, organs transplanted per donor, and organs recovered for transplant and not transplanted (ie, nonuse).

Definitions of Terms Related to Deceased Organ Donation

Donation service area (DSA): The geographic area designated by the Centers for Medicare & Medicaid Services (CMS) that is served by one organ procurement organization (OPO).
DBD: Donation after brain death.
DCD: Donation after circulatory death.
Donor: A person from whom at least one organ was recovered for transplant, regardless of whether the organ was transplanted.
Nonuse: Organs recovered for transplant but not transplanted.
Nonuse rate: Number of organs not used divided by number of organs recovered for transplant.
Organs authorized for recovery: Authorization requested and given for recovery of specific organs from a donor. Recovery of organs for transplant must be authorized by the individual(s) authorizing the donation (donor or surrogate decision maker), consistent with applicable state law.
Organs recovered per donor (ORPD): Total number of organs recovered for transplant, divided by the number of donors, not limited to eligible deaths.
Organs transplanted per donor (OTPD): Total number of organs transplanted, divided by the number of donors, not limited to eligible deaths (eg, OTPD for kidneys is the total number of kidneys transplanted, divided by the total number of all donors).

2 Donors and Organs

In 2023, the overall count of deceased donors increased to a record high of 16,335, continuing the trend over the past decade of an increasing number of donors annually. This represents a doubling of the deceased donors over the past decade (from 8,144 in 2012) and a 9.6% increase from 14,904 in 2022 (Figure DD 1). Although the numbers of both DBD and DCD donors have increased annually, most of this increase in the past year was from DCD donors. In 2023, there were 5,463 DCD donors without normothermic regional perfusion (NRP), a 19.6% increase from 4,568 in 2022, and 431 DCD donors with NRP, more than double such donors compared with 2022 (Figure DD 2).

The record number of donors was accompanied by record numbers of organs authorized, organs recovered, and organs transplanted, all of which have increased annually since 2012. In 2023, the number of organs transplanted rose to 40,588, an 8.8% increase from 2022 (Figure DD 3).

3 Organs Recovered Per Donor

In 2023, there were 59,115 organs recovered, a 10.2% increase from 53,666 in 2022 (Figure DD 3). The ORPD for all organs was 3.30, similar to in 2022. Over the past decade, this ORPD has ranged from 3.30 to 3.55. Since each donor can potentially donate two kidneys, the organ-specific ORPD remained highest for kidneys at 1.89 in 2023 and was relatively stable since 2022. Over the past decade, the ORPD for kidneys has ranged from 1.80 to 1.90 (Figure DD 4). In 2023, from 15,745 donors, 775 left kidneys and 745 right kidneys were not recovered. The most common reasons for nonrecovery were diseased organ and poor organ function (Figure DD 22 and Figure DD 23).

Consistent with the decline in the ORPD for all organs combined, the ORPDs for pancreas, liver, and intestine have declined over the past decade. In 2023, from 16,335 donors, 11,562 pancreata were not recovered. The most common reasons were organ refused by all national program, donor medical history, and poor organ function (Figure DD 25). From the 16,335 donors, 4,328 livers were not recovered, with the most common reasons being organ refused by all national program and ruled out after evaluation in OR [operating room] (Figure DD 26); 15,401 intestines were not recovered, most commonly because organ refused by all national program and “Other” reason (Figure DD 27). The ORPDs for heart and lung have remained relatively stable over the past decade (Figure DD 5). In 2023, from the 16,335 donors, 9,312 hearts were not recovered, with the most common reasons being poor organ function and diseased organ (Figure DD 28); 11,365 lungs were not recovered, most commonly for poor organ function and organ refused by all national program (Figure DD 29).

The ORPD for all organs varies by DSA and in 2023 ranged from 2.35 to 3.71. Because the ORPD is an unadjusted number, it does not account for mix of donor types, including young, old, DBD, and DCD, which explains some of the differences seen between DSAs (Figure DD 6).

4 Organs Transplanted Per Donor

The number of organs transplanted increased to 40,588 in 2023, from 37,316 in 2022 (Figure DD 3). However, the OTPD has declined over the past decade to 2.67 in 2023, from 3.02 in 2012. Because each donor can potentiality donate two kidneys, the organ-specific OTPD was highest for kidneys at 1.36 in 2023. This OTPD has fluctuated between 1.36 and 1.50 over the past decade (Figure DD 7). In 2023, the OTPD from DBD donors was 3.17, higher than the OTPDs of DCD donors with and without NRP: 2.67 and 1.70, respectively (Figure DD 10). The OTPD for kidneys varies by kidney donor profile index (KDPI) and this trend has been stable for the past decade. In 2023, the OTPD for kidneys was 1.95 for the highest quality kidneys, defined as KDPI of less than 20%. For kidneys with KDPI of 20-<35%, 35-<85%, and 85% or greater, the OTPDs were 1.84, 1.46, and 0.52, respectively (Figure DD 17). The percentage of deceased donors with KDPI of 85% or greater varies across OPOs and ranged from 1.2% to 14.3% (Figure DD 21). In 2023, from 15,745 donors, 10,818 left kidney transplants and 10,659 right kidney transplants were performed (Figure DD 22 and Figure DD 23). From 590 donors, 372 en bloc kidneys were transplanted (Figure DD 24).

In 2023, the OTPD for pancreas was 0.056, a 9.0% decrease from 0.061 in 2022. Over the past decade, the pancreas OTPD has decreased annually (Figure DD 8). In 2023, the OTPD for pancreata from DBD donors was 0.084, higher than the OTPDs from DCD donors with and without NRP: 0.0046 and 0.0060, respectively (Figure DD 12). In 2023, from 16,335 donors, 917 pancreata were transplanted, including 2 that were transplanted as islets (Figure DD 25).

The OTPD for liver was 0.61 in 2023, a 2.1% increase from 0.59 in 2022. This is likely a result of increased use of NRP. Prior to 2023, the OTPD for liver had typically decreased every year and was 0.73 in 2012 (Figure DD 8). In 2023, the OTPD for liver from DBD donors was 0.78, higher than the OTPDs from DCD donors with and without NRP: 0.54 and 0.26, respectively (Figure DD 13). In 2023, from 16,335 donors, 9,910 livers were transplanted (Figure DD 26).

The OTPD for intestine was 0.0058 in 2023, similar to 0.0056 in 2022. Over the past decade, the OTPD for intestine has declined, from 0.013 in 2012 (Figure DD 8). The intestines transplanted were primarily from DBD donors (Figure DD 14). In 2023, from 16,335 donors, 95 intestines were transplanted (Figure DD 27).

The OTPD for heart was 0.28 in 2023, almost identical to the 0.28 in 2022. Over the past decade, the OTPD for heart has declined slightly and was 0.30 in 2012 (Figure DD 8). In 2023, the OTPD for heart from DBD donors was 0.38, lower than the OTPD of 0.41 from DCD donors with

NRP and higher than the OTPD of 0.079 from DCD donors without NRP (Figure DD 15). Thus, heart transplants stand out from all other organs, with the OTPD from DCD donors with NRP being the highest among all other types of heart donors. In 2023, from 16,335 donors, 4,596 hearts were transplanted (Figure DD 28).

The OTPD for lung was 0.35 in 2023, a 5.2% increase from 0.33 in 2022. This is likely from increased use of NRP. In 2023, the OTPD of lungs from DBD donors was 0.49, higher than the OTPDs from DCD donors with and without NRP: 0.18 and 0.098, respectively (Figure DD 16). In 2023, from 16,335 donors, 3,016 lungs were transplanted (Figure DD 29).

The OTPD for all organs combined varies by OPO and in 2023 ranged from 2.07 to 3.15 (Figure DD 9). The OTPD also varies by donor status; at 3.17, the OTPD from DBD donors was higher than the OTPDs for DCD donors with and without NRP, respectively: 2.66 and 1.70 (Figure DD 10). The percentage of DCD donors varies across DSAs and in 2023 ranged from 0% to 54% (Figure DD 19). The percentage of DCD donors with NRP across DSAs ranged from 0% to 14% (Figure DD 20).

