

OPTN/SRTR 2015 Annual Data Report: Heart

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Abstract

The number of heart transplant candidates and transplants performed continued to rise each year. In 2015, 2819 heart transplants were performed. In addition, the number of new adult candidates on the waiting list increased 51% since 2004. The number of adult heart transplant survivors continued to increase, and in 2015, 29,172 recipients were living with heart transplants. Patient mortality following transplant has declined. The number of pediatric candidates and transplants performed also increased. New listings for pediatric heart transplants increased from 451 in 2004 to 644 in 2015. The number of pediatric heart transplants performed each year increased from 297 in 2004 to 460 in 2015. Among pediatric patients who underwent transplant in 2014, death occurred in 7.2% at 6 months and 9.6% at 1 year.

Keywords: End-stage heart failure, heart transplant, transplant outcomes, ventricular assist device.

1 Introduction

Heart transplant continues to afford advanced heart failure patients the best option for long-term survival. The number of heart transplant candidates who are listed and the number of heart transplants performed continue to increase. Mechanical circulatory support has provided attractive alternatives for heart failure patients who do not qualify for transplant and a mechanism for longer survival while awaiting transplant for those who do. The number of left ventricular assist devices (LVADs) implanted worldwide exceeds 20,000, and the number of candidates and recipients with VADs has increased dramatically. More patients are undergoing transplant at higher urgency categories and waiting times are increasing. Despite this, posttransplant survival is improving and waitlist mortality has declined. Recent efforts to revise the heart allocation system are anticipated to provide better risk stratification and affect the waiting time of the most critically ill patients. In this report, we highlight the most significant trends in heart transplant over the past decade.

2 Adult Heart Transplant

2.1 Waitlist Trends: New Listings, Time to Transplant, and Waitlist Mortality

The number of candidates awaiting heart transplant has steadily increased since 2007 (Figure HR 2). Between 2004 and 2015, the number of new active listings increased by 51% (Figure HR 1). The number of candidates actively awaiting heart transplant on December 31 increased 90% from 1525 in 2004 to 2904 in 2015; however, the number of inactive candidates decreased 39% during that period (Figure HR 2). The heart transplant waiting list is aging, with a slow but steady increase in numbers of candidates aged 65 years or older. In 2015, 18% of candidates were aged 65 years or older; however, most were aged 50 to 65 years (Figure HR 3). Ethnic diversity is increasing. In 2004, 74.3% of candidates were white. In 2015, the proportion of white candidates declined to 62.6% due to increased proportions of all ethnic groups, but most notably of black candidates, whose proportion increased from 15.4% in 2004 to 24.9% in 2015 (Figure HR 4). Cardiomyopathy remained the most prevalent indication for transplant and its proportion increased to 57.8% of candidates in 2015 (Figure HR 5). The proportion of candidates on the waiting list for less than 1 year has fluctuated, peaking at 64.8% in 2009 and declining since to 59.9%, while the proportion on the list for 1 to 2 years increased to 20.1% (Figure HR 6). Similar fluctuations occurred for candidates listed for 2 to 4 years, with a slight overall increase, but a continuing decrease in those listed for 5 or more years. The trends among candidates at the highest urgency categories continued to be remarkable. The proportion of status 1A and 1B candidates has almost doubled since 2004 (Figure HR 7). In 2015, 43.9% of candidates were status 1A and 30.9% were status 1B, compared with 22.0% and 15.8%, respectively, in 2004. Status 2 candidates have declined from 37.3% to 17.3%. Inactive candidates were much rarer, only 8.0% in 2015. Sex distribution remained stable (Figure HR 9), while use of VADs, as reported at listing, continued to increase, to 29.4% of candidates in 2015, compared with only 18.1% in 2010 (Figure HR 8).

Over the past decade, heart transplant rates (Figure HR 11, Figure HR 12, Figure HR 13) peaked at 149 transplants per 100 waitlist years in 2007, and gradually declined to 79.3 in 2015, with similar trends in many subgroups (Figure HR 13). Candidates aged 65 years or older underwent transplant at a higher rate, 84.8 per 100 waitlist years, than the other age groups (Figure HR 11). The transplant rate was lowest among candidates aged 18 to 34 years. In 2015, wide variability remained in transplant rates by blood type (Figure HR 12). Candidates with blood type AB underwent heart transplant at a rate of 281.8 per 100 waitlist years, more than 5-fold higher than for those with blood type O, 55.5 per 100 waitlist years. Candidates with blood type A underwent transplant at a rate of 99.7 per 100 waitlist years. Finally, although transplant rates have declined among all status groups since 2006, the gap has widened between status 1A and 1B candidates (Figure HR 13). In 2015, the transplant rate among status 1A candidates was 406.1 per 100 waitlist years, compared with 43.1 for status 1B candidates and 7.0 for candidates listed as status 2. Geographic variability in access to donor hearts persisted. On average, 51.1% of candidates listed in 2014 underwent transplant in less than 1 year; however, the proportion of candidates undergoing transplant within this time frame varied from 14.3% to 100% depending on the donation service area (DSA) (Figure HR 20). Among DSAs with more than 10 candidates, the proportion of candidates undergoing transplant in less than 1 year ranged from 18.8% to 69.8%.

Of candidates listed in 2012, 54.3% underwent transplant during the first year on the waiting list, 30.7% were still waiting, and 7.8% had died (Figure HR 14). At 3 years, 10.1% had died, 13.5% had been removed from the list, 67.0% had undergone transplant, and 9.4% were still waiting.

In 2004, approximately 50% of candidates had undergone transplant within 6 months of listing; however, in 2014, this proportion declined to only 36.8% (Figure HR 19). Among candidates listed in 2014, 48.2% had undergone transplant within a year, compared with 60.2% of candidates listed in 2004. Despite a decline in 2006-2007, the median time to transplant has increased substantially since 2004-2005, from 5.3 months to 12.4 months in 2014-2015 (Figure HR 15). Women waited 9.9 months and men almost 3 months longer. Candidates with blood type AB waited 2.9 months and those with blood type O 22.3 months (Figure HR 16). Candidates listed as status 1A waited 3.7 months; those listed as status 1B waited substantially longer, 11.4 months (Figure HR 17). Time to transplant also varied by body mass index (BMI); candidates with BMI ≥ 31 kg/m² waited 20.5 months, and those with BMI 23 kg/m² or less waited 6.4 months (Figure HR 18). Candidates with BMI 24-26 kg/m² waited a median of 9.8 months.

Pretransplant mortality continued to decline and reached 10.6 per 100 waitlist years in 2014-2015 (Figure HR 21). While pretransplant mortality declined in most subgroups over the past 10 years, increases occurred in the most recent era for candidates aged 50-64 years, candidates with congenital heart disease (Figure HR 24), inactive candidates (Figure HR 25), and women (Figure HR 23). Inactive candidates make up one of the few subgroups with fairly consistent increases in pretransplant mortality over the past 10 years, 26.8 deaths per 100 waitlist years in 2014-2015, compared with 15.5 in 2004-2005. In the most recent 2-year period, the pretransplant mortality rate was lowest for candidates aged 18 to 34 years, 8.5 per 100 waitlist years. Of note, pretransplant mortality among candidates with VADs at listing has steadily declined and was 8.5 deaths per 100

waitlist years in 2014-2015, compared with 11.4 among candidates without VADs (Figure HR 26). This should be interpreted cautiously, however, since candidates without a VAD at listing may have received one after listing. Also notable, pretransplant mortality among status 1A candidates reached a low of 16.4 deaths per 100 waitlist years, still substantially higher than among status 1B (4.5) and 2 (3.5) candidates. The high mortality among inactive candidates suggests that many were too ill to be made active. As with time to transplant, pretransplant mortality varied geographically. Pretransplant mortality based on DSA ranged from 2.9 to 22.8 deaths per 100 waitlist years (Figure HR 27). Deaths within 6 months of removal from the waiting lists have fluctuated, peaking at 33.4% in 2013 and declining to 21.4% in 2015 (Figure HR 28). The overall increase since 2005 is mostly due to increases in death after removal among inactive candidates; this group has made up over half of the deaths after removal (data not shown). Candidates at status 1A at the time of removal had the highest percentage of deaths within 6 months after removal.

In 2015, similar to 2005, the typical heart transplant candidate was white, male, and aged 50-64 years (Table HR 1). Since 2005, however, candidates have been more likely to be diagnosed with cardiomyopathy, be listed as status 1A or 1B, and have a VAD. In 2015, 43.8% of candidates were listed as status 1B, compared with 11.3% in 2005. The proportion of candidates listed as status 1A increased from 1.9% to 10.0% during this time. The number of candidates with VADs increased from 138 in 2005 to 1174 in 2015.

2.2 Donor Trends

Overall, the deceased heart donor rate was 2.8 per 1000 deaths, but it varied by state, ranging from 0.09 to 4.94 per 1000 deaths (Figure HR 31). Forty-nine percent of donors were aged 18 to 34 years (Figure HR 29). Rates of hearts recovered for transplant but not transplanted reached a nadir in 2008-2011 and have trended up since (Figure HR 32). In 2014-2015, 1.1% of recovered hearts were not transplanted. The upswing is most notable among age groups 18 to 34 and 50 years or older.

Head trauma remained the most common cause of death among heart donors; however, an increasing proportion of deaths were due to anoxia, 33% in 2015 (Figure HR 33). Since 2004, anoxia has tripled in prevalence as cause of death, surpassing cerebrovascular accident and stroke.

2.3 Overall Trends in Heart Transplant

In 2015, 2819 heart transplants were performed, 460 of which were in pediatric recipients, an increase of 37.2% since 2004 (Figure HR 34). Although recipients aged 50 to 64 years made up the greatest proportion of heart transplant recipients, a relatively large increase occurred since 2014 among recipients aged 35 to 49 years (Figure HR 35). Increases occurred in all subgroups since 2004, except for recipients with valvular heart disease for whom, despite yearly variation, the overall trend was downward (Figure HR 38).

2.4 Recipient Characteristics

In 2015, most heart transplant recipients were aged 50-64 years; however, the proportion aged 65 years or older increased to 18.9%, compared with 11.4% in 2005 (Table HR 5). The typical recipient was white, male, with blood type A or O, representing no substantial change since 2005. However, a greater proportion of recipients were non-white, and more recipients underwent transplant at status 1A than in 2005. The proportion of recipients who underwent transplant at status 2 declined precipitously from 28.8% in 2005 to 2.6% in 2015. VADs at transplant were much more prevalent in 2015 than in 2005, 48.4% vs. 28.9%. In addition, coronary artery disease was less prevalent among recipients in 2015 than in 2005. Most patients had private payers; however, in 2005 56.9% of recipients had private payers and 48.7% in 2015, due to more recipients with Medicare. Retransplant declined since 2005 to 2.9% of heart transplants in 2015. Heart-lung transplants declined, but the number of heart-kidney transplants increased from 53 to 140 and the number of heart-liver transplants from 5 to 27. Waiting time increased, as evidenced by a shift in the proportion of recipients who waited longer than 6 months. The number and proportion of patients on any form of life support increased from 1547 (76.8%) in 2005 to 1990 (84.4%) in 2015 (Table HR 4). Most patients on life support had either intravenous inotropes or LVADs. In 2015, the proportion of recipients with an LVAD at transplant increased to 44.8%. Intra-aortic balloon pumps also increased from 5.0% to 7.0%, extracorporeal membrane oxygenation was similar at 1.0% both years, and the proportion of total artificial hearts increased from 1.3% to 1.7%. Ventilator use declined from 2.9% to 1.0%

2.5 Posttransplant Survival and Morbidity

One-year survival for patients who underwent heart transplant 2008-2010 was 89.6%, 3-year survival was 82.9%, and 5-year survival 77.0% (Figure HR 47). One-year survival among many subgroups was similar to overall survival but tended to be lower among recipients who were aged 65 years or older (Figure HR 45), black (Figure HR 46), or status 2 at transplant (Figure HR 50). After the first year posttransplant, however, survival declined more rapidly for recipients aged 18 to 35 years, black recipients, and retransplant recipients. By 5 years, survival was 73.8% for recipients aged 18 to 34 years, 72.2% for black recipients, and 74.5% among retransplant recipients. Survival did not differ meaningfully between the medical urgency categories at any time, but tended to be lower for status 2 recipients. Since 2004, patient death after transplant decreased overall at 6 months and at 1, 3, and 5 years, despite slight increases in 6-month and 1- and 3-year mortality between 2013 and 2014 (Figure HR 51). The number of heart transplant survivors has increased since 2004. On June 30, 2015, 29,172 heart transplant recipients were alive with a functioning graft; most had undergone transplant at age 50 years or older (Figure HR 52).

The incidence of acute rejection in the first year posttransplant decreased from 25.1% among recipients who underwent transplant 2009-2010 to 23.0% among recipients who underwent transplant 2013-2014 (Figure HR 53). Acute rejection was least prevalent in recipients aged 65 years or older, occurring in only 18.3%, and most prevalent in recipients aged 18 to 34 years, 30.2%. Posttransplant lymphoproliferative disorder (PTLD) remained uncommon, with an overall cumulative incidence of only 1% by 5 years posttransplant (Fig-

ure HR 54). The most common documented causes of death in the first posttransplant year were infection, cardiovascular/cerebrovascular disease, and graft failure (Figure HR 55). By the second year, cardiovascular/cerebrovascular disease was the leading documented cause of death through year 5 (Figure HR 56). Malignancy was relatively infrequent as a cause of death, 1.7% of deaths at 5 years.

3 Pediatric Heart Transplant

3.1 Pediatric Waitlist Trends

In 2015, the number of new pediatric candidates added to the heart transplant waiting list continued its increase to the highest number yet, 644, with few at inactive status (Figure HR 57). At year-end 2015, 370 candidates listed before their eighteenth birthdays were awaiting heart transplant, 62.4% active (Figure HR 58). The largest pediatric age group on the waiting list in 2015 was 11 to 17 years (34.0%), followed by ages younger than 1 year (25.8%), 1 to 5 years (24.2%), and 6 to 10 years (16.0%) (Figure HR 59). Over half of heart transplant candidates were white, 21.2% were Hispanic, 17.3% were black, and 5.2% were Asian (Figure HR 60). The proportion of waitlist candidates aged younger than 1 year almost doubled from 7.6% on December 31, 2005, to 14.0% on December 31, 2015 (Table HR 7). The proportion of male candidates remained high, 60.7%. The proportion of Hispanic candidates increased from 16.4% on December 31, 2005, to 24.9% on December 31, 2015. For candidates waiting on December 31, 2015, congenital defect was the leading cause of heart disease (53.6%). Thirty-three percent of candidates were listed as status 1A in 2015, compared with only 10.5% in 2005. Increases in status 1B listings were also increased, from 7.1% in 2005 to 13.4% in 2015. The percentage of candidates using VADs at the time of listing increased from 2.1% in 2005 to 4.4% in 2015. Listings for heart-only transplants increased from 90.3% in 2005 to 98.4% in 2015, and listings for heart-lung and heart-kidney transplants decreased to less than 1%. Among candidates removed from the waiting list in 2015, 463 (72.9%) were removed due to undergoing transplant, 80 (12.6%) died, 48 (7.6%) were removed due to improved condition, and 24 (3.8%) were considered too sick to undergo transplant (Table HR 9).

Nearly 75% of candidates newly listed in 2012 underwent transplant within 3 years, 9.7% died, 11.7% were removed from the list, and 4.3% were still waiting (Figure HR 64). The rate of heart transplants among active pediatric waitlist candidates decreased from a peak of almost 300 per 100 waitlist years in 2006 to 189 per 100 waitlist years in 2015, likely attributable to a growing waiting list. Transplant rates varied by age, with the highest rates for candidates aged younger than 1 year, at 401 transplants per 100 waitlist years in 2015, followed by candidates aged 11 to 17 years, at 187 transplants per 100 waitlist years (Figure HR 65). Pretransplant mortality remained stable at 21.8 deaths per 100 waitlist years in 2014-2015 (Figure HR 66). The pretransplant mortality rate was highest for candidates aged younger than 1 year, at 42.9 deaths per 100 waitlist years in 2014-2015, followed by candidates aged 1 to 5 years at 18.5, 6 to 10 years at 16.8, and 11 to 17 years at 8.3. Regarding cause of disease, pretransplant mortality was highest for candidates with dilated myopathy/myocarditis or congenital defects (Figure HR 68).

Pretransplant mortality was highest for status 1A candidates (34.1 deaths per 100 waitlist years) and inactive candidates (32.0), compared with 4.3 and 0.6 for status 1B and status 2 candidates, respectively (Figure HR 69).

3.2 Pediatric Transplant

The number of pediatric heart transplants performed each year increased from 297 in 2004 to 460 in 2015 (Figure HR 70). In 2015, 36 of 127 total heart transplant centers performed pediatric heart transplants exclusively, compared with 23 centers in 2004 (Figure HR 71). Over the past decade, the age, sex, and race of pediatric heart transplant recipients changed little. Congenital defects remained the most common primary cause of disease, affecting 45.3% of recipients who underwent transplant in 2012-2015. The proportion of ABO-incompatible transplants in 2012-2015 was 3.7%, increased from 1.7% a decade earlier. The proportion of patients who underwent transplant as status 1A increased from 72.0% in 2002-2005 to 88.6% in 2012-2015. VAD use tripled from only 8.8% of transplant recipients in 2002-2005 to 24.6% in 2012-2015 (Table HR 10).

3.3 Pediatric Immunosuppression and Outcomes

In 2015, the most common induction therapy was T-cell depleting agents, used in 64.2% of heart transplant recipients, followed by interleukin-2 receptor antagonists (IL-2-RA) in 14.4%. No induction therapy was reported in 22.8% of recipients (Figure HR 72). Regarding induction use by panel-reactive antibody (PRA), T-cell depleting agents were generally used more frequently for the most sensitized patients, while IL-2-RA was used less frequently for sensitized patients (Figure HR 77). The initial immunosuppression agents used most commonly in 2015 were tacrolimus (88.7%, Figure HR 73), mycophenolate (93.1%, Figure HR 74), and steroids (60.0%, Figure HR 76). In 2014, mammalian target of rapamycin inhibitors were used in only 1.2% of recipients at the time of transplant, but use increased to 13.8% at 1 year posttransplant (Figure HR 75). Among patients who underwent transplant in 2014, steroid use was 67.2% at transplant and 58.7% at 1 year posttransplant (Figure HR 76).

Among pediatric heart transplant recipients from 2011 to 2015, 46.5% were cytomegalovirus (CMV) negative and 43.4% were Epstein-Barr virus (EBV) negative (Table HR 12). The combination of a CMV-positive donor and CMV-negative recipient occurred in 23.5% of transplants; for EBV, this occurred in 29.7% of transplants.

Recipient death occurred in 7.2% at 6 months and 9.6% at 1 year among heart transplants performed in 2014, in 10.6% at 3 years for transplants performed in 2012, in 14.9% at 5 years for transplants performed in 2010, and in 33.6% at 10 years for transplants performed in 2005 (Figure HR 81). Overall, 1-year and 5-year patient survival were 88.7% and 77.2%, respectively, among recipients who underwent transplant in 2003-2010 (Figure HR 82). By age, 5-year patient survival was 71.2% for recipients aged younger than 1 year, 78.4% for ages 1 to 5 years, 87.5% for ages 6 to 10 years, and 77.4% for ages 11 to 17 years (Figure HR 82). The leading identified causes of death in the first 5 years posttransplant were graft failure (5.4%) and cardio/cerebrovascular disease (4.8%) (Figure HR 84).

The incidence of PTLD among EBV-negative recipients was 5.5% at 5 years posttransplant, compared with 2.5% among EBV-positive recipients (Figure HR 80). The overall incidence of first acute rejection in the first posttransplant year was 17.8% in 2013-2014 (Figure HR 79). By age, the highest incidence of rejection was 25.6% in the group aged 6 to 10 years.

