

Chapter 1: Waiting List

Authors: Angela Webster, Paul Robertson, Tia Mark, James Hedley, Patrick Kelly

Overview of waiting list activity

Definitions

Patients join the waiting list on the date they are referred to the transplanting centre; however, this may occur some time before their kidneys fail. Patients are therefore classified as “under consideration” until they medically require a kidney pancreas transplant. Once they require a kidney pancreas transplant they are classified as “active” on the list while they remain medically fit. The “under consideration” classification also captures people recently referred to the transplant centre, who are still undergoing assessment about their medical fitness for pancreas transplant. People referred to a transplanting centre when they are already on dialysis, become “active” on the list as soon as they are accepted as medically fit. People referred to a transplanting centre when their kidneys still function, become active once their kidney disease progresses to such a level that dialysis is planned in the near future. Once active on the waiting list, patients are transplanted in order of their waiting time, by blood group.

Patient waiting list flow

The patient waiting list activity in the last three years for Australia (Westmead and Monash Units) and New Zealand are shown in Tables 1.1 and 1.2 respectively. In Australia, although the number of transplants has increased over the last three years, the number of patients on the active waiting list has continued to increase.

Table 1.1: Waiting list activity in Australia for the last three years

Activity	Patients (n)		
	2017	2018	2019
On active list at beginning of year	51	75	47
Added to active list during the year	83	36	51
Removed from active list during year	6	6	1
Pancreas transplants to patients on waiting list ¹	48	50	40
Kidney only transplants to patients on waiting list	3	5	2
Transplants performed outside Australia/New Zealand	0	0	0
Died while active on list	2	3	6
On active waiting list at the end of year	75	47	49
Died within 12 months of removal from list	0	0	0
Under consideration but not active on list	186	203	176
Referred but declined for pancreas transplantation	57	60	63

¹ Includes one combined kidney islet transplant performed in 2017

Table 1.2: Waiting list activity in New Zealand for the last three years

Activity	Patients (n)		
	2017	2018	2019
On active list at beginning of year	3	5	2
Added to active list during the year	6	5	5
Removed from active list during year	0	2	0
Transplants to patients on waiting list	4	6	4
Kidney only transplants to patients on waiting list	0	0	0
Transplants performed outside Australia/New Zealand	0	0	0
Died while active on list	0	0	0
On active waiting list at the end of year	5	2	3
Died within 12 months of removal from list	0	0	0
Under consideration but not active on list	3	10	5
Referred but declined for pancreas transplantation	0	1	1

Distribution of active patients by state

Figure 1.1 and Table 1.3 show the state and country of residence for people active on the pancreas waiting list, by year and the pancreas transplanting centre they were referred to (Australia only).

Figure 1.1: Distribution of people active on the waiting list by state or country of residence, as of December 2019

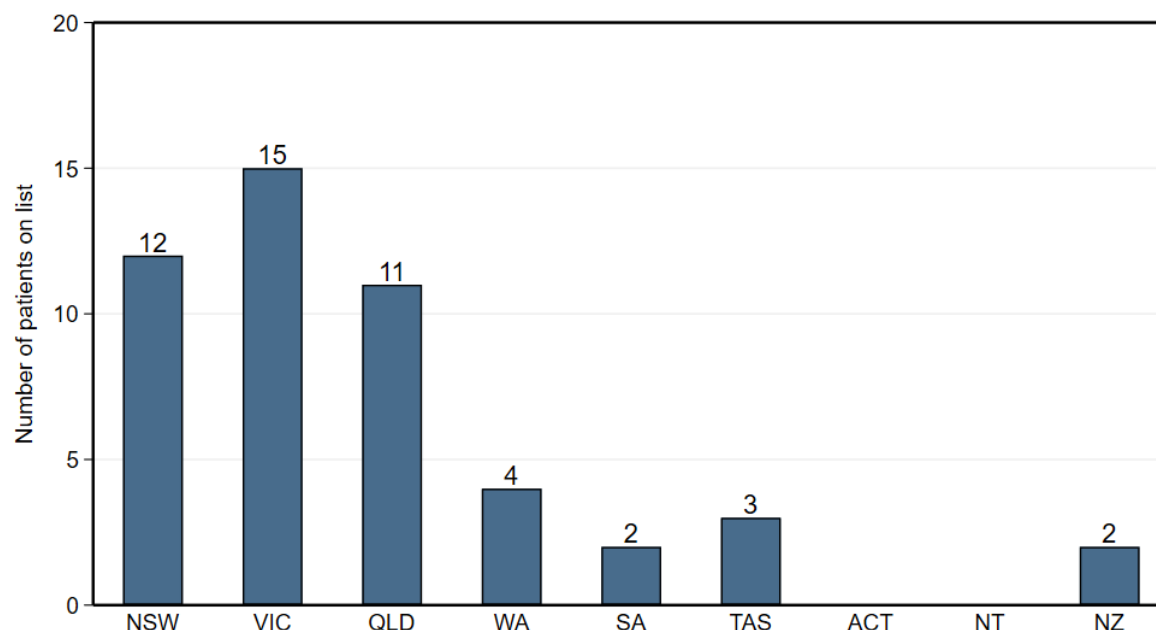


Table 1.3: Patient state of residence by Australian pancreas transplant unit for people active on the list, December 2019

People active on the 1st, December, 2019									
	State of residence, n (row %)								
Year	NSW	VIC	QLD	WA	SA	TAS	ACT	NT	Total
Westmead (NSW)									
2019	6 (27)	1 (5)	9 (41)	6 (27)	0 (0)	0 (0)	0 (0)	0 (0)	22
2018	12 (44)	0 (0)	11 (41)	4 (15)	0 (0)	0 (0)	0 (0)	0 (0)	27
2017	24 (51)	0 (0)	15 (32)	7 (15)	1 (2)	0 (0)	0 (0)	0 (0)	47
Monash (VIC)									
2019	1 (4)	18 (75)	0 (0)	0 (0)	1 (4)	4 (17)	0 (0)	0 (0)	24
2018	0 (0)	15 (75)	0 (0)	0 (0)	2 (10)	3 (15)	0 (0)	0 (0)	20
2017	0 (0)	20 (74)	0 (0)	0 (0)	4 (15)	3 (11)	0 (0)	0 (0)	27
Royal Adelaide (SA)									
2019	0 (0)	0 (0)	0 (0)	0 (0)	3 (100)	0 (0)	0 (0)	0 (0)	3
2018	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
2017	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)	1

Table 1.4 shows the state of residence for people who are under consideration together with people who are active on the pancreas waiting list, by the pancreas transplanting

centre they were referred to, in Australia. For New Zealand data, there is no breakdown beyond that seen in Table 1.2.

Table 1.4: Patient state of residence by Australian pancreas transplant unit for people under consideration and active on the list, December 2019

	State of residence, n (row %)								
Year	NSW	VIC	QLD	WA	SA	TAS	ACT	NT	Total
Westmead (NSW)									
2019	37 (32)	1 (<1)	33 (28)	37 (32)	7 (6)	1 (<1)	0 (0)	0 (0)	116
2018	51 (36)	1 (<1)	42 (30)	39 (28)	7 (5)	1 (<1)	0 (0)	0 (0)	141
2017	62 (40)	0 (0)	44 (28)	41 (26)	8 (5)	1 (<1)	0 (0)	0 (0)	156
Monash (VIC)									
2019	2 (2)	81 (77)	1 (<1)	0 (0)	8 (8)	12 (11)	0 (0)	1 (<1)	105
2018	4 (4)	79 (75)	1 (<1)	0 (0)	10 (10)	10 (10)	0 (0)	1 (<1)	105
2017	1 (<1)	79 (78)	1 (<1)	0 (0)	10 (10)	9 (9)	0 (0)	1 (<1)	101
Royal Adelaide (SA)									
2019	0 (0)	0 (0)	0 (0)	0 (0)	4 (100)	0 (0)	0 (0)	0 (0)	4
2018	0 (0)	0 (0)	0 (0)	0 (0)	4 (100)	0 (0)	0 (0)	0 (0)	4
2017	0 (0)	0 (0)	0 (0)	0 (0)	4 (100)	0 (0)	0 (0)	0 (0)	4

New referrals received over time

Table 1.5 shows the number of new referrals received by transplanting units in Australia and New Zealand over time, and by state of residence (for Australian units only).

Table 1.5: New referrals received over time by pancreas transplant unit and state of residence

	State of residence, n (row %)								
Year	NSW	VIC	QLD	WA	SA	TAS	ACT	NT	Total
Westmead (NSW)									
2019	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1
2018	5 (36)	1 (7)	6 (43)	1 (7)	1 (7)	0 (0)	0 (0)	0 (0)	14
2017	24 (59)	0 (0)	15 (37)	1 (2)	1 (2)	0 (0)	0 (0)	0 (0)	41
Monash (VIC) ¹									
2019	0 (0)	27 (90)	0 (0)	0 (0)	0 (0)	3 (10)	0 (0)	0 (0)	30
2018	3 (8)	26 (72)	1 (3)	0 (0)	2 (6)	4 (11)	0 (0)	0 (0)	36
2017	0 (0)	40 (85)	1 (2)	0 (0)	3 (6)	2 (4)	0 (0)	1 (2)	47
Royal Adelaide (SA)									
2019	0 (0)	0 (0)	0 (0)	0 (0)	3 (100)	0 (0)	0 (0)	0 (0)	3
2018	0 (0)	0 (0)	0 (0)	0 (0)	4 (100)	0 (0)	0 (0)	0 (0)	4
2017	0 (0)	0 (0)	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	0 (0)	2
Auckland (NZ)									
2019	-	-	-	-	-	-	-	-	2
2018	-	-	-	-	-	-	-	-	10
2017	-	-	-	-	-	-	-	-	4

¹ Excludes one multi-organ pancreas transplant for a Victorian resident performed at Austin Hospital in 2017

Patient characteristics for those active on the list in 2019

The following figures illustrate the distribution of other characteristics of those active on the waiting list in 2019, including the distribution of blood groups and patient ages.

