



*Blood and Transplant*

# **ANNUAL REPORT ON LIVING KIDNEY TRANSPLANTATION**

**REPORT FOR 2015/2016  
(1 APRIL 2001 – 31 MARCH 2016)**

**PUBLISHED AUGUST 2016**



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# **Executive Summary**

This report presents key figures about living kidney transplantation in the UK. The period reported covers 15 years of transplant data, from 1 April 2001. The report presents information on the number of transplants, follow-up data and survival analysis on a national and centre-specific basis.

## **Key findings**

- There were 944 adult living kidney transplants performed in the UK in 2015/16 an increase of 1 transplant compared to 2014/15. Of these, 447 were related, 220 were unrelated, 26 were HLAi, 52 were ABOi, 118 were paired/pooled and 81 were altruistic donor transplants. The equivalent number of paediatric transplants was 78 a 14% decrease from the previous year.
- The proportion of living donors across the UK being prescribed anti-hypertensive drugs is 5% at one year, 8% at five years and 13% at ten years post donation.
- Serum creatinine for living donors in the UK is 103 (IQ-range 90-121) at one year, 97 (84-110) at five years and 93 (81-107) at ten years post donation.
- The national rate of graft survival five years after adult living donor kidney transplant by type is; unrelated 94%, related 91%, HLAi 80%, ABOi 91%, Paired exchange 93% and Altruistic 91%

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

Annual Report on Living Kidney Transplantation 2015/16. NHS Blood and Transplant

# Introduction

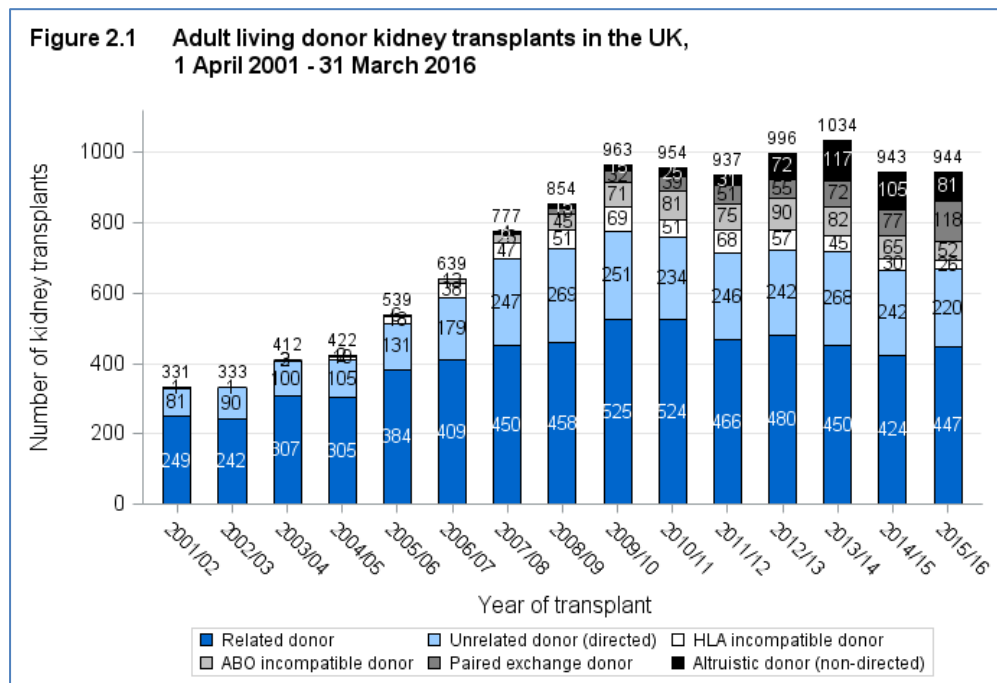
This report presents information on transplant activity between 1 April 2001 and 31 March 2016, for all 24 centres performing living kidney transplantation in the UK. Data were obtained from the UK Transplant Registry, at NHS Blood & Transplant, that holds information relating to donors, recipients and 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 2011 to 31 March 2015 and five-year post-transplant for the period 1 April 2007 to 31 March 2011. Results are described separately according to the type of donor.

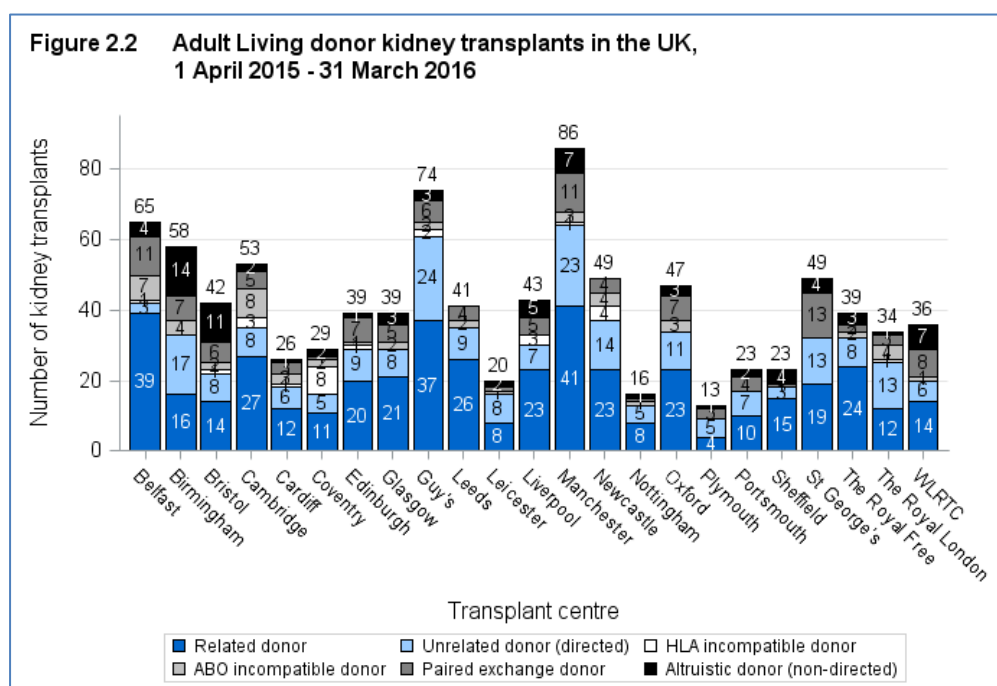
Throughout this report West London Renal and Transplant Centre is labeled as WLRTC and Great Ormond Street Hospital is labeled as GOSH.

## ADULT

**Figure 2.1** shows the number of adult living donor kidney transplants performed in the UK between 1 April 2001 and 31 March 2016. The number of transplants increased from 331 in 2001/02 to 944 in 2015/16.



**Figure 2.2** and **Table 2.1** show the number of adult living donor kidney transplants performed in 2015/16 in each transplant centre. Manchester performed the most living kidney transplants last year with 86 patients receiving a transplant.

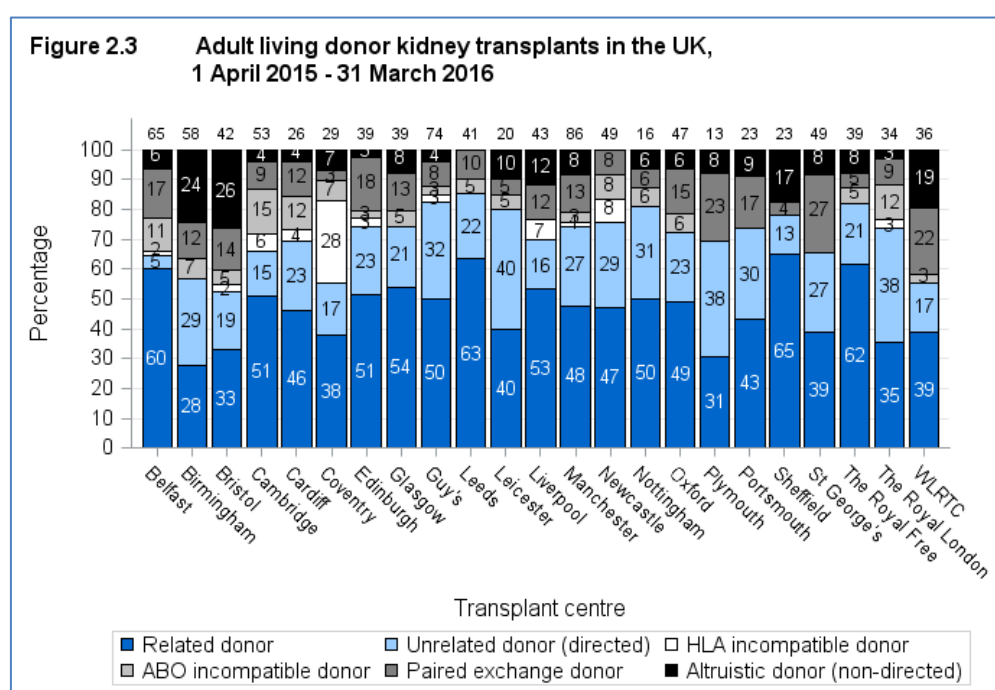




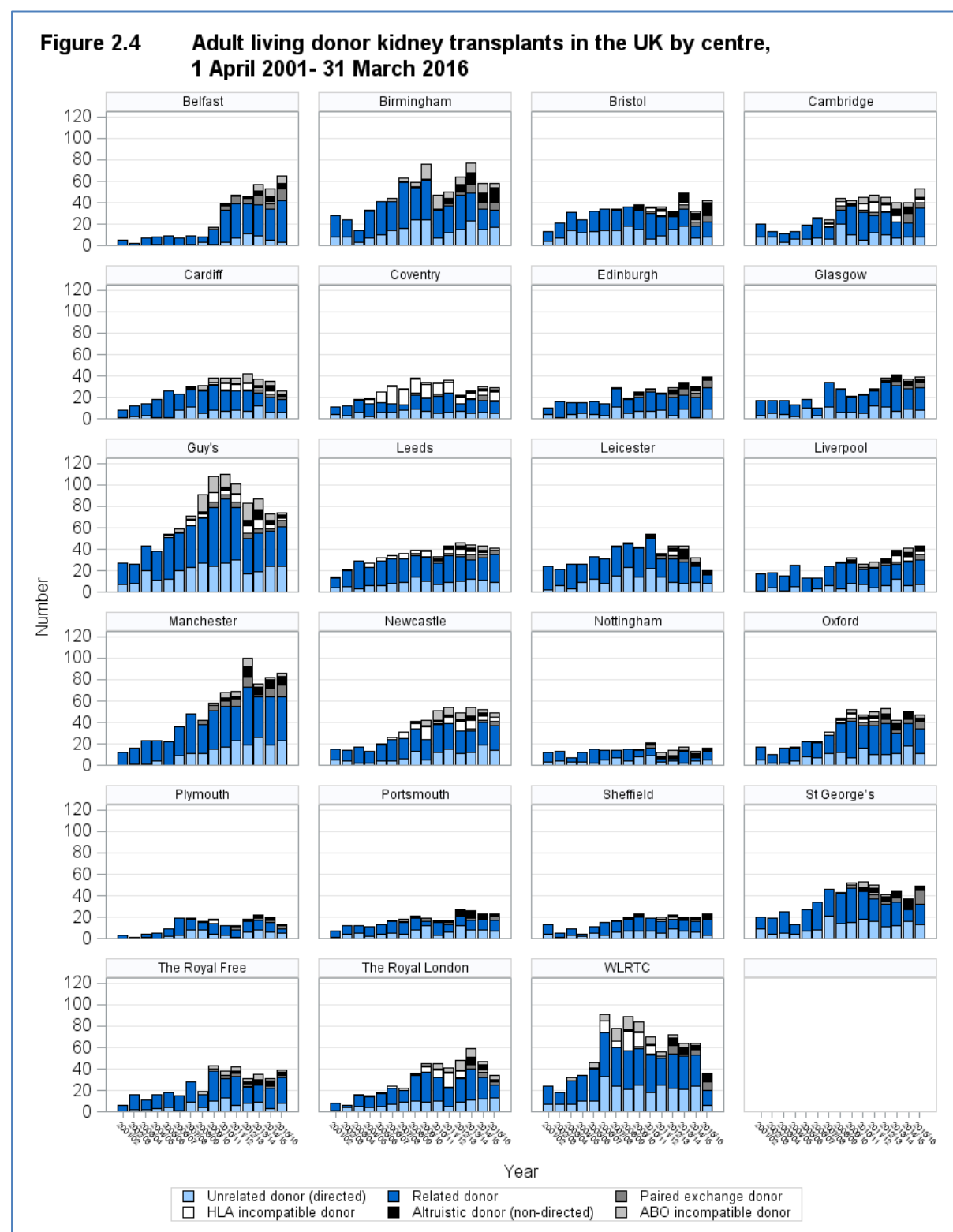
**Table 2.1 Adult living donor kidney transplants in the UK, 1 April 2015 - 31 March 2016**

Transplant Centre	Donor type					
	Related donor	Unrelated donor (directed)	HLA incompatible donor	ABO incompatible donor	Paired exchange donor	Altruistic donor (non-directed)
Belfast	39	3	1	7	11	4
Birmingham	16	17	0	4	7	14
Bristol	14	8	1	2	6	11
Cambridge	27	8	3	8	5	2
Cardiff	12	6	1	3	3	1
Coventry	11	5	8	2	1	2
Edinburgh	20	9	1	1	7	1
Glasgow	21	8	0	2	5	3
Guy's	37	24	2	2	6	3
Leeds	26	9	0	2	4	0
Leicester	8	8	0	1	1	2
Liverpool	23	7	3	0	5	5
Manchester	41	23	1	3	11	7
Newcastle	23	14	4	4	4	0
Nottingham	8	5	0	1	1	1
Oxford	23	11	0	3	7	3
Plymouth	4	5	0	0	3	1
Portsmouth	10	7	0	0	4	2
Sheffield	15	3	0	0	1	4
St George's	19	13	0	0	13	4
The Royal Free	24	8	0	2	2	3
The Royal London	12	13	1	4	3	1
WLRTC	14	6	0	1	8	7

**Figure 2.3** shows the proportion of adult living donor kidney transplants by donor type and centre in 2015/16.

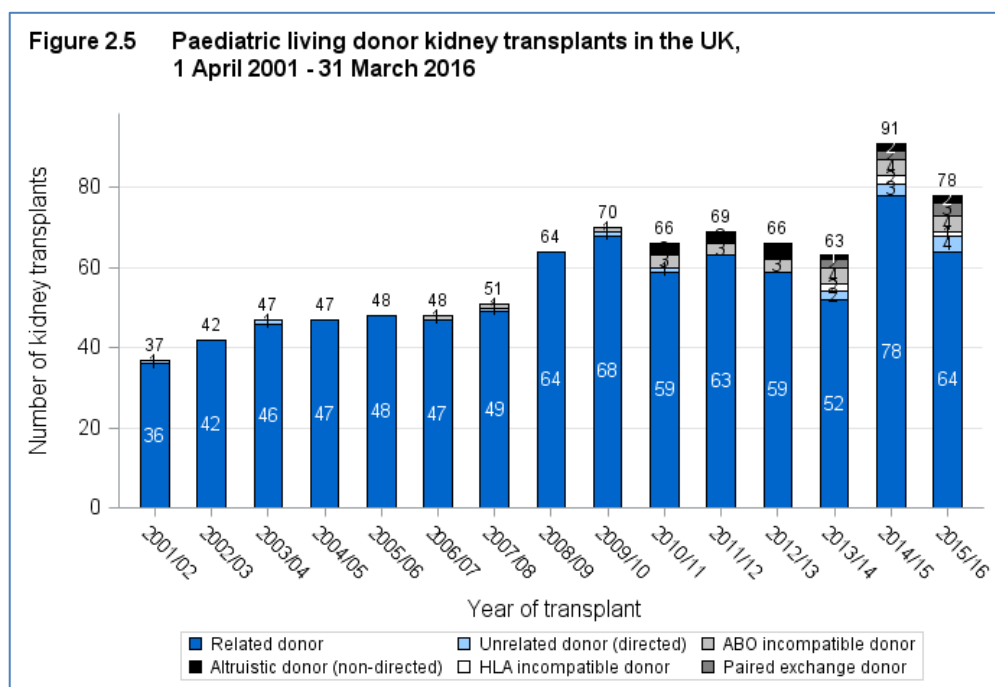


**Figure 2.4** shows the number of adult living donor kidney transplants by donor type and centre between 1 April 2001 and 31 March 2016.

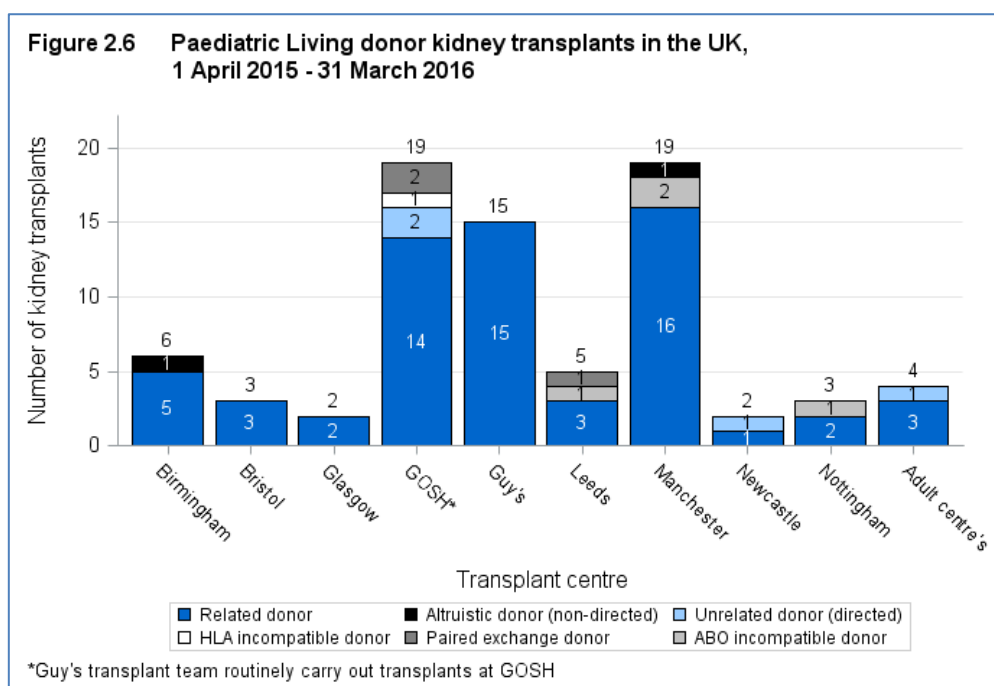


## PAEDIATRIC

**Figure 2.5** shows the number of paediatric living donor kidney transplants performed in the UK between 1 April 2001 and 31 March 2016. The number of transplants increased from 37 in 2001/02 to 78 in 2015/16.



**Figure 2.6** and **Table 2.2** show the number of paediatric living donor kidney transplants performed in 2015/16 in each transplant centre. Guy's transplant team performed the most living kidney transplants last year with 34 patients receiving a transplant (19 at GOSH and 15 at Guy's).

