NHS
Blood and Transplant

INTERIM REPORT ON PANCREAS AND ISLET TRANSPLANTATION

5 YEAR REPORT
(1 OCTOBER 2011 – 30 SEPTEMBER 2016)

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PRODUCED IN COLLABORATION WITH NHS ENGLAND

Contents

Executive Summary

This report presents key figures about pancreas and islet transplantation in the UK. The period reported covers 5 years of pancreas and islets transplant data, from 1 October 2011. 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 30 September 2016, there were 240 patients on the UK active pancreas and islet transplant list, which represents a 6% increase in the number of patients from 6 months earlier. The number of patients on the active pancreas list increased by 6% to 215 in 6 months while the active islet transplant list decreased by 11% to 25 patients in the same time period.

- There were 81 pancreas transplants and 15 islet transplants performed in the UK from April to September 2016. Of these 79% of transplants were from donations after brain death. From 1 October 2015 to 30 September 2016 24% of pancreas and islet transplants were from donations after circulatory death.

- The median waiting time for patients registered, between 1 October 2010 to 30 September 2013, for a pancreas transplant in the UK was 359 days. The median ranged from 171 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 285 days.

- The national rates of graft survival one- and five-years after first simultaneous pancreas and kidney transplant from deceased donors are 88% and 77%, respectively. These rates vary between centres, ranging from 80% to 95% at one-year and 58% to 84% 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 97% and 88%, respectively. These rates vary between centres, ranging from 94% to 100% at one-year and 61% to 97% 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 79% and 49%, respectively. The national rates of patient survival one- and five-years are 98% 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 transplant activity between 1 October 2011 and 30 September 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, from 1 October 2010 to 30 September 2016. Islet transplantation was first commissioned in the UK from 1 April 2008. 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 2011 to 30 September 2015 and five-year post-transplant for the period 1 October 2007 to 30 September 2011. The centre specific results for survival estimates 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) 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.

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 2012 to 2016. The number of patients actively waiting for a pancreas or islet transplant has gradually declined each 6 monthly period from 269 in March 2014 to 227 in March 2016, but has increased to 240 in September 2016.

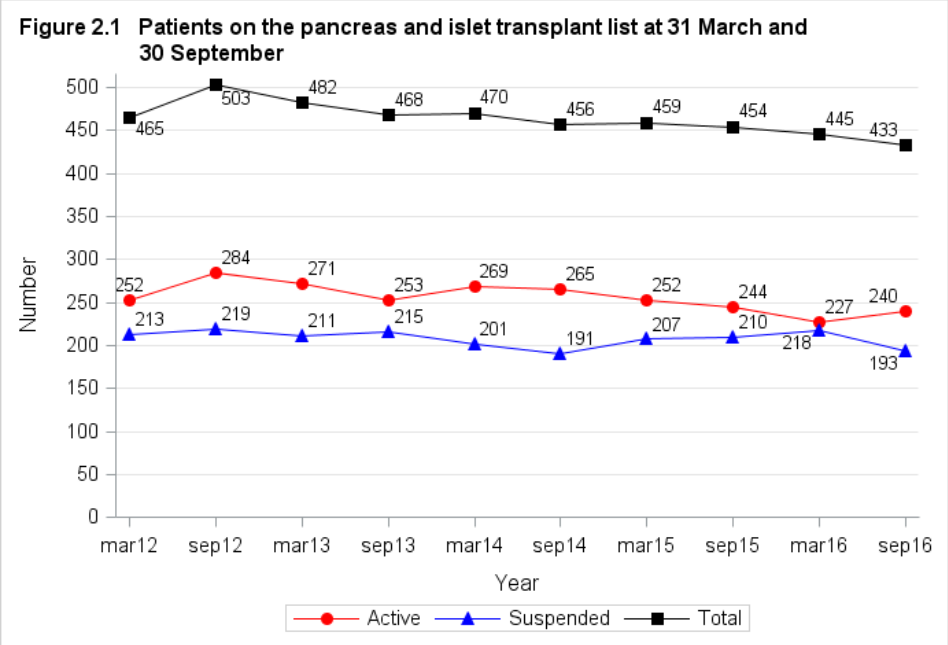


Figure 2.2 shows the number of patients on the pancreas and islet transplant list at 30 September 2016 for each transplant centre. Cambridge, Cardiff, Guy's and WLRTC only perform pancreas transplants while Bristol, King's College and the Royal Free only perform islet transplants. Oxford has the largest transplant list with 83 patients registered for a pancreas or islet transplant. Further, Oxford has the most patients registered for an islet transplant (n=9).

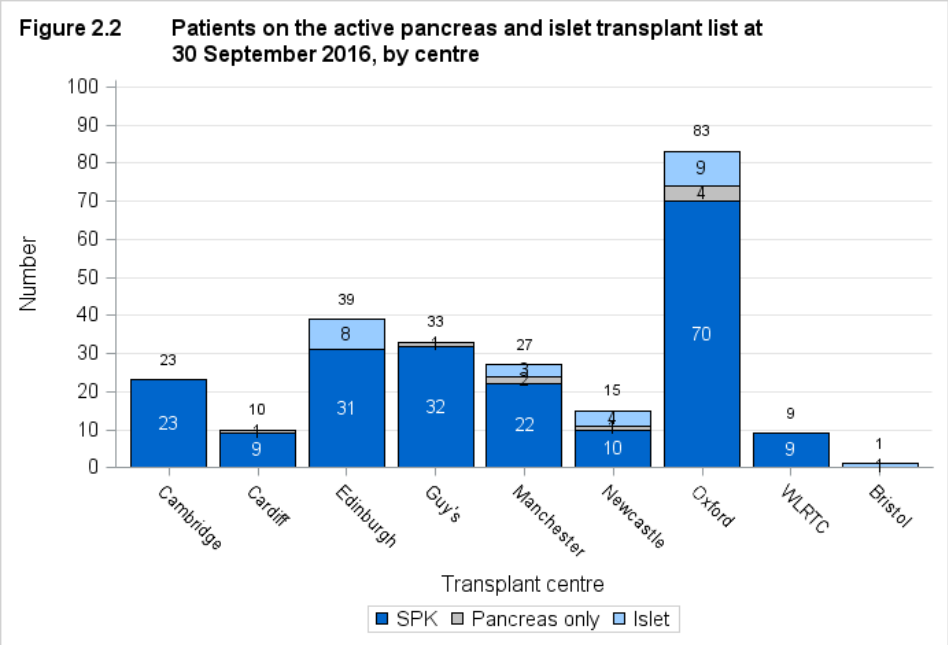


Figure 2.3 shows the total number of pancreas and islet transplants performed in the last five years. The number of transplants on the whole fluctuated in the last couple of years such that; April to September had less activity compared to October to March. Although the number of islet transplants remained constant, at 15, from October 2015 to March 2016 compared to April to September 2016.

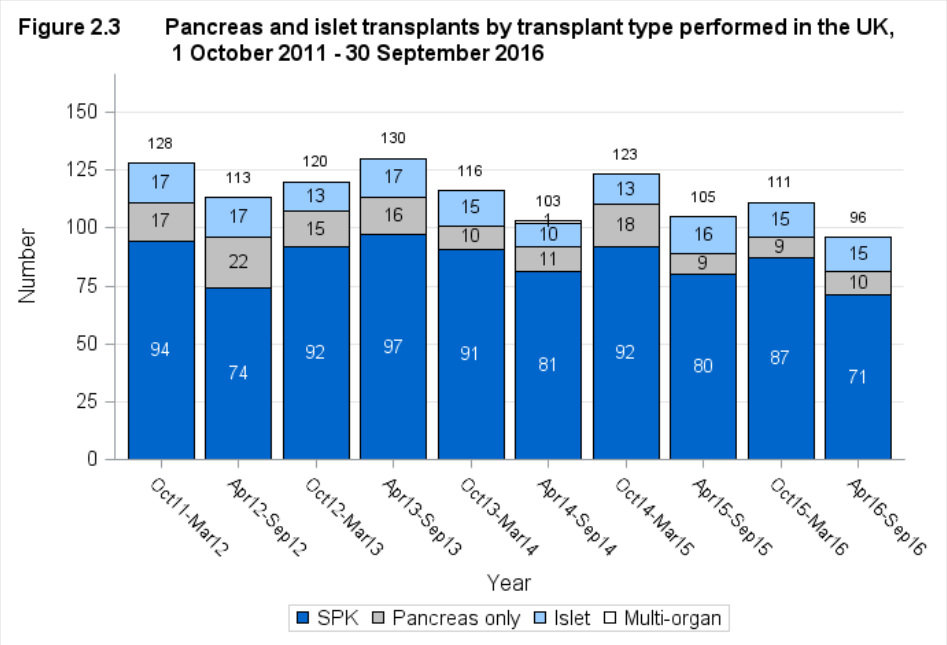


Figure 2.4 shows the total number of pancreas and islet transplants performed from April to September 2016 at each transplant centre. Oxford performed the most pancreas and islet transplants, a total of 34 transplants. The Royal Free islet only transplant centre performed 0 islet transplants.

