NHS
Blood and Transplant

KIDNEY TRANSPLANTATION ANNUAL RENAL UNIT REPORT

REPORT FOR 2016/2017
(1 APRIL 2011 – 31 MARCH 2017)

SEPTEMBER 2018

PRODUCED IN COLLABORATION WITH THE UK RENAL REGISTRY

Contents

Introduction

This report presents information on transplant activity between 1 April 2014 and 31 March 2017, for all 71 renal centres 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. Renal unit information was supplied by the UK Renal Registry.

Graft and patient survival estimates are reported at one-year post-transplant for the period 1 April 2012 to 31 March 2016 and five-year post-transplant for the period 1 April 2008 to 31 March 2012. Results are described separately according to the type of donor (deceased and living).

eGFR post-transplant is reported at 3 months and one year post transplant for a deceased and living donor adult kidney only transplant between 1 April 2012 and 31 March 2016. Results are described separately according to the type of donor (deceased and living).

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 for adult (aged≥18years) patients.

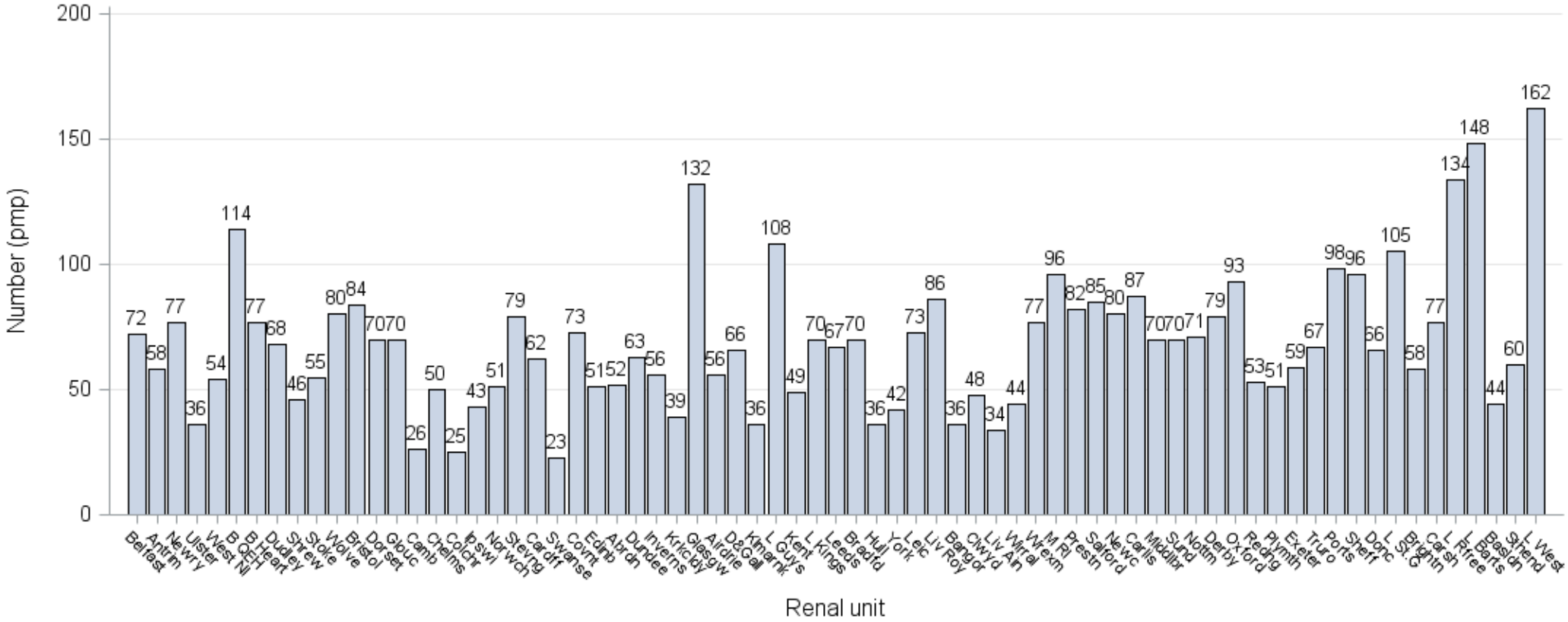
Use of the contents of this report should be acknowledged as follows:
Annual Report on Kidney Transplantation 2017/18 by Renal Unit, NHS Blood and Transplant.

Adult kidney transplant list

1.1 Patients on the kidney transplant list as at 31 March 2017

Figure 1.1 shows the number of adult patients on the active kidney only transplant list per millions population (pmp) at 31 March 2017 by renal unit. London West had the highest rate of adult patients on the waiting list per million population.

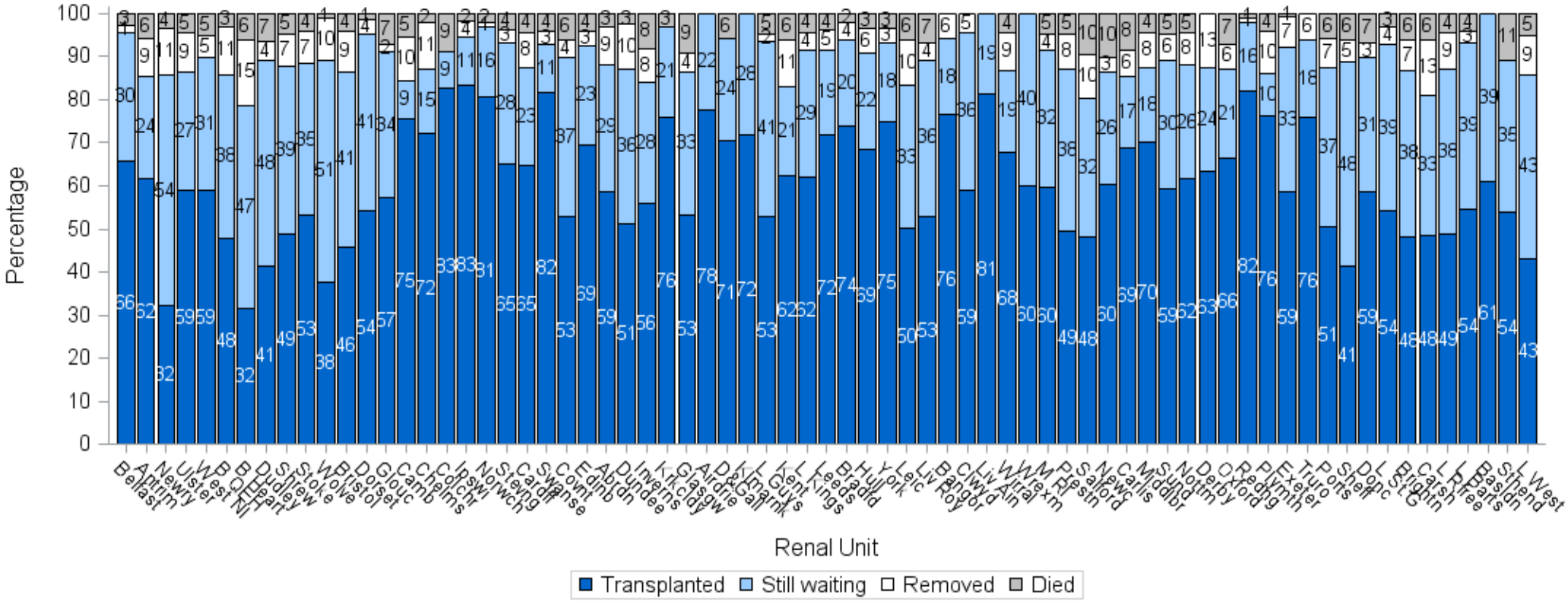
Figure 1.1 Adult patients on the active kidney only transplant list (pmp) end of month average, 30 April 2016 - 31 March 2017, by renal unit



1.2 Post-registration outcomes, 1 April 2011 – 31 March 2014

Figure 1.2 shows the proportion of patients transplanted or still waiting three years after joining the list by renal unit. The proportion of patients transplanted three years after listing at each unit ranges from 32% at Newry to 83% at Colchester and Ipswich.

Figure 1.2 Three-year post-registration outcome for 8654 new adult kidney only registrations made in the UK, 1 April 2011 - 31 March 2014, by renal unit



1.3 Demographic characteristics, 1 April 2014 – 31 March 2017

The ethnicity and age group of patients on the transplant list are shown by renal unit in **Figure 1.3** and **1.4,** 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.

Figure 1.3 Adult registrations on the active kidney only transplant list, 1 April 2014 and 31 March 2017, by renal unit

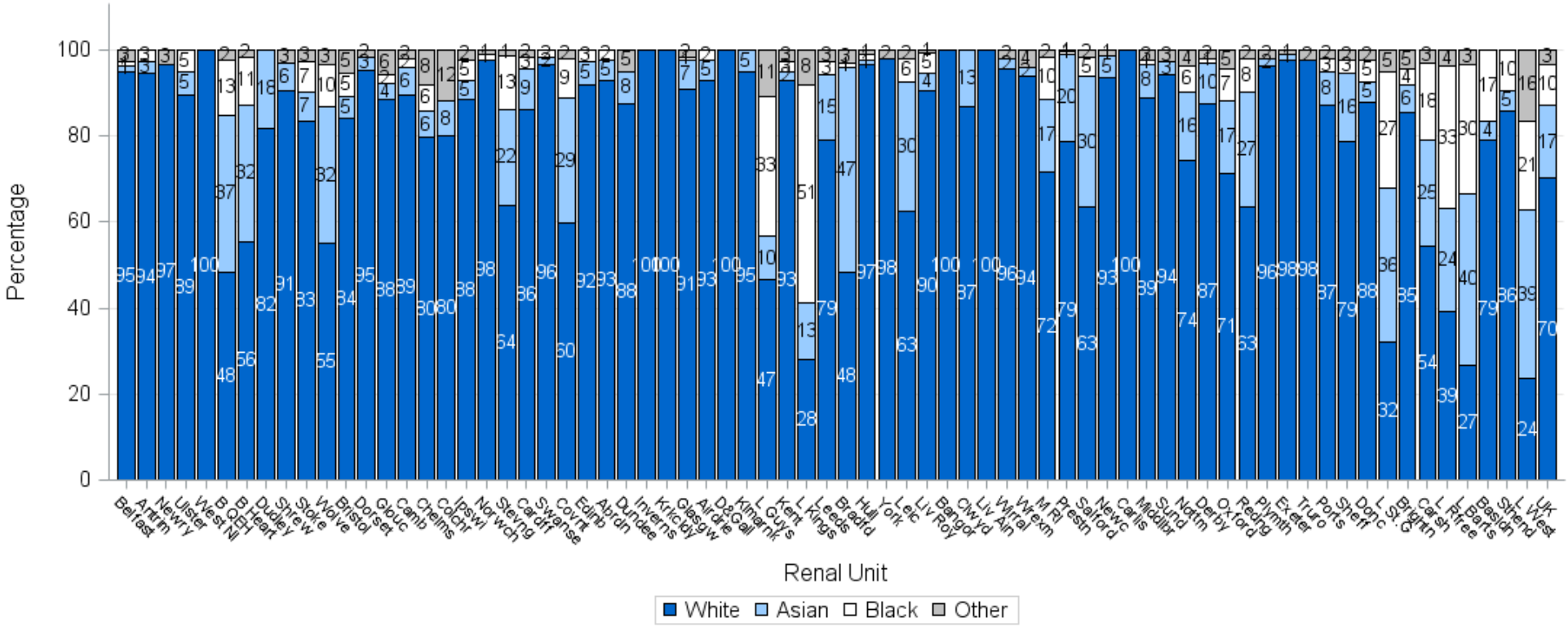
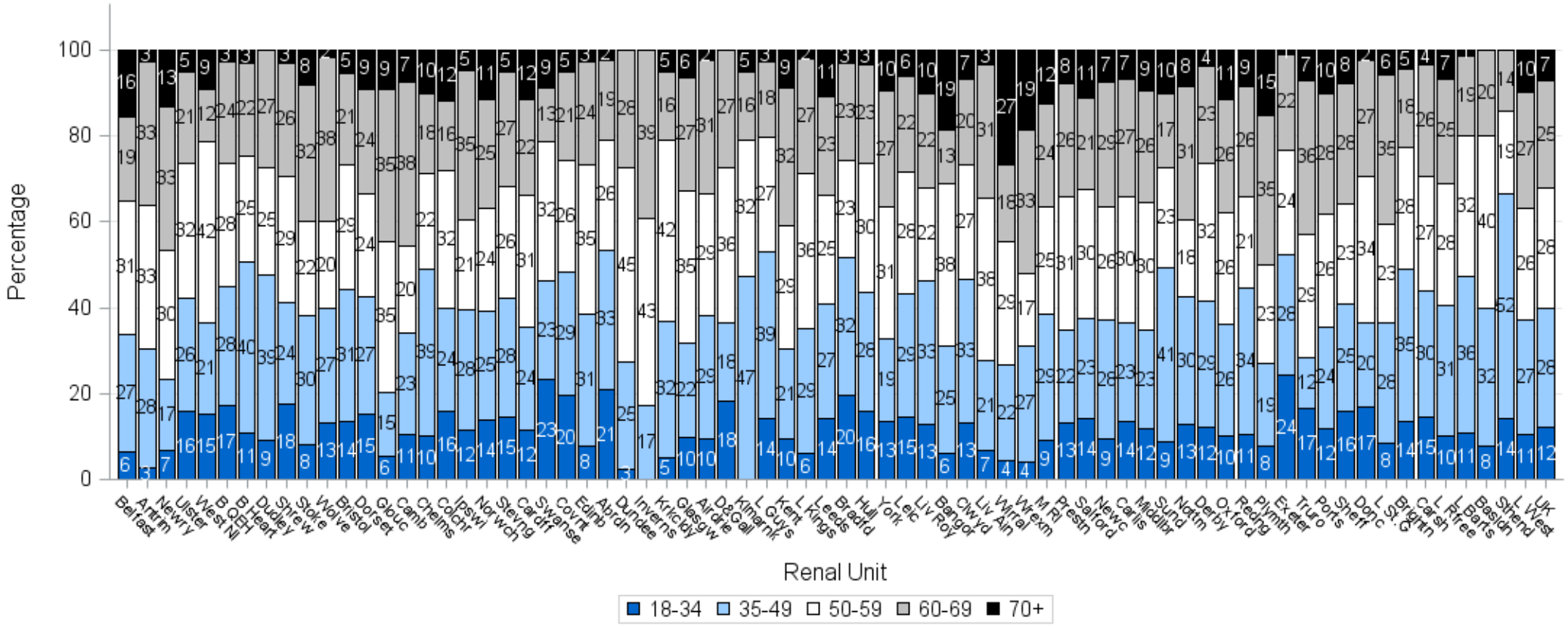


