

## CHAPTER VI Kidney and Pancreas Transplantation

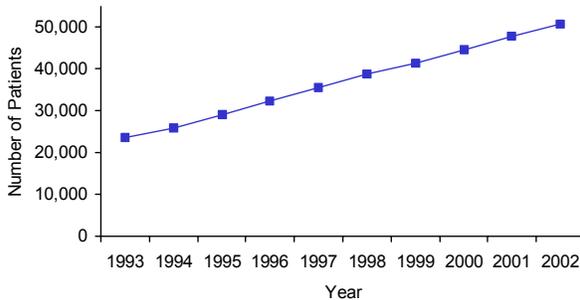
### INTRODUCTION

This overview of kidney and pancreas transplantation focuses on developments during 2002 and provides an important summary of trends over the past decade. The transplant process is examined first through analyses of waiting list characteristics and outcomes, followed by assessments of transplant recipient characteristics and of patient and allograft survival. The characteristics of expanded criteria donors and the unique outcomes of patients receiving expanded donor kidney transplants is described, followed by sections addressing simultaneous kidney-pancreas, pancreas after kidney, and isolated pancreas transplantation.

### KIDNEY TRANSPLANTATION

Kidney transplantation continues to be recognized as the treatment of choice for medically suitable patients with end-stage kidney disease, leading to a continued and marked growth in the size of the kidney transplant waiting list (Figure VI-1). The particular advantage of pre-emptive kidney transplantation — prior to the initiation of dialysis — is now well-recognized and is being progressively exploited, especially by patients receiving living donor kidney transplants (1,2).

**Figure VI-1. Growth in the Waiting List for Deceased Donor Kidneys, 1993-2002**



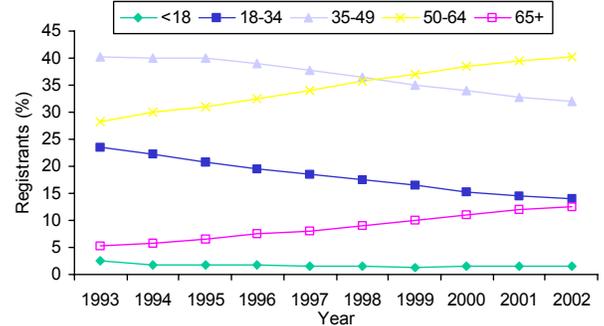
Source: 2003 OPTN/SRTR Annual Report, Table 5.1.

### The Kidney Transplant Waiting List

The number of candidates on the kidney waiting list has grown steadily, increasing from 47,830 (2001) to 50,855 during 2002 [Table 5.1]. Almost 75% of the increase occurred among patients 50 years of age or older, who now constitute over 50% of the total waiting list, compared to only 34% in 1993 (Figure VI-2). African-

Americans continued to be disproportionately represented on the waiting list. African-Americans now represent 37% of the waiting list, a similar proportion to their 38% of the dialysis population overall (3). Of all candidates on the waiting list, 19% had received a previous kidney transplant, while 34% had a peak panel reactive antibody (PRA) of 10% or greater. As would be expected, given the relatively static deceased donor kidney supply and increase in the waiting list size, waiting times continued to increase steadily. Twenty-five percent of new waiting list registrants for 2002 were transplanted by 341 days, compared to 297 days in 1998 and 235 days in 1993 [Table 5.2].

**Figure VI-2. Percentage on the Kidney Waiting List, by Age Group, 1993-2002**



Source: 2003 OPTN/SRTR Annual Report, Table 5.1.

Recognition of the clear survival advantage obtained by patients undergoing kidney transplantation as compared to remaining on the waiting list — and of the adverse impact of time on dialysis on transplant survival — underscores the importance of equity in kidney transplant waiting time. Current OPTN/UNOS kidney allocation policies acknowledge children’s and adolescents’ disproportionate need for transplantation; as a result of the increased priority afforded them, patients younger than 18 years of age enjoy shorter waiting times [Table 5.2]. In contrast, African-American, Asian, and other non-white candidates experience longer waiting times. The point at which 25% of new registrants were transplanted could be calculated only for those minority candidates registered in 2001, with the 25th percentile of time to transplant being 268 days for whites, 630 days for African-Americans, 626 days for Asians and 483 days for other non-white patients [Table 5.2]. Other factors resulting in apparently prolonged waiting times as measured by 25th percentile of time to transplant included Hispanic-Latino ethnicity (442 versus 326 days for non-Hispanic/non-

Latino in 2002), blood type B or O (521 or 462, respectively, versus 223 days for blood type A), having received a previous transplant (430 versus 328 days), and anti-HLA sensitization (1,018 days for peak PRA of 80% or greater, compared to only 288 days for unsensitized candidates in 2000).

