
Chapter 7: Transplantation

- 17,600 kidney transplants were performed in the United States in 2013 (16,253 were kidney-alone).
- Less than one-third of kidneys transplanted were from living donors in 2013.
- From 2012 to 2013, there was a 3.1% increase in the cumulative number of recipients with a functioning kidney transplant.
- On December 31, 2013, the kidney transplant waiting list had 86,965 candidates (dialysis patients only) with 48,311 active candidates. 83% of all candidates were awaiting their first transplant.
- Among candidates newly wait-listed for either a first-time or repeat kidney-alone transplant in 2009, the median waiting time to transplant was 3.6 years.
- The number of deceased donors has increased significantly since 2003, reaching 8,021 in 2013.
- The rate of deceased donors among Blacks more than doubled from 1999 to 2013.
- 16% of kidneys recovered from deceased donors were discarded in 2013.
- In 2012, the probability of one-year graft survival was 92% and 97% for deceased and living donor kidney transplant recipients, respectively.
- The probability of patient survival within one year post-transplant was 95% and 98% in deceased and living donor kidney transplant recipients, respectively, in 2012.
- Since 1996, the probabilities of graft survival and patient survival have steadily improved among recipients of both living and deceased donor kidney transplants.
- The one-year graft survival and patient survival advantage experienced by living donor transplant recipients persists at five and ten years post-transplant.

Introduction

Kidney transplantation is the renal replacement therapy of choice for a majority of patients with end stage renal disease (ESRD). Successful kidney transplantation is associated with improved survival, improved quality of life and healthcare cost savings when compared to dialysis. This chapter reports on the trends of the kidney transplant waiting list, kidney transplants performed over the years, and the health outcomes of those who have received a transplant. In addition, to further enhance our understanding of the donor pool, this year we report the trends and epidemiology of deceased kidney donations over the years.

ANALYTICAL METHODS

See the ESRD Analytical Methods chapter for an explanation of analytical methods used to generate the figures and tables in this chapter.

Overview

During the year 2013, 17,600 kidney transplants, including 16,253 kidney-alone and 1,347 kidney plus at least one additional organ, were performed in the United States. Of these transplants, 5,721 were identified as coming from living donors and 11,878 from deceased donors. Overall, there were 356 more kidney transplants in the United States in 2013 than in 2012. Although the number of kidney transplants has, in general, remained stable since 2005, ranging from a high of 18,018 in 2006, to a low of 17,244 in 2012, the cumulative number of recipients living with a functioning kidney transplant continues to grow, reaching 193,262 in 2013, a 3.1% increase over 2012.

As of December 31, 2013, the kidney transplant waiting list increased by 3% over the previous year to 86,965 candidates (dialysis patients only), 83% of which were awaiting their first kidney transplant. Fifty-six percent (48,311) of wait-listed candidates were in active

status and 44% (38,654) were inactive. With less than 18,000 kidney transplants performed in 2013, the active waiting list was 2.7 times larger than the supply of donor kidneys, which presents a continuing challenge. An additional 14,541 (14%) patients not yet on dialysis were on the waiting list as of December 31, 2013.

Among incident ESRD patients who started their dialysis in 2012, 13% were added to the waiting list or received a deceased or living donor transplant within one year of ESRD initiation. Among candidates newly wait-listed for either a first-time or repeat kidney-alone transplant in 2009, the median waiting time to transplant was 3.6 years, i.e., by 3.6 years after being wait-listed for a transplant, 50% of patients had received a transplant.

The probability of one-year graft survival for deceased donor kidney transplant recipients in 2012 was 92%, unchanged from 2011. Analyzing the separate components of graft failure, the probability of either returning to dialysis or undergoing repeat transplantation was 5%, while that of death was 4%. The probability of one-year graft survival for living donor transplant recipients was 97%, which was substantially higher than that for deceased donor transplant recipients. Analyzing the separate components of graft failure, the probability of either returning to dialysis or undergoing repeat transplantation was 2% and that of death was 2%.

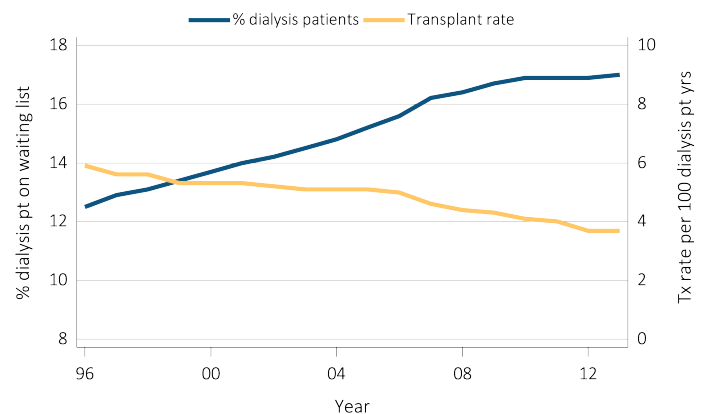
For recipients of deceased donor transplants in 2008, the probability of five-year graft survival improved from 72% to 73% compared to the prior year. Five-year graft survival for living donor transplant recipients in 2008 also improved, from 83% to 85%.

The percentage of acute rejection during the first year was highest in 1996 among both deceased (51%) and living (52%) donor recipients. Subsequently, instances of acute rejection declined over the next decade.

The unadjusted transplant rate per 100 dialysis patient years has been falling, while the percentage of prevalent dialysis patients wait-listed for a kidney has been rising (Figure 7.1). Probable contributing causes include a higher prevalent dialysis population, longer survival of ESRD patients on dialysis, and the growing imbalance between donor supply and demand, which in turn leads to longer kidney transplant waiting times. Waiting list counts and median waiting time to transplantation continue to grow (Figure 7.2). The number of candidates on the waiting list for repeat kidney transplant has plateaued at approximately

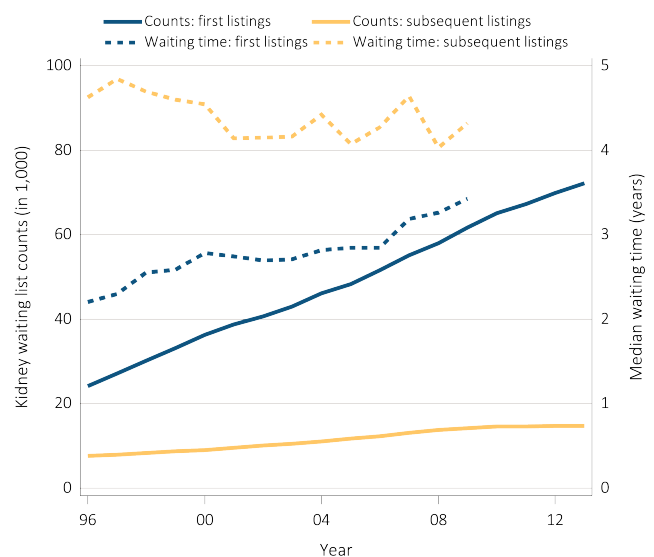
14,500 over the last four years. The median waiting time for first-time transplants was 3.4 years in 2009, 11 months shorter than that for repeat transplants. The total number of kidney transplants has leveled off over the past decade (Figure 7.3). During this period, a small overall increase in deceased donations has balanced a small decrease in living donations. The latter is driven in part by changes in the pediatric allocation policy that direct deceased donor kidneys from donors under the age of 35 years to children. Introduction of this policy has been associated with a decrease in living donations to children. As noted above, the total number of recipients with functioning kidney transplants continues to grow (Figure 7.4).

vol 2 Figure 7.1 Percentage of dialysis patients wait-listed and unadjusted kidney transplant rates, 1996-2013



