



**Blood and Transplant**

# **ANNUAL REPORT ON KIDNEY TRANSPLANTATION**

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

**PUBLISHED November 2019**

**PRODUCED IN COLLABORATION WITH NHS ENGLAND**



# Contents



<b>1</b>	<b>Executive Summary .....</b>	<b>1</b>
<b>2</b>	<b>Introduction .....</b>	<b>3</b>
	<b>ADULT.....</b>	<b>12</b>
<b>3</b>	<b>Transplant list.....</b>	<b>12</b>
3.1	Patients on the kidney transplant list as at 31 March, 2010 – 2019 .....	13
3.2	Post-registration outcomes, 1 April 2015 – 31 March 2016.....	15
3.3	Demographic characteristics, 1 April 2018 – 31 March 2019.....	16
3.4	Patient waiting times for those currently on the list, 31 March 2019 .....	17
3.5	Median waiting time to transplant, 1 April 2013 – 31 March 2016.....	18
3.6	Pre-emptive listing rates, 1 April 2017 - 31 March 2018.....	22
3.7	Median time from start of dialysis to transplant, 1 April 2018 - 31 March 2019...	23
<b>4</b>	<b>Response to kidney offers.....</b>	<b>24</b>
4.1	DBD Standard criteria offer decline rates, 1 April 2016 – 31 March 2019.....	26
4.2	DBD Extended criteria offer decline rates, 1 April 2016 – 31 March 2019 .....	28
4.3	DCD Standard criteria offer decline rates, 1 April 2016 – 31 March 2019.....	30
4.4	Reallocation of kidneys, 1 April 2016 – 31 March 2019 .....	32
<b>5</b>	<b>Transplants .....</b>	<b>34</b>
5.1	Kidney only transplants, 1 April 2009 – 31 March 2019 .....	35
5.2	Demographic characteristics of recipients, 1 April 2018 - 31 March 2019.....	38
5.3	Pre-emptive transplant rates, 1 April 2018 - 31 March 2019.....	40
5.4	Kidney donor risk-index <sup>1</sup> , 1 April 2016 – 31 March 2019 .....	41
5.5	Cold ischaemia time, 1 April 2016 – 31 March 2019.....	45
<b>6</b>	<b>Kidney outcomes.....</b>	<b>54</b>
6.1	Deceased donor graft and patient survival.....	56
6.2	Living donor graft and patient survival.....	59
6.3	Graft and patient survival from listing .....	62
<b>7</b>	<b>Form return rates.....</b>	<b>64</b>
7.1	Deceased donor form return rates, 1 April 2018 – 31 March 2019 .....	65
7.2	Living donor form return rates, 1 April 2018 – 31 March 2019 .....	67
	<b>PAEDIATRIC.....</b>	<b>69</b>
<b>8</b>	<b>Transplant list.....</b>	<b>69</b>
8.1	Patients on the kidney transplant list as at 31 March, 2010 – 2019 .....	70
8.2	Demographic characteristics, 1 April 2018 – 31 March 2019.....	72
8.3	Patient waiting times for those currently on the list, 31 March 2019 .....	73
8.4	Median waiting time to transplant, 1 April 2013 - 31 March 2016.....	74

8.5	Pre-emptive listing rates, 1 April 2017 - 31 March 2018.....	76
<b>9</b>	<b>Response to kidney offers.....</b>	<b>77</b>
9.1	Standard criteria offer decline rates, 1 April 2016 – 31 March 2019 .....	79
<b>10</b>	<b>Transplants .....</b>	<b>80</b>
10.1	Kidney only transplants, 1 April 2009 – 31 March 2019 .....	81
10.2	Pre-emptive transplant rates, 1 April 2018 - 31 March 2019 .....	83
<b>11</b>	<b>Kidney outcomes.....</b>	<b>84</b>
11.1	Deceased donor graft and patient survival .....	86
11.2	Living donor graft and patient survival.....	89
<b>12</b>	<b>Form Return rates .....</b>	<b>92</b>
12.1	Deceased donor form return rates, 1 April 2018 – 31 March 2019 .....	93
12.2	Living donor form return rates, 1 April 2018 – 31 March 2019 .....	94
<b>Appendix</b>	<b>.....</b>	<b>95</b>
A1	Glossary of terms .....	96
A2	Statistical methodology and risk-adjustment for survival rate estimation .....	100
A3	Factors used in risk-adjusted models for patient survival from listing .....	103

# **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 2009. 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 2019, there were 4,647 adult patients on the UK active kidney transplant list which represents a 2% decrease in the number of patients a year earlier. The equivalent number of paediatric patients was 92, representing a 48% increase from the previous year
- There were 3,280 adult kidney only transplants performed in the UK in 2018/19, a decrease of 2 compared to 2017/18. Of these, 1,369 were from DBD donors, 970 were from DCD donors and 941 were from living donors. The equivalent number of paediatric transplants was 139 representing a 5% increase from the previous year.
- The national rate of graft survival five years after first adult deceased donor kidney only transplant is 87%. These rates vary between centres, ranging from 78% to 91% (risk-adjusted). The equivalent rate after first paediatric deceased donor kidney only transplant is 86%, ranging from 80% to 100%.
- The national rate of graft survival five years after first adult living donor kidney only transplant is 92%. These rates vary between centres, ranging from 88% to 96% (risk-adjusted). The equivalent rate after first paediatric living donor kidney only transplant is 89%, ranging from 74% to 100%.
- The national rate of ten year patient survival from listing for deceased donor kidney only transplants in adult patients is 75%. These rates vary between centres, ranging from 68% to 89% (risk-adjusted).

Use of the contents of this report should be acknowledged as follows:

Annual Report on Kidney Transplantation 2018/19, NHS Blood and Transplant

# Introduction

This report presents information on transplant activity between 1 April 2009 and 31 March 2019, 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 2014 to 31 March 2018 and five-year post-transplant for the period 1 April 2010 to 31 March 2014. 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 2007 and 31 December 2018.

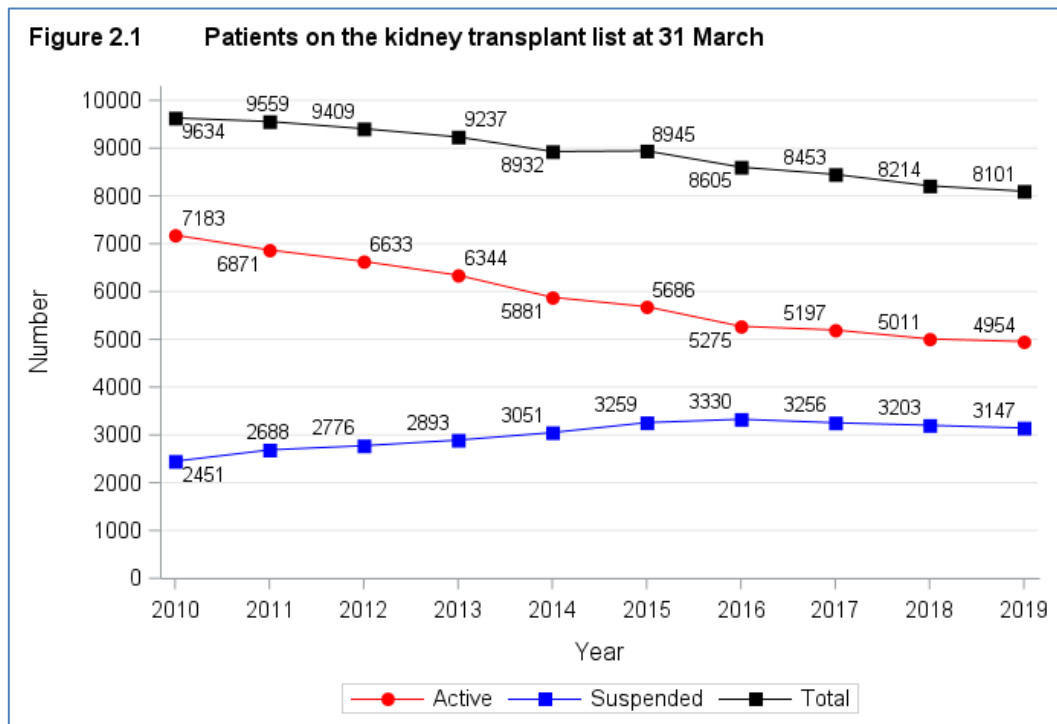
The centre specific results for survival estimates are adjusted for differences in [risk factors](#) between the centres. The risk models used are described in the Appendix.

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.

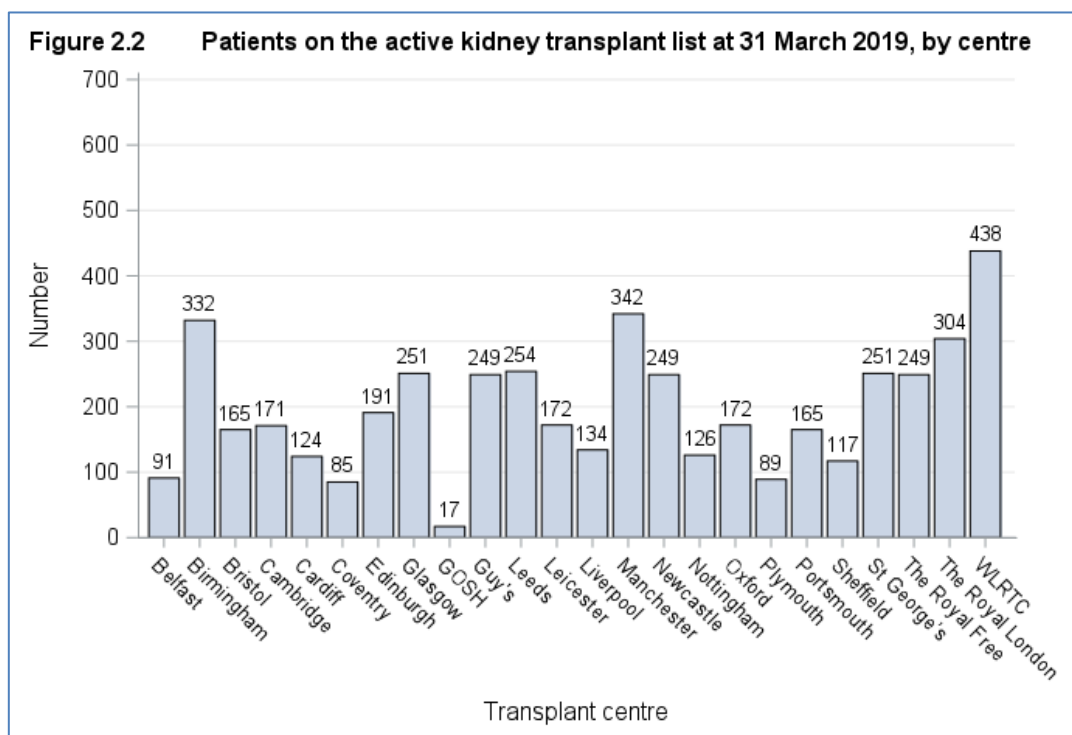
Throughout this report West London Renal and Transplant Centre is labeled as WLRTC.



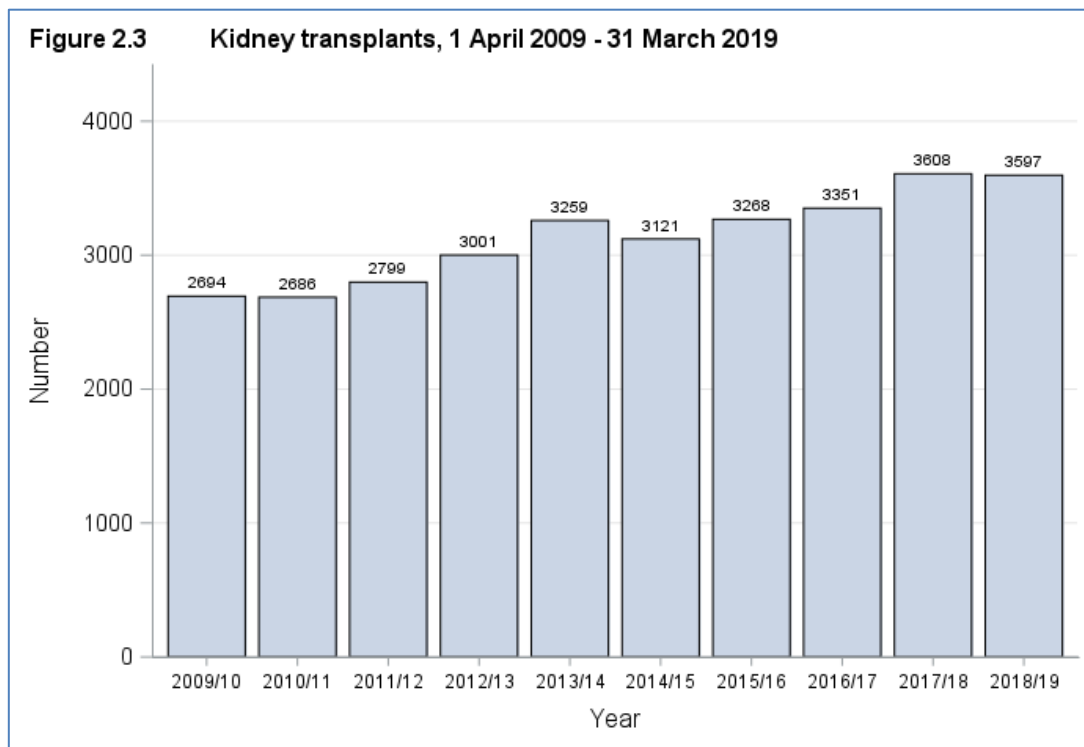
**Figure 2.1** shows the number of patients on the kidney [transplant list](#) at 31 March each year between 2010 and 2019. The number of patients actively waiting for a kidney transplant decreased from 7,183 in 2010 to 4,954 in 2019.



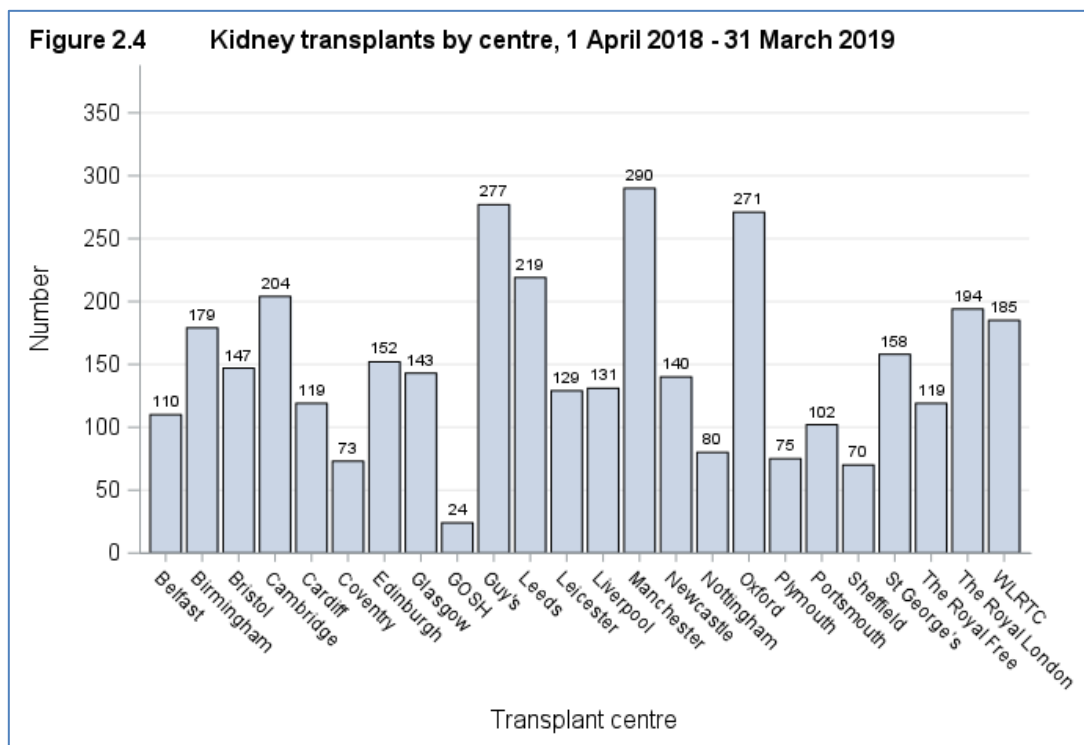
**Figure 2.2** shows the number of patients on the kidney [transplant list](#) at 31 March 2019 for each transplant centre. WLRTC has the largest active [transplant list](#) with 438 patients registered for a kidney transplant.



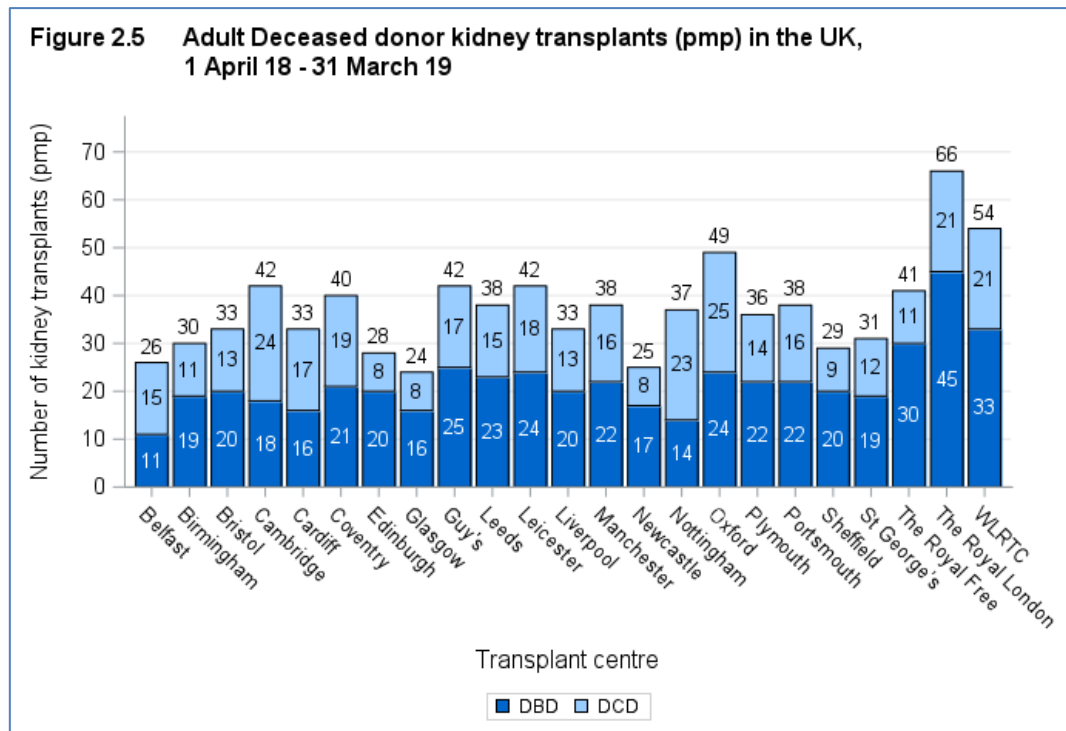
**Figure 2.3** shows the total number of kidney transplants performed in the last ten years. The number of transplants steadily increased from 2,694 in 2009/10 to 3,597 in 2018/19.



**Figure 2.4** shows the total number of kidney transplants performed in 2018/19 at each transplant centre. Manchester performed the most kidney transplants last year with 290 patients receiving a transplant.

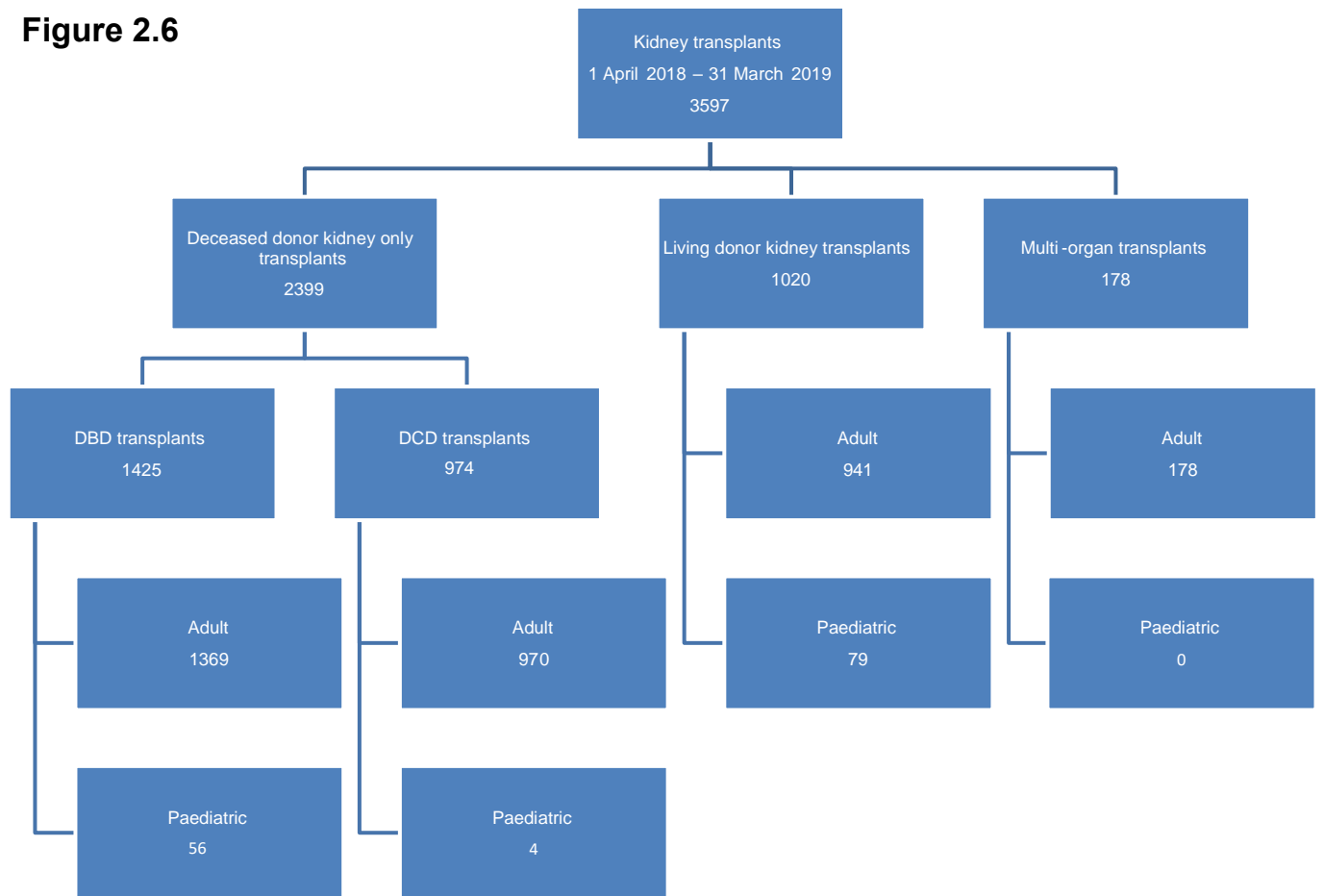


**Figure 2.5** shows the total number of kidney transplants performed per million population in 2018/19 at each transplant centre. The Royal London had the highest number of adult deceased donor kidney transplants per million population.



**Figure 2.6** details the 3,597 kidney transplants performed in the UK between 1 April 2018 and 31 March 2019. Of these, 2,399 (67%) were deceased donor kidney only transplants and 1,020 (28%) were living donor kidney transplants. Of the 178 multi-organ transplants, 158 were simultaneous kidney and pancreas transplants, 12 were kidney and liver transplants and 8 were simultaneous kidney and islet transplants.

**Figure 2.6**



## Geographical variation in registration and transplant rates

All NHS group 1 patients who were registered onto the kidney transplant list with an active status between 1 April 2018 and 31 March 2019 were extracted from the UK Transplant Registry on 14 June 2019 (numerator). Only patients registered for kidney only were considered. Patients were assigned to Strategic Health Authorities (SHA) in England using their postcode of residence, as reported at registration. The number of registrations per million population (pmp) by SHA was obtained using mid-2017 population estimates based on the Office for National Statistics (ONS) 2012 Census figures (denominator). No SHA age- or sex-specific standardisation of rates was performed.

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

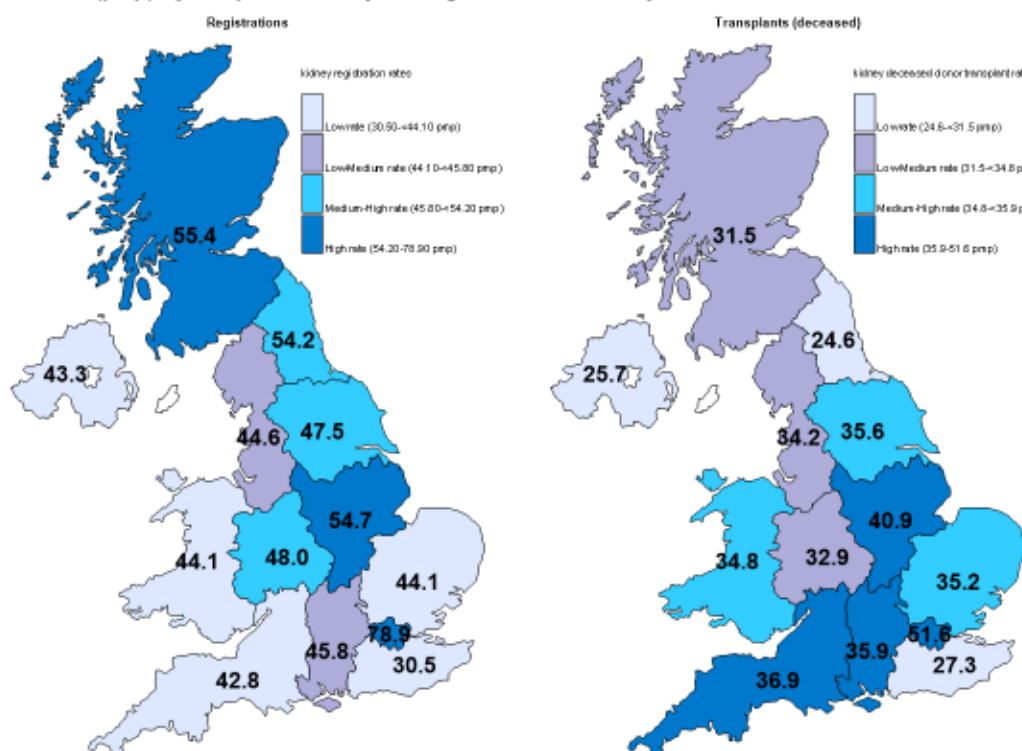
Transplant rates pmp were obtained as the number of kidney only transplants in NHS group 1 recipients between 1 April 2018 and 31 March 2019 (numerator), divided by the mid-2017 population estimates from the ONS (denominator). Transplant rates pmp were categorised and visualised in a map as done for the registration rates.

For systematic component of variation only registrations or transplants in England between 1 April 2017 and 31 March 2018 were included. If a patient was re-registered during the time period, only the first registration was considered. If a patient underwent more than one deceased donor kidney transplant in the time period, only the first transplant was considered, similarly for living donor kidney transplants.

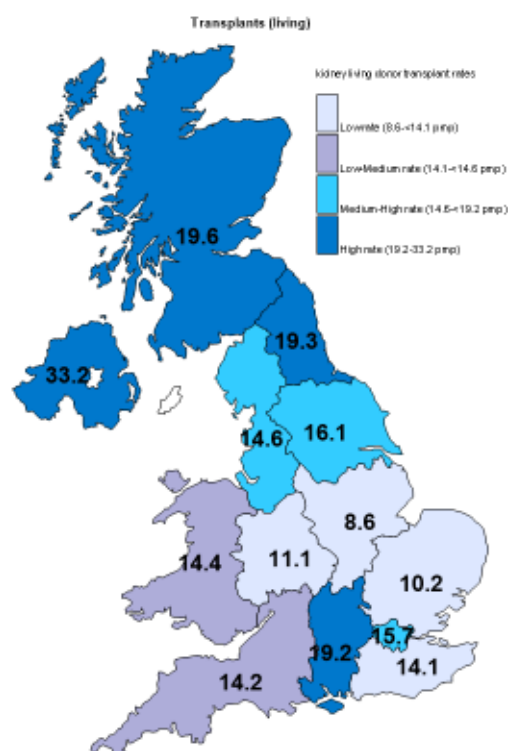
**Figure 2.7** shows rates of registration to the kidney only transplant list per million population (pmp) between 1 April 2018 and 31 March 2019 compared with deceased donor kidney only transplant rates pmp for the same time period, by recipient country/Strategic Health Authority (SHA) of residence. **Figure 2.8** shows the transplant rates pmp for living donor kidney only transplants in the same period. **Table 2.1** shows the breakdown of these numbers by recipient country/Strategic Health Authority of residence. No adjustments have been made for potential demographic differences in populations. If a patient has had more than one registration/transplant in the period, each registration/transplant is considered. Note that this analysis only considered NHS Group 1 patients.

Since there will inevitably be some random variation in rates between areas, the systematic component of variation (SCV) was used to identify if the variation is more (or less) than a random effect for the different SHAs in England only. Only first registrations and transplants in this period were considered. The larger the SCV the greater the evidence of a high level of systematic variation between areas. Registration, deceased donor transplant and living donor transplant rates yielded low SCV values at 0.0516, 0.0318 and 0.0442, respectively, and therefore, no evidence of geographical variation beyond what would be expected at random.

