



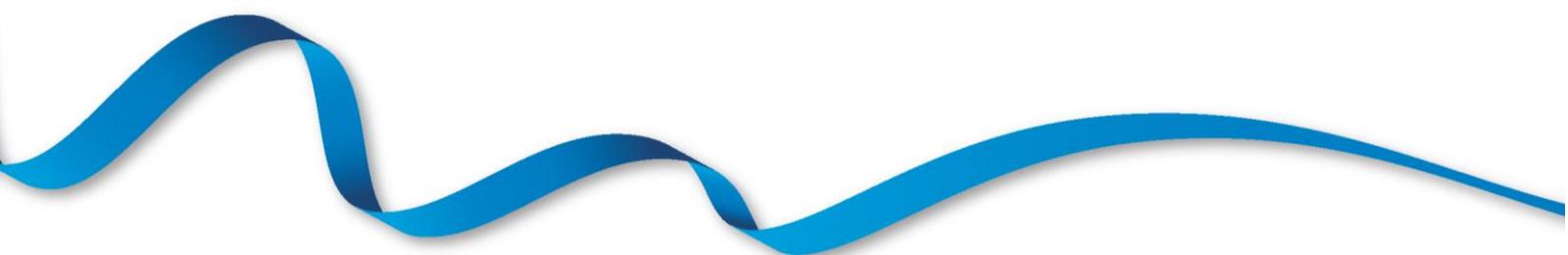
Blood and Transplant

**INTERIM REPORT ON PANCREAS AND ISLET
TRANSPLANTATION**

**5 YEAR REPORT
(1 OCTOBER 2013 – 30 SEPTEMBER 2018)**

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PRODUCED IN COLLABORATION WITH NHS ENGLAND



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Executive Summary

This report presents key figures about pancreas and islet transplantation in the UK. The period reported covers five years of pancreas and islets transplant data, from 1 October 2013. The report presents information on the number of pancreas and islet transplants as well as survival analysis after first simultaneous pancreas and kidney and pancreas only transplantation on a national and centre-specific basis.

Key findings

- On the 30 September 2018, there were 217 patients on the UK active pancreas and islet [transplant list](#), which represents an 8% decrease in the number of patients from one year earlier. The number of patients on the active pancreas list decreased by 11% to 188 in one year, while the active islet [transplant list](#) increased by 21% to 29 patients in the same time period.
- There were 96 pancreas transplants and 14 islet transplants performed in the UK from April to September 2018. Of these 73% of transplants were from [donations after brain death](#). From 1 October 2017 to 30 September 2018, 25% of pancreas and islet transplants were from [donations after circulatory death](#).
- The median waiting time for patients registered, between 1 October 2012 to 30 September 2015, for a pancreas transplant in the UK was 344 days. The median ranged from 240 to 535 days depending on which centre the patient was registered at. The median waiting time for an islet transplant for patients registered in the same time frame was 422 days.
- The national rates of [graft](#) survival one- and five-years after first simultaneous pancreas and kidney transplant from deceased donors are 89% and 80%, respectively. These rates vary between centres, ranging from 84% to 97% at one-year and 62% to 91% at five-years. All centre rates are [risk-adjusted](#).
- The national rates of [patient](#) survival one- and five-years after first simultaneous pancreas and kidney transplant from deceased donors are 98% and 89%, respectively. These rates vary between centres, ranging from 93% to 100% at one-year and 81% to 94% at five-years. All centre rates are [risk-adjusted](#).
- The national rates of [graft](#) survival one- and five-years after first pancreas only transplant from deceased donors are 89% and 48%, respectively. The national rates of patient survival one- and five-years are 97% and 80%. Centre specific estimates of these rates must be interpreted with caution due to the small number of transplants upon which they are based.

Introduction

This report presents information on pancreas and islet transplant activity between 1 October 2013 and 30 September 2018, for all eight centres performing pancreas transplantation and all seven centres performing islet transplantation in the UK. Data were obtained from the UK Transplant Registry, at NHS Blood & Transplant, that holds information relating to donors, recipients and outcomes for all pancreas and islet transplants performed in the UK.

[Graft](#) and [patient](#) pancreas survival estimates are reported at one-year post-transplant for the period 1 October 2013 to 30 September 2017 and five-year post-transplant for the period 1 October 2009 to 30 September 2013. The centre specific results for survival estimates after first simultaneous pancreas and kidney transplants are adjusted for differences in [risk factors](#) between the centres. The risk models used are described in the Appendix.

Methods used are also described in the Appendix.

Patients requiring [multi-organ transplants](#) (except simultaneous pancreas and kidney transplants (SPK) and simultaneous islet and kidney (SIK)) are excluded from all analyses apart from in the introduction. All results are described separately for pancreas and islet patients other than those presented in the introduction section. Intestinal transplants that involve a pancreas are excluded from all sections of the report.

Throughout this report West London Renal and Transplant Centre is labeled as WLRTC.

Figure 2.1 shows the number of patients on the pancreas and islet [transplant list](#) at 31 March and 30 September each year from 2014 to 2018. Overall the number of patients actively waiting for a pancreas or islet transplant has gradually declined, with minor fluctuations, from 269 in March 2014 to 217 in September 2018, with minor fluctuations.

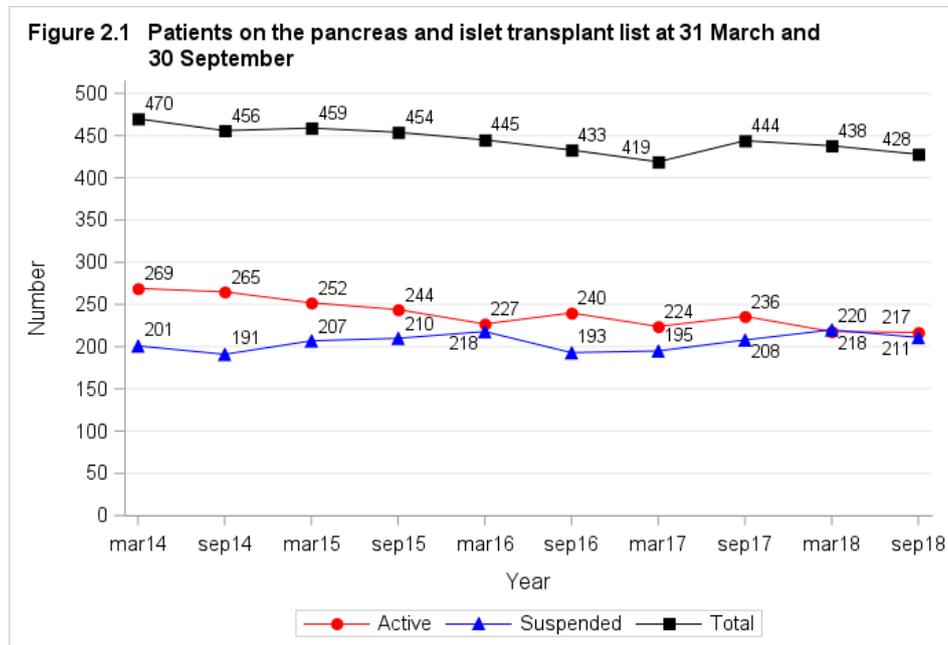


Figure 2.2 shows the number of patients on the pancreas and islet [transplant list](#) at 30 September 2018 for each transplant centre. Cambridge, Cardiff, Guy’s and WLRTC only perform pancreas transplants while Bristol, King’s College and The Royal Free only perform islet transplants. Oxford had the largest [transplant list](#) with 62 patients registered for a pancreas or islet transplant. There were 11 registrations for an SIK transplant at Manchester (nine), Newcastle (one) and Edinburgh (one).

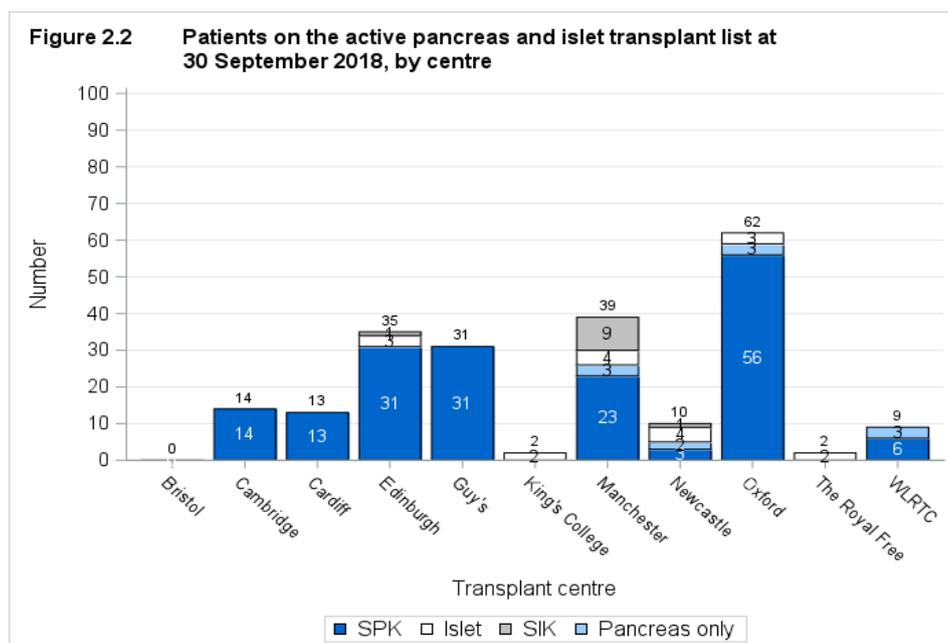


Figure 2.3 shows the total number of pancreas and islet transplants performed in the last five years. The number of transplants on the whole fluctuated in the last couple of years such that; April to September had less activity compared to October to March. There was an increase of 3% in transplant activity between October 2016 – September 2017 and October 2017 – September 2018, 216 and 222 respectively.