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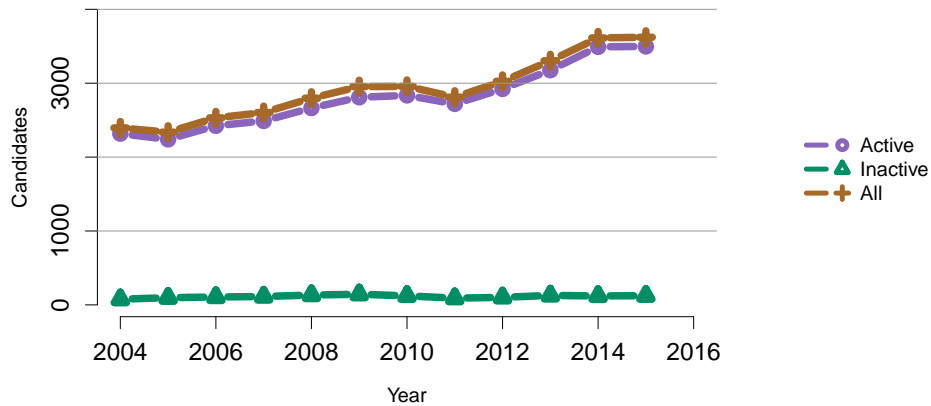


Figure HR 1. New adult candidates added to the heart transplant waiting list. A new candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and subsequently relisted are considered new. Candidates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

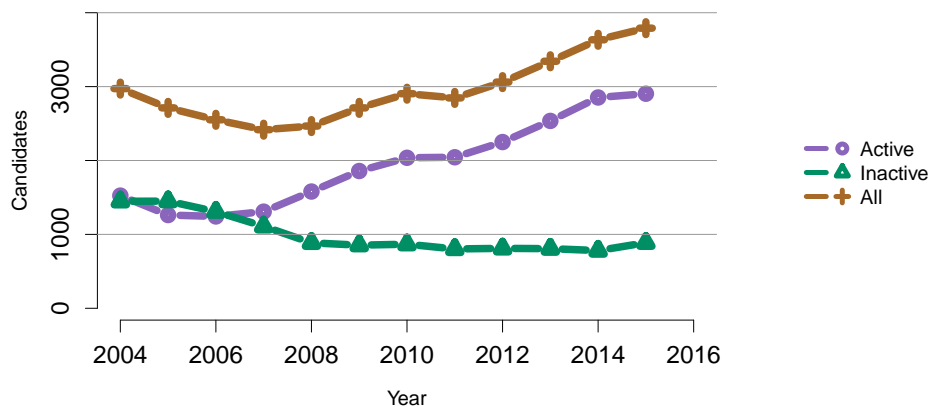


Figure HR 2. Adults listed for heart transplant on December 31 each year. Candidates concurrently listed at multiple centers are counted once. Those with concurrent listings and active at any program are considered active.

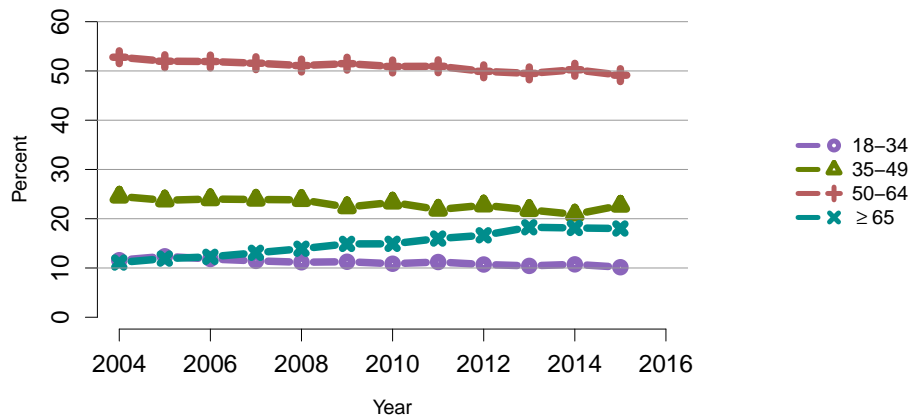


Figure HR 3. Distribution of adults waiting for heart transplant by age. Candidates waiting for transplant at any time in the given year. Candidates listed concurrently at multiple centers are counted once. Age is determined at the later of listing date or January 1 of the given year. Active and inactive candidates are included.

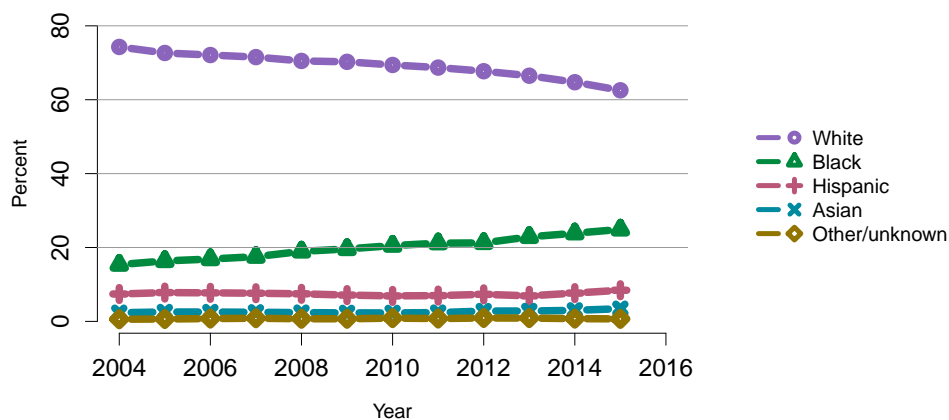


Figure HR 4. Distribution of adults waiting for heart transplant by race. Candidates waiting for transplant at any time in the given year. Candidates listed concurrently at multiple centers are counted once. Active and inactive candidates are included.

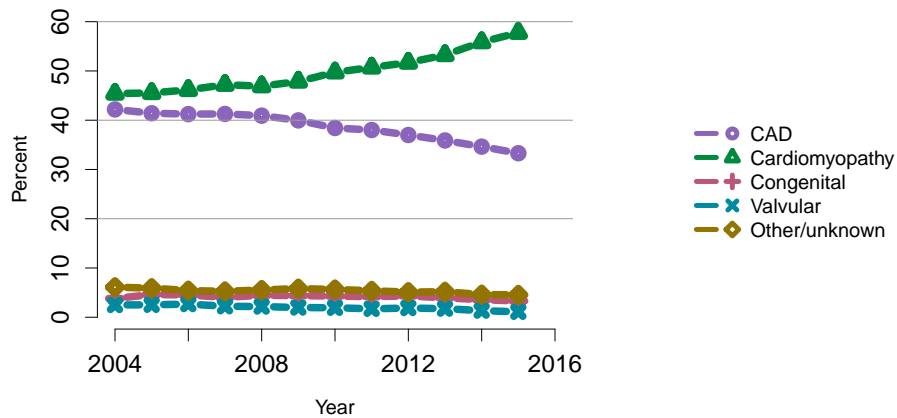


Figure HR 5. Distribution of adults waiting for heart transplant by diagnosis. Candidates waiting for transplant at any time in the given year. Candidates listed concurrently at multiple centers are counted once. Active and inactive patients are included. CAD, coronary artery disease.

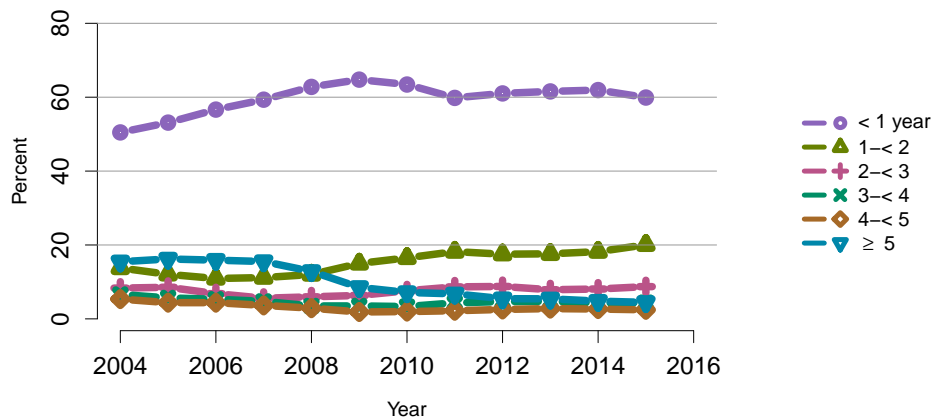


Figure HR 6. Distribution of adults waiting for heart transplant by waiting time. Candidates waiting for transplant at any time in the given year. Candidates listed concurrently at multiple centers are counted once. Time on the waiting list is determined at the earlier of December 31 or removal from the waiting list. Active and inactive candidates are included.

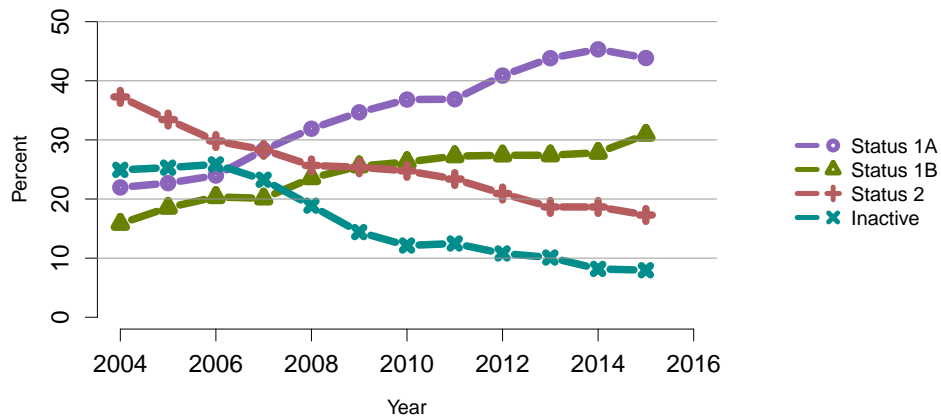


Figure HR 7. Distribution of adults waiting for heart transplant by medical urgency. Candidates waiting for transplant at any time in the given year. Candidates listed concurrently at multiple centers are counted once. Medical urgency status is the most severe during the year. Active and inactive patients are included.

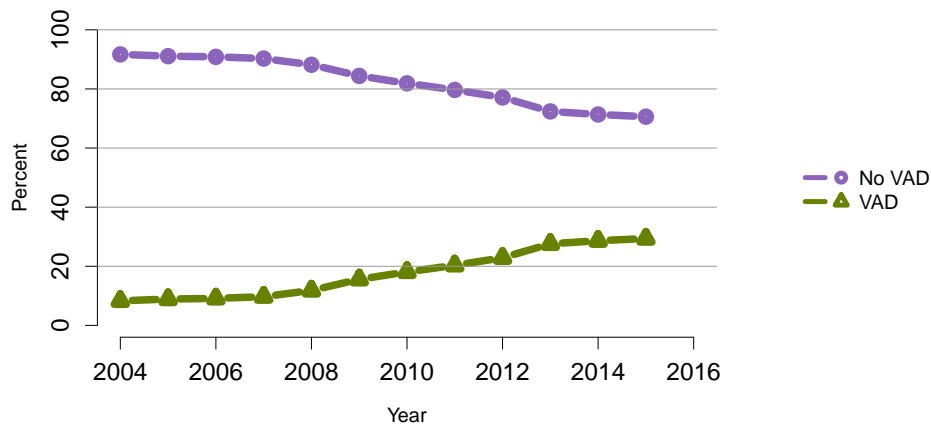


Figure HR 8. Distribution of adults waiting for heart transplant by VAD status at listing. Candidates waiting for transplant at any time in the given year. Candidates listed concurrently at multiple centers are counted once. Active and inactive patients are included. VAD, ventricular assist device.

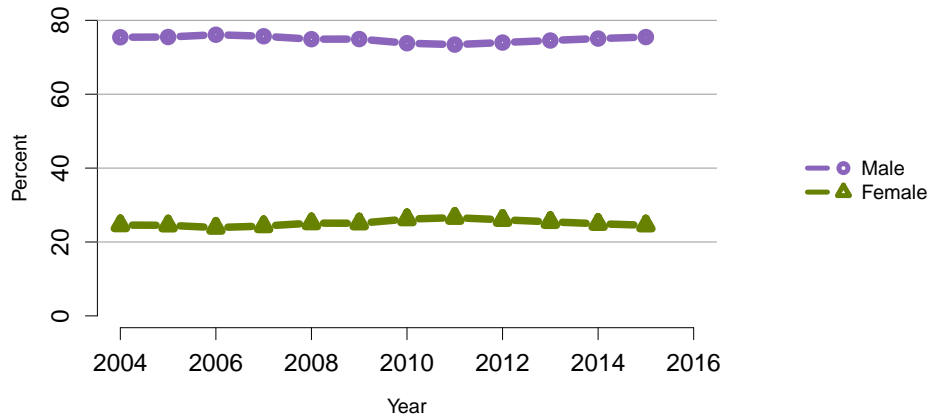


Figure HR 9. Distribution of adults waiting for heart transplant by sex. Candidates waiting for transplant at any time in the given year. Candidates listed concurrently at multiple centers are counted once. Active and inactive patients are included.

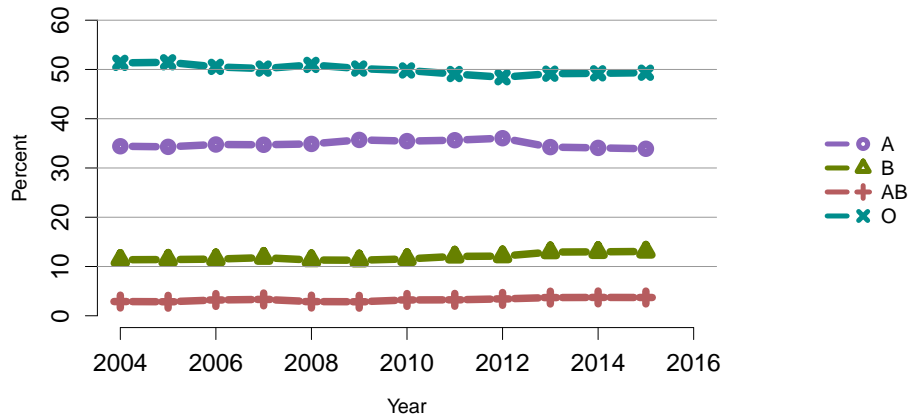


Figure HR 10. Distribution of adults waiting for heart transplant by blood type. Candidates waiting for transplant at any time in the given year. Candidates listed concurrently at multiple centers are counted once. Active and inactive patients are included.

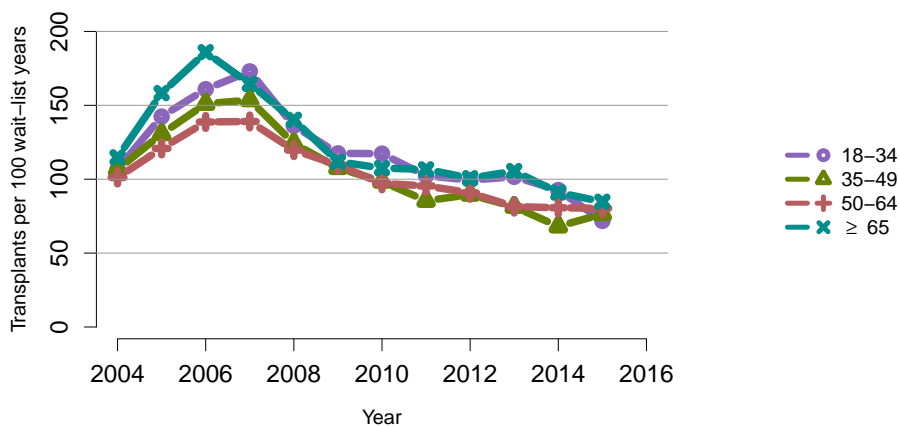


Figure HR 11. Deceased donor heart transplant rates among active adult waitlist candidates by age. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of active wait time in a given year. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year. Rates with less than 10 patient-years of exposure are not shown.

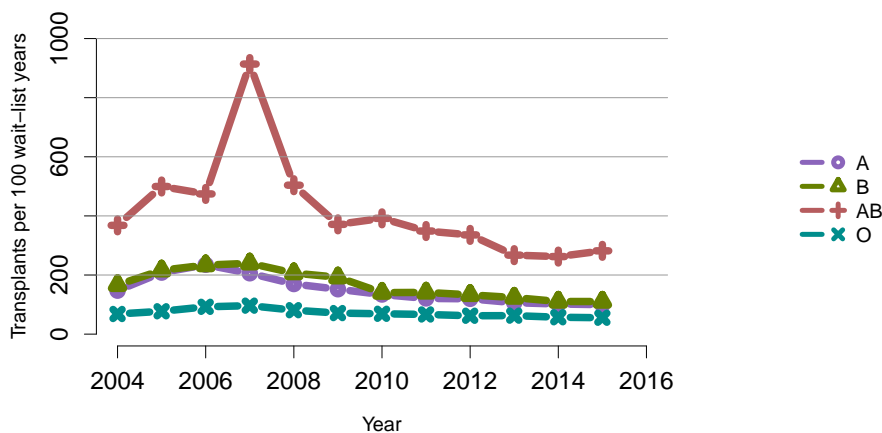


Figure HR 12. Deceased donor heart transplant rates among active adult waitlist candidates by blood type. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of active wait time in a given year. Individual listings are counted separately. Rates with less than 10 patient-years of exposure are not shown.

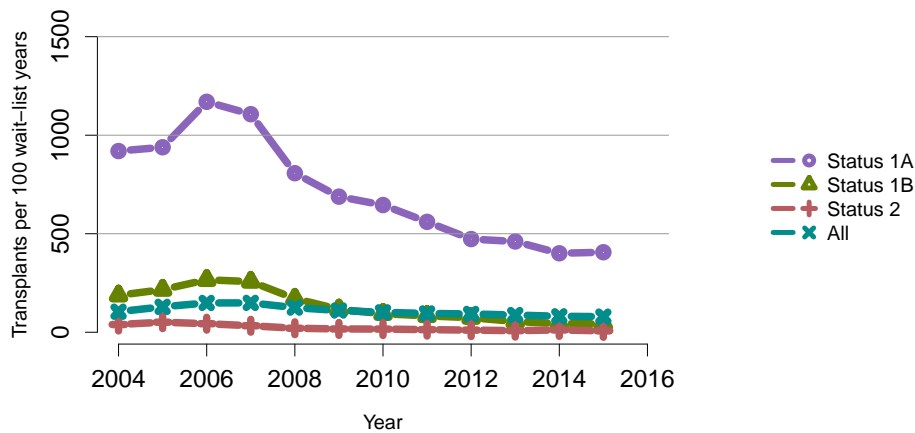


Figure HR 13. Deceased donor heart transplant rates among active adult waitlist candidates by medical urgency. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of active wait time in a given year. Individual listings are counted separately. Rates with less than 10 patient-years of exposure are not shown.

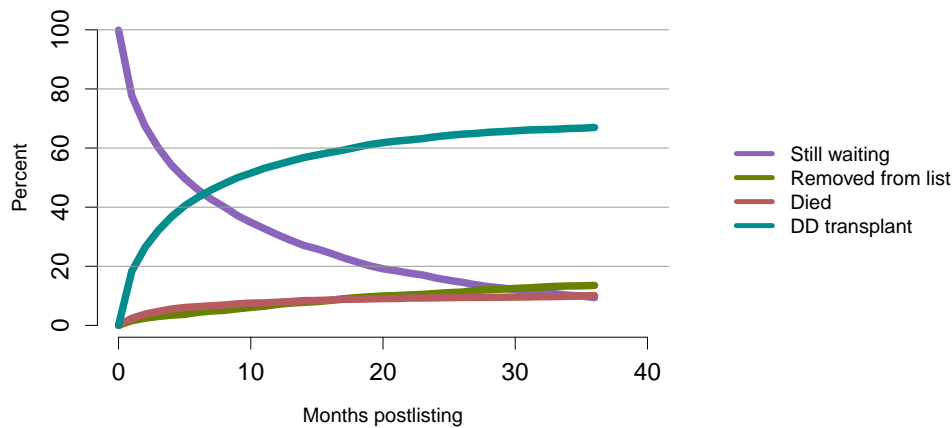


Figure HR 14. Three-year outcomes for adults waiting for heart transplant, new listings in 2012. Adults waiting for heart transplant and first listed in 2012. Candidates concurrently listed at more than one center are counted once, from the time of earliest listing to the time of latest removal. DD, deceased donor.