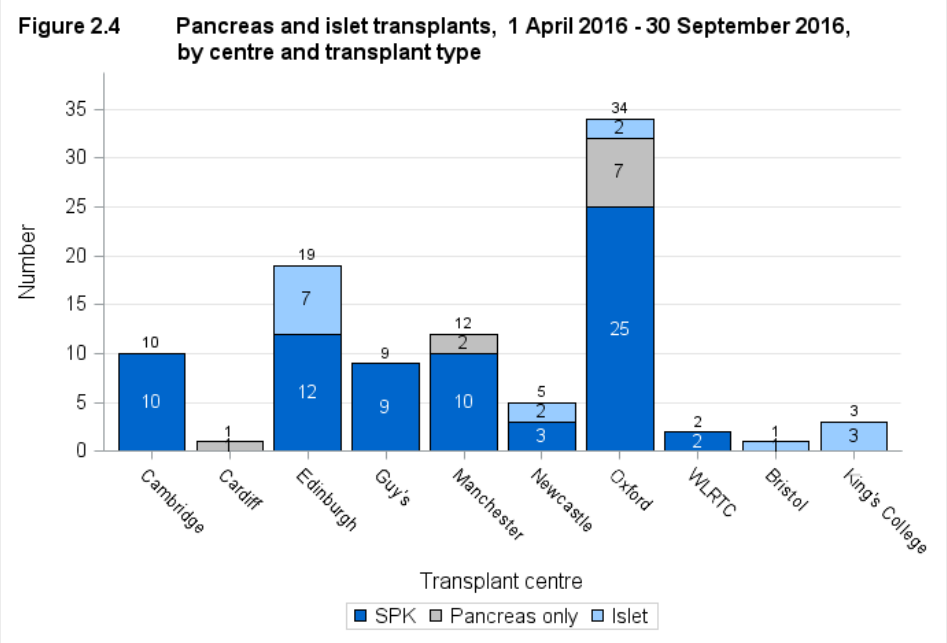
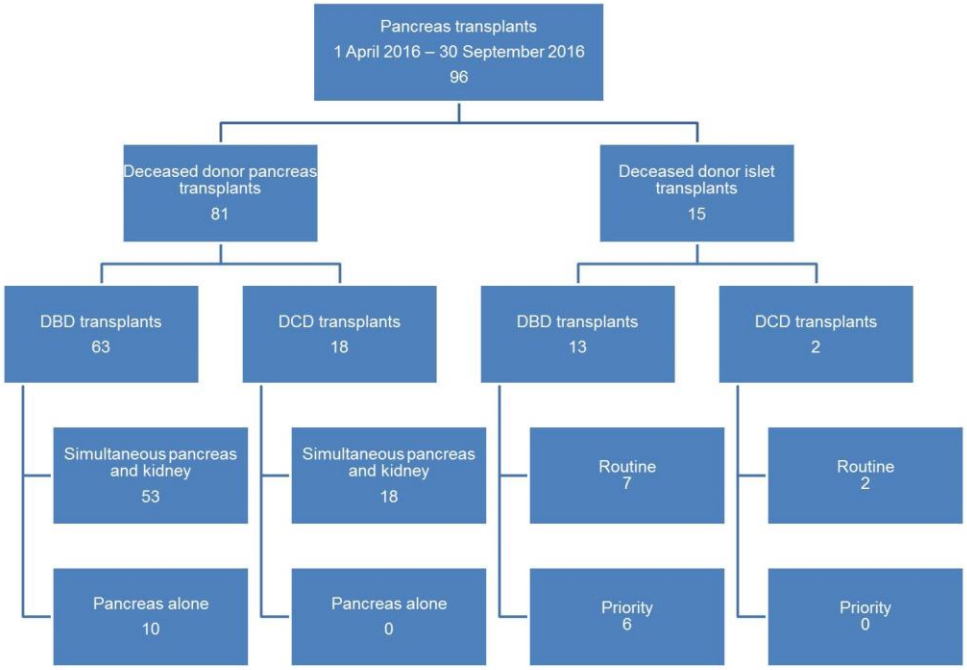


Figure 2.5 details the 96 pancreas and islet transplants performed in the UK between 1 April 2016 and 30 September 2016. 79% of these were from DBD deceased donors. 81 were pancreas transplants and 15 were islet transplants. 88% of pancreas transplants were SPK's in this time period. For islet transplantation, 9 were routine and 6 were priority.

Figure 2.5 Pancreas and islet transplants performed in the UK, 1 April 2016 – 30 September 2016



Pancreas transplant list

3.1 Patients on the pancreas transplant list as at 31 March and 30 September, 2012 – 2016

Figure 3.1 shows the number of patients on the pancreas transplant list at 31 March and 30 September between 2012 and 2016. The number of patients actively waiting for a pancreas transplant gradually reduced six monthly from 236 in March 2014 to 202 in March 2016. However, the number increased to 215 in September 2016.

Figure 3.1 Patients on the pancreas transplant list at 31 March and 30 September

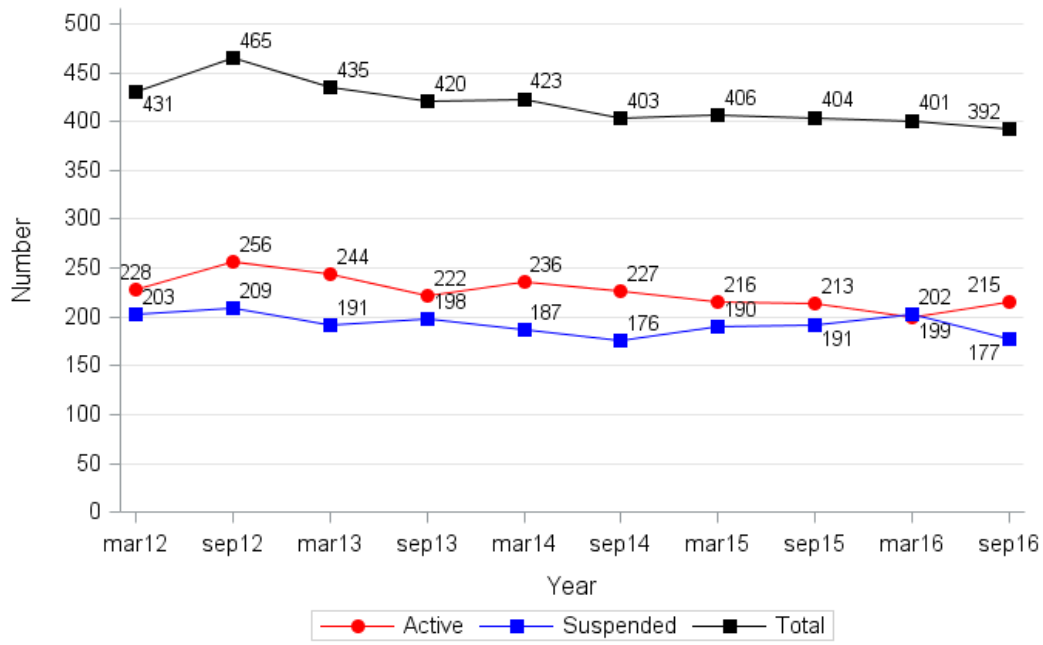
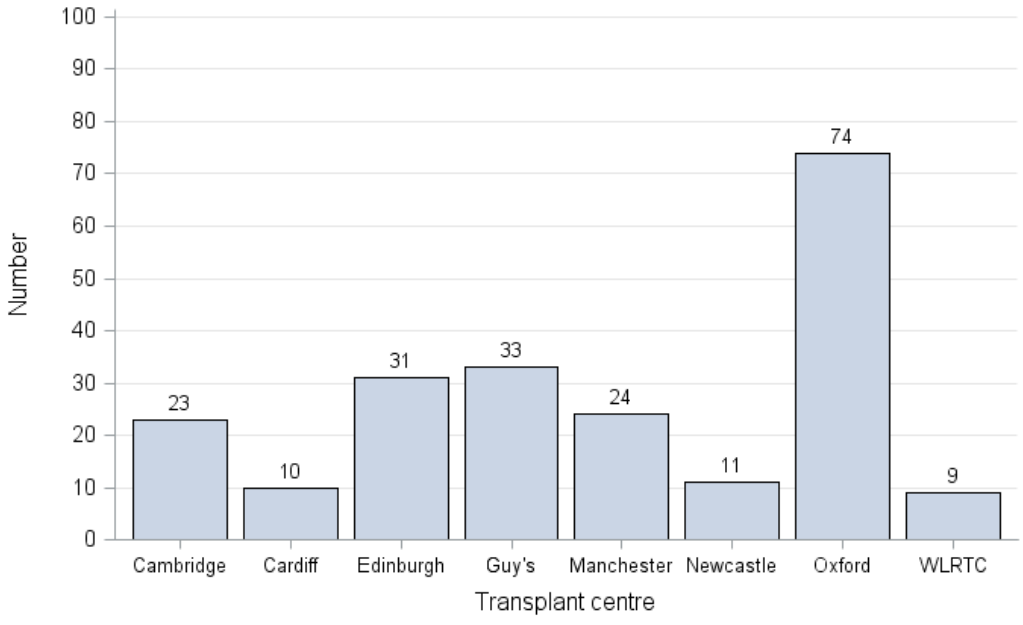


Figure 3.2 shows the number of patients on the active pancreas transplant list at 30 September 2016 by centre. Oxford had the largest proportion of the transplant list (34%) and WLRTC had the smallest proportion (4%).

Figure 3.2 Patients on the active pancreas transplant list by centre at 30 September 2016



3.2 Median waiting time to transplant, 1 October 2010 - 30 September 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 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 2010 and 30 September 2013 is 359 days, just under a year. This ranged from 171 days at Cardiff to 525 days at Edinburgh.