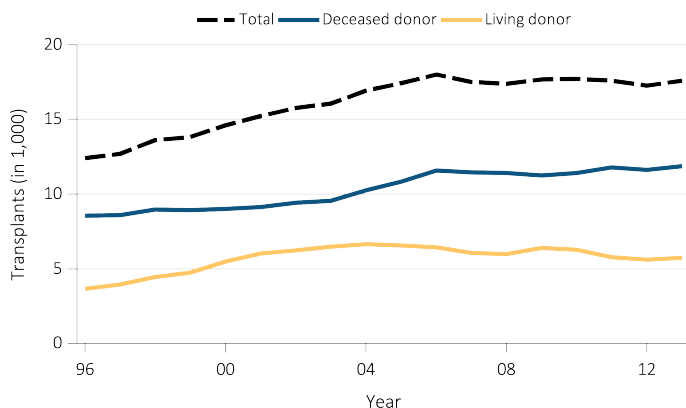
Data Source: Reference Tables E4 and E9. Percentage of dialysis patients on the kidney waiting list is for all dialysis patients. Unadjusted transplant rates are for all dialysis patients. Abbreviations: Tx, transplant; pt yrs, patient years.

vol 2 Figure 7.2 Number of patients wait-listed for kidney transplant, 1996-2013, and waiting time, 1996-2010



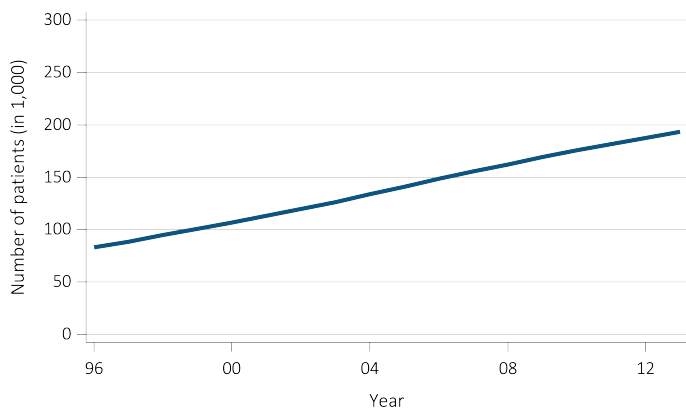
Data Source: Reference Tables E2 and E3. Waiting list counts include all candidates listed for a kidney transplant on December 31 of each year. Waiting time is calculated for all candidates enrolled on the waiting list in a given year.

vol 2 Figure 7.3 Number of kidney transplants, 1996-2013



Data Source: Reference Tables E8, E8(2), and E8(3). Counts of transplants are for all dialysis patients.

vol 2 Figure 7.4 Number of patients with a functioning kidney transplant, 1996-2013

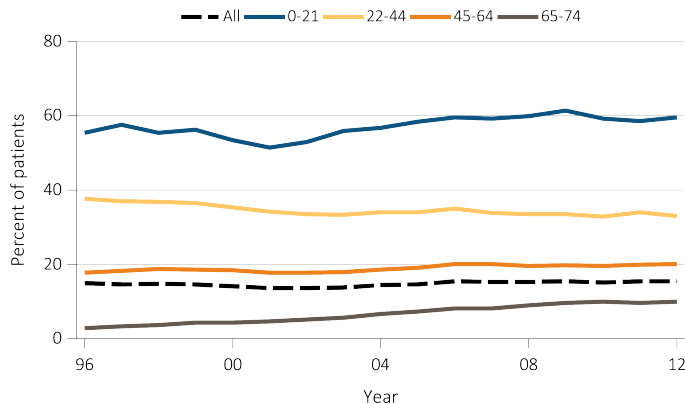


Data Source: Reference Table D9. Prevalent counts of patients with a functioning kidney transplant as of December 31 of each year.

Kidney Transplant Waiting List

The percentage of patients wait-listed or receiving a transplant in their first ESRD-year has declined for those between the ages of 22 and 44 years, but has increased slightly in recent years for those aged 45 years and older (Figure 7.5). Patients aged 0-21 and 65-74 years old experienced the greatest percentage increase of those being wait-listed or receiving a kidney transplant within one year of ESRD initiation, steadily rising from 5% in 2002 to 10% in 2012. Increasing age continues to be associated with a decreasing percentage of patients being wait-listed or transplanted within one year of ESRD initiation.

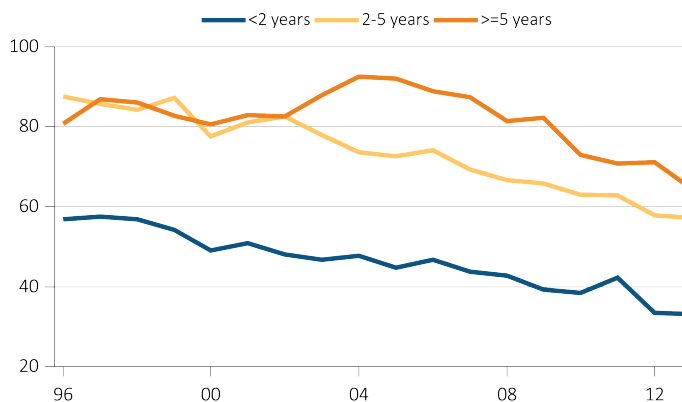
vol 2 Figure 7.5 Percentage of incident patients being wait-listed or receiving a kidney transplant within one year of ESRD initiation, by age, 1996-2012



Data Source: Reference Table E5(2). Waiting list or transplantation among incident ESRD patients by age (0-74 years).

There has been a 27% relative decline in the overall mortality rate for dialysis patients on the kidney transplant waiting list since 2004 (Figure 7.6).

vol 2 Figure 7.6 Annual mortality rates for dialysis patients on the kidney transplant waiting list by time on the list, 1996-2013



Data Source: Reference Table H6. Annual mortality rates of dialysis patients on the kidney transplant waiting list per 1,000 dialysis patient years at risk, by patient vintage. Abbreviation: pt yrs, patient years.

Transplant Counts and Rates

The number of annual kidney transplants has remained relatively stable since 2005, ranging from a high of 18,018 in 2006, to a low of 17,244 in 2012. However, the annual transplant rate has seen a continuous decline (Table 7.1). During 2004-2013, this trend was more pronounced in those aged 22-44 and 45-64 years. This decline is noticeable in both males and females, and across all racial groups and causes of ESRD.

vol 2 Table 7.1 Unadjusted kidney transplant rates, all donor types, by age, sex, race, and primary cause of ESRD, per 100 dialysis patient years, 2004-2013

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
0-21	31.2	34.9	35.4	30.3	30.9	33.3	31.5	30.5	31.2	30.4
22-44	11.6	11.2	10.8	10.1	9.2	9.3	8.7	8.3	8.2	7.9
45-64	6.1	6.0	6.0	5.6	5.3	5.1	5.0	4.8	4.4	4.5
65-74	2.3	2.6	2.7	2.5	2.6	2.6	2.6	2.6	2.5	2.5
75 and up	0.2	0.3	0.3	0.4	0.3	0.4	0.4	0.4	0.4	0.3
Sex										
Male	5.6	5.6	5.6	5.1	4.9	4.7	4.5	4.3	4.1	4.0
Female	4.5	4.5	4.3	4.1	3.8	3.9	3.7	3.5	3.3	3.3
Race										
White	6.2	6.1	6.0	5.6	5.2	5.0	4.7	4.5	4.3	4.2
Black/African American	3.2	3.3	3.3	3.1	3.0	3.0	3.0	2.9	2.6	2.6
Native American	3.7	3.3	3.9	3.0	3.6	3.7	3.0	3.2	2.7	2.4
Asian	5.4	5.5	5.3	4.8	5.0	4.6	4.7	4.4	4.5	4.5
Primary Cause of ESRD										
Diabetes	3.4	3.4	3.2	3.0	2.9	2.8	2.6	2.5	2.3	2.3
Hypertension	3.1	3.2	3.2	3.1	2.9	2.9	2.8	2.6	2.6	2.5
Glomerulonephritis	10.2	9.7	9.9	9	8.7	8.7	8.8	8.3	7.9	7.7
All	5.1	5.1	5.0	4.7	4.4	4.3	4.1	4.0	3.7	3.7

Data Source: Reference Table E9.