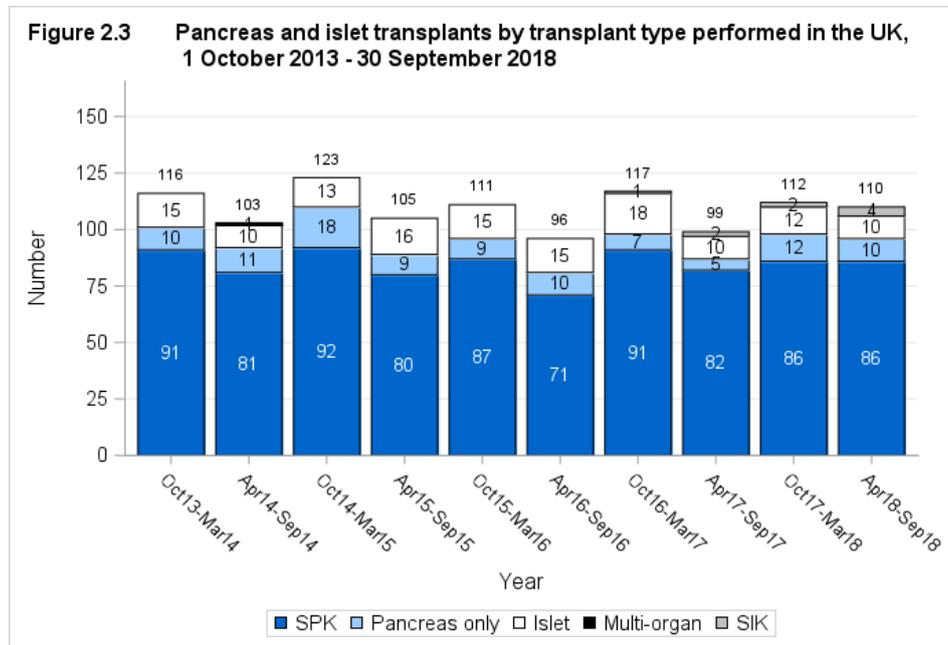


Figure 2.4 shows the total number of pancreas and islet transplants performed from April to September 2018 at each transplant centre. Oxford performed the most pancreas and islet transplants, a total of 38 transplants. Edinburgh and Manchester performed a total of four SIK transplants and Newcastle had the highest proportion of islet transplantation (50%).

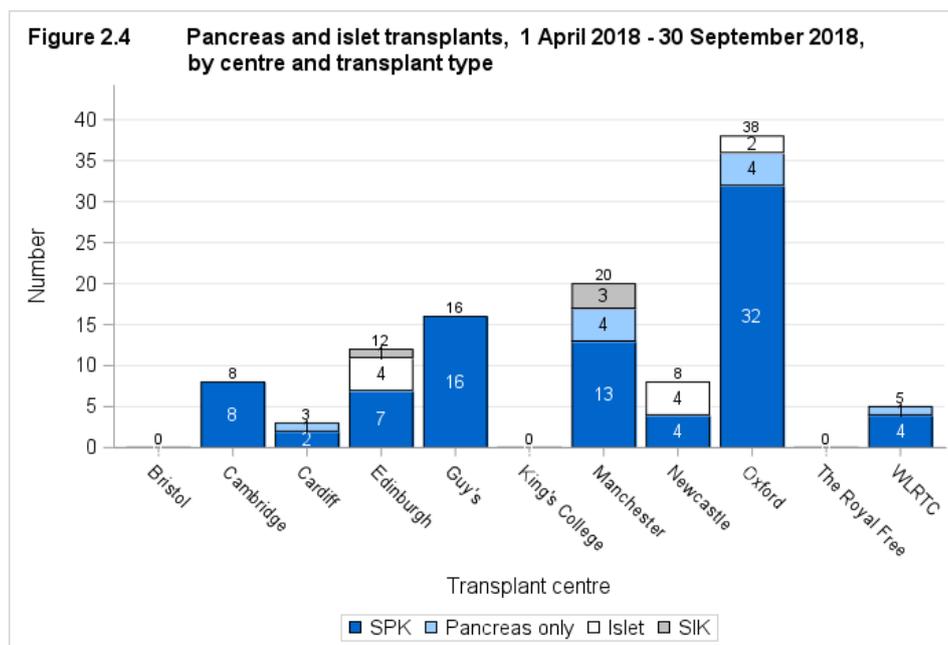
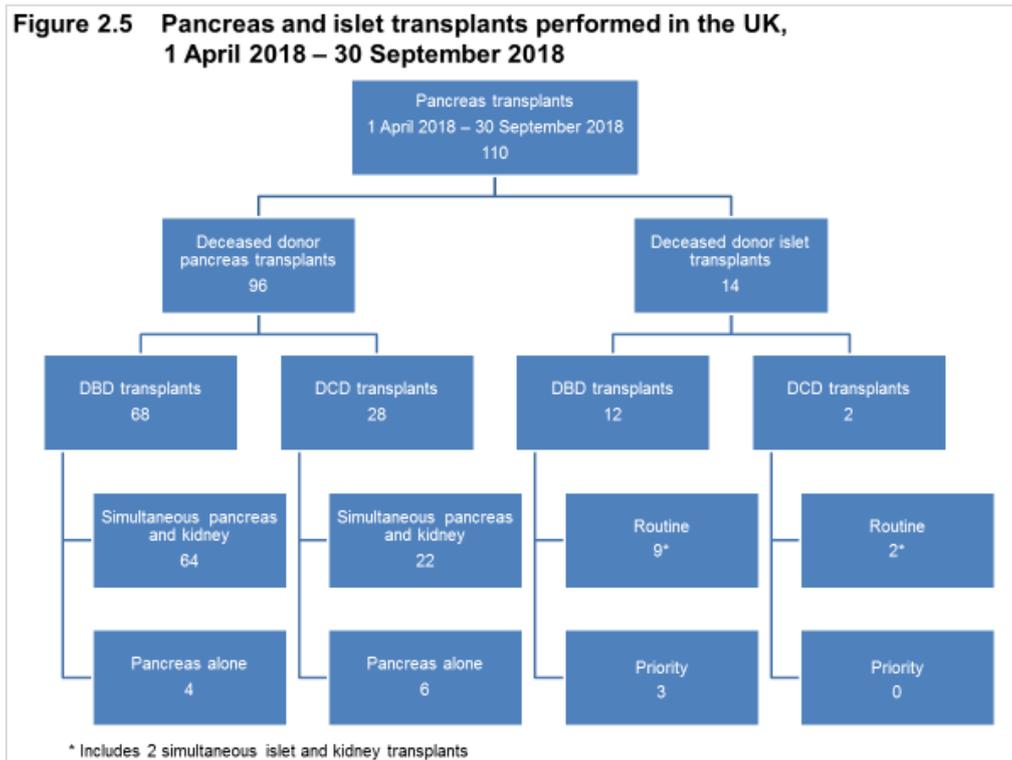


Figure 2.5 details the 110 pancreas and islet transplants performed in the UK between 1 April 2018 and 30 September 2018. 73% of these were from DBD deceased donors. 96 were pancreas transplants and 14 were islet transplants. 90% of pancreas transplants were SPK's in this time period. For islet transplantation, 11 were routine and three were priority, with the routine transplants including four SIK transplants.



Pancreas transplant list

3.1 Patients on the pancreas transplant list as at 31 March and 30 September, 2014 – 2018

Figure 3.1 shows the number of patients on the pancreas [transplant list](#) at 31 March and 30 September between 2014 and 2018. Overall the number of patients actively waiting for a pancreas transplant gradually reduced by 20% from 236 in March 2014 to 188 in September 2018, with fluctuations six monthly between March 2016 – September 2017.

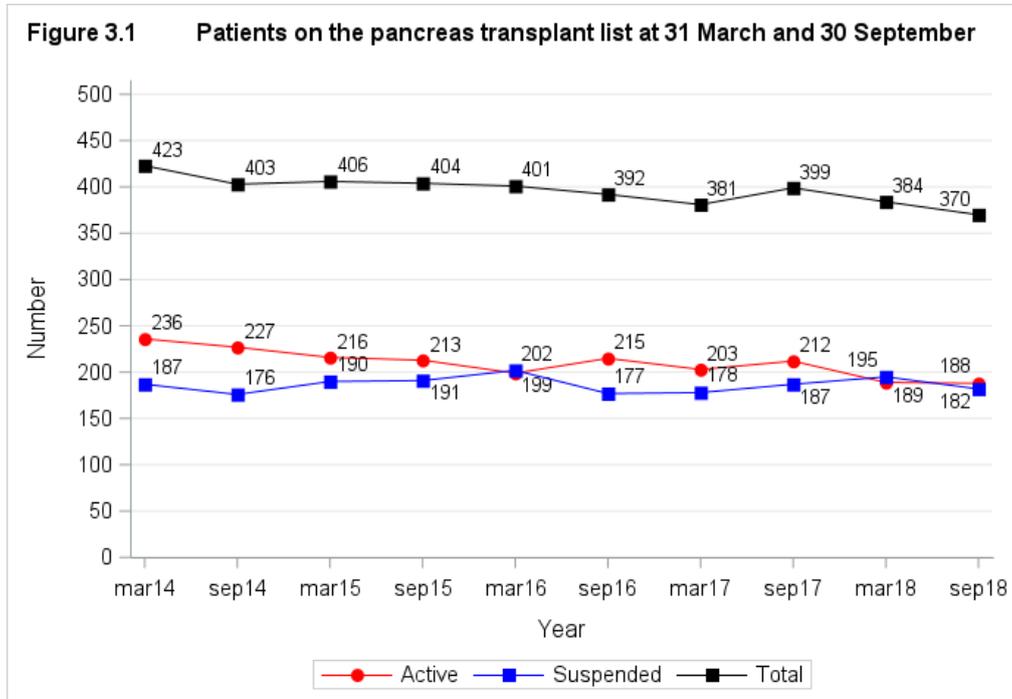
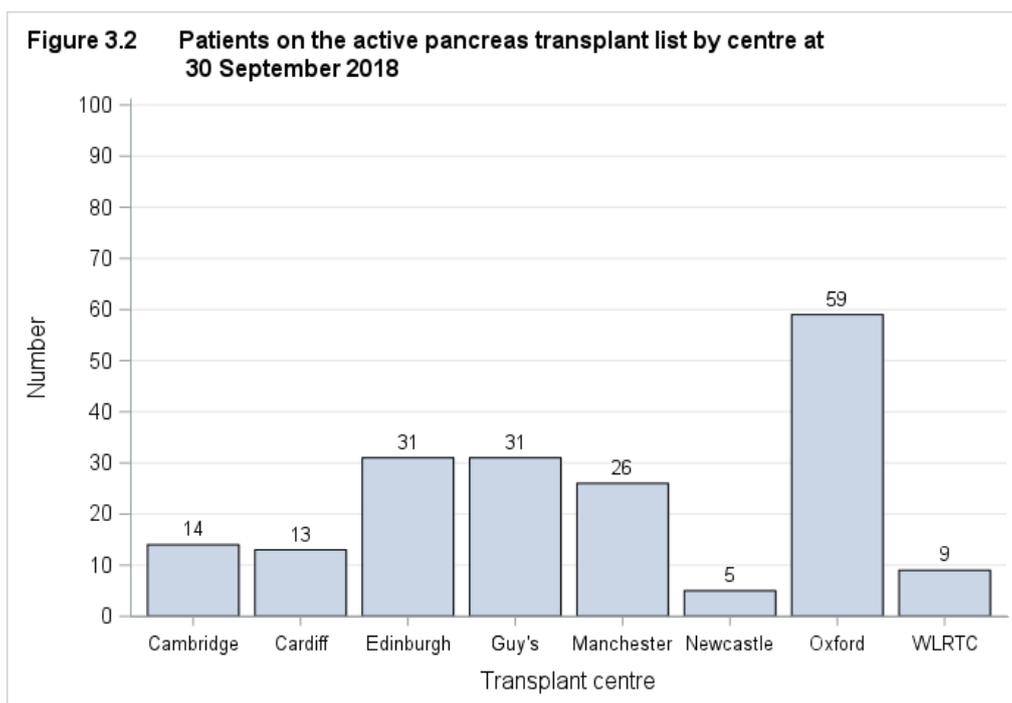


Figure 3.2 shows the number of patients on the active pancreas [transplant list](#) at 30 September 2018 by centre. Oxford had the largest proportion on the [transplant list](#) (31%) and Newcastle had the smallest proportion (3%).



