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Contents

Chapter 1
Summary of findings in the 2009 UK Renal Registry Report

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In 2008, all renal centres supplied electronic data extracts to the UK Renal Registry. In all analyses, marked variations between centres are reported.

In 2008, the acceptance rate in the UK was 108 per million population (pmp). Acceptance rates in Scotland (103 pmp), Northern Ireland (97 pmp) and Wales (117 pmp) have all fallen compared to previous years, although Wales still remained the country with the highest acceptance rate. Diabetic renal disease remained the single most common cause of renal failure (24%). The incidence of late presentation (<90 days) has fallen from 28% in 2003 to 22% in 2008.

There were 47,525 adult patients receiving RRT in the UK on 31/12/2008, equating to a UK prevalence of 774 pmp. This represented an annual increase in prevalence of approximately 4.4%. The growth rate from 2007 to 2008 for prevalent patients by treatment modality in the UK was 5.9% for haemodialysis (HD), a fall of 9.2% for peritoneal dialysis (PD) and growth of 4.6% with a functioning transplant. For all ages, prevalence rates in males exceeded those in females, peaking in the 75–79 years age group at 2,582 pmp for males and in the 70–74 years age group at 1,408 pmp for females.

The total number of kidney transplants performed in 2008 was 2,486 compared to 2,218 in 2007 and 2,067 in 2006. Compared to 2007, there were 37 (4%) more transplants from heartbeating deceased donors, 139 (46%) more transplants from non-heartbeating deceased donors and 120 (15%) more transplants from living kidney donors. The number of simultaneous kidney/pancreas transplants fell from 197 in 2007 to 162 in 2008. Analysis of prevalent transplants by chronic kidney disease stage showed 14.7% with an eGFR <30ml/min/1.73 m^2 and 2.1% <15ml/min/1.73 m^2. Of those with CKD stage 5T, 40.4% had haemoglobin (Hb) concentrations <10.5 g/dl, 25.9% phosphate concentrations $\geqslant 1.8$ mmol/L, 9.0% adjusted calcium concentrations $\geqslant 2.6$ mmol/L and 40.8% PTH concentrations $\geqslant 32$ pmol/L.

Reporting of comorbidity at the start of RRT remained incomplete in many centres. Diabetes mellitus and ischaemic heart disease were the most common comorbidities reported at the start of RRT, in 30.1% and 22.7% of patients respectively. In multivariate survival analysis, malignancy and ischaemic/neuropathic ulcers were the strongest independent predictors of poor survival at 1 year after 90 days from the start of RRT.

The age-adjusted survival (adjusted to age 60) of prevalent dialysis patients rose from 85% in 2000 to 89% in 2007. Diabetic prevalent patient survival rose from 76.5% in 2000 to 83.0% in 2007. The age-standardised mortality ratio for prevalent RRT patients compared with the general population was 28.6 at age 30 years (and was lower than in the 1998–2001 cohort

in all age groups up to 45–49) and 4.6 at age 80 years. The median life years remaining for a 25–29 year old on RRT was 20 years and 5 years for a 70 year old.

There has been an increase from 56% in 1998 to 83% in 2008 in the proportion of patients in the UK who met the UK Clinical Practice Guideline for URR (>65%). There was considerable variation from one centre to another, with 9 centres attaining the RA clinical practice guideline in >90% of patients and 5 centres attaining the standard in <70% of patients.

In HD patients, 54% of patients had a Hb $\geqslant$10.5 and $\leqslant$12.5 g/dl in 2008 compared with 53% in 2007. In PD patients, 55% of patients had a Hb $\geqslant$10.5 and $\leqslant$12.5 g/dl in 2008, compared with 52% in 2007. The proportion of patients with Hb $\geqslant$10 g/dl fell in 2008 compared to 2007. The median ferritin in HD patients in England, Wales and Northern Ireland was 436 µg/L (IQR 289–622); 95% of HD patients had a ferritin $\geqslant$100 µg/L. The median ferritin in PD patients in England, Wales and Northern Ireland was 246 µg/L (IQR 141–399) with 84% of PD patients having a ferritin $\geqslant$100 µg/L. In England, Wales and Northern Ireland the mean ESA dose was higher for HD than PD patients (9,166 vs. 6,302 IU/week).

Serum phosphate was between 1.1 and 1.8 mmol/L in 55% of HD and 64% of PD patients, which was similar to 2007. A revised adjusted serum calcium target of 2.2–2.5 mmol/L was achieved by 63% of HD and 65% of PD patients. The audit measure for bicarbonate was achieved in 71% of HD and 82% of PD patients. Overall, 43% of diabetic dialysis patients exceeded the target of 7.5% HbA1c.

In 2008, only 26.3% of peritoneal dialysis and 27.4% of transplant patients achieved the Renal Association guidelines standard of BP <130/80 mmHg.

Since the removal of BP targets for haemodialysis (HD) patients within the Renal Association Clinical Practice Guidelines, there has been a reduction in the number of HD patients achieving BP <130/80 mmHg. In 2008, 43.1% of patients achieved BP <140/90 mmHg pre-HD and 46.8% BP <130/80 mmHg post-HD.

From April 2008 until March 2009 171 discrete episodes of MRSA bacteraemia were identified from the Health Protection Agency database as being potentially associated with patients in established renal failure (ERF) requiring dialysis. Of the 139 episodes amongst confirmed dialysis patients for whom data on vascular access were available, all occurred in patients on haemodialysis. Of these patients, 30.2% were utilising an arteriovenous fistula or graft and 69.8% were dialysing on a non-tunnelled or tunnelled venous catheter. The median centre-specific rate of MRSA bacteraemia was 0.64 (range 0–3.49) episodes per 100 haemodialysis patients per year, and 0.55 (range 0–2.89) episodes per 100 dialysis (haemodialysis and peritoneal dialysis combined) patients per year.

In a pilot study in 9 UK renal centres of 8,810 patients, 1,616 (18.3%) were flagged by criteria based on biochemical values at around the start of RRT, as having a potentially incorrect reported date of start of RRT. Of these, 61.7% had been assigned an incorrect date of start of haemodialysis (HD), 5.7% had evidence of acute RRT being given before the reported date of start of HD and 9.2% had evidence of starting peritoneal dialysis exchanges prior to the reported date of start.

The UK paediatric established renal failure (ERF) population in December 2008 was 905 patients. The prevalence under the age of 16 years was 56 per million age related population (pmarp) and the incidence 7.4 pmarp. The incidence and prevalence for South Asian patients was much higher than that of the White and Black populations. Anthropometric data confirmed that children with ERF in the UK are short compared with their peers with no change in recent trends. In the UK as a whole, the control of blood pressure, anaemia and bone biochemistry is suboptimal, but for some parameters these appear to be better in the 2008 cohort than in the 1999–2008 cohort.

Chapter 2
Introduction

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Key Words
UK Renal Registry

Abstract
The 12th Annual Report from the UK Renal Registry (UKRR) contains analyses of data submitted from every centre providing clinical supervision of renal replacement therapy (RRT) in England, Wales, Northern Ireland and (via the Scottish Renal Registry) Scotland. The data are largely extracted direct from clinical information systems used for direct clinical care [1] and the inclusion of laboratory data permit analyses not only of the incidence, prevalence, and outcomes of RRT in the UK, but also the achievement of clinical performance measures as defined by the Renal Association's Clinical Practice Guidelines. The UKRR remains unique amongst renal registries in not only publishing centre-specific analyses of outcomes, including laboratory variables but also including age-adjusted survival statistics. Data are still incomplete, particularly on those data items that require clinical input, including primary renal disease and comorbidity at the start of RRT, and these deficiencies limit the Registry's ability to perform analyses that are fully adjusted for case-mix. In England, the issue of a Dataset Change Notice [2] has made submission of a defined dataset on each patient undergoing RRT mandatory, but how quickly this will accelerate improvement in data returns remains to be determined.

National developments

The National Health Service has seen unprecedented increases in funding over the past 10 years, and in renal medicine this has removed restrictions on the availability of dialysis places that may have led in the past, to covert 'rationing' of RRT. There can now be more confidence that the incidence of RRT now reflects true clinical need for RRT, whilst recognising that some patients opt (usually for reasons of advanced age or comorbidity) for maximal conservative care in preference to dialysis. However, regional variation in RRT acceptance rates remains unexplained, and could reflect differences at the level of primary care or renal centre, particularly relating to initiation of RRT in elderly patients and those with significant comorbidity. The publication of guidelines on the management of chronic kidney disease (CKD) in the UK [3, 4] has also led to an increase in referral rate to renal services, resulting in reductions in the rate of late referral of patients who subsequently require RRT. Despite these advances, the analyses in this Report still show marked variations in the use of peritoneal dialysis and home haemodialysis. These variations are the subject of continuing research and have prompted the production of Renal Association working party reports [5, 6].

As a result of the global recession and the massive public debt in the UK, the NHS now faces a period in which continued growth in funding is very unlikely; most commentators anticipate that, at most, the NHS will receive 'flat cash' funding over the next 5 years. Even with continuing improvements in preventive care, earlier referral of patients with advanced CKD and where appropriate, provision of supportive care in place of RRT for patients with CKD5 with significant comorbidity, it is inevitable that the prevalence of RRT will continue to increase. Given the cost of RRT, this

combination of circumstances will create major challenges for the UK renal community. It will be more important than ever to submit high quality data on the outcomes of RRT, and to develop reliable analyses of the epidemiology and outcomes of conservative management of advanced CKD.

To date, the Registry's analyses of the quality of care have largely been confined to clinical and surrogate outcomes and have not included costs or hospitalisation. The UKRR is working to develop linkages with both the Hospital Episode Statistics database (which holds information not only on hospital admissions but on discharge diagnoses and procedure codes) and with the Programme Budgeting Atlas (that provides estimates of expenditure in secondary care according to specialty).

The UK government's document 'High Quality Care for All' [7] established quality (in three domains – safety, effectiveness, and patient experience) as the 'organising principle of the NHS'. Following the publication of this Report, the Department of Health commissioned the Information Centre to develop a set of 'Indicators for Quality Improvement' for use across the NHS. The indicators include several that are relevant to the renal community: measures of the quality of care of CKD patients in primary care (derived from the Quality Analysis and Management System, and based on the Quality and Outcomes Framework [8]); a number of markers relating to organ donation; markers relating to MRSA infection amongst patients on dialysis; and a number of markers directly derived from UKRR analyses. A list of markers, together with 'metadata' supporting their use, can be downloaded from the Information Centre's website [9].

Clinical information systems used in UK renal centres

As described elsewhere [1], the Registry obtains data extracts direct from information systems used for direct patient care. This minimises the requirements for data entry, but means that information is derived from a variety of different information systems with differing functionality. At present, of centres in England, Wales and Northern Ireland that submit data directly to the UKRR, 30 centres are using a CCL Proton system, 11 Mediqal, 4 RenalPlus, 3 VitalData, 3 CCL ClinicalVision, 2 B Braun, 1 CCL Windows, 1 Cybernius, 1 Fresenius, 1 iSoft, and 6 centres are using 'in-house' systems that are not commercially available or an integral part of a main hospital IT system.

Completeness of returns from UK renal centres

Table 2.1 gives completeness of data returns on ethnic origin, primary renal diagnosis, date first seen by a nephrologist and comorbidity at the start of RRT, from each centre in the UK.

Interpretation of centre-specific comparisons

The Registry continues to advise caution in the interpretation of the comparisons of centre-specific attainment of clinical performance measures provided in this Report. As in previous reports, the 95% confidence interval is shown for compliance with a Standard. The calculation of this confidence interval (based on the Binomial distribution) and the width of the confidence interval depends on the number of values falling within the Standard and the number of patients with reported data.

To assess whether there is an overall significant difference in the percentage reaching the Standard between centres, a Chi-squared test has been used. Caution should be used when interpreting 'no overlap' of 95% confidence intervals between centres in these presentations. When comparing data between many centres, it is not necessarily correct to conclude that two centres are significantly different if their 95% confidence intervals do not overlap. In this process, the eye compares centre X with the other 71 centres and then centre Y with the other 70 centres. Thus, 141 comparisons have been made and at the commonly accepted 1 in 20 level at least 7 are likely to appear 'statistically significant' by chance. If 72 centres were compared with each other, 2,556 such individual comparisons would be made and one would expect to find 127 apparently 'statistically significant' differences at the $p = 0.05$ level and still 25 at the $p = 0.01$ level. Thus, if the renal centres with the highest and lowest achievement of a standard are selected and compared, it is probable that an apparently 'statistically significant result' will be obtained. Such comparisons of renal centres selected after reviewing the data are statistically invalid. The UKRR has therefore not tested for 'significant difference' between the highest achiever of a standard and the lowest achiever, as these centres

Table 2.1. Percentage completeness of data returns for ethnicity, primary renal diagnosis, date first seen by a nephrologist and comorbidity at the start of RRT (incident patients 2008)

Centre	Ethnicity	Primary diagnosis	Date 1st seen	Comorbidity	Average completeness	Country
L Kings	98.0	100.0	96.7	100.0	98.7	England
Newry	85.0	100.0	100.0	100.0	96.3	N Ireland
Dorset	100.0	98.8	98.8	83.3	95.2	England
Basldn	92.5	100.0	90.0	97.5	95.0	England
Ulster	84.6	100.0	92.3	100.0	94.2	N Ireland
Derby	90.2	98.9	95.7	91.3	94.0	England
Wolve	98.9	100.0	96.5	75.9	92.8	England
Swanse	95.8	95.8	93.2	85.8	92.7	Wales
Carlis	96.8	96.8	77.4	96.8	91.9	England
Bradfd	89.8	98.3	79.7	91.5	89.8	England
Middlbr	77.4	100.0	93.5	80.7	87.9	England
Chelms	72.7	100.0	97.0	78.8	87.1	England
Wrexm	100.0	100.0	100.0	45.5	86.4	Wales
Nottm	99.1	100.0	96.5	44.4	85.0	England
Derry	83.3	100.0	83.3	66.7	83.3	N Ireland
Tyrone	84.0	100.0	96.0	52.0	83.0	N Ireland
Leic	95.8	90.2	72.4	73.0	82.9	England
Stevng	98.0	99.0	94.0	38.6	82.4	England
Antrim	70.7	100.0	70.7	73.2	78.7	N Ireland
Oxford	89.0	98.0	99.3	28.1	78.6	England
Donc	92.0	100.0	92.0	28.0	78.0	England
Shrew	100.0	100.0	98.4	12.9	77.8	England
Kent	84.1	100.0	97.0	28.8	77.5	England
Ipswi	76.3	100.0	97.3	34.2	77.0	England
Newc	98.0	99.0	100.0	2.0	74.8	England
Bristol	91.7	81.2	61.6	61.9	74.1	England
Sheff	51.1	98.9	97.7	45.0	73.2	England
York	87.9	72.7	93.5	36.4	72.6	England
Glouc	22.2	91.1	84.4	91.1	72.2	England
Ports	71.0	98.2	85.0	34.3	72.1	England
Sund	84.1	100.0	[b] 0.0	100.0	71.0	England
Belfast	70.6	100.0	63.2	45.6	69.8	N Ireland
Leeds	76.1	54.2	69.1	65.2	66.1	England
L Barts	80.1	100.0	0.5	68.7	62.3	England
Wirral	97.6	61.0	82.1	4.9	61.4	England
Carsh	80.7	100.0	0.0	61.3	60.5	England
Norwch	54.3	93.5	12.0	76.1	59.0	England
L St.G	75.3	97.8	0.0	57.3	57.6	England
Redng	99.0	100.0	7.1	1.0	51.8	England
M RI	91.9	48.5	27.2	33.8	50.4	England
Camb	91.3	[a] 33.3	72.5	1.5	49.6	England
B Heart	99.1	99.1	0.0	0.0	49.5	England
L West	48.3	100.0	[b] 0.0	48.3	49.1	England
B QEH	97.8	97.4	0.0	0.0	48.8	England
Sthend	22.9	100.0	0.0	68.6	47.9	England
Dudley	83.7	100.0	0.0	0.0	45.9	England
Prestn	87.5	92.0	0.0	0.0	44.9	England
Hull	4.3	90.6	0.0	82.9	44.4	England
Covnt	72.6	100.0	0.0	0.0	43.1	England
Cardff	66.7	100.0	0.0	1.3	42.0	Wales
L Guys	59.8	100.0	2.4	1.2	40.8	England
Bangor	4.8	100.0	[b] 0.0	57.1	40.5	Wales
M Hope	99.1	[a] 0.9	48.6	0.9	37.4	England
Plymth	14.3	100.0	2.9	31.4	37.2	England

Table 2.1. Continued

Centre	Ethnicity	Primary diagnosis	Date 1st seen	Comorbidity	Average completeness	Country
Brightn	55.2	92.2	0.0	0.9	37.1	England
L Rfree	93.1	20.0	0.6	0.6	28.6	England
Liv RI	44.7	[a] 31.1	0.0	32.0	26.9	England
Truro	30.8	38.5	[b] 0.0	35.9	26.3	England
Stoke	2.4	100.0	[b] 0.0	[c] 0.0	25.6	England
Exeter	10.4	33.6	11.4	3.0	14.6	England
Clwyd	23.1	[a] 30.8	0.0	0.0	13.5	Wales
Liv Ain	19.0	[a] 0.0	0.0	0.0	4.8	England
Colchr	11.3	0.0	0.0	[c] 0.0	2.8	England
Airdrie	5.1	100.0				Scotland
Edinb	0.0	99.0				Scotland
Dunfn	0.0	96.7				Scotland
D & Gall	0.0	94.7				Scotland
Glasgw	0.0	94.4				Scotland
Abrdn	0.0	89.1				Scotland
Inverns	0.0	68.0				Scotland
Dundee	1.5	60.0				Scotland
Klmarnk	0.0	41.2				Scotland

[a] data from these centres included a high proportion of patients whose primary renal diagnosis was 'uncertain'. As discussed in chapter 3, this appears to have been largely because software in these centres was defaulting missing values to 'uncertain'
[b] as in previous Reports, all 'first seen' dates have been set to 'missing' because at least 10% of the dates returned were identical to the date of start of RRT. Whilst it is possible to start RRT on the day of presentation, comparison with the data returned from other centres raises the possibility, requiring further investigation, of incorrect data entry or extraction from these centres
[c] comorbidity data were available in some patients reported by these centres, but the distribution of different comorbidities was judged statistically highly unlikely, raising concerns about incorrect data entry or extraction from these centres

were not identified in advance of looking at the data. The uncertainty surrounding ranking of centres can be illustrated by Monte Carlo simulation [10].

In chapters 3 and 4, tables are presented to allow Primary Care Trusts and other organisations representing relatively small populations to assess whether their incident and prevalent rates for renal failure are significantly different from that expected from the age and gender breakdown of the population they serve.

The role of the UKRR in improvement and the identification of underperformance

The UKRR is part of the Renal Association. The Chair of the UKRR is appointed by the Renal Association and reports to the Management Board, comprising the Trustees of the Renal Association plus the Director, Deputy Director, and Manager of the UKRR. The UKRR has no statutory powers. However, the fact that the UKRR provides centre-specific analyses of important clinical outcomes, including survival, makes it important to define how the UKRR responds to apparent underperformance. Open publication of the analyses, together with an Executive Summary for Commissioners, should by itself drive up the quality of care provided. The UKRR also ensures that the Clinical Director of any service that is identified as an 'outlier' for age-adjusted survival is informed in advance of publication of this finding and asked to provide evidence that the Clinical Governance department and Chief Executive of the Trust housing the service are informed. In the event that no such evidence is provided, the Chair of the UKRR would inform the President of the Renal Association, who would then take action to ensure that the findings were properly investigated. These procedures are followed even if there is evidence that further adjustment, for instance for comorbidity, might explain outlier status.

Information governance

The UKRR operates within a comprehensive governance framework which concerns data handling, reporting

and research, including data linkages and sharing agreements. The Chair of the UKRR Management Board is appointed as the Lead for Governance, with the UKRR Deputy Director responsible for day to day management of governance compliance. The Framework is based on good practice, as described in the Information Governance Framework (http://www.connectingforhealth.nhs.uk/systemsandservices/infogov/igap/igaf) and the Research Governance Framework for Health and Social Care (2005) (http://www.dh.gov.uk/en/Aboutus/Researchanddevelopment/A-Z/Researchgovernance/DH_4002112).

Details of how the Registry extracts, analyses and reports on data for patients on RRT have been described previously [1].

The Registry has temporary exemption, granted by the Secretary of State under section 251 of The National Health Service Act (2006), to hold patient identifiable data. This exemption is reviewed annually.

Paediatric Registry

The British Association for Paediatric Nephrology Registry Committee has previously collected data on children under the care of paediatric nephrology centres using paper census returns. During 2009, all data held on the paediatric registry were transferred to the UKRR and data from most of the 13 paediatric centres was returned electronically. Some paediatric centres use renal IT systems for routine clinical care, whilst others currently only use these systems for the purpose of data submission. Those paediatric centres not currently submitting data electronically all have plans to do so.

Peer-reviewed publications since the last Annual Report

The UKRR's primary role is to use data to develop high-quality analyses to drive a cycle of continuous improvement in the care of patients with kidney disease in the UK. Research however, is an important part of improving the quality of existing analyses and developing new ones. A number of articles have been published in peer-reviewed journals since the publication of the last Report [11–18] in addition to articles published in collaboration with the EDTA-ERA Registry [19–22]. A full list of publications involving analyses of UKRR data is available on the UKRR website at www.renalreg.org.

Conflict of interest: none

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Chapter 3
UK ESRD Incident Rates in 2008: national and centre-specific analyses

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Key Words
Acceptance rates · Comorbidity · Dialysis · End stage renal disease · End stage renal failure · Haemodialysis · Incidence · Peritoneal dialysis · Primary Care Trust · Renal replacement therapy · Transplantation

Abstract
Introduction: This chapter describes the characteristics of adult patients starting renal replacement therapy (RRT) in the UK in 2008 and the acceptance rates for RRT in Primary Care Trusts and Local Authorities (PCT/LAs) in the UK. ***Methods:*** The basic demographics and clinical characteristics are reported on patients starting RRT from all UK renal centres. Late referral, defined as time between first being seen by a nephrologist and start of RRT being <90 days was also studied. Age and gender standardised ratios for acceptance rate in PCT/LAs were calculated. ***Results:*** In 2008, the acceptance rate in the UK was 108 per million population (pmp). Acceptance rates in Scotland (103 pmp), Northern Ireland (97 pmp) and Wales (117 pmp) have all fallen although Wales still remains the country with the highest acceptance rate. There were wide variations between PCT/LAs with respect to the standardised ratios, which were lower in more PCT/LAs in the North West and South East of England and higher in London, the West Midlands, Scotland, Northern Ireland, and Wales. The median age of all incident patients was 64.1 years and for non-Whites 56.1 years. Diabetic renal disease remains the single most common cause of renal failure (24%). By 90 days, 67.7% of patients were on haemodialysis, 19.8% on peritoneal dialysis, 5.9% had had a transplant and 6.6% had died or had stopped treatment. By 90 days, 77.4% of all dialysis patients were on HD. The geometric mean eGFR at the start of RRT was 8.6 ml/min/1.73 m^2 which was similar to the eGFR of those starting in 2007. The incidence of late presentation (<90 days) has fallen from 28% in 2003 to 22% in 2008. There was no relationship between social deprivation and referral pattern. ***Conclusions:*** Acceptance rates have fallen in Northern Ireland, Scotland and Wales whilst they have plateaued in England over the last three years. Wales continued to have the highest acceptance rate of the countries making up the UK.

Introduction

The term established renal failure (ERF) used within this chapter is synonymous with the terms end stage renal failure (ESRF) and end stage renal disease (ESRD), which are in more widespread international usage. Within the UK, patient groups have disliked the term 'end stage' which formerly reflected the inevitable outcome of this disease.

Table 3.1. Number of new adult patients starting RRT in the UK in 2008

	England	Wales	Scotland	N Ireland	**UK**
All UK centres	5,585	349	532	173	**6,639**
* Total estimated population mid-2008 (millions)	51.4	3.0	5.2	1.8	**61.4**
Acceptance rate (pmp)	109	117	103	97	**108**
(95% CI)	(106–111)	(104–129)	(94–112)	(83–112)	**(106–111)**

* Data extrapolated by the Office for National Statistics – based on the 2001 census

UK Renal Registry coverage

This chapter includes analyses of adult patients starting renal replacement therapy (RRT) in the UK in 2008. It describes regional and national variations in acceptance rates on to RRT in the UK, the demographics and clinical characteristics of all patients starting RRT in the UK and late referral to a renal centre for initiation of RRT. The methodology and the results for these analyses are discussed for the 3 sections separately.

For the first time, in 2008, the UK Renal Registry (UKRR) received individual patient level data returns from all adult renal centres in the UK (5 renal centres in Wales, 6 in Northern Ireland, 9 in Scotland and 52 in England). Data from centres in Scotland were obtained from the Scottish Renal Registry. Data on children and young adults can be found in chapter 14 Demography of the UK Paediatric RRT Population.

1 Geographical variation in acceptance rates

Over the years there have been wide variations in trends in acceptance between renal centres. Equity of access to RRT is an important aim and the need for RRT depends on many variables including social and demographic factors such as age, gender, social deprivation and ethnicity. Hence comparison of crude acceptance rates by geographical area can be misleading. This section, as in previous reports, uses age and gender standardisation and ethnic minority profiles to compare RRT incident rates. The impact of social deprivation was recorded in the 2003 report [1].

Methods

Crude acceptance rates were calculated per million population (pmp) and standardised acceptance ratios were calculated as detailed in appendix D: methodology used for analyses of PCT incidence and prevalence rates and of standardised ratios (www.renalreg.org). Briefly, data from all covered areas was used to calculate overall age and gender specific acceptance rates. The age and gender breakdown of the population in each Primary Care Trust (PCT) area in England, Local Authority (LA) area in Wales, Scotland (called Council Area) and in Northern Ireland (called District Council Area) was obtained from the 2001 Census data from the Office for National Statistics (ONS) [2]. These will be referred to by the umbrella term 'PCT/LA' in this report. This population breakdown was extrapolated by the ONS from the 2001 census data to mid-2006 estimates. This is the second year that the mid-2006 estimates have been used. The population breakdown and the overall acceptance rates were used to calculate the expected age and gender specific acceptance numbers for each PCT/LA. The age and gender standardised acceptance ratio was the observed acceptance numbers divided by the expected acceptance numbers. A ratio below 1 indicated that the observed rate was less than expected given the area's population structure. This was statistically significant at the 5% level if the upper confidence limit was less than 1. Analyses were undertaken for each of the last 6 years and, as the incident numbers for one year can be small for smaller areas, a combined years analysis was also done. The proportion of non-Whites in each PCT/LA area was obtained from the ONS.

Results

In 2008 the number of adult patients starting RRT in the UK was 6,639 equating to an acceptance rate of 108 pmp (table 3.1), very similar to the rate of 109 pmp in 2007. Acceptance rates in Scotland (103 pmp), Northern Ireland (97 pmp) and Wales (117 pmp) have all fallen although Wales still remained the country with the highest acceptance rate (figure 3.1). In England, acceptance rates remained stable for the last 3 years. There continues to be very marked gender differences in take-on rates, 135 pmp (95% CI 131–139) in males and 82 pmp (95% CI 79–85) in females.

Table 3.2 shows acceptance rates and standardised ratios for PCTs and LAs. The 95% confidence intervals are given for the standardised ratios from the combined years analysis and ratios that are significantly different

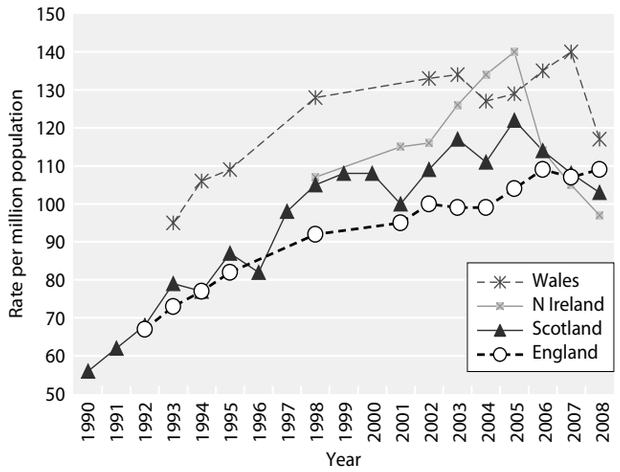

Fig. 3.1. RRT incident rates in the countries of the UK 1990–2008

from 1 are highlighted, provided that the area has been covered for at least three years. Small differences in the 2003–2007 results may be seen in comparison with previous publications because of retrospective data updating in collaboration with local renal centres.

In 2008 two small areas had no incident patients and hence crude acceptance rates of 0 pmp (table 3.2). These were Shetland Islands (population 22,000) and Limavady (population 33,900). With just two/three incident patients respectively these areas would have had rates close to the national average. The highest rate was 262 pmp on the Isle of Anglesey (population 68,800). There were similar wide variations in the standardised acceptance ratios from 0 (the two areas as above) to 3.04 in the Heart of Birmingham PCT (population 271,400). The latter PCT has a 60% non-White population. Changes over the 6 years between 2003 and 2008 showed wide variations in annual standardised acceptance ratios, particularly as would be expected, in areas with small populations. Over this 6-year period, of those PCT/LA areas with data for a minimum of 3 years, 45 had significantly low ratios, 52 had high ratios and 118 normal ratios. There were significant differences between regions ($p < 0.0001$), with acceptance rates being lower in more PCT/LAs in North West and South East England and higher in London, the West Midlands, Northern Ireland, Scotland and Wales (table 3.3). Importantly, the North East and North West of England have seen a rise in the number of PCT/LAs with significantly lower acceptance rates.

Confidence intervals are not presented for the crude rates but figure 3.2 has been included to enable assessment of whether an observed acceptance rate differs significantly from the national average. For any population size (x-axis), the upper and lower 95% confidence intervals around the national average acceptance rate (dotted lines) can be read from the y-axis. An observed acceptance rate outside these limits is significantly different from the national average. In order to be judged as significantly different from national norms the observed acceptance rate for a population of 80,000 would have to be outside the limits of 36 to 180 pmp per year, whilst for a population of 1 million, the limits are from 88 to 128 pmp per year. The plot begins at population 80,000 because below this the number of expected cases is small and the statistical assumptions used to produce the plot are not valid.

In those PCT/LA areas with significantly high acceptance ratios the median percentage of the population who were non-White was 20.6%, which was significantly higher (Wilcoxon rank sum test $p < 0.001$) than in those areas with low (2.3%) or normal (1.3%) ratios (figure 3.3). Likewise, those PCT/LAs with >10% of the population non-White (42 of 215 PCT/LAs) were significantly more likely to have high standardised acceptance ratios ($p < 0.0001$).

The number of new patients accepted by each renal centre from 2003 to 2008 is shown in table 3.4, along with the percentage difference between these years for each of those 52 centres with full reporting during that period and for the same centres on a national level. There have been large variations in acceptance trends between centres ranging from an increase of 81.7% in Guys to a reduction of 42.1% in York. The variation may reflect chance fluctuation, completeness of reporting, changing incidence of established renal failure, changes in referral patterns or catchment populations and areas, and the introduction of conservative care programmes. Acceptance rates of individual renal centres have not been calculated, as their catchment populations are not precisely defined.

By country, only England has seen an increase in numbers of accepted patients (7.2%), whilst both Scotland and Wales have seen a fall. Northern Ireland could not be included in the analysis as the UKRR only received data from 2005 onwards. The overall number of accepted patients in the UK remained relatively stable between 2007 and 2008 and this was consistent when looking only at those centres with complete reporting from 2003 to 2008. The increase of 3.8% in the number of UK patients accepted between 2003 and 2008 is considerably less than the 9.2% increase between 2002 and 2007 and the 12% increase between 2002 and 2006.