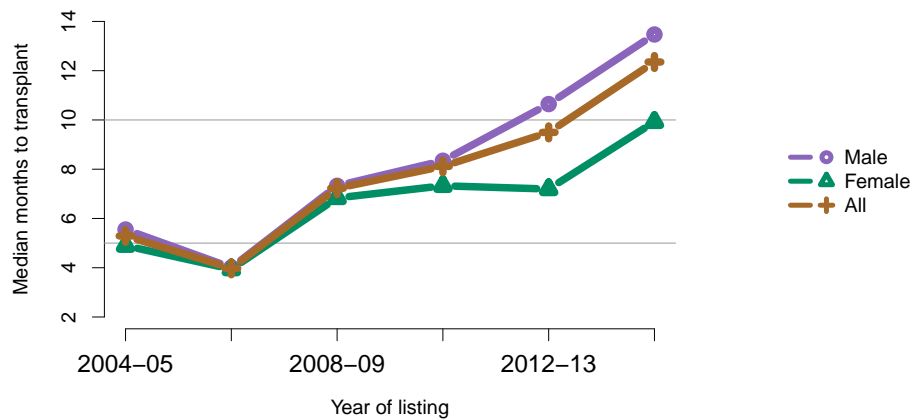


Figure HR 15. Median months to heart transplant for waitlisted adults by sex. Observations censored on December 31, 2015; Kaplan-Meier competing risk methods used to estimate time to transplant. Analysis performed per candidate, not per listing. If an estimate is not plotted, 50% of the cohort listed in that year had not undergone transplant by the censoring date. Only the first transplant is counted.

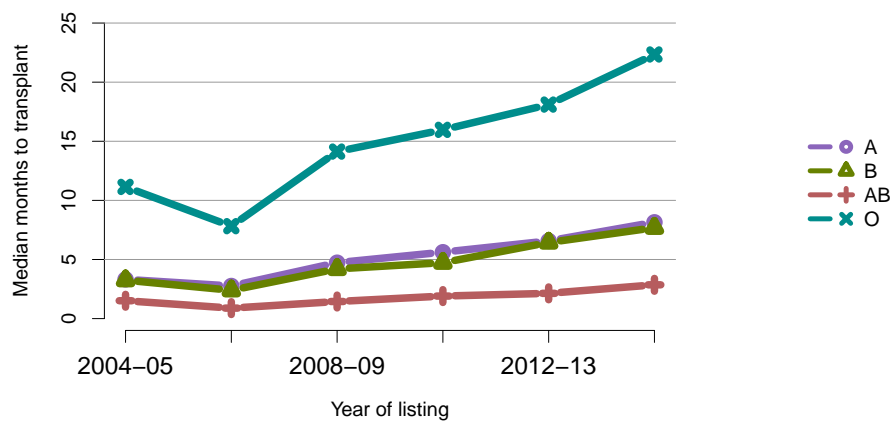


Figure HR 16. Median months to heart transplant for waitlisted adults by blood type. Observations censored on December 31, 2015; Kaplan-Meier competing risk methods used to estimate time to transplant. Analysis performed per candidate, not per listing. If an estimate is not plotted, 50% of the cohort listed in that year had not undergone transplant by the censoring date. Only the first transplant is counted.

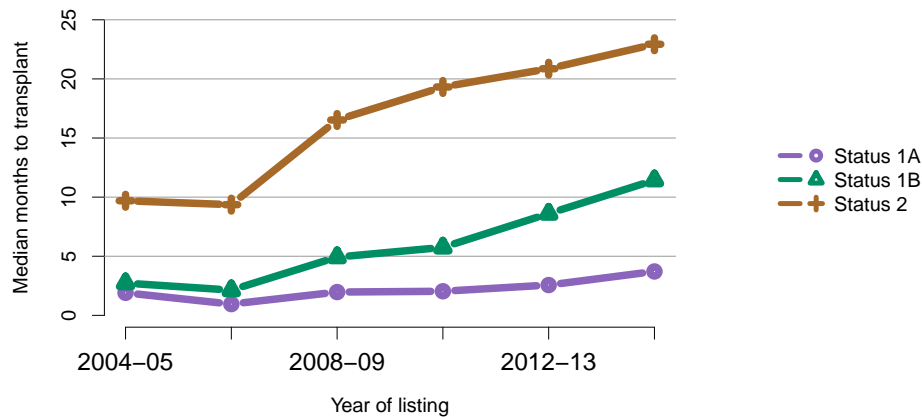


Figure HR 17. Median months to heart transplant for waitlisted adults by medical urgency at listing. Observations censored on December 31, 2015; Kaplan-Meier competing risk methods used to estimate time to transplant. Analysis performed per candidate, not per listing. If an estimate is not plotted, 50% of the cohort listed in that year had not undergone transplant by the censoring date. Only the first transplant is counted.

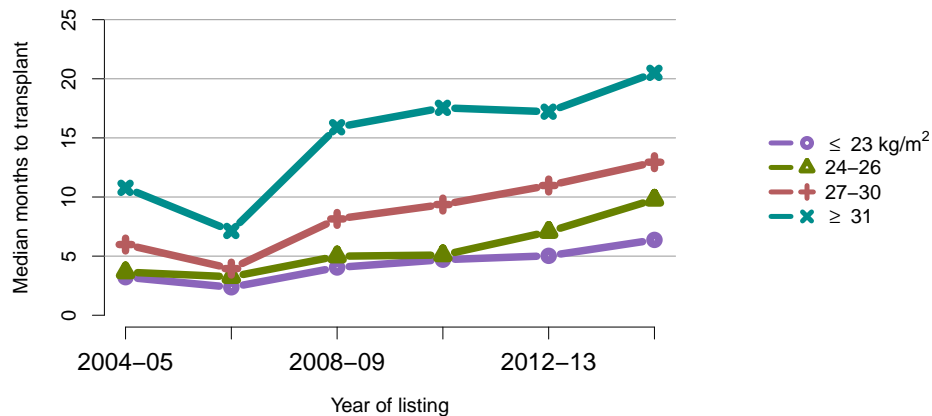


Figure HR 18. Median months to heart transplant for waitlisted adults by BMI at listing. Observations censored on December 31, 2015; Kaplan-Meier competing risk methods used to estimate time to transplant. Analysis performed per candidate, not per listing. If an estimate is not plotted, 50% of the cohort listed in that year had not undergone transplant by the censoring date. Only the first transplant is counted.

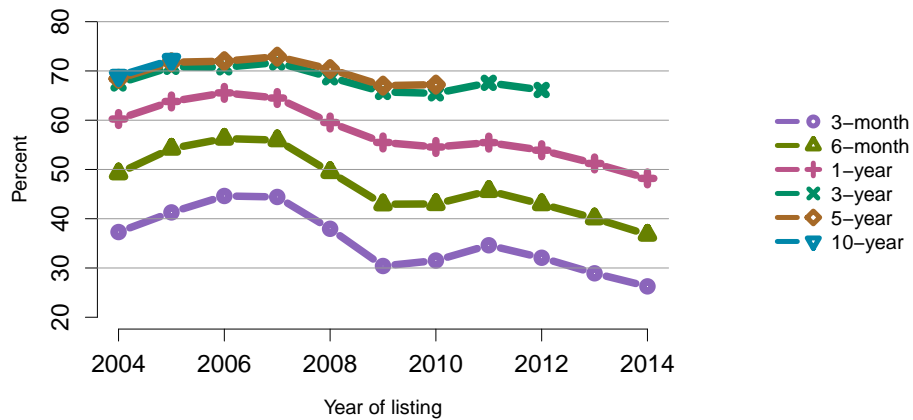


Figure HR 19. Percentage of adults who underwent deceased donor heart transplant within a given time period of listing. Candidates concurrently listed at more than one center are counted once, from the time of earliest listing to the time of latest removal.

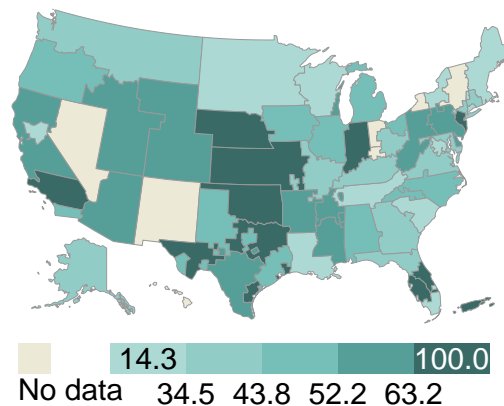


Figure HR 20. Percentage of adults who underwent deceased donor heart transplant within 1 year of listing in 2014 by DSA. Candidates listed concurrently in a single DSA are counted once in that DSA, from the time of earliest listing to the time of latest removal; candidates listed in multiple DSAs are counted separately per DSA.

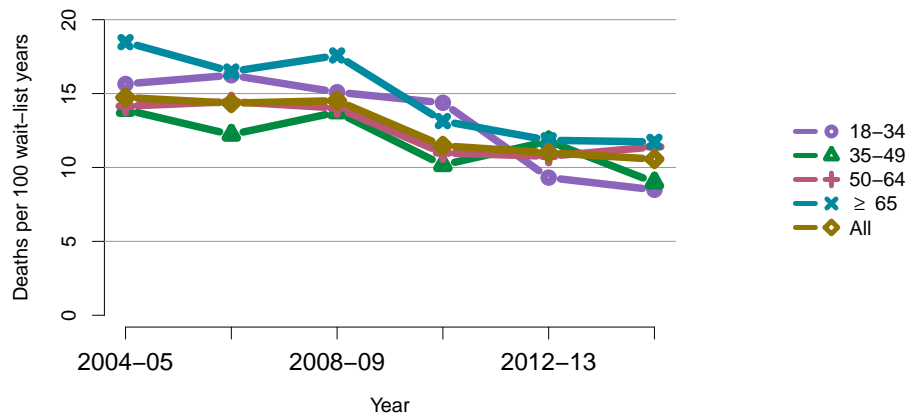


Figure HR 21. Pretransplant mortality rates among adults waitlisted for heart transplant by age. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Individual listings are counted separately. Rates with less than 10 patient-years of exposure are not shown. Age is determined at the later of listing date or January 1 of the given year.

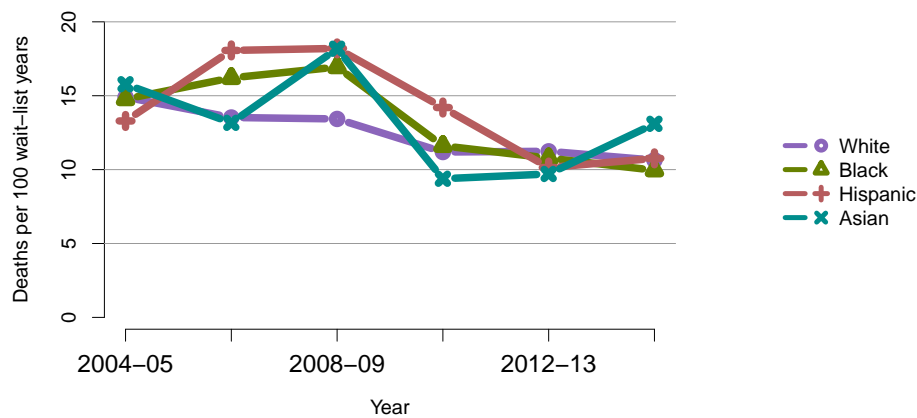


Figure HR 22. Pretransplant mortality rates among adults waitlisted for heart transplant by race. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Individual listings are counted separately. Rates with less than 10 patient-years of exposure are not shown.

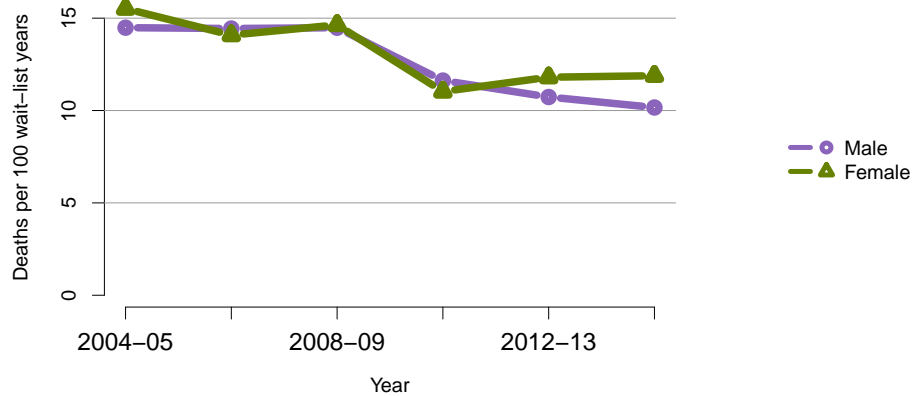


Figure HR 23. Pretransplant mortality rates among adults waitlisted for heart transplant by sex. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Individual listings are counted separately. Rates with less than 10 patient-years of exposure are not shown.

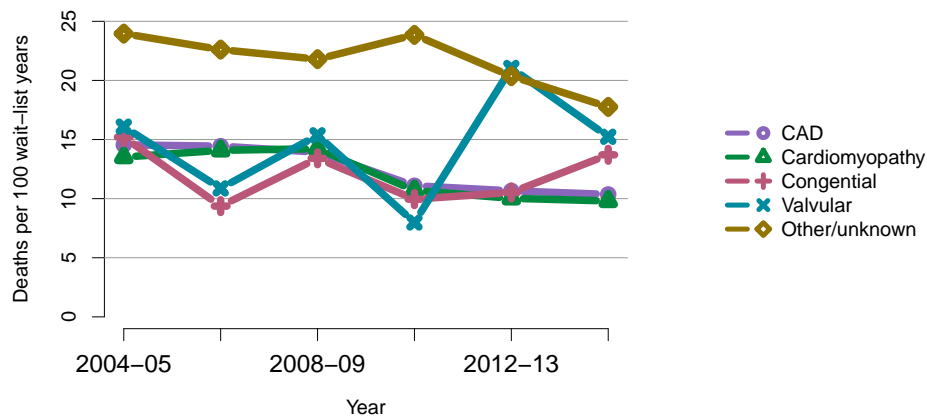


Figure HR 24. Pretransplant mortality rates among adults waitlisted for heart transplant by diagnosis. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Individual listings are counted separately. Rates with less than 10 patient-years of exposure are not shown. CAD, coronary artery disease.

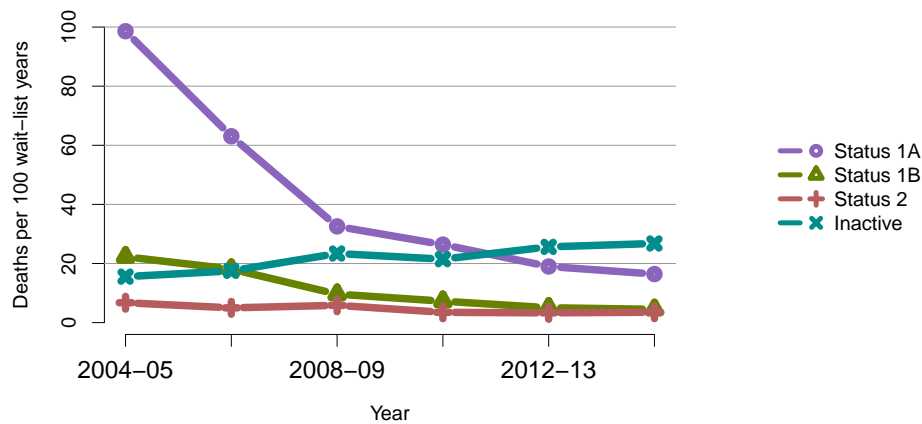


Figure HR 25. Pretransplant mortality rates among adults waitlisted for heart transplant by medical urgency. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Individual listings are counted separately. Rates with less than 10 patient-years of exposure are not shown.

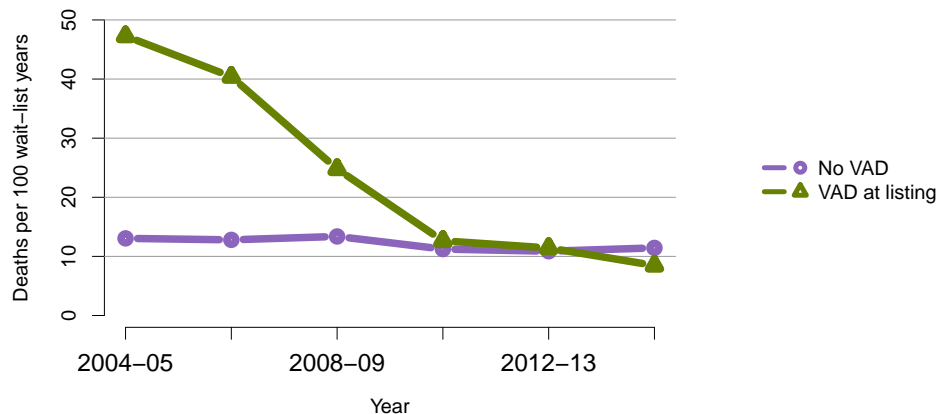


Figure HR 26. Pretransplant mortality rates among adults waitlisted for heart transplant by VAD at listing. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Individual listings are counted separately. Rates with less than 10 patient-years of exposure are not shown. VAD, ventricular assist device.

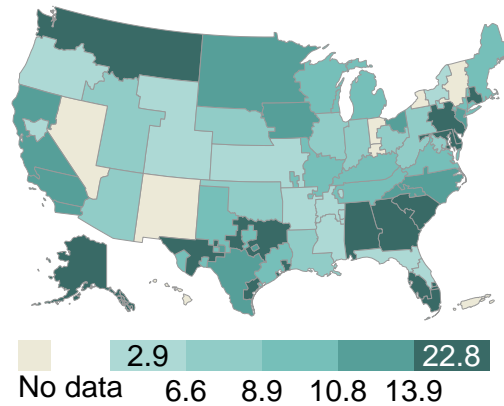


Figure HR 27. Pretransplant mortality rates among adults waitlisted for heart transplant in 2014-2015, by DSA. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Individual listings are counted separately. Rates with less than 10 patient-years of exposure are not shown.

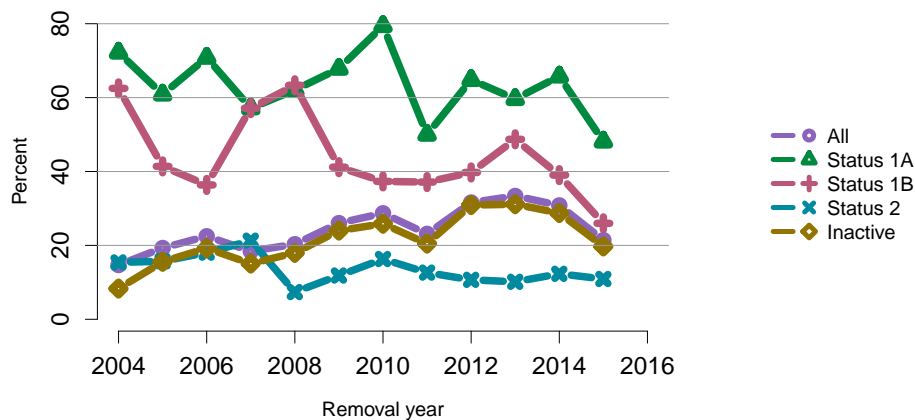


Figure HR 28. Deaths within six months after removal among adult heart waitlist candidates. Denominator includes only candidates removed from the waiting list for reasons other than transplant or death while on the list.