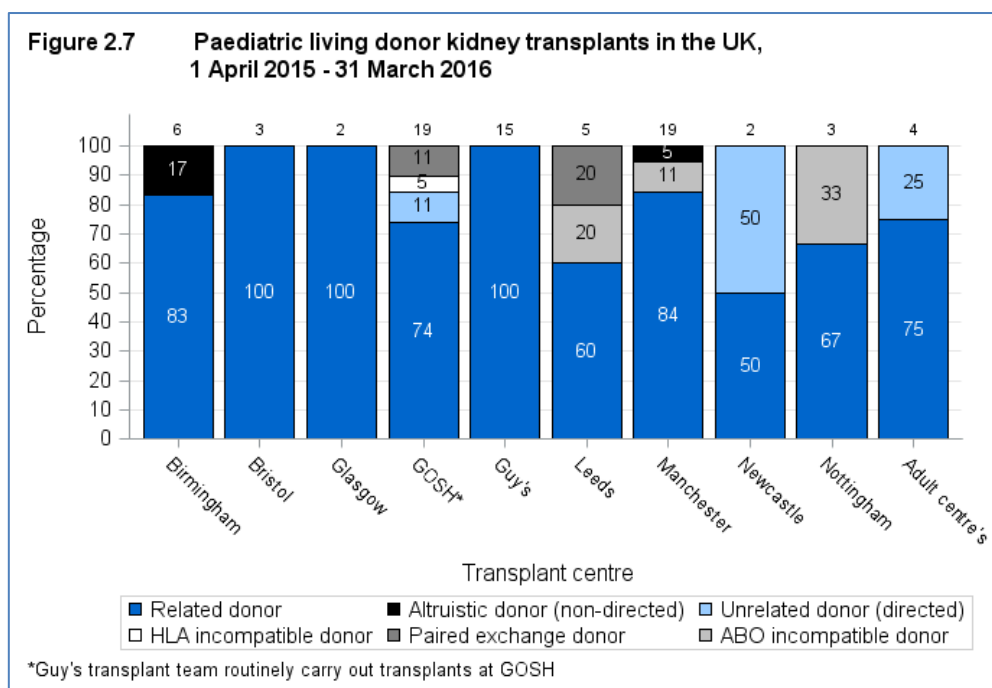


**Table 2.2 Paediatric living donor kidney transplants in the UK, 1 April 2015 - 31 March 2016**

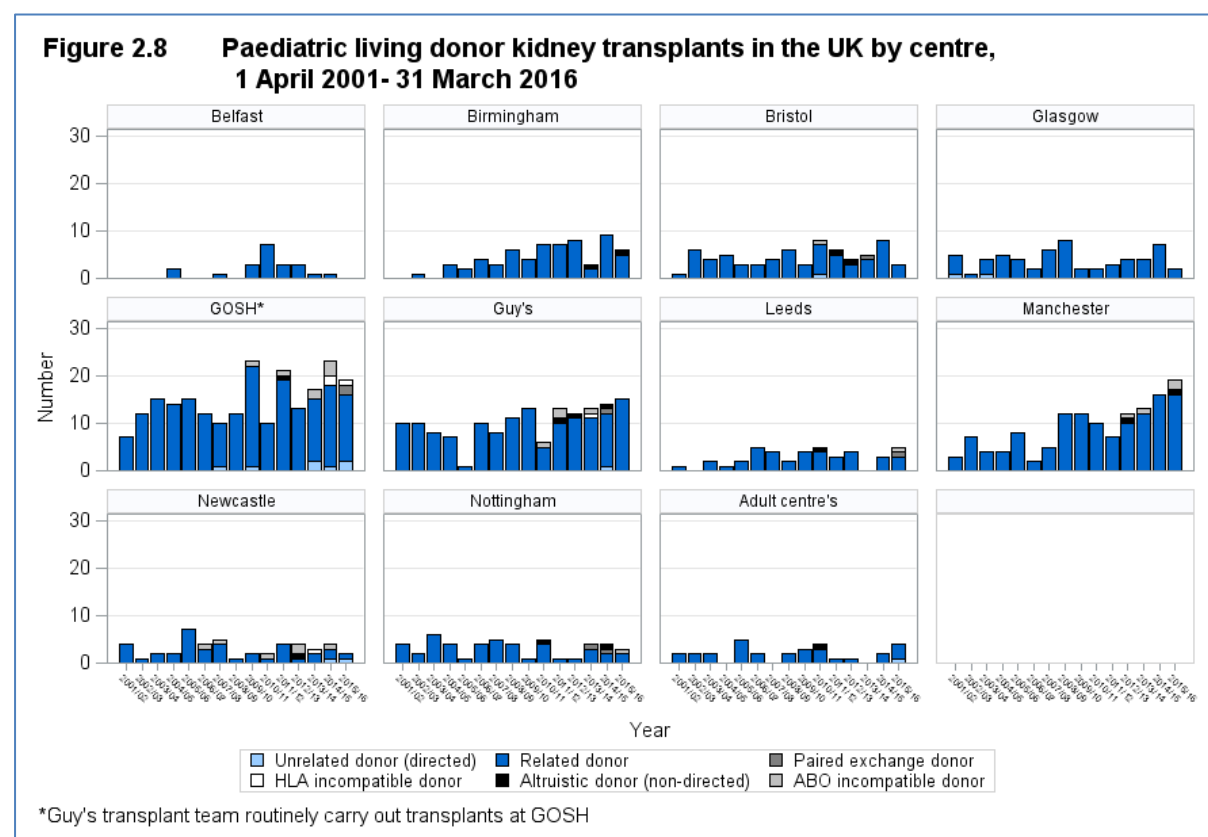
Transplant Centre	Donor type					
	Related donor	Unrelated donor (directed)	HLA incompatible donor	ABO incompatible donor	Paired exchange donor	Altruistic donor (non-directed)
Birmingham	5	0	0	0	0	1
Bristol	3	0	0	0	0	0
GOSH*	14	2	1	0	2	0
Glasgow	2	0	0	0	0	0
Guy's	15	0	0	0	0	0
Leeds	3	0	0	1	1	0
Manchester	16	0	0	2	0	1
Newcastle	1	1	0	0	0	0
Nottingham	2	0	0	1	0	0
Adult centre's	3	1	0	0	0	0

\*Guy's transplant team routinely carry out transplants at GOSH

**Figure 2.7** shows the proportion of paediatric living donor kidney transplants by donor type and centre in 2015/16.



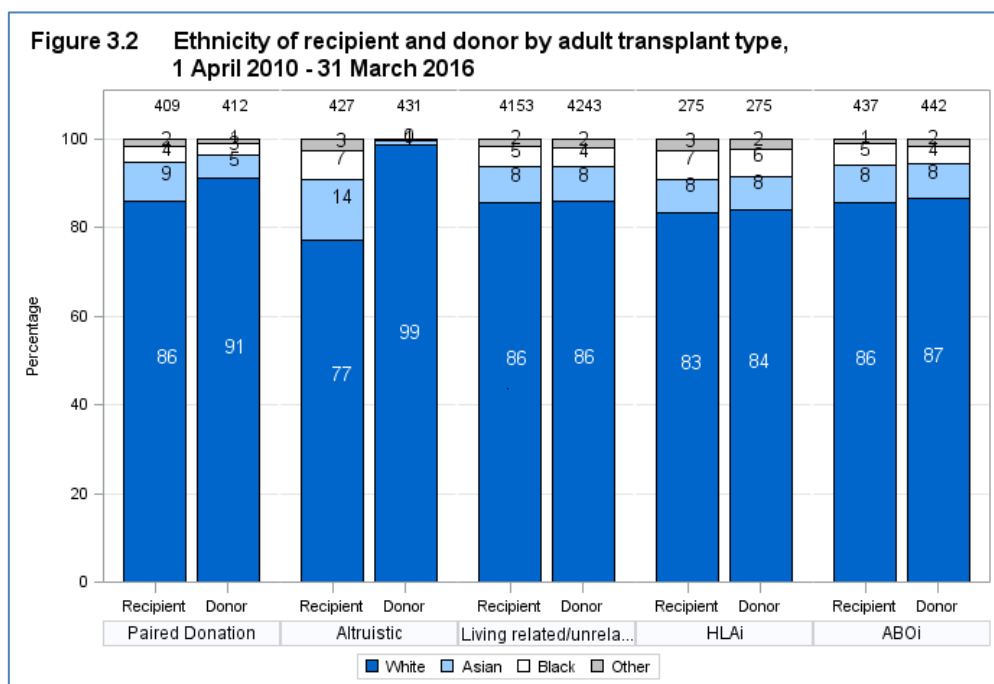
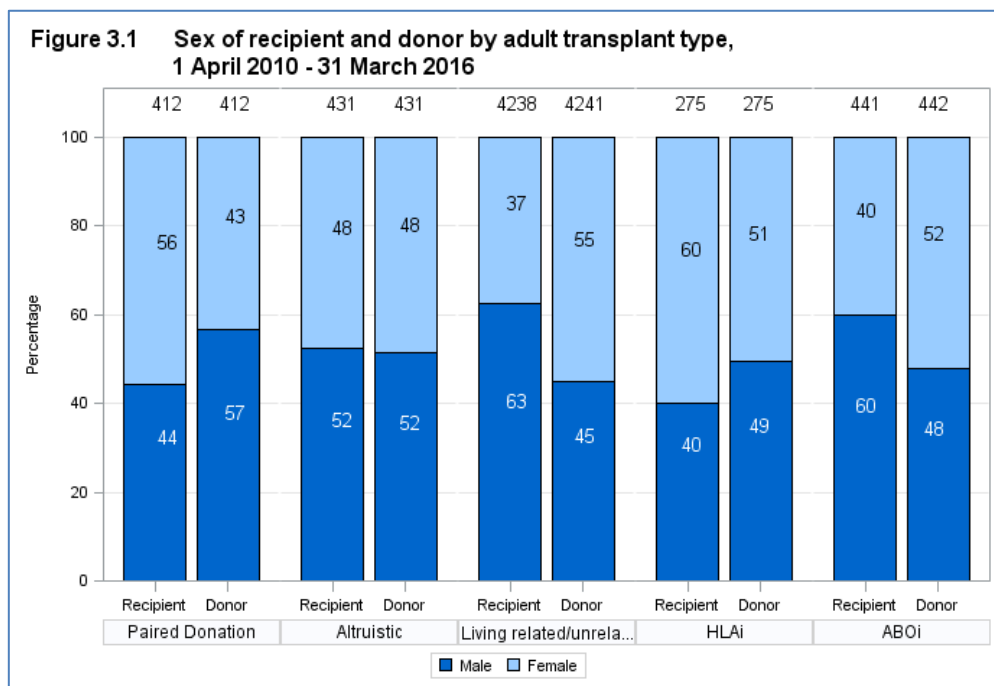
**Figure 2.8** shows the number of paediatric living donor kidney transplants by donor type and centre between 1 April 2001 and 31 March 2016.



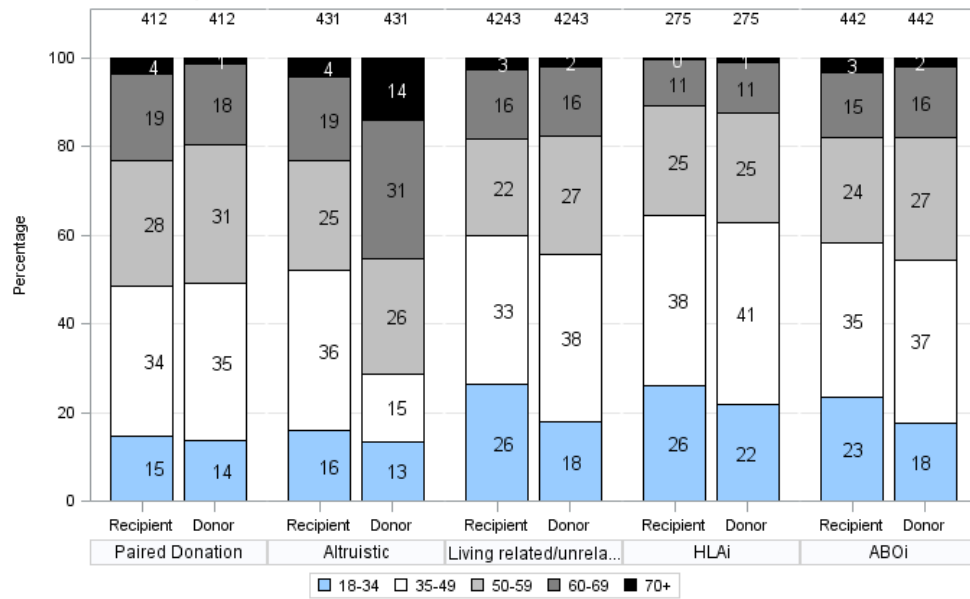
# **Demographic Characteristics**

## ADULT

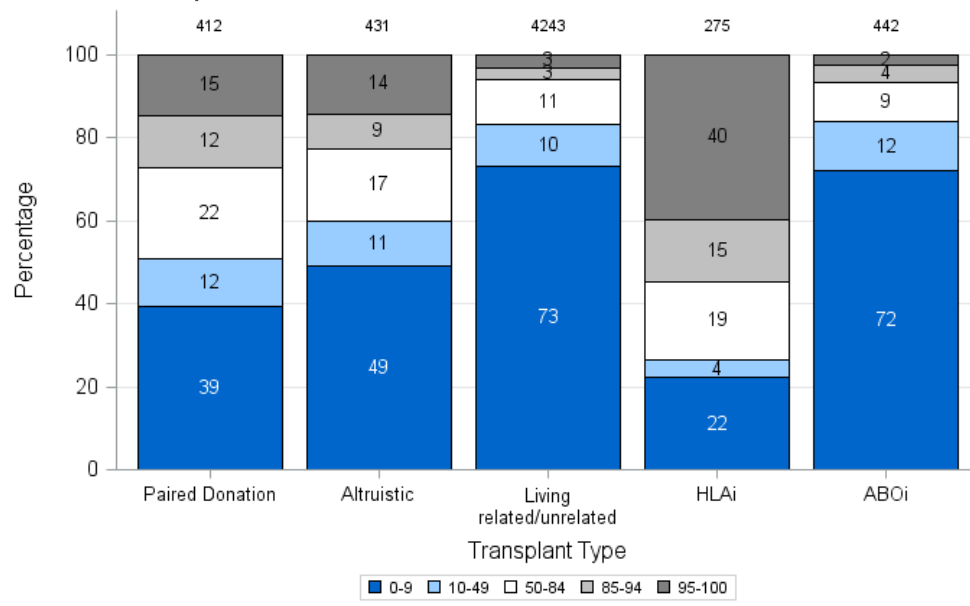
The sex, ethnicity, age group, sensitisation (cRF), blood group and dialysis status of donors and recipients of adult living kidney transplants are shown by centre in **Figure 3.1, 3.2, 3.3, 3.4, 3.5** and **3.6**, respectively. Note that all percentages quoted are based only on data where relevant information was available.



**Figure 3.3 Age of recipient and donor by adult transplant type, 1 April 2010 - 31 March 2016**

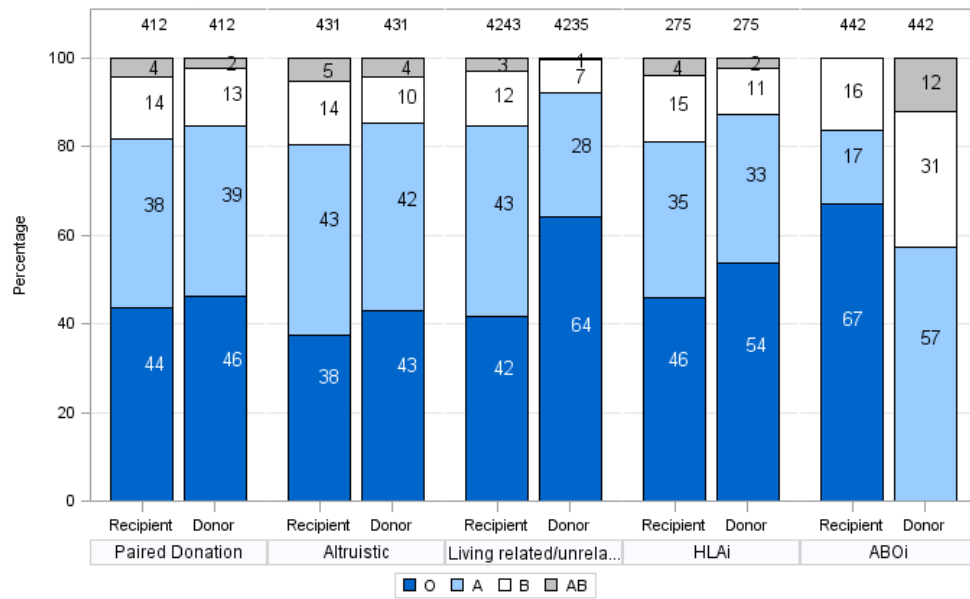


**Figure 3.4 Recipient Calculated Reaction Frequency by adult transplant type 1 April 2010 - 31 March 2016**

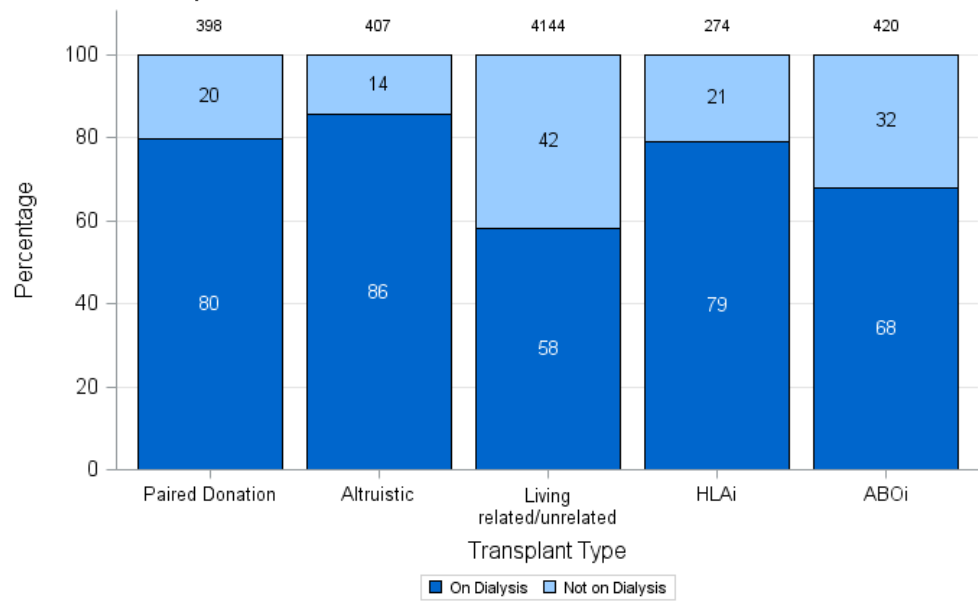




**Figure 3.5 Recipient and donor blood group by adult transplant type, 1 April 2010 - 31 March 2016**

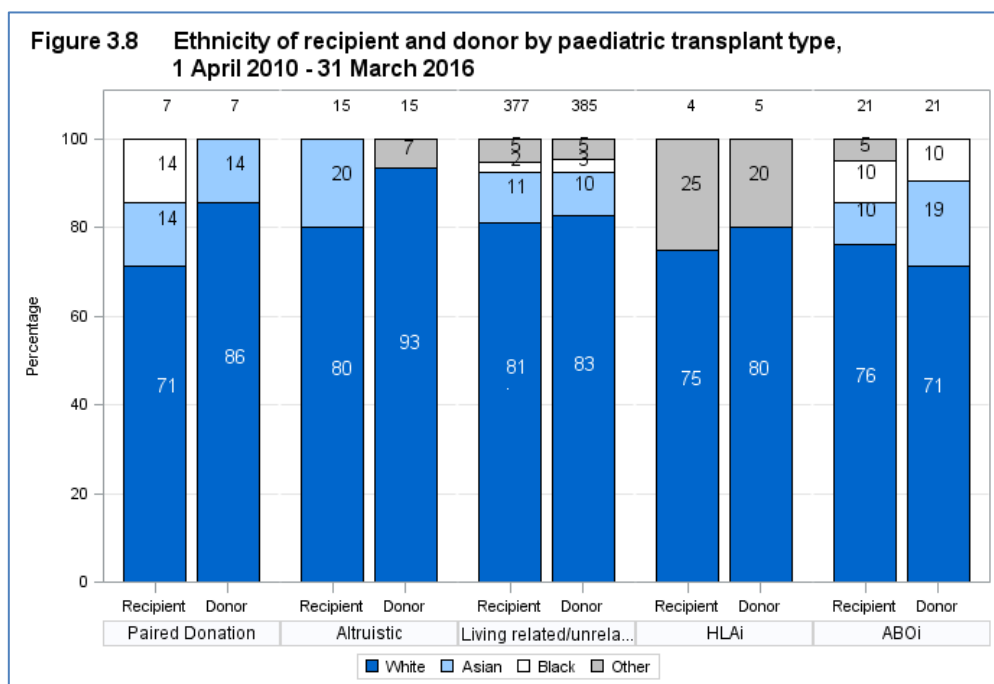
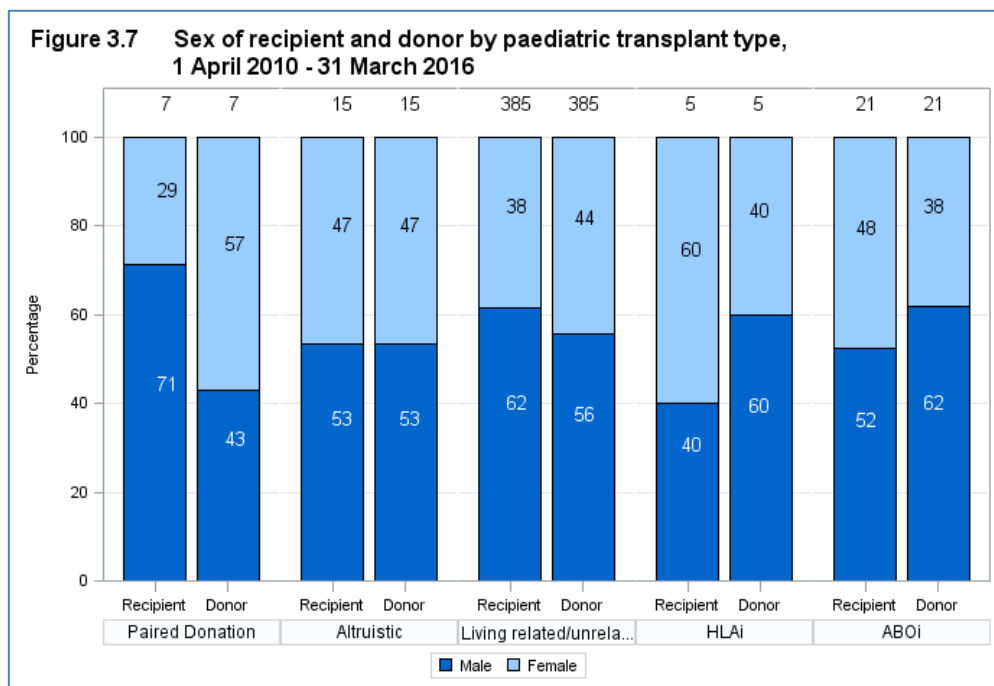