3.2 Median waiting time to transplant, 1 October 2012 - 30 September 2015

The length of time a patient waits for a pancreas transplant varies across the UK. The [median](#) waiting time for deceased donor pancreas transplantation is shown in **Figure 3.3** and **Table 3.1** for patients registered at each individual unit.

The [median](#) waiting time to transplant for patients registered on the pancreas [transplant list](#) between 1 October 2012 and 30 September 2015 is 344 days, less than a year. This ranged from 240 days at Cardiff to 535 days at Newcastle.



Table 3.1 Median waiting time to pancreas transplant in the UK, for patients registered 1 October 2012 - 30 September 2015

Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Cambridge	88	245	214 - 276
Cardiff	48	240	170 - 310
Edinburgh	64	510	451 - 569
Guy's	106	329	260 - 398
Manchester	123	330	276 - 384
Newcastle	31	535	471 - 599
Oxford	234	367	322 - 412
WLRTC	32	310	238 - 382
UK	726	344	326 - 362

Response to pancreas offers

4.1 Offer decline rates, 1 April 2015 – 30 September 2018

Pancreas offers from [DBD](#) and [DCD](#) donors whose pancreas was retrieved, offered directly on behalf of a named individual patient and resulted in transplantation are included in the analysis. Any offers of pancreases declined for transplantation, pancreases offered for [multi-organ](#) or small bowel transplant were excluded, as were offers made through the fast track scheme or the reallocation of the pancreas.

[Funnel plots](#) are used to compare centre specific offer decline rates and indicate how consistent the rates of the individual transplant centres are with the national rate. Patient [case mix](#) is known to influence the number of offers a centre may receive. In this analysis however only individual offers for named patients were considered which excluded any [ABO](#)- and [HLA](#)-incompatible patients. For this reason it was decided not to risk adjust for known centre differences in patient [case mix](#).

Figure 4.1 compares individual centre offer [DBD](#) decline rates with the national rate over the time period, 1 April 2015 and 30 September 2018. Centres can be identified by the information shown in **Table 4.1**. Cambridge had an offer decline rate significantly lower than the national average, whilst Edinburgh and Newcastle had significantly higher offer decline rates than the national average.

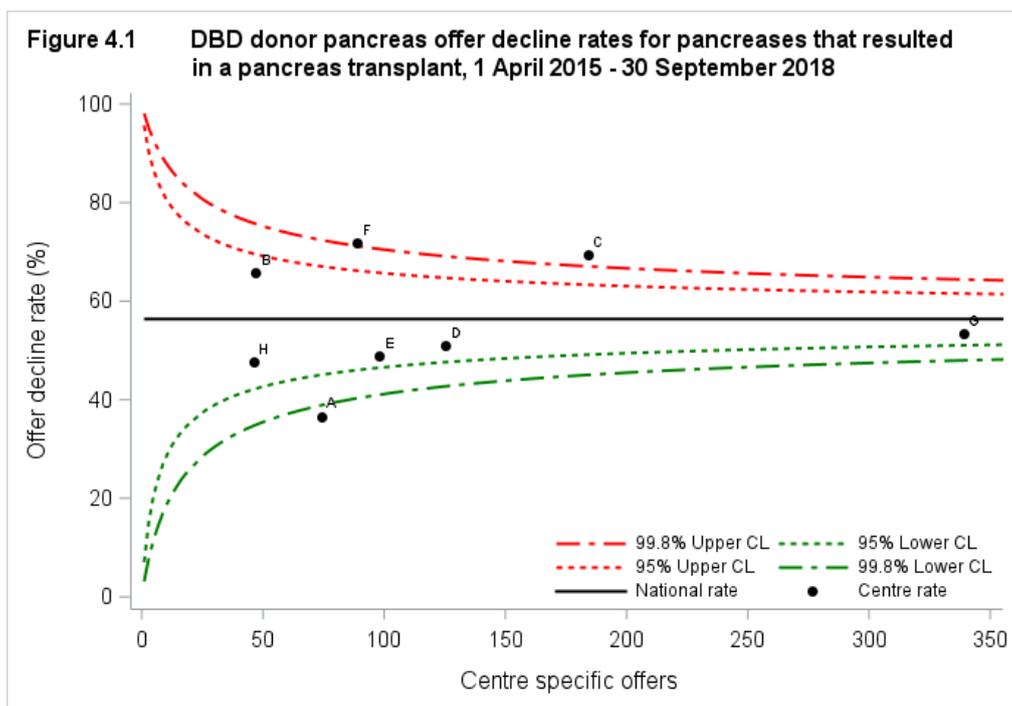


Table 4.1 compares individual centre offer decline rates over time by financial year. The decline rate for Cardiff was 83%, the highest rate, and 29% for Manchester, the lowest rate, from April to September 2018.

Table 4.1 DBD donor pancreas offer decline rates by transplant centre, 1 April 2015 and 30 September 2018											
Centre	Code	2015/16		2016/17		2017/18		Apr - Sep 18		Overall	
		No. offers	(% declined)	No. offers	(% declined)	No. offers	(% declined)	No. offers	(% declined)	No. offers	(% declined)
Cambridge	A	21	(33)	20	(30)	23	(39)	10	(50)	74	(36)
Cardiff	B	22	(68)	4	(0)	15	(73)	6	(83)	47	(66)
Edinburgh	C	58	(72)	56	(64)	48	(73)	22	(68)	184	(70)
Guy's	D	33	(39)	31	(58)	39	(51)	22	(59)	125	(51)
Manchester	E	43	(63)	29	(45)	19	(32)	7	(29)	98	(49)
Newcastle	F	24	(79)	29	(72)	23	(65)	13	(69)	89	(72)
Oxford	G	99	(57)	92	(50)	97	(56)	51	(49)	339	(53)
WLRTC	H	15	(40)	10	(70)	14	(43)	7	(43)	46	(48)
UK		315	(59)	271	(54)	278	(56)	138	(56)	1002	(56)
		<div style="display: flex; flex-direction: column; gap: 5px;"> <div style="background-color: red; width: 20px; height: 10px; display: inline-block;"></div> Centre has reached the upper 99.8% confidence limit <div style="background-color: #f08080; width: 20px; height: 10px; display: inline-block;"></div> Centre has reached the upper 95% confidence limit <div style="background-color: #90ee90; width: 20px; height: 10px; display: inline-block;"></div> Centre has reached the lower 95% confidence limit <div style="background-color: #008000; width: 20px; height: 10px; display: inline-block;"></div> Centre has reached the lower 99.8% confidence limit </div>									

Figure 4.2 compares individual centre offer [DCD](#) decline rates with the national rate over the time period, 1 April 2015 and 30 September 2018. Centres can be identified by the information shown in **Table 4.2**. Guy's and Cambridge had offer decline rates significantly lower than the national rate, whilst Edinburgh and Newcastle had significantly higher rates than the national average.

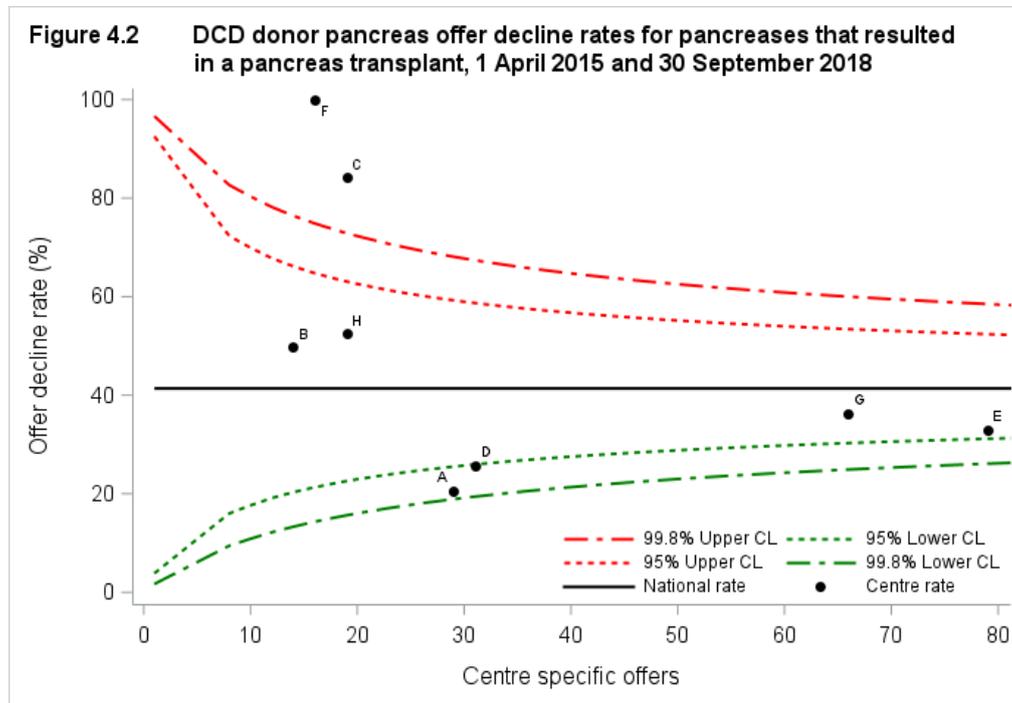


Table 4.2 DCD donor pancreas offer decline rates by transplant centre, 1 April 2015 and 30 September 2018

Centre	Code	2015/16		2016/17		2017/18		Apr - Sep 18		Overall	
		No. offers	(% declined)	No. offers	(% declined)	No. offers	(% declined)	No. offers	(% declined)	No. offers	(% declined)
Cambridge	A	11	(27)	7	(14)	7	(0)	4	(50)	29	(21)
Cardiff	B	3	(33)	3	(67)	5	(60)	3	(33)	14	(50)
Edinburgh	C	7	(100)	4	(100)	6	(50)	2	(100)	19	(84)
Guy's	D	9	(22)	9	(22)	7	(29)	6	(33)	31	(26)
Manchester	E	21	(43)	17	(35)	25	(16)	16	(44)	79	(33)
Newcastle	F	7	(100)	3	(100)	3	(100)	3	(100)	16	(100)
Oxford	G	19	(32)	22	(41)	16	(38)	9	(33)	66	(36)
WLRTC	H	5	(40)	5	(40)	7	(71)	2	(50)	19	(53)
UK		82	(45)	70	(41)	76	(34)	45	(47)	273	(41)

Centre has reached the upper 99.8% confidence limit

Centre has reached the upper 95% confidence limit

Centre has reached the lower 95% confidence limit

Centre has reached the lower 99.8% confidence limit

Pancreas transplants

5.1 Pancreas transplants, 1 October 2013 – 30 September 2018

Figure 5.1 shows the total number of pancreas transplants performed in the last five years, by type of donor. The figure shows that 53 pancreas transplants were from [DCD](#) donors from October 2017 to September 2018; this amounts to 27% of pancreas transplants in that time period. There were 68 [DBD](#) pancreas transplants from April to September 2018, a 13% increase compared to April to September 2017.