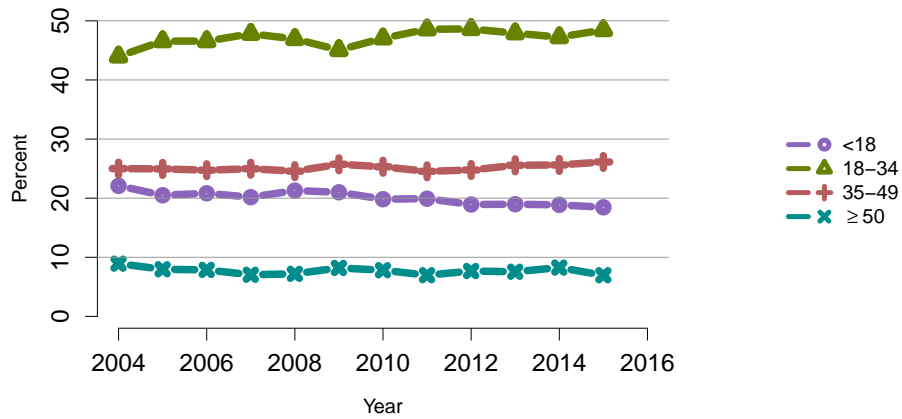


Figure HR 29. Deceased heart donors by age. Deceased donors whose hearts were recovered for transplant.

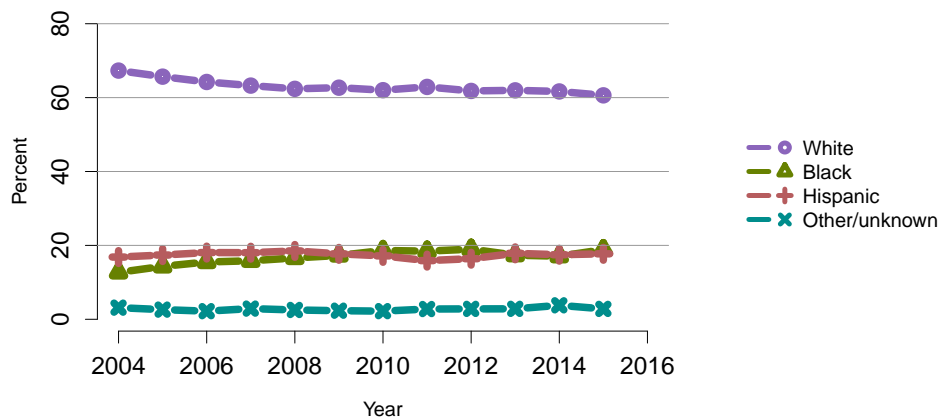


Figure HR 30. Deceased heart donors by race. Deceased donors whose hearts were recovered for transplant.

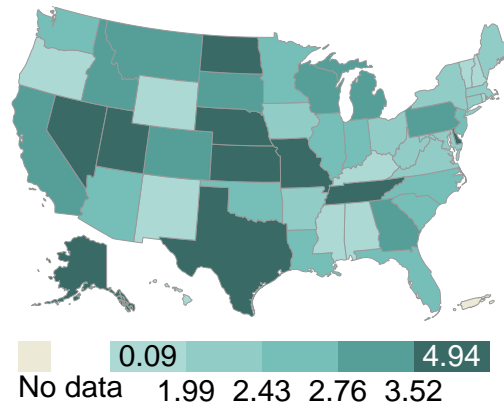


Figure HR 31. Deceased donor heart donation rates (per 1000 deaths) by state, 2012-2014. Numerator: Deceased donors aged < 70 years, by state of death, whose heart was recovered for transplant from 2012 through 2014. Denominator: US deaths aged < 70 years, by state of death, from 2012 through 2014. State death data by age obtained through agreement with NAPHSIS (<http://www.naphsis.org/programs/vital-statistics-data-research-request-process>).

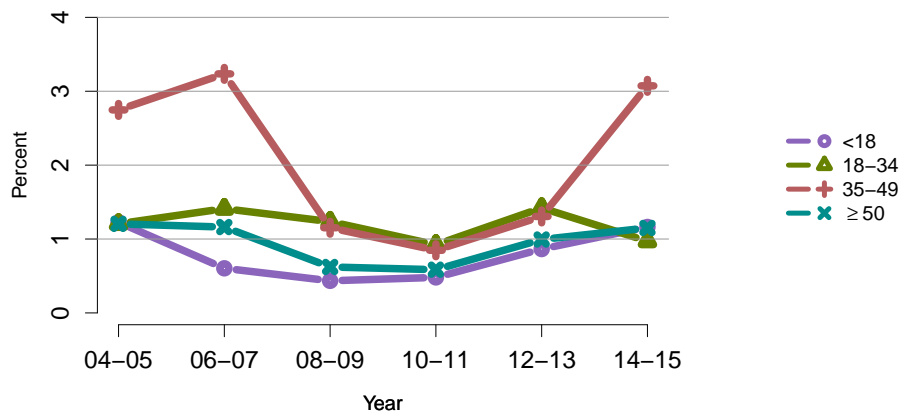


Figure HR 32. Rates of hearts recovered for transplant and not transplanted by age. Percentages of hearts not transplanted out of all hearts recovered for transplant.

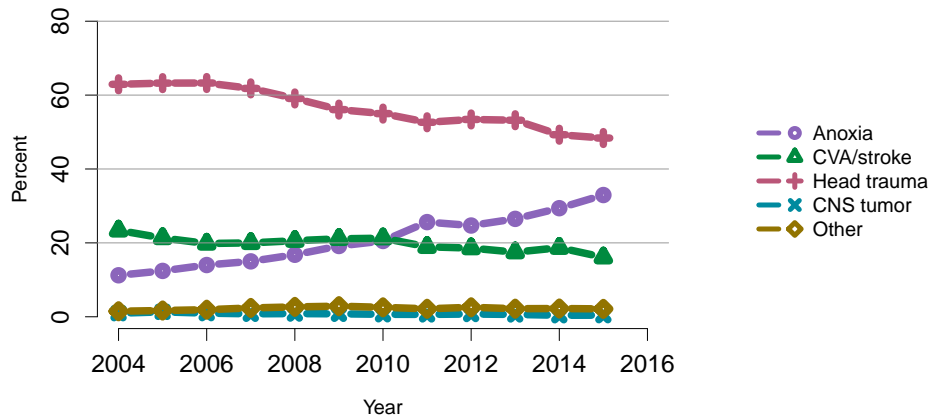


Figure HR 33. Cause of death among deceased heart donors. Deceased donors whose hearts were transplanted. CNS, central nervous system; CVA, cerebrovascular accident.

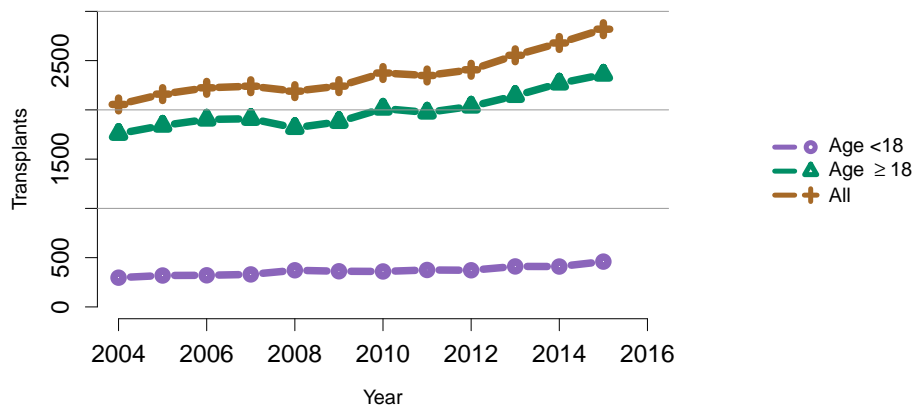


Figure HR 34. Total heart transplants. All heart transplant recipients, including adult and pediatric, retransplant, and multi-organ recipients.

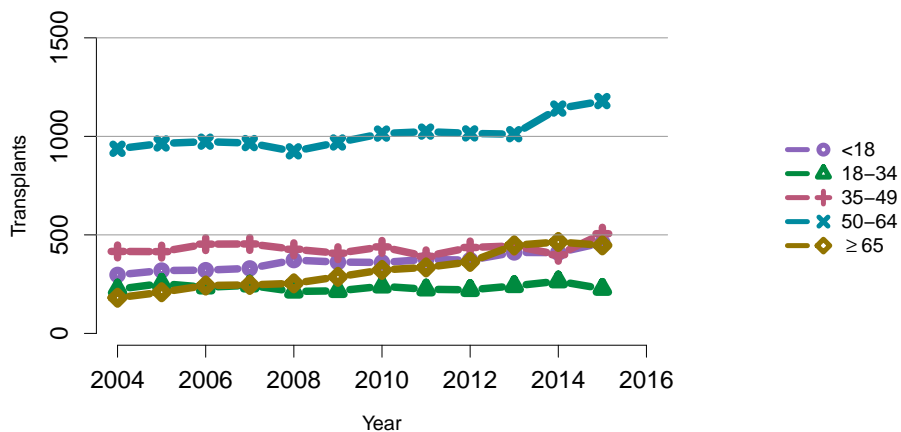


Figure HR 35. Total heart transplants by age. All heart transplant recipients, including adult and pediatric, retransplant, and multi-organ recipients.

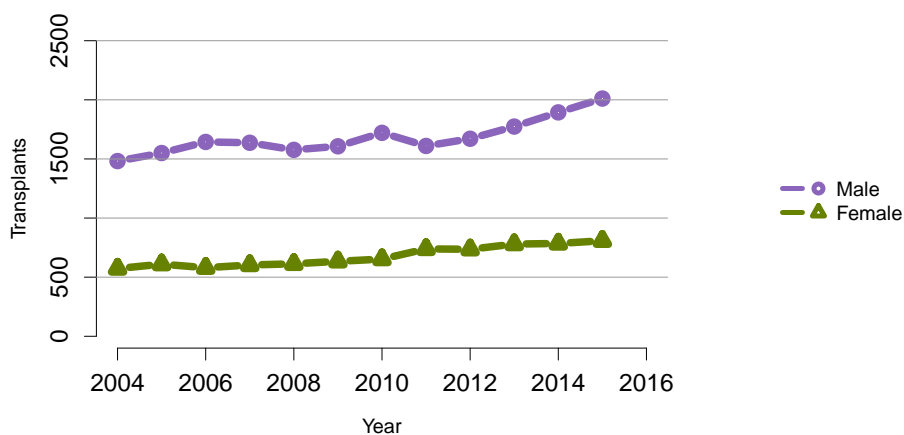


Figure HR 36. Total heart transplants by sex. All heart transplant recipients, including adult and pediatric, retransplant, and multi-organ recipients.

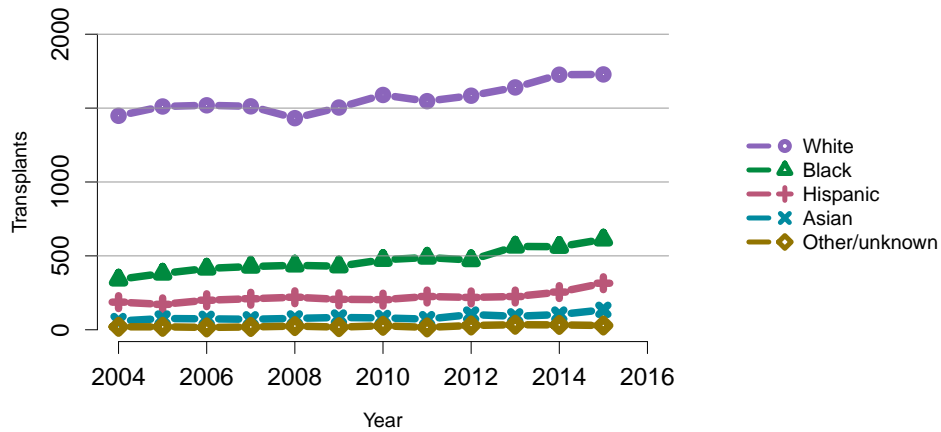


Figure HR 37. Total heart transplants by race. All heart transplant recipients, including adult and pediatric, retransplant, and multi-organ recipients.

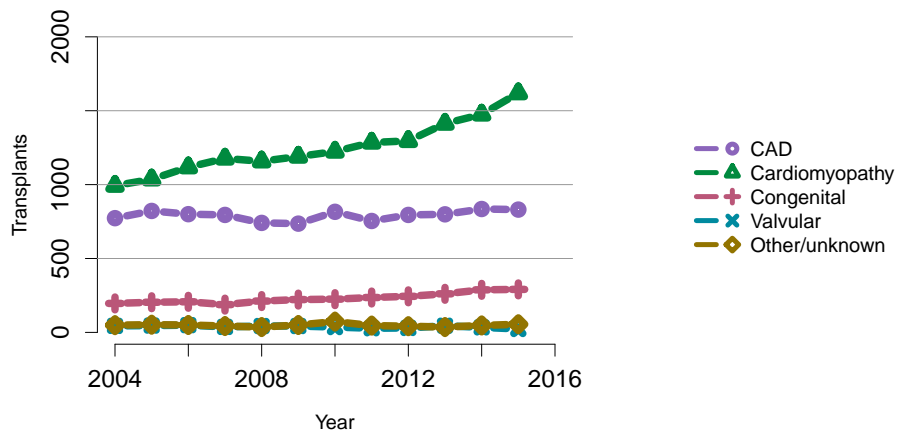


Figure HR 38. Total heart transplants by diagnosis. All heart transplant recipients, including adult and pediatric, retransplant, and multi-organ recipients. CAD, coronary artery disease.

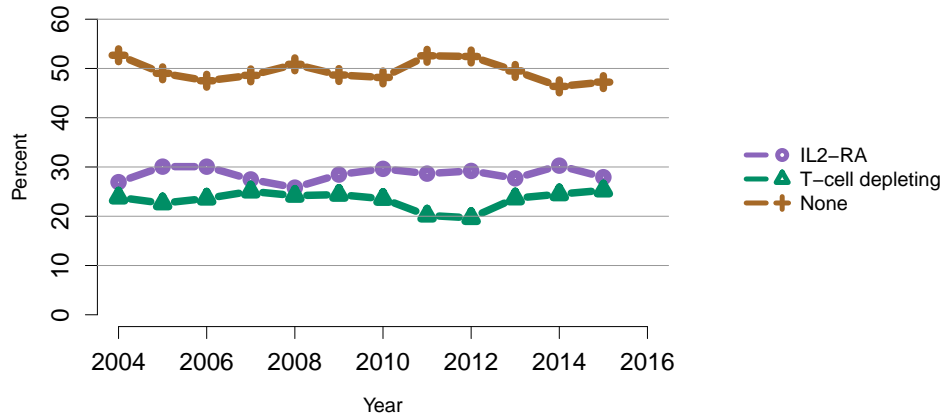


Figure HR 39. Induction agent use in adult heart transplant recipients. Immunosuppression at transplant reported to the OPTN. IL2-RA, interleukin-2 receptor antagonist.

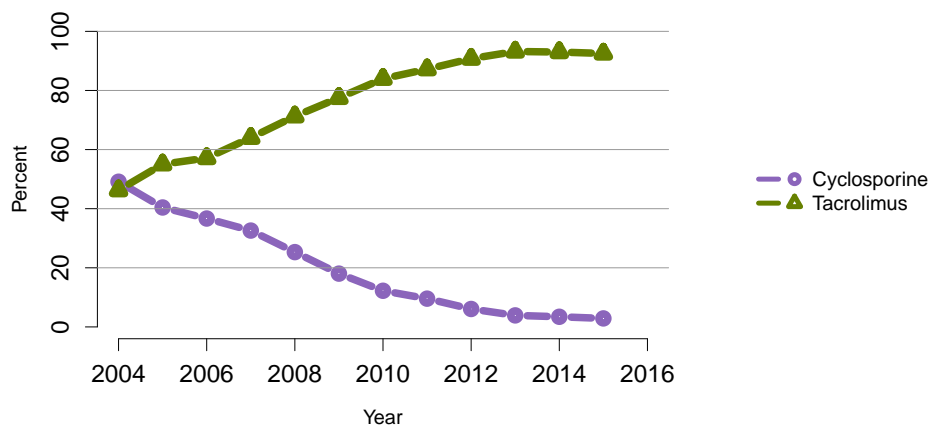


Figure HR 40. Calcineurin inhibitor use in adult heart transplant recipients. Immunosuppression at transplant reported to the OPTN.

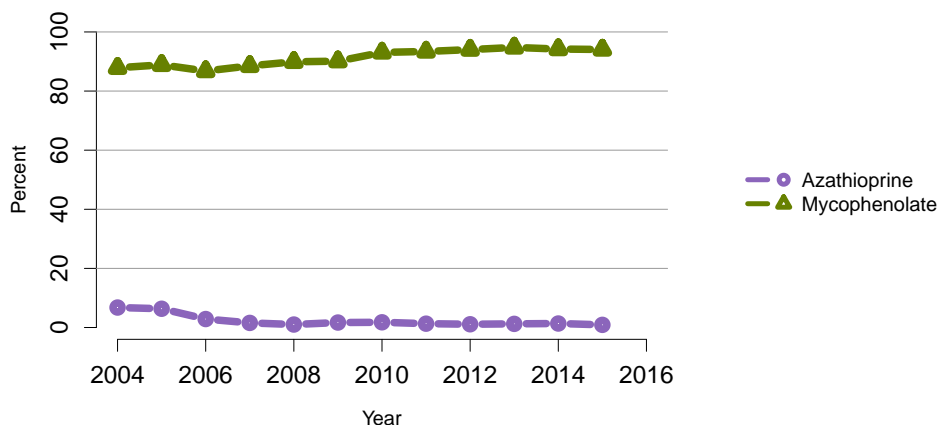


Figure HR 41. Anti-metabolite use in adult heart transplant recipients. Immunosuppression at transplant reported to the OPTN. Mycophenolate includes mycophenolate mofetil and mycophenolate sodium.

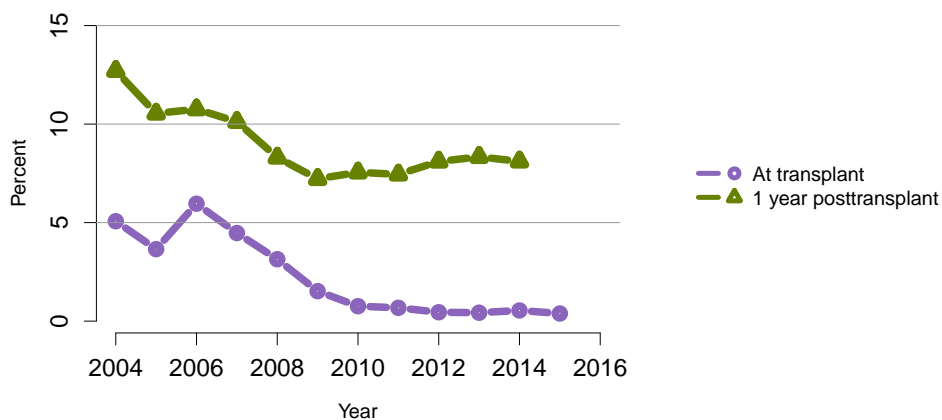


Figure HR 42. mTOR inhibitor use in adult heart transplant recipients. Immunosuppression at transplant reported to the OPTN. One-year posttransplant data are limited to patients alive with graft function at 1 year posttransplant. mTOR, mammalian target of rapamycin.

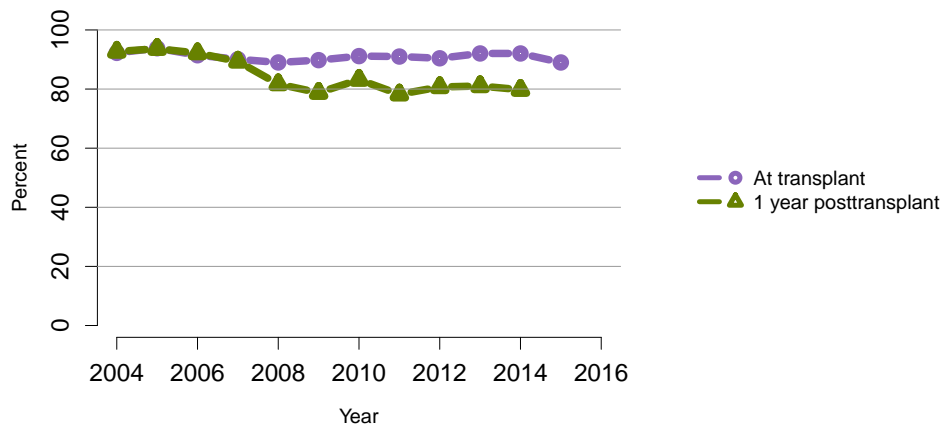


Figure HR 43. Steroid use in adult heart transplant recipients. Immunosuppression at transplant reported to the OPTN. One-year posttransplant data are limited to patients alive with graft function at 1 year posttransplant.

