



chapter seven

transplantation

There been times that I thought I couldn't last for long
But now I think I'm able to carry on
It's been a long, a long time coming
But I know a change gonna come, oh yes it will

SAM COOKE, "A CHANGE IS GONNA COME"

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In 2009, the most recent year of available data, 17,736 kidney transplants were performed in the United States — 323 more than in the previous year, ending a two-year decline in the annual number of transplants performed.

There were 420 more living donor transplants performed in 2009 compared with 2008, an increase of 7 percent, compared with a 1 percent decline in deceased donor transplants. The number of living-unrelated transplants rose 11 percent, compared with a 3 percent increase in living-related transplants.

Paired donation drove much of this increase. Reported living-to-living paired donation, when two incompatible donor-recipient pairs exchange to form two compatible pairs, increased 23 percent, with 277 transplants taking place in 2009. The continued expansion of regional kidney-paired exchange programs, along with the Kidney Paired Donation Pilot Program currently being tested by the Organ Procurement and Transplantation Network (OPTN), will likely increase the number of kidney-paired exchanges. Living-deceased paired donation, when a non-compatible donor donates to the deceased donor waiting list in exchange for priority listing of their intended recipient, rose 28 percent in 2009, with 127 transplants, while non-directed living donation rose 48 percent, to 119 transplants.

The number of patients on the wait list continues to increase, growing 6 percent in 2009 to reach 71,975 on December 31. New listings have grown 2 percent, with 28,494 candidates added to the list, paralleling a 2 percent increase in the ESRD incidence rate during the same period. Among new listings, 72 percent were active at listing; only 64 percent of listed patients, however, were designated as active on December 31, 2009. Twenty-one percent of 2008 incident ESRD patients were added to the

wait list or received a deceased donor transplant within one year of initiation, a number remaining fairly stable over the past two decades. The percentage of adult candidates who receive a deceased donor transplant within three years of listing varies by candidate blood type, from 22 percent for those with Type O to 50 percent of those with Type AB.

Rates of deceased donation remained flat in 2009, at 21.6 donors per million population in 2009, and at 2.4 donations per 1,000 deaths in 2008–2009 combined. Transplant rates per 100 dialysis patient years continue to decline, in 2009 reaching 2.5 and 1.4 for deceased and living donor transplants, respectively.

One-year survival with a functioning transplant continues to reach all-time highs, at 92 percent for recipients of first-time, deceased donor transplants, and 96 percent for recipients of first-time, living donor transplants in 2008. Five-year survival has increased to 70 and 83 percent. In 2009, delayed graft function was reported in 22 and 3 percent of deceased and living donor transplants, respectively. The rate varies, from 20 percent for standard criteria donors to 31 and 37 percent for expanded criteria donors and donations after cardiac death.

Attention continues to focus on reducing the incidence of acute rejection and other post-transplant complications, and on improving long-term outcomes. The incidence of reported acute rejection episodes during the first year post-transplant, reported in 10 percent of both deceased and living donor recipients in 2007, has declined more

than 50 percent over the past decade. New-onset diabetes following transplant, however, remains common, with over 40 percent of adult, non-diabetic recipients having evidence of diabetes by the end of the third year after transplant. Twenty-eight percent of non-diabetic transplant recipients have claims for insulin during the first six months post-transplant, while 10 percent have claims for sulfonylureas. And in the three years post-transplant, lymphoproliferative disorders are reported in 0.5 and 1.9 percent of adult and pediatric recipients, respectively.

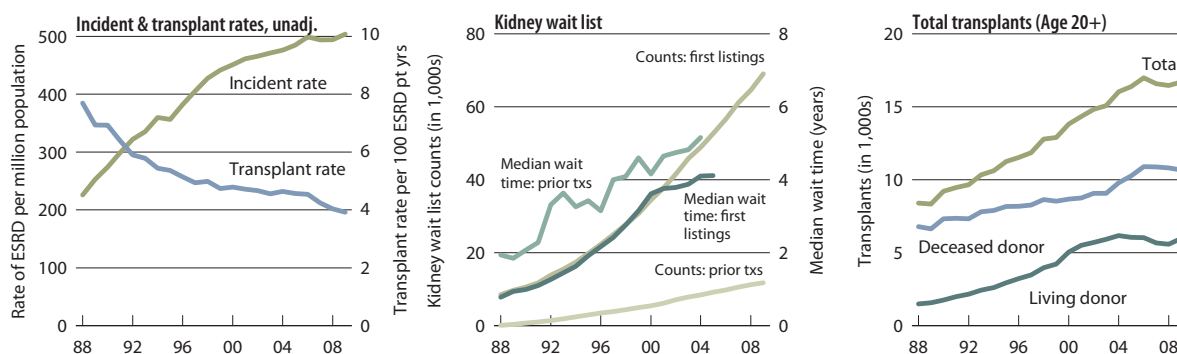
Congestive heart failure remains the leading cause of cardiovascular hospitalization during the first two years post-transplant, and urinary tract infections the leading cause of hospitalization due to infection. Among recipients who die with a functioning transplant, cardiovascular disease continues to be the leading cause of death, accounting for 30 percent of deaths, followed by infectious causes and malignancies at 21 and 9 percent.