COUNTS AND RATES OF DECEASED DONOR TRANSPLANTS

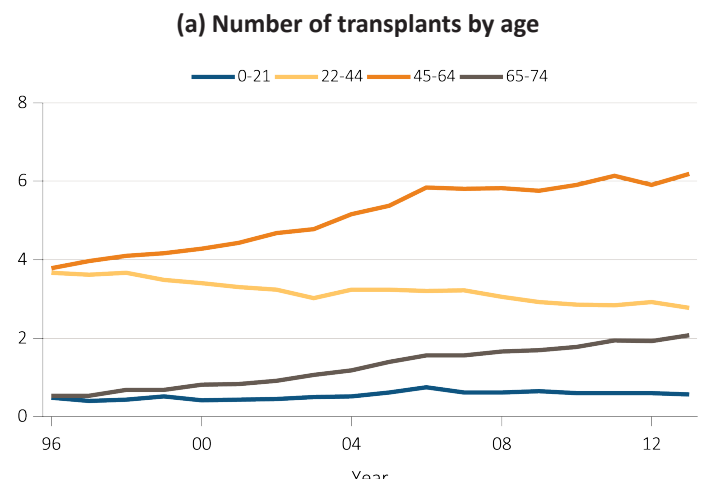
The overall number of deceased donor transplants has leveled off since 2007 (Figure 7.3). In this section, we review trends in counts and rates of deceased donor transplants by age, sex, race, and primary cause of ESRD (Figures 7.7-7.10).

For patients aged 45-64 and 65-74 years, the number of deceased donor transplant recipients has continued to increase throughout the past two decades, although less markedly since 2006. The counts were highest for recipients aged 45-64 years old, reaching 6,190 in 2013 (Figure 7.7.a, Number of transplants by age). In contrast, during this same time period, the number of deceased donor transplant recipients has decreased steadily to 2,781 for those aged 22-44 years.

Rates and counts of deceased donor transplantation per 100 dialysis patient years are presented in Figure 7.7 by age categories without statistical adjustment. The patterns for deceased donor transplant counts in Figure 7.7.a and rates in 7.7.b look very dissimilar, because the number of dialysis patients varies and increases markedly with age. Due to the small denominator for children on dialysis and the pediatric allocation priority for kidneys from deceased donors under the age of 35 years, deceased donor transplant

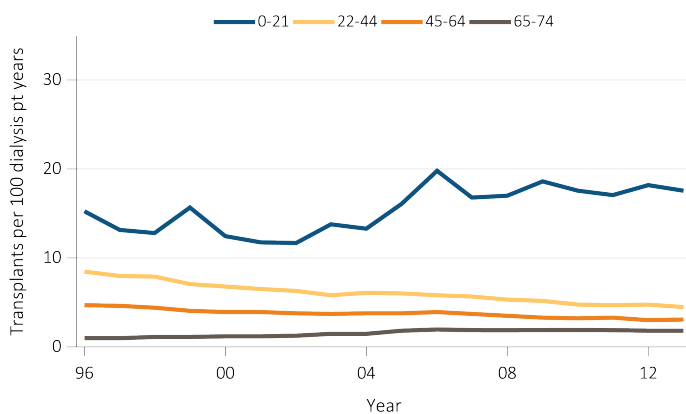
rates are highest in children (<22 years old), and their rates increased in 2005-2007, stabilizing thereafter. While there has been a reduction in deceased donor kidney transplantation rates for those aged 22-44 and 45-64 years, the rates for those aged 65-74 years have stabilized at low levels.

vol 2 Figure 7.7 Number of deceased donor transplants and unadjusted transplant rates among deceased donor kidney recipients, by recipient age, 1996-2013



Data Source: Reference Table E8(2). Deceased donor kidney transplant counts by recipient age.

(b) Transplant rates by age



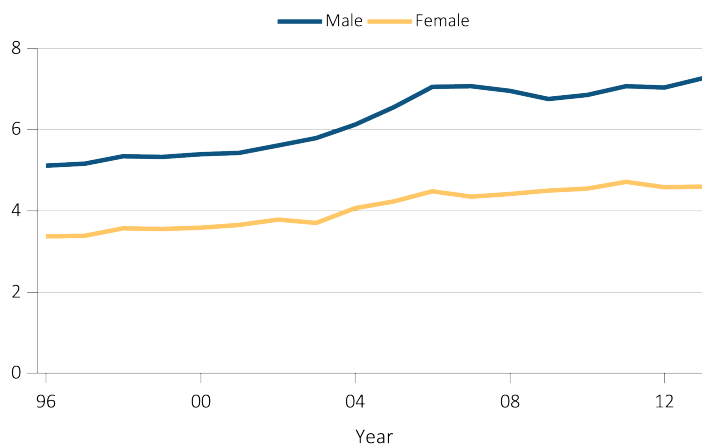
Data Source: Reference Table E9(2). Unadjusted deceased donor kidney transplant rates by recipient age. Abbreviation: pt, patient.

The trends for counts of deceased donor transplants by year are similar for males and females, rising over the past decade with some leveling off after 2006 (Figure 7.8.a, Number of transplants by sex). Males received substantially more transplants than females. This difference seems to be largely explained by the fact that males account for more than 60% of wait-listed candidates.

The rates of deceased donor kidney transplantation during 1996-2013 declined for both male and female dialysis patients (Figure 7.8.b, Transplant rates by sex). This is explained partly by the growing number of dialysis patients. The difference in transplantation rates between males and females has been narrowing in recent years.

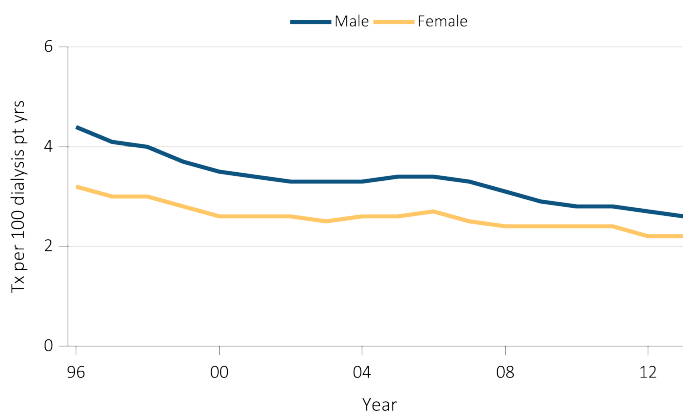
vol 2 Figure 7.8 Number of deceased donor transplants and unadjusted transplant rates among deceased donor kidney recipients, by recipient sex, 1996-2013

(a) Number of transplants by sex



Data Source: Reference Table E8(2). Deceased donor kidney transplant counts by recipient sex.

(b) Transplant rates by sex



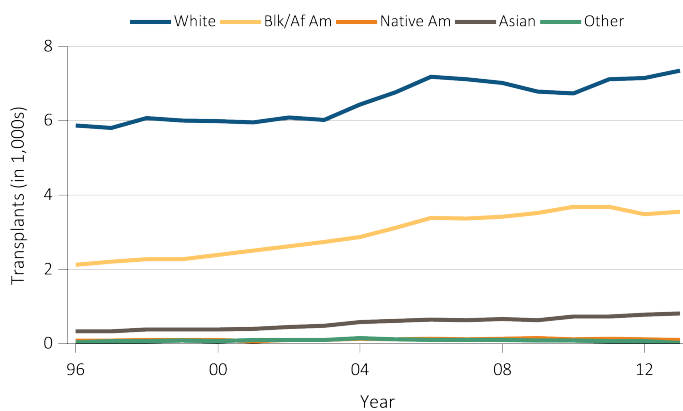
Data Source: Reference Table E9(2). Unadjusted deceased donor kidney transplant rates by recipient sex. Abbreviation: pt yrs, patient years.