These observations were supported by a recent multivariate analysis of transplant waiting time by the SRTR. After adjusting for recipient age, gender, cause of ESRD, blood type, race, ethnicity, current PRA, source of insurance payment, dialysis modality, transplant number, previous transfusions, HLA type, and organ procurement organization (OPO), this study showed that patients who were over age 50, African-American, Hispanic, B blood type, sensitized against HLA, or had undergone a previous transplant were markedly less likely to be transplanted (Table VI-1). Table VI-2 shows the distribution of these factors among wait-listed and transplanted patients in 2002. Interestingly, the apparent prolongation in waiting time suffered by Asian-Americans was not seen when the model incorporated adjustments for HLA and OPO (4,5).

Death rates per 1,000 patient years at risk among wait-listed candidates have tended to remain stable, ranging from 66 to 82 over the past four years. As expected, death rates increased with age but tended to be lower among non-white candidates [Table 5.3].

**Table VI-1. Recipient Factors Resulting in Prolonged Kidney Transplant Waiting Times, 1994-2000**

Factor	RR Tx	Reference Group
Age 50-64	0.912	Age 35-49
Age 65 or greater	0.827	Age 35-49
Blood type B	0.850	Type O
African-American race	0.766	White
Hispanic/Latino ethnicity	0.904	Non-Hispanic/Non-Latino
Current PRA 10-40%	0.707	PRA 0-9%
Current PRA 41-79%	0.483	PRA 0-9%
Current PRA ≥80%	0.413	PRA 0-9%
Having received previous transplant	0.559	No previous Tx

RR Tx = Relative rate of transplantation. P-values for all rates <0.0001 vs. reference group. Source: Wolfe et al., 2001 (4)

**Table VI-2. Distribution of Recipient Factors Resulting in Increased Kidney Waiting Time Among Waiting and Transplanted Patients, 2002**

Factor	% Waiting List	% Deceased Donor Recipients (non-ECD)	% Living Donor Transplants
Age 50-64	40.2	37.4	30.8
Age 65 or greater	12.5	9.9	8.3
ABO Type B	16.9	12.1	12.9
African-American race	36.5	29.1	13.9
Hispanic/Latino ethnicity	15.7	14.0	12.6
Peak PRA 10-79%	19.5	21.4	14.8
Peak PRA ≥80%	14.0	9.9	2.7
Having received previous transplant	18.6	14.5	10.7

Source: 2003 OPTN/SRTR Annual Report, Tables 5.1, 5.4a, 5.4c

### **Kidney Transplant Recipients**

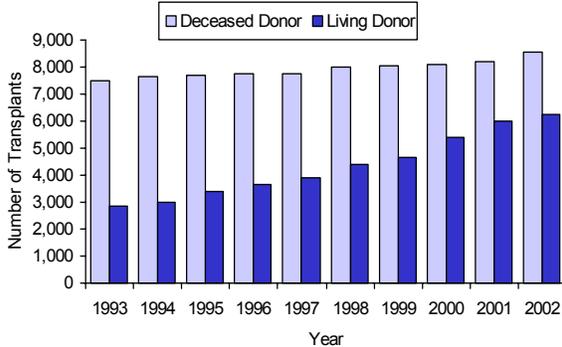
2002 was marked by modest growth in deceased donor kidney transplantation, which increased 3% (from 8,065 to 8,287) in contrast to the 1% increase seen the year before. At the same time, the marked growth in living donor kidney transplantation observed from 2000 to 2001 (11%) appears to have slowed, with only a 4% increase in 2002. Over the decade, however, living donation has become much more common, with living donor kidney transplants increasing from 28% of kidney transplants performed in 1993 to 43% in 2002 (Figure VI-3) [Table 1.8].

In general, recipients in 2002 were older, with the percentages of deceased donor transplant recipients ages 50-64 years and 65 years and older having increased from 29% and 5% (1993) to 37% and 10% (2002), respectively [Table 5.4a]. Among all recipients of living donor kidneys, recipients aged 50 to 64 increased from 17% to 31% from 1993 to 2002, while recipients 65 and older increased from 2% to 8% [Table 5.4c].

With the principal exceptions of retransplantation/graft failure and renovascular disease, the rank order of the etiologies of kidney failure remained relatively constant throughout the decade. Recipients listed with a primary diagnosis of retransplantation or graft failure increased from 1% to 13% of deceased donor kidney transplants, and from 0.9% to 10% of living donor transplants over the decade. The percentage with renovascular and other vascular causes increased from 0.6% to 5% of deceased

donor transplants, and from 0.5% to 4% of living donor transplants [Tables 5.4a, 5.4c].

