

NHS BLOOD AND TRANSPLANT

LIVER ADVISORY GROUP

NHSBT LIVER TRANSPLANT REPORT 2015/16

- 1 The 2015/16 NHSBT Liver Transplant Report was published on 8 September 2016 and is provided as an **Appendix**.
- 2 The report is prepared once a year with a shorter, interim report produced six months after each full report. The report monitors activity and outcomes for the liver transplant programme in the UK and is produced in collaboration with NHS England.
- 3 The report
 - a. Covers all transplant centres
 - b. Includes named centre data
 - c. Was validated by centres before publication
 - d. Is available publically at <http://www.odt.nhs.uk/uk-transplant-registry/organ-specific-reports/>
- 4 A short survey to collect feedback and to improve the report is accessible from this webpage: <https://www.surveymonkey.co.uk/r/2DB9RHP>. Please complete the survey before **30th November 2016** and disseminate to your colleagues for their responses.



Blood and Transplant

**ANNUAL REPORT ON
LIVER TRANSPLANTATION**

**REPORT FOR 2015/2016
(1 APRIL 2006 – 31 MARCH 2016)**

PUBLISHED SEPTEMBER 2016

PRODUCED IN COLLABORATION WITH NHS ENGLAND



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EXECUTIVE SUMMARY



EXECUTIVE SUMMARY

This report presents key figures about liver transplantation in the UK. The period reported covers ten years of transplant data, from 1 April 2006 to 31 March 2016. The report presents information of patients on the transplant list, number of transplants, demographic characteristics of donors and transplant recipients, and survival post registration and post first liver transplant. The data are reported both on a national and centre-specific basis, where relevant.

Key findings

- On 31 March 2016, there were 577 patients on the UK [active transplant list](#), which represents a 6% decrease in the number of patients a year earlier. The number of patients on the transplant list has doubled since March 2008. Of those patients joining the [elective](#) liver only waiting list, approximately 78% had received a transplant within two years of listing.
- There were 7714 liver transplants performed in the UK in the ten year period. The number of liver transplants using [donors after circulatory death](#) has steadily increased in the last five years while the number of transplants from [donors after brain death](#) decreased in 2014/15 but has increased slightly in the most recent year.
- The unadjusted national rates of patient survival one and five years after first liver only transplantation are given below

Unadjusted patient survival (%) post-transplant for first liver transplants		
	One year patient survival (%)	Five year patient survival (%)
Adult		
Elective	93	81
Super-urgent	89	79
Paediatric		
Elective	96	92
Super-urgent	82	73

- The [risk-adjusted](#) national rates of patient survival after joining the transplant list for adult elective first liver only patients is 82% at one, 69% at five and 58% at ten years post-registration.

How to cite this report:

Annual Report on Liver Transplantation 2015/2016. NHS Blood and Transplant.

INTRODUCTION



INTRODUCTION

This report presents information on the UK transplant list, transplant activity and transplant outcomes between 1 April 2006 and 31 March 2016, for all seven centres performing liver transplantation in the UK. Data were obtained from the UK Transplant Registry, at NHS Blood & Transplant, that holds information relating to donors, recipients and outcomes for all liver transplants performed in the UK.

[Patient survival](#) post-transplant is reported for cohorts of patients transplanted between 1 April 2007 and 31 March 2011 for 5 year survival, and 1 April 2011 to 31 March 2015 for 1 year survival. Patient survival from registration is presented for the period 1 January 2004 to 31 December 2015. Results are described separately for adult (aged ≥ 17 years) and paediatric patients (aged < 17 years) and according to the urgency of the transplantation ([elective and super-urgent](#)). Note, however, that the survival from listing analysis assumes adults are aged ≥ 18 years.

TRANSPLANT LIST

Figure 1 shows the total number of liver patients on the [active transplant list](#) at 31 March each year between 2007 and 2016. The number of patients waiting for a transplant increased each year from 268 in 2008 to 611 in 2015, with an exception in 2013. There was a slight decrease to 577 patients in 2016.

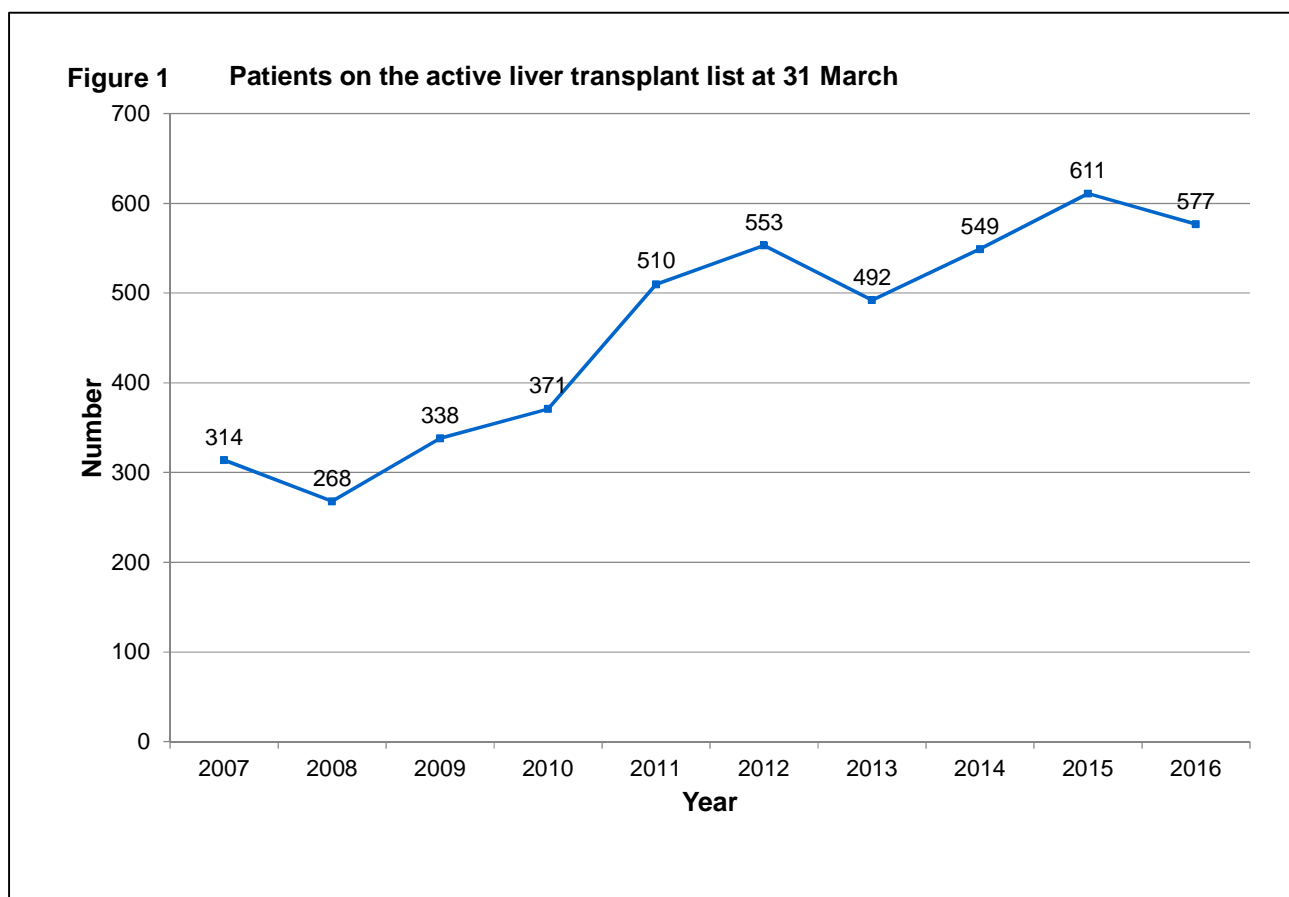
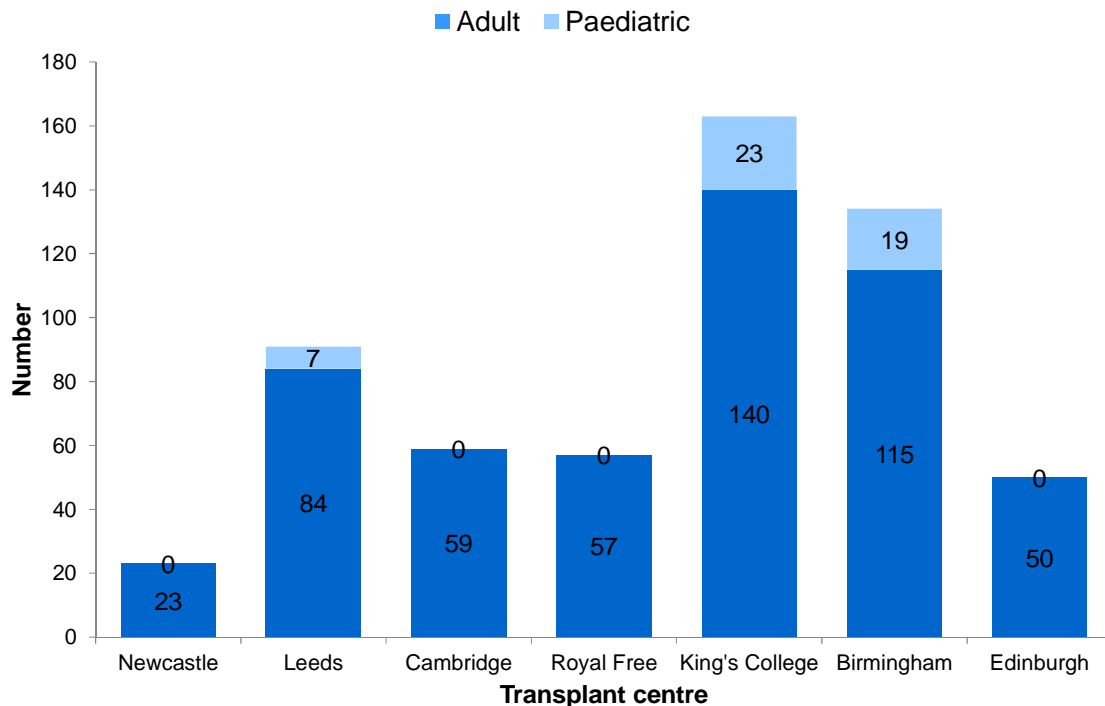


Figure 2 shows the number of adult and paediatric patients on the transplant list at 31 March 2016, by centre. In total, there were 528 adults and 49 paediatric patients. King's College Hospital had the largest share of the transplant list (28%) and Newcastle the smallest (4%). This figure includes [elective](#) and [super-urgent](#) registrations.

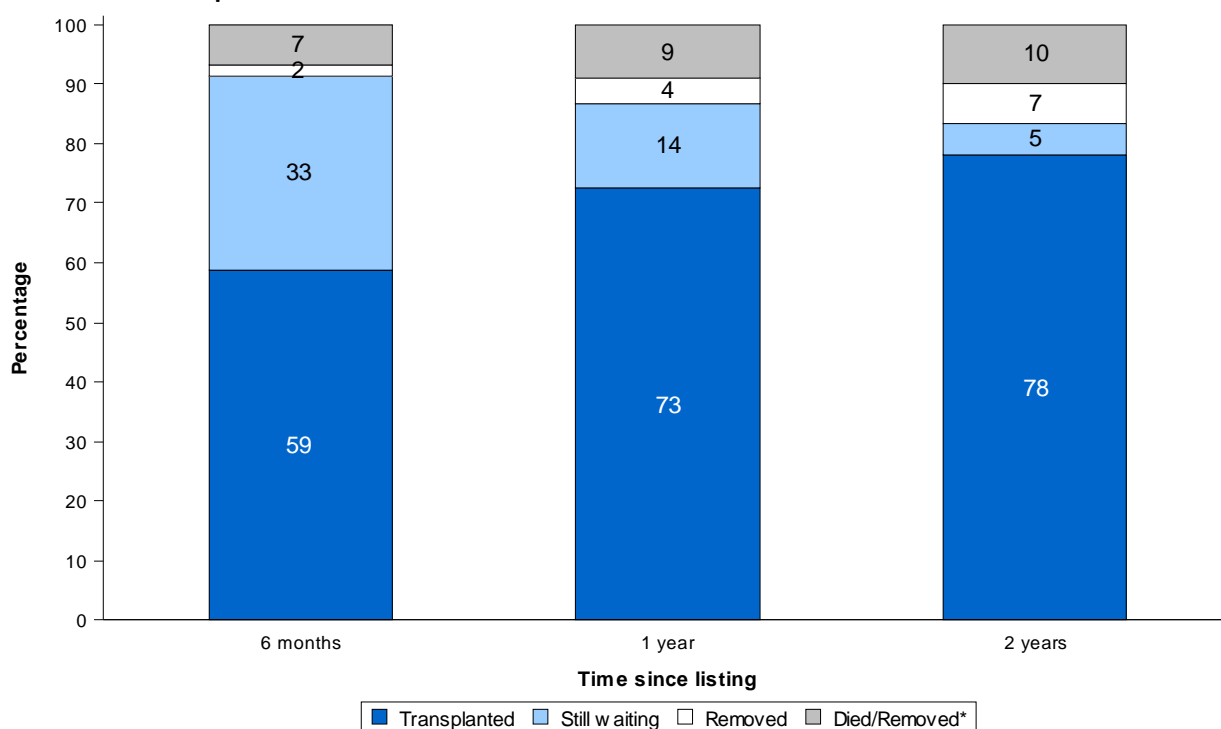
Figure 2 Patients on the active liver transplant list at 31 March 2016, by centre



An indication of long-term outcomes for patients listed between April 2013 and March 2014 for a liver transplant is summarised in **Figure 3**. This shows the proportion of patients transplanted or still waiting six months, one year and two years after joining the transplant list. At one year post-registration 73% of patients had received a transplant and 14% were still waiting.

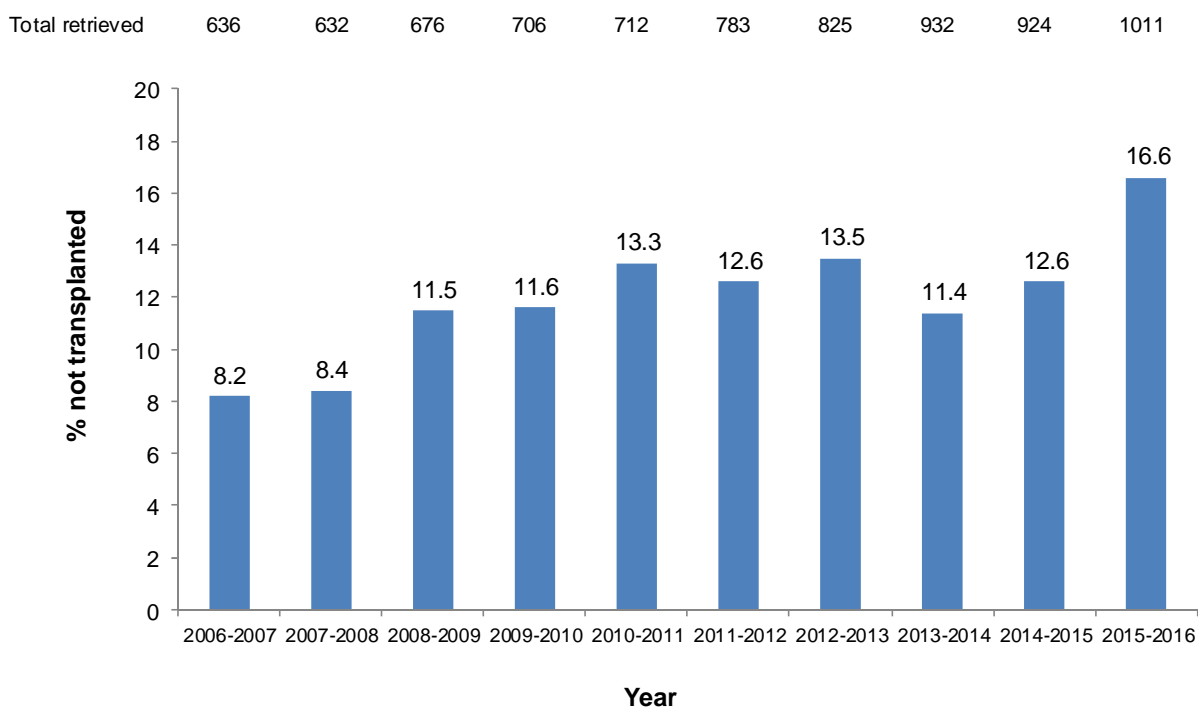
Figure 4 shows the percentage of livers retrieved that were not transplanted. The rates are shown over the last decade. It can be seen that the non-utilisation rate has been generally increasing over time. The most common reason for non-utilisation was fatty livers (39%), followed by other reasons (18%) and too long cold ischaemia time (7%).

Figure 3 Post-registration outcome for 1023 new elective liver only registrations made in the UK, 1 April 2013 - 31 March 2014



*Removals due to condition deteriorating

Figure 4 Percentage of livers retrieved that were not transplanted from deceased organ donors in the UK, 1 April 2006 – 31 March 2016



TRANSPLANT ACTIVITY

Figure 5 shows the total number of liver transplants performed in the last ten years, by type of donor. The number of transplants from donors after circulatory death ([DCD](#)) has been steadily increasing over the time period to 206 in the last financial year. The number of transplants from donors after brain death ([DBD](#)) has slightly increased in the most recent year to 672 in 2015/2016. There were 36 [living donor](#) liver transplants and 3 [domino](#) transplants performed in the last financial year.

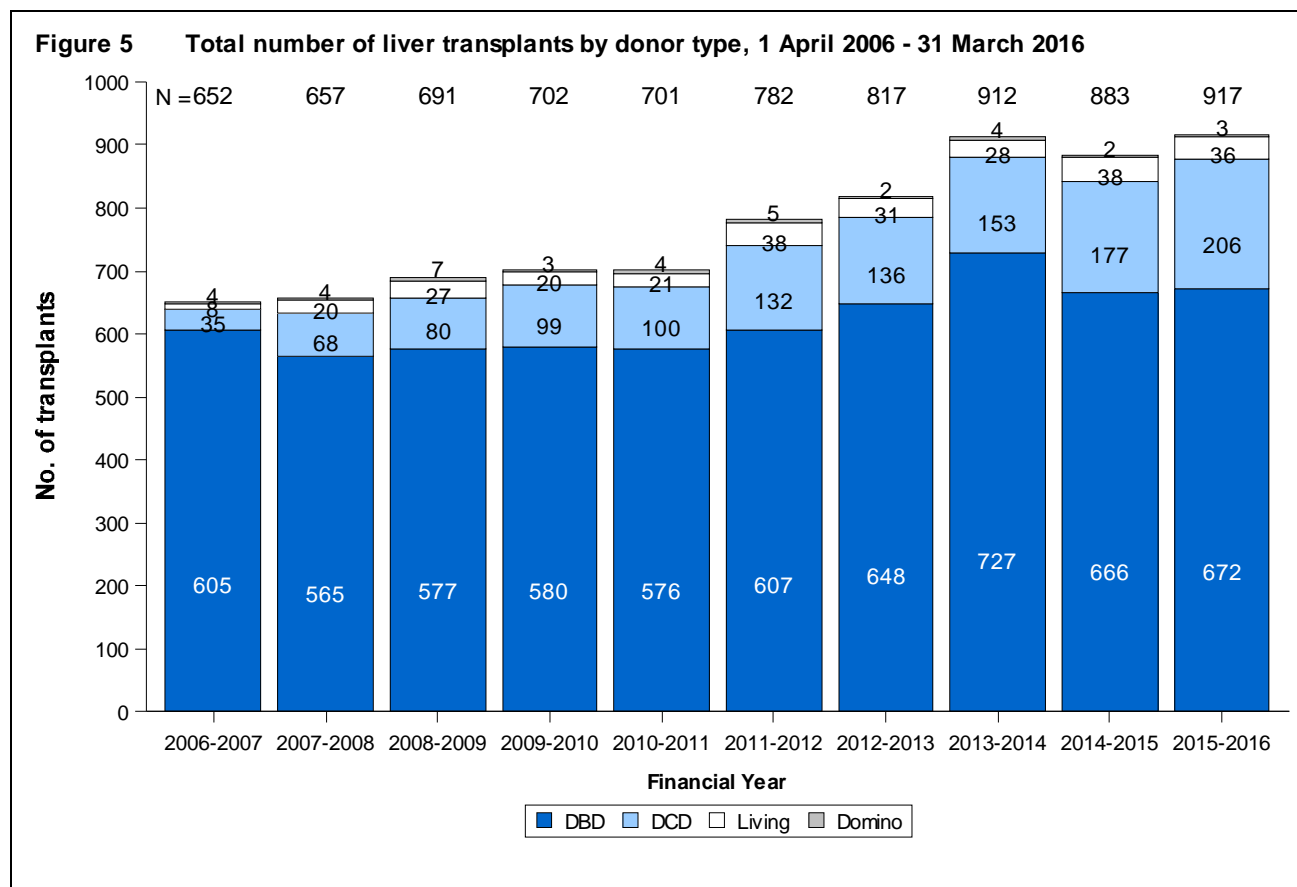
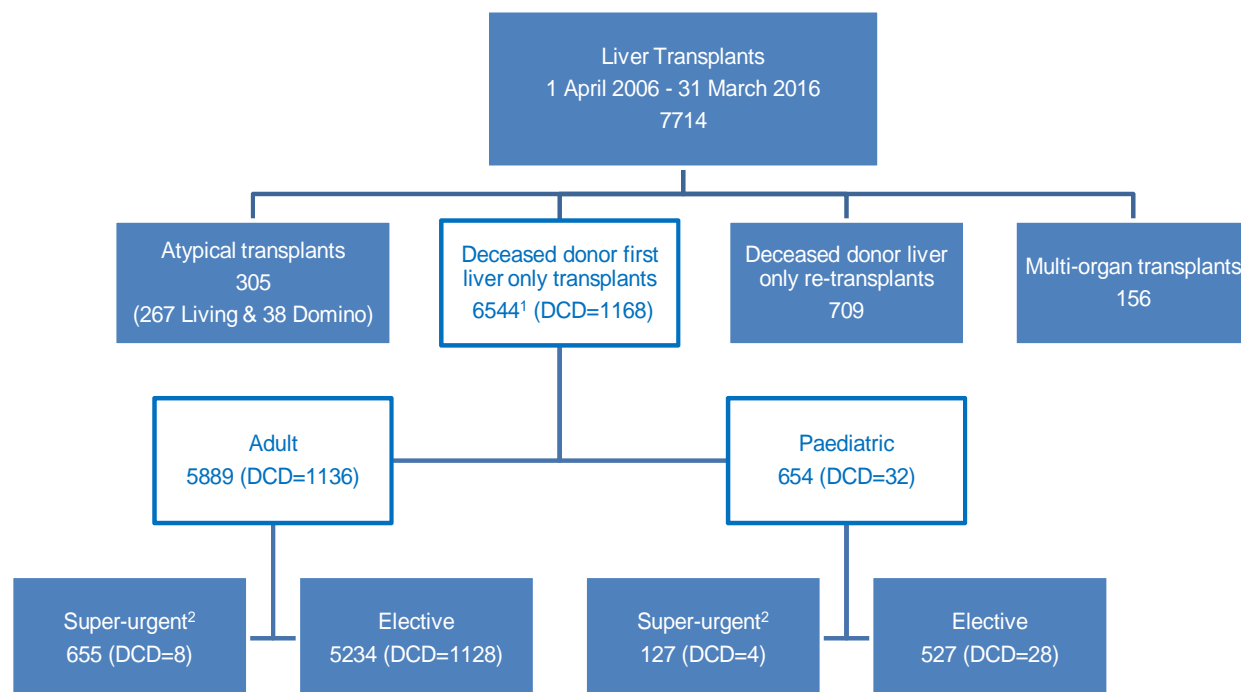


Figure 6 details the 7714 liver transplants performed in the UK in the ten year period. Of these, 6544 (85%) were deceased donor first liver only transplants. One transplant recipient refused consent for their data to be used in analysis and, therefore, could not be categorised as an adult or a paediatric patient. Of the 6543 transplants that were analysed, 5889 (90%) were performed in adult and 654 (10%) in paediatric patients. Similarly, 5761 (88%) were [elective](#) and 782 (12%) were [super-urgent](#) transplants.