Figure 1.2: Distribution of people active on the list by their blood group, at December 2019

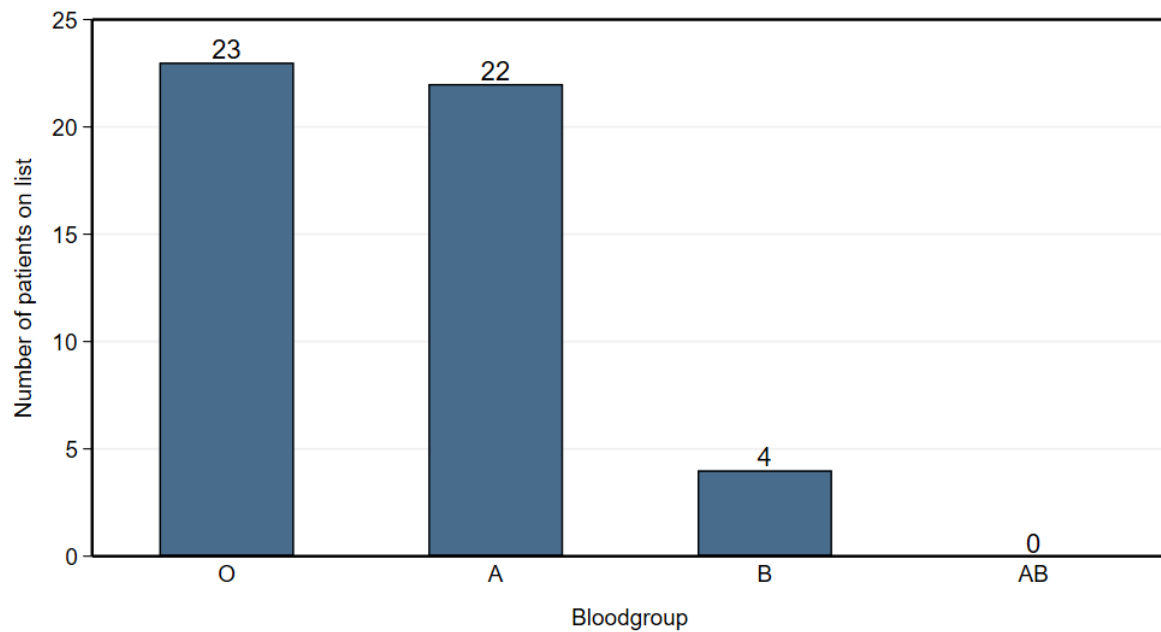
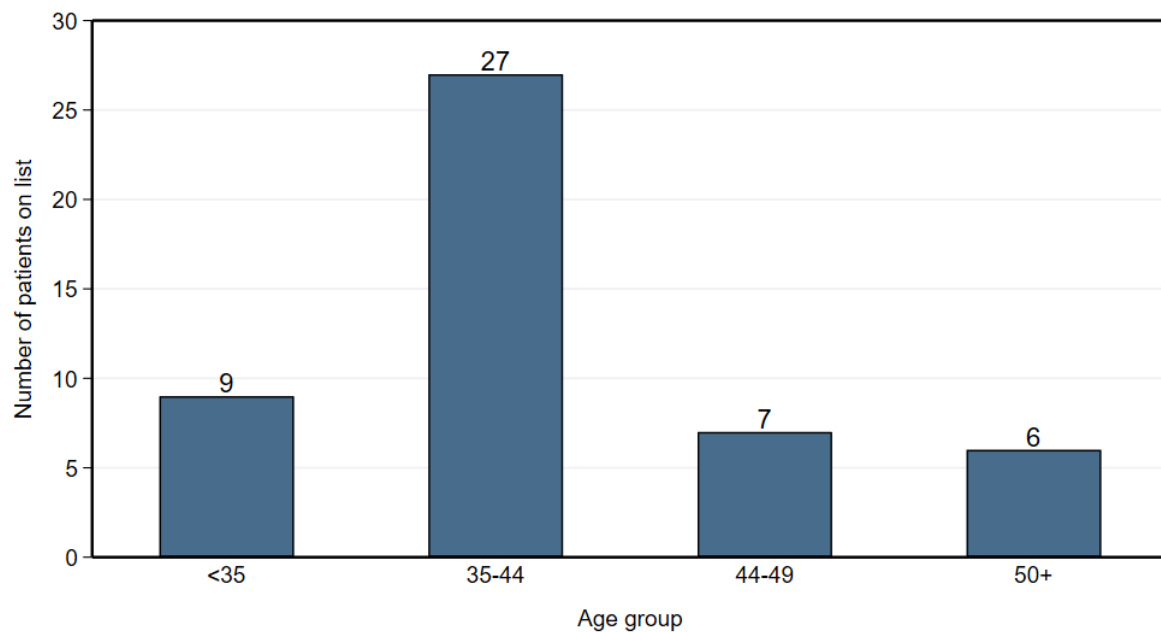


Figure 1.3: Distribution of people active on the list by their age, at December 2019



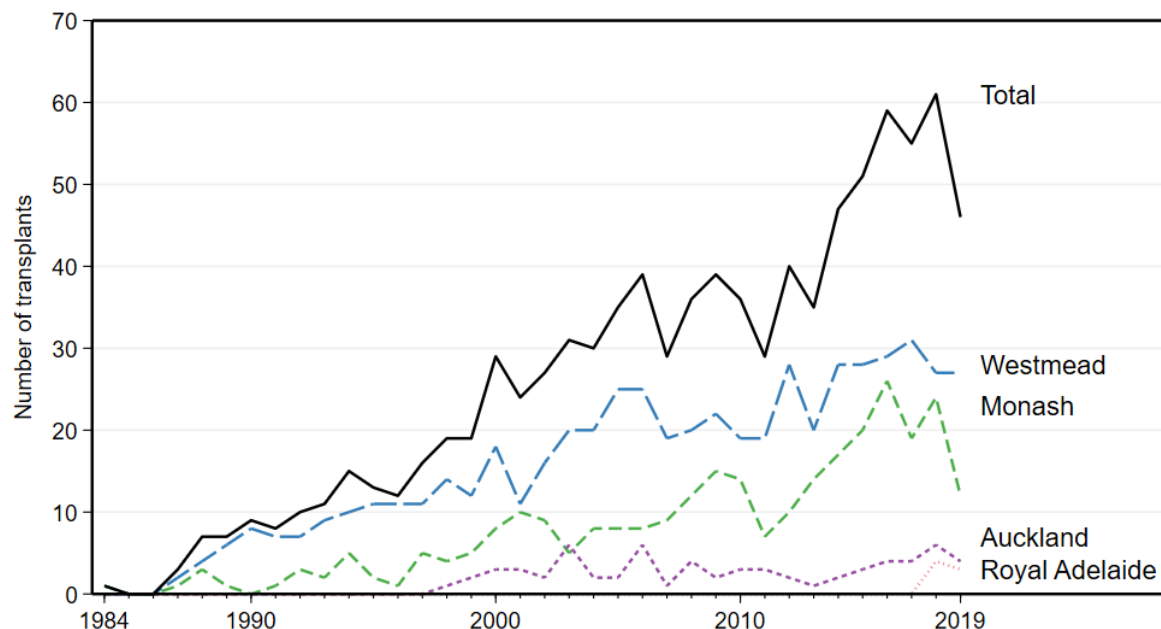
Chapter 2: Pancreas transplant recipients

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Pancreas transplant incidence

A total of 910 solid organ pancreas transplants have been performed in Australia and New Zealand (ANZ) from 1984-2019. Transplants have been performed in Westmead (560), Monash (273), Auckland (66), and Royal Adelaide (7). In 2019 the Royal Adelaide Hospital recommenced pancreas transplantation in South Australia and the Northern Territory using an ATG based steroid free protocol. There have also been multi-organ transplants including pancreas at Royal Prince Alfred (1), Royal Melbourne Hospital (1), Queen Elizabeth Hospital (1), and Austin Hospital (1). Figure 2.1 shows pancreas transplants over time. The number of transplants has substantially increased in last decade compared to previous years.

Figure 2.1: Incidence of pancreas transplants over time, 1984-2019



Note: There have been four pancreas transplants performed in Australia, which were not conducted by either Westmead, Monash, or Royal Adelaide. These occurred in 1988, 1990, 2005, and 2017

In 2019, 44 people received a pancreas transplant, by centre this was; Monash (10), Westmead (27), Royal Adelaide (3), and Auckland (4). The number of transplants in 2019 decreased by 21% compared to 2018.

Not all pancreas transplant operations are undertaken with the same organs. Simultaneous pancreas-kidney transplant (SPK) is the most common operation, representing 99% of all pancreas transplants in Australia and New Zealand. From 44 transplants performed in 2018, 42 were SPK, 2 were Pancreas after kidney (PAK), and none were Pancreas transplant alone (PTA). PAK operations are done for type 1 diabetic people who either had a first kidney transplant without a pancreas (most commonly from a living donor relative) and subsequently opt for a pancreas, or for people who underwent an SPK and have good kidney transplant function, but had a pancreas transplant failure, so need a further pancreas transplant. Pancreas transplant alone (PTA) is a less common operation and occurs very rarely. Its indications include management of patients with hypoglycaemic unawareness or brittle diabetes that have failed best medical therapy. On rarer occasions, a multi-organ transplant is undertaken which includes a pancreas transplant. There was one simultaneous pancreas, liver, and kidney transplant which was performed in 2005, one liver, pancreas, and intestine transplant in 2012, one liver and pancreas transplant in 2016, and one liver, kidney, pancreas, stomach and intestine transplant in 2017. The distribution of operation types is shown in Figure 2.2, and the number of transplants by operation type is shown in Table 2.1.