During the first six months post-transplant, beta blockers are prescribed for 77 and 71 percent of deceased and

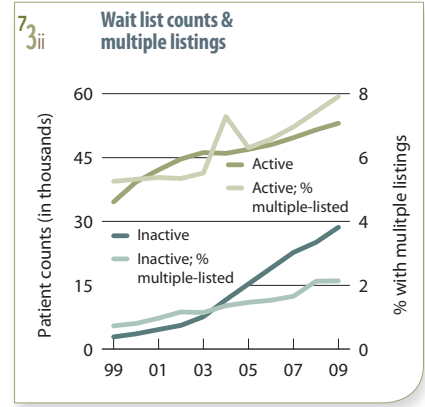
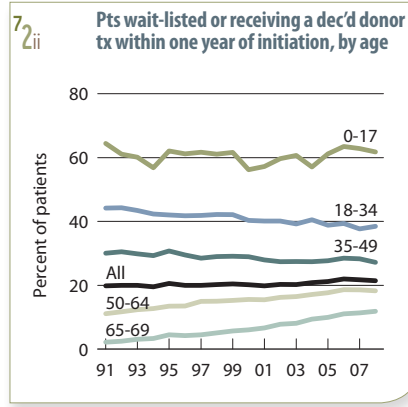
living donor recipients. ACE inhibitors are prescribed for approximately 25 percent of all recipients, calcium channel blockers for 60 percent, and loop diuretics for 44 percent of deceased donor recipients and 26 percent of living donor recipients. Approximately 38 percent of transplant recipients with Medicare Part D coverage have claims for statins during the first six months post-transplant, and 90 percent of recipients age 35 or older at transplant have a lipid screening performed during the first year. Targeting post-transplant cardiovascular complications will continue to yield improvements in recipient outcomes.

>> **Figure 7.1;** see page 388 for analytical methods. *Unadjusted incident & transplant rates: limited to ESRD patients age 20 & older, thus yielding a computed incident rate higher than the overall rate presented elsewhere in the ADR. Wait list counts: patients age 20 & older listed for a kidney or kidney-pancreas transplant on December 31 of each year. Wait time: patients age 20 & older entering wait list in the given year. Transplant counts: patients age 20 & older as known to the USRDS.*

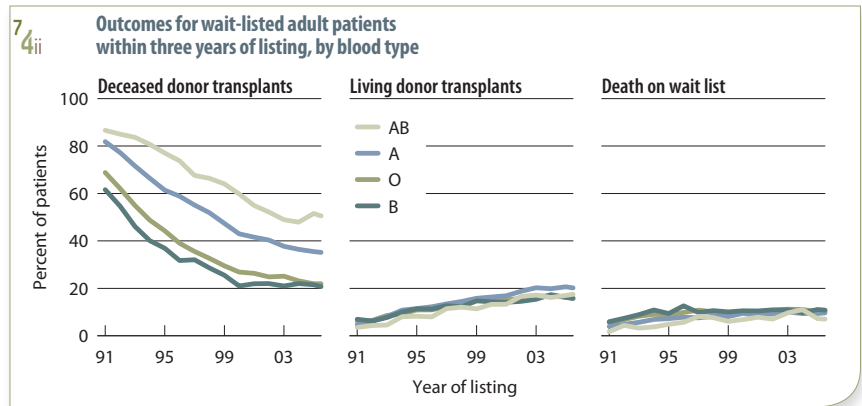
7.1ii Trends in transplantation: unadjusted rates, wait list, & total transplants, patients age 20 & older



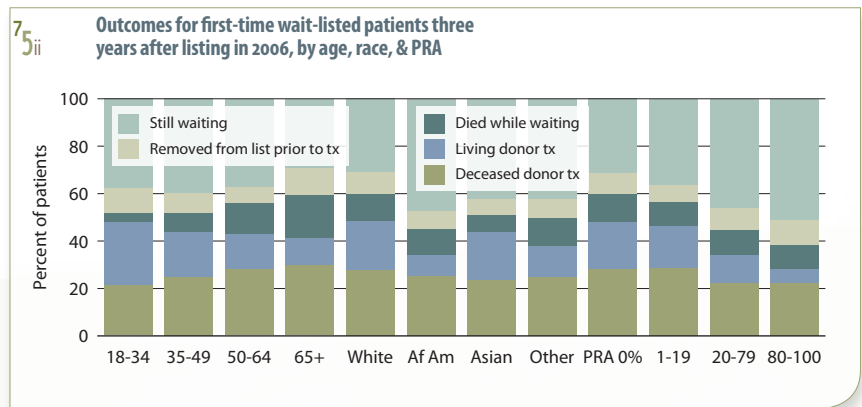
Sixty-two percent of pediatric patients starting ESRD therapy in 2008 were wait-listed or received a deceased donor transplant within one year, compared to 27 percent of those age 35–49. At the end of 2009, there were 53,075 active patients on the wait list for a kidney or kidney-pancreas transplant, and 28,636 inactive patients. >> **Figures 7.2–3;** see page 388 for analytical methods. *Incident ESRD pts younger than 70 (7.2). Patients age 18 & older listed for a kidney or kidney-pancreas transplant on December 31 of each year (7.3).*



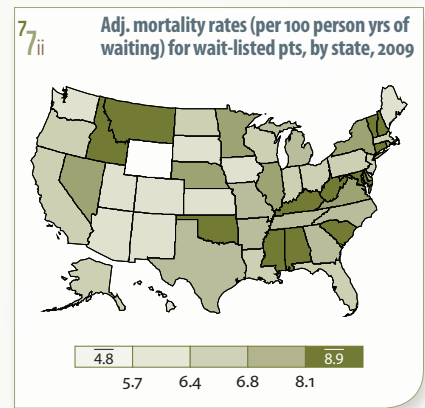
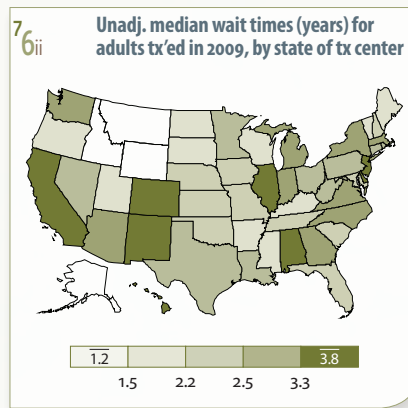
The percentage of adult patients receiving a deceased donor transplant within three years of listing has fallen considerably since 1991, and varies by blood type. It continues to be highest for those of blood type AB — at 50 percent for patients listed in 2006 — and lowest for those of type O or B. The percentage receiving a living donor transplant has been rising, and varies little by blood type. >> **Figure 7.4;** see page 388 for analytical methods. *Pts age 18 & older listed for a first-time kidney or kidney-pancreas transplant.*