Figure 6 Liver transplants in the UK, 1 April 2006 – 31 March 2016



¹ One patient refused consent for their data to be used in analysis and has been excluded from subsequent categorisation

² Super-urgent registration categories were changed on 17 June 2015 to account for developments in treatment of patients with acute liver failure.

The number of liver transplants by recipient country/Strategic Health Authority of residence are shown in **Table 1**. No adjustments have been made for potential demographic differences in populations. The deceased donor transplant rate ranged from 8.6 to 17.7 pmp across the Strategic Health Authorities and overall was 13.3 pmp.

Table 1 Liver transplant rates per million population (pmp) in the UK, 1 April 2015 - 31 March 2016, by country/ Strategic Health Authority								
Country/ Strategic Health Authority	Deceased transplants (pmp)						Living transplants (pmp)	
	DBD		DCD		Total			
North East	34	(13.0)	5	(1.9)	39	(14.9)	1	(0.4)
North West	68	(9.5)	26	(3.6)	94	(13.2)	5	(0.7)
Yorkshire and The Humber	51	(9.5)	12	(2.2)	63	(11.8)	4	(0.7)
North of England	153	(10.1)	43	(2.8)	196	(13.0)	10	(0.7)
East Midlands	38	(8.2)	10	(2.2)	48	(10.3)	1	(0.2)
West Midlands	71	(12.4)	30	(5.3)	101	(17.7)	5	(0.9)
East of England	56	(9.3)	30	(5.0)	86	(14.3)	3	(0.5)
Midlands and East	165	(10.1)	70	(4.3)	235	(14.4)	9	(0.5)
London	93	(10.9)	25	(2.9)	118	(13.8)	5	(0.6)
South East Coast	34	(7.4)	9	(2.0)	43	(9.4)	2	(0.4)
South Central	30	(7.0)	7	(1.6)	37	(8.6)	0	(0.0)
South West	44	(8.1)	9	(1.7)	53	(9.8)	0	(0.0)
South of England	108	(7.6)	25	(1.7)	133	(9.3)	2	(0.1)
England	519	(9.6)	163	(3.0)	682	(12.6)	26	(0.5)
Isle of Man	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)
Channel Islands	2	(12.5)	1	(6.3)	3	(18.8)	0	(0.0)
Wales	36	(11.7)	8	(2.6)	44	(14.2)	0	(0.0)
Scotland	79	(14.8)	23	(4.3)	102	(19.1)	3	(0.6)
Northern Ireland	24	(13.0)	9	(4.9)	33	(17.9)	1	(0.5)
TOTAL¹	660	(10.2)	204	(3.1)	864	(13.3)	30²	(0.5)

¹ Excludes 23 recipients who reside outside the UK (12 DBD, 2 DCD, 9 Living).
² Includes 3 domino donor transplants.

ADULT LIVER TRANSPLANTATION



ADULT LIVER TRANSPLANTATION

OVERVIEW

The number of adult deceased donor first liver only transplants in the last ten years is shown overall and by centre in **Figures 7 and 8**, respectively. Of the 704 transplants in the latest financial year, 643 were [elective](#) and 61 were [super-urgent](#) transplants. See **Appendix 1** for further details.

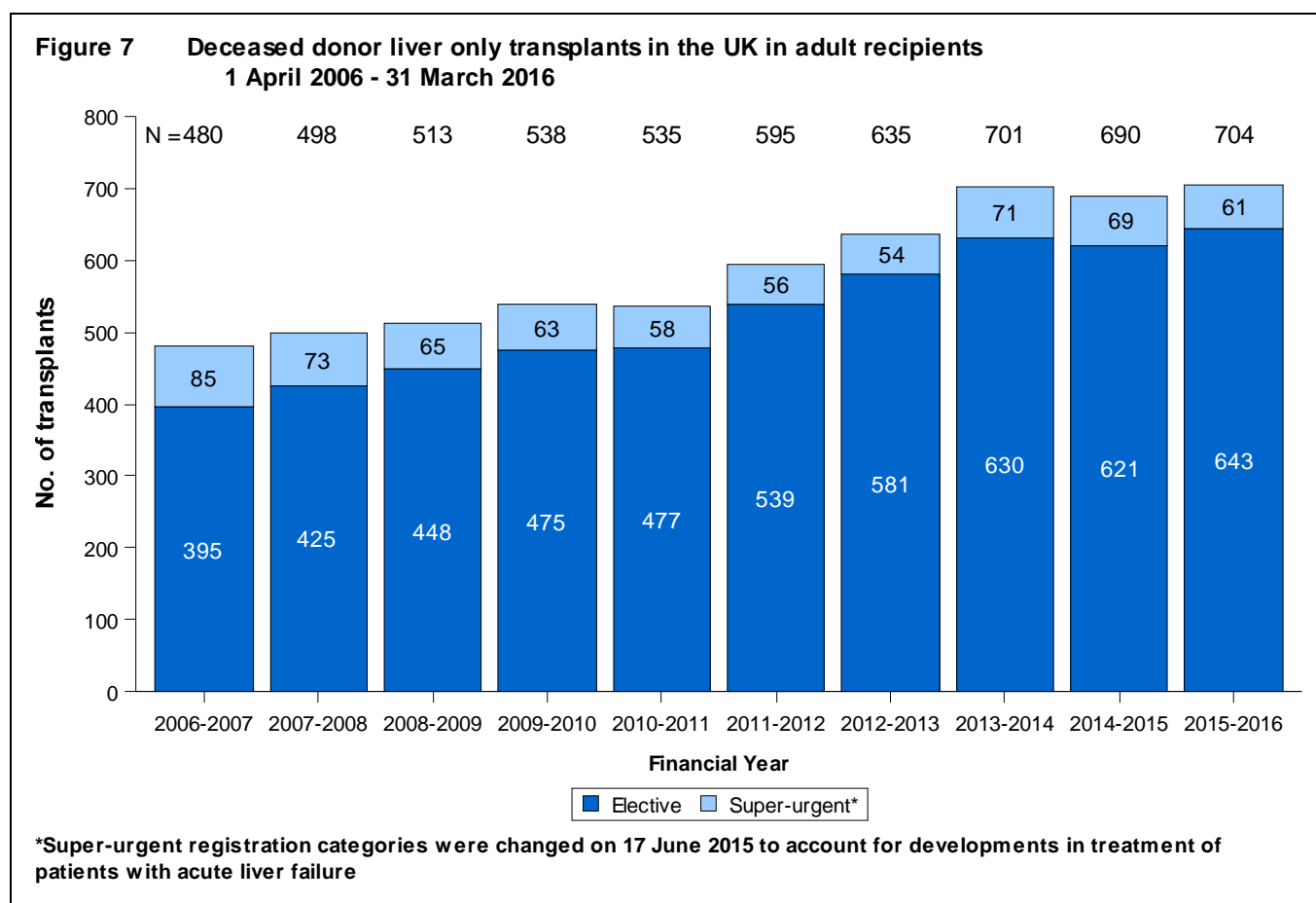
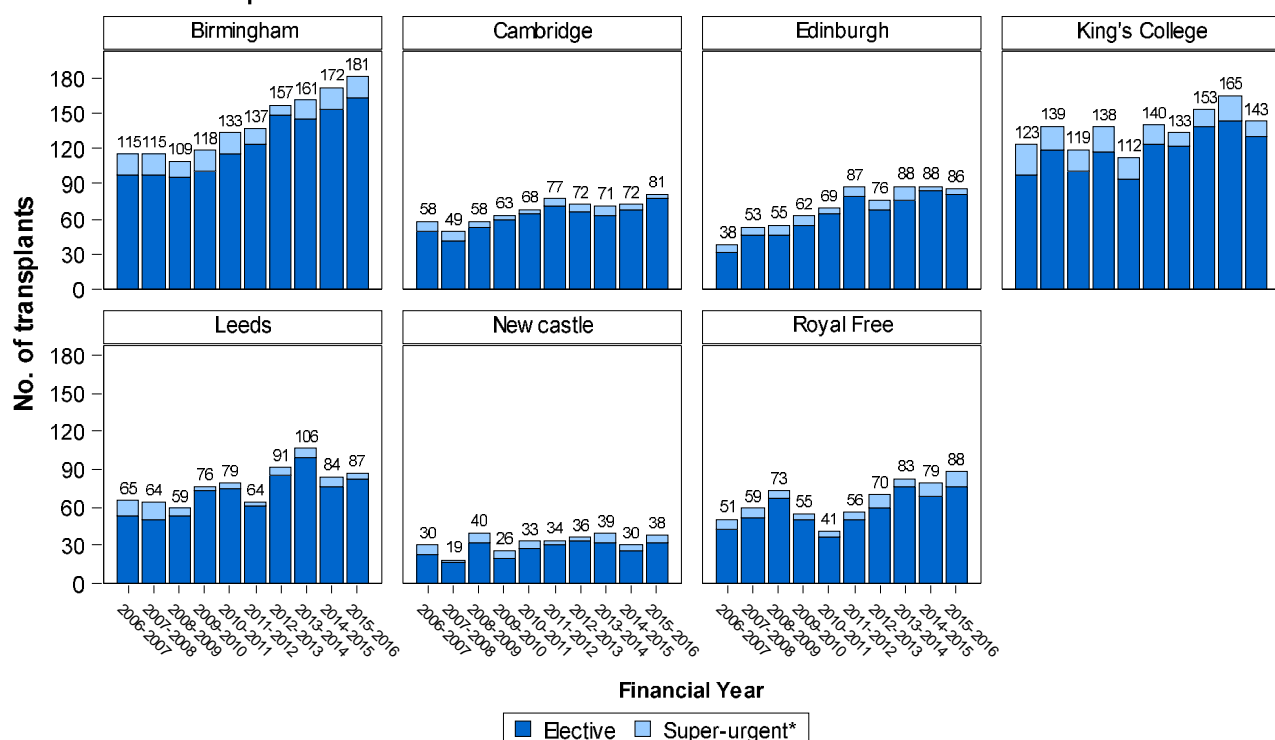


Figure 8 Deceased donor liver only transplants in the UK in adult recipients, 1 April 2006 - 31 March 2016



*Super-urgent registration categories were changed on 17 June 2015 to account for developments in treatment of patients with acute liver failure

The [median cold ischaemia times](#) for adult transplant recipients are shown in **Figures 9 and 10** for [DBD](#) and [DCD](#) donors, respectively. Median cold ischaemia times were calculated each year during the last ten years, by transplant centre. The national median cold ischaemia time for transplants from DBD donors has decreased from 9 hours in 2006/07 to 8 hours in 2015/16. The median cold ischaemia time in the last financial year ranged between 8 and 10 hours across transplant centres. The national median for DCD donor transplants has remained relatively stable over the ten year period, at 7 hours. In the last financial year, the median cold ischaemia time for DCD donor transplants at different centres ranged from 6 to 11 hours.

Figure 9 Median cold ischaemia time in all adult DBD donor liver transplants,
1 April 2006 - 31 March 2016

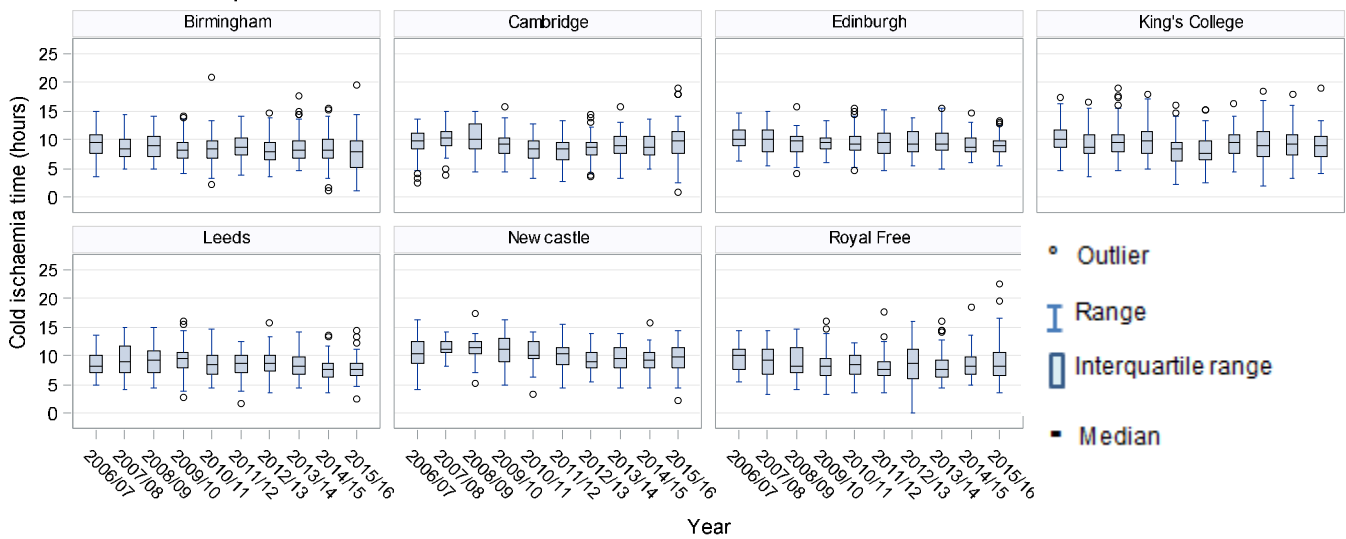
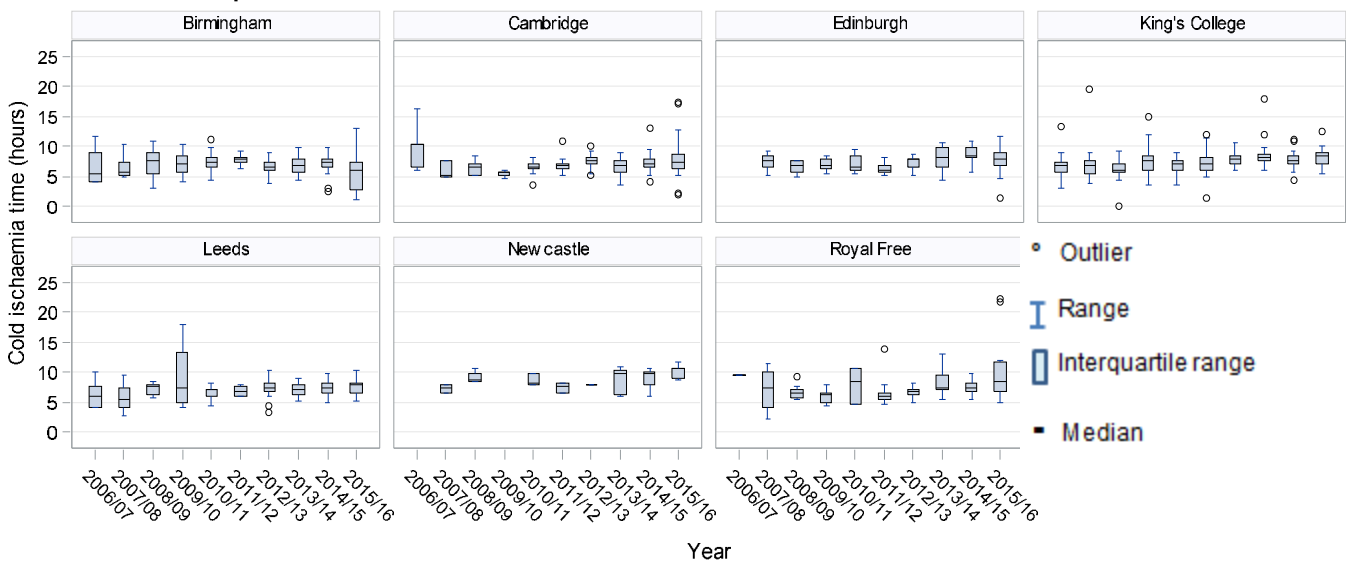


Figure 10 Median cold ischaemia time in all adult DCD donor liver transplants,
1 April 2006 - 31 March 2016



ADULT LIVER TRANSPLANTATION

ELECTIVE PATIENTS



ELECTIVE PATIENTS

TRANSPLANT LIST

Figure 11 shows the number of adult [elective](#) patients on the first liver only transplant list at 31 March each year between 2007 and 2016. The number of patients on the [active](#) liver only transplant list increased almost each year from 274 in 2007 to 490 in 2016. In addition, a small number of patients are temporarily suspended from the list at any one time.

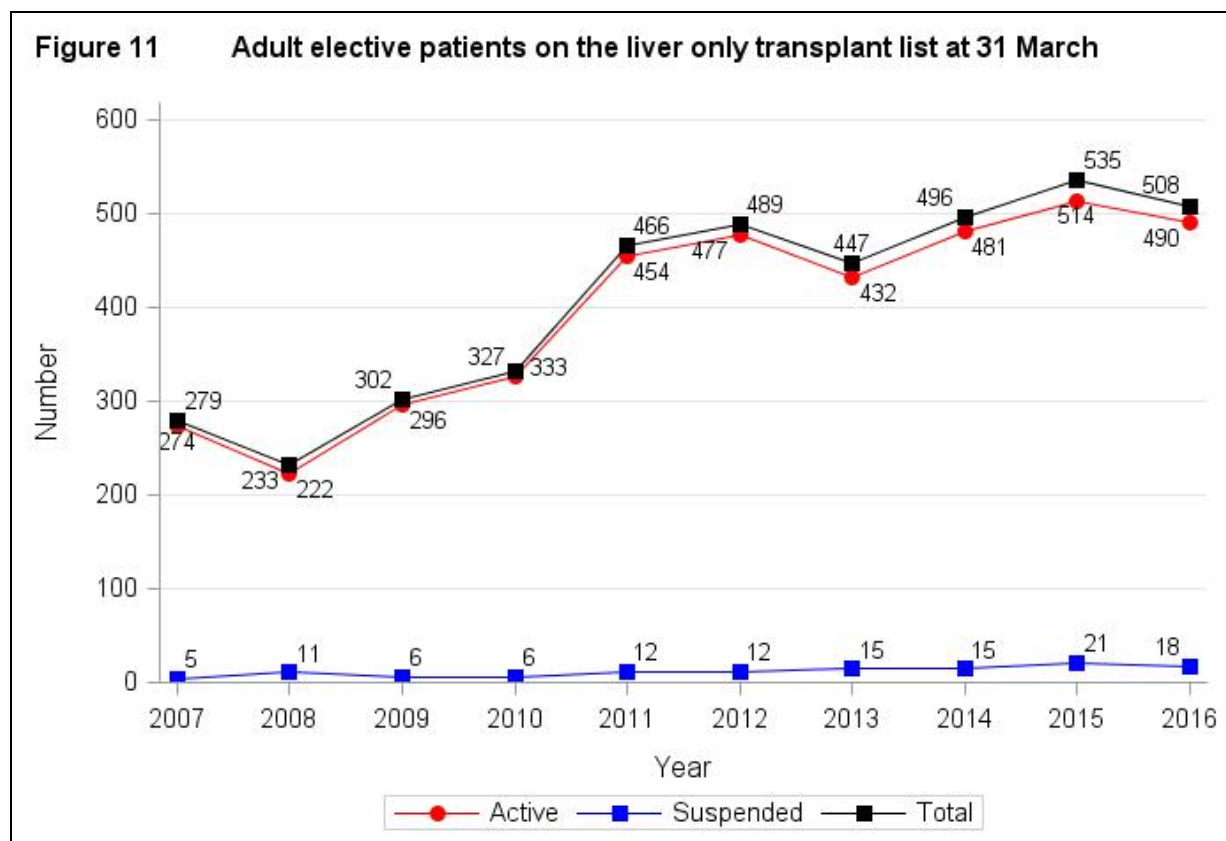
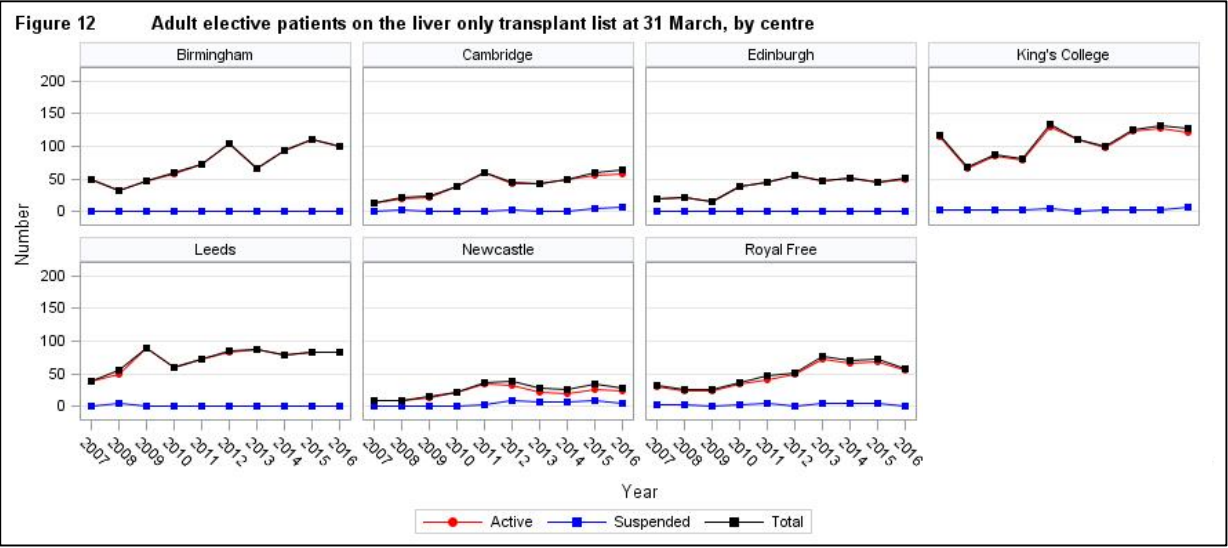


Figure 12 shows the number of adult patients on the transplant list at 31 March each year between 2007 and 2016, by transplant centre.



An indication of outcomes for adult [elective](#) patients listed for a liver transplant is summarised in **Figure 13**. This shows the proportion of patients transplanted or still waiting six months, one and two years after joining the list. It also shows the proportion removed from the transplant list and those dying while on the waiting list.

