NHS
Blood and Transplant

ANNUAL REPORT ON LIVER TRANSPLANTATION

REPORT FOR 2019/2020
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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 2010 to 31 March 2020. 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 29 February 2020, there were 466 patients on the UK active transplant list, which represents an 8% increase in the number of patients compared to 31 March 2019.

- Of the patients joining the elective liver only waiting list, approximately 82% had received a transplant within two years of listing.

- There were 8980 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 6% 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	84
Super-urgent	90	82
Paediatric		
Elective	96	93
Super-urgent	90	74

- The national rates of patient survival after joining the transplant list for adult elective first liver only patients was 85% at one and 72% at five years post-registration.

How to cite this report:
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Introduction

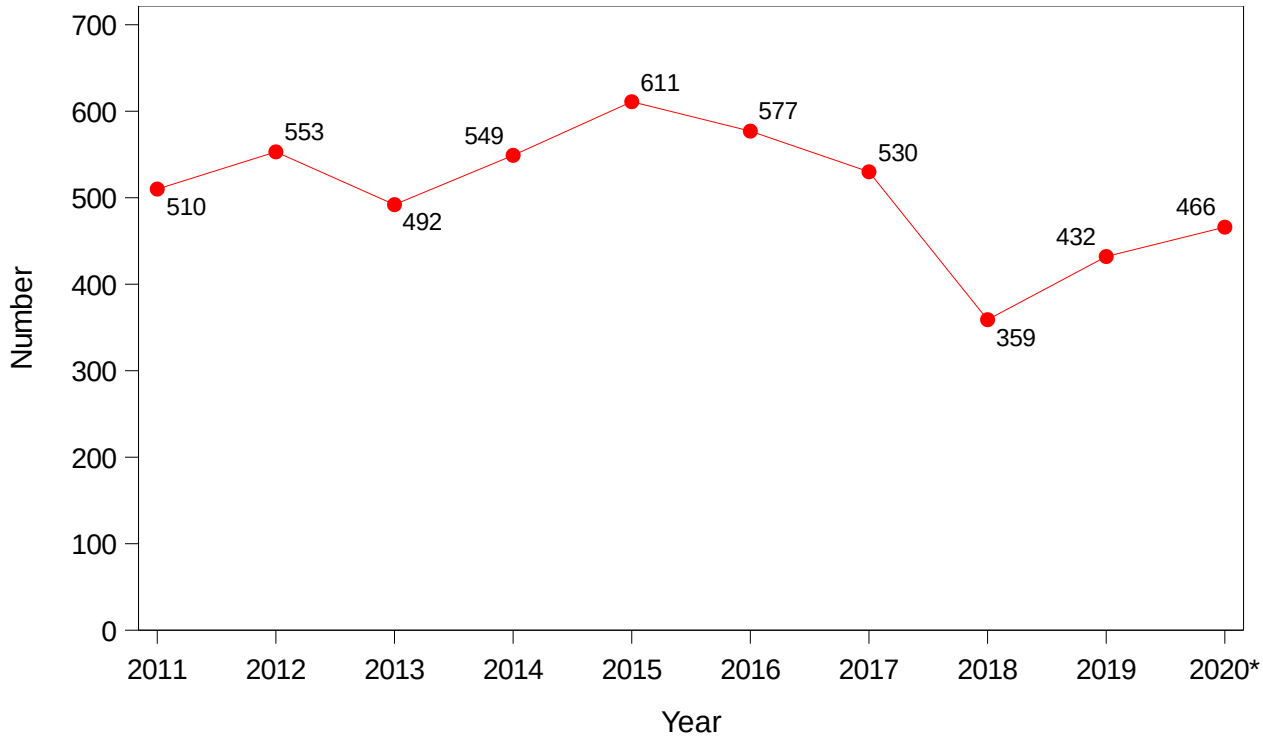
This report presents information on the UK transplant list, transplant activity and transplant outcomes between 1 April 2010 and 31 March 2020, for all seven centres performing liver transplantation in the UK. Data were obtained from the UK Transplant Registry, at NHS Blood & Transplant, that holds information 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 2011 and 31 March 2015 for 5 year survival, and 1 April 2015 to 31 March 2019 for 1 year survival. Patient survival from registration is presented for the period 1 January 2008 to 31 December 2019. 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 2011 and 2019 and at 29 February 2020. The number of patients waiting for a transplant increased from 510 in 2011 to 611 in 2015. There has been a decline in the number of active patients since 2015 to 359 patients in 2018 with a subsequent increase to 466 in 2020. The change in the number of patients actively listed in 2018 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.

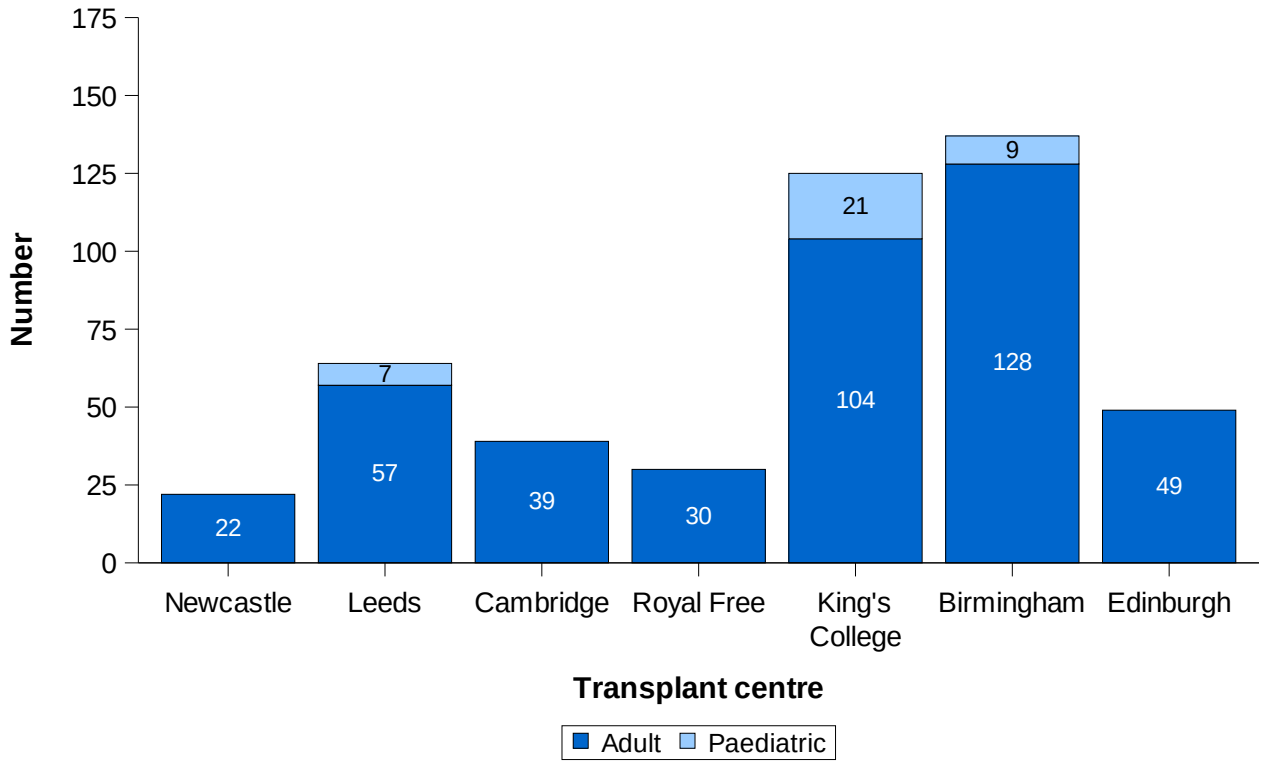
Figure 2.1 Patients on the active liver transplant list at 31 March



[1] Waiting list as at 29 February 2020

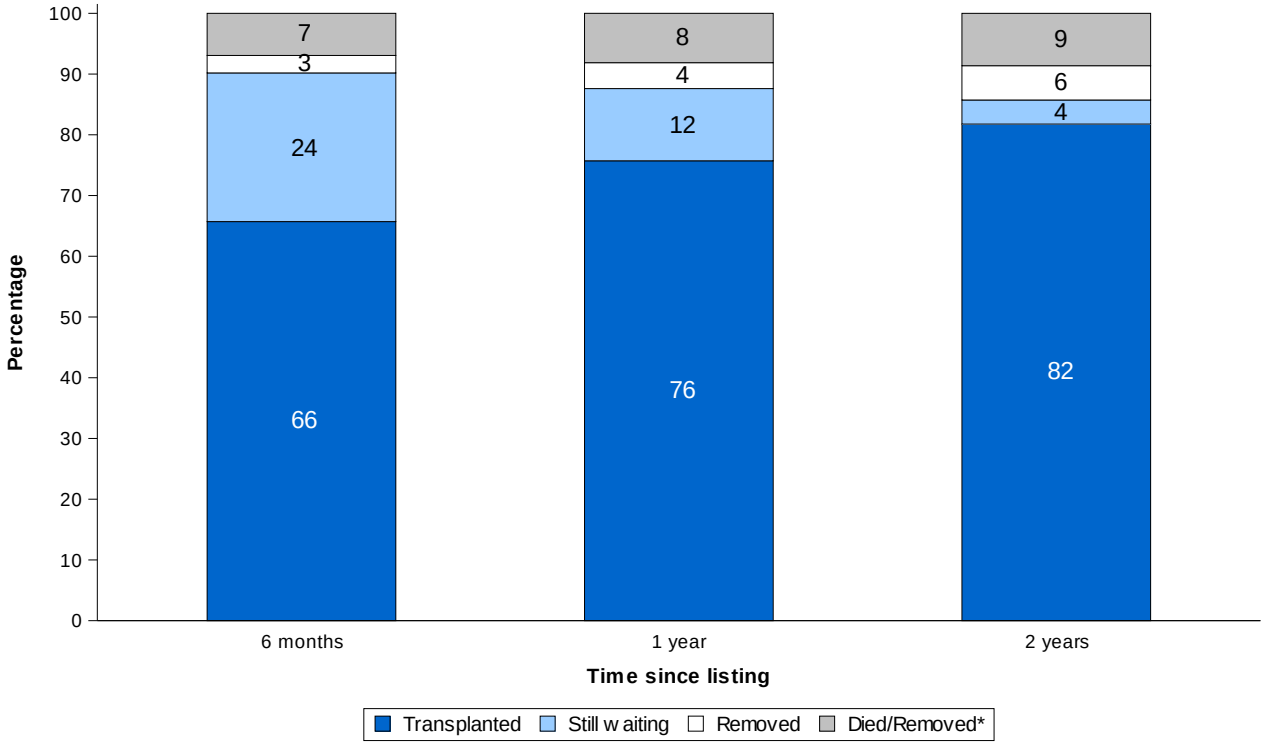
Figure 2.2 shows the number of adult and paediatric patients on the transplant list at 29 February 2020, by centre. In total, there were 429 adults and 37 paediatric patients on the active transplant list. Birmingham had the largest share of the transplant list (29%) and Newcastle the smallest (5%). This figure includes multi-organ, elective and super-urgent registrations.

Figure 2.2 Patients on the active liver transplant list at 29 February 2020



An indication of long-term outcomes for patients listed between April 2017 and March 2018 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, 66% of patients had received a transplant and 24% were still waiting.

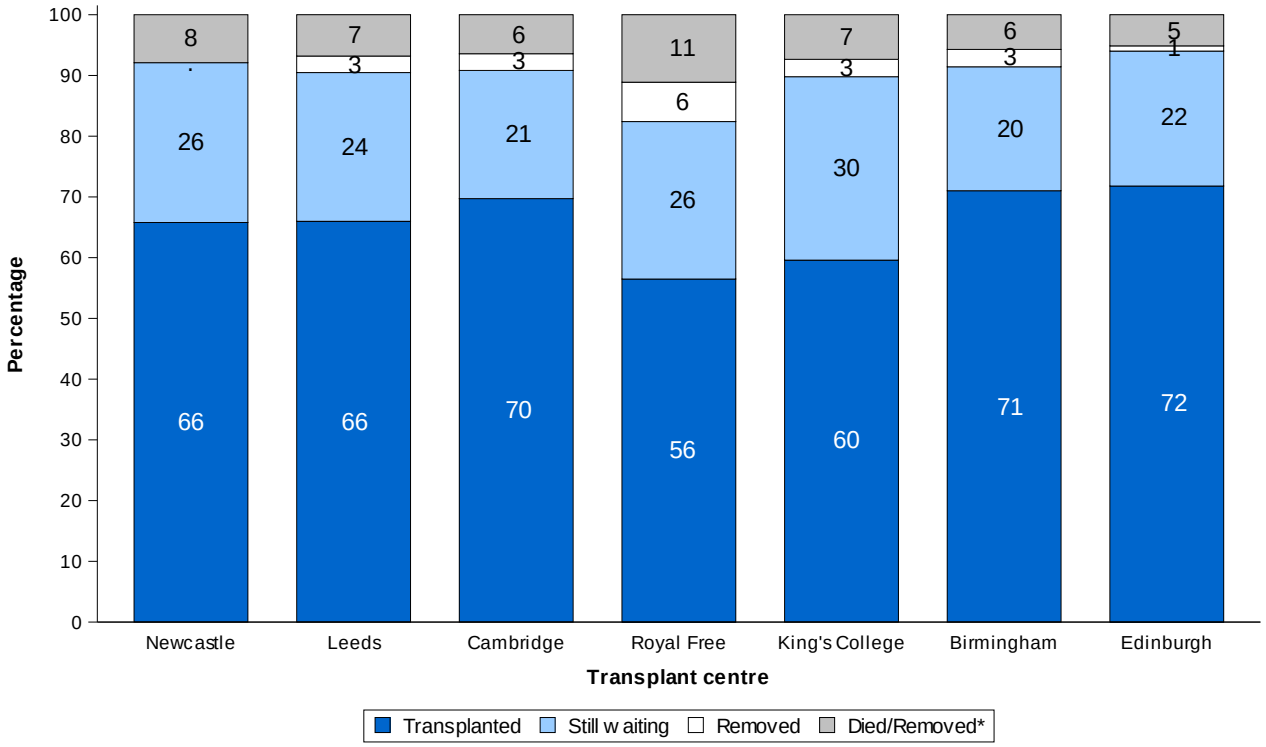
Figure 2.3 Post-registration outcome for 1009 new elective liver only registrations made in the UK, 1 April 2017 - 31 March 2018



***Removals due to condition deteriorating**

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 56% at The Royal Free to 72% at Edinburgh.

Figure 2.4 **Six month post-registration outcome for 1009 new elective liver only registrations made in the UK by centre, 1 April 2017 - 31 March 2018**



***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 170 in 2019/2020. The number of transplants from donors after brain death (DBD) has decreased in the most recent year to 753. There were 18 living donor liver transplants and 1 domino transplant performed in the last financial year.

Figure 2.5 Total number of liver transplants by donor type, 1 April 2010 - 31 March 2020

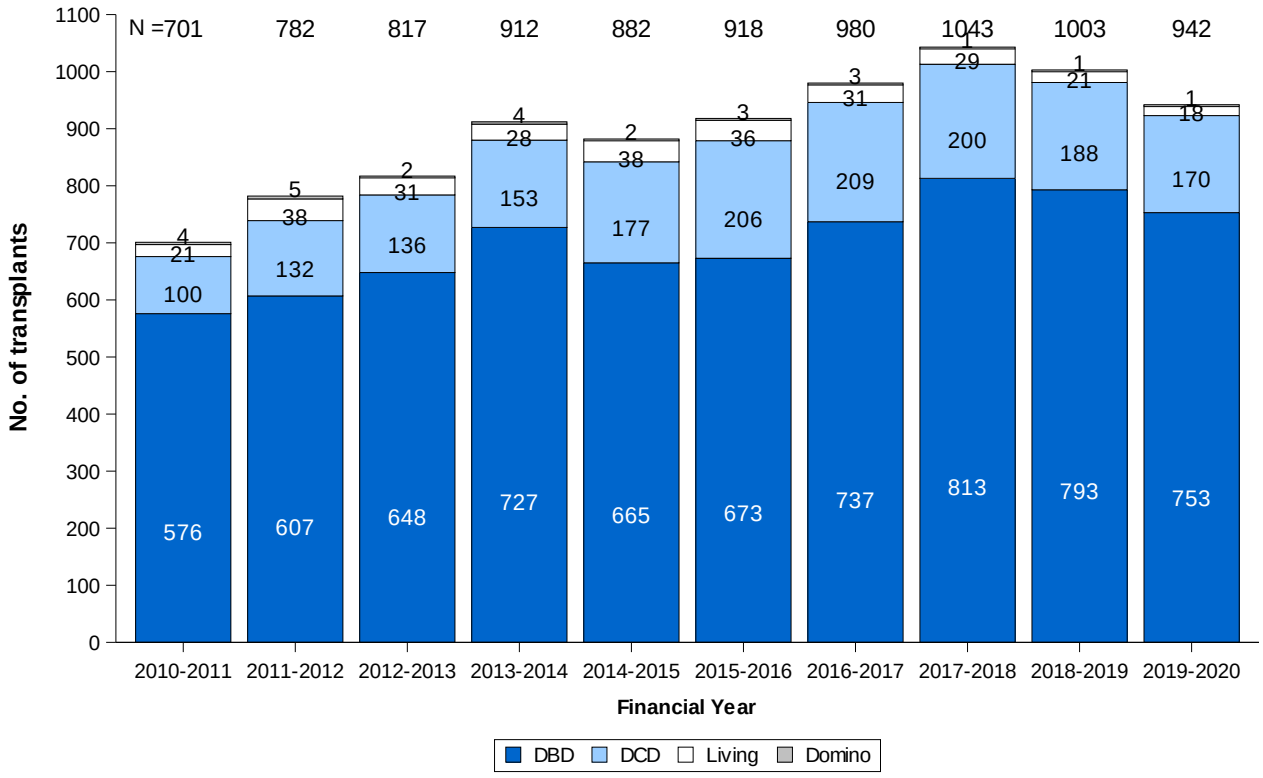


Figure 2.6 Total number of liver transplants by transplant centre and donor type, 1 April 2010 - 31 March 2020

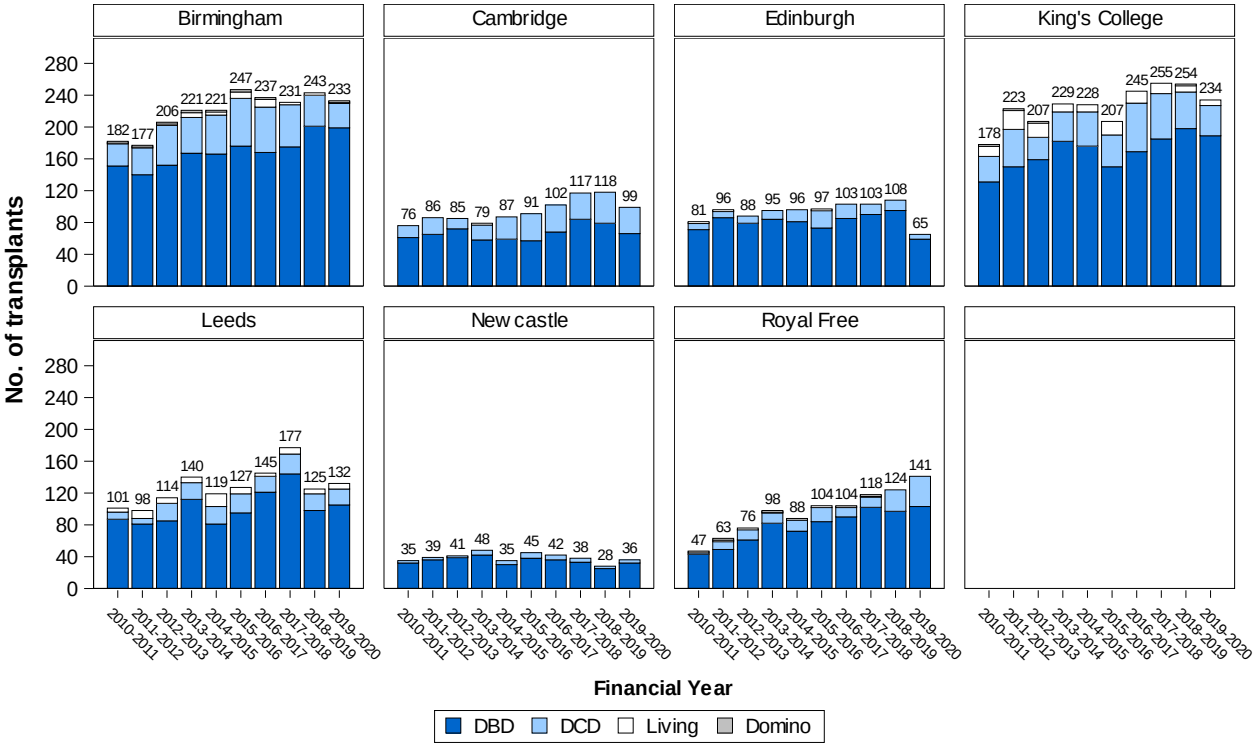
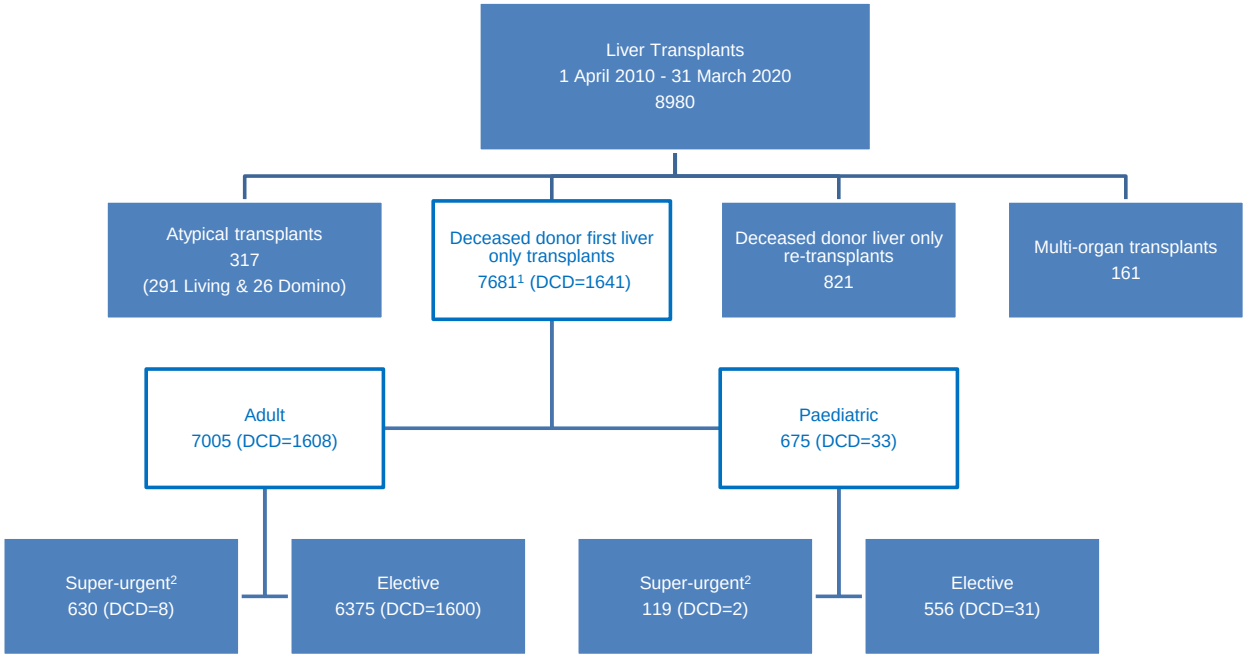


Figure 2.7 details the 8980 liver transplants performed in the UK in the ten year period. Of these, 7681 (86%) were deceased donor first liver only transplants. One transplant recipient refused consent for their data to be used in analysis and, therefore, could not be categorised as an adult or a paediatric patient. Of the 7680 transplants that had consent and were analysed, 7005 (91%) were performed in adult and 675 (9%) in paediatric patients. Similarly including both adult and paediatric, 6931 (90%) were elective and 749 (10%) were super-urgent transplants.

Figure 2.7 Liver transplants in the UK, 1 April 2010 – 31 March 2020



[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 86 performed in 2019/2020. During the last ten years,158 DBD and 3 DCD multi-organ transplants involving the liver were performed of which 13 were retransplants. Of the 158 multi-organ DBD transplants, 149 were simultaneous liver and kidney transplants (12 of which were retransplants), four were simultaneous liver and pancreas transplants (one of which was a retransplant), three 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 27 DCD retransplant liver only transplants and three simultaneous liver/kidney DCD transplants.