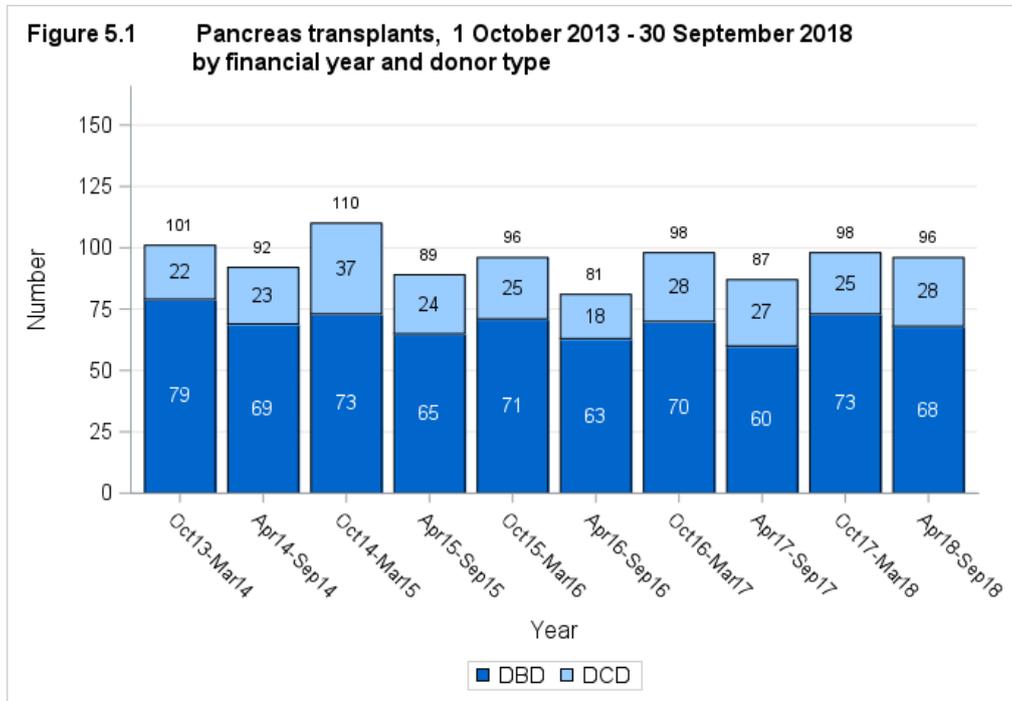


Figure 5.2 shows the total number of pancreas transplants performed from April to September 2018, by centre and type of donor. The same information is presented in **Figure 5.3** but this shows the proportion of [DBD](#) and [DCD](#) transplants performed at each centre.

Oxford performed the most [DBD](#) and [DCD](#) transplants, 36, with 81% being [DBD](#) transplants. There were no [DCD](#) transplants performed at Newcastle and Edinburgh, whilst all other centres had a proportion of 19% or more. Cardiff had the largest proportion of [DCD](#) transplants at 67%, followed by Manchester at 59%.

Figure 5.2 Pancreas transplants, 1 April 2018 - 30 September 2018 by centre and donor type

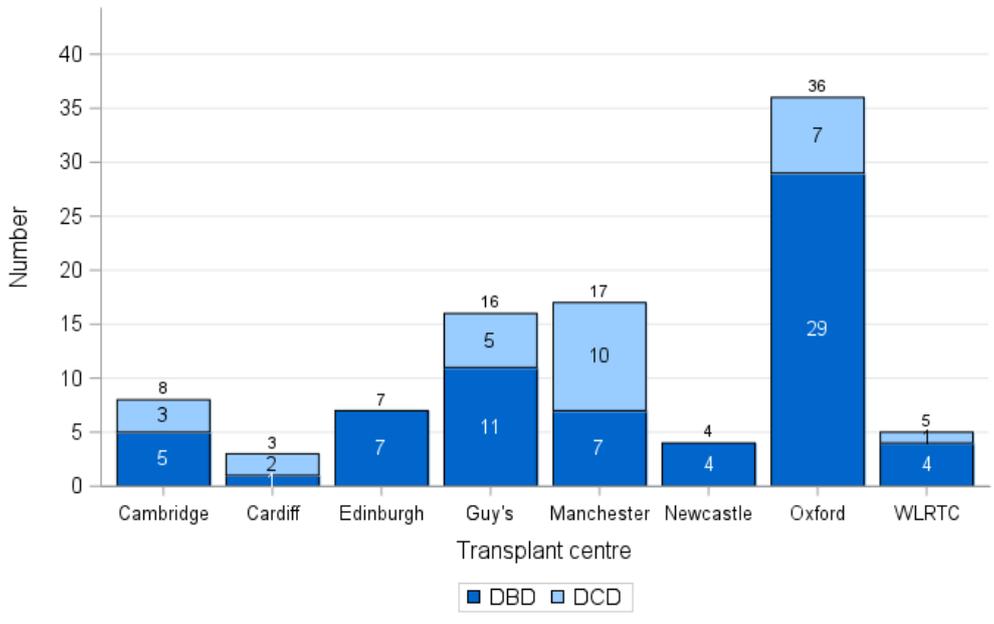
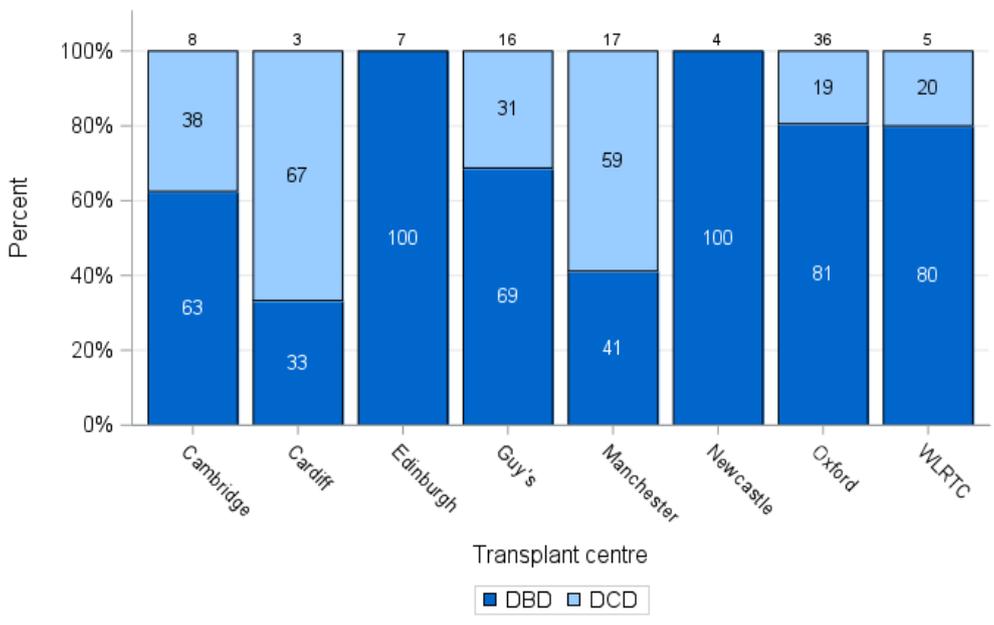


Figure 5.3 Pancreas transplants, 1 April 2018 - 30 September 2018 by centre and donor type



Pancreas outcomes

6.1 Deceased donor graft and patient survival for first SPK transplant

[Funnel plots](#) are used to compare centre specific [risk-adjusted patient](#) and [graft](#) survival rates and indicate how consistent these rates are with the national survival rates. Note that some patients return to local renal units for follow-up care after their transplant and although we report survival according to transplant unit, patients may in fact be followed up quite distantly from their transplant centre. It is important to note that adjusting for patient mix through the use of risk-adjustment models may not account for all possible causes of centre differences. There may be other factors that are not taken into account in the risk-adjustment process that may affect the survival rate of a particular centre.

Figures 6.1 and **6.2** compare individual centre survival estimates with the national rates for one-year [patient](#) and [graft](#) survival for deceased donor first SPK transplants. **Figures 6.3** and **6.4** compare five-year survival estimates. The [funnel plots](#) show that, for the most part, the centres lie within the [confidence limits](#). Some of the [funnel plots](#) show some centres to be above the upper 99.8% [confidence limit](#). This suggests that these centres may have survival rates that are considerably higher than the national rate. None of [funnel plots](#) show centres to be below the lower 95% [confidence limit](#). Centres can be identified by the information shown in **Tables 6.1** and **6.2**.