Figure 3.3 Median waiting time to deceased donor transplant for patients registered on the pancreas transplant list, 1 October 2010 - 30 September 2013

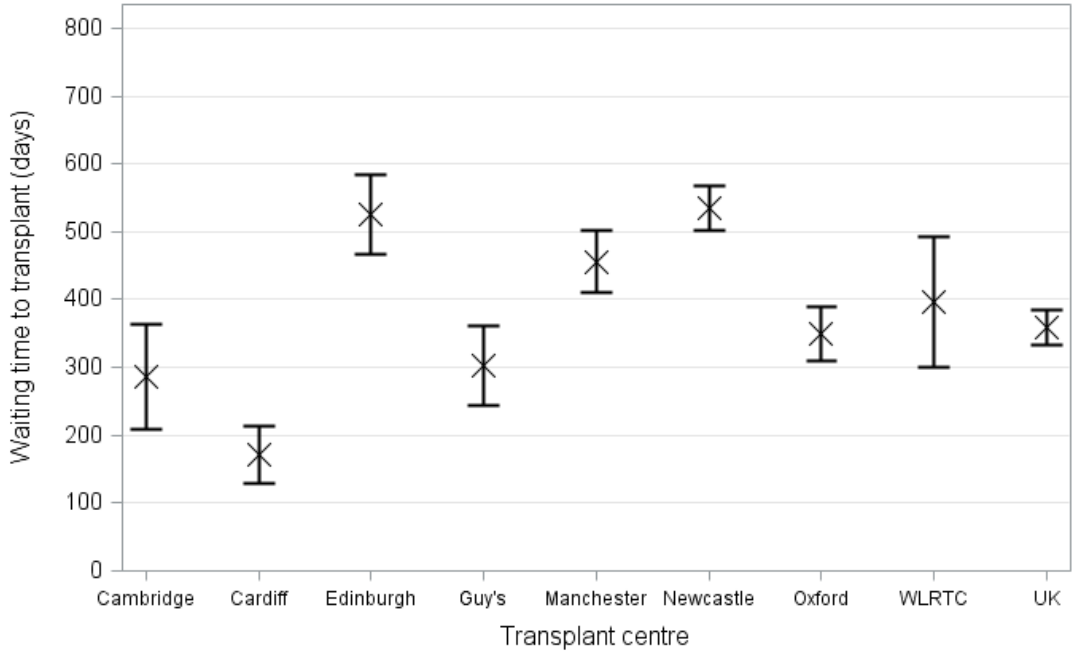


Table 3.1 Median waiting time to pancreas transplant in the UK, for patients registered 1 October 2010 - 30 September 2013

Transplant centre	Number of patients registered	Waiting time (days) Median	95% Confidence interval
Cambridge	83	287	210 - 364
Cardiff	54	171	129 - 213
Edinburgh	55	525	466 - 584
Guy's	103	303	245 - 361
Manchester	110	456	411 - 501
Newcastle	27	535	502 - 568
Oxford	238	350	310 - 390
WLRTC	46	397	301 - 493
UK	**716**	**359**	**334 - 384**

Response to pancreas offers

4.1 Offer decline rates, 1 April 2013 – 30 September 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 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 2013 and 30 September 2016. Centres can be identified by the information shown in **Table 4.1**. Guy's, Oxford and Cambridge had offer decline rates better than the national rate, whilst Edinburgh and Newcastle had higher rates than the national average.

Figure 4.1 **DBD donor pancreas offer decline rates for pancreases that resulted in a pancreas transplant, 1 April 2013 and 30 September 2016**

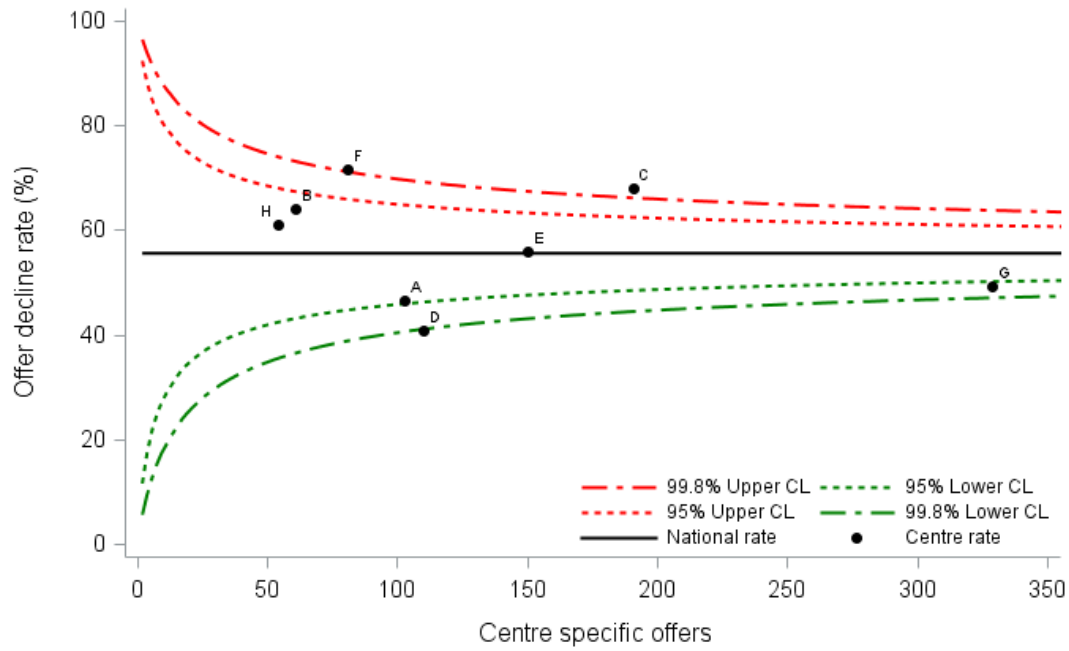


Table 4.1 compares individual centre offer decline rates over time by financial year. The offer decline rate for Edinburgh was 50% from April to September 2016, showing an improvement from 72% in 2015/16. The decline rate for WLRTC was 80% and 0% for Cardiff from April to September 2016.

Table 4.1 DBD donor pancreas offer decline rates by transplant centre, 1 April 2013 and 30 September 2016

Centre	Code	2013/14		2014/15		2015/16		Apr - Sep 16		Overall	
		N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Cambridge	A	35	(43)	38	(61)	21	(33)	9	(33)	103	(47)
Cardiff	B	14	(50)	24	(71)	22	(68)	1	(0)	61	(64)
Edinburgh	C	66	(70)	43	(70)	58	(72)	24	(50)	191	(68)
Guy's	D	36	(36)	29	(41)	33	(39)	12	(58)	110	(41)
Manchester	E	52	(58)	43	(51)	43	(63)	12	(42)	150	(56)
Newcastle	F	23	(65)	21	(67)	24	(79)	13	(77)	81	(72)
Oxford	G	99	(42)	81	(47)	99	(57)	50	(52)	329	(49)
WLRTC	H	11	(64)	23	(70)	15	(40)	5	(80)	54	(61)
UK		**336**	**(52)**	**302**	**(57)**	**315**	**(59)**	**126**	**(53)**	**1079**	**(56)**

Figure 4.2 compares individual centre offer DCD decline rates with the national rate over the time period, 1 April 2013 and 30 September 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.

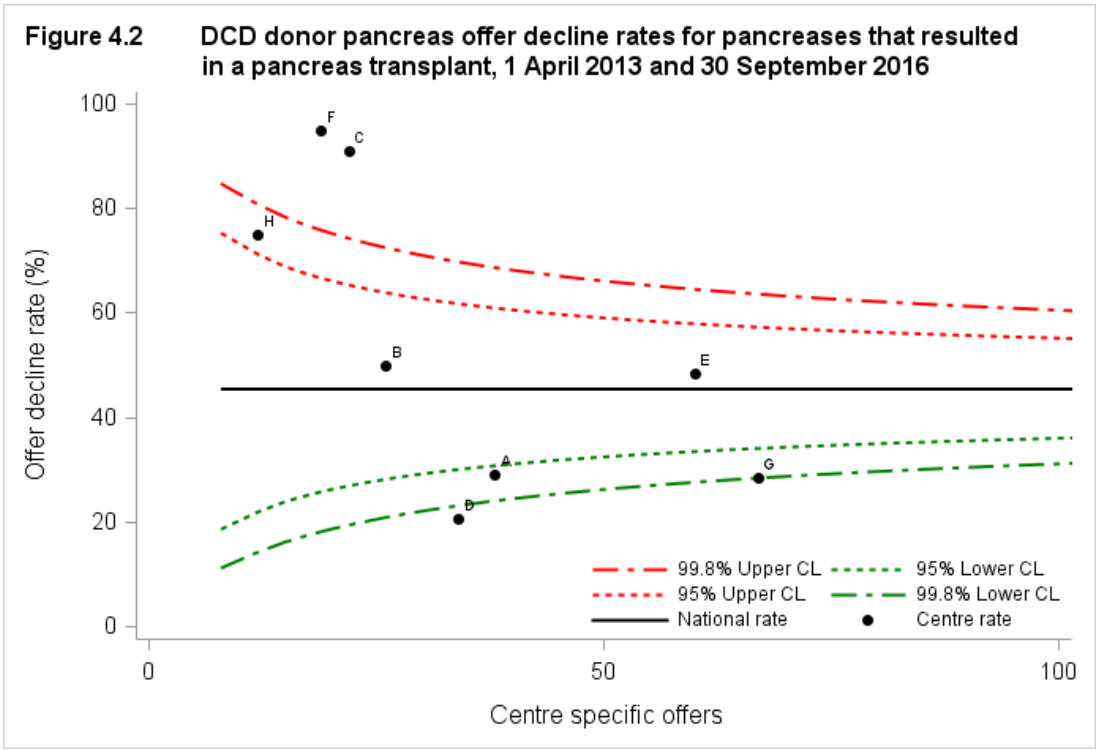


Table 4.2 DCD donor pancreas offer decline rates by transplant centre, 1 April 2013 and 30 September 2016

Centre	Code	2013/14		2014/15		2015/16		Apr - Sep 16		Overall	
		N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Cambridge	A	9	(33)	16	(31)	11	(27)	2	(0)	38	(29)
Cardiff	B	6	(33)	16	(56)	3	(33)	1	(100)	26	(50)
Edinburgh	C	6	(100)	7	(71)	7	(100)	2	(100)	22	(91)
Guy's	D	9	(11)	13	(23)	9	(22)	3	(33)	34	(21)
Manchester	E	13	(46)	21	(57)	21	(43)	5	(40)	60	(48)
Newcastle	F	5	(80)	4	(100)	7	(100)	3	(100)	19	(95)
Oxford	G	14	(21)	24	(33)	19	(32)	10	(20)	67	(28)
WLRTC	H	2	(100)	4	(100)	5	(40)	1	(100)	12	(75)
UK		**64**	**(42)**	**105**	**(48)**	**82**	**(45)**	**27**	**(44)**	**278**	**(45)**

Pancreas transplants

5.1 Pancreas transplants, 1 October 2011 – 30 September 2016

Figure 5.1 shows the total number of pancreas transplants performed in the last five years, by type of donor. The figure shows that 43 pancreas transplants were from DCD donors from October 2015 to September 2016; this amounted to a quarter of pancreas transplants. There were 63 DBD pancreas transplants from April to September 2016. This was the lowest recorded 6 month period.