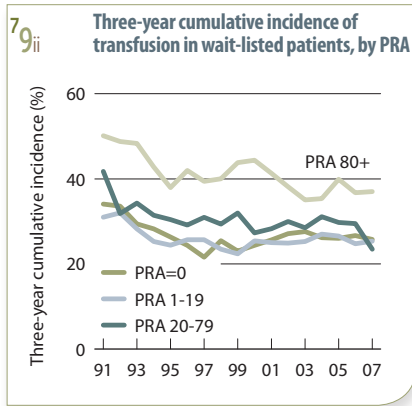
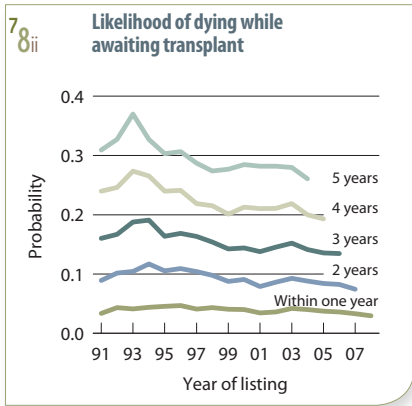


Of patients listed in 2006, 21 percent of whites and Asians received a living donor transplant within three years, compared to just 8.7 percent of African Americans. Forty-two and 47 percent of Asians and African Americans were still waiting after three years, rates considerably higher than the 31 percent among whites. >> **Figure 7.5;** see page 388 for analytical methods. *Pts age 18 & older listed for a first-time, kidney-only tx in 2006; transplanted patients may have subsequent outcomes in the three-year follow-up period.*

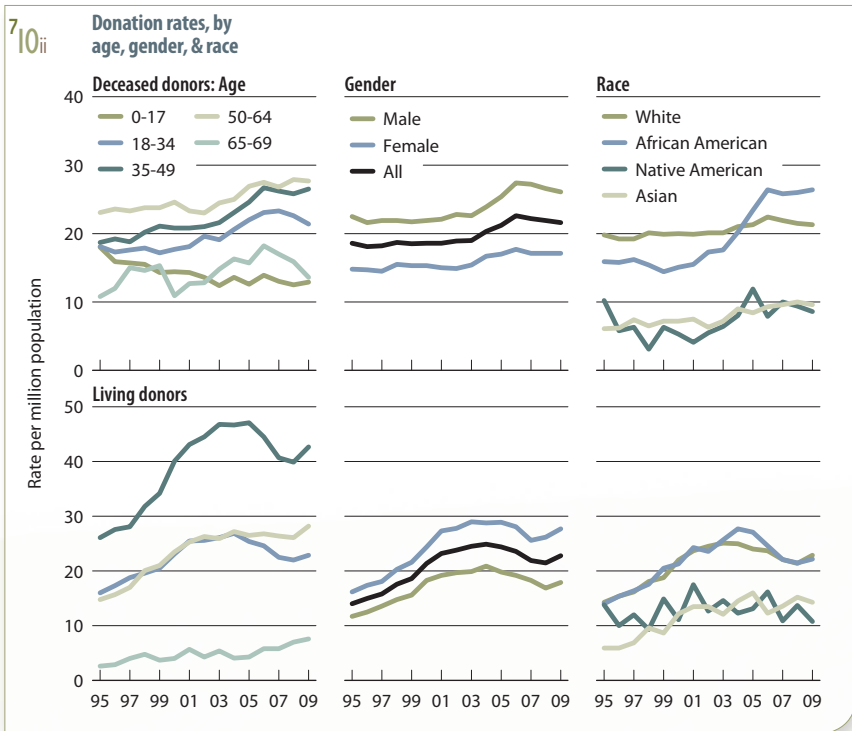


Median wait times for patients transplanted in 2009 exceeded four years in Alabama, Delaware, and New Jersey; the median was 2.3. Adjusted mortality among wait-listed patients in 2009 reached 6.7 deaths per 100 person years of waiting, and exceeded 10 in Idaho and West Virginia. >> **Figures 7.6–7;** see page 388 for analytical methods. *Pts age 18+ receiving a first-time, deceased-donor, kidney-only tx in 2009 (7.6). Pts age 18+, listed for a kidney or kidney-pancreas tx as of Jan. 1, 2009; see appendix for adjustments (7.7).*



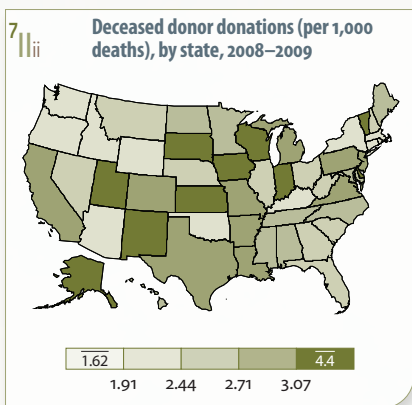


For first-time transplant candidates, the probabilities of dying within one or five years have fallen to 0.03 and 0.26, respectively. Transfusions are most common among patients who are highly sensitized at the time of transplant (PRA of 80 percent or higher). >> Figures 7.8-9; see page 388 for analytical methods. *Patients age 18 & older, listed for a first-time kidney or kidney-pancreas transplant (7.8); patients age 18 & older with Medicare primary coverage & listed for a kidney transplant in the given year (7.9).*



