



Blood and Transplant

ANNUAL REPORT ON PANCREAS AND ISLET TRANSPLANTATION

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Executive Summary

This report presents key figures about pancreas and islet transplantation in the UK. The period reported covers 10 years of pancreas transplant data, from 1 April 2006 and seven years of islet transplant data, from 1 April 2008. The report presents information on the number of transplants and survival analysis after first simultaneous pancreas and kidney and pancreas only transplantation on a national and centre-specific basis.

Key findings

- On the 31 March 2016, there were 227 patients on the UK active pancreas and islet [transplant list](#), which represents a 6% decrease in number of patients a year earlier. The number of patients on the active pancreas list decreased by 8% to 199 in 2016 while the active islet [transplant list](#) decreased by 22% to 28 patients in the same time period.
- There were 2,219 pancreas transplants performed in the UK in the ten year period and 183 islet transplants performed in the eight years since islet transplantation was first commissioned in the UK. The number of transplants from [donations after brain death](#) has decreased slightly in the last year to 161. However, the number of transplants from [donations after circulatory death](#) has decreased by 17% in the last year to 52.
- The national rates of [graft](#) survival one- and five-years after first simultaneous pancreas and kidney transplant from deceased donors are 87% and 74%, respectively. These rates vary between centres, ranging from 78% to 94% at one-year and 47% to 83% 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 96% and 85%, respectively. These rates vary between centres, ranging from 94% to 98% at one-year and 81% to 90% 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 75% and 45%, respectively. The national rates of patient survival one- and five-years are 98% and 78%. Centre specific estimates of these rates must be interpreted with caution due to the small number of transplants upon which they are based.
- The national rate of ten year [patient](#) survival from listing for deceased donor simultaneous pancreas and kidney transplant is 73%. These rates vary between centres, ranging from 66% to 82%. All centre rates are [risk-adjusted](#).
- Reductions in annual rate of severe [hypoglycaemic](#) events, [HbA1c](#), and insulin dose have been reported at one-year post routine islet transplant.

Use of the contents of this report should be acknowledged as follows:

Annual Report on Pancreas and Islet Transplantation 2015/16, NHS Blood and Transplant

Introduction

This report presents information on pancreas transplant activity between 1 April 2006 and 31 March 2016, for all eight centres performing pancreas transplantation in the UK. Information on islet transplant activity is presented for all seven centres performing islet transplantation, since 1 April 2008 when islet transplantation was first commissioned in the UK. Cambridge, Cardiff, Guy's and WLRTC only perform pancreas transplants while Bristol, King's College and the Royal Free only perform islet transplants. Throughout this report West London Renal and Transplant Centre is labeled as WLRTC.

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 April 2011 to 31 March 2015 and five-year post-transplant for the period 1 April 2007 to 31 March 2011.

Islet transplant survival is measured by four key variables: graft survival, and a reduction in [HbA1c](#), insulin requirements and the annual rate of severe [hypoglycaemic](#) events. Islet outcomes are reported at one-year post-transplant for the period 1 April 2009 to 31 March 2015 for the national cohort only. Islet outcomes are [unadjusted](#) for risk. Islet outcome data from the UK Transplant Registry is supplemented by data collected from the UK Islet Transplant Consortium.

Pancreas [patient](#) survival from listing is reported at one, five and ten year post registration for a deceased donor pancreas, simultaneous pancreas and kidney (SPK) or islet transplant between 1 January 2004 and 31 December 2015.

The centre specific results for survival estimates are adjusted for differences in [risk factors](#) between the centres. The risk models and methods used are described in the Appendix.

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

Figure 2.1 shows the number of patients on the pancreas and islet [transplant list](#) at 31 March each year between 2007 and 2016. The number of patients actively waiting for a pancreas or islet transplant increased each year from 183 in 2007 to 333 in 2010, falling to 252 in 2012 and has since remained fairly steady with 227 patients active on 31 March 2016.

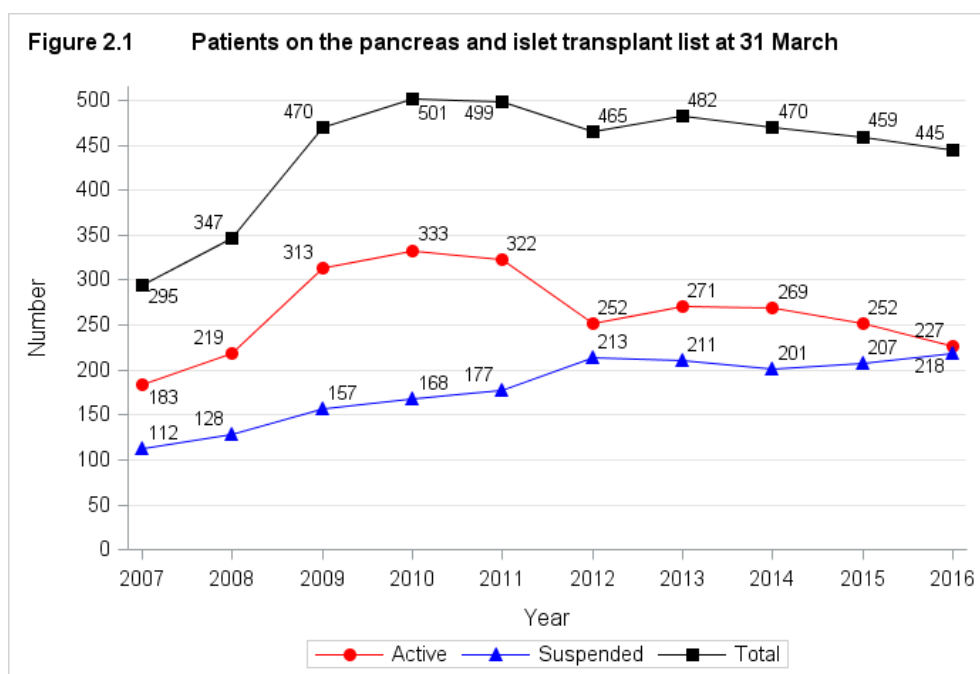


Figure 2.2 shows the number of patients on the pancreas and islet [transplant list](#) at 31 March 2016 for each transplant centre. Oxford has the largest [transplant list](#) with 77 patients registered for a pancreas or islet transplant. Of these patients, 64 are registered for a simultaneous pancreas and kidney (SPK) transplant, 8 are registered for a pancreas only transplant and 5 are registered for an islet transplant.

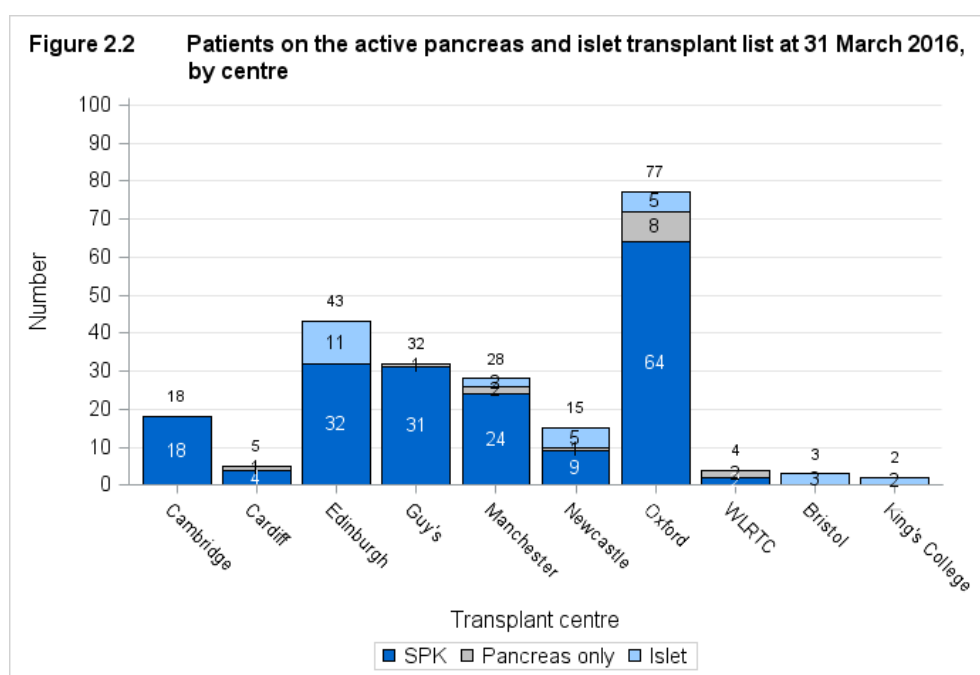


Figure 2.3 shows the total number of pancreas and islet transplants performed in the last ten years. Transplant numbers steadily increased from 214 in 2008/09 to 246 in 2013/14. However, the number of transplants performed in 2014/15 has decreased to 226 and further to 216 in 2015/16. In particular the number of pancreas only transplants has decreased from 29 transplants in 2014/15 to 18 in 2015/16.

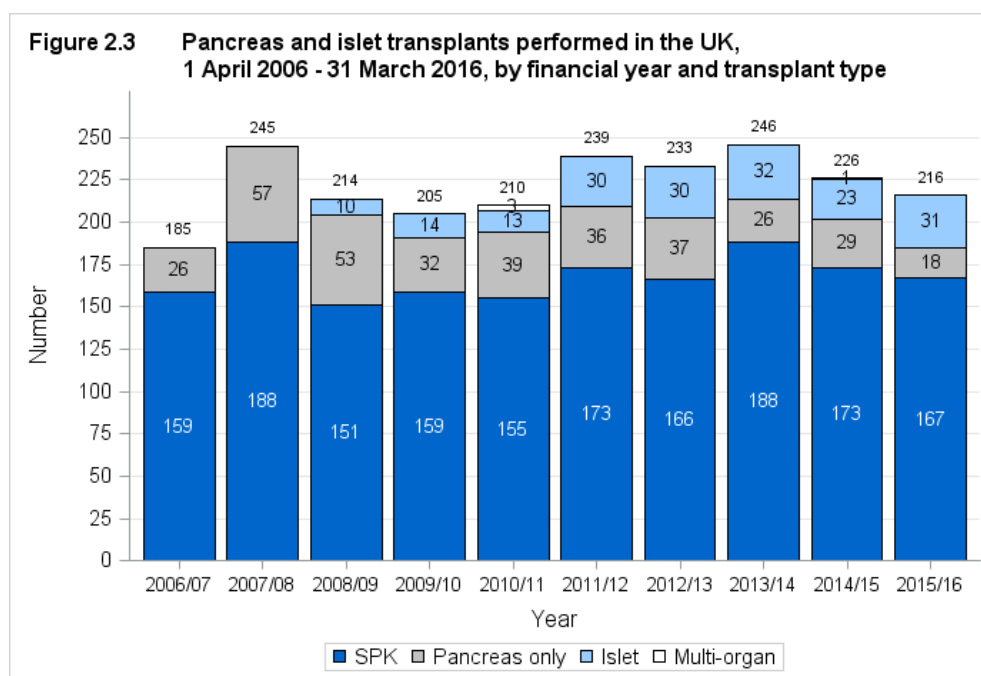


Figure 2.4 shows the total number of pancreas and islet transplants performed in 2015/16 at each transplant centre. Oxford performed the most pancreas and islet transplants last year, a total of 60 transplants. Edinburgh performed the most islet transplants (19). The Royal Free performed no transplants during the last financial year.

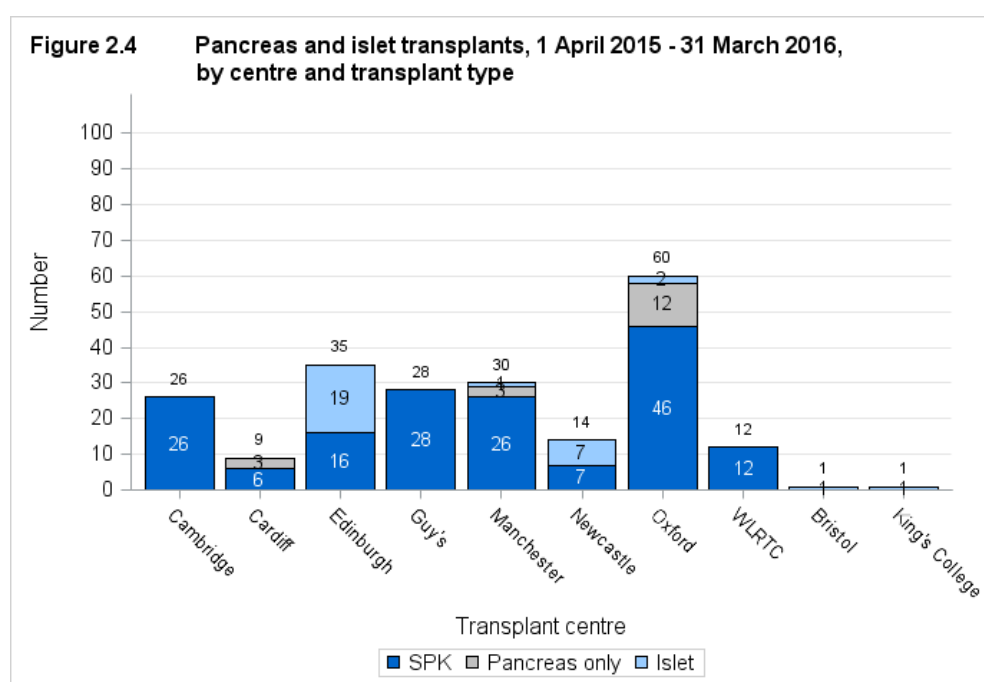
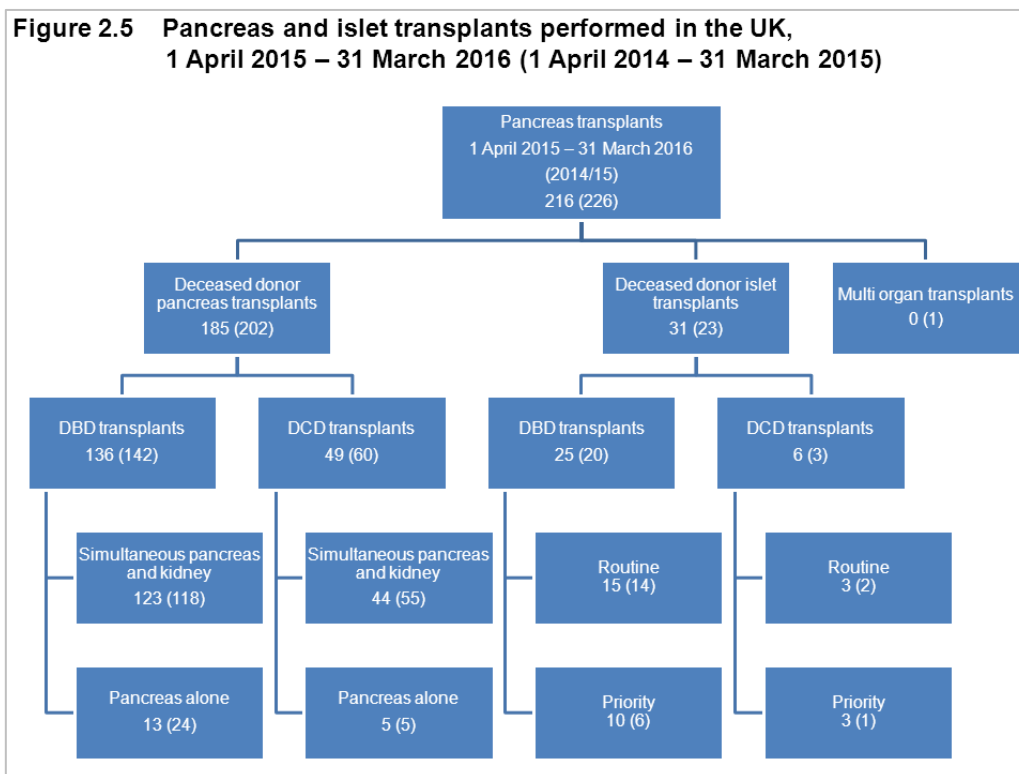


Figure 2.5 details the 216 pancreas and islet transplants performed in the UK between 1 April 2015 and 31 March 2016. Data for transplants performed in 2014/15 are also presented. The overall number of pancreas and islet transplants performed in 2015/16 has fallen compared with 2014/15, particularly in the number of pancreas alone transplants.



Pancreas transplant list

3.1 Patients on the pancreas transplant list as at 31 March, 2007 – 2016

Figure 3.1 shows the number of patients on the pancreas [transplant list](#) at 31 March each year between 2007 and 2016. The number of patients actively waiting for a pancreas transplant increased from 183 in 2007 to 316 in 2010 and then fell to 228 in 2012. Since then, numbers have remained fairly consistent and 199 patients were listed for a pancreas transplant at 31 March 2016.

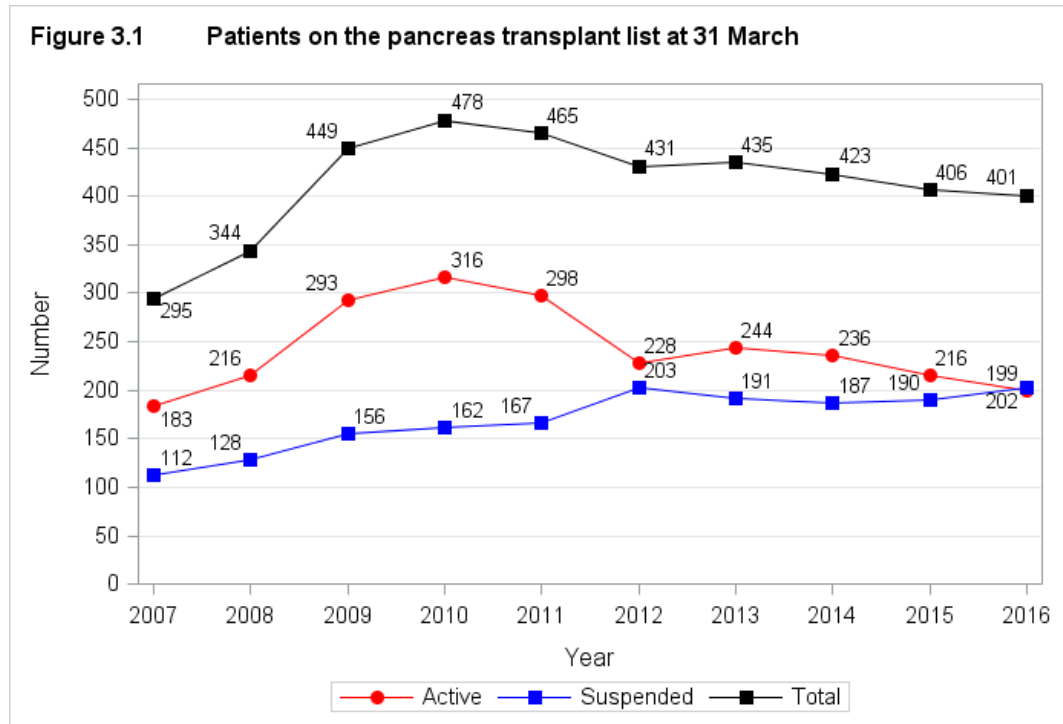


Figure 3.2 shows the number of patients on the active pancreas [transplant list](#) at 31 March 2016 by centre. Oxford had the largest proportion of the [transplant list](#) (36%) and WLRTC had the smallest proportion (2%).

