



Blood and Transplant

**ANNUAL REPORT ON
LIVER TRANSPLANTATION**

**REPORT FOR 2018/2019
(1 APRIL 2009 – 31 MARCH 2019)**

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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 2009 to 31 March 2019. 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 for offering livers from donors after brain death (DBD).

Key findings

- On 31 March 2019, there were 432 patients on the UK [active transplant list](#), which represents a 20% increase in the number of patients a year earlier.
- Of the patients joining the [elective](#) liver only waiting list, approximately 79% had received a transplant within two years of listing.
- There were 8740 liver transplants performed in the UK in the ten year period. The number of liver transplants using [donors after circulatory death](#) has remained steady over the last five years. In the most recent year, the number of transplants from [donors after brain death](#) has dropped by 2% since last year.
- The unadjusted national rates of patient survival one and five years after first liver only transplantation are given below

Unadjusted patient survival (%) post-transplant for first liver transplants		
	One year patient survival (%)	Five year patient survival (%)
Adult		
Elective	94	83
Super-urgent	88	82
Paediatric		
Elective	97	92
Super-urgent	94	70

- The national rates of patient survival after joining the transplant list for adult elective first liver only patients was 84% at one and 72% at five 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 2009 and 31 March 2019, 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 2010 and 31 March 2014 for 5 year survival, and 1 April 2014 to 31 March 2018 for 1 year survival. Patient survival from registration is presented for the period 1 January 2007 to 31 December 2018. 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 2010 and 2019. The number of patients waiting for a transplant increased from 371 in 2010 to 611 in 2015. There has been a subsequent decline in the number of active patients since 2015 to 359 patients in 2018 with a subsequent increase to 432 in 2019. The change 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.

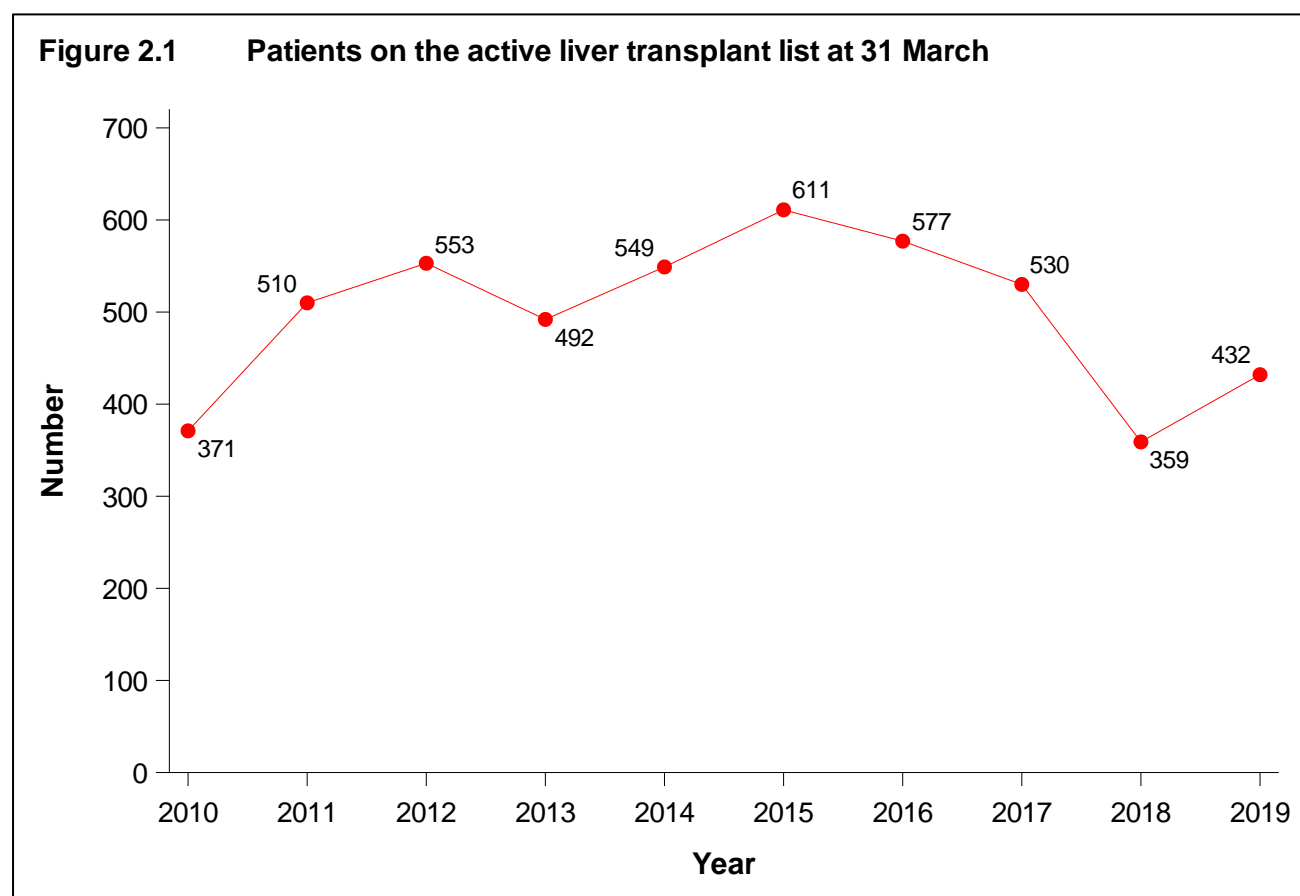
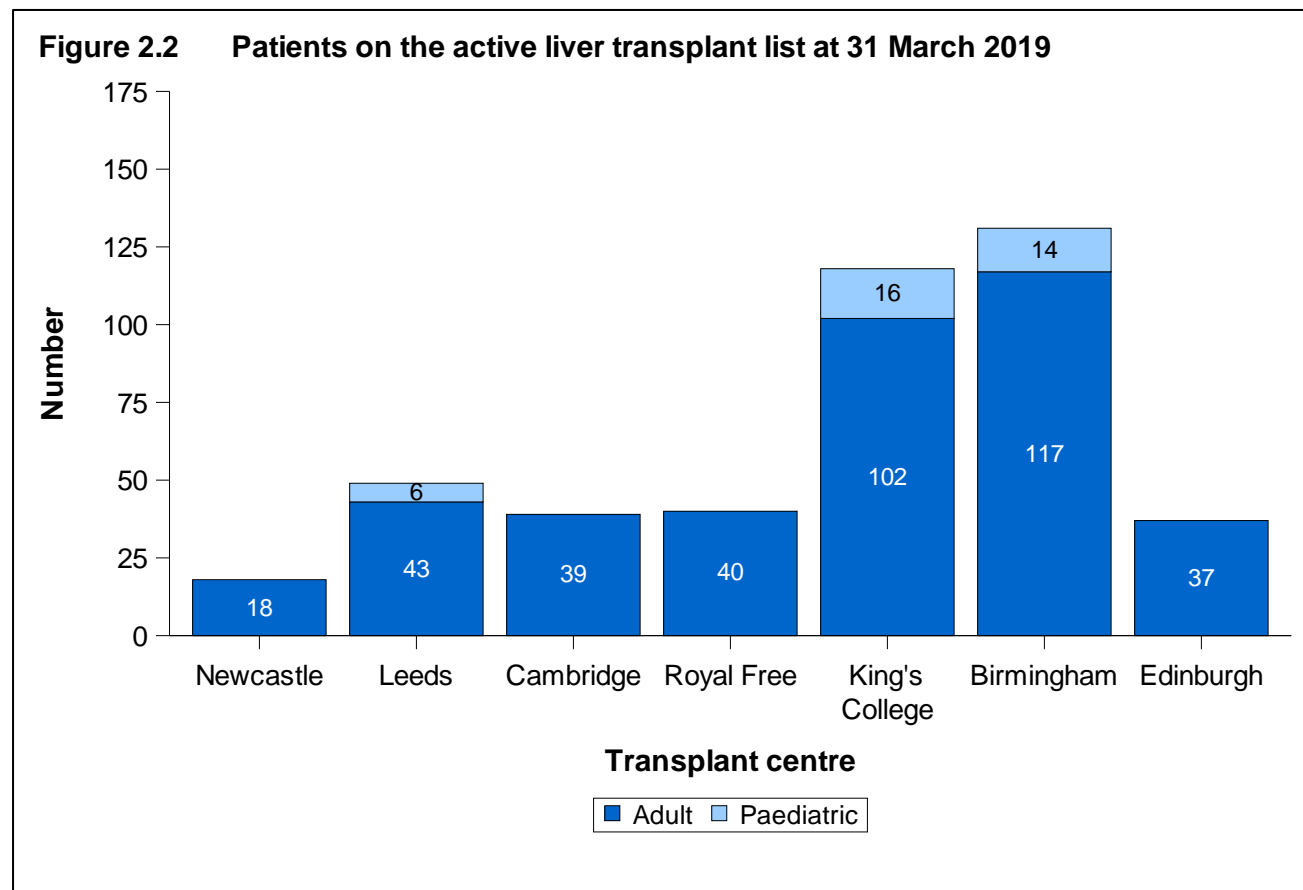


Figure 2.2 shows the number of adult and paediatric patients on the transplant list at 31 March 2019, by centre. In total, there were 396 adults and 36 paediatric patients on the active transplant list. Birmingham had the largest share of the transplant list (30%) and Newcastle the smallest (4%). This figure includes [multi-organ](#), [elective](#) and [super-urgent](#) registrations.



An indication of long-term outcomes for patients listed between April 2016 and March 2017 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 six months post-registration, 60% of patients had received a transplant and 29% were still waiting.

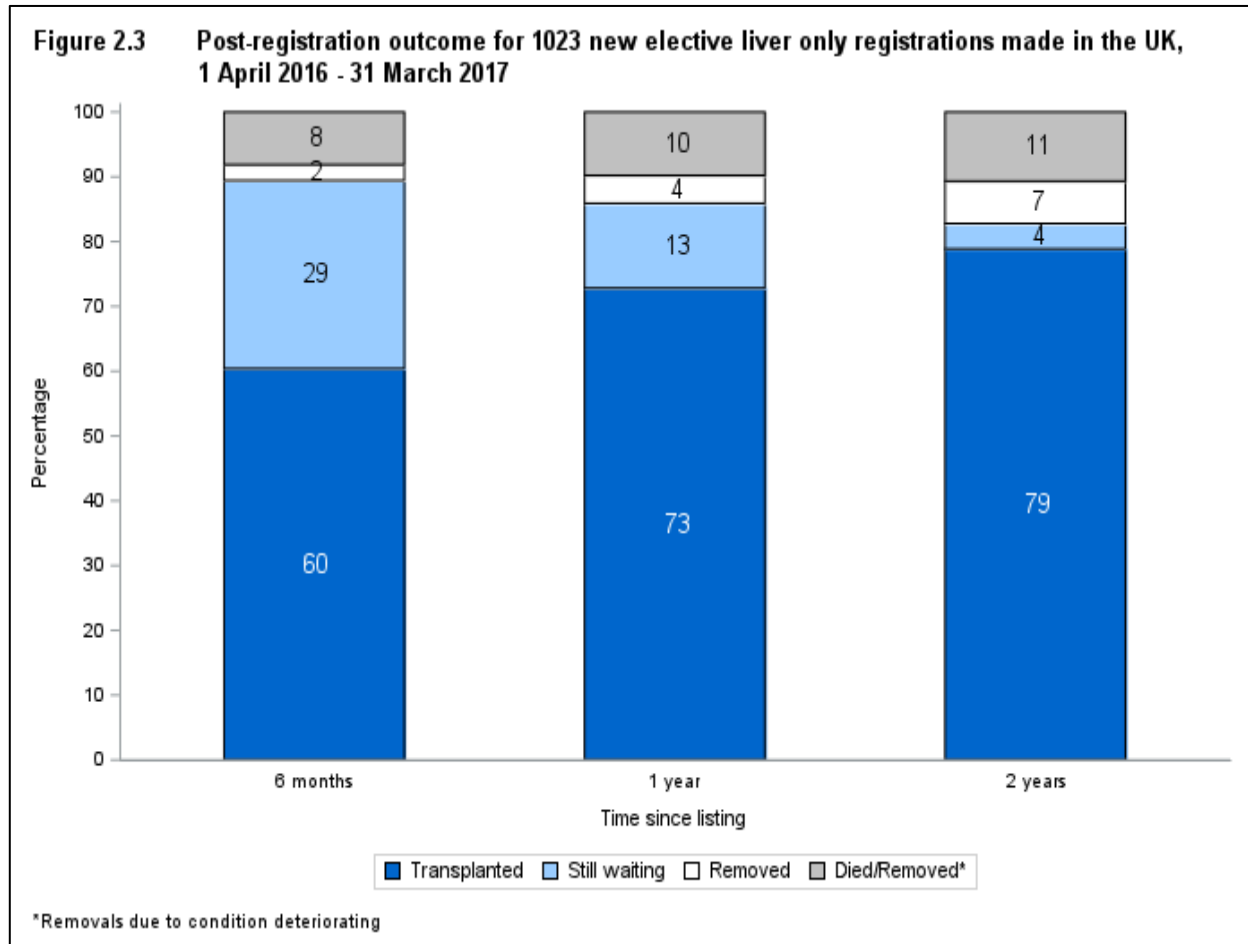
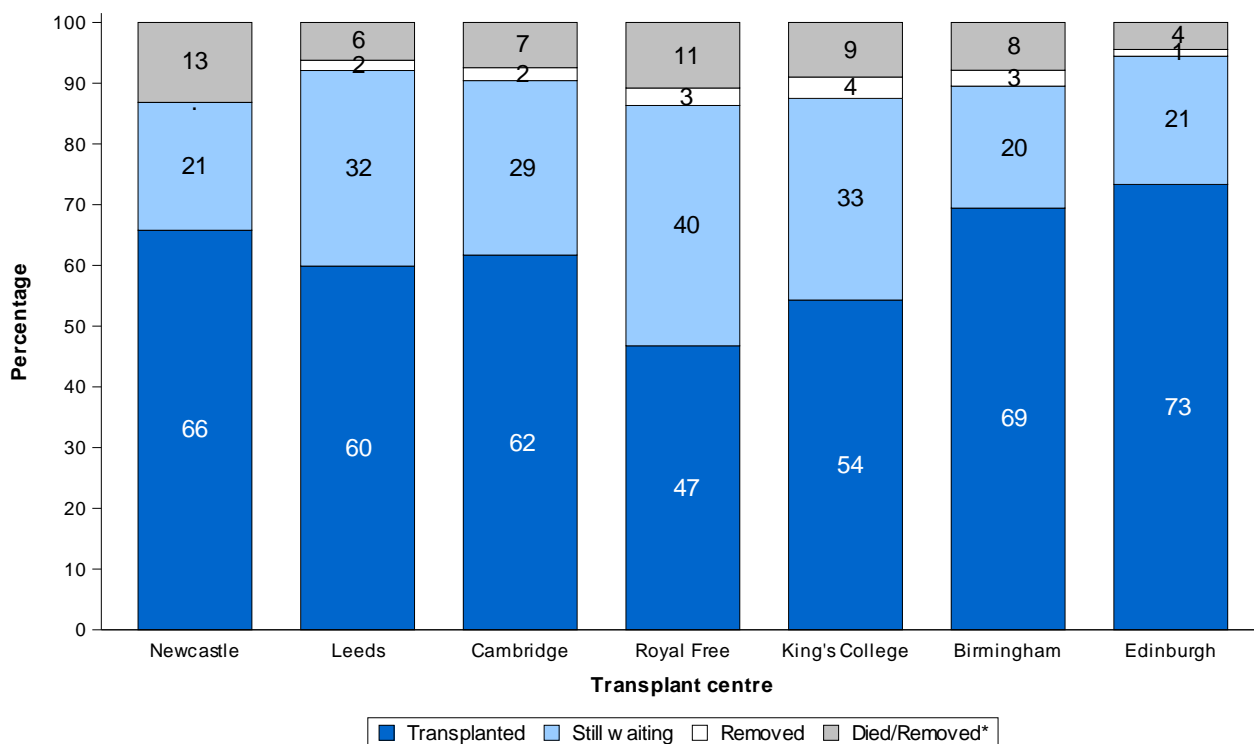


Figure 2.4 shows the six month registration outcome by centre. The proportion of patients transplanted six months after listing at each centre ranges from 47% at The Royal Free to 73% at Edinburgh.

Figure 2.4 Six month Post-registration outcome for 1023 new elective liver only registrations made in the UK by centre, 1 April 2016 - 31 March 2017



*Removals due to condition deteriorating

2.2 Transplant activity

Figure 2.5 shows the total number of liver transplants performed in the last ten years, by type of donor while **Figure 2.6** shows the equivalent information by transplant centre. 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 has reduced slightly to 188 in 2018/2019. The number of transplants from donors after brain death ([DBD](#)) has decreased in the most recent year to 793. There were 21 [living donor](#) liver transplants and 1 [domino](#) transplant performed in the last financial year.

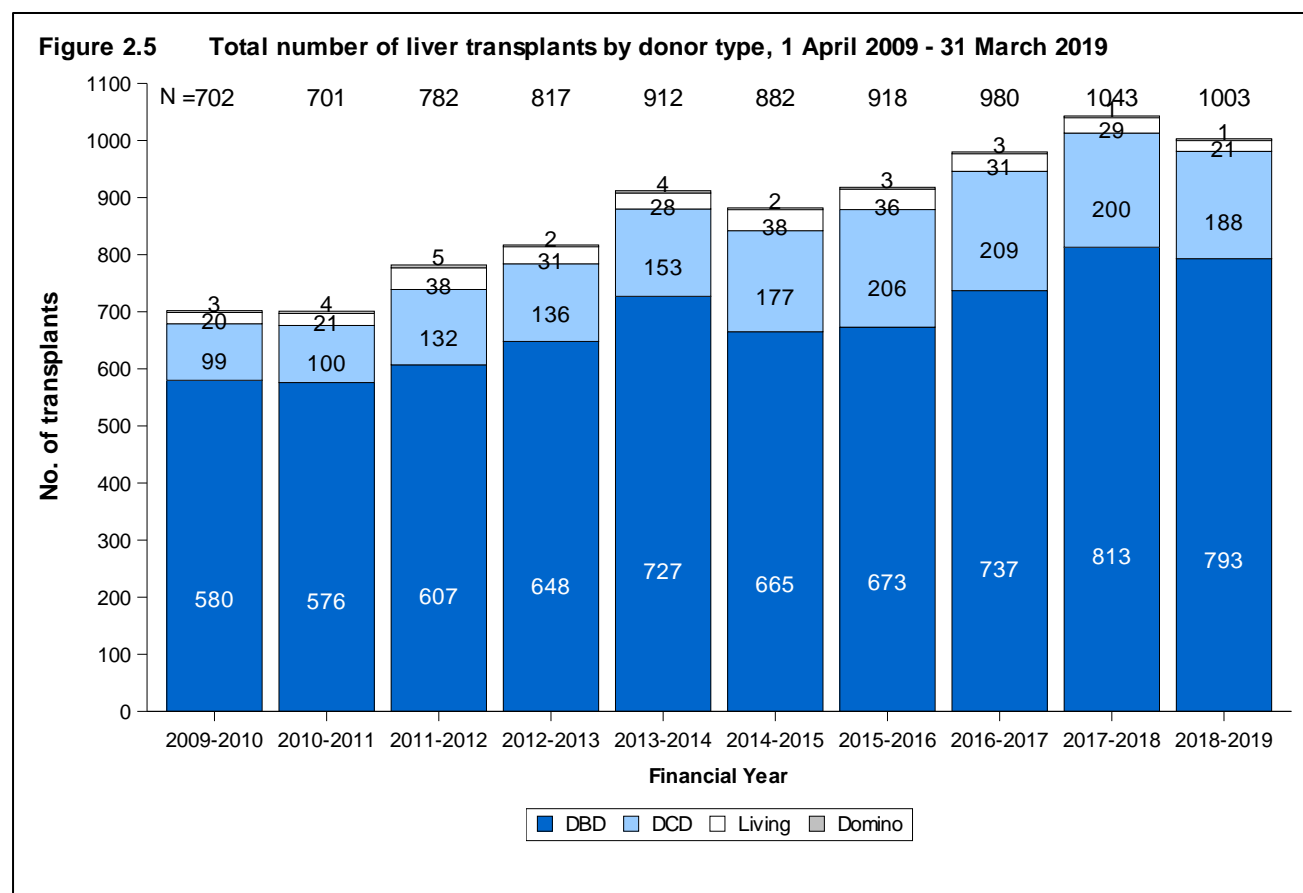


Figure 2.6 Total number of liver transplants by transplant centre and donor type, 1 April 2009 - 31 March 2019

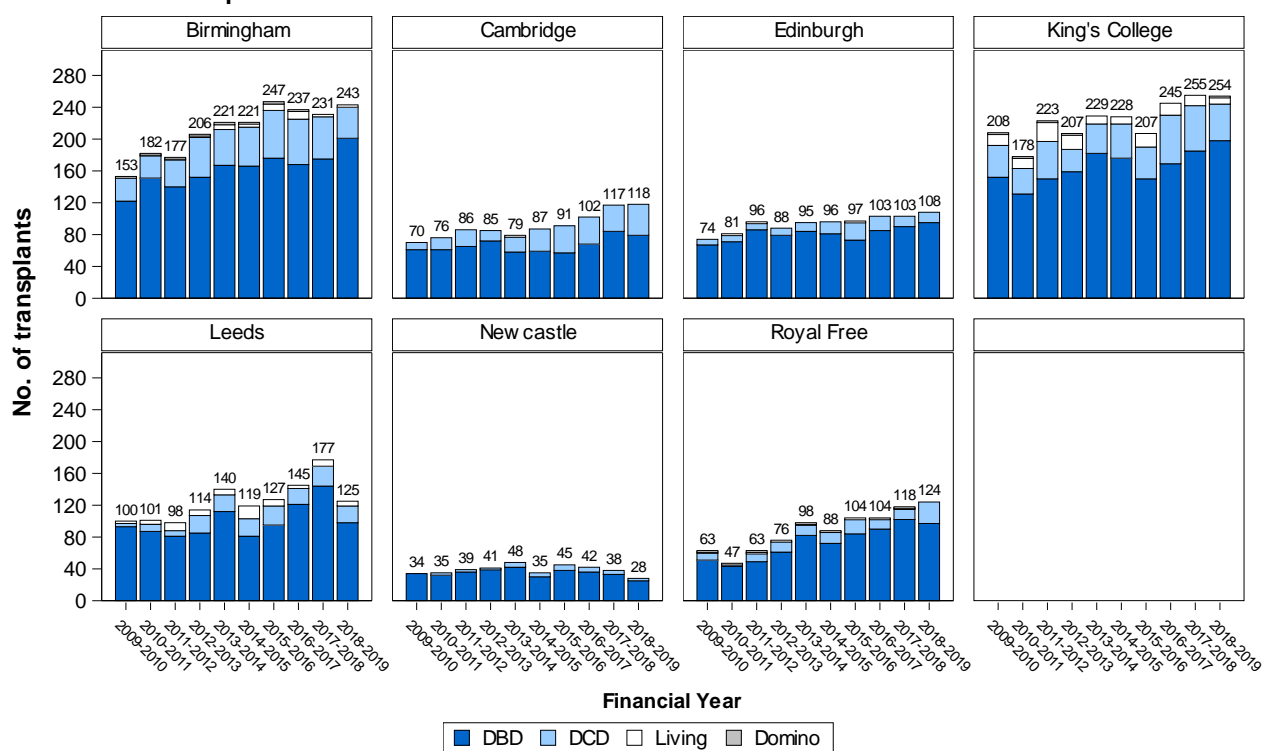
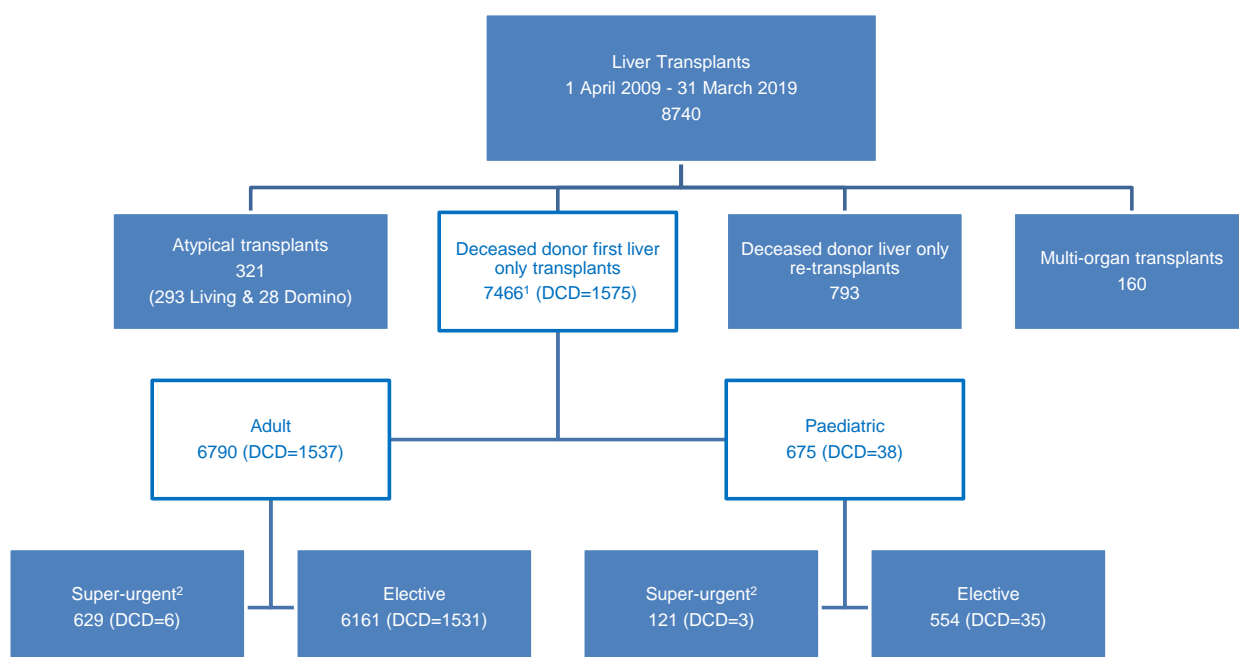


Figure 2.7 details the 8740 liver transplants performed in the UK in the ten year period. Of these, 7466 (85%) were deceased donor first liver only transplants. One transplant recipient refused consent for their data to be used in analysis and, therefore, could not be categorised as an adult or a paediatric patient. Of the 7465 transplants that had consent and were analysed, 6790 (91%) were performed in adult and 675 (9%) in paediatric patients. Similarly including both adult and paediatric, 6715 (90%) were [elective](#) and 750 (10%) were [super-urgent](#) transplants.

Figure 2.7 Liver transplants in the UK, 1 April 2009 – 31 March 2019



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.

