

# UK Renal Registry 19th Annual Report: Chapter 3 Demographic and Biochemistry Profile of Kidney Transplant Recipients in the UK in 2015: National and Centre-specific Analyses

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## Keywords

Blood pressure · Bone metabolism · Chronic kidney disease · Clinical Commissioning Group · Deceased donor · eGFR · Epidemiology · Ethnicity · Graft function · Haemoglobin · Live donor · Outcomes · Renal transplantation · Survival

## Summary

- There was a 1% fall in overall renal transplant numbers in 2015, with a fall in kidney donation from donors after brainstem death (6%) and from living donors (5%).
- In 2015, death-censored renal transplant failure rates in prevalent patients were similar to previous years at 2.7% per annum. Transplant patient death rates were similar at 2.5 per 100 patient years.
- The median age of incident and prevalent renal transplant patients in the UK was 50.9 and 53.8 years respectively.

- The median eGFR of prevalent renal transplant recipients was 51.8 ml/min/1.73 m<sup>2</sup>.
- The median eGFR of patients one year after transplantation was 57.5 ml/min/1.73 m<sup>2</sup> post live transplant, 53.7 ml/min/1.73 m<sup>2</sup> post brainstem death transplant and 50.4 ml/min/1.73 m<sup>2</sup> post circulatory death transplant.
- In 2015, 13.3% of prevalent transplant patients had eGFR <30 ml/min/1.73 m<sup>2</sup>.
- The median decline in eGFR slope beyond the first year after transplantation was –0.56 ml/min/1.73 m<sup>2</sup>/year.
- In 2015, infection (24%) and malignancy (22%) remained the commonest causes of death in patients with a functioning renal transplant.

## Introduction

This chapter includes independent analyses regarding renal transplant activity and survival data from the UK Transplant Registry, held by the Organ Donation and Transplantation Directorate (ODT) of NHS Blood and Transplant (NHSBT). The UK Renal Registry (UKRR) has performed additional analyses of renal transplant recipient follow-up data examining demographics, clinical and biochemical variables. NHSBT records all information regarding the episode of transplantation (donor and recipient details) and the UKRR holds additional information on key clinical and biochemical variables in renal transplant recipients. The co-operation between these two organisations results in a comprehensive database describing the clinical care delivered to renal transplant patients within the UK. This allows for the comparison of key quality measures between centres and provides insight into the processes involved in the care of such patients in the UK.

This chapter is divided into six sections: (1) transplant activity, waiting list and survival data; (2) transplant demographics; (3) clinical and laboratory outcomes; (4) analysis of prevalent patients by chronic kidney disease (CKD) stage; (5) eGFR slope analysis; and (6) cause of death in transplant recipients. Methodology, results and a discussion of these analyses are provided in detail for all six sections separately.

The UK Renal Registry methodology has previously been described [1]. The UKRR collects quarterly clinical data via an electronic data extraction process from hospital based renal IT systems on all patients receiving renal replacement therapy. Throughout the chapter, the number preceding the centre name in each figure indicates the percentage of missing data for that centre for that variable.

Unless otherwise specified, prevalent transplant patients were defined as patients with a functioning renal transplant on the 31st December 2015.

A list of the Renal Association recommended audit measures which are relevant to the transplant population are given in appendix 1 of this chapter. Several of the audit measures are not currently reported by the UKRR in the annual report; the reasons behind this are varied, but predominantly relate to a high proportion of incomplete data or that the relevant variable is not currently within the specified UKRR dataset. Over time it is hoped to work with the renal community to improve reporting across the range of recommended standards.

## Transplant activity, waiting list activity and survival data

### Introduction

NHSBT prospectively collects donor and recipient data at the time of transplantation. They also request that transplant centres provide an annual paper based data return on the status of the recipient including graft function. This enables ODT to generate comprehensive analyses of renal transplant activity and graft survival statistics.

NHSBT attributes a patient to the centre that performed the transplant operation irrespective of where the patient was cared for before or after the procedure and hence only reports on transplant centre performance.

### Methods

In 2015, there were 23 UK adult renal transplant centres, 19 in England, two in Scotland and one each in Northern Ireland and Wales.

Annual organ-specific updates and five-year reports with comprehensive data concerning the number of patients on the transplant waiting list, percentage of pre-emptive listing, the number of transplants performed, the number of deceased kidney donors (donor after brainstem death and donor after circulatory death), living kidney donors, patient survival and graft survival are available on the NHSBT website (<https://www.organdonation.nhs.uk/statistics/>)

### Results

During 2015, 3,174 kidney or kidney plus transplants were performed (table 3.1). The absolute number of living kidney donors showed a small decline in 2015, but still represented 32.9% of all transplants performed. Compared to the relative fall observed in 2014, there was recovery in the number of donor after circulatory death (DCD) transplants (+12%), whereas the number of deceased brainstem death donors did not increase. The number of kidney plus other organ transplants has not changed.

There were small differences in one- and five-year risk adjusted patient and graft survival rates amongst UK kidney transplant centres (table 3.2). These graft survival rates include grafts with primary non-function, which are excluded from analysis by some registries.

Using data from the UKRR on prevalent renal transplant patients on 1st January 2015, the death rate during 2015 was 2.5 per 100 patient years (CI 2.3–2.7) when censored for return to dialysis, and 2.7 per 100 patient years (CI 2.5–2.9) without censoring for dialysis. These death rates were similar to those observed over the last five years and have not shown any impact from the increasing age or comorbidity of the transplanted cohort.

**Table 3.1.** UK kidney and kidney plus other organ transplant numbers in the UK (including paediatric), 1/1/2013–31/12/2015

Organ	2013	2014	2015	% change 2014–2015
Donor after brainstem death <sup>a</sup>	1,160	1,205	1,130	–6
Donor after circulatory death <sup>b</sup>	794	713	802	12
Living donor kidney	1,104	1,097	1,044	–5
Kidney and liver <sup>c</sup>	11	12	21	
Kidney and heart	1	1	0	
Kidney and pancreas <sup>d</sup>	190	171	175	2
Kidney and lung	0	1	0	
Small bowel (inc kidney)	1	1	2	
<b>Total kidney transplants</b>	<b>3,261</b>	<b>3,201</b>	<b>3,174</b>	<b>–1</b>

<sup>a</sup>Includes en bloc kidney transplants (4 in 2013, 3 in 2014, 4 in 2015) and double kidney transplants (18 in 2013, 22 in 2014, 15 in 2015)

<sup>b</sup>Includes en bloc kidney transplants (6 in 2013, 4 in 2014, 8 in 2015) and double kidney transplants (53 in 2013, 51 in 2014, 31 in 2015)

<sup>c</sup>Includes DCD transplants (2 in 2013)

<sup>d</sup>Includes DCD transplants (36 in 2013, 47 in 2014, 50 in 2015)

**Table 3.2.** Risk-adjusted first adult kidney transplant only, graft and patient survival percentage rates for UK centres\*

Centre	Deceased donor 1 year survival		Deceased donor 5 year survival		Living kidney donor 1 year survival		Living kidney donor 5 year survival	
	Graft	Patient	Graft	Patient	Graft	Patient	Graft	Patient
B QEH	92	97	83	90	96	99	93	95
Belfast	98	92	91	87	96	100	93	100
Bristol	94	94	83	87	97	100	96	95
Camb	94	96	85	90	99	99	97	96
Cardff	96	96	88	89	96	99	86	97
Covnt	89	92	87	86	99	100	90	96
Edin	95	97	82	85	95	99	89	93
Glasgw	93	96	90	90	95	99	94	95
L Barts	89	90	86	85	95	99	92	94
L Guys	93	98	85	90	98	99	93	96
L Rfree	93	96	90	93	98	100	98	98
L St.G	94	97	89	95	98	99	93	95
L West	96	98	85	92	96	99	87	96
Leeds	94	97	86	88	95	99	90	96
Leic	93	99	83	81	97	97	91	96
Liv Roy	91	93	87	88	97	98	85	95
M RI	96	96	89	90	99	98	96	95
Newc	95	96	82	86	99	100	93	95
Nottm	96	97	82	81	100	100	92	94
Oxford	93	96	89	90	96	99	96	93
Plymth	87	94	85	90	97	100	89	96
Ports	95	94	84	86	100	99	88	93
Sheff	95	94	85	94	99	100	96	98
<b>All centres</b>	<b>94</b>	<b>96</b>	<b>86</b>	<b>89</b>	<b>97</b>	<b>99</b>	<b>92</b>	<b>95</b>

Cohorts for survival rate estimation: 1 year survival: 1/4/2010 – 31/03/2014; 5 year survival: 1/4/2006 – 31/03/2010; first grafts only – re-grafts excluded for patient survival estimation. Since the cohorts to estimate 1- and 5-year survival are different, some centres may appear to have 5 year survival better than 1 year survival

\*Information courtesy of NHSBT: number of transplants, patients and 95% CI for each estimate; statistical methodology for computing risk-adjusted estimates can be obtained from the NHSBT website (see [http://odt.nhs.uk/pdf/organ\\_specific\\_report\\_kidney\\_2015.pdf](http://odt.nhs.uk/pdf/organ_specific_report_kidney_2015.pdf))

During 2015, 2.7% of prevalent transplant patients experienced graft failure (excluding death as a cause of graft failure), which was a slight increase on the rate in 2014 (2.4%), and above the mean rate for 2009–2014 (2.5%).

Discussion

During 2015, there was a 1% reduction in overall kidney transplant numbers, with a fall in the number of living kidney donors. The number of deceased donor transplants remained stable, whilst there was an increase in deceased cardiac death kidney transplants compared to 2014. The graft failure rate of 2.7% per annum and the patient death rate of 2.5 per 100 patient years are similar to previous years, despite the changes in donor and recipient populations.

Transplant demographics

Introduction

Since 2008, all UK renal centres have established electronic linkage to the UKRR or Scottish Renal Registry, giving the UKRR complete coverage of individual patient level data across the UK.

The following sections should be interpreted in the context of centre-specific variations in repatriation policies; some transplant centres continue to follow up and report on all patients they transplant, whereas others refer patients back to non-transplanting centres at some point post-transplant. Some transplant centres only refer back patients when their graft is failing. The time post-transplantation that a patient is referred back to their local centre varies between transplant centres, but the UKRR can detect duplicate patients (being reported from both transplant and referring centres) and in such situations care is usually attributed to the referring centre (see appendix B for allocation procedure). This process may result in some discrepancies in transplant numbers particularly in Oxford/Reading and Clywd/Liverpool Royal.

Methods

Cambridge renal centre (Addenbrooke’s) was unable to submit the 2015 data at patient level on time for the end of 2015 UKRR data collection. The centre was able to submit summary numbers of patients still on renal replacement therapy (RRT) at the end of 2015, by treatment modality, and incident numbers. Cambridge renal centre is therefore excluded from all centre level prevalent analysis. However their data have been included in the transplant rates calculation in England and UK, where only summary numbers are needed. For the calculation of transplant rates by Clinical Commissioning Groups (CCG) or Health Board/Social Care Areas (HB), where patient-level information are needed for age/gender standardisation, Cambridge data from 2014 were used instead, which will cause a slight underestimation of the rates. Those CCGs that are at least in part covered by Addenbrooke’s were identified using 2014 data and they are flagged in table 3.4 (in CCGs where between 10–70% of the RRT population was seen in Addenbrooke’s, rates are shown but the CCG is flagged, while for the two CCGs where most patients (>70%) are thought to be seen in Addenbrooke’s, rates have been blanked as they would represent mainly 2014 data.

As Colchester did not have any transplant patients they were excluded from some of the analyses, though their dialysis patients were included in the relevant dialysis population denominators. Also, this year Bangor directly submitted its data on transplant patients (previously submitted mainly by Liverpool Royal) and it is therefore now included separately in centre analyses.

For the analysis of primary renal diagnosis (PRD) in transplant recipients, a few centres were excluded from some of the incidence years because of concerns relating to the reliability of PRD coding (with these centres submitting a high percentage of uncertain or missing aetiology codes).

Information on patient demographics (age, gender, ethnicity and PRD) for patients in a given renal centre was obtained from UKRR patient registration data fields. Individual patients were assigned to the centre that returned data for them during 2015. The prevalence of transplant patients in areas covered by individual CCG or HB was estimated based on the postcode of the registered address for patients on RRT. Data on ethnic origin, supplied as Patient Administration System (PAS) codes, were retrieved from fields within renal centre IT systems. For the purpose of this analysis, patients were grouped into White, South Asian, Black, Other and Unknown categories. The details of ethnicity regrouping into the above categories are provided in appendix H: Coding <https://www.renalreg.org/publications-reports/>.

Results and Discussion

Prevalent transplant numbers across the UK are described in table 3.3.

**Table 3.3.** The prevalence per million population (pmp) of renal transplants in adults in the UK on 31/12/2015, by country

	England	N Ireland	Scotland	Wales	UK
Number of prevalent transplant patients	27,246	994	2,709	1,675	32,624
Total population, mid-2015 estimates* (millions)	54.8	1.9	5.4	3.1	65.1
Prevalence transplant rate (pmp)	497	537	504	540	501

\*Data from the Office of National Statistics, National Records of Scotland and the Northern Ireland Statistics and Research Agency – based on the 2011 census

**Table 3.4.** The prevalence per million population (pmp) of patients with a renal transplant and standardised rate ratio in the UK, as on 31st December 2011–2015, by CCG/HB

CCG/HB – CCG in England, Health and Social Care Areas in Northern Ireland, Local Health Boards in Wales and Health Boards in Scotland

O/E – age and gender standardised transplant prevalence rate ratio

LCL – lower 95% confidence limit

UCL – upper 95% confidence limit

pmp – per million population

CCG/HBs with significantly high average rate ratios are bold in greyed areas

CCG/HBs with significantly low average rate ratios are italicised in greyed areas

Mid-2015 population data at CCG/HB level was obtained from the Office for National Statistics, National Records of Scotland and the Northern Ireland Statistics and Research Agency – based on the 2011 census

% non-White – percentage of the CCG/HB population that is non-White, from 2011 Census

\*CCGs where at least 10% of the RRT population was seen in Cambridge renal centre. In these CCGs the rate is underestimated. In the CCGs with >70% RRT population covered by Cambridge, the rates for 2015 have been blanked (see methods for details)