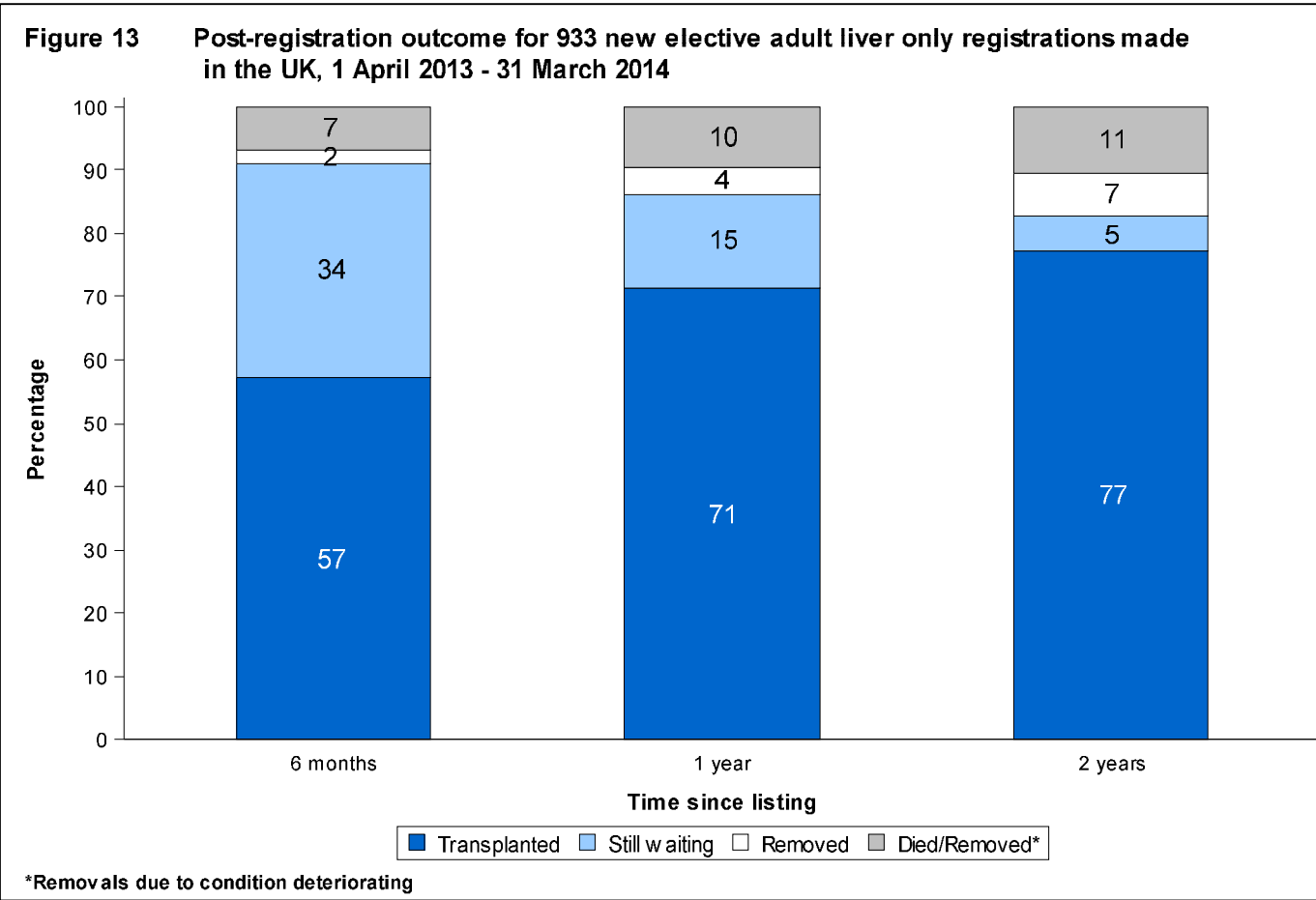


Table 2 shows the [median waiting time](#) to deceased donor liver only transplant for adult [elective](#) patients. The national median waiting time to transplant for adult elective patients is 144 days. The median waiting time to transplant is shorter at Edinburgh (108 days) and longer at Royal Free (207 days), compared to the national median waiting time. Note that these waiting times are not adjusted to account for the patient [case-mix](#) at centres.

Table 2 Median waiting time to deceased donor liver only transplant in the UK, for adult elective patients registered 1 April 2010 - 31 March 2013			
Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Adult			
Edinburgh	285	108	90 - 126
Birmingham	538	119	102 - 136
Cambridge	283	138	104 - 172
Newcastle	147	154	92 - 216
King's College	509	170	137 - 203
Leeds	383	202	155 - 249
Royal Free	257	207	162 - 252
UK	2402	144	133 - 155

TRANSPLANT ACTIVITY

Figure 14 shows the number of first liver only transplants from deceased and living (including domino) donors performed in the last ten years, by type of donor. **Figure 15** shows the same information by centre.

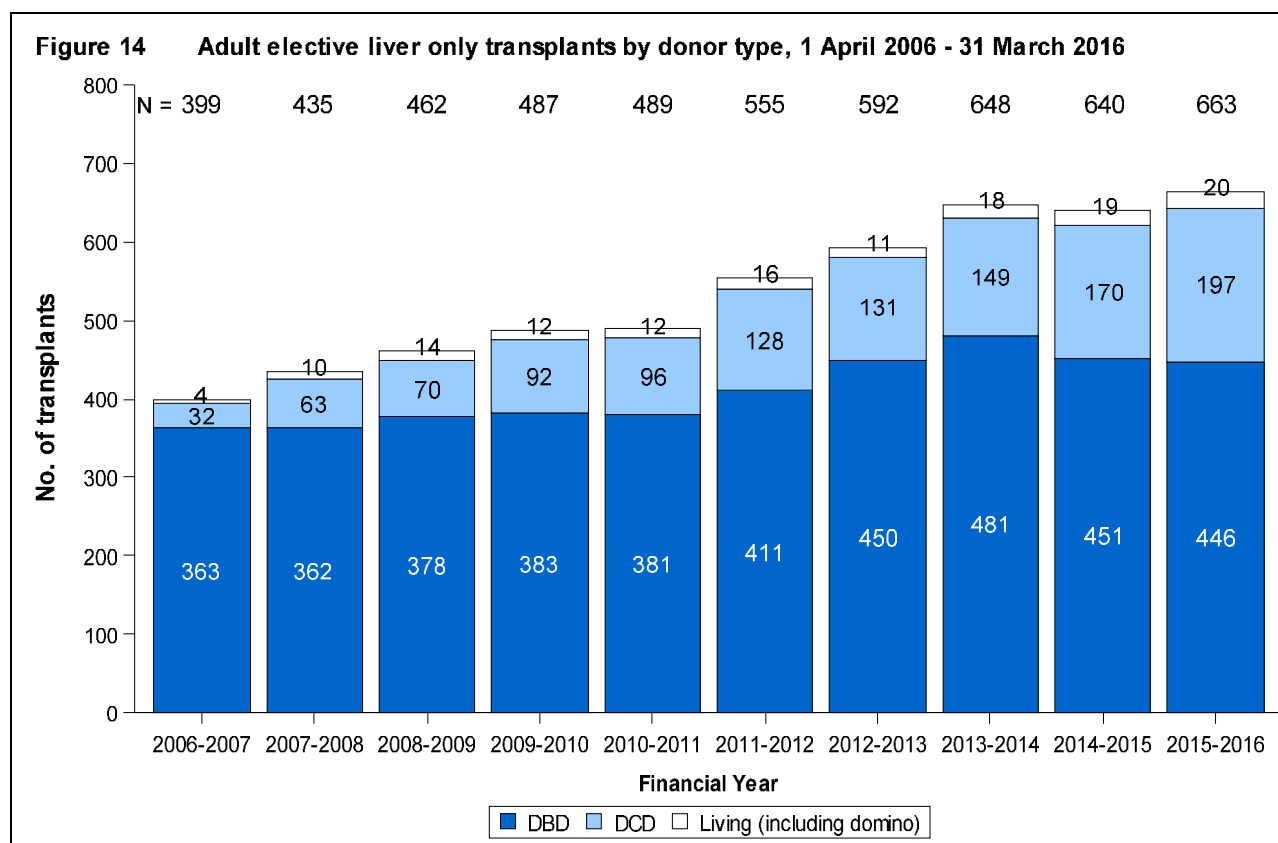
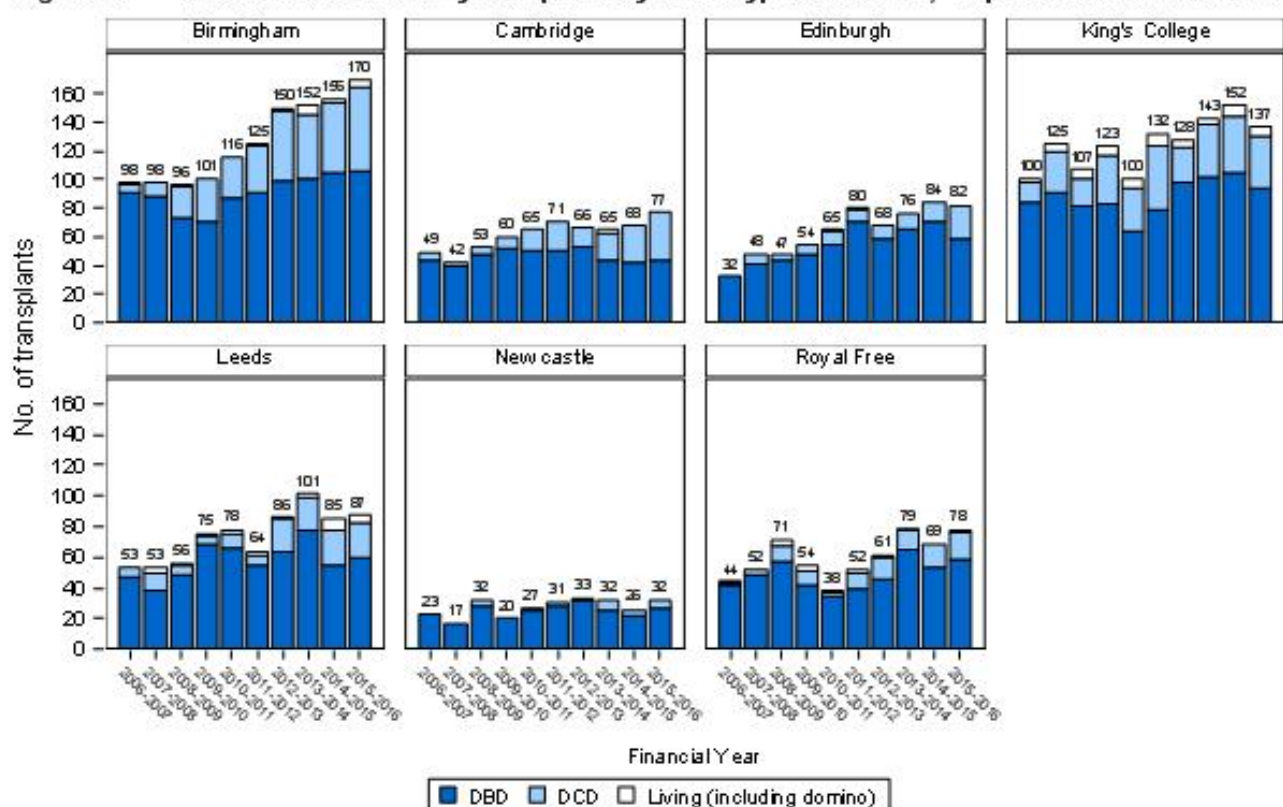
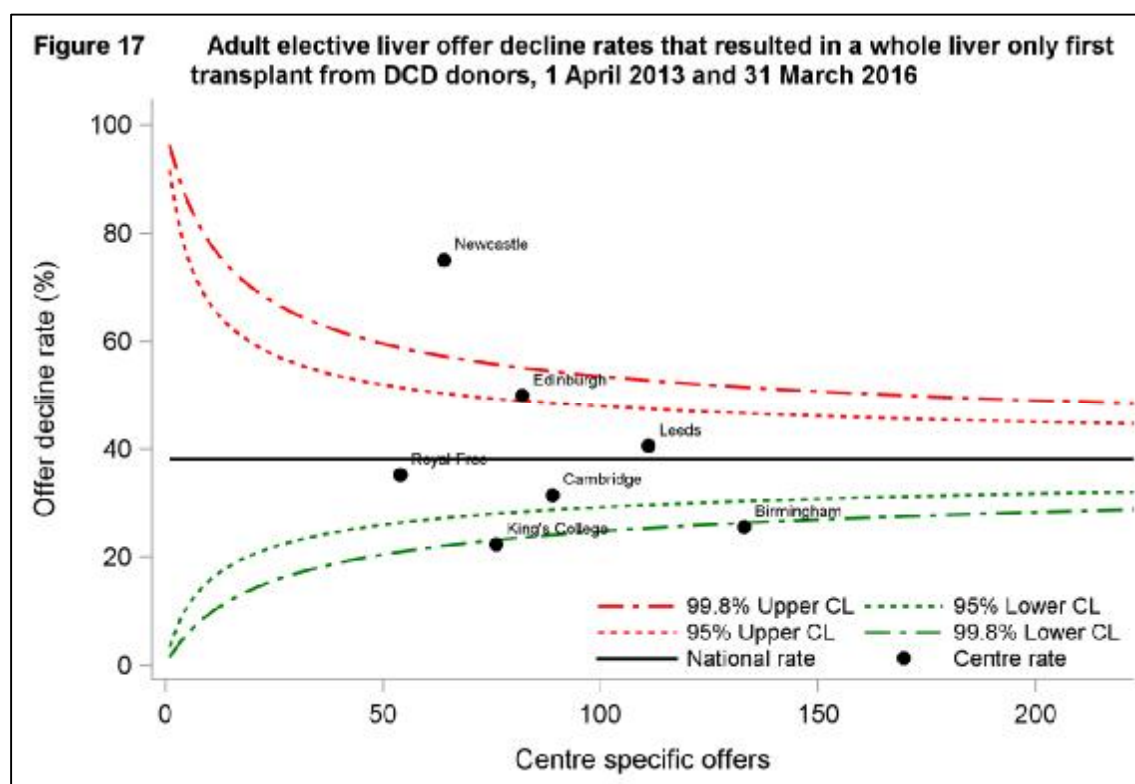
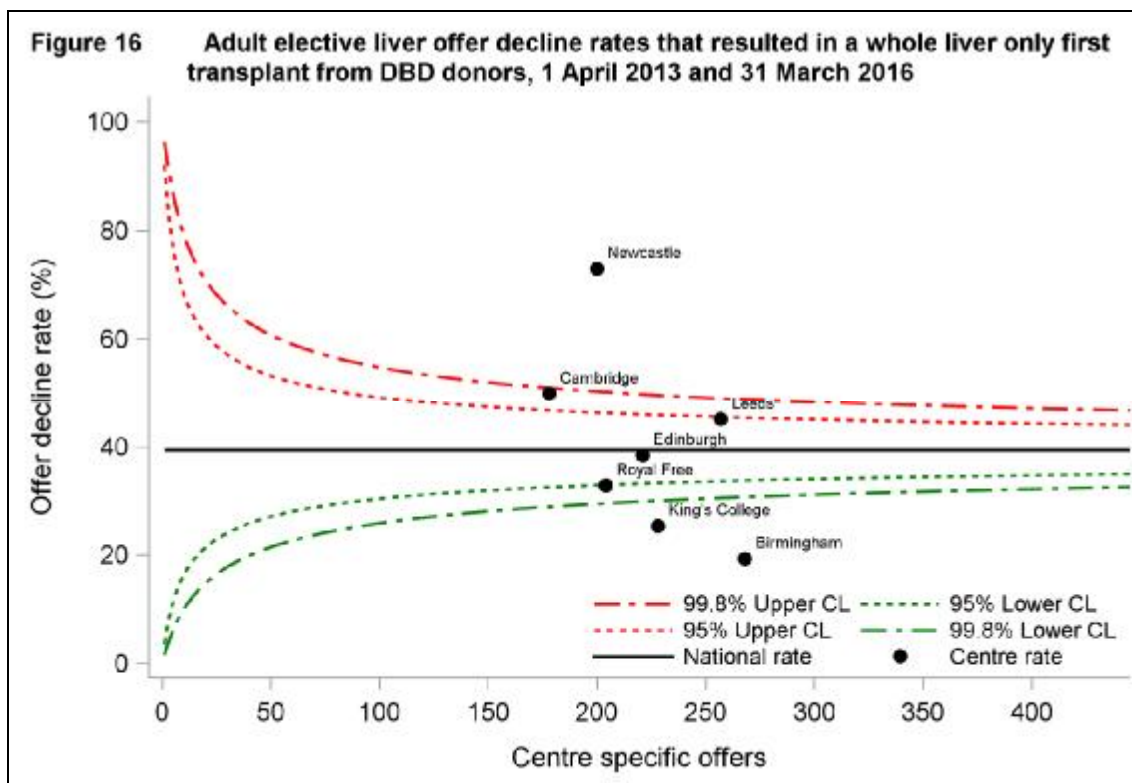


Figure 15 Adult elective liver only transplants by donor type and centre, 1 April 2006 - 31 March 2016



The decline reasons for offers for whole livers, which were subsequently transplanted, are provided in **Table 3** and **Table 4**, for [DBD](#) and [DCD](#) respectively. For some offers, due to rounding, percentages may not add up to 100. **Figure 16** and **Figure 17** are funnel plots of the offer decline rates, for DBD and DCD respectively. A liver transplant can involve a whole liver, reduced liver or split liver. The term reduced is used when only one lobe of the liver is transplanted and the term split applies when both lobes of the liver are transplanted into two different recipients. Only whole liver offers which resulted in whole liver transplants are reported on. This may affect the decline rates for centres that perform a large number of split or reduced liver transplants. Only offers from donors aged 65 and under for DBD, and under 60 for DCD were included to ensure a meaningful analysis across centres, since some centres specify an upper donor age limit for receipt of offers.

It can be seen that those centres with the smaller number of patients on the transplant list have the higher decline rates (Newcastle, Cambridge, Edinburgh). Because of the matching of donor to recipient there may not always be a suitable patient on the list in those centres (e.g. the matching of an AB donor) and declined offers in these cases have, nevertheless, been included in our analysis.



The demographic characteristics of 643 adult [elective](#) transplant recipients in the latest year are shown by centre and overall in **Table 5**. Over two thirds of these recipients were male and the [median](#) age was 56 years. The most common indication for transplantation was alcoholic liver disease followed by cancer. The median recipient BMI was 27. For some characteristics, due to rounding, percentages may not add up to 100.

Table 3 Number of whole liver offers declined from donors after brain death aged ≤65 years old in the UK, where whole livers were subsequently transplanted, by reason for decline and transplant centre, 1 April 2013 to 31 March 2016

	Liver transplant centre															
	Birmingham		Cambridge		Edinburgh		King's College		Leeds		Newcastle		Royal Free		TOTAL	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
DECLINED	52	19	89	50	85	35	58	25	116	43	146	71	67	33	613	38
Donor reasons	35	13	58	33	51	21	46	20	72	27	100	48	53	26	415	26
ABO type	0	0	3	2	3	1	1	0	1	0	2	1	4	2	14	1
Ischaemia time too long-cold	1	0	2	1	0	0	0	0	1	0	1	0	0	0	5	0
Ischaemia time too long-warm	0	0	1	1	0	0	0	0	0	0	1	0	1	0	3	0
Donor unsuitable - age	4	1	2	1	0	0	3	1	5	2	0	0	0	0	14	1
Donor unsuitable - cause of death	0	0	1	1	1	0	0	0	1	0	1	0	0	0	4	0
Donor unsuitable - past history	13	5	27	15	25	10	22	10	29	11	50	24	17	8	183	11
Donor unsuitable - size	12	4	0	0	2	1	6	3	7	3	9	4	5	2	41	3
Donor unsuitable – other	1	0	6	3	5	2	4	2	6	2	9	4	4	2	35	2
Fatty/fibrotic organ	2	1	3	2	1	0	1	0	3	1	3	1	4	2	17	1
Poor function	2	1	13	7	14	6	9	4	19	7	23	11	17	8	97	6
Tumour	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	0
Recipient reasons	1	0	2	1	3	1	1	0	6	2	0	0	0	0	13	1
Recipient refused/did not need transplant	0	0	0	0	1	0	1	0	4	1	0	0	0	0	6	0
Recipient unfit/died	1	0	2	1	2	1	0	0	2	1	0	0	0	0	7	0
No suitable recipients	0	0	14	8	10	4	7	3	16	6	25	12	8	4	80	5
Organ damaged	0	0	1	1	0	0	0	0	1	0	2	1	2	1	6	0
Logistical reasons	16	6	14	8	21	9	5	2	21	8	19	9	4	2	100	6
Centre already retrieving/transplanting	5	2	11	6	15	6	0	0	6	2	13	6	1	0	51	3
No beds/staff/theatre	2	1	0	0	0	0	0	0	11	4	0	0	0	0	13	1
Other	9	3	3	2	6	2	4	2	4	1	6	3	3	1	35	2
NLA PAYBACK	0	0	0	0	21	9	0	0	10	4	7	3	0	0	38	2
ACCEPTED (NUMBER OF LIVERS)	216	81	89	50	136	56	170	75	141	53	54	26	137	67	943	59
TOTAL NUMBER OF OFFERS	268	100	178	100	242	100	228	100	267	100	207	100	204	100	1594	100

Table 4 Number of whole liver offers declined from donors after circulatory death aged ≤60 years old in the UK, where livers were subsequently transplanted, by reason for decline and transplant centre, 1 April 2013 to 31 March 2016

	Liver transplant centre														TOTAL	
	Birmingham		Cambridge		Edinburgh		King's College		Leeds		Newcastle		Royal Free			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
DECLINED	34	26	28	31	41	50	17	22	45	40	48	75	19	35	233	38
Donor reasons	13	10	11	12	18	22	8	11	19	17	26	41	12	22	107	18
Donor unsuitable - age	0	0	0	0	2	2	0	0	3	3	1	2	0	0	6	1
Donor unsuitable - past history	6	5	6	7	11	13	3	4	7	6	18	28	4	7	55	9
Donor unsuitable - size	1	1	3	3	0	0	1	1	1	1	1	2	0	0	7	1
Donor unsuitable - virology	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0
Infection	1	1	1	1	0	0	0	0	0	0	0	0	0	0	2	0
Poor function	5	4	1	1	5	6	0	0	6	5	6	9	3	6	26	4
Warm ischaemia time too long	0	0	0	0	0	0	3	4	1	1	0	0	2	4	6	1
Fatty organ	0	0	0	0	0	0	1	1	0	0	0	0	1	2	2	0
ABO match	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0
Anatomical	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0
Recipient reasons	1	1	1	1	0	0	1	1	0	0	0	0	1	2	4	1
Recipient refused	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
Recipient unfit	1	1	1	1	0	0	0	0	0	0	0	0	1	2	3	0
No suitable recipients	8	6	7	8	9	11	4	5	13	12	13	20	4	7	58	10
Logistical reasons	12	9	9	10	14	17	4	5	13	12	9	14	2	4	63	10
Centre already retrieving/ transplanting	9	7	5	6	7	9	2	3	4	4	5	8	0	0	32	5
No beds/staff/theatre	0	0	2	2	0	0	0	0	2	2	2	3	0	0	6	1
No time	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0
Other	3	2	2	2	6	7	2	3	7	6	2	3	2	4	24	4
NLA PAYBACK	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0
ACCEPTED (NUMBER OF LIVERS)	99	74	61	69	41	50	59	78	66	59	16	25	35	65	377	62
TOTAL NUMBER OF OFFERS	133	100	89	100	82	100	76	100	112	100	64	100	54	100	610	100