Figure 2.8 shows the number of liver transplants performed in the last ten years, by type of transplant and donor whilst **Figure 2.9** shows the equivalent information by transplant centre. The number of liver only retransplants from donors after brain death ([DBD](#)) ranged between 51 in 2010/2011 and 98 in 2013/2014 with 91 performed in 2018/2019. During the last ten years, 158 DBD and 2 DCD multi-organ transplants involving the liver were performed of which 14 were retransplants. Of the 158 multi-organ DBD transplants, 150 were simultaneous liver and kidney transplants (13 of which were retransplants), four were simultaneous liver and pancreas transplants (one of which was a retransplant), two were simultaneous liver and heart transplants and two were simultaneous liver and lung transplants.

The majority of transplants (98%) performed over the last ten years involving donors after circulatory death ([DCD](#)) were first liver only transplants, with only 23 DCD retransplant liver only transplants and two simultaneous liver/kidney DCD transplants.

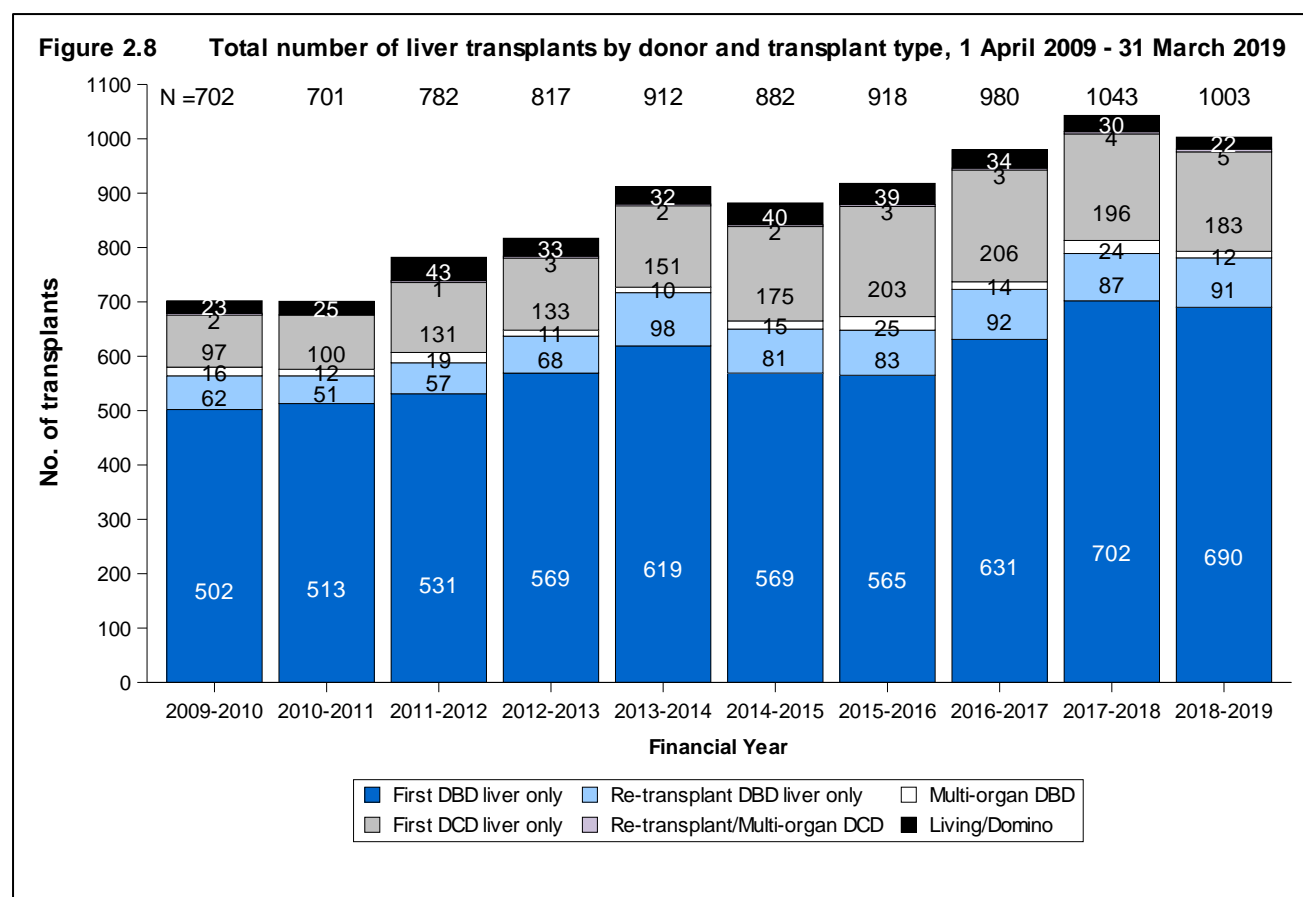
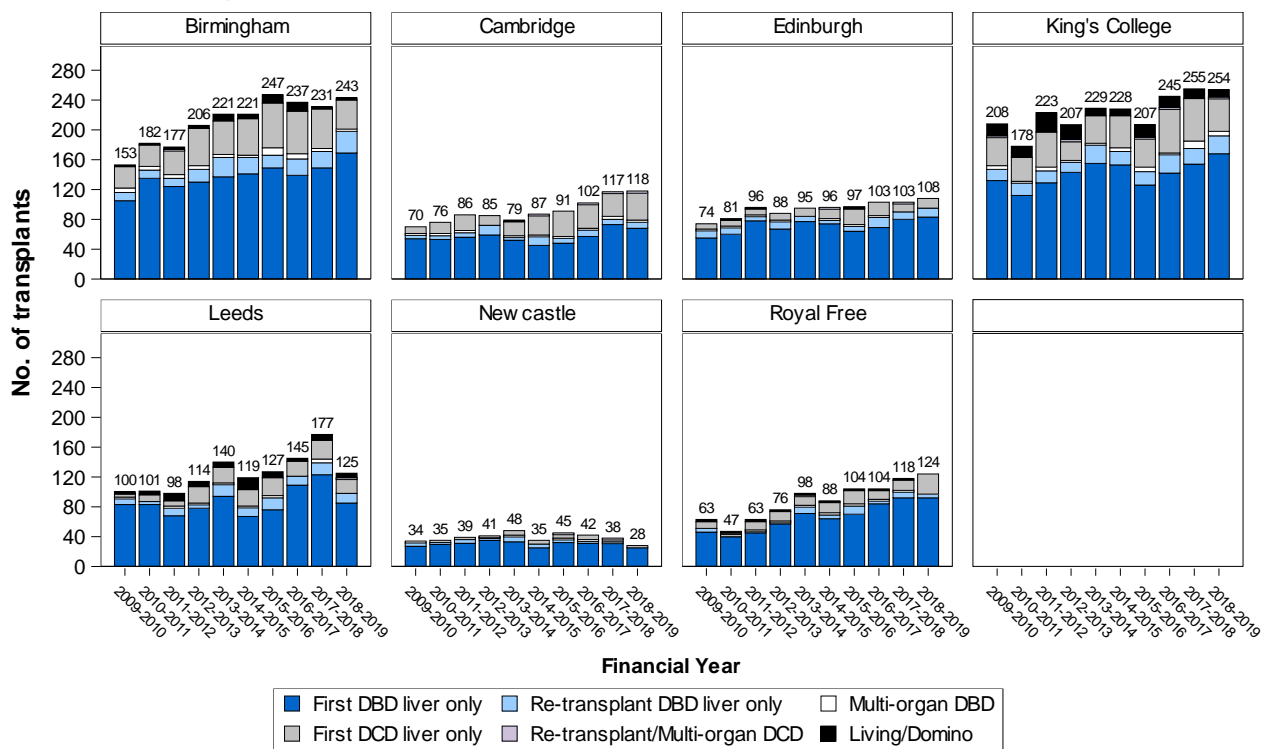


Figure 2.9 Total number of liver transplants by transplant centre, donor type and transplant type, 1 April 2009 - 31 March 2019



Geographical variation in registration and transplant rates

Figure 2.10 shows rates of registration to the liver transplant list per million population (pmp) between 1 April 2018 and 31 March 2019 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 coefficient 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 0.0429 and 0.0345, respectively, and therefore, no evidence of geographical variation beyond what would be expected at random.

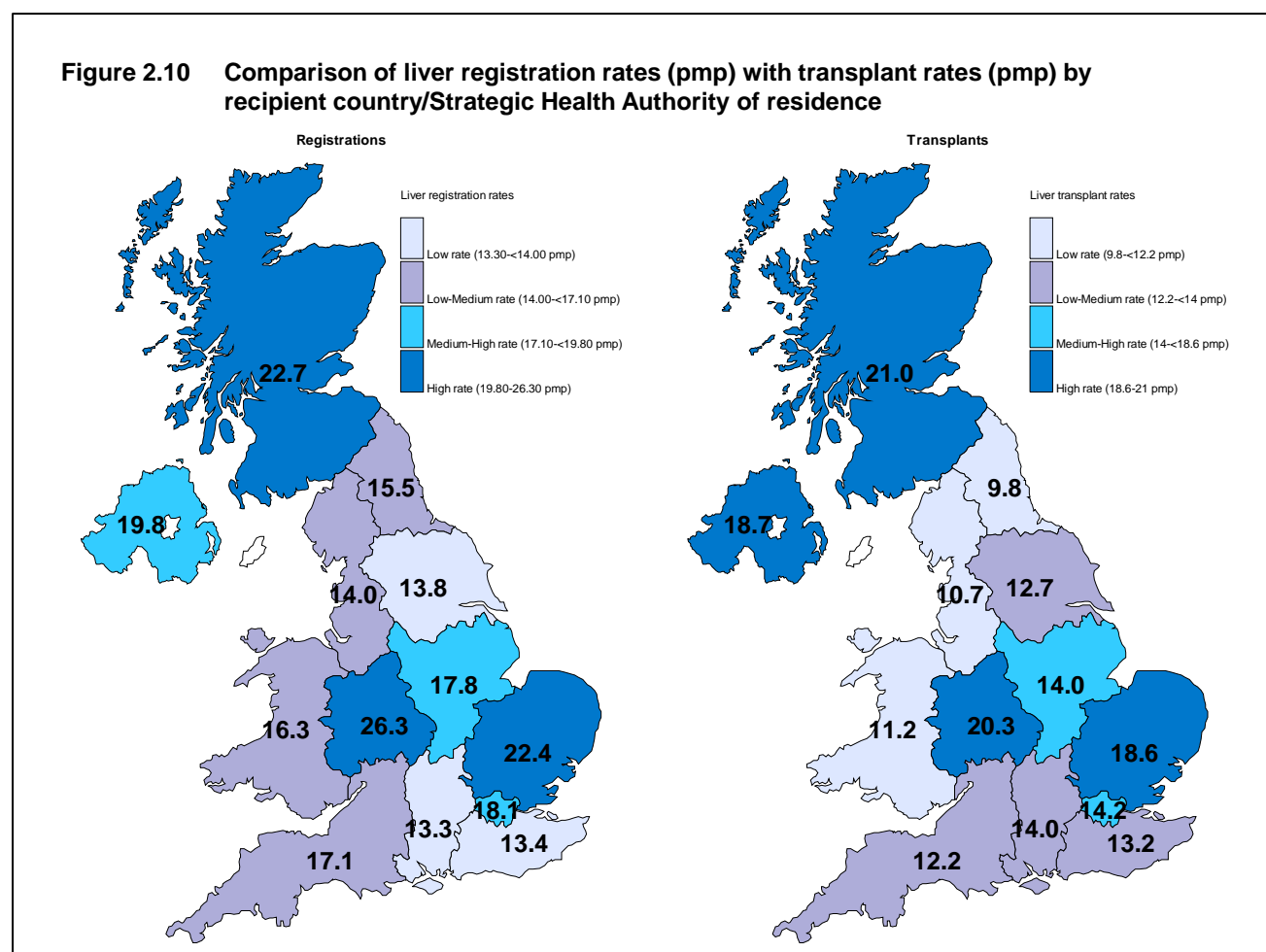


Table 2.1 Liver registration and transplant rates per million population (pmp) in the UK, 1 April 2018 - 31 March 2019, by Country/Strategic Health Authority

Country/ Strategic Health Authority	Registrations (pmp)		Transplants (pmp)	
North East	41	(15.5)	26	(9.8)
North West	102	(14)	78	(10.7)
Yorkshire and The Humber	75	(13.8)	69	(12.7)
North of England	218	(14.2)	173	(11.3)
East Midlands	85	(17.8)	67	(14)
West Midlands	154	(26.3)	119	(20.3)
East of England	138	(22.4)	115	(18.6)
Midlands and East	377	(22.4)	301	(17.9)
London	160	(18.1)	125	(14.2)
South East Coast	63	(13.4)	62	(13.2)
South Central	58	(13.3)	61	(14)
South West	95	(17.1)	68	(12.2)
South of England	216	(14.8)	191	(13.1)
England	971	(17.5)	790	(14.2)
Isle of Man	0		0	
Channel Islands	3	(18.8)	3	(18.8)
Wales	51	(16.3)	35	(11.2)
Scotland	123	(22.7)	114	(21)
Northern Ireland	37	(19.8)	35	(18.7)
TOTAL	1190¹	(18)	986²	(14.9)

¹ Registrations include 5 recipients whose postcode was unknown and excludes 5 recipients who reside in the Republic of Ireland and 3 recipients who reside overseas

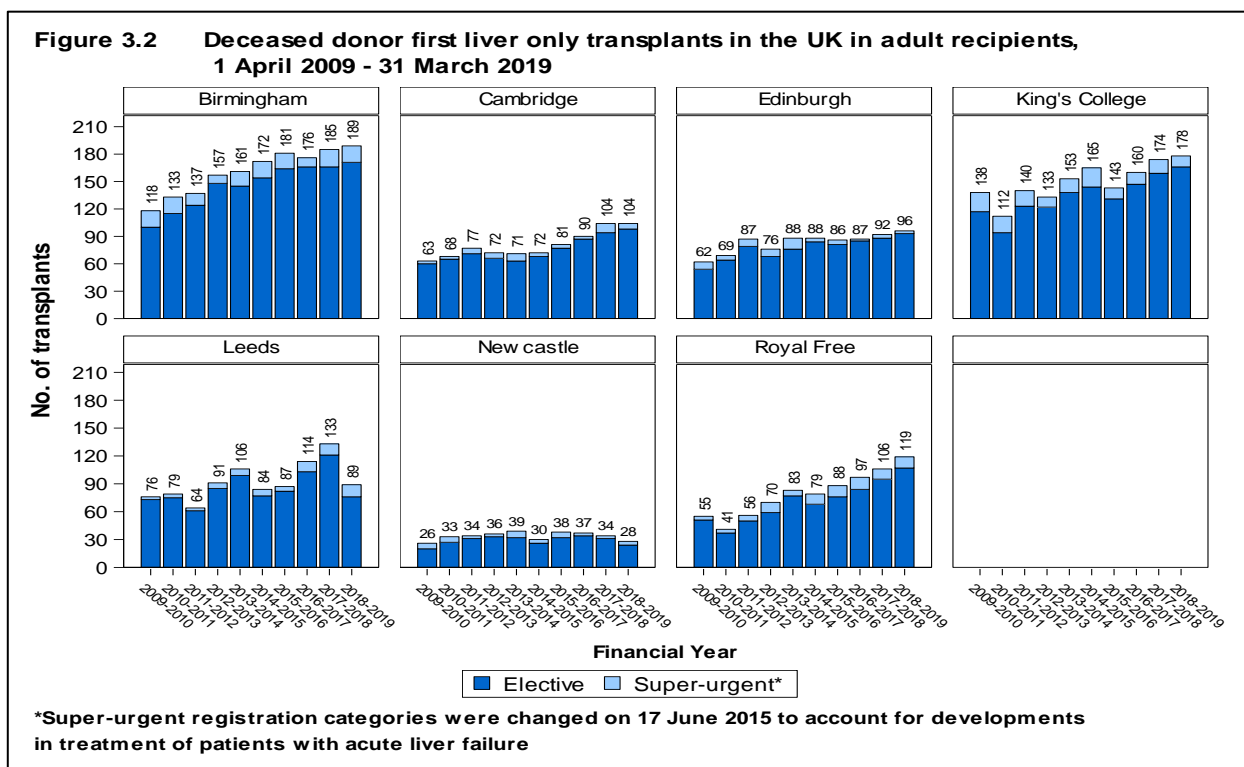
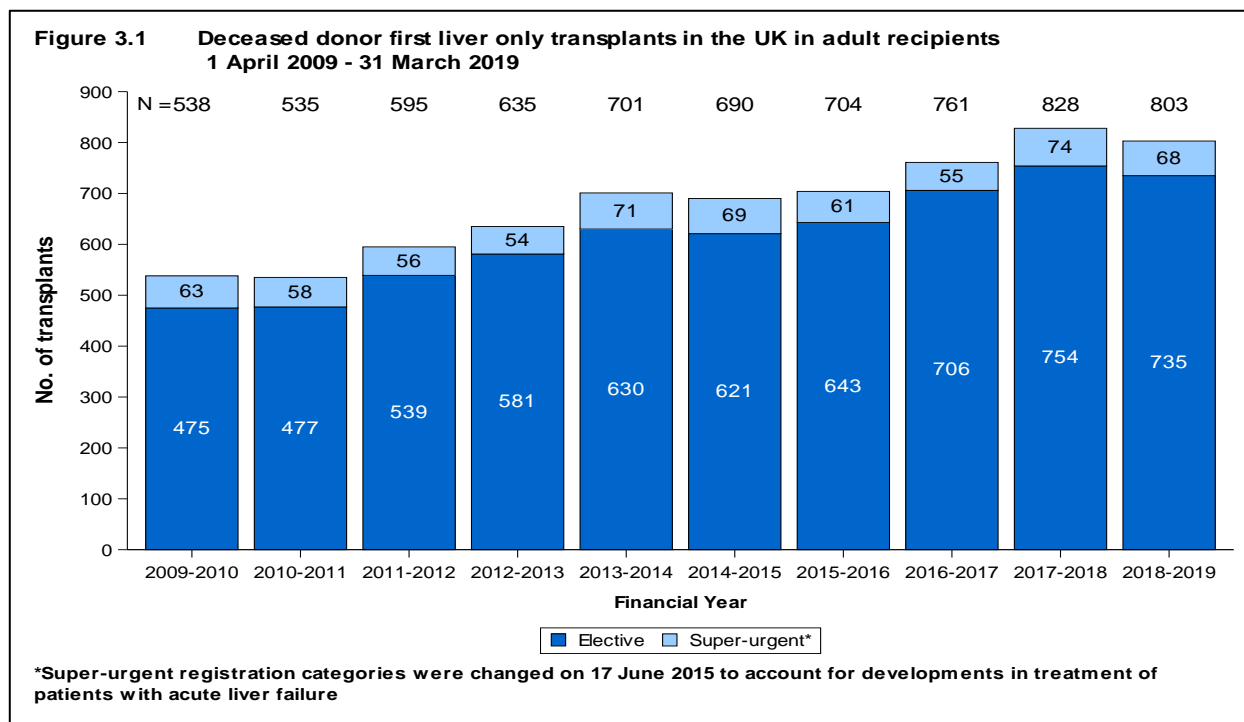
² Transplants include 9 recipients whose postcode was unknown and excludes 1 recipients who reside in the Republic of Ireland and 2 recipients who reside overseas

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 803 transplants in the latest financial year, 735 (92%) were [elective](#) and 68 (8%) were [super-urgent](#) transplants. See **Appendix 1** for further details.



The overall [median cold ischaemia times](#) (CIT) for adult transplant recipients are shown by financial year in **Figure 3.3** for [DBD](#) and [DCD](#) donors, respectively. The national median CIT for transplants from DBD donors has remained relatively stable and was 9.1 hours in 2009/10 and 9.0 hours in 2018/19. Similarly, the national median for DCD donor transplants has remained relatively stable over the ten year period and was 6.7 hours in 2009/10 and 7.6 hours in 2018/19.

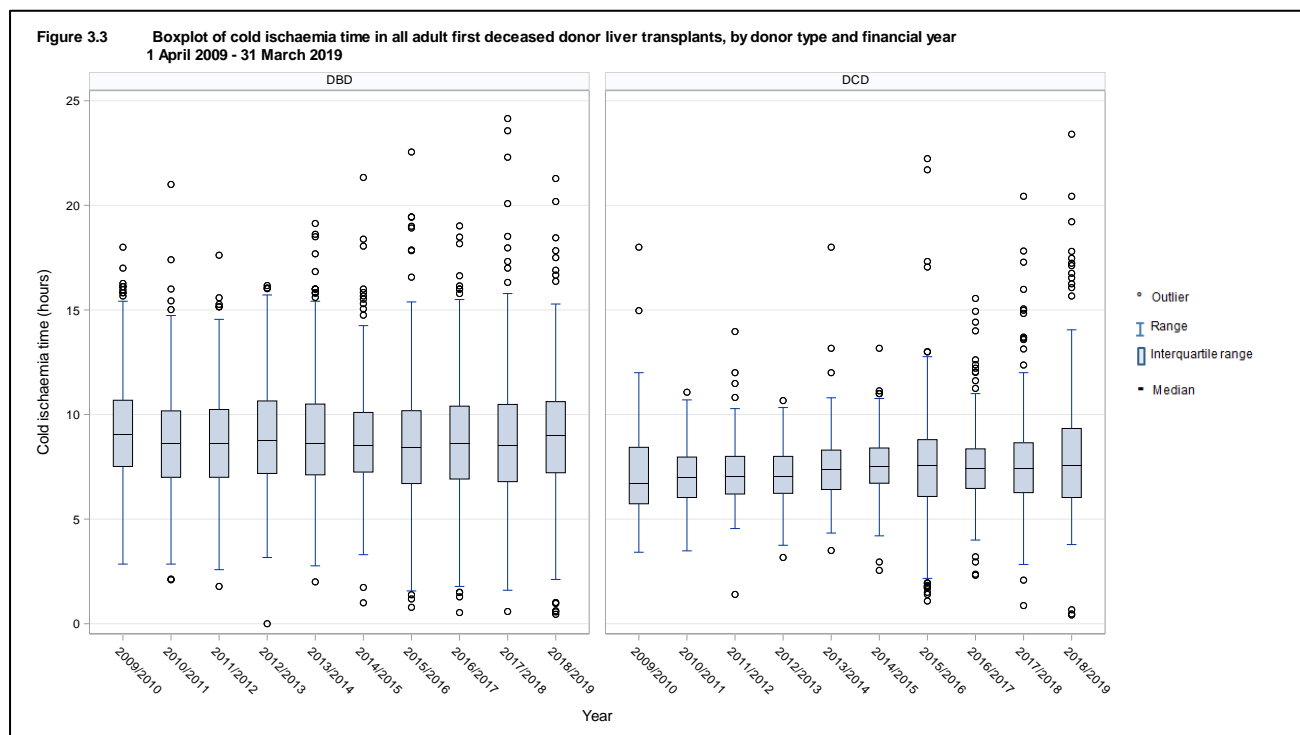


Figure 3.4 shows boxplots of [cold ischaemia times](#) (CIT) for adult transplant recipients by centre and donor type in the latest financial year (2018/2019) while **Figure 3.5** and **Figure 3.6** show the equivalent information by centre over the last ten financial years for [DBD](#) and [DCD](#) donors, respectively. The median CIT for DBD in the last financial year ranged between 7.5 and 10.8 hours across transplant centres whilst the median CIT for DCD ranged between 6.0 and 11.7 hours.

The cold ischaemia time used is as reported on the liver transplant record form and may include periods of machine perfusion; no adjustment has been made for this. Sixty-three (8%) of adult deceased donor first liver only transplants performed in the latest financial year were reported to have involved machine perfusion (either normothermically or hypothermically). The proportion involving machine perfusion by centre ranged between 0% at Leeds and Royal Free to 42% at Cambridge.