Table 3.2. Crude adult acceptance rates (pmp) and standardised ratios 2003–2008

O/E = standardised acceptance ratio
[a] For those areas not covered by the Registry for the entire period 2003–2008, the standardised acceptance ratio and the acceptance rates are averages for the years covered by the Registry
[b] per million population
[c] Lower confidence limit
[d] Upper confidence limit
Blank cells – no data returned to the Registry for that year
Areas with data for minimum 3 years and with significantly low acceptance ratios over 6 years are italicised in greyed areas, those with significantly high ratios are bold in greyed areas
% non-White = percentage of the PCT/LA population that is non-White, from 2001 census
PCT/LA = Primary Care Trust (England), Local Authority (Wales), Council Area (Scotland), District Council (N Ireland)

			2003	2004	2005	2006	2007	2008		2003–2008[a]				% non-
UK Area	PCT/LA	Tot Pop	O/E	O/E	O/E	O/E	O/E	O/E	pmp[b]	O/E	LCL[c]	UCL[d]	pmp	White
North	*County Durham*	*500,400*	*0.83*	*0.84*	*0.92*	*0.83*	*0.67*	*0.70*	*80*	*0.80*	*0.71*	*0.90*	*89*	*1.0*
East	Darlington	99,100	0.99	0.79	0.46	0.70	1.15	0.98	111	0.85	0.65	1.10	92	2.1
	Redcar and Cleveland	139,200	1.15	1.08	0.83	0.90	0.98	0.74	86	0.94	0.76	1.16	107	1.1
	Hartlepool	91,100	1.32	0.88	0.83	1.37	0.50	1.30	143	1.03	0.80	1.33	110	1.1
	Middlesbrough	138,500	1.15	0.92	1.08	1.37	1.25	1.12	116	1.15	0.95	1.41	116	6.3
	North Tees	189,200	0.93	1.10	0.82	0.88	0.59	0.84	90	0.86	0.70	1.04	88	2.7
	Gateshead	*190,500*	*1.00*	*1.00*	*0.71*	*0.67*	*0.86*	*0.68*	*79*	*0.82*	*0.67*	*0.99*	*91*	*1.6*
	Newcastle	270,400	0.95	1.19	1.01	0.71	1.26	1.04	107	1.02	0.88	1.19	102	6.9
	North Tyneside	*195,100*	*0.88*	*1.08*	*0.69*	*0.48*	*0.84*	*0.49*	*56*	*0.73*	*0.60*	*0.90*	*82*	*1.9*
	Northumberland	*309,900*	*0.84*	*0.93*	*0.63*	*0.67*	*0.73*	*0.68*	*84*	*0.74*	*0.64*	*0.87*	*88*	*1.0*
	South Tyneside	151,000	0.76	1.07	0.89	0.95	1.03	0.52	60	0.87	0.71	1.07	97	2.7
	Sunderland Teaching	280,600	1.27	0.64	0.73	0.72	1.05	0.80	89	0.87	0.74	1.01	93	1.9
North	Wirral	311,100	1.00	1.24	1.20	0.73	0.71	0.77	90	0.93	0.81	1.07	106	1.7
West	Liverpool	436,200	0.81	1.06	1.32	1.18	1.07	1.16	119	1.10	0.98	1.24	110	5.7
	Central and Eastern Cheshire	451,200					0.66	0.63	73	0.65	0.51	0.82	75	1.6
	Western Cheshire	*235,100*	*0.68*	*1.07*	*0.60*	*0.88*	*0.86*	*0.61*	*72*	*0.78*	*0.66*	*0.93*	*89*	*1.6*
	Knowsley	151,500	1.39	0.98	0.65	0.87	1.01	0.44	46	0.88	0.71	1.10	89	1.6
	Sefton	*277,500*	*0.69*	*0.56*	*0.92*	*0.79*	*0.53*	*0.81*	*97*	*0.72*	*0.61*	*0.85*	*84*	*1.6*
	Halton and St Helens	297,000	0.79	0.82	1.29	1.22	1.05	0.59	64	0.96	0.83	1.11	101	1.2
	Warrington	*194,300*	*0.63*	*0.94*	*0.74*	*0.79*	*0.66*	*0.62*	*67*	*0.73*	*0.59*	*0.90*	*76*	*2.1*
	Blackburn with Darwen	141,200	1.33	1.00	1.41	1.40	1.27	0.45	42	1.14	0.93	1.41	104	22.0
	Blackpool	*142,800*	*0.32*	*0.32*	*0.73*	*0.57*	*0.87*	*0.88*	*105*	*0.62*	*0.49*	*0.80*	*72*	*1.6*
	North Lancashire	*329,000*	*0.63*	*0.35*	*0.38*	*0.46*	*0.59*	*0.52*	*64*	*0.49*	*0.41*	*0.59*	*58*	*1.7*
	Cumbria	*496,000*	*0.76*	*0.61*	*0.87*	*0.62*	*0.62*	*0.72*	*89*	*0.70*	*0.62*	*0.79*	*83*	*0.7*
	Central Lancashire	*451,600*	*0.51*	*0.67*	*0.71*	*0.59*	*0.78*	*0.93*	*102*	*0.70*	*0.61*	*0.80*	*75*	*5.6*
	East Lancashire	*384,500*	*0.69*	*0.67*	*0.73*	*0.90*	*0.69*	*0.67*	*73*	*0.73*	*0.63*	*0.84*	*76*	*8.1*
	Ashton, Leigh and Wigan	*305,500*	*0.86*	*0.80*	*0.94*	*0.71*	*0.57*	*0.45*	*49*	*0.72*	*0.61*	*0.84*	*75*	*1.3*
	Bolton	*262,500*	*0.99*	*0.71*	*0.71*	*0.88*	*0.82*	*0.65*	*69*	*0.79*	*0.67*	*0.94*	*81*	*11.0*
	Bury	*182,900*	*0.57*	*0.91*	*0.80*	*0.55*	*0.61*	*0.67*	*71*	*0.68*	*0.55*	*0.85*	*70*	*6.1*
	Manchester	451,900					1.32	1.37	119	1.34	1.11	1.63	117	19.0
	Heywood, Middleton and Rochdale	206,400					0.94	0.85	87	0.89	0.65	1.23	92	11.4
	Oldham	*219,800*	*0.79*	*0.69*	*0.56*	*0.84*	*0.85*	*1.12*	*114*	*0.81*	*0.67*	*0.98*	*80*	*13.9*
	Salford	*217,800*	*1.35*	*0.53*	*0.41*	*0.90*	*0.52*	*1.10*	*115*	*0.80*	*0.66*	*0.97*	*81*	*3.9*
	Stockport	280,800					0.84	0.78	89	0.81	0.62	1.07	93	4.3
	Tameside and Glossop	247,700					1.37	0.69	73	1.03	0.79	1.34	109	4.9
	Trafford	212,100					0.95	0.61	66	0.78	0.56	1.08	85	8.4

Table 3.2. Continued

UK area	PCT/LA	Tot pop	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2008 pmp[b]	2003–2008[a] O/E	2003–2008[a] LCL[c]	2003–2008[a] UCL[d]	2003–2008[a] pmp	% non-White
Yorkshire and the Humber	*East Riding of Yorkshire*	*331,100*	*1.02*	*0.72*	*1.10*	*0.59*	*0.67*	*1.07*	*133*	*0.86*	*0.75*	*0.98*	*104*	*1.2*
	Hull	256,200	0.89	1.19	1.24	0.76	1.00	1.00	101	1.01	0.86	1.18	99	2.3
	North East Lincolnshire	159,900	0.68	1.04	1.21	1.03	1.05	1.11	125	1.03	0.85	1.24	112	1.4
	North Lincolnshire	155,200	0.73	1.34	0.97	0.97	0.71	0.88	103	0.93	0.76	1.13	105	2.5
	North Yorkshire and York	*783,200*	*1.11*	*1.00*	*0.89*	*0.88*	*0.77*	*0.73*	*87*	*0.89*	*0.81*	*0.97*	*102*	*1.4*
	Barnsley	223,700	0.71	0.88	0.75	0.94	0.83	1.12	125	0.87	0.74	1.04	95	0.9
	Doncaster	*290,400*	*0.98*	*0.88*	*0.70*	*0.78*	*0.58*	*0.83*	*93*	*0.78*	*0.67*	*0.92*	*86*	*2.3*
	Rotherham	253,000	0.94	1.18	1.07	0.91	1.03	1.39	154	1.09	0.94	1.26	117	3.1
	Sheffield	526,100	0.97	1.19	1.08	1.13	1.14	1.13	120	1.11	1.00	1.23	113	8.8
	Bradford and Airedale	**493,000**	**1.54**	**1.25**	**1.34**	**0.84**	**1.52**	**1.13**	**110**	**1.27**	**1.14**	**1.40**	**119**	**21.7**
	Calderdale	198,600	1.35	1.03	0.88	0.83	0.74	0.79	86	0.93	0.77	1.11	97	7.0
	Wakefield District	*321,000*	*0.87*	*1.06*	*0.64*	*1.00*	*0.56*	*0.73*	*81*	*0.81*	*0.69*	*0.94*	*86*	*2.3*
	Kirklees	398,400	1.21	1.31	0.76	1.19	0.72	0.70	73	0.97	0.86	1.11	97	14.4
	Leeds	750,300	1.06	1.02	1.12	0.92	0.82	0.96	97	0.98	0.89	1.08	96	8.1
East Midlands	**Leicester City**	**289,700**	**1.70**	**1.34**	**1.57**	**1.60**	**1.88**	**1.51**	**138**	**1.60**	**1.41**	**1.82**	**142**	**36.1**
	Leicestershire County and Rutland	*673,600*	*0.81*	*0.71*	*0.77*	*0.87*	*0.87*	*0.71*	*80*	*0.79*	*0.71*	*0.88*	*87*	*5.1*
	Northamptonshire	*669,200*	*0.74*	*0.70*	*0.84*	*0.88*	*1.00*	*0.96*	*102*	*0.86*	*0.77*	*0.95*	*87*	*4.9*
	Nottinghamshire County	657,500	1.06	1.04	1.22	1.17	1.08	0.91	105	1.08	0.99	1.18	120	2.8
	Bassetlaw	111,000	0.94	0.60	1.04	0.61	1.61	0.70	81	0.92	0.73	1.16	104	1.4
	Derby City	236,400	0.92	1.06	1.16	1.21	0.99	1.56	165	1.16	0.99	1.34	118	12.6
	Derbyshire County	*720,800*	*0.87*	*0.70*	*0.71*	*0.67*	*0.79*	*1.05*	*123*	*0.80*	*0.72*	*0.88*	*91*	*1.5*
	Lincolnshire	*688,700*	*0.57*	*0.75*	*1.05*	*0.83*	*0.79*	*0.66*	*83*	*0.78*	*0.70*	*0.86*	*94*	*1.4*
	Nottingham City	286,400	0.93	1.15	1.35	1.29	0.92	1.30	119	1.16	1.00	1.34	102	15.1
West Midlands	Dudley	305,200	0.81	1.19	1.00	0.92	0.96	0.88	102	0.96	0.83	1.10	107	6.4
	Birmingham East and North	**395,900**		**1.59**	**1.83**	**1.78**	**1.36**	**1.67**	**167**	**1.65**	**1.47**	**1.84**	**161**	**22.3**
	Heart of Birmingham Teaching	**271,400**		**2.25**	**2.10**	**2.37**	**2.63**	**3.04**	**243**	**2.49**	**2.20**	**2.81**	**194**	**59.9**
	South Birmingham	**339,400**		**1.66**	**1.22**	**1.10**	**1.32**	**1.53**	**153**	**1.36**	**1.19**	**1.55**	**133**	**15.1**
	Sandwell	**287,700**		**1.91**	**1.46**	**1.28**	**1.53**	**2.13**	**226**	**1.66**	**1.46**	**1.88**	**172**	**20.3**
	Solihull	203,000	1.56	1.22	1.10	1.25	0.81	0.98	113	1.15	0.98	1.34	128	5.4
	Walsall Teaching	**254,700**	**1.25**	**1.56**	**1.13**	**1.45**	**1.09**	**1.31**	**145**	**1.30**	**1.13**	**1.48**	**139**	**13.6**
	Wolverhampton City	**236,900**	**1.65**	**1.65**	**1.63**	**1.24**	**0.96**	**1.38**	**152**	**1.41**	**1.23**	**1.61**	**150**	**22.2**
	Coventry Teaching	**306,600**	**1.21**	**0.89**	**0.97**	**1.11**	**1.32**	**1.51**	**153**	**1.17**	**1.02**	**1.34**	**115**	**16.0**
	Herefordshire	178,000		0.97	0.77	0.69	0.79	0.92	118	0.82	0.67	1.01	103	0.9
	Warwickshire	522,300	0.72	0.90	0.97	1.06	1.04	0.98	113	0.95	0.85	1.06	106	4.4
	Worcestershire	*553,000*		*0.91*	*0.80*	*0.66*	*0.81*	*1.03*	*121*	*0.84*	*0.75*	*0.95*	*97*	*2.4*
	North Staffordshire	211,400					0.56	0.84	99	0.70	0.50	0.97	83	1.5
	South Staffordshire	603,500					0.98	0.96	109	0.97	0.82	1.15	111	2.7
	Shropshire County	289,500		1.10	0.86	0.95	0.66	1.14	142	0.94	0.81	1.10	115	1.2
	Stoke on Trent	247,600					1.21	1.03	113	1.12	0.87	1.44	123	5.1
	Telford and Wrekin	161,800		1.41	0.82	1.37	1.45	1.03	105	1.21	1.00	1.48	121	5.2
East of England	*Bedfordshire*	*403,600*	*0.91*	*0.78*	*0.61*	*1.08*	*0.58*	*0.86*	*92*	*0.80*	*0.70*	*0.92*	*82*	*6.7*
	Luton	**187,200**	**1.74**	**0.81**	**1.58**	**1.22**	**1.57**	**1.13**	**107**	**1.34**	**1.14**	**1.59**	**123**	**28.1**
	West Hertfordshire	*530,600*	*0.61*	*0.62*	*0.75*	*1.02*	*0.79*	*1.15*	*123*	*0.83*	*0.74*	*0.94*	*86*	*7.6*
	East and North Hertfordshire	*527,800*	*0.94*	*0.71*	*0.77*	*0.89*	*0.69*	*0.75*	*80*	*0.79*	*0.70*	*0.89*	*81*	*5.0*
	Mid Essex	361,400		1.05	0.83	0.91	0.95	0.75	83	0.90	0.77	1.04	97	2.4
	North East Essex	315,400						1.34	162	1.34	1.01	1.76	162	2.6
	South East Essex	329,900		1.21	0.90	1.23	1.02	0.95	112	1.06	0.92	1.21	123	3.0

Table 3.2. Continued

UK area	PCT/LA	Tot pop	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2008 pmp[b]	2003–2008[a] O/E	2003–2008[a] LCL[c]	2003–2008[a] UCL[d]	2003–2008[a] pmp	% non-White
East of England	South West Essex	388,300		1.30	0.84	1.08	0.95	1.13	118	1.06	0.92	1.21	109	3.8
	West Essex	*274,700*		*0.94*	*0.75*	*0.74*	*0.68*	*0.39*	*44*	*0.70*	*0.57*	*0.84*	*76*	*4.2*
	Cambridgeshire	589,600	0.82	0.91	0.95	1.15	0.88	0.91	98	0.94	0.84	1.04	98	4.1
	Peterborough	163,400	1.13	0.93	1.25	1.25	1.02	0.91	92	1.08	0.89	1.31	106	10.3
	Norfolk	738,900		0.89	1.17	0.98	1.04	0.81	103	0.98	0.89	1.07	122	1.5
	Suffolk	*585,300*		*0.80*	*0.98*	*0.77*	*0.90*	*0.86*	*101*	*0.86*	*0.77*	*0.96*	*99*	*3.1*
	Great Yarmouth and Waveney	**210,600**		**1.38**	**1.26**	**1.30**	**1.18**	**1.22**	**157**	**1.27**	**1.09**	**1.47**	**160**	**1.3**
London	**Barnet**	**328,400**			**0.70**	**1.55**	**1.90**	**1.41**	**140**	**1.40**	**1.21**	**1.62**	**138**	**26.0**
	Camden	227,200			0.77	1.31	1.00	0.94	79	1.01	0.80	1.26	84	26.8
	Enfield	**285,400**			**1.08**	**1.52**	**1.04**	**1.29**	**126**	**1.23**	**1.04**	**1.46**	**120**	**22.9**
	Haringey Teaching	**225,600**			**1.44**	**1.47**	**1.38**	**1.54**	**129**	**1.46**	**1.21**	**1.76**	**121**	**34.4**
	Islington	**185,500**			**1.74**	**1.66**	**1.48**	**1.15**	**97**	**1.51**	**1.23**	**1.85**	**125**	**24.6**
	Barking and Dagenham	165,400		1.25	0.76	0.78	0.99	1.65	151	1.08	0.87	1.35	97	14.8
	City and Hackney Teaching	**216,200**				**1.19**	**1.43**	**1.26**	**102**	**1.30**	**1.02**	**1.64**	**105**	**39.7**
	Havering	227,500				0.98	0.76	0.73	84	0.82	0.65	1.05	95	4.8
	Newham	**248,300**		**2.08**	**2.33**	**2.32**	**1.70**	**1.91**	**145**	**2.06**	**1.79**	**2.38**	**152**	**60.6**
	Redbridge	**251,800**		**1.37**	**0.95**	**1.10**	**1.44**	**1.69**	**163**	**1.31**	**1.12**	**1.53**	**123**	**36.5**
	Tower Hamlets	**212,500**		**1.26**	**1.56**	**1.50**	**1.82**	**2.00**	**151**	**1.64**	**1.37**	**1.95**	**120**	**48.6**
	Waltham Forest	**222,100**				**1.72**	**2.60**	**1.38**	**122**	**1.90**	**1.58**	**2.29**	**168**	**35.5**
	Brent Teaching	**271,400**				**1.69**	**2.06**	**2.06**	**192**	**1.94**	**1.65**	**2.28**	**181**	**54.7**
	Ealing	**306,400**	**1.88**	**2.17**	**1.82**	**1.90**	**2.02**	**1.60**	**147**	**1.89**	**1.69**	**2.12**	**168**	**41.3**
	Hammersmith and Fulham	**171,400**	**2.05**	**1.79**	**1.26**	**1.13**	**1.54**	**0.67**	**58**	**1.39**	**1.16**	**1.66**	**117**	**22.2**
	Harrow	**214,600**				**1.44**	**0.68**	**1.83**	**186**	**1.32**	**1.07**	**1.63**	**135**	**41.2**
	Hillingdon	**250,100**		**1.40**	**1.10**	**1.56**	**1.10**	**1.55**	**152**	**1.34**	**1.15**	**1.57**	**129**	**20.9**
	Hounslow	**218,600**		**2.24**	**1.52**	**1.94**	**1.61**	**1.31**	**119**	**1.72**	**1.47**	**2.00**	**152**	**35.1**
	Kensington and Chelsea	178,000				0.80	0.63	1.10	107	0.84	0.63	1.13	82	21.4
	Westminster	231,700				1.49	0.79	1.40	129	1.22	0.98	1.53	114	26.8
	Bexley	221,600	1.06	0.83	0.95	1.06	1.12	1.17	126	1.04	0.88	1.22	108	8.6
	Bromley	299,400	0.94	1.00	1.04	0.86	0.69	1.24	137	0.96	0.83	1.11	102	8.4
	Greenwich Teaching	**222,600**	**1.37**	**0.55**	**2.13**	**0.98**	**1.54**	**1.69**	**153**	**1.38**	**1.19**	**1.62**	**121**	**22.9**
	Lambeth	**272,200**	**1.28**	**1.46**	**1.78**	**1.48**	**1.98**	**1.62**	**132**	**1.61**	**1.40**	**1.84**	**126**	**37.6**
	Lewisham	**255,600**	**1.01**	**1.89**	**1.77**	**1.72**	**1.96**	**1.65**	**141**	**1.67**	**1.46**	**1.91**	**138**	**34.1**
	Southwark	**269,000**	**1.56**	**1.19**	**1.81**	**1.46**	**2.32**	**2.18**	**182**	**1.77**	**1.55**	**2.01**	**142**	**37.0**
	Croydon	**337,000**	**1.28**	**1.25**	**1.72**	**1.02**	**1.73**	**1.58**	**154**	**1.43**	**1.27**	**1.62**	**135**	**29.8**
	Kingston	156,000					0.87	1.21	115	1.04	0.73	1.48	99	15.5
	Richmond and Twickenham	179,500					0.78	0.79	78	0.79	0.54	1.14	78	9.0
	Sutton and Merton	382,000					1.37	1.46	141	1.41	1.17	1.71	137	18.1
	Wandsworth	279,200					1.87	1.31	111	1.59	1.27	1.99	134	22.0
South East	*Isle of Wight*	*138,200*	*0.61*	*0.66*	*0.40*	*0.48*	*0.16*	*0.27*	*36*	*0.42*	*0.32*	*0.57*	*54*	*1.3*
	Hampshire	*1,265,900*	*0.73*	*0.64*	*0.67*	*0.84*	*0.80*	*0.81*	*92*	*0.75*	*0.69*	*0.81*	*83*	*2.2*
	Portsmouth City Teaching	*196,300*	*0.92*	*0.58*	*0.60*	*0.77*	*0.94*	*0.88*	*87*	*0.78*	*0.63*	*0.97*	*74*	*5.3*
	Southampton City	229,100	0.85	0.60	0.76	0.76	0.86	1.18	113	0.84	0.70	1.02	78	7.6
	West Kent	662,600					1.07	1.02	113	1.05	0.89	1.23	116	3.9
	Medway	251,900					1.42	0.71	71	1.07	0.82	1.39	107	5.4
	Eastern and Coastal Kent	720,400					1.31	1.17	136	1.24	1.08	1.42	145	2.4
	Hastings and Rother	176,200		1.05	0.72	1.02	0.56	0.79	102	0.83	0.67	1.01	106	2.4
	Brighton and Hove City	251,500		0.95	0.89	0.85	0.86	1.13	115	0.94	0.78	1.12	93	5.7
	East Sussex Downs and Weald	*330,200*		*1.21*	*0.65*	*0.96*	*0.84*	*0.66*	*85*	*0.86*	*0.74*	*0.99*	*109*	*2.3*

Table 3.2. Continued

UK area	PCT/LA	Tot pop	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2008 pmp[b]	2003–2008[a] O/E	2003–2008[a] LCL[c]	2003–2008[a] UCL[d]	2003–2008[a] pmp	% non-White
South East	*Surrey*	*1,073,400*		*0.79*	*0.60*	*0.79*	*0.82*	*0.97*	*108*	*0.79*	*0.72*	*0.87*	*86*	*4.9*
	West Sussex	*770,600*		*0.59*	*0.82*	*0.87*	*0.84*	*0.89*	*109*	*0.81*	*0.73*	*0.89*	*97*	*3.4*
	Milton Keynes	230,100	1.25	0.99	0.79	0.74	1.21	0.98	91	0.99	0.83	1.18	88	9.1
	Berkshire East	**382,200**	**0.91**	**0.95**	**1.22**	**1.18**	**1.30**	**1.26**	**123**	**1.14**	**1.01**	**1.30**	**108**	**16.0**
	Berkshire West	445,400	1.04	0.97	1.07	0.92	0.96	1.14	115	1.02	0.90	1.15	98	7.3
	Oxfordshire	*607,400*	*1.10*	*0.77*	*0.88*	*0.79*	*0.71*	*0.68*	*71*	*0.82*	*0.73*	*0.91*	*82*	*5.0*
	Buckinghamshire	*500,700*	*0.82*	*0.79*	*0.63*	*0.70*	*0.81*	*0.81*	*88*	*0.76*	*0.67*	*0.86*	*80*	*7.7*
South West	Bath and North East Somerset	175,600	0.67	1.28	1.05	0.85	1.01	0.71	80	0.93	0.77	1.12	101	2.8
	Bristol	**410,700**	**1.33**	**1.25**	**1.20**	**1.37**	**0.98**	**1.55**	**151**	**1.28**	**1.14**	**1.43**	**120**	**8.2**
	Gloucestershire	*578,500*	*0.85*	*0.91*	*0.85*	*1.02*	*0.88*	*0.62*	*73*	*0.86*	*0.77*	*0.95*	*97*	*2.9*
	Swindon	192,600	1.00	1.23	0.73	0.74	0.55	1.16	119	0.90	0.74	1.09	89	4.8
	South Gloucestershire	254,200	1.03	0.91	1.12	0.98	0.86	0.97	106	0.98	0.84	1.14	104	2.4
	Wiltshire	*448,600*	*0.60*	*0.51*	*0.81*	*0.71*	*0.64*	*0.86*	*98*	*0.69*	*0.60*	*0.79*	*77*	*1.6*
	Bournemouth and Poole	*297,900*		*0.67*	*0.63*	*0.65*	*0.61*	*0.83*	*101*	*0.68*	*0.57*	*0.81*	*81*	*2.6*
	Dorset	*403,100*		*0.71*	*0.63*	*0.53*	*0.70*	*0.87*	*119*	*0.69*	*0.60*	*0.79*	*93*	*1.2*
	North Somerset	201,200	1.35	1.16	1.13	0.91	0.77	1.22	149	1.08	0.93	1.27	128	1.4
	Somerset	*518,800*	*0.83*	*0.87*	*0.63*	*0.76*	*0.68*	*0.78*	*96*	*0.76*	*0.67*	*0.85*	*91*	*1.2*
	Devon	740,600	0.86	1.04	1.04	0.92	1.07	1.12	143	1.01	0.93	1.10	124	1.1
	Plymouth Teaching	**247,900**	**1.46**	**1.13**	**1.06**	**1.82**	**1.73**	**0.98**	**105**	**1.37**	**1.20**	**1.57**	**141**	**1.6**
	Torbay	133,000	1.09	1.33	1.01	0.73	0.92	1.61	211	1.11	0.92	1.34	140	1.2
	Cornwall and Isles of Scilly	526,200	1.21	1.35	0.68	1.04	0.92	0.91	116	1.01	0.92	1.12	124	1.0
Wales	**Cardiff**	**317,500**	**1.61**	**1.40**	**1.34**	**1.41**	**1.61**	**1.23**	**120**	**1.43**	**1.27**	**1.62**	**134**	**8.4**
	Merthyr Tydfil	**55,800**	**1.78**	**2.48**	**1.83**	**2.68**	**1.92**	**0.48**	**54**	**1.86**	**1.46**	**2.36**	**200**	**1.0**
	Rhondda, Cynon, Taff	**234,100**	**1.11**	**1.58**	**1.36**	**1.33**	**1.50**	**1.28**	**141**	**1.36**	**1.19**	**1.56**	**145**	**1.2**
	Vale of Glamorgan	123,200	0.87	1.26	0.81	1.26	0.92	0.79	89	0.99	0.79	1.23	108	2.2
	Carmarthenshire	**177,800**	**1.40**	**1.19**	**1.08**	**1.02**	**1.30**	**1.18**	**146**	**1.19**	**1.02**	**1.40**	**143**	**0.9**
	Ceredigion	77,100	0.59	0.93	0.77	0.52	1.05	1.16	143	0.84	0.63	1.12	99	1.4
	Pembrokeshire	116,800	1.28	0.75	1.05	0.93	0.95	1.02	128	1.00	0.80	1.23	121	0.9
	Powys	130,900	0.32	0.96	1.21	0.74	1.10	0.99	130	0.90	0.73	1.10	113	0.9
	Blaenau Gwent	69,500	0.14	1.11	1.18	0.99	1.00	0.38	43	0.80	0.58	1.11	89	0.8
	Caerphilly	**171,300**	**1.07**	**1.06**	**1.61**	**1.37**	**1.92**	**1.34**	**146**	**1.40**	**1.20**	**1.65**	**148**	**0.9**
	Monmouthshire	87,800	0.72	1.01	1.14	0.90	0.64	1.20	148	0.94	0.73	1.21	112	1.1
	Newport	140,500	1.38	0.94	0.89	1.10	1.38	0.99	107	1.11	0.91	1.36	116	4.8
	Torfaen	91,000	1.17	0.95	0.89	0.94	1.34	0.48	55	0.96	0.74	1.24	106	0.9
	Bridgend	**132,600**	**1.69**	**1.31**	**1.10**	**1.49**	**1.65**	**0.73**	**83**	**1.33**	**1.11**	**1.59**	**146**	**1.4**
	Neath Port Talbot	**137,100**	**1.64**	**1.30**	**0.90**	**1.33**	**1.60**	**1.49**	**175**	**1.38**	**1.16**	**1.63**	**157**	**1.1**
	Swansea	**227,000**	**1.76**	**1.25**	**1.02**	**1.34**	**1.29**	**1.29**	**150**	**1.32**	**1.15**	**1.52**	**148**	**2.2**
	Conwy	111,300	0.52	1.17	0.76	1.05	1.14	0.87	117	0.92	0.74	1.15	120	1.0
	Denbighshire	95,900	0.37	1.10	1.90	0.57	0.67	0.75	94	0.89	0.70	1.15	108	1.2
	Flintshire	150,000	1.25	1.05	1.35	1.05	1.12	0.59	67	1.06	0.88	1.29	116	0.8
	Gwynedd	**118,200**	**1.47**	**1.23**	**1.51**	**1.78**	**1.53**	**1.19**	**144**	**1.45**	**1.22**	**1.74**	**171**	**1.2**
	Isle of Anglesey	**68,800**	**1.42**	**1.15**	**1.56**	**1.25**	**1.74**	**2.09**	**262**	**1.54**	**1.23**	**1.93**	**187**	**0.7**
	Wrexham	131,000	1.21	0.83	1.13	0.87	0.82	0.89	99	0.95	0.77	1.19	103	1.1
Scotland	Aberdeen City	207,000	1.08	1.72	1.11	0.79	0.71	0.93	101	1.04	0.88	1.24	110	2.9
	Aberdeenshire	236,300	0.71	0.92	1.02	0.74	1.20	0.87	97	0.91	0.77	1.08	99	0.7
	Angus	109,500	0.99	1.32	1.24	0.95	1.04	1.20	146	1.12	0.91	1.38	132	0.8
	Argyll & Bute	91,200	1.44	0.96	0.81	0.76	0.95	0.61	77	0.91	0.71	1.17	111	0.8
	Scottish Borders	110,300	0.73	1.36	0.68	0.86	1.16	1.10	136	0.98	0.78	1.22	118	0.6

Table 3.2. Continued

UK area	PCT/LA	Tot pop	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2008 pmp[b]	2003–2008[a] O/E	2003–2008[a] LCL[c]	2003–2008[a] UCL[d]	2003–2008[a] pmp	% non-White
Scotland	Clackmannanshire	48,800	1.44	1.03	1.36	0.73	1.48	1.31	143	1.22	0.89	1.68	130	0.8
	West Dunbartonshire	91,100	0.67	1.45	0.42	1.48	0.90	1.11	121	1.01	0.78	1.30	106	0.7
	Dumfries & Galloway	148,000	1.38	1.03	1.18	1.01	0.83	1.09	142	1.08	0.91	1.29	136	0.7
	Dundee City	**142,100**	**1.91**	**1.36**	**2.12**	**1.52**	**1.67**	**1.43**	**162**	**1.67**	**1.42**	**1.95**	**183**	**3.7**
	East Ayrshire	119,300	1.22	0.73	1.22	1.66	0.88	0.88	101	1.10	0.89	1.36	122	0.7
	East Dunbartonshire	105,700	1.34	0.72	0.67	1.19	0.65	0.41	47	0.82	0.64	1.06	93	3.1
	East Lothian	92,600	0.31	0.82	0.87	0.82	1.48	0.74	86	0.85	0.65	1.11	95	0.7
	East Renfrewshire	89,000	0.99	0.88	1.24	0.97	1.09	0.70	79	0.98	0.75	1.27	107	3.8
	Edinburgh, City of	463,300	1.06	1.12	1.00	1.02	0.71	1.09	112	1.00	0.89	1.12	99	4.1
	Falkirk	149,500	0.67	0.67	1.26	1.02	1.46	0.79	87	0.99	0.81	1.21	105	1.0
	Fife	359,200	0.93	1.01	1.46	1.04	0.98	0.99	111	1.07	0.94	1.21	116	1.3
	Glasgow City	**580,600**	**1.79**	**1.50**	**1.35**	**1.18**	**1.11**	**1.03**	**103**	**1.32**	**1.20**	**1.44**	**128**	**5.5**
	Highland	**215,400**	**1.37**	**1.24**	**1.77**	**0.91**	**0.88**	**0.85**	**102**	**1.16**	**1.00**	**1.35**	**135**	**0.8**
	Inverclyde	81,300	1.19	1.07	1.01	0.85	1.07	1.19	135	1.06	0.82	1.37	117	0.9
	Midlothian	**79,000**	**1.77**	**2.14**	**1.30**	**1.57**	**0.91**	**1.03**	**114**	**1.44**	**1.14**	**1.81**	**154**	**0.9**
	Moray	86,700	1.30	0.97	1.32	1.24	0.58	0.98	115	1.06	0.83	1.36	121	0.9
	North Ayrshire	135,300	1.20	1.13	1.33	1.57	0.70	1.03	118	1.16	0.96	1.40	129	0.7
	North Lanarkshire	323,700	1.26	0.98	0.80	0.93	1.03	0.91	96	0.98	0.85	1.13	99	1.3
	Orkney Islands	20,000	1.83	0.46	1.29	0.81	0.41	1.24	150	1.00	0.59	1.69	117	0.4
	Perth & Kinross	140,200	1.28	1.27	0.90	0.68	1.04	0.93	114	1.01	0.83	1.22	120	1.0
	Renfrewshire	169,300	1.23	1.23	1.27	0.94	0.95	0.96	106	1.09	0.91	1.30	117	1.2
	Shetland Islands	22,000	0.45	1.34	0.42	0.00	1.60	0.00	0	0.63	0.33	1.20	68	1.1
	South Ayrshire	111,900	1.25	0.86	1.03	0.76	0.99	0.71	89	0.93	0.74	1.16	113	0.7
	South Lanarkshire	307,700	0.91	0.94	0.88	0.98	0.88	0.68	75	0.88	0.76	1.02	94	1.1
	Stirling	*87,600*	*0.69*	*0.69*	*0.43*	*1.02*	*1.04*	*0.52*	*57*	*0.74*	*0.54*	*1.00*	*78*	*1.5*
	West Lothian	165,700	0.53	0.60	1.13	1.07	0.84	0.85	84	0.84	0.68	1.05	81	1.3
	Eilean Siar	25,900	1.01	1.34	0.00	0.89	1.81	0.30	39	0.89	0.55	1.43	109	0.6
N Ireland	**Antrim**	**51,500**			**2.39**	**1.65**	**1.25**	**1.67**	**155**	**1.73**	**1.23**	**2.43**	**160**	**0.5**
	Ards	76,000			1.02	0.84	0.97	0.49	53	0.83	0.57	1.21	89	0.9
	Armagh	56,400			1.91	0.72	0.18	1.10	106	0.97	0.63	1.48	93	0.5
	Ballymena	61,400			1.27	1.05	1.38	1.07	114	1.19	0.84	1.70	126	1.3
	Ballymoney	29,300			1.45	0.68	1.73	1.04	102	1.22	0.72	2.06	119	0.6
	Banbridge	45,400			0.96	1.36	0.69	1.38	132	1.10	0.70	1.72	105	0.4
	Belfast	**267,600**			**1.24**	**1.40**	**1.39**	**1.05**	**105**	**1.27**	**1.07**	**1.50**	**126**	**0.4**
	Carrickfergus	**39,800**			**2.53**	**2.39**	**3.15**	**1.22**	**126**	**2.32**	**1.69**	**3.19**	**239**	**0.3**
	Castlereagh	65,600			2.25	1.33	0.81	0.41	46	1.19	0.86	1.66	133	0.4
	Coleraine	**56,900**			**2.90**	**0.97**	**1.48**	**0.99**	**105**	**1.57**	**1.14**	**2.16**	**167**	**0.3**
	Cookstown	34,600			2.67	0.95	1.27	0.64	58	1.37	0.85	2.20	123	1.3
	Craigavon	86,800			1.62	0.35	0.95	0.96	92	0.96	0.68	1.36	92	0.6
	Derry	107,800			1.01	1.38	0.75	0.64	56	0.95	0.68	1.32	81	0.8
	Down	68,400			1.71	1.91	0.75	0.90	88	1.31	0.94	1.83	128	0.7
	Dungannon	52,700			1.27	0.40	0.61	1.02	95	0.82	0.50	1.33	76	0.7
	Fermanagh	60,600			1.01	1.43	0.97	0.32	33	0.94	0.62	1.41	95	0.8
	Larne	31,400			0.89	1.12	0.86	1.72	191	1.15	0.70	1.88	127	0.4
	Limavady	33,900			1.73	1.31	1.32	0.00	0	1.08	0.63	1.87	96	0.6
	Lisburn	113,300			1.54	0.73	0.83	1.20	115	1.07	0.80	1.43	102	0.7
	Magherafelt	42,900			0.78	0.99	0.25	1.76	163	0.95	0.57	1.57	87	0.7
	Moyle	17,000			0.00	1.63	0.55	0.55	59	0.69	0.29	1.67	74	0.3

Table 3.2. Continued

UK area	PCT/LA	Tot pop	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2008 pmp[b]	2003–2008[a] O/E	LCL[c]	UCL[d]	pmp	% non-White
N Ireland	Newry & Mourne	93,600			0.85	0.69	0.58	0.82	75	0.73	0.49	1.08	67	0.4
	Newtownabbey	81,400			1.09	1.14	1.28	1.05	111	1.14	0.83	1.56	120	0.3
	North Down	79,000			1.29	0.88	1.01	0.90	101	1.02	0.73	1.41	114	1.0
	Omagh	51,200			0.66	1.25	0.85	1.70	156	1.12	0.73	1.72	103	0.4
	Strabane	39,200			0.55	0.78	1.58	1.58	153	1.13	0.70	1.81	108	0.8

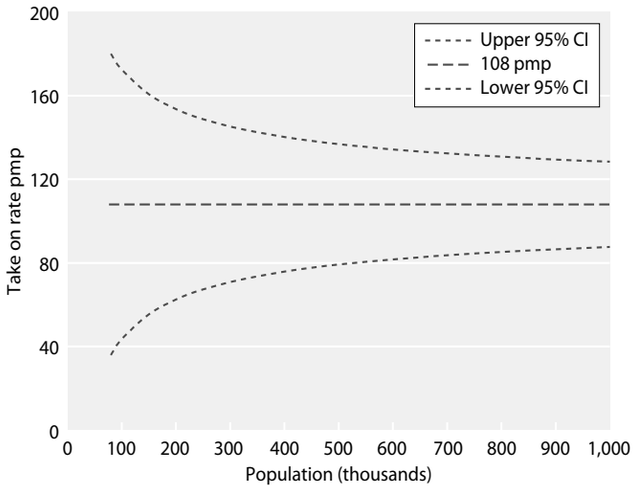

Fig. 3.2. 95% confidence limits for take on rate of 108 pmp for population size 80,000–1 million

2 Demographics and clinical characteristics of patients accepted onto RRT

Methods

Age, gender, primary renal disease, ethnic origin and first modality at start of RRT were examined in those patients starting RRT. Some centres electronically upload ethnicity coding to their renal information technology (IT) system from the hospital Patient Administration Systems (PAS). Ethnicity coding in these PAS systems is based on self-reported ethnicity and uses a different coding system [3]. For the remaining centres, ethnicity coding is performed by clinical staff and recorded directly into the renal IT system (using a variety of coding systems). For all these analyses, data on ethnic origin were grouped into Whites, South Asians, Blacks, Chinese and Others. The details of regrouping of the PAS codes into the above ethnic categories are provided in appendix G: Ethnicity and ERA-EDTA coding. Chi-squared, Fisher's exact, ANOVA and Kruskal Wallis tests were used as appropriate to test for significant differences between groups.