Table 5 Demographic characteristics of adult elective liver deceased donor transplant recipients, 1 April 2015 - 31 March 2016

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	TOTAL N (%)
Number		164	77	81	131	82	32	76	643 (100)
Recipient details									
Recipient sex	Male	111 (68)	48 (62)	53 (65)	82 (63)	58 (71)	17 (53)	58 (76)	427 (66)
	Female	53 (32)	29 (38)	28 (35)	49 (37)	24 (29)	15 (47)	18 (24)	216 (34)
Recipient ethnicity	White	152 (93)	74 (96)	79 (98)	112 (85)	72 (88)	32 (100)	51 (67)	572 (89)
	Non-white	12 (7)	3 (4)	2 (2)	19 (15)	10 (12)	0	25 (33)	71 (11)
Indication	Cancer	34 (21)	13 (17)	17 (21)	39 (30)	24 (29)	5 (16)	23 (30)	155 (24)
	Hepatitis C	7 (4)	2 (3)	8 (10)	9 (7)	3 (4)	2 (6)	5 (7)	36 (6)
	Alcoholic liver disease	48 (29)	22 (29)	26 (32)	28 (21)	21 (26)	10 (31)	19 (25)	174 (27)
	Hepatitis B	1 (1)	1 (1)	0	5 (4)	3 (4)	0	2 (3)	12 (2)
	Primary sclerosing cholangitis	23 (14)	10 (13)	9 (11)	9 (7)	8 (10)	3 (9)	10 (13)	72 (11)
	Primary biliary cirrhosis	12 (7)	7 (9)	9 (11)	12 (9)	8 (10)	5 (16)	3 (4)	56 (9)
	Autoimmune and cryptogenic disease	6 (4)	1 (1)	2 (2)	9 (7)	6 (7)	2 (6)	5 (7)	31 (5)
	Metabolic	19 (12)	17 (22)	8 (10)	10 (8)	6 (7)	5 (16)	3 (4)	68 (11)
	Other	14 (9)	4 (5)	2 (2)	10 (8)	3 (4)	0	6 (8)	39 (6)
Recipient HCV status	Negative	146 (89)	60 (78)	65 (80)	106 (81)	72 (88)	30 (94)	62 (82)	541 (84)
	Positive	16 (10)	7 (9)	12 (15)	25 (19)	7 (9)	1 (3)	14 (18)	82 (13)
	Not reported	2 (1)	10 (13)	2 (2)	0	3 (4)	1 (3)	0	18 (3)
Pre-transplant in-patient status	Out-patient	154 (94)	58 (75)	70 (86)	111 (85)	66 (80)	29 (91)	73 (96)	561 (87)
	In-patient	10 (6)	19 (25)	11 (14)	20 (15)	16 (20)	3 (9)	3 (4)	82 (13)
Ascites	Absence	55 (34)	23 (30)	39 (48)	69 (53)	36 (44)	20 (63)	32 (42)	274 (43)
	Presence	107 (65)	54 (70)	42 (52)	61 (47)	44 (54)	12 (38)	44 (58)	364 (57)

Table 5 Demographic characteristics of adult elective liver deceased donor transplant recipients, 1 April 2015 - 31 March 2016

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	TOTAL N (%)
	Not reported	2 (1)	0	0	1 (1)	2 (2)	0	0	5 (1)
Encephalopathy	Absence	100 (61)	42 (55)	42 (52)	96 (73)	51 (62)	24 (75)	76 (100)	431 (67)
	Presence	64 (39)	35 (45)	24 (30)	35 (27)	29 (35)	8 (25)	0	195 (30)
	Not reported	0	0	15 (19)	0	2 (2)	0	0	17 (3)
Pre-transplant renal support	No	155 (95)	77 (100)	67 (83)	118 (90)	80 (98)	30 (94)	74 (97)	601 (94)
	Yes	9 (5)	0	14 (17)	11 (8)	2 (2)	1 (3)	2 (3)	39 (6)
Previous abdominal surgery	No	147 (90)	72 (94)	69 (85)	119 (91)	72 (88)	32 (100)	67 (88)	578 (90)
	Yes	16 (10)	5 (6)	12 (15)	10 (8)	8 (10)	0	8 (11)	59 (9)
	Not reported	1 (1)	0	0	2 (2)	2 (2)	0	1 (1)	6 (1)
Varices & shunt	Absence	33 (20)	25 (32)	10 (12)	79 (60)	43 (52)	12 (38)	21 (28)	223 (35)
	Presence without treatment	125 (76)	37 (48)	67 (83)	46 (35)	36 (44)	18 (56)	50 (66)	379 (59)
	Presence with TIPS	5 (3)	1 (1)	1 (1)	6 (5)	0	2 (6)	4 (5)	19 (3)
	Not reported	1 (1)	14 (18)	3 (4)	0	3 (4)	0	1 (1)	22 (3)
Life style activity	Normal	0	0	21 (26)	1 (1)	5 (6)	1 (3)	1 (1)	29 (5)
	Restricted	74 (45)	15 (19)	25 (31)	67 (51)	14 (17)	12 (38)	0	207 (32)
	Self-care	85 (52)	39 (51)	22 (27)	40 (31)	38 (46)	17 (53)	71 (93)	312 (49)
	Confined	4 (2)	18 (23)	10 (12)	21 (16)	16 (20)	2 (6)	4 (5)	75 (12)
	Reliant	1 (1)	2 (3)	3 (4)	2 (2)	1 (1)	0	0	9 (1)
	Not reported	0	3 (4)	0	0	8 (10)	0	0	11 (2)
Graft appearance	Normal	144 (88)	53 (69)	73 (90)	33 (25)	66 (80)	27 (84)	54 (71)	450 (70)
	Abnormal	20 (12)	21 (27)	7 (9)	4 (3)	15 (18)	5 (16)	20 (26)	92 (14)
	Not reported	0	3 (4)	1 (1)	94 (72)	1 (1)	0	2 (3)	101 (16)
Recip age (years)	Median (IQR)	55 (47,61)	56 (48,61)	58 (48,64)	54 (46,61)	57 (51,62)	60 (53,65)	53 (45,59)	56 (48,62)
	Not reported	0	0	0	0	0	0	0	0

Table 5		Demographic characteristics of adult elective liver deceased donor transplant recipients, 1 April 2015 - 31 March 2016							
		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	TOTAL N (%)
BMI kg/m2	Median (IQR) Not reported	27 (23,31) 0	29 (23,33) 0	27 (24,32) 0	27 (24,29) 0	27 (24,31) 0	26 (23,30) 0	27 (23,29) 0	27 (24,31) 0
Serum Bilirubin umol/l	Median (IQR) Not reported	32 (17,52) 0	64 (34,142) 0	57 (29,84) 0	39 (25,70) 0	56 (30,107) 0	52 (32,117) 0	37 (20,63) 1	42 (23,83) 1
Serum Creatinine umol/l	Median (IQR) Not reported	76 (63,97) 0	68 (52,88) 0	72 (63,92) 0	78 (62,101) 0	74 (59,91) 0	79 (65,101) 0	78 (60,91) 0	74 (61,94) 0
Serum sodium mmol/l	Median (IQR) Not reported	137 (134,140) 0	136 (133,138) 0	136 (132,139) 0	140 (136,142) 0	136 (132,139) 1	137 (133,140) 0	138 (135,141) 1	137 (134,140) 2
Serum potassium mmol/l	Median (IQR) Not reported	4.3 (4.0,4.6) 0	4.3 (3.9,4.8) 0	4.2 (3.9,4.5) 0	4.3 (3.9,4.6) 0	4.3 (3.9,4.6) 1	4.2 (3.9,4.7) 1	4.1 (3.8,4.6) 2	4.3 (3.9,4.6) 4
INR	Median (IQR) Not reported	1.3 (1.1,1.5) 0	1.5 (1.2,2.0) 5	1.4 (1.1,1.6) 2	1.6 (1.3,2.0) 0	1.4 (1.2,1.7) 0	1.5 (1.3,1.9) 0	1.3 (1.2,1.6) 2	1.4 (1.2,1.7) 9
Serum Albumin g/l	Median (IQR) Not reported	37 (32,42) 0	28 (24,32) 3	28 (23,32) 1	29 (23,35) 0	31 (28,34) 1	34 (29,38) 0	34 (28,38) 1	32 (26,37) 6
Cold Ischaemia Time (hrs)	Median (IQR) Not reported	7 (4,9) 0	8 (7,11) 8	9 (8,10) 1	9 (7,11) 96	8 (7,9) 0	10 (9,12) 0	8 (7,11) 1	8 (6,10) 106
Time on list (days)	Median (IQR) Not reported	71 (32,195) 0	70 (30,192) 0	50 (24,124) 0	196 (105,301) 0	60 (16,134) 1	89 (44,246) 0	120 (41,224) 0	98 (33,219) 1

Table 5 Demographic characteristics of adult elective liver deceased donor transplant recipients, 1 April 2015 - 31 March 2016									
		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	TOTAL N (%)
Donor details									
Donor sex	Male	79 (48)	45 (58)	41 (51)	83 (63)	42 (51)	15 (47)	42 (55)	347 (54)
	Female	85 (52)	32 (42)	40 (49)	48 (37)	40 (49)	17 (53)	34 (45)	296 (46)
Donor ethnicity	White	151 (92)	73 (95)	77 (95)	114 (87)	77 (94)	28 (88)	60 (79)	580 (90)
	Non-white	5 (3)	1 (1)	1 (1)	9 (7)	1 (1)	1 (3)	12 (16)	30 (5)
	Not reported	8 (5)	3 (4)	3 (4)	8 (6)	4 (5)	3 (9)	4 (5)	33 (5)
Donor cause of death	Trauma	150 (91)	67 (87)	75 (93)	114 (87)	74 (90)	27 (84)	61 (80)	568 (88)
	CVA	4 (2)	6 (8)	5 (6)	8 (6)	3 (4)	2 (6)	9 (12)	37 (6)
	Others	10 (6)	4 (5)	1 (1)	9 (7)	5 (6)	3 (9)	6 (8)	38 (6)
Donor history of diabetes	No	142 (87)	75 (97)	74 (91)	118 (90)	73 (89)	32 (100)	71 (93)	585 (91)
	Yes	17 (10)	2 (3)	6 (7)	11 (8)	8 (10)	0	3 (4)	47 (7)
	Not reported	5 (3)	0	1 (1)	2 (2)	1 (1)	0	2 (3)	11 (2)
Donor type	Donor after brain death	106 (65)	43 (56)	59 (73)	94 (72)	59 (72)	27 (84)	58 (76)	446 (69)
	Donor after cardiac death	58 (35)	34 (44)	22 (27)	37 (28)	23 (28)	5 (16)	18 (24)	197 (31)
ABO match	Identical	158 (96)	76 (99)	81 (100)	130 (99)	81 (99)	32 (100)	76 (100)	634 (99)
	Compatible	6 (4)	0	0	1 (1)	1 (1)	0	0	8 (1)
	Incompatible	0	1 (1)	0	0	0	0	0	1 (0)
Graft type	Whole	151 (92)	73 (95)	79 (98)	120 (92)	77 (94)	31 (97)	74 (97)	605 (94)
	Segmental	13 (8)	4 (5)	2 (2)	11 (8)	5 (6)	1 (3)	2 (3)	38 (6)
Donor age years	Median (IQR)	53 (41,64)	52 (42,61)	54 (43,63)	56 (42,67)	49 (39,59)	55 (45,61)	48 (31,57)	53 (40,63)
	Not reported	0	0	0	0	0	0	0	0
Donor BMI kg/m2	Median (IQR)	26 (23,30)	25 (23,29)	26 (23,29)	25 (23,28)	25 (23,29)	27 (25,30)	25 (22,27)	25 (23,29)
	Not reported	0	0	0	0	0	0	0	0

POST-TRANSPLANT SURVIVAL

LONG-TERM PATIENT SURVIVAL

Table 6 shows one year [unadjusted](#) and [risk-adjusted patient survival](#) for 2141 of the 2369 transplants in the period, 1 April 2011 to 31 March 2015. Transplants were excluded if they were [auxiliary](#) or if survival information or [risk factors](#) were missing. The overall patient survival rate is 93.4% and, after risk adjustment, two centres had a lower survival rate than the national rate. None of these centres lie outside of the 95% [confidence limit](#), as shown in **Figure 18**.

Table 6 One year patient survival for adult elective deceased donor first liver transplants, 1 April 2011 - 31 March 2015					
Centre	Number of transplants	1-year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Newcastle	112	96.4	(90.6 - 98.6)	93.9	(83.7 - 97.7)
Leeds	295	91.4	(87.5 - 94.1)	92.0	(88.1 - 94.6)
Cambridge	229	92.9	(88.6 - 95.6)	94.4	(90.9 - 96.6)
Royal Free	234	93.1	(89.0 - 95.7)	94.7	(91.3 - 96.7)
King's College	487	95.0	(92.7 - 96.6)	94.3	(91.5 - 96.2)
Birmingham	533	92.4	(89.7 - 94.4)	92.1	(89.2 - 94.2)
Edinburgh	251	94.4	(90.7 - 96.6)	93.7	(89.4 - 96.3)
Total	2141	93.4	(92.3 - 94.4)	.	.

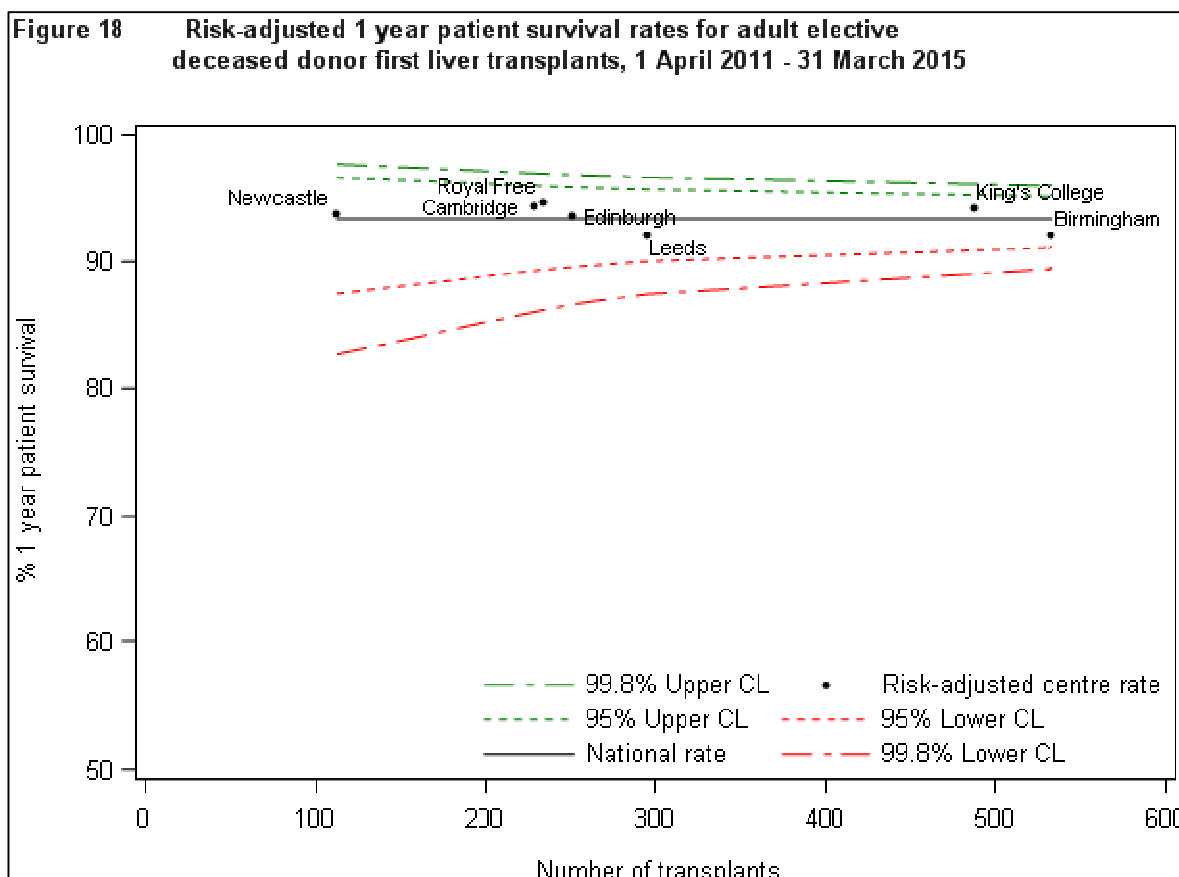


Table 7 shows the five year [unadjusted](#) and [risk-adjusted patient survival](#) for 1719 of the 1825 transplants in the period, 1 April 2007 to 31 March 2011. The national rate is 80.5% and four centres have a lower survival rate after risk adjustment. None of these centres lie outside of the 95% [confidence limit](#), as shown in **Figure 19**.

Table 7 Five year patient survival for adult elective deceased donor first liver transplants, 1 April 2007 - 31 March 2011					
Centre	Number of transplants	5-year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Newcastle	90	73.0	(62.4 - 81.0)	74.2	(61.5 - 82.7)
Leeds	230	81.5	(75.0 - 86.4)	81.3	(74.2 - 86.4)
Cambridge	193	81.2	(74.7 - 86.1)	84.7	(78.7 - 89.0)
Royal Free	197	81.5	(75.3 - 86.3)	78.6	(70.3 - 84.6)
King's College	403	83.0	(78.7 - 86.5)	83.4	(78.7 - 87.0)
Birmingham	404	79.4	(75.1 - 83.1)	77.2	(71.6 - 81.7)
Edinburgh	202	77.9	(71.4 - 83.0)	79.9	(72.9 - 85.0)
Total	1719	80.5	(78.5 - 82.3)		

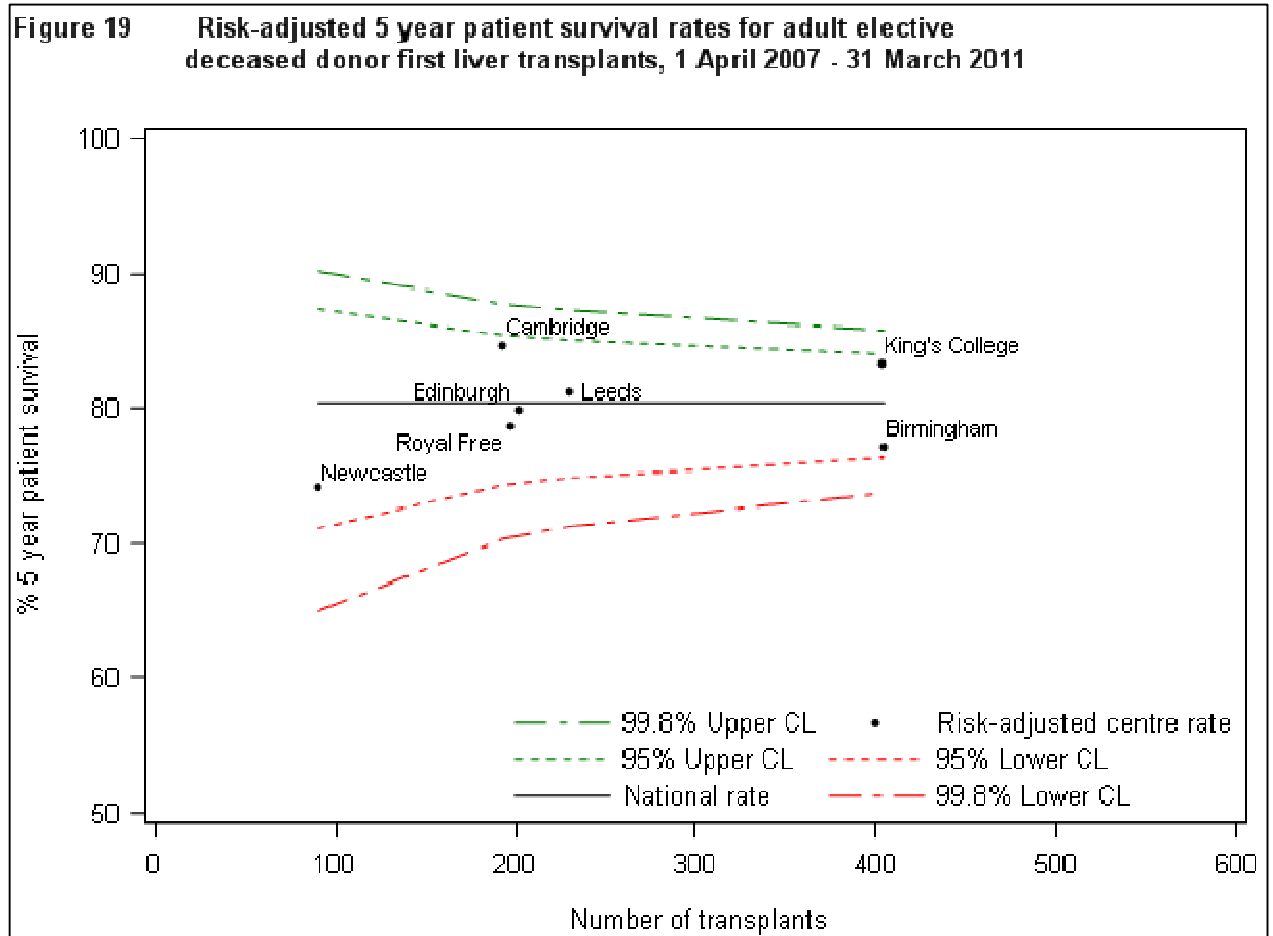


Table 8 shows one year [unadjusted](#) and [risk-adjusted patient survival](#), by primary disease group. The overall patient survival rate is 93.4% and, after risk adjustment, patients with cancer, autoimmune and cryptogenic, or metabolic disease had a lower survival rate than the national rate.

Table 8 One year patient survival for adult elective deceased donor first liver transplants, 1 April 2011 - 31 March 2015					
Primary disease	Number of transplants	1-year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Cancer	527	89.9	(87.0 - 92.2)	90.2	(87.2 - 92.5)
Hepatitis B and C	256	96.1	(92.8 - 97.9)	96.7	(93.9 - 98.2)
Alcoholic liver disease	489	93.8	(91.3 - 95.6)	94.4	(92.1 - 96.1)
Primary sclerosing cholangitis	239	96.6	(93.4 - 98.3)	95.4	(90.7 - 97.7)
Primary biliary cirrhosis	188	96.8	(92.9 - 98.5)	96.3	(91.7 - 98.3)
Autoimmune and cryptogenic	139	91.2	(85.1 - 94.9)	89.7	(81.8 - 94.1)
Metabolic	192	91.4	(86.4 - 94.7)	92.1	(87.0 - 95.1)
Other	111	95.5	(89.4 - 98.1)	93.9	(85.4 - 97.5)
Total	2141	93.4	(92.3 - 94.4)		

Table 9 shows five year [unadjusted](#) and [risk-adjusted patient survival](#), the overall patient survival rate is 80.5%. After risk adjustment patients with cancer, metabolic, or other disease had a lower survival rate than the national rate.