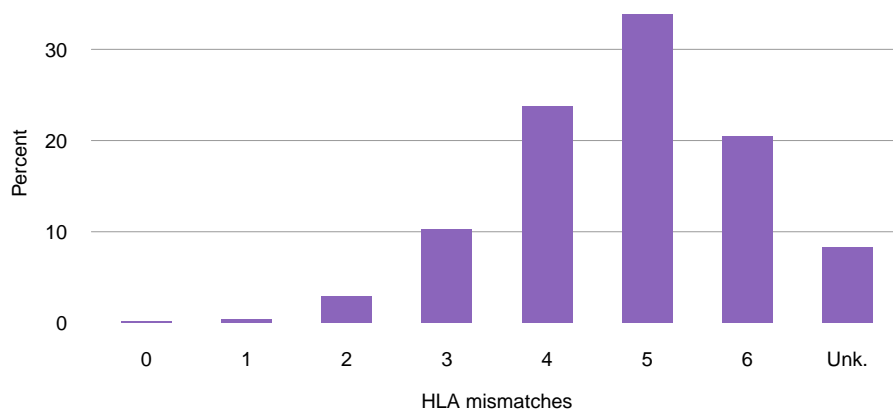


Figure HR 44. Total HLA A, B, and DR mismatches among adult deceased donor heart transplant recipients, 2011-2015. Donor and recipient antigen matching is based on OPTN antigen values and split equivalences policy as of 2015.

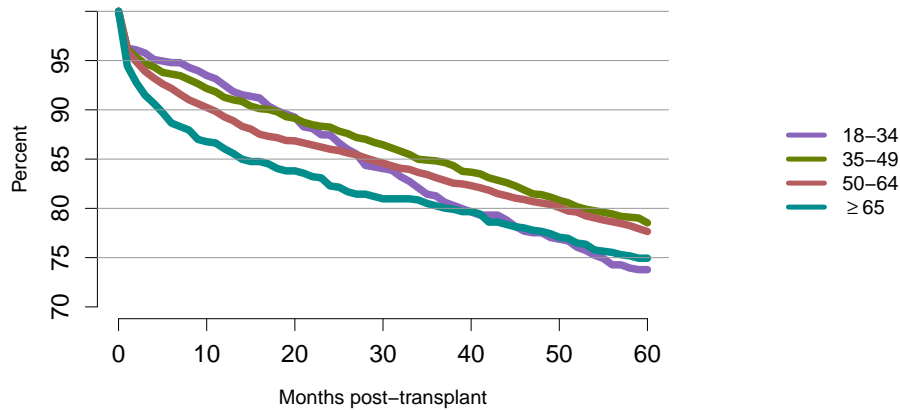


Figure HR 45. Patient survival among adult heart transplant recipients, 2008-2010, by age. Patient survival estimated using unadjusted Kaplan-Meier methods. For recipients of more than one transplant during the period, only the first is considered.

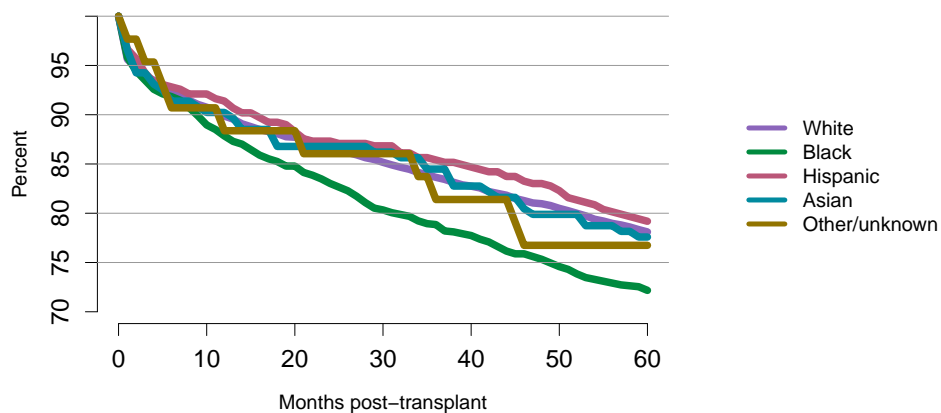


Figure HR 46. Patient survival among adult heart transplant recipients, 2008-2010, by race. Patient survival estimated using unadjusted Kaplan-Meier methods. For recipients of more than one transplant during the period, only the first is considered.

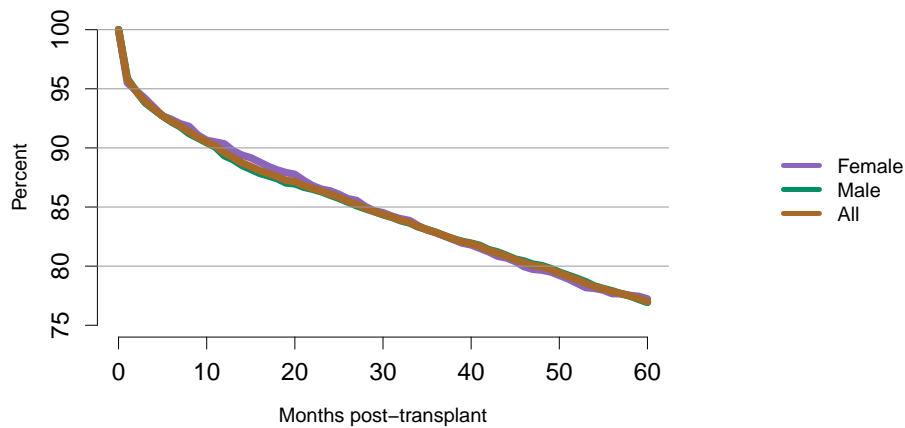


Figure HR 47. Patient survival among adult heart transplant recipients, 2008-2010, by sex. Patient survival estimated using unadjusted Kaplan-Meier methods. For recipients of more than one transplant during the period, only the first is considered.

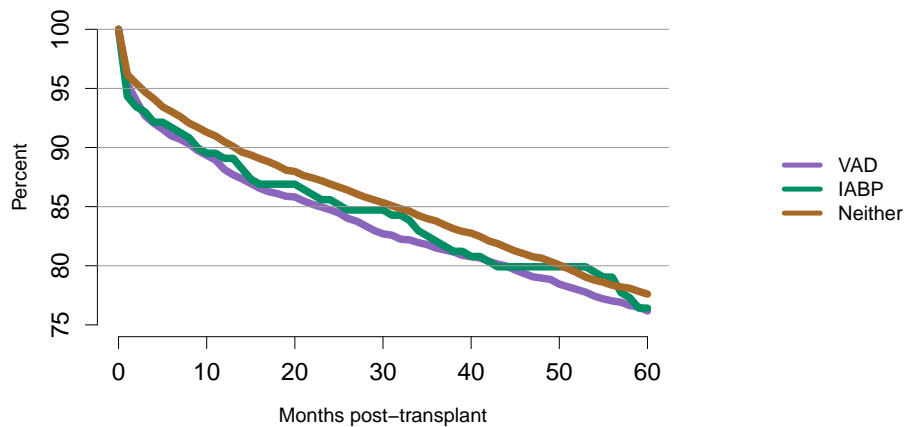


Figure HR 48. Patient survival among adult heart transplant recipients, 2008-2010, by circulatory support. Patient survival estimated using unadjusted Kaplan-Meier methods. For recipients of more than one transplant during the period, only the first is considered. Ventricular assist device (VAD) status at time of transplant. IABP, intra-aortic balloon pump.

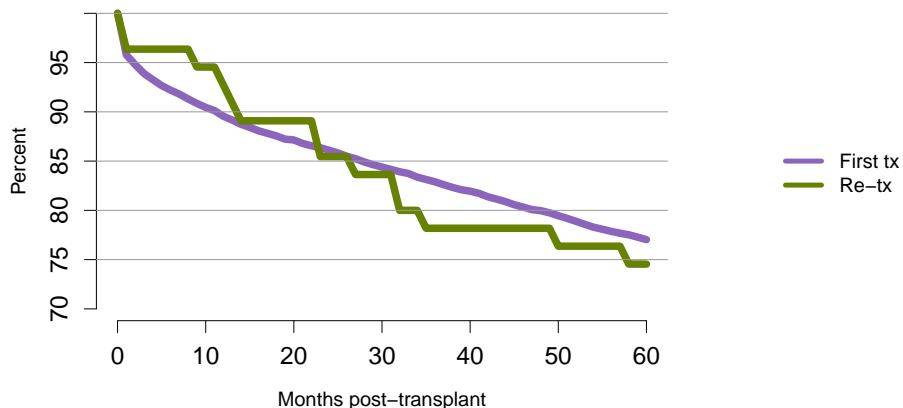


Figure HR 49. Patient survival among adult heart transplant recipients, 2008-2010, by first vs. retransplant. Patient survival estimated using unadjusted Kaplan-Meier methods. For recipients of more than one transplant during the period, only the first is considered.

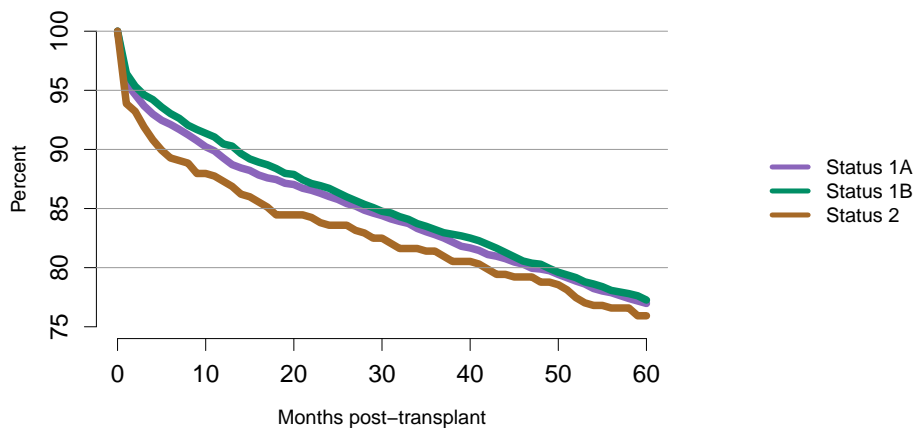


Figure HR 50. Patient survival among adult heart transplant recipients, 2008-2010, by medical urgency. Patient survival estimated using unadjusted Kaplan-Meier methods. For recipients of more than one transplant during the period, only the first is considered.

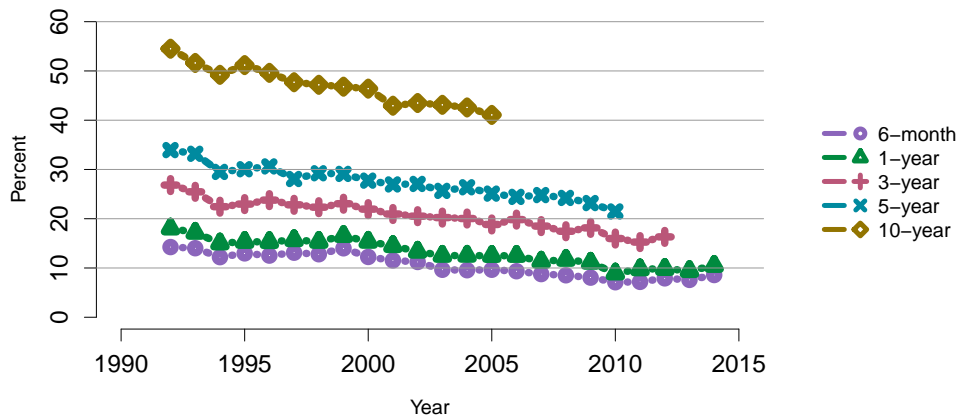


Figure HR 51. Patient death among adult heart transplant recipients. All adult recipients of deceased donor hearts, including multi-organ transplants. Patients are followed until the earlier of death or December 31, 2015. Estimates computed with Cox proportional hazards models adjusted for age, sex, and race.

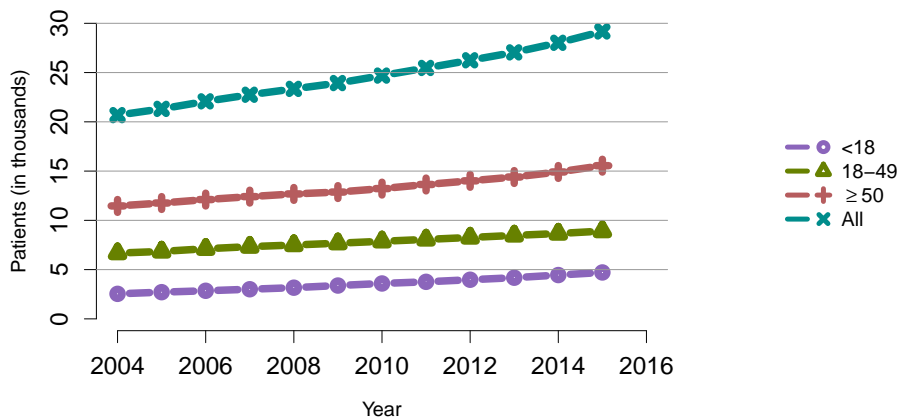


Figure HR 52. Recipients alive with a functioning heart graft on June 30 of the year, by age at transplant. Recipients are assumed to be alive with function unless a death or graft failure is recorded. A recipient may experience a graft failure and be removed from the cohort, undergo retransplant, and re-enter the cohort.

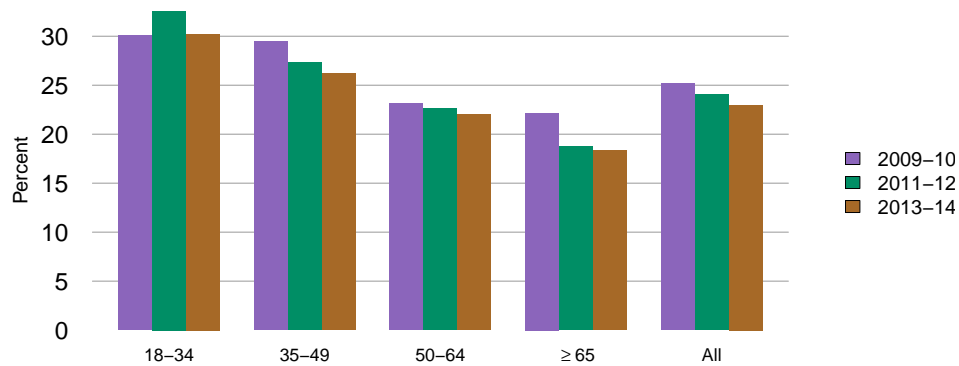


Figure HR 53. Incidence of acute rejection by 1 year posttransplant among adult heart transplant recipients by age. Acute rejection is defined as a record of acute or hyperacute rejection, as reported on the OPTN Transplant Recipient Registration or Transplant Recipient Follow-up Form. Only the first rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier competing risk method.

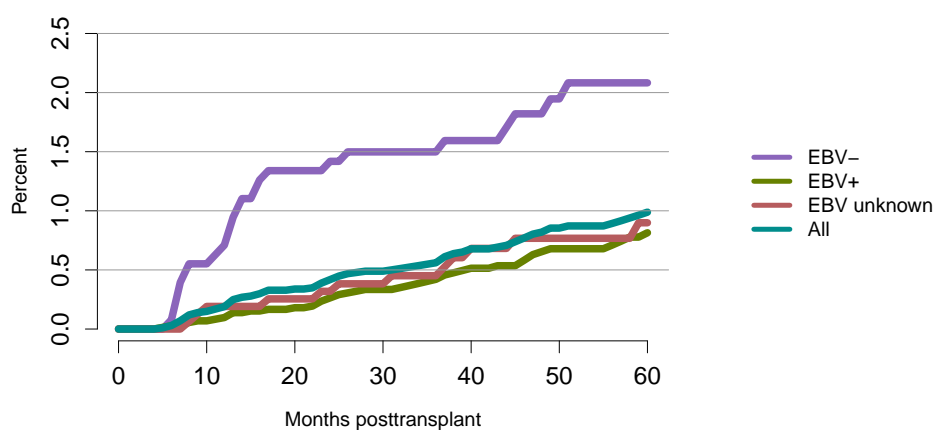


Figure HR 54. Incidence of PTLD among adult heart transplant recipients by recipient EBV status at transplant, 2009-2013. Cumulative incidence is estimated using the Kaplan-Meier competing risk method. PTLD is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus; PTLD, posttransplant lymphoproliferative disorder.

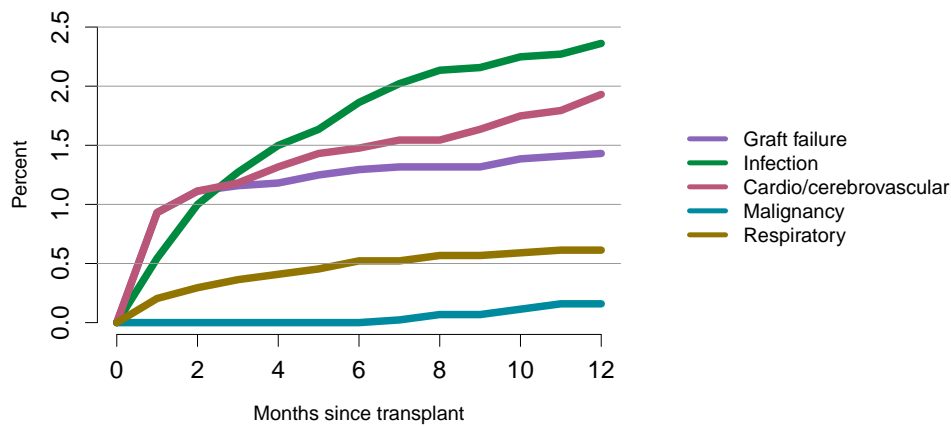


Figure HR 55. One-year cumulative incidence of death by cause among adult heart recipients, 2013-2014. Primary cause of death is as reported on the OPTN Transplant Recipient Registration and Follow-up Forms. Other causes of death include hemorrhage, trauma, nonadherence, unspecified other, unknown, etc. Cumulative incidence is estimated using Kaplan-Meier competing risk methods.

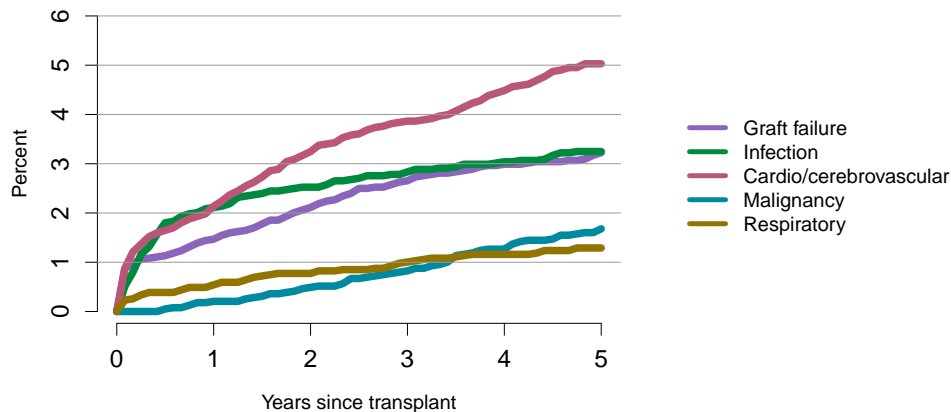


Figure HR 56. Five-year cumulative incidence of death by cause among adult heart recipients, 2009-2010. Primary cause of death is as reported on the OPTN Transplant Recipient Registration and Follow-up Forms. Other causes of death include hemorrhage, trauma, nonadherence, unspecified other, unknown, etc. Cumulative incidence is estimated using Kaplan-Meier competing risk methods.

