Chapter VII

Renal Transplantation: Access and Outcomes

Key Words:
Cadaveric renal transplants
Living related renal transplants
Transplant patient survival
Renal graft survival
Race in transplantation
Cadaveric graft loss
Access to transplantation
Organ allocation
Gender in transplantation

Despite the enduring problem of cadaveric organ shortage, a significant proportion of cadaveric renal transplants are being performed in prior renal transplant recipients. In this report, we show a trend towards identity in the cadaveric renal transplantation rates between adults receiving a kidney transplant for the first time and repeat recipients. More recent studies also indicate persistent disparity in access to renal transplantation between various sociodemographic groups (Kasiske 1998). Short-term renal allograft survival continues to improve in all groups. Prior racial differences in renal allograft survival are less evident. Newer therapies and tailoring of immunosuppressive regimens according to immunologic risk profiles are undoubtedly responsible for most of the substantial gains in graft outcomes (Vincenti 1998; Mayer 1997; The Tricontinental Mycophenolate Mofetil Renal Transplant Study Group 1996; Halloran 1997). The impact of these new therapies on long-term graft survival are not yet fully known but early reports suggest some modest improvement in graft survival beyond the first year (Mathew 1998). The *1999 Annual Data Report (ADR)* continues to show a sustained trend of improved results in all indicators of patient and allograft outcomes in renal transplant recipients.

In the current report, transplant data collected by the United Network for Organ Sharing (UNOS) and the Health Care Financing Administration (HCFA) have been consolidated to allow extended and more complete reporting of ESRD treatment provided to patients in the United States. This chapter of the ADR provides a general overview of both Medicare and non-Medicare kidney transplants performed between 1977 and 1997. A more detailed outcomes analysis was performed on the 115,716 renal transplants performed between 1987 and 1997.

Methods

The data presented in this chapter were derived from multiple sources including: the Health Care Financing Administration (HCFA) Medicare data files; the United Network for Organ Sharing (UNOS) transplant registration and followup files; the HCFA Annual Facility Survey (AFS); and the non-Medicare patient files treated by U.S. Department of Veterans Affairs facilities. Collectively, these data sources cover 98 percent of all adult and pediatric kidney transplants in the United States. In order to ensure complete patient and facility information, the data are considered for analysis after a 6-month consolidation period (see Chapter XIII). Information concerning transplant activities are updated for all U.S. renal transplant centers through December 31, 1997. The statistical analyses on ABO blood types and transplantation rates were limited to transplants performed in 1997 and 1994-1997, respectively. The transplant counts and rates reported here for 1997 should be considered preliminary. In previous editions of the Annual Data Report, preliminary data

reported for the most recent years were 97-98 percent complete. Lastly, changes in transplant counts or rates are reported as percentages, that is, the relative proportional change instead of the absolute difference (percentage points).

Statistical analysis

Starting this year, both patient and renal graft survival were estimated using Cox proportional hazards models. For graft survival, deaths were counted as graft failures. The survival curves for patient or graft survival, in each incident cohort, were adjusted to correspond to the average type of patient in the reference population. In this chapter, the reference population is the cohort of patients who first received renal transplants during 1995 (see Chapter XIII for further details).

The tables and figures for various patient populations have been adjusted for race, age, sex, and diabetes as the cause of ESRD. For example, a race-specific figure has been adjusted for the 3 other variables, e.g., age, sex, and diabetic nephropathy. Figures with different adjustment covariates are indicated as such. Patient age group refers to the age at transplantation. Less than 3 percent of transplant recipients were older than 65 years of age and they were generally excluded in the statistical analyses.

Supply of Kidneys for Transplantation

A total of 8,523 cadaver donor kidneys were transplanted in 1997, representing virtually no change from 1996 (8,526). The cadaveric (CAD) kidney donation rate has been stagnant since 1993 which was the last year that donation rate increased by 6.8 percent (or over 500 additional kidneys compared to the preceding year). While donation rates remained stagnant, the number of patients on the cadaveric renal transplant waiting list increased by 2,432 patients between 1993 and 1996 (UNOS 1997). The gap between waiting list registrations and organ donation resisted all conventional strategies aimed at enhancing organ donation, at least nationally. However, dramatic regional increases in cadaveric organ donation have been reported following comprehensive legislative initiatives (Nathan 1998).

Cadaveric kidney donation was evaluated during two distinct periods (1991-1992 and 1996-1997). The results are shown in Figure VII-1. Donation is expressed as CAD kidney donation per million population (pmp) in the ≤65 years age group. During these two time periods, there was a minimal change in CAD kidney donation from Black males, while White males experienced a small decline from 39.1 pmp to 36.0 pmp. There was no change in the rate for White females, but Black females experienced a 27 percent