**Figure VI-3. Kidney Transplants Performed in the United States, by Year and Donor Source, 1993-2002**



Source: 2003 OPTN/SRTR Annual Report, Table 1.8.

Approximately 16% of deceased donor transplants were zero-antigen mismatched, a figure that has been stable since 1995. The vast majority of deceased donor transplants were mismatched at three or more antigens (73% in 2002). Only 4% of deceased donor and 1% of living donor transplants were performed in patients whose PRA at transplant was 80% or greater [Tables 5.4a, 5.4c].

Concern regarding potential inequities in the current kidney allocation system has led the OPTN to modify the weight assigned to HLA identity in the kidney allocation system. In particular, African-American and Asian recipients — who suffer longer waiting times for transplantation — have been found to receive a much lower percentage of zero HLA mismatched kidneys (6% and 5% of transplants, respectively, compared to 16% for whites) and to receive relatively more kidneys with higher degrees of mismatch (61% and 69% with HLA mismatch of 4 or greater, respectively, compared to 46% for whites) (6). Further analysis by the SRTR showed that identity for HLA A and HLA B no longer appeared to significantly impact graft survival, and projected that elimination of HLA B from the kidney allocation system would assist in addressing the lower rate of transplantation among African-American candidates (7).

**Outcomes Following Kidney Transplantation**

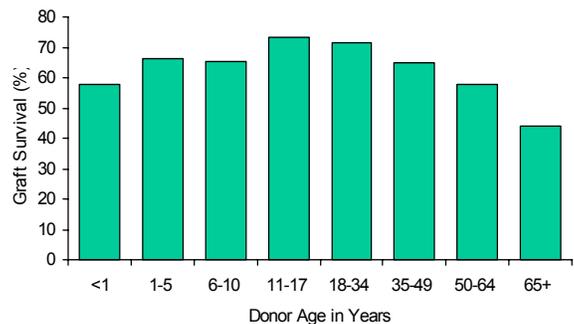
Mean unadjusted kidney graft survival rates progressively improved between 1992 and 2001 for recipients of first deceased donor and living donor kidney transplants [Table 1.12b]. One-year deceased donor graft survival increased from 84% in 1992 to 89% in 2001, while one-year living donor graft survival improved from 92% to 94%. Five- and ten-year deceased donor kidney graft survival rates were 66%

and 36%, respectively. Living donor graft survival rates reached 79% at five years and 55% at ten years [Table 1.14].

**Deceased Donor Recipients — Graft Survival.**

Unadjusted deceased donor kidney allograft survival rates were higher among recipients who are under age 50, Asian or white, and Hispanic/Latino, and were lower for those with blood type B and for individuals with prior kidney transplants. The highest unadjusted five-year deceased donor allograft survival rates were among recipients with a primary diagnosis of polycystic kidneys (76%), neoplasm (73%), congenital and rare familial and metabolic disorders (73%), glomerular diseases (68%), or tubular and interstitial diseases (68%). Lesser unadjusted five-year allograft survival rates were found among recipients with a primary diagnosis of retransplant/graft failure (62%), hypertension/nephrosclerosis (62%), diabetes (61%) or renovascular and other vascular diseases (60%). PRA levels below 10% at time of transplant were associated with superior deceased donor allograft survival at each of the time intervals tested. At the fifth posttransplant year, this translated into unadjusted deceased donor allograft survival rates of 67%, 62%, and 58% for PRAs of 0%-9%, 10%-79%, and 80% or higher, respectively. Dialysis within the first week of transplantation was an adverse predictor of deceased donor allograft success at three months, one year, three years, and five years. By five years, those without posttransplant dialysis had a deceased donor allograft survival rate of 71%, whereas those who received dialysis during the first posttransplant week demonstrated 51% survival [Table 5.9a].

**Figure VI-4. Graft Survival Five Years After Deceased Donor Kidney Transplantation, by Donor Age**



Source: 2003 OPTN/SRTR Annual Report, Table 5.9a. The cohort is transplants performed during the 1996-1997 year.

Donor ages of 49 years and younger were associated with higher unadjusted deceased donor allograft survival rates. Unadjusted five-year deceased donor allograft survival increased steadily with decreasing donor age,

from a low of 44% for donors age 65 years and older, to 58% for donors age 50-64, to 65% at 35-49, to 72% between 18 and 34, and to 73% for donors 11-17 (Figure VI-4). Organs from the youngest pediatric deceased donors were associated with somewhat shorter survival than that seen for organs from deceased donors aged 11-17. Deceased donors aged 6-10, 1-5, and younger than 1 had five-year deceased donor allograft survival rates of 66%, 66%, and 58%, respectively [Table 5.9a]. The relative risk of kidney allograft failure, adjusted for recipient age, is shown in Table VI-3.