Figure 1.4 Adult registrations on the active kidney only transplant list, 1 April 2014 and 31 March 2017, by renal unit

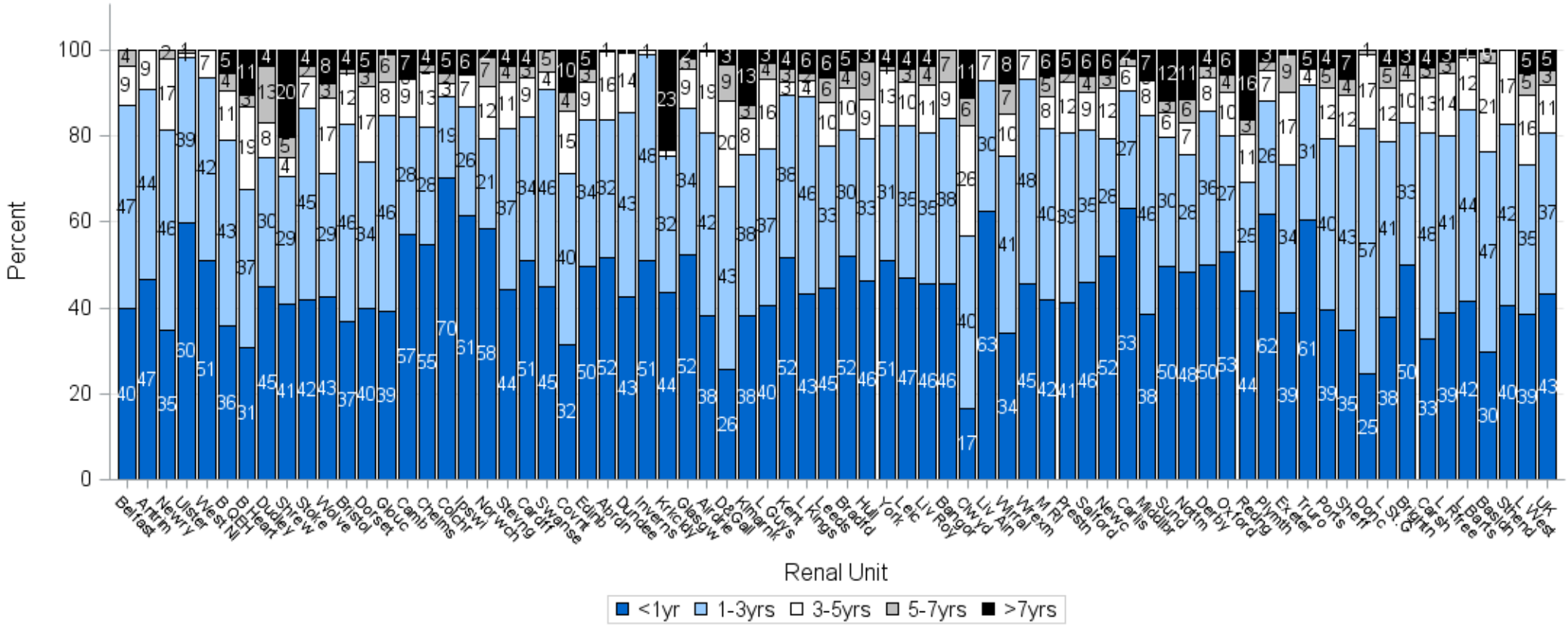


1.4 Patient waiting times for those currently on the list, 31 March 2017

Figure 1.5 shows the length of time patients have been waiting on the kidney only transplant list at 31 March 2017 by renal unit. A small proportion of patients have been waiting for a transplant for more than seven years, 99% of these are highly sensitised with a calculated reaction frequency (cRF) of 85% or higher. 89% have a cRF of 100% which makes these patients very difficult to match.

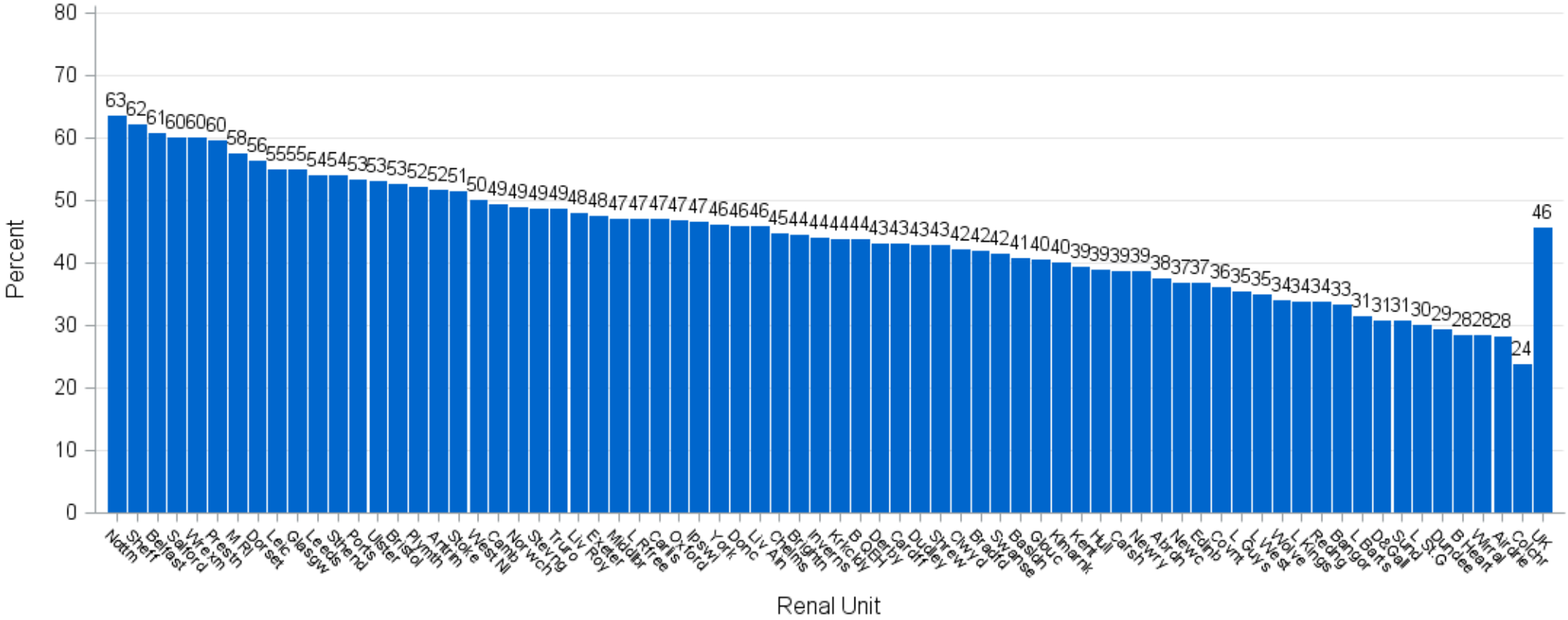
1.5 Pre-emptive listing rates, 1 April 2013 - 31 March 2016

Figure 1.5 Adult patients on the active kidney only transplant list as at 31 March 2017, by renal unit



Rates of pre-emptive kidney only listings are shown in **Figure 1.6** for adult patients joining the list between 1 April 2013 and 31 March 2016. 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 46% of all adult registrations across the UK ranging from 63% at Nottingham to 24% at Colchester.

Figure 1.6 Adult pre-emptive listing rates by centre, registrations between 1 April 2013 and 31 March 2016



Adult kidney transplants

2.1 Kidney only transplants, 1 April 2014 – 31 March 2017

Figure 2.1 shows the number of adult kidney only transplants performed per million population (pmp) between 1 April 2014 and 31 March 2017, by renal unit and type of donor. Guy's had the highest rate of adult kidney only transplants per million population. **Figure 2.2** shows the proportion of DBD, DCD and living donor transplants performed for each unit.