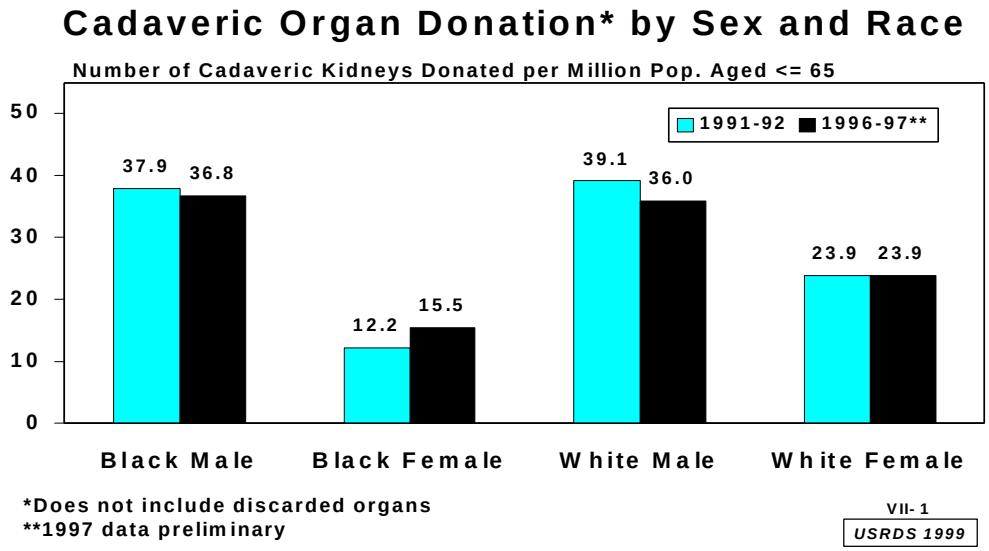

Figure VII-1

Cadaveric organ donation by sex and race, 1991-92 and 1996-97. Includes U.S. population only. Organ donation excludes discarded organs. Source: Special Analysis.

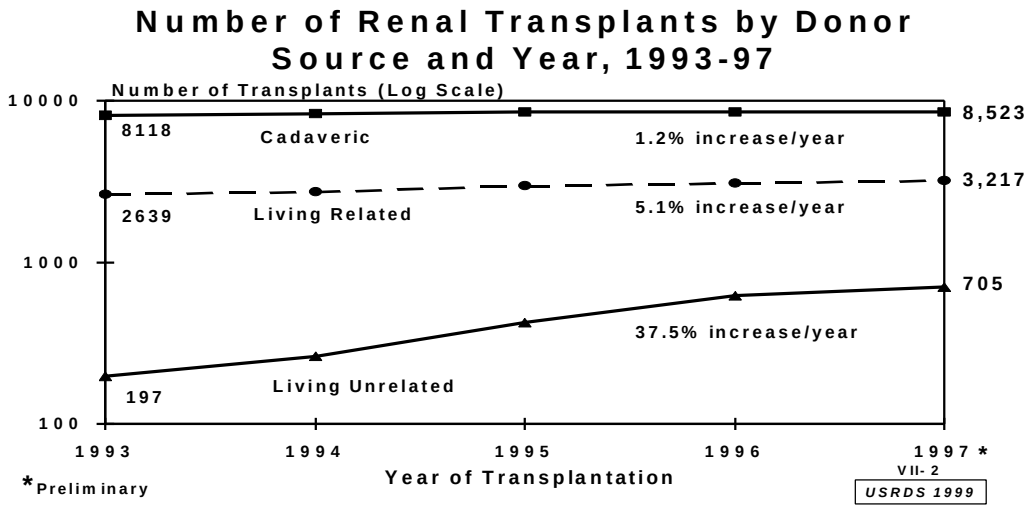

Figure VII-2

Total number of renal transplants by donor source and year, 1993-97. Number of transplants shown on log scale. Source: Reference Table F.1 Facility Survey.

increase in donation from 12.2 pmp to 15.5 pmp. The data shown include only the cadaver kidneys that were procured and transplanted, excluding discarded organs.

Figure VII-2 shows the count and annualized percentage increase for each kidney donor source between 1993 and 1997. During this period, kidney donation from spousal and biologically unrelated donors increased annually by 37.5 percent whereas living-related kidney donation increased annually by 5.1 percent and cadaveric donation showed a minimal increase (1.2 percent per year). The substantial increase in kidney donation from living non-biologic relatives is most likely due to several factors including the critical shortage of cadaver kidneys and encouraging results of kidney transplant from spousal donors (Terasaki 1995). Further expansion of the biologically unrelated renal donor pool may depend on overcoming ABO blood group incompatibility (Fehrman-Ekholm 1996; Bia 1995) and use of innovative programs such as volunteer living donor registry analogous to the existing bone marrow donor registry. New strategies are urgently needed to enhance the supply of both CAD and living donor kidneys.

Access to Kidney Transplantation

Even though nearly all ESRD patients have the theoretic prospect of kidney transplantation, a number of barriers exist in addition to the shortage of organs. Medical suitability is a limiting factor for a large proportion of older ESRD patients. Socioeconomic barriers have also been widely reported (Held 1988; OIG 1991; Gaylin 1993; Kallich 1993; Kjellstrand 1990; Bloembergen 1997; Wolfe 1997a). A more recent study found a lower rate of pre-dialysis listing for renal transplantation in patients belonging to racial and ethnic minorities and also in patients with lower educational levels and fewer financial resources (Kasiske 1998). Here we describe the recent trend in transplantation rates among various demographic groups.