**Figure 3.6 Dialysis status at transplant by adult transplant type, 1 April 2010 - 31 March 2016**

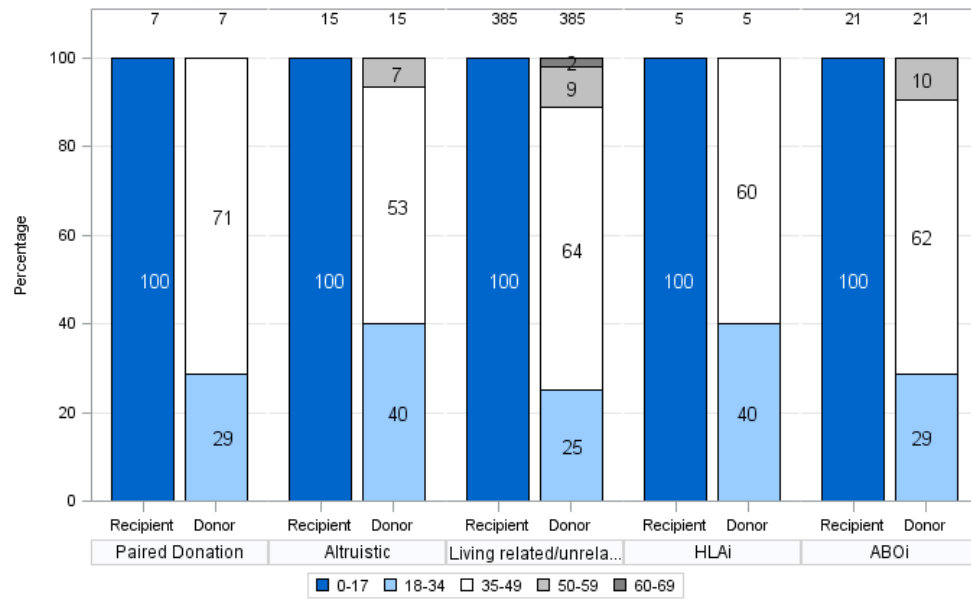


## PAEDIATRIC

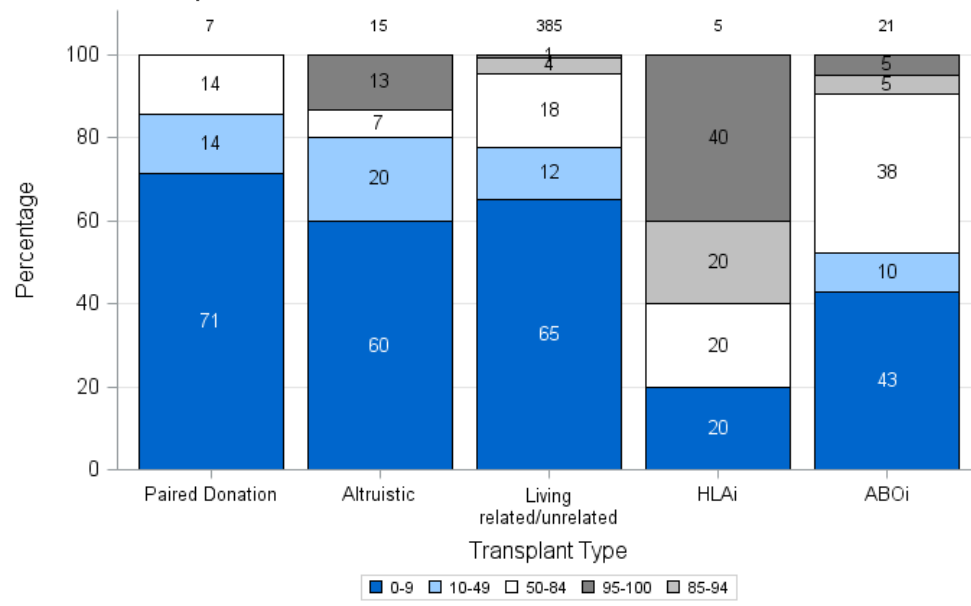
The sex, ethnicity, age group, sensitisation (cRF), blood group and dialysis status of donors and recipients of paediatric living kidney transplants are shown by centre in **Figure 3.7, 3.8, 3.9, 3.10, 3.11 and 3.12**, respectively. Note that all percentages quoted are based only on data where relevant information was available.



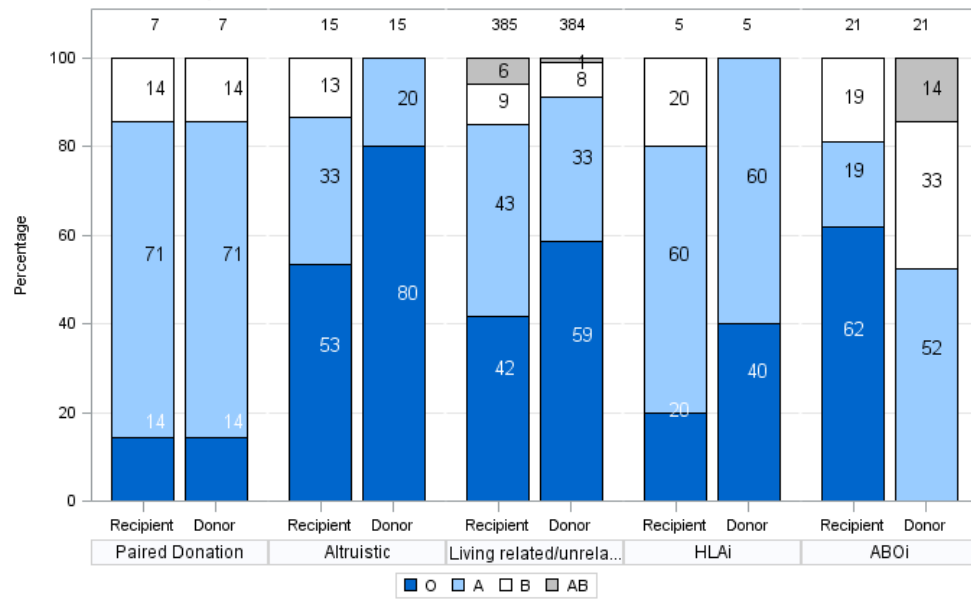
**Figure 3.9 Age of recipient and donor by paediatric transplant type, 1 April 2010 - 31 March 2016**



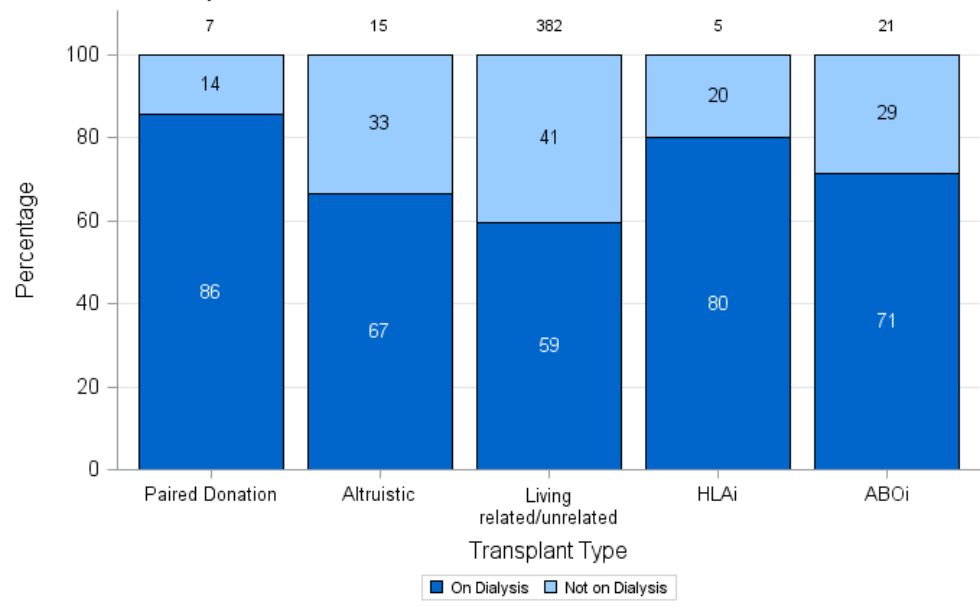
**Figure 3.10 Recipient Calculated Reaction Frequency by paediatric transplant type 1 April 2010 - 31 March 2016**



**Figure 3.11 Recipient and donor blood group by paediatric transplant type, 1 April 2010 - 31 March 2016**



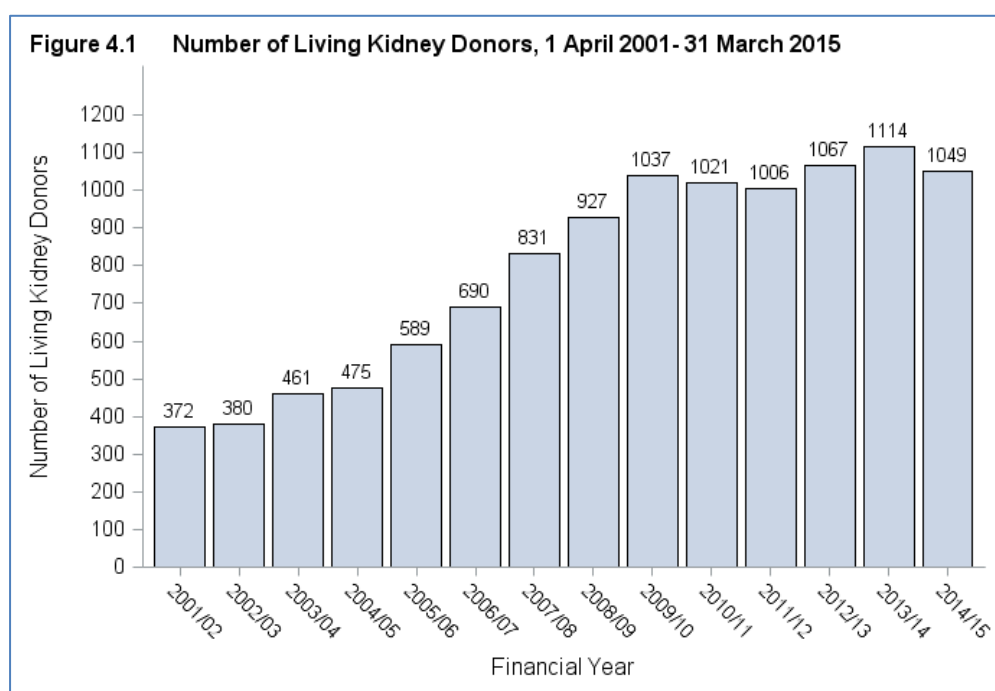
**Figure 3.12 Dialysis status at transplant by paediatric transplant type, 1 April 2010 - 31 March 2016**



# **Living Donor Follow-Up**

This section contains information on all living donors including transplants performed in both adult and paediatric recipients. Percentages are omitted if the reported proportion of the data item at 1 year is less than 75%, at 5 years is less than 50% or at 10 years is less than 35% at each centre

**Figure 4.1** shows the number of living kidney donors by financial year from 2001/02 to 2014/15. The number of living donors has increased from 372 in 2001/02 to 1049 in 2014/15.

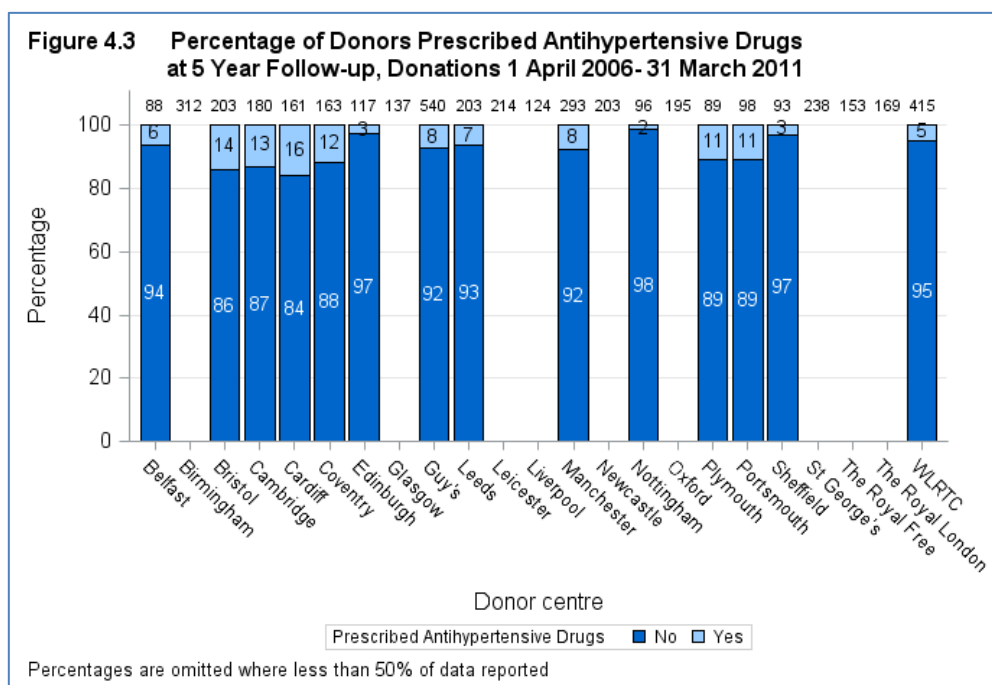
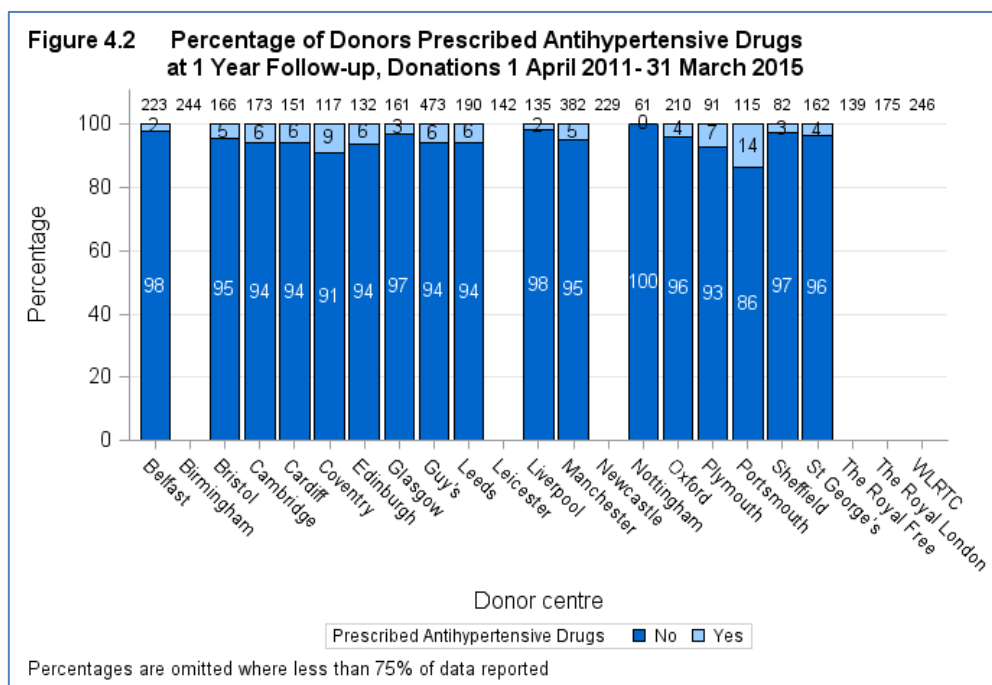


Of the living donors over this period, 61 deaths have been recorded. The causes of death are shown in **Table 3.1**. No donors have joined the kidney waiting list, although one has received a kidney transplant from a living donor.

<b>Table 3.1 Cause of death for living donors 1 April 2001 – 31 March 2015</b>		
<b>Cause of Death</b>	<b>N</b>	<b>%</b>
Cancer	26	43
Bowel	2	3
Breast	1	2
Colonic	1	2
Gastric	1	2
Liver	1	2
Lung	3	5
Oesophagus	3	5
Pancreatic	3	5
Stomach	1	2
Throat	2	3
Uterus	1	2
Other	7	11
Brain Tumor	5	8
Intracranial hemorrhage	3	5
Ischaemic heart disease	1	2
Motor neuron disease	1	2
Myelodysplasia	1	2
Myocardial infarction	1	2
Parkinson's disease	1	2
Pulmonary embolism	1	2
bronchopneumonia	2	3
Other	7	11
Unknown	12	20
<b>TOTAL</b>	<b>61</b>	<b>100</b>

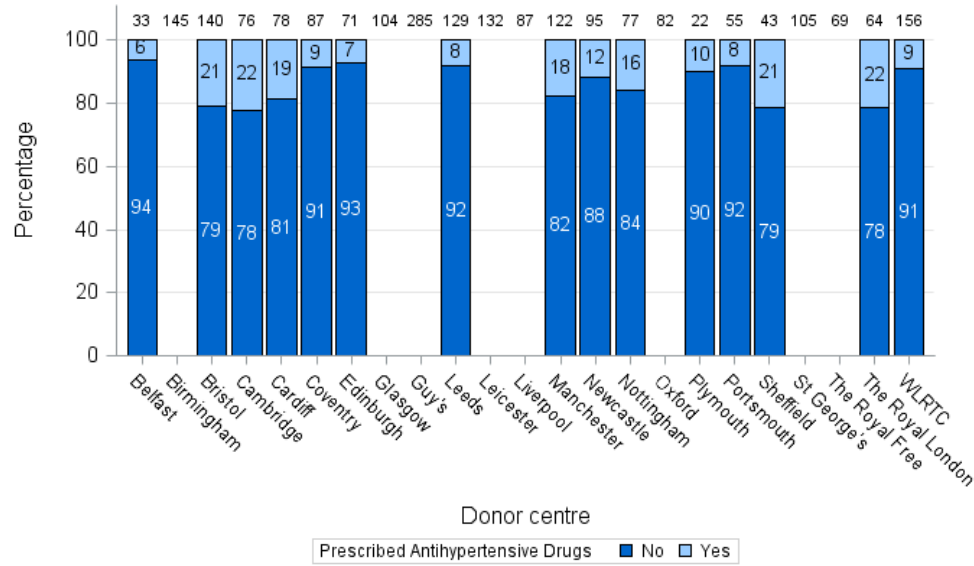
## 4.1 Prescription of Antihypertensive drugs, 1 April 2001 – 31 March 2015

Figure 4.2, 4.3 and 4.4 show the proportion of living kidney donors where the donor has been prescribed antihypertensive drugs at 1, 5 and 10 year follow-up by centre, respectively. The same information is summarised in Table 4.2.





