



**Blood and Transplant**

# **ANNUAL REPORT ON KIDNEY TRANSPLANTATION**

**REPORT FOR 2020/2021  
(1 APRIL 2011 – 31 MARCH 2021)**

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**PRODUCED IN COLLABORATION WITH NHS ENGLAND**



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# **Executive Summary**

This report presents key figures about kidney transplantation in the UK. The period reported covers 10 years of transplant data, from 1 April 2011. The report presents information on the number of transplants and survival analysis after first kidney only transplantation on a national and centre-specific basis.

## Key findings

- On 31 March 2021, there were 3,519 adult patients on the UK active kidney [transplant list](#) which represents a 29% decrease in the number of patients a year earlier. The equivalent number of paediatric patients was 113, representing a 5% increase from the previous year. On 31 March 2021 many patients were still suspended due to the impact of the COVID-19 pandemic and therefore these figures should be interpreted with caution.
- There were 2,167 adult kidney only transplants performed in the UK in 2020/21 a decrease of 32% compared to 2019/20. Of these, 1,137 were from [DBD](#) donors, 654 were from [DCD](#) donors and 376 were from living donors. The equivalent number of paediatric transplants was 96 representing a 17% decrease from the previous year. Much of the reduction in activity is due to the impact of the COVID-19 pandemic.

Use of the contents of this report should be acknowledged as follows:  
Annual Report on Kidney Transplantation 2020/21, NHS Blood and Transplant

# Introduction

This report presents information on transplant activity between 1 April 2011 and 31 March 2021, for all 24 centres performing kidney 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 kidney transplants performed in the UK.

[Graft](#) and [patient survival](#) estimates are reported at one-year post-transplant for the period 1 April 2016 to 31 March 2020 and five-year post-transplant for the period 1 April 2012 to 31 March 2016. Results are described separately according to the type of donor (deceased and living).

[Patient survival](#) from listing is reported at one-, five- and ten-year post registration for a deceased donor adult kidney only transplant between 1 January 2009 and 31 December 2020.

The centre specific results for survival estimates are adjusted for differences in [risk factors](#) between the centres. The risk models used are described in the Appendix.

Patients requiring [multi-organ transplants](#) are excluded from all analyses and all results are described separately for adult (aged $\geq$ 18years) and paediatric patients (aged $<$ 18 years) other than those presented in this Introduction section.

Throughout this report West London Renal and Transplant Centre is labeled as WLRTC.

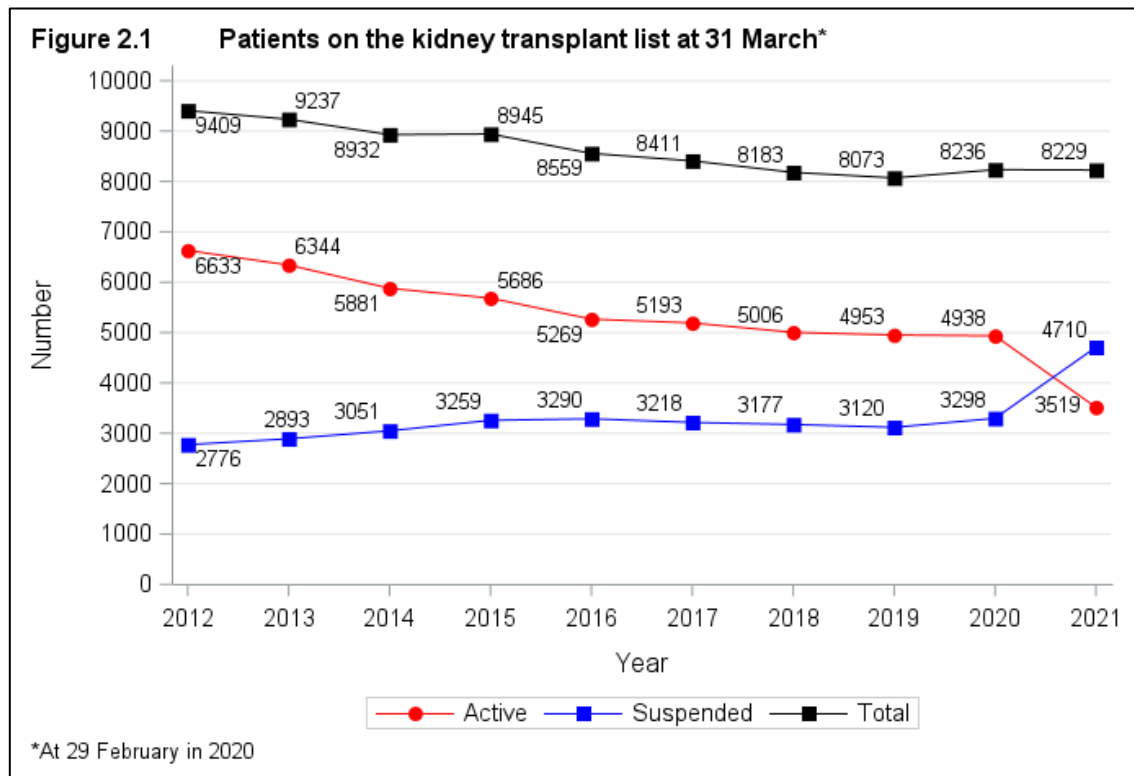
On 11 September 2019, a new National Kidney Offering Scheme was introduced to offer kidneys from both donors after brain death and donors after circulatory death. This is a change from the previous system where kidneys from donors after circulatory death were offered under a different scheme than kidneys from donors after brain death. The scheme has two tiers with priority going to patients who are the most difficult to match or who have waited over 7 years for a transplant.

The COVID-19 pandemic has led to unprecedented challenges for UK transplantation. Concerns about the ability to care for transplant recipients, lack of access to resource because it is being used for patients in the pandemic, and the risk versus benefit for immunosuppressed transplant recipients, have resulted in a major reduction in the number of organ transplants undertaken.

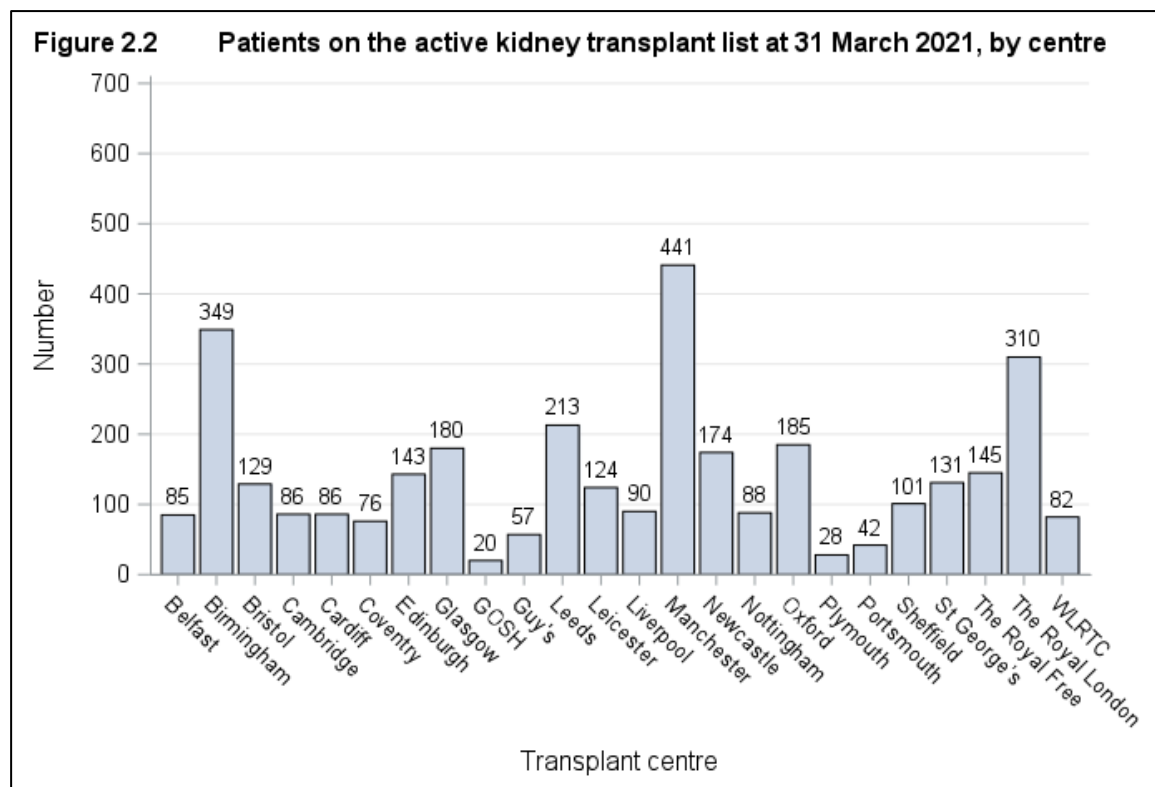
Waiting list figures at the 31 March 2020 do not accurately reflect the need for kidney transplantation due to the COVID-19 pandemic. Different practices were established across the UK with regards to waiting list management. Due to this, a snapshot of the waiting list at 29 February 2020 has been used to better reflect activity near the end of the 2019-2020 financial year.



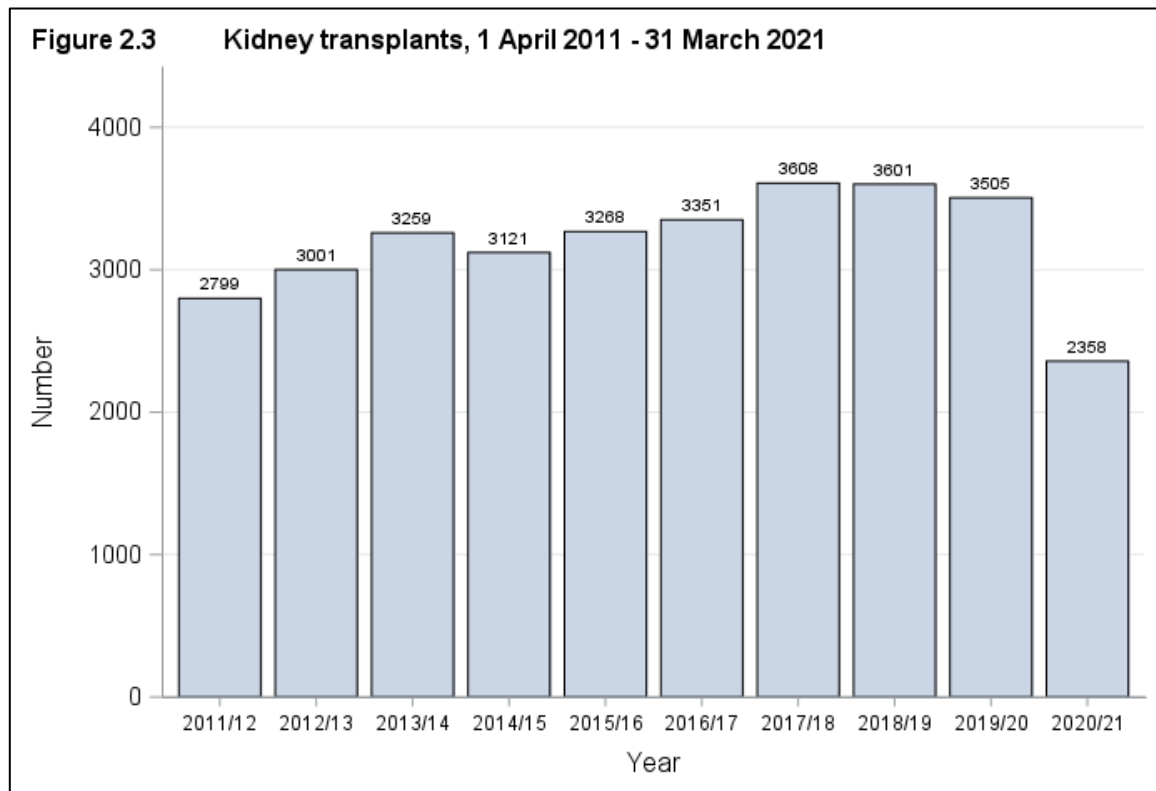
**Figure 2.1** shows the number of patients on the kidney [transplant list](#) on 31 March each year between 2012 and 2021 and at 29 February 2020. The number of patients actively waiting for a kidney transplant decreased from 6,633 in 2012 to 3,519 in 2021.



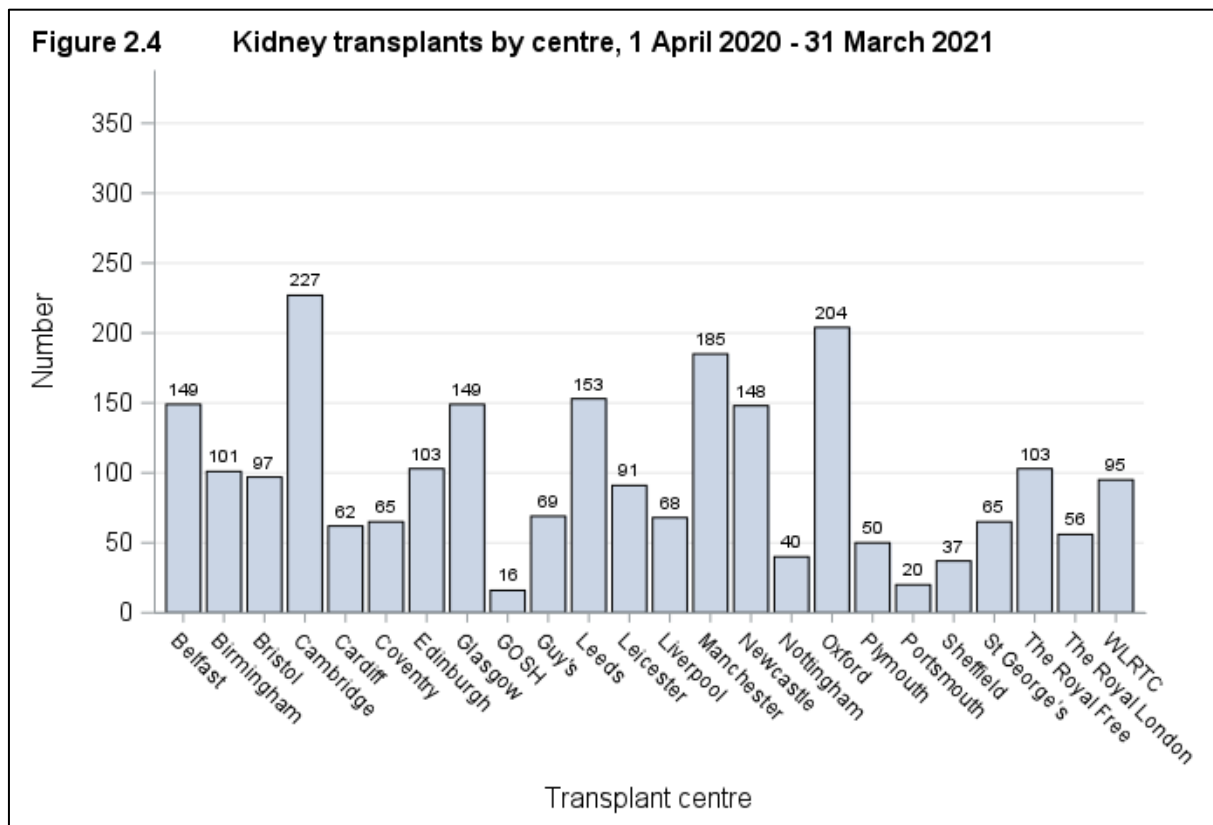
**Figure 2.2** shows the number of patients on the kidney [transplant list](#) at 31 March 2021 for each transplant centre. Manchester has the largest active [transplant list](#) with 441 patients registered for a kidney transplant.



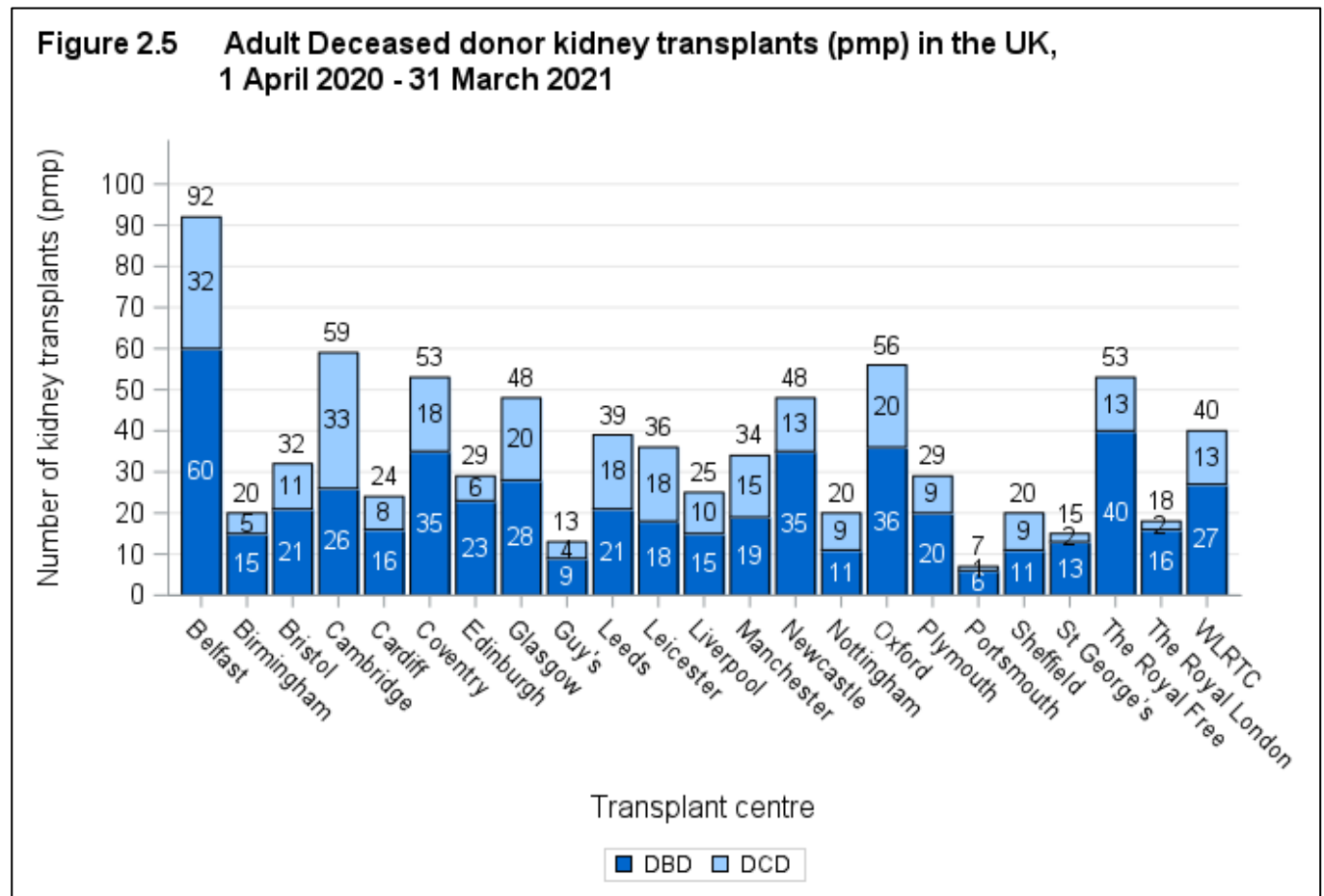
**Figure 2.3** shows the total number of kidney transplants performed in the last ten years. The number of transplants steadily increased from 2,799 in 2011/12 to 3,505 in 2019/20 with 2,358 recorded in 2020/21.



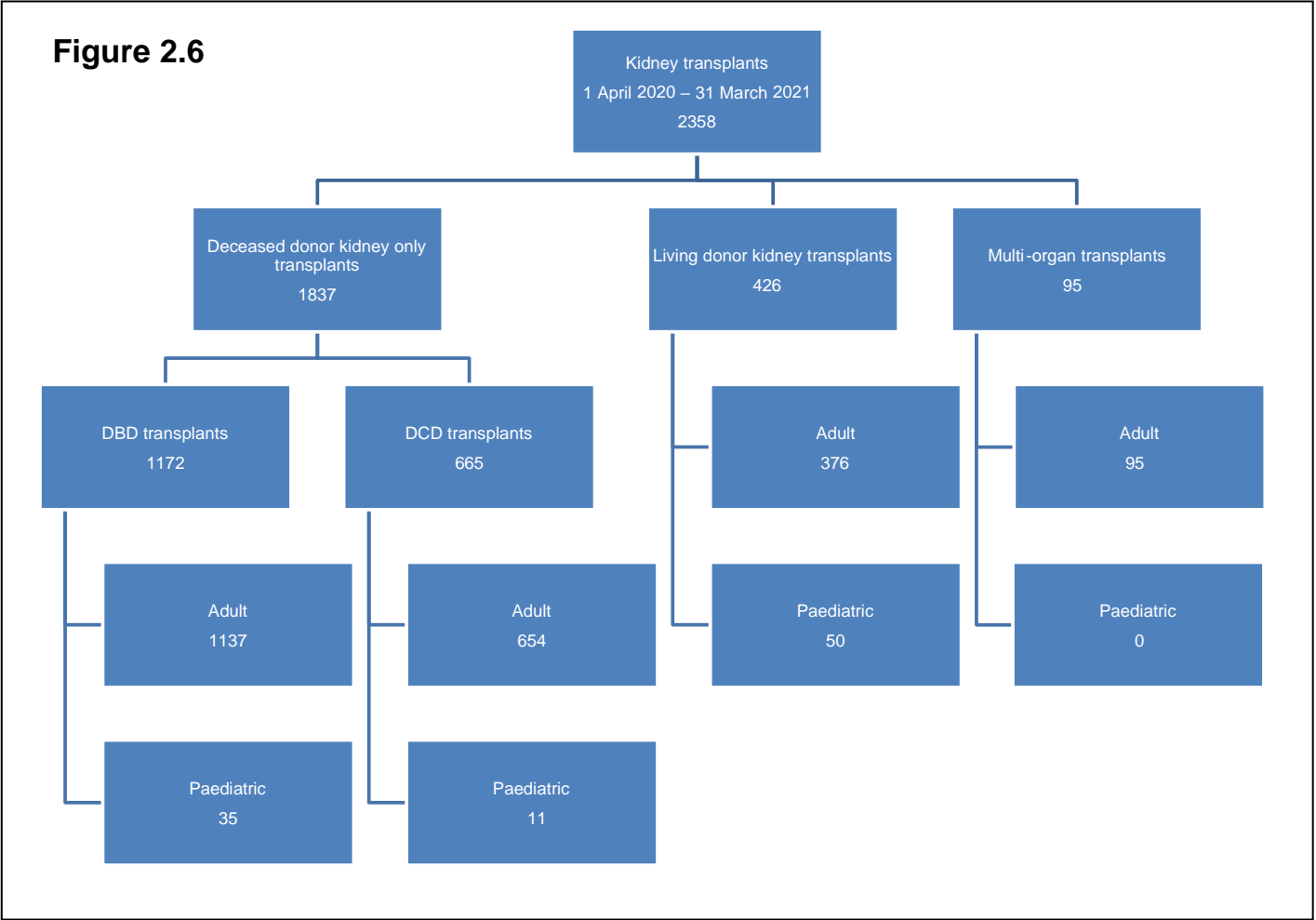
**Figure 2.4** shows the total number of kidney transplants performed in 2020/21 at each transplant centre. Cambridge performed the most kidney transplants last year with 227 patients receiving a transplant.



**Figure 2.5** shows the total number of kidney transplants performed per million population in 2020/21 at each transplant centre. Belfast had the highest number of adult deceased donor kidney transplants per million population.



**Figure 2.6** details the 2,358 kidney transplants performed in the UK between 1 April 2020 and 31 March 2021. Of these, 1,837 (78%) were deceased donor kidney only transplants and 426 (18%) were living donor kidney transplants. Of the 95 [multi-organ transplants](#), 83 were simultaneous kidney and pancreas transplants, 7 were kidney and liver transplants, and 5 were simultaneous kidney and islet transplants.

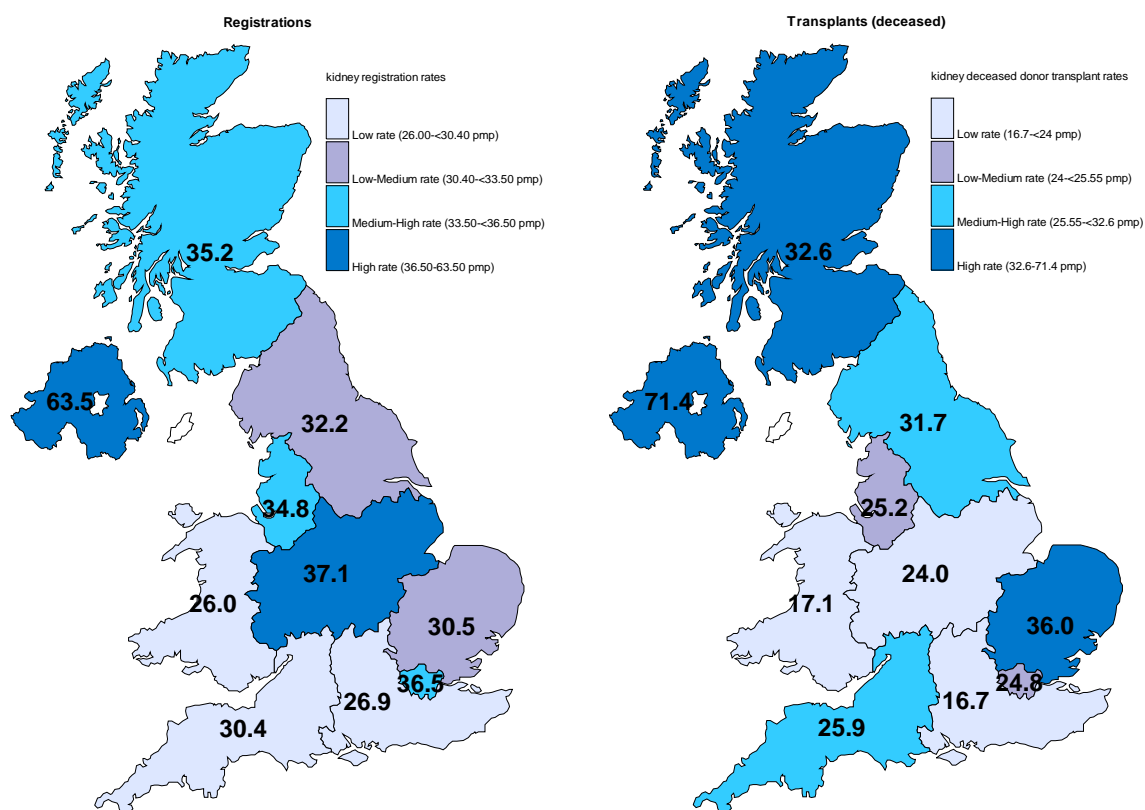


## Geographical variation in registration and transplant rates

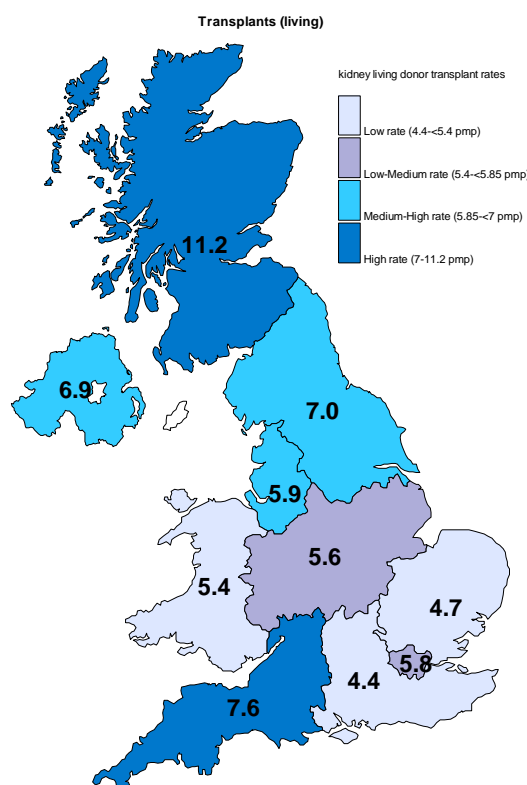
**Figure 2.7** shows rates of registration to the kidney only transplant list per million population (pmp) between 1 April 2020 and 31 March 2021 compared with deceased donor kidney only transplant rates pmp for the same time period, by recipient country/NHS region of residence. **Figure 2.8** shows the transplant rates pmp for living donor kidney only transplants in the same period. Table 2.2 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, deceased donor transplant, and living donor transplant rates yielded an SCV of 0.007 (p-value = 0.004), 0.043 (p-value <0.001), and 0.0115 (p-value = 0.104) 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, strong evidence of geographical variation beyond what would be expected at random for registrations and deceased donor transplants, and no evidence for living donors. 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 2.7 Comparison of kidney registration rates (pmp) with deceased donor transplant rates (pmp) by recipient country/NHS region of residence**



**Figure 2.8 Living donor kidney transplant rates (pmp) by recipient country/NHS region of residence**



**Table 2.2 Kidney registration and transplant rates per million population (pmp) in the UK, 1 April 2020 - 31 March 2021, by Country/NHS region**

<b>Country/ NHS region</b>	<b>Registrations (pmp)</b>		<b>Deceased Donor Transplants (pmp)</b>		<b>Living Donor Transplants (pmp)</b>	
North East and Yorkshire	277	(32.2)	273	(31.7)	60	(7.0)
North West	246	(34.8)	178	(25.2)	42	(5.9)
Midlands	393	(37.1)	254	(24.0)	59	(5.6)
East of England	199	(30.5)	235	(36.0)	31	(4.7)
London	327	(36.5)	222	(24.8)	52	(5.8)
South East	239	(26.9)	149	(16.7)	39	(4.4)
South West	171	(30.4)	146	(25.9)	43	(7.6)
<b>England</b>	<b>1852</b>	<b>(32.9)</b>	<b>1457</b>	<b>(25.9)</b>	<b>326</b>	<b>(5.8)</b>
<b>Isle of Man</b>	<b>3</b>	<b>(37.5)</b>	<b>2</b>	<b>(25.0)</b>	<b>0</b>	<b>(0.0)</b>
<b>Channel Islands</b>	<b>7</b>	<b>(41.2)</b>	<b>4</b>	<b>(23.5)</b>	<b>1</b>	<b>(5.9)</b>
<b>Wales</b>	<b>82</b>	<b>(26.0)</b>	<b>54</b>	<b>(17.1)</b>	<b>17</b>	<b>(5.4)</b>
<b>Scotland</b>	<b>192</b>	<b>(35.2)</b>	<b>178</b>	<b>(32.6)</b>	<b>61</b>	<b>(11.2)</b>
<b>Northern Ireland</b>	<b>120</b>	<b>(63.5)</b>	<b>135</b>	<b>(71.4)</b>	<b>13</b>	<b>(6.9)</b>
<b>TOTAL</b>	<b>2259<sup>1</sup></b>	<b>(33.7)</b>	<b>1836<sup>2</sup></b>	<b>(27.4)</b>	<b>419<sup>3</sup></b>	<b>(6.3)</b>

<sup>1</sup> Registrations include 3 recipients whose postcode was unknown

<sup>2</sup> Deceased donor transplants include 6 recipients whose postcode was unknown

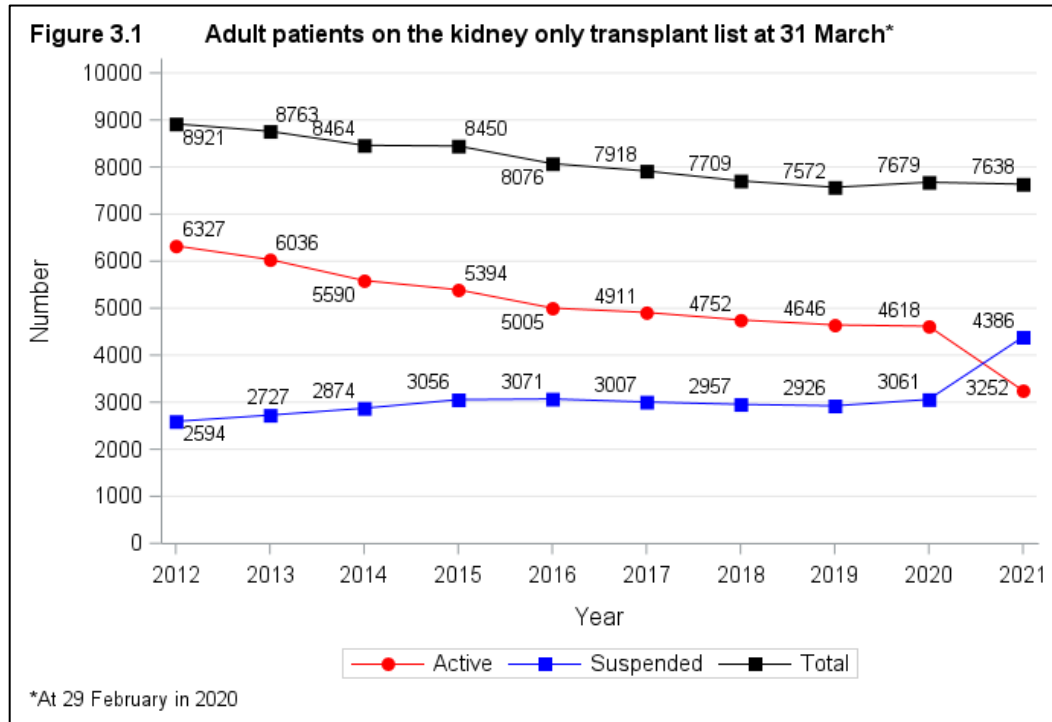
<sup>3</sup> Living donor transplants include 1 recipient whose postcode was unknown and excludes 1 recipient who reside in the Republic of Ireland

## **Adult kidney transplant list**

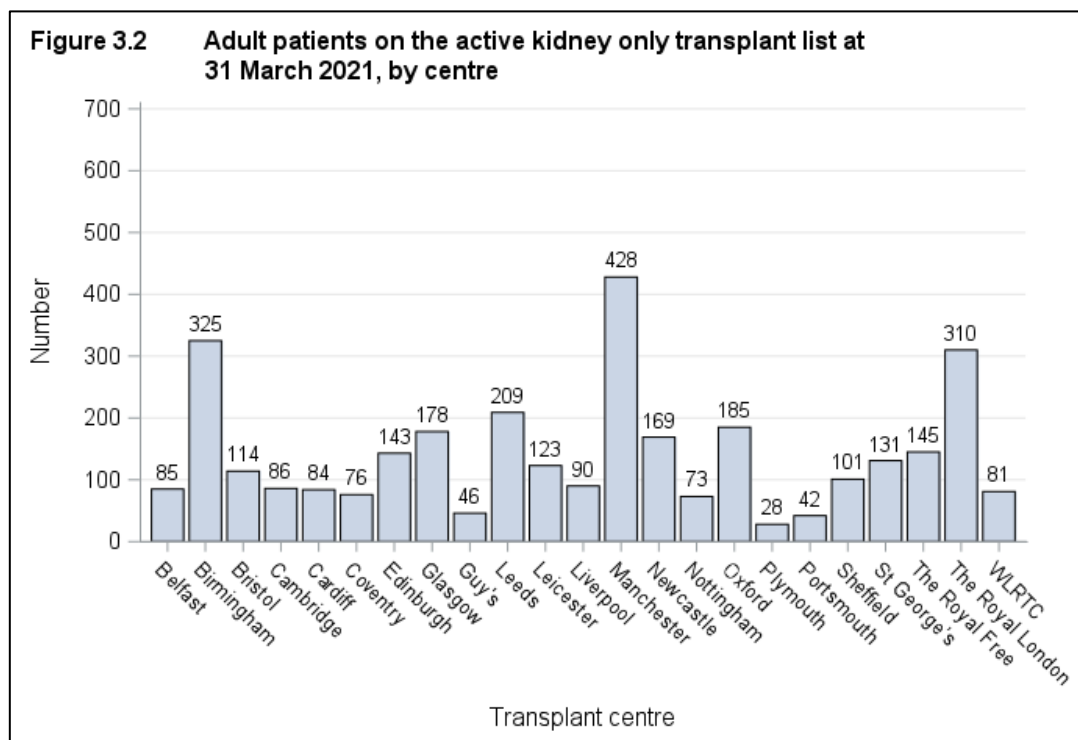


### 3.1 Patients on the kidney transplant list as at 31 March, 2012 – 2021

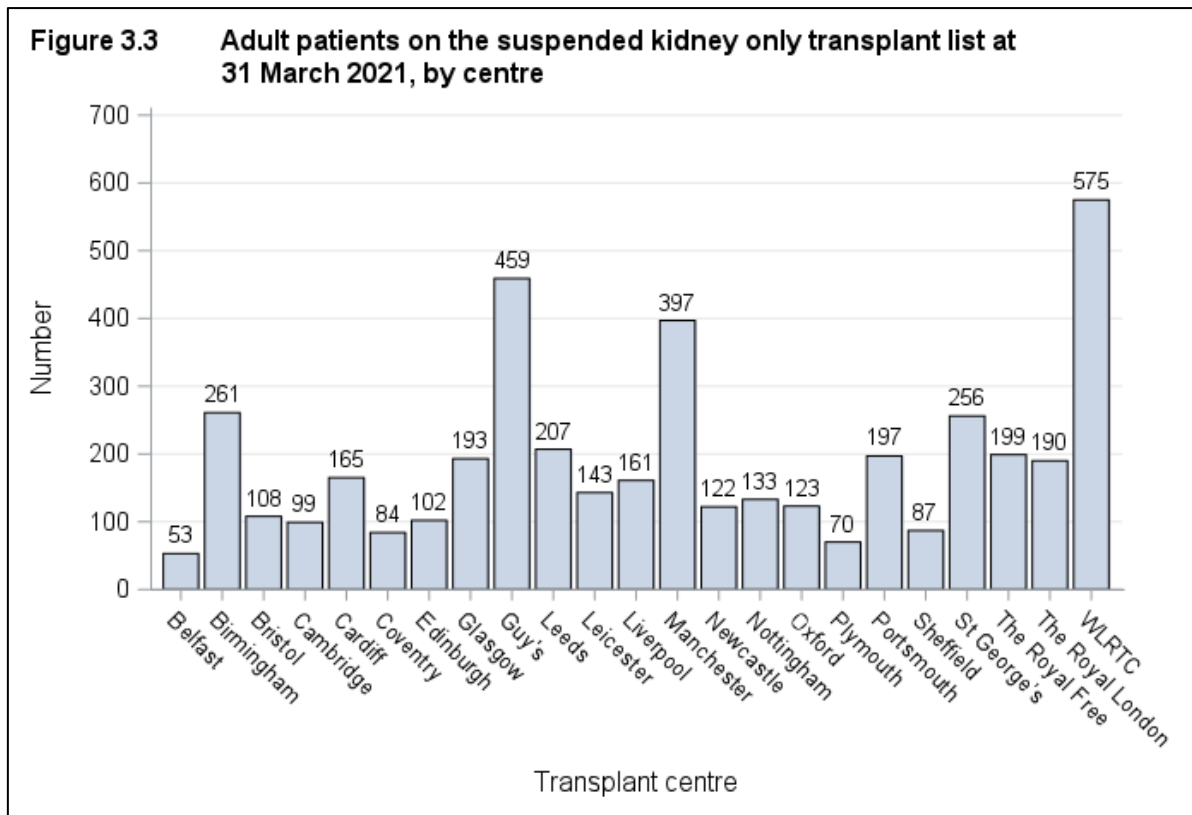
**Figure 3.1** shows the number of adult patients on the kidney only [transplant list](#) at 31 March each year between 2012 and 2021 and at 29 February 2020. The number of patients actively waiting for a kidney transplant decreased from 6,327 in 2012 to 3,252 in 2021.



**Figure 3.2** shows the number of adult patients on the active kidney only [transplant list](#) at 31 March 2021 by centre. In total, there were 3,252 adults patients. Manchester had the largest proportion of the [transplant list](#) (13%) and Plymouth had the smallest (<1%).

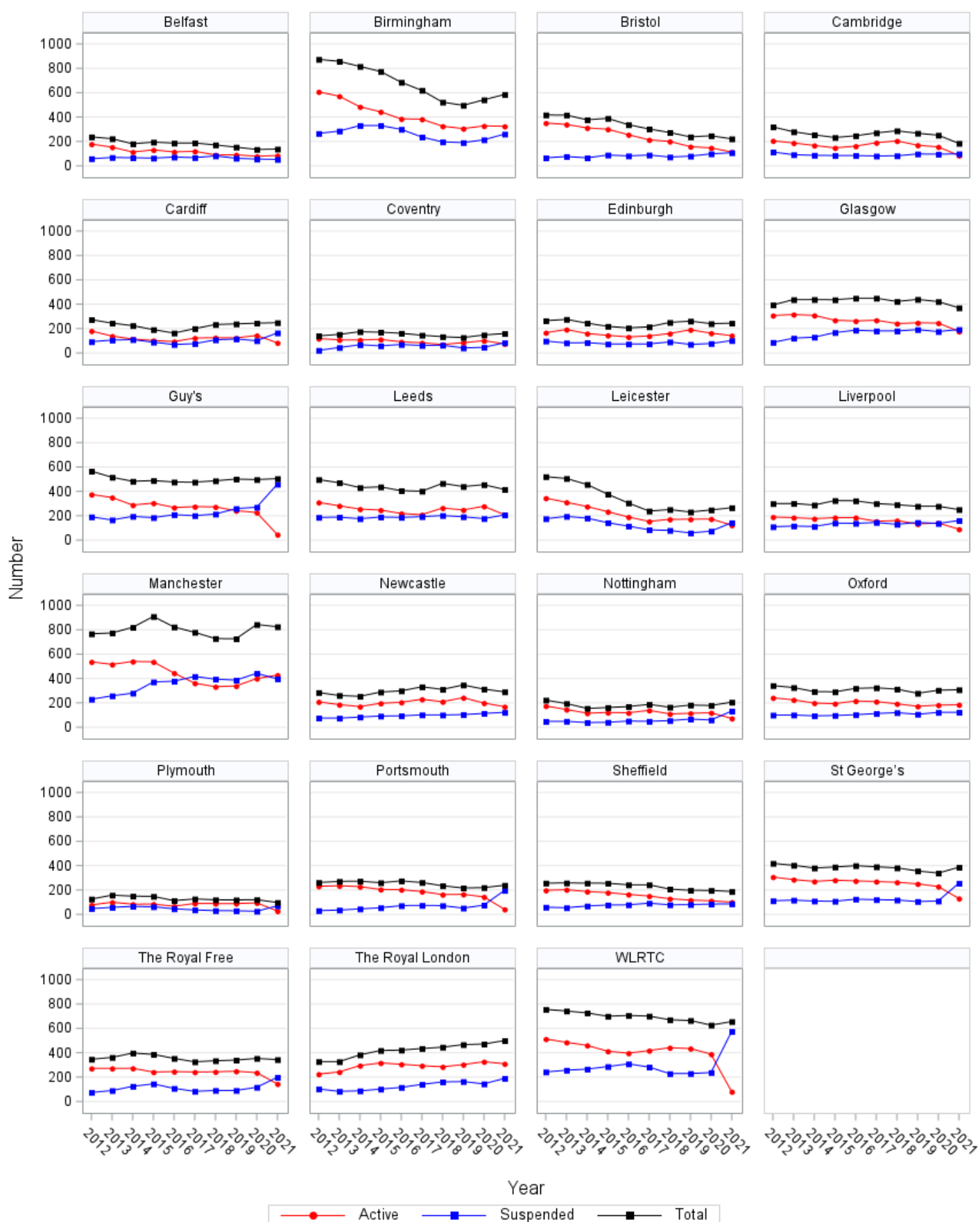


**Figure 3.3** shows the number of adult patients on the suspended kidney only [transplant list](#) at 31 March 2021 by centre. In total, there were 4,386 adults patients. WLRTC had the largest proportion of patients on the suspended [transplant list](#) (13%) and Belfast had the smallest (1%).



**Figure 3.4** shows the number of adult patients on the [transplant list](#) at 31 March each year between 2012 and 2021 and 29 February 2020 for each transplant centre.