Figures VII-3 and VII-4 show the total number of primary kidney transplants performed in 1997 and the adjusted transplantation rates from living and cadaver donors, respectively by recipient age group. The transplantation rate was calculated per 100 dialysis patient years at risk. Pediatric patients (age group 0-19 years) continue to have the highest renal transplantation rates, 20.8 and 25.9 per 100 dialysis-patient years for CAD and living donor (LD) kidneys, respectively, but as a group they receive a very small fraction of the total number of primary kidney transplants (6.0 percent). The renal transplantation rates were lowest in the 50-65 year age group. In particular, this older age group had a LD transplantation rate of 1.5 per 100 dialysis-patient years, which was less than half the rate in the next

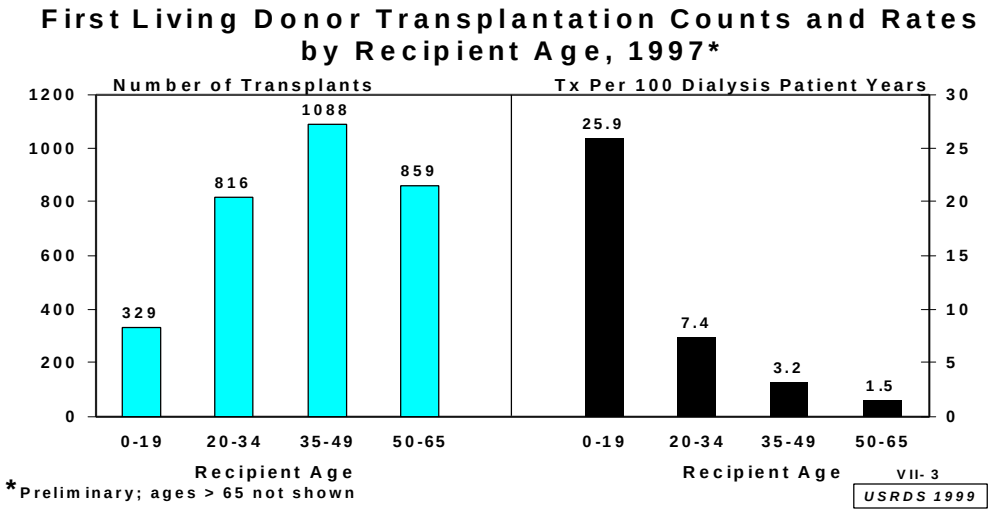

Figure VII-3

First living donor transplantation counts and rates by recipient age, 1997. Includes age < 65 only. Source: Special Analysis.

youngest age group (35-49 years) and approximately one-twentieth of the pediatric age group.

Transplantation rates by race, gender, and age groups for the period 1994-1997 are shown in Figure VII-5. White females in the age group 0-19 had substantially higher primary CAD transplantation compared to Black females in the same age group.

There was a small racial difference in rates for males in the age group 0-19 years. In the two older age groups (20-44, 45-64 years), the primary CAD transplantation rates in Blacks were 50 percent or less than the rates in Whites. The results of the analysis of a 5-year trend in primary CAD transplantation rates are shown in Figure VII-6. During this entire

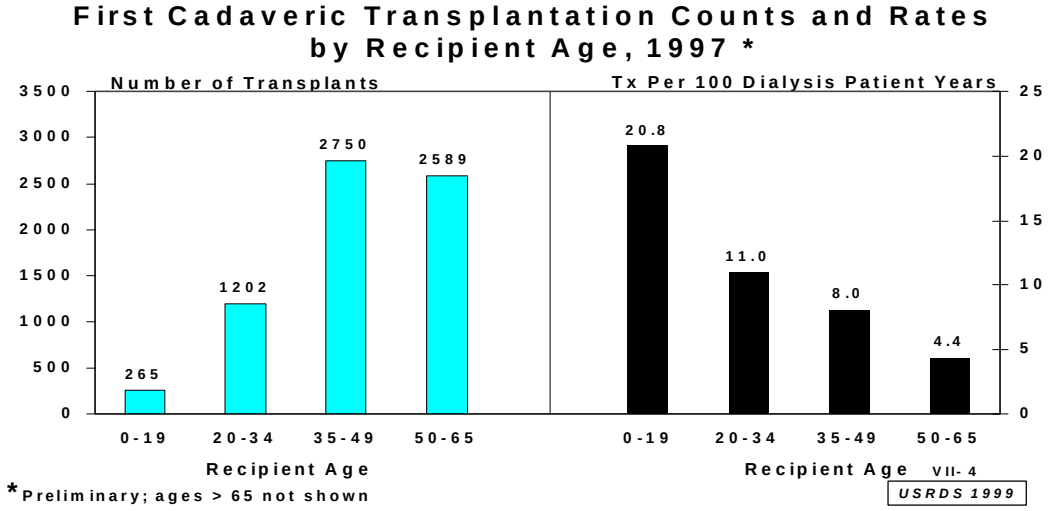

Figure VII-4

First cadaveric transplantation counts and rates by recipient age, 1997. Includes age < 65 only. Source: Special Analysis.