UK area	CCG/HB	Total population	O/E				2015			Crude rate pmp	% non-White
			2011	2012	2013	2014	O/E	95% LCL	95% UCL		
Cheshire, Warrington and Wirral	NHS Eastern Cheshire	196,500	0.87	0.88	0.88	0.87	0.88	0.72	1.07	478	3.7
	NHS South Cheshire	178,900	0.89	0.87	0.91	0.97	0.99	0.80	1.21	520	2.9
	NHS Vale Royal	102,900	0.69	0.72	0.75	0.73	0.77	0.57	1.04	408	2.1
	NHS Warrington	207,700	0.87	0.89	0.97	0.94	0.89	0.73	1.09	462	4.1
	NHS West Cheshire	231,000	0.95	0.94	0.94	0.95	0.87	0.72	1.05	455	2.8
	<i>NHS Wirral</i>	<i>320,900</i>	<i>0.86</i>	<i>0.81</i>	<i>0.78</i>	<i>0.75</i>	<i>0.74</i>	<i>0.62</i>	<i>0.88</i>	<i>383</i>	<i>3.0</i>
Durham, Darlington and Tees	NHS Darlington	105,400	0.95	0.92	0.96	0.99	0.96	0.73	1.26	493	3.8
	NHS Durham Dales, Easington and Sedgfield	274,000	1.05	1.02	1.04	1.09	1.04	0.89	1.22	555	1.2
	NHS Hartlepool and Stockton-on-Tees	287,300	1.03	1.03	1.01	1.02	1.01	0.86	1.18	508	4.4
	<i>NHS North Durham</i>	<i>245,700</i>	<i>0.95</i>	<i>0.93</i>	<i>0.89</i>	<i>0.85</i>	<i>0.82</i>	<i>0.68</i>	<i>1.00</i>	<i>423</i>	<i>2.5</i>
	<b>NHS South Tees</b>	<b>274,800</b>	<b>1.38</b>	<b>1.35</b>	<b>1.27</b>	<b>1.25</b>	<b>1.22</b>	<b>1.05</b>	<b>1.42</b>	<b>608</b>	<b>6.7</b>
Greater Manchester	<b>NHS Bolton</b>	<b>281,600</b>	<b>1.26</b>	<b>1.28</b>	<b>1.23</b>	<b>1.21</b>	<b>1.27</b>	<b>1.09</b>	<b>1.47</b>	<b>621</b>	<b>18.1</b>
	NHS Bury	187,900	1.00	1.01	0.96	1.00	1.05	0.86	1.27	527	10.8
	<b>NHS Central Manchester</b>	<b>188,900</b>	<b>1.06</b>	<b>1.07</b>	<b>1.12</b>	<b>1.18</b>	<b>1.29</b>	<b>1.05</b>	<b>1.58</b>	<b>487</b>	<b>48.0</b>
	NHS Heywood, Middleton & Rochdale	214,200	1.09	1.10	1.09	0.95	1.01	0.83	1.22	490	18.3
	NHS North Manchester	178,700	0.85	0.91	0.95	0.95	0.99	0.79	1.25	414	30.8
	NHS Oldham	230,800	1.04	1.01	1.07	1.02	1.07	0.89	1.28	507	22.5
	NHS Salford	245,600	0.95	1.03	0.97	1.00	1.02	0.85	1.22	476	9.9
	NHS South Manchester	162,700	0.82	0.87	0.86	0.90	0.92	0.72	1.17	399	19.6
	NHS Stockport	288,700	0.97	0.95	0.94	0.92	0.94	0.80	1.11	485	7.9
	NHS Tameside and Glossop	254,900	1.10	1.06	1.03	1.06	1.04	0.88	1.23	534	8.2
	NHS Trafford	233,300	0.85	0.88	0.90	0.94	0.96	0.80	1.16	480	14.5
	NHS Wigan Borough	322,000	1.05	1.07	1.10	1.06	1.02	0.88	1.19	534	2.7
Lancashire	NHS Blackburn with Darwen	146,800	0.97	0.99	1.01	1.06	1.07	0.86	1.35	504	30.8
	NHS Blackpool	139,600	0.83	0.93	1.04	1.05	1.03	0.82	1.29	537	3.3
	NHS Chorley and South Ribble	172,500	0.95	0.90	0.94	0.95	0.97	0.79	1.20	510	2.9
	NHS East Lancashire	374,200	1.08	1.04	1.05	1.03	1.04	0.91	1.20	532	11.9
	NHS Fylde & Wyre	167,900	0.82	0.85	0.84	0.80	0.87	0.70	1.08	476	2.1
	NHS Greater Preston	202,800	0.81	0.88	0.85	0.86	0.87	0.70	1.07	424	14.7
	<i>NHS Lancashire North</i>	<i>161,500</i>	<i>0.84</i>	<i>0.80</i>	<i>0.77</i>	<i>0.77</i>	<i>0.77</i>	<i>0.60</i>	<i>0.99</i>	<i>384</i>	<i>4.0</i>
	NHS West Lancashire	112,700	0.86	0.88	0.84	0.81	0.84	0.63	1.11	435	1.9
Merseyside	NHS Halton	126,500	1.00	1.04	0.99	1.02	1.01	0.79	1.28	514	2.2
	NHS Knowsley	147,200	0.97	0.97	0.97	0.91	0.89	0.69	1.13	441	2.8
	NHS Liverpool	478,600	0.95	0.95	0.98	0.98	0.94	0.82	1.08	443	11.1
	NHS South Sefton	158,600	0.91	0.95	0.91	0.89	0.87	0.69	1.09	454	2.2
	<i>NHS Southport and Formby</i>	<i>115,100</i>	<i>0.72</i>	<i>0.63</i>	<i>0.73</i>	<i>0.69</i>	<i>0.70</i>	<i>0.52</i>	<i>0.94</i>	<i>374</i>	<i>3.1</i>
	NHS St Helens	177,600	0.85	0.82	0.85	0.92	0.89	0.72	1.11	467	2.0



**Table 3.4.** Continued

UK area	CCG/HB	Total population	O/E				2015			Crude rate pmp	% non-White
			2011	2012	2013	2014	O/E	95% LCL	95% UCL		
Cumbria, Northumberland, Tyne and Wear	NHS Cumbria	504,100	0.94	0.92	0.93	0.91	0.92	0.82	1.04	508	1.5
	NHS Newcastle Gateshead	493,900	1.04	1.00	0.96	0.94	0.91	0.80	1.04	431	10.1
	NHS North Tyneside	202,500	1.41	1.35	1.26	1.13	1.12	0.93	1.34	588	3.4
	NHS Northumberland	315,300	0.97	0.93	0.93	0.92	0.86	0.73	1.01	476	1.6
	NHS South Tyneside	148,700	1.19	1.15	1.17	1.02	0.95	0.76	1.19	498	4.1
	NHS Sunderland	277,200	1.14	1.14	1.12	1.07	1.01	0.85	1.18	520	4.1
North Yorkshire and Humber	NHS East Riding of Yorkshire	315,100	0.93	0.93	1.00	0.96	0.93	0.80	1.09	517	1.9
	NHS Hambleton, Richmondshire and Whitby	151,800	0.75	0.73	0.78	0.91	0.88	0.70	1.10	481	2.7
	NHS Harrogate and Rural District	157,000	1.12	1.20	1.13	1.12	1.13	0.92	1.38	605	3.7
	NHS Hull	259,000	1.02	1.04	1.05	1.03	1.09	0.92	1.29	517	5.9
	NHS North East Lincolnshire	159,600	0.99	1.00	0.99	0.92	0.94	0.75	1.18	476	2.6
	<i>NHS North Lincolnshire</i>	<i>169,800</i>	<i>0.67</i>	<i>0.65</i>	<i>0.64</i>	<i>0.69</i>	<i>0.69</i>	<i>0.54</i>	<i>0.89</i>	<i>365</i>	<i>4.0</i>
	NHS Scarborough and Ryedale	110,700	1.10	1.04	0.93	0.93	0.94	0.73	1.22	515	2.5
	NHS Vale of York	355,400	1.00	1.07	1.07	1.07	1.06	0.92	1.23	543	4.0
South Yorkshire and Bassetlaw	NHS Barnsley	239,300	0.95	0.93	0.91	0.96	0.96	0.80	1.15	501	2.1
	NHS Bassetlaw	114,500	0.73	0.69	0.66	0.71	0.79	0.60	1.05	428	2.6
	NHS Doncaster	304,800	0.91	0.91	0.87	0.90	0.93	0.79	1.09	472	4.7
	NHS Rotherham	260,800	1.04	1.04	1.04	1.08	1.04	0.88	1.23	537	6.4
	NHS Sheffield	569,700	1.00	0.98	0.98	0.96	0.94	0.83	1.06	435	16.3
West Yorkshire	NHS Airedale, Wharfedale and Craven	159,300	1.03	1.02	1.00	0.97	1.02	0.83	1.26	534	11.1
	<b>NHS Bradford City</b>	<b>83,900</b>	<b>1.31</b>	<b>1.53</b>	<b>1.62</b>	<b>1.59</b>	<b>1.82</b>	<b>1.40</b>	<b>2.37</b>	<b>668</b>	<b>72.2</b>
	<b>NHS Bradford Districts</b>	<b>337,700</b>	<b>1.24</b>	<b>1.30</b>	<b>1.32</b>	<b>1.29</b>	<b>1.31</b>	<b>1.14</b>	<b>1.50</b>	<b>607</b>	<b>28.7</b>
	NHS Calderdale	208,400	1.19	1.21	1.12	1.03	1.01	0.84	1.22	523	10.3
	NHS Greater Huddersfield	243,800	1.06	1.07	1.04	1.06	1.08	0.91	1.28	541	17.4
	NHS Leeds North	200,800	1.07	1.04	0.98	1.01	1.03	0.85	1.25	518	17.4
	NHS Leeds South and East	249,700	1.01	1.01	1.05	0.98	0.99	0.83	1.20	449	18.3
	NHS Leeds West	323,600	0.92	1.01	1.05	1.10	1.07	0.92	1.26	482	10.8
	<b>NHS North Kirklees</b>	<b>190,500</b>	<b>1.23</b>	<b>1.18</b>	<b>1.29</b>	<b>1.37</b>	<b>1.38</b>	<b>1.16</b>	<b>1.64</b>	<b>661</b>	<b>25.3</b>
	<i>NHS Wakefield</i>	<i>333,800</i>	<i>0.85</i>	<i>0.85</i>	<i>0.84</i>	<i>0.83</i>	<i>0.82</i>	<i>0.69</i>	<i>0.96</i>	<i>425</i>	<i>4.6</i>
Arden, Herefordshire and Worcester-shire	NHS Coventry and Rugby	448,800	1.04	1.05	1.01	1.07	1.08	0.95	1.23	495	22.2
	<i>NHS Herefordshire</i>	<i>188,100</i>	<i>0.70</i>	<i>0.71</i>	<i>0.68</i>	<i>0.68</i>	<i>0.73</i>	<i>0.58</i>	<i>0.92</i>	<i>393</i>	<i>1.8</i>
	<i>NHS Redditch and Bromsgrove</i>	<i>180,500</i>	<i>0.79</i>	<i>0.83</i>	<i>0.79</i>	<i>0.81</i>	<i>0.78</i>	<i>0.62</i>	<i>0.98</i>	<i>410</i>	<i>6.0</i>
	NHS South Warwickshire	261,500	0.95	1.02	1.00	0.98	0.99	0.83	1.17	516	7.0
	<i>NHS South Worcestershire</i>	<i>298,600</i>	<i>0.81</i>	<i>0.79</i>	<i>0.79</i>	<i>0.78</i>	<i>0.74</i>	<i>0.62</i>	<i>0.88</i>	<i>392</i>	<i>3.7</i>
	NHS Warwickshire North	189,100	1.07	1.01	0.98	0.92	0.91	0.74	1.12	476	6.5
	<i>NHS Wyre Forest</i>	<i>99,500</i>	<i>0.80</i>	<i>0.80</i>	<i>0.83</i>	<i>0.74</i>	<i>0.69</i>	<i>0.50</i>	<i>0.95</i>	<i>372</i>	<i>2.8</i>
Birmingham and the Black Country	NHS Birmingham CrossCity	740,800	1.03	1.04	1.04	1.07	1.08	0.97	1.20	472	35.2
	NHS Birmingham South and Central	202,300	1.06	0.98	1.07	1.13	1.11	0.91	1.36	470	40.4
	<i>NHS Dudley</i>	<i>316,500</i>	<i>0.74</i>	<i>0.66</i>	<i>0.69</i>	<i>0.69</i>	<i>0.72</i>	<i>0.60</i>	<i>0.87</i>	<i>367</i>	<i>10.0</i>
	NHS Sandwell and West Birmingham	487,700	0.98	0.99	1.08	1.03	1.03	0.91	1.18	457	45.3
	<i>NHS Solihull</i>	<i>210,400</i>	<i>0.76</i>	<i>0.77</i>	<i>0.74</i>	<i>0.76</i>	<i>0.75</i>	<i>0.60</i>	<i>0.93</i>	<i>385</i>	<i>10.9</i>
	NHS Walsall	276,100	1.07	1.06	1.10	1.12	1.07	0.91	1.26	514	21.1
	NHS Wolverhampton	254,400	0.76	0.78	0.88	0.88	0.84	0.69	1.02	401	32.0

**Table 3.4.** Continued

UK area	CCG/HB	Total population	O/E				2015				% non-White
			2011	2012	2013	2014	O/E	95% LCL	95% UCL	Crude rate pmp	
Derbyshire and Nottinghamshire	NHS Erewash	96,300	0.65	0.64	0.80	0.85	0.81	0.59	1.10	415	3.2
	NHS Hardwick	110,500	0.66	0.62	0.54	0.60	0.64	0.47	0.88	344	1.8
	NHS Mansfield & Ashfield	196,400	0.98	1.05	1.04	1.04	0.98	0.81	1.19	509	2.5
	NHS Newark & Sherwood	118,700	1.09	1.15	1.16	1.16	1.10	0.87	1.39	590	2.4
	NHS North Derbyshire	272,900	0.78	0.84	0.78	0.74	0.75	0.62	0.90	410	2.5
	NHS Nottingham City	318,900	0.93	0.96	0.98	0.96	0.99	0.84	1.18	417	28.5
	NHS Nottingham North & East	149,500	0.90	0.91	0.91	0.80	0.81	0.63	1.03	421	6.2
	NHS Nottingham West	112,300	1.04	1.01	1.04	1.05	1.09	0.85	1.39	570	7.3
	NHS Rushcliffe	114,500	0.88	0.87	0.94	0.86	0.78	0.59	1.04	411	6.9
	NHS Southern Derbyshire	523,800	0.93	0.94	0.96	0.95	0.97	0.85	1.09	487	11.0
East Anglia	NHS Cambridgeshire and Peterborough*	876,400	0.97	0.95	0.94	0.94	0.90	0.82	1.00	447	9.5
	NHS Great Yarmouth & Waveney	214,800	0.78	0.80	0.93	0.98	1.01	0.84	1.21	531	2.7
	NHS Ipswich and East Suffolk*	399,500	0.88	0.84	0.90	0.88	0.91	0.79	1.05	478	5.6
	NHS North Norfolk	170,600	0.93	0.82	1.01	0.91	0.93	0.75	1.14	522	1.5
	NHS Norwich	198,200	0.77	0.72	0.89	0.90	0.93	0.76	1.15	444	7.3
	NHS South Norfolk*	243,400	0.85	0.84	0.98	0.95	0.98	0.82	1.16	518	2.6
	NHS West Norfolk*	174,100	0.82	0.86	0.83	0.85					2.6
	NHS West Suffolk*	226,300	0.92	0.95	0.91	0.87					4.6
Essex	NHS Basildon and Brentwood	257,800	0.95	0.92	1.03	0.91	0.89	0.74	1.06	442	7.1
	NHS Castle Point, Rayleigh and Rochford	174,300	0.85	0.82	0.88	0.98	0.90	0.72	1.11	482	3.0
	NHS Mid Essex*	385,700	1.00	0.92	0.98	0.94	0.93	0.80	1.07	485	4.4
	NHS North East Essex*	325,100	0.94	0.92	0.94	0.99	0.95	0.81	1.11	483	5.5
	NHS Southend	178,700	0.83	0.89	0.96	0.97	0.92	0.74	1.14	464	8.4
	NHS Thurrock	165,200	0.86	0.83	0.81	0.81	0.80	0.62	1.02	381	14.1
	NHS West Essex*	300,200	0.86	0.89	0.85	0.88	0.87	0.73	1.03	440	8.2
Hertfordshire and the South Midlands	NHS Bedfordshire*	440,300	1.00	1.08	1.04	1.06	1.01	0.88	1.15	513	11.2
	NHS Corby	66,900	0.87	0.80	0.74	0.68	0.89	0.62	1.28	434	4.5
	NHS East and North Hertfordshire*	559,100	0.94	0.97	0.97	0.99	0.97	0.86	1.09	478	10.4
	NHS Herts Valleys	588,200	1.00	0.98	0.99	1.01	1.03	0.92	1.16	508	14.6
	NHS Luton*	214,700	1.14	1.22	1.24	1.33	1.42	1.20	1.68	619	45.3
	NHS Milton Keynes	267,800	1.02	1.04	0.98	1.06	1.11	0.94	1.30	534	19.6
	NHS Nene	640,000	0.97	0.91	0.90	0.95	0.95	0.85	1.06	483	9.1
Leicestershire and Lincolnshire	NHS East Leicestershire and Rutland	325,900	0.91	0.89	0.88	0.92	0.90	0.77	1.05	476	9.8
	NHS Leicester City	342,600	1.49	1.49	1.54	1.62	1.64	1.44	1.86	706	49.5
	NHS Lincolnshire East	232,000	0.85	0.84	0.85	0.85	0.84	0.70	1.02	465	2.0
	NHS Lincolnshire West	234,300	0.84	0.81	0.83	0.83	0.76	0.62	0.93	384	3.0
	NHS South Lincolnshire*	146,000	0.65	0.67	0.63	0.70	0.69	0.53	0.90	370	2.3
	NHS South West Lincolnshire	124,300	0.74	0.73	0.71	0.71	0.69	0.51	0.92	370	2.3
	NHS West Leicestershire	387,500	1.05	1.03	1.02	1.00	1.00	0.88	1.15	519	6.9
Shropshire and Staffordshire	NHS Cannock Chase	134,900	0.76	0.72	0.74	0.70	0.65	0.49	0.87	341	2.4
	NHS East Staffordshire	125,700	0.59	0.56	0.66	0.61	0.66	0.49	0.89	342	9.0
	NHS North Staffordshire	216,700	0.90	0.92	0.94	0.88	0.90	0.74	1.09	480	3.5
	NHS Shropshire	311,400	0.83	0.76	0.72	0.71	0.75	0.63	0.89	408	2.0
	NHS South East Staffs and Seisdon and Peninsular	224,800	0.89	0.82	0.85	0.87	0.86	0.71	1.05	463	3.6
	NHS Stafford and Surrounds	152,200	0.87	0.88	0.90	0.92	0.93	0.75	1.17	506	4.7
	NHS Stoke on Trent	259,900	1.00	1.02	0.96	0.96	0.93	0.78	1.12	458	11.0
	NHS Telford & Wrekin	171,200	0.71	0.66	0.72	0.70	0.77	0.61	0.98	386	7.3