For the first time this year, rather than allocating all pre-emptive transplants to the transplanting centre, if an individual had a modality code 36 (transfer out pre-emptive transplant) from another centre up to 7 days before the transplant then

Table 3.3. Number of PCT/LAs with low, normal and high standardised acceptance ratios (2003–2008)

	Standardised acceptance ratio			
Region	Low	Normal	High	Total
NE England	4	8	0	12
NW England	13	5	0	18
Yorkshire & Humber	4	9	1	14
East Midlands	4	4	1	9
West Midlands	1	6	7	14
East of England	5	6	2	13
London	0	7	20	27
SE England	8	5	1	14
SW England	5	7	2	14
England	**44**	**57**	**34**	**135**
Wales	**0**	**12**	**10**	**22**
Scotland	**1**	**27**	**4**	**32**
N Ireland	**0**	**22**	**4**	**26**
Total	**45**	**118**	**52**	**215**

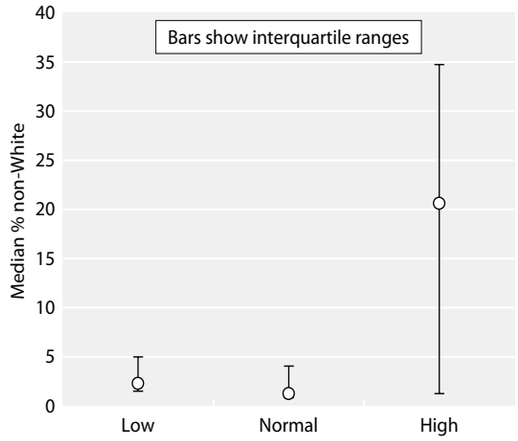

Fig. 3.3. Percentage non-Whites in PCT/LA areas with low, normal and high age-gender standardised ratios (2003–2008)

Table 3.4. Number of new patients accepted by individual renal centres reporting to the UK Renal Registry 2003–2008

Country	Centre	Year						% change since 2003
		2003	2004	2005	2006	2007	2008	
England	B Heart	103	102	116	115	101	108	4.9
	B QEH		194	196	186	222	271	
	Basldn	53	46	28	45	39	40	−24.5
	Bradfd	74	62	66	50	87	59	−20.3
	Brightn		118	110	130	117	116	
	Bristol	163	163	175	176	154	181	11.0
	Camb	94	107	110	156	125	102	8.5
	Carlis	31	29	32	27	26	31	0.0
	Carsh	199	168	178	185	195	212	6.5
	Chelms		49	37	48	51	33	
	Colche	n/a	n/a	n/a	n/a	n/a	47	
	Covnt	75	76	83	102	110	113	50.7
	Derby	60	67	71	70	61	92	53.3
	Donc	n/a	n/a	n/a	n/a	18	25	
	Dorset	66	60	47	53	59	84	27.3
	Dudley	41	54	38	44	39	49	19.5
	Exeter	97	109	111	105	125	134	38.1
	Glouc	53	54	60	73	58	45	−15.1
	Hull	80	108	126	100	99	117	46.3
	Ipswi	37	45	58	42	39	38	2.7
	Kent					172	132	
	L Barts		185	185	187	210	201	
	L Guys	93	100	128	132	162	169	81.7
	L Kings	108	114	136	113	126	151	39.8
	L Rfree			131	210	184	160	
	L St.G					89	89	
	L West	268	290	309	316	276	317	18.3
	Leeds*	185	178	161	172	125	155	−16.2*
	Leic	167	162	226	242	244	215	28.7
	Liv Ain	n/a	n/a	29	34	35	42	
	Liv RI**	114	130	139	139	114	103	−9.6
	M Hope	143	111	112	130	107	112	−21.7
	M RI					155	136	
	Middlbr	103	101	84	109	99	93	−9.7
	Newc	109	114	101	85	107	101	−7.3
	Norwch		94	118	106	106	92	
	Nottm	115	107	145	137	128	117	1.7
	Oxford	186	170	155	157	145	146	−21.5
	Plymth	64	62	58	91	76	70	9.4
	Ports	140	117	151	174	157	169	20.7
	Prestn	97	79	118	121	129	112	15.5
	Redng	65	60	79	75	93	99	52.3
	Sheff	159	167	157	168	166	180	13.2
	Shrew		55	42	54	55	62	
	Stevng	123	83	92	121	88	101	−17.9
	Sthend	42	39	34	47	35	35	−16.7
	Stoke					87	84	
	Sund	55	50	59	56	62	44	−20.0
	Truro	53	67	32	50	46	39	−26.4
	Wirral	52	66	59	53	53	41	−21.2
	Wolve	88	105	92	87	67	87	−1.1
	York	57	48	43	48	35	33	−42.1
N Ireland	Antrim			42	33	36	41	
	Belfast			130	112	89	68	

Table 3.4. Continued

Country	Centre	Year						% change since 2003
		2003	2004	2005	2006	2007	2008	
N Ireland	Derry				3	7	6	
	Newry			28	13	15	20	
	Tyrone			23	30	22	25	
	Ulster			9	8	15	13	
Scotland	Abrdn	52	69	63	53	56	55	5.8
	Airdrie	51	51	39	56	50	39	−23.5
	D&Gall	22	16	21	21	17	19	−13.6
	Dundee	64	62	76	52	61	65	1.6
	Dunfn	27	29	44	37	37	30	11.1
	Edinb	90	98	99	106	95	103	14.4
	Glasgw	221	189	201	187	189	162	−26.7
	Inverns	34	33	44	26	27	25	−26.5
	Klmarnk	40	29	44	57	36	34	−15.0
Wales	Bangor	33	36	40	42	36	42	27.3
	Cardff	161	185	181	205	220	153	−5.0
	Clwyd	11	14	27	18	23	13	18.2
	Swanse	134	95	98	115	128	120	−10.4
	Wrexm	32	29	41	27	27	22	−31.3
England		**3,812**	**4,465**	**4,817**	**5,122**	**5,458**	**5,585**	
N Ireland				**232**	**199**	**184**	**173**	
Scotland		**601**	**576**	**631**	**595**	**568**	**532**	
Wales		**371**	**359**	**387**	**406**	**434**	**349**	
UK		**4,784**	**5,400**	**6,067**	**6,322**	**6,644**	**6,639**	
Including only centres reporting continuously 2003–2008								
England		**3,812**	**3,770**	**3,969**	**4,167**	**3,957**	**4,087**	**7.2**
Scotland		**601**	**576**	**631**	**595**	**568**	**532**	**−11.5**
Wales		**371**	**359**	**387**	**406**	**434**	**349**	**−5.9**
UK		**4,784**	**4,705**	**4,987**	**5,168**	**4,959**	**4,968**	**3.8**

Blank cells – no data returned to the registry for that year
n/a – renal centre not yet operational
* Doncaster split from Leeds centre and accounts for an apparent fall
** Aintree split from Liverpool Royal

they were allocated to the 'transfer out'/'work up' centre rather than the transplanting centre. This affected 56 patients in 2008 and 101 of all take-on patients included in this year's analyses. Not all centres sent this level of data. Some patients remain incorrectly allocated to the transplanting centre.

Estimated glomerular filtration rate (eGFR) at the start of RRT was studied amongst patients with eGFR data within 14 days before the start of RRT. The eGFR was calculated using the abbreviated 4 variable MDRD study equation [4]. For the purpose of the eGFR calculation, patients who had missing ethnicity but a valid serum creatinine measurement were classed as Whites. The eGFR values were log transformed in order to normalise the data. Patients with an eGFR >20 ml/min/1.73 m^2 were excluded from the eGFR analyses due to concerns about possible data extraction errors.

Derry was excluded from the centre-specific analyses as they started less than 10 patients on RRT in 2008.

Results

Age

Acceptance rates within the UK have levelled off in the last three years but were still rising in those aged 65 and over until 2006. It now looks like even in these patients acceptance rates have plateaued and are even falling slightly (figure 3.4).

In 2008, the median age of patients starting renal replacement therapy was 64.1 years (table 3.5). Patients starting in England were the youngest of the four countries of the United Kingdom and this reflects the higher percentage of ethnic minorities who make up the population in England. In Northern Ireland the

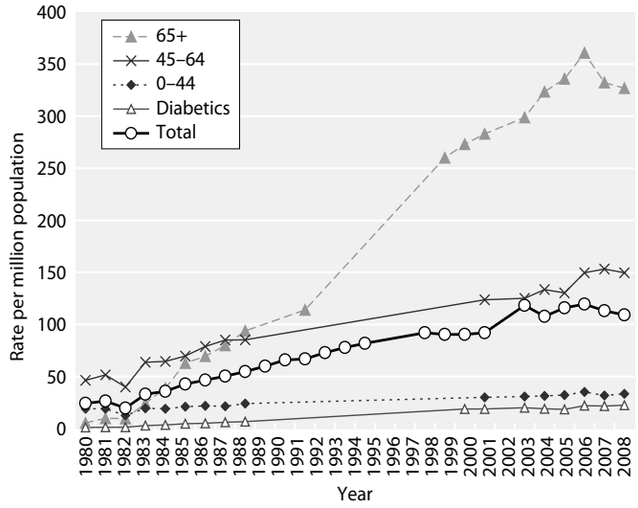

Fig. 3.4. Change in rate of UK incident RRT patients between 1980 and 2008

Table 3.6. Acceptance rate pmp by age band and country in 2008

	Pmp			
Age	England	Wales	Scotland	N Ireland
20–24	29	51	27	39
25–29	46	68	35	27
30–34	55	53	50	43
35–39	61	54	62	62
40–44	80	125	72	46
45–49	106	86	69	68
50–54	142	113	122	79
55–59	153	154	116	92
60–64	229	248	204	276
65–69	292	348	238	284
70–74	356	382	387	488
75–79	408	498	458	411
80–84	352	260	371	548
85+	166	150	148	191

median age of incident patients was 66.9 years, slightly higher than in Scotland (66.0 years) and Wales (65.2 years) and higher than in England (63.8 years). The median age of incident UK non-White patients was considerably lower at 56.1 years. This reflects the younger age distribution of ethnic minority populations in general compared with the White population (5.1% of ethnic minorities were over 65 years old compared to 16.9% of Whites) [5] and the higher rates of diabetes in the South Asians and Blacks.

Acceptance rates of patients over the age of 80 were much higher in Northern Ireland, as also reported in the 2008 Registry Report. In Wales, however, rates in that age cohort, having previously in 2007 been approximately twice as high as in England and Scotland, have fallen and are now the lowest (table 3.6). In England, Scotland, and Wales the acceptance rate peaked in the 75–79 age band (at 408, 458 and 498 pmp respectively). In Northern Ireland the peak was in those aged 80–84 years (548 pmp). In Wales there were increases in the numbers of patients aged 20–24 starting RRT (51 pmp) compared with last year and with the other countries of the UK.

There were large differences between centres with respect to the median age of their incident patients (figure 3.5). In 8 centres, the median age was <60 years and in 9 it was over 70 years. Possible explanations include chance fluctuations due to low take-on rates, the difference in the age structure of the underlying general population, the transplant status of the centre, variations in ethnic mix, differences in local approaches to conservative management, and other potential differences in the prevalence, nature and management of renal disease. The median age of patients in transplant centres remained slightly but significantly lower than that in non-transplant centres (62.5 vs. 65.4 years: $p < 0.0001$). Five of the 8 centres whose incident cohort had a median age <60 years were transplanting centres. Four

Table 3.5. Median age of patients starting renal replacement therapy 2003–2008

	Year					
Country	2003	2004	2005	2006	2007	2008
England	64.5	64.9	65.1	64.7	63.7	63.8
N Ireland			68.1	68.2	68.1	66.9
Scotland	66.4	65.5	65.9	65.8	61.7	66.0
Wales	66.4	68.7	67.5	67.2	67.6	65.2
UK	**64.9**	**65.2**	**65.4**	**65.1**	**64.0**	**64.1**

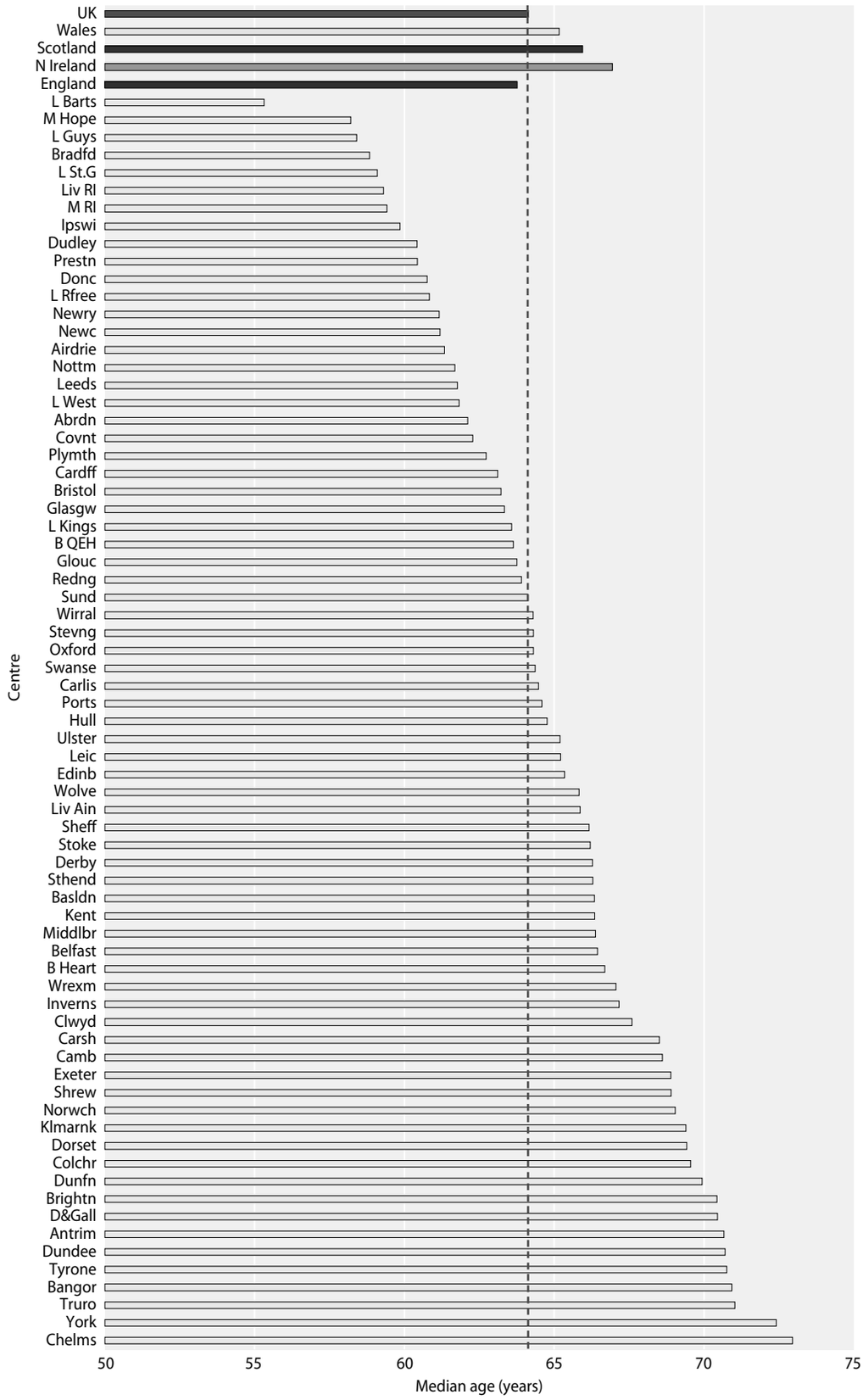

Fig. 3.5. Median age of new patients in each centre in 2008

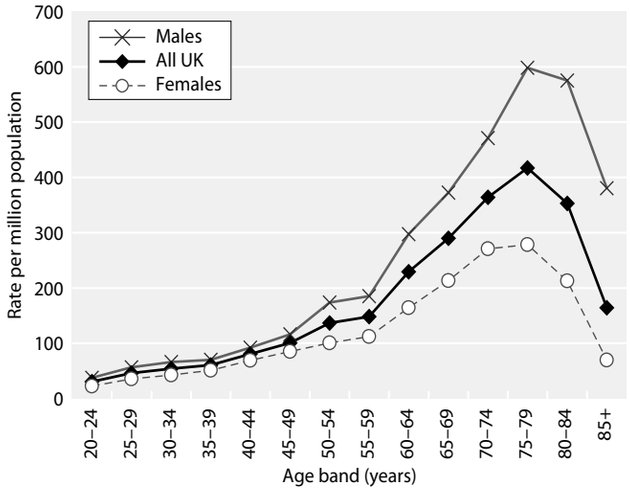

Fig. 3.6. Incident rates by age and gender in 2008

of the 9 centres whose incident cohort had a median age >70 years accepted less than 40 patients during 2008.

Gender

As in previous UKRR reports there was an excess of males starting RRT in all age groups but this was more prominent with older age (figure 3.6). Peak acceptance rate was in the 75–79 year age band in both males and females. The proportion of males remained fairly stable with age but was most prominent in those aged >85 years (figure 3.7).

In the UK as a whole, 61.4% of the 2008 incident cohort were male (figure 3.8). The proportion of incident male patients varied from 42–79% between centres. All except five centres had an excess of incident males, whilst two were equally split male and female. It should be noted that five of these seven centres had accepted less than 50 patients during 2008. Likewise the three centres with >75% males accepted less than 40 patients for RRT in 2008. Wales, as last year, had a higher proportion of males starting RRT (66.8%, male to female ratio of 2).

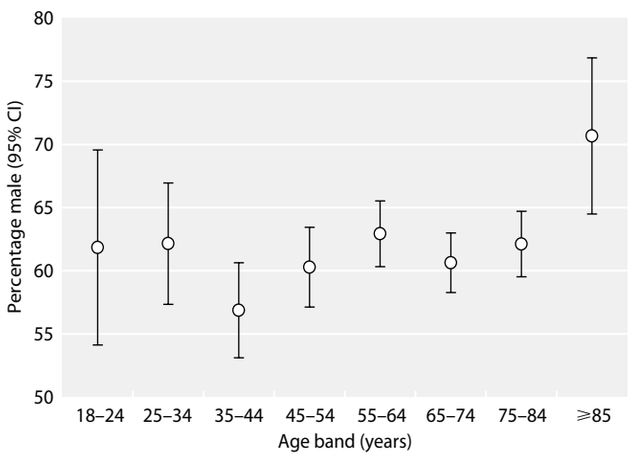

Fig. 3.7. Percentage of total starting RRT who are male, by age band in 2008

Ethnicity

This year 49 centres who accepted more than 10 patients onto RRT, returned ethnicity data that were 50% or more complete (table 3.7). Only 23 of these centres provided data that were 90% or more complete. From Welsh centres there has been an increase in data returns. Ethnicity is not a mandatory data item for the Scottish Renal Registry. The lack of ethnicity completeness means results should be interpreted with some caution. All of the English centres who were last year recorded as having 100% white patients, had some ethnic mix this year. There was great variation between centres with respect to the ethnic mix of incident patients ranging from 0% ethnic minorities in Sunderland, Carlisle, Ipswich, Wrexham and all Northern Ireland centres to over 50% in Bradford, London Barts and London Royal Free; all the latter centres cover areas with high standardised acceptance ratios.

Primary renal diagnosis

The distribution of incident patients by age, gender and primary renal disease (PRD) is shown in table 3.8 and the distribution of primary renal disease by centre is shown in table 3.9. Data for PRD were missing in 10.8% of patients and there remains a marked centre difference in completeness of data returns. Thirty-five centres provided data on all incident patients, whilst 11 centres had more than 25% data incompleteness for PRD, one of which returned no data. In the centres with >25% missing data, the percentages in the other diagnostic categories have not been calculated.

The Registry is concerned about some of the centres with apparently 100% data completeness for PRD but who also have very high rates of 'uncertain' diagnoses (EDTA codes 00 and 10). It is accepted that there will inevitably be a number of patients with uncertain aetiology, and that the proportion of these patients will vary between clinicians and centres as the definitions of renovascular disease, hypertensive nephropathy and chronic glomerulonephritis without tissue diagnosis remain relatively subjective. However, some centres with very high rates of uncertain diagnosis appear to have no patients with the more objective diagnoses such as polycystic kidney disease, reflux

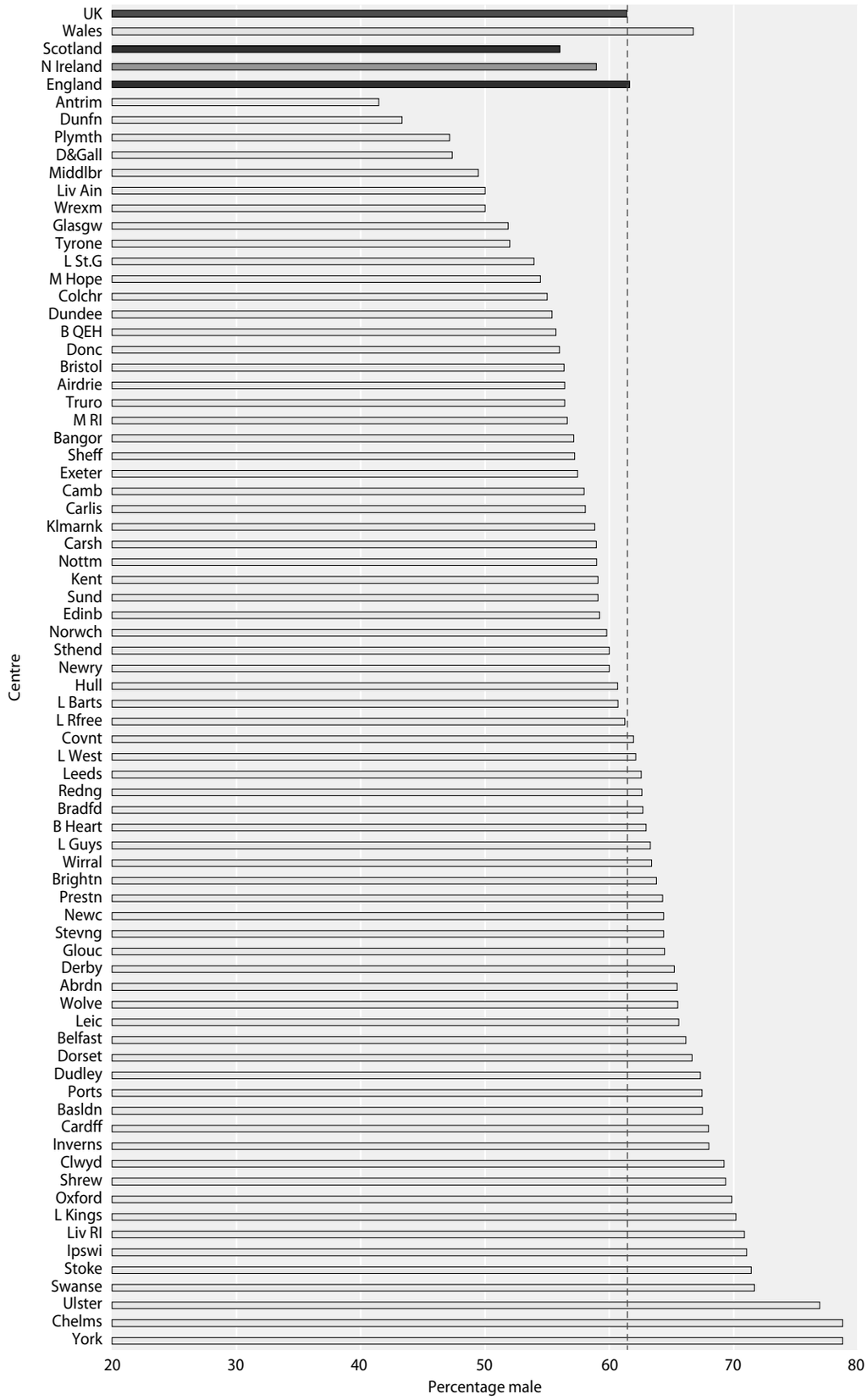

Fig. 3.8. Percentage of new patients who are male in renal centres reporting to UKRR in 2008

Table 3.7. Percentage of patients in different ethnic groups by centre

Country	Centre	% completion	Percentage				
			White	Black	South Asian	Chinese	Other
England	Dorset	100.0	97.6		2.4		
	Shrew	100.0	95.2		1.6	1.6	1.6
	Nottm	99.1	84.5	7.8	5.2		2.6
	M Hope	99.1	82.9	0.9	14.4		1.8
	B Heart	99.1	66.4	2.8	29.0	0.9	0.9
	Redng	99.0	72.4	6.1	21.4		
	Wolve	98.9	73.3	10.5	16.3		
	Newc	98.0	94.9	1.0	2.0	1.0	1.0
	Stevng	98.0	76.8	8.1	13.1	2.0	
	L Kings	98.0	64.2	27.0	8.8		
	B QEH	97.8	66.0	11.3	20.0	0.8	1.9
	Wirral	97.6	92.5	2.5			5.0
	Carlis	96.8	100.0				
	Leic	95.8	81.6	1.5	16.0	0.5	0.5
	L Rfree	93.1	49.0	20.8	14.8		15.4
	Basldn	92.5	91.9	5.4			2.7
	Donc	92.0	95.7	4.3			
	M RI	91.9	76.8	10.4	11.2	1.6	
	Bristol	91.7	84.9	6.0	4.2	4.2	0.6
	Camb	91.3	96.8		3.2		
	Derby	90.2	88.0	1.2	10.8		
	Bradfd	89.8	49.1	1.9	47.2		1.9
	Oxford	89.0	90.0	4.6	5.4		
	York	87.9	96.6	3.4			
	Prestn	87.5	84.7	1.0	14.3		
	Sund	84.1	100.0				
	Kent	84.1	99.1	0.9			
	Dudley	83.7	85.4	7.3	2.4	2.4	2.4
	Carsh	80.7	81.9	8.8	7.0	1.2	1.2
	L Barts	80.1	27.3	16.1	37.3	0.6	18.6
	Middlbr	77.4	95.8		2.8		1.4
	Ipswi	76.3	100.0				
	Leeds	76.1	79.7	2.5	16.9		0.8
	L St.G	75.3	70.1	11.9	9.0		9.0
	Chelms	72.7	87.5		8.3	4.2	
	Covnt	72.6	84.1	4.9	11.0		
	Ports	71.0	92.5	1.7	3.3	0.8	1.7
	L Guys	59.8	62.4	34.7	2.0		1.0
	Brightn	55.2	96.9	1.6	1.6		
	Norwch	54.3	98.0				2.0
	Sheff	51.1	91.3	2.2	5.4		1.1
N Ireland	Newry	85.0	100.0				
	Ulster	84.6	100.0				
	Tyrone	84.0	100.0				
	Antrim	70.7	100.0				
	Belfast	70.6	100.0				
Wales	Wrexm	100.0	100.0				
	Swanse	95.8	96.5	0.9	2.6		
	Cardff	66.7	97.1		2.0	1.0	
England		**73.9**	**78.0**	**7.4**	**11.3**	**0.6**	**2.6**
N Ireland		**75.7**	**100.0**				
Scotland		**0.6**	**66.7**			**33.3**	
Wales		**69.6**	**97.1**	**0.4**	**2.1**	**0.4**	
UK		**67.8**	**79.7**	**6.8**	**10.5**	**0.6**	**2.4**

Centres with fewer than 10 patients or with less than 50% data completeness are not shown
The national and UK averages include all centres

Table 3.8. Percentage distribution of primary renal diagnosis by age and gender ratio, in the 2008 incident cohort

	Age <65		Age ⩾65		All patients		
Diagnosis	Including data not available	Excluding data not available	Including data not available	Excluding data not available	Including data not available	Excluding data not available	M:F
Uncertain aetiology*	14.2	*15.8*	23.1	*26.1*	18.5	*20.7*	1.6
Glomerulonephritis	13.6	*15.2*	7.1	*8.1*	10.5	*11.8*	2.2
Pyelonephritis	7.3	*8.2*	6.5	*7.4*	6.9	*7.8*	1.5
Diabetes	23.5	*26.2*	19.1	*21.5*	21.4	*24.0*	1.6
Renal vascular disease	1.8	*2.0*	10.8	*12.2*	6.1	*6.9*	1.9
Hypertension	4.8	*5.4*	5.9	*6.6*	5.3	*6.0*	2.2
Polycystic kidney	9.8	*10.9*	3.0	*3.4*	6.5	*7.3*	1.1
Other	14.7	*16.4*	13.1	*14.8*	13.9	*15.6*	1.4
Data not available	10.2	–	11.5	–	10.8	–	1.3

* includes presumed glomerulonephritis not biopsy proven
M:F = male:female ratio

Table 3.9. Percentage distribution of primary renal diagnosis by centre in the 2008 incident cohort

Country	Centre	Data not available	Uncertain aetiology*	Diabetes	Glomerulo-nephritis	Hyper-tension	Other	Polycystic kidney	Pyelo-nephritis	Renal vascular disease
England	B Heart	0.9	27.1	29.0	8.4	2.8	15.9	1.9	7.5	7.5
	B QEH	2.6	18.9	25.0	11.7	5.7	14.4	4.9	9.1	10.2
	Basldn	0.0	12.5	22.5	12.5	5.0	20.0	10.0	2.5	15.0
	Bradfd	1.7	25.9	20.7	13.8	8.6	12.1	6.9	10.3	1.7
	Brightn	7.8	27.1	15.9	13.1	2.8	15.0	9.4	10.3	6.5
	Bristol	18.8	17.7	27.2	15.7	5.4	12.9	8.2	8.8	4.1
	Camb	0.0	66.7							
	Carlis	3.2	13.3	10.0	16.7	0.0	23.3	13.3	10.0	13.3
	Carsh	0.0	28.8	22.6	6.1	5.2	24.1	3.3	7.1	2.8
	Chelms	0.0	24.2	27.3	3.0	6.1	24.2	6.1	3.0	6.1
	Colchr	100.0								
	Covnt	0.0	15.9	22.1	9.7	7.1	14.2	14.2	7.1	9.7
	Derby	1.1	20.9	25.3	11.0	0.0	15.4	7.7	9.9	9.9
	Donc	0.0	40.0	24.0	8.0	8.0	8.0	8.0	0.0	4.0
	Dorset	1.2	25.3	13.3	6.0	9.6	13.3	12.1	13.3	7.2
	Dudley	0.0	20.4	30.6	8.2	10.2	14.3	8.2	6.1	2.0
	Exeter	66.4								
	Glouc	8.9	24.4	12.2	14.6	2.4	22.0	12.2	4.9	7.3
	Hull	9.4	25.5	15.1	12.3	12.3	16.0	5.7	12.3	0.9
	Ipswi	0.0	44.7	10.5	15.8	0.0	7.9	21.1	0.0	0.0
	Kent	0.0	25.8	14.4	12.9	6.1	18.2	12.1	7.6	3.0
	L Barts	0.0	18.9	33.3	9.5	8.0	15.4	6.5	7.0	1.5
	L Guys	0.0	7.7	27.8	13.6	13.6	14.2	10.7	8.3	4.1
	L Kings	0.0	11.3	34.4	9.3	14.6	17.9	1.3	4.6	6.6
	L Rfree	80.0								
	L St.G	2.3	13.8	31.0	16.1	8.1	14.9	4.6	9.2	2.3
	L West	0.0	17.0	30.6	10.1	3.8	17.4	5.7	9.5	6.0
	Leeds	45.8								
	Leic	9.8	26.3	20.1	10.3	3.1	9.3	8.3	11.9	10.8
	Liv Ain	0.0	100.0							
	Liv RI	0.0	68.9							
	M Hope	0.0	99.1							
	M RI	51.5								
	Middlbr	0.0	29.0	24.7	12.9	2.2	17.2	3.2	7.5	3.2

Table 3.9. Continued

Country	Centre	Data not available	Uncertain aetiology*	Diabetes	Glomerulo-nephritis	Hyper-tension	Other	Polycystic kidney	Pyelo-nephritis	Renal vascular disease
	Newc	1.0	23.0	16.0	6.0	5.0	26.0	8.0	7.0	9.0
	Norwch	6.5	30.2	20.9	10.5	0.0	17.4	9.3	5.8	5.8
	Nottm	0.0	23.9	23.1	14.5	2.6	19.7	9.4	5.1	1.7
	Oxford	2.1	22.4	21.7	18.2	2.8	16.1	7.7	7.7	3.5
	Plymth	0.0	11.4	22.9	14.3	5.7	18.6	12.9	5.7	8.6
	Ports	1.8	15.1	22.9	11.5	6.6	21.1	7.2	6.0	9.6
	Prestn	8.0	13.6	26.2	15.5	9.7	16.5	9.7	4.9	3.9
	Redng	0.0	18.2	36.4	13.1	1.0	10.1	5.1	8.1	8.1
	Sheff	1.1	23.6	23.0	7.9	6.2	10.7	9.0	13.5	6.2
	Shrew	0.0	11.3	21.0	8.1	17.7	11.3	8.1	8.1	14.5
	Stevng	1.0	30.0	22.0	7.0	5.0	14.0	9.0	5.0	8.0
	Sthend	0.0	22.9	17.1	17.1	0.0	17.1	11.4	8.6	5.7
	Stoke	0.0	9.5	20.2	10.7	11.9	14.3	10.7	10.7	11.9
	Sund	0.0	9.1	34.1	6.8	22.7	11.4	2.3	6.8	6.8
	Truro	61.5								
	Wirral	39.0								
	Wolve	0.0	20.7	28.7	18.4	6.9	5.8	4.6	5.8	9.2
	York	27.3								
N Ireland	Antrim	0.0	41.5	31.7	4.9	0.0	9.8	7.3	2.4	2.4
	Belfast	0.0	23.5	17.7	14.7	2.9	14.7	7.4	7.4	11.8
	Newry	0.0	20.0	30.0	15.0	0.0	10.0	10.0	5.0	10.0
	Tyrone	0.0	8.0	8.0	8.0	12.0	32.0	20.0	4.0	8.0
	Ulster	0.0	38.5	15.4	0.0	7.7	30.8	7.7	0.0	0.0
Scotland	Abrdn	10.9	18.4	20.4	14.3	4.1	18.4	8.2	12.2	4.1
	Airdrie	0.0	12.8	30.8	15.4	2.6	15.4	5.1	5.1	12.8
	D&Gall	5.3	16.7	16.7	16.7	11.1	22.2	5.6	5.6	5.6
	Dundee	40.0								
	Dunfn	3.3	17.2	34.5	10.3	6.9	10.3	3.5	6.9	10.3
	Edinb	1.0	16.7	17.7	8.8	8.8	23.5	8.8	5.9	9.8
	Glasgw	5.6	27.5	21.6	11.8	2.6	13.1	3.9	10.5	9.2
	Inverns	32.0								
	Klmarnk	58.8								
Wales	Bangor	0.0	26.2	21.4	2.4	4.8	31.0	4.8	2.4	7.1
	Clwyd	0.0	69.2							
	Cardff	0.0	30.1	32.0	18.3	5.9	4.6	5.2	3.3	0.7
	Swanse	4.2	9.6	26.1	10.4	1.7	16.5	6.1	10.4	19.1
	Wrexm	0.0	4.6	22.7	13.6	4.6	18.2	13.6	4.6	18.2
England		**11.5**	**20.7**	**23.9**	**11.6**	**6.2**	**15.6**	**7.5**	**8.0**	**6.5**
N Ireland		**0.0**	**26.0**	**20.8**	**9.8**	**4.6**	**17.3**	**9.3**	**4.6**	**7.5**
Scotland		**13.5**	**18.9**	**23.0**	**12.8**	**5.9**	**16.3**	**5.7**	**7.8**	**9.6**
Wales		**1.5**	**20.9**	**27.8**	**13.3**	**4.2**	**13.0**	**6.0**	**5.7**	**9.1**
UK		**10.8**	**20.7**	**24.0**	**11.8**	**6.0**	**15.6**	**7.3**	**7.8**	**6.9**

* includes presumed glomerulonephritis not biopsy proven
The percentage in each category has been calculated after excluding those patients with a missing diagnosis
For those centres with >25% missing primary diagnoses, the percentages in the other diagnostic categories have not been calculated
For those centres with >45% uncertain aetiology, the percentages in the other diagnostic categories have not been calculated

nephropathy, diabetic nephropathy or biopsy-proven glomerulonephritis, which is clearly improbable. Preliminary enquiries have shown that software in these centres, by default, assigns patients whose data is missing the code for 'uncertain' (EDTA code 00). These centres have now taken steps to rectify this, so that only patients in whom the clinician is genuinely uncertain as to the PRD will be assigned the 'uncertain' PRD code.

