



Blood and Transplant

**ANNUAL REPORT ON
LIVER TRANSPLANTATION**

**REPORT FOR 2016/2017
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Contents



1 Executive summary	4
2 Introduction	6
2.1 Transplant list.....	7
2.2 Transplant activity	9
2.3 Geographical variation in registration and transplant rates	11
3 Adult liver transplantation	13
3.1 Overview	14
3.2 Elective patients	17
3.2.1 Transplant list	18
3.2.2 Transplant activity.....	24
3.2.3 Post-transplant survival	31
3.2.4 Survival from listing	34
3.3 Super-urgent patients.....	37
3.3.1 Transplant list	38
3.3.2 Transplant activity.....	41
3.3.3 Post-transplant survival	47
3.4 Form return rates	50
4 Paediatric liver transplantation.....	52
4.1 Overview	53
4.2 Elective patients	59
4.2.1 Transplant list	60
4.2.2 Transplant activity.....	62
4.2.3 Post-transplant survival	63
4.3 Super-urgent patients.....	65
4.3.1 Transplant list	66
4.3.2 Transplant activity.....	66
4.3.3 Post-transplant survival	68
4.4 Form return rates	69
A Appendix	71
A1 Data	72
A2 Methods.....	74
A3 Risk models	76
A4 Glossary of terms.....	80

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 2007 to 31 March 2017. 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 2017, there were 530 patients on the UK [active transplant list](#), which represents an 8% 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 74% had received a transplant within two years of listing.
- There were 8042 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. The number of transplants from [donors after brain death](#) is higher in the most recent year than at any point in the ten year period.
- 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	94	81
Super-urgent	89	80
Paediatric		
Elective	97	92
Super-urgent	86	74

- The national rates of patient survival after joining the transplant list for adult elective first liver only patients is 83% at one, 70% at five and 57% at ten years post-registration.

How to cite this report:

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Introduction



This report presents information on the UK transplant list, transplant activity and transplant outcomes between 1 April 2007 and 31 March 2017, 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 2008 and 31 March 2012 for 5 year survival, and 1 April 2012 to 31 March 2016 for 1 year survival. Patient survival from registration is presented for the period 1 January 2005 to 31 December 2016. 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.

2.1 Transplant list

Figure 2.1 shows the total number of liver patients on the [active transplant list](#) at 31 March each year between 2008 and 2017. 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 has been a decline in patients since 2015 to 530 patients in 2017.

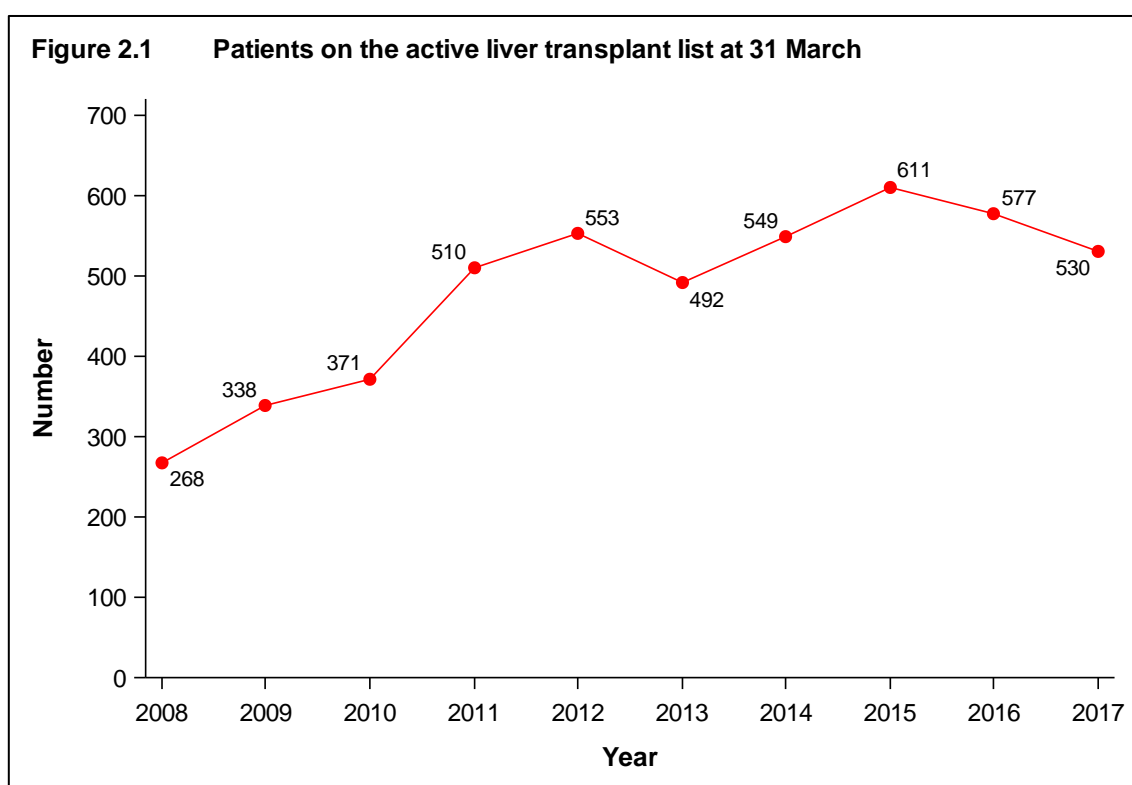
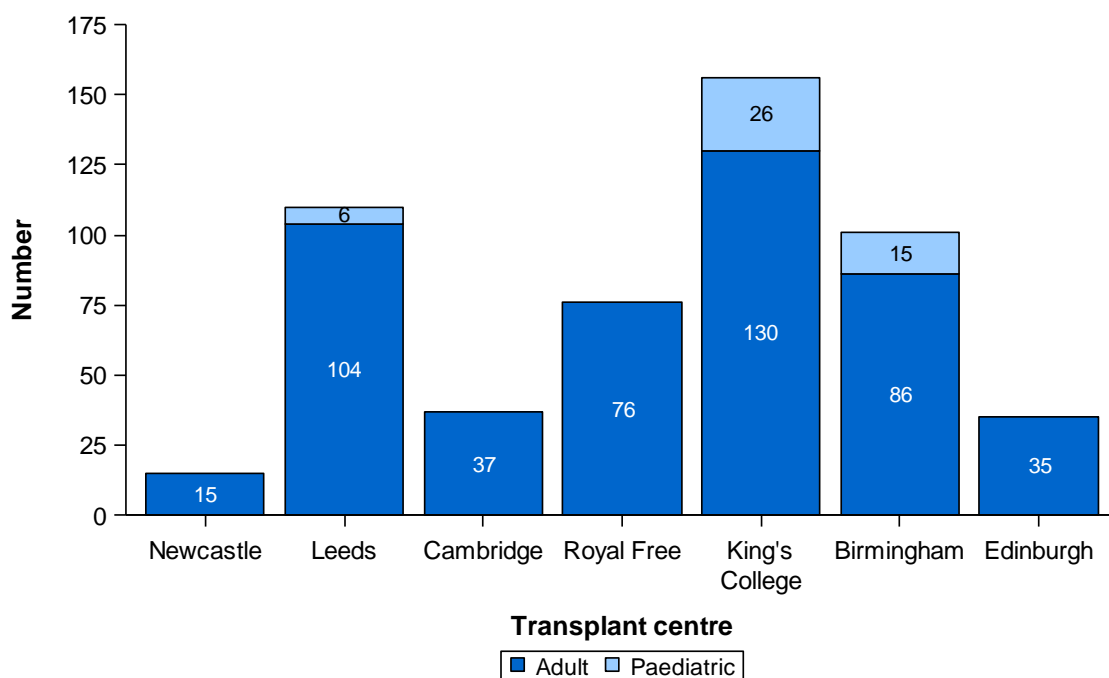


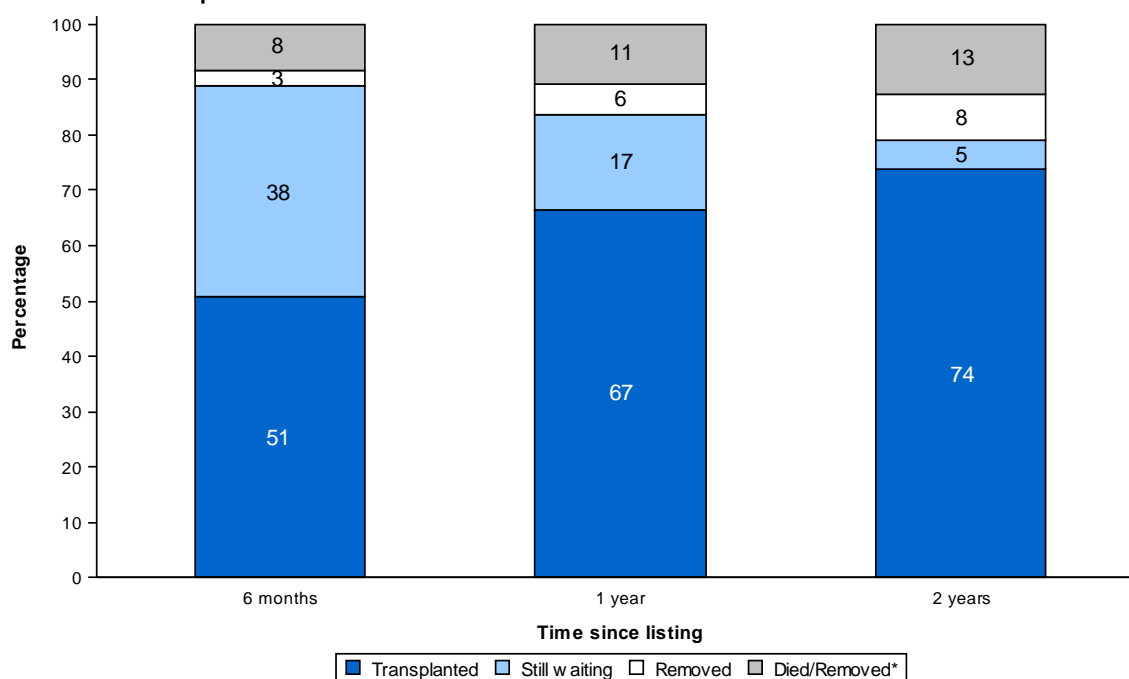
Figure 2.2 shows the number of adult and paediatric patients on the transplant list at 31 March 2017, by centre. In total, there were 483 adults and 47 paediatric patients. King's College Hospital had the largest share of the transplant list (29%) and Newcastle the smallest (3%). This figure includes [multi-organ](#), [elective](#) and [super-urgent](#) registrations.

Figure 2.2 Patients on the active liver transplant list at 31 March 2017



An indication of long-term outcomes for patients listed between April 2014 and March 2015 for a liver transplant is summarised in **Figure 2.3**. 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 67% of patients had received a transplant and 17% were still waiting.

Figure 2.3 Post-registration outcome for 1029 new elective liver only registrations made in the UK, 1 April 2014 - 31 March 2015



*Removals due to condition deteriorating

2.2 Transplant activity

Figure 2.4 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 208 in the last financial year. The number of transplants from donors after brain death ([DBD](#)) has increased in the most recent year to 738. There were 31 [living donor](#) liver transplants and 3 [domino](#) transplants performed in the last financial year.

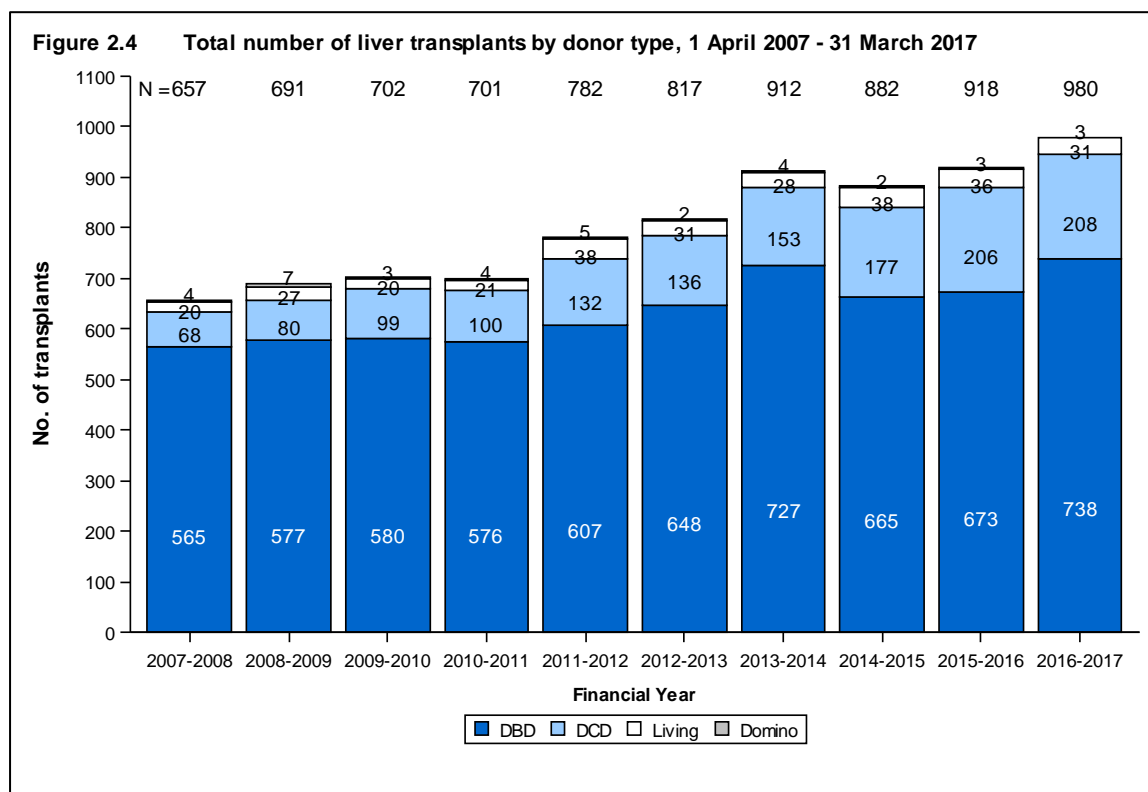
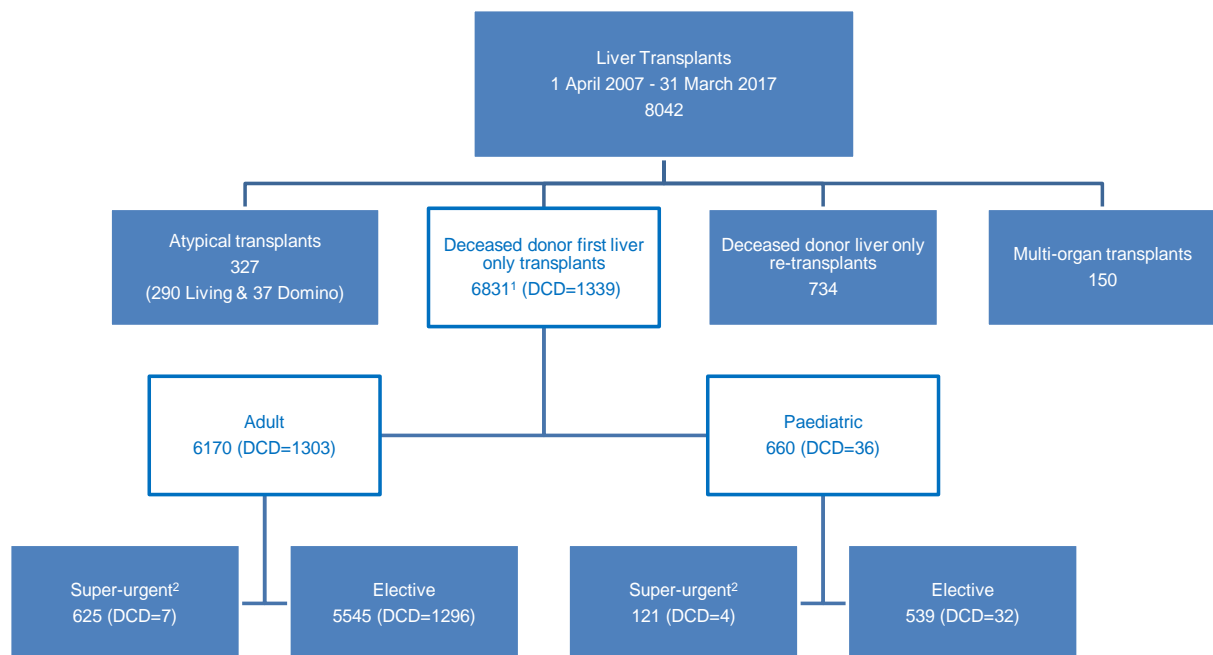


Figure 2.5 details the 8042 liver transplants performed in the UK in the ten year period. Of these, 6831 (85%) were deceased donor first liver only transplants. One transplant recipient refused consent for their data to be used in analysis and, therefore, could not be categorised as an adult or a paediatric patient. Of the 6830 transplants that were analysed, 6170 (90%) were performed in adult and 660 (10%) in paediatric patients. Similarly including both adult and paediatric, 6084 (89%) were [elective](#) and 746 (11%) were [super-urgent](#) transplants.

Figure 2.5 Liver transplants in the UK, 1 April 2007 – 31 March 2017



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.

2.3 Geographical variation in registration and transplant rates

Figure 2.6 shows rates of registration to the liver transplant list per million population (pmp) between 1 April 2016 and 31 March 2017 compared with liver transplant rates pmp for the same time period, by recipient country/Strategic Health Authority (SHA) of residence. **Table 2.1** shows the breakdown of these numbers by recipient country/Strategic Health Authority of residence. No adjustments have been made for potential demographic differences in populations. If a patient has had more than one registration/transplant in the period, each registration/transplant is considered. Note that this analysis only considered NHS Group 1 patients.

Since there will inevitably be some random variation in rates between areas, the systematic component of variation (SCV) was used to identify if the variation is more (or less) than a random effect for the different SHAs in England only. Only first registrations and transplants in this period were considered. The larger the SCV the greater the evidence of a high level of systematic variation between areas. Both registration and transplant rates yielded a low SCV at 0 and 0, respectively, and therefore, no evidence of geographical variation beyond what would be expected at random.

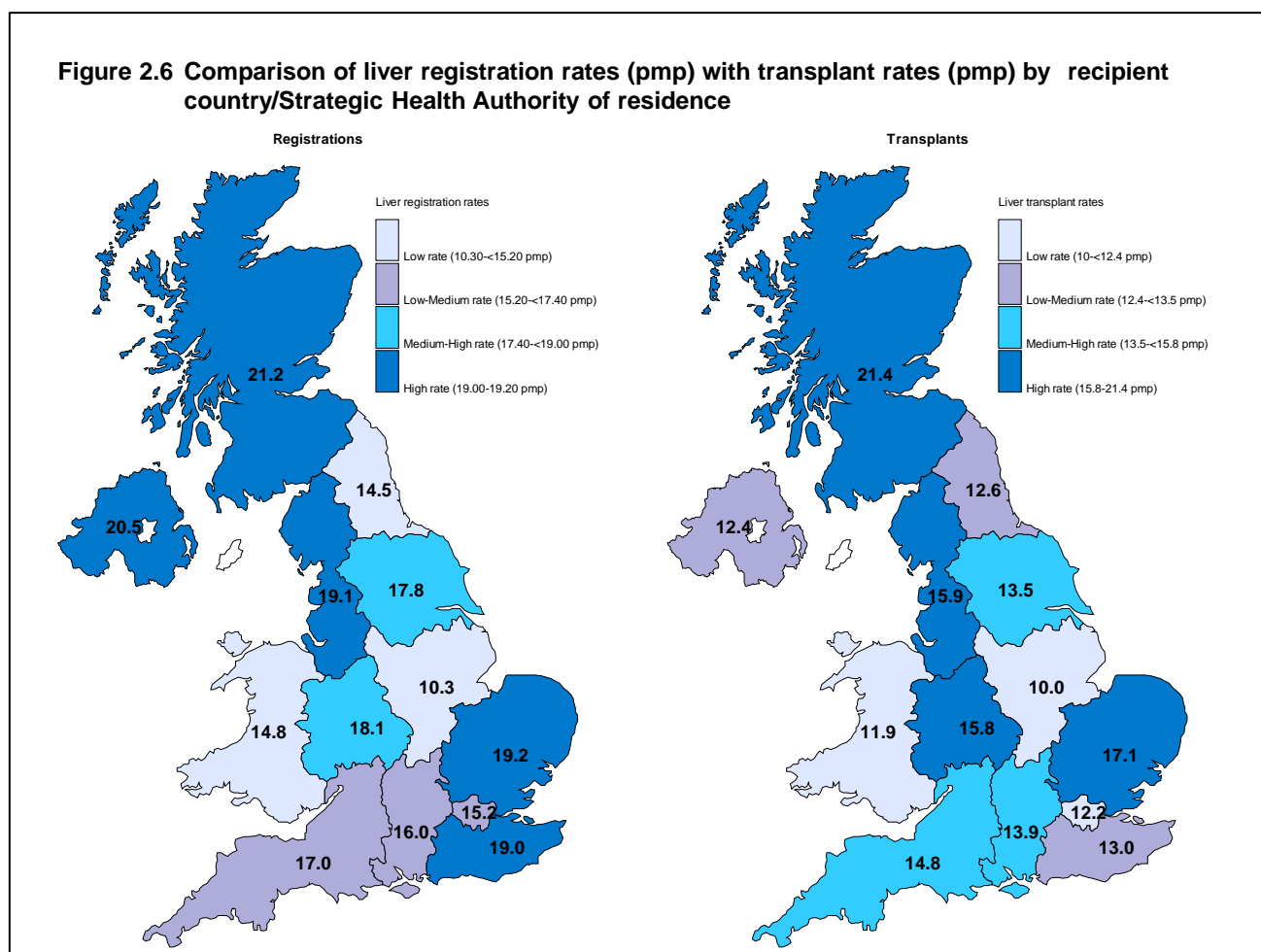


Table 2.1 Liver registration and transplant rates per million population (pmp) in the UK, 1 April 2016 – 31 March 2017, by Country/Strategic Health Authority				
Country/ Strategic Health Authority	Registrations (pmp)		Transplants (pmp)	
North East	38	(14.5)	33	(12.6)
North West	137	(19.1)	114	(15.9)
Yorkshire and The Humber	96	(17.8)	73	(13.5)
North of England	271	(17.9)	220	(14.5)
East Midlands	48	(10.3)	47	(10)
West Midlands	104	(18.1)	91	(15.8)
East of England	117	(19.2)	104	(17.1)
Midlands and East	269	(16.3)	242	(14.7)
London	132	(15.2)	106	(12.2)
South East Coast	88	(19)	60	(13)
South Central	69	(16)	60	(13.9)
South West	93	(17)	81	(14.8)
South of England	250	(17.3)	201	(13.9)
England	922	(16.8)	769	(14)
Isle of Man	2	(25)	3	(37.5)
Channel Islands	0		1	(6.3)
Wales	46	(14.8)	37	(11.9)
Scotland	114	(21.2)	115	(21.4)
Northern Ireland	38	(20.5)	23	(12.4)
TOTAL	1131¹	(17.3)	953²	(14.6)
¹ Registrations include 9 recipients whose postcode was unknown and excludes 8 recipients who reside in the Republic of Ireland and 7 recipients who reside overseas ² Transplants include 5 recipients whose postcode was unknown and excludes 11 recipients who reside in the Republic of Ireland and 5 recipients who reside overseas				

Adult Liver Transplantation



3.1 Overview

The number of adult deceased donor first liver only transplants in the last ten years is shown overall and by centre in **Figures 3.1 and 3.2**, respectively. Of the 761 transplants in the latest financial year, 706 were [elective](#) and 55 were [super-urgent](#) transplants. See **Appendix 1** for further details.