Among Whites and Blacks/African Americans, the number of deceased donor transplants has grown substantially over the past decade, with smaller increases for Asians, and small decreases for Native American and Other races (Figure 7.9.a, Number of transplants by race).

Since 1996, deceased donor transplant rates for White dialysis patients have been declining. Since 2003, deceased donor transplant rates for Asians have surpassed and remain higher than for Whites (Figure 7.9.b, Transplant rates by race). The rates of deceased donor transplants for Blacks and Native Americans continue to remain low compared to Whites.

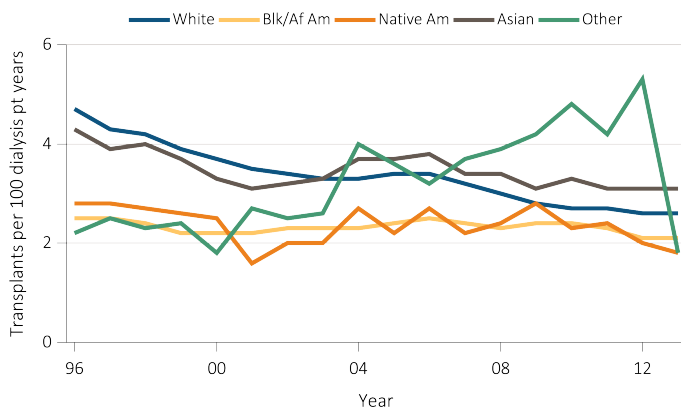
vol 2 Figure 7.9 Number of deceased donor transplants and unadjusted transplant rates among deceased donor kidney recipients, by recipient race, 1996-2013

(a) Number of transplants by race



Data Source: Reference Table E8(2). Deceased donor kidney transplant counts by recipient race. Abbreviations: Blk/Af Am, Black/African American; Native Am, Native American.

(b) Transplant rates by race



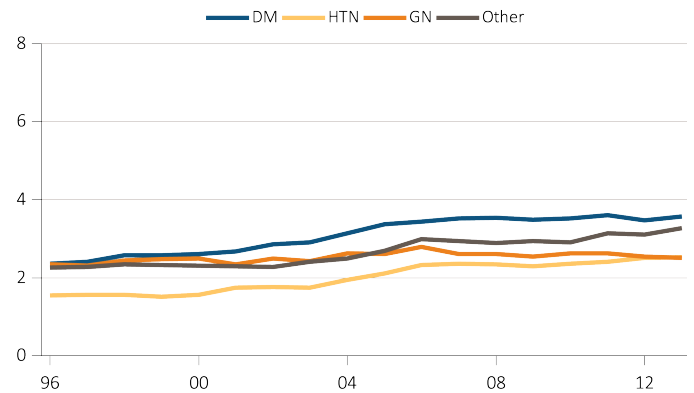
Data Source: Reference Table E9(2). Unadjusted deceased donor kidney transplant rates by recipient race. Abbreviations: Blk/Af Am, Black/African American; Native Am, Native American; pt, patient.

The largest growth in deceased donor transplantation numbers has been among recipients with diabetes or hypertension. Diabetes was the most common disease among the major causes of ESRD (Figure 7.10.a, Number of transplants by primary cause).

The rates of deceased donor transplants for all diagnosis groups have been declining since 2006 (Figure 7.10.b, Transplant rates by primary cause of ESRD). Transplant rates among dialysis patients with glomerular disease by far exceeded those for any other causes, followed by the Other causes category (including cystic disease). Deceased donor transplant rates for candidates with ESRD attributed to hypertension and diabetes are similar to each other, but were lower than those observed for the glomerulonephritis and Other categories. This rank order is partly explained by differences in the number of patients with these diagnoses as the cause of ESRD.

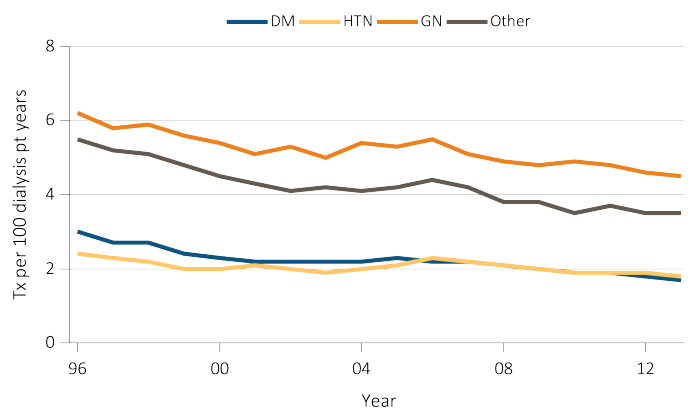
vol 2 Figure 7.10 Number of deceased donor transplants and unadjusted transplant rates among deceased donor kidney recipients, by recipient primary cause of ESRD, 1996-2013

(a) Number of transplants by primary cause of ESRD



Data Source: Reference Table E8(2). Deceased donor kidney transplant counts by recipient primary cause of ESRD. Abbreviations: DM, diabetes mellitus; ESRD, end-stage renal disease; GN, glomerulonephritis; HTN, hypertension.

(b) Transplant rates by primary cause of ESRD



Data Source: Reference Table E9(2). Unadjusted deceased donor kidney transplant rates by recipient primary cause of ESRD. Abbreviations: DM, diabetes mellitus; ESRD, end-stage renal disease; GN, glomerulonephritis; HTN, hypertension; pt, patient.

COUNTS AND RATES OF LIVING DONOR TRANSPLANTS

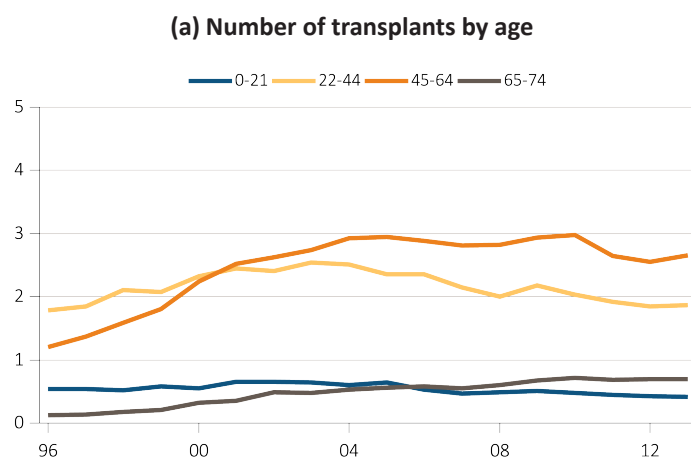
Though annual living donor kidney transplant counts rose steadily for adult recipients between 1996 and 2004, there has since been a steady decline. In this section, we review trends in annual counts and rates of living donor kidney transplants by age, sex, race, and primary cause of ESRD (Figures 7.11-7.14).