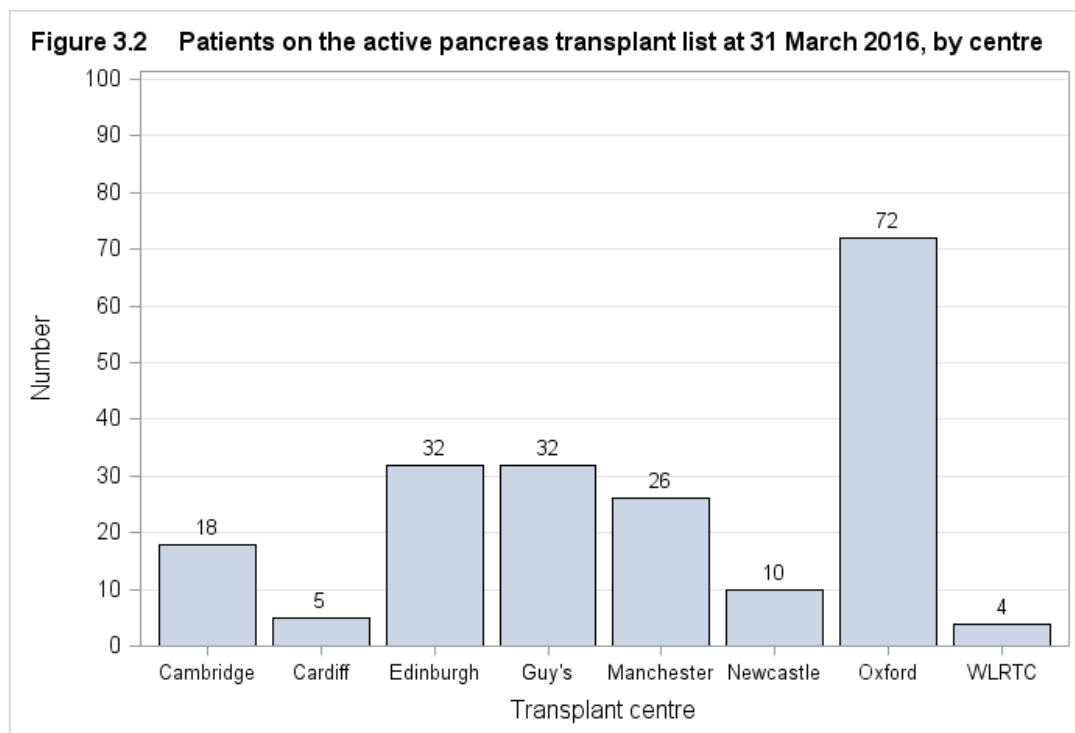
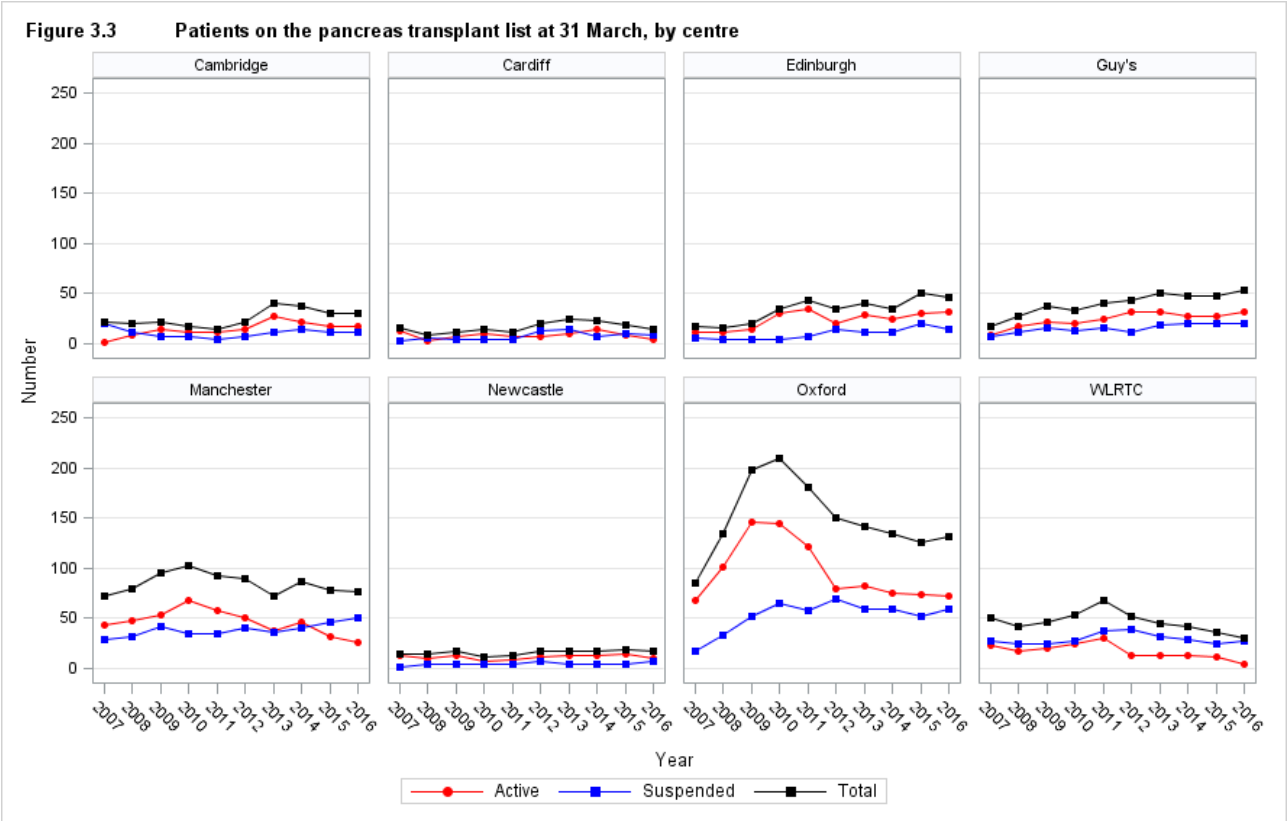


Figure 3.3 shows the number of patients on the pancreas [transplant list](#) at 31 March each year between 2007 and 2016 for each transplant centre.



3.2 Post-registration outcomes, 1 April 2012 – 31 March 2013

An indication of outcomes for patients listed for a pancreas transplant is summarised in **Figure 3.4**. This shows the proportion of patients transplanted or still waiting one and three years after joining the list. It also shows the proportion removed from the [transplant list](#) (typically because they become too unwell for transplant) and those dying while on the [transplant list](#). Only 35% of patients registered between 1 April 2012 and 31 March 2013 were transplanted within one year, while three years after listing 77% of patients had received a transplant. 6% of patients had died waiting for a transplant within 3 years of listing.

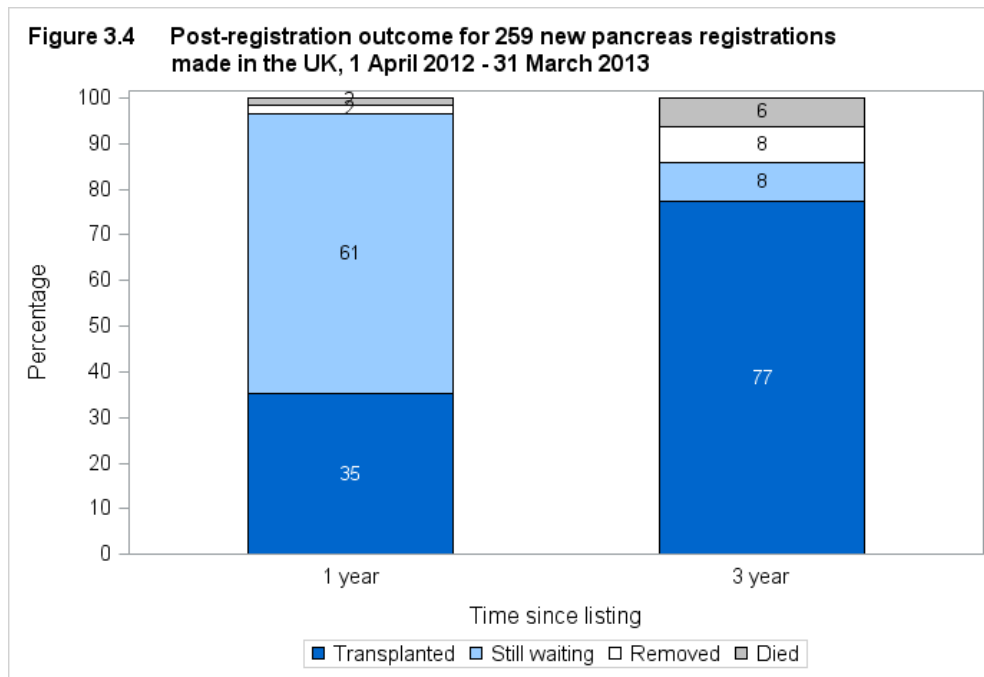
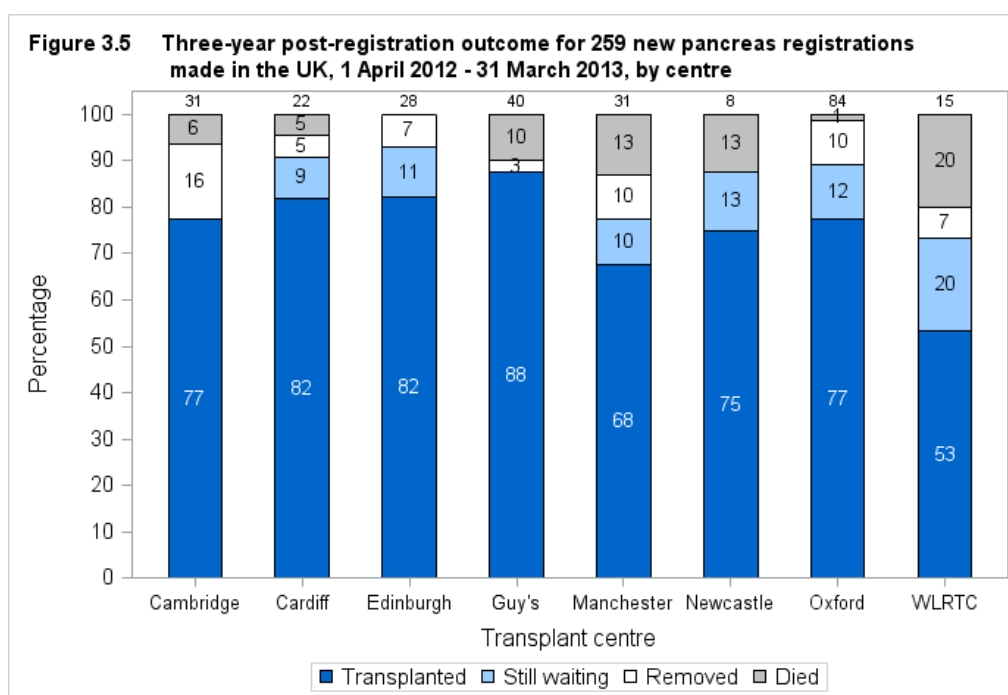


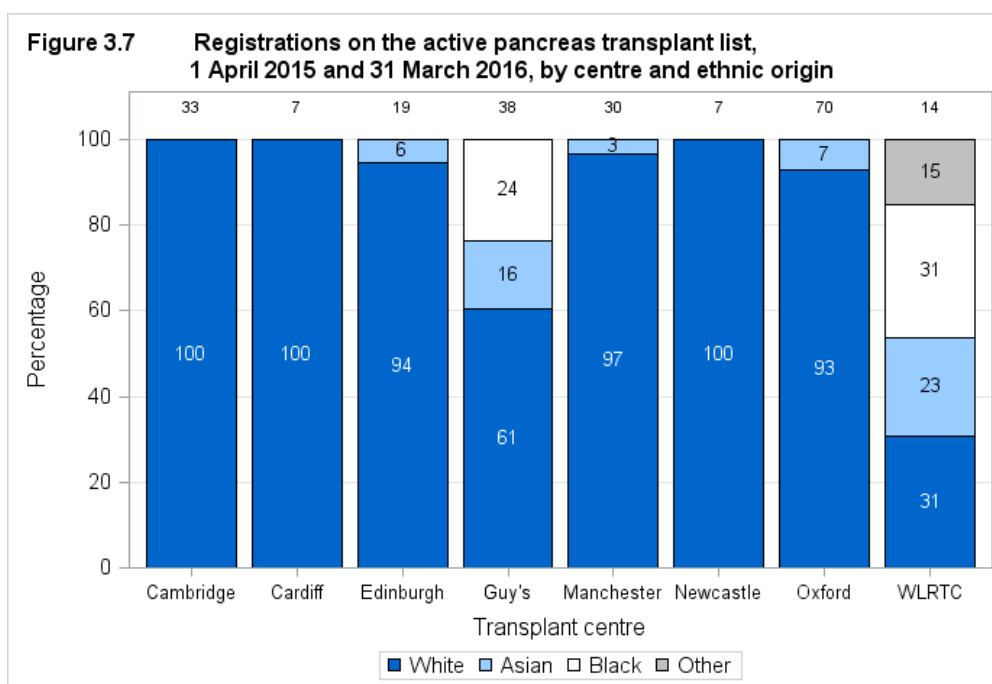
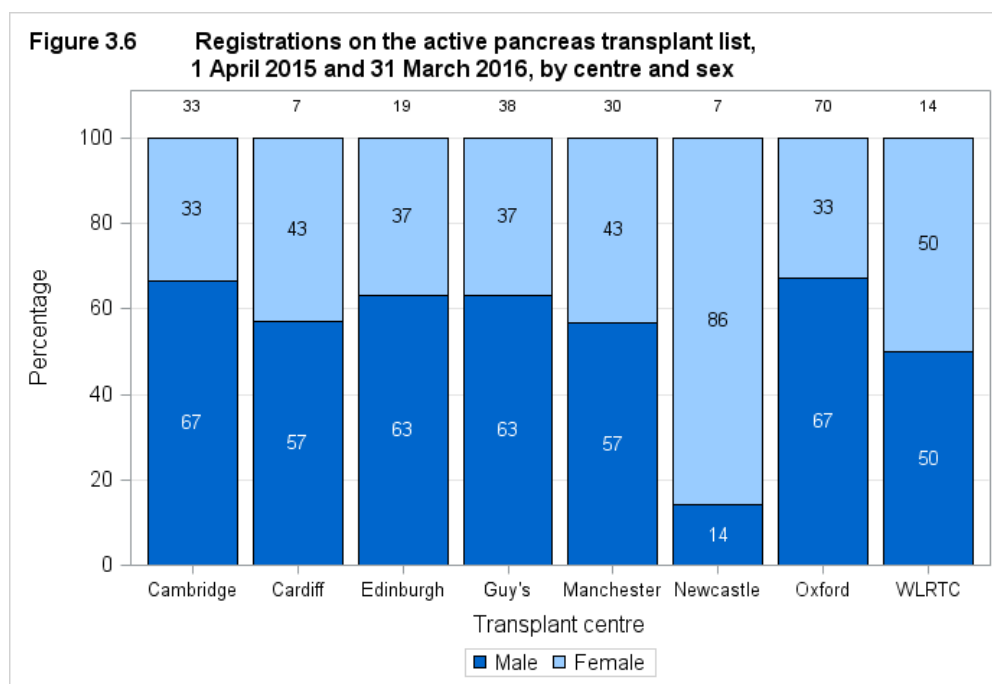
Figure 3.5 shows the proportion of patients transplanted or still waiting three years after joining the list by centre. Three years after listing, Edinburgh had transplanted 88% of their patients while WLRTC transplanted 53%.

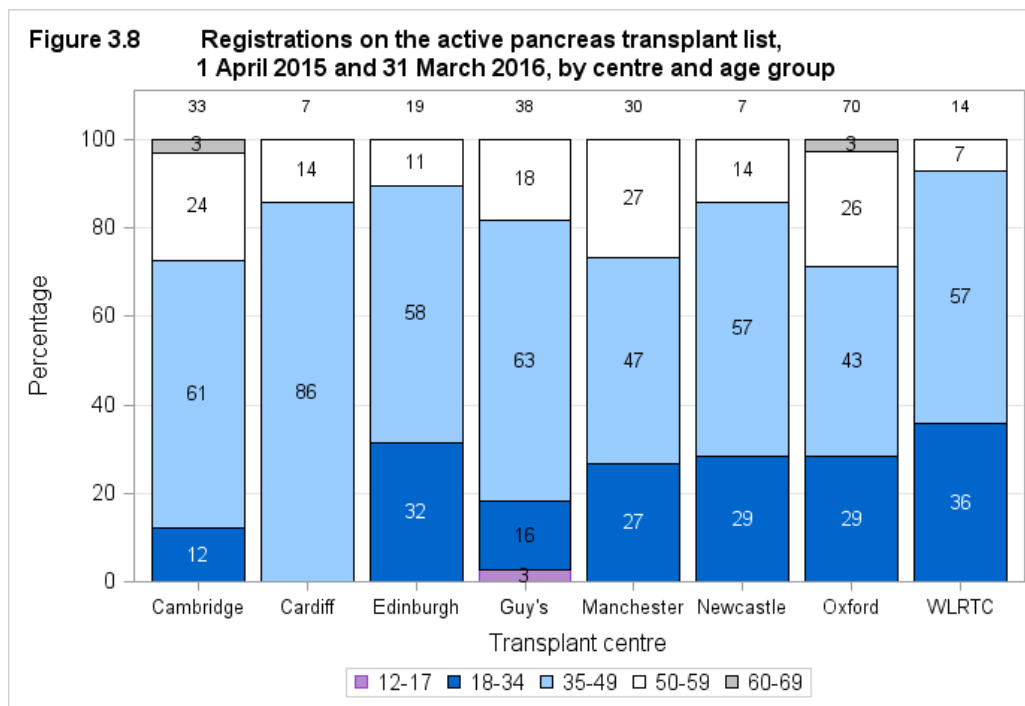


3.3 Demographic characteristics, 1 April 2015 – 31 March 2016

The sex, ethnicity and age group of patients registered on the pancreas [transplant list](#) in 2015/16 are shown by centre in **Figure 3.6**, **3.7** and **3.8**, respectively. Note that all percentages quoted are based only on data where relevant information was available. Overall, 89% of patients registered on the pancreas transplant list were waiting for a simultaneous kidney/pancreas transplant, 62% were male, 85% were white and the median age was 42 years.