**Table 3.4.** Continued

UK area	CCG/HB	Total population	O/E				2015				% non-White
			2011	2012	2013	2014	O/E	95% LCL	95% UCL	Crude rate pmp	
London	NHS Barking & Dagenham	202,000	1.07	1.04	1.12	1.15	1.18	0.96	1.43	485	41.7
	<b>NHS Barnet</b>	<b>379,700</b>	<b>1.29</b>	<b>1.41</b>	<b>1.39</b>	<b>1.36</b>	<b>1.37</b>	<b>1.21</b>	<b>1.56</b>	<b>637</b>	<b>35.9</b>
	NHS Camden	241,100	1.10	1.11	1.07	1.02	1.02	0.85	1.23	465	33.7
	NHS City and Hackney	277,800	0.80	0.83	0.87	0.95	1.01	0.85	1.21	432	44.6
	<b>NHS Enfield</b>	<b>328,400</b>	<b>1.37</b>	<b>1.45</b>	<b>1.40</b>	<b>1.45</b>	<b>1.50</b>	<b>1.32</b>	<b>1.71</b>	<b>685</b>	<b>39.0</b>
	<b>NHS Haringey</b>	<b>272,900</b>	<b>1.16</b>	<b>1.20</b>	<b>1.22</b>	<b>1.27</b>	<b>1.36</b>	<b>1.17</b>	<b>1.58</b>	<b>619</b>	<b>39.5</b>
	NHS Havering	249,100	0.80	0.78	0.84	0.78	0.83	0.68	1.01	405	12.3
	<b>NHS Islington</b>	<b>227,700</b>	<b>1.19</b>	<b>1.23</b>	<b>1.21</b>	<b>1.25</b>	<b>1.27</b>	<b>1.07</b>	<b>1.51</b>	<b>558</b>	<b>31.8</b>
	<b>NHS Newham</b>	<b>332,800</b>	<b>0.85</b>	<b>0.95</b>	<b>1.05</b>	<b>1.16</b>	<b>1.18</b>	<b>1.01</b>	<b>1.38</b>	<b>487</b>	<b>71.0</b>
	<b>NHS Redbridge</b>	<b>296,800</b>	<b>1.13</b>	<b>1.20</b>	<b>1.18</b>	<b>1.27</b>	<b>1.27</b>	<b>1.09</b>	<b>1.47</b>	<b>569</b>	<b>57.5</b>
	NHS Tower Hamlets	295,200	0.77	0.83	0.82	0.91	0.91	0.75	1.10	362	54.8
	<b>NHS Waltham Forest</b>	<b>271,200</b>	<b>1.10</b>	<b>1.10</b>	<b>1.15</b>	<b>1.26</b>	<b>1.35</b>	<b>1.16</b>	<b>1.57</b>	<b>608</b>	<b>47.8</b>
	<b>NHS Brent</b>	<b>324,000</b>	<b>1.55</b>	<b>1.59</b>	<b>1.63</b>	<b>1.62</b>	<b>1.68</b>	<b>1.48</b>	<b>1.90</b>	<b>772</b>	<b>63.7</b>
	NHS Central London (Westminster)	174,100	1.05	1.06	1.03	1.10	1.15	0.94	1.40	563	36.2
	<b>NHS Ealing</b>	<b>343,100</b>	<b>1.55</b>	<b>1.55</b>	<b>1.52</b>	<b>1.59</b>	<b>1.60</b>	<b>1.41</b>	<b>1.81</b>	<b>746</b>	<b>51.0</b>
	NHS Hammersmith and Fulham	179,400	1.13	1.14	1.13	1.13	1.11	0.91	1.36	513	31.9
	<b>NHS Harrow</b>	<b>247,100</b>	<b>1.72</b>	<b>1.70</b>	<b>1.61</b>	<b>1.65</b>	<b>1.66</b>	<b>1.44</b>	<b>1.91</b>	<b>793</b>	<b>57.8</b>
	<b>NHS Hillingdon</b>	<b>297,700</b>	<b>1.48</b>	<b>1.49</b>	<b>1.42</b>	<b>1.48</b>	<b>1.42</b>	<b>1.23</b>	<b>1.63</b>	<b>648</b>	<b>39.4</b>
	<b>NHS Hounslow</b>	<b>268,800</b>	<b>1.23</b>	<b>1.20</b>	<b>1.29</b>	<b>1.34</b>	<b>1.39</b>	<b>1.20</b>	<b>1.61</b>	<b>644</b>	<b>48.6</b>
	NHS West London (Kensington and Chelsea, Queen's Park and Paddington)	225,900	1.13	1.07	1.04	1.06	1.01	0.84	1.22	496	33.4
	<b>NHS Bexley</b>	<b>242,100</b>	<b>1.28</b>	<b>1.25</b>	<b>1.27</b>	<b>1.22</b>	<b>1.30</b>	<b>1.10</b>	<b>1.52</b>	<b>624</b>	<b>18.1</b>
	NHS Bromley	324,900	1.14	1.15	1.13	1.10	1.11	0.96	1.28	551	15.7
	NHS Croydon	379,000	0.90	0.89	0.93	0.93	0.97	0.83	1.12	456	44.9
	<b>NHS Greenwich</b>	<b>274,800</b>	<b>1.02</b>	<b>1.07</b>	<b>1.11</b>	<b>1.26</b>	<b>1.30</b>	<b>1.11</b>	<b>1.52</b>	<b>582</b>	<b>37.5</b>
	NHS Kingston	173,500	1.01	1.06	1.02	1.02	1.04	0.84	1.29	490	25.5
	NHS Lambeth	324,400	0.94	1.02	1.07	1.11	1.15	0.99	1.34	512	42.9
	NHS Lewisham	297,300	0.91	0.90	1.03	1.06	1.14	0.98	1.34	518	46.5
	NHS Merton	204,600	1.08	1.15	1.17	1.19	1.19	0.99	1.43	562	35.1
	NHS Richmond	194,700	0.79	0.84	0.85	0.85	0.82	0.66	1.02	411	14.0
	<b>NHS Southwark</b>	<b>308,900</b>	<b>1.27</b>	<b>1.36</b>	<b>1.39</b>	<b>1.44</b>	<b>1.42</b>	<b>1.24</b>	<b>1.64</b>	<b>635</b>	<b>45.8</b>
	NHS Sutton	200,100	1.09	1.12	1.09	1.02	1.02	0.84	1.24	500	21.4
	NHS Wandsworth	314,500	0.95	0.98	1.00	1.06	1.07	0.91	1.26	477	28.6
Bath, Gloucestershire, Swindon and Wiltshire	<i>NHS Bath and North East Somerset</i>	<i>184,900</i>	<i>0.68</i>	<i>0.66</i>	<i>0.75</i>	<i>0.80</i>	<i>0.77</i>	<i>0.61</i>	<i>0.98</i>	<i>373</i>	<i>5.4</i>
	<i>NHS Gloucestershire</i>	<i>617,200</i>	<i>0.92</i>	<i>0.86</i>	<i>0.90</i>	<i>0.85</i>	<i>0.85</i>	<i>0.76</i>	<i>0.96</i>	<i>446</i>	<i>4.6</i>
	NHS Swindon	222,800	1.01	0.99	1.00	1.03	1.10	0.92	1.31	552	10.0
	<i>NHS Wiltshire</i>	<i>486,100</i>	<i>0.89</i>	<i>0.89</i>	<i>0.84</i>	<i>0.86</i>	<i>0.86</i>	<i>0.75</i>	<i>0.98</i>	<i>451</i>	<i>3.4</i>
Bristol, North Somerset, Somerset and South Gloucestershire	<b>NHS Bristol</b>	<b>449,300</b>	<b>1.26</b>	<b>1.27</b>	<b>1.25</b>	<b>1.24</b>	<b>1.23</b>	<b>1.08</b>	<b>1.39</b>	<b>543</b>	<b>16.0</b>
	NHS North Somerset	209,900	1.07	1.08	1.07	1.01	1.00	0.83	1.20	529	2.7
	<i>NHS Somerset</i>	<i>545,400</i>	<i>0.95</i>	<i>0.91</i>	<i>0.89</i>	<i>0.86</i>	<i>0.84</i>	<i>0.74</i>	<i>0.95</i>	<i>446</i>	<i>2.0</i>
	NHS South Gloucestershire	274,700	1.13	1.09	1.08	1.05	1.04	0.88	1.22	528	5.0



Table 3.4. Continued

							2015			Crude	%
UK area	CCG/HB	Total population	2011	2012	2013	2014	O/E	95% LCL	95% UCL	rate pmp	non-White
Devon, Cornwall and Isles of Scilly	NHS Kernow	551,700	1.13	1.16	1.12	1.09	1.08	0.97	1.21	584	1.8
	NHS North, East, West Devon	890,600	1.04	1.04	1.04	1.01	1.00	0.91	1.09	513	3.0
	NHS South Devon and Torbay	278,600	1.16	1.11	1.14	1.13	1.08	0.92	1.25	589	2.1
Kent and Medway	NHS Ashford	124,300	1.15	1.21	1.13	1.15	1.12	0.88	1.41	563	6.3
	NHS Canterbury and Coastal	207,700	1.10	1.18	1.13	1.17	1.10	0.92	1.33	539	5.9
	NHS Dartford, Gravesham and Swanley	258,200	1.18	1.16	1.15	1.18	1.21	1.03	1.41	596	13.0
	NHS Medway	276,500	0.97	0.96	0.98	0.94	0.91	0.76	1.09	445	10.4
	NHS South Kent Coast	205,500	0.84	0.85	0.86	0.92	0.90	0.74	1.10	482	4.5
	NHS Swale	112,500	1.32	1.34	1.38	1.33	1.30	1.04	1.64	658	3.8
	NHS Thanet	139,800	1.06	1.19	1.20	1.18	1.21	0.98	1.49	615	4.5
	NHS West Kent	476,800	0.88	0.89	0.88	0.87	0.86	0.75	0.98	438	4.9
Surrey and Sussex	NHS Brighton & Hove	285,300	0.90	0.88	0.84	0.84	0.88	0.73	1.05	414	10.9
	NHS Coastal West Sussex	495,000	1.01	0.95	0.96	0.94	0.93	0.82	1.06	495	3.8
	NHS Crawley	110,900	0.75	0.76	0.71	0.70	0.65	0.46	0.91	307	20.1
	NHS East Surrey	182,000	0.83	0.80	0.80	0.74	0.75	0.59	0.94	379	8.3
	NHS Eastbourne, Hailsham and Seaford	188,100	0.77	0.75	0.75	0.73	0.73	0.57	0.92	377	4.4
	NHS Guildford and Waverley	206,100	0.65	0.71	0.70	0.71	0.70	0.56	0.89	344	7.2
	NHS Hastings & Rother	184,400	0.84	0.78	0.77	0.79	0.76	0.61	0.95	407	4.6
	NHS High Weald Lewes Havens	171,600	0.76	0.85	0.79	0.79	0.73	0.58	0.93	396	3.1
	NHS Horsham and Mid Sussex	230,300	0.74	0.72	0.73	0.80	0.82	0.67	1.00	425	4.9
	NHS North West Surrey	343,000	1.02	1.02	1.00	0.98	0.97	0.83	1.12	490	12.5
	NHS Surrey Downs	287,000	0.96	0.91	0.91	0.91	0.91	0.77	1.08	474	9.1
NHS Surrey Heath	95,900	1.20	1.21	1.06	0.93	0.90	0.67	1.21	469	9.3	
Thames Valley	NHS Aylesbury Vale	207,000	1.22	1.22	1.16	1.13	1.10	0.91	1.31	560	9.7
	NHS Bracknell and Ascot	137,000	1.08	1.06	1.05	0.99	0.95	0.74	1.21	474	9.5
	NHS Chiltern	324,000	1.00	1.06	1.04	0.99	0.99	0.85	1.16	503	15.8
	NHS Newbury and District	106,400	1.33	1.29	1.22	1.14	1.04	0.80	1.34	536	4.4
	NHS North & West Reading	100,300	0.99	1.01	1.05	1.00	0.95	0.72	1.26	488	10.4
	NHS Oxfordshire	663,600	1.06	1.08	1.05	1.08	1.08	0.97	1.20	530	9.3
	NHS Slough	145,700	1.62	1.63	1.83	1.84	1.93	1.61	2.30	844	54.3
	NHS South Reading	111,000	1.39	1.29	1.31	1.36	1.46	1.15	1.85	621	30.5
	NHS Windsor, Ascot and Maidenhead	141,400	1.08	1.21	1.25	1.29	1.26	1.02	1.55	623	14.7
NHS Wokingham	160,400	1.00	1.00	0.97	0.98	0.97	0.78	1.21	499	11.6	
Wessex	NHS Dorset	765,700	0.96	0.90	0.86	0.86	0.85	0.76	0.94	445	4.0
	NHS Fareham and Gosport	199,500	0.99	0.93	1.02	1.01	0.99	0.81	1.20	516	3.4
	NHS Isle of Wight	139,400	0.77	0.74	0.64	0.63	0.69	0.53	0.90	380	2.7
	NHS North East Hampshire and Farnham	209,200	0.84	0.85	0.86	0.88	0.89	0.73	1.09	449	9.7
	NHS North Hampshire	220,800	0.86	0.86	0.83	0.82	0.85	0.70	1.04	439	6.4
	NHS Portsmouth	211,800	1.01	0.98	0.98	0.92	0.87	0.71	1.08	397	11.6
	NHS South Eastern Hampshire	211,900	0.98	1.00	0.96	1.02	1.00	0.83	1.21	529	3.1
	NHS Southampton	249,500	1.02	1.06	1.08	1.10	1.10	0.92	1.32	485	14.1
	NHS West Hampshire	554,900	0.99	0.95	0.92	0.90	0.87	0.77	0.99	460	3.9
Wales	Betsi Cadwaladr University	694,500	0.88	0.82	0.73	0.72	0.85	0.76	0.95	446	2.5
	Powys Teaching	132,600	0.95	0.80	0.78	0.76	0.73	0.56	0.96	407	1.6
	Hywel Dda	383,200	1.08	1.00	1.06	1.00	0.95	0.83	1.10	504	2.2
	Abertawe Bro Morgannwg University	525,500	1.32	1.32	1.29	1.25	1.20	1.08	1.34	613	3.9
	Cwm Taf	296,700	1.62	1.59	1.60	1.50	1.43	1.25	1.63	721	2.6
	Aneurin Bevan	581,800	1.27	1.34	1.28	1.23	1.18	1.07	1.31	608	3.9
	Cardiff and Vale University	484,800	1.22	1.24	1.19	1.13	1.14	1.01	1.28	532	12.2