Figure 2.2: Pancreas transplants over time by type, Australia and New Zealand

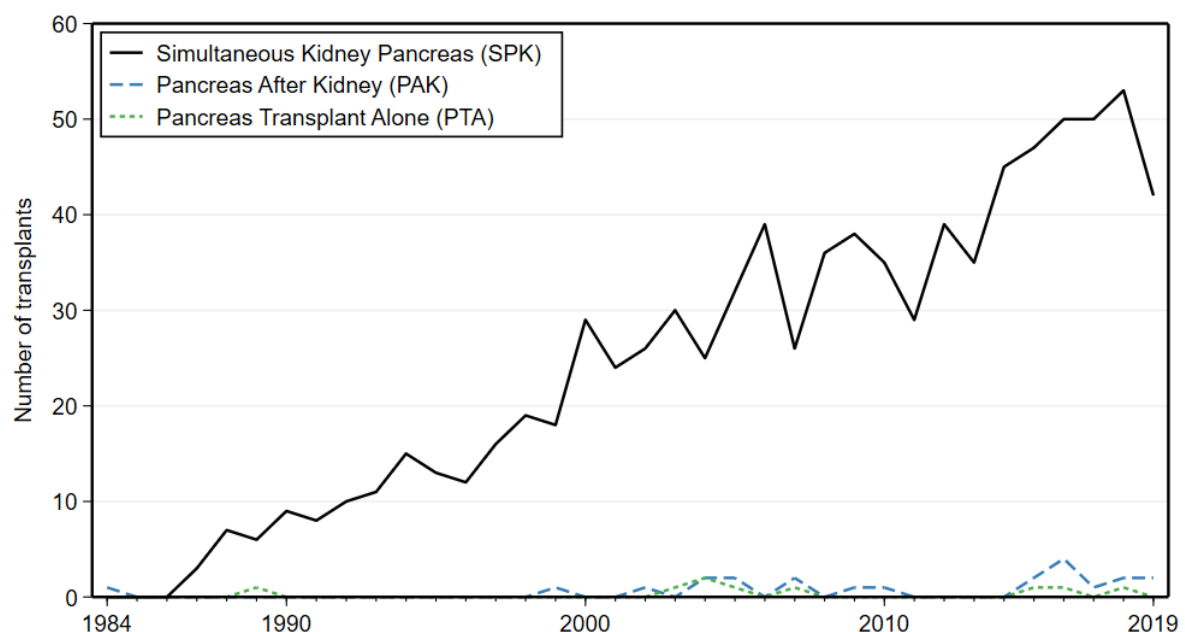


Table 2.1: Pancreas transplant operations over time, by transplant hospital

Year	Hospital and transplant type, n (row %)								
	<i>Westmead</i>			<i>Monash</i>			<i>Royal Adelaide</i>	<i>New Zealand</i>	<i>Total</i>
	<i>SPK</i>	<i>PAK</i>	<i>PTA</i>	<i>SPK</i>	<i>PAK</i>	<i>PTA</i>	<i>All</i>	<i>All</i>	<i>All</i>
2019	26 (59)	1 (2)	0 (0)	10 (23)	0 (0)	0 (0)	3 (7)	4 (9)	44
2018	24 (43)	2 (4)	0 (0)	20 (36)	0 (0)	0 (0)	4 (7)	6 (11)	56
2017	30 (59)	0 (0)	0 (0)	16 (31)	1 (2)	0 (0)	0 (0)	4 (8)	51
2016	26 (47)	3 (5)	0 (0)	20 (36)	1 (2)	1 (2)	0 (0)	4 (7)	55
2015	27 (54)	1 (2)	0 (0)	18 (36)	1 (2)	0 (0)	0 (0)	3 (6)	50
2014	28 (62)	0 (0)	0 (0)	15 (33)	0 (0)	0 (0)	0 (0)	2 (4)	45
2013	20 (57)	0 (0)	0 (0)	14 (40)	0 (0)	0 (0)	0 (0)	1 (3)	35
2012	28 (72)	0 (0)	0 (0)	9 (23)	0 (0)	0 (0)	0 (0)	2 (5)	39
2011	19 (66)	0 (0)	0 (0)	7 (24)	0 (0)	0 (0)	0 (0)	3 (10)	29
2010	19 (53)	0 (0)	0 (0)	14 (39)	0 (0)	0 (0)	0 (0)	3 (8)	36
2009	22 (56)	0 (0)	0 (0)	14 (36)	1 (3)	0 (0)	0 (0)	2 (5)	39
2008	20 (56)	0 (0)	0 (0)	12 (33)	0 (0)	0 (0)	0 (0)	4 (11)	36
2007	16 (55)	2 (7)	1 (3)	9 (31)	0 (0)	0 (0)	0 (0)	1 (3)	29
2006	25 (64)	0 (0)	0 (0)	8 (21)	0 (0)	0 (0)	0 (0)	6 (15)	39
2005	21 (62)	2 (6)	1 (3)	8 (24)	0 (0)	0 (0)	0 (0)	2 (6)	34
2004	15 (52)	2 (7)	2 (7)	8 (28)	0 (0)	0 (0)	0 (0)	2 (7)	29
2003	19 (61)	0 (0)	1 (3)	5 (16)	0 (0)	0 (0)	0 (0)	6 (19)	31
2002	15 (56)	1 (4)	0 (0)	9 (33)	0 (0)	0 (0)	0 (0)	2 (7)	27
2001	11 (46)	0 (0)	0 (0)	10 (42)	0 (0)	0 (0)	0 (0)	3 (13)	24
2000	18 (62)	0 (0)	0 (0)	8 (28)	0 (0)	0 (0)	0 (0)	3 (10)	29
1999	11 (58)	1 (5)	0 (0)	5 (26)	0 (0)	0 (0)	0 (0)	2 (11)	19
1998	14 (74)	0 (0)	0 (0)	4 (21)	0 (0)	0 (0)	0 (0)	1 (5)	19
1997	11 (69)	0 (0)	0 (0)	5 (31)	0 (0)	0 (0)	0 (0)	0 (0)	16
1996	11 (92)	0 (0)	0 (0)	1 (8)	0 (0)	0 (0)	0 (0)	0 (0)	12
1995	11 (85)	0 (0)	0 (0)	2 (15)	0 (0)	0 (0)	0 (0)	0 (0)	13
1994	10 (67)	0 (0)	0 (0)	5 (33)	0 (0)	0 (0)	0 (0)	0 (0)	15
1993	9 (82)	0 (0)	0 (0)	2 (18)	0 (0)	0 (0)	0 (0)	0 (0)	11
1992	7 (70)	0 (0)	0 (0)	3 (30)	0 (0)	0 (0)	0 (0)	0 (0)	10
1991	7 (88)	0 (0)	0 (0)	1 (13)	0 (0)	0 (0)	0 (0)	0 (0)	8
1990	8 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	8
1989	5 (71)	0 (0)	1 (14)	1 (14)	0 (0)	0 (0)	0 (0)	0 (0)	7
1988	4 (67)	0 (0)	0 (0)	2 (33)	0 (0)	0 (0)	0 (0)	0 (0)	6
1987	2 (67)	0 (0)	0 (0)	1 (33)	0 (0)	0 (0)	0 (0)	0 (0)	3
1986	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
1985	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
1984	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)	1
Total	539 (60)	15 (2)	6 (<1)	266 (29)	5 (<1)	1 (<1)	7 (<1)	66 (7)	905

SPK, simultaneous pancreas-kidney; PAK, pancreas after kidney; PTA, pancreas alone

The above table excludes the four transplants performed in Australia outside of Westmead, Monash, or Royal Adelaide in 1988, 1990, 2005, and 2017.

The above table also excludes one combined liver-pancreas transplant performed at Monash in 2016.

Patients transplanted by state

Demographics of new pancreas transplant recipients

The characteristics of pancreas transplant recipients in 2019 and in previous years are shown in Table 2.3. The primary diagnosis causing end stage kidney disease of recipients during 2019 and historically was type I diabetes. The number of diabetic recipients with other cause of end stage kidney failure was small. The number of type II diabetics accepted for pancreas transplantation was also small, and none were transplanted in 2019.

Table 2.3: Demographics and characteristics of pancreas transplant recipients

Patients, n (column %)	2019	1984-2018	Total
Age category			
Median (IQR)	39 (35, 44)	39 (33, 44)	39 (33, 44)
0-34	9 (20)	276 (34)	285 (33)
35-44	25 (56)	391 (48)	416 (48)
45-50	9 (20)	140 (17)	149 (17)
50+	1 (2)	59 (7)	60 (7)
Sex			
Female	23 (52)	403 (49)	426 (49)
Male	21 (47)	463 (57)	484 (56)
Cause of end stage kidney disease			
Diabetes type 1	43 (97)	843 (97)	886 (97)
Diabetes type 2	0 (0)	1 (<1)	1 (<1)
Haemolytic uraemic syndrome	0 (0)	1 (<1)	1 (<1)
Interstitial nephritis	0 (0)	1 (<1)	1 (<1)
Wegener's granulomatosis	0 (0)	1 (<1)	1 (<1)
No kidney disease ¹	1 (2)	17 (1)	18 (1)
Not reported	0 (0)	2 (<1)	2 (<1)
Ethnicity²			
Indigenous Australian	0 (0)	2 (<1)	2 (<1)
Maori	3 (6)	5 (<1)	8 (<1)
Pacific islander	1 (2)	9 (1)	10 (1)
White	37 (84)	820 (94)	857 (94)
North Asian	0 (0)	3 (<1)	3 (<1)
South-East Asian	0 (0)	0 (0)	0 (0)
Southern and Central Asian	0 (0)	17 (1)	17 (1)
North African and Middle Eastern	3 (6)	9 (1)	12 (1)
Not reported	0 (0)	1 (<1)	1 (<1)
Blood group			
O	19 (43)	406 (50)	425 (49)
A	20 (45)	339 (41)	359 (42)
B	4 (9)	80 (9)	84 (9)
AB	1 (2)	41 (5)	42 (4)
Total	44	866	910

¹ Ethnicity classified according to the Australian Bureau of Statistics standard classification, 2nd Edition;

<http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/1249.02011>

² Includes 11 pancreas transplants after kidney (PAK) and 6 pancreas transplants alone (PTA)

The type of pancreas transplants and the types of donors for transplants performed in 2019 is presented in Table 2.4, stratified by country and sex.

Table 2.4: Transplant and donor types in 2019 by country and sex¹

	Australia		New Zealand		Overall		Total
	Female	Male	Female	Male	Female	Male	
Pancreas alone	0	2	0	0	0	2	2
<i>DBD</i>	0	1	0	0	0	1	1
<i>DCD</i>	0	1	0	0	0	1	1
SPK	10	21	1	1	11	22	33
<i>DBD</i>	8	18	1	1	9	19	28
<i>DCD</i>	2	3	0	0	2	3	5

DBD, donor after brain death; DCD, donor after circulatory death; SPK, simultaneous pancreas-kidney

¹ Donor sex not reported for 9 transplants

Balance of donor and recipient characteristics in 2019

Cross tabulations of donor and recipient blood group and gender for people transplanted in 2019 are displayed in Table 2.5 and Table 2.6. These distributions remain similar to previous years.

Table 2.5: Cross tabulation of recipient and donor blood groups for 2019

Recipient blood group	Donor blood group ¹ , n (row %)				Total
	<i>O</i>	<i>A</i>	<i>B</i>	<i>AB</i>	
<i>O</i>	17 (100)	0 (0)	0 (0)	0 (0)	17
<i>A</i>	3 (15)	16 (84)	0 (0)	0 (0)	19
<i>B</i>	0 (0)	0 (0)	4 (100)	0 (0)	4
<i>AB</i>	0 (0)	1 (100)	0 (0)	0 (0)	1
Total	20 (48)	17 (41)	4 (9)	0 (0)	41

¹ Donor blood group not reported for 3 transplants

Table 2.6: Cross tabulation of recipient and donor sex for 2019

Recipient sex	Donor sex ¹ , n (row %)		Total
	Female	Male	
Female	6 (40)	9 (60)	15
Male	5 (25)	15 (75)	20
Total	11 (31)	24 (68)	35

McNemar's test for difference $p=0.4$

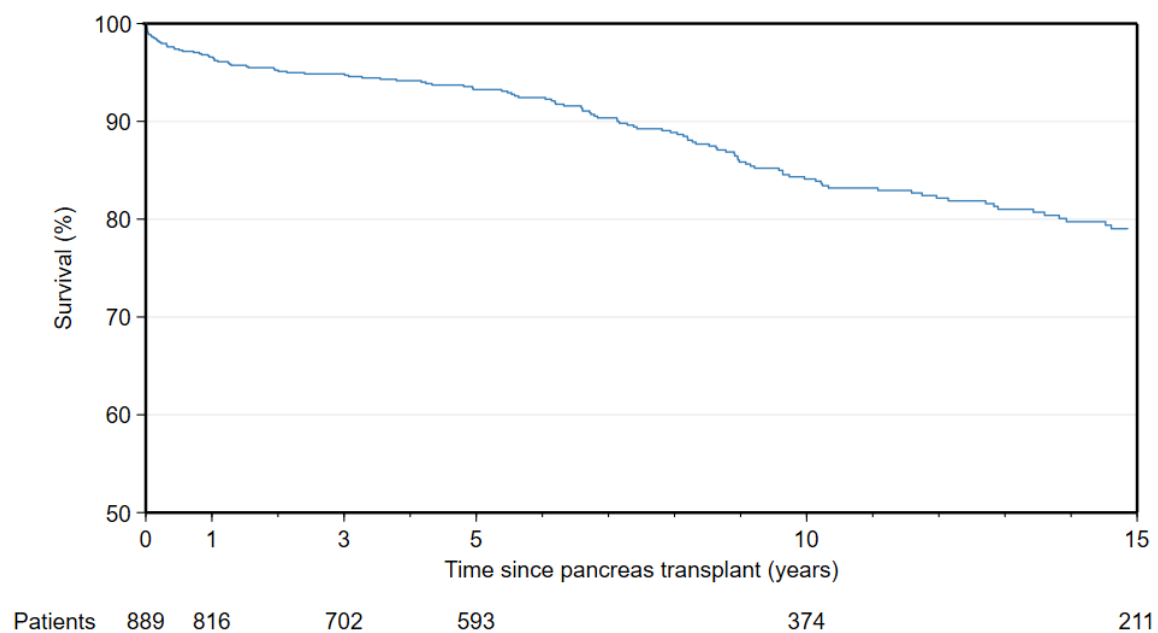
¹ Donor sex not reported for 9 transplants

Patient survival

Patient survival is calculated from the date of transplantation until death. Patients still alive at the end of the follow-up period are censored. For people who had more than one transplant, their survival is calculated from the date of their first transplant. For these analyses we had survival data for 889 patients, 21 of whom have received a second pancreas transplant, for a total of 910 pancreas transplants. Note that for the following survival plots survival proportion on the y-axis does not always start at zero; this is to better demonstrate some observed differences.