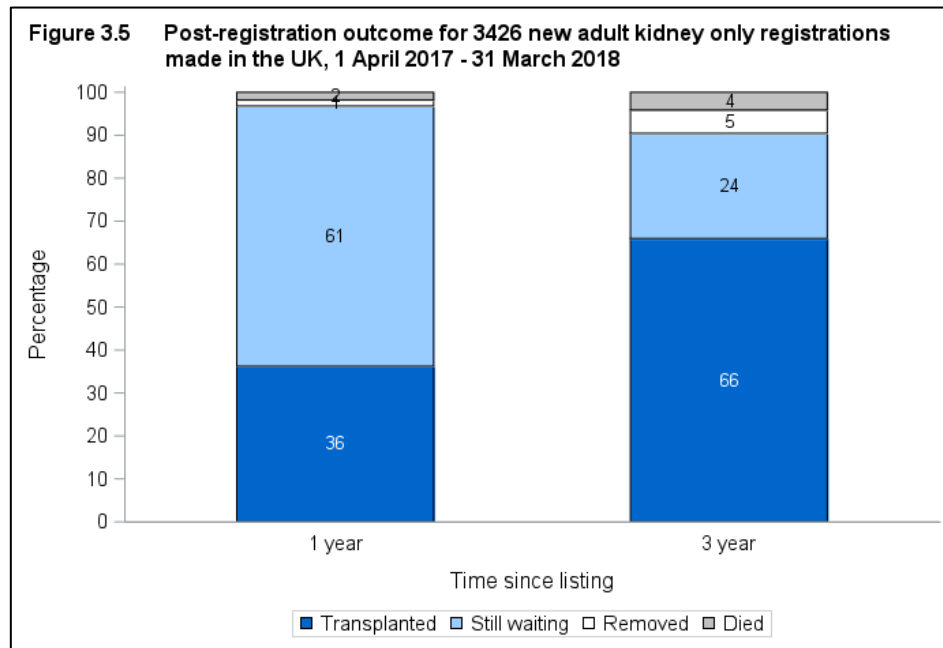
**Figure 3.4 Adult patients on the kidney only transplant list at 31 March\*, by centre**



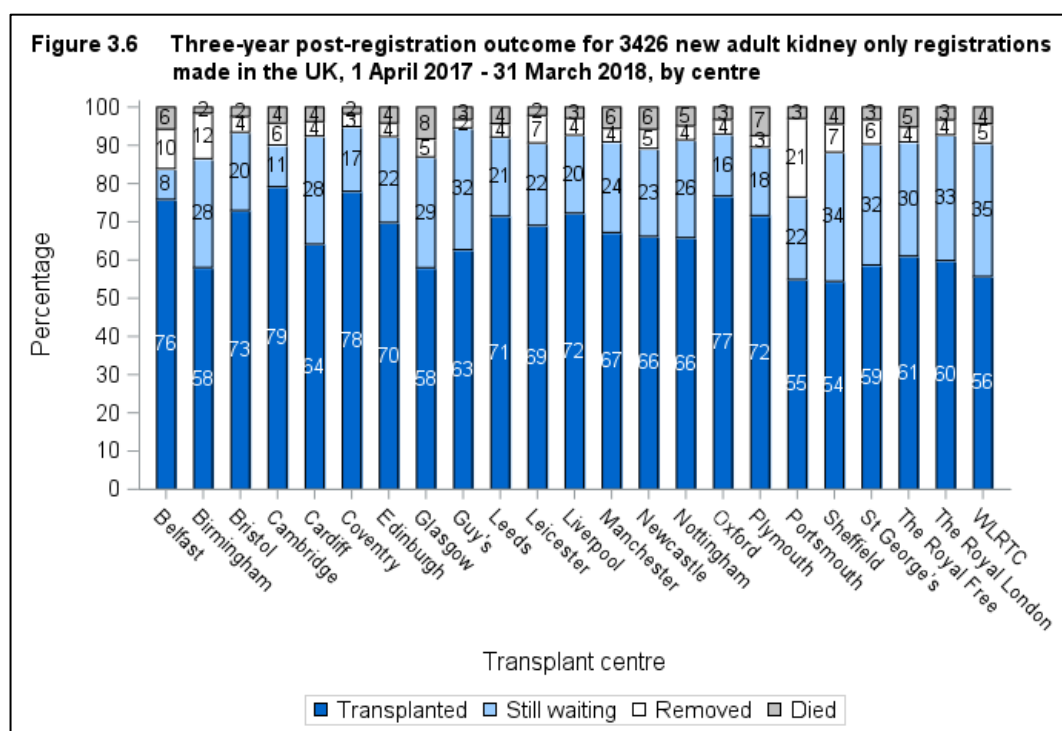
\*At 29 February in 2020

### 3.2 Post-registration outcomes, 1 April 2017 – 31 March 2018

An indication of outcomes for patients listed for a kidney transplant is summarised in **Figure 3.5**. This shows the proportion of patients transplanted or still waiting one and three years after joining the list. It also shows the proportion removed from the [transplant list](#) (typically because they become too unwell for transplant) and those dying while on the [transplant list](#). Only 36% of patients are transplanted within one year, while three years after listing 66% of patients have received a transplant.

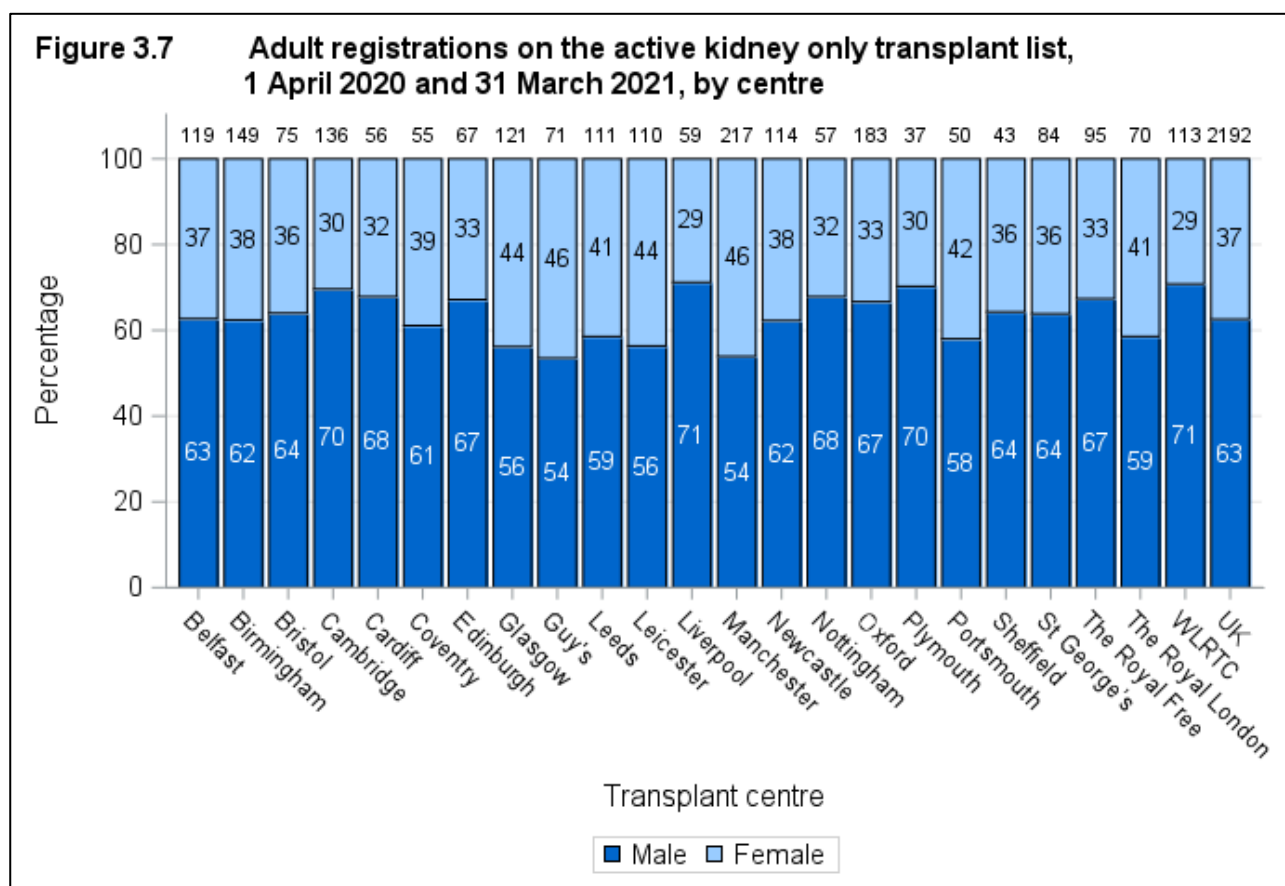


**Figure 3.6** shows the proportion of patients transplanted or still waiting three years after joining the list by centre. The proportion of patients transplanted three years after listing at each centre ranges from 54% at Sheffield to 79% at Cambridge. Higher proportions of transplanted patients can in part be attributed to strong [DCD](#) programmes within centres.

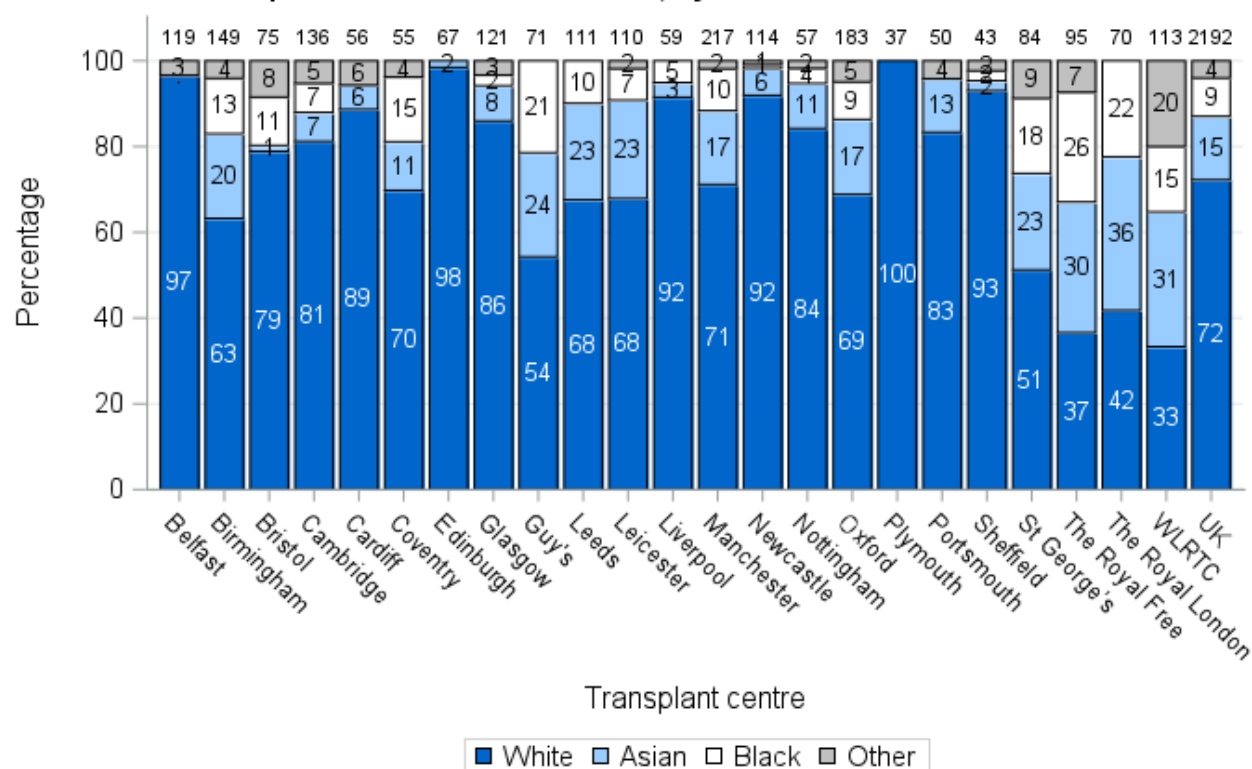


### 3.3 Demographic characteristics, 1 April 2020 – 31 March 2021

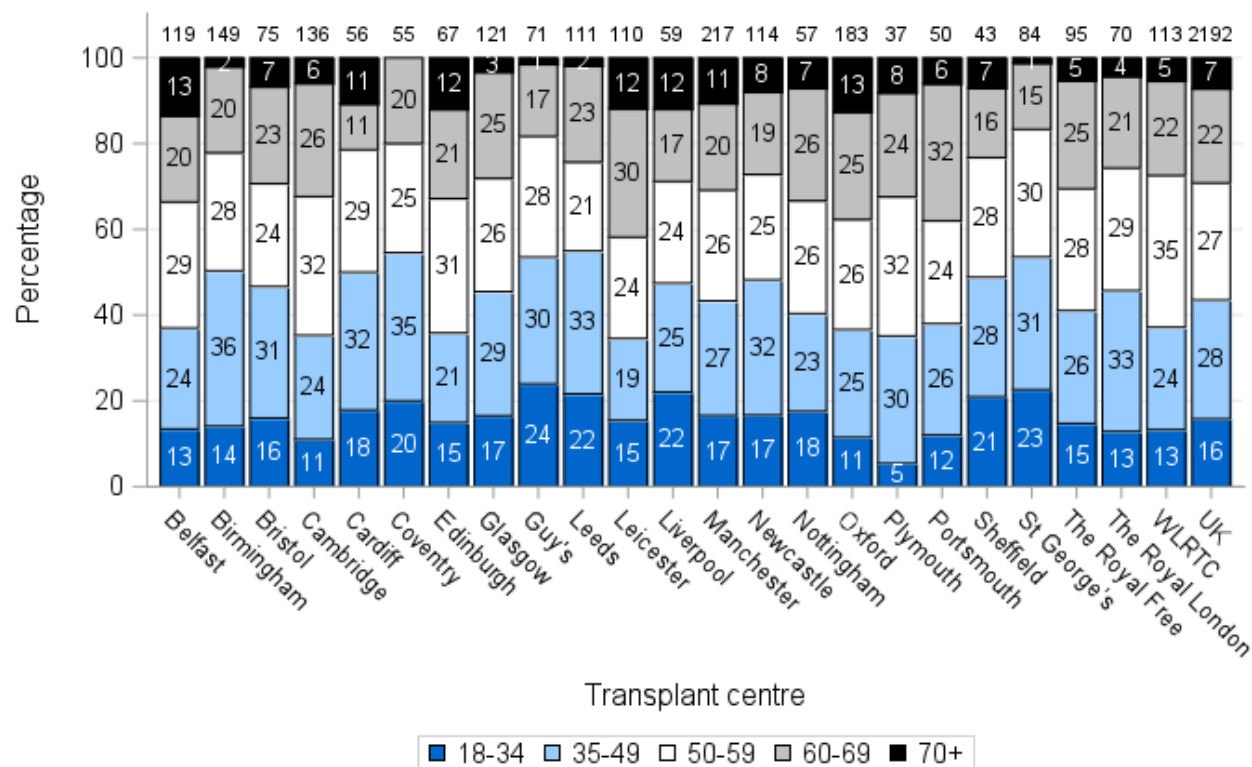
The sex, ethnicity, age group and primary renal disease of patients on the transplant list are shown by centre in **Figure 3.7, 3.8, 3.9 and 3.10**, respectively. Note that all percentages quoted are based only on data where relevant information was available. Data are not presented where the proportion of missing data was over 50%. Changes made to the Kidney Allocation Scheme in 2006, and the 2019 National Kidney Offering Scheme mean that tissue matching criteria between donor and recipient are less strict than previously and waiting time to transplant is now more important than it was in deciding kidney allocation. These changes have an indirect benefit for patients from ethnic minority groups, who are less often a good tissue match with the predominantly white donor pool. As a result, access to transplantation is becoming more equitable.



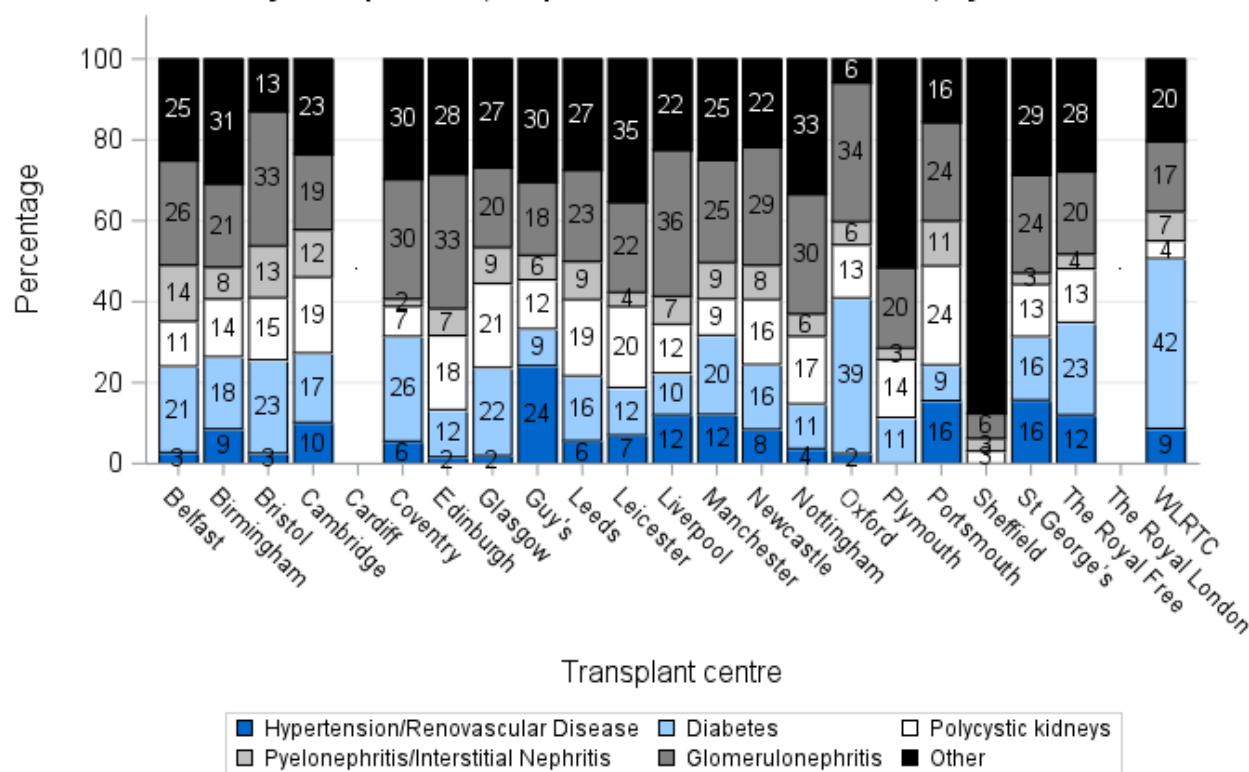
**Figure 3.8 Adult registrations on the active kidney only transplant list, 1 April 2020 and 31 March 2021, by centre**



**Figure 3.9 Adult registrations on the active kidney only transplant list, 1 April 2020 and 31 March 2021, by centre**



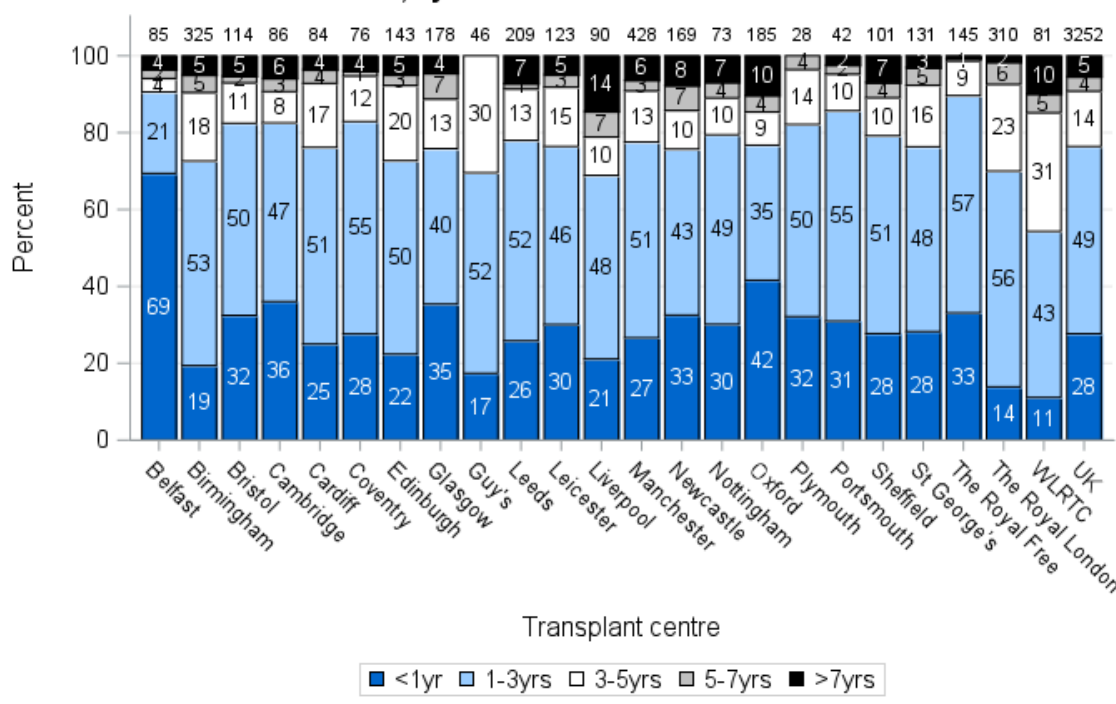
**Figure 3.10 Primary renal disease of adult registrations on the active kidney only transplant list, 1 April 2020 and 31 March 2021, by centre**



### 3.4 Patient waiting times for those currently on the list, 31 March 2021

**Figure 3.11** shows the length of time patients have been waiting on the kidney only [transplant list](#) at 31 March 2020 by centre. A small proportion of patients have been waiting for a transplant for more than seven years, 99% of these are highly sensitised with a calculated reaction frequency (cRF) of 85% or higher. Of those waiting for more than seven years, 92% have a cRF of 100% which makes these patients very difficult to match.

**Figure 3.11 Adult patients on the active kidney only transplant list as at 31 March 2021, by centre**





### 3.5 Median waiting time to transplant, 1 April 2015 – 31 March 2018

The length of time a patient waits for a kidney transplant varies across the UK. The [median](#) waiting time for adult deceased donor kidney only transplantation is shown in **Figure 3.12** and **Table 3.1** for patients registered at each individual unit. Risk-adjusted median waiting time to adult deceased donor kidney only transplantation is shown in **Figure 3.13** and **Table 3.1**. The data shown are for all adult patients, joining the list within the time period shown, including those still awaiting a transplant on the day of analysis. Active waiting time only is taken into account. Patients who received a [live donor](#) or [multi-organ transplant](#) are not included. The national allocation scheme introduced in April 2006 helped to reduce the variability in deceased donor kidney waiting times across the country but currently some variability remains. Waiting times across centres continue to differ in a way that it is difficult for centres to control, given that the 2006 [National Kidney Allocation Scheme](#) determined allocation of all kidneys available for transplant from donors after brain death ([DBD](#)). This has continued following the introductions of the 2019 National Kidney Offering Scheme which determines allocation of all DBD kidneys and kidneys from donations after circulatory death (DCD).

#### 2006 National Kidney Allocation Scheme

Only kidneys from donors after brain death were allocated via a national allocation scheme during the majority of the time period analysed. DCD kidneys were allocated to patients through local allocation arrangements and these vary across the country because some centres have a larger DCD programme than others. From 3 September 2014 one kidney from DCD donors aged between 5 and 49 years were allocated within four pre-defined regions using the 2006 DBD allocation principles and as such should reduce variability in waiting times across the country.

Kidneys from DBD are allocated to patients listed nationally through the 2006 Kidney Allocation Scheme. The 2006 Kidney Allocation Scheme introduced in April 2006 prioritised patients with ideal tissue matches (000 HLA mismatches) and then assigned points to patients based on the level of tissue match between donor and recipient, the length of time spent waiting for a transplant, age of the recipient (with a progressive reduction in points given after the age of thirty) and location points such that patients geographically close to the retrieval centre received more points. The patients with the highest number of points for a donated kidney were preferentially offered the kidney, no matter where in the UK they received their treatment.

#### 2019 National Kidney Offering Scheme

The 2019 Kidney Offering Scheme was introduced on 11 September 2019 and this is a single scheme for offering all kidneys from deceased donors in the UK. This scheme prioritises patients who are difficult to match or have waited a long time for a transplant

We present a visual comparison of median waiting time to transplant among centres that is based on a graphical display known as a [funnel plot](#) (1, 2). This display is used to show how consistent the waiting times of the different transplant units are with the national rate accounting for different patient mix within centres. [Funnel plots](#) show the [risk-adjusted median waiting time to transplant](#) plotted against the number of patients registered at each centre, with the overall national [unadjusted waiting time to transplant](#) (solid line), and its 95% (thin dotted lines) and 99.8% (thick dotted lines) [confidence limits](#) superimposed. Each dot in the plot represents one of the centres.



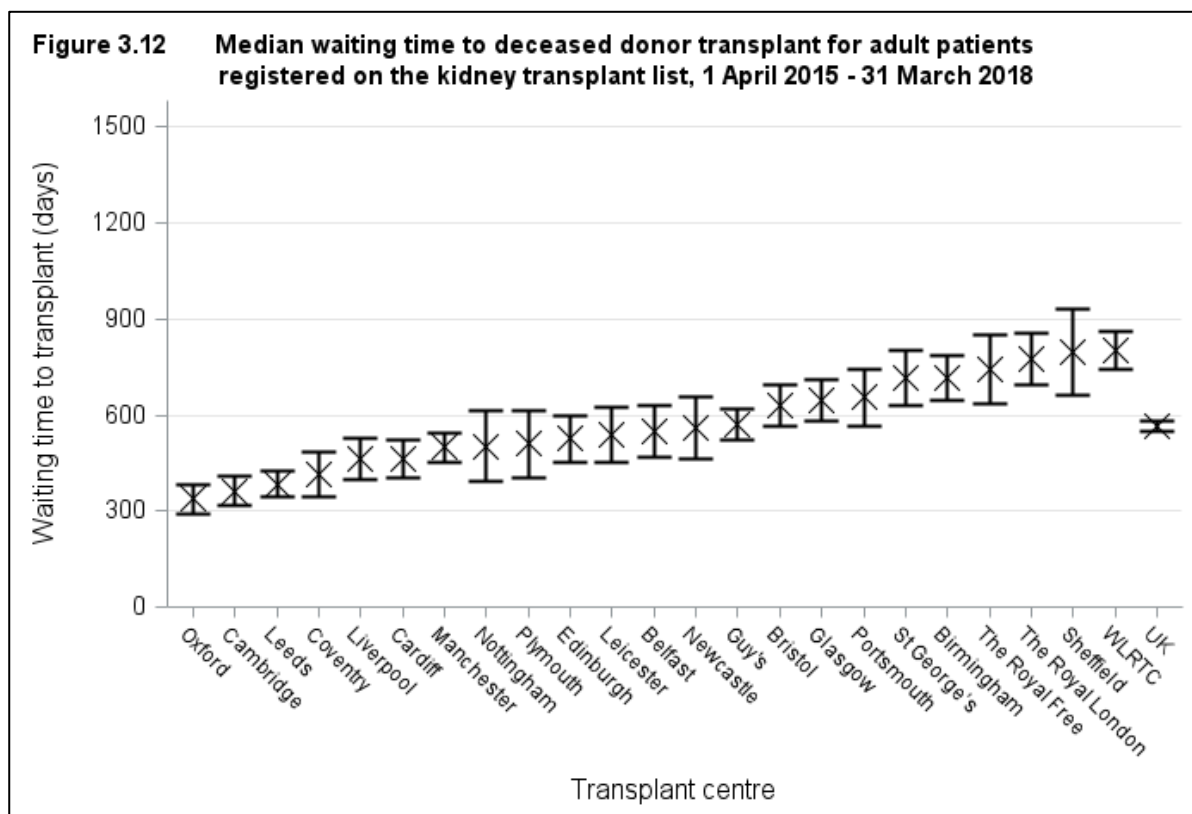
### Interpreting the [funnel plots](#)

If a centre lies within all the limits, then that centre has a median waiting time to transplant that is statistically consistent with the national rate. If a centre lies outside the 95% [confidence limits](#), this serves as an alert that the centre may have a median waiting time to transplant that is significantly different from the national rate. If a centre lies outside the 99.8% limits, then further investigations may be carried out to determine the reasons for the possible difference. When a centre lies above the upper limits, this indicates a median waiting time to transplant that is higher than the national rate, while a centre that lies below the lower limits has a median waiting time to transplant that is lower than the national rate. It is important to note that adjusting for patient mix through the use of risk-adjustment models may not account for all possible causes of centre differences. There may be other factors that are not taken into account in the risk-adjustment process that may affect the median waiting time to transplant of a particular centre.

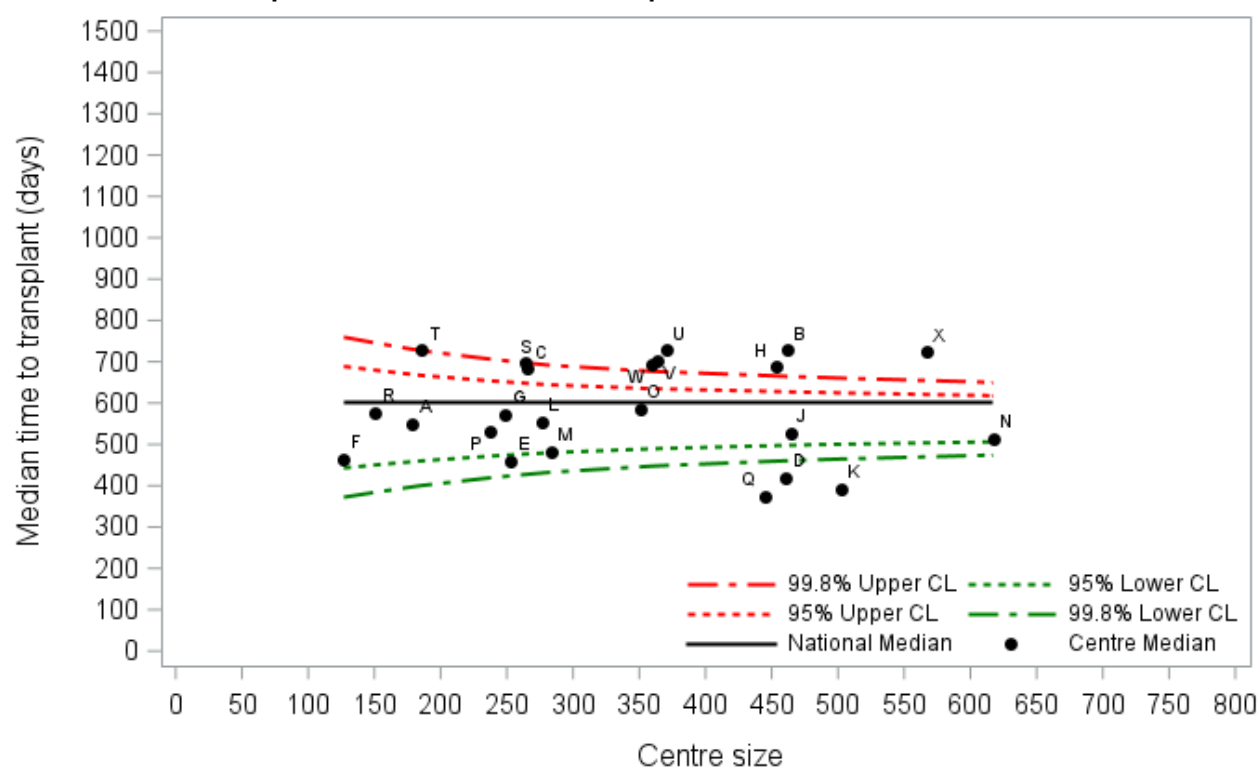
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1. Tekkis PP, McCulloch P, Steger AC, Benjamin IS, Poloniecki JD. Mortality control charts for comparing performance of surgical units: validation study using hospital mortality data. *British Medical Journal* 2003; 326: 786 – 788.
2. Stark J, Gallivan S, Lovegrove J, Hamilton JRL, Monro JL, Pollock JCS, Watterson KG. Mortality rates after surgery for congenital heart defects in children and surgeons' performance. *Lancet* 2000; 355: 1004 – 1007.

The [median](#) waiting time to transplant for adult patients registered on the kidney only [transplant list](#) between 1 April 2015 and 31 March 2018 is 563 days. This ranged from 337 days at Oxford to 800 days at WLRTC.



**Figure 3.13** Adult risk-adjusted median waiting times  
for patients listed between 1 April 2015 and 31 March 2018

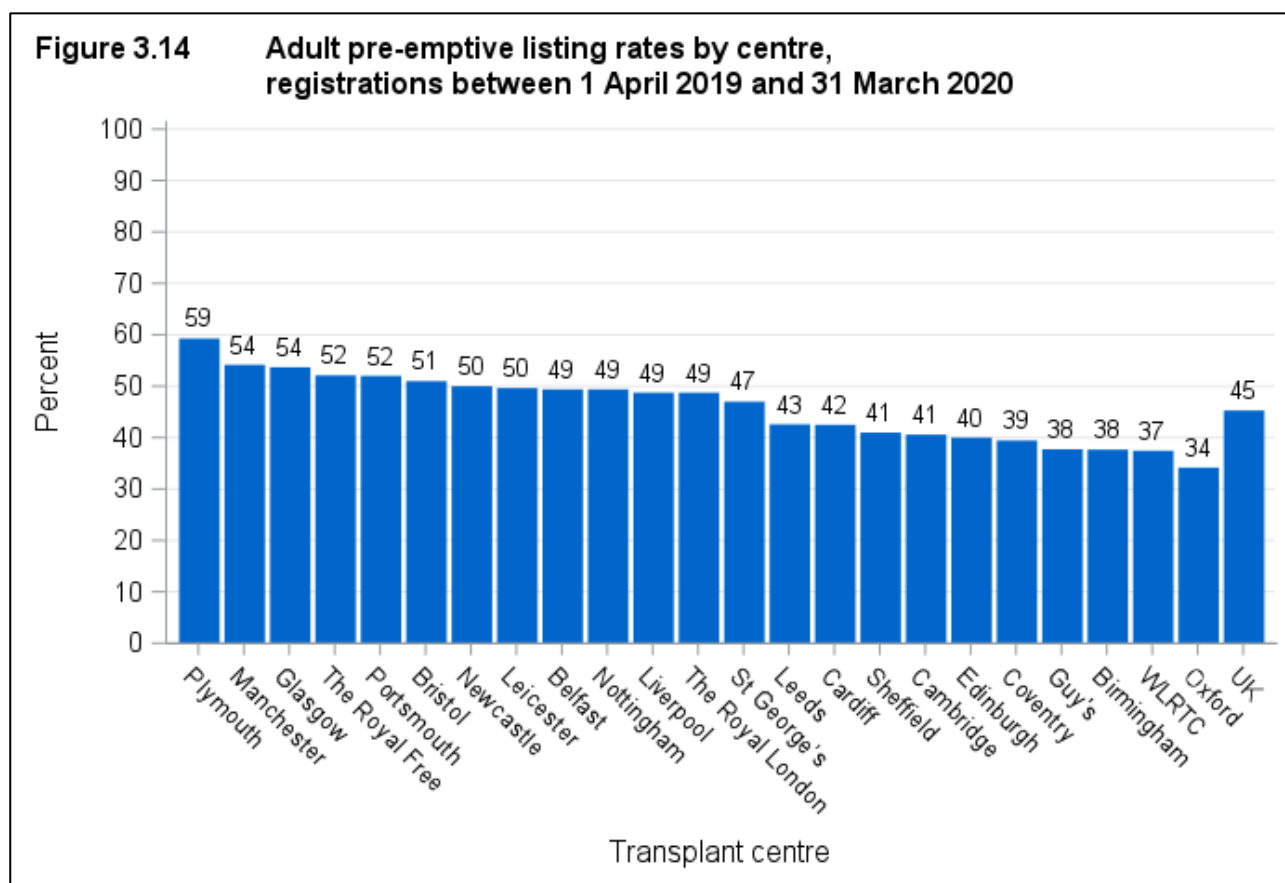


**Table 3.1 Median waiting time to kidney only transplant in the UK,  
for adult patients registered 1 April 2015 - 31 March 2018**

Transplant centre	Code	Number of patients registered	Waiting time (days)		
			Unadjusted Median	95% Confidence interval	Risk-adjusted median
Adult					
Oxford	Q	451	337	292 - 382	374
Cambridge	D	466	363	316 - 410	418
Leeds	K	508	385	344 - 426	394
Coventry	F	129	413	343 - 483	466
Liverpool	M	284	463	401 - 525	481
Cardiff	E	262	463	402 - 524	462
Manchester	N	619	500	455 - 545	515
Nottingham	P	239	503	394 - 612	532
Plymouth	R	152	509	406 - 612	576
Edinburgh	G	252	526	453 - 599	574
Leicester	L	280	539	452 - 626	556
Belfast	A	179	550	468 - 632	549
Newcastle	O	353	561	464 - 658	586
Guy's	J	473	571	521 - 621	529
Bristol	C	269	629	564 - 694	684
Glasgow	H	457	644	579 - 709	689
Portsmouth	S	265	655	567 - 743	700
St George's	U	375	714	627 - 801	729
Birmingham	B	466	715	647 - 783	729
The Royal Free	V	365	742	636 - 848	701
The Royal London	W	374	773	692 - 854	695
Sheffield	T	190	797	664 - 930	728
WLRTC	X	572	800	741 - 859	726
UK		7980	563	547 - 579	

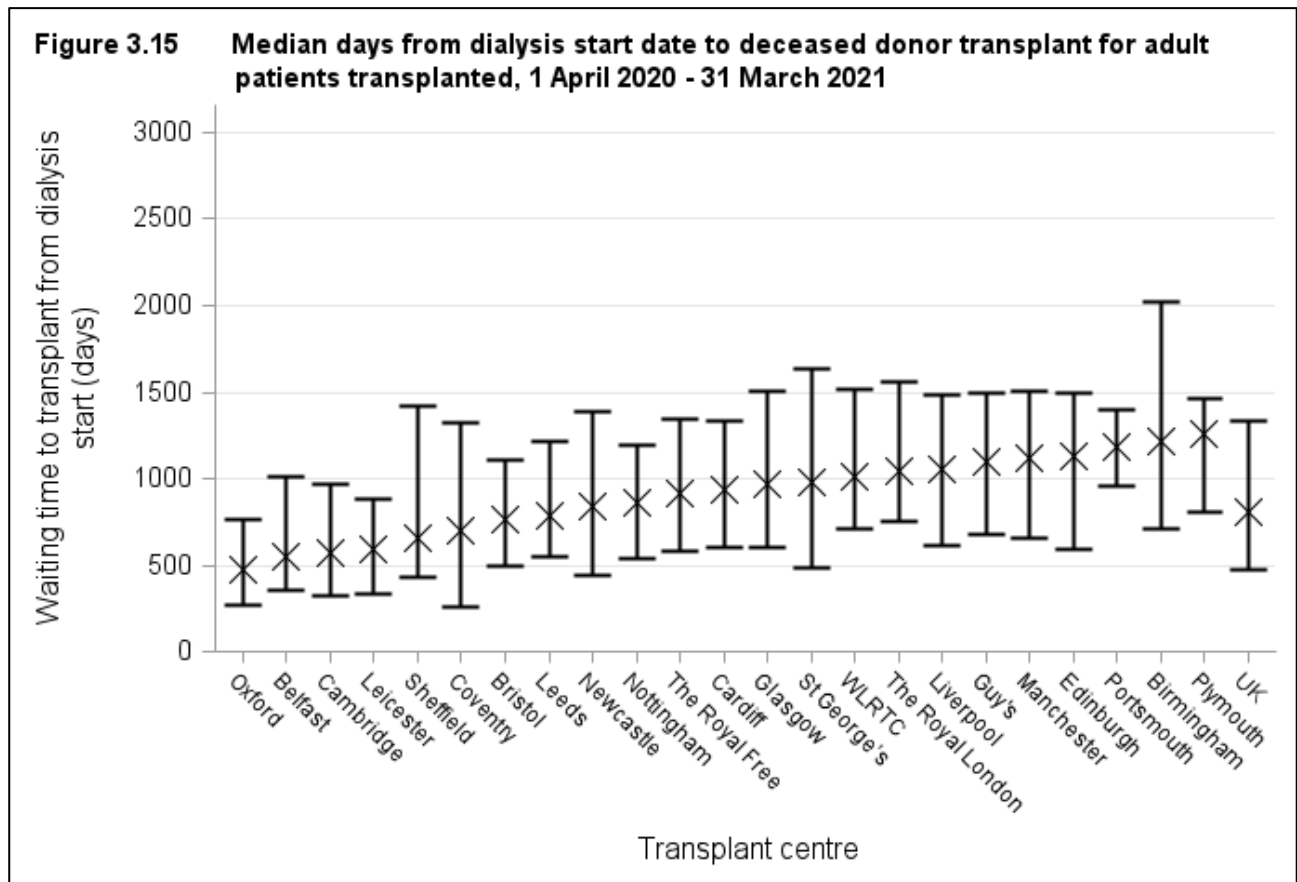
### 3.6 Pre-emptive listing rates, 1 April 2019 - 31 March 2020

Rates of [pre-emptive](#) kidney only listings are shown in **Figure 3.14** for adult patients joining the list between 1 April 2019 and 31 March 2020. Patients listed on the deceased donor [transplant list](#) prior to receiving a living donor transplant are excluded and in order to remove the effect of these patients an earlier cohort was selected. [Pre-emptive](#) listing accounted for 45% of all adult registrations across the UK ranging from 59% at Plymouth to 34% at Oxford.



### 3.7 Median time from start of dialysis to transplant, 1 April 2020 - 31 March 2021

The median time from dialysis start date to deceased donor transplant for adult patients transplanted between 1 April 2020 and 31 March 2021 is shown in **Figure 3.15**. The UK [median](#) time is 813 days. This ranged from 475 days at Oxford to 1257 days at Plymouth.



## **Response to adult kidney offers**

## Offer decline rates

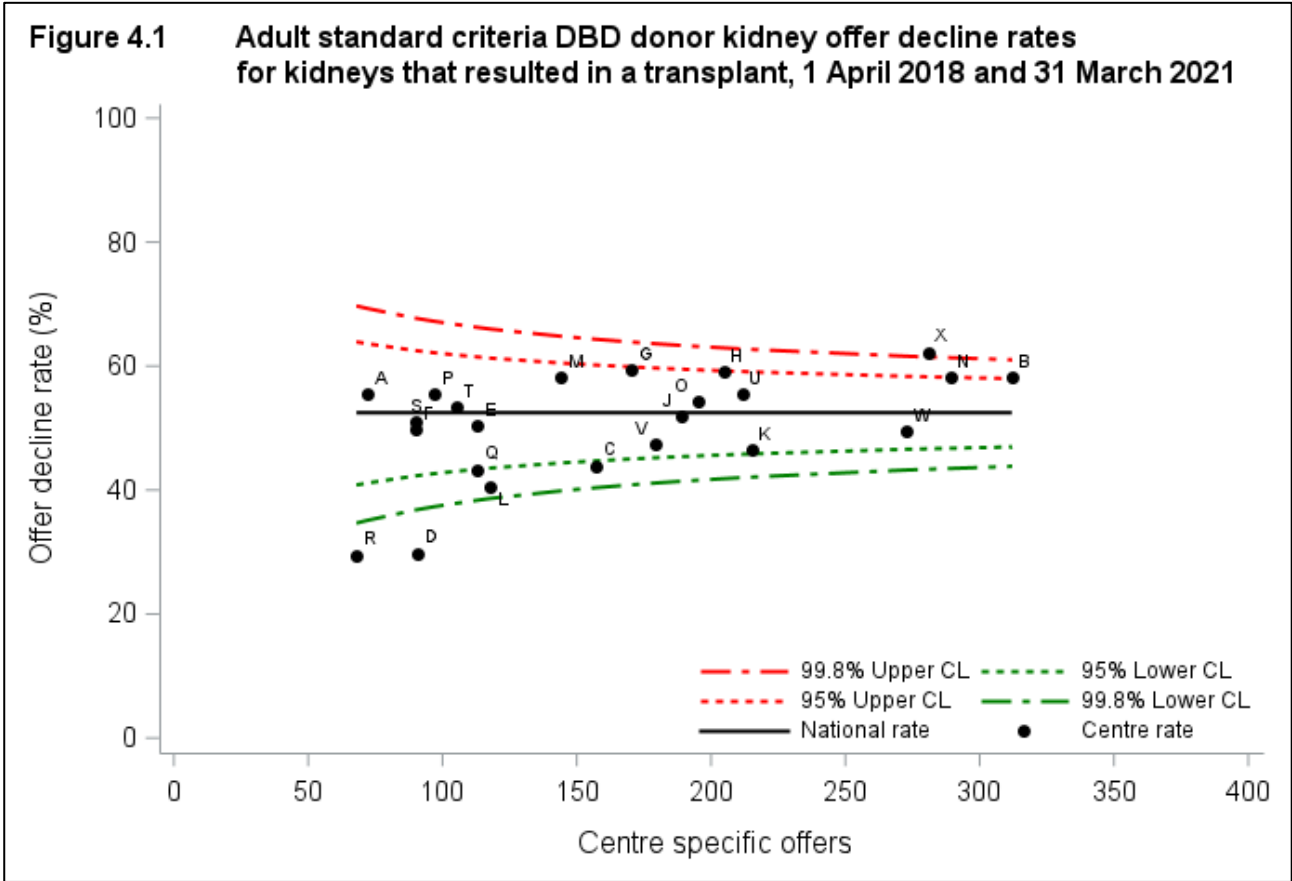
Kidney-only offers from [DBD](#) and [DCD](#) donors who had at least one kidney retrieved, offered directly and on behalf of a named individual patient and resulted in transplantation are included in the analysis. Any offers made through the reallocation of kidneys, declined kidney or fast track schemes were excluded. Only offers through the [DCD](#) kidney allocation scheme are presented, all local [DCD](#) offers are excluded.