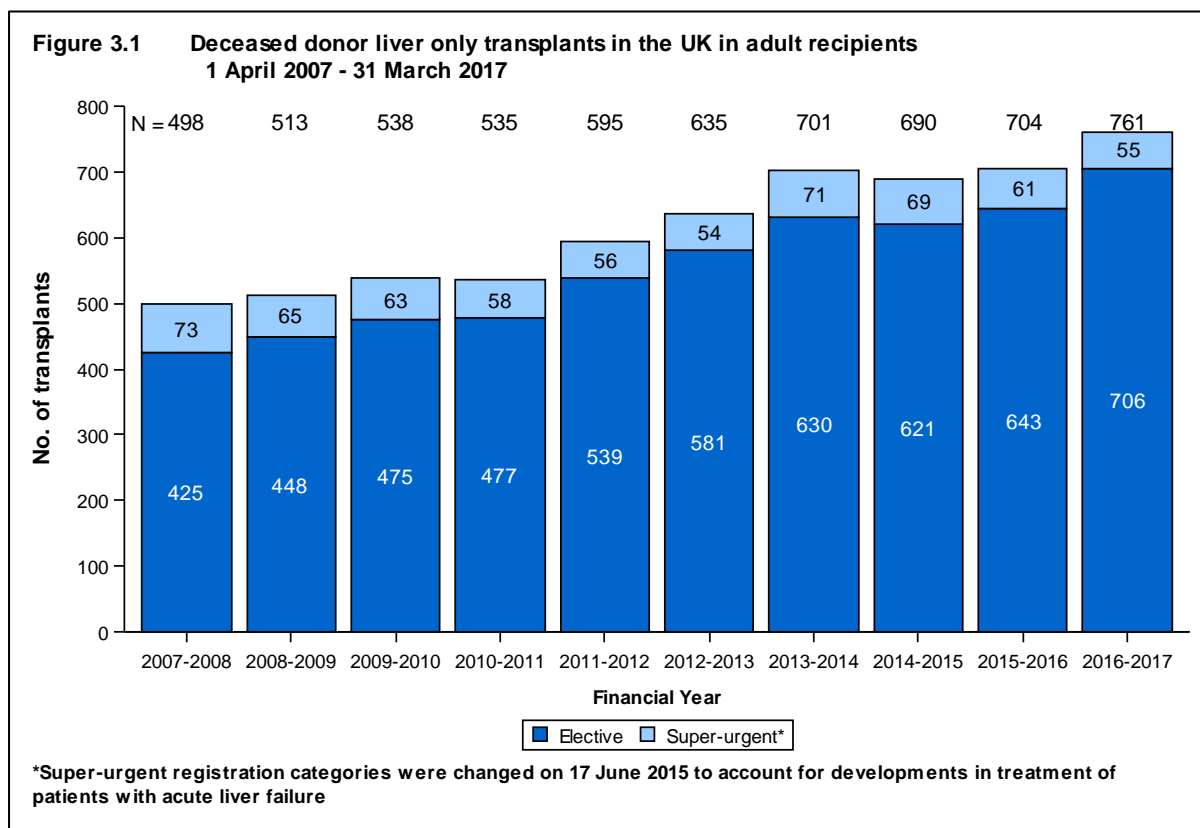
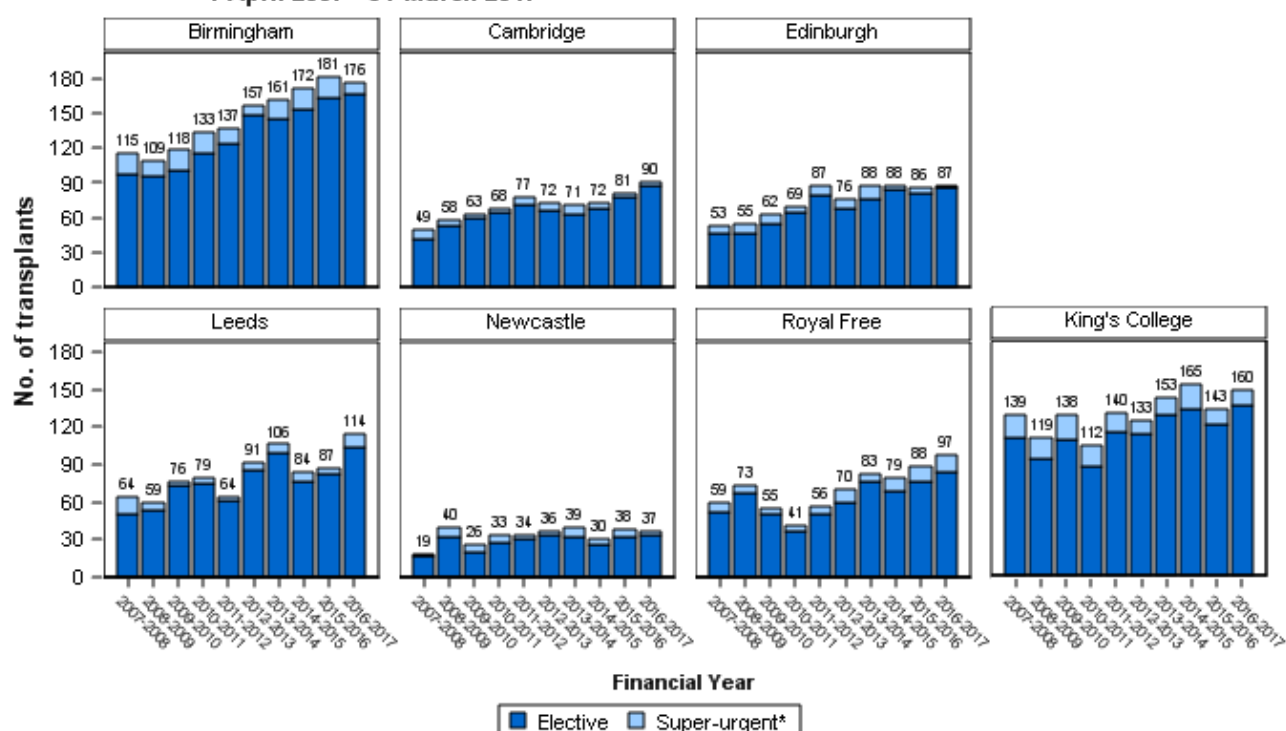


Figure 3.2 Deceased donor liver only transplants in the UK in adult recipients, 1 April 2007 - 31 March 2017



*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 3.3 and 3.4** 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 9.4 hours in 2007/08 to 8.6 hours in 2016/17. The median cold ischaemia time in the last financial year ranged between 7.4 and 10.6 hours across transplant centres. The national median for DCD donor transplants has remained relatively stable over the ten year period, from 6.6 hours in 2007/08 to 7.4 hours in 2016/17. In the last financial year, the median cold ischaemia time for DCD donor transplants at different centres ranged from 6.6 to 8.9 hours.

Figure 3.3

**Median cold ischaemia time in all adult DBD donor liver transplants,
1 April 2007 - 31 March 2017**

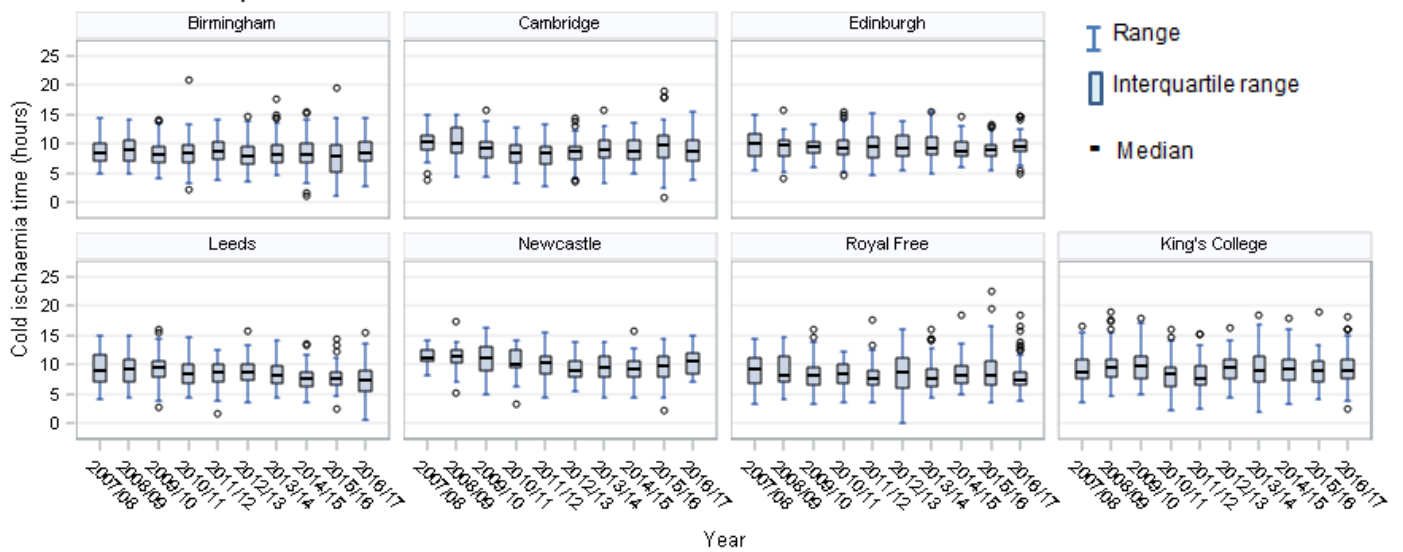
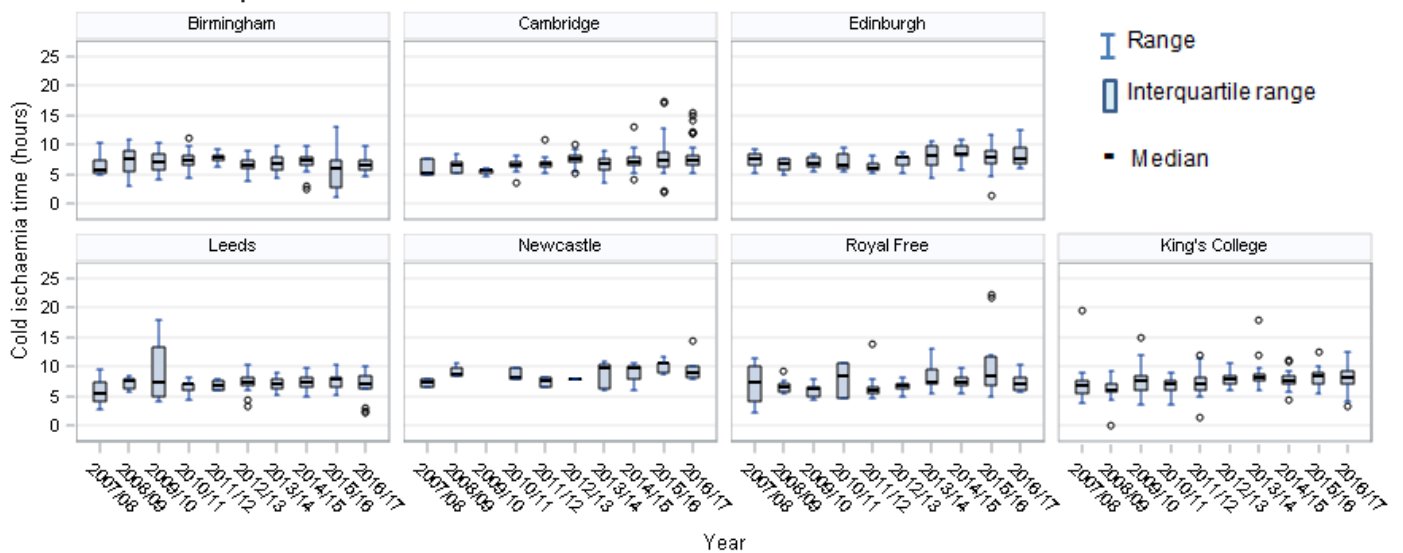


Figure 3.4

**Median cold ischaemia time in all adult DCD donor liver transplants,
1 April 2007 - 31 March 2017**



Adult Liver Transplantation Elective Patients



3.2.1 Transplant list

Figure 3.5 shows the number of adult [elective](#) patients on the first liver only transplant list at 31 March each year between 2008 and 2017. A small number of patients are temporarily suspended from the list at any one time. The number of patients on the [active](#) liver only transplant list increased almost each year from 222 in 2008 to 514 in 2015. In recent years the number has been dropping to 446 in 2017; the lowest since 2013.

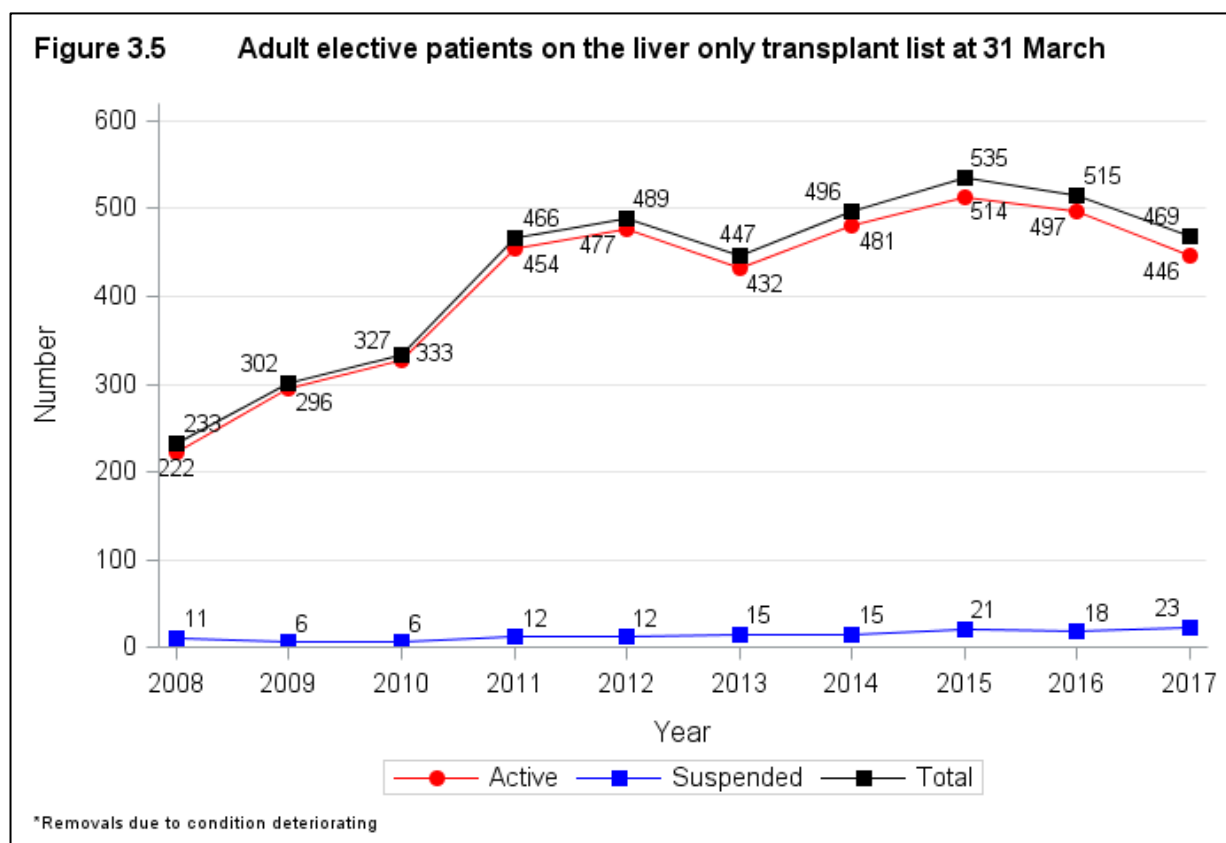
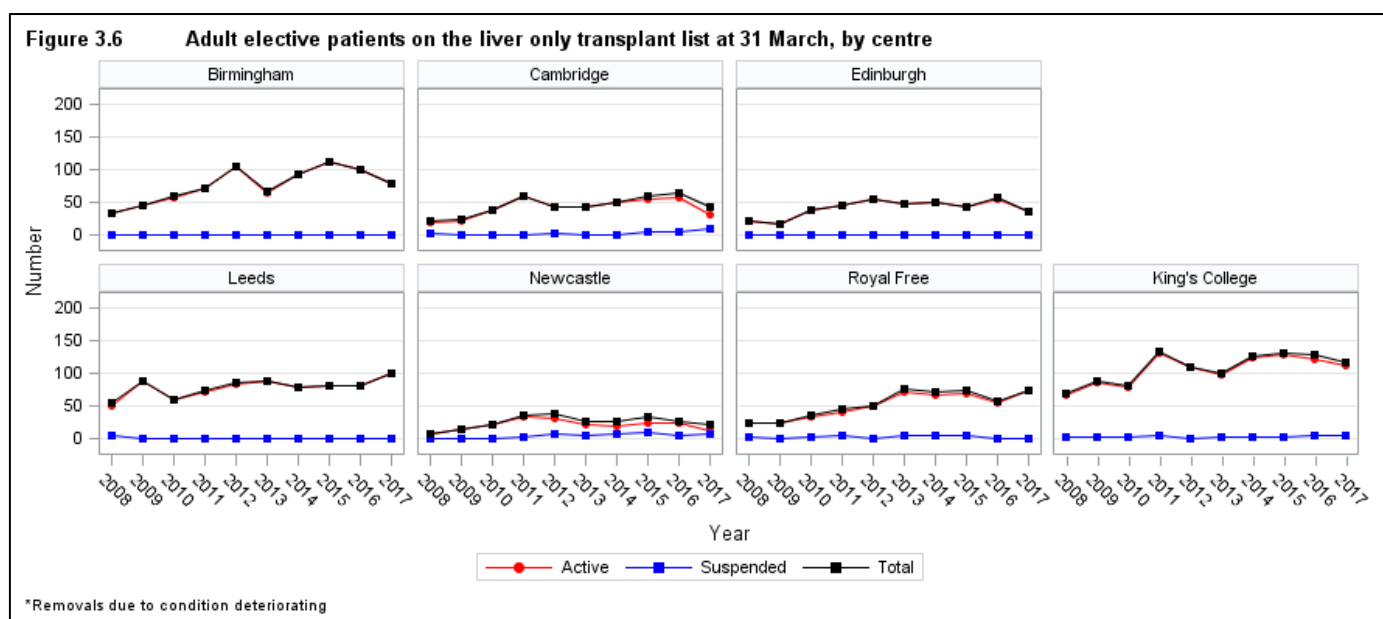


Figure 3.6 shows the number of adult patients on the transplant list at 31 March each year between 2008 and 2017, by transplant centre.



An indication of outcomes for adult [elective](#) patients listed for a liver transplant is summarised in **Figure 3.7**. 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.

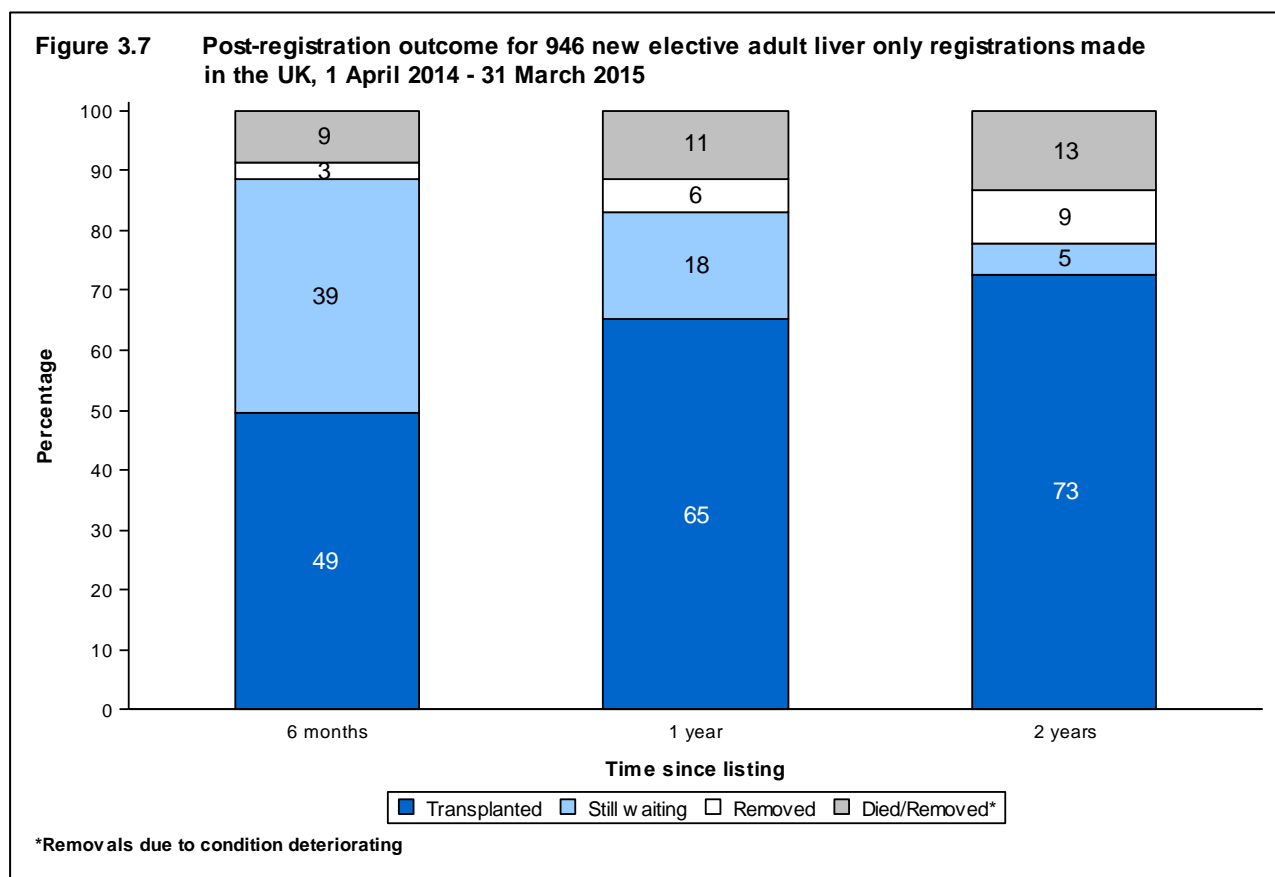


Table 3.1 shows the [median waiting time](#) to deceased donor liver only transplant for adult [elective](#) patients. The national median waiting time to transplant for adult elective patients is 135 days. The median waiting time to transplant is shorter at Edinburgh (87 days) and longer at Leeds (170 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 3.1 Median waiting time to liver only transplant in the UK, for adult elective patients registered 1 April 2011 - 31 March 2014			
Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Adult			
Edinburgh	308	87	66 - 108
Cambridge	269	110	74 - 146
Birmingham	599	113	96 - 130
Newcastle	140	132	67 - 197
King's College	513	155	133 - 177
Royal Free	289	168	130 - 206
Leeds	374	170	132 - 208
UK	2492	135	124 - 146

Table 3.2 shows the demographics of 933 adult [elective](#) liver patients registered from 1 April 2016 to 31 March 2017, by transplant centre.