5 Organs Recovered for Transplant but Not Transplanted

In 2023, there were 10,085 organs recovered for transplant but not transplanted (ie, nonuse), a 7.8% increase from 9,354 in 2022. These unused organs represent 19.3% of all organs recovered combined in 2023. The percentage of nonuse varies by organ and has increased annually since 2018. In 2023, kidney had the highest percentage of nonuse at 27.9%, followed by pancreas (22.8%), liver (9.6%), lung (9.0%), intestine (4.0%), and heart (1.5%) (Figure DD 18); by their numeric values, 4,038 left kidneys, 4,220 right kidneys, 160 en block kidneys, 279 pancreata, 1,056 livers, 260 lungs, 4 intestines, and 68 hearts were not used. Thus, 2023 represents the first year in the past decade that kidney had the highest percentage of nonuse.

6 Change in Characteristics of Donors Over the Past Decade

During the past decade, there has been an increase in the use of organs from donors of lower estimated quality, as determined by higher KDPI donor kidneys. In 2023, 23.1% of donors had a KDPI of 85% or greater, up from 17.6% of donors in 2013. Consistent with this trend, in 2023 there was a decline in the percentage of donors with a KDPI of less than 20% compared with 2013. There was also an increase in the use of human immunodeficiency virus–positive (nucleic acid test) donors, hepatitis C virus–positive (antibody or nucleic acid test) donors, donors aged 65 years or older, and DCD donors (Table DD 1).

Donor mechanisms of death have changed over the past decade. Drug intoxication as mechanism of death increased to 16.6% in 2023, from 6.8% in 2013. Cardiovascular mechanism of death has also increased: 21.4% in 2023 versus 15.6% in 2013. In contrast, gunshot wound, blunt injury, and stroke have decreased as mechanisms of death in 2023 compared with 2013. Donor causes of death have also changed during this period. Anoxia as cause of death increased to 49.4% in 2023, from 31.4% in 2013; stroke and head trauma also increased (Table DD 2).

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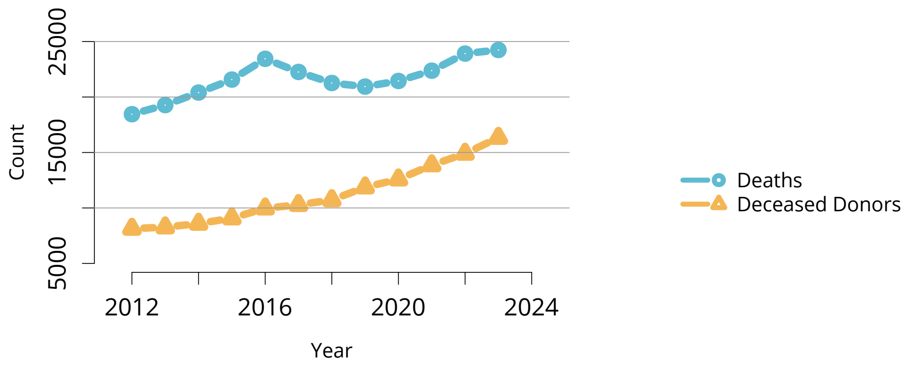
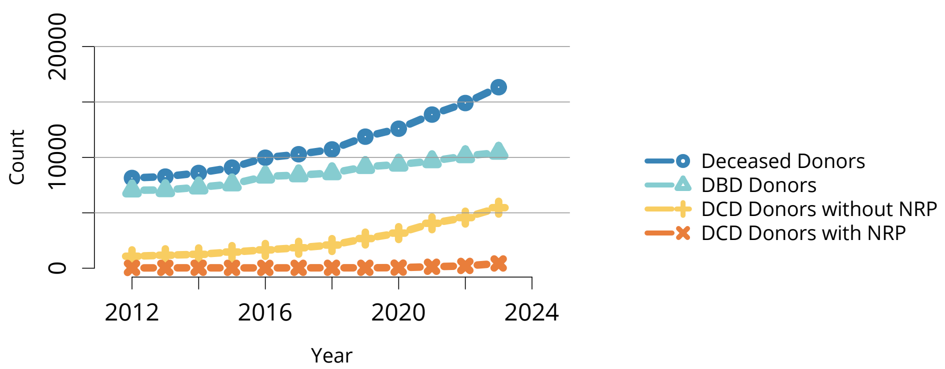
This report is available at https://srtr.transplant.hrsa.gov/annualdatareports. Individual chapters may be downloaded.



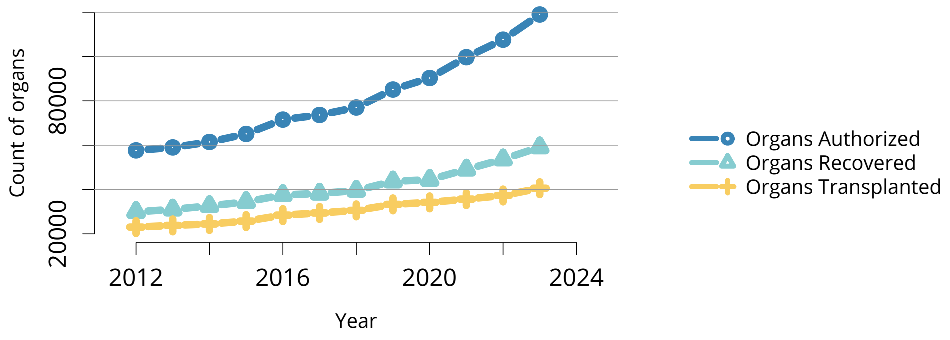
OPTN/SRTR 2023 Annual Data Report

Figure DD 1: Overall counts of deaths and donors, 2012-2023. The number and source of donors.



OPTN/SRTR 2023 Annual Data Report

Figure DD 2: Overall counts of deceased donors, DBD donors, and DCD donors with and without NRP, 2012-2023. The number of deceased donors, DBD donors, and DCD donors. Deceased donor counts include all donors for whom at least one organ was recovered for transplant. DBD, donation after brain death; DCD, donation after circulatory death; NRP, normothermic regional perfusion.



OPTN/SRTR 2023 Annual Data Report

Figure DD 3: Overall counts of authorized, recovered, and transplanted organs, 2012-2023. The number of authorized , recovered, and transplanted organs.

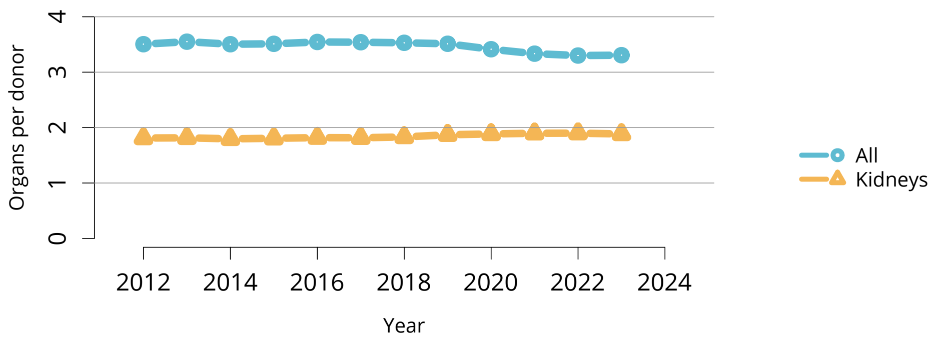


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Figure DD 4: Organs recovered per donor, all organs and kidney. Average number of overall organs and kidneys recovered per donor, calculated as the sum of recovered organs and by organ type; e.g., up to two kidneys can be recovered from each donor, but only one heart.