Counts for living donor transplants for those aged 22-44 years old decreased from 2,523 in 2004 to 1,866 in 2013. The number of living donor transplants for the group aged 45-64 years has shown a more recent decline, falling from 2,985 in 2010 to 2,658 in 2013 (Figure 7.11.a, Number of transplants by age). While

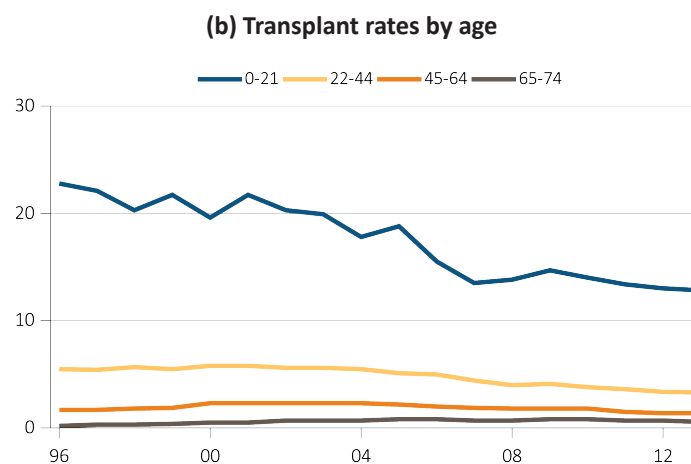
transplant counts for those over 65 years old have shown an increase since 1996, from 2010 to 2013, they have remained stable at close to 800 per year.

Kidney transplantation rates from living donors per 100 dialysis patient years show that younger age groups have substantially higher annual rates and also a steeper decline in these rates since about 1999 (Figure 7.11.b, Transplant rates by age). Among adults, the 22-44 year old group has the highest transplantation rate. Only the very low rates for ages 65-74 years have remained stable over the past decade.

vol 2 Figure 7.11 Number of living donor transplants and unadjusted transplant rates among living donor kidney recipients, by recipient age, 1996-2013



Data Source: Reference Table E8(3). Living donor kidney transplant counts by recipient age.

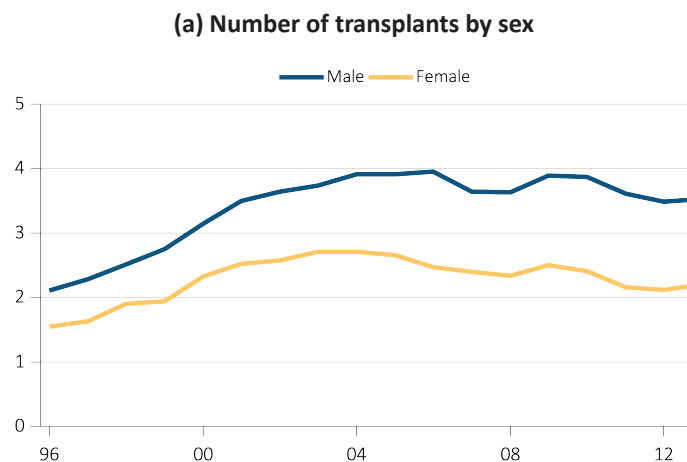


Data Source: Reference Table E9(3). Unadjusted living donor kidney transplant rates by recipient age. Abbreviation: pt, patient.

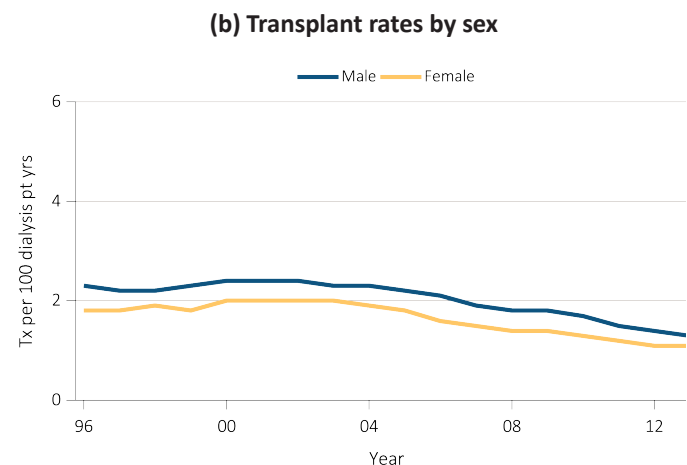
The annual counts of living donor kidney transplantation show consistently higher numbers of male compared to female recipients (Figure 7.12.a, Number of transplants by sex). However, since 2009, living donor kidney transplant counts have decreased for both males and females. The living donor

transplant rates are higher for males than for females but the difference is relatively small (Figure 7.12.b, Transplant rates by sex).

vol 2 Figure 7.12 Number of living donor transplants and unadjusted transplant rates among living donor kidney recipients, by recipient sex, 1996-2013



Data Source: Reference Table E8(3). Living donor kidney transplant counts by recipient sex.

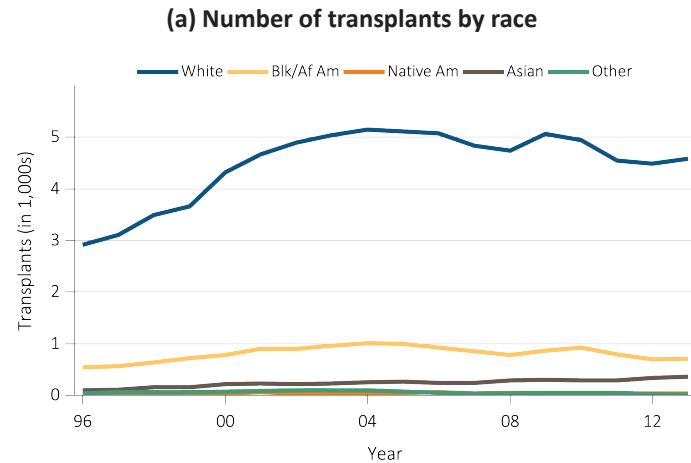


Data Source: Reference Table E9(3). Unadjusted living donor kidney transplant rates by recipient sex. Abbreviation: pt yrs, patient years.

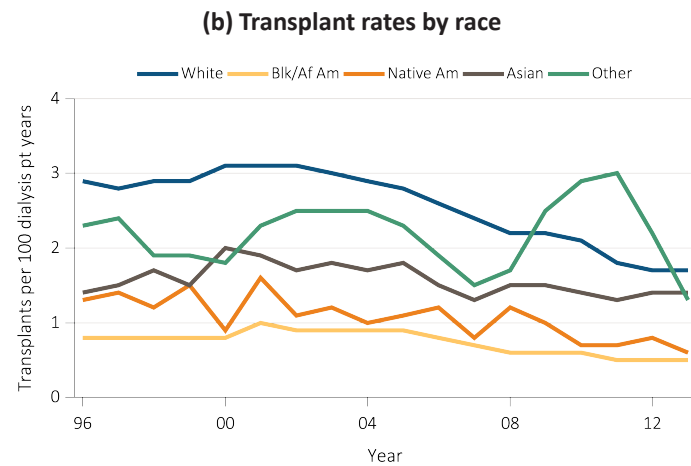
Overall living donor kidney transplant counts had been steadily increasing until 2004 for all races (Figure 7.13.a, Number of transplants by race). Since then, the annual number of living donor kidney transplants has decreased for Whites and Blacks while the counts for Asians have shown a small increase.

Living donor transplant rates for Whites are the highest among all race groups, while rates among Native Americans are the lowest (Figure 7.13.b, Transplant rates by race). From 2012 to 2013, living donor transplant rates have increased slightly among Whites, Blacks, and Asians, while they have declined among Native Americans and Others.

vol 2 Figure 7.13 Number of living donor transplants and unadjusted transplant rates among living donor kidney recipients, by recipient race, 1996-2013



Data Source: Reference Table E8(3). Living donor kidney transplant counts by recipient race. Abbreviations: Blk/Af Am, Black/African American; Native Am, Native American.