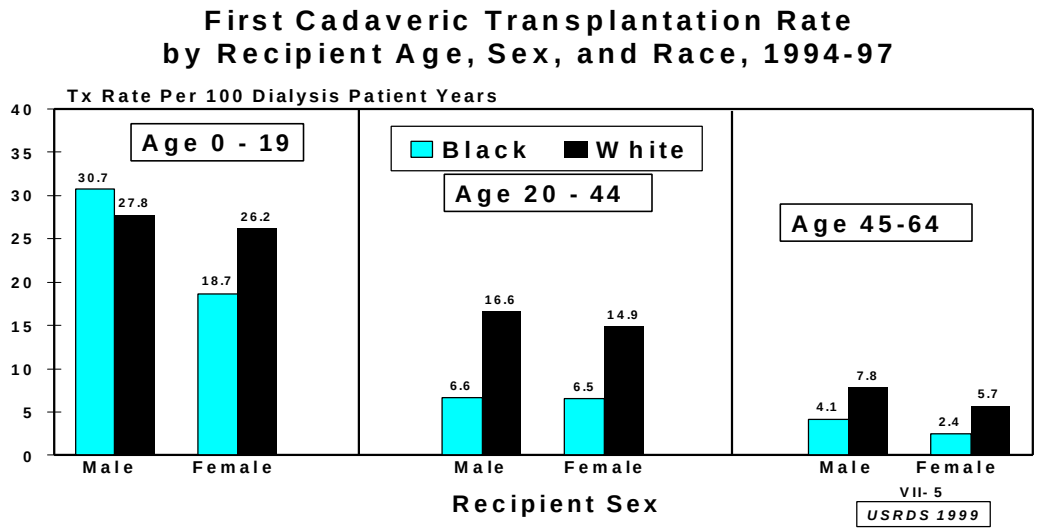

Figure VII-5

First cadaveric transplantation rate per 100 dialysis patient years by recipient age, sex and race, 1994-97. Includes Black and White patients aged < 65 only. Source: Reference Table F.25.

period, the rates in age group 0-19 years were approximately twice as high as the rates in the age group 20-44 years, who in turn have rates that were approximately twice as high as the rates in the oldest age group considered in the analysis (45-64 years). Between 1994 and 1997, primary CAD transplantation rates fell by 38.5 percent from 33.8 to 20.8 per 100 dialysis patient-years in the 0-19 year age group. A diminishing trend in primary CAD transplantation rates was also observed in 20-44 and 45-64 year age groups. Between 1993 and 1997, the rates in the age group 20-44 years fell by 29.6 percent

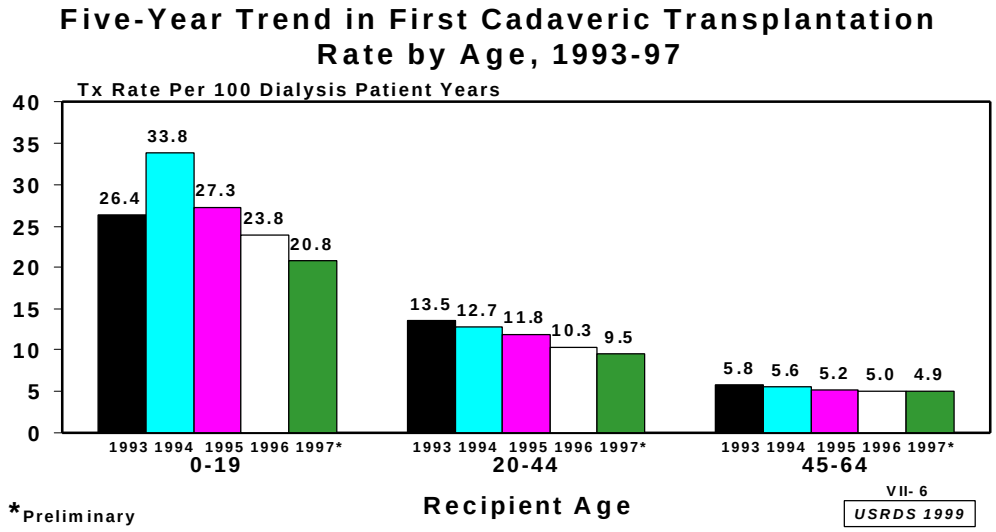

Figure VII-6

Five-year trend in first cadaveric transplantation rate per 100 dialysis patient years by age, 1993-97. Includes age < 65 only. Source: Reference Table F.28.