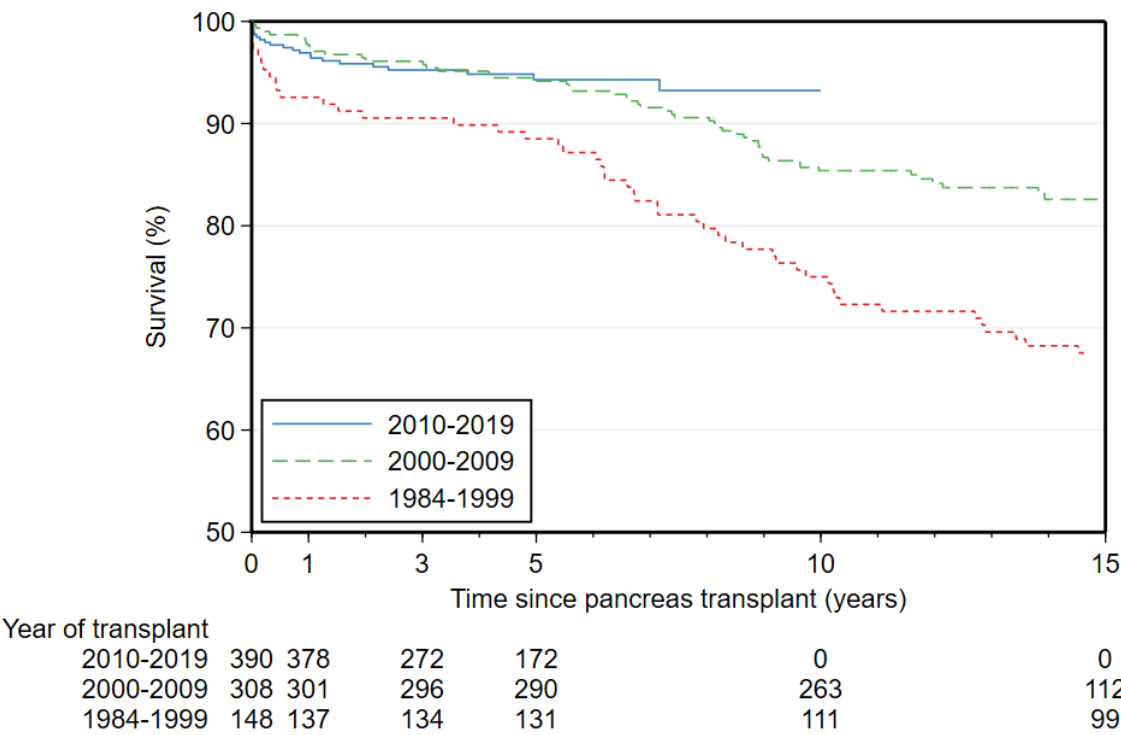
Figure 2.3 shows overall survival following pancreas transplant. There were 8,572 years of follow-up, and 147 people died in that time. Survival at 1 year was 96.6%, at 5 years 93.3%, at 10 years 84.1% and at 15 years 79.0%.

Figure 2.3: Patient survival following pancreas transplantation in Australia and New Zealand.



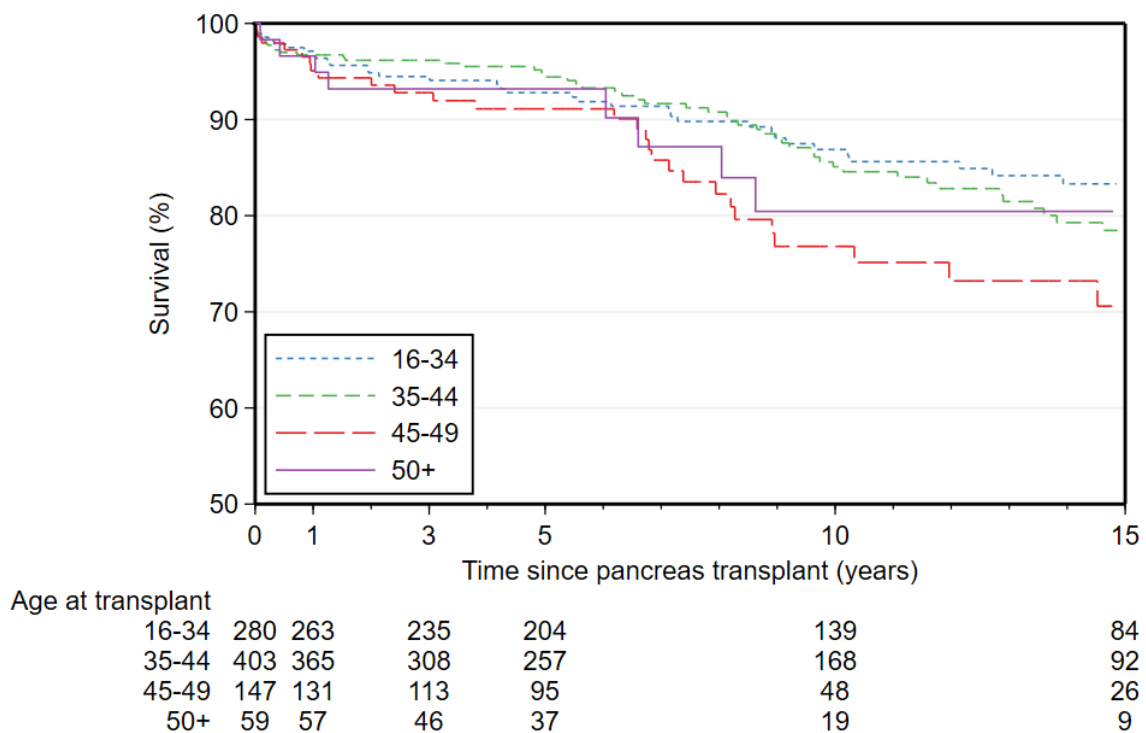
Patient survival by era of transplantation is shown in Figure 2.4. Survival has improved over time ($p<0.001$). Survival at 1 year for people transplanted before 2000 was 92.6%; in recent years this has risen to 96.9%. Survival at 5 years was 88.5% for those transplanted before 2000, where for those transplanted in 2010 or later, 5-year survival was 94.3%.

Figure 2.4: Patient survival by era of transplantation



Patient survival by age at transplantation is shown in Figure 2.5. People that were older at the time of pancreas transplantation had poorer survival than those who were younger ($p=0.03$). Survival at 1 year for recipients aged <35 years was 97.1%, and for those aged 35-44 was 96.7%, whereas for those aged 45-49 was 95.1% and for those 50 or older was 96.6%. Survival at 5 years for those aged <35 years was 92.8%, and for those aged 35-44 was 94.4%, whereas for those aged 45-49 was 91.1% and for those 50 or older was 93.2%. The greater survival for the 50 years and older group may be because these recipients are a more highly selected population.

Figure 2.5: Patient survival by age at transplantation



Pancreas survival

Pancreas transplant survival was calculated from the time of transplant until the time of permanent return to insulin therapy or pancreatectomy. We calculated both pancreas failure including death with a functioning pancreas and pancreas failure censored at death with a functioning transplant. For pancreas transplant survival we included all pancreas transplants undertaken, including those who had received a pancreas transplant twice (21 patients). At the time of this report, we had survival records for 910 pancreas transplants.

Figure 2.6 shows pancreas transplant survival censored at death. Over 7,377 years of follow-up, there were 145 pancreas transplant failures (excluding people who died with a functioning transplant). Overall, 1-year pancreas transplant survival was 90.7%, 5-year survival 86.3%, and 10-year survival 83.0%.

Figure 2.6: Pancreas transplant survival (censored at death)

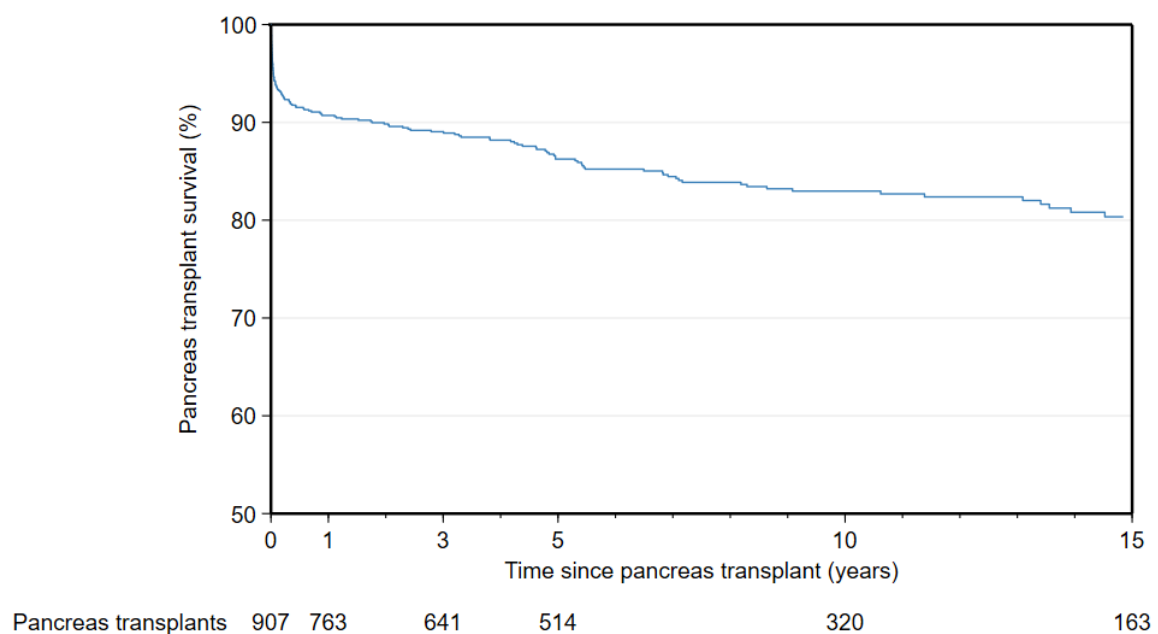
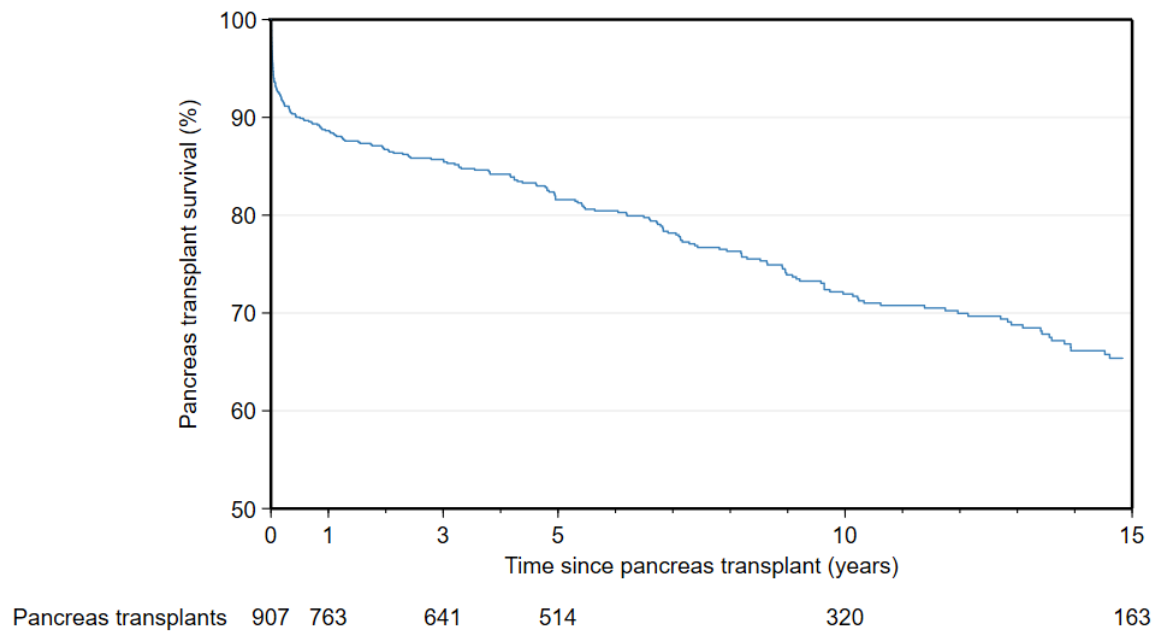