**Table VI-3. Relative Rate of Graft Failure for Donor and Recipient Age Categories, 1995-2001**

Donor Ages	Relative Risk	P Value
0-17	0.97	0.35
18-44	1.00	Ref
45-54	1.31	<0.0001
55-64	1.67	<0.0001
65+	2.33	<0.0001

42,276 cadaveric kidneys transplanted between 3/6/95 and 6/30/01, Cox proportional hazards model adjusted for NHBD, donor age, donor hypertension, donor diabetes, donor creatinine, donor race, recipient age, recipient sex, recipient race, cause of ESRD, HLA mismatch, cold ischemia time, PRA, year of transplant, ABO compatibility. Source: SRTR Analysis.

The level of HLA match also influences deceased donor kidney allograft survival [Table 5.9a]. By five years posttransplant, the highest unadjusted deceased donor allograft survival rate (72%) was seen for recipients of zero HLA mismatched kidney transplants. Intermediate five-year deceased donor allograft survival rates of 70%, 68%, and 68% were seen with one, two, and three HLA mismatches, and the lowest rates, 63%, 61%, and 60%, were seen with four, five, and six HLA mismatched transplants, respectively. There was no consistent relationship between transplant center volume and deceased donor allograft survival rates.

#### Deceased Donor Recipients — Patient Survival.

Unadjusted one-year patient survival rates have remained stable over the past decade at approximately 94% for recipients of deceased donor kidneys and 97% for recipients of living donor kidneys [Table 1.13b]. Five-year patient survival of deceased and living donor kidney recipients were 81% and 90%, respectively, while ten-year patient survival rates of the same categories of recipients were 58% and 77% [Table 1.14].

Five-year unadjusted patient survival was highest for recipients younger than 35; survival rates fell steadily

with increasing age. Asians exhibited a higher deceased donor five-year unadjusted patient survival rate (87%) than whites (81%) and African-Americans (79%). Five-year unadjusted patient survival among those of Hispanic/Latino ethnicity (85%) was higher than that seen among those with non-Hispanic/non-Latino ethnicity (81%) [Table 5.11a].

Many of the other factors that influence graft survival similarly affect patient survival. The highest unadjusted five-year deceased donor patient survival rates were achieved by recipients with primary diagnoses of congenital and rare familial and metabolic disorders (89%), polycystic kidney disease (88%), glomerular diseases (87%), tubular and interstitial diseases (86%), and neoplasm (82%). Lesser unadjusted five-year patient survival rates were found among recipients with primary diagnoses of renovascular and other vascular diseases (80%), hypertension/nephrosclerosis (80%), and diabetes (69%). PRA levels below 10% at time of transplant are associated with higher deceased donor patient survival at each of the time intervals tested. At the fifth posttransplant year, unadjusted deceased donor patient survival rates were 81% for recipients with PRAs between 0% and 9%, and 80% and 75% for PRAs of 10%-79% and 80% or higher, respectively. Dialysis within the first week of transplantation was an adverse predictor of deceased donor patient survival at each time interval. Five years following transplantation, those without dialysis had an unadjusted deceased donor patient survival rate of 83%, whereas those with a dialysis in the first posttransplant week had a survival rate of 73% [Table 5.11a].

In general, organs from donors 49 years old or younger were associated with superior unadjusted deceased donor patient survival rates [Table 5.11a]. Unadjusted five-year patient survival dropped from a range of 81-88% for recipients of kidneys from deceased donors 49 or younger, to 75% for recipients of kidneys from deceased donors 50-64 years old, and to 64% for recipients of kidneys from deceased donors age 65 years or older.

**Living Donor Recipients — Graft Survival.** The highest unadjusted five-year living donor allograft survival rates were demonstrated among recipients with primary diagnoses of polycystic kidneys (87%), congenital and rare familial and metabolic disorders (83%), and glomerular diseases (80%). Lesser unadjusted five-year living donor allograft survival rates were found among recipients with primary diagnoses of diabetes (76%), retransplant/graft failure (76%), neoplasms (77%), hypertension/nephrosclerosis (73%), and renovascular and other vascular diseases (72%). PRA levels at the time of transplant that are below 10%

are associated with higher living donor allograft survival at each of the time intervals tested, but differences are small by the fifth posttransplant year. Dialysis within the first week of transplantation was a strong adverse predictor of living donor allograft outcomes at each time interval. By five years, those without dialysis had a living donor allograft survival rate of 79%, whereas those who had required dialysis (only 6% of the sample) demonstrated 45% survival [Table 5.9b].