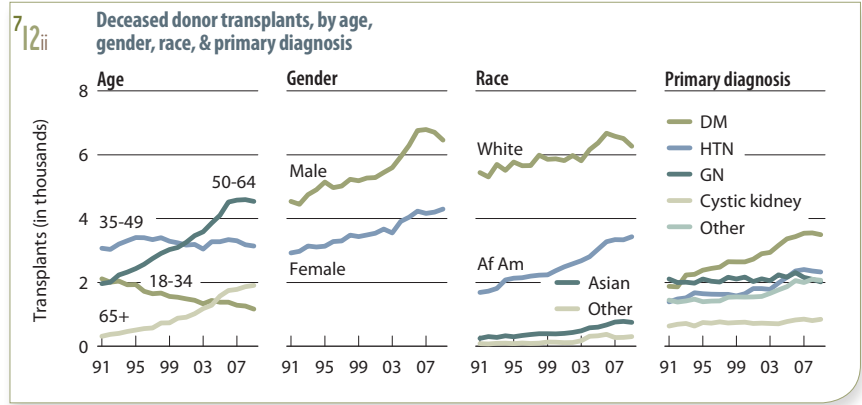
Rates of kidney donation from deceased donors remain highest among those age 50-64 and among males, reaching 27.7 and 26.1 per million population, respectively, in 2009. Since 2005, rates by race have been highest in the African American population, reaching 26.4 in 2009, compared to just 8.6-9.6 among Native Americans and Asians.

Rates of donations from living donors are greatest among patients age 35-49, reaching 47 per million population in 2003-2005, and 43 in 2009. By race, rates in 2009 ranged from 10.8 and 14.3 among Native Americans and Asians to 22-23 among whites and African Americans. >> Figure 7.10; see page 388 for analytical methods. *Donors younger than 70 whose organs are eventually transplanted.*

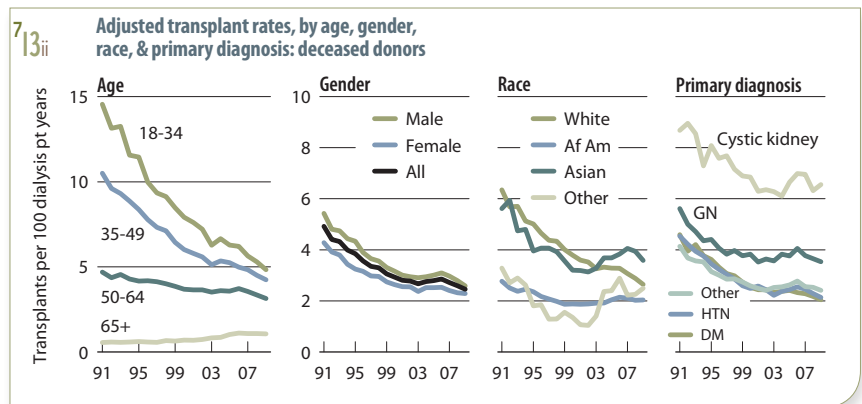


In 2008-2009, the rate of donations from deceased donors was 2.4 per 1,000 deaths overall. Rates by state were greater than 4 per 1,000 deaths in Alaska, Delaware, Iowa, Indiana, and Utah. >> Figure 7.11; see page 388 for analytical methods. *Deaths from July 1, 2008 to July 1, 2009.*

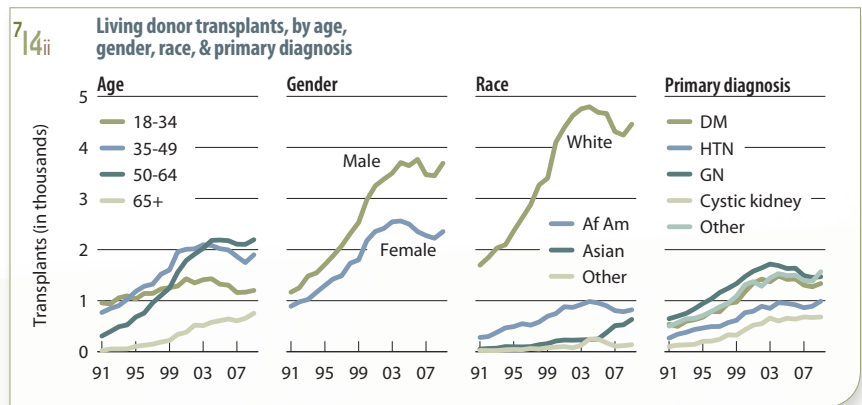
Since 2000, the number of deceased donor transplants among patients age 65 and older has more than doubled, to 1,911, and there has been an increase of 47 percent among patients age 50–64. Among those age 18–34, in contrast, transplants have fallen 24 percent, to 1,166. Among African Americans and Asians, the number of transplants has grown 45 and 92 percent, respectively. >> **Figure 7.12**; see page 388 for analytical methods. *Pts age 18 & older. Includes kidney-alone & kidney-pancreas transplants.*