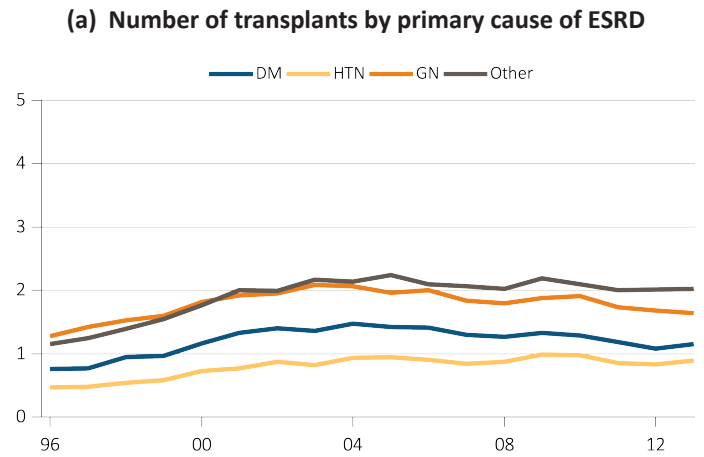
Data Source: Reference Table E9(3). Unadjusted living donor kidney transplant rates by recipient race. Abbreviations: Blk/Af Am, Black/African American; Native Am, Native American; pt, patient.

The ranking of living donor kidney transplantation counts by primary cause of ESRD has remained the same over the past decade, from highest to lowest frequency: other, glomerulonephritis, diabetes, and hypertension (Figure 7.14.a, Number of transplants by primary cause of ESRD). However, this contrasts with the pattern among deceased donor recipients, because the numbers with ESRD caused by hypertension and diabetes mellitus have grown steadily in comparison to other causes.

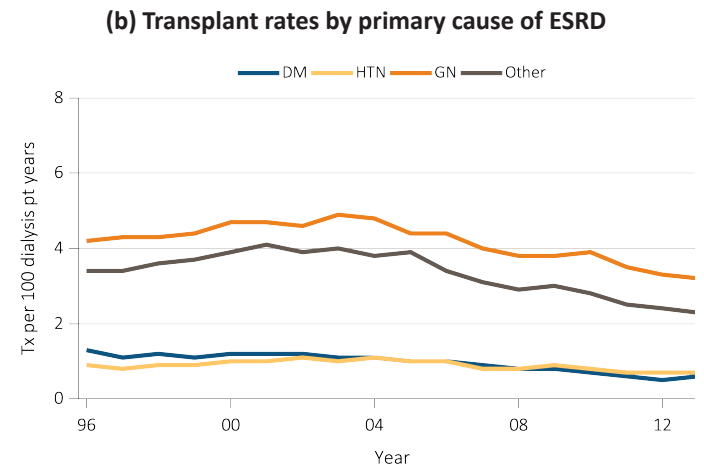
The rates of living donor transplantation for all diagnosis groups have been declining over the past decade (Figure 7.14.b, Transplant rates by primary cause of ESRD). The rates of living donor transplants among patients with glomerular disease by far exceed those for any other causes, followed by other causes (including cystic

disease), and are lowest for those with hypertension and diabetes.

vol 2 Figure 7.14 Number of living donor transplants and unadjusted transplant rates among living donor kidney recipients, by recipient primary cause of ESRD, 1996-2013



Data Source: Reference Table E8(3). Living donor kidney transplant counts by recipient primary cause of ESRD. Abbreviations: DM, diabetes mellitus; ESRD, end-stage renal disease; GN, glomerulonephritis; HTN, hypertension.



Data Source: Reference Table E9(3). Unadjusted living donor kidney transplant rates by recipient primary cause of ESRD. Abbreviations: DM, diabetes mellitus; ESRD, end-stage renal disease; GN, glomerulonephritis; HTN, hypertension; pt, patient.

Deceased Donation Counts and Rates

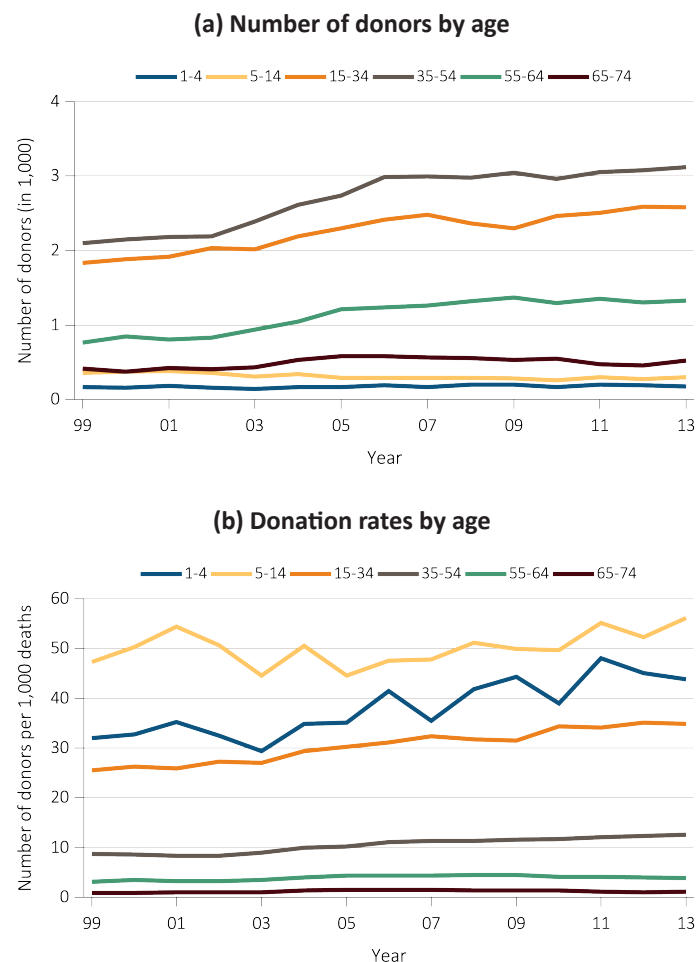
The number of deceased donors with at least one kidney retrieved has been increasing since 2003, reaching 8,021 in 2013 (Figure 7.15.a, Number of donors by age).

Since 2002, the number of donors among those aged 1-4, 5-14, and 65-74 years old has been relatively stable, but the number of donors among those aged 15-34, 35-54, and 55-64 years old has been increasing. Donors aged 35-54 years old have been the leading source of kidney donations during the past 15 years, with donors

aged 15-34 years old being the second highest source, and those aged 55-64 years old being the third highest.

Annual donation rates were calculated as the number of deceased donors from whom at least one kidney was retrieved per 1,000 deaths in the U.S. population (Centers for Disease Control and Prevention, 2015). Donation rates among those aged younger than 55 have been increasing during 2003-2013 (Figure 7.15.b, Donation rates by age), with those aged 1-4 and 5-14 years old having the highest donation rates during 1999-2013.

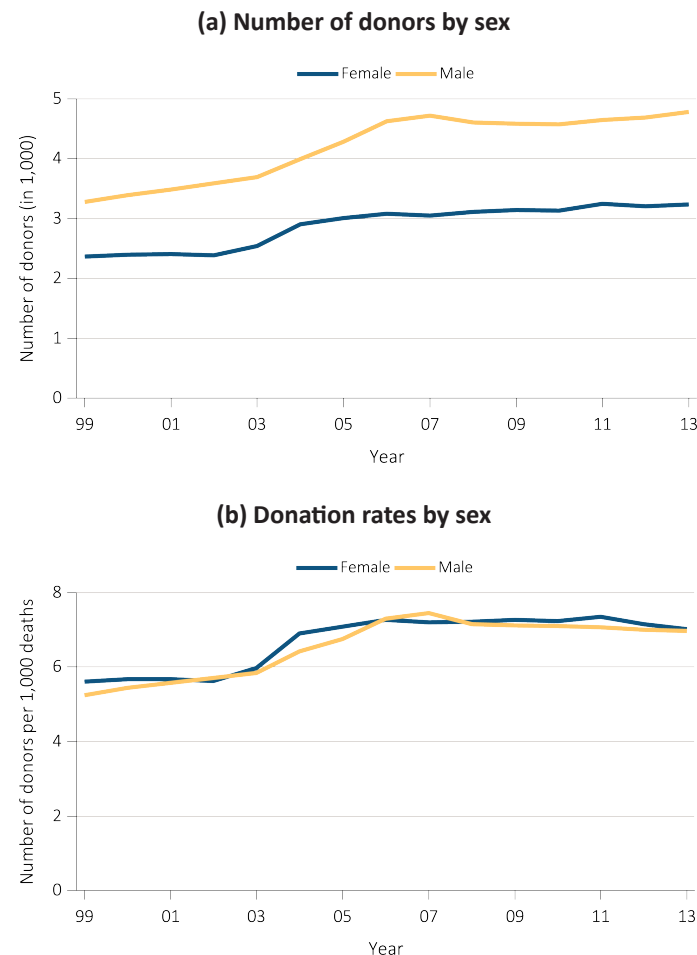
vol 2 Figure 7.15 Number of deceased kidney donors and unadjusted kidney donation rates, by donor age, 1999-2013



