pancreas

The number of new patients waiting for pancreas transplant rose and fell over the past decade (Figure 1.1). Transplant rates for adult patients wait-listed for pancreas transplant have dropped, with the most pronounced drop among pancreas after kidney transplant (PAK) recipients (Figure 1.4). Three years after listing, 59.3% of patients had undergone pancreas transplant alone (PTA), 57.1% simultaneous pancreas-kidney transplant (SPK), and 50.8% PAK (Figure 1.6). The median time to transplant for all candidates who were active at listing was 7.0 months for PTA, 11.5 months for SPK, and 12.8 months for PAK (Figure 1.7). A cross-section of the waiting list on December 31, 2009, shows that most PTA and SPK patients were aged 18 to 44 years. Four percent of PTA, 10% of SPK, and 6% of PAK candidates self-reported type 2 diabetes (Figure 1.11).

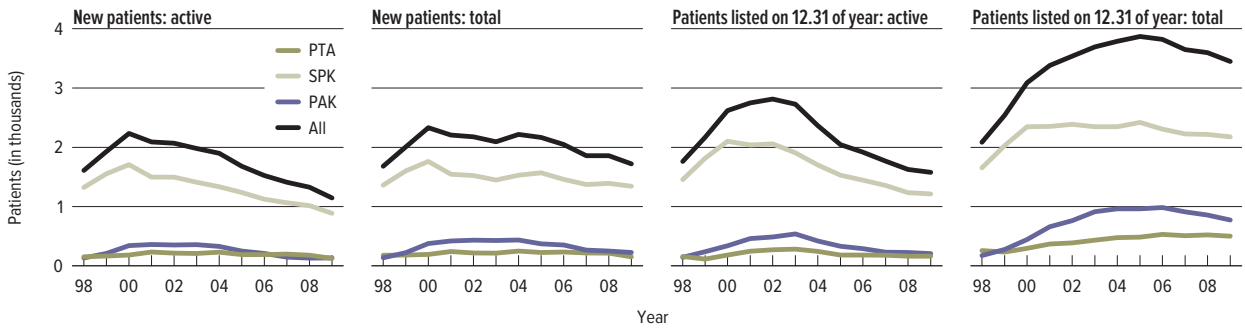
The number of adult pancreas transplants steadily decreased since peaking at 1,454 in 2004, and is currently at 1,170. The decline is most marked for PAK (Figure 3.1). Recipient age has gradually shifted toward ages 50 years or older and away from ages 18 to 34 years. The proportion of recipients with body mass index (BMI) 25.0 to 29.9 kg/m^2 has increased, and the proportion with BMI 18.5 to 24.9 kg/m^2 has decreased (Figure 3.2).

The 1-year PTA graft survival was 75.4% for transplants in 2008 (Figure 5.2). The 1-year graft survival of the pancreas in SPK recipients was at a high of 86.4% (Figure 5.3). The 1-year pancreas graft survival in PAK recipients decreased slightly from 2008, falling to 79.3% from 81.1% (Figure 5.5). Estimated half-lives for pancreas allografts transplanted in 2007 are 20.6, 12.0, and 5.1 years for SPK, PAK, and PTA, respectively (Figure 5.7).

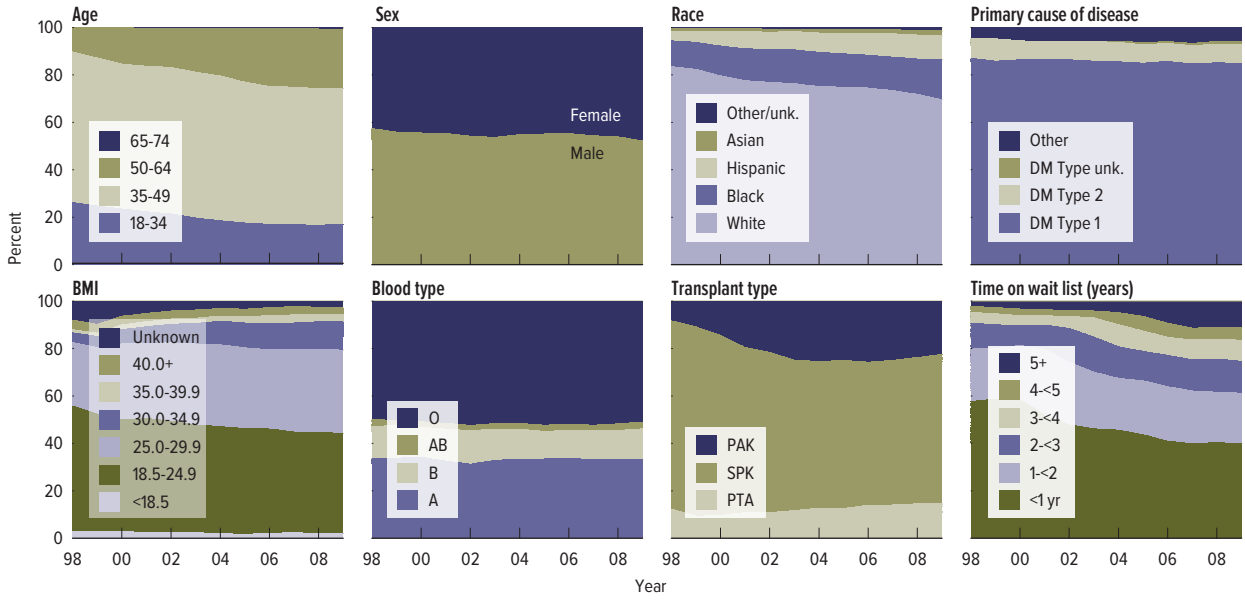
Jesse was able to enhance the lives of eight people at the time of his death. At our time of great sorrow it was nice to know that others could rejoice as he was able to share the gift of life with them. Jesse's generous and giving nature made any answer other than "yes" seem impossible to the entire family.

Audre, donor mom

PA1.1 Adult patients waiting for a pancreas transplant



PA1.2 Distribution of adult patients waiting for a pancreas transplant

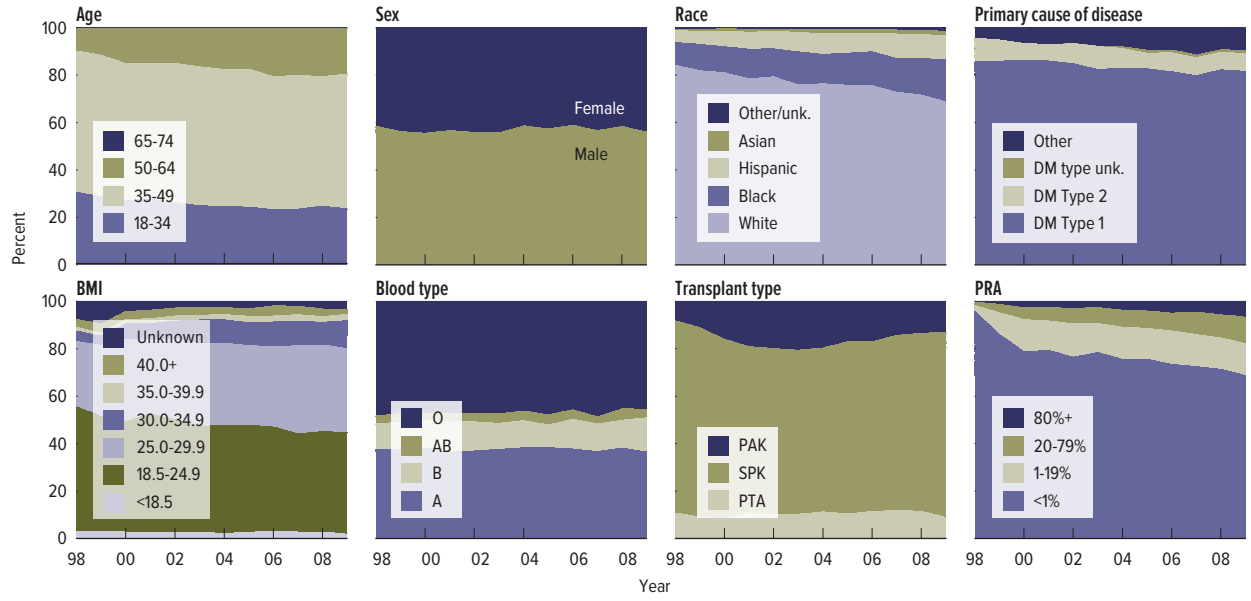


wait list

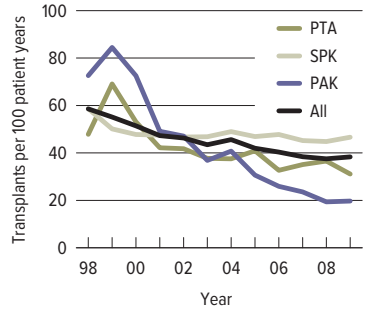
The number of new patients waiting for pancreas transplant has changed over the past decade, with a net increase in counts on all three lists until 2004–2005, after which counts declined to levels similar to 1998. Over the past 6 years, the number of active patients has decreased sharply, especially those awaiting SPK transplant (Figure 1.1). In 2003, a policy change by the Organ Procurement and Transplantation Network (OPTN) allowed individuals on the waiting list to accrue time while inactive.