Figure 2.8 Total number of liver transplants by donor and transplant type, 1 April 2010 - 31 March 2020

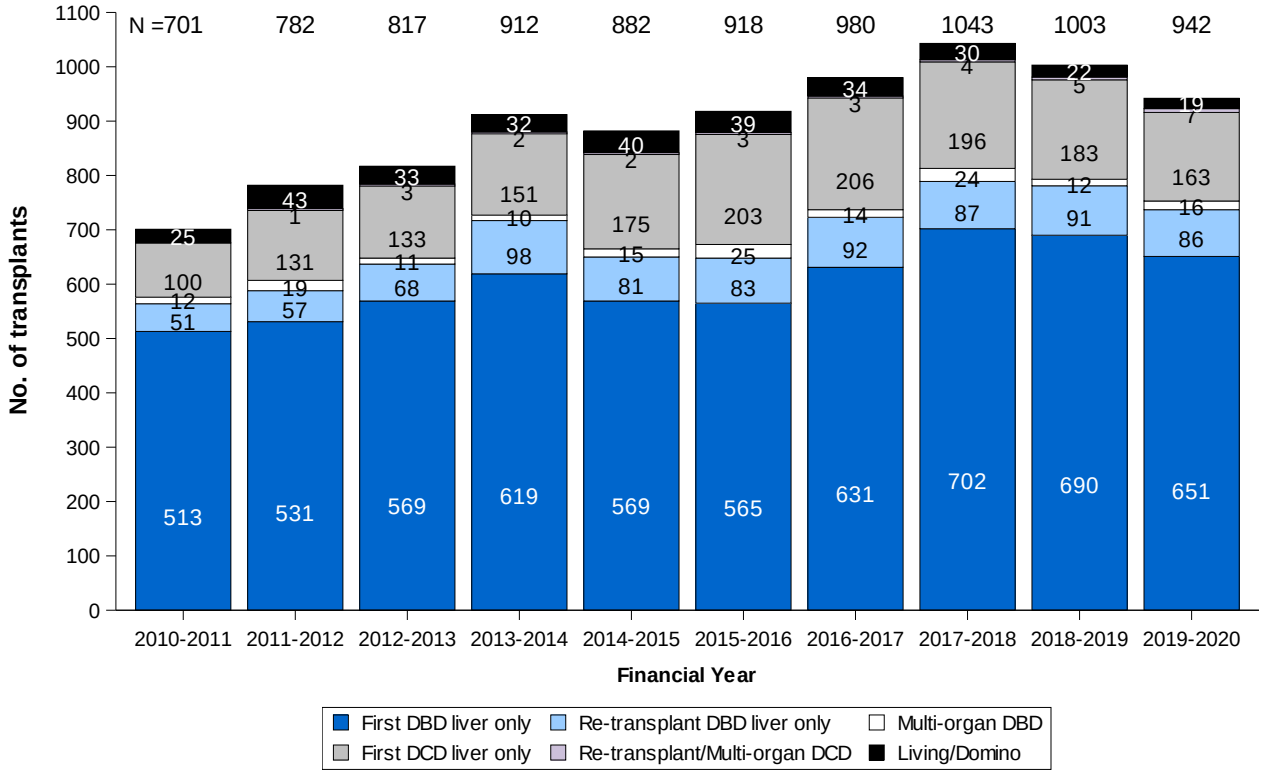
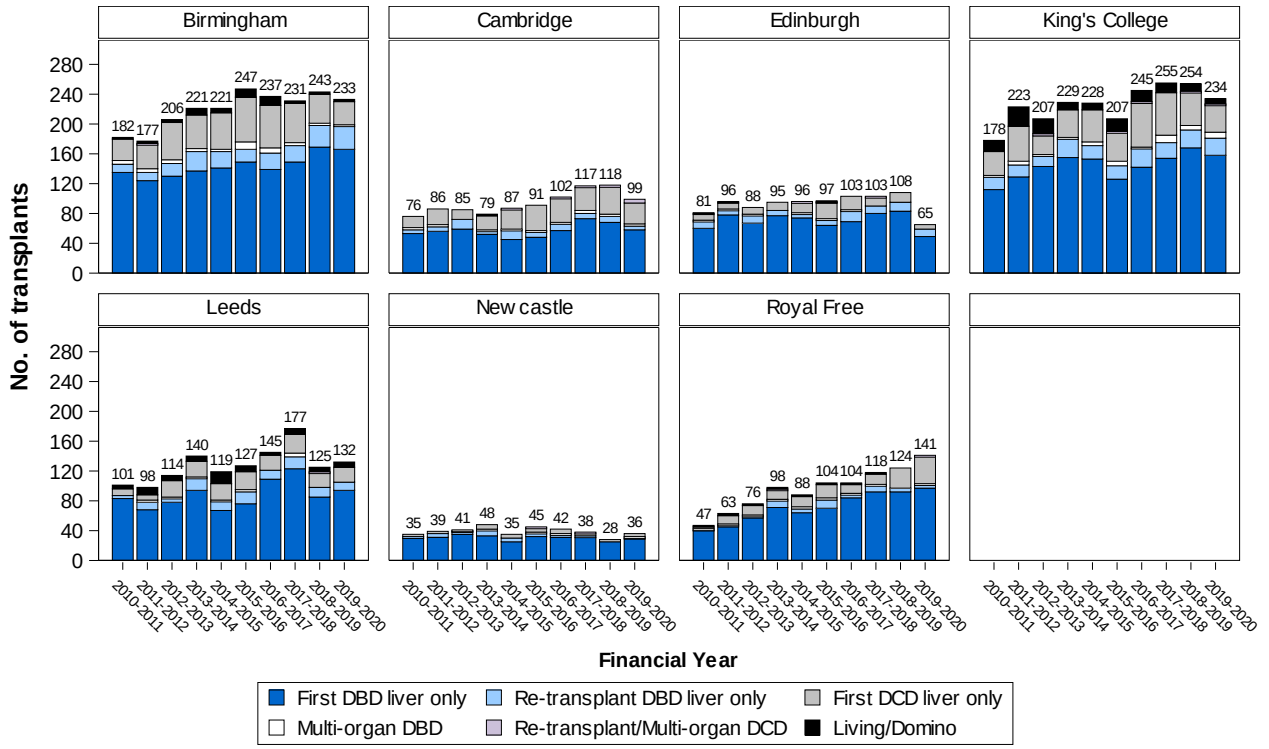


Figure 2.9 Total number of liver transplants by transplant centre, donor type and transplant type, 1 April 2010 - 31 March 2020



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 2019 and 31 March 2020 compared with liver transplant rates pmp for the same time period, by recipient country/NHS region of residence. **Table 2.1** shows the breakdown of these numbers by recipient country/NHS region of residence. No adjustments have been made for potential demographic differences in populations. If a patient has had more than one registration/transplant in the period, each registration/transplant is considered. Note that this analysis only considered NHS Group 1 patients.

Since there will inevitably be some random variation in rates between areas, the systematic component of variation (SCV) was used to identify if the variation is more (or less) than a random effect for the different NHS regions 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. Registration and transplant rates yielded an SCV of 0.004 (p-value = 0.101) and 0.0134 (p-value = 0.012), respectively. The p-value shows the probability that an SCV of this size (or higher) would be observed by chance if only random variation existed and therefore, no evidence of geographical variation for registrations beyond what would be expected at random and moderate evidence for transplants. No adjustment has been made for area-specific demographic characteristics that may impact the rates of registration to the transplant list and transplantation such as age and sex. Therefore, these results should be interpreted with caution.

Figure 2.10 **Comparison of liver registration rates (pmp) with transplant rates (pmp) by recipient country/NHS region of residence**

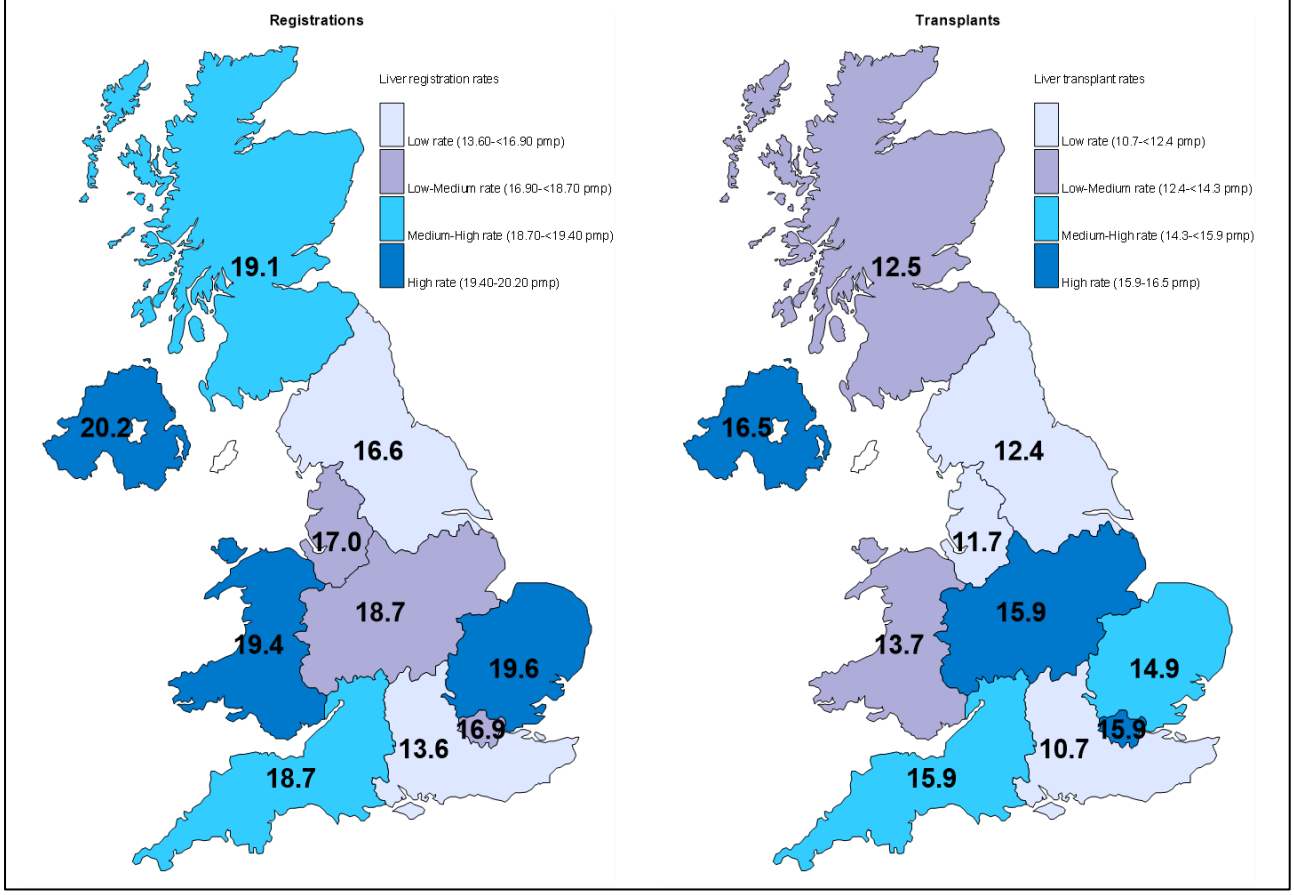


Table 2.1 Liver registration and transplant rates per million population (pmp) in the UK, 1 April 2019 - 31 March 2020, by Country/NHS region

Country/NHS region	Registrations	(pmp)	Transplants	(pmp)
North East and Yorkshire	142	(16.6)	106	(12.4)
North West	119	(17.0)	82	(11.7)
Midlands	197	(18.7)	168	(15.9)
East of England	127	(19.6)	97	(14.9)
London	151	(16.9)	142	(15.9)
South East	120	(13.6)	95	(10.7)
South West	105	(18.7)	89	(15.9)
England	**961**	**(17.2)**	**779**	**(13.9)**
Isle of Man	**5**	**(62.5)**	**3**	**(37.5)**
Channel Islands	**0**	**(0.0)**	**2**	**(12.5)**
Wales	**61**	**(19.4)**	**43**	**(13.7)**
Scotland	**104**	**(19.1)**	**68**	**(12.5)**
Northern Ireland	**38**	**(20.2)**	**31**	**(16.5)**
TOTAL	**1173[1]**	**(17.7)**	**930[2]**	**(14.0)**

[1] Registrations include 4 recipients whose postcode was unknown and excludes 7 recipients who reside in the Republic of Ireland and 3 recipients who reside overseas

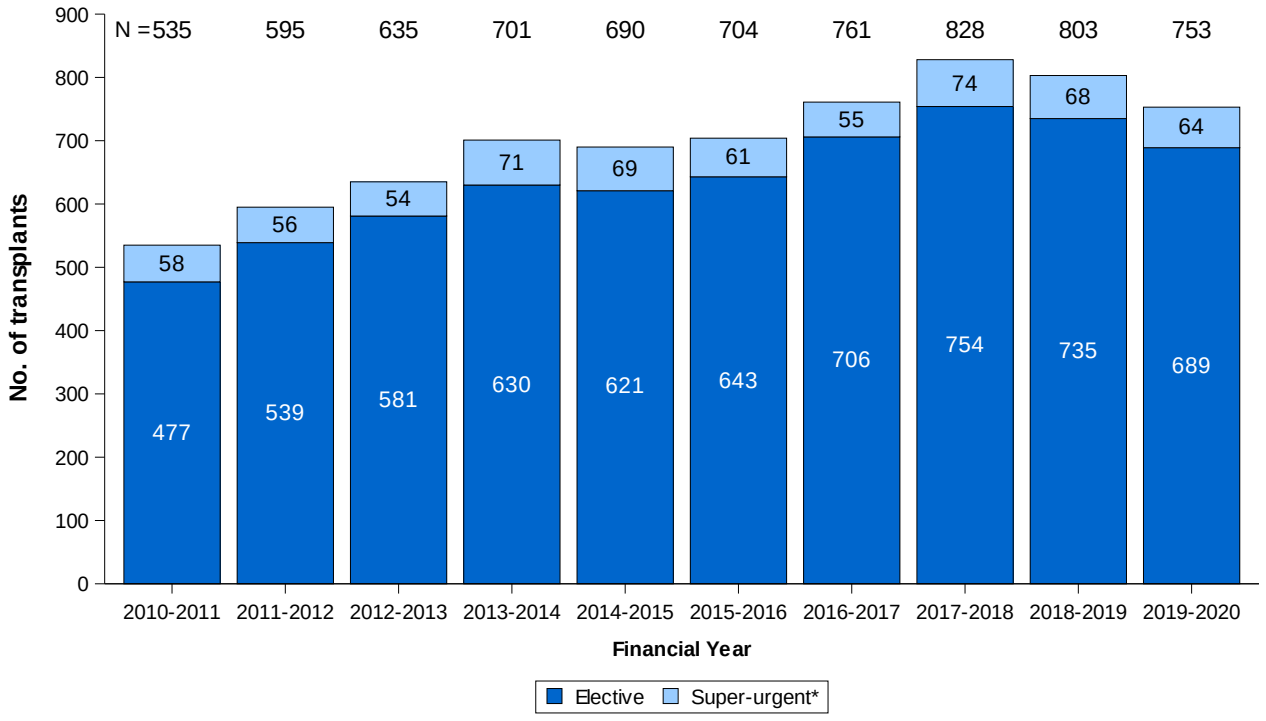
[2] Transplants include 4 recipients whose postcode was unknown and excludes 5 recipients who reside in the Republic of Ireland

Adult Liver Transplantation

3.1 Overview

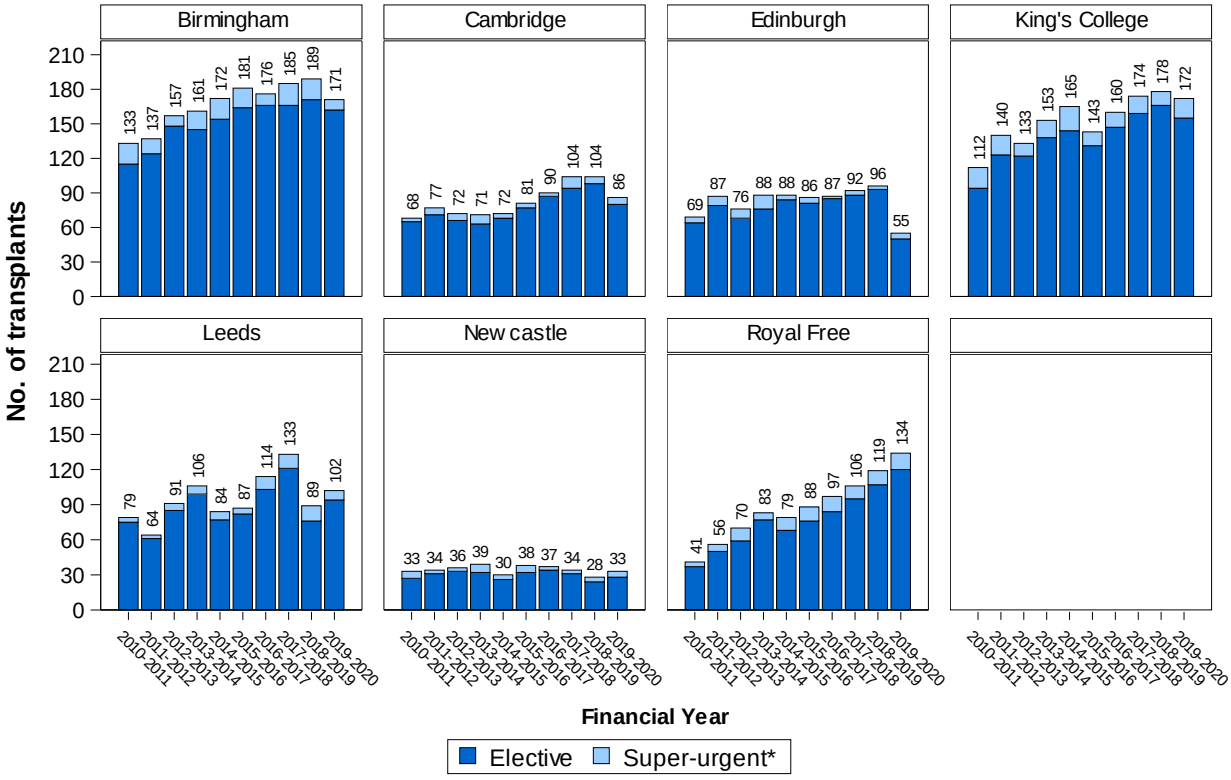
The number of adult deceased donor first liver only transplants in the last ten years is shown overall and by centre in **Figures 3.1 and 3.2**, respectively. Of the 753 transplants in the latest financial year, 689 (92%) were elective and 64 (8%) were super-urgent transplants. See **Appendix 1** for further details.

Figure 3.1 Deceased donor first liver only transplants in the UK in adult recipients 1 April 2010 - 31 March 2020



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

Figure 3.2 Deceased donor first liver only transplants in the UK in adult recipients, 1 April 2010 - 31 March 2020



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

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 8.7 hours in 2010/11 and 9.0 hours in 2019/20. Similarly, the national median for DCD donor transplants has remained relatively stable over the ten year period and was 7.0 hours in 2010/11 and 7.1 hours in 2019/20.

Figure 3.3 Boxplot of cold ischaemia time in all adult first deceased donor liver transplants, by donor type and financial year
1 April 2010 - 31 March 2020

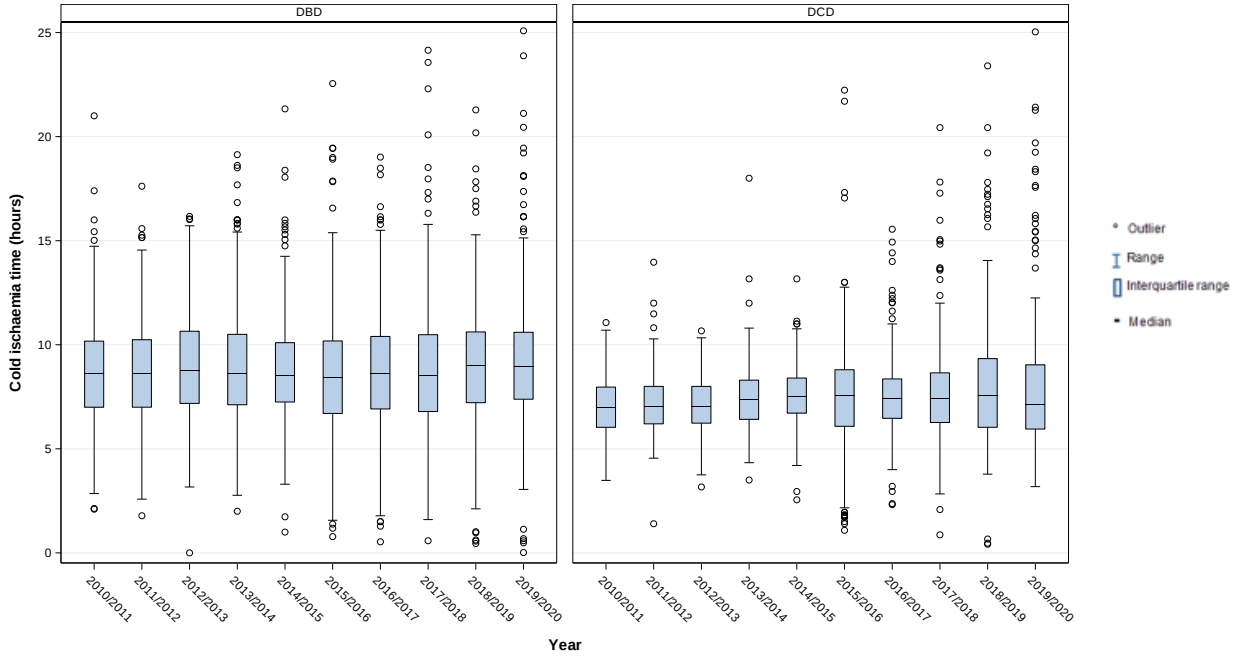


Figure 3.4 shows boxplots of cold ischaemia times (CIT) for adult transplant recipients by centre and donor type in the latest financial year (2019/2020) while **Figure 3.5** and **Figure 3.6** show the equivalent information by centre over the last ten financial years for DBD and DCD donors, respectively. The median CIT for DBD in the last financial year ranged between 8.1 and 11.2 hours across transplant centres whilst the median CIT for DCD ranged between 5.8 and 15.2 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. Eighty seven (12%) 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). This ranged from 2% of donors that were transplanted at Kings College to 34% of donors transplanted at the Royal Free for the centres who informed NHSBT.