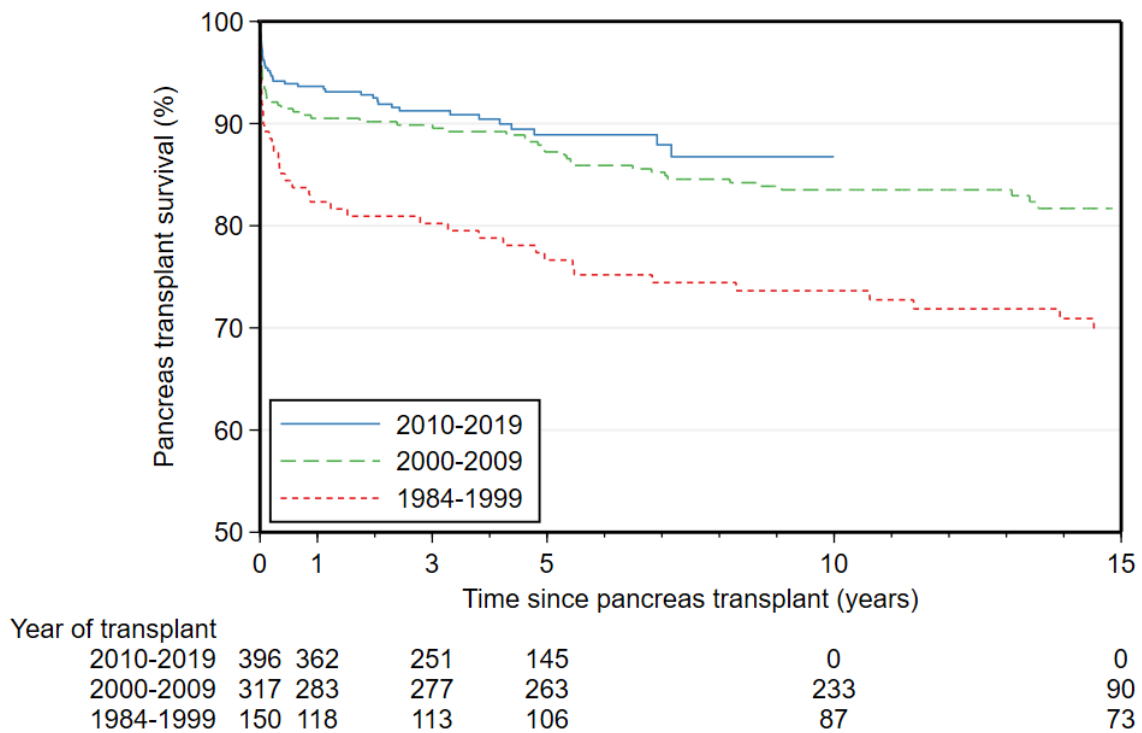
Figure 2.7 shows pancreas transplant survival including death with a functioning pancreas. Over the same observation time there were 255 recipients who either died or experienced pancreas transplant failure. Survival at 1, 5 and 10 years was 88.6%, 81.6% and 71.9% respectively.

Figure 2.7: Pancreas transplant survival (including death as transplant failure)



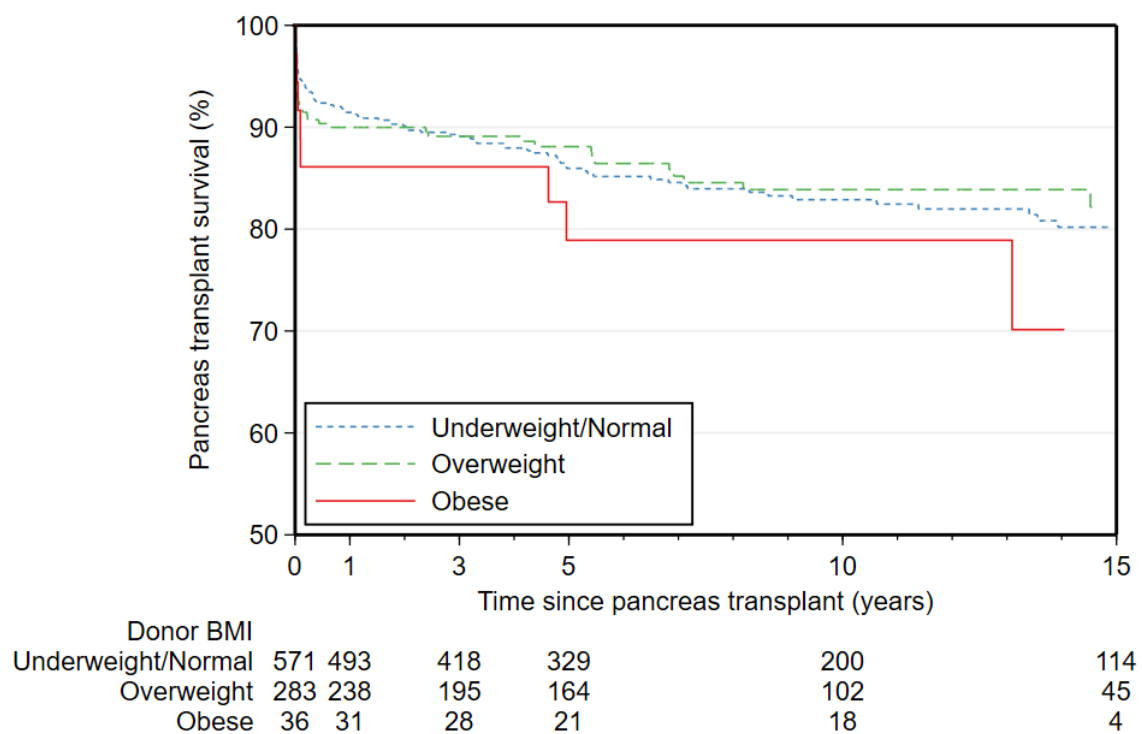
Survival of pancreas transplants has changed over time, as shown in Figure 2.8. Survival improved markedly over time ($p=0.001$). For those transplanted prior to 2000, 1-year pancreas transplant survival was 82.3%, and 5-year survival 76.6%. For those transplanted in 2010 or later, 1-year survival was 94.0% and 5-year survival 89.0%.

Figure 2.8: Pancreas transplant survival over time (censored at death)



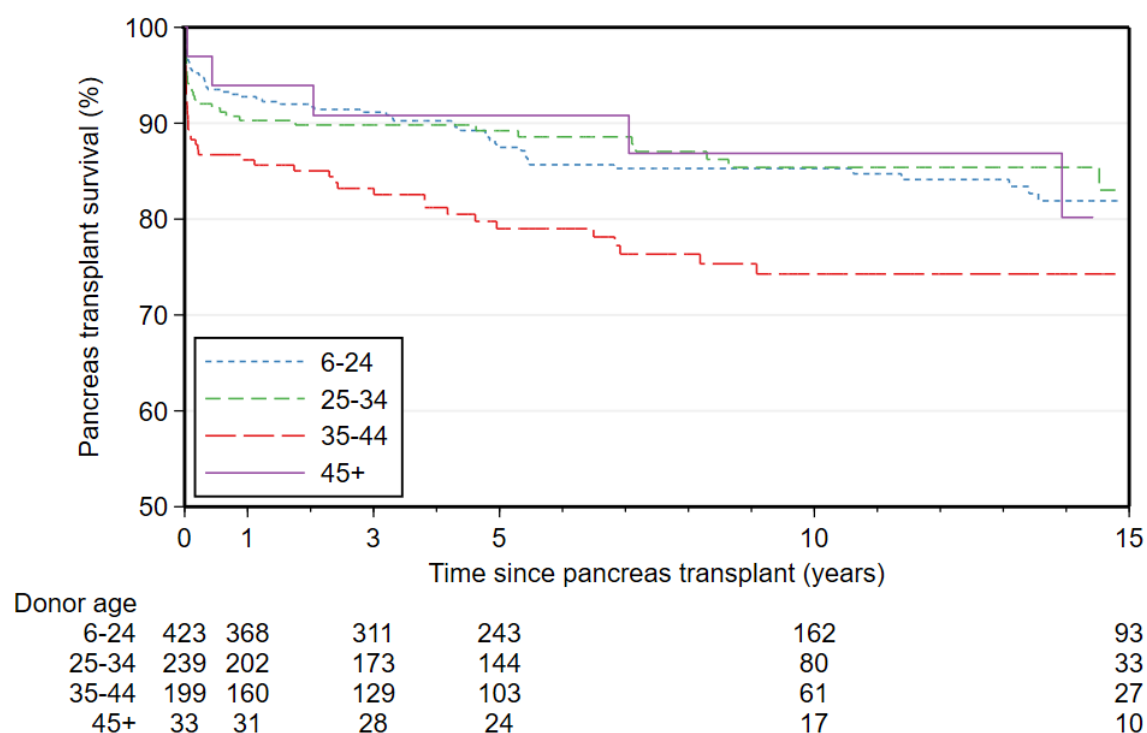
Pancreas transplant survival by donor BMI is presented in Figure 2.9. Most donors (64%) were either underweight or normal weight (BMI <25). However, 32% were overweight (BMI 25-29) and 4% were obese (BMI 30+). While Figure 2.9 suggests separation of survival curves, there was no statistical association between donor BMI and pancreas survival ($p=0.6$). Pancreas transplant survival at 1 year was 91.5% for transplants where the donor was underweight/normal BMI, 90.0% for transplants where the donor was overweight, and 86.1% where the donor was obese.

Figure 2.9: Pancreas transplant survival by donor BMI (censored at death)



Pancreas transplant survival by donor age is presented in Figure 2.10. The survival curves are poorer for donors aged 35-44 compared with those 45 and older, or younger donors ($p=0.02$). We can only hypothesise that any difference may be due to donors over 45 being a more highly selected group, compared to the donors aged 35-44. Pancreas transplant survival at 1 year was 92.8% for transplants from donors aged 6-24 years, 90.3% for donors aged 25-34 years, 86.2% for donors aged 35-44 years, and 93.9% for donors aged 45+ years.

Figure 2.10: Pancreas transplant survival by donor age (censored at death)



Pancreas transplant survival at 1 year and 5 years post-transplant, censored at death and stratified by country and era of transplantation is presented in Table 2.7.