Figure 5.1 Pancreas transplants, 1 October 2011 - 30 September 2016 by financial year and donor type

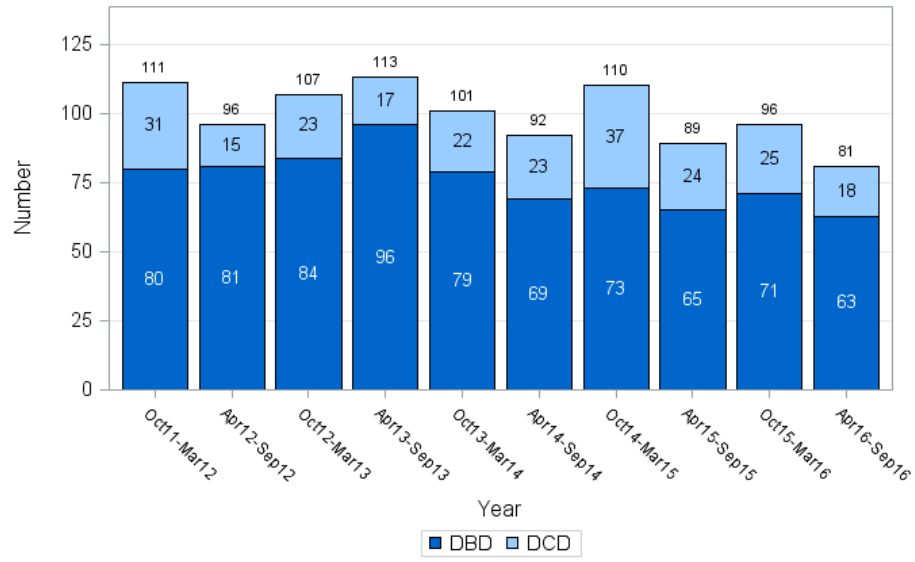


Figure 5.2 shows the total number of pancreas transplants performed from April to September 2016, by centre and type of donor. The same information is presented in **Figure 5.3** but this shows the proportion of DBD and DCD transplants performed at each centre. Oxford performed the most DBD and DCD transplants. There were no DCD transplants performed at Cardiff, Edinburgh, Newcastle, WLRTC. Guy's and Manchester had the largest proportions of DCD transplants (33%), closely followed by Cambridge (30%).

Figure 5.2 Pancreas transplants, 1 April 2016 - 30 September 2016 by centre and donor type

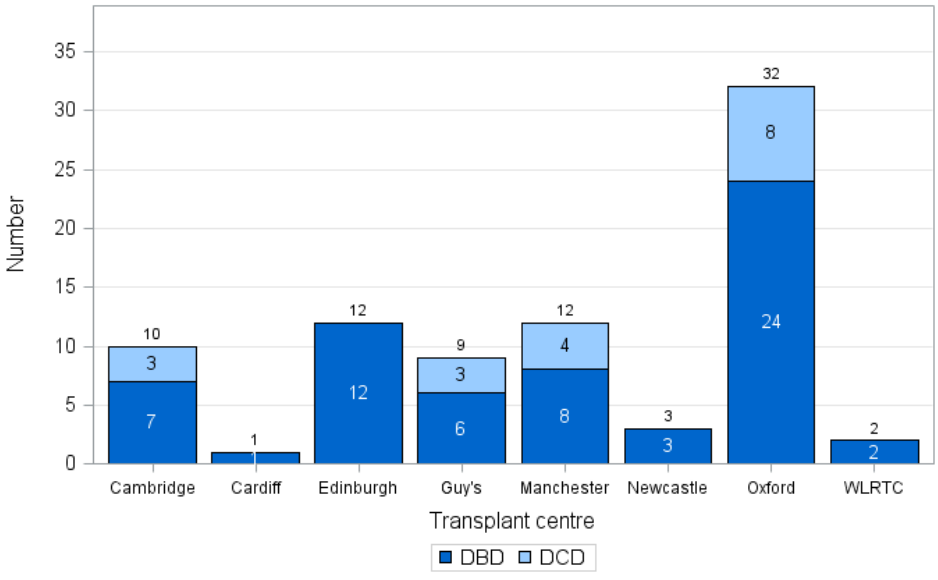
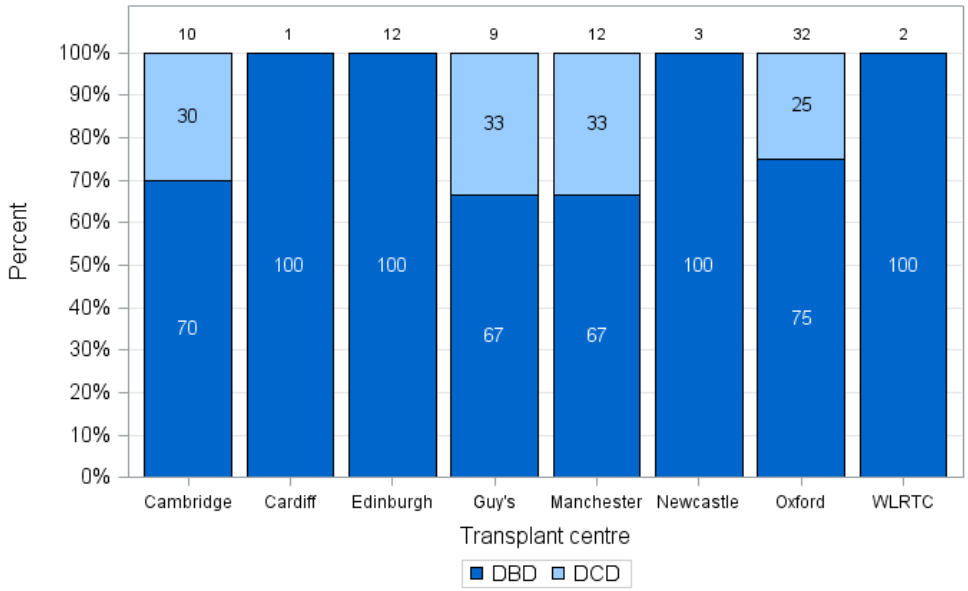


Figure 5.3 **Pancreas transplants, 1 April 2016 - 30 September 2016 by centre and donor type**



5.2 Cold ischaemia time, 1 October 2011 – 30 September 2016

Median cold ischaemia times (CIT) are shown in addition to inter-quartile ranges in **Figures 5.4** to **5.7**. 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 5.4 shows the median cold ischaemia time in DBD donor pancreas transplants over the last 5 years. The overall median cold ischaemia time has been fluctuating between 10 and 11 hours 6 monthly between 2014 and 2016.

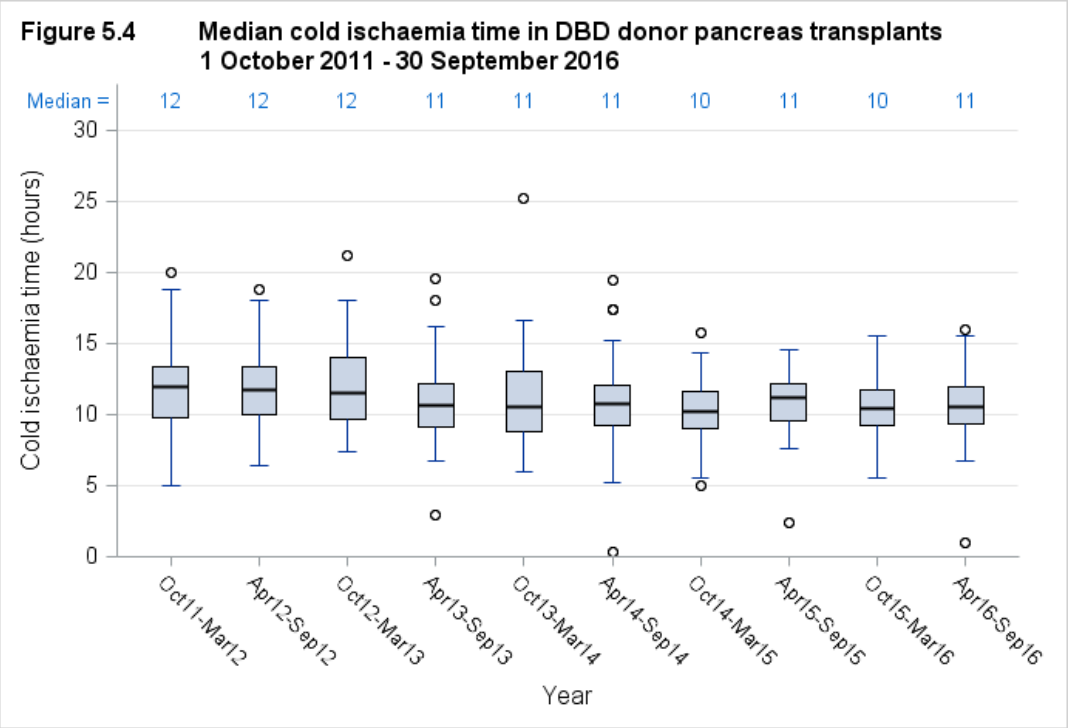


Figure 5.5 shows the median cold ischaemia time in DBD donor pancreas transplants from April to September 2016 for each transplant centre. WLRTC had the longest median cold ischaemia time of 13 hours compared with Cambridge who had the shortest, 9 hours.