**Figure 4.4 Percentage of Donors Prescribed Antihypertensive Drugs at 10 Year Follow-up, Donations 1 April 2001- 31 March 2006**



**Table 4.2 Percentage of Donors Prescribed Antihypertensive Drugs by Centre, Donations April 2001 - March 2015**

Donor centre	1 Year			5 Year			10 Year		
	N	% <sup>1</sup>	% <sup>2</sup>	N	% <sup>1</sup>	% <sup>2</sup>	N	% <sup>1</sup>	% <sup>2</sup>
Belfast	223	94	2	88	53	6	33	48	-
Birmingham	244	70	-	312	49	-	145	30	-
Bristol	166	77	5	203	55	14	140	47	21
Cambridge	173	87	6	180	70	13	76	64	22
Cardiff	151	96	6	161	86	16	78	74	19
Coventry	117	76	9	163	56	12	87	39	9
Edinburgh	132	83	6	117	62	3	71	59	7
Glasgow	161	81	3	137	17	-	104	14	-
Guy's	473	86	6	540	54	8	285	32	-
Leeds	190	76	6	203	67	7	129	48	8
Leicester	142	17	-	214	16	-	132	9	-
Liverpool	135	76	2	124	43	-	87	23	-
Manchester	382	86	5	293	55	8	122	42	18
Newcastle	229	55	-	203	35	-	95	35	12
Nottingham	61	85	0	96	64	2	77	48	16
Oxford	210	82	4	195	44	-	82	28	-
Plymouth	91	75	7	89	61	11	22	45	-
Portsmouth	115	89	14	98	76	11	55	44	8
Sheffield	82	88	3	93	70	3	43	65	21
St George's	162	81	4	238	45	-	105	27	-
The Royal Free	139	68	-	153	48	-	69	19	-
The Royal London	175	67	-	169	44	-	64	58	22
WLRTC	246	65	-	415	52	5	156	50	9
UK	4199	77	5	4484	52	8	2257	39	13

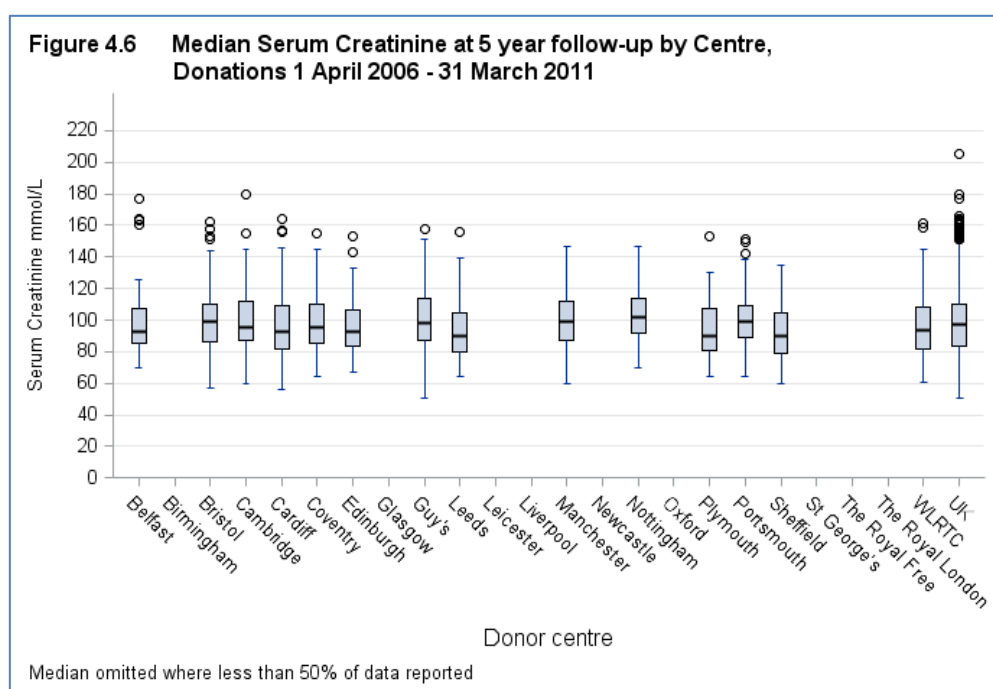
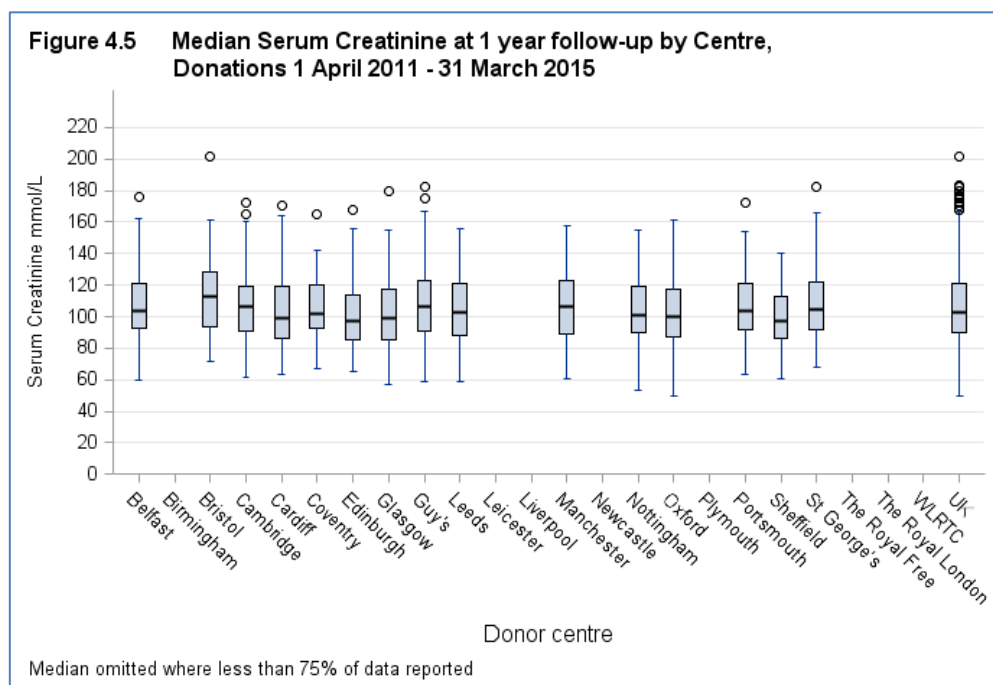
<sup>1</sup>% of donors with follow-up reported

<sup>2</sup>% of donors that have been prescribed antihypertensive drugs (where follow-up returned)

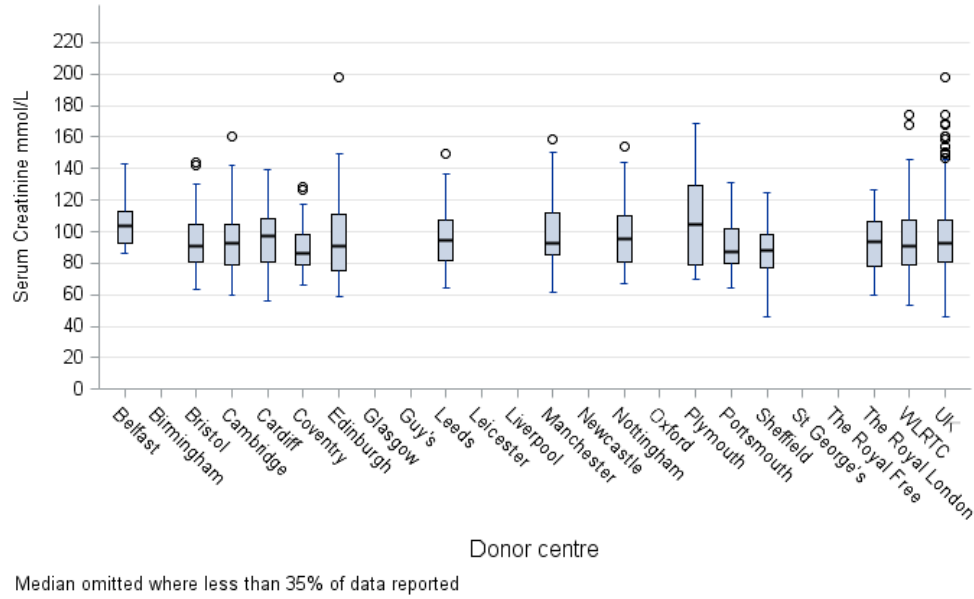
- Percentages are omitted where less than 75%, 50% or 35% of data reported at 1yr, 5yrs or 10yrs

## 4.2 Serum creatinine, 1 April 2001 – 31 March 2015

Figure 4.5, 4.6 and 4.7 show the median serum creatinine at 1, 5 and 10 year follow-up by centre, respectively. The same information is summarised in Table 4.3.



**Figure 4.7** Median Serum Creatinine at 10 year follow-up by Centre,  
Donations 1 April 2001 - 31 March 2006



**Table 4.3 Median Serum Creatinine at 1 Year follow up by Centre, Donations  
1 April 2011 – 31 March 2015**

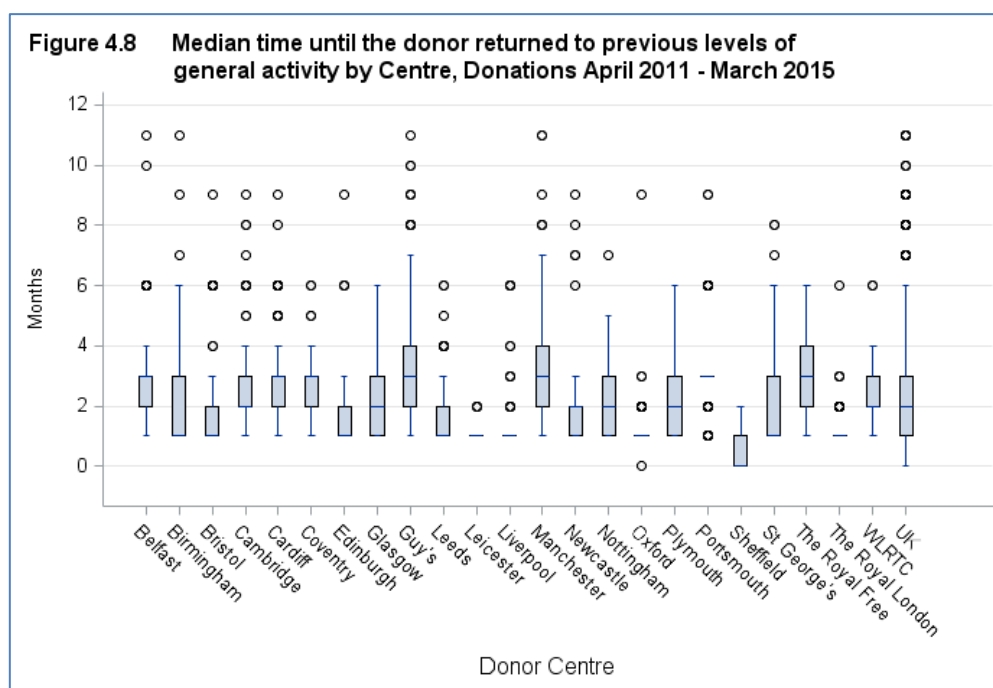
Centre	1 Year			5 Year			10 Year		
	N	% <sup>1</sup>	Median (IQ range)	N	% <sup>1</sup>	Median (IQ range)	N	% <sup>1</sup>	Median (IQ range)
Belfast	223	94	104 (93-121)	88	53	93 (85-107)	33	48	104 (93-113)
Birmingham	244	69	(-)	312	49	(-)	145	29	(-)
Bristol	166	76	113 (94-128)	203	55	99 (86-110)	140	46	91 (81-105)
Cambridge	173	87	106 (91-119)	180	69	95 (87-112)	76	63	93 (79-105)
Cardiff	151	95	99 (86-119)	161	86	93 (82-109)	78	74	97 (81-108)
Coventry	117	75	102 (93-120)	163	56	95 (85-110)	87	39	87 (79-98)
Edinburgh	132	83	97 (85-114)	117	62	93 (84-107)	71	59	91 (75-111)
Glasgow	161	81	99 (85-117)	137	17	(-)	104	14	(-)
Guy's	473	86	106 (91-123)	540	54	98 (87-114)	285	32	(-)
Leeds	190	76	103 (89-121)	203	66	90 (80-105)	129	48	95 (82-107)
Leicester	142	15	(-)	214	15	(-)	132	9	(-)
Liverpool	135	67	(-)	124	40	(-)	87	23	(-)
Manchester	382	86	106 (89-123)	293	54	99 (87-112)	122	41	93 (85-112)
Newcastle	229	54	(-)	203	35	(-)	95	35	91 (82-106)
Nottingham	61	87	101 (90-119)	96	64	102 (92-114)	77	48	95 (81-110)
Oxford	210	81	100 (87-117)	195	44	(-)	82	28	(-)
Plymouth	91	75	104 (95-117)	89	61	90 (81-107)	22	45	105 (79-129)
Portsmouth	115	89	104 (92-121)	98	74	99 (89-109)	55	44	87 (80-102)
Sheffield	82	88	97 (86-113)	93	70	90 (79-105)	43	65	89 (77-99)
St George's	162	78	105 (92-122)	238	45	(-)	105	27	(-)
The Royal Free	139	68	(-)	153	48	(-)	69	19	(-)
The Royal London	175	66	(-)	169	44	(-)	64	58	94 (78-106)
WLRTC	246	65	(-)	415	52	94 (82-108)	156	50	91 (79-107)
<b>UK</b>	<b>4199</b>	<b>76</b>	<b>103 (90-121)</b>	<b>4486</b>	<b>51</b>	<b>97 (84-110)</b>	<b>2258</b>	<b>38</b>	<b>93 (81-107)</b>

<sup>1</sup>% of donors with follow-up reported

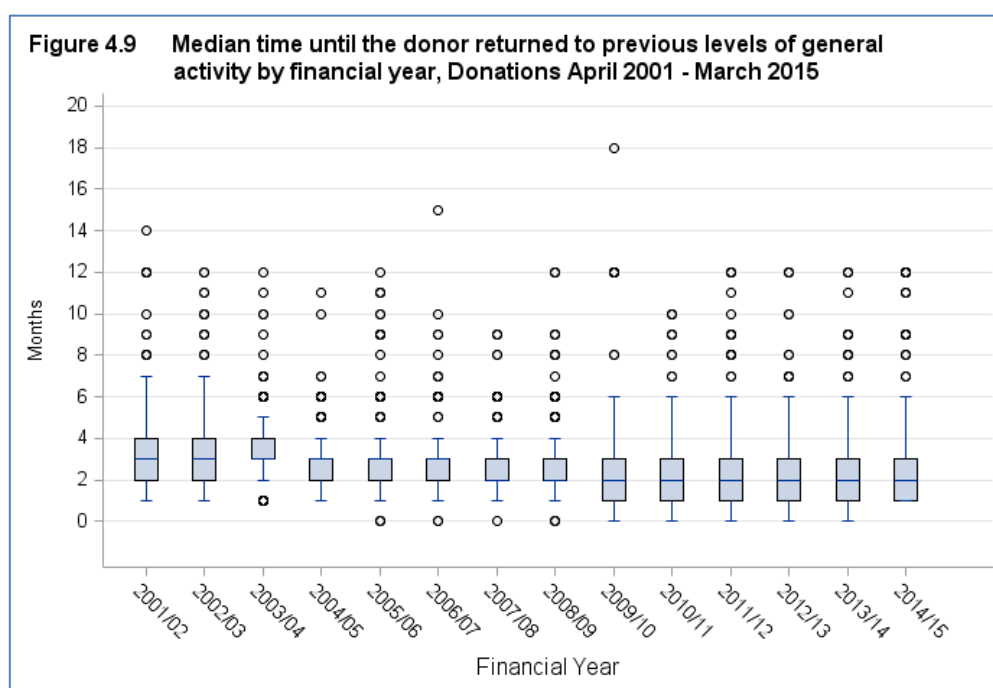
- Medians are omitted where less than 75%, 50% or 35% of data reported at 1yr, 5yrs or 10yrs

### 4.3 Return to normal activity, 1 April 2001 – 31 March 2015

**Figure 4.8** shows the median time (in months) to return to normal activity after donation, by centre. The median ranged from 1 to 3 months post-transplant.



**Figure 4.9** shows the median time (in months) to return to normal activity after donation in the UK, by financial year.