Five centres with >45% 'uncertain' diagnoses have been excluded from further analyses, because it is likely

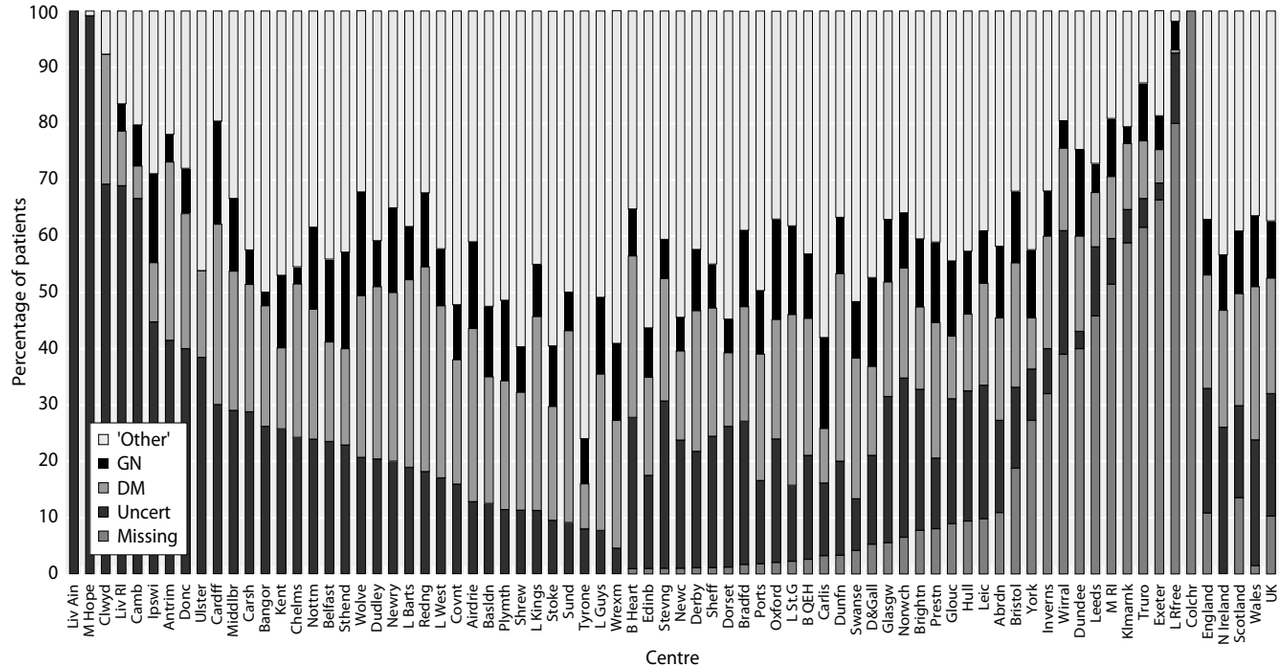

Fig. 3.9. Proportion of primary renal diagnoses by centre
'Other' = all other PRD categories, including: PKD, Pyelonephritis, HTN, RVD and Other

that the estimates of incidence of specific PRDs in these centres are falsely low. These centres have also been excluded from other analyses where PRD is included in the case-mix adjustment. This is more easily seen in figure 3.9. The centres on the right hand side of the graph have high rates of incomplete data returns and those with excessive or high uncertain diagnostic codes that have been excluded from table 3.9 are seen to the left. It is also more apparent that while many centres have a spectrum of diagnostic codes, their aggregate numbers are similar. This may reflect the subjectivity of softer diagnostic categories (renal vascular disease, hypertension, glomerulonephritis-no biopsy and CKD-uncertain).

Diabetic nephropathy was the most common specific renal diagnosis accounting for 24% of incident diagnoses (having excluded patients with missing data). This was the case irrespective of age, though the proportion was slightly higher in those aged <65 years. Biopsy proven glomerulonephritis (15.2% vs. 8.1%) and adult polycystic kidney disease (10.9% vs. 3.4%) were much more common in the younger incident cohort, whilst renal vascular disease was much more common in older incident patients (12.2% vs. 2.0%). It was perhaps not surprising that uncertainty about the underlying diagnosis was also more common in the older cohort (26.1% vs. 15.8%). The proportion of each major diagnosis has changed little in the last few years.

For all primary renal diagnoses except polycystic kidney disease, the male to female ratio was greater than 1.5. This gender difference may relate to factors such as hypertension, atheroma and renal vascular disease, which are more common in males and more common with increasing age. These factors may influence the rate of progression of renal failure. As would be expected from the mode of inheritance, adult polycystic kidney disease (PKD) is a major exception, the ratio approximating one in this condition.

Taking into account the excluded centres outlined above, there has been a further slight reduction in the UK as a whole with respect to uncertain aetiology (20.7%), although there is great variation between centres. Some of this variation is likely to reflect the lack of a clear definition of certain diagnostic categories e.g. hypertensive renal disease and renal vascular disease; some may result from differences between centres in attitudes to the degree of certainty required to record other diagnoses. In keeping with this, there are significant negative correlations between the frequency of uncertain diagnosis and all other diagnostic categories.

The proportion of incident patients whose primary renal disease was recorded as diabetes varied between

Table 3.10. Primary renal diagnosis incidence rates per million population (unadjusted) 2008

	England		Northern Ireland		Scotland		Wales		UK	
Diagnosis	Pmp	%	Pmp	%	Pmp	%	Pmp	%	Pmp	%
Uncertain aetiology*	20.3	18.3	25.4	26.0	16.8	16.4	24.3	20.5	20.3	18.5
Glomerulonephritis	11.4	10.3	9.6	9.8	11.4	11.1	15.5	13.1	11.5	10.5
Pyelonephritis	7.9	7.1	4.5	4.6	7.0	6.8	6.7	5.7	7.6	6.9
Diabetes	23.4	21.1	20.3	20.8	20.5	19.9	32.4	27.4	23.5	21.4
Polycystic kidney	7.3	6.6	9.0	9.2	5.0	4.9	7.0	6.0	7.2	6.5
Hypertension	6.0	5.5	4.5	4.6	5.2	5.1	4.9	4.2	5.9	5.3
Renal vascular disease	6.3	5.7	7.3	7.5	8.5	8.3	10.6	8.9	6.8	6.1
Other	15.3	13.8	16.9	17.3	14.5	14.1	15.1	12.8	15.3	13.9
Data not available	12.7	11.5	0.0	0.0	13.9	13.5	1.8	1.5	11.9	10.8
All	**111**	**100.0**	**97**	**100.0**	**103**	**100.0**	**118**	**100.0**	**110**	**100.0**

* includes presumed glomerulonephritis not biopsy proven

centres from 8% to 36%. Having excluded those centres with very high 'uncertain' PRD rates, no centres reported zero patients with diabetic nephropathy and only one centre reported a rate of <10%. These low rates may relate to chance fluctuations due to low take-on numbers and the ethnic mix of the incident population. Of the 12 centres reporting that 30% or more of their incident cohort had diabetes as the primary renal disease, 4 reported a high proportion of non-Whites in the incident population (27–72%) and a further 5 took on 56 patients or fewer in 2008. These factors undoubtedly contribute to the variation between centres with respect to the proportion of other primary renal disease in the incident cohort, as well as the variable diagnostic criteria in disease categories such as hypertension and renal vascular disease.

Table 3.10, showing the PRD incidence rates per million population in the 2008 cohort in the four home countries, reveals some national variations. There were no missing data for Northern Ireland and only 1.5% for Wales, whilst England and Scotland had 11.5% and 13.5% respectively. The incidence rate of uncertain diagnoses was higher in Northern Ireland (25.4 pmp) and Wales (24.3 pmp) than in Scotland (16.8 pmp) and England (20.3 pmp). The incidence of diabetes was much higher again in Wales (32.4 pmp) than in England (23.4 pmp), Northern Ireland (20.3 pmp) and Scotland (20.5 pmp). Likewise the incidence rate of renal vascular disease causing ERF was higher in Wales than other parts of the UK.

First established treatment modality

In the UK in 2008, haemodialysis (HD) was the first modality of RRT (defined as the first treatment recorded irrespective of any later change) in 75.8% of patients, peritoneal dialysis (PD) in 18.9% and pre-emptive transplant in 5.3%. The frequency of HD as the first treatment modality has remained relatively stable over the last few years, though it has increased considerably since the late 1990s (58% of incident patients in 1998). The frequency of PD usage however has fallen whilst pre-emptive transplantation has risen. This may be as a consequence of drives nationally to encourage live donation and pre-emptive transplantation and it is the 'fitter' patients approaching ERF who traditionally have started on PD.

Many patients, especially those referred late, undergo a brief period of HD, before switches to other modalities are, or can be, considered. Hence, the established modality at 90 days is more representative of the elective first modality. By 90 days in the 2008 UK cohort, 6.2% of incident patients had died and a further 0.4% had stopped treatment, leaving 93.4% of the original cohort remaining on RRT (table 3.11). Expressed as a percentage of the whole 2008 UK incident cohort, 67.7% were on HD, 19.8% on PD and 5.9% had received a transplant. Expressed as a percentage of those still receiving RRT at 90 days, 72.5% were on HD, 21.2% on PD and 6.3% had received a transplant (figure 3.10). Of those still on RRT at 90 days, only 0.1% were receiving home haemodialysis, with the vast majority of HD patients on centre-based treatment either in main hospital centres (48.6% of total) or satellite units (20.5%). Although Northern Ireland continued to have fewer patients on PD at 90 days (15.1% of the total incident cohort) compared with other parts of the UK, this was an increase from 9.1% of the 2007 incident cohort. The percentages in the 3 other countries have all fallen, most dramatically in Wales (24.6% to 20.9%) and Scotland (21.3% to 18.1%). This comes at a time when the Department of

Table 3.11. RRT modality at 90 days by centre in the 2008 cohort

		Percentage of patients				
Country	Centre	HD	PD	Tx	Stopped treatment	Died
England	B Heart	79.8	11.4	1.8	0.0	7.0
	B QEH	65.3	22.1	5.0	0.0	7.6
	Basldn	73.0	16.2	0.0	5.4	5.4
	Bradfd	79.7	13.0	0.0	0.0	7.3
	Brightn	64.3	29.5	2.7	0.0	3.6
	Bristol	64.7	19.6	9.8	0.0	6.0
	Camb	82.3	6.5	8.1	0.0	3.2
	Carlis	66.7	30.0	0.0	0.0	3.3
	Carsh	73.6	16.8	2.0	0.0	7.6
	Chelms	61.7	27.7	0.0	4.3	6.4
	Colchr	95.5	0.0	0.0	0.0	4.6
	Covnt	60.7	22.3	8.0	0.9	8.0
	Derby	56.6	37.4	0.0	0.0	6.1
	Donc	41.7	54.2	0.0	0.0	4.2
	Dorset	52.6	21.8	6.4	5.1	14.1
	Dudley	57.5	29.8	0.0	0.0	12.8
	Exeter	69.3	20.7	0.7	0.0	9.3
	Glouc	66.0	16.0	6.0	0.0	12.0
	Hull	70.0	24.0	0.0	0.0	6.0
	Kent	64.8	23.0	7.2	0.0	5.0
	Ipswi	62.2	33.3	2.2	0.0	2.2
	L Barts	55.6	40.3	2.0	0.0	2.0
	L Guys	63.3	12.1	22.3	0.0	2.4
	L Kings	71.8	23.1	1.9	0.0	3.2
	L Rfree	78.2	10.1	7.3	0.0	4.5
	L St.G	54.4	20.0	21.1	0.0	4.4
	L West	78.0	4.3	12.2	0.0	5.6
	Leeds	64.8	17.9	11.7	0.0	5.5
	Leic	70.0	12.4	11.9	0.0	5.7
	Liv Ain	85.7	5.7	0.0	0.0	8.6
	Liv RI	61.4	24.8	7.9	0.0	5.9
	M Hope	39.8	49.1	7.4	0.9	2.8
	M RI	70.1	13.9	9.5	0.0	6.6
	Middlbr	71.7	12.3	4.7	0.0	11.3
	Newc	71.7	15.8	8.3	0.8	3.3
	Norwch	77.3	11.8	4.6	0.9	5.5
	Nottm	60.6	26.6	5.3	0.0	7.5
	Oxford	46.2	35.6	11.4	0.0	6.8
	Plymth	50.7	28.2	15.5	0.0	5.6
	Ports	63.2	19.6	9.2	0.0	8.0
	Prestn	70.7	17.1	4.9	0.0	7.3
	Redng	52.8	31.9	8.8	0.0	6.6
	Sheff	77.1	11.4	6.0	1.0	4.5
	Shrew	76.2	19.1	0.0	1.6	3.2
	Stevng	81.8	13.1	2.0	0.0	3.0
	Sthend	65.7	17.1	2.9	0.0	14.3
	Stoke	69.6	23.2	0.0	0.0	7.3
	Sund	67.3	26.9	1.9	0.0	3.9
	Truro	73.2	14.6	2.4	0.0	9.8
	Wirral	58.5	36.6	0.0	0.0	4.9
	Wolve	68.8	25.0	2.5	0.0	3.8
	York	59.4	25.0	0.0	0.0	15.6
N Ireland	Antrim	68.4	10.5	0.0	10.5	10.5
	Belfast	77.4	14.5	3.2	0.0	4.8
	Newry	58.8	29.4	0.0	5.9	5.9

Table 3.11. Continued

Country	Centre	Percentage of patients				
		HD	PD	Tx	Stopped treatment	Died
N Ireland	Tyrone	86.7	10.0	0.0	3.3	0.0
	Ulster	64.3	28.6	0.0	0.0	7.1
Scotland	Abrdn	79.3	15.5	0.0	1.7	3.5
	Airdrie	78.1	14.6	0.0	0.0	7.3
	D&Gall	52.9	41.2	0.0	0.0	5.9
	Dundee	68.8	12.5	1.6	0.0	17.2
	Dunfn	73.0	24.3	2.7	0.0	0.0
	Edinb	62.9	20.6	6.2	0.0	10.3
	Glasgw	75.2	10.9	6.1	0.0	7.9
	Inverns	61.5	30.8	3.9	0.0	3.9
	Klmarnk	63.2	34.2	0.0	0.0	2.6
Wales	Bangor	56.4	15.4	0.0	15.4	12.8
	Clwyd	64.3	35.7	0.0	0.0	0.0
	Cardff	72.9	15.2	6.6	0.7	4.6
	Swanse	64.5	26.6	2.4	0.0	6.5
	Wrexm	52.4	28.6	0.0	0.0	19.1
England		**67.3**	**20.0**	**6.4**	**0.3**	**6.0**
N Ireland		**74.1**	**15.1**	**1.2**	**3.6**	**6.0**
Scotland		**70.5**	**18.1**	**3.5**	**0.2**	**7.7**
Wales		**66.5**	**20.9**	**3.7**	**2.0**	**6.9**
UK		**67.7**	**19.8**	**5.9**	**0.4**	**6.2**

Health is trying to increase the proportion of patients on home therapies, of which PD is the most common. Although the median age of patients starting RRT has not increased in latter years it may be that is a group of patients with increasing comorbidity who are unsuitable for PD.

The percentage of incident patients who had died by day 90 varied considerably between centres (0% to 19%, table 3.11). The definition of whether patients have acute or chronic renal failure may be a factor in this apparent variation. Many other factors probably contribute to these differences including centre size, age and attitudes to conservative therapy and 'trials of dialysis' for borderline dialysis candidates. Three of the five centres with a death rate above 14% accepted 50 or fewer patients and all 5 centres had a median age higher than the UK incident median (2 centres had a median age over 70 years). This may also account for some of the variation in the proportions stopping treatment during the first 90 days.

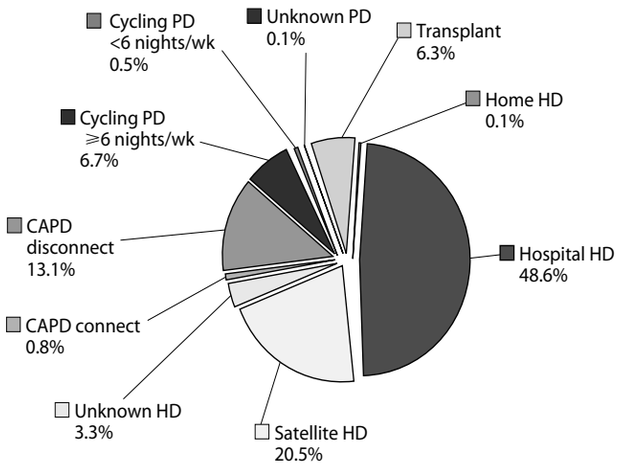

Fig. 3.10. RRT modality at day 90 in the 2008 incident cohort

The range in the proportion of incident patients who had a functioning transplant at 90 days was 0 to 22%. Of the 26 centres in which more than 5% of their incident cohort had received a transplant by 90 days, 23 were transplant centres. The mean percentage of the incident cohort with a functioning transplant by 90 days was significantly greater in transplanting compared to non-transplanting centres (8.9 vs. 3.2%: $p < 0.0001$). One possible reason could be that patients transplanted pre-emptively or early were attributed to the incident cohort of the transplanting centre rather than that of the referring centre (see below).

There were also major differences between individual centres in the percentage of new dialysis patients established on HD at 90 days (range 39.8–95.5%, table

3.11). Some of the centres with low HD numbers had high transplant numbers at day 90 (London Guys, London St Georges and Plymouth), whilst others had high PD numbers (Doncaster, London Barts, Reading, Manchester Hope and Dumfries). As discussed above, it is likely that some of the variation seen in transplant rates is artificial. For example, Dorset has 6% of patients transplanted by day 90, compared with 1.9% at London Kings. The likely explanation is that many of the patients who started RRT at Kings remain allocated to the transplanting centre (London Guys). Four centres had 40% or more of their incident dialysis patients on PD at day 90. Two of these four took on 40 or less patients during 2008.

Older patients were more likely to be on HD rather than PD at 90 days (median age on HD 66.1 years vs. PD 58.3 years). In the UK as a whole, 71.1% of incident patients aged less than 65 years were on HD at this stage compared with 84.0% of patients aged over 65 ($p < 0.001$) (table 3.12). The percentage of patients on PD at 90 days was almost twice as high in patients aged <65 years as in older patients (28.9 % vs. 16.0%). In only 6 centres (London West, London Barts, Chelmsford, York, Ipswich and Coventry) was this trend reversed and they were all different to the 7 centres from last year; these centres had a higher proportion of older patients on PD.

Between centres there was a large variation between the male:female ratio of patients on HD and PD (figure 3.11). Within the UK there was no significant difference in the male:female ratio of incident patients on HD and PD.

Renal function at the time of starting RRT

The mean eGFR at initiation of RRT in 2008 was 8.6 ml/min/1.73 m^2. This was highest in patients who were aged 85 and over, at 9.1 ml/min/1.73 m^2 (figure 3.12). There was a trend of increasing eGFR at initiation of RRT with increasing age.

When analysing serial data from centres reporting annually to the UKRR since 1997, figure 3.13 shows a continued tendency over the last 4 years to initiate PD at a higher mean eGFR than HD patients. In patients starting HD, there may be some plateauing of this level around an eGFR of 8.5 ml/min/1.73 m^2.

Some caution should be applied to the analysis of eGFR at the start of RRT. A review of pre-RRT biochemistry in nine renal centres revealed that up to 18% of patients may have an incorrect date of start of RRT allocated (by up to 5 weeks). In these patients, the

Table 3.12. Percentage of incident patients on dialysis at 90 days by modality and age

	Age <65 (%)		Age ⩾65 (%)		All patients (%)	
Centre	HD	PD	HD	PD	HD	PD
Abrdn	77.4	22.6	91.7	8.3	83.6	16.4
Airdrie	80.0	20.0	88.9	11.1	84.2	15.8
Antrim	76.9	23.1	94.1	5.9	86.7	13.3
B Heart	86.0	14.0	89.4	10.6	87.5	12.5
B QEH	71.5	28.5	78.3	21.7	74.7	25.3
Bangor	69.2	30.8	86.7	13.3	78.6	21.4
Basldn	73.3	26.7	88.9	11.1	81.8	18.2
Belfast	80.8	19.2	87.1	12.9	84.2	15.8
Bradfd	84.4	15.6	89.5	10.5	85.9	14.1
Brightn	56.8	43.2	75.0	25.0	68.6	31.4
Bristol	69.8	30.2	85.5	14.5	76.8	23.2
Camb	80.0	20.0	100.0	0.0	92.7	7.3
Cardff	75.0	25.0	90.8	9.2	82.7	17.3
Carlis	64.3	35.7	73.3	26.7	69.0	31.0
Carsh	76.0	24.0	85.4	14.6	81.5	18.5
Chelms	70.0	30.0	68.2	31.8	69.0	31.0
Clwyd	62.5	37.5	66.7	33.3	64.3	35.7
Colchr*	100.0		100.0		100.0	
Covnt	74.5	25.5	71.7	28.3	73.1	26.9
D&Gall	37.5	62.5	75.0	25.0	56.3	43.8
Derby	43.8	56.3	77.8	22.2	60.2	39.8
Donc	30.8	69.2	60.0	40.0	43.5	56.5
Dorset	61.9	38.1	75.7	24.3	70.7	29.3

Table 3.12. Continued

	Age <65 (%)		Age ⩾65 (%)		All patients (%)	
Centre	HD	PD	HD	PD	HD	PD
Dudley	58.6	41.4	83.3	16.7	65.9	34.1
Dundee	75.0	25.0	88.9	11.1	84.6	15.4
Dunfn	76.9	23.1	73.9	26.1	75.0	25.0
Edinb	64.3	35.7	87.2	12.8	75.3	24.7
Exeter	69.2	30.8	82.4	17.6	77.0	23.0
Glasgw	83.8	16.2	91.2	8.8	87.3	12.7
Glouc	70.8	29.2	94.1	5.9	80.5	19.5
Hull	67.3	32.7	83.3	16.7	74.5	25.5
Inverns	66.7	33.3	66.7	33.3	66.7	33.3
Ipswi	64.3	35.7	66.7	33.3	65.1	34.9
Kent	57.4	42.6	86.8	13.2	73.8	26.2
Klmarnk	44.4	55.6	84.2	15.8	64.9	35.1
L Barts	58.2	41.8	57.4	42.6	58.0	42.0
L Guys	77.0	23.0	90.6	9.4	84.0	16.0
L Kings	67.1	32.9	86.4	13.6	75.7	24.3
L Rfree	85.6	14.4	93.4	6.6	88.6	11.4
L St.G	71.0	29.0	75.0	25.0	73.1	26.9
L West	95.8	4.2	93.5	6.5	94.8	5.2
Leeds	67.7	32.3	89.7	10.3	78.3	21.7
Leic	76.6	23.4	91.7	8.3	85.0	15.0
Liv Ain	87.5	12.5	100.0	0.0	93.8	6.3
Liv RI	65.3	34.7	78.9	21.1	71.3	28.7
M Hope	41.3	58.7	51.5	48.5	44.8	55.2
M RI	77.3	22.7	91.8	8.2	83.5	16.5
Middlbr	79.5	20.5	90.0	10.0	85.4	14.6
Newc	75.4	24.6	89.6	10.4	81.9	18.1
Newry	44.4	55.6	100.0	0.0	66.7	33.3
Norwch	81.1	18.9	90.2	9.8	86.7	13.3
Nottm	60.0	40.0	81.1	18.9	69.5	30.5
Oxford	49.2	50.8	66.0	34.0	56.5	43.5
Plymth	50.0	50.0	83.3	16.7	64.3	35.7
Ports	70.8	29.2	81.4	18.6	76.3	23.7
Prestn	74.3	25.7	92.1	7.9	80.6	19.4
Redng	51.2	48.8	75.0	25.0	62.3	37.7
Sheff	86.9	13.1	87.2	12.8	87.1	12.9
Shrew	69.0	31.0	90.3	9.7	80.0	20.0
Stevng	80.4	19.6	93.0	7.0	86.2	13.8
Sthend	68.8	31.3	92.3	7.7	79.3	20.7
Stoke	68.6	31.4	82.8	17.2	75.0	25.0
Sund	65.2	34.8	76.9	23.1	71.4	28.6
Swanse	67.3	32.7	74.1	25.9	70.8	29.2
Truro	71.4	28.6	90.9	9.1	83.3	16.7
Tyrone	76.9	23.1	100.0	0.0	89.7	10.3
Ulster	60.0	40.0	75.0	25.0	69.2	30.8
Wirral	60.9	39.1	62.5	37.5	61.5	38.5
Wolve	67.6	32.4	78.9	21.1	73.3	26.7
Wrexm	62.5	37.5	66.7	33.3	64.7	35.3
York	80.0	20.0	64.7	35.3	70.4	29.6
England	**71.0**	**29.0**	**83.7**	**16.3**	**77.1**	**22.9**
N Ireland	**73.5**	**26.5**	**91.3**	**8.8**	**83.1**	**16.9**
Scotland	**72.6**	**27.4**	**86.2**	**13.8**	**79.6**	**20.4**
Wales	**70.4**	**29.6**	**81.7**	**18.3**	**76.1**	**23.9**
UK	**71.1**	**28.9**	**84.0**	**16.0**	**77.4**	**22.6**

* HD patients only

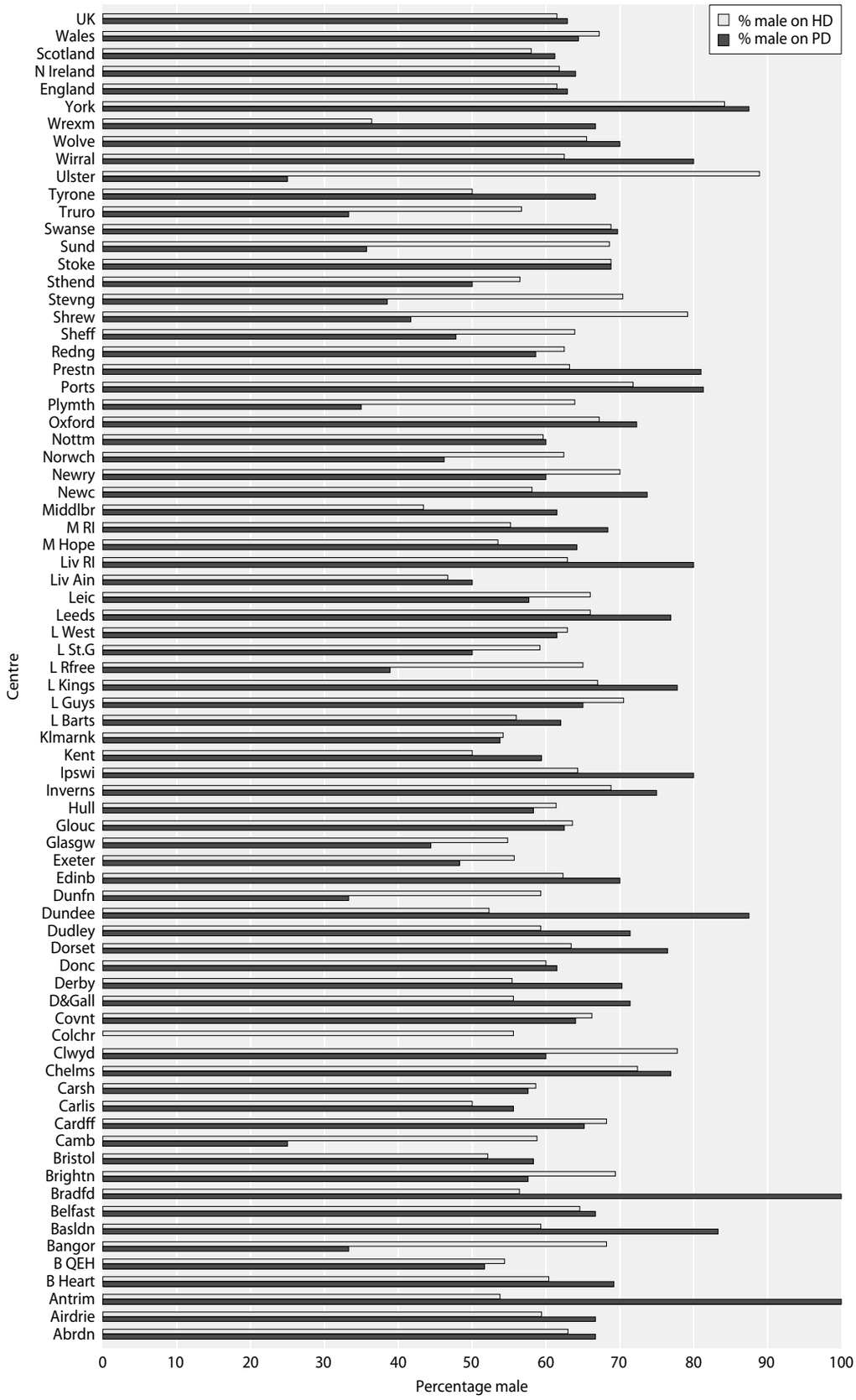

Fig. 3.11. Percentage of patients who are male by dialysis modality in incident cohort 2008

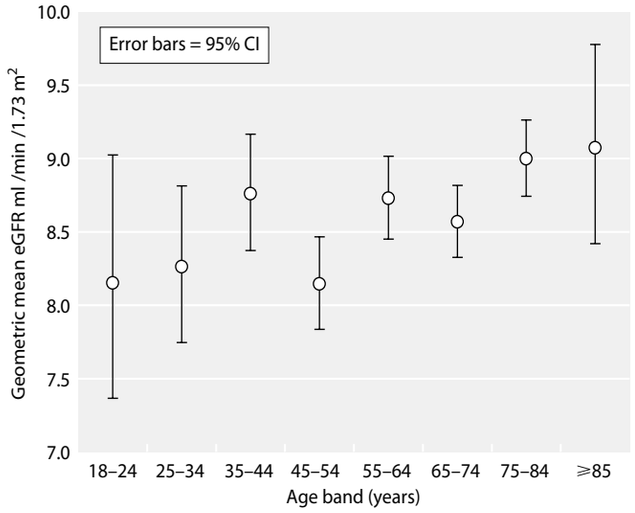

Fig. 3.12. Geometric mean eGFR at start of RRT by age band

eGFR used for analysis in some patients may have been taken whilst already receiving RRT and thus be artificially high. The details of this analysis and a subsequent validation study are described in detail in chapter 13 The UK Renal Registry Advanced CKD Study.

3 Late presentation (referral) of incident patients

Introduction

Late presentation to a nephrologist has many definitions and a range of possible causes. Chronic kidney disease may be asymptomatic until very advanced stages and patients may present with a variety of rapidly progressive glomerulopathies that present late and should be termed 'late presenters'. In contrast there are patients with chronic kidney disease, who may be regularly monitored in primary or secondary care, and referral to nephrological services has been delayed (late referral). The analyses presented encompass all these possibilities in any patient referred to renal services within 90 days of requiring RRT.

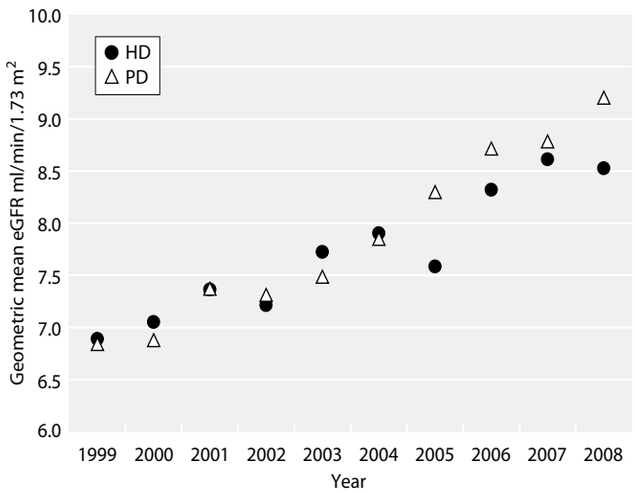

Fig. 3.13. eGFR on starting RRT 1999–2008; PD and HD
Restricted to centres reporting since 1997

Methods

Data were included from all incident patients in the years 2003–2008. The date first seen in a renal centre and the date of starting RRT were used to calculate the referral time. This is the number of days between first being seen and starting RRT. Two percent of data were excluded because of actual or potential inconsistencies. Only data from those centres with 75% or more completeness were used. Data were excluded for centres in the years where 10% or more of the patients were reported to have started RRT on the same date as the first presentation. After these exclusions, data on 9,913 patients were available for analysis. Referral times of 90 days or more were defined as early presentation. Referral times of less than 90 days were defined as late presentation.

Results

Table 3.13 shows the percentage completeness of data from 2003 to 2008 excluding centres with 10% or more of start dates for RRT being on the same day as first presentation. Overall there has been no change in the proportion of patients analysed with a reported date of referral.

Late presentation by centre and year

Late presentation ranged by centre from 8–41% in patients commencing RRT in 2008 (table 3.14). The overall rate of late presentation was 22.2%, comparable with last year.

There had been a steady decline nationally in the proportion of patients referred late to renal services in the previous 2 years. This may have been as a consequence of the National CKD guidelines published by the Medical and GP Royal Colleges [6] and the Quality and Outcomes Framework (QOF) initiative (www.dh.gov.uk) raising awareness of CKD amongst non-nephrologists. The incidence rate may have now plateaued, though some centres achieve <10% late presentation rates. The reasons for this are probably multifactorial and may include education policies, local referral guidelines and use of remote IT monitoring.