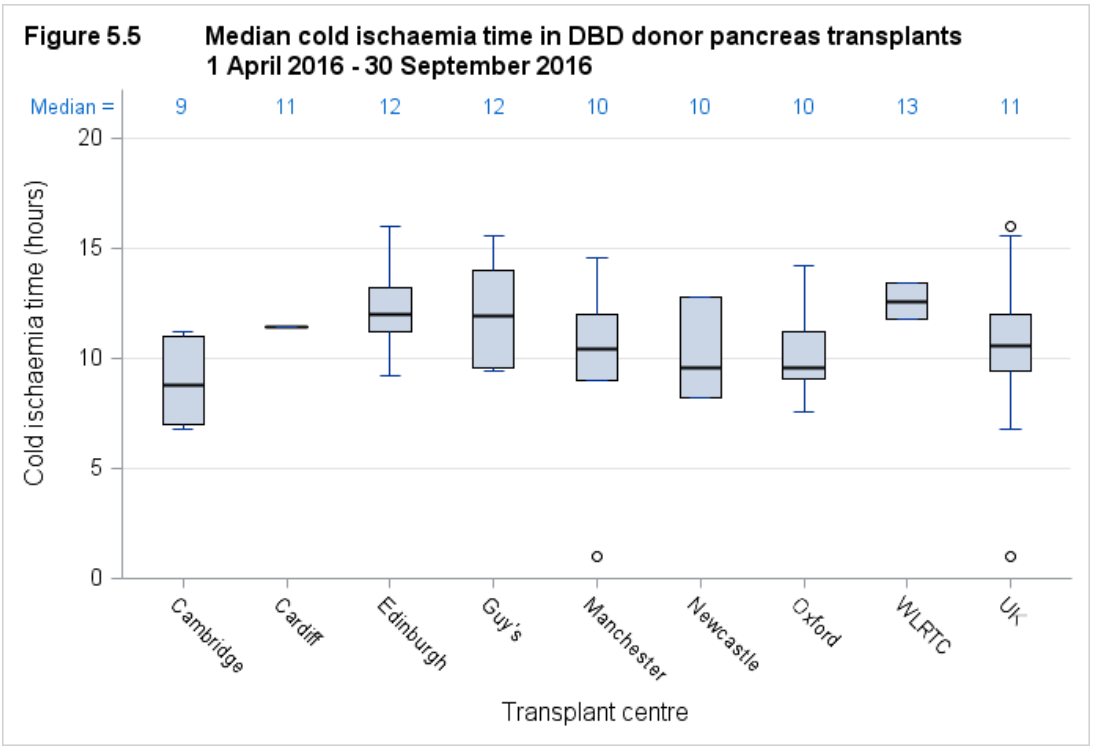


Figure 5.6 shows the median cold ischaemia time in DCD donor pancreas transplants over the last five years. Overall median cold ischaemia time has fluctuated between 10 and 11 hours six monthly from October 2013 to September 2016.

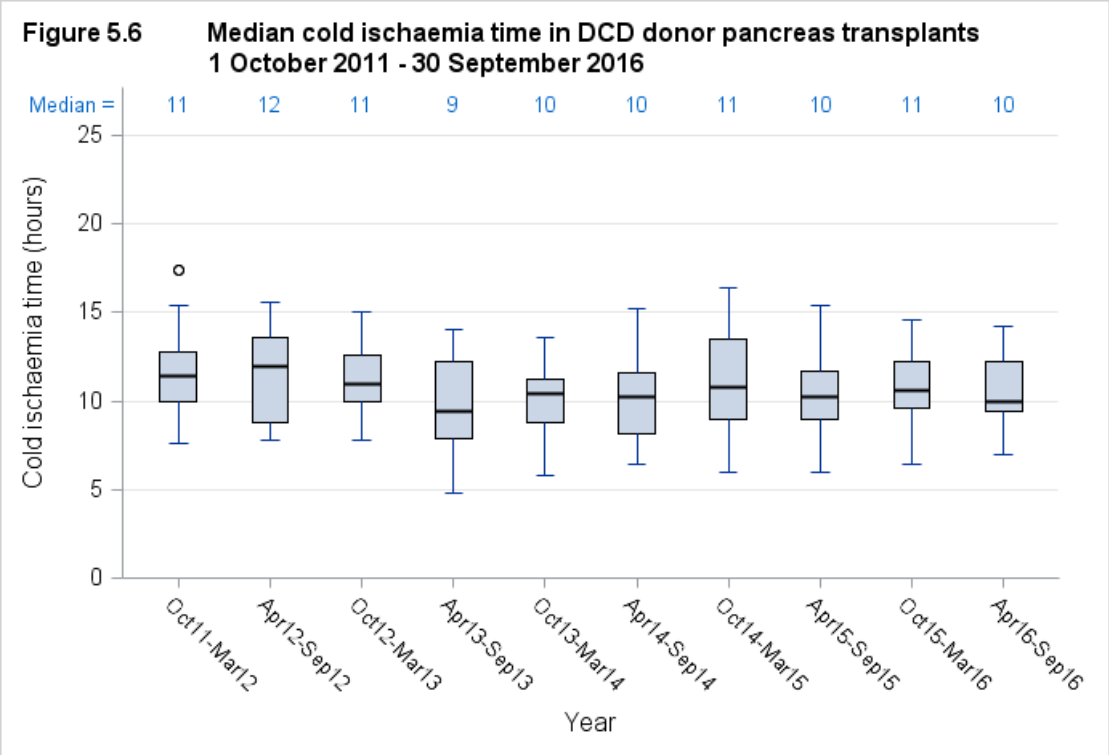
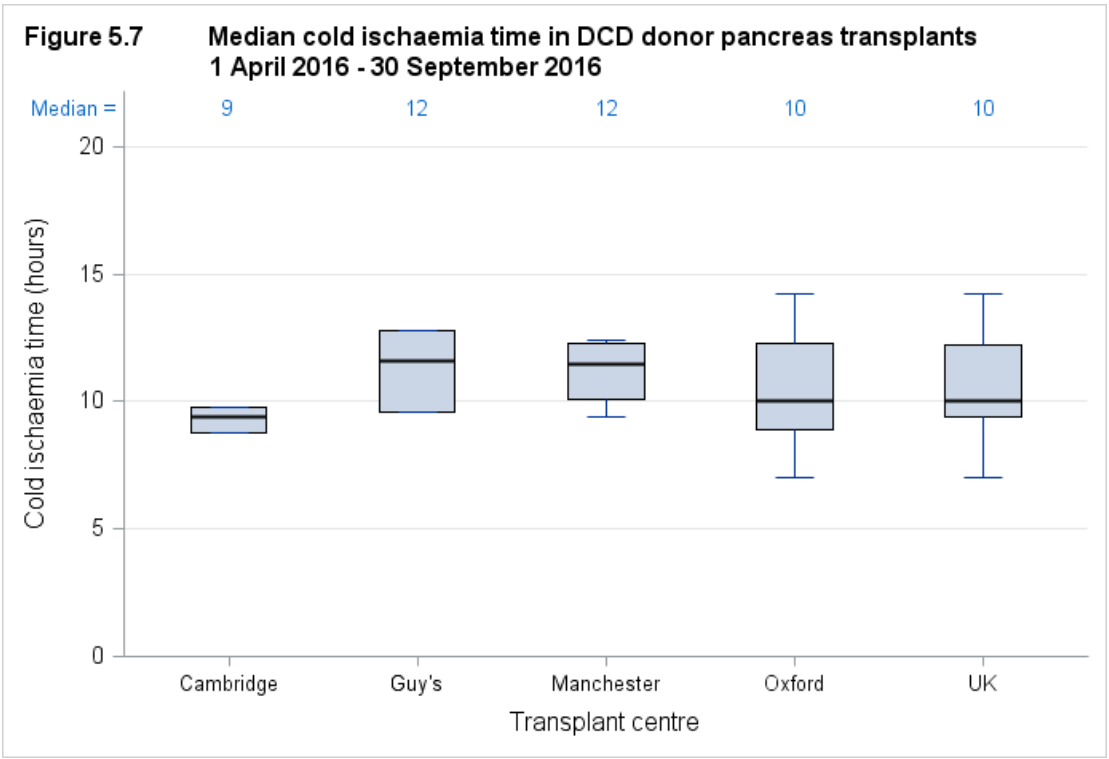


Figure 5.7 shows the median cold ischaemia time in DCD donor pancreas transplants in April to September 2016 for each transplant centre. Cambridge had the shortest median cold ischaemia time of 9 hours, whilst Guy's and Manchester had the longest median ischaemia times of 12 hours.