In order to understand centre practices more fully, data are presented separately for [DBD](#) and [DCD](#) standard and extended criteria donors (SCD & ECD). ECD have been defined as donors aged  $\geq 60$  years at the time of death OR aged 50 to 59 years with at least two or three donor characteristics: hypertension, creatinine  $> 130 \mu\text{mol/l}$  or death due to intracranial haemorrhage. SCD are donors that did not meet the ECD criteria.

[Funnel plots](#) were used to compare centre specific offer decline rates and indicate how consistent the rates of the individual transplant centres are with the national rate. The overall national unadjusted offer decline rate is shown by the solid line while the 95% and 99.8% confidence lines are indicated via a thin and thick dotted line, respectively. Each dot in the plot represents an individual transplant centre. Centres that are positioned above the upper limits indicate an offer decline rate that is higher than the national rate, while centres positioned below the lower limits indicate an offer decline rate that is lower than the national rate. Patient [case mix](#) is known to influence the number of offers a centre may receive. In this analysis however only individual offers for named patients were considered which excluded any [ABO](#)- and HLA-incompatible patients. For this reason it was decided not to risk adjust for known centre differences in patient [case mix](#).

4.1 DBD Standard criteria offer decline rates, 1 April 2018 – 31 March 2021

**Figure 4.1** compares individual centre offer decline rates with the national rate for SCD over the time period, 1 April 2018 and 31 March 2021. Centres can be identified by the information shown in **Table 4.1**.



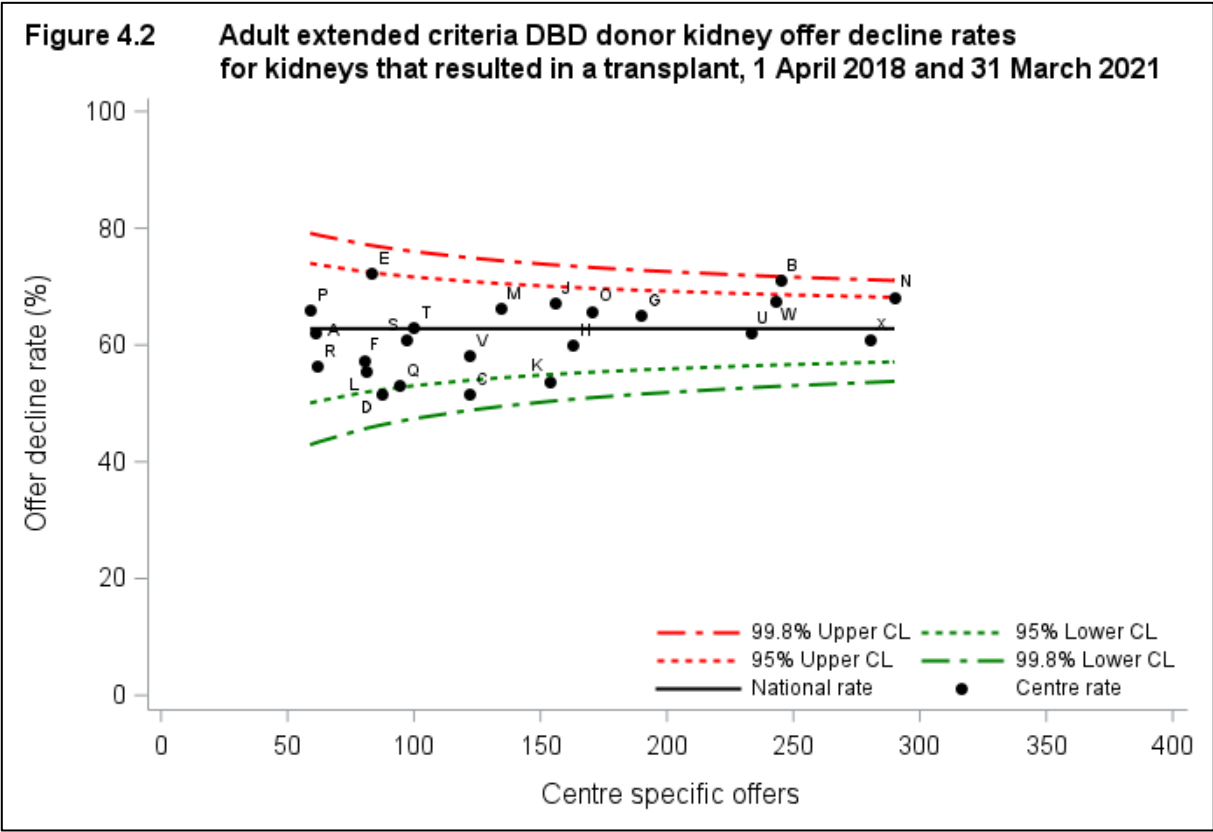


**Table 4.1** compares individual centre offer decline rates for SCD over time by financial year.

<b>Table 4.1 Adult standard criteria DBD donor kidney offer decline rates by transplant centre, 1 April 2018 and 31 March 2021</b>									
Centre	Code	2018/19		2019/20		2020/21		Overall	
		N	(%)	N	(%)	N	(%)	N	(%)
Belfast	A	17	(53)	17	(12)	38	(76)	72	(56)
Birmingham	B	77	(43)	112	(57)	123	(69)	312	(58)
Bristol	C	55	(42)	47	(49)	55	(42)	157	(44)
Cambridge	D	31	(29)	29	(17)	31	(42)	91	(30)
Cardiff	E	35	(49)	31	(48)	47	(53)	113	(50)
Coventry	F	28	(25)	26	(62)	36	(61)	90	(50)
Edinburgh	G	47	(55)	46	(50)	77	(68)	170	(59)
Glasgow	H	58	(52)	64	(55)	83	(67)	205	(59)
Guy's	J	86	(51)	70	(51)	33	(55)	189	(52)
Leeds	K	78	(42)	62	(37)	75	(59)	215	(47)
Leicester	L	37	(27)	50	(40)	31	(58)	118	(41)
Liverpool	M	43	(42)	47	(53)	54	(76)	144	(58)
Manchester	N	70	(51)	82	(46)	137	(69)	289	(58)
Newcastle	O	60	(60)	53	(53)	82	(51)	195	(54)
Nottingham	P	26	(54)	42	(50)	29	(66)	97	(56)
Oxford	Q	41	(46)	29	(45)	43	(40)	113	(43)
Plymouth	R	23	(30)	20	(25)	25	(32)	68	(29)
Portsmouth	S	40	(45)	39	(56)	11	(55)	90	(51)
Sheffield	T	31	(45)	28	(32)	46	(72)	105	(53)
St George's	U	70	(49)	93	(56)	49	(65)	212	(56)
The Royal Free	V	46	(39)	69	(52)	64	(48)	179	(47)
The Royal London	W	104	(41)	97	(48)	72	(63)	273	(49)
WLRTC	X	96	(60)	110	(63)	75	(64)	281	(62)
<b>UK</b>		<b>1199</b>	<b>(46)</b>	<b>1263</b>	<b>(50)</b>	<b>1316</b>	<b>(61)</b>	<b>3778</b>	<b>(53)</b>
		Centre has reached the upper 99.8% confidence limit							
		Centre has reached the upper 95% confidence limit							
		Centre has reached the lower 95% confidence limit							
		Centre has reached the lower 99.8% confidence limit							

**4.2 DBD Extended criteria offer decline rates, 1 April 2018 – 31 March 2021**

**Figure 4.2** compares individual centre offer decline rates with the national rate for ECD over the time period, 1 April 2018 and 31 March 2021. Centres can be identified by the information shown in **Table 4.2**.

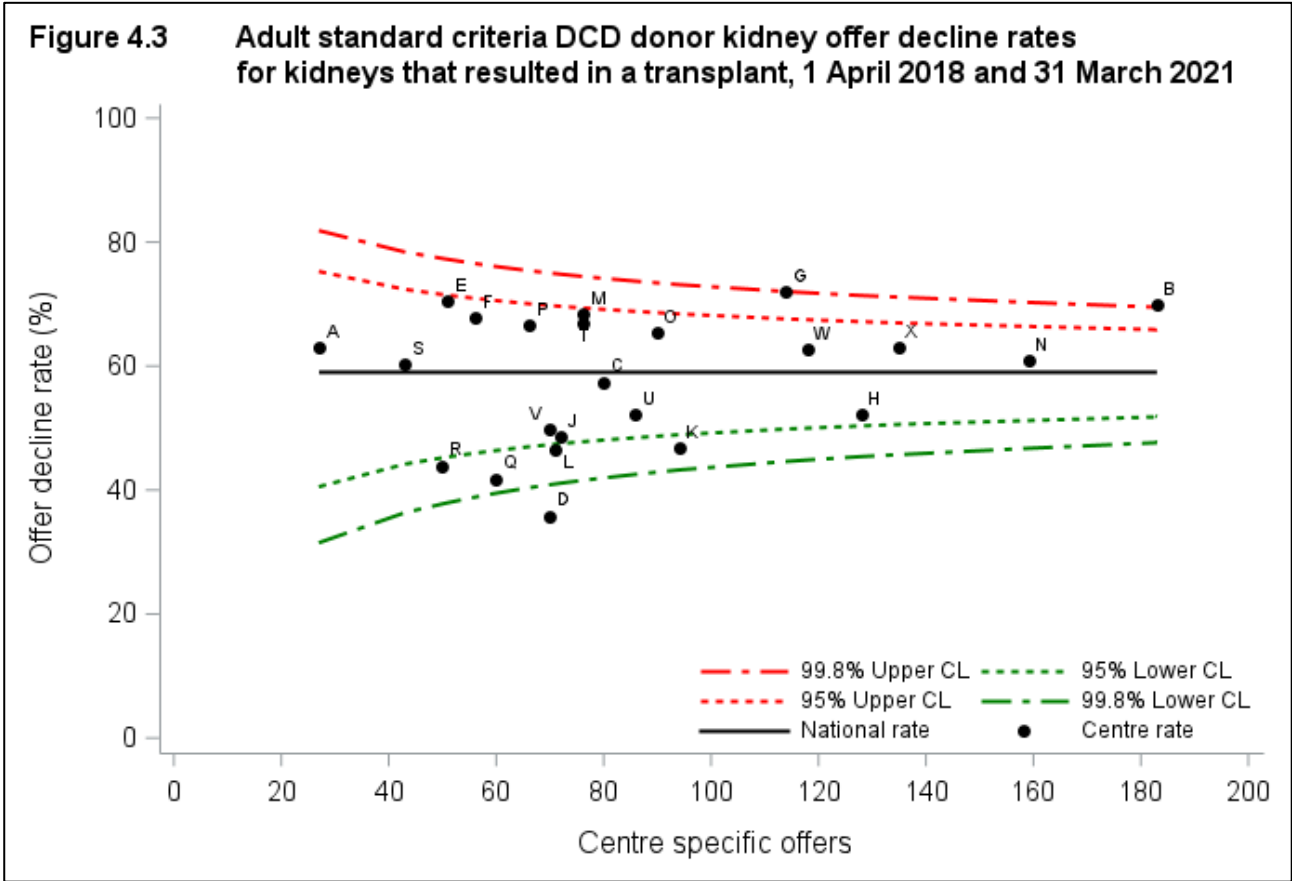


**Table 4.2** compares individual centre offer decline rates for ECD over time by financial year.

<b>Table 4.2 Adult extended criteria DBD donor kidney offer decline rates by transplant centre, 1 April 2018 and 31 March 2021</b>									
Centre	Code	2018/19		2019/20		2020/21		Overall	
		N	(%)	N	(%)	N	(%)	N	(%)
Belfast	A	25	(64)	17	(59)	19	(63)	61	(62)
Birmingham	B	89	(64)	87	(66)	69	(87)	245	(71)
Bristol	C	58	(50)	42	(50)	22	(59)	122	(52)
Cambridge	D	39	(54)	30	(50)	18	(50)	87	(52)
Cardiff	E	35	(69)	22	(64)	26	(85)	83	(72)
Coventry	F	19	(53)	36	(47)	25	(76)	80	(58)
Edinburgh	G	67	(61)	56	(61)	67	(73)	190	(65)
Glasgow	H	71	(63)	46	(46)	46	(70)	163	(60)
Guy's	J	87	(75)	47	(62)	22	(50)	156	(67)
Leeds	K	57	(47)	41	(51)	56	(63)	154	(54)
Leicester	L	33	(42)	20	(60)	28	(68)	81	(56)
Liverpool	M	56	(68)	40	(63)	38	(68)	134	(66)
Manchester	N	90	(58)	71	(56)	129	(82)	290	(68)
Newcastle	O	65	(74)	52	(63)	53	(58)	170	(66)
Nottingham	P	23	(43)	20	(80)	16	(81)	59	(66)
Oxford	Q	42	(55)	29	(52)	23	(52)	94	(53)
Plymouth	R	26	(58)	16	(50)	20	(60)	62	(56)
Portsmouth	S	49	(61)	38	(63)	10	(50)	97	(61)
Sheffield	T	54	(69)	31	(52)	15	(67)	100	(63)
St George's	U	110	(70)	88	(52)	35	(63)	233	(62)
The Royal Free	V	41	(63)	44	(59)	37	(51)	122	(58)
The Royal London	W	128	(74)	89	(57)	26	(69)	243	(67)
WLRTC	X	103	(62)	104	(55)	73	(68)	280	(61)
<b>UK</b>		<b>1367</b>	<b>(63)</b>	<b>1066</b>	<b>(57)</b>	<b>873</b>	<b>(69)</b>	<b>3306</b>	<b>(63)</b>
		Centre has reached the upper 99.8% confidence limit							
		Centre has reached the upper 95% confidence limit							
		Centre has reached the lower 95% confidence limit							
		Centre has reached the lower 99.8% confidence limit							

4.3 DCD Standard criteria offer decline rates, 1 April 2018 – 31 March 2021

**Figure 4.3** compares individual centre offer decline rates with the national rate for SCD over the time period, 1 April 2018 and 31 March 2021. Centres can be identified by the information shown in **Table 4.3**.



**Table 4.3** compares individual centre offer decline rates for SCD over time by financial year.

<b>Table 4.3 Adult standard criteria DCD donor kidney offer decline rates by transplant centre, 1 April 2018 and 31 March 2021</b>									
Centre	Code	2018/19		2019/20		2020/21		Overall	
		N	(%)	N	(%)	N	(%)	N	(%)
Belfast	A	3	(0)	12	(58)	12	(83)	27	(63)
Birmingham	B	34	(47)	84	(70)	65	(82)	183	(70)
Bristol	C	24	(58)	17	(47)	39	(62)	80	(58)
Cambridge	D	24	(33)	17	(35)	29	(38)	70	(36)
Cardiff	E	13	(38)	12	(75)	26	(85)	51	(71)
Coventry	F	10	(40)	22	(68)	24	(79)	56	(68)
Edinburgh	G	23	(70)	36	(53)	55	(85)	114	(72)
Glasgow	H	30	(40)	44	(39)	54	(70)	128	(52)
Guy's	J	25	(36)	34	(53)	13	(62)	72	(49)
Leeds	K	15	(33)	30	(47)	49	(51)	94	(47)
Leicester	L	11	(18)	30	(43)	30	(60)	71	(46)
Liverpool	M	19	(53)	29	(79)	28	(68)	76	(68)
Manchester	N	17	(59)	60	(58)	82	(63)	159	(61)
Newcastle	O	15	(67)	28	(68)	47	(64)	90	(66)
Nottingham	P	10	(50)	24	(75)	32	(66)	66	(67)
Oxford	Q	15	(13)	26	(54)	19	(47)	60	(42)
Plymouth	R	17	(29)	12	(50)	21	(52)	50	(44)
Portsmouth	S	18	(56)	15	(47)	10	(90)	43	(60)
Sheffield	T	13	(77)	29	(59)	34	(71)	76	(67)
St George's	U	40	(28)	25	(68)	21	(81)	86	(52)
The Royal Free	V	17	(29)	33	(48)	20	(70)	70	(50)
The Royal London	W	41	(44)	52	(67)	25	(84)	118	(63)
WLRTC	X	35	(57)	54	(63)	46	(67)	135	(63)
<b>UK</b>		<b>469</b>	<b>(44)</b>	<b>725</b>	<b>(59)</b>	<b>781</b>	<b>(68)</b>	<b>1975</b>	<b>(59)</b>
		Centre has reached the upper 99.8% confidence limit							
		Centre has reached the upper 95% confidence limit							
		Centre has reached the lower 95% confidence limit							
		Centre has reached the lower 99.8% confidence limit							

#### 4.4 Reallocation of kidneys, 1 April 2018 – 31 March 2021

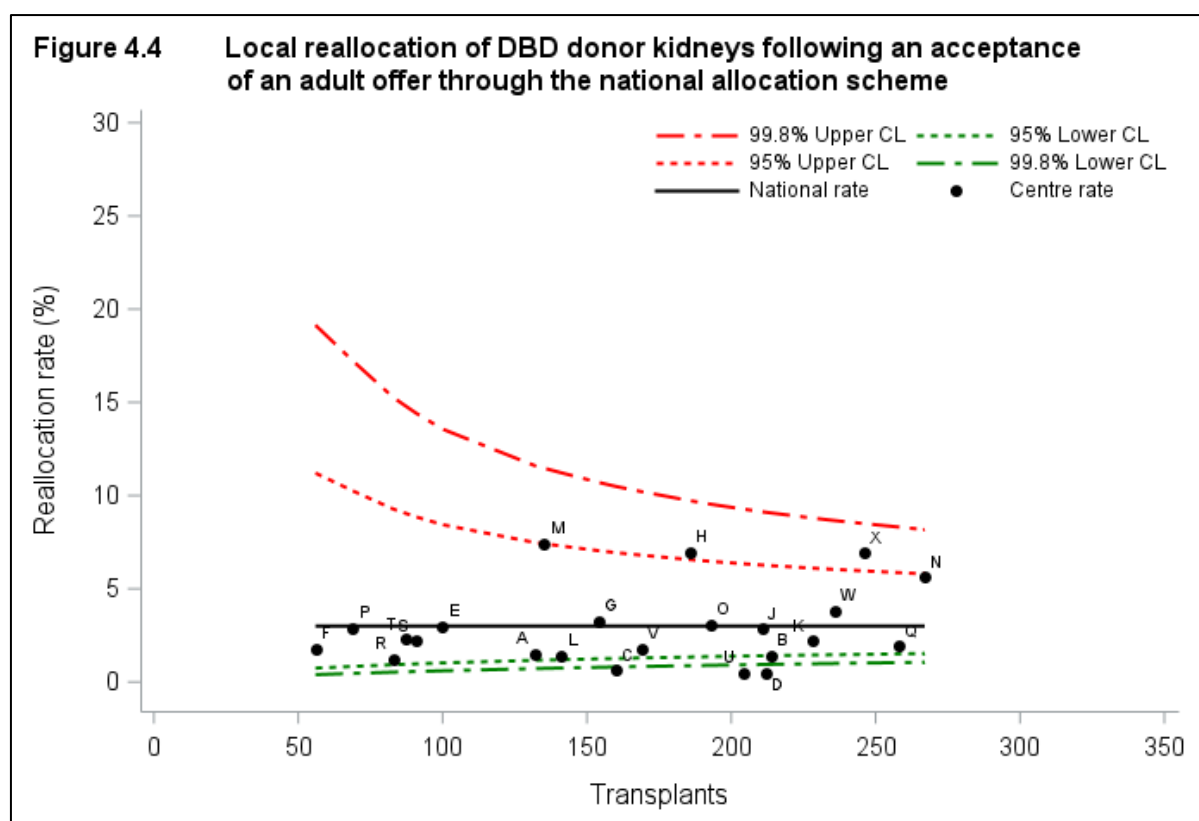
Between 3 April 2006 and 11 September 2019 all kidneys from donation after brain death (DBD) donors have been allocated through the 2006 National Kidney Allocation Scheme. There are however certain situations when a kidney can be reallocated to an alternative patient of the centre's choice. This occurs when the kidney is accepted and dispatched to a named patient but is subsequently declined and there are no other patients listed nationally who fall within Tiers A to D of the kidney allocation scheme (000 mismatched adult and paediatric patients or favourably matched paediatric patients).

In this situation the centre in receipt of the kidney can reallocate the organ to a locally listed patient of their choice based on an individual centre matching run.

Since 11 September 2019 all kidneys from deceased donors have been allocated through the 2019 National Kidney Offering Scheme. In a similar fashion to the 2006 scheme, if a kidney needs to be reallocated because the patient for whom the kidney has been accepted cannot subsequently receive the transplant then the kidney can be reallocated to an alternative patient of the centre's choice if the kidney has been dispatched to the transplant centre and there are no suitable patients in Tier A.

[Funnel plots](#) were used to compare centre specific reallocation rates and indicate how consistent the rates of the individual transplant centres are with the national rate. The overall national reallocation rate is shown by the solid line while the 95% and 99.8% confidence lines are indicated via a thin and thick dotted line, respectively. Each dot in the plot represents an individual transplant centre. Centres that are positioned above the upper limits indicate a reallocation rate that is higher than the national rate, while centres positioned below the lower limits indicates a reallocation rate that is lower than the national rate.

**Figure 4.4** compares individual centre reallocation rates with the national rate over the time period, 1 April 2018 and 31 March 2021. Centres can be identified by the information shown in **Table 4.4**. Nationally 3% of all [DBD](#) kidney only transplants used kidneys that had been reallocated.



**Table 4.4** compares individual reallocation rates over time by financial year.

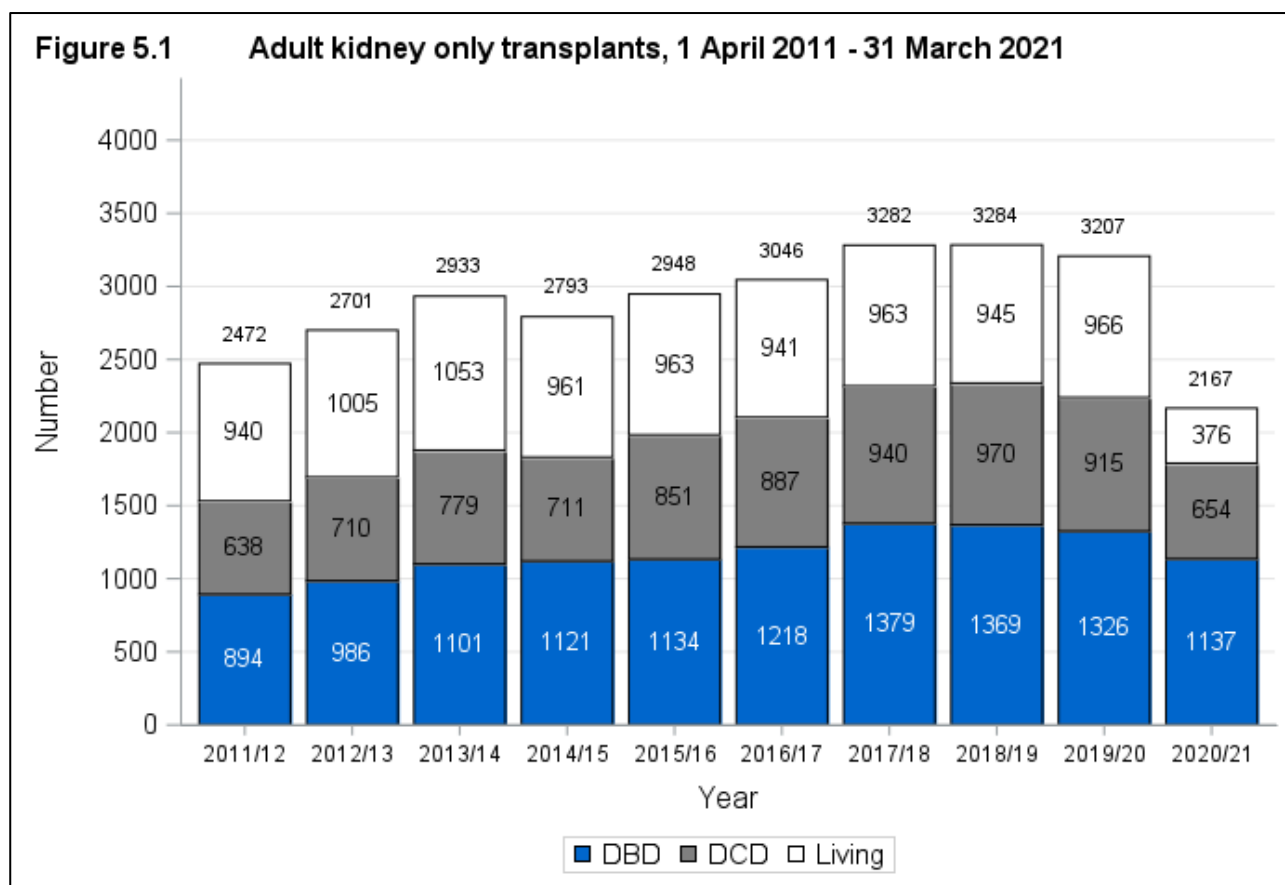
<b>Table 4.4 Local reallocation of DBD donor kidneys following an acceptance of an adult offer through the national allocation scheme</b>									
Centre	Code	2018/19		2019/20		2020/21		Overall	
		N	(%)	N	(%)	N	(%)	N	(%)
Belfast	A	20	(10)	25	(0)	87	(0)	132	(2)
Birmingham	B	79	(1)	83	(0)	52	(4)	214	(1)
Bristol	C	62	(0)	49	(2)	49	(0)	160	(1)
Cambridge	D	66	(2)	64	(0)	82	(0)	212	(0)
Cardiff	E	37	(3)	34	(3)	29	(3)	100	(3)
Coventry	F	23	(0)	24	(0)	9	(11)	56	(2)
Edinburgh	G	53	(4)	50	(2)	51	(4)	154	(3)
Glasgow	H	60	(7)	63	(3)	63	(11)	186	(7)
Guy's	J	93	(1)	88	(6)	30	(0)	211	(3)
Leeds	K	88	(2)	74	(1)	66	(3)	228	(2)
Leicester	L	57	(0)	48	(4)	36	(0)	141	(1)
Liverpool	M	54	(7)	48	(10)	33	(3)	135	(7)
Manchester	N	103	(7)	89	(6)	75	(4)	267	(6)
Newcastle	O	51	(2)	54	(4)	88	(3)	193	(3)
Nottingham	P	25	(0)	28	(0)	16	(13)	69	(3)
Oxford	Q	78	(4)	56	(4)	124	(0)	258	(2)
Plymouth	R	30	(3)	27	(0)	26	(0)	83	(1)
Portsmouth	S	43	(5)	37	(0)	11	(0)	91	(2)
Sheffield	T	35	(3)	35	(3)	17	(0)	87	(2)
St George's	U	72	(0)	89	(1)	43	(0)	204	(0)
The Royal Free	V	56	(4)	54	(2)	59	(0)	169	(2)
The Royal London	W	100	(5)	101	(4)	35	(0)	236	(4)
WLRTC	X	84	(8)	106	(6)	56	(7)	246	(7)
<b>UK</b>		<b>1369</b>	<b>(3)</b>	<b>1326</b>	<b>(3)</b>	<b>1137</b>	<b>(2)</b>	<b>3832</b>	<b>(3)</b>
		Centre has reached the upper 99.8% confidence limit							
		Centre has reached the upper 95% confidence limit							
		Centre has reached the lower 95% confidence limit							
		Centre has reached the lower 99.8% confidence limit							

# **Adult kidney transplants**

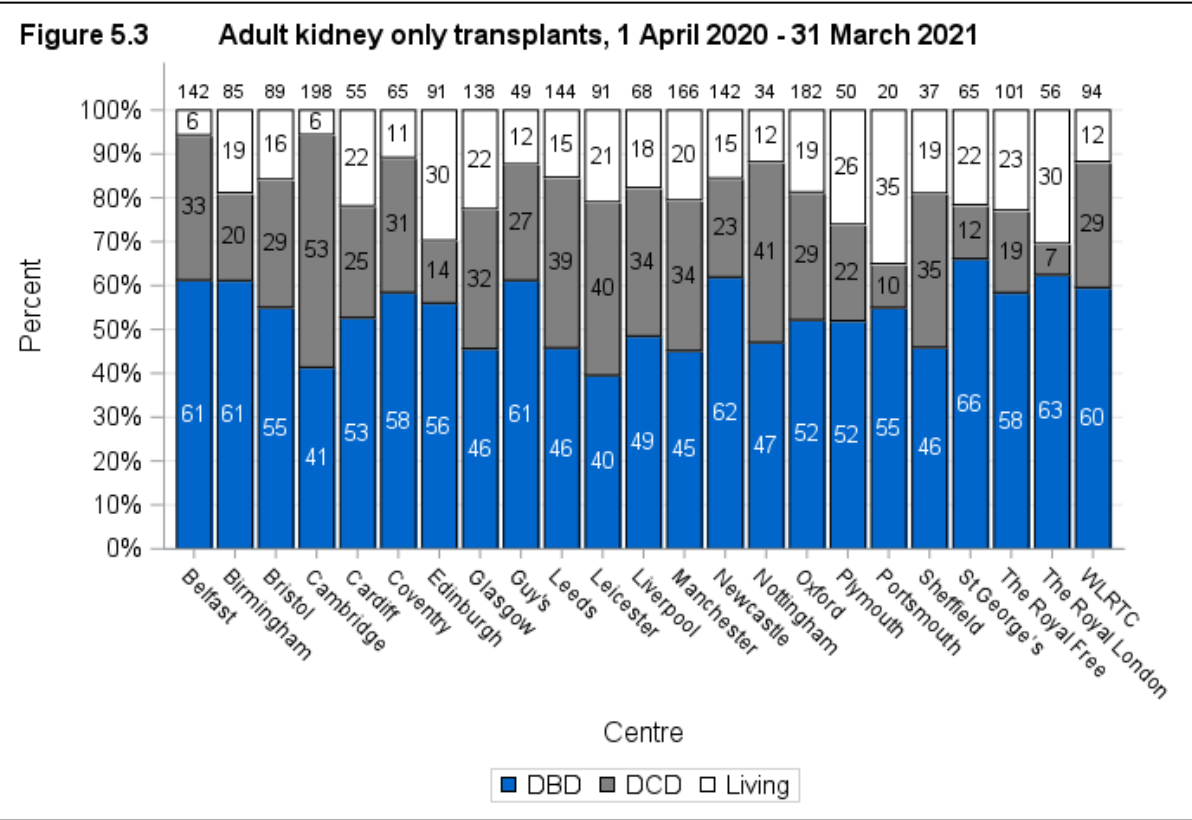
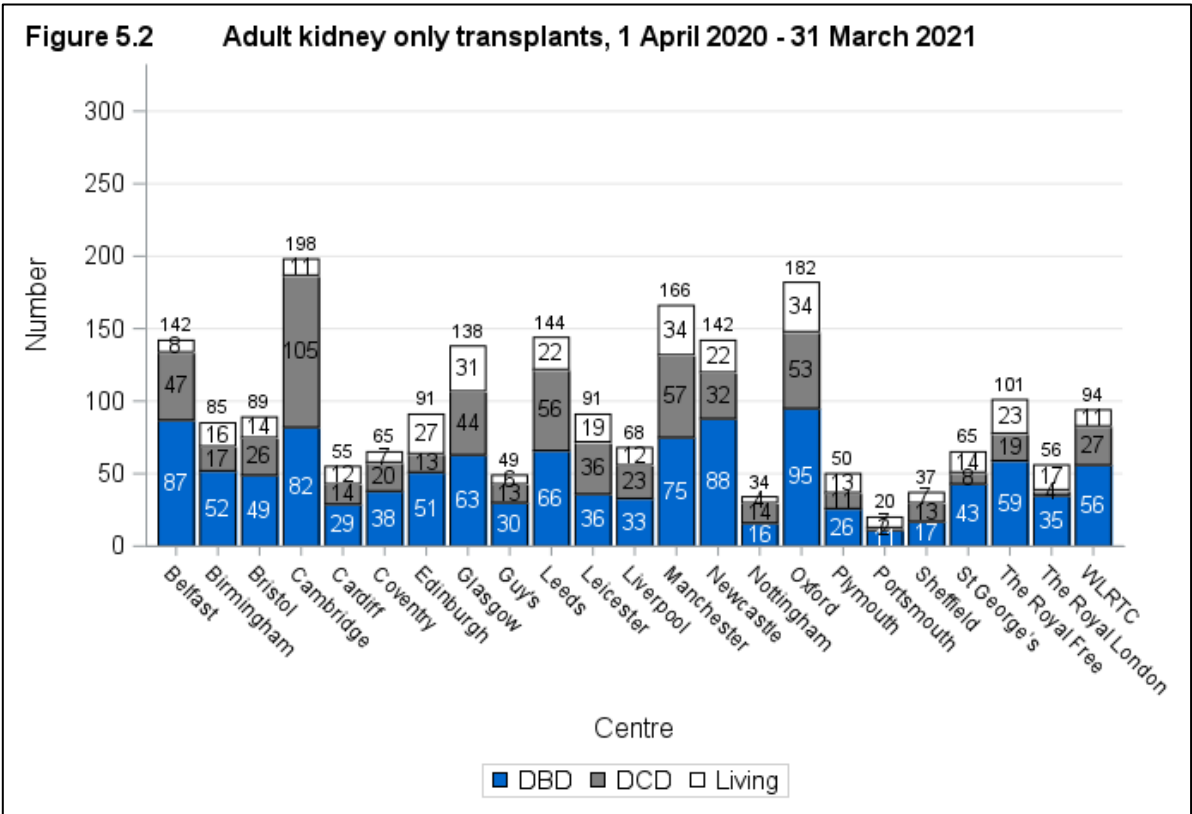


## 5.1 Kidney only transplants, 1 April 2011 – 31 March 2021

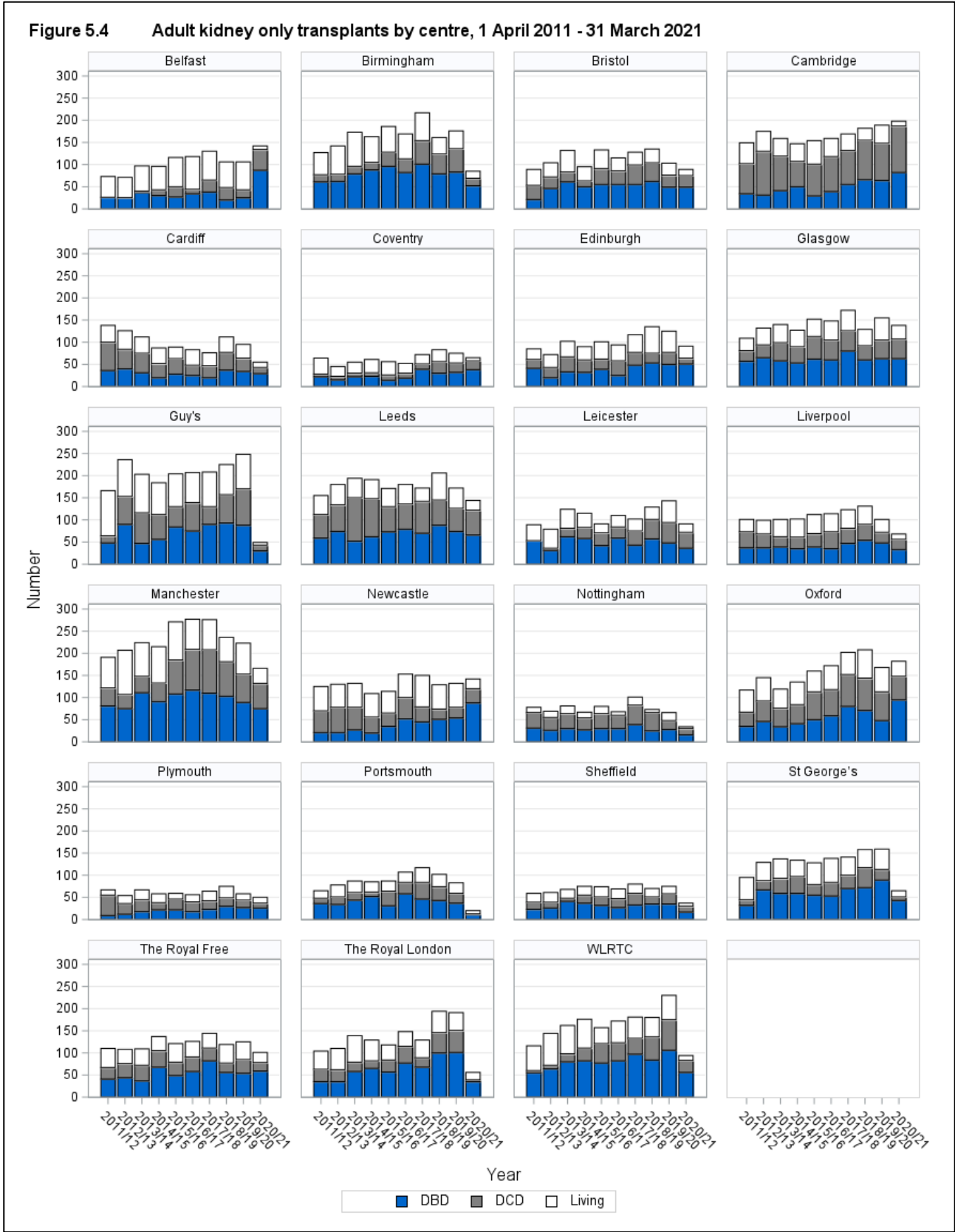
**Figure 5.1** shows the total number of adult kidney only transplants performed in the last ten years, by type of donor. The number of adult transplants from donors after circulatory death ([DCD](#)) steadily increased from 638 in 2011/12 to 970 in 2018/19 with a dip in activity since. The number of adult transplants from donors after brain death ([DBD](#)) increased from 894 in 2011/12 to 1379 in 2017/18 with a decrease to 1326 in 2019/20 and a further decrease this year. The number of adult living kidney transplants performed was steadily increasing over time from 940 in 2011/12 to 1053 in 2013/14 before decreasing to 966 in 2019/20 and to 376 in 2020/21.



**Figure 5.2** shows the total number of adult kidney only transplants performed in 2020/21, by centre and type of donor. The same information is presented in **Figure 5.3**, but this shows the proportion of [DBD](#), [DCD](#) and living donor transplants performed at each centre.

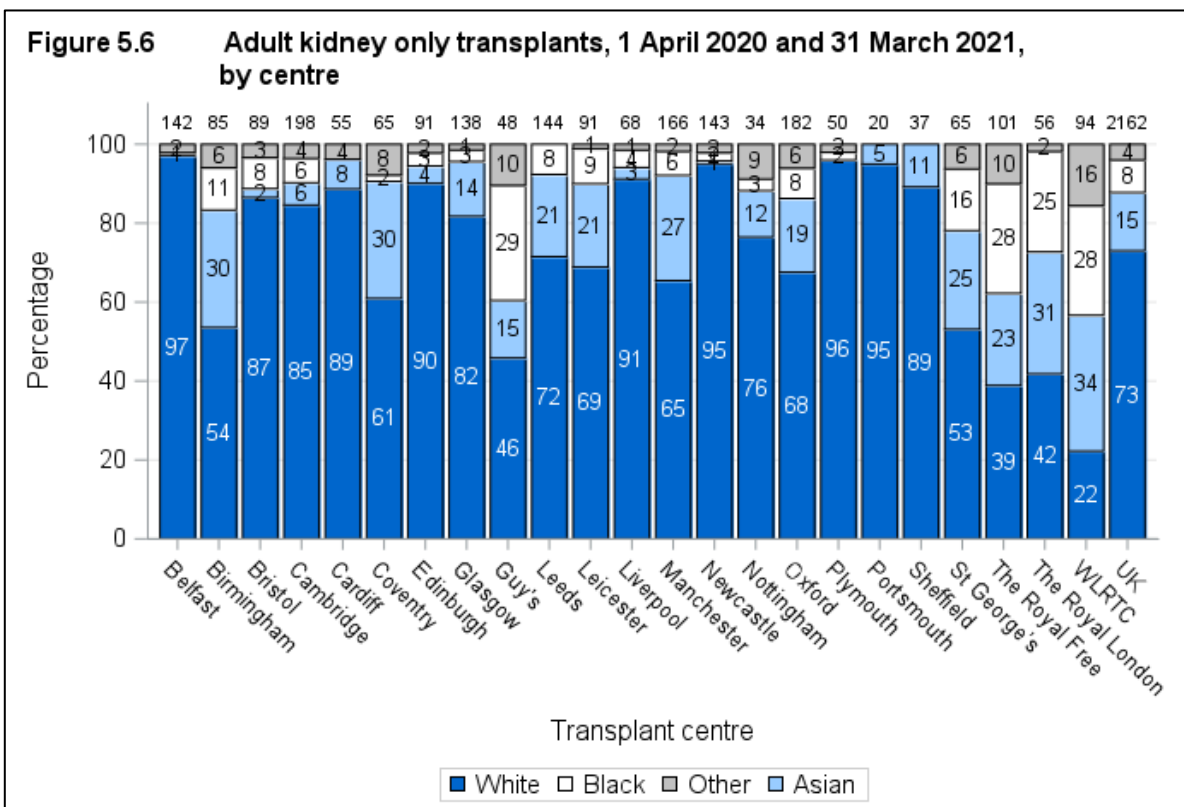
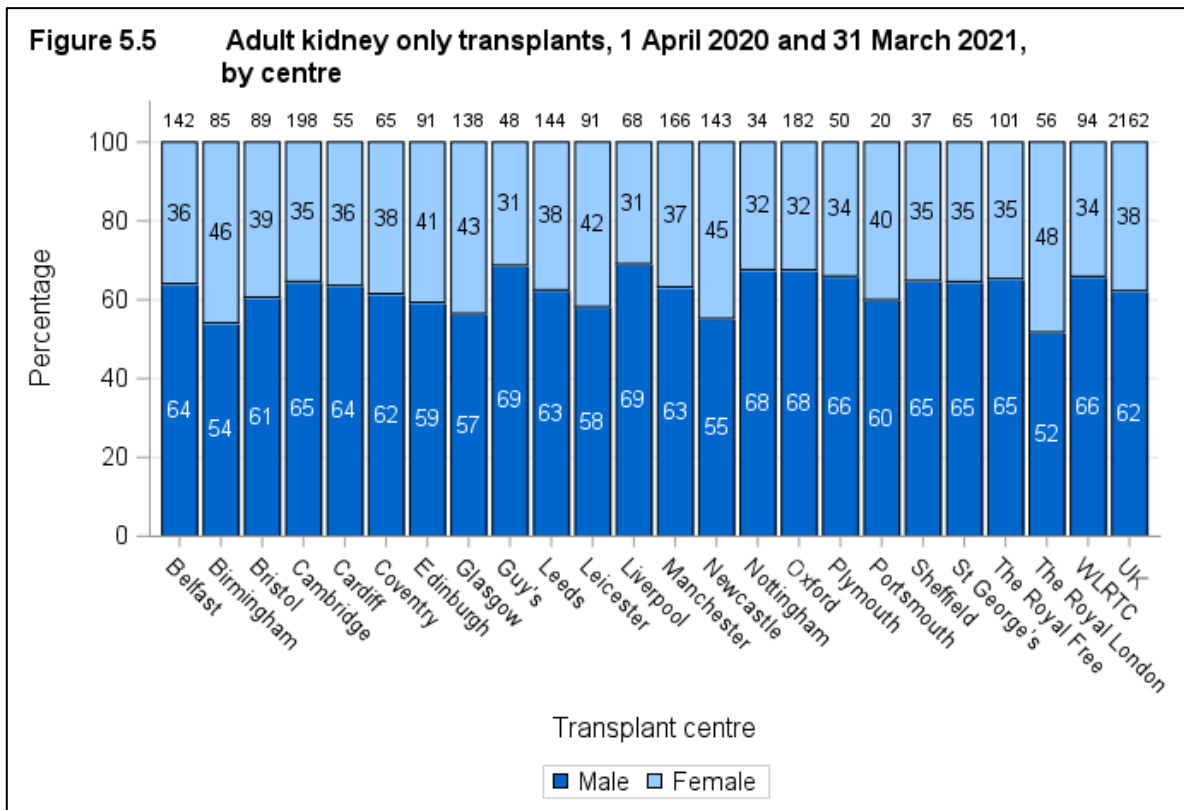


**Figure 5.4** shows the total number of adult kidney only transplants performed in last ten years, by centre and type of donor.