Figure 2.1 Adult kidney only transplants (pmp) annual average, 1 April 2014 - 31 March 2017

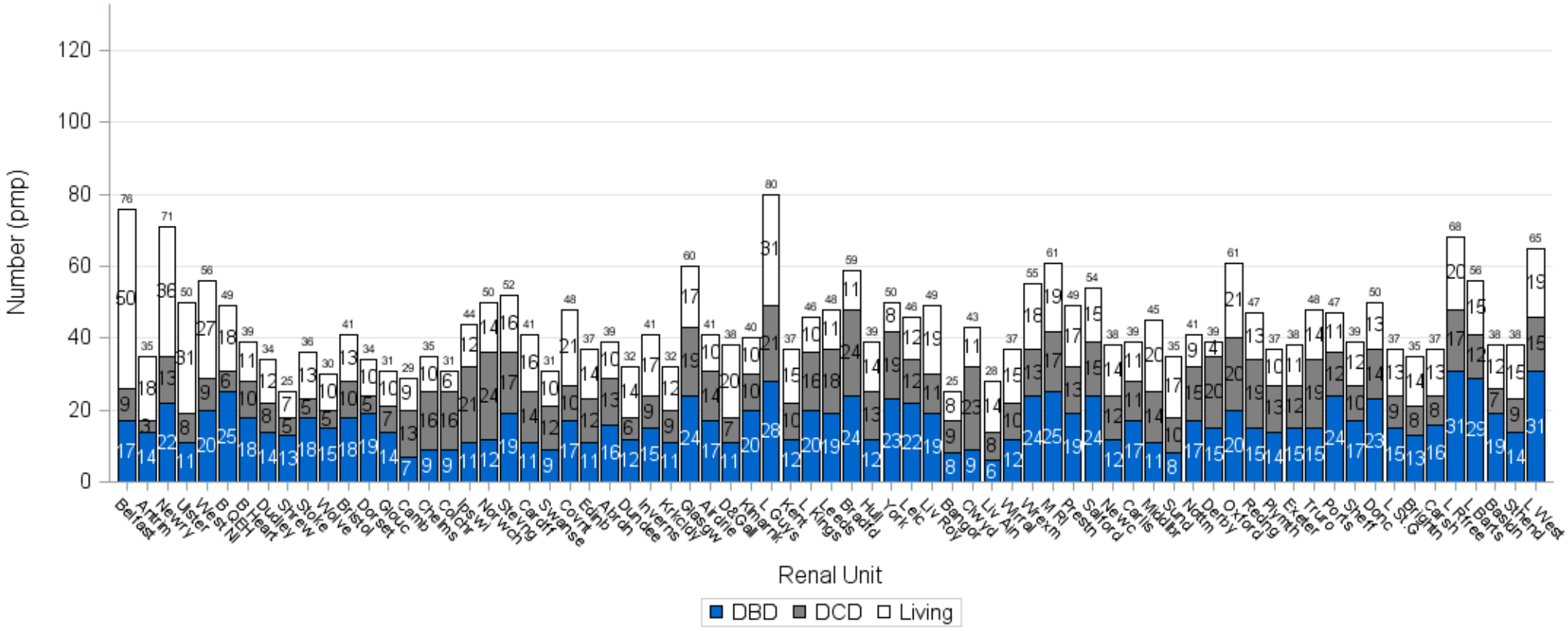
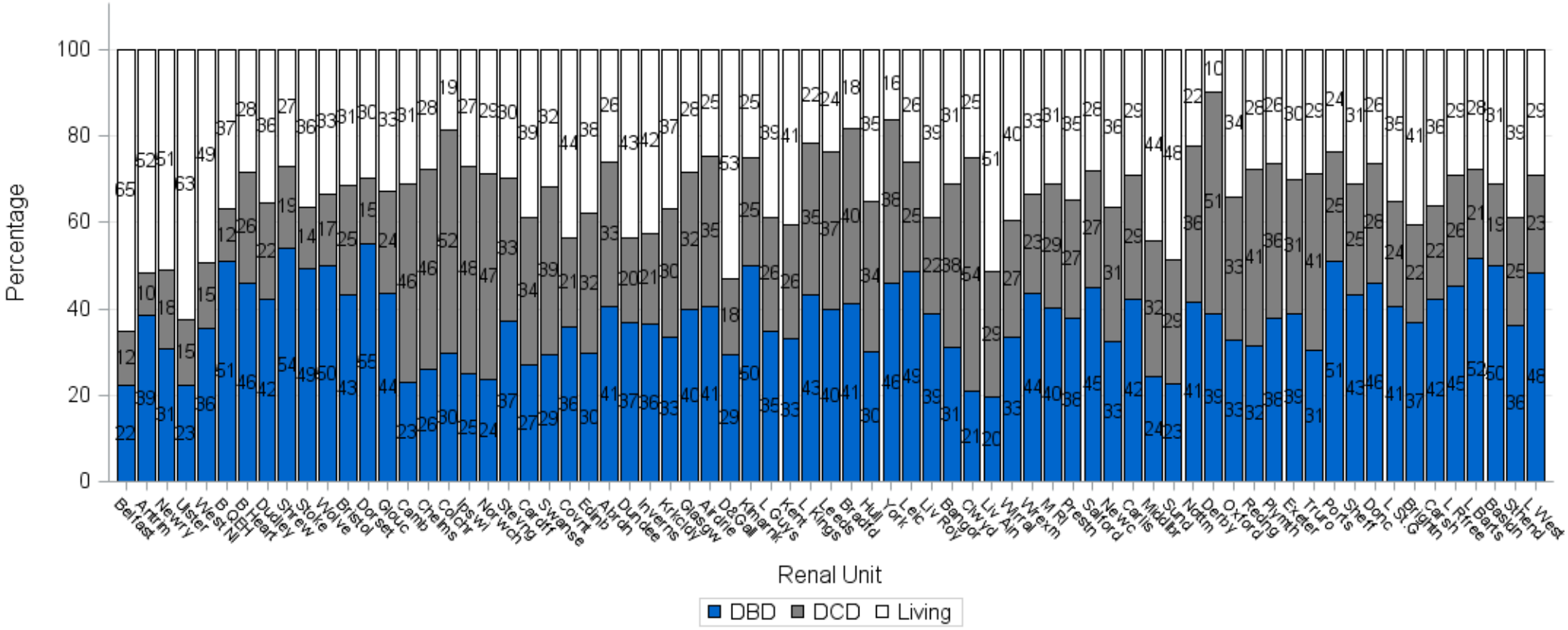


Figure 2.2 Adult kidney only transplants, 1 April 2014 and 31 March 2017, by renal unit



2.2 Demographic characteristics of recipients, 1 April 2014 - 31 March 2017

The ethnicity and age group of patients who received a kidney only transplant are shown by renal unit in **Figure 2.3** and **2.4,** respectively. Note that all percentages quoted are based only on data where relevant information was available.

Figure 2.3 Adult kidney only transplants, 1 April 2014 and 31 March 2017, by renal unit

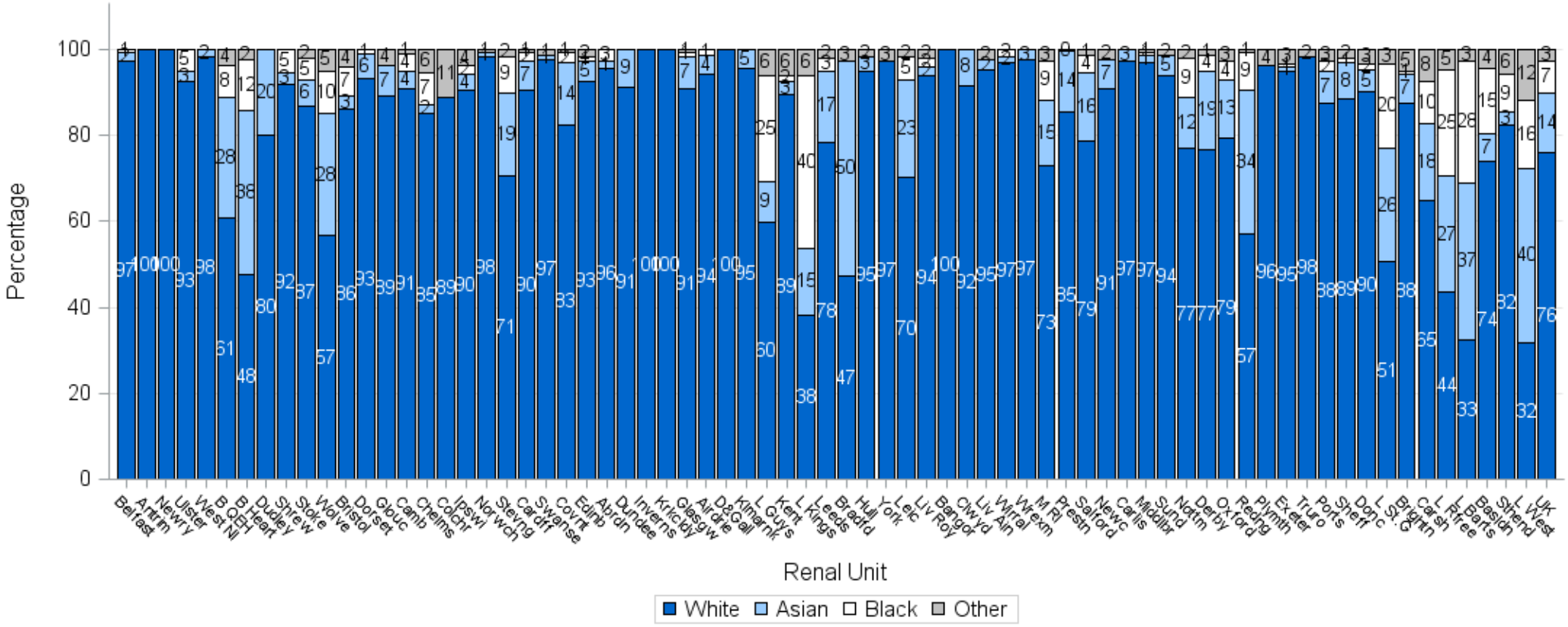
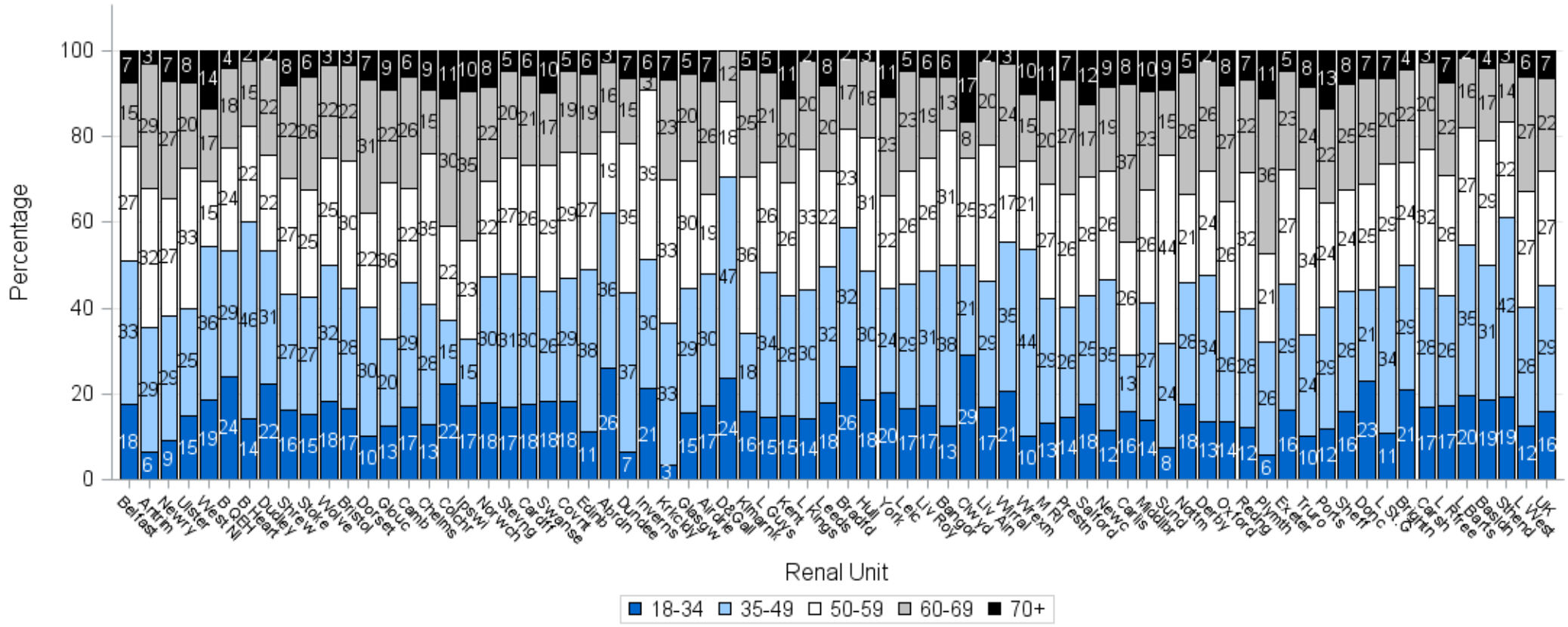


Figure 2.4 Adult kidney only transplants, 1 April 2014 and 31 March 2017, by renal unit



2.3 Pre-emptive transplant rates, 1 April 2014 - 31 March 2017

Rates of pre-emptive kidney only transplantation are shown in **Figure 2.5** for adult deceased donor transplants and **Figure 2.6** for adult living donor transplants. Living donor transplants are more likely to be carried out before the need for dialysis than deceased donor transplants: 37% and 16% 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 33% at Plymouth to 0% at Aberdeen, Basildon, Dumfries and Galloway and Southend. Adult living donor pre-emptive transplant rates ranged from 54% at Belfast to 0% at Bangor.