Figure 3.4 Boxplot of cold ischaemia time in all adult first deceased donor liver transplants, by donor type and transplant centre
1 April 2018 - 31 March 2019

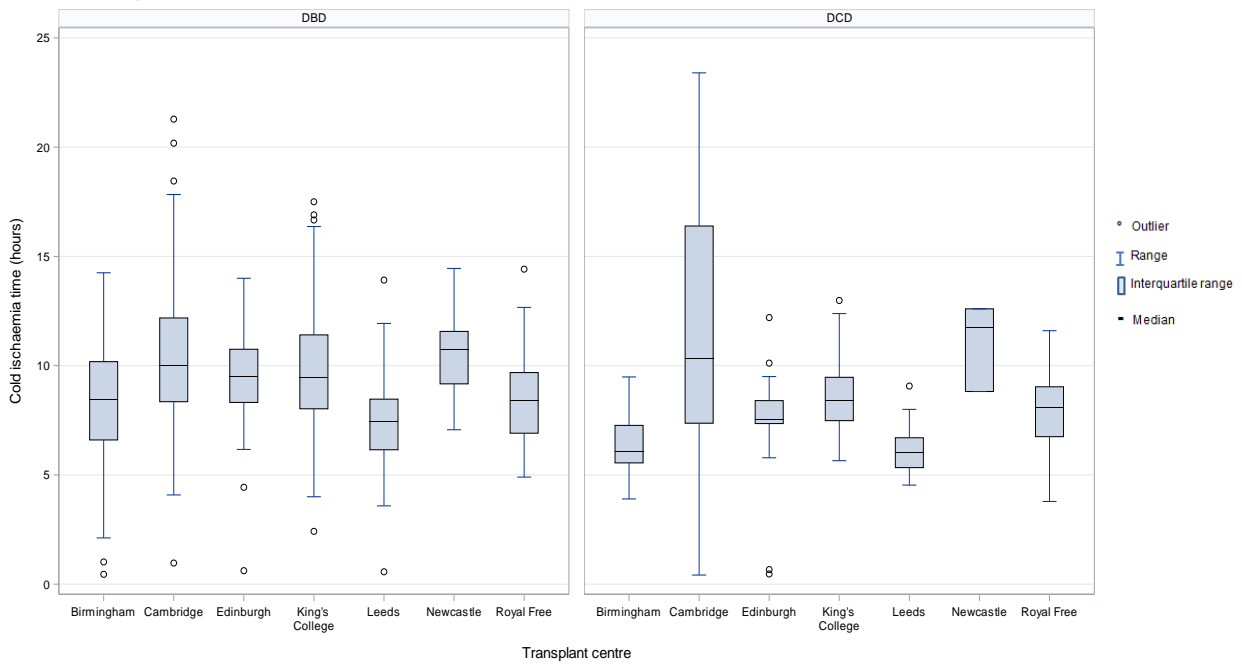


Figure 3.5 Boxplot of cold ischaemia time in all adult first DBD donor liver transplants,
1 April 2009 - 31 March 2019

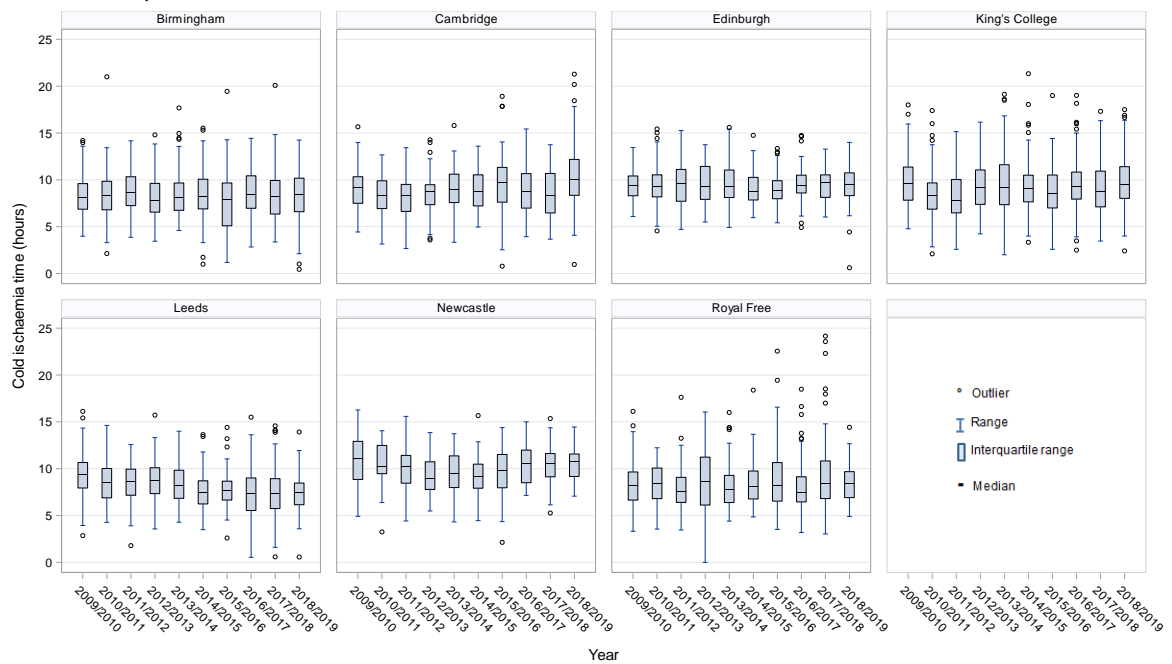
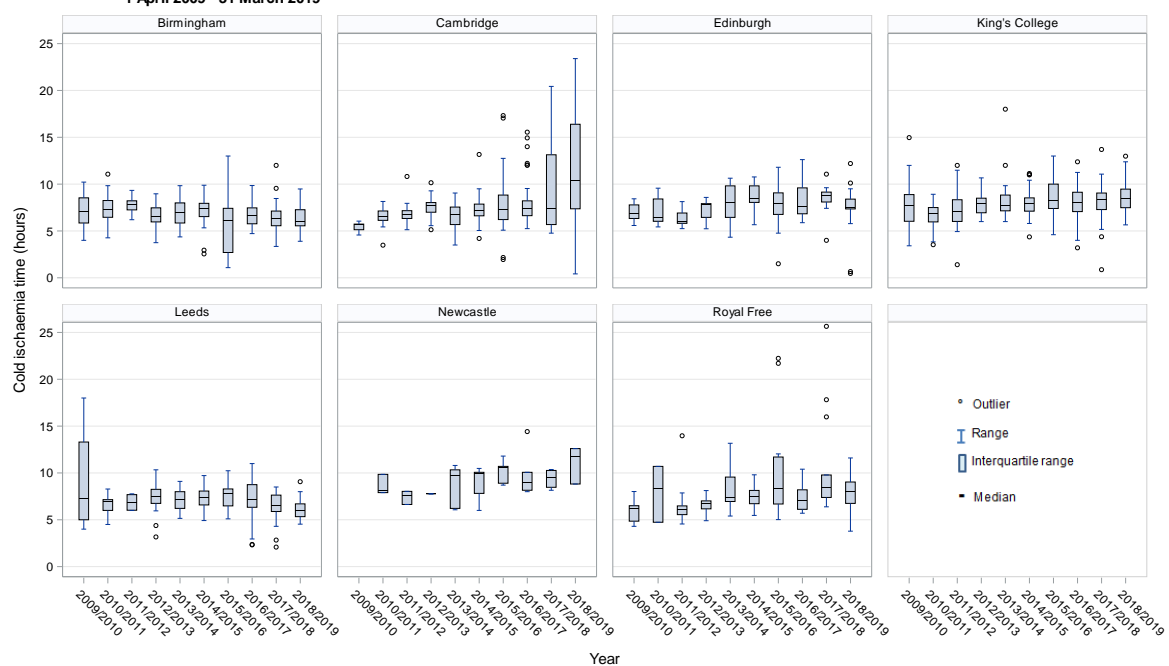


Figure 3.6 Boxplot of cold ischaemia time in all adult first DCD donor liver transplants, 1 April 2009 - 31 March 2019



Adult Liver Transplantation Elective Patients



3.2.1 Transplant list

Figure 3.7 shows the number of adult [elective](#) patients on the first liver only transplant list at 31 March each year between 2010 and 2019. The number of patients on the [active](#) liver only transplant list increased almost every year from 327 in 2010 to 514 in 2015. This reduced to 301 in 2018 and has increased to 371 active patients in 2019. The number of patients suspended on the transplant list has decreased from 86 in 2018 to 57 in 2019.

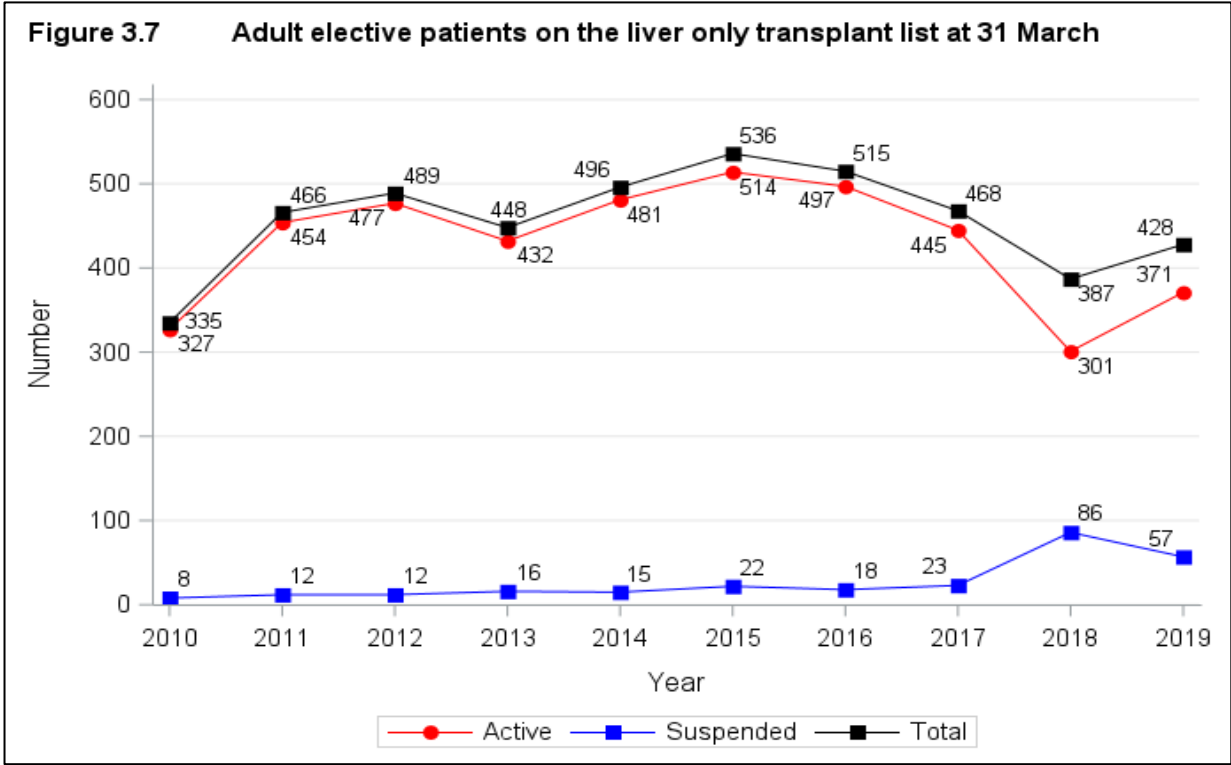
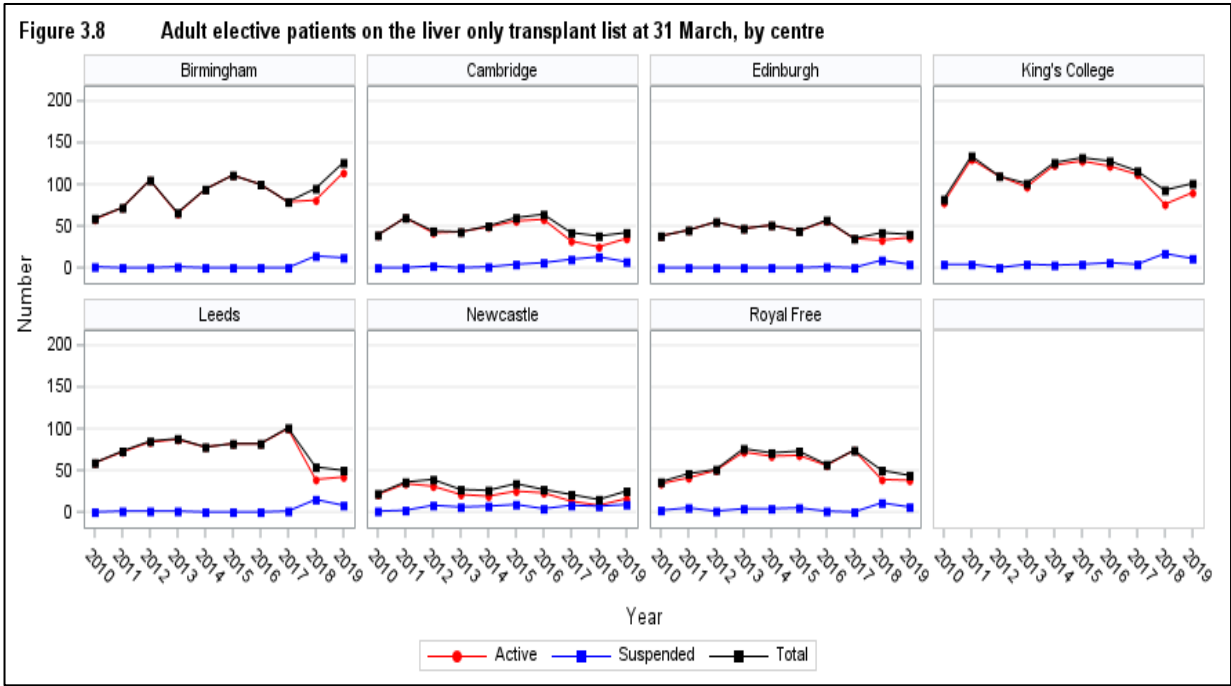


Figure 3.8 shows the number of adult patients on the transplant list at 31 March each year between 2010 and 2019, by transplant centre.



An indication of outcomes for adult [elective](#) patients listed for a liver transplant is summarised in **Figure 3.9**. 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.

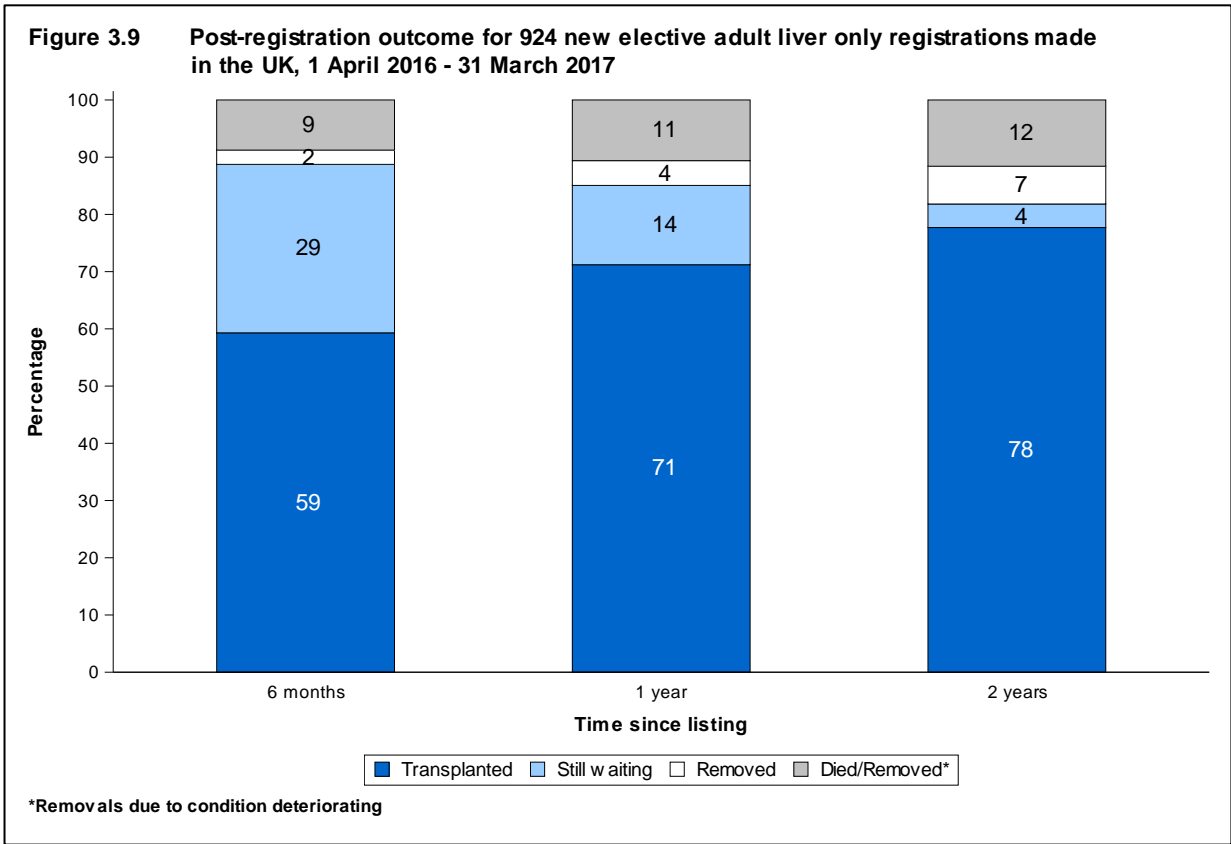


Figure 3.10 shows the proportion of patients transplanted, removed, died while waiting, or still waiting on the list at 6 months after joining the list at each transplant centre. The proportion of patients transplanted six months after listing at each centre ranges from 47% at The Royal Free to 73% at Edinburgh.

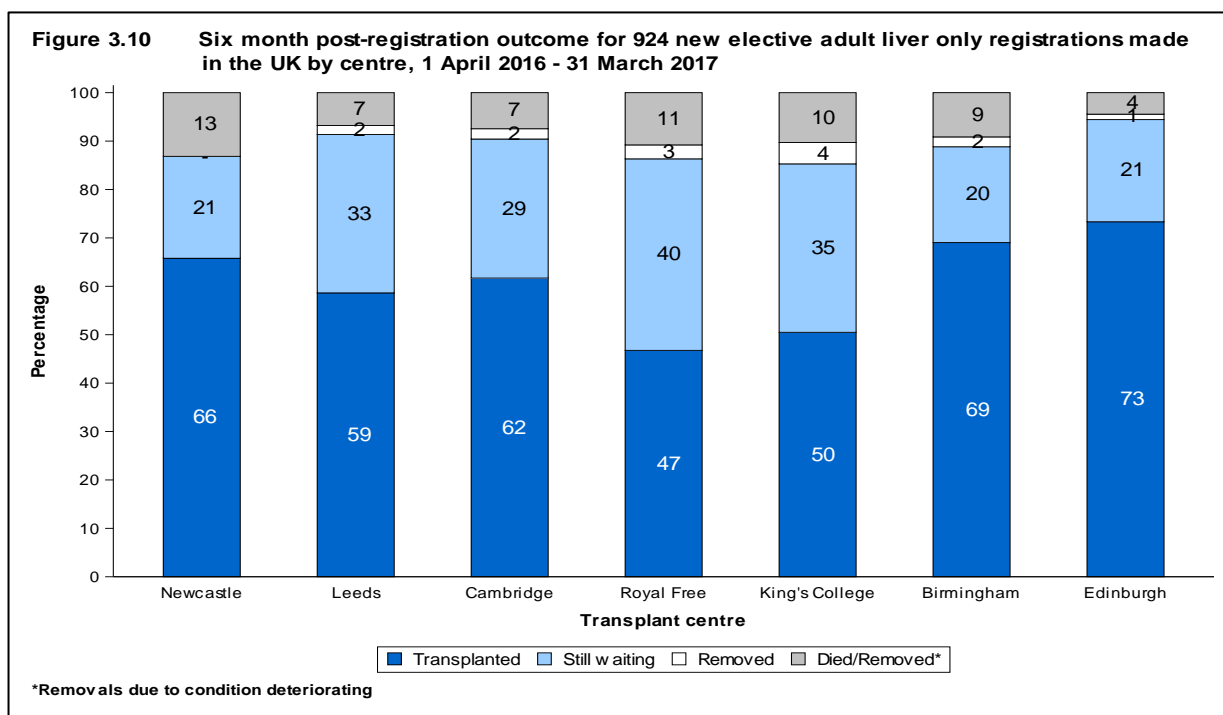


Table 3.1 shows the [median waiting time](#) to deceased donor liver only transplant for adult [elective](#) patients. The national median waiting time to transplant for adult elective patients is 99 days. The median waiting time to transplant is shorter at Birmingham (63 days) and longer at King's (154 days) and Royal Free (156 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 are based on both the old centre-based offering scheme and the NLOS.

Table 3.1 Median waiting time to liver only transplant in the UK, for adult elective patients registered 1 April 2015 - 31 March 2018			
Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Adult			
Birmingham	626	63	53 - 73
Edinburgh	315	70	54 - 86
Newcastle	118	78	52 - 104
Leeds	410	88	66 - 110
Cambridge	312	96	68 - 124
King's College	576	154	133 - 175
Royal Free	341	156	124 - 188
UK	2698	99	91 - 107

Table 3.2 shows the demographics of 996 adult [elective](#) liver patients registered from 1 April 2018 to 31 March 2019, by transplant centre. The majority of patients that were registered were male (64%), white (86%) with a [median](#) age of 56 and a median BMI of 28. 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 2018 - 31 March 2019

		Birmingham	Cambridge	Edinburgh	King's college	Leeds	Newcastle	Royal Free	Total
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Number		258	128	107	222	106	41	134	996
Recipient sex	Male	163 (63)	85 (66)	64 (60)	129 (58)	69 (65)	32 (78)	99 (74)	641 (64)
	Female	95 (37)	43 (34)	43 (40)	93 (42)	37 (35)	9 (22)	35 (26)	355 (36)
Recipient ethnicity	White	215 (83)	118 (92)	105 (98)	185 (83)	96 (91)	39 (95)	102 (76)	860 (86)
	Non-white	20 (8)	10 (8)	2 (2)	37 (17)	10 (9)	2 (5)	32 (24)	113 (11)
	Not reported	23 (9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	23 (2)
Indication	Cancer	48 (19)	19 (15)	22 (21)	38 (17)	29 (27)	6 (15)	31 (23)	193 (19)
	Hepatitis C	6 (2)	5 (4)	0 (0)	4 (2)	3 (3)	0 (0)	10 (7)	28 (3)
	Alcoholic liver disease	73 (28)	47 (37)	25 (23)	49 (22)	30 (28)	12 (29)	36 (27)	272 (27)
	Hepatitis B	2 (1)	0 (0)	1 (1)	3 (1)	2 (2)	1 (2)	2 (1)	11 (1)
	Primary sclerosing cholangitis	23 (9)	8 (6)	10 (9)	21 (9)	11 (10)	4 (10)	22 (16)	99 (10)
	Autoimmune and cryptogenic disease	15 (6)	2 (2)	11 (10)	17 (8)	3 (3)	4 (10)	12 (9)	64 (6)
	Primary biliary cholangitis	20 (8)	5 (4)	11 (10)	17 (8)	10 (9)	2 (5)	4 (3)	69 (7)
	Metabolic liver disease	23 (9)	24 (19)	16 (15)	20 (9)	9 (8)	10 (24)	11 (8)	113 (11)
	Other	24 (9)	13 (10)	7 (7)	37 (17)	6 (6)	2 (5)	6 (4)	95 (10)
	Regraft	24 (9)	5 (4)	4 (4)	16 (7)	3 (3)	0 (0)	0 (0)	52 (5)
Recipient HCV	No	235 (91)	117 (91)	102 (95)	203 (91)	96 (91)	40 (98)	114 (85)	907 (91)
	Yes	23 (9)	11 (9)	5 (5)	19 (9)	10 (9)	1 (2)	20 (15)	89 (9)
Encephalopathy	Absence	165 (64)	70 (55)	85 (79)	160 (72)	71 (67)	25 (61)	88 (66)	664 (67)
	Presence	93 (36)	58 (45)	22 (21)	62 (28)	35 (33)	16 (39)	46 (34)	332 (33)
Renal support	No	254 (98)	127 (99)	105 (98)	217 (98)	103 (97)	40 (98)	133 (99)	979 (98)
	Yes	4 (2)	1 (1)	2 (2)	5 (2)	3 (3)	1 (2)	1 (1)	17 (2)
Previous abdominal surgery	No	188 (73)	102 (80)	80 (75)	154 (69)	90 (85)	40 (98)	107 (80)	761 (76)
	Yes	70 (27)	26 (20)	27 (25)	68 (31)	16 (15)	1 (2)	27 (20)	235 (24)
Recip age (years)	Median (IQR)	56 (47, 62)	55 (47, 62)	58 (47, 63)	53 (41, 60)	56 (50, 62)	58 (53, 64)	56 (49, 63)	56 (47, 62)

Table 3.2 Demographic characteristics of adult elective liver patients registered from 1 April 2018 - 31 March 2019

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's college N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	Total N (%)
BMI kg/m2	Median (IQR)	29 (24, 32)	28 (24, 33)	27 (25, 31)	27 (23, 31)	27 (25, 31)	27 (25, 31)	27 (25, 30)	28 (24, 32)
Serum bilirubin umol/l	Median (IQR)	33 (16, 65)	44 (24, 89)	48 (28, 113)	40 (21, 84)	41 (17, 87)	36 (20, 60)	41 (24, 80)	39 (20, 83)
Serum creatinine umol/l	Median (IQR) Not reported	76 (64, 93) 2	67 (54, 88) 0	70 (61, 97) 0	71 (57, 88) 0	68 (57, 94) 0	73 (65, 98) 0	80 (71, 92) 0	73 (60, 91) 2
Serum sodium mmol/l	Median (IQR)	139 (135, 141)	136 (133, 139)	135 (132, 138)	136 (134, 139)	137 (134, 139)	137 (133, 139)	138 (134, 141)	137 (134, 140)
Serum potassium mmol/l	Median (IQR)	4 (4, 5)	4 (4, 5)	4 (4, 4)	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, 2)	1 (1, 2)
Serum albumin g/l	Median (IQR)	36 (32, 41)	30 (25, 32)	25 (22, 31)	33 (29, 37)	30 (26, 34)	35 (31, 39)	35 (30, 39)	33 (28, 37)

Figure 3.11 shows the offer decline rate funnel plot for named adult elective DBD offers. All fast-track offers, regardless of whether the fast-track offer was accepted and the liver transplanted, were excluded along with offers to super-urgent, hepatoblastoma, paediatric, intestinal or liver and cardiothoracic patients. **Figure 3.12** shows the corresponding funnel plot of offer decline rates for DCD. Unlike **Figure 3.11**, fast-track offers were only included in **Figure 3.12** if the offer was accepted and transplanted.

A DBD liver transplant can involve a whole liver, reduced liver or split liver. The term reduced is used when only one lobe of the liver is transplanted and the term split applies when both lobes of the liver are transplanted into two different recipients. Offers of whole livers and right lobes which resulted in transplantation are included in **Figure 3.11** and offer decline rates by centre and organ offered are presented in **Table 3.3**. **Table 3.3** also shows the offer decline rates by centre for DBD donors aged 65 years or under and DCD donors aged 60 years or under.