Figure 3.4 **Boxplot of cold ischaemia time in all adult first deceased donor liver transplants, by donor type and transplant centre 1 April 2019 - 31 March 2020**

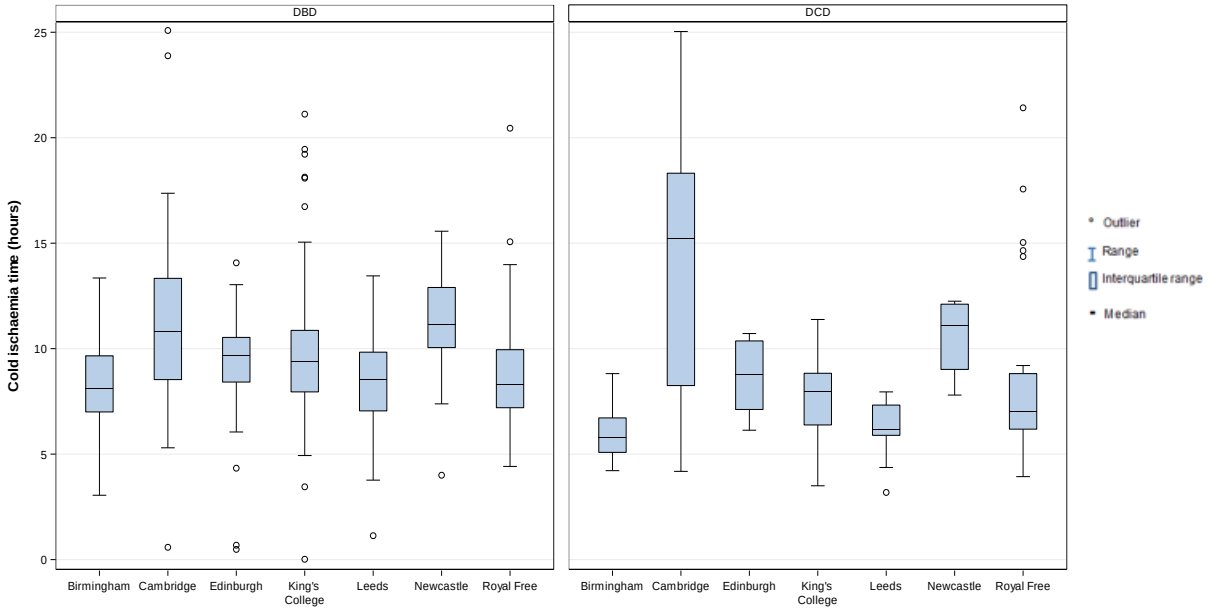


Figure 3.5 **Boxplot of cold ischaemia time in all adult first DBD donor liver transplants, 1 April 2010 - 31 March 2020**

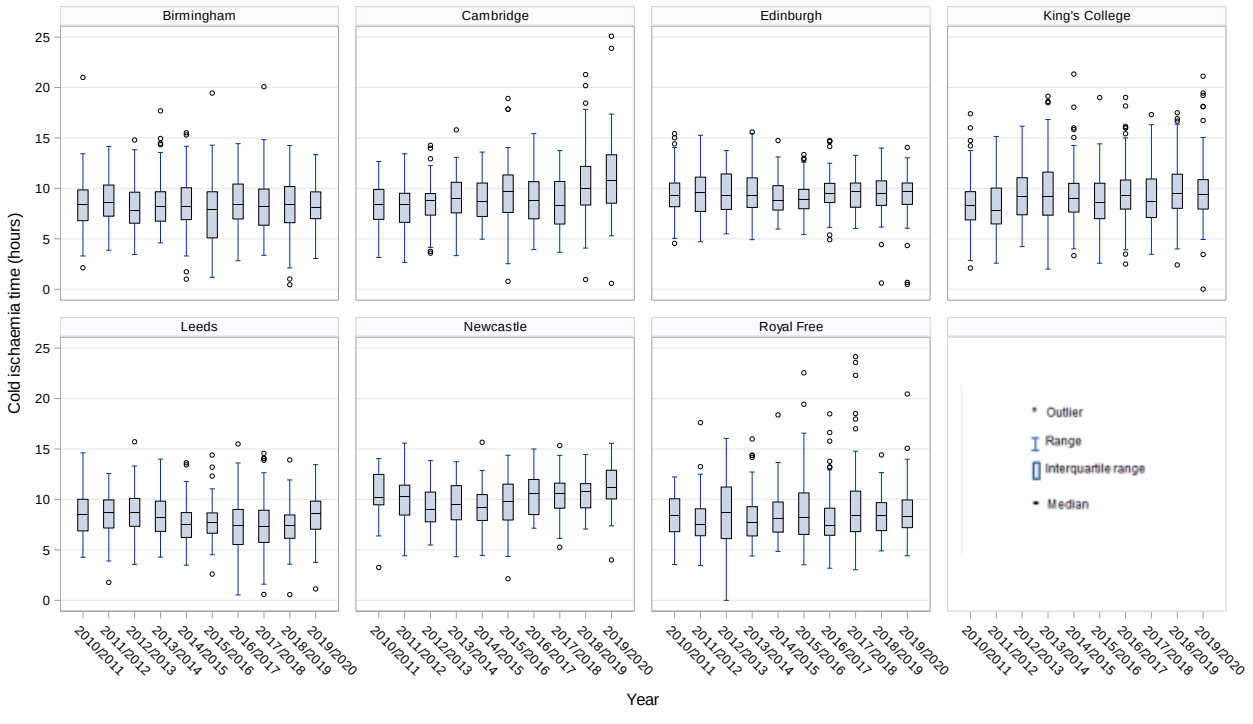
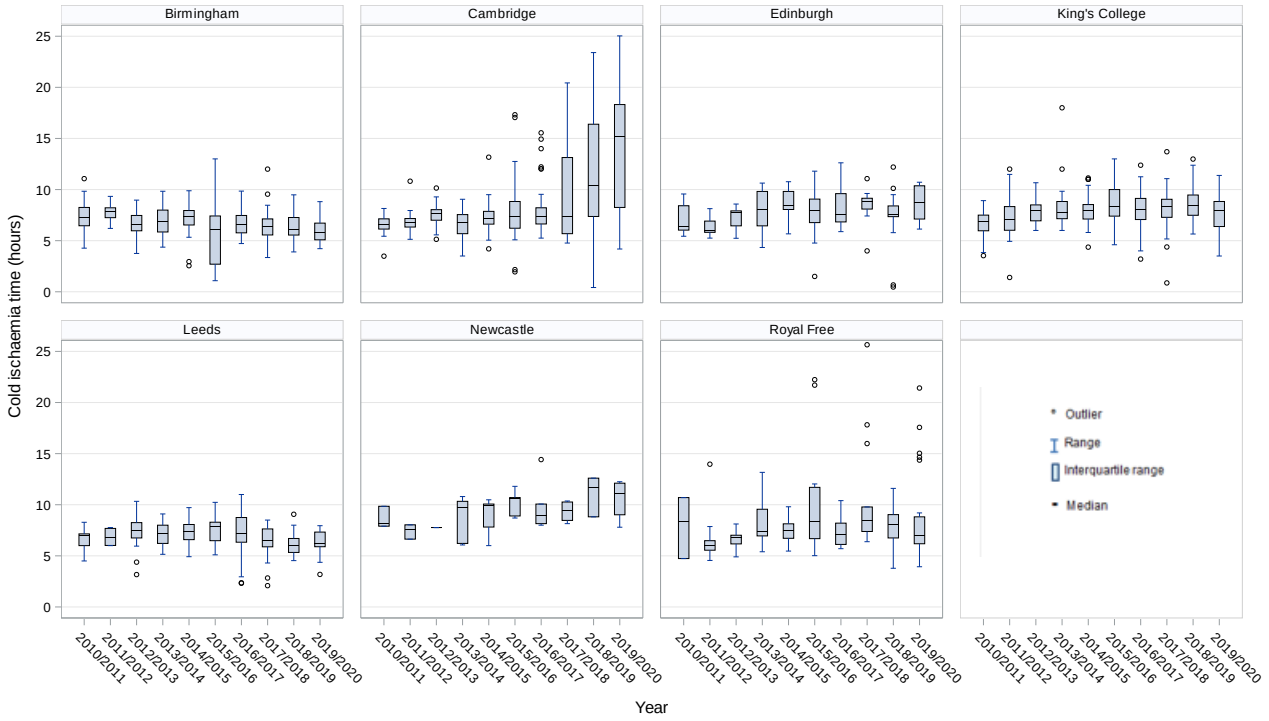


Figure 3.6 Boxplot of cold ischaemia time in all adult first DCD donor liver transplants, 1 April 2010 - 31 March 2020



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 2011 and 2019. The waiting list in 2020 is as at 29 February due to the Covid-19 pandemic affecting the numbers of active transplant registrations. The number of patients on the active liver only transplant list increased almost every year from 454 in 2011 to 514 in 2015. This reduced to 301 in 2018 and has increased to 389 active patients in 2020. The number of patients suspended on the transplant list has increased from 86 in 2018 to 97 in 2020.

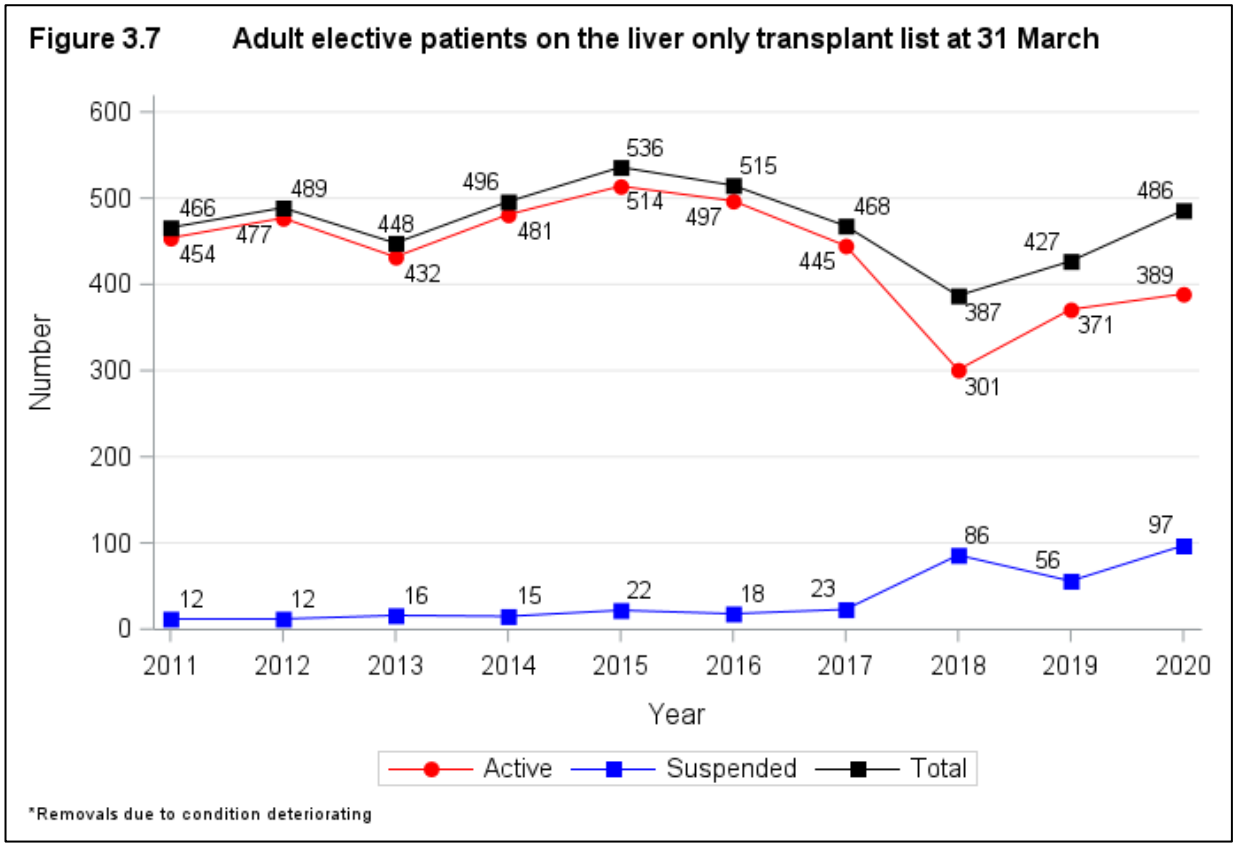
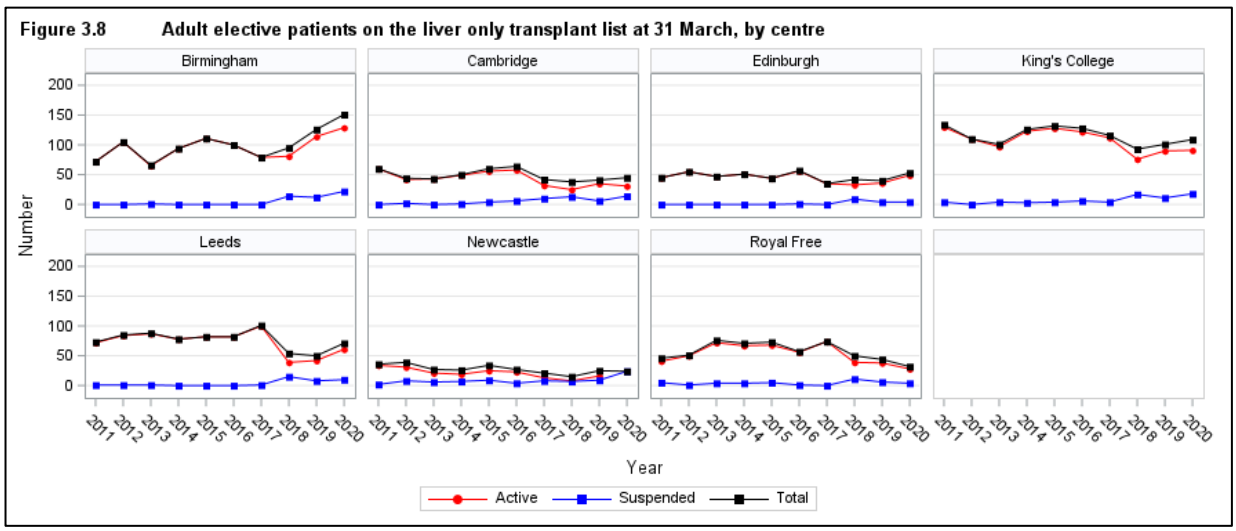
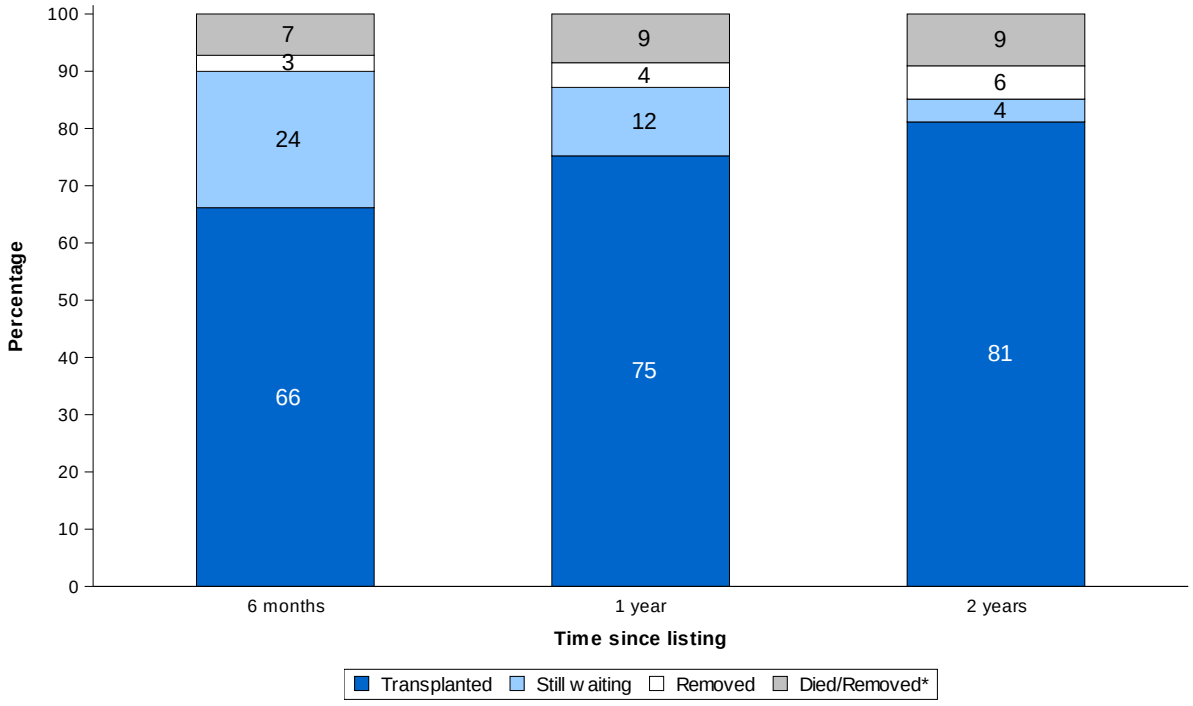


Figure 3.8 shows the number of adult patients on the transplant list at 31 March each year between 2011 and 2019, by transplant centre. The waiting list in 2020 is as at 29 February.



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.

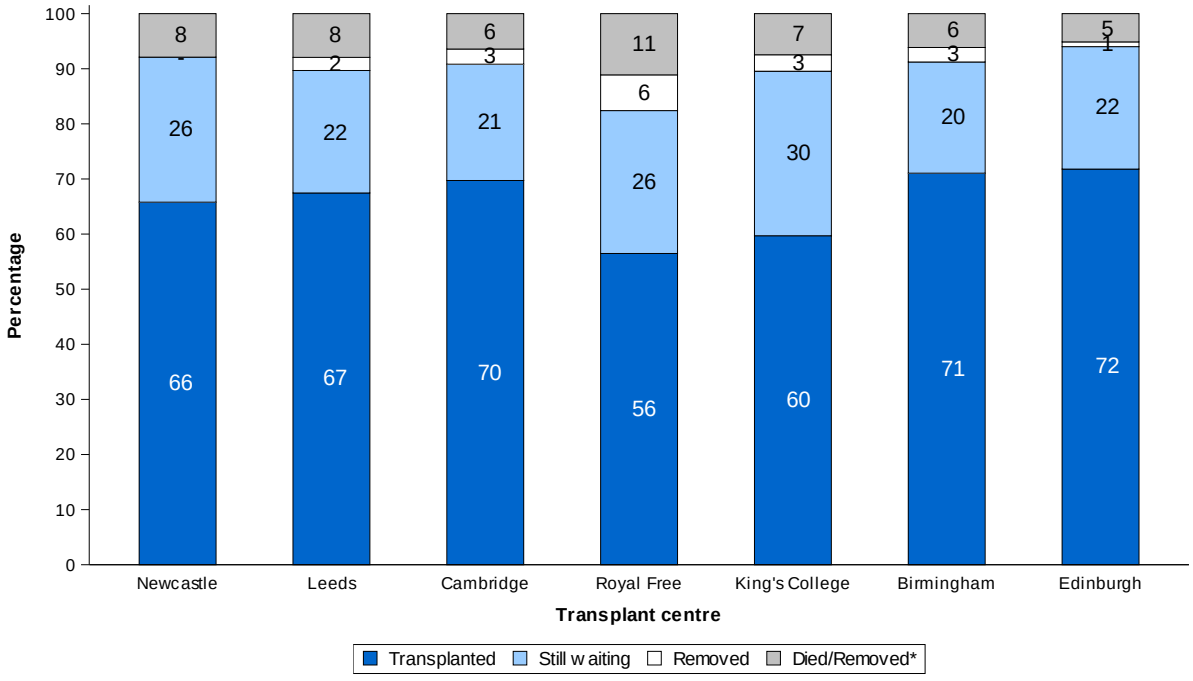
Figure 3.9 **Post-registration outcome for 928 new elective adult liver only registrations made in the UK, 1 April 2017 - 31 March 2018**



***Removals due to condition deteriorating**

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 56% at The Royal Free to 72% at Edinburgh.

Figure 3.10 **Six month post-registration outcome for 928 new elective adult liver only registrations made in the UK by centre, 1 April 2017 - 31 March 2018**



*Removals due to condition deteriorating

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 65 days. The median waiting time to transplant is shorter at Edinburgh (40 days) and longer at Newcastle (114 days), compared to the national median waiting time.

Note that these waiting times are not adjusted to account for the patient case-mix at centres.

Table 3.1 **Median waiting time to liver only transplant in the UK, for adult elective patients registered 1 April 2018 - 31 March 2019**

Transplant centre	Number of patients registered	Waiting time (days) Median	95% Confidence interval
Adult			
Edinburgh	105	40	17 - 63
Royal Free	134	55	39 - 71
Cambridge	122	57	36 - 78
Leeds	102	73	34 - 112
Birmingham	255	77	53 - 101
King's College	218	79	53 - 105
Newcastle	40	114	70 - 158
UK	**976**	**65**	**54 - 76**

Table 3.2 shows the demographics of 979 adult elective liver patients registered from 1 April 2019 to 31 March 2020, by transplant centre. The majority of patients that were registered were male (61%), white (84%) with a median age of 56 and a median BMI of 27. The most common indication for registration was alcoholic liver disease, followed by cancer. For some characteristics, due to rounding, percentages may not add up to 100.

Table 3.2 Demographic characteristics of adult elective liver patients registered from 1 April 2019 - 31 March 2020

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's college N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	Total N (%)
Number		244	114	84	218	142	44	133	**979**
Recipient sex	Male	155 (64)	67 (59)	47 (56)	123 (56)	89 (63)	30 (68)	82 (62)	**593 (61)**
	Female	89 (36)	47 (41)	37 (44)	95 (44)	53 (37)	14 (32)	51 (38)	**386 (39)**
Recipient ethnicity	White	188 (77)	106 (93)	81 (96)	172 (79)	126 (89)	42 (95)	109 (82)	**824 (84)**
	Non-white	19 (8)	8 (7)	3 (4)	46 (21)	16 (11)	2 (5)	24 (18)	**118 (12)**
	Not reported	37 (15)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**37 (4)**
Indication	Cancer	40 (16)	17 (15)	19 (23)	25 (11)	35 (25)	10 (23)	37 (28)	**183 (19)**
	Hepatitis C	3 (1)	1 (1)	3 (4)	10 (5)	4 (3)	0 (0)	1 (1)	**22 (2)**
	Alcoholic liver disease	59 (24)	38 (33)	14 (17)	47 (22)	44 (31)	11 (25)	36 (27)	**249 (25)**
	Hepatitis B	4 (2)	1 (1)	0 (0)	1 (0)	0 (0)	0 (0)	4 (3)	**10 (1)**
	Primary sclerosing cholangitis	25 (10)	10 (9)	14 (17)	30 (14)	8 (6)	3 (7)	18 (14)	**108 (11)**
	Autoimmune and cryptogenic disease	14 (6)	2 (2)	2 (2)	25 (11)	15 (11)	2 (5)	7 (5)	**67 (7)**
	Primary biliary cholangitis	19 (8)	11 (10)	9 (11)	13 (6)	8 (6)	5 (11)	6 (5)	**71 (7)**
	Metabolic liver disease	33 (14)	22 (19)	10 (12)	18 (8)	21 (15)	6 (14)	12 (9)	**122 (12)**
	Other	29 (12)	9 (8)	7 (8)	33 (15)	3 (2)	5 (11)	11 (8)	**97 (10)**
	Acute hepatic failure	4 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**4 (0)**
	Regraft	14 (6)	3 (3)	6 (7)	16 (7)	4 (3)	2 (5)	1 (1)	**46 (5)**
Recipient HCV	No	236 (97)	106 (93)	76 (90)	200 (92)	129 (91)	44 (100)	113 (85)	**904 (92)**
	Yes	8 (3)	8 (7)	8 (10)	18 (8)	13 (9)	0 (0)	20 (15)	**75 (8)**
Encephalopathy	Absence	159 (65)	57 (50)	76 (90)	148 (68)	71 (50)	33 (75)	95 (71)	**639 (65)**
	Presence	85 (35)	57 (50)	8 (10)	70 (32)	71 (50)	11 (25)	38 (29)	**340 (35)**
Renal support	No	239 (98)	112 (98)	84 (100)	209 (96)	140 (99)	41 (93)	130 (98)	**955 (98)**
	Yes	5 (2)	2 (2)	0 (0)	9 (4)	2 (1)	3 (7)	3 (2)	**24 (2)**
Previous abdominal surgery	No	181 (74)	95 (83)	57 (68)	148 (68)	114 (80)	38 (86)	101 (76)	**734 (75)**
	Yes	63 (26)	19 (17)	27 (32)	70 (32)	28 (20)	6 (14)	32 (24)	**245 (25)**
Recip age (years)	Median (IQR)	55 (42, 62)	58 (51, 63)	56 (50, 63)	53 (43, 61)	57 (47, 62)	59 (51, 66)	56 (49, 62)	**56 (47, 62)**
BMI (kg/m2)	Median (IQR)	27 (24, 31)	28 (25, 32)	28 (24, 33)	26 (23, 30)	28 (24, 31)	27 (25, 31)	26 (24, 30)	**27 (24, 31)**

Table 3.2 Demographic characteristics of adult elective liver patients registered from 1 April 2019 - 31 March 2020

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's college N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	Total N (%)
Serum bilirubin (umol/l)	Median (IQR)	39 (21, 83)	45 (25, 88)	51 (24, 96)	37 (17, 82)	49 (27, 90)	46 (29, 91)	42 (24, 82)	**43 (22, 87)**
Serum creatinine (umol/l)	Median (IQR)	71 (58, 90)	64 (52, 76)	68 (62, 83)	70 (58, 93)	68 (57, 92)	74 (57, 98)	78 (68, 94)	**71 (58, 90)**
Serum sodium (mmol/l)	Median (IQR)	137 (134, 139)	136 (132, 138)	138 (135, 139)	137 (134, 140)	138 (135, 140)	138 (135, 140)	137 (135, 140)	**137 (134, 139)**
Serum potassium (mmol/l)	Median (IQR)	4 (4, 5)	4 (4, 4)	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, 1)	1 (1, 2)	1 (1, 2)	1 (1, 2)	1 (1, 1)	**1 (1, 2)**
Serum albumin (g/l)	Median (IQR)	32 (28, 38)	29 (24, 32)	27 (24, 32)	34 (30, 38)	30 (26, 34)	34 (31, 37)	35 (31, 38)	**32 (27, 36)**

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**.