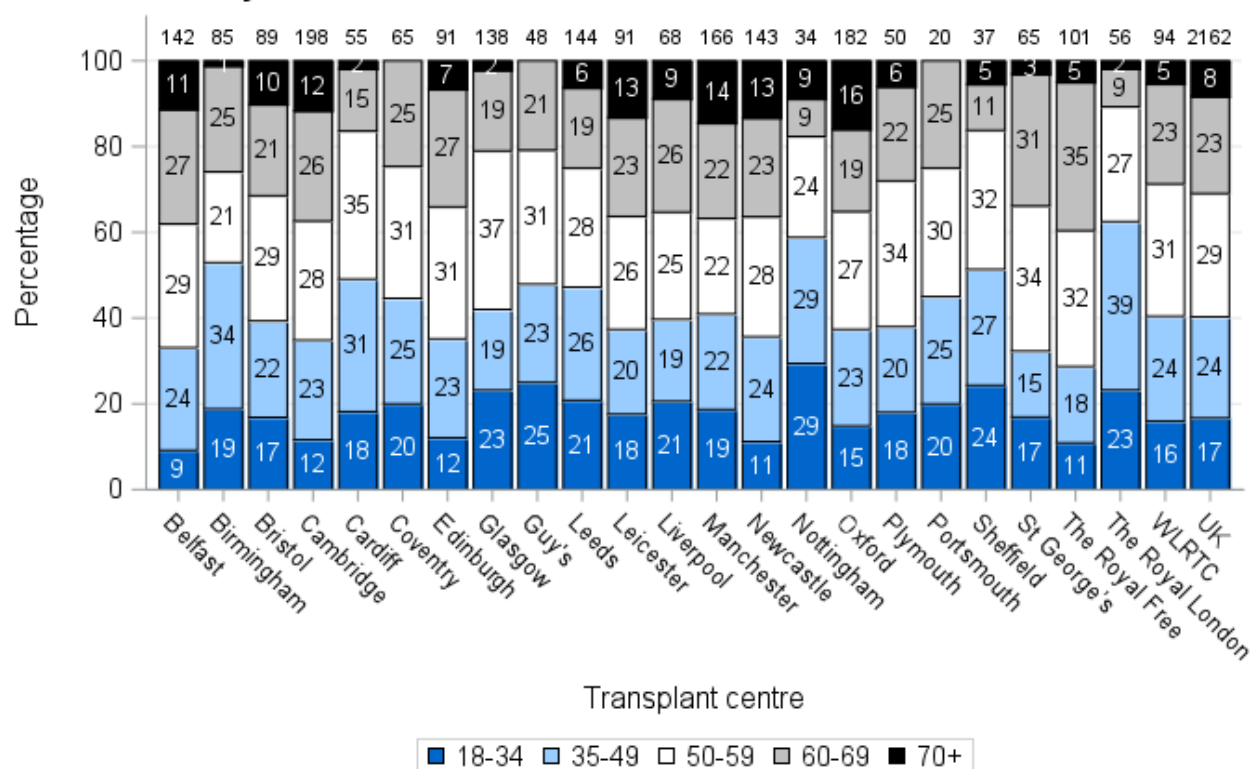


## 5.2 Demographic characteristics of recipients, 1 April 2020 - 31 March 2021

The sex, ethnicity and age group of patients who received a kidney only transplant are shown by centre in **Figure 5.5, 5.6 and 5.7**, respectively. Note that all percentages quoted are based only on data where relevant information was available.

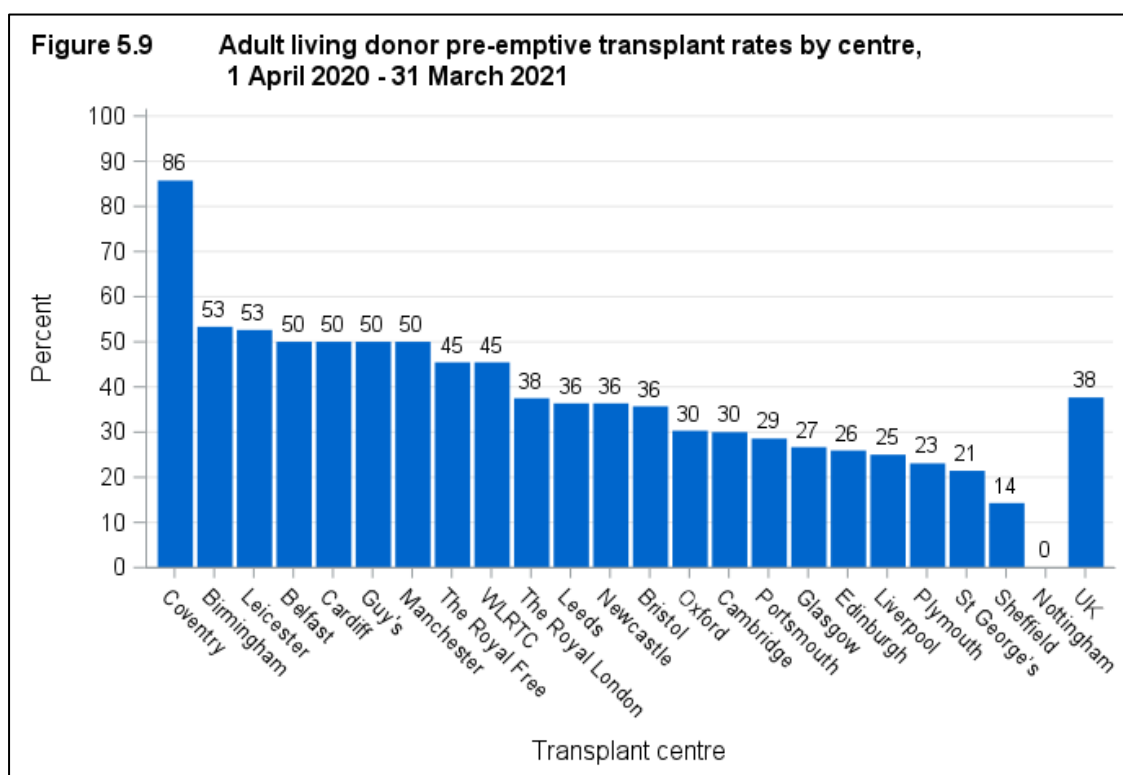
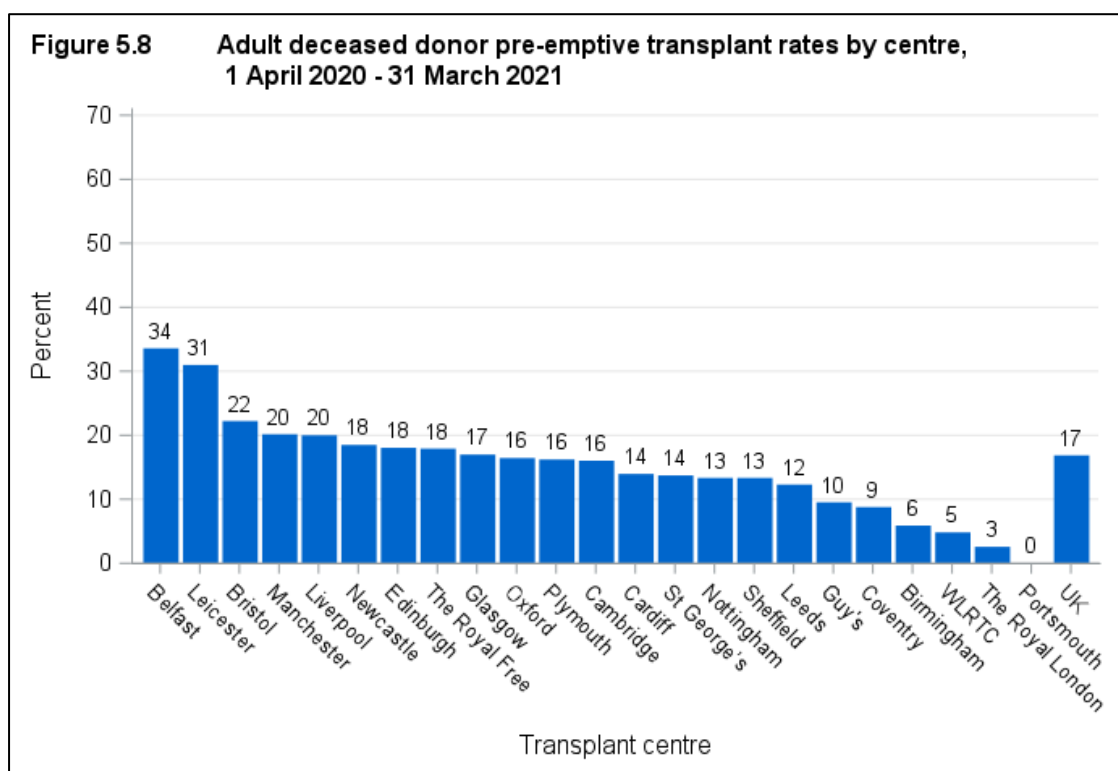


**Figure 5.7 Adult kidney only transplants, 1 April 2020 and 31 March 2021, by centre**



### 5.3 Pre-emptive transplant rates, 1 April 2020 - 31 March 2021

Rates of [pre-emptive](#) kidney only transplantation are shown in **Figure 5.8** for adult deceased donor transplants and **Figure 5.9** for adult living donor transplants. Living donor transplants are more likely to be carried out before the need for dialysis than deceased donor transplants: 38% and 17% respectively. This is because a living donor transplant can often be carried out more quickly than a deceased donor kidney transplant as the latter often necessitates a long waiting time. Adult deceased donor [pre-emptive](#) transplant rates ranged from 34% at Belfast to 0% at Portsmouth. Adult living donor [pre-emptive](#) transplant rates ranged from 86% at Coventry to 0% at Nottingham.



## 5.4 Kidney donor risk-index<sup>1</sup>

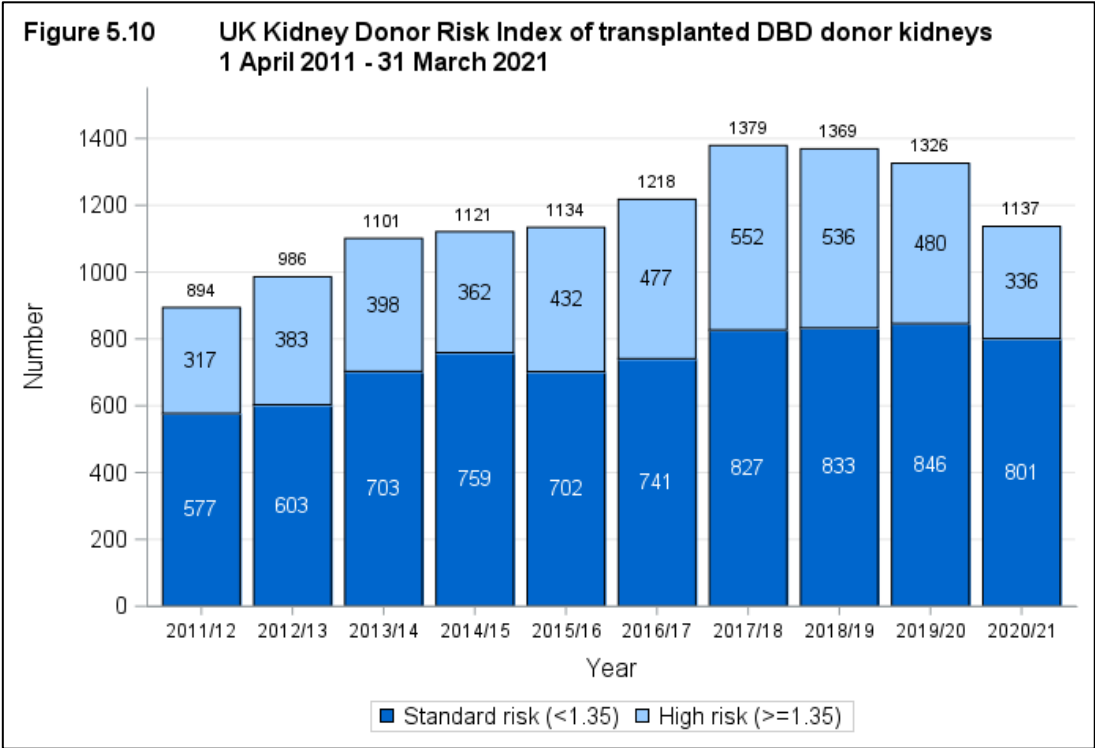
The severe shortage of deceased donor (DD) organs available for transplantation has led to increased use of kidneys from suboptimal donors with potentially less good transplant outcome. Categorising such kidneys according to anticipated outcome is important because it enables clinicians to be better informed when making decisions about organ allocation and allows appropriate counselling of potential recipients. Kidneys from suboptimal donors are variously referred to as marginal, extended criteria, or expanded criteria organs. Although categorising DD kidneys as either standard or expanded criteria has the advantage of simplicity, it does not adequately reflect the wide spectrum of donor kidney quality, and this has led to the development of more refined approaches to assessing the quality of DD kidneys. A donor risk index was developed by determining the factors that influence transplant survival, the time from transplant to the earlier of graft failure or patient death. A UK donor risk index was derived from the parameter estimates of the donor factors in the Cox model developed for overall transplant survival. This gives the following index:

$$\begin{aligned} \text{UKKDRI} = & \exp\{-0.245 \times (\text{donor age} < 40) + \\ & 0.396 \times (\text{donor age} \geq 60) + \\ & 0.265 \times (\text{history of hypertension}) + \\ & 0.0253 \times [\text{donor weight(kg)} - 75]/10) + \\ & 0.00461 \times (\text{days in hospital}) + \\ & 0.0465 \times (\text{adrenaline})\} \end{aligned}$$

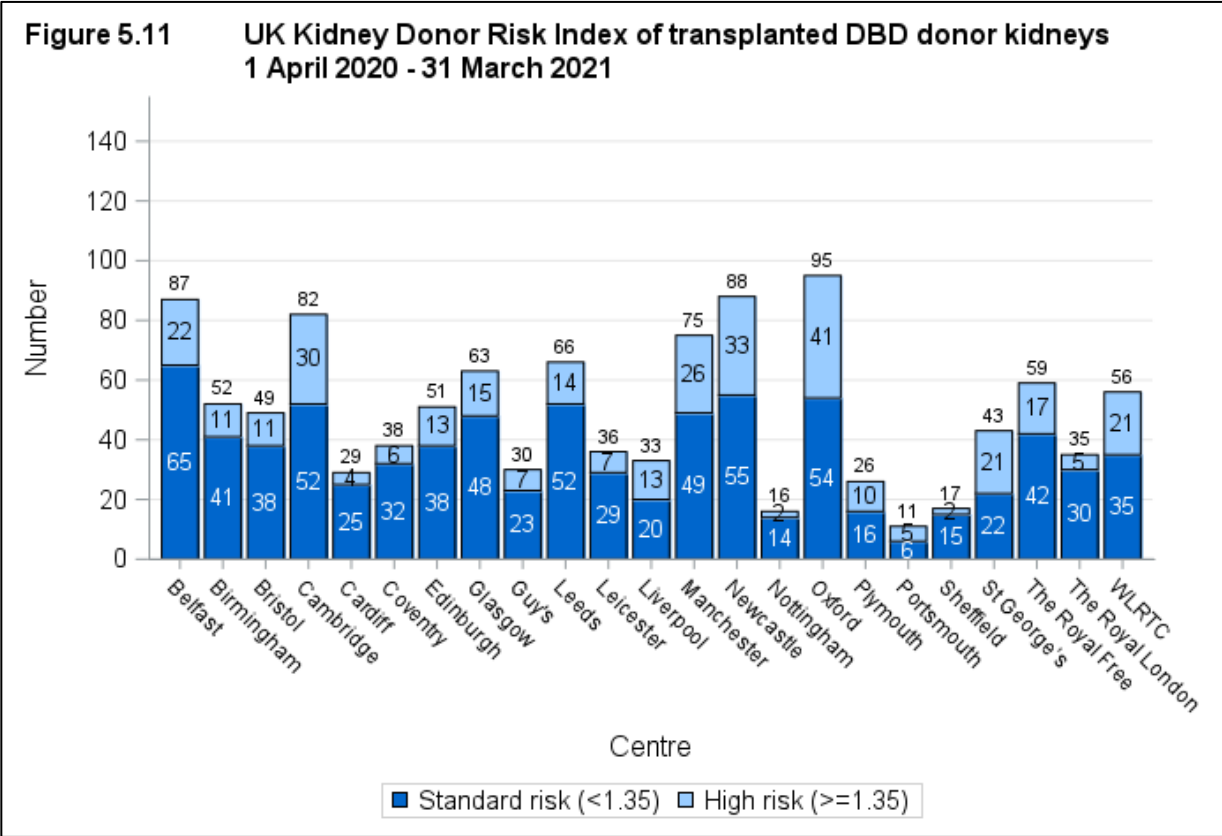
### Reference

- 1 Watson CJE, Johnson RJ, Birch R, Collett D, Bradley JA. A simplified donor risk index for predicting outcome after deceased donor kidney transplantation. *Transplantation*, 2012; 93: 314-318

**Figure 5.10** shows the number of transplanted [DBD](#) donor kidneys over the last ten financial years by kidney donor risk index group. In 2011/12 36% of all transplants were performed using kidneys from donors categorised as high risk (UK Donor risk index  $\geq 1.35$ ) compared with 30% in 2020/21.

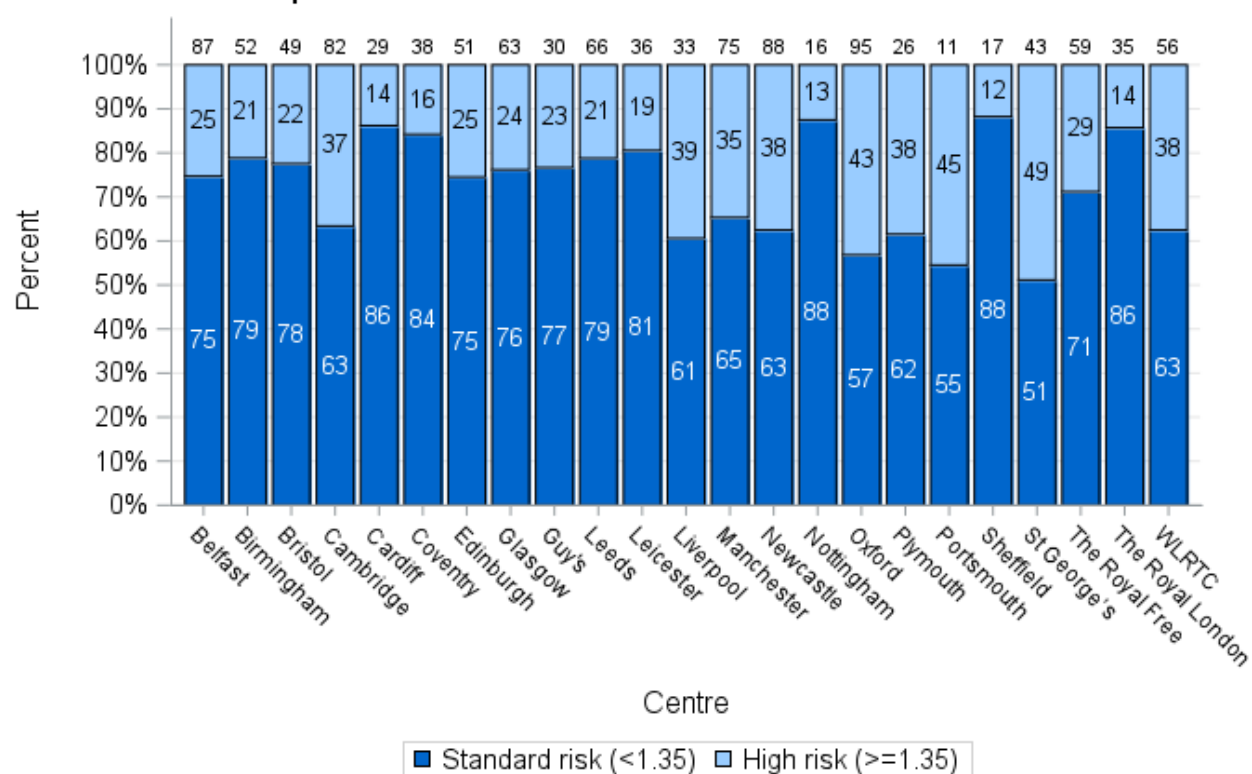


**Figure 5.11** shows the number of transplanted [DBD](#) donor kidneys in 2020/21 by kidney donor risk index group for each transplant centre. The same information is presented in **Figure 5.12** but this shows the proportion of standard risk and high risk donor transplants performed at each centre.

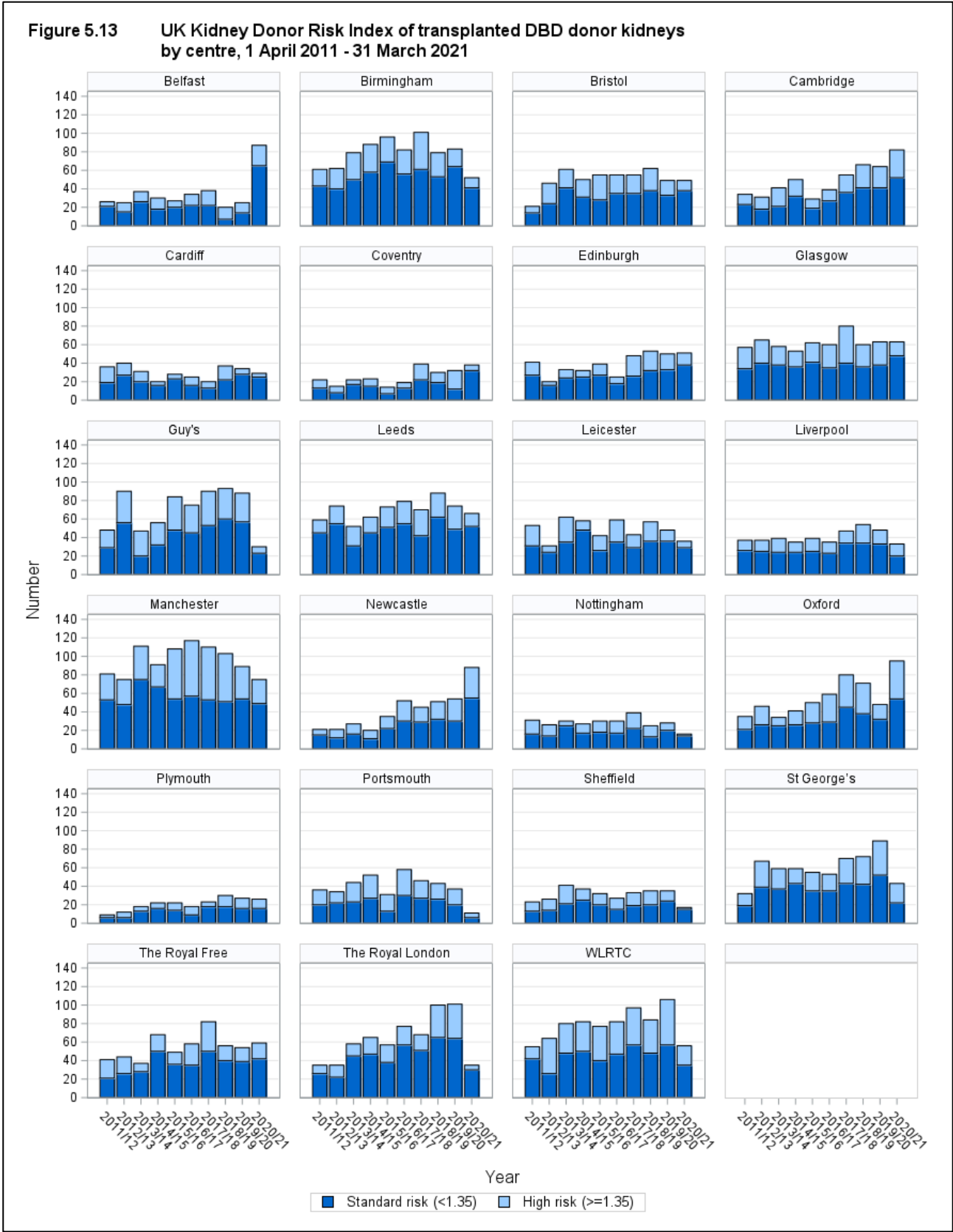




**Figure 5.12 UK Kidney Donor Risk Index of transplanted DBD donor kidneys  
1 April 2020 - 31 March 2021**



**Figure 5.13** shows the number of transplanted [DBD](#) donor kidneys in the last ten years by kidney donor risk index group for each transplant centre.



## 5.5 2019 Kidney Offering Scheme Donor Risk Index and Recipient Risk Index, 1 April 2020 – 31 March 2021

A new Kidney Donor Risk Index (DRI) was developed for deceased donors alongside the change in kidney offering scheme in 2019. This DRI is calculated using seven risk factors. A donor is then categorised into one of four groups (D1-D4) based on the risk score and by pre-determined cut-off values.

$$\begin{aligned} \text{DRI} = & \exp \{ 0.023 \times (\text{donor age}-50) & + \\ & -0.152 \times ([\text{donor height}-170]/10) & + \\ & 0.149 \times (\text{history of hypertension}) & + \\ & -0.184 \times (\text{female donor}) & + \\ & 0.190 \times (\text{CMV +ve donor}) & + \\ & -0.023 \times ([\text{offer eGFR}-90]/10) & + \\ & 0.015 \times (\text{days in hospital}) \} \end{aligned}$$

D1 → DRI ≤ 0.79 (lowest risk)

D2 → DRI 0.79 – 1.12

D3 → DRI 1.12 – 1.50

D4 → DRI ≥ 1.50 (highest risk)

A Recipient Risk Score (RRI) is now also calculated for each eligible patient using four risk factors. Similarly to DRI, a recipient can then be categorised into one of four groups (R1 - R4) based on this risk score and by pre-determined cut-off values.

$$\begin{aligned} \text{RRI} = & \exp \{ 0 \times (\text{recipient age} \leq 25) - 75) & + \\ & 0.016 \times ((\text{recipient age} > 25) - 75) & + \\ & 0.361 \times (\text{recipient on dialysis at registration}) & + \\ & 0.033 \times ([\text{waiting time from dialysis}-950]/365.25) & + \\ & 0.252 \times (\text{Diabetic recipient}) \} \end{aligned}$$

R1 → RRI ≤ 0.74 (lowest risk)

R2 → RRI 0.74 - 0.94

R3 → RRI 0.94 – 1.20

R4 → RRI ≥ 1.20 (highest risk)

**Table 5.1** presents the DRI and RRI groups and average scores for kidneys transplanted between 1 April 2020 and 31 March 2021.

**Table 5.1 UK Kidney Donor Risk Index of transplanted deceased donor kidneys and Recipient Risk Index of those receiving them, 1 April 2020 - 31 March 2021**

Transplant centre	Donor Risk Group					Recipient Risk Group				
	D1	D2	D3	D4	Avg. DRI	R1	R2	R3	R4	Avg. RRI
Belfast	58	32	26	19	1	56	34	22	23	0.87
Birmingham	34	26	12	8	0.94	29	19	14	16	0.89
Bristol	32	23	19	6	0.97	32	24	16	8	0.85
Cambridge	78	44	47	46	1.07	59	50	64	41	0.94
Cardiff	20	17	8	5	0.9	20	16	12	2	0.82
Coventry	4	3	5	5	1.32	4	3	6	4	0.97
Edinburgh	25	27	15	9	0.98	20	29	16	11	0.92
Glasgow	34	28	34	18	1.1	46	29	26	13	0.84
GOSH	7	0	0	0	0.38	7	0	0	0	0.53
Guy's	21	11	9	10	0.99	21	14	9	8	0.87
Leeds	47	37	21	21	0.99	47	34	31	14	0.87
Leicester	24	25	14	9	1	22	23	21	6	0.86
Liverpool	20	14	12	10	1.05	16	15	14	11	0.93
Manchester	52	37	37	22	1.07	46	39	35	28	0.92
Newcastle	38	29	36	20	1.08	29	38	31	25	0.96
Nottingham	22	8	3	2	0.79	19	10	4	2	0.74
Oxford	61	60	41	49	1.13	63	46	49	53	0.96
Plymouth	12	7	14	4	1.06	10	4	13	10	1.01
Portsmouth	3	4	2	4	1.17	5	1	4	3	0.98
Sheffield	10	13	6	1	0.96	12	9	9	0	0.81
St George's	10	10	11	20	1.31	13	9	19	10	0.95
The Royal Free	18	25	21	16	1.14	18	20	27	13	0.96
The Royal London	15	14	8	2	0.89	14	14	7	4	0.87
WLRTC	23	17	27	17	1.22	27	18	22	17	0.95
<b>UK</b>	<b>668</b>	<b>511</b>	<b>428</b>	<b>323</b>	<b>1.05</b>	<b>635</b>	<b>498</b>	<b>471</b>	<b>322</b>	<b>0.91</b>

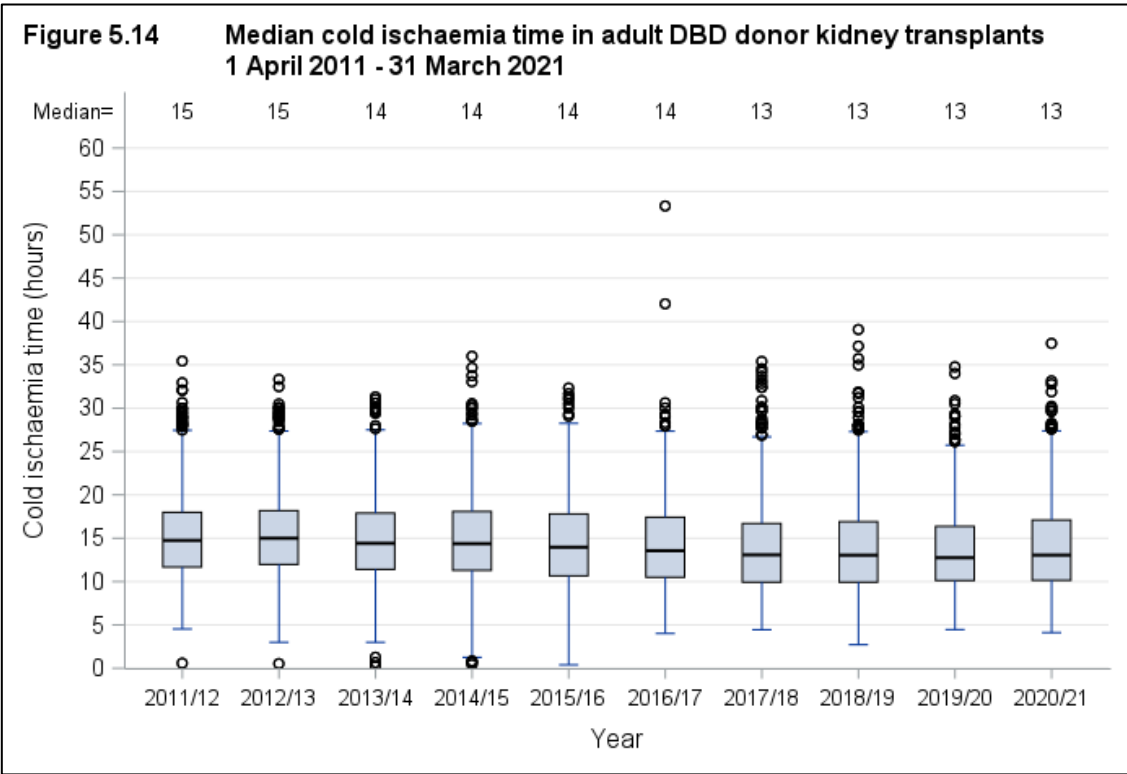
## 5.6 Cold ischaemia time, 1 April 2018 – 31 March 2021

The length of time that elapses between a kidney being removed from the donor to its transplantation into the recipient is called the Cold Ischaemia Time (CIT). Generally, the shorter this time, the more likely the kidney is to work immediately and the better the long-term outcome. One of the reasons why [live donor](#) kidney transplantation is so successful is because the CIT is only one to two hours long. For deceased donor renal transplants, CIT can never be as short as this, but efforts are made to keep the time to a minimum. Evidence indicates that the outcome is only adversely affected when CIT is longer than 20 hours, although many deceased donor kidney transplants with a CIT of more than 20 hours have been very successful.

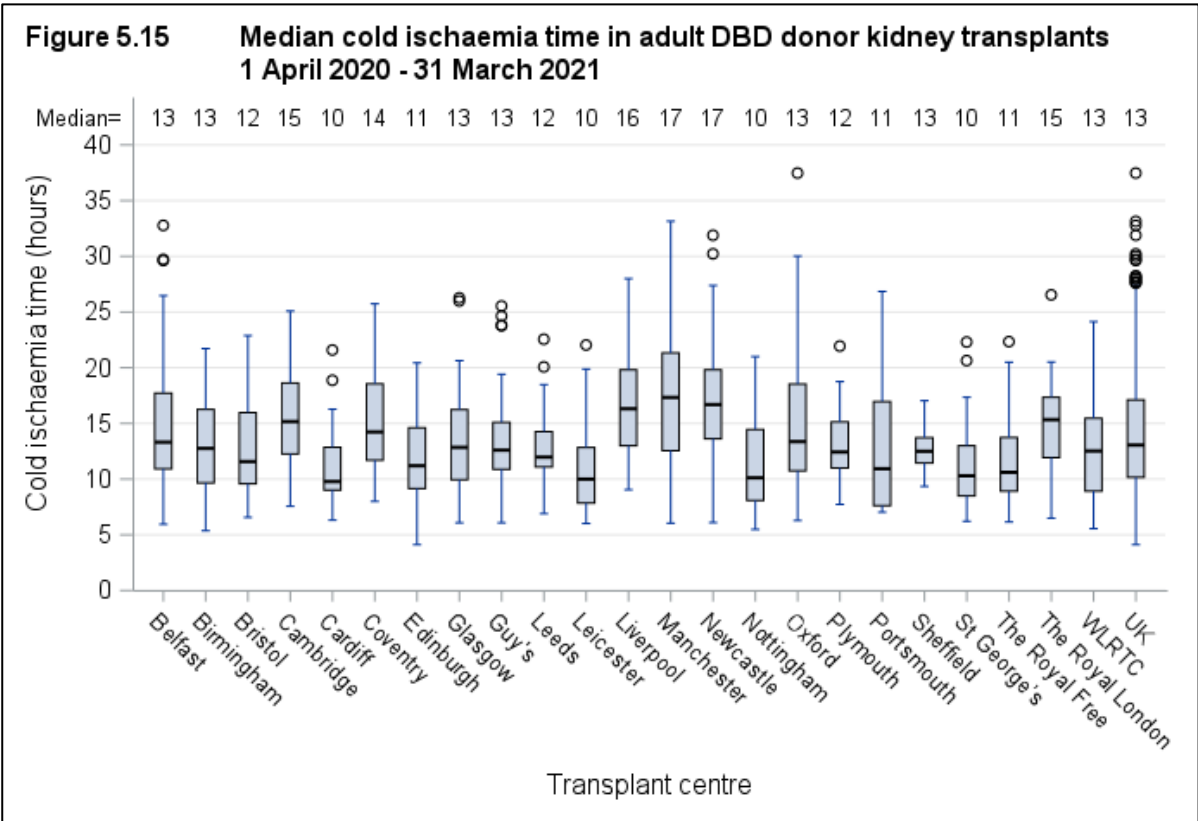
The factors which determine CIT include a) transportation of the kidney from the retrieval hospital to the hospital where the transplant is performed, b) the need to tissue type the donor and [cross-match](#) the donor and potential recipients, c) the occasional necessity of moving the kidney to another hospital if a transplant cannot go ahead, d) contacting and preparing the recipient for the transplant and e) access to the operating theatre.

[Median](#) CITs are shown in addition to [inter-quartile ranges](#). Fifty percent of the transplants have a CIT within the [inter-quartile range](#). There is some variation in average ([median](#)) CIT between different transplant centres although all centres continually try to reduce this time.

**Figure 5.14** shows the [median](#) total cold ischaemia time in adult [DBD](#) donor kidney only transplants over the last 10 years. The [median](#) total cold ischaemia time has fallen over the last 10 years from 15 hours in 2011/12 to 13 hours in 2020/21.



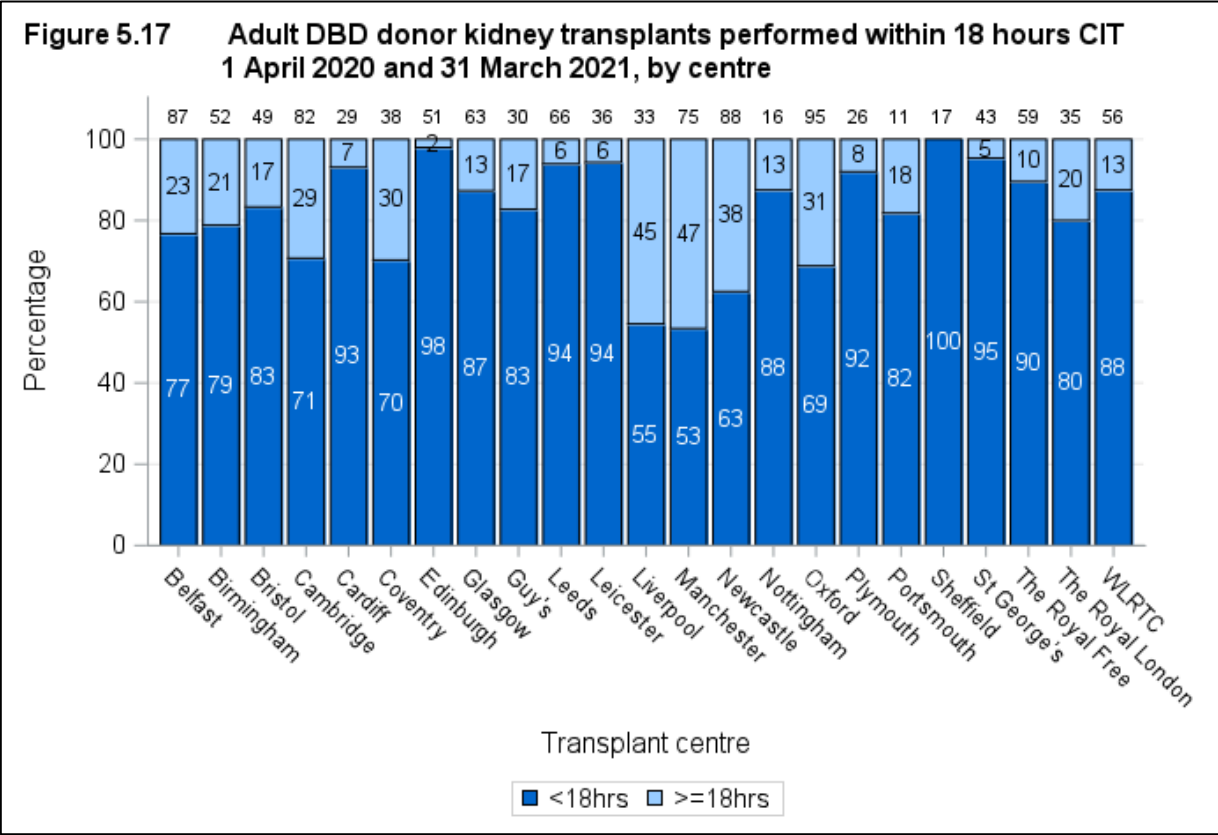
**Figure 5.15** shows the [median](#) total cold ischaemia time in adult [DBD](#) donor kidney only transplants in 2020/21 for each transplant centre. Manchester and Newcastle had the longest [median](#) cold ischaemia time, 17 hours in 2020/21 compared with Cardiff, Leicester, Nottingham and St George's who had the shortest, 10 hours.



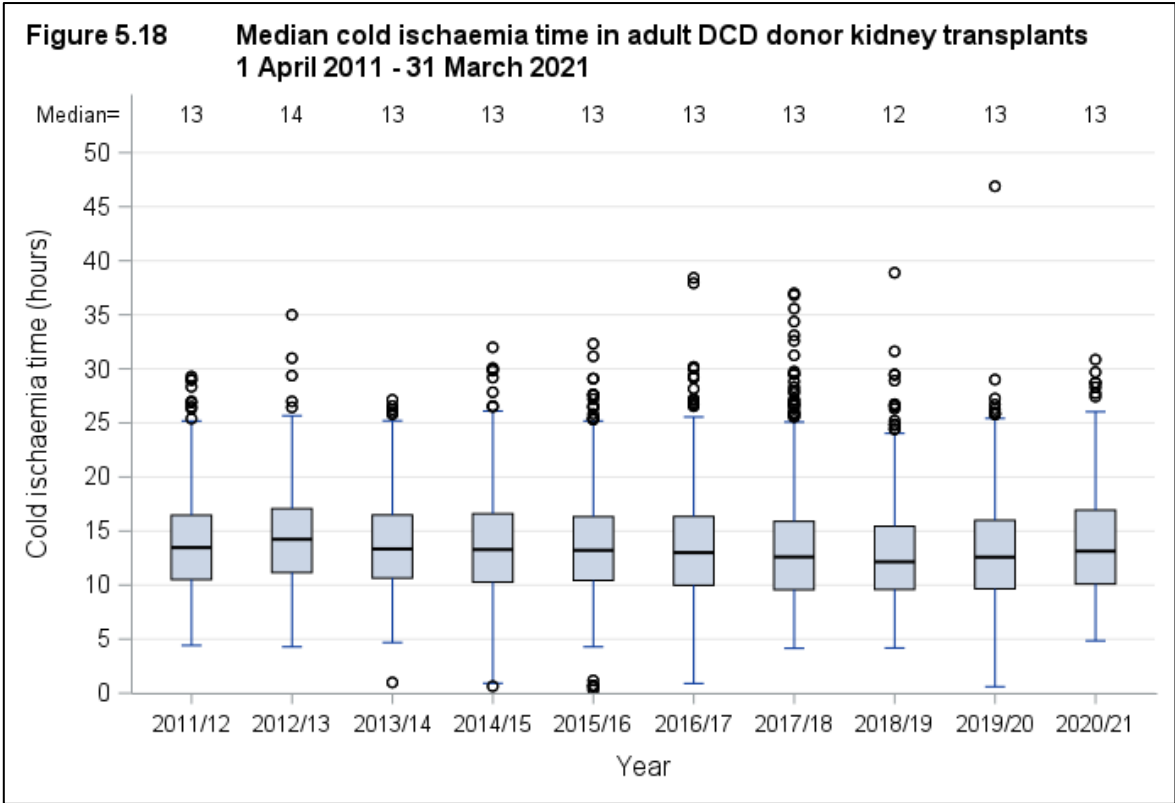
**Figure 5.16** shows the [median](#) total cold ischaemia time in adult [DBD](#) donor kidney only transplants over the last ten years for each transplant centre.