Figure 3.8 and **Figure 3.9** 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, and 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.

Table 3.2 Demographic characteristics of adult elective liver patients registered from , 1 April 2016 - 31 March 2017

		Birmingham	Cambridge	Edinburgh	King's college	Leeds	Newcastle	Royal Free	Total
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Number		196	98	90	208	162	40	139	933
Recipient sex	Male	129 (66)	57 (58)	63 (70)	134 (64)	99 (61)	26 (65)	99 (71)	607 (65)
	Female	67 (34)	41 (42)	27 (30)	74 (36)	63 (39)	14 (35)	40 (29)	326 (35)
Recipient ethnicity	White	172 (88)	91 (93)	86 (96)	181 (87)	141 (87)	37 (93)	102 (73)	810 (87)
	Non-white	24 (12)	7 (7)	4 (4)	26 (13)	21 (13)	3 (8)	37 (27)	122 (13)
	Not reported	0 (0)	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	1 (0)
Indication	Cancer	27 (14)	8 (8)	30 (33)	34 (16)	33 (20)	4 (10)	35 (25)	171 (18)
	Hepatitis C	7 (4)	6 (6)	3 (3)	10 (5)	7 (4)	1 (3)	9 (6)	43 (5)
	Alcoholic liver disease	54 (28)	26 (27)	22 (24)	55 (26)	53 (33)	20 (50)	29 (21)	259 (28)
	Hepatitis B	4 (2)	1 (1)	0 (0)	3 (1)	0 (0)	0 (0)	5 (4)	13 (1)
	Primary sclerosing cholangitis	28 (14)	14 (14)	6 (7)	15 (7)	16 (10)	1 (3)	19 (14)	99 (11)
	Autoimmune and cryptogenic disease	12 (6)	4 (4)	3 (3)	23 (11)	15 (9)	3 (8)	12 (9)	72 (8)
	Primary biliary cirrhosis	11 (6)	11 (11)	6 (7)	12 (6)	10 (6)	3 (8)	6 (4)	59 (6)
	Metabolic liver disease	22 (11)	15 (15)	11 (12)	23 (11)	15 (9)	3 (8)	11 (8)	100 (11)
	Other	27 (14)	8 (8)	6 (7)	19 (9)	6 (4)	0 (0)	9 (6)	75 (8)
	Acute hepatic failure	1 (1)	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)	1 (1)	3 (0)
Recipient HCV	No	181 (92)	87 (89)	73 (81)	188 (90)	148 (91)	39 (98)	116 (83)	832 (89)
	Yes	15 (8)	11 (11)	17 (19)	20 (10)	14 (9)	1 (3)	23 (17)	101 (11)
Encephalopathy	Absence	137 (70)	60 (61)	68 (76)	117 (56)	100 (62)	25 (63)	102 (73)	609 (65)
	Presence	59 (30)	38 (39)	22 (24)	91 (44)	62 (38)	15 (38)	37 (27)	324 (35)

Table 3.2 Demographic characteristics of adult elective liver patients registered from , 1 April 2016 - 31 March 2017

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's college N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	Total N (%)
Renal support	No	193 (98)	96 (98)	87 (97)	205 (99)	162 (100)	40 (100)	137 (99)	920 (99)
	Yes	3 (2)	2 (2)	3 (3)	3 (1)	0 (0)	0 (0)	2 (1)	13 (1)
Previous abdominal surgery	No	151 (77)	88 (90)	66 (73)	137 (66)	128 (79)	36 (90)	115 (83)	721 (77)
	Yes	45 (23)	10 (10)	24 (27)	71 (34)	34 (21)	4 (10)	24 (17)	212 (23)
Recip age (years)	Median (IQR)	53 (43, 62)	57 (50, 63)	60 (54, 64)	55 (44, 60)	55 (46, 61)	57 (47, 64)	54 (44, 60)	55 (46, 62)
BMI kg/m2	Median (IQR)	28 (24, 31)	27 (24, 31)	28 (24, 31)	27 (23, 31)	27 (24, 32)	29 (23, 32)	26 (23, 31)	27 (24, 31)
Serum bilirubin umol/l	Median (IQR)	42 (22, 79)	42 (26, 91)	44 (23, 97)	44 (24, 105)	44 (24, 79)	45 (31, 103)	46 (22, 86)	44 (23, 88)
Serum creatinine umol/l	Median (IQR)	76 (64, 92)	72 (59, 89)	73 (61, 103)	73 (59, 89)	68 (54, 87)	79 (65, 101)	70 (56, 90)	73 (59, 91)
Serum sodium mmol/l	Median (IQR)	137 (135, 140)	136 (133, 138)	137 (133, 140)	137 (134, 139)	137 (134, 140)	135 (133, 138)	138 (135, 140)	137 (134, 140)
Serum potassium mmol/l	Median (IQR)	4 (4, 5)	4 (4, 5)	4 (4, 5)	4 (4, 5)	4 (4, 5)	4 (4, 5)	4 (4, 5)	4 (4, 5)
	Not reported	0	0	0	1	0	0	0	1
INR	Median (IQR)	1 (1, 2)	1 (1, 2)	1 (1, 2)	1 (1, 2)	1 (1, 2)	2 (1, 2)	1 (1, 2)	1 (1, 2)
Serum albumin g/l	Median (IQR)	36 (32, 41)	29 (25, 32)	28 (24, 33)	31 (28, 37)	29 (25, 33)	32 (28, 36)	34 (30, 38)	32 (27, 37)

Figure 3.8 Adult elective liver offer decline rates that resulted in a whole liver only first transplant from DBD donors, 1 April 2014 and 31 March 2017

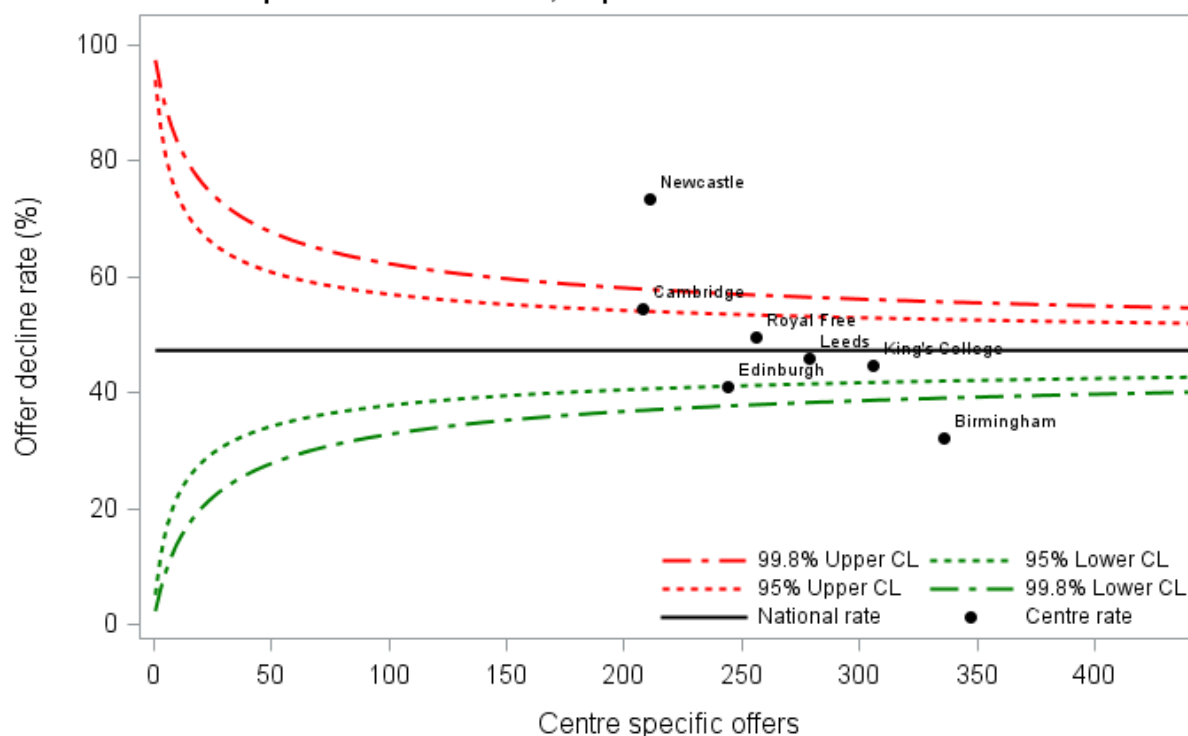
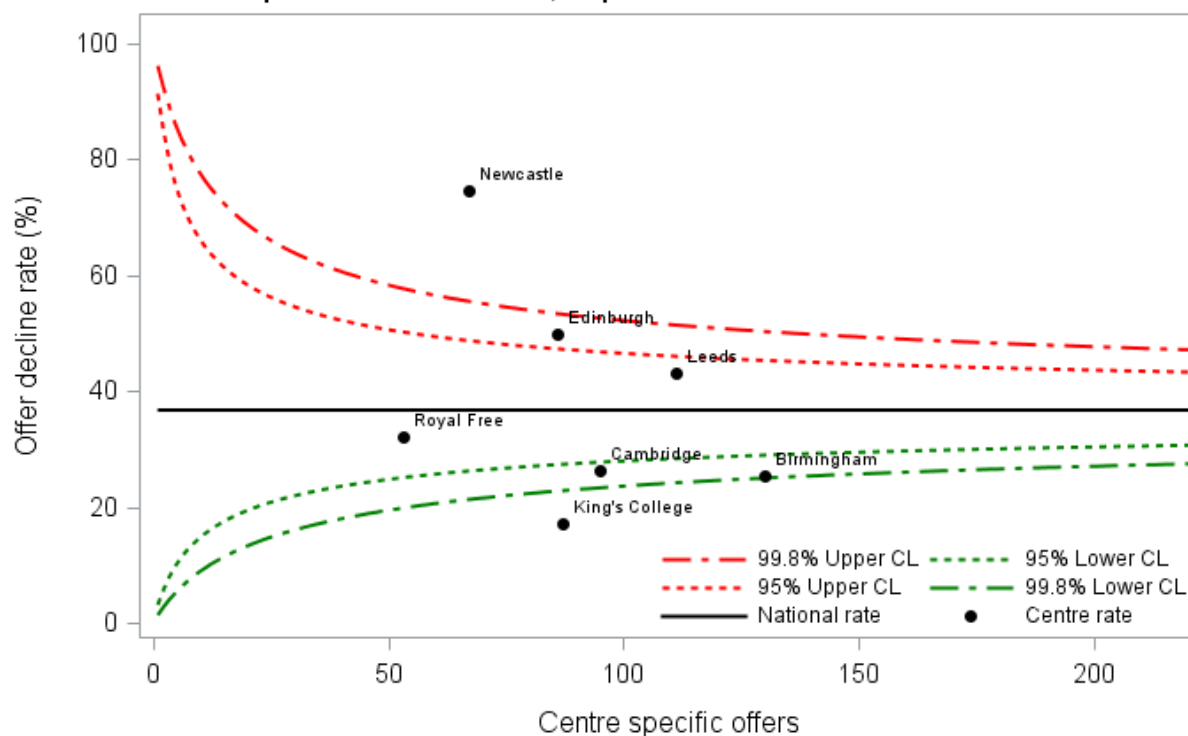


Figure 3.9 Adult elective liver offer decline rates that resulted in a whole liver only first transplant from DCD donors, 1 April 2014 and 31 March 2017



3.2.2 Transplant activity

Figure 3.10 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 3.11** shows the same information by centre.

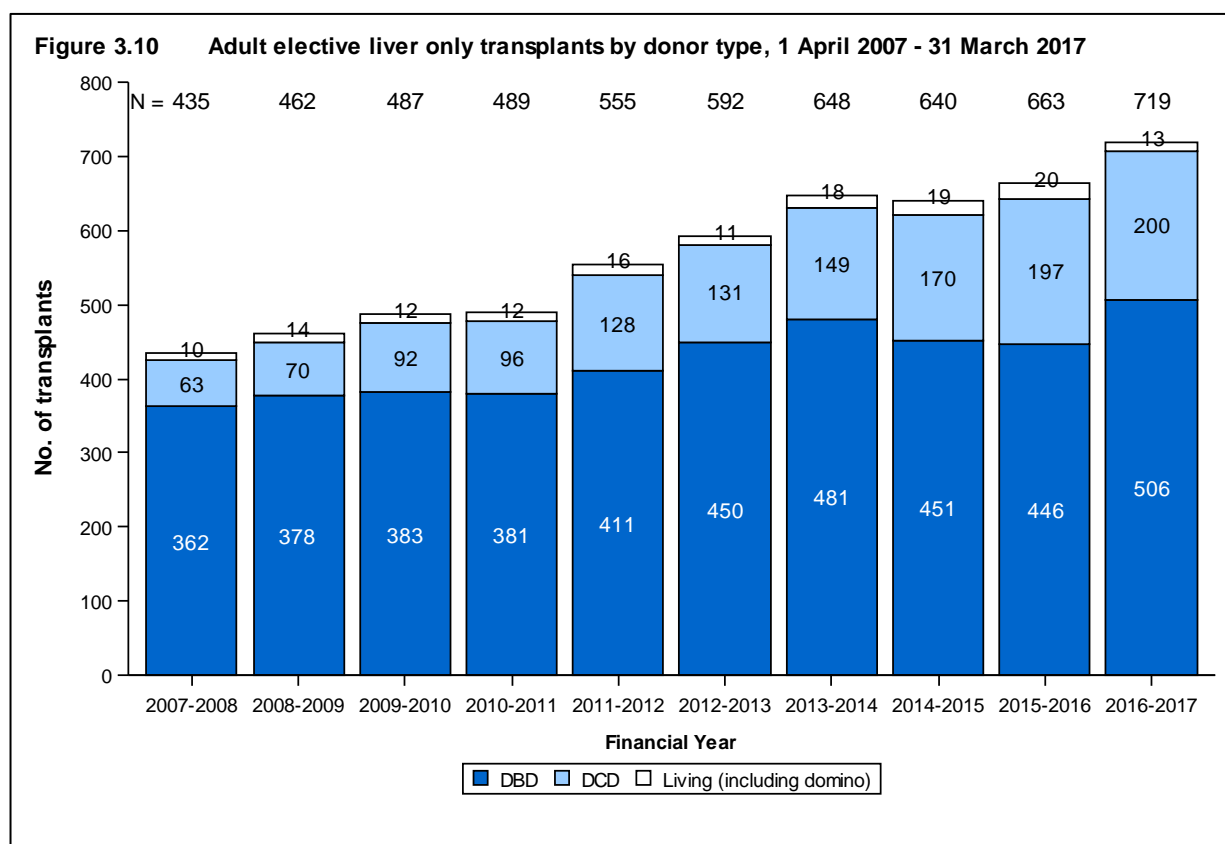
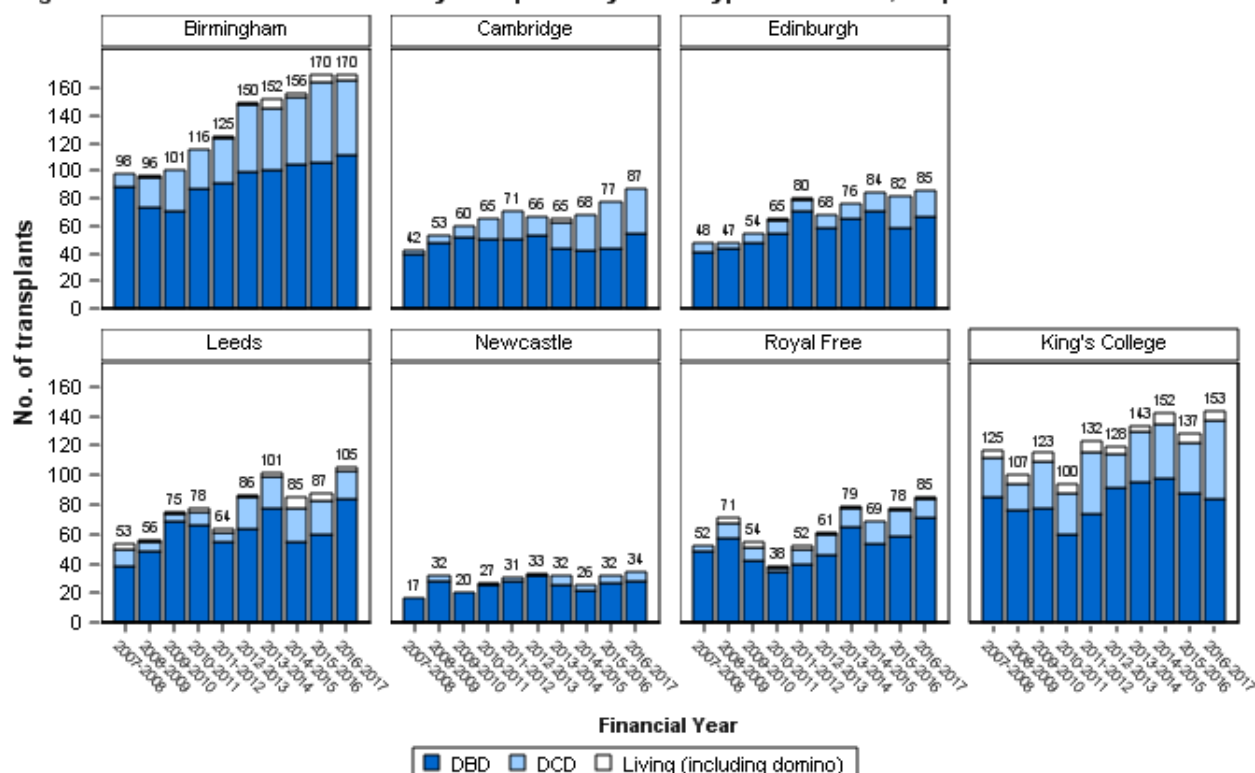


Figure 3.11 Adult elective liver only transplants by donor type and centre, 1 April 2007 - 31 March 2017



The demographic characteristics of 706 adult [elective](#) transplant recipients in the latest year are shown by centre and overall in **Table 3.3**. 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 28. For some characteristics, due to rounding, percentages may not add up to 100.