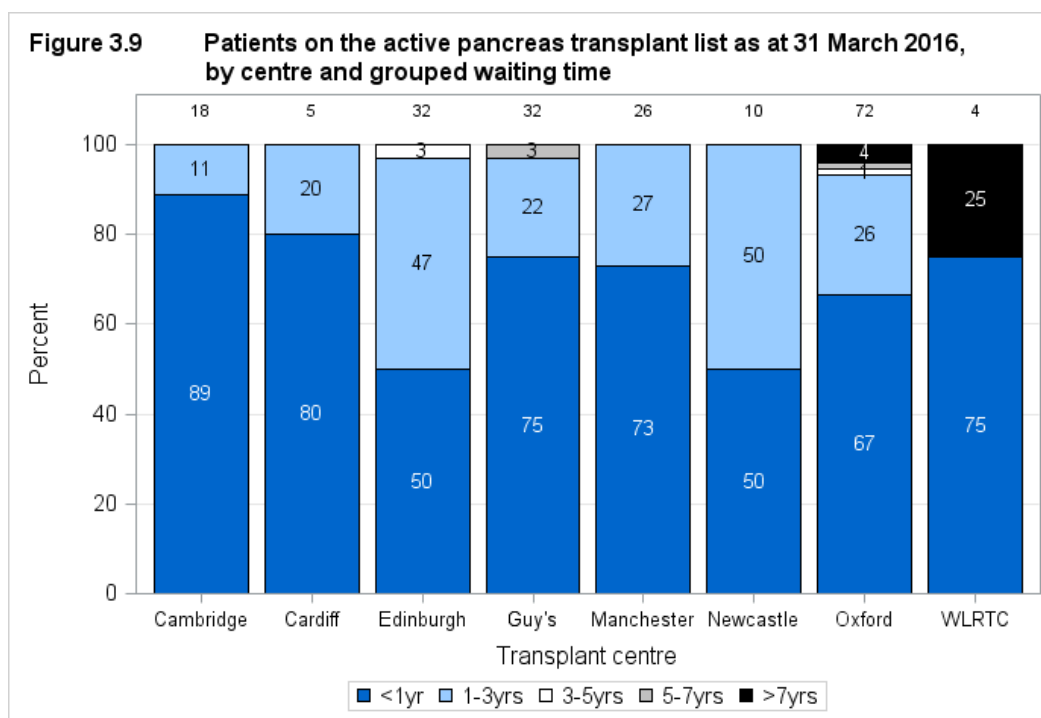
Of the patients on the pancreas only transplant list, 61% were male, 91% were white and the median age was 46 years.





3.4 Patient waiting times for those currently on the list, 31 March 2016

Figure 3.9 shows the length of time patients have been waiting on the pancreas [transplant list](#) at 31 March 2016 by centre. The majority of patients currently listed have been waiting less than one year. Three patients at Oxford (two simultaneous kidney/pancreas patients and one pancreas only patient) and one pancreas only patient at WLRTC have been waiting more than 7 years for transplant; all four patients are highly sensitised with a [cRF](#) of 99% or more.



3.5 Median waiting time to transplant, 1 April 2010 - 31 March 2013

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 calculated using the [Kaplan-Meier method](#) and is shown in **Figure 3.10** 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 April 2010 and 31 March 2013 is 366 days, just over 12 months. This ranged from 149 days at Cardiff to 542 days at Edinburgh.

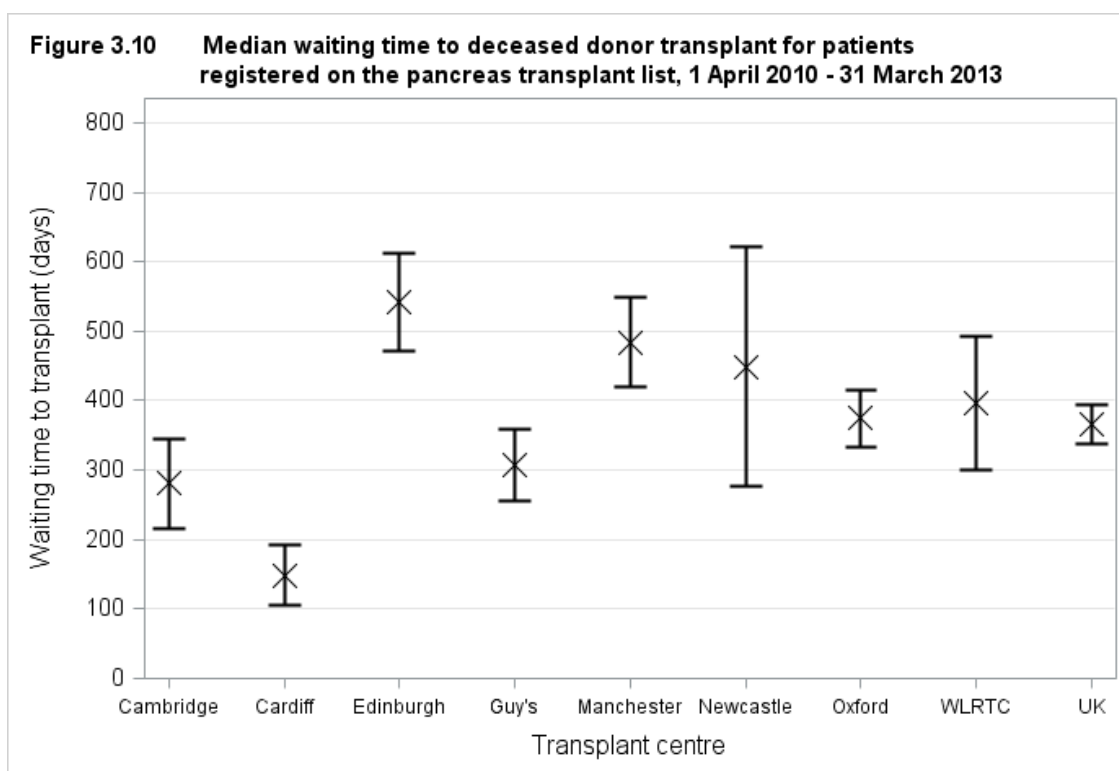


Table 3.1 Median waiting time to pancreas transplant in the UK, for patients registered 1 April 2010 - 31 March 2013

Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Cambridge	77	281	217 - 345
Cardiff	53	149	106 - 192
Edinburgh	54	542	471 - 613
Guy's	105	308	256 - 360
Manchester	96	484	420 - 548
Newcastle	27	449	277 - 621
Oxford	241	375	334 - 416
WLRTC	53	397	301 - 493
UK	706	366	337 - 395

Response to pancreas offers

4.1 Offer decline rates, 1 April 2013 – 31 March 2016

Pancreas offers from [DBD](#) and [DCD](#) donors whose pancreas was retrieved, offered directly on behalf of a named individual patient and resulted in transplantation were analysed separately. 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 2013 and 31 March 2016. Centres can be identified by the information shown in **Table 4.1**. Guy's and Oxford had offer decline rates better than the national rate, whilst Edinburgh and Newcastle had higher rates than the national average.

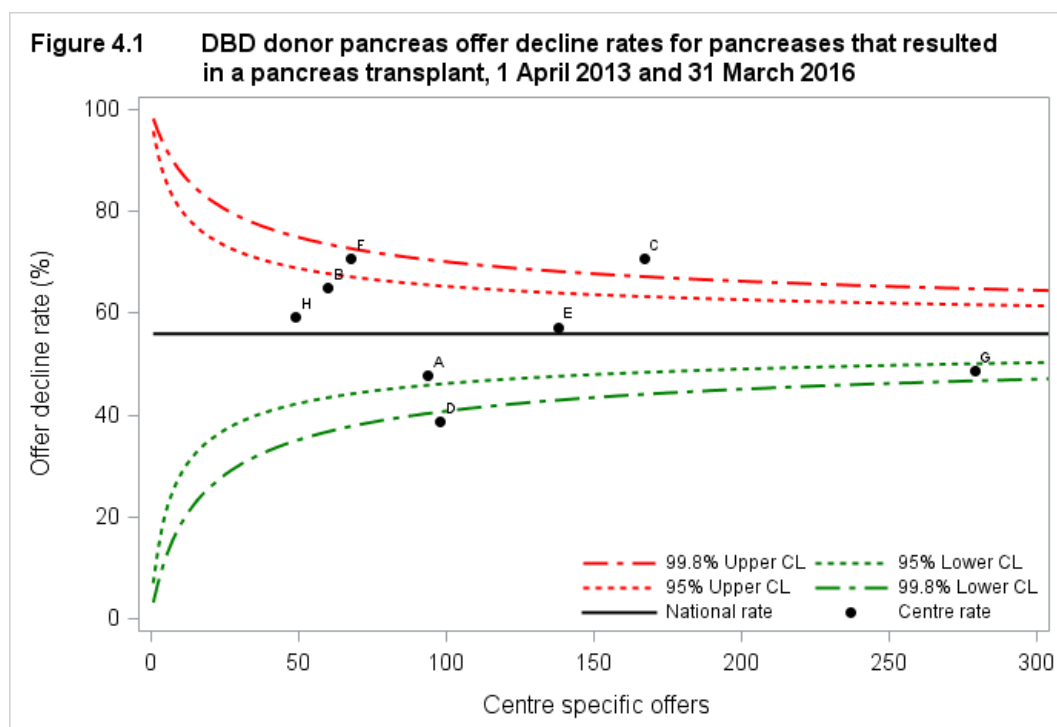


Table 4.1 compares individual centre offer decline rates over time by financial year. The offer decline rate for Edinburgh has risen to 72% and 79% for Newcastle this financial year, significantly higher than the national rate.

Centre	Code	2013/14		2014/15		2015/16		Overall	
		N	(%)	N	(%)	N	(%)	N	(%)
Cambridge	A	35	(43)	38	(61)	21	(33)	94	(48)
Cardiff	B	14	(50)	24	(71)	22	(68)	60	(65)
Edinburgh	C	66	(70)	43	(70)	58	(72)	167	(71)
Guy's	D	36	(36)	29	(41)	33	(39)	98	(39)
Manchester	E	52	(58)	43	(51)	43	(63)	138	(57)
Newcastle	F	23	(65)	21	(67)	24	(79)	68	(71)
Oxford	G	99	(42)	81	(47)	99	(57)	279	(49)
WLRTC	H	11	(64)	23	(70)	15	(40)	49	(59)
UK		336	(52)	302	(57)	315	(59)	953	(56)

Figure 4.2 compares individual centre offer DCD decline rates with the national rate over the time period, 1 April 2013 and 31 March 2016. Centres can be identified by the information shown in **Table 4.2**. Guy's, Oxford and Cambridge had offer decline rates better than the national rate, whilst Edinburgh, Newcastle and WLRTC had higher rates than the national average.

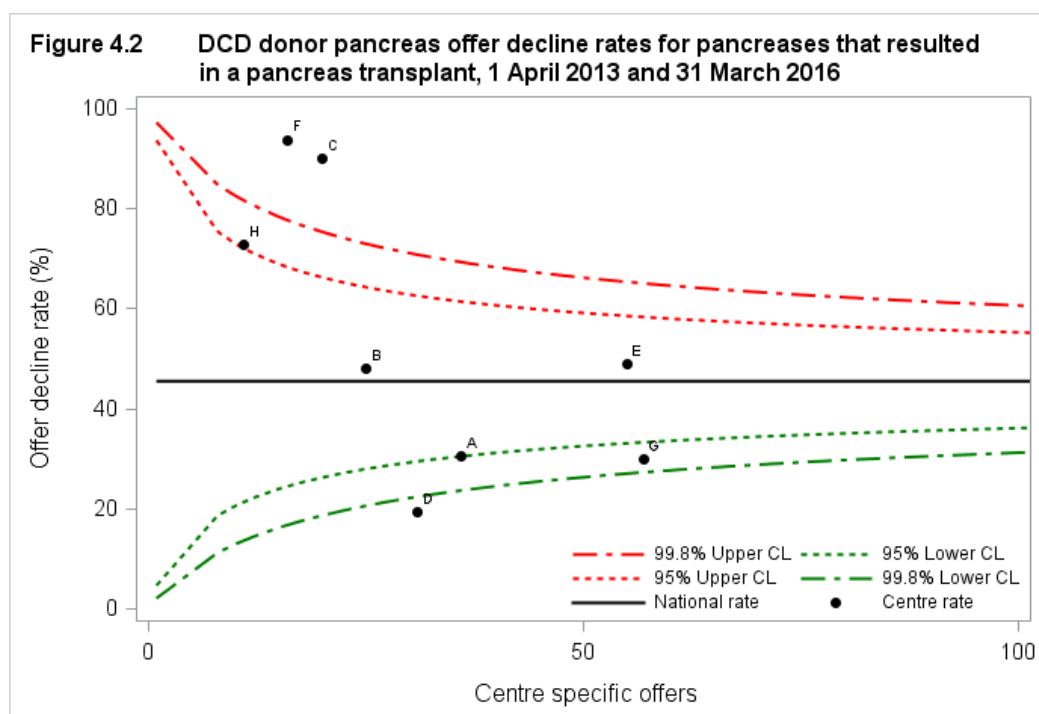


Table 4.2 DCD donor pancreas offer decline rates by transplant centre, 1 April 2013 and 31 March 2016									
Centre	Code	2013/14		2014/15		2015/16		Overall	
		N	(%)	N	(%)	N	(%)	N	(%)
Cambridge	A	9	(33)	16	(31)	11	(27)	36	(31)
Cardiff	B	6	(33)	16	(56)	3	(33)	25	(48)
Edinburgh	C	6	(100)	7	(71)	7	(100)	20	(90)
Guy's	D	9	(11)	13	(23)	9	(22)	31	(19)
Manchester	E	13	(46)	21	(57)	21	(43)	55	(49)
Newcastle	F	5	(80)	4	(100)	7	(100)	16	(94)
Oxford	G	14	(21)	24	(33)	19	(32)	57	(30)
WLRTC	H	2	(100)	4	(100)	5	(40)	11	(73)
UK		64	(42)	105	(48)	82	(45)	251	(45)

Pancreas transplants

5.1 Pancreas transplants, 1 April 2006 – 31 March 2016

Figure 5.1 shows the total number of pancreas transplants performed in the last ten years, by type of donor. The first [DCD](#) pancreas transplant was performed in 2005/06 and by 2007/08 there were 36 [DCD](#) transplants (15%). This number remained between 30 and 40 transplants per year (16% - 19%) with the exception of 2011/12 when there were 48 [DCD](#) transplants performed (23%). The number of [DCD](#) transplants performed in 2014/15 increased by 54% compared with 2013/14. Within the last financial year, DCD pancreas transplants have dropped to 49 and accounts for a quarter of pancreas transplants.

After a fall in 2008/09 and 2009/10, [DBD](#) numbers steadily increased between 2010/11 and 2013/14. However, the number of [DBD](#) transplants has decreased in 2014/15 and 2015/16 to 136 transplants.

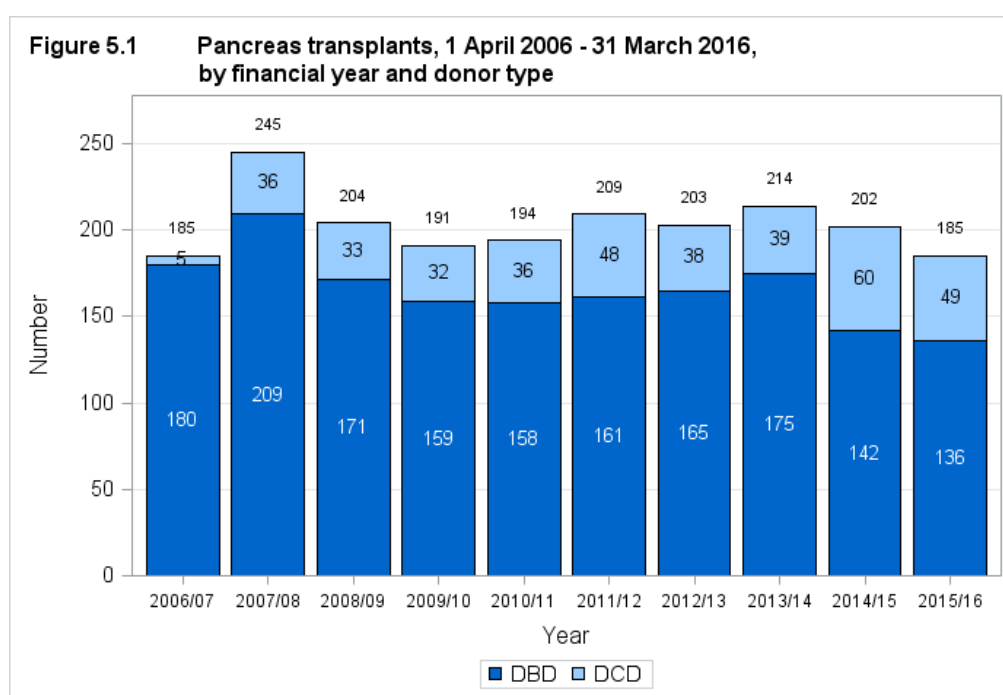


Figure 5.2 shows the total number of pancreas transplants performed in 2015/16, by centre and type of donor. The same information is presented in **Figure 5.3** but this shows the proportion of [DBD](#) and [DCD](#) transplants performed at each centre. Oxford performed the most [DBD](#) and [DCD](#) transplants. There were no [DCD](#) transplants performed at Newcastle and Edinburgh in the last financial year. Manchester had the largest proportion of [DCD](#) transplants (41%). Of the transplants performed last year at Cambridge and Guy's, 38% and 29%, respectively, were from [DCD](#) donors.