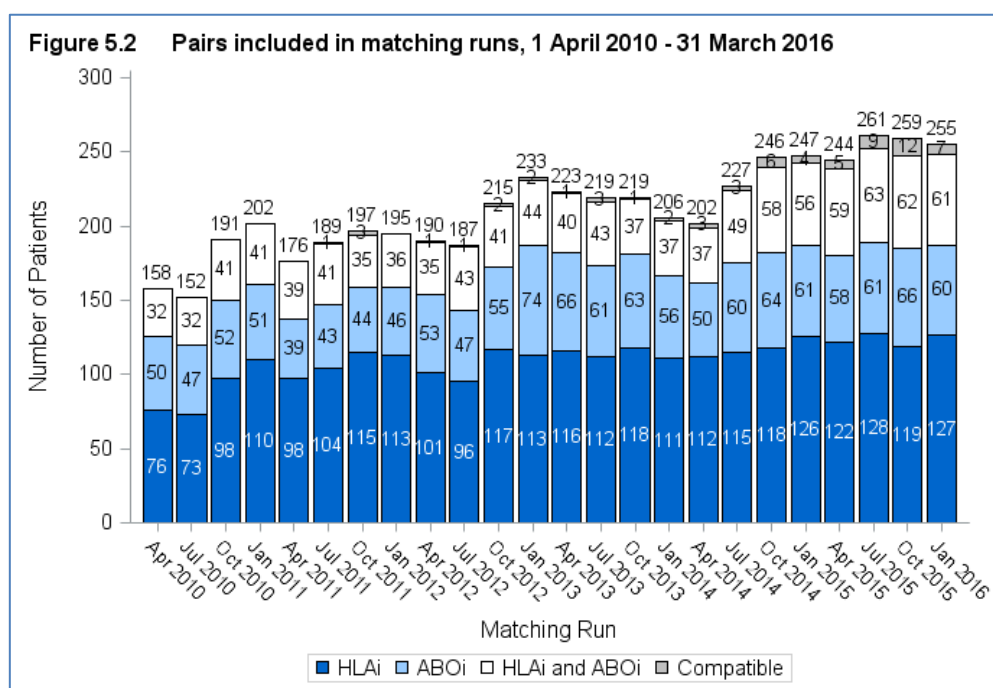
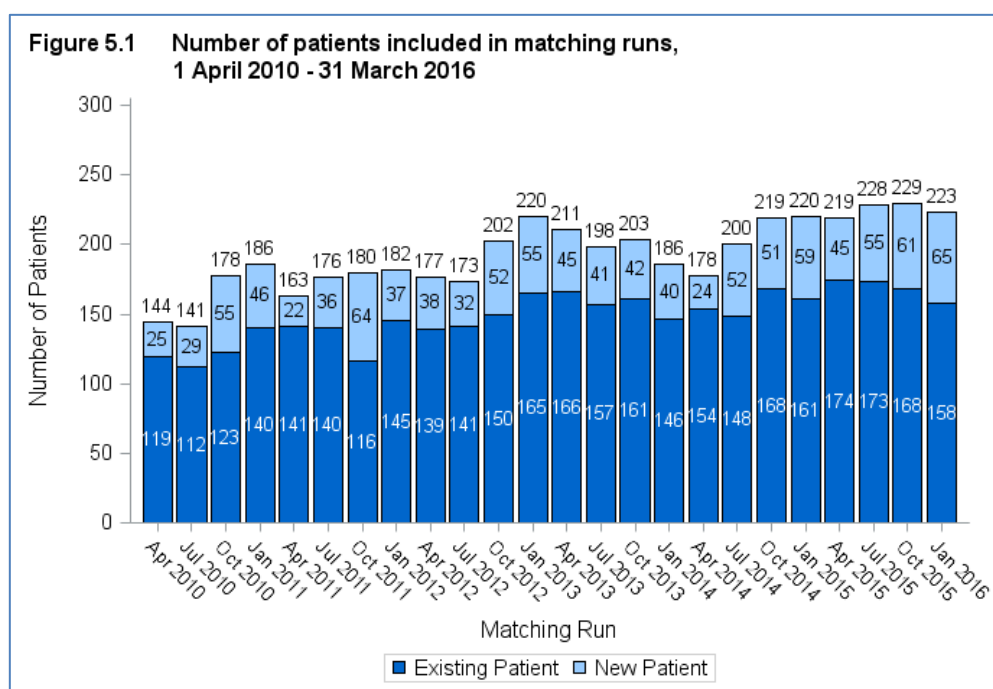


# **UK Living Kidney Sharing Schemes**

## 5.1 Paired Donation Scheme

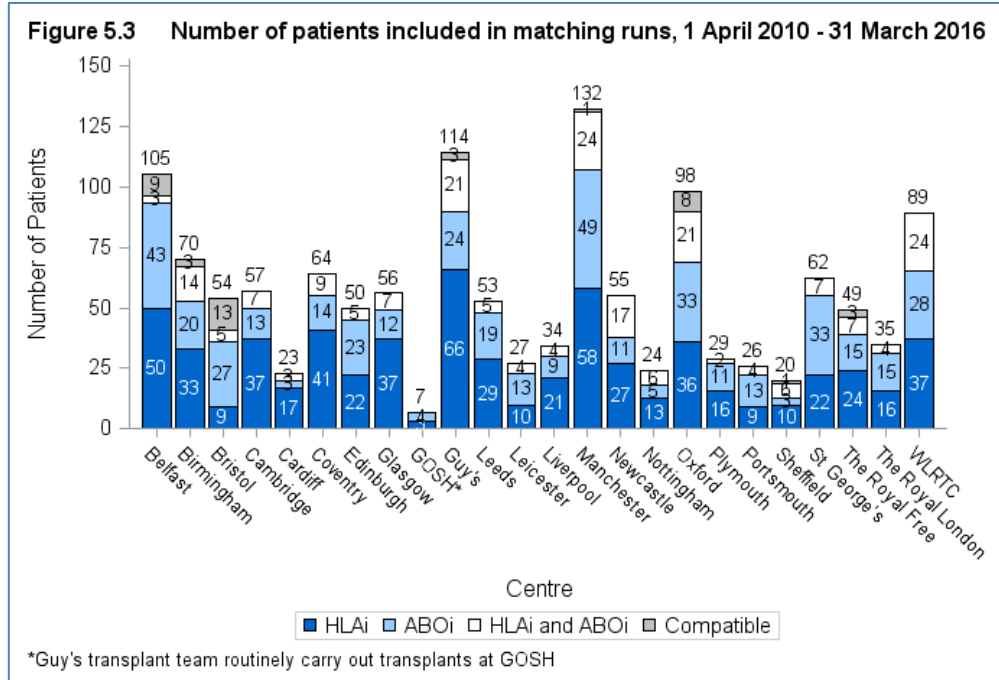
### 5.1.1 Registrations: Matching Runs, 1 April 2010 – 31 March 2016

**Figure 5.1** shows the number of patients included in matching runs from 1 April 2010 to 31 March 2016. The number of patients included has increased over this period with 144 in April 2010 to 223 in January 2016. Overall, there were 1,333 patients included in matching runs over this period. **Figure 5.2** shows the number of pairs included in each matching run, split by pair incompatibility.





**Figure 5.3** shows the number of patients included in matching runs from 1 April 2010 to 31 March 2016 by centre. This is broken down further by the nature of the incompatibility between the pair. It can be seen that Manchester has had the highest number of patients registered over this time period. Most pairs registered over this period were HLA incompatible (49%). This information is also shown in **Table 5.1**.

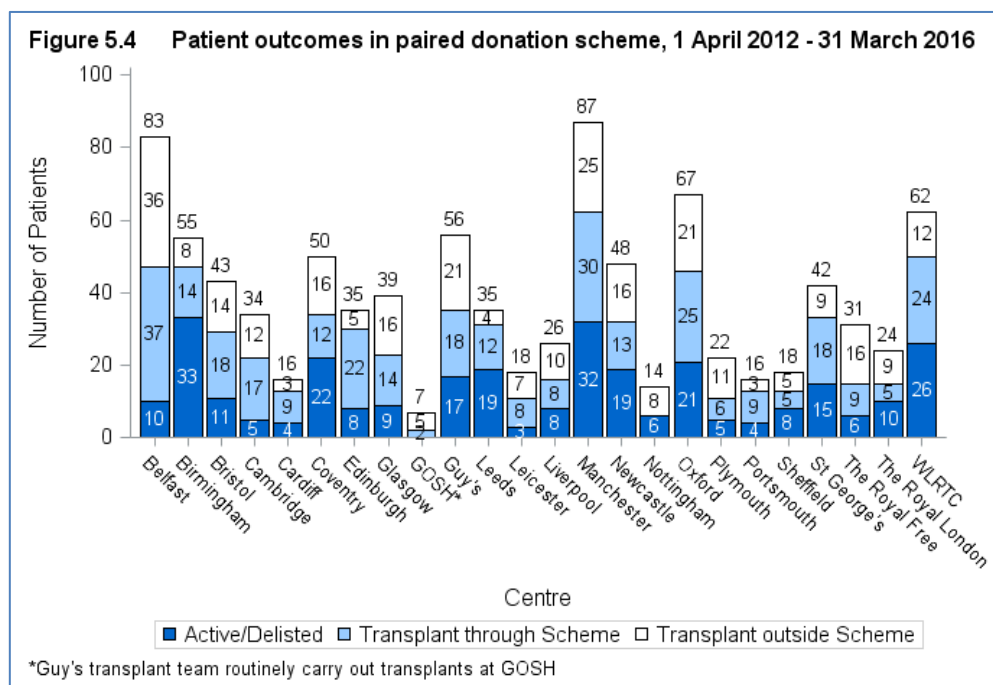


**Table 5.1**                      **Pairs included in matching runs by compatibility and Centre, 1 April 2010 – 31 March 2016**

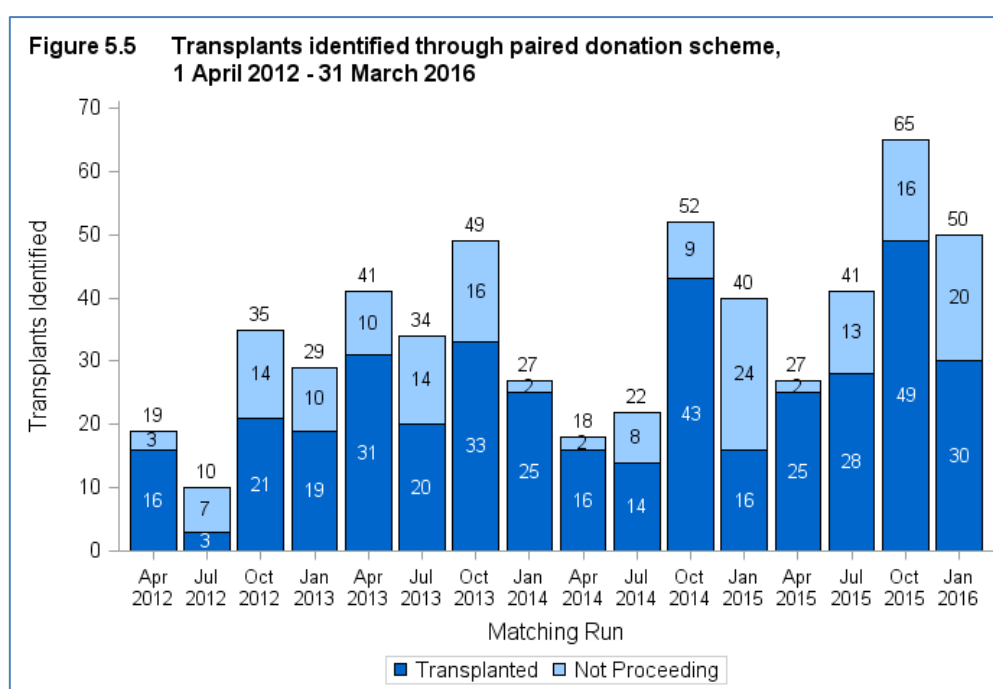
Centre	Number of pairs	HLAi	ABOi	HLAi and ABOi	Compatible
Belfast	105	50	43	3	9
Birmingham	70	33	20	14	3
Bristol	54	9	27	5	13
Cambridge	57	37	13	7	0
Cardiff	23	17	3	3	0
Coventry	64	41	14	9	0
Edinburgh	50	22	23	5	0
Glasgow	56	37	12	7	0
GOSH	7	3	4	0	0
Guy's	114	66	24	21	3
Leeds	53	29	19	5	0
Leicester	27	10	13	4	0
Liverpool	34	21	9	4	0
Manchester	132	58	49	24	1
Newcastle	55	27	11	17	0
Nottingham	24	13	5	6	0
Oxford	98	36	33	21	8
Plymouth	29	16	11	2	0
Portsmouth	26	9	13	4	0
Sheffield	20	10	3	6	1
St George's	62	22	33	7	0
The Royal Free	49	24	15	7	3
The Royal London	35	16	15	4	0
WLRTC	89	37	28	24	0
<b>UK</b>	<b>1333</b>	<b>643</b>	<b>440</b>	<b>209</b>	<b>41</b>

## 5.1.2 Outcomes: Matching Runs, 1 April 2012 – 31 March 2016

**Figure 5.4** shows the outcomes of patients included in matching runs from 1 April 2012 to 31 March 2016, split by centre. Overall, 29% of patients registered have had a transplant through the paired donation scheme



**Figure 5.5** shows the transplants identified in each matching run from 1 April 2012 to 31 March 2016. The number of those that proceeded to transplant is also shown. Overall, 68% of transplants identified through the paired donation scheme have proceeded to transplant over this period.

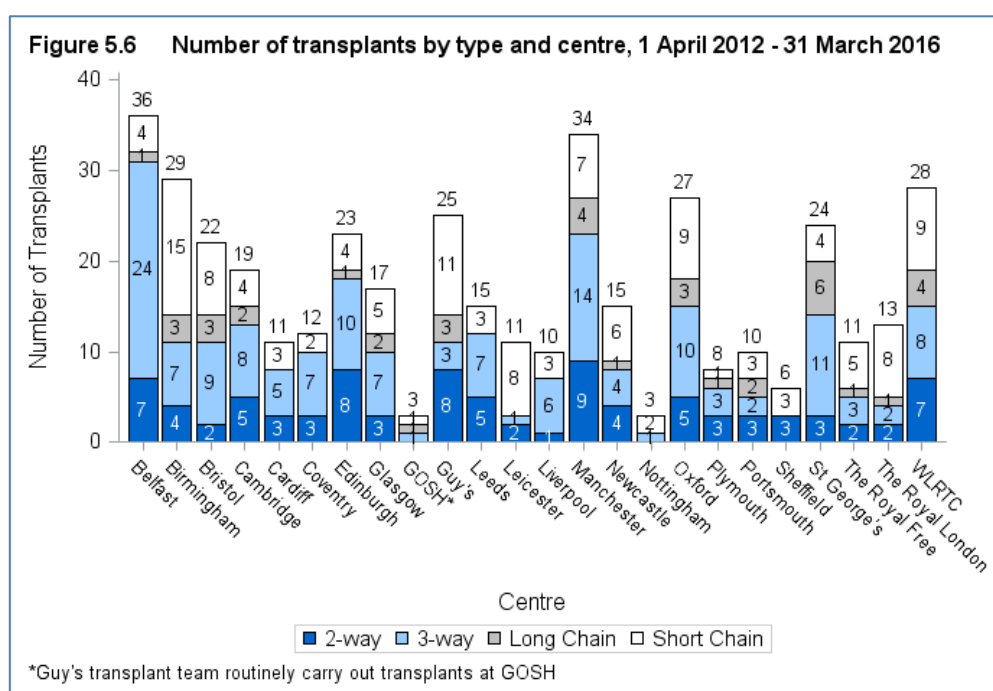


**Tables 5.2 and 5.3** show the number of transplants split by patient calculated reaction frequency and patient and donor blood group respectively.

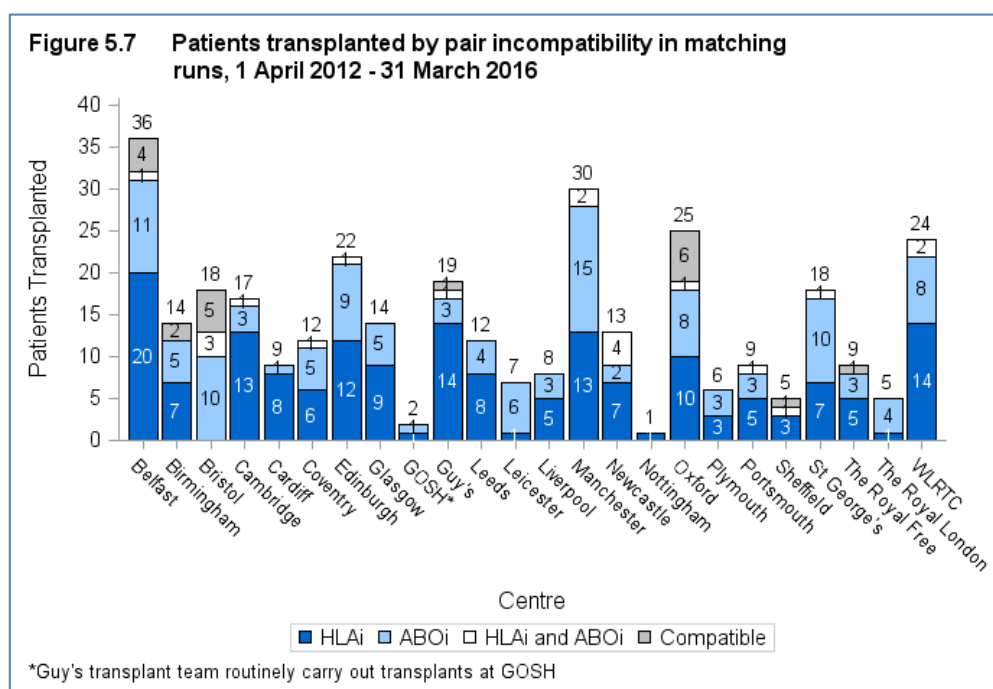
<b>Table 5.2 Transplants as a proportion of registered patients by calculated reaction frequency, 1 April 2012 – 31 March 2016</b>			
Calculated Reaction Frequency	Patients Registered	Patients Transplanted N	(%)
0-9%	276	122	(44)
10-84%	214	116	(54)
85-94%	94	42	(45)
95-99%	204	48	(24)
100%	140	5	(4)

<b>Table 5.3 Transplants as a proportion of registered pairs by blood group, 1 April 2012 – 31 March 2016</b>											
Donor Blood Group	Patient Blood Group (Patients Transplanted/Pairs Registered (%))										
	O			A			B			AB	
O	69/	221	(31%)	58/	95	(61%)	12/	26	(46%)	3/	9 (33%)
A	75/	313	(24%)	38/	131	(29%)	21/	41	(51%)	2/	9 (22%)
B	19/	77	(25%)	18/	31	(58%)	8/	31	(26%)	1/	5 (20%)
AB	2/	12	(17%)	5/	8	(63%)	2/	11	(18%)	0/	3 (0%)

**Figure 5.6** shows the number of patients transplanted from matching runs between 1 April 2012 and 31 March 2016. This is split by centre and exchange type.



**Figure 5.7** shows the patients transplanted from matching runs between 1 April 2012 and 31 March 2016. This is split by centre and the incompatibility of the patient with their registered donor. **Table 5.4** shows the percentage of pairs transplanted through paired donation given that they have been included in 1 or more, 2 or more or 5 or more matching runs. **Table 5.5** shows the average waiting time for transplant in the paired donation scheme. Data is censored if the patient received a transplant outside the scheme.



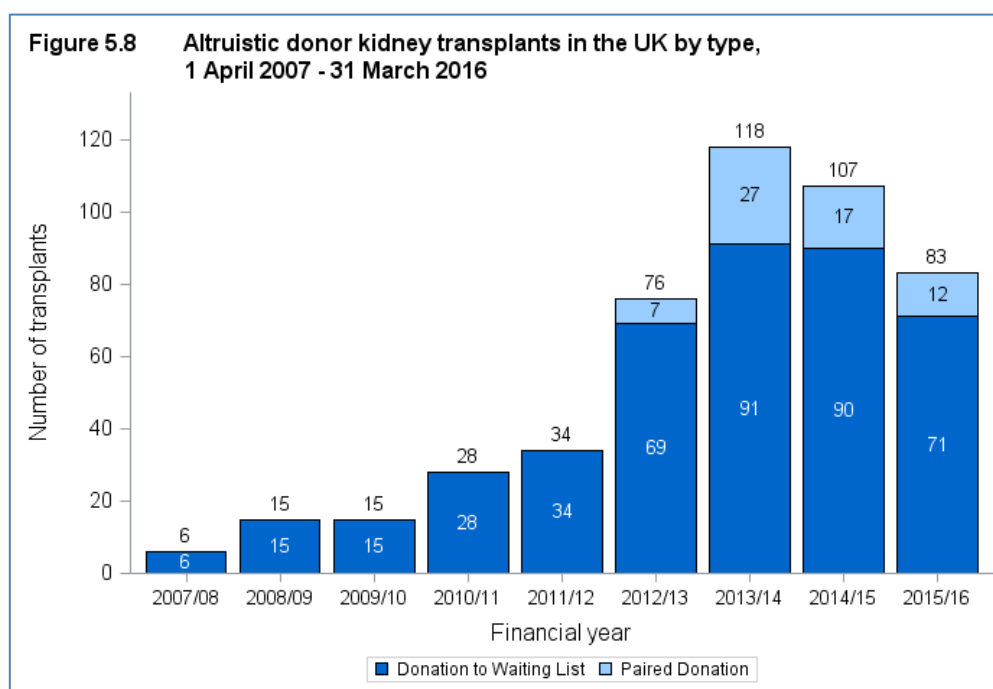
<b>Table 5.4 Transplants by group type and Centre, 1 April 2012 – 31 March 2016</b>				
Centre	Number of Transplants	2-way	3-way	Short Chain
Belfast	36	7	24	1
Birmingham	29	4	7	3
Bristol	22	2	9	3
Cambridge	19	5	8	2
Cardiff	11	3	5	0
Coventry	12	3	7	0
Edinburgh	23	8	10	1
Glasgow	17	3	7	2
GOSH*	3	0	1	1
Guy's	25	8	3	3
Leeds	15	5	7	0
Leicester	11	2	1	0
Liverpool	10	1	6	0
Manchester	34	9	14	4
Newcastle	15	4	4	1
Nottingham	3	0	1	0
Oxford	27	5	10	3
Plymouth	8	3	3	1
Portsmouth	10	3	2	2
Sheffield	6	3	0	0
St George's	24	3	11	6
The Royal Free	11	2	3	1
The Royal London	13	2	2	1
WLRTC	28	7	8	4
<b>UK</b>	<b>412</b>	<b>92</b>	<b>153</b>	<b>39</b>