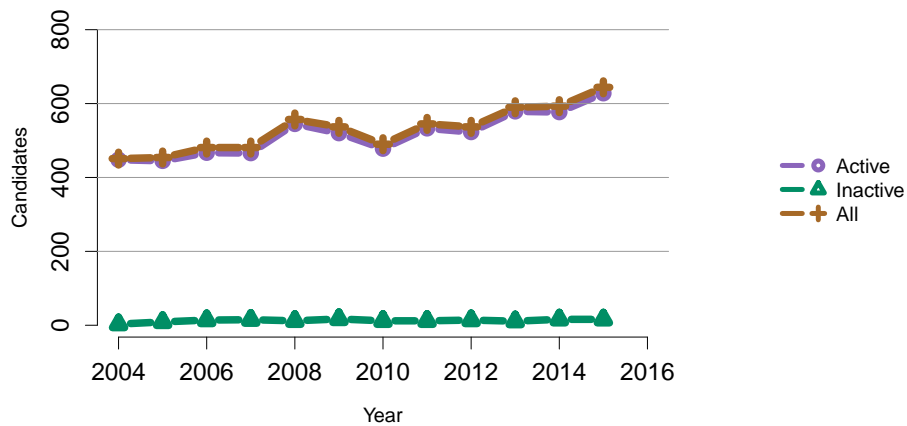


Figure HR 57. New pediatric candidates added to the heart transplant waiting list. A new candidate is one who first joined the list during the given year, without having been listed in a previous year. Previously listed candidates who underwent transplant and subsequently relisted are considered new. Candidates concurrently listed at multiple centers are counted once. Active and inactive patients are included. Age determined at listing.

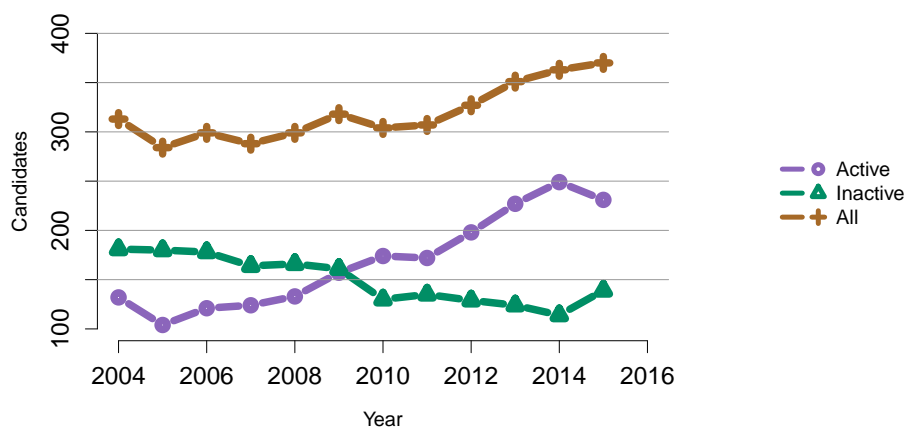


Figure HR 58. Pediatric candidates listed for heart transplant on December 31 each year. Candidates concurrently listed at multiple centers are counted once. Those with concurrent listings and active at any program are considered active.

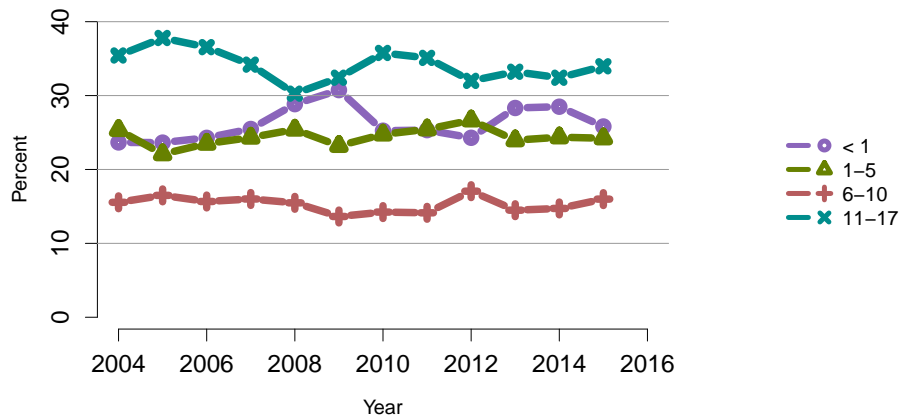


Figure HR 59. Distribution of pediatric candidates waiting for heart transplant by age. Candidates waiting for transplant at any time in the given year. Candidates listed concurrently at multiple centers are counted once. Age is determined at the later of listing date or January 1 of the given year. Active and inactive candidates are included.

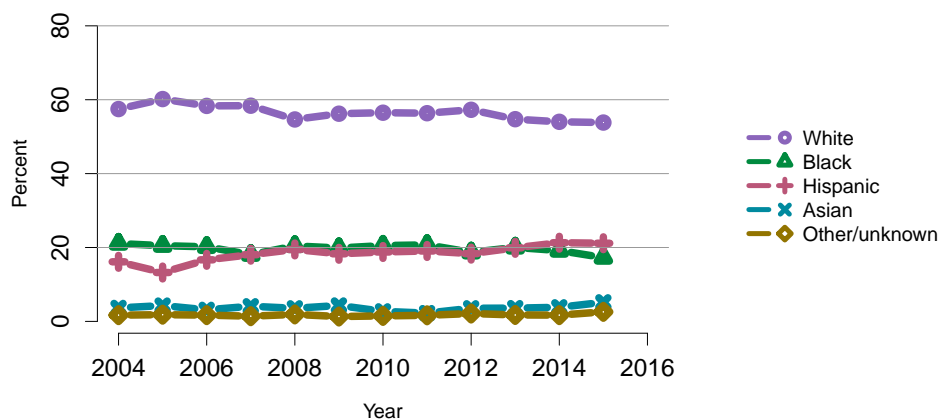


Figure HR 60. Distribution of pediatric candidates waiting for heart transplant by race. Candidates waiting for transplant any time in the given year. Candidates listed concurrently at multiple centers are counted once. Active and inactive candidates are included.

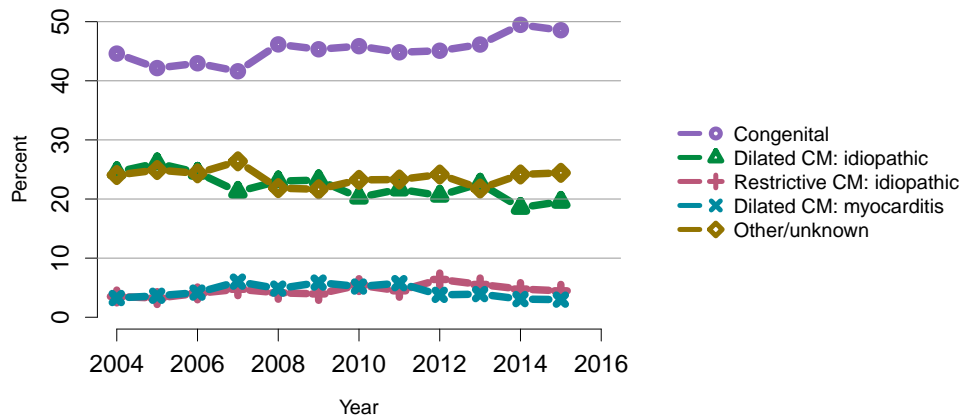


Figure HR 61. Distribution of pediatric candidates waiting for heart transplant by diagnosis. Candidates waiting for transplant any time in the given year. Candidates listed concurrently at multiple centers are counted once. Active and inactive candidates are included. CM, cardiomyopathy.

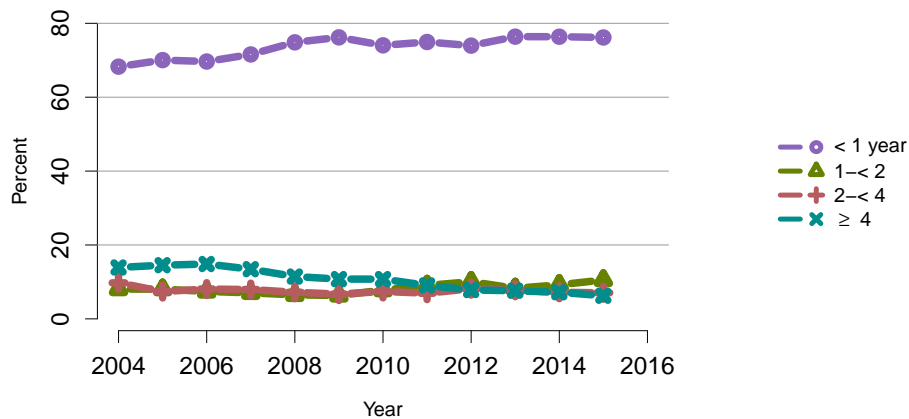


Figure HR 62. Distribution of pediatric candidates waiting for heart transplant by waiting time. Candidates waiting for transplant any time in the given year. Candidates listed concurrently at multiple centers are counted once. Time on the waiting list is determined at the earlier of December 31 or removal from the waiting list. Active and inactive candidates are included.

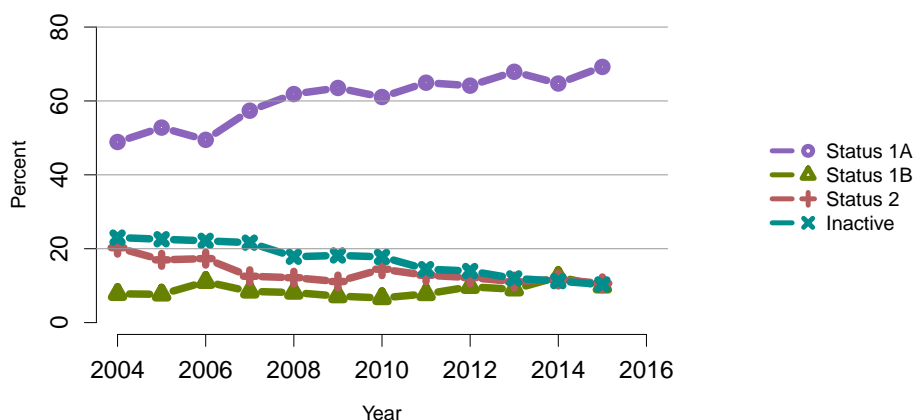


Figure HR 63. Distribution of pediatric candidates waiting for heart transplant by medical urgency. Candidates waiting for transplant any time in the given year. Candidates listed concurrently at multiple centers are counted once. Medical urgency status is the most severe during the year. Active and inactive patients are included.

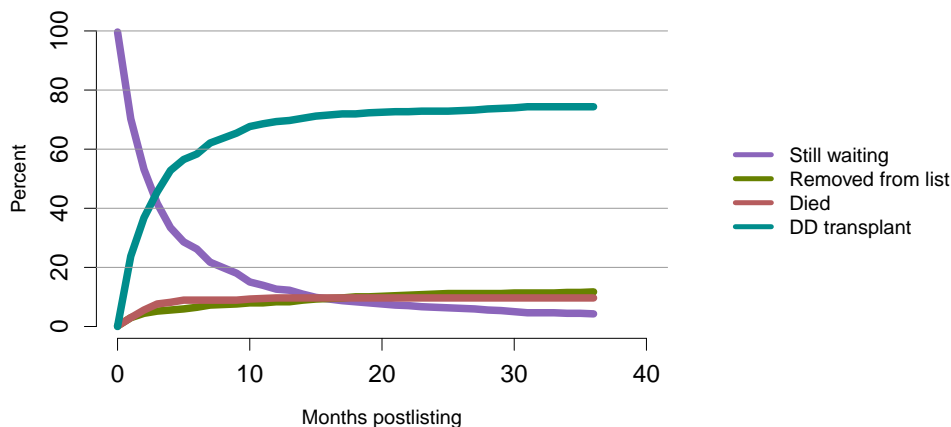


Figure HR 64. Three-year outcomes for newly listed pediatric candidates waiting for heart transplant, 2012. Candidates aged 0-11 who joined the heart or heart-lung waitlist in 2012. Candidates concurrently listed at more than one center are counted once, from the time of earliest listing to the time of latest removal. DD, deceased donor.

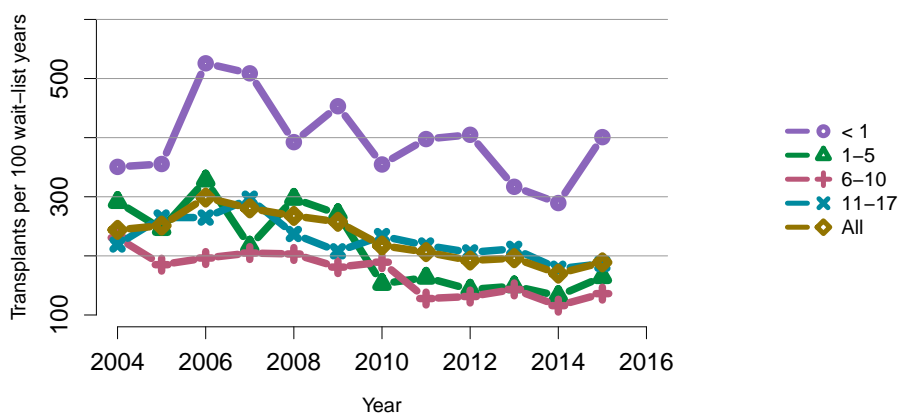


Figure HR 65. Heart transplant rates among active pediatric waitlist candidates by age. Transplant rates are computed as the number of deceased donor transplants per 100 patient-years of active waiting in a given year. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year. Rates with less than 10 patient-years of exposure are not shown.

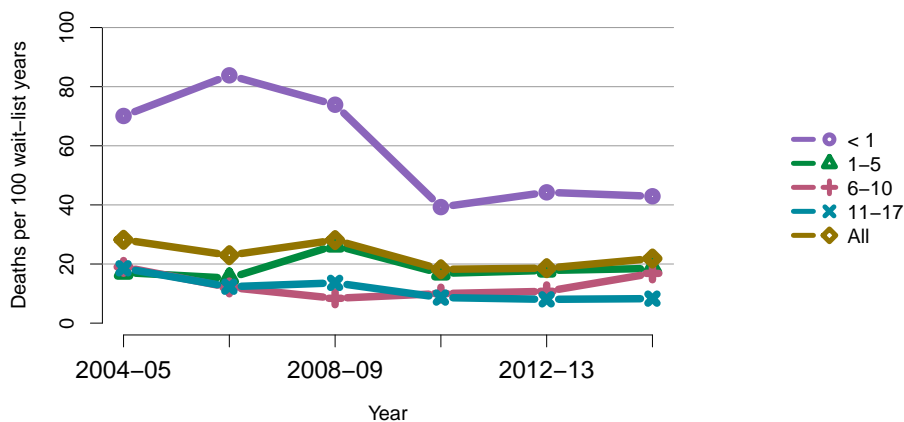


Figure HR 66. Pretransplant mortality rates among pediatric waitlisted for heart transplant by age. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Individual listings are counted separately. Age is determined at the later of listing date or January 1 of the given year. Rates with less than 10 patient-years of exposure are not shown.

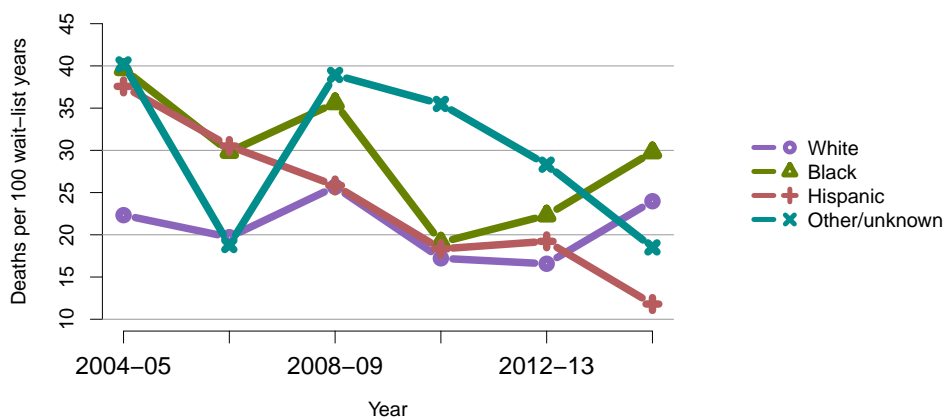


Figure HR 67. Pretransplant mortality rates among pediatric heart transplant waitlisted for heart transplant by race. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Individual listings are counted separately. Rates with less than 10 patient-years of exposure are not shown.

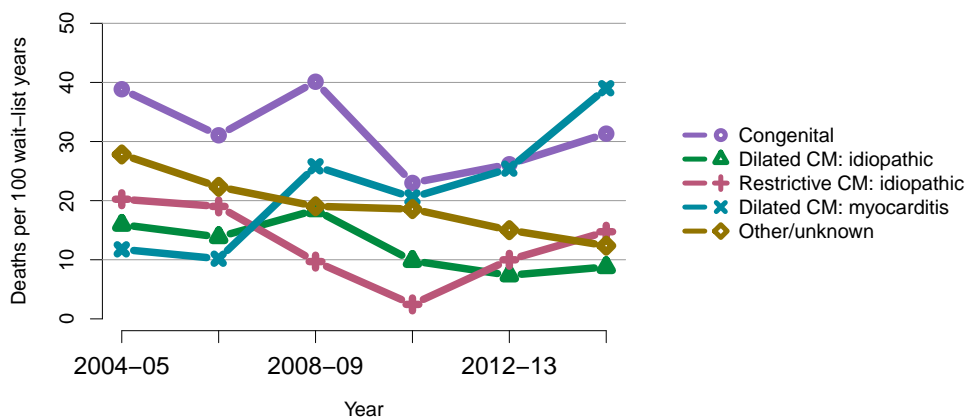


Figure HR 68. Pretransplant mortality rates among pediatric heart transplant waitlisted for heart transplant by diagnosis. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Individual listings are counted separately. Rates with less than 10 patient-years of exposure are not shown. CM, cardiomyopathy.

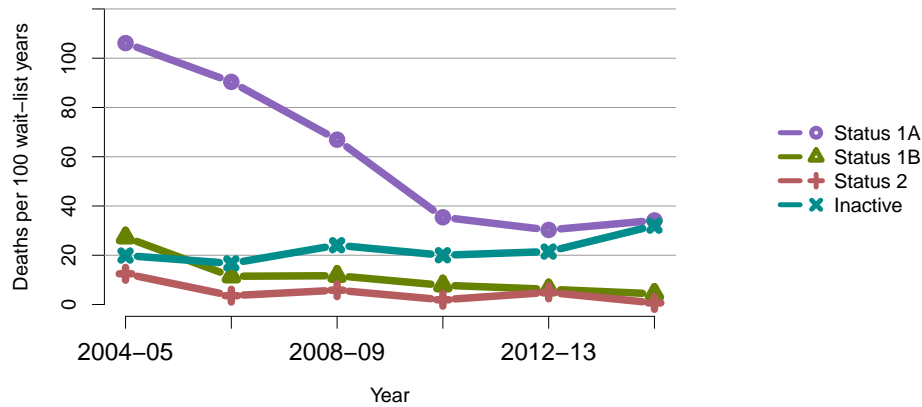


Figure HR 69. Pretransplant mortality rates among pediatric heart transplant waitlisted for heart transplant by medical urgency. Mortality rates are computed as the number of deaths per 100 patient-years of waiting in the given year. Individual listings are counted separately. Rates with less than 10 patient-years of exposure are not shown.