Since 1998, the number of older patients (aged 50 to 64 years) has gradually increased and the number of younger patients (aged 18 to 34 years) has decreased correspondingly. Numbers of Hispanic and black patients have increased, with a corresponding decrease in numbers of white patients. In 2009, 8.1% of patients self-reported type 2 diabetes. The percentage of obese patients (BMI greater than 30 kg/m^2) is steadily increasing, with most obese patients having a BMI of 30 to 35 kg/m^2. The blood group distribution on the waiting list has remained stable. The number of PAK listings increased between 1999 (when PAK transplants received Medicare approval) and 2005; since then, the number of PAK listings has gradually declined and the number of SPK listings has gradually increased. PTA transplants constitute a minority

PA 1.3 **Distribution of adult patients newly listed for a pancreas transplant**



PA 1.4 **Transplant rates among adult patients wait-listed for a pancreas transplant**



PA 1.5 **Pancreas transplant waiting list activity among adult patients**

	PTA			SPK			PAK		
	2007	2008	2009	2007	2008	2009	2007	2008	2009
Listings at start of year	539	517	526	2,368	2,297	2,292	1,001	929	867
Listings added during year	293	321	257	1,612	1,600	1,559	386	335	309
Listings removed during year	315	312	282	1,683	1,605	1,610	458	397	385
Listings at end of year	517	526	501	2,297	2,292	2,241	929	867	791
Removal reason									
Living donor kidney transplant	.	.	.	132	137	144	.	.	.
Deceased donor transplant	195	193	165	1,018	982	1,012	229	184	166
Patient died	23	21	18	233	215	185	24	27	34
Too sick for transplant	9	6	7	57	53	72	37	31	27
Condition improved	14	5	7	25	15	14	8	4	5
Other	74	87	85	218	203	183	160	151	153

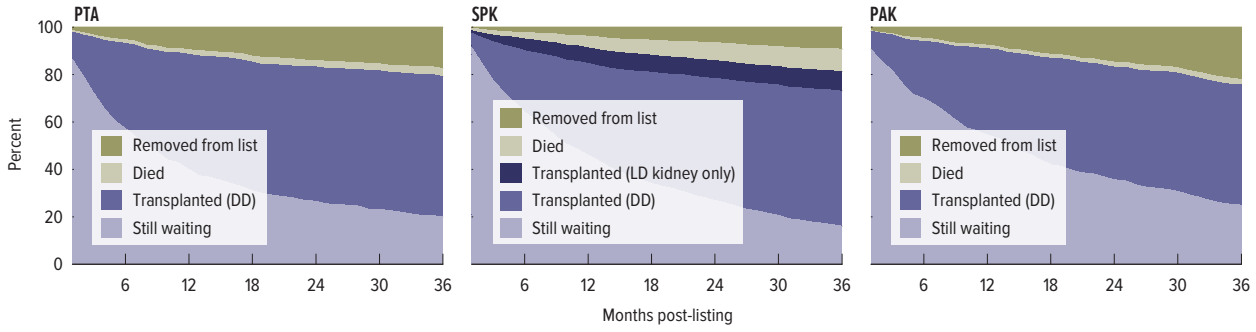
and have remained stable. Time on the waiting list has gradually increased since 2002 (Figure 1.2).

Changes in the demographics of newly listed adult patients over the past decade are similar to those seen with currently wait-listed patients. The number of sensitized patients (panel reactive antibody [PRA] greater than 0%) is steadily increasing (Figure 1.3).

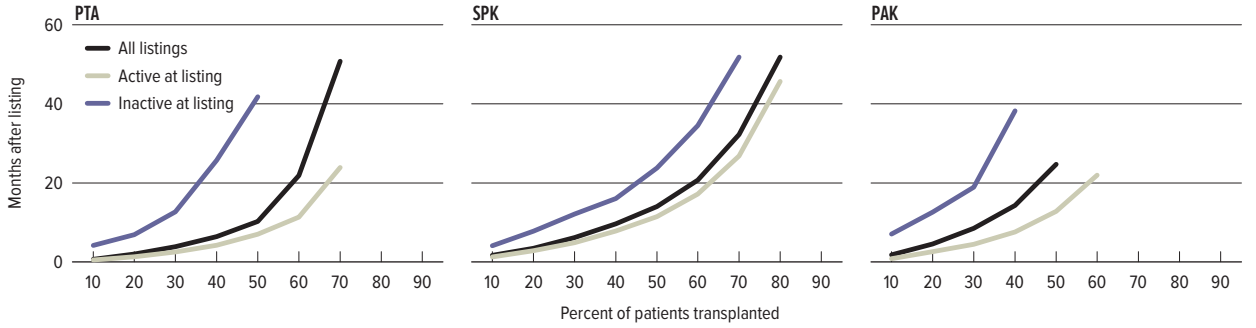
Transplant rates for adult patients wait-listed for a pancreas transplant have dropped over the past decade, with the most pronounced drop among PAK recipients. In 2009 (compared with 2008), the overall transplant rates marginally increased from 33.8 to 34.3 per 100 patient-years; however, the rate for the PTA group fell from 36.7 to 31.2 per 100 patient-years.. This is the lowest transplant rate for PTA in the past decade (Figure 1.4).

In 2009, 144 living donor kidney transplants were performed in SPK wait-listed patients, compared with 132 in 2007 and 137 in 2008. This is consistent with the 6.6% increase in living donor kidney transplants from 2008 to 2009 (see Kidney chapter). The number of patients on each pancreas waiting list at the end of 2009 was the lowest in the 3-year period starting in 2007 (Figure 1.5).

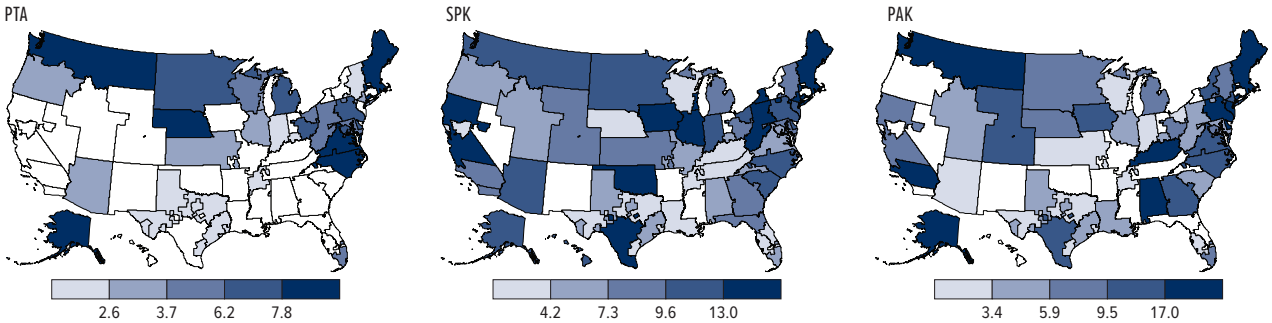
PA1.6 **Pancreas transplant waiting list status by month post-listing among new adult listings in 2006**



PA1.7 **Percentiles of time to pancreas transplant for new adult listings, 2005–2009**



PA1.8 **Median months to pancreas transplant for adult patients transplanted in 2009, by DSA**



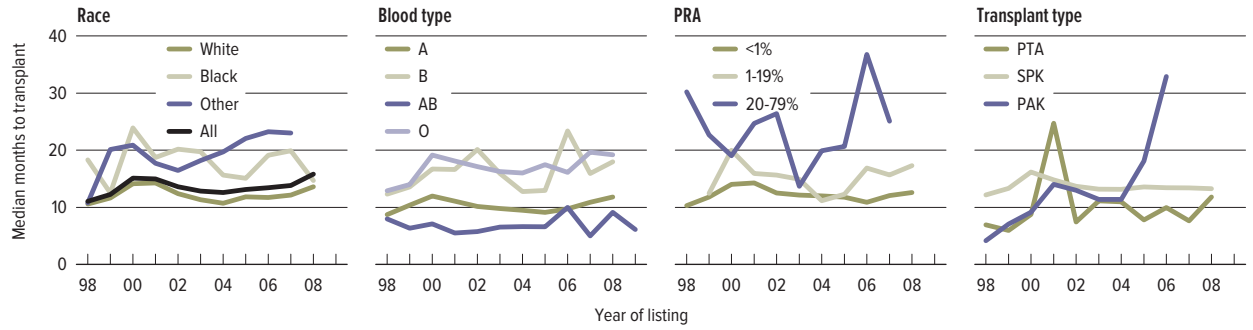
wait list

Three years after joining a given waiting list, 59.3% of patients had undergone PTA, 65.2% SPK or a living donor kidney transplant, and 50.8% PAK (Figure 1.6). At 3 years, 3.3% of patients wait-listed for PTA had died, as had 9.4% of those listed for SPK and 2.5% of those listed for PAK. In addition, 17.4% of those awaiting PTA, 9.3% of those awaiting SPK, and 21.7% of those awaiting PAK had been removed from the list. At the end of 3 years, 20.0%, 16.1%, and 24.9% were still awaiting PTA, SPK, and PAK, respectively.

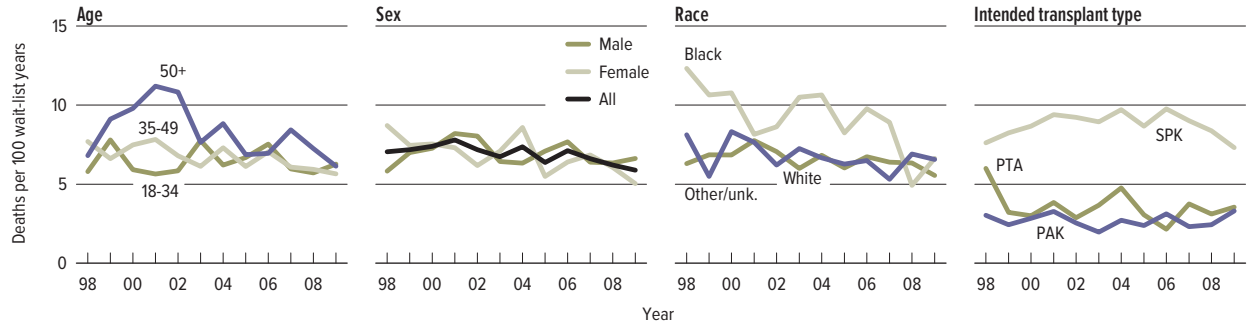
The median time to transplant for all candidates who were active at listing was 7.0 months for PTA, 11.5 months for SPK, and 12.8 months for PAK (Figure 1.7). It is not uncommon for PAK-listed patients to be activated at the time of living donor kidney transplant in case a deceased donor pancreas becomes available then. After undergoing living donor kidney transplant, a patient may not be listed as active again for 6 weeks to 3 months, depending on center practice and patient condition. This could account for the prolonged waiting times for PAK.

The median months to deceased donor pancreas transplant for patients undergoing transplant in 2009 was 3.5 for PTA, 8.3 for SPK, and 6.9 for PAK. The geographical variations by donor service area (DSA) in waiting times for SPK closely mirror those for kidneys

PA 1.9 Median months to pancreas transplant for wait-listed adult patients



PA 1.10 Pre-transplant mortality rates among adult patients wait-listed for a pancreas transplant



(see Figure 1.9, Kidney chapter). For PTA and PAK, the waiting times are low except in some scattered areas (Figure 1.8).