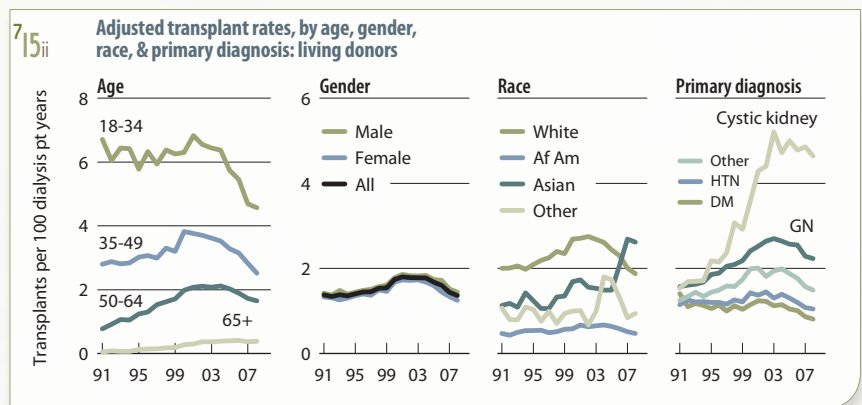
The adjusted deceased donor transplant rate has grown 51 percent since 2000 for patients age 65 and older, while falling 39 percent for those age 18–34. By race, the rate is down 30 percent among whites, while rising 8.5 and 12 percent for African Americans and Asians. >> **Figure 7.13**; see page 388 for analytical methods. *Patients age 18 & older. Adj: age/gender/race/primary diagnosis (rates by one factor adjusted for remaining three); ref: prevalent dialysis patients, 2009.*



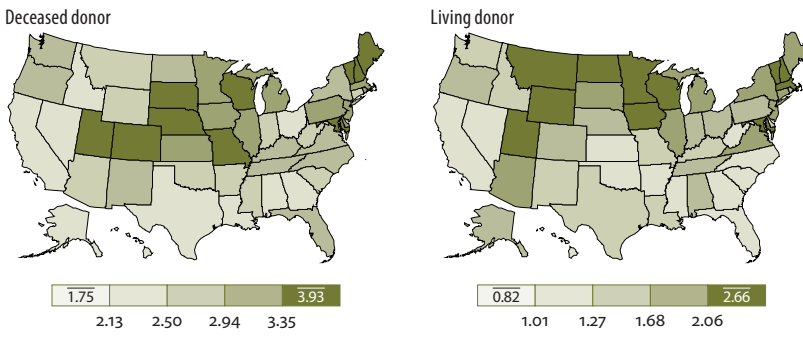
Among patients younger than 50, the number of living donor transplants has fallen 3–7 percent since 2000. For those age 50–64, in contrast, the number is now 41 percent higher, and for patients age 65 and older it has more than doubled. While living donor transplants among whites and African Americans have increased just 9–10 percent in this period, they have tripled among Asians. >> **Figure 7.14**; see page 388 for analytical methods. *Patients age 18 & older. Includes kidney-alone & kidney-pancreas transplants.*



Rates of living donor transplants peaked at the beginning of the decade, and have since fallen for many patient groups. As with deceased donor transplants, rates by race are now greatest in the Asian population, reaching 3 per 100 dialysis patient years in 2009 — 76 percent higher than in 2000. >> **Figure 7.15**; see page 388 for analytical methods. *Patients age 18 & older. Adj: age/gender/race/primary diagnosis (rates by one factor adjusted for remaining three); ref: prevalent dialysis patients, 2009.*

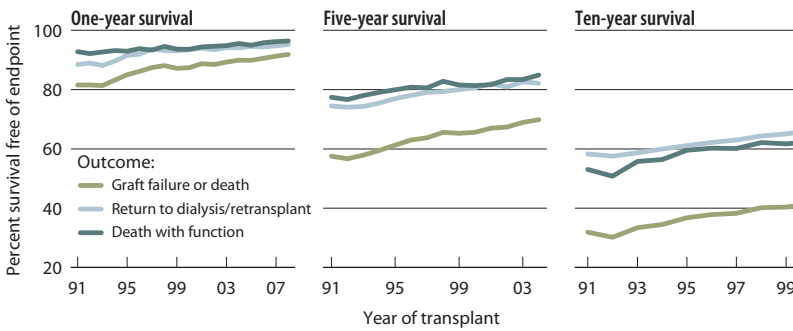


7.16ii Adjusted transplant rates (per 100 dialysis patient years) by state of patient residence & donor type, 2009



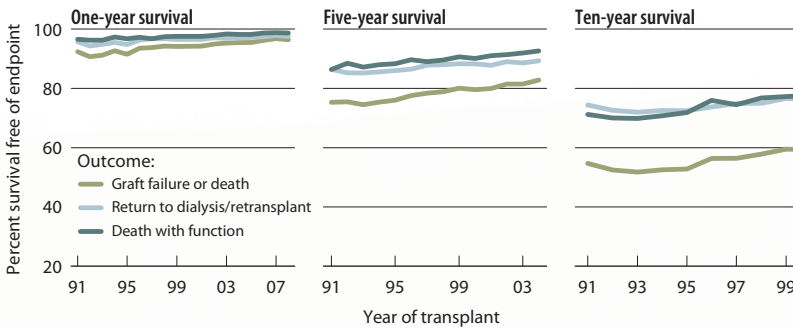
In 2009, the rate of deceased donor transplants reached 5.8 per 100 dialysis patient years in Vermont, and 4.0–4.2 in South Dakota, Maryland, and New Hampshire. Rates of living donor transplants were greatest in Wyoming, Montana, and Minnesota, at 3.2–3.8. >> **Figure 7.16**; see page 388 for analytical methods. *Patients age 18 & older. Adj: age/gender/race/primary diagnosis; ref: prevalent dialysis patients, 2009.*

7.17ii Outcomes: deceased donor transplants



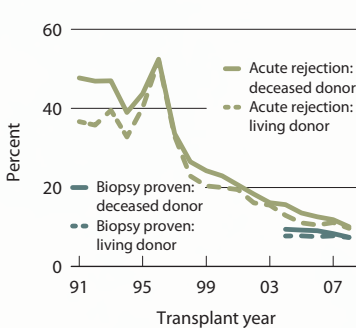
More than 96 percent of patients who receive a deceased donor kidney transplant, and nearly 99 percent of those receiving a kidney from a living donor, survive the first year with a functioning graft. For those transplanted in 2004, five-year survival reached 85 and 93 percent, respectively, and ten-year survival for those transplanted in 2000 reached 62 and 78 percent.