Figure 3.11 Named adult elective liver offer decline rates that resulted in a liver only first transplant from DBD donors, 1 April 2018 and 31 March 2020

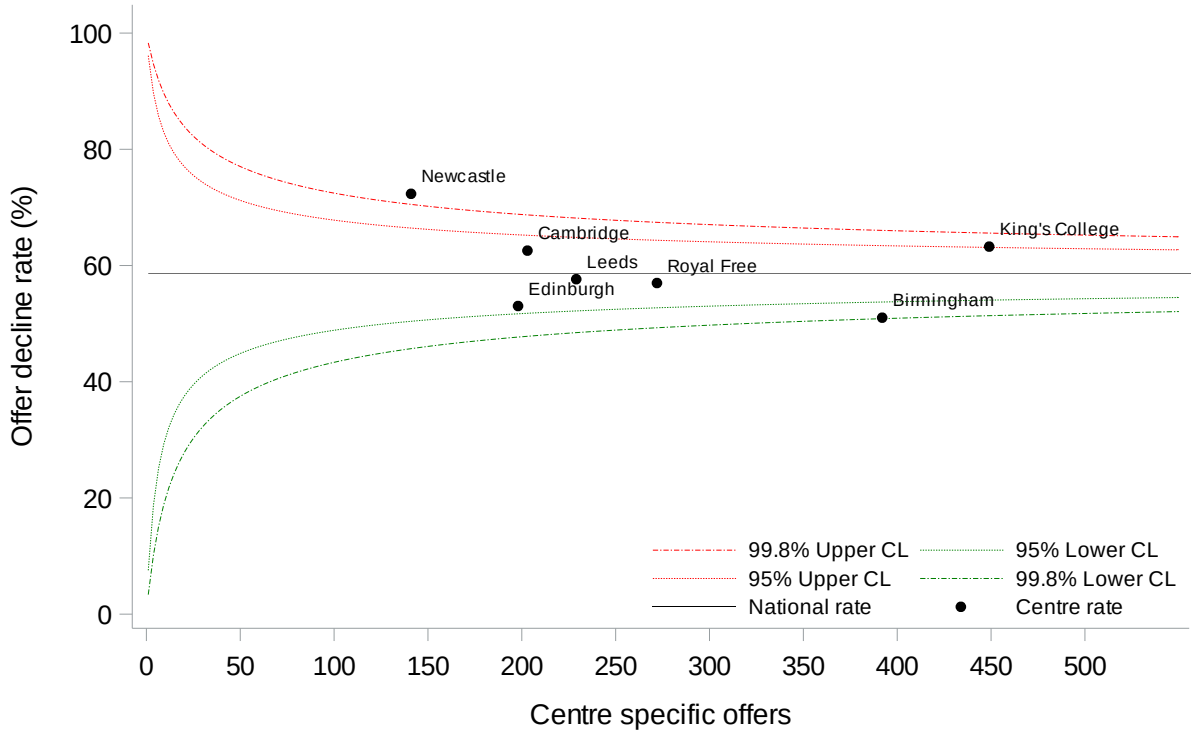


Figure 3.12 **Adult elective liver offer decline rates that resulted in a liver only first transplant from DCD donors, 1 April 2018 and 31 March 2020**

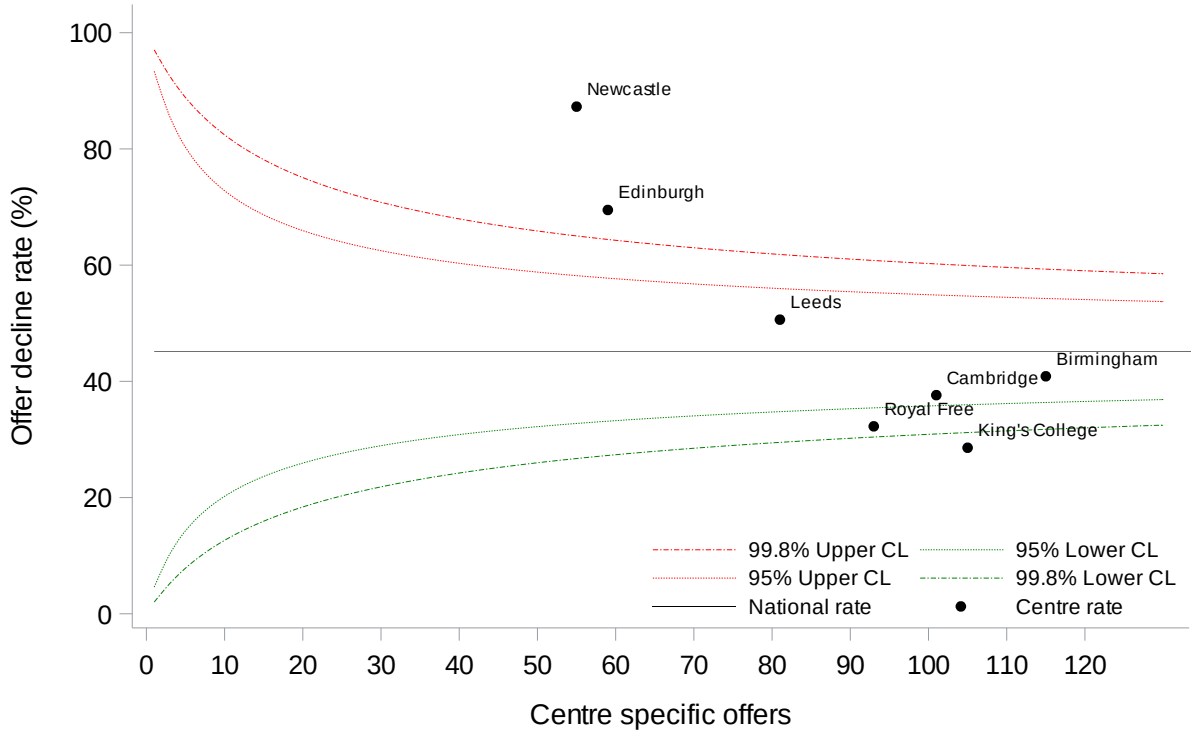


Table 3.3 **Offer decline rates for each centre by offered organ and donor type 1 April 2018 and 31 March 2020**

Centre	DBD Donors Whole Livers		DBD Donors Right Lobe		DBD Donors All Livers		DCD Donors Whole Livers	
	Offers	% Decline	Offers	% Decline	Offers	% Decline	Offers	% Decline
A. All donors								
Birmingham	354	49	38	74	392	51	115	41
Cambridge	171	58	32	84	203	63	101	38
Edinburgh	157	43	41	90	198	53	59	69
King's College	390	63	59	68	449	63	105	29
Leeds	192	52	37	89	229	58	81	51
Newcastle	116	66	25	100	141	72	55	87
Royal Free	232	53	40	78	272	57	93	32
Total	**1612**	**55**	**272**	**81**	**1884**	**59**	**609**	**45**
B. DBD donors≤65 years and DCD≤60 years								
Birmingham	239	44	38	74	277	48	82	49
Cambridge	115	46	32	84	147	54	80	40
Edinburgh	103	40	41	90	144	54	41	61
King's College	251	61	59	68	310	62	63	30
Leeds	136	44	37	89	173	54	63	38
Newcastle	67	63	25	100	92	73	38	82
Royal Free	153	44	40	78	193	51	65	28
Total	**1064**	**49**	**272**	**81**	**1336**	**56**	**432**	**44**

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**.

Only Leeds, Royal Free and Newcastle observed an increase in the number of adult elective first liver only transplants performed in 2019/2020 compared with 2018/2019.

Figure 3.13 Adult elective liver only transplants by donor type, 1 April 2010 - 31 March 2020

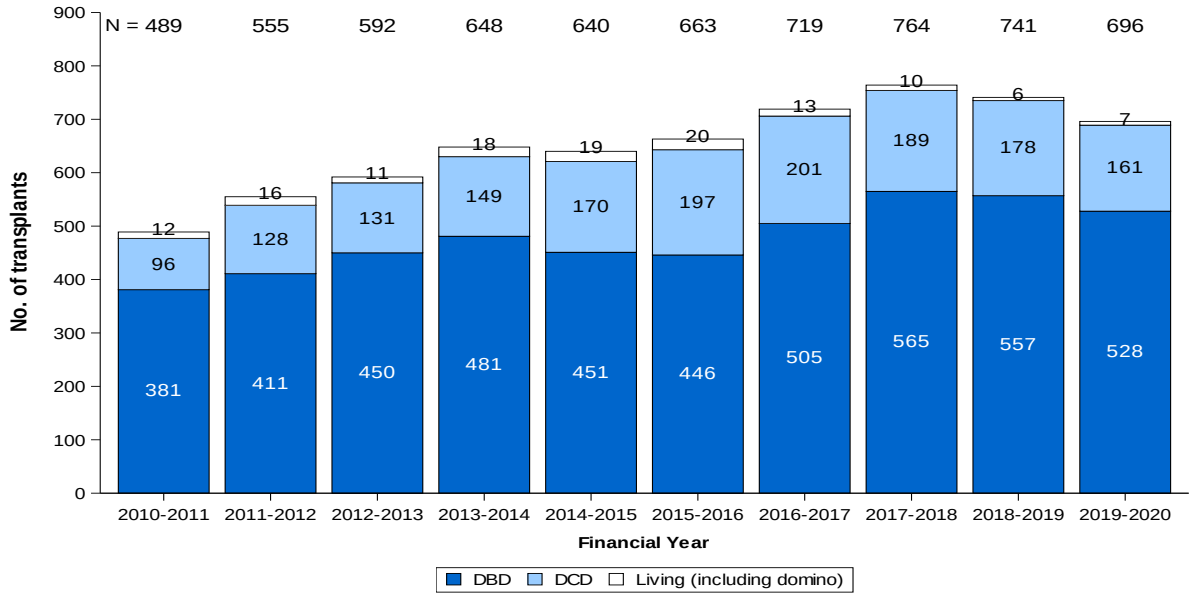
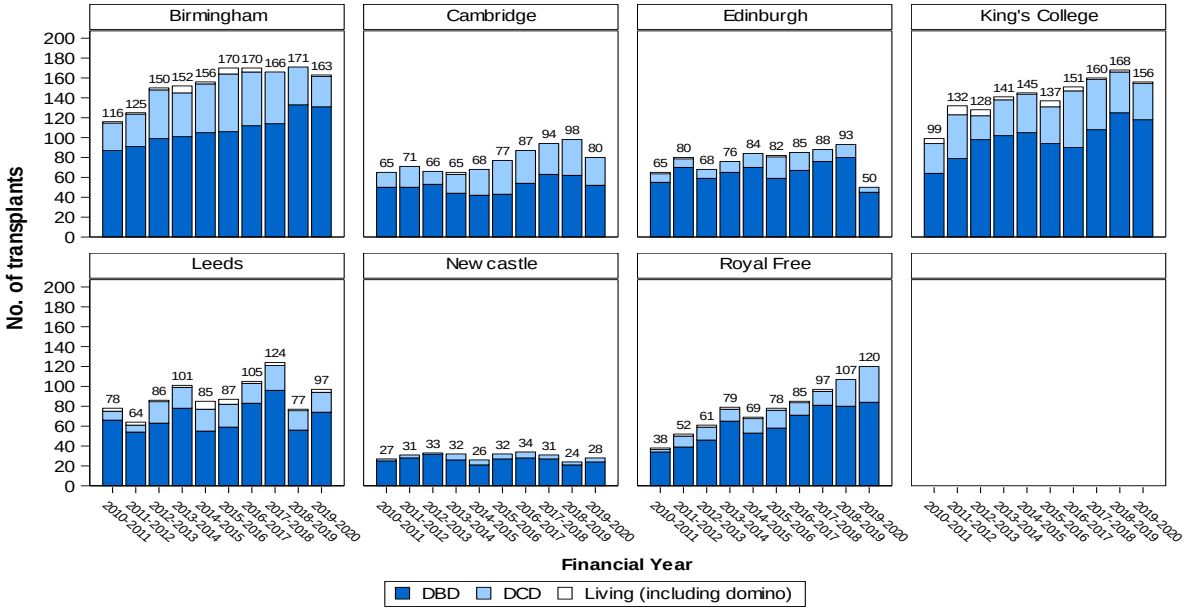


Figure 3.14 Adult elective liver only transplants by donor type and centre, 1 April 2010 - 31 March 2020



*Excludes 16 and 5 living liver transplants at London Bridge Hospital and Cromwell Hospital, respectively

The demographic characteristics of 689 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 (77%) 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 2019 - 31 March 2020

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	**TOTAL N (%)**
Number		162	80	50	155	94	28	120	**689 (100)**
Recipient sex	Male	99 (61)	50 (63)	33 (66)	85 (55)	57 (61)	21 (75)	78 (65)	**423 (61)**
	Female	63 (39)	30 (38)	17 (34)	70 (45)	37 (39)	7 (25)	42 (35)	**266 (39)**
Recipient ethnicity	White	137 (85)	78 (98)	48 (96)	129 (83)	84 (89)	28 (100)	95 (79)	**599 (87)**
	Non-white	14 (9)	2 (3)	2 (4)	26 (17)	10 (11)	0	25 (21)	**79 (12)**
	Not reported	11 (7)	0	0	0	0	0	0	**11 (2)**
Indication	Cancer	29 (18)	7 (9)	10 (20)	21 (14)	26 (28)	5 (18)	38 (32)	**136 (20)**
	Hepatitis C	1 (1)	1 (1)	5 (10)	9 (6)	2 (2)	0	3 (3)	**21 (3)**
	Alcoholic liver disease	38 (23)	29 (36)	11 (22)	33 (21)	29 (31)	8 (29)	34 (28)	**182 (26)**
	Hepatitis B	2 (1)	0	0	2 (1)	0	0	4 (3)	**8 (1)**
	Primary sclerosing cholangitis	20 (12)	6 (8)	8 (16)	27 (17)	3 (3)	2 (7)	16 (13)	**82 (12)**
	Primary biliary cholangitis	18 (11)	9 (11)	2 (4)	17 (11)	9 (10)	5 (18)	4 (3)	**64 (9)**
	Autoimmune and cryptogenic disease	15 (9)	2 (3)	3 (6)	14 (9)	10 (11)	3 (11)	6 (5)	**53 (8)**
	Metabolic	24 (15)	21 (26)	8 (16)	17 (11)	14 (15)	5 (18)	11 (9)	**100 (15)**
	Other	13 (8)	5 (6)	3 (6)	15 (10)	1 (1)	0	4 (3)	**41 (6)**
	Acute Hepatic failure	2 (1)	0	0	0	0	0	0	**2 (0)**
Recipient HCV status	Negative	154 (95)	68 (85)	42 (84)	139 (90)	85 (90)	28 (100)	103 (86)	**619 (90)**
	Positive	8 (5)	7 (9)	6 (12)	15 (10)	9 (10)	0	14 (12)	**59 (9)**
	Not reported	0	5 (6)	2 (4)	1 (1)	0	0	3 (3)	**11 (2)**

Table 3.4 Demographic characteristics of adult elective first deceased donor liver only transplant recipients, 1 April 2019 - 31 March 2020

		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	155 (96)	65 (81)	43 (86)	135 (87)	83 (88)	27 (96)	112 (93)	**620 (90)**
	In-patient	7 (4)	15 (19)	7 (14)	20 (13)	11 (12)	1 (4)	5 (4)	**66 (10)**
	Not reported	0	0	0	0	0	0	3 (3)	**3 (0)**
Ascites	Absence	92 (57)	22 (28)	23 (46)	56 (36)	45 (48)	20 (71)	68 (57)	**326 (47)**
	Presence	70 (43)	58 (73)	27 (54)	99 (64)	49 (52)	8 (29)	52 (43)	**363 (53)**
Encephalopathy	Absence	132 (81)	35 (44)	36 (72)	104 (67)	49 (52)	18 (64)	86 (72)	**460 (67)**
	Presence	28 (17)	45 (56)	14 (28)	51 (33)	45 (48)	10 (36)	34 (28)	**227 (33)**
	Not reported	2 (1)	0	0	0	0	0	0	**2 (0)**
Pre-transplant renal support	No	157 (97)	80 (100)	49 (98)	146 (94)	92 (98)	25 (89)	110 (92)	**659 (96)**
	Yes	5 (3)	0	1 (2)	9 (6)	1 (1)	3 (11)	10 (8)	**29 (4)**
	Not reported	0	0	0	0	1 (1)	0	0	**1 (0)**
Previous abdominal surgery	No	142 (88)	70 (88)	43 (86)	122 (79)	83 (88)	28 (100)	97 (81)	**585 (85)**
	Yes	20 (12)	10 (13)	7 (14)	33 (21)	11 (12)	0	23 (19)	**104 (15)**
Varices & shunt	Absence	62 (38)	13 (16)	10 (20)	25 (16)	45 (48)	9 (32)	33 (28)	**197 (29)**
	Presence without treatment	95 (59)	60 (75)	38 (76)	127 (82)	47 (50)	19 (68)	78 (65)	**464 (67)**
	Presence with surgical shunt	0	2 (3)	0	0	0	0	0	**2 (0)**
	Presence with TIPS	4 (2)	4 (5)	1 (2)	3 (2)	1 (1)	0	9 (8)	**22 (3)**
	Not reported	1 (1)	1 (1)	1 (2)	0	1 (1)	0	0	**4 (1)**
Life style activity	Normal	14 (9)	11 (14)	12 (24)	2 (1)	6 (6)	2 (7)	54 (45)	**101 (15)**
	Restricted	32 (20)	19 (24)	17 (34)	54 (35)	22 (23)	12 (43)	44 (37)	**200 (29)**
	Self-care	107 (66)	42 (53)	17 (34)	81 (52)	61 (65)	12 (43)	17 (14)	**337 (49)**
	Confined	8 (5)	7 (9)	4 (8)	12 (8)	5 (5)	2 (7)	1 (1)	**39 (6)**
	Reliant	1 (1)	1 (1)	0	6 (4)	0	0	1 (1)	**9 (1)**
	Not reported	0	0	0	0	0	0	3 (3)	**3 (0)**
Graft appearance	Normal	142 (88)	62 (78)	48 (96)	148 (95)	74 (79)	24 (86)	85 (71)	**583 (85)**
	Abnormal	20 (12)	18 (23)	2 (4)	7 (5)	20 (21)	4 (14)	35 (29)	**106 (15)**

Table 3.4 Demographic characteristics of adult elective first deceased donor liver only transplant recipients, 1 April 2019 - 31 March 2020

		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 (48,64)	57 (51,63)	56 (51,61)	54 (46,63)	58 (53,63)	62 (57,67)	57 (51,64)	**57 (50,63)**
BMI kg/m2	Median (IQR)	27 (24,31)	29 (25,32)	28 (25,33)	26 (23,30)	28 (24,31)	28 (25,32)	26 (23,30)	**27 (24,31)**
Serum bilirubin umol/l	Median (IQR)	43 (22,101)	51 (27,101)	52 (22,140)	43 (20,80)	47 (23,79)	46 (22,104)	41 (20,80)	**45 (21,95)**
	Not reported	1	0	0	0	0	0	0	**1**
Serum creatinine umol/l	Median (IQR)	71 (61,88)	64 (54,82)	75 (65,96)	67 (56,89)	66 (54,86)	72 (59,87)	80 (68,95)	**72 (59,89)**
	Not reported	1	0	0	1	2	0	4	**8**
Serum sodium mmol/l	Median (IQR)	137 (134,140)	135 (132,138)	136 (133,139)	136 (133,139)	137 (134,140)	138 (135,140)	137 (135,140)	**137 (134,139)**
	Not reported	1	0	0	0	0	0	0	**1**
Serum potassium mmol/l	Median (IQR)	4.1 (3.8,4.5)	4.1 (3.8,4.5)	4.3 (3.8,4.5)	4.1 (3.8,4.5)	4.1 (3.8,4.5)	4.2 (4.0,4.7)	4.1 (3.9,4.5)	**4.1 (3.8,4.5)**
	Not reported	7	0	0	0	0	0	0	**7**
INR	Median (IQR)	1.3 (1.1,1.5)	1.6 (1.2,1.8)	1.3 (1.1,1.6)	1.4 (1.2,1.9)	1.5 (1.2,1.7)	1.3 (1.3,1.6)	1.3 (1.2,1.4)	**1.3 (1.2,1.6)**
	Not reported	1	64	0	2	2	1	3	**73**
Serum albumin g/l	Median (IQR)	33 (28,37)	28 (26,33)	27 (22,32)	34 (31,38)	29 (24,33)	34 (30,38)	35 (31,39)	**32 (28,37)**
	Not reported	1	0	0	0	0	0	0	**1**
Cold ischaemia time (hrs)	Median (IQR)	8 (6,9)	12 (8,15)	10 (8,11)	9 (7,11)	8 (6,10)	11 (10,12)	8 (7,10)	**9 (7,11)**
	Not reported	0	2	0	0	0	0	0	**2**
Time on list (days)	Median (IQR)	50 (9,162)	20 (9,71)	46 (17,148)	54 (14,155)	35 (9,110)	49 (20,127)	43 (14,99)	**43 (11,126)**
Donor sex	Male	77 (48)	49 (61)	25 (50)	92 (59)	48 (51)	18 (64)	72 (60)	**381 (55)**
	Female	85 (52)	31 (39)	25 (50)	63 (41)	46 (49)	10 (36)	48 (40)	**308 (45)**

Table 3.4 Demographic characteristics of adult elective first deceased donor liver only transplant recipients, 1 April 2019 - 31 March 2020

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	**TOTAL N (%)**
Donor ethnicity	White	155 (96)	71 (89)	46 (92)	143 (92)	83 (88)	26 (93)	102 (85)	**626 (91)**
	Non-white	6 (4)	9 (11)	4 (8)	12 (8)	7 (7)	1 (4)	10 (8)	**49 (7)**
	Not reported	1 (1)	0	0	0	4 (4)	1 (4)	8 (7)	**14 (2)**
Donor cause of death	Intracranial	147 (91)	72 (90)	44 (88)	142 (92)	78 (83)	24 (86)	106 (88)	**613 (89)**
	Trauma	5 (3)	3 (4)	1 (2)	0	8 (9)	2 (7)	4 (3)	**23 (3)**
	Others	10 (6)	5 (6)	5 (10)	13 (8)	8 (9)	2 (7)	10 (8)	**53 (8)**
Donor history of diabetes	No	142 (88)	77 (96)	41 (82)	140 (90)	89 (95)	24 (86)	103 (86)	**616 (89)**
	Yes	17 (10)	3 (4)	8 (16)	15 (10)	3 (3)	3 (11)	11 (9)	**60 (9)**
	Not reported	3 (2)	0	1 (2)	0	2 (2)	1 (4)	6 (5)	**13 (2)**
Donor type	Donor after brain death	131 (81)	52 (65)	45 (90)	118 (76)	74 (79)	24 (86)	84 (70)	**528 (77)**
	Donor after cardiac death	31 (19)	28 (35)	5 (10)	37 (24)	20 (21)	4 (14)	36 (30)	**161 (23)**
ABO match	Identical	152 (94)	75 (94)	47 (94)	149 (96)	87 (93)	28 (100)	113 (94)	**651 (95)**
	Compatible	10 (6)	5 (6)	3 (6)	6 (4)	7 (7)	0	7 (6)	**38 (6)**
Graft type	Whole	155 (96)	75 (94)	48 (96)	144 (93)	91 (97)	28 (100)	112 (93)	**653 (95)**
	Segmental	7 (4)	5 (6)	2 (4)	11 (7)	3 (3)	0	8 (7)	**36 (5)**
Donor age years	Median (IQR)	55 (44,66)	49 (28,57)	56 (43,65)	56 (44,68)	47 (37,57)	55 (43,68)	49 (35,60)	**53 (39,64)**
Donor BMI kg/m2	Median (IQR)	26 (23,30)	26 (23,28)	27 (23,30)	26 (23,29)	26 (23,29)	27 (24,32)	25 (23,28)	**26 (23,29)**

3.2.3 Post-transplant survival

LONG-TERM PATIENT SURVIVAL

Table 3.5 shows one year unadjusted and risk-adjusted patient survival for 2612 of the 2838 transplants in the period, 1 April 2015 to 31 March 2019. Transplants were excluded if they were auxiliary or if survival information or risk factors were missing. The overall patient survival rate is 94.2% and, after risk adjustment, four centres had a lower survival rate than the national rate. All centres apart from Cambridge lie within the 95% confidence limit, as shown in **Figure 3.15**.