**Figure 5.17** shows the proportion of adult [DBD](#) donor kidney only transplants in 2020/21 that have been performed within 18 hours of CIT for each transplant centre. All centres have at least half of all [DBD](#) kidney only transplants performed within 18 hours CIT.

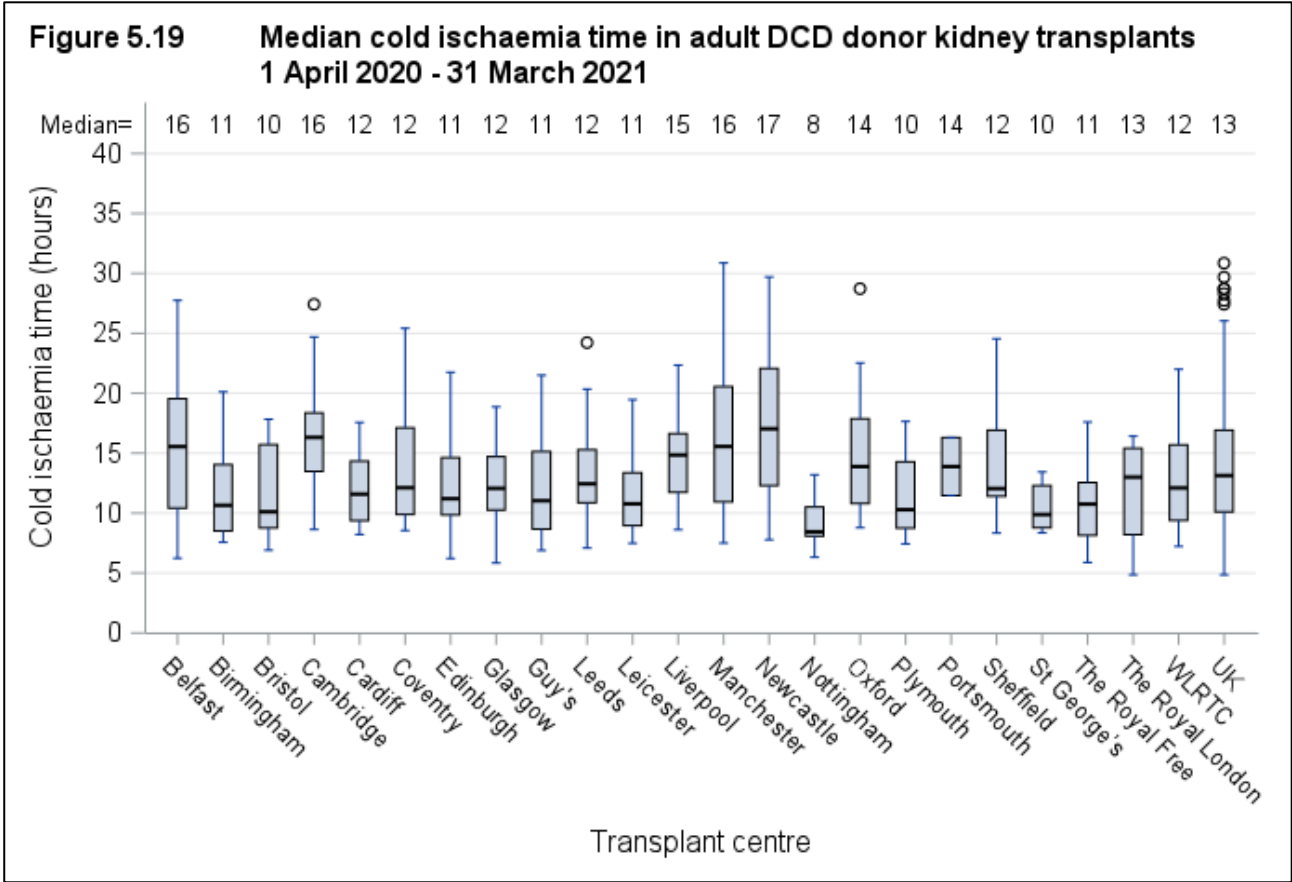


**Figure 5.18** shows the [median](#) total cold ischaemia time in adult [DCD](#) donor kidney only transplants over the last 10 years. The [median](#) total ischaemia time has remained almost unchanged over the last 10 years.



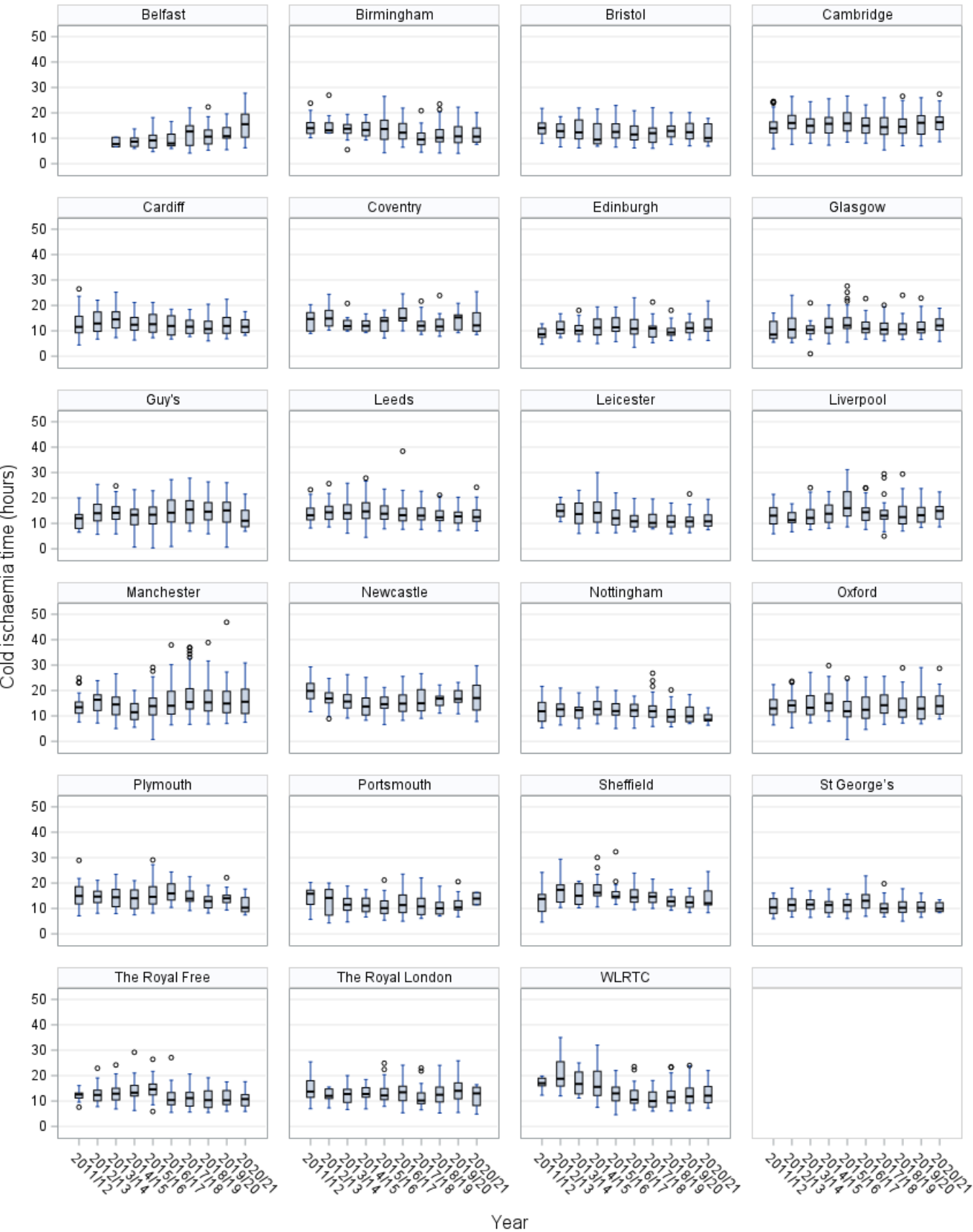


**Figure 5.19** shows the [median](#) total cold ischaemia time in adult [DCD](#) donor kidney only transplants in 2020/21 for each transplant centre. Newcastle had the longest [median](#) cold ischaemia time, 17 hours in 2020/21 compared with Nottingham who had the shortest, 8 hours.

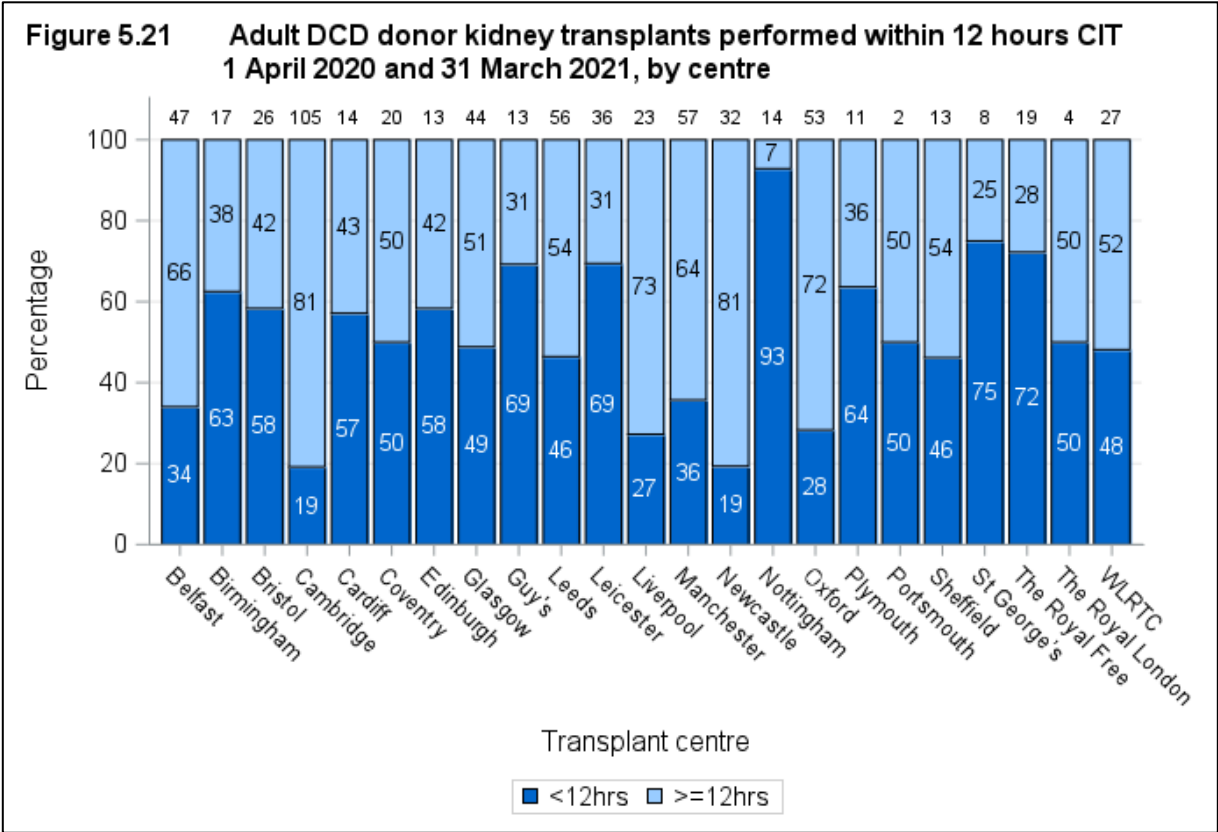


**Figure 5.20** shows the [median](#) total cold ischaemia time in adult [DCD](#) donor kidney only transplants over the last ten years for each transplant centre.

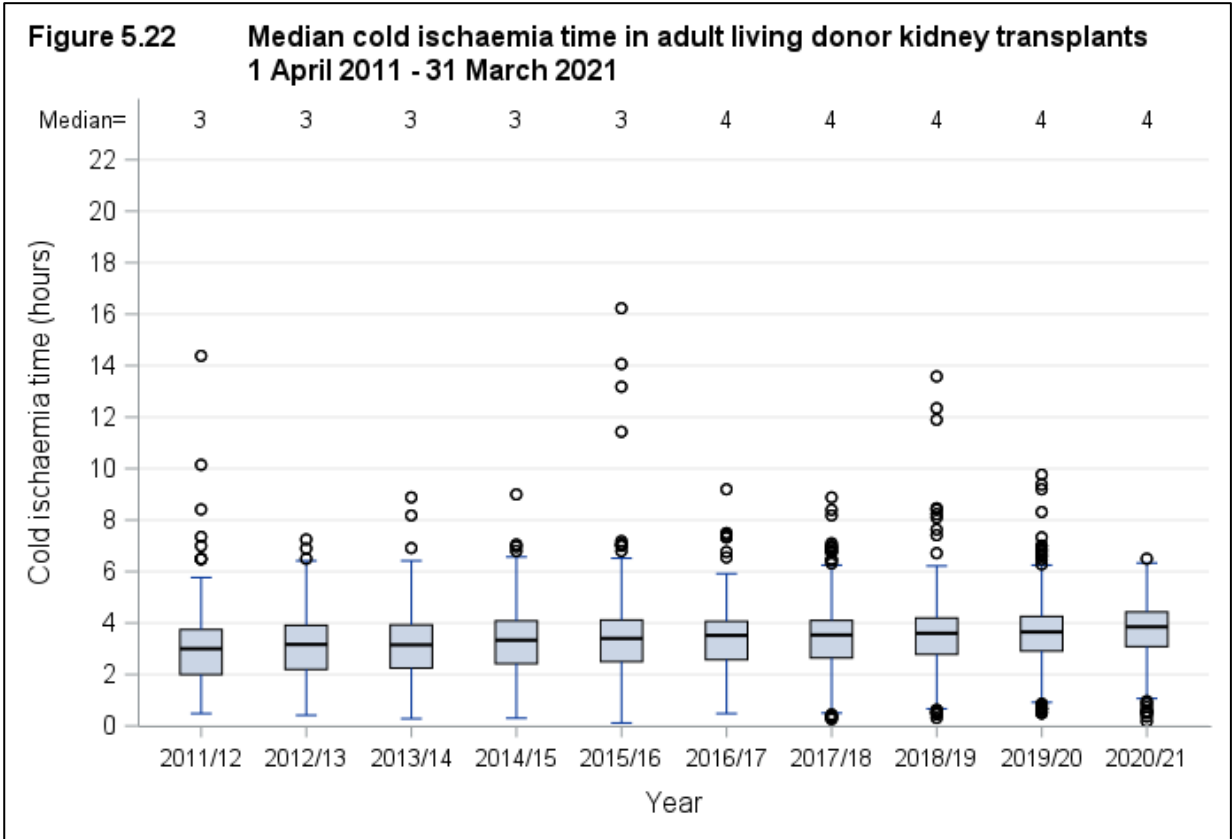
**Figure 5.20** Median cold ischaemia time in adult DCD donor kidney transplants, 1 April 2011 - 31 March 2021



**Figure 5.21** shows the proportion of adult [DCD](#) donor kidney only transplants in 2020/21 that have been performed within 12 hours of CIT for each transplant centre. The wide variability across centres can partly be explained by the proportion of kidneys that the centre imports from across the UK.



**Figure 5.22** shows the [median](#) total cold ischaemia time in adult living donor kidney transplants over the last 10 years. The [median](#) total cold ischaemia time has increased marginally over the last ten years.



**Figure 5.23** shows the [median](#) total cold ischaemia time in adult living donor kidney transplants in 2020/21 for each transplant centre.

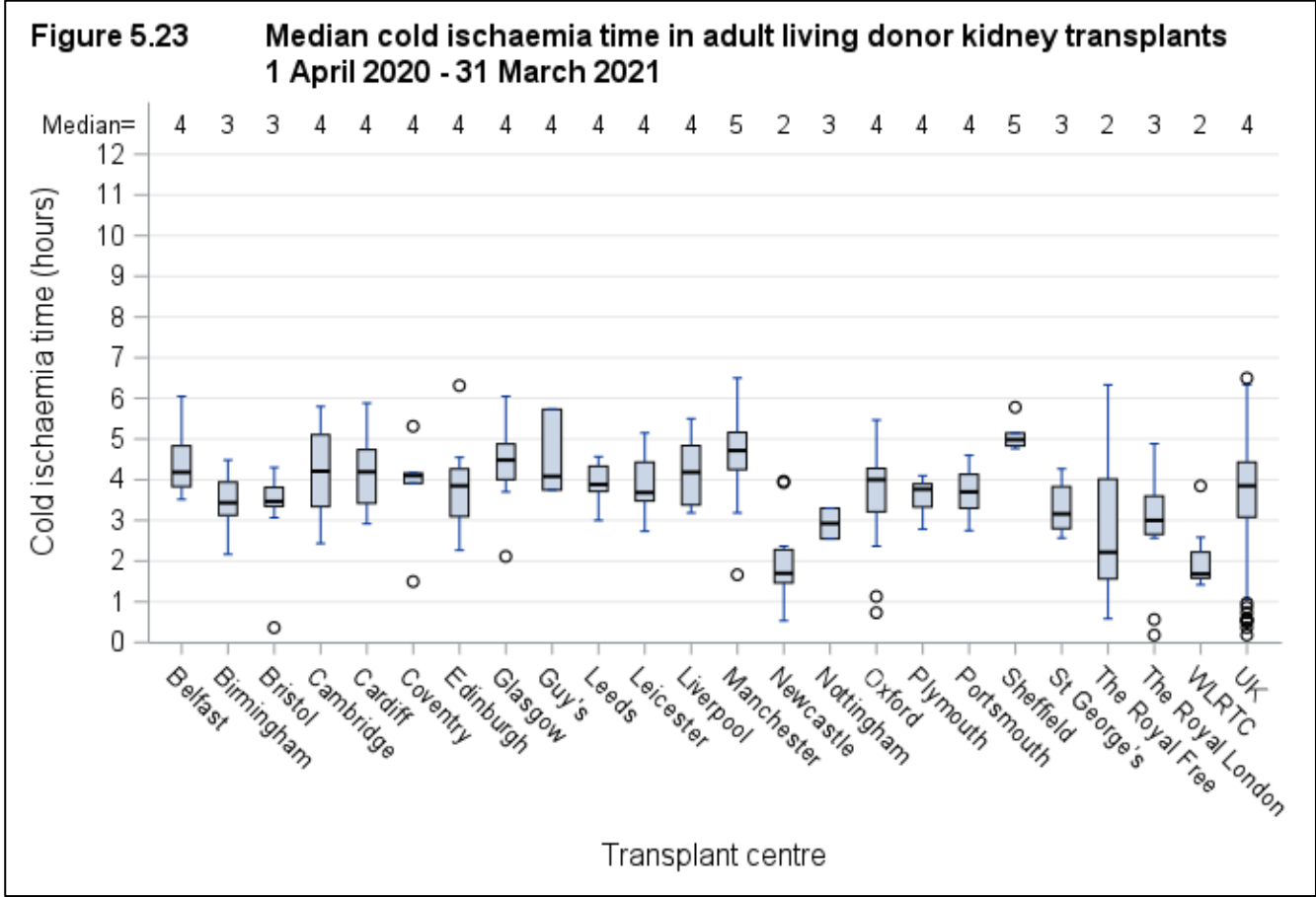
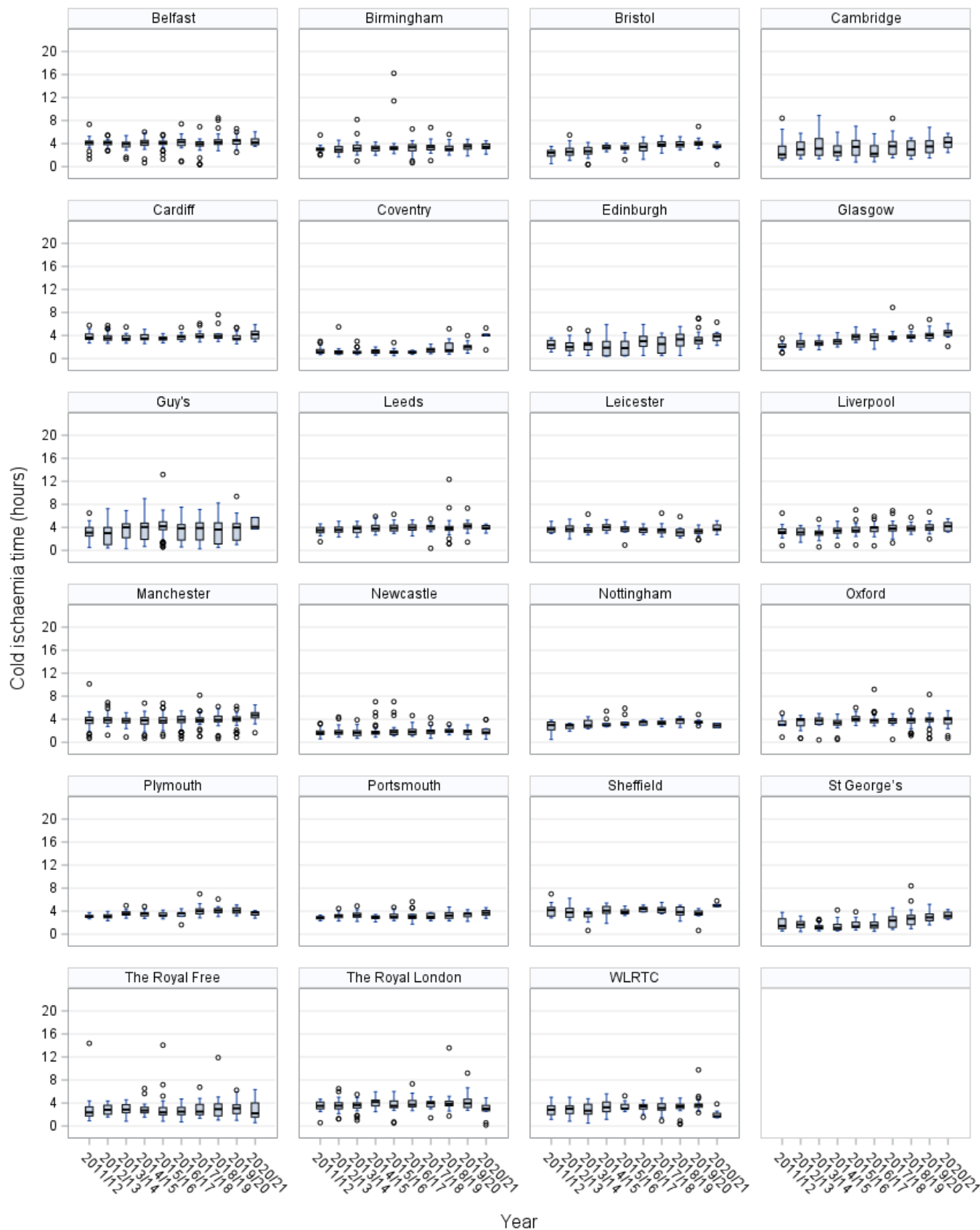


Figure 5.24 shows the [median](#) total cold ischaemia time in adult living donor kidney transplants over the last ten years for each transplant centre.

**Figure 5.24** Median cold ischaemia time in adult living donor kidney transplants, 1 April 2011 - 31 March 2021

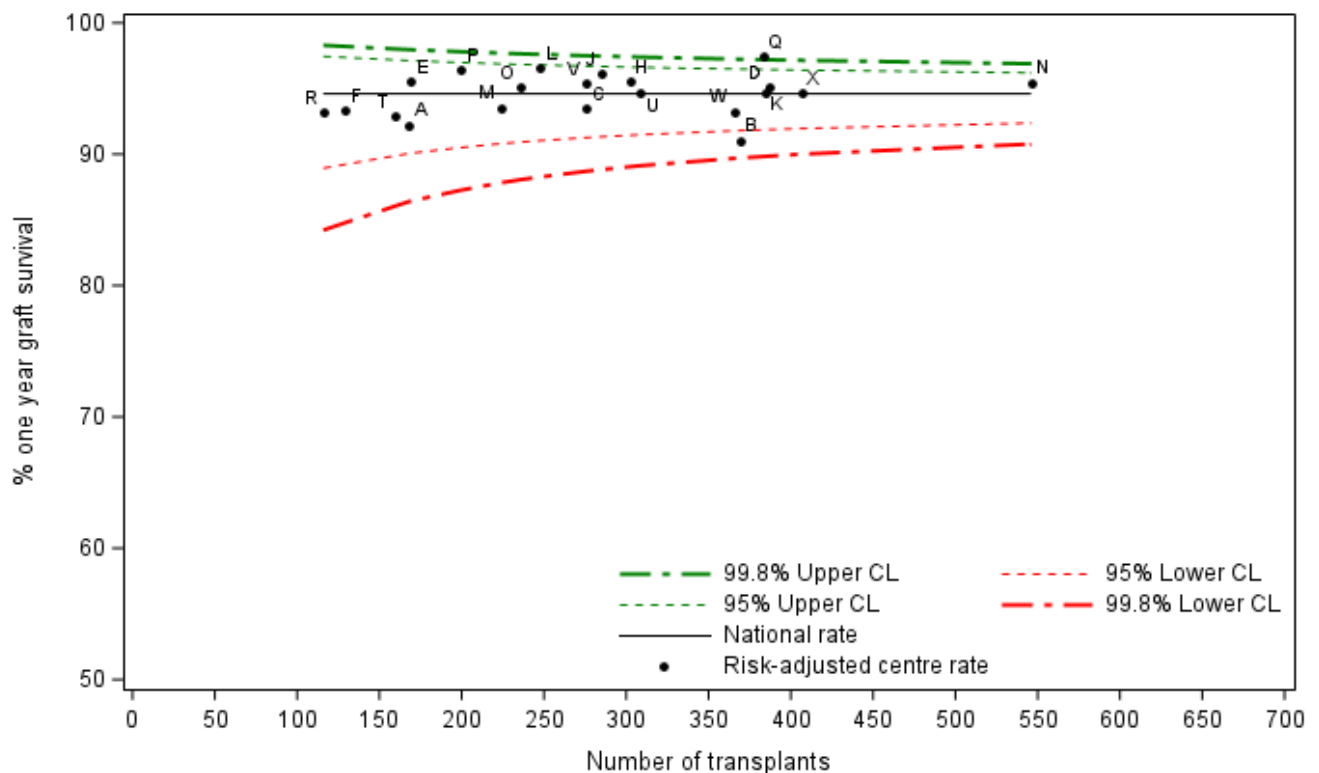


## **Adult kidney outcomes**

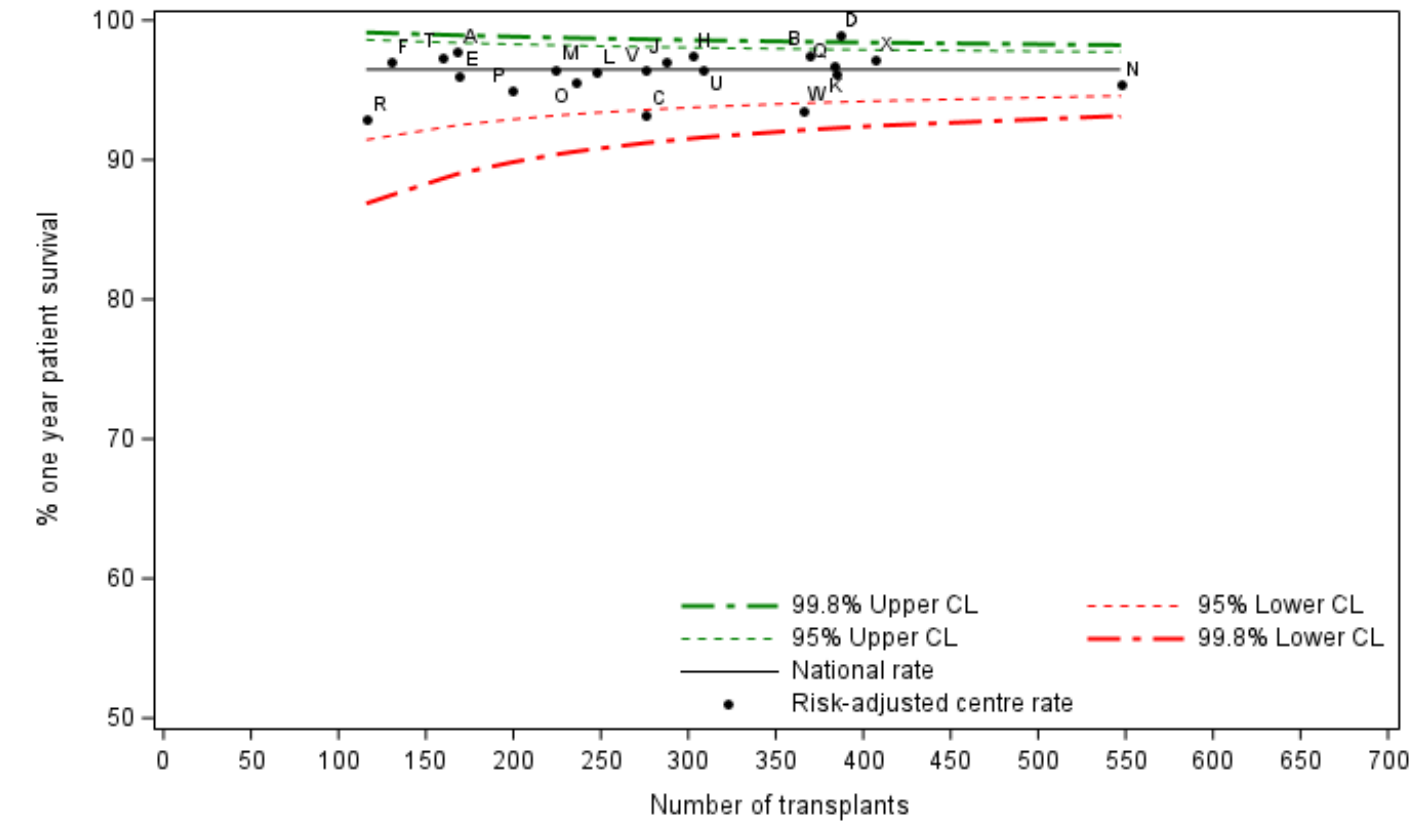
## 6.1 Deceased donor graft and patient survival

The [funnel plots](#) show that, for the most part, the centres lie within the [confidence limits](#). Some of the [funnel plots](#) show some centres lie outside the lower 95% [confidence limits](#), indicating that these centres have survival rates that are significantly lower than the national rate. Some of the [funnel plots](#) show some centres to be above the upper 99.8% [confidence limit](#). This suggests that these centres may have survival rates that are considerably higher than the national rate. Centres can be identified by the information shown in **Table 6.1**.

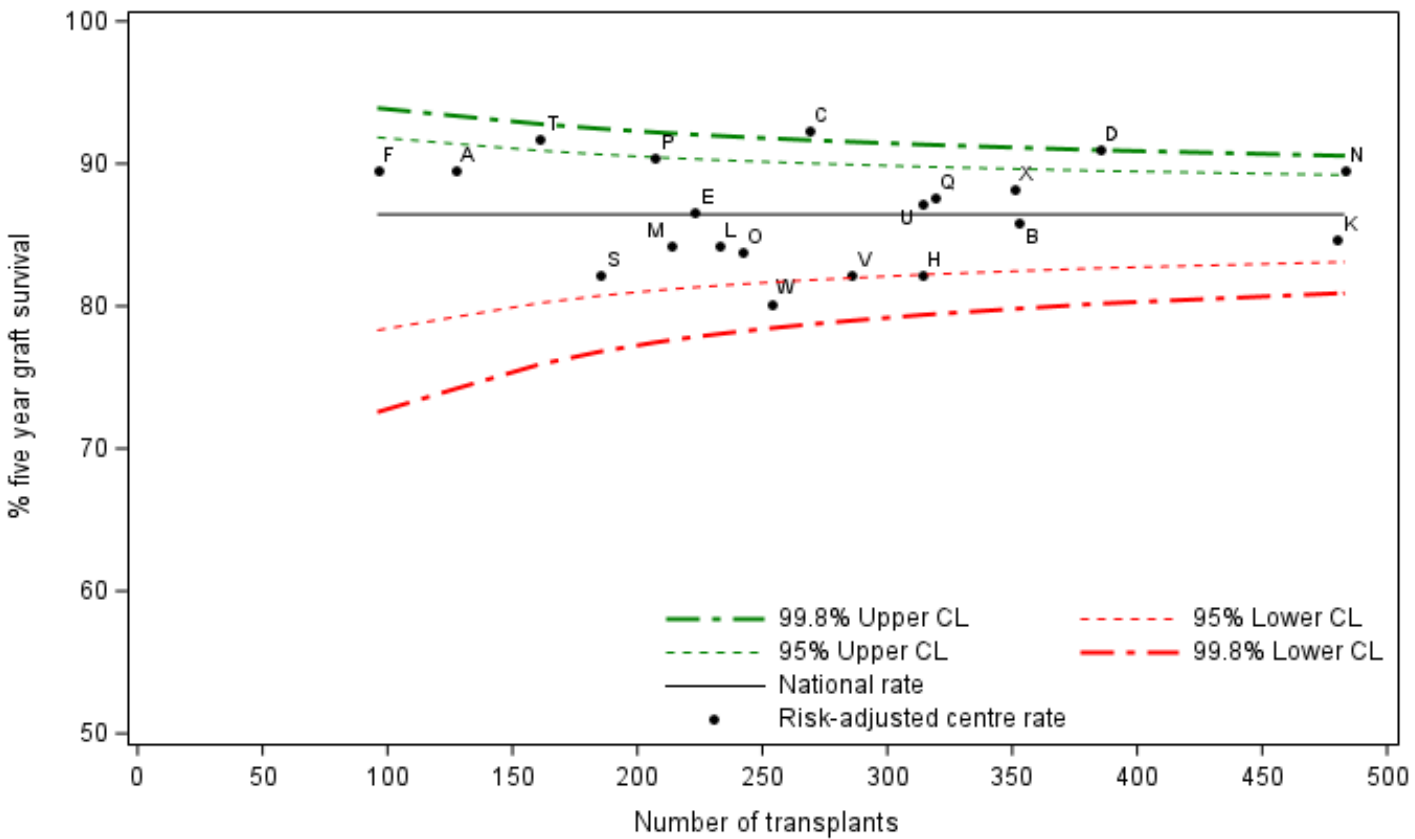
**Figure 6.1** Risk-adjusted one year graft (death censored) survival rates for first deceased donor kidney transplants in adult patients, between 1 April 2016 and 31 March 2020



**Figure 6.2     Risk-adjusted one year patient survival rates for first deceased donor kidney transplants in adult patients, between 1 April 2016 and 31 March 2020**

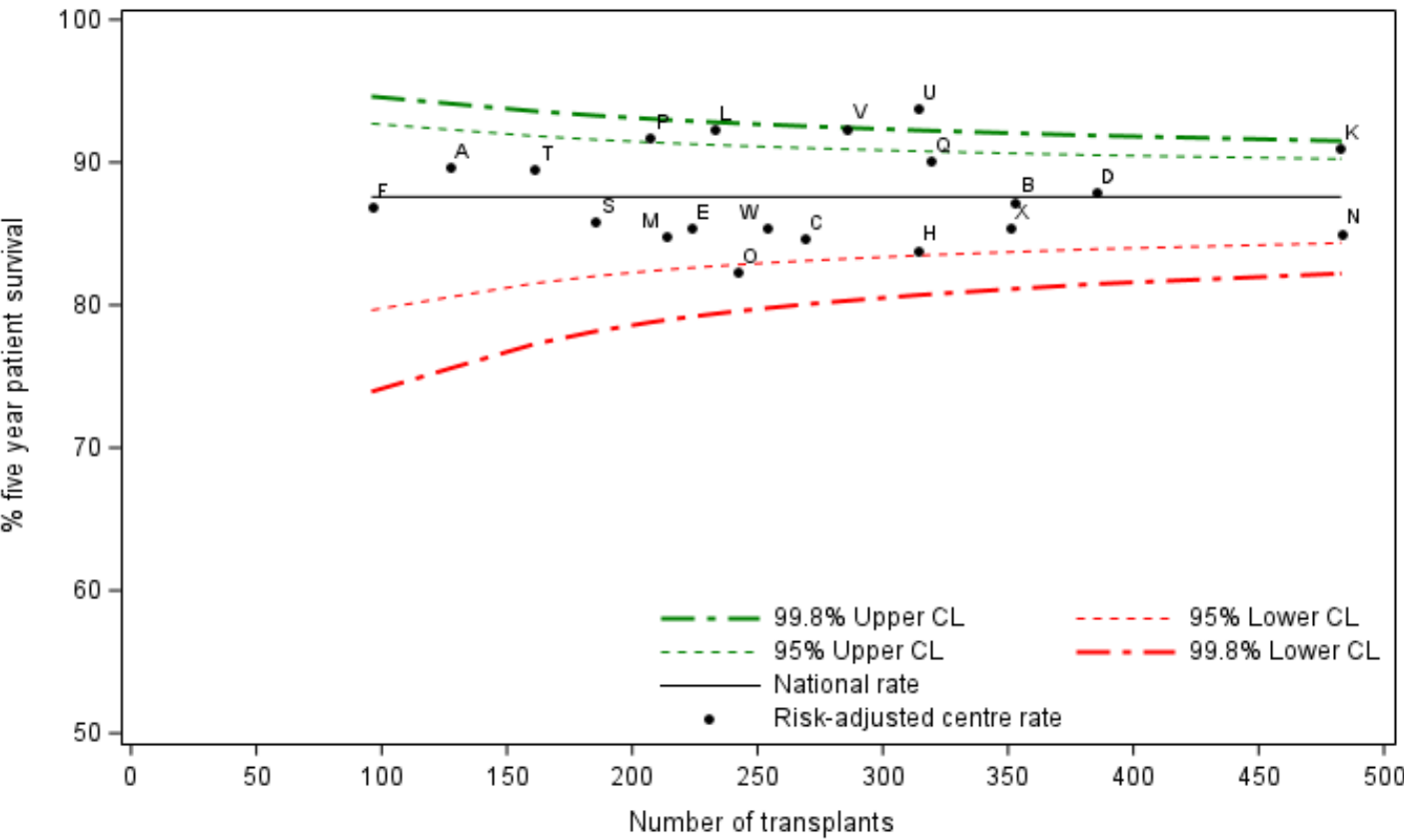


**Figure 6.3     Risk-adjusted five year graft (death censored) survival rates for first deceased donor kidney transplants in adult patients, between 1 April 2012 and 31 March 2016**





**Figure 6.4** Risk-adjusted five year patient survival rates for first deceased donor kidney transplants in adult patients, between 1 April 2012 and 31 March 2016



**Table 6.1 One and five year first adult kidney-only graft and patient survival using kidneys from deceased donors**

Centre	Code	Kidney graft survival				Patient survival			
		One-year*		Five-year**		One-year*		Five-year**	
		%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Belfast	A	92	(87 - 96)	90	(81 - 95)	98	(94 - 99)	90	(82 - 95)
Birmingham	B	91	(88 - 94)	86	(81 - 89)	98	(95 - 99)	87	(82 - 91)
Bristol	C	94	(90 - 96)	92	(88 - 96)	93	(89 - 96)	85	(79 - 89)
Cambridge	D	95	(93 - 97)	91	(87 - 94)	99	(97 - 100)	88	(84 - 91)
Cardiff	E	96	(92 - 98)	87	(81 - 91)	96	(92 - 98)	85	(80 - 90)
Coventry	F	93	(88 - 97)	90	(79 - 96)	97	(92 - 99)	87	(77 - 93)
Edinburgh	G	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Glasgow	H	96	(93 - 97)	82	(76 - 87)	97	(95 - 99)	84	(78 - 88)
Guy's	J	96	(93 - 98)	N/A	N/A	97	(94 - 99)	N/A	N/A
Leeds	K	95	(92 - 97)	85	(80 - 88)	96	(94 - 98)	91	(88 - 94)
Leicester	L	97	(94 - 98)	84	(78 - 89)	96	(93 - 98)	92	(88 - 95)
Liverpool	M	94	(90 - 96)	84	(77 - 90)	96	(93 - 98)	85	(78 - 90)
Manchester	N	95	(94 - 97)	89	(86 - 92)	95	(93 - 97)	85	(81 - 88)
Newcastle	O	95	(92 - 97)	84	(77 - 89)	96	(92 - 98)	82	(76 - 87)
Nottingham	P	96	(93 - 98)	90	(85 - 94)	95	(91 - 98)	92	(86 - 95)
Oxford	Q	97	(95 - 99)	88	(83 - 91)	97	(95 - 98)	90	(86 - 93)
Plymouth	R	93	(87 - 97)	N/A	N/A	93	(85 - 97)	N/A	N/A
Portsmouth	S	N/A	N/A	82	(74 - 88)	N/A	N/A	86	(80 - 91)
Sheffield	T	93	(88 - 96)	92	(86 - 96)	97	(94 - 99)	90	(83 - 94)
St George's	U	95	(92 - 97)	87	(82 - 91)	96	(94 - 98)	94	(90 - 96)
The Royal Free	V	95	(92 - 98)	82	(76 - 87)	96	(93 - 98)	92	(88 - 95)
The Royal London	W	93	(90 - 95)	80	(74 - 85)	94	(90 - 96)	85	(79 - 90)
WLRTC	X	95	(92 - 96)	88	(84 - 92)	97	(95 - 98)	85	(81 - 89)
<b>UK</b>		<b>95</b>	<b>(94 - 95)</b>	<b>86</b>	<b>(86 - 87)</b>	<b>96</b>	<b>(96 - 97)</b>	<b>88</b>	<b>(87 - 88)</b>
		Centre has reached the upper 99.8% confidence limit							
		Centre has reached the upper 95% confidence limit							
		Centre has reached the lower 95% confidence limit							
		Centre has reached the lower 99.8% confidence limit							

\* Includes transplants performed between 1 april 2016 - 31 March 2020

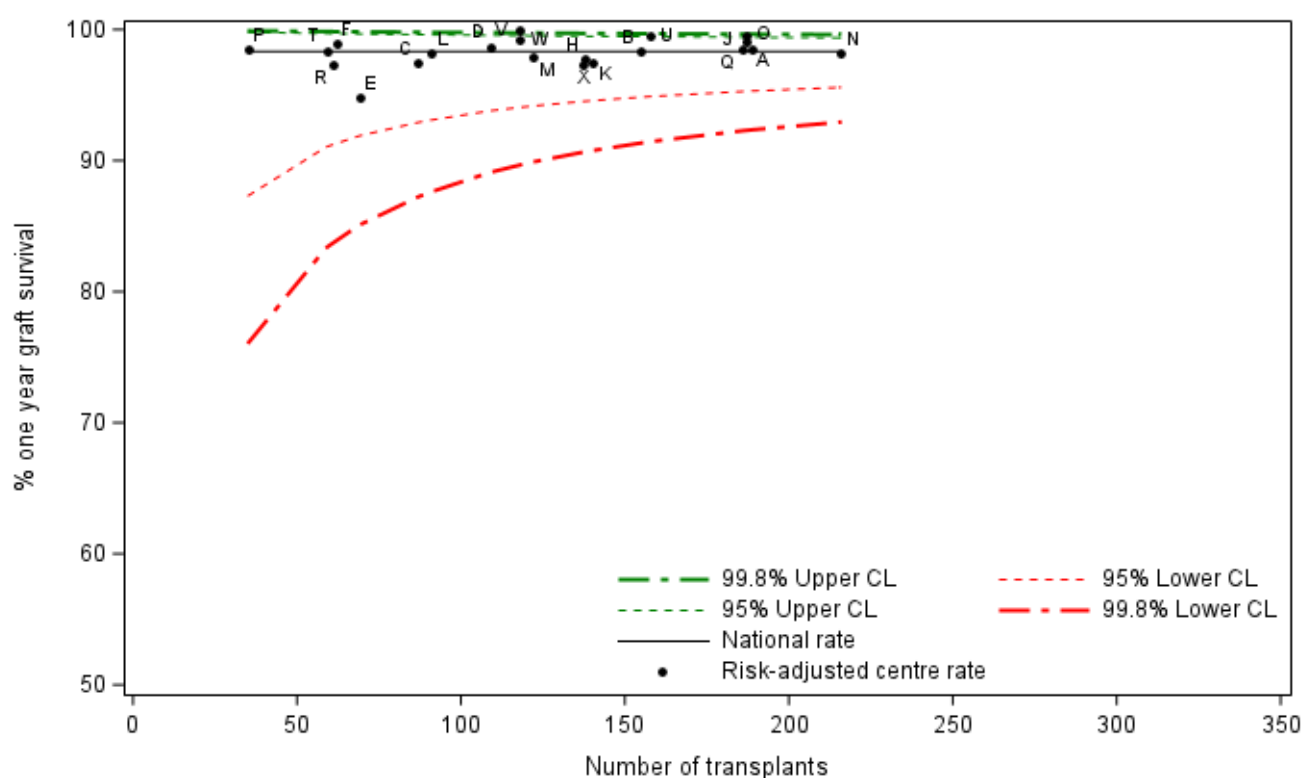
\*\* Includes transplants performed between 1 april 2012 - 31 March 2016

Centres have been omitted where less than 75% of data reported

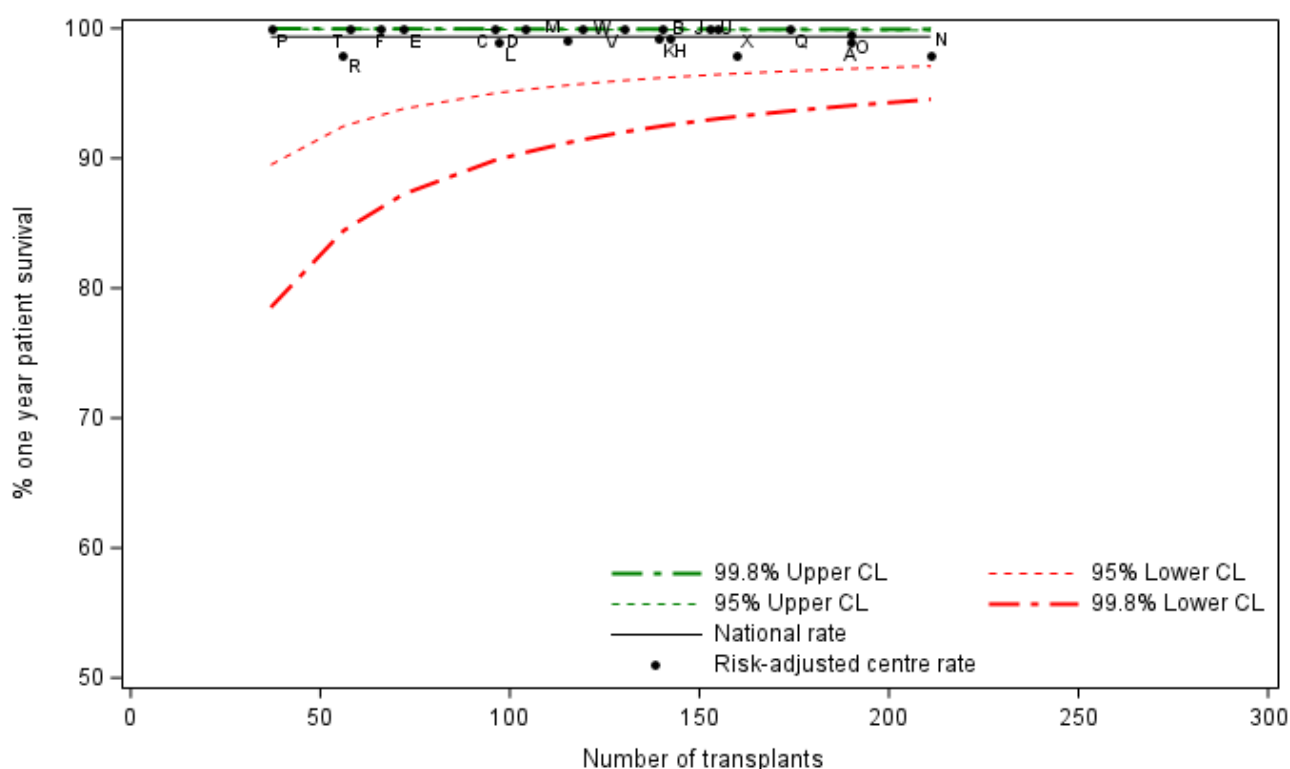
## 6.2 Living donor graft and patient survival

The [funnel plots](#) show that, for the most part, the centres lie within the [confidence limits](#). None of the [funnel plots](#) show any centres that lie outside the lower 95% [confidence limits](#). Some of the [funnel plots](#) show some centres to be above the upper 95% [confidence limit](#). This suggests that these centres may have survival rates that are considerably higher than the national rate. Centres can be identified by the information shown in **Table 6.2**. Living donor antibody incompatible kidney transplants are included in the analysis and these transplants are known to have inferior graft survival rates. **Table 6.3** shows the number of such transplants performed by each centre for each of the time periods analysed.

