



Blood and Transplant

**ANNUAL REPORT ON
LIVER TRANSPLANTATION**

**REPORT FOR 2017/2018
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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 2008 to 31 March 2018. 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.

The National Liver Offering Scheme (NLOS) was introduced on 20th March 2018 initially for offering livers from donors after brain death (DBD). This report includes the first 11 days.

Key findings

- On 31 March 2018, there were 359 patients on the UK [active transplant list](#), which represents a 32% decrease in the number of patients a year earlier.
- Of the patients joining the [elective](#) liver only waiting list, approximately 78% had received a transplant within two years of listing.
- There were 8428 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. In the most recent year, the number of transplants from [donors after brain death](#) has been higher than at any point in the last 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	80
Super-urgent	90	81
Paediatric		
Elective	97	93
Super-urgent	94	69

- The national rates of patient survival after joining the transplant list for adult elective first liver only patients is 84% at one, 70% at five and 58% at ten years post-registration.

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Introduction



This report presents information on the UK transplant list, transplant activity and transplant outcomes between 1 April 2008 and 31 March 2018, 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 2009 and 31 March 2013 for 5 year survival, and 1 April 2013 to 31 March 2017 for 1 year survival. Patient survival from registration is presented for the period 1 January 2006 to 31 December 2017. 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 2009 and 2018. The number of patients waiting for a transplant increased each year from 338 in 2009 to 611 in 2015, with an exception in 2013. There has been a decline in patients since 2015 to 359 patients in 2018. The large drop in the number of patients actively listed may be due to the introduction of the National Liver Offering Scheme (NLOS) on 20 March 2018. It may also be due to changes in medical treatment options for patients with certain aetiologies.

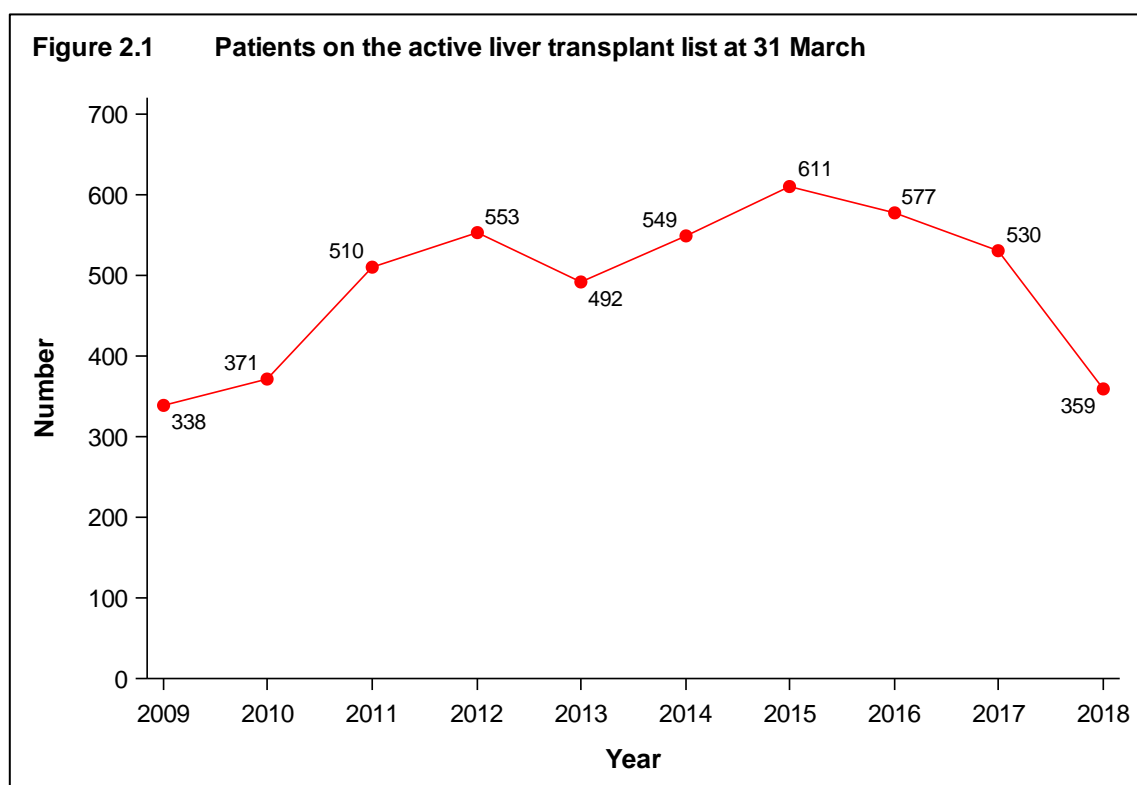
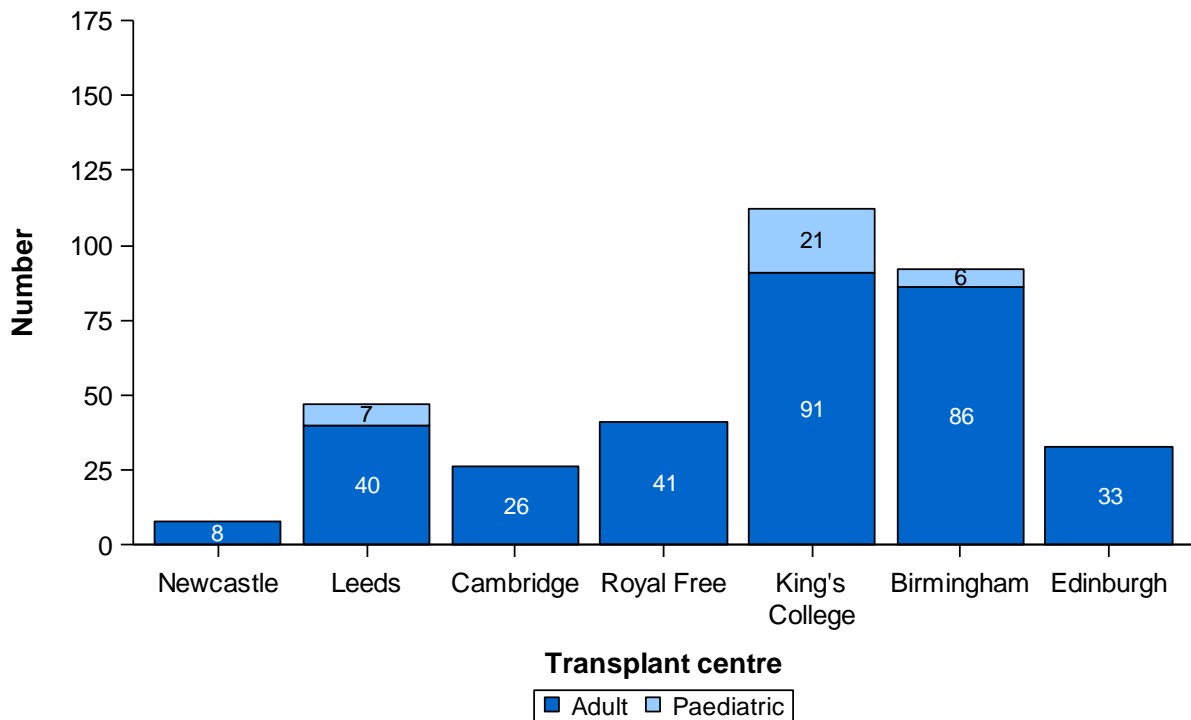


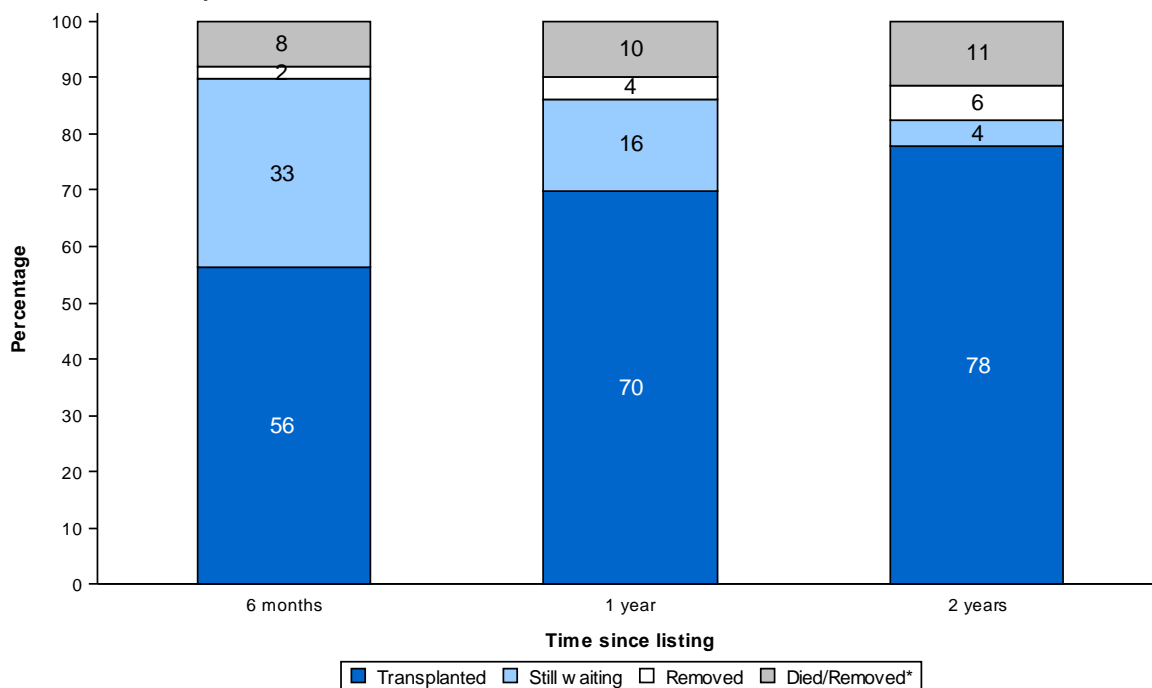
Figure 2.2 shows the number of adult and paediatric patients on the transplant list at 31 March 2018, by centre. In total, there were 325 adults and 34 paediatric patients. King's College Hospital had the largest share of the transplant list (31%) and Newcastle the smallest (2%). This figure includes [multi-organ](#), [elective](#) and [super-urgent](#) registrations.

Figure 2.2 Patients on the active liver transplant list at 31 March 2018



An indication of long-term outcomes for patients listed between April 2015 and March 2016 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, 70% of patients had received a transplant and 16% were still waiting.

Figure 2.3 Post-registration outcome for 994 new elective liver only registrations made in the UK, 1 April 2015 - 31 March 2016



*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](#)) steadily increased over the time period to 209 in 2016/17. However, the number of DCD transplants reduced slightly to 200 in 2017/2018. The number of transplants from donors after brain death ([DBD](#)) has increased in the most recent year to 813. There were 29 [living donor](#) liver transplants and 1 [domino](#) transplant performed in the last financial year.

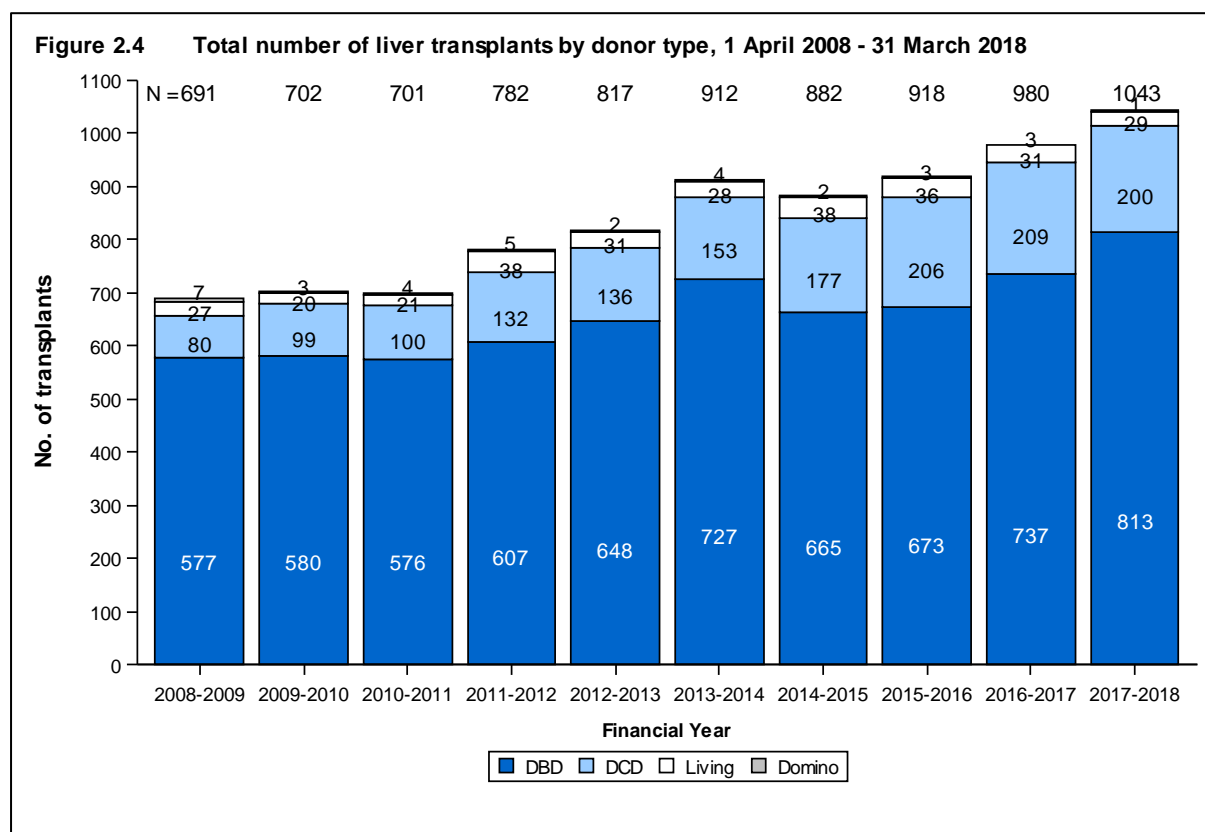
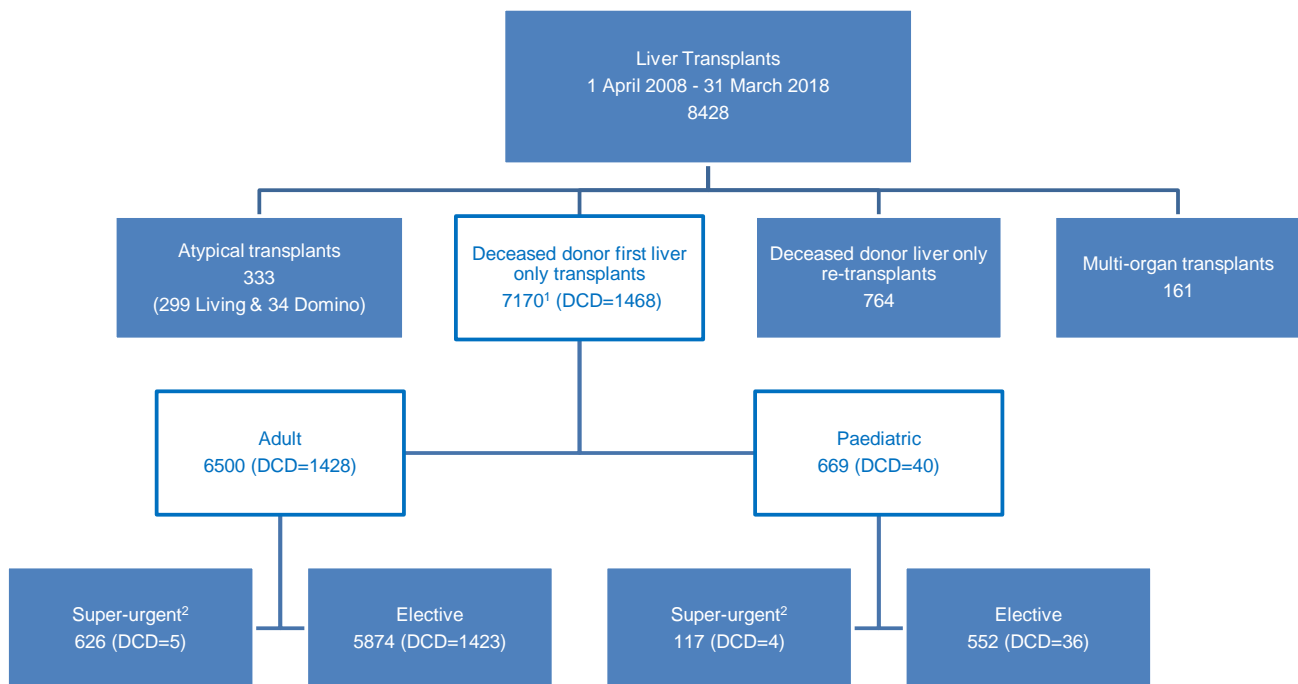


Figure 2.5 details the 8428 liver transplants performed in the UK in the ten year period. Of these, 7170 (85%) were deceased donor first liver only transplants. One transplant recipient refused consent for their data to be used in analysis and, therefore, could not be categorised as an adult or a paediatric patient. Of the 7170 transplants that were analysed, 6500 (91%) were performed in adult and 669 (9%) in paediatric patients. Similarly including both adult and paediatric, 6426 (90%) were elective and 743 (10%) were super-urgent transplants.

Figure 2.5 Liver transplants in the UK, 1 April 2008 – 31 March 2018



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 2017 and 31 March 2018 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.

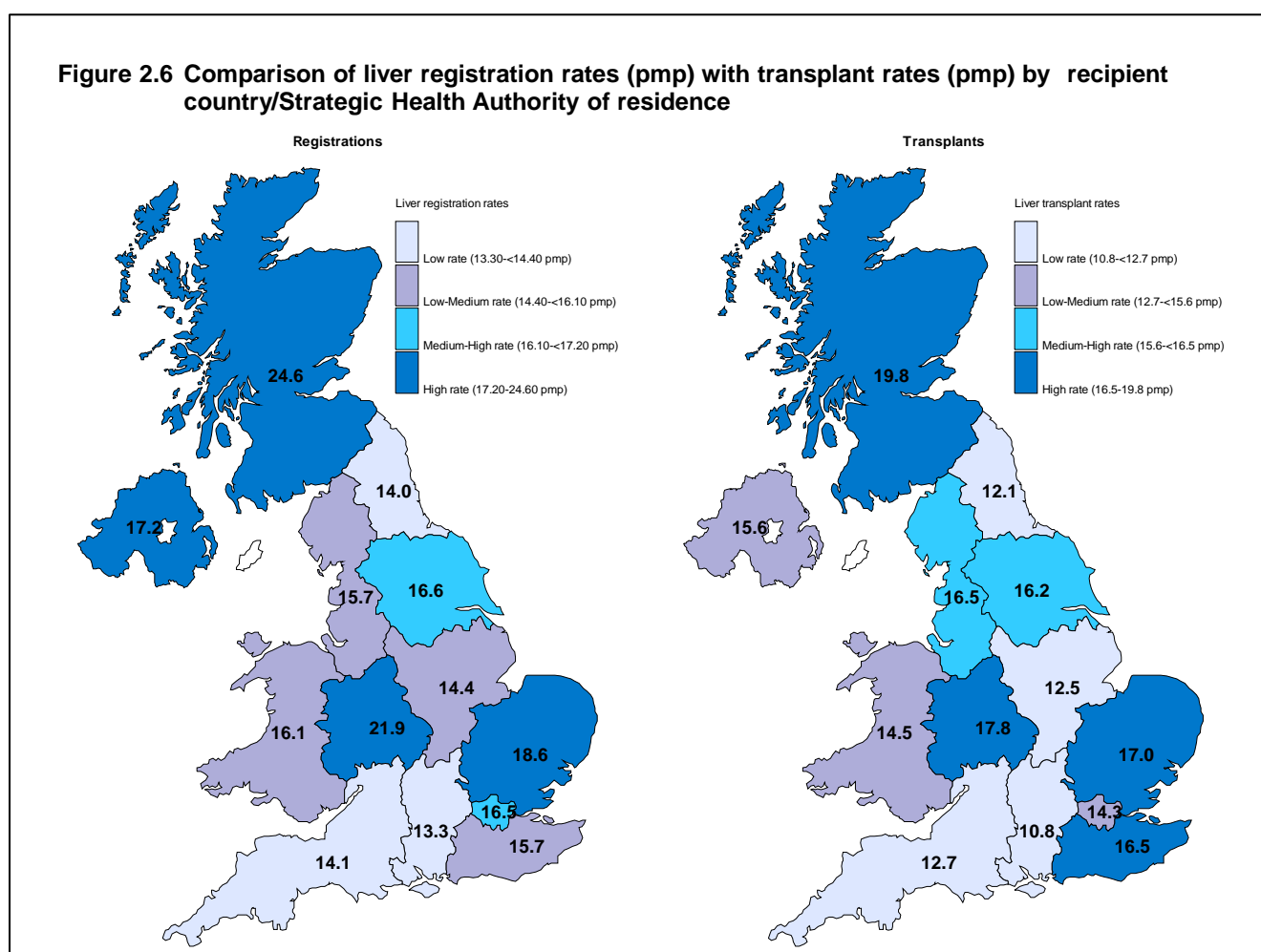


Table 2.2 Liver registration and transplant rates per million population (pmp) in the UK, 1 April 2017 - 31 March 2018, by Country/Strategic Health Authority

Country/ Strategic Health Authority	Registrations (pmp)		Transplants (pmp)	
North East	37	(14)	32	(12.1)
North West	113	(15.7)	119	(16.5)
Yorkshire and The Humber	90	(16.6)	88	(16.2)
North of England	240	(15.7)	239	(15.6)
East Midlands	68	(14.4)	59	(12.5)
West Midlands	127	(21.9)	103	(17.8)
East of England	114	(18.6)	104	(17)
Midlands and East	309	(18.6)	266	(16)
London	145	(16.5)	126	(14.3)
South East Coast	73	(15.7)	77	(16.5)
South Central	58	(13.3)	47	(10.8)
South West	78	(14.1)	70	(12.7)
South of England	209	(14.4)	194	(13.4)
England	903	(16.3)	825	(14.9)
Isle of Man	2	(25)	2	(25)
Channel Islands	2	(12.5)	2	(12.5)
Wales	50	(16.1)	45	(14.5)
Scotland	133	(24.6)	107	(19.8)
Northern Ireland	32	(17.2)	29	(15.6)
TOTAL	1128	(17.1)	1014	(15.4)

¹ Registrations include 6 recipients whose postcode was unknown and excludes 5 recipients who reside in the Republic of Ireland and 8 recipients who reside overseas

² Transplants include 4 recipients whose postcode was unknown and excludes 5 recipients who reside in the Republic of Ireland and 9 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 828 transplants in the latest financial year, 754 (91%) were [elective](#) and 74 (9%) were [super-urgent](#) transplants. See **Appendix 1** for further details.

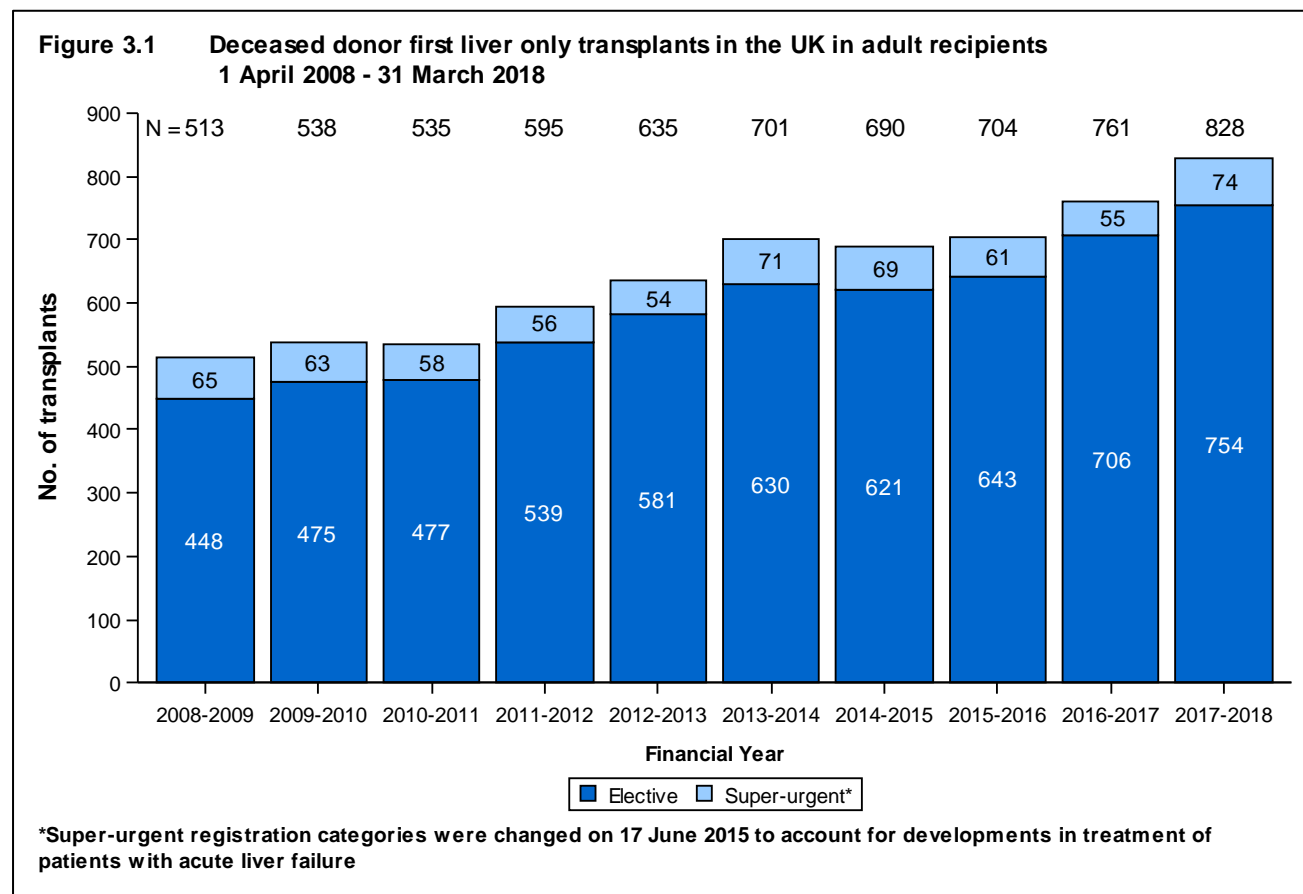
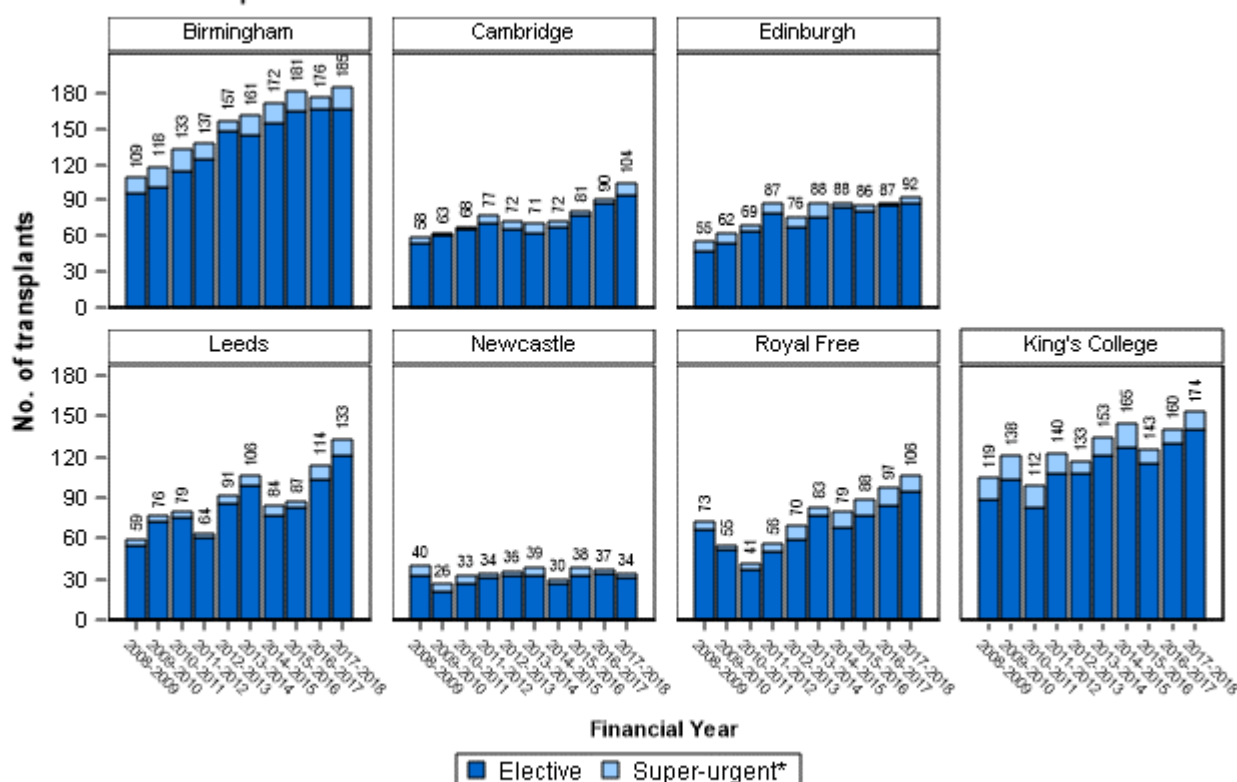


Figure 3.2 Deceased donor first liver only transplants in the UK in adult recipients, 1 April 2008 - 31 March 2018



*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](#) (CIT) 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 CIT for transplants from DBD donors has decreased from 9.5 hours in 2008/09 to 8.5 hours in 2017/18. The median CIT in the last financial year ranged between 7.3 and 10.6 hours across transplant centres.

The national median for DCD donor transplants has remained relatively stable over the ten year period, from 6.8 hours in 2008/09 to 7.4 hours in 2017/18. In the last financial year, the median CIT for DCD donor transplants at different centres ranged from 6.3 to 9.5 hours. Note that the reported CIT may include periods of machine perfusion.

Figure 3.3 Median cold ischaemia time in all adult DBD donor liver transplants, 1 April 2008 - 31 March 2018

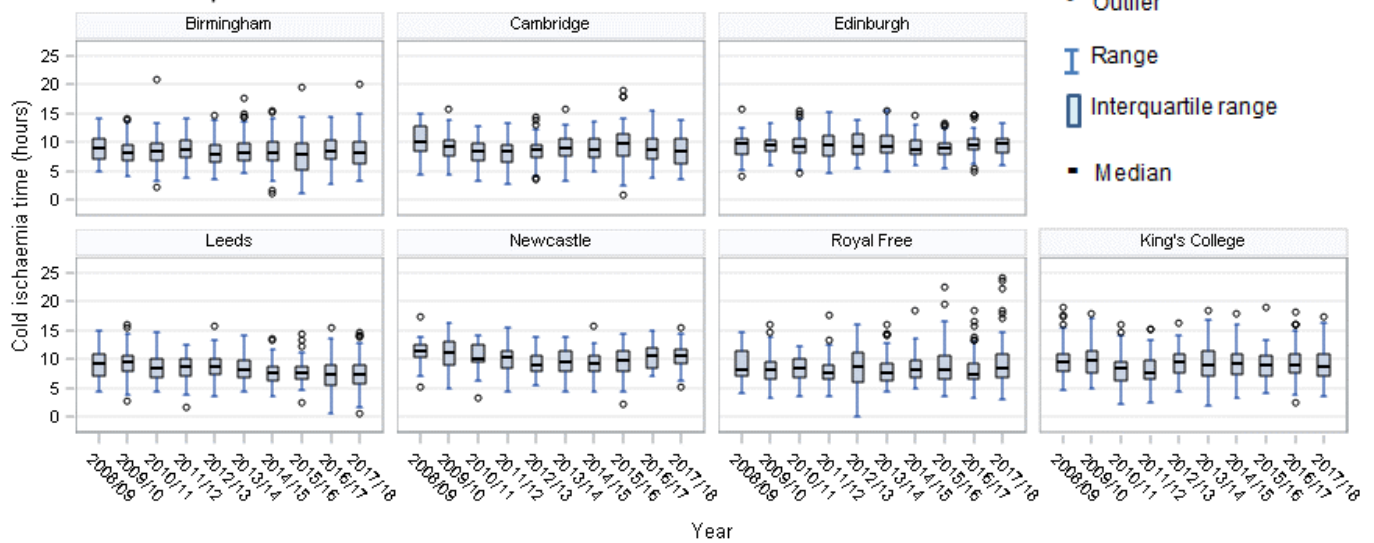
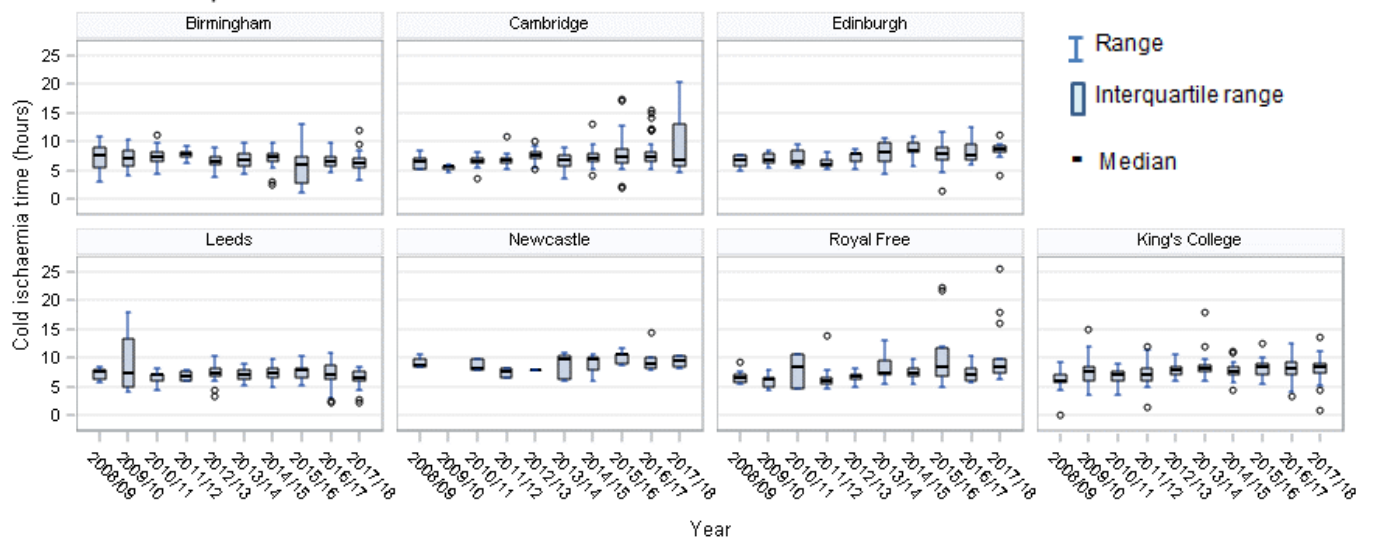


Figure 3.4 Median cold ischaemia time in all adult DCD donor liver transplants, 1 April 2008 - 31 March 2018



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 2009 and 2018. The number of patients on the [active](#) liver only transplant list increased almost every year from 296 in 2009 to 514 in 2015. This has reduced to 301 active patients in 2018. The number of patients suspended on the transplant list has increased from 23 in 2017 to 86 in 2018.

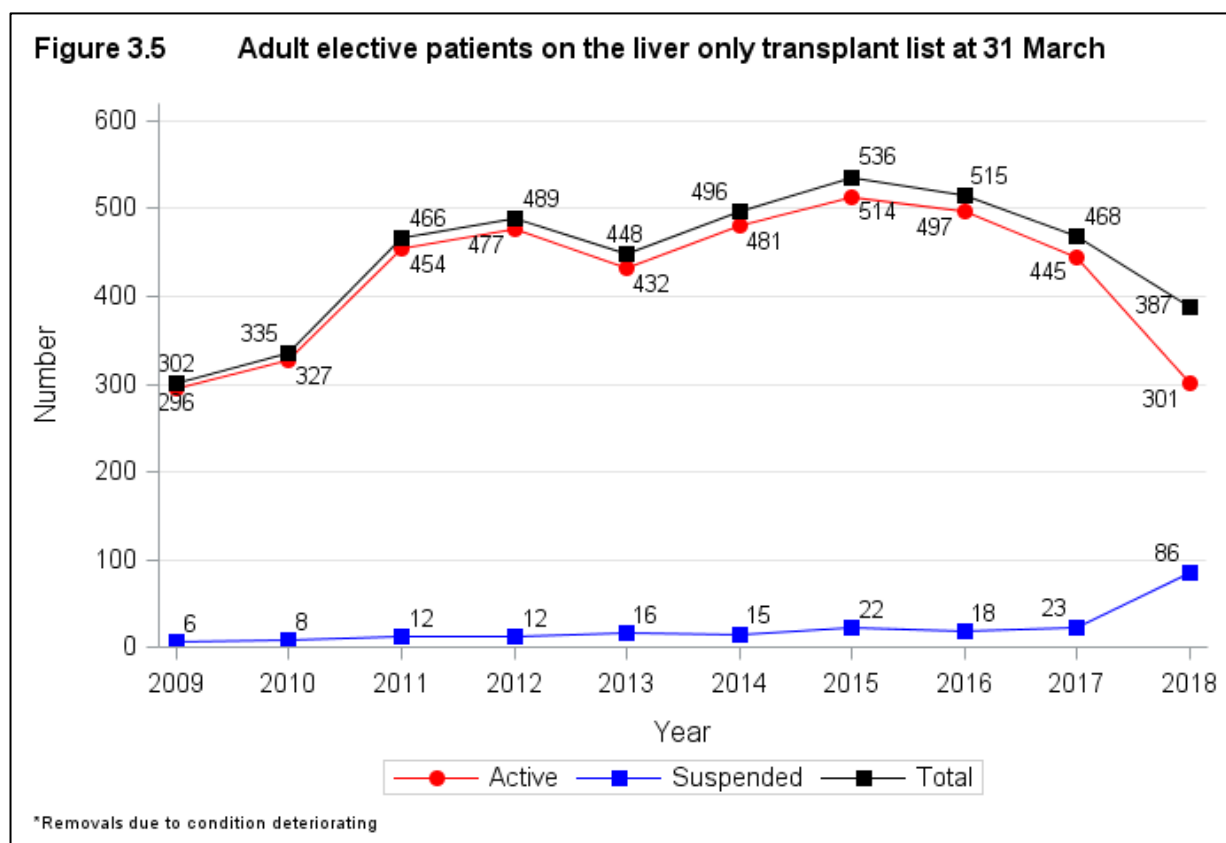
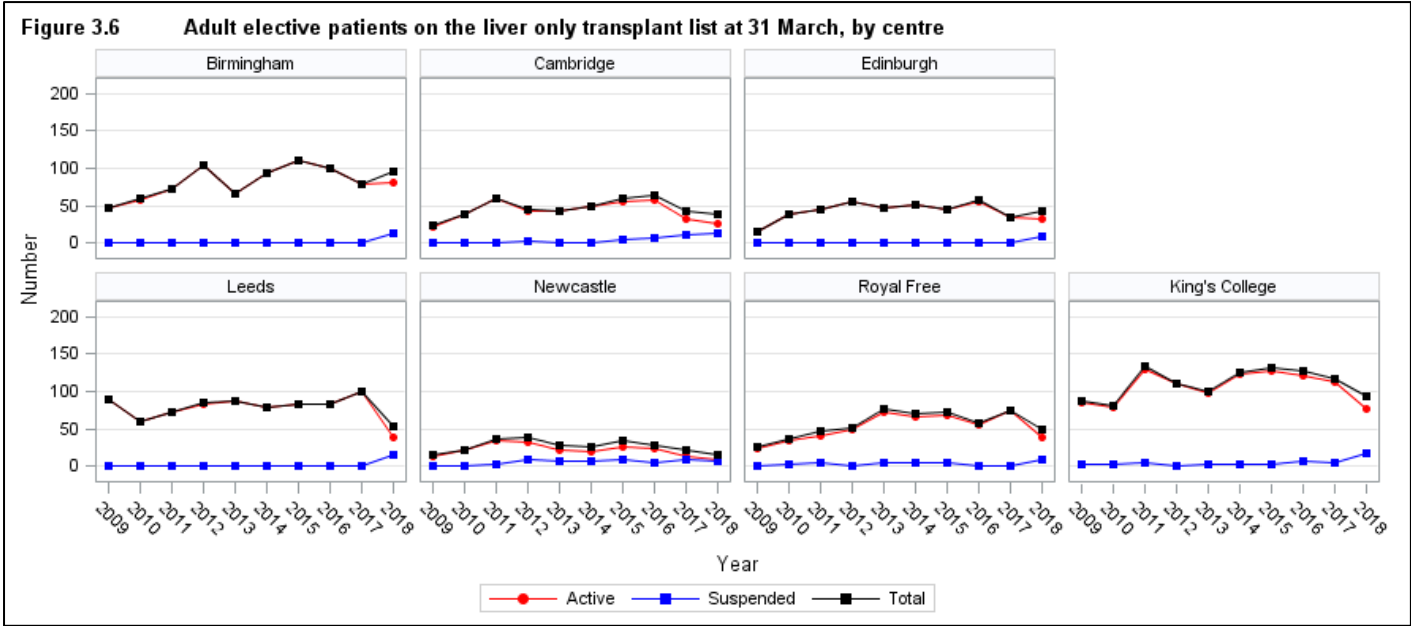


Figure 3.6 shows the number of adult patients on the transplant list at 31 March each year between 2009 and 2018, by transplant centre.



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.

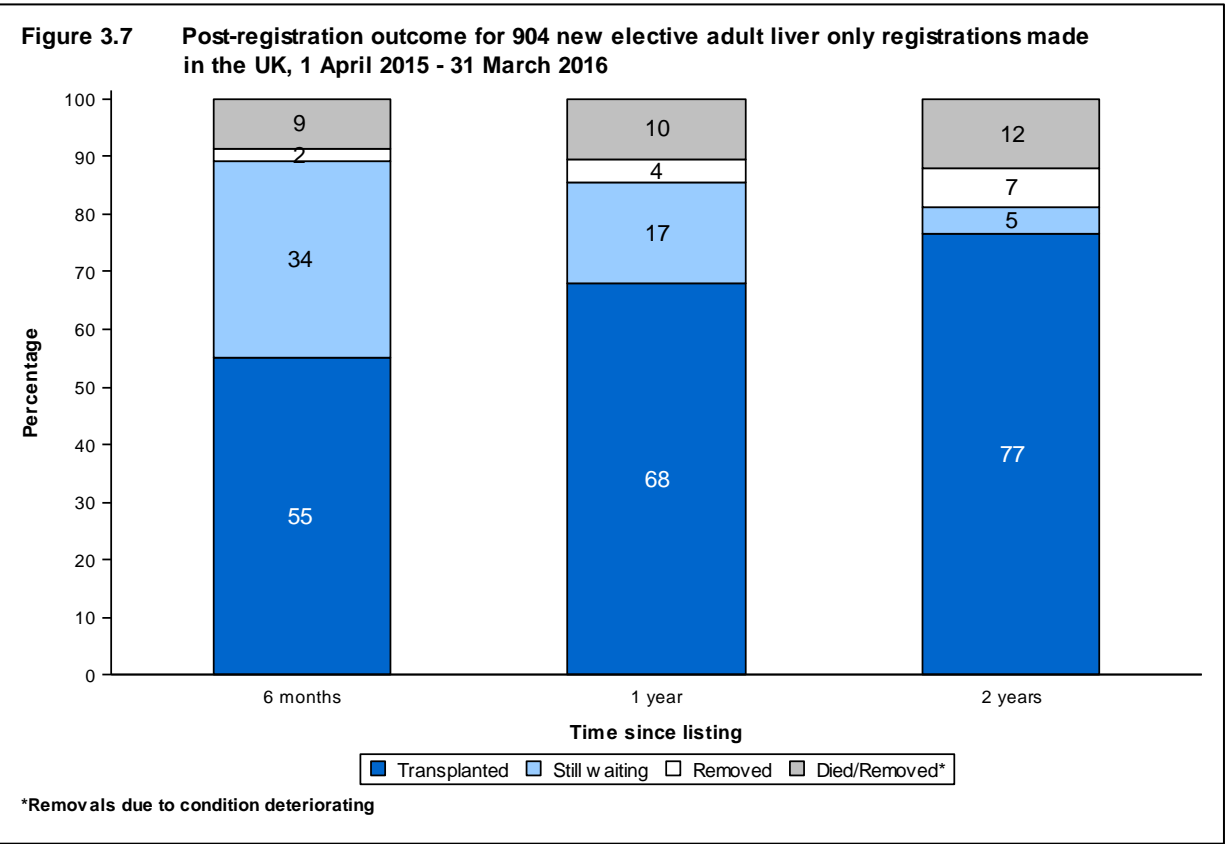


Table 3.1 shows the [median waiting time](#) to deceased donor liver only transplant for adult [elective](#) patients. The national median waiting time to transplant for adult elective patients is 134 days. The median waiting time to transplant is shorter at Edinburgh (79 days) and longer at King's (189 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. It is also important to note that these median waiting times were based on the old centre based offering scheme and that median waiting time under the new NLOS may be different.

Table 3.1 Median waiting time to liver only transplant in the UK, for adult elective patients registered 1 April 2012 - 31 March 2015			
Transplant centre	Number of patients registered	Waiting time (days) Median	95% Confidence interval
Adult			
Edinburgh	298	79	61 - 97
Birmingham	633	104	89 - 119
Cambridge	294	120	79 - 161
Leeds	376	122	95 - 149
Newcastle	132	133	85 - 181
Royal Free	306	181	143 - 219
King's College	562	189	163 - 215
UK	2601	134	124 - 144

Table 3.2 shows the demographics of 943 adult [elective](#) liver patients registered from 1 April 2017 to 31 March 2018, by transplant centre. The majority of patients that were registered were male (66%), white (89%) with a [median](#) age of 55 and a BMI of 27. The most common indication for registration was alcoholic liver disease, followed by cancer. For some characteristics, due to rounding, percentages may not add up to 100.

Table 3.2 Demographic characteristics of adult elective liver patients registered from 1 April 2017 - 31 March 2018

		Birmingham	Cambridge	Edinburgh	King's college	Leeds	Newcastle	Royal Free	Total
Number		N (%) 230	N (%) 112	N (%) 118	N (%) 207	N (%) 128	N (%) 39	N (%) 109	N (%) 943
Recipient sex	Male	143 (62)	77 (69)	79 (67)	135 (65)	89 (70)	28 (72)	70 (64)	621 (66)
	Female	87 (38)	35 (31)	39 (33)	72 (35)	39 (30)	11 (28)	39 (36)	322 (34)
Recipient ethnicity	White	211 (92)	103 (92)	112 (95)	167 (81)	118 (92)	38 (97)	91 (83)	840 (89)
	Non-white	17 (7)	7 (6)	6 (5)	40 (19)	10 (8)	1 (3)	18 (17)	99 (10)
	Not reported	2 (1)	2 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (0)
Indication	Cancer	31 (13)	28 (25)	28 (24)	39 (19)	21 (16)	9 (23)	35 (32)	191 (20)
	Hepatitis C	6 (3)	5 (4)	3 (3)	4 (2)	4 (3)	0 (0)	5 (5)	27 (3)
	Alcoholic liver disease	50 (22)	18 (16)	35 (30)	36 (17)	45 (35)	9 (23)	23 (21)	216 (23)
	Hepatitis B	2 (1)	0 (0)	0 (0)	2 (1)	1 (1)	0 (0)	6 (6)	11 (1)
	Primary sclerosing cholangitis	34 (15)	13 (12)	6 (5)	22 (11)	21 (16)	3 (8)	13 (12)	112 (12)
	Autoimmune and cryptogenic disease	17 (7)	1 (1)	6 (5)	16 (8)	8 (6)	6 (15)	8 (7)	62 (7)
	Primary biliary cirrhosis	20 (9)	6 (5)	12 (10)	11 (5)	1 (1)	3 (8)	4 (4)	57 (6)
	Metabolic liver disease	29 (13)	21 (19)	15 (13)	23 (11)	13 (10)	4 (10)	12 (11)	117 (12)
	Other	25 (11)	13 (12)	10 (8)	49 (24)	8 (6)	3 (8)	3 (3)	111 (12)
	Acute hepatic failure	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0)
	Re-transplantation	15 (7)	7 (6)	3 (3)	5 (2)	6 (5)	2 (5)	0 (0)	38 (4)
Recipient HCV	No	219 (95)	97 (87)	102 (86)	191 (92)	120 (94)	36 (92)	94 (86)	859 (91)
	Yes	11 (5)	15 (13)	16 (14)	16 (8)	8 (6)	3 (8)	15 (14)	84 (9)
Encephalopathy	Absence	149 (65)	77 (69)	88 (75)	153 (74)	68 (53)	30 (77)	83 (76)	648 (69)
	Presence	81 (35)	35 (31)	30 (25)	54 (26)	60 (47)	9 (23)	26 (24)	295 (31)

Table 3.2 Demographic characteristics of adult elective liver patients registered from 1 April 2017 - 31 March 2018

		Birmingham	Cambridge	Edinburgh	King's college	Leeds	Newcastle	Royal Free	Total
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Renal support	No	224 (97)	109 (97)	118 (100)	194 (94)	127 (99)	38 (97)	109 (100)	919 (97)
	Yes	6 (3)	3 (3)	0 (0)	13 (6)	1 (1)	1 (3)	0 (0)	24 (3)
Previous abdominal surgery	No	178 (77)	88 (79)	91 (77)	130 (63)	93 (73)	34 (87)	91 (83)	705 (75)
	Yes	52 (23)	24 (21)	27 (23)	77 (37)	35 (27)	5 (13)	18 (17)	238 (25)
Recip age (years)	Median (IQR)	53 (43, 61)	56 (48, 62)	57 (51, 62)	54 (41, 60)	53 (46, 60)	62 (53, 65)	57 (48, 63)	55 (46, 62)
BMI (kg/m2)	Median (IQR)	28 (24, 32)	28 (25, 33)	29 (24, 32)	27 (23, 30)	26 (23, 30)	28 (23, 32)	27 (24, 31)	27 (23, 31)
Serum bilirubin (umol/l)	Median (IQR)	36 (19, 76)	46 (22, 74)	41 (24, 90)	37 (19, 86)	44 (28, 110)	34 (19, 84)	36 (20, 59)	39 (21, 78)
Serum creatinine (umol/l)	Median (IQR)	71 (61, 90)	63 (54, 81)	75 (64, 94)	71 (59, 94)	73 (55, 95)	79 (69, 89)	79 (69, 92)	73 (60, 91)
	Not reported	0	1	0	0	0	0	0	1
Serum sodium (mmol/l)	Median (IQR)	138 (136, 141)	136 (134, 139)	135 (132, 139)	137 (133, 139)	136 (134, 139)	138 (135, 140)	138 (135, 141)	137 (134, 140)
Serum potassium (mmol/l)	Median (IQR)	4 (4, 5)	4 (4, 4)	4 (4, 5)	4 (4, 5)	4 (4, 5)	4 (4, 5)	4 (4, 5)	4 (4, 5)
INR	Median (IQR)	1 (1, 2)	1 (1, 2)	1 (1, 2)	1 (1, 2)	1 (1, 2)	1 (1, 2)	1 (1, 1)	1 (1, 2)
Serum albumin (g/l)	Median (IQR)	37 (32, 41)	29 (26, 33)	27 (24, 31)	33 (29, 38)	30 (26, 33)	35 (29, 40)	33 (30, 39)	32 (28, 37)

3.2.2 Transplant activity

Figure 3.8 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 3.9** shows the same information by centre. Please note that living liver transplants performed at London Bridge and Cromwell Hospitals are included in **Figure 3.8** but not in **Figure 3.9**.

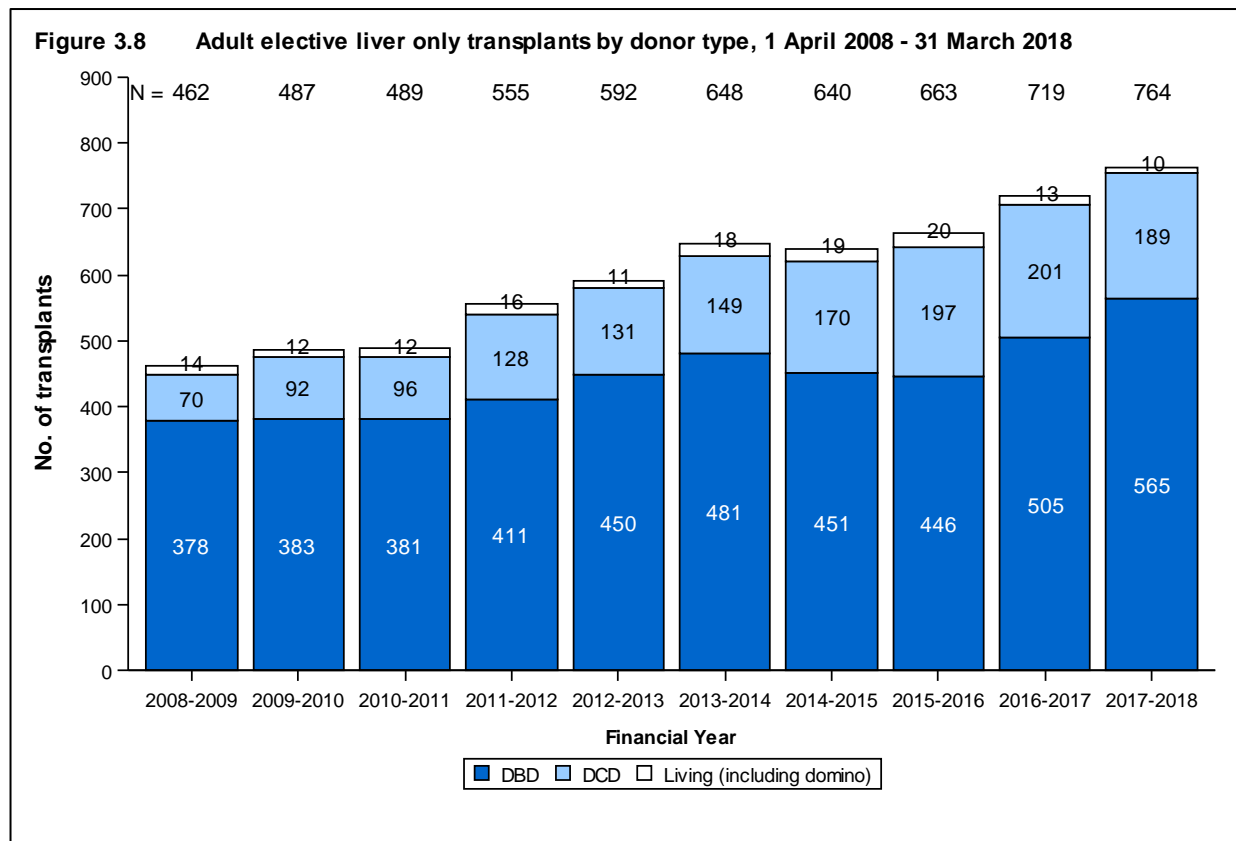
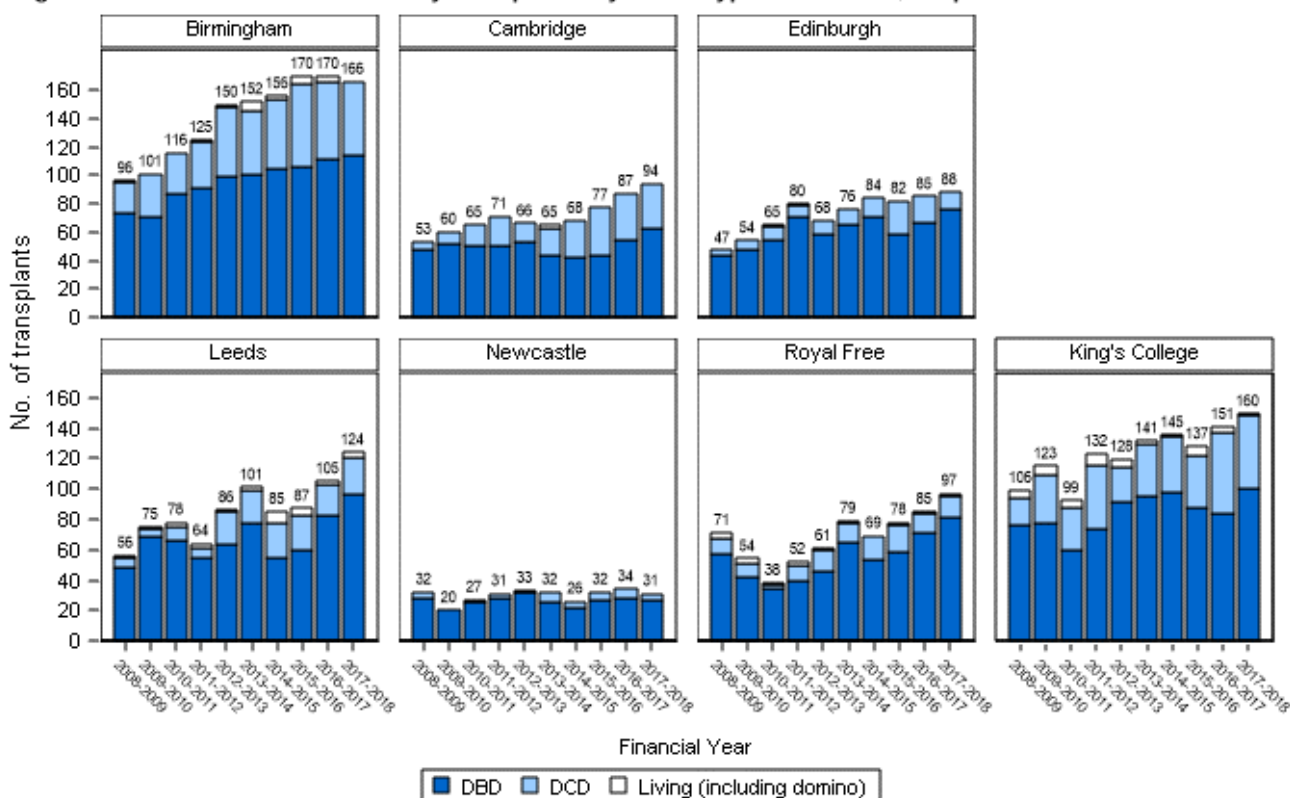


Figure 3.9 Adult elective liver only transplants by donor type and centre, 1 April 2008 - 31 March 2018



*Excludes 12 and 5 living liver transplants at London Bridge Hospital and Cromwell Hospital, respectively

The demographic characteristics of 754 adult [elective](#) deceased donor liver only transplant recipients in the latest year are shown by centre and overall in **Table 3.3**. The profile of patients are similar to those in **Table 3.2** which shows the demographics of patients registered. The profile donor was often a white (90%), male (54%), brainstem death (75%) with a [median](#) age of 54 and a BMI of 26. For some characteristics, due to rounding, percentages may not add up to 100.

Table 3.3 Demographic characteristics of adult elective first deceased donor liver only transplant recipients, 1 April 2017 - 31 March 2018

		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Number		166	94	88	159	121	31	95	754 (100)
Recipient sex	Male	99 (60)	62 (66)	59 (67)	108 (68)	77 (64)	19 (61)	59 (62)	483 (64)
	Female	67 (40)	32 (34)	29 (33)	51 (32)	44 (36)	12 (39)	36 (38)	271 (36)
Recipient ethnicity	White	149 (90)	88 (94)	83 (94)	133 (84)	113 (93)	30 (97)	85 (89)	681 (90)
	Non-white	16 (10)	6 (6)	5 (6)	26 (16)	8 (7)	1 (3)	10 (11)	72 (10)
	Not reported	1 (1)	0 (0)	0	0	0	0	0	1 (0)
Indication	Cancer	14 (8)	21 (22)	19 (22)	42 (26)	20 (17)	7 (23)	26 (27)	149 (20)
	Hepatitis C	8 (5)	7 (7)	3 (3)	5 (3)	5 (4)	0	6 (6)	34 (5)
	Alcoholic liver disease	38 (23)	15 (16)	27 (31)	35 (22)	42 (35)	9 (29)	21 (22)	187 (25)
	Hepatitis B	3 (2)	0	0	2 (1)	1 (1)	0	7 (7)	13 (2)
	Primary sclerosing cholangitis	26 (16)	15 (16)	6 (7)	24 (15)	18 (15)	3 (10)	11 (12)	103 (14)
	Primary biliary cirrhosis	18 (11)	7 (7)	13 (15)	7 (4)	8 (7)	5 (16)	3 (3)	61 (8)
	Autoimmune and cryptogenic disease	15 (9)	2 (2)	6 (7)	12 (8)	10 (8)	4 (13)	5 (5)	54 (7)
	Metabolic	26 (16)	20 (21)	11 (13)	18 (11)	12 (10)	3 (10)	10 (11)	100 (13)
	Other	17 (10)	7 (7)	3 (3)	14 (9)	5 (4)	0	6 (6)	52 (7)
	Acute Hepatic failure	1 (1)	0	0	0	0	0	0	1 (0)
Recipient HCV status	Negative	154 (93)	82 (87)	77 (88)	139 (87)	110 (91)	30 (97)	79 (83)	671 (89)
	Positive	11 (7)	12 (13)	5 (6)	18 (11)	8 (7)	1 (3)	16 (17)	71 (9)
	Not reported	1 (1)	0 (0)	6 (7)	2 (1)	3 (2)	0	0	12 (2)
Pre-transplant in-patient status	Out-patient	160 (96)	86 (91)	75 (85)	141 (89)	109 (90)	31 (100)	93 (98)	695 (92)
	In-patient	6 (4)	8 (9)	13 (15)	18 (11)	12 (10)	0	2 (2)	59 (8)

Table 3.3 Demographic characteristics of adult elective first deceased donor liver only transplant recipients, 1 April 2017 - 31 March 2018

		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Ascites	Absence	75 (45)	39 (41)	41 (47)	50 (31)	50 (41)	19 (61)	31 (33)	305 (40)
	Presence	89 (54)	55 (59)	44 (50)	109 (69)	70 (58)	12 (39)	64 (67)	443 (59)
	Not reported	2 (1)	0	3 (3)	0	1 (1)	0	0	6 (1)
Encephalopathy	Absence	85 (51)	64 (68)	63 (72)	78 (49)	67 (55)	24 (77)	93 (98)	474 (63)
	Presence	80 (48)	30 (32)	24 (27)	81 (51)	50 (41)	7 (23)	2 (2)	274 (36)
	Not reported	1 (1)	0	1 (1)	0	4 (3)	0	0	6 (1)
Pre-transplant renal support	No	159 (96)	93 (99)	83 (94)	151 (95)	119 (98)	28 (90)	92 (97)	725 (96)
	Yes	7 (4)	1 (1)	5 (6)	8 (5)	2 (2)	3 (10)	2 (2)	28 (4)
	Not reported	0	0	0	0	0	0	1 (1)	1 (0)
Previous abdominal surgery	No	143 (86)	81 (86)	78 (89)	114 (72)	106 (88)	29 (94)	84 (88)	635 (84)
	Yes	22 (13)	13 (14)	9 (10)	45 (28)	13 (11)	2 (6)	11 (12)	115 (15)
	Not reported	1 (1)	0	1 (1)	0	2 (2)	0	0	4 (1)
Varices & shunt	Absence	32 (19)	23 (24)	20 (23)	48 (30)	68 (56)	10 (32)	31 (33)	232 (31)
	Presence without treatment	124 (75)	68 (72)	65 (74)	105 (66)	46 (38)	19 (61)	55 (58)	482 (64)
	Presence with surgical shunt	1 (1)	2 (2)	0	1 (1)	0	0	0	4 (1)
	Presence with TIPS	8 (5)	1 (1)	3 (3)	5 (3)	2 (2)	2 (6)	7 (7)	28 (4)
	Not reported	1 (1)	0	0	0	5 (4)	0	2 (2)	8 (1)
Life style activity	Normal	0	13 (14)	29 (33)	14 (9)	7 (6)	5 (16)	2 (2)	70 (9)
	Restricted	96 (58)	39 (41)	24 (27)	76 (48)	32 (26)	11 (35)	0	278 (37)
	Self-care	64 (39)	35 (37)	21 (24)	57 (36)	66 (55)	14 (45)	92 (97)	349 (46)
	Confined	6 (4)	6 (6)	10 (11)	6 (4)	11 (9)	1 (3)	0	40 (5)
	Reliant	0	1 (1)	3 (3)	4 (3)	2 (2)	0	1 (1)	11 (2)
	Not reported	0	0	1 (1)	2 (1)	3 (2)	0	0	6 (1)

Table 3.3 Demographic characteristics of adult elective first deceased donor liver only transplant recipients, 1 April 2017 - 31 March 2018

		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Graft appearance	Normal	131 (79)	59 (63)	85 (97)	142 (89)	96 (79)	27 (87)	65 (68)	605 (80)
	Abnormal	34 (20)	35 (37)	3 (3)	16 (10)	24 (20)	4 (13)	30 (32)	146 (19)
	Not reported	1 (1)	0	0	1 (1)	1 (1)	0	0	3 (0)
Recip age (years)	Median (IQR)	55 (45,62)	57 (51,62)	59 (54,64)	56 (48,61)	56 (48,61)	62 (58,66)	57 (48,63)	56 (48,62)
BMI (kg/m2)	Median (IQR)	28 (24,31)	28 (25,32)	28 (24,31)	27 (23,31)	27 (24,31)	29 (23,32)	27 (23,31)	27 (24,31)
Serum bilirubin (umol/l)	Median (IQR)	35 (19,71)	45 (27,78)	43 (25,112)	39 (20,74)	48 (28,76)	33 (17,60)	40 (25,89)	41 (22,78)
	Not reported	1	0	0	0	2	0	0	3
Serum creatinine (umol/l)	Median (IQR)	70 (60,88)	68 (53,84)	77 (64,100)	72 (57,86)	71 (55,93)	75 (61,92)	80 (71,99)	73 (60,91)
	Not reported	0	0	0	0	3	0	0	3
Serum sodium (mmol/l)	Median (IQR)	138 (136,141)	137 (133,139)	136 (132,139)	137 (134,139)	136 (133,139)	138 (135,140)	138 (134,141)	137 (134,139)
	Not reported	0	0	0	0	2	0	0	2
Serum potassium (mmol/l)	Median (IQR)	4.3 (4.0,4.6)	4.1 (3.8,4.3)	4.3 (3.9,4.6)	4.2 (3.9,4.5)	4.2 (3.9,4.6)	4.2 (4.0,4.6)	4.2 (3.9,4.6)	4.2 (3.9,4.6)
	Not reported	0	0	1	2	2	0	1	6
INR	Median (IQR)	1.3 (1.2,1.5)	1.3 (1.1,1.6)	1.4 (1.2,1.6)	1.4 (1.2,1.7)	1.3 (1.2,1.6)	1.4 (1.2,1.6)	1.3 (1.1,1.4)	1.3 (1.2,1.6)
	Not reported	0	0	0	1	2	0	2	5
Serum albumin (g/l)	Median (IQR)	37 (33,41)	28 (24,33)	26 (23,30)	34 (30,38)	29 (25,33)	35 (29,41)	34 (29,39)	32 (27,37)
	Not reported	0	0	0	1	3	0	4	8
Cold ischaemia time (hrs)	Median (IQR)	7 (6,9)	8 (6,11)	10 (8,11)	9 (7,10)	7 (6,9)	10 (9,12)	8 (7,11)	8 (7,10)
	Not reported	0	1	2	0	0	0	0	3
Time on list (days)	Median (IQR)	36 (15,93)	65 (21,178)	44 (10,109)	109 (29,257)	58 (22,263)	70 (23,137)	93 (29,234)	61 (20,186)
	Not reported	0	0	0	0	1	0	0	1

Table 3.3 Demographic characteristics of adult elective first deceased donor liver only transplant recipients, 1 April 2017 - 31 March 2018

		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Donor sex	Male	89 (54)	55 (59)	40 (45)	93 (58)	64 (53)	13 (42)	54 (57)	408 (54)
	Female	77 (46)	39 (41)	48 (55)	66 (42)	57 (47)	18 (58)	40 (42)	345 (46)
	Not reported	0	0	0	0	0	0	1 (1)	1 (0)
Donor ethnicity	White	155 (93)	88 (94)	83 (94)	143 (90)	113 (93)	27 (87)	71 (75)	680 (90)
	Non-white	6 (4)	5 (5)	4 (5)	15 (9)	6 (5)	3 (10)	22 (23)	61 (8)
	Not reported	5 (3)	1 (1)	1 (1)	1 (1)	2 (2)	1 (3)	2 (2)	13 (2)
Donor cause of death	Intracranial	142 (86)	81 (86)	76 (86)	131 (82)	105 (87)	28 (90)	82 (86)	645 (86)
	Trauma	3 (2)	5 (5)	4 (5)	8 (5)	6 (5)	2 (6)	3 (3)	31 (4)
	Others	21 (13)	8 (9)	8 (9)	20 (13)	10 (8)	1 (3)	10 (11)	78 (10)
Donor history of diabetes	No	155 (93)	89 (95)	82 (93)	148 (93)	111 (92)	28 (90)	87 (92)	700 (93)
	Yes	10 (6)	5 (5)	5 (6)	10 (6)	7 (6)	3 (10)	7 (7)	47 (6)
	Not reported	1 (1)	0	1 (1)	1 (1)	3 (2)	0	1 (1)	7 (1)
Donor type	Donor after brain death	114 (69)	63 (67)	76 (86)	108 (68)	96 (79)	27 (87)	81 (85)	565 (75)
	Donor after cardiac death	52 (31)	31 (33)	12 (14)	51 (32)	25 (21)	4 (13)	14 (15)	189 (25)
ABO match	Identical	161 (97)	91 (97)	87 (99)	159 (100)	121 (100)	31 (100)	93 (98)	743 (99)
	Compatible	5 (3)	3 (3)	1 (1)	0	0	0	1 (1)	10 (1)
	Incompatible	0	0	0	0	0	0	1 (1)	1 (0)
Graft type	Whole	157 (95)	92 (98)	84 (95)	147 (92)	114 (94)	31 (100)	89 (94)	714 (95)
	Segmental	9 (5)	2 (2)	4 (5)	12 (8)	7 (6)	0	6 (6)	40 (5)
Donor age (years)	Median (IQR)	55 (45,66)	50 (39,62)	50 (37,60)	58 (44,70)	52 (34,61)	57 (49,66)	53 (40,64)	54 (40,65)
Donor BMI (kg/m2)	Median (IQR)	27 (24,31)	27 (23,32)	26 (23,29)	26 (24,29)	26 (23,30)	25 (23,29)	25 (22,28)	26 (23,30)

3.2.3 Post-transplant survival

LONG-TERM PATIENT SURVIVAL

Table 3.4 shows one year [unadjusted](#) and [risk-adjusted patient survival](#) for 23732 of the 2600 transplants in the period, 1 April 2013 to 31 March 2017. Transplants were excluded if they were [auxiliary](#) or if survival information or [risk factors](#) were missing. The overall patient survival rate is 93.8% and, after risk adjustment, three 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 3.10**.

Table 3.4 One-year patient survival for adult elective deceased donor first liver transplants, 1 April 2013 - 31 March 2017					
Centre	Number of transplants	1-year survival % (95% CI)			
		Unadjusted		Risk-adjusted	
Newcastle	116	91.9	85.0 - 95.7	92	84.7 - 95.9
Leeds	316	93.3	90.0 - 95.6	92.2	88.1 - 94.9
Cambridge	240	93.2	89.2 - 95.8	94.9	91.7 - 96.9
Royal Free	285	92.6	88.8 - 95.1	94.3	91.3 - 96.3
King's College	546	95	92.7 - 96.5	94.6	92.1 - 96.3
Birmingham	610	93.8	91.6 - 95.5	92.3	89.4 - 94.4
Edinburgh	260	94.8	91.2 - 97.0	95.5	92.3 - 97.4
Total	2373	93.8	92.8 - 94.7		

	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

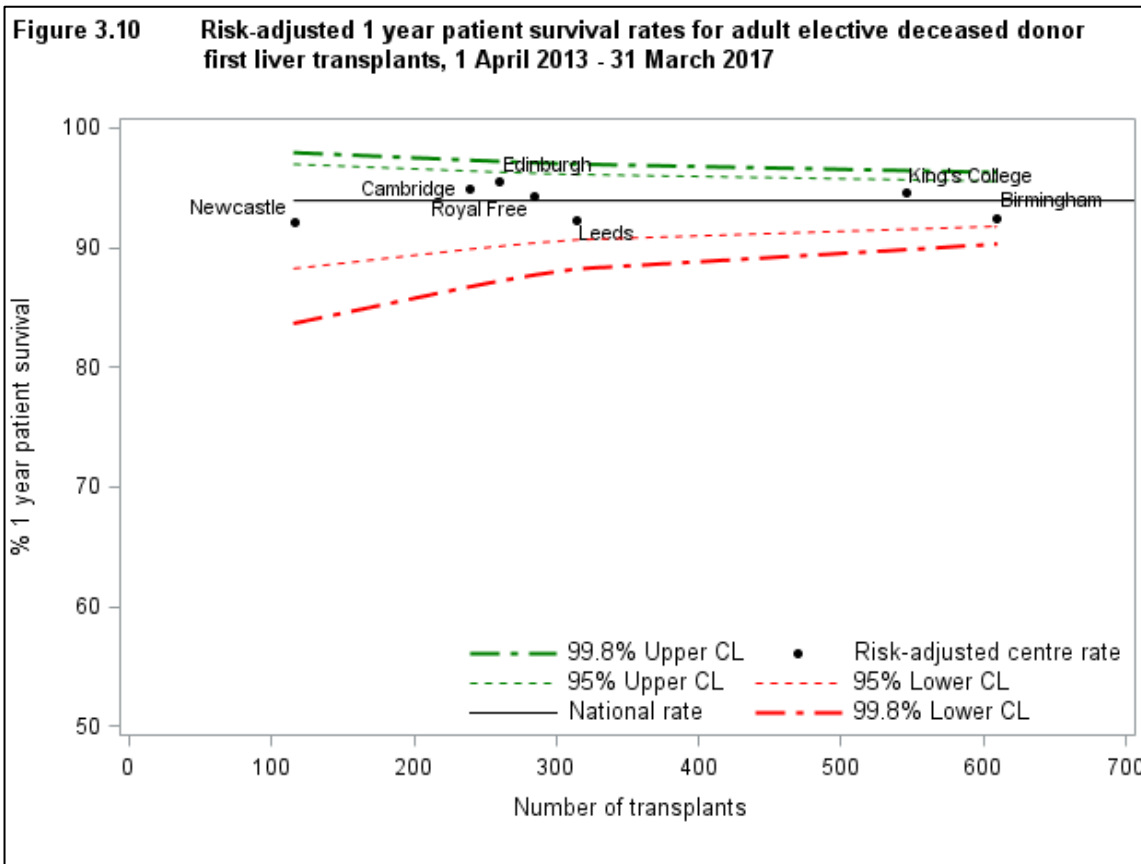


Table 3.5 shows the five year [unadjusted](#) and [risk-adjusted patient survival](#) for 1691 of the 1771 transplants in the period, 1 April 2009 to 31 March 2013. Note that transplants performed at Leeds have been excluded due to a lack of follow-up beyond 4 years. The national rate is 81.3% and three centres have a lower survival rate after risk adjustment, as shown in **Figure 3.11**. 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 3.11** ranges from 217 days for Edinburgh to 358 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 2009 - 31 March 2013					
Centre	Number of transplants	5-year survival % (95% CI)			
		Unadjusted		Risk-adjusted	
Newcastle	104	75.5	65.9 - 82.7	76.7	65.6 - 84.3
Cambridge	232	86.2	81.0 - 90.1	87.2	81.8 - 91.0
Royal Free	188	82.6	76.2 - 87.3	81.3	73.5 - 86.8
King's College	433	84.7	80.8 - 87.9	83	78.2 - 86.8
Birmingham	485	77.8	73.8 - 81.3	78.3	73.8 - 82.1
Edinburgh	249	79.6	73.9 - 84.1	81.1	75.1 - 85.7
Total	1691	81.3	79.4 - 83.2		

<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 4 years

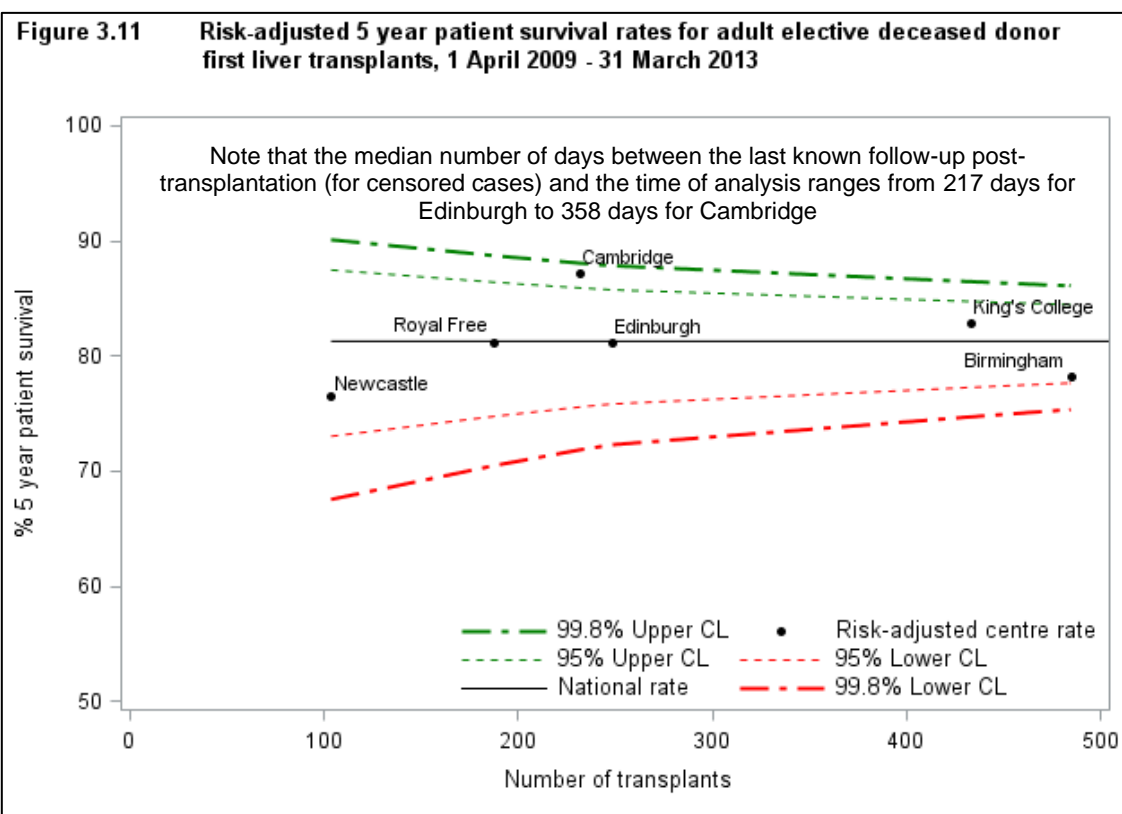


Table 3.6 shows one year [unadjusted](#) and [risk-adjusted patient survival](#), by primary disease group. The overall patient survival rate is 93.8% and, after risk adjustment, patients with cancer, autoimmune and cryptogenic, metabolic disease or other liver disease had a lower survival rate than the national rate.

Table 3.6 One year patient survival for adult elective deceased donor first liver transplants, 1 April 2013 - 31 March 2017				
Primary disease	Number of transplants	1-year survival % (95% CI)		
		Unadjusted		Risk adjusted
Cancer	575	92.2	(89.6 - 94.1)	92.6 (90.0 - 94.5)
Hepatitis B and C	217	96.8	(93.3 - 98.4)	96.3 (92.2 - 98.2)
Alcoholic liver disease	606	94.0	(91.8 - 95.6)	94.2 (91.9 - 95.8)
Primary sclerosing cholangitis	268	94.3	(90.8 - 96.6)	94.8 (91.4 - 96.9)
Primary biliary cirrhosis	186	96.8	(92.9 - 98.5)	96.8 (92.8 - 98.6)
Autoimmune and cryptogenic	151	94.7	(89.6 - 97.3)	93.2 (86.3 - 96.6)
Metabolic	231	92.8	(88.6 - 95.6)	92.5 (87.7 - 95.4)
Other	139	91.3	(85.3 - 95.0)	91.2 (84.5 - 95.0)
Total	2373	93.8	(92.8 - 94.7)	

Table 3.7 shows five year [unadjusted](#) and [risk-adjusted patient survival](#), the overall patient survival rate is 81.3%. After risk adjustment patients with cancer, autoimmune and cryptogenic, metabolic disease 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 2009 - 31 March 2013				
Primary disease	Number of transplants	5-year survival % (95% CI)		
		Unadjusted		Risk adjusted
Cancer	414	72.9	(68.2 - 77.0)	77.1 (72.4 - 81.1)
Hepatitis B and C	193	78.4	(71.8 - 83.7)	83.0 (76.8 - 87.5)
Alcoholic liver disease	379	85.1	(81.0 - 88.4)	84.9 (80.3 - 88.5)
Primary sclerosing cholangitis	179	87.0	(81.1 - 91.2)	82.5 (73.7 - 88.4)
Primary biliary cirrhosis	176	88.0	(82.2 - 92.0)	85.3 (77.5 - 90.4)
Autoimmune and cryptogenic	123	82.8	(74.6 - 88.6)	78.9 (67.3 - 86.4)
Metabolic	123	82.2	(74.0 - 88.1)	80.6 (70.3 - 87.4)
Other	104	82.4	(73.5 - 88.5)	80.3 (68.8 - 87.6)
Total	1691	81.3	(79.4 - 83.2)	

Leeds have been excluded due to a lack of follow up beyond 4 years

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 2006 and 31 December 2017. 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 3.12, 3.13 and 3.14**, respectively.

At one year, centre-specific risk adjusted survival rates range between 80% at both Leeds and Birmingham and 87% 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 53% while Edinburgh has the highest at 65%.

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 3.13** ranges from 322 days for Edinburgh to 447 days for Cambridge. The medians for all other centres fall in between these extremes. Similarly, in **Figure 3.14**, Edinburgh achieves the lowest median 'lack of follow up post-transplant' while all other units, particularly 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 2006 - 31 December 2017

Centre	Number of registrations	Patient survival					
		One year		Five year		Ten year	
		%	(95% CI)	%	(95% CI)	%	(95% CI)
Newcastle	439	83	(80 - 86)	68	(62 - 72)	54	(47 - 61)
Leeds	1332	80	(78 - 83)	-	-	-	-
Cambridge	998	85	(83 - 87)	73	(70 - 76)	61	(57 - 66)
Royal Free	997	81	(78 - 84)	68	(64 - 72)	55	(49 - 60)
King's College	1829	84	(83 - 86)	72	(70 - 75)	61	(58 - 64)
Birmingham	1933	80	(78 - 82)	66	(63 - 69)	53	(49 - 57)
Edinburgh	964	87	(84 - 89)	75	(72 - 78)	65	(60 - 69)
Total	8492	83	(82 - 84)	71	(69 - 72)	59	(56 - 61)

	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 4 years

Figure 3.12 Risk-adjusted 1 year patient survival rate from time of listing for adult* elective first liver registrations, 1 January 2006 - 31 December 2017

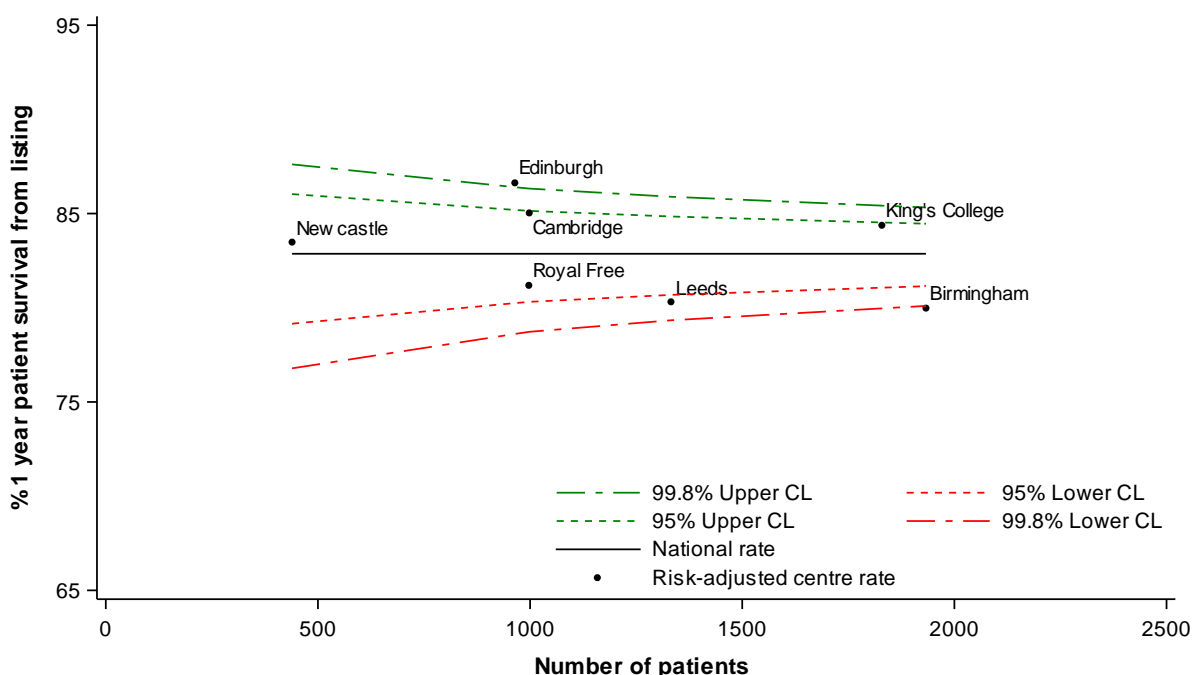


Figure 3.13 Risk-adjusted 5 year patient survival rate from time of listing for adult* elective first liver registrations, 1 January 2006 - 31 December 2017

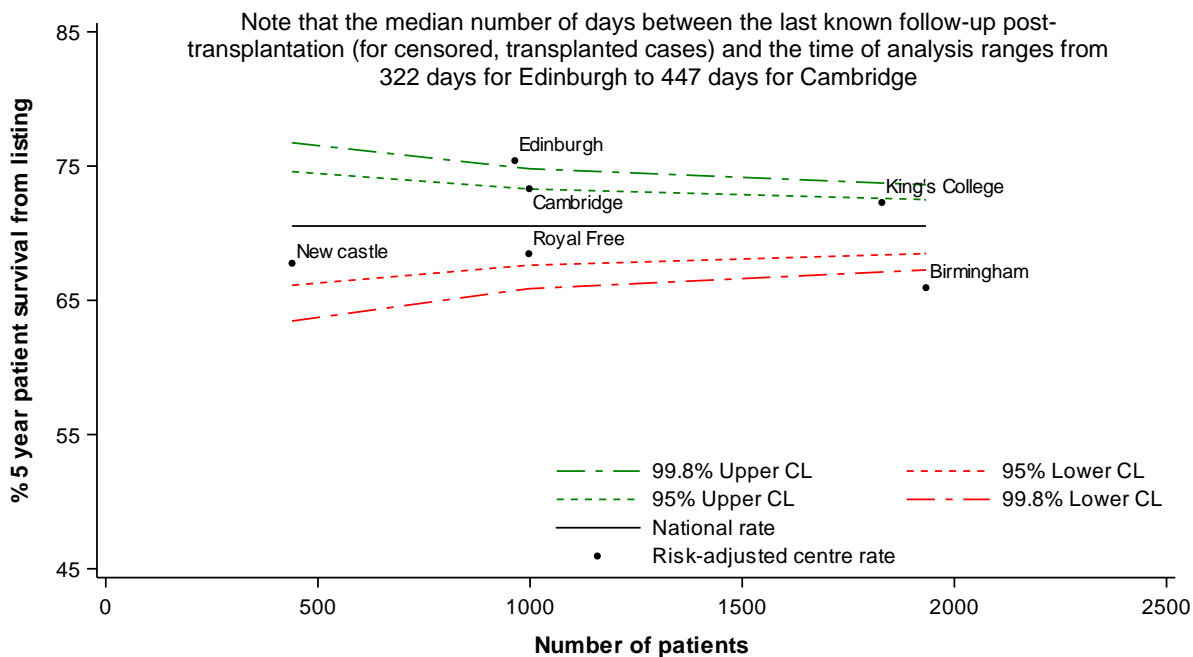
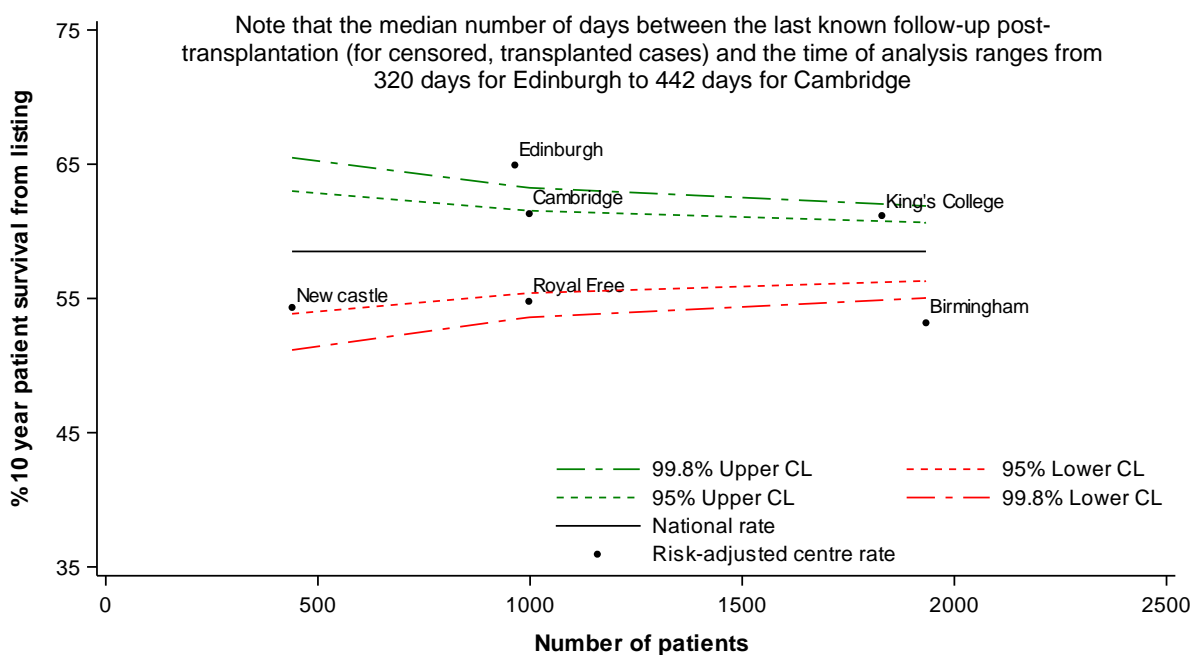


Figure 3.14 Risk-adjusted 10 year patient survival rate from time of listing for adult* elective first liver registrations, 1 January 2006 - 31 December 2017



* 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 4 years.

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 Newcastle and the Royal Free, 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 2012 - 31 March 2015			
Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Birmingham	81	2	2 - 2
Cambridge	36	2	1 - 3
Edinburgh	46	2	1 - 3
King's College	75	2	1 - 3
Leeds	45	2	1 - 3
Newcastle	22	3	2 - 4
Royal Free	45	3	2 - 4
UK	350	2	2 - 2

The demographic characteristics of 114 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 2017 - 31 March 2018

		Birmingham	Cambridge	Edinburgh	King's college	Leeds	Newcastle	Royal Free	Total
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Number		26	14	11	19	20	4	20	114
Recipient sex	Male	8 (31)	5 (36)	4 (36)	8 (42)	8 (40)	1 (25)	9 (45)	43 (38)
	Female	18 (69)	9 (64)	7 (64)	11 (58)	12 (60)	3 (75)	11 (55)	71 (62)
Recipient ethnicity	White	17 (65)	13 (93)	11 (100)	14 (74)	15 (75)	4 (100)	14 (70)	88 (77)
	Non-white	8 (31)	1 (7)	0 (0)	4 (21)	5 (25)	0 (0)	6 (30)	24 (21)
	Not reported	1 (4)	0 (0)	0 (0)	1 (5)	0 (0)	0 (0)	0 (0)	2 (2)
Recipient HCV	No	26 (100)	14 (100)	11 (100)	19 (100)	20 (100)	4 (100)	20 (100)	114 (100)
	Yes	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Encephalopathy	Absence	4 (15)	4 (29)	2 (18)	1 (5)	0 (0)	0 (0)	6 (30)	17 (15)
	Presence	18 (69)	7 (50)	7 (64)	14 (74)	14 (70)	4 (100)	13 (65)	77 (68)
	Not reported	4 (15)	3 (21)	2 (18)	4 (21)	6 (30)	0 (0)	1 (5)	20 (18)
Renal support	No	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	Yes	26 (100)	14 (100)	11 (100)	19 (100)	20 (100)	4 (100)	20 (100)	114 (100)
Recip age (years)	Median (IQR)	39 (29, 56)	51 (27, 60)	51 (46, 66)	45 (35, 61)	40 (28, 57)	41 (29, 46)	51 (44, 57)	48 (29, 59)
BMI (kg/m2)	Median (IQR)	29 (23, 32)	26 (22, 29)	26 (23, 28)	24 (22, 31)	27 (19, 32)	29 (23, 32)	26 (22, 31)	26 (23, 31)
	Not reported	0	0	0	0	0	1	1	2
Serum bilirubin (umol/l)	Median (IQR)	285 (78, 367)	279 (127, 427)	75 (22, 165)	154 (55, 383)	187 (67, 338)	244 (52, 534)	243 (62, 404)	165 (66, 370)
	Not reported	1	0	0	0	0	0	0	1
Serum creatinine (umol/l)	Median (IQR)	77 (69, 139)	83 (55, 116)	194 (63, 248)	156 (75, 171)	88 (63, 149)	109 (59, 165)	81 (71, 96)	90 (69, 158)
	Not reported	2	1	0	0	1	0	1	5

Table 3.10 Demographic characteristics of adult super urgent liver patients registered from 1 April 2017 - 31 March 2018

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's college N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	Total N (%)
Serum sodium (mmol/l)	Median (IQR)	141 (139, 144)	138 (135, 139)	137 (129, 140)	137 (135, 142)	139 (134, 141)	138 (134, 144)	138 (134, 140)	139 (135, 142)
	Not reported	2	0	0	0	0	0	0	2
Serum potassium (mmol/l)	Median (IQR)	4 (4, 4)	4 (4, 5)	5 (4, 6)	4 (4, 5)	4 (4, 5)	4 (4, 5)	4 (4, 5)	4 (4, 5)
	Not reported	2	0	0	0	0	0	0	2
INR	Median (IQR)	3 (2, 8)	4 (2, 4)	2 (2, 6)	5 (4, 8)	3 (2, 6)	7 (4, 10)	2 (1, 4)	4 (2, 6)
	Not reported	1	4	1	0	0	2	1	9
Serum albumin (g/l)	Median (IQR)	32 (29, 37)	23 (19, 25)	26 (22, 31)	28 (25, 30)	23 (20, 29)	31 (26, 35)	28 (24, 31)	28 (23, 31)
	Not reported	1	0	1	0	0	0	0	2

3.2.2 Transplant activity

Figure 3.15 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 have been 5 DCD super-urgent transplants during the ten year period and one living donor transplant performed in 2011/12. The number of super-urgent transplants slowly decreased between 2013/14 and 2016/17 to 55. However, the number of super-urgent transplants performed in 2017/18 was the highest in the last ten years (74).

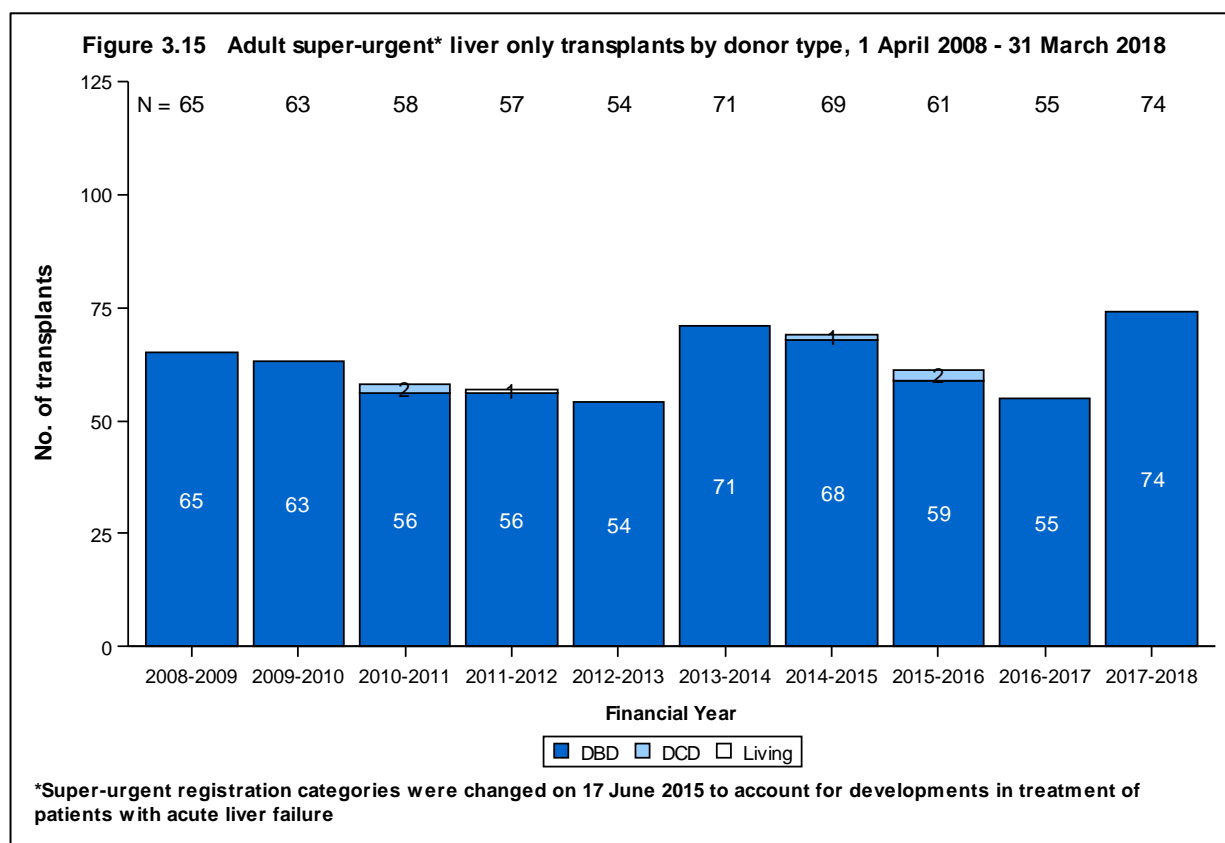
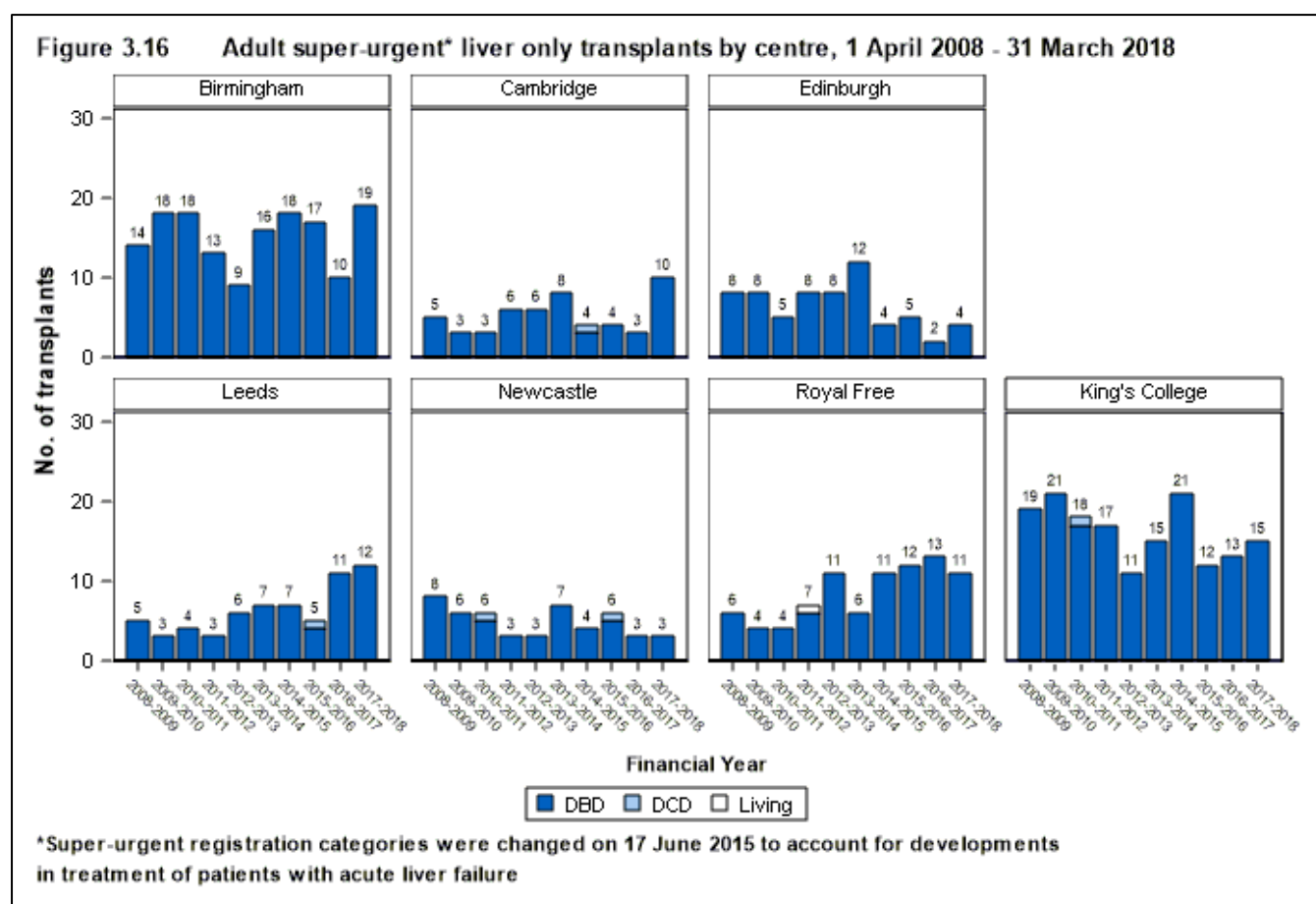


Figure 3.16 shows the number of adult [super-urgent](#) first liver only transplants from deceased and living donors performed in the last ten years, by type of donor and transplant centre.



The demographic characteristics of 74 adult [super-urgent](#) transplant recipients in the last financial year are shown by centre and overall in **Table 3.11**. Sixty two percent of these recipients were female and the [median](#) age was 45 years. All super-urgent transplants have been performed in this time period using a [DBD](#) donor. The median recipient BMI was 25. 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 2017 - 31 March 2018

		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Number		19	10	4	15	12	3	11	74 (100)
Recipient sex	Male	7 (37)	2 (20)	1 (25)	6 (40)	5 (42)	1 (33)	6 (55)	28 (38)
	Female	12 (63)	8 (80)	3 (75)	9 (60)	7 (58)	2 (67)	5 (45)	46 (62)
Recipient ethnicity	White	13 (68)	10 (100)	4 (100)	11 (73)	7 (58)	3 (100)	7 (64)	55 (74)
	Non-white	5 (26)	0	0	4 (27)	5 (42)	0	4 (36)	18 (24)
	Not reported	1 (5)	0	0	0	0	0	0	1 (1)
Recipient HCV status	Negative	19 (100)	5 (50)	4 (100)	14 (93)	10 (83)	3 (100)	9 (82)	64 (87)
	Positive	0	0	0	0	1 (8)	0	1 (9)	2 (3)
	Not reported	0	5 (50)	0	1 (7)	1 (8)	0	1 (9)	8 (11)
Pre-transplant in-patient status	Out-patient	1 (5)	1 (10)	0	0	0	1 (33)	0	3 (4)
	In-patient	18 (95)	9 (90)	4 (100)	15 (100)	12 (100)	2 (67)	11 (100)	71 (96)
Ascites	Absence	15 (79)	4 (40)	4 (100)	13 (87)	8 (67)	2 (67)	4 (36)	50 (68)
	Presence	4 (21)	6 (60)	0	2 (13)	3 (25)	1 (33)	7 (64)	23 (31)
	Not reported	0	0	0	0	1 (8)	0	0	1 (1)
Encephalopathy	Absence	1 (5)	2 (20)	1 (25)	0	0	0	0	4 (5)
	Presence	18 (95)	8 (80)	2 (50)	15 (100)	9 (75)	3 (100)	8 (73)	63 (85)
	Not reported	0	0	1 (25)	0	3 (25)	0	3 (27)	7 (10)
Pre-transplant renal support	No	9 (47)	5 (50)	2 (50)	2 (13)	10 (83)	1 (33)	5 (45)	34 (46)
	Yes	10 (53)	4 (40)	1 (25)	13 (87)	2 (17)	2 (67)	6 (55)	38 (51)
	Not reported	0	1 (10)	1 (25)	0	0	0	0	2 (3)
Previous abdominal surgery	No	17 (89)	10 (100)	2 (50)	13 (87)	10 (83)	3 (100)	11 (100)	66 (89)
	Yes	2 (11)	0	1 (25)	2 (13)	1 (8)	0	0	6 (8)
	Not reported	0	0	1 (25)	0	1 (8)	0	0	2 (3)

Table 3.11 Demographic characteristics of adult super-urgent deceased donor liver transplant recipients, 1 April 2017 - 31 March 2018

		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Varices & shunt	Absence	15 (79)	6 (60)	3 (75)	11 (73)	10 (83)	0	10 (91)	55 (74)
	Presence without treatment	4 (21)	3 (30)	1 (25)	4 (27)	1 (8)	3 (100)	1 (9)	17 (23)
	Not reported	0	1 (10)	0	0	1 (8)	0	0	2 (3)
Life style activity	Normal	0	4 (40)	0	1 (7)	2 (17)	0	0	7 (10)
	Restricted	0	1 (10)	0	0	2 (17)	0	0	3 (4)
	Self-care	0	1 (10)	0	0	0	0	0	1 (1)
	Confined	5 (26)	1 (10)	1 (25)	0	2 (17)	0	0	9 (12)
	Reliant	14 (74)	3 (30)	3 (75)	13 (87)	5 (42)	3 (100)	11 (100)	52 (70)
	Not reported	0	0	0	1 (7)	1 (8)	0	0	2 (3)
Graft appearance	Normal	19 (100)	9 (90)	4 (100)	12 (80)	10 (83)	3 (100)	9 (82)	66 (89)
	Abnormal	0	1 (10)	0	3 (20)	1 (8)	0	2 (18)	7 (10)
	Not reported	0	0	0	0	1 (8)	0	0	1 (1)
Recip age (years)	Median (IQR)	36 (29,55)	51 (28,60)	62 (40,66)	49 (40,62)	44 (23,51)	43 (20,48)	47 (31,56)	45 (29,56)
BMI (kg/m²)	Median (IQR)	28 (22,32)	26 (23,27)	26 (22,31)	23 (22,31)	25 (21,30)	29 (23,32)	26 (24,31)	25 (22,31)
Serum bilirubin (umol/l)	Median (IQR)	226 (119,347)	366 (101,521)	151 (80,280)	251 (106,399)	325 (243,348)	361 (83,627)	340 (212,454)	277 (132,397)
Serum creatinine (umol/l)	Median (IQR)	92 (66,130)	60 (49,115)	72 (63,153)	97 (80,156)	78 (68,117)	111 (33,117)	82 (72,96)	83 (67,126)
Serum sodium (mmol/l)	Median (IQR)	147 (138,151)	138 (135,143)	137 (136,140)	140 (138,147)	136 (136,140)	144 (138,149)	138 (133,143)	140 (136,146)
Serum potassium (mmol/l)	Median (IQR)	4.2 (4.1,4.6)	3.7 (3.7,4.4)	4.1 (3.5,4.7)	4.5 (4.3,4.7)	4.2 (3.9,4.5)	3.8 (3.7,4.3)	4.4 (4.2,4.6)	4.3 (3.9,4.6)

Table 3.11 Demographic characteristics of adult super-urgent deceased donor liver transplant recipients, 1 April 2017 - 31 March 2018

		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
INR	Median (IQR)	3.1 (2.0,4.9)	3.1 (2.3,4.2)	1.4 (1.3,1.6)	3.4 (2.6,4.9)	2.9 (1.7,3.8)	2.2 (1.2,4.2)	3.0 (2.1,3.7)	3.0 (2.0,4.2)
Serum albumin (g/l)	Median (IQR)	29 (26,35)	24 (21,30)	22 (13,24)	26 (24,29)	23 (18,27)	26 (26,33)	27 (22,28)	26 (23,29)
	Not reported	0	0	1	0	0	0	0	1
Time on list (days)	Median (IQR)	2 (1,4)	2 (1,4)	2 (1,2)	2 (1,3)	2 (1,3)	3 (2,5)	2 (2,3)	2 (1,3)
Donor sex	Male	6 (32)	4 (40)	3 (75)	7 (47)	7 (58)	1 (33)	6 (55)	34 (46)
	Female	13 (68)	6 (60)	1 (25)	8 (53)	5 (42)	2 (67)	5 (45)	40 (54)
Donor ethnicity	White	15 (79)	8 (80)	4 (100)	15 (100)	11 (92)	3 (100)	10 (91)	66 (89)
	Non-white	4 (21)	2 (20)	0	0	0	0	1 (9)	7 (10)
	Not reported	0	0	0	0	1 (8)	0	0	1 (1)
Donor cause of death	Intracranial	16 (84)	7 (70)	4 (100)	15 (100)	11 (92)	2 (67)	11 (100)	66 (89)
	Trauma	1 (5)	0	0	0	0	0	0	1 (1)
	Others	2 (11)	3 (30)	0	0	1 (8)	1 (33)	0	7 (10)
Donor history of diabetes	No	16 (84)	9 (90)	4 (100)	14 (93)	12 (100)	3 (100)	11 (100)	69 (93)
	Yes	3 (16)	1 (10)	0	1 (7)	0	0	0	5 (7)
Donor type	Donor after brain death	19 (100)	10 (100)	4 (100)	15 (100)	12 (100)	3 (100)	11 (100)	74 (100)
ABO match	Identical	15 (79)	9 (90)	3 (75)	8 (53)	8 (67)	2 (67)	5 (45)	50 (68)
	Compatible	4 (21)	1 (10)	1 (25)	7 (47)	4 (33)	1 (33)	6 (55)	24 (32)
Graft type	Whole	18 (95)	10 (100)	4 (100)	15 (100)	11 (92)	3 (100)	11 (100)	72 (97)
	Segmental	1 (5)	0	0	0	1 (8)	0	0	2 (3)
Donor age (years)	Median (IQR)	48 (39,59)	48 (31,53)	53 (31,73)	56 (48,66)	49 (32,56)	51 (29,57)	59 (28,69)	51 (39,59)
Donor BMI (kg/m2)	Median (IQR)	25 (23,27)	25 (23,30)	25 (23,29)	26 (23,27)	25 (21,28)	26 (23,26)	25 (23,28)	25 (23,28)

3.3.3 Post-transplant survival

LONG-TERM PATIENT SURVIVAL

Table 3.12 shows one year [unadjusted](#) and [risk-adjusted patient survival](#) for 227 of the 253 transplants in the period 1 April 2013 to 31 March 2017. Transplants were excluded if they were [auxiliary](#) or if survival information or [risk factors](#) were missing. The overall patient survival rate is 89.8% and, after risk adjustment, three centres had a lower survival rate than the national rate but within the [confidence limits](#), as shown in **Figure 3.17**.

Table 3.12 One year patient survival for adult super-urgent deceased donor first liver transplants, 1 April 2013 - 31 March 2017					
Centre	Number of transplants	1-year survival % (95% CI)			
		Unadjusted		Risk-adjusted	
Newcastle	19	89.5	64.1 - 97.3	93.5	74.1 - 98.4
Leeds	28	89.3	70.4 - 96.4	87.3	60.7 - 95.9
Cambridge	17	94.1	65.0 - 99.1	93.2	52.0 - 99.0
Royal Free	36	86.1	69.8 - 94.0	89.7	75.2 - 95.7
King's College	52	88.4	75.9 - 94.6	81.8	59.4 - 91.8
Birmingham	54	94.4	83.7 - 98.2	91.1	72.5 - 97.1
Edinburgh	21	85.7	62.0 - 95.2	90.7	71.3 - 97.0
Total	227	89.8	85.1 - 93.1		
<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>					

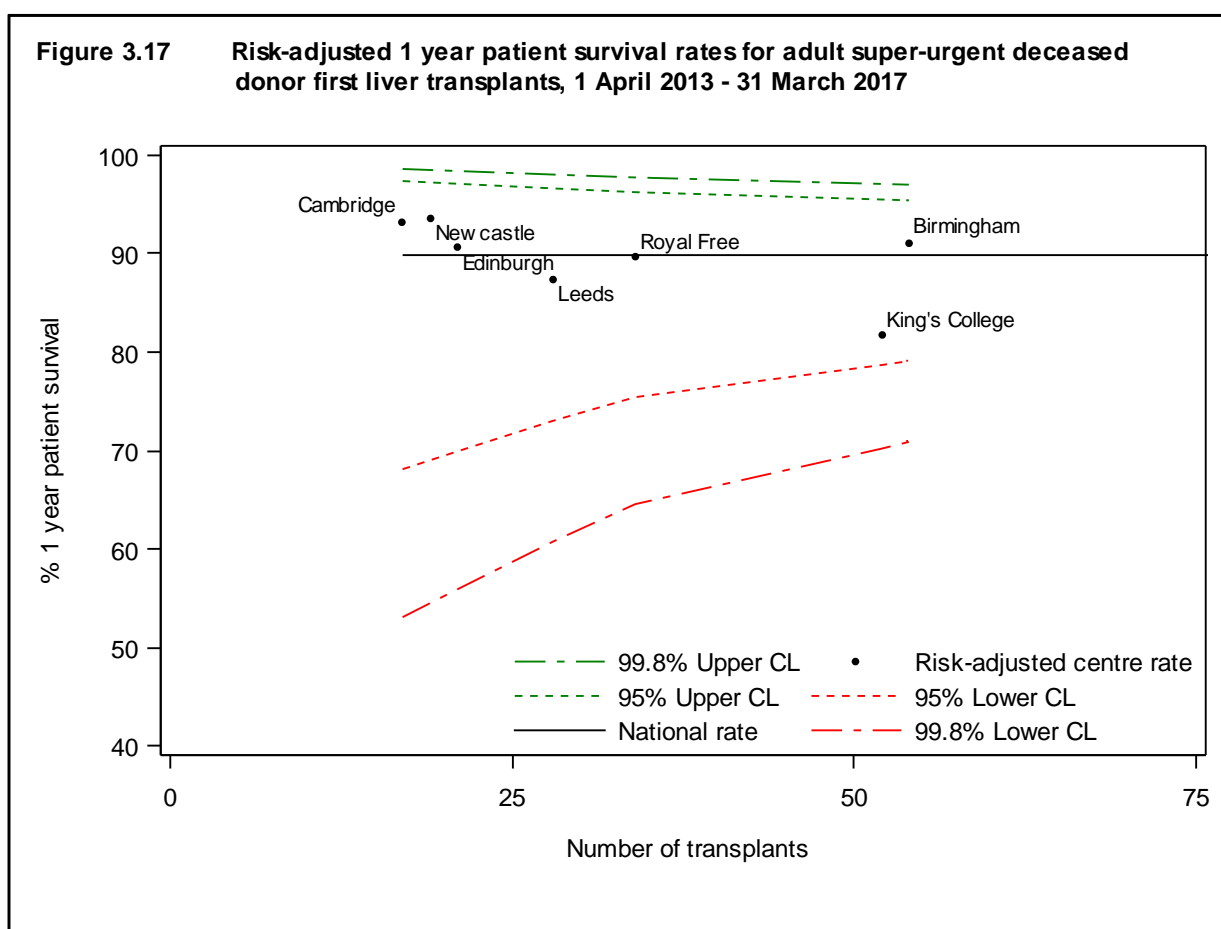


Table 3.13 shows the five year [unadjusted](#) and [risk-adjusted patient survival](#) for 202 of the 210 transplants in the period, 1 April 2009 to 31 March 2013. Note that Leeds have been excluded due to a lack of follow-up after 4 years post-transplant. The national rate is 81.3% and two centres have a lower survival rate after risk adjustment as shown in **Figure 3.18**, but all fall within the 99.8% 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 3.18** ranges from 308 days for Royal free to 481 days for Edinburgh. The medians for all other centres fall in between these extremes. Results should therefore be interpreted in that light.

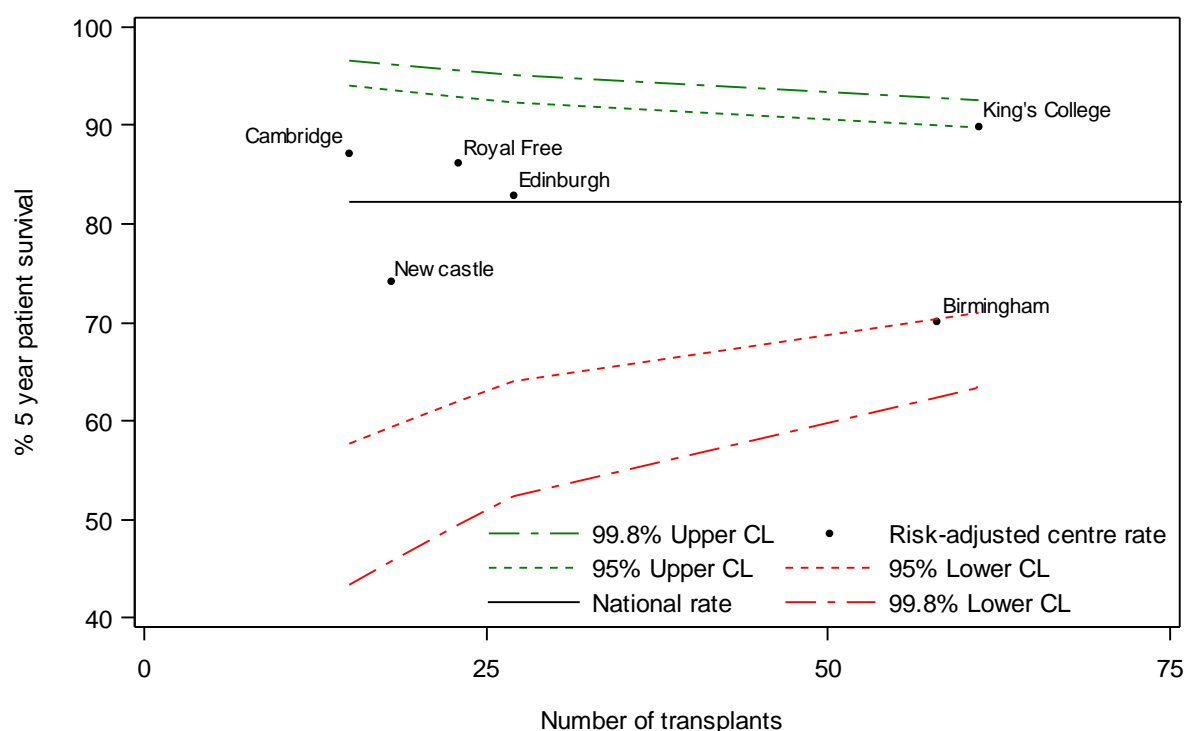
Table 3.13 Five year patient survival for adult super-urgent deceased donor first liver transplants, 1 April 2009 - 31 March 2013

Centre	Number of transplants	5-year survival % (95% CI)			
		Unadjusted		Risk-adjusted	
Newcastle	18	77.8	51.1 - 91.0	74.1	31.0 - 90.3
Cambridge	15	86.7	56.4 - 96.5	87.3	49.1 - 96.8
Royal Free	23	78.3	55.4 - 90.3	86.2	66.8 - 94.2
King's College	61	89.6	78.3 - 95.2	89.9	77.6 - 95.5
Birmingham	58	75.2	61.6 - 84.5	70.1	49.5 - 82.3
Edinburgh	27	85.2	65.2 - 94.2	82.8	54.2 - 93.6
Total	202	81.3	75.2 - 86.0		

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 a lack of follow-up beyond four years

Figure 3.18 Risk-adjusted 5 year patient survival rates for adult super-urgent deceased donor first liver transplants, 1 April 2009 - 31 March 2013



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 2017 and 31 December 2017 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. However, NHSBT are working closely with Leeds to ensure that all forms are completed and returned.

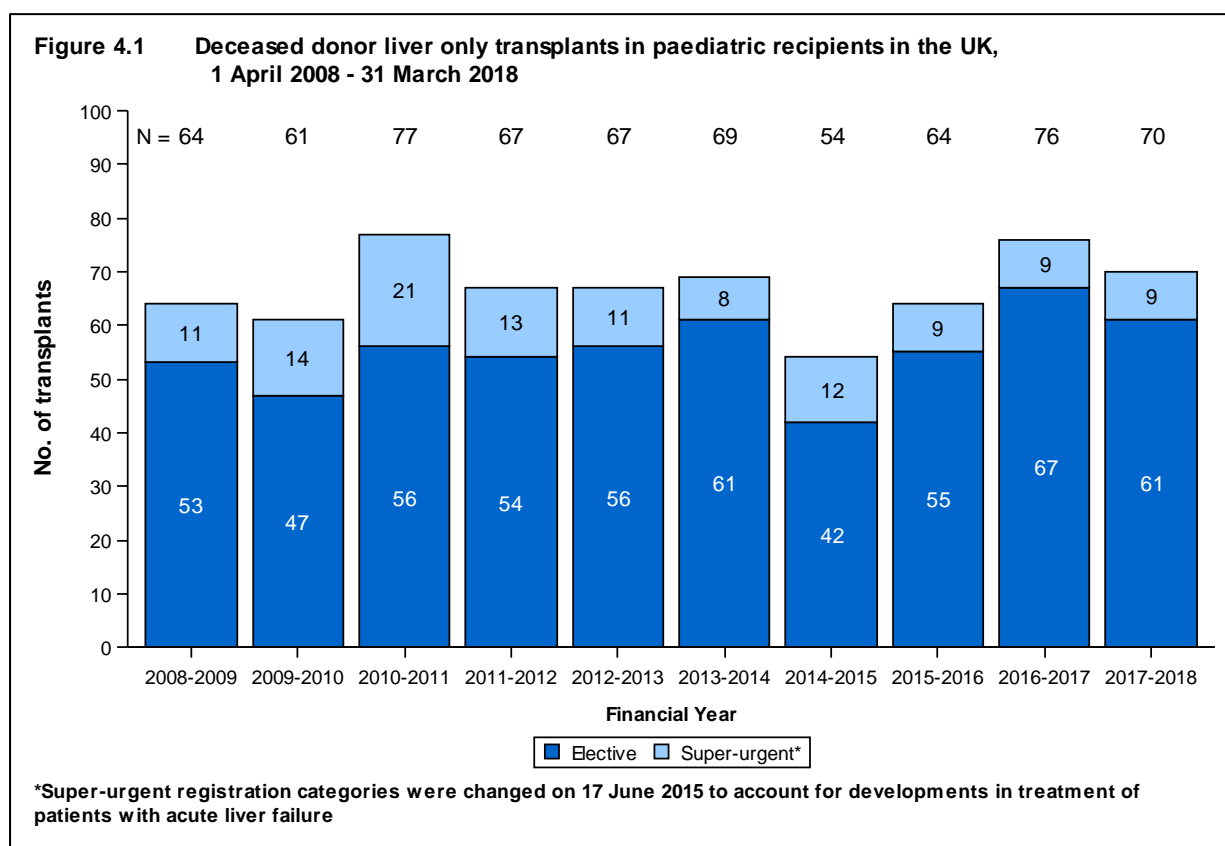
Table 3.14 Form return rates, 1 January 2017 and 31 December 2017								
Centre	Transplant record		3 month follow-up		1 year follow-up		Lifetime follow-up	
	N	% returned	N	% returned	N	% returned	N	% returned
Newcastle	36	97	30	100	36	100	201	99
Leeds	123	100	131	100	101	100	512	40
Cambridge	96	100	94	100	79	100	451	95
Royal Free	110	100	107	100	87	100	426	99
King's College	161	100	167	100	157	98	865	95
Birmingham	179	100	174	100	160	99	900	95
Edinburgh	88	100	87	94	83	94	465	96

Paediatric Liver Transplantation



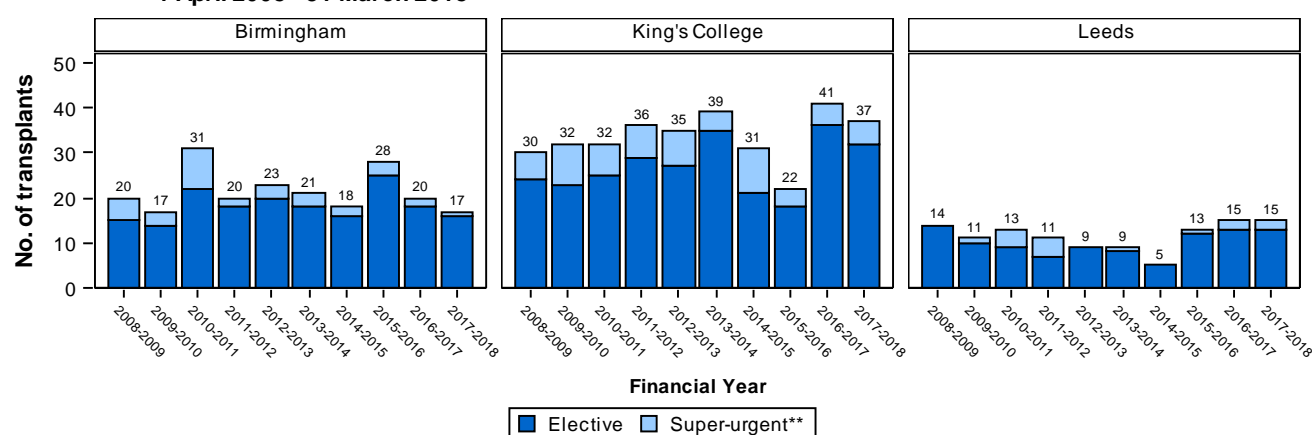
4.1 Overview

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, 70 transplants in paediatric patients were performed, of which, one was transplanted at Newcastle (an adult centre in the UK). Sixty-one (87%) of these transplants were for patients on the [elective](#) list and nine (13%) for patients on the [super-urgent](#) list.

Figure 4.2 Deceased donor liver only transplants in paediatric recipients* in the UK, 1 April 2008 - 31 March 2018

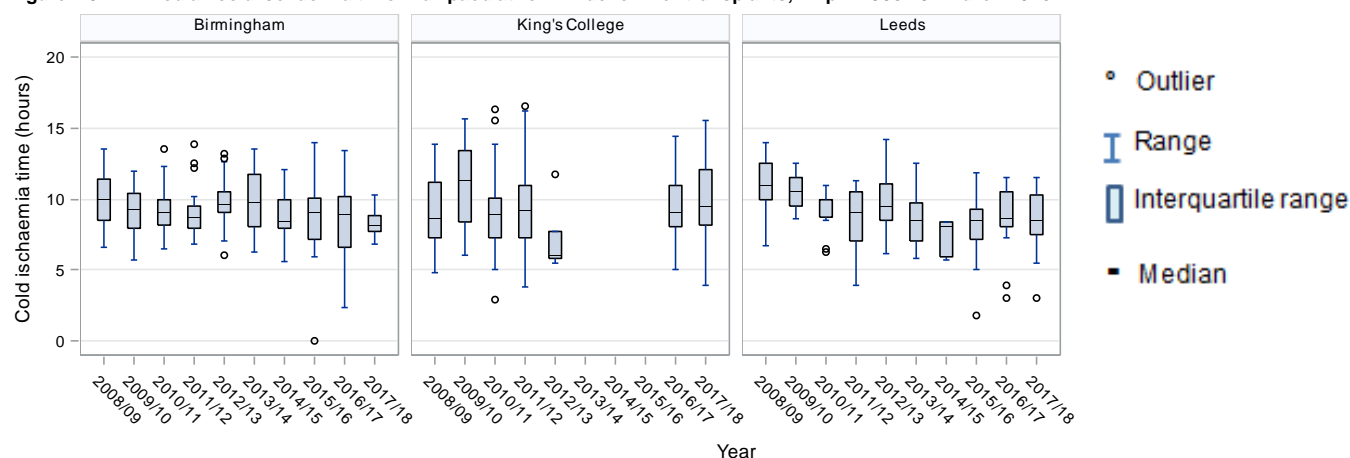


*Excludes four super-urgent paediatric patients who were transplanted at non-paediatric centre

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

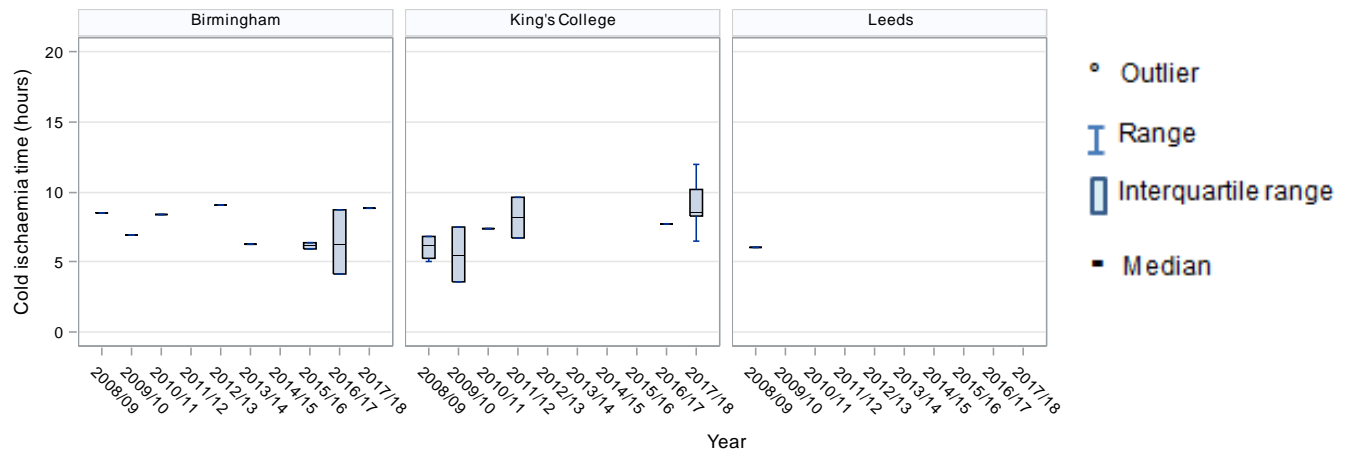
The [median cold ischaemia times](#) for paediatric transplant recipients are shown in **Figures 4.3 and 4.4** for [DBD](#) and [DCD](#) donors, respectively. Median cold ischaemia times were calculated each year during the last ten years, by transplant centre. The national median cold ischaemia time for transplants from DBD donors has remained relatively stable over the ten year period, at 9 hours. The median cold ischaemia time in the last financial year was 8.5 hours for all transplant centres.

Figure 4.3 Median cold ischaemia time in all paediatric DBD donor liver transplants, 1 April 2008 - 31 March 2018



The corresponding median for DCD donor transplants has decreased from 11 hours in 2006/07 (data not presented) to 8.7 hours in 2017/18 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 8.5 hours and 8.8 hours for Birmingham. There was no data for cold ischemia time in paediatric DCD transplants in 2014/15.

Figure 4.4 Median cold ischaemia time in all paediatric DCD donor liver transplants, 1 April 2008 - 31 March 2018



The demographic characteristics of 90 paediatric registrations and 69 paediatric transplant recipients in the latest year are shown by centre and nationally in **Table 4.1**. Please note that one super-urgent patient registered and transplanted at Newcastle was excluded from the Table. Of the patients registered for a liver transplant, 54% were male, 28% were between 1 - 4 years old and 20% were registered as super-urgent. Of the transplant recipients, 52% were female and 38% were aged between one and four years old. Of the 70 transplants, 9 (13%) 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 2017 - 31 March 2018

		Birmingham N (%)		King's College N (%)		Leeds N (%)		TOTAL N (%)	
		Registration	Transplant	Registration	Transplant	Registration	Transplant	Registration	Transplant
Number		22	17	45	37	23	15	90 (100)	69 (100)
Recip age years	<1	6 (27)	6 (35)	15 (33)	7 (19)	3 (13)	2 (13)	24 (27)	15 (22)
	1-4	3 (14)	4 (24)	11 (24)	14 (38)	11 (48)	8 (53)	25 (28)	26 (38)
	5-12	5 (23)	4 (24)	12 (27)	7 (19)	5 (22)	3 (20)	22 (24)	14 (20)
	13-16	8 (36)	3 (18)	7 (16)	9 (24)	4 (17)	2 (13)	19 (21)	14 (20)
Recipient sex	Male	15 (68)	8 (47)	23 (51)	18 (49)	11 (48)	7 (47)	49 (54)	33 (48)
	Female	7 (32)	9 (53)	22 (49)	19 (51)	12 (52)	8 (53)	41 (46)	36 (52)
Indication	Super Urgent	5 (23)	1 (6)	9 (20)	5 (14)	4 (17)	2 (13)	18 (20)	8 (12)
	Biliary Atresia	4 (18)	5 (29)	21 (47)	22 (59)	4 (17)	4 (27)	29 (32)	31 (45)
	Other Cholestatic	0 (0)	0	1 (2)	2 (5)	0 (0)	0	1 (1)	2 (3)
	Metabolic	3 (14)	4 (24)	2 (4)	1 (3)	6 (26)	5 (33)	11 (12)	10 (15)
	Other	10 (45)	7 (41)	12 (27)	7 (19)	9 (39)	4 (27)	31 (34)	18 (26)
Pre-transplant in-patient status	Out-patient		12 (71)		25 (68)		11 (73)		48 (70)
	In-patient		5 (29)		11 (30)		4 (27)		20 (29)
	Not reported		0		1 (3)		0		1 (1)
Pre-transplant renal support	No		13 (76)		35 (95)		14 (93)		62 (90)
	Yes		4 (24)		1 (3)		1 (7)		6 (9)
	Not reported		0		1 (3)		0		1 (1)
Ascites	Absence		7 (41)		25 (68)		13 (87)		45 (65)
	Presence		10 (59)		10 (27)		2 (13)		22 (32)
	Not reported		0		2 (5)		0		2 (3)
Previous abdominal surgery	No	10 (45)	9 (53)	17 (38)	14 (38)	13 (57)	12 (80)	40 (44)	35 (51)
	Yes	7 (32)	8 (47)	19 (42)	22 (59)	6 (26)	3 (20)	32 (36)	33 (48)
	Not reported	5 (23)	0	9 (20)	1 (3)	4 (17)	0	18 (20)	1 (1)

Table 4.1 Demographic characteristics of paediatric registrations and deceased donor liver transplant recipients, 1 April 2017 - 31 March 2018

		Birmingham N (%)		King's College N (%)		Leeds N (%)		TOTAL N (%)	
		Registration	Transplant	Registration	Transplant	Registration	Transplant	Registration	Transplant
INR	<=1.0	8 (36)	11 (65)	9 (20)	3 (8)	5 (22)	1 (7)	22 (24)	15 (22)
	1.1-1.5	8 (36)	2 (12)	25 (56)	23 (62)	10 (43)	10 (67)	43 (48)	35 (51)
	1.6-3.0	2 (9)	3 (18)	5 (11)	6 (16)	4 (17)	2 (13)	11 (12)	11 (16)
	>3.0	2 (9)	0	6 (13)	4 (11)	4 (17)	2 (13)	12 (13)	6 (9)
	Not reported	2 (9)	1 (6)	0 (0)	1 (3)	0 (0)	0	2 (2)	2 (3)
Serum sodium mmol/l	<135	5 (23)	3 (18)	2 (4)	2 (5)	0 (0)	1 (7)	7 (8)	6 (9)
	>=135	17 (77)	14 (82)	43 (96)	34 (92)	23 (100)	14 (93)	83 (92)	62 (90)
	Not reported	0 (0)	0	0 (0)	1 (3)	0 (0)	0	0 (0)	1 (1)
Donor age years	<5		1 (6)		3 (8)		1 (7)		5 (7)
	5-16		4 (24)		6 (16)		1 (7)		11 (16)
	17-30		2 (12)		17 (46)		8 (53)		27 (39)
	>=31		10 (59)		11 (30)		5 (33)		26 (38)
Donor sex	Male		8 (47)		21 (57)		9 (60)		38 (55)
	Female		9 (53)		16 (43)		6 (40)		31 (45)
Donor type	Donor after brain death		16 (94)		31 (84)		15 (100)		62 (90)
	Donor after cardiac death		1 (6)		6 (16)		0		7 (10)
Graft appearance	Normal		17 (100)		35 (95)		15 (100)		67 (97)
	Abnormal		0		1 (3)		0		1 (1)
	Not reported		0		1 (3)		0		1 (1)
Graft type	Whole		5 (29)		11 (30)		5 (33)		21 (30)
	Segmental		12 (71)		26 (70)		10 (67)		48 (70)
Urgency Status	Elective	17 (77)	16 (94)	36 (80)	32 (86)	19 (83)	13 (87)	72 (80)	61 (88)
	Super Urgent	5 (23)	1 (6)	9 (20)	5 (14)	4 (17)	2 (13)	18 (20)	8 (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 2009 and 2018. 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 decreased to 32.

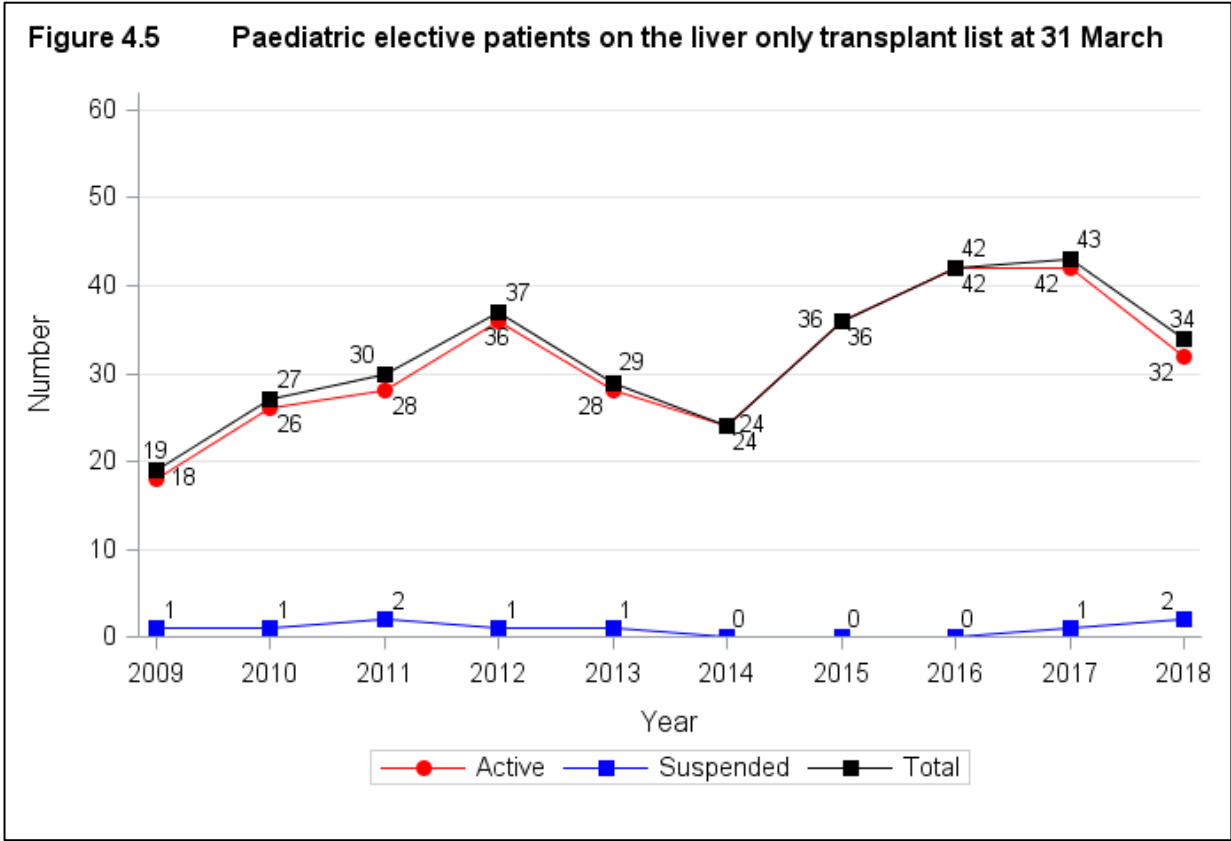
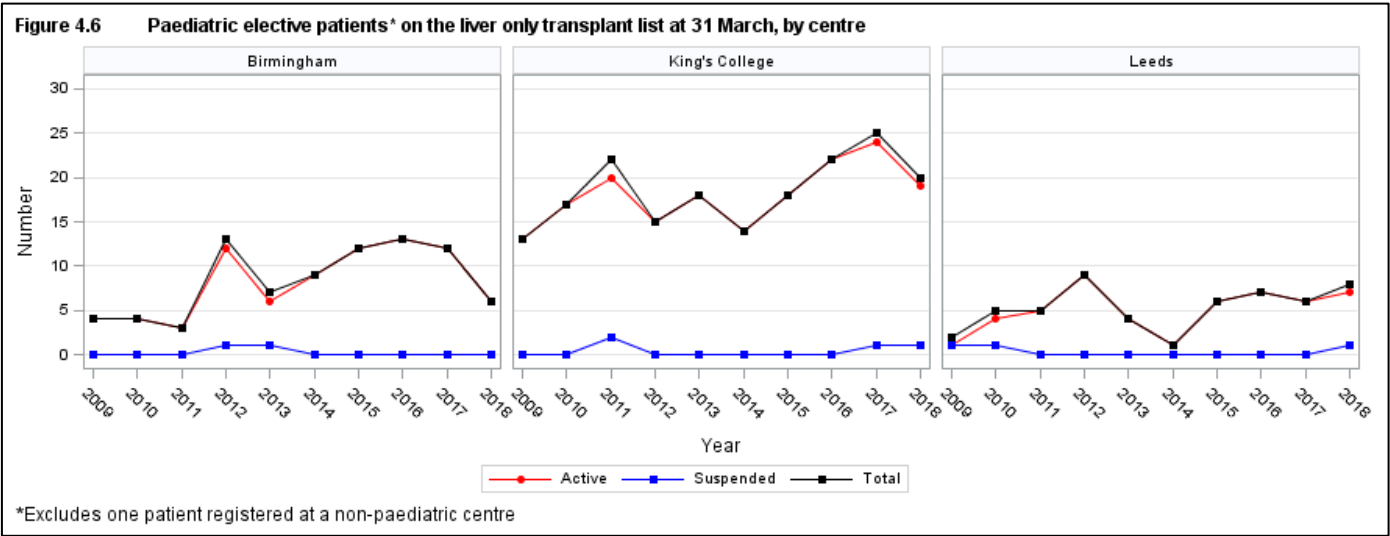


Figure 4.6 shows the number of [elective](#) patients on the transplant list at 31 March each year between 2009 and 2018 for each transplant centre.



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 88% of patients have had a liver transplant, and 7% are still waiting.

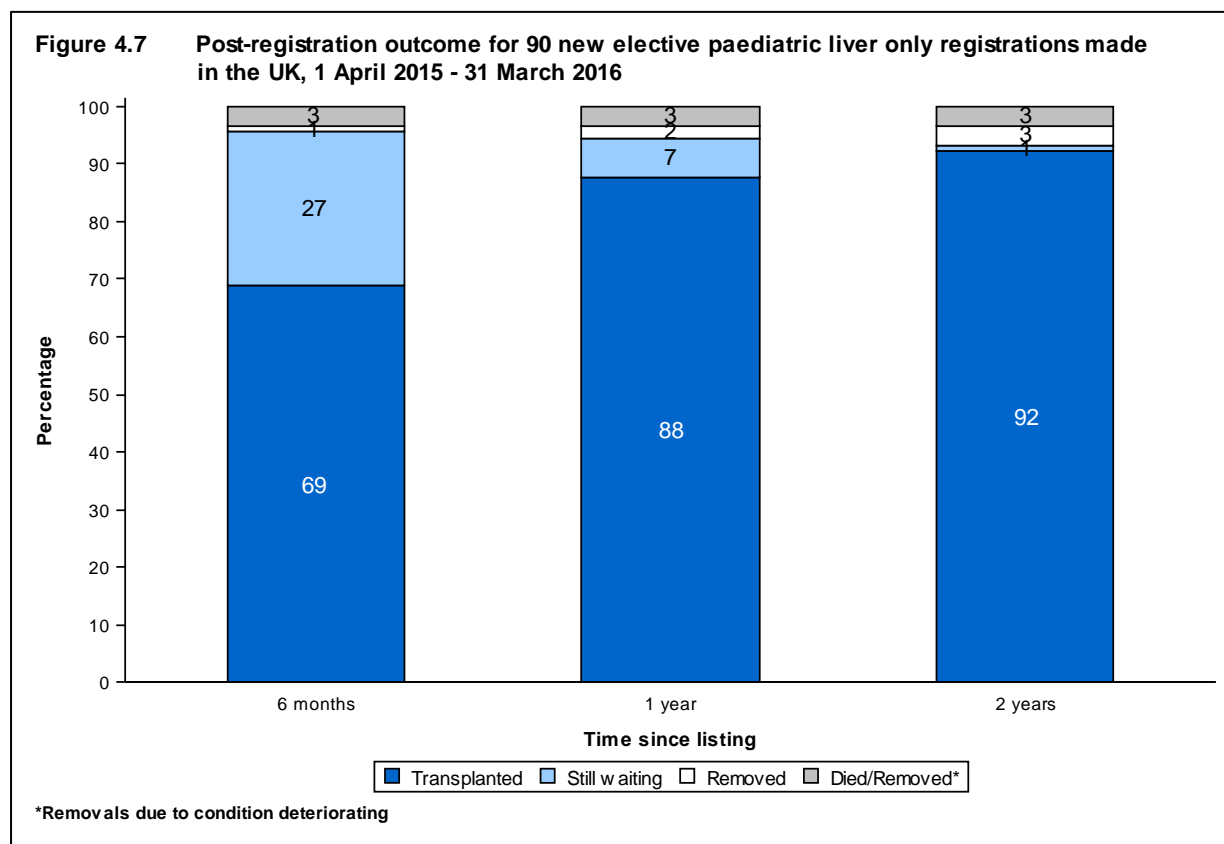
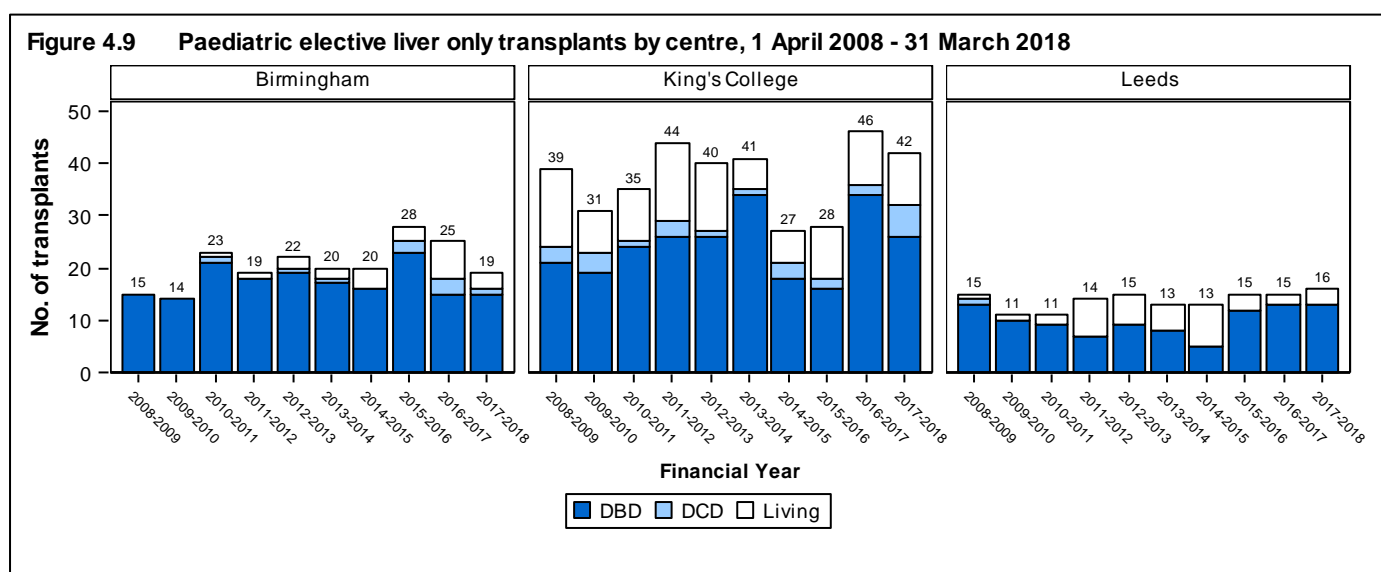
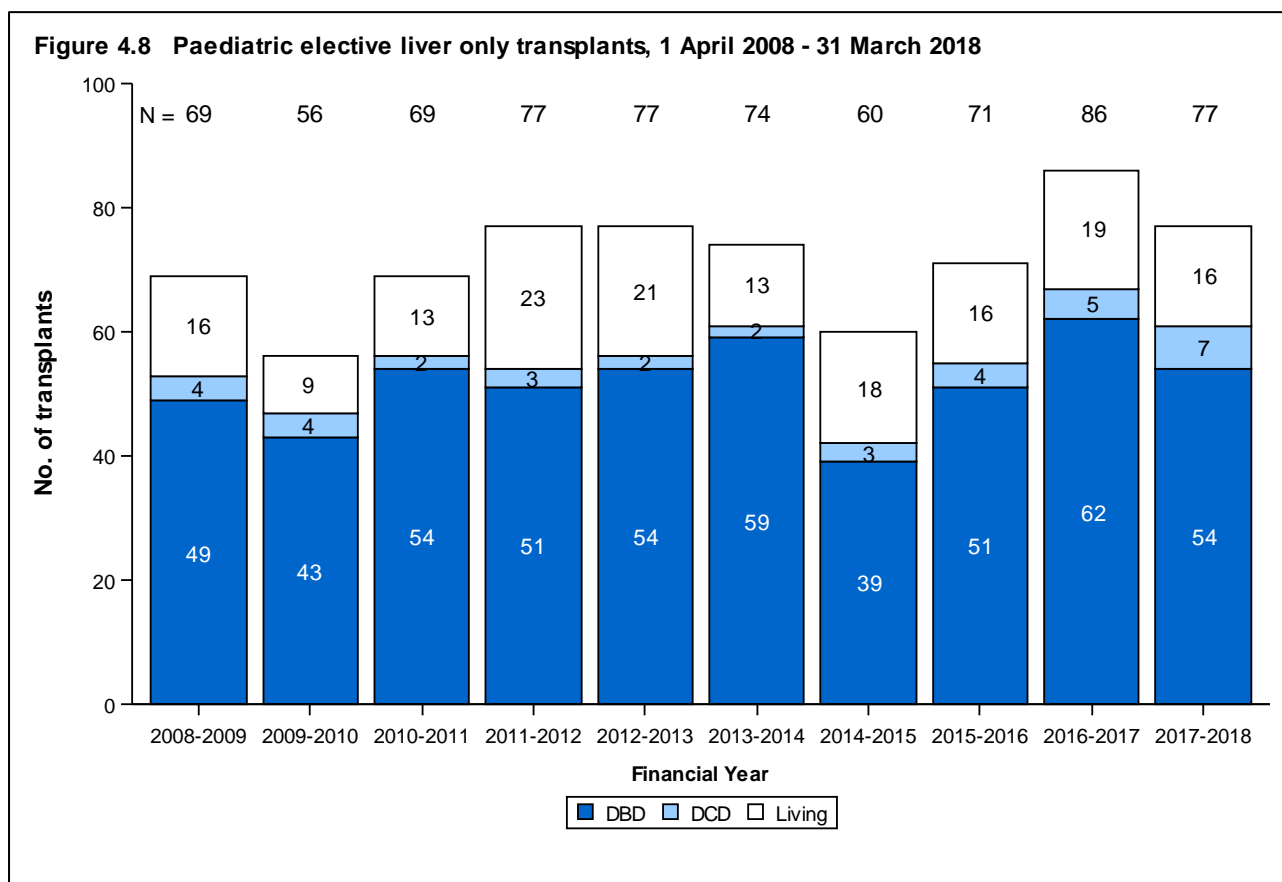


Table 4.2 shows the [median waiting time](#) to deceased donor liver only transplant for paediatric [elective](#) patients. The median waiting time to transplant is shortest at Leeds at 49 days, and longest at King's College Hospital, at 90 days. The national median waiting time to transplant is 80 days.

Table 4.2 Median waiting time to liver only transplant in the UK, for paediatric elective patients registered 1 April 2012 - 31 March 2015			
Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Paediatric			
Leeds	30	49	37 - 61
Birmingham	76	79	25 - 133
King's College	99	90	63 - 117
UK*	206	80	56 - 104

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 222 deceased donor transplants (excluding 2 [auxiliary](#) transplants) from 1 April 2013 to 31 March 2017, 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 2013 - 31 March 2017			
Centre	Number of transplants	1-year survival % (95% CI)	
Leeds	38	100.0	(-)
King's College	107	97.2	(91.5 - 99.1)
Birmingham	77	96.1	(88.4 - 98.7)
Total	222	97.3	(94.1 - 98.8)

Table 4.4 shows the [unadjusted](#) five year paediatric [patient survival](#) for all 210 transplants (excluding 3 [auxiliary](#) transplants) from 1 April 2009 to 31 March 2013, 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 2009 - 31 March 2013			
Centre	Number of transplants	5-year survival % (95% CI)	
Leeds	35	91.4	(75.7 - 97.2)
King's College	101	94.5	(87.2 - 97.7)
Birmingham	74	89.0	(79.2 - 94.3)
Total	210	92.1	(87.4 - 95.1)

Paediatric Liver Transplantation Super-Urgent Patients



4.3.1 Transplant list

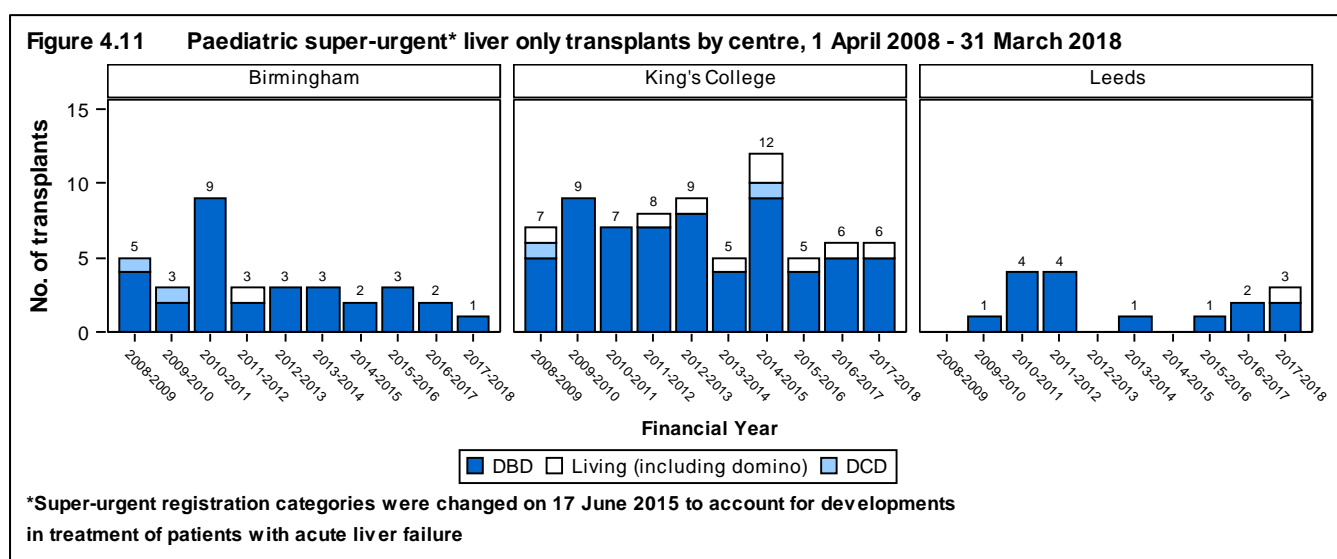
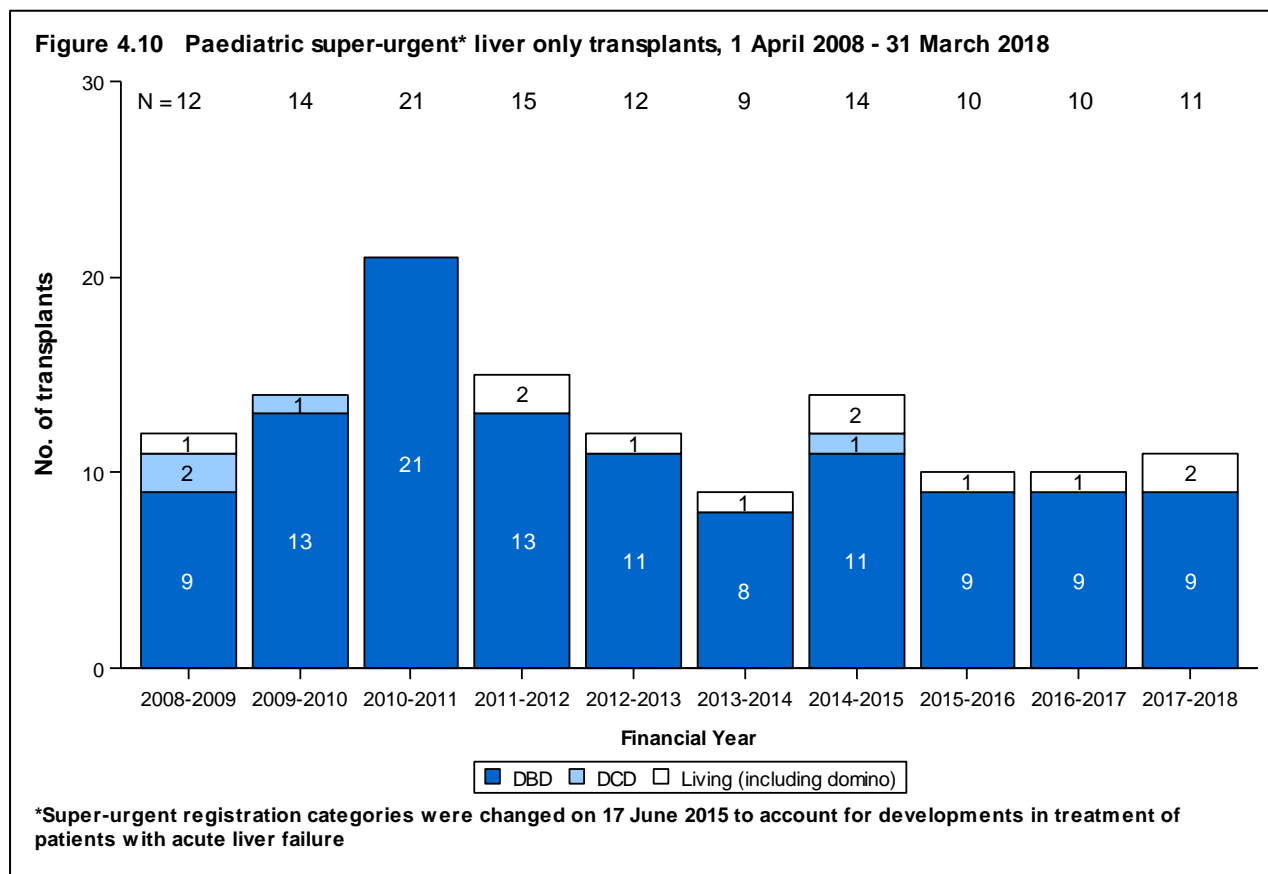
Table 4.5 shows the [median waiting time](#) to deceased donor liver only transplant for paediatric [super-urgent](#) patients. The median waiting time to transplant is shortest at Birmingham but there is no statistically significant difference across the three centres. The national median waiting time 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 2012 - 31 March 2015			
Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Paediatric			
Birmingham	20	3	2 - 4
Leeds	5	4	0 - 8
King's College	35	6	4 - 8
UK	60	4	3 - 5

Table 4.5 includes registrations for a re-transplant. Of the 60 registrations for the UK in the three-year time period, 45 led to transplants (the remaining 15 led to removal or death). Fourteen of the 45 transplants were re-transplanted, hence, the difference between the 31 *first* deceased donor liver only transplants reported in **Figure 4.10** for the period 2012 – 2015 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.



4.3.3 Post-transplant survival

One year [unadjusted patient survival](#) for 36 transplants (excluding 2 [auxiliary](#) transplants) between 1 April 2013 and 31 March 2017 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 2013 - 31 March 2017			
Centre	Number of transplants	1-year survival % (95% CI)	
Leeds	4 ¹	(-)	
King's College	21	88.9	(61.8 - 97.2)
Birmingham	10	100.0	(-)
Total*	36	93.5	(76.3 - 98.4)
* Includes 1 patients transplanted at a non-paediatric centre			
¹ Survival rates for less than 10 transplants are not presented due to small numbers			

Table 4.7 shows the [unadjusted](#) five year paediatric [patient survival](#) for 58 transplants (excluding 1 [auxiliary](#) transplant) between 1 April 2009 and 31 March 2013, 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 2009 - 31 March 2013			
Centre	Number of transplants	5-year survival % (95% CI)	
Leeds	9 ¹	(-)	
King's College	31	73.6	(54.0 - 85.9)
Birmingham	16	62.5	(34.9 - 81.1)
Total*	58	68.7	(55.0 - 79.0)
* Includes 2 patients transplanted at a non-paediatric centre			
¹ Survival rates for less than 10 transplants are not presented due to small numbers			

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.

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 2017 and 31 December 2017 for the transplant record, and all requests for follow-up forms issued in this time period. Newcastle 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 and that NHSBT are working closely with Leeds to ensure that all forms are completed and returned to NHSBT.

Table 4.8 Form return rates, 1 January 2017 and 31 December 2017								
Centre	Transplant record		3 month follow-up		1 year follow-up		Lifetime follow-up	
	N	% returned	N	% returned	N	% returned	N	% returned
Leeds	12	100	12	100	15	87	72	86
King's College	35	100	39	100	38	97	204	85
Birmingham	15	100	19	100	18	100	145	100



Appendix



A1 Data

Data were obtained from the UK Transplant Registry for the ten year time period, 1 April 2008 to 31 March 2018 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 2017 and 31 March 2018 were extracted from the UK Transplant Registry on 25 July 2018 (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 2017 and 31 March 2018 (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 2017 and 31 March 2018 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		Last 3 years		Last 10 years	
	April 2017-March 2018		April 2015-March 2018		April 2008-March 2018	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	34	3	111	13	339	59
Leeds	136	18	343	45	927	103
Cambridge	104	13	279	30	769	92
Royal Free	100	18	275	51	724	117
King's College	186	17	519	47	1493	198
Birmingham	184	22	554	58	1515	198
Edinburgh	94	9	278	25	796	99
TOTAL	842¹	100	2365²	269	6581³	866

¹ Includes 4 living transplants performed at London Bridge Hospital

² Includes 6 living transplants performed at London Bridge Hospital

³ Includes 13 and 5 living transplants at London Bridge Hospital and Cromwell Hospital, respectively

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		Last 3 years		Last 10 years	
	April 2017-March 2018		April 2015-March 2018		April 2008-March 2018	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	31	3	97	12	298	49
Leeds	121	12	306	28	830	63
Cambridge	94	10	258	17	704	52
Royal Free	95	11	255	36	664	84
King's College	159	15	437	40	1275	162
Birmingham	166	19	496	46	1377	152
Edinburgh	88	4	254	11	726	64
TOTAL	754	74	2103	190	5874	626

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

Table A1.3 Number of paediatric liver transplants in each time period, by transplant centre and urgency status

Transplant centre	Latest year		Last 3 years		Last 10 years	
	April 2017-March 2018		April 2015-March 2018		April 2008-March 2018	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	0	1	0	1	0	2
Leeds	18	5	49	12	151	27
Cambridge	0	0	0	1	0	1
Royal Free	0	0	0	0	1	2
King's College	45	7	122	19	403	85
Birmingham	22	3	93	10	256	52
TOTAL	85	16	264	43	811	169

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		Last 3 years		Last 10 years	
	April 2017-March 2018		April 2015-March 2018		April 2008-March 2018	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	0	1	0	1	0	2
Leeds	13	2	38	5	100	15
Cambridge	0	0	0	1	0	1
Royal Free	0	0	0	0	0	1
King's College	32	5	86	14	270	65
Birmingham	16	1	59	6	182	33
TOTAL	61	9	183	27	552	117

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

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

Table A3.1 Risk factors and categories used in the adult elective risk adjusted survival models post transplantation	
Donor history of diabetes	No Yes
Donor type	Donor after brain death Donor after cardiac death
ABO match	Identical Compatible Incompatible
Graft type	Whole Segmental
Donor age years	Per 1 year increase
Donor BMI kg/m ²	Per 1 kg/ m ² increase

Table 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
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

Table A3.2 Risk factors and categories used in the adult super-urgent risk adjusted survival models post transplantation

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. Note that NHSBT currently do not record whether machine perfusion was used either prior to retrieval or prior to the organ being transplanted. In cases where organ maintenance systems were used not all of this time duration is ischaemic, and no adjustment has been made for this in this report.

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.

Prepared by:

Statistics and Clinical Studies, NHS Blood and Transplant

Miss Cathy Hopkinson

Mrs Rhiannon Taylor