**Figure 2.7 Comparison of kidney registration rates (pmp) with deceased donor transplant rates (pmp) by recipient country/Strategic Health Authority of residence**



**Figure 2.8 Living donor kidney transplant rates (pmp) by recipient country/Strategic Health Authority of residence**



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

<b>Country/ Strategic Health Authority</b>	<b>Registrations (pmp)</b>		<b>Deceased Donor Transplants (pmp)</b>		<b>Living Donor Transplants (pmp)</b>	
North East	143	(54.2)	65	(24.6)	51	(19.3)
North West	324	(44.6)	248	(34.2)	106	(14.6)
Yorkshire and The Humber	259	(47.5)	194	(35.6)	88	(16.1)
<b>North of England</b>	<b>726</b>	<b>(47.3)</b>	<b>507</b>	<b>(33)</b>	<b>245</b>	<b>(16)</b>
East Midlands	261	(54.7)	195	(40.9)	41	(8.6)
West Midlands	281	(48)	193	(32.9)	65	(11.1)
East of England	272	(44.1)	217	(35.2)	63	(10.2)
<b>Midlands and East</b>	<b>814</b>	<b>(48.5)</b>	<b>605</b>	<b>(36)</b>	<b>169</b>	<b>(10.1)</b>
<b>London</b>	<b>697</b>	<b>(78.9)</b>	<b>456</b>	<b>(51.6)</b>	<b>139</b>	<b>(15.7)</b>
South East Coast	143	(30.5)	128	(27.3)	66	(14.1)
South Central	200	(45.8)	157	(35.9)	84	(19.2)
South West	238	(42.8)	205	(36.9)	79	(14.2)
<b>South of England</b>	<b>581</b>	<b>(39.7)</b>	<b>490</b>	<b>(33.5)</b>	<b>229</b>	<b>(15.7)</b>
<b>England</b>	<b>2818</b>	<b>(50.7)</b>	<b>2058</b>	<b>(37)</b>	<b>782</b>	<b>(14.1)</b>
<b>Isle of Man</b>	<b>0</b>		<b>2</b>	<b>(25)</b>	<b>2</b>	<b>(25)</b>
<b>Channel Islands</b>	<b>4</b>	<b>(25)</b>	<b>9</b>	<b>(56.3)</b>	<b>2</b>	<b>(12.5)</b>
<b>Wales</b>	<b>138</b>	<b>(44.1)</b>	<b>109</b>	<b>(34.8)</b>	<b>45</b>	<b>(14.4)</b>
<b>Scotland</b>	<b>300</b>	<b>(55.4)</b>	<b>171</b>	<b>(31.5)</b>	<b>106</b>	<b>(19.6)</b>
<b>Northern Ireland</b>	<b>81</b>	<b>(43.3)</b>	<b>48</b>	<b>(25.7)</b>	<b>62</b>	<b>(33.2)</b>
<b>TOTAL</b>	<b>3345<sup>1</sup></b>	<b>(50.7)</b>	<b>2399<sup>2</sup></b>	<b>(36.3)</b>	<b>1000<sup>3</sup></b>	<b>(15.1)</b>

<sup>1</sup> Registrations include 4 recipients whose postcode was unknown and excludes 1 recipients who reside overseas

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

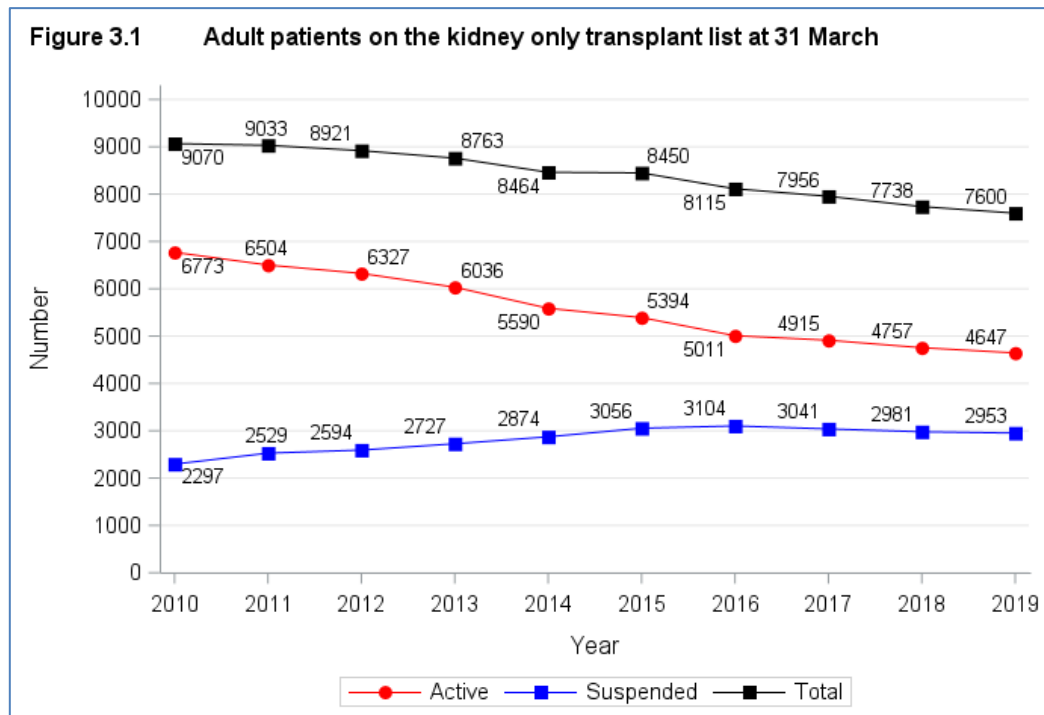
<sup>3</sup> Living donor transplants include 1 recipients whose postcode was unknown and excludes 2 recipients who reside in the Republic of Ireland and 2 recipients who reside overseas

## **Adult kidney transplant list**

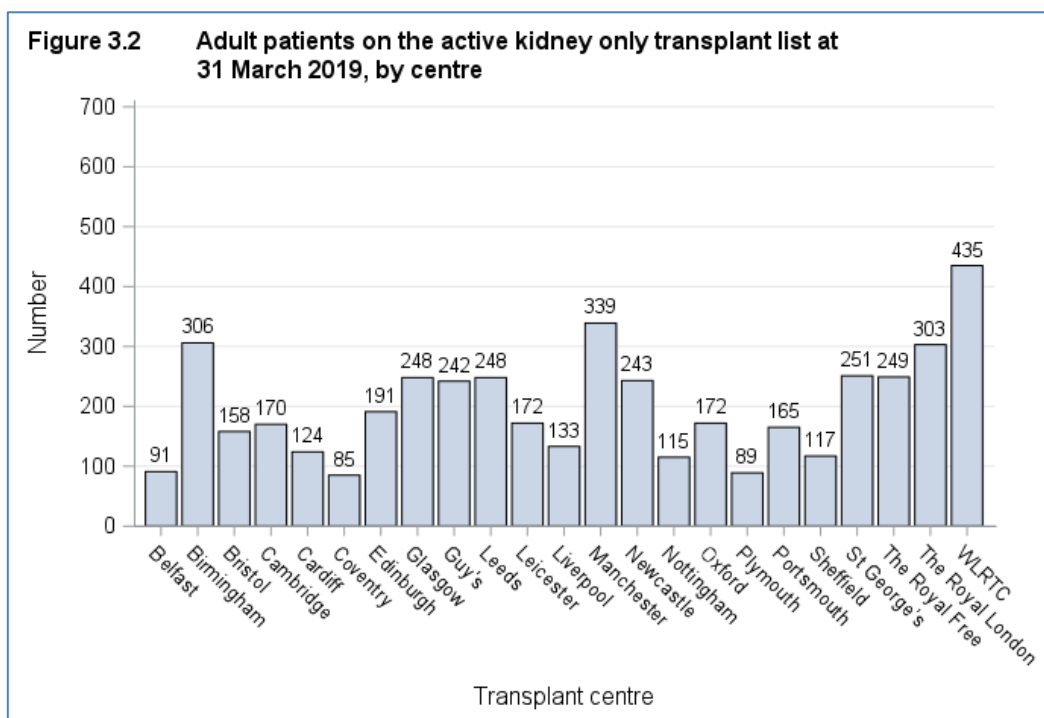


### 3.1 Patients on the kidney transplant list as at 31 March, 2010 – 2019

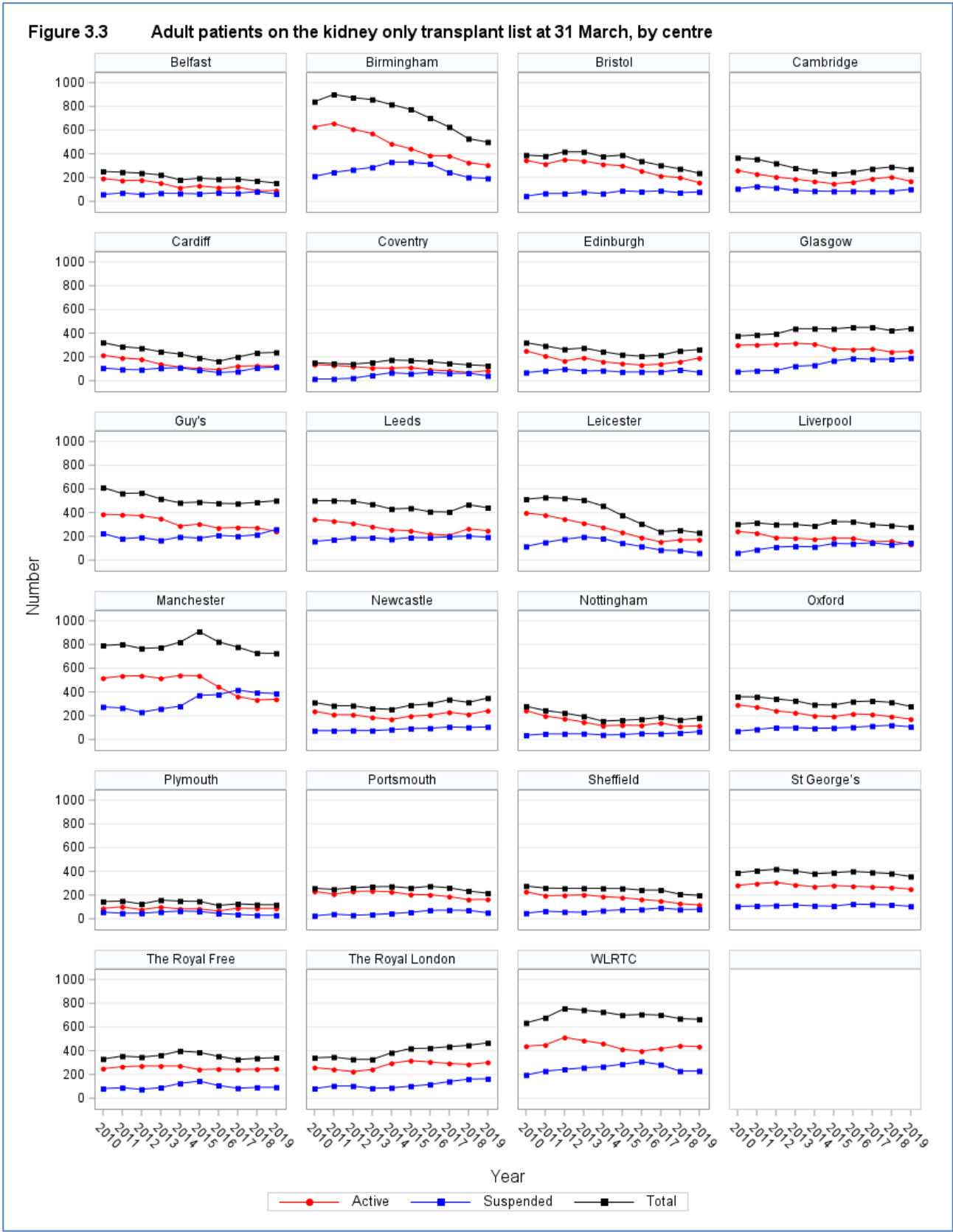
**Figure 3.1** shows the number of adult patients on the kidney only [transplant list](#) at 31 March each year between 2010 and 2019. The number of patients actively waiting for a kidney transplant decreased from 6,773 in 2010 to 4,647 in 2019.



**Figure 3.2** shows the number of adult patients on the active kidney only [transplant list](#) at 31 March 2019 by centre. In total, there were 4,647 adults patients. WLRTC had the largest proportion of the [transplant list](#) (9%) and Coventry had the smallest (2%).

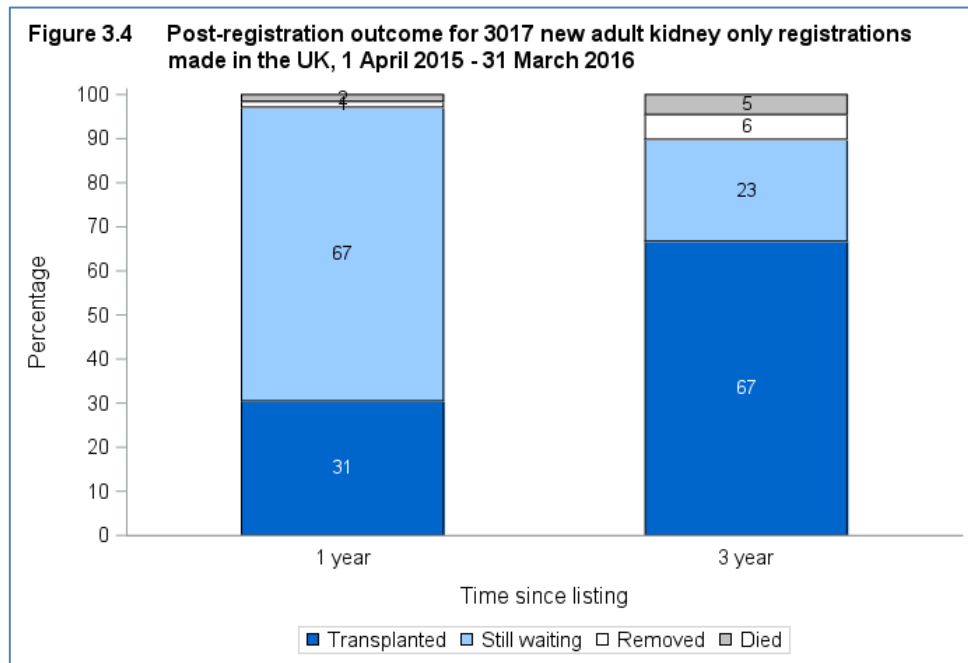


**Figure 3.3** shows the number of adult patients on the [transplant list](#) at 31 March each year between 2010 and 2019 for each transplant centre.

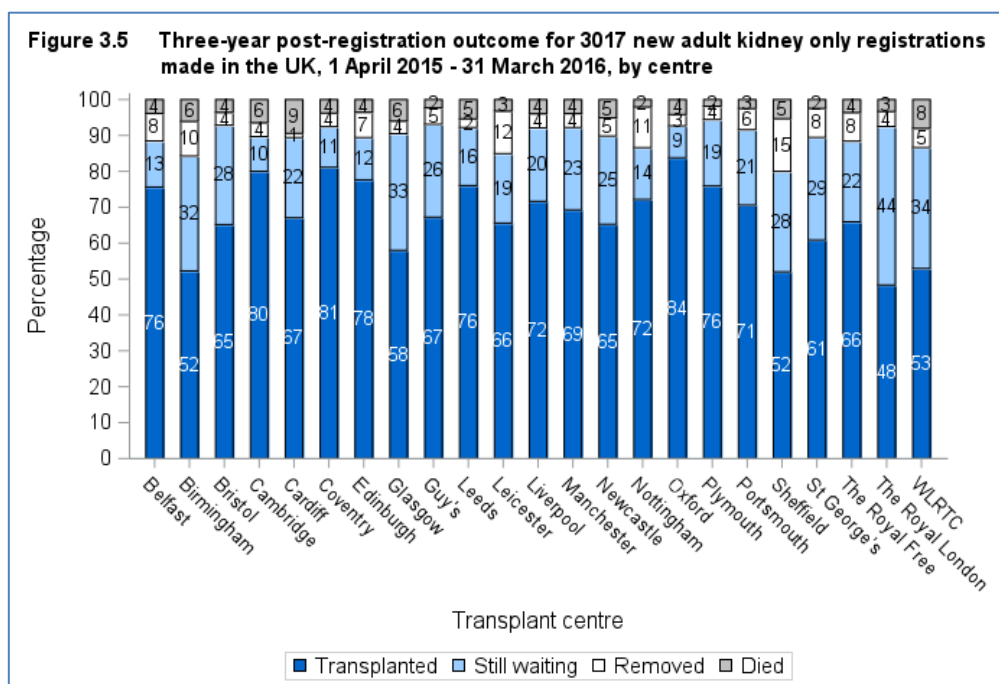


### 3.2 Post-registration outcomes, 1 April 2015 – 31 March 2016

An indication of outcomes for patients listed for a kidney transplant is summarised in **Figure 3.4**. 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 31% of patients are transplanted within one year, while three years after listing 67% of patients have received a transplant.

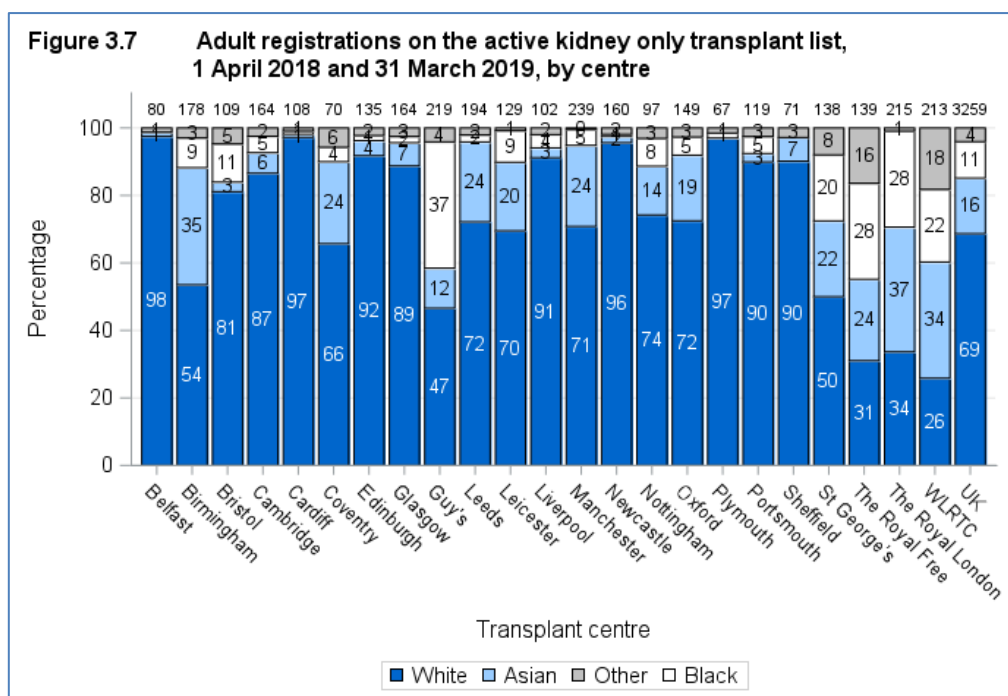
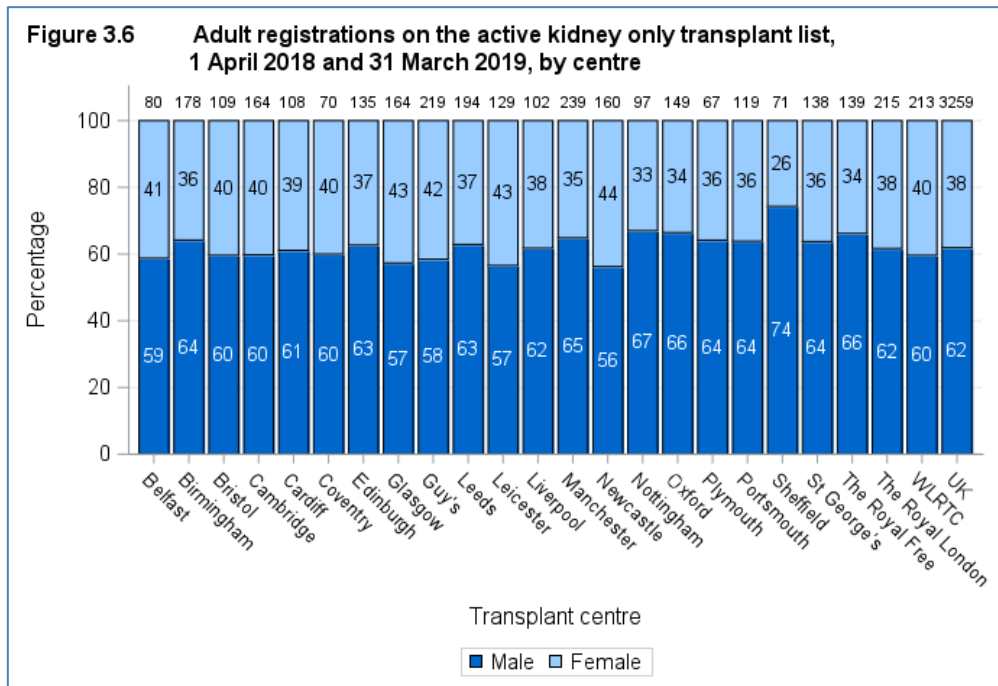


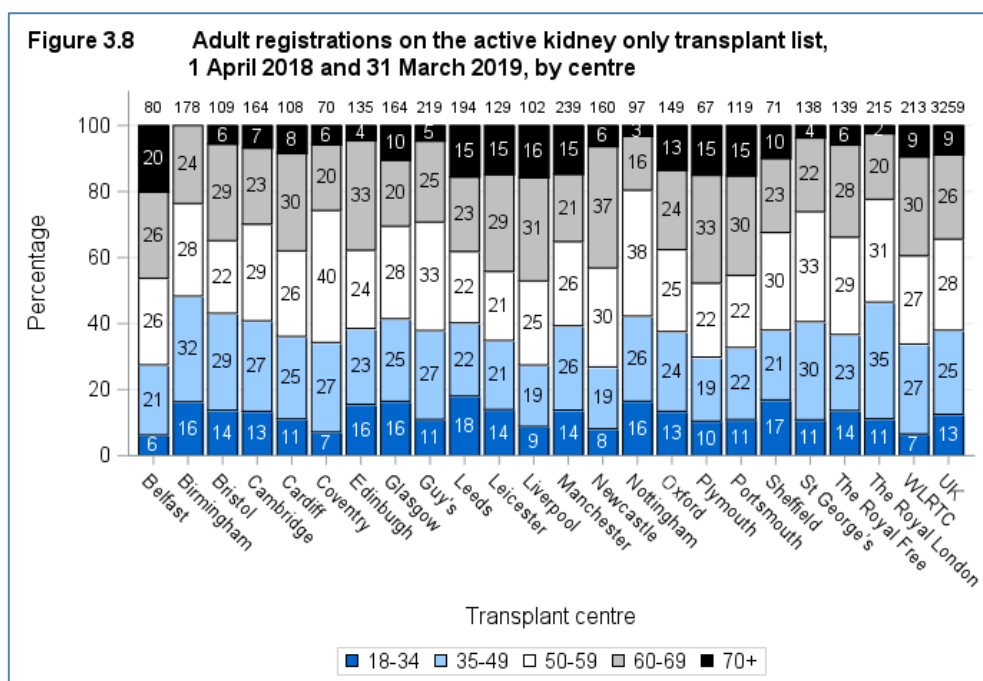
**Figure 3.5** shows the proportion of patients transplanted or still waiting three years after joining the list by centre. The proportion of patients transplanted three years after listing at each centre ranges from 48% at The Royal London to 84% at Oxford. Higher proportions of transplanted patients can in part be attributed to strong [DCD](#) programmes within centres.



### 3.3 Demographic characteristics, 1 April 2018 – 31 March 2019

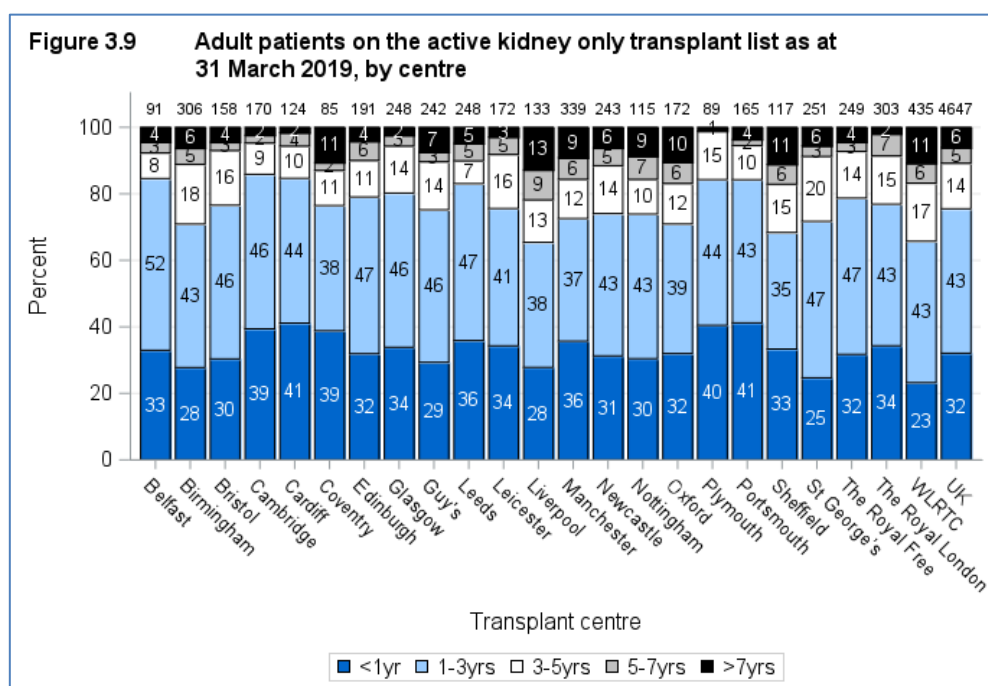
The sex, ethnicity and age group of patients on the transplant are shown by centre in **Figure 3.6, 3.7** and **3.8**, respectively. Note that all percentages quoted are based only on data where relevant information was available. Changes made to the Kidney Allocation Scheme in 2006 mean that tissue 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 has become more equitable.





### 3.4 Patient waiting times for those currently on the list, 31 March 2019

**Figure 3.9** shows the length of time patients have been waiting on the kidney only [transplant list](#) at 31 March 2019 by centre. A small proportion of patients have been waiting for a transplant for more than seven years, 98% of these are highly sensitised with a calculated reaction frequency (cRF) of 85% or higher. Of those waiting for more than seven years, 84% have a cRF of 100% which makes these patients very difficult to match.



### 3.5 Median waiting time to transplant, 1 April 2013 – 31 March 2016

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 3.10** and **Table 3.1** for patients registered at each individual unit. During this period local allocation arrangements were in place for [DCD](#) kidneys while [DBD](#) kidneys were allocated via the [National Kidney Allocation Scheme](#). 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. Patients who received a [live donor](#) or [multi-organ transplant](#) are not included. The national allocation scheme introduced in April 2006 is slowly reducing the variability in deceased donor kidney waiting times across the country but currently some variability remains.

Risk-adjusted median waiting time to adult deceased donor kidney only transplantation is shown in **Figure 3.11** and **Table 3.1** for patients registered at each individual unit. 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.

#### 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.

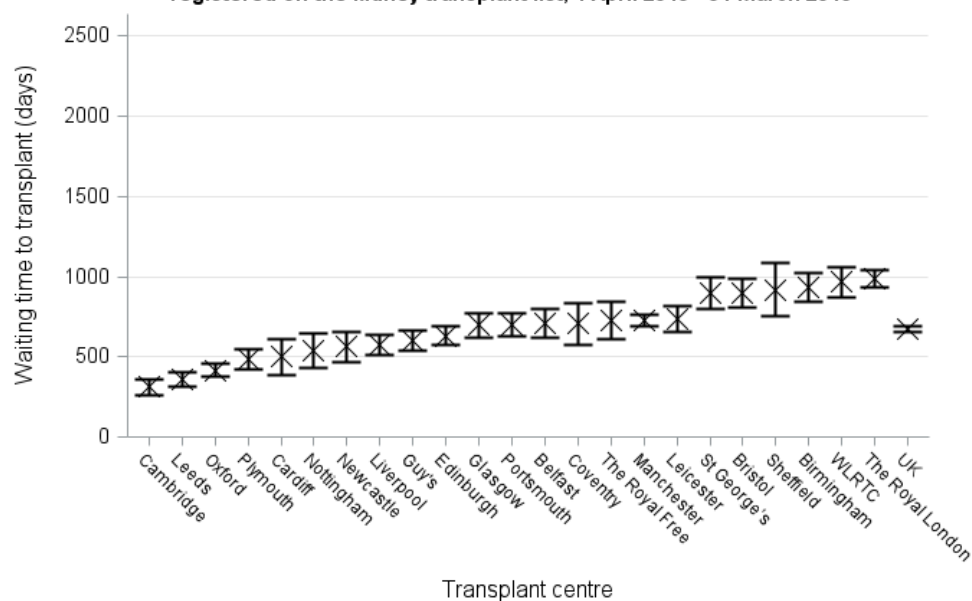
## **National Kidney Allocation Scheme**

Only kidneys from donors after brain death were allocated via a national allocation scheme during the time period analysed. Kidneys from donations after circulatory death ([DCD](#)) were allocated to patients through local allocation arrangements and these vary across the country because some centres have a larger [DCD](#) programme than others. As of 3 September 2014 one kidney from [DCD](#) donors aged between 5 and 49 years is allocated within four pre-defined regions using the 2006 [DBD](#) allocation principles.

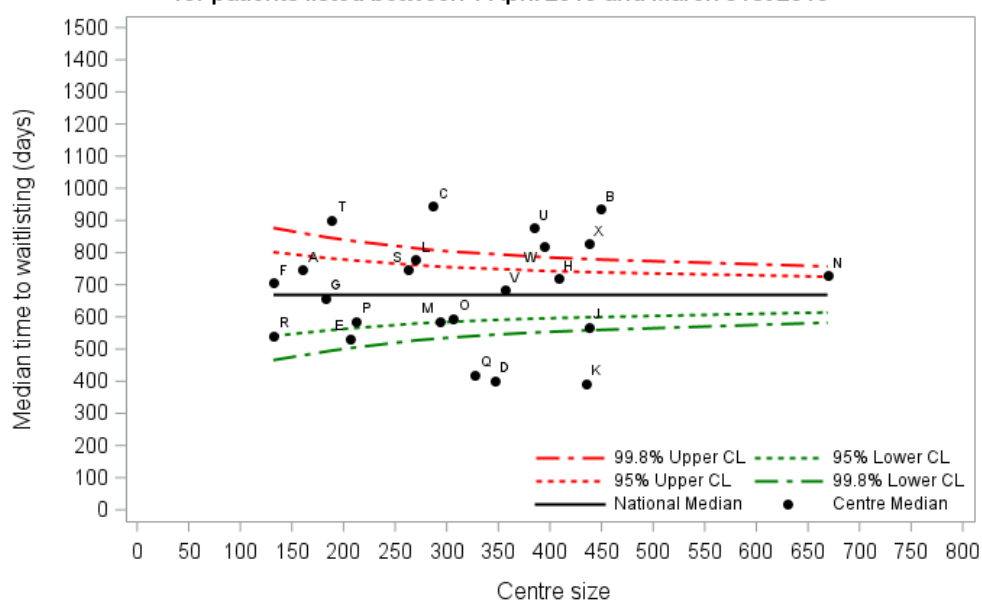
Kidneys from [DBD](#) are allocated to patients listed nationally through the Kidney Allocation Scheme. The Kidney Allocation Scheme introduced in April 2006 prioritises patients with ideal tissue matches (000 [HLA mismatches](#)) and then assigns points to patients based on the level of tissue match 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 receive more points. The patients with the highest number of points for a donated kidney are preferentially offered the kidney, no matter where in the UK they receive their treatment.

The [median](#) waiting time to transplant for adult patients registered on the kidney only [transplant list](#) between 1 April 2013 and 31 March 2016 is 675 days. This ranged from 314 days at Cambridge to 985 days at the Royal London.

**Figure 3.10** Median waiting time to deceased donor transplant for adult patients registered on the kidney transplant list, 1 April 2013 - 31 March 2016



**Figure 3.11** Adult risk-adjusted median waiting times for patients listed between 1 April 2013 and March 31st 2016



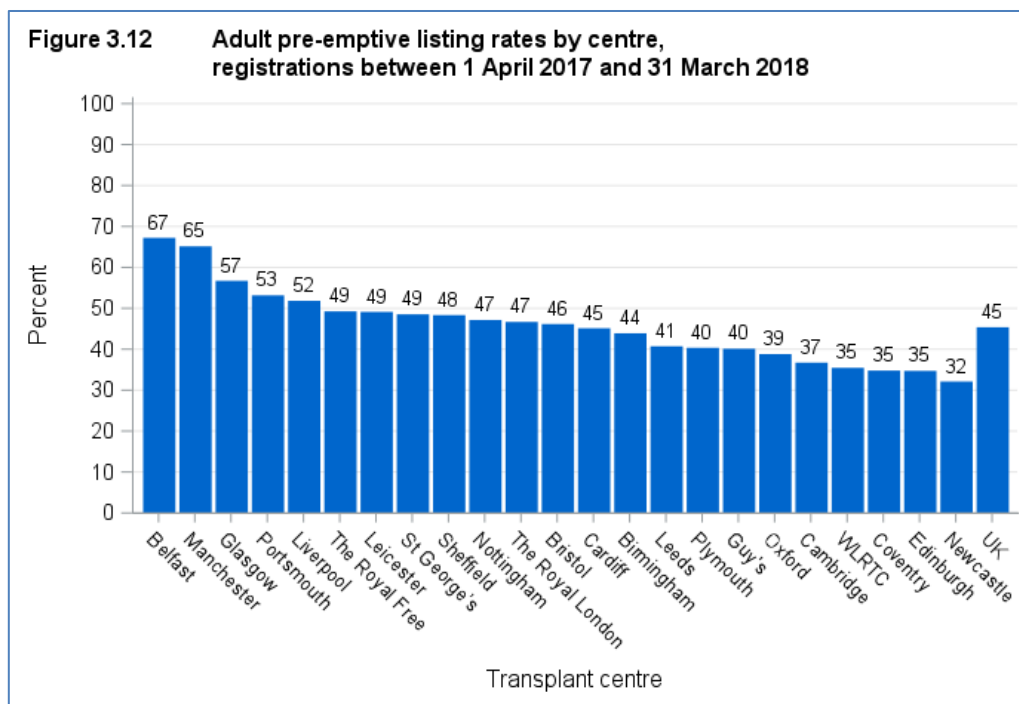


**Table 3.1 Median waiting time to kidney only transplant in the UK,  
for adult patients registered 1 April 2013 - 31 March 2016**

Centre	Code	Number of patients registered	Unadjusted Median	Waiting time (days) 95% Confidence interval	Risk-adjusted Median
<b>Adult</b>					
Cambridge	D	352	314	266 - 362	400
Leeds	K	439	361	317 - 405	394
Oxford	Q	329	417	377 - 457	419
Plymouth	R	135	487	425 - 549	543
Cardiff	E	218	503	391 - 615	531
Nottingham	P	212	539	433 - 645	586
Newcastle	O	308	562	472 - 652	597
Liverpool	M	295	576	514 - 638	584
Guy's	J	442	602	542 - 662	570
Edinburgh	G	184	632	571 - 693	657
Glasgow	H	418	699	622 - 776	721
Portsmouth	S	263	700	627 - 773	750
Belfast	A	162	706	617 - 795	746
Coventry	F	133	708	579 - 837	707
The Royal Free	V	357	727	611 - 843	684
Manchester	N	671	729	695 - 763	728
Leicester	L	284	734	652 - 816	778
St George's	U	389	897	795 - 999	877
Bristol	C	287	899	810 - 988	947
Sheffield	T	195	918	751 - 1085	903
Birmingham	B	452	936	846 - 1026	935
WLRTC	X	441	967	873 - 1061	827
The Royal London	W	401	985	929 - 1041	819
<b>UK</b>		<b>7367</b>	<b>675</b>	<b>657 - 693</b>	

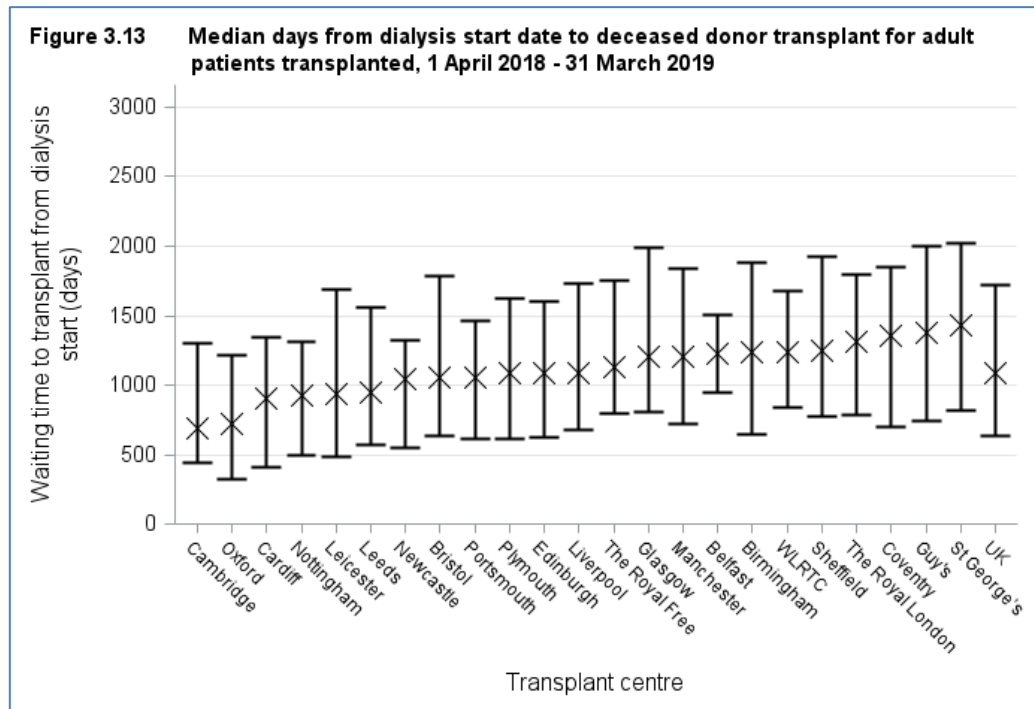
### 3.6 Pre-emptive listing rates, 1 April 2017 - 31 March 2018

Rates of [pre-emptive](#) kidney only listings are shown in **Figure 3.12** for adult patients joining the list between 1 April 2017 and 31 March 2018. 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 67% at Belfast to 32% at Newcastle.