Table 3.13. Percentage completeness of late presentation data (2003 to 2008) by centre

	Year					
Centre	2003	2004	2005	2006	2007	2008
Antrim			*	39.4	52.8	70.7
B Heart	0.0	0.0	0.0	0.9	1.0	0.0
B QEH		0.0	0.0	0.0	0.5	0.0
Bangor	*	97.1	89.7	*	*	*
Basldn	96.2	97.8	89.3	100.0	100.0	90.0
Belfast			53.1	63.1	78.7	63.2
Bradfd	*	95.2	98.5	98.0	95.4	79.7
Brightn		0.0	0.0	0.0	0.0	0.0
Bristol	74.1	76.7	83.1	92.0	66.0	61.6
Camb	*	65.1	68.5	51.3	63.2	72.5
Cardff	0.0	0.5	0.0	0.0	0.9	0.0
Carlis	22.6	*	*	61.5	*	77.4
Carsh	0.5	0.6	0.0	0.0	0.0	0.0
Chelms		79.6	54.1	91.7	94.1	97.0
Clwyd	0.0	0.0	0.0	0.0	4.3	0.0
Colchr	n/a	n/a	n/a	n/a	n/a	0.0
Covnt	0.0	0.0	0.0	2.0	1.9	0.0
Derby	*	*	62.9	76.8	85.2	95.7
Donc	n/a	n/a	n/a	n/a	100.0	92.0
Dorset	98.5	100.0	97.9	100.0	100.0	98.8
Dudley	14.6	*	*	*	0.0	0.0
Exeter	54.6	64.2	50.0	53.8	23.8	11.4
Glouc	0.0	13.2	95.0	82.2	96.6	84.4
Hull	2.5	0.9	2.4	0.0	1.0	0.0
Ipswi	*	*	96.4	95.2	*	97.3
Kent					*	97.0
L Barts		0.5	0.0	19.8	0.0	0.5
L Guys	0.0	0.0	0.0	0.0	1.9	2.4
L Kings	23.4	16.8	15.4	10.6	17.6	96.7
L Rfree			0.0	0.0	0.0	0.6
L St.G					0.0	0.0
L West	*	*	*	*	*	*
Leeds	76.6	88.7	88.1	85.1	78.2	69.1
Leic	93.8	92.5	62.9	55.8	65.0	72.4
Liv Ain	n/a	n/a	0.0	0.0	0.0	0.0
Liv RI	0.0	0.8	0.0	0.0	0.9	0.0
M Hope	52.4	59.5	75.9	86.2	80.4	48.6
M RI					15.5	27.2
Middlbr	92.2	88.1	91.7	74.3	80.8	93.5
Newc	*	*	*	*	100.0	100.0
Newry			78.6	*	100.0	100.0
Norwch		52.1	30.5	28.3	17.0	12.0
Nottm	99.1	98.0	98.6	97.8	99.2	96.5
Oxford	90.2	88.8	88.2	90.8	99.3	99.3
Plymth	0.0	0.0	0.0	1.1	1.3	2.9
Ports	94.9	93.9	91.9	93.6	86.5	85.0
Prestn	0.0	0.0	0.0	0.8	0.8	0.0
Redng	4.6	18.3	12.8	12.0	12.9	7.1
Sheff	98.7	98.8	97.4	94.6	97.5	97.7
Shrew		*	*	*	*	98.4
Stevng	95.9	91.4	78.3	77.3	89.7	94.0
Sthend	0.0	0.0	0.0	0.0	0.0	0.0
Stoke					*	*
Sund	*	*	*	0.0	3.2	*
Swanse	58.3	63.4	93.9	98.2	96.8	93.2

Table 3.13. Continued

Centre	Year					
	2003	2004	2005	2006	2007	2008
Truro	75.5	59.7	71.0	54.0	91.1	*
Tyrone			95.7	96.6	90.9	96.0
Ulster			*	100.0	100.0	92.3
Wirral	38.5	48.5	76.3	76.5	82.4	82.1
Wolve	79.1	96.1	98.9	97.5	95.5	96.5
Wrexm	*	*	*	*	*	100.0
York	85.7	93.8	*	97.9	88.2	93.5
Total	**41.9**	**40.2**	**39.5**	**41.0**	**37.6**	**42.3**

Blank cells – data not available
* = data not shown as >10% of patients reported as starting RRT on the same date as first presentation
n/a = renal centre not yet operational

Table 3.14. Percentage of patients presenting to a nephrologist less than 90 days before dialysis initiation

Centre	Year					
	2003	2004	2005	2006	2007	2008
Bangor		36.4	40.0			
Basldn	39.2	35.6	20.0	26.7	20.5	33.3
Belfast					25.7	
Bradfd		16.9	32.8	16.3	20.5	19.1
Bristol		28.7	24.5	16.3		
Carlis						16.7
Chelms		23.1		29.5	25.0	25.0
Derby				17.0	21.2	19.3
Donc					27.8	13.0
Dorset	26.2	18.6	34.8	17.0	22.0	20.7
Glouc			19.3	21.7	21.4	18.4
Ipswi			51.9	35.0		36.1
Kent						40.6
L Kings						19.2
Leeds	36.2	29.9	31.4	29.4	23.7	
Leic	21.1	23.0				
M Hope			20.0	13.4	3.5	
Middlbr	27.4	31.5	22.1		17.5	18.6
Newc					20.0	27.7
Newry			22.7		20.0	10.0
Nottm	29.5	34.0	33.6	24.4	18.5	23.9
Oxford	27.3	26.7	28.9	26.1	20.6	18.9
Ports	26.0	29.9	27.2	30.4	23.0	24.6
Sheff	27.9	21.5	22.4	22.3	19.5	12.9
Shrew						29.5
Stevng	31.0	21.6	13.9	13.0	19.2	10.6
Swanse			43.5	37.8	27.3	25.7
Truro	15.0				17.1	
Tyrone			22.7	10.7	15.0	16.7
Ulster				12.5	26.7	8.3
Wirral			33.3	59.0	45.2	31.3
Wolve	26.5	30.6	30.0	25.3	27.0	25.3
Wrexm						18.2
York	22.9	26.7		26.1	23.3	13.8
Total	**27.8**	**26.9**	**28.6**	**24.3**	**21.3**	**22.2**

Blank cells = data not available, poor data completeness (<75%) or >10% with same date of start as date first seen

Table 3.15. Presentation times in 4 groups by year restricted to 8 centres contributing continuous data 2003–2008

Year	% <3 months	% 3–6 months	% 6–12 months	% ⩾12 months
2003	28.5	6.5	10.9	54.1
2004	26.9	6.3	9.0	57.8
2005	27.0	5.8	10.6	56.6
2006	23.9	6.8	9.6	59.7
2007	20.9	5.8	11.0	62.3
2008	19.8	5.7	8.6	65.9

Time referred before dialysis initiation in the 2008 incident cohort

In 2008, 62.5% of incident patients had been referred over a year before they needed to start dialysis. There were 9.2% of patients referred within 6–12 months, 6.2% within 3–6 months and 22.2% within 3 months. Table 3.15 shows data relating to time referred before dialysis initiation from those 8 centres supplying data for each of the last 6 years with >75% completeness (Basildon, Dorset, Nottingham, Oxford, Portsmouth, Sheffield, Stevenage and Wolverhampton). The proportion of patients presenting late in these centres since 2003 has steadily fallen, particularly since 2005 (figure 3.14), and similarly there has been an increase in those presenting 12 months or more before starting RRT.

Age and late presentation

In the 2003–2008 cohort, patients who presented late were significantly older than patients who presented earlier (>90 days before dialysis initiation) (median age 66.9 vs. 64.8 years: $p < 0.0001$). Furthermore, the median duration of pre-dialysis care diminished progressively with increasing age beyond the 45–54 age group (figure 3.15).

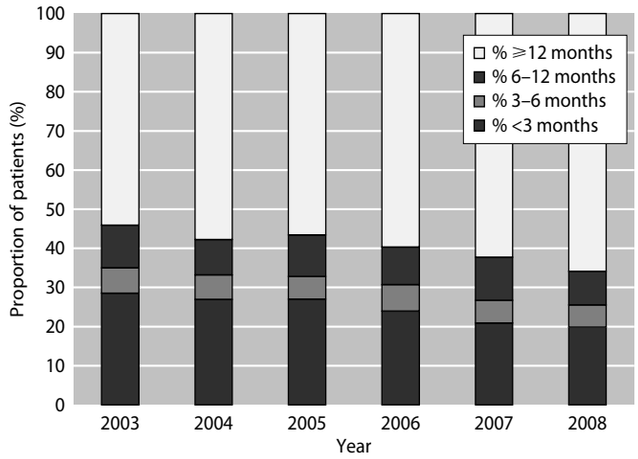

Fig. 3.14. Change in rate of late presentation by year 2003–2008

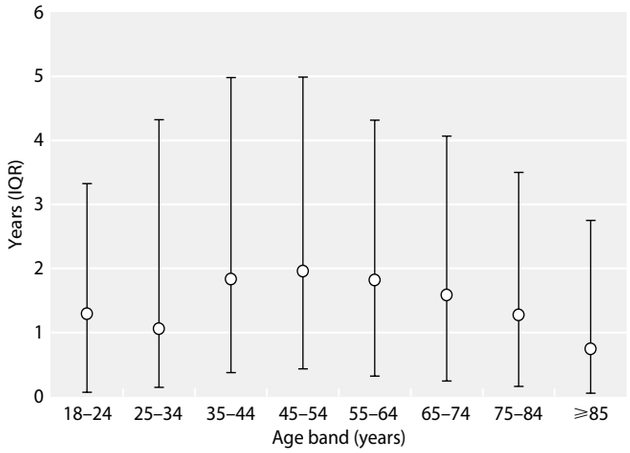

Fig. 3.15. Median duration of pre-dialysis care by age

Gender and late presentation

There was no significant difference in the proportion of males and females by time of presentation (male:female ratio 1.66 in early presenters, 1.72 in late presenters, $p = 0.47$).

Ethnicity, social deprivation and late presentation

This analysis of the 2003–2008 cohort was limited to patients from centres with >70% ethnicity and >75% referral time data. Patients from the Chinese and Other ethnic minority groups were excluded due to the small numbers with referral data. The percentage of non-Whites (South Asian and Black) presenting late (<90 days) was significantly lower than in Whites (21.2% vs. 25%: $p = 0.013$). The high incidence of diabetes in non-Whites (as discussed below, patients with diabetes tended to be referred earlier) and the older median age of incident Whites, may have a bearing. There was no relationship between social deprivation and referral pattern.

Primary renal disease and late presentation

In the 2003–2008 cohort, late presentation differed significantly between primary renal diagnoses (Chi-squared test $p < 0.0001$) (table 3.16). Patients with a diagnosis of 'other identified category', 'not available', and the aetiology uncertain/glomerulonephritis unproven groups appeared to have higher rates of late referral. Those with diabetes and adult polycystic kidney disease had lower rates.

Table 3.16. Late presentation by primary renal diagnosis

	Late presentation	
Diagnosis	N	%
Uncertain aetiology*	645	27.3
Diabetes	267	13.1
Glomerulonephritis	207	20.7
Other identified category	684	46.1
Polycystic kidney	55	8.3
Pyelonephritis	167	21.9
Renal vascular disease	331	26.2
Data not available	115	34.2

* includes presumed glomerulonephritis not biopsy proven

Modality and late presentation

In the 2003–2008 cohort, late presentation was associated with variations in initial choice of modality. The percentage of patients whose first modality was PD was significantly less in the late presentation group compared to those presenting earlier (11.5% vs. 27.4%: $p < 0.0001$). By 90 days after dialysis initiation this difference was reduced, although still highly significant (17.6% vs. 29.0%: $p < 0.0001$). This pattern has been evident for the last few years with little improvement in PD rates in the late presenters.

Comorbidity and late presentation

In the 2003–2008 cohort, significantly fewer patients who had presented late were assessed as having no comorbidity when compared with the group who presented earlier (40.1% vs. 43.6%: $p = 0.014$). Peripheral vascular disease was significantly less common in the group presenting late. Malignancy was significantly more common in those presenting late, perhaps because of the potential for rapid decline in renal function in this setting (table 3.17).

Table 3.17. Percentage prevalence of specific comorbidities amongst patients presenting late (0–89 days) compared with those presenting early ($\geqslant$90 days)

Comorbidity	0–89 days	$\geqslant$90 days	p-value
Cerebrovascular disease	10.2	10.3	0.9
COPD	6.9	6.8	0.8
Diabetes (not a cause of ERF)	8.2	8.8	0.5
Ischaemic heart disease	23.0	24.5	0.2
Liver disease	2.9	2.3	0.2
Malignancy	18.1	10.4	<0.0001
Peripheral vascular disease	10.7	13.5	0.003
Smoking	16.7	15.3	0.2

Haemoglobin and late presentation

In the 2003–2008 cohort, patients presenting late had a significantly lower haemoglobin concentration at dialysis initiation than patients presenting earlier (9.5 vs. 10.5 g/dl: $p < 0.0001$). This may reflect inadequate pre-dialysis care with limited anaemia management, but alternatively those presenting late may be more likely to have anaemia because of multisystem disease or intercurrent illness.

eGFR at start of RRT and late presentation

In the data set 2003–2008, eGFR was lower in patients who presented late (7.6 vs. 8.3 ml/min/1.73 m^2: $p < 0.0001$), both in males (7.8 vs. 8.5: $p < 0.0001$) and females (7.3 vs. 7.9: $p = 0.0001$). The same relationship held in older patients (>65 years) (7.8 vs. 8.5: $p < 0.0001$) and in younger patients (18–44 years) (6.8 vs. 8.1: $p < 0.0001$), but not in those in the intermediate age range (45–64 years) (7.6 vs. 8.0: $p = 0.06$). Similarly the relationship held in Whites (7.6 vs. 8.3: $p < 0.0001$) and Asians (7.0 vs. 7.9: $p = 0.05$) but not in Blacks (8.1 vs. 7.7: $p = 0.6$). It should be noted that patient numbers were small in ethnic minority groups.

eGFR at start of RRT was significantly lower in patients presenting late rather than early with renal disease of uncertain aetiology (6.9 vs. 8.0: $p < 0.0001$) and 'other diagnoses' (7.5 vs. 8.2: $p = 0.0009$). No differences were seen in any of the other diagnostic categories. When stratifying by comorbidity, eGFR was significantly lower in patients who presented late compared to earlier presentation in all comorbidity groups except cerebrovascular and peripheral vascular disease and diabetes. For example, amongst patients with liver disease, the eGFR at the start of RRT was 8.7 in those who presented early compared to 6.7 in those who presented late ($p = 0.0004$).

Survival of incident patients

This analysis is to be found in chapter 7 Survival and Causes of Death in UK Adult Patients on RRT in 2008.

Summary

For the first time this year, the UKRR had individual patient level coverage of all UK renal centres compared

with last year's report when one centre could only provide centre level data. This has enabled acceptance rates to be more accurately assigned to centres. Acceptance rates have fallen in Northern Ireland, Scotland and Wales whilst they have plateaued in England over the last 3 years. Wales continues to have the highest acceptance rates but it may be that the other parts of the UK are tending towards more similar rates. There remain large centre variations in acceptance rates for RRT and they are significantly affected by age, gender, primary renal diagnosis and ethnicity. Significant numbers of patients continue to present late to renal centres and the improvement of recent years may have halted.

Conflict of interest: none

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Chapter 4
UK ESRD Prevalent Rates in 2008: national and centre-specific analyses

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Key Words
Comorbidity · Diabetes · Dialysis · End stage renal disease · End stage renal failure · Ethnicity · Haemodialysis · Peritoneal dialysis · Prevalence · Primary Care Trust · Renal replacement therapy · Transplantation · Treatment modality

Abstract
Introduction: This chapter describes the characteristics of adult patients on renal replacement therapy (RRT) in the UK in 2008 and the prevalence rate per million population (pmp) in Primary Care Trusts and local authorities (Council Areas or District Councils) (PCT/LAs) were calculated. ***Methods:*** Complete data were electronically collected from all 72 renal centres within the UK. A series of cross-sectional and longitudinal analyses were performed to describe the demographics of prevalent RRT patients in 2008 at centre and national level in the UK. Age and gender standardised ratios of actual to expected for prevalence rates in PCT/LAs were calculated. ***Results:*** There were 47,525 adult patients receiving RRT in the UK on 31/12/2008, equating to a UK prevalence of 774 pmp. This represents an annual increase in prevalence of approximately 4.4% although there was significant variation between PCT/LA areas. The pmp growth rate from 2007 to 2008 for prevalent patients by treatment modality in the UK was 5.9% for haemodialysis (HD), a fall of 9.2% for peritoneal dialysis (PD) and growth of 4.6% with a functioning transplant. Over the long term (1982–2007), the steady growth in transplant prevalent numbers was maintained at 4%. There was a slow but steady decline in PD patient numbers from 1999 onwards. Median RRT vintage was 5.3 years. The median age of prevalent patients was 57.3 years (HD 65.5 years, PD 61.0 years and transplant 50.4 years). For all ages, prevalence rates in males exceeded those in females peaking in the 75–79 years age group at 2,582 pmp for males and 70–74 years age group at 1,408 pmp for females. The most common identifiable renal diagnosis was biopsy-proven glomerulonephritis (16.0%), followed by diabetes (14.1%). Transplantation was the most common treatment modality (47%) followed closely by HD (43%). However, HD was increasingly common with increasing older age at the expense of transplantation. ***Conclusions:*** The HD and transplant population continued to expand whilst the PD population contracted. There was national, regional and dialysis centre level variation in prevalence rates. This has implications for service planning and ensuring equity of care for RRT patients.

Introduction

This chapter presents data on all adult patients on RRT in the UK in 2008. In 2008, the UK Renal Registry

(UKRR) received data returns from all 5 renal centres in Wales, all 6 in Northern Ireland and all 52 in England. Data from all 9 centres in Scotland were obtained from the Scottish Renal Registry. Data on children and young adults can be found in chapter 14 Demography of the UK Paediatric RRT population.

These analyses of prevalent RRT patients are performed annually to aid clinicians and policy makers in planning future RRT requirements in the UK. It is important to understand national, regional and centre level variation in numbers of prevalent patients as part of this planning process. In addition, variation in case mix is also reported to improve understanding of where resources should be focussed to improve equity of provision of RRT in the UK.

The term established renal failure (ERF) used within this chapter is synonymous with the terms end stage renal failure (ESRF) and end stage renal disease (ESRD), which are in more widespread international usage. Within the UK, patient groups have disliked the term 'end stage' which formerly reflected the inevitable outcome of this disease.

Methods

These analyses relate to the prevalent RRT cohort in the UK in 2008. The cohort was defined as all adult patients prevalent on RRT on the UKRR database on 31/12/2008. Population estimates were obtained from the UK Office of National Statistics (ONS) [1].

The number of prevalent RRT patients was calculated for the UK as a whole, and for each UK country, using UKRR data from all renal centres. Crude prevalence rates were calculated per million population (pmp) and standardised prevalence ratios were calculated as detailed in appendix D: methodology used for analyses of PCT/LA incidence and prevalence rates and of standardised ratios (www.renalreg.org). Briefly, data from all covered areas were used to calculate overall age and gender specific prevalence rates. The age and gender breakdown of the population in each PCT area in England or Local Authority area in Wales, in Scotland (also called Council Areas) and in Northern Ireland (also called District Councils) was obtained from the mid 2006 population estimate based on 2001 Census data from the ONS [1]. These areas will be referred to in this report as 'PCT/LA'. The population breakdown and the overall prevalence rates were used to calculate the expected age and gender specific prevalence numbers for each PCT/LA. The age and gender standardised prevalence ratio was the observed prevalence numbers divided by the expected prevalence numbers. A ratio below 1 indicated that the observed rate was less than expected given the area's population structure. This was statistically significant at the 5% level if the upper confidence limit was less than 1. Analyses were done for each of the last 6 years and, as the prevalent numbers for one year can be small for smaller areas, a combined years' analysis was also done. The proportion of non-Whites in each PCT/LA was obtained from the ONS [1]. To enable assessment of whether a centre was an outlier, funnel plots for smaller and larger populations have been included which show the 95% confidence intervals around the national average prevalence.

Prevalent patients on RRT in 2008 were examined by time on RRT, age group, gender, ethnic origin, primary renal disease, presence of diabetes (2009 Report appendix G) and treatment modality. Some centres electronically upload ethnicity coding to their renal information technology (IT) system from the hospital Patient Administration System (PAS). Ethnicity coding in these PAS systems is based on self-reported ethnicity and uses a different coding system [2]. For the remaining centres, ethnicity coding is performed by clinical staff and recorded directly into the renal IT system (using a variety of coding systems). For all these analyses, data on ethnic origin were grouped into Whites, South Asians, Blacks, Chinese and Others. The details of regrouping of the PAS codes into the above ethnic categories are provided in appendix G Ethnicity, EDTA Primary Renal Diagnoses, EDTA Causes of Death and Treatment Timeline Modality Codes. Time on RRT was defined as median time on treatment and was calculated from the most recent start date. Patients without an accurate start date were excluded from this calculation. Analyses were done for the UK as a whole, by UK country, at centre level and split by treatment modality when appropriate. Chi-squared test, Fisher's exact test, ANOVA linear regression and Kruskal Wallis test were used as appropriate to test for significant differences between groups. The data were analysed using SAS 9.1.3.

Results

Prevalent patient numbers and changes in prevalence

The number of patients calculated for each country (table 4.1) (by adding the patient numbers in each renal centre) differ marginally from those quoted elsewhere when patients are allocated to geographical areas by their individual post codes, as some centres treat patients across national boundaries.

There were 47,525 adult patients receiving RRT in the UK at the end of 2008, giving a UK population prevalence of 774 pmp (table 4.1) compared to 746 pmp in 2007 [3]. Prevalence rates increased in all UK countries compared to 2007 [3]. Prevalence rates remained lowest in England (767 pmp) with Wales once again having the highest prevalence (827 pmp) among the four UK countries. PD prevalence decreased again in all UK countries, with the largest decrease in Wales (109 pmp in 2007 vs. 87 pmp in 2008), whilst transplant prevalence once more increased in the UK, with the largest increase in Wales (350 pmp in 2007 vs. 384 pmp in 2008). The prevalent rate for each of the UK countries (figure 4.1) shows that Northern Ireland had a higher prevalent rate for patients aged 70+ compared to the other UK countries.

Table 4.1. Prevalence of RRT in the UK on 31/12/2008

	England	N Ireland	Scotland	Wales	UK
All UK centres	39,476	1,431	4,142	2,476	47,525
Total population, mid-2008 (millions)*	51.4	1.8	5.2	3.0	61.4
Prevalence pmp HD	337	405	355	357	342
Prevalence pmp PD	69	57	63	87	69
Prevalence pmp dialysis	407	463	418	444	411
Prevalence pmp transplant	361	344	383	384	363
Prevalence pmp total	767	806	801	827	774
Confidence intervals total	760–775	764–848	777–826	795–860	767–781

* estimates from ONS web site
pmp = per million population

Prevalent patients by RRT centre

Both the number of prevalent patients in each renal centre and the distribution of their treatment modalities varied widely (table 4.2). Many factors including geography, local population density, age distribution, ethnic composition and social deprivation index of that population have contributed to this. The transplanting status of a renal centre also played a role in determining the modality distribution of prevalent patients. The 23 transplant centres had higher median prevalent numbers in all modalities than non-transplanting centres ($p < 0.001$ for all modalities), and also had a higher transplant number/dialysis number ratio (1.28 vs. 0.65, $p < 0.001$). The wide variability in this ratio both in transplanting (0.77–1.79) and non-transplanting (0.07–1.21) centres suggests considerable variation in transplant follow-up policies. Most transplant centres transfer patients back to the referring renal centre but at varying times after transplantation.

The distribution of treatment modalities was also dependent on centre size, in terms of the number of RRT patients (although size is also correlated with being a transplanting centre). As centre size increased, the proportion of transplant patients increased at the expense of the proportion of haemodialysis patients (figure 4.2). When centres were grouped into four quartiles (Q1 to Q4) based on centre size (Q1 the quartile with the smallest centres, Q4 the quartile with the largest centres) with an equal number of centres in each, the proportion of transplanting centres increased through the quartiles (Q1 = 0%, Q2 = 6%, Q3 = 28%, Q4 = 94%). The only transplanting centre in Q2 was Plymouth and the only non-transplanting centre in Q4 was Carshalton (which had been a transplanting centre until 2003).

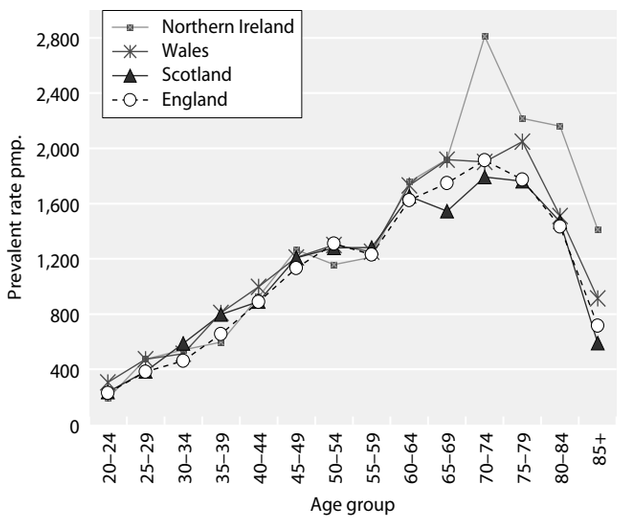

Fig. 4.1. Prevalent rate per million population by age band and UK country on 31/12/2008

Changes in prevalence

Overall growth in the prevalent UK RRT population from 2007 to 2008 was 4.4% (table 4.3) which has been fairly consistent over the last 10–15 years (figure 4.3). Over the 2005–2008 period, Scotland and Northern Ireland showed slower average yearly growth than England at 3.0%, 3.5% and 4.5% respectively. During the same period Wales showed an average growth of 6.5% although this is exaggerated as it was in part related to an error in the numbers from Wrexham during the period of changing renal IT systems.

This prevalent growth disguises the differential growth in the different RRT modalities of HD, PD and Transplant over this period and these data are shown in table 4.4. From 2007 to 2008, there was pmp growth of prevalent patients on HD by 5.9% and those with a functioning transplant of 4.6%, but a 9.2% decrease in

Table 4.2. Number of prevalent RRT patients per treatment modality by centre on 31/12/2008

Country	Centre	HD	PD	Dialysis	Transplant	RRT
England	B Heart	411	33	444	150	594
	B QEH*	807	149	956	758	1,714
	Basldn	139	34	173	44	217
	Bradfd	194	33	227	187	414
	Brightn	327	96	423	299	722
	Bristol*	453	88	541	706	1,247
	Camb*	358	45	403	524	927
	Carlis	81	21	102	101	203
	Carsh	630	128	758	491	1,249
	Chelms	102	43	145	57	202
	Colchr	118		118		118
	Covnt*	317	78	395	350	745
	Derby	240	79	319	70	389
	Donc	80	39	119	35	154
	Dorset	211	55	266	247	513
	Dudley	139	54	193	77	270
	Exeter	319	83	402	306	708
	Glouc	160	35	195	129	324
	Hull	319	76	395	301	696
	Ipswi	104	53	157	137	294
	Kent	324	81	405	309	714
	L Barts*	633	230	863	663	1,526
	L Guys*	517	54	571	860	1,431
	L Kings	415	82	497	287	784
	L RFree*	646	91	737	773	1,510
	L St. G*	226	56	282	342	624
	L West*	1,236	44	1,280	1,290	2,570
	Leeds*	487	102	589	753	1,342
	Leic*	733	162	895	765	1,660
	Liv Ain	127	3	130		130
	Liv RI*	403	106	509	691	1,200
	M Hope	314	136	450	308	758
	M RI*	417	101	518	904	1,422
	Middlbr	292	24	316	366	682
	Newc*	271	52	323	578	901
	Norwch	303	64	367	200	567
	Nottm*	395	123	518	426	944
	Oxford*	358	122	480	826	1,306
	Plymth*	128	52	180	263	443
	Ports*	450	93	543	725	1,268
	Prestn	443	63	506	367	873
	Redng	260	80	340	238	578
	Sheff*	606	78	684	532	1,216
	Shrew	184	37	221	104	325
	Stevng	364	40	404	176	580
	Sthend	131	16	147	57	204
	Stoke	272	78	350	253	603
	Sund	162	23	185	158	343
	Truro	142	29	171	122	293
	Wirral	179	37	216		216
	Wolve	301	62	363	126	489
	York	121	21	142	132	274
Wales	Bangor	82	30	112		112
	Cardff*	491	125	616	794	1,410
	Clwyd	74	10	84	62	146
	Swanse	346	69	415	170	585
	Wrexm	76	25	101	122	223

Table 4.2. Continued

Country	Centre	HD	PD	Dialysis	Transplant	RRT
Scotland	Abrdn	207	37	244	212	456
	Airdrie	159	13	172	73	245
	D & Gall	53	16	69	44	113
	Dundee	161	26	187	183	370
	Dunfn	111	25	136	84	220
	Edinb*	272	76	348	347	695
	Glasgw*	639	64	703	865	1,568
	Inverns	91	29	120	92	212
	Klmarnk	142	42	184	79	263
N Ireland	Antrim	133	19	152	68	220
	Belfast*	261	51	312	414	726
	Derry	54	6	60	36	96
	Newry	98	12	110	48	158
	Tyrone	89	9	98	38	136
	Ulster	84	5	89	6	95
Total	**England**	**17,349**	**3,564**	**20,913**	**18,563**	**39,476**
	N Ireland	**719**	**102**	**821**	**610**	**1,431**
	Scotland	**1,835**	**328**	**2,163**	**1,979**	**4,142**
	Wales	**1,069**	**259**	**1,328**	**1,148**	**2,476**
	UK	**20,972**	**4,253**	**25,225**	**22,300**	**47,525**

* Transplant centres
Centres prefixed 'L' are London centres.
The numbers of patients calculated for each country quoted above differ marginally from those quoted elsewhere when patients are allocated to areas by their individual post codes, as some centres treat patients from across national boundaries.

patients on PD. During the period 2005–2008 there has been a 5.3% pmp growth in HD, 6.3% pmp fall in PD, and 4.7% pmp growth in prevalent transplant patients in the UK (table 4.4).

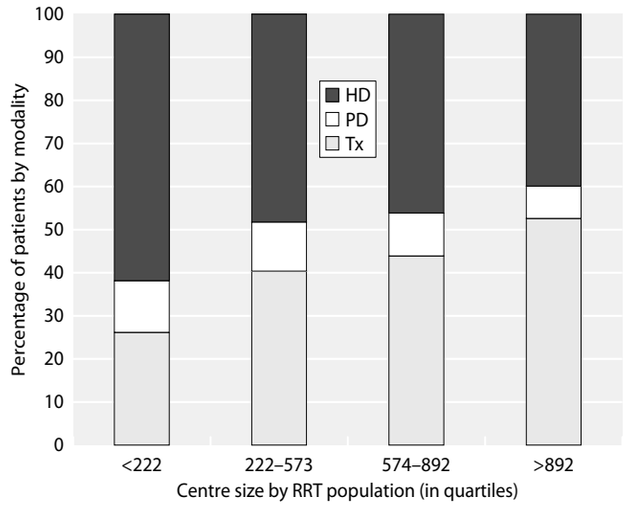

Fig. 4.2. Distribution of treatment modalities in relation to the number of prevalent RRT patients (displayed in quartiles) on 31/12/2008

There were large variations between centres as well as countries. In 2007–2008 growth increased by more than 20% in 5 centres (table 4.3), the greatest growth being 52.4% in Derry and 50.7% in Dumfries. In 2008, transplant patients were allocated not to the transplant centre, but to the centre responsible for patient care, which may have been the original non-transplanting referral centre. This resulted in a decline in transplant patient numbers at some transplant centres and an increase at other renal centres. There was a decrease in prevalent patient numbers in 16 centres, and most of the decreases were due either to the reduction in prevalent PD patient numbers or the reallocation of transplant patients to the centre where they were followed up. A few centres also had large increases in transplant patient numbers, due to the reallocation of transplant patients. The decline in prevalent patients on PD was evident at 40 of the 72 renal centres in the UK.

The long-term (1982–2007) UK prevalence pattern by treatment modality is shown in figure 4.3. The steady growth in transplant numbers was maintained but haemodialysis patient numbers have increased more rapidly associated with a slow contraction in home-based therapies, particularly PD.

Table 4.3. Number of prevalent patients on RRT by centre 2005–2008

Centre	Date				% change
	31/12/2005	31/12/2006	31/12/2007	31/12/2008	2007–2008
Abrdn	415	428	452	456	0.9
Airdrie	171	233	230	245	6.5
Antrim	188	200	198	220	11.1
B Heart	538	578	576	594	3.1
B QEH	1,514	1,555	1,626	1,714	5.4
Bangor	101	103	98	112	14.3
Basldn	168	186	208	217	4.3
Belfast	738	750	744	726	−2.4
Bradfd	361	365	395	414	4.8
Brightn	615	647	684	722	5.6
Bristol	1,158	1,200	1,234	1,247	1.1
Camb	816	905	935	927	−0.9
Cardff	1,267	1,334	1,438	1,410	−1.9
Carlis	183	188	198	203	2.5
Carsh	994	1,101	1,162	1,249	7.5
Chelms	134	155	194	202	4.1
Clwyd	83	79	152	146	−3.9
Colchr	n/a	84	100	118	18.0
Covnt	636	675	717	745	3.9
D & Gall	69	76	75	113	50.7
Derby	279	301	313	389	24.3
Derry	n/a	34	63	96	52.4
Donc[a]	n/a	n/a	108	154	42.6
Dorset	382	395	452	513	13.5
Dudley	257	261	261	270	3.4
Dundee	355	362	376	370	−1.6
Dunfn	150	156	220	220	0.0
Edinb	669	701	720	695	−3.5
Exeter	580	621	664	708	6.6
Glasgw	1,583	1,541	1,600	1,568	−2.0
Glouc	280	319	323	324	0.3
Hull	585	610	674	696	3.3
Inverns	198	199	207	212	2.4
Ipswi	290	283	284	294	3.5
Kent		546	617	714	15.7
Klmarnk	180	211	210	263	25.2
L Barts	1,332	1,415	1,473	1,526	3.6
L Guys	1,220	1,315	1,395	1,431	2.6
L Kings	633	669	711	784	10.3
L Rfree	1,310	1,382	1,437	1,510	5.1
L St.G	544	595	576	624	8.3
L West[b]	2,280	2,152	2,162	2,570	18.9
Leeds	1,300	1,366	1,379	1,342	−2.7
Leic[c]	1,427	1,497	1,593	1,660	4.2
Liv Ain	81	98	114	130	14.0
Liv RI	1,293	1,360	1,274	1,200	−5.8
M Hope	612	714	759	758	−0.1
M RI	1,420	1,400	1,402	1,422	1.4
Middlbr	589	639	687	682	−0.7
Newc	863	898	902	901	−0.1
Newry	155	148	147	158	7.5
Norwch	408	436	494	567	14.8
Nottm	887	922	971	944	−2.8
Oxford	1,192	1,286	1,328	1,306	−1.7
Plymth	367	411	421	443	5.2

Table 4.3. Continued

Centre	Date				% change
	31/12/2005	31/12/2006	31/12/2007	31/12/2008	2007–2008
Ports	1,085	1,144	1,182	1,268	7.3
Prestn	765	828	858	873	1.7
Redng	410	530	553	578	4.5
Sheff[a]	1,164	1,230	1,171	1,216	3.8
Shrew	235	260	291	325	11.7
Stevng	557	604	547	580	6.0
Sthend	181	188	193	204	5.7
Stoke	550	588	591	603	2.0
Sund	277	269	344	343	−0.3
Swanse	462	499	544	585	7.5
Truro	269	289	281	293	4.3
Tyrone	165	160	149	136	−8.7
Ulster	44	61	85	95	11.8
Wirral	191	199	216	216	0.0
Wolve	438	448	449	489	8.9
Wrexm[d]	137[d]	130[d]	217	223	2.8
York	200	223	231	274	18.6
England	**34,585**	**36,462**	**37,610**	**39,476**	**5.0**
N Ireland	**1,290**	**1,353**	**1,386**	**1,431**	**3.2**
Scotland	**3,790**	**3,907**	**4,090**	**4,142**	**1.3**
Wales	**2,050**	**2,145**	**2,449**	**2,476**	**1.1**
UK	**41,715**	**43,867**	**45,535**	**47,525**	**4.4**

[a] Doncaster previously part of Sheffield centre
[b] Hammersmith + Charing Cross amalgamated with St Marys
[c] Oxford transferred Northamptonshire LA to Leicester
[d] Wrexham data suspect from previous renal IT system

Prevalence of RRT in Primary Care Trusts (PCT) in England or Local Authority (LA) areas in Wales, Scotland (Council Areas) and Northern Ireland (District Councils)

The need for RRT depends on many factors including social and demographic factors such as age, gender, social deprivation and ethnicity. Hence comparison of crude prevalence rates by geographical area can be misleading. This section, as in previous reports, uses age and gender standardisation and ethnic minority profile to compare RRT prevalent rates. The impact of social deprivation was analysed in the 2003 UKRR Report [4].