Table 3.5 One year patient survival for adult elective deceased donor first liver transplants, 1 April 2015 - 31 March 2019

Centre	Number of transplants	1-year survival % (95% CI) Unadjusted		Risk-adjusted	
Newcastle	114	92.9	86.4 - 96.4	89.5	79.1 - 94.8
Leeds	328	91.9	88.3 - 94.4	91.9	88.0 - 94.5
Cambridge	311	96.1	93.3 - 97.8	96.8	94.4 - 98.2
Royal Free	332	92.2	88.6 - 94.7	92.4	88.7 - 94.9
King's College	589	96.4	94.5 - 97.7	95.6	93.2 - 97.2
Birmingham	635	93.6	91.4 - 95.3	94.1	91.9 - 95.6
Edinburgh	302	94.2	90.8 - 96.3	94.4	91.0 - 96.5
Total	**2612**	**94.2**	**93.2 - 95.0**		

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

Figure 3.15 **Risk-adjusted 1 year patient survival rates for adult elective deceased donor first liver transplants, 1 April 2015 - 31 March 2019**

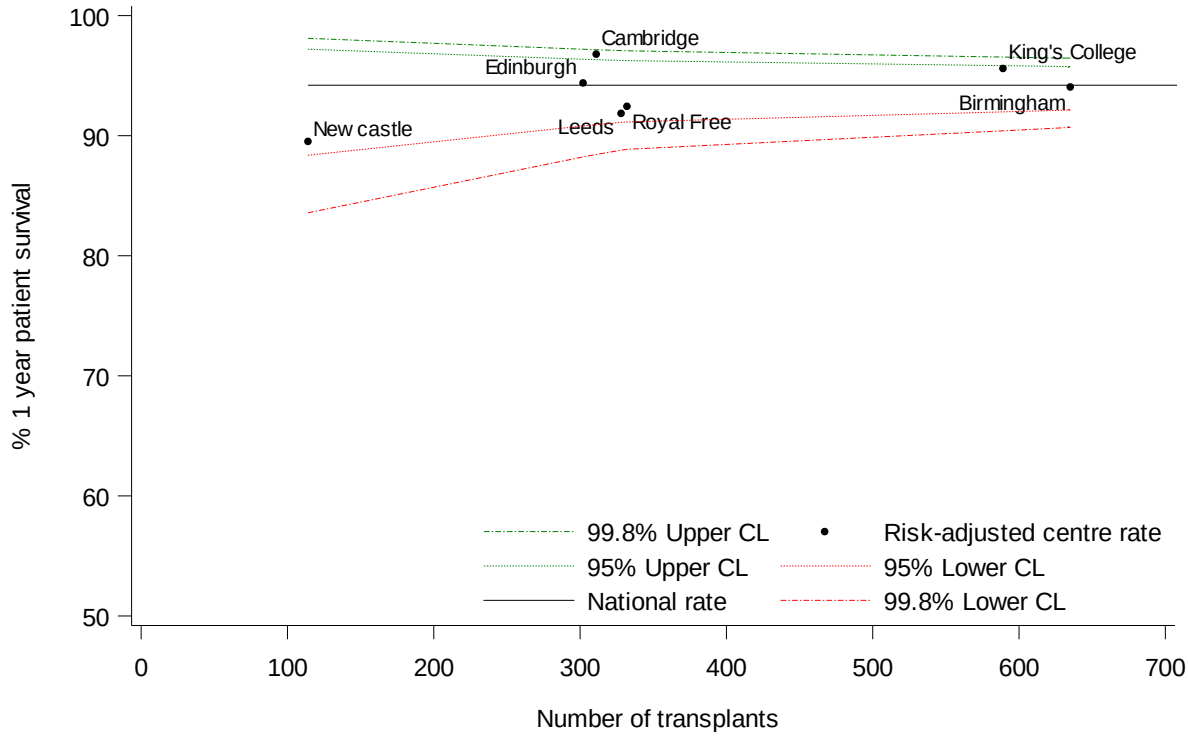


Table 3.6 shows the five year unadjusted and risk-adjusted patient survival for 2243 of the 2371 transplants in the period, 1 April 2011 to 31 March 2015. The national rate is 83.8% and two centres have a lower survival rate after risk adjustment, as shown in **Figure 3.16**. The median number of days 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 337 days for Birmingham to 553 days for Royal Free. 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 2011 - 31 March 2015

Centre	Number of transplants	5-year survival % (95% CI) Unadjusted		Risk-adjusted	
Newcastle	115	82.2	73.8 - 88.2	77.3	64.8 - 85.4
Leeds	308	81.0	76.0 - 85.1	82.0	76.7 - 86.2
Cambridge	241	86.1	80.9 - 89.9	87.6	82.6 - 91.2
Royal Free	245	87.5	82.5 - 91.1	88.7	83.8 - 92.1
King's College	509	86.5	83.1 - 89.2	84.4	80.1 - 87.7
Birmingham	562	80.3	76.7 - 83.4	81.0	77.0 - 84.2
Edinburgh	263	84.6	79.5 - 88.5	84.3	78.5 - 88.5
Total	2243	83.8	82.2 - 85.3		

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

Figure 3.16 Risk-adjusted 5 year patient survival rates for adult elective deceased donor first liver transplants, 1 April 2011 - 31 March 2015

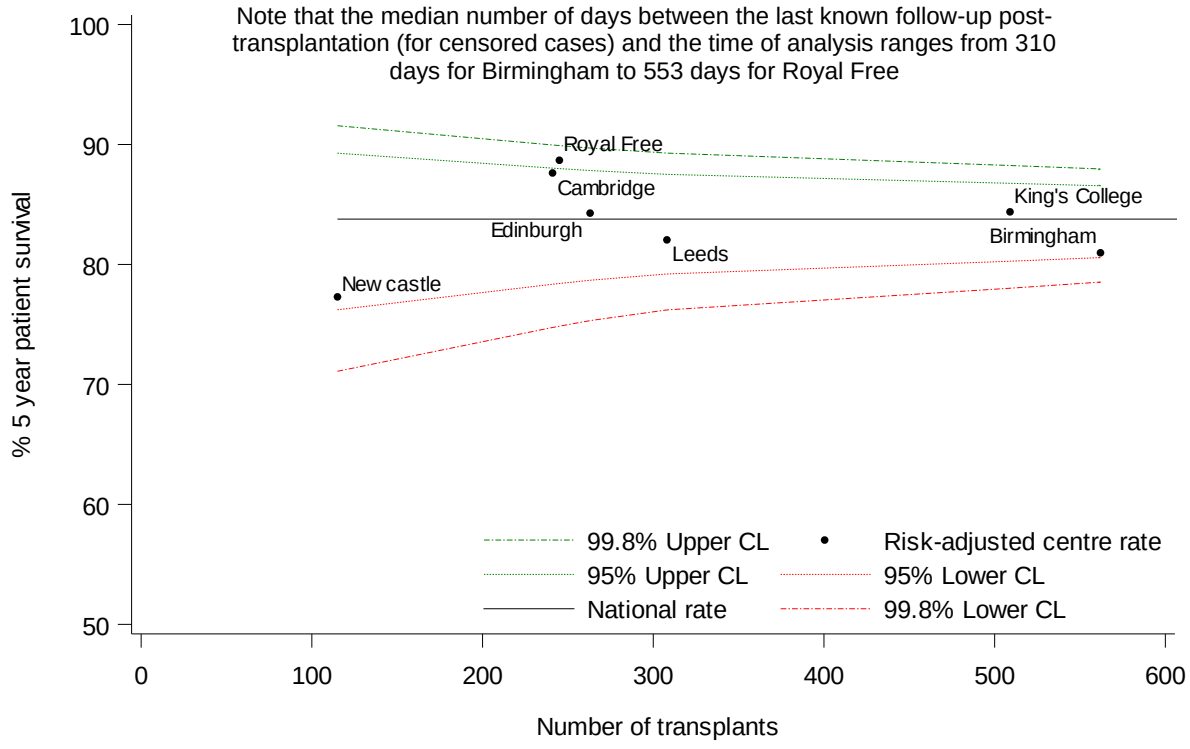


Table 3.7 shows one year unadjusted and risk-adjusted patient survival, by primary disease group. The overall patient survival rate is 94.2% and, after risk adjustment, patients with primary sclerosing cholangitis, autoimmune and cryptogenic, metabolic disease or other liver disease had lower survival than the national rate.

Table 3.7 One year patient survival for adult elective deceased donor first liver transplants, 1 April 2015 - 31 March 2019

Primary disease	Number of transplants	1-year survival % (95% CI) Unadjusted		Risk adjusted	
Cancer	565	93.8	(91.4 - 95.6)	94.7	(92.5 - 96.2)
Hepatitis B and C	151	96.0	(91.3 - 98.2)	94.9	(88.7 - 97.7)
Alcoholic liver disease	725	96.0	(94.3 - 97.2)	95.8	(93.9 - 97.1)
Primary sclerosing cholangitis	310	93.5	(90.0 - 95.7)	92.4	(88.3 - 95.1)
Primary biliary cholangitis	214	95.3	(91.4 - 97.4)	95.5	(91.7 - 97.6)
Autoimmune and cryptogenic	175	94.7	(90.1 - 97.2)	93.4	(87.4 - 96.6)
Metabolic	306	92.1	(88.4 - 94.7)	92.4	(88.6 - 94.9)
Other	166	89.1	(83.2 - 93.0)	90.4	(84.8 - 94.0)
Total	**2612**	**94.2**	**(93.2 - 95.1)**		

Table 3.8 shows five year unadjusted and risk-adjusted patient survival, the overall patient survival rate is 83.8%. After risk adjustment, patients with cancer, primary sclerosing cholangitis, or autoimmune and cryptogenic had lower survival than the national rate.

Table 3.8 Five year patient survival for adult elective deceased donor first liver transplants, 1 April 2011 - 31 March 2015

Primary disease	Number of transplants	5-year survival % (95% CI) Unadjusted		Risk adjusted	
Cancer	551	77.1	(73.3 - 80.5)	79.3	(75.3 - 82.7)
Hepatitis B and C	270	85.3	(80.4 - 89.1)	87.9	(83.4 - 91.2)
Alcoholic liver disease	516	85.6	(82.2 - 88.4)	85.8	(82.2 - 88.8)
Primary sclerosing cholangitis	247	86.3	(81.3 - 90.1)	82.6	(75.5 - 87.6)
Primary biliary cholangitis	196	89.2	(83.9 - 92.8)	88.4	(82.1 - 92.4)
Autoimmune and cryptogenic	148	82.9	(75.6 - 88.3)	79.5	(69.4 - 86.3)
Metabolic	197	84.7	(78.7 - 89.1)	84.0	(77.0 - 88.9)
Other	118	88.4	(80.8 - 93.1)	85.4	(74.9 - 91.5)
Total	**2243**	**83.8**	**(82.2 - 85.3)**		

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 2008 and 31 December 2019. 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.

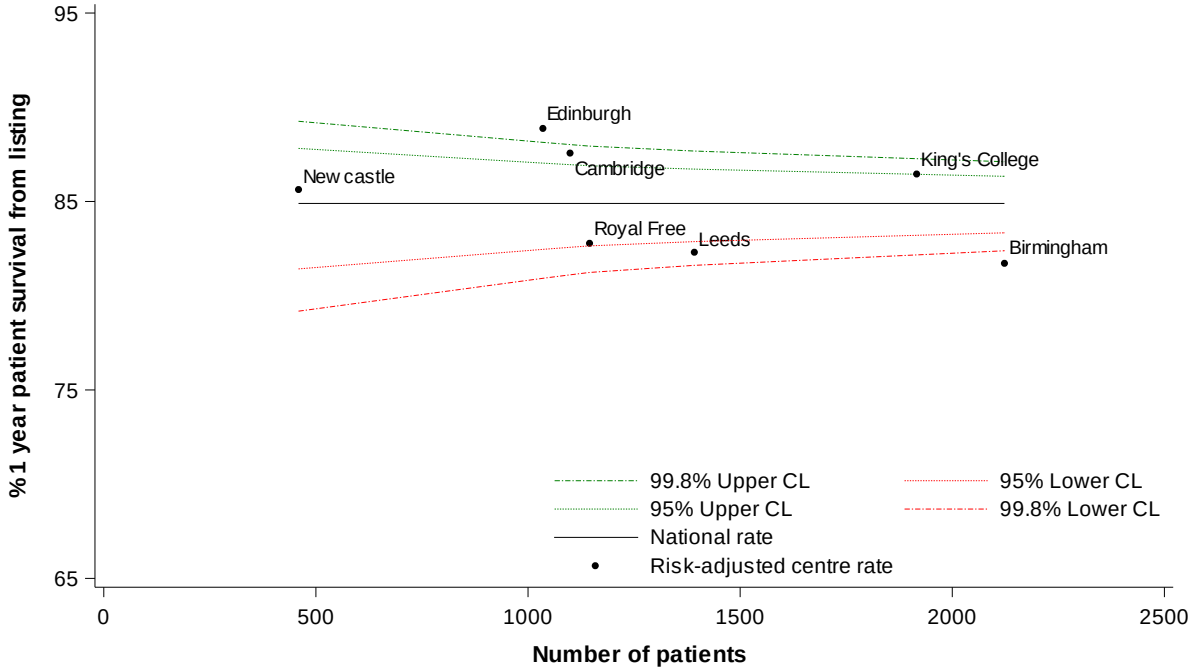
At one year, centre-specific risk adjusted survival rates range between 82% at Leeds and Birmingham and 89% at Edinburgh. At five years, Leeds and Birmingham have the lowest survival rate at 67% and Edinburgh has the highest at 79%; the remaining centres achieve survival rates that range in between these 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 329 days for Birmingham to 600 days for Leeds. 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 2008 - 31 December 2019

Centre	Number of registrations	Patient survival					
		One year			Five year		
		Number at Risk at 1 year	Survival Rate %	(95% CI)	Number at Risk at 5 years	Survival Rate %	(95% CI)
Newcastle	459	336	85.6	(82.5 - 88.2)	147	70.6	(65.5 - 74.9)
Leeds	1392	973	82.3	(79.8 - 84.5)	290	66.8	(63.1 - 70.1)
Cambridge	1099	800	87.6	(85.4 - 89.4)	343	76.6	(73.4 - 79.3)
Royal Free	1145	767	82.8	(80.1 - 85.1)	324	69.5	(65.6 - 72.9)
King's College	1916	1414	86.5	(84.7 - 88.0)	605	75.2	(72.6 - 77.5)
Birmingham	2123	1499	81.7	(79.7 - 83.5)	642	67.0	(64.1 - 69.7)
Edinburgh	1035	757	88.9	(86.9 - 90.6)	312	78.7	(75.7 - 81.4)
UK	**9169**	**6546**	**84.9**	**(84.1 - 85.6)**	**2663**	**72.0**	**(70.9 - 73.1)**

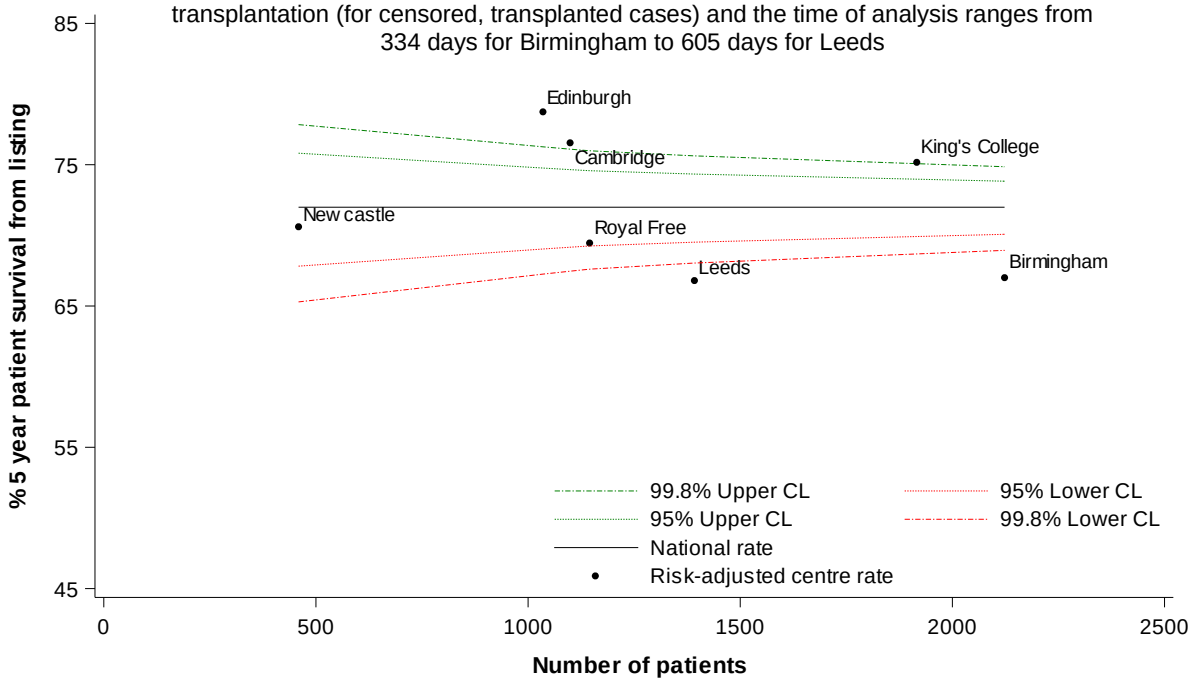
Figure 3.17 Risk-adjusted 1 year patient survival rate from time of listing for adult* elective first liver registrations, 1 January 2008 - 31 December 2019



*** 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 2008 - 31 December 2019

Note that the median number of days between the last known follow-up post-transplantation (for censored, transplanted cases) and the time of analysis ranges from 334 days for Birmingham to 605 days for Leeds



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

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 four of the seven centres.

Table 3.10 Median waiting time to liver only transplant in the UK, for adult super urgent patients registered 1 April 2018 - 31 March 2019

Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Adult			
Newcastle	5	2	-
Leeds	21	2	1 - 3
King's College	17	2	2 - 2
Birmingham	27	2	-
Royal Free	20	3	2 - 4
Edinburgh	12	3	1 - 5
Cambridge	15	4	3 - 5
UK	**117**	**2**	**2 - 2**

The demographic characteristics of 110 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 (60%) and the median age was 42 with a median BMI of 27. 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 from, 1 April 2019 - 31 March 2020

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's college N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	Total N (%)
Number		17	13	12	23	20	7	18	**110**
Recipient sex	Male	3 (18)	3 (23)	5 (42)	7 (30)	11 (55)	4 (57)	11 (61)	**44 (40)**
	Female	14 (82)	10 (77)	7 (58)	16 (70)	9 (45)	3 (43)	7 (39)	**66 (60)**
Recipient ethnicity	White	8 (47)	12 (92)	11 (92)	17 (74)	17 (85)	7 (100)	9 (50)	**81 (74)**
	Non-white	7 (41)	1 (8)	0 (0)	6 (26)	3 (15)	0 (0)	9 (50)	**26 (24)**
	Not reported	2 (12)	0 (0)	1 (8)	0 (0)	0 (0)	0 (0)	0 (0)	**3 (3)**
Recipient HCV	No	17 (100)	13 (100)	12 (100)	23 (100)	20 (100)	7 (100)	18 (100)	**110 (100)**
	Yes	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**0 (0)**
Encephalopathy	Absence	6 (35)	2 (15)	3 (25)	2 (9)	2 (10)	1 (14)	2 (11)	**18 (16)**
	Presence	6 (35)	10 (77)	8 (67)	16 (70)	15 (75)	5 (71)	12 (67)	**72 (65)**
	Not reported	5 (29)	1 (8)	1 (8)	5 (22)	3 (15)	1 (14)	4 (22)	**20 (18)**
Renal support	No	6 (35)	8 (62)	5 (42)	7 (30)	10 (50)	2 (29)	11 (61)	**49 (45)**
	Yes	11 (65)	5 (38)	7 (58)	16 (70)	10 (50)	5 (71)	7 (39)	**61 (55)**
Recip age (years)	Median (IQR)	33 (26, 41)	59 (52, 60)	38 (36, 49)	42 (28, 51)	44 (39, 59)	28 (23, 61)	37 (30, 56)	**42 (30, 56)**
BMI kg/m2	Median (IQR)	25 (22, 32)	31 (27, 36)	26 (24, 35)	26 (23, 32)	31 (27, 35)	26 (19, 29)	26 (21, 29)	**27 (23, 32)**
	Not reported	0	1	0	0	0	0	0	**1**
Serum bilirubin umol/l	Median (IQR)	245 (115, 334)	114 (38, 439)	112 (61, 225)	278 (167, 384)	104 (52, 356)	121 (89, 127)	293 (90, 387)	**167 (71, 356)**
	Not reported	0	0	0	1	1	2	1	**5**
Serum creatinine umol/l	Median (IQR)	77 (53, 144)	79 (45, 125)	86 (78, 196)	80 (65, 134)	104 (53, 150)	106 (91, 151)	92 (60, 162)	**91 (60, 150)**
	Not reported	5	3	0	5	1	0	1	**15**
Serum sodium mmol/l	Median (IQR)	139 (136, 142)	137 (133, 140)	138 (134, 142)	137 (133, 140)	137 (134, 141)	138 (135, 142)	140 (137, 141)	**138 (135, 141)**

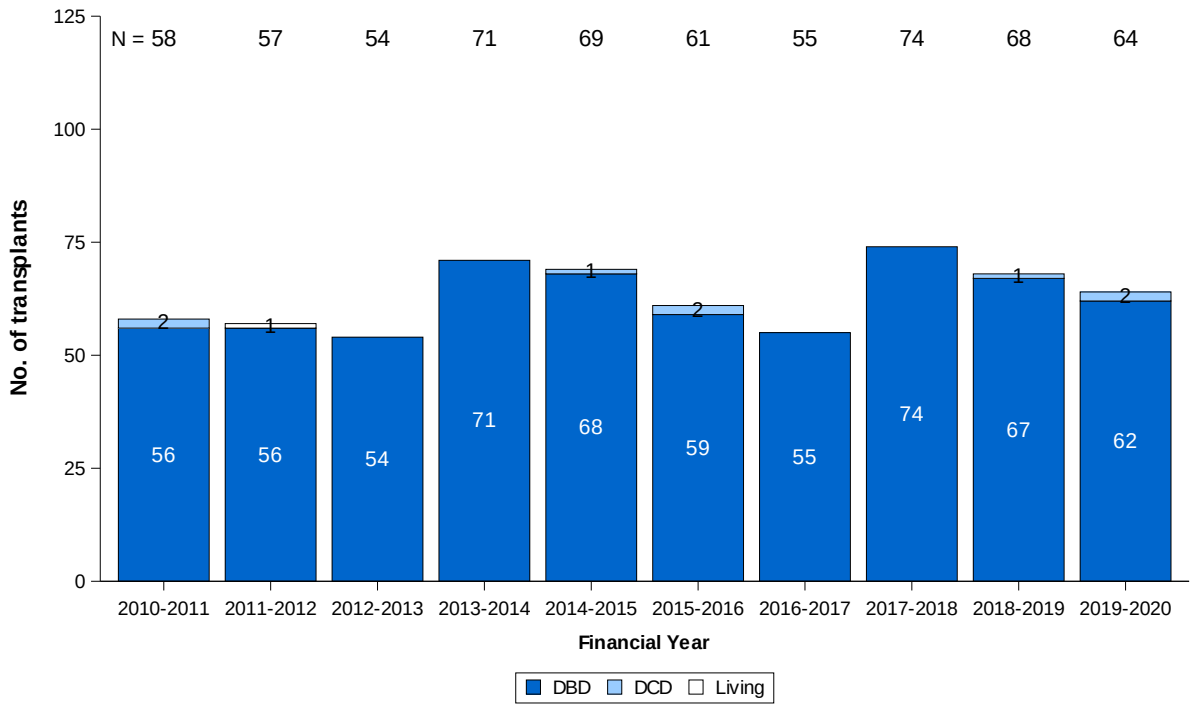
Table 3.11 Demographic characteristics of adult super urgent liver patients registered from, 1 April 2019 - 31 March 2020

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's college N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	Total N (%)
	Not reported	0	0	0	0	1	0	1	**2**
Serum potassium mmol/l	Median (IQR)	4 (4, 5)	4 (4, 5)	4 (4, 5)	4 (4, 5)	4 (4, 5)	4 (4, 5)	5 (4, 5)	**4 (4, 5)**
	Not reported	0	0	0	0	1	0	1	**2**
INR	Median (IQR)	4 (2, 4)	3 (2, 3)	5 (2, 9)	4 (3, 10)	3 (2, 10)	5 (2, 10)	3 (2, 7)	**4 (2, 7)**
	Not reported	0	5	0	0	1	4	0	**10**
Serum albumin g/l	Median (IQR)	25 (22, 33)	24 (21, 29)	23 (21, 26)	27 (24, 30)	22 (20, 26)	34 (26, 44)	28 (24, 29)	**25 (21, 30)**
	Not reported	0	1	0	1	1	0	1	**4**

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 8 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 2019/20 has slightly decreased compared to the previous financial year.