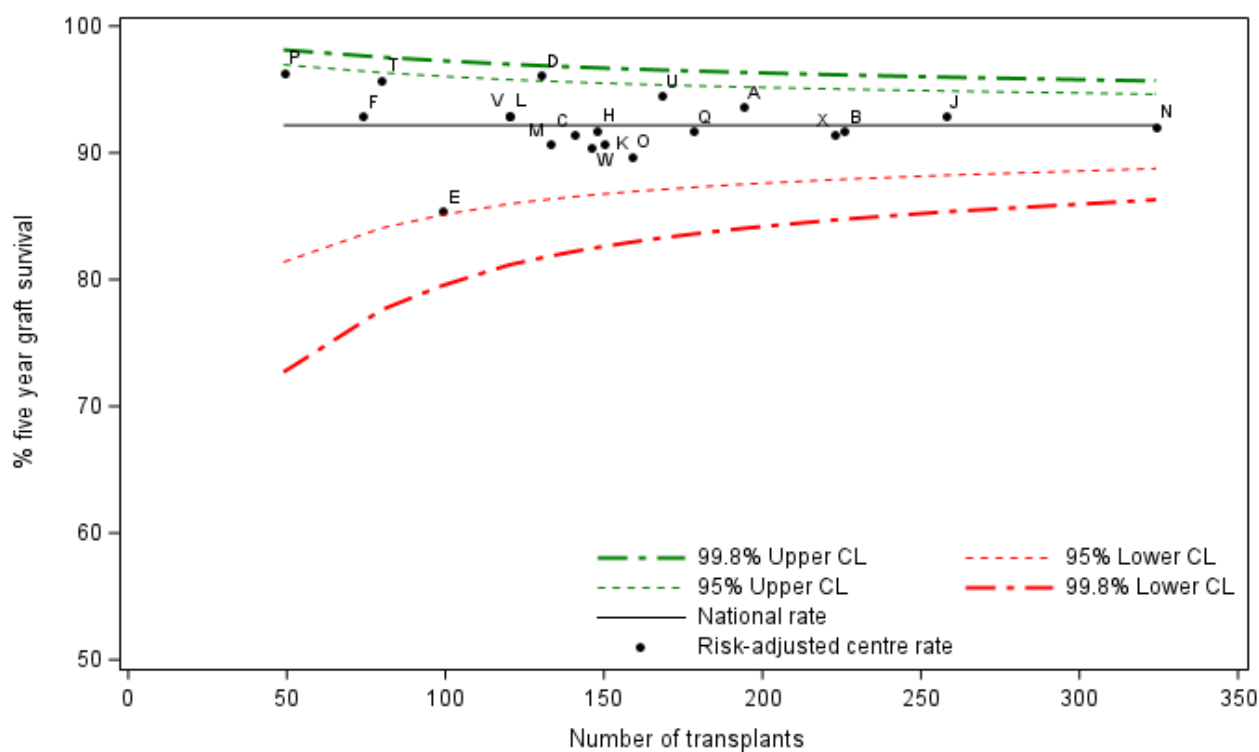
**Figure 6.5** Risk-adjusted one year graft (death censored) survival rates for first live donor kidney transplants in adult patients, between 1 April 2016 and 31 March 2020



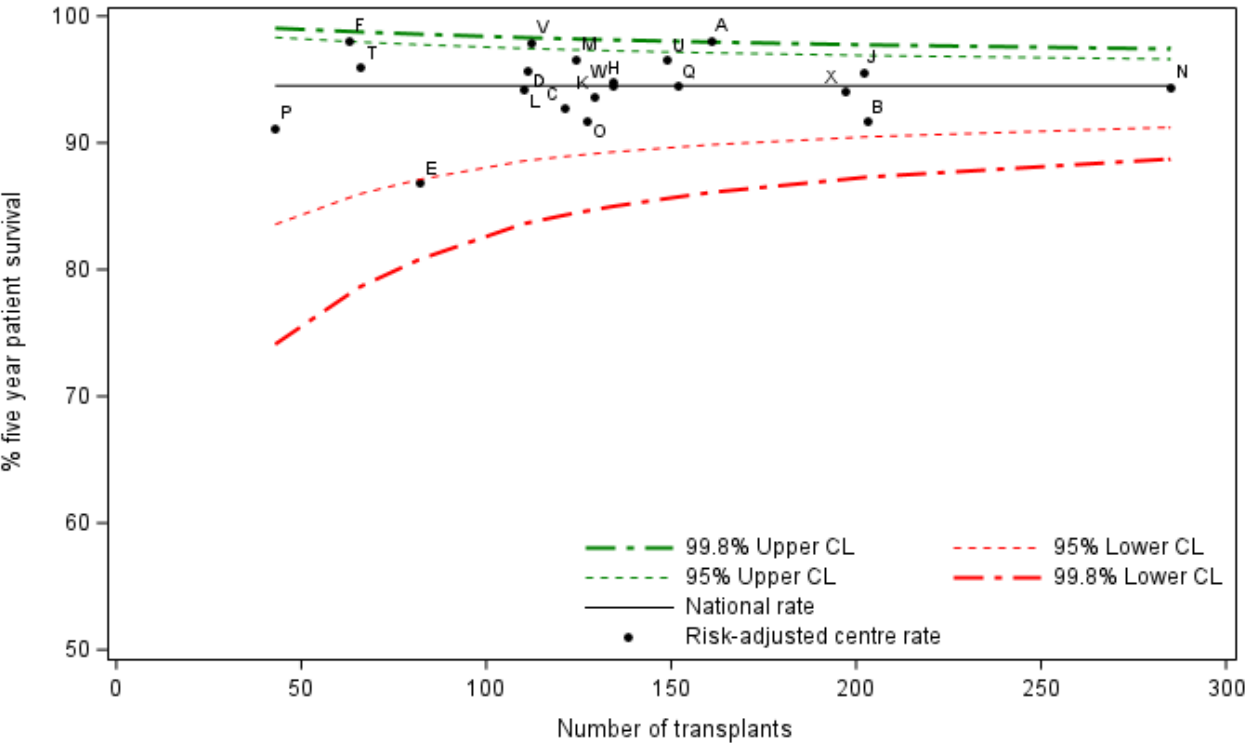
**Figure 6.6 Risk-adjusted one year patient survival rates for first live donor kidney transplants in adult patients, between 1 April 2016 and 31 March 2020**



**Figure 6.7 Risk-adjusted five year graft (death censored) survival rates for first live donor kidney transplants in adult patients, between 1 April 2012 and 31 March 2016**



**Figure 6.8** Risk-adjusted five year patient survival rates for first live donor kidney transplants in adult patients, between 1 April 2012 and 31 March 2016



**Table 6.2 One and five year first adult kidney-only graft and patient survival using kidneys from living donors**

Centre	Code	Kidney graft survival				Patient survival			
		One-year*		Five-year**		One-year*		Five-year**	
		%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Belfast	A	99	(96 - 100)	94	(88 - 97)	99	(96 - 100)	98	(94 - 100)
Birmingham	B	98	(95 - 100)	92	(87 - 95)	100	N/A	92	(87 - 95)
Bristol	C	97	(93 - 99)	91	(84 - 96)	100	N/A	93	(86 - 97)
Cambridge	D	99	(95 - 100)	96	(91 - 99)	100	N/A	96	(89 - 99)
Cardiff	E	95	(87 - 99)	85	(75 - 92)	100	N/A	87	(76 - 94)
Coventry	F	99	(94 - 100)	93	(83 - 98)	100	N/A	98	(90 - 100)
Edinburgh	G	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Glasgow	H	98	(94 - 99)	92	(86 - 96)	99	(96 - 100)	95	(89 - 98)
Guy's	J	99	(97 - 100)	93	(88 - 96)	100	N/A	96	(92 - 98)
Leeds	K	98	(94 - 99)	91	(84 - 95)	99	(96 - 100)	94	(87 - 97)
Leicester	L	98	(93 - 100)	93	(87 - 97)	99	(94 - 100)	94	(87 - 98)
Liverpool	M	98	(94 - 100)	91	(83 - 96)	99	(95 - 100)	97	(91 - 99)
Manchester	N	98	(96 - 99)	92	(88 - 95)	98	(95 - 99)	94	(91 - 97)
Newcastle	O	100	(98 - 100)	90	(83 - 94)	100	(97 - 100)	92	(85 - 96)
Nottingham	P	98	(91 - 100)	96	(87 - 100)	100	N/A	91	(78 - 98)
Oxford	Q	98	(96 - 100)	92	(86 - 95)	100	N/A	95	(90 - 98)
Plymouth	R	97	(90 - 100)	N/A	N/A	98	(89 - 100)	N/A	N/A
Portsmouth	S	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sheffield	T	98	(91 - 100)	96	(89 - 99)	100	N/A	96	(86 - 100)
St George's	U	100	(97 - 100)	95	(89 - 98)	100	N/A	97	(92 - 99)
The Royal Free	V	100	N/A	93	(86 - 97)	100	N/A	98	(93 - 100)
The Royal London	W	99	(95 - 100)	90	(84 - 95)	100	N/A	94	(88 - 98)
WLRTC	X	97	(94 - 99)	91	(87 - 95)	98	(94 - 100)	94	(90 - 97)
<b>UK</b>		<b>98</b>	<b>(98 - 99)</b>	<b>92</b>	<b>(91 - 93)</b>	<b>99</b>	<b>(99 - 100)</b>	<b>95</b>	<b>(94 - 95)</b>
		Centre has reached the upper 99.8% confidence limit							
		Centre has reached the upper 95% confidence limit							
		Centre has reached the lower 95% confidence limit							
		Centre has reached the lower 99.8% confidence limit							

\* Includes transplants performed between 1 april 2016 - 31 March 2020

\*\* Includes transplants performed between 1 april 2012 - 31 March 2016

Centres have been omitted where less than 75% of data reported

### 6.3 Graft and patient survival from listing

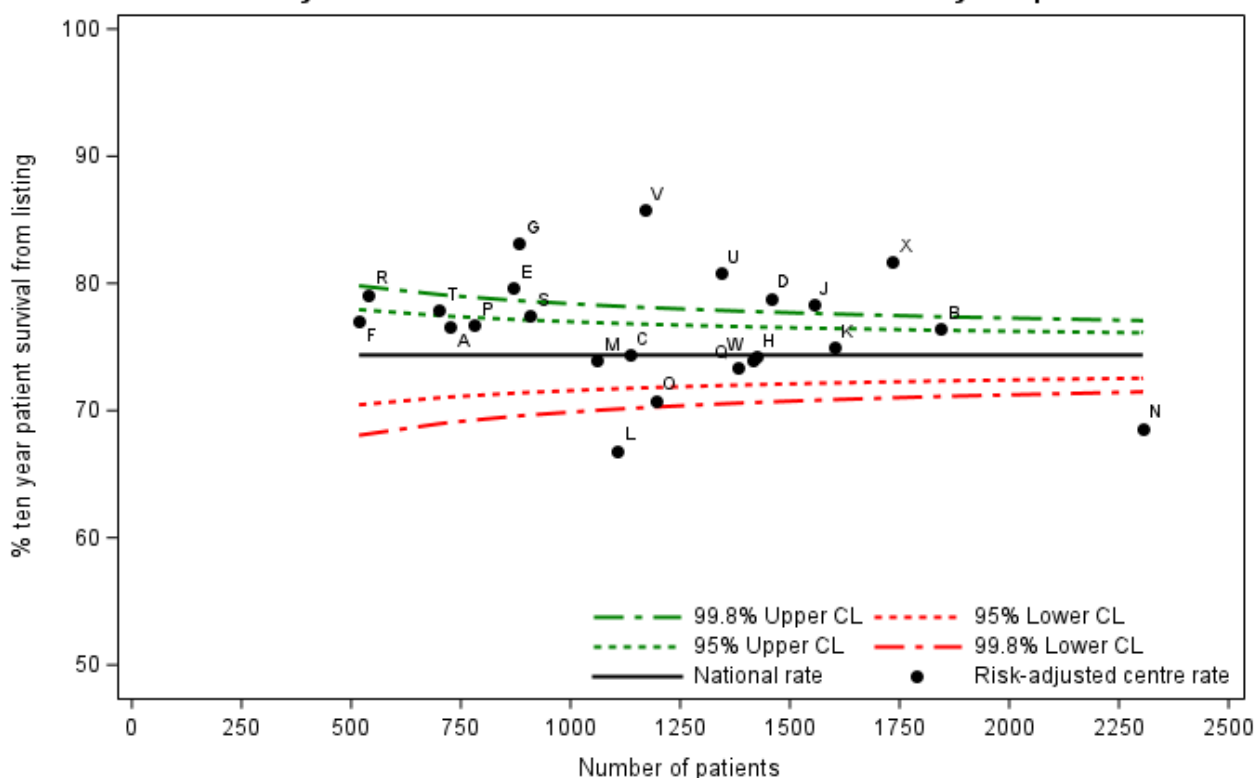
Survival from listing was analysed for all adult ( $\geq 18$  years) patients registered for the first time for a kidney only between 1 January 2009 and 31 December 2020. Survival time was defined as the time from joining the [transplant list](#) to death, regardless of the length of time on the [transplant list](#), whether or not the patient was transplanted and any factors associated with such a transplant e.g. donor type. Survival time was censored at either the date of removal from the list, or at the last known follow up date post transplant when no death date was recorded, or at the time of analysis if the patient was still active on the [transplant list](#).

Renal patients may receive a [live donor](#) kidney without prior registration on the [transplant list](#), although centre practices differ in relation to listing of potential [live donor](#) recipients. Consequently, patients who received a [live donor](#) kidney transplant within 6 months of listing were excluded from the analysis to minimise centre bias.

Ten year [risk-adjusted survival rates](#) from the point of kidney transplant listing are shown by centre in **Figure 6.9**. Seven centres were above the upper 99.8% [confidence limit](#) indicating that these centres have 10-year survival rates from listing that are considerably higher than the national rate. Leicester and Manchester fell below the 99.8% lower [confidence limit](#) and Newcastle fell below the 95% lower confidence limit. This suggests that 10-year survival from listing at Leicester, Manchester, and Newcastle may be significantly lower than the national rate.

Centres can be identified by the information shown in **Table 6.3**, which also shows one, five and ten year [risk-adjusted survival rates](#) from the point of kidney transplant listing.

**Figure 6.9** Risk-adjusted 10 year patient survival from listing in adult patients registered between 1 January 2009 and 31 December 2020 for deceased donor kidney transplants



**Table 6.3 Risk-adjusted 1, 5 and 10 year patient survival from listing for adult patients registered between 1 January 2009 and 31 December 2020 for deceased donor kidney transplants**

Centre	Code	One year		Five year		Ten year	
		N	(%)	N	(%)	N	(%)
Belfast	A	726	(98)	726	(88)	726	(77)
Birmingham	B	1845	(99)	1845	(89)	1845	(77)
Bristol	C	1136	(99)	1136	(88)	1136	(74)
Cambridge	D	1457	(99)	1457	(91)	1457	(79)
Cardiff	E	869	(99)	869	(91)	869	(80)
Coventry	F	518	(98)	518	(88)	518	(77)
Edinburgh	G	883	(99)	883	(92)	883	(83)
Glasgow	H	1424	(98)	1424	(87)	1424	(74)
Guy's	J	1554	(99)	1554	(89)	1554	(78)
Leeds	K	1603	(99)	1603	(88)	1603	(75)
Leicester	L	1107	(98)	1107	(83)	1107	(67)
Liverpool	M	1058	(99)	1058	(87)	1058	(74)
Manchester	N	2305	(98)	2305	(84)	2305	(69)
Newcastle	O	1197	(98)	1197	(86)	1197	(71)
Nottingham	P	782	(98)	782	(88)	782	(77)
Oxford	Q	1381	(99)	1381	(87)	1381	(73)
Plymouth	R	540	(98)	540	(90)	540	(79)
Portsmouth	S	909	(99)	909	(88)	909	(77)
Sheffield	T	699	(99)	699	(89)	699	(78)
St Georges	U	1344	(99)	1344	(90)	1344	(81)
The Royal Free	V	1170	(99)	1170	(94)	1170	(86)
The Royal London	W	1415	(98)	1415	(87)	1415	(74)
WLRTC	X	1735	(99)	1735	(92)	1735	(82)
<b>UK</b>		<b>27657</b>	<b>(98)</b>	<b>27657</b>	<b>(87)</b>	<b>27657</b>	<b>(74)</b>
<div> <div></div>Centre has reached the upper 99.8% confidence limit <div></div>Centre has reached the upper 95% confidence limit <div></div>Centre has reached the lower 95% confidence limit <div></div>Centre has reached the lower 99.8% confidence limit </div>							
Centres have been omitted where less than 75% of data reported							



## **Form Return Rates**

## 7.1 Deceased donor form return rates, 1 April 2020 – 31 March 2021

Form return rates are reported in **Table 7.1** for the kidney transplant record, three month and one year follow up form, along with lifetime follow up (more than two years). These include all adult deceased donor kidney only transplants between 1 April 2019 and 31 March 2020 for the transplant record, and all requests for follow up forms issued in this time period. Centres highlighted are transplant centres.

Centre	TX RECORD		THREE MONTHS		ONE YEAR		LIFETIME	
	N	% returned	N	% returned	N	% returned	N	% returned
Aberdeen, Aberdeen Royal Infirmary							175	99
Airdrie, Monklands District General Hospital							35	100
Bangor, Ysbyty Gwynedd District General Hospital							63	95
Basildon, Basildon Hospital							67	97
Belfast, Antrim Hospital							67	63
Belfast, Belfast City Hospital	134	100	129	99	57	77	290	90
Birmingham, Birmingham Heartlands Hospital							108	49
Birmingham, Queen Elizabeth Hospital Birmingham	69	100	76	95	120	90	677	99
Bodelwyddan, Glan Clwyd District General Hospital							51	100
Bradford, St Lukes Hospital							274	95
Brighton, Royal Sussex County Hospital							258	97
Bristol, Southmead Hospital	75	100	73	82	66	83	697	82
Cambridge, Addenbrooke's Hospital	187	98	179	100	142	98	525	100
Canterbury, Kent And Canterbury Hospital							291	9
Cardiff, University Of Wales Hospital	43	100	36	100	59	97	696	82
Carlisle, Cumberland Infirmary							89	97
Carshalton, St Helier Hospital							404	100
Chelmsford, Broomfield Hospital							86	100
County Down, Daisy Hill Hospital							79	85
Coventry, University Hospital	17	100	20	100	39	92	295	98
Derby, Royal Derby Hospital							187	100
Doncaster, Doncaster Royal Infirmary							62	100
Dorchester, Dorset County Hospital							236	46
Dudley, Russells Hall Hospital							67	96
Dulwich, King's College Hospital							386	0
Dundee, Ninewells Hospital							121	98
Edinburgh, Royal Infirmary Of Edinburgh	64	100	57	89	67	49	497	3
Exeter, Royal Devon And Exeter Hospital (Wonford)							249	94
Glasgow, Queen Elizabeth University Hospital	108	98	95	100	95	100	1042	91
Gloucester, Gloucestershire Royal Hospital							168	23
Great Yarmouth, James Paget Hospital							27	96
Hereford, The County Hospital							28	82
Hull, Hull Royal Infirmary							270	99
Inverness, Raigmore Hospital							78	100
Ipswich, Ipswich Hospital							160	97
Kings Lynn, The Queen Elizabeth Hospital							22	95
Leeds, St James's University Hospital	122	100	117	89	110	89	771	92
Leicester, Leicester General Hospital	72	100	91	99	81	100	685	99
Liverpool, Royal Liverpool University Hospital	56	98	52	96	63	100	423	96
London, Guy's Hospital	43	100	58	55	154	52	565	89
London, Hammersmith Hospital	83	100	130	98	148	97		
London, Royal Free Hospital	78	100	81	100	79	92	856	83
London, St George's Hospital	51	100	61	97	101	93	377	24
London, St Mary's Hospital							159	99
London, The Royal London Hospital (Whitechapel)	39	100	49	96	125	96	716	98
London, West London Renal And Transplant Centre							841	99
Londonderry, Altnagelvin Area Hospital							50	74
Manchester, Manchester Royal Infirmary	132	100	121	94	129	75	771	95
Middlesbrough, The James Cook University Hospital							294	70
Newcastle, Freeman Hospital	120	100	104	95	72	86	384	99
Northampton, Northampton General Hospital							54	81

**Table 7.1 Deceased donor form return rates, 1 April 2020 and 31 March 2021**

Centre	TX RECORD		THREE MONTHS		ONE YEAR		LIFETIME	
	N	% returned	N	% returned	N	% returned	N	% returned
Norwich, Norfolk And Norwich University Hospital							287	95
Nottingham, Nottingham City Hospital	30	100	32	100	40	95	481	48
Omagh, Tyrone County Hospital							56	5
Oxford, Churchill Hospital	189	100	186	98	123	85	726	92
Plymouth, Derriford Hospital	37	100	40	75	36	56	201	95
Portsmouth, Queen Alexandra Hospital	13	100	18	100			779	1
Preston, Royal Preston Hospital							430	19
Reading, Royal Berkshire Hospital							307	84
Salford, Salford Royal							443	98
Sheffield, Northern General Hospital	30	100	32	97	49	100	509	55
Shrewsbury, Royal Shrewsbury Hospital							80	96
St Helier, Jersey General Hospital							26	100
Stevenage, Lister Hospital							219	88
Stoke-On-Trent, Royal Stoke University Hospital							215	43
Sunderland, Sunderland Royal Hospital							145	100
Swansea, Morriston Hospital							179	97
Truro, Royal Cornwall Hospital (Treliske)							210	25
Westcliff On Sea, Southend Hospital							73	18
Wirral, Arrowe Park Hospital							120	4
Wolverhampton, New Cross Hospital							129	98
Wrexham, Maelor General Hospital							97	100
York, York District Hospital							210	95

**7.2 Living donor form return rates, 1 April 2020 – 31 March 2021**

Form return rates are reported in **Table 7.2** for the kidney transplant record, three month and one year follow up form, along with lifetime follow up (more than two years). These include all adult living donor kidney only transplants between 1 April 2020 and 31 March 2021 for the transplant record, and all requests for follow up forms issued in this time period. Centres highlighted are transplant centres.

<b>Table 7.2 Living donor form return rates, 1 April 2020 and 31 March 2021</b>								
Centre	TX RECORD		THREE MONTHS		ONE YEAR		LIFETIME	
	N	% returned	N	% returned	N	% returned	N	% returned
Aberdeen, Aberdeen Royal Infirmary							86	98
Bangor, Ysbyty Gwynedd District General Hospital							23	91
Basildon, Basildon Hospital							36	100
Belfast, Antrim Hospital							59	63
Belfast, Belfast City Hospital	8	100	21	95	58	90	286	90
Birmingham, Birmingham Heartlands Hospital							43	60
Birmingham, Queen Elizabeth Hospital Birmingham	16	94	14	79	36	86	417	100
Bodelwyddan, Glan Clwyd District General Hospital							26	100
Bradford, St Lukes Hospital							55	98
Brighton, Royal Sussex County Hospital							175	99
Bristol, Southmead Hospital	14	100	13	85	26	77	356	81
Cambridge, Addenbrooke's Hospital	11	100	16	100	37	92	269	100
Canterbury, Kent And Canterbury Hospital							242	10
Cardiff, University Of Wales Hospital	12	100	15	80	26	85	373	80
Carlisle, Cumberland Infirmary							38	87
Carshalton, St Helier Hospital							280	99
Chelmsford, Broomfield Hospital							30	93
County Down, Daisy Hill Hospital							61	95
Coventry, University Hospital	9	100	11	82	21	100	240	97
Derby, Royal Derby Hospital							43	100
Doncaster, Doncaster Royal Infirmary							29	100
Dorchester, Dorset County Hospital							92	29
Dudley, Russells Hall Hospital							27	96
Dundee, Ninewells Hospital							72	96
Edinburgh, Royal Infirmary Of Edinburgh	27	100	25	100	46	46	241	2
Exeter, Royal Devon And Exeter Hospital (Wonford)							110	96
Glasgow, Queen Elizabeth University Hospital	31	100	38	100	48	100	453	91
Gloucester, Gloucestershire Royal Hospital							67	28
Hull, Hull Royal Infirmary							138	99
Inverness, Raigmore Hospital							42	98
Ipswich, Ipswich Hospital							51	98
Leeds, St James's University Hospital	22	100	22	77	41	85	267	92
Leicester, Leicester General Hospital	19	100	26	100	45	100	418	99
Liverpool, Royal Liverpool University Hospital	12	100	16	100	25	92	275	97
London, Cromwell Hospital	3	100						
London, Guy's Hospital	4	100	21	43	69	52	472	86
London, Hammersmith Hospital	11	100	16	100	48	100		
London, Royal Free Hospital	23	100	29	100	38	79	444	80
London, St George's Hospital	14	100	17	100	42	98	167	23
London, St Mary's Hospital							118	99
London, The Royal London Hospital (Whitechapel)	16	100	24	96	36	92	356	96
London, West London Renal And Transplant Centre							533	99
Londonderry, Altnagelvin Area Hospital							43	88
Manchester, Manchester Royal Infirmary	34	100	34	91	62	77	382	97
Middlesbrough, The James Cook University Hospital							203	75
Newcastle, Freeman Hospital	22	100	22	100	50	90	248	100
Northampton, Northampton General Hospital							23	65
Norwich, Norfolk And Norwich University Hospital							72	93
Nottingham, Nottingham City Hospital	4	100	4	100	15	93	147	59
Omagh, Tyrone County Hospital							40	3
Oxford, Churchill Hospital	32	100	36	94	46	91	421	92
Plymouth, Derriford Hospital	13	100	13	100	13	69	89	94
Portsmouth, Queen Alexandra Hospital	7	100	13	100	20	10	330	2

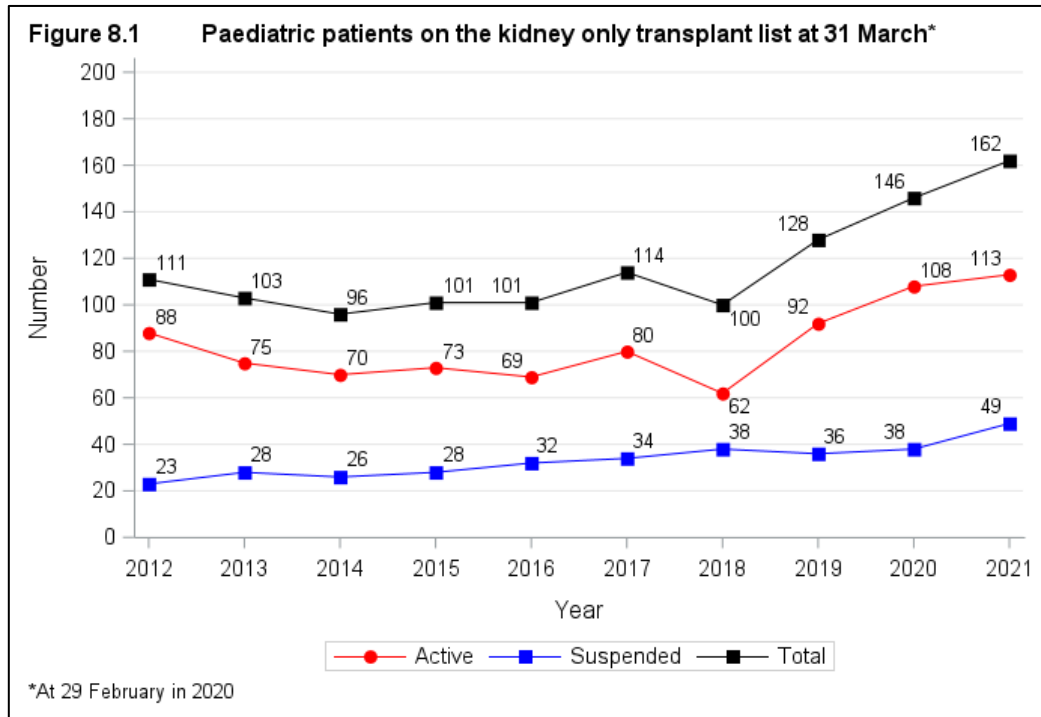
**Table 7.2 Living donor form return rates, 1 April 2020 and 31 March 2021**

Centre	TX RECORD		THREE MONTHS		ONE YEAR		LIFETIME	
	%		%		%		%	
	N	returned	N	returned	N	returned	N	returned
Preston, Royal Preston Hospital							229	19
Reading, Royal Berkshire Hospital							107	84
Salford, Salford Royal							178	99
Sheffield, Northern General Hospital	7	100	12	100	17	100	239	52
Shrewsbury, Royal Shrewsbury Hospital							50	96
Stevenage, Lister Hospital							75	88
Stoke-On-Trent, Royal Stoke University Hospital							155	46
Sunderland, Sunderland Royal Hospital							85	100
Swansea, Morriston Hospital							58	100
Truro, Royal Cornwall Hospital (Treliske)							85	28
Westcliff On Sea, Southend Hospital							50	36
Wirral, Arrowe Park Hospital							61	3
Wolverhampton, New Cross Hospital							55	100
Wrexham, Maelor General Hospital							45	100
York, York District Hospital							62	95

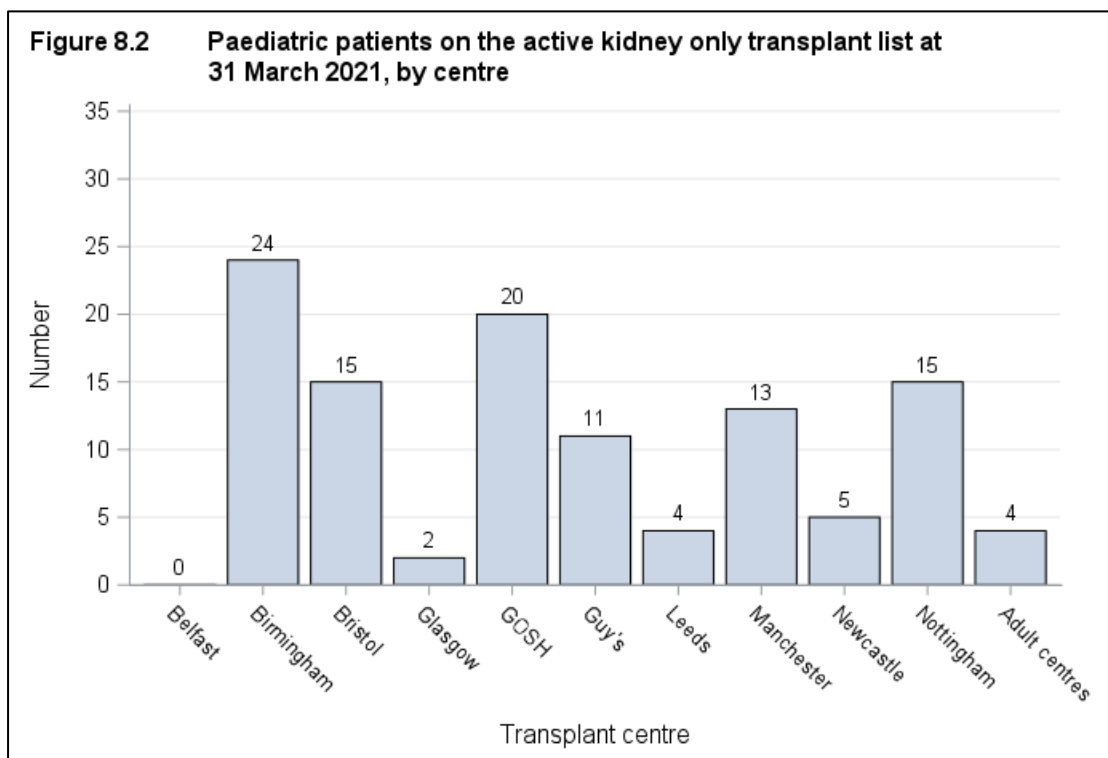
## **Paediatric kidney transplant list**

## 8.1 Patients on the kidney transplant list as at 31 March, 2012 – 2021

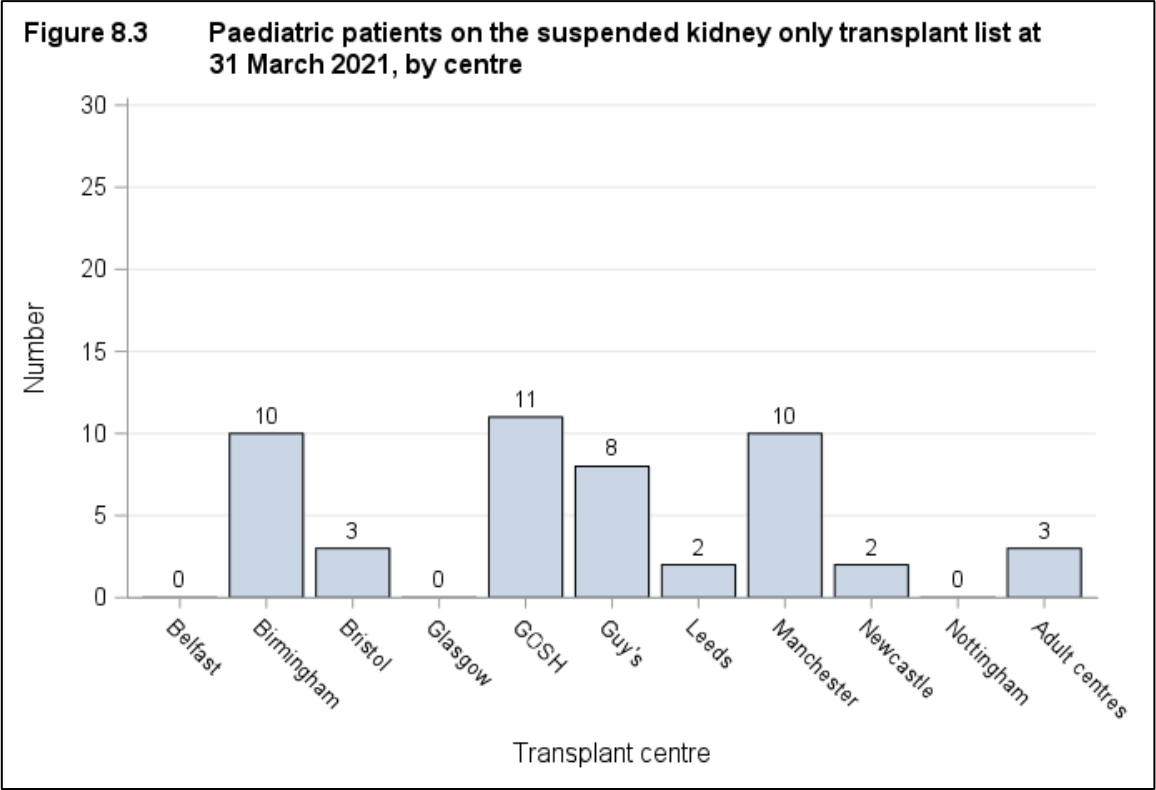
**Figure 8.1** shows the number of paediatric patients on the kidney only [transplant list](#) at 31 March each year between 2011 and 2021 (29 February in 2020). The number of patients actively waiting for a kidney transplant fell from 88 in 2012 to 62 in 2018, with an increase to 113 patients by 2021.



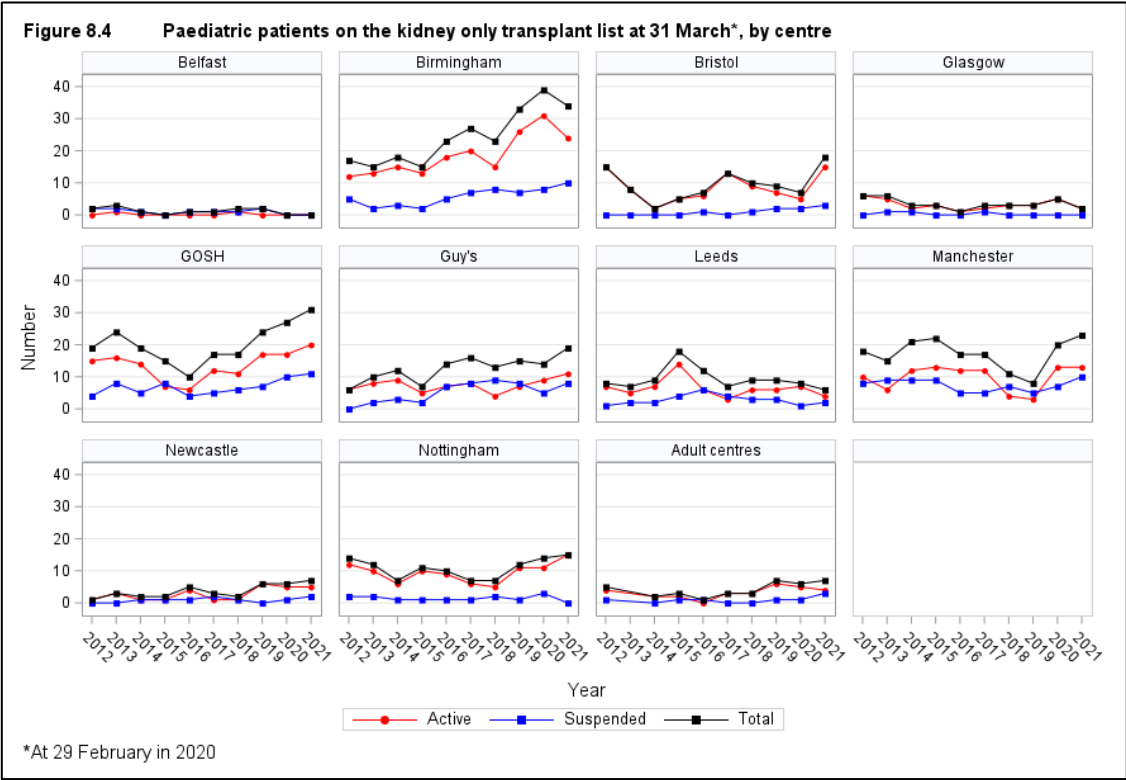
**Figure 8.2** shows the number of paediatric patients on the active kidney only [transplant list](#) at 31 March 2021 by centre. Of the total 113 paediatric patients, Birmingham had the largest proportion of the [transplant list](#) (21%) and Belfast had the smallest (0%).



**Figure 8.3** shows the number of paediatric patients on the suspended kidney only [transplant list](#) at 31 March 2021 by centre. Of the 49 suspended paediatric patients, GOSH had the largest proportion of the [transplant list](#) (22%) and Belfast, Glasgow, and Nottingham had the smallest (0%).