**Table 3.4.** Continued

UK area	CCG/HB	Total population	O/E				2015			Crude rate pmp	% non-White
			2011	2012	2013	2014	O/E	95% LCL	95% UCL		
Scotland	Ayrshire and Arran	370,600	0.95	0.96	0.96	0.97	0.96	0.84	1.11	521	1.2
	Borders	114,000	1.03	1.10	1.04	1.00	0.95	0.74	1.22	535	1.3
	Dumfries and Galloway	149,700	0.93	0.88	0.82	0.84	0.86	0.68	1.09	481	1.2
	<i>Fife</i>	368,100	0.87	0.87	0.87	0.85	0.84	0.72	0.98	443	2.4
	Forth Valley	302,700	0.85	0.87	0.87	0.92	0.93	0.79	1.09	489	2.2
	Grampian	587,800	0.91	0.91	0.92	0.88	0.91	0.81	1.02	468	4.0
	<b>Greater Glasgow and Clyde</b>	<b>1,149,900</b>	<b>1.09</b>	<b>1.15</b>	<b>1.16</b>	<b>1.16</b>	<b>1.14</b>	<b>1.06</b>	<b>1.23</b>	<b>576</b>	<b>7.3</b>
	Highland	321,000	1.11	1.05	1.03	1.02	1.02	0.88	1.18	564	1.3
	Lanarkshire	654,500	1.04	1.06	1.03	1.07	1.04	0.94	1.16	547	2.0
	<i>Lothian</i>	867,800	0.90	0.87	0.84	0.85	0.84	0.76	0.93	419	5.6
	Orkney	21,700	0.84	0.79	0.74	0.52	0.50	0.22	1.10	277	0.7
	Shetland	23,200	0.51	0.58	0.54	0.51	0.48	0.22	1.08	259	1.5
	Tayside	415,000	1.00	0.96	0.94	0.90	0.90	0.78	1.03	465	3.2
	Western Isles	27,100	0.75	0.71	0.66	0.62	0.59	0.31	1.13	332	0.9
Northern Ireland	<b>Belfast</b>	<b>353,800</b>	<b>1.10</b>	<b>1.14</b>	<b>1.13</b>	<b>1.18</b>	<b>1.19</b>	<b>1.04</b>	<b>1.37</b>	<b>557</b>	<b>3.2</b>
	Northern	471,200	0.95	0.93	0.94	0.99	1.01	0.89	1.15	501	1.2
	Southern	373,000	0.89	0.96	0.96	1.02	1.12	0.97	1.29	528	1.2
	South Eastern	354,700	0.96	0.92	0.92	0.96	1.00	0.87	1.16	505	1.3
	<b>Western</b>	<b>299,000</b>	<b>0.92</b>	<b>0.89</b>	<b>1.02</b>	<b>1.15</b>	<b>1.20</b>	<b>1.03</b>	<b>1.39</b>	<b>582</b>	<b>1.0</b>

The prevalence of renal transplant recipients in each CCG in England, Northern Ireland (Health and Social Care Trust Areas), Scotland (Health Boards) and Wales (Local Health Boards) and the proportion of prevalent patients according to modality in the renal centres across the UK are described in tables 3.4 and 3.5 respectively.

After standardisation for age and gender, unexplained variability was evident in the prevalence of renal transplant recipients, with some areas having higher than the predicted number of prevalent transplant patients per million population and others lower. There are a number of potential explanations for these inconsistencies, including geographical differences in access to renal transplantation in the UK. This has previously been analysed in detail by the UKRR [2] and is currently the focus of a large national study (access to Transplant and Transplant Outcome Measures (ATTOM)) [3].

The proportion of prevalent RRT patients with a transplant relative to the number on dialysis has gradually risen over the last decade.

#### *Age and gender*

The gender ratio amongst incident and prevalent kidney transplant patients has remained stable for at

least the last ten years (table 3.6, figure 3.1). The median age of incident transplant recipients has increased during the same time period, which reflects changes to the renal replacement therapy population. This is mirrored by an increase in the median age of the prevalent population, which reflects the increase in age at which patients are transplanted, the increase access to transplantation for older recipients, as well as improved survival after kidney transplantation over the last 10 years.

#### *Primary renal diagnosis*

The primary renal diagnosis of patients receiving a kidney transplant in the UK has remained relatively stable over the last five years (table 3.7).

#### *Ethnicity*

The ethnicity of those receiving a kidney transplant between 2010 and 2015 is shown in table 3.8. A comparison of the proportion of patients within each ethnic group receiving a transplant to those commencing dialysis from the same group is difficult because data on ethnicity were missing, or there was a high proportion with ethnicity classified as 'missing'. This is a particular issue in Scotland, where ethnicity reporting is not mandatory. Analysis isolated to the remainder of the

**Table 3.5.** Distribution of prevalent patients on RRT by centre and modality on 31/12/2015

Centre	N	% HD	% PD	% transplant
<b>Transplant centres</b>				
B QEH	2,254	45	6	49
Belfast	773	24	3	73
Bristol	1,477	36	4	61
Camb <sup>a</sup>	1,539	38	3	59
Cardff	1,613	31	5	64
Covnt	958	37	9	54
Edinb	773	37	3	60
Glasgw	1,715	35	3	62
L Barts	2,286	44	9	47
L Guys	2,011	34	2	65
L Rfree	2,088	34	7	58
L St.G <sup>b</sup>	845	40	6	54
L West	3,320	44	2	54
Leeds	1,524	34	4	63
Leic	2,186	42	5	53
Liv Roy	1,292	30	5	65
M RI <sup>b</sup>	1,896	28	3	69
Newc	1,010	31	5	64
Nottm	1,114	35	7	58
Oxford <sup>b</sup>	1,697	26	6	69
Plymth	505	27	7	66
Ports	1,671	40	4	56
Sheff <sup>b</sup>	1,390	43	5	53
<b>Dialysis centres</b>				
Abrdn	532	41	5	54
Airdrie	425	46	4	50
Antrim	239	51	8	41
B Heart	657	64	8	28
Bangor	182	46	8	46
Basldn	275	59	13	28
Bradfd	581	40	3	57
Brightn	952	46	7	47
Carlis	281	29	14	58
Carsh	1,582	52	7	41
Chelms	285	51	9	40
Clwyd	185	45	11	44
Colchr	120	100		
D & Gall	130	42	8	50
Derby <sup>b</sup>	537	45	15	40
Donc	301	60	8	32
Dorset	679	43	6	51
Dudley	312	55	18	27
Dundee	421	44	4	52
Exeter <sup>b</sup>	965	45	9	46
Glouc	443	51	8	40
Hull <sup>b</sup>	857	42	9	49
Inverns	253	37	5	58
Ipswi	407	35	9	56
Kent	1,042	41	6	54
Klmarnk	309	44	12	44
Krkldy	295	51	7	42
L Kings	1,085	52	8	40

**Table 3.5.** Continued

Centre	N	% HD	% PD	% transplant
Liv Ain	228	77	17	7
Middlbr <sup>b</sup>	902	39	2	58
Newry	226	39	10	51
Norwch	741	46	5	49
Prestn <sup>b</sup>	1,217	47	4	49
Redng	778	39	8	53
Salford <sup>b</sup>	977	41	10	49
Shrew	370	55	9	36
Stevng	827	62	2	37
Sthend	246	51	7	42
Stoke	789	42	10	48
Sund	459	48	4	48
Swanse <sup>b</sup>	757	48	8	44
Truro <sup>b</sup>	416	39	5	56
Ulster	170	63	4	34
West NI	293	42	4	54
Wirral	228	82	8	10
Wolve	581	55	14	32
Wrexm	293	38	13	49
York	489	33	6	61
<b>England</b>	<b>51,672</b>	<b>41</b>	<b>6</b>	<b>53</b>
<b>N Ireland</b>	<b>1,701</b>	<b>37</b>	<b>5</b>	<b>58</b>
<b>Scotland</b>	<b>4,853</b>	<b>40</b>	<b>5</b>	<b>56</b>
<b>Wales</b>	<b>3,030</b>	<b>38</b>	<b>7</b>	<b>55</b>
<b>UK</b>	<b>61,256</b>	<b>41</b>	<b>6</b>	<b>53</b>

<sup>a</sup>Cambridge was unable to submit any patient level data for 2015 but provided the total number of adult patients on treatment at the end of the year by treatment modality. Those numbers have been added in tables 3.3 and 3.5 only, therefore Cambridge is not included in any of the centre level analyses

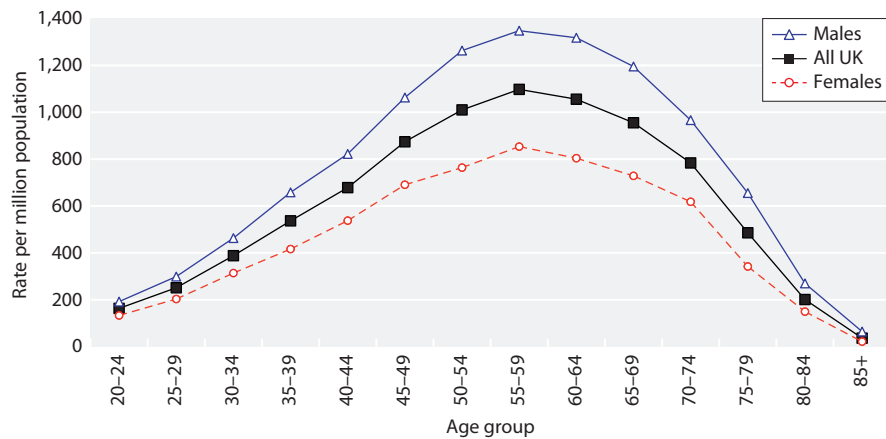
<sup>b</sup>Subsequent to closing the 2015 database some centres reported variation to the numbers returned for 2015. Tables 3.3 and 3.5 (but not the remainder of this chapter) reflect these revisions. For most centres the change reported was small (<5 patients), but a few centres reported notable numbers of patients not submitted (Sheffield 51 HD, 6 PD, 8 transplant; Salford 2 HD, 9 PD, 2 transplant and Middlesbrough 9 transplant patients)

Blank cells: no patients on that modality

**Table 3.6.** Median age and gender ratio of incident and prevalent transplant patients 2010–2015

Year	Incident transplants			Prevalent transplants*		
	N	Median age	M:F ratio	N	Median age	M:F ratio
2010	2,584	49.6	1.7	24,885	51.2	1.5
2011	2,628	49.1	1.7	26,172	51.7	1.6
2012	2,782	50.5	1.6	27,535	52.3	1.5
2013	3,128	50.4	1.6	29,442	52.8	1.6
2014	3,031	50.6	1.5	31,044	53.3	1.5
2015	2,864	50.9	1.5	31,692	53.8	1.5

\*As on 31st December for given year



**Fig. 3.1.** Transplant prevalence rate per million population by age and gender on 31/12/2015

**Table 3.7.** Primary renal diagnosis in renal transplant recipients 2010–2015

Primary renal diagnosis	New transplants by year							Established transplants on 31/12/2015	
	2010	2011	2012	2013	2014	2015		%	N
	%	%	%	%	%	%	N		
Aetiology uncertain	15.1	15.1	12.3	13.3	12.3	12.3	349	14.7	4,671
Diabetes	13.1	13.6	15.1	13.9	15.3	15.1	430	10.6	3,375
Glomerulonephritis	20.7	23.4	23.0	22.8	21.7	21.5	612	23.0	7,299
Polycystic kidney disease	14.4	12.6	13.6	13.9	14.0	13.7	389	13.5	4,290
Pyelonephritis	10.7	10.2	10.5	10.2	9.0	9.2	261	12.8	4,054
Reno-vascular disease	7.7	7.2	7.2	8.2	7.7	8.1	230	6.3	2,002
Other	17.1	17.0	17.1	15.0	17.0	15.8	448	17.5	5,554
Not available	1.2	1.0	1.2	2.6	3.0	4.4	124	1.4	447

**Table 3.8.** Ethnicity of patients who received a transplant in the years 2010–2015

Year	% White	% S Asian	% Black	% Other	% Unknown
2010	76.9	10.5	5.7	2.6	4.3
2011	76.3	9.6	6.2	2.9	5.1
2012	73.1	10.2	7.1	3.2	6.4
2013	71.5	12.1	6.9	2.8	6.7
2014	69.2	12.3	6.5	4.2	7.8
2015	67.5	12.7	7.4	3.9	8.4

UK, where completeness of data was good, may allow assessment of variation in access to transplantation in future reports.

There has been a year on year increase in the percentage of incident kidney recipients from non-White ethnic groups, which reflects the changing population of the UK, the different incidence of CKD in different groups and improved access to transplantation across these ethnic backgrounds.

## Clinical and laboratory outcomes

### Introduction

There continued to be marked variation in the completeness of data (tables 3.9a, 3.9b) reported by each renal centre, particularly for blood pressure and parathyroid hormone, which limits the ability to perform more meaningful comparisons between centres, or determine the causes of inter-centre differences in outcomes.

**Table 3.9a.** Percentage completeness of ethnicity, eGFR and blood pressure by centre for prevalent transplant patients on 31/12/2015

Centre	N	Ethnicity <sup>a</sup>	eGFR	Blood pressure <sup>b</sup>	Centre	N	Ethnicity <sup>a</sup>	eGFR	Blood pressure <sup>b</sup>
<b>England</b>									
B Heart	180	100	94	0	Salford	479	100	97	0
B QEH	1,057	100	95	0	Sheff	705	100	99	96
Basldn	77	100	94	91	Shrew	134	100	98	0
Bradfd	315	100	96	62	Stevng	286	100	98	45
Brightn	436	99	98	49	Sthend	101	100	99	80
Bristol	868	100	99	78	Stoke	368	100	99	0
Camb <sup>c</sup>					Sund	218	100	99	0
Carlis	158	100	92	0	Truro	222	100	99	3
Carsh	640	100	91	4	Wirral	19	100	84	0
Chelms	112	98	96	96	Wolve	184	100	96	73
Covnt	504	100	97	87	York	294	99	95	69
Derby	200	100	98	92	<b>N Ireland</b>				
Donc	82	100	99	98	Antrim	97	100	99	96
Dorset	341	100	89	87	Belfast	543	99	100	52
Dudley	80	100	96	40	Newry	104	100	98	88
Exeter	430	100	99	90	Ulster	55	100	98	98
Glouc	174	99	98	80	West NI	149	100	100	95
Hull	411	99	91	2	<b>Scotland</b>				
Ipswi	220	99	98	95	Abrdn	278	56	99	n/a
Kent	542	100	97	86	Airdrie	212	61	73	n/a
L Barts	1,028	100	68	0	D & Gall	65	28	88	n/a
L Guys	1,261	99	98	0	Dundee	211	62	98	n/a
L Kings	415	100	99	100	Edinb	451	25	94	n/a
L RFree	1,183	99	97	77	Glasgw	1,018	24	74	n/a
L St.G	440	96	96	49	Inverns	140	83	84	n/a
L West	1,762	100	98	0	Klmarnk	132	67	79	n/a
Leeds	918	100	99	98	Krkldy	119	36	97	n/a
Leic	1,132	98	97	28	<b>Wales</b>				
Liv Ain	14	93	100	0	Bangor	81	100	99	83
Liv Roy	812	99	95	1	Cardff	1,006	100	99	97
M RI	1,220	99	98	7	Clwyd	79	100	100	94
Middlbr	504	100	95	34	Swanse	316	100	99	100
Newc	630	100	98	96	Wrexm	141	100	99	89
Norwch	352	100	99	2	<b>England</b>				
Nottm	617	100	100	92		25,423	99	96	39
Oxford	1,096	95	99	15	<b>N Ireland</b>				
Plymth	316	100	98	92		948	100	99	70
Ports	909	99	95	11	<b>Scotland</b>				
Prestn	576	100	98	0		2,626	39	84	n/a
Redng	401	98	99	95	<b>Wales</b>				
						1,623	100	99	96
					<b>UK</b>				
						30,620	94	95	43 <sup>d</sup>

n/a – not available

<sup>a</sup>Patients with missing ethnicity were classed as White for eGFR calculation<sup>b</sup>Scottish centres excluded from blood pressure analysis as data not provided by the Scottish Renal Registry<sup>c</sup>Cambridge was unable to submit data for 2015<sup>d</sup>Excluding Scotland

The 71 renal centres in the UK comprise 52 centres in England, five in Wales, five in Northern Ireland and nine in Scotland. Colchester was reported as having no transplanted patients and was therefore excluded. Cambridge was unable to submit patient level data for 2015. After exclusion of these centres, prevalent

patient data from 69 renal centres across the UK were analysed.

For the one-year post-transplant analyses, in which patients were assigned to the centre that performed their transplant, all 23 transplant centres across the UK were included in the analysis.