### 3.7 Median time from start of dialysis to transplant, 1 April 2018 - 31 March 2019

The median time from dialysis start date to deceased donor transplant for adult patients transplanted between 1 April 2018 and 31 March 2019 is shown in **Figure 3.13**. The [median](#) time is 1088 days. This ranged from 692 days at Oxford to 1433 days at St George's.



## **Response to adult kidney offers**

## Offer decline rates

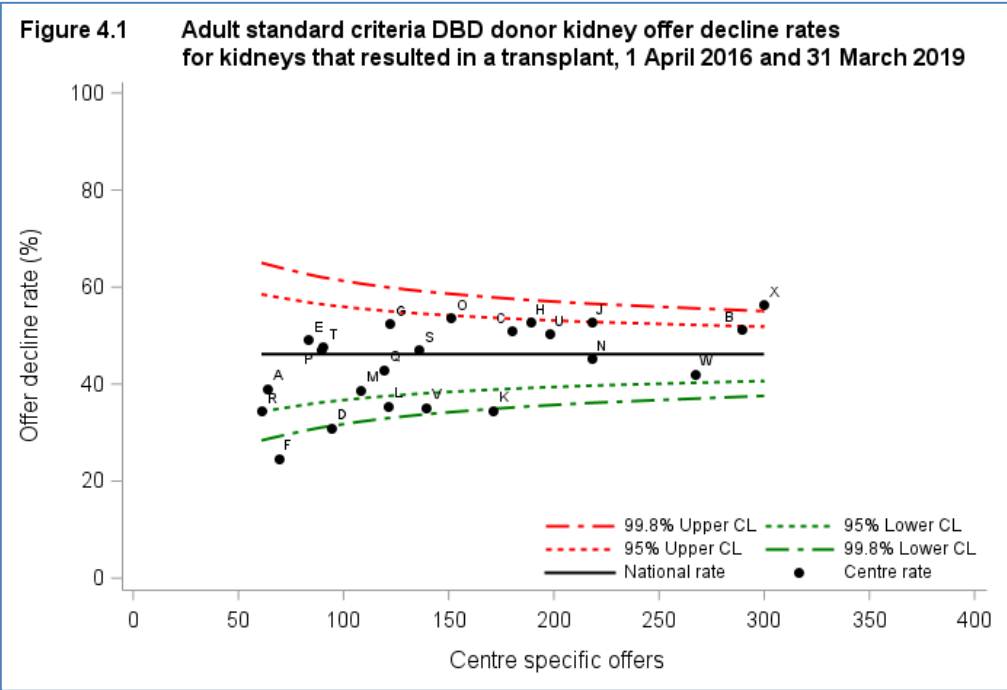
Kidney-only offers from [DBD](#) and [DCD](#) donors who had at least one kidney retrieved, offered directly and on behalf of a named individual patient and resulted in transplantation are included in the analysis. Any offers made through the reallocation of kidneys, declined kidney or fast track schemes 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 2016 – 31 March 2019

**Figure 4.1** compares individual centre offer decline rates with the national rate for SCD over the time period, 1 April 2016 and 31 March 2019. Centres can be identified by the information shown in **Table 4.1**.

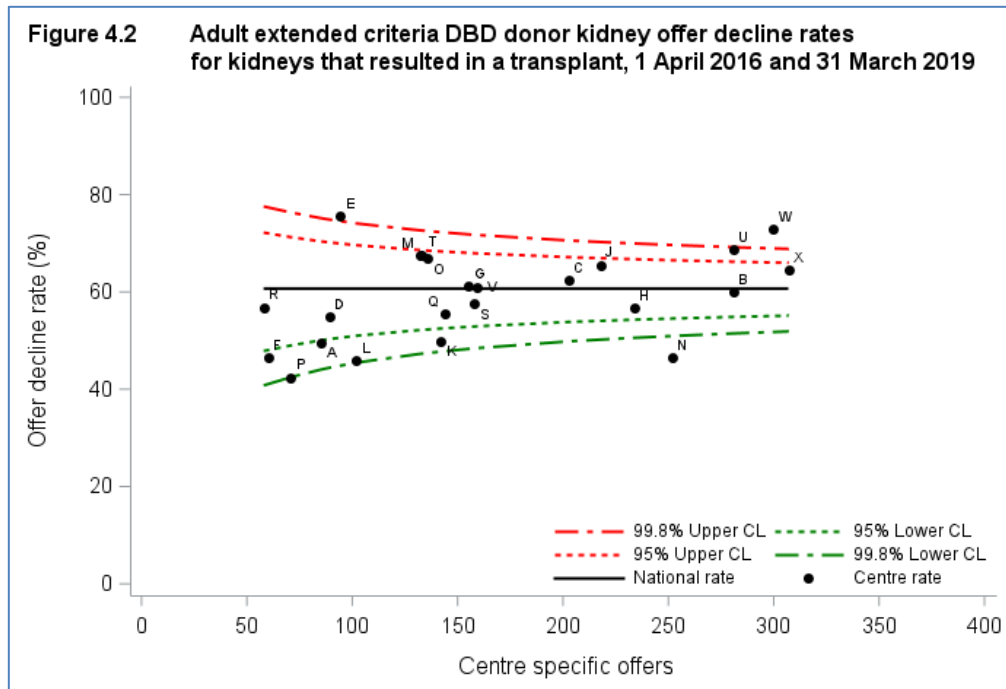


**Table 4.1** compares individual centre offer decline rates for SCD over time by financial year. Leicester and Newcastle have shown improvements in their SCD offer decline rates over time.

<b>Table 4.1 Adult standard criteria DBD donor kidney offer decline rates by transplant centre, 1 April 2016 and 31 March 2019</b>									
Centre	Code	2016/17		2017/18		2018/19		Overall	
		N	(%)	N	(%)	N	(%)	N	(%)
Belfast	A	23	(30)	24	(38)	17	(53)	64	(39)
Birmingham	B	116	(57)	96	(51)	77	(43)	289	(51)
Bristol	C	64	(55)	61	(56)	55	(42)	180	(51)
Cambridge	D	27	(26)	36	(36)	31	(29)	94	(31)
Cardiff	E	26	(46)	22	(55)	35	(49)	83	(49)
Coventry	F	19	(26)	22	(23)	28	(25)	69	(25)
Edinburgh	G	31	(55)	44	(48)	47	(55)	122	(52)
Glasgow	H	68	(63)	63	(43)	58	(52)	189	(53)
Guy's	J	61	(48)	71	(59)	86	(51)	218	(53)
Leeds	K	45	(18)	47	(38)	79	(42)	171	(35)
Leicester	L	41	(37)	43	(42)	37	(27)	121	(36)
Liverpool	M	29	(41)	36	(33)	43	(42)	108	(39)
Manchester	N	77	(45)	71	(39)	70	(51)	218	(45)
Newcastle	O	44	(43)	47	(55)	60	(60)	151	(54)
Nottingham	P	31	(61)	32	(28)	26	(54)	89	(47)
Oxford	Q	40	(50)	38	(32)	41	(46)	119	(43)
Plymouth	R	15	(33)	23	(39)	23	(30)	61	(34)
Portsmouth	S	48	(40)	48	(56)	40	(45)	136	(47)
Sheffield	T	23	(43)	36	(53)	31	(45)	90	(48)
St George's	U	52	(48)	76	(54)	70	(49)	198	(51)
The Royal Free	V	34	(38)	58	(31)	47	(38)	139	(35)
The Royal London	W	77	(35)	86	(49)	104	(41)	267	(42)
WLRTC	X	97	(56)	107	(53)	96	(60)	300	(56)
<b>UK</b>		<b>1088</b>	<b>(46)</b>	<b>1187</b>	<b>(46)</b>	<b>1201</b>	<b>(46)</b>	<b>3476</b>	<b>(46)</b>

## 4.2 DBD Extended criteria offer decline rates, 1 April 2016 – 31 March 2019

**Figure 4.2** compares individual centre offer decline rates with the national rate for ECD over the time period, 1 April 2016 and 31 March 2019. Centres can be identified by the information shown in **Table 4.2**.



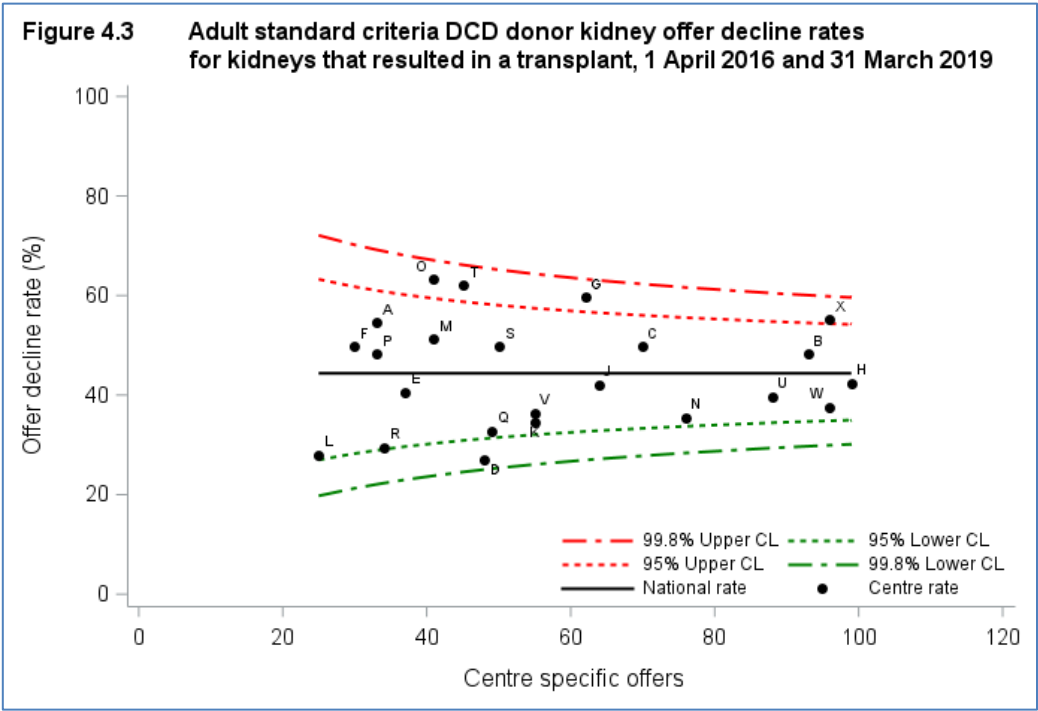


**Table 4.2** compares individual centre offer decline rates for ECD over time by financial year. Leicester has shown improvements in their ECD offer decline rate over time.

<b>Table 4.2 Adult extended criteria DBD donor kidney offer decline rates by transplant centre, 1 April 2016 and 31 March 2019</b>									
Centre	Code	2016/17		2017/18		2018/19		Overall	
		N	(%)	N	(%)	N	(%)	N	(%)
Belfast	A	28	(43)	32	(44)	25	(64)	85	(49)
Birmingham	B	90	(69)	102	(49)	89	(64)	281	(60)
Bristol	C	73	(64)	72	(71)	58	(50)	203	(63)
Cambridge	D	18	(56)	32	(56)	39	(54)	89	(55)
Cardiff	E	31	(81)	28	(79)	35	(69)	94	(76)
Coventry	F	12	(67)	29	(34)	19	(53)	60	(47)
Edinburgh	G	32	(69)	55	(56)	68	(62)	155	(61)
Glasgow	H	67	(51)	96	(56)	71	(63)	234	(57)
Guy's	J	61	(59)	70	(60)	87	(75)	218	(66)
Leeds	K	30	(50)	56	(54)	56	(46)	142	(50)
Leicester	L	41	(49)	28	(46)	33	(42)	102	(46)
Liverpool	M	32	(56)	43	(74)	57	(68)	132	(67)
Manchester	N	79	(38)	82	(41)	91	(58)	252	(46)
Newcastle	O	33	(55)	36	(64)	67	(75)	136	(67)
Nottingham	P	24	(38)	24	(46)	23	(43)	71	(42)
Oxford	Q	49	(51)	53	(60)	42	(55)	144	(56)
Plymouth	R	15	(47)	17	(65)	26	(58)	58	(57)
Portsmouth	S	49	(45)	60	(65)	49	(61)	158	(58)
Sheffield	T	43	(72)	36	(61)	54	(69)	133	(68)
St George's	U	68	(62)	103	(72)	110	(70)	281	(69)
The Royal Free	V	44	(57)	74	(62)	41	(63)	159	(61)
The Royal London	W	76	(71)	96	(73)	128	(74)	300	(73)
WLRTC	X	90	(61)	114	(69)	103	(62)	307	(64)
<b>UK</b>		<b>1085</b>	<b>(58)</b>	<b>1338</b>	<b>(60)</b>	<b>1371</b>	<b>(63)</b>	<b>3794</b>	<b>(61)</b>

4.3 DCD Standard criteria offer decline rates, 1 April 2016 – 31 March 2019

**Figure 4.3** compares individual centre offer decline rates with the national rate for SCD over the time period, 1 April 2016 and 31 March 2019. 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 2016 and 31 March 2019</b>									
Centre	Code	2016/17		2017/18		2018/19		Overall	
		N	(%)	N	(%)	N	(%)	N	(%)
Belfast	A	10	(60)	20	(60)	3	(0)	33	(55)
Birmingham	B	21	(57)	38	(45)	34	(47)	93	(48)
Bristol	C	27	(44)	19	(47)	24	(58)	70	(50)
Cambridge	D	10	(20)	14	(21)	24	(33)	48	(27)
Cardiff	E	13	(23)	11	(64)	13	(38)	37	(41)
Coventry	F	11	(55)	9	(56)	10	(40)	30	(50)
Edinburgh	G	17	(53)	22	(55)	23	(70)	62	(60)
Glasgow	H	34	(50)	35	(37)	30	(40)	99	(42)
Guy's	J	26	(38)	13	(62)	25	(36)	64	(42)
Leeds	K	23	(35)	17	(35)	15	(33)	55	(35)
Leicester	L	6	(17)	8	(50)	11	(18)	25	(28)
Liverpool	M	14	(57)	8	(38)	19	(53)	41	(51)
Manchester	N	26	(19)	33	(36)	17	(59)	76	(36)
Newcastle	O	12	(58)	14	(64)	15	(67)	41	(63)
Nottingham	P	7	(57)	16	(44)	10	(50)	33	(48)
Oxford	Q	11	(27)	23	(48)	15	(13)	49	(33)
Plymouth	R	5	(20)	12	(33)	17	(29)	34	(29)
Portsmouth	S	14	(43)	18	(50)	18	(56)	50	(50)
Sheffield	T	9	(56)	23	(57)	13	(77)	45	(62)
St George's	U	24	(54)	24	(46)	40	(28)	88	(40)
The Royal Free	V	21	(33)	17	(47)	17	(29)	55	(36)
The Royal London	W	33	(27)	22	(41)	41	(44)	96	(38)
WLRTC	X	35	(49)	26	(62)	35	(57)	96	(55)
<b>UK</b>		<b>409</b>	<b>(42)</b>	<b>442</b>	<b>(47)</b>	<b>469</b>	<b>(44)</b>	<b>1320</b>	<b>(44)</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							

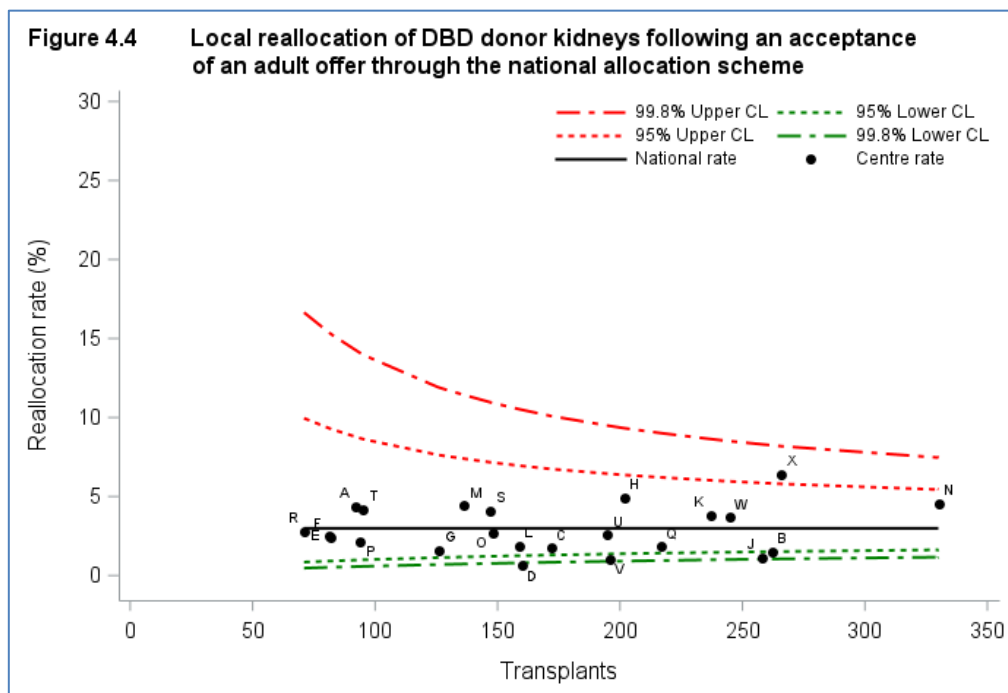
#### 4.4 Reallocation of kidneys, 1 April 2016 – 31 March 2019

Since 3 April 2006 all kidneys from donation after brain death ([DBD](#)) donors have been allocated through the 2006 [National Kidney Allocation Scheme](#) (KAS). 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.

[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 2016 and 31 March 2019. 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. WLRTC have reallocation rates consistently higher than the national rate.



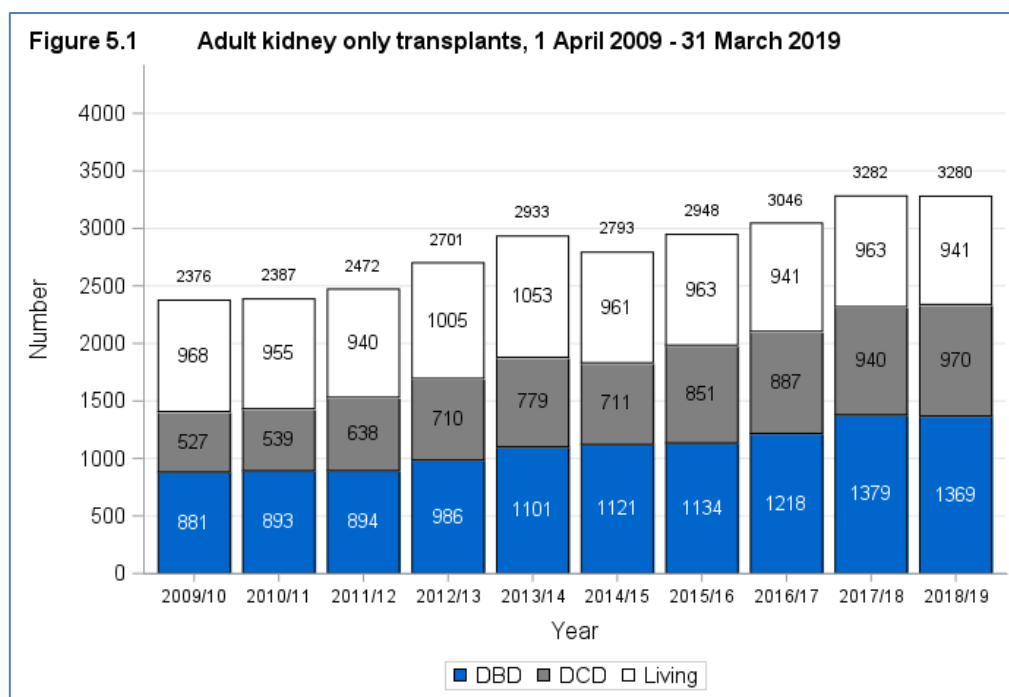
**Table 4.4** compares individual reallocation rates over time by financial year.

<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	2016/17		2017/18		2018/19		Overall	
		N	(%)	N	(%)	N	(%)	N	(%)
Belfast	A	34	(3)	38	(3)	20	(10)	92	(4)
Birmingham	B	82	(4)	101	(0)	79	(1)	262	(2)
Bristol	C	55	(0)	55	(5)	62	(0)	172	(2)
Cambridge	D	39	(0)	55	(0)	66	(2)	160	(1)
Cardiff	E	25	(0)	20	(5)	37	(3)	82	(2)
Coventry	F	19	(0)	39	(5)	23	(0)	81	(2)
Edinburgh	G	25	(0)	48	(0)	53	(4)	126	(2)
Glasgow	H	60	(3)	80	(3)	62	(10)	202	(5)
Guy's	J	75	(1)	90	(1)	93	(1)	258	(1)
Leeds	K	79	(4)	70	(6)	88	(2)	237	(4)
Leicester	L	59	(3)	43	(2)	57	(0)	159	(2)
Liverpool	M	35	(3)	47	(2)	54	(7)	136	(4)
Manchester	N	117	(4)	110	(3)	103	(7)	330	(5)
Newcastle	O	52	(2)	45	(4)	51	(2)	148	(3)
Nottingham	P	30	(3)	39	(3)	25	(0)	94	(2)
Oxford	Q	59	(0)	80	(1)	78	(4)	217	(2)
Plymouth	R	18	(0)	23	(4)	30	(3)	71	(3)
Portsmouth	S	58	(3)	46	(4)	43	(5)	147	(4)
Sheffield	T	27	(7)	33	(3)	35	(3)	95	(4)
St George's	U	53	(2)	70	(6)	72	(0)	195	(3)
The Royal Free	V	58	(0)	82	(0)	56	(4)	196	(1)
The Royal London	W	77	(5)	68	(0)	100	(5)	245	(4)
WLRTC	X	82	(2)	98	(6)	86	(10)	266	(6)
<b>UK</b>		<b>1218</b>	<b>(3)</b>	<b>1380</b>	<b>(3)</b>	<b>1373</b>	<b>(4)</b>	<b>3971</b>	<b>(3)</b>

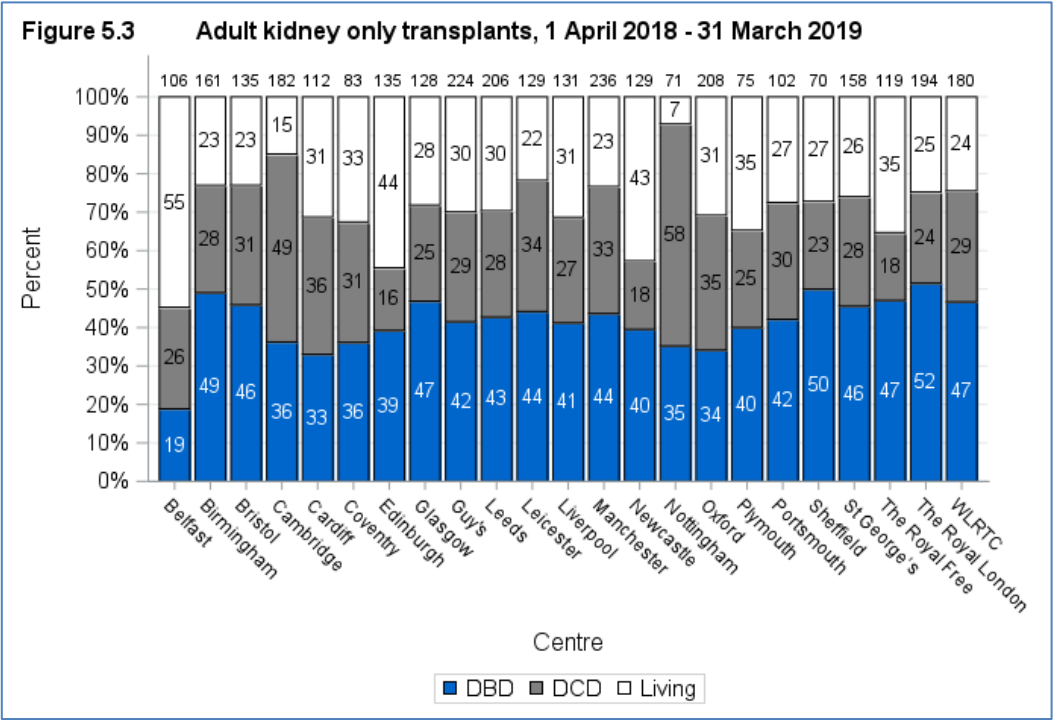
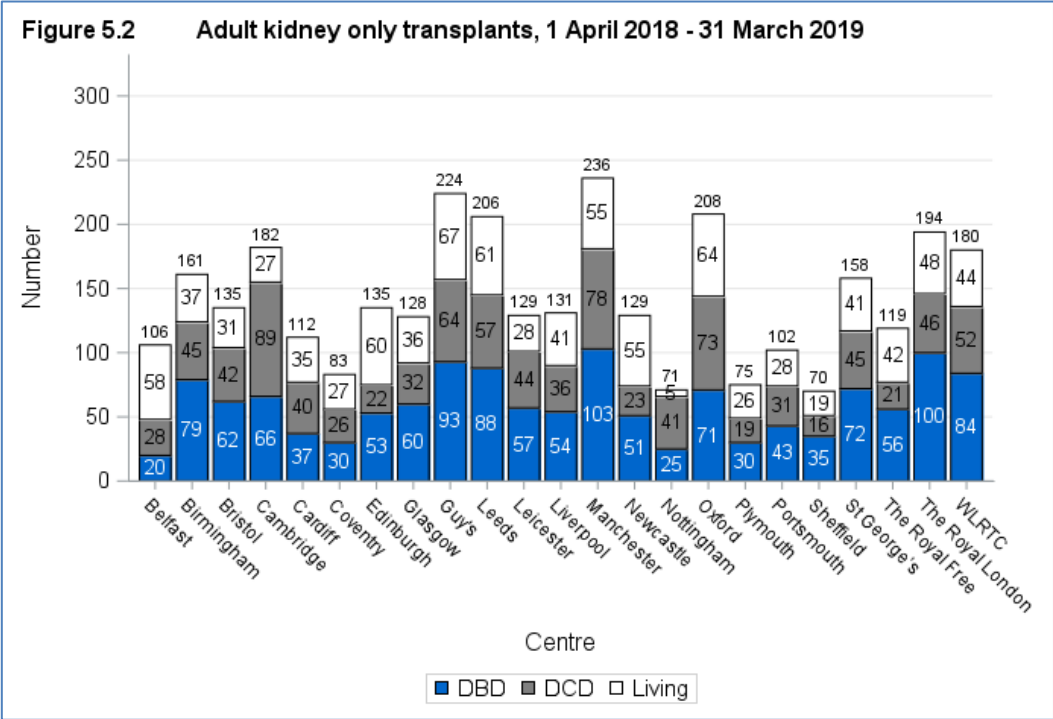
# **Adult kidney transplants**

## 5.1 Kidney only transplants, 1 April 2009 – 31 March 2019

**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 527 in 2009/2010 to 970 in 2018/2019 with a slight dip to 711 in 2014/15. The number of adult transplants from donors after brain death (DBD) has increased in the last 5 years to 1,379 in 2017/2018 with fewer transplants in 2018/19. The number of adult living kidney transplants performed was steadily increasing over time before decreasing by 11% from 1,053 in 2013/14 to 941 in the latest financial year.

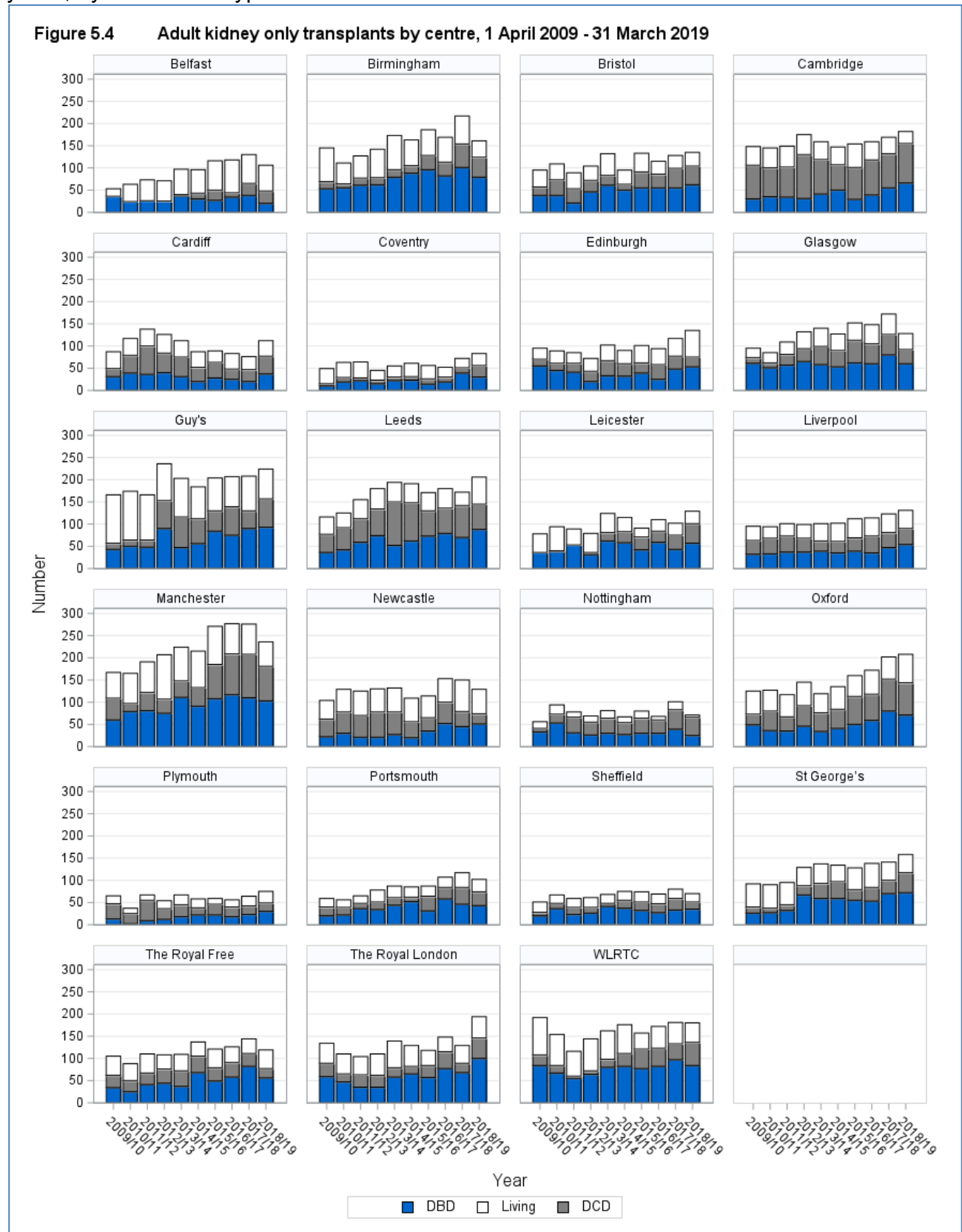


**Figure 5.2** shows the total number of adult kidney only transplants performed in 2018/19, by centre and type of donor. The same information is presented in **Figure 5.3** but this shows the proportion of [DBD](#), [DCD](#) and living donor transplants performed at each centre.