Table 2.7: Pancreas transplant survival censored at death, by country and era

Year of transplant	Australia					New Zealand				
	N	1-year		5-year		N	1-year		5-year	
		n	%	n	%		n	%	n	%
2011-2016	239	215	91.6%	109	86.5%	15	14	93.3%	7	93.3%
2012-2017	261	236	92.6%	88	87.6%	16	15	93.8%	4	93.8%
2013-2018	274	250	93.7%	60	89.9%	20	19	95.0%	2	95.0%
2014-2019	280	220	94.5%	34	92.3%	23	18	95.7%	1	95.7%

Prevalence of functioning pancreas transplants

We calculated the point prevalence of people living in Australia and New Zealand who were alive with a functioning transplant on 31st December each year for the last five years (Table 2.8). The below numbers exclude people still alive, but whose pancreas transplant has failed. The number of functioning transplants is remaining steady over time, possibly because recipients of early transplants are ageing (with increased deaths and pancreas transplant failures) which is being offset by the increase in new transplants performed.

Table 2.8: People alive with a functioning pancreas transplant in Australia and New Zealand by year and residence, at year's end

State/country of residence	2015	2016	2017	2018	2019
New South Wales	171	168	164	163	162
Victoria	184	184	181	179	177
Queensland	129	126	122	122	122
Western Australia	36	35	32	31	31
South Australia	53	52	52	51	50
Tasmania	27	27	27	27	27
Australian Capital Territory	14	13	12	12	12
Northern Territory	4	4	4	4	4
New Zealand	52	52	52	52	52
Total	670	661	646	641	637

Kidney transplant survival

Kidney transplant survival was calculated for those who received SPK transplants, from the time of transplantation until the time of return to dialysis. We calculated both kidney failure including death with a functioning kidney and kidney failure censored at death with a functioning graft. For kidney transplant survival we included only SPK transplants and excluded PAK transplant recipients. We had survival records for 877 SPK transplants.

Figure 2.11 shows kidney survival censored at death. Over 7,729 years of observation, there were 88 kidney transplant failures (excluding people who died with a functioning kidney transplant). Overall, 1-year kidney transplant survival was 97.1%, 5-year survival 94.3%, and 10-year survival 89.5%.

Figure 2.11: Kidney transplant survival for people receiving SPK transplants (censored at death)

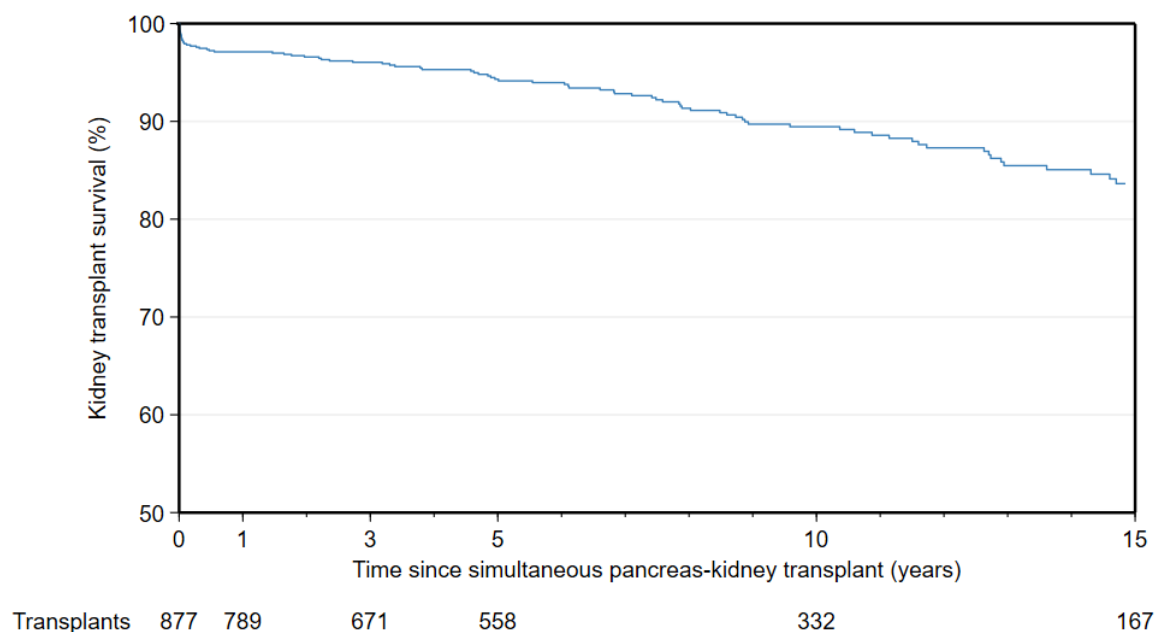
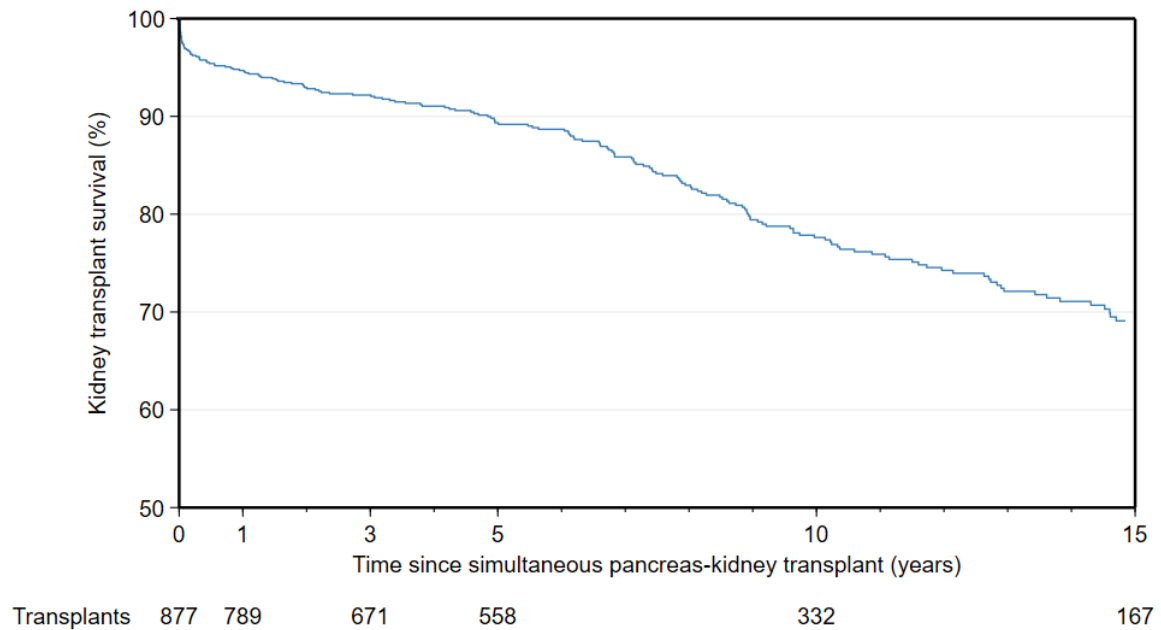


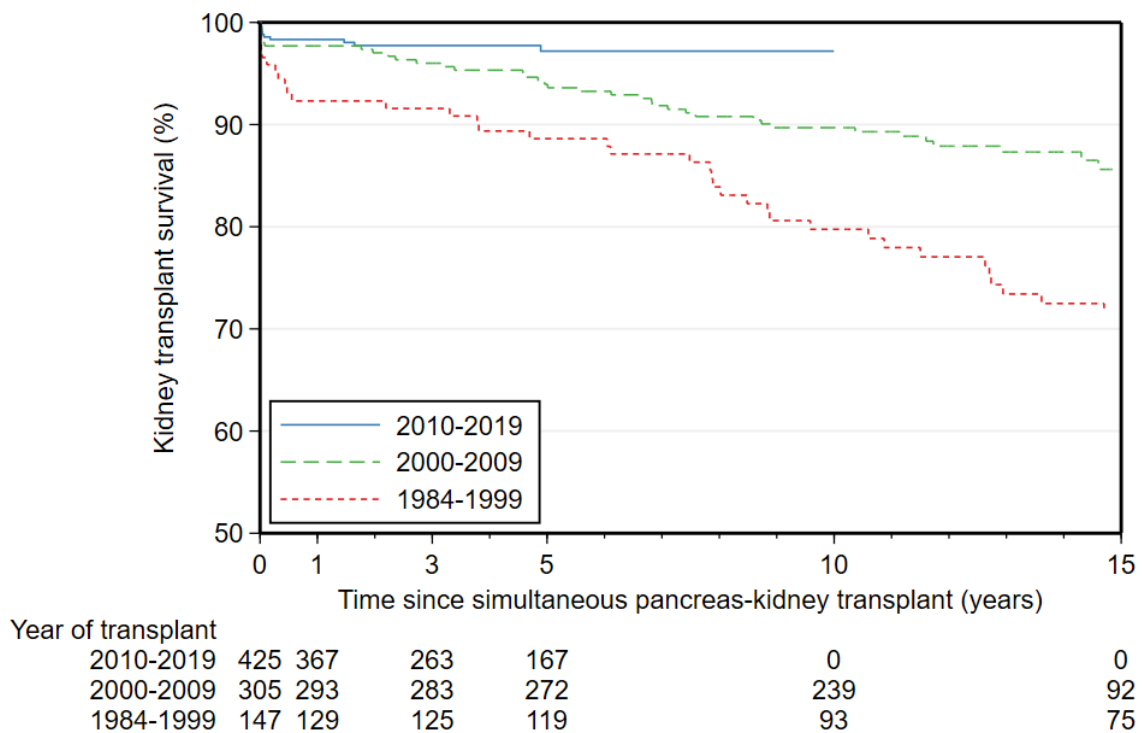
Figure 2.12 shows kidney survival including death with a functioning kidney. Over the same observation time there were 196 recipients who either died with kidney transplant function or experienced kidney transplant failure. Kidney transplant survival at 1, 5 and 10 years was 94.7%, 89.3% and 77.6% respectively.