**Table 3.9b.** Percentage completeness of haemoglobin, serum cholesterol, serum calcium, serum phosphate and serum PTH by centre for prevalent transplant patients on 31/12/2015

Centre	N	Haemoglobin	Total serum cholesterol	Adjusted serum calcium <sup>a</sup>	Serum phosphate	Serum PTH
<b>England</b>						
B Heart	180	93	54	91	91	11
B QEH	1,057	94	95	95	94	6
Basldn	77	92	64	92	92	16
Bradfd	315	95	63	74	45	25
Brightn	436	97	69	95	95	42
Bristol	868	99	93	99	99	99
Camb <sup>b</sup>						
Carlis	158	93	66	89	82	15
Carsh	640	90	52	89	89	33
Chelms	112	93	81	96	78	18
Covnt	504	97	80	95	69	32
Derby	200	98	95	95	93	90
Donc	82	99	66	98	98	34
Dorset	341	86	71	86	67	33
Dudley	80	96	91	96	96	84
Exeter	430	99	96	98	97	40
Glouc	174	98	61	95	95	26
Hull	411	92	25	88	88	18
Ipswi	220	99	55	98	98	58
Kent	542	96	76	95	95	19
L Barts	1,028	98	98	98	98	97
L Guys	1,261	99	64	97	98	42
L Kings	415	99	77	99	99	67
L RFree	1,183	97	78	97	97	88
L St.G	440	96	91	96	96	88
L West	1,762	98	55	98	98	34
Leeds	918	98	99	98	98	30
Leic	1,132	96	96	95	95	57
Liv Ain	14	100	86	100	100	79
Liv Roy	812	94	64	89	91	68
M RI	1,220	98	72	98	98	62
Middlbr	504	95	37	94	94	16
Newc	630	98	86	98	98	70
Norwch	352	98	97	97	97	22
Nottm	617	99	79	96	94	88
Oxford	1,096	99	68	99	99	49
Plymth	316	98	78	97	96	62
Ports	909	95	62	95	90	31
Prestn	576	98	76	97	94	51
Redng	401	99	72	98	76	57
Salford	479	96	76	96	96	5
Sheff	705	99	59	99	99	11
Shrew	134	97	81	95	95	10
Stevng	286	77	54	94	90	44
Sthend	101	99	42	97	92	14
Stoke	368	99	100	99	99	70
Sund	218	99	78	98	99	95
Truro	222	98	96	99	99	89
Wirral	19	79	42	74	74	53
Wolve	184	94	82	95	85	71
York	294	94	65	92	92	14

**Table 3.9b.** Continued

Centre	N	Haemoglobin	Total serum cholesterol	Adjusted serum calcium <sup>a</sup>	Serum phosphate	Serum PTH
<b>N Ireland</b>						
Antrim	97	99	99	97	99	98
Belfast	543	99	99	99	99	32
Newry	104	97	99	96	97	97
Ulster	55	98	100	95	98	15
West NI	149	99	100	99	100	91
<b>Scotland</b>						
Abrdn	278	99	n/a	96	96	n/a
Airdrie	212	98	n/a	97	96	n/a
D & Gall	65	98	n/a	98	98	n/a
Dundee	211	98	n/a	97	97	n/a
Edinb	451	94	n/a	92	81	n/a
Glasgw	1,018	97	n/a	97	97	n/a
Inverns	140	79	n/a	72	68	n/a
Klmarnk	132	98	n/a	97	96	n/a
Krkldy	119	97	n/a	97	97	n/a
<b>Wales</b>						
Bangor	81	98	100	99	99	27
Cardff	1,006	99	95	99	99	21
Clwyd	79	96	100	99	99	81
Swanse	316	99	91	99	99	72
Wrexm	141	99	100	99	99	100
<b>England</b>	<b>25,423</b>	<b>97</b>	<b>75</b>	<b>96</b>	<b>94</b>	<b>49</b>
<b>N Ireland</b>	<b>948</b>	<b>99</b>	<b>99</b>	<b>98</b>	<b>99</b>	<b>54</b>
<b>Scotland<sup>c</sup></b>	<b>2,626</b>	<b>96</b>	<b>n/a</b>	<b>95</b>	<b>93</b>	<b>n/a</b>
<b>Wales</b>	<b>1,623</b>	<b>99</b>	<b>95</b>	<b>99</b>	<b>99</b>	<b>41</b>
<b>UK</b>	<b>30,620</b>	<b>97</b>	<b>77<sup>d</sup></b>	<b>96</b>	<b>94</b>	<b>48<sup>d</sup></b>

n/a – not available

<sup>a</sup>Serum calcium corrected for serum albumin<sup>b</sup>Cambridge was unable to submit data for 2015<sup>c</sup>Dataset provided by the Scottish Renal Registry for Scottish centres shown did not include data on serum cholesterol or serum PTH<sup>d</sup>Excluding Scotland

### Methods

Data for key laboratory variables are reported for all prevalent patients with valid data returns for a given renal centre (both transplanting and non-transplanting centres) and for one year post-transplant results for patients transplanted 2008–2014, with patients attributed to the transplant centre that performed the procedure.

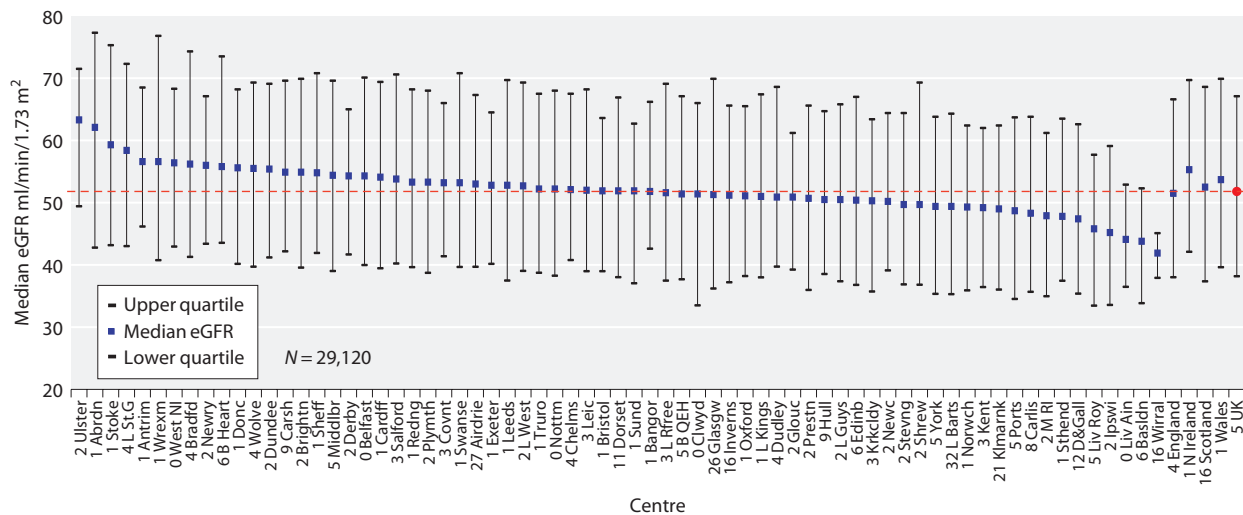
Time since transplantation may have a significant effect on key biochemical and clinical variables and this is likely to be independent of a centre's clinical practices. Therefore, inter-centre comparison of data on prevalent transplant patients is open to bias. To minimise bias relating to fluctuations in biochemical and clinical parameters occurring in the initial post-transplant period, one year post-transplantation outcomes are also reported. It is presumed that patient selection policies and local clinical practices are more likely to be relevant in influencing outcomes 12 months post-transplant and therefore comparison of outcomes between centres is more robust. However, even the 12 months post-transplant comparisons could be biased by the fact that in some

centres, repatriation of patients only occurs if the graft is failing whereas in others it only occurs if the graft function is stable.

Centres with <10 patients or <50% data completeness have been excluded from the figures. Scottish centres were also excluded from blood pressure analyses as data were not provided.

### Prevalent patient data

Biochemical and clinical data for patients with a functioning transplant followed in either a transplanting or non-transplanting centre were included in the analyses. The cohort consisted of prevalent patients as on 31st December 2015. Patients were considered as having a functioning transplant if 'transplant' was listed as the last mode of RRT in the last quarter of 2015. Patients were assigned to the renal centre that sent the data to the UKRR but some patients will have received care in more than one centre. If data for the same transplant patient were received from both the transplant centre and non-transplant centre, care was usually allocated to the non-transplant centre (see appendix B). Patients with a functioning transplant of less than three months duration



**Fig. 3.2.** Median eGFR in prevalent transplant patients by centre on 31/12/2015

were excluded from analyses. For haemoglobin, estimated glomerular filtration rate (eGFR), corrected calcium, phosphate and blood pressure (BP), the latest value in quarter 3 or quarter 4 of 2015 was used.

#### Estimated glomerular filtration rate (eGFR)

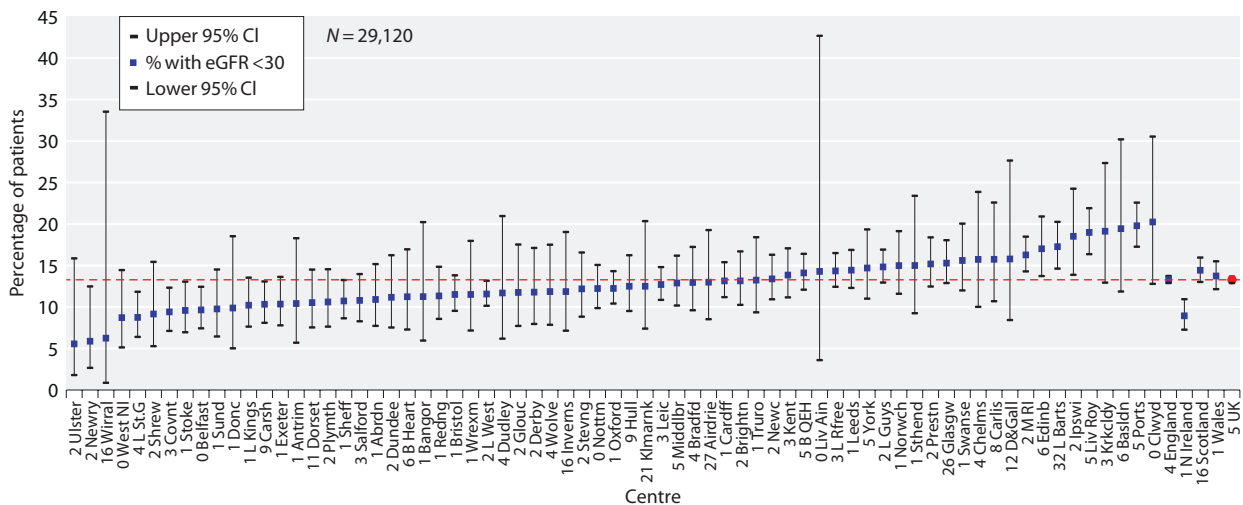
For the purpose of eGFR calculation, the original 4-variable MDRD formula was used (with a constant of 186) to calculate eGFR from the serum creatinine concentration as reported by the centre (unless otherwise stated). A wide variety of creatinine assays are in use in clinical biochemistry laboratories in the UK, and it is not possible to ensure that all measurements of creatinine concentration collected by the UKRR are harmonised. Patients with valid serum creatinine results but no ethnicity data were classed as White for the purpose of the eGFR calculation.

#### One year post-transplant data

Patients who received a renal transplant between 1st January 2008 and 31st December 2014 were assigned according to the renal centre in which they were transplanted. In a small number of instances, the first documented evidence of transplantation in a patient's record is from a timeline entry in data returned from a non-transplant centre, in these instances the patient was re-assigned to the nearest transplant centre.

As this analysis is stratified by transplant type, and for some of the renal centres reporting of donor type to the UKRR is poor, donor-type used in this analysis was obtained from NHSBT.

Patients who had died or experienced graft failure within 12 months of transplantation were excluded from the analyses. Patients with more than one transplant during 2008–2014 were included as separate episodes provided each of the transplants functioned for a year.



**Fig. 3.3.** Percentage of prevalent transplant patients by centre on 31/12/2015 with eGFR <30 ml/min/1.73 m<sup>2</sup>

For each patient, the most recent laboratory or blood pressure result for the relevant 4th/5th quarter after renal transplantation was taken to be representative of the one year post-transplant outcome. Again, for the purpose of the eGFR calculation patients with valid serum creatinine results but missing ethnicity data were classed as White.

## Results and Discussion

### Post-transplant eGFR in prevalent transplant patients

When interpreting eGFR post-transplantation, it is important to remember that estimated GFR formulae only have a modest predictive performance in the transplant population [4]. Median eGFR in each centre and percentage of patients with eGFR <30 ml/min/1.73 m<sup>2</sup> are shown in figures 3.2 and 3.3.

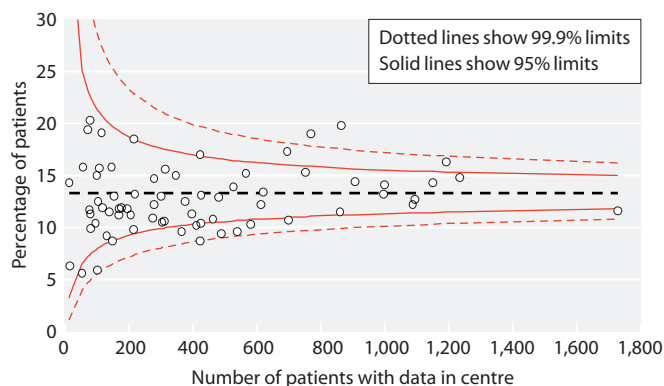
The median eGFR was 51.8 ml/min/1.73 m<sup>2</sup>, with 13.3% of prevalent transplant recipients having an

eGFR <30 ml/min/1.73 m<sup>2</sup>, summarised by centre in table 3.10. Whilst local repatriation policies on timing of transfer of care for patients with failing transplants from transplant centres to referring centres might explain some of the differences, it is notable that both transplanting and non-transplanting centres feature at both ends of the scale in figure 3.3. The accuracy of the 4-variable MDRD equation in estimating GFR ≥60 ml/min/1.73 m<sup>2</sup> is questionable [5], therefore a figure describing this is not included in this chapter.

Figure 3.4 shows the percentage of prevalent patients by centre with eGFR <30 ml/min/1.73 m<sup>2</sup> as a funnel plot, enabling a more reliable comparison of outcomes between centres across the UK. The solid lines show the 2 standard deviation limits (95%) and the dotted lines the limits for 3 standard deviations (99.9%). With

**Table 3.10.** Percentage of prevalent transplant patients with eGFR <30 ml/min/1.73 m<sup>2</sup> on 31/12/2015

Centre	Patients with eGFR data N	Percentage with eGFR <30	Centre	Patients with eGFR data N	Percentage with eGFR <30
Liv Ain	14	14.3	Swanse	314	15.6
Wirral	16	6.3	Norwch	347	15.0
Ulster	54	5.6	Stoke	365	9.6
D & Gall	57	15.8	Hull	376	12.5
Basldn	72	19.4	Redng	397	11.3
Dudley	77	11.7	L Kings	411	10.2
Clwyd	79	20.3	L St.G	423	8.7
Bangor	80	11.3	Edinb	423	17.0
Donc	81	9.9	Exeter	425	10.4
Antrim	96	10.4	Brightn	426	13.1
Sthend	100	15	Salford	463	10.8
Newry	102	5.9	Middlbr	481	12.9
Klmarnk	104	12.5	Covnt	489	9.4
Chelms	108	15.7	Kent	527	13.9
Krkldy	115	19.1	Belfast	539	9.6
Inverns	118	11.9	Prestn	566	15.2
Shrew	131	9.2	Carsh	581	10.3
Wrexm	139	11.5	Nottm	613	12.2
Carlis	146	15.8	Newc	620	13.4
West NI	149	8.7	L Barts	695	17.3
Airdrie	154	13	Sheff	699	10.7
B Heart	169	11.2	Glasgw	752	15.3
Glouc	170	11.8	Liv Roy	769	19.0
Wolve	177	11.9	Bristol	860	11.5
Derby	195	11.8	Ports	864	19.8
Dundee	206	11.2	Leeds	907	14.4
Sund	215	9.8	Cardff	996	13.2
Ipswi	216	18.5	B QEH	999	14.1
Truro	219	13.2	Oxford	1,087	12.2
Abrdn	275	10.9	Leic	1,094	12.7
Stevng	279	12.2	L Rfree	1,150	14.3
York	279	14.7	M RI	1,192	16.3
Bradfd	301	13	L Guys	1,234	14.8
Dorset	304	10.5	L West	1,728	11.6
Plymth	311	10.6			



**Fig. 3.4.** Funnel plot of percentage of prevalent transplant patients with eGFR  $<30$  ml/min/1.73 m<sup>2</sup> by centre size on 31/12/2015

69 centres included and a normal distribution, 3–4 centres would be expected to fall between the 95–99.9% CI (1 in 20) and no centres should fall outside the 99.9% limits.