Table 3.3 Demographic characteristics of adult elective deceased donor liver transplant recipients, 1 April 2016 - 31 March 2017

		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Number		166	87	85	147	103	34	84	706 (100)
Recipient sex	Male	117 (70)	54 (62)	59 (69)	90 (61)	66 (64)	23 (68)	60 (71)	469 (66)
	Female	49 (30)	33 (38)	26 (31)	57 (39)	37 (36)	11 (32)	24 (29)	237 (34)
Recipient ethnicity	White	151 (91)	80 (92)	80 (94)	128 (87)	92 (89)	33 (97)	66 (79)	630 (89)
	Non-white	15 (9)	7 (8)	5 (6)	19 (13)	11 (11)	1 (3)	18 (21)	76 (11)
Indication	Cancer	28 (17)	12 (14)	27 (32)	29 (20)	26 (25)	4 (12)	26 (31)	152 (22)
	Hepatitis C	8 (5)	3 (3)	1 (1)	8 (5)	5 (5)	2 (6)	1 (1)	28 (4)
	Alcoholic liver disease	52 (31)	18 (21)	23 (27)	39 (27)	33 (32)	14 (41)	18 (21)	197 (28)
	Hepatitis B	2 (1)	1 (1)	1 (1)	2 (1)	1 (1)	1 (3)	4 (5)	12 (2)
	Primary sclerosing cholangitis	26 (16)	15 (17)	7 (8)	11 (7)	14 (14)	2 (6)	10 (12)	85 (12)
	Primary biliary cirrhosis	14 (8)	10 (11)	7 (8)	10 (7)	5 (5)	5 (15)	7 (8)	58 (8)
	Autoimmune and cryptogenic disease	7 (4)	4 (5)	2 (2)	16 (11)	7 (7)	2 (6)	8 (10)	46 (7)
	Metabolic	19 (11)	16 (18)	12 (14)	18 (12)	8 (8)	2 (6)	5 (6)	80 (11)
	Other	9 (5)	8 (9)	5 (6)	14 (10)	4 (4)	2 (6)	5 (6)	47 (7)
	Acute Hepatic failure	1 (1)	0	0	0	0	0	0	1 (0)

Table 3.3 Demographic characteristics of adult elective deceased donor liver transplant recipients, 1 April 2016 - 31 March 2017

		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Recipient HCV status	Negative	147 (89)	35 (40)	73 (86)	127 (86)	89 (86)	32 (94)	72 (86)	575 (81)
	Positive	19 (11)	5 (6)	10 (12)	17 (12)	12 (12)	2 (6)	10 (12)	75 (11)
	Not reported	0	47 (54)	2 (2)	3 (2)	2 (2)	0	2 (2)	56 (8)
Pre-transplant in-patient status	Out-patient	157 (95)	79 (91)	76 (89)	121 (82)	91 (88)	30 (88)	78 (93)	632 (90)
	In-patient	9 (5)	8 (9)	8 (9)	23 (16)	12 (12)	4 (12)	4 (5)	68 (10)
	Not reported	0	0	1 (1)	3 (2)	0	0	2 (2)	6 (1)
Ascites	Absence	55 (33)	40 (46)	46 (54)	79 (54)	52 (50)	13 (38)	35 (42)	320 (45)
	Presence	110 (66)	45 (52)	37 (44)	65 (44)	50 (49)	20 (59)	44 (52)	371 (53)
	Not reported	1 (1)	2 (2)	2 (2)	3 (2)	1 (1)	1 (3)	5 (6)	15 (2)
Encephalopathy	Absence	91 (55)	51 (59)	53 (62)	110 (75)	54 (52)	23 (68)	82 (98)	464 (66)
	Presence	75 (45)	36 (41)	24 (28)	34 (23)	41 (40)	11 (32)	0	221 (31)
	Not reported	0	0	8 (9)	3 (2)	8 (8)	0	2 (2)	21 (3)
Pre-transplant renal support	No	161 (97)	86 (99)	75 (88)	140 (95)	102 (99)	31 (91)	81 (96)	676 (96)
	Yes	5 (3)	0	9 (11)	4 (3)	1 (1)	3 (9)	0	22 (3)
	Not reported	0	1 (1)	1 (1)	3 (2)	0	0	3 (4)	8 (1)
Previous abdominal surgery	No	148 (89)	80 (92)	68 (80)	129 (88)	86 (83)	33 (97)	67 (80)	611 (87)
	Yes	16 (10)	7 (8)	16 (19)	15 (10)	15 (15)	0	15 (18)	84 (12)
	Not reported	2 (1)	0	1 (1)	3 (2)	2 (2)	1 (3)	2 (2)	11 (2)

Table 3.3 Demographic characteristics of adult elective deceased donor liver transplant recipients, 1 April 2016 - 31 March 2017

		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Varices & shunt	Absence	35 (21)	18 (21)	20 (24)	72 (49)	55 (53)	14 (41)	28 (33)	242 (34)
	Presence without treatment	121 (73)	56 (64)	60 (71)	69 (47)	40 (39)	19 (56)	50 (60)	415 (59)
	Presence with surgical shunt	0	2 (2)	0	0	0	0	0	2 (0)
	Presence with TIPS	10 (6)	1 (1)	2 (2)	3 (2)	4 (4)	1 (3)	1 (1)	22 (3)
	Not reported	0	10 (11)	3 (4)	3 (2)	4 (4)	0	5 (6)	25 (4)
Life style activity	Normal	1 (1)	1 (1)	31 (36)	7 (5)	6 (6)	6 (18)	4 (5)	56 (8)
	Restricted	101 (61)	18 (21)	23 (27)	76 (52)	23 (22)	7 (21)	0	248 (35)
	Self-care	55 (33)	54 (62)	24 (28)	43 (29)	55 (53)	17 (50)	74 (88)	322 (46)
	Confined	9 (5)	12 (14)	3 (4)	15 (10)	11 (11)	3 (9)	3 (4)	56 (8)
	Reliant	0	1 (1)	2 (2)	3 (2)	2 (2)	1 (3)	1 (1)	10 (1)
	Not reported	0	1 (1)	2 (2)	3 (2)	6 (6)	0	2 (2)	14 (2)
Graft appearance	Normal	133 (80)	63 (72)	81 (95)	94 (64)	78 (76)	26 (76)	54 (64)	529 (75)
	Abnormal	31 (19)	18 (21)	3 (4)	17 (12)	23 (22)	8 (24)	28 (33)	128 (18)
	Not reported	2 (1)	6 (7)	1 (1)	36 (24)	2 (2)	0	2 (2)	49 (7)
Recip age (years)	Median (IQR)	56 (44,63)	57 (48,63)	60 (55,65)	57 (47,62)	55 (46,62)	53 (49,64)	54 (42,61)	56 (46,63)
BMI kg/m2	Median (IQR)	28 (24,31)	27 (24,31)	28 (25,32)	28 (24,31)	27 (24,31)	27 (24,31)	28 (24,33)	28 (24,31)
Serum bilirubin umol/l	Median (IQR)	38 (19,74)	51 (28,83)	37 (21,65)	51 (30,87)	54 (26,101)	52 (28,152)	44 (23,76)	46 (24,83)
	Not reported	0	1	1	3	1	0	3	9

Table 3.3 Demographic characteristics of adult elective deceased donor liver transplant recipients, 1 April 2016 - 31 March 2017									
		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Serum creatinine umol/l	Median (IQR) Not reported	72 (63,89)	72 (57,93)	75 (64,102)	81 (60,104)	67 (55,84)	71 (58,87)	70 (58,88)	72 (60,93)
Serum sodium mmol/l	Median (IQR) Not reported	138 (135,141) 0	137 (133,139) 1	137 (134,139) 1	139 (135,142) 3	135 (132,139) 1	137 (134,138) 0	139 (135,140) 2	138 (134,140) 8
Serum potassium mmol/l	Median (IQR) Not reported	4.2 (3.9,4.5) 0	4.2 (3.9,4.5) 1	4.2 (3.9,4.6) 3	4.4 (4.0,4.8) 3	4.3 (4.0,4.6) 1	4.2 (3.8,4.5) 0	4.2 (3.9,4.5) 2	4.2 (3.9,4.6) 10
INR	Median (IQR) Not reported	1.4 (1.2,1.6) 0	1.4 (1.3,1.7) 13	1.2 (1.1,1.4) 6	1.6 (1.4,1.9) 3	1.4 (1.2,1.7) 3	1.6 (1.4,2.4) 0	1.3 (1.2,1.6) 3	1.4 (1.2,1.7) 28
Serum albumin g/l	Median (IQR) Not reported	37 (33,41) 0	28 (24,32) 4	27 (23,33) 2	27 (23,33) 3	29 (24,34) 3	33 (28,35) 0	35 (31,38) 3	31 (26,36) 15
Cold ischaemia time (hrs)	Median (IQR) Not reported	8 (6,10) 0	8 (7,10) 0	9 (8,10) 1	9 (7,10) 34	7 (6,9) 3	10 (9,12) 0	7 (6,9) 2	8 (7,10) 40
Time on list (days)	Median (IQR) Not reported	61 (23,153) 0	112 (34,264) 0	71 (23,207) 0	124 (57,323) 0	62 (29,156) 0	40 (9,226) 0	125 (57,240) 1	86 (32,217) 1
Donor sex	Male	90 (54)	52 (60)	50 (59)	89 (61)	52 (50)	24 (71)	55 (65)	412 (58)
	Female	76 (46)	35 (40)	35 (41)	58 (39)	51 (50)	10 (29)	29 (35)	294 (42)
Donor ethnicity	White	146 (88)	78 (90)	81 (95)	136 (93)	99 (96)	33 (97)	70 (83)	643 (91)
	Non-white	14 (8)	6 (7)	2 (2)	10 (7)	2 (2)	1 (3)	11 (13)	46 (7)
	Not reported	6 (4)	3 (3)	2 (2)	1 (1)	2 (2)	0	3 (4)	17 (2)

Table 3.3 Demographic characteristics of adult elective deceased donor liver transplant recipients, 1 April 2016 - 31 March 2017

		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Donor cause of death	Intracranial	145 (87)	75 (86)	72 (85)	120 (82)	86 (83)	28 (82)	70 (83)	596 (84)
	Trauma	3 (2)	3 (3)	4 (5)	9 (6)	1 (1)	4 (12)	2 (2)	26 (4)
	Others	18 (11)	9 (10)	9 (11)	18 (12)	16 (16)	2 (6)	12 (14)	84 (12)
Donor history of diabetes	No	156 (94)	81 (93)	78 (92)	134 (91)	96 (93)	31 (91)	74 (88)	650 (92)
	Yes	6 (4)	5 (6)	5 (6)	13 (9)	6 (6)	3 (9)	5 (6)	43 (6)
	Not reported	4 (2)	1 (1)	2 (2)	0	1 (1)	0	5 (6)	13 (2)
Donor type	Donor after brain death	112 (67)	54 (62)	67 (79)	90 (61)	84 (82)	28 (82)	71 (85)	506 (72)
	Donor after cardiac death	54 (33)	33 (38)	18 (21)	57 (39)	19 (18)	6 (18)	13 (15)	200 (28)
ABO match	Identical	160 (96)	87 (100)	85 (100)	146 (99)	102 (99)	34 (100)	84 (100)	698 (99)
	Compatible	6 (4)	0	0	1 (1)	1 (1)	0	0	8 (1)
Graft type	Whole	156 (94)	79 (91)	80 (94)	139 (95)	99 (96)	33 (97)	70 (83)	656 (93)
	Segmental	10 (6)	8 (9)	5 (6)	8 (5)	4 (4)	1 (3)	14 (17)	50 (7)
Donor age years	Median (IQR)	52 (40,66)	50 (39,58)	54 (42,62)	56 (46,68)	52 (39,62)	53 (47,63)	49 (32,59)	52 (40,64)
Donor BMI kg/m2	Median (IQR)	26 (23,29)	27 (24,30)	26 (23,30)	26 (23,28)	25 (23,29)	27 (23,30)	25 (22,27)	26 (23,29)

3.2.3 Post-transplant survival

LONG-TERM PATIENT SURVIVAL

Table 3.4 shows one year [unadjusted](#) and [risk-adjusted patient survival](#) for 2306 of the 2475 transplants in the period, 1 April 2012 to 31 March 2016. Transplants were excluded if they were [auxiliary](#) or if survival information or [risk factors](#) were missing. The overall patient survival rate is 93.9% 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 3.12**.

Table 3.4 One year patient survival for adult elective deceased donor first liver transplants, 1 April 2012 - 31 March 2016					
Centre	Number of transplants	1-year survival % (95% CI)			
		Unadjusted		Risk-adjusted	
Newcastle	115	95.3	89.1 - 98.0	90.4	76.8 - 96.0
Leeds	314	93.8	90.4 - 96.0	94.4	91.3 - 96.5
Cambridge	232	92.9	88.6 - 95.6	95.0	91.8 - 96.9
Royal Free	268	91.7	87.6 - 94.4	93.5	90.1 - 95.7
King's College	519	95.9	93.7 - 97.3	93.8	90.5 - 96.0
Birmingham	602	92.9	90.5 - 94.7	93.5	91.1 - 95.2
Edinburgh	256	94.8	91.3 - 97.0	94.1	89.9 - 96.6
Total	2306	93.9	92.8 - 94.8		
<div> <div></div> Centre has reached the lower 99.8% confidence limit </div>					
<div> <div></div> Centre has reached the lower 95% confidence limit </div>					
<div> <div></div> Centre has reached the upper 95% confidence limit </div>					
<div> <div></div> Centre has reached the upper 99.8% confidence limit </div>					

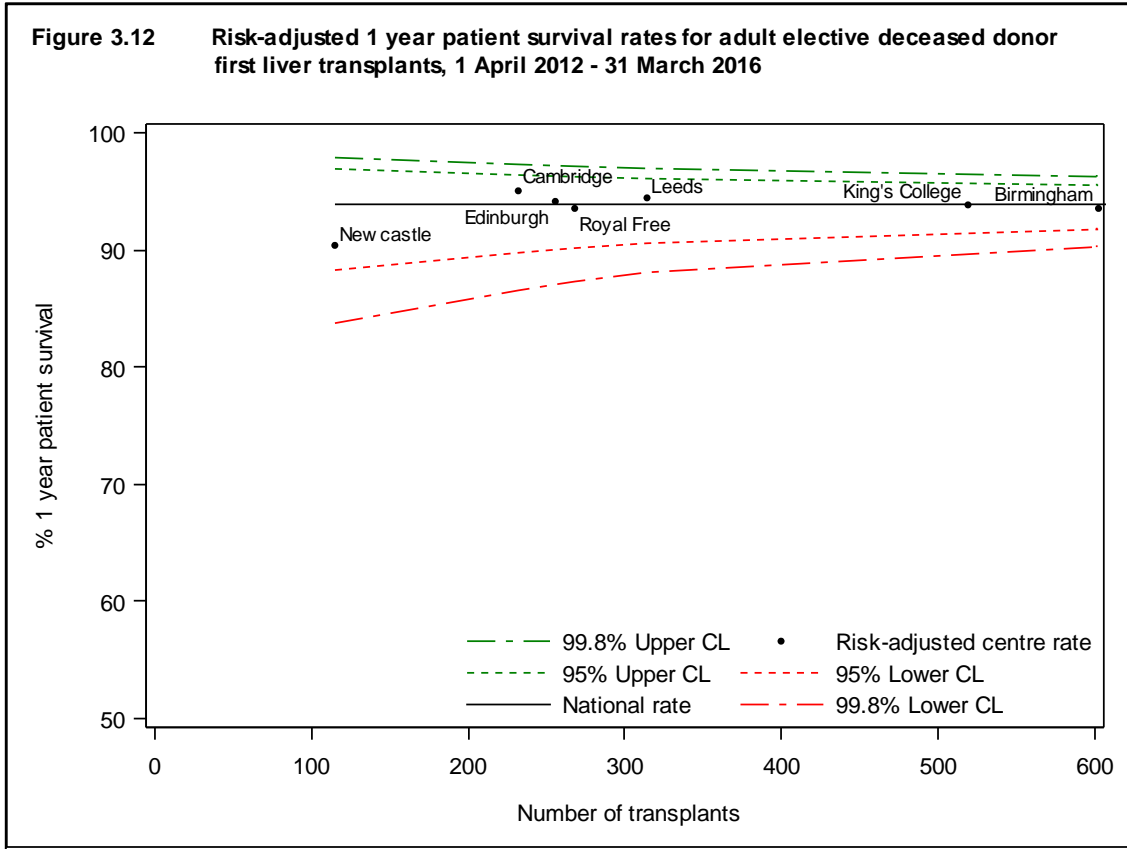


Table 3.5 shows the five year [unadjusted](#) and [risk-adjusted patient survival](#) for 1850 of the 1939 transplants in the period, 1 April 2008 to 31 March 2012. The national rate is 81.2% and four centres have a lower survival rate after risk adjustment, as shown in **Figure 3.13**. The median number of days between the last known follow-up post-transplantation (for censored cases) and the time of analysis in **Table 3.5** and **Figure 3.13** ranges from 366 days for Birmingham to 540 days for King's College and 558 days for Cambridge. The medians for all other centres fall in between these extremes. Results should therefore be interpreted in that light.

Table 3.5 Five year patient survival for adult elective deceased donor first liver transplants, 1 April 2008 - 31 March 2012					
Centre	Number of transplants	5-year survival % (95% CI)			
		Unadjusted		Risk-adjusted	
Newcastle	106	74.7	65.1 - 82.0	80.9	71.9 - 87.0
Cambridge	223	83.1	77.2 - 87.6	85.1	79.3 - 89.3
Royal Free	197	83.5	77.5 - 88.1	79.7	71.2 - 85.6
King's College	411	85.2	81.1 - 88.4	84.8	80.2 - 88.3
Birmingham	432	79.2	75.0 - 82.8	77.4	72.1 - 81.6
Edinburgh	228	77.2	71.1 - 82.1	78.9	72.3 - 84.0
Total	1597	81.2	79.1 - 83.0		

<div style="width: 20px; height: 10px; background-color: red; border: 1px solid black;"></div>	Centre has reached the lower 99.8% confidence limit
<div style="width: 20px; height: 10px; background-color: lightcoral; border: 1px solid black;"></div>	Centre has reached the lower 95% confidence limit
<div style="width: 20px; height: 10px; background-color: lightgreen; border: 1px solid black;"></div>	Centre has reached the upper 95% confidence limit
<div style="width: 20px; height: 10px; background-color: green; border: 1px solid black;"></div>	Centre has reached the upper 99.8% confidence limit

Leeds have been excluded due to a lack of follow up beyond 12 months

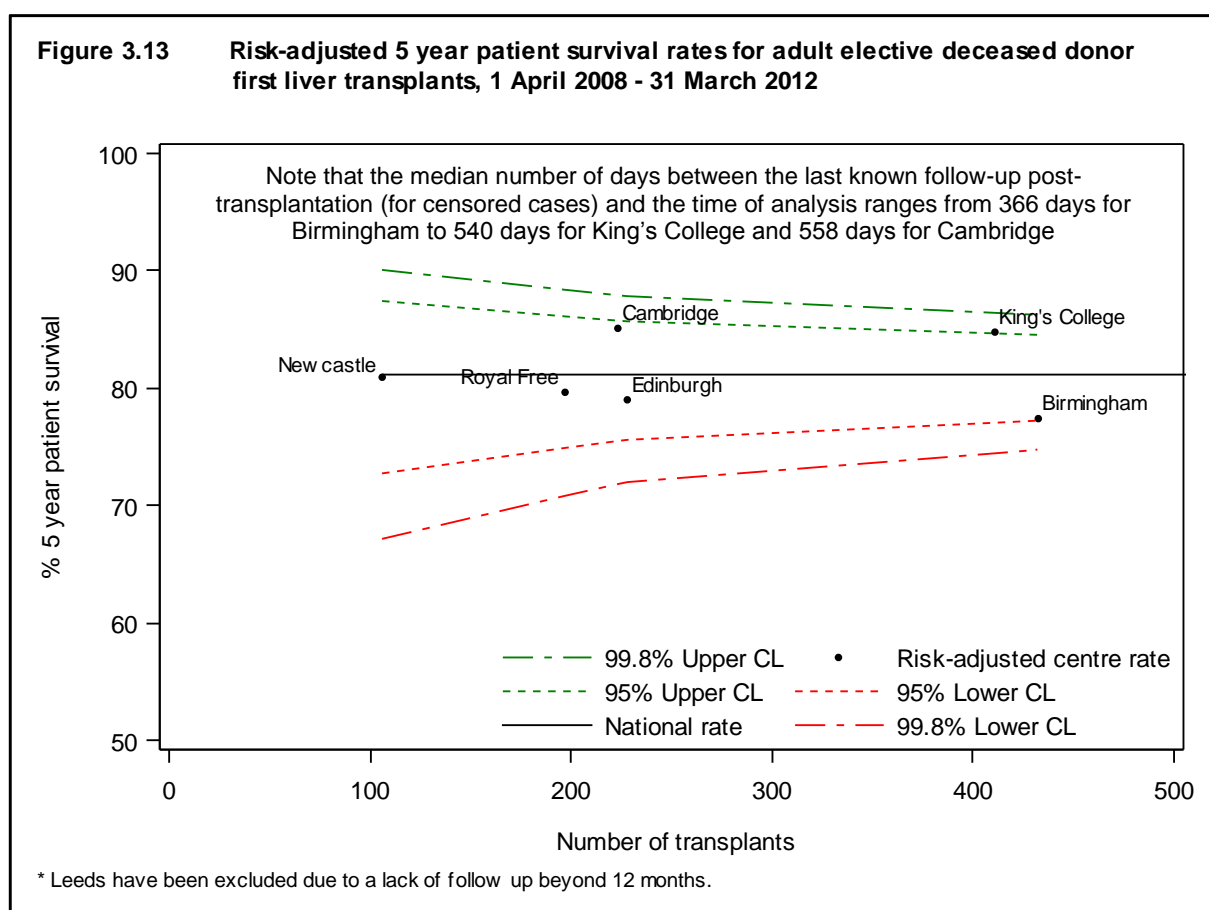


Table 3.6 shows one year [unadjusted](#) and [risk-adjusted patient survival](#), by primary disease group. The overall patient survival rate is 93.9% and, after risk adjustment, patients with cancer, metabolic disease, autoimmune and cryptogenic, alcoholic liver disease or other liver disease had a lower survival rate than the national rate.

Table 3.6 One year patient survival for adult elective deceased donor first liver transplants, 1 April 2012 - 31 March 2016					
Primary disease	Number of transplants	1-year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Cancer	560	91.8	(89.2 - 93.9)	92.3	(89.7 - 94.3)
Hepatitis B and C	253	97.2	(94.2 - 98.7)	97.0	(93.6 - 98.5)
Alcoholic liver disease	566	93.3	(90.9 - 95.1)	93.7	(91.3 - 95.4)
Primary sclerosing cholangitis	255	94.8	(91.3 - 97.0)	94.3	(90.2 - 96.7)
Primary biliary cirrhosis	191	97.9	(94.5 - 99.2)	97.8	(94.1 - 99.2)
Autoimmune and cryptogenic	150	93.2	(87.7 - 96.3)	91.8	(84.7 - 95.6)
Metabolic	207	92.5	(87.8 - 95.4)	93.3	(88.9 - 96.0)
Other	124	93.5	(87.5 - 96.7)	92.6	(85.2 - 96.3)
Total	2306	93.9	(92.8 - 94.8)		

Table 3.7 shows five year [unadjusted](#) and [risk-adjusted patient survival](#), the overall patient survival rate is 81.2%. After risk adjustment patients with cancer, autoimmune and cryptogenic, metabolic or other liver disease had a lower survival rate than the national rate.

Table 3.7 Five year patient survival for adult elective deceased donor first liver transplants, 1 April 2008 - 31 March 2012					
Primary disease	Number of transplants	5-year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Cancer	406	73.4	(68.6 - 77.5)	77.3	(72.4 - 81.3)
Hepatitis B and C	197	76.7	(70.0 - 82.1)	82.0	(75.8 - 86.6)
Alcoholic liver disease	345	84.6	(80.2 - 88.1)	84.4	(79.4 - 88.2)
Primary sclerosing cholangitis	169	87.8	(81.7 - 91.9)	82.9	(73.5 - 89.0)
Primary biliary cirrhosis	156	87.7	(81.4 - 92.0)	84.9	(76.3 - 90.3)
Autoimmune and cryptogenic	113	85.1	(76.8 - 90.6)	80.8	(68.7 - 88.3)
Metabolic	110	80.3	(71.0 - 86.9)	80.0	(69.1 - 87.1)
Other	101	83.9	(75.0 - 89.8)	81.0	(69.0 - 88.4)
Total	1597	81.2	(79.1 - 83.0)		

Leeds have been excluded due to a lack of follow up beyond 12 months

3.2.4 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 2005 and 31 December 2016. One, five and ten year [risk-adjusted survival rates](#) from the point of liver transplant listing are provided in **Table 3.8** and shown by centre in **Figures 3.14, 3.15 and 3.16**, respectively.