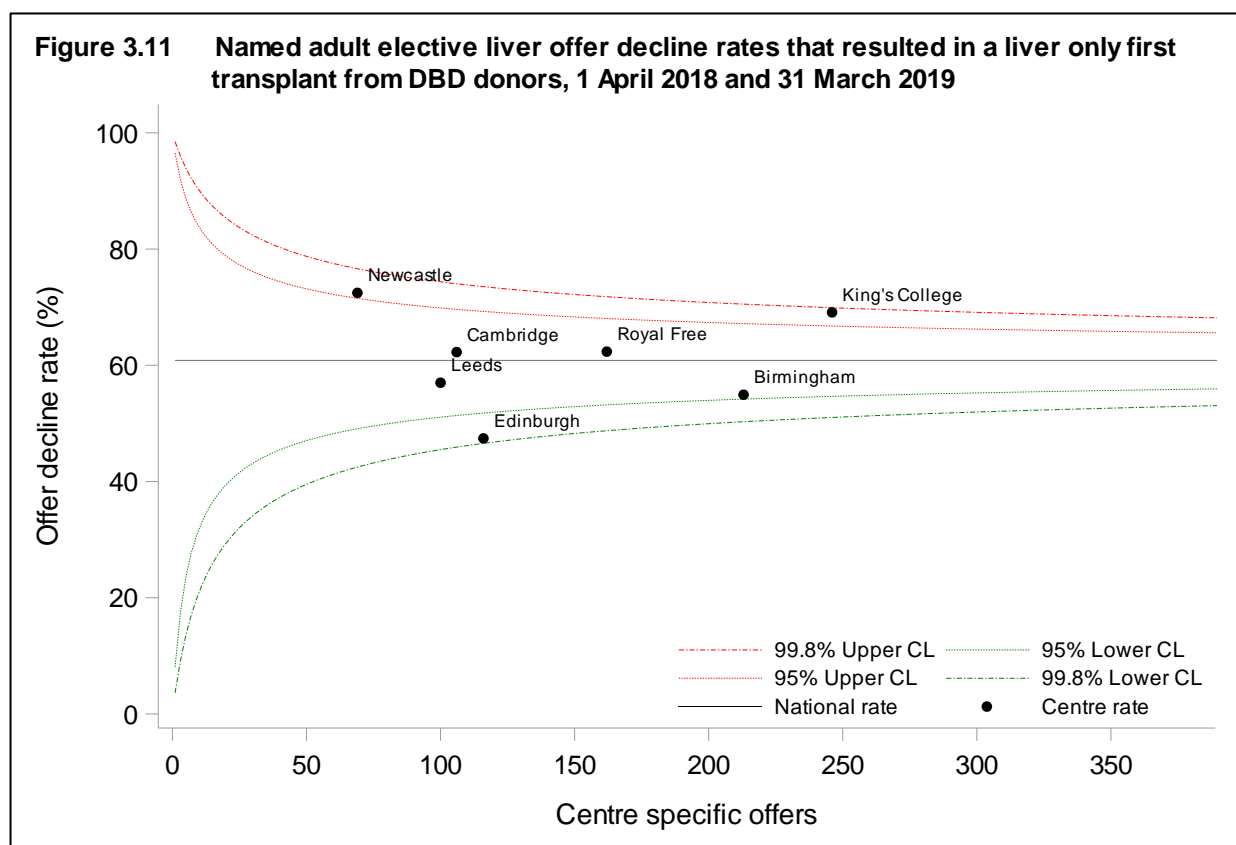


Figure 3.12 Adult elective liver offer decline rates that resulted in a liver only first transplant from DCD donors, 1 April 2018 and 31 March 2019

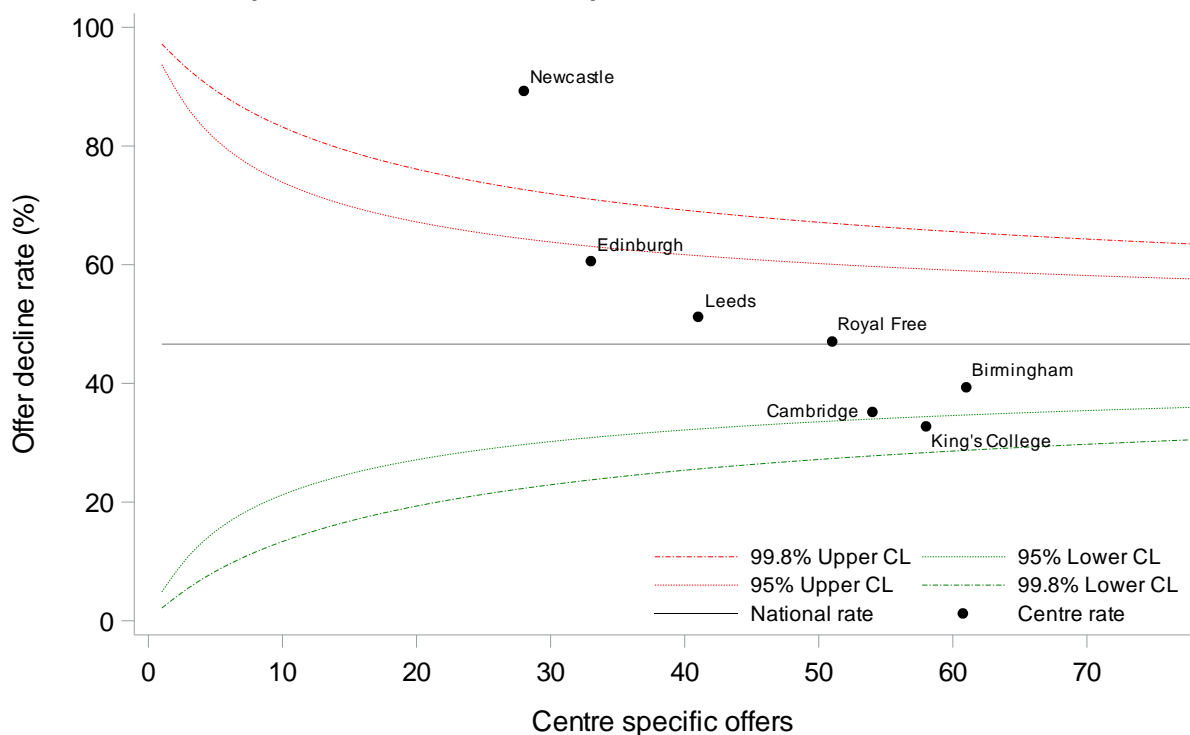


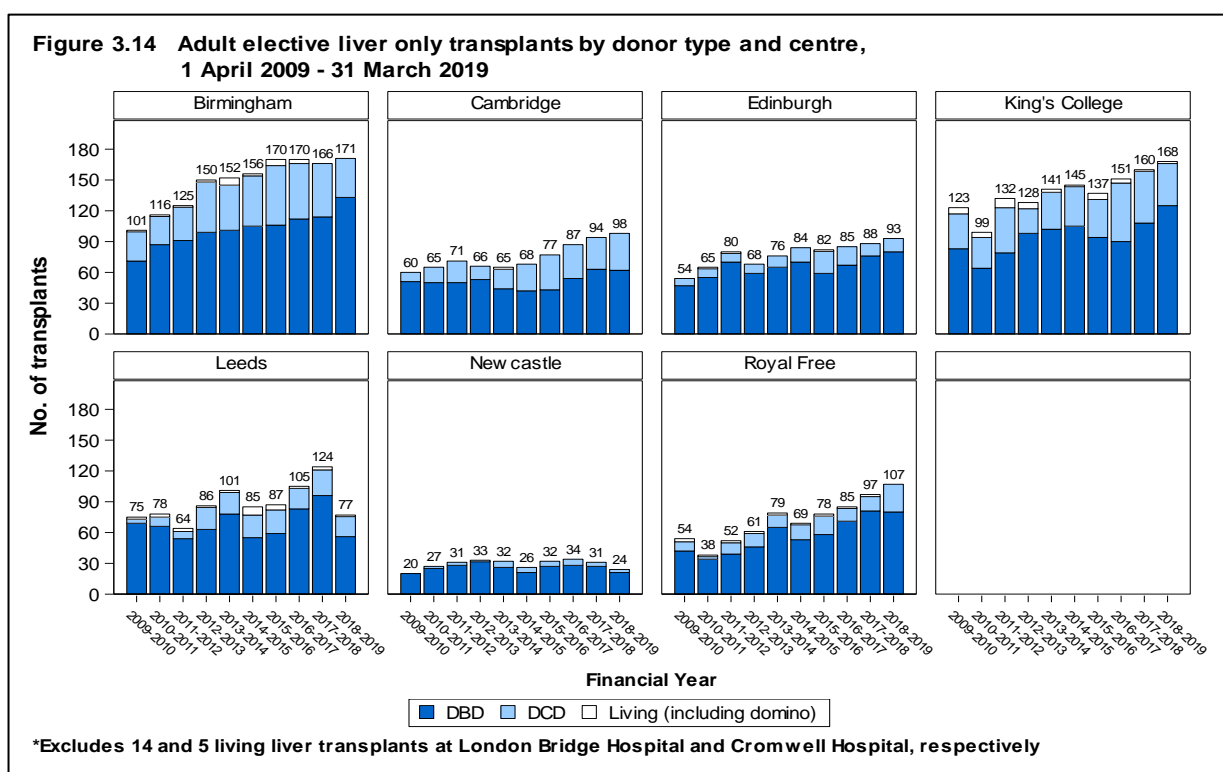
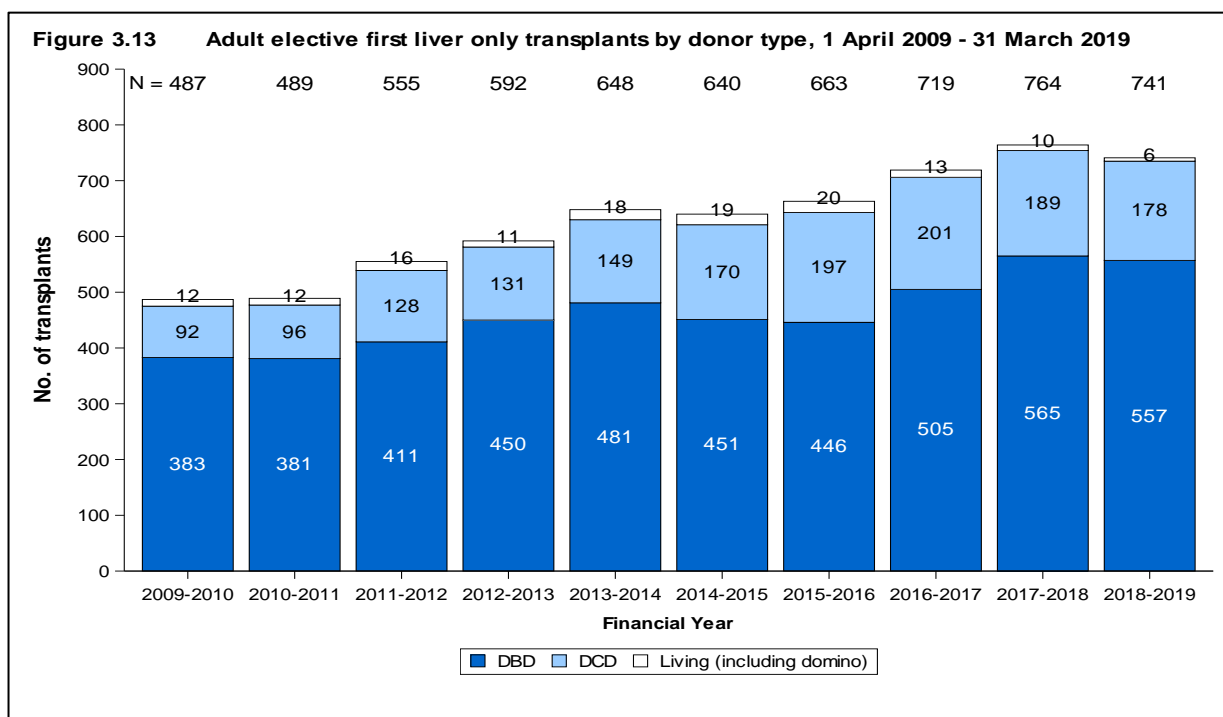
Table 3.3 Offer decline rates for each centre by offered organ and donor type
1 April 2018 and 31 March 2019

Centre	Whole Livers		DBD Donors Right Lobe		All Livers		DCD Donors	
	Offers	% Decline	Offers	% Decline	Offers	% Decline	Offers	% Decline
A. All donors								
Birmingham	192	53	21	76	213	55	61	39
Cambridge	89	58	17	82	106	62	54	35
Edinburgh	93	38	23	87	116	47	33	61
King's College	212	69	34	71	246	69	58	33
Leeds	83	52	17	82	100	57	41	51
Newcastle	57	67	12	100	69	72	28	89
Royal Free	139	58	23	87	162	62	51	47
Total	865	57	147	82	1012	61	326	47
B. DBD donors≤65 years and DCD donors≤60 years								
Birmingham	135	49	21	76	156	53	35	49
Cambridge	59	47	17	82	76	55	41	34
Edinburgh	58	34	23	87	81	49	21	38
King's College	133	66	34	71	167	67	35	37
Leeds	56	43	17	82	73	52	28	32
Newcastle	38	63	12	100	50	72	16	81
Royal Free	92	49	23	87	115	57	33	39
Total	571	52	147	82	718	58	209	42

3.2.2 Transplant activity

Figure 3.13 shows the number of first liver only transplants from deceased and living/domino donors performed in the last ten years, by type of donor. **Figure 3.14** shows the same information by centre. Please note that living liver transplants performed at London Bridge and Cromwell Hospitals are included in **Figure 3.13** but not in **Figure 3.14**.

All centres apart from Leeds and Newcastle observed an increase in the number of adult elective first liver only transplants performed in 2018/2019 compared with 2017/2018.



The demographic characteristics of 735 adult [elective](#) first deceased donor liver only transplant recipients in the latest year are shown by centre and overall in **Table 3.4**. 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 (91%), male (55%), brainstem death (76%) with a [median](#) age of 53 and a median BMI of 26. For some characteristics, due to rounding, percentages may not add up to 100.

Table 3.4 Demographic characteristics of adult elective first deceased donor liver only transplant recipients, 1 April 2018 - 31 March 2019									
		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	TOTAL N (%)
Number		171	98	93	166	76	24	107	735 (100)
Recipient sex	Male	120 (70)	64 (65)	58 (62)	101 (61)	50 (66)	21 (88)	79 (74)	493 (67)
	Female	51 (30)	34 (35)	35 (38)	65 (39)	26 (34)	3 (13)	28 (26)	242 (33)
Recipient ethnicity	White	160 (94)	92 (94)	92 (99)	138 (83)	65 (86)	22 (92)	85 (79)	654 (89)
	Non-white	10 (6)	6 (6)	1 (1)	28 (17)	11 (14)	2 (8)	22 (21)	80 (11)
	Not reported	1 (1)	0	0	0	0	0	0	1 (0)
Indication	Cancer	34 (20)	22 (22)	22 (24)	34 (20)	21 (28)	3 (13)	28 (26)	164 (22)
	Hepatitis C	4 (2)	2 (2)	1 (1)	1 (1)	2 (3)	0	7 (7)	17 (2)
	Alcoholic liver disease	52 (30)	36 (37)	26 (28)	44 (27)	23 (30)	9 (38)	24 (22)	214 (29)
	Hepatitis B	3 (2)	0	1 (1)	4 (2)	2 (3)	1 (4)	3 (3)	14 (2)
	Primary sclerosing cholangitis	18 (11)	9 (9)	6 (6)	19 (11)	12 (16)	2 (8)	16 (15)	82 (11)
	Primary biliary cholangitis	17 (10)	6 (6)	10 (11)	13 (8)	4 (5)	0	5 (5)	55 (8)
	Autoimmune and cryptogenic disease	13 (8)	0	10 (11)	18 (11)	3 (4)	5 (21)	8 (7)	57 (8)
	Metabolic	20 (12)	17 (17)	14 (15)	15 (9)	8 (11)	4 (17)	14 (13)	92 (13)
	Other	10 (6)	6 (6)	3 (3)	18 (11)	1 (1)	0	2 (2)	40 (5)
Recipient HCV status	Negative	156 (91)	86 (88)	83 (89)	150 (90)	70 (92)	22 (92)	90 (84)	657 (89)
	Positive	15 (9)	12 (12)	5 (5)	16 (10)	6 (8)	2 (8)	17 (16)	73 (10)
	Not reported	0	0	5 (5)	0	0	0	0	5 (1)

Table 3.4 Demographic characteristics of adult elective first deceased donor liver only transplant recipients, 1 April 2018 - 31 March 2019

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	TOTAL N (%)
Pre-transplant in-patient status	Out-patient	158 (92)	83 (85)	83 (89)	152 (92)	72 (95)	23 (96)	103 (96)	674 (92)
	In-patient	13 (8)	15 (15)	10 (11)	14 (8)	4 (5)	1 (4)	4 (4)	61 (8)
Ascites	Absence	82 (48)	39 (40)	40 (43)	55 (33)	40 (53)	12 (50)	47 (44)	315 (43)
	Presence	89 (52)	59 (60)	53 (57)	111 (67)	36 (47)	12 (50)	60 (56)	419 (57)
Encephalopathy	Absence	91 (53)	51 (52)	66 (71)	82 (49)	47 (62)	18 (75)	86 (80)	441 (69)
	Presence	80 (47)	47 (48)	25 (27)	84 (51)	29 (38)	5 (21)	21 (20)	291 (40)
	Not reported	0	0	2 (2)	0	0	1 (4)	0	3 (0)
Pre-transplant renal support	No	167 (98)	98 (100)	88 (95)	161 (97)	74 (97)	24 (100)	105 (98)	717 (98)
	Yes	4 (2)	0	5 (5)	5 (3)	2 (3)	0	2 (2)	18 (2)
Previous abdominal surgery	No	163 (95)	87 (89)	79 (85)	130 (78)	67 (88)	23 (96)	91 (84)	640 (87)
	Yes	8 (5)	11 (11)	12 (13)	36 (22)	9 (12)	1 (4)	16 (14)	93 (13)
	Not reported	0	0	2 (2)	0	0	0	0	2 (0)
Varices & shunt	Absence	30 (18)	20 (20)	9 (10)	54 (33)	47 (62)	8 (33)	38 (36)	206 (28)
	Presence without treatment	135 (79)	74 (76)	74 (80)	103 (62)	27 (36)	16 (67)	65 (61)	494 (67)
	Presence with TIPS	6 (4)	3 (3)	7 (8)	9 (5)	2 (3)	0	4 (4)	31 (4)
	Not reported	0	1 (1)	3 (3)	0	0	0	0	4 (1)
Life style activity	Normal	7 (4)	11 (11)	27 (29)	3 (2)	8 (11)	4 (17)	19 (18)	79 (11)
	Restricted	62 (36)	33 (34)	28 (30)	81 (49)	28 (37)	11 (46)	25 (23)	268 (37)
	Self-care	93 (54)	38 (39)	29 (31)	73 (44)	34 (45)	7 (29)	62 (58)	336 (46)
	Confined	9 (5)	14 (14)	6 (6)	6 (4)	6 (8)	2 (8)	1 (1)	44 (6)
	Reliant	0	2 (2)	2 (2)	3 (2)	0	0	0	7 (1)
	Not reported	0	0	1 (1)	0	0	0	0	1 (0)
Graft appearance	Normal	158 (92)	69 (70)	84 (90)	159 (96)	57 (75)	22 (92)	75 (70)	624 (85)
	Abnormal	13 (8)	29 (30)	8 (9)	7 (4)	19 (25)	2 (8)	32 (30)	110 (15)
	Not reported	0	0	1 (1)	0	0	0	0	1 (0)

Table 3.4 Demographic characteristics of adult elective first deceased donor liver only transplant recipients, 1 April 2018 - 31 March 2019									
		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	TOTAL N (%)
Recip age (years)	Median (IQR)	58 (49,63)	56 (49,64)	59 (50,64)	56 (44,62)	58 (53,62)	61 (56,66)	56 (49,61)	57 (49,63)
BMI kg/m ²	Median (IQR)	27 (24,31)	28 (24,33)	29 (25,32)	27 (24,32)	27 (24,31)	27 (24,31)	27 (25,32)	28 (24,32)
Serum bilirubin umol/l	Median (IQR)	35 (17,67)	48 (25,94)	58 (30,96)	39 (22,87)	47 (18,79)	42 (27,95)	42 (24,92)	42 (22,85)
Serum creatinine umol/l	Median (IQR)	74 (62,94)	67 (55,86)	73 (65,95)	74 (60,92)	66 (54,77)	90 (64,105)	81 (70,95)	74 (62,93)
Serum sodium mmol/l	Median (IQR)	137 (135,140)	135 (132,139)	136 (131,138)	136 (132,139)	137 (133,139)	137 (133,140)	138 (136,141)	137 (133,139)
Serum potassium mmol/l	Median (IQR) Not reported	4.3 (4.0,4.6) 0	4.0 (3.8,4.6) 0	4.2 (3.9,4.5) 0	4.2 (3.9,4.5) 0	4.1 (3.9,4.4) 1	4.2 (3.7,4.7) 0	4.2 (3.9,4.5) 0	4.2 (3.9,4.5) 1
INR	Median (IQR) Not reported	1.4 (1.2,1.6) 0	1.4 (1.2,1.7) 0	1.3 (1.2,1.6) 1	1.4 (1.2,1.8) 0	1.3 (1.1,1.5) 0	1.4 (1.3,1.7) 0	1.3 (1.2,1.5) 0	1.4 (1.2,1.6) 1
Serum albumin g/l	Median (IQR)	35 (31,40)	29 (25,33)	27 (22,31)	34 (29,39)	30 (26,34)	34 (31,39)	34 (29,39)	33 (28,37)
Cold ischaemia time (hrs)	Median (IQR) Not reported	8 (6,10) 0	10 (8,14) 0	9 (8,11) 1	9 (8,11) 0	7 (6,8) 0	11 (9,12) 0	9 (7,10) 0	9 (7,10) 0
Time on list (days)	Median (IQR) Not reported	33 (11,95) 0	34 (13,88) 1	36 (8,122) 0	46 (13,176) 0	42 (11,119) 0	43 (20,98) 0	41 (9,140) 0	37 (11,111) 1
Donor sex	Male	97 (57)	54 (55)	43 (46)	91 (55)	41 (54)	14 (58)	63 (59)	403 (55)
	Female	74 (43)	44 (45)	50 (54)	75 (45)	35 (46)	10 (42)	44 (41)	332 (45)
Donor ethnicity	White	156 (91)	91 (93)	78 (84)	151 (91)	72 (95)	22 (92)	95 (89)	665 (91)
	Non-white	13 (8)	6 (6)	15 (16)	13 (8)	3 (4)	2 (8)	9 (8)	61 (8)
	Not reported	2 (1)	1 (1)	0	2 (1)	1 (1)	0	3 (3)	9 (1)

Table 3.4 Demographic characteristics of adult elective first deceased donor liver only transplant recipients, 1 April 2018 - 31 March 2019									
		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Donor cause of death	Intracranial	146 (85)	88 (90)	84 (90)	149 (90)	68 (89)	22 (92)	96 (90)	653 (89)
	Trauma	4 (2)	1 (1)	2 (2)	4 (2)	2 (3)	0	3 (3)	16 (2)
	Others	21 (12)	9 (9)	7 (8)	13 (8)	6 (8)	2 (8)	8 (7)	66 (9)
Donor history of diabetes	No	150 (88)	92 (94)	87 (94)	154 (93)	69 (91)	22 (92)	102 (95)	676 (92)
	Yes	18 (11)	5 (5)	6 (6)	9 (5)	6 (8)	2 (8)	4 (4)	50 (7)
	Not reported	3 (2)	1 (1)	0	3 (2)	1 (1)	0	1 (1)	9 (1)
Donor type	Donor after brain death	133 (78)	63 (64)	80 (86)	125 (75)	56 (74)	21 (88)	80 (75)	558 (76)
	Donor after cardiac death	38 (22)	35 (36)	13 (14)	41 (25)	20 (26)	3 (13)	27 (25)	177 (24)
ABO match	Identical	166 (97)	92 (94)	91 (98)	163 (98)	76 (100)	24 (100)	106 (99)	718 (98)
	Compatible	5 (3)	6 (6)	2 (2)	3 (2)	0	0	1 (1)	17 (2)
Graft type	Whole	164 (96)	94 (96)	90 (97)	149 (90)	73 (96)	24 (100)	104 (97)	698 (95)
	Segmental	7 (4)	4 (4)	3 (3)	17 (10)	3 (4)	0	3 (3)	37 (5)
Donor age years	Median (IQR)	55 (42,66)	51 (38,60)	52 (39,65)	55 (41,69)	48 (38,57)	56 (46,64)	52 (39,64)	53 (40,64)
Donor BMI kg/m ²	Median (IQR)	27 (24,32)	26 (22,29)	27 (23,29)	26 (23,28)	26 (23,29)	28 (25,31)	26 (24,29)	26 (23,29)
	Not reported	0	0	0	1	0	0	0	1

3.2.3 Post-transplant survival

LONG-TERM PATIENT SURVIVAL

Table 3.5 shows one year [unadjusted](#) and [risk-adjusted patient survival](#) for 2467 of the 2719 transplants in the period, 1 April 2014 to 31 March 2018. Transplants were excluded if they were [auxiliary](#) or if survival information or [risk factors](#) were missing. The overall patient survival rate is 94.0% and, after risk adjustment, three centres had a lower survival rate than the national rate. All centres apart from Newcastle lie within the 95% [confidence limit](#), as shown in **Figure 3.15**.

Centre	Number of transplants	1-year survival % (95% CI)			
		Unadjusted		Risk-adjusted	
Newcastle	115	92.0	85.2 - 95.8	88.0	76.9 - 93.7
Leeds	324	92.3	88.7 - 94.8	92.4	88.7 - 94.9
Cambridge	273	94.3	90.7 - 96.5	95.2	92.1 - 97.1
Royal Free	295	92.8	89.1 - 95.2	94.3	91.3 - 96.3
King's College	565	95.9	93.8 - 97.3	95.1	92.5 - 96.8
Birmingham	618	93.2	90.9 - 95.0	93.0	90.5 - 94.9
Edinburgh	278	95.8	92.5 - 97.7	95.8	92.4 - 97.7
Total	2468	94.0	93.0 - 94.9		

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

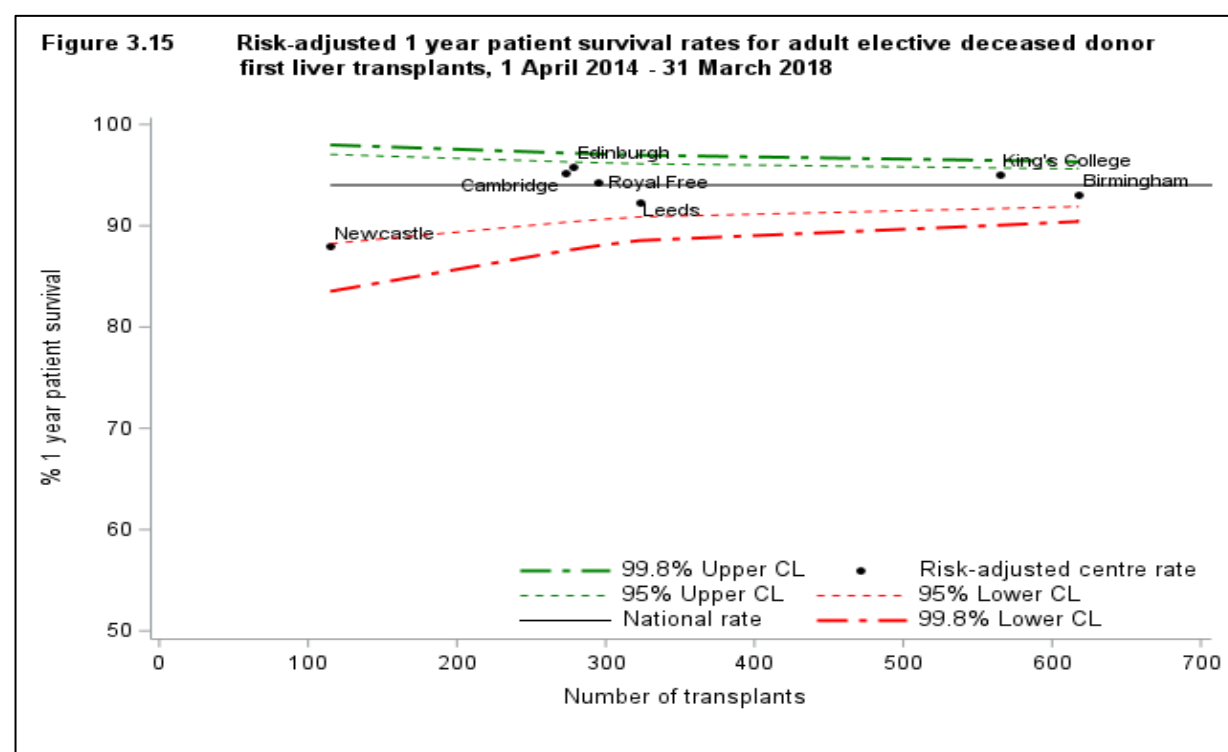


Table 3.6 shows the five year [unadjusted](#) and [risk-adjusted patient survival](#) for 1821 of the 2284 transplants in the period, 1 April 2010 to 31 March 2014. Note that transplants performed at Leeds have been excluded due to a lack of follow-up beyond 4 years. The national rate is 82.7% and three centres have a lower survival rate after risk adjustment, as shown in **Figure 3.16**. The median number of days between the last known follow-up post-transplantation (for censored cases) and the time of analysis in **Table 3.6** and **Figure 3.16** ranges from 291 days for Birmingham to 477 days for Cambridge. The medians for all other centres fall in between these extremes. Results should therefore be interpreted in that light.