The median time to pancreas transplant has increased in the past decade (1998–2008), with the sharpest increase noted in PAK (4.1 months in 1998 to 32.9 months in 2006). For PTA, median time was 6.9 months in 1998 and 11.8 months in 2008; for SPK, 12.2 months in 1998 and 13.3 months in 2008. The difference in waiting times between whites and blacks seems to be decreasing, with the most recent year showing a 1-month difference. However, the waiting time for other racial groups has been steadily increasing. Blood group and PRA disparities resemble those for kidney transplants (see Figure 1.10, Kidney chapter), with the O and B groups waiting longer than the AB group, and the high PRA (20% to 79%) group waiting the longest (Figure 1.9). Median wait times for the highest PRA group (80%+) were not consistently observed.

Pre-transplant mortality trends have held steady over the past decade, with the highest mortality, as expected, in the SPK group. The trend toward higher mortality in recipients aged 50 years or older seen in 2001–2002 has improved. Blacks had higher pre-transplant mortality a decade ago, but this has progressively decreased (Figure 1.10).

PA 1.11 Characteristics of adult patients on the pancreas transplant waiting list on December 31, 2009

	Level	PTA N	%	SPK N	%	PAK N	%
Age	18-44	260	52.0	1,243	57.1	379	49.2
	45-64	233	46.6	927	42.6	388	50.3
	65+	7	1.4	8	0.4	4	0.5
Gender	Male	211	42.2	1,166	53.5	421	54.6
	Female	289	57.8	1,012	46.5	350	45.4
Race	White	442	88.4	1,352	62.1	605	78.5
	Black	26	5.2	471	21.6	85	11.0
	Hispanic	23	4.6	257	11.8	70	9.1
	Asian	6	1.2	55	2.5	8	1.0
	Other/unknown	3	0.6	43	2.0	3	0.4
Primary cause of disease	Diabetes Type 1	433	86.6	1,793	82.3	700	90.8
	Diabetes Type 2	19	3.8	217	10.0	43	5.6
	Diabetes type unk.	3	0.6	25	1.1	14	1.8
	Other cause/unk.	45	9.0	143	6.6	14	1.8
Transplant history	Listed for first tx	430	86.0	2,012	92.4	572	74.2
	Listed for sub. tx	70	14.0	166	7.6	199	25.8

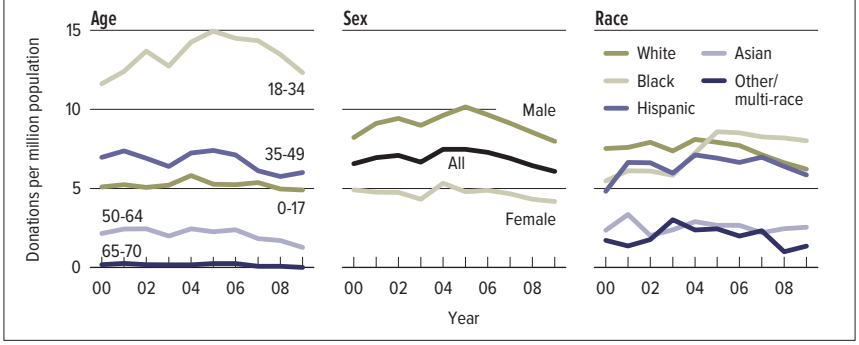
	Level	PTA N	%	SPK N	%	PAK N	%
Blood type	A	185	37.0	686	31.5	275	35.7
	B	50	10.0	310	14.2	86	11.2
	AB	10	2.0	65	3.0	24	3.1
	O	255	51.0	1,117	51.3	386	50.1
PRA	<10%	369	73.8	1,614	74.1	571	74.1
	10%+	131	26.2	564	25.9	200	25.9
Time on list	<1 year	158	31.6	1,000	45.9	224	29.1
	1-<2	106	21.2	495	22.7	139	18.0
	2-<3	50	10.0	287	13.2	125	16.2
	3-<4	37	7.4	173	7.9	88	11.4
	4-<5	30	6.0	91	4.2	63	8.2
	5+	119	23.8	132	6.1	132	17.1
BMI (kg/m^2)	<18.5	18	3.6	34	1.6	15	1.9
	18.5-24.9	211	42.2	923	42.4	323	41.9
	25.0-29.9	173	34.6	760	34.9	281	36.4
	30.0-34.9	63	12.6	312	14.3	100	13.0
	35.0-39.9	15	3.0	69	3.2	29	3.8
	40.0+	1	0.2	20	0.9	4	0.5
	Unknown	19	3.8	60	2.8	19	2.5
Total		500		2,178		771	

wait list

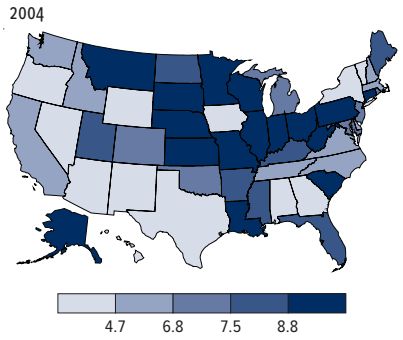
A cross-section of the waiting list on December 31, 2009, shows that most PTA and SPK patients were aged 18 to 44 years; PAK patients aged 45 to 64 years were a slim majority. Most PTA candidates were female (58%), and most SPK and PAK candidates were male (54% and 55%, respectively). Whites comprised 88% of the PTA, 62% of the SPK, and 79% of the PAK lists. Analysis for type of diabetes, a self-reported variable, showed that 4% of PTA, 10% of SPK, and 6% of PAK candidates self-reported type 2 diabetes (Figure 1.11).

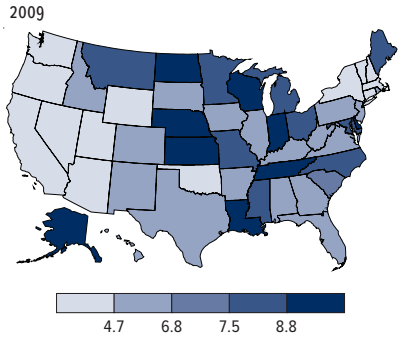
The percentage of patients listed for re-transplant varied widely by list: 14% of PTA, 8% of SPK, and 26% of PAK listed patients were waiting for a re-transplant. Patients with blood type O accounted for 51% of listings, and type A 33%. PRA greater than 10% was recorded in 26% of patients. Seventy-seven percent of listed patients had a BMI between 18.5 and 29.9 kg/m^2, 14% had a BMI between 30 and 34.9 kg/m^2, and 4% had a BMI greater than 35 kg/m^2. With regard to time on the waiting list, 32% of PTA, 46% of SPK, and 29% of PAK listed patients had been on the list less than 1 year, while 24% of PTA, 6% of SPK, and 17% of PAK listed patients had been on the list for 5 or more years. (Figure 1.11).

PA 2.1 Pancreas donations from deceased donors per million population

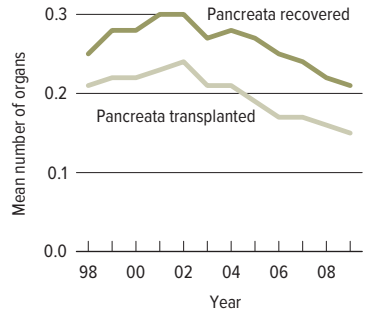


PA 2.2 Deceased donor pancreas donation rates (per million population)

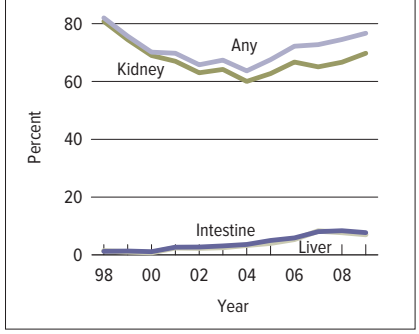




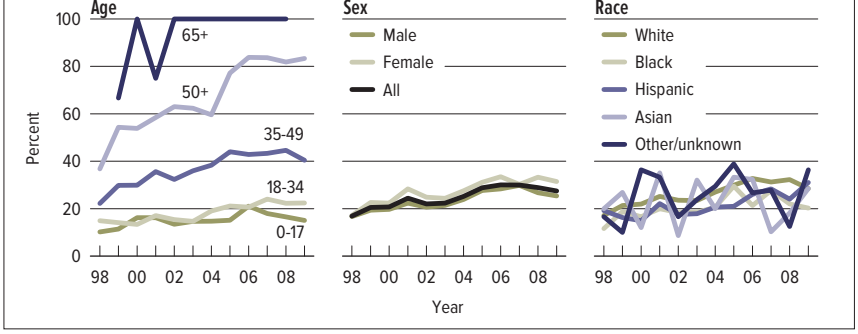
PA 2.3 Pancreata recovered per donor & pancreata transplanted per donor



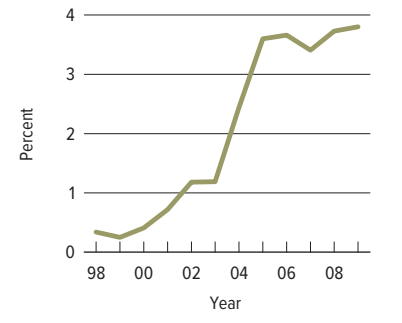
PA 2.4 Deceased donor pancreata transplanted with another organ



PA 2.5 Discard rates for pancreata recovered for transplant



PA 2.6 Pancreas donors who are DCD



donation

Deceased pancreas donation rates, per million population (pmp), have decreased since 2005. This may reflect the overall increase in the age of the deceased donor pool and the use of only ideal donors for pancreas transplant. Rates were highest for patients aged 18 to 34 years (12 pmp in 2009), followed by those aged 35 to 49 years (6 pmp) and those younger than 18 years (5 pmp). Male donation rates have been twice rates for females. Blacks have become the racial group with the highest donation rates (8 pmp in 2009) (Figure 2.1). Geographic heterogeneity in donation rates is substantial (Figure 2.2).