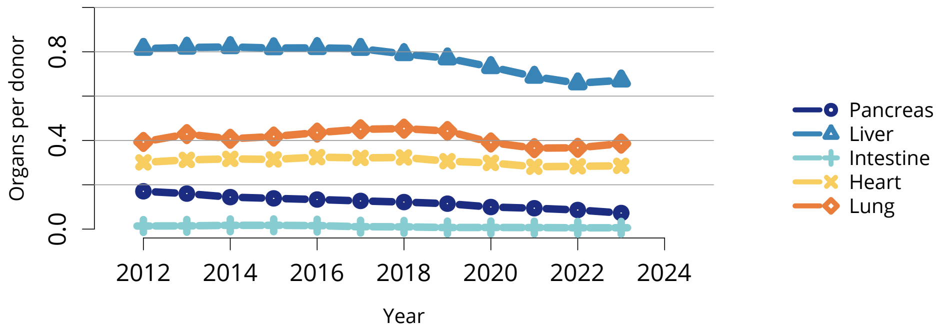

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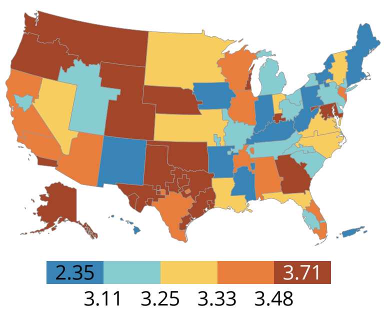
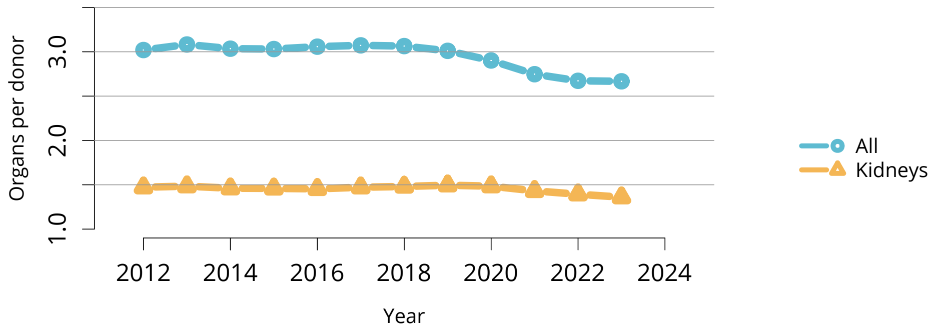
Figure DD 5: Organs recovered per donor, pancreas, liver, intestine, heart, and lung. Average number of organs other than kidneys recovered per donor, calculated as the sum of recovered organs and by organ type. Pancreata recovered for islet transplant are excluded.



OPTN/SRTR 2023 Annual Data Report

Figure DD 6: Organs recovered per donor by DSA, 2023. Average number of organs recovered per donor, calculated as the sum of recovered organs and by organ type; e.g., up to two kidneys can be recovered from each donor, but only one heart. Pancreata recovered for islet transplant are excluded. DSA, donation service area.



OPTN/SRTR 2023 Annual Data Report

Figure DD 7: Organs transplanted per donor, all organs and kidney. Average number of overall organs and kidneys transplanted per donor. As organs divided into segments (liver, lung, pancreas, intestine) may account for more than one transplant, the number or organs transplanted may exceed the number recovered. Based on a count of recovered organs that are transplanted, which differs from number of transplant operations. Pancreata recovered for islet transplant are excluded.

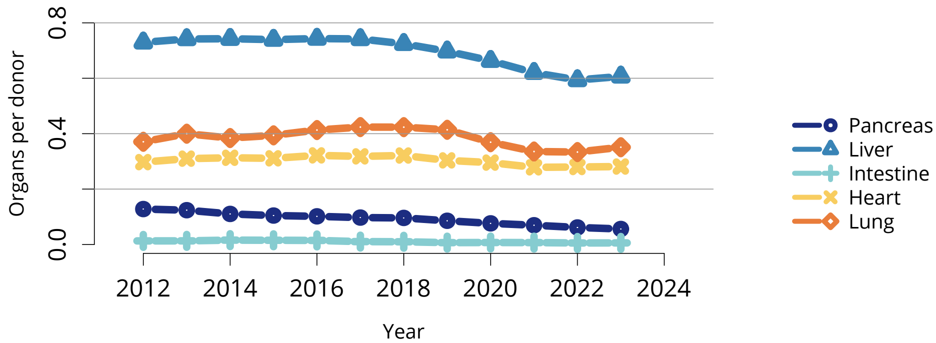


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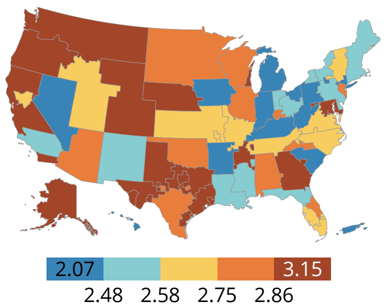
Figure DD 8: Organs transplanted per donor, pancreas, liver, intestine, heart, and lung. Average number of organs other than kidneys transplanted per donor. As organs divided into segments (liver, lung, pancreas, intestine) may account for more than one transplant, the number or organs transplanted may exceed the number recovered. Based on a count of recovered organs that are transplanted, which differs from number of transplant operations. Pancreata recovered for islet transplant are excluded.



OPTN/SRTR 2023 Annual Data Report

Figure DD 9: Organs transplanted per donor, by DSA, 2023. Average number of organs transplanted per donor. As organs divided into segments (liver, lung, pancreas, intestine) may account for more than one transplant, the number or organs transplanted may exceed the number recovered. Based on a count of recovered organs that are transplanted, which differs from number of transplant operations. DSA-level means are shown. Pancreata recovered for islet transplant are excluded. DSA, donation service area.

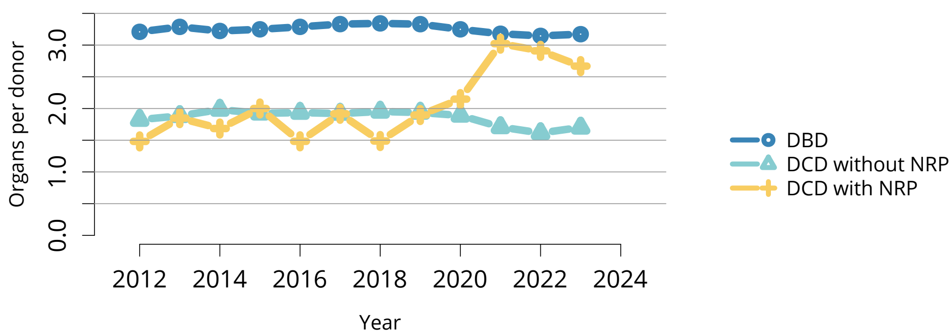


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Figure DD 10: Organs transplanted per donor, by DBD and DCD status. Average number of organs transplanted per donor. As organs divided into segments (liver, lung, pancreas, intestine) may account for more than one transplant, the number of organs transplanted may exceed the number recovered. Based on a count of recovered organs that are transplanted, which differs from number of transplant operations. Pancreata recovered for islet transplant are excluded. DBD, donation after brain death; DCD, donation after circulatory death; NRP, normothermic regional perfusion.

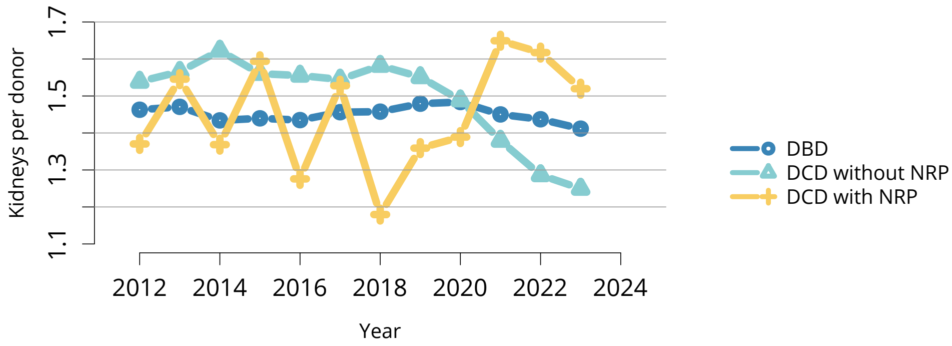

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Figure DD 11: Kidneys transplanted per donor, by DBD and DCD status. Average number of kidneys transplanted per donor. Based on a count of recovered kidneys that are transplanted, which differs from number of transplant operations. DBD, donation after brain death; DCD, donation after circulatory death; NRP, normothermic regional perfusion.