The relationships between recipient age and unadjusted three-month, and one-, three-, and five-year deceased donor kidney allograft survivals were not as linear as those seen for recipients of living donor kidney transplants [Table 5.9a, 5.9b]. Pediatric unadjusted living donor five-year allograft survival ranged from a low of 72% among recipients 11-17 years old to a high of 89% for recipients younger than 1 year old. Asians, whites, Hispanics/Latinos, and males had higher living donor kidney allograft survival at three years, while those with blood type B exhibited lower survival rates. Adult unadjusted five-year allograft survival ranged from a low of 72% among recipients 65 and older to a high of 81% for recipients 35 to 49 years old. Individuals with prior kidney transplants had worse unadjusted living donor allograft survival at each time point tested. At five years posttransplant, recipients of living donor kidney transplants who had received a prior transplant exhibited a 72% unadjusted survival rate, compared to 79% for those who had not.

The level of HLA match and the relationship between donor and recipient also influenced kidney transplant survival. At posttransplant year five, the highest unadjusted living donor kidney allograft survival rate, 87%, was seen for recipients of zero HLA mismatched transplants. Among mismatched living donor kidney recipients, however, there was no relationship between the level of mismatch and five-year allograft survival, which ranged from 76% to 80%. The highest five-year living donor allograft survival, 82%, was seen when the donor was a sibling. Donations by parents and children resulted in identical 76% unadjusted five year allograft survival, while other related donors achieved a 79% success rate. Spousal and other unrelated living donation resulted in five-year allograft survival rates of 76.7% and 77.4%, respectively [Table 5.9b].

**Living Donor Recipients — Patient Survival.** Five-year unadjusted patient survival among recipients of living kidney transplants was highest for those younger than 35 years old. Five-year survival remained above 90% until age 50-64, when it dropped to 84%. There was a further decrease to 77% for those age 65 and older. Asians had a higher living donor five-year unadjusted patient survival rate (94%) than whites

(90%) and African-Americans (88%). The five-year unadjusted patient survival rate among Hispanic/Latino recipients (93%) was higher than that of non-Hispanic/non-Latino recipients (90%). Unadjusted five-year patient survival ranged from 90% (blood type O) to 94% (type AB), and was 90% for females and 91% for males [Table 5.11b].

The highest unadjusted five-year living donor patient survivals were achieved by recipients with primary diagnoses of congenital and rare familial and metabolic disorders (96%), glomerular diseases (94%), polycystic kidney disease (92%), neoplasm (93%), tubular and interstitial diseases (91%), and renovascular and other vascular diseases (91%). The lowest unadjusted five-year patient survival rates were found among recipients with primary diagnoses of hypertension/nephrosclerosis (86%), and diabetes (82%). PRA levels at time of transplant that are below 10% were not associated with superior living donor patient survival. Dialysis within the first week of transplantation was an adverse predictor of living donor patient survival at each time interval. By five years, those without dialysis had an unadjusted living donor patient survival rate of 91%, whereas the patient survival of those with dialysis in the first posttransplant week was 81% [Table 5.11b].

Patient survival among recipients of zero mismatched living donor kidneys was 95% at five years. Five-year patient survival at other levels of mismatch ranged from 88% to 90%. As with graft survival, there was no relationship between level of HLA mismatch and patient survival among recipients of mismatched living donor kidneys. There was also no relationship between transplant center volume and living donor patient survival rates. The highest five-year living donor patient survival, 94%, was seen when the donor was a parent. Five-year patient survival was 92% when the living donor was a sibling, 82% for living donation by an offspring, and 93% when from another category of relative. Spousal and other unrelated living donation resulted in five-year patient survival rates of 87% and 89%, respectively.

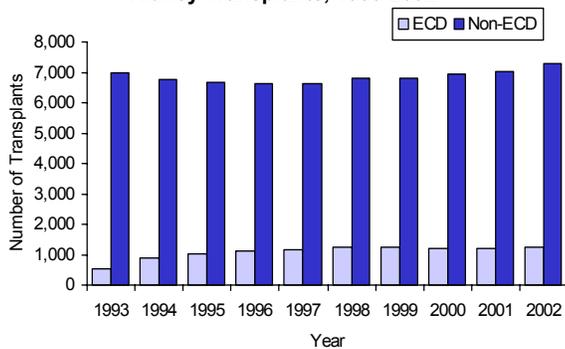
#### EXPANDED CRITERIA DONOR KIDNEY TRANSPLANTATION