Figure 2.12: Kidney transplant survival for people receiving SPK transplants (including death as a kidney transplant failure)



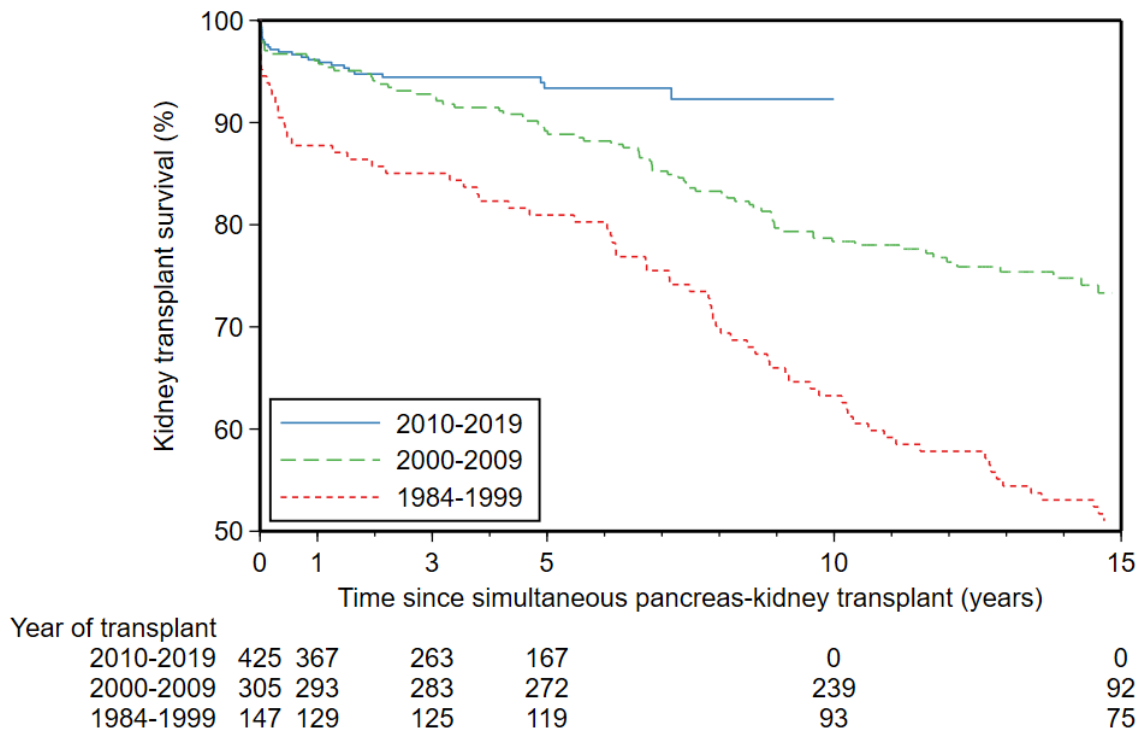
Kidney transplant survival improved over time, with longer survival for those transplanted in more recent years ($p < 0.001$). For those transplanted before 2000, kidney transplant survival was 92.3% at 1 year and 88.6% at 5 years but was 98.3% at 1 year and 97.2% at 5 years for those transplanted in 2010 or later (Figure 2.13).

Figure 2.13: Kidney transplant survival for SPK recipients over time (censored at death)



The era effect was even stronger when considering kidney failure including death with kidney function ($p < 0.001$). For those transplanted before 2000, survival was 87.8% at 1 year and 81.0% at 5 years but was 96.2% at 1 year and 93.4% at 5 years for those transplanted in 2010 or later (Figure 2.14).

Figure 2.14: Kidney transplant survival for SPK recipients over time (including death as a kidney transplant failure)



Pancreas transplant operative data

Characteristics of the pancreas transplant operations for 2019, previous years, and overall are shown in Table 2.9 below.

Table 2.9: Descriptive characteristics of pancreas transplant operations

	2019	1984-2018	Total
Pancreas transplant			
Total pancreas transplants	44	866	910
Cold ischaemic time (hours)			
Patients (%)	27 (61)	700 (81)	727 (80)
Mean (SD)	8.5 (2.9)	11.3 (19.6)	11.2 (19.2)
Median (IQR)	8 (6, 10)	10 (8, 12)	10 (8, 12)
Anastomosis time (minutes)			
Patients (%)	8 (18)	687 (79)	695 (76)
Mean (SD)	24.0 (6.0)	29.7 (8.0)	29.7 (8.0)
Median (IQR)	25 (20, 29)	30 (25, 34)	30 (25, 34)
Exocrine drainage			
Enteric, n (%)	44 (100)	629 (73)	673 (74)
Bladder, n (%)	0 (0)	164 (19)	164 (18)
Not reported, n (%)	0 (0)	73 (8)	73 (8)
Kidney transplant			
Total SPK transplants	42	835	877
Cold ischaemic time (hours)			
Patients (%)	25 (57)	675 (78)	700 (77)
Mean (SD)	8.5 (3.1)	11.3 (19.9)	11.2 (19.6)
Median (IQR)	8 (6, 10)	10 (8, 12)	10 (8, 12)
Anastomosis time (minutes)			
Patients (%)	7 (16)	661 (76)	668 (73)
Mean (SD)	24.9 (6.0)	29.8 (8.0)	29.7 (8.0)
Median (IQR)	26 (22, 30)	30 (25, 34)	30 (25, 34)
Kidney donor arteries			
None, n (%)	0 (0)	2 (<1)	2 (<1)
One, n (%)	28 (64)	609 (70)	637 (70)
Two, n (%)	1 (2)	68 (8)	69 (8)
Three, n (%)	0 (0)	4 (<1)	4 (<1)
Not reported, n (%)	13 (30)	152 (18)	165 (18)

SPK, simultaneous pancreas-kidney

To investigate how much the total cold ischaemic time varied dependant on the donor state, and distance travelled to the transplanting centre, Table 2.10 displays a cross tabulation of donor state of origin with transplanting centre.

Table 2.10: Comparison of cold ischaemic time of pancreas transplants by donor state, for Australian pancreas transplants 2019

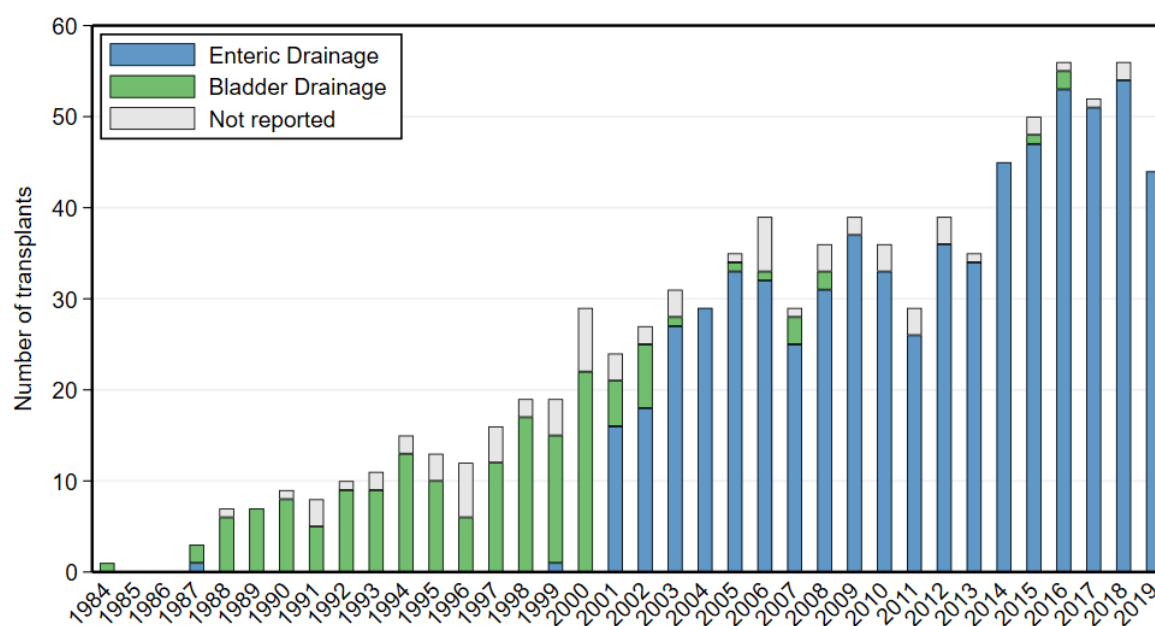
Donor state	Cold ischaemic time in hours					
	Westmead (NSW)		Monash (VIC)		Royal Adelaide (SA)	
	<i>N</i>	<i>Mean (SD)</i>	<i>N</i>	<i>Mean (SD)</i>	<i>N</i>	<i>Mean (SD)</i>
New South Wales	7	7.1 (1.2)	0	-	0	-
Victoria	1	9 (-)	9	8.9 (3.5)	0	-
Queensland	2	9 (1.4)	0	-	0	-
Western Australia	2	8 (4.2)	0	-	2	6.5 (2.1)
South Australia	0	-	1	10 (-)	0	-
Tasmania	0	-	0	-	0	-
Australian Capital Territory	1	5 (-)	0	-	0	-
Northern Territory	0	-	0	-	1	12 (-)
Total	13	7.5 (1.9)	10	10.5 (3.5)	3	8.5 (4.9)

Note: There is a lot of missing data for cold ischaemic times, hence data in this table may not be representative of all pancreas transplants

Surgical technique

Exocrine drainage of the pancreas transplant has changed over time. Enteric drainage of the pancreas was first used in Australia and New Zealand during 2001. Figure 2.15 illustrates the number of transplants by pancreas duct management. Since 2001, most pancreas transplants have used enteric drainage of the pancreas duct.

Figure 2.15: Change in management of exocrine drainage of the pancreas over time



The site of donor vessel anastomoses onto the recipient vessels is dependent on many things, including but not limited to surgeon's preference, surgical ease of access, length and relative calibre of donor vessels. The sites of anastomosis for donor arteries and veins are displayed in Figure 2.16 and Figure 2.17 below.

Figure 2.16: Site of donor artery anastomosis onto recipient vessel

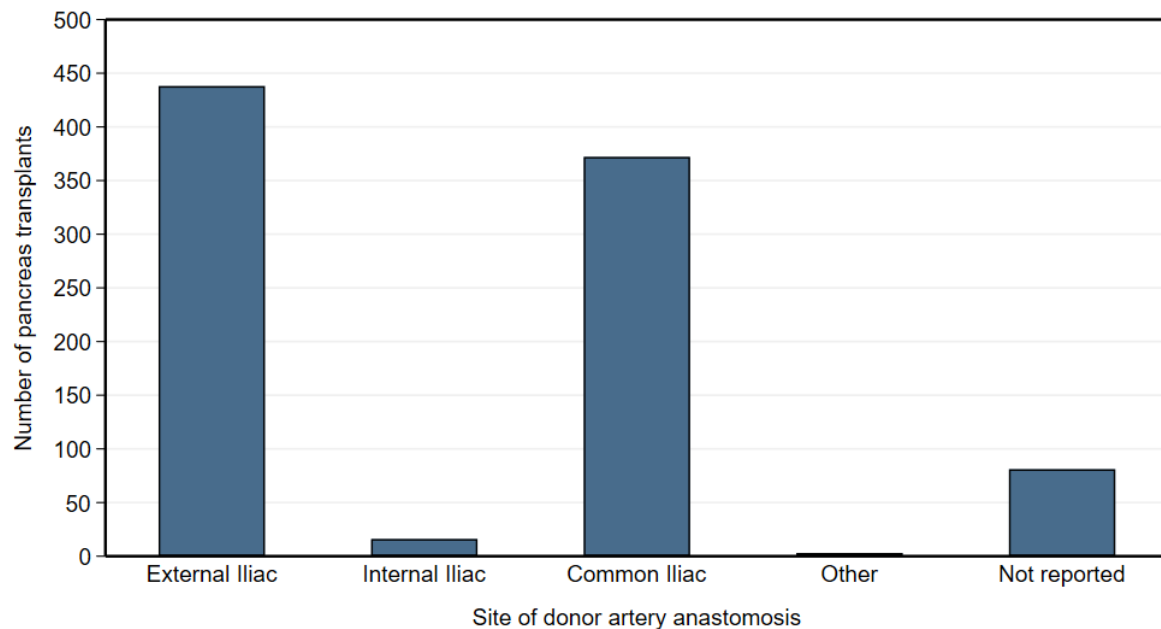
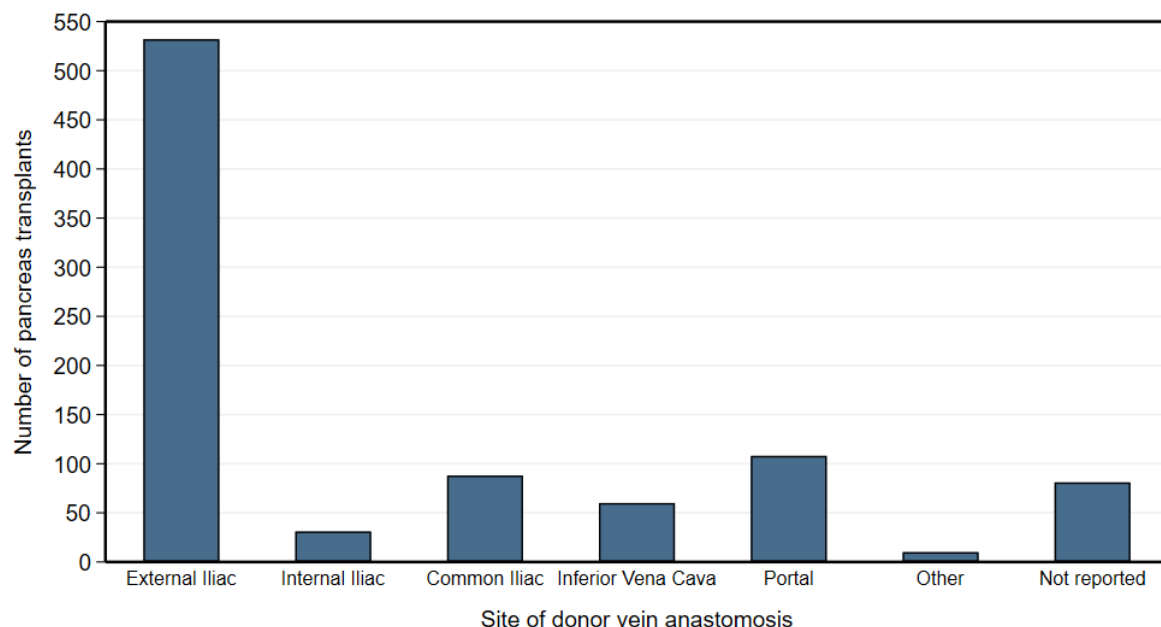