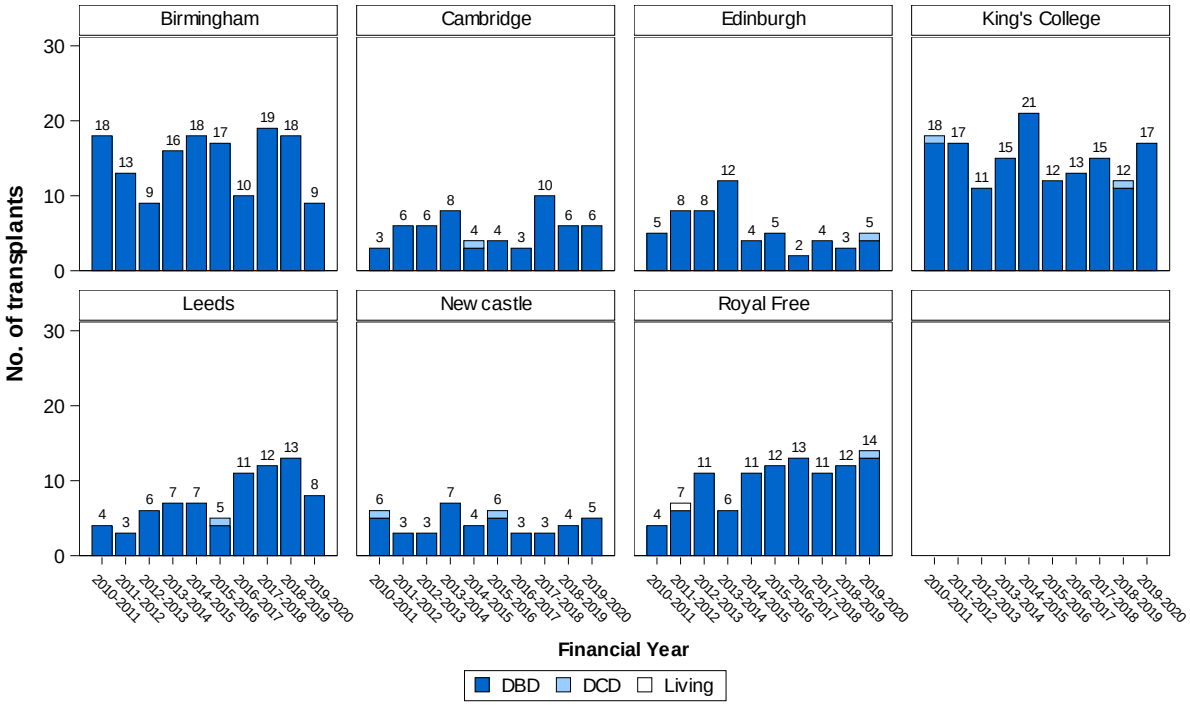
Figure 3.19 Adult super-urgent* liver only transplants by donor type, 1 April 2010 - 31 March 2020



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

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 2010 - 31 March 2020



***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 64 adult super-urgent transplant recipients in the last financial year are shown by centre and overall in **Table 3.12**. Sixty six percent of these recipients were female and the median age was 38 years. All but two super-urgent transplant have been performed in this time period using a DBD donor. The median recipient BMI was 27. 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 2019 - 31 March 2020

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	**TOTAL N (%)**
Number		9	6	5	17	8	5	14	**64 (100)**
Recipient sex	Male	0	1 (17)	2 (40)	5 (29)	4 (50)	3 (60)	7 (50)	**22 (34)**
	Female	9 (100)	5 (83)	3 (60)	12 (71)	4 (50)	2 (40)	7 (50)	**42 (66)**
Recipient ethnicity	White	5 (56)	5 (83)	5 (100)	12 (71)	8 (100)	5 (100)	6 (43)	**46 (72)**
	Non-white	3 (33)	1 (17)	0	5 (29)	0	0	8 (57)	**17 (27)**
	Not reported	1 (11)	0	0	0	0	0	0	**1 (2)**
Recipient HCV status	Negative	9 (100)	6 (100)	4 (80)	17 (100)	8 (100)	5 (100)	13 (93)	**62 (97)**
	Positive	0	0	0	0	0	0	1 (7)	**1 (2)**
	Not reported	0	0	1 (20)	0	0	0	0	**1 (2)**
Pre-transplant in-patient status	Out-patient	8 (89)	0	0	1 (6)	0	1 (20)	4 (29)	**14 (22)**
	In-patient	1 (11)	6 (100)	5 (100)	16 (94)	8 (100)	4 (80)	10 (71)	**50 (78)**
Ascites	Absence	8 (89)	4 (67)	4 (80)	6 (35)	5 (63)	4 (80)	11 (79)	**42 (66)**
	Presence	1 (11)	2 (33)	1 (20)	11 (65)	3 (38)	1 (20)	3 (21)	**22 (34)**
Encephalopathy	Absence	8 (89)	0	0	1 (6)	0	0	6 (43)	**15 (23)**
	Presence	1 (11)	6 (100)	5 (100)	16 (94)	8 (100)	5 (100)	8 (57)	**49 (77)**
Pre-transplant renal support	No	8 (89)	2 (33)	2 (40)	3 (18)	5 (63)	1 (20)	9 (64)	**30 (47)**
	Yes	1 (11)	4 (67)	3 (60)	14 (82)	3 (38)	4 (80)	5 (36)	**34 (53)**
Previous abdominal surgery	No	8 (89)	5 (83)	5 (100)	15 (88)	7 (88)	5 (100)	13 (93)	**58 (91)**
	Yes	1 (11)	1 (17)	0	2 (12)	1 (13)	0	1 (7)	**6 (9)**
Varices & shunt	Absence	9 (100)	4 (67)	1 (20)	7 (41)	7 (88)	1 (20)	11 (79)	**40 (63)**
	Presence without treatment	0	2 (33)	4 (80)	10 (59)	1 (13)	4 (80)	3 (21)	**24 (38)**

Table 3.12 Demographic characteristics of adult super-urgent deceased donor liver transplant recipients, 1 April 2019 - 31 March 2020

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	**TOTAL N (%)**
Life style activity	Normal	8 (89)	0	0	0	3 (38)	1 (20)	1 (7)	**13 (20)**
	Restricted	0	0	0	0	0	0	2 (14)	**2 (3)**
	Self-care	0	1 (17)	0	0	3 (38)	0	2 (14)	**6 (9)**
	Confined	1 (11)	1 (17)	0	2 (12)	0	1 (20)	3 (21)	**8 (13)**
	Reliant	0	4 (67)	5 (100)	15 (88)	2 (25)	3 (60)	6 (43)	**35 (55)**
Graft appearance	Normal	9 (100)	6 (100)	5 (100)	17 (100)	8 (100)	4 (80)	10 (71)	**59 (92)**
	Abnormal	0	0	0	0	0	1 (20)	4 (29)	**5 (8)**
Recip age (years)	Median (IQR)	36 (28,41)	54 (52,60)	36 (35,37)	42 (33,51)	40 (34,48)	28 (23,55)	37 (30,50)	**38 (30,53)**
BMI kg/m2	Median (IQR)	28 (25,37)	35 (29,36)	25 (22,25)	26 (23,30)	29 (27,38)	27 (26,29)	23 (20,28)	**27 (23,31)**
Serum bilirubin umol/l	Median (IQR)	330 (254,413)	366 (182,515)	169 (136,526)	281 (160,449)	338 (83,413)	153 (142,163)	233 (126,374)	**271 (145,447)**
Serum creatinine umol/l	Median (IQR)	49 (48,52)	94 (74,130)	64 (56,203)	105 (92,149)	80 (61,153)	152 (110,170)	93 (65,146)	**92 (61,148)**
	Not reported	0	0	0	0	0	0	1	**1**
Serum sodium mmol/l	Median (IQR)	138 (137,144)	138 (136,140)	141 (139,142)	137 (135,144)	138 (133,139)	145 (143,146)	142 (138,145)	**140 (137,144)**
Serum potassium mmol/l	Median (IQR)	3.6 (3.6,3.8)	4.4 (4.0,4.6)	3.9 (3.8,4.6)	4.0 (3.3,4.5)	4.6 (4.3,5.1)	4.0 (4.0,4.6)	4.3 (3.9,4.5)	**4.2 (3.6,4.6)**
INR	Median (IQR)	3.0 (2.8,4.5)	2.8 (1.6,2.9)	4.6 (4.5,4.7)	3.4 (2.9,4.6)	2.0 (1.7,2.9)	4.4 (4.0,4.6)	2.6 (1.7,3.7)	**3.0 (2.1,4.6)**
	Not reported	0	3	0	0	0	0	0	**3**
Serum albumin g/l	Median (IQR)	23 (22,27)	21 (20,24)	23 (23,24)	28 (25,30)	23 (21,26)	34 (30,36)	29 (24,34)	**26 (23,30)**
Time on list (days)	Median (IQR)	2 (1,3)	4 (3,4)	1 (1,2)	2 (1,2)	2 (2,3)	3 (2,3)	2 (1,3)	**2 (1,3)**
Donor sex	Male	5 (56)	5 (83)	1 (20)	9 (53)	3 (38)	2 (40)	7 (50)	**32 (50)**
	Female	4 (44)	1 (17)	4 (80)	8 (47)	5 (63)	3 (60)	7 (50)	**32 (50)**

Table 3.12 Demographic characteristics of adult super-urgent deceased donor liver transplant recipients, 1 April 2019 - 31 March 2020

		Birmingham N (%)	Cambridge N (%)	Edinburgh N (%)	King's College N (%)	Leeds N (%)	Newcastle N (%)	Royal Free N (%)	**TOTAL N (%)**
Donor ethnicity	White	9 (100)	6 (100)	5 (100)	16 (94)	6 (75)	5 (100)	12 (86)	**59 (92)**
	Non-white	0	0	0	1 (6)	2 (25)	0	1 (7)	**4 (6)**
	Not reported	0	0	0	0	0	0	1 (7)	**1 (2)**
Donor cause of death	Intracranial	8 (89)	6 (100)	4 (80)	15 (88)	6 (75)	5 (100)	14 (100)	**58 (91)**
	Others	1 (11)	0	1 (20)	2 (12)	2 (25)	0	0	**6 (9)**
Donor history of diabetes	No	7 (78)	6 (100)	4 (80)	17 (100)	7 (88)	4 (80)	13 (93)	**58 (91)**
	Yes	1 (11)	0	1 (20)	0	1 (13)	0	0	**3 (5)**
	Not reported	1 (11)	0	0	0	0	1 (20)	1 (7)	**3 (5)**
Donor type	Donor after brain death	9 (100)	6 (100)	4 (80)	17 (100)	8 (100)	5 (100)	13 (93)	**62 (97)**
	Donor after cardiac death	0	0	1 (20)	0	0	0	1 (7)	**2 (3)**
ABO match	Identical	6 (67)	4 (67)	3 (60)	9 (53)	6 (75)	5 (100)	6 (43)	**39 (61)**
	Compatible	3 (33)	2 (33)	2 (40)	8 (47)	2 (25)	0	8 (57)	**25 (39)**
Graft type	Whole	9 (100)	6 (100)	5 (100)	16 (94)	8 (100)	5 (100)	14 (100)	**63 (98)**
	Segmental	0	0	0	1 (6)	0	0	0	**1 (2)**
Donor age (years)	Median (IQR)	36 (24,54)	33 (24,42)	42 (31,55)	49 (32,58)	52 (42,66)	65 (60,75)	39 (25,57)	**46 (30,61)**
Donor BMI kg/m2	Median (IQR)	23 (23,24)	22 (22,32)	28 (26,29)	25 (23,27)	26 (24,28)	25 (24,29)	23 (21,26)	**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 221 of the 322 transplants in the period 1 April 2015 to 31 March 2019. Transplants were excluded if they were auxiliary or if survival information or risk factors were missing. The overall patient survival rate is 89.5% and, after risk adjustment, four of the seven centres had a lower survival rate than the national rate but within the confidence limits, as shown in **Figure 3.21**.

Table 3.13 One year patient survival for adult super-urgent deceased donor first liver transplants, 1 April 2015 - 31 March 2019

Centre	Number of transplants	1-year survival % (95% CI) Unadjusted		Risk-adjusted	
Newcastle	15	86.7	56.4 - 96.5	72.7	0.0 - 93.2
Leeds	30	93.3	75.9 - 98.3	93.1	72.3 - 98.3
Cambridge	21	95.2	70.7 - 99.3	94	57.5 - 99.2
Royal Free	40	77.6	61.2 - 87.7	84.1	69.5 - 91.7
King's College	42	88.1	73.7 - 94.9	87.9	70.9 - 95.0
Birmingham	57	96.5	86.7 - 99.1	96.2	84.7 - 99.0
Edinburgh	14	85.7	53.9 - 96.2	71.1	0.0 - 92.8
Total	**221**	**89.5**	**84.7 - 92.9**		

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

Figure 3.21 **Risk-adjusted 1 year patient survival rates for adult super-urgent deceased donor first liver transplants, 1 April 2015 - 31 March 2019**

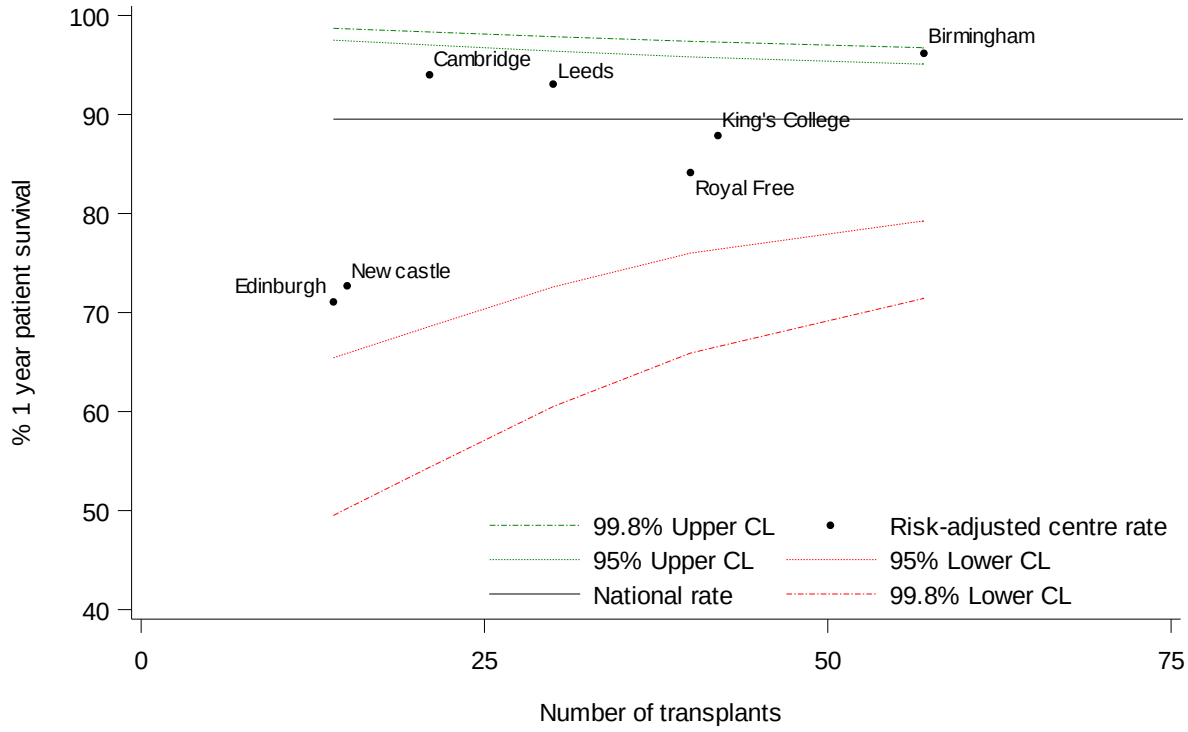


Table 3.14 shows the five year unadjusted and risk-adjusted patient survival for 229 of the 250 transplants in the period, 1 April 2011 to 31 March 2015. The national rate is 81.7% and four centres have a lower survival rate after risk adjustment as shown in **Figure 3.22**. All fall within the 95% confidence limits.

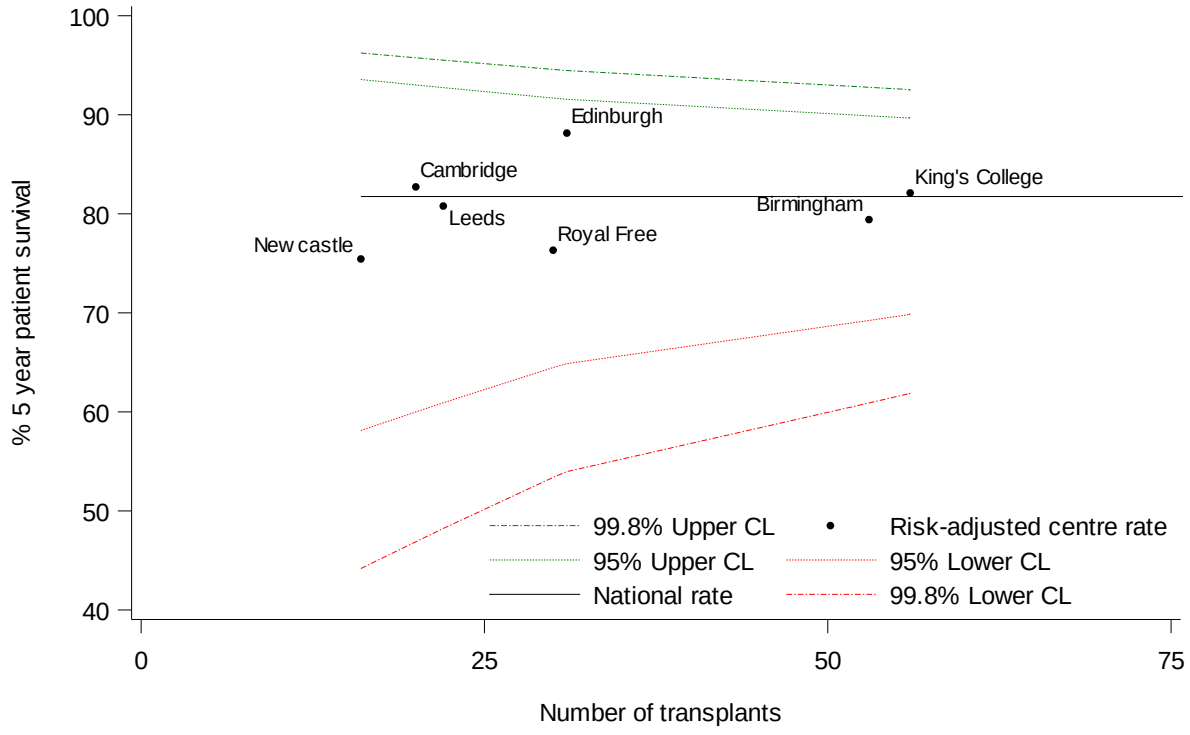
The median number of days between the last known follow-up post-transplantation (for censored patients) and the time of analysis in **Table 3.14** and **Figure 3.22** ranges from 350 days for Birmingham to 1018 days for Leeds. The medians for all other centres fall in between these extremes.

Table 3.14 Five year patient survival for adult super-urgent deceased donor first liver transplants, 1 April 2011 - 31 March 2015

Centre	Number of transplants	5-year survival % (95% CI) Unadjusted		Risk-adjusted	
Newcastle	16	75.0	46.3 - 89.8	75.4	34.6 - 90.8
Leeds	22	76.4	52.0 - 89.5	80.8	53.8 - 92.0
Cambridge	20	81.0	56.9 - 92.4	82.7	54.0 - 93.5
Royal Free	30	82.0	61.6 - 92.2	76.3	43.1 - 90.1
King's College	56	85.4	72.9 - 92.4	82.1	64.2 - 91.1
Birmingham	53	80.1	66.0 - 88.8	79.4	61.7 - 88.9
Edinburgh	31	86.6	68.1 - 94.8	88.2	68.4 - 95.6
Total	**229**	**81.7**	**75.9 - 86.3**		

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

Figure 3.22 Risk-adjusted 5 year patient survival rates for adult super-urgent deceased donor first liver transplants, 1 April 2011 - 31 March 2015



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 2019 and 31 December 2019 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. NHSBT are also working with the Royal Free to ensure forms are completed and returned.

It should be noted that some of the forms issued later in 2019 may not have yet been "chased" by NHSBT when the report was produced in August 2020.

Table 3.15 Form return rates for adult liver transplants, 1 January 2019 to 31 December 2019

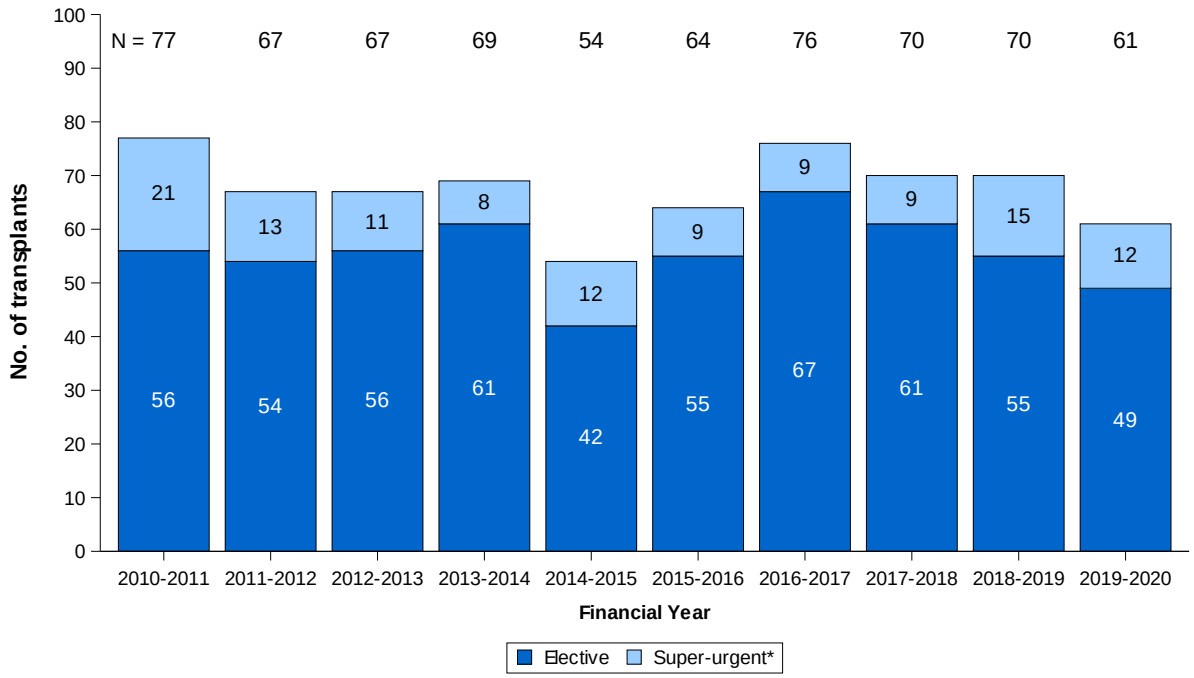
Centre	Transplant record		3 month follow-up		1 year follow-up		Lifetime follow-up	
	N	% Returned	N	% Returned	N	% Returned	N	% Returned
Newcastle	30	100	31	100	27	100	213	100
Leeds	97	100	98	100	82	100	601	70
Cambridge	92	100	90	100	97	100	499	100
Royal Free	130	99	132	98	106	55	496	51
King's College	176	100	171	100	166	95	920	87
Birmingham	174	100	176	100	177	99	975	96
Edinburgh	57	100	65	100	92	84	510	77
Total	**756**	**100**	**763**	**100**	**747**	**90**	**4214**	**83**

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.