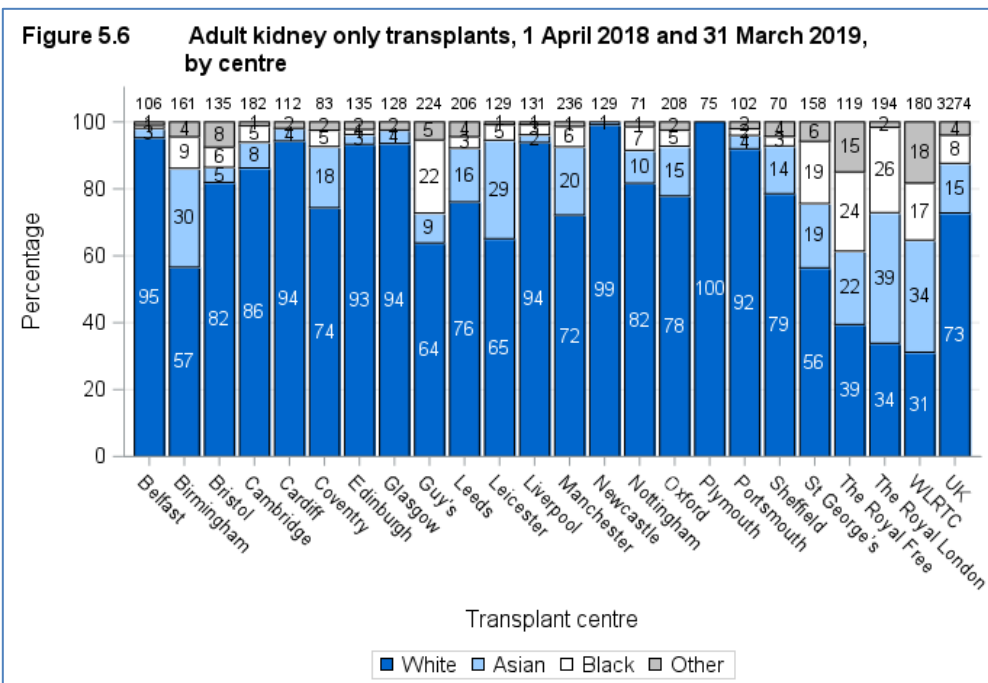
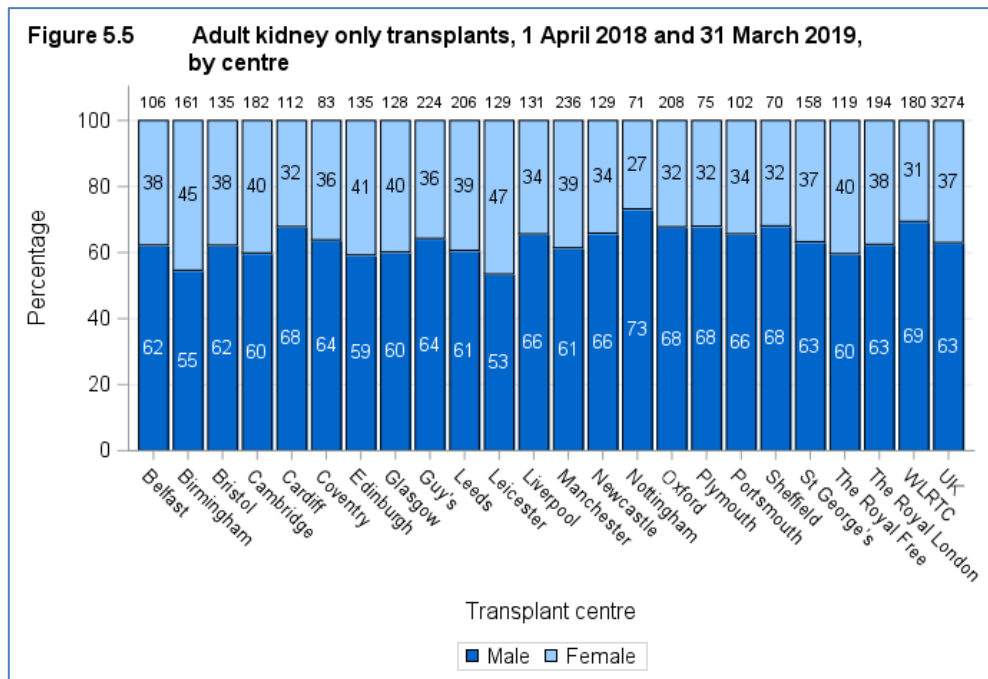


**Figure 5.4** shows the total number of adult kidney only transplants performed in last ten years, by centre and type of donor.

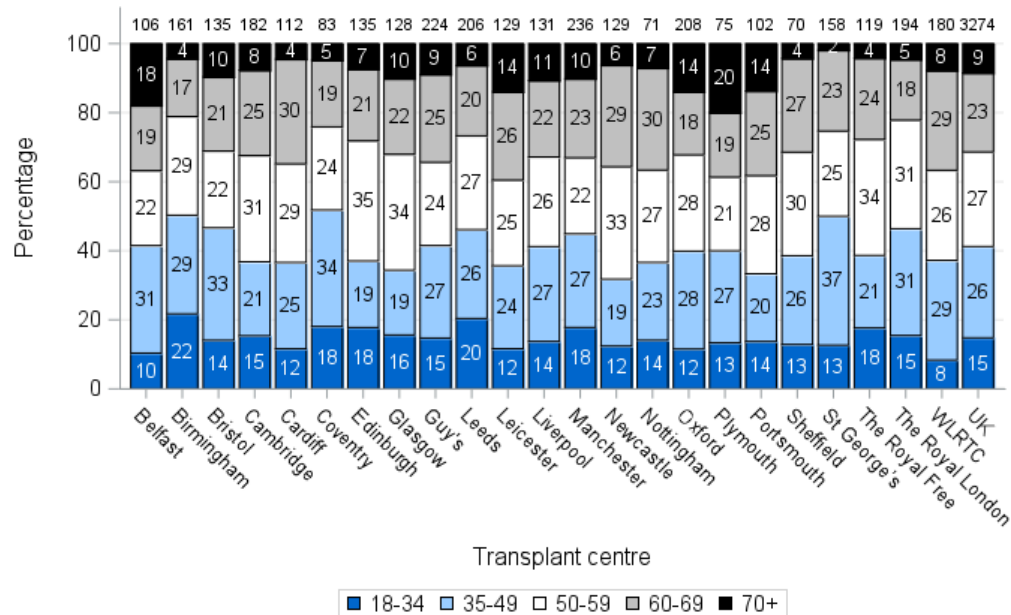


## 5.2 Demographic characteristics of recipients, 1 April 2018 - 31 March 2019

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.

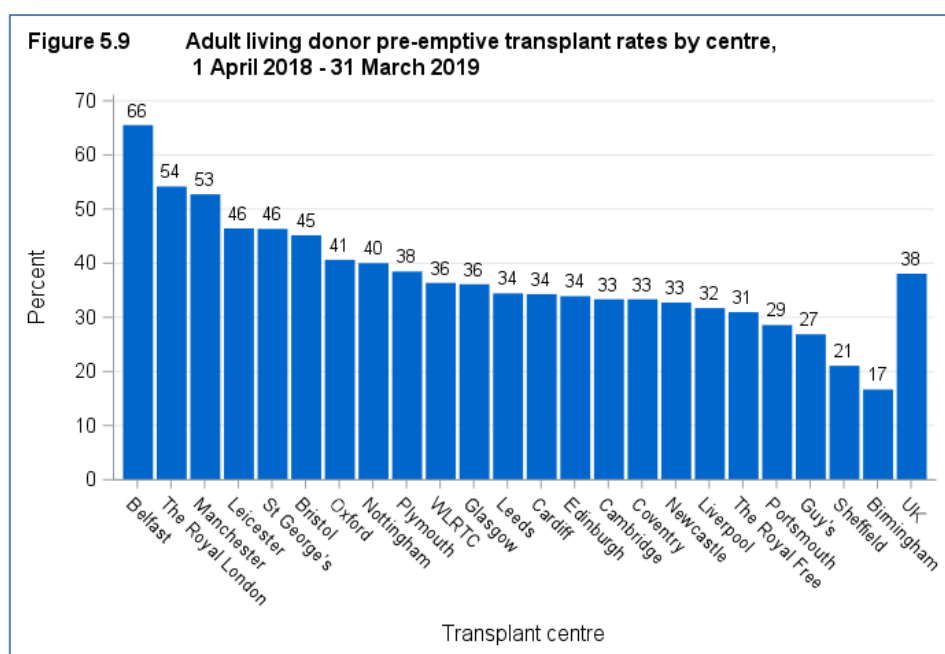
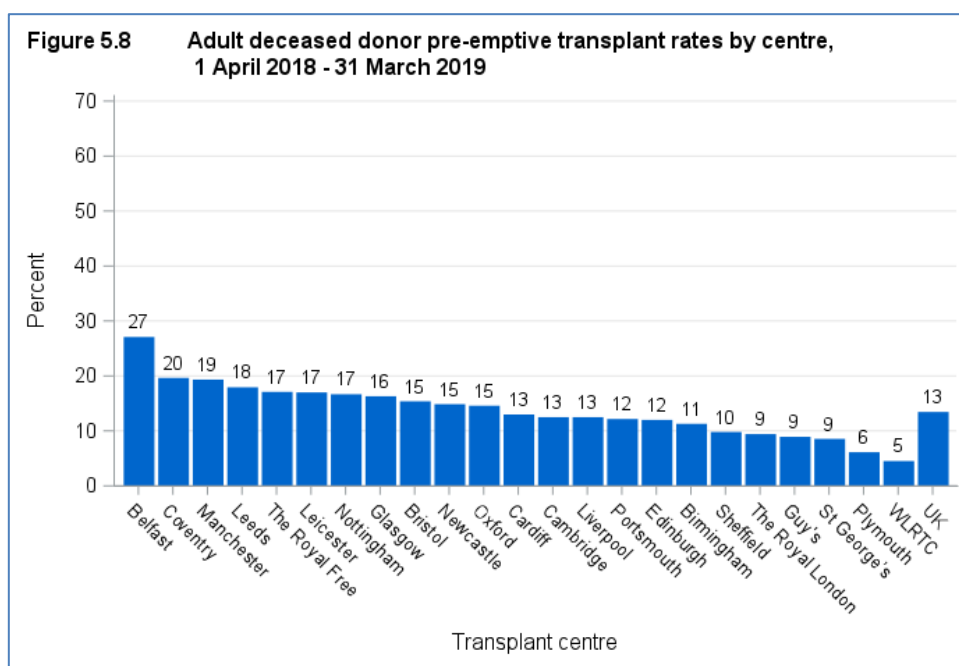


**Figure 5.7 Adult kidney only transplants, 1 April 2018 and 31 March 2019, by centre**



### 5.3 Pre-emptive transplant rates, 1 April 2018 - 31 March 2019

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 13% 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 27% at Belfast to 5% at WLRTC. Adult living donor pre-emptive transplant rates ranged from 66% at Belfast to 17% at Birmingham.



#### 5.4 Kidney donor risk-index<sup>1</sup>, 1 April 2016 – 31 March 2019

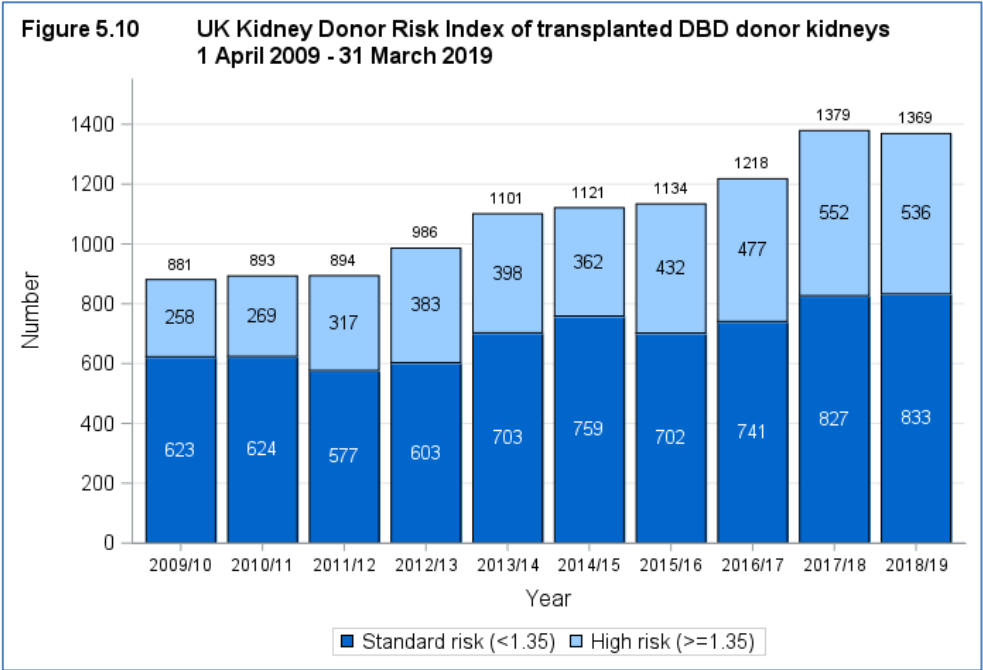
The severe shortage of deceased donor (DD) organs available for transplantation has led to increased use of kidneys from suboptimal donors with potentially less good transplant outcome. Categorising such kidneys according to anticipated outcome is important because it enables clinicians to be better 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:

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

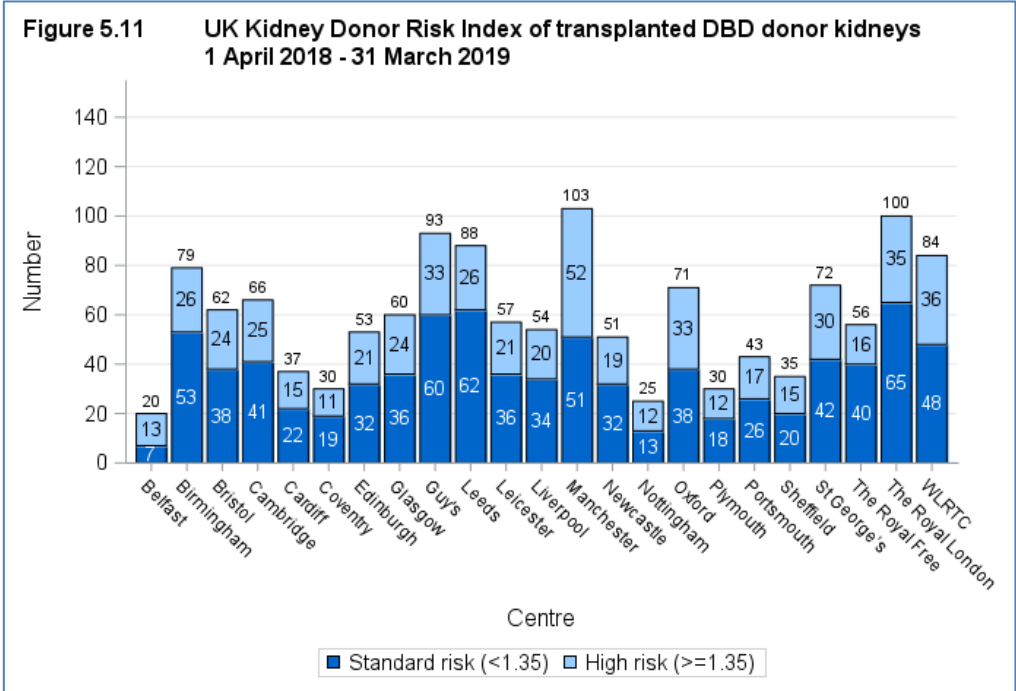
#### Reference

- 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

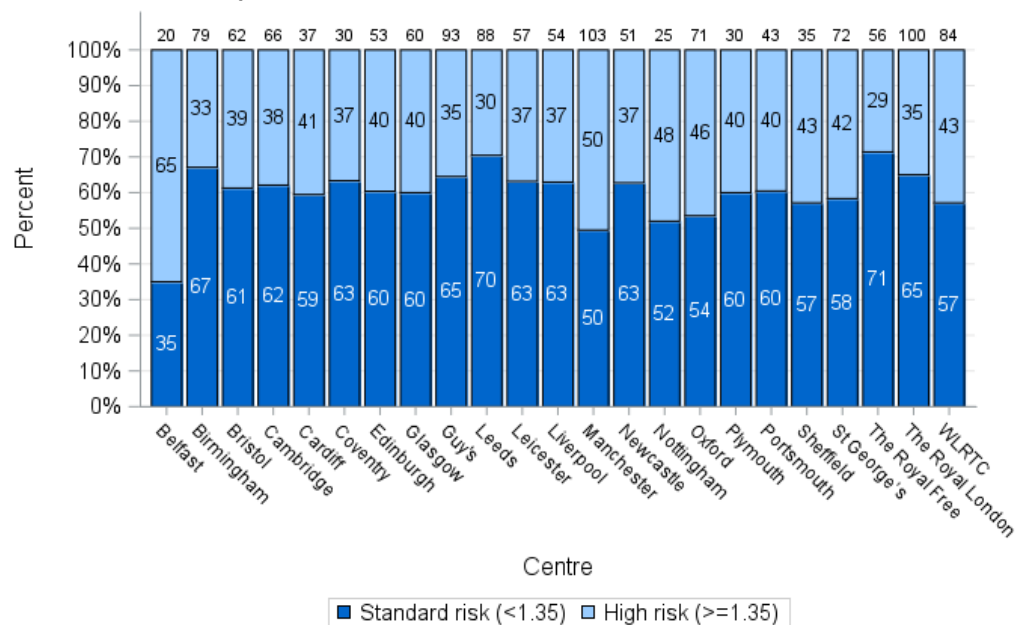
**Figure 5.10** shows the number of transplanted [DBD](#) donor kidneys over the last ten financial years by kidney donor risk index group. In 2009/10 29% of all transplants were performed using kidneys from donors categorised as high risk (UK Donor risk index  $\geq 1.35$ ) compared with 39% in 2018/19.



**Figure 5.11** shows the number of transplanted [DBD](#) donor kidneys in 2018/19 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.

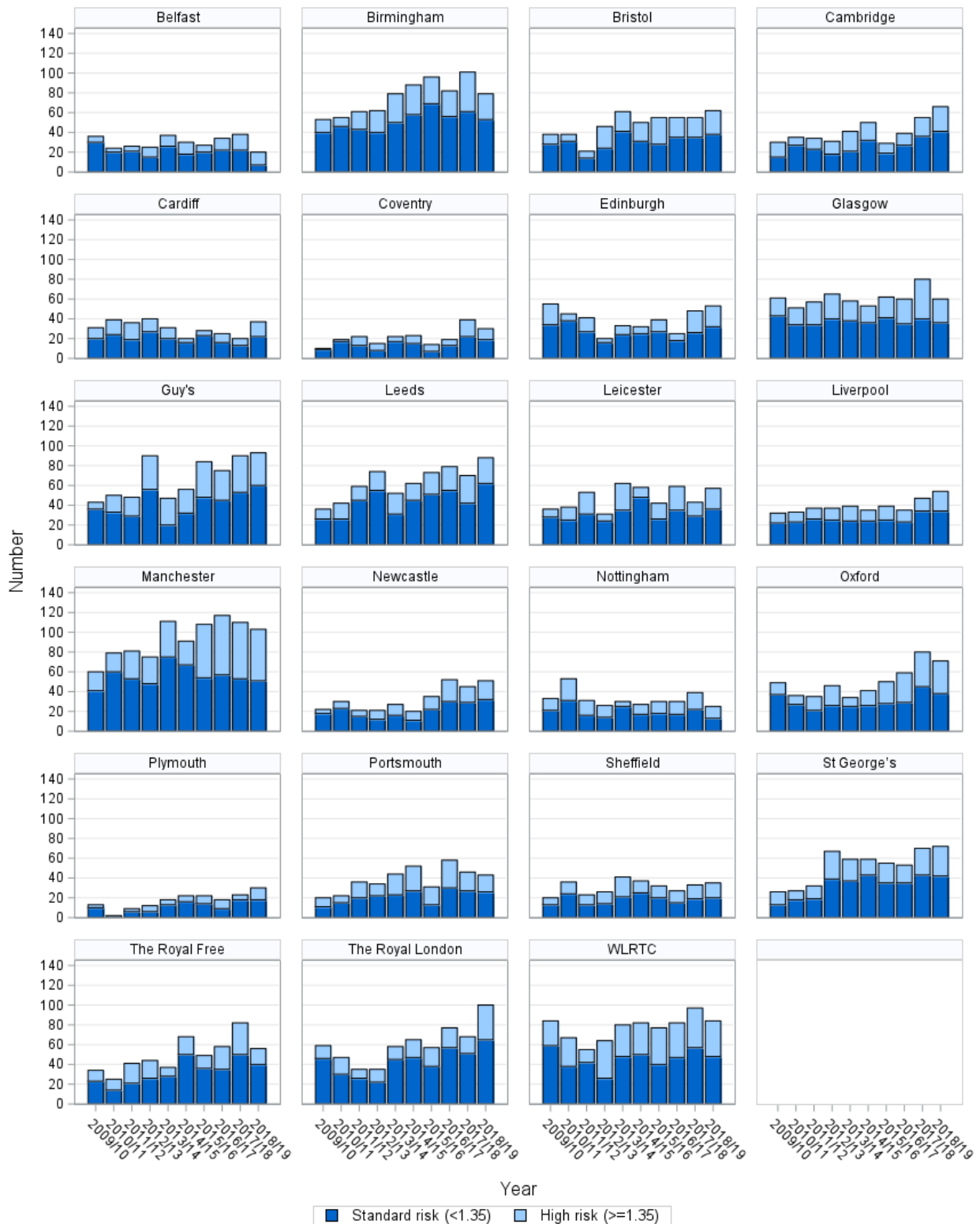


**Figure 5.12 UK Kidney Donor Risk Index of transplanted DBD donor kidneys  
1 April 2018 - 31 March 2019**



**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.

**Figure 5.13** UK Kidney Donor Risk Index of transplanted DBD donor kidneys by centre, 1 April 2009 - 31 March 2019





## 5.5 Cold ischaemia time, 1 April 2016 – 31 March 2019

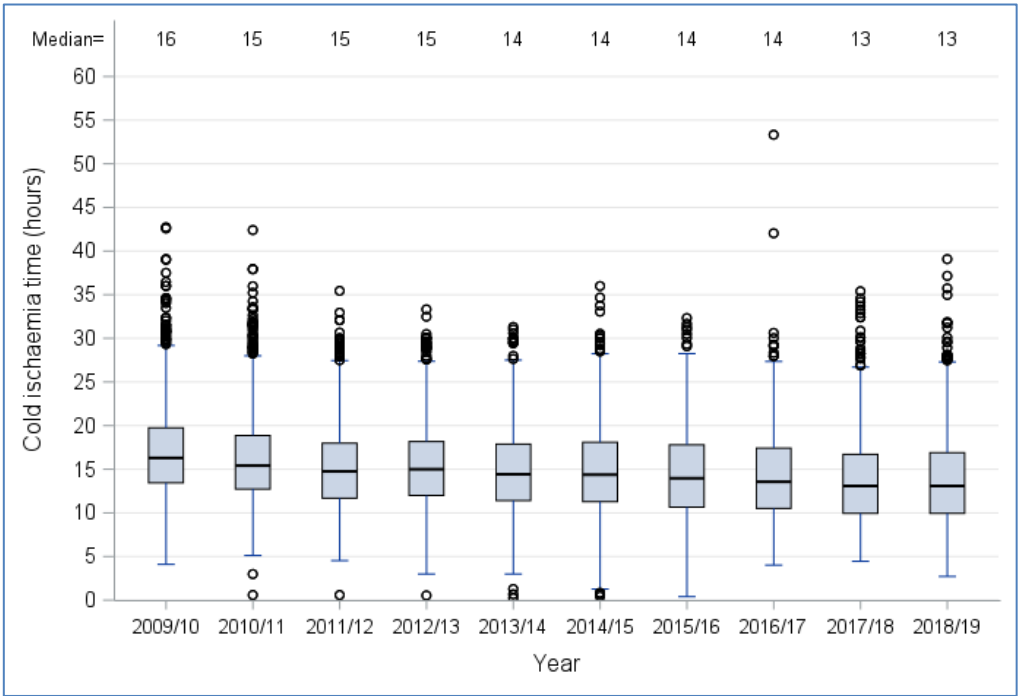
The length of time that elapses between a kidney being removed from the donor to its transplantation into the recipient is called the Cold Ischaemia Time (CIT). Generally, the shorter this time, the more likely the kidney is to work immediately and the better the long-term outcome. One of the reasons 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.

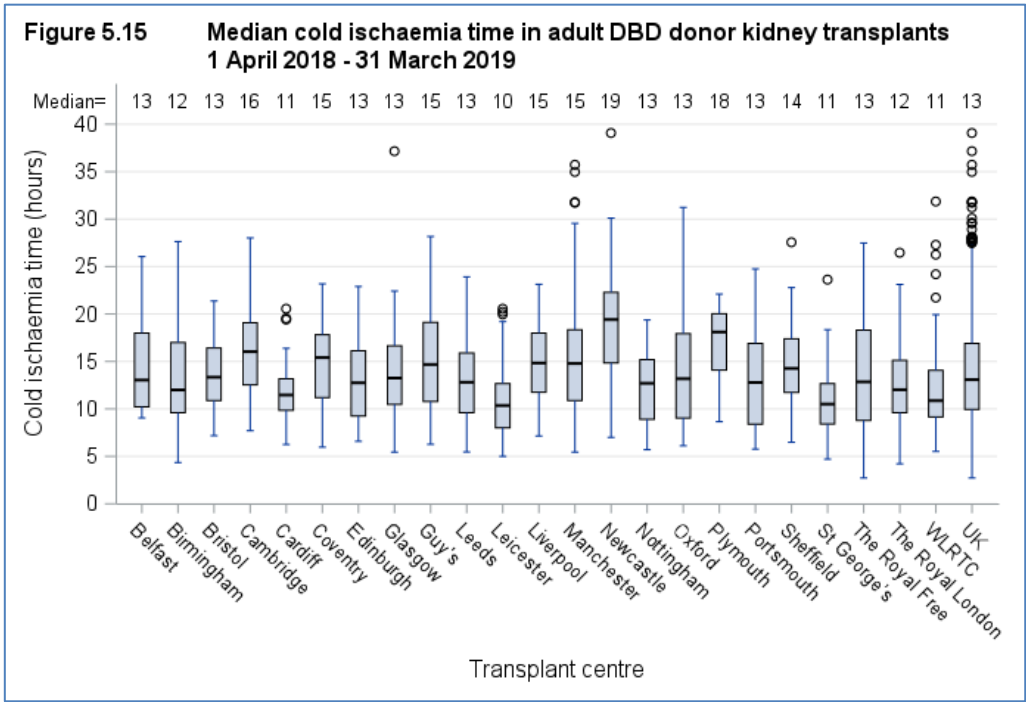
The cold ischaemia times used for all donors, is as reported on the kidney transplant record form and may include periods of machine perfusion; no adjustment has been made for this.

[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.

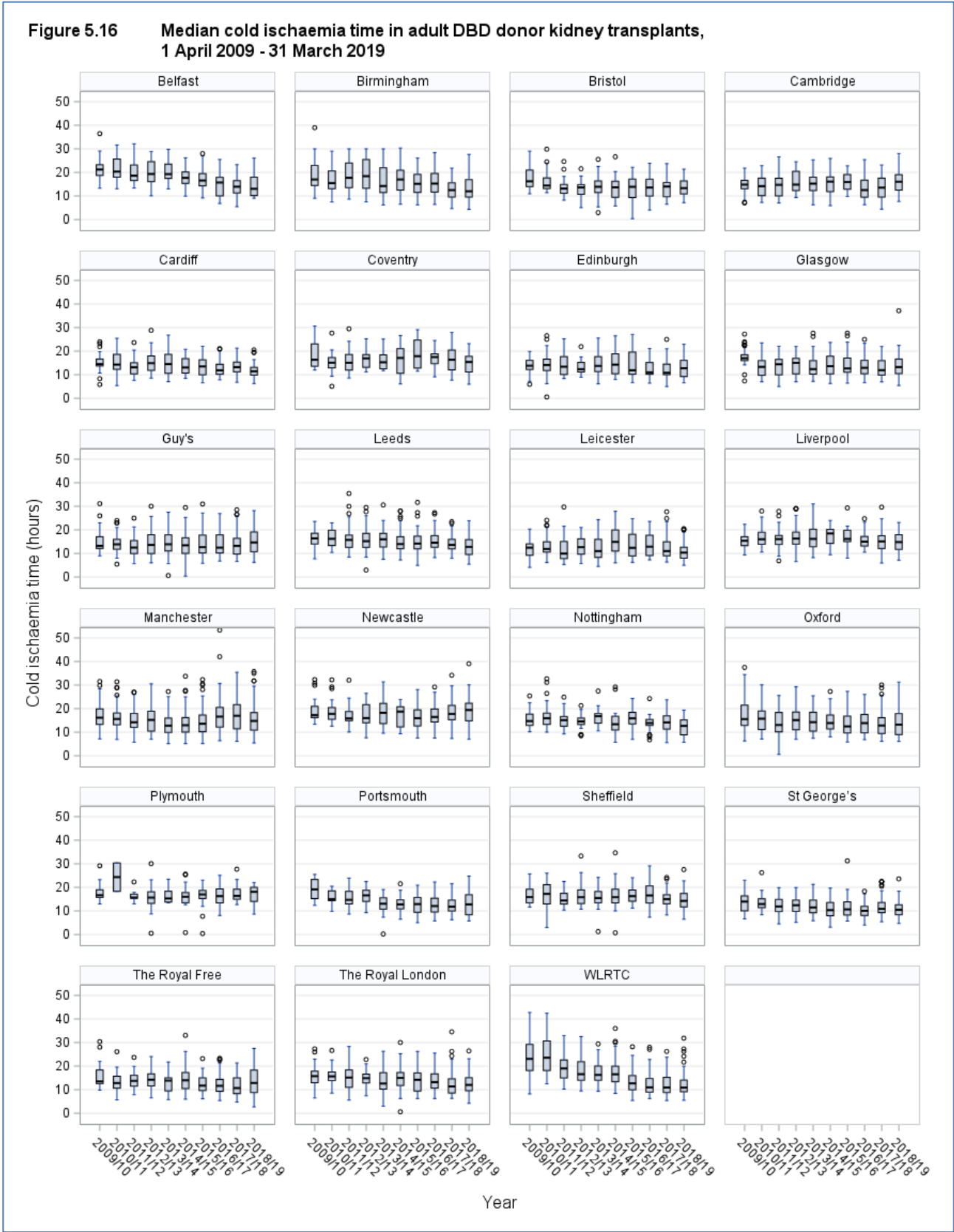
**Figure 5.14** shows the [median](#) total cold ischaemia time in adult [DBD](#) donor kidney only transplants over the last 10 years. The [median](#) total cold ischaemia time has fallen over the last 10 years from 16 hours in 2009/10 to 13 hours in 2018/19.