There continued to be variation between centres; these data show over-dispersion with 15 centres falling outside the 95% CI. Liverpool Royal and Portsmouth both fell outside the upper 99.9% CI suggesting a higher than expected proportion of patients with eGFR  $<30$  ml/min/1.73 m<sup>2</sup>.

#### *eGFR in patients one year after transplantation*

Graft function at one year post-transplantation may predict subsequent long-term graft outcome [6]. Figures 3.5a, 3.5b, and 3.5c show the median one-year post-transplant eGFR for patients transplanted between 2008–2014, by transplant type. Living kidney donation had the highest median eGFR at one year (57.5 ml/min/1.73 m<sup>2</sup>), followed by donation after brainstem death (53.7 ml/min/1.73 m<sup>2</sup>) and donation after circulatory death (50.4 ml/min/1.73 m<sup>2</sup>).

Figures 3.6a, 3.6b and 3.6c show one-year post-transplant eGFR by donor type and year of transplantation. There was no trend in eGFR over the time period for live kidney donation transplantation, donation after brainstem death or donation after circulatory death.

#### *Haemoglobin in prevalent transplant patients*

The Renal Association Anaemia guidelines recommend ‘**achieving a population distribution centred on a mean of 11 g/dl with a range of 10–12 g/dl**’ [7] (equivalent to 110 g/L, range 100–120 g/L). However, many transplant patients with good transplant function will

have haemoglobin concentrations  $>120$  g/L without the use of erythropoiesis stimulating agents, and so it is inappropriate to audit performance using the higher limit.

A number of factors, including comorbidity, immunosuppressive medication, graft function, ACE inhibitor use, erythropoietin (EPO) use, intravenous or oral iron use, that affect centre-specific protocols for management of anaemia will affect haemoglobin concentrations in transplant patients. Most of these data are not collected by the UKRR and therefore caution must be used when interpreting analyses of haemoglobin attainment.

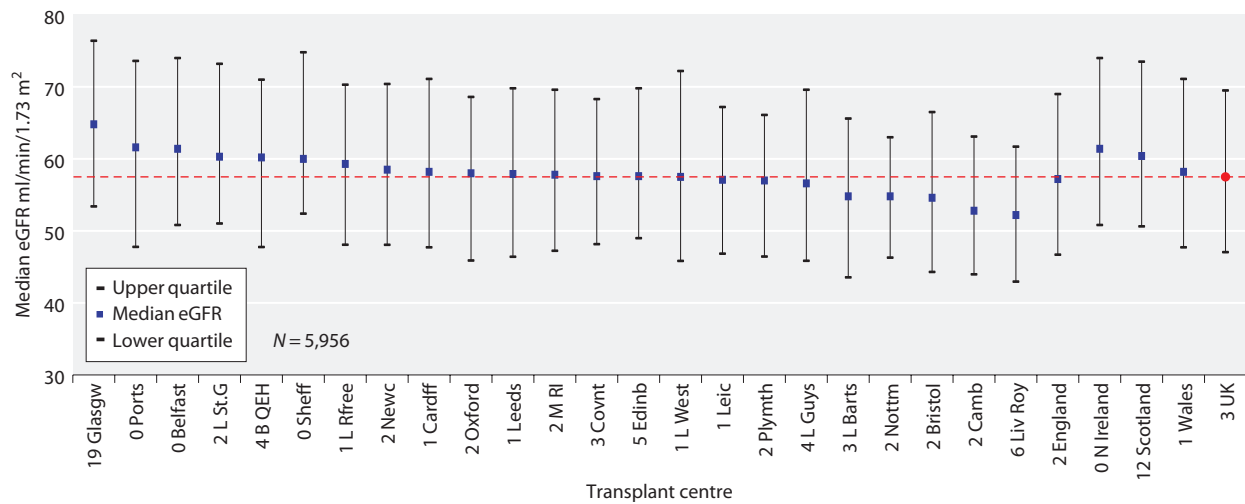
Figures 3.7a and 3.7b report centre results stratified according to graft function as estimated by eGFR. The percentage of prevalent transplant patients achieving Hb  $\geq 100$  g/L in each centre, stratified by eGFR, is displayed in figures 3.8a and 3.8b.

Figure 3.9 describes the percentage of prevalent patients by centre with haemoglobin  $<100$  g/L as a funnel plot enabling more reliable comparison of outcomes between centres across the UK. With 69 centres included and a normal distribution, 3–4 centres would be expected to fall between the 95%–99.9% CI (1 in 20) and no centres should fall outside the 99.9% CI purely as a chance event.

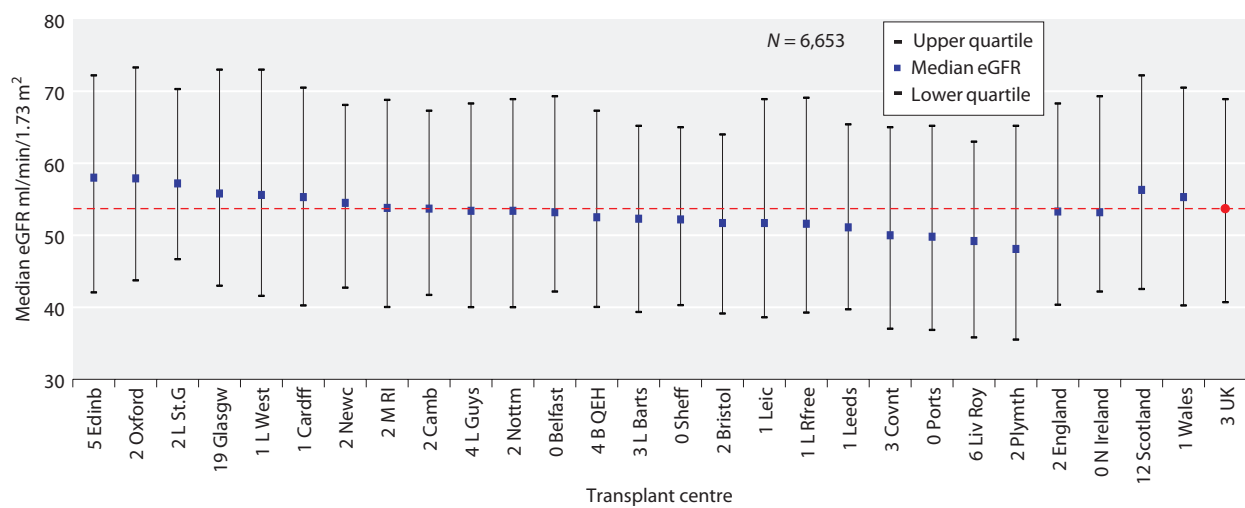
One centre (London St Bartholomew’s) fell outside the upper 99.9% CI and two further centres (London Guys and London Kings) fell outside the upper 95% CI indicating a higher than predicted proportion of transplant patients not achieving the haemoglobin target. Seven centres fell outside the lower 99.9% CI, indicating they performed better than expected with fewer than predicted patients having a haemoglobin  $<100$  g/L.

#### *Blood pressure in prevalent transplant patients*

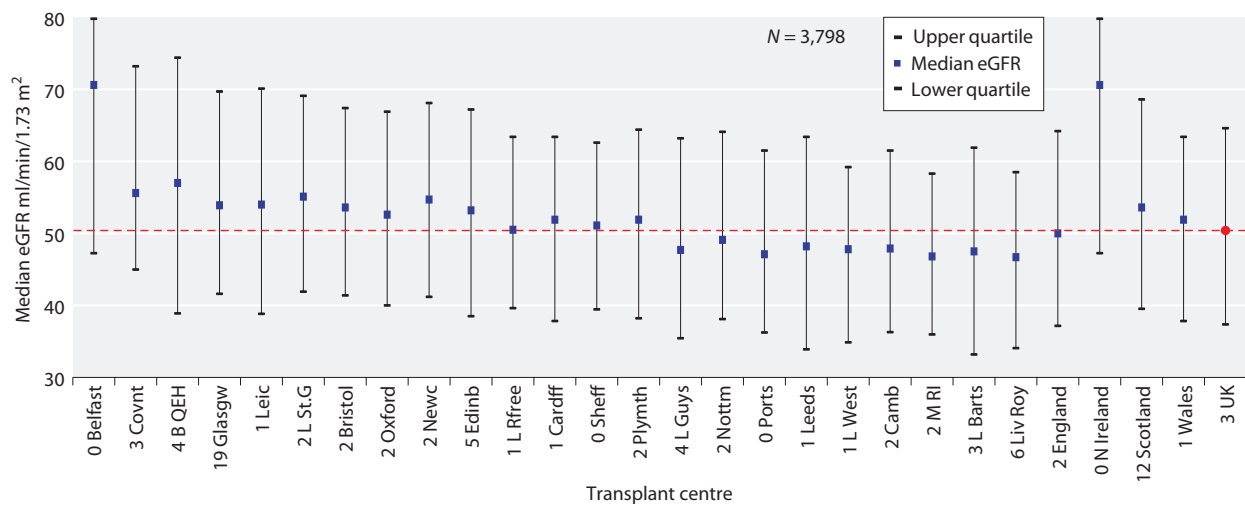
The UK Renal Association (RA) guideline for the care of kidney transplant recipients recommends that ‘**Blood pressure should be  $<130/80$  mmHg (or  $<125/75$  mmHg if proteinuria)**’ [8]. This blood pressure (BP) target is the same as that used in previous annual reports. Completeness for blood pressure data returns was variable with some centres unable to report. Data from 34 centres with  $>50\%$  data returns were included in the analysis. Despite this restriction, caution needs to be exercised in interpretation of these results because of the volume of missing data and potential bias, (e.g. a centre may be more likely to record and report blood pressure data electronically in patients with poor BP control).



**Fig. 3.5a.** Median eGFR one year post-live donor transplant by transplant centre 2008–2014

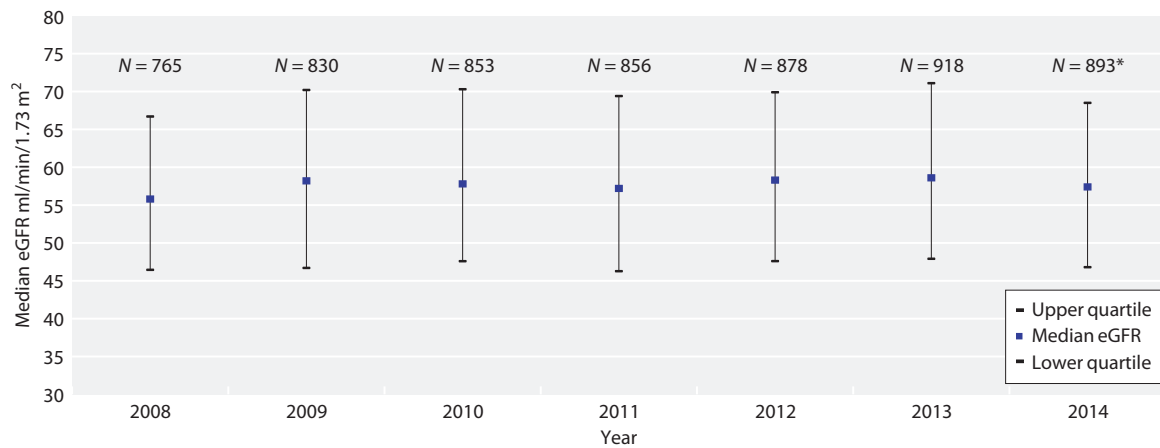


**Fig. 3.5b.** Median eGFR one year post-brainstem death donor transplant by transplant centre 2008–2014



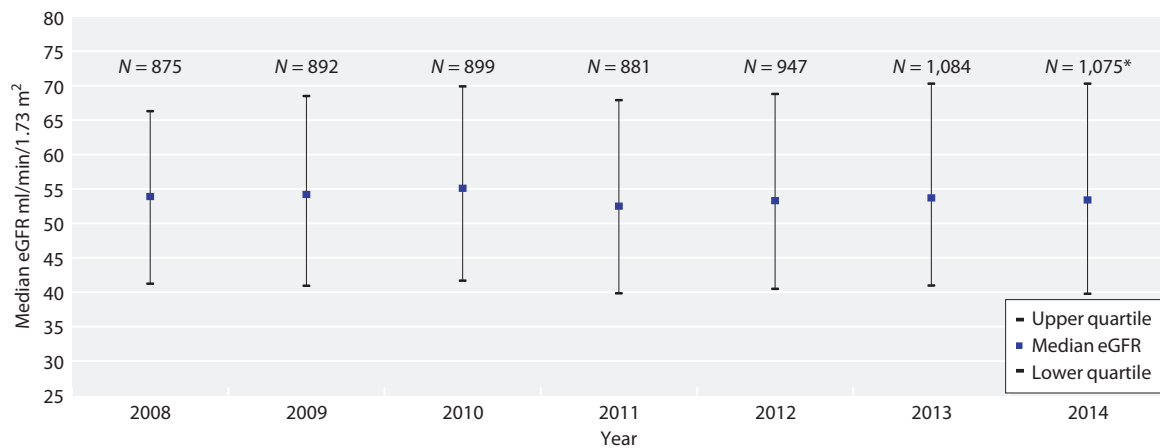
**Fig. 3.5c.** Median eGFR one year post-circulatory death donor transplant by transplant centre 2008–2014





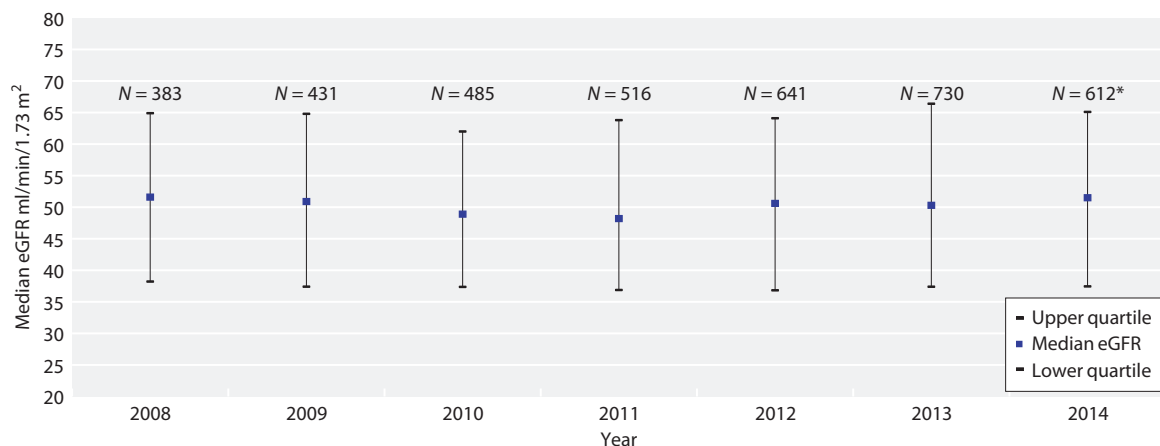
**Fig. 3.6a.** Median eGFR one year post-live donor transplant by year of transplantation 2008–2014

\*This number does not include live-donor transplants performed in 2014 that were followed-up in Cambridge in 2015, as Cambridge was unable to submit data for 2015