<b>Table 5.5 Median waiting time to paired donation kidney transplant in the UK, for patients registered 1 April 2006 - 31 March 2012</b>			
Pair Incompatibility	Number of patients registered	Waiting time (days)	
		Median	95% Confidence interval
HLAi	314	1147	686 - 1608
ABOi	247	771	616 - 926
All Pairs	665	1135	815 - 1455

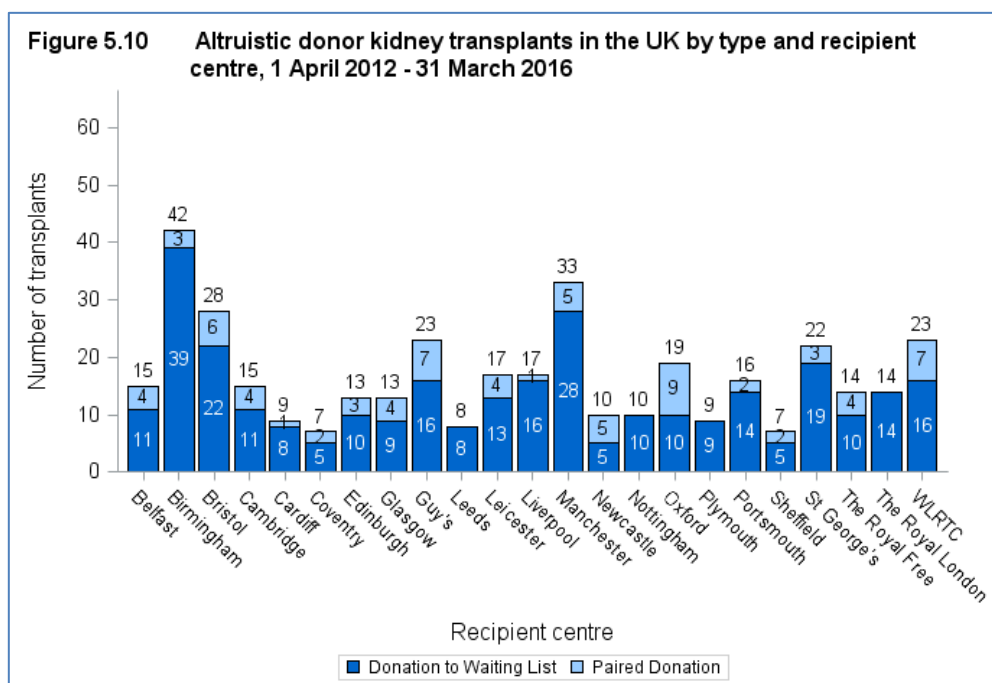
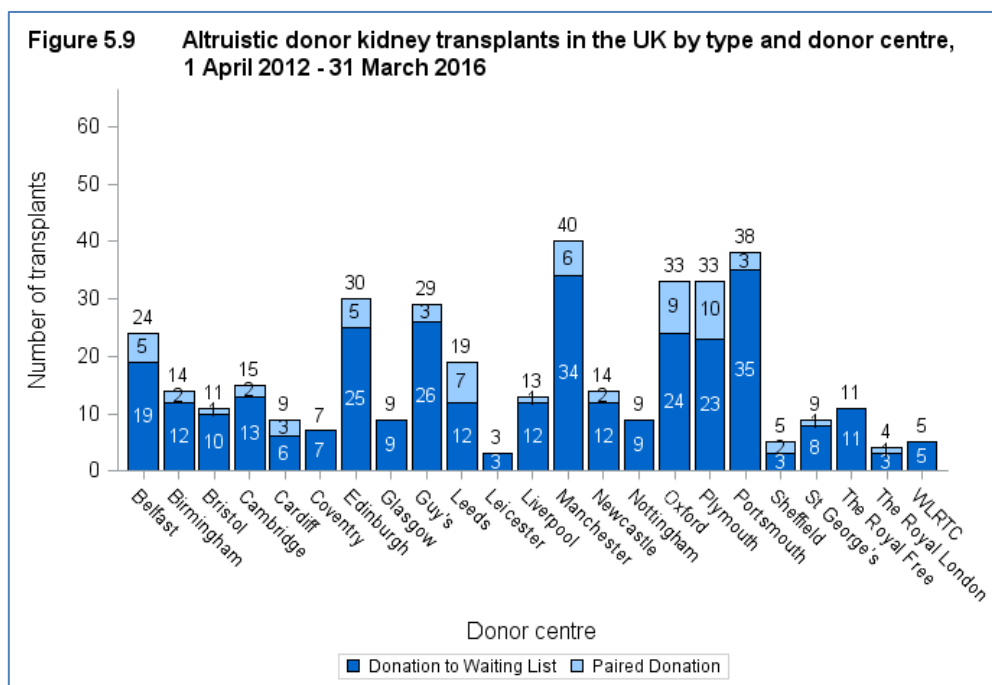
## 5.2 Non-directed Altruistic Donation

### 5.2.1 Transplants, 1 April 2007 – 31 March 2016

**Figure 5.8** shows the number of altruistic donor kidney transplants from 1 April 2007 to 31 March 2016. This is split by whether the donation was to the deceased donor waiting list or the paired donation scheme. The number of transplants has increased from 6 in 2007/08 to 83 in 2015/16.



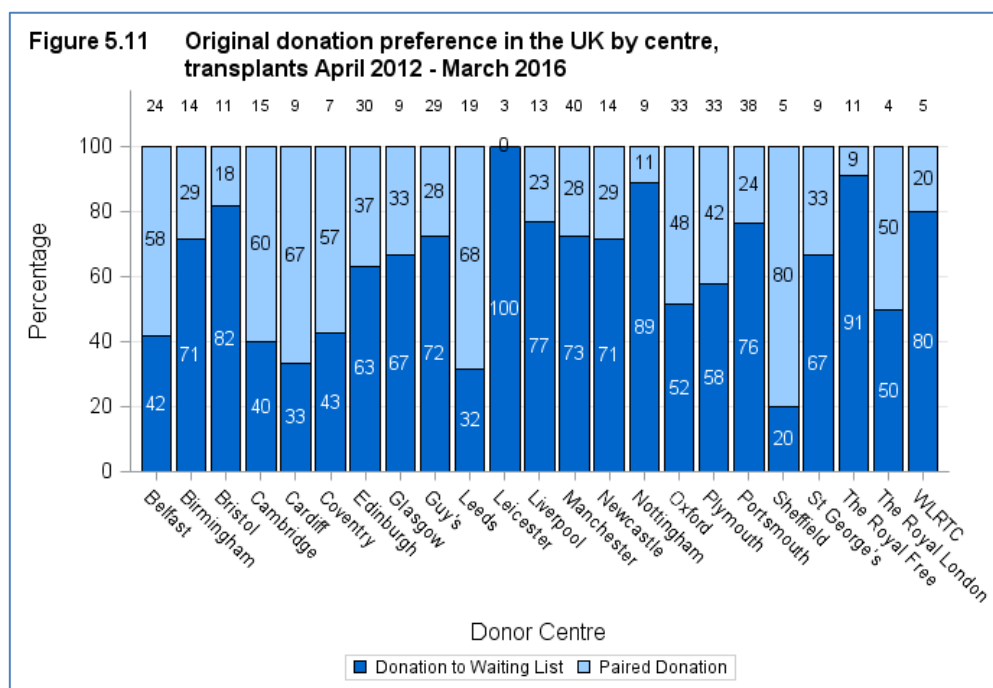
**Figure 5.9** shows the number of altruistic donor kidney transplants from 1 April 2012 to 31 March 2016 by donor centre. Manchester had the highest number of altruistic donors. **Figure 5.10** shows the number of altruistic donor kidney transplant from 1 April 2012 to 31 March 2016 by recipient centre. Birmingham had the highest number of recipients of altruistic donors.





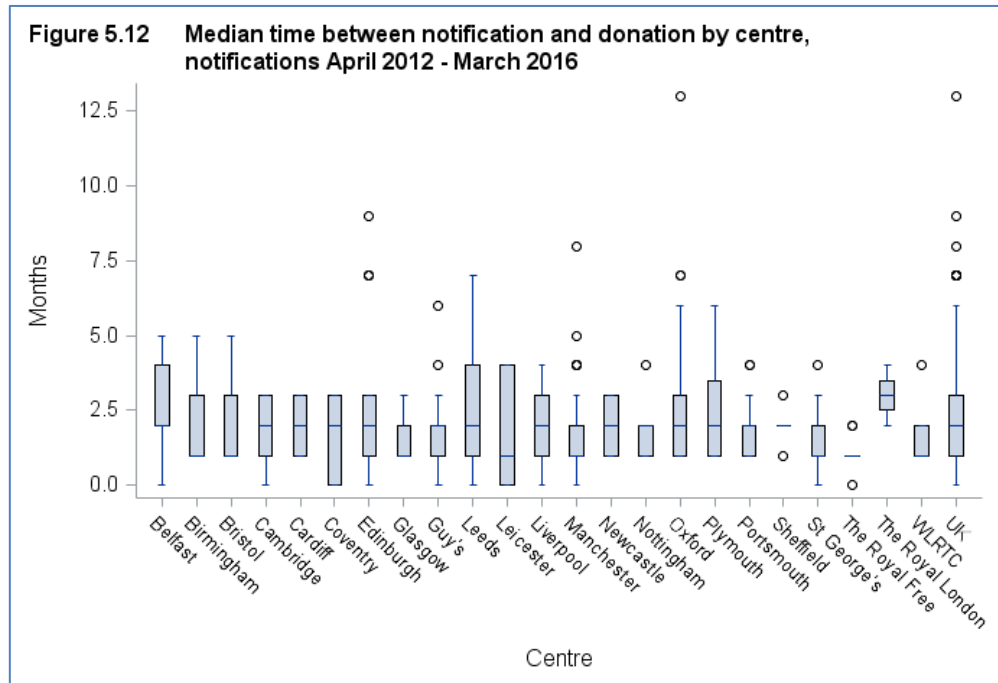
## 5.2.2 Donation Preference, 1 April 2012 – 31 March 2016

**Figure 5.11** shows the original donation preference for altruistic donors from 1 April 2012 to 31 March 2016, by centre. The proportion indicating a preference for donating to the paired donation scheme varies from 0% in Leicester to 80% in Sheffield.



### 5.2.3 Time to donation, 1 April 2012 – 31 March 2016

**Figure 5.12** shows the median time in months from notification to donation from 1 April 2012 to 31 March 2016, by centre. This ranged from 1 to 4 months. This data is shown further in **Table 5.6**.



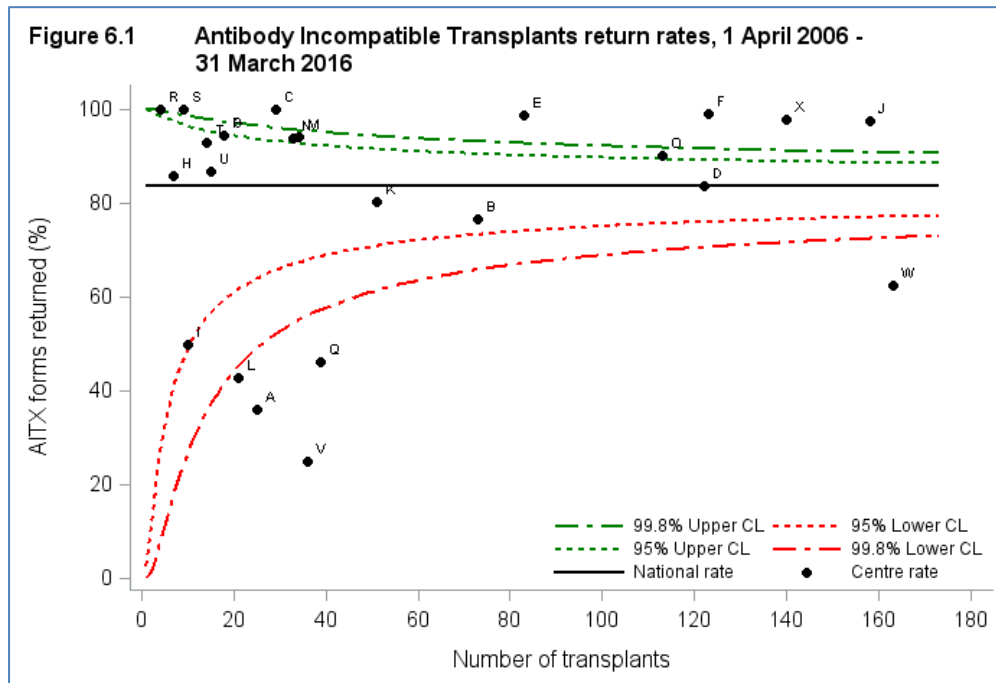
**Table 5.6**      **Median time between notification and donation  
by Centre, Donations April 2012 - March 2016**

Centre	Number of donors	Median	Interquartile range
Belfast	24	2	2 - 4
Birmingham	14	1	1 - 3
Bristol	11	1	1 - 3
Cambridge	15	2	1 - 3
Cardiff	9	2	1 - 3
Coventry	7	2	0 - 3
Edinburgh	29	2	1 - 3
Glasgow	9	1	1 - 2
Guy's	28	2	1 - 2
Leeds	18	2	1 - 4
Leicester	3	1	0 - 4
Liverpool	13	2	1 - 3
Manchester	38	1	1 - 2
Newcastle	14	2	1 - 3
Nottingham	9	2	1 - 2
Oxford	33	2	1 - 3
Plymouth	32	2	1 - 3
Portsmouth	37	2	1 - 2
Sheffield	5	2	2 - 2
St George's	9	1	1 - 2
The Royal Free	10	1	1 - 1
The Royal London	4	3	2 - 3
WLRTC	5	1	1 - 2
			-
<b>UK</b>	<b>376</b>	<b>2</b>	<b>1 - 3</b>
			-

# **Antibody Incompatible Transplants**

This section only includes living donor antibody incompatible kidney only transplants.

Antibody Incompatible transplant data is collected on the Antibody Incompatible Transplant Details form. **Figure 6.1** and **Table 6.1** show the form return rates by centre.



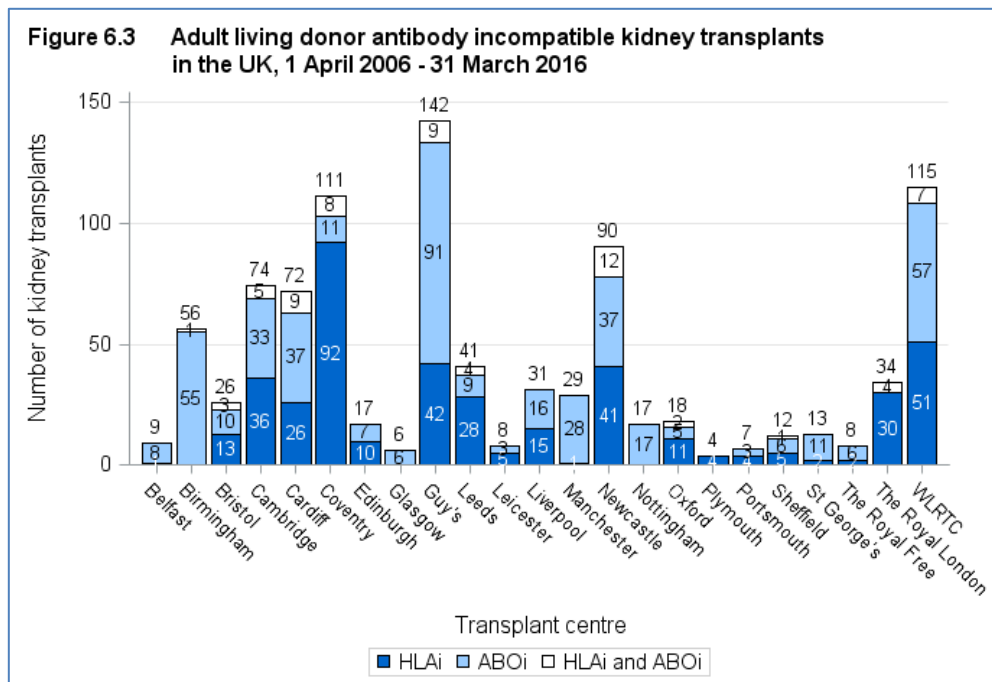
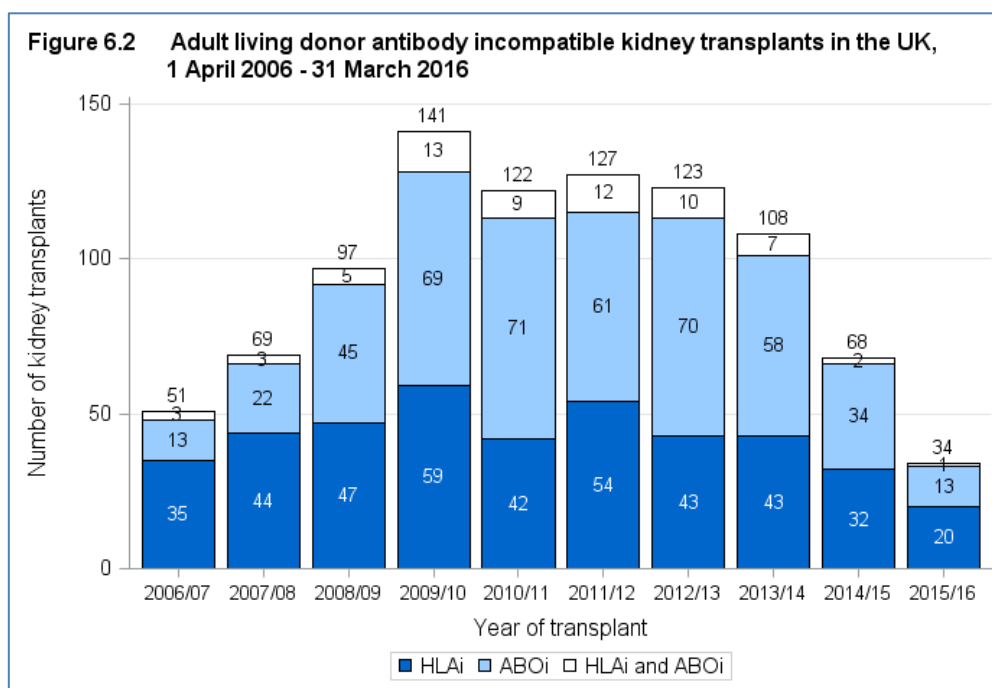
**Table 6.1****Antibody incompatible transplant form return rates,  
1 April 2006 – 31 March 2016**

Transplant Centre	Code	Number of transplants	AITX forms returned	
			N	%
Belfast	A	25	9	36
Birmingham	B	73	56	77
Bristol	C	29	29	100
Cambridge	D	122	102	84
Cardiff	E	83	82	99
Coventry	F	123	122	99
Edinburgh	G	18	17	94
Glasgow	H	7	6	86
GOSH*	I	10	5	50
Guy's	J	158	154	97
Leeds	K	51	41	80
Leicester	L	21	9	43
Liverpool	M	34	32	94
Manchester	N	33	31	94
Newcastle	O	113	102	90
Nottingham	P	18	17	94
Oxford	Q	39	18	46
Plymouth	R	4	4	100
Portsmouth	S	9	9	100
Sheffield	T	14	13	93
St George's	U	15	13	87
The Royal Free	V	36	9	25
The Royal London	W	163	102	63
WLRTC	X	140	137	98
<b>UK</b>		<b>1338</b>	<b>1119</b>	<b>84</b>

In the remainder of this section, data is only presented for those cases where an antibody incompatible form has been returned to NHS Blood and Transplant.

## ADULT

Figures 6.2 and 6.3 show the number of living donor antibody incompatible kidney transplants by financial year and centre respectively.