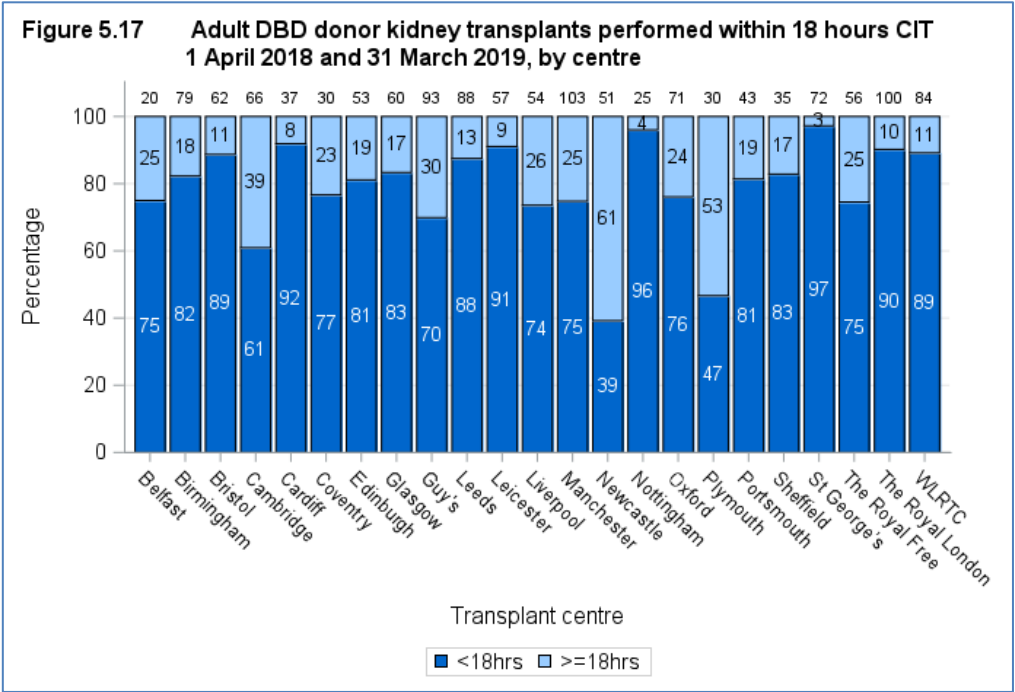
**Figure 5.15** shows the [median](#) total cold ischaemia time in adult [DBD](#) donor kidney only transplants in 2018/19 for each transplant centre. Newcastle had the longest [median](#) cold ischaemia time, 19 hours in 2018/19 compared with Leicester who had the shortest, 10 hours.



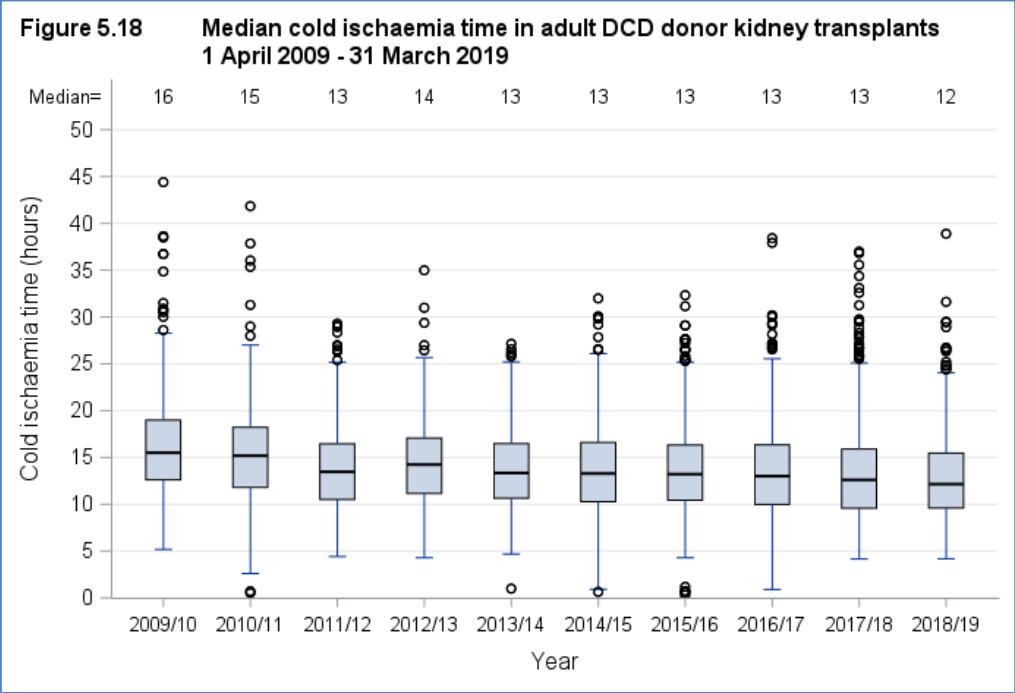
**Figure 5.16** shows the median total cold ischaemia time in adult DBD donor kidney only transplants over the last ten years for each transplant centre.



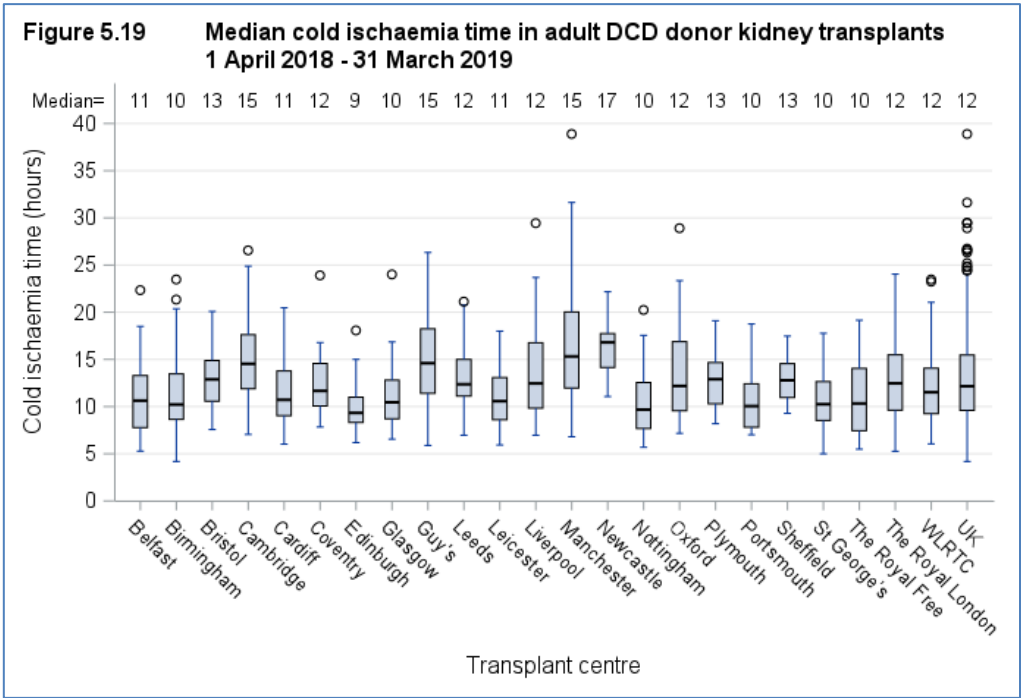
**Figure 5.17** shows the proportion of adult [DBD](#) donor kidney only transplants in 2018/19 that have been performed within 18 hours of CIT for each transplant centre. The majority of centres have at least half of all [DBD](#) kidney only transplants performed within 18 hours CIT.



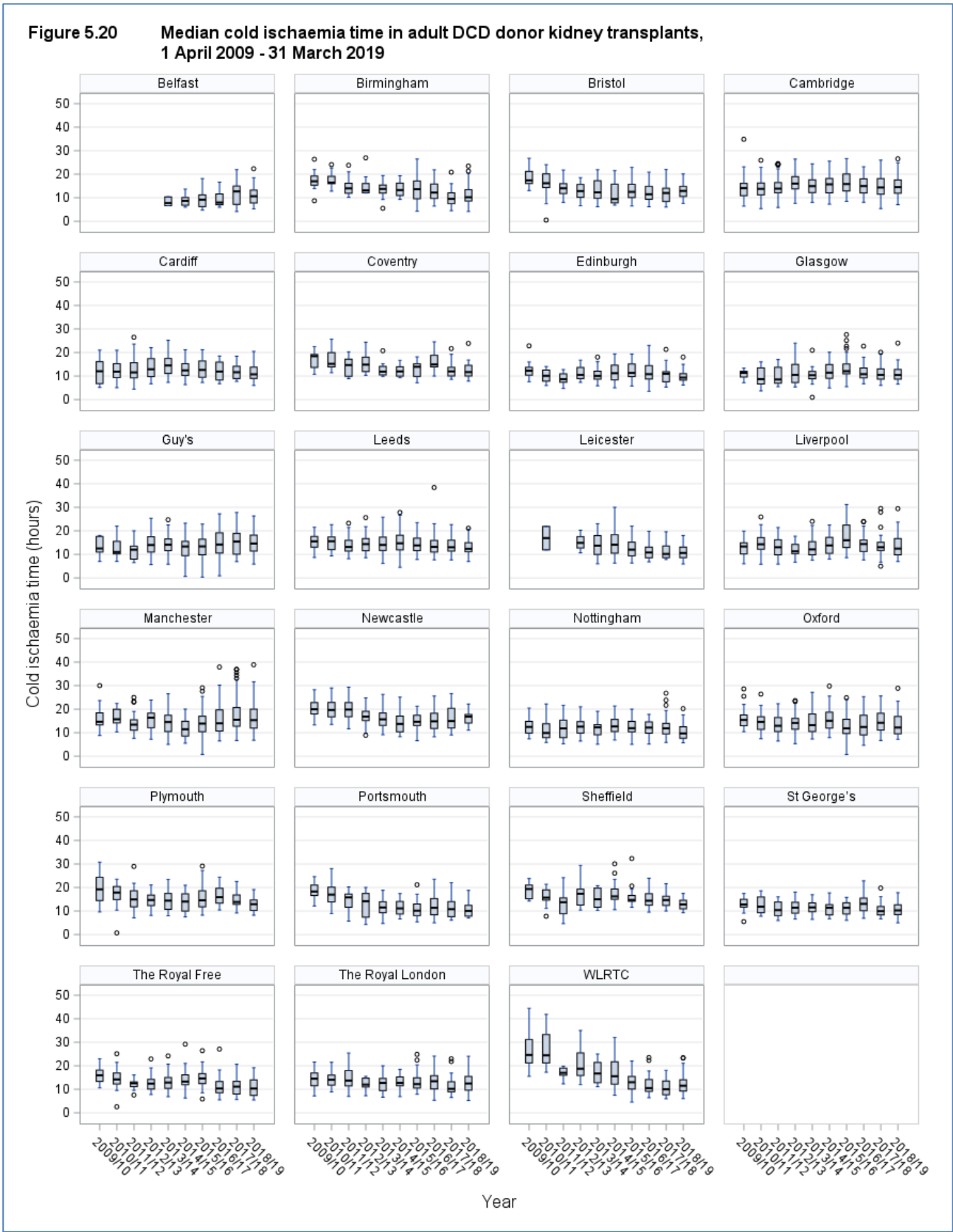
**Figure 5.18** shows the [median](#) total cold ischaemia time in adult [DCD](#) donor kidney only transplants over the last 10 years. The [median](#) total ischaemia time has fallen over the last 10 years from 16 hours in 2009/10 to 12 hours in 2018/19.



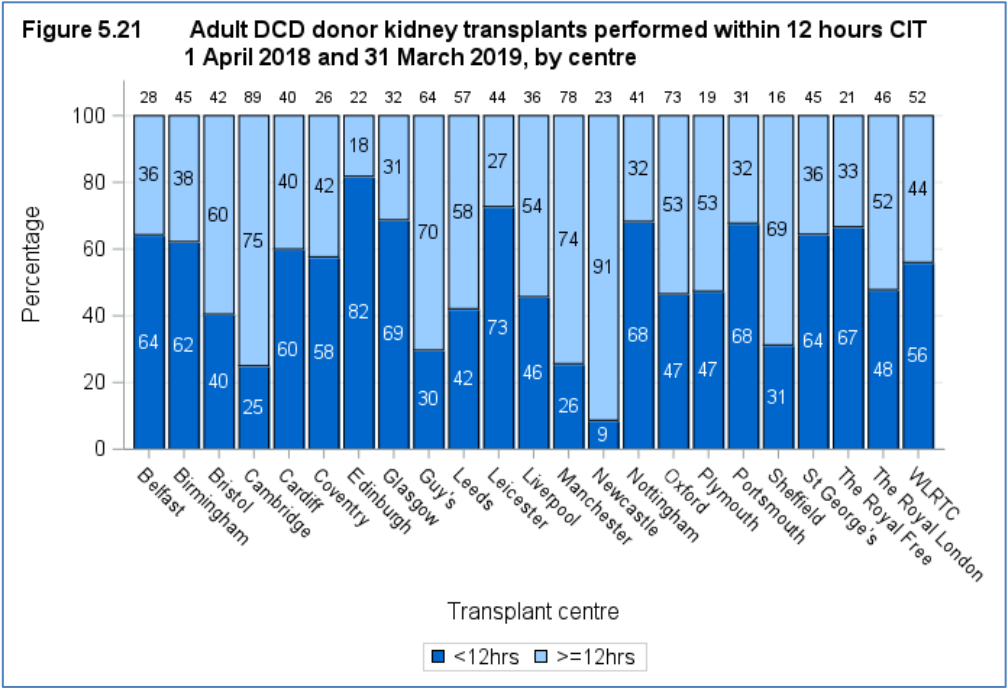
**Figure 5.19** shows the median total cold ischaemia time in adult DCD donor kidney only transplants in 2018/19 for each transplant centre. Newcastle had the longest median cold ischaemia time, 17 hours in 2018/19 compared with Edinburgh who had the shortest, 9 hours.



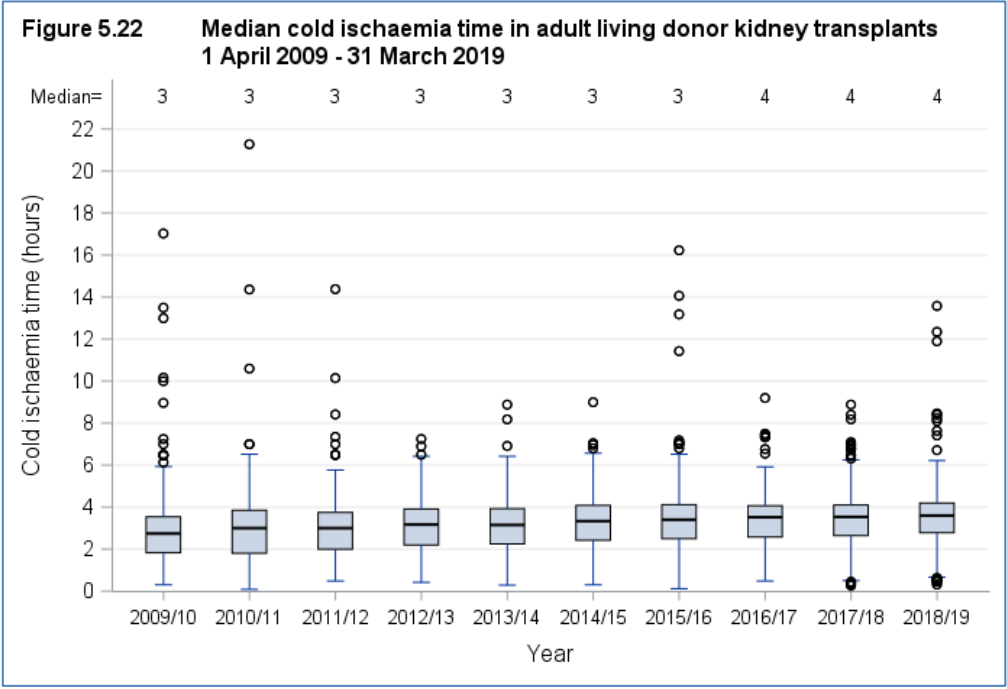
**Figure 5.20** shows the [median](#) total cold ischaemia time in adult [DCD](#) donor kidney only transplants over the last ten years for each transplant centre.



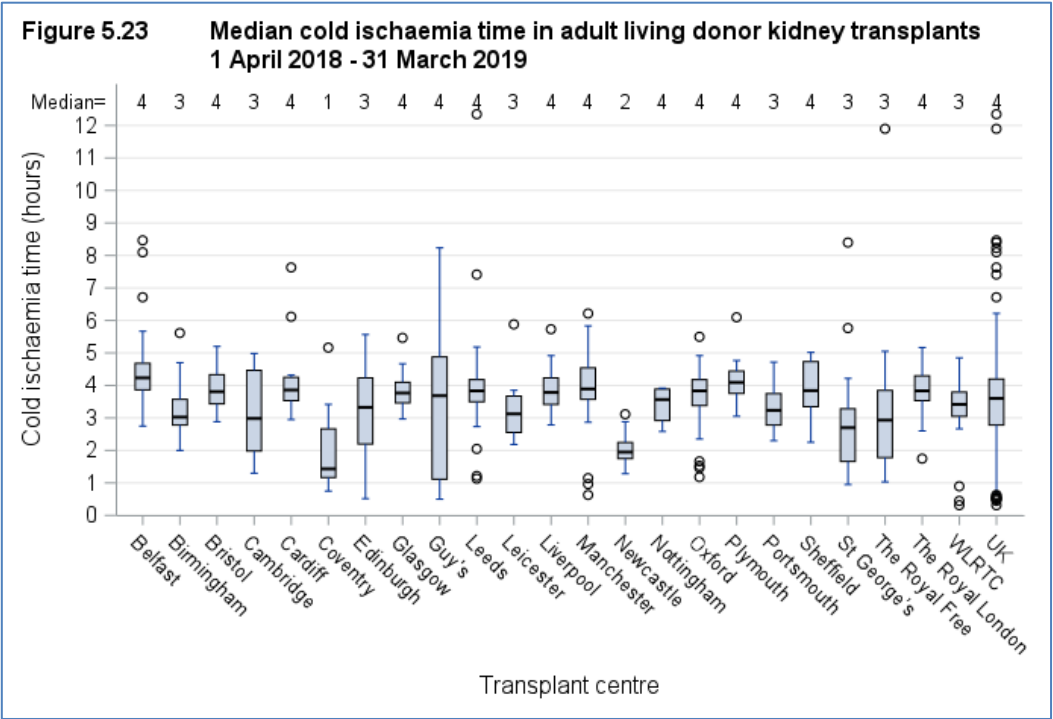
**Figure 5.21** shows the proportion of adult [DCD](#) donor kidney only transplants in 2018/19 that have been performed within 12 hours of CIT for each transplant centre. The wide variability across centres can partly be explained by the proportion of kidneys that the centre imports from across the 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 10 years.

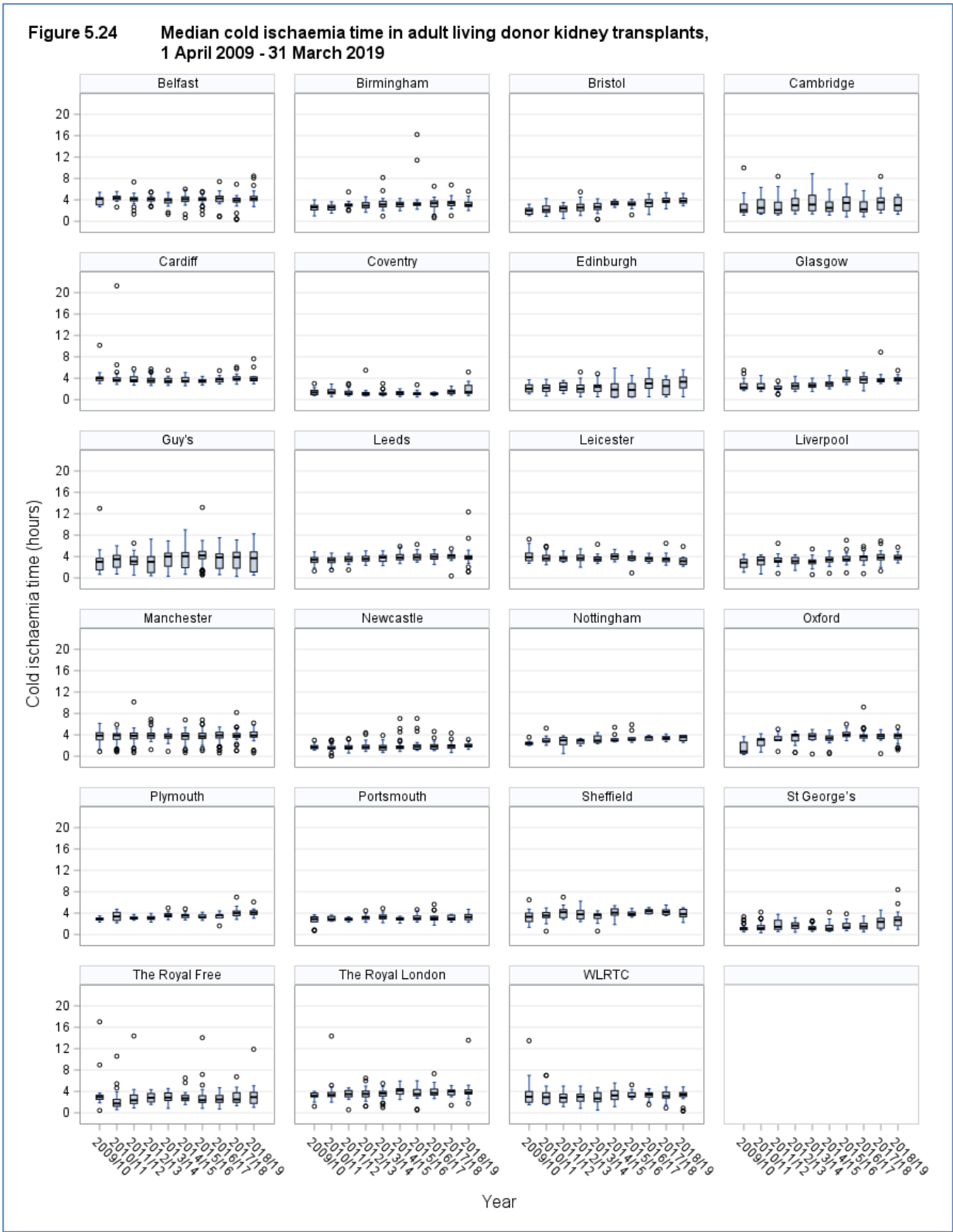


**Figure 5.23** shows the median total cold ischaemia time in adult living donor kidney transplants in 2018/19 for each transplant centre.





**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.



## **Adult 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](#)

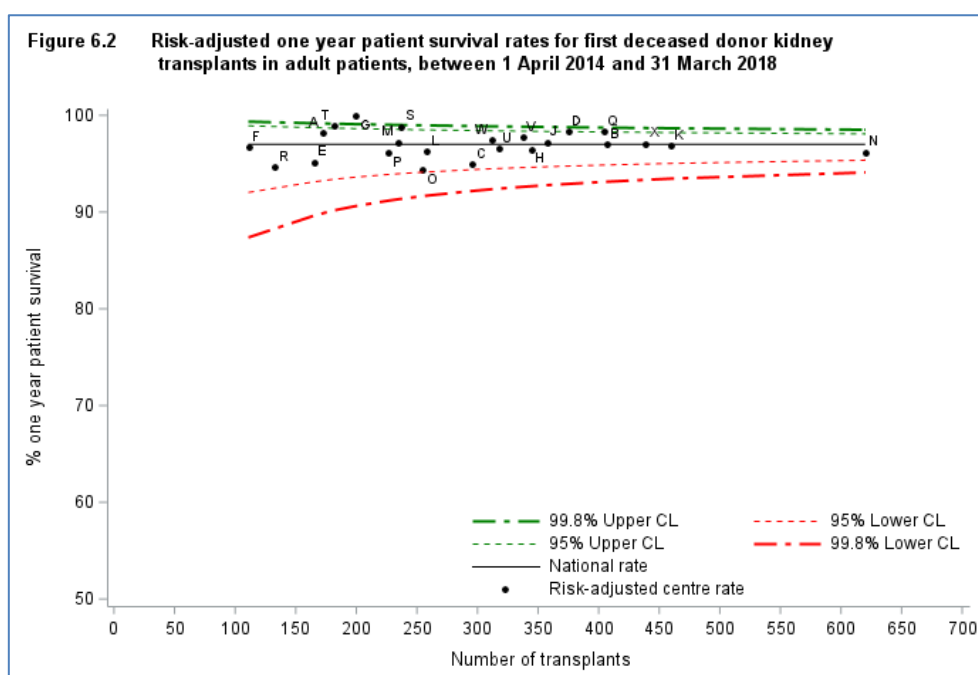
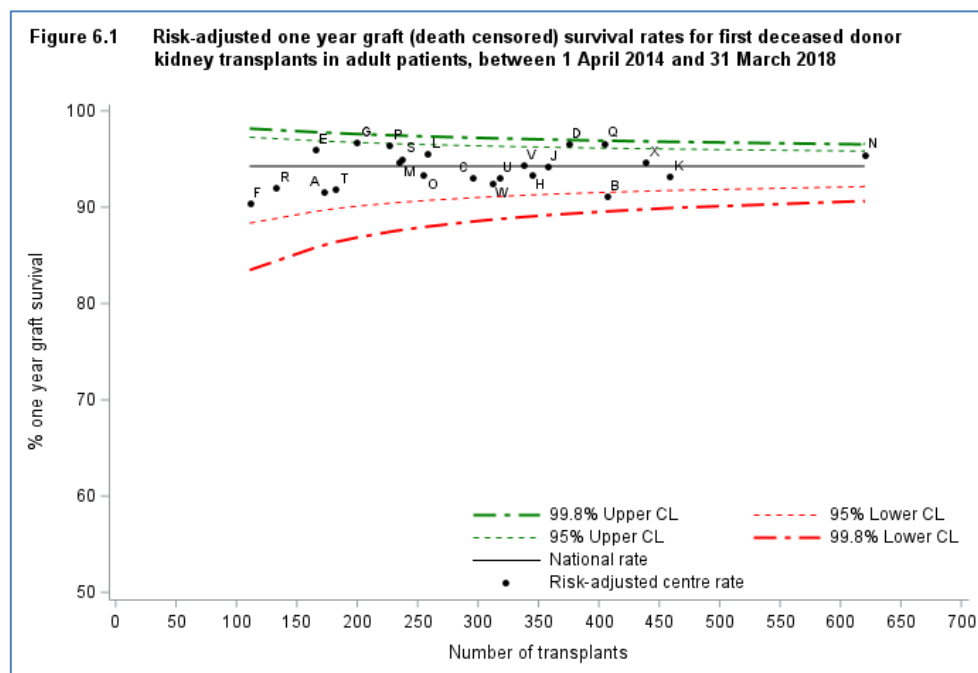
If a centre lies within all the limits, then that centre has a survival rate that is statistically consistent with the national rate. If a centre lies outside the 95% [confidence limits](#), this serves as an alert that the centre may have a rate that is significantly different from the national rate. 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

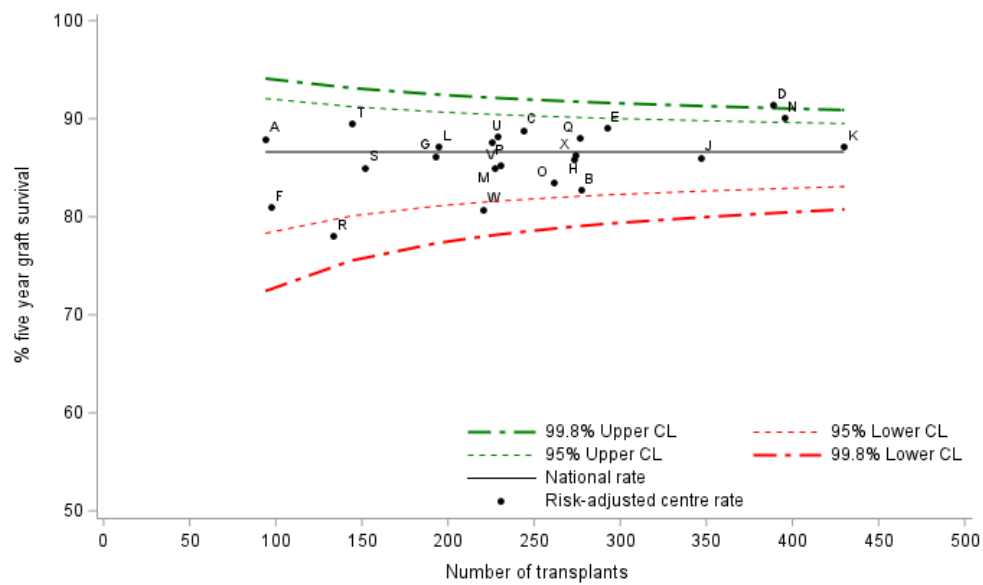
1. Tekkis PP, McCulloch P, Steger AC, Benjamin IS, Poloniecki JD. Mortality control charts for comparing performance of surgical units: validation study using hospital mortality data. *British Medical Journal* 2003; 326: 786 – 788.
2. Stark J, Gallivan S, Lovegrove J, Hamilton JRL, Monro JL, Pollock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

## 6.1 Deceased donor graft and patient survival

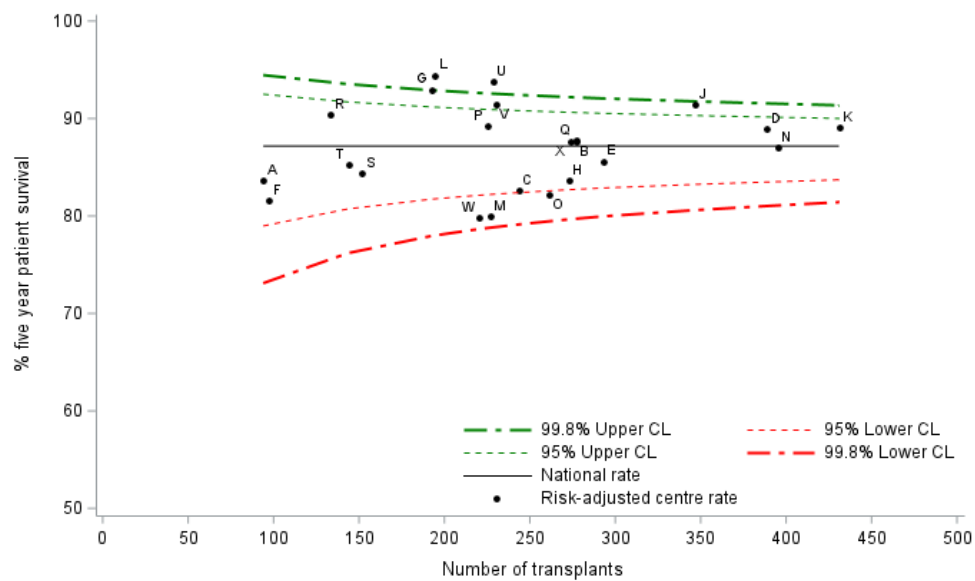
The [funnel plots](#) show that, for the most part, the centres lie within the [confidence limits](#). Some of the [funnel plots](#) show some centres lie outside the lower 95% [confidence limits](#), indicating that these centres have survival rates that are significantly lower than the national rate. 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 6.3** Risk-adjusted five year graft (death censored) survival rates for first deceased donor kidney transplants in adult patients, between 1 April 2010 and 31 March 2014



**Figure 6.4** Risk-adjusted five year patient survival rates for first deceased donor kidney transplants in adult patients, between 1 April 2010 and 31 March 2014