Table 3.6 Five year patient survival for adult elective deceased donor first liver transplants, 1 April 2010 - 31 March 2014					
Centre	Number of transplants	5-year survival % (95% CI)			
		Unadjusted		Risk-adjusted	
Newcastle	116	76.4	67.4 - 83.1	77.2	66.7 - 84.3
Cambridge	243	86.8	81.8 - 90.5	88.1	83.1 - 91.6
Royal Free	214	83.3	77.5 - 87.7	82.9	76.2 - 87.8
King's College	457	85.9	82.2 - 88.9	83.7	79.0 - 87.3
Birmingham	529	79.9	76.2 - 83.1	81.2	77.2 - 84.5
Edinburgh	262	81.5	76.2 - 85.8	81.4	75.3 - 86.0
Total	1821	82.7	80.9 - 84.4		

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

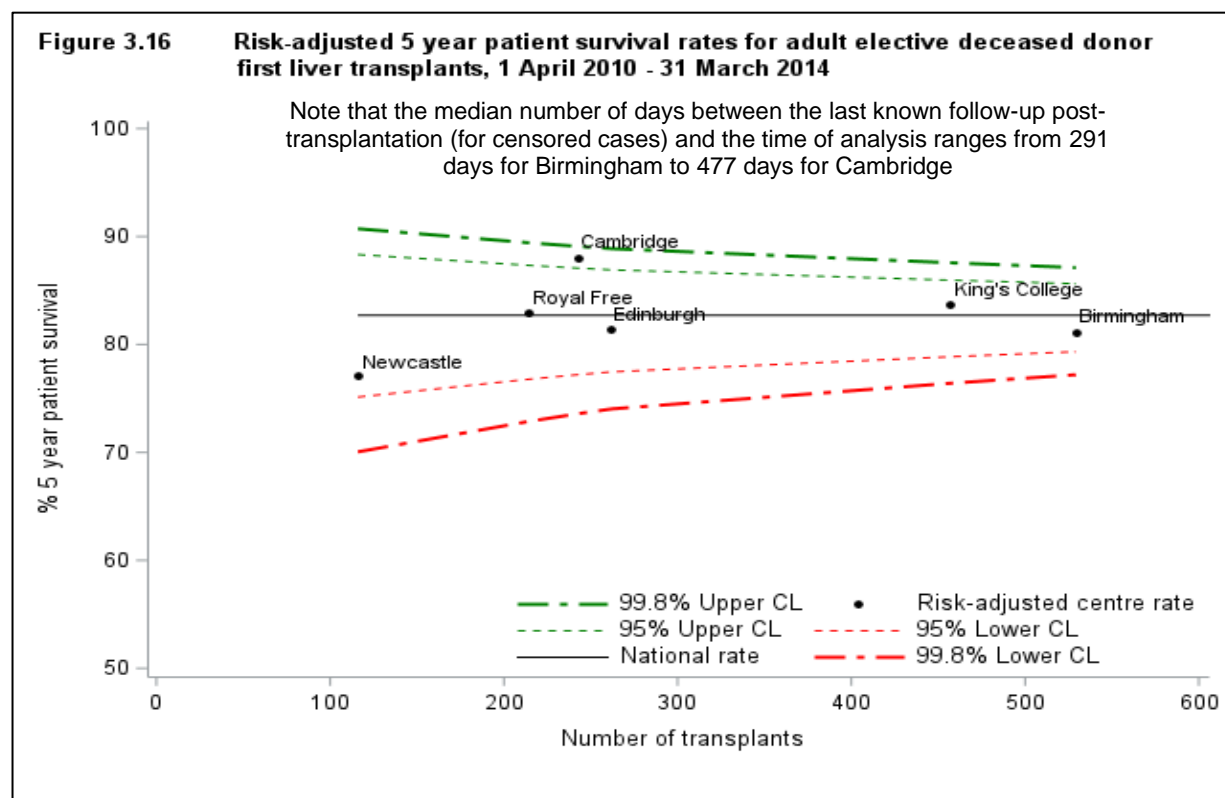


Table 3.7 shows one year [unadjusted](#) and [risk-adjusted patient survival](#), by primary disease group. The overall patient survival rate is 94.0% and, after risk adjustment, patients with cancer, primary sclerosing cholangitis, autoimmune and cryptogenic, metabolic disease or other liver disease had lower survival than the national rate.

Table 3.7 One year patient survival for adult elective deceased donor first liver transplants, 1 April 2014 - 31 March 2018					
Primary disease	Number of transplants	1-year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Cancer	559	92.9	(90.3 - 94.8)	93.4	(90.9 - 95.2)
Hepatitis B and C	182	96.7	(92.7 - 98.5)	95.8	(90.6 - 98.1)
Alcoholic liver disease	645	95.0	(92.9 - 96.4)	94.9	(92.9 - 96.4)
Primary sclerosing cholangitis	293	93.7	(90.2 - 96.0)	93.8	(90.2 - 96.1)
Primary biliary cholangitis	201	97.0	(93.4 - 98.6)	96.9	(93.2 - 98.6)
Autoimmune and cryptogenic	160	94.3	(89.3 - 97.0)	92.5	(85.5 - 96.1)
Metabolic	275	93.0	(89.1 - 95.6)	93.1	(89.0 - 95.7)
Other	153	89.4	(83.2 - 93.3)	89.6	(82.9 - 93.6)
Total	2467	94.0	(93.0 - 94.9)		

Table 3.8 shows five year [unadjusted](#) and [risk-adjusted patient survival](#), the overall patient survival rate is 82.7%. After risk adjustment, patients with cancer, primary sclerosing cholangitis, autoimmune and cryptogenic or other liver disease had lower survival than the national rate.

Table 3.8 Five year patient survival for adult elective deceased donor first liver transplants, 1 April 2010 - 31 March 2014					
Primary disease	Number of transplants	5-year survival % (95% CI)			
		Unadjusted		Risk adjusted	
Cancer	443	75.6	(71.2 - 79.4)	79.4	(75.0 - 83.0)
Hepatitis B and C	212	81.1	(75.0 - 85.8)	84.2	(78.4 - 88.5)
Alcoholic liver disease	405	84.9	(81.0 - 88.1)	84.9	(80.5 - 88.3)
Primary sclerosing cholangitis	200	85.7	(80.0 - 89.9)	80.8	(72.2 - 86.7)
Primary biliary cholangitis	168	89.8	(84.1 - 93.5)	87.4	(79.8 - 92.2)
Autoimmune and cryptogenic	127	85.1	(77.3 - 90.3)	81.6	(70.8 - 88.4)
Metabolic	153	84.2	(77.2 - 89.2)	84.6	(76.8 - 89.7)
Other	113	85.2	(76.9 - 90.7)	82.0	(70.6 - 89.0)
Total	1821	82.7	(80.8 - 84.4)		

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 2007 and 31 December 2018. One and five year [risk-adjusted survival rates](#) from the point of liver transplant listing are provided in **Table 3.9** and are shown by centre in **Figures 3.17** and **3.18** respectively.

At one year, centre-specific risk adjusted survival rates range between 81% at both Leeds and Birmingham and 89% at Edinburgh. At five years, Birmingham has the lowest survival rate at 66% and Edinburgh has the highest at 78%; the remaining centres achieve survival rates that range in between these two extremes.

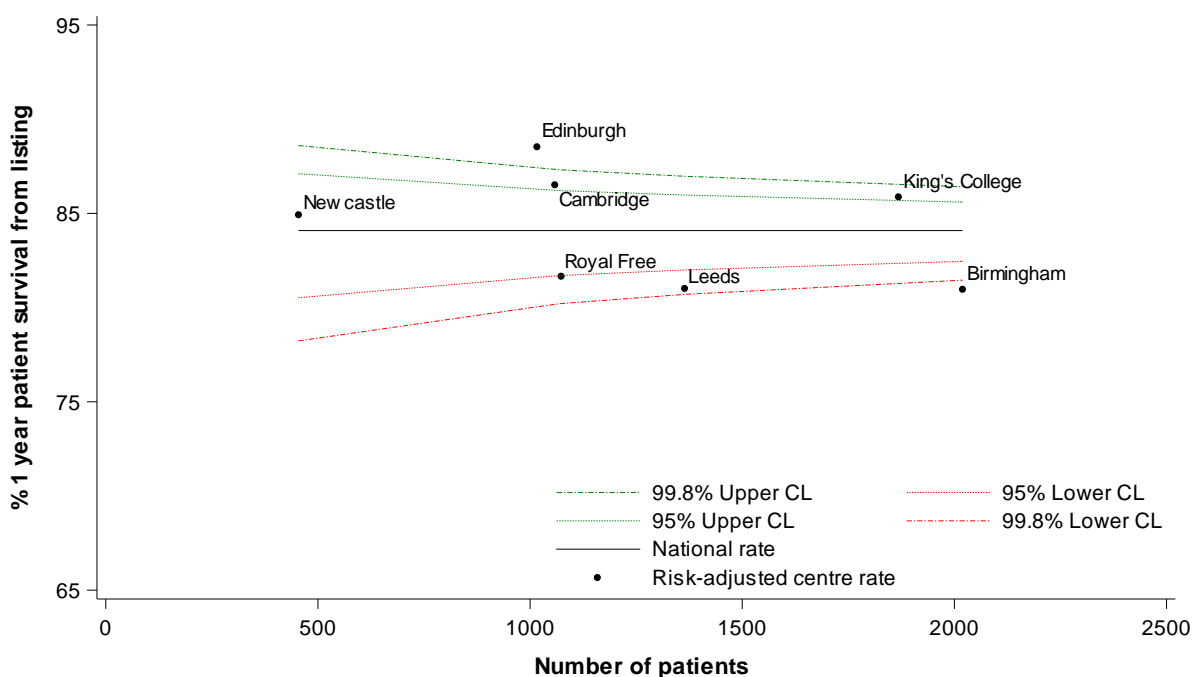
Note, however, that the median number of days between the last known follow-up post-transplantation (for censored, transplanted cases) and the time of analysis in **Figure 3.18** ranges from 256 days for Birmingham to 415 days for Cambridge. The medians for all other centres fall in between these extremes. Results should therefore be interpreted in that light.

Table 3.9 Risk adjusted 1 and 5 year patient survival rate from listing for adult elective first liver registrations, 1 January 2007 - 31 December 2018

Centre	Number of registrations	Patient survival					
		Number at Risk at 1 year	One year Survival Rate %	(95% CI)	Number at Risk at 5 years	Five year Survival Rate %	(95% CI)
Newcastle	454	330	84.9	(81.6 - 87.6)	140	69.7	(64.5 - 74.2)
Leeds	1364	946	81.0	(78.4 - 83.3)	-	-	-
Cambridge	1058	759	86.5	(84.2 - 88.5)	326	74.7	(71.4 - 77.7)
Royal Free	1073	751	81.7	(78.8 - 84.1)	316	68.8	(64.8 - 72.3)
King's College	1868	1401	85.9	(84.1 - 87.5)	565	74.1	(71.5 - 76.5)
Birmingham	2019	1419	81.0	(78.9 - 82.9)	582	66.5	(63.6 - 69.3)
Edinburgh	1016	752	88.5	(86.5 - 90.3)	311	78.1	(75.0 - 80.8)
UK	7487	6358	84.1	(83.3 - 84.9)	2240	71.9	(70.7 - 73.1)

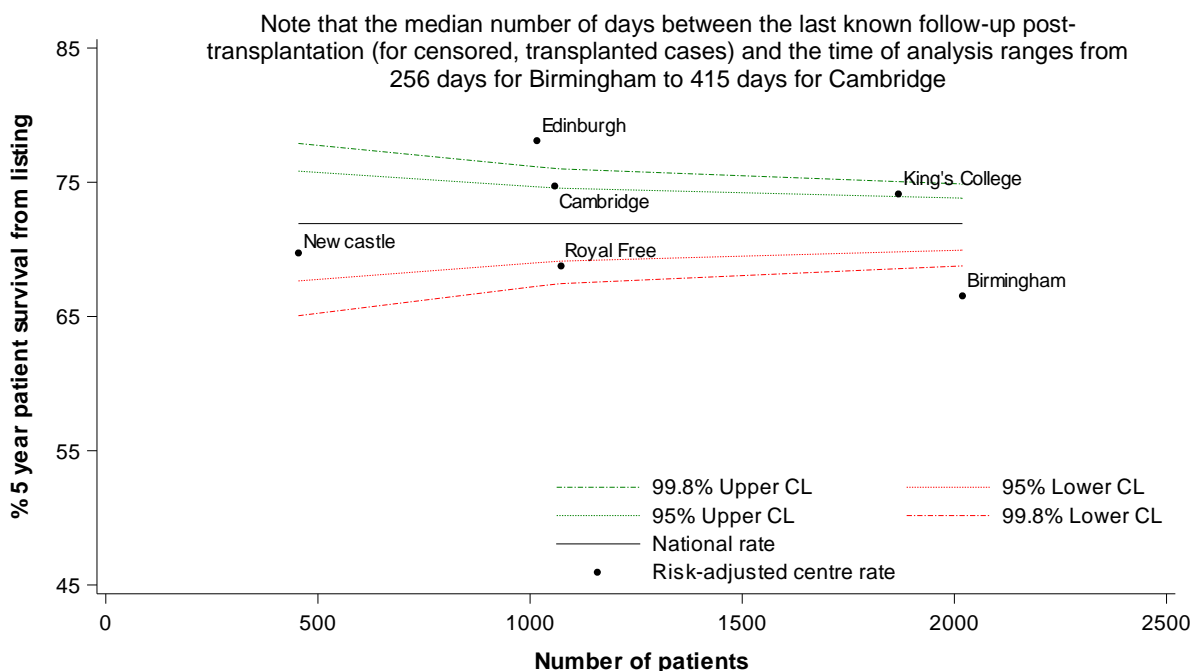
Leeds have been excluded from 5 year survival due to a lack of follow up beyond 4 years

Figure 3.17 Risk-adjusted 1 year patient survival rate from time of listing for adult* elective first liver registrations, 1 January 2007 - 31 December 2018



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

Figure 3.18 Risk-adjusted 5 year patient survival rate from time of listing for adult* elective first liver registrations, 1 January 2007 - 31 December 2018



* 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 3.10 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 Birmingham, where it is three days.

Table 3.10 Median waiting time to liver only transplant in the UK, for adult super urgent patients registered 1 April 2015 - 31 March 2018			
Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Adult			
Newcastle	15	2	1 - 3
Leeds	55	2	1 - 3
Cambridge	38	2	1 - 3
Royal Free	59	2	2 - 2
King's College	58	2	2 - 2
Edinburgh	34	2	1 - 3
Birmingham	78	3	2 - 4
UK	337	2	2 - 2

The demographic characteristics of 117 adult [super-urgent](#) registrations in the last financial year are shown by centre and overall in **Table 3.11**. The majority of patients listed for a super-urgent liver were female (56%) and the median age was 45 with a median BMI of 25. For some characteristics, due to rounding, percentages may not add up to 100.

Table 3.11 Demographic characteristics of adult super urgent liver patients registered in the UK, 1 April 2018 - 31 March 2019

		Birmingham	Cambridge	Edinburgh	King's college	Leeds	Newcastle	Royal Free	Total
Number		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
		27	15	12	17	21	5	20	117
Recipient sex	Male	9 (33)	8 (53)	6 (50)	5 (29)	9 (43)	3 (60)	11 (55)	51 (44)
	Female	18 (67)	7 (47)	6 (50)	12 (71)	12 (57)	2 (40)	9 (45)	66 (56)
Recipient ethnicity	White	19 (70)	14 (93)	12 (100)	13 (76)	17 (81)	5 (100)	13 (65)	93 (79)
	Non-white	4 (15)	1 (7)	0 (0)	4 (24)	4 (19)	0 (0)	7 (35)	20 (17)
	Not reported	4 (15)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (3)
Recipient HCV	No	27 (100)	15 (100)	12 (100)	17 (100)	21 (100)	5 (100)	20 (100)	117 (100)
	Yes	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Encephalopathy	Absence	2 (7)	6 (40)	4 (33)	1 (6)	3 (14)	0 (0)	6 (30)	22 (19)
	Presence	22 (81)	6 (40)	5 (42)	13 (76)	14 (67)	4 (80)	12 (60)	76 (65)
	Not reported	3 (11)	3 (20)	3 (25)	3 (18)	4 (19)	1 (20)	2 (10)	19 (16)
Renal support	No	13 (48)	7 (47)	8 (67)	5 (29)	11 (52)	2 (40)	13 (65)	59 (50)
	Yes	14 (52)	8 (53)	4 (33)	12 (71)	10 (48)	1 (20)	7 (35)	56 (48)
	Not reported	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (40)	0 (0)	2 (2)
Recip age (years)	Median (IQR)	43 (29, 55)	39 (31, 50)	55 (46, 60)	37 (31, 51)	44 (31, 60)	58 (45, 62)	53 (34, 59)	45 (32, 58)
BMI kg/m2	Median (IQR)	27 (24, 32)	24 (21, 27)	29 (27, 35)	24 (21, 25)	27 (23, 31)	27 (24, 31)	23 (22, 27)	25 (23, 30)
	Not reported	0	0	0	0	0	1	0	1
Serum bilirubin umol/l	Median (IQR)	312 (96, 408)	126 (39, 308)	80 (54, 121)	249 (110, 391)	164 (58, 306)	58 (40, 91)	331 (115, 492)	205 (61, 372)
	Not reported	0	0	0	0	1	0	0	1
Serum creatinine umol/l	Median (IQR)	86 (57, 111)	66 (47, 101)	83 (66, 162)	76 (61, 116)	64 (46, 102)	130 (61, 151)	79 (65, 120)	75 (58, 118)
	Not reported	4	0	0	7	1	1	2	15
Serum sodium mmol/l	Median (IQR)	140 (136, 144)	136 (132, 139)	135 (132, 139)	139 (137, 145)	137 (134, 139)	144 (135, 144)	140 (138, 143)	138 (135, 143)
	Not reported	1	0	0	0	1	0	0	2

Table 3.11 Demographic characteristics of adult super urgent liver patients registered in the UK, 1 April 2018 - 31 March 2019

		Birmingham	Cambridge	Edinburgh	King's college	Leeds	Newcastle	Royal Free	Total
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Serum potassium mmol/l	Median (IQR)	4 (4, 5)	4 (4, 5)	4 (4, 5)	5 (4, 5)	5 (4, 5)	5 (5, 5)	4 (4, 5)	4 (4, 5)
	Not reported	1	0	0	0	2	0	0	3
INR	Median (IQR)	4 (3, 8)	2 (1, 7)	2 (1, 6)	3 (3, 5)	3 (1, 4)	4 (2, 7)	3 (2, 5)	3 (2, 7)
	Not reported	0	5	0	0	1	1	0	7
Serum albumin g/l	Median (IQR)	31 (25, 35)	27 (21, 29)	26 (21, 29)	28 (24, 30)	23 (19, 25)	32 (31, 33)	29 (27, 33)	28 (24, 32)
	Not reported	0	0	0	1	1	0	0	2

3.2.2 Transplant activity

Figure 3.19 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 6 DCD super-urgent transplants during the ten year period and one living donor transplant performed in 2011/12. The number of super-urgent transplants in 2018/19 has decreased compared to the previous financial year, which was a 10-year high.

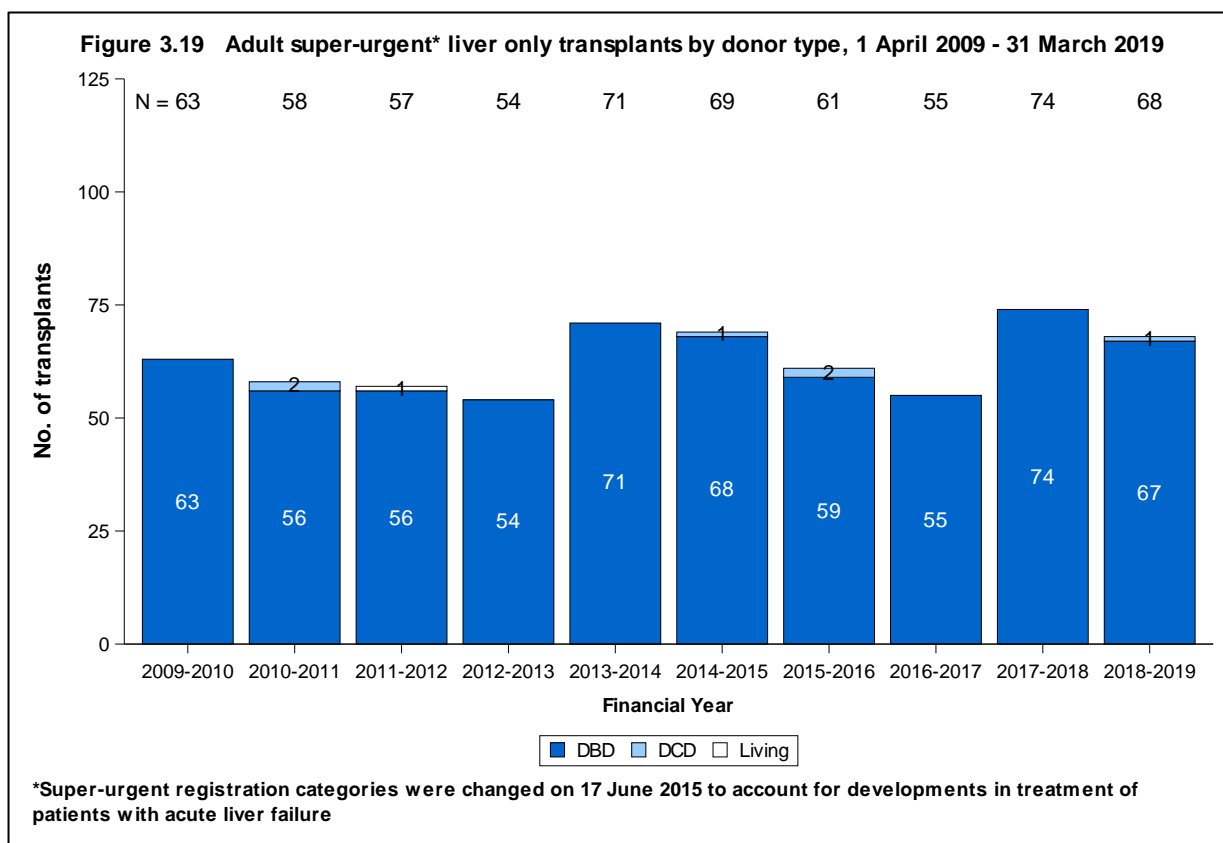
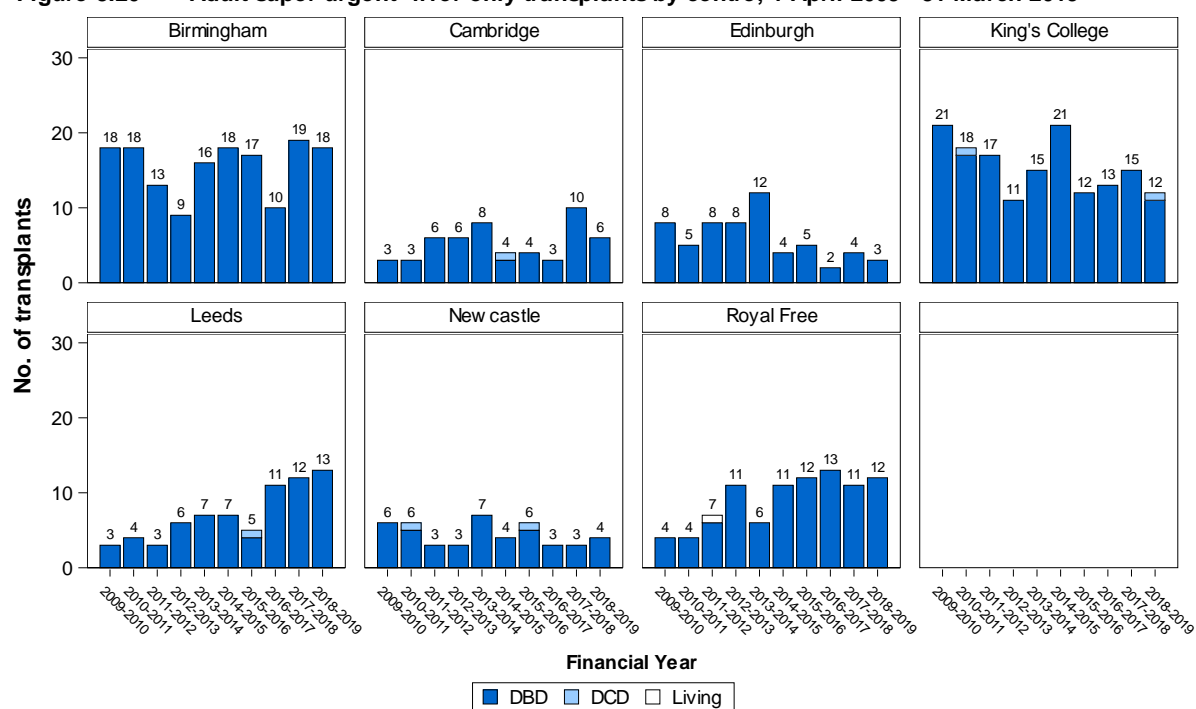


Figure 3.20 shows the number of adult [super-urgent](#) first liver only transplants from deceased and living donors performed in the last ten years, by type of donor and transplant centre.