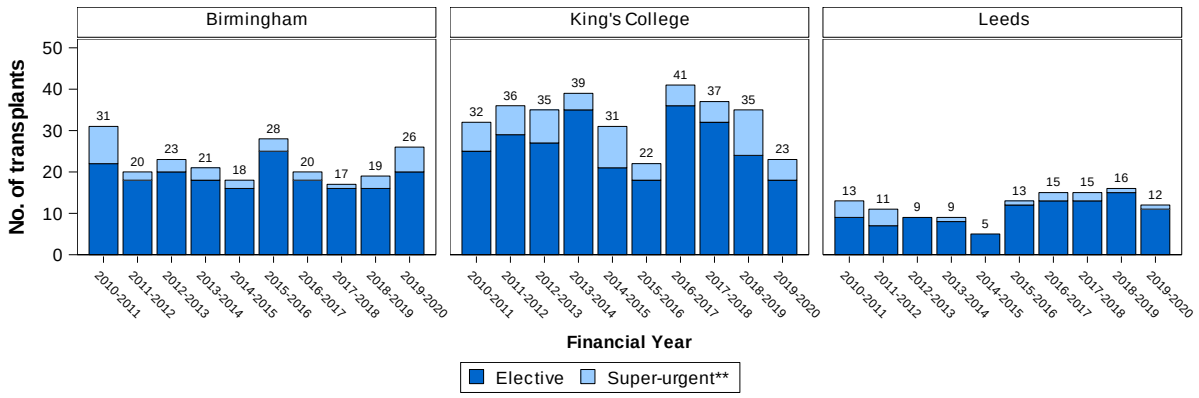
Figure 4.1 Deceased donor liver only transplants in paediatric recipients in the UK, 1 April 2010 - 31 March 2020



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

In the last year, 61 transplants in paediatric patients were performed. Forty nine (80%) of these transplants were for patients on the elective list and twelve (20%) for patients on the super-urgent list.

Figure 4.2 Deceased donor liver only transplants in paediatric recipients* in the UK, 1 April 2010 - 31 March 2020



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

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

The 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. Please note that there were no paediatric DCD transplants in the last financial year. The national median CIT for transplants from DBD donors has decreased slightly from 8.9 hours in 2010/11 to 8.0 hours in 2019/20. Similarly, the national median for DCD donor transplants has remained relatively stable over the ten year period, from 7.9 hours in 2010/11 to 7.7 hours in 2018/19.

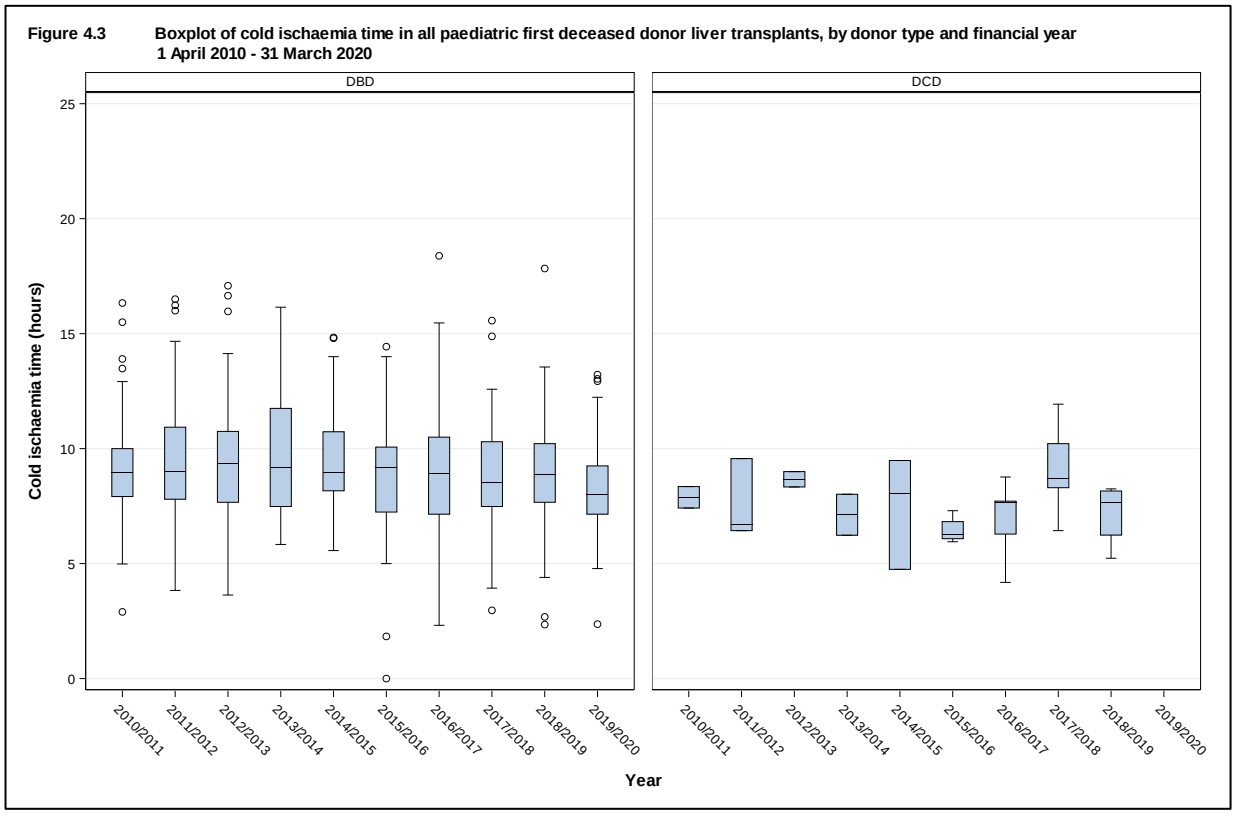


Figure 4.4 shows boxplots of cold ischaemia times (CIT) for paediatric transplant recipients by centre in the latest financial year (2019/2020) while **Figure 4.5** and **Figure 4.6** show the equivalent information by centre and donor type over the last ten financial years for DBD and DCD donors, respectively. The median CIT for DBD in the last financial year was 8.1 hours at King's College, 7.7 hours at Birmingham and 7.6 hours at Leeds.

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 2019 - 31 March 2020**

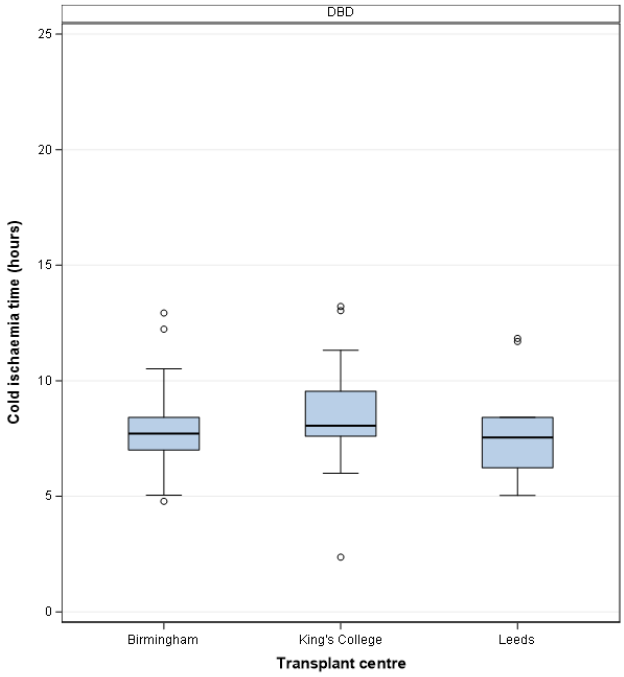


Figure 4.5 **Boxplot of cold ischaemia time in all paediatric first DBD donor liver transplants, 1 April 2010 - 31 March 2020**

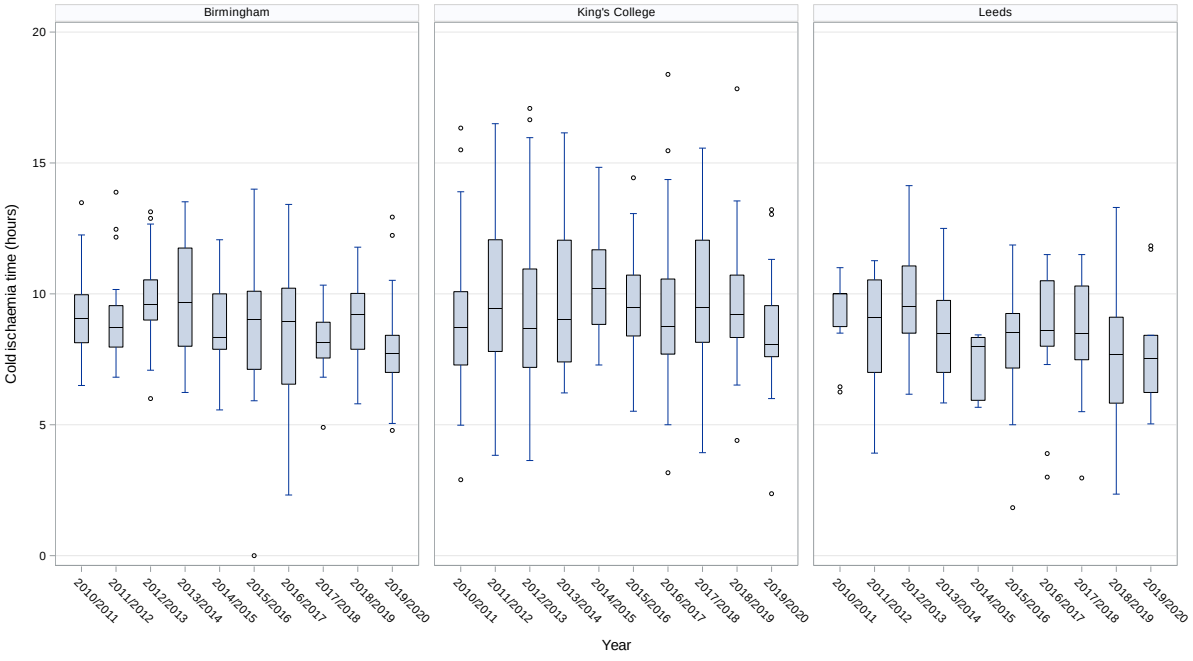
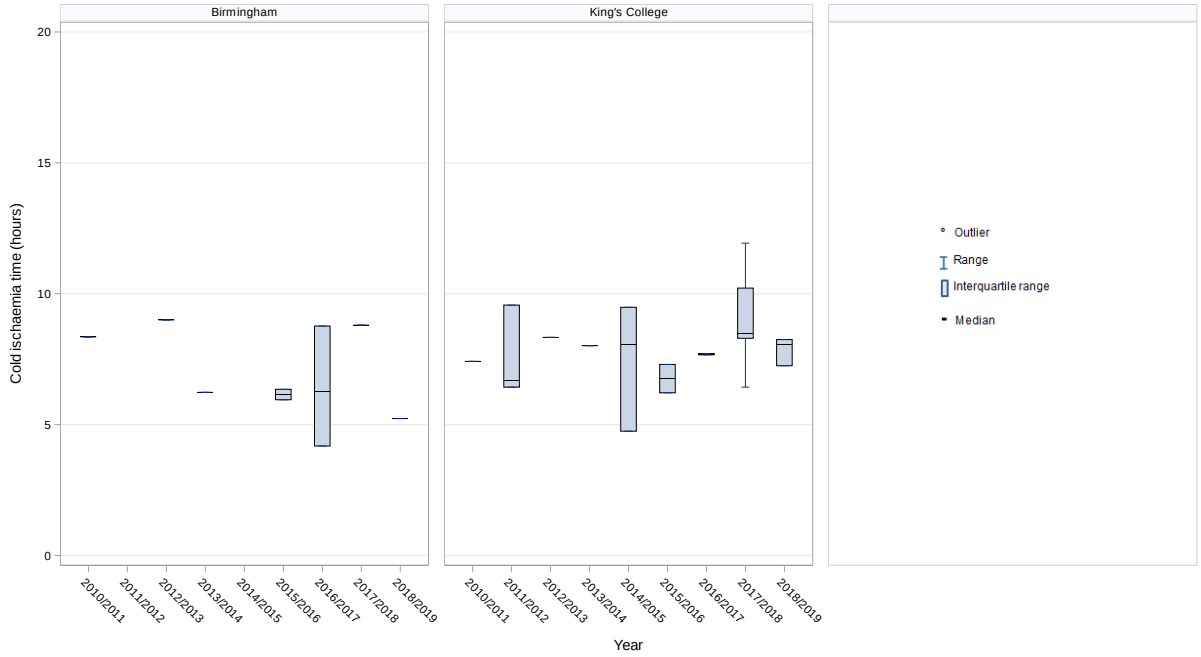


Figure 4.6 Boxplot of cold ischaemia time in all paediatric first DCD donor liver transplants, 1 April 2010 - 31 March 2020



The demographic characteristics of 99 paediatric registrations and 61 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, 48% were male, 30% were between 1 - 4 years old and 20% were registered as super-urgent. Of the transplant recipients, 49% were male, 34% were aged between one and four years old and 12 (20%) 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 2019 - 31 March 2020

		Birmingham N (%)		King's College N (%)		Leeds N (%)		**TOTAL N (%)**	
		Registration	Transplant	Registration	Transplant	Registration	Transplant	Registration	Transplant
Number		40	26	41	23	18	12	**99 (100)**	**61 (100)**
Recip age years	<1	8 (20)	4 (15)	16 (39)	8 (35)	7 (39)	1 (8)	**31 (31)**	**13 (21)**
	1-4	16 (40)	8 (31)	9 (22)	8 (35)	5 (28)	5 (42)	**30 (30)**	**21 (34)**
	5-12	10 (25)	8 (31)	10 (24)	4 (17)	4 (22)	4 (33)	**24 (24)**	**16 (26)**
	13-16	6 (15)	6 (23)	6 (15)	3 (13)	2 (11)	2 (17)	**14 (14)**	**11 (18)**
Recipient sex	Male	15 (38)	15 (58)	22 (54)	10 (43)	11 (61)	5 (42)	**48 (48)**	**30 (49)**
	Female	25 (63)	11 (42)	19 (46)	13 (57)	7 (39)	7 (58)	**51 (52)**	**31 (51)**
Indication	Super Urgent	12 (30)	6 (23)	7 (17)	5 (22)	1 (6)	1 (8)	**20 (20)**	**12 (20)**
	Biliary Atresia	5 (13)	6 (23)	18 (44)	10 (43)	4 (22)	2 (17)	**27 (27)**	**18 (30)**
	Other	1 (3)	1 (4)	0 (0)	0	2 (11)	2 (17)	**3 (3)**	**3 (5)**
	Cholestatic Metabolic	1 (3)	0	3 (7)	2 (9)	1 (6)	1 (8)	**5 (5)**	**3 (5)**
	Other	21 (53)	13 (50)	13 (32)	6 (26)	10 (56)	6 (50)	**44 (44)**	**25 (41)**
Pre-transplant in-patient status	Out-patient		22 (85)		12 (52)		8 (67)		**42 (69)**
	In-patient		4 (15)		9 (39)		3 (25)		**16 (26)**
	Not reported		0		2 (9)		1 (8)		**3 (5)**
Pre-transplant renal support	No		23 (88)		18 (78)		10 (83)		**51 (84)**
	Yes		1 (4)		3 (13)		1 (8)		**5 (8)**
	Not reported		2 (8)		2 (9)		1 (8)		**5 (8)**
Ascites	Absence		17 (65)		9 (39)		7 (58)		**33 (54)**
	Presence		9 (35)		12 (52)		4 (33)		**25 (41)**
	Not reported		0		2 (9)		1 (8)		**3 (5)**
Previous abdominal surgery	No	17 (43)	17 (65)	11 (27)	9 (39)	11 (61)	7 (58)	**39 (39)**	**33 (54)**
	Yes	11 (28)	9 (35)	23 (56)	12 (52)	6 (33)	4 (33)	**40 (40)**	**25 (41)**
	Not reported	12 (30)	0	7 (17)	2 (9)	1 (6)	1 (8)	**20 (20)**	**3 (5)**

Table 4.1 Demographic characteristics of paediatric registrations and deceased donor liver transplant recipients, 1 April 2019 - 31 March 2020

		Birmingham N (%)		King's College N (%)		Leeds N (%)		**TOTAL N (%)**	
		Registration	Transplant	Registration	Transplant	Registration	Transplant	Registration	Transplant
INR	<=1.0	10 (25)	6 (23)	10 (24)	4 (17)	3 (17)	5 (42)	**23 (23)**	**15 (25)**
	1.1-1.5	16 (40)	7 (27)	19 (46)	11 (48)	8 (44)	3 (25)	**43 (43)**	**21 (34)**
	1.6-3.0	4 (10)	6 (23)	5 (12)	3 (13)	5 (28)	2 (17)	**14 (14)**	**11 (18)**
	>3.0	9 (23)	6 (23)	7 (17)	3 (13)	2 (11)	1 (8)	**18 (18)**	**10 (16)**
	Not reported	1 (3)	1 (4)	0 (0)	2 (9)	0 (0)	1 (8)	**1 (1)**	**4 (7)**
Serum sodium mmol/l	<135	6 (15)	4 (15)	8 (20)	3 (13)	2 (11)	1 (8)	**16 (16)**	**8 (13)**
	>=135	34 (85)	22 (85)	33 (80)	18 (78)	16 (89)	10 (83)	**83 (84)**	**50 (82)**
	Not reported	0 (0)	0	0 (0)	2 (9)	0 (0)	1 (8)	**0 (0)**	**3 (5)**
Donor age years	<5		0		1 (4)		0		**1 (2)**
	5-16		3 (12)		2 (9)		2 (17)		**7 (12)**
	17-30		7 (27)		11 (48)		8 (67)		**26 (43)**
	>=31		16 (62)		9 (39)		2 (17)		**27 (44)**
Donor sex	Male		13 (50)		14 (61)		6 (50)		**33 (54)**
	Female		13 (50)		9 (39)		6 (50)		**28 (46)**
Donor type	DBD		26 (100)		23 (100)		12 (100)		**61 (100)**
Graft appearance	Normal		25 (96)		21 (91)		11 (92)		**57 (93)**
	Abnormal		1 (4)		0		0		**1 (2)**
	Not reported		0		2 (9)		1 (8)		**3 (5)**
Graft type	Whole		7 (27)		5 (22)		4 (33)		**16 (26)**
	Segmental		19 (73)		18 (78)		8 (67)		**45 (74)**
Urgency Status	Elective	28 (70)	20 (77)	34 (83)	18 (78)	17 (94)	11 (92)	**79 (80)**	**49 (80)**
	Super Urgent	12 (30)	6 (23)	7 (17)	5 (22)	1 (6)	1 (8)	**20 (20)**	**12 (20)**

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 2011 and 2019. In 2020 the transplant list is as at 29 February. The number of patients on the active liver only transplant list has ranged between 24 and 42 each year with 34 paediatric patients active on the liver only transplants on 29 February 2020.

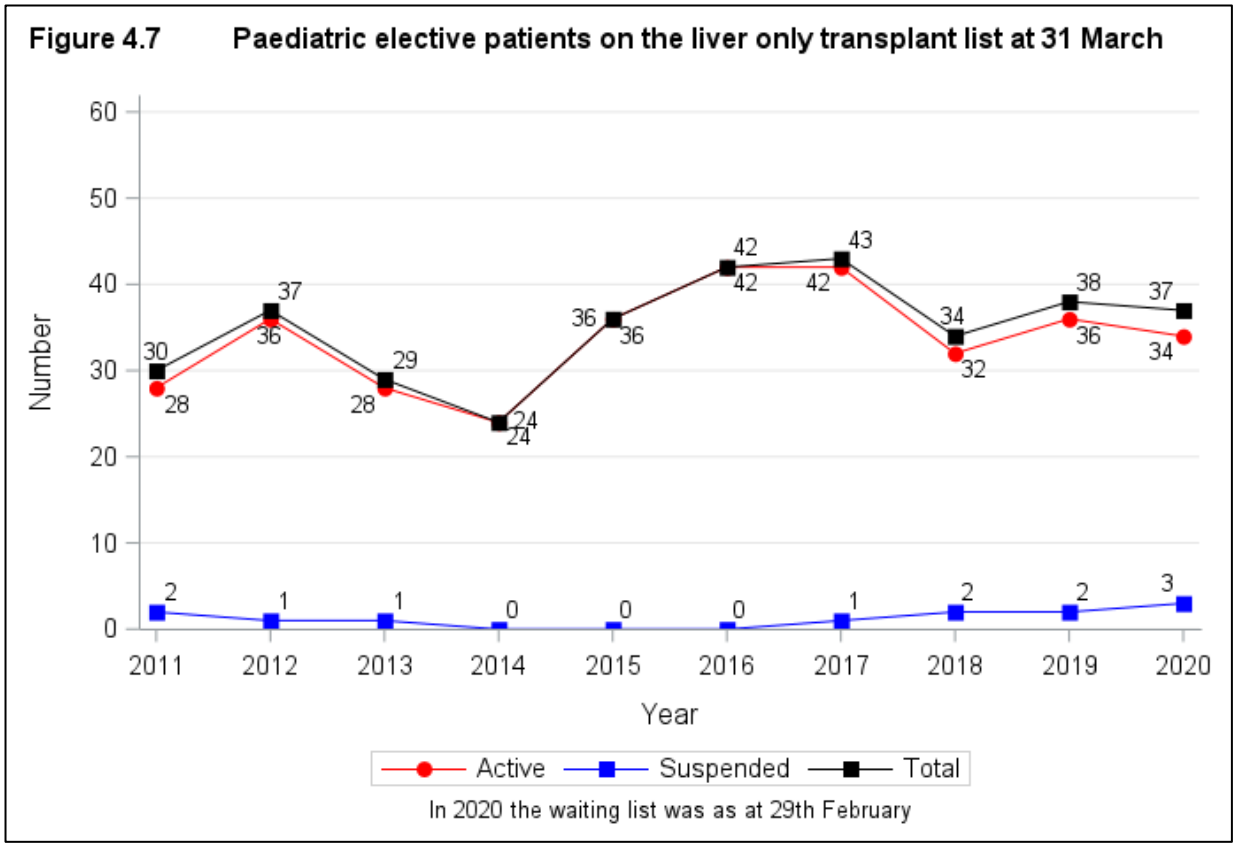
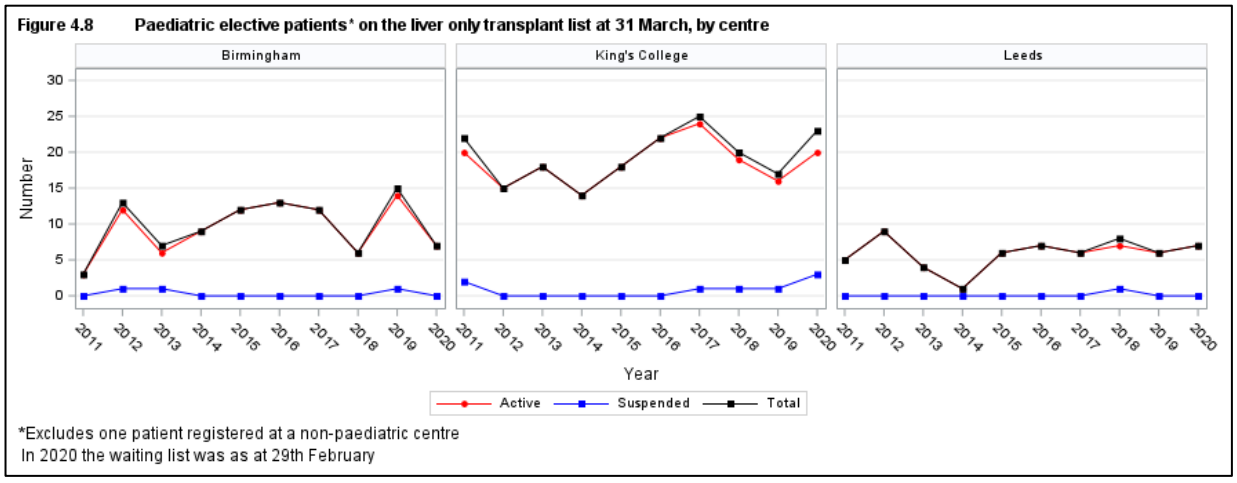
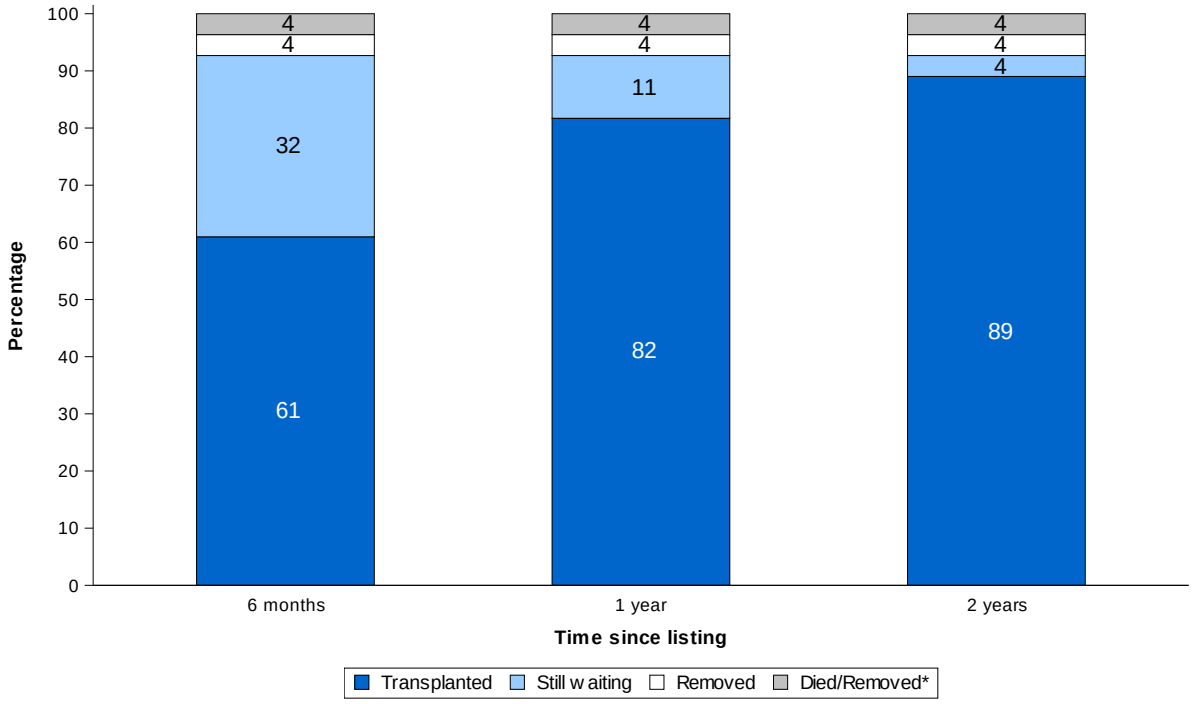


Figure 4.8 shows the number of elective patients on the transplant list at 31 March each year between 2011 and 2019 for each transplant centre. In 2020 the transplant list is as at 29 February.