**Table 6.1** shows the donor and recipient blood group for all ABOi transplants.

<b>Table 6.1 Donor and recipient blood group for adult ABOi transplants, 1 April 2006 - 31 March 2016</b>						
<b>Recipient blood group</b>	<b>Donor blood group</b>					
	<b>A</b>		<b>B</b>		<b>AB</b>	
	<b>N</b>	<b>(%)</b>	<b>N</b>	<b>(%)</b>	<b>N</b>	<b>(%)</b>
A	-		56	(10.8)	37	(7.1)
B	62	(11.9)	-		22	(4.2)
O	250	(48.1)	86	(16.5)	7	(1.3)

**Table 6.2** shows the donor and recipient ABO by recipient CRF at transplant.

<b>Table 6.2 Donor and recipient ABO by recipient CRF at transplant, 1 April 2006 - 31 March 2016</b>								
<b>Donor-Recipient ABO</b>	<b>0-9</b>		<b>10-84</b>		<b>85-94</b>		<b>95-100</b>	
	<b>N</b>	<b>(%)</b>	<b>N</b>	<b>(%)</b>	<b>N</b>	<b>(%)</b>	<b>N</b>	<b>(%)</b>
A-A	19	(2)	26	(3)	20	(2)	44	(5)
A-AB	1	(<1)	2	(<1)	1	(<1)	2	(<1)
A-B	40	(4)	10	(1)	3	(<1)	9	(1)
A-O	166	(18)	57	(6)	6	(1)	22	(2)
AB-A	27	(3)	7	(1)	2	(<1)	1	(<1)
AB-AB	1	(<1)	-		1	(<1)	3	(<1)
AB-B	16	(2)	3	(<1)	1	(<1)	2	(<1)
AB-O	6	(1)	-		-		1	(<1)
B-A	40	(4)	8	(1)	3	(<1)	5	(1)
B-AB	1	(<1)	-		1	(<1)	1	(<1)
B-B	6	(1)	4	(<1)	3	(<1)	7	(1)
B-O	58	(6)	20	(2)	3	(<1)	5	(1)
O-A	18	(2)	16	(2)	9	(1)	19	(2)
O-AB	3	(<1)	1	(<1)	-		-	
O-B	2	(<1)	12	(1)	2	(<1)	9	(1)
O-O	37	(4)	45	(5)	30	(3)	73	(8)



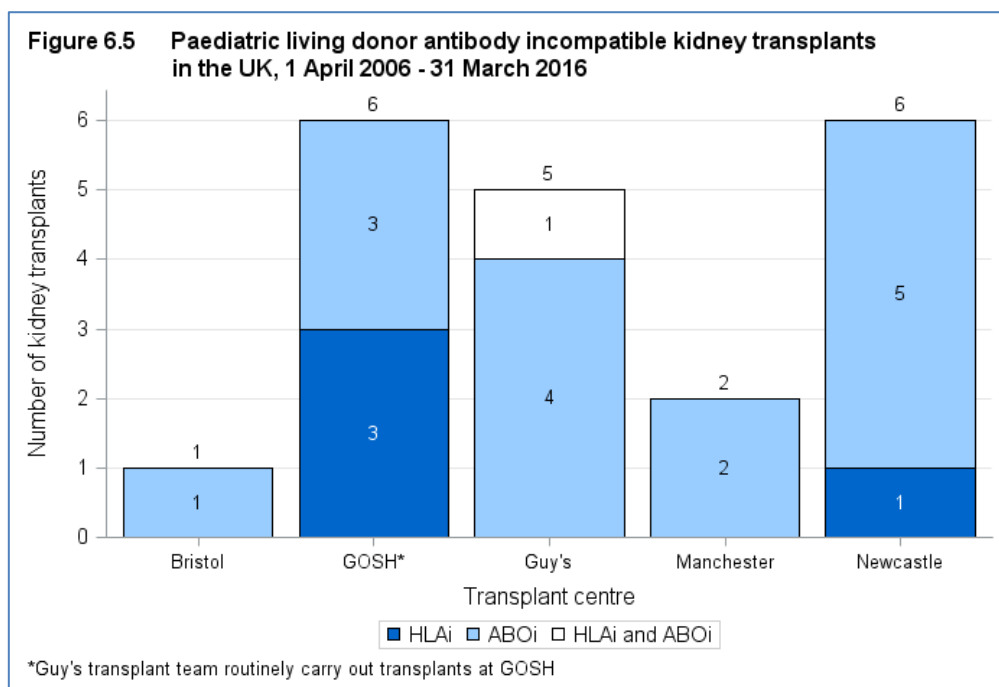
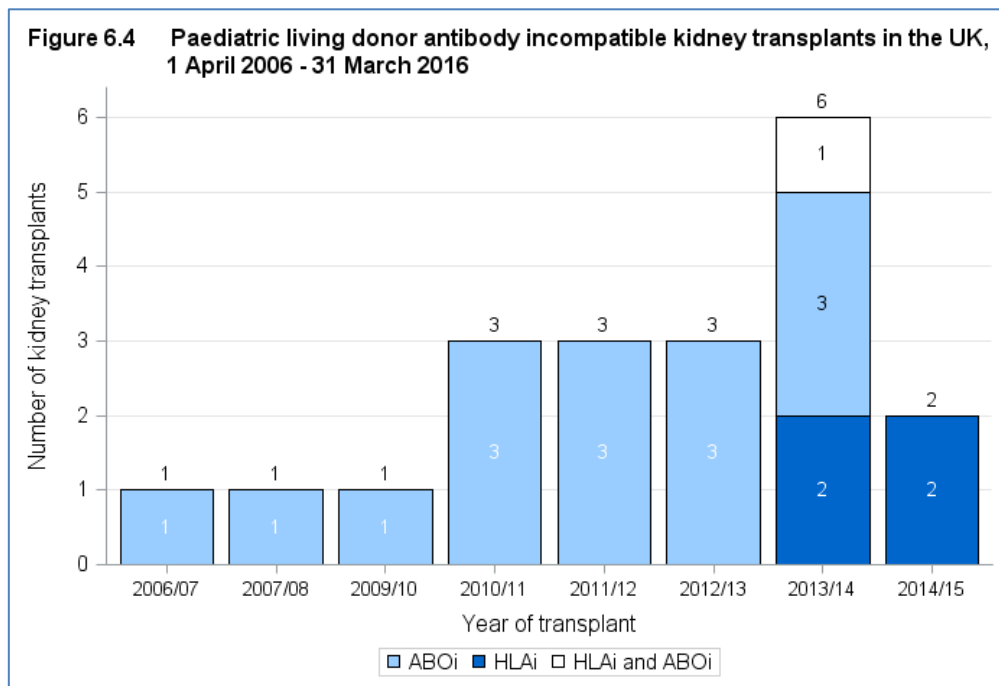
**Table 6.3** shows the pre and at transplant level group for all HLAI transplants. **Table 6.4** shows the calculated reaction frequency by incompatibility type.

Table 6.3 Pre and at transplant antibody level group for all adult HLAI transplants, 1 April 2006 - 31 March 2016										
Pre treatment antibody level group	At Transplant antibody level group									
	CDC pos, Flow pos, DSA SPA pos N (%)	CDC neg, Flow pos, DSA SPA pos N (%)	CDC neg, Flow neg, DSA SPA pos N (%)	CDC neg, Flow neg, DSA SPA neg N (%)	CDC NT, Flow pos, DSA SPA pos N (%)	Unknown N (%)				
CDC NT, Flow pos, DSA SPA pos	-	1 (<1)	22 (5)	2 (<1)	13 (3)	1 (<1)				
CDC neg, Flow neg, DSA SPA pos	-	1 (<1)	118 (24)	27 (6)	-	1 (<1)				
CDC neg, Flow pos, DSA SPA pos	-	101 (21)	54 (11)	47 (10)	-	18 (4)				
CDC pos, Flow pos, DSA SPA pos	15 (3)	27 (6)	14 (3)	7 (1)	1 (<1)	3 (1)				
Unknown	-	1 (<1)	-	2 (<1)	-	9 (2)				

Table 6.4 At transplant calculated reaction frequency by incompatibility type, 1 April 2006 - 31 March 2016						
Calculated Reaction Frequency	ABOi		HLAi		HLAi and ABOi	
	N	%	N	%	N	%
0-9	12	(19)	342	(75)	88	(21)
10-84	16	(25)	89	(20)	106	(25)
85-94	7	(11)	11	(2)	67	(16)
95-100	30	(46)	14	(3)	159	(38)

## PAEDIATRIC

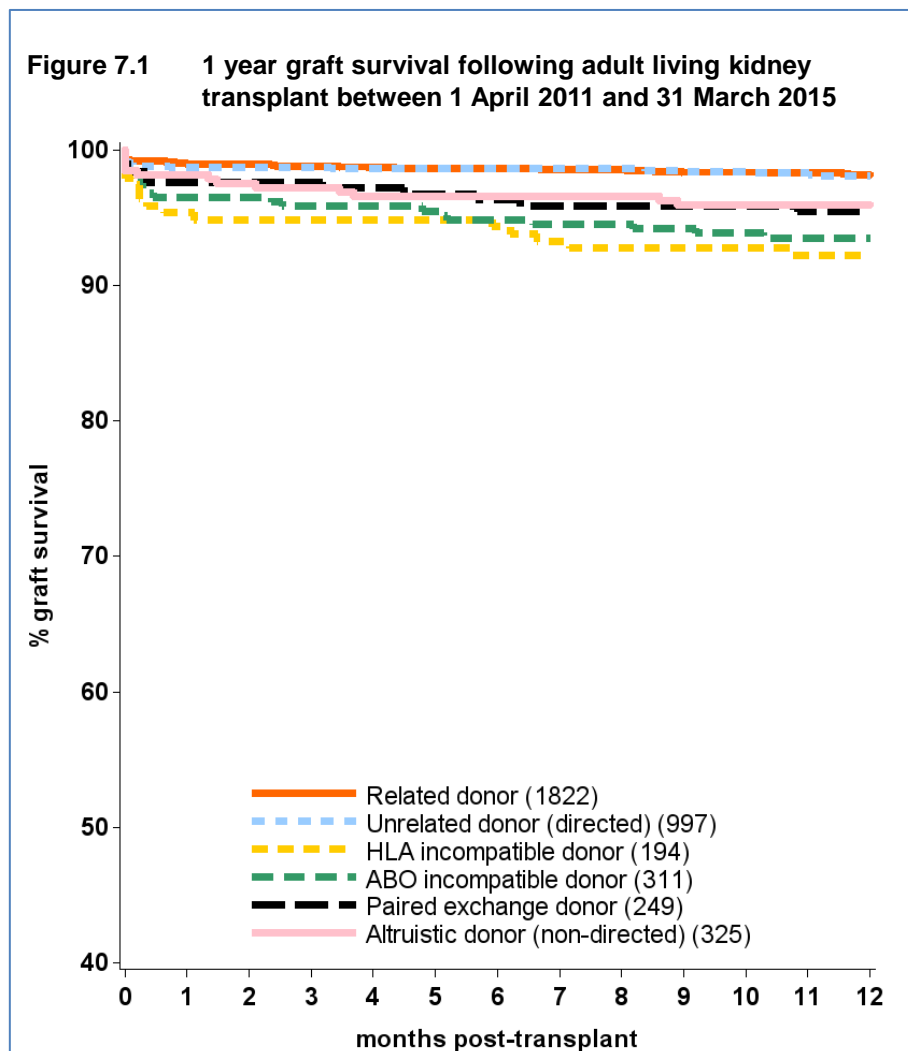
Figures 6.4 and 6.5 show the number of living donor antibody incompatible kidney transplants by financial year and centre respectively.



## **Recipient Graft and Patient survival**

## ADULT

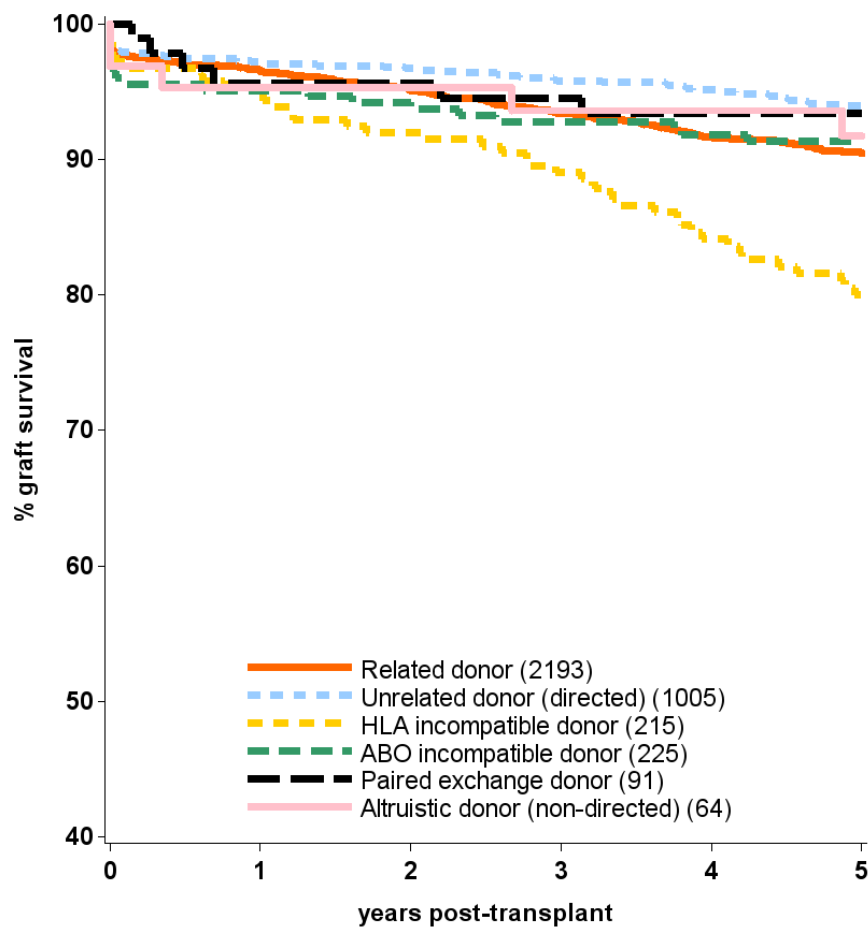
One and five year graft and patient survival are shown in **Figures 7.1-7.4** following adult living donor kidney transplants by donor type. **Tables 7.1-7.4** show the survival rates and 95% confidence limits.



**Table 7.1 1 year graft survival following adult living kidney transplant between 1 April 2011 and 31 March 2015 (p<0.0001)**

Living Donors	No. at risk on day 0	% Graft survival	(95% confidence interval)
Related donor	1822	98.2	(97-99)
Unrelated donor (directed)	997	98.1	(97-99)
Altruistic donor (non-directed)	325	95.9	(93-98)
Paired exchange donor	249	95.4	(92-97)
ABO incompatible donor	311	93.5	(90-96)
HLA incompatible donor	194	92.2	(87-95)

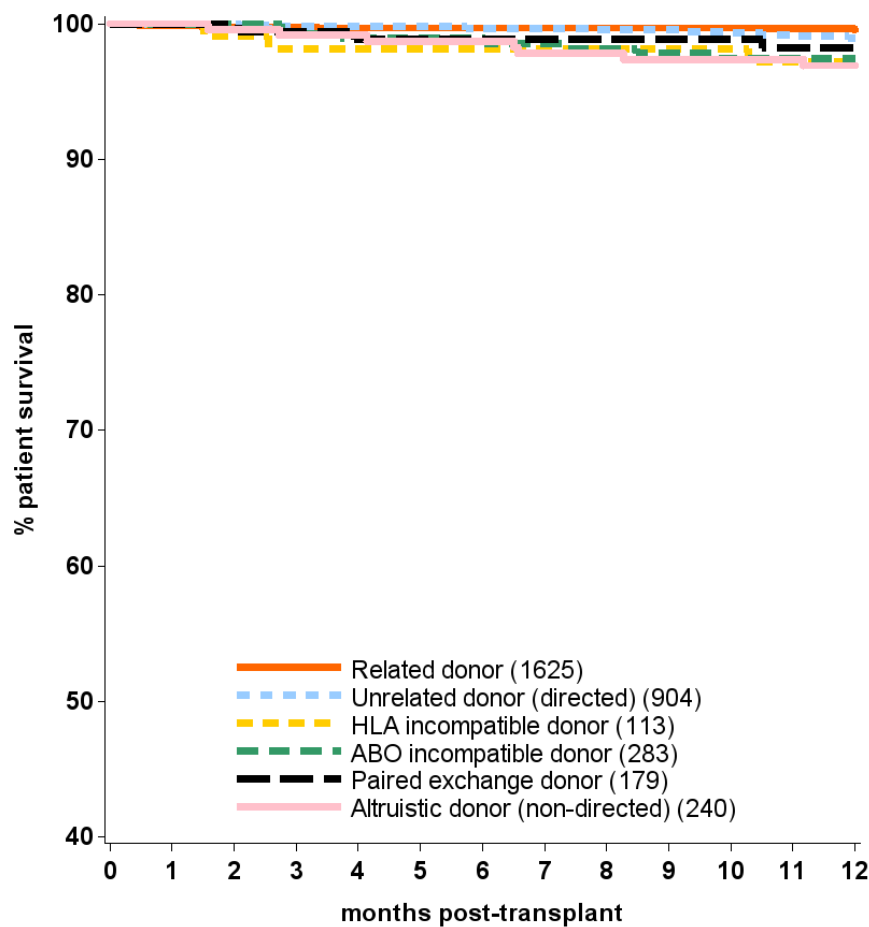
**Figure 7.2** 5 year graft survival following adult living kidney transplant between 1 April 2007 and 31 March 2011



**Table 7.2** 5 year graft survival following adult living kidney transplant between 1 April 2007 and 31 March 2011 (p<0.0001)

Living Donors	No. at risk on day 0	% Patient survival	(95% confidence interval)
Unrelated donor (directed)	1002	94.1	(92-95)
Paired exchange donor	91	93.4	(86-97)
Altruistic donor (non-directed)	61	91.3	(80-96)
ABO incompatible donor	220	91.1	(86-94)
Related donor	1958	90.7	(89-92)
HLA incompatible donor	215	80.0	(74-85)

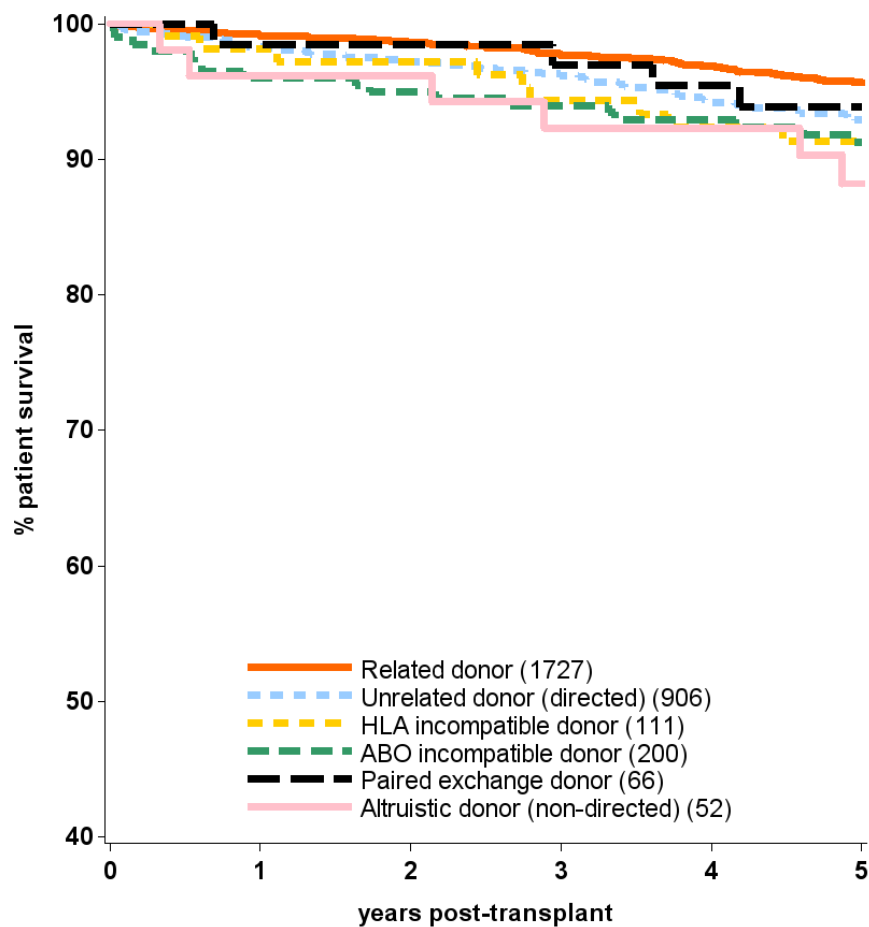
**Figure 7.3 1 year patient survival following adult living kidney transplant between 1 April 2011 and 31 March 2015**