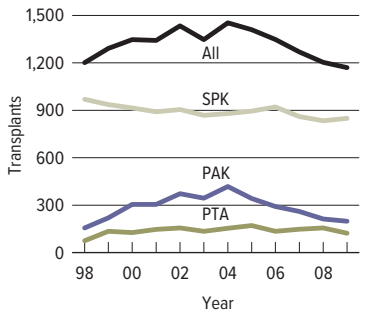
In 1998, 0.25 pancreata were recovered for per donor; this number peaked at 0.30 in 2002, and declined to 0.21 in 2009. In 2009, 0.15 pancreata were transplanted per donor (Figure 2.3).

Approximately 76% of pancreata were co-transplanted with another organ in 2009, mostly with kidneys (70%). However, the numbers of livers and intestines co-transplanted with a pancreas have increased (Figure 2.4). Many of these are pancreas transplants for technical reasons, not diabetes.

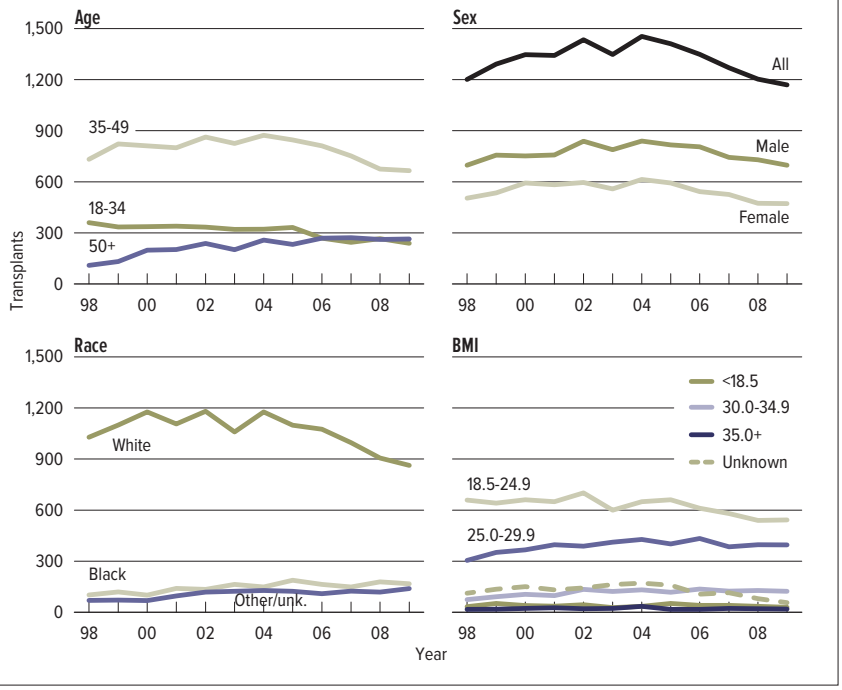
Discard rates have increased across all age groups since 1998, though most dramatically for donors aged 50 to 64 years (36.8% to 83.3% in 2009). The overall discard rate, which was 17% in 1998, peaked at 30% in 2006, and was at 27% in 2009 (Figure 2.5).

The number of donations after circulatory death (DCD) has been increasing steadily. DCD donations were 0.34% in 1998 and 3.8% in 2009 (Figure 2.6).

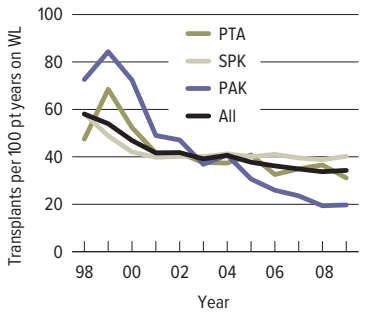
PA 3.1 Total number of adult pancreas transplants



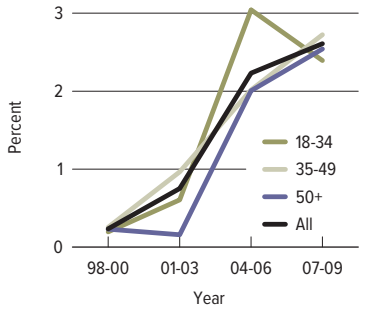
PA 3.2 Adult pancreas transplants



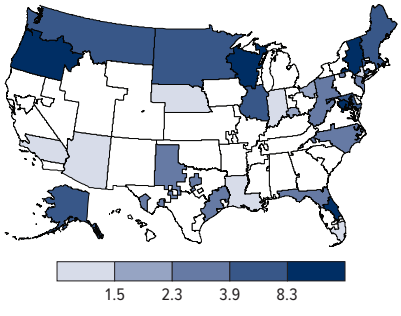
PA 3.3 Pancreas transplant rates in adult recipients



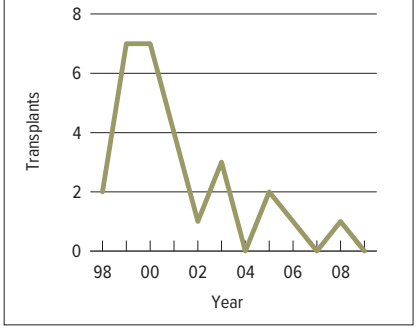
PA 3.4 Use of DCD pancreata among adult recipients, by recipient age



PA 3.5 Percent of adult, deceased donor pancreas transplants that are DCD, by DSA, 2007–09



PA 3.6 Adult pancreas transplants from living donors



transplant

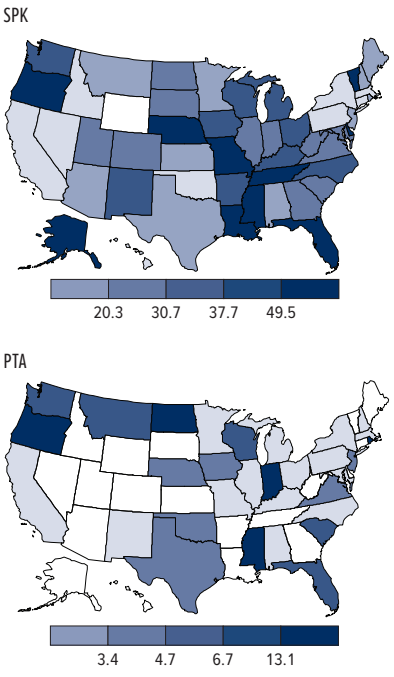
The number of adult pancreas transplants has steadily decreased since peaking at 1,454 in 2004, and is currently at 1,170. The decline is most marked for PAK transplants. After CMS approved coverage for PAK transplants in 1999 (http://www.cms.gov/transmittals/downloads/R124CIM.pdf), the number almost doubled over the next 2 years, peaked in 2004, and has declined gradually since. SPK transplants, on the other hand, have seen a gradual decrease over the past decade (Figure 3.1).

Recipient ages have gradually shifted toward 50 years or older and away from 18 to 34 years. The percentage of minority recipients (black or other/unknown) has increased steadily. The proportion of recipients with BMI 25.0 to 29.9 kg/m^2 has increased, and the proportion with BMI 18.5 to 24.9 kg/m^2 has decreased (Figure 3.2).

Transplants per 100 patient-years on the waiting list had been decreasing over 9 years, but this decline leveled off in 2009. This may be the result of a combination of improved list management and regional allocation variances allowing for preferences to SPK transplants (Figure 3.3).

Willingness to use DCD pancreata is recent (Figure 3.4). By DSA, use of DCD pancreata showed wide variation (Figure 3.5).

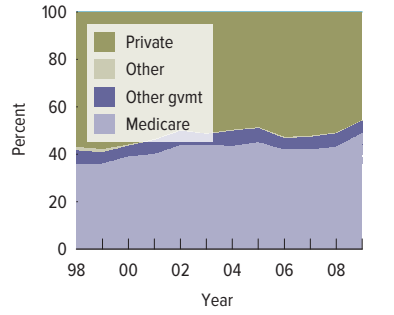
PA 3.7 Pancreas transplant rates per 100 patient years on the waiting list, adult pts, 2009



PA 3.8 Characteristics of adult pancreas transplant recipients, 2009

		All		PTA		SPK		PAK	
	Level	N	%	N	%	N	%	N	%
Age	18-34	240	20.5	35	28.5	170	20.0	35	17.7
	35-49	666	56.9	53	43.1	497	58.5	116	58.6
	50-64	261	22.3	34	27.6	180	21.2	47	23.7
	65+	3	0.3	1	0.8	2	0.2	0	0.0
Gender	Female	472	40.3	76	61.8	321	37.8	75	37.9
	Male	698	59.7	47	38.2	528	62.2	123	62.1
Race	White	863	73.8	117	95.1	583	68.7	163	82.3
	Black	168	14.4	3	2.4	156	18.4	9	4.5
	Hispanic	111	9.5	2	1.6	87	10.2	22	11.1
	Asian	20	1.7	1	0.8	16	1.9	3	1.5
	Other/uknown	8	0.7	0	0.0	7	0.8	1	0.5
Primary cause of disease	Diabetes Type 1	1,018	87.0	94	76.4	736	86.7	188	94.9
	Diabetes Type 2	67	5.7	0	0.0	61	7.2	6	3.0
	Diabetes type unk.	9	0.8	1	0.8	4	0.5	4	2.0
	Other cause/unk.	76	6.5	28	22.8	48	5.7	0	0.0
Blood type	A	433	37.0	55	44.7	293	34.5	85	42.9
	B	143	12.2	10	8.1	110	13.0	23	11.6
	AB	49	4.2	4	3.3	37	4.4	8	4.0
	O	545	46.6	54	43.9	409	48.2	82	41.4
BMI (kg/m²)	<18.5	30	2.6	7	5.7	17	2.0	6	3.0
	18.5-24.9	543	46.4	49	39.8	410	48.3	84	42.4
	25.0-29.9	396	33.8	38	30.9	291	34.3	67	33.8
	30.0-34.9	124	10.6	16	13.0	86	10.1	22	11.1
	35.0-39.9	14	1.2	1	0.8	13	1.5	0	0.0
	40.0+	6	0.5	1	0.8	4	0.5	1	0.5
	Unknown	57	4.9	11	8.9	28	3.3	18	9.1
Time on waiting list	<30 days	133	11.4	23	18.7	88	10.4	22	11.1
	31-60 days	92	7.9	21	17.1	55	6.5	16	8.1
	61-90 days	83	7.1	11	8.9	59	6.9	13	6.6
	3-<6 months	194	16.6	22	17.9	138	16.3	34	17.2
	6-<12 months	310	26.5	26	21.1	239	28.2	45	22.7
	1-<2 years	209	17.9	9	7.3	160	18.8	40	20.2
	2-<3 years	77	6.6	5	4.1	58	6.8	14	7.1
	3+ years	72	6.2	6	4.9	52	6.1	14	7.1
Insurance	Private	535	45.7	81	65.9	362	42.6	92	46.5
	Medicare	570	48.7	29	23.6	442	52.1	99	50.0
	Other government	62	5.3	12	9.8	43	5.1	7	3.5
	Other	3	0.3	1	0.8	2	0.2	0	0.0
Pancreas tx history	First transplant	1,075	91.9	114	92.7	833	98.1	128	64.6
	Subsequent transplant	95	8.1	9	7.3	16	1.9	70	35.4
Total		1,170	100.0	123	100.0	849	100.0	198	100.0