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

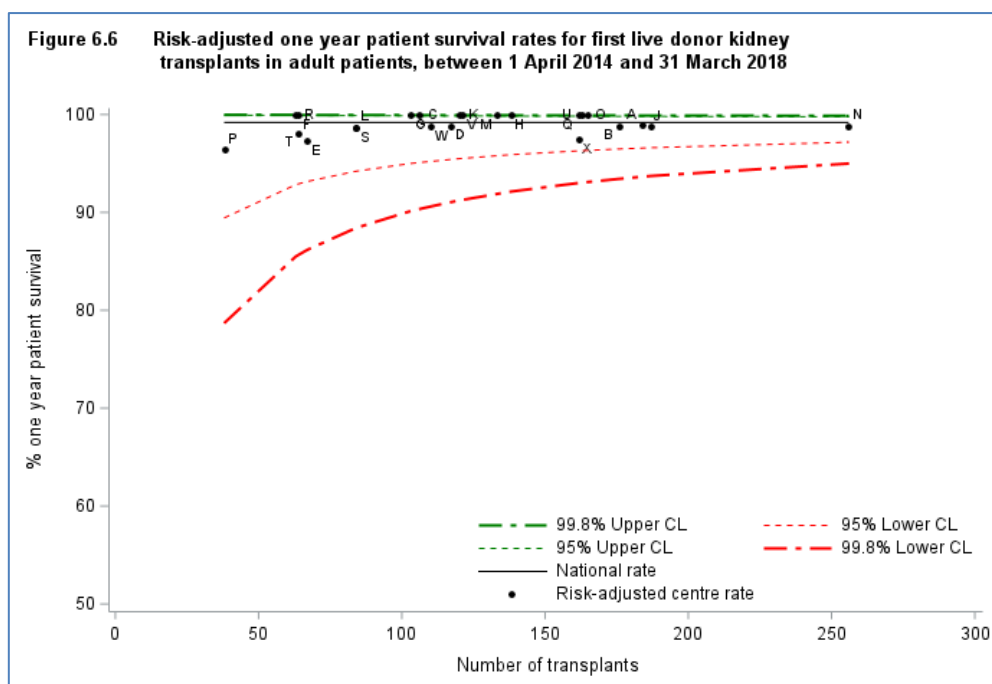
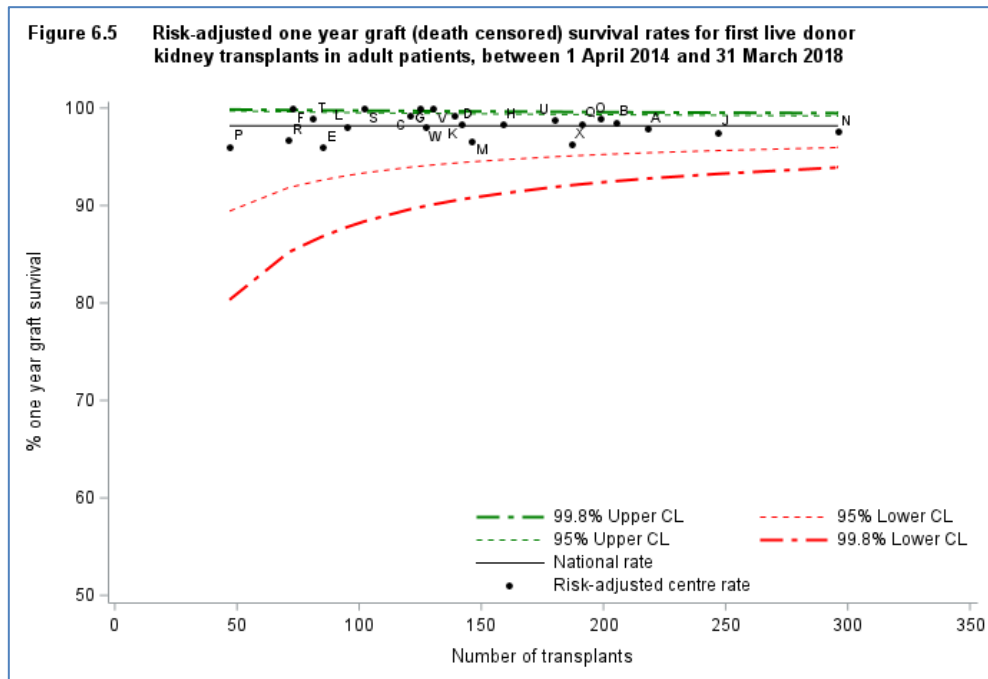
Centre	Code	Kidney graft survival				Patient survival			
		One-year*		Five-year**		One-year*		Five-year**	
		%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Belfast	A	92	(85 - 96)	88	(77 - 95)	98	(95 - 100)	84	(73 - 91)
Birmingham	B	91	(88 - 94)	83	(77 - 87)	97	(95 - 99)	88	(82 - 92)
Bristol	C	93	(89 - 96)	89	(83 - 93)	95	(91 - 98)	83	(76 - 88)
Cambridge	D	97	(94 - 98)	91	(88 - 94)	98	(96 - 99)	89	(85 - 92)
Cardiff	E	96	(92 - 98)	89	(84 - 93)	95	(91 - 98)	86	(81 - 89)
Coventry	F	90	(82 - 96)	81	(69 - 89)	97	(90 - 99)	82	(70 - 90)
Edinburgh	G	97	(93 - 99)	86	(79 - 92)	100	N/A	93	(87 - 97)
Glasgow	H	93	(90 - 96)	86	(80 - 90)	97	(94 - 98)	84	(77 - 89)
Guy's	J	94	(91 - 96)	86	(82 - 90)	97	(95 - 99)	91	(87 - 95)
Leeds	K	93	(90 - 95)	87	(83 - 91)	97	(95 - 98)	89	(85 - 92)
Leicester	L	96	(92 - 98)	87	(81 - 92)	96	(93 - 98)	94	(90 - 97)
Liverpool	M	95	(91 - 97)	85	(79 - 90)	97	(94 - 99)	80	(73 - 85)
Manchester	N	95	(94 - 97)	90	(86 - 93)	96	(94 - 98)	87	(83 - 90)
Newcastle	O	93	(89 - 96)	84	(77 - 88)	94	(90 - 97)	82	(76 - 87)
Nottingham	P	96	(93 - 99)	88	(82 - 92)	96	(91 - 99)	89	(84 - 93)
Oxford	Q	97	(94 - 98)	88	(83 - 92)	98	(97 - 99)	88	(83 - 91)
Plymouth	R	92	(84 - 97)	78	(68 - 86)	95	(88 - 98)	90	(84 - 95)
Portsmouth	S	95	(91 - 98)	85	(77 - 91)	99	(97 - 100)	84	(77 - 90)
Sheffield	T	92	(87 - 95)	90	(83 - 94)	99	(96 - 100)	85	(77 - 91)
St George's	U	93	(89 - 96)	88	(82 - 93)	97	(94 - 98)	94	(89 - 97)
The Royal Free	V	94	(91 - 97)	85	(80 - 90)	98	(95 - 99)	91	(87 - 95)
The Royal London	W	92	(89 - 95)	81	(74 - 86)	97	(95 - 99)	80	(71 - 86)
WLRTC	X	95	(92 - 97)	86	(81 - 90)	97	(95 - 98)	88	(83 - 91)
<b>UK</b>		<b>94</b>	<b>(94 - 95)</b>	<b>87</b>	<b>(86 - 88)</b>	<b>97</b>	<b>(97 - 97)</b>	<b>87</b>	<b>(86 - 88)</b>

\* Includes transplants performed between 1 April 2014 - 31 March 2018

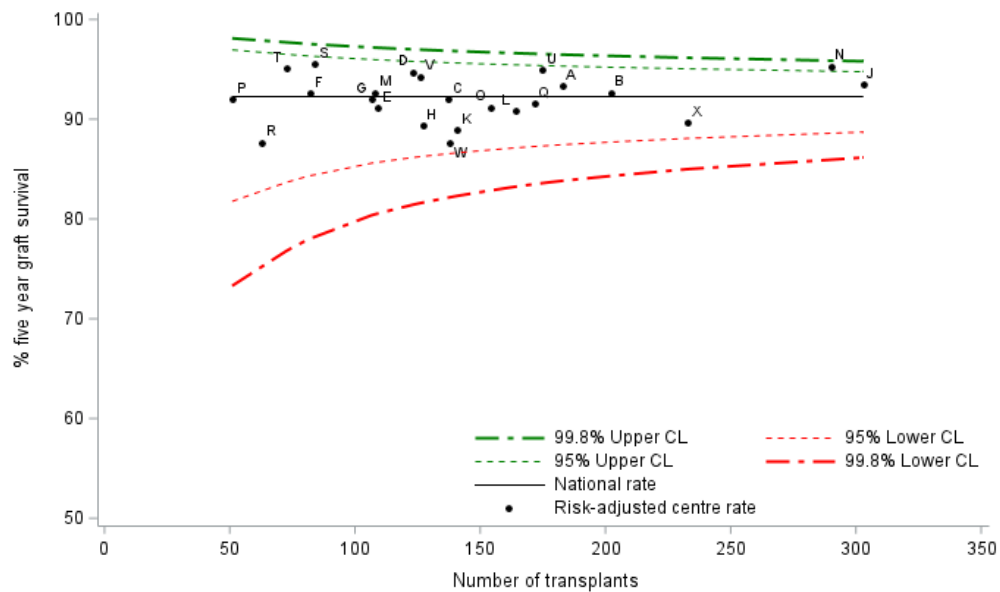
\*\* Includes transplants performed between 1 April 2010 - 31 March 2014

## 6.2 Living donor graft and patient survival

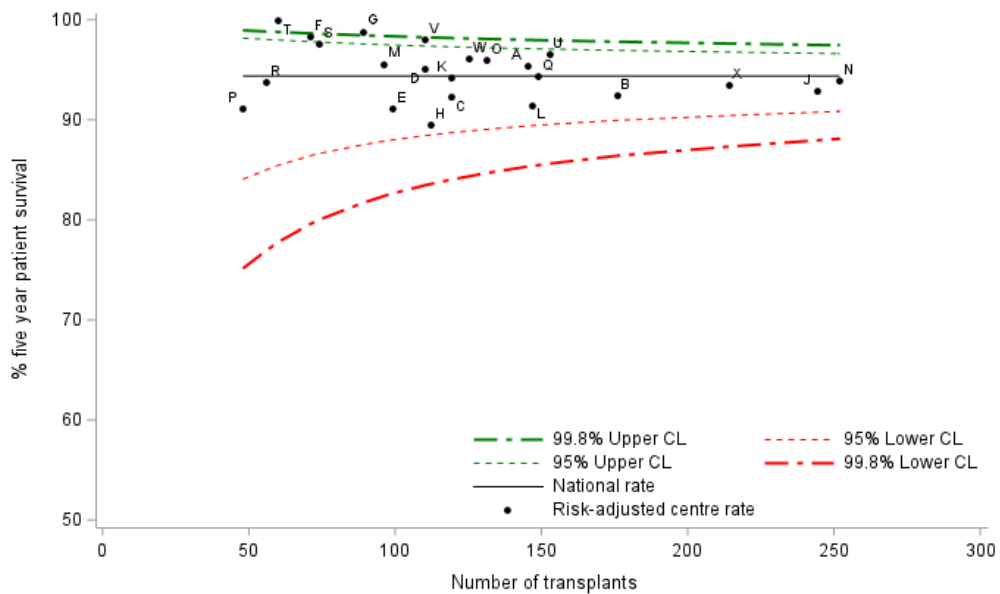
The [funnel plots](#) show that, for the most part, the centres lie within the [confidence limits](#). None of the [funnel plots](#) show any centres that lie outside the lower 95% [confidence limits](#). Some of the [funnel plots](#) show some centres to be above the upper 95% [confidence limit](#). 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 6.7** Risk-adjusted five year graft (death censored) survival rates for first live donor kidney transplants in adult patients, between 1 April 2010 and 31 March 2014



**Figure 6.8** Risk-adjusted five year patient survival rates for first live donor kidney transplants in adult patients, between 1 April 2010 and 31 March 2014





**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	98	(94 - 100)	93	(88 - 97)	99	(96 - 100)	95	(90 - 98)
Birmingham	B	99	(96 - 100)	93	(88 - 96)	99	(96 - 100)	92	(87 - 96)
Bristol	C	99	(95 - 100)	92	(85 - 96)	100	N/A	92	(85 - 97)
Cambridge	D	99	(96 - 100)	95	(89 - 98)	99	(94 - 100)	95	(88 - 98)
Cardiff	E	96	(90 - 99)	91	(84 - 96)	97	(90 - 100)	91	(82 - 96)
Coventry	F	100	N/A	93	(84 - 97)	100	N/A	98	(91 - 100)
Edinburgh	G	100	N/A	92	(84 - 97)	100	N/A	99	(94 - 100)
Glasgow	H	98	(95 - 100)	89	(82 - 94)	100	N/A	90	(80 - 95)
Guy's	J	98	(94 - 99)	93	(90 - 96)	99	(96 - 100)	93	(89 - 96)
Leeds	K	98	(94 - 100)	89	(82 - 94)	100	N/A	94	(87 - 98)
Leicester	L	98	(93 - 100)	91	(85 - 95)	99	(93 - 100)	92	(85 - 96)
Liverpool	M	97	(91 - 99)	93	(85 - 97)	100	N/A	96	(89 - 99)
Manchester	N	98	(95 - 99)	95	(92 - 98)	99	(97 - 100)	94	(90 - 97)
Newcastle	O	99	(96 - 100)	91	(85 - 95)	100	N/A	96	(91 - 99)
Nottingham	P	96	(86 - 100)	92	(79 - 98)	96	(80 - 100)	91	(77 - 98)
Oxford	Q	98	(95 - 100)	92	(85 - 96)	100	N/A	94	(89 - 97)
Plymouth	R	97	(88 - 100)	88	(75 - 95)	100	N/A	94	(82 - 99)
Portsmouth	S	100	N/A	96	(87 - 99)	99	(92 - 100)	98	(91 - 100)
Sheffield	T	99	(94 - 100)	95	(87 - 99)	98	(90 - 100)	100	N/A
St George's	U	99	(96 - 100)	95	(90 - 98)	100	N/A	97	(92 - 99)
The Royal Free	V	100	N/A	94	(88 - 98)	100	N/A	98	(93 - 100)
The Royal London	W	98	(94 - 100)	88	(81 - 93)	99	(93 - 100)	96	(89 - 99)
WLRTC	X	96	(93 - 98)	90	(84 - 94)	97	(93 - 99)	93	(89 - 96)
<b>UK</b>		<b>98</b>	<b>(98 - 99)</b>	<b>92</b>	<b>(91 - 93)</b>	<b>99</b>	<b>(99 - 99)</b>	<b>94</b>	<b>(93 - 95)</b>

\* Includes transplants performed between 1 april 2014 - 31 March 2018

\*\* Includes transplants performed between 1 april 2010 - 31 March 2014

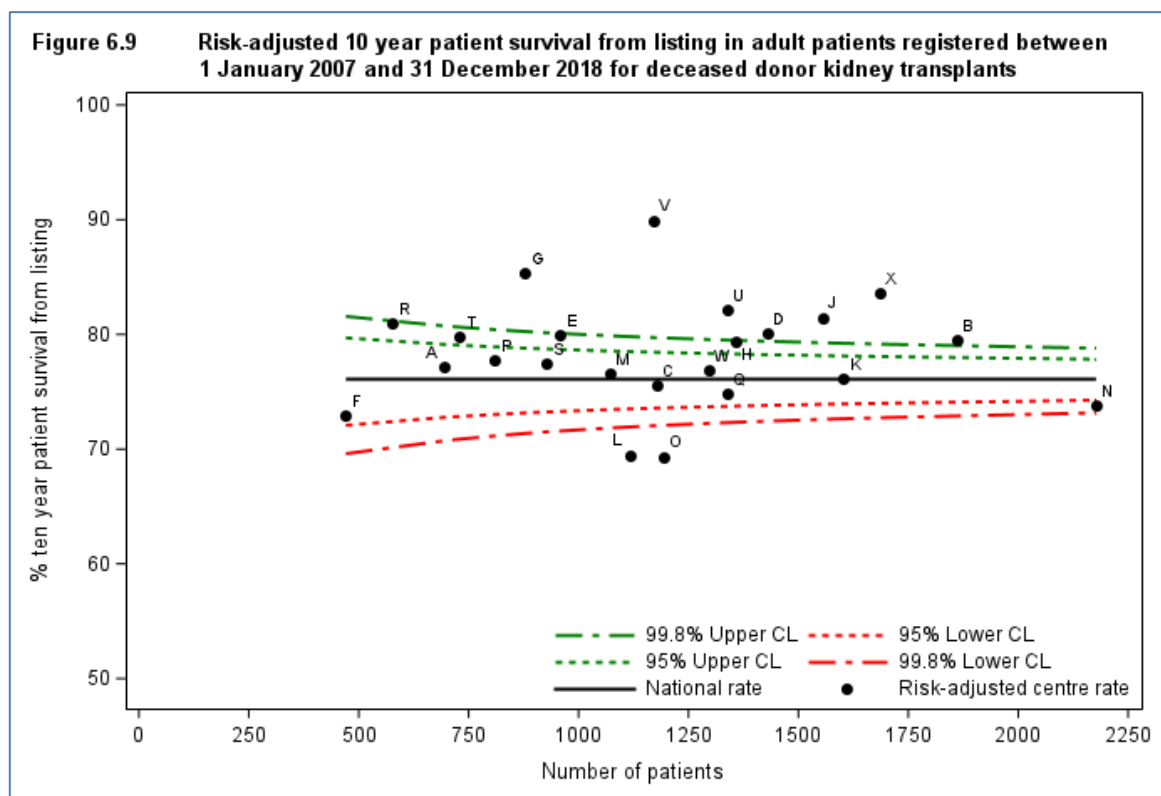
### 6.3 Graft and patient survival from listing

Survival from listing was analysed for all adult ( $\geq 18$  years) patients registered for the first time for a kidney only between 1 January 2007 and 31 December 2018. 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 eg 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**. Eight 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 Newcastle fell below the 99.8% lower [confidence limit](#). This suggests that 10 year survival from listing at Leicester 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 and five year [risk-adjusted survival rates](#) from the point of kidney transplant listing.



**Table 6.3 Risk-adjusted 1, 5 and 10 year patient survival from listing for adult patients registered between 1 January 2007 and 31 December 2018 for deceased donor kidney transplants**

Centre	Code	One year		Five year		Ten year	
		N	(%)	N	(%)	N	(%)
Belfast	A	696	(98)	696	(88)	696	(77)
Birmingham	B	1861	(98)	1861	(90)	1861	(79)
Bristol	C	1180	(98)	1180	(88)	1180	(76)
Cambridge	D	1429	(98)	1429	(91)	1429	(80)
Cardiff	E	959	(98)	959	(91)	959	(80)
Coventry	F	471	(98)	471	(88)	471	(73)
Edinburgh	G	876	(98)	876	(92)	876	(85)
Glasgow	H	1357	(98)	1357	(89)	1357	(79)
Guy's	J	1555	(98)	1555	(91)	1555	(81)
Leeds	K	1603	(98)	1603	(89)	1603	(76)
Leicester	L	1118	(98)	1118	(84)	1118	(69)
Liverpool	M	1071	(98)	1071	(88)	1071	(77)
Manchester	N	2177	(98)	2177	(86)	2177	(74)
Newcastle	O	1193	(98)	1193	(85)	1193	(69)
Nottingham	P	809	(98)	809	(89)	809	(78)
Oxford	Q	1339	(98)	1339	(87)	1339	(75)
Plymouth	R	578	(98)	578	(90)	578	(81)
Portsmouth	S	928	(98)	928	(88)	928	(78)
Sheffield	T	728	(98)	728	(90)	728	(80)
St Georges	U	1340	(98)	1340	(91)	1340	(82)
The Royal Free	V	1171	(98)	1171	(96)	1171	(90)
The Royal London	W	1295	(98)	1295	(88)	1295	(77)
WLRTC	X	1686	(98)	1686	(92)	1686	(84)
<b>UK</b>		<b>27420</b>	<b>(98)</b>	<b>27420</b>	<b>(88)</b>	<b>27420</b>	<b>(76)</b>

## Form Return Rates

## 7.1 Deceased donor form return rates, 1 April 2018 – 31 March 2019

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 2018 and 31 March 2019 for the transplant record, and all requests for follow up forms issued in this time period. Centres highlighted are transplant centres.

Table 7.1 Deceased donor form return rates, 1 April 2018 – 31 March 2019								
Centre	Transplant record		3 month follow-up		1 year follow-up		Lifetime follow-up	
	N	% returned	N	% returned	N	% returned	N	% returned
Aberdeen, Aberdeen Royal Infirmary							159	97
Airdrie, Monklands District General Hospital							39	97
Bangor, Ysbyty Gwynedd District General Hospital							58	100
Basildon, Basildon Hospital							50	80
Belfast, Antrim Hospital							56	91
Belfast, Belfast City Hospital	48	100	53	94	66	41	267	35
Birmingham, Birmingham Heartlands Hospital							91	100
Birmingham, Queen Elizabeth Hospital Birmingham	124	100	133	97	138	99	641	97
Bodelwyddan, Glan Clwyd District General Hospital							48	100
Bradford, St Lukes Hospital							254	85
Brighton, Royal Sussex County Hospital							245	98
Bristol, Southmead Hospital	104	100	111	99	97	31	677	69
Cambridge, Addenbrooke's Hospital	155	98	156	99	134	56	498	48
Cardiff, University Of Wales Hospital	77	100	82	100	44	98	654	86
Carlisle, Cumberland Infirmary							94	88
Carshalton, St Helier Hospital							352	92
Chelmsford, Broomfield Hospital							79	92
County Down, Daisy Hill Hospital							78	67
Coventry, University Hospital	40	100	40	98	51	63	270	80
Derby, Royal Derby Hospital							148	97
Doncaster, Doncaster Royal Infirmary							54	100
Dorchester, Dorset County Hospital							215	7
Dudley, Russells Hall Hospital							58	86
Dundee, Ninewells Hospital							117	97
Dunfermline, Queen Margaret Hospital							22	5
Edinburgh, Royal Infirmary Of Edinburgh	75	100	79	91	77	84	444	39
Exeter, Royal Devon And Exeter Hospital (Wonford)							210	96
Glasgow, Queen Elizabeth University Hospital	92	100	100	98	114	95	944	93
Gloucester, Gloucestershire Royal Hospital							106	26

<b>Table 7.1 Deceased donor form return rates, 1 April 2018 – 31 March 2019</b>								
Centre	Transplant record		3 month follow-up		1 year follow-up		Lifetime follow-up	
Great Yarmouth, James Paget Hospital							38	97
Hull, Hull Royal Infirmary							253	95
Inverness, Raigmore Hospital							80	95
Ipswich, Ipswich Hospital							156	69
Leeds, St James's University Hospital	145	100	149	98	145	86	699	82
Leicester, Leicester General Hospital	101	99	92	100	78	99	588	99
Liverpool, Royal Liverpool University Hospital	90	98	84	100	69	99	421	97
London, Guy's Hospital	157	100	149	56	126	48	544	95
London, Royal Free Hospital	77	100	86	95	104	81	768	87
London, St George's Hospital	117	100	105	89	101	61	325	1
London, St Mary's Hospital							181	73
London, The Royal London Hospital (Whitechapel)	146	100	129	98	89	51	686	55
London, West London Renal And Transplant Centre	136	99	142	100	135	99	732	98
Londonderry, Altnagelvin Area Hospital							47	77
Manchester, Manchester Royal Infirmary	181	100	189	97	197	89	772	96
Middlesbrough, The James Cook University Hospital							306	88
Newcastle, Freeman Hospital	74	100	68	97	72	90	357	91
Northampton, Northampton General Hospital							57	32
Norwich, Norfolk And Norwich University Hospital							244	100
Nottingham, Nottingham City Hospital	66	100	70	99	78	18	454	29
Omagh, Tyrone County Hospital							49	6
Oxford, Churchill Hospital	160	100	143	94	138	74	652	96
Plymouth, Derriford Hospital	49	100	53	89	45	62	202	96
Portsmouth, Queen Alexandra Hospital	74	100	72	97	80	75	648	69
Preston, Royal Preston Hospital							370	99
Reading, Royal Berkshire Hospital							284	60
Salford, Salford Royal							384	99
Sheffield, Northern General Hospital	51	100	56	96	55	64	495	64
Shrewsbury, Royal Shrewsbury Hospital							78	85
Stevenage, Lister Hospital							208	91
Stoke-On-Trent, Royal Stoke University Hospital							193	98
Sunderland, Sunderland Royal Hospital							143	85
Swansea, Morriston Hospital							192	98
Truro, Royal Cornwall Hospital (Treliske)							181	29
Westcliff On Sea, Southend Hospital							51	88
Wirral, Arrowe Park Hospital							99	24
Wolverhampton, New Cross Hospital							102	91
Wrexham, Maelor General Hospital							87	100
York, York District Hospital							210	90

## 7.2 Living donor form return rates, 1 April 2018 – 31 March 2019

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 2018 and 31 March 2019 for the transplant record, and all requests for follow up forms issued in this time period. Centres highlighted are transplant centres.

Table 7.2 Living donor form return rates, 1 April 2018 - 31 March 2019								
Centre	Transplant record		3 month follow-up		1 year follow-up		Lifetime follow-up	
	N	% returned	N	% returned	N	% returned	N	% returned
Aberdeen, Aberdeen Royal Infirmary							72	94
Basildon, Basildon Hospital							30	53
Belfast, Antrim Hospital							43	86
Belfast, Belfast City Hospital	58	100	56	98	63	51	239	38
Birmingham, Birmingham Heartlands Hospital							35	97
Birmingham, Queen Elizabeth Hospital Birmingham	37	97	48	100	66	89	418	95
Bodelwyddan, Glan Clwyd District General Hospital							26	100
Bradford, St Lukes Hospital							49	80
Brighton, Royal Sussex County Hospital							147	93
Bristol, Southmead Hospital	31	100	32	94	30	47	333	71
Cambridge, Addenbrooke's Hospital	27	100	24	100	34	74	250	48
Canterbury, Kent And Canterbury Hospital							225	0
Cardiff, University Of Wales Hospital	35	100	37	73	27	74	328	85
Carlisle, Cumberland Infirmary							36	75
Carshalton, St Helier Hospital							255	90
Chelmsford, Broomfield Hospital							25	96
County Down, Daisy Hill Hospital							47	49
Coventry, University Hospital	33	100	29	90	20	55	263	82
Derby, Royal Derby Hospital							41	98
Dorchester, Dorset County Hospital							89	4
Dudley, Russells Hall Hospital							21	90
Dundee, Ninewells Hospital							63	98
Edinburgh, Royal Infirmary Of Edinburgh	60	98	60	92	44	55	193	4
Exeter, Royal Devon And Exeter Hospital (Wonford)							95	94
Glasgow, Queen Elizabeth University Hospital	36	100	39	100	43	100	395	92
Gloucester, Gloucestershire Royal Hospital							52	27
Hull, Hull Royal Infirmary							126	98
Inverness, Raigmore Hospital							36	94

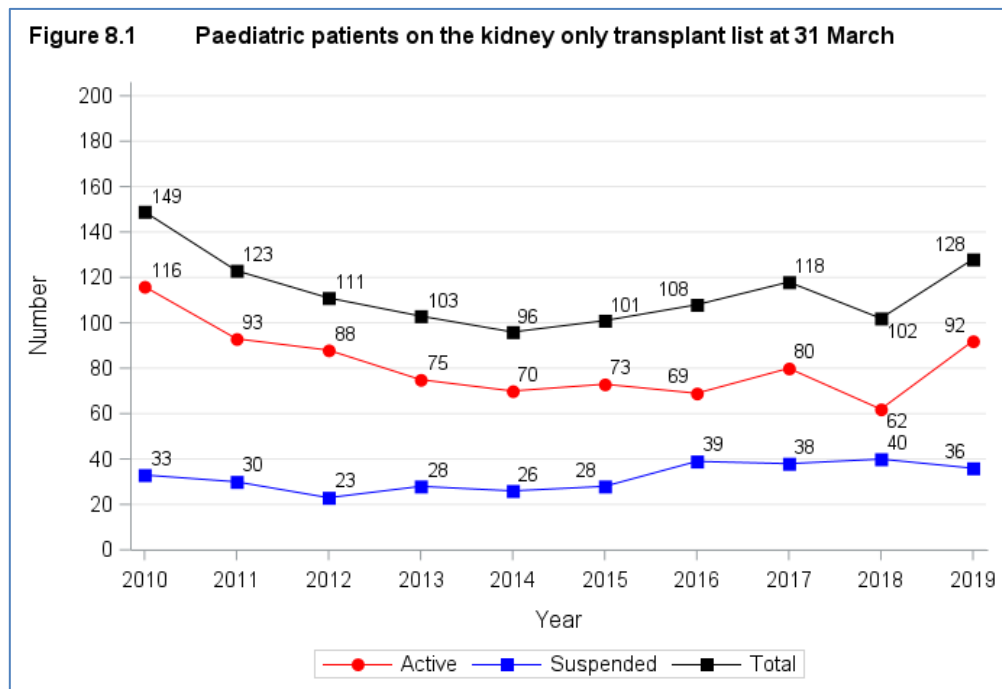
<b>Table 7.2 Living donor form return rates, 1 April 2018 - 31 March 2019</b>								
Centre	Transplant record		3 month follow-up		1 year follow-up		Lifetime follow-up	
Ipswich, Ipswich Hospital							46	57
Leeds, St James's University Hospital	61	100	55	98	29	83	221	86
Leicester, Leicester General Hospital	28	100	24	100	28	93	415	99
Liverpool, Royal Liverpool University Hospital	41	100	40	100	42	100	262	97
London, Cromwell Hospital	3	67						
London, Guy's Hospital	67	100	67	66	77	57	446	97
London, Royal Free Hospital	42	100	52	88	38	82	397	88
London, St George's Hospital	41	100	48	88	39	74	153	2
London, St Mary's Hospital							124	64
London, The Royal London Hospital (Whitechapel)	48	100	52	96	44	52	368	54
London, West London Renal And Transplant Centre	44	100	51	100	44	100	511	98
Londonderry, Altnagelvin Area Hospital							34	85
Manchester, Manchester Royal Infirmary	55	100	58	100	67	93	358	96
Middlesbrough, The James Cook University Hospital							170	88
Newcastle, Freeman Hospital	55	100	61	97	68	88	219	90
Northampton, Northampton General Hospital							21	48
Norwich, Norfolk And Norwich University Hospital							74	97
Nottingham, Nottingham City Hospital	7	100	4	100	17	41	139	35
Oxford, Churchill Hospital	58	100	58	97	52	87	394	96
Plymouth, Derriford Hospital	26	100	25	80	21	62	86	95
Portsmouth, Queen Alexandra Hospital	28	100	25	100	35	54	272	74
Preston, Royal Preston Hospital							211	99
Reading, Royal Berkshire Hospital							105	70
Salford, Salford Royal							162	98
Sheffield, Northern General Hospital	19	100	26	100	22	55	227	63
Shrewsbury, Royal Shrewsbury Hospital							49	92
St Helier, Jersey General Hospital							20	90
Stevenage, Lister Hospital							76	84
Stoke-On-Trent, Royal Stoke University Hospital							142	98
Sunderland, Sunderland Royal Hospital							77	84
Swansea, Morriston Hospital							56	96
Truro, Royal Cornwall Hospital (Treliske)							61	31
Westcliff On Sea, Southend Hospital							27	89
Wirral, Arrowe Park Hospital							41	37
Wolverhampton, New Cross Hospital							48	90
Wrexham, Maelor General Hospital							38	100
York, York District Hospital							59	88



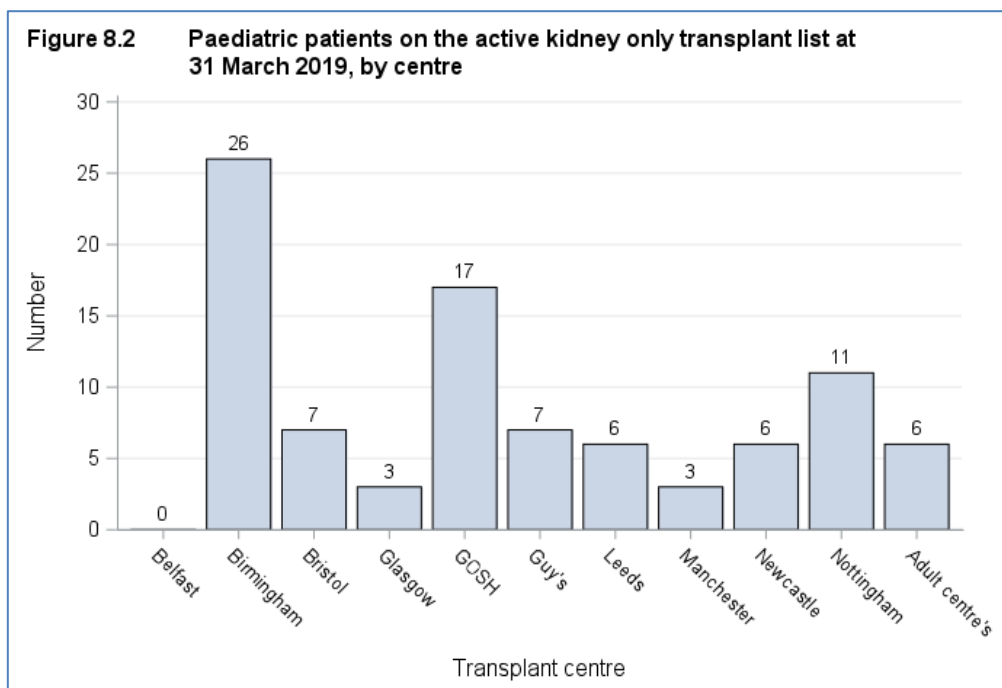
## **Paediatric kidney transplant list**

## 8.1 Patients on the kidney transplant list as at 31 March, 2010 – 2019

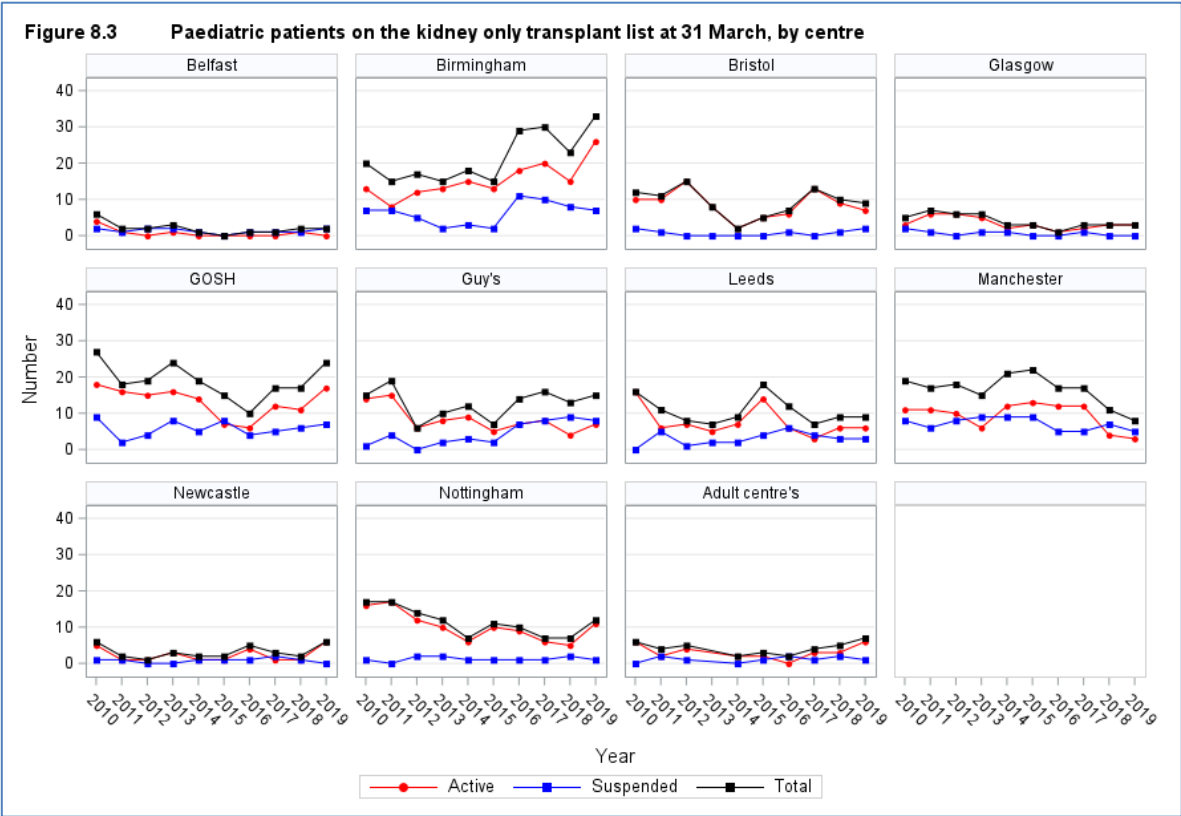
**Figure 8.1** shows the number of paediatric patients on the kidney only transplant list at 31 March each year between 2010 and 2019. The number of patients actively waiting for a kidney transplant fell from 116 in 2010 to 62 in 2018, with an increase to 92 patients in 2019.