In an attempt to encourage and facilitate deceased donor transplantation, policies and procedures to identify and expedite the allocation of kidneys with unfavorable donor characteristics were developed and implemented by the OPTN during 2002. These expanded criteria donor (ECD) kidneys are defined as kidneys with a relative risk of graft loss of 1.7 or greater, based on a combination of donor factors including age, history of hypertension, death from cerebrovascular accident, and

elevated creatinine at the time of kidney recovery (8). Using this definition, ECD kidneys constituted only 8% of deceased donor transplants in 1993, but this percentage increased to over 16% by 1996 [Tables 5.4a, 5.4b]. In 2002, 15% of deceased donor transplants were performed with ECD kidneys (Figure VI-5). As expected, ECD kidneys had lower deceased donor allograft survival rates. Unadjusted three-month, and one-, three-, and five-year deceased donor kidney allograft survivals were 90%, 81%, 67%, and 51% for recipients of ECD kidneys, compared to 95%, 90%, 81%, and 68% for recipients of non-ECD kidneys, respectively [Table 5.9a].

The most appropriate use of expanded criteria donor kidneys continues to be debated. In 2002, patients aged 50 years or more and those with diabetic or hypertensive kidney failure were more commonly transplanted with ECD kidneys, while sensitized patients and those who had undergone kidney transplantation previously were less likely to receive them [Table 5.4b]. In addition, only 8% of ECD kidneys were transplanted to zero antigen mismatched recipients, in contrast to 16% of non-ECD kidneys (Table VI-4) [Tables 5.4a, 5.4b]. The use of ECD kidneys in older patients has become progressively more common over the past decade, with recipients 50 years of age and greater now receiving 70% of ECD kidneys compared to 47% of non-ECD kidneys [Tables 5.4a, 5.4b]. It is uncertain whether this pattern of use is optimal; preliminary evidence suggests that the decrement in transplant survival between ECD and non-ECD kidneys is actually greater in older patients (9,10).

Figure VI-5. Expanded and Non-Expanded Criteria Donor Kidney Transplants, 1993-2002



Source: 2003 OPTN/SRTR Annual Report, Table 5.4.

Table VI-4. Distribution of Use of Expanded Criteria Donor Kidneys, 2002

Recipient Factor	Donor Type	
	Non-ECD	ECD
<b>Age</b>		
Less than 35	20.1%	7.2%
65 and over	9.9%	22.9%
White race	64.3%	60.3%
Male gender	59.5%	60.6%
ABO Type O	43.7%	46.6%
Recipient of previous kidney transplant	14.5%	7.2%
Current PRA > 10%	15.5%	10.6%
Peak PRA > 10%	31.3%	24.2%
0 Antigen mismatch	15.6%	8.3%
<b>Cause of kidney failure</b>		
DM	19.9%	28.2%
Hypertension	16.1%	22.2%
Other	64.0%	49.6%

Source: 2003 OPTN/SRTR Annual Report, Table 5.4

**SIMULTANEOUS KIDNEY-PANCREAS (SPK) TRANSPLANTATION**

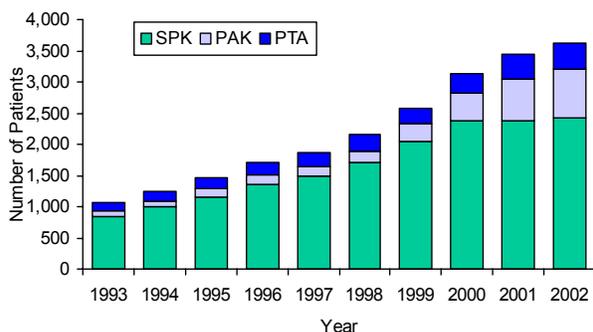
**The Kidney-Pancreas Waiting List**

The number of potential recipients on the kidney-pancreas (SPK) transplant waiting list increased from 855 in 1993 to 2,425 in 2002 [Table 8.1]. However, the waiting list registration for SPK transplants has remained stable over the past three years (Figure VI-6). The majority of registrants were white (80%) with smaller numbers of African-Americans (18%) and Hispanic/Latino candidates (9%). The percentage of African-American candidates increased from 13% in 1999 to 18% in 2002. Since 1993, the proportion of registrations in the 18-34 year age group have declined from 35% to 23%, while the 50-64 age group increased from 6% to 17%. In the 35-49 year age group, the proportion of candidates has remained stable at about 60% over the decade. There was little change in the gender distribution of the waiting list over the decade, with 55% of candidates being male and 45% female in 2002. Twelve percent of the waiting list had received a previous transplanted organ, compared to 20% on the kidney-only waiting list [Tables 5.1, 8.1].