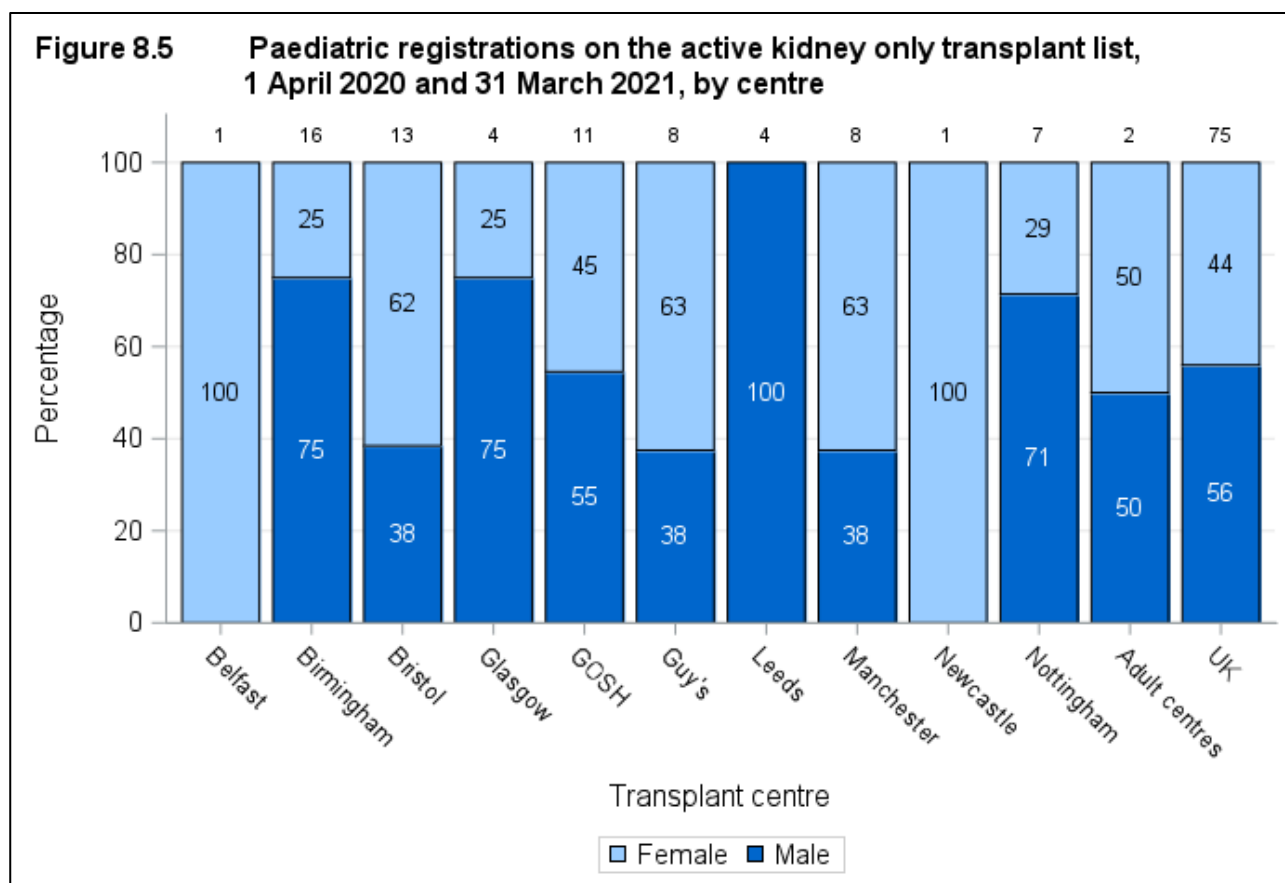
**Figure 8.4** shows the number of paediatric patients on the [transplant list](#) at 31 March each year between 2012 and 2021 and at 29 February in 2020 for each transplant centre.



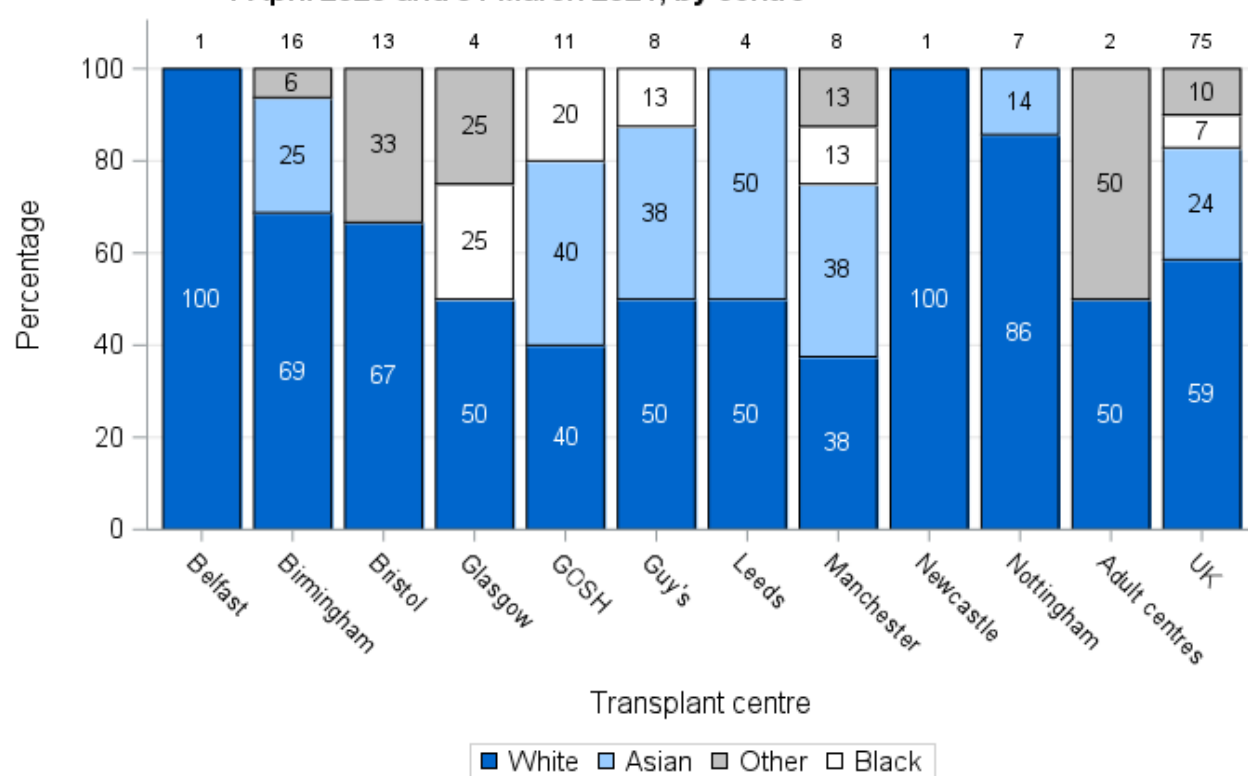


## 8.2 Demographic characteristics, 1 April 2020 – 31 March 2021

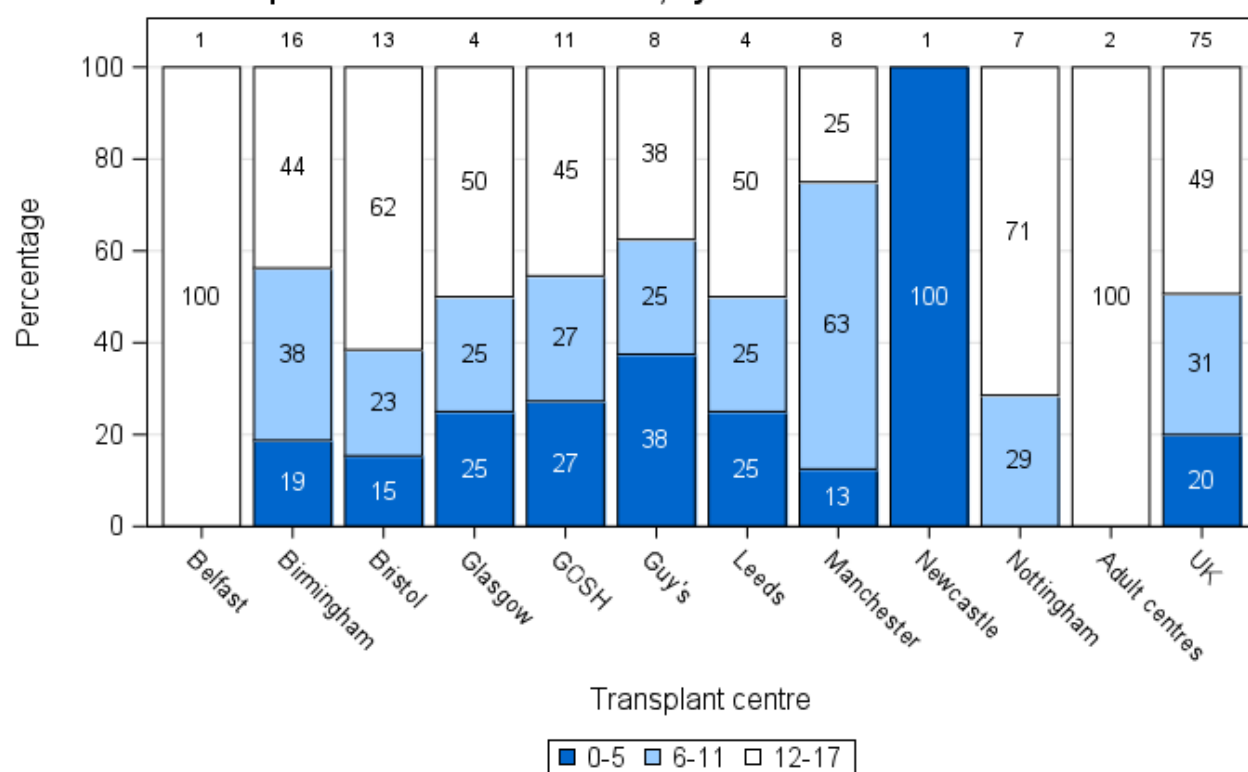
The sex, ethnicity and age group of patients on the transplant are shown by centre in **Figure 8.5, 8.6 and 8.7**, respectively. Note that all percentages quoted are based only on data where relevant information was available. Changes made to the Kidney Allocation Scheme in 2006 and the 2019 National Kidney Offering Scheme mean that tissue matching criteria between donor and recipient are less strict than previously and waiting time to transplant is now more important than it was in deciding kidney allocation. These changes have an indirect benefit for patients from ethnic minority groups, who are less often a good tissue match with the predominantly white donor pool. As a result, access to transplantation is becoming more equitable.



**Figure 8.6 Paediatric registrations on the active kidney only transplant list, 1 April 2020 and 31 March 2021, by centre**

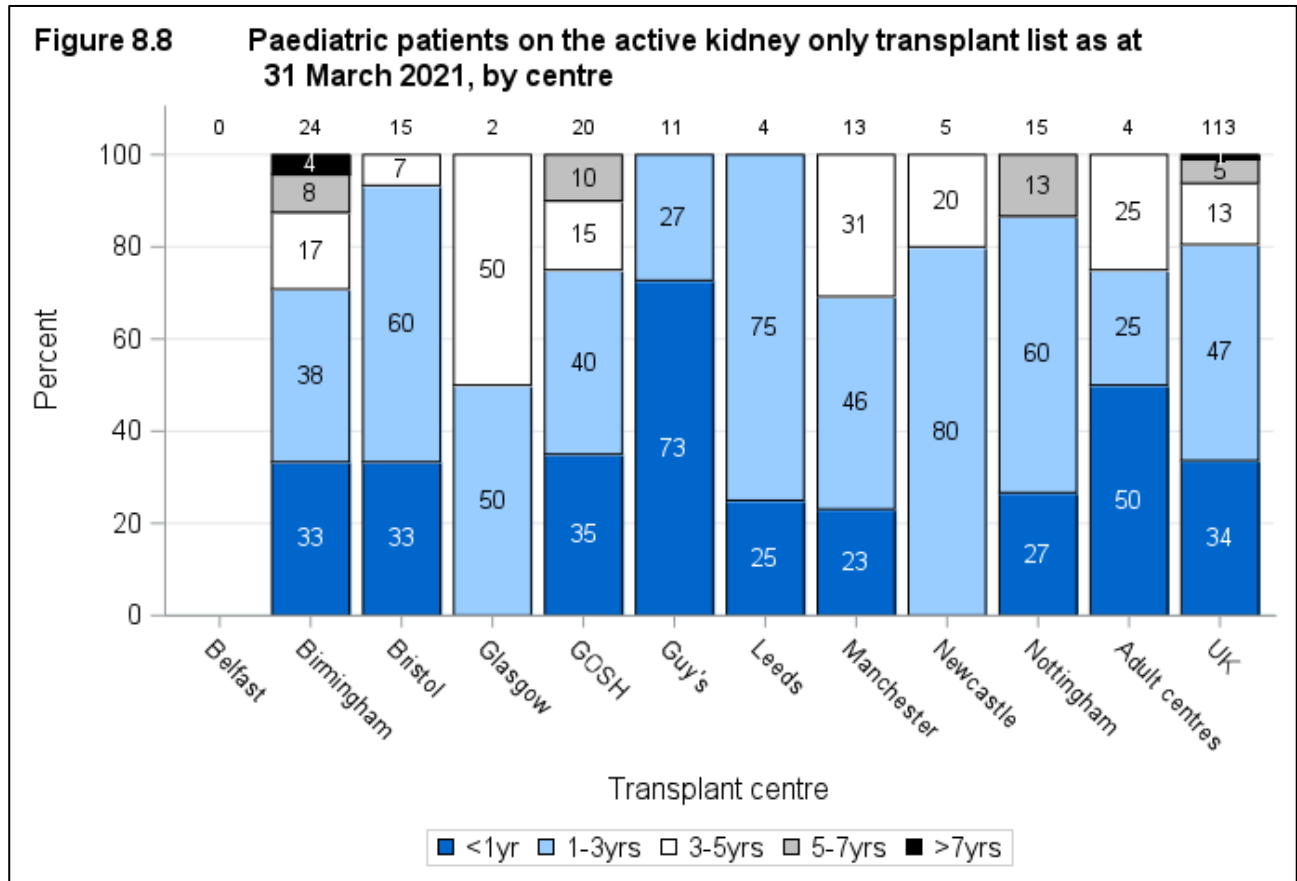


**Figure 8.7 Paediatric registrations on the active kidney only transplant list, 1 April 2020 and 31 March 2021, by centre**



### 8.3 Patient waiting times for those currently on the list, 31 March 2021

**Figure 8.8** shows the length of time patients have been waiting on the kidney only [transplant list](#) at 31 March 2021 by centre.



#### 8.4 Median waiting time to transplant, 1 April 2015 - 31 March 2018

The length of time a patient waits for a kidney transplant varies across the UK. The [median](#) waiting time for paediatric deceased donor kidney only transplantation is shown in **Figure 8.8** and **Table 8.1** for patients registered at each individual unit. The data shown are for all paediatric patients, joining the list within the time period shown, including those still awaiting a transplant on the day of analysis. Patients who received a [live donor](#) or [multi-organ transplant](#) are not included. The national allocation scheme introduced in April 2006 helped to reduce the variability in deceased donor kidney waiting times across the country but currently some variability remains. Waiting times across centres continue to differ in a way that it is difficult for centres to control, given that the 2006 [National Kidney Allocation Scheme](#) determined allocation of all kidneys available for transplant from donors after brain death (DBD). This has continued following the introductions of the 2019 National Kidney Offering Scheme which determines allocation of all DBD kidneys and kidneys from donations after circulatory death (DCD).

##### 2006 National Kidney Allocation Scheme

Only kidneys from donors after brain death were allocated via a national allocation scheme during the majority of the time period analysed. DCD kidneys were allocated to patients through local allocation arrangements and these vary across the country because some centres have a larger DCD programme than others. From 3 September 2014 one kidney from DCD donors aged between 5 and 49 years were allocated within four pre-defined regions using the 2006 DBD allocation principles and as such should reduce variability in waiting times across the country.

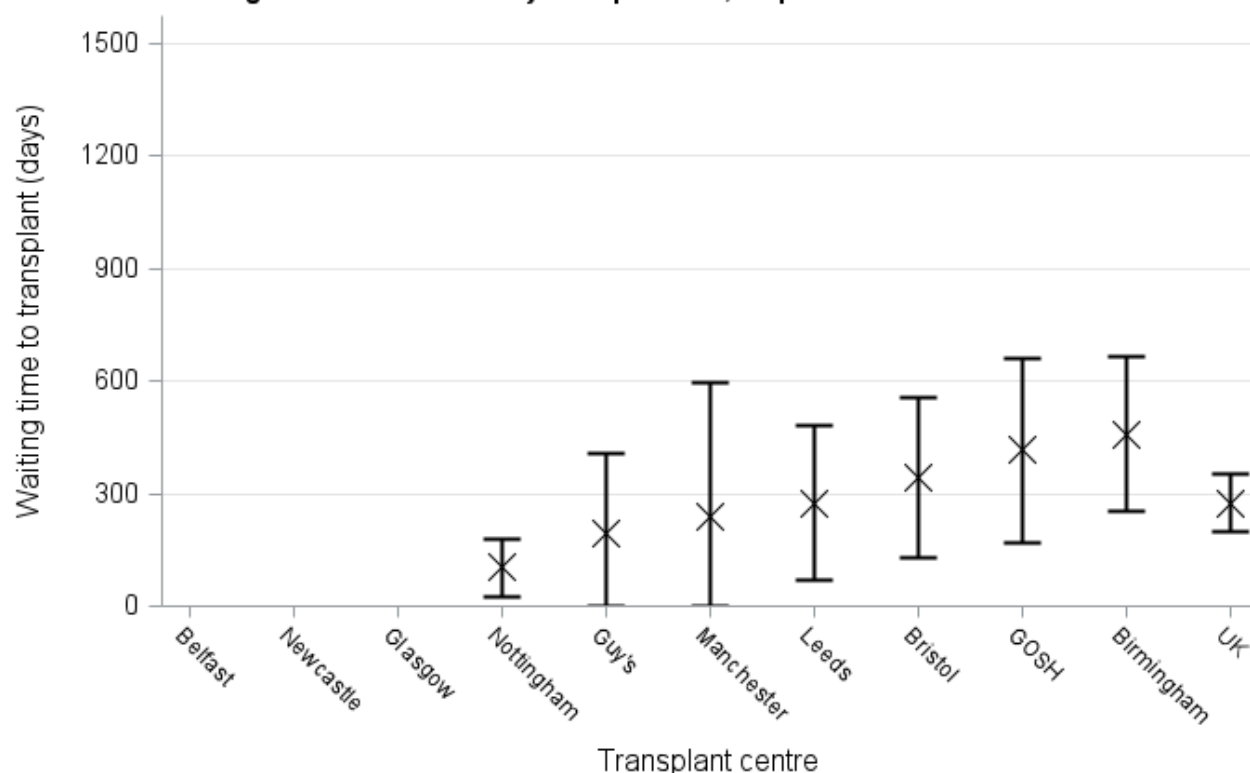
Kidneys from DBD are allocated to patients listed nationally through the 2006 Kidney Allocation Scheme. The 2006 Kidney Allocation Scheme introduced in April 2006 prioritised patients with ideal tissue matches (000 HLA mismatches) and then assigned points to patients based on the level of tissue match between donor and recipient, the length of time spent waiting for a transplant, age of the recipient (with a progressive reduction in points given after the age of thirty) and location points such that patients geographically close to the retrieval centre received more points. The patients with the highest number of points for a donated kidney were preferentially offered the kidney, no matter where in the UK they received their treatment.

##### 2019 National Kidney Offering Scheme

The 2019 Kidney Offering Scheme was introduced on 11 September 2019 and this is a single scheme for offering all kidneys from deceased donors in the UK. This scheme prioritises patients who are difficult to match or have waited a long time for a transplant

The [median](#) waiting time to transplant for paediatric patients registered on the kidney only [transplant list](#) between 1 April 2015 and 31 March 2018 is 276 days. This ranged from 105 days at Nottingham to 459 days at Birmingham.

**Figure 8.9** Median waiting time to deceased donor transplant for paediatric patients registered on the kidney transplant list, 1 April 2015 - 31 March 2018

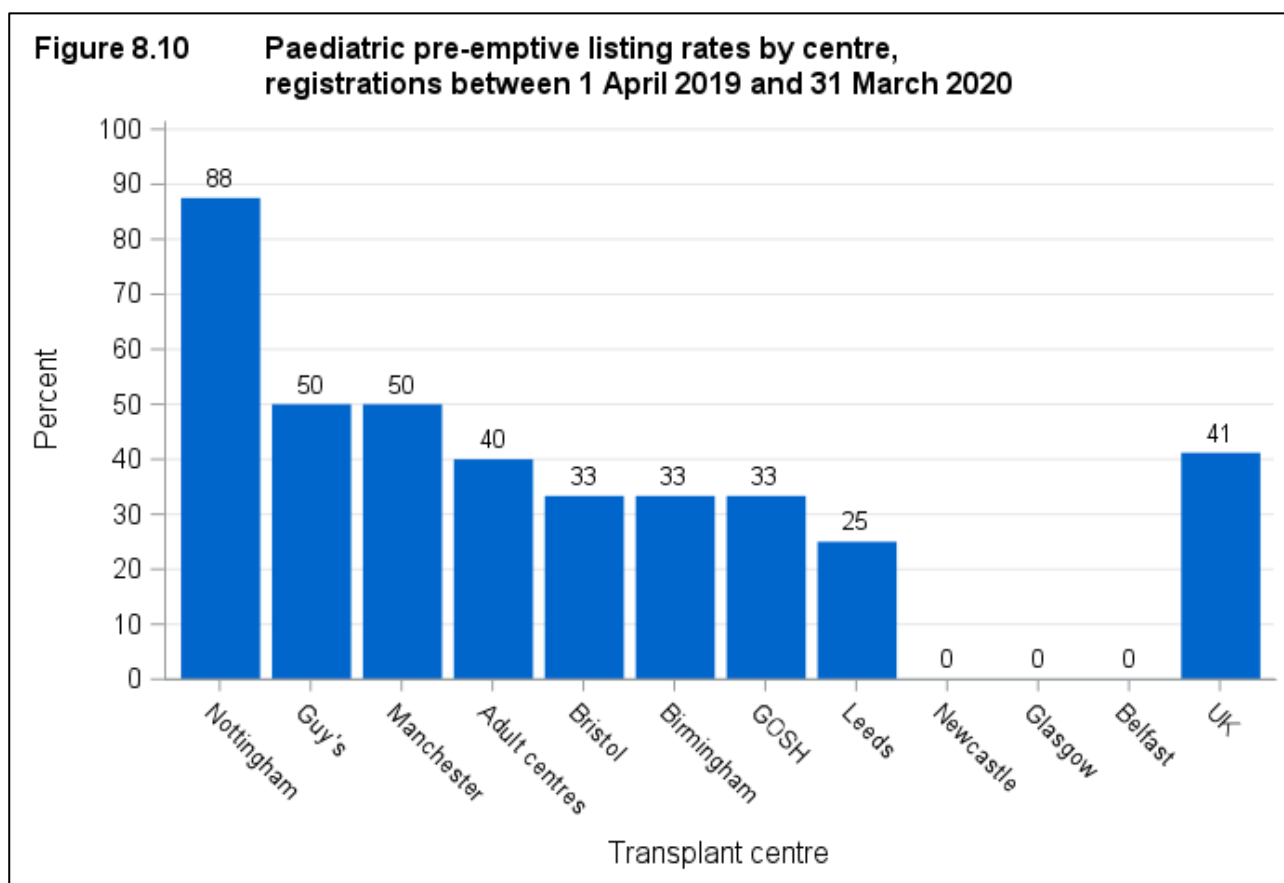


**Table 8.1** Median waiting time to kidney only transplant in the UK, for paediatric patients registered 1 April 2015 - 31 March 2018

Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
Paediatric			
Belfast	0	-	
Newcastle	0	-	
Glasgow	0	-	
Nottingham	25	105	28 - 182
Guy's	23	194	0 - 410
Manchester	20	240	0 - 598
Leeds	17	276	70 - 482
Bristol	21	343	131 - 555
GOSH	23	416	172 - 660
Birmingham	34	459	252 - 666
<b>UK</b>	<b>197</b>	<b>276</b>	<b>200 - 352</b>

## 8.5 Pre-emptive listing rates, 1 April 2019 - 31 March 2020

Rates of [pre-emptive](#) kidney only listings are shown in **Figure 8.10** for paediatric patients joining the list between 1 April 2019 and 31 March 2020. Patients listed on the deceased donor [transplant list](#) prior to receiving a living donor transplant are excluded and in order to remove the effect of these patients an earlier cohort was selected. [Pre-emptive](#) listing accounted for 41% of all paediatric registrations across the UK ranging from 88% at Nottingham to 0% at Belfast, Newcastle, and Glasgow.



## **Response to paediatric kidney offers**

## Offer decline rates

Kidney-only offers from [DBD](#) donors who had at least one kidney retrieved, offered directly and on behalf of a named individual patient and resulted in transplantation are included in the analysis. Any offers made through the reallocation of kidneys, declined kidney or fast track schemes were excluded, as were offers of kidneys from donations after circulatory death donors.

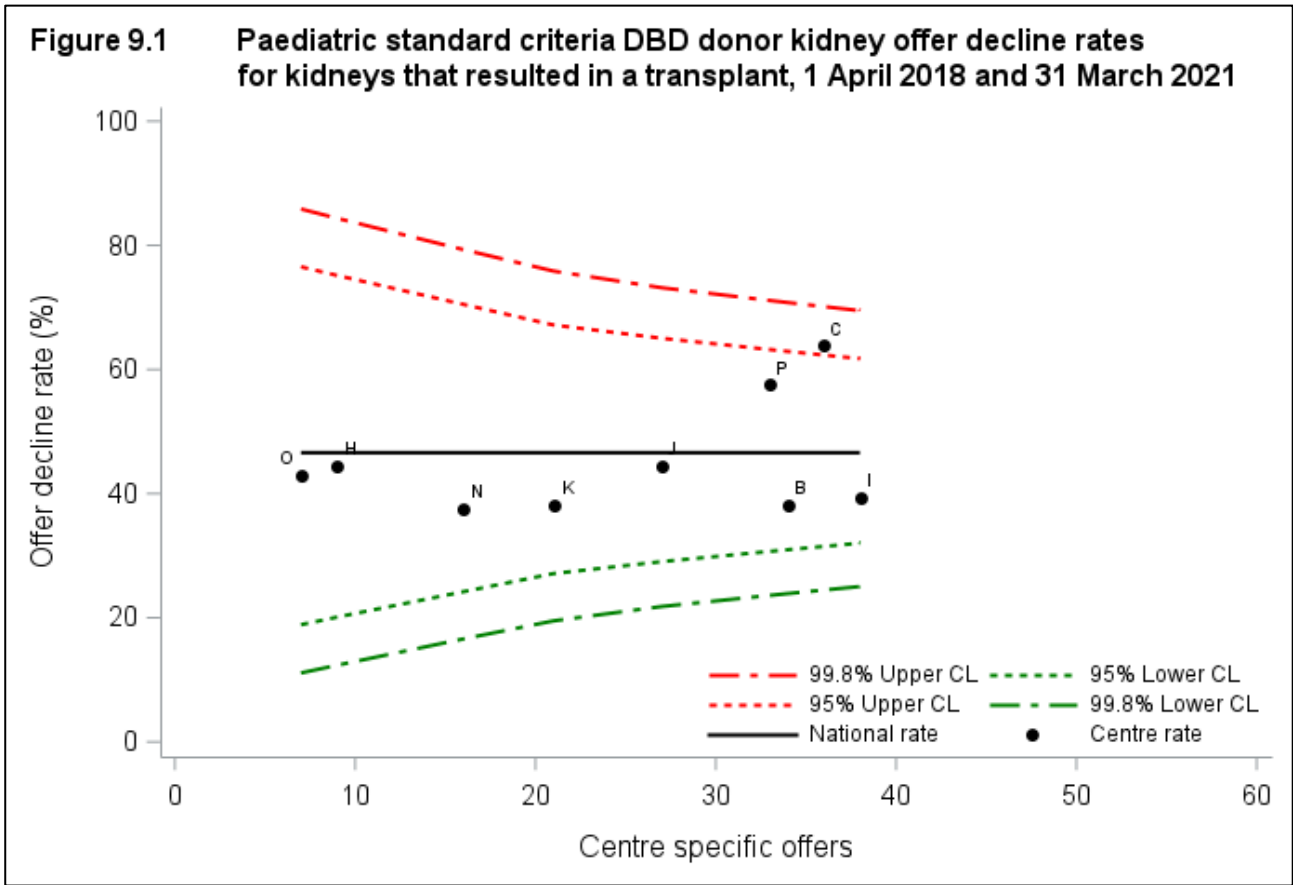
Data are presented for standard criteria donors (SCD). SCD are [DBD](#) donors aged <50 at the time of death.

[Funnel plots](#) were used to compare centre specific offer decline rates and indicate how consistent the rates of the individual transplant centres are with the national rate. The overall national unadjusted offer decline rate is shown by the solid line while the 95% and 99.8% confidence lines are indicated via a thin and thick dotted line, respectively. Each dot in the plot represents an individual transplant centre. Centres that are positioned above the upper limits indicate an offer decline rate that is higher than the national rate, while centres positioned below the lower limits indicate an offer decline rate that is lower than the national rate. Patient [case mix](#) is known to influence the number of offers a centre may receive. In this analysis however only individual offers for named patients were considered which excluded any [ABO](#)- and HLA-incompatible patients. For this reason it was decided not to risk adjust for known centre differences in patient [case mix](#).



9.1 Standard criteria offer decline rates, 1 April 2018 – 31 March 2021

**Figure 9.1** compares individual centre offer decline rates with the national rate for SCD over the time period, 1 April 2018 and 31 March 2021. Centres can be identified by the information shown in **Table 9.1**. One centre has an offer decline rate falls above the 95% upper confidence limit, suggesting this centre has a rate different from the national rate.



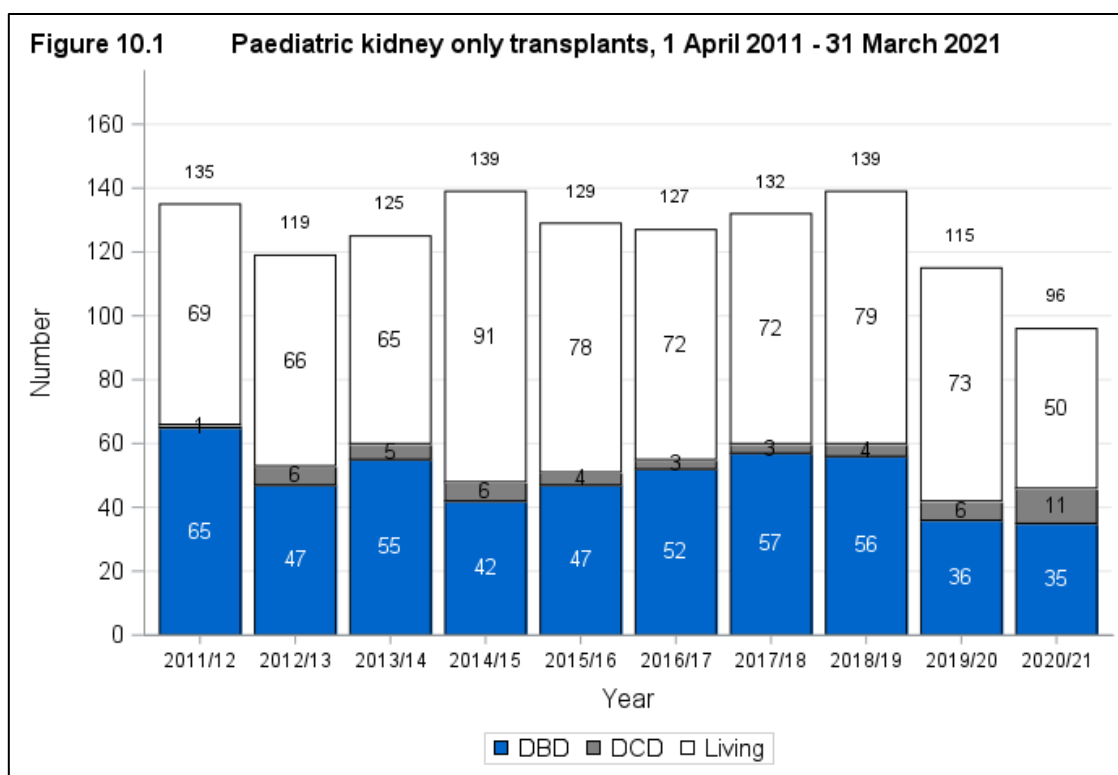
**Table 9.1** compares individual centre offer decline rates for SCD over time by financial year.

<b>Table 9.1 Paediatric standard criteria DBD donor kidney offer decline rates by transplant centre, 1 April 2018 and 31 March 2021</b>									
Centre	Code	2018/19		2019/20		2020/21		Overall	
		N	(%)	N	(%)	N	(%)	N	(%)
Birmingham	B	12	(42)	9	(22)	13	(46)	34	(38)
Bristol	C	10	(70)	12	(75)	14	(50)	36	(64)
GOSH	I	15	(47)	6	(33)	17	(35)	38	(39)
Glasgow	H			2	(0)	7	(57)	9	(44)
Guy's	J	8	(38)	3	(67)	16	(44)	27	(44)
Leeds	K	3	(33)	6	(33)	12	(42)	21	(38)
Manchester	N	3	(33)	5	(40)	8	(38)	16	(38)
Newcastle	O	5	(40)	2	(50)			7	(43)
Nottingham	P	5	(60)	16	(69)	12	(42)	33	(58)
<b>UK</b>		<b>61</b>	<b>(48)</b>	<b>61</b>	<b>(51)</b>	<b>99</b>	<b>(43)</b>	<b>221</b>	<b>(47)</b>

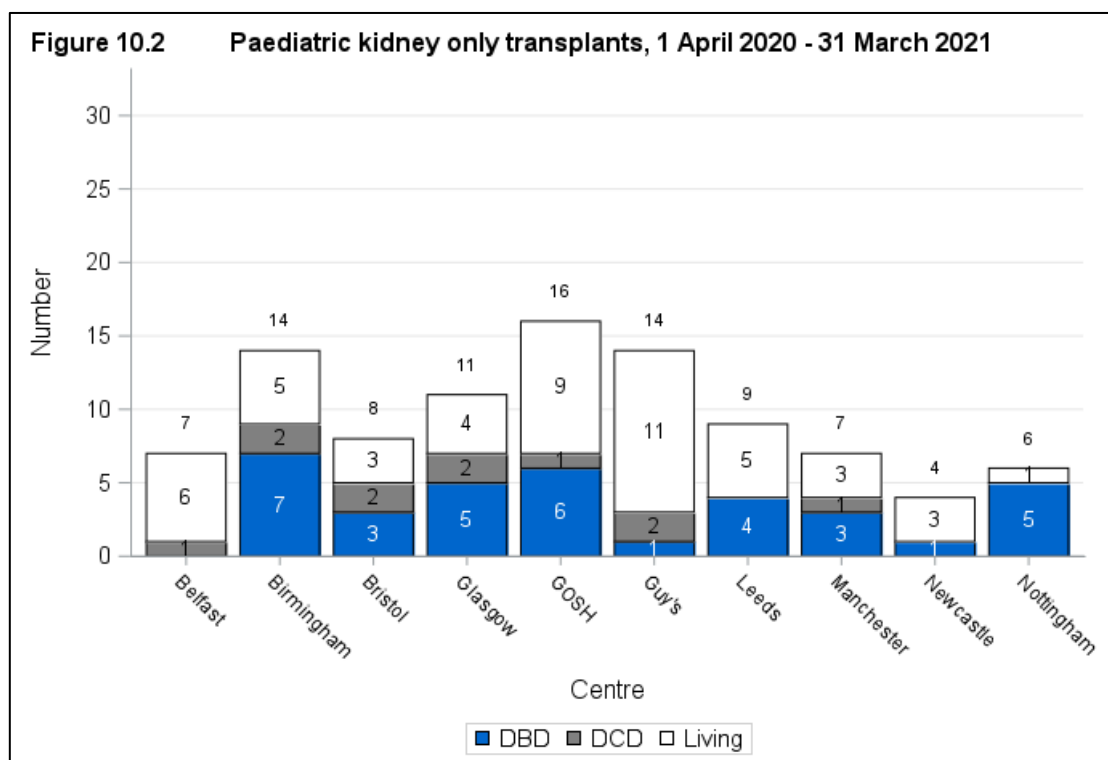
# **Paediatric kidney transplants**

## 10.1 Kidney only transplants, 1 April 2011 – 31 March 2021

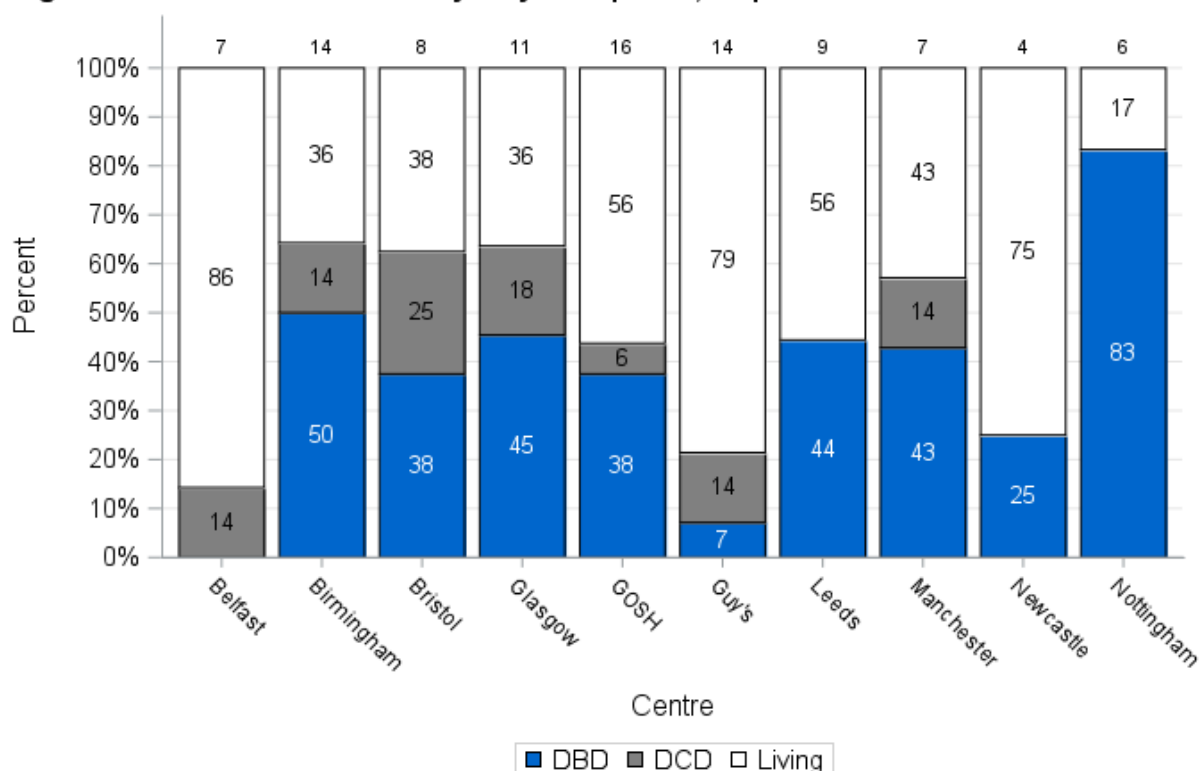
**Figure 10.1** shows the total number of paediatric kidney only transplants performed in the last ten years, by type of donor. Only a small number of paediatric transplants use kidneys from donors after circulatory death ([DCD](#)), 11 in 2020/21.



**Figure 10.2** shows the total number of paediatric kidney only transplants performed in 2020/21, by centre and type of donor. The same information is presented in Figure 10.3 but this shows the proportion of [DBD](#), [DCD](#) and living donor transplants performed at each centre.

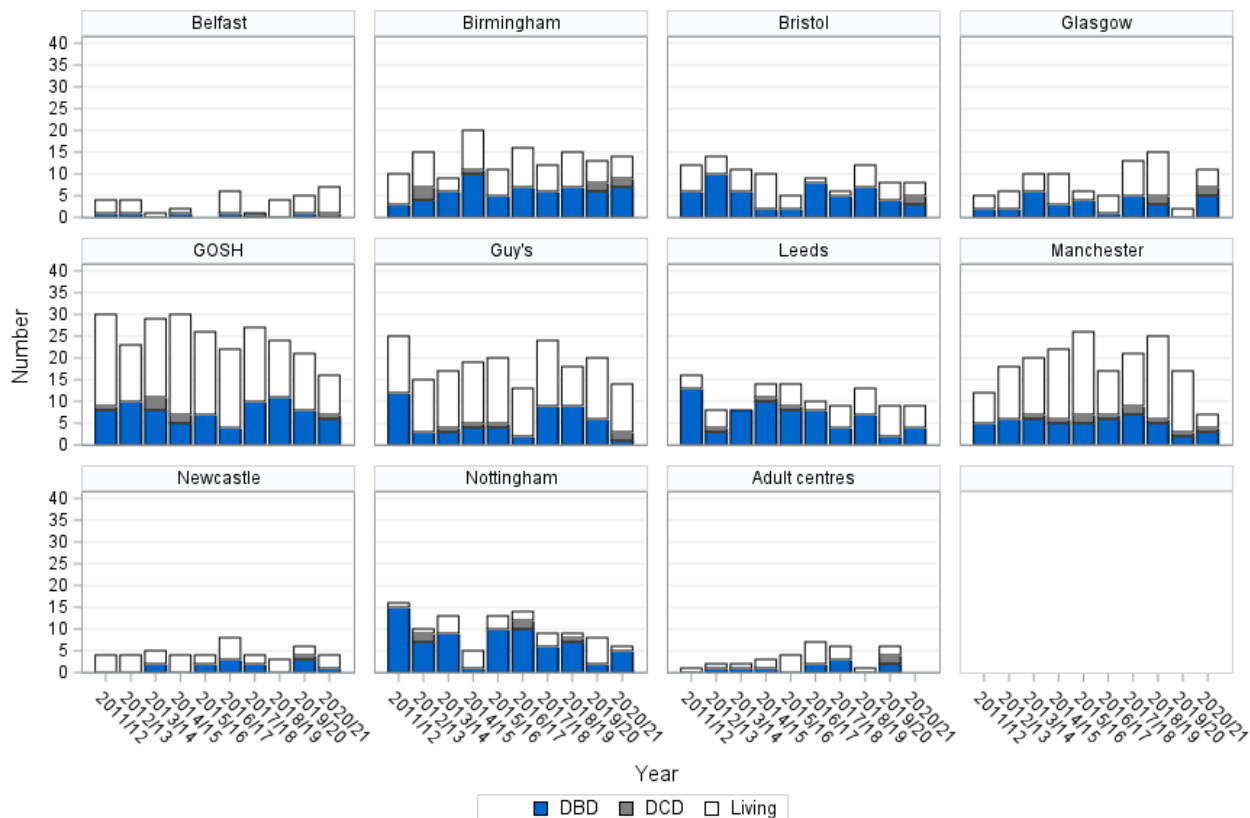


**Figure 10.3 Paediatric kidney only transplants, 1 April 2020 - 31 March 2021**



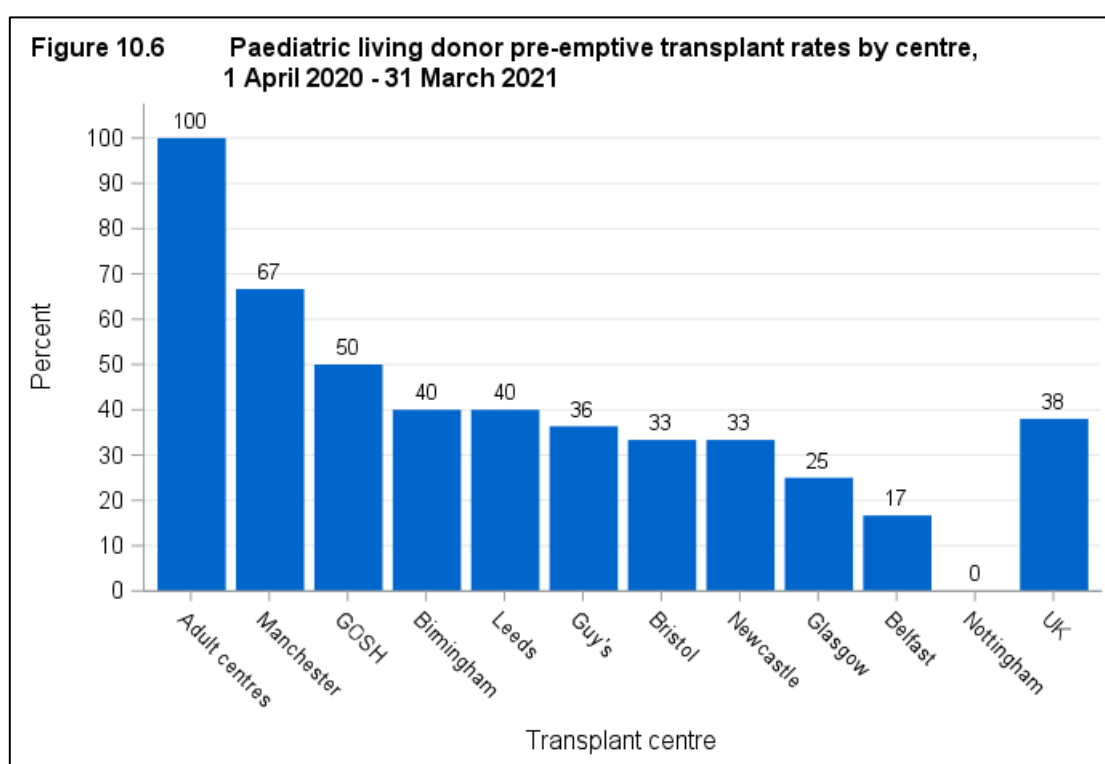
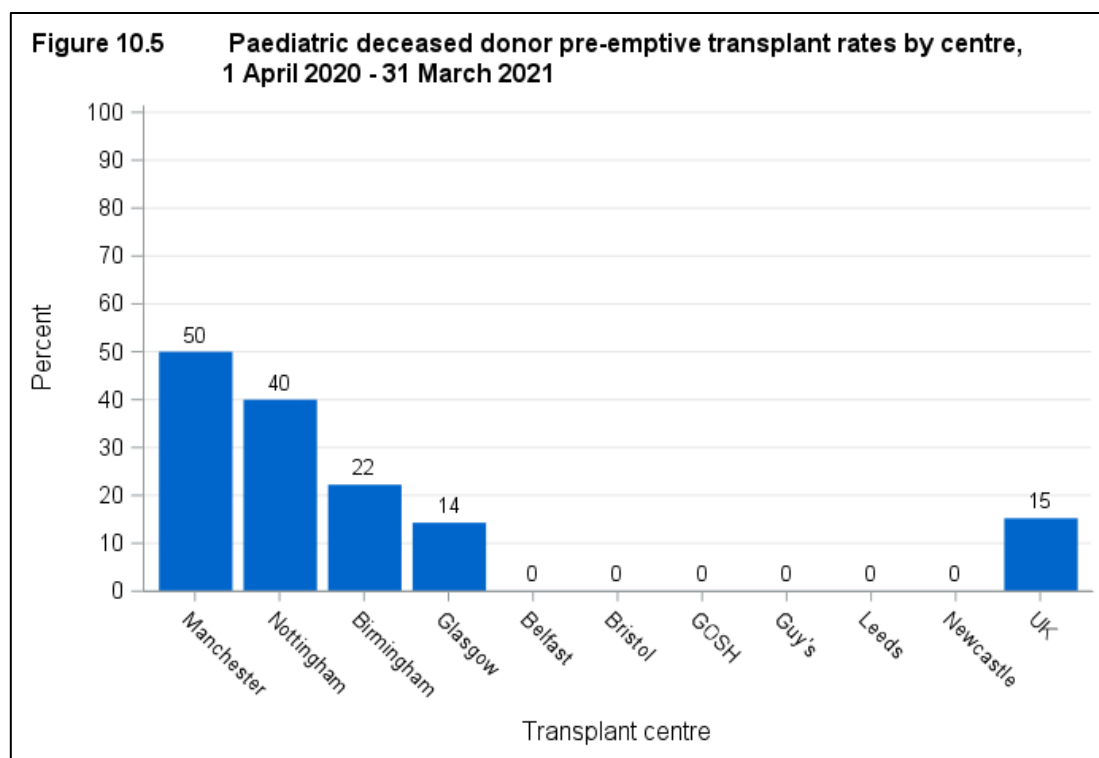
**Figure 10.4** shows the total number of paediatric kidney only transplants performed in last ten years, by centre and type of donor.