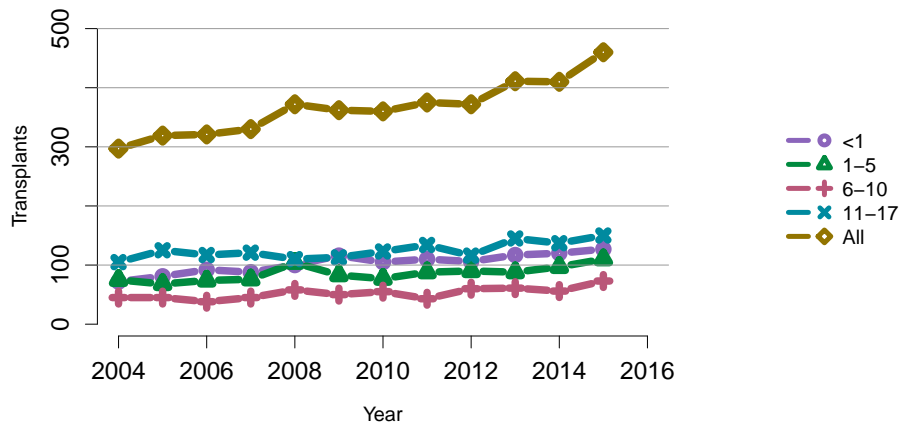


Figure HR 70. Pediatric heart transplants by age. All pediatric heart transplant recipients, including retransplant, and multi-organ recipients.

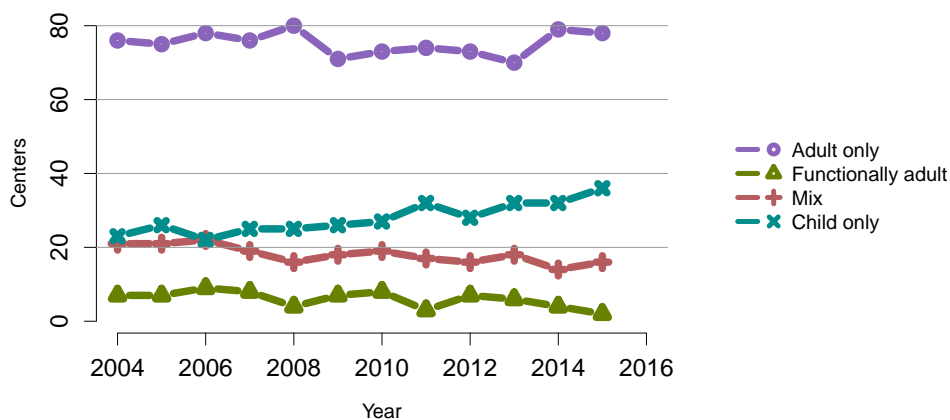


Figure HR 71. Number of centers performing pediatric and adult heart transplants by center's age mix. Adult centers transplanted only recipients aged 18 years or older. Functionally adult centers transplant 80% adults or more, and the remainder were children aged 15-17 years. Mixed included adults and children of any age groups. Child only centers transplanted recipients aged 0-17 years, and small number of adults up to age 21 years.

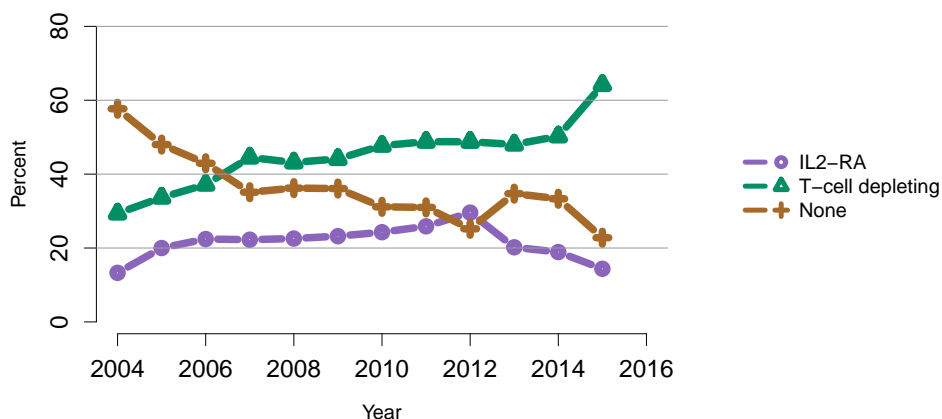


Figure HR 72. Induction agent use in pediatric heart transplant recipients. Immunosuppression at transplant reported to the OPTN. IL2-RA, interleukin-2 receptor antagonist.

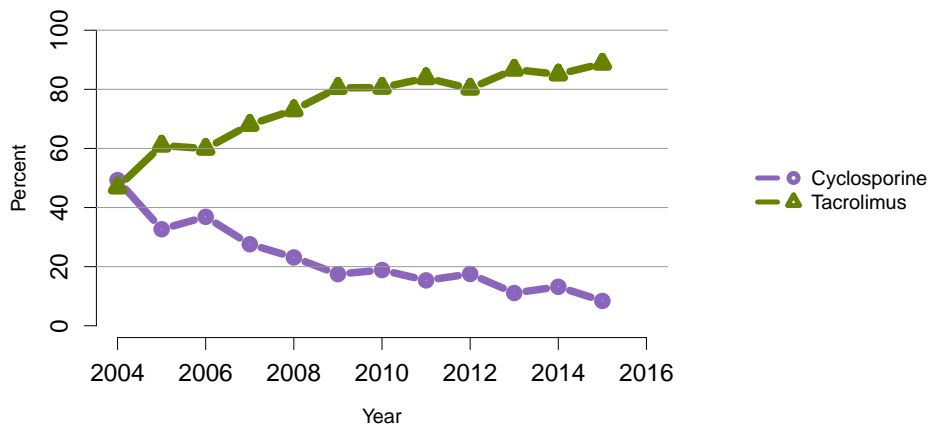


Figure HR 73. Calcineurin inhibitor use in pediatric heart transplant recipients. Immunosuppression at transplant reported to the OPTN.

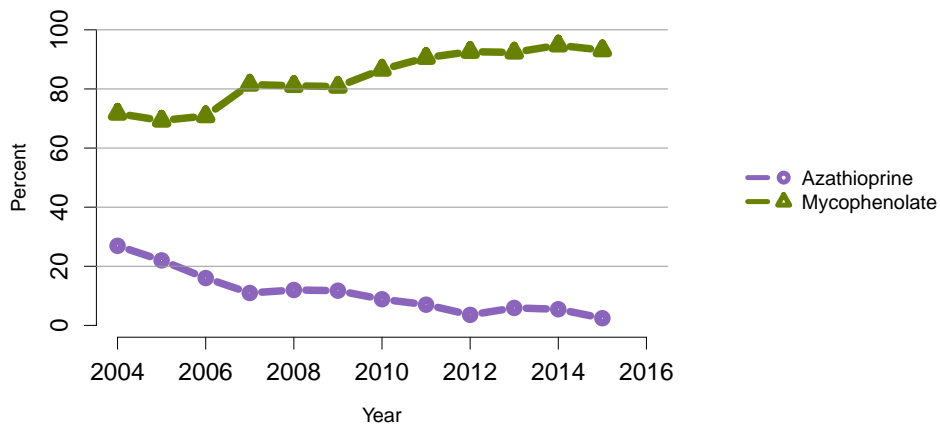


Figure HR 74. Anti-metabolite use in pediatric heart transplant recipients. Immunosuppression at transplant reported to the OPTN. Mycophenolate includes mycophenolate mofetil and mycophenolate sodium.

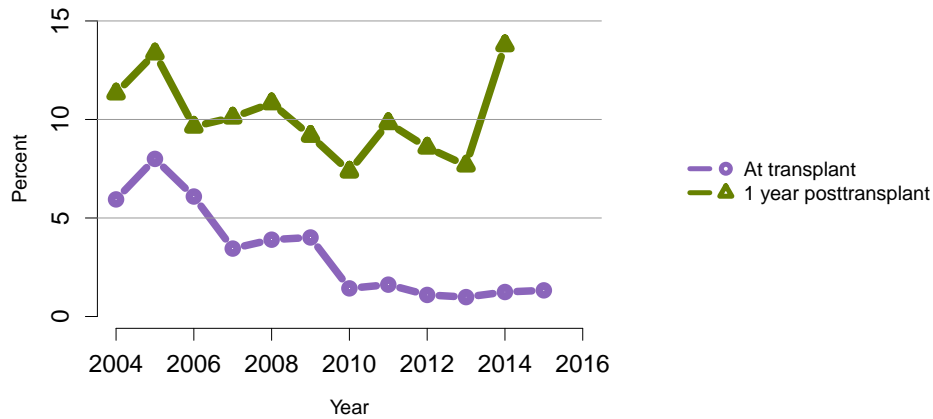


Figure HR 75. mTOR inhibitor use in pediatric heart transplant recipients. Immunosuppression at transplant reported to the OPTN. One-year posttransplant data are limited to patients alive with graft function at 1 year posttransplant. mTOR, mammalian target of rapamycin.

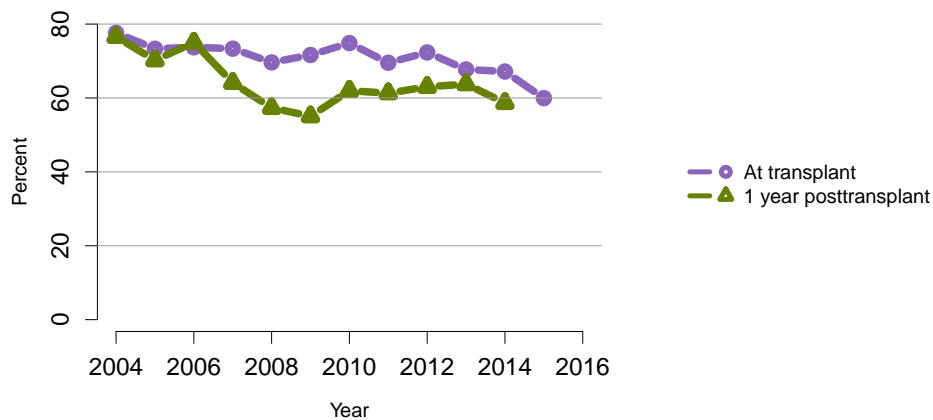


Figure HR 76. Steroid use in pediatric heart transplant recipients. Immunosuppression at transplant reported to the OPTN. One-year posttransplant data are limited to patients alive with graft function at 1 year posttransplant.

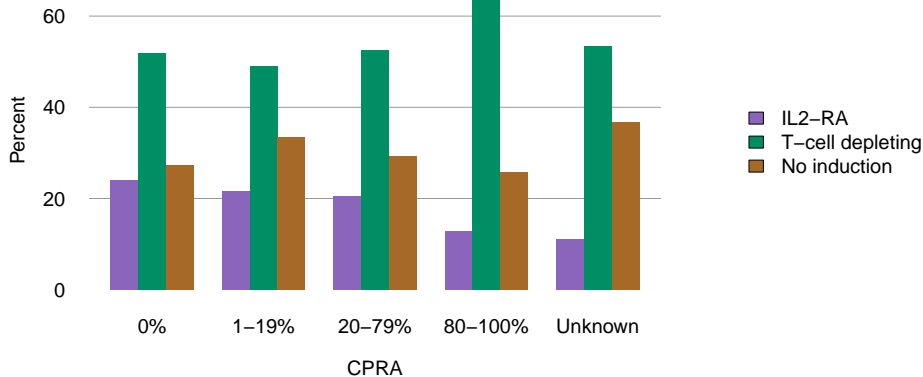


Figure HR 77. Induction use by CPRA among pediatric heart transplant recipients, 2011-2015. Collection of calculated PRA (CPRA) began March 31, 2015. Prior to that, PRA class I and II values were used. IL2-RA, interleukin-2 receptor antagonist.

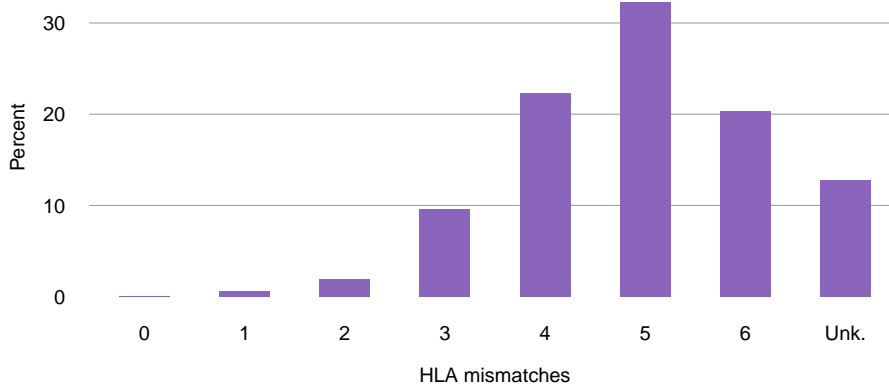


Figure HR 78. Total HLA A, B, and DR mismatches among pediatric deceased donor heart transplant recipients, 2011-2015. Donor and recipient antigen matching is based on OPTN antigen values and split equivalences policy as of 2015.

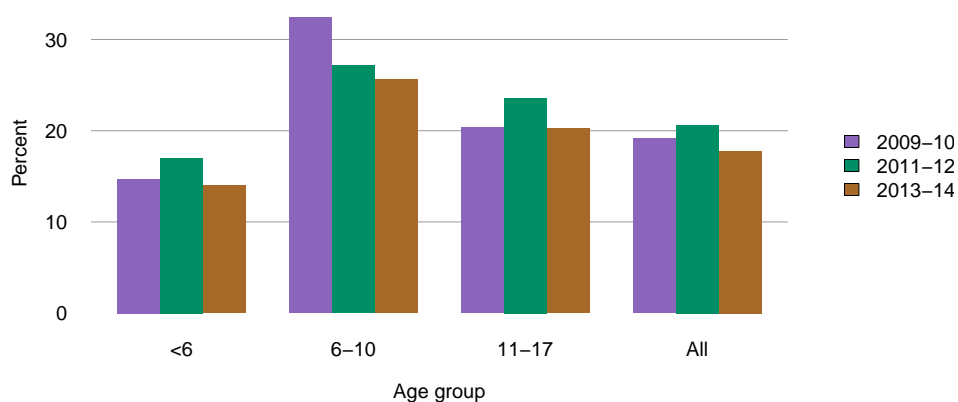


Figure HR 79. Incidence of acute rejection by 1 year posttransplant among pediatric heart transplant recipients by age. Acute rejection is defined as a record of acute or hyperacute rejection, as reported on the OPTN Transplant Recipient Registration Form or Transplant Recipient Follow-up Form. Only the first rejection event is counted. Cumulative incidence is estimated using the Kaplan-Meier competing risk method.

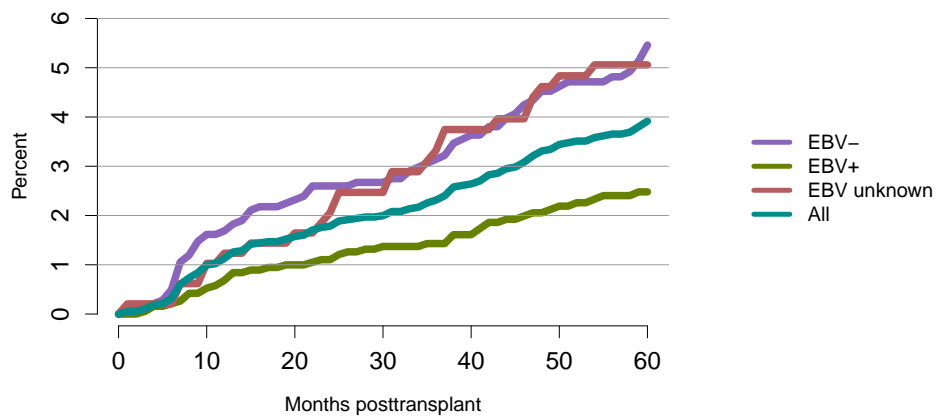


Figure HR 80. Incidence of PTLD among pediatric heart transplant recipients by recipient EBV status at transplant, 2003-2013. Cumulative incidence is estimated using the Kaplan-Meier competing risk method. Posttransplant lymphoproliferative disorder (PTLD) is identified as a reported complication or cause of death on the OPTN Transplant Recipient Follow-up Form or on the Posttransplant Malignancy Form as polymorphic PTLD, monomorphic PTLD, or Hodgkin disease. Only the earliest date of PTLD diagnosis is considered. EBV, Epstein-Barr virus.

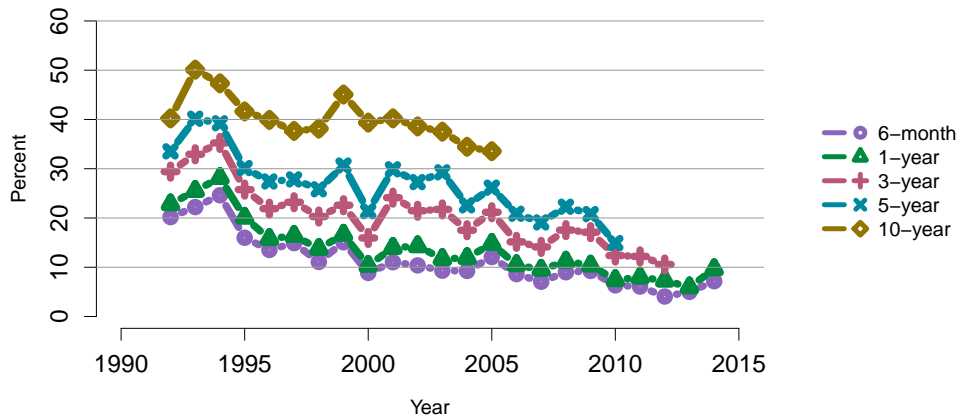


Figure HR 81. Patient death among pediatric heart transplant recipients. All pediatric recipients of deceased donor hearts, including multi-organ transplants. Patients are followed until the earlier of death or December 31, 2015. Estimates computed with Cox proportional hazards models adjusted for age, sex, and race.

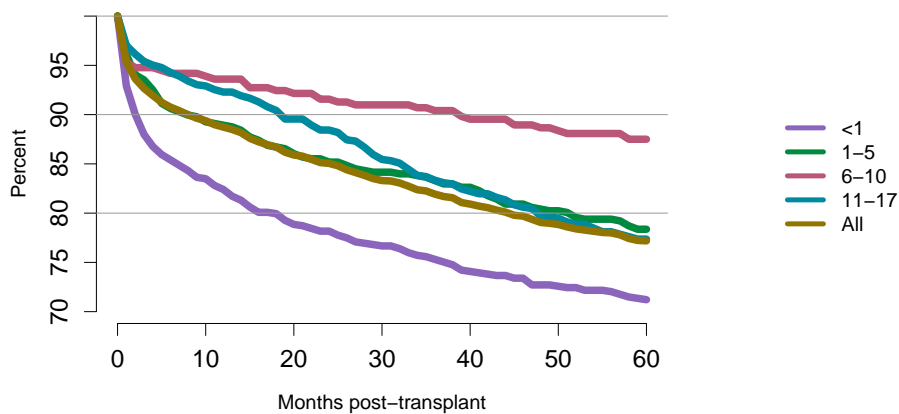


Figure HR 82. Patient survival among pediatric deceased donor heart transplant recipients, 2003-2010, by age. Recipient survival estimated using unadjusted Kaplan-Meier methods.

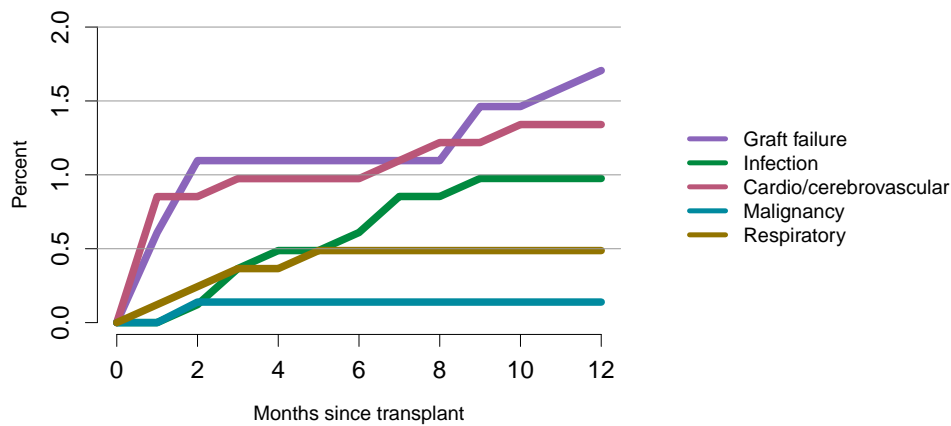


Figure HR 83. One-year cumulative incidence of death by cause among pediatric heart recipients, 2013-2014. Primary cause of death is as reported on the OPTN Transplant Recipient Registration and Follow-up Forms. Other causes of death include hemorrhage, trauma, nonadherence, unspecified other, unknown, etc. Cumulative incidence is estimated using Kaplan-Meier competing risk methods.