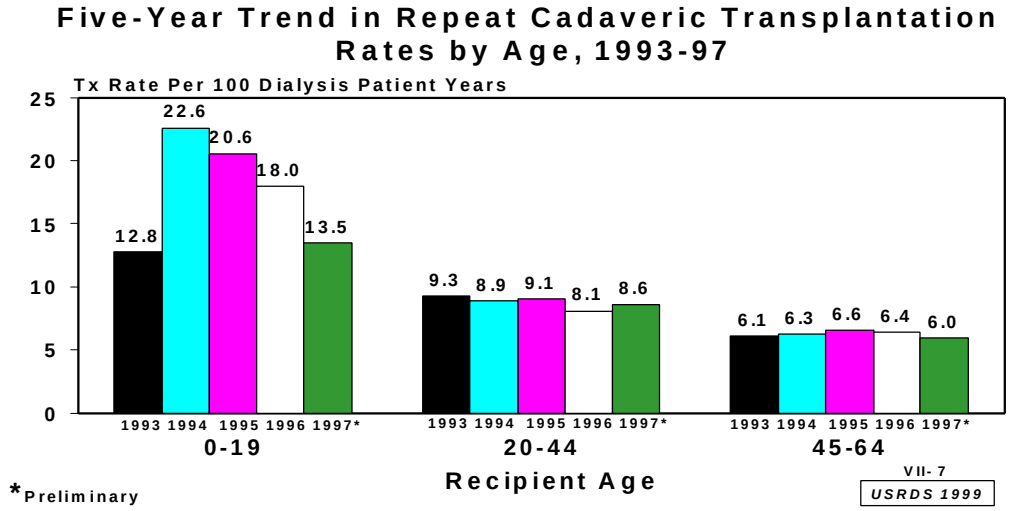

Figure VII-7

Five-year trend in repeat cadaveric transplantation rate per 100 dialysis patient years by age, 1997. Includes age < 65 only. Source: Reference Table F.28.

from 13.5 to 9.5 per 100 dialysis patient years and by 15.5 percent from 5.8 to 4.9 per 100 dialysis patient years in the age group 45-64 years.

Figure VII-7 shows the trend in repeat cadaveric transplantation rates by age for 1993-97. In contrast to the markedly diminishing trends in the rates for primary CAD transplantation observed in all age groups, there was only minimal change in the repeat cadaveric transplantation rates for all age groups except for the 0-19 year age group.

ABO Blood Group and Kidney Transplantation

The existing UNOS kidney allocation policy requires that blood group "O" kidneys should be

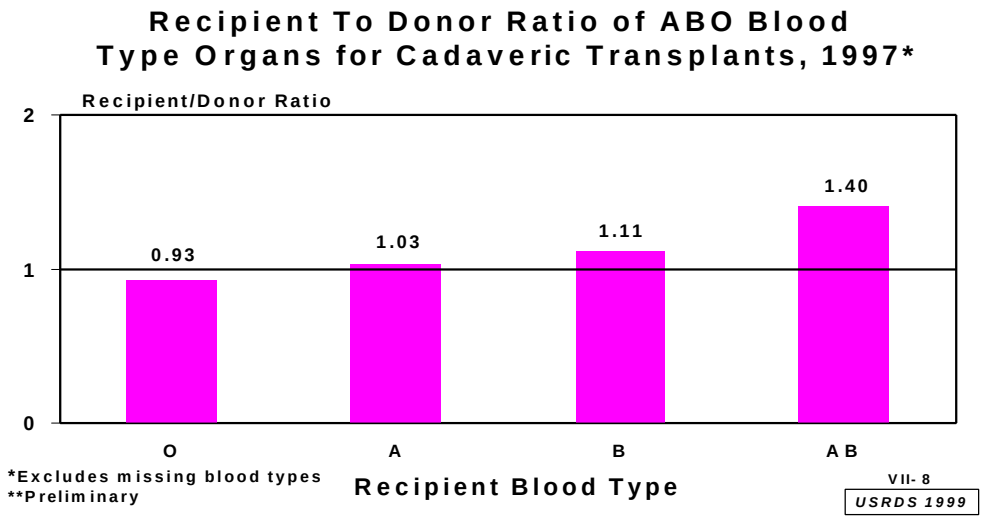

Figure VII-8

Recipient to donor ratio of ABO blood type organs, 1997. Recipients and donors with missing blood groups are excluded. Source: Reference Table F.24.

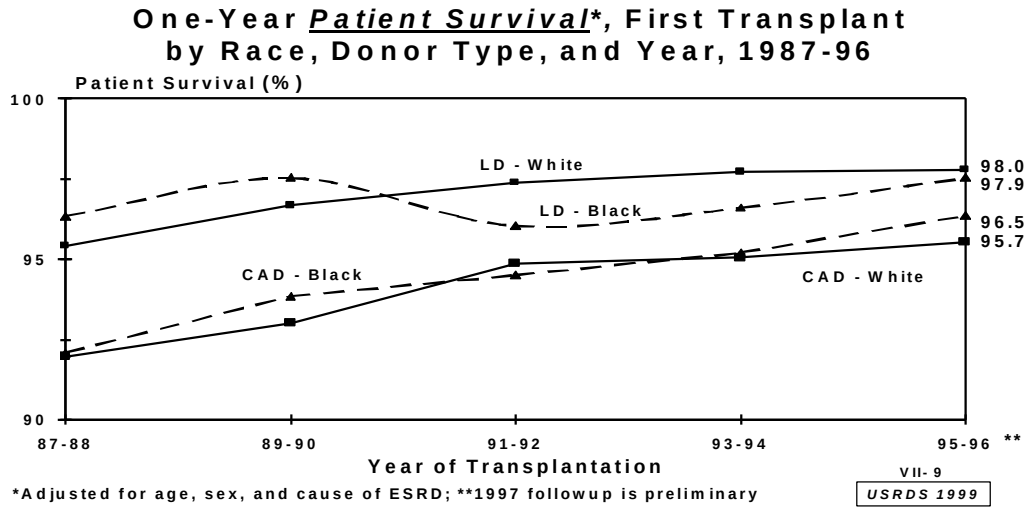

Figure VII-9

One-year patient survival, first transplant by race, donor type and year, 1987-96. Adjusted for age, sex, and cause of ESRD (diabetes/nondiabetes). Includes Black and White patients only. Source: Reference Tables E.70 (CAD) and E.87 (LD).