Figure 2.5 Adult deceased donor pre-emptive transplant rates by renal unit, 1 April 2014 - 31 March 2017

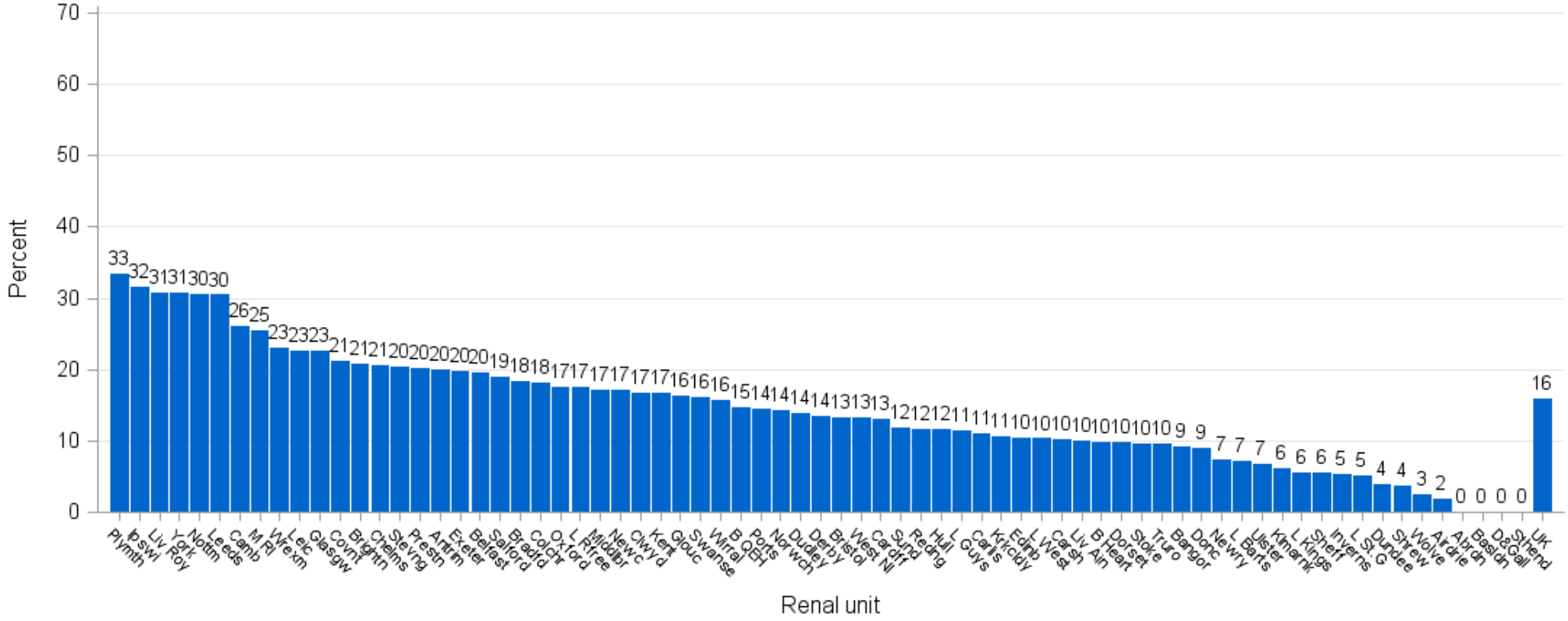
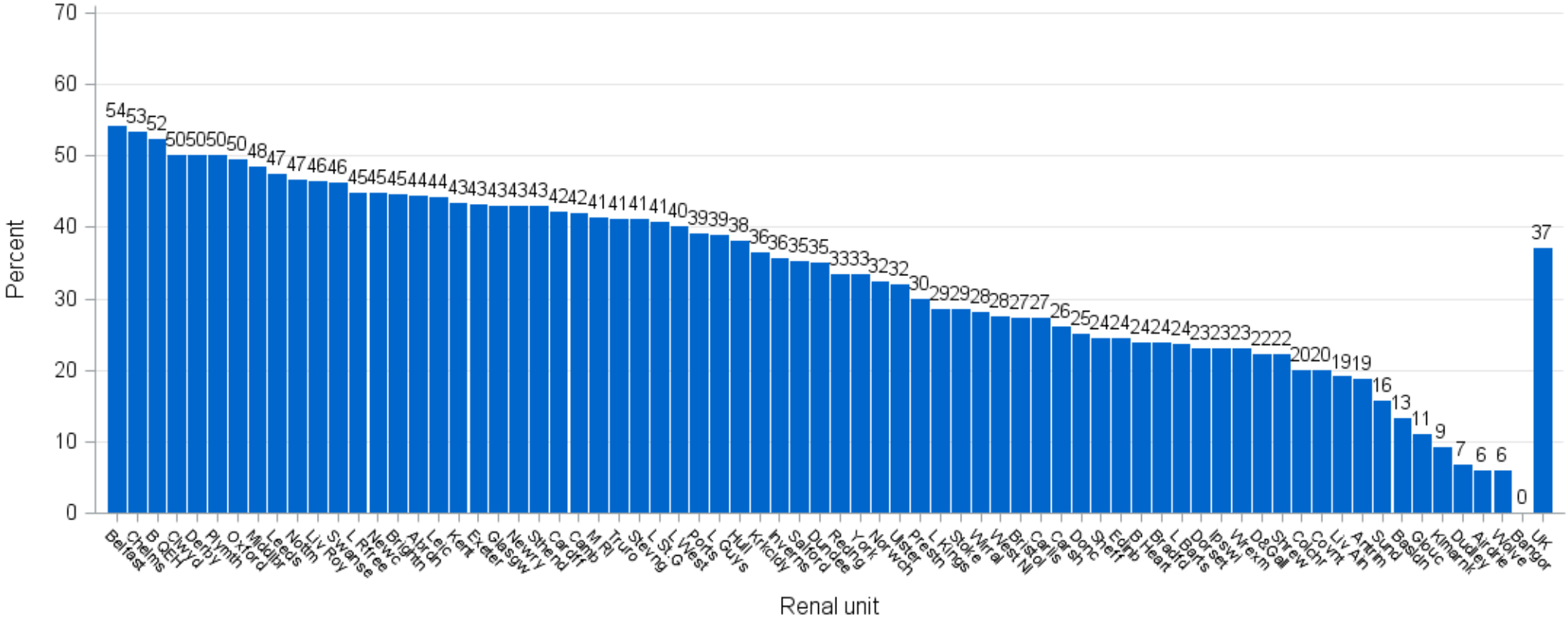


Figure 2.6 Adult living donor pre-emptive transplant rates by renal unit, 1 April 2014 - 31 March 2017



Adult kidney outcomes

We present a visual comparison of survival rates among renal units 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 renal units are with the national rate. Funnel plots show the risk-adjusted survival rate plotted against the number of transplants for each unit, 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 units.

Note that although we report survival according to renal unit, many patients receive after care from their transplant centre before returning to their local renal units. **We do not know at what point a patient is transferred back from the transplant centre to their renal unit, but we do know that this practice can differ widely across the country.**

Interpreting the funnel plots
If a unit lies within all the limits, then that unit has a survival rate that is statistically consistent with the national rate. If a unit lies outside the 95% confidence limits, this serves as an alert that the unit may have a rate that is significantly different from the national rate. If a unit lies outside the 99.8% limits, then further investigations may be carried out to determine the reasons for the possible difference. When a unit lies above the upper limits, this indicates a survival rate that is higher than the national rate, while a unit 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 unit 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 unit.

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.

3.1 Deceased donor graft and patient survival

The funnel plots show that, for the most part, the renal units lie within the confidence limits. Some of the funnel plots show some units lie outside the lower 95% confidence limits, indicating that these units have survival rates that are significantly lower than the national rate. Some of the funnel plots show some units to be above the upper 99.8% confidence limit. This suggests that these units may have survival rates that are considerably higher than the national rate. Units can be identified by the information shown in **Table 3.1**.

Figure 3.1 **Risk-adjusted one year graft (death censored) survival rates for first deceased donor kidney transplants in adult patients, between 1 April 2012 and 31 March 2016**

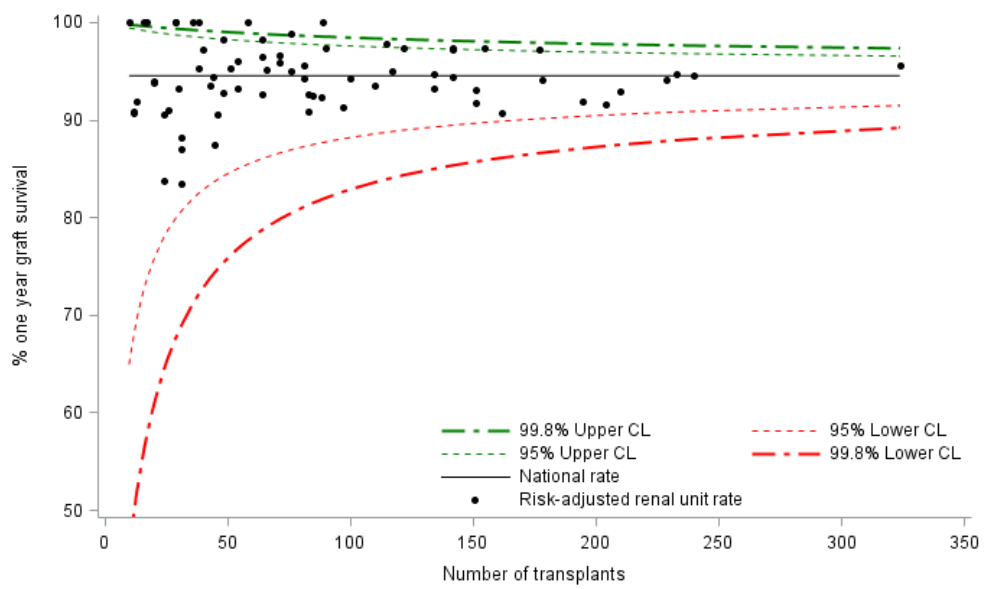


Figure 3.2 **Risk-adjusted one year patient survival rates for first deceased donor kidney transplants in adult patients, between 1 April 2012 and 31 March 2016**

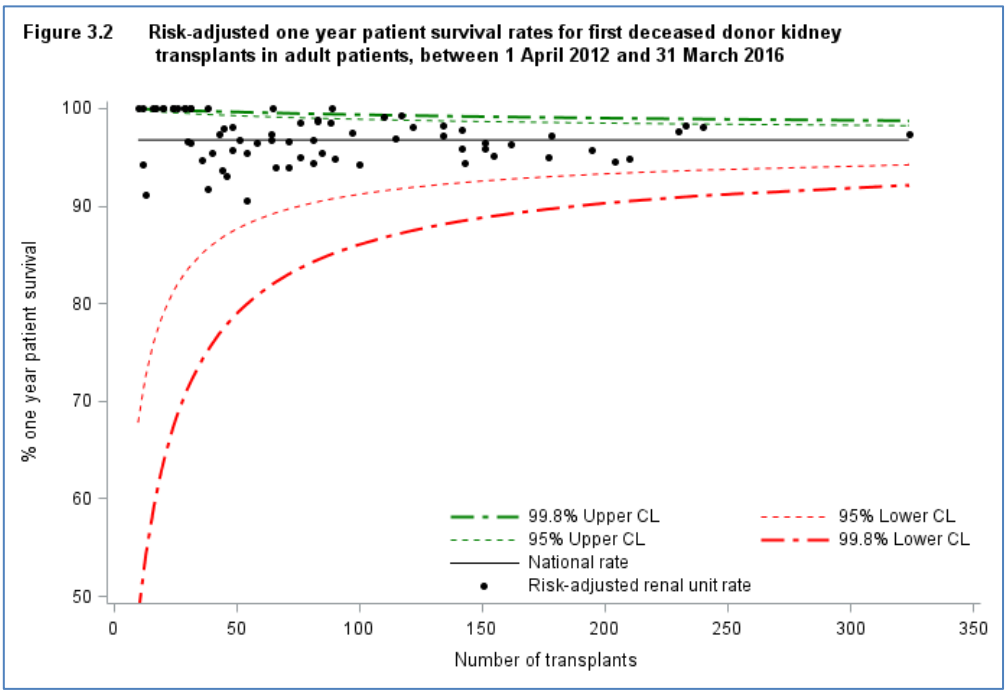


Figure 3.3 **Risk-adjusted five year graft (death censored) survival rates for first deceased donor kidney transplants in adult patients, between 1 April 2008 and 31 March 2012**