Figure 5.2 Pancreas transplants, 1 April 2015 - 31 March 2016, by centre and donor type

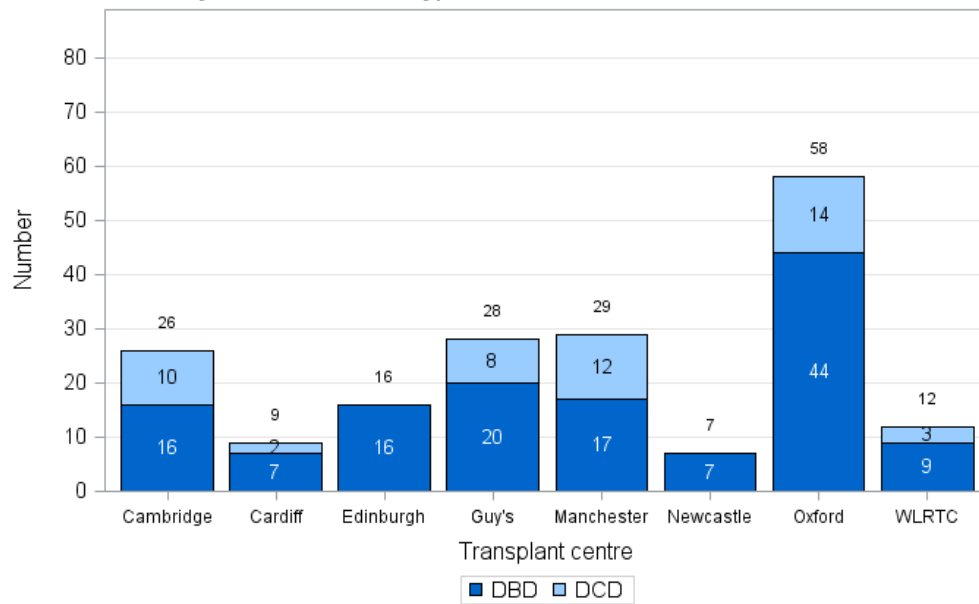


Figure 5.3 Pancreas transplants, 1 April 2015 - 31 March 2016, by centre and donor type

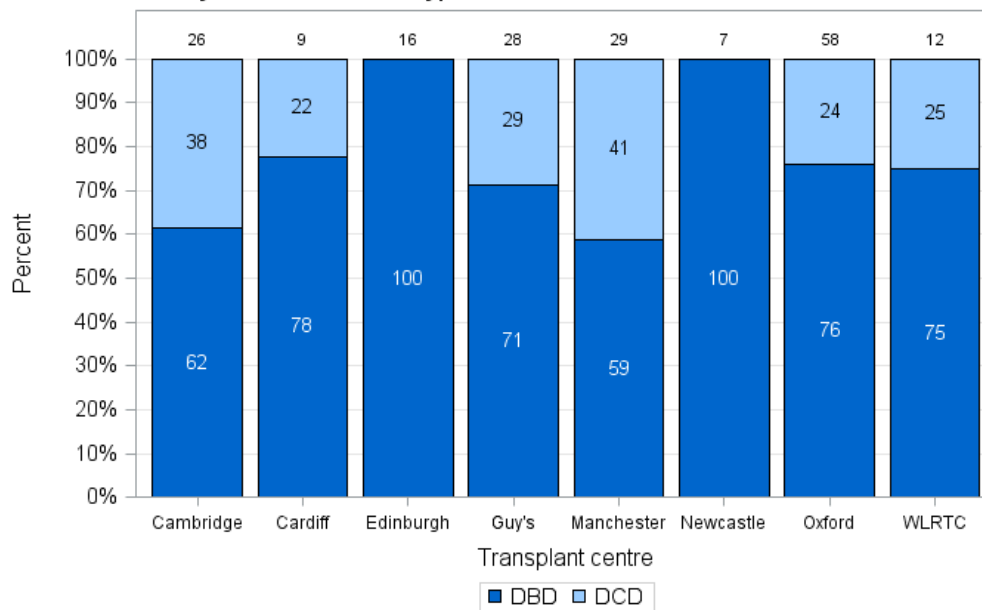
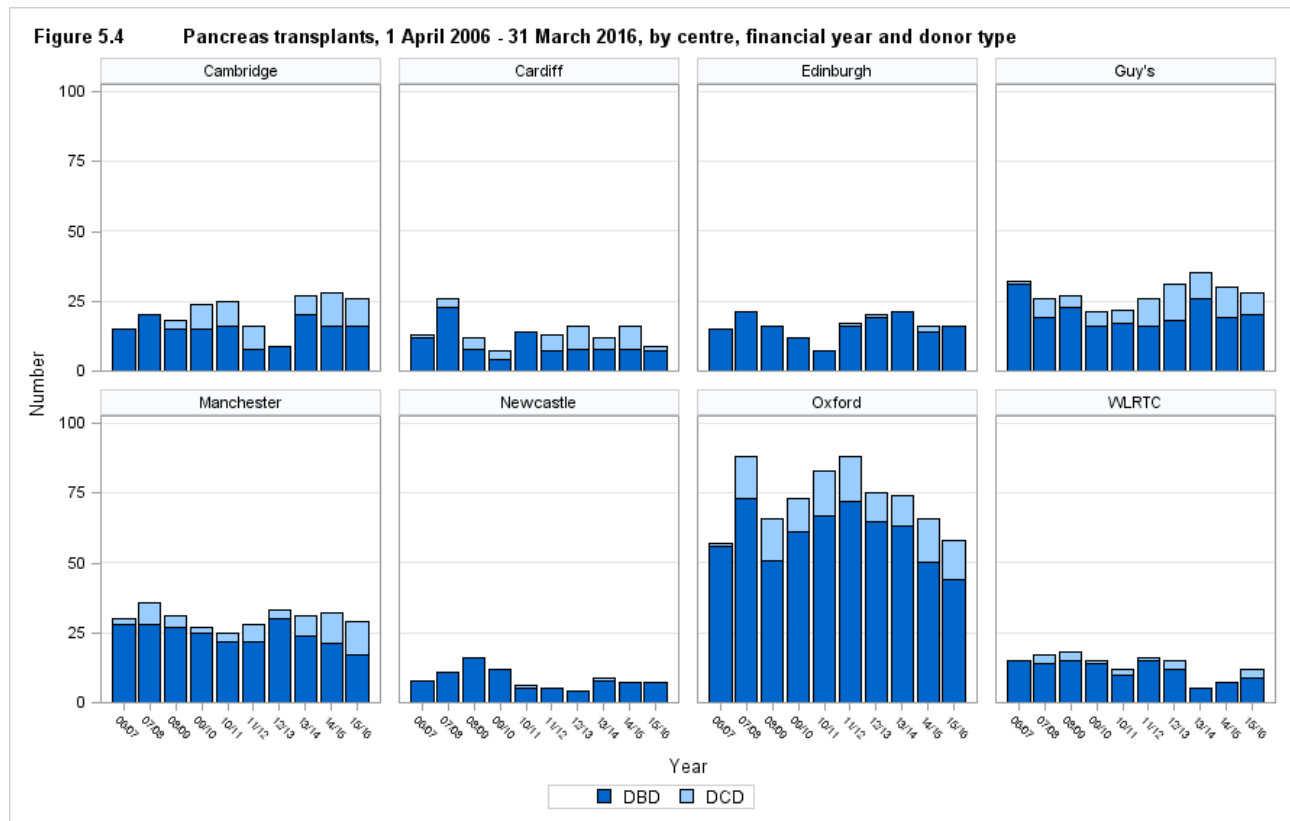


Figure 5.4 shows the total number of pancreas transplants performed in last ten years, by centre and type of donor. Oxford have consistently performed a large number of pancreas transplants since 2006/07 including a number of [DCD](#) transplants over the last seven years. However, the number of transplants performed at Oxford has decreased since 2011/12.



5.2 Cold ischaemia time, 1 April 2006 – 31 March 2016

[Median](#) cold ischaemia times ([CIT](#)) are shown in addition to [inter-quartile](#) ranges in **Figures 5.5 to 5.10**. Fifty percent of the transplants have a [CIT](#) within the [inter-quartile](#) range (indicated by a box). Where there is only one observation to report, the single data point is represented by a dash as per the [median](#) for multiple observations. There is some variation in average ([median](#)) [CIT](#) between different transplant centres although all centres continually try to reduce this time.

Figure 5.5 shows the median total ischaemia time in DBD donor pancreas transplants over the last 10 years. The overall median cold ischaemia time has been slowly falling over the last 10 years from 13 hours in 2006/07 to 11 hours in 2015/16.

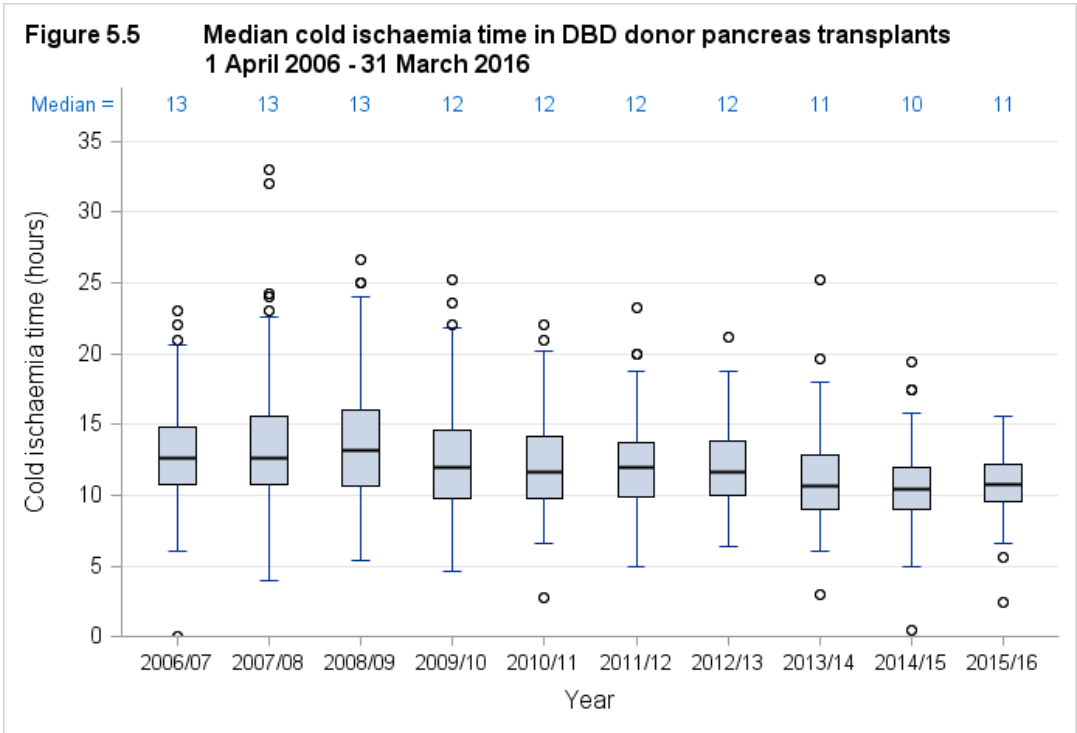


Figure 5.6 shows the median total ischaemia time in DBD donor pancreas transplants in 2015/16 for each transplant centre. Four centres had the longest median cold ischaemia time in 2015/16 of 12 hours compared with Oxford and Manchester who had the shortest, 10 hours.

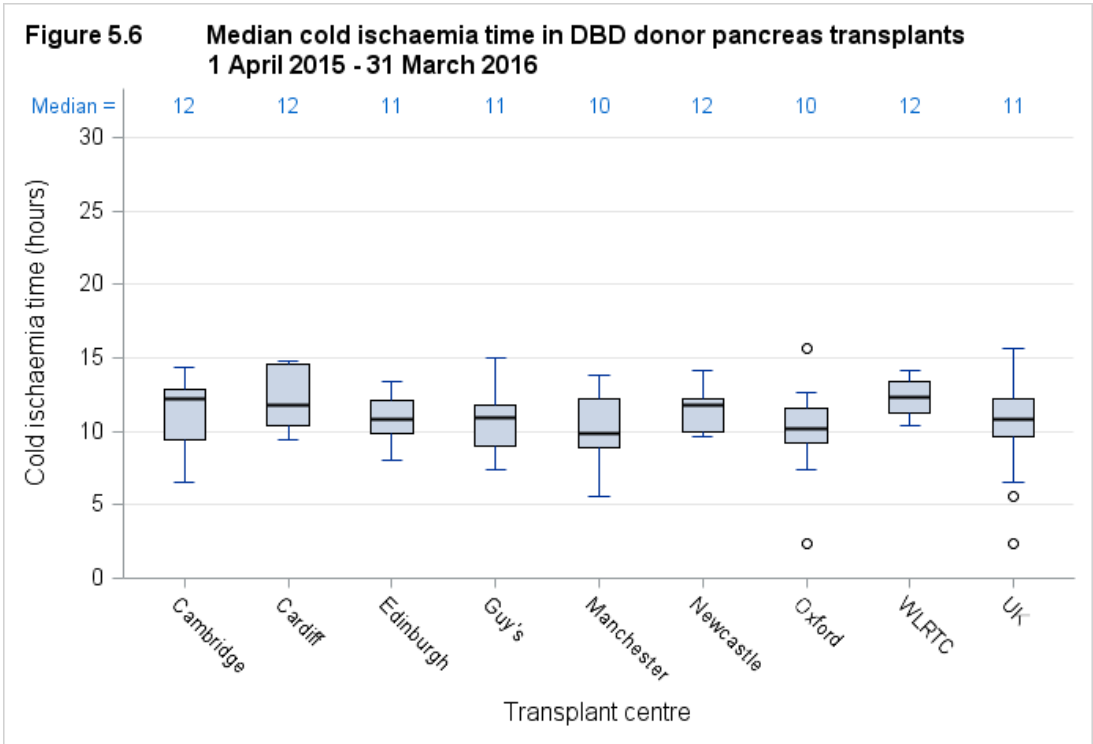


Figure 5.7 shows the median total ischaemia time in DBD donor pancreas transplants over the last ten years for each transplant centre.

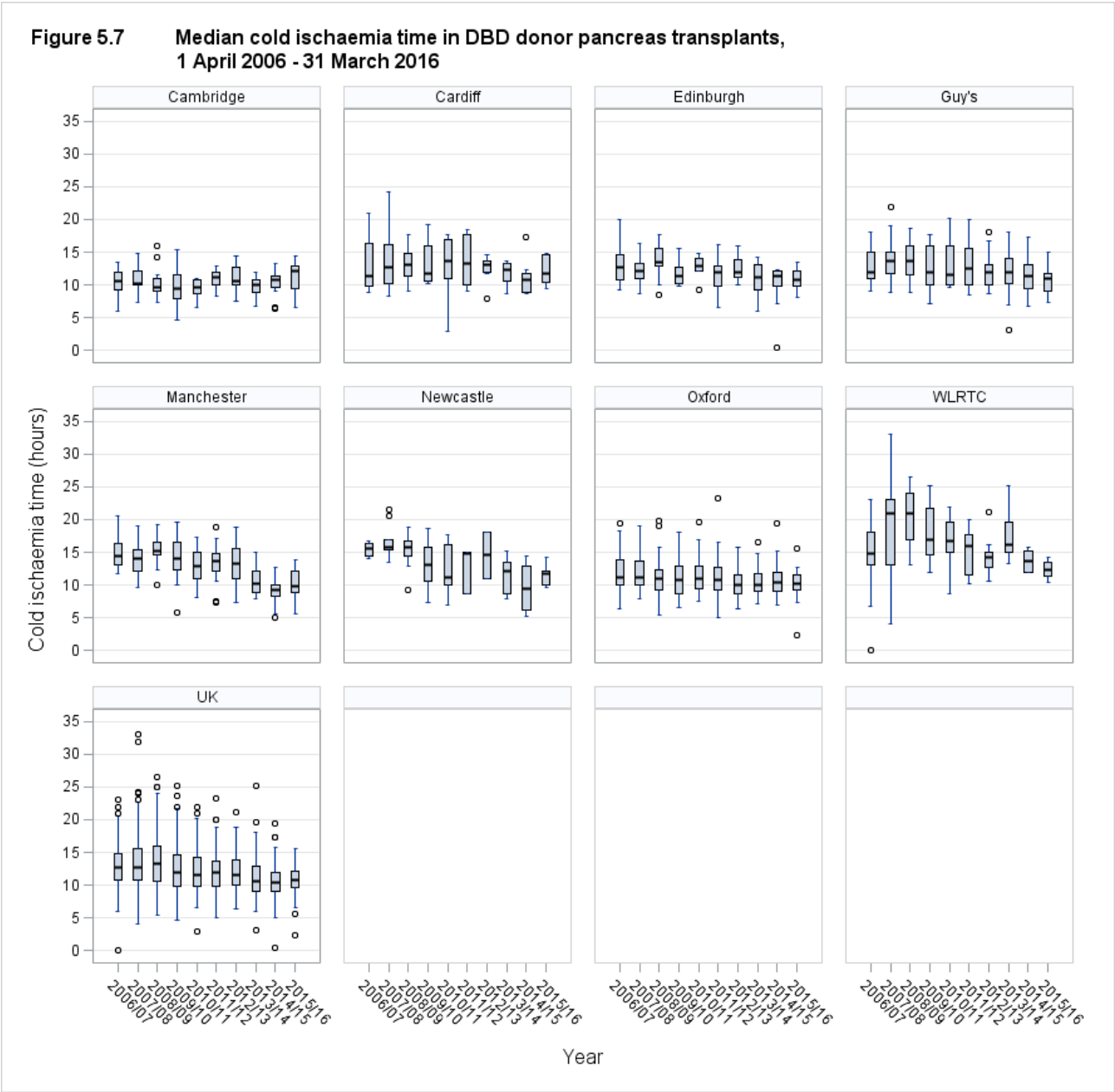


Figure 5.8 shows the median total ischaemia time in DCD donor pancreas transplants over the last ten years since the first DCD pancreas transplant. Overall median cold ischaemia time has fallen from 15 hours in 2007/08 to 10 hours in 2015/16.

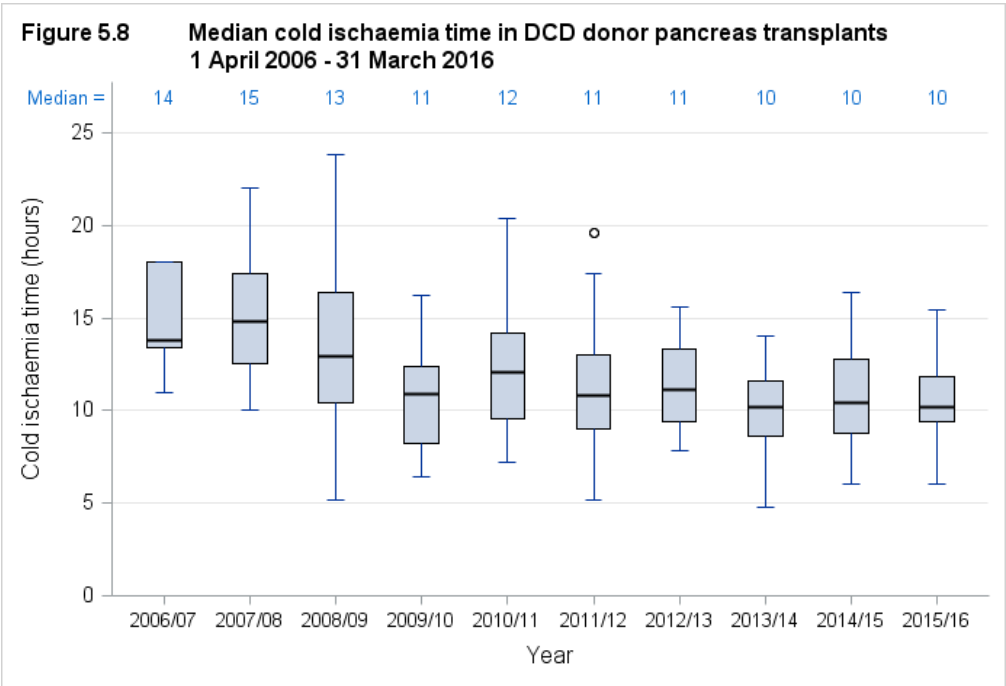


Figure 5.9 shows the median total ischaemia time in DCD donor pancreas transplants in 2015/16 for each transplant centre. Manchester and Guy’s had the shortest median cold ischaemia time of 10 hours, whilst WLRTC had the longest median ischaemia time of 14 hours.