Table 9 Five year patient survival for adult elective deceased donor first liver transplants, 1 April 2007 - 31 March 2011					
Primary disease	Number of transplants	5-year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Cancer	425	73.5	(68.8 - 77.5)	77.1	(72.3 - 81.1)
Hepatitis B and C	220	76.8	(70.3 - 82.0)	81.3	(75.1 - 86.0)
Alcoholic liver disease	400	84.1	(80.0 - 87.4)	83.1	(78.3 - 86.9)
Primary sclerosing cholangitis	163	84.6	(77.8 - 89.4)	82.6	(74.0 - 88.3)
Primary biliary cirrhosis	178	86.1	(80.0 - 90.5)	84.0	(76.1 - 89.3)
Autoimmune and cryptogenic	132	84.9	(77.3 - 90.1)	81.1	(70.4 - 88.0)
Metabolic	78	77.6	(65.9 - 85.7)	76.9	(62.2 - 85.8)
Other	123	82.2	(74.0 - 88.0)	78.3	(66.7 - 85.8)
Total	1719	80.5	(78.5 - 82.3)		

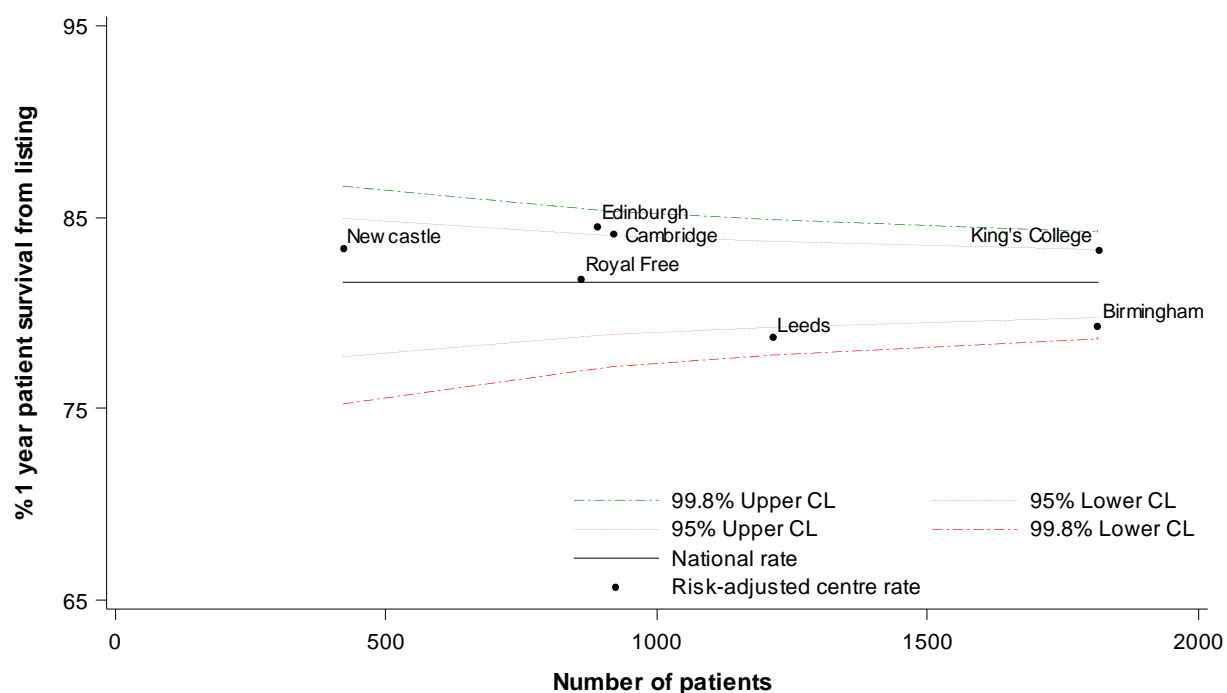
SURVIVAL FROM LISTING

Survival from listing was analysed for patients aged ≥ 18 years registered for the first time for a liver transplant between 1 January 2004 and 31 December 2015. One, five and ten year [risk-adjusted survival rates](#) from the point of liver transplant listing are provided in **Table 10** and shown by centre in **Figures 20, 21 and 22**, respectively.

At one year, centre-specific risk adjusted survival rates range between 79% at both Leeds and Birmingham (95% CI 76-81% and 77-81%, respectively) and 84% at both Cambridge and Edinburgh (95% CI 81-86% and 82-87%, respectively). At five years, Leeds has the lowest survival rate at 63% (95% CI 59-67%) and Edinburgh has the highest at 73% (95% CI 70-77%); the remaining centres achieve survival rates that range in between these two extremes. Similarly, at ten years, Leeds achieves the lowest survival rate at 51% (95% CI 45-56%) while Edinburgh has the highest at 63% (95% CI 58-67%).

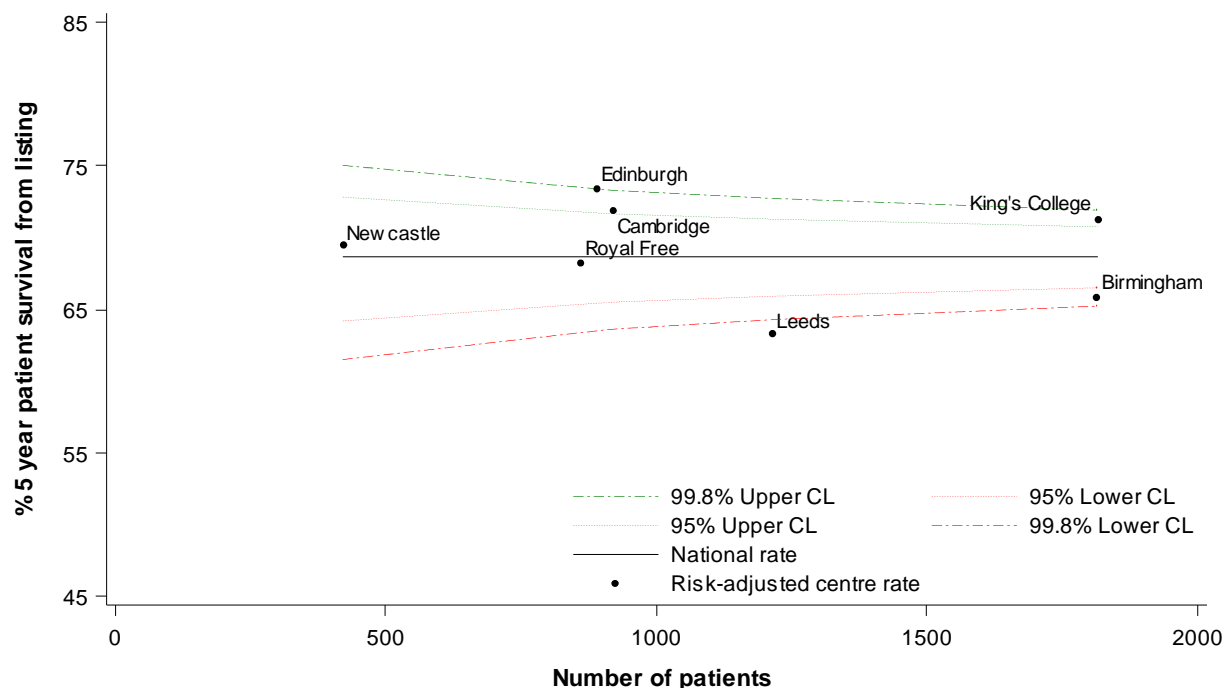
Table 10 Risk-adjusted 1, 5 and 10 year patient survival rate from listing for adult elective first liver registrations, 1 January 2004 - 31 December 2015				
Centre	Number of registrations	One year (%)	Patient survival Five year (%)	Ten year (%)
Newcastle	420	83	70	58
Leeds	1215	79	63	51
Cambridge	920	84	72	62
Royal Free	861	82	68	56
King's College	1815	83	71	62
Birmingham	1814	79	66	54
Edinburgh	889	84	73	63
TOTAL	7934	82	69	58

Figure 20 Risk-adjusted 1 year patient survival rate from time of listing for adult* elective first liver registrations, 1 January 2004 - 31 December 2015



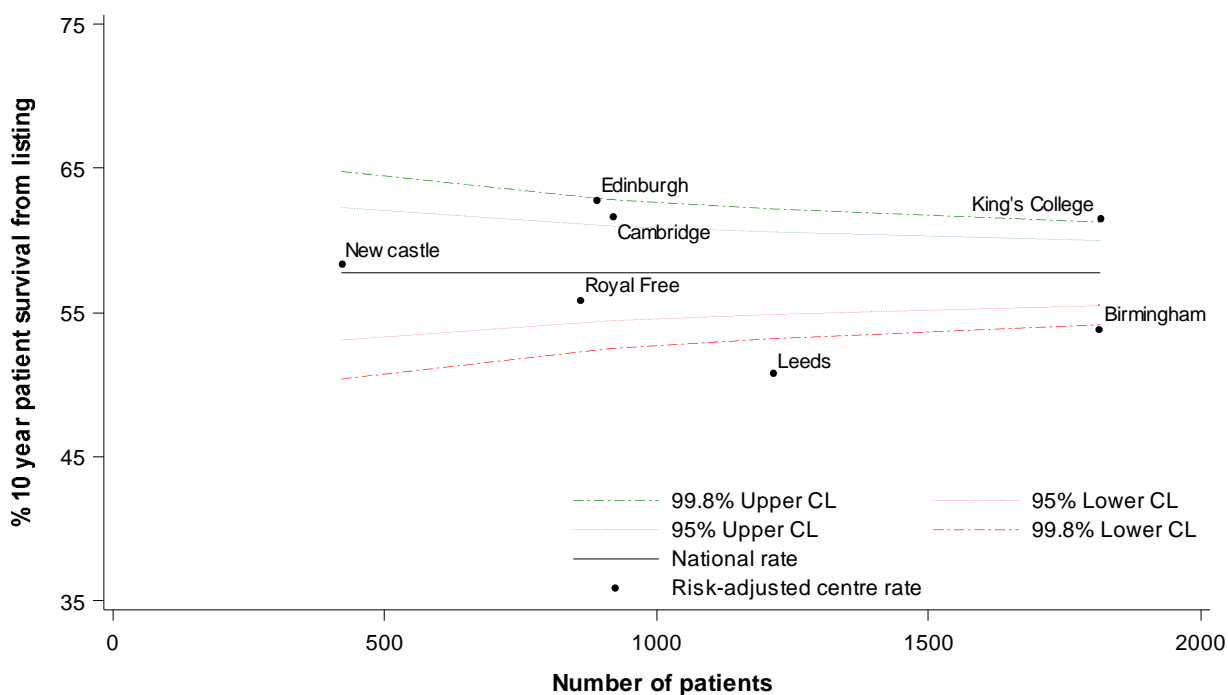
* In this analysis, adult patients are defined as 18 years old and older.

Figure 21 Risk-adjusted 5 year patient survival rate from time of listing for adult* elective first liver registrations, 1 January 2004 - 31 December 2015



* In this analysis, adult patients are defined as 18 years old and older.

Figure 22 Risk-adjusted 10 year patient survival rate from time of listing for adult* elective first liver registrations, 1 January 2004 - 31 December 2015



ADULT LIVER TRANSPLANTATION

SUPER-URGENT PATIENTS



SUPER-URGENT PATIENTS

TRANSPLANT LIST

Table 11 shows the [median waiting time](#) to deceased donor liver only transplant for adult [super-urgent](#) patients. The median waiting time to transplant is two days at all centres except Newcastle, Leeds and the Royal Free, where it is three days. The national median waiting time to transplant is two days.

Table 11 Median waiting time to deceased donor liver only transplant in the UK, for adult super urgent patients registered 1 April 2010 - 31 March 2013			
Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Adult			
Cambridge	30	2	2 - 2
King's College	66	2	1 - 3
Birmingham	70	2	1 - 3
Edinburgh	41	2	2 - 2
Newcastle	22	3	1 - 5
Leeds	34	3	2 - 4
Royal Free	33	3	2 - 4
UK	296	2	2 - 2

TRANSPLANT ACTIVITY

Figure 23 shows the number of adult [super-urgent](#) first liver only transplants from deceased and living donors performed in the last ten years, by type of donor. There was one living donor transplant performed in 2011-2012.

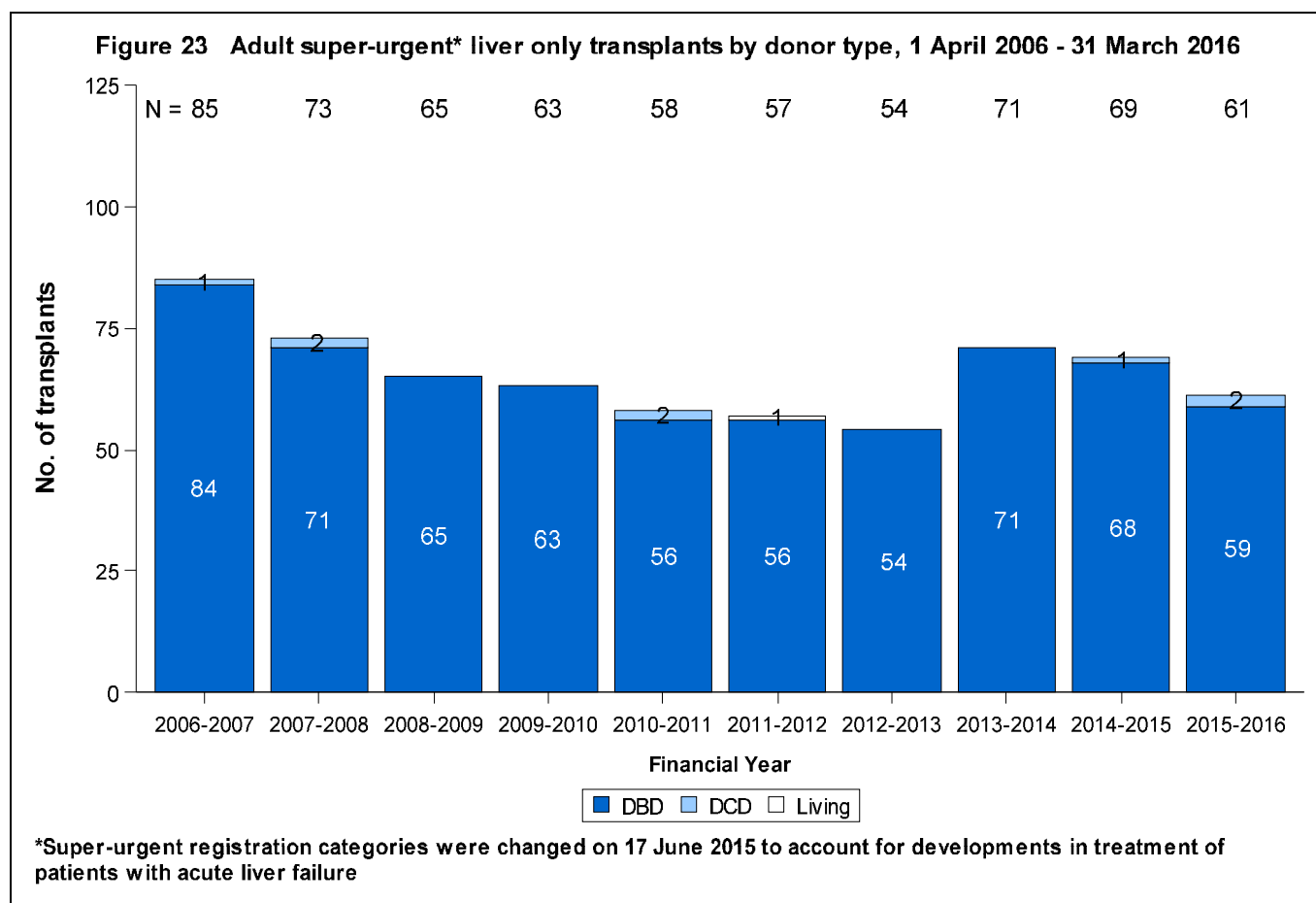
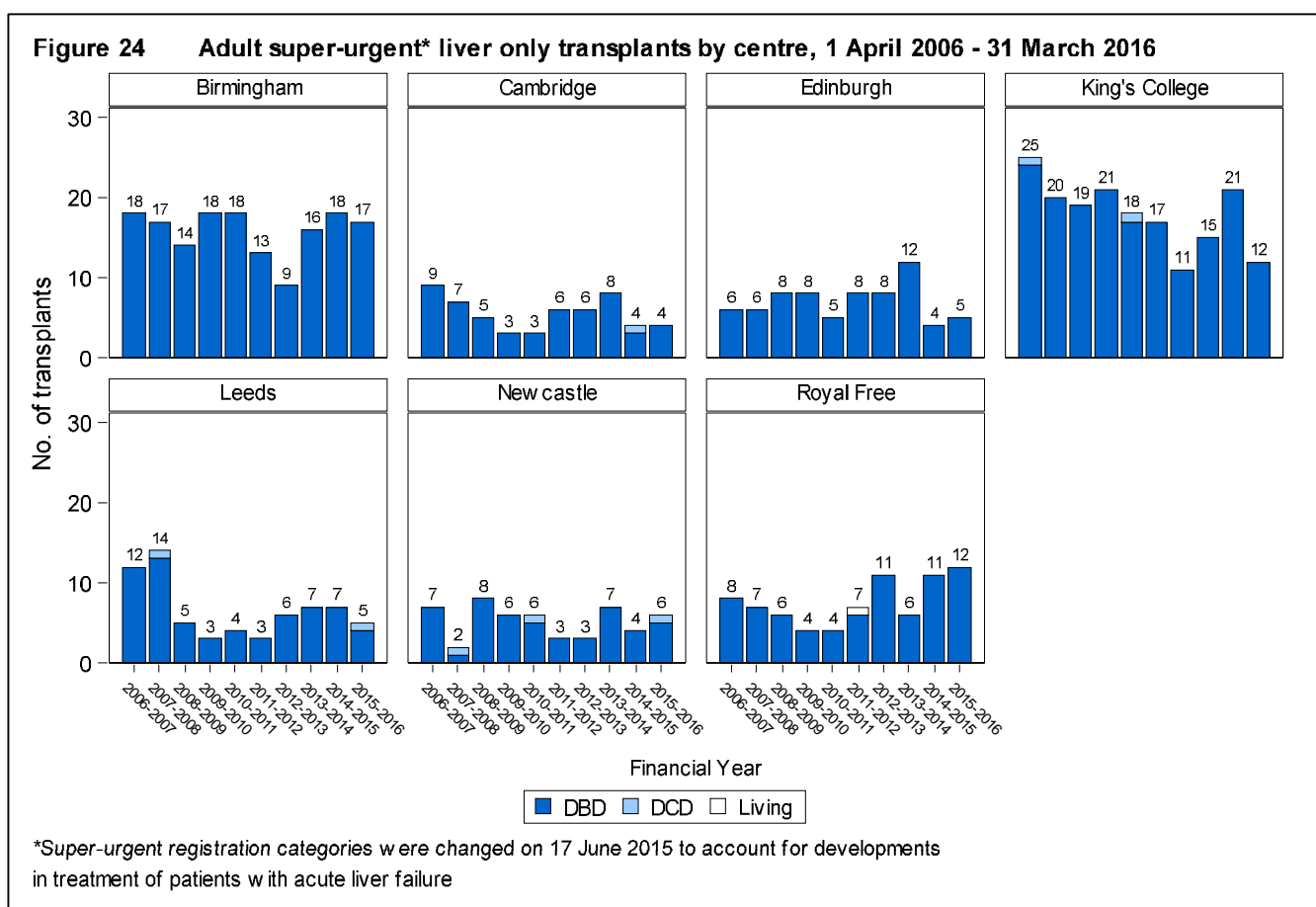


Figure 24 shows the number of adult [super-urgent](#) first liver only transplants from deceased and living donors performed in the last ten years, by type of donor and transplant centre.



The demographic characteristics of 311 adult [super-urgent](#) transplant recipients in the last five years are shown by centre and overall in **Table 12**. Two thirds of these recipients were female and the [median](#) age was 41 years. Only three super-urgent transplants have been performed in this time period using a [DCD](#) donor. The median recipient BMI was 25. For some characteristics, due to rounding, percentages may not add up to 100.