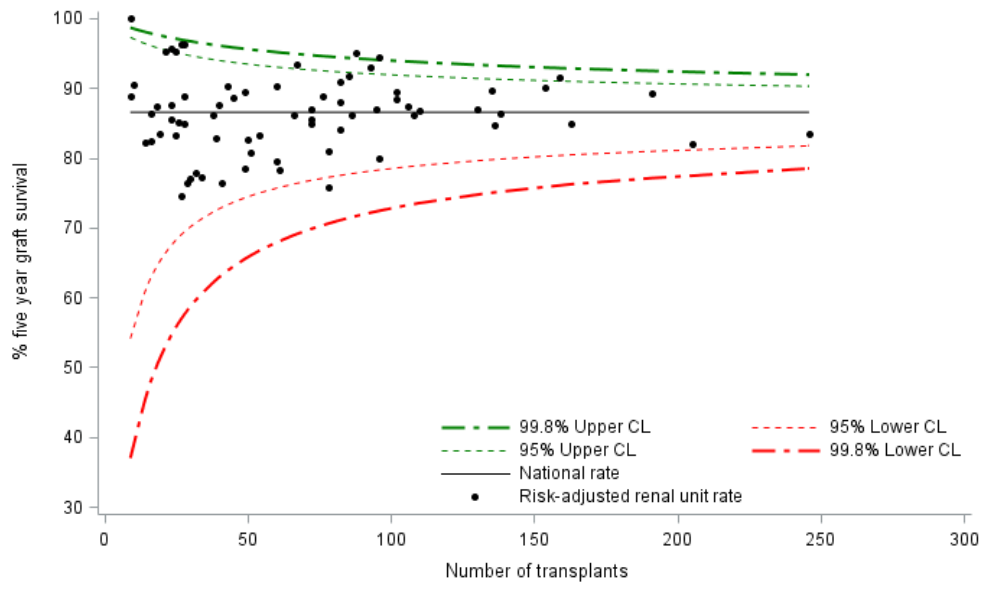


Figure 3.4 **Risk-adjusted five year patient survival rates for first deceased donor kidney transplants in adult patients, between 1 April 2008 and 31 March 2012**

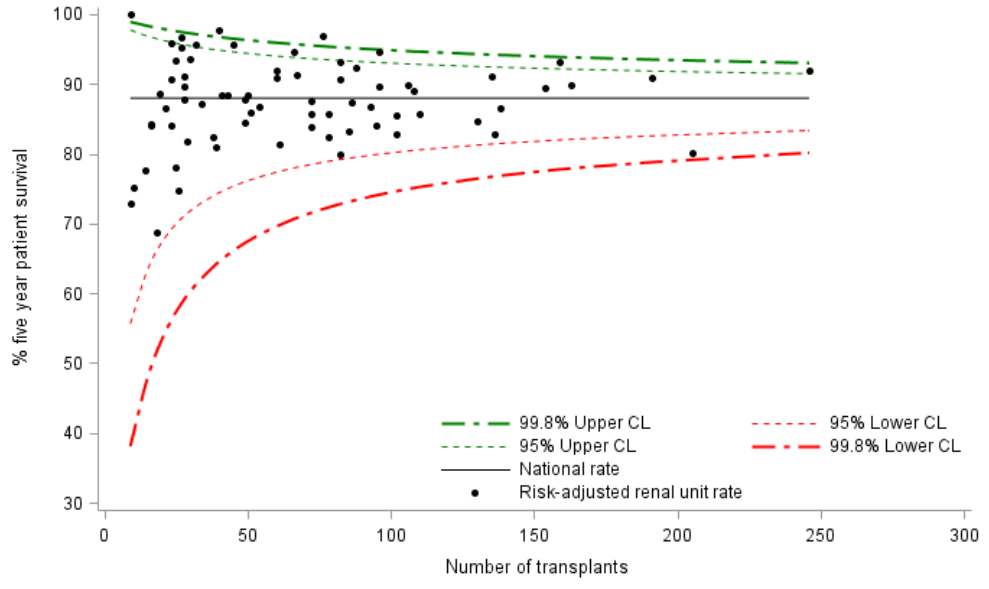


Table 3.1 **One and five year first adult kidney-only graft and patient survival using kidneys from deceased donors**

	Kidney graft survival				Patient survival			
	One-year*		Five-year**		One-year*		Five-year**	
Unit	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Belfast	94	(80 - 99)	83	(63 - 94)	94	(81 - 99)	81	(56 - 94)
Antrim	91	(48 - 100	82	(36 - 98)	94	(68 - 100	78	(19 - 97)
Newry	84	(58 - 96)	86	(51 - 98)	100	N/A	84	(43 - 98)
Ulster	100	N/A	100	N/A	100	N/A	100	N/A
West NI	100	N/A	87	(54 - 98)	100	N/A	69	(27 - 90)
B QEH	93	(88 - 96)	80	(68 - 88)	96	(92 - 99)	95	(86 - 99)
B Heart	96	(88 - 99)	78	(63 - 88)	97	(88 - 100	81	(66 - 91)
Dudley	88	(70 - 97)	83	(51 - 97)	100	N/A	89	(59 - 99)
Shrew	83	(61 - 95)	95	(74 - 100	100	N/A	93	(62 - 100
Stoke	100	N/A	83	(66 - 92)	96	(87 - 100	88	(73 - 96)
Wolve	98	(90 - 100	78	(54 - 91)	96	(85 - 99)	96	(76 - 100
Bristol	97	(92 - 99)	89	(80 - 95)	98	(93 - 100	85	(75 - 92)
Dorset	95	(86 - 99)	88	(68 - 97)	94	(84 - 98)	98	(87 - 100
Glouc	93	(76 - 99)	77	(50 - 92)	97	(85 - 100	87	(67 - 97)
Camb	100	N/A	95	(88 - 98)	100	N/A	92	(85 - 97)
Chelms	95	(83 - 99)	78	(62 - 89)	92	(76 - 98)	88	(73 - 96)
Colchr	100	N/A	82	(48 - 96)	100	N/A	84	(53 - 97)
Ipswi	96	(86 - 100	90	(75 - 97)	95	(84 - 99)	88	(70 - 97)
Norwch	92	(83 - 97)	93	(85 - 97)	99	(92 - 100	87	(77 - 93)
Stevng	94	(89 - 97)	87	(77 - 93)	96	(91 - 98)	84	(73 - 91)
Cardff	97	(93 - 99)	90	(84 - 94)	94	(89 - 97)	89	(84 - 93)
Swanse	94	(87 - 98)	92	(83 - 97)	97	(90 - 99)	83	(73 - 90)
Covnt	97	(88 - 100	81	(64 - 91)	94	(85 - 98)	86	(71 - 94)
Edinb	98	(90 - 100	88	(76 - 95)	97	(85 - 100	93	(84 - 98)
Abrdn	95	(83 - 99)	89	(75 - 97)	97	(82 - 100	84	(66 - 94)
Dundee	91	(66 - 99)	77	(53 - 91)	100	N/A	93	(76 - 99)
Inverns	94	(66 - 100	83	(57 - 95)	100	N/A	78	(49 - 93)
Krkcldy	100	N/A	85	(61 - 96)	100	N/A	88	(64 - 97)
Glasgw	93	(88 - 96)	91	(85 - 96)	95	(90 - 97)	93	(87 - 97)
Airdrie	93	(81 - 98)	96	(79 - 100	97	(88 - 100	90	(70 - 98)
D&Gall	91	(48 - 100	89	(38 - 100	100	N/A	73	(21 - 94)
Klmarnk	91	(67 - 99)	89	(67 - 98)	100	N/A	91	(68 - 99)
L Guys	91	(85 - 95)	91	(81 - 96)	96	(92 - 99)	91	(79 - 97)
Kent	94	(87 - 97)	93	(83 - 98)	99	(95 - 100	91	(81 - 97)
L Kings	97	(93 - 99)	90	(80 - 96)	98	(93 - 100	92	(79 - 98)
Leeds	94	(90 - 97)	85	(76 - 91)	98	(94 - 99)	83	(74 - 89)
Bradfd	94	(88 - 98)	87	(75 - 94)	94	(85 - 98)	88	(76 - 95)
Hull	91	(82 - 96)	76	(61 - 86)	99	(92 - 100	82	(69 - 91)
York	96	(87 - 100	89	(73 - 96)	100	N/A	96	(84 - 99)
Leic	94	(91 - 97)	85	(77 - 90)	98	(95 - 99)	90	(83 - 94)
Liv Roy	97	(90 - 100	88	(80 - 94)	95	(87 - 99)	83	(71 - 91)
Bangor	100	N/A	95	(73 - 100	100	N/A	86	(61 - 97)
Clwyd	92	(54 - 100	90	(47 - 100	91	(51 - 100	75	(27 - 95)
Liv Ain	93	(75 - 99)	85	(62 - 96)	97	(81 - 100	75	(45 - 91)

Table 3.1 **One and five year first adult kidney-only graft and patient survival using kidneys from deceased donors**

	Kidney graft survival				Patient survival			
	One-year*		Five-year**		One-year*		Five-year**	
Unit	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Wirral	91	(76 - 97)	86	(68 - 96)	93	(80 - 99)	82	(65 - 92)
Wrexm	100	N/A	85	(57 - 97)	100	N/A	84	(63 - 95)
M RI	97	(93 - 99)	87	(79 - 93)	95	(91 - 98)	90	(81 - 95)
Prestn	95	(89 - 98)	86	(75 - 93)	97	(93 - 99)	87	(75 - 95)
Salford	97	(93 - 99)	90	(82 - 94)	95	(91 - 98)	91	(84 - 95)
Newc	95	(87 - 99)	85	(72 - 93)	95	(87 - 99)	84	(72 - 92)
Carlis	100	N/A	76	(48 - 91)	95	(81 - 99)	82	(53 - 95)
Middlbr	92	(84 - 97)	84	(72 - 92)	95	(88 - 99)	80	(67 - 89)
Sund	97	(84 - 100	76	(56 - 89)	95	(83 - 99)	88	(70 - 97)
Nottm	93	(87 - 97)	87	(77 - 93)	98	(94 - 100	86	(76 - 92)
Derby	99	(93 - 100	85	(73 - 92)	99	(92 - 100	86	(74 - 93)
Oxford	94	(89 - 97)	87	(78 - 93)	97	(93 - 99)	85	(76 - 91)
Redng	95	(90 - 98)	94	(87 - 98)	99	(96 - 100	90	(82 - 95)
Plymth	93	(80 - 99)	79	(64 - 89)	91	(78 - 97)	91	(80 - 97)
Exeter	95	(87 - 99)	81	(67 - 90)	94	(86 - 98)	86	(74 - 93)
Truro	93	(79 - 98)	86	(75 - 93)	98	(89 - 100	95	(88 - 98)
Ports	92	(86 - 95)	86	(78 - 92)	96	(92 - 98)	86	(79 - 92)
Sheff	98	(93 - 100	86	(77 - 92)	97	(92 - 99)	89	(81 - 94)
Donc	87	(72 - 95)	96	(75 - 100	98	(88 - 100	96	(76 - 100
L St.G	93	(84 - 97)	96	(79 - 100	99	(93 - 100	97	(81 - 100
Brightn	91	(82 - 97)	83	(67 - 93)	97	(91 - 100	87	(71 - 95)
Carsh	92	(85 - 96)	89	(78 - 95)	96	(90 - 99)	97	(89 - 100
L Rfree	95	(91 - 97)	89	(84 - 93)	98	(96 - 100	91	(86 - 94)
L Barts	92	(87 - 95)	82	(75 - 87)	94	(89 - 98)	80	(72 - 87)
Basldn	87	(66 - 96)	74	(47 - 90)	96	(80 - 100	95	(73 - 100
Sthend	94	(65 - 100	88	(64 - 97)	100	N/A	91	(66 - 99)
L West	96	(93 - 97)	83	(77 - 88)	97	(95 - 99)	92	(87 - 95)
UK	**94**	**(94 - 95)**	**86**	**(85 - 87)**	**97**	**(96 - 97)**	**88**	**(87 - 89)**

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

* Includes transplants performed between 1 April 2012 - 31 March 2016
** Includes transplants performed between 1 April 2008 - 31 March 2012

3.2 Living donor graft and patient survival

The funnel plots show that, for the most part, the renal units lie within the confidence limits. Some of the funnel plots show some units lie outside the lower 95% confidence limits, indicating that these units have survival rates that are significantly lower than the national rate. Some of the funnel plots show some units to be above the upper 99.8% confidence limit. This suggests that these units may have survival rates that are considerably higher than the national rate. Units can be identified by the information shown in **Table 3.2**.