At one year, centre-specific risk adjusted survival rates range between 80% at both Leeds and Birmingham and 85% at Edinburgh. At five years, Birmingham has the lowest survival rate at 66% and Edinburgh has the highest at 75%; the remaining centres achieve survival rates that range in between these two extremes. Similarly, at ten years, Birmingham achieves the lowest survival rate at 52% while Edinburgh has the highest at 62%. Note, however, that the median number of days between the last

known follow-up post-transplantation (for censored, transplanted cases) and the time of analysis in **Figure 3.15** ranges from 244 days for Birmingham to 371 days for King's College and 376 days for Cambridge. The medians for all other centres fall in between these extremes. Similarly, in **Figure 3.16**, Birmingham achieves the lowest median 'lack of follow up post-transplant' while all other units, especially King's College and Cambridge, have longer periods during which follow-up has not been returned to NHSBT. Results should therefore be interpreted in that light.

Table 3.8. Risk adjusted 1, 5 and 10 year patient survival rate from listing for adult elective first liver registrations, 1 January 2005 - 31 December 2016

Centre	Number of registrations	Patient survival					
		One year		Five year		Ten year	
		%	(95% CI)	%	(95% CI)	%	(95% CI)
Newcastle	424	83	(80 - 86)	69	(64 - 73)	55	(48 - 61)
Leeds	1295	80	(77 - 82)	-	-	-	-
Cambridge	961	85	(82 - 87)	73	(69 - 76)	59	(54 - 63)
Royal Free	935	82	(79 - 84)	69	(65 - 72)	54	(48 - 59)
King's College	1811	83	(81 - 85)	72	(69 - 74)	59	(55 - 63)
Birmingham	1871	80	(77 - 82)	66	(63 - 69)	52	(47 - 55)
Edinburgh	918	85	(83 - 87)	75	(71 - 78)	62	(57 - 66)
Total	6920	83	(82 - 83)	70	(69 - 71)	57	(55 - 59)

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

Leeds have been excluded due to a lack of follow up beyond 12 months

Figure 3.14 Risk-adjusted 1 year patient survival rate from time of listing for adult* elective first liver registrations, 1 January 2005 - 31 December 2016

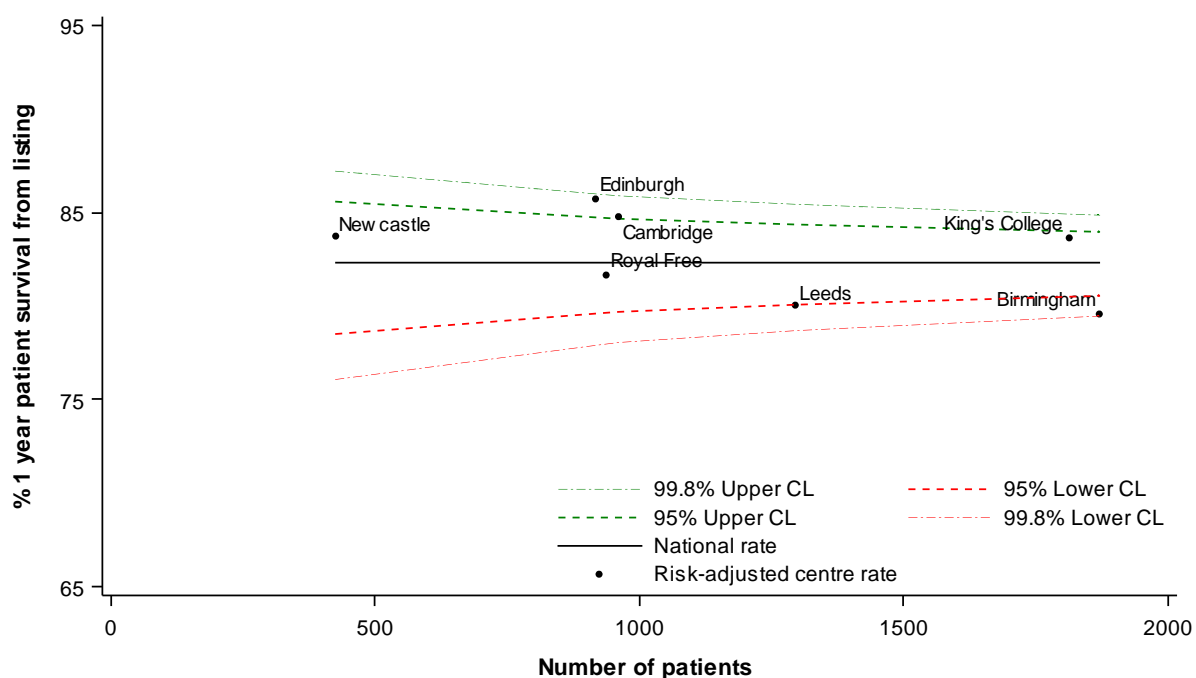
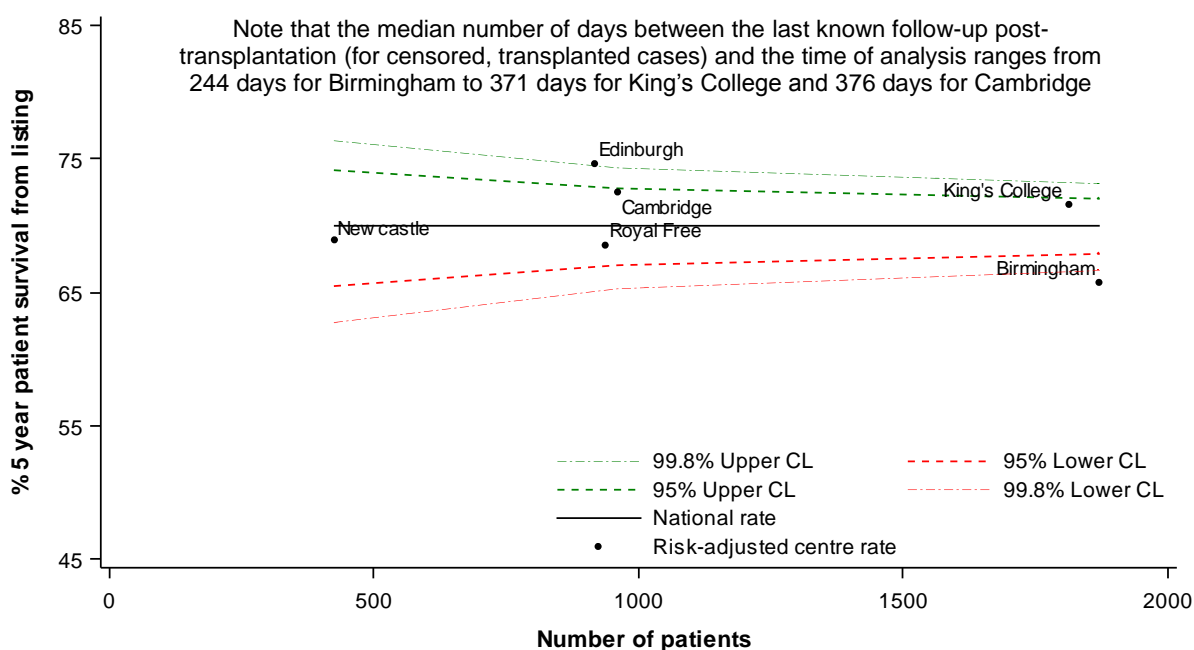


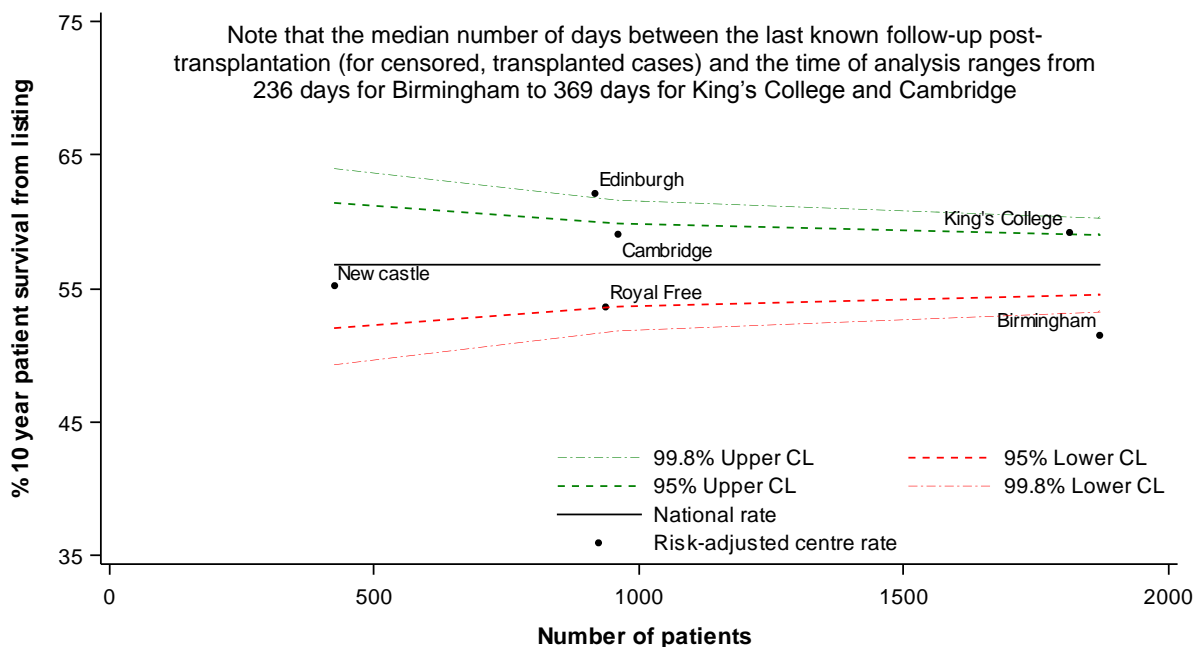
Figure 3.15 Risk-adjusted 5 year patient survival rate from time of listing for adult* elective first liver registrations, 1 January 2005 - 31 December 2016



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

* Leeds have been excluded due to a lack of follow up beyond 12 months.

Figure 3.16 Risk-adjusted 10 year patient survival rate from time of listing for adult* elective first liver registrations, 1 January 2005 - 31 December 2016



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

* Leeds have been excluded due to a lack of follow up beyond 12 months.

Adult Liver Transplantation Super-Urgent Patients



3.3.1 Transplant list

Table 3.9 shows the [median waiting time](#) to deceased donor liver only transplant for adult [super-urgent](#) patients. The national median waiting time to transplant is two days and at all centres except Leeds, where it is three days.

Table 3.9 Median waiting time to liver only transplant in the UK, for adult super urgent patients registered 1 April 2011 - 31 March 2014			
Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Adult			
Newcastle	23	2	1 - 3
Cambridge	37	2	2 - 2
Royal Free	38	2	1 - 3
King's College	66	2	2 - 2
Birmingham	71	2	2 - 2
Edinburgh	50	2	2 - 2
Leeds	42	3	2 - 4
UK	327	2	2 - 2

The demographic characteristics of 107 adult [super-urgent](#) registrations in the last financial year are shown by centre and overall in **Table 3.10**. The majority of patients listed for a super-urgent liver were female and the average age was 36 with a BMI of 24. For some characteristics, due to rounding, percentages may not add up to 100.

Table 3.10 Demographic characteristics of adult super urgent liver patients registered from , 1 April 2016 - 31 March 2017

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's college N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	Total N (%)
Number		25	13	10	18	19	3	19	107
Recipient sex	Male	13 (52)	4 (31)	4 (40)	7 (39)	10 (53)	0 (0)	9 (47)	47 (44)
	Female	12 (48)	9 (69)	6 (60)	11 (61)	9 (47)	3 (100)	10 (53)	60 (56)
Recipient ethnicity	White	16 (64)	11 (85)	10 (100)	15 (83)	16 (84)	3 (100)	13 (68)	84 (79)
	Non-white	8 (32)	2 (15)	0 (0)	3 (17)	3 (16)	0 (0)	5 (26)	21 (20)
	Not reported	1 (4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (5)	2 (2)
Recipient HCV	No	25 (100)	13 (100)	10 (100)	18 (100)	19 (100)	3 (100)	19 (100)	107 (100)
	Yes	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Encephalopathy	Absence	6 (24)	3 (23)	2 (20)	2 (11)	0 (0)	0 (0)	6 (32)	19 (18)
	Presence	14 (56)	8 (62)	5 (50)	13 (72)	13 (68)	3 (100)	13 (68)	69 (64)
	Not reported	5 (20)	2 (15)	3 (30)	3 (17)	6 (32)	0 (0)	0 (0)	19 (18)
Renal support	No	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	Yes	25 (100)	12 (92)	10 (100)	17 (94)	17 (89)	3 (100)	19 (100)	103 (96)
	Not reported	0 (0)	1 (8)	0 (0)	1 (6)	2 (11)	0 (0)	0 (0)	4 (4)
Recip age (years)	Median (IQR)	36 (22, 51)	48 (36, 58)	32 (21, 61)	28 (23, 40)	43 (27, 58)	36 (20, 55)	41 (30, 55)	36 (27, 55)
BMI kg/m ²	Median (IQR)	27 (23, 29)	25 (22, 31)	25 (21, 26)	22 (20, 23)	25 (23, 35)	18 (18, 18)	25 (21, 29)	24 (21, 29)
	Not reported	0	1	0	0	0	2	1	4
Serum bilirubin umol/l	Median (IQR)	181 (102, 292)	110 (53, 304)	82 (71, 438)	130 (58, 313)	244 (84, 420)	75 (64, 576)	252 (130, 413)	184 (76, 334)
	Not reported	1	0	0	0	0	0	0	1

Table 3.10 Demographic characteristics of adult super urgent liver patients registered from , 1 April 2016 - 31 March 2017

		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)	104 (74, 168)	138 (60, 193)	78 (58, 196)	128 (89, 167)	69 (56, 108)	116 (6, 226)	99 (58, 153)	99 (64, 160)
	Not reported	1	1	1	2	2	1	1	9
Serum sodium mmol/l	Median (IQR)	140 (136, 143)	136 (135, 142)	135 (132, 140)	139 (134, 141)	138 (133, 141)	141 (137, 145)	137 (132, 139)	138 (134, 141)
	Not reported	1	0	0	1	0	0	1	3
Serum potassium mmol/l	Median (IQR)	4 (4, 5)	5 (4, 5)	4 (4, 5)	4 (4, 5)	5 (4, 5)	4 (4, 4)	4 (4, 5)	4 (4, 5)
	Not reported	1	0	0	0	0	0	1	2
INR	Median (IQR)	3 (2, 6)	5 (2, 12)	2 (2, 6)	5 (3, 7)	3 (2, 5)	9 (8, 10)	3 (2, 4)	3 (2, 6)
	Not reported	2	5	1	0	0	1	0	9
Serum albumin g/l	Median (IQR)	36 (29, 39)	26 (24, 27)	24 (19, 27)	26 (23, 30)	20 (15, 26)	34 (31, 35)	27 (25, 31)	27 (22, 32)
	Not reported	3	0	0	1	0	0	0	4

3.2.2 Transplant activity

Figure 3.17 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. The number of super-urgent transplants has been slowly decreasing since 2013-2014.

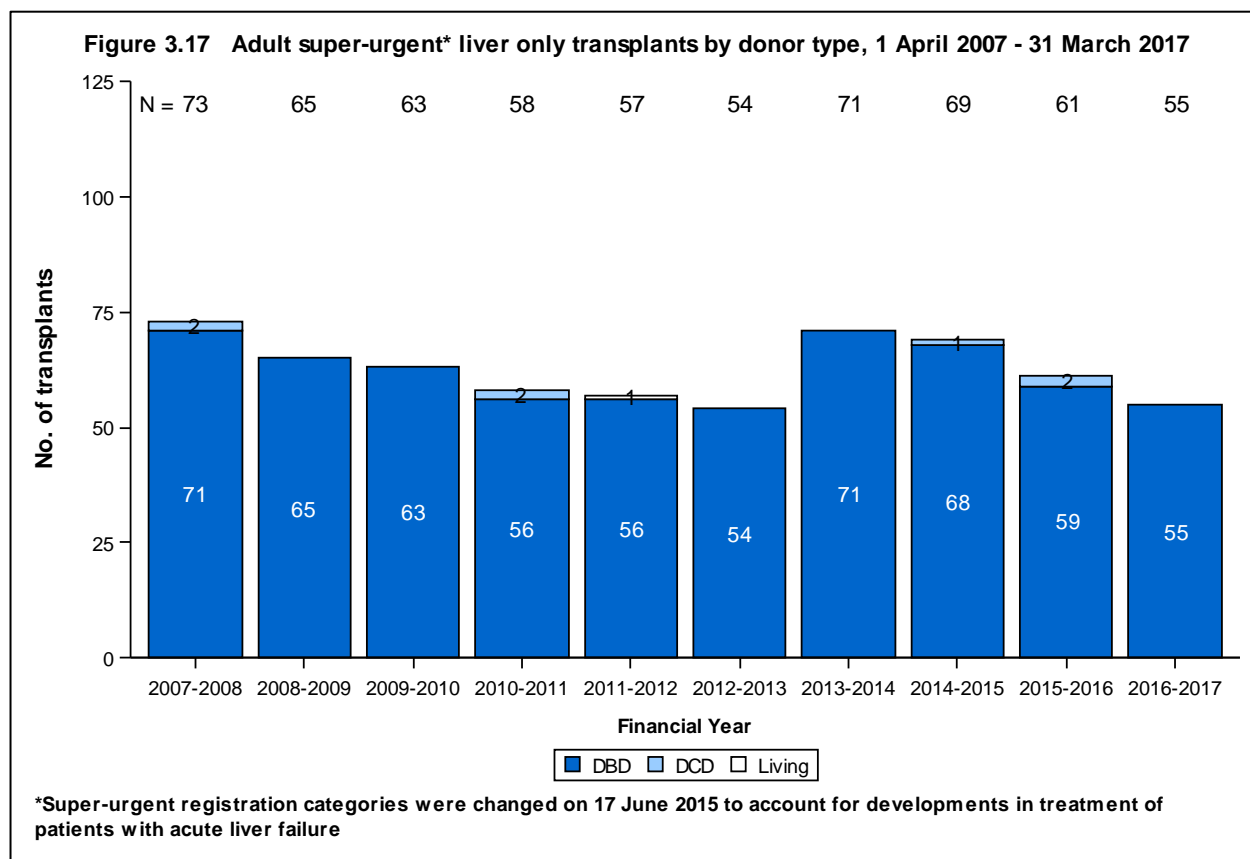
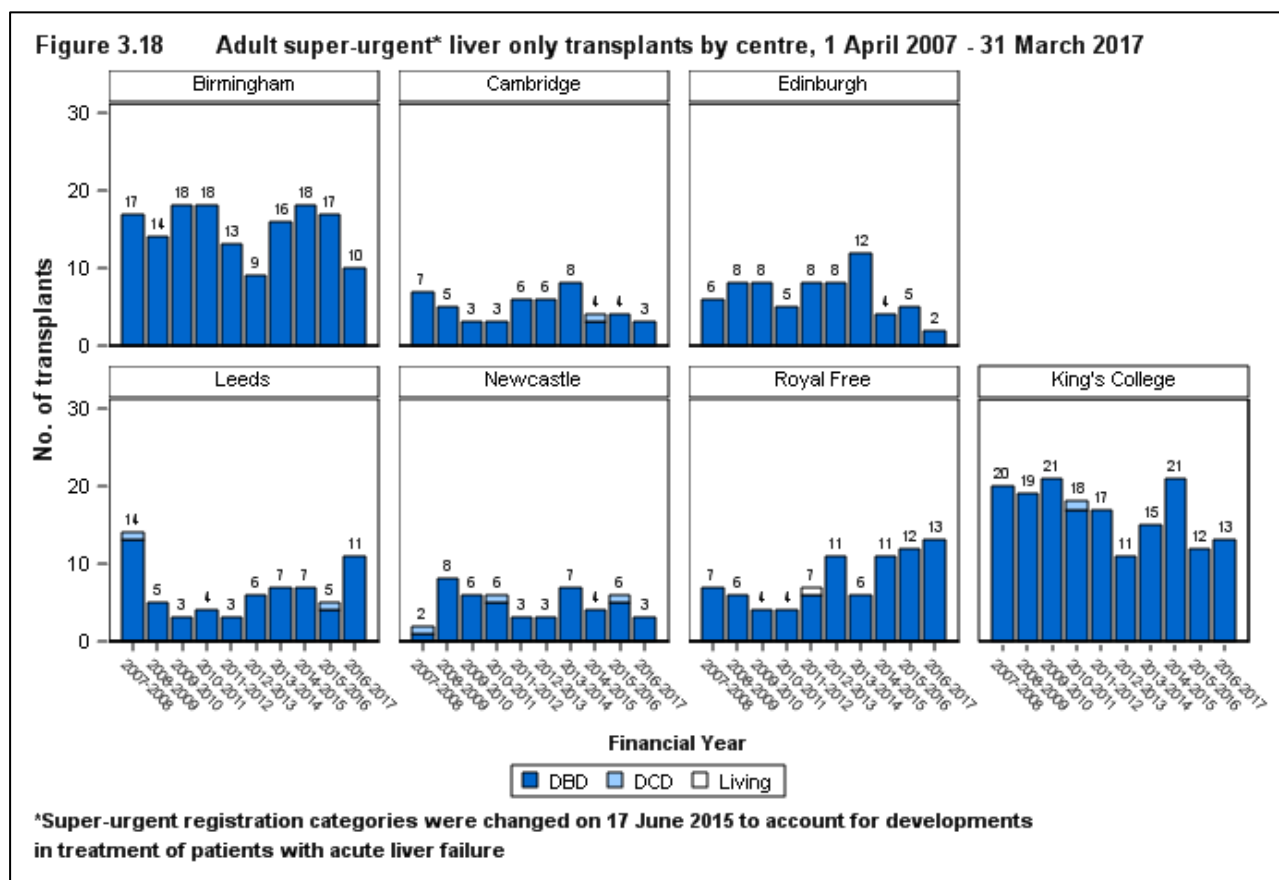


Figure 3.18 shows the number of adult [super-urgent](#) first liver only transplants from deceased and living donors performed in the last ten years, by type of donor and transplant centre.