Table 12 Demographic characteristics of adult super-urgent deceased donor liver transplant recipients, 1 April 2011 - 31 March 2016

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	TOTAL N (%)
Number		73	28	37	76	28	23	46	311 (100)
Recipient details									
Recipient sex	Male	29 (40)	7 (25)	11 (30)	27 (36)	12 (43)	4 (17)	18 (39)	108 (35)
	Female	44 (60)	21 (75)	26 (70)	49 (64)	16 (57)	19 (83)	28 (61)	203 (65)
Recipient ethnicity	White	62 (85)	24 (86)	34 (92)	60 (79)	26 (93)	23 (100)	23 (50)	252 (81)
	Non-white	10 (14)	4 (14)	3 (8)	16 (21)	2 (7)	0	23 (50)	58 (19)
	Not reported	1 (1)	0	0	0	0	0	0	1 (0)
Recipient HCV status	Negative	67 (92)	25 (89)	36 (97)	76 (100)	21 (75)	22 (96)	46 (100)	293 (94)
	Positive	2 (3)	0	1 (3)	0	0	0	0	3 (1)
	Not reported	4 (5)	3 (11)	0	0	6 (21)	1 (4)	0	14 (5)
Pre-transplant in-patient status	Out-patient	4 (5)	3 (11)	0	0	3 (11)	0	2 (4)	12 (4)
	In-patient	68 (93)	25 (89)	37 (100)	76 (100)	25 (89)	23 (100)	44 (96)	298 (96)
	Not reported	1 (1)	0	0	0	0	0	0	1 (0)
Ascites	Absence	45 (62)	13 (46)	33 (89)	66 (87)	19 (68)	20 (87)	22 (48)	218 (70)
	Presence	28 (38)	14 (50)	4 (11)	8 (11)	9 (32)	3 (13)	24 (52)	90 (29)
	Not reported	0	1 (4)	0	2 (3)	0	0	0	3 (1)
Encephalopathy	Absence	0	2 (7)	2 (5)	1 (1)	2 (7)	1 (4)	5 (11)	13 (4)
	Presence	73 (100)	25 (89)	34 (92)	73 (96)	26 (93)	22 (96)	40 (87)	293 (94)
	Not reported	0	1 (4)	1 (3)	2 (3)	0	0	1 (2)	5 (2)
Pre-transplant renal support	No	35 (48)	11 (39)	18 (49)	22 (29)	20 (71)	5 (22)	28 (61)	139 (45)
	Yes	38 (52)	17 (61)	19 (51)	54 (71)	8 (29)	17 (74)	18 (39)	171 (55)

Table 12 Demographic characteristics of adult super-urgent deceased donor liver transplant recipients, 1 April 2011 - 31 March 2016									
		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Previous abdominal surgery	No	70 (96)	26 (93)	36 (97)	69 (91)	26 (93)	21 (91)	42 (91)	290 (93)
	Yes	2 (3)	2 (7)	1 (3)	5 (7)	2 (7)	2 (9)	3 (7)	17 (6)
	Not reported	1 (1)	0	0	2 (3)	0	0	1 (2)	4 (1)
Varices & shunt	Absence	65 (89)	13 (46)	23 (62)	74 (97)	20 (71)	10 (43)	41 (89)	246 (79)
	Presence without treatment	7 (10)	15 (54)	14 (38)	2 (3)	8 (29)	13 (57)	2 (4)	61 (20)
	Presence with TIPS	1 (1)	0	0	0	0	0	1 (2)	2 (1)
Life style activity	Normal	0	0	0	0	3 (11)	0	0	3 (1)
	Restricted	3 (4)	0	0	0	2 (7)	1 (4)	0	6 (2)
	Self-care	0	1 (4)	0	2 (3)	2 (7)	0	0	5 (2)
	Confined	22 (30)	0	4 (11)	9 (12)	7 (25)	2 (9)	5 (11)	49 (16)
	Reliant	48 (66)	26 (93)	33 (89)	64 (84)	13 (46)	20 (87)	41 (89)	245 (79)
	Not reported	0	1 (4)	0	0	1 (4)	0	0	2 (1)
Graft appearance	Normal	70 (96)	22 (79)	34 (92)	17 (22)	23 (82)	18 (78)	36 (78)	220 (71)
	Abnormal	3 (4)	5 (18)	2 (5)	2 (3)	4 (14)	5 (22)	10 (22)	31 (10)
	Not reported	0	1 (4)	1 (3)	57 (75)	1 (4)	0	0	60 (19)
Recip age (years)	Median (IQR)	41 (30,51)	46 (27,56)	44 (36,58)	36 (25,47)	45 (31,54)	44 (23,55)	41 (33,49)	41 (28,52)
	Not reported	0	0	0	0	0	0	0	0
BMI kg/m2	Median (IQR)	26 (24,29)	25 (22,29)	25 (22,30)	23 (21,26)	25 (22,29)	25 (20,27)	27 (23,30)	25 (22,29)
	Not reported	0	0	0	2	0	7	6	15
Serum Bilirubin umol/l	Median (IQR)	296 (170,461)	293 (153,439)	178 (125,479)	231 (96,401)	272 (107,392)	115 (65,315)	338 (193,506)	285 (125,429)
	Not reported	0	0	0	0	0	0	0	0

Table 12 Demographic characteristics of adult super-urgent deceased donor liver transplant recipients, 1 April 2011 - 31 March 2016

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	TOTAL N (%)
Serum Creatinine umol/l	Median (IQR) Not reported	95 (61,133) 0	105 (68,179) 0	132 (65,222) 0	106 (65,146) 0	78 (59,123) 0	89 (63,113) 0	84 (62,127) 0	95 (64,143) 0
Serum sodium mmol/l	Median (IQR) Not reported	140 (136,150) 0	139 (135,141) 0	136 (134,138) 0	143 (139,148) 0	138 (135,140) 0	139 (136,143) 0	140 (136,146) 0	140 (136,146) 0
Serum potassium mmol/l	Median (IQR) Not reported	4.3 (3.9,4.6) 0	4.1 (3.9,4.5) 0	3.8 (3.6,4.4) 0	4.3 (4.0,4.6) 0	4.3 (3.7,4.8) 0	4.0 (3.7,4.1) 0	4.2 (3.8,4.5) 0	4.2 (3.8,4.5) 0
INR	Median (IQR) Not reported	2.6 (2.0,4.4) 0	4.1 (2.8,6.0) 2	3.2 (2.3,4.5) 0	2.4 (1.8,4.3) 0	2.4 (1.7,5.8) 0	2.7 (2.2,3.4) 0	3.4 (2.4,5.6) 0	2.8 (2.0,4.7) 2
Serum Albumin g/l	Median (IQR) Not reported	29 (25,34) 0	26 (21,30) 0	24 (19,28) 0	25 (22,28) 0	27 (24,32) 0	31 (27,35) 0	27 (23,31) 1	27 (23,31) 1
Time on list (days)	Median (IQR) Not reported	2 (1,3) 0	2 (1,4) 0	2 (1,2) 0	2 (1,3) 0	2 (1,4) 0	2 (1,3) 0	2 (2,4) 0	2 (1,3) 0
Donor details									
Donor sex	Male	34 (47)	13 (46)	17 (46)	48 (63)	6 (21)	11 (48)	16 (35)	145 (47)
	Female	39 (53)	15 (54)	20 (54)	28 (37)	22 (79)	12 (52)	30 (65)	166 (53)
Donor ethnicity	White	67 (92)	25 (89)	33 (89)	65 (86)	25 (89)	21 (91)	42 (91)	278 (89)
	Non-white	3 (4)	3 (11)	3 (8)	6 (8)	1 (4)	1 (4)	3 (7)	20 (6)
	Not reported	3 (4)	0	1 (3)	5 (7)	2 (7)	1 (4)	1 (2)	13 (4)
Donor cause of death	Trauma	57 (78)	25 (89)	33 (89)	59 (78)	21 (75)	21 (91)	43 (93)	259 (83)
	CVA	12 (16)	2 (7)	0	11 (14)	5 (18)	2 (9)	0	32 (10)
	Others	4 (5)	1 (4)	4 (11)	6 (8)	2 (7)	0	3 (7)	20 (6)

Table 12		Demographic characteristics of adult super-urgent deceased donor liver transplant recipients, 1 April 2011 - 31 March 2016							
		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	TOTAL N (%)
Donor history of diabetes	No	71 (97)	26 (93)	35 (95)	71 (93)	26 (93)	22 (96)	44 (96)	295 (95)
	Yes	1 (1)	2 (7)	2 (5)	5 (7)	1 (4)	1 (4)	2 (4)	14 (5)
	Not reported	1 (1)	0	0	0	1 (4)	0	0	2 (1)
Donor type	Donor after brain death	73 (100)	27 (96)	37 (100)	76 (100)	27 (96)	22 (96)	46 (100)	308 (99)
	Donor after cardiac death	0	1 (4)	0	0	1 (4)	1 (4)	0	3 (1)
ABO match	Identical	48 (66)	19 (68)	31 (84)	40 (53)	16 (57)	17 (74)	31 (67)	202 (65)
	Compatible	25 (34)	7 (25)	6 (16)	36 (47)	12 (43)	6 (26)	15 (33)	107 (34)
	Incompatible	0	2 (7)	0	0	0	0	0	2 (1)
Graft type	Whole	72 (99)	27 (96)	37 (100)	64 (84)	26 (93)	23 (100)	44 (96)	293 (94)
	Segmental	1 (1)	1 (4)	0	12 (16)	2 (7)	0	2 (4)	18 (6)
Donor age (years)	Median (IQR)	45 (31,58)	48 (28,58)	49 (34,64)	51 (34,57)	50 (36,64)	52 (39,57)	48 (34,60)	48 (33,58)
	Not reported	0	0	0	0	0	0	0	0
Donor BMI kg/m2	Median (IQR)	25 (23,28)	24 (22,27)	26 (23,29)	26 (23,28)	25 (23,27)	23 (22,28)	23 (21,26)	25 (22,28)
	Not reported	0	0	0	0	0	0	0	0

POST-TRANSPLANT SURVIVAL

LONG-TERM PATIENT SURVIVAL

Table 13 shows one year [unadjusted](#) and [risk-adjusted patient survival](#) for 222 of the 243 transplants in the period 1 April 2011 to 31 March 2015. Transplants were excluded if they were [auxiliary](#) or if survival information or [risk factors](#) were missing. The overall patient survival rate is 88.7% and, after risk adjustment, four centres had a lower survival rate than the national rate but within the [confidence limits](#), as shown in **Figure 25**.

Table 13 One year patient survival for adult super-urgent deceased donor first liver transplants, 1 April 2011 - 31 March 2015					
Centre	Number of transplants	1-year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Newcastle	16	81.3	(52.5 - 93.5)	86.5	(58.3 - 95.7)
Leeds	21	81.0	(56.9 - 92.4)	85.6	(61.6 - 94.6)
Cambridge	21	90.5	(67.0 - 97.5)	89.8	(59.1 - 97.4)
Royal Free	30	90.0	(72.1 - 96.7)	87.6	(61.5 - 96.0)
King's College	53	88.5	(76.1 - 94.7)	88.8	(75.0 - 95.0)
Birmingham	51	90.2	(77.9 - 95.8)	88.3	(71.8 - 95.1)
Edinburgh	30	93.3	(75.9 - 98.3)	93.5	(74.2 - 98.4)
Total	222	88.7	(83.7 - 92.2)	.	.

Figure 25 Risk-adjusted 1 year patient survival rates for adult super-urgent deceased donor first liver transplants, 1 April 2011 - 31 March 2015

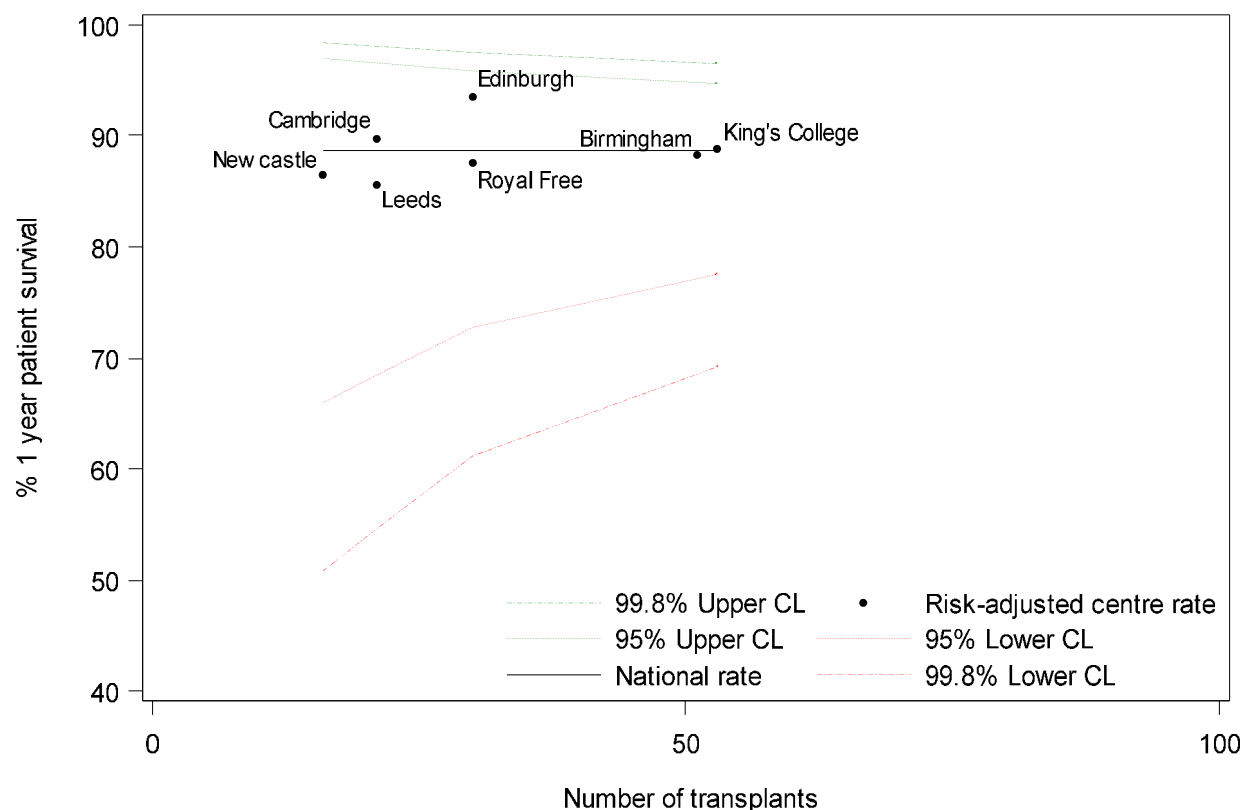
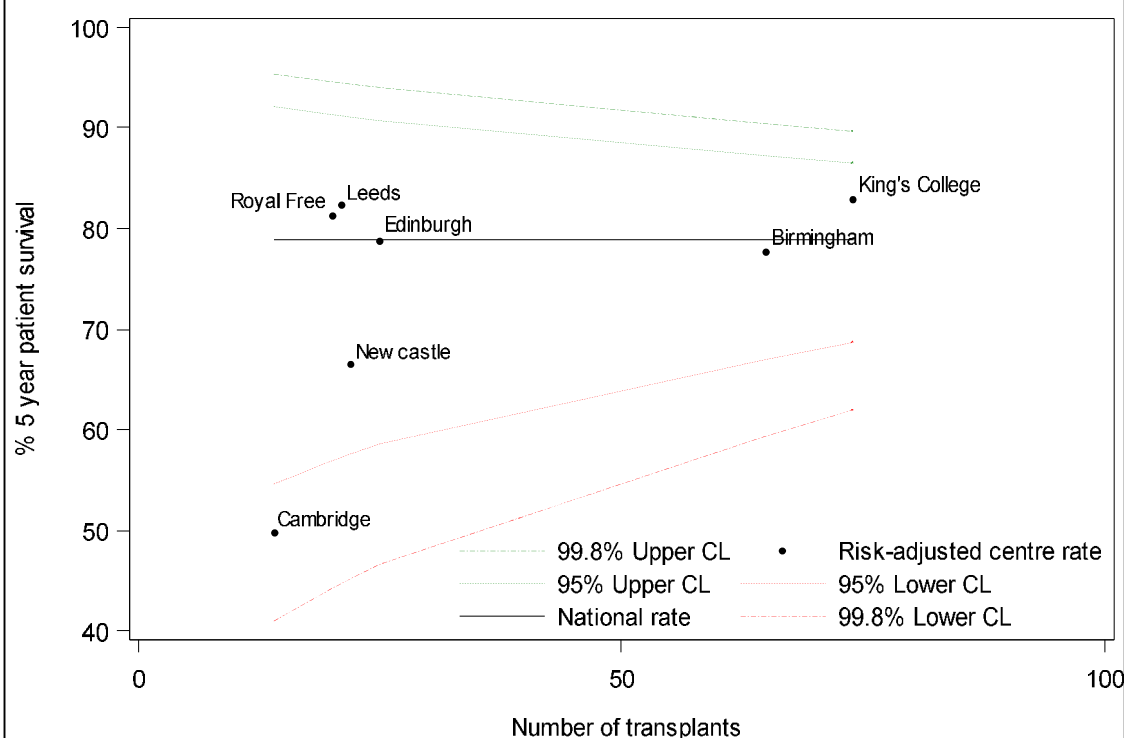


Table 14 shows the five year [unadjusted](#) and [risk-adjusted patient survival](#) for 241 of the 252 transplants in the period, 1 April 2007 to 31 March 2011. The national rate is 78.9% and four centres have a lower survival rate after risk adjustment, with Cambridge being below the 95% [confidence limits](#), as shown in **Figure 26**.

Table 14 Five year patient survival for adult super-urgent deceased donor first liver transplants, 1 April 2007 - 31 March 2011					
Centre	Number of transplants	5-year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Newcastle	22	77.0	(53.2 - 89.7)	66.5	(19.4 - 86.0)
Leeds	21	70.8	(46.2 - 85.7)	82.3	(60.5 - 92.0)
Cambridge	14	77.9	(45.9 - 92.3)	49.7	(0.0 - 83.8)
Royal Free	20	80.0	(55.1 - 92.0)	81.2	(50.0 - 93.0)
King's College	74	83.6	(72.9 - 90.3)	82.9	(69.9 - 90.3)
Birmingham	65	74.6	(61.8 - 83.6)	77.7	(63.5 - 86.3)
Edinburgh	25	84.0	(62.8 - 93.7)	78.8	(43.6 - 92.0)
Total	241	78.9	(73.1 - 83.6)		

Figure 26 Risk-adjusted 5 year patient survival rates for adult super-urgent deceased donor first liver transplants, 1 April 2007 - 31 March 2011



DATA COLLECTION

Return rates are reported in **Table 15** for the liver transplant record, three month and one year follow up forms, along with lifetime follow up (after the first year). These include all adult [elective and super-urgent](#) deceased donor transplants between 1 January 2015 and 31 December 2015 for the transplant record, and all requests for follow-up forms issued in this time period. Leeds have a particularly low lifetime follow-up forms return rate because they do not have the capacity to send paper/electronic lifetime follow up forms; Leeds Data Collector contract ended at the beginning of 2016.

Table 15 Form return rates, 1 January 2015 and 31 December 2015								
Centre	Transplant record		3 month follow-up		1 year follow-up		Lifetime follow-up	
	N	% returned	N	% returned	N	% returned	N	% returned
Newcastle	31	100	30	90	32	94	184	92
Leeds	85	100	83	98	77	91	475	8
Cambridge	76	100	66	100	68	100	391	97
Royal Free	84	100	81	100	72	97	379	98
King's College	141	100	147	100	158	99	794	97
Birmingham	183	99	183	100	170	100	763	98
Edinburgh	86	100	85	99	84	99	401	96

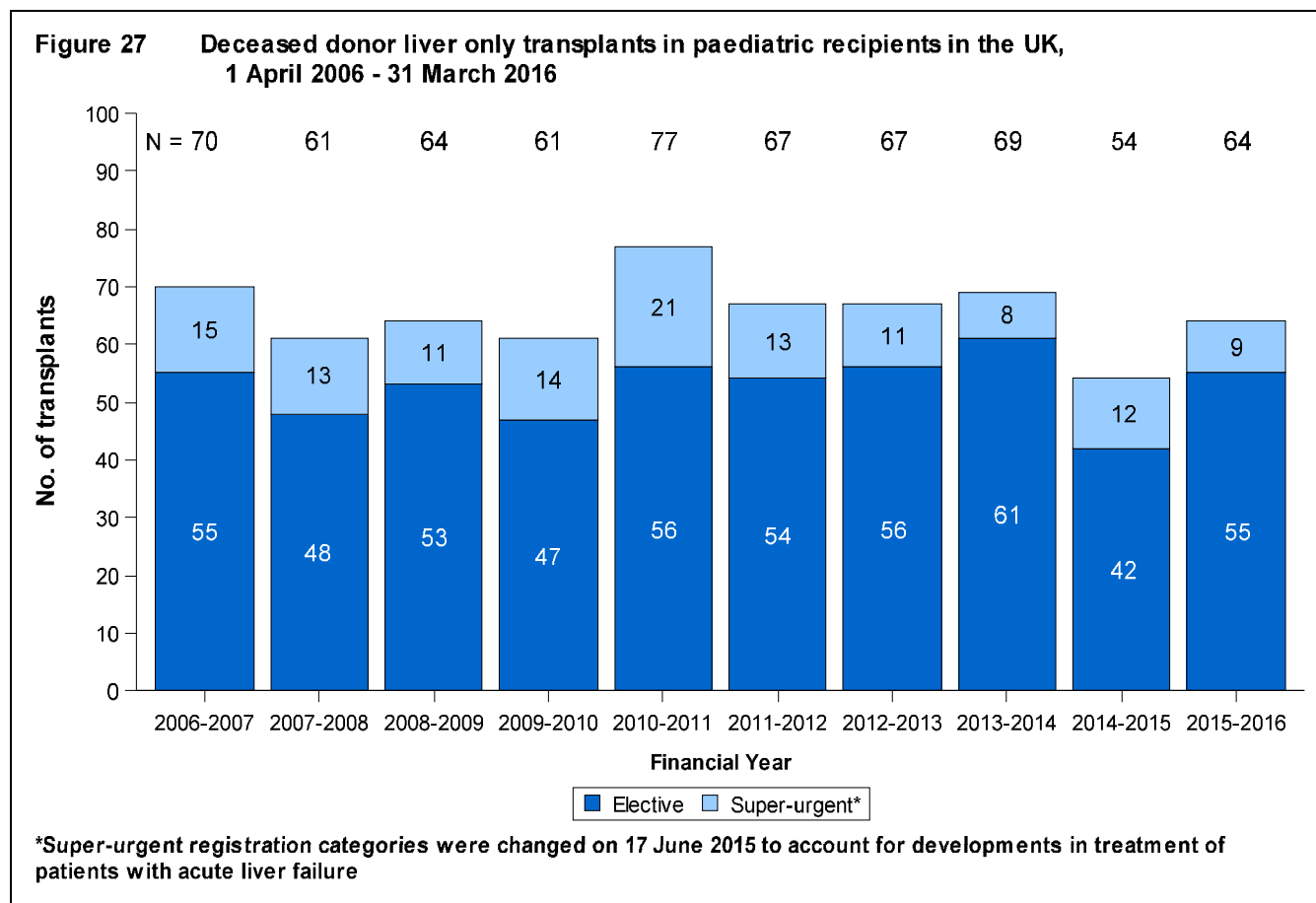
PAEDIATRIC LIVER TRANSPLANTATION



PAEDIATRIC LIVER TRANSPLANTATION

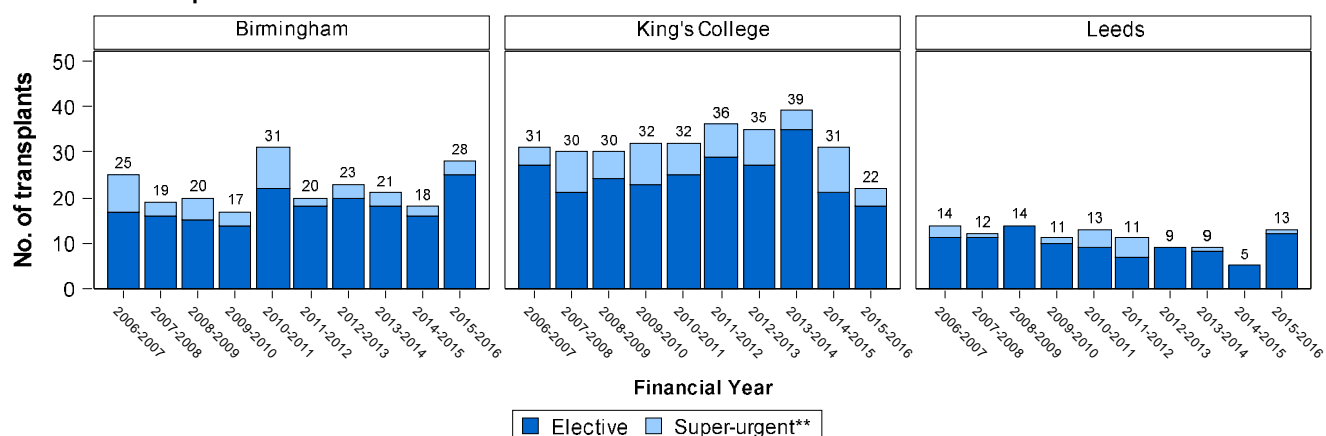
OVERVIEW

The number of deceased donor first liver only transplants for paediatric patients in the last ten years is shown overall and by centre in **Figures 27 and 28**, respectively. See **Appendix 1** for further details.



In the last year, 64 transplants in paediatric patients were performed, 63 at the three paediatric centres in the UK and one at an adult centre (Cambridge). Fifty-five of these transplants were for patients on the [elective](#) list and nine for patients on the [super-urgent](#) list.