7.18ii Outcomes: living donor transplants



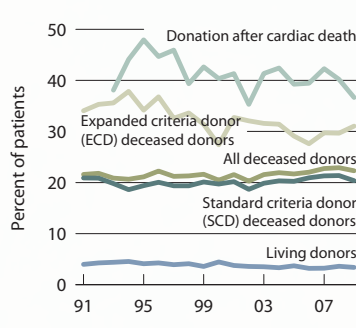
From 1991 to 2008, one-year all-cause graft survival increased from 81.5 percent to 91.9 percent among recipients of a deceased donor transplant, and from 92.4 to 96.4 percent in those with a transplant from a living donor. Between 1991 and 2000, ten-year all-cause graft survival rose from 31.9 to 41.4 for deceased donor transplant recipients. Among patients with a living donor transplant, survival fell slightly during the early 1990s, then increased again to reach 59.4 in 2000. >> **Figures 7.17–18**; see page 388 for analytical methods. *Patients age 18 & older receiving a first-time, kidney-only transplant. Adj (survival): age/gender/race/primary diagnosis.*

7.19ii Acute rejection within the first year post-transplant

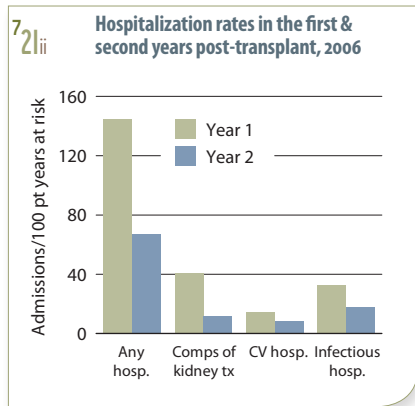


The percentage of transplant patients experiencing an acute rejection has declined steadily over the past decade, and 74–76 percent of reported acute rejections are biopsy-proven. In 2009, delayed graft function was reported in 3.4 percent of transplants from living donors, compared to 20, 31, and 37 percent of SCDDs, ECDs, and donations after cardiac death. >> **Figures 7.19–20**; see page 388 for analytical methods. *Pts age 18 & older (7.19); patients age 18 & older with a functioning graft at discharge (7.20).*

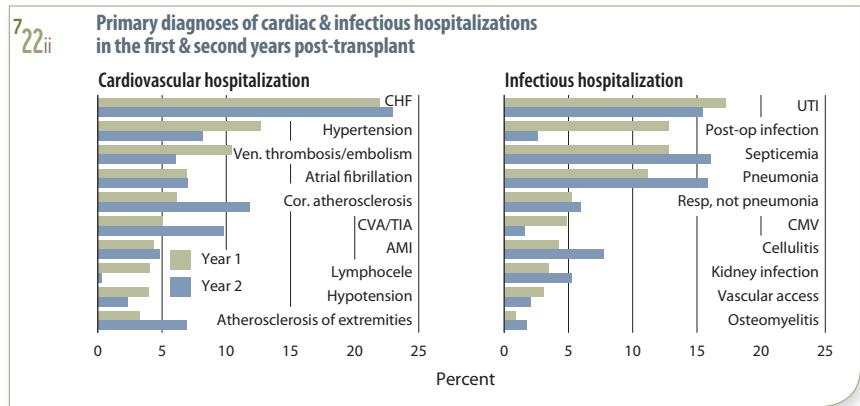
7.20ii Transplants with delayed graft function (DGF), by donor type



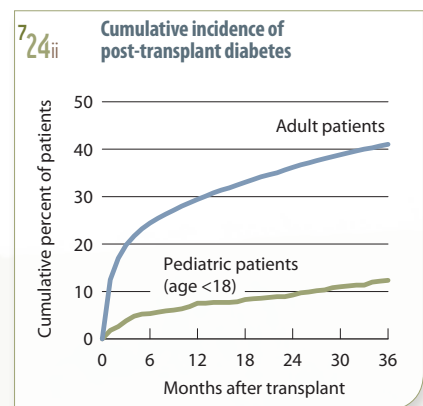
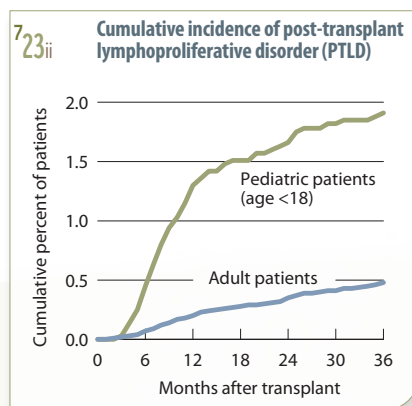
In the second year post-transplant, hospitalization rates for adult recipients are 54 percent lower than in the first year, at 67 admissions per 100 patient years. Admissions due to transplant complications fall 71 percent, to 11.7, while admissions due to cardiovascular causes and to infection fall 40 and 46 percent, to 8.7 and 17.5. >> **Figure 7.21**; see page 389 for analytical methods. *First-time, kidney-only tx recipients, age 18 & older, transplanted in 2007; ref: transplant patients, 2006.*