Data Source: Data on the annual number of deaths in the US population are obtained from the Centers for Disease Control and Prevention; the deceased donor data are obtained from UNOS. Deceased donor kidney donation rates by donor age.

Deceased kidney donor counts of males have been consistently around 1.5 times greater than those of females (Figures 7.16.a Number of donors by sex, and 7.16.b Donation rates by sex), but the donation rates are similar between males and females. Both groups have demonstrated an increase in the donor number and rate since 2003, and have been stable since 2008.

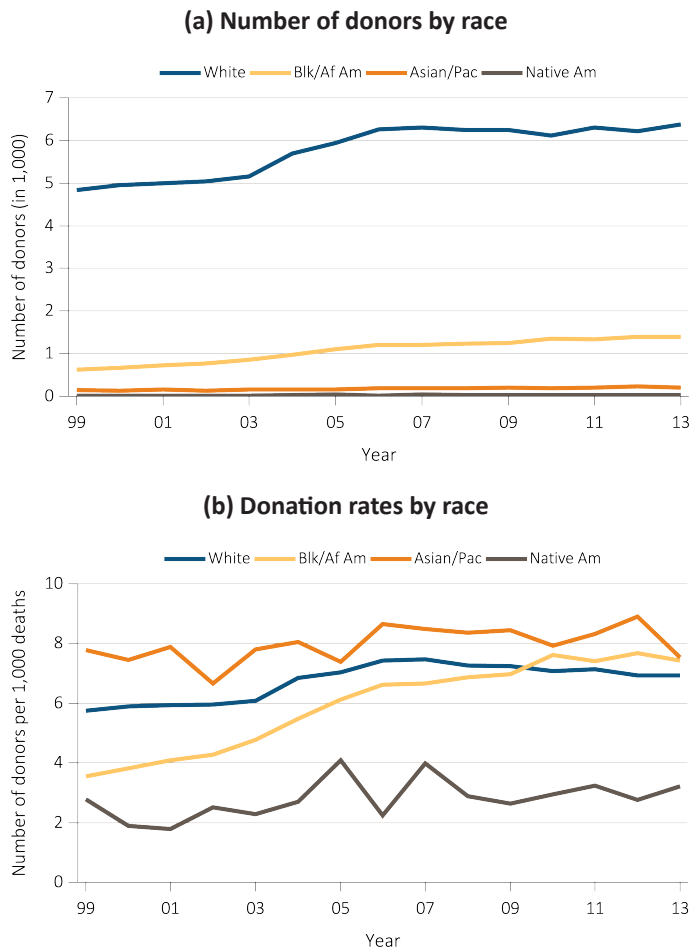
vol 2 Figure 7.16 Number of deceased kidney donors and unadjusted kidney donation rates, by donor sex, 1999-2013



Data Source: Data on the annual number of deaths in the US population are obtained from the Centers for Disease Control and Prevention; the deceased donor data are obtained from UNOS. Deceased donor kidney donation rates by donor sex.

Whites have contributed the most to the number of deceased donors each year during 1999-2013 (Figure 7.17.a Number of donors by race), but Blacks have surpassed Whites in donation rates since 2000 (Figure 7.17.b Donation rates by race). The rate of deceased donors per 1,000 deaths among Blacks more than doubled from 1999 to 2013. Since 1999, Asian or Pacific Islanders have had the highest donation rate, and Native Americans have had the lowest donation rates.

vol 2 Figure 7.17 Number of deceased kidney donors and unadjusted kidney donation rates, by donor race, 1999-2013



Data Source: The US death population data are obtained from the Centers for Disease Control and Prevention; the deceased donor data are obtained from UNOS. Deceased donor kidney donation rates by donor race. Abbreviations: Asian/Pac, Asian/Pacific Islander; Blk/Af Am, Black/African American; Native Am, Native American.

In 2013, among 15,689 kidneys that were recovered from deceased donors, 2,551 (16%) were discarded due to various reasons.

Transplant Outcomes

There has been a progressive improvement in outcomes of kidney transplant recipients in the last few years. In this section, we review the trends in probability of all-cause graft failure, probability of returning to dialysis, and probability of death at one, five, and ten years post-transplant. We will also review the trends in acute rejection and hospitalization of patients who received a kidney transplant.

During 1996-2012, kidney transplant patients experienced improved health outcomes, with decreases in deaths and all-cause graft failure. Among the recipients of deceased donor kidney transplants,

the probability of all-cause graft failure in the first year following transplant decreased from 14% in 1996 to 8% in 2012, while the probability of death decreased from 6% in 1996 to 4% in 2012. Similarly, among those who received living donor kidney transplants, the probability of all-cause graft failure in the first year following transplant decreased from 7% in 1996 to 3% in 2012, while probability of death decreased from 2.3% to 1.5% over the same time period.

Improvements in patient survival probabilities have persisted for most of the five- and ten-year outcomes. Among deceased donor kidney transplant recipients, the probability of all-cause graft failure by the fifth year improved, dropping from 36% in 1996 to 27% in 2008, and by the tenth year post-transplant it also decreased from 59% in 1996 to 55% in 2003. Probability of death by the fifth year post-transplant improved by dropping from 19% in 1996 to 16% in 2008, and for tenth year post transplant improved by decreasing from 39% in 1996 to 38% in 2003. Similarly, for living donor kidney transplant recipients, the probability of all-cause graft failure by the fifth year decreased from 23% in 1996 to 15% in 2008, while in the tenth year it decreased from 43% in 1996 to 40% in 2003. The probability for death by fifth year post-transplant also improved by falling from 10% in 1996 to 8% in 2008, but the probability of death by tenth year post-transplant remained unchanged at 23% from 1996 to 2003. Overall, the outcomes have been consistently more advantageous in living donor kidney transplant recipients in comparison to deceased donor transplant recipients (Tables 7.2 and 7.3).

vol 2 Table 7.2 Trend in 1-, 5-, & 10-year deceased donor kidney transplant outcomes, 1996-2012