Figure 28 Deceased donor liver only transplants in paediatric recipients* in the UK, 1 April 2006 - 31 March 2016

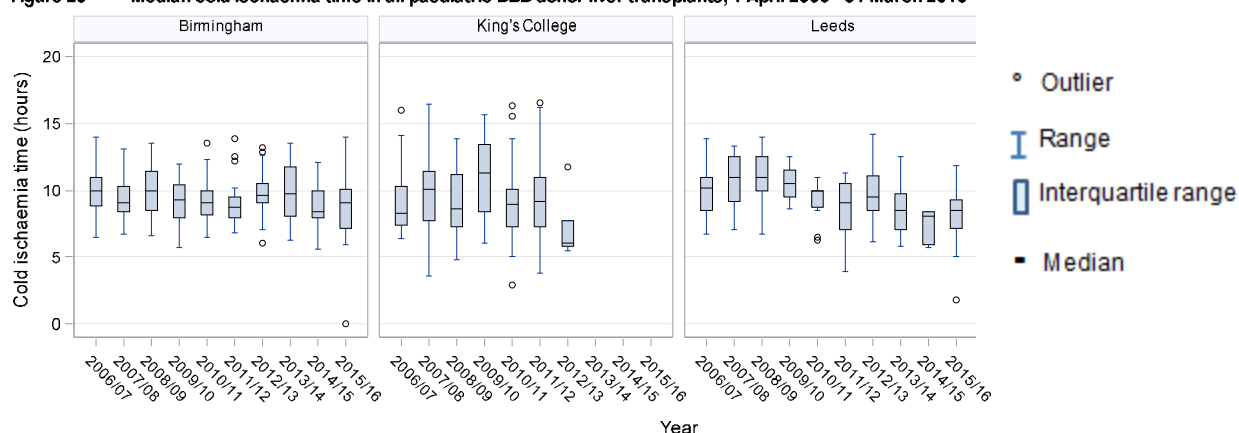


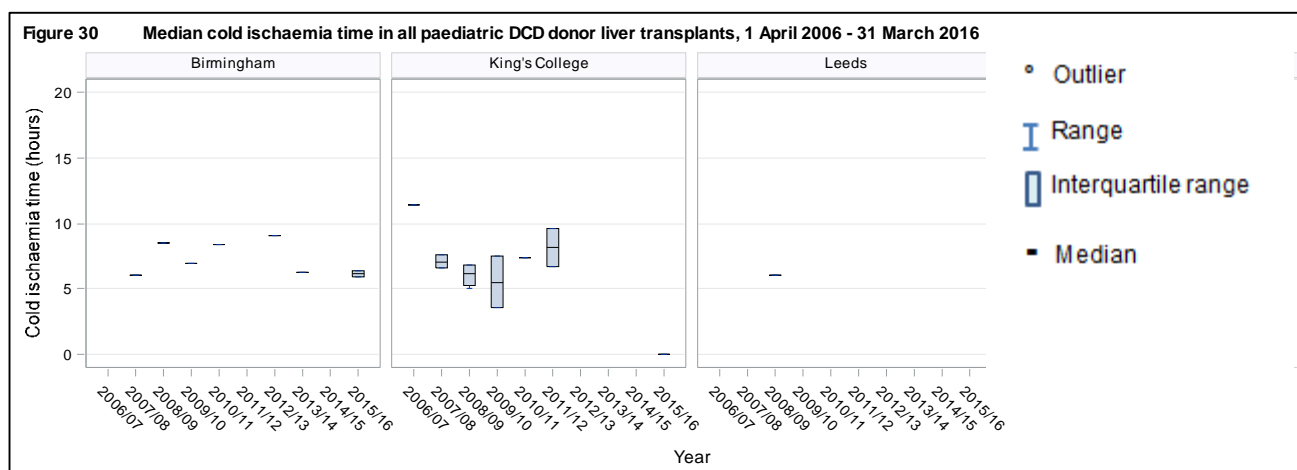
*Excludes one super-urgent paediatric patient who was transplanted at non-paediatric centre

**Super-urgent registration categories were changed on 17 June 2015 to account for developments in treatment of patients with acute liver failure

The [median cold ischaemia times](#) for paediatric transplant recipients are shown in **Figures 29 and 30** for [DBD](#) and [DCD](#) donors, respectively. Median cold ischaemia times were calculated each year during the last ten years, by transplant centre. The national median cold ischaemia time for transplants from DBD donors has remained relatively stable over the ten year period, at 9 hours. The median cold ischaemia time in the last financial year ranged between 7 and 9 hours for all transplant centres. The corresponding median for DCD donor transplants has decreased from 11 hours in 2006/07 to 6 hours in 2015/16 but note that this is based on very few paediatric recipients transplanted from a DCD donor. There was no data for cold ischemia time in paediatric DCD transplants in 2014/15.

Figure 29 Median cold ischaemia time in all paediatric DBD donor liver transplants, 1 April 2006 - 31 March 2016





The demographic characteristics of 64 paediatric transplant recipients in the latest year are shown by centre and nationally in **Table 16**. Of these recipients, 48% were male and 39% were aged between five and twelve years old. Of the 64 transplants, 9 (14%) were of [super-urgent](#) status. For some characteristics, due to rounding, percentages may not add up to 100.

Table 16 Demographic characteristics of paediatric deceased donor liver transplant recipients, 1 April 2015 - 31 March 2016					
		Birmingham N (%)	King's College N (%)	Leeds N (%)	TOTAL N (%)
Number		28	22	13	64 (100)
Recipient details					
Recip age years	<1	6 (21)	0	2 (15)	8 (13)
	1-4	10 (36)	9 (41)	3 (23)	22 (34)
	5-12	8 (29)	10 (45)	7 (54)	25 (39)
	13-16	4 (14)	3 (14)	1 (8)	9 (14)
Recipient sex	Male	12 (43)	12 (55)	6 (46)	31 (48)
	Female	16 (57)	10 (45)	7 (54)	33 (52)
Indication	Super Urgent	3 (11)	4 (18)	1 (8)	9 (14)
	Metabolic	3 (11)	3 (14)	2 (15)	8 (13)
	Other	22 (79)	15 (68)	10 (77)	47 (73)
Pre-transplant in-patient status	Out-patient	19 (68)	15 (68)	9 (69)	43 (67)
	In-patient	9 (32)	7 (32)	4 (31)	21 (33)
Pre-transplant renal support	No	23 (82)	19 (86)	12 (92)	54 (84)
	Yes	5 (18)	3 (14)	1 (8)	10 (16)
Ascites	Absence	19 (68)	19 (86)	11 (85)	50 (78)
	Presence	9 (32)	3 (14)	2 (15)	14 (22)

Table 16 Demographic characteristics of paediatric deceased donor liver transplant recipients, 1 April 2015 - 31 March 2016

		Birmingham N (%)	King's College N (%)	Leeds N (%)	TOTAL N (%)
Previous abdominal surgery	No	20 (71)	16 (73)	9 (69)	46 (72)
	Yes	8 (29)	6 (27)	4 (31)	18 (28)
INR	<=1.0	11 (39)	2 (9)	5 (38)	18 (28)
	1.1-1.5	6 (21)	13 (59)	6 (46)	25 (39)
	1.6-3.0	6 (21)	5 (23)	0	12 (19)
	>3.0	4 (14)	2 (9)	1 (8)	7 (11)
	Not reported	1 (4)	0	1 (8)	2 (3)
Serum sodium mmol/l	<135	5 (18)	1 (5)	2 (15)	8 (13)
	>=135	23 (82)	21 (95)	11 (85)	56 (88)
Donor details					
Donor age years	<5	0	2 (9)	0	2 (3)
	5-16	6 (21)	5 (23)	5 (38)	16 (25)
	17-30	11 (39)	10 (45)	2 (15)	23 (36)
	>=31	11 (39)	5 (23)	6 (46)	23 (36)
Donor sex	Male	16 (57)	15 (68)	3 (23)	34 (53)
	Female	12 (43)	7 (32)	10 (77)	30 (47)
Donor type	Donor after brain death	26 (93)	20 (91)	13 (100)	60 (94)
	Donor after cardiac death	2 (7)	2 (9)	0	4 (6)
Graft appearance	Normal	27 (96)	4 (18)	13 (100)	45 (70)
	Not reported	1 (4)	18 (82)	0	19 (30)
Graft type	Whole	5 (18)	7 (32)	3 (23)	16 (25)
	Segmental	23 (82)	15 (68)	10 (77)	48 (75)
Urgency Status	Elective	25 (89)	18 (82)	12 (92)	55 (86)
	Super Urgent	3 (11)	4 (18)	1 (8)	9 (14)

¹ One paediatric transplant was performed at Cambridge and is included in the total count

PAEDIATRIC LIVER TRANSPLANTATION

ELECTIVE PATIENTS



ELECTIVE PATIENTS

TRANPLANT LIST

Figure 31 shows the number of paediatric [elective](#) patients on the liver only transplant list at 31 March each year between 2007 and 2016. The number of patients on the [active](#) liver only transplant list has ranged between 18 and 42 each year. In the last year the number has increased from 36 to 42.

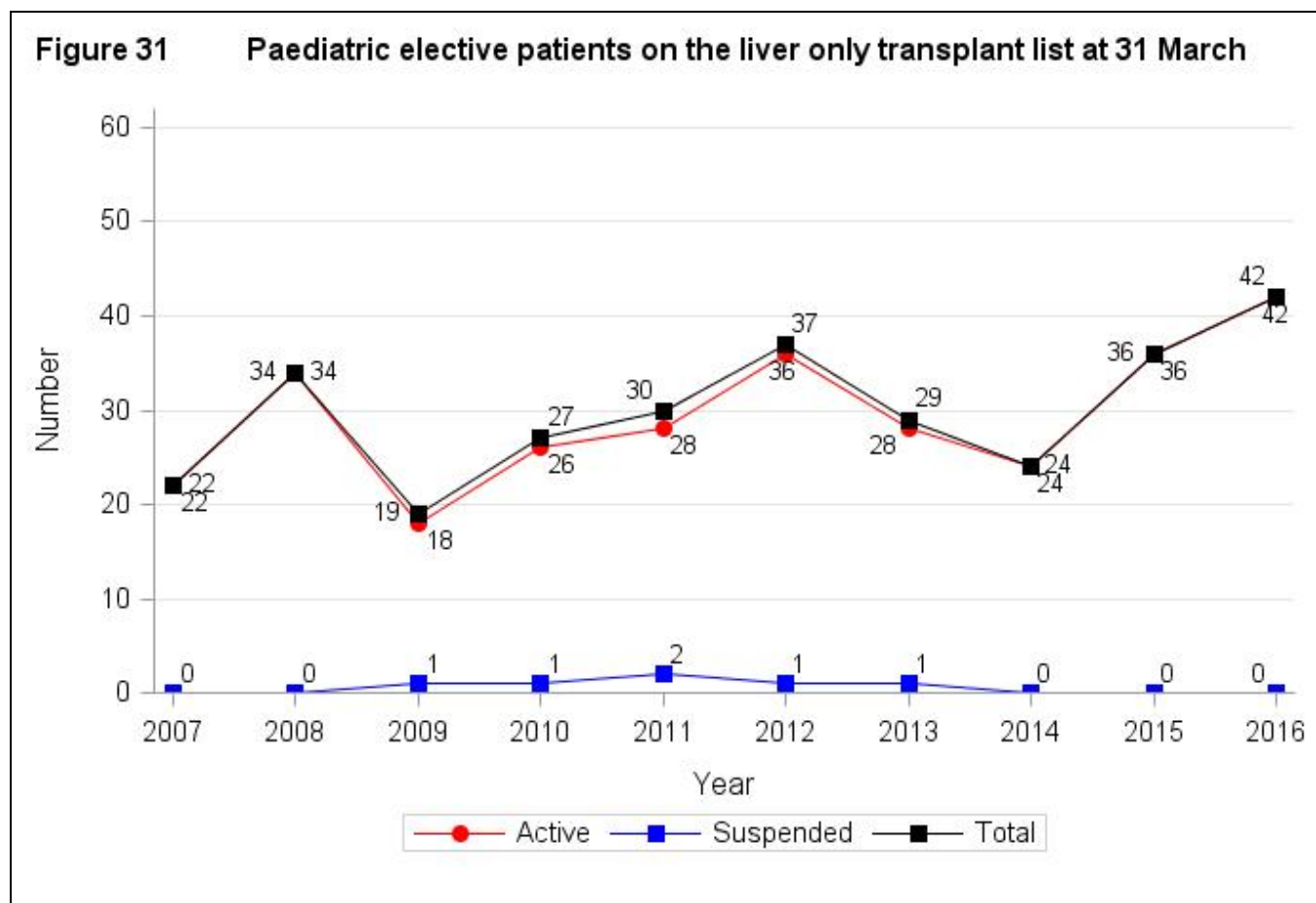
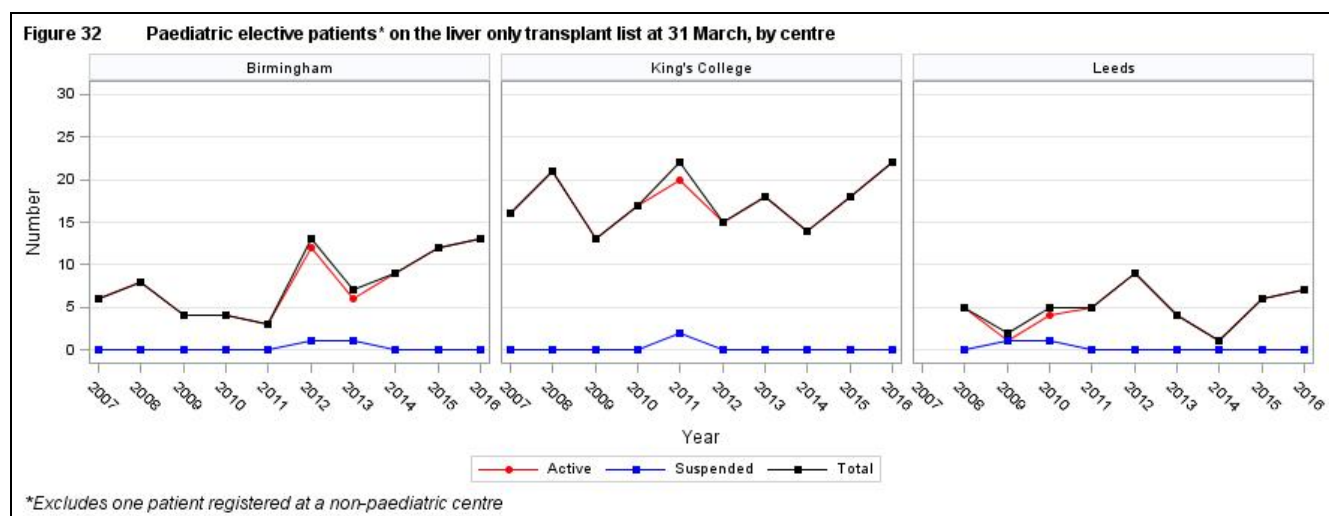


Figure 32 shows the number of [elective](#) patients on the transplant list at 31 March each year between 2007 and 2016 for each transplant centre.



An indication of outcomes for paediatric patients listed for a liver transplant is summarised in **Figure 33**. This shows the proportion of patients transplanted or still waiting six months, one and two years after joining the list. After one year 85% of patients have had a liver transplant, and 8% are still waiting.

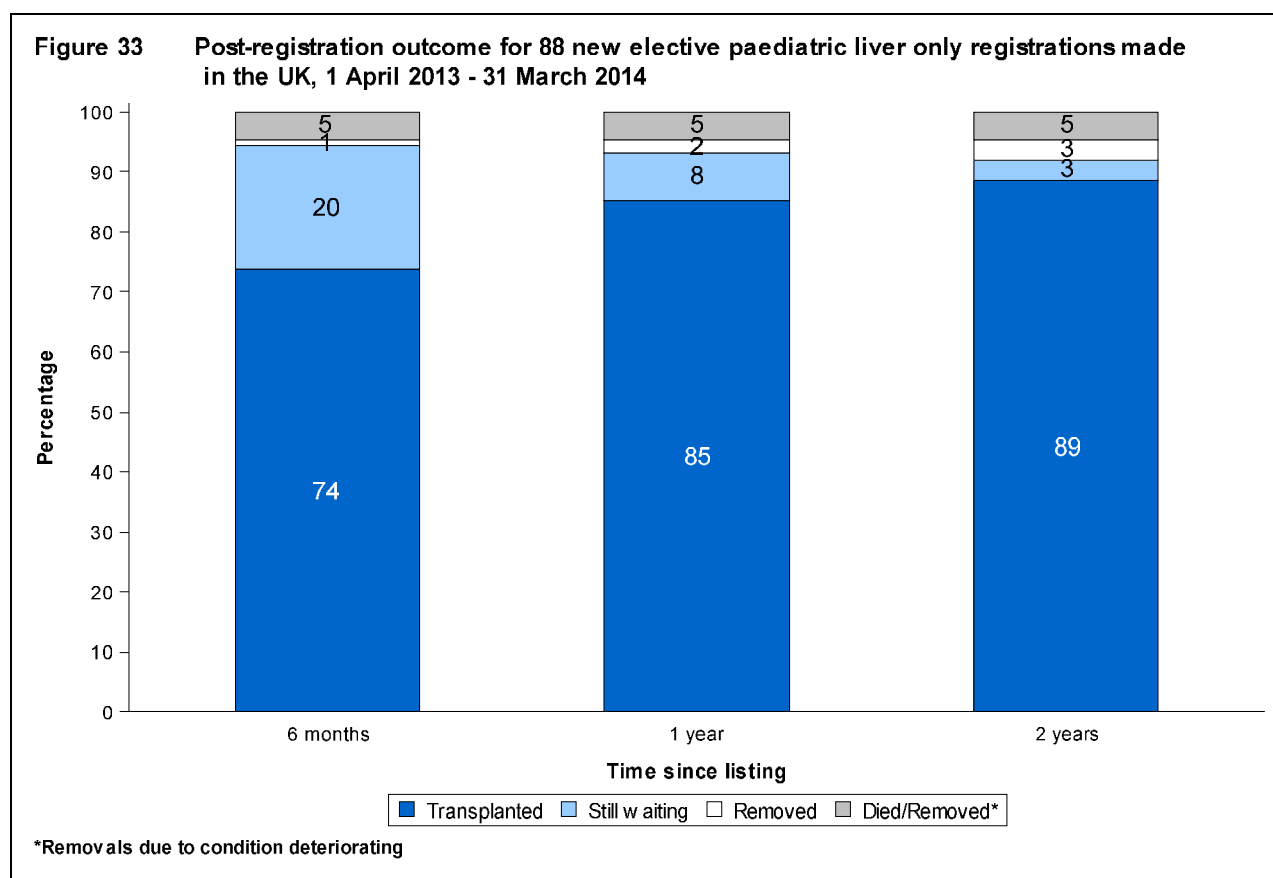
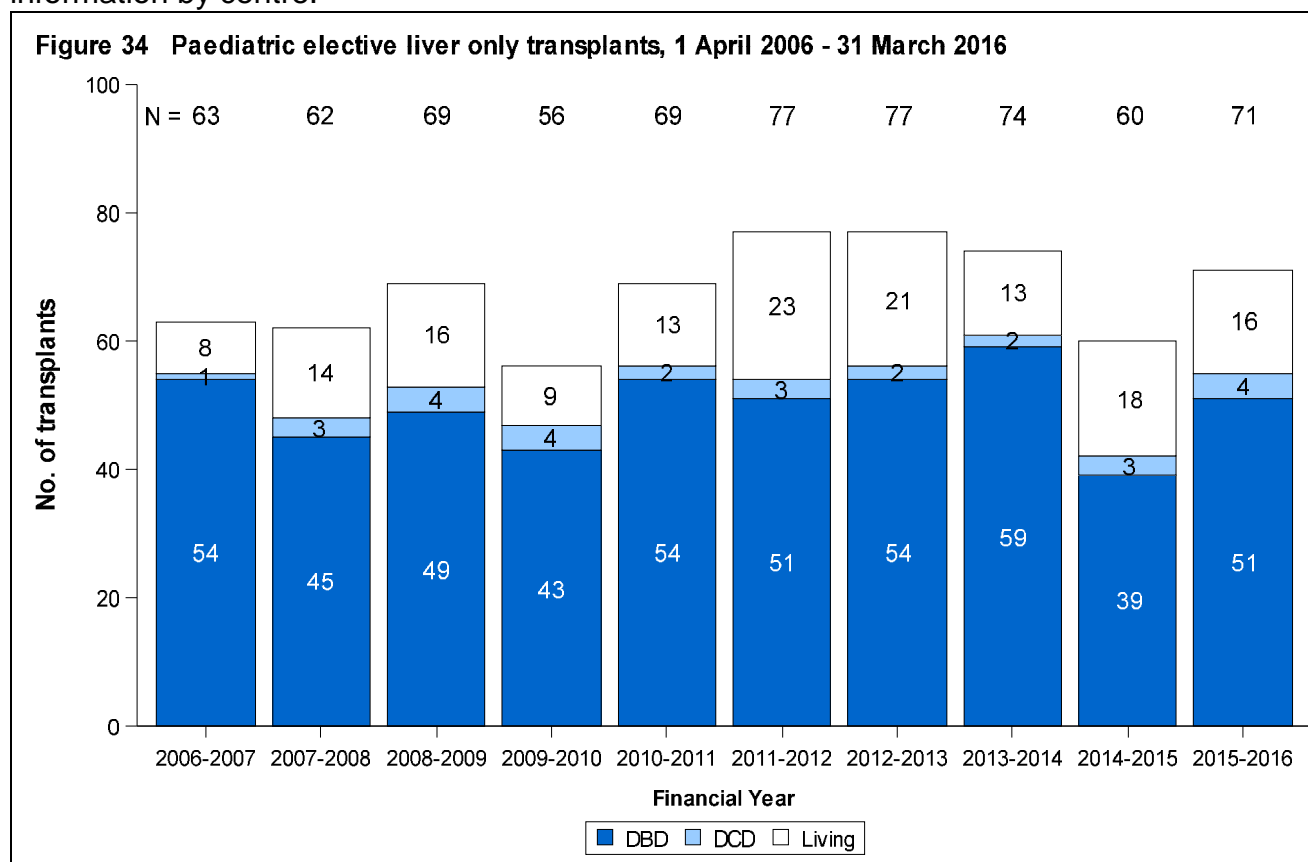


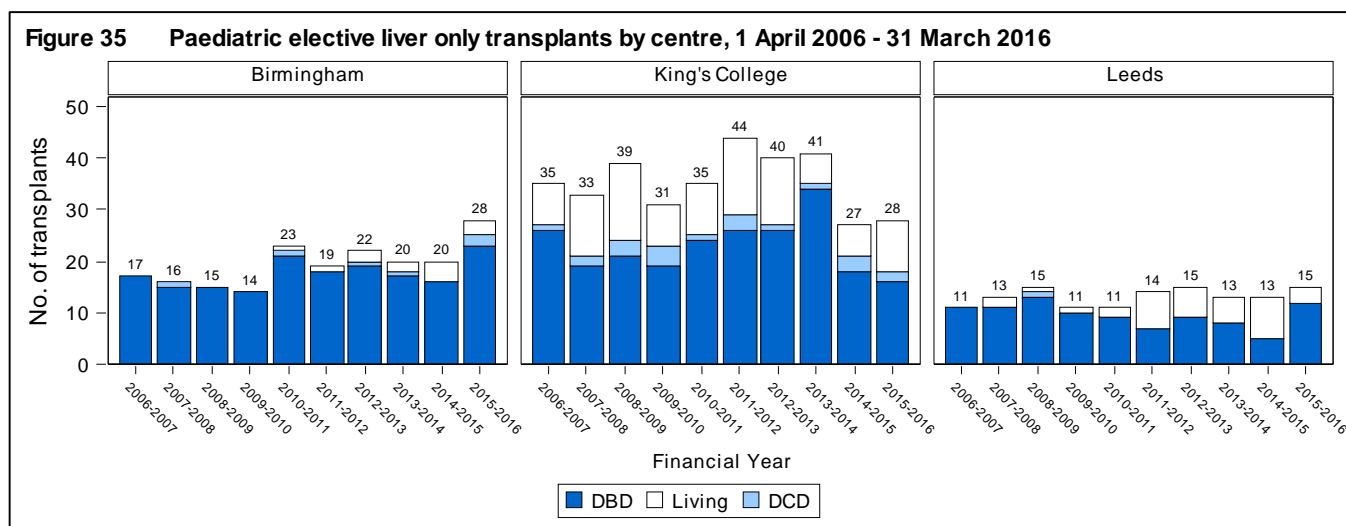
Table 17 shows the [median waiting time](#) to deceased donor liver only transplant for paediatric [elective](#) patients. The median waiting time to transplant is shortest at Birmingham, at 56 days, and longest at King's College Hospital, at 97 days. The national median waiting time to transplant is 72 days.