Figure 2.17: Site of donor vein anastomosis onto recipient vessel



The immunological matching of donor-recipient pairs is shown in Table 2.11, and the cytomegalovirus (CMV) and Epstein-Barr virus (EBV) matching is illustrated in Table 2.12.

Table 2.11: Immunological cross-matching of donor recipient pairs

	Donor-recipient pairs, n (column %)	
	<i>Current</i>	<i>Peak</i>
Crossmatch		
T-cell Positive	0 (0)	2 (<1)
B-cell Positive	3 (<1)	4 (<1)
T and B cell Negative	745 (82)	730 (80)
DTT Negative	1 (<1)	1 (<1)
None recorded	0 (0)	2 (<1)
Not reported	161 (18)	171 (19)
Panel Reactive Antibodies (%)		
0-49	132 (15)	130 (14)
50+	1 (<1)	9 (<1)
Not reported	777 (85)	771 (85)

Table 2.12: Infectious disease serology cross-tabulation of donor-recipient pairs

Recipient serology	Donor serology, n (column %)		
	<i>Positive</i>	<i>Negative</i>	<i>Not reported</i>
Cytomegalovirus (CMV)			
Positive	96 (18)	45 (14)	4 (8)
Negative	16 (3)	9 (3)	0 (0)
Not reported	425 (79)	271 (83)	44 (92)
Epstein-Barr virus (EBV)			
Positive	120 (23)	18 (22)	28 (9)
Negative	3 (<1)	0 (0)	1 (<1)
Not reported	408 (77)	65 (78)	267 (90)

Chapter 3: Pancreas donors

Authors: Angela Webster, Paul Robertson, Tia Mark, James Hedley, Patrick Kelly

This chapter gives an overview of donors in 2019 and over time. Donor eligibility criteria guidelines are available in the TSANZ consensus statement

<http://www.tsanz.com.au/organallocationprotocols/> , but briefly require donors to be over 25kg, and up to the age of 45, without known diabetes mellitus or pancreatic trauma, or history of alcoholism or pancreatic trauma. Donation after cardiac death may be considered up to the age of 35. As these are guidelines, there may be occasions when there is minor deviation from these advised criteria.

Donor BMI is perceived as impacting recipient outcomes. Obese donors are more likely to have fatty pancreas, which results in more difficult surgery and increased post –operative complications, and suboptimal insulin secretion. Alcohol consumption is defined by a history of consumption of more than 40g/day. Table 3.1 describes pancreas donor characteristics in Australia and New Zealand to date.

Pancreas donor characteristics

Table 3.1: Demographics and characteristics of pancreas transplant donors

	Donors, n (column %)		
	2019	1984-2018	Total
Total (row %)	44 (100)	866 (100)	910 (100)
Age category			
0-24	13 (30)	412 (48)	425 (47)
25-34	14 (32)	226 (26)	240 (26)
35-44	7 (16)	192 (22)	199 (22)
45+	0 (0)	33 (4)	33 (4)
Not reported	10 (23)	3 (<1)	13 (1)
Sex			
Female	11 (25)	506 (58)	517 (57)
Male	24 (55)	359 (41)	383 (42)
Not reported	9 (20)	1 (<1)	10 (1)
BMI (kg/m2)			
Underweight/Normal (<24.9)	18 (41)	556 (64)	574 (63)
Overweight (25-29.9)	12 (27)	271 (31)	283 (31)
Obese (30+)	0 (0)	36 (4)	36 (4)
Not reported	14 (32)	3 (<1)	17 (2)
Donor type			
Brain death (DBD)	38 (86)	854 (99)	892 (98)
Circulatory death (DCD)	6 (14)	12 (1)	18 (2)
Donor mode of death			
Cerebral hypoxia/ischaemia	14 (32)	101 (12)	115 (13)
Cerebral infarct	0 (0)	17 (2)	17 (2)
Intracranial haemorrhage	7 (16)	231 (27)	238 (26)
Non-neurological condition	0 (0)	194 (22)	194 (21)
Other neurological condition	2 (5)	18 (2)	20 (2)
Traumatic brain injury	11 (25)	302 (35)	313 (34)
Not reported	10 (23)	3 (<1)	13 (1)
Alcohol consumption			
Never	16 (36)	653 (75)	669 (74)
Former	3 (7)	4 (<1)	7 (<1)
Current	11 (25)	49 (6)	60 (7)
Not reported	14 (32)	160 (18)	174 (19)
Smoking history			
Never	14 (32)	519 (60)	533 (59)
Former	3 (7)	34 (4)	37 (4)
Current	14 (32)	208 (24)	222 (24)
Not reported	14 (32)	105 (12)	119 (13)
Donor's blood group			
O	20 (45)	440 (51)	460 (51)
A	17 (39)	321 (37)	338 (37)
B	4 (9)	83 (10)	87 (10)
AB	0 (0)	21 (2)	21 (2)
Not reported	3 (7)	1 (<1)	4 (<1)

	Donors, n (column %)		
	2019	1984-2018	Total
Kidney biopsy			
Performed	15 (34)	654 (76)	669 (74)
Not performed	24 (55)	187 (22)	211 (23)
Not reported	5 (11)	25 (3)	30 (3)
Cytomegalovirus (CMV)			
Positive	26 (59)	511 (59)	537 (59)
Negative	5 (11)	320 (37)	325 (36)
Not reported	13 (30)	35 (4)	48 (5)
Epstein-Barr virus (EBV)			
Positive	24 (55)	507 (59)	531 (58)
Negative	2 (5)	81 (9)	83 (9)
Not reported	18 (41)	278 (32)	296 (33)

DBD, donor after brain death; DCD, donor after circulatory death

The distribution of donor states of origin by transplanting unit for Australian pancreas donors is shown in Table 3.2.

Table 3.2: Distribution of state of residence of pancreas donors in Australia over time, by national pancreas transplant unit

State	Donors, n (column %)					
	2019	2018	2017	2016	2015	2014
Westmead (NSW)						
NSW	14 (52)	13 (50)	14 (47)	10 (34)	15 (54)	10 (36)
VIC	3 (11)	1 (4)	0 (0)	1 (3)	1 (4)	2 (7)
QLD	4 (15)	7 (27)	4 (13)	10 (34)	4 (14)	3 (11)
WA	4 (15)	2 (8)	7 (23)	5 (17)	4 (14)	3 (11)
SA	1 (4)	0 (0)	1 (3)	0 (0)	3 (11)	5 (18)
TAS	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
ACT	1 (4)	3 (12)	3 (10)	3 (10)	1 (4)	5 (18)
NT	0 (0)	0 (0)	1 (3)	0 (0)	0 (0)	0 (0)
Monash (VIC)						
NSW	0 (0)	1 (5)	0 (0)	0 (0)	0 (0)	1 (7)
VIC	9 (90)	17 (85)	15 (88)	16 (70)	16 (84)	11 (73)
QLD	0 (0)	0 (0)	1 (6)	0 (0)	0 (0)	0 (0)
WA	0 (0)	1 (5)	1 (6)	3 (13)	0 (0)	1 (7)
SA	1 (10)	1 (5)	0 (0)	2 (9)	3 (16)	0 (0)
TAS	0 (0)	0 (0)	0 (0)	1 (4)	0 (0)	2 (13)
ACT	0 (0)	0 (0)	0 (0)	1 (4)	0 (0)	0 (0)
NT	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

State	Donors, n (column %)					
	2019	2018	2017	2016	2015	2014
Royal Adelaide (SA)						
NSW	0 (0)	0 (0)	0 -	0 -	0 -	0 -
VIC	0 (0)	0 (0)	0 -	0 -	0 -	0 -
QLD	0 (0)	0 (0)	0 -	0 -	0 -	0 -
WA	0 (0)	0 (0)	0 -	0 -	0 -	0 -
SA	2 (67)	3 (75)	0 -	0 -	0 -	0 -
TAS	0 (0)	0 (0)	0 -	0 -	0 -	0 -
ACT	0 (0)	0 (0)	0 -	0 -	0 -	0 -
NT	1 (33)	1 (25)	0 -	0 -	0 -	0 -

Donor and recipient state/territory

Table 3.3 shows the distribution of donor organs according to state of origin, cross-tabulated with the state of origin of the recipients who received those organs, for 2019, and from inception of the pancreas program. Note, these tables include Australian donors and recipients only.

Table 3.3: Number of pancreas transplants by donor and recipient state of residence in Australia for 2019 and all years

Recipient state	Donor state (number of transplants)									Total
	NSW	VIC	QLD	WA	SA	TAS	ACT	NT	Not reported	
2019 only	14	12	4	4	4	0	1	1	0	40
NSW	7	2	2	3	1	0	0	0	0	15
VIC	0	6	0	0	1	0	0	0	0	7
QLD	6	0	2	1	0	0	1	0	0	10
WA	1	1	0	0	0	0	0	0	0	2
SA	0	1	0	0	2	0	0	1	0	4
TAS	0	2	0	0	0	0	0	0	0	2
ACT	0	0	0	0	0	0	0	0	0	0
NT	0	0	0	0	0	0	0	0	0	0
All years (1984-2019)	318	248	77	58	74	23	38	3	3	842
NSW	151	11	28	19	22	4	18	0	0	253
VIC	22	190	1	5	7	16	2	0	3	246
QLD	74	9	29	16	23	0	11	1	0	163
WA	21	5	12	10	5	1	2	0	0	56
SA	17	20	3	5	13	1	5	2	0	66
TAS	16	12	1	0	1	1	0	0	0	31
ACT	16	1	3	1	2	0	0	0	0	23
NT	1	0	0	2	1	0	0	0	0	4