Figure 3.5 **Risk-adjusted one year graft (death censored) survival rates for first live donor kidney transplants in adult patients, between 1 April 2012 and 31 March 2016**

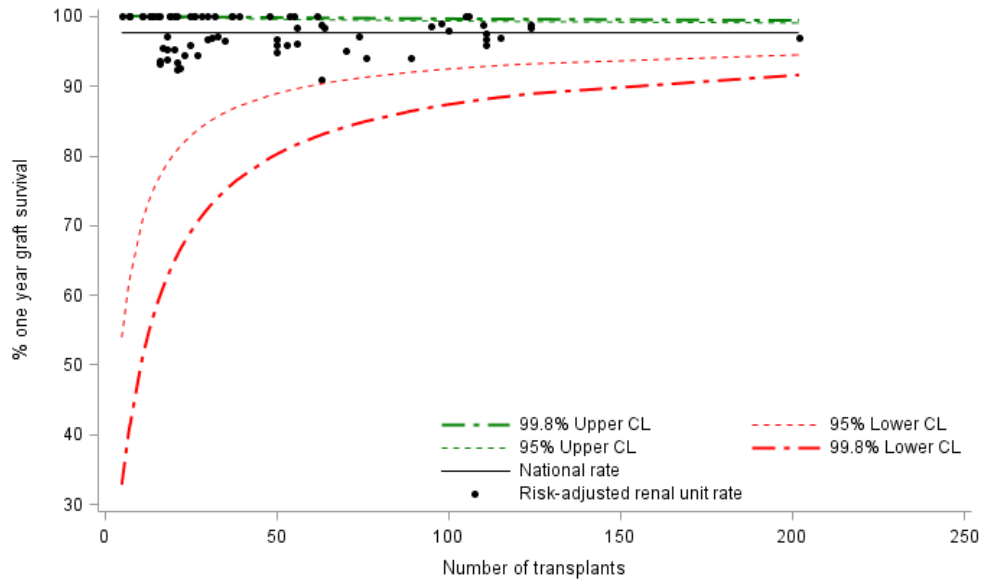


Figure 3.6 **Risk-adjusted one year patient survival rates for first live donor kidney transplants in adult patients, between 1 April 2012 and 31 March 2016**

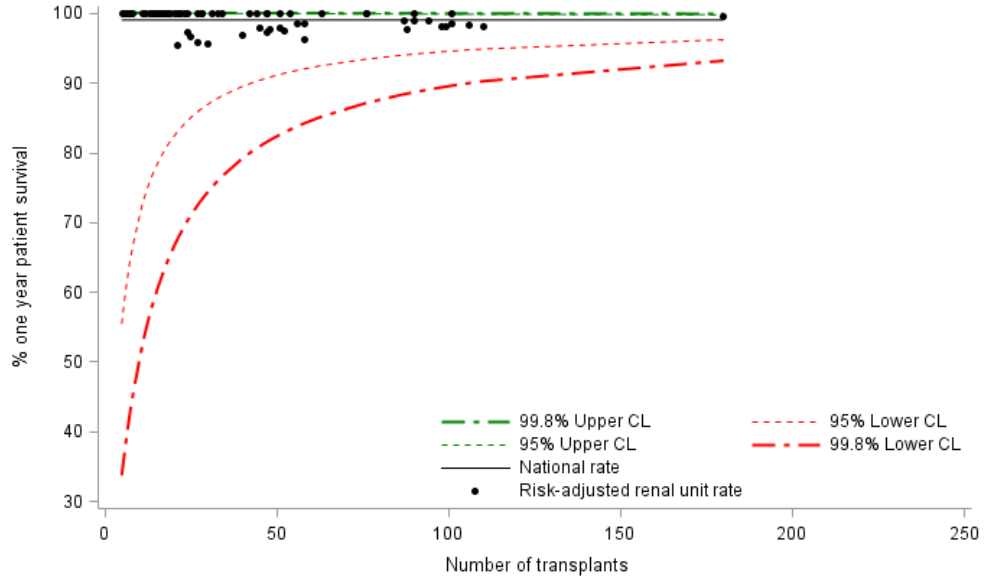


Figure 3.7 **Risk-adjusted five year graft (death censored) survival rates for first live donor kidney transplants in adult patients, between 1 April 2008 and 31 March 2012**

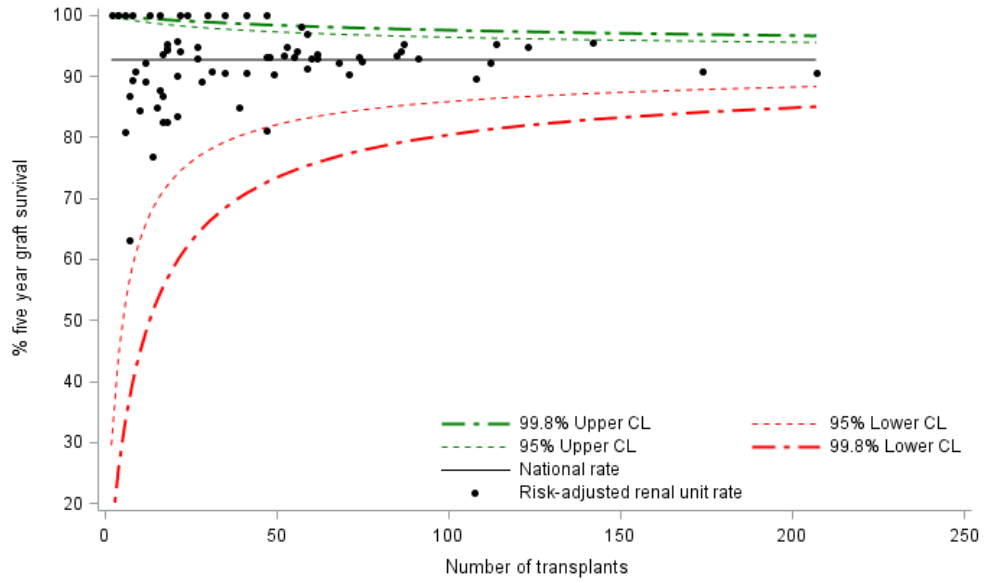


Figure 3.8 **Risk-adjusted five year patient survival rates for first live donor kidney transplants in adult patients, between 1 April 2008 and 31 March 2012**

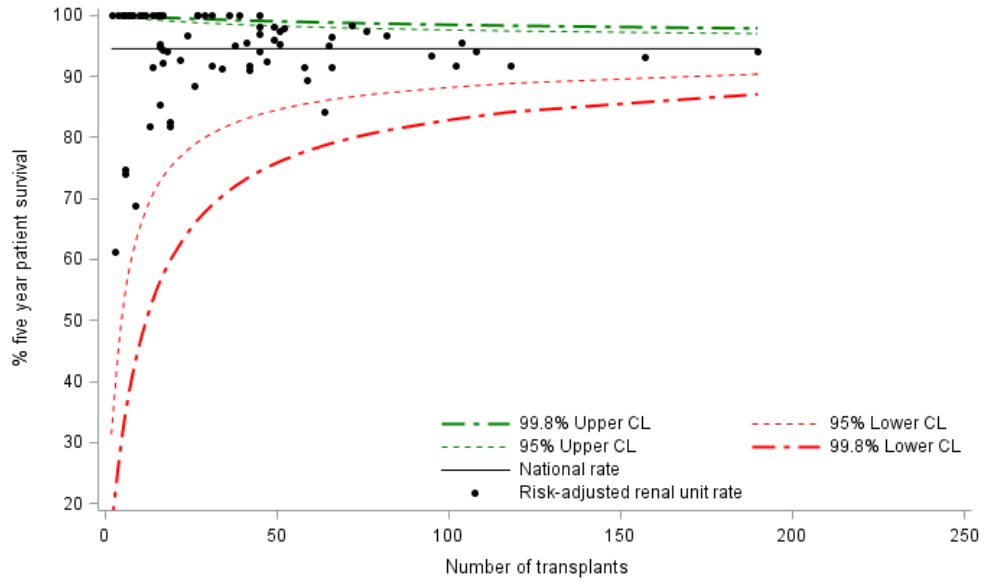


Table 3.2 One and five year first adult kidney-only graft and patient survival using kidneys from living donors

	Kidney graft survival				Patient survival			
	One-year*		Five-year**		One-year*		Five-year**	
Unit	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Belfast	99	(92 - 100	93	(82 - 98)	100	N/A	94	(79 - 99)
Antrim	93	(63 - 100	100	N/A	100	N/A	100	N/A
Newry	100	N/A	89	(39 - 100	100	N/A	100	N/A
Ulster	94	(69 - 100	100	N/A	100	N/A	61	(0 - 99)
West NI	97	(81 - 100	100	N/A	100	N/A	93	(73 - 99)
B QEH	97	(93 - 99)	93	(86 - 98)	98	(93 - 100	98	(90 - 100
B Heart	97	(83 - 100	91	(73 - 98)	96	(75 - 100	100	N/A
Dudley	93	(62 - 100	84	(44 - 98)	100	N/A	100	N/A
Shrew	100	N/A	88	(55 - 99)	100	N/A	100	N/A
Stoke	97	(88 - 100	93	(82 - 98)	98	(89 - 100	97	(82 - 100
Wolve	92	(72 - 99)	100	N/A	100	N/A	82	(48 - 96)
Bristol	94	(85 - 98)	90	(80 - 96)	100	N/A	95	(85 - 99)
Dorset	100	N/A	95	(71 - 100	100	N/A	88	(70 - 97)
Glouc	97	(81 - 100	94	(69 - 100	100	N/A	95	(74 - 100
Camb	100	N/A	90	(75 - 97)	100	N/A	92	(78 - 98)
Chelms	100	N/A	83	(49 - 96)	100	N/A	85	(47 - 98)
Colchr	100	N/A	100	N/A	100	N/A	100	N/A
Ipswi	100	N/A	94	(64 - 100	100	N/A	100	N/A
Norwch	96	(77 - 100	89	(68 - 98)	95	(75 - 100	100	N/A
Stevng	96	(86 - 100	100	N/A	97	(86 - 100	95	(82 - 99)
Cardff	95	(87 - 99)	92	(83 - 97)	96	(87 - 100	96	(87 - 100
Swanse	100	N/A	91	(76 - 97)	97	(82 - 100	100	N/A
Covnt	100	N/A	94	(84 - 98)	100	N/A	92	(78 - 98)
Edinb	100	N/A	90	(72 - 98)	100	N/A	92	(76 - 98)
Abrdn	100	N/A	93	(74 - 99)	100	N/A	97	(81 - 100
Dundee	100	N/A	92	(57 - 100	100	N/A	100	N/A
Inverns	100	N/A	81	(0 - 100)	100	N/A	100	N/A
Krkcldy	100	N/A	77	(32 - 95)	100	N/A	69	(0 - 99)
Glasgw	96	(90 - 99)	92	(82 - 97)	100	N/A	89	(75 - 97)
Airdrie	95	(74 - 100	96	(76 - 100	100	N/A	92	(56 - 100
D&Gall	100	N/A	89	(40 - 100	100	N/A	100	N/A
Klmarnk	100	N/A	100	N/A	100	N/A	100	N/A
L Guys	97	(91 - 99)	96	(90 - 98)	98	(92 - 100	92	(84 - 96)
Kent	97	(90 - 100	93	(84 - 97)	99	(92 - 100	97	(90 - 99)
L Kings	100	N/A	93	(80 - 99)	97	(83 - 100	93	(78 - 98)
Leeds	100	N/A	91	(79 - 97)	100	N/A	96	(85 - 100
Bradfd	100	N/A	87	(52 - 98)	100	N/A	82	(53 - 95)
Hull	96	(85 - 100	93	(80 - 99)	97	(85 - 100	100	N/A
York	95	(73 - 100	82	(49 - 96)	100	N/A	100	N/A
Leic	99	(96 - 100	91	(85 - 95)	98	(93 - 100	93	(87 - 97)
Liv Roy	91	(77 - 98)	93	(82 - 98)	99	(92 - 100	95	(83 - 99)
Bangor	100	N/A	100	N/A	100	N/A	100	N/A
Clwyd	100	N/A	63	(0 - 96)	100	N/A	100	N/A