PA 3.9 Insurance coverage among adult pancreas transplant recipients at time of transplant

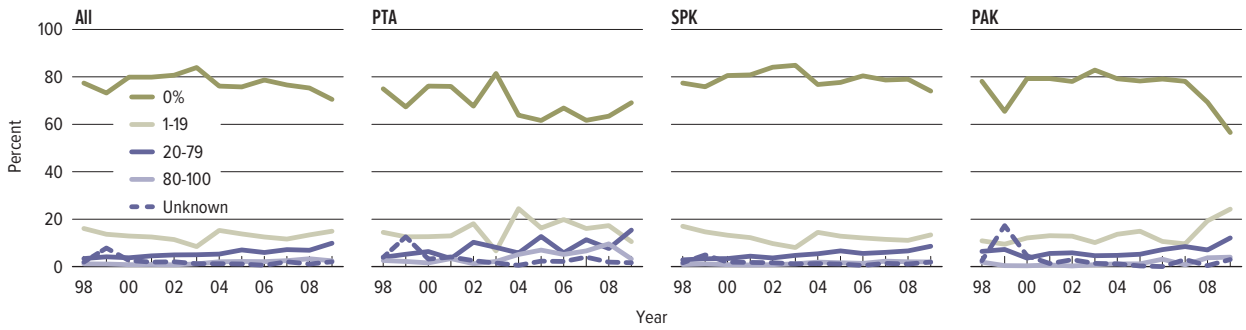


The number of living donor pancreas transplants has decreased in the last decade, with 2 transplants nationwide in the past 4 years, and none in 2009 (Figure 3.6). Transplant rates for all types of pancreas transplants show wide geographic variation (Figure 3.7).

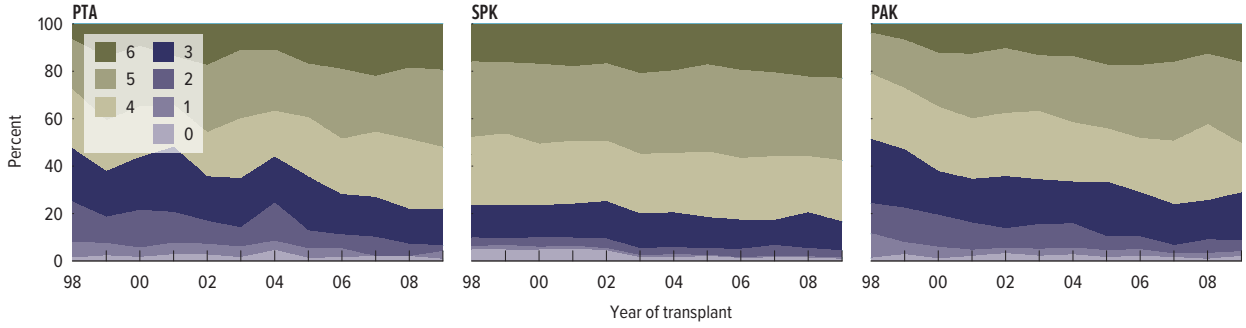
The characteristics of patients undergoing transplant in 2009 are summarized in Figure 3.8. The greatest proportion of transplants was performed in patients aged 35 to 49 years for SPK, PAK, and PTA. Women predominated in the PTA group compared with other groups. With regard to primary cause of disease, it is interesting that 23% of PTA recipients were classified as other cause/unknown; some of these cases can be accounted for by surgical diabetes after pancreatectomy for chronic pancreatitis or premalignant tumors, although the question arises as to whether PTA is being performed for other causes, such as disabling exocrine failure with or without diabetes. In 2009, private insurance paid for 65.9% of PTA transplants, 42.6% of SPK, and 46.5% of PAK. Medicare was the primary payer for 23.6%, 52.1%, and 50.0% of PTA, SPK, and PAK transplants, respectively.

The percentage of recipients covered by Medicare increased steadily over the past decade, from 35.8% in 1998 to 48.7% in 2009. Private insurance coverage declined from 57.1% to 45.7% during this period (Figure 3.9).

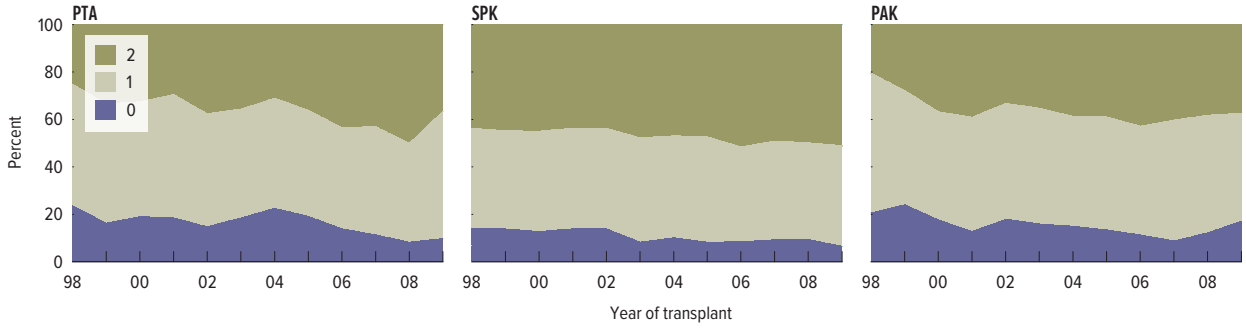
PA 4.1 PRA at time of pancreas transplant in adult recipients



PA 4.2 Total HLA mismatches among adult pancreas transplant recipients



PA 4.3 HLA-A mismatches among adult pancreas transplant recipients

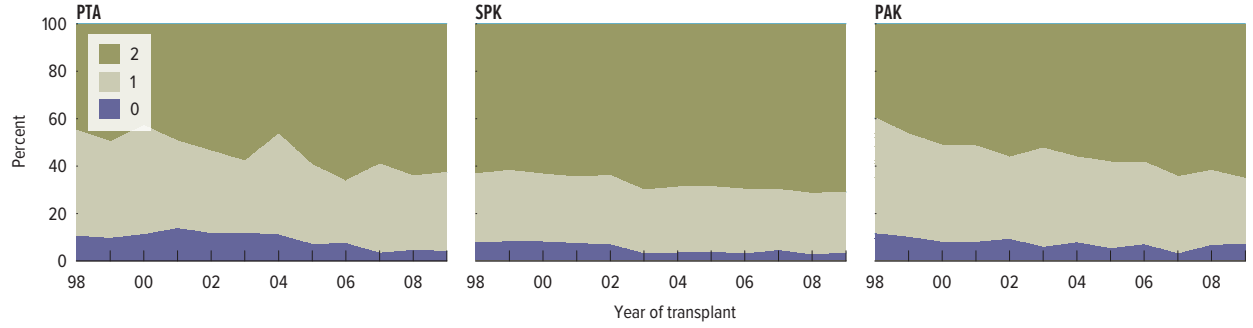


donor-recipient matching

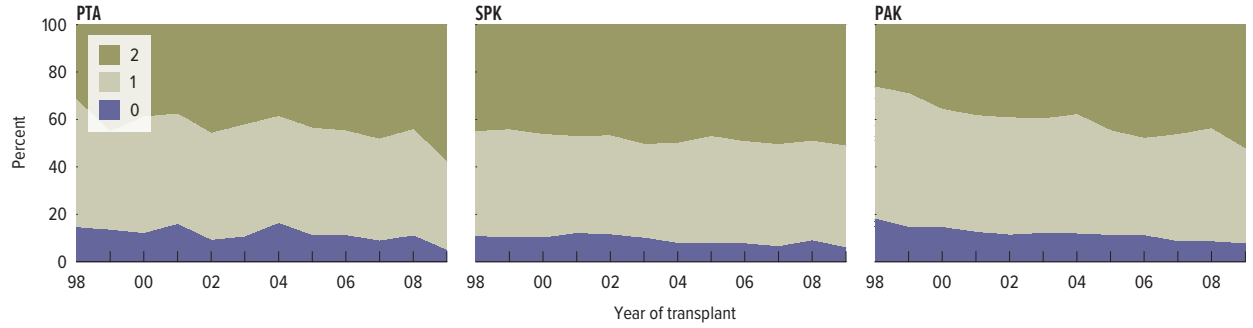
The percentage of unsensitized (PRA 0%) pancreas recipients has decreased over the past few years as the number of re-transplants has likely increased the rate of sensitization. Between 1998 and 2009, the percentage of unsensitized pancreas recipients declined from 77.4% to 70.6%. The decline was from 75.0% to 69.1% in PTA, from 77.5% to 74.1% in SPK, and from 78.2% to 56.6% in PAK. As expected, the proportion of sensitized (PRA > 0%) recipients is highest in the PAK group, likely due to the previous kidney transplant, although 60.0% of these sensitized patients had only a low level of sensitization, i.e., PRA 1% to 19% (Figure 4.1).

Human leukocyte antigen (HLA) matching trends for pancreas transplants show that the percentage of highly mismatched transplants (5 and 6 HLA mismatches) has increased over the past decade. Between 1998 and 2009, the percentage with 5 or 6 HLA mismatches increased from 27.7% to 51.2% for PTA, from 47.6% to 57.6% for SPK, and from 21.2% to 50.5% for PAK (Figure 4.2). In 2009, 55.7% of all pancreas transplants had 5 or 6 antigen mismatches (up from 42.9% in 1998); the increase in the total number of HLA mismatches for all pancreas transplants correlates with the drop in solitary pancreas transplants (PTA and PAK) as a percentage of overall pancreas transplants (Figure 3.1), where HLA matching is considered more important.