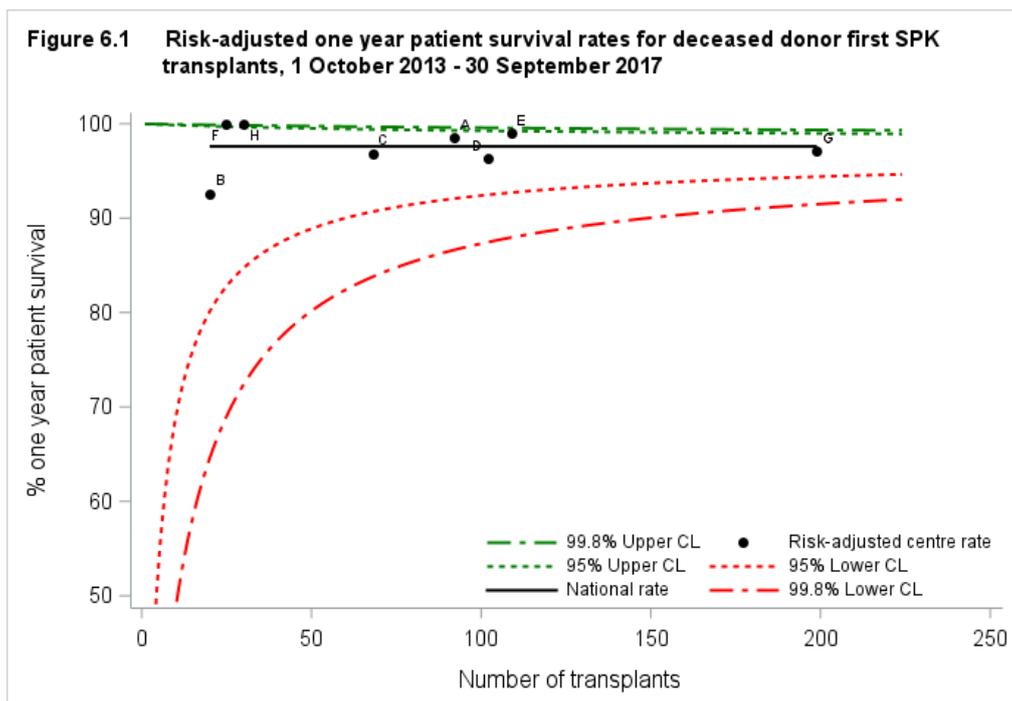


Figure 6.2 Risk-adjusted one year pancreas graft (death censored) survival rates for all deceased donor first SPK transplants, 1 October 2013 - 30 September 2017

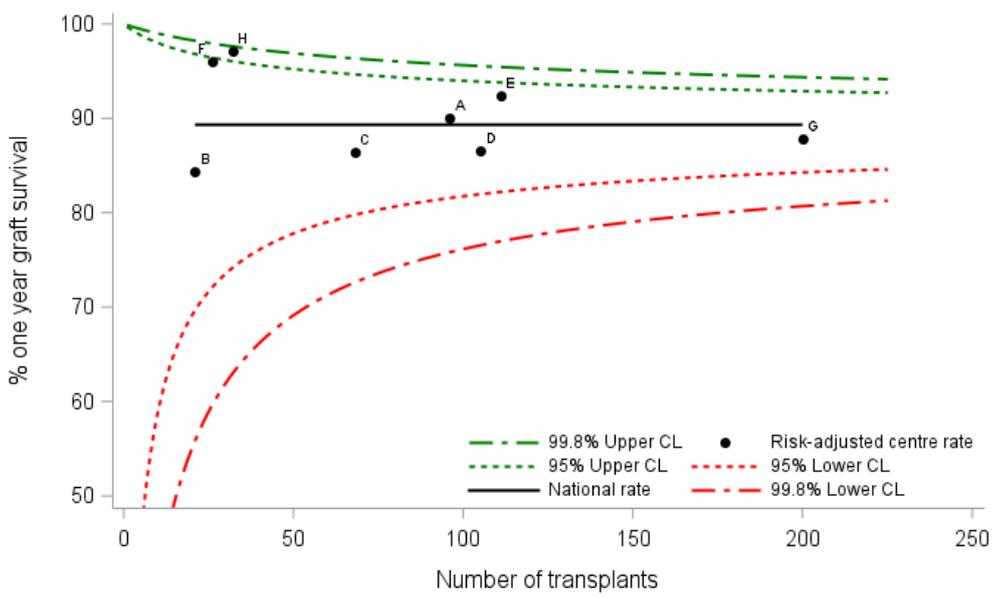


Figure 6.3 Risk-adjusted five year patient survival rates for deceased donor first SPK transplants, 1 October 2009 - 30 September 2013

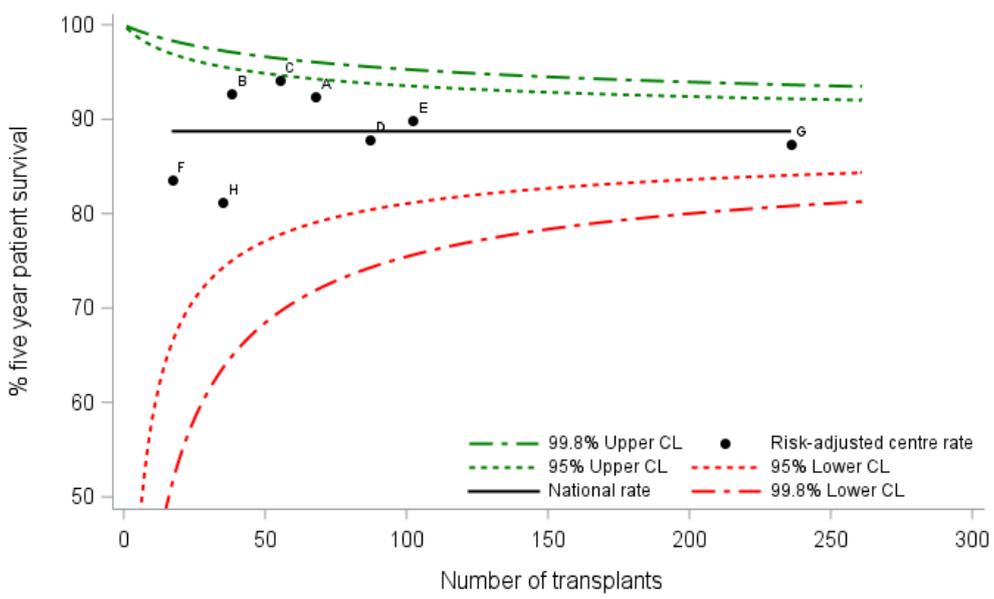


Figure 6.4 Risk-adjusted five year pancreas graft (death censored) survival rates for all deceased donor first SPK transplants, 1 October 2009 - 30 September 2013

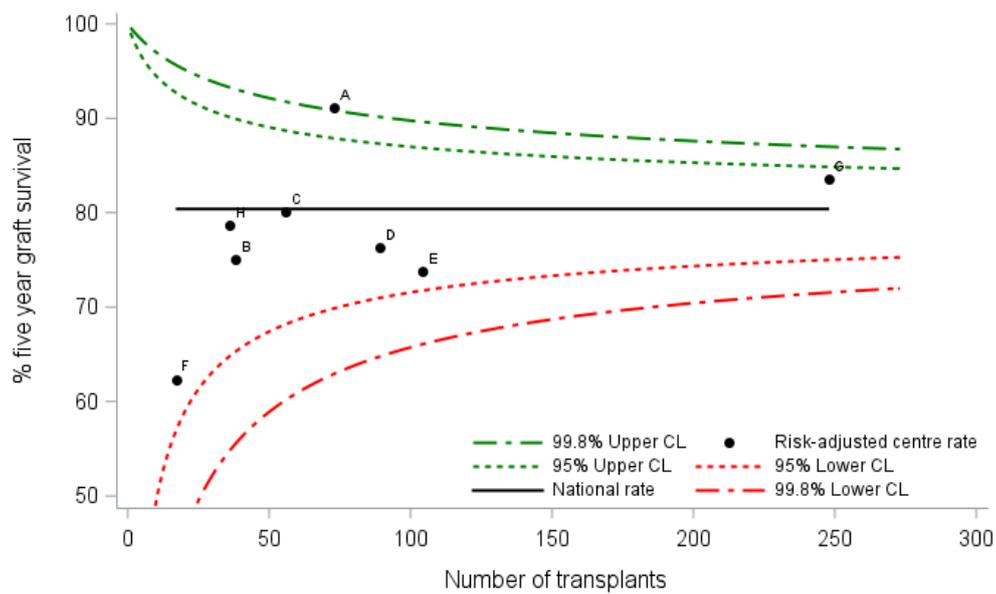


Table 6.1 Risk-adjusted one and five-year patient survival for first SPK transplants using pancreases from deceased donors

Centre	Code	N	patient survival				
			One-year*		Five-year**		
			%	(95% CI)	N	%	(95% CI)
Cambridge	A	92	98	(92 - 100)	68	92	(80 - 98)
Cardiff	B	20	93	(59 - 100)	38	93	(74 - 99)
Edinburgh	C	68	97	(89 - 100)	55	94	(83 - 99)
Guy's	D	102	96	(89 - 99)	87	88	(75 - 95)
Manchester	E	109	99	(94 - 100)	102	90	(81 - 95)
Newcastle	F	25	100	N/A	17	84	(41 - 98)
Oxford	G	199	97	(94 - 99)	236	87	(82 - 91)
WLRTC	H	30	100	N/A	35	81	(56 - 94)
UK		645	98	(96 - 99)	638	89	(86 - 91)

Centre has reached the lower 99.8% confidence limit
 Centre has reached the lower 95% confidence limit
 Centre has reached the upper 95% confidence limit
 Centre has reached the upper 99.8% confidence limit

* Includes transplants performed between 1 October 2013 - 30 September 2017

** Includes transplants performed between 1 October 2009 - 30 September 2013

Table 6.2 Risk-adjusted one and five-year pancreas graft survival for first SPK transplants using pancreases from deceased donors							
Centre	Code	N	pancreas graft survival				
			One-year*		N	Five-year**	
			%	(95% CI)		%	(95% CI)
Cambridge	A	96	90	(81 - 95)	73	91	(82 - 96)
Cardiff	B	21	84	(54 - 97)	38	75	(56 - 88)
Edinburgh	C	68	86	(73 - 94)	56	80	(63 - 90)
Guy's	D	105	87	(77 - 93)	89	76	(64 - 85)
Manchester	E	111	92	(85 - 97)	104	74	(61 - 83)
Newcastle	F	26	96	(78 - 100)	17	62	(18 - 86)
Oxford	G	200	88	(82 - 92)	248	84	(77 - 88)
WLRTC	H	32	97	(84 - 100)	36	79	(56 - 91)
UK		659	89	(87 - 91)	661	80	(77 - 83)

	Centre has reached the lower 99.8% confidence limit
	Centre has reached the lower 95% confidence limit
	Centre has reached the upper 95% confidence limit
	Centre has reached the upper 99.8% confidence limit

* Includes transplants performed between 1 October 2013 - 30 September 2017
** Includes transplants performed between 1 October 2009 - 30 September 2013

6.2 Deceased donor graft and patient survival for first PO transplants

Individual centre survival estimates and national rates for one-year and five-year [patient](#) and pancreas [graft](#) survival for deceased donor first pancreas only (PO) transplants are shown in **Tables 6.3** and **6.4**, respectively. Centre specific estimates of these rates must be interpreted with caution due to the small number of transplants upon which they are based.