Table 3.2 **One and five year first adult kidney-only graft and patient survival using kidneys from living donors**

	Kidney graft survival				Patient survival			
	One-year*		Five-year**		One-year*		Five-year**	
Unit	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Liv Ain	94	(66 - 100	100	N/A	100	N/A	75	(0 - 99)
Wirral	100	N/A	83	(58 - 95)	97	(85 - 100	100	N/A
Wrexm	100	N/A	91	(48 - 100	100	N/A	100	N/A
M RI	98	(94 - 100	95	(88 - 99)	98	(94 - 100	97	(90 - 100
Prestn	100	N/A	98	(90 - 100	99	(94 - 100	98	(88 - 100
Salford	94	(86 - 98)	93	(84 - 98)	100	N/A	84	(70 - 93)
Newc	96	(85 - 99)	100	N/A	100	N/A	95	(84 - 99)
Carlis	100	N/A	95	(74 - 100	100	N/A	94	(69 - 100
Middlbr	98	(91 - 100	81	(63 - 92)	100	N/A	91	(77 - 98)
Sund	100	N/A	100	N/A	100	N/A	100	N/A
Nottm	97	(83 - 100	85	(67 - 94)	96	(77 - 100	91	(74 - 98)
Derby	94	(64 - 100	90	(64 - 99)	100	N/A	94	(67 - 100
Oxford	97	(90 - 99)	95	(89 - 98)	98	(93 - 100	93	(85 - 98)
Redng	95	(85 - 99)	95	(85 - 99)	100	N/A	98	(89 - 100
Plymth	94	(69 - 100	94	(66 - 100	100	N/A	82	(47 - 96)
Exeter	100	N/A	93	(80 - 99)	100	N/A	100	N/A
Truro	100	N/A	95	(70 - 100	100	N/A	95	(71 - 100
Ports	100	N/A	94	(86 - 98)	99	(94 - 100	92	(80 - 97)
Sheff	99	(93 - 100	97	(88 - 100	98	(88 - 100	97	(85 - 100
Donc	95	(75 - 100	85	(45 - 98)	100	N/A	91	(52 - 100
L St.G	100	N/A	100	N/A	100	N/A	100	N/A
Brightn	98	(91 - 100	94	(83 - 99)	98	(87 - 100	98	(89 - 100
Carsh	98	(92 - 100	92	(85 - 97)	99	(94 - 100	94	(88 - 98)
L Rfree	99	(94 - 100	95	(89 - 98)	100	N/A	95	(89 - 99)
L Barts	99	(95 - 100	89	(82 - 94)	99	(92 - 100	92	(81 - 97)
Basldn	97	(84 - 100	87	(25 - 100	100	N/A	74	(0 - 99)
Sthend	93	(73 - 99)	100	N/A	100	N/A	100	N/A
L West	97	(94 - 99)	90	(85 - 94)	99	(97 - 100	94	(90 - 97)
UK	**98**	**(97 - 98)**	**93**	**(92 - 93)**	**99**	**(99 - 99)**	**94**	**(94 - 95)**

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

* Includes transplants performed between 1 April 2012 - 31 March 2016
** Includes transplants performed between 1 April 2008 - 31 March 2012

4.1 Risk adjusted eGFR

Funnel plots were used to compare the adjusted mean 3 and 12 month eGFR at each renal unit to the national average. The plots show each unit's adjusted mean eGFR at 3 and 12 months post-transplant against the number of patients at each unit. The national adjusted mean eGFRs at 3 and 12 months post-transplant are shown by the black line and the 95% and 99.8% confidence limits around this national average are shown by the dotted lines. Units that fall within the upper and lower 95% confidence limits have an adjusted mean eGFR statistically consistent with the national average eGFR. Those units that are above the 95% upper confidence limit have significantly higher adjusted mean eGFR than the national average and units that are below the 95% lower confidence limit have significantly lower adjusted mean eGFR than the national average.

Figure 4.1 Adjusted mean eGFR at 3 months by renal unit for first adult deceased donor kidney transplants in the UK, 1 April 2012 and 31 March 2016

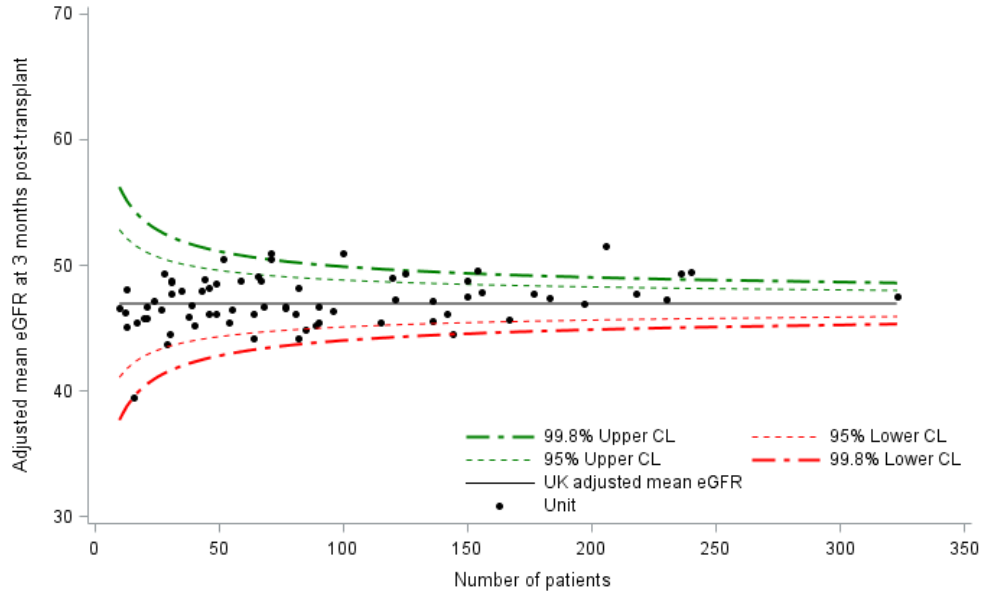


Figure 4.2 Adjusted mean eGFR at 12 months by renal unit for first adult deceased donor kidney transplants in the UK, 1 April 2012 and 31 March 2016

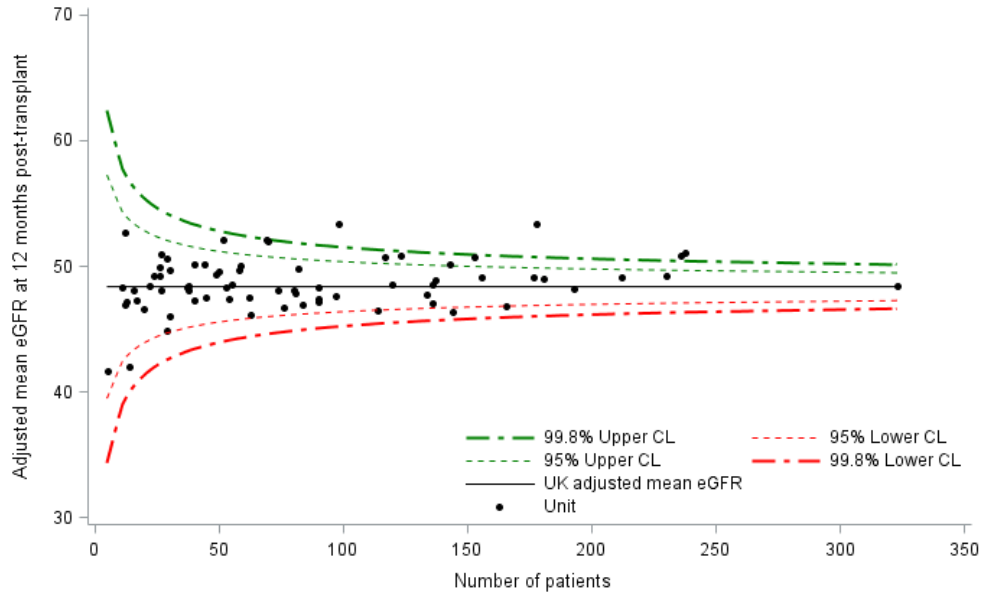


Figure 4.3 Adjusted mean eGFR at 3 months by renal unit for first adult living donor kidney transplants in the UK, 1 April 2012 and 31 March 2016

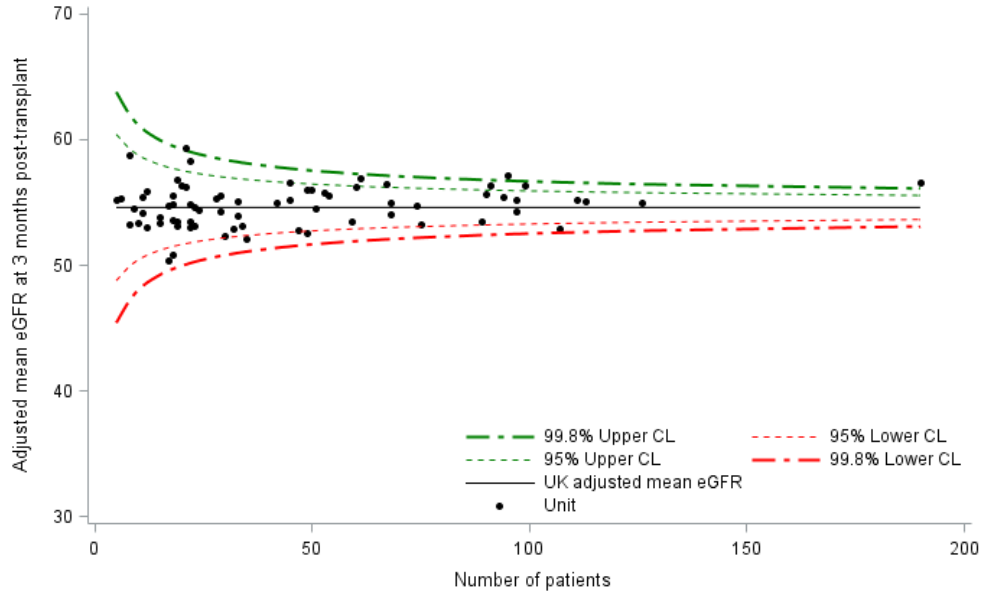


Figure 4.4 Adjusted mean eGFR at 12 months by renal unit for first adult living donor kidney transplants in the UK, 1 April 2012 and 31 March 2016