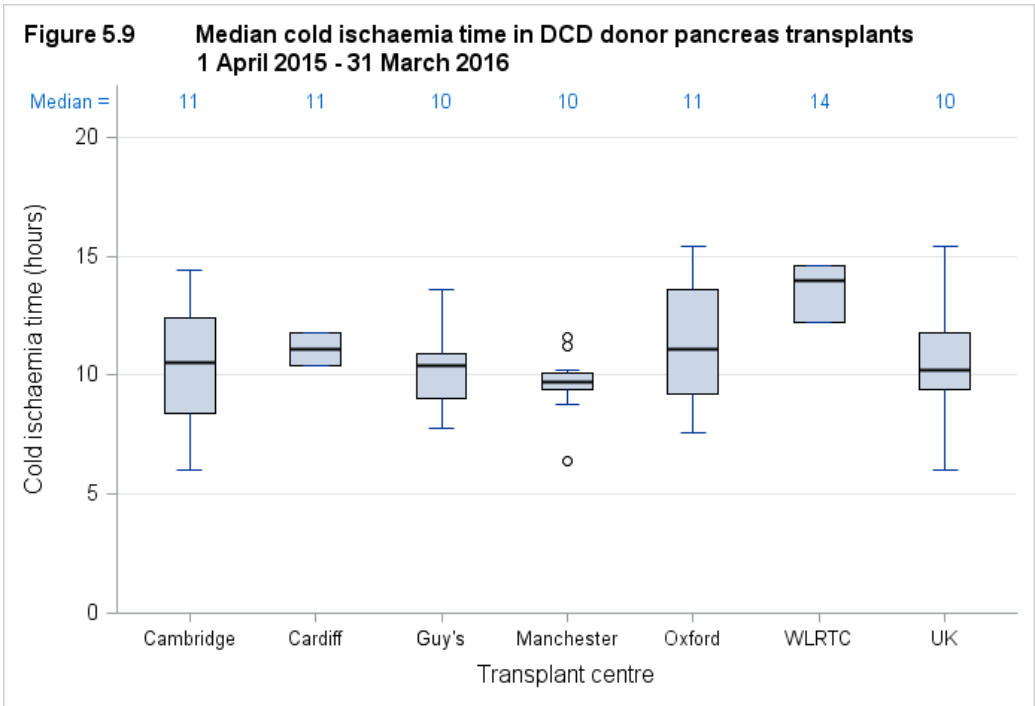
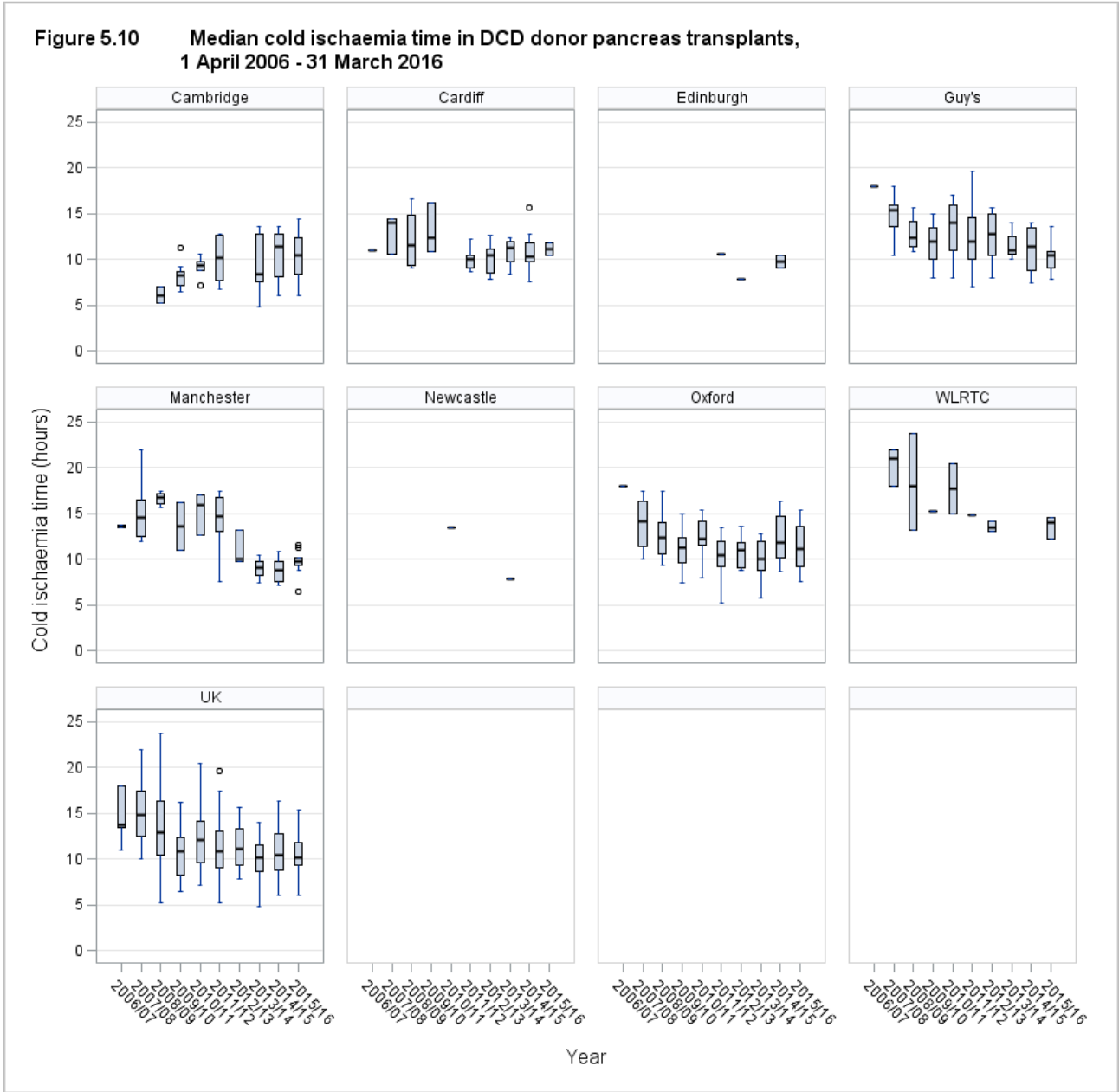


Figure 5.10 shows the [median](#) total ischaemia time in [DCD](#) donor pancreas transplants for each transplant centre over the last ten years since the first [DCD](#) pancreas transplant.



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 simultaneous pancreas and kidney (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. **Figures 6.3** shows one centre outside the lower 95% [confidence limit](#), indicating that this centre may have a significantly lower five-year [patient](#) survival rate than the national rate. Similarly, **Figure 6.4** shows that one centre may have a significantly lower five year [graft](#) survival rate compared with the national rate. Centres can be identified by the information shown in **Tables 6.1** and **6.2**.

Figure 6.1 Risk-adjusted one year patient survival rates for deceased donor first SPK transplants, between 1 April 2011 and 31 March 2015

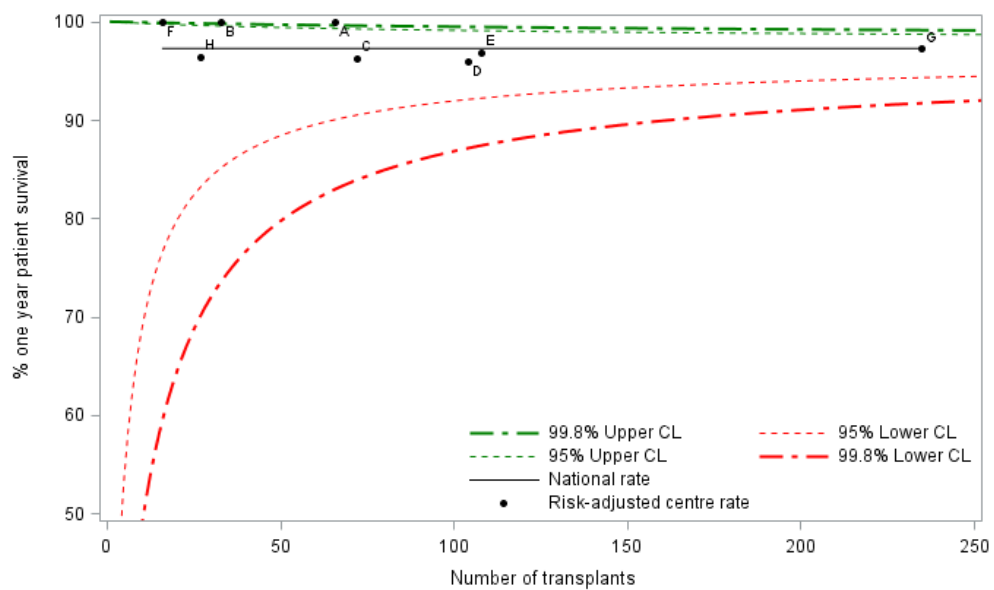


Figure 6.2 Risk-adjusted one year pancreas graft (death censored) survival rates for all deceased donor first SPK transplants, between 1 April 2011 and 31 March 2015

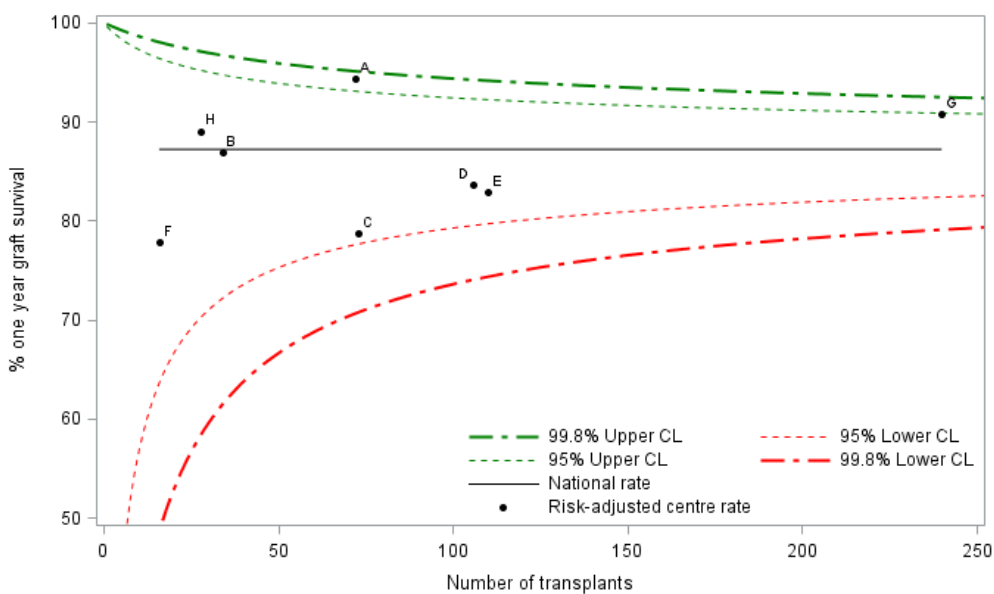


Figure 6.3 Risk-adjusted five year patient survival rates for deceased donor first SPK transplants, between 1 April 2007 and 31 March 2011

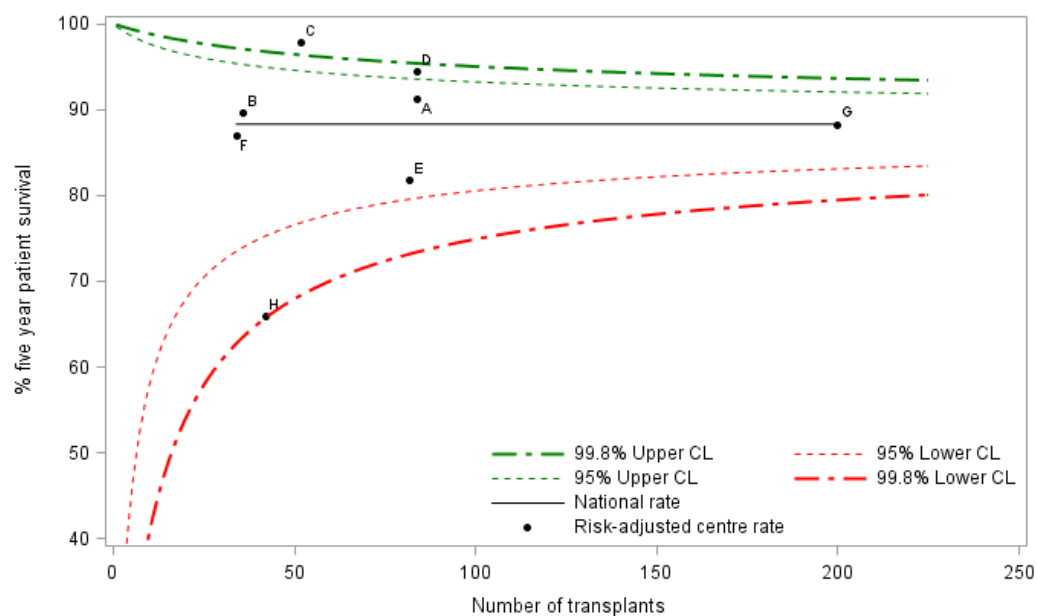


Figure 6.4 Risk-adjusted five year pancreas graft (death censored) survival rates for all deceased donor first SPK transplants, between 1 April 2007 and 31 March 2011

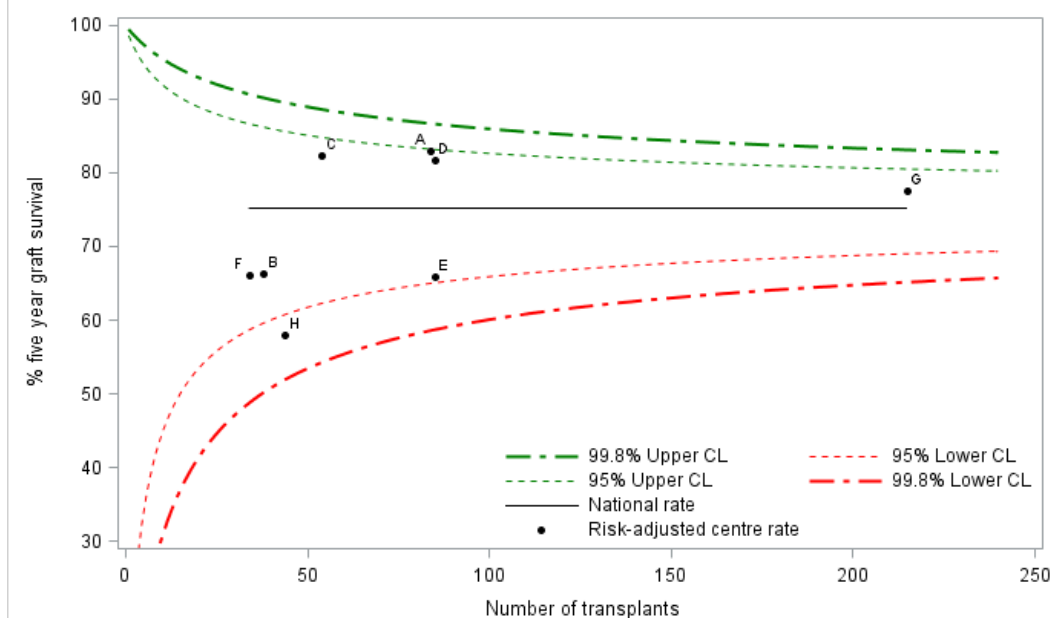


Table 6.1 Risk-adjusted one and five year patient survival for first SPK transplants using pancreases from deceased donors							
Centre	Code	N	Patient survival				
			One-year*		Five-year**		
			%	(95% CI)	N	%	(95% CI)
Cambridge	A	66	100	N/A	84	91	(81 - 97)
Cardiff	B	33	100	N/A	36	90	(70 - 98)
Edinburgh	C	72	96	(89 - 99)	52	98	(87 - 100)
Guy's	D	104	96	(88 - 99)	84	94	(86 - 98)
Manchester	E	108	97	(91 - 99)	82	82	(69 - 90)
Newcastle	F	16	100	N/A	34	87	(67 - 96)
Oxford	G	235	97	(94 - 99)	200	88	(83 - 92)
WLRTC	H	27	96	(80 - 100)	42	66	(35 - 84)
UK		661	97	(96 - 98)	614	88	(85 - 91)
* Includes transplants performed between 1 April 2011 - 31 March 2015 ** Includes transplants performed between 1 April 2007 - 31 March 2011							

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*		Five-year**		
			%	(95% CI)	N	%	(95% CI)
Cambridge	A	72	94	(85 - 98)	84	83	(71 - 91)
Cardiff	B	34	87	(70 - 96)	38	66	(42 - 82)
Edinburgh	C	73	79	(64 - 88)	54	82	(66 - 92)
Guy's	D	106	84	(74 - 90)	85	82	(70 - 90)
Manchester	E	110	83	(73 - 90)	85	66	(50 - 77)
Newcastle	F	16	78	(35 - 95)	34	66	(41 - 82)
Oxford	G	240	91	(86 - 94)	215	78	(70 - 83)
WLRTC	H	28	89	(68 - 98)	44	58	(32 - 75)
UK		679	87	(84 - 90)	639	75	(72 - 78)
* Includes transplants performed between 1 April 2011 - 31 March 2015 ** Includes transplants performed between 1 April 2007 - 31 March 2011							

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 Risk-adjusted one and five year patient survival for first PO transplants using pancreases from deceased donors							
Centre	Code	N	Patient survival				
			One-year*		Five-year**		
			%	(95% CI)	N	%	(95% CI)
Cardiff	B	10	100	N/A	3	-	-
Guy's	D	5	-	-	1	-	-
Manchester	E	3	-	-	10	93	(59 - 100)
Newcastle	F	2	-	-	4	-	-
Oxford	G	33	100	N/A	51	76	(55 - 88)
Edinburgh	C	0	-	-	1	-	-
WLRTC	H	0	-	-	1	-	-
UK		59	98	(87 - 100)	71	78	(64 - 87)
* Includes transplants performed between 1 April 2011 - 31 March 2015 ** Includes transplants performed between 1 April 2007 - 31 March 2011 - Data not presented where less than 10 transplants included							

Table 6.4 Risk-adjusted 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	3	-	-	0	-	-
Cardiff	B	17	66	(20 - 89)	15	59	(10 - 85)
Edinburgh	C	1	-	-	1	-	-
Guy's	D	9	-	-	4	-	-
Manchester	E	5	-	-	21	26	(0 - 58)
Newcastle	F	7	-	-	6	-	-
Oxford	G	44	79	(60 - 90)	80	52	(35 - 66)
WLRTC	H	8	-	-	15	24	(0 - 62)
UK		94	75	(65 - 83)	142	45	(36 - 53)
* Includes transplants performed between 1 April 2011 - 31 March 2015 ** Includes transplants performed between 1 April 2007 - 31 March 2011 - Data not presented where less than 10 transplants included							

Survival from listing

7.1 Patient survival from listing for SPK transplant

Survival from listing was analysed for all adult (≥ 18 years) patients registered for the first time for simultaneous pancreas and kidney (SPK) between 1 January 2004 and 31 December 2015. Patients registered for a pancreas only or islet transplant have been excluded from this analysis. Survival time was defined as the time from joining the [transplant list](#) to death, regardless of the length of time on the [transplant list](#), whether or not the patient was transplanted and any factors associated with such a transplant eg donor type. Survival time was censored at either the date of removal from the list, or at the last known follow up date post-transplant when no death date was recorded, or at the time of analysis if the patient was still active on the [transplant list](#).