Table 6.3 Unadjusted one and five-year patient survival for first PO transplants using pancreases from deceased donors							
Centre	Code	N	patient survival				
			One-year*		N	Five-year**	
			%	(95% CI)		%	(95% CI)
Cambridge	A	0			0		
Cardiff	B	5	-	-	8	-	-
Edinburgh	C	0			1	-	-
Guy's	D	2	-	-	4	-	-
Manchester	E	3	-	-	5	-	-
Newcastle	F	1	-	-	3	-	-
Oxford	G	22	95	(71 - 99)	52	78	(61 - 88)
WLRTC	H	0			0		
UK		33	97	(79 - 100)	73	80	(65 - 89)

* Includes transplants performed between 1 October 2013 - 30 September 2017
** Includes transplants performed between 1 October 2009 - 30 September 2013
- Data not presented where less than 10 transplants included

Table 6.4 Unadjusted one and five-year pancreas graft survival for first PO transplants using pancreases from deceased donors

Centre	Code	N	pancreas graft survival				
			One-year*		Five-year**		
			%	(95% CI)	N	%	(95% CI)
Cambridge	A	2	-	-	1	-	-
Cardiff	B	8	-	-	14	36	(13 - 59)
Edinburgh	C	0	-	-	2	-	-
Guy's	D	2	-	-	7	-	-
Manchester	E	6	-	-	10	30	(7 - 58)
Newcastle	F	4	-	-	6	-	-
Oxford	G	31	86	(68 - 95)	59	59	(45 - 71)
WLRTC	H	2	-	-	9	-	-
UK		55	89	(77 - 95)	108	48	(38 - 57)

* Includes transplants performed between 1 October 2013 - 30 September 2017

** Includes transplants performed between 1 October 2009 - 30 September 2013

- Data not presented where less than 10 transplants included

Islet transplant list

7.1 Patients on the islet transplant list as at 31 March and 30 September, 2014 – 2018

Figure 7.1 shows the number of patients on the islet [transplant list](#) at 31 March and 30 September each year between 2014 and 2018. The number of patients active on the islet [transplant list](#) has increased by 38%, from 21 in March 2017 to 29 in September 2018.

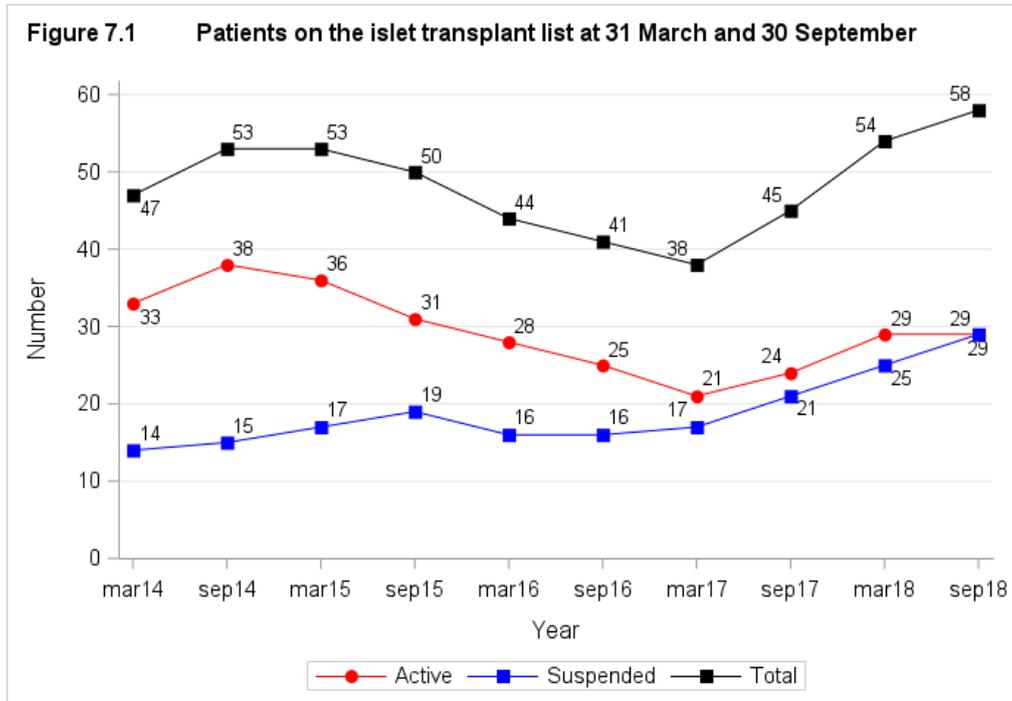
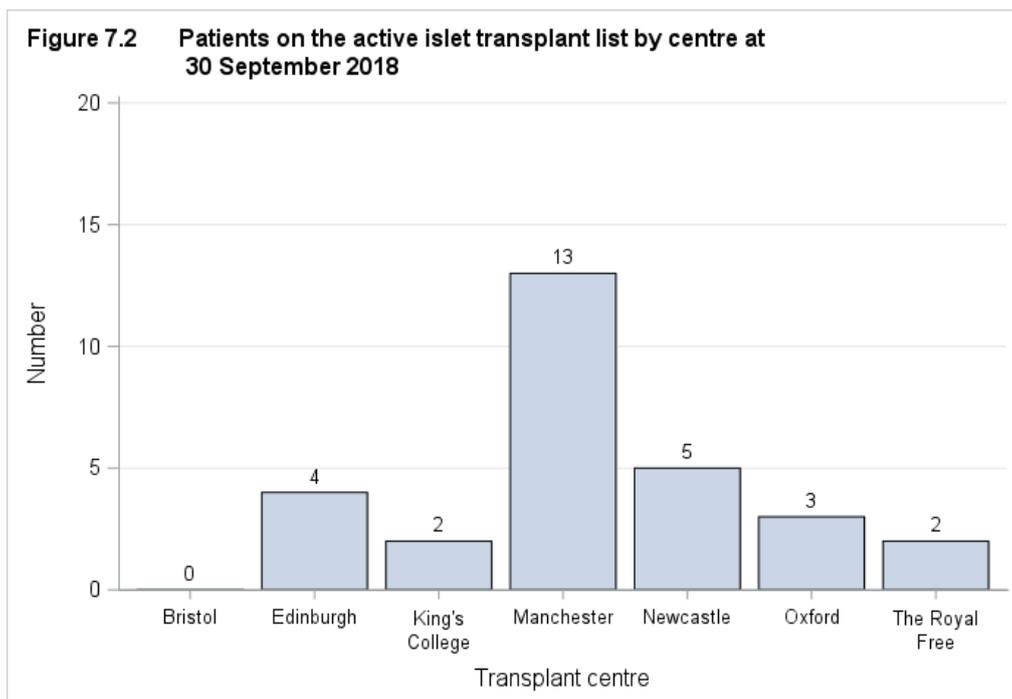


Figure 7.2 shows the number of patients on the active islet [transplant list](#) at 30 September 2018 by centre. 13 (45%) of the patients on the active [transplant list](#) were registered at Manchester, whilst there were no patients on the active list registered at Bristol.



7.2 Median waiting time to transplant, 1 October 2012 – 30 September 2015

The length of time a patient waits for an islet transplant varies across the UK. The [median](#) waiting time for deceased donor islet transplantation is shown in **Figure 7.3** and **Table 7.1** for patients registered at each individual unit.

The [median](#) waiting time to transplant for patients registered on the islet [transplant list](#) between 1 October 2012 and 30 September 2015 is 442 days, over a year, ranging from 357 days at Oxford to 384 days at Edinburgh.

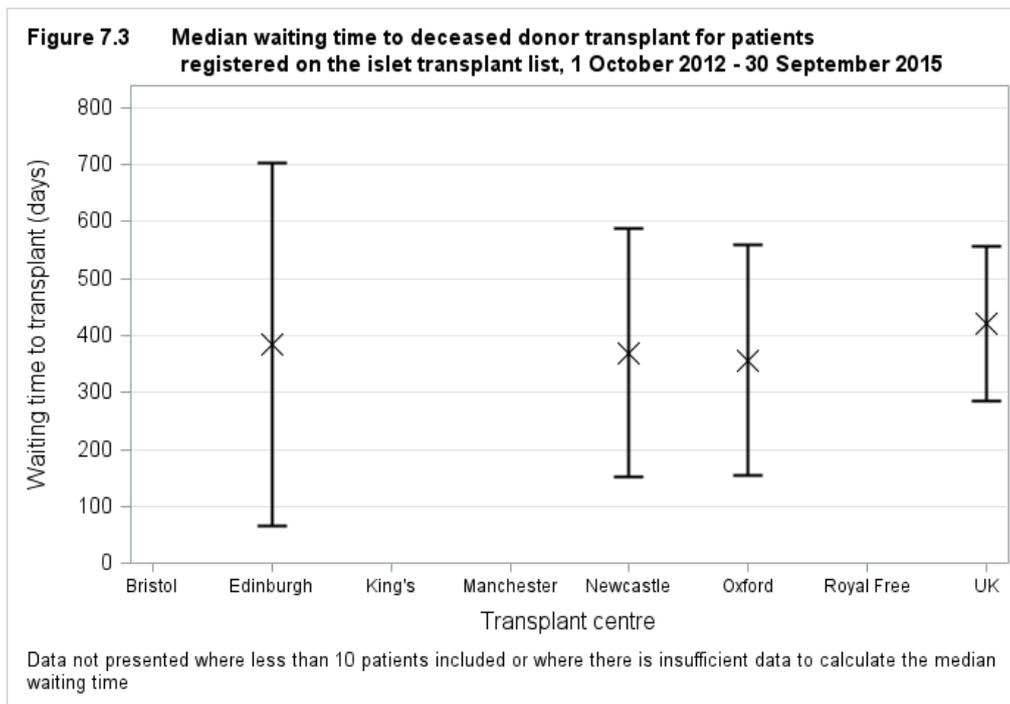


Table 7.1 Median waiting time to islet transplant in the UK, for patients registered 1 October 2012 - 30 September 2015

Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Bristol	0	-	-
Edinburgh	47	384	66 - 702
King's	7	-	-
Manchester	9	-	-
Newcastle	24	370	153 - 587
Oxford	20	357	155 - 559
Royal Free	6	-	-
UK	116	442	286 - 558

- Data not presented where less than 10 patients included

Islet transplants

8.1 Islet transplants, 1 October 2013 – 30 September 2018

Figure 8.1 shows the total number of islet transplants performed in the last five years by type of donor. The number of islet transplants has ranged from 10 to 19 from October 2013 to September 2018, by six-month periods. Of these, [DCD](#) islet transplants have ranged from 0 to 5. In the last two six-month periods, the total number of islet transplants has remained constant at 14 transplants.