Figure 3.20 Adult super-urgent* liver only transplants by centre, 1 April 2009 - 31 March 2019



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

The demographic characteristics of 68 adult [super-urgent](#) transplant recipients in the last financial year are shown by centre and overall in **Table 3.12**. Sixty eight percent of these recipients were female and the [median](#) age was 41 years. All but one super-urgent transplant 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 3.12 Demographic characteristics of adult super-urgent deceased donor liver transplant recipients, 1 April 2018 - 31 March 2019

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	TOTAL N (%)
Number		18	6	3	12	13	4	12	68 (100)
Recipient sex	Male	3 (17)	3 (50)	1 (33)	2 (17)	4 (31)	2 (50)	7 (58)	22 (32)
	Female	15 (83)	3 (50)	2 (67)	10 (83)	9 (69)	2 (50)	5 (42)	46 (68)
Recipient ethnicity	White	12 (67)	5 (83)	3 (100)	9 (75)	11 (85)	4 (100)	8 (67)	52 (77)
	Non-white	5 (28)	1 (17)	0	3 (25)	2 (15)	0	4 (33)	15 (22)
	Not reported	1 (11)	0	0	0	0	0	0	1 (2)
Recipient HCV status	Negative	18 (100)	6 (100)	3 (100)	12 (100)	13 (100)	3 (75)	12 (100)	67 (99)
	Not reported	0	0	0	0	0	1 (25)	0	1 (2)
Pre-transplant in-patient status	Out-patient	5 (28)	0	0	1 (8)	2 (15)	0	0	8 (12)
	In-patient	13 (72)	6 (100)	3 (100)	11 (92)	10 (77)	4 (100)	12 (100)	59 (87)
	Not reported	0	0	0	0	1 (8)	0	0	1 (2)
Ascites	Absence	10 (56)	5 (83)	1 (33)	10 (83)	10 (77)	3 (75)	9 (75)	48 (71)
	Presence	8 (44)	1 (17)	2 (67)	2 (17)	3 (23)	0	3 (25)	19 (28)
	Not reported	0	0	0	0	0	1 (25)	0	1 (2)
Encephalopathy	Absence	4 (22)	4 (67)	0	0	0	0	2 (17)	10 (15)
	Presence	14 (78)	2 (33)	3 (100)	12 (100)	13 (100)	4 (100)	10 (83)	58 (85)
Pre-transplant renal support	No	10 (56)	4 (67)	1 (33)	3 (25)	9 (69)	1 (25)	10 (83)	38 (56)
	Yes	8 (44)	2 (33)	2 (67)	9 (75)	4 (31)	3 (75)	2 (17)	30 (44)
Previous abdominal surgery	No	16 (89)	5 (83)	3 (100)	9 (75)	12 (92)	4 (100)	11 (92)	60 (88)
	Yes	2 (11)	1 (17)	0	3 (25)	1 (8)	0	1 (8)	8 (12)
Varices & shunt	Absence	12 (67)	5 (83)	2 (67)	12 (100)	10 (77)	1 (25)	9 (75)	51 (75)
	Presence without treatment	6 (33)	1 (17)	0	0	3 (23)	3 (75)	3 (25)	16 (24)
	Not reported	0	0	1 (33)	0	3 (23)	0	1 (8)	1 (2)

Table 3.12 Demographic characteristics of adult super-urgent deceased donor liver transplant recipients, 1 April 2018 - 31 March 2019

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	TOTAL N (%)
Life style activity	Normal	5 (28)	1 (17)	0	0	4 (31)	0	0	10 (15)
	Restricted	0	0	0	0	1 (8)	0	0	1 (2)
	Self-care	0	3 (50)	0	0	0	0	1 (8)	4 (6)
	Confined	6 (33)	1 (17)	0	1 (8)	3 (23)	1 (25)	1 (8)	13 (19)
	Reliant	7 (39)	1 (17)	3 (100)	11 (92)	5 (38)	3 (75)	10 (83)	40 (59)
Graft appearance	Normal	16 (89)	5 (83)	3 (100)	11 (92)	10 (77)	4 (100)	10 (83)	59 (87)
	Abnormal	2 (11)	1 (17)	0	1 (8)	3 (23)	0	2 (17)	9 (13)
Recip age (years)	Median (IQR)	37 (28,53)	41 (37,52)	36 (31,54)	35 (29,52)	47 (35,60)	52 (40,60)	43 (30,57)	41 (31,55)
BMI kg/m2	Median (IQR)	28 (24,33)	24 (22,28)	27 (25,32)	23 (21,24)	28 (25,32)	28 (25,33)	24 (21,27)	25 (22,30)
	Not reported	0	0	0	0	0	1	0	1
Serum bilirubin umol/l	Median (IQR)	304 (266,441)	255 (37,357)	154 (127,488)	361 (159,401)	355 (94,389)	93 (76,285)	331 (235,457)	309 (111,413)
Serum creatinine umol/l	Median (IQR)	65 (46,76)	62 (55,68)	147 (56,221)	93 (74,129)	81 (54,109)	100 (81,125)	86 (66,110)	73 (58,104)
Serum sodium mmol/l	Median (IQR)	145 (136,150)	135 (127,140)	134 (127,143)	141 (139,146)	137 (133,139)	142 (135,145)	140 (138,141)	140 (136,144)
Serum potassium mmol/l	Median (IQR)	4.1 (3.8,4.3)	3.7 (3.5,4.0)	3.6 (3.5,4.1)	4.6 (4.1,4.9)	4.6 (4.1,4.9)	3.8 (3.6,4.1)	4.4 (4.1,4.5)	4.2 (3.8,4.6)
INR	Median (IQR)	2.9 (2.0,4.0)	2.3 (1.7,3.0)	3.4 (1.4,6.1)	3.2 (2.1,4.3)	2.4 (1.8,3.1)	4.3 (2.8,5.0)	4.1 (2.5,6.0)	3.0 (2.0,4.4)
Serum albumin g/l	Median (IQR)	30 (27,35)	22 (15,27)	29 (24,38)	27 (24,30)	23 (18,26)	30 (28,33)	29 (26,33)	27 (25,30)
Time on list (days)	Median (IQR)	2 (1,3)	3 (2,4)	2 (1,4)	2 (2,3)	2 (1,2)	2 (2,2)	2 (1,3)	2 (1,3)
Donor sex	Male	4 (22)	3 (50)	0	7 (58)	6 (46)	3 (75)	4 (33)	27 (40)
	Female	14 (78)	3 (50)	3 (100)	5 (42)	7 (54)	1 (25)	8 (67)	41 (60)

Table 3.12 Demographic characteristics of adult super-urgent deceased donor liver transplant recipients, 1 April 2018 - 31 March 2019									
		Birmingham	Cambridge	Edinburgh	King's College	Leeds	Newcastle	Royal Free	TOTAL
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Donor ethnicity	White	16 (89)	6 (100)	3 (100)	11 (92)	12 (92)	4 (100)	10 (83)	62 (91)
	Non-white	2 (11)	0	0	1 (8)	0	0	2 (17)	5 (7)
	Not reported	0	0	0	0	1 (8)	0	0	1 (2)
Donor cause of death	Intracranial	17 (94)	6 (100)	3 (100)	11 (92)	12 (92)	3 (75)	10 (83)	62 (91)
	Trauma	0	0	0	0	1 (8)	0	1 (8)	2 (3)
	Others	1 (6)	0	0	1 (8)	0	1 (25)	1 (8)	4 (6)
Donor history of diabetes	No	16 (89)	5 (83)	3 (100)	10 (83)	13 (100)	4 (100)	12 (100)	63 (93)
	Yes	2 (11)	1 (17)	0	2 (17)	0	0	0	5 (7)
Donor type	Donor after brain death	18 (100)	6 (100)	3 (100)	11 (92)	13 (100)	4 (100)	12 (100)	67 (99)
	Donor after cardiac death	0	0	0	1 (8)	0	0	0	1 (2)
ABO match	Identical	15 (83)	4 (67)	2 (67)	8 (67)	7 (54)	2 (50)	7 (58)	45 (66)
	Compatible	3 (17)	2 (33)	1 (33)	4 (33)	6 (46)	2 (50)	5 (42)	23 (34)
Graft type	Whole	18 (100)	6 (100)	3 (100)	9 (75)	13 (100)	4 (100)	12 (100)	65 (96)
	Segmental	0	0	0	3 (25)	0	0	0	3 (4)
Donor age (years)	Median (IQR)	54 (36,65)	49 (27,68)	70 (40,75)	53 (39,59)	41 (24,61)	57 (51,68)	53 (35,59)	52 (34,63)
Donor BMI kg/m2	Median (IQR)	24 (21,27)	23 (22,26)	33 (23,33)	25 (22,27)	24 (24,25)	27 (26,30)	23 (19,28)	24 (22,27)

3.3.3 Post-transplant survival

LONG-TERM PATIENT SURVIVAL

Table 3.13 shows one year [unadjusted](#) and [risk-adjusted patient survival](#) for 219 of the 259 transplants in the period 1 April 2014 to 31 March 2018. Transplants were excluded if they were [auxiliary](#) or if survival information or [risk factors](#) were missing. The overall patient survival rate is 88.2% and, after risk adjustment, five of the seven centres had a lower survival rate than the national rate but within the [confidence limits](#), as shown in **Figure 3.21**.

Centre	Number of transplants	1-year survival % (95% CI)			
		Unadjusted		Risk-adjusted	
Newcastle	16	81.3	52.5 - 93.5	84.4	51.6 - 95.0
Leeds	26	88.5	68.4 - 96.1	85.8	56.1 - 95.4
Cambridge	18	94.4	66.6 - 99.2	92.2	45.0 - 98.9
Royal Free	37	82.1	66.0 - 91.0	81.8	61.8 - 91.3
King's College	52	82.7	69.4 - 90.6	87.8	76.5 - 93.6
Birmingham	57	98.2	88.2 - 99.8	97.2	80.0 - 99.6
Edinburgh	12	83.3	48.2 - 95.6	80.5	22.2 - 95.1
Total	220	88.2	83.1 - 91.8		

	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

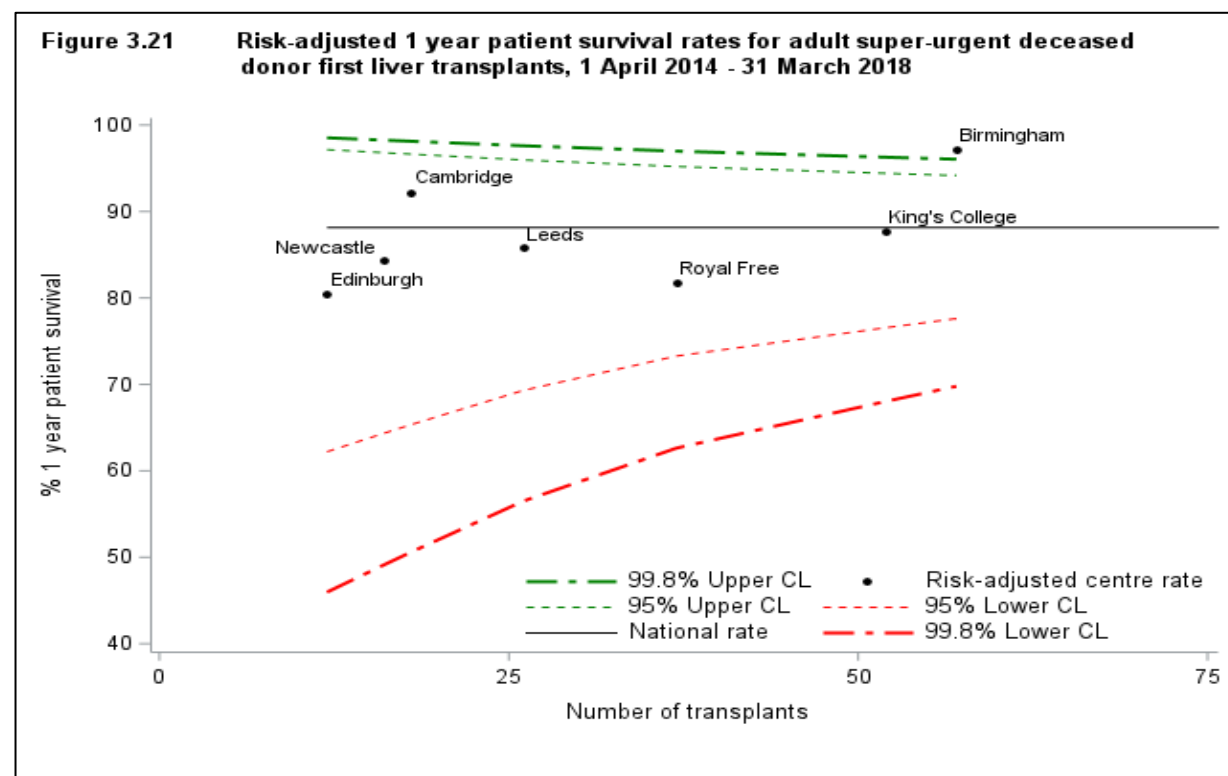


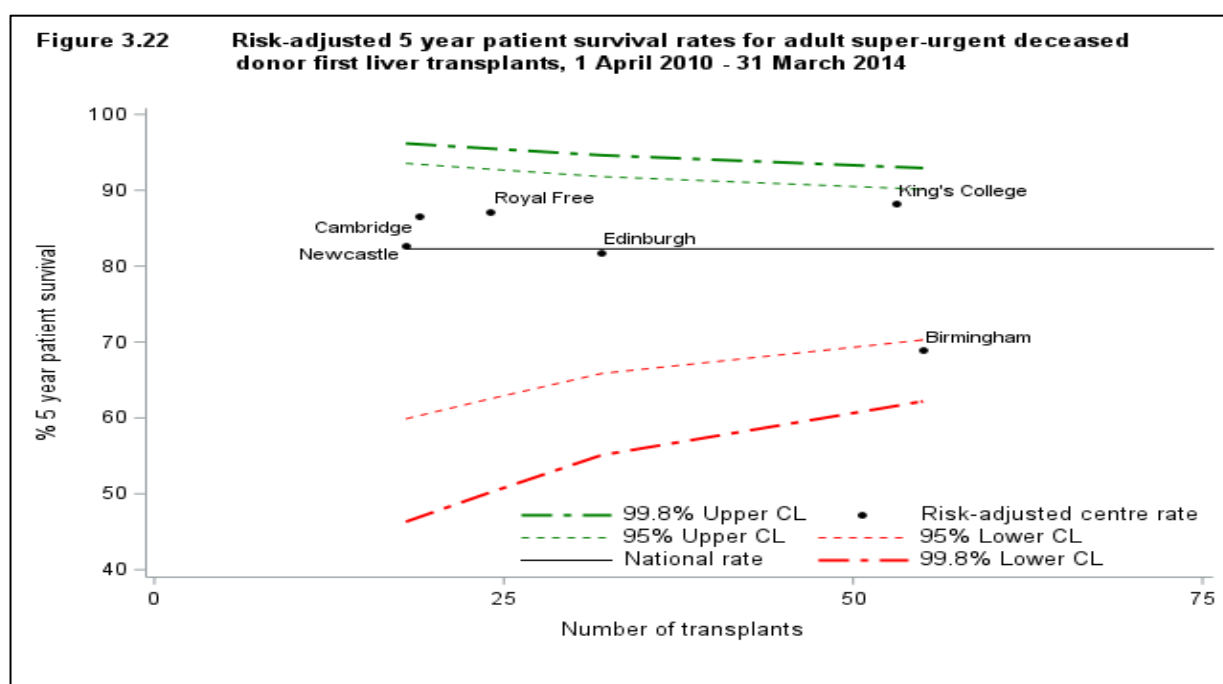
Table 3.14 shows the five year [unadjusted](#) and [risk-adjusted patient survival](#) for 202 of the 240 transplants in the period, 1 April 2010 to 31 March 2014. Note that Leeds have been excluded due to a lack of follow-up after 4 years post-transplant. The national rate is 82.3% and two centres have a lower survival rate after risk adjustment as shown in **Figure 3.22**. 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 3.14** and **Figure 3.22** ranges from 315 days for Birmingham to 563 days for Leeds. The medians for all other centres fall in between these extremes.

Centre	Number of transplants	5-year survival % (95% CI)			
		Unadjusted		Risk-adjusted	
Newcastle	18	83.3	56.8 - 94.3	82.6	46.2 - 94.4
Cambridge	19	85.0	60.4 - 94.9	86.5	58.3 - 95.7
Royal Free	24	82.0	58.5 - 92.9	87.2	66.0 - 95.2
King's College	53	89.5	76.3 - 95.5	88.3	71.9 - 95.1
Birmingham	55	73.8	59.7 - 83.6	69.0	47.7 - 81.6
Edinburgh	32	83.6	64.8 - 92.9	81.9	56.4 - 92.5
Total	202	82.3	76.1 - 87.0		

	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



Adult Liver Transplantation

Form return rates



Form return rates are reported in **Table 3.15** for the liver transplant record, three month and one year follow up forms, along with lifetime follow up (after the first year). These include all adult [elective and super-urgent](#) deceased donor transplants between 1 January 2018 and 31 December 2018 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.

It should be noted that some of the forms issued later in 2018 may not have yet been “chased” by NHSBT when the report was run in July 2019.

Table 3.15 Form return rates for adult liver transplants, 1 January 2018 to 31 December 2018

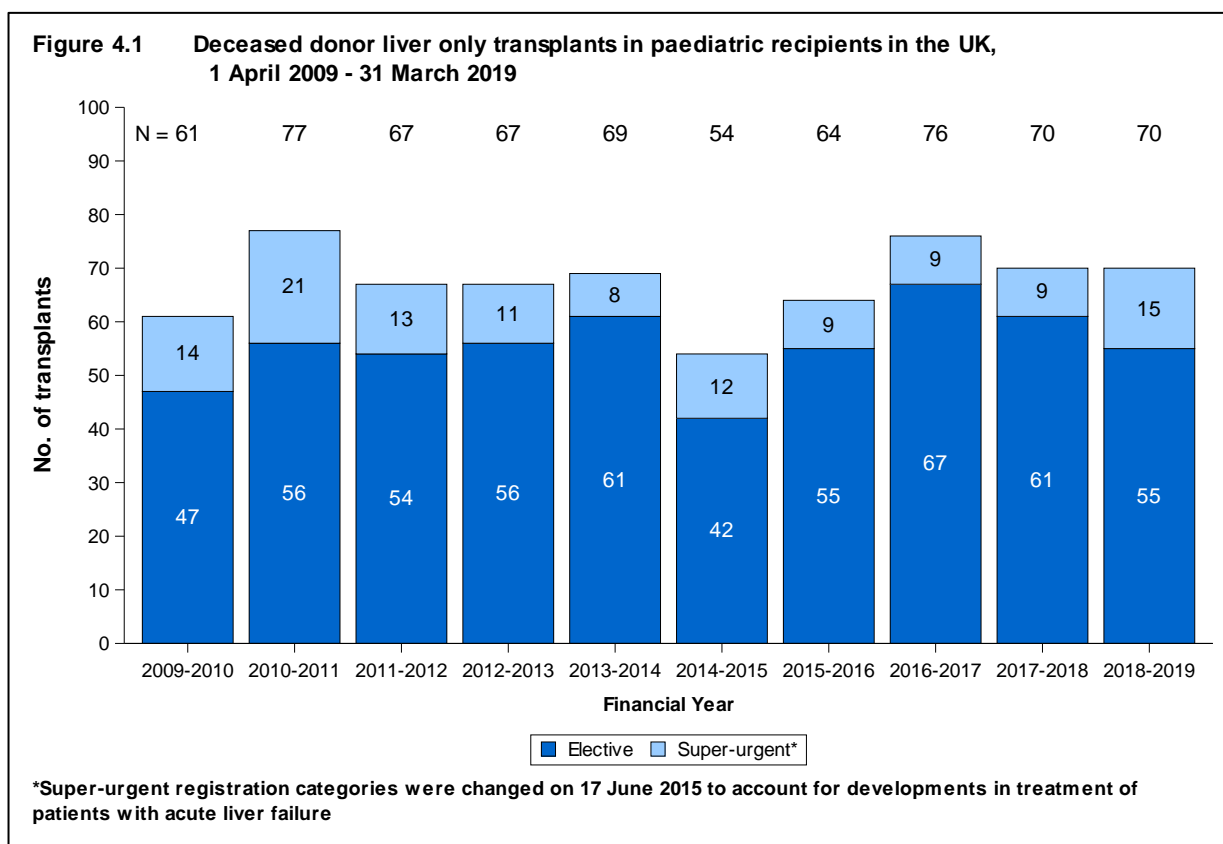
Centre	Transplant record		3 month follow-up		1 year follow-up		Lifetime follow-up	
	N	% Returned	N	% Returned	N	% Returned	N	% Returned
Newcastle	29	100	32	97	30	97	205	86
Leeds	113	100	110	100	122	79	549	47
Cambridge	111	99	114	100	99	95	461	84
Royal Free	121	100	123	100	95	89	444	81
King's College	178	100	182	100	152	94	891	84
Birmingham	202	100	203	100	174	99	932	96
Edinburgh	105	100	101	88	83	94	483	92
Total	859	100	865	98	755	92	3965	82

Paediatric Liver Transplantation

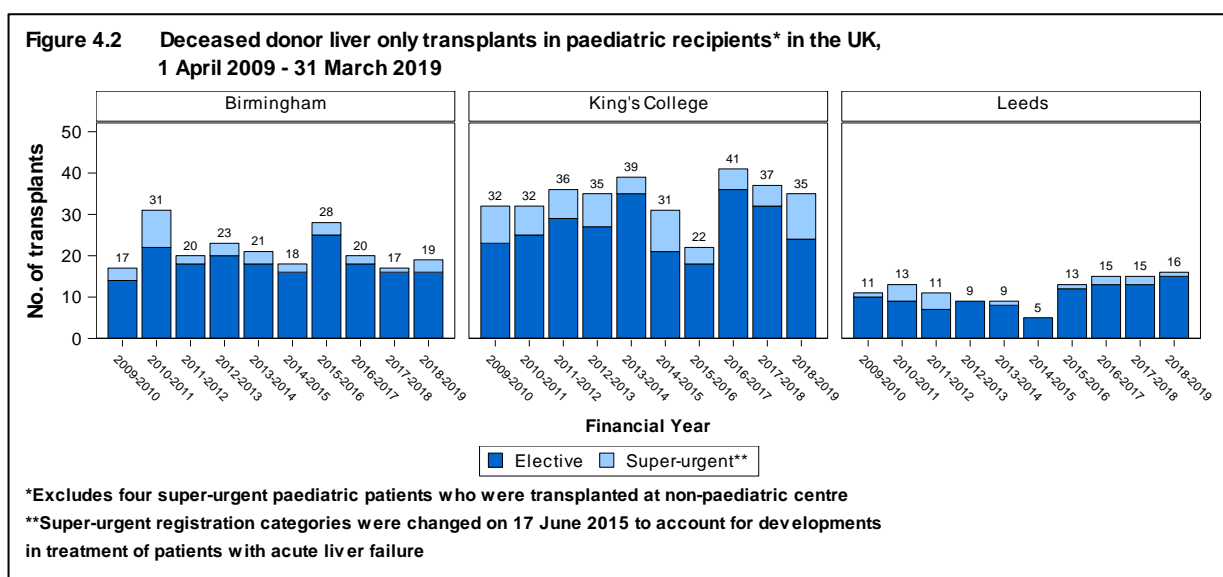


4.1 Overview

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. Fifty five (79%) of these transplants were for patients on the [elective](#) list and fifteen (21%) for patients on the [super-urgent](#) list.



The overall [median cold ischaemia times](#) (CIT) for paediatric transplant recipients are shown by financial year in **Figure 4.3** for [DBD](#) and [DCD](#) donors, respectively. The national median CIT for transplants from DBD donors has decreased slightly from 9.7 hours in 2009/10 to 8.9 hours in 2018/19. Similarly, the national median for DCD donor transplants has remained relatively stable over the ten year period, from 7.5 hours in 2009/10 to 7.7 hours in 2018/19.

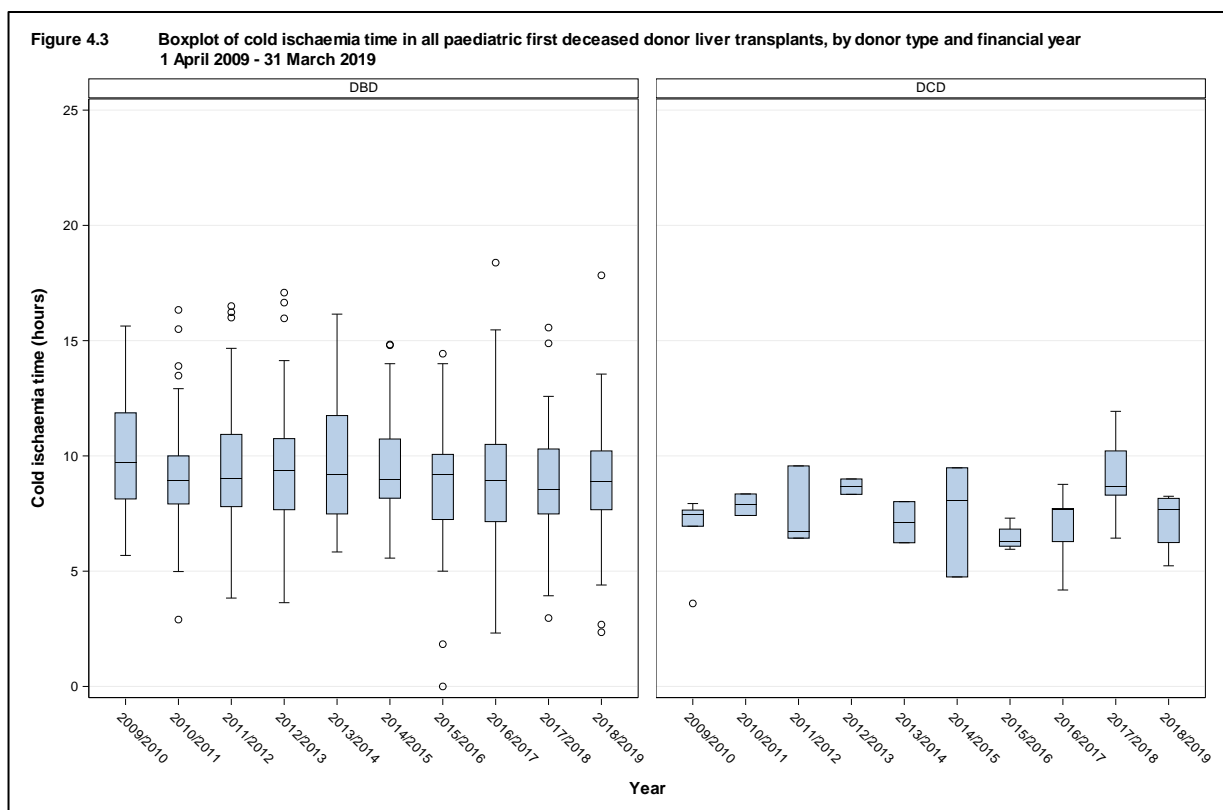


Figure 4.4 shows boxplots of [cold ischaemia times](#) (CIT) for paediatric transplant recipients by centre and donor type in the latest financial year (2018/2019) while **Figure 4.5** and **Figure 4.6** show the equivalent information by centre over the last ten financial years for [DBD](#) and [DCD](#) donors, respectively. The median CIT for DBD in the last financial year was 9.2 hours at both King's College and Birmingham and 7.8 hours at Leeds whilst the median CIT for DCD was 5.2 hours at Birmingham and 8.1 hours at King's College. However, it should be noted that these medians are based on one and three DCD transplants respectively.

The cold ischaemia time used is as reported on the liver transplant record form and may include periods of machine perfusion; no adjustment has been made for this. None of paediatric deceased donor first liver only transplants performed in the latest financial year were reported to have involved machine perfusion.