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 99.8% 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 October 2011 and 30 September 2015**

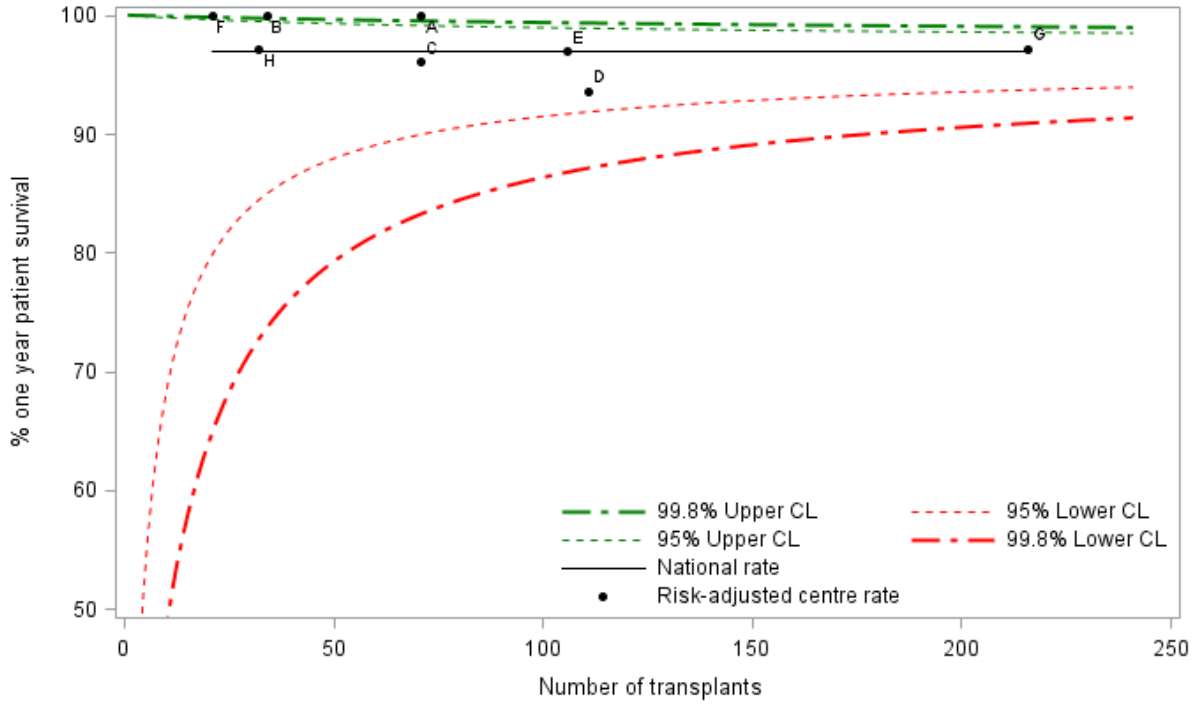


Figure 6.2 **Risk-adjusted one year pancreas graft (death censored) survival rates for all deceased donor first SPK transplants, between 1 October 2011 and 30 September 2015**

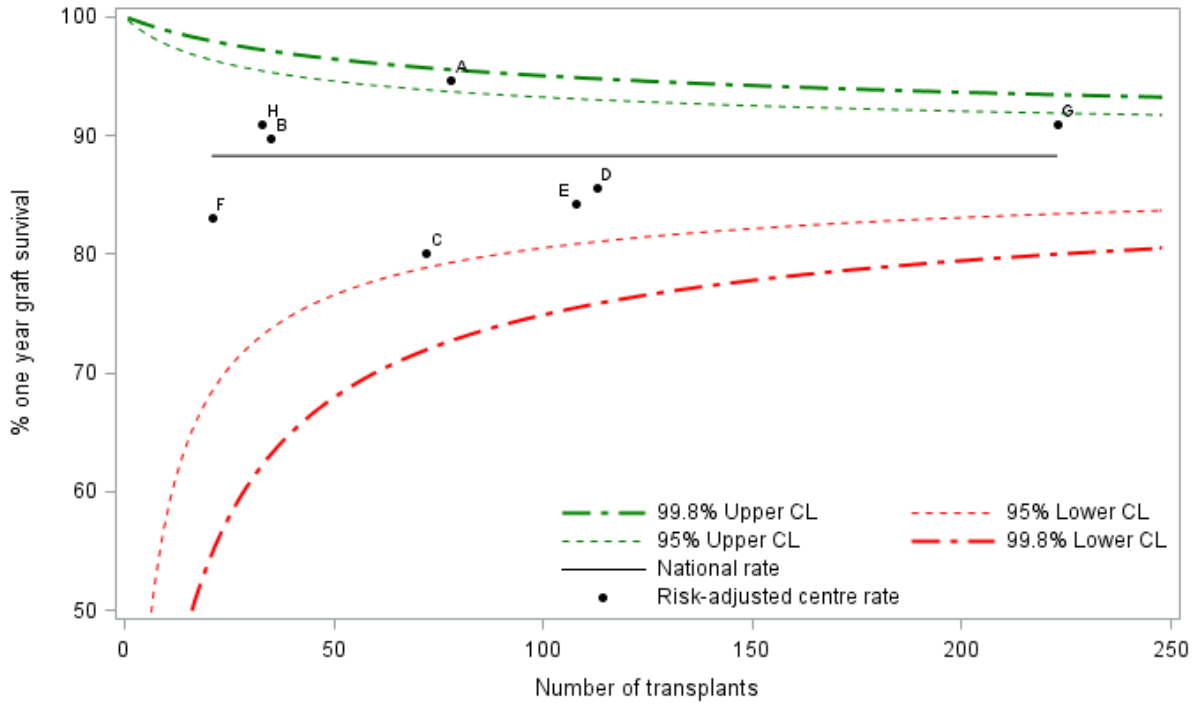


Figure 6.3 **Risk-adjusted five year patient survival rates for deceased donor first SPK transplants, between 1 October 2007 and 30 September 2011**

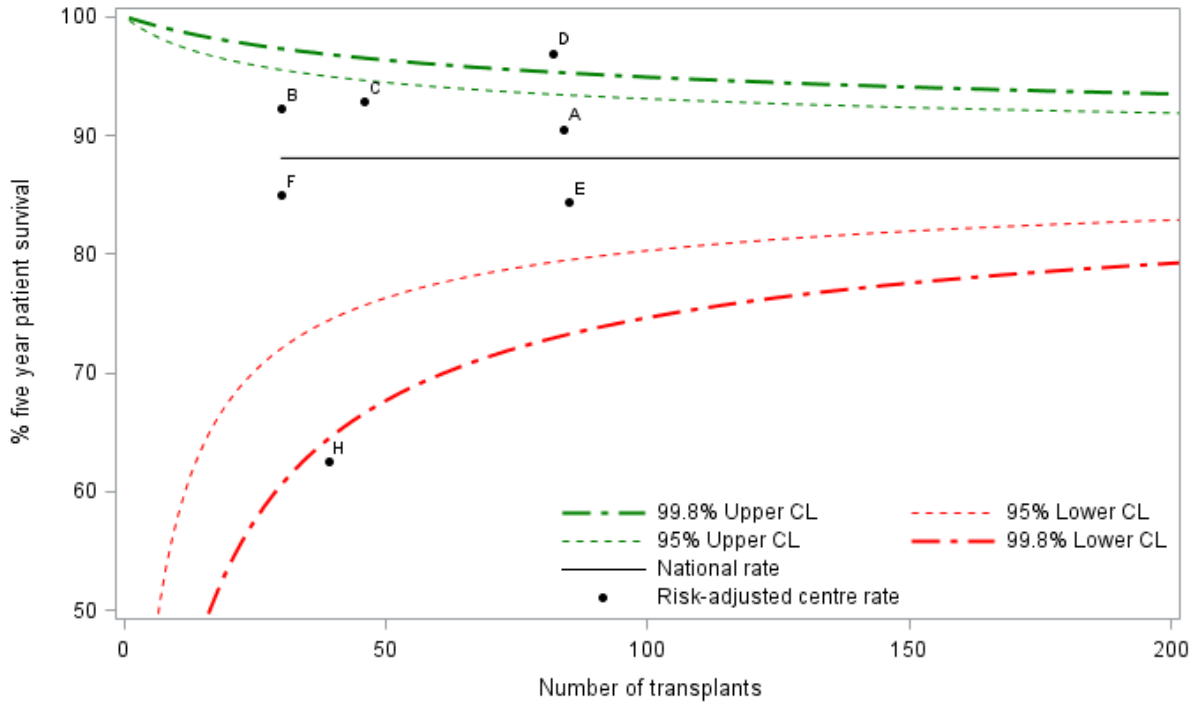


Figure 6.4 **Risk-adjusted five year pancreas graft (death censored) survival rates for all deceased donor first SPK transplants, between 1 October 2007 and 30 September 2011**

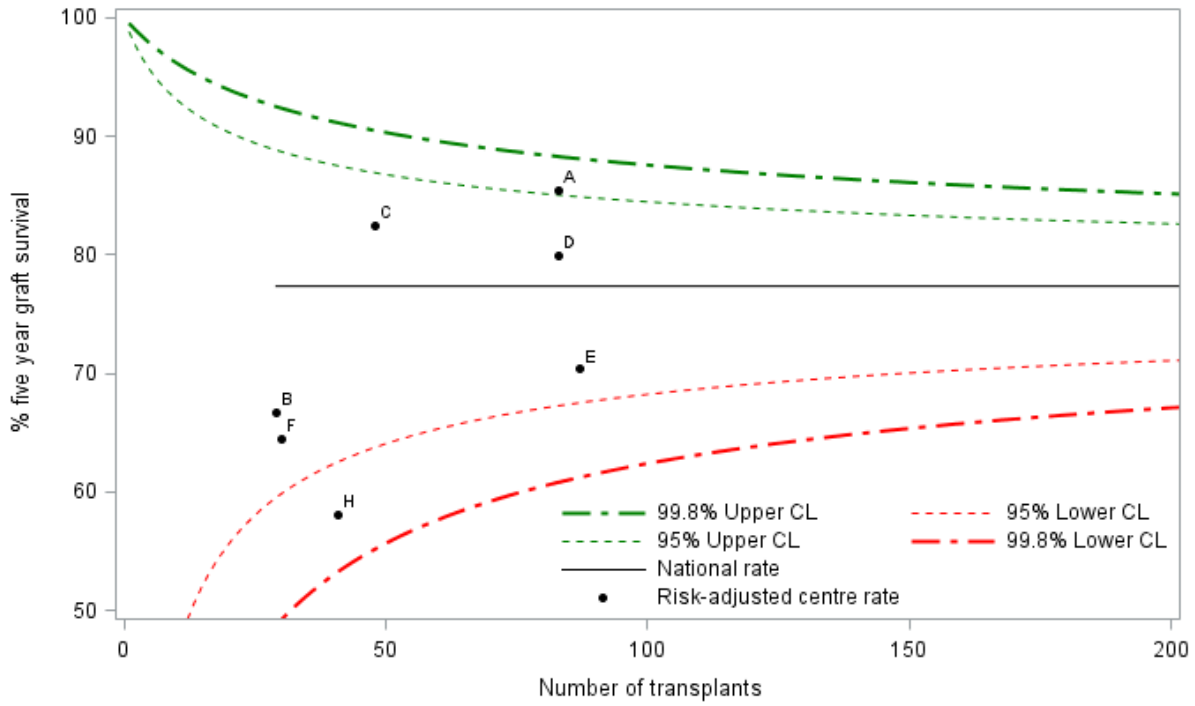


Table 6.1 **Risk-adjusted one and five year patient survival for first SPK transplants using pancreases from deceased donors**

		patient survival					
		One-year*			Five-year**		
Centre	Code	N	%	(95% CI)	N	%	(95% CI)
Cambridge	A	71	100	N/A	84	91	(79 - 97)
Cardiff	B	34	100	N/A	30	92	(72 - 99)
Edinburgh	C	71	96	(88 - 99)	46	93	(79 - 99)
Guy's	D	111	94	(85 - 98)	82	97	(89 - 100
Manchester	E	106	97	(91 - 99)	85	84	(73 - 92)
Newcastle	F	21	100	N/A	30	85	(62 - 96)
Oxford	G	216	97	(94 - 99)	212	88	(83 - 92)
WLRTC	H	32	97	(84 - 100	39	63	(29 - 83)
UK		**662**	**97**	**(95 - 98)**	**608**	**88**	**(85 - 90)**