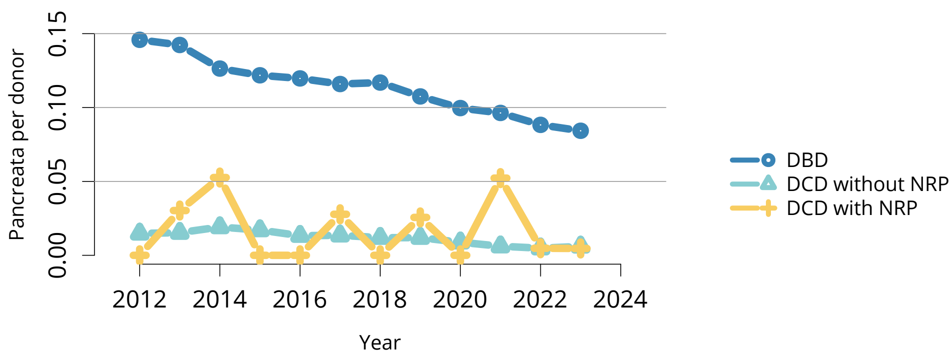

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Figure DD 12: Pancreata transplanted per donor, by DBD and DCD status. Average number of pancreata transplanted per donor. Pancreata divided into segments may account for more than one transplant, thus the number of pancreata transplanted may exceed the number recovered. Based on a count of recovered pancreata that are transplanted, which differs from number of transplant operations. Pancreata recovered for islet transplant are excluded. DBD, donation after brain death; DCD, donation after circulatory death; NRP, normothermic regional perfusion.

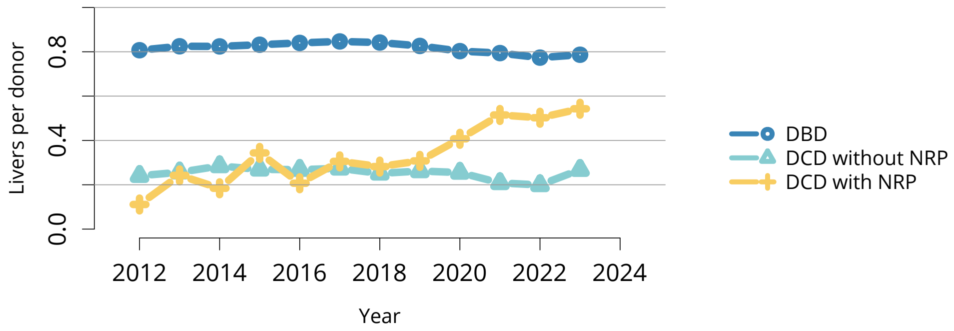

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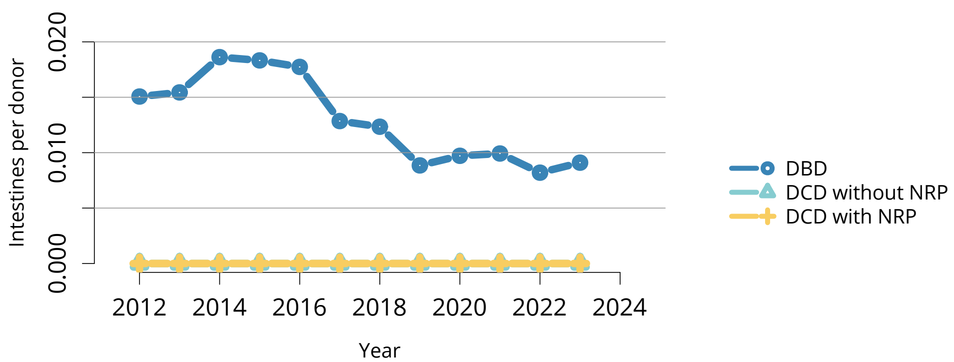
Figure DD 13: Livers transplanted per donor, by DBD and DCD status. Average number of livers transplanted per donor. Livers divided into segments may account for more than one transplant, thus the number of livers transplanted may exceed the number recovered. Based on a count of recovered livers that are transplanted, which differs from number of transplant operations. DBD, donation after brain death; DCD, donation after circulatory death; NRP, normothermic regional perfusion.



OPTN/SRTR 2023 Annual Data Report

Figure DD 14: Intestines transplanted per donor, by DBD and DCD status. Average number of intestines transplanted per donor. Intestines divided into segments may account for more than one transplant, thus the number of intestines transplanted may exceed the number recovered. Based on a count of recovered intestines that are transplanted, which differs from number of transplant operations. DBD, donation after brain death; DCD, donation after circulatory death; NRP, normothermic regional perfusion.

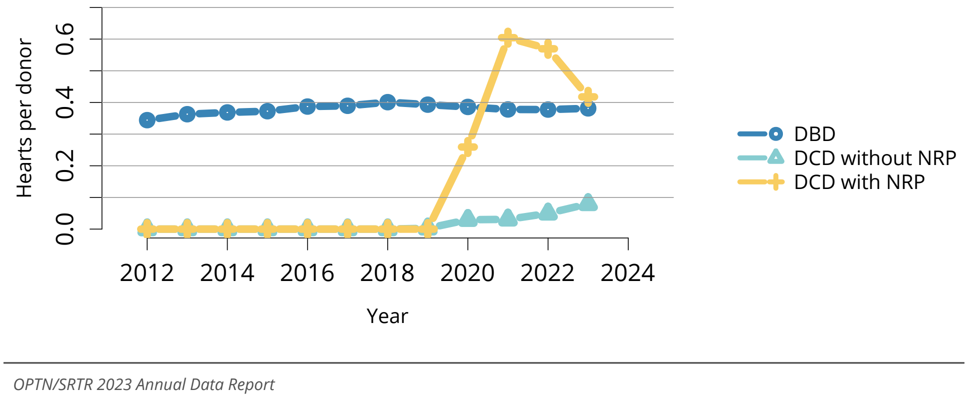


Figure DD 15: Hearts transplanted per donor, by DBD and DCD status. Average number of hearts transplanted per donor. Based on a count of recovered hearts that are transplanted, which differs from number of transplant operations. DBD, donation after brain death; DCD, donation after circulatory death; NRP, normothermic regional perfusion.

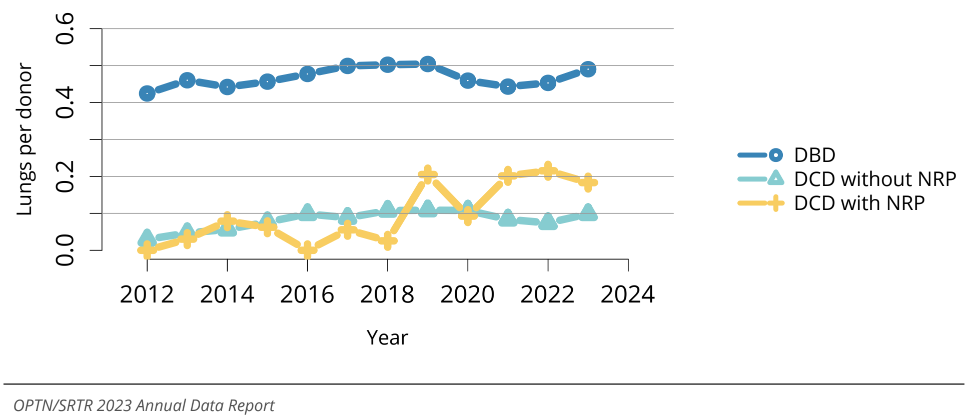


Figure DD 16: Lungs transplanted per donor, by DBD and DCD status. Average number of lungs transplanted per donor. Lungs divided into segments may account for more than one transplant, thus the number of lungs transplanted may exceed the number recovered. Based on a count of recovered lungs that are transplanted, which differs from number of transplant operations. DBD, donation after brain death; DCD, donation after circulatory death; NRP, normothermic regional perfusion.