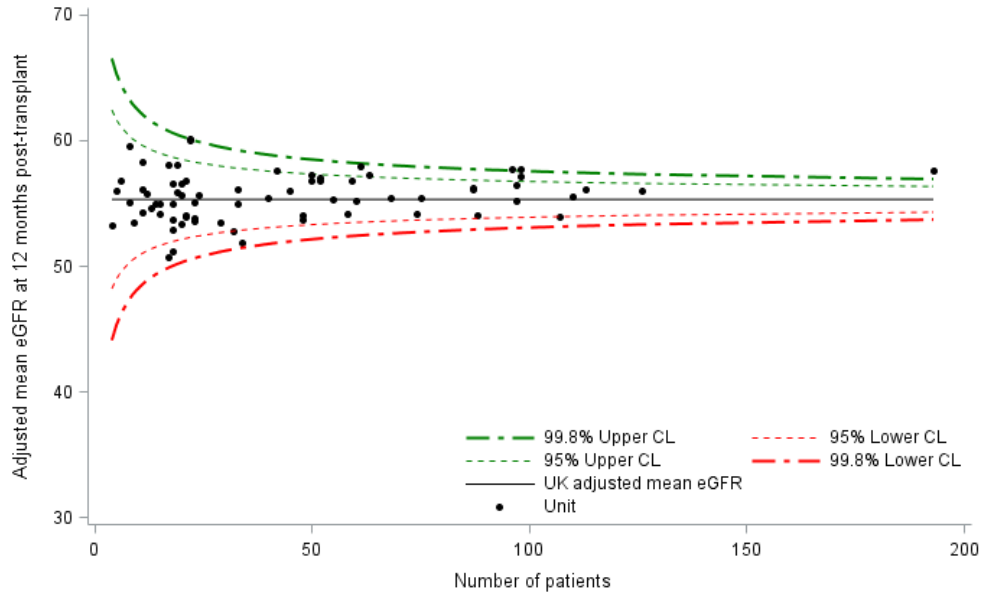


Table 4.1 Adjusted mean eGFR at 3 and 12 months, by donor type and renal unit

	Deceased donor transplants				Living donor transplants			
	3 months post-transplant*		12 months post-transplant**		3 months post-transplant***		12 months post-transplant****	
Unit	N	Mean	N	Mean	N	Mean	N	Mean
Belfast	44	48.8	44	50.1	90	55.6	87	56.2
Antrim	13	48.0	11	48.2	19	53.5	18	55.0
Newry	24	47.2	22	48.4	22	58.2	22	60.1
Ulster	10	46.5	5	41.6	23	54.6	19	55.9
West NI	35	47.9	27	51.0	29	54.3	21	54.0
B QEH	154	49.6	153	50.7	113	55.0	113	56.1
B Heart	71	50.9	70	52.0	33	55.1	33	56.1
Dudley	31	48.6	30	49.7	18	54.8	18	56.6
Shrew	31	48.8	29	50.6	15	53.8	15	54.1
Stoke	59	48.8	58	49.7	47	52.8	48	54.1
Wolve	49	48.5	49	49.3	22	52.9	20	53.4
Bristol	125	49.3	123	50.9	68	54.1	60	55.2
Dorset	68	46.7	53	48.3	23	53.0	21	53.9
Glouc	43	47.9	26	49.2	28	55.3	17	58.0
Camb	90	45.4	90	47.3	42	54.9	40	55.4
Chelms	39	46.8	38	48.4	17	50.3	17	50.7
Colchr	29	43.7	29	44.9	5	55.2	5	56.0
Ipswi	54	45.4	54	47.4	12	52.9	11	54.2
Norwch	89	45.1	90	47.1	32	52.8	32	52.7
Stevng	142	46.1	134	47.7	67	56.4	63	57.2
Cardff	144	44.5	144	46.4	75	53.2	74	54.2
Swanse	82	44.1	76	46.6	35	52.1	34	51.8
Covnt	71	50.4	69	52.0	60	56.3	59	56.7
Edinb	66	49.1	50	49.5	34	53.1	23	53.5
Abrdn	52	50.4	52	52.0	21	59.3	22	59.9
Dundee	21	46.7	24	49.2	19	53.1	18	52.9
Inverns	20	45.7	20	46.5	18	55.6	15	55.0
Krkcldy	28	49.4	12	52.6	11	55.4	4	53.3
Glasgw	218	47.7	212	49.1	97	55.2	97	56.4
Airdrie	64	46.1	62	47.4	19	56.8	19	58.0
D&Gall	12	46.2	12	46.9	8	53.2	8	55.1
Klmarnk	27	46.5	27	48.0	11	54.1	12	55.7
L Guys	167	45.6	166	46.8	99	56.3	98	57.1
Kent	115	45.4	114	46.4	68	54.9	68	55.4
L Kings	150	47.4	137	48.8	45	56.6	42	57.6
Leeds	230	47.3	230	49.2	53	55.7	52	56.7
Bradfd	100	50.9	98	53.3	21	56.3	21	56.8
Hull	81	46.0	81	47.8	49	55.9	50	57.2
York	64	44.1	63	46.1	18	50.8	18	51.1
Leic	240	49.4	238	51.0	126	55.0	126	56.0
Liv Roy	90	46.7	90	48.3	61	56.9	61	57.9
Bangor	16	39.4	14	41.9	8	58.8	8	59.5
Clwyd	13	45.0	13	47.1	6	55.3	6	56.8
Liv Ain	30	44.5	30	45.9	20	56.3	20	56.5
Wirral	46	46.0	45	47.5	30	52.3	29	53.5
Wrexm	17	45.4	17	47.2	15	53.3	14	54.9
M RI	177	47.7	177	49.0	111	55.2	110	55.6

Table 4.1 Adjusted mean eGFR at 3 and 12 months, by donor type and renal unit

	Deceased donor transplants				Living donor transplants			
	3 months post-transplant*		12 months post-transplant**		3 months post-transplant***		12 months post-transplant****	
Unit	N	Mean	N	Mean	N	Mean	N	Mean
Prestn	136	47.1	136	48.5	97	54.2	97	55.1
Salford	156	47.9	156	49.1	74	54.8	75	55.4
Newc	77	46.6	80	48.1	51	54.5	55	55.3
Carlis	38	45.9	38	48.0	10	53.4	9	53.5
Middlbr	85	44.8	84	46.9	59	53.4	58	54.1
Sund	40	45.1	40	47.2	22	54.8	23	55.1
Nottm	136	45.5	136	47.0	33	53.9	33	54.9
Derby	77	46.7	74	48.1	18	53.5	18	53.7
Oxford	183	47.3	181	49.0	107	52.8	107	53.9
Redng	120	48.9	117	50.7	45	55.2	45	55.9
Plymth	55	46.4	55	48.5	24	54.4	24	55.6
Exeter	82	48.2	82	49.8	49	52.6	48	53.7
Truro	49	46.1	37	48.3	22	53.5	20	55.7
Ports	197	46.9	193	48.2	89	53.4	88	54.1
Sheff	121	47.2	120	48.5	54	55.5	52	57.0
Donc	46	48.2	40	50.1	12	55.9	11	58.2
L St.G	67	48.8	59	50.0	29	55.5	23	53.8
Brightn	96	46.3	97	47.6	50	56.0	50	56.8
Carsh	150	48.8	143	50.1	94	55.4	87	56.1
L Rfree	236	49.3	236	50.8	95	57.1	96	57.6
L Barts	206	51.5	178	53.4	91	56.3	98	57.8
Basldn	31	47.7	26	49.8	17	54.7	13	54.6
Sthend	21	45.7	16	48.0	9	54.5	11	56.1
L West	323	47.5	323	48.3	190	56.5	193	57.6
UK	**6269**	**47.5**	**6055**	**49.0**	**3204**	**54.9**	**3122**	**55.8**

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

* Adjusted for recipient ethnicity, donor type, donor hypertension, recipient sex, donor diabetes history, donor alcohol abuse history, donor ethnicity, recipient diabetic status, donor age, donor height and cold ischaemia time.
** Adjusted for recipient sex, recipient ethnicity, donor hypertension history, donor type, donor diabetes history, donor alcohol abuse history, donor age, donor height, cold ischaemia time, waiting time and recipient age
*** Adjusted for recipient ethnicity, relationship between donor and recipient, donor age, donor GFR, donor weight, cold ischaemia time and donor BMI.
**** Adjusted for recipient ethnicity, recipient sex, financial year of transplant, donor age, donor GFR, donor weight, donor height and cold ischaemia time.

Appendix

A1 Glossary of terms

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

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

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

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

Confidence limit
The upper and lower bounds of a confidence interval.

Cox Proportional Hazards model
A statistical model that relates the instantaneous risk (hazard) of an event occurring at a given time point to the risk factors that influence the length of time it takes for the event to occur. This model can be used to compare the hazard of an event of interest, such as graft failure or patient death, across different groups of patients.

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

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

Donor after circulatory death (DCD)
A donor whose heart stops beating before their brain stops working and who is then certified dead. The organs are then removed.

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

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

HLA mismatch
Human Leucocyte Antigen (HLA) antigens are carried on many cells in the body and the immune system can distinguish between those that can be recognised as ‘self’ (belonging to you or identical to your own) and those that can be recognised as ‘nonself’. The normal response of the immune system is to attack foreign/non-self material by producing antibodies against the foreign material. This is one of the mechanisms that provide protection against infection. This is unfortunate from the point of view of transplantation as the immune system will see the graft as just another ‘infection’ to be destroyed, produce antibodies against the graft and rejection of the grafted organ will take place. To help overcome this response, it is recognised that ‘matching’ the recipient and donor on the basis of HLA (and blood group) reduces the chances of acute rejection and, with the added use of

immunosuppressive drugs, very much improves the chances of graft survival. 'Matching' refers to the similarity of the recipient HLA type and donor HLA type. HLA mismatch refers to the number of mismatches between the donor and the recipient at the A, B and DR (HLA) loci. There can only be a total of two mismatches at each locus. For example, an HLA mismatch value of 000, means that the donor and recipient are identical at all three loci, while an HLA mismatch value of 210 means that the donor and recipient differ completely at the A locus, are partly the same at the B locus and are identical at the DR locus.

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

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

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

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

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

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

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

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

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

Risk-adjusted survival rate

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

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

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

A2 Statistical methodology and risk-adjustment for survival rate estimation

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

Computing unadjusted survival rates

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

Computing risk-adjusted survival rates

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

Risk-adjusted survival estimates were obtained through indirect standardisation. A Cox Proportional Hazards model was used to determine the probability of survival for each patient based on their individual risk factor values. The sum of these probabilities for all patients at a centre gives the number, E, of patients or grafts expected to survive at least one year or five years after transplant at that centre. The number of patients who actually survive the given time period is given by O. The risk-adjusted estimate is then calculated by multiplying the ratio O/E by the overall unadjusted survival rate across all centres.

The risk-adjustment models used were based on results from previous studies that looked at factors affecting the survival rates of interest. The factors included in the models are shown in the table below.

Systematic component of variation

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

To allow for the possibility that, even after allowing for area-specific Poisson rates, area differences remain, introduce an additional multiplicative rate factor which varies from area to area. Postulate a non-parametric distribution for the multiplicative factor, with variance σ^2. If the factor is one for all areas, then area differences are fully explained by the area-specific Poisson rate. If the factor varies with a nonzero variance, σ^2, then we conclude that there are unexplained area differences.

The systematic component of variation (SCV; McPherson *et al., N Engl J Med* 1982, **307:** 1310-4) is the moment estimator of σ^2. Under the null hypothesis of homogeneity across areas, the SCV would be zero. The SCV, therefore, allows us to detect variability across areas beyond that expected by chance; the larger the SCV, the greater the evidence of systematic variation across areas.

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

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

Prepared by:

Statistics and Clinical Studies, NHS Blood and Transplant

Miss Lisa Mumford
Miss Chloe Brown