Table 17 Median waiting time to deceased donor liver only transplant in the UK, for paediatric elective patients registered 1 April 2010 - 31 March 2013			
Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Paediatric			
Birmingham	74	56	33 - 79
Leeds	31	66	41 - 91
King's College	104	97	55 - 139
UK	209	72	57 - 87

TRANSPLANT ACTIVITY

Figure 34 shows the number of paediatric [elective](#) liver only transplants from deceased and living donors performed in the last ten years, by type of donor. **Figure 35** shows the same information by centre.





POST-TRANSPLANT SURVIVAL

Table 18 shows the [unadjusted](#) one year paediatric [patient survival](#) for all 210 transplants (excluding [auxiliary](#) ones) from 1 April 2011 to 31 March 2015, nationally and by centre.

Table 18 One year unadjusted patient survival for paediatric elective deceased donor first liver transplants, 1 April 2011 - 31 March 2015			
Centre	Number of transplants	1-year survival % (95% CI)	
Leeds	29	96.4	(77.2 - 99.5)
King's College	109	95.4	(89.3 - 98.1)
Birmingham	72	95.8	(87.6 - 98.6)
Total	210	95.7	(91.9 - 97.7)

Table 19 shows the [unadjusted](#) five year paediatric [patient survival](#) for all 202 transplants (excluding [auxiliary](#) ones) from 1 April 2007 to 31 March 2011, nationally and by centre.

Table 19 Five year unadjusted patient survival for paediatric elective deceased donor first liver transplants, 1 April 2007 - 31 March 2011			
Centre	Number of transplants	5-year survival % (95% CI)	
Leeds	44	86.3	(72.0 - 93.6)
King's College	91	93.2	(85.4 - 96.9)
Birmingham	67	94.0	(84.8 - 97.7)
Total	202	91.8	(87.0 - 94.9)

PAEDIATRIC LIVER TRANSPLANTATION

SUPER URGENT PATIENTS



SUPER-URGENT PATIENTS

TRANSPLANT LIST

Table 20 shows the [median waiting time](#) to deceased donor liver only transplant for paediatric [super-urgent](#) patients. The median waiting time to transplant is shortest at Leeds and longest at King's College but there is no statistically significant difference across the three centres. The national median waiting time to transplant is four days.

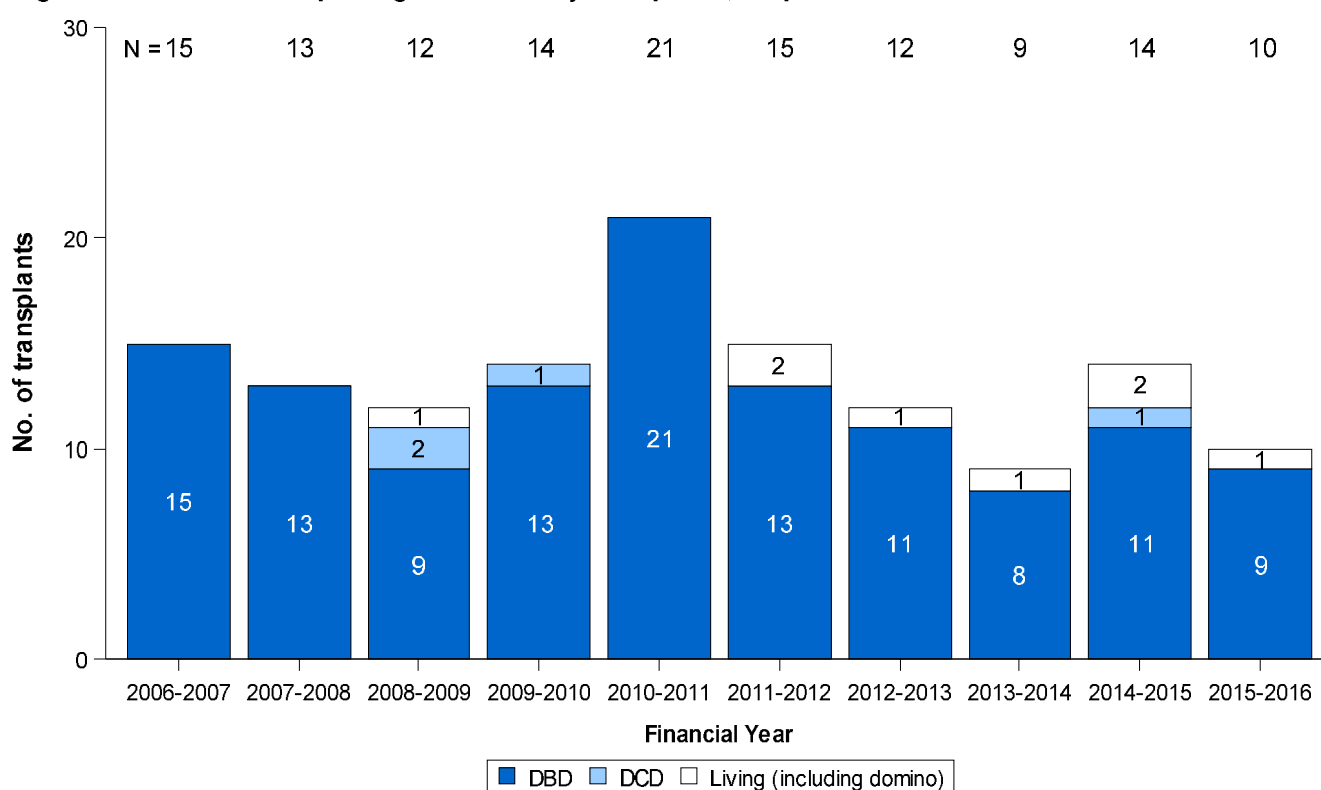
Table 20 Median waiting time to deceased donor liver only transplant in the UK, for paediatric super-urgent patients registered 1 April 2010 - 31 March 2013			
Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Paediatric			
Leeds	13	2	1 - 3
Birmingham	29	3	1 - 5
King's College	40	4	2 - 6
UK*	83	4	3 - 5
* Includes 1 patient registered at a non-paediatric centre			

Table 20 includes registrations for a re-transplant. Of the 83 registrations for the UK in the three-year time period, only 56 led to transplants (the remaining 27 led to removal or death). Eleven of the 56 transplants were re-transplants, hence, the difference between the 45 *first* deceased donor liver only transplants reported in **Figure 36** for the period 2010 – 2013 and **Table 20**.

TRANSPLANT ACTIVITY

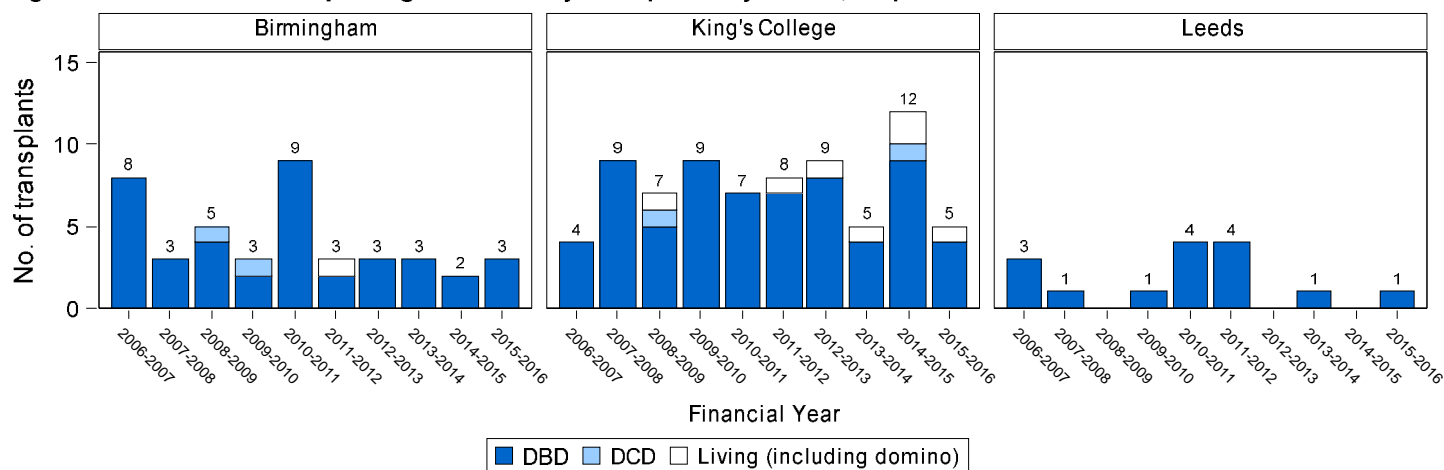
Figure 36 shows the number of paediatric [super-urgent](#) first liver only transplants from deceased and living (including domino) donors performed in the last ten years, by type of donor. There was one domino donor. **Figure 37** shows the same information by transplant centre.

Figure 36 Paediatric super-urgent* liver only transplants, 1 April 2006 - 31 March 2016



*Super-urgent registration categories were changed on 17 June 2015 to account for developments in treatment of patients with acute liver failure

Figure 37 Paediatric super-urgent* liver only transplants by centre, 1 April 2006 - 31 March 2016



*Super-urgent registration categories were changed on 17 June 2015 to account for developments in treatment of patients with acute liver failure

POST-TRANSPLANT SURVIVAL

One year [unadjusted patient survival](#) for 42 transplants between 1 April 2011 and 31 March 2015 is shown in **Table 21**. There were no patient deaths in Leeds.

Table 21 One year unadjusted patient survival¹ for paediatric deceased donor super urgent first liver transplants, 1 April 2011 - 31 March 2015			
Centre	Number of transplants	1-year survival % (95% CI)	
Leeds ¹	5	-	-
King's College	27	79.5	(57.2 - 91.0)
Birmingham	10	80.0	(40.9 - 94.6)
Total	42	82.2	(66.1 - 91.2)
¹ Survival rates for transplant types with less than 10 transplants are not presented due to small numbers			

Table 22 shows the [unadjusted](#) five year paediatric [patient survival](#) for 56 transplants between 1 April 2007 and 31 March 2011, nationally and by centre.

Table 22 Five year unadjusted patient¹ survival² for paediatric deceased donor super urgent first liver transplants, 1 April 2007 - 31 March 2011			
Centre	Number of transplants	5-year survival % (95% CI)	
Leeds ²	6	-	-
King's College	29	75.7	(55.7 - 87.6)
Birmingham	19	78.9	(53.2 - 91.5)
Total¹	56	73.1	(59.4 - 82.8)
¹ Includes 2 patients transplanted at a non-paediatric centre			
² Survival rates for transplant types with less than 10 transplants are not presented due to small numbers			

[Auxiliary](#) transplants are excluded from the results in **Table 21** and **Table 22**. The survival rates presented in the two tables have wide confidence intervals due to the small number of transplants performed and should, therefore, be interpreted with caution.

DATA COLLECTION

Return rates are reported in **Table 23** for the liver transplant record, three month and one year follow up forms, along with lifetime follow-up (after the first year). These include all paediatric [elective and super-urgent](#) deceased donor transplants between 1 January 2015 and 31 December 2015 for the transplant record, and all requests for follow-up forms issued in this time period. Note that the Leeds Data Collector contract ended at the beginning of 2016.

Table 23 Form return rates, 1 January 2015 and 31 December 2015								
Centre	Transplant record		3 month follow-up		1 year follow-up		Lifetime follow-up	
	N	% returned	N	% returned	N	% returned	N	% returned
Leeds	11	100	8	100	6	83	70	77
King's College	25	100	25	100	28	100	210	86
Birmingham	28	100	26	100	19	100	139	99

APPENDIX



APPENDIX

APPENDIX 1 - DATA

Data were obtained from the UK Transplant Registry for the ten year time period, 1 April 2006 to 31 March 2016 and include NHS Group 2 transplants, [auxiliary](#) transplants, liver only transplants for intestinal failure patients and exclude all other transplants involving the liver for intestinal failure patients.

The adult and paediatric sections are limited to first liver only transplants, and survival is only estimated for deceased donor transplants, excluding [auxiliary](#) transplants.

Table 1 shows the total number of adult transplants in the three time periods defined in the report, including atypical donor, [multi-organ](#) and re-transplants. **Table 2** shows the number of adult deceased donor first liver only transplants.

Table 1 Number of adult liver transplants in each time period, by transplant centre and urgency status						
Centre	Latest year		Last 3 years		Last 10 years	
	April 2015-March 2016		April 2013-March 2016		April 2006-March 2016	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	38	7	106	22	314	66
Leeds	94	14	299	37	789	104
Cambridge	80	10	225	31	678	92
Royal Free	88	16	248	40	639	102
King's College	158	15	484	63	1397	217
Birmingham	184	21	521	67	1357	206
Edinburgh	86	10	256	32	697	102
TOTAL	728	93	2139	292	5871	889

Table 2 Number of deceased donor adult first liver only transplants in each time period, by transplant centre and urgency status						
Centre	Latest year		Last 3 years		Last 10 years	
	April 2015-March 2016		April 2013-March 2016		April 2006-March 2016	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	32	6	90	17	273	52
Leeds	82	5	258	19	709	66
Cambridge	77	4	208	16	614	55
Royal Free	76	12	221	29	580	75
King's College	131	12	413	48	1186	179
Birmingham	164	17	463	51	1240	158
Edinburgh	81	5	241	21	632	70
TOTAL	643	61	1894	201	5234	655

Table 3 shows the total number of paediatric transplants in the three time periods defined in the report, including atypical donor, [multi-organ](#) and re-transplants. **Table 4** shows the number of paediatric deceased donor first liver only transplants

Table 3 Number of paediatric liver transplants in each time period, by transplant centre and urgency status						
Centre	Latest year		Last 3 years		Last 10 years	
	April 2015-March 2016		April 2013-March 2016		April 2006-March 2016	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	0	0	0	0	0	1
Leeds	15	4	45	5	141	24
Cambridge	0	1	0	1	0	1
Royal Free	0	0	1	1	1	2
King's College	29	5	101	26	385	89
Birmingham	38	4	87	14	248	61
TOTAL	82	14	234	47	775	178

Table 4 Number of deceased donor paediatric first liver only transplants in each time period, by transplant centre and urgency status						
Centre	Latest year		Last 3 years		Last 10 years	
	April 2015-March 2016		April 2013-March 2016		April 2006-March 2016	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	0	0	0	0	0	1
Leeds	12	1	25	2	96	15
Cambridge	0	1	0	1	0	1
Royal Free	0	0	0	0	0	1
King's College	18	4	74	18	250	68
Birmingham	25	3	59	8	181	41
TOTAL	55	9	158	29	527	127

Transplants were excluded from the [patient survival](#) analysis if [risk factors](#) were missing. Therefore, missing factors were not imputed.

APPENDIX 2 - METHODS

Waiting time to transplant

Waiting time is calculated from date of registration to date of transplant, for patients registered for a liver. Patients who are registered for another organ are excluded and only deceased donor transplants are included. Registrations for a re-transplant are included. [Kaplan-Meier](#) estimates are used to calculate waiting time, where patients who are removed or died on the waiting list are censored at the date of the event. Patients who are still actively waiting for a transplant are censored at that time. Any periods of suspension are not included in the waiting time.

Unadjusted survival rates

[Unadjusted patient survival](#) and [graft function](#) rates were estimated using [Kaplan-Meier](#) methods. Patient survival rates are based on the number of patients transplanted and the number and timing of those that die within the post-transplant period of interest. Patients can be included in this method of analysis irrespective of the length of follow-up recorded. If a patient is alive at the end of the follow-up, then information about the survival of the patient is censored at the time of analysis. Death, irrespective of whether the graft is still functioning or not, is classed as an event. Estimates of graft function follow similar principles but the event of interest is graft failure in living post-transplant patients instead of patient death.

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 the same mix of patients as the one seen nationally. The risk-adjusted rate therefore presents estimates for which differences in the 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 the 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 time period of interest 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 **survival post transplantation** models are shown in **Tables 5 and 6** below.

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 in this case were: recipient blood group, recipient age at registration, recipient ethnic group, recipient primary disease at registration, recipient sex, recipient BMI, serum creatinine, serum sodium, serum bilirubin, INR and year of registration, as shown in **Table 7**.

APPENDIX 3 - RISK MODELS

Table 5 Risk factors and categories used in the adult elective risk adjusted survival models post transplantation	
Recipient sex	Male Female
Recipient ethnicity	White Non-white
Indication	Cancer HCV ALD HBV PSC PBC AID Metabolic Other Acute hepatic failure
Recipient HCV status	Negative Positive
Pre-transplant in-patient status	Out-patient In-patient
Ascites	Absence Presence
Encephalopathy	Absence Presence
Pre-transplant renal support	No Yes
Previous abdominal surgery	No Yes
Varices & shunt	Absence Presence without treatment Presence with surgical shunt Presence with TIPS

Table 5 Risk factors and categories used in the adult elective risk adjusted survival models post transplantation	
Life style activity	Normal Restricted Self-care Confined Reliant
Graft appearance	Normal Abnormal
Recipient age years	Per 1 year increase
BMI kg/m ²	Per 1 kg/m ² increase
Serum Bilirubin µmol/l	≤30 31-50 51-70 71-90 ≥91
Serum Creatinine µmol/l	≤70 71-90 91-110 111-130 ≥131
Serum sodium mmol/l	Per 10 mmol/l increase
Serum potassium mmol/l	Per 1 mmol/l increase
INR	Per 1 unit increase
Serum Albumin g/l	Per 5g/l increase
Cold Ischaemia time	Per 1 hour increase
Time on transplant list	Per 1 month increase
Donor sex	Male Female
Donor ethnicity	White Non-white
Donor cause of death	Trauma CVA Others
Donor history of diabetes	No Yes
Donor type	Donor after brain death Donor after cardiac death
ABO match	Identical Compatible Incompatible
Graft type	Whole Segmental
Donor age years	Per 1 year increase
Donor BMI kg/m ²	Per 1 kg/ m ² increase

Table 6 Risk factors and categories used in the adult super-urgent risk adjusted survival models post transplantation	
Recipient sex	Male Female
Recipient ethnicity	White Non-white
Recipient HCV status	Negative Positive
Pre-transplant in-patient status	Out-patient In-patient
Ascites	Absence Presence
Encephalopathy	Absence Presence
Pre-transplant renal support	No Yes
Previous abdominal surgery	No Yes
Varices & shunt	Absence Presence without treatment Presence with surgical shunt Presence with TIPS
Life style activity	Normal Restricted Self-care Confined Reliant
Graft appearance	Normal Abnormal
Recip age years	Per 1 year increase
BMI kg/m ²	Per 1 kg/m ² increase
Serum Bilirubin µmol/l	≤100 101-200 201-300 301-400 ≥401
Serum Creatinine µmol/l	≤100 101-130 131-160 161-190 ≥191
Serum sodium mmol/l	Per 10 mmol/l increase
Serum potassium mmol/l	Per 1 mmol/l increase
INR	Per 1 unit increase
Serum Albumin g/l	Per 5g/l increase
Cold Ischaemia time	Per 1 hour increase
Time on transplant list	Per 1 day increase
Donor sex	Male Female
Donor ethnicity	White Non-white
Donor cause of death	Trauma CVA Others

Table 6 Risk factors and categories used in the adult super-urgent risk adjusted survival models post transplantation	
Donor history of diabetes	No Yes
Donor type	Donor after brain death Donor after cardiac death
ABO match	Identical Compatible Incompatible
Graft type	Whole Segmental
Donor age years	Per 1 year increase
Donor BMI kg/m ²	Per 1 kg/ m ² increase

Table 7 Risk factors and categories used in the adult elective risk adjusted survival models post registration	
Recipient sex	Male Female
Recipient ethnicity	White Non-white
Recipient age at registration years	Per 1 year increase
Recipient BMI kg/m ²	Per 1 kg/m ² increase
Recipient blood group	O A B AB
Indication	Cancer HCV ALD HBV PSC PBC AID Metabolic Other
Serum sodium mmol/l	Per 10 mmol/l increase
Serum creatinine μ mol/l	Per 10 μ mol/l increase
Serum bilirubin μ mol/l	Per 10 μ mol/l increase
INR	Per 1 unit increase
Year of registration	Split into three time intervals equally divided

APPENDIX 4 - GLOSSARY OF TERMS

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 organ becomes available, the patient is included among those who are matched against the donor to determine whether or not the organ 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 organs that become available. Permanent suspension is known as a removal from the waiting list and is not included in suspended figures.

Auxiliary transplant

An auxiliary liver transplant involves surgically attaching part of a donor liver to the whole liver of the recipient without removal. The donor liver supports the native liver until it recovers. The donor liver can then be removed or left attached.

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.

Cold ischaemia time (CIT)

The length of time that elapses between an organ being removed from the donor to its transplantation into the recipient is called Cold Ischaemia Time (CIT). Generally, the shorter this time, the more likely the organ is to work immediately and the better the long-term outcome. The factors which determine CIT include a) transportation of the organ 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 organ 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.

Donor type

Liver donors can be of different types.

Donor after brain death (DBD). 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 (DCD). A donor whose heart stops beating before their brain stops working and who is then certified dead. The organs are then removed.

Living donor. A donor who is a living person and who is usually, but not always, a relative of the transplant patient. For example, a parent may donate part of their liver to their child.

Domino donor. A donor with a certain type of rare degenerative liver disease who receives a liver transplant to treat their condition. This donor gives their liver to another recipient in a domino liver transplant, because the liver still functions well for other recipients.

Elective and super-urgent patients

Separate selection criteria to join the liver transplant list have been devised for those patients requiring emergency transplantation (super-urgent) compared to those who require a routine procedure (elective transplantation). The two groups have a different range of aetiologies with markedly different short-term prognoses; different criteria are required to define that prognosis. Similarly, processes to allocate a donor liver are different for super-urgent and elective transplantation, reflecting those patient groups with a different risk of death without transplantation.

Funnel plot

A graphical method that shows how consistent the rates, such as survival rates or decline rates, of the different transplant units are compared to the national rate. For survival rates, 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 function

The percentage of patients who are alive with a functioning graft. This is usually specified for a given time period after transplant. For example, a 90 day graft function rate is the percentage of patients alive with a functioning graft 90 days after transplant.

Inter-quartile range (IQR)

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 liver and kidney.

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 first 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.

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.

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