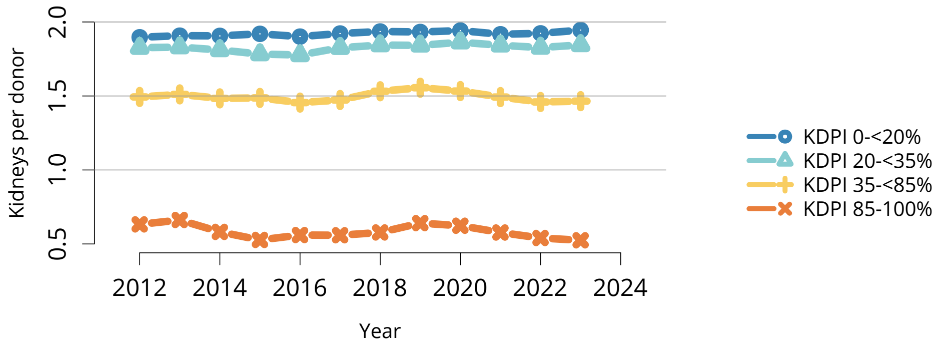


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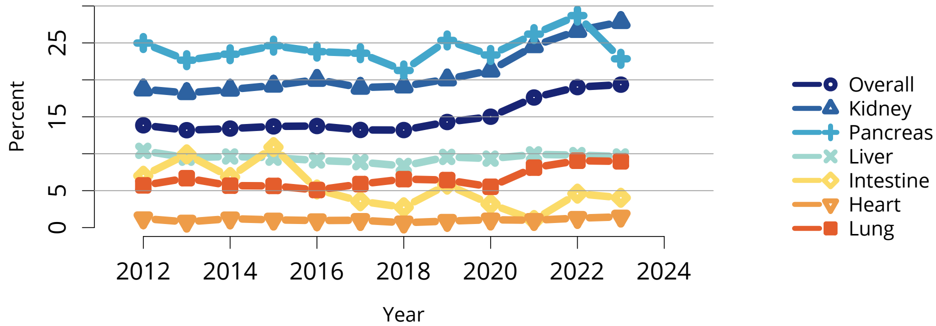
Figure DD 17: Kidneys transplanted per donor, by KDPI. Average number of kidneys transplanted per donor. Based on a count of recovered kidneys that are transplanted, which differs from number of transplant operations. KDPI, kidney donor profile index.



OPTN/SRTR 2023 Annual Data Report

Figure DD 18: Organs recovered for transplant and not transplanted. Percents are calculated as the difference between the number of organs recovered and the number of organs transplanted, divided by the number of organs recovered. Pancreata recovered for islet transplant are excluded.

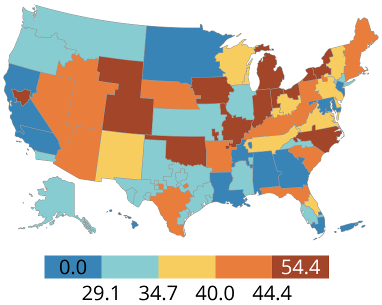


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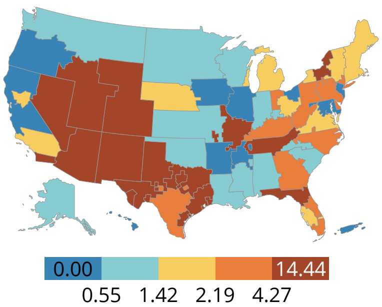
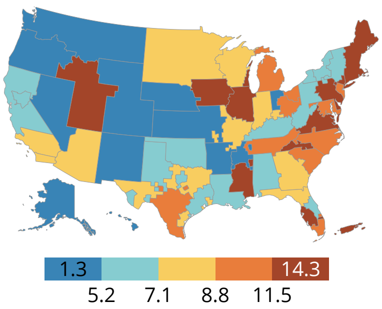
Figure DD 19: The percentage of DCD donors across DSAs from all donors, 2023. Percentage of DCD donors within a DSA. DCD, donation after circulatory death; DSA, donation service area.



OPTN/SRTR 2023 Annual Data Report

Figure DD 20: The percentage of DCD donors with NRP across DSAs from all donors, 2023. Percentage of DCD donors with NRP within a DSA. DCD, donation after circulatory death; DSA, donation service area; NRP, normothermic regional perfusion.



OPTN/SRTR 2023 Annual Data Report

Figure DD 21: The percentage of kidney donors with KDPI of 85% or greater among deceased donor kidney transplant recipients across DSAs, 2023. Percentage of kidney donors within a DSA with a donor KDPI of 85% or greater. DSA, donation service area; KDPI, kidney donor profile index.

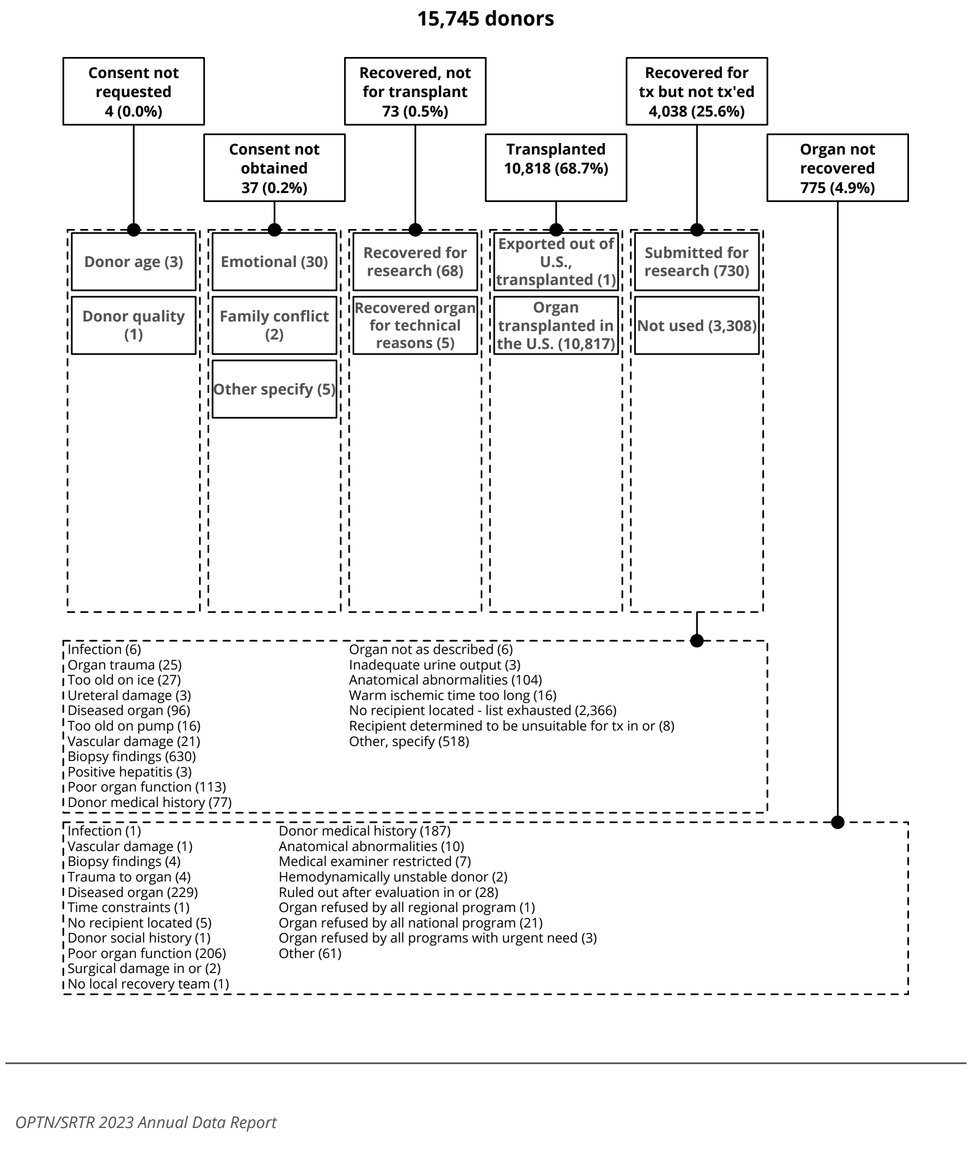


Figure DD 22: Organ use chart for reported left kidneys, 2023. A summary of the consent, recovered, transplanted, or nonuse status for donated left kidneys. The number of left and right kidneys may not equal the total number of donors. or, operating room; tx, transplant.