**Figure 8.2** shows the number of paediatric patients on the active kidney only transplant list at 31 March 2019 by centre. In total, there were 92 paediatric patients. Birmingham had the largest proportion of the transplant list (28%) and Belfast had the smallest (0%).

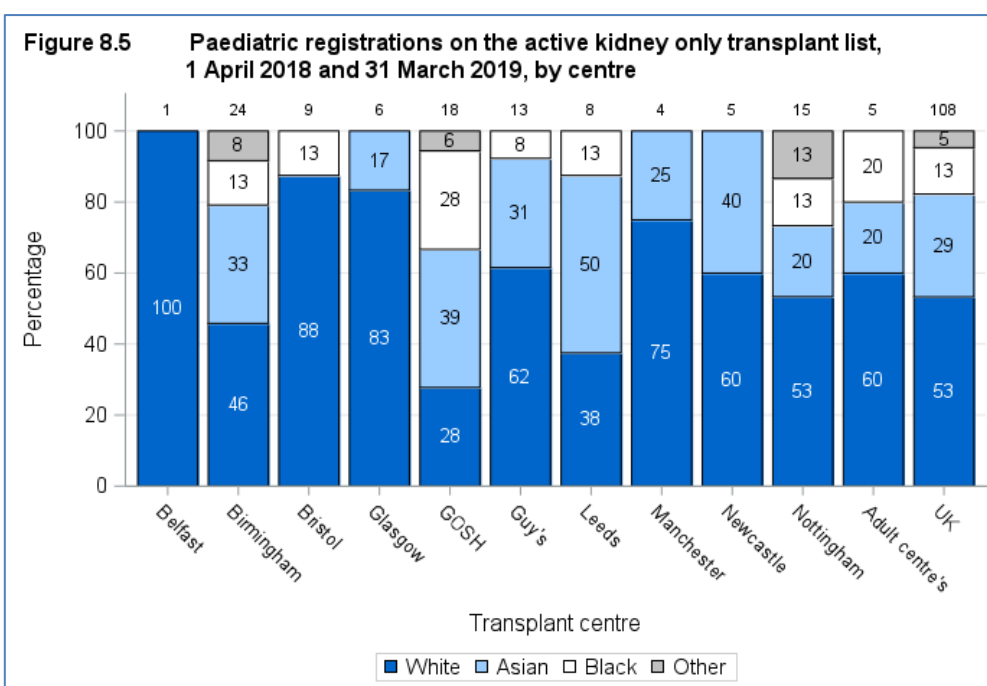
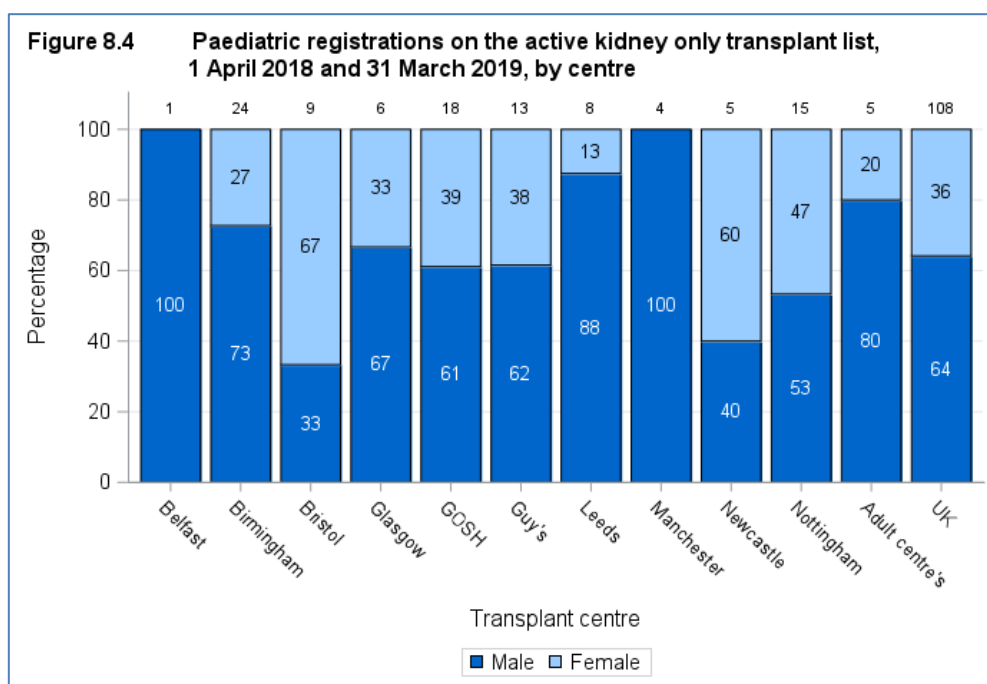


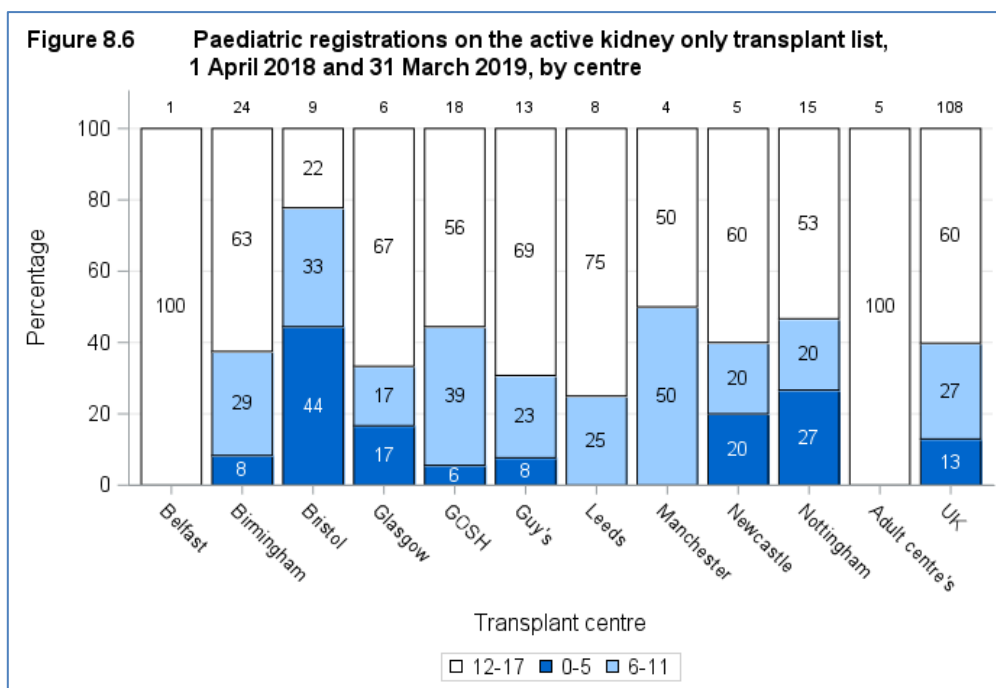
**Figure 8.3** shows the number of paediatric patients on the transplant list at 31 March each year between 2010 and 2019 for each transplant centre.



## 8.2 Demographic characteristics, 1 April 2018 – 31 March 2019

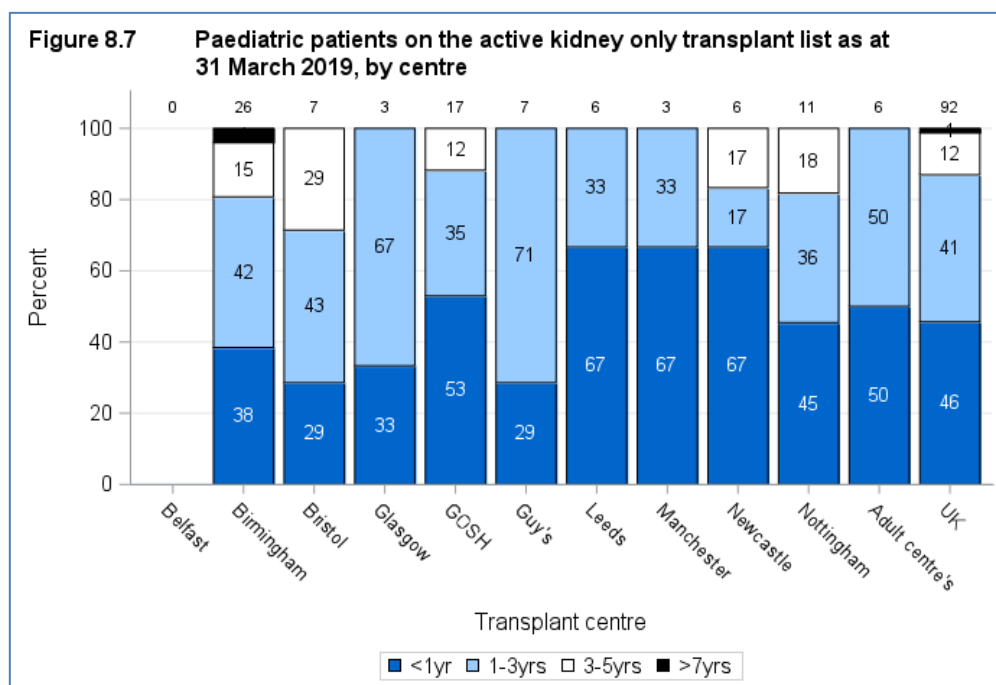
The sex, ethnicity and age group of patients on the transplant are shown by centre in **Figure 8.4**, **8.5** and **8.6**, respectively. Note that all percentages quoted are based only on data where relevant information was available. Changes made to the Kidney Allocation Scheme in 2006 mean that tissue 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.





### 8.3 Patient waiting times for those currently on the list, 31 March 2019

**Figure 8.7** shows the length of time patients have been waiting on the kidney only [transplant list](#) at 31 March 2019 by centre.



#### 8.4 Median waiting time to transplant, 1 April 2013 - 31 March 2016

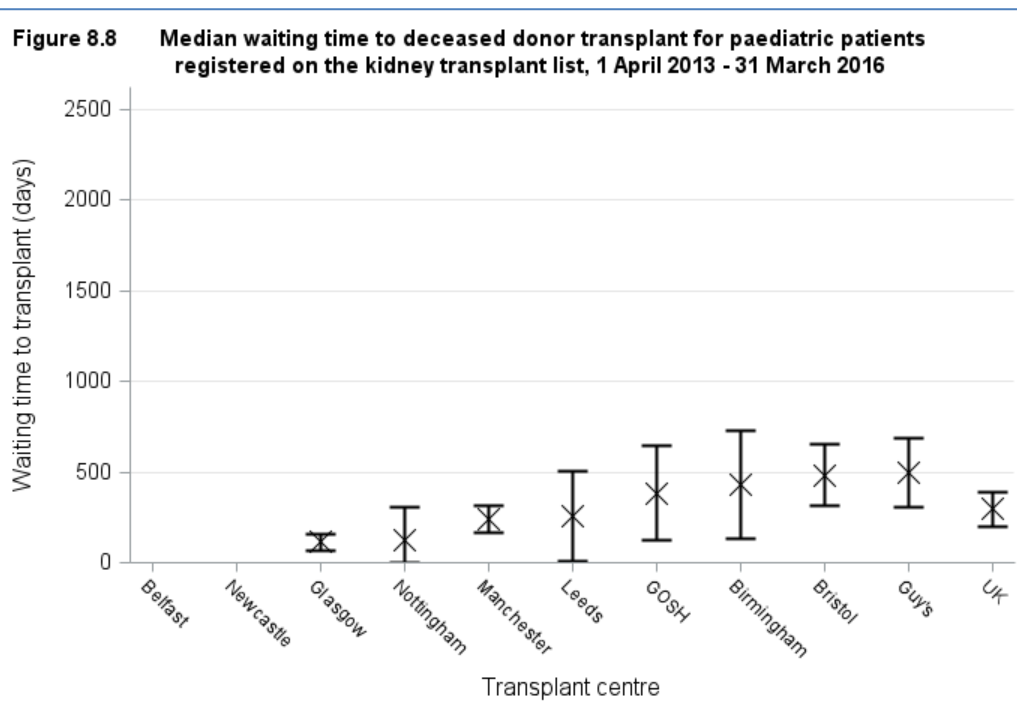
The length of time a patient waits for a kidney transplant varies across the UK. The [median](#) waiting time for paediatric deceased donor kidney only transplantation is shown in **Figure 8.8** and **Table 8.1** for patients registered at each individual unit. During this period local allocation arrangements were in place for [DCD](#) kidneys while [DBD](#) kidneys were allocated via the [National Kidney Allocation Scheme](#). 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 is slowly reducing the variability in deceased donor kidney waiting times across the country but currently some variability remains.

##### **National Kidney Allocation Scheme**

Only kidneys from donors after brain death were allocated via a national allocation scheme during the time period analysed. Kidneys from donations after circulatory death ([DCD](#)) were allocated to patients through local allocation arrangements and these vary across the country because some centres have a larger [DCD](#) programme than others. As of 3 September 2014 one kidney from [DCD](#) donors aged between 5 and 49 years are allocated within four pre-defined regions using the 2006 [DBD](#) allocation principles.

Kidneys from [DBD](#) are allocated to patients listed nationally through the Kidney Allocation Scheme. The Kidney Allocation Scheme introduced in April 2006 prioritises patients with ideal tissue matches (000 [HLA mismatches](#)) and then assigns 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 receive more points. The patients with the highest number of points for a donated kidney are preferentially offered the kidney, no matter where in the UK they receive their treatment.

The [median](#) waiting time to transplant for paediatric patients registered on the kidney only [transplant list](#) between 1 April 2013 and 31 March 2016 is 298 days. This ranged from 114 days at Glasgow to 498 days at Guy's.

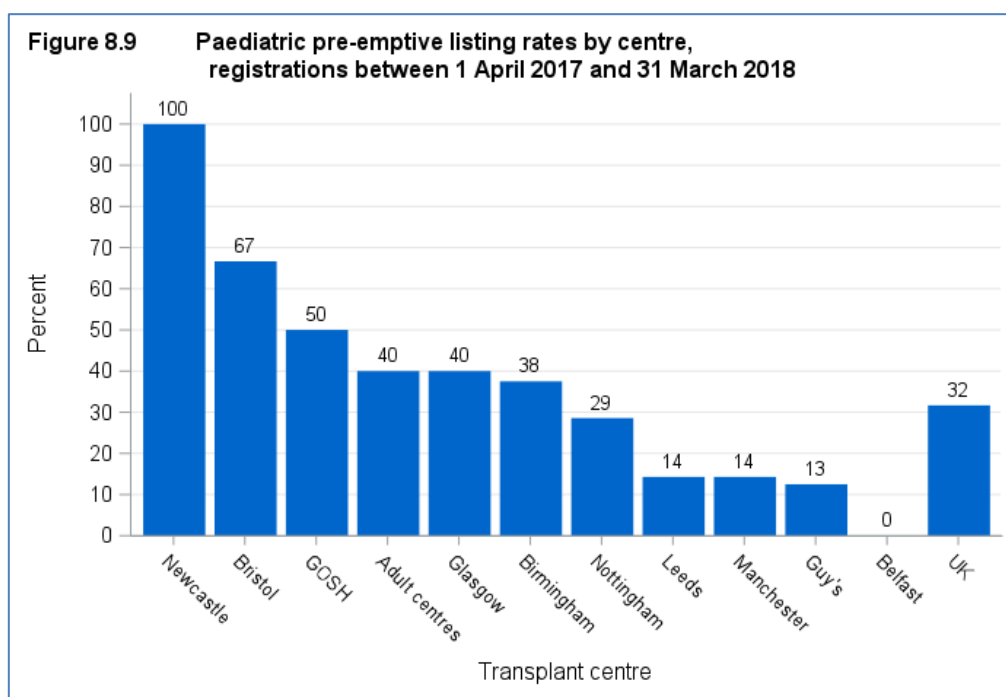


**Table 8.1** Median waiting time to kidney only transplant in the UK, for paediatric patients registered 1 April 2013 - 31 March 2016

Transplant centre	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
<b>Paediatric</b>			
Belfast	0	-	
Newcastle	0	-	
Glasgow	10	114	71 - 157
Nottingham	23	123	0 - 305
Manchester	27	239	164 - 314
Leeds	29	258	14 - 502
GOSH	18	385	123 - 647
Birmingham	30	428	130 - 726
Bristol	13	484	315 - 653
Guy's	22	498	305 - 691
<b>UK</b>	<b>187</b>	<b>298</b>	<b>204 - 392</b>

## 8.5 Pre-emptive listing rates, 1 April 2017 - 31 March 2018

Rates of [pre-emptive](#) kidney only listings are shown in **Figure 8.9** for paediatric patients joining the list between 1 April 2017 and 31 March 2018. 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 32% of all paediatric registrations across the UK ranging from 100% at Newcastle to 0% at Belfast.





## **Response to paediatric kidney offers**

## Offer decline rates

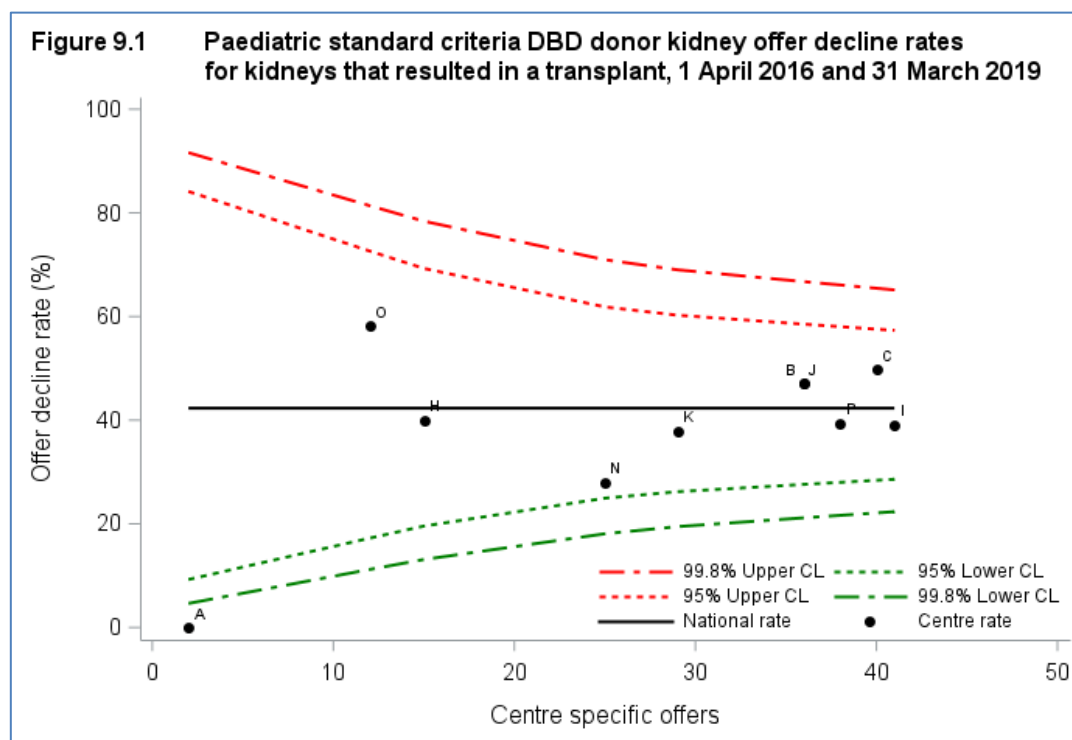
Kidney-only offers from [DBD](#) donors who had at least one kidney retrieved, offered directly and on behalf of a named individual patient and resulted in transplantation are included in the analysis. Any offers made through the reallocation of kidneys, declined kidney or fast track schemes were excluded, 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 2016 – 31 March 2019

**Figure 9.1** compares individual centre offer decline rates with the national rate for SCD over the time period, 1 April 2016 and 31 March 2019. Centres can be identified by the information shown in **Table 9.1**. All centres have an offer decline rate that is in line with the national rate apart from Belfast which has a lower decline rate.



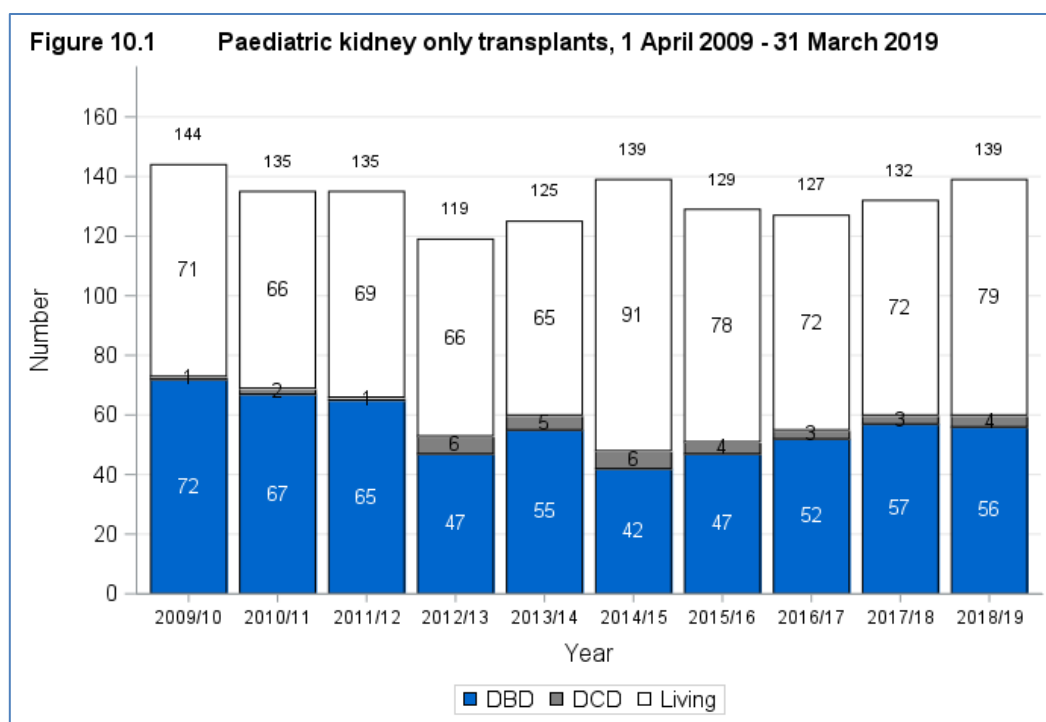
**Table 9.1** compares individual centre offer decline rates for SCD over time by financial year.

<b>Table 9.1 Paediatric standard criteria DBD donor kidney offer decline rates by transplant centre, 1 April 2016 and 31 March 2019</b>									
Centre	Code	2016/17		2017/18		2018/19		Overall	
		N	(%)	N	(%)	N	(%)	N	(%)
Belfast	A	2	(0)					2	(0)
Birmingham	B	9	(22)	14	(64)	13	(46)	36	(47)
Bristol	C	13	(38)	13	(62)	14	(50)	40	(50)
GOSH	I	7	(43)	17	(41)	17	(35)	41	(39)
Glasgow	H	1	(0)	7	(29)	7	(57)	15	(40)
Guy's	J	6	(67)	14	(43)	16	(44)	36	(47)
Leeds	K	11	(36)	6	(33)	12	(42)	29	(38)
Manchester	N	8	(25)	9	(22)	8	(38)	25	(28)
Newcastle	O	6	(50)	6	(67)			12	(58)
Nottingham	P	16	(38)	10	(40)	12	(42)	38	(39)
<b>UK</b>		<b>79</b>	<b>(37)</b>	<b>96</b>	<b>(46)</b>	<b>99</b>	<b>(43)</b>	<b>274</b>	<b>(42)</b>

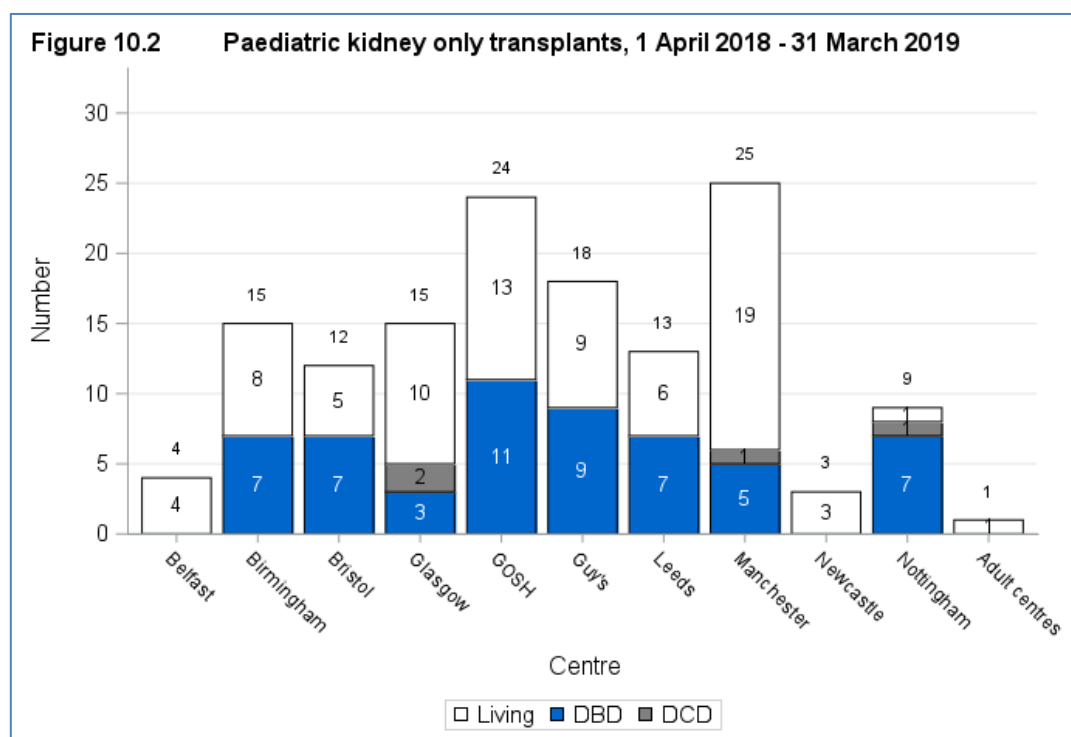
# **Paediatric kidney transplants**

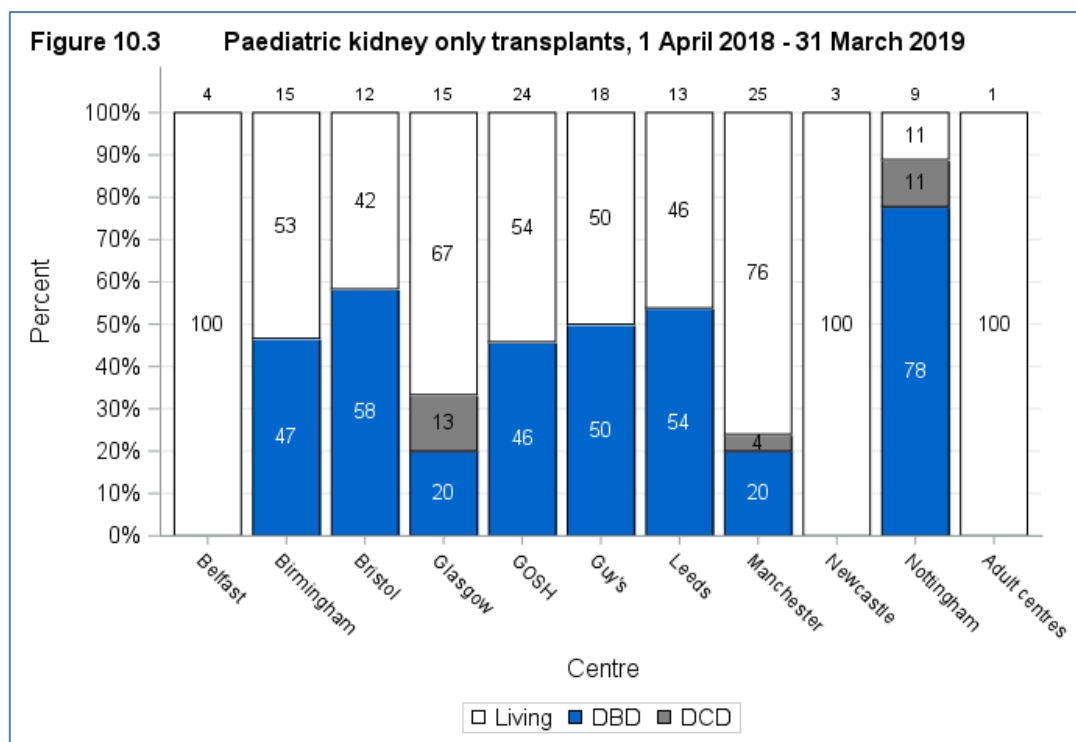
## 10.1 Kidney only transplants, 1 April 2009 – 31 March 2019

**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](#)), 4 in 2018/19.

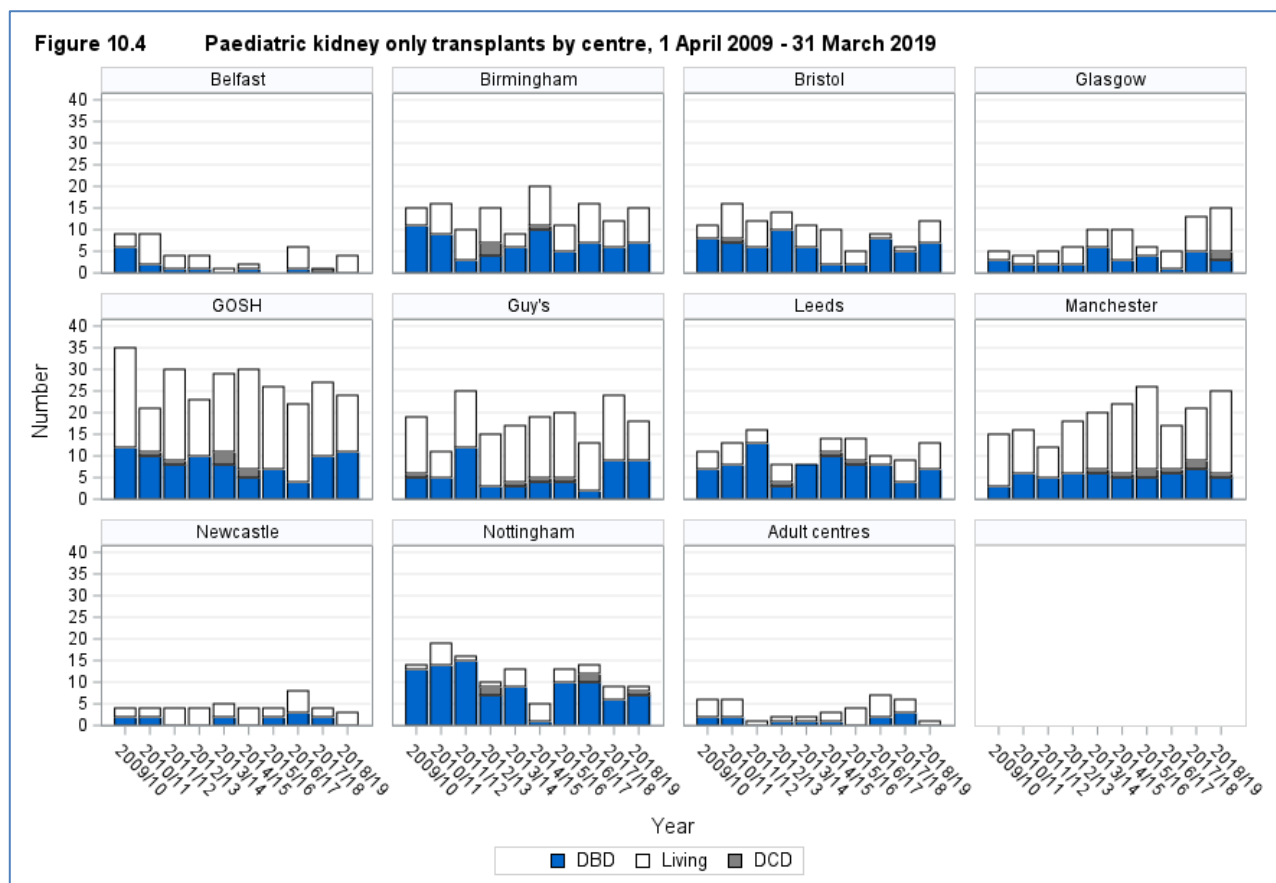


**Figure 10.2** shows the total number of paediatric kidney only transplants performed in 2018/19, by centre and type of donor. The same information is presented in **Figure 10.3** but this shows the proportion of [DBD](#), [DCD](#) and living donor transplants performed at each centre. Adult centres include patients under 18 years transplanted at adult units.