Year	One year post-transplant			Five years post-transplant			Ten years post-transplant		
	Prob. of all-cause graft failure	Prob. of return to dialysis or repeat transplant	Prob. of death	Prob. of all-cause graft failure	Prob. of return to dialysis or repeat transplant	Prob. of death	Prob. of all-cause graft failure	Prob. of return to dialysis or repeat transplant	Prob. of death
1996	14.3%	10.2%	5.8%	36.2%	25.7%	19.4%	59.1%	42.9%	39.3%
1997	12.9%	8.5%	6.2%	34.7%	23.7%	19.2%	58.1%	40.8%	39.6%
1998	12.8%	9.2%	5.5%	33.8%	24.0%	18.1%	56.8%	40.4%	38.1%
1999	13.7%	9.2%	5.9%	34.0%	23.1%	18.9%	56.8%	39.4%	38.4%
2000	13.2%	8.6%	6.4%	34.6%	23.1%	19.7%	57.3%	39.1%	39.3%
2001	12.2%	8.0%	5.7%	33.3%	21.4%	19.9%	55.8%	37.0%	38.7%
2002	12.3%	8.3%	5.8%	33.0%	22.2%	18.9%	54.1%	36.2%	37.4%
2003	12.1%	7.6%	5.7%	32.1%	20.6%	18.6%	54.9%	36.1%	37.9%
2004	11.5%	7.3%	5.5%	31.7%	20.8%	18.4%			
2005	11.4%	7.1%	6.0%	30.2%	19.3%	18.0%			
2006	10.8%	7.0%	5.2%	29.6%	18.9%	17.3%			
2007	9.7%	6.2%	4.7%	28.5%	17.9%	16.9%			
2008	9.5%	6.2%	4.4%	26.9%	16.2%	16.3%			
2009	9.5%	5.7%	5.0%						
2010	9.0%	5.6%	4.5%						
2011	7.6%	4.6%	3.9%						
2012	7.6%	4.6%	3.8%						

Data Source: Reference Tables F2, F14, I26; F5, F17, I29; F6, F18, I30. Outcomes among recipients of a first-time deceased donor kidney transplant; unadjusted. Abbreviations: Prob., probability.

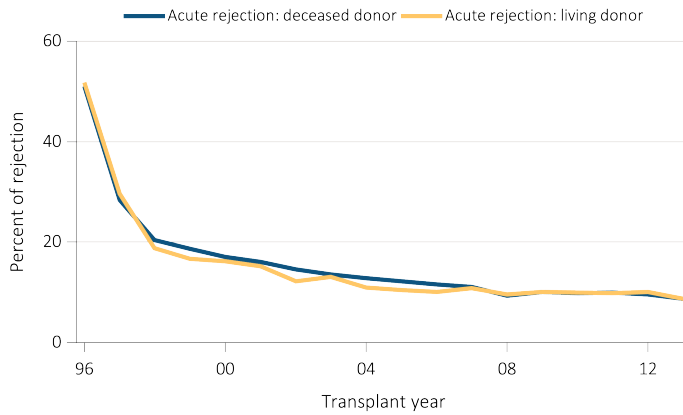
vol 2 Table 7.3 Trend in 1-, 5-, & 10-year living donor kidney transplant outcomes, 1996-2012

Year	One year post-transplant			Five years post-transplant			Ten years post-transplant		
	Prob. of all-cause graft failure	Prob. of return to dialysis or repeat transplant	Prob. of death	Prob. of all-cause graft failure	Prob. of return to dialysis or repeat transplant	Prob. of death	Prob. of all-cause graft failure	Prob. of return to dialysis or repeat transplant	Prob. of death
1996	6.9%	5.2%	2.3%	22.9%	16.8%	9.6%	43.3%	32.4%	22.7%
1997	6.7%	4.8%	2.7%	22.2%	15.8%	10.5%	43.2%	31.1%	24.4%
1998	6.0%	4.4%	2.3%	20.9%	14.6%	10.0%	42.4%	30.6%	23.4%
1999	6.1%	4.3%	2.2%	20.8%	14.7%	9.6%	41.2%	29.0%	22.7%
2000	6.6%	4.6%	2.6%	21.9%	14.9%	10.6%	42.2%	29.1%	24.0%
2001	6.2%	4.1%	2.5%	21.3%	14.3%	10.2%	41.2%	27.8%	24.0%
2002	5.8%	3.9%	2.5%	20.5%	13.6%	10.3%	40.0%	26.2%	24.6%
2003	5.4%	3.9%	1.9%	20.1%	13.8%	9.5%	39.6%	26.1%	23.3%
2004	5.2%	3.5%	2.1%	18.8%	12.7%	8.8%			
2005	5.3%	3.7%	2.0%	18.7%	12.6%	8.8%			
2006	4.4%	3.0%	1.7%	16.8%	11.1%	8.1%			
2007	3.8%	2.4%	1.4%	16.6%	10.5%	8.0%			
2008	4.1%	2.7%	1.6%	15.3%	9.9%	7.5%			
2009	3.9%	2.6%	1.4%						
2010	3.5%	2.2%	1.4%						
2011	3.4%	2.2%	1.9%						
2012	3.2%	1.9%	1.5%						

Data Source: Reference Tables F8, F20, I32; F11, F23, I35; F12, F24, I36. Outcomes among recipients of a first-time living donor kidney transplant; unadjusted. Abbreviations: Prob., probability.

The percentage of kidney transplant recipients experiencing an acute rejection during the first year post-transplant has declined steadily since 1996 and has stabilized in recent years (Figure 7.18). In 2013, 7.3% of living donor transplant recipients and 7.5% of deceased donor transplant recipients experienced at least one acute rejection during the first year post-transplant. As of 2013, the risk of rejection is similar for living donor and deceased donor kidney transplants.

vol 2 Figure 7.18 Acute rejection within the first year post-transplant for kidney transplant recipients, 1996-2013



Data Source: Special analyses, USRDS ESRD Database. Acute rejection rates during the first year post-transplant for recipients age 18 and older with a functioning graft at discharge.

Hospitalization rates for all kidney transplant recipients have steadily declined from 954 hospitalizations per 1,000 patient years in 2004 to 788 in 2013 (Table 7.4). Hospitalization rates were higher in females and Blacks during this period.

References

Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2013 on CDC WONDER Online Database, released 2015. Data are from the Multiple Cause of Death Files, 1999-2013, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. <http://wonder.cdc.gov/ucd-icd10.html>. Accessed June 30, 2015.

vol 2 Table 7.4 Hospital admission rates (per 1,000 patient years), by age, sex, race, ethnicity, and primary cause of ESRD, among transplant patients, 2004-2013

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
0-21	1,145	1,143	1,302	1,129	1,121	1,254	1,274	1,198	1,226	1,137
22-29	897	947	873	893	966	889	846	1,007	952	897
30-39	957	1,009	925	842	867	862	880	875	853	788
40-49	892	866	850	818	789	808	748	758	728	704
50-59	914	897	855	876	839	822	806	829	776	722
60-64	985	971	944	861	919	879	881	817	850	786
65-69	1,039	1,077	963	917	891	898	842	867	896	812
70-74	1,086	1,003	1,091	995	898	902	878	918	915	864
75-79	1,038	1,065	988	980	863	911	850	960	897	901
80-84	999	1,113	1,370	1,195	990	876	844	751	861	957
85+	0	3,305	677	1,595	833	1,811	1,428	754	1,096	775
Sex										
Male	888	870	835	804	802	799	775	778	761	716
Female	1,049	1,080	1,056	1,011	986	985	958	981	962	898
Race										
White	925	920	902	860	836	836	835	843	825	789
Black/African American	1,090	1,100	1,031	1,000	1,002	1,015	935	945	920	842
Native American	1,222	1,224	1,161	1,004	964	825	752	942	1,016	816
Asian	553	612	605	620	672	577	548	561	572	487
Ethnicity										
Hispanic	899	922	922	839	843	844	849	845	850	769
Non-Hispanic	963	961	924	894	880	876	846	861	839	792
Primary Cause of ESRD										
Diabetes	1,285	1,289	1,245	1,146	1,136	1,127	1,092	1,141	1,078	1,016
Hypertension	878	833	798	811	797	773	767	744	759	677
Glomerulonephritis	803	773	793	741	754	726	714	692	710	675
Other cause	807	870	795	806	763	805	765	797	769	736
All	954	956	924	886	874	871	846	858	841	788

Data Source: Reference Table G5. All kidney transplant recipients. Abbreviation: ESRD, end-stage renal disease.