Figure 4.4 Boxplot of cold ischaemia time in all paediatric first deceased donor liver transplants, by donor type and transplant centre
1 April 2018 - 31 March 2019

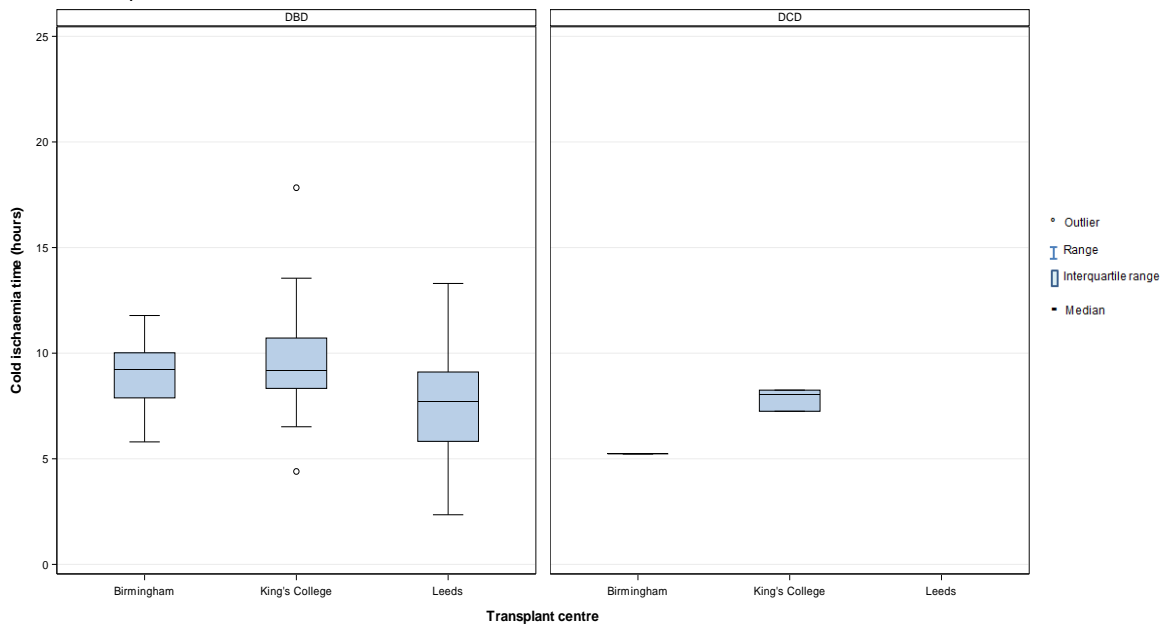
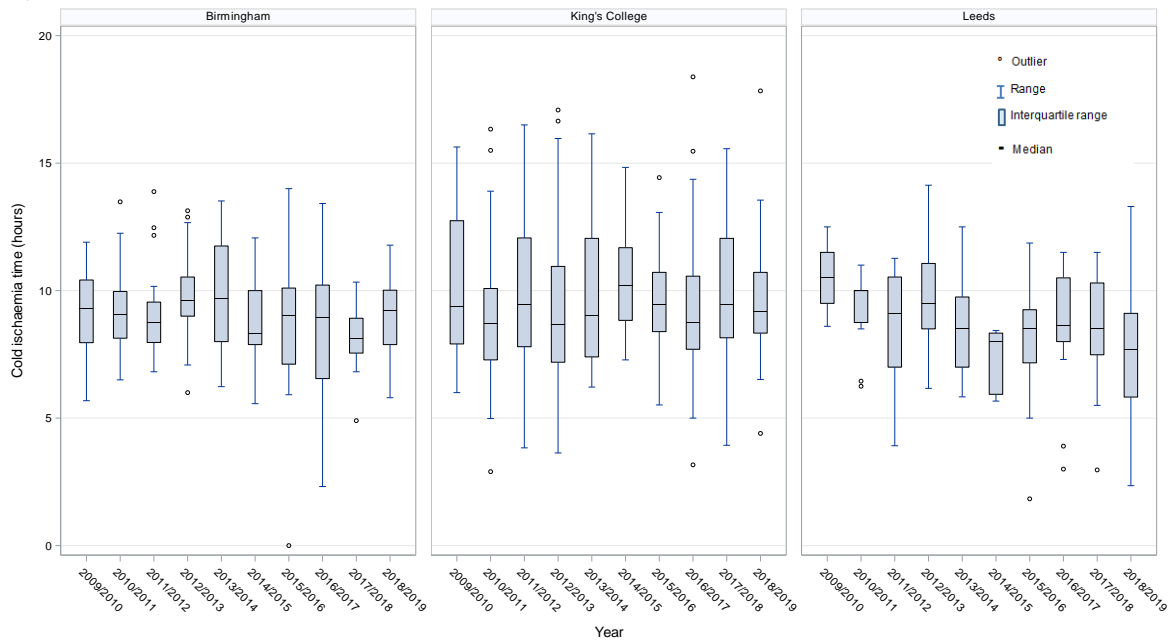
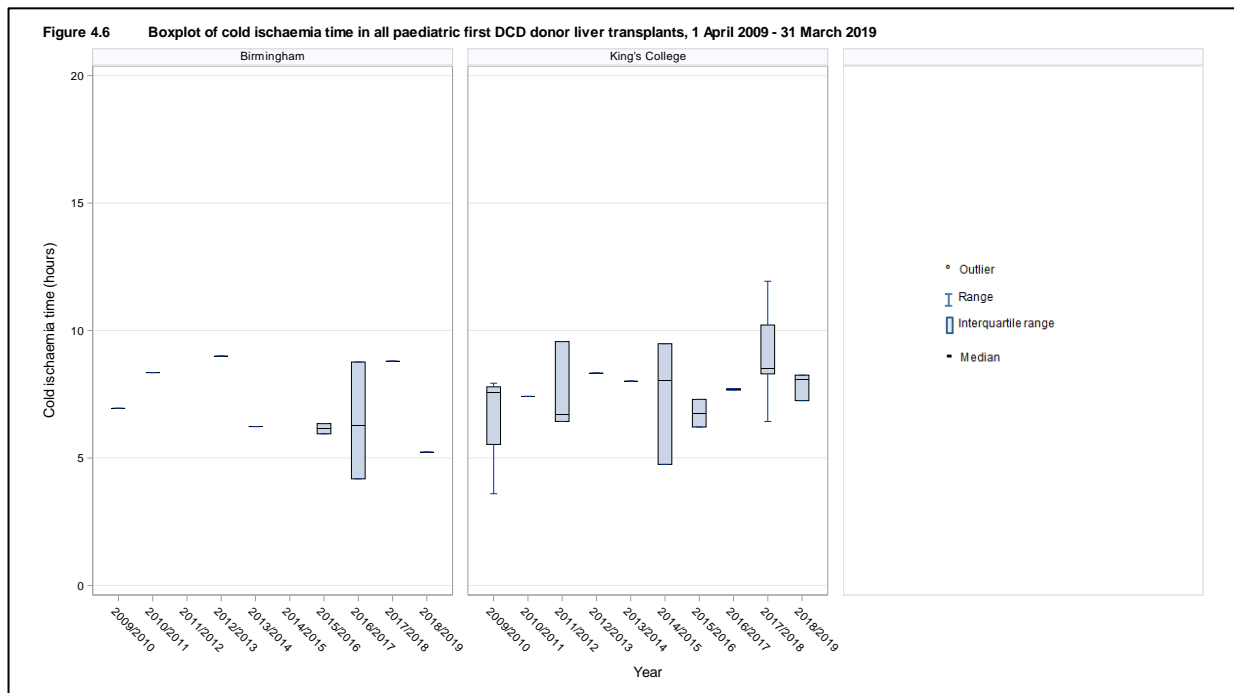


Figure 4.5 Boxplot of cold ischaemia time in all paediatric first DBD donor liver transplants, 1 April 2009 - 31 March 2019





The demographic characteristics of 93 paediatric registrations and 70 paediatric transplant recipients in the latest year are shown by centre and nationally in **Table 4.1**. Of the patients registered for a liver transplant, 60% were male, 33% were between 1 - 4 years old and 22% were registered as super-urgent. Of the transplant recipients, 63% were male, 37% were aged between one and four years old and 15 (21%) 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 2018 - 31 March 2019

		Birmingham N (%)		King's College N (%)		Leeds N (%)		TOTAL N (%)	
		Registration	Transplant	Registration	Transplant	Registration	Transplant	Registration	Transplant
Number		33	19	44	35	16	16	93 (100)	70 (100)
Recip age years	<1	6 (18)	4 (21)	9 (20)	8 (23)	2 (13)	1 (6)	17 (18)	13 (19)
	1-4	7 (21)	6 (32)	17 (39)	14 (40)	7 (44)	6 (38)	31 (33)	26 (37)
	5-12	15 (45)	5 (26)	10 (23)	8 (23)	4 (25)	5 (31)	29 (31)	18 (26)
	13-16	5 (15)	4 (21)	8 (18)	5 (14)	3 (19)	4 (25)	16 (17)	13 (19)
Recipient sex	Male	24 (73)	13 (68)	25 (57)	22 (63)	7 (44)	9 (56)	56 (60)	44 (63)
	Female	9 (27)	6 (32)	19 (43)	13 (37)	9 (56)	7 (44)	37 (40)	26 (37)
Indication	Super Urgent	5 (15)	3 (16)	13 (30)	11 (31)	2 (13)	1 (6)	20 (22)	15 (21)
	Biliary Atresia	10 (30)	5 (26)	11 (25)	11 (31)	5 (31)	2 (13)	26 (28)	18 (26)
	Other	0 (0)		1 (2)		0 (0)		1 (1)	
	Cholestatic								
	Metabolic	1 (3)	2 (11)	4 (9)	4 (11)	2 (13)	5 (31)	7 (8)	11 (16)
	Other	17 (52)	9 (47)	15 (34)	9 (26)	7 (44)	8 (50)	39 (42)	26 (37)
Pre-transplant in-patient status	Out-patient		13 (68)		21 (60)		13 (81)		47 (67)
	In-patient		6 (32)		13 (37)		3 (19)		22 (31)
	Not reported		0		1 (3)		0		1 (1)
Pre-transplant renal support	No		17 (89)		30 (86)		16 (100)		63 (90)
	Yes		2 (11)		4 (11)		0		6 (9)
	Not reported		0		1 (3)		0		1 (1)
Ascites	Absence		10 (53)		23 (66)		15 (94)		48 (69)
	Presence		9 (47)		10 (29)		1 (6)		20 (29)
	Not reported		0		2 (6)		0		2 (3)
Previous abdominal surgery	No	15 (45)	9 (47)	13 (30)	24 (69)	5 (31)	11 (69)	33 (35)	44 (63)
	Yes	13 (39)	9 (47)	18 (41)	10 (29)	9 (56)	4 (25)	40 (43)	23 (33)
	Not reported	5 (15)	1 (5)	13 (30)	1 (3)	2 (13)	1 (6)	20 (22)	3 (4)

Table 4.1 Demographic characteristics of paediatric registrations and deceased donor liver transplant recipients, 1 April 2018 - 31 March 2019

		Birmingham N (%)		King's College N (%)		Leeds N (%)		TOTAL N (%)	
		Registration	Transplant	Registration	Transplant	Registration	Transplant	Registration	Transplant
INR	<=1.0	9 (27)	5 (26)	10 (23)	4 (11)	6 (38)	0	25 (27)	9 (13)
	1.1-1.5	20 (61)	8 (42)	18 (41)	16 (46)	8 (50)	12 (75)	46 (49)	36 (51)
	1.6-3.0	1 (3)	3 (16)	4 (9)	7 (20)	1 (6)	3 (19)	6 (6)	13 (19)
	>3.0	2 (6)	3 (16)	12 (27)	7 (20)	1 (6)	1 (6)	15 (16)	11 (16)
	Not reported	1 (3)	0	0 (0)	1 (3)	0 (0)	0	1 (1)	1 (1)
Serum sodium mmol/l	<135	5 (15)	5 (26)	5 (11)	5 (14)	0 (0)	1 (6)	10 (11)	11 (16)
	>=135	28 (85)	14 (74)	39 (89)	29 (83)	16 (100)	15 (94)	83 (89)	58 (83)
	Not reported	0 (0)	0	0 (0)	1 (3)	0 (0)	0	0 (0)	1 (1)
Donor age years	<5		0		2 (6)		2 (13)		4 (6)
	5-16		3 (16)		3 (9)		2 (13)		8 (11)
	17-30		7 (37)		13 (37)		7 (44)		27 (39)
	>=31		9 (47)		17 (49)		5 (31)		31 (44)
Donor sex	Male		10 (53)		17 (49)		10 (63)		37 (53)
	Female		9 (47)		18 (51)		6 (38)		33 (47)
Donor type	Donor after brain death		18 (95)		32 (91)		16 (100)		66 (94)
	Donor after cardiac death		1 (5)		3 (9)		0		4 (6)
Graft appearance	Normal		19 (100)		33 (94)		16 (100)		68 (97)
	Abnormal		0		1 (3)		0		1 (1)
	Not reported		0		1 (3)		0		1 (1)
Graft type	Whole		4 (21)		4 (11)		1 (6)		9 (13)
	Segmental		15 (79)		31 (89)		15 (94)		61 (87)
Urgency Status	Elective	28 (85)	16 (84)	31 (70)	24 (69)	14 (88)	15 (94)	73 (78)	55 (79)
	Super Urgent	5 (15)	3 (16)	13 (30)	11 (31)	2 (13)	1 (6)	20 (22)	15 (21)

Paediatric Liver Transplantation Elective Patients



4.2.1 Transplant list

Figure 4.7 shows the number of paediatric [elective](#) patients on the liver only transplant list at 31 March each year between 2010 and 2019. The number of patients on the [active](#) liver only transplant list has ranged between 24 and 42 each year with 36 paediatric patients active on the liver only transplants on 31 March 2019.

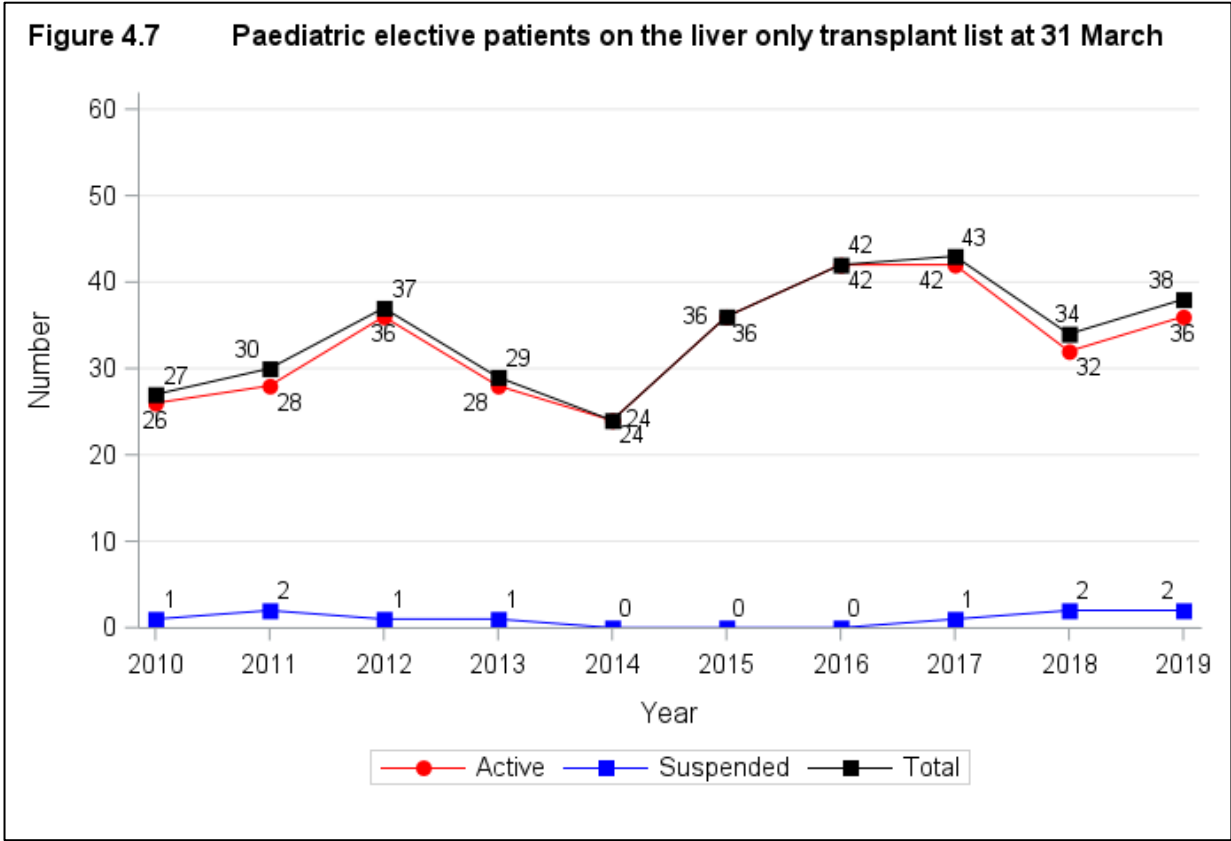
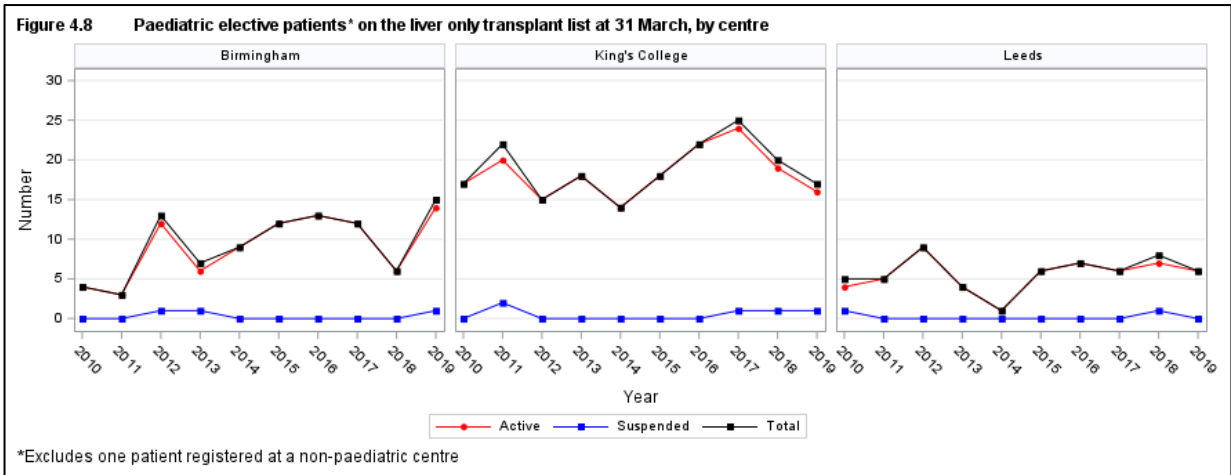


Figure 4.8 shows the number of [elective](#) patients on the transplant list at 31 March each year between 2010 and 2019 for each transplant centre.



An indication of outcomes for paediatric patients listed for a liver transplant is summarised in **Figure 4.9**. This shows the proportion of patients transplanted or still waiting six months, one and two years after joining the list. After six months, 71% of patients have had a liver transplant, and 25% were still waiting.

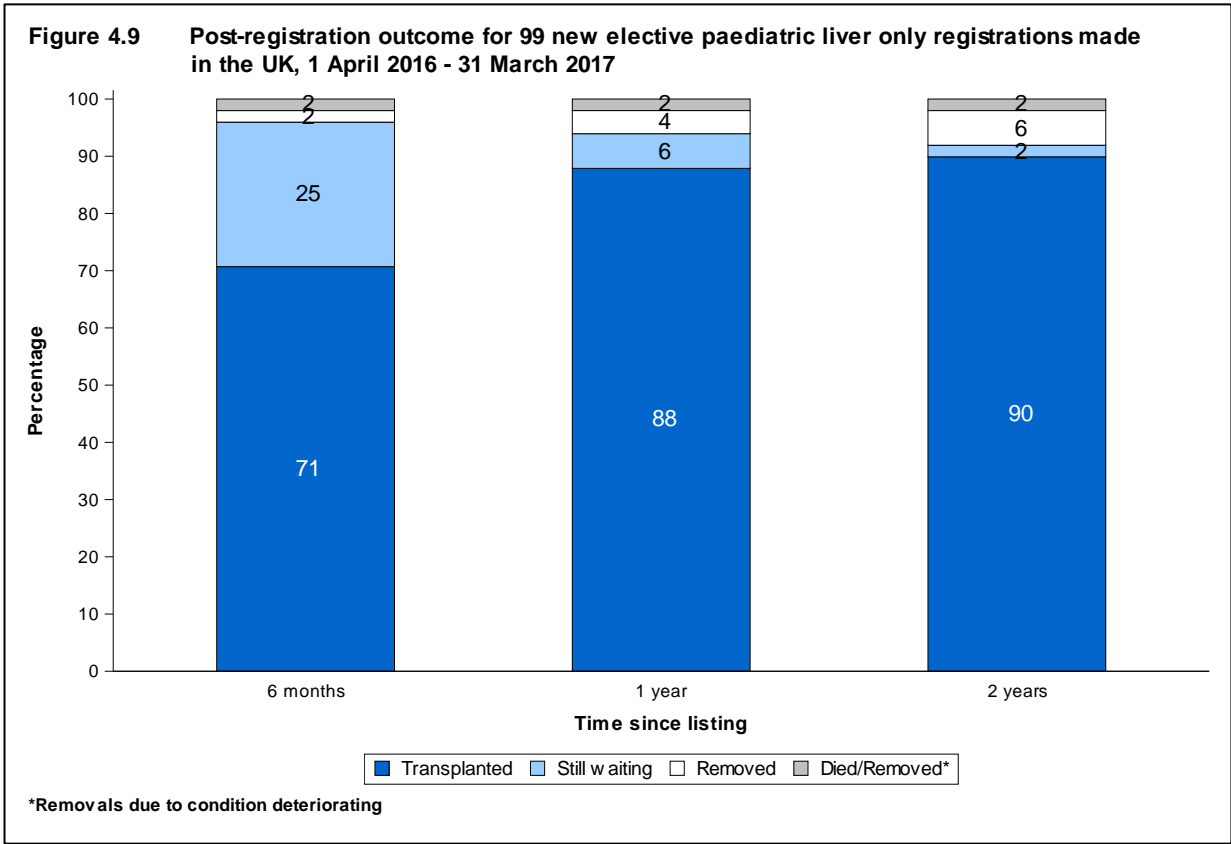


Figure 4.10 shows the proportion of patients transplanted, removed, died while waiting, or still waiting on the list at 6 months after joining the list at each transplant centre. The proportion of patients transplanted six months after listing at each centre ranges from 69% at King's College to 73% at Leeds.

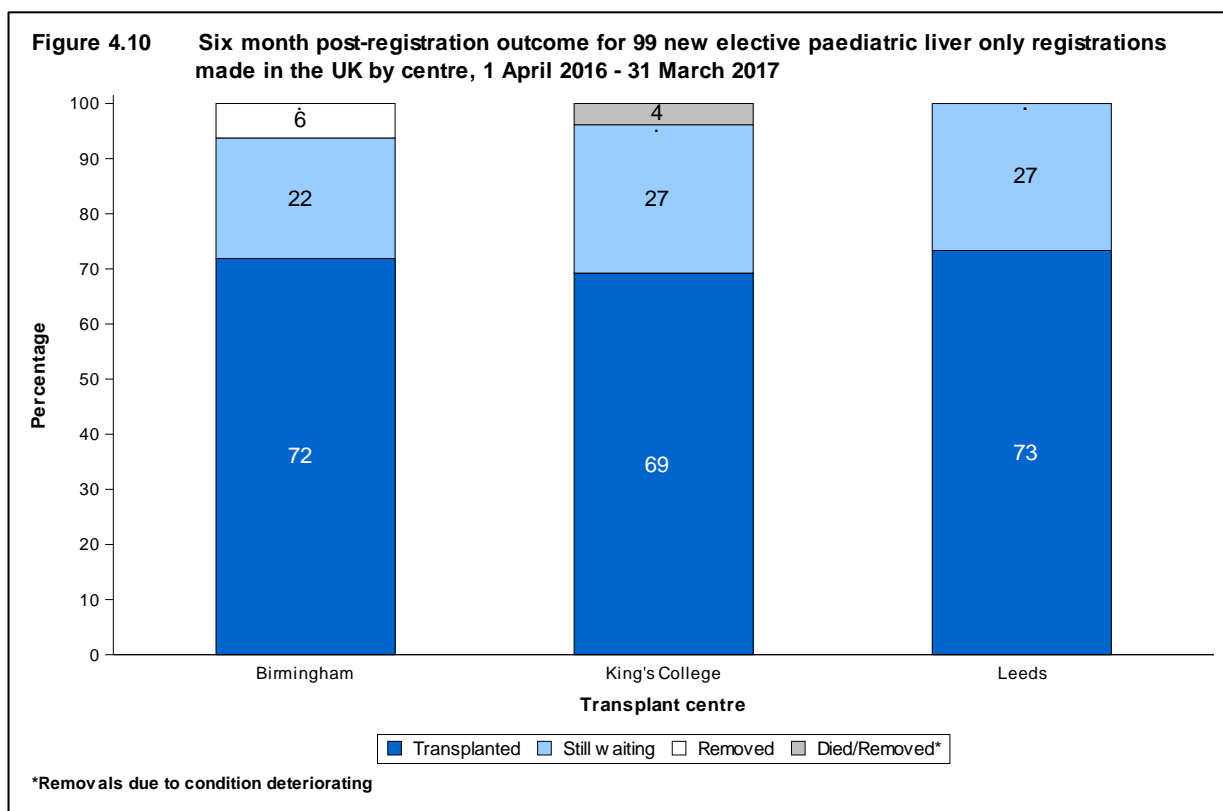
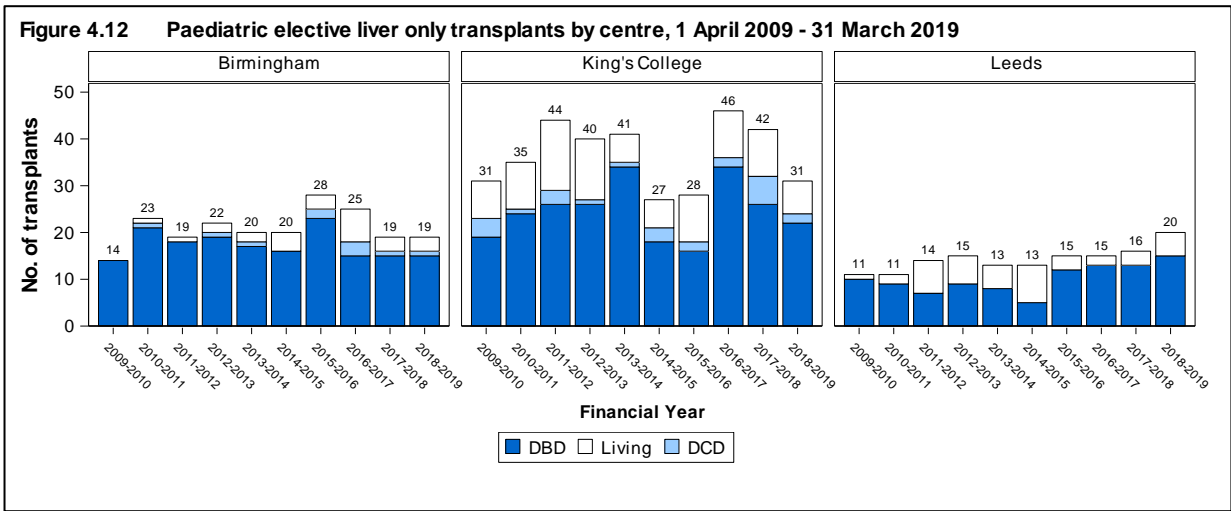
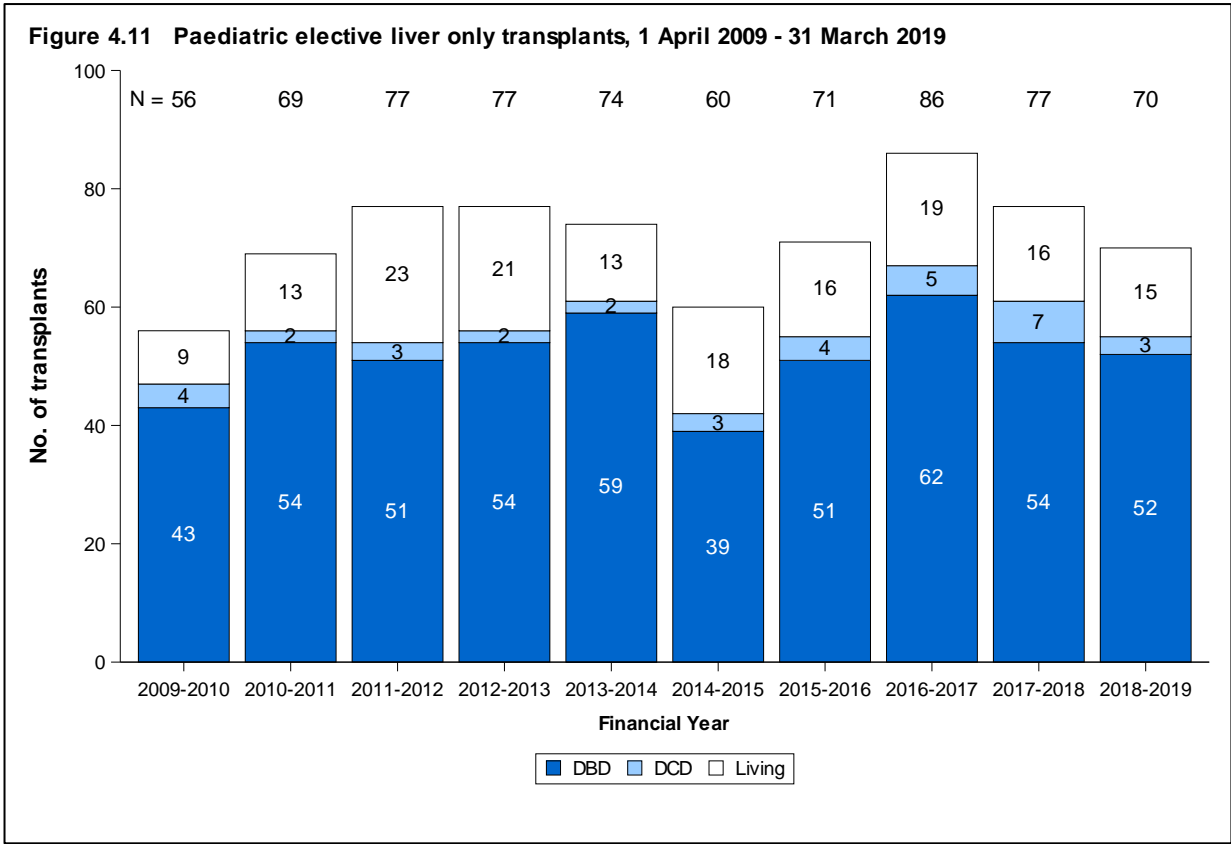


Table 4.2 shows the [median waiting time](#) to deceased donor liver only transplant for paediatric [elective](#) patients. The median waiting time to transplant is shortest at Birmingham at 102 days, and longest at King's College Hospital, at 141 days. The national median waiting time to transplant is 107 days.