PA 4.4 HLA-B mismatches among adult pancreas transplant recipients



PA 4.5 HLA-DR mismatches among adult pancreas transplant recipients



Similarly, the number of 0 HLA mismatched pancreas transplants has been steadily decreasing, down from 4.1% in 1998 to 1.1% in 2009, indicative of gradual changes in policy and practices regarding mandatory sharing for 0 HLA mismatches. This decline can be almost entirely accounted for by the decline in 0 HLA mismatched SPK, from 4.8% in 1998 to 0.9% in 2009, while over this same time period there was a small increase from 1.3% to 2.0% for PAK and only a small decline from 1.3% to 0.8% for PTA. The HLA-B loci are the most mismatched, with 69.0% of pancreas transplants showing 2 (complete) HLA-B mismatches, 61.8% of PTAs , 71.0% of SPKs, and 65.2% of PAKs (Figures 4.3, 4.4, and 4.5).

PA4.6 Adult pancreas donor-recipient cytomegalovirus (CMV) serology matching, 2005–2009

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	18.7	28.0	0.3	46.9
Positive	17.9	29.1	0.2	47.2
Unknown	2.2	3.7	0.0	5.8
Total	38.8	60.8	0.5	100

PA4.7 Adult pancreas donor-recipient Epstein-Barr virus (EBV) serology matching, 2005–2009

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	0.7	9.9	2.6	13.3
Positive	4.1	39.8	20.0	63.9
Unknown	1.0	11.5	10.3	22.8
Total	5.8	61.2	33.0	100

PA4.8 Adult pancreas donor-recipient hepatitis B core antibody (HBcAb) serology matching, 2005–2009

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	71.6	0.8	0.3	72.7
Positive	3.1	0.1	0.0	3.2
Unknown	23.8	0.2	0.0	24.0
Total	98.6	1.1	0.3	100

PA4.9 Adult pancreas donor-recipient hepatitis B surface antigen (HBsAg) serology matching, 2005–2009

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	85.0	0.0	0.2	85.1
Positive	1.2	0.0	0.0	1.2
Unknown	13.7	0.0	0.0	13.7
Total	99.8	0.0	0.2	100

PA4.10 Adult pancreas donor-recipient hepatitis C serology matching, 2005–2009

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	85.0	0.0	0.2	85.2
Positive	3.2	0.0	0.0	3.2
Unknown	11.5	0.0	0.0	11.6
Total	99.7	0.1	0.2	100

PA4.11 Adult pancreas donor-recipient human immunodeficiency virus (HIV) serology matching, 2005–2009

	DONOR			
RECIPIENT	Negative	Positive	Unknown	Total
Negative	77.0	0.0	0.1	77.1
Positive	0.0	0.0	0.0	0.0
Unknown	22.9	0.0	0.0	22.9
Total	99.9	0.0	0.1	100

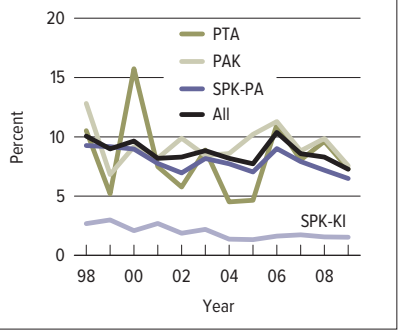
donor-recipient matching

Donor-recipient virology data were analyzed for 2005–2009. Cytomegalovirus (CMV) analysis shows that the high-risk group (donor positive and recipient negative, or D+/R-) was 28% of the total, higher than in the kidney transplant cohorts (see Figure 5.6, Kidney chapter). The difference is attributable mostly to the R+ percentage in pancreas transplant, which is much lower than in deceased donor kidney transplants (66% vs. 47%). The D+/R+ group was the largest by a slim margin in pancreas transplants (29%) (Figure 4.6).

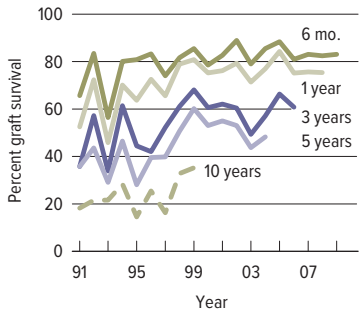
Overall, donor-recipient serologic status for Epstein-Barr virus (EBV) in pancreas transplants was similar to that seen in deceased donor kidney transplants (see Figure 5.7, Kidney chapter), with the high-risk group (D+/R-) accounting for 9.9%, slightly higher than in deceased donor kidney transplants (7.7%) (Figure 4.7).

Hepatitis B virus, hepatitis C virus, and human immunodeficiency virus (HIV) rates of positive serology were extremely low in donors and recipients. Only 1.1% of pancreas recipients received a hepatitis B core antibody positive donor pancreas (Figure 4.8), and no donors were positive for hepatitis B surface antigen (Figure 4.9). However, 3.2% of recipients were positive for hepatitis core antibody (Figure 4.8), and 1.2% were hepatitis B surface antigen positive (Figure 4.9). For antibody to hepatitis C, only 3.2% of recipients were positive (Figure 4.10). There were no reported HIV-positive donors or recipients during this period (Figure 4.11).

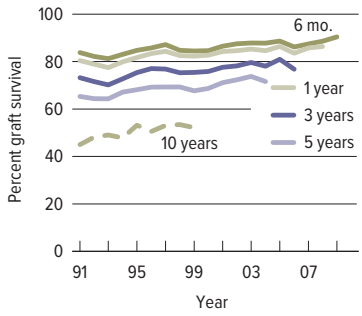
PA 5.1 Early (reported w/i 6 wks of tx) graft failure among adult pancreas transplant recipients



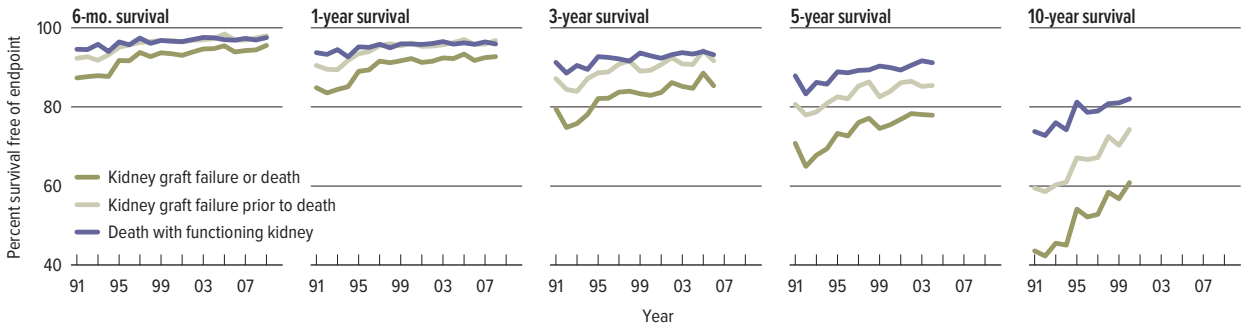
PA 5.2 Graft failure among adult PTA transplant recipients



PA 5.3 Graft failure among adult SPK transplant recipients: pancreas outcomes



PA 5.4 Outcomes among adult SPK transplant recipients: kidney outcomes



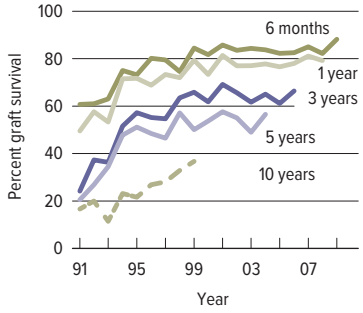
outcomes

The number of early (within the first 6 weeks after transplant) pancreas graft failures has gradually decreased since 2006 for SPK, PAK, and PTA (Figure 5.1). In 2009, early pancreas graft failures were reported in 6.5%, 7.6%, and 7.3%, respectively. Most noticeable are the large improvements in preventing early graft loss and thrombosis in the pre-uremic pancreas transplant recipients, compared with results in 2006–2008 (Figure 5.1). Hopefully, improvements in early outcomes for pre-uremic pancreas recipients with higher rates of graft thrombosis will translate to improved long-term results.

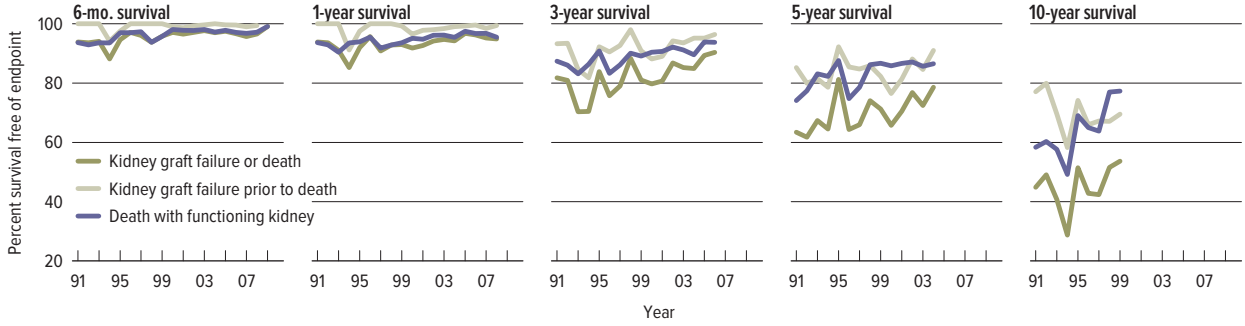
One-year PTA graft survival was 75.4% for transplants in 2008 (Figure 5.2). For PTA recipients in 2004, 5-year graft survival was 48.3%. Although graft loss was not specifically defined, centers presumably reported loss of function as return to insulin therapy. With early graft success for PTA now approximating that of the pancreas in SPK, hopefully further refinement in immunosuppressive strategies will make the long-term results for PTA comparable to the more successful long-term results for SPK transplant.

In 2009, 1-year graft survival of the pancreas in SPK recipients reached a high of 86.4% (Figure 5.3). Five-year graft survival of the pancreas in SPK transplants performed in 2004 was 72%; again, longer-term improvements may be expected in this group of patients, who have enjoyed a marked benefit from simultaneous transplant of the pancreas and kidney. One-year graft survival of the kidney (not censored for death) in SPK recipients remains excellent, at 93% (Figure 5.4).