**Table 7.3 1 year patient survival following adult living kidney transplant between 1 April 2011 and 31 March 2015 (p=0.0003)**

Living Donors	No. at risk on day 0	% Graft survival	(95% confidence interval)
Related donor	1625	99.6	(99-100)
Unrelated donor (directed)	904	98.9	(98-99)
Paired exchange donor	179	98.2	(95-99)
ABO incompatible donor	283	97.4	(95-99)
HLA incompatible donor	113	97.2	(92-99)
Altruistic donor (non-directed)	240	96.9	(94-99)

**Figure 7.4 5 year patient survival following adult living kidney transplant between 1 April 2007 and 31 March 2011**



**Table 7.4 5 year patient survival following adult living kidney transplant between 1 April 2007 and 31 March 2011 (p=0.003)**

Living Donors	No. at risk on day 0	% Patient survival (95% confidence interval)	
Related donor	1727	95.7	(95-97)
Paired exchange donor	66	93.9	(85-98)
Unrelated donor (directed)	906	92.9	(91-94)
HLA incompatible donor	111	91.3	(84-95)
ABO incompatible donor	200	91.2	(86-94)
Altruistic donor (non-directed)	52	88.2	(76-95)

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 survival rate plotted against the number of transplants for each centre, with the overall national 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

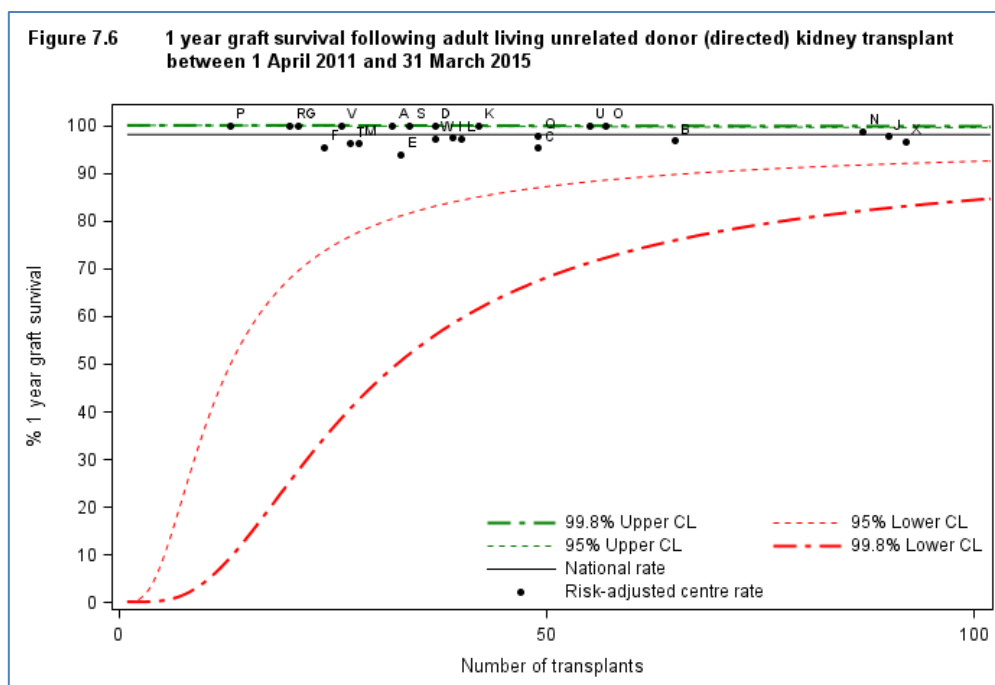
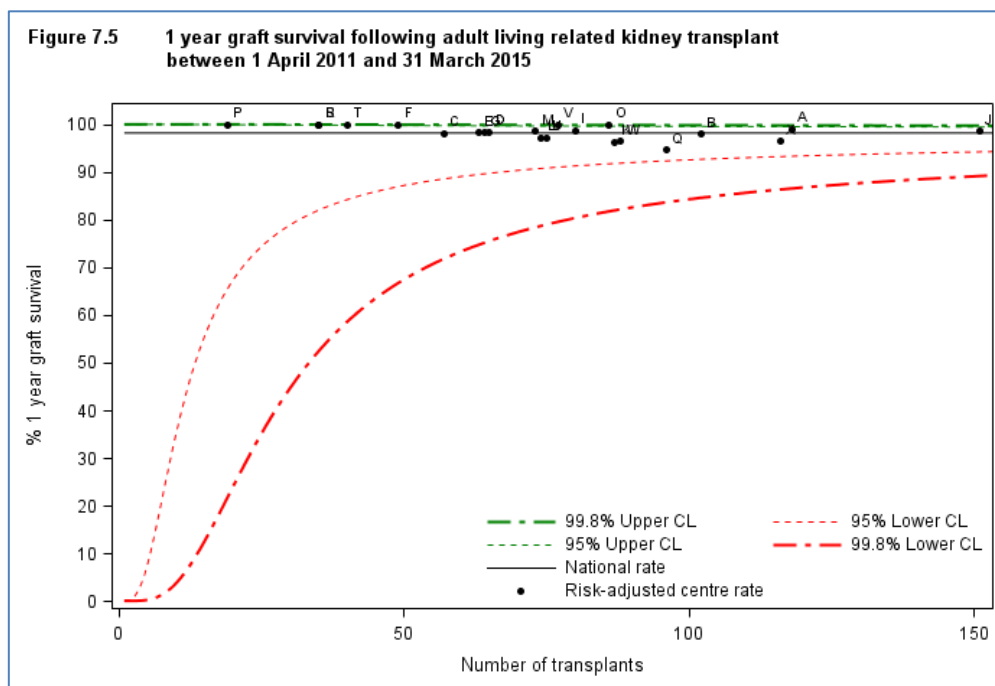
If a centre lies within all the limits, then that centre has a survival rate that is statistically consistent with the national rate. If a centre lies outside the 95% confidence limits, this serves as an alert that the centre may have a rate that is significantly different from the national rate. If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

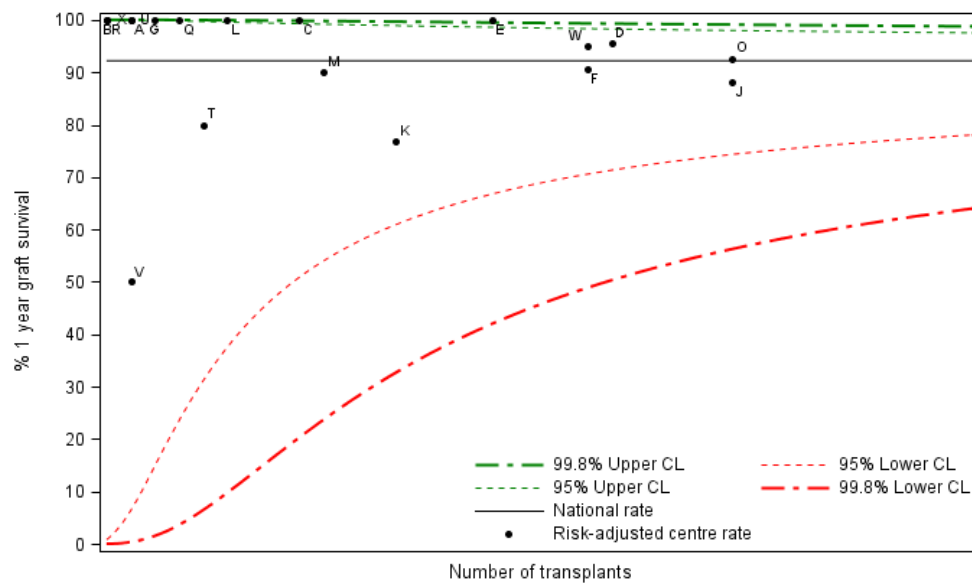
1. Tekkis PP, McCulloch P, Steger AC, Benjamin IS, Poloniecki JD. Mortality control charts for comparing performance of surgical units: validation study using hospital mortality data. *British Medical Journal* 2003; 326: 786 – 788.
2. Stark J, Gallivan S, Lovegrove J, Hamilton JRL, Monroe JL, Pollock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



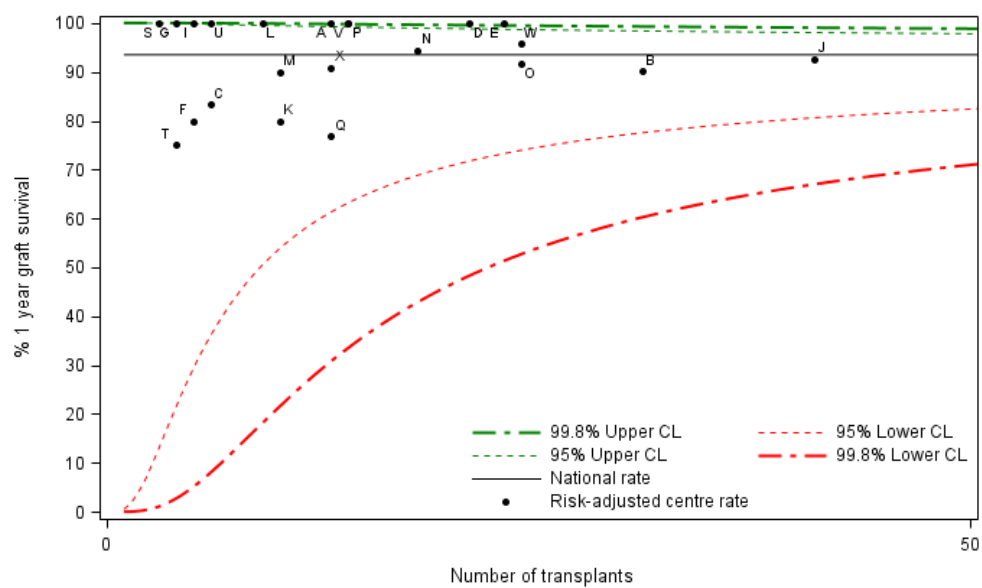
**Figures 7.5 to 7.10** shows one year risk adjusted survival rates following adult living donor kidney transplants by centre for each donor type. **Table 7.5** shows the survival rates by centre and donor type.



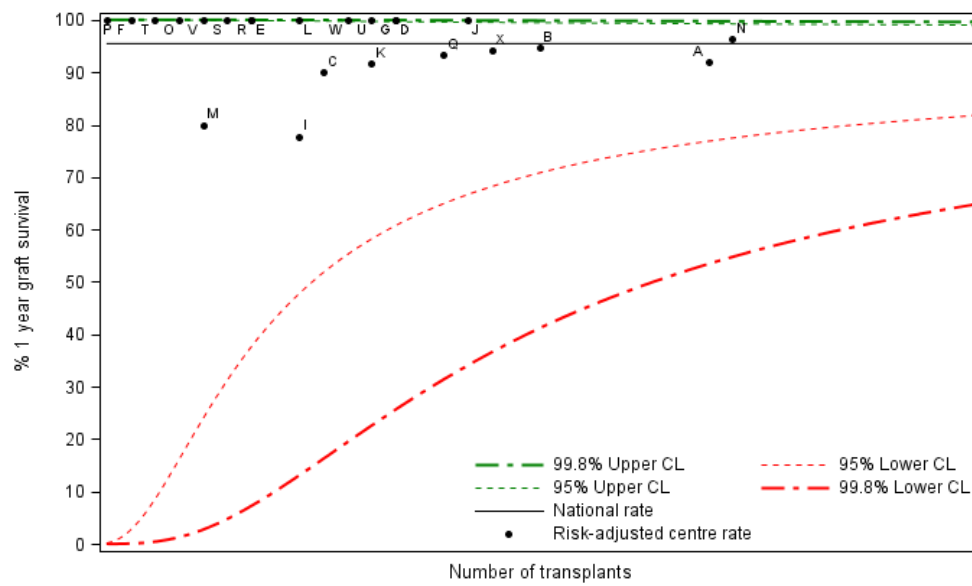
**Figure 7.7 1 year graft survival following adult living HLAi donor kidney transplant between 1 April 2011 and 31 March 2015**



**Figure 7.8 1 year graft survival following adult living ABOi donor kidney transplant between 1 April 2011 and 31 March 2015**



**Figure 7.9 1 year graft survival following adult living paired exchange donor kidney transplant between 1 April 2011 and 31 March 2015**



**Figure 7.10 1 year graft survival following adult living altruistic donor (non-directed) kidney transplant between 1 April 2011 and 31 March 2015**

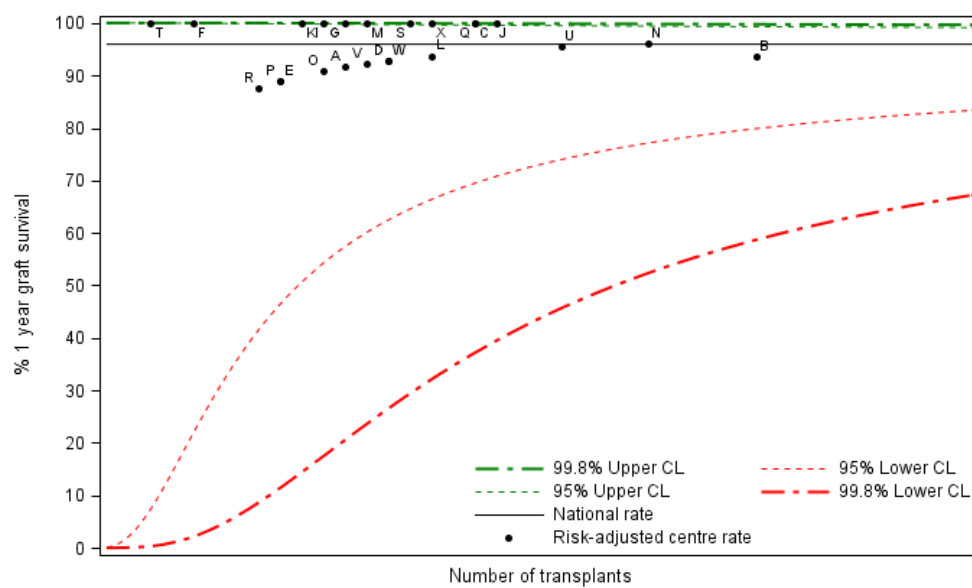


Table 7.5													
1 year graft survival following adult living donor kidney transplant between 1 April 2011 and 31 March 2015, by donor type and centre													
Centre	Code	Related		Unrelated		HLAi		ABOi		Paired		Altruistic	
		N	% <sup>1</sup>	N	% <sup>1</sup>	N	% <sup>1</sup>	N	% <sup>1</sup>	N	% <sup>1</sup>	N	% <sup>1</sup>
Belfast	A	118	99	32	100	2	100	13	100	26	92	12	92
Birmingham	B	102	98	65	97	1	100	31	90	19	95	31	94
Bristol	C	57	98	49	95	9	100	6	83	10	90	18	100
Cambridge	D	65	98	37	100	22	95	21	100	13	100	14	93
Cardiff	E	63	98	33	94	17	100	23	100	7	100	9	89
Coventry	F	49	100	24	95	21	90	5	80	2	100	5	100
Edinburgh	G	64	98	21	100	3	100	4	100	13	100	12	100
Glasgow	I	80	99	39	97	0		5	100	9	78	11	100
Guy's	J	151	99	90	98	27	88	41	93	16	100	19	100
Leeds	K	87	96	42	100	13	77	10	80	12	92	10	100
Leicester	L	74	97	40	97	6	100	9	100	9	100	16	94
Liverpool	M	73	99	28	96	10	90	10	90	5	80	13	100
Manchester	N	168	98	87	99	0		18	94	27	96	26	96
Newcastle	O	86	100	57	100	27	93	24	92	4	100	11	91
Nottingham	P	19	100	13	100	0		14	100	1	100	9	89
Oxford	Q	96	95	49	98	4	100	13	77	15	93	18	100
Plymouth	R	35	100	20	100	1	100	0		7	100	8	88
Portsmouth	S	35	100	34	100	0		3	100	6	100	15	100
Sheffield	T	40	100	27	96	5	80	4	75	3	100	3	100
St George's	U	75	97	55	100	2	100	6	100	12	100	22	95
The Royal Free	V	77	100	26	100	2	50	14	100	5	100	13	92
The Royal London	W	88	97	37	97	21	95	24	96	11	100	14	93
WLRTC	X	116	97	92	97	1	100	13	91	17	94	16	100
UK		1818	98	997	98	194	92	311	93	249	95	325	96
<sup>1</sup> % 1 year graft survival													

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Numbers are too small to present paediatric graft and patient survival broken down by living donor transplant type. Overall living donor survival is presented in the Annual report on kidney transplantation.

# Appendix

## **A1 Glossary of terms**

### **ABO**

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

### **Active transplant list**

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

### **Case mix**

The types of patients treated at a unit for a common condition. This can vary across units depending on the facilities available at the unit as well as the types of people in the catchment area of the unit. The definition of what type of patient a person is depends on the patient characteristics that influence the outcome of the treatment. For example the case mix for patients registered for a kidney transplant is defined in terms of various factors such as the blood group, tissue type and age of the patient. These factors have an influence on the chance of a patient receiving a transplant.

### **Confidence interval (CI)**

When an estimate of a quantity such as a survival rate is obtained from data, the value of the estimate depends on the set of patients whose data were used. If, by chance, data from a different set of patients had been used, the value of the estimate may have been different. There is therefore some uncertainty linked with any estimate. A confidence interval is a range of values whose width gives an indication of the uncertainty or precision of an estimate. The number of transplants or patients analysed influences the width of a confidence interval. Smaller data sets tend to lead to wider confidence intervals compared to larger data sets. Estimates from larger data sets are therefore more precise than those from smaller data sets. Confidence intervals are calculated with a stated probability, usually 95%. We then say that there is a 95% chance that the confidence interval includes the true value of the quantity we wish to estimate.

### **Confidence limit**

The upper and lower bounds of a confidence interval.

### **Cox Proportional Hazards model**

A statistical model that relates the instantaneous risk (hazard) of an event occurring at a given time point to the risk factors that influence the length of time it takes for the

event to occur. This model can be used to compare the hazard of an event of interest, such as graft failure or patient death, across different groups of patients.

### **Cross-match**

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

### **Donor after brain death (DBD)**

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

### **Donor after circulatory death (DCD)**

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

### **Funnel plot**

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

### **Graft survival rate**

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

### **HLA mismatch**

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

locus. For example, an HLA mismatch value of 000, means that the donor and recipient are identical at all three loci, while an HLA mismatch value of 210 means that the donor and recipient differ completely at the A locus, are partly the same at the B locus and are identical at the DR locus.

### **Inter-quartile range**

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

### **Kaplan-Meier method**

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

### **Live donor**

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

### **Median**

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

### **Multi-organ transplant**

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

### **National Kidney Allocation Scheme**

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

### **Patient survival rate**

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



**p value**

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

**Pre-emptive**

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

**Risk-adjusted survival rate**

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

**Risk factors**

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

**Unadjusted survival rate**

Unadjusted survival rates do not take account of risk factors and are based only on the number of transplants at a given centre and the number and timing of those that fail within the post-transplant period of interest. In this case, unlike for risk-adjusted rates, all transplants are assumed to be equally likely to fail at any given time. However, some centres may have lower unadjusted survival rates than others simply because they tend to undertake transplants that have increased risks of failure. Comparison of unadjusted survival rates across centres and to the national rate is therefore inappropriate.

## **A2 Statistical methodology for survival rate estimation**

Unadjusted 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.

### **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.

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