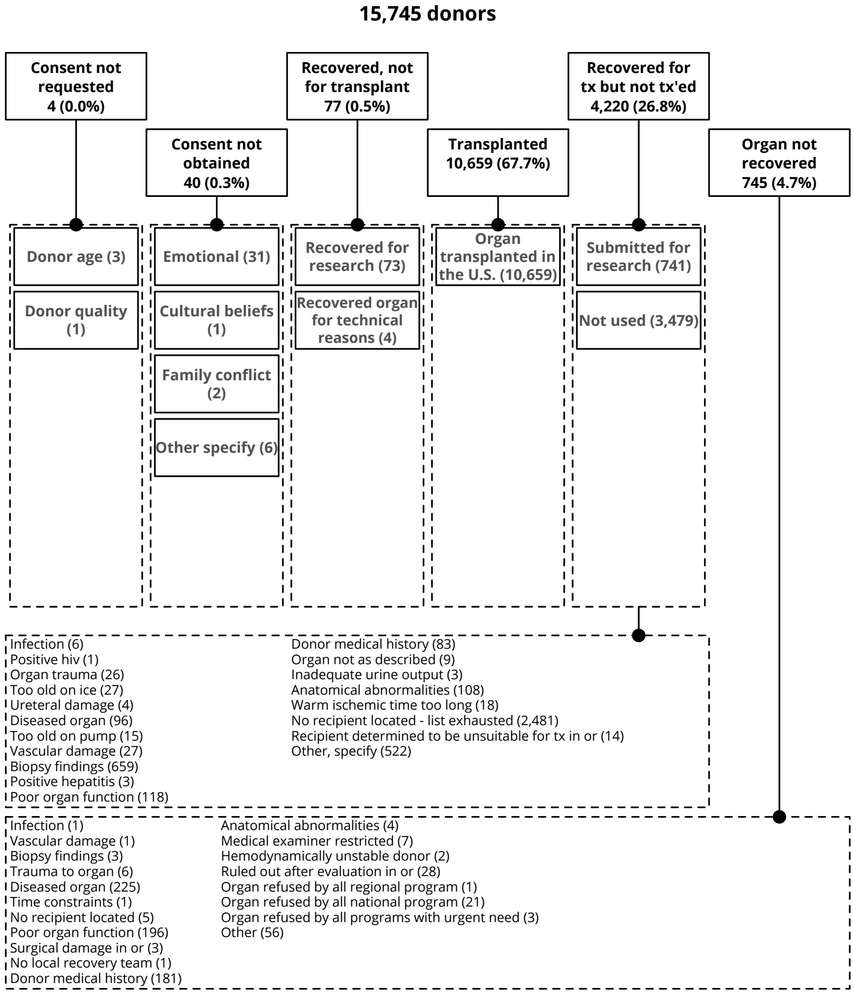


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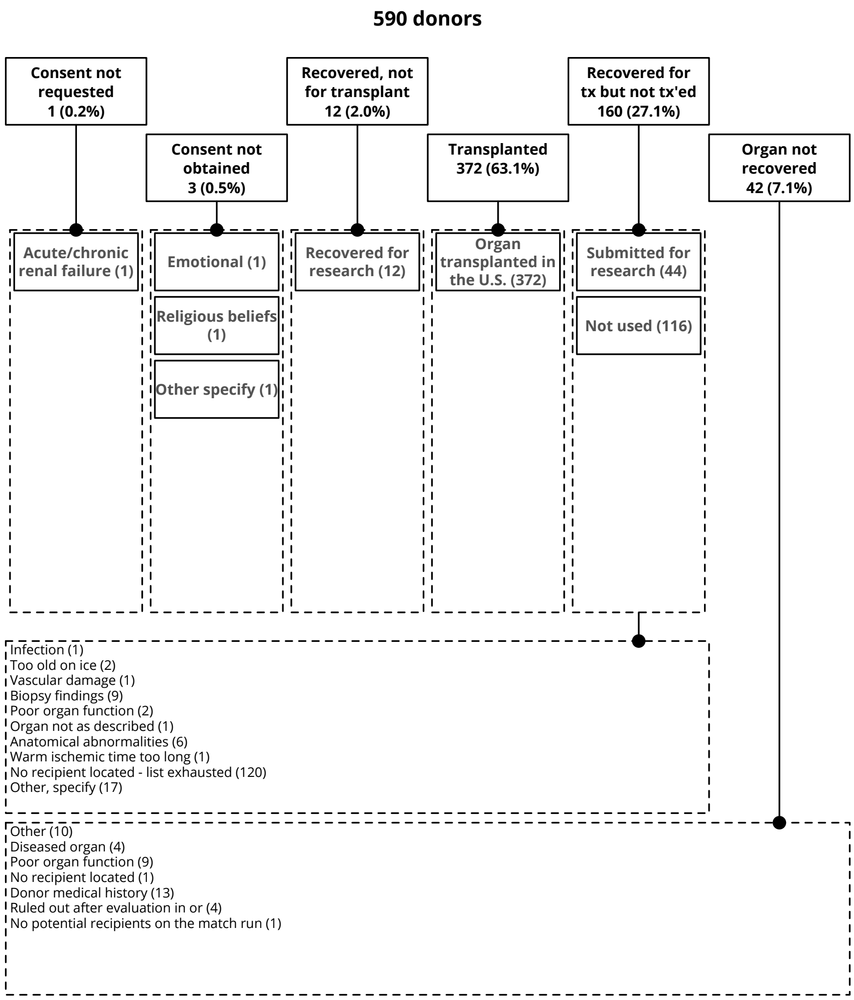
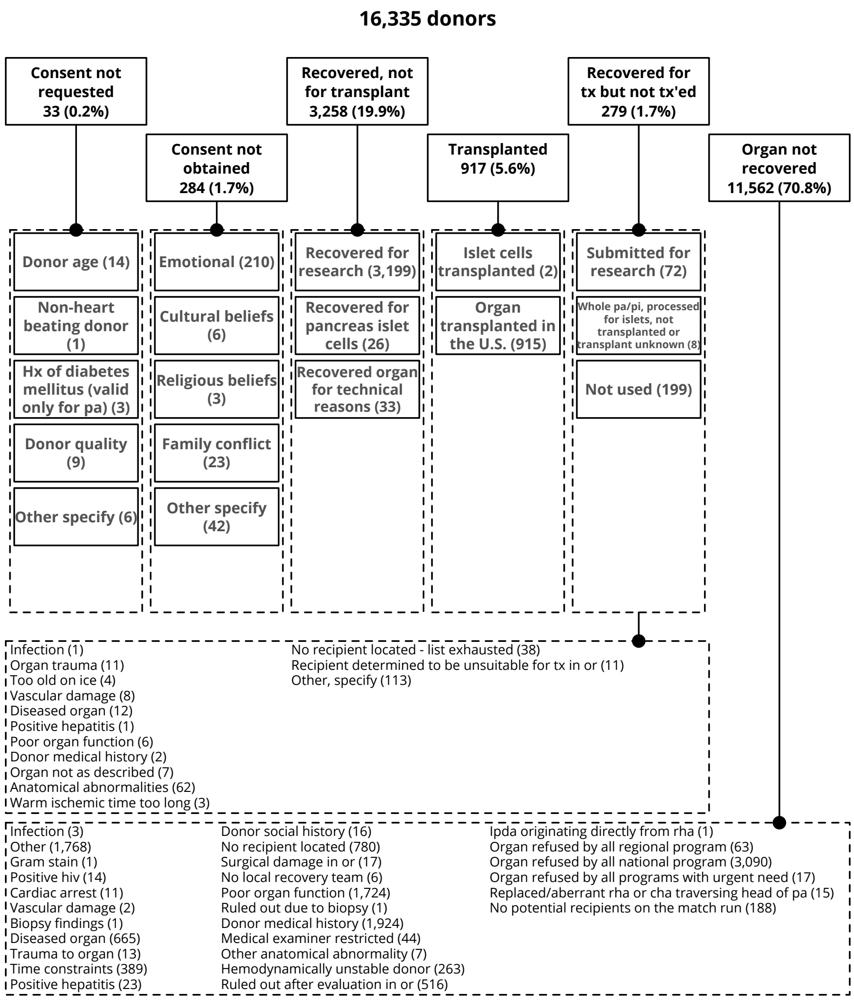
Figure DD 23: Organ use chart for reported right kidneys, 2023. A summary of the consent, recovered, transplanted, or nonuse status for donated right kidneys. The number of left and right kidneys may not equal the total number of donors. hiv, human immunodeficiency virus; or, operating room; tx, transplant.