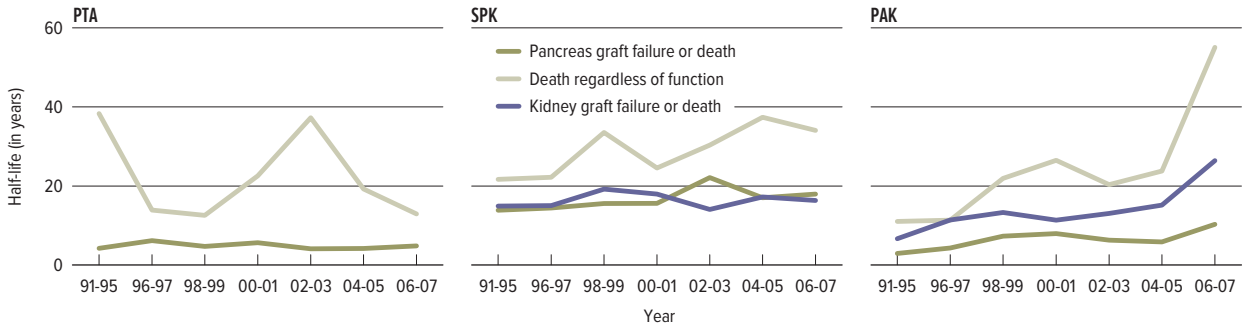
PA 5.5 Pancreas graft failure among adult PAK transplant recipients



PA 5.6 Outcomes among adult PAK transplant recipients: kidney outcomes (from time of pancreas transplant)



PA 5.7 Half-lives for adult pancreas transplant recipients surviving with a functioning pancreas for at least one year



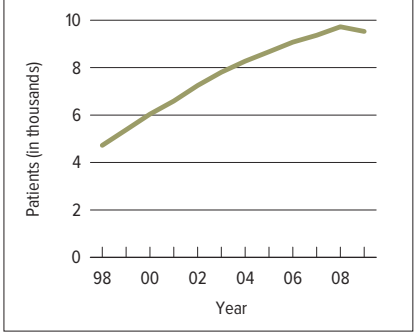
outcomes

Six-month pancreas survival in PAK transplants also was at a high, improved from 82.2% for transplants performed in 2008 to 88.2% for those performed in 2009 (Figure 5.5). Of equal significance, almost no loss of kidney grafts from the time of the PAK occurred, with 6-month graft survival of the kidney for PAK performed in 2008 at 99.1% (Figure 5.6). Graft half-lives (estimated median survival time of the graft for patients alive with function at 1 year post-transplant) were generally stable for PTA and SPK (Figure 5.7). Kidney graft half-life and patient survival half-life appear to have improved for PAK recipients. Estimated half-lives for the pancreas allograft (not censored for death) for 2006–2007 transplants (conditional on 1-year post-transplant survival) are 17.9, 10.3, and 4.8 years for SPK, PAK, and PTA transplants, respectively (Figure 5.7).

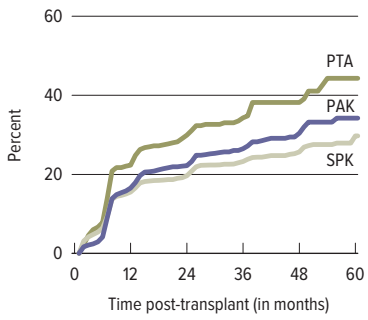
The 2-fold growth in the number of patients alive with a functioning transplanted pancreas, from 4,726 in 1998 to 9,725 in 2008, is remarkable (Figure 5.8). However, recent declines in new pancreas transplants have led to a slight decline in the number of pancreas transplant recipients who are alive with a functioning pancreas, to 9,535 in 2009.

Figure 5.9 shows the cumulative incidence of acute pancreas rejection after PTA and PAK, and acute pancreas and/or kidney rejection after SPK. The rejection rates for pancreata have decreased over the past decade, but remain higher than rates for kidneys. Pancreas

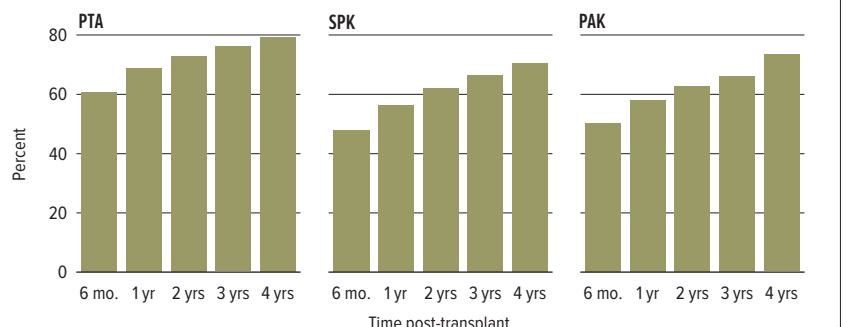
PA 5.8 Adult recipients alive & with a functioning pancreas transplant on June 30 of the year



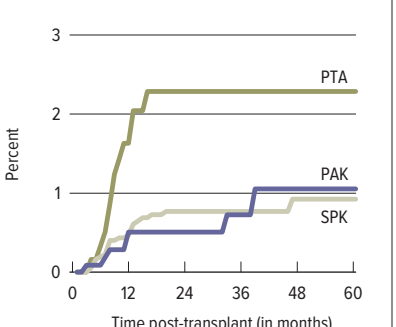
PA 5.9 Incidence of first acute rejection among adult pts receiving a pancreas tx in 05–09



PA 5.10 Reported hospitalizations among adult patients receiving a pancreas transplant in 2005–2009



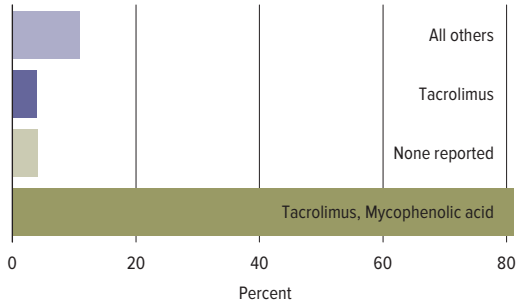
PA 5.11 Incidence of PTLD among adult pts receiving a pancreas transplant in 2005–2009



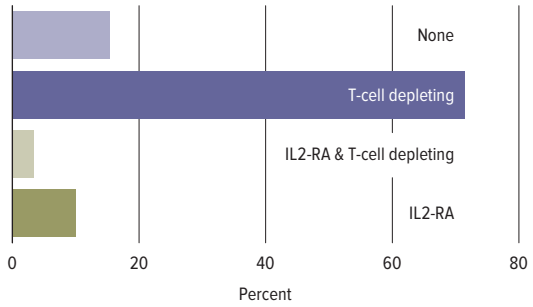
transplants performed in pre-uremic diabetic patients have higher rejection rates in PTA (44.3% at 5 years) than in PAK or SPK (34.3% and 29.7%, respectively) (Figure 5.9). This may be secondary to a more robust immune system in the non-uremic recipient.

The complexity of and high degree of morbidity after pancreas transplant are reflected in the high frequency of hospitalizations. More than 70% of patients are hospitalized within 4 years (Figure 5.10). The cumulative incidence of post-transplant lymphoproliferative disorder (PTLD) at 4 years was 2.3% after PTA, 0.9% after SPK, and 1.1% after PAK (Figure 5.11). The higher frequency of PTLD in PTA patients is likely related to their increased immunosuppressive requirements and higher rates of acute rejection.

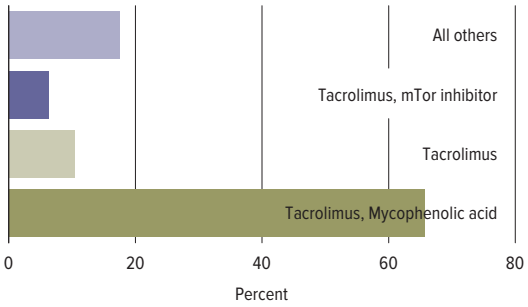
PA6.1 Initial immunosuppression regimen in adult pancreas transplant recipients, 2009 (steroids not considered)



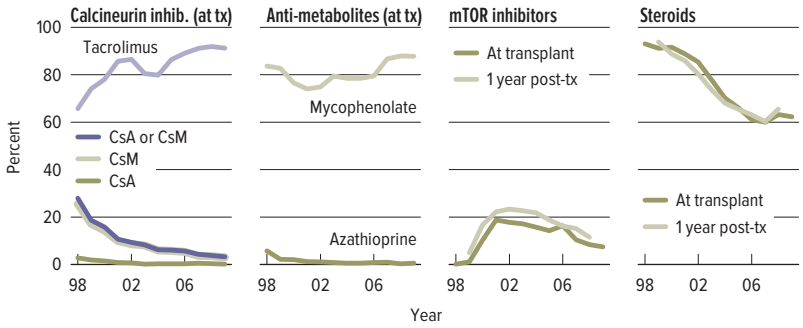
PA6.2 Induction agents used at time of pancreas transplant, adult recipients 2009



PA6.3 Immunosuppression regimen at one year in adult pancreas transplant recipients, 2008 (steroids not considered)



PA6.4 Immunosuppression use in adult pancreas transplant recipients

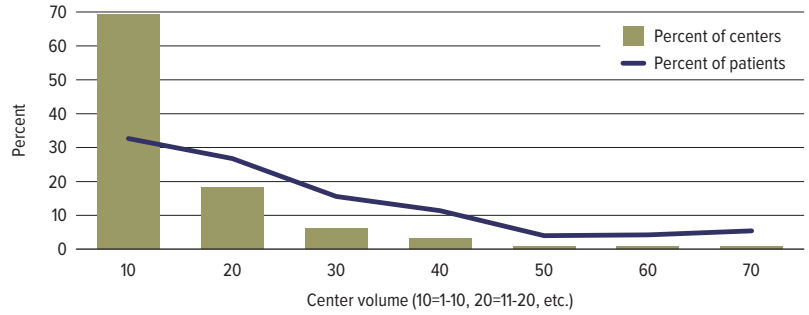


immunosuppression

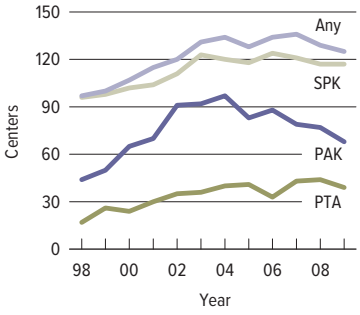
The effect of the higher rejection rates observed with pancreas transplant is reflected in the more aggressive immunosuppressive regimens used with most pancreas transplant recipients. Induction therapy using the potent lymphocyte depleting regimens was used in 71.4% of the recipients, and anti-interleukin-2 (IL2-RA) receptor antibodies were used as the sole induction agent in only 10% (Figure 6.2). Maintenance immunosuppression included both tacrolimus and mycophenolate in more than 80% of cases (Figure 6.1). Furthermore, most of these recipients were on the calcineurin inhibitor and anti-metabolite at 1 year (65.7%) (Figure 6.3).