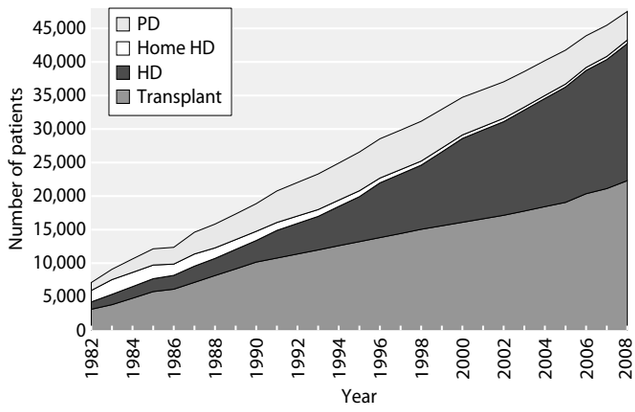

Fig. 4.3. Growth in prevalent patients, by treatment modality at the end of each year 1982–2008

Prevalence rates have been reported in relation to the catchment area populations of PCTs in England. Data by equivalent local authority areas for the other UK countries continues to be reported (called Local Authorities in Wales, Council Areas in Scotland and District Councils in Northern Ireland) and described as PCT/LA. There were substantial variations in the crude PCT/LA prevalence from 409 per million population (pmp) (Shetland Islands, population 22,000) to 1,492 pmp (Brent Teaching, population 271,400). There were similar variations in standardised prevalence ratios (SPR) from 0.50 (Shetland Islands) to 2.49 (Heart of Birmingham Teaching, population 271,400) (table 4.5). PCT/LAs with small populations have wide confidence limits for SPR (figures 4.4 and 4.5), making difficult the interpretation of data from a single year. The annual standardised prevalence ratio was inherently

Table 4.4. Change in RRT prevalence rates pmp 2005–2008 by modality

Year	HD prevalence pmp	PD prevalence pmp	Dialysis prevalence pmp	Transplant prevalence pmp	RRT prevalence pmp	% prevalence pmp growth			
						HD	PD	Tx	RRT
2005	293	84	377	316	693				
2006	311	78	389	336	725	6.1	−7.1	6.3	4.5
2007	323	76	399	347	746	3.9	−2.6	3.3	2.9
2008	342	69	411	363	774	5.9	−9.2	4.6	3.8
Average annual growth during 2005–2008						**5.3**	**−6.3**	**4.7**	**3.7**

more stable than the annual standardised acceptance ratio, although some areas have shown progressive annual increases (e.g. Bolton, Bury, Oldham) (chapter 3). These areas with progressive increases in SPRs started with low ratios in 2003.

Factors associated with variation in standardised prevalence ratios in PCTs in England, Local Authorities in Wales, Scotland and Northern Ireland (PCT/LA)

Geographical considerations and ethnicity were the major factors underlying the variation in SPR (table 4.5). In 2008, there were 52 PCT/LAs with a significantly low SPR, 128 with a normal SPR and 52 with a significantly high SPR. This is not dissimilar to last year's report [3]. The geographical distribution of these is summarised in table 4.6. North West England, East of England, the South East and South West of England all had a significantly higher proportion of areas with a low SPR compared with the UK as a whole. In London there were a significantly higher proportion of areas with a high SPR, and the West Midlands (41%) and Wales (27%) had a relatively higher percentage of PCT/LAs with high SPRs but this did not reach significance.

PCT/LAs with a high SPR had significantly higher ethnic minority populations than those with low or normal SPRs ($p < 0.0001$) (figures 4.6, 4.7a and b). Mean SPR was significantly higher in the 47 PCT/LAs with an ethnic minority population greater than 10% than in those with lower ethnic minority populations (1.38 vs. 0.96: $p < 0.0001$). The SPR ($r = 0.283$, $p < 0.001$) was correlated with ethnicity. For each 10% increase in ethnic minority population the age standardised prevalence ratio increased by 0.18.

In figure 4.7a, the relationship between the ethnic composition of a PCT/LA and its SPR is demonstrated. Figure 4.7b excludes those centres with <1% ethnic minority populations.

None of the 47 PCTs (all within England) with ethnic minority populations greater than 10% had low SPR, whereas 37 had high SPRs. In contrast only 15 of the 185 PCT/LAs with ethnic minority populations less than 10% had high SPRs. Six of these were in Wales (Caerphilly, Cardiff, Merthyr Tydfil, Neath and Port Talbot, Rhondda-Cynon-Taff, Swansea), 3 in Scotland (Glasgow City, Inverclyde, North Ayrshire) and 4 in Northern Ireland (Antrim, Belfast, Carrickfergus, Castlereagh). The only PCTs in England with ethnic minority populations less than 10% and with high SPRs, were Bristol and Bexley. The factors contributing to these regional disparities remained unclear but social deprivation was likely to be an important factor.

Case mix in prevalent RRT patients

Time on RRT

For patients who recovered for >90 days and then restarted RRT, median time from the start of RRT was calculated from the most recent start date. Table 4.7 shows the median time, in years, of the prevalent RRT patients on 31/12/2008 since starting RRT. Median time on RRT of the whole cohort was 5.3 years. Patients with functioning transplants had survived a median of 10.4 years on RRT whilst the median time on RRT of HD and PD patients was much less (2.9 and 2.0 years respectively). The dialysis population was older (table 4.8) and would be expected to have shorter survival than the transplant patients. There has been little change over the last few years [3].

Age

The median age of prevalent UK patients on RRT was 57.3 years on 31/12/2008 (table 4.8). This has changed little in the last few years but there were marked differences between modalities. The median age of HD patients (65.5 years) was greater than those on PD (61.0 years) and substantially higher than those

Table 4.5. Prevalence of RRT and standardised prevalence ratios in Primary Care Trusts/Local Authorities

O/E = standardised prevalence rate ratio
[a] per million population
Blank cells – no data returned to the Registry for that year
Areas with significantly low prevalence ratios in 2008 are italicised in greyed areas, those with significantly high prevalence ratios in 2008 are bold in greyed areas
% non-White = the sum of % South Asian and Black from the 2001 UK census
PCT/LA = Primary Care Trust (England), Local Authority (Wales), Council Area (Scotland), District Council (Northern Ireland)

		Mid-2006	2003	2004	2005	2006	2007	2008				2003–2008	% non-
Region	PCT/LA	population	O/E	O/E	O/E	O/E	O/E	O/E	LCL	UCL	pmp[a]	O/E	White
NE	*County Durham*	*500,400*	*0.93*	*0.94*	*0.96*	*0.93*	*0.90*	*0.88*	*0.80*	*0.98*	*721*	*0.92*	*1.0*
England	Darlington	99,100	0.89	0.92	0.93	0.80	0.82	0.84	0.66	1.07	676	0.86	2.1
	Gateshead	190,500	1.07	1.04	0.99	0.93	0.88	0.85	0.71	1.00	688	0.95	1.6
	Hartlepool	91,100	0.92	1.04	0.96	1.03	0.90	0.92	0.73	1.18	724	0.96	1.1
	Middlesbrough	138,500	1.17	1.08	1.00	1.07	1.08	1.08	0.90	1.30	801	1.08	6.3
	Newcastle	270,400	0.96	0.90	0.92	0.91	0.94	0.97	0.85	1.12	714	0.93	6.9
	North Tees	189,200	0.76	0.84	0.87	0.95	0.86	0.85	0.71	1.01	655	0.86	2.7
	North Tyneside	195,100	1.05	1.05	1.06	1.02	0.97	0.91	0.77	1.07	743	1.00	1.9
	Northumberland	*309,900*	*0.92*	*0.93*	*0.88*	*0.82*	*0.81*	*0.78*	*0.68*	*0.89*	*674*	*0.85*	*1.0*
	Redcar and Cleveland	139,200	0.91	1.00	0.98	1.00	1.02	0.97	0.80	1.17	797	0.98	1.1
	South Tyneside	151,000	0.93	0.95	0.97	0.99	0.96	0.90	0.75	1.08	728	0.95	2.7
	Sunderland Teaching	280,600	1.06	1.05	0.98	0.92	0.89	0.92	0.80	1.05	727	0.96	1.9
NW	*Ashton, Leigh and Wigan*	*305,500*	*0.54*	*0.57*	*0.62*	*0.68*	*0.90*	*0.81*	*0.70*	*0.93*	*638*	*0.70*	*1.3*
England	**Blackburn with Darwen**	**141,200**	**1.01**	**1.04**	**1.11**	**1.13**	**1.33**	**1.24**	**1.04**	**1.48**	**857**	**1.16**	**22.0**
	Blackpool	*142,800*	*0.75*	*0.73*	*0.69*	*0.62*	*0.76*	*0.78*	*0.64*	*0.96*	*651*	*0.72*	*1.6*
	Bolton	262,500	0.69	0.69	0.78	0.81	1.06	1.01	0.88	1.16	773	0.85	11.0
	Bury	182,900	0.28	0.38	0.42	0.46	0.89	0.84	0.71	1.01	651	0.57	6.1
	Central and Eastern Cheshire	*451,200*					*0.79*	*0.74*	*0.66*	*0.83*	*612*	*0.76*	*1.6*
	Central Lancashire	*451,600*	*0.70*	*0.72*	*0.77*	*0.73*	*0.80*	*0.83*	*0.74*	*0.93*	*658*	*0.76*	*5.6*
	Cumbria	*496,000*	*0.81*	*0.78*	*0.76*	*0.75*	*0.74*	*0.74*	*0.66*	*0.82*	*633*	*0.76*	*0.7*
	East Lancashire	384,500	0.86	0.91	0.89	0.92	1.06	1.01	0.90	1.13	783	0.95	8.1
	Halton and St Helens	297,000	0.89	0.88	0.90	0.97	1.00	0.93	0.82	1.07	731	0.93	1.2
	Heywood, Middleton and Rochdale	206,400					0.99	0.99	0.84	1.16	736	0.99	11.4
	Knowsley	151,500	1.25	1.25	1.17	1.12	1.08	1.01	0.84	1.22	759	1.14	1.6
	Liverpool	436,200	1.23	1.22	1.16	1.15	1.09	1.11	1.00	1.23	816	1.15	5.7
	Manchester	**451,900**					**1.08**	**1.16**	**1.04**	**1.29**	**744**	**1.12**	**19.0**
	North Lancashire	*329,000*	*0.81*	*0.78*	*0.70*	*0.66*	*0.75*	*0.70*	*0.61*	*0.81*	*593*	*0.73*	*1.7*
	Oldham	219,800	0.44	0.50	0.49	0.60	0.92	0.92	0.78	1.08	678	0.67	13.9
	Salford	217,800	0.69	0.62	0.60	0.64	0.80	0.86	0.73	1.02	647	0.71	3.9
	Sefton	*277,500*	*0.94*	*0.89*	*0.90*	*0.88*	*0.85*	*0.83*	*0.72*	*0.95*	*692*	*0.88*	*1.6*
	Stockport	*280,800*					*0.85*	*0.86*	*0.75*	*0.99*	*694*	*0.86*	*4.3*
	Tameside and Glossop	247,700					0.97	0.92	0.79	1.06	706	0.94	4.9
	Trafford	*212,100*					*0.77*	*0.75*	*0.63*	*0.89*	*585*	*0.76*	*8.4*
	Warrington	194,300	0.89	0.89	0.80	0.81	0.88	0.84	0.71	1.00	664	0.85	2.1
	Western Cheshire	235,100	0.97	1.02	0.96	0.91	0.89	0.92	0.80	1.07	766	0.94	1.6
	Wirral	*311,100*	*1.13*	*1.11*	*1.06*	*1.02*	*0.94*	*0.86*	*0.76*	*0.99*	*704*	*1.01*	*1.7*
Yorkshire	Barnsley	223,700	1.22	1.23	1.13	1.10	1.04	1.04	0.90	1.20	831	1.12	0.9
& Humber	**Bradford and Airedale**	**493,000**	**1.26**	**1.23**	**1.23**	**1.12**	**1.17**	**1.18**	**1.07**	**1.30**	**832**	**1.19**	**21.7**
	Calderdale	198,600	1.06	1.08	1.07	1.08	1.08	1.09	0.93	1.26	846	1.08	7.0
	Doncaster	290,400	1.12	1.10	1.02	1.02	0.93	0.94	0.83	1.08	754	1.02	2.3
	East Riding of Yorkshire	*331,100*	*0.84*	*0.81*	*0.80*	*0.80*	*0.79*	*0.82*	*0.72*	*0.93*	*710*	*0.81*	*1.2*
	Hull	256,200	0.92	0.95	0.96	0.96	1.00	0.93	0.80	1.08	679	0.96	2.3
	Kirklees	398,400	1.23	1.21	1.16	1.19	1.12	1.06	0.95	1.18	793	1.16	14.4

Table 4.5. Continued

Region	PCT/LA	Mid-2006 population	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2008 LCL	2008 UCL	2008 pmp[a]	2003–2008 O/E	% non-White
Yorkshire & Humber	Leeds	750,300	1.02	1.00	1.00	1.01	0.96	0.92	0.84	1.00	666	0.98	8.1
	North East Lincolnshire	159,900	0.90	0.96	0.95	0.98	0.97	0.97	0.81	1.16	769	0.96	1.4
	North Lincolnshire	155,200	0.99	0.94	0.89	0.94	0.92	0.89	0.74	1.07	741	0.93	2.5
	North Yorkshire and York	*783,200*	*0.82*	*0.81*	*0.81*	*0.80*	*0.81*	*0.81*	*0.75*	*0.89*	*677*	*0.81*	*1.4*
	Rotherham	253,000	1.23	1.26	1.18	1.09	1.07	1.12	0.99	1.28	893	1.15	3.1
	Sheffield	526,100	1.08	1.12	1.07	1.09	1.08	1.07	0.97	1.18	806	1.08	8.8
	Wakefield District	*321,000*	*0.86*	*0.85*	*0.85*	*0.88*	*0.84*	*0.81*	*0.70*	*0.92*	*642*	*0.85*	*2.3*
East Midlands	Bassetlaw	111,000	0.74	0.78	0.81	0.79	0.93	0.86	0.69	1.07	712	0.82	1.4
	Derby City	236,400	1.17	1.16	1.11	1.11	1.01	1.10	0.96	1.27	829	1.11	12.6
	Derbyshire County	*720,800*	*0.90*	*0.86*	*0.84*	*0.83*	*0.86*	*0.88*	*0.81*	*0.96*	*731*	*0.86*	*1.5*
	Leicester City	**289,700**	**1.85**	**1.85**	**1.82**	**1.76**	**1.76**	**1.76**	**1.59**	**1.96**	**1,187**	**1.80**	**36.1**
	Leicestershire County and Rutland	*673,600*	*0.97*	*0.99*	*0.93*	*0.93*	*0.92*	*0.90*	*0.83*	*0.99*	*733*	*0.94*	*5.1*
	Lincolnshire	*688,700*	*0.79*	*0.81*	*0.81*	*0.78*	*0.78*	*0.76*	*0.70*	*0.84*	*658*	*0.79*	*1.4*
	Northamptonshire	*669,200*	*0.92*	*0.74*	*0.90*	*0.88*	*0.89*	*0.90*	*0.82*	*0.98*	*692*	*0.87*	*4.9*
	Nottingham City	**286,400**	**1.32**	**1.30**	**1.23**	**1.19**	**1.14**	**1.15**	**1.01**	**1.31**	**758**	**1.22**	**15.1**
	Nottinghamshire County	657,500	1.06	1.06	1.05	1.01	1.00	0.98	0.90	1.06	798	1.02	2.8
West Midlands	**Birmingham East and North**	**395,900**		**1.55**	**1.58**	**1.59**	**1.48**	**1.51**	**1.38**	**1.66**	**1,076**	**1.54**	**22.3**
	Coventry Teaching	**306,600**	**1.39**	**1.32**	**1.24**	**1.20**	**1.18**	**1.20**	**1.06**	**1.35**	**868**	**1.25**	**16.0**
	Dudley	*305,200*	*0.77*	*0.99*	*0.96*	*0.91*	*0.91*	*0.87*	*0.76*	*1.00*	*711*	*0.90*	*6.4*
	Heart of Birmingham Teaching	**271,400**		**2.48**	**2.48**	**2.47**	**2.46**	**2.49**	**2.25**	**2.74**	**1,470**	**2.48**	**59.9**
	Herefordshire	*178,000*		*0.90*	*0.88*	*0.84*	*0.80*	*0.74*	*0.62*	*0.89*	*652*	*0.83*	*0.9*
	North Staffordshire	*211,400*					*0.83*	*0.82*	*0.70*	*0.97*	*686*	*0.82*	*1.5*
	Sandwell	**287,700**		**1.48**	**1.45**	**1.44**	**1.42**	**1.48**	**1.33**	**1.66**	**1,119**	**1.45**	**20.3**
	Shropshire County	289,500		0.89	0.89	0.87	0.86	0.91	0.80	1.04	788	0.88	1.2
	Solihull	203,000	0.88	1.04	1.00	1.04	0.94	0.89	0.76	1.05	724	0.96	5.4
	South Birmingham	**339,400**		**1.45**	**1.43**	**1.35**	**1.30**	**1.30**	**1.16**	**1.45**	**934**	**1.36**	**15.1**
	South Staffordshire	*603,500*					*0.89*	*0.90*	*0.82*	*0.99*	*741*	*0.90*	*2.7*
	Stoke on Trent	247,600					1.08	1.04	0.90	1.19	808	1.06	5.1
	Telford and Wrekin	161,800		0.92	0.82	0.91	1.05	1.02	0.85	1.21	766	0.95	5.2
	Walsall Teaching	**254,700**	**0.88**	**1.36**	**1.34**	**1.30**	**1.26**	**1.30**	**1.15**	**1.47**	**1,017**	**1.25**	**13.6**
	Warwickshire	522,300	1.04	1.12	1.09	1.05	1.04	0.99	0.90	1.09	816	1.05	4.4
	Wolverhampton City	**236,900**	**1.27**	**1.36**	**1.34**	**1.28**	**1.21**	**1.22**	**1.07**	**1.40**	**946**	**1.28**	**22.2**
	Worcestershire	*553,000*		*0.85*	*0.86*	*0.82*	*0.81*	*0.82*	*0.74*	*0.90*	*682*	*0.83*	*2.4*
East of England	*Bedfordshire*	*403,600*	*0.84*	*0.86*	*0.82*	*0.85*	*0.80*	*0.82*	*0.73*	*0.93*	*637*	*0.83*	*6.7*
	Cambridgeshire	*589,600*	*0.86*	*0.89*	*0.92*	*0.92*	*0.88*	*0.82*	*0.74*	*0.91*	*639*	*0.88*	*4.1*
	East and North Hertfordshire	*527,800*	*0.77*	*0.79*	*0.90*	*0.85*	*0.83*	*0.82*	*0.74*	*0.91*	*631*	*0.83*	*5.0*
	Great Yarmouth and Waveney	*210,600*		*0.42*	*0.40*	*0.43*	*0.51*	*0.76*	*0.65*	*0.90*	*665*	*0.51*	*1.3*
	Luton	**187,200**	**1.18**	**1.15**	**1.28**	**1.28**	**1.30**	**1.35**	**1.16**	**1.56**	**935**	**1.26**	**28.1**
	Mid Essex	*361,400*		*0.84*	*0.83*	*0.85*	*0.88*	*0.86*	*0.76*	*0.97*	*686*	*0.85*	*2.4*
	Norfolk	*738,900*		*0.92*	*0.93*	*0.93*	*0.93*	*0.89*	*0.82*	*0.97*	*774*	*0.92*	*1.5*
	North East Essex	*315,400*						*0.84*	*0.73*	*0.95*	*694*	*0.84*	*2.6*
	Peterborough	163,400	0.95	1.00	1.00	1.04	1.04	0.97	0.81	1.16	716	1.00	10.3
	South East Essex	329,900		0.96	0.93	0.96	0.94	0.92	0.81	1.04	761	0.94	3.0
	South West Essex	388,300		0.91	0.93	0.95	0.97	0.97	0.87	1.09	742	0.95	3.8
	Suffolk	*585,300*		*0.82*	*0.82*	*0.82*	*0.82*	*0.80*	*0.72*	*0.88*	*658*	*0.81*	*3.1*
	West Essex	*274,700*		*0.80*	*0.84*	*0.80*	*0.74*	*0.68*	*0.58*	*0.80*	*542*	*0.77*	*4.2*
	West Hertfordshire	530,600	0.43	0.40	0.59	0.78	0.84	1.01	0.92	1.11	780	0.70	7.6
London	Barking and Dagenham	165,400		1.13	1.14	1.14	1.14	1.15	0.97	1.37	774	1.14	14.8
	Barnet	**328,400**			**1.12**	**1.25**	**1.45**	**1.49**	**1.34**	**1.65**	**1,075**	**1.34**	**26.0**

Table 4.5. Continued

Region	PCT/LA	Mid-2006 population	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2008 LCL	2008 UCL	2008 pmp[a]	2003–2008 O/E	% non-White
London	**Bexley**	**221,600**	**1.23**	**1.17**	**1.13**	**1.17**	**1.17**	**1.17**	**1.02**	**1.34**	**903**	**1.17**	**8.6**
	Brent Teaching	**271,400**				**1.29**	**1.95**	**2.14**	**1.94**	**2.36**	**1,492**	**1.81**	**54.7**
	Bromley	299,400	1.00	1.01	1.00	0.99	0.94	0.97	0.85	1.10	762	0.98	8.4
	Camden	**227,200**			**0.98**	**1.05**	**1.13**	**1.17**	**1.01**	**1.36**	**761**	**1.09**	**26.8**
	City and Hackney Teaching	**216,200**				**1.40**	**1.44**	**1.38**	**1.19**	**1.59**	**865**	**1.41**	**39.7**
	Croydon	**337,000**	**1.12**	**1.16**	**1.21**	**1.19**	**1.37**	**1.39**	**1.25**	**1.55**	**1,009**	**1.25**	**29.8**
	Ealing	**306,400**	**1.37**	**1.45**	**1.41**	**1.48**	**1.61**	**1.91**	**1.73**	**2.10**	**1,328**	**1.55**	**41.3**
	Enfield	**285,400**			**1.49**	**1.48**	**1.42**	**1.42**	**1.26**	**1.59**	**1,023**	**1.45**	**22.9**
	Greenwich Teaching	**222,600**	**1.04**	**0.93**	**1.13**	**1.14**	**1.17**	**1.25**	**1.08**	**1.44**	**845**	**1.12**	**22.9**
	Hammersmith and Fulham	**171,400**	**1.41**	**1.44**	**1.28**	**1.32**	**1.28**	**1.32**	**1.12**	**1.55**	**881**	**1.34**	**22.2**
	Haringey Teaching	**225,600**			**1.52**	**1.54**	**1.54**	**1.60**	**1.41**	**1.82**	**1,046**	**1.55**	**34.4**
	Harrow	**214,600**					**1.63**	**1.81**	**1.61**	**2.03**	**1,342**	**1.72**	**41.2**
	Havering	*227,500*					*0.79*	*0.77*	*0.66*	*0.91*	*624*	*0.78*	*4.8*
	Hillingdon	**250,100**		**0.89**	**0.99**	**1.05**	**1.00**	**1.34**	**1.18**	**1.52**	**964**	**1.07**	**20.9**
	Hounslow	**218,600**		**1.57**	**1.46**	**1.42**	**1.40**	**1.67**	**1.47**	**1.89**	**1,153**	**1.51**	**35.1**
	Islington	**185,500**			**1.39**	**1.51**	**1.43**	**1.39**	**1.19**	**1.61**	**906**	**1.43**	**24.6**
	Kensington and Chelsea	178,000					0.77	0.94	0.79	1.13	691	0.86	21.4
	Kingston	156,000					1.05	1.15	0.97	1.37	821	1.10	15.5
	Lambeth	**272,200**	**1.33**	**1.36**	**1.34**	**1.34**	**1.64**	**1.62**	**1.44**	**1.82**	**1,040**	**1.45**	**37.6**
	Lewisham	**255,600**	**1.56**	**1.66**	**1.67**	**1.70**	**1.74**	**1.71**	**1.52**	**1.91**	**1,135**	**1.68**	**34.1**
	Newham	**248,300**		**1.47**	**1.66**	**1.77**	**1.80**	**1.80**	**1.59**	**2.03**	**1,067**	**1.71**	**60.6**
	Redbridge	**251,800**		**1.15**	**1.25**	**1.24**	**1.24**	**1.39**	**1.22**	**1.57**	**985**	**1.26**	**36.5**
	Richmond and Twickenham	*179,500*					*0.67*	*0.74*	*0.61*	*0.90*	*552*	*0.71*	*9.0*
	Southwark	**269,000**	**1.59**	**1.56**	**1.59**	**1.58**	**1.69**	**1.73**	**1.54**	**1.93**	**1,123**	**1.63**	**37.0**
	Sutton and Merton	**382,000**					**1.19**	**1.21**	**1.09**	**1.35**	**877**	**1.20**	**18.1**
	Tower Hamlets	**212,500**		**1.15**	**1.19**	**1.23**	**1.31**	**1.39**	**1.20**	**1.62**	**814**	**1.26**	**48.6**
	Waltham Forest	**222,100**				**1.36**	**1.54**	**1.50**	**1.32**	**1.72**	**1,009**	**1.47**	**35.5**
	Wandsworth	**279,200**					**1.40**	**1.39**	**1.23**	**1.57**	**903**	**1.39**	**22.0**
	Westminster	231,700					1.00	1.09	0.94	1.26	760	1.04	26.8
SE England	**Berkshire East**	**382,200**	**1.03**	**1.06**	**1.03**	**1.10**	**1.20**	**1.19**	**1.07**	**1.32**	**863**	**1.11**	**16.0**
	Berkshire West	445,400	1.01	1.03	0.97	1.03	1.11	1.10	0.99	1.22	815	1.04	7.3
	Brighton and Hove City	251,500		0.86	0.84	0.85	0.85	0.86	0.74	1.00	636	0.85	5.7
	Buckinghamshire	500,700	1.01	0.98	0.98	0.97	0.95	0.93	0.84	1.03	729	0.96	7.7
	East Sussex Downs and Weald	*330,200*		*0.86*	*0.82*	*0.78*	*0.81*	*0.75*	*0.66*	*0.86*	*657*	*0.80*	*2.3*
	Eastern and Coastal Kent	*720,400*					*0.87*	*0.92*	*0.84*	*1.00*	*744*	*0.89*	*2.4*
	Hampshire	*1,265,900*	*0.78*	*0.79*	*0.76*	*0.78*	*0.76*	*0.78*	*0.73*	*0.83*	*633*	*0.77*	*2.2*
	Hastings and Rother	*176,200*		*0.85*	*0.78*	*0.77*	*0.71*	*0.72*	*0.60*	*0.87*	*630*	*0.76*	*2.4*
	Isle of Wight National Health Service	*138,200*	*0.77*	*0.76*	*0.65*	*0.64*	*0.60*	*0.58*	*0.46*	*0.73*	*521*	*0.66*	*1.3*
	Medway	251,900					0.90	0.94	0.81	1.09	699	0.92	5.4
	Milton Keynes	230,100	0.99	0.98	0.96	0.89	0.96	0.97	0.83	1.13	691	0.95	9.1
	Oxfordshire	607,400	1.13	1.11	1.05	1.05	0.96	0.91	0.83	1.00	687	1.03	5.0
	Portsmouth City Teaching	196,300	1.12	1.09	1.02	0.96	0.96	0.95	0.80	1.13	672	1.01	5.3
	Southampton City	229,100	0.91	0.93	0.92	0.89	0.90	0.94	0.80	1.11	655	0.92	7.6
	Surrey	*1,073,400*		*0.77*	*0.76*	*0.77*	*0.86*	*0.88*	*0.82*	*0.95*	*704*	*0.81*	*4.9*
	West Kent	*662,600*					*0.88*	*0.91*	*0.83*	*0.99*	*721*	*0.89*	*3.9*
	West Sussex	*770,600*		*0.80*	*0.79*	*0.78*	*0.82*	*0.84*	*0.77*	*0.91*	*707*	*0.81*	*3.4*
SW England	*Bath and North East Somerset*	*175,600*	*0.72*	*0.85*	*0.89*	*0.87*	*0.87*	*0.81*	*0.67*	*0.98*	*638*	*0.84*	*2.8*
	Bournemouth and Poole	*297,900*		*0.87*	*0.83*	*0.83*	*0.85*	*0.83*	*0.72*	*0.95*	*681*	*0.84*	*2.6*
	Bristol	**410,700**	**1.39**	**1.38**	**1.32**	**1.32**	**1.23**	**1.28**	**1.15**	**1.41**	**898**	**1.31**	**8.2**

Table 4.5. Continued

Region	PCT/LA	Mid-2006 population	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2008 LCL	2008 UCL	2008 pmp[a]	2003–2008 O/E	% non-White
SW	Cornwall and Isles of Scilly	526,200	1.00	1.06	0.98	0.99	0.96	0.96	0.87	1.05	836	0.99	1.0
England	*Devon*	*740,600*	*0.82*	*0.85*	*0.81*	*0.84*	*0.85*	*0.87*	*0.81*	*0.95*	*760*	*0.84*	*1.1*
	Dorset	*403,100*		*0.80*	*0.81*	*0.78*	*0.78*	*0.80*	*0.71*	*0.89*	*729*	*0.79*	*1.2*
	Gloucestershire	*578,500*	*0.89*	*0.92*	*0.92*	*0.93*	*0.89*	*0.82*	*0.75*	*0.91*	*676*	*0.89*	*2.9*
	North Somerset	201,200	1.11	1.14	1.04	0.99	0.91	0.92	0.79	1.08	785	1.01	1.4
	Plymouth Teaching	247,900	1.19	1.12	1.05	1.16	1.13	1.09	0.95	1.25	827	1.12	1.6
	Somerset	*518,800*	*0.91*	*0.90*	*0.88*	*0.87*	*0.83*	*0.82*	*0.74*	*0.91*	*698*	*0.86*	*1.2*
	South Gloucestershire	254,200	1.09	1.08	1.04	1.04	0.97	0.95	0.82	1.10	751	1.03	2.4
	Swindon	192,600	0.94	1.03	0.96	0.97	0.90	0.88	0.74	1.05	665	0.94	4.8
	Torbay	133,000	0.88	0.97	0.88	0.85	0.79	0.93	0.77	1.12	820	0.88	1.2
	Wiltshire	*448,600*	*0.69*	*0.65*	*0.68*	*0.69*	*0.72*	*0.73*	*0.65*	*0.83*	*595*	*0.70*	*1.6*
Wales	Blaenau Gwent	69,500	1.29	1.23	1.21	1.13	1.17	1.04	0.80	1.34	835	1.17	0.8
	Bridgend	132,600	1.18	1.20	1.20	1.27	1.33	1.19	1.00	1.41	958	1.23	1.4
	Caerphilly	**171,300**	**1.20**	**1.19**	**1.18**	**1.19**	**1.19**	**1.23**	**1.06**	**1.44**	**963**	**1.20**	**0.9**
	Cardiff	**317,500**	**1.30**	**1.32**	**1.24**	**1.24**	**1.25**	**1.16**	**1.03**	**1.31**	**813**	**1.25**	**8.4**
	Carmarthenshire	177,800	1.13	1.15	1.11	1.10	1.02	1.04	0.89	1.21	889	1.09	0.9
	Ceredigion	77,100	0.86	0.93	0.87	0.77	0.79	0.85	0.65	1.11	713	0.84	1.4
	Conwy	111,300	1.03	1.02	0.91	0.91	0.93	0.90	0.73	1.11	809	0.94	1.0
	Denbighshire	95,900	0.94	0.94	1.04	0.89	0.89	0.87	0.69	1.09	740	0.92	1.2
	Flintshire	150,000	1.07	1.06	1.03	1.01	1.01	0.98	0.82	1.17	793	1.02	0.8
	Gwynedd	118,200	1.26	1.08	1.06	0.98	1.05	1.01	0.83	1.23	838	1.07	1.2
	Isle of Anglesey	68,800	0.95	0.93	1.00	0.97	0.89	0.99	0.77	1.28	858	0.96	0.7
	Merthyr Tydfil	**55,800**	**1.48**	**1.68**	**1.61**	**1.84**	**1.94**	**1.60**	**1.27**	**2.02**	**1,272**	**1.70**	**1.0**
	Monmouthshire	87,800	1.18	1.16	1.19	1.05	0.98	1.02	0.81	1.27	877	1.09	1.1
	Neath Port Talbot	**137,100**	**1.20**	**1.20**	**1.14**	**1.15**	**1.16**	**1.19**	**1.01**	**1.41**	**985**	**1.17**	**1.1**
	Newport	140,500	1.31	1.27	1.19	1.14	1.21	1.07	0.89	1.28	819	1.19	4.8
	Pembrokeshire	116,800	0.97	0.94	1.00	0.95	0.91	0.95	0.78	1.16	822	0.95	0.9
	Powys	130,900	0.47	0.90	0.93	0.88	0.85	0.86	0.71	1.05	772	0.83	0.9
	Rhondda, Cynon, Taff	**234,100**	**1.26**	**1.37**	**1.31**	**1.31**	**1.35**	**1.36**	**1.20**	**1.54**	**1,068**	**1.33**	**1.2**
	Swansea	**227,000**	**1.34**	**1.32**	**1.27**	**1.21**	**1.19**	**1.15**	**1.00**	**1.32**	**925**	**1.24**	**2.2**
	Torfaen	91,000	1.29	1.26	1.19	1.14	1.20	1.09	0.88	1.36	879	1.19	0.9
	Vale of Glamorgan	123,200	0.98	1.08	0.94	0.97	0.93	0.86	0.69	1.06	690	0.96	2.2
	Wrexham	131,000	1.43	1.33	1.20	1.15	1.02	0.97	0.80	1.18	779	1.17	1.1
Scotland	Aberdeen City	207,000	1.08	1.19	1.15	1.09	1.07	1.07	0.93	1.25	841	1.11	2.9
	Aberdeenshire	236,300	0.94	0.93	0.95	0.94	0.95	0.95	0.82	1.10	779	0.94	0.7
	Angus	109,500	1.24	1.31	1.28	1.22	1.13	1.12	0.92	1.35	959	1.21	0.8
	Argyll & Bute	91,200	0.99	0.99	0.89	0.90	0.91	0.84	0.67	1.07	746	0.92	0.8
	Clackmannanshire	48,800	0.83	0.83	0.93	0.81	0.87	0.92	0.66	1.28	738	0.87	0.8
	Dumfries & Galloway	148,000	1.20	1.06	1.05	0.98	0.90	0.95	0.80	1.13	851	1.01	0.7
	Dundee City	142,100	1.32	1.25	1.30	1.35	1.31	1.18	1.00	1.40	936	1.28	3.7
	East Ayrshire	119,300	1.03	1.01	1.08	1.14	1.06	1.07	0.88	1.29	872	1.07	0.7
	East Dunbartonshire	105,700	1.33	1.22	1.11	1.07	0.99	0.89	0.71	1.11	738	1.09	3.1
	East Lothian	92,600	1.07	1.07	0.95	0.93	0.98	0.86	0.68	1.10	713	0.97	0.7
	East Renfrewshire	89,000	1.16	1.14	1.20	1.14	1.09	1.03	0.82	1.29	831	1.12	3.8
	Edinburgh, City of	463,300	1.00	1.02	0.97	0.95	0.93	0.93	0.83	1.04	693	0.96	4.1
	Eilean Siar	25,900	0.72	0.91	0.58	0.59	0.88	0.78	0.49	1.24	695	0.74	0.6
	Falkirk	149,500	1.06	0.99	1.03	0.99	1.09	1.05	0.88	1.25	836	1.04	1.0
	Fife	359,200	0.96	0.96	0.99	0.95	0.93	0.95	0.84	1.07	766	0.96	1.3
	Glasgow City	**580,600**	**1.45**	**1.37**	**1.34**	**1.29**	**1.25**	**1.20**	**1.10**	**1.31**	**878**	**1.31**	**5.5**