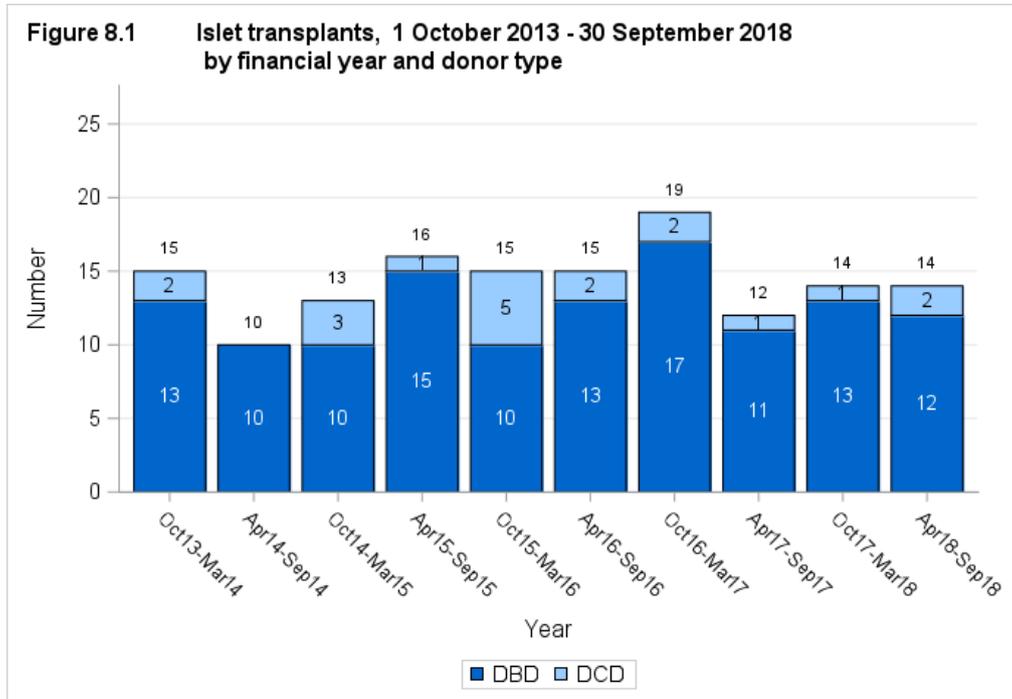


Figure 8.2 shows the total number of islet transplants performed from April to September 2018, by centre and type of donor. The same information is presented in **Figure 8.3**, but this shows the proportion of [DBD](#) and [DCD](#) transplants performed at each centre.

Edinburgh performed the most islet transplants followed by Newcastle from April to September 2018 (five and four, respectively). The only [DCD](#) transplants in the time frame were performed in Manchester.

Figure 8.2 Islet transplants, 1 April 2018 - 30 September 2018 by centre and donor type

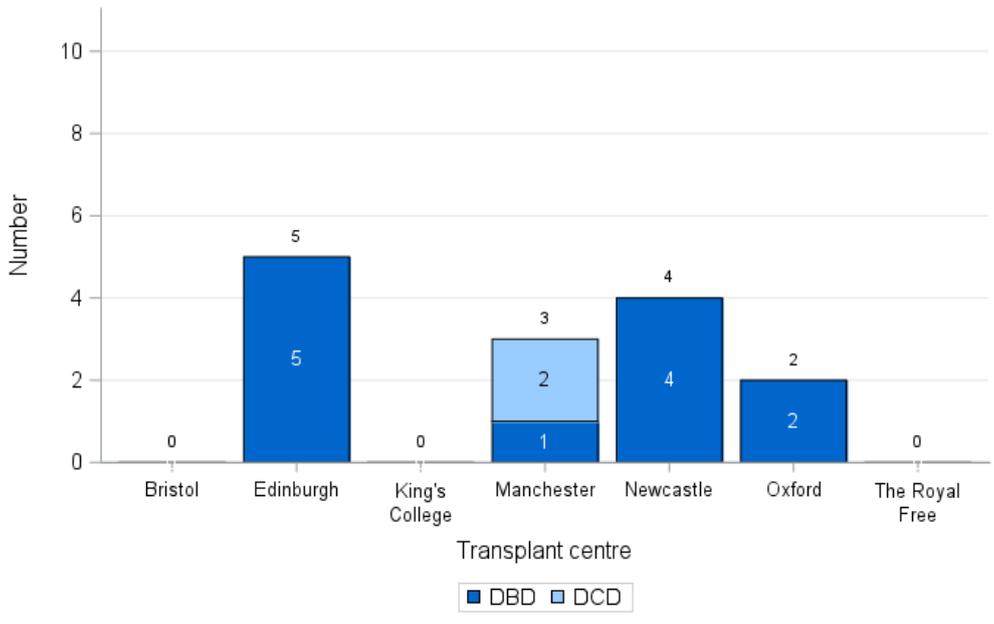
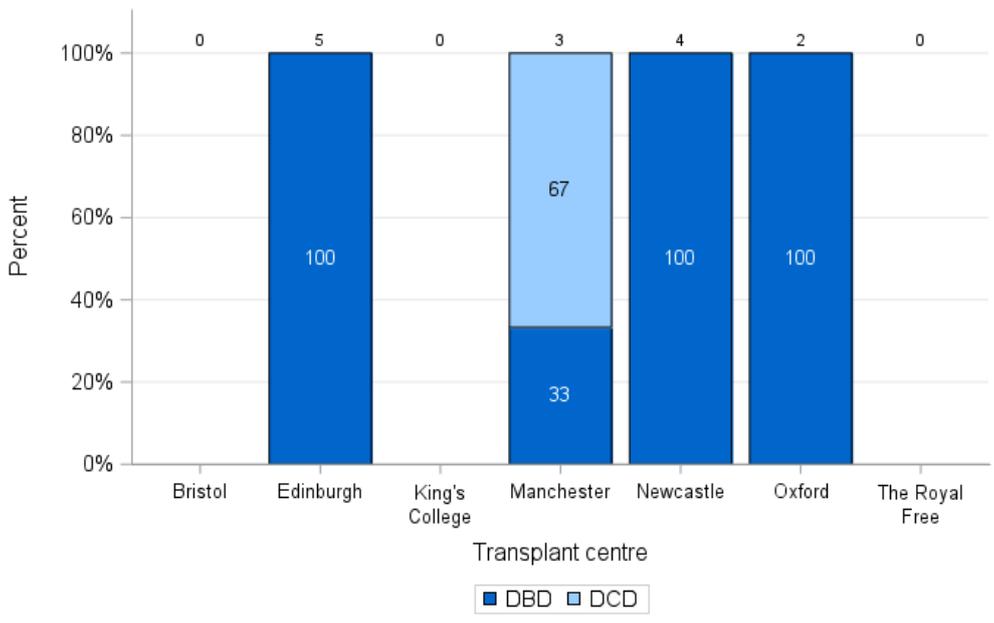


Figure 8.3 Islet transplants, 1 April 2018 - 30 September 2018 by centre and donor type



Appendix

A1 Glossary of terms

ABO

The most important human blood group system for transplantation is the ABO system. Every human being is of blood group O, A, B, AB, or one of the minor variants of these four groups. ABO blood groups are present on other tissues and, unless special precautions are taken, a blood group A pancreas transplanted to a blood group O patient will be rapidly rejected.

Active transplant list

When a patient is registered for a transplant, they are registered on what is called the 'active' transplant list. This means that when a donor pancreas becomes available, the patient is included among those who are matched against the donor to determine whether or not the pancreas is suitable for them. It may sometimes be necessary to take a patient off the transplant list, either temporarily or permanently. This may be done, for example, if someone becomes too ill to receive a transplant. The patient is told about the decision to suspend them from the list and is informed whether the suspension is temporary or permanent. If a patient is suspended from the list, they are not included in the matching of any donor pancreases that become available.

Calculated Reaction Frequency (cRF)

For a given patient with detectable [HLA](#) antibodies, the proportion of blood group identical donors from a pool of 10,000 and for which they would be [HLA](#) incompatible is calculated. This percentage of donors is termed the 'calculated Reaction Frequency' (cRF), more commonly referred to as the [sensitisation](#) level. Patients with no detectable [HLA](#) antibodies will have 0 [sensitisation](#) (0% cRF).

Case mix

The types of patients treated at a unit for a common condition. This can vary across units depending on the facilities available at the unit as well as the types of people in the catchment area of the unit. The definition of what type of patient a person is depends on the patient characteristics that influence the outcome of the treatment. For example the case mix for patients registered for a pancreas transplant is defined in terms of various factors such as the blood group, tissue type and age of the patient. These factors have an influence on the chance of a patient receiving a transplant.

Cold ischaemia time (CIT)

The length of time that elapses between a pancreas being removed from the donor to its transplantation into the recipient is called the Cold Ischaemia Time (CIT). Generally, the shorter this time, the more likely the pancreas is to work immediately and the better the long-term outcome. The factors which determine CIT include a) transportation of the pancreas from the retrieval hospital to the hospital where the transplant is performed, b) the need to tissue type the donor and [cross-match](#) the donor and potential recipients, c) the occasional necessity of moving the pancreas to another hospital if a transplant cannot go ahead, d) contacting and preparing the recipient for the transplant, and e) access to the operating theatre.

Confidence interval (CI)

When an estimate of a quantity such as a survival rate is obtained from data, the value of the estimate depends on the set of patients whose data were used. If, by chance, data from a different set of patients had been used, the value of the estimate may have been different. There is therefore some uncertainty linked with any estimate. A confidence

interval is a range of values whose width gives an indication of the uncertainty or precision of an estimate. The number of transplants or patients analysed influences the width of a confidence interval. Smaller data sets tend to lead to wider confidence intervals compared to larger data sets. Estimates from larger data sets are therefore more precise than those from smaller data sets. Confidence intervals are calculated with a stated probability, usually 95%. We then say that there is a 95% chance that the confidence interval includes the true value of the quantity we wish to estimate.

Confidence limit

The upper and lower bounds of a confidence interval.