The demographic characteristics of 55 adult [super-urgent](#) transplant recipients in the last financial year are shown by centre and overall in **Table 3.11**. Two thirds of these recipients were female and the [median](#) age was 31 years. All super-urgent transplants have been performed in this time period using a [DBD](#) donor. The median recipient BMI was 24. For some characteristics, due to rounding, percentages may not add up to 100.

Table 3.11 Demographic characteristics of adult super-urgent deceased donor liver transplant recipients, 1 April 2016 - 31 March 2017

		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Number		10	3	2	13	11	3	13	55 (100)
Recipient sex	Male	4 (40)	1 (33)	0	5 (38)	4 (36)	0	5 (38)	19 (35)
	Female	6 (60)	2 (67)	2 (100)	8 (62)	7 (64)	3 (100)	8 (62)	36 (66)
Recipient ethnicity	White	6 (60)	2 (67)	2 (100)	10 (77)	10 (91)	3 (100)	10 (77)	43 (78)
	Non-white	3 (30)	1 (33)	0	3 (23)	1 (9)	0	3 (23)	11 (20)
	Not reported	1 (10)	0	0	0	0	0	0	1 (2)
Recipient HCV status	Negative	10 (100)	1 (33)	2 (100)	13 (100)	9 (82)	3 (100)	11 (85)	49 (89)
	Not reported	0	2 (67)	0	0	2 (18)	0	2 (15)	6 (11)
Pre-transplant in-patient status	Out-patient	1 (10)	0	0	0	0	0	0	1 (2)
	In-patient	9 (90)	3 (100)	2 (100)	13 (100)	11 (100)	3 (100)	11 (85)	52 (95)
	Not reported	0	0	0	0	0	0	2 (15)	2 (4)
Ascites	Absence	5 (50)	3 (100)	0	12 (92)	7 (64)	3 (100)	8 (62)	38 (69)
	Presence	5 (50)	0	1 (50)	0	3 (27)	0	3 (23)	12 (22)
	Not reported	0	0	1 (50)	1 (8)	1 (9)	0	2 (15)	5 (9)
Encephalopathy	Absence	0	0	0	0	1 (9)	0	4 (31)	5 (9)
	Presence	10 (100)	3 (100)	1 (50)	12 (92)	9 (82)	3 (100)	7 (54)	45 (82)
	Not reported	0	0	1 (50)	1 (8)	1 (9)	0	2 (15)	5 (9)
Pre-transplant renal support	No	5 (50)	1 (33)	0	3 (23)	6 (55)	0	7 (54)	22 (40)
	Yes	5 (50)	2 (67)	1 (50)	9 (69)	5 (45)	3 (100)	3 (23)	28 (51)
	Not reported	0	0	1 (50)	1 (8)	0	0	3 (23)	5 (9)

Table 3.11 Demographic characteristics of adult super-urgent deceased donor liver transplant recipients, 1 April 2016 - 31 March 2017

		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Previous abdominal surgery	No	10 (100)	3 (100)	2 (100)	12 (92)	9 (82)	3 (100)	10 (77)	49 (89)
	Yes	0	0	0	1 (8)	1 (9)	0	1 (8)	3 (6)
	Not reported	0	0	0	0	1 (9)	0	2 (15)	3 (6)
Varices & shunt	Absence	7 (70)	0	1 (50)	13 (100)	7 (64)	2 (67)	7 (54)	37 (67)
	Presence without treatment	3 (30)	3 (100)	1 (50)	0	4 (36)	1 (33)	3 (23)	15 (27)
	Not reported	0	0	0	0	0	0	3 (23)	3 (6)
Life style activity	Normal	0	0	0	0	1 (9)	0	0	1 (2)
	Self-care	0	0	0	0	0	0	1 (8)	1 (2)
	Confined	1 (10)	1 (33)	0	1 (8)	2 (18)	0	2 (15)	7 (13)
	Reliant	9 (90)	2 (67)	2 (100)	12 (92)	7 (64)	3 (100)	8 (62)	43 (78)
	Not reported	0	0	0	0	1 (9)	0	2 (15)	3 (6)
Graft appearance	Normal	10 (100)	1 (33)	2 (100)	6 (46)	11 (100)	2 (67)	8 (62)	40 (73)
	Abnormal	0	1 (33)	0	0	0	1 (33)	3 (23)	5 (9)
	Not reported	0	1 (33)	0	7 (54)	0	0	2 (15)	10 (18)
Recip age (years)	Median (IQR)	30 (23,45)	31 (19,45)	24 (19,29)	28 (24,40)	31 (23,46)	36 (20,55)	45 (30,60)	31 (24,46)
BMI kg/m ²	Median (IQR)	27 (24,29)	25 (22,27)	27 (26,27)	22 (20,23)	25 (22,32)	18 (18,18)	24 (21,31)	24 (21,29)
	Not reported	0	1	0	0	0	2	1	4
Serum bilirubin umol/l	Median (IQR)	222 (149,423)	286 (96,856)	301 (101,500)	170 (96,310)	284 (192,455)	213 (138,347)	387 (205,412)	233 (155,411)
	Not reported	0	0	0	0	0	0	3	3

Table 3.11 Demographic characteristics of adult super-urgent deceased donor liver transplant recipients, 1 April 2016 - 31 March 2017

		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Serum creatinine umol/l	Median (IQR)	62 (49,98)	54 (46,109)	137 (74,200)	102 (65,142)	73 (52,178)	92 (72,105)	100 (86,126)	89 (60,130)
	Not reported	0	0	1	0	0	0	2	3
Serum sodium mmol/l	Median (IQR)	141 (136,148)	145 (145,146)	140 (140,140)	140 (138,149)	136 (133,140)	143 (138,144)	138 (136,143)	140 (136,145)
	Not reported	0	0	1	0	0	0	2	3
Serum potassium mmol/l	Median (IQR)	4.2 (4.1,4.5)	4.3 (4.0,4.9)	4.1 (4.1,4.1)	4.5 (4.1,4.6)	4.0 (3.8,4.5)	4.4 (3.7,4.5)	4.1 (3.6,4.5)	4.3 (4.0,4.5)
	Not reported	0	0	1	0	0	0	2	3
INR	Median (IQR)	2.7 (2.2,4.4)	9.7 (3.4,27.1)	1.5 (1.5,1.5)	2.5 (1.8,4.8)	4.5 (2.3,8.8)	2.2 (2.2,5.6)	4.0 (2.4,7.8)	2.9 (2.2,5.7)
	Not reported	0	0	1	0	0	0	2	3
Serum albumin g/l	Median (IQR)	30 (28,35)	25 (19,25)	12 (0,24)	25 (24,26)	22 (18,28)	32 (24,35)	26 (22,32)	25 (22,30)
	Not reported	0	0	0	0	0	0	2	2
Time on list (days)	Median (IQR)	3 (2,4)	4 (2,4)	3 (1,5)	2 (1,2)	2 (1,3)	2 (1,5)	2 (1,3)	2 (1,3)
Donor sex	Male	5 (50)	1 (33)	0	5 (38)	5 (45)	0	4 (31)	20 (36)
	Female	5 (50)	2 (67)	2 (100)	8 (62)	6 (55)	3 (100)	9 (69)	35 (64)
Donor ethnicity	White	9 (90)	2 (67)	2 (100)	10 (77)	11 (100)	3 (100)	13 (100)	50 (91)
	Non-white	1 (10)	1 (33)	0	0	0	0	0	2 (4)
	Not reported	0	0	0	3 (23)	0	0	0	3 (6)
Donor cause of death	Intracranial	9 (90)	2 (67)	2 (100)	11 (85)	10 (91)	2 (67)	8 (62)	44 (80)
	Trauma	0	0	0	0	1 (9)	0	2 (15)	3 (6)
	Others	1 (10)	1 (33)	0	2 (15)	0	1 (33)	3 (23)	8 (15)

Table 3.11 Demographic characteristics of adult super-urgent deceased donor liver transplant recipients, 1 April 2016 - 31 March 2017

		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Donor history of diabetes	No	10 (100)	3 (100)	2 (100)	11 (85)	10 (91)	2 (67)	12 (92)	50 (91)
	Yes	0	0	0	1 (8)	1 (9)	0	1 (8)	3 (6)
	Not reported	0	0	0	1 (8)	0	1 (33)	0	2 (4)
Donor type	Donor after brain death	10 (100)	3 (100)	2 (100)	13 (100)	11 (100)	3 (100)	13 (100)	55 (100)
ABO match	Identical	10 (100)	2 (67)	1 (50)	10 (77)	6 (55)	2 (67)	10 (77)	41 (75)
	Compatible	0	1 (33)	1 (50)	3 (23)	5 (45)	1 (33)	3 (23)	14 (26)
Graft type	Whole	10 (100)	3 (100)	2 (100)	11 (85)	11 (100)	3 (100)	13 (100)	53 (96)
	Segmental	0	0	0	2 (15)	0	0	0	2 (4)
Donor age (years)	Median (IQR)	47 (34,60)	41 (21,68)	51 (41,61)	48 (42,55)	50 (40,53)	51 (50,72)	50 (41,65)	50 (40,59)
Donor BMI kg/m ²	Median (IQR)	23 (22,25)	23 (21,30)	22 (20,23)	27 (22,30)	23 (21,29)	26 (23,30)	24 (22,26)	24 (22,27)

3.3.3 Post-transplant survival

LONG-TERM PATIENT SURVIVAL

Table 3.12 shows one year [unadjusted](#) and [risk-adjusted patient survival](#) for 235 of the 255 transplants in the period 1 April 2012 to 31 March 2016. Transplants were excluded if they were [auxiliary](#) or if survival information or [risk factors](#) were missing. The overall patient survival rate is 88.9% and, after risk adjustment, four centres had a lower survival rate than the national rate but within the [confidence limits](#), as shown in **Figure 3.19**.

Table 3.12 One year patient survival for adult super-urgent deceased donor first liver transplants, 1 April 2012 - 31 March 2016					
Centre	Number of transplants	1-year survival % (95% CI)			
		Unadjusted		Risk-adjusted	
Newcastle	19	78.9	53.2 - 91.5	80.2	47.3 - 92.6
Leeds	24	87.5	66.1 - 95.8	88.8	65.4 - 96.4
Cambridge	19	94.7	68.1 - 99.2	93.9	56.3 - 99.1
Royal Free	35	86.1	69.8 - 94.0	79.9	51.8 - 91.6
King's College	54	88.7	76.6 - 94.8	86.1	69.0 - 93.7
Birmingham	55	92.7	81.7 - 97.2	92.4	79.8 - 97.2
Edinburgh	28	89.3	70.4 - 96.4	92.7	77.4 - 97.7
Total	235	88.9	84.1 - 92.3		
<div> <div></div> <div>Centre has reached the lower 99.8% confidence limit</div> </div>					
<div> <div></div> <div>Centre has reached the lower 95% confidence limit</div> </div>					
<div> <div></div> <div>Centre has reached the upper 95% confidence limit</div> </div>					
<div> <div></div> <div>Centre has reached the upper 99.8% confidence limit</div> </div>					

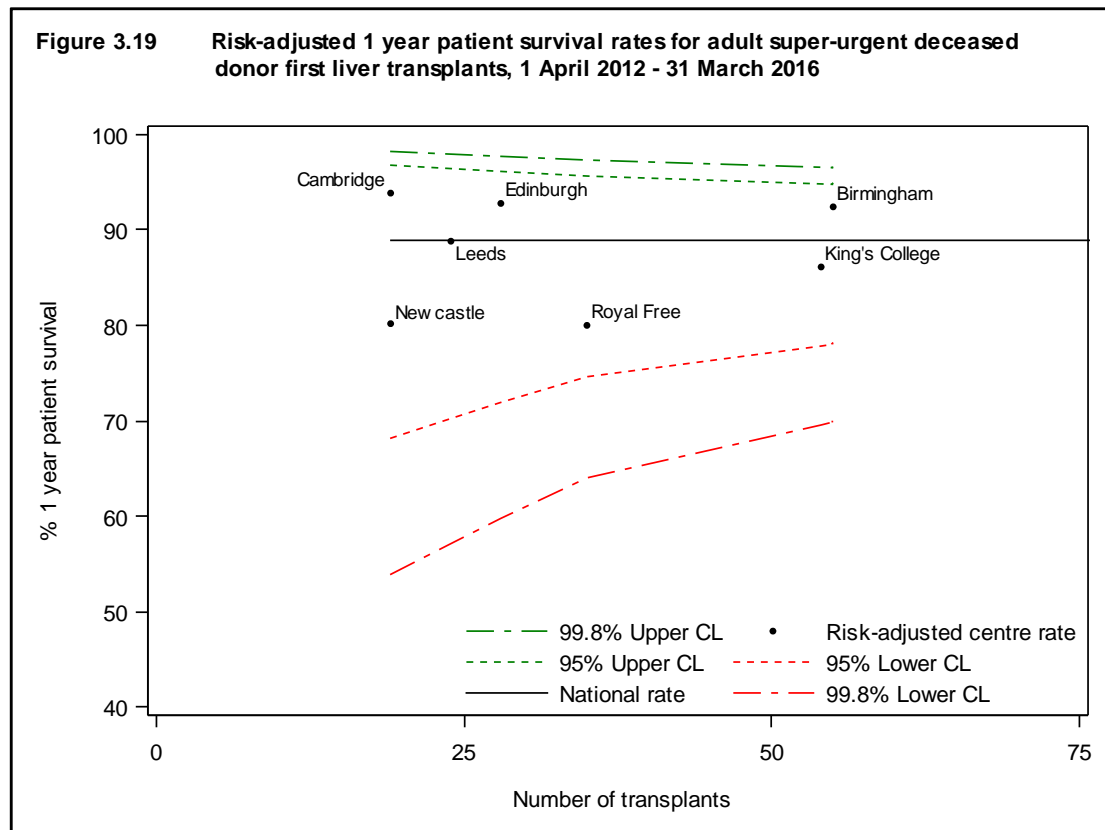


Table 3.13 shows the five year [unadjusted](#) and [risk-adjusted patient survival](#) for 229 of the 242 transplants in the period, 1 April 2008 to 31 March 2012. The national rate is 80.1% and four centres have a lower survival rate after risk adjustment as shown in **Figure 3.20**, but all fall within the confidence limits. The median number of days between the last known follow-up post-transplantation (for censored patients) and the time of analysis in **Table 3.13** and **Figure 3.20** ranges from 380 days for Birmingham to 543 days for Cambridge and 578 days for King's College. The medians for all other centres fall in between these extremes. Results should therefore be interpreted in that light.

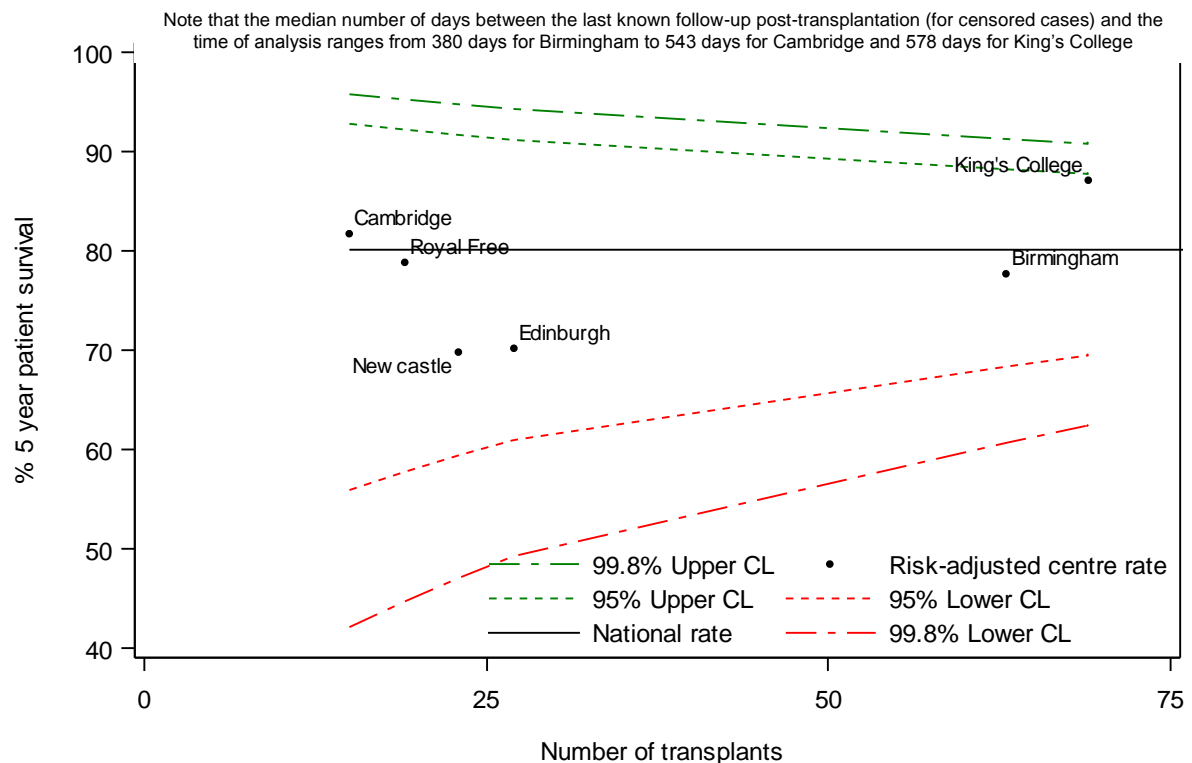
Table 3.13 Five year patient survival for adult super-urgent deceased donor first liver transplants, 1 April 2008 - 31 March 2012

Centre	Number of transplants	5-year survival % (95% CI)			
		Unadjusted	Risk-adjusted		
Newcastle	23	78	55.0 - 90.2	69.8	27.3 - 87.4
Cambridge	15	86.2	55.0 - 96.4	81.6	26.6 - 95.4
Royal Free	19	68.4	42.8 - 84.4	78.7	52.7 - 90.5
King's College	69	85.3	74.4 - 91.8	87	75.9 - 93.0
Birmingham	63	78.5	65.8 - 87.0	77.7	61.6 - 87.1
Edinburgh	27	77.8	57.1 - 89.3	70.3	33.9 - 86.7
Total	216	80.1	74.0 - 84.9		

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

Leeds have been excluded due to a lack of follow up beyond 12 months

Figure 3.20 Risk-adjusted 5 year patient survival rates for adult super-urgent deceased donor first liver transplants, 1 April 2008 - 31 March 2012



* Leeds have been excluded due to a lack of follow up beyond 12 months.

Adult Liver Transplantation

Form return rates



Form return rates are reported in **Table 3.14** 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 2016 and 31 December 2016 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.

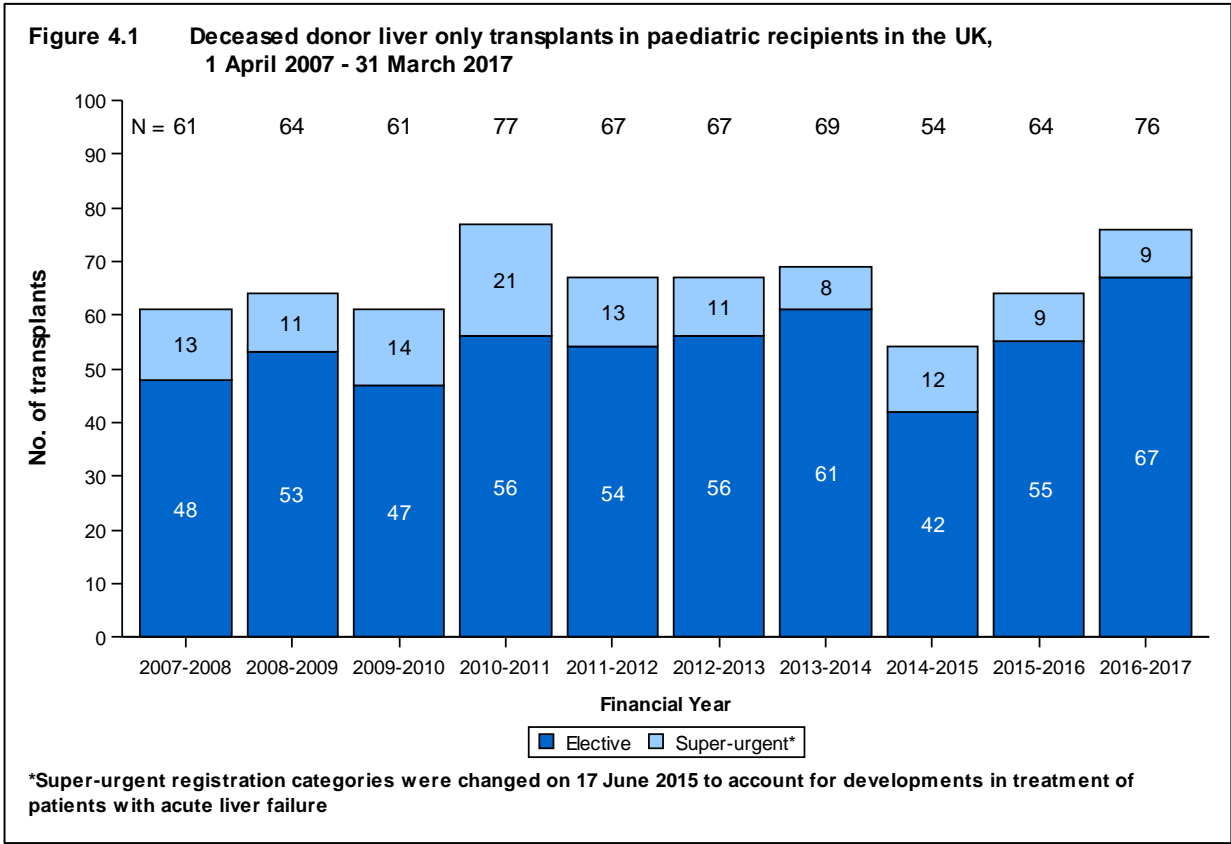
Table 3.14 Form return rates, 1 January 2016 and 31 December 2016								
Centre	Transplant record		3 month follow-up		1 year follow-up		Lifetime follow-up	
	N	% returned	N	% returned	N	% returned	N	% returned
Newcastle	41	100	27	66	33	100	168	92
Leeds	101	100	90	100	64	82	6	1
Cambridge	90	100	91	100	63	84	313	77
Royal Free	87	100	83	100	75	97	389	96
King's College	163	100	154	100	131	94	632	75
Birmingham	174	100	172	100	171	100	803	97
Edinburgh	79	100	80	96	66	89	425	95

Paediatric Liver Transplantation



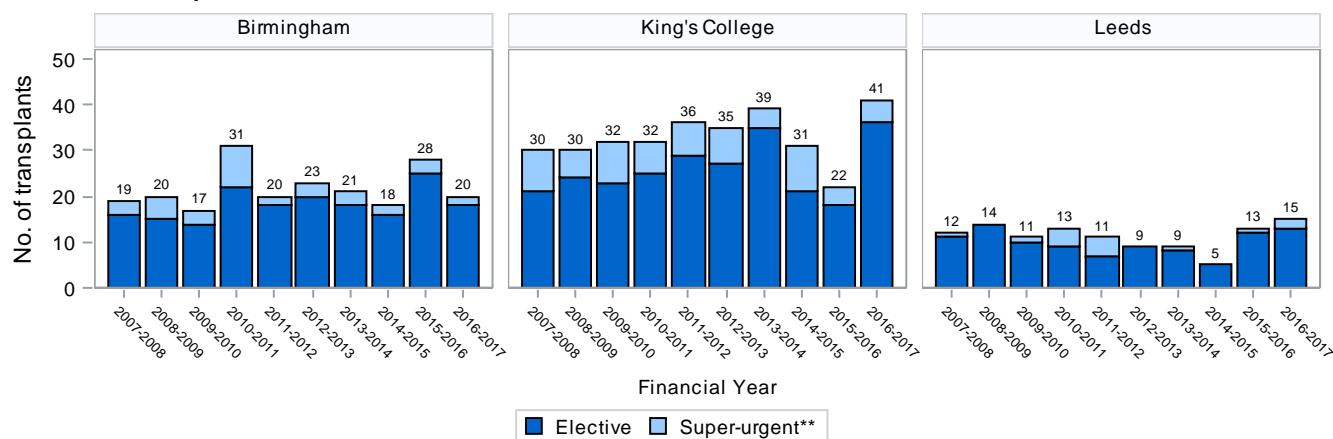
4.1 Overview

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 4.1 and 4.2**, respectively. See **Appendix 1** for further details.