Table 4.5. Continued

Region	PCT/LA	Mid-2006 population	2003 O/E	2004 O/E	2005 O/E	2006 O/E	2007 O/E	2008 O/E	2008 LCL	2008 UCL	2008 pmp[a]	2003–2008 O/E	% non-White
Scotland	Highland	215,400	1.04	1.11	1.16	1.10	1.07	1.10	0.96	1.26	938	1.10	0.8
	Inverclyde	**81,300**	**1.45**	**1.40**	**1.37**	**1.25**	**1.15**	**1.30**	**1.05**	**1.61**	**1,058**	**1.31**	**0.9**
	Midlothian	79,000	1.14	1.19	1.14	1.25	1.17	1.10	0.87	1.40	886	1.17	0.9
	Moray	86,700	0.90	0.90	1.03	1.09	0.98	0.98	0.77	1.23	819	0.98	0.9
	North Ayrshire	**135,300**	**1.19**	**1.23**	**1.22**	**1.33**	**1.24**	**1.28**	**1.08**	**1.51**	**1,050**	**1.25**	**0.7**
	North Lanarkshire	323,700	1.23	1.20	1.11	1.07	1.02	0.99	0.88	1.13	763	1.10	1.3
	Orkney Islands	20,000	1.12	1.14	1.13	1.13	0.86	1.05	0.66	1.67	900	1.07	0.4
	Perth & Kinross	140,200	1.05	1.02	0.93	0.90	0.89	0.86	0.71	1.05	742	0.93	1.0
	Renfrewshire	169,300	1.25	1.22	1.22	1.14	1.08	1.04	0.88	1.23	839	1.15	1.2
	Scottish Borders	110,300	0.79	0.82	0.81	0.80	0.90	0.95	0.77	1.16	825	0.85	0.6
	Shetland Islands	*22,000*	*0.68*	*0.80*	*0.61*	*0.50*	*0.71*	*0.50*	*0.26*	*0.96*	*409*	*0.62*	*1.1*
	South Ayrshire	111,900	1.13	1.03	1.08	1.07	1.00	1.00	0.82	1.22	876	1.05	0.7
	South Lanarkshire	307,700	1.21	1.17	1.09	1.04	0.98	0.97	0.86	1.10	777	1.07	1.1
	Stirling	*87,600*	*0.95*	*0.92*	*0.88*	*0.84*	*0.78*	*0.72*	*0.55*	*0.96*	*571*	*0.84*	*1.5*
	West Dunbartonshire	91,100	1.00	1.01	0.93	0.98	0.90	0.88	0.68	1.12	692	0.94	0.7
	West Lothian	165,700	1.08	1.01	1.03	0.98	0.95	0.92	0.77	1.11	694	0.99	1.3
N Ireland	**Antrim**	**51,500**			**1.43**	**1.51**	**1.47**	**1.50**	**1.15**	**1.96**	**1,049**	**1.48**	**0.5**
	Ards	76,000			1.38	1.29	0.99	0.90	0.69	1.18	711	1.13	0.9
	Armagh	56,400			1.39	1.30	1.14	1.23	0.93	1.62	869	1.26	0.5
	Ballymena	61,400			1.13	1.11	1.04	1.07	0.81	1.41	814	1.09	1.3
	Ballymoney	29,300			0.80	0.80	1.00	0.85	0.54	1.35	614	0.87	0.6
	Banbridge	45,400			0.96	1.11	1.07	1.20	0.88	1.64	859	1.09	0.4
	Belfast	**267,600**			**1.23**	**1.22**	**1.25**	**1.20**	**1.05**	**1.36**	**848**	**1.23**	**0.4**
	Carrickfergus	**39,800**			**1.89**	**1.85**	**1.94**	**1.80**	**1.38**	**2.35**	**1,357**	**1.87**	**0.3**
	Castlereagh	**65,600**			**1.51**	**1.54**	**1.36**	**1.31**	**1.03**	**1.66**	**1,037**	**1.42**	**0.4**
	Coleraine	56,900			1.08	1.04	1.05	0.97	0.71	1.31	738	1.03	0.3
	Cookstown	34,600			0.77	0.78	0.73	0.64	0.39	1.07	434	0.73	1.3
	Craigavon	86,800			1.25	1.10	1.12	1.02	0.80	1.31	726	1.12	0.6
	Derry	107,800			1.21	1.26	1.24	1.13	0.91	1.41	742	1.21	0.8
	Down	68,400			1.13	1.18	1.19	1.10	0.84	1.44	789	1.15	0.7
	Dungannon	52,700			0.70	0.69	0.73	0.83	0.58	1.19	569	0.74	0.7
	Fermanagh	60,600			0.89	1.06	1.01	1.00	0.75	1.34	743	0.99	0.8
	Larne	31,400			1.50	1.40	1.31	1.32	0.94	1.85	1,051	1.38	0.4
	Limavady	33,900			1.15	1.13	1.15	1.09	0.74	1.61	737	1.13	0.6
	Lisburn	113,300			1.16	1.11	1.06	1.14	0.92	1.39	803	1.11	0.7
	Magherafelt	42,900			1.35	1.43	1.12	1.13	0.80	1.59	769	1.25	0.7
	Moyle	17,000			0.83	0.96	0.81	0.77	0.41	1.42	588	0.84	0.3
	Newry & Mourne	93,600			1.33	1.16	1.02	1.01	0.79	1.29	684	1.12	0.4
	Newtownabbey	81,400			1.21	1.26	1.20	1.12	0.88	1.41	848	1.19	0.3
	North Down	79,000			1.05	0.98	1.04	1.04	0.82	1.32	835	1.03	1.0
	Omagh	51,200			1.30	1.22	1.17	1.16	0.86	1.58	801	1.21	0.4
	Strabane	39,200			1.08	1.14	1.18	1.19	0.85	1.68	842	1.15	0.8

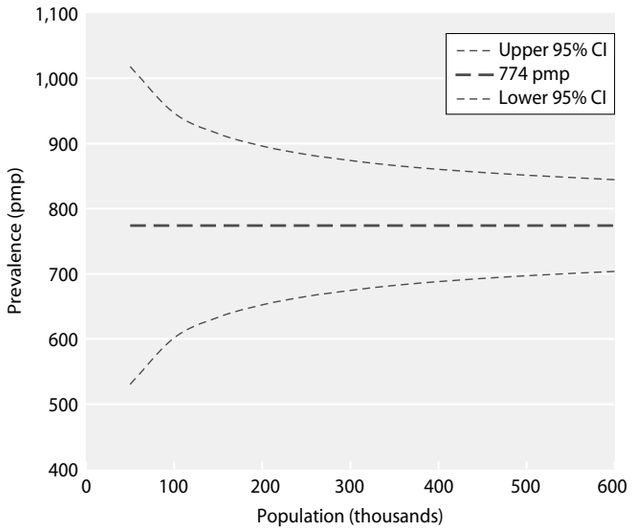

Fig. 4.4. 95% confidence limits for prevalence of 774 pmp for population sizes 50,000–600,000

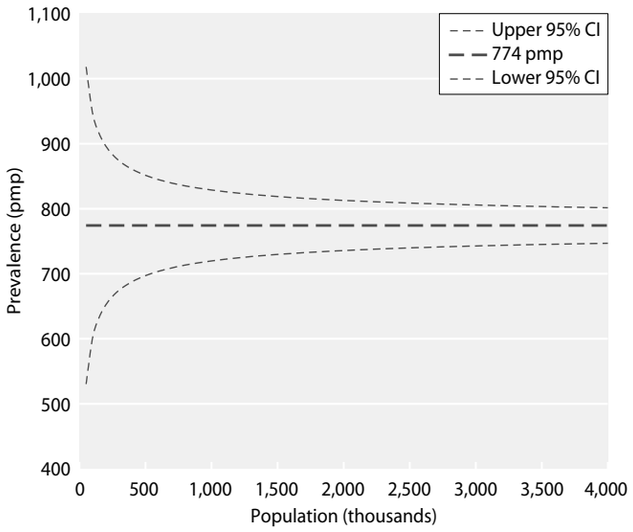

Fig. 4.5. 95% confidence limits for prevalence of 774 pmp for population sizes 50,000–4 million

of transplanted patients (50.4 years). These represented slightly older ages compared with 2007, with the biggest increase in the median age for patients on PD (60.3 years in 2007). Northern Ireland and Wales had a higher proportion (37% and 36% respectively) of prevalent patients on RRT who were aged over 65 years, when compared with England (33%) or Scotland (31%). As a result HD patients in Northern Ireland and Wales and PD patients in Wales were slightly older than in the rest of the UK.

There were however wide inter-centre variations in the median age of patients on RRT (52.0 to 69.9 years). Prevalent dialysis patients in Truro had the highest median age (72.4 years), and London Barts and Manchester RI had the lowest median ages (57.8 years and 58.1 years respectively). The median age of all patients with ERF in transplanting centres was less than in non-transplanting centres (55.7 vs. 60.3 years, $p < 0.001$). The median age of HD patients was slightly

Table 4.6. Summary of the regional distribution of PCT/LA areas with significantly low, normal or significantly high values of SPR and mean (weighted by PCT/LA size) % non-Whites per region on 31/12/2008

Region	SPR group			Total	Mean % non-White	Weighted mean % non-White
	Low	Normal	High			
NE England	2	10	0	12	2.5	2.4
NW England	10	12	2	24	5.9	5.6
Yorkshire & Humber	3	10	1	14	5.5	6.5
East Midlands	4	3	2	9	9.0	6.6
West Midlands	5	5	7	17	12.0	11.4
East of England	9	4	1	14	6.0	4.9
London	2	5	24	31	28.5	28.9
SE England	8	8	1	17	5.4	4.9
SW England	7	6	1	14	2.4	2.3
England	**50**	**63**	**39**	**152**	**10.7**	**9.1**
Wales	**0**	**16**	**6**	**22**	**1.6**	**2.1**
Scotland	**2**	**27**	**3**	**32**	**1.4**	**2.0**
N Ireland	**0**	**22**	**4**	**26**	**0.6**	**0.6**
All Regions	**52**	**128**	**52**	**232**	**7.4**	**8.0**

SPR = standardised prevalence ratio (appendix D, www.renalreg.org)

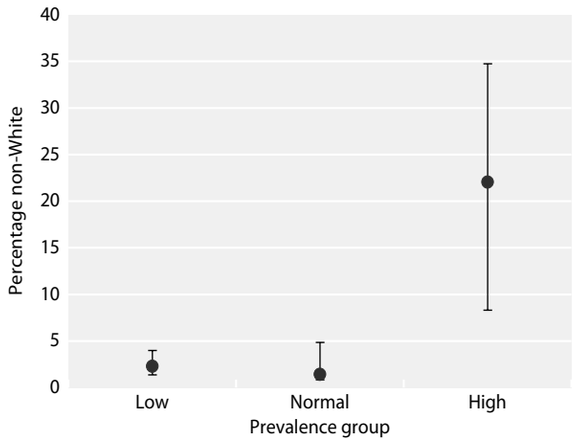

Fig. 4.6. Percentage non-Whites in PCT/LAs with significantly low, normal and significantly high SPR values (median and inter-quartiles) on 31/12/2008

Table 4.7. Median vintage of prevalent RRT patients on 31/12/2008

Modality	Number of patients	Median time treated (years)
Haemodialysis	20,445	2.9
Peritoneal dialysis	4,194	2.0
Transplant	20,844	10.4
All modalities	**45,483**	**5.3**

Median time on RRT is calculated from the most recent start date
Patients with an initial treatment modality of transferred in or transferred out were excluded from the calculation of median time on RRT, since their treatment start date is not accurately known

less in transplanting than in non-transplanting centres (65.0 vs. 66.6, $p < 0.04$), but there was no significant difference in the median ages of PD and transplant patients. This implies that a major factor accounting for the lower median age of RRT patients in transplanting centres was the higher number of transplants patients under follow-up in transplant centres. Transplant centres also tend to be situated in the major cities where there is also a larger proportion of the population from the ethnic minorities (who are younger). The differing age distributions of the transplant and dialysis populations are illustrated in figure 4.8, demonstrating that the age peak for prevalent dialysis patients is around 20 years later than for prevalent transplant patients.

In the UK on 31/12/2008, 59% of patients aged under 65 years on RRT had a functioning transplant (table 4.14) compared with only 22% aged 65 years and over. This was similar in all four UK countries.

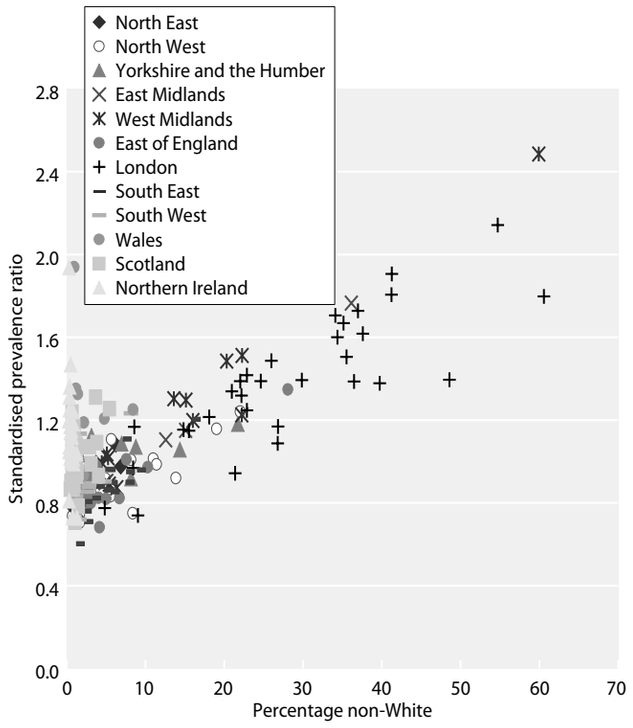

Fig. 4.7a. Ethnicity and standardised prevalence ratios for all PCT/LAs by percentage non-White with available data

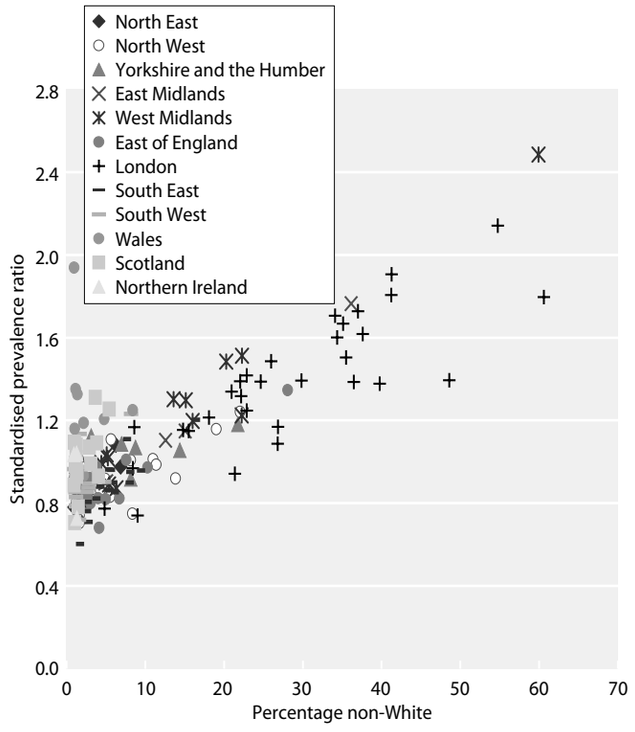

Fig. 4.7b. Ethnicity and standardised prevalence ratios for all PCT/LAs by percentage non-White (excluding low percentage ethnic minority areas <1%)

Table 4.8. Median age of prevalent RRT patients by treatment modality by renal centre on 31/12/2008

Centre	Median age HD	Median age PD	Median age transplant	Median age all	Centre	Median age HD	Median age PD	Median age transplant	Median age all
Abrdn	64.4	51.2	51.7	56.0	L Rfree	64.2	57.5	49.0	55.1
Airdrie	61.4	49.0	45.8	55.8	L St.G	67.4	68.9	51.2	58.3
Antrim	70.8	65.4	49.1	64.3	L West	65.3	62.7	51.6	57.3
B Heart	66.2	64.0	51.7	62.9	Leeds	66.2	54.8	50.0	55.3
B QEH	65.0	57.6	50.3	56.5	Leic	64.3	63.6	49.8	57.7
Bangor	66.6	69.2		68.2	Liv Ain	62.5	37.1		62.5
Basldn	63.7	68.6	47.0	62.5	Liv RI	60.7	56.2	49.8	53.4
Belfast	63.7	52.9	48.6	53.4	M Hope	61.7	58.3	48.3	55.5
Bradfd	61.8	50.8	48.6	54.4	M RI	59.0	56.5	49.3	52.0
Brightn	70.2	65.0	52.1	62.0	Middlbr	67.3	57.5	50.0	57.5
Bristol	67.6	60.4	51.7	58.4	Newc	61.9	58.9	52.1	56.1
Camb	69.5	58.5	49.5	55.8	Newry	66.4	54.6	53.8	62.4
Cardff	67.3	62.1	49.7	56.5	Norwch	68.9	61.7	49.5	62.2
Carlis	67.3	58.3	51.4	58.3	Nottm	65.8	59.2	47.7	55.6
Carsh	68.0	61.8	49.5	59.8	Oxford	65.5	62.8	50.4	55.7
Chelms	69.5	66.9	52.3	62.8	Plymth	71.5	64.7	52.4	59.0
Clwyd	62.1	57.1	53.5	59.6	Ports	66.9	61.9	50.3	56.5
Colchr	68.7			68.7	Prestn	64.0	55.5	51.6	58.2
Covnt	64.3	64.7	48.4	55.7	Redng	68.9	59.4	53.9	60.0
D & Gall	70.8	62.2	47.2	61.1	Sheff	65.9	63.4	50.7	58.2
Derby	66.2	63.6	54.6	63.3	Shrew	66.9	57.5	51.1	60.2
Derry	65.5	65.6	50.0	60.6	Stevng	65.9	61.8	51.7	60.1
Donc	66.7	61.4	52.9	60.7	Sthend	68.1	60.5	56.8	63.5
Dorset	67.4	69.5	55.5	62.0	Stoke	64.4	58.9	48.9	56.2
Dudley	63.5	59.9	58.4	59.9	Sund	62.2	55.6	50.5	55.5
Dundee	68.3	60.9	51.9	60.3	Swanse	68.3	65.4	53.0	62.8
Dunfn	62.5	64.5	50.3	57.7	Truro	74.1	63.9	55.0	64.6
Edinb	61.5	55.8	50.9	55.6	Tyrone	66.8	63.4	43.0	62.0
Exeter	70.7	65.9	49.3	60.5	Ulster	70.7	50.4	53.4	69.9
Glasgw	63.3	59.5	49.2	54.4	Wirral	64.6	61.9		64.5
Glouc	71.9	61.9	52.7	61.5	Wolve	66.9	58.2	47.3	60.7
Hull	65.4	59.0	49.6	57.5	Wrexm	63.6	67.6	50.6	55.8
Inverns	66.6	65.0	48.4	56.6	York	67.5	72.4	50.1	57.3
Ipswi	61.1	61.4	52.1	56.6	**England**	**65.4**	**60.8**	**50.5**	**57.3**
Kent	66.6	60.0	51.2	59.3	**N Ireland**	**66.8**	**59.8**	**49.1**	**59.2**
Klmarnk	65.7	60.6	47.4	59.1	**Scotland**	**64.1**	**59.7**	**49.7**	**56.1**
L Barts	57.8	58.0	49.6	53.8	**Wales**	**67.0**	**64.2**	**50.8**	**59.1**
L Guys	62.9	58.2	49.8	53.1	**UK**	**65.5**	**61.0**	**50.4**	**57.3**
L Kings	61.9	61.8	50.2	56.4					

Blank cells – not applicable

Gender

In 2008, the highest prevalence rates of RRT occurred in the 55–64 year age group for both males and females (figure 4.9). There were however wide inter-centre variations in the male:female ratio of the RRT prevalent population, ranging from 1.2 in Liverpool Aintree to more than 2 in Ipswich, Dudley and Bangor.

Standardising the age of the UK RRT prevalent patients by using the age and gender distribution of the UK population by PCT/LA (from ONS mid-2006 population estimates), allowed estimation of crude prevalence rates by age and gender (figure 4.10). This shows a progressive increase in prevalence rate, peaking at 1,925 pmp in the age group 70–74 years. Crude prevalence rates in males exceeded those of females for all age groups, peaking in age group 75–79 years at 2,582 pmp and for females in age group 70–74 years at 1,408 pmp.

The male:female ratio of the crude prevalence rate was stable with increasing age at around 1.5 until age

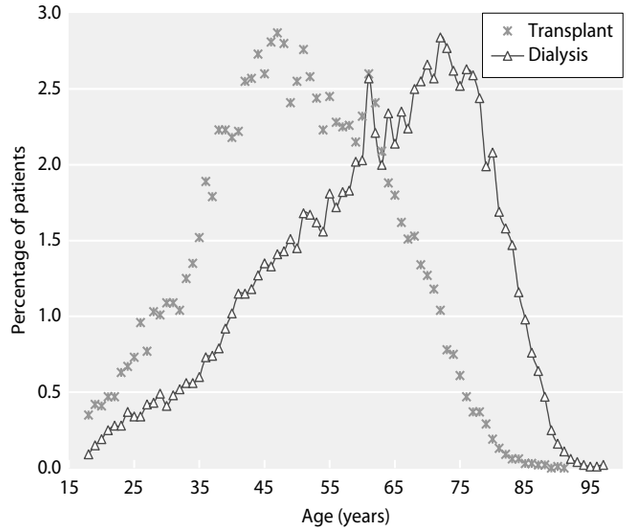

Fig. 4.8. Age profile of prevalent RRT patients on 31/12/2008

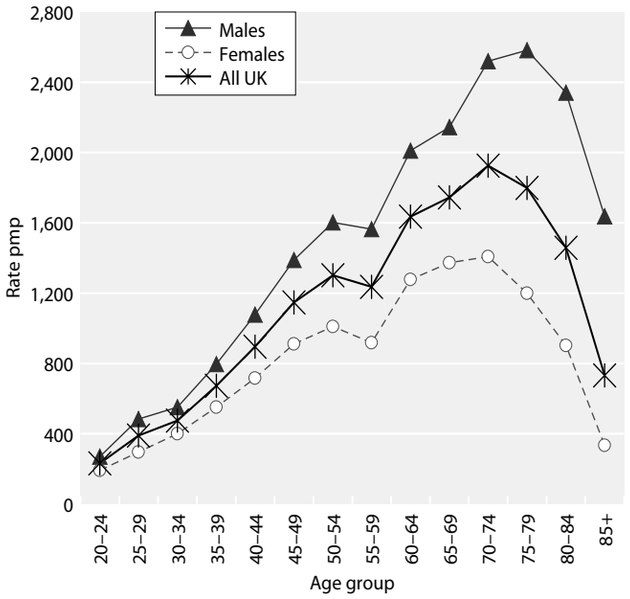

Fig. 4.10. Prevalence rate of RRT patients per million population by age and gender on 31/12/2008

group 65–69 years and then increased markedly thereafter peaking at 4.9 in those over 85 years of age (figure 4.11).

Ethnicity

Thirty-eight of the 72 centres (53%) provided ethnicity data that were at least 90% complete (table 4.9). Ethnicity completeness for prevalent RRT patients improved slightly in the UK from 80.2% in 2007 to 81.0% in 2008 with a big improvement in Wales from 63.5% in 2007 to 75.2% in 2008. Data from 63 centres had greater than 50% ethnicity returns. Ethnicity completeness is generally slightly worse in prevalent PD patients with the best ethnicity completeness recorded for prevalent transplant patients.

In 2008, 15.5% of the prevalent UK RRT population (with assigned ethnicity) were from an ethnic minority and 18.4% in England were from ethnic minorities. The proportions in Wales, Scotland and Northern Ireland were very small, although there was a high level of missing ethnicity data in Scotland (where ethnicity is not a mandated item). This compared with

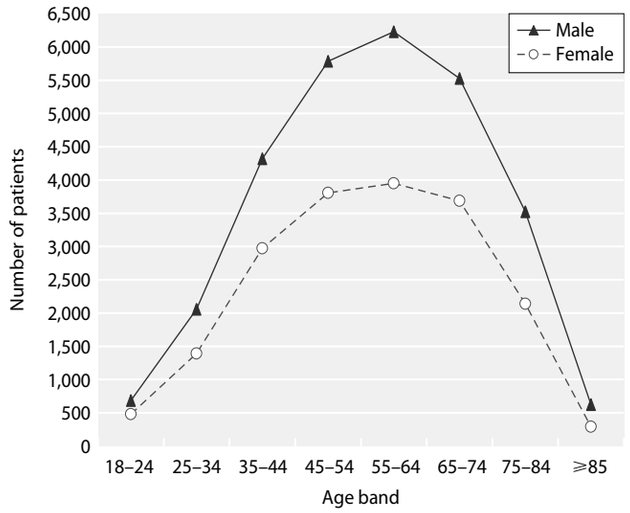

Fig. 4.9. Age profile of prevalent RRT patients by gender 31/12/2008

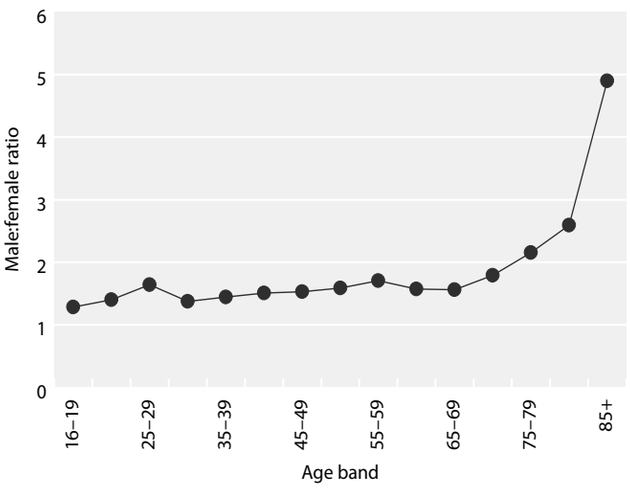

Fig. 4.11. Prevalence rate pmp male:female ratio in UK RRT patients by age-band on 31/12/2008

Table 4.9. Ethnicity of prevalent RRT patients by renal centre on 31/12/2008

Centre	% White	% Black	% Asian	% Chinese	% Other	% Missing
Abrdn	55.9	0.0	0.4	0.4	0.2	43.0
Airdrie	48.6	0.0	0.8	0.4	0.0	50.2
Antrim	98.2	0.0	0.0	0.0	0.0	1.8
B Heart	63.1	7.4	27.8	0.2	1.2	0.3
B QEH	66.7	10.0	20.1	1.0	1.8	0.5
Bangor	72.3	0.9	0.9	0.0	0.0	25.9
Basldn	92.2	3.2	2.8	0.5	0.9	0.5
Belfast	96.3	0.0	0.4	0.3	0.0	3.0
Bradfd	45.2	2.7	32.4	0.0	1.0	18.8
Brightn	51.8	1.1	0.6	0.1	0.7	45.7
Bristol	88.1	3.7	3.0	2.2	0.9	2.2
Camb	87.5	1.0	4.3	0.6	0.8	5.8
Cardff	60.7	0.6	1.8	0.4	0.1	36.5
Carlis	97.5	0.0	0.5	0.0	0.0	2.0
Carsh	69.3	8.3	10.1	1.5	2.7	8.0
Chelms	68.3	2.0	2.5	1.5	0.5	25.2
Clwyd	57.5	0.0	0.0	0.7	0.0	41.8
Colchr	34.7	0.0	1.7	0.8	0.8	61.9
Covnt	77.6	2.7	12.5	0.7	0.1	6.4
D & Gall	9.7	0.0	0.0	0.0	0.0	90.3
Derby	79.2	3.1	11.6	0.5	0.3	5.4
Derry	93.8	0.0	0.0	1.0	0.0	5.2
Donc	95.5	0.6	0.6	0.0	0.0	3.2
Dorset	96.9	0.8	0.8	0.6	1.0	0.0
Dudley	85.6	3.7	8.5	1.1	0.4	0.7
Dundee	63.0	0.0	0.8	0.0	0.3	35.9
Dunfn	24.5	0.0	0.5	0.5	0.5	74.1
Edinb	7.3	0.0	0.7	0.1	0.0	91.8
Exeter	54.4	0.4	0.1	0.1	0.3	44.6
Glasgw	8.4	0.0	1.2	0.2	0.0	90.2
Glouc	83.3	0.6	0.3	0.6	0.0	15.1
Hull	42.4	0.3	0.1	0.3	0.4	56.5
Inverns	51.9	0.0	0.5	0.0	0.0	47.6
Ipswi	92.2	1.4	2.4	0.3	0.3	3.4
Kent	80.3	0.8	1.3	0.1	0.4	17.1
Klmarnk	6.8	0.0	0.0	0.0	0.0	93.2
L Barts	41.3	12.6	24.5	1.8	14.5	5.2
L Guys	55.2	21.2	2.5	1.0	0.1	19.9
L Kings	52.9	31.9	10.6	1.8	0.3	2.6
L Rfree	51.9	19.3	17.7	1.9	7.8	1.3
L St.G	41.2	18.1	8.0	1.1	5.6	26.0
L West	38.2	13.5	20.2	0.6	8.8	18.8
Leeds	61.7	3.1	12.0	0.0	1.0	22.2
Leic	75.1	2.8	16.2	0.2	1.0	4.8
Liv Ain	57.7	0.0	0.8	0.8	0.8	40.0
Liv RI	79.3	1.3	0.9	0.9	0.8	16.9
M Hope	81.7	0.9	13.5	0.4	1.3	2.2
M RI	76.7	5.0	10.6	0.7	0.1	7.0
Middlbr	87.1	0.1	2.9	0.3	0.1	9.4
Newc	95.2	0.2	2.8	0.6	0.8	0.4
Newry	97.5	0.0	0.0	0.6	0.0	1.9
Norwch	77.2	0.4	0.9	0.4	0.2	21.0
Nottm	86.4	5.3	5.8	0.0	0.7	1.7
Oxford	52.6	2.5	4.7	0.4	0.8	39.1
Plymth	60.5	1.6	0.0	0.2	0.5	37.2
Ports	89.3	1.0	2.4	0.6	0.6	6.2

Table 4.9. Continued

Centre	% White	% Black	% Asian	% Chinese	% Other	% Missing
Prestn	81.1	0.9	12.6	0.0	0.6	4.8
Redng	74.2	5.9	16.3	0.9	2.6	0.2
Sheff	79.9	1.7	3.5	0.5	0.8	13.5
Shrew	95.4	0.9	3.1	0.3	0.3	0.0
Stevng	76.6	7.2	14.7	0.7	0.9	0.0
Sthend	55.4	1.0	1.0	1.5	0.0	41.2
Stoke	37.6	0.0	1.8	0.3	0.3	59.9
Sund	92.4	0.9	0.3	0.6	0.3	5.5
Swanse	96.8	0.7	1.0	0.0	0.2	1.4
Truro	59.0	2.0	0.0	0.0	0.0	38.9
Tyrone	98.5	0.7	0.0	0.0	0.0	0.7
Ulster	98.9	0.0	0.0	0.0	0.0	1.1
Wirral	93.5	0.9	0.5	1.4	2.3	1.4
Wolve	73.8	8.4	16.0	0.6	0.2	1.0
Wrexm	98.7	0.0	0.4	0.0	0.4	0.4
York	85.4	0.4	0.0	0.0	0.7	13.5
England	**68.2**	**6.1**	**9.4**	**0.7**	**2.2**	**13.4**
N Ireland	**96.9**	**0.1**	**0.2**	**0.3**	**0.0**	**2.5**
Scotland	**23.7**	**0.0**	**0.8**	**0.2**	**0.1**	**75.2**
Wales	**73.0**	**0.5**	**1.4**	**0.2**	**0.1**	**24.8**
UK	**65.4**	**5.1**	**7.9**	**0.6**	**1.8**	**19.0**

(Appendix G ethnicity coding structure www.renalreg.org)

approximately 11% of the UK general population who were designated as belonging to an ethnic minority.

Among the centres with more than 50% returns, there was wide variation between centres with respect to the proportion of patients from ethnic minorities, ranging from 0% in 2 centres (Antrim, Ulster) to over 40% in London Barts, London Royal Free, London Kings and London West. Centres with an ethnic minority population greater than 10% had the higher number of prevalent patients on RRT (median 909 vs. 294, $p < 0.001$), both on dialysis (502 vs. 182, $p < 0.001$), and with functioning transplants (397 vs. 135, $p < 0.001$). Sixty-five percent of transplanting centres had an ethnic minority population greater than 10% compared with 22% for non-transplanting centres ($p < 0.001$).

As would be expected, ethnicity also affected the median age of the prevalent cohort. Those centres with an ethnic minority population of >10% had a lower median age (57 years vs. 58 years).

Primary renal diagnosis

Data for primary renal diagnosis were not sent in 4.4% of patients and there remained a marked inter-centre difference in completeness of data returns. Where centres had ⩾50% primary renal diagnosis data not sent, the centres were excluded (Colchester 64.4%). The Registry is also concerned about some centres with very high rates of primary renal diagnosis uncertain (EDTA codes 00 and 10). It is accepted that there will inevitably be a number of patients with uncertain aetiology, and that the proportion of these patients will vary between clinicians and centres as the definitions of renovascular disease, hypertensive nephropathy and chronic glomerulonephritis without tissue diagnosis remain relatively subjective. However, some centres with very high rates of uncertain diagnosis appear to have fewer patients with the more objective diagnoses such as polycystic kidney disease or biopsy-proven GN. It is believed that the software in these centres defaults any missing data to 'uncertain' (EDTA code 00). This issue has been raised with the centres and software suppliers and is expected to be resolved for future years. As a result, four centres with ⩾40% 'uncertain' diagnoses (Clwyd 48.6%, Liverpool Aintree 75.4%, Manchester Hope 71.6% and Wirral 42.6%) have been excluded from the inter-centre analysis and the UK and nation totals have been adjusted. They have also been excluded from other analyses where PRD is included in the case-mix adjustment.

Biopsy-proven glomerulonephritis remained the most common specific primary renal diagnosis in the 2008 prevalent cohort at 16.0% (table 4.10) although 20.5% had an uncertain diagnostic code. Diabetes accounted for 14.1% of renal disease in the prevalent patients on

Table 4.10. Primary renal disease in prevalent RRT patients by age and gender on 31/12/2008

Primary diagnosis*	% all patients	Inter-centre range %	% age <65	% age ⩾65	M:F ratio
Aetiology uncertain/GN (not biopsy proven)**	20.5	7.4–36.4	18.1	25.1	1.6
GN (biposy proven)**	16.0	7.4–22.2	18.5	10.7	2.2
Pyelonephritis	12.0	4.1–18.9	13.7	8.6	1.1
Diabetes	14.1	7.7–26.4	13.1	16.0	1.6
Polycystic kidney	9.6	3.6–15.2	10.0	8.7	1.1
Hypertension	5.6	0.5–14.0	4.8	7.1	2.4
Renal vascular disease	3.5	1.0–13.0	1.2	8.3	2.0
Other	14.5	8.1–25.0	16.1	11.2	1.3
Not sent	4.4	0.1–38.9	4.4	4.3	1.5

* See appendix G for ERA-EDTA coding www.renalreg.org
** GN = glomerulonephritis
Excluded centres with ⩾40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Clwyd, Liverpool Aintree, Manchester Hope and Wirral) as well as centres with ⩾50% primary renal diagnosis not sent (Colchester)

RRT, although it was more common in the ⩾65-year age group (16%). This contrasts to the pattern in the 2008 incident cohort group in whom diabetes predominated as the specific diagnostic code. This reflects the different ages and survival of patients with these diagnoses. Younger patients (age <65 years) were more likely to have a specific diagnosis and far less likely to have renal vascular disease or hypertension as the cause of their renal failure.

There was wide inter-centre variation in the proportion of primary renal diagnoses not sent in the RRT prevalent population, with 4 centres having >20% not sent (Exeter 23%, London Royal Free 39%, Manchester RI 35% and Wrexham 28%). Uncertain primary renal diagnosis also ranged widely between centres and 4 centres had >30% uncertain diagnosis (Stevenage 32%, Cambridge 32%, Liverpool RI 36% and Chelmsford 31%).

The male:female ratio was greater than unity for all primary renal diseases. The gender imbalance may be influenced by the presence of factors, such as hypertension, atheroma and renovascular disease, which are more common in males and more common with increasing age and which may increase the rate of progression of kidney failure. As would be expected from the mode of inheritance, adult polycystic kidney disease (APKD) was a major exception, the ratio approximating unity in this condition and this was similar in the incident cohort.