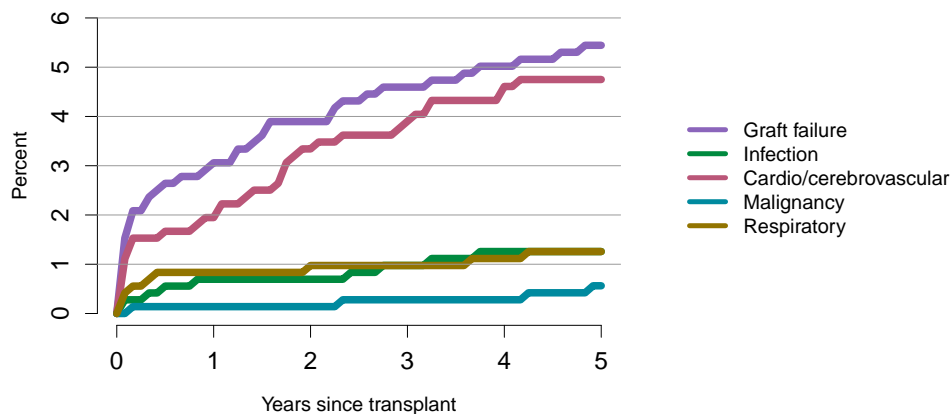


Figure HR 84. Five-year cumulative incidence of death by cause among pediatric heart recipients, 2009-2010. Primary cause of death is as reported on the OPTN Transplant Recipient Registration and Follow-up Forms. Other causes of death include hemorrhage, trauma, nonadherence, unspecified other, unknown, etc. Cumulative incidence is estimated using Kaplan-Meier competing risk methods.

Characteristic	2005		2015	
	N	Percent	N	Percent
Age				
18-34 years	296	10.9%	384	10.1%
35-49 years	627	23.1%	888	23.4%
50-64 years	1415	52.2%	1847	48.7%
≥65 years	374	13.8%	672	17.7%
Sex				
Female	645	23.8%	880	23.2%
Male	2067	76.2%	2911	76.8%
Race/ethnicity				
White	1976	72.9%	2347	61.9%
Black	439	16.2%	987	26.0%
Hispanic	221	8.1%	331	8.7%
Asian	57	2.1%	105	2.8%
Other/unknown	19	0.7%	21	0.6%
Diagnosis				
Coronary artery disease	1112	41.0%	1256	33.1%
Cardiomyopathy	1213	44.7%	2181	57.5%
Congenital disease	153	5.6%	141	3.7%
Valvular disease	77	2.8%	43	1.1%
Other/unknown	157	5.8%	170	4.5%
Transplant history				
First	2628	96.9%	3681	97.1%
Retransplant	84	3.1%	110	2.9%
Blood type				
A	814	30.0%	1186	31.3%
B	257	9.5%	446	11.8%
AB	49	1.8%	79	2.1%
O	1592	58.7%	2080	54.9%

Table HR 1 Characteristics of adults on the heart transplant waiting list on December 31, 2005 and December 31, 2015 (continued on next page). Candidates waiting for transplant on December 31, 2005, and December 31, 2015, regardless of first listing date; active/inactive status is on this date, and multiple listings are not counted. VAD, ventricular assist device.

Characteristic	2005		2015	
	N	Percent	N	Percent
Wait time				
< 1 year	919	33.9%	1919	50.6%
1-< 2 years	391	14.4%	884	23.3%
2-< 3 years	312	11.5%	415	10.9%
3-< 4 years	224	8.3%	214	5.6%
4-< 5 years	181	6.7%	128	3.4%
≥ 5 years	685	25.3%	231	6.1%
Medical urgency				
Status 1A	52	1.9%	380	10.0%
Status 1B	306	11.3%	1659	43.8%
Status 2	904	33.3%	865	22.8%
Inactive status	1450	53.5%	887	23.4%
VAD at listing	138	5.1%	1174	31.0%
Tx type				
Heart only	2553	94.1%	3531	93.1%
Heart-kidney	47	1.7%	179	4.7%
Heart-lung	102	3.8%	48	1.3%
Other	10	0.4%	33	0.9%
All candidates	2712	100.0%	3791	100.0%

Table HR 1 Characteristics of adults on the heart transplant waiting list on December 31, 2005 and December 31, 2015 (continued from previous page). Candidates waiting for transplant on December 31, 2005, and December 31, 2015, regardless of first listing date; active/inactive status is on this date, and multiple listings are not counted. VAD, ventricular assist device.

Waiting list state	2013	2014	2015
Patients at start of year	3058	3339	3626
Patients added during year	3304	3613	3622
Patients removed during year	3018	3318	3457
Patients at end of year	3344	3634	3791

Table HR 2 Heart transplant waitlist activity among adults. Candidates concurrently listed at more than one center are counted once, from the time of earliest listing to the time of latest removal. Candidates who are listed, undergo transplant, and are relisted are counted more than once. Candidates are not considered to be on the list on the day they are removed; counts on January 1 may differ from counts on December 31 of the prior year. Candidates listed for multi-organ transplants are included.

Removal reason	2013	2014	2015
Deceased donor transplant	2109	2229	2330
Patient died	345	375	393
Patient refused transplant	14	22	24
Improved, transplant not needed	146	201	162
Too sick for transplant	223	271	300
Other	181	220	248

Table HR 3 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.

Support	2010		2015	
	N	Percent	N	Percent
Any life support	1547	76.8%	1990	84.4%
Intravenous inotropes	744	36.9%	856	36.3%
Left ventricular assist device	717	35.6%	1056	44.8%
Intra-aortic balloon pump	101	5.0%	165	7.0%
Ventilator	59	2.9%	23	1.0%
Right ventricular assist device	57	2.8%	51	2.2%
Total artificial heart	26	1.3%	41	1.7%
Extra corporeal membrane oxygenation	20	1.0%	23	1.0%
Inhaled NO	9	0.4%	3	0.1%
Prostaglandins	3	0.1%	2	0.1%

Table HR 4 Adult heart recipients on circulatory support before transplant. Patients may have more than one type of circulatory support.

Characteristic	2005		2015	
	N	Percent	N	Percent
Age				
18-34 years	253	13.7%	227	9.6%
35-49 years	415	22.5%	506	21.4%
50-64 years	964	52.4%	1179	50.0%
≥65 years	209	11.4%	447	18.9%
Sex				
Female	451	24.5%	611	25.9%
Male	1390	75.5%	1748	74.1%
Race/ethnicity				
White	1326	72.0%	1483	62.9%
Black	298	16.2%	539	22.8%
Hispanic	142	7.7%	212	9.0%
Asian	61	3.3%	107	4.5%
Other/unknown	14	0.8%	18	0.8%
Diagnosis				
Coronary artery disease	816	44.3%	825	35.0%
Cardiomyopathy	872	47.4%	1400	59.3%
Congenital disease	64	3.5%	75	3.2%
Valvular disease	45	2.4%	23	1.0%
Other/unknown	44	2.4%	36	1.5%
Transplant history				
First	1773	96.3%	2291	97.1%
Retransplant	68	3.7%	68	2.9%
Blood type				
A	785	42.6%	912	38.7%
B	260	14.1%	367	15.6%
AB	91	4.9%	151	6.4%
O	705	38.3%	929	39.4%

Table HR 5 Characteristics of adult heart transplant recipients, 2005 and 2015 (continued on next page). Adult heart transplant recipients, including re-transplants. Ventricular assist device (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 calculated PRA (CPRA) began March 31, 2015. Prior to that, PRA class I and II values were used.

Characteristic	2005		2015	
	N	Percent	N	Percent
Insurance				
Private	1047	56.9%	1149	48.7%
Medicare	481	26.1%	819	34.7%
Medicaid	217	11.8%	285	12.1%
Other government	68	3.7%	68	2.9%
Unknown	28	1.5%	38	1.6%
Wait time				
< 31 days	558	30.3%	553	23.4%
31-60 days	261	14.2%	311	13.2%
61-90 days	168	9.1%	206	8.7%
3-< 6 months	310	16.8%	394	16.7%
6-< 12 months	266	14.4%	403	17.1%
1-< 2 years	141	7.7%	321	13.6%
2-< 3 years	59	3.2%	99	4.2%
≥ 3 years	78	4.2%	72	3.1%
Medical urgency				
Status 1A	609	33.1%	1565	66.3%
Status 1B	702	38.1%	732	31.0%
Status 2	530	28.8%	62	2.6%
On VAD	476	25.9%	1141	48.4%
Tx type				
Heart only	1752	95.2%	2180	92.4%
Heart-lung	30	1.6%	12	0.5%
Heart-kidney	53	2.9%	140	5.9%
Heart-liver	5	0.3%	27	1.1%
Other	1	0.1%	0	0.0%

Table HR 5 Characteristics of adult heart transplant recipients, 2005 and 2015 (continued from previous page and onto next page). Adult heart transplant recipients, including retransplants. Ventricular assist device (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 calculated PRA (CPRA) began March 31, 2015. Prior to that, PRA class I and II values were used.

Characteristic	2005		2015	
	N	Percent	N	Percent
HLA mismatches				
0	1	0.1%	1	0.0%
1	5	0.3%	7	0.3%
2	44	2.4%	73	3.1%
3	169	9.2%	259	11.0%
4	418	22.7%	564	23.9%
5	590	32.0%	796	33.7%
6	328	17.8%	485	20.6%
Unknown	286	15.5%	174	7.4%
CPRA				
< 1%	1101	59.8%	1260	53.4%
1-< 20%	309	16.8%	313	13.3%
20-< 80%	217	11.8%	337	14.3%
80-< 98%	42	2.3%	62	2.6%
98-100%	48	2.6%	19	0.8%
Unknown	124	6.7%	368	15.6%
All recipients	1841	100.0%	2359	100.0%

Table HR 5 Characteristics of adult heart transplant recipients, 2005 and 2015 (continued from previous page). Adult heart transplant recipients, including retransplants. Ventricular assist device (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 calculated PRA (CPRA) began March 31, 2015. Prior to that, PRA class I and II values were used.

Donor	Recipient	CMV	EBV	HIV
D-	R-	12.3%	0.7%	95.3%
D-	R+	17.8%	4.5%	0.2%
D-	R unk	8.3%	0.6%	3.9%
D+	R-	18.9%	10.8%	0.0%
D+	R+	29.4%	71.9%	0.0%
D+	R unk	13.0%	11.3%	0.0%
D unk	R-	0.1%	0.0%	0.6%
D unk	R+	0.1%	0.2%	0.0%
D unk	R unk	0.1%	0.0%	0.0%

Table HR 6 Adult heart donor-recipient serology matching, 2011-2015.

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. If all fields are unknown, incomplete, or pending, the person is categorized as unknown for that serology; otherwise, serology is assumed negative. CMV, cytomegalovirus; EBV, Epstein-Barr virus; HB, hepatitis B; HCV, hepatitis C virus; HIV, human immunodeficiency virus.

Characteristic	2005		2015	
	N	Percent	N	Percent
Age				
< 1 year	18	7.6%	45	14.0%
1-5 years	80	33.6%	100	31.2%
6-10 years	61	25.6%	68	21.2%
11-17 years	79	33.2%	108	33.6%
Sex				
Female	93	39.1%	126	39.3%
Male	145	60.9%	195	60.7%
Race/ethnicity				
White	146	61.3%	158	49.2%
Black	40	16.8%	64	19.9%
Hispanic	39	16.4%	80	24.9%
Asian	10	4.2%	9	2.8%
Other/unknown	3	1.3%	10	3.1%
Diagnosis				
Congenital defect	97	40.8%	172	53.6%
Idiopathic dilated CM	67	28.2%	58	18.1%
Familial dilated CM	2	0.8%	9	2.8%
Idiopathic restrictive CM	7	2.9%	16	5.0%
Myocarditis	15	6.3%	5	1.6%
Other/unknown	50	21.0%	61	19.0%
Transplant history				
First	222	93.3%	304	94.7%
Retransplant	16	6.7%	17	5.3%
Blood type				
A	80	33.6%	97	30.2%
B	21	8.8%	38	11.8%
AB	5	2.1%	5	1.6%
O	132	55.5%	181	56.4%

Table HR 7 Characteristics of pediatric candidates on the heart transplant waiting list on December 31, 2005 and December 31, 2015 (continued on next page). Candidates aged younger than 18 years waiting for transplant on December 31, 2005, and December 31, 2015, regardless of first listing date; active/inactive status is on this date, and multiple listings are not counted. CM, cardiomyopathy; VAD, ventricular assist device.

Characteristic	2005		2015	
	N	Percent	N	Percent
Wait time				
< 1 year	103	43.3%	200	62.3%
1-< 2 years	38	16.0%	55	17.1%
2-< 3 years	21	8.8%	28	8.7%
3-< 4 years	19	8.0%	15	4.7%
4-< 5 years	12	5.0%	6	1.9%
≥ 5 years	45	18.9%	17	5.3%
Medical urgency				
Status 1A	25	10.5%	105	32.7%
Status 1B	17	7.1%	43	13.4%
Status 2	54	22.7%	57	17.8%
Inactive status	142	59.7%	116	36.1%
VAD at listing	5	2.1%	14	4.4%
Tx type				
Heart only	215	90.3%	316	98.4%
Heart-kidney	1	0.4%	3	0.9%
Heart-lung	22	9.2%	1	0.3%
Other	0	0.0%	1	0.3%
All candidates	238	100.0%	321	100.0%

Table HR 7 Characteristics of pediatric candidates on the heart transplant waiting list on December 31, 2005 and December 31, 2015 (continued from previous page). Candidates aged younger than 18 years waiting for transplant on December 31, 2005, and December 31, 2015, regardless of first listing date; active/inactive status is on this date, and multiple listings are not counted. CM, cardiomyopathy; VAD, ventricular assist device.

Waiting list state	2013	2014	2015
Patients at start of year	328	349	361
Patients added during year	591	593	644
Patients removed during year	568	579	635
Patients at end of year	351	363	370

Table HR 8 Heart transplant waitlist activity among pediatric candidates.

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

Removal reason	2013	2014	2015
Deceased donor transplant	418	422	463
Patient died	53	77	80
Patient refused transplant	2	1	3
Improved, transplant not needed	47	43	48
Too sick for transplant	30	29	24
Other	18	7	17

Table HR 9 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.

Characteristic	2002-05		2012-15	
	N	Percent	N	Percent
Age				
< 1 year	307	25.5%	470	28.4%
1-5 years	270	22.4%	385	23.3%
6-10 years	183	15.2%	250	15.1%
11-17 years	443	36.8%	548	33.2%
Sex				
Female	568	47.2%	749	45.3%
Male	635	52.8%	904	54.7%
Race/ethnicity				
White	678	56.4%	891	53.9%
Black	256	21.3%	323	19.5%
Hispanic	189	15.7%	321	19.4%
Asian	56	4.7%	77	4.7%
Other/unknown	24	2.0%	41	2.5%
Diagnosis				
Congenital defect	540	44.9%	748	45.3%
Idiopathic dilated CM	381	31.7%	443	26.8%
Familial dilated CM	41	3.4%	76	4.6%
Idiopathic restrictive CM	72	6.0%	91	5.5%
Myocarditis	30	2.5%	64	3.9%
Other/unknown	139	11.6%	231	14.0%
Transplant history				
First	1110	92.3%	1563	94.6%
Retransplant	93	7.7%	90	5.4%
Blood type				
A	489	40.6%	599	36.2%
B	147	12.2%	226	13.7%
AB	46	3.8%	66	4.0%
O	521	43.3%	762	46.1%
ABO				
Compatible/identical	1183	98.3%	1592	96.3%
Incompatible	20	1.7%	61	3.7%

Table HR 10 Characteristics of pediatric heart transplant recipients, 2002-2005 and 2012-2015 (continued on next page). Heart transplant recipients, including retransplants. Collection of calculated PRA (CPRA) began March 31, 2015. Prior to that, measured PRA values were used. CM, cardiomyopathy; VAD, ventricular assist device.

Characteristic	2002-05		2012-15	
	N	Percent	N	Percent
Insurance				
Private	606	50.4%	725	43.9%
Medicaid	500	41.6%	766	46.3%
Other government	63	5.2%	121	7.3%
Unknown	34	2.8%	41	2.5%
Wait time				
< 31 days	523	43.5%	485	29.3%
31-60 days	235	19.5%	310	18.8%
61-90 days	134	11.1%	228	13.8%
3-< 6 months	177	14.7%	321	19.4%
6-< 12 months	77	6.4%	197	11.9%
1-< 2 years	37	3.1%	75	4.5%
2-< 3 years	11	0.9%	21	1.3%
≥ 3 years	9	0.7%	16	1.0%
Medical urgency				
Status 1A	866	72.0%	1465	88.6%
Status 1B	143	11.9%	134	8.1%
Status 2	194	16.1%	54	3.3%
On VAD	106	8.8%	407	24.6%
Tx type				
Heart only	1171	97.3%	1627	98.4%
Heart-lung	22	1.8%	18	1.1%
Heart-kidney	9	0.7%	4	0.2%
Heart-liver	0	0.0%	4	0.2%
Other	1	0.1%	0	0.0%
CPRA				
< 1%	633	52.6%	754	45.6%
1-< 20%	171	14.2%	278	16.8%
20-< 80%	104	8.6%	331	20.0%
80-< 98%	46	3.8%	89	5.4%
98-100%	37	3.1%	46	2.8%
Unknown	212	17.6%	155	9.4%

Table HR 10 Characteristics of pediatric heart transplant recipients, 2002-2005 and 2012-2015 (continued from previous page and onto next page). Heart transplant recipients, including retransplants. Collection of calculated PRA (CPRA) began March 31, 2015. Prior to that, measured PRA values were used. CM, cardiomyopathy; VAD, ventricular assist device.

Characteristic	2002-05		2012-15	
	N	Percent	N	Percent
All recipients	1203	100.0%	1653	100.0%

Table HR 10 Characteristics of pediatric heart transplant recipients, 2002-2005 and 2012-2015 (continued from previous page). Heart transplant recipients, including retransplants. Collection of calculated PRA (CPRA) began March 31, 2015. Prior to that, measured PRA values were used. CM, cardiomyopathy; VAD, ventricular assist device.

Support	2010		2015	
	N	Percent	N	Percent
Any life support	236	65.6%	316	68.7%
Intravenous inotropes	178	49.4%	224	48.7%
Left ventricular assist device	62	17.2%	99	21.5%
Ventilator	58	16.1%	61	13.3%
Right ventricular assist device	24	6.7%	15	3.3%
Extra corporeal membrane oxygenation	16	4.4%	18	3.9%
Prostaglandins	6	1.7%	9	2.0%
Inhaled NO	3	0.8%	1	0.2%
Intra-aortic balloon pump	1	0.3%	0	0.0%
Total artificial heart	0	0.0%	2	0.4%

Table HR 11 Pediatric heart recipients on circulatory support before transplant. Patients may have more than one type of circulatory support.

Donor	Recipient	CMV	EBV
D-	R-	22.5%	13.3%
D-	R+	14.7%	14.0%
D-	R unk	11.0%	1.2%
D+	R-	23.5%	29.7%
D+	R+	16.9%	38.5%
D+	R unk	10.7%	3.0%
D unk	R-	0.5%	0.4%
D unk	R+	0.1%	0.0%
D unk	R unk	0.1%	0.0%

Table HR 12 Pediatric heart donor-recipient serology matching, 2011-2015. 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. If all fields are unknown, incomplete, or pending, the person is categorized as unknown for that serology; otherwise, serology is assumed negative. CMV, cytomegalovirus; EBV, Epstein-Barr virus.