Cox Proportional Hazards model

A statistical model that relates the instantaneous risk (hazard) of an event occurring at a given time point to the [risk factors](#) that influence the length of time it takes for the event to occur. This model can be used to compare the hazard of an event of interest, such as graft failure or patient death, across different groups of patients.

Cross-match

A cross-match is a test for patient antibodies against donor antigens. A positive cross-match shows that the donor and patient are incompatible. A negative cross-match means there is no reaction between donor and patient and that the transplant may proceed.

Donor after brain death

A donor whose heart is still beating when their entire brain has stopped working so that they cannot survive without the use of a ventilator. Organs for transplant are removed from the donor while their heart is still beating, but only after extensive tests determine that the brain cannot recover and they have been certified dead.

Donor after circulatory death

A donor whose heart stops beating before their brain stops working and who is then certified dead. The organs are then removed.

Funnel plot

A graphical method that shows how consistent the survival rates of the different transplant units are compared to the national rate. The graph shows for each unit, a survival rate plotted against the number of transplants undertaken, with the national rate and confidence limits around this national rate superimposed. In this report, 95% and 99.8% confidence limits were used. Units that lie within the confidence limits have survival rates that are statistically consistent with the national rate. When a unit is close to or outside the limits, this is an indication that the centre may have a rate that is considerably different from the national rate.

Graft survival rate

The percentage of patients whose grafts are still functioning. This is usually specified for a given time period after transplant. For example, a five-year transplant survival rate is the percentage of transplants still functioning five years after transplant. For the purposes of pancreas transplantation, graft failure is defined as a return to permanent insulin dependence while for islet transplantation graft failure is defined as a C-peptide less than 50 pmol/l.

HbA1c

HbA1c refers to glycated haemoglobin which is measured by clinicians to obtain an overall picture of an individual's average blood sugar levels over a particular period. HbA1c is a valuable indicator of diabetes control.

HLA mismatch

Human Leucocyte Antigen (HLA) antigens are carried on many cells in the body and the immune system can distinguish between those that can be recognised as 'self' (belonging to you or identical to your own) and those that can be recognised as 'nonself'. The normal response of the immune system is to attack foreign/non-self material by producing antibodies against the foreign material. This is one of the mechanisms that provide protection against infection. This is unfortunate from the point of view of transplantation as the immune system will see the graft as just another 'infection' to be destroyed, produce antibodies against the graft and rejection of the grafted organ will take place. To help overcome this response, it is recognised that 'matching' the recipient and donor on the basis of HLA (and blood group) reduces the chances of acute rejection and, with the added use of immunosuppressive drugs, very much improves the chances of graft survival. 'Matching' refers to the similarity of the recipient HLA type and donor HLA type. HLA mismatch refers to the number of mismatches between the donor and the recipient at the A, B and DR (HLA) loci. There can only be a total of two mismatches at each locus. For example, an HLA mismatch value of 000, means that the donor and recipient are identical at all three loci, while an HLA mismatch value of 210 means that the donor and recipient differ completely at the A locus, are partly the same at the B locus and are identical at the DR locus.

Hypoglycaemia

Hypoglycaemia occurs when the level of glucose present in the blood falls below a set point and is the most common complication of insulin therapy. Severe hypoglycaemia is defined as having low blood glucose levels that requires third party assistance to treat and is classed as a diabetic emergency.

Inter-quartile range

The values between which the middle 50% of the data fall. The lower boundary is the lower quartile, the upper boundary the upper quartile.

Kaplan-Meier method

A method that allows patients with incomplete follow-up information to be included in estimating survival rates. For example, in a cohort for estimating one year patient survival rates, a patient was followed up for only nine months before they relocated. If we calculated a crude survival estimate using the number of patients who survived for at least a year, this patient would have to be excluded as it is not known whether or not the patient was still alive at one year after transplant. The Kaplan-Meier method allows information about such patients to be used for the length of time that they are followed-up, when this information would otherwise be discarded. Such instances of incomplete follow-up are not uncommon and the Kaplan-Meier method allows the computation of estimates that are more meaningful in these cases.

Median

The midpoint in a series of numbers, so that half the data values are larger than the median, and half are smaller.

Multi-organ transplant

A transplant in which the patient receives more than one organ. For example, a patient may undergo a transplant of a pancreas and liver. Intestinal transplants involving a pancreas are excluded from the whole report.

National Pancreas Allocation Scheme

A nationally agreed set of rules for sharing and allocating deceased donor pancreases for pancreas or islet transplant between transplant centres in the UK. The scheme was introduced on 1 December 2010 and is administered by NHS Blood and Transplant. Prior to December 2010 deceased donors were allocated on a centre basis.

The Pancreas Allocation Scheme prioritises all blood group eligible patients and assigns an individual point score to all patients based on a number of clinically relevant donor, recipient and transplant related factors. The individual points score assigns more points to patients with lower levels of [HLA mismatch](#), longer waiting times, higher levels of patient [sensitisation](#), short travel times between retrieval to transplant centre, longer duration of dialysis and better donor to recipient age matching. In addition, donors with a lower BMI are clinically desirable for pancreas transplantation whereas donors with a higher BMI are preferable for islet transplantation. As a result, where the donor has a low BMI more points are awarded for patients waiting for a pancreas transplant and where the donor has a high BMI more points are awarded to islet patients. Patients listed nationally for either a pancreas or islet transplant are then ranked by their total points score and the pancreas is offered preferentially to the patient with the highest total number of points, no matter where in the UK they receive their treatment or whether they are waiting for a pancreas or islet transplant.

Patient survival rate

The percentage of patients who are still alive (whether the graft is still functioning or not). This is usually specified for a given time period after transplant. For example, a five-year patient survival rate is the percentage of patients who are still alive five years after their first transplant.

***p* value**

In the context of comparing survival rates across centres, the *p* value is the probability that the differences observed in the rates across centres occurred by chance. As this is a probability, it takes values between 0 and 1. If the *p* value is small, say less than 0.05, this implies that the differences are unlikely to be due to chance and there may be some identifiable cause for these differences. If the *p* value is large, say greater than 0.1, then it is quite likely that any differences seen are due to chance.

Risk-adjusted survival rate

Some transplants have a higher chance than others of failing at any given time. The differences in expected survival times arise due to differences in certain factors, the [risk factors](#), among patients. A risk-adjusted survival rate for a centre is the expected survival rate for that centre given the case mix of their patients. Adjusting for case mix in estimating centre-specific survival rates allows valid comparison of these rates across centres and to the national rate.

Risk factors

These are the characteristics of a patient, transplant or donor that influence the length of time that a graft is likely to function or a patient is likely to survive following a transplant.

For example, when all else is equal, a transplant from a younger donor is expected to survive longer than that from an older donor and so donor age is a risk factor.

Sensitisation

Potential recipients can develop a number of different [HLA](#) antibodies as a result of exposure to the different [HLA](#) antigens through blood transfusion, previous transplants and pregnancy. Many patients however, have no detectable [HLA](#) antibodies. If a potential recipient has an antibody to an [HLA](#) antigen then they cannot receive a transplant from a donor with that [HLA](#) antigen, thus restricting the pool of potential donors. Patients who are clinically incompatible with the donor are excluded from the offering sequence by the [Pancreas Allocation Scheme](#).

Unadjusted survival rate

Unadjusted survival rates do not take account of [risk factors](#) and are based only on the number of transplants at a given centre and the number and timing of those that fail within the post-transplant period of interest. In this case, unlike for risk-adjusted rates, all transplants are assumed to be equally likely to fail at any given time. However, some centres may have lower unadjusted survival rates than others simply because they tend to undertake transplants that have increased risks of failure. Comparison of unadjusted survival rates across centres and to the national rate is therefore inappropriate.

A2 Statistical methodology and risk-adjustment for survival rate estimation

[Unadjusted](#) and [risk-adjusted](#) estimates of [patient](#) and [graft](#) survival for pancreas and simultaneous pancreas and kidney (SPK) transplant are given for each centre.

[Unadjusted](#) rates give an estimate of what the survival rate at a centre is, assuming that all patients at the centre have the same chance of surviving a given length of time after transplant. In reality, patients differ and a [risk-adjusted](#) rate that allows for these differences would give a more meaningful estimate of survival.

Computing unadjusted survival rates

[Unadjusted](#) survival rates were calculated using the [Kaplan-Meier](#) method, which allows patients with incomplete follow-up information to be included in the computation. For example, in a cohort for estimating one-year [patient](#) survival rates, a patient was followed up for only nine months before they relocated. If we calculated a crude survival estimate using the number of patients who survived for at least a year, this patient would have to be excluded, as it is not known whether or not the patient was still alive one year after transplant. The [Kaplan-Meier](#) method allows information about such patients to be used for the length of time that they are followed-up, when this information would otherwise be discarded. Such instances of incomplete follow-up are not uncommon in the analysis of survival data and the [Kaplan-Meier](#) method therefore allows the computation of survival estimates that are more meaningful.

Computing risk-adjusted survival rates

A [risk-adjusted](#) survival rate is an estimate of what the survival rate at a centre would have been if they had had the same mix of patients as that seen nationally. The [risk-adjusted](#) rate therefore presents estimates in which differences in patient mix across centres have been removed as much as possible. For that reason, it is valid to only compare centres using [risk-adjusted](#) rather than [unadjusted](#) rates, as differences among the latter can be attributed to differences in patient mix.

[Risk-adjusted](#) survival estimates were obtained through indirect standardisation. A [Cox](#) Proportional Hazards model was used to determine the probability of survival for each patient based on their individual risk factor values. The sum of these probabilities for all patients at a centre gives the number, E, of patients or grafts expected to survive at least one year or five years after transplant at that centre. The number of patients who actually survive the given time period is given by O. The [risk-adjusted](#) estimate is then calculated by multiplying the ratio O/E by the overall [unadjusted](#) survival rate across all centres. The risk-adjustment models used were based on results from previous studies that looked at factors affecting the survival rates of interest. The factors included in the models are shown in the table below.

First transplants from deceased donors

Simultaneous pancreas and kidney (SPK) and pancreas only survival

1 and 5 year [patient](#) and [graft](#) survival Donor age, donor type, donor BMI and waiting time

Funnel plots for comparing risk-adjusted survival rates

The [funnel plot](#) is a graphical method to show how consistent the survival rates of the different transplant centres are compared to the national rate. The graph shows for each centre, a survival rate plotted against the number of transplants undertaken, with the national rate and [confidence limits](#) around this national rate superimposed. In this report,

95% and 99.8% [confidence limits](#) were used. Units that lie within the [confidence limits](#) have survival rates that are statistically consistent with the national rate. When a unit is close to or outside the limits, this is an indication that the centre may have a rate that is considerably different from the national rate.

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