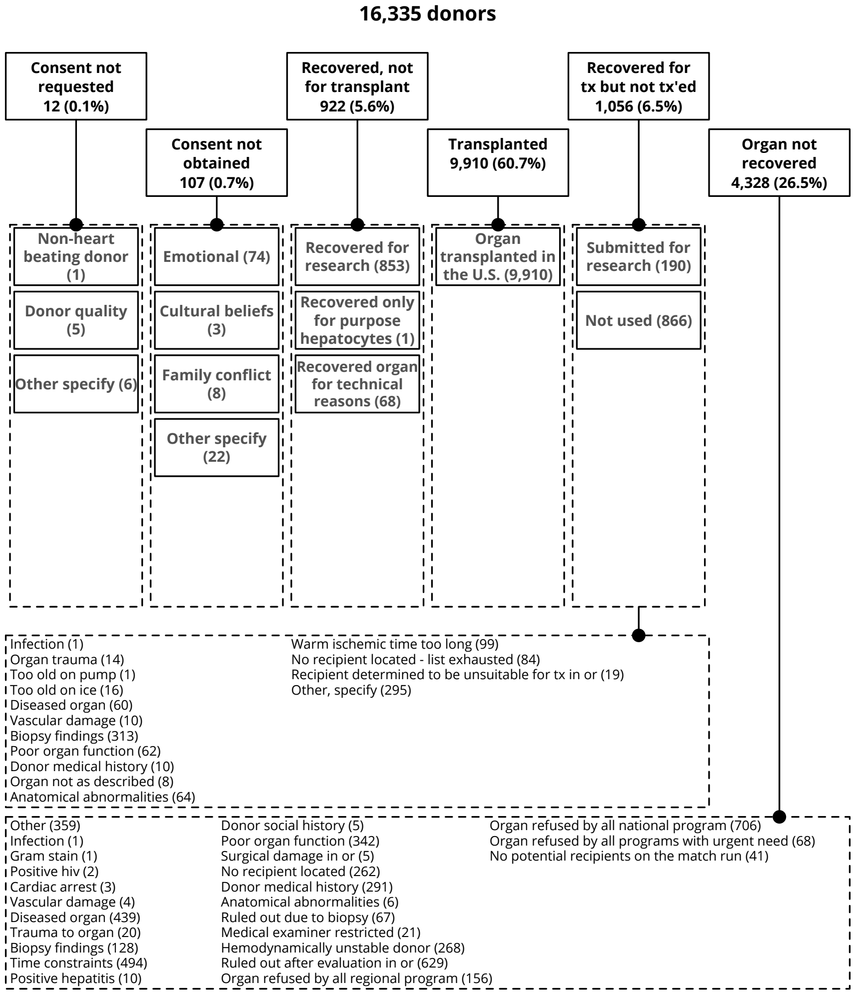
OPTN/SRTR 2023 Annual Data Report

Figure DD 24: Organ use chart for reported en bloc kidneys, 2023. A summary of the consent, recovered, transplanted, or nonuse status for donated en bloc kidneys. The number of en bloc kidneys may not equal the total number of donors. or, operating room; tx, transplant.



OPTN/SRTR 2023 Annual Data Report

Figure DD 25: Organ use chart for pancreas, 2023. A summary of the consent, recovered, transplanted, or nonuse status for donated pancreas. cha, common hepatic artery; hx, history; hiv, human immunodeficiency virus; ipda-sma, inferior pancreaticoduodenal artery-superior mesenteric artery; pa, pancreas; pi, pancreas islets; rha, right hepatic artery; tx, transplant.



OPTN/SRTR 2023 Annual Data Report

Figure DD 26: Organ use chart for liver, 2023. A summary of the consent, recovered, transplanted, or nonuse status for donated livers. hiv, human immunodeficiency virus; or, operating room; tx, transplant.

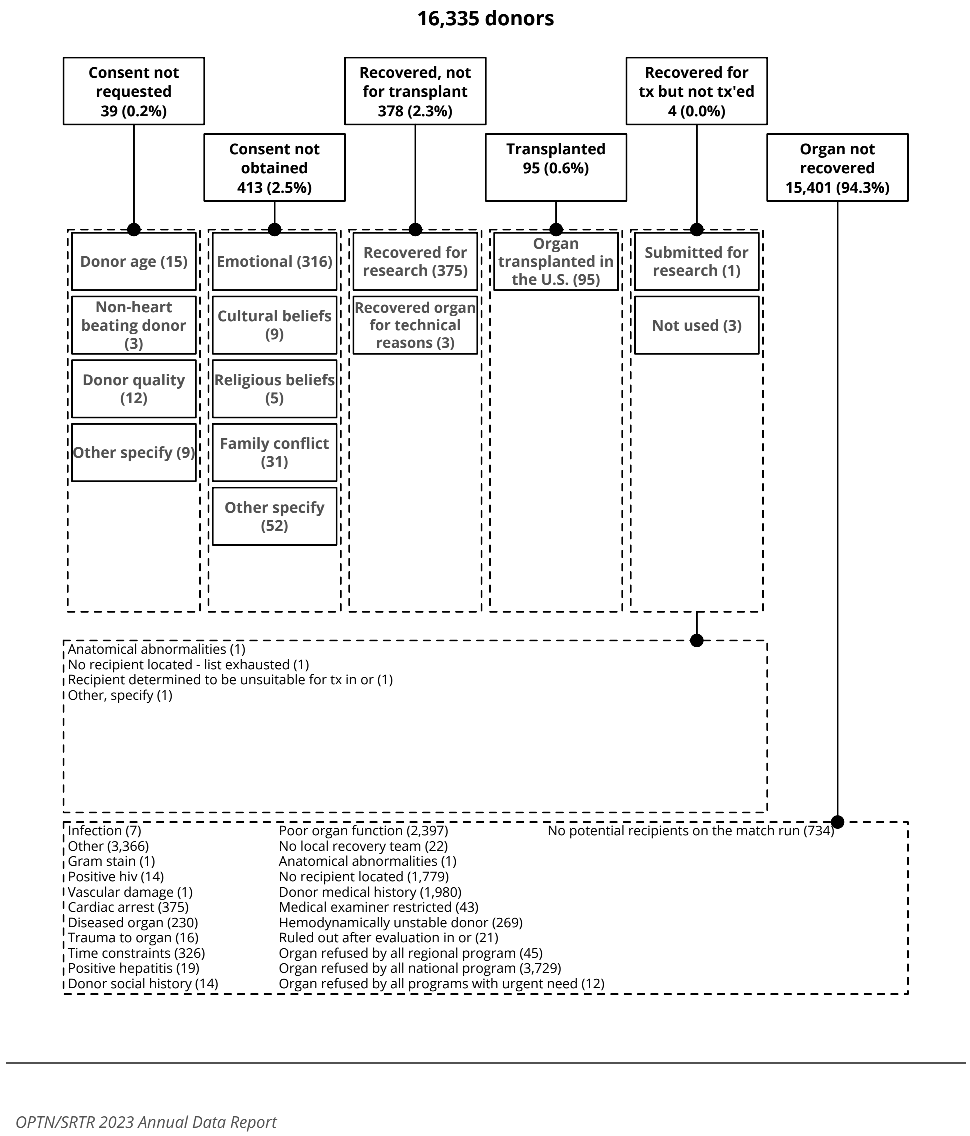
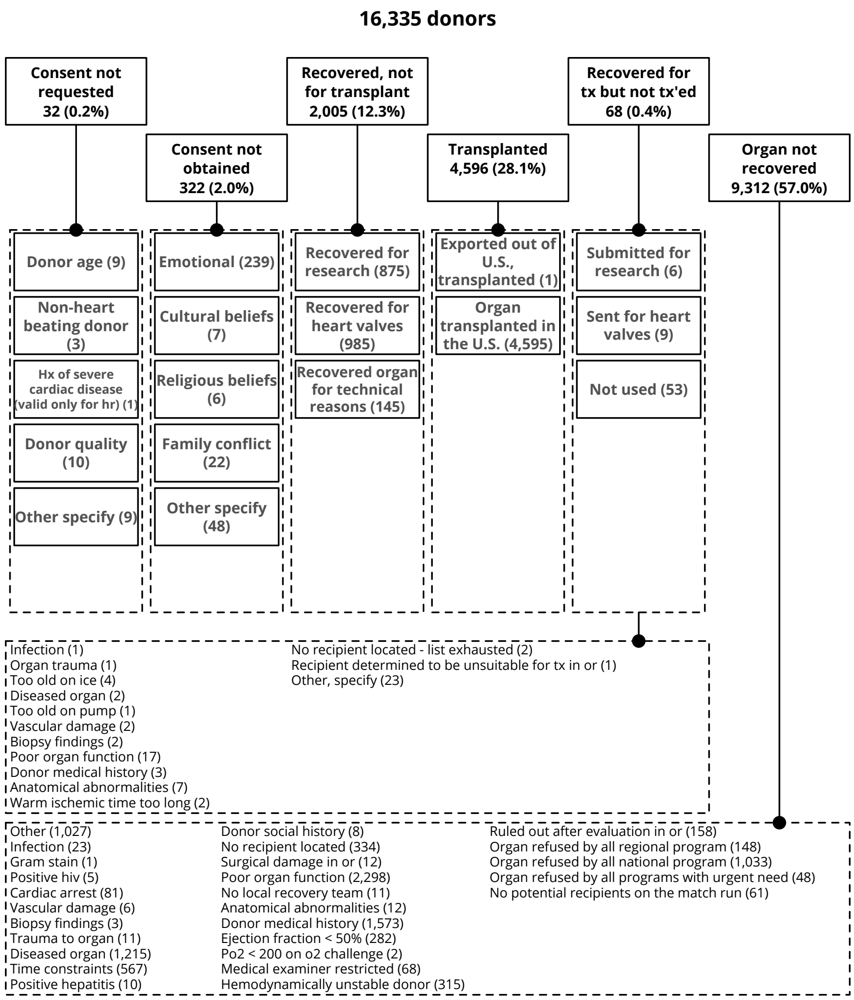