* Includes transplants performed between 1 October 2011 - 30 September 2015
** Includes transplants performed between 1 October 2007 - 30 September 2011

Table 6.2 **Risk-adjusted one and five year pancreas graft survival for first SPK transplants using pancreases from deceased donors**

		pancreas graft survival					
		One-year*			Five-year**		
Centre	Code	N	%	(95% CI)	N	%	(95% CI)
Cambridge	A	78	95	(86 - 99)	83	85	(74 - 92)
Cardiff	B	35	90	(74 - 97)	29	67	(39 - 84)
Edinburgh	C	72	80	(65 - 90)	48	82	(65 - 92)
Guy's	D	113	86	(77 - 92)	83	80	(67 - 88)
Manchester	E	108	84	(74 - 91)	87	70	(56 - 81)
Newcastle	F	21	83	(50 - 96)	30	64	(36 - 82)
Oxford	G	223	91	(86 - 94)	227	81	(75 - 86)
WLRTC	H	33	91	(73 - 98)	41	58	(32 - 76)
UK		**683**	**88**	**(86 - 90)**	**628**	**77**	**(74 - 80)**

* Includes transplants performed between 1 October 2011 - 30 September 2015
** Includes transplants performed between 1 October 2007 - 30 September 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 Unadjusted one and five year patient survival for first PO transplants using pancreases from deceased donors

		patient survival					
		One-year*			Five-year**		
Centre	Code	N	%	(95% CI)	N	%	(95% CI)
Cardiff	B	11	100	N/A	3	-	-
Guy's	D	5	-	-	2	-	-
Manchester	E	2	-	-	10	89	(43 - 98)
Newcastle	F	2	-	-	4	-	-
Oxford	G	35	97	(81 – 100)	58	79	(64 - 88)
Edinburgh	C	0	-	-	1	-	-
UK		**55**	**98**	**(86 – 100)**	**78**	**80**	**(67 - 88)**

* Includes transplants performed between 1 October 2011 - 30 September 2015
** Includes transplants performed between 1 October 2007 - 30 September 2011
- 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

		pancreas graft survival					
		One-year*			Five-year**		
Centre	Code	N	%	(95% CI)	N	%	(95% CI)
Cambridge	A	3	-	-	0	-	-
Cardiff	B	17	65	(38 - 82)	10	80	(41 - 95)
Edinburgh	C	1	-	-	1	-	-
Guy's	D	7	-	-	5	-	-
Manchester	E	4	-	-	19	30	(11 - 51)
Newcastle	F	5	-	-	8	-	-
Oxford	G	43	86	(71 - 93)	81	56	(44 - 66)
WLRTC	H	8	-	-	14	27	(7 - 51)
UK		**88**	**79**	**(69 - 86)**	**138**	**49**	**(40 - 57)**

* Includes transplants performed between 1 October 2011 - 30 September 2015
** Includes transplants performed between 1 October 2007 - 30 September 2011
- 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, 2012 – 2016

Figure 7.1 shows the number of patients on the islet transplant list at 31 March and 30 September each year between 2012 and 2016. The number of patients active on the islet transplant list has decreased from 31 in September 2015 to 25 in September 2016.

Figure 7.1 Patients on the islet transplant list at 31 March and 30 September

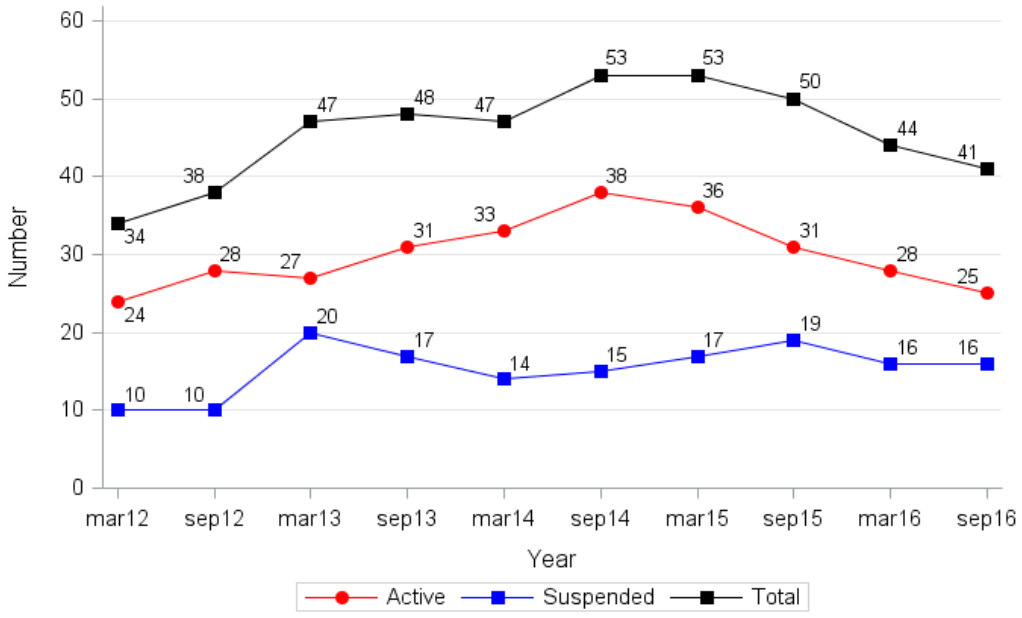
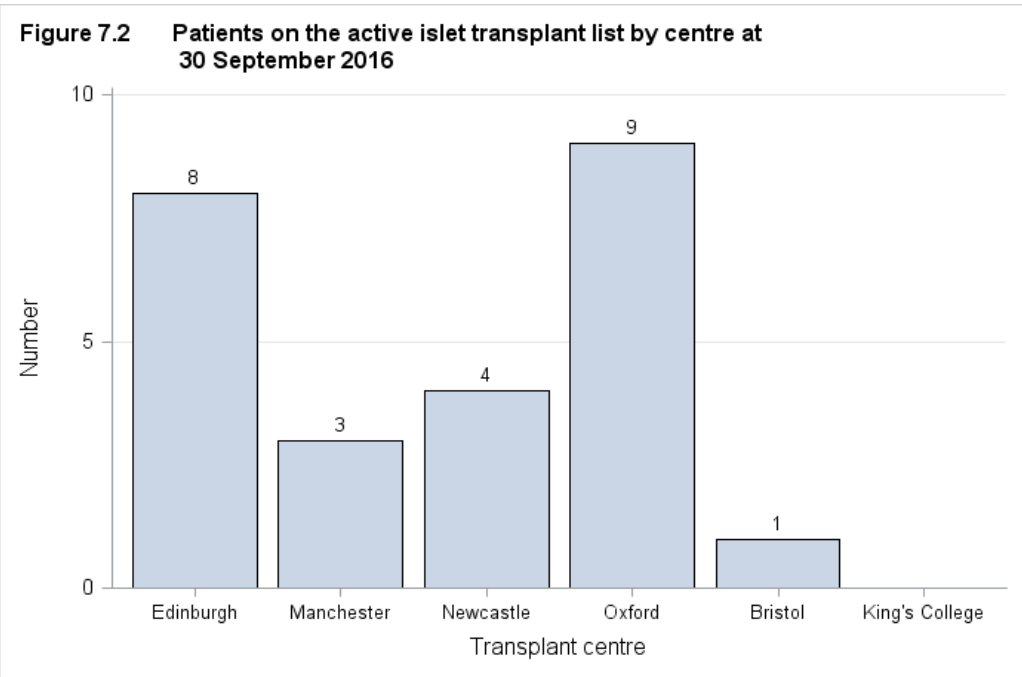


Figure 7.2 shows the number of patients on the active islet transplant list at 30 September 2016 by centre. 9 (36%) of the patients on the active transplant list were registered at Oxford, whilst there were no patients on the active list registered at King's College and no patients registered at the Royal Free.

Figure 7.2 Patients on the active islet transplant list by centre at 30 September 2016



7.2 Median waiting time to transplant, 1 October 2010 – 30 September 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 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 2010 and 30 September 2013 is 285 days (9 months), ranging from 145 days at Edinburgh to 443 days at Oxford. Although both of these centres had few patients registered in this time.