The distribution of patients between the modalities was also influenced by the primary renal diagnosis (table 4.11), particularly the likelihood of having a functioning renal transplant. In younger patients (age <65 years), the ratios of prevalent patients with functioning transplants to those on dialysis were higher for diagnosis pyelonephritis (2.2), glomerulonephritis (1.9) and polycystic kidney disease (1.8) than in the groups with diabetes (0.7) and renal vascular disease (0.7), suggesting a much higher transplant rate in the former groups. In older patients (age ⩾65 years) the transplant rate was generally much lower for all primary renal diseases, with the exception of polycystic kidney disease with a transplant:dialysis ratio of 1.1.

Diabetes

Diabetes included all prevalent patients with type 1 or type 2 diabetes as primary renal diagnosis (ERA-EDTA coding) and did not include patients with diabetes as a comorbidity. This analysis did not differentiate between

Table 4.11. Transplant:dialysis ratios by age and primary renal disease in the prevalent RRT population on 31/12/2008

	Transplant:dialysis ratio	
Primary diagnosis*	<65	⩾65
Aetiology uncertain/ GN (not biopsy proven)**	1.6	0.3
GN (biopsy proven)**	1.9	0.5
Pyelonephritis	2.2	0.3
Diabetes	0.7	0.1
Polycystic kidney	1.8	1.1
Hypertension	1.1	0.3
Renal vascular disease	0.7	0.1
Other	1.6	0.3
Not sent	1.4	0.2

* See appendix G for ERA-EDTA coding www.renalreg.org
** GN = glomerulonephritis
Excluded centres with ⩾40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Clwyd, Liverpool Aintree, Manchester Hope and Wirral) as well as centres with ⩾50% primary renal diagnosis not sent (Colchester).

Table 4.12. Median age, gender ratio and treatment modality in diabetic and non-diabetic prevalent RRT patients on 31/12/2008

	All diabetes	Non-diabetics
Number	6,574	37,646
M:F ratio	1.57	1.54
Median age on 31/12/08	60	57
Median age at start of RRT	56	47
Median years on RRT	2.9	6.2
% HD	61	41
% PD	10	9
% transplant	29	51

Excluded centres with ⩾40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Clwyd, Liverpool Aintree, Manchester Hope and Wirral).
Diabetic patients are patients with a primary renal disease code of diabetes
Non-diabetic patients are calculated as all patients excluding diabetic patients and patients with a missing primary renal disease code

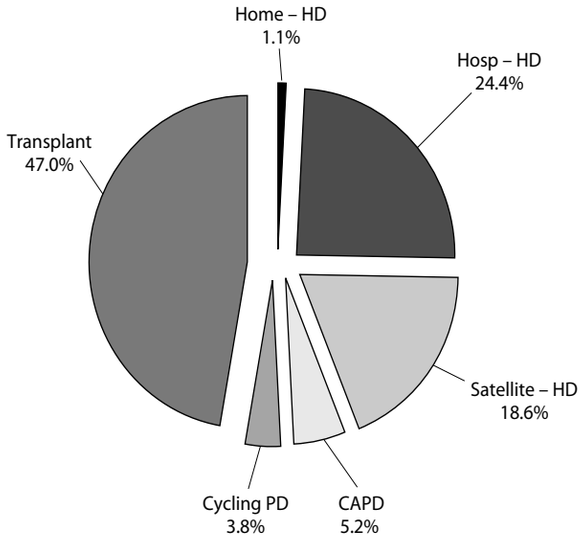

Fig. 4.12. Treatment modality in prevalent RRT patients on 31/12/2008

type 1 and type 2 diabetes, since this distinction was not made in the data submitted by centres in Northern Ireland and some centres in Scotland.

The number of prevalent patients with diabetes as a primary renal diagnosis increased to 6,574 in 2008, representing 14.1% of all prevalent patients (tables 4.10 and 4.12). The median age at start of RRT for diabetic patients was 9 years higher compared to non-diabetics, although the median age at the end of 2008 for diabetic patients was only 3 years higher. This may reflect reduced survival for diabetic patients compared to non-diabetic patients on RRT. Median time on RRT for diabetic patients was less compared to non-diabetics (2.9 years vs. 6.2 years). Diabetic patients starting RRT in Scotland were 4 years younger compared to the UK average.

Diabetes as primary renal diagnosis also influenced the modality distribution. The predominant mode of treatment for diabetics was HD (61%). The percentage of patients with a functioning transplant was much lower in prevalent diabetics than in non-diabetics (29% vs. 51%). As would be expected, this difference was even more pronounced for older diabetic patients (age ⩾65 years) (table 4.13), with only 7.6% of prevalent patients with diabetes having a functioning transplant compared to 25.4% for the non-diabetic peers. In Northern Ireland, only 22% of diabetic patients had a functioning transplant compared to the UK average of 29%.

Modalities of treatment

Transplantation was the most common treatment modality (47%) for prevalent RRT patients in 2008, followed closely by centre-based HD (43%) in either hospital centre (24.4%) or satellite unit (18.6%) (figure 4.12). Home therapies made up the remaining 10% of treatment therapies, largely PD in its different formats (9%). This represented a 1% fall in PD compared to 10.1% of therapies in 2007. The proportion of PD patients on continuous ambulatory peritoneal dialysis

Table 4.13. Age relationships in diabetic and non-diabetic patients and modality in prevalent RRT patients on 31/12/2008

	<65		⩾65	
	Diabetics	Non-diabetics	Diabetics	Non-diabetics
Number	4,100	25,419	2,474	12,227
% HD	48.3	29.5	82.1	63.9
% PD	10.0	7.6	10.3	10.7
% transplant	41.7	63.0	7.6	25.4

Excluded centres with ⩾40% primary renal diagnosis aetiology uncertain/glomerulonephritis (not biopsy proven) (Clwyd, Liverpool Aintree, Manchester Hope and Wirral)
Diabetic patients are patients with a primary renal disease code of diabetes
Non-diabetic patients are calculated as all patients excluding diabetic patients and patients with a missing primary renal disease code

Table 4.14. Treatment modalities by age in UK countries on 31/12/2008

	<65 years			⩾65 years		
UK country	% HD	% PD	% transplant	% HD	% PD	% transplant
England	32.4	8.2	59.4	67.0	10.8	22.3
N Ireland	36.1	7.6	56.3	74.1	6.4	19.5
Scotland	33.3	7.5	59.2	68.9	8.9	22.1
Wales	30.3	8.4	61.3	66.4	14.2	19.5
UK	**32.5**	**8.1**	**59.4**	**67.3**	**10.7**	**22.0**

(CAPD) and cycling PD (automated PD) was 5.2% and 3.8% respectively, though the proportion on cycling PD may be an underestimate due to centre coding issues that mean the Registry cannot always distinguish between CAPD and cycling PD. The term CAPD has been used for patients receiving non-disconnect as well as disconnect CAPD systems, because the proportion of patients using non-disconnect systems was very small. The numbers of patients on home HD has stopped falling and is beginning to show a slight rise (see below).

As mentioned earlier, treatment modality is affected by patient age. Younger patients (age <65 years), were more likely to have a functioning transplant (59%) when compared with patients aged over 65 years (22%) (table 4.14). HD was the principal modality in the older patients (67.3%). There were differences among the four UK countries with respect to the proportion of prevalent patients on PD according to age. England and Wales had a higher proportion of older prevalent patients on PD and Northern Ireland was the only nation with more younger than older patients on PD.

Figure 4.13 clearly shows the affect of age on modality distribution. With increasing age beyond 64 years, transplant prevalence reduced, whilst HD prevalence increased. The proportion of each age group treated by PD remained fairly stable across the age spectrum.

The proportion of prevalent dialysis patients receiving HD, ranged from 66% in Ipswich to 100% in Colchester. In 8 centres the national pattern of a higher percentage of older dialysis patients (age ⩾65 years) receiving HD was reversed (see figure 4.14).

The number of centres (26) with no prevalent HD patients treated at satellite units remained the same as in 2007, although three of these centres were unable to record these data in their renal IT systems. There are 20 satellite units in Scotland but data is not provided to distinguish between main centre and satellite unit haemodialysis treatment. There was an increase in the number of centres from 11 in 2007 to 16 in 2008 that had more than 50% of their HD activity taking place in satellite units (table 4.15 and figure 4.15). There was also wide variation between centres in the proportion of PD patients on cycling treatments, ranging from 0 to 17.8% (table 4.15). Thirteen of the 71 centres with a PD programme, had no patients on cycling PD, whilst in three centres (Liverpool Aintree, Newry and Ulster) all PD patients were on this form of the modality. The majority of centres did not have any patients on connect PD, 7 centres reported small numbers of patients on this modality (Chelmsford, Derby, Derry, London Royal Free, London St George, Manchester RI and Shrewsbury). Cambridge PD patients were all reported as receiving unknown PD and are not included (table 4.15).

Home haemodialysis

The proportion of prevalent dialysis patients on home HD had been declining since the first recorded prevalence numbers in 1982 (43.0%) until 2008 (2.1%) (figure 4.3 and table 4.15). There was a peak in the

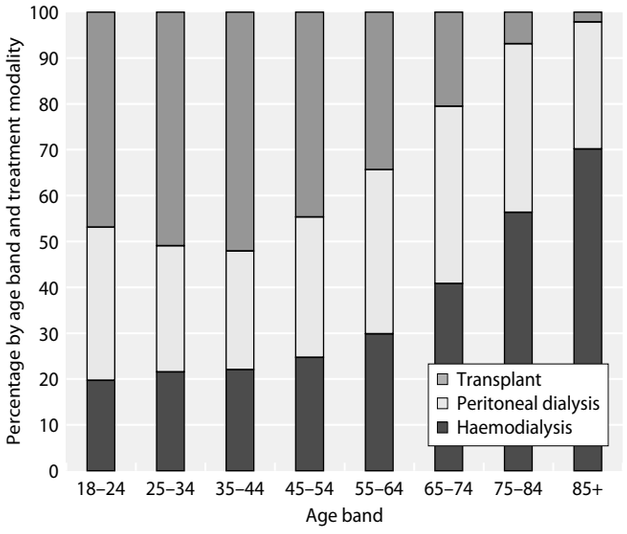

Fig. 4.13. Treatment modality distribution by age in prevalent RRT patients on 31/12/2008

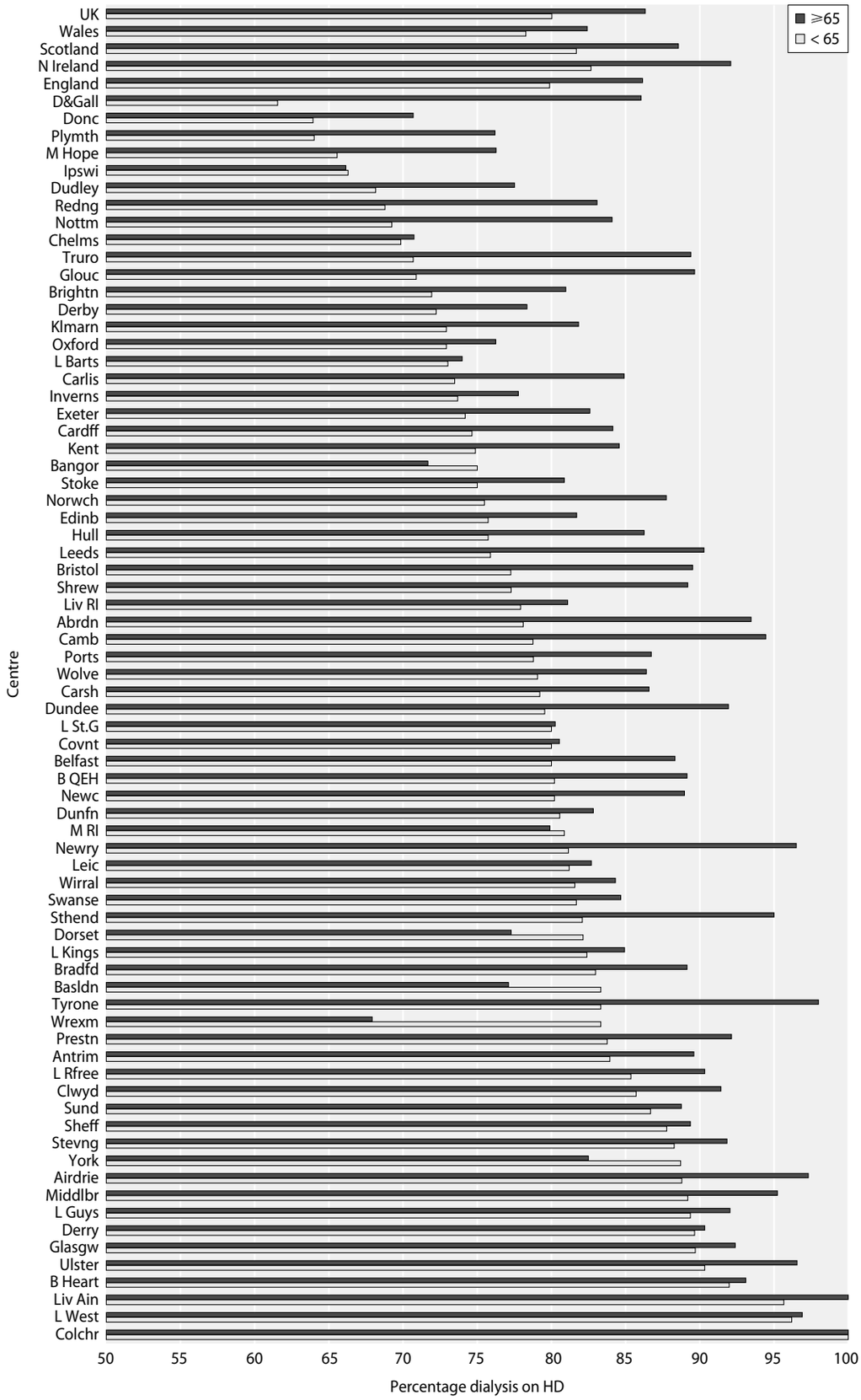

Fig. 4.14. Percentage of prevalent dialysis patients on haemodialysis by age and centre 31/12/08

Table 4.15. Percentage of prevalent dialysis patients by dialysis modality by centre on 31/12/2008

	Haemodialysis				Peritoneal dialysis			
Centre	Total	Home	Hospital	Satellite	Connect	Disconnect	Cycled ⩾6 nights	Cycled <6 nights
Abrdn*	84.8	2.5	82.4	0.0	0.0	9.0	6.2	0.0
Airdrie*	92.4	0.0	92.4	0.0	0.0	0.6	7.0	0.0
Antrim	87.5	1.3	86.2	0.0	0.0	2.6	9.2	0.7
B Heart	92.6	3.2	83.1	6.3	0.0	7.2	0.2	0.0
B QEH	84.4	1.8	19.5	63.2	0.0	8.4	7.2	0.0
Bangor	73.2	4.5	68.8	0.0	0.0	11.6	15.2	0.0
Basldn	80.4	0.0	80.4	0.0	0.0	9.3	9.8	0.6
Belfast	83.7	2.6	80.8	0.3	0.0	3.9	11.9	0.0
Bradfd	85.5	0.0	59.5	26.0	0.0	4.4	10.1	0.0
Brightn	77.3	5.7	40.2	31.4	0.0	12.1	10.6	0.0
Bristol	83.7	5.0	13.1	65.6	0.0	11.7	4.6	0.0
Camb	87.4	1.4	36.6	49.4	0.0	0.0	0.0	0.0
Cardff	79.7	0.3	35.0	44.4	0.0	20.3	0.0	0.0
Carlis	79.4	0.0	52.9	26.5	0.0	4.9	15.7	0.0
Carsh	83.1	0.3	32.7	50.1	0.0	7.3	9.6	0.0
Chelms	70.4	0.7	69.7	0.0	0.7	19.3	7.6	2.1
Clwyd	88.1	1.2	86.9	0.0	0.0	8.3	3.6	0.0
Colchr	100.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
Covnt	80.3	1.8	78.5	0.0	0.0	19.8	0.0	0.0
D & Gall*	76.8	0.0	76.8	0.0	0.0	1.5	13.0	8.7
Derby	75.2	3.8	71.5	0.0	0.3	22.6	1.9	0.0
Derry	90.0	0.0	88.3	1.7	1.7	0.0	8.3	0.0
Donc	67.2	0.0	67.2	0.0	0.0	15.1	16.8	0.8
Dorset	79.3	0.8	24.8	53.8	0.0	10.2	10.2	0.4
Dudley	72.0	1.0	52.3	18.7	0.0	28.0	0.0	0.0
Dundee*	86.1	0.0	86.1	0.0	0.0	1.1	11.8	1.1
Dunfn*	81.6	0.0	81.6	0.0	0.0	2.2	16.2	0.0
Edinb	78.2	2.3	75.9	0.0	0.0	9.2	12.6	0.0
Exeter	79.4	0.3	33.6	45.5	0.0	13.4	6.7	0.5
Glasgw*	90.9	4.1	86.8	0.0	0.0	5.8	3.0	0.3
Glouc	82.1	0.0	82.1	0.0	0.0	4.6	13.3	0.0
Hull	80.8	3.3	42.5	34.9	0.0	7.1	12.2	0.0
Inverns*	75.8	3.3	72.5	0.0	0.0	8.3	15.8	0.0
Ipswi	66.2	1.9	64.3	0.0	0.0	19.8	13.4	0.0
Kent	80.0	1.2	22.0	56.8	0.0	20.0	0.0	0.0
Klmarnk*	77.2	0.5	76.6	0.0	0.0	6.5	8.7	7.6
L Barts	73.4	0.9	38.8	33.6	0.0	8.8	17.8	0.0
L Guys	90.5	5.1	25.6	59.9	0.0	4.2	0.0	5.3
L Kings	83.5	0.0	26.2	57.3	0.0	4.6	11.9	0.0
L Rfree	87.7	1.9	37.0	48.7	0.1	4.1	8.0	0.1
L St.G	80.1	1.8	60.6	17.7	2.5	5.3	12.1	0.0
L West	96.6	0.7	28.2	67.7	0.0	1.6	1.8	0.0
Leeds	82.7	2.9	11.9	67.9	0.0	5.8	11.5	0.0
Leic	81.9	2.1	23.7	56.1	0.0	8.4	9.7	0.0
Liv Ain	97.7	3.1	12.3	82.3	0.0	0.0	2.3	0.0
Liv RI	79.2	1.2	42.6	35.4	0.0	8.8	11.0	1.0
M Hope	69.8	1.6	37.6	30.7	0.0	22.7	6.4	0.2
M RI	80.5	11.4	27.2	41.9	0.2	4.4	11.8	3.1
Middlbr	92.4	1.3	32.3	58.9	0.0	7.3	0.3	0.0
Newc	83.9	3.1	80.8	0.0	0.0	2.5	13.6	0.0
Newry	89.1	1.8	87.3	0.0	0.0	0.0	10.9	0.0
Norwch	82.6	2.5	48.2	31.9	0.0	15.5	0.8	1.1
Nottm	76.3	1.7	46.3	28.2	0.0	9.1	14.7	0.0
Oxford	74.6	3.5	70.4	0.6	0.0	13.3	12.1	0.0

Table 4.15. Continued

	Haemodialysis				Peritoneal dialysis			
Centre	Total	Home	Hospital	Satellite	Connect	Disconnect	Cycled ⩾6 nights	Cycled <6 nights
Plymth	71.1	0.6	70.6	0.0	0.0	18.9	10.0	0.0
Ports	82.9	0.0	32.4	50.5	0.0	17.1	0.0	0.0
Prestn	87.6	4.6	23.1	59.9	0.0	4.4	7.9	0.0
Redng	76.3	0.3	57.4	18.6	0.0	23.7	0.0	0.0
Sheff	88.6	5.7	39.5	43.4	0.0	11.4	0.0	0.0
Shrew	83.3	0.5	52.0	30.8	0.5	16.3	0.0	0.0
Stevng	90.1	0.0	31.0	59.1	0.0	9.9	0.0	0.0
Sthend	89.1	0.0	89.1	0.0	0.0	10.9	0.0	0.0
Stoke	77.7	1.7	47.4	28.6	0.0	7.1	15.1	0.0
Sund	87.6	0.5	67.6	19.5	0.0	7.6	4.9	0.0
Swanse	83.4	3.6	66.8	13.0	0.0	16.6	0.0	0.0
Truro	83.0	1.8	39.2	42.1	0.0	7.6	9.4	0.0
Tyrone	90.8	1.0	89.8	0.0	0.0	1.0	8.2	0.0
Ulster	94.4	1.1	92.1	1.1	0.0	0.0	5.6	0.0
Wirral	82.9	1.9	38.0	43.1	0.0	6.5	10.7	0.0
Wolve	82.9	0.0	25.3	57.6	0.0	16.8	0.3	0.0
Wrexm	75.3	4.0	71.3	0.0	0.0	23.8	0.0	1.0
York	85.2	0.7	51.4	33.1	0.0	14.1	0.7	0.0
England	**82.9**	**2.1**	**40.2**	**40.7**	**0.1**	**9.6**	**6.9**	**0.3**
N Ireland	**87.6**	**1.7**	**85.5**	**0.4**	**0.1**	**2.1**	**9.9**	**0.1**
Scotland*	**84.8**	**2.2**	**82.6**	**0.0**	**0.0**	**5.7**	**8.3**	**1.1**
Wales	**80.5**	**2.0**	**53.8**	**24.6**	**0.0**	**17.9**	**1.5**	**0.1**
UK	**83.1**	**2.1**	**46.0**	**35.0**	**0.1**	**9.5**	**6.8**	**0.4**

* All haemodialysis patients in centres in Scotland are shown as receiving treatment in home or hospital as no information is available regarding numbers using satellite dialysis centres

number of home haemodialysis patients in 1983, when 59% of HD patients were on home HD (about 2,200 patients). With the increase in the HD programme size, number of renal centres and provision of satellite HD there has been a continued fall in numbers of patients on home HD until 2003 when numbers levelled off and stabilised. By 2003 only about 430 patients were on home HD and this number increased gradually over

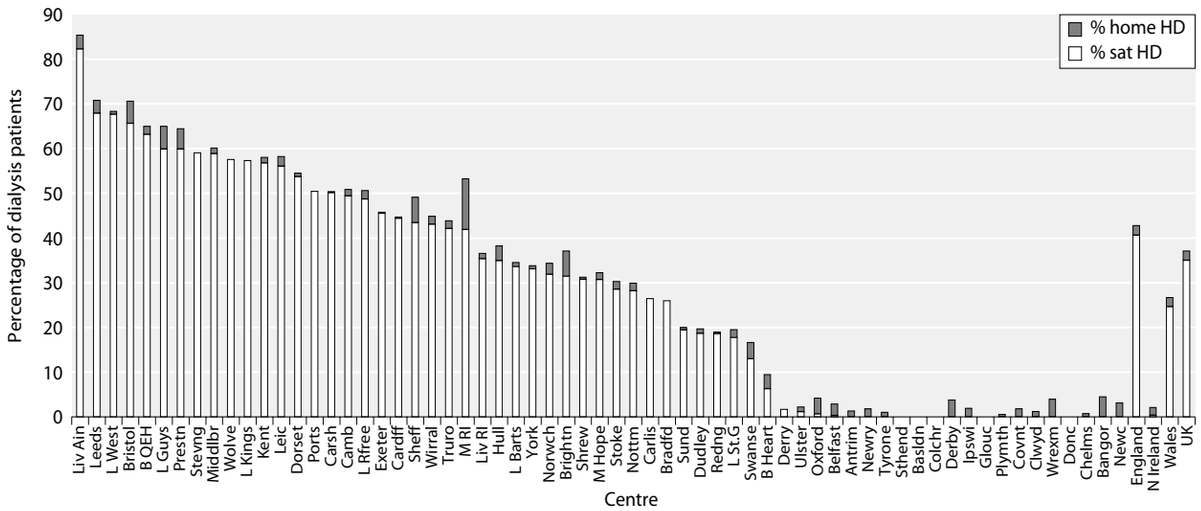

Fig. 4.15. Percentage of prevalent haemodialysis patients treated with satellite or home haemodialysis by centre on 31/12/2008
*Scottish centres excluded as information on satellite HD is not available.

the years, to 530 prevalent patients on home HD in 2008, accounting for 2.5% of the HD patient population. The recent increase in pre-emptive transplantation and live donation rates will also have had an impact on the numbers of patients who would be suitable for a home HD programme.

In 2008, the percentage of dialysis patients receiving home HD varied from 0% in 16 centres, to greater than 5% in 4 centres, namely Brighton 5.7%, London Guys 5.1%, Manchester RI 11.4% and Sheffield 5.7% (table 4.15).

There was some evidence of a slow increase in home HD activity since the NICE guidance was issued. Of those centres with a zero return for home haemodialysis in 2007 [3], 6 centres subsequently reported patients on home HD, namely Carshalton 0.3%, Cardiff 0.3%, Chelmsford 0.7%, Liverpool Aintree 3.1%, Newry 1.8% and Wrexham 4.0%. Notable increases in the proportion of prevalent dialysis patients on home HD in 2008 compared to 2007 [3], were seen at Inverness (1.6% vs. 3.3%), Liverpool Aintree (1.7% vs. 3.1%), Manchester RI (8.6% vs. 11.4%), Newry (0% vs. 1.8%), Preston (3.6% vs. 4.6%), Wirral (0.5% vs. 1.9%) and Wrexham (0% vs. 4.0%).

Change in modality

The relative proportion of RRT modalities in prevalent patients has changed dramatically over the past decade. The main features are depicted in figure 4.16, which describes a sustained decrease in the proportion of patients treated by PD after 2000. One possible explanation may have been that with recent concerns regarding the risk of encapsulating peritoneal sclerosis, patients may be being switched from PD to HD after a fixed time interval. Analysis of UKRR data has shown that this is not the explanation as the vintage of PD patients has not changed substantially over the last 8 years. The reduction in prevalent PD patients is due to a decrease in the number of new patients who are started on peritoneal dialysis. This may be multi-factorial, due to an increase in HD capacity and the effect of patient or physician choice regarding the treatment modality at start of RRT. It may reflect the general health and fitness of patients starting RRT and whether they would be capable of undertaking PD independently, it may also reflect the rise in patients receiving a live related transplant who may otherwise have gone onto PD, and lastly the perceived risk of encapsulating peritoneal sclerosis. With the advent of assisted PD (more commonly used in France) in conjunction with the increasing age of PD patients, there may be potential for some reversal or slowing in this decline.

The proportion of patients treated by HD was still increasing, although at a slower rate, and it may have begun to plateau. The proportion of patients with a functioning transplant had been on a slight downward trend but this was reversed when the proportion increased in both 2007 and 2008, probably due to continued increases in living organ and non-heart beating donation.

Figure 4.17 depicts in more detail the modality changes in the prevalent dialysis population during this time and highlights a sustained reduction in the proportion of patients treated by disconnect PD. There was a sustained increase in the proportion of prevalent HD patients treated at satellite units with a steady decline in hospital centre haemodialysis since 2004.

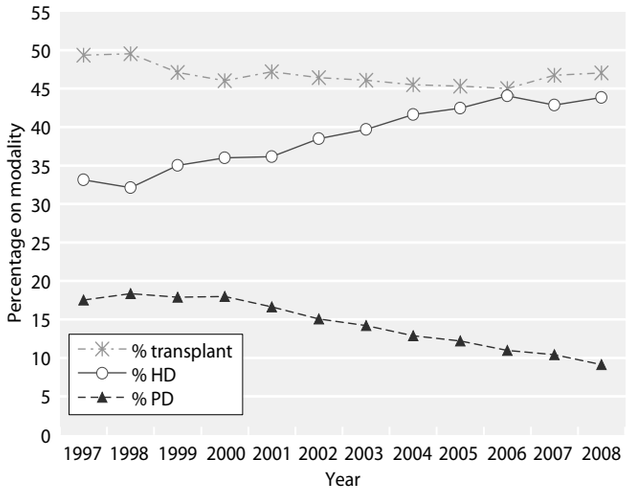

Fig. 4.16. Modality changes in prevalent RRT patients from 1997–2008 (England and Wales)

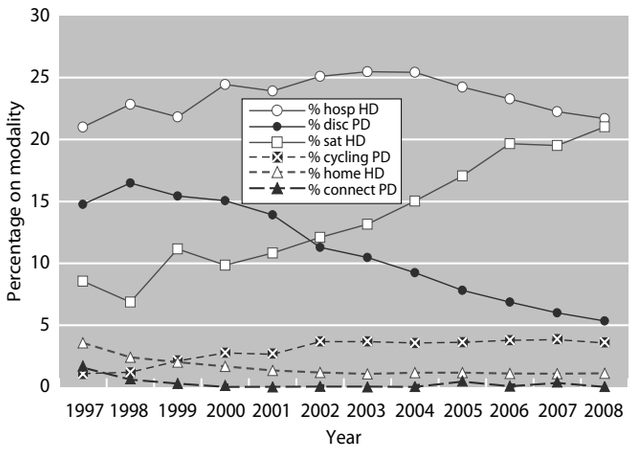

Fig. 4.17. Detailed dialysis modality changes in prevalent RRT patients from 1997–2008 (England and Wales)

Summary

There continues to be growth across the UK in prevalent patients on RRT with national, regional and centre level variation. In general, areas with large ethnic minority populations have high SPRs. This growth is reflected in increasing numbers of patients on HD and with a functioning transplant, and falling numbers on PD. Despite NICE guidance, increases in home HD have remained small and several centres are still unable to offer this modality.

Conflict of interest: none

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Chapter 5
Demographic and Biochemistry Profile of Kidney Transplant Recipients in the UK in 2008: national and centre-specific analyses

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Key Words
Anaemia · Bone metabolism · Chronic kidney disease · Deceased donor · eGFR · Epidemiology · Graft function · Live donor · Outcomes · Quality improvement · Renal transplantation · Survival

Abstract
Introduction: National renal transplant registries routinely report on centre-specific patient and graft survival following renal transplantation. However, other outcomes such as graft function (as measured by eGFR), haemoglobin and blood pressure are also important indicators of quality of care. ***Methods:*** Transplant activity and incident graft survival data were obtained from NHS Blood and Transplant, laboratory and clinical variables and prevalent survival data were obtained from the UK Renal Registry. Data were analysed separately for prevalent and one year post-transplant patients. ***Results:*** Increasing live and non-heartbeating donors were responsible for the increasing transplant activity. Graft failure occurred in 2.9% of prevalent transplant patients and death rates remained stable at 2.4/100 patient years. In transplant recipients with a specified cause of death, 21% died due to malignancy and 21% as a consequence of cardiac disease. There was centre variation in outcomes including eGFR and haemoglobin in prevalent and 1 year post-transplant recipients. Analysis of prevalent transplants by chronic kidney disease stage showed 14.7% with an eGFR <30 ml/min/1.73 m^2 and 2.1% <15 ml/min/1.73 m^2. Of those with CKD stage 5T, 40.4% had Hb concentrations <10.5 g/dl, 25.9% phosphate concentrations $\geqslant 1.8$ mmol/L, 9.0% adjusted calcium concentrations $\geqslant 2.6$ mmol/L and 40.8% PTH concentrations $\geqslant 32$ pmol/L. With the exception of PTH, transplant recipients with CKD stage 5T were less likely to achieve the UK standards compared to prevalent dialysis patients. ***Conclusion:*** Wide variations in clinical and biochemical outcomes amongst transplant recipients continue to exist and may reflect differences in healthcare delivery across the UK.

Introduction

This chapter includes independent analyses regarding renal transplant activity and survival data from the Directorate of Organ Donation and Transplantation (ODT, formally UK Transplant) within NHS Blood and Transplant (NHSBT). The UK Renal Registry (UKRR)

has performed additional analyses of renal transplant recipient data examining demographics, clinical and biochemical variables. Whilst NHSBT records all the information regarding the episode of transplantation (donor and recipient details), 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 further allows for the comparison of key outcomes between centres and provides insight into the processes involved in the care of such patients in the UK.

This chapter is divided into 5 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; and (5) causes of death in transplant recipients. Methodology, results and conclusions of these analyses are discussed in detail for all five sections separately.

Transplant activity, waiting list activity and survival data

Introduction

NHSBT prospectively collects donor and recipient data around the episode of transplantation. They also request transplant centres provide an annual paper based data return on the status of the recipient's 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. Patients whose clinical management subsequently transfers back to a dialysis centre may be lost to NHSBT follow up, but, since all dialysis and transplant renal centres in the UK return data to the UKRR or Scottish Renal Registry, follow-up data are available for such patients.

The UK Renal Registry methodology is described elsewhere [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.

The number preceding the centre name in each figure indicates the percentage of missing data for that centre.

Method

Following a recent period of consolidation and re-organisation, there are now 23 UK adult renal transplant centres with 19 in England, 2 in Scotland and 1 each in Northern Ireland and Wales.

Comprehensive information from 1999 onwards, concerning the number of patients on the transplant waiting list, the number of transplants performed, the number of deceased (heart-beating and non-heartbeating) and living donors, and patient and graft survival is available on the NHSBT website (www.uktransplant.org.uk/ukt/statistics/statistics.jsp).

Results

As of 31st December 2008, there were 9,586 patients (adult and paediatric) active or suspended on the renal, or renal plus other organ waiting list, an increase of 6.8% compared to 2007. During 2008, absolute numbers of live donor and non-heartbeating donor transplants continued to increase and comprised 37% and 18% of all kidney transplants performed respectively (table 5.1). The number of combined pancreas and kidney transplants performed in 2008 fell by 18%.

There are small differences in one year and five year risk-adjusted patient and graft survival rates amongst UK renal transplant centres (table 5.2). These graft survival rates included grafts with primary non-function (excluded in some other countries).

Using data from the UKRR on prevalent renal-only transplant patients on 1/1/2008, the death rate during 2008 was 2.4/100 patient years (CI 2.2–2.6) when censored for return to dialysis and 2.5/100 patient years (CI 2.3–2.8) without censoring for dialysis. These death rates are similar to 2007.

During 2008, 2.9% of prevalent transplant patients experienced graft failure (excluding death as a cause of graft failure). This figure has remained almost constant since 2003.

Conclusions

The increased number of kidney transplants performed in 2008 was mostly due to the growing use of non-heartbeating and living kidney donors. There was little difference in graft survival between UK centres. Graft failure rates remained stable at 2.9% per annum and transplant patient death rates remained similar at 2.4 per 100 patient years.

Transplant demographics

Introduction

Since mid-2008, all 72 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 for the first time. The UKRR is now able to obtain, analyse, and report on a complete national cohort.

The following sections need to be interpreted in the context of variable repatriation policies; some transplant centres continue to follow up and report on all patients they transplant, whereas others refer patients back to non-transplant centres for most or all ongoing post-transplant care. Some transplant centres only refer back patients when their graft is failing. The time post-transplantation that such referral may happen also varies between transplant centres. The UKRR is able to detect duplicate patients (being reported from both transplant and referring centres) and in such situations care is attributed to the referring centre.

Methods

Four centres (Bangor, Colchester, Liverpool Aintree, Wirral) did not have any transplant patients and were excluded from some of the analyses. Their dialysis patients were included in the relevant dialysis population denominators. The nine centres in Scotland do not currently submit laboratory data to the UKRR and were not included in the analyses on post-transplant outcomes.

For the analysis of primary renal disease (PRD) in transplant recipients (table 5.7), five centres (Cambridge, Clwyd, Manchester Hope, Liverpool Aintree, Liverpool RI) were excluded because of concerns relating to the reliability of PRD coding (see chapter 3, figure 3.9).

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 2008. The prevalence of transplant patients in areas covered by individual primary care trusts (PCT) was estimated based on the post code 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 Whites, South Asians, Blacks, Others and Unknown. The details of regrouping of the PAS codes into the above ethnic categories are provided