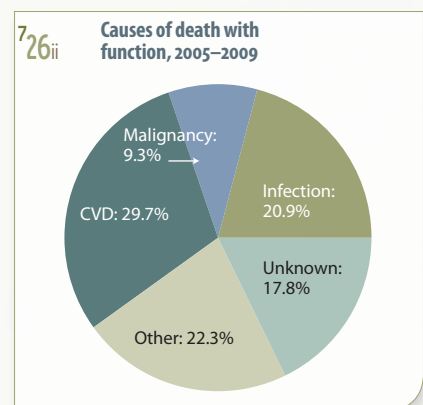
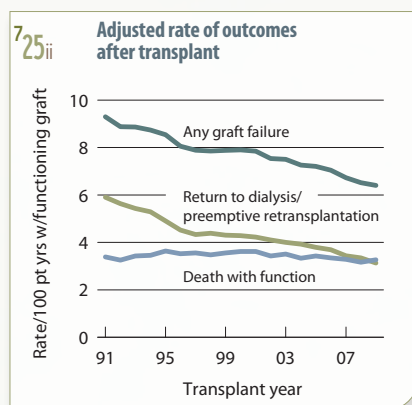
In the first year after transplant, 22 percent of cardiovascular hospitalizations are due to congestive heart failure; this number rises only slightly in the second year, to 23 percent. Hospitalizations for coronary atherosclerosis and CVA/TIA also increase, from 6.2 and 5.0 percent, respectively, in year one to 11.8 and 9.8 percent in year two. Urinary tract infection, septicemia, and pneumonia are the most common diagnoses among transplant patients admitted for infection, at 16 percent in the second year after transplant. >> **Figure 7.22**; see page 389 for analytical methods. *First-time, kidney-only transplant recipients, age 18 & older, with Medicare primary payor coverage, transplanted in 2005–2009.*

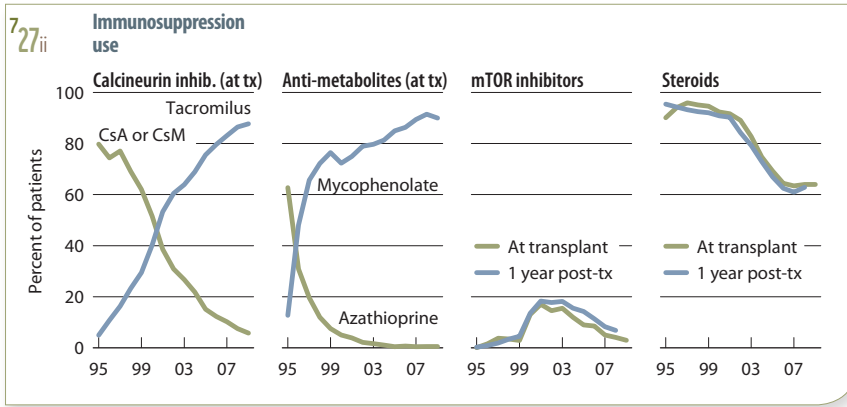


At 36 months after transplant, the cumulative incidence of post-transplant lymphoproliferative disorder (PTLD) is four times greater among pediatric patients than among adults, at 1.91 percent compared to 0.48. Adults, in contrast, have a higher incidence of post-transplant diabetes, reaching 41 percent at 36 months, compared to 12 percent among pediatric patients. >> **Figures 7.23–24**; see page 389 for analytical methods. *Patients receiving a first-time, kidney-only transplant, 2002–2006 combined.*

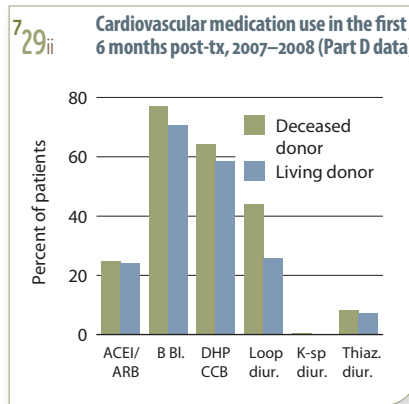
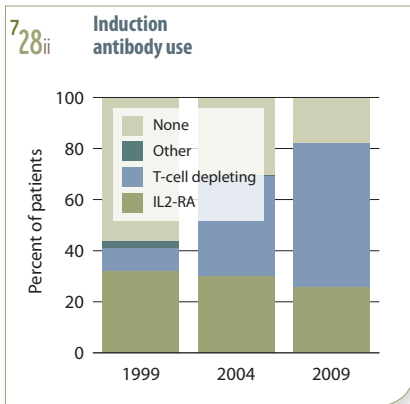


The overall graft failure rate among adult transplant recipients fell to 6.4 per 100 patient years in 2009, while the rate of failure requiring dialysis or retransplantation fell to 3.1. Cardiovascular disease and infection are the main cause of death for 30 and 21 percent of adult patients who die with a functioning graft. >> **Figure 7.25–26**; see page 389 for analytical methods. *Pts age 18+ at tx; adj: age/gender/race; ref: 2009 prev. dial. pts (7.25). First-time, kidney-only tx recipients, age 18+, 2005–2009, who died with functioning graft (7.26).*

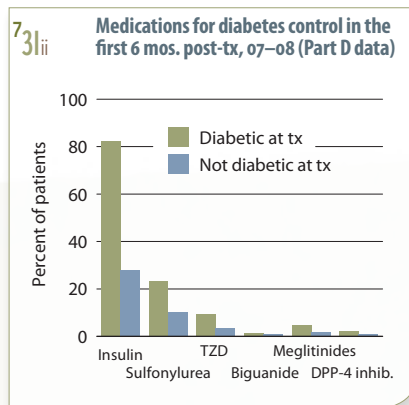
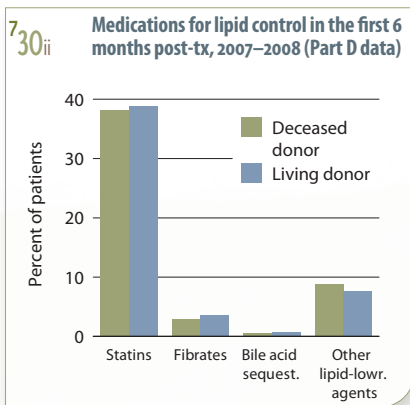