Although more patients have been placed on the SPK waiting list, the number of SPK transplants has declined from a peak of 970 transplants in 1998 to 905 transplants in 2002 [Table 8.4]. This decline may be due

to the increasing numbers of pancreas after kidney (PAK) transplants during this period. The lack of increase in SPK procedures has resulted in increasing waiting times. Until 1997, the median waiting time was less than a year. Since 1997, the median waiting time has increased, reaching 491 days in 2001. Longer waiting times were associated with increasing age (584 days for age 50-64 compared to 470 days for age 18-34 in 2001). Whites waited a median of 468 days in 2002, less than African-American candidates (640 days) and Hispanic/Latino candidates (586 days). The median waiting time for candidates with A and AB blood types was less than a year for a SPK transplant in 2001; those with O and B blood types waited 588 days and 548 days, respectively. Previously transplanted candidates experience twice the waiting time of candidates with no previous transplants [Table 8.2].

**Figure VI-6. Patients on the Pancreas Waiting List, by Category, 1993-2002**



Source: 2003 OPTN/SRTR Annual Report, Tables 6.1, 7.1, 8.1.

The death rate on the waiting list increased slightly over the past 10 years, from 76 deaths per 1,000 patient years at risk in 1993 to 86 in 2002. As expected, the risk of death on the waiting list increased with increasing age. The death rate in 2002 on the waiting list for candidates 18-34 years old was 58/1,000 patient years at risk compared to 114/1,000 patient years at risk for ages 50-64 [Table 8.3].

### **Kidney-Pancreas Transplant Recipients**

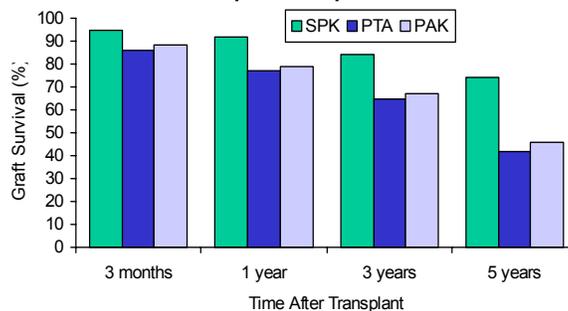
There has been little change in SPK recipient characteristics over the past decade: the majority of SPK recipients are white and/or male. The number of African-American SPK transplant recipients more than doubled since 1993, but still only accounted for 12% of total SPK transplants in 2002. Whites accounted for 86% of SPK transplants, down from 93% in 1993. SPK transplant recipients continued to have a significant degree of HLA mismatch, with 75% receiving organs with more than three HLA mismatches [Table 8.4].

### **Outcomes Following Kidney-Pancreas Transplantation**

**Graft Survival — Kidney.** Overall unadjusted kidney graft survival one and five years following SPK transplantation were 92% and 74%, respectively. African-Americans had poorer five-year graft survival than whites or Asians (66%, 75%, and 82%, respectively). Kidneys from the youngest and oldest (<5 years and >50 years) donors were associated with poorer five-year graft survival; kidneys from donors over 50 years had 64% five-year graft survival compared to 77% in donors 11-35 years of age. Although few in number, donors aged 6 to 10 years exhibited the best five-year graft survival (85%). High PRA, retransplantation, and HLA mismatching did not appear to be significant long-term risk factors for graft loss. Male recipient gender was associated with 6% higher kidney graft survival at five years compared to female gender [Table 8.9].

**Graft Survival — Pancreas.** Overall, the unadjusted one- and five-year pancreas graft survival rates following SPK transplantation were 85% and 70%, respectively (Figure VI-7). As noted for kidney graft survival, African-Americans and recipients of organs from older donors experienced poorer five-year graft survival. For recipients with a previous transplant, there was a 6% lower graft survival at five years. HLA sensitization was also associated with more pancreas graft loss at five years (pancreas graft survival was 70% for unsensitized recipients and 43% for recipients with a current PRA of 80% or greater) [Table 8.9].

**Figure VI-7. Pancreas Graft Survival Among Pancreas Transplant Recipients**



Source: 2003 OPTN/SRTR Annual Report, Tables 6.9, 7.9, 8.9. Cohorts are transplants performed during 2000-2001 for 3-month and 1-year; 1998-1999 for 3-year; and 1996-1997 for 5-year survival.

### **Simultaneous Kidney-Pancreas Recipient Survival.**

The death rate in the first year following SPK transplant began declining in 1995, coinciding with the introduction of mycophenolate mofetil and tacrolimus immunosuppression (11). The death rate declined dramatically from 86/1,000 patient years at risk in 1993 to 52/1,000 patient years at risk in 1999; it has remained below 60 since then and is lower than the unadjusted

death rate among wait-listed candidates. The reduction in deaths occurred despite a shift in the surgical community to more enteric drained pancreas transplants, a more technically demanding procedure (12). Risk factors that confer a higher mortality rate include increasing age, retransplantation, and PRA>80% [Tables 8.3, 8.7].