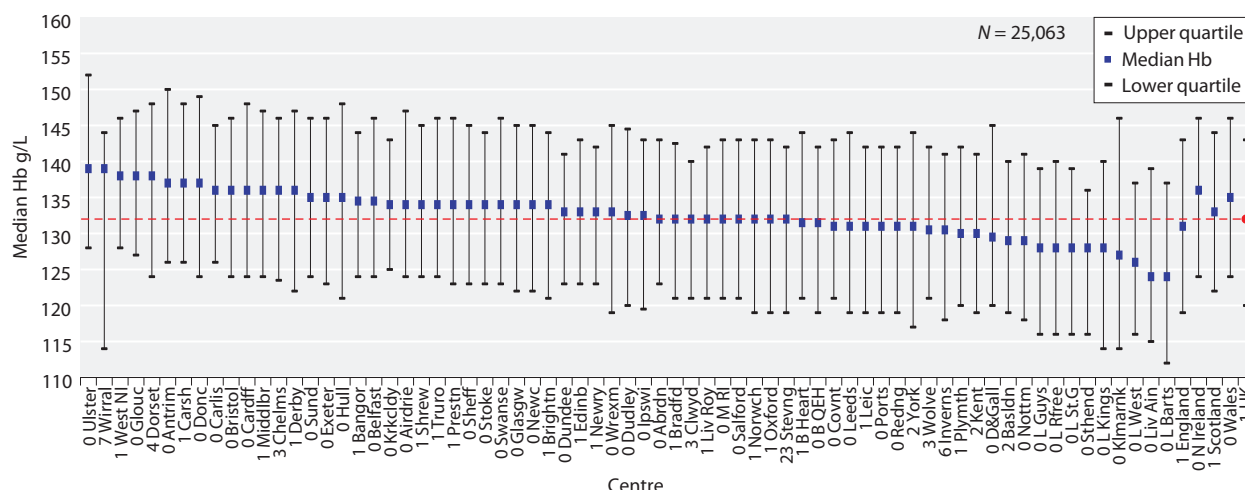
**Fig. 3.6b.** Median eGFR one year post-brainstem death donor transplant by year of transplantation 2008–2014

\*This number does not include post-brainstem death donor transplants performed in 2014 that were followed-up in Cambridge in 2015, as Cambridge was unable to submit data for 2015

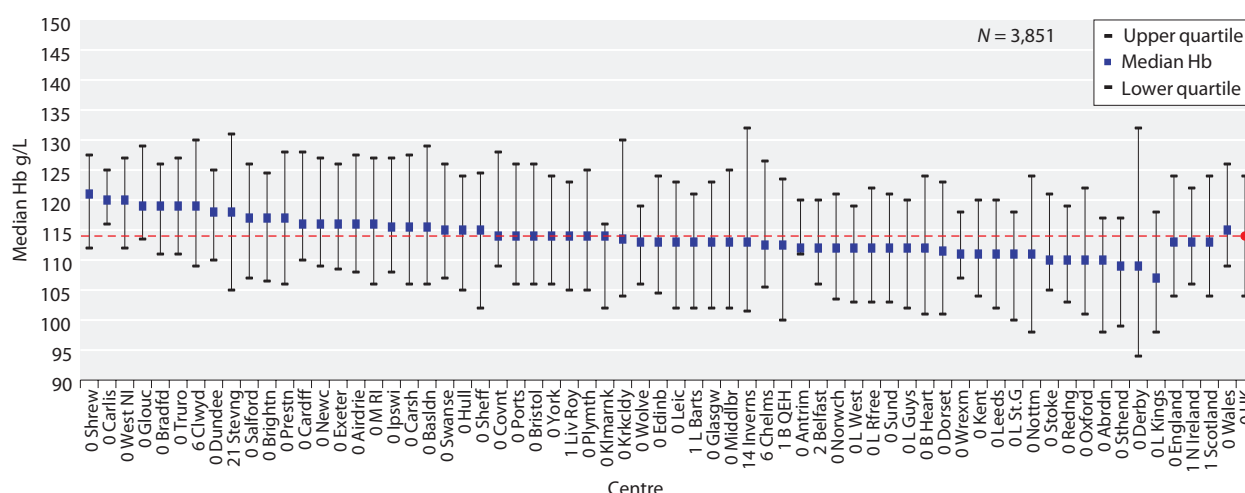


**Fig. 3.6c.** Median eGFR one year post-circulatory death donor transplant by year of transplantation 2008–2014

\*This number does not include post-circulatory death donor transplants performed in 2014 that were followed-up in Cambridge in 2015, as Cambridge was unable to submit data for 2015



**Fig. 3.7a.** Median haemoglobin for prevalent transplant patients with  $\text{eGFR} \geq 30 \text{ ml/min/1.73 m}^2$  by centre on 31/12/2015



**Fig. 3.7b.** Median haemoglobin for prevalent transplant patients with  $\text{eGFR} < 30 \text{ ml/min/1.73 m}^2$  by centre on 31/12/2015

Figures 3.10a and 3.10b show the percentage of patients with a blood pressure of  $<130/80 \text{ mmHg}$ , by eGFR. The percentage of patients with BP  $<130/80$  (systolic BP  $<130$  and diastolic BP  $<80 \text{ mmHg}$ ) was higher (26.6% vs. 21.8%) in those with better renal function ( $\text{eGFR} \geq 30 \text{ ml/min/1.73 m}^2$ ).

### Analysis of prevalent patients by CKD stage

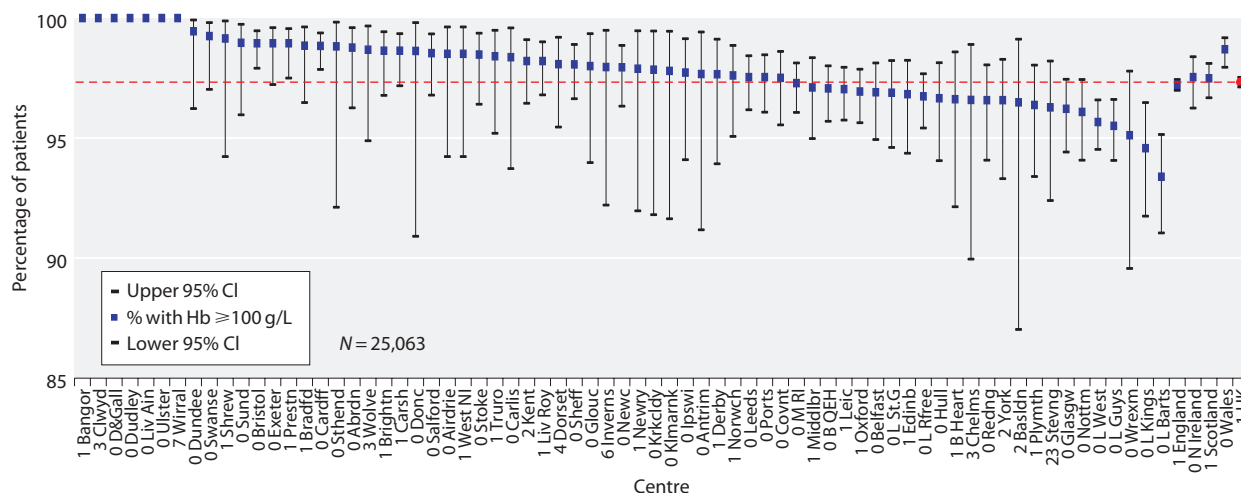
#### Introduction

Approximately 2.7% of prevalent transplant patients returned to dialysis in 2015, a similar percentage to that seen over the last few years. Amongst patients with native chronic kidney disease, late presentation is associated with

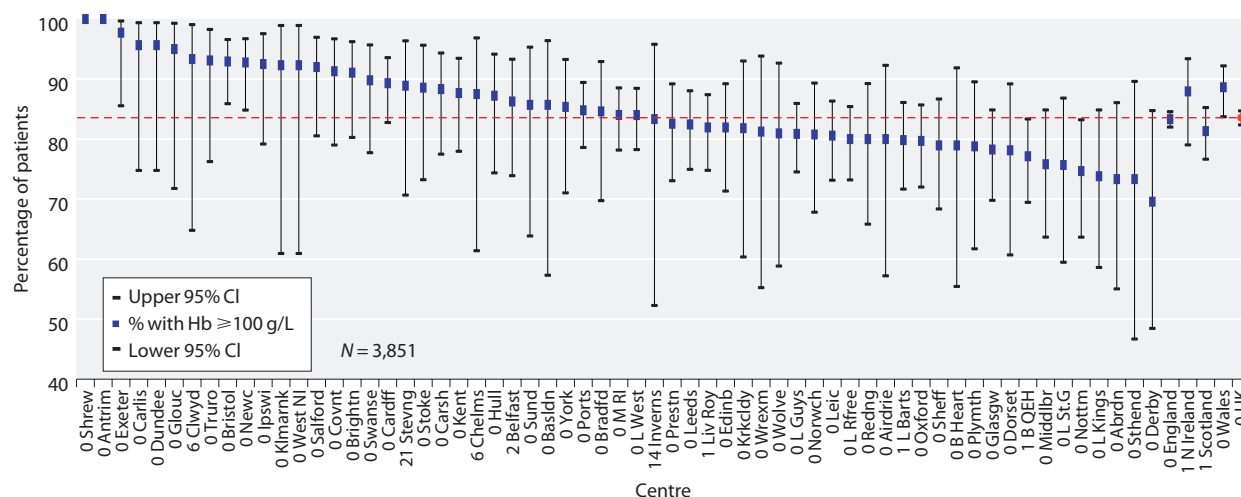
poor outcomes, largely attributable to lack of specialist management of anaemia, acidosis, hyperphosphataemia and to inadequate advance preparation for dialysis. Transplant recipients on the other hand, are almost always followed up regularly in specialist transplant or renal clinics and it would be reasonable to expect patients with failing grafts to receive appropriate care and therefore have many of their modifiable risk factors addressed before complete graft failure and return to dialysis.

#### Methods

The transplant cohort consisted of prevalent transplant recipients as on 31st December 2015 and patients were classified according to the KDIGO staging criteria with the suffix of 'T' to represent their transplant status. Patients with missing ethnicity information were classified as White for the purpose of calculating eGFR. Prevalent dialysis patients, except those who commenced dialysis



**Fig. 3.8a.** Percentage of prevalent transplant patients with  $\text{eGFR} \geq 30 \text{ ml/min/1.73 m}^2$  achieving haemoglobin  $\geq 100 \text{ g/L}$  by centre on 31/12/2015

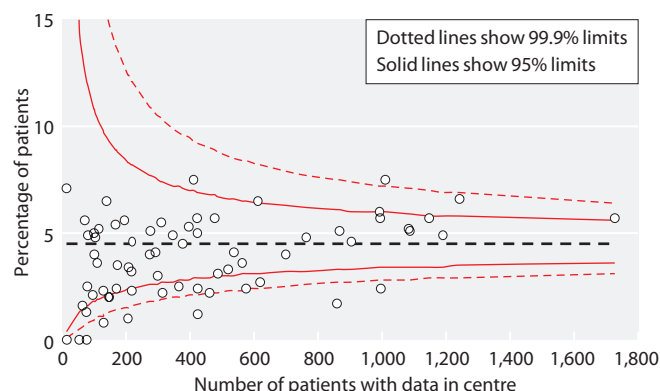


**Fig. 3.8b.** Percentage of prevalent transplant patients with  $\text{eGFR} < 30 \text{ ml/min/1.73 m}^2$  achieving haemoglobin  $\geq 100 \text{ g/L}$  by centre on 31/12/2015

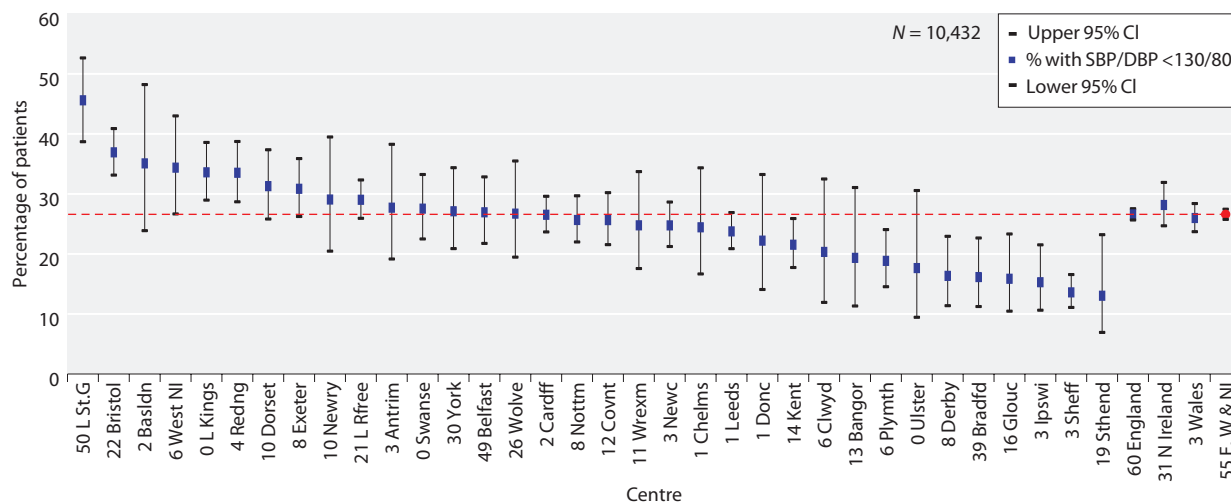
in 2015, comprised the comparison dialysis cohort ( $N = 21,367$ ) including 2,163 peritoneal dialysis patients. Only patients on peritoneal dialysis were considered when examining differences in serum phosphate between transplant recipients and dialysis patients. For both the transplant and dialysis cohorts, the analysis used the most recent available value from the last two quarters of the 2015 laboratory data. Scottish centres were excluded from blood pressure, cholesterol and PTH analyses as corresponding data were not provided.

### Results and Discussion

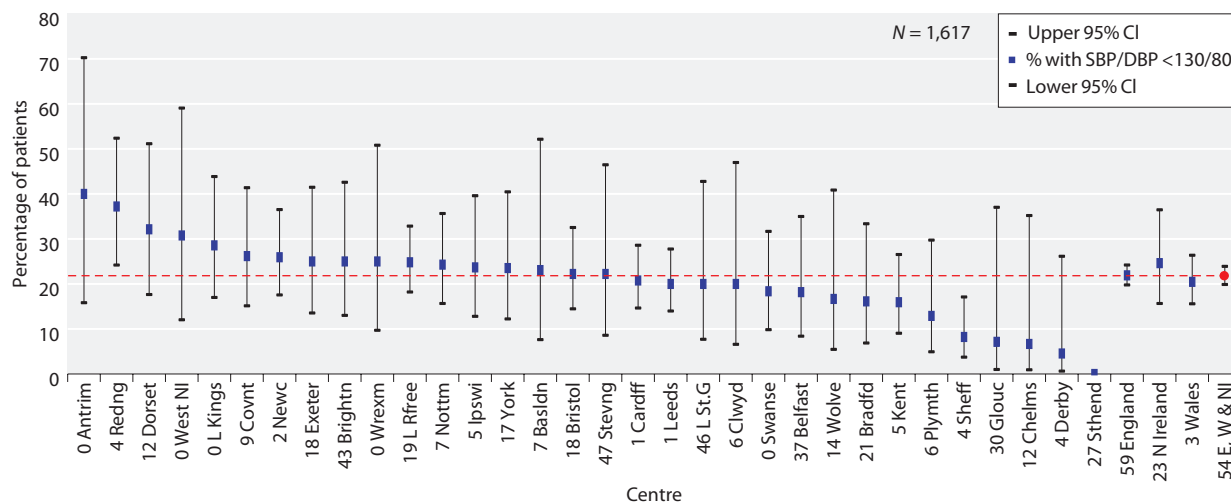
Table 3.11 shows that 13.3% of the prevalent transplant population (3,868 patients), had moderate to advanced renal impairment of  $\text{eGFR} < 30 \text{ ml/min/1.73 m}^2$ . The table also demonstrates that patients with failing grafts had poorer blood pressure control, and



**Fig. 3.9.** Funnel plot of percentage of prevalent transplant patients with haemoglobin  $< 100 \text{ g/L}$  by centre size on 31/12/2015



**Fig. 3.10a.** Percentage of prevalent transplant patients with eGFR  $\geq 30$  ml/min/1.73 m<sup>2</sup> achieving blood pressure of <130/80 mmHg by centre on 31/12/2015



**Fig. 3.10b.** Percentage of prevalent transplant patients with eGFR < 30 ml/min/1.73 m<sup>2</sup> achieving blood pressure of <130/80 mmHg by centre on 31/12/2015

achieved UK Renal Association standards for some key biochemical and clinical outcome variables less often than dialysis patients. This substantial group of patients continues to represent a challenge, and improved pre-dialysis management should allow for timely re-listing for transplantation if appropriate, and a smooth transition to another renal replacement modality.