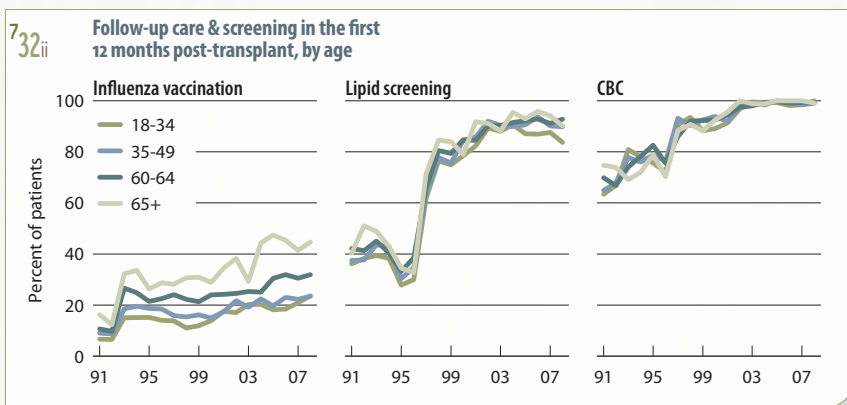
Eighty-eight percent of patients transplanted in 2009 used tacrolimus as their initial calcineurin inhibitor, and mycophenolate has almost completely replaced azathioprine as the anti-metabolite used in new transplant recipients. Use of mTOR inhibitors, both initially and post-transplant, has continued to fall, while steroid use seems to be stabilizing. >> Figure 7.27; see page 389 for analytical methods. *Patients age 18 & older receiving a first-time, kidney-only tx.* CsA: cyclosporine A; CsM: cyclosporine microemulsion.



In 2009, 26 percent of transplant patients received IL2-RA, and 56 percent were on a T-cell depleting antibody; just 18 percent received no treatment. Use of cardiovascular medications in the first six months after transplant is highest among recipients of deceased donor transplants, reaching 77 percent for beta blockers, and 64 percent for DHP calcium channel blockers. >> Figures 7.28–29; see page 389 for analytical methods. *Patients age 18 & older receiving a first-time, kidney-only transplant.*



In the first six months after transplant, 38–39 percent of patients receive statins, while just 2.9–3.6 percent receive fibrates. Use of medications for diabetes control is far higher among patients who were diabetic at the time of transplant; insulin use, for example, reaches 83 percent in these patients, compared to 28 percent among those whose diabetes occurs post-transplant. >> Figures 7.30–31; see page 389 for analytical methods. *Patients age 18 & older receiving a first-time, kidney-only transplant.*



In 2008, 24 percent of recipients age 18–49 received an influenza vaccination in the 12 months post-transplant, compared to 32 percent of those 60–64, and 45 percent of those age 65 and older. Lipid screening rates range from 84 percent in the youngest adults to 93 percent in those age 60–64. Since 2003, nearly all recipients have received a CBC test in the year after transplant. >> Figure 7.32; see page 389 for analytical methods. *Patients age 18 & older receiving a first-time, kidney-only transplant.*

kidney transplants in patients age 20 and older, 2009

» DECEASED DONOR 10,679 » LIVING DONOR 5,981 (FIG 7.1)

wait-listed patients receiving a deceased donor transplant within three years of listing in 2006, by blood type

» TYPE O 22% » TYPE A 35% » TYPE B 20% » TYPE AB 50% (FIG 7.4)

patients waiting for a transplant three years after listing in 2006

» WHITE 31% » AFRICAN AMERICAN 47% » ASIAN 42% » OTHER RACE 42% (FIG 7.5)

likelihood of dying while awaiting transplant

PROBABILITY

WITHIN ONE YEAR 0.03 » WITHIN THREE YEARS 0.13 » WITHIN FIVE YEARS 0.26 (FIG 7.8)

rate of kidney donation, 2009

PER MILLION POPULATION

DECEASED DONORS

» WHITE 21 » AFRICAN AMERICAN 26 » NATIVE AMERICAN 8.6 » ASIAN 9.6 (FIG 7.10)

LIVING DONORS

» WHITE 23 » AFRICAN AMERICAN 22 » NATIVE AMERICAN 11 » ASIAN 14 (FIG 7.10)

adjusted rate of deceased donor transplants, 2009

PER 100 DIALYSIS PATIENT YEARS

» WHITE 2.7 » AFRICAN AMERICAN 2.0 » ASIAN 3.6 » OTHER RACE 2.5 (FIG 7.13)

adjusted rate of living donor transplants, 2009

PER 100 DIALYSIS PATIENT YEARS

» WHITE 1.9 » AFRICAN AMERICAN 0.5 » ASIAN 3.0 » OTHER RACE 1.1 (FIG 7.15)

survival with a functioning graft

ONE-YEAR SURVIVAL: 2008 TRANSPLANTS

» DECEASED DONOR 92% » LIVING DONOR 96% (FIGS 7.17-18)

FIVE-YEAR SURVIVAL: 2004 TRANSPLANTS

» DECEASED DONOR 70% » LIVING DONOR 83% (FIGS 7.17-18)

TEN-YEAR SURVIVAL: 2000 TRANSPLANTS

» DECEASED DONOR 41% » LIVING DONOR 59% (FIGS 7.17-18)

cumulative incidence of post-transplant lymphoproliferative disorder at 36 months after transplant

» PEDIATRIC PATIENTS 1.91% » ADULT PATIENTS 0.48% (FIG 7.23)

cumulative incidence of post-transplant diabetes at 36 months after transplant

» PEDIATRIC PATIENTS 12.4% » ADULT PATIENTS 41% (FIG 7.24)

causes of death with a functioning graft

» MALIGNANCY 9.3% » INFECTION 21% » CARDIOVASCULAR DISEASE 30% (FIG 7.26)