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, 61% of patients have had a liver transplant, and 32% were still waiting.

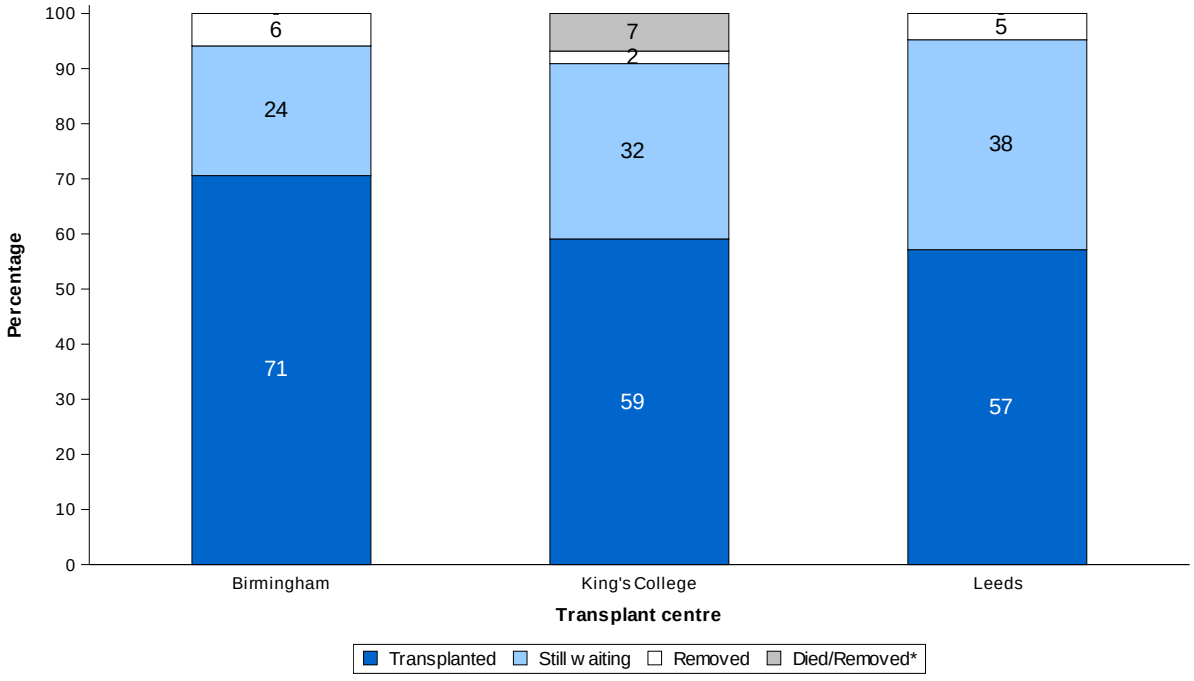
Figure 4.9 **Post-registration outcome for 82 new elective paediatric liver only registrations made in the UK, 1 April 2017 - 31 March 2018**



***Removals due to condition deteriorating**

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 57% at Leeds to 71% at Birmingham.

Figure 4.10 **Six month post-registration outcome for 82 new elective paediatric liver only registrations made in the UK by centre, 1 April 2017 - 31 March 2018**



***Removals due to condition deteriorating**

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 longest at Birmingham at 148 days, and shortest at Leeds, at 66 days. The national median waiting time to transplant is 77 days.

Table 4.2 **Median waiting time to liver only transplant in the UK, for paediatric elective patients registered 1 April 2018 - 31 March 2019**

Transplant centre	Number of patients registered	Waiting time (days) Median	95% Confidence interval
Paediatric			
Leeds	13	66	0 - 148
King's College	29	72	13 - 131
Birmingham	27	148	9 - 287
UK	**69**	**77**	**48 - 106**

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.

Figure 4.11 Paediatric elective liver only transplants, 1 April 2010 - 31 March 2020

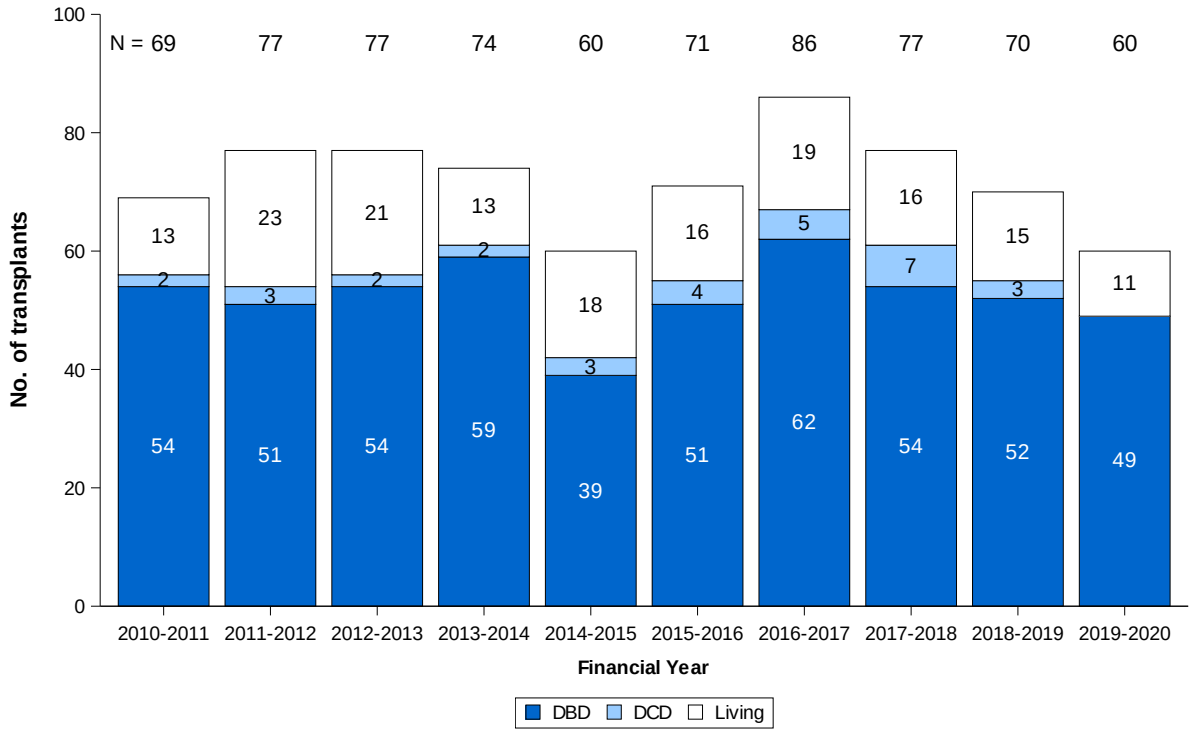
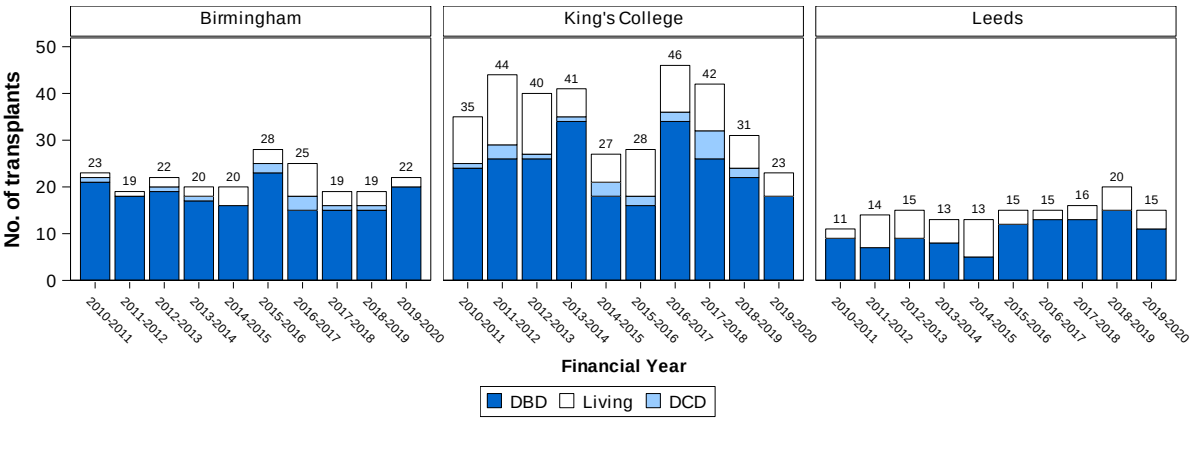


Figure 4.12 Paediatric elective liver only transplants by centre, 1 April 2010 - 31 March 2020



4.2.3 Post-transplant survival

Table 4.3 shows the unadjusted one year paediatric patient survival for all 236 deceased donor transplants (excluding auxiliary transplants) from 1 April 2015 to 31 March 2019, nationally and by centre. Note that these survival rates should be interpreted with caution as one-year patient follow-up is incomplete for two 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 2015 - 31 March 2019

Centre	Number of transplants	1-year survival % (95% CI)	
Leeds	53	98.1	(87.4 - 99.7)
King's College	108	97.2	(91.6 - 99.1)
Birmingham	75	91.9	(82.9 - 96.3)
Total*	236	95.7	(92.2 - 97.7)

Table 4.4 shows the unadjusted five year paediatric patient survival for all 210 transplants (excluding auxiliary transplants) from 1 April 2011 to 31 March 2015, 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 2011 - 31 March 2015

Centre	Number of transplants	5-year survival % (95% CI)	
Leeds	29	96.6	(77.9 - 99.5)
King's College	109	92.1	(84.7 - 96.0)
Birmingham	72	93.0	(84.0 - 97.0)
Total	210	93.1	(88.6 - 95.8)

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 2018 - 31 March 2019

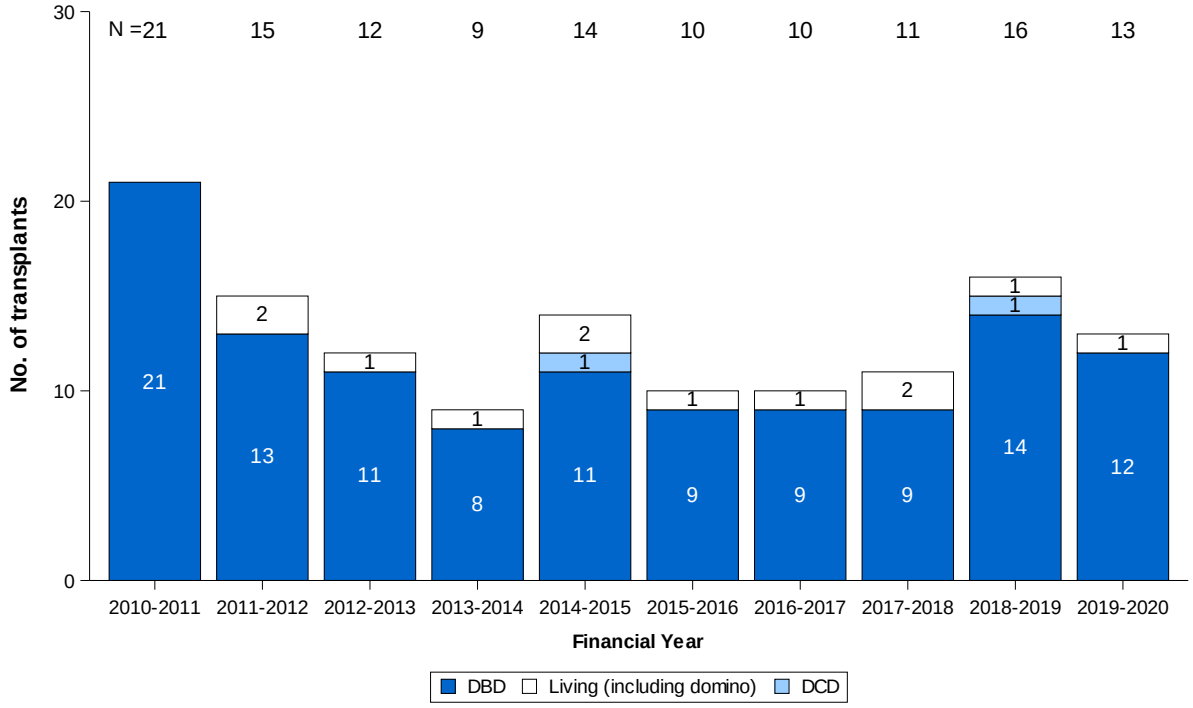
Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Paediatric			
Birmingham	5	2	1 - 3
King's College	13	4	2 - 6
Leeds	2	7	-
UK	**20**	**4**	**2 - 6**

Table 4.5 includes registrations for re-transplants. Of the 20 registrations for the UK in the time period, all led to transplants. 5 of the 20 transplants were re-transplanted, hence, the difference between the 15 *first* deceased donor liver only transplants reported in **Figure 4.13** for the period 2018 – 2019 and **Table 4.5.**

4.3.2 Transplant activity

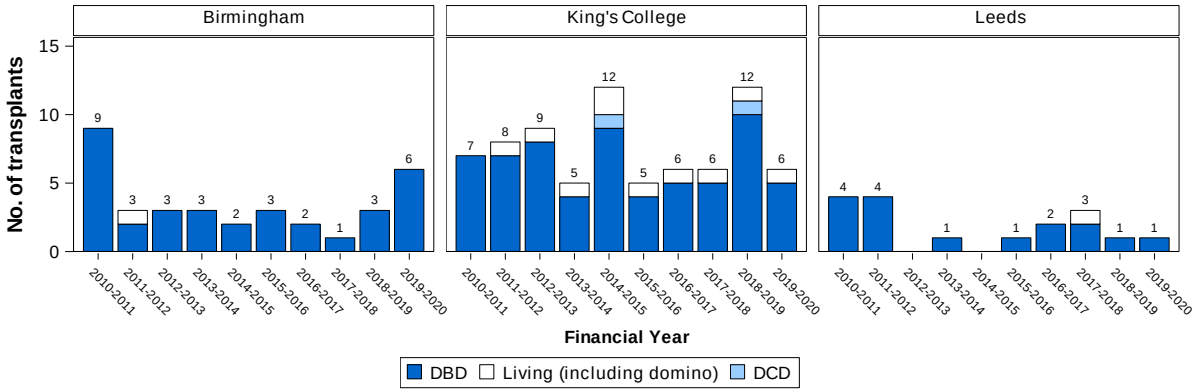
Figure 4.13 shows the number of paediatric super-urgent first liver only transplants from deceased and living (including domino) donors performed in the last ten years, by type of donor. **Figure 4.14** shows the same information by transplant centre.

Figure 4.13 Paediatric super-urgent* liver only transplants, 1 April 2010 - 31 March 2020



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

Figure 4.14 Paediatric super-urgent* liver only transplants by centre, 1 April 2010 - 31 March 2020



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

4.3.3 Post-transplant survival

One year unadjusted patient survival for 32 transplants (excluding auxiliary transplants) between 1 April 2015 and 31 March 2019 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 two 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 2015 - 31 March 2019

Centre	Number of transplants	1-year survival % (95% CI)	
Leeds	6[1]	-	-
King's College	15	86.7	(56.4 - 96.5)
Birmingham	9[1]	-	-
Total*	32	90.4	(73.1 - 96.8)

* 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 42 transplants (excluding auxiliary transplants) between 1 April 2011 and 31 March 2015, 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 2011 - 31 March 2015

Centre	Number of transplants	5-year survival % (95% CI)	
Leeds	5[1]	-	-
King's College	27	73.2	(51.7 - 86.3)
Birmingham	10	60.0	(25.3 - 82.7)
Total	42	73.5	(57.2 - 84.4)

[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 2019 and 31 December 2019 for the transplant record, and all requests for follow-up forms issued in this time period. Note that the Leeds Data Collector contract ended at the beginning of 2016 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 2019 - 31 December 2019

Centre	Transplant Record		3 Month follow-up		1 year follow-up		Lifetime follow-up	
	N	% returned	N	% returned	N	% returned	N	% returned
Leeds	9	100	13	100	15	87	78	63
King's College	30	90	29	100	34	100	220	81
Birmingham	24	100	21	100	15	100	136	99
Total	**63**	**95**	**63**	**100**	**64**	**97**	**434**	**83**

Appendix

A1 Data

Data were obtained from the UK Transplant Registry for the ten year time period, 1 April 2010 to 31 March 2020 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 2019 and 31 March 2020 were extracted from the UK Transplant Registry on 3 July 2020 (numerator). Patients registered for an intestinal transplant requiring a liver were excluded. Patients were assigned to NHS regions in England using their postcode of residence, as reported at registration. The number of registrations per million population (pmp) by NHS region was obtained using mid-2018 population estimates based on the Office for National Statistics (ONS) 2011 Census figures (denominator). No NHS region 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 2019 and 31 March 2020 (numerator), divided by the mid-2018 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 2019 and 31 March 2020 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

	Latest year April 2019-March 2020		Last 3 years April 2017-March 2020		Last 10 years April 2010-March 2020	
Transplant centre	**Elective**	**Super-urgent**	**Elective**	**Super-urgent**	**Elective**	**Super-urgent**
Newcastle	31	5	89	12	335	51
Leeds	103	11	324	47	972	120
Cambridge	89	10	301	33	839	100
Royal Free	126	15	336	47	830	129
King's College	176	22	552	55	1599	188
Birmingham	184	14	563	60	1682	197
Edinburgh	57	8	248	28	834	98
TOTAL	**768**[1]	**85**	**2422**[2]	**282**	**7113**[3]	**883**

[1] Includes 2 living transplants performed at London Bridge Hospital
[2] Includes 9 living transplants performed at London Bridge Hospital
[3] Includes 17 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

	Latest year April 2019-March 2020		Last 3 years April 2017-March 2020		Last 10 years April 2010-March 2020	
Transplant centre	**Elective**	**Super-urgent**	**Elective**	**Super-urgent**	**Elective**	**Super-urgent**
Newcastle	28	5	83	12	298	44
Leeds	94	8	291	33	873	76
Cambridge	80	6	272	22	769	56
Royal Free	120	14	322	37	773	100
King's College	155	17	480	44	1379	151
Birmingham	162	9	499	46	1515	147
Edinburgh	50	5	231	12	768	56
TOTAL	**689**	**64**	**2178**	**206**	**6375**	**630**

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

	Latest year April 2019-March 2020		Last 3 years April 2017-March 2020		Last 10 years April 2010-March 2020	
Transplant centre	**Elective**	**Super-urgent**	**Elective**	**Super-urgent**	**Elective**	**Super-urgent**
Newcastle	0	0	0	1	0	1
Leeds	17	1	55	8	160	26
Cambridge	0	0	0	0	0	1
Royal Free	0	0	0	0	1	2
King's College	29	7	108	28	385	88
Birmingham	28	7	69	15	266	53
TOTAL	**74**	**15**	**232**	**52**	**812**	**171**

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

	Latest year April 2019-March 2020		Last 3 years April 2017-March 2020		Last 10 years April 2010-March 2020	
Transplant centre	**Elective**	**Super-urgent**	**Elective**	**Super-urgent**	**Elective**	**Super-urgent**
Newcastle	0	0	0	1	0	1
Leeds	11	1	39	4	102	16
Cambridge	0	0	0	0	0	1
Royal Free	0	0	0	0	0	1
King's College	18	5	74	21	265	66
Birmingham	20	6	52	10	189	34
TOTAL	**49**	**12**	**165**	**36**	**556**	**119**

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.

Geographical variation analysis

For a given individual who is a resident in a given NHS region 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.

A one-sided p-value for the hypothesis that the SCV is greater than zero versus the null hypothesis that the SCV is equal to zero was derived using a parametric bootstrap where data were simulated from the Poisson distribution that would be consistent with the null hypothesis (multiplicative rate factor is equal to one in all areas and σ^2 equal to zero). The observed SCV was then compared against this simulated data to

calculate the probability that an SCV of at least this size would be observed due to chance if the null hypothesis were true.

10,000 bootstrap samples of size 7 (number of areas) were simulated, where the registration/transplant count in each area was drawn from a Poisson distribution with its expected value being the area-specific expected count (the rate of transplants/registrations in the total population multiplied by the population of the area) . The SCV was then calculated in each of the 10,000 samples and a bootstrap p-value for the SCV in the observed data was estimated as:

$$P_{boot} = \frac{1 + \#\{SCV_{sim} \geq SCV_{obs}\}}{10000 + 1}$$

where $\#\{SCV_{sim} \geq SCV_{obs}\}$ is the number of SCV values in the simulated datasets which are greater than or equal to the SCV in the observed data. This follows the simulation method given in Ibanez et al., BMC Health Services Research, 2009, 9:60. No adjustment was made for area-specific demographic characteristics that may impact the rates of registration to the transplant list and transplantation such as age and sex.

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

Table A3.1	Risk factors and categories used in the adult elective risk adjusted survival models post transplantation
	71-90 ≥91
Serum Creatinine µmol/l	≤70 71-90 91-110 111-130 ≥131
Serum sodium mmol/l	Per 10 mmol/l increase
Serum potassium mmol/l	Per 1 mmol/l increase
INR	Per 1 unit increase
Serum Albumin g/l	Per 5g/l increase
Cold Ischaemia time	Per 1 hour increase
Time on transplant list	Per 1 month increase
Donor sex	Male Female
Donor ethnicity	White Non-white
Donor cause of death	Trauma CVA Others
Donor history of diabetes	No Yes
Donor type	Donor after brain death Donors after circulatory 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 Donors after circulatory 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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