Figure DD 27: Organ use chart for intestine, 2023. A summary of the consent, recovered, transplanted, or nonuse status for donated intestines. hiv, human immunodeficiency virus; or, operating room; tx, transplant.



OPTN/SRTR 2023 Annual Data Report

Figure DD 28: Organ use chart for heart, 2023. A summary of the consent, recovered, transplanted, or nonuse status for donated hearts. hiv, human immunodeficiency virus; Hx, history; or, operating room; tx, transplant.

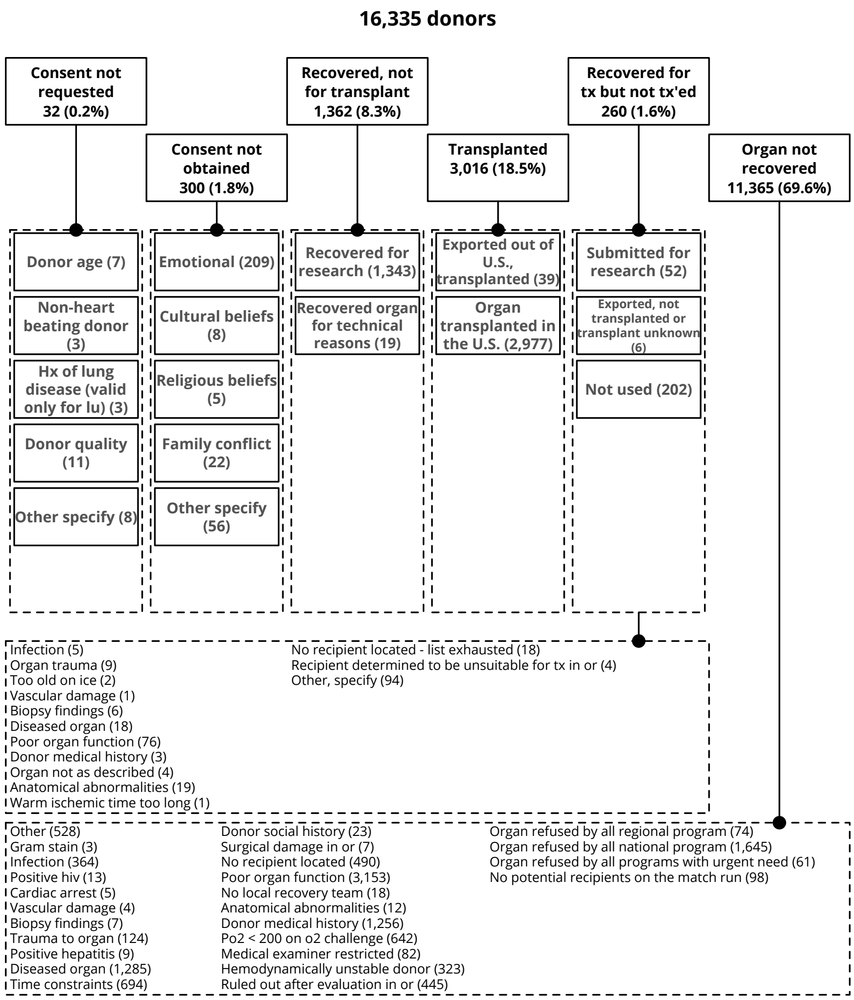


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Figure DD 29: Organ use chart for lung, 2023. A summary of the consent, recovered, transplanted, or nonuse status for donated lungs. hiv, human immunodeficiency virus; Hx, history; or, operating room; tx, transplant.

Table DD 1: Characteristics of deceased donors, 2013 and 2023. The way citizenship data are collected changed in 2012, so differences may be misleading. DBD, donation after brain death; DCD, donation after circulatory death; HCV, hepatitis C virus; KDPI, kidney donor profile index; NAT, nucleic acid test; NRP, normothermic regional perfusion.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
KDPI				
0-<20%	1707	20.6	2292	14
20-<35%	1072	13	1932	11.8
35-<85%	4030	48.7	8338	51
85-100%	1459	17.6	3767	23.1
Unknown/missing	1	0	6	0
HIV (NAT)				
Not Positive	0	0	16303	99.8
Positive	0	0	32	0.2
HCV (antibody or NAT)				
Not Positive	7908	95.6	15576	95.4
Positive	361	4.4	759	4.6
Citizenship				
US	7965	96.3	14750	90.3
Non-US	304	3.7	424	2.6
Other/unknown	0	0	1161	7.1
Sex				
Female	3363	40.7	6210	38
Male	4906	59.3	10125	62
Age				
<18 years	873	10.6	879	5.4
18-34 years	2319	28	3717	22.8
35-49 years	2158	26.1	4849	29.7
50-64 years	2285	27.6	5397	33
>=65 years	634	7.7	1493	9.1
Ethnicity				
Non-Latino/unknown	7093	85.8	13986	85.6
Latino	1176	14.2	2349	14.4
Race				
Asian	189	2.3	420	2.6
Black	1434	17.3	2628	16.1
White	6572	79.5	13003	79.6
Other/unknown	74	0.9	284	1.7
DCD status				
DCD without NRP	1174	14.2	5463	33.4
DCD with NRP	33	0.4	431	2.6
DBD	7062	85.4	10441	63.9

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Table DD 2: Characteristics of deceased donors, 2013 and 2023. Data and categories are from the Deceased Donor Registration form. The three table sections have the same totals (eg, 16,335 donors in 2023). CNS, central nervous system; MVA, motor vehicle accident; SIDS, sudden infant death syndrome.

	2013		2023	
Characteristic	**N**	**Percent**	**N**	**Percent**
Mechanism of Death				
Drowning	94	1.1	138	0.8
Seizure	75	0.9	183	1.1
Drug Intoxication	560	6.8	2714	16.6
Asphyxiation	398	4.8	727	4.5
Cardiovascular	1288	15.6	3489	21.4
Electrical	9	0.1	10	0.1
Gunshot Wound	742	9	994	6.1
Stab	12	0.1	21	0.1
Blunt Injury	1858	22.5	2599	15.9
SIDS	5	0.1	11	0.1
Stroke	2813	34	3996	24.5
Natural Causes	249	3	1104	6.8
Other/unknown	166	2	349	2.1
Circumstance of Death				
MVA	1299	15.7	1746	10.7
Suicide	796	9.6	1184	7.2
Homicide	404	4.9	472	2.9
Child-Abuse	80	1	42	0.3
Non-MVA Accident	880	10.6	3164	19.4
Natural Causes	3770	45.6	7927	48.5
Other/unknown	1040	12.6	1800	11
Cause of Death				
Anoxia	2600	31.4	8076	49.4
Stroke	2760	33.4	3924	24
Head Trauma	2682	32.4	3565	21.8
CNS Tumor	37	0.4	53	0.3
Other/unknown	190	2.3	717	4.4

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