**Figure 10.4 Paediatric kidney only transplants by centre, 1 April 2011 - 31 March 2021**



## 10.2 Pre-emptive transplant rates, 1 April 2020 - 31 March 2021

Rates of [pre-emptive](#) kidney only transplantation are shown in **Figure 10.5** for paediatric deceased donor transplants and **Figure 10.6** for paediatric living donor transplants. Living donor transplants are more likely to be carried out before the need for dialysis than deceased donor transplants: 38% and 15% respectively. This is because a living donor transplant can often be carried out more quickly than a deceased donor kidney transplant as the latter often necessitates a long waiting time. Paediatric deceased donor [pre-emptive](#) transplant rates ranged from 50% at Manchester to 0% at a number of centres. Paediatric living donor [pre-emptive](#) transplant rates ranged from 100% at Adult Centres to 0% at Nottingham.



## **Paediatric kidney outcomes**

We present a visual comparison of survival rates among centres that is based on a graphical display known as a [funnel plot](#) (1, 2). This display is used to show how consistent the rates of the different transplant units are with the national rate. [Funnel plots](#) show the [risk-adjusted survival rate](#) plotted against the number of transplants for each centre, with the overall national [unadjusted survival rate](#) (solid line), and its 95% (thin dotted lines) and 99.8% (thick dotted lines) [confidence limits](#) superimposed. Each dot in the plot represents one of the centres. Note that many patients return to local renal units for follow-up care after their transplant and although we report survival according to transplant unit, patients may in fact be followed up quite distantly from their transplant centre.

#### Interpreting the [funnel plots](#)

If a centre lies within all the limits, then that centre has a survival rate that is statistically consistent with the national rate. If a centre lies outside the 95% [confidence limits](#), this serves as an alert that the centre may have a rate that is significantly different from the national rate. If a centre lies outside the 99.8% limits, then further investigations may be carried out to determine the reasons for the possible difference. When a centre lies above the upper limits, this indicates a survival rate that is higher than the national rate, while a centre that lies below the lower limits has a survival rate that is lower than the national rate. It is important to note that adjusting for patient mix through the use of risk-adjustment models may not account for all possible causes of centre differences. There may be other factors that are not taken into account in the risk-adjustment process that may affect the survival rate of a particular centre.

#### References

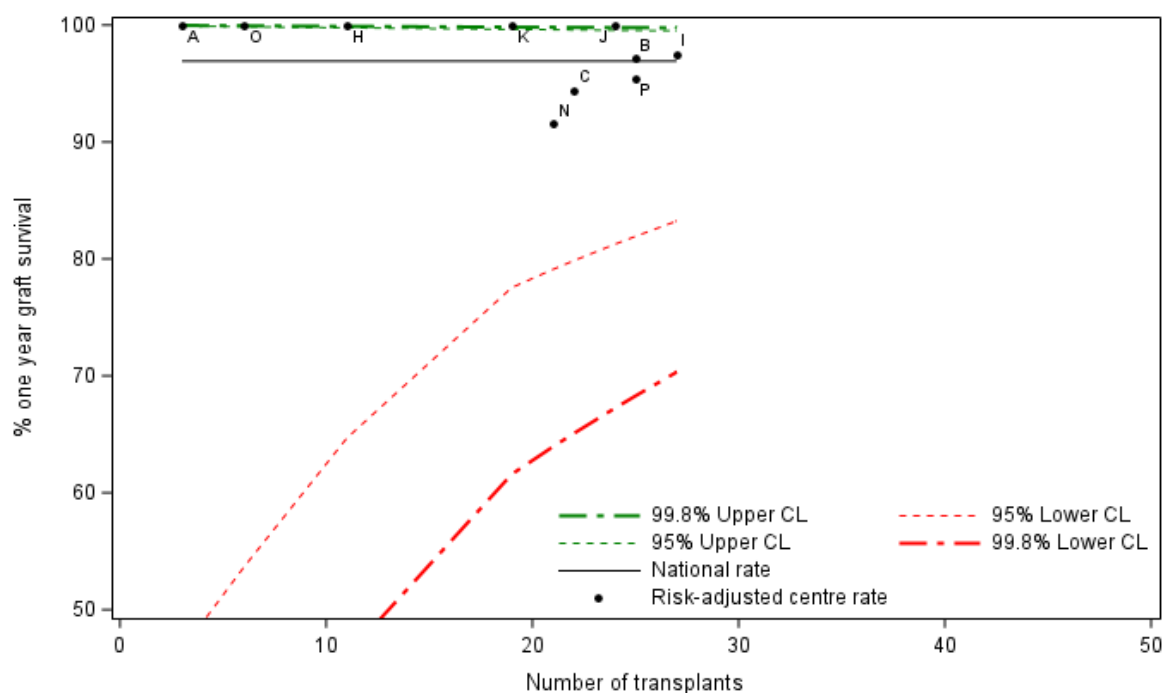
1. Tekkis PP, McCulloch P, Steger AC, Benjamin IS, Poloniecki JD. Mortality control charts for comparing performance of surgical units: validation study using hospital mortality data. *British Medical Journal* 2003; 326: 786 – 788.
2. Stark J, Gallivan S, Lovegrove J, Hamilton JRL, Monro JL, Pollock JCS, Watterson KG. Mortality rates after surgery for congenital heart defects in children and surgeons' performance. *Lancet* 2000; 355: 1004 – 1007.



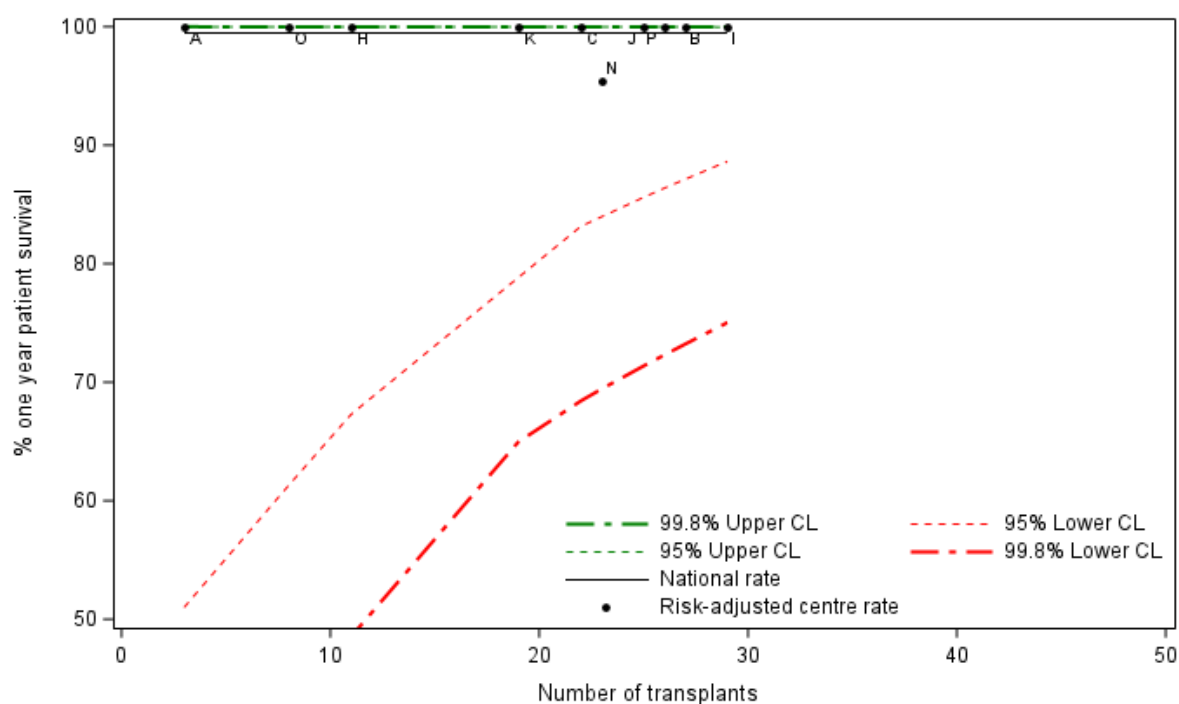
## 11.1 Deceased donor graft and patient survival

The [funnel plots](#) show that, for the most part, the centres lie within the [confidence limits](#). None of the [funnel plots](#) show any centres that lie outside the lower 95% [confidence limits](#). Some of the [funnel plots](#) show some centres to be above the upper 99.8% [confidence limit](#). This suggests that these centres may have survival rates that are considerably higher than the national rate. Centres can be identified by the information shown in **Table 11.1**.

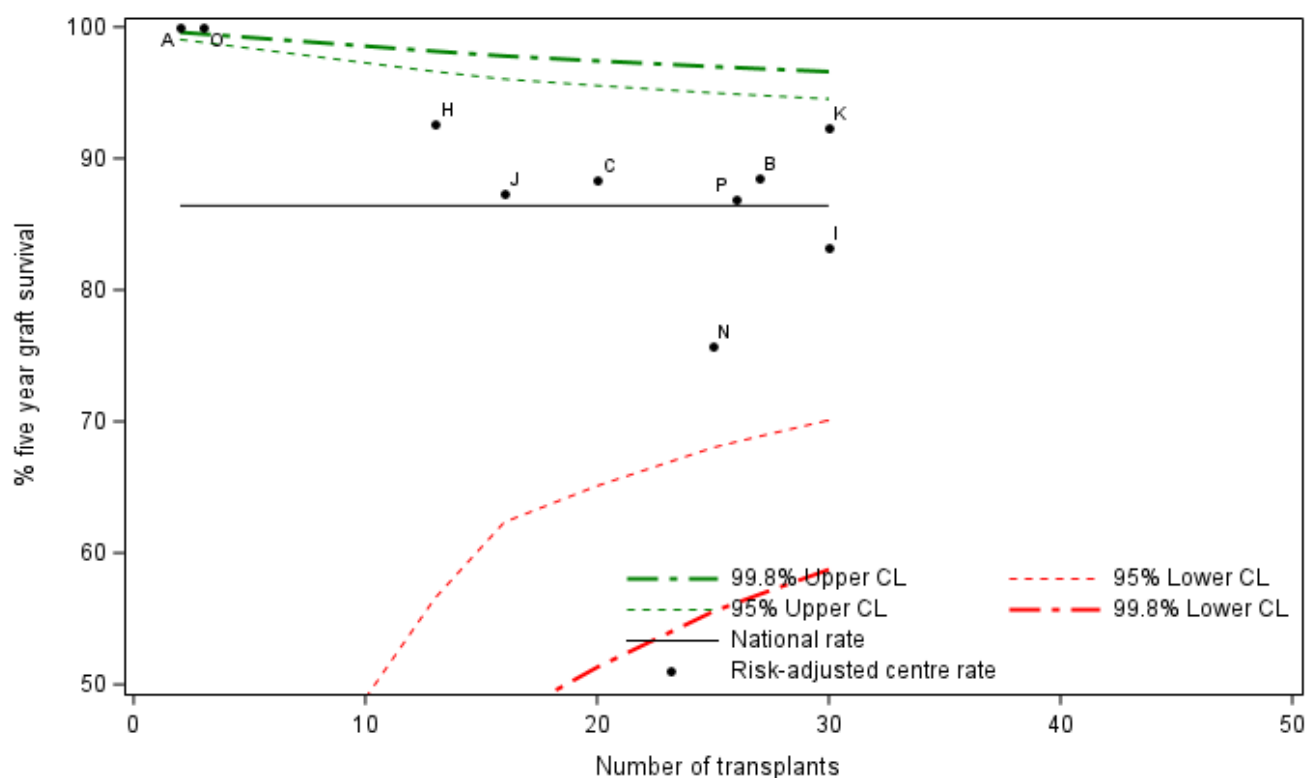
**Figure 11.1** Risk-adjusted one year graft (death censored) survival rates for first deceased donor kidney transplants in paediatric patients, between 1 April 2016 and 31 March 2020



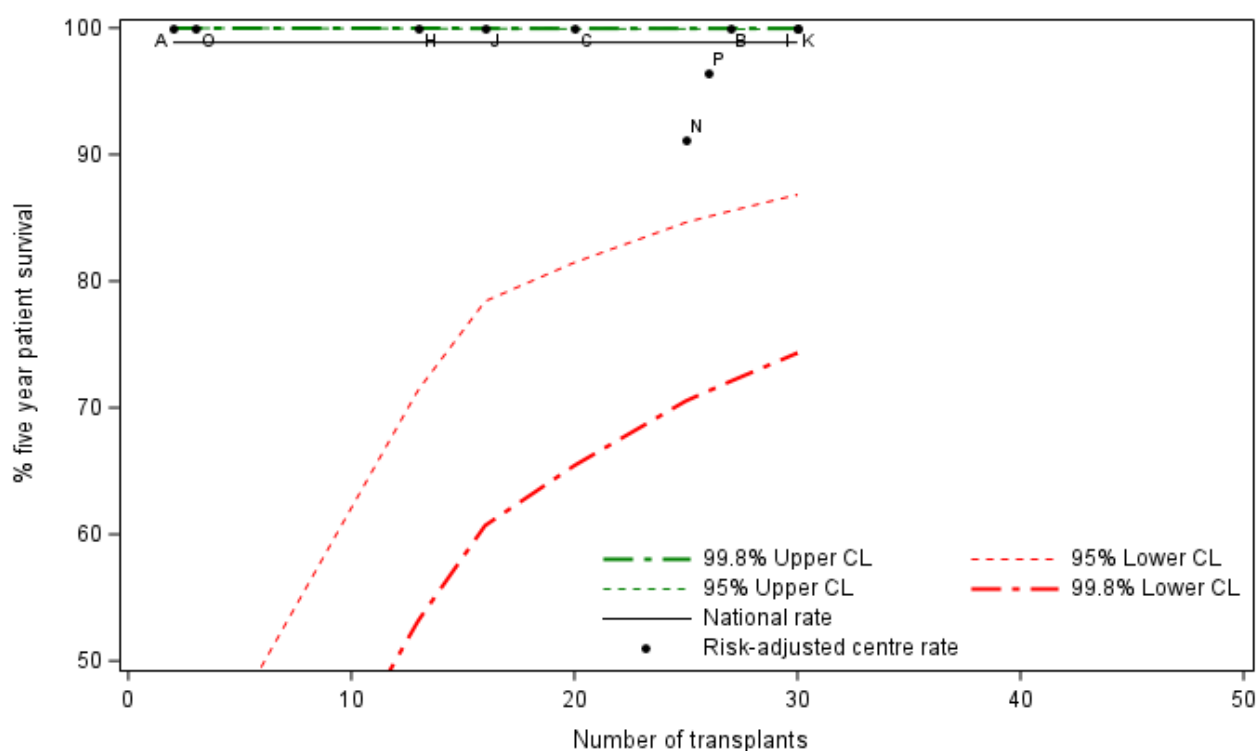
**Figure 11.2** Risk-adjusted one year patient survival rates for first deceased donor kidney transplants in paediatric patients, between 1 April 2016 and 31 March 2020



**Figure 11.3 Risk-adjusted five year graft (death censored) survival rates for first deceased donor kidney transplants in paediatric patients, between 1 April 2012 and 31 March 2016**



**Figure 11.4 Risk-adjusted five year patient survival rates for first deceased donor kidney transplants in paediatric patients, between 1 April 2012 and 31 March 2016**



**Table 11.1 One and five year first paediatric kidney-only graft and patient survival using kidneys from deceased donors**

Centre	Code	Kidney graft survival				Patient survival			
		One-year*		Five-year**		One-year*		Five-year**	
		%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Belfast	A	100	N/A	100	N/A	100	N/A	100	N/A
Birmingham	B	97	(84 - 100	89	(67 - 98)	100	N/A	100	N/A
Bristol	C	94	(69 - 100	88	(58 - 99)	100	N/A	100	N/A
GOSH	I	98	(86 - 100	83	(61 - 95)	100	N/A	100	N/A
Glasgow	H	100	N/A	93	(59 - 100	100	N/A	100	N/A
Guy's	J	100	N/A	87	(54 - 98)	100	N/A	100	N/A
Leeds	K	100	N/A	92	(72 - 99)	100	N/A	100	N/A
Manchester	N	92	(70 - 99)	76	(47 - 91)	95	(75 - 100)	91	(51 - 100)
Newcastle	O	100	N/A	100	N/A	100	N/A	100	N/A
Nottingham	P	95	(74 - 100	87	(62 - 97)	100	N/A	96	(80 - 100
<b>UK</b>		<b>97</b>	<b>(93 - 99)</b>	<b>86</b>	<b>(81 - 91)</b>	<b>99</b>	<b>(96 - 100</b>	<b>99</b>	<b>(96 - 100</b>

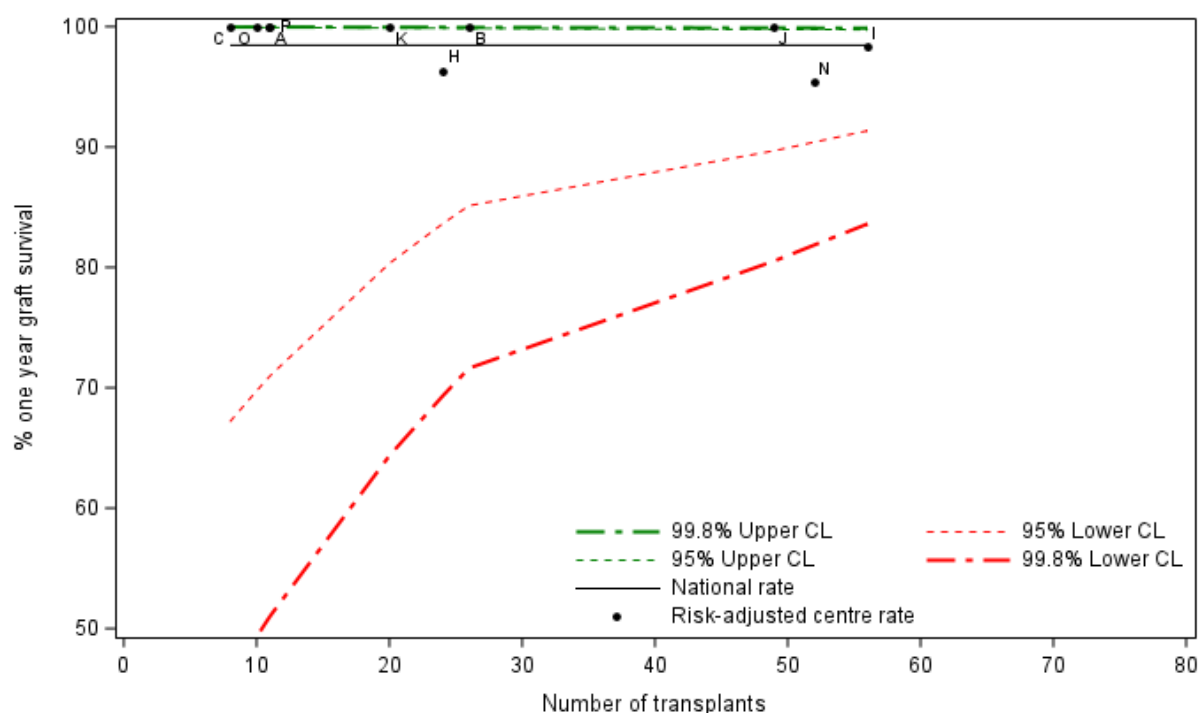
\* Includes transplants performed between 1 april 2016 - 31 March 2020

\*\* Includes transplants performed between 1 april 2012 - 31 March 2016

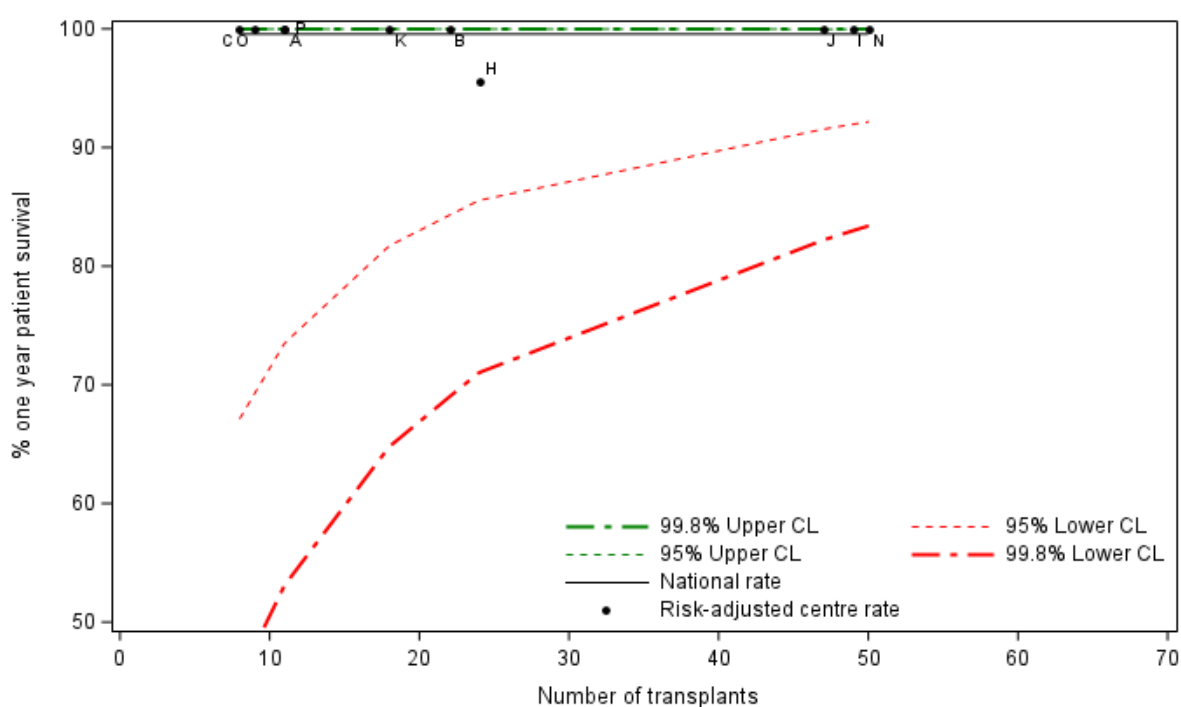
## 11.2 Living donor graft and patient survival

The [funnel plots](#) show that, for the most part, the centres lie within the [confidence limits](#). None of the [funnel plots](#) show any centres that lie outside the lower 95% [confidence limits](#). Some of the [funnel plots](#) show some centres to be above the upper 99.8% [confidence limit](#). This suggests that these centres may have survival rates that are considerably higher than the national rate. Centres can be identified by the information shown in **Table 11.2**.

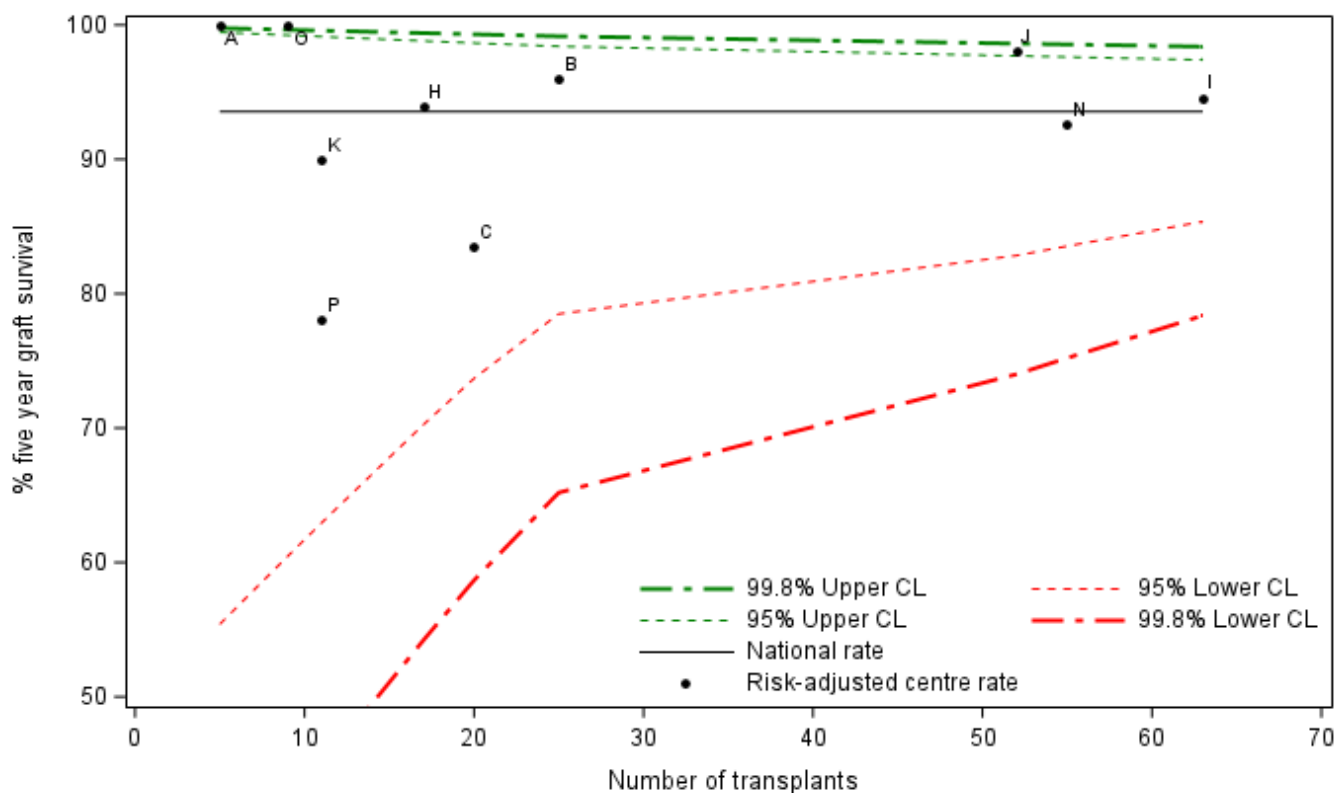
**Figure 11.5 Risk-adjusted one year graft (death censored) survival rates for first live donor kidney transplants in paediatric patients, between 1 April 2016 and 31 March 2020**



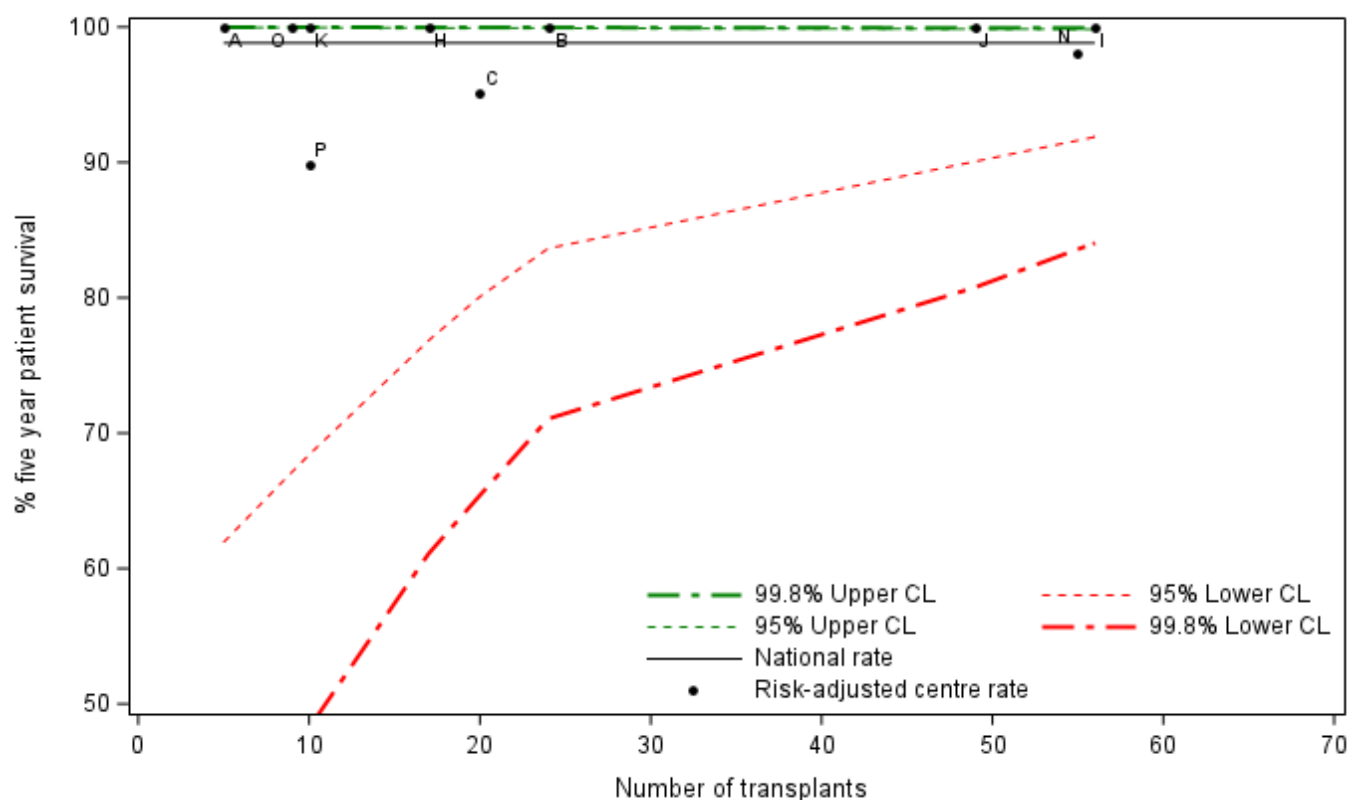
**Figure 11.6 Risk-adjusted one year patient survival rates for first live donor kidney transplants in paediatric patients, between 1 April 2016 and 31 March 2020**



**Figure 11.7 Risk-adjusted five year graft (death censored) survival rates for first live donor kidney transplants in paediatric patients, between 1 April 2012 and 31 March 2016**



**Figure 11.8 Risk-adjusted five year patient survival rates for first live donor kidney transplants in paediatric patients, between 1 April 2012 and 31 March 2016**



**Table 11.2 One and five year first paediatric kidney-only graft and patient survival using kidneys from living donors**

Centre	Code	Kidney graft survival				Patient survival			
		One-year*		Five-year**		One-year*		Five-year**	
		%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Belfast	A	100	N/A	100	N/A	100	N/A	100	N/A
Birmingham	B	100	N/A	96	(78 – 100)	100	N/A	100	N/A
Bristol	C	100	N/A	83	(52 - 97)	100	N/A	95	(73 – 100)
GOSH	I	98	(91 – 100)	95	(84 - 99)	100	N/A	100	N/A
Glasgow	H	96	(80 – 100)	94	(66 – 100)	96	(75 - 100)	100	N/A
Guy's	J	100	N/A	98	(89 – 100)	100	N/A	100	N/A
Leeds	K	100	N/A	90	(44 – 100)	100	N/A	100	N/A
Manchester	N	95	(83 - 99)	93	(81 - 98)	100	N/A	98	(90 – 100)
Newcastle	O	100	N/A	100	N/A	100	N/A	100	N/A
Nottingham	P	100	N/A	78	(21 - 97)	100	N/A	90	(43 – 100)
<b>UK</b>		<b>98</b>	<b>(96 - 99)</b>	<b>94</b>	<b>(90 - 96)</b>	<b>100</b>	<b>(97 - 100)</b>	<b>99</b>	<b>(96 - 100)</b>

\* Includes transplants performed between 1 april 2016 - 31 March 2020

\*\* Includes transplants performed between 1 april 2012 - 31 March 2016

## Form return rates

## 12.1 Deceased donor form return rates, 1 April 2020 – 31 March 2021

Form return rates are reported in **Table 12.1** for the kidney transplant record, three month and one year follow up form, along with lifetime follow up (more than two years). These include all paediatric deceased donor kidney only transplants between 1 April 2020 and 31 March 2021 for the transplant record, and all requests for follow up forms issued in this time period.

**Table 12.1 Deceased donor form return rates, 1 April 2020 and 31 March 2021**

Centre	TX RECORD		THREE MONTHS		ONE YEAR		LIFETIME	
	N	% returned	N	% returned	N	% returned	N	% returned
Birmingham, Birmingham Children's Hospital			1	100	1	100	24	100
Birmingham, Queen Elizabeth Hospital Birmingham	9	100	7	100	6	100	72	99
Bradford, St Lukes Hospital							22	100
Bristol, Bristol Royal Hospital For Children							20	100
Bristol, Southmead Hospital	5	100	4	100	4	100	53	77
Cardiff, University Of Wales Hospital					1	100	43	70
Glasgow, Queen Elizabeth University Hospital							43	67
Leeds, St James's University Hospital	4	100	3	33			111	85
Leicester, Leicester General Hospital							25	100
London, Great Ormond Street Hospital For Children	7	100	6	100	7	100	40	100
London, Guy's Hospital	3	100	2	50	6	33	75	59
London, Royal Free Hospital							35	69
London, The Royal London Hospital (Whitechapel)					1	100	28	93
Manchester, Manchester Royal Infirmary	4	100	4	100	3	100	51	94
Nottingham, Nottingham City Hospital	5	100	5	100	2	100	76	50
Portsmouth, Queen Alexandra Hospital							24	17
Sheffield, Northern General Hospital							33	48



## 12.2 Living donor form return rates, 1 April 2020 – 31 March 2021

Form return rates are reported in **Table 12.2** for the kidney transplant record, three month and one year follow up form, along with lifetime follow up (more than two years). These include all paediatric living donor kidney only transplants between 1 April 2020 and 31 March 2021 for the transplant record, and all requests for follow up forms issued in this time period.

Table 12.2 Living donor form return rates, 1 April 2020 and 31 March 2021								
Centre	TX RECORD		THREE MONTHS		ONE YEAR		LIFETIME	
	N	% returned	N	% returned	N	% returned	N	% returned
Belfast, Royal Belfast Hospital For Sick Children							26	27
Birmingham, Birmingham Children's Hospital							37	100
Birmingham, Queen Elizabeth Hospital Birmingham	5	100	6	100	5	100	29	100
Bristol, Southmead Hospital	3	100	4	50	3	67	20	80
Cardiff, University Of Wales Hospital							43	63
Glasgow, Queen Elizabeth University Hospital							39	79
Leeds, St James's University Hospital	5	100	4	100	7	86	34	91
Liverpool, Alder Hey Children's Hospital							29	100
Liverpool, Royal Liverpool University Hospital							20	85
London, Great Ormond Street Hospital For Children	8	100	11	100	8	88	77	100
London, Guy's Hospital	11	100	12	25	12	17	120	48
London, Royal Free Hospital							24	75
Manchester, Manchester Royal Infirmary	3	100	5	100	11	100	30	100
Manchester, Royal Manchester Children's Hospital							38	100
Newcastle, Royal Victoria Infirmary							28	36
Nottingham, Nottingham City Hospital	1	100	2	100	5	80	37	49
Oxford, Churchill Hospital							21	95
Portsmouth, Queen Alexandra Hospital							25	4
Southampton, Southampton University Hospitals							21	67

# Appendix

## **A1 Glossary of terms**

### **ABO**

The most important human blood group system for transplantation is the ABO system. Every human being is of blood group O, A, B or AB, or of one of the minor variants of these four groups. ABO blood groups are present on other tissues and, unless special precautions are taken, a group A kidney transplanted to a group O patient will be rapidly rejected.

### **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 kidney becomes available, the patient is included among those who are matched against the donor to determine whether or not the kidney 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 kidneys that become available.

### **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. For example the case mix for patients registered for a kidney transplant is defined in terms of various factors such as the blood group, tissue type and age of the patient. These factors have an influence on the chance of a patient receiving a transplant.

### **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.

**Cross-match**

A cross-match is a test for patient antibodies against donor antigens. A positive cross-match shows that the donor and patient are incompatible. A negative cross-match means there is no reaction between donor and patient and that the transplant may proceed.

**Donor after brain death (DBD)**

A donor whose heart is still beating when their entire brain has stopped working so that they cannot survive without the use of a ventilator. Organs for transplant are removed from the donor while their heart is still beating, but only after extensive tests determine that the brain cannot recover and they have been certified dead.

**Donor after circulatory death (DCD)**

A donor whose heart stops beating before their brain stops working and who is then certified dead. The organs are then removed.

**Funnel plot**

A graphical method that shows how consistent the survival rates of the different transplant units are compared to the national rate. 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 survival rate**

The percentage of patients whose grafts are still functioning. This is usually specified for a given time period after transplant. For example, a five-year transplant survival rate is the percentage of transplants still functioning five years after transplant.

**HLA mismatch**

Human Leucocyte Antigen (HLA) antigens are carried on many cells in the body and the immune system can distinguish between those that can be recognised as 'self' (belonging to you or identical to your own) and those that can be recognised as 'nonself'. The normal response of the immune system is to attack foreign/non-self material by producing antibodies against the foreign material. This is one of the mechanisms that provide protection against infection. This is unfortunate from the point of view of transplantation as the immune system will see the graft as just another 'infection' to be destroyed, produce antibodies against the graft and rejection of the grafted organ will take place. To help overcome this response, it is recognised that 'matching' the recipient and donor on the basis of HLA (and blood group) reduces the chances of acute rejection and, with the added use of immunosuppressive drugs, very much improves the chances of graft survival. 'Matching' refers to the similarity of the recipient HLA type and donor HLA type. HLA mismatch refers to the number of mismatches between the donor and the recipient at the A, B and DR (HLA) loci. There can only be a total of two mismatches at each locus. For example, an HLA mismatch value of 000, means that the donor and recipient are identical at all three loci, while an HLA mismatch value of 210 means that the donor and recipient differ completely at the A locus, are partly the same at the B locus and are identical at the DR locus.

**Inter-quartile range**

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.

**Live 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 one of their kidneys to their child.

**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 kidney and liver.

**National Kidney Allocation Scheme**

A nationally agreed set of rules for sharing and allocating kidneys for transplant between transplant centres in the UK. The scheme is administered by NHS Blood and Transplant.

**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 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.

**Pre-emptive**

Patients that are placed on the kidney transplant list or receive a transplant prior to the need for dialysis are termed as pre-emptive. Patients listed pre-emptively will usually require dialysis within six months of being placed on the transplant list.

**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.

## **A2 Statistical methodology and risk-adjustment for survival rate estimation**

Unadjusted and risk-adjusted estimates of patient and graft survival are given for each centre. Unadjusted rates give an estimate of what the survival rate at a centre is, assuming that all patients at the centre have the same chance of surviving a given length of time after transplant. In reality, patients differ and a risk-adjusted rate that allows for these differences would give a more meaningful estimate of survival.

### **Computing unadjusted survival rates**

Unadjusted survival rates were calculated using the Kaplan-Meier method, which allows patients with incomplete follow-up information to be included in the computation. 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 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 in the analysis of survival data and the Kaplan-Meier method therefore allows the computation of survival estimates that are more meaningful.

### **Computing 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 had the same mix of patients as that seen nationally. The risk-adjusted rate therefore presents estimates in which differences in 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 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 given time period 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 models are shown in the table below.

### **Systematic component of variation**

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

To allow for the possibility that, even after allowing for area-specific Poisson rates, area differences remain, introduce an additional multiplicative rate factor which varies from area to area. Postulate a non-parametric distribution for the multiplicative factor, with variance  $\sigma^2$ . 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,  $\sigma^2$ , 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  $\sigma^2$ . 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.



## Risk adjustment factors

### Adult waiting time

**Median waiting time** Age at registration, sex, ethnicity, highly sensitised, blood group, dialysis status, matchability score, primary renal disease

### Adult patient transplants

#### First transplants from deceased donors

1 year graft survival	Donor age, donor type, donor cause of death, recipient age, waiting time to transplant, primary renal disease, HLA mismatch group, cold ischaemic time*, recipient ethnicity
1 year patient survival	Donor age, recipient age, waiting time to transplant, primary renal disease, HLA mismatch group, cold ischaemic time*
5 year graft survival	Graft year, donor age, donor type, donor cause of death, recipient age, waiting time to transplant, primary renal disease, HLA mismatch group, recipient ethnicity
5 year patient survival	Graft year, donor age, recipient age, waiting time to transplant, primary renal disease

#### Transplants from live donors

1 year graft survival	Donor age, recipient age, primary renal disease, number of HLA mismatches
1 year patient survival	Recipient age
5 year graft survival	Graft year, donor age, recipient age, primary renal disease, number of HLA mismatches
5 year patient survival	Recipient age, primary renal disease

### Paediatric patient transplants

#### First transplants from deceased donors

1 year graft survival	Donor age, recipient age, HLA mismatch group, cold ischaemic time*
1 year patient survival	Recipient age
5 year graft survival	Donor age, recipient age, HLA mismatch group
5 year patient survival	Recipient age

#### Transplants from live donors

1 year graft survival	Donor age, recipient age
1 year patient survival	Recipient age
5 year graft survival	Donor age, recipient age
5 year patient survival	Recipient age

\*Time between retrieval of kidney from the donor and time of transplant in the patient.

### **A3 Factors used in risk-adjusted models for patient survival from listing**

#### **Adult patient registrations**

#### **First registrations for deceased donor transplant**

1, 5 and 10 year patient survival from listing      age, gender, ethnicity, blood group, BMI, cRF\*>85%, primary disease, dialysis status

\* Calculated reaction frequency

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