Figure 7.3 Median waiting time to deceased donor transplant for patients registered on the islet transplant list, 1 October 2010 - 30 September 2013

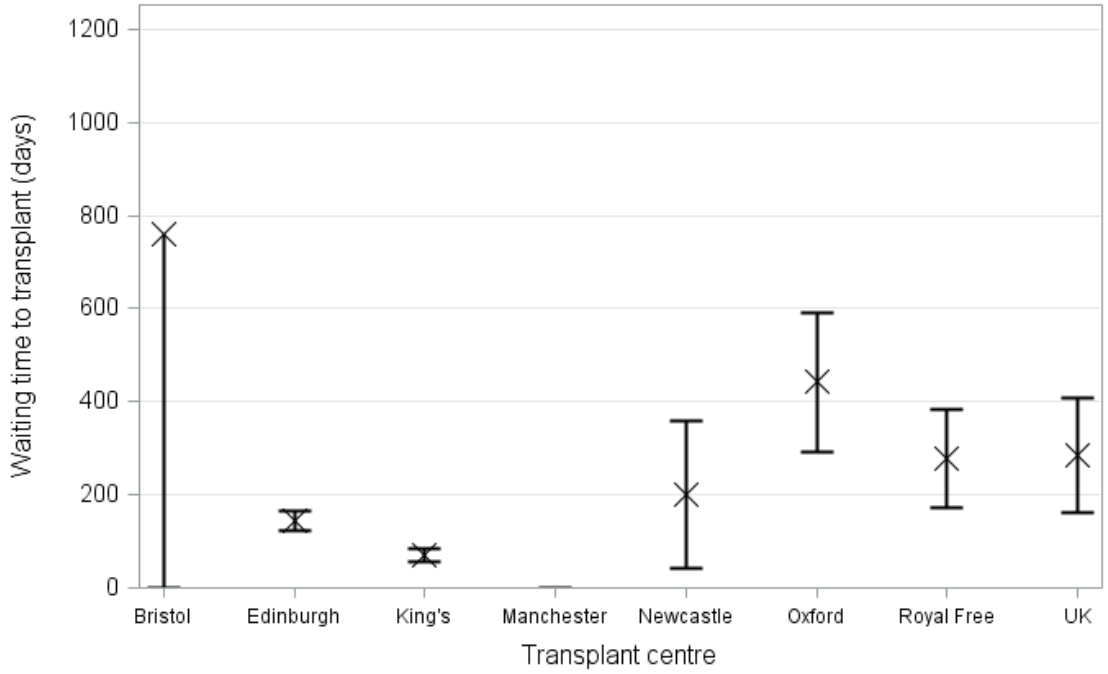


Table 7.1 Median waiting time to islet transplant in the UK, for patients registered 1 October 2010 - 30 September 2013

Transplant centre	Number of patients registered	Waiting time (days) Median	95% Confidence interval
Bristol	2	-	-
Edinburgh	38	145	124 - 166
King's	7	-	-
Manchester[1]	16	-	-
Newcastle	23	201	44 - 358
Oxford	19	443	294 - 592
Royal Free	10	279	173 - 385
UK	**115**	**285**	**162 - 408**

- Data not presented where less than 10 patients included
[1] Insufficient data to calculate median waiting time

Islet transplants

8.1 Islet transplants, 1 October 2011 – 30 September 2016

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 17 since October 2011 to September 2016, by six month periods. Of these DCD islets have ranged from 0 to 5. In the last three 6 month periods, the number of DBD islets transplants decreased from 15 to 10 and then increased to 13.

Figure 8.1 Islet transplants, 1 October 2011 - 30 September 2016 by financial year and donor type

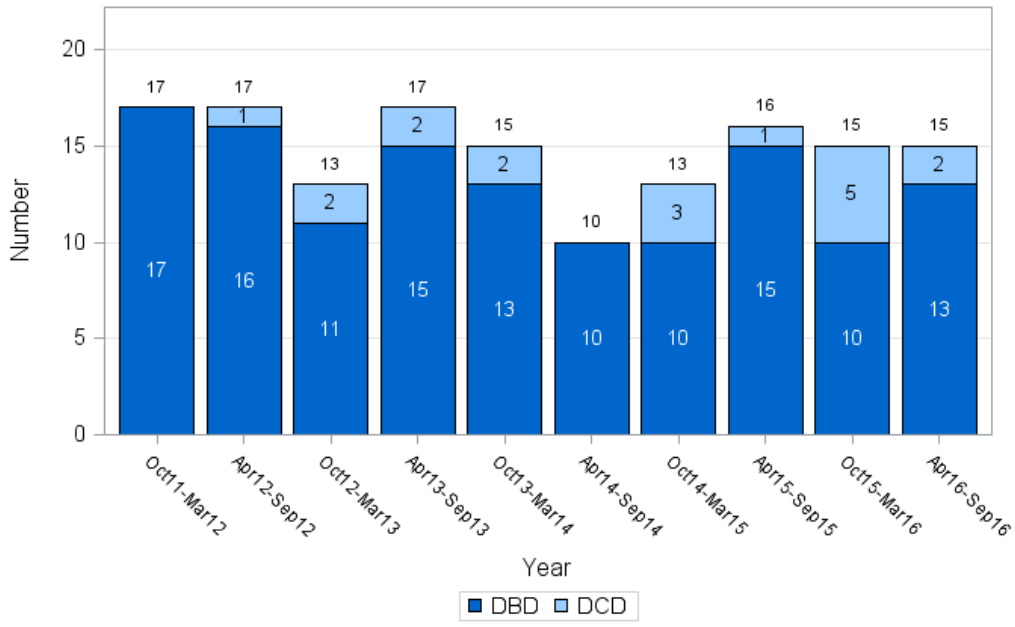


Figure 8.2 shows the total number of islet transplants performed from April to September 2016, by centre and type of donor. The same information is presented in **Figure 8.3** but this shows the proportion of DBD and DCD transplants performed at each centre. Edinburgh performed the most followed by King's College for islet transplants from April to September 2016 (7, 3, respectively).

Figure 8.2 Islet transplants, 1 April 2016 - 30 September 2016 by centre and donor type

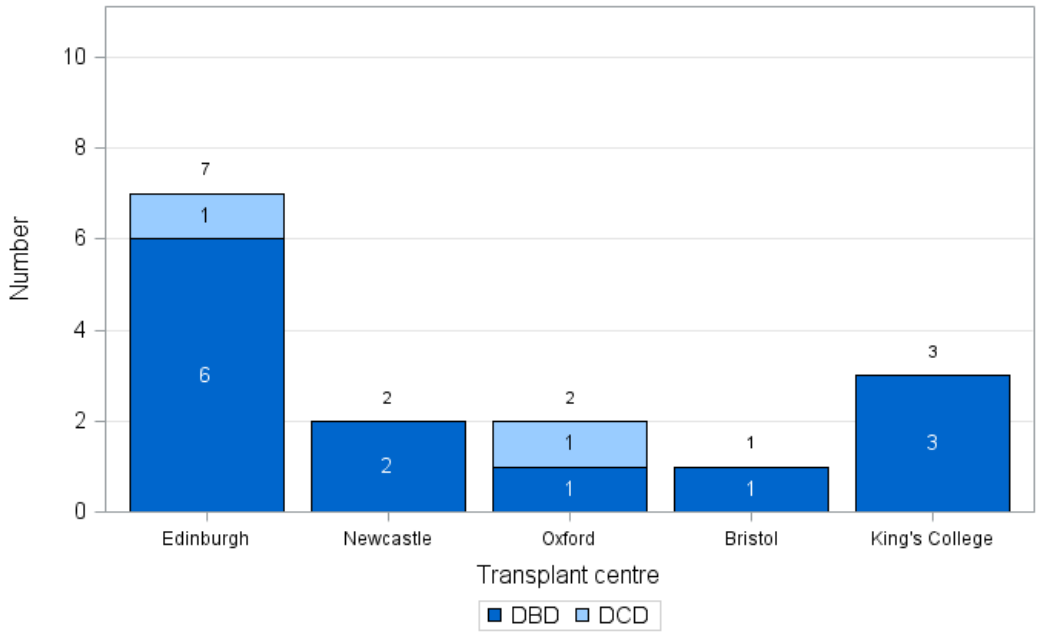
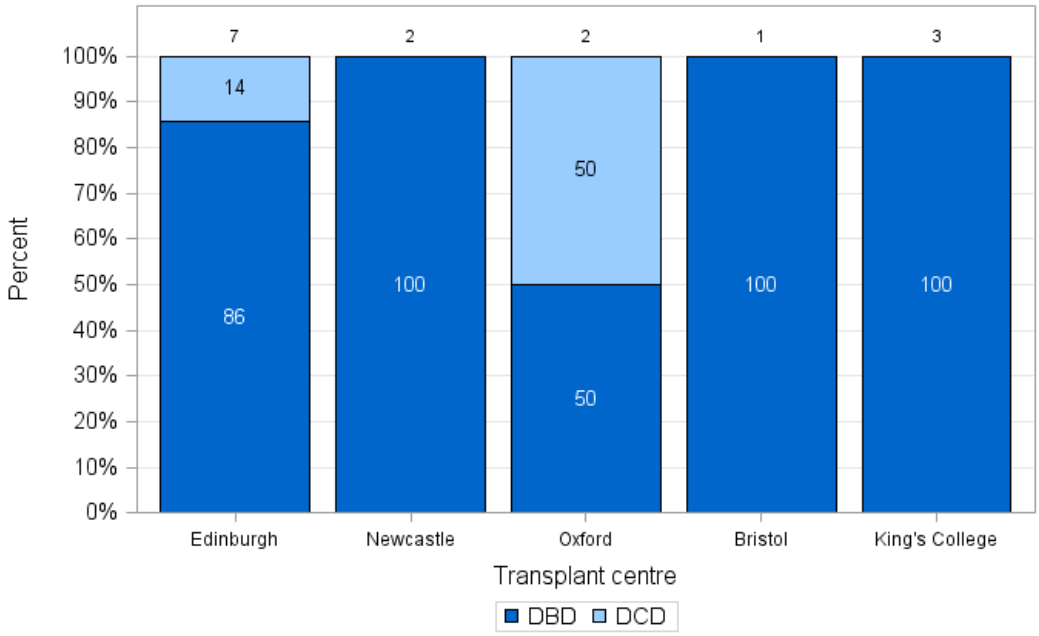


Figure 8.3 Islet transplants, 1 April 2016 - 30 September 2016 by centre and donor type



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 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
Hypoclycaemia 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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