In the last year, 76 transplants in paediatric patients were performed, all transplanted at the three paediatric centres in the UK. Sixty-seven of these transplants were for patients on the [elective](#) list and nine for patients on the [super-urgent](#) list.

Figure 4.2 Deceased donor liver only transplants in paediatric recipients* in the UK, 1 April 2007 - 31 March 2017



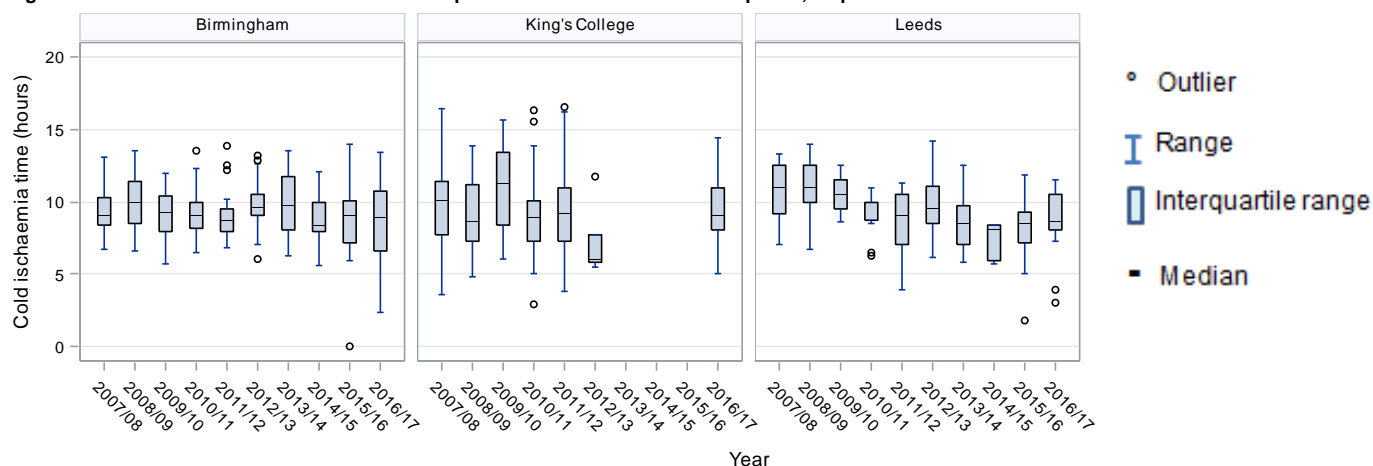
*Excludes one super-urgent paediatric patient who was transplanted at non-paediatric centre

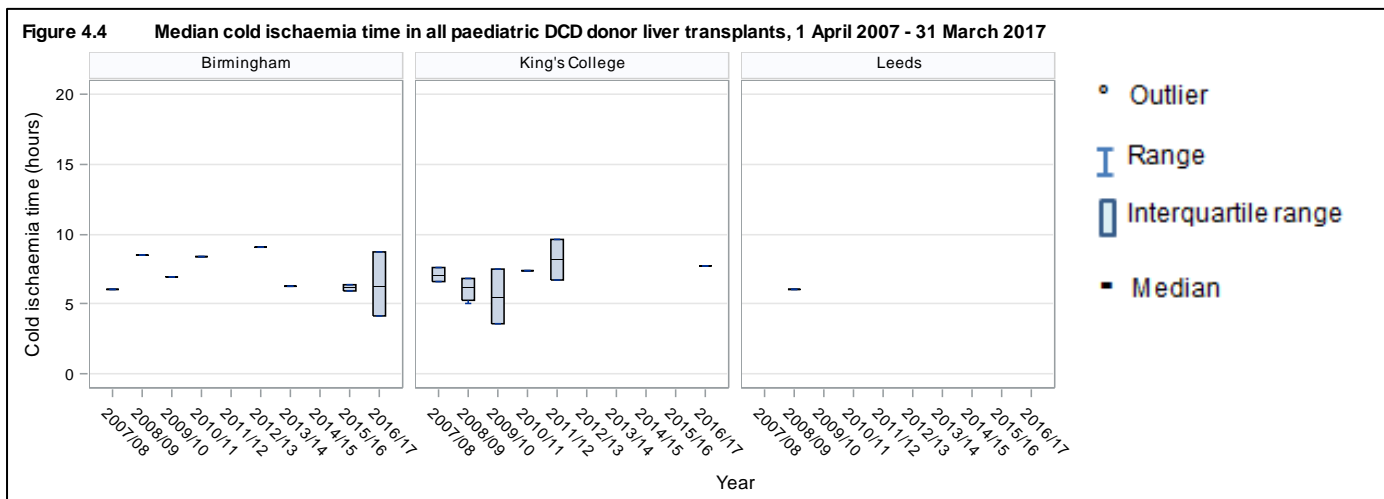
**Super-urgent registration categories were changed on 17 June 2015 to account for developments in treatment of patients with acute liver failure

The [median cold ischaemia times](#) for paediatric transplant recipients are shown in **Figures 4.3 and 4.3** 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 was 9 hours for all transplant centres.

The corresponding median for DCD donor transplants has decreased from 11 hours in 2006/07 to 8 hours in 2016/17 but note that this is based on very few paediatric recipients transplanted from a DCD donor. The median cold ischaemia time for DCD paediatric patients in the last financial year for King's was 8 hours and 6 hours for Birmingham. There was no data for cold ischemia time in paediatric DCD transplants in 2014/15.

Figure 4.3 Median cold ischaemia time in all paediatric DBD donor liver transplants, 1 April 2007 - 31 March 2017





The demographic characteristics of 108 paediatric registrations and 76 paediatric transplant recipients in the latest year are shown by centre and nationally in **Table 4.1**. Of the patients registered for a liver transplant, 51% were male, 32% were under 1 years old and 18% were registered as super-urgent. Of the transplant recipients, 53% were male and 43% were aged between one and four years old. Of the 76 transplants, 9 (12%) were of [super-urgent](#) status. For some characteristics, due to rounding, percentages may not add up to 100.

Table 4.1 Demographic characteristics of paediatric registrations and deceased donor liver transplant recipients, 1 April 2016 - 31 March 2017

		Birmingham N (%)		King's College N (%)		Leeds N (%)		TOTAL N (%)	
		Registration	Transplant	Registration	Transplant	Registration	Transplant	Registration	Transplant
Number		39	20	52	41	17	15	108 (100)	76 (100)
Recip age years	<1	15 (38)	7 (35)	16 (31)	8 (20)	4 (24)	3 (20)	35 (32)	18 (24)
	1-4	11 (28)	7 (35)	14 (27)	20 (49)	6 (35)	6 (40)	31 (29)	33 (43)
	5-12	7 (18)	4 (20)	12 (23)	8 (20)	2 (12)	2 (13)	21 (19)	14 (18)
	13-16	6 (15)	2 (10)	10 (19)	5 (12)	5 (29)	4 (27)	21 (19)	11 (15)
Recipient sex	Male	18 (46)	9 (45)	28 (54)	24 (59)	9 (53)	7 (47)	55 (51)	40 (53)
	Female	21 (54)	11 (55)	24 (46)	17 (41)	8 (47)	8 (53)	53 (49)	36 (47)
Indication	Super Urgent	6 (15)	2 (10)	10 (19)	5 (12)	3 (18)	2 (13)	19 (18)	9 (12)
	Biliary Atresia	12 (31)	7 (35)	24 (46)	17 (41)	3 (18)	4 (27)	39 (36)	28 (37)
	Other	0 (0)	0	2 (4)	0	2 (12)	1 (7)	4 (4)	1 (1)
	Cholestatic								
	Metabolic	4 (10)	2 (10)	3 (6)	3 (7)	2 (12)	1 (7)	9 (8)	6 (8)
	Other	17 (44)	9 (45)	13 (25)	16 (39)	7 (41)	7 (47)	37 (34)	32 (42)
Pre-transplant in-patient status	Out-patient		14 (70)		30 (73)		11 (73)		55 (72)
	In-patient		5 (25)		10 (24)		4 (27)		19 (25)
	Not reported		1 (5)		1 (2)		0		2 (3)
Pre-transplant renal support	No		18 (90)		32 (78)		15 (100)		65 (86)
	Yes		1 (5)		7 (17)		0		8 (11)
	Not reported		1 (5)		2 (5)		0		3 (4)
Ascites	Absence		7 (35)		36 (88)		13 (87)		56 (74)
	Presence		12 (60)		3 (7)		2 (13)		17 (22)
	Not reported		1 (5)		2 (5)		0		3 (4)

Table 4.1 Demographic characteristics of paediatric registrations and deceased donor liver transplant recipients, 1 April 2016 - 31 March 2017

		Birmingham N (%)		King's College N (%)		Leeds N (%)		TOTAL N (%)	
		Registration	Transplant	Registration	Transplant	Registration	Transplant	Registration	Transplant
Previous abdominal surgery	No	15 (38)	10 (50)	17 (33)	24 (59)	7 (41)	8 (53)	39 (36)	42 (55)
	Yes	18 (46)	9 (45)	25 (48)	15 (37)	7 (41)	6 (40)	50 (46)	30 (40)
	Not reported	0 (0)	1 (5)	0 (0)	2 (5)	0 (0)	1 (7)	0 (0)	4 (5)
	Not collected for super-urgent	6 (15)		10 (19)		3 (18)		19 (18)	
INR	<=1.0	13 (33)	2 (10)	9 (17)	3 (7)	8 (47)	7 (47)	30 (28)	12 (16)
	1.1-1.5	18 (46)	9 (45)	27 (52)	17 (41)	5 (29)	4 (27)	50 (46)	30 (40)
	1.6-3.0	4 (10)	5 (25)	8 (15)	17 (41)	2 (12)	2 (13)	14 (13)	24 (32)
	>3.0	1 (3)	3 (15)	8 (15)	3 (7)	2 (12)	2 (13)	11 (10)	8 (11)
	Not reported	3 (8)	1 (5)	0 (0)	1 (2)	0 (0)	0	3 (3)	2 (3)
Serum sodium mmol/l	<135	9 (23)	5 (25)	7 (13)	2 (5)	1 (6)	1 (7)	17 (16)	8 (11)
	>=135	30 (77)	14 (70)	45 (87)	38 (93)	16 (94)	13 (87)	91 (84)	65 (86)
	Not reported	0 (0)	1 (5)	0 (0)	1 (2)	0 (0)	1 (7)	0 (0)	3 (4)
Donor age years	<5		0		3 (7)		0		3 (4)
	5-16		6 (30)		6 (15)		4 (27)		16 (21)
	17-30		10 (50)		18 (44)		7 (47)		35 (46)
	>=31		4 (20)		14 (34)		4 (27)		22 (29)
Donor sex	Male		16 (80)		28 (68)		9 (60)		53 (70)
	Female		4 (20)		13 (32)		6 (40)		23 (30)
Donor type	Donor after brain death		17 (85)		39 (95)		15 (100)		71 (93)
	Donor after cardiac death		3 (15)		2 (5)		0		5 (7)

Table 4.1 Demographic characteristics of paediatric registrations and deceased donor liver transplant recipients, 1 April 2016 - 31 March 2017									
		Birmingham N (%)		King's College N (%)		Leeds N (%)		TOTAL N (%)	
		Registration	Transplant	Registration	Transplant	Registration	Transplant	Registration	Transplant
Graft appearance	Normal		18 (90)		23 (56)		15 (100)		56 (74)
	Not reported		2 (10)		18 (44)		0		20 (26)
Graft type	Whole		3 (15)		8 (20)		4 (27)		15 (20)
	Segmental		17 (85)		33 (80)		11 (73)		61 (80)
Urgency Status	Elective	33 (85)	18 (90)	42 (81)	36 (88)	14 (82)	13 (87)	89 (82)	67 (88)
	Super Urgent	6 (15)	2 (10)	10 (19)	5 (12)	3 (18)	2 (13)	19 (18)	9 (12)

Paediatric Liver Transplantation Elective Patients



4.2.1 Transplant list

Figure 4.5 shows the number of paediatric [elective](#) patients on the liver only transplant list at 31 March each year between 2008 and 2017. 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 not increased.

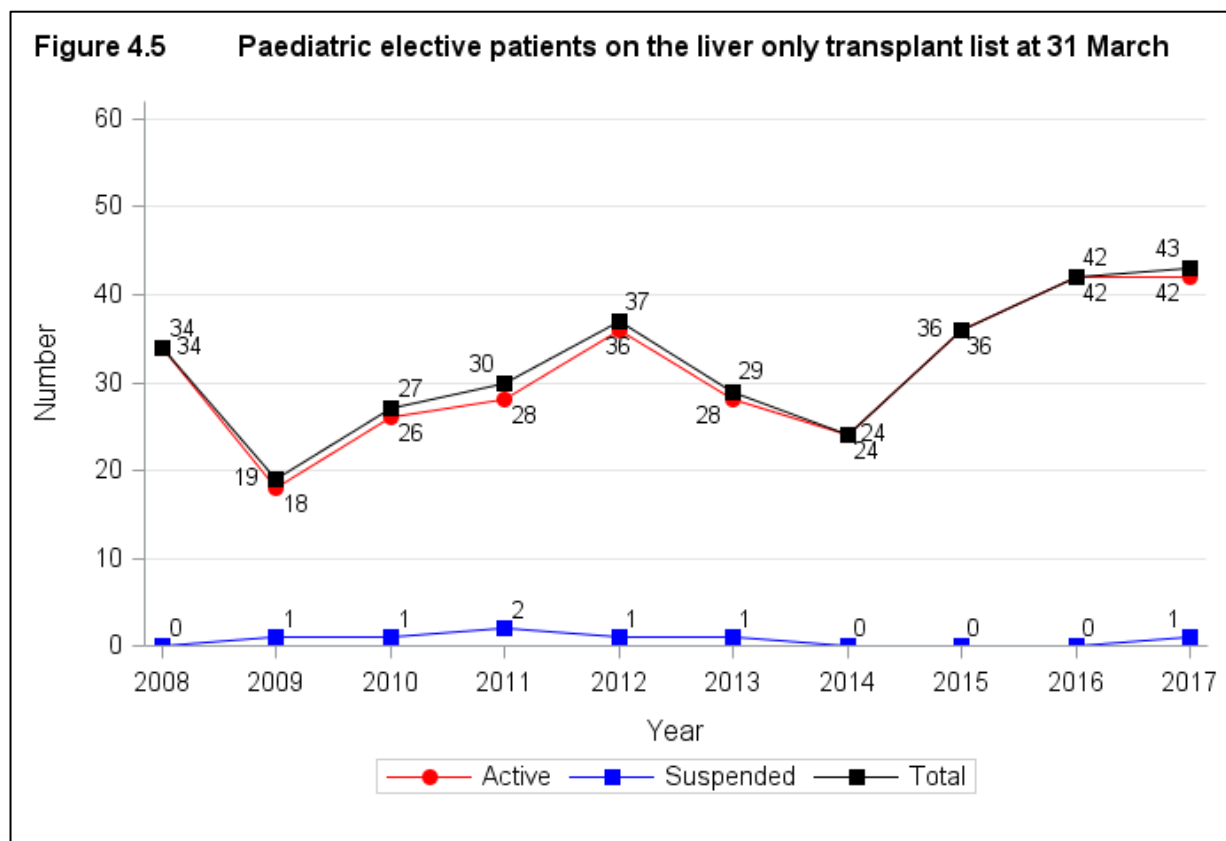
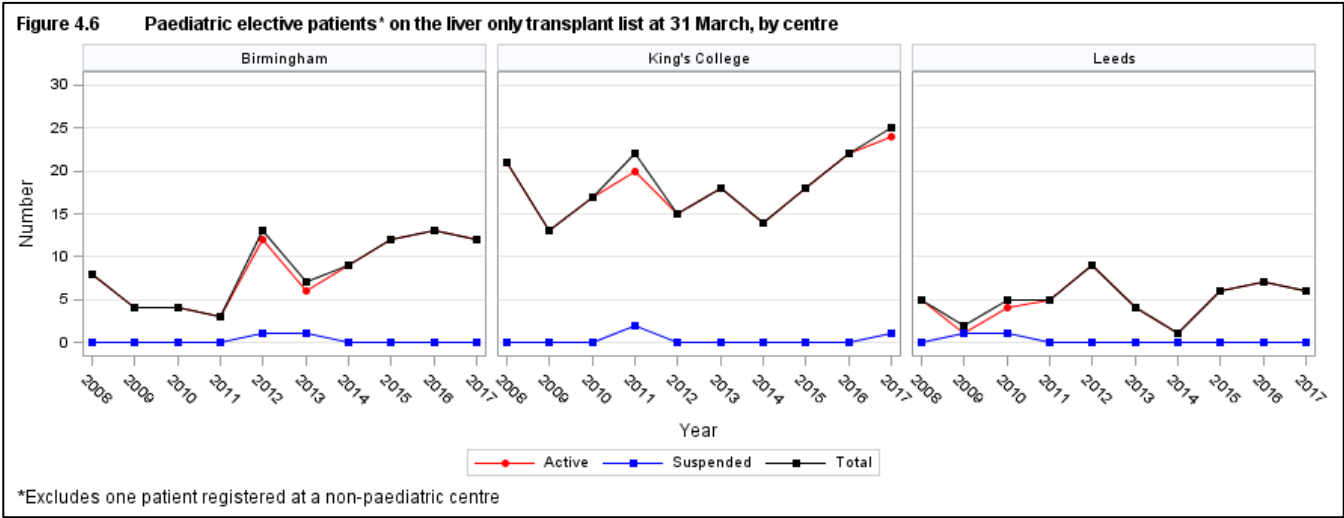


Figure 4.6 shows the number of [elective](#) patients on the transplant list at 31 March each year between 2008 and 2017 for each transplant centre.



An indication of outcomes for paediatric patients listed for a liver transplant is summarised in **Figure 4.7**. This shows the proportion of patients transplanted or still waiting six months, one and two years after joining the list. After one year 82% of patients have had a liver transplant, and 10% are still waiting.