The [funnel plot](#) shown in **Figure 7.1**, compares centre specific ten-year [risk-adjusted patient](#) survival rates from the point of pancreas, simultaneous pancreas and kidney (SPK) or islet transplant listing and indicates how consistent the rates of the individual transplant centres are with the national rate. Cambridge, Edinburgh and Guy's all have 10 year survival rates above the upper 99.8% [confidence limit](#) indicating that these centres have 10 year survival rates from listing that are considerably higher than the national rate. The 10 year survival rate for Manchester and Oxford were on the lower 99.5% [confidence limit](#). This suggests that 10 year survival from listing at Manchester and Oxford are significantly lower than the national rate. Centres can be identified by the information shown in **Table 7.1**, which also shows one- and five-year [risk-adjusted](#) survival rates from the point of transplant listing.

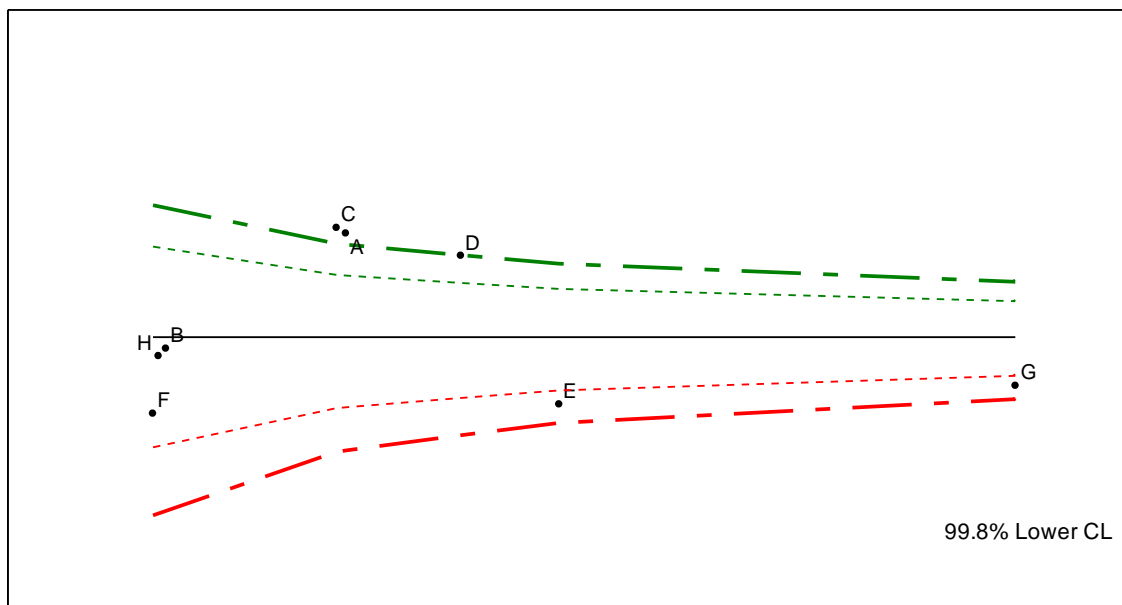


Table 7.1 **Risk-adjusted 1, 5 and 10 year patient survival from listing for first deceased donor SPK transplant in patients registered between 1 January 2004 and 31 December 2015**

Centre	Code	One year		Five year		Ten year	
		N	(%)	N	(%)	N	(%)
Cambridge	A	239	(98)	239	(90)	239	(82)
Cardiff	B	108	(95)	108	(84)	108	(72)
Edinburgh	C	232	(97)	232	(90)	232	(82)
Guy's	D	322	(97)	322	(88)	322	(80)
Manchester	E	394	(97)	394	(81)	394	(67)
Newcastle	F	99	(94)	99	(82)	99	(66)
Oxford	G	726	(96)	726	(82)	726	(69)
WLRTC	H	102	(98)	102	(87)	102	(71)
UK		2222	(96)	2222	(85)	2222	(73)

Form return rates

8.1 Pancreas form return rates, 1 January – 31 December 2015

Form return rates are reported in **Table 8.1** for the pancreas transplant record, three month and 1 year follow up form, along with lifetime follow up (more than 2 years). These include all pancreas transplants performed between 1 January and 31 December 2015 for the transplant record, and all requests for follow up forms issued in this time period. Centres highlighted are transplant centres. Overall, 100% of transplant record forms issued and 95% of follow-up forms issued have been returned.

Table 8.1 Form return rates following pancreas transplantation, by centre, 1 January 2015 - 31 December 2015

Centre	Transplant record		3 month follow-up		12 month follow-up		Lifetime follow-up	
	N	% returned	N	% returned	N	% returned	N	% returned
Aberdeen, Aberdeen Royal Infirmary			1	100			17	65
Bangor, Ysbyty Gwynedd District General Hospital							2	100
Basildon, Basildon Hospital							3	100
Belfast, Antrim Hospital							2	100
Belfast, Belfast City Hospital					1	100	5	100
Belfast, The Ulster Hospital							1	100
Birmingham, Birmingham Heartlands Hospital							10	100
Birmingham, Queen Elizabeth Hospital Birmingham			1	100	5	100	25	100
Bradford, St Lukes Hospital					2	100	2	100
Brighton, Royal Sussex County Hospital			1	100	2	100	21	100
Bristol, Southmead Hospital					4	100	51	100
Camberley, Frimley Park Hospital							1	100
Cambridge, Addenbrookes Hospital	25	100	25	100	21	100	79	100
Canterbury, Kent And Canterbury Hospital					5	100	25	100
Cardiff, University Of Wales Hospital	14	100	15	100	10	100	65	100
Carlisle, Cumberland Infirmary			2	100			2	0
Carshalton, St Helier Hospital							14	86
Chelmsford, Broomfield Hospital							1	100
Chester, Countess Of Chester Hospital							1	100
Closed - Glasgow, Glasgow Western Infirmary			1	100				
County Down, Daisy Hill Hospital			2	100			1	100
Coventry, University Hospital (walsgrave)			3	100	1	100	21	100
Crewe, Leighton Hospital					1	100		
Derby, Royal Derby Hospital							4	100
Doncaster, Doncaster Royal Infirmary					1	100	1	100
Dorchester, Dorset County Hospital					2	100	32	100
Douglas, Nobles I-o-m Hospital			1	100			1	100
Dudley, Russells Hall Hospital							2	100
Dulwich, Kings College							1	100
Dumfries, Dumfries And Galloway Royal Infirmary							2	100
Dundee, Ninewells Hospital			1	100			11	100
Edinburgh, Royal Infirmary Of Edinburgh	16	100	13	100	11	100	63	48
Exeter, Royal Devon And Exeter Hospital (wonford)			1	100	2	100	19	100
Glasgow, Queen Elizabeth University Hospital					2	100	16	100
Glasgow, Stobhill General Hospital							1	0
Gloucester, Gloucestershire Royal Hospital							13	92
Hereford, The County Hospital							2	100

**Table 8.1 Form return rates following pancreas transplantation, by centre,
1 January 2015 - 31 December 2015**

Centre	Transplant record		3 month follow-up		12 month follow-up		Lifetime follow-up	
	N	% returned	N	% returned	N	% returned	N	% returned
Hull, The Hull Royal Infirmary			3	67	2	100	7	100
Inverness, Raigmore Hospital							8	88
Ipswich, Ipswich Hospital							8	100
Kilmarnock, Crosshouse Hospital							3	67
Leeds, St James's University Hospital			2	100	2	100	10	90
Leicester, Leicester General Hospital							16	100
Lincoln, Lincoln County Hospital							4	100
Liverpool, Royal Liverpool University Hospital							11	100
London, Guys Hospital	26	100	27	100	19	100	98	100
London, Kings College Hospital							1	100
London, St Georges Hospital							5	100
London, The Royal Free Hospital			4	100	3	100	36	100
London, The Royal London Hospital (Whitechapel)					1	100	9	100
Londonderry, Altnagelvin Area Hospital							1	100
Manchester, Manchester Royal Infirmary	32	100	27	100	9	100	83	100
Middlesbrough, The James Cook University Hospital			2	100	1	100	15	87
Newcastle, Freeman Hospital	8	100	5	100	6	100	33	100
Northampton, Northampton General Hospital							7	71
Norwich, Norfolk And Norwich University Hospital					3	100	16	100
Nottingham, Nottingham University Hospitals City Campus					4	100	24	100
Omagh, Tyrone County Hospital							1	100
Oxford, Churchill Hospital	65	100	42	100	42	100	111	100
Peterborough, Peterborough City Hospital							1	0
Plymouth, Derriford Hospital			3	67	2	100	17	94
Portsmouth, Queen Alexandra Hospital			3	100	3	100	37	100
Preston, Royal Preston Hospital					2	100	13	100
Reading, Royal Berkshire Hospital							26	100
Salford, Salford Royal					2	100	14	100
Sheffield, Northern General Hospital					3	100	6	100
Shrewsbury, Royal Shrewsbury Hospital							2	50
St Helier, Jersey General Hospital							1	100
Stevenage, Lister Hospital					1	100	2	100
Stoke-on-Trent, Royal Stoke University Hospital							8	100
Sunderland, Sunderland Royal Hospital							3	67
Swansea, Morriston Hospital							10	80
Truro, Royal Cornwall Hospital (Treliske)			1	100	1	100	16	100
West London Renal Transplant Centre	12	100	10	100	5	100	78	100
Westcliff On Sea, Southend Hospital							3	100
Wolverhampton, New Cross Hospital			1	100	3	100	17	100
Wrexham, Maelor General Hospital							7	86
York, York District Hospital							16	100
Overall	198	100	197	99	184	100	1302	95

Islet transplant list

9.1 Patients on the islet transplant list as at 31 March, 2008 – 2016

Figure 9.1 shows the number of patients on the islet [transplant list](#) at 31 March each year between 2008 and 2016. The number of patients active on the islet [transplant list](#) has increased from 3 in 2008 (when islet transplantation was first commissioned in the UK) to 36 in 2015 but it has now dropped to 28 in 2016.

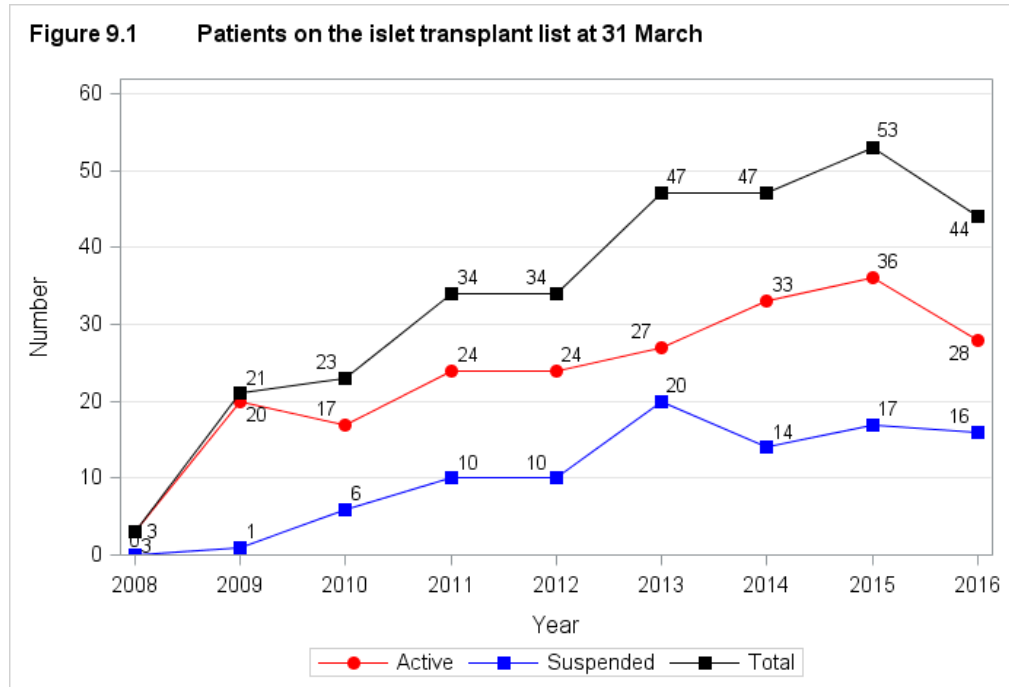


Figure 9.2 shows the number of patients on the active islet [transplant list](#) at 31 March 2016 by centre. Eleven (39%) of the patients on the active [transplant list](#) were registered at Edinburgh, whilst there were no patients registered at the Royal Free.

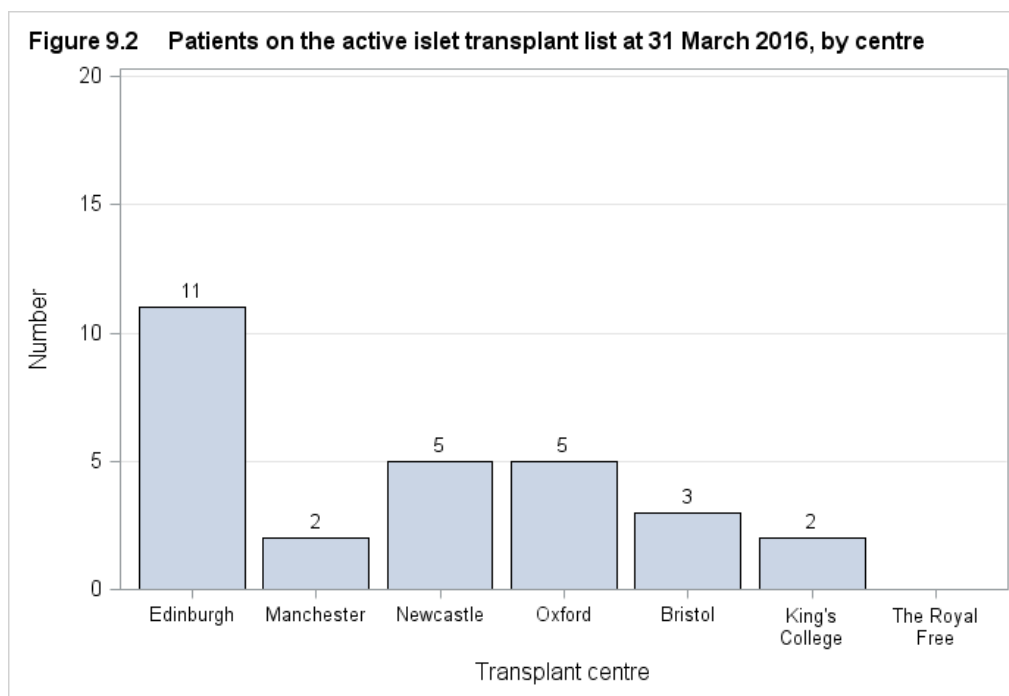
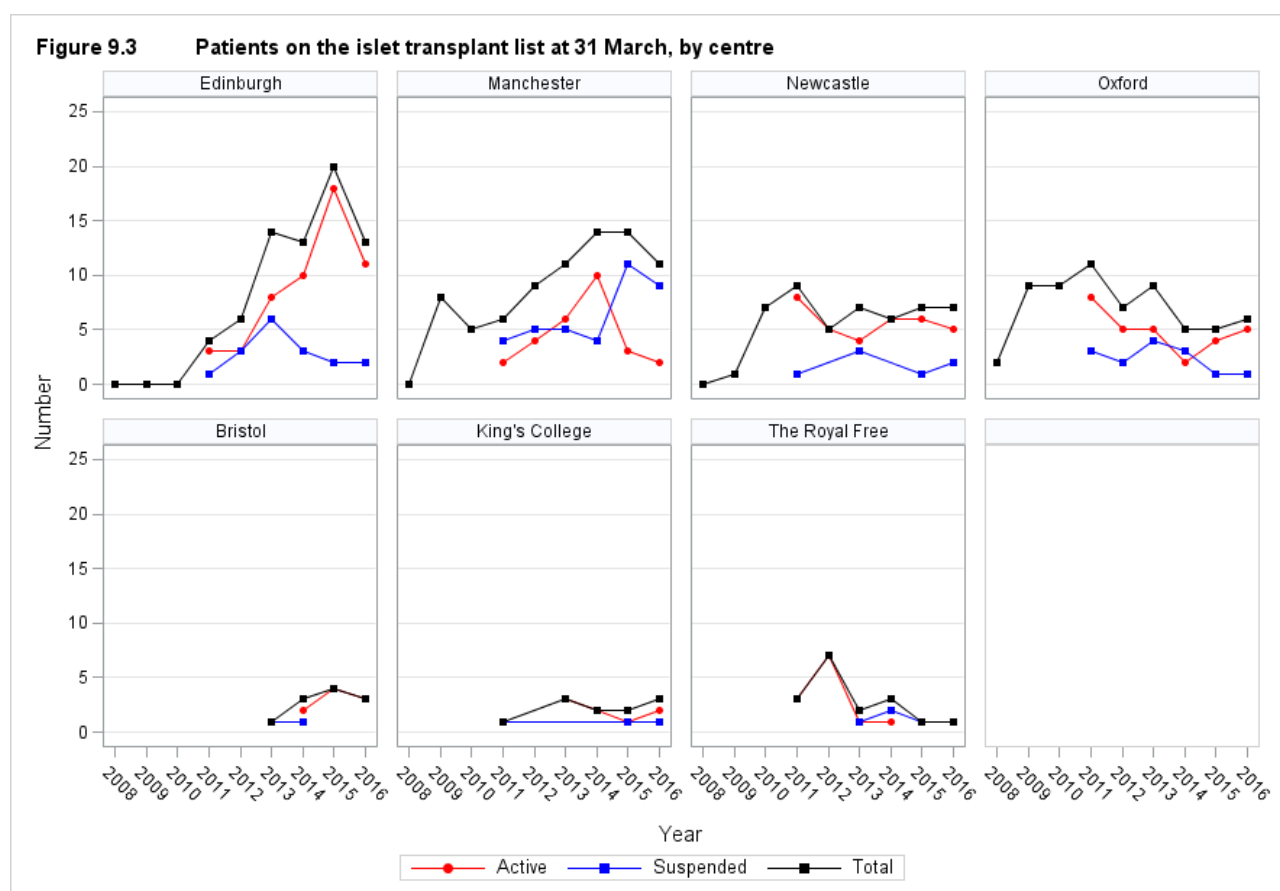


Figure 9.3 shows the number of patients on the islet [transplant list](#) at 31 March each year between 2008 and 2015 for each transplant centre. The number of active and suspended patients by centre is not recorded prior to 2011, hence only the total number are reported between 2008 and 2010. The number of patients actively registered at Edinburgh has decreased from 18 on 31 March 2015 to 11 on 31 March 2016.



9.2 Post-registration outcomes, 1 April 2012 – 31 March 2013

An indication of outcomes for patients listed for an islet transplant is summarised in **Figure 9.4**. This shows the proportion of patients transplanted or still waiting one and three years after joining the list. It also shows the proportion removed from the [transplant list](#) (typically because they become too unwell for transplant) and those dying while on the [transplant list](#). 54% of patients are transplanted within one year, while three years after listing 80% of patients have received a transplant.