Unadjusted one-year patient survival for SPK recipients was 95%; 5-year survival was 84%. Race, ethnicity, gender, PRA, center volume, and level of HLA mismatch are not associated with increased mortality at 5 years [Table 8.11]. Of the 8,622 SPK transplants performed since 1993, 6,544 patients (76%) were alive at the end of 2002 [Tables 8.4, 8.12].

### **PANCREAS AFTER KIDNEY TRANSPLANTATION**

#### **Pancreas After Kidney Waiting List**

In contrast to the SPK waiting list, the number of patients awaiting pancreas after kidney (PAK) transplantation continued to grow, increasing 16% to 781 candidates in 2002 (Figure VI-6). As with SPK transplants, the majority of PAK candidates were 35-49 years old, white and non-Hispanic/non-Latino. Nearly one-quarter had undergone previous pancreas transplantation [Table 7.1]. Median waiting time increased as the waiting list grew from 214 days in 1999 to 550 days in 2001. White and African-American patients experienced similar waiting times. Females, who constituted only 42% of the PAK waiting list, waited 110 days longer than males [Tables 7.1, 7.2]. The death rate among candidates on the PAK waiting list was much lower than that seen on the SPK list, ranging from 24.3 to 34.7 per 1,000 patient years at risk from 1999 through 2002 [Table 7.3].

#### **Pancreas After Kidney Transplant Recipients**

The number of PAK transplants also continued to increase, reaching 377 in 2002. Recipient characteristics mirrored those of candidates on the waiting list. Most recipients were 35-49 years old (62%), white (91%), non-Hispanic/non-Latino (94%), and male (58%). Twenty-one percent had undergone previous pancreas transplantation [Table 7.4].

#### **Outcomes Following Pancreas After Kidney Transplantation**

**Graft Survival.** Pancreas graft survival following PAK transplantation was significantly poorer than that seen following SPK transplantation, with one-year unadjusted

graft survival of 79% falling to 46% at five years (Figure VI-7). Recipient age over 50 years and donor age over 35 years both appear to reduce graft survival. A consistent effect of HLA mismatch on graft survival was not observed [Tables 7.9, 8.9].

**Patient Survival.** Unadjusted patient survival was similar to that seen following SPK transplantation until five years posttransplant, when PAK was worse (77%) than SPK (84%) [Tables 7.11, 8.11]. Older recipient and donor age were also associated with lower patient survival. Death rates during the first year after PAK transplantation were higher than that seen among wait-listed candidates, ranging from 31 to 61 per 1,000 patient years between 1999 and 2002 [Tables 7.3, 7.7].

### **ISOLATED PANCREAS TRANSPLANTATION**

#### **The Pancreas Transplant Alone Waiting List**

The list of candidates awaiting pancreas transplant alone (PTA) continued to show modest growth, increasing 5% to 408 in 2002. As with SPK and PAK, the majority of candidates were aged 35-49 (60%), white (94%), and non-Hispanic/non-Latino (95%). Females, however, constituted a majority of the PTA waiting list (57%). Only 5% had previously undergone pancreas transplantation [Table 6.1]. Waiting times for PTA have tended to be relatively short. Median waiting time, which ranged from 219 to 343 days between 1999 and 2000, jumped to 501 days in 2002; the time by which 25% of candidates were transplanted increased from 62 days in 2000 to 121 days in 2001. The latter figure dropped to 59 days in 2002, however, suggesting that the prolonged waiting time seen in 2001 may have been an aberration [Table 6.2]. The death rate per 1,000 patient years at risk among candidates on the PTA waiting list varied widely from year to year, ranging from 18 to 63 between 1999 and 2002 [Table 6.3].

#### **Pancreas Transplant Alone Recipients**

The number of PTA transplants increased 8% to 175 in 2002. Recipient characteristics were similar to those of wait-listed candidates [Tables 6.1, 6.4]. Only five centers reported performing ten or more PTA transplants in 2002 [Table 6.13].

#### **Outcomes Following Pancreas Transplant Alone**

**Graft Survival.** Graft survival following PTA was similar to that seen following PAK transplantation (Figure VI-7) [Tables 6.9, 7.9]. The number of cases within subgroups makes comparisons difficult but, as with PAK, there did not appear to be an effect of HLA

matching on either short- or long-term unadjusted graft survival.

**Patient Survival.** Patient survival was quite good following PTA, remaining above 90% at three years. Death rates during the first year posttransplant varied widely — from 0 to 39 per 1,000 patient years at risk between 1999 and 2002 — but have tended to be lower than those seen among wait-listed patients, which ranged from 18 to 63 during the same time period [Tables 6.3, 6.7, 6.11].

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