transplanted to blood group "O" candidates with the exception of the mandatorily shared zero-HLA mismatched kidneys and simultaneous kidney-extrarenal organ transplants. Figure VII-8 shows the ratio of the total number of cadaveric kidneys received by each recipient blood group to the total number of cadaveric organs transplanted by each blood group during 1997.

A ratio of 1.0 (such as is the experience in blood group A) would demonstrate equality in the number of organs received to the number of organs donated, whereas a deviation from 1.0 demonstrates unbalanced sharing among non-identical blood groups. A ratio higher than 1.0 shows that patients in these blood groups received ABO mismatched organs. As high as 40 percent more cadaveric kidneys are received by AB patients than are derived from blood group AB donors. In the case of blood group "O" patients, 93 percent of available group "O" kidneys go to "O" recipients, i.e. 7 percent of organs are given to non-"O" recipients.

This shortfall of 7 percent (recipient/donor ratio of 0.93) over time would substantially lengthen the time spent by potential blood group "O" recipients on the cadaveric renal transplant waiting list as has been previously shown (Port 1991).

Patient and Renal Allograft Survival

The superiority of renal transplantation in enhancing the longevity of ESRD patients is well established (Port 1993, Ojo 1994, Wolfe 1997b). Unlike dialysis therapy, which has been associated with variable patient survival according to the primary cause of ESRD (Bloembergen 1995), differences in transplant recipient survival have narrowed considerably. Figure VII-9 shows the adjusted 1-year survival of patients with primary CAD and LD transplantation. For LD transplants, Black and White recipients have similar 1-year survival of 97.9 and 98.0 percent, respectively. There was a very small difference in 1-year patient survival among CAD recipients of both races (96.5 and 95.7 percent in Blacks and Whites, respectively).

Prior differences between Whites and Blacks in graft survival have also been almost eliminated. Figure VII-10 shows the trends in graft survival among Black and White recipients from 1987 to 1996 according to the donor source. The 1987 Black recipients of both CAD and LD transplants had significantly lower 1-year graft survival compared to White recipients. Over time, these differences diminished gradually. One-year graft survival for the 1996 LD transplants was 93.5 percent and 94.1

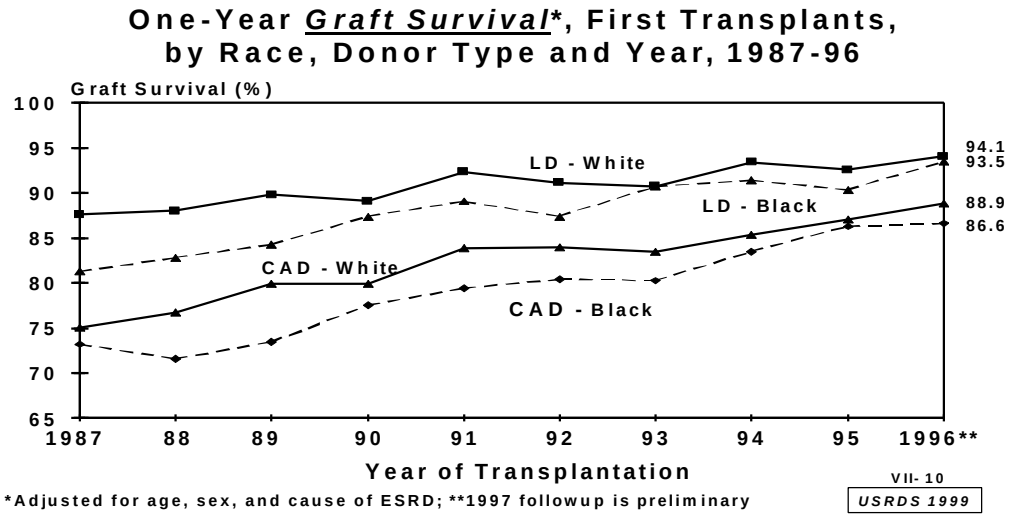

Figure VII-10

One-year graft survival, first transplants by race, donor type and year, 1987-96. Adjusted for age, sex, and cause of ESRD (diabetes/nondiabetes). Includes Black and White patients only. Source: Reference Tables G.19 (CAD) and G.43 (LD).

percent in Blacks and Whites, respectively. One-year CAD graft survival for the 1996 recipients also differed little between Blacks (86.6 percent) and Whites (88.9 percent).