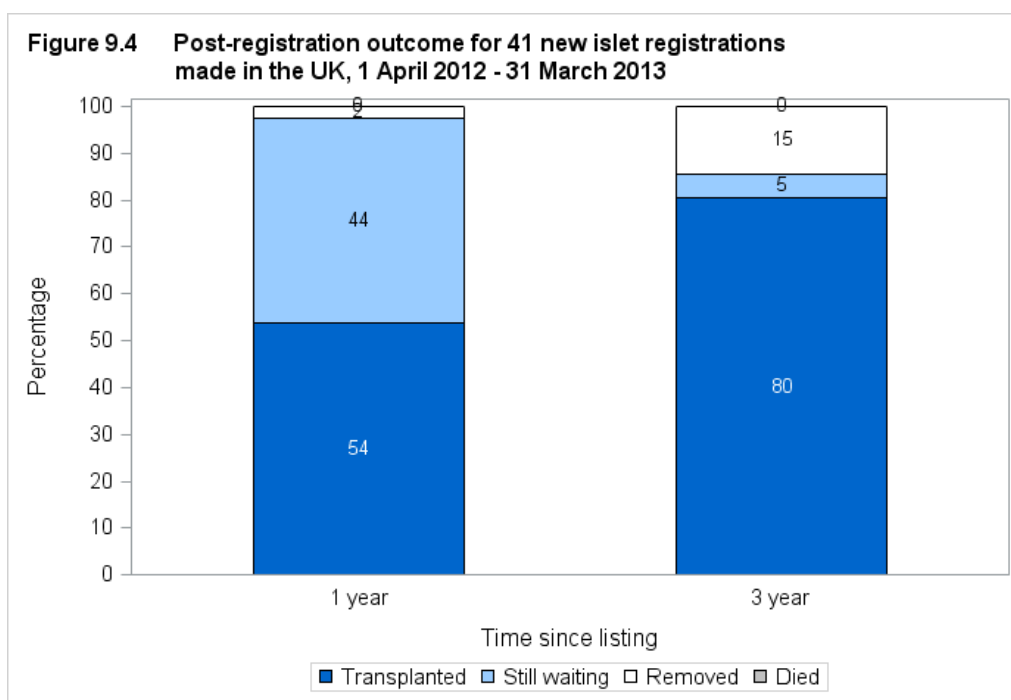
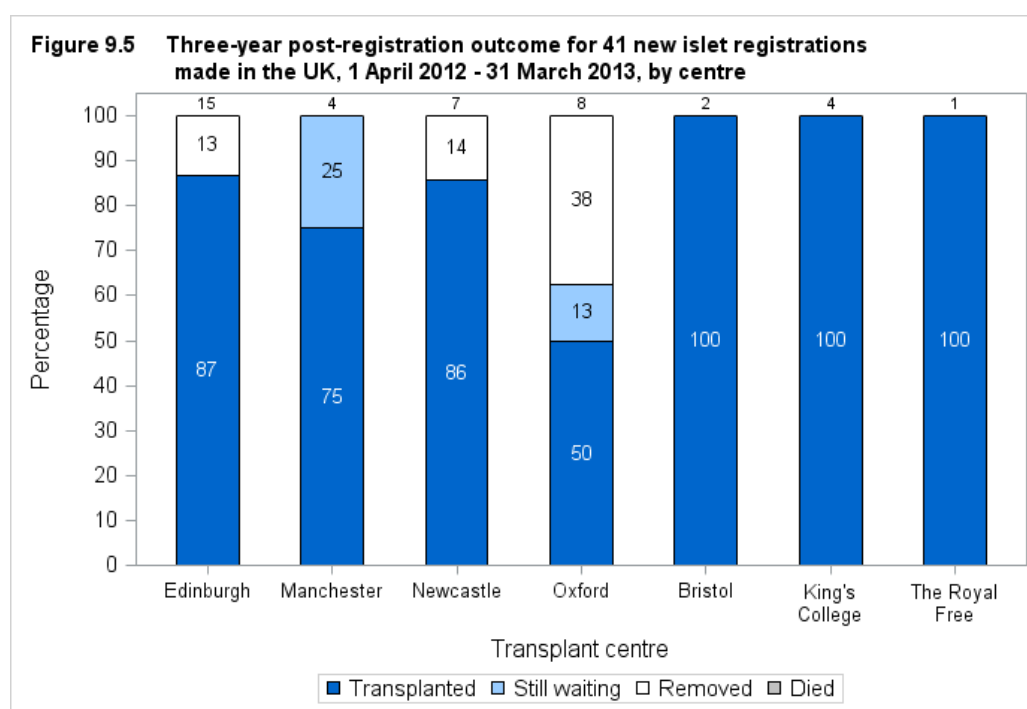
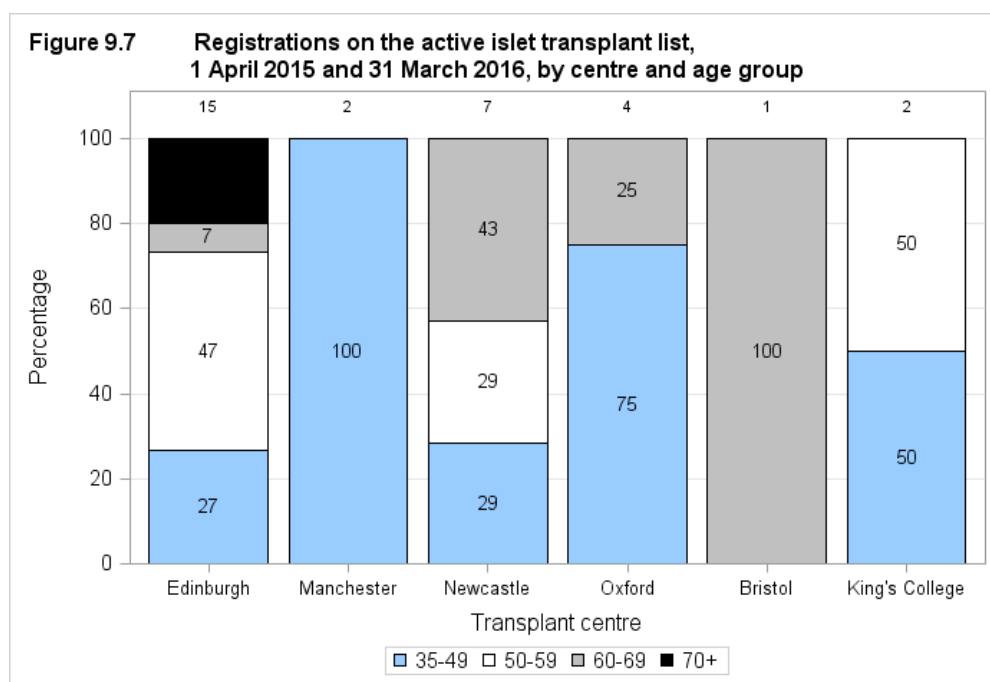
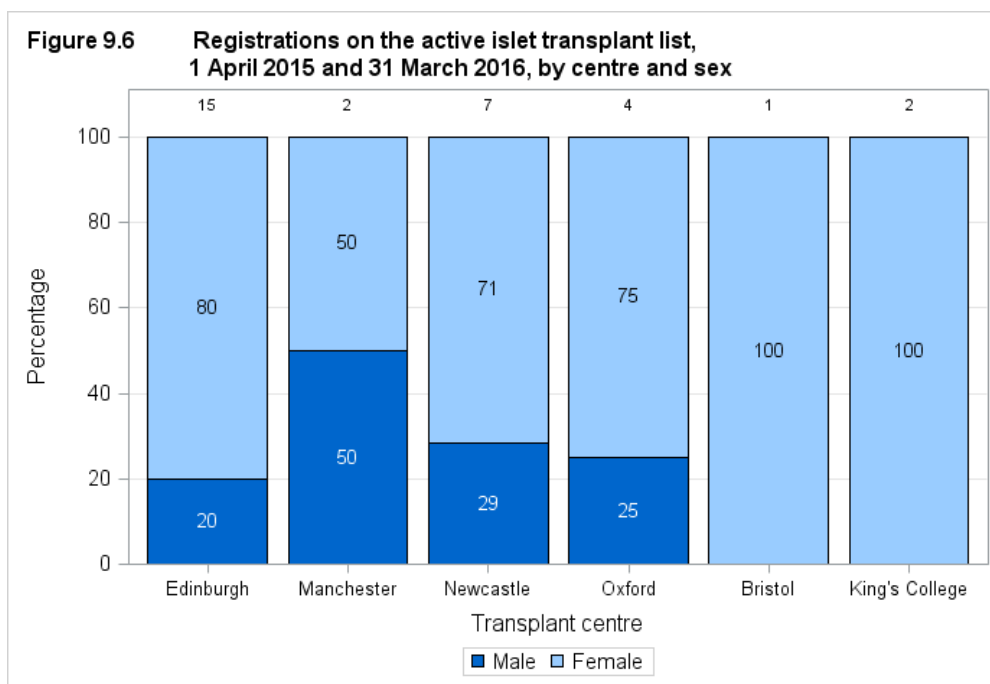


Figure 9.5 shows the proportion of patients transplanted or still waiting three years after joining the list by centre. Three years after registration, 38% of patients were removed from the list at Oxford, although the number of registrations was small. Overall the majority of centres transplanted 75% of patients registered within 3 years. None of the patients died whilst waiting for a transplant.



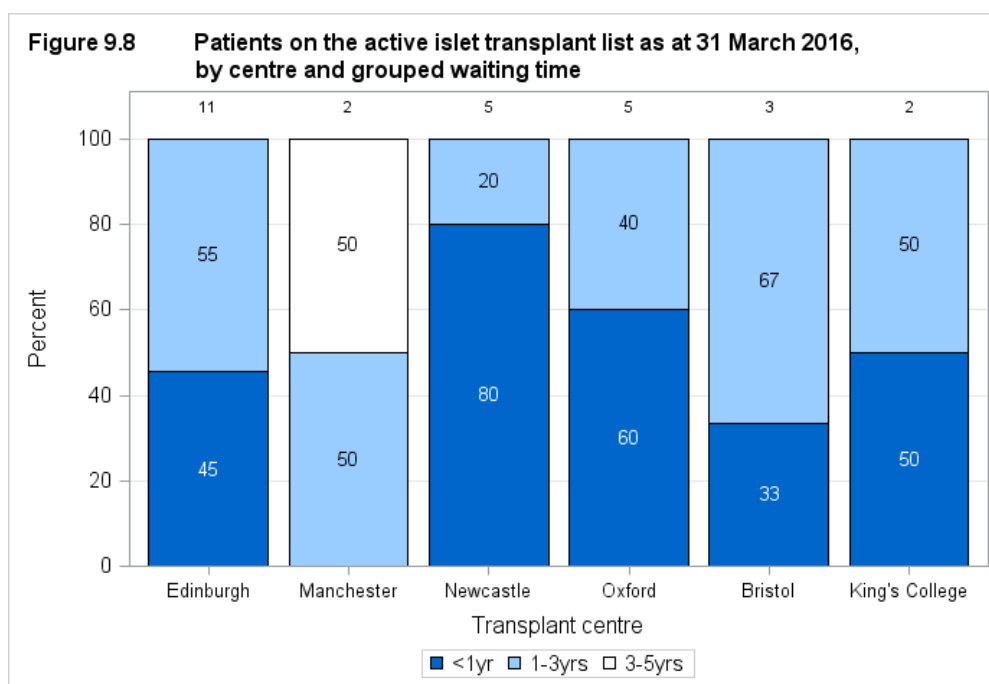
9.3 Demographic characteristics, 1 April 2015 – 31 March 2016

The sex and age group of patients registered on the [transplant list](#) during 2015/16 are shown by centre in **Figures 9.6** and **9.7**, respectively. Note that all percentages quoted are based only on data where relevant information was available. Overall, the majority of patients registered on the islet transplant list were female and the median age was 44 years.



9.4 Patient waiting times for those currently on the list, 31 March 2016

Figure 9.8 shows the length of time patients have been waiting on the islet [transplant list](#) at 31 March 2016 by centre. One highly sensitised patient (98% [cRF](#)) registered at Manchester has been waiting more than three years for transplant.



9.5 Median waiting time to transplant, 1 April 2010 - 31 March 2013

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 calculated using the [Kaplan-Meier method](#) and is shown in **Figure 9.9** and **Table 9.1** for patients registered at each individual unit.

The [median](#) waiting time to transplant for patients registered on the islet [transplant list](#) between 1 April 2010 and 31 March 2013 is 279 days (9 months), ranging from 146 days at Edinburgh to 594 days at Oxford.

There was insufficient data to calculate a median waiting time to islet transplant for patients registered at Manchester in this time period. However, for 12 patients registered at Manchester between 1 April 2009 and 31 March 2013, the median waiting time to islet transplant was 1010 days.

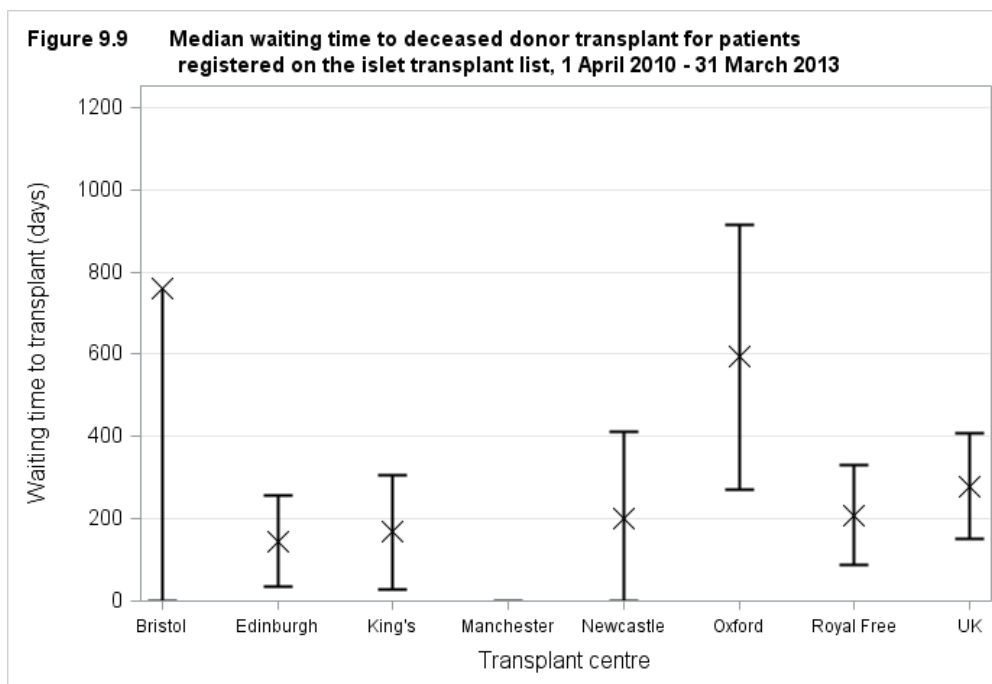


Table 9.1 Median waiting time to islet transplant in the UK, for patients registered 1 April 2010 - 31 March 2013

Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Bristol	2	-	-
Edinburgh	30	146	35 - 257
King's	6	-	-
Manchester ¹	11	-	-
Newcastle	19	201	0 - 413
Oxford	19	594	272 - 916
Royal Free	12	209	87 - 331
UK	99	279	151 - 407

- Data not presented where less than 10 patients included

¹ Insufficient data to calculate median waiting time

Response to islet offers

Offer decline rates

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

10.1 Offer decline rates, 1 April 2013 – 31 March 2016

Individual centre offer decline rates by financial year and over the time period, 1 April 2013 and 31 March 2016 are shown in **Table 10.1**. Royal Free had the lowest overall rates whilst Bristol had the highest rate (67%).

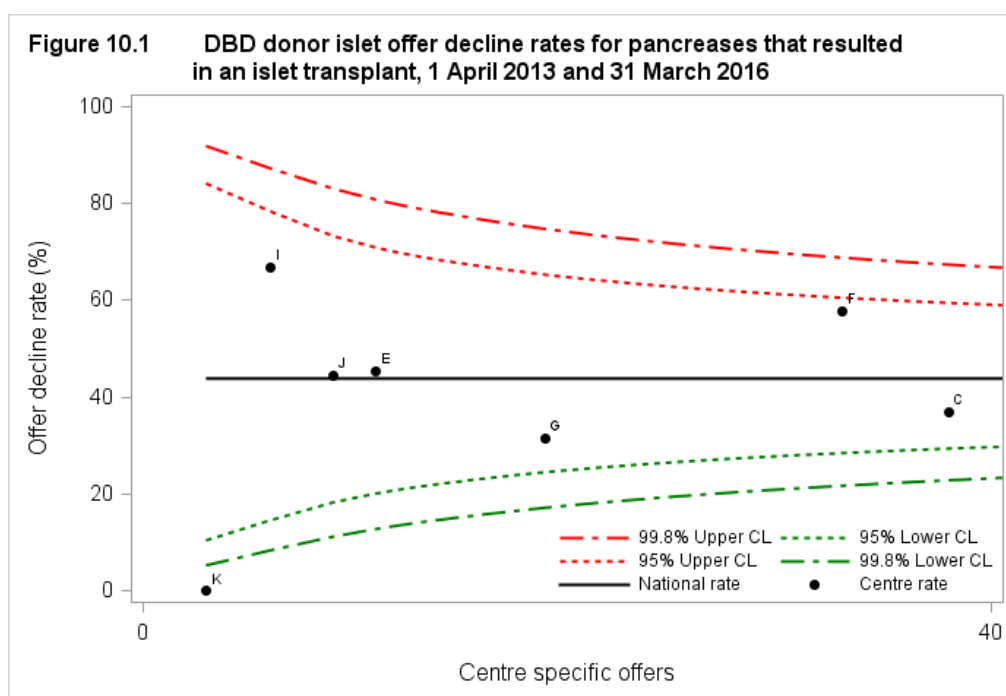


Table 10.1 DBD donor islet offer decline rates by transplant centre, 1 April 2013 and 31 March 2016

Centre	Code	2013/14		2014/15		2015/16		Overall	
		N	(%)	N	(%)	N	(%)	N	(%)
Bristol	I			4	(75)	2	(50)	6	(67)
Edinburgh	C	11	(27)	10	(50)	17	(35)	38	(37)
King's	J	5	(20)	2	(100)	2	(50)	9	(44)
Manchester	E	7	(57)	3	(33)	1	(0)	11	(45)
Newcastle	F	10	(50)	8	(63)	15	(60)	33	(58)
Oxford	G	8	(25)	9	(44)	2	(0)	19	(32)
Royal Free	K			3	(0)			3	(0)
UK		40	(48)	41	(37)	39	(51)	120	(45)

Islet transplants

11.1 Islet transplants, 1 April 2008 – 31 March 2016

Figure 11.1 shows the total number of islet transplants performed in the last eight years since islet transplantation was first commissioned in the UK, by type of donor. There was a significant increase in 2011/12 from 13 to 30 transplants a year, following the introduction of the national [Pancreas Allocation Scheme](#) in 2010 which provided islet patients with equal access to donated pancreases for the first time. Since 2011/12, the number of islet transplants remained fairly constant with 31 transplants in 2015/16. However, the number of islet transplants performed dropped to 23 in 2014/15.