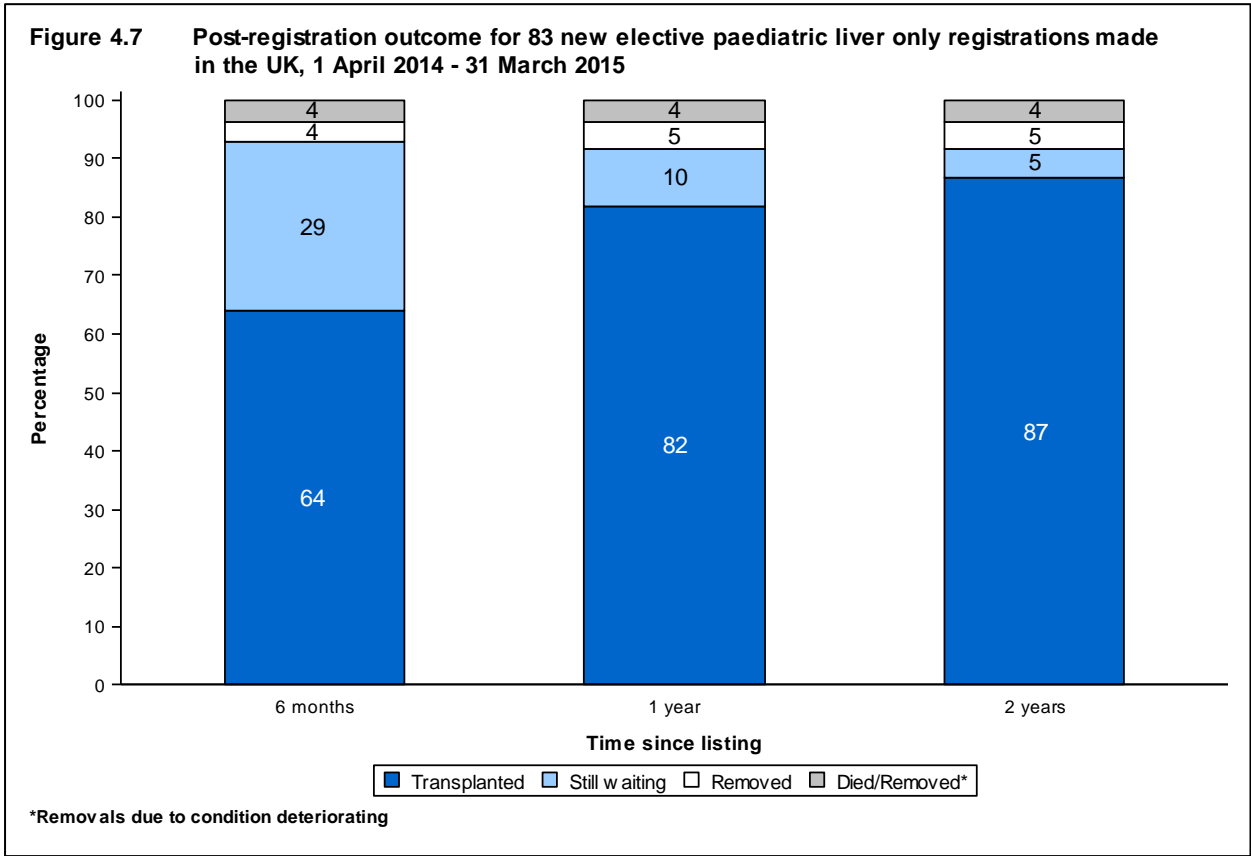
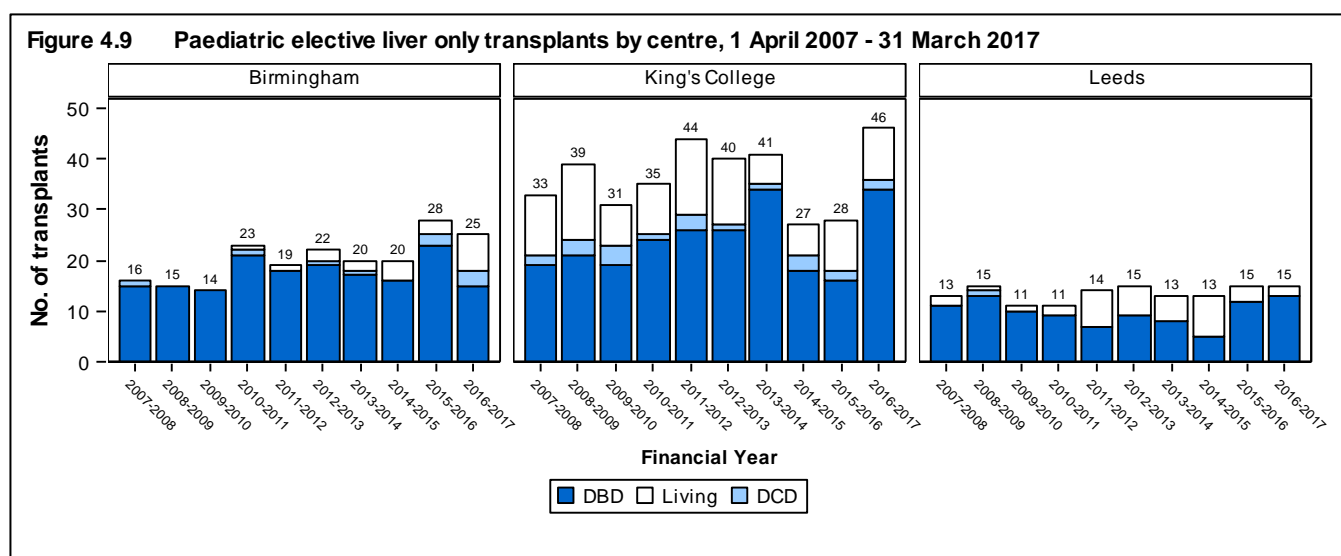
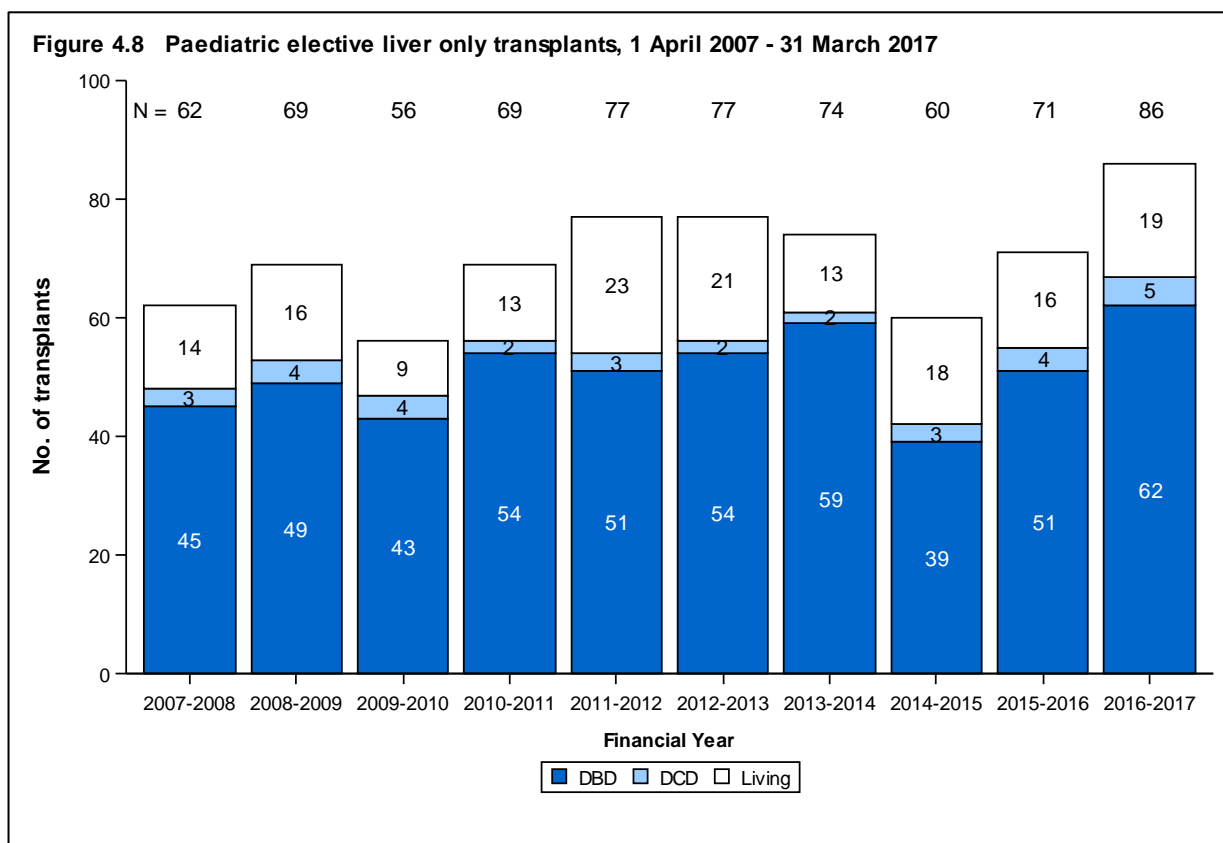


Table 4.2 shows the [median waiting time](#) to deceased donor liver only transplant for paediatric [elective](#) patients. The median waiting time to transplant is shortest at Leeds at 49 days, and longest at King's College Hospital, at 78 days. The national median waiting time to transplant is 73 days.

Table 4.2 Median waiting time to liver only transplant in the UK, for paediatric elective patients registered 1 April 2011 - 31 March 2014			
Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Paediatric			
Leeds	31	49	37 - 61
Birmingham	83	75	56 - 94
King's College	105	78	52 - 104
UK	219	73	57 - 89

4.2.2 Transplant activity

Figure 4.8 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 4.9** shows the same information by centre.



4.2.3 Post-transplant survival

Table 4.3 shows the [unadjusted](#) one year paediatric [patient survival](#) for all 212, deceased donor transplants (excluding 2 [auxiliary](#) transplants) from 1 April 2012 to 31 March 2016, nationally and by centre. Note that these survival rates should be interpreted with caution as one-year patient follow-up is incomplete for all centres (refer to **Table 4.8**).

Table 4.3 One year unadjusted patient survival for paediatric elective deceased donor first liver transplants, 1 April 2012 - 31 March 2016			
Centre	Number of transplants	1-year survival % (95% CI)	
Leeds	34	100.0	(-)
King's College	99	95.9	(89.5 - 98.5)
Birmingham	79	97.4	(89.9 - 99.3)
Total	212	97.1	(93.7 - 98.7)

Table 4.4 shows the [unadjusted](#) five year paediatric [patient survival](#) for all 207 transplants (excluding 3 [auxiliary](#) transplants) from 1 April 2008 to 31 March 2012, nationally and by centre. Note that these survival rates should be interpreted with caution as lifetime patient follow-up is incomplete for all centres (refer to **Table 4.8**).

Table 4.4 Five year unadjusted patient survival for paediatric elective deceased donor first liver transplants, 1 April 2008 - 31 March 2012			
Centre	Number of transplants	5-year survival % (95% CI)	
Leeds	40	90.0	(75.5 - 96.1)
King's College	98	93.5	(86.1 - 97.0)
Birmingham	69	89.6	(79.4 - 94.9)
Total	207	91.5	(86.7 - 94.6)

Paediatric Liver Transplantation Super-Urgent Patients



4.3.1 Transplant list

Table 4.5 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 but there is no statistically significant difference across the three centres. The national median waiting time to transplant is four days.

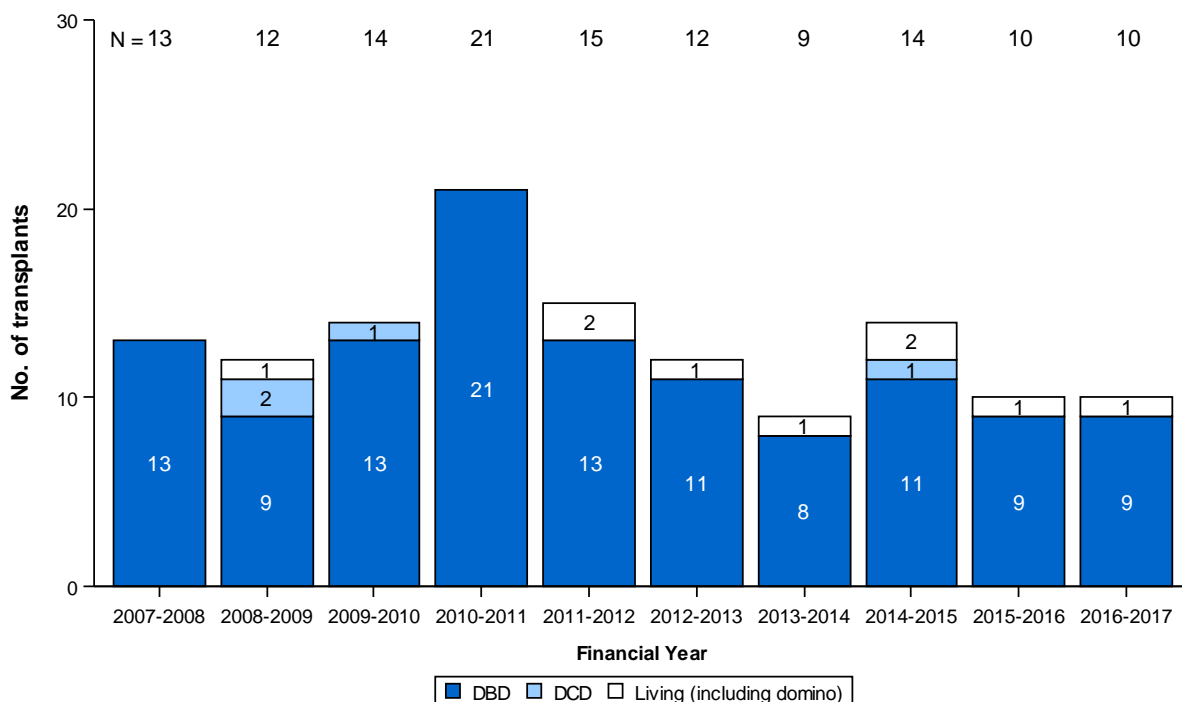
Table 4.5 Median waiting time to liver only transplant in the UK for, paediatric super urgent patients registered 1 April 2011 - 31 March 2014			
Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Paediatric			
Leeds	10	2	0 - 4
King's College	32	4	2 - 6
Birmingham	23	4	3 - 5
UK	65	4	3 - 5

Table 4.5 includes registrations for a re-transplant. Of the 65 registrations for the UK in the three-year time period, only 47 led to transplants (the remaining 18 led to removal or death). Fifteen of the 47 transplants were re-transplanted, hence, the difference between the 45 *first* deceased donor liver only transplants reported in **Figure 4.10** for the period 2011 – 2014 and **Table 4.5**.

4.3.2 Transplant activity

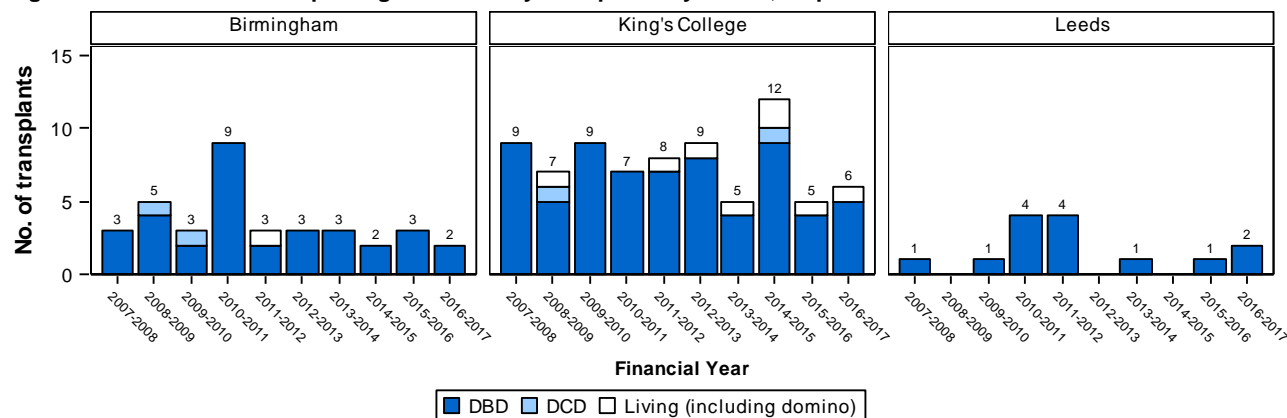
Figure 4.10 shows the number of paediatric [super-urgent](#) first liver only transplants from deceased and living (including domino) donors performed in the last ten years, by type of donor. There was one domino donor. **Figure 4.11** shows the same information by transplant centre.

Figure 4.10 Paediatric super-urgent* liver only transplants, 1 April 2007 - 31 March 2017



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

Figure 4.11 Paediatric super-urgent* liver only transplants by centre, 1 April 2007 - 31 March 2017



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

4.3.3 Post-transplant survival

One year [unadjusted patient survival](#) for 40 transplants (excluding 2 [auxiliary](#) transplants) between 1 April 2012 and 31 March 2016 is shown in **Table 4.6**. Note that these survival rates should be interpreted with caution as one-year patient follow-up is incomplete for all centres (refer to **Table 4.8**).

Table 4.6 One year unadjusted patient survival for paediatric deceased donor super urgent first transplants, 1 April 2012 - 31 March 2016			
Centre	Number of transplants	1-year survival % (95% CI)	
Leeds	2 ¹	-	(-)
King's College	24	82.2	(59.2 - 93.0)
Birmingham	11	90.9	(50.8 - 98.7)
Total*	38	86.1	(69.6 - 94.0)
* Includes 1 patients transplanted at a non-paediatric centre			

Table 4.7 shows the [unadjusted](#) five year paediatric [patient survival](#) for 59 transplants (excluding 1 [auxiliary](#) transplant) between 1 April 2008 and 31 March 2012, nationally and by centre. Note that these survival rates should be interpreted with caution as lifetime patient follow-up is incomplete for all centres (refer to **Table 4.8**).

Table 4.7 Five year unadjusted patient survival for paediatric deceased donor super urgent first transplants, 1 April 2008 - 31 March 2012			
Centre	Number of transplants	5-year survival % (95% CI)	
Leeds	9 ¹	-	(-)
King's College	29	79.3	(59.6 - 90.1)
Birmingham	18	72.2	(45.6 - 87.4)
Total*	58	74.1	(60.8 - 83.5)
* Includes 2 patients transplanted at a non-paediatric centre			

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.

¹ Survival rates for less than 10 transplants are not presented due to small numbers.

Paediatric Liver Transplantation

Form return rates



Form return rates are reported in **Table 4.8** 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 2016 and 31 December 2016 for the transplant record, and all requests for follow-up forms issued in this time period. Cambridge has also returned 100% follow up at 3 months and 1 year for a paediatric patient that they treated. Note that the Leeds Data Collector contract ended at the beginning of 2016.

Table 4.8 Form return rates, 1 January 2016 and 31 December 2016								
Centre	Transplant record		3 month follow-up		1 year follow-up		Lifetime follow-up	
	N	% returned	N	% returned	N	% returned	N	% returned
Leeds	13	100	13	87	10	83	50	76
King's College	38	100	32	100	22	96	130	62
Birmingham	20	100	18	100	26	93	118	87

Appendix



A1 Data

Data were obtained from the UK Transplant Registry for the ten year time period, 1 April 2007 to 31 March 2017 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.

Geographical variation analysis

In relation to registration rates, all NHS group 1 patients who were registered onto the liver transplant list with an active status between 1 April 2016 and 31 March 2017 were extracted from the UK Transplant Registry on 12 June 2017 (numerator). Patients registered for an intestinal transplant requiring a liver were excluded. Patients were assigned to Strategic Health Authorities (SHA) in England using their postcode of residence, as reported at registration. The number of registrations per million population (pmp) by SHA was obtained using mid-2015 population estimates based on the Office for National Statistics (ONS) 2011 Census figures (denominator). No SHA age- or sex-specific standardisation of rates was performed.

The registration rates pmp were categorised into four groups – low, low-medium, medium-high and high – based on the quartiles of their distribution and visualised in a map using contrasting colours.

Transplant rates pmp were obtained as the number of liver transplants on NHS group 1 recipients between 1 April 2016 and 31 March 2017 (numerator), divided by the mid-2015 population estimates from the ONS (denominator). Patients who received an intestinal transplant containing a liver were excluded. Transplant rates pmp were categorised and visualised in a map as done for the registration rates.

Systematic component of variation; only registrations or transplants in England between 1 April 2016 and 31 March 2017 were included. If a patient was re-registered during the time period, only the first registration was considered. If a patient underwent more than one liver transplant in the time period, only the first transplant was considered.

Adult and paediatric analysis

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 A1.1 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 A1.2** shows the number of adult deceased donor first liver only transplants.

Table A1.1 Number of adult liver transplants in each time period, by transplant centre and urgency status						
Transplant centre	Latest year April 2016-March 2017		Last 3 years April 2014-March 2017		Last 10 years April 2007-March 2017	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	39	3	107	15	327	58
Leeds	113	13	302	37	846	103
Cambridge	95	7	252	27	714	89
Royal Free	87	17	250	46	677	108
King's College	177	15	505	55	1459	204
Birmingham	186	15	541	59	1438	198
Edinburgh	97	6	272	24	754	98
TOTAL	794	76	2229	263	6215	858

Table A1.2 Number of deceased donor adult first liver only transplants in each time period, by transplant centre and urgency status						
Transplant centre	Latest year April 2016-March 2017		Last 3 years April 2014-March 2017		Last 10 years April 2007-March 2017	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	34	3	92	13	284	48
Leeds	103	11	262	23	759	65
Cambridge	87	3	232	11	652	49
Royal Free	84	13	228	36	621	80
King's College	147	13	422	46	1235	167
Birmingham	166	10	484	45	1309	150
Edinburgh	85	2	250	11	685	66
TOTAL	706	55	1970	185	5545	625

Table A1.3 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 A1.4** shows the number of paediatric deceased donor first liver only transplants

Table A1.3 Number of paediatric liver transplants in each time period, by transplant centre and urgency status						
Transplant centre	Latest year April 2016-March 2017		Last 3 years April 2014-March 2017		Last 10 years April 2007-March 2017	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	0	0	0	0	0	1
Leeds	16	3	45	7	146	24
Cambridge	0	0	0	1	0	1
Royal Free	0	0	0	0	1	2
King's College	48	7	104	26	395	90
Birmingham	33	3	96	9	255	53
TOTAL	97	13	245	43	797	171

Table A1.4 Number of deceased donor paediatric first liver only transplants in each time period, by transplant centre and urgency status

Transplant centre	Latest year April 2016-March 2017		Last 3 years April 2014-March 2017		Last 10 years April 2007-March 2017	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	0	0	0	0	0	1
Leeds	13	2	30	3	98	14
Cambridge	0	0	0	1	0	1
Royal Free	0	0	0	0	0	1
King's College	36	5	75	19	259	69
Birmingham	18	2	59	7	182	35
TOTAL	67	9	164	30	539	121

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

A2 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 within the timeframe 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.

Systematic component of variation

For a given individual who is a resident in a given English Strategic Health Authority (SHA), registration to the transplant list is modelled as a Bernoulli trial. At the whole area level, this becomes a Binomial process which can be approximated by a Poisson distribution when rare events are modelled. Transplant counts follow similar assumptions.

To allow for the possibility that, even after allowing for area-specific Poisson rates, area differences remain, introduce an additional multiplicative rate factor which varies from area to area. Postulate a non-parametric distribution for the multiplicative factor, with variance σ^2 . If the factor is one for all areas, then area differences are fully explained by the area-specific Poisson rate. If the factor varies with a nonzero variance, σ^2 , then we conclude that there are unexplained area differences. The systematic component of variation (SCV; McPherson *et al.*, *N Engl J Med* 1982, **307**: 1310-4) is the moment estimator of σ^2 . Under the null hypothesis of homogeneity across areas, the SCV would be zero. The SCV, therefore, allows us to detect variability across areas beyond that expected by chance; the larger the SCV, the greater the evidence of systematic variation across areas.

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 A3.1 and A3.2** 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 A3.3**.

A3 Risk models

Table A3.1 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
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

Table A3.1 Risk factors and categories used in the adult elective risk adjusted survival models post transplantation

	≥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 A3.2 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

Table A3.2 Risk factors and categories used in the adult super-urgent risk adjusted survival models post transplantation	
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
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 A3.3 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 µmol/l	Per 10 µmol/l increase
Serum bilirubin µmol/l	Per 10 µmol/l increase
INR	Per 1 unit increase
Year of registration	Split into three time intervals equally divided

A4 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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