## eGFR slope analysis

### Introduction

The gradient of deterioration in eGFR (slope) may predict patients likely to have early graft failure. The eGFR slope and its relationship to specific patient characteristics are presented here.

**Table 3.11.** Analysis by CKD stage for prevalent transplant patients compared with prevalent dialysis patients on 31/12/2015

	Stage 1–2T (≥ 60)	Stage 3T (30–59)	Stage 4T (15–29)	Stage 5T (<15)	Stage 5D
Number of patients	10,379	14,886	3,394	474	21,367
% of patients	35.6	51.1	11.7	1.6	
<b>eGFR ml/min/1.73 m<sup>2a</sup></b>					
mean ± SD	77.1 ± 15.5	45.7 ± 8.3	23.8 ± 4.1	12.0 ± 2.1	
Median	73.2	46.1	24.3	12.4	
<b>Systolic BP mmHg</b>					
mean ± SD	133.8 ± 16.2	135.8 ± 17.0	139.6 ± 19.2	144.6 ± 21.0	132.7 ± 24.8
% ≥ 130	60.1	64.3	70.1	76.8	52.3
<b>Diastolic BP mmHg</b>					
mean ± SD	79.1 ± 10.4	78.5 ± 10.7	79.1 ± 11.9	80.3 ± 12.7	68.7 ± 14.9
% ≥ 80	49.6	48.0	49.7	55.8	22.0
<b>Cholesterol mmol/L</b>					
mean ± SD	4.5 ± 1.0	4.6 ± 1.1	4.7 ± 1.2	4.7 ± 1.3	3.9 ± 1.1
% ≥ 4	68.0	71.7	71.1	68.8	42.4
<b>Haemoglobin g/L</b>					
mean ± SD	136.7 ± 15.9	128.0 ± 16.5	115.3 ± 15.4	105.2 ± 13.9	110.3 ± 13.6
% <100.0	1.4	3.6	14.3	32.1	19.5
<b>Phosphate mmol/L<sup>b</sup></b>					
mean ± SD	0.9 ± 0.2	1.0 ± 0.2	1.1 ± 0.3	1.5 ± 0.4	1.6 ± 0.4
% >1.7	0.1	0.2	2.4	25.8	36.0
<b>Corrected calcium mmol/L</b>					
mean ± SD	2.4 ± 0.1	2.4 ± 0.1	2.4 ± 0.2	2.4 ± 0.2	2.4 ± 0.2
% >2.5	26.7	26.7	19.4	18.7	15.9
% <2.2	3.3	3.8	8.1	15.1	16.8
<b>PTH pmol/L</b>					
Median	8.7	10.1	16.8	32.6	33.5
% >72	0.3	0.7	3.8	20.6	19.6

<sup>a</sup>Prevalent transplant patients with no ethnicity data were classed as White

<sup>b</sup>Only PD patients included in stage 5D, *N* = 2,163

### Methods

All UK patients aged ≥ 18 years receiving their first renal transplant between 1st January 2004 and 31st December 2013, were considered for inclusion. A minimum duration of 18 months graft function was required and three or more creatinine measurements from the second year of graft function onwards were used to plot eGFR slope. If a transplant failed but there were at least three creatinine measurements between one year post-transplant and graft failure, the patient was included but no creatinine measurements after the quarter preceding the recorded date of transplant failure were analysed.

Slopes were calculated using linear regression, assuming linearity, and the effect of age, ethnicity, gender, diabetes, donor type, year of transplant and current transplant status were analysed. *P* values were calculated using the Kruskal-Wallis test. eGFR was calculated using the CKD-EPI equation and results expressed as ml/min/1.73 m<sup>2</sup>/year. The CKD-EPI equation was used in preference to the MDRD formula as it is thought to have a greater degree of accuracy at higher levels of eGFR [9].

### Results and Discussion

The study cohort consisted of 17,357 patients. The median GFR slope was −0.56 ml/min/1.73 m<sup>2</sup>/year (table 3.12). The gradient was steeper for Black recipients (−1.01 ml/min/1.73 m<sup>2</sup>/year), in keeping with previously published data suggesting poorer outcomes for this group [10].

There was no statistically significant difference in eGFR slope in recipients of deceased donor kidneys (−0.57 ml/min/1.73 m<sup>2</sup>/year) compared to patients who received organs from live donors (−0.54 ml/min/1.73 m<sup>2</sup>/year), although there was a significant difference in the eGFR slope in recipients of deceased cardiac death kidneys (−0.33 ml/min/1.73 m<sup>2</sup>/year, *P* < 0.001). Female patients had a steeper slope (−0.98 ml/min/1.73 m<sup>2</sup>/year) than males (−0.33 ml/min/1.73 m<sup>2</sup>/year),

**Table 3.12.** Differences in median eGFR slope between subgroups of prevalent transplant patients

Patients characteristics		N	Median slope	Lower quartile	Upper quartile	p-value
Age at transplant	<40	4,936	−1.07	−4.14	0.95	<0.0001
	40–55	6,618	−0.38	−2.70	1.46	
	>55	5,803	−0.39	−2.68	1.59	
Ethnicity	Asian	1,729	−0.94	−4.29	1.30	<0.0001
	Black	1,083	−1.01	−4.16	1.41	
	Other	489	−0.81	−3.79	1.36	
	White	13,205	−0.47	−2.82	1.36	
Gender	Male	10,678	−0.33	−2.69	1.53	<0.0001
	Female	6,679	−0.98	−3.63	1.09	
Diabetes	No-diabetes	14,679	−0.46	−2.88	1.41	<0.0001
	Diabetes	2,541	−1.15	−4.12	0.98	
Donor	Deceased	11,211	−0.57	−3.14	1.37	0.6
	Live	6,146	−0.54	−2.95	1.36	
Year of transplant	2004	1,145	−0.42	−2.04	0.72	0.0002
	2005	1,136	−0.41	−2.16	0.90	
	2006	1,445	−0.63	−2.46	0.72	
	2007	1,581	−0.67	−2.43	0.81	
	2008	1,810	−0.51	−2.49	0.98	
	2009	1,898	−0.74	−2.85	0.95	
	2010	1,984	−0.52	−3.01	1.30	
	2011	1,949	−0.38	−3.30	2.12	
	2012	2,155	−0.47	−4.20	2.52	
	2013	2,254	−0.78	−6.46	3.96	
Status of transplant at end of follow-up	Died	1,261	−0.75	−3.95	1.83	<0.0001
	Failed	1,306	−6.32	−12.06	−3.03	
	Re-transplanted	70	−3.93	−7.31	−1.85	
	Functioning	14,720	−0.28	−2.36	1.53	
<b>All</b>		<b>17,357</b>	<b>−0.56</b>	<b>−3.09</b>	<b>1.36</b>	

as did patients with diabetes (−1.15 ml/min/1.73 m<sup>2</sup>/year) compared to patients without (−0.46 ml/min/1.73 m<sup>2</sup>/year). The slope was steeper in younger recipients, possibly reflecting differences in causes of graft failure. As might be expected, the steepest slope was in patients where the transplant subsequently failed. This analysis has assumed linearity of progression of fall in GFR and further work is ongoing to characterise the patterns of progression more precisely.

### Cause of death in transplant recipients

#### Introduction

Differences in causes of death between dialysis and transplant patients may be expected due to selection for transplantation and use of immunosuppression. Chapter 5 includes a more detailed discussion on cause of death in dialysis patients.

#### Methods

The cause of death is sent by renal centres as an ERA-EDTA registry code. These have been grouped into the following categories: cardiac disease, cerebrovascular disease, infection, malignancy, treatment withdrawal, other and uncertain.

Some centres have high data returns to the UKRR regarding cause of death, whilst others return no information. Provision of this information is not mandatory. Analysis of prevalent patients included all those aged over 18 years and receiving RRT on 1st January 2015.

#### Results and Discussion

Table 3.13 and figure 3.11 show the differences in the cause of death between prevalent dialysis and transplant patients. Table 3.14 shows the cause of death for prevalent transplant patients by age.

Death due to cardiovascular disease was less common in transplanted patients than in dialysis patients, perhaps reflecting the lower age of the transplanted patients, and cardiovascular screening undertaken during transplant work-up; transplant recipients are a pre-selected lower



**Table 3.13.** Cause of death by modality in prevalent RRT patients on 1/1/2015, who died in 2015

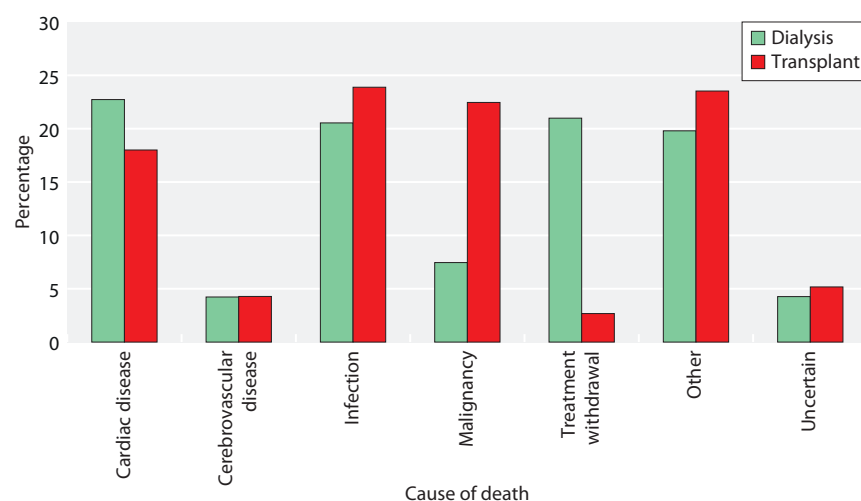
Cause of death	All modalities		Dialysis		Transplant	
	N	%	N	%	N	%
Cardiac disease	714	22	613	23	101	18
Cerebrovascular disease	138	4	114	4	24	4
Infection	688	21	554	21	134	24
Malignancy	327	10	201	7	126	22
Treatment withdrawal	581	18	566	21	15	3
Other	666	20	534	20	132	24
Uncertain	144	4	115	4	29	5
<b>Total</b>	<b>3,258</b>		<b>2,697</b>		<b>561</b>	
No cause of death data	1,747	35	1,439	35	308	35

**Table 3.14.** Cause of death in prevalent transplant patients on 1/1/2015 by age, who died in 2015

Cause of death	All age groups		<65 years		≥ 65 years	
	N	%	N	%	N	%
Cardiac disease	101	18	54	21	47	15
Cerebrovascular disease	24	4	13	5	11	4
Infection	134	24	58	23	76	25
Malignancy	126	22	58	23	68	22
Treatment withdrawal	15	3	3	1	12	4
Other	132	24	61	24	71	23
Uncertain	29	5	10	4	19	6
<b>Total</b>	<b>561</b>		<b>257</b>		<b>304</b>	
No cause of death data	308	35	142	36	166	35

risk group of patients. The leading causes of death amongst transplant patients were malignancy (22%) and infection (24%). There has been a reduction over time in the proportion of deaths in transplant patients attributed to cardiovascular or cerebrovascular disease

(43% in 2003 compared to 22% in 2015) with an increase in the proportion ascribed to infection or malignancy (30% in 2003 compared to 46% in 2015). The increased death rate secondary to malignancy and infection may include the increasing age of transplant recipients and

**Fig. 3.11.** Cause of death by modality for prevalent patients on 1/1/2015, who died in 2015

the increased intensity of immunosuppressive regimens, particularly the use of lymphocyte depleting induction regimens.

Conflicts of interest: Dr E Sharples has received travel honoraria from Alexion pharmaceuticals.

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## Appendix 1: Reporting status of audit measures

**Table 3.15.** The reporting status of the recommended Renal Association Audit Measures for the Post-operative Care of Kidney Transplant Recipients in the 19th Annual Report

RA audit measure	Included in UKRR annual report?	Reason for non-inclusion
1. Proportion of blood results available for review, and reviewed, within 24 hours	No	UKRR does not currently collect these data
2. Proportion of renal centres with a written follow-up schedule available to all staff and patients	No	UKRR does not currently collect these data
3. Percentage of patients accessing their results through Renal Patient View	No	Requires linkage with RPV
4. Percentage of total patients assessed in an annual review clinic.	No	UKRR does not currently collect these data
5. Percentage of total patients receiving induction with ILRAs and TDAs	No	Poor data completeness
6. Percentage of de novo KTRs receiving tacrolimus	No	Poor data completeness
7. Percentage of de novo KTRs receiving MPA based immunosuppression	No	Poor data completeness
8. Percentage of de novo KTRs receiving corticosteroid maintenance therapy	No	Poor data completeness
9. Use of generic agents	No	UKRR does not currently collect these data
10. Severity of biopsy proven acute rejection (BPAR) recorded by BANFF criteria.	No	UKRR does not currently collect these data
11. Percentage of KTRs with BPAR in first 3 months and first 12 months.	No	UKRR does not currently collect these data
12. Percentage of KTRs requiring TDAs to treat rejection in first year	No	UKRR does not currently collect these data
13. Complication rates after renal transplant biopsy	No	UKRR does not currently collect these data
14. Proportion of patients receiving a target blood pressure of 130/80 mmHg or 125/75 mmHg in the presence of proteinuria (PCR >100 or ACR >70)	No	Poor data completeness on proteinuria
15. Proportion of patients receiving an ACE inhibitor or angiotensin receptor blocker	No	Poor data completeness
16. Proportion of patients with proteinuria assessed by dipstick and, if present, quantified at each clinic visit.	No	UKRR does not currently collect these data
17. Proportion of renal transplant recipients with an annual fasting lipid profile	No	UKRR does not currently collect these data
18. Proportion of KTR taking statins (including the type of statin) for primary and secondary prevention of premature cardiovascular disease	No	UKRR does not currently collect these data
19. Proportion of patients on other lipid lowering agents	No	Poor data completeness
20. Proportion of patients achieving dyslipidaemia targets	Partly	Reported but not a centre level, but by transplant status
21. Incidence of new onset diabetes after transplantation (NODAT) at three months and at annual intervals thereafter	No	UKRR does not currently collect these data
22. Proportion of patients who require insulin, and in whom remedial action is undertaken – minimisation of steroids and switching of CNIs	No	UKRR does not currently collect these data
23. Proportion of patients with ischaemic heart disease	No	Poor data completeness
24. Proportion of patients suffering myocardial infarction	No	Poor data completeness
25. Proportion of patients undergoing primary revascularisation	No	Poor data completeness

**Table 3.15.** Continued

RA audit measure	Included in UKRR annual report?	Reason for non-inclusion
26. Proportion of patients receiving secondary prevention with a statin, anti-platelet agents and RAS blockers	No	UKRR does not currently collect these data
27. Proportion of patients who are obese	No	Poor data completeness
28. Proportion of patients having screening procedures for neoplasia at the annual review clinic	No	UKRR does not currently collect these data
29. Incidence of CMV disease	No	Poor data completeness
30. Rate of EBV infection and PTLT	No	UKRR does not currently collect these data
31. Completeness of records for EBV donor and recipient serology	No	UKRR does not currently collect these data
32. Rates of primary VZV and shingles infection	No	UKRR does not currently collect these data
33. Completeness of records for VZV recipient serology	No	UKRR does not currently collect these data
34. Rates and outcomes of HSV infection.	No	UKRR does not currently collect these data
35. Rates of BK viral infection in screening tests.	No	UKRR does not currently collect these data
36. Rates and outcomes of BK nephropathy	No	UKRR does not currently collect these data
37. Frequency of bisphosphonate use	No	UKRR does not currently collect these data
38. Incidence of fractures	No	UKRR does not currently collect these data
39. Incidence of hyperparathyroidism	Partly	Reported but not a centre level, due to poor data completeness
40. Incidence of parathyroidectomy	No	UKRR does not currently collect these data
41. Use of cinacalcet	No	Poor data completeness
42. Frequency of hyperuricaemia and gout	No	UKRR does not currently collect these data
43. Prevalence of anaemia	Yes	
44. Prevalence of polycythaemia	No	Poor data completeness
45. Pregnancy rates and outcomes	No	UKRR does not currently collect these data
46. Prevalence of sexual dysfunction	No	UKRR does not currently collect these data