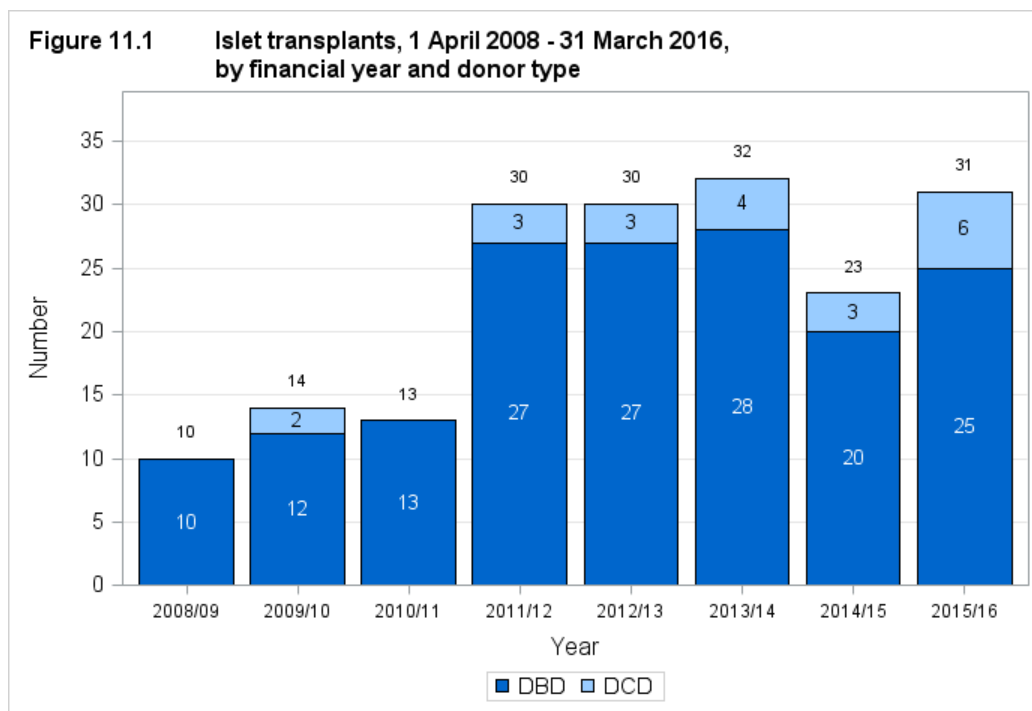


Figure 11.2 shows the total number of islet transplants performed in 2015/16, by centre and type of donor. The same information is presented in **Figure 11.3** but this shows the proportion of **DBD** and **DCD** transplants performed at each centre. Edinburgh performed the most islet transplants in 2015/16 (19) followed by Newcastle (7). Edinburgh was the only transplant centre that performed any **DCD** transplants.

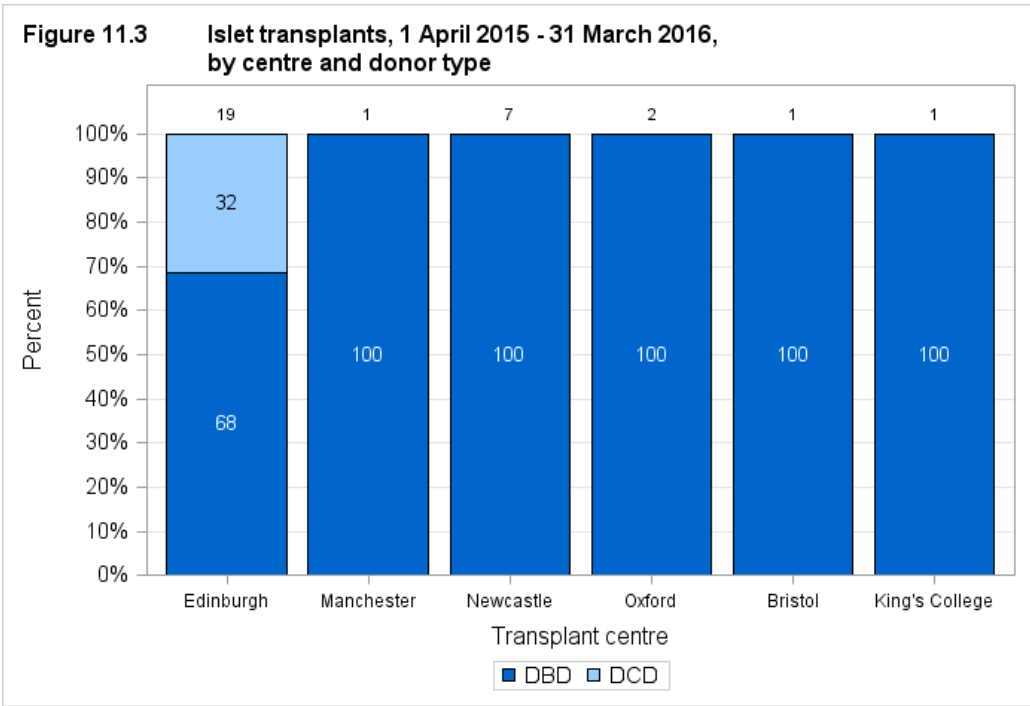
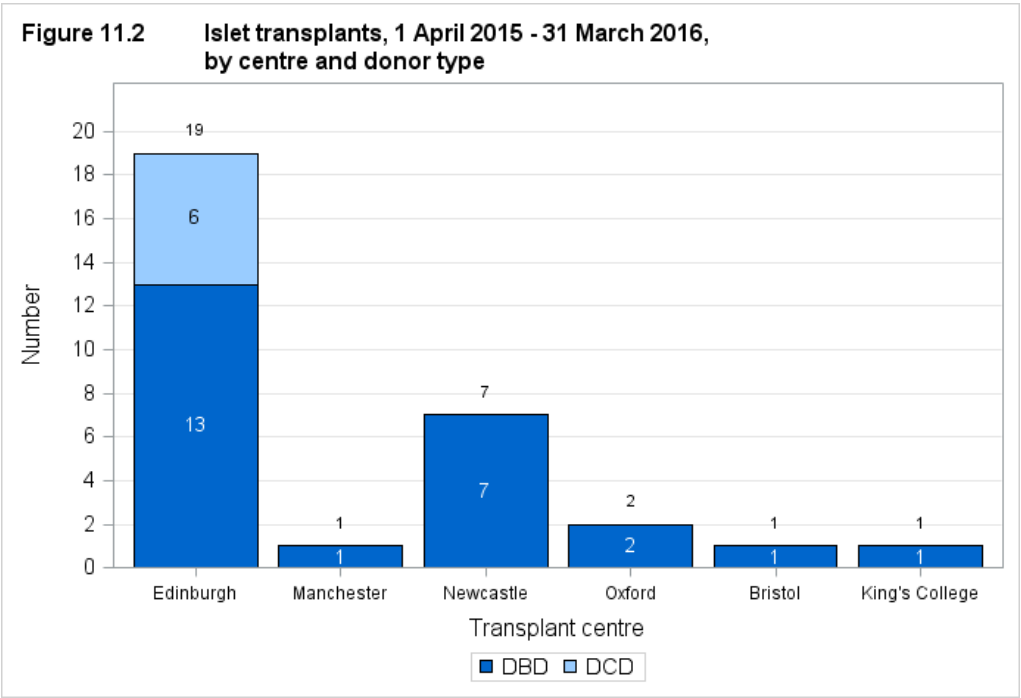
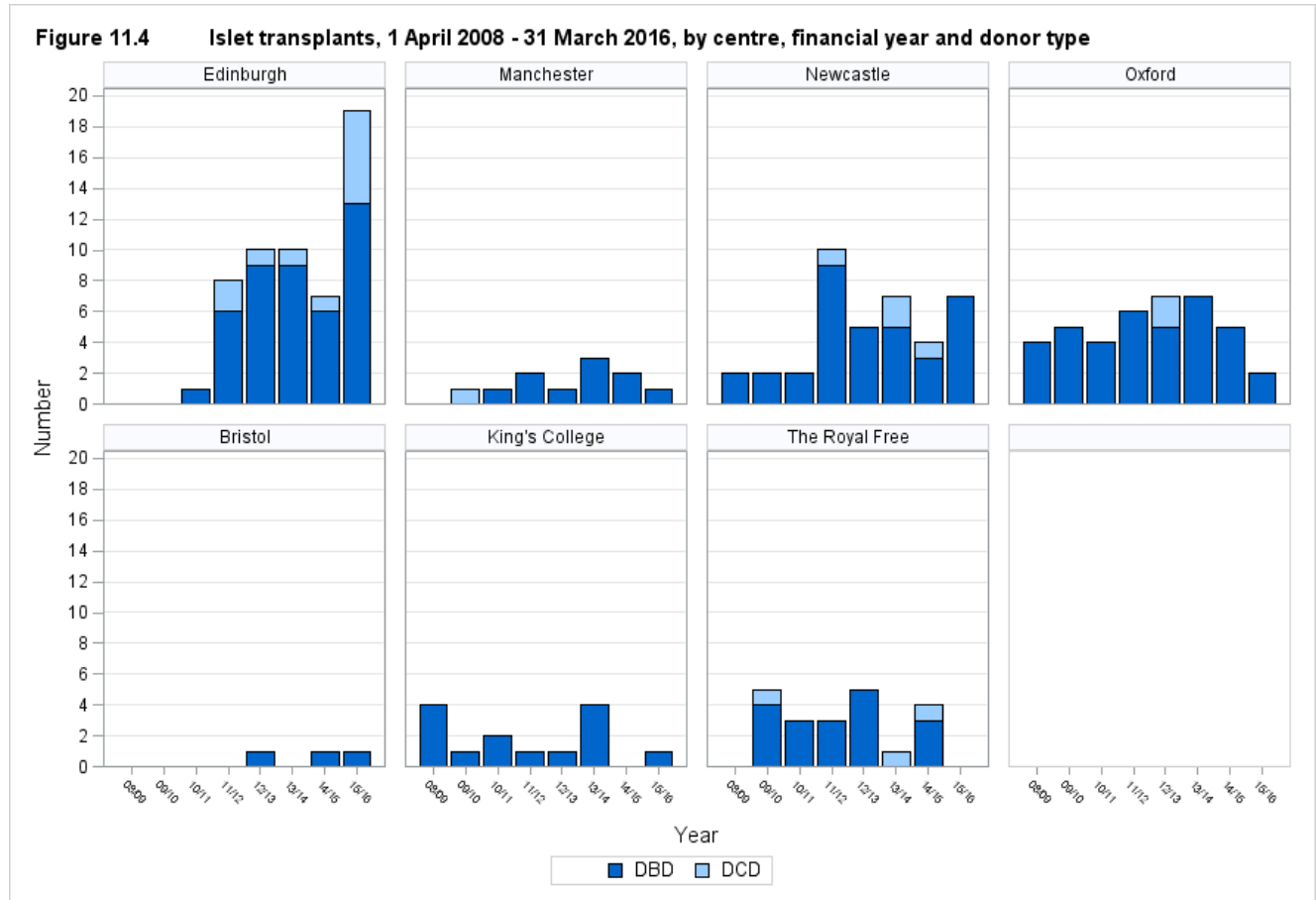


Figure 11.4 shows the total number of islet transplants performed in last eight years, by centre and type of donor. Oxford and Newcastle have consistently performed a number of islet transplants each year, while Edinburgh has increased their transplant activity in the last five years. Bristol has performed very few transplants in the last seven years.



Islet outcomes

12.1 Outcome measures for routine islet transplants

Key measures of islet outcome include annual rate of severe [hypoglycaemic](#) events, [HbA1c](#) and insulin requirements.

The [median](#) annual rate of severe [hypoglycaemic](#) events prior to transplant was 9.5 events per year, and at one-year post-transplant this had been reduced to no events per year. In the year post-transplant, 85% of patients experienced no severe [hypoglycaemic](#) events and fourteen patients experienced between one and five events.

Figure 12.1 shows the reduction in [median HbA1c](#) (%) for routine islet transplants. [Median HbA1c](#) dropped from 8.0% prior to transplant to 6.8% at one-year post-transplant. At one-year, 47 patients (57%) had an [HbA1c](#) less than 7%.

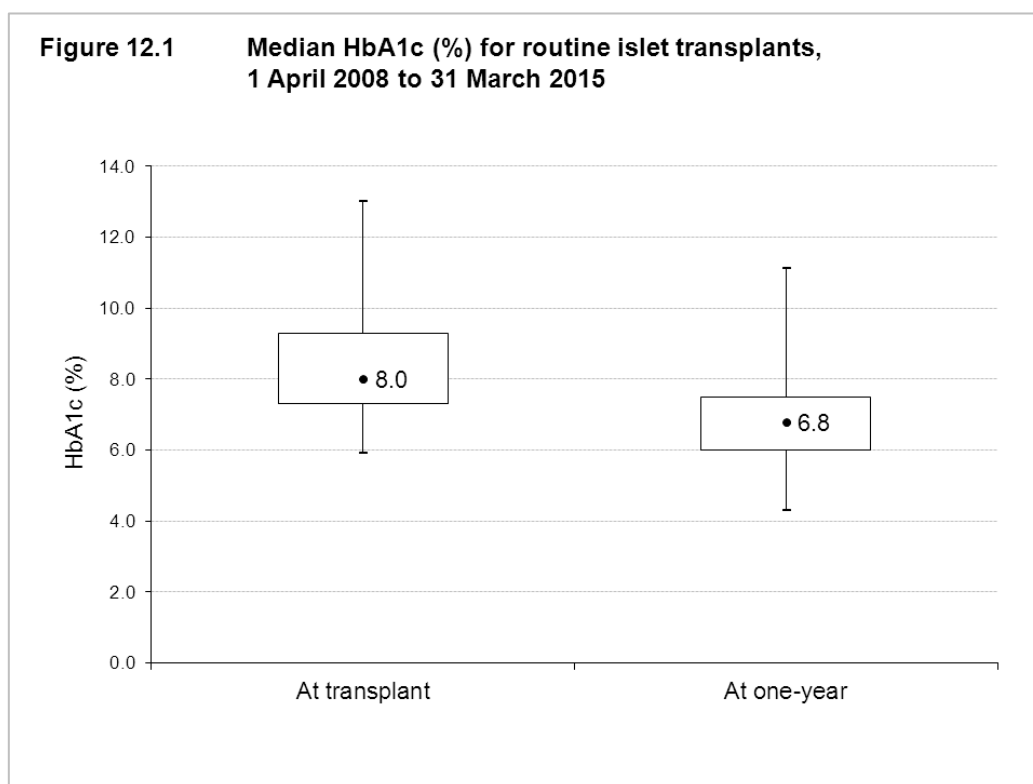
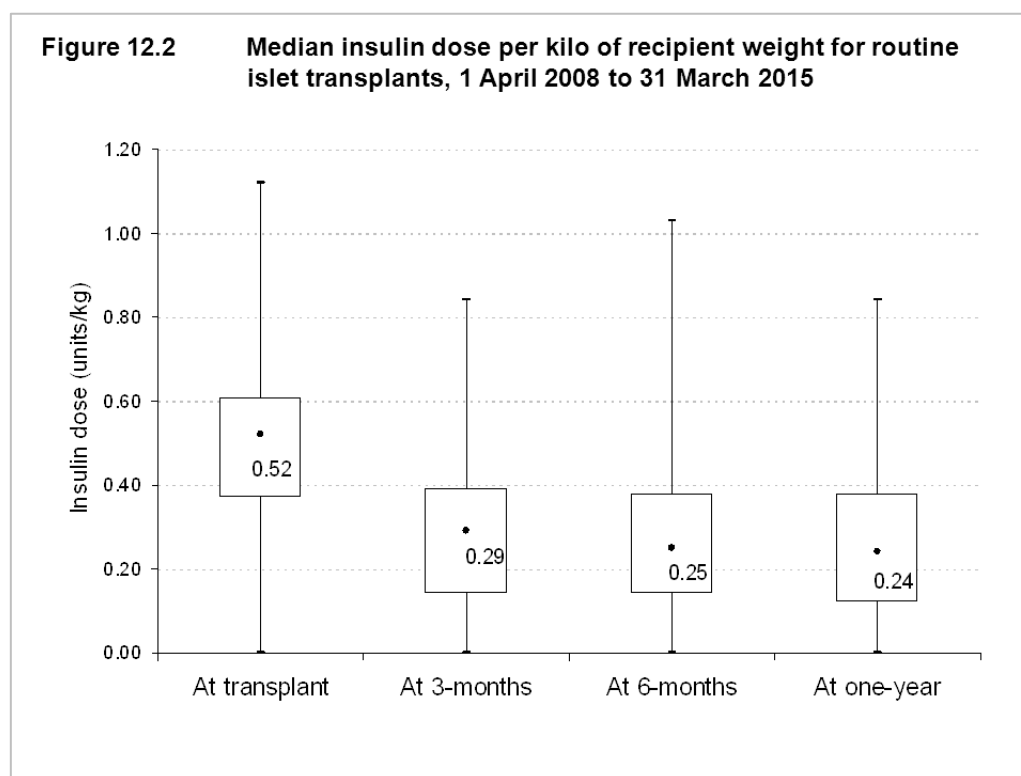


Figure 12.2 shows the [median](#) reduction in insulin dose per kilo recipient body weight at three-months, six-months and one-year post-transplant. Prior to transplant the [median](#) insulin dose is 0.52 units/kg, by three-months the [median](#) dose has dropped to 0.29 units/kg and this reduction has been maintained at one-year post-transplant with a [median](#) dose of 0.24 units/kg. Following islet transplantation, 12 (14%) of the 84 patients with known insulin dose at one year achieved insulin independence at some point during the first year.



Form return rates

13.1 Islet form return rates, 1 January – 31 December 2015

Form return rates are reported in **Table 13.1** for the islet transplant record, three month and 1 year follow up form, along with lifetime follow up (more than 2 years). These include all islet transplants performed between 1 January and 31 December 2015 for the transplant record, and all requests for follow up forms issued in this time period. All but one follow-up forms were issued to transplant centres.

Table 13.1 Form return rates following islet transplantation, by centre, 1 January 2015 - 31 December 2015								
Centre	Transplant record		3 month follow-up		12 month follow-up		Lifetime follow-up	
	N	% returned	N	% returned	N	% returned	N	% returned
Bristol, Southmead Hospital					1	100	1	100
Edinburgh, Royal Infirmary Of Edinburgh	16	100	8	100	5	100	13	100
Glasgow, Queen Elizabeth University Hospital							1	100
London, Kings College Hospital	1	100	1	100	.	.	3	100
London, The Royal Free Hospital	2	100	.	.	1	100	7	100
Manchester, Manchester Royal Infirmary	2	100	1	100	.	.	4	100
Newcastle, Freeman Hospital	8	100	4	100	4	100	8	100
Oxford, Churchill Hospital	3	100	2	100	2	100	14	100
Overall	32	100	16	100	13	100	51	100

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](#) compatible 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.

A fundamentally similar method was used to conduct the survival from listing analysis. The [risk factors](#) used are detailed in the table below.

First registrations for simultaneous pancreas and kidney (SPK) transplant

1, 5 and 10 year [patient](#) Age, gender, grouped registration year, ethnicity, blood group, [cRF](#)>85% survival from listing

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