Despite the increased use of potent induction and maintenance therapy with tacrolimus and mycophenolate over the past decade, it is interesting that there has been a trend toward steroid avoidance (Figure 6.4). Currently, approximately 40% of the recipients have been maintained on a steroid-free regimen. It is important to note that in this group of steroid-free recipients, the avoidance of steroids appeared to be from the time of transplant, as the percentage of steroid-free recipients was the same at the time of transplant and 1 year after transplant. The use of mammalian target of rapamycin (mTOR) inhibitors continues to decrease, and was reported in 7.5% of the pancreas transplant recipients in 2009.

PA 7.1 Distribution by center volume of the number of pancreas transplants performed (includes kidney-pancreas), 2009



PA 7.2 Centers performing pancreas transplants

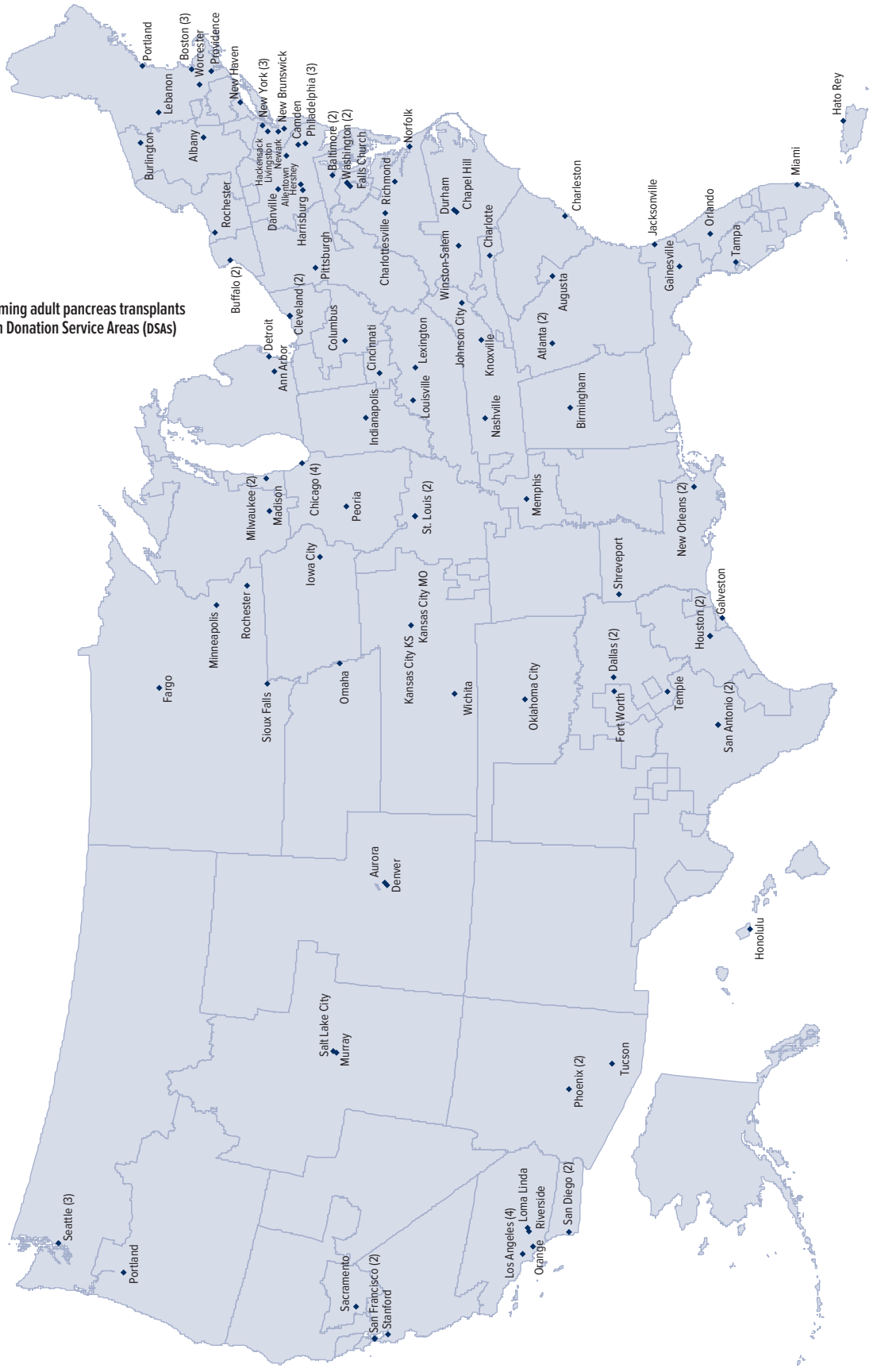


center characteristics

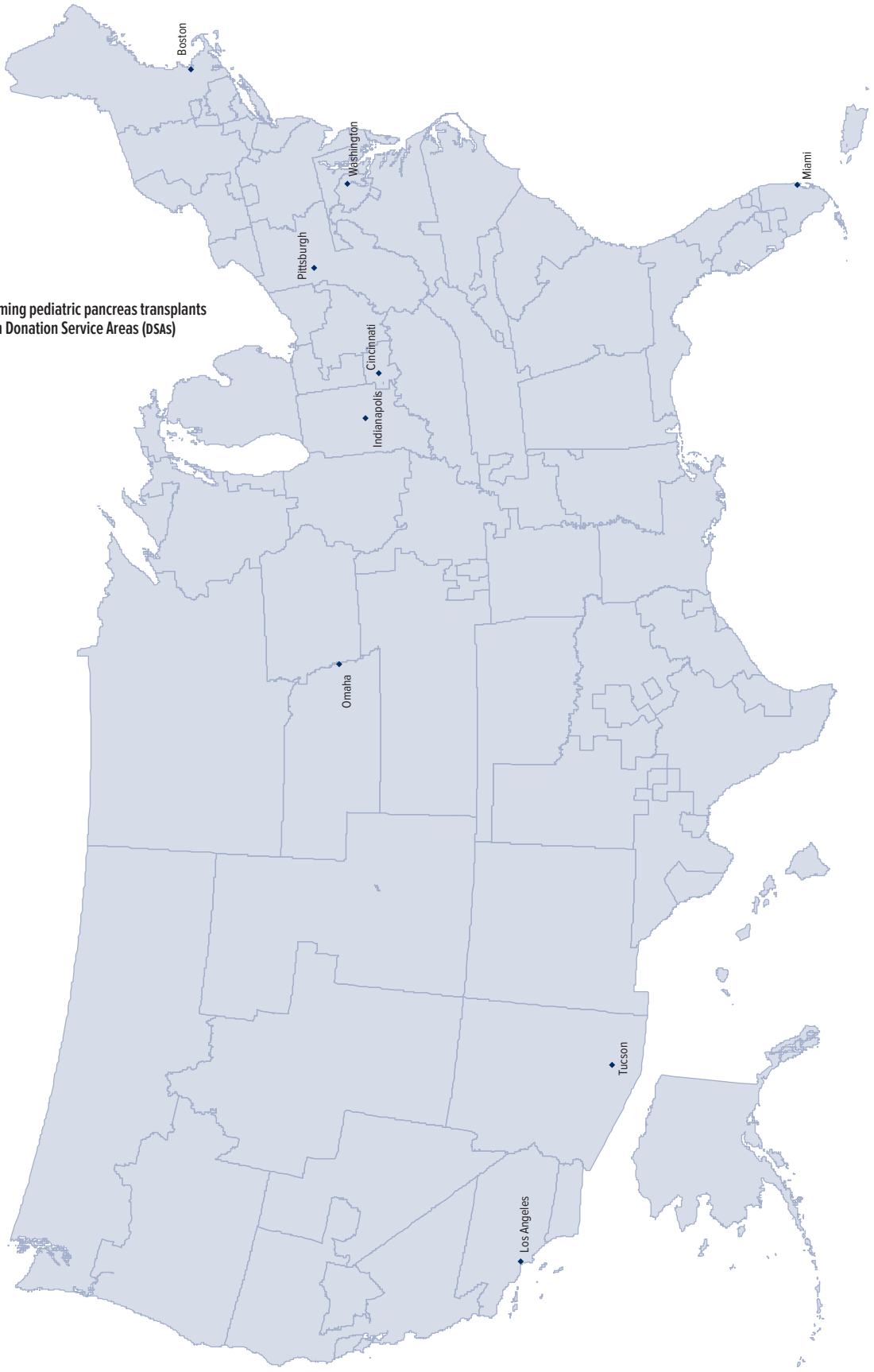
Very few pancreas transplants are performed in recipients aged younger than 18 years. In 2009, only 63 pancreas transplants (58 PTA, 5 SPK) were performed in children and adolescents, and most of these were performed as part of a multi-organ transplant procedure. Few pancreas transplants in children and adolescents are performed for diabetes. Given the very small numbers of these transplants, these data are not shown.

Seventy percent of pancreas transplant centers performed 10 or fewer pancreas transplants in 2009 (Figure 7.1). Only 5.6% of centers performed more than 30 during that time. Of 125 centers that performed pancreas transplants in 2009, 117 performed SPK, 68 PAK, and only 39 performed PTA (Figure 7.2).

PA 8.1 **Centers performing adult pancreas transplants in 2009, within Donation Service Areas (DSAs)**



PA 8.2 **Centers performing pediatric pancreas transplants in 2009, within Donation Service Areas (DSAs)**



PA 8.3 **Centers performing adult pancreas transplants in 2009, within OPTN regions**