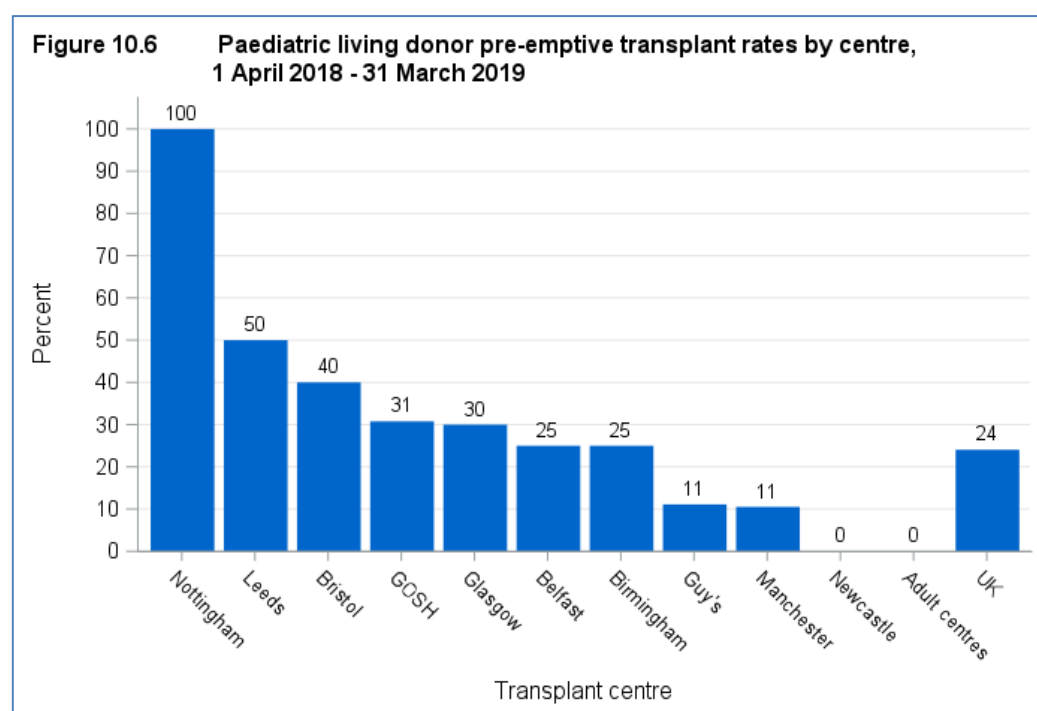
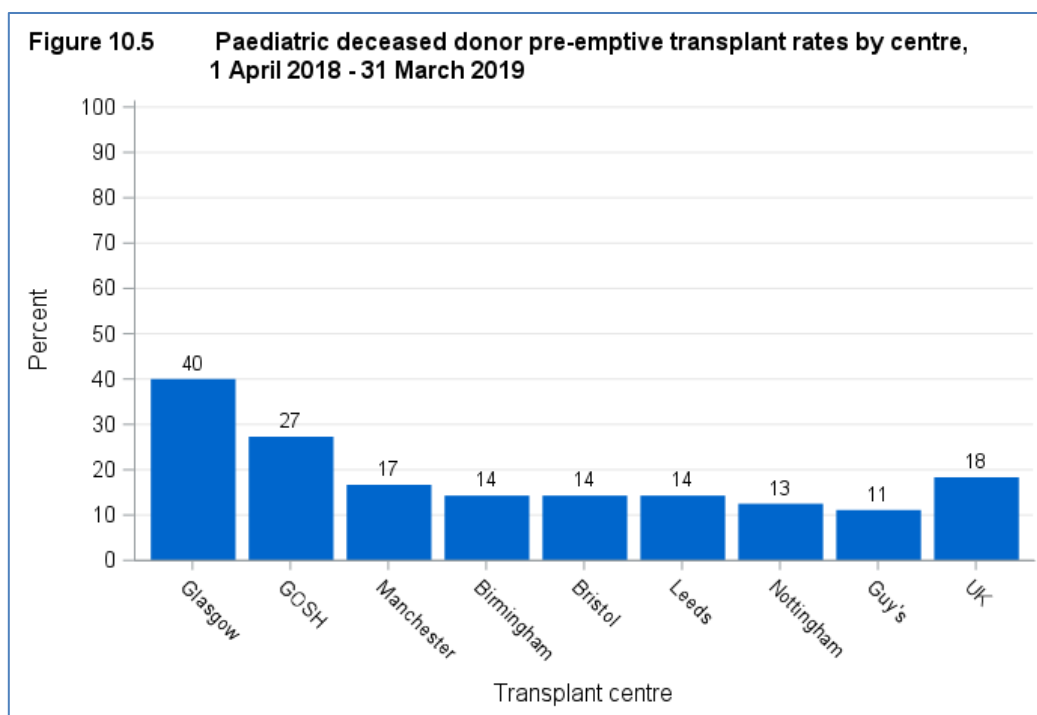


**Figure 10.4** shows the total number of paediatric kidney only transplants performed in last ten years, by centre and type of donor.



## 10.2 Pre-emptive transplant rates, 1 April 2018 - 31 March 2019

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: 24% and 18% 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 40% at Glasgow to 11% at Guy's. Paediatric living donor [pre-emptive](#) transplant rates ranged from 100% at Nottingham to 0% at Newcastle and Adult centres.



## **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](#)

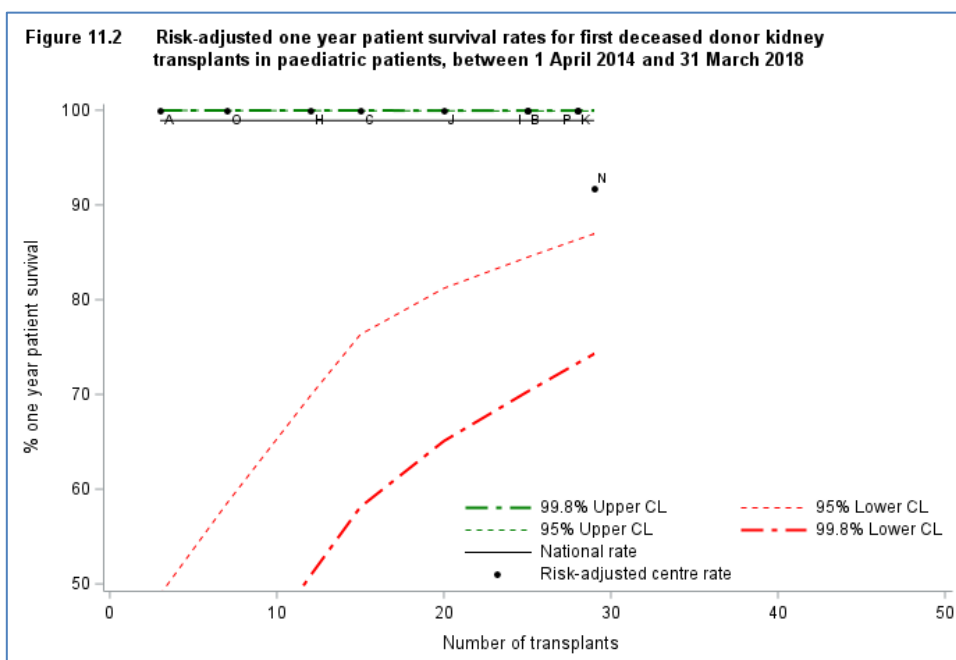
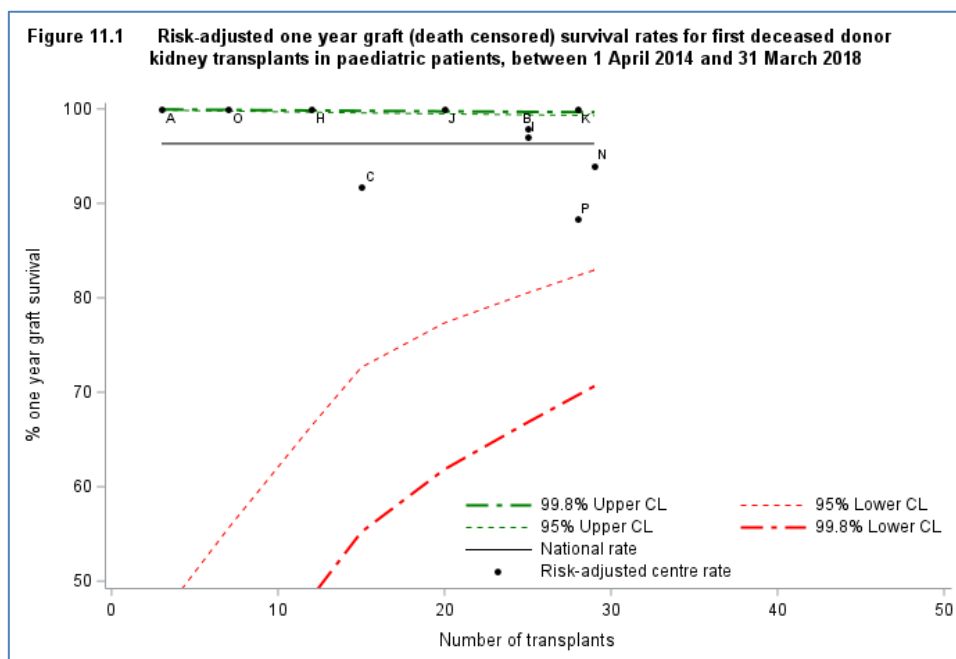
If a centre lies within all the limits, then that centre has a survival rate that is statistically consistent with the national rate. If a centre lies outside the 95% [confidence limits](#), this serves as an alert that the centre may have a rate that is significantly different from the national rate. 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

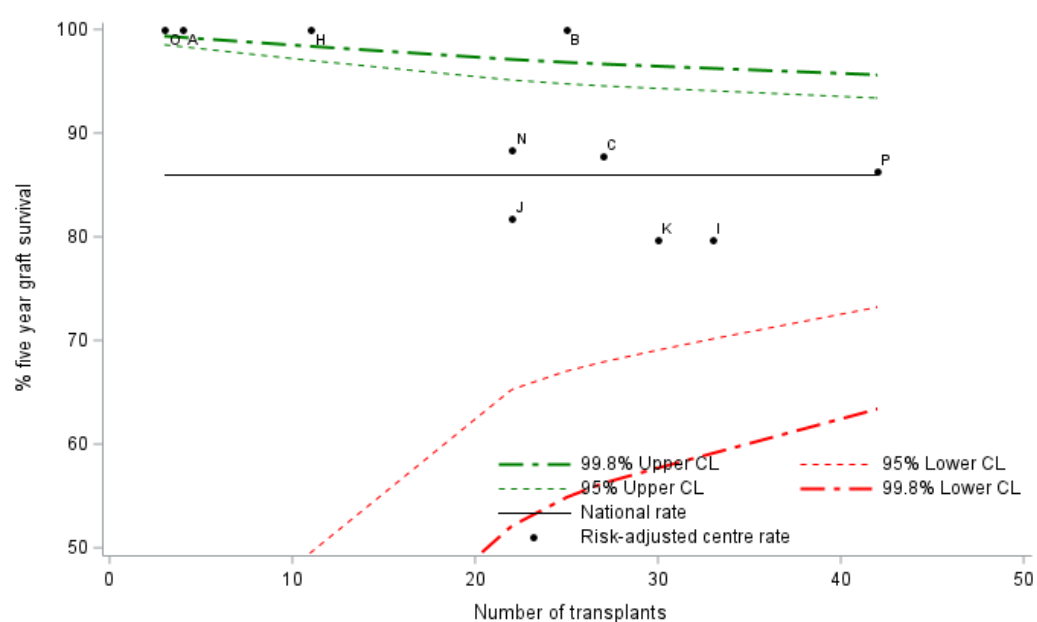
1. Tekkis PP, McCulloch P, Steger AC, Benjamin IS, Poloniecki JD. Mortality control charts for comparing performance of surgical units: validation study using hospital mortality data. *British Medical Journal* 2003; 326: 786 – 788.
2. Stark J, Gallivan S, Lovegrove J, Hamilton JRL, Monro JL, Pollock 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

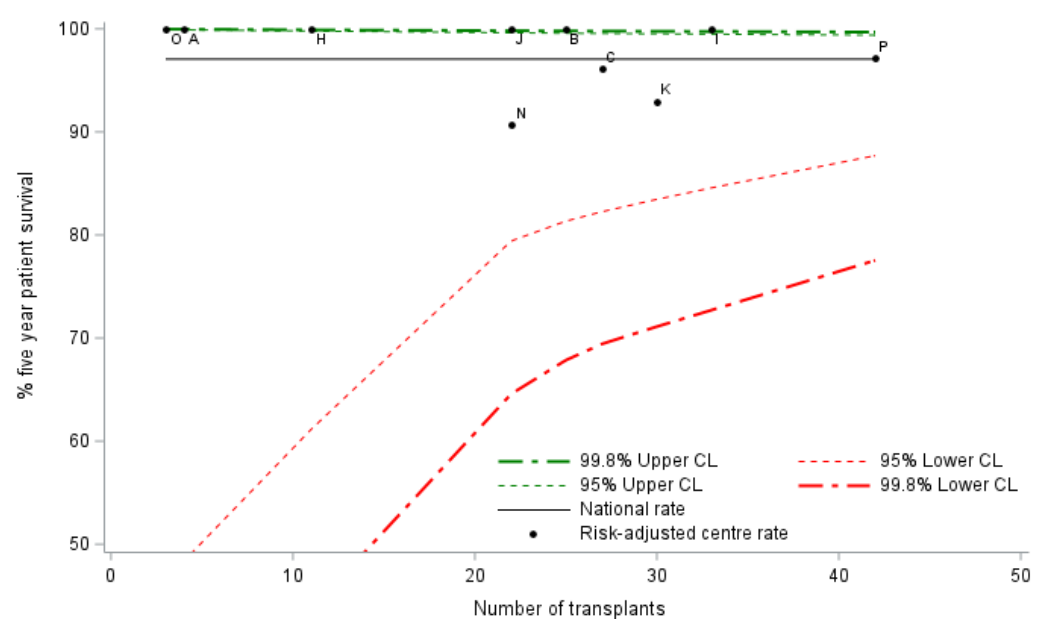
The [funnel plots](#) show that, for the most part, the centres lie within the [confidence limits](#). None of the [funnel plots](#) show any centres that lie outside the lower 95% [confidence limits](#). Some of the [funnel plots](#) show some centres to be above the upper 99.8% [confidence limit](#). 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 11.3 Risk-adjusted five year graft (death censored) survival rates for first deceased donor kidney transplants in paediatric patients, between 1 April 2010 and 31 March 2014**



**Figure 11.4 Risk-adjusted five year patient survival rates for first deceased donor kidney transplants in paediatric patients, between 1 April 2010 and 31 March 2014**



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

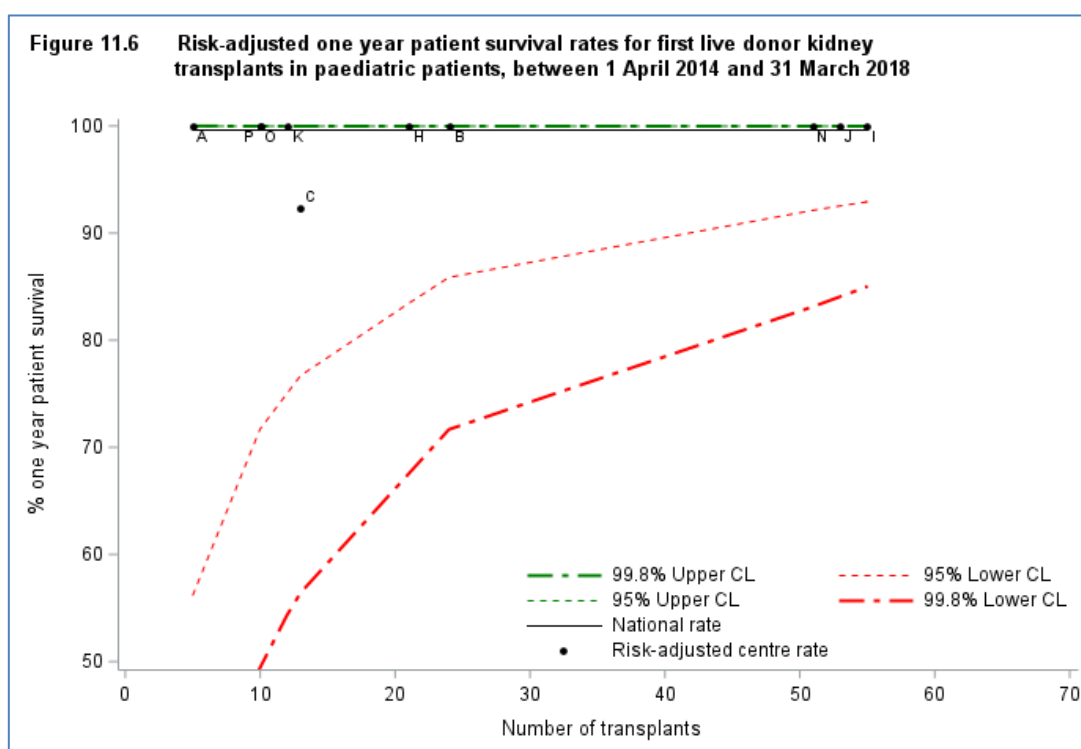
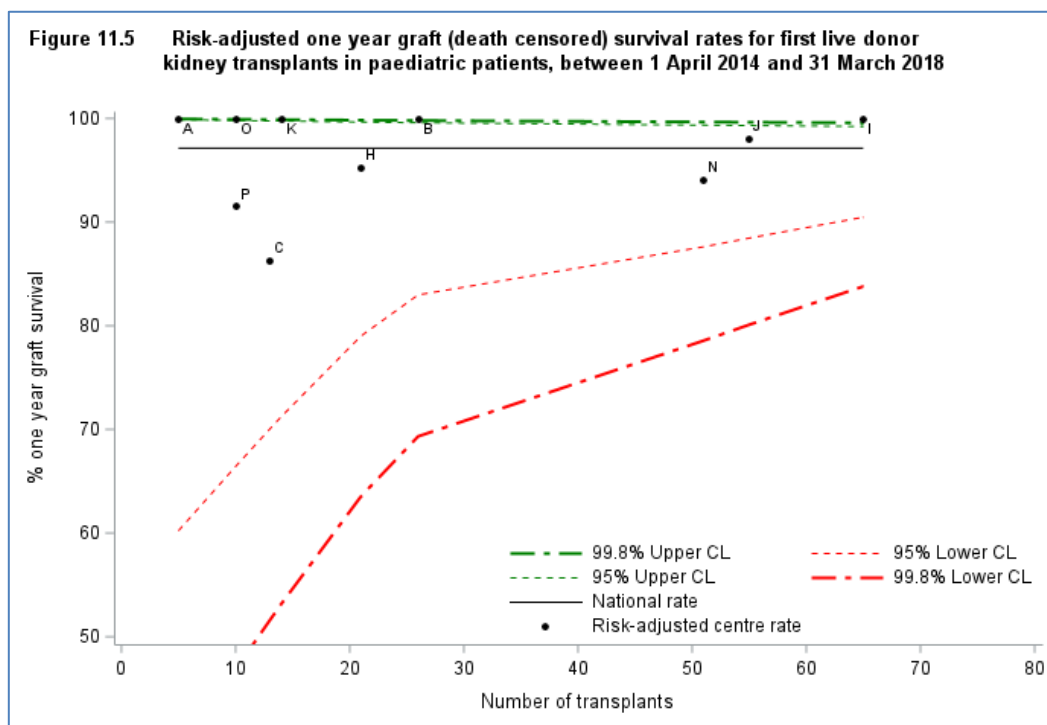
Centre	Code	Kidney graft survival				Patient survival			
		One-year*		Five-year**		One-year*		Five-year**	
		%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Belfast	A	100	N/A	100	N/A	100	N/A	100	N/A
Birmingham	B	98	(88 - 100	100	N/A	100	N/A	100	N/A
Bristol	C	92	(54 - 100	88	(64 - 97)	100	N/A	96	(78 - 100
GOSH	I	97	(83 - 100	80	(60 - 91)	100	N/A	100	N/A
Glasgow	H	100	N/A	100	N/A	100	N/A	100	N/A
Guy's	J	100	N/A	82	(53 - 95)	100	N/A	100	N/A
Leeds	K	100	N/A	80	(53 - 93)	100	N/A	93	(75 - 99)
Manchester	N	94	(78 - 99)	88	(58 - 99)	92	(70 - 99)	91	(67 - 99)
Newcastle	O	100	N/A	100	N/A	100	N/A	100	N/A
Nottingham	P	88	(58 - 99)	86	(70 - 95)	100	N/A	97	(84 - 100
<b>UK</b>		<b>96</b>	<b>(92 - 98)</b>	<b>86</b>	<b>(81 - 90)</b>	<b>99</b>	<b>(96 - 100</b>	<b>97</b>	<b>(94 - 99)</b>

\* Includes transplants performed between 1 April 2014 - 31 March 2018

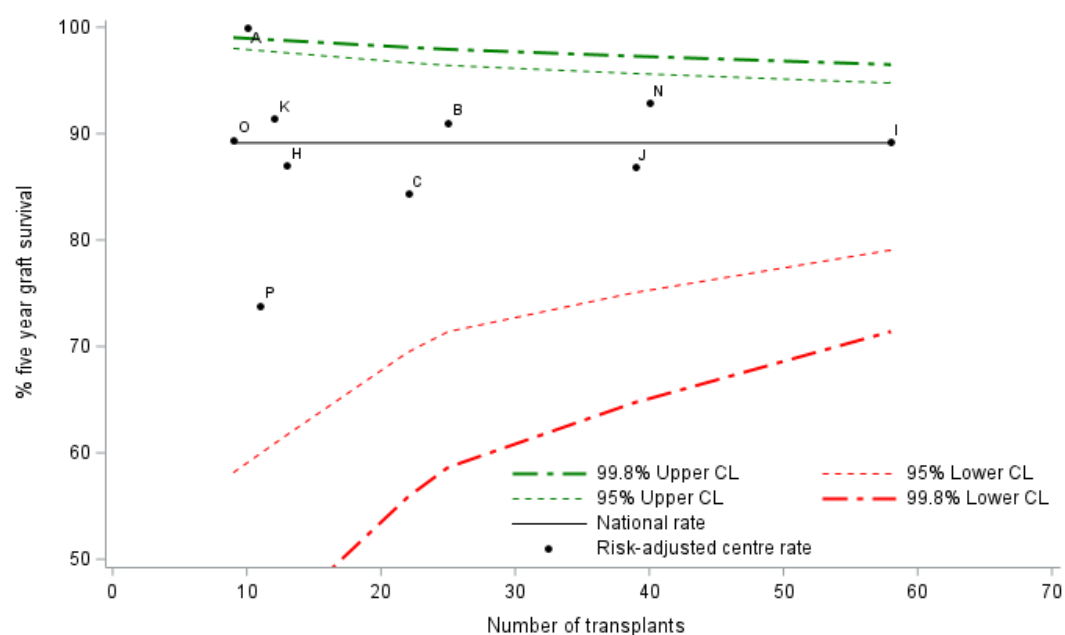
\*\* Includes transplants performed between 1 April 2010 - 31 March 2014

## 11.2 Living donor graft and patient survival

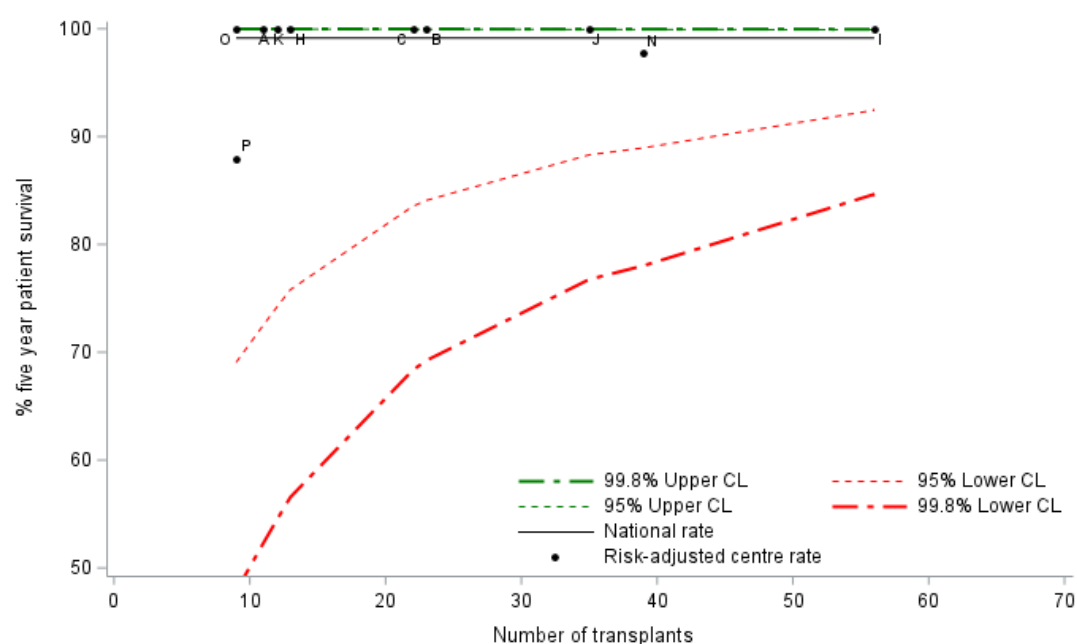
The [funnel plots](#) show that, for the most part, the centres lie within the [confidence limits](#). None of the [funnel plots](#) show any centres that lie outside the lower 95% [confidence limits](#). Some of the [funnel plots](#) show some centres to be above the upper 99.8% [confidence limit](#). 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 11.7** Risk-adjusted five year graft (death censored) survival rates for first live donor kidney transplants in paediatric patients, between 1 April 2010 and 31 March 2014



**Figure 11.8** Risk-adjusted five year patient survival rates for first live donor kidney transplants in paediatric patients, between 1 April 2010 and 31 March 2014



**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	91	(68 - 99)	100	N/A	100	N/A
Bristol	C	86	(51 - 98)	84	(54 - 97)	92	(57 - 100)	100	N/A
GOSH	I	100	N/A	89	(75 - 96)	100	N/A	100	N/A
Glasgow	H	95	(74 - 100)	87	(53 - 98)	100	N/A	100	N/A
Guy's	J	98	(90 - 100)	87	(69 - 96)	100	N/A	100	N/A
Leeds	K	100	N/A	91	(52 - 100)	100	N/A	100	N/A
Manchester	N	94	(83 - 99)	93	(79 - 99)	100	N/A	98	(87 - 100)
Newcastle	O	100	N/A	89	(41 - 100)	100	N/A	100	N/A
Nottingham	P	92	(53 - 100)	74	(5 - 97)	100	N/A	88	(33 - 100)
<b>UK</b>		<b>97</b>	<b>(94 - 99)</b>	<b>89</b>	<b>(84 - 93)</b>	<b>100</b>	<b>(97 - 100)</b>	<b>99</b>	<b>(97 - 100)</b>

\* Includes transplants performed between 1 april 2014 - 31 March 2018

\*\* Includes transplants performed between 1 april 2010 - 31 March 2014

## Form return rates



## 12.1 Deceased donor form return rates, 1 April 2018 – 31 March 2019

Form return rates are reported in **Table 12.1** for the kidney transplant record, three month and 1 year follow up form, along with lifetime follow up (more than 2 years). These include all paediatric deceased donor kidney only transplants between 1 April 2018 and 31 March 2019 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 2018 - 31 March 2019								
Centre	Transplant record		3 month follow-up		1 year follow-up		Lifetime follow-up	
	N	% returned	N	% returned	N	% returned	N	% returned
Birmingham, Birmingham Children's Hospital							28	100
Birmingham, Queen Elizabeth Hospital Birmingham	7	100	7	57	5	100	66	89
Bradford, St Lukes Hospital							27	89
Bristol, Bristol Royal Hospital For Children							23	91
Bristol, Southmead Hospital	7	100	6	100	5	60	53	66
Cardiff, University Of Wales Hospital					1	100	41	78
Glasgow, Queen Elizabeth University Hospital							35	80
Leeds, St James's University Hospital	7	100	6	100	4	100	106	83
Leicester, Leicester General Hospital							23	100
London, Great Ormond Street Hospital For Children	11	100	9	100	10	80	41	68
London, Guy's Hospital	9	100	9	100	10	90	70	93
London, Royal Free Hospital							37	78
London, The Royal London Hospital (Whitechapel)					1	100	20	40
Manchester, Manchester Royal Infirmary	6	100	9	78	7	100	67	94
Nottingham, Nottingham City Hospital	8	100	7	100	9	22	81	33
Sheffield, Northern General Hospital							32	53

## 12.2 Living donor form return rates, 1 April 2018 – 31 March 2019

Form return rates are reported in **Table 12.2** for the kidney transplant record, three month and 1 year follow up form, along with lifetime follow up (more than 2 years). These include all paediatric living donor kidney only transplants between 1 April 2018 and 31 March 2019 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 2018 - 31 March 2019								
Centre	Transplant record		3 month follow-up		1 year follow-up		Lifetime follow-up	
	N	% returned	N	% returned	N	% returned	N	% returned
Belfast, Royal Belfast Hospital For Sick Children							24	13
Birmingham, Birmingham Children's Hospital							35	100
Birmingham, Queen Elizabeth Hospital Birmingham	8	100	6	33	7	71	22	95
Cardiff, University Of Wales Hospital					1	100	36	69
Glasgow, Queen Elizabeth University Hospital							22	82
Leeds, St James's University Hospital	6	100	7	86	6	83	29	83
Liverpool, Alder Hey Children's Hospital							29	93
London, Great Ormond Street Hospital For Children	13	100	16	94	15	80	86	76
London, Guy's Hospital	9	100	11	91	14	100	108	98
London, Royal Free Hospital							31	84
Manchester, Manchester Royal Infirmary	19	100	19	100	10	90	25	68
Manchester, Royal Manchester Children's Hospital							38	100
Newcastle, Royal Victoria Infirmary							30	90
Nottingham, Nottingham City Hospital	1	100	3	100			30	33
Southampton, Southampton University Hospitals							20	95

# 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)**

Donation after Brainstem Death (DBD) means donation which takes place following the diagnosis of death using neurological criteria.

**Donor after circulatory death (DCD)**

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

**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 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

Prepared by:

Statistics and Clinical Studies, NHS Blood and Transplant

Dr Matthew Robb

Miss Rebecca Hendry