Overall graft survival, as measured by the rate of graft loss in the first year post-transplant, also showed substantial improvement between 1987 and 1996. Figures VII-11 and VII-12 show the rate of graft loss for primary CAD and LD transplants during the first

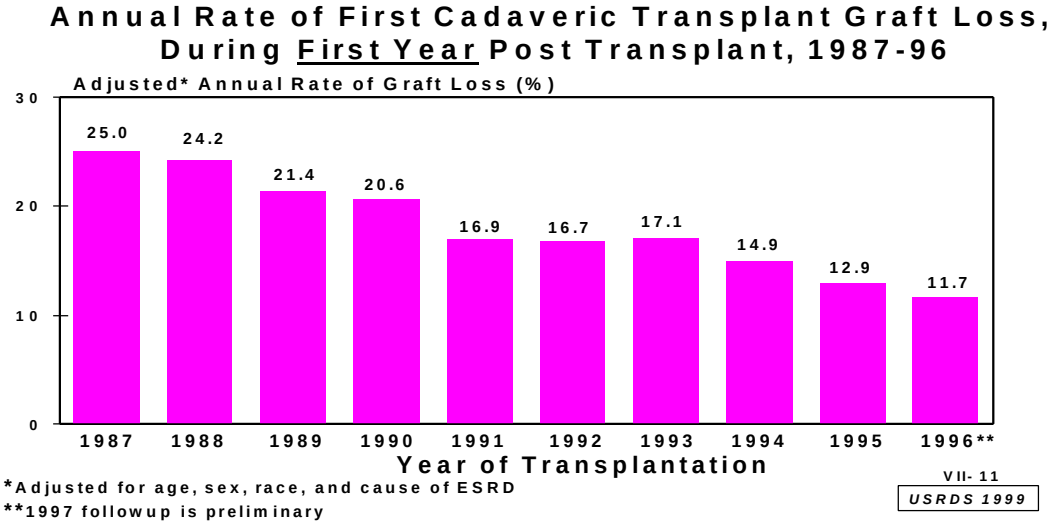

Figure VII-11

Annual rate of graft loss for first cadaveric donor transplants during the first year after transplantation by year, 1987-96. Rates adjusted for age, sex, race and cause of ESRD (diabetes/nondiabetes). Source: Reference Table G.19.

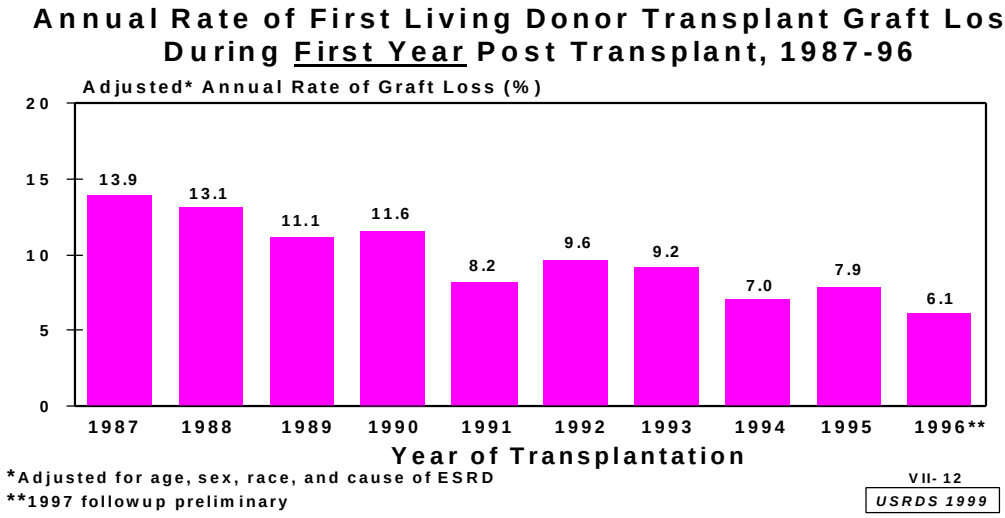

Figure VII-12

Annual rate of graft loss for first living donor transplants during the first year after transplantation by year, 1987-96. Rates adjusted for age, sex, race and cause of ESRD (diabetes/nondiabetes). Source: Reference Table G.43.

year according to the year of transplantation. CAD and LD graft loss rates declined by more than 50 percent during this period. The initial dramatic reduction in the first year allograft loss rate associated with the introduction of cyclosporine in 1983 had already occurred prior to 1987 (USRDS 1994). Thus, the steady decline in graft loss rate that occurred between 1987 and 1996 is most likely the result of multiple factors including, but not limited to, the availability of newer immunosuppressive and anti-rejection drugs (Vanrenterghem 1997).

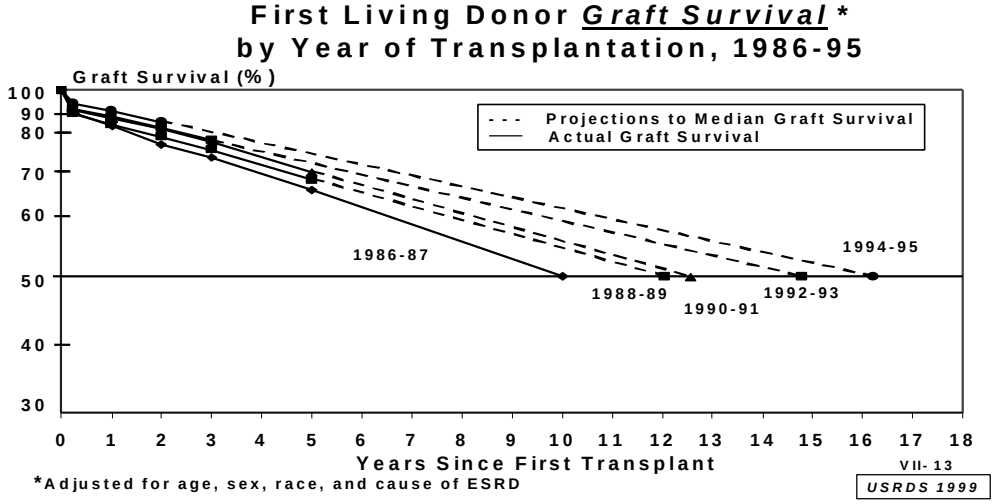

Figure VII-13

Living donor kidney graft survival for first transplants,1986-95. Rates adjusted for age, sex, race and cause of ESRD (diabetes/nondiabetes). Projections (shown by dashed line) were calculated by extrapolating from 12 months to last followup trend to predict graft half-life. Source: Reference Tables G.41-G.52.

Long-term survival has also improved steadily in the last decade (USRDS 1997). Long-term graft survival curves for five 2-year cohorts of CAD and LD recipients are shown in Figures VII-13 and VII-14. Three-year LD graft survival improved from 77.8 percent in the 1986-1987 cohort to 83.1 percent for the 1992-1993 cohort. Five-year LD graft survival also showed a substantial improvement from 69.0 percent in the 1986-1987 cohort to 75.2 percent for transplants performed in 1992. Among CAD recipients, 3-year graft survival also improved from 61.4 in 1986-1987 to 72.2 in 1992-1993. Five-year CAD graft survival also increased from 51.3 percent in 1986-1987 to 59.8 percent in 1990-1991. These findings suggest that long-term graft survival has improved along with the more substantial increases in short-term graft survival.

Median allograft survival (years) was derived from the survival curves shown in Figures VII-13 and VII-14. The projections, shown by the dashed lines in these figures, were calculated by extrapolating from 12 months to the last followup trend to predict graft half-life. Median primary CAD graft survival improved from 5.2 years in 1986-87 to 10.2 years in 1994-95. This two-fold increase occurred in a nearly steady fashion between the time periods studied. Median primary LD graft survival also increased, from 10 years in 1986-87 to 16.2 years in 1994-95. This signifies a 40 percent improvement, and again occurred in a steady fashion. These findings are similar to the near 50 percent improvement in first year graft survival. This observation argues against the prevailing notion that long-term graft survival has not improved as much as the increment seen in short-term graft survival.

Summary

Patient and allograft outcomes of kidney transplantation have improved substantially. Prior racial differences in short-term patient and allograft survival have been minimized. The large number of observational time accruable in the registry database has made it possible to detect sustained and substantial improvement in both short-term and long-term graft survival. These encouraging trends are tempered by stagnant cadaveric kidney donation rates. Use of blood group "O" donor kidneys in non-"O" recipients remains a significant problem that disproportionately lengthens the waiting times for potential blood group "O" recipients. The fast rate of growth of kidney donation by emotionally-related living donors is encouraging and presently represents a feasible avenue for increasing the supply of transplantable kidneys.

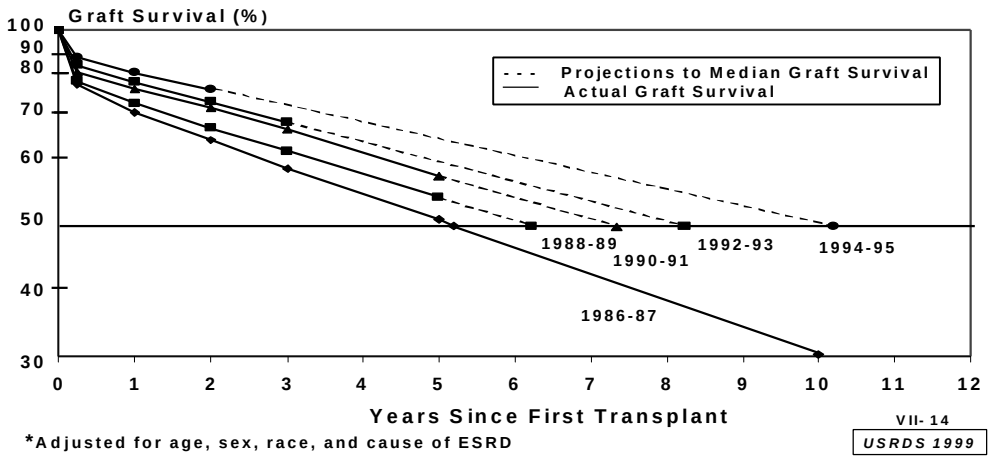

Figure VII-14

Cadaveric kidney graft survival for first transplants, 1986-95. Rates adjusted for age, sex, race and cause of ESRD. Projections (shown by dashed line) were calculated by extrapolating from 12 months to last followup trend to predict graft half-life. Source: Reference Tables G.17-G.28.

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