Table 4.2 Median waiting time to liver only transplant in the UK, for paediatric elective patients registered 1 April 2015 - 31 March 2018			
Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Paediatric			
Birmingham	74	102	49 - 155
Leeds	46	106	59 - 153
King's College	100	141	89 - 193
UK*	220	107	84 - 130

4.2.2 Transplant activity

Figure 4.11 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 4.12 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 223 deceased donor transplants (excluding [auxiliary](#) transplants) from 1 April 2014 to 31 March 2018, nationally and by centre. Note that these survival rates should be interpreted with caution as one-year patient follow-up is incomplete for one of the three transplant centres (refer to **Table 4.8**).

Table 4.3 One year unadjusted patient survival for paediatric elective deceased donor first liver transplants, 1 April 2014 - 31 March 2018			
Centre	Number of transplants	1-year survival % (95% CI)	
Leeds	43	97.7	(84.6 - 99.7)
King's College	105	99.0	(93.3 - 99.9)
Birmingham	75	93.3	(84.6 - 97.2)
Total	223	96.8	(93.5 - 98.5)

Table 4.4 shows the [unadjusted](#) five year paediatric [patient survival](#) for all 223 transplants (excluding [auxiliary](#) transplants) from 1 April 2010 to 31 March 2014, 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 2010 - 31 March 2014			
Centre	Number of transplants	5-year survival % (95% CI)	
Leeds	33	93.9	(77.9 - 98.4)
King's College	112	91.1	(83.4 - 95.3)
Birmingham	78	90.8	(81.7 - 95.5)
Total	223	91.5	(86.8 - 94.6)

Paediatric Liver Transplantation Super-Urgent Patients



4.3.1 Transplant list

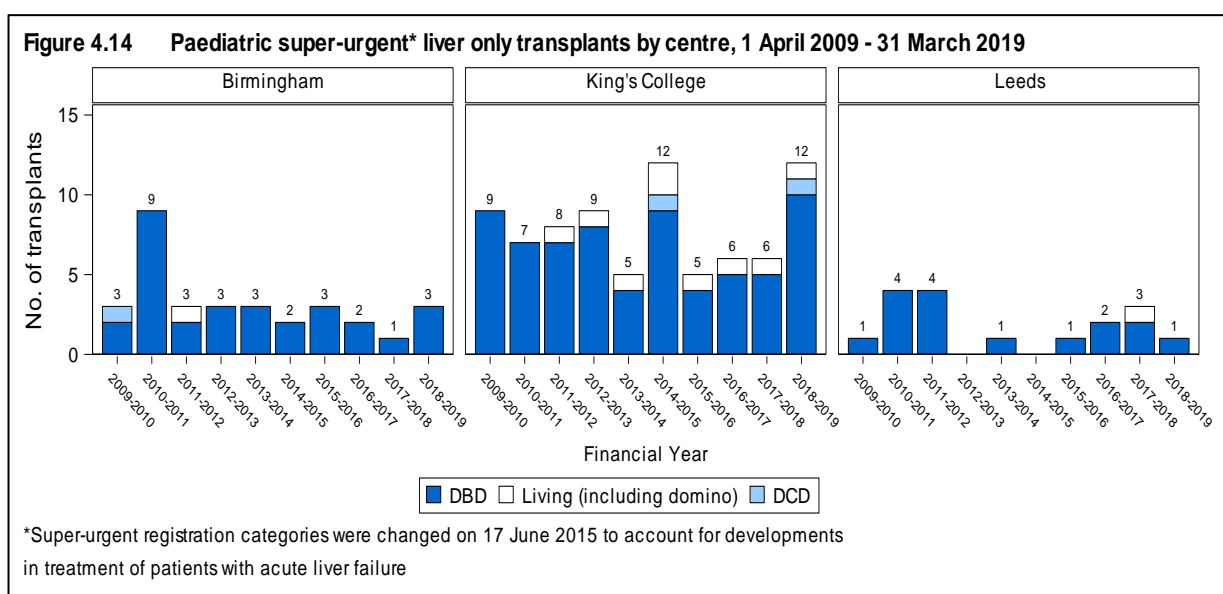
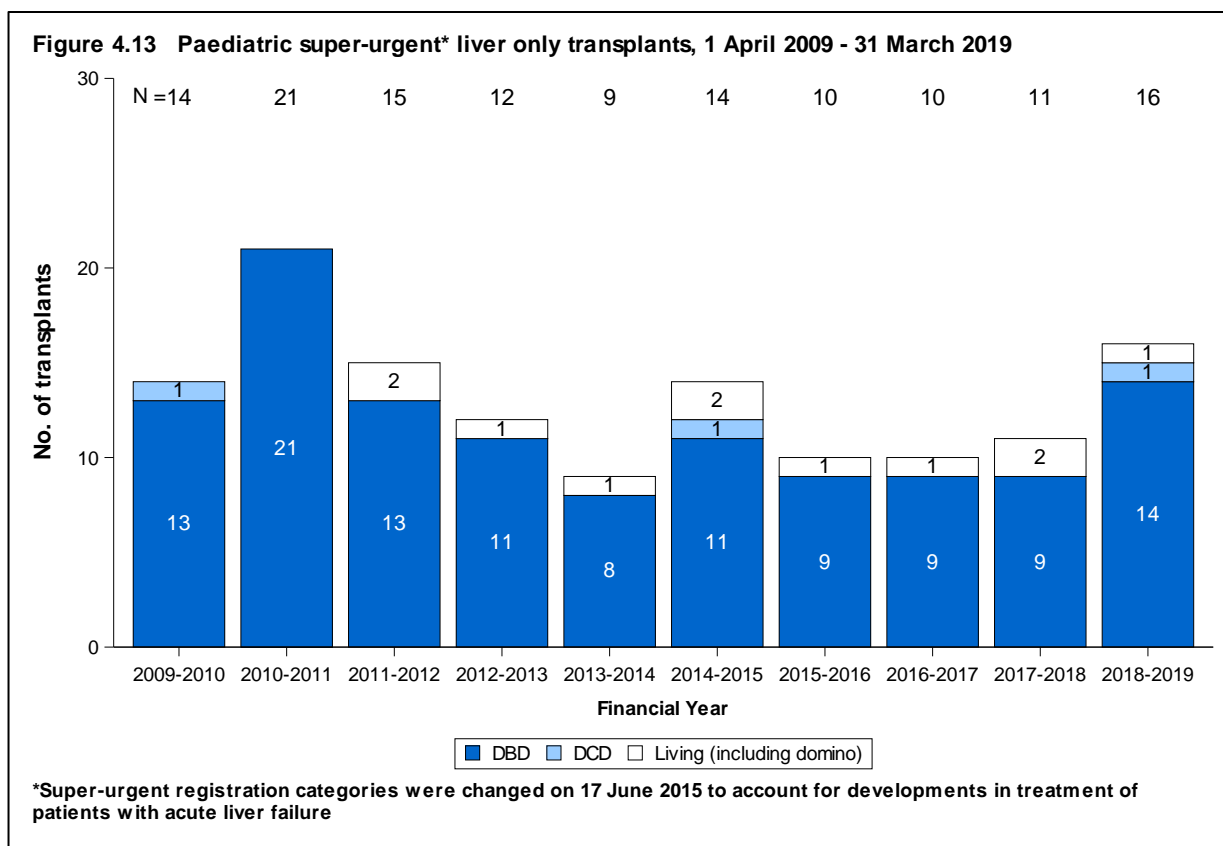
Table 4.5 shows the [median waiting time](#) to deceased donor liver only transplant for paediatric [super-urgent](#) patients. The median waiting time to transplant is shortest at Birmingham but there is no statistically significant difference across the three centres. The national median waiting time 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 2015 - 31 March 2018			
Transplant centre	Number of patients registered	Waiting time (days) Median	95% Confidence interval
Paediatric			
Birmingham	15	3	2 - 4
King's College	29	4	1 - 7
Leeds	11	5	2 - 8
UK*	57	4	2 - 6
* Includes 2 patients registered at a non-paediatric centre			

Table 4.5 includes registrations for a re-transplant. Of the 57 registrations for the UK in the three-year time period, 38 led to transplants (the remaining 19 led to removal or death). 11 of the 38 transplants were re-transplanted, hence, the difference between the 27 *first* deceased donor liver only transplants reported in **Figure 4.13** for the period 2015 – 2018 and **Table 4.5**.

4.3.2 Transplant activity

Figure 4.13 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. **Figure 4.14** shows the same information by transplant centre.



4.3.3 Post-transplant survival

One year [unadjusted patient survival](#) for 33 transplants (excluding [auxiliary](#) transplants) between 1 April 2014 and 31 March 2018 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 of the three transplant centres (refer to **Table 4.8**).

Table 4.6 One year unadjusted patient survival for paediatric deceased donor super urgent first transplants, 1 April 2014 - 31 March 2018			
Centre	Number of transplants	1-year survival % (95% CI)	
Leeds	5 ¹	(-)	
King's College	18	88.5	(61.4 - 97.0)
Birmingham	8 ¹	(-)	
Total*	33	93.5	(76.5 - 98.3)
* Includes 2 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 51 transplants (excluding [auxiliary](#) transplants) between 1 April 2010 and 31 March 2014, 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 2010 - 31 March 2014			
Centre	Number of transplants	5-year survival % (95% CI)	
Leeds	9 ¹	-	-
King's College	25	71.1	(48.5 - 85.1)
Birmingham	16	62.5	(34.9 - 81.1)
Total*	51	70.3	(55.5 - 80.9)
* Includes 1 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 2018 and 31 December 2018 for the transplant record, and all requests for follow-up forms issued in this time period. Newcastle has also returned 100% follow up at 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 2018 - 31 December 2018

Centre	Transplant Record		3 Month follow-up		1 year follow-up		Lifetime follow-up	
	N	% returned	N	% returned	N	% returned	N	% returned
Leeds	20	100	17	94	12	92	76	74
King's College	34	97	34	100	35	100	213	72
Birmingham	20	100	20	100	13	100	140	99
Total¹	74	99	71	99	61	98	430	81

¹ Includes one one-year follow-up form issued to Newcastle and a three-year follow-up form issued to Cambridge



Appendix



A1 Data

Data were obtained from the UK Transplant Registry for the ten year time period, 1 April 2009 to 31 March 2019 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 Registration rates

All NHS group 1 patients who were registered onto the liver transplant list with an active status between 1 April 2018 and 31 March 2019 were extracted from the UK Transplant Registry on 14 June 2019 (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-2017 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

Transplant rates pmp were obtained as the number of liver transplants on NHS group 1 recipients between 1 April 2018 and 31 March 2019 (numerator), divided by the mid-2017 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 2018 and 31 March 2019 were included. If a patient was re-registered during the time period, only the first registration was considered. If a patient underwent more than one liver transplant in the time period, only the first transplant was considered.

Adult and paediatric analysis

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

Table A1.1 shows the total number of adult transplants in the three time periods defined in the report, including atypical donor, [multi-organ](#) and re-transplants. **Table A1.2** shows the number of adult deceased donor first liver only transplants.

Table A1.1 Number of adult liver transplants in each time period, by transplant centre and urgency status

Transplant centre	Latest year April 2018-March 2019		Last 3 years April 2016-March 2019		Last 10 years April 2009-March 2019	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	24	4	97	10	329	54
Leeds	85	18	334	49	950	115
Cambridge	108	10	307	30	816	94
Royal Free	110	14	297	49	760	121
King's College	190	16	551	48	1560	191
Birmingham	195	24	565	61	1606	205
Edinburgh	97	11	288	26	839	102
TOTAL	812¹	97	2448²	273	6880³	882

¹ Includes 3 living transplants performed at London Bridge Hospital

² Includes 9 living transplants performed at London Bridge Hospital

³ Includes 15 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 April 2018-March 2019		Last 3 years April 2016-March 2019		Last 10 years April 2009-March 2019	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	24	4	89	10	290	45
Leeds	76	13	300	36	852	71
Cambridge	98	6	279	19	749	53
Royal Free	107	12	286	36	704	90
King's College	166	12	472	40	1341	155
Birmingham	171	18	503	47	1453	156
Edinburgh	93	3	266	9	772	59
TOTAL	735	68	2195	197	6161	629

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 April 2018-March 2019		Last 3 years April 2016-March 2019		Last 10 years April 2009-March 2019	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	0	0	0	1	0	2
Leeds	20	2	54	10	154	27
Cambridge	0	0	0	0	0	1
Royal Free	0	0	0	0	1	2
King's College	34	14	127	28	393	90
Birmingham	19	5	74	11	256	51
TOTAL	73	21	255	50	804	173

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 2018-March 2019		April 2016-March 2019		April 2009-March 2019	
	Elective	Super-urgent	Elective	Super-urgent	Elective	Super-urgent
Newcastle	0	0	0	1	0	2
Leeds	15	1	41	5	101	16
Cambridge	0	0	0	0	0	1
Royal Free	0	0	0	0	0	1
King's College	24	11	92	21	270	70
Birmingham	16	3	50	6	183	31
TOTAL	55	15	183	33	554	121

A2 Methods

Waiting time to transplant

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

Systematic component of variation

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

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

Unadjusted survival rates

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

Risk-adjusted survival rates

A [risk-adjusted survival rate](#) is an estimate of what the survival rate at a centre would have been if they had the same mix of patients as the one seen nationally. The risk-adjusted rate therefore presents estimates for which differences in the patient mix across centres have been removed as much as possible. For that reason, it is valid to only compare centres using risk-adjusted rather than unadjusted rates, as differences among the latter can be attributed to differences in the patient mix.

Risk-adjusted survival estimates were obtained through indirect standardisation. A [Cox Proportional Hazards model](#) was used to determine the probability of survival for each patient based on their individual risk factor values. The sum of these probabilities for all patients at a centre gives the number, E , of patients or grafts expected to survive at least one year or five years after transplant at that centre. The number of patients who actually survive the time period of interest is given by O . The risk-adjusted estimate is then calculated by multiplying the ratio O/E by the overall unadjusted survival rate across all centres. The risk-adjustment models used were based on results from previous studies that looked at factors affecting the survival rates of interest. The factors included in the **survival post transplantation** models are shown in **Tables A3.1 and A3.2** below.

The [funnel plot](#) is a graphical method to show how consistent the survival rates of the different transplant centres are compared to the national rate. The graph shows for each centre, a survival rate plotted against the number of transplants undertaken, with the national rate and [confidence limits](#) around this national rate superimposed. In this report, 95% and 99.8% confidence limits were used. Units that lie within the confidence limits have survival rates that are statistically consistent with the national rate. When a unit is close to or outside the limits, this is an indication that the centre may have a rate that is considerably different from the national rate.

A fundamentally similar method was used to conduct the **survival from listing** analysis. The [risk factors](#) used in this case were: recipient blood group, recipient age at registration, recipient ethnic group, recipient primary disease at registration, recipient sex, recipient BMI, serum creatinine, serum sodium, serum bilirubin, INR and year of registration, as shown in **Table A3.3**.

A3 Risk models

Table A3.1 Risk factors and categories used in the adult elective risk adjusted survival models post transplantation	
Recipient sex	Male Female
Recipient ethnicity	White Non-white
Indication	Cancer HCV ALD HBV PSC PBC AID Metabolic Other Acute hepatic failure
Recipient HCV status	Negative Positive
Pre-transplant in-patient status	Out-patient In-patient
Ascites	Absence Presence
Encephalopathy	Absence Presence
Pre-transplant renal support	No Yes
Previous abdominal surgery	No Yes
Varices & shunt	Absence Presence without treatment Presence with surgical shunt Presence with TIPS
Life style activity	Normal Restricted Self-care Confined Reliant
Graft appearance	Normal Abnormal
Recipient age years	Per 1 year increase
BMI kg/m ²	Per 1 kg/m ² increase
Serum Bilirubin µmol/l	≤30 31-50 51-70 71-90 ≥91
Serum Creatinine µmol/l	≤70 71-90 91-110 111-130 ≥131

Table A3.1 Risk factors and categories used in the adult elective 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 month increase
Donor sex	Male Female
Donor ethnicity	White Non-white
Donor cause of death	Trauma CVA Others
Donor history of diabetes	No Yes
Donor type	Donor after brain death Donor after cardiac death
ABO match	Identical Compatible Incompatible
Graft type	Whole Segmental
Donor age years	Per 1 year increase
Donor BMI kg/m ²	Per 1 kg/ m ² increase

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

Recipient sex	Male Female
Recipient ethnicity	White Non-white
Recipient HCV status	Negative Positive
Pre-transplant in-patient status	Out-patient In-patient
Ascites	Absence Presence
Encephalopathy	Absence Presence
Pre-transplant renal support	No Yes
Previous abdominal surgery	No Yes
Varices & shunt	Absence Presence without treatment Presence with surgical shunt Presence with TIPS

Table A3.2 Risk factors and categories used in the adult super-urgent risk adjusted survival models post transplantation	
Life style activity	Normal Restricted Self-care Confined Reliant
Graft appearance	Normal Abnormal
Recip age years	Per 1 year increase
BMI kg/m ²	Per 1 kg/m ² increase
Serum Bilirubin µmol/l	≤100 101-200 201-300 301-400 ≥401
Serum Creatinine µmol/l	≤100 101-130 131-160 161-190 ≥191
Serum sodium mmol/l	Per 10 mmol/l increase
Serum potassium mmol/l	Per 1 mmol/l increase
INR	Per 1 unit increase
Serum Albumin g/l	Per 5g/l increase
Cold Ischaemia time	Per 1 hour increase
Time on transplant list	Per 1 day increase
Donor sex	Male Female
Donor ethnicity	White Non-white
Donor cause of death	Trauma CVA Others
Donor history of diabetes	No Yes
Donor type	Donor after brain death Donor after cardiac death
ABO match	Identical Compatible Incompatible
Graft type	Whole Segmental
Donor age years	Per 1 year increase
Donor BMI kg/m ²	Per 1 kg/ m ² increase

Table A3.3 Risk factors and categories used in the adult elective risk adjusted survival models post registration	
Recipient sex	Male Female
Recipient ethnicity	White Non-white
Recipient age at registration years	Per 1 year increase
Recipient BMI kg/m ²	Per 1 kg/m ² increase
Recipient blood group	O A B AB
Indication	Cancer HCV ALD HBV PSC PBC AID Metabolic Other
Serum sodium mmol/l	Per 10 mmol/l increase
Serum creatinine µmol/l	Per 10 µmol/l increase
Serum bilirubin µmol/l	Per 10 µmol/l increase
INR	Per 1 unit increase
Year of registration	Split into three time intervals equally divided

A4 Glossary of terms

Active transplant list

When a patient is registered for a transplant, they are registered on what is called the 'active' transplant list. This means that when a donor organ becomes available, the patient is included among those who are matched against the donor to determine whether or not the organ is suitable for them. It may sometimes be necessary to take a patient off the transplant list, either temporarily or permanently. This may be done, for example, if someone becomes too ill to receive a transplant. The patient is told about the decision to suspend them from the list and is informed whether the suspension is temporary or permanent. If a patient is suspended from the list, they are not included in the matching of any donor organs that become available. Permanent suspension is known as a removal from the waiting list and is not included in suspended figures.

Auxiliary transplant

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

Case mix

The types of patients treated at a unit for a common condition. This can vary across units depending on the facilities available at the unit as well as the types of people in the catchment area of the unit. The definition of what type of patient a person is depends on the patient characteristics that influence the outcome of the treatment.

Cold ischaemia time (CIT)

The length of time that elapses between an organ being removed from the donor to its transplantation into the recipient is called Cold Ischaemia Time (CIT). Generally, the shorter this time, the more likely the organ is to work immediately and the better the long-term outcome. The factors which determine CIT include a) transportation of the organ from the retrieval hospital to the hospital where the transplant is performed, b) the need to tissue type the donor and cross-match the donor and potential recipients, c) the occasional necessity of moving the organ to another hospital if a transplant cannot go ahead, d) contacting and preparing the recipient for the transplant and e) access to the operating theatre. 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) means donation which takes place following the diagnosis of death using neurological criteria.

Donor after circulatory death (DCD) means donation which takes place following the diagnosis of death using circulatory criteria.

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

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

Elective and super-urgent patients

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

Funnel plot

A graphical method that shows how consistent the rates, such as survival rates or decline rates, of the different transplant units are compared to the national rate. For survival rates, the graph shows for each unit, a survival rate plotted against the number of transplants undertaken, with the national rate and [confidence limits](#) around this national rate superimposed. In this report, 95% and 99.8% confidence limits were used. Units that lie within the confidence limits have survival rates that are statistically consistent with the national rate. When a unit is close to or outside the limits, this is an indication that the centre may have a rate that is considerably different from the national rate.

Graft function

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

Inter-quartile range (IQR)

The values between which the middle 50% of the data fall. The lower boundary is the lower quartile, the upper boundary the upper quartile.

Kaplan-Meier method

A method that allows patients with incomplete follow-up information to be included in estimating survival rates. For example, in a cohort for estimating one year [patient survival](#) rates, a patient was followed up for only nine months before they relocated. If we calculated a crude survival estimate using the number of patients who survived for at least a year, this patient would have to be excluded as it is not known whether or not the patient was still alive at one year after transplant. The Kaplan-Meier method allows information about such patients to be used for the length of time that they are followed-up, when this information would otherwise be discarded. Such instances of incomplete follow-up are not uncommon and the Kaplan-Meier method allows the computation of estimates that are more meaningful in these cases.

Median

The midpoint in a series of numbers, so that half the data values are larger than the median, and half are smaller.

Multi-organ transplant

A transplant in which the patient receives more than one organ. For example, a patient may undergo a transplant of a liver and kidney.

Patient survival rate

The percentage of patients who are still alive (whether the graft is still functioning or not). This is usually specified for a given time period after first transplant. For example, a five-year patient survival rate is the percentage of patients who are still alive five years after their first transplant.

***p* value**

In the context of comparing survival rates across centres, the *p* value is the probability that the differences observed in the rates across centres occurred by chance. As this is a probability, it takes values between 0 and 1. If the *p* value is small, say less than 0.05, this implies that the differences are unlikely to be due to chance and there may be some identifiable cause for these differences. If the *p* value is large, say greater than 0.1, then it is quite likely that any differences seen are due to chance.

Risk-adjusted survival rate

Some transplants have a higher chance than others of failing at any given time. The differences in expected survival times arise due to differences in certain factors, the [risk factors](#), among patients. A risk-adjusted survival rate for a centre is the expected survival rate for that centre given the [case mix](#) of their patients. Adjusting for case mix in estimating centre-specific survival rates allows valid comparison of these rates across centres and to the national rate.

Risk factors

These are the characteristics of a patient, transplant or donor that influence the length of time that a graft is likely to function or a patient is likely to survive following a transplant. For example, when all else is equal, a transplant from a younger donor is expected to survive longer than that from an older donor and so donor age is a risk factor.

Unadjusted survival rate

Unadjusted survival rates do not take account of [risk factors](#) and are based only on the number of transplants at a given centre and the number and timing of those that fail within the post-transplant period of interest. In this case, unlike for [risk-adjusted rates](#), all transplants are assumed to be equally likely to fail at any given time.

However, some centres may have lower unadjusted survival rates than others simply because they tend to undertake transplants that have increased risks of failure.

Comparison of unadjusted survival rates across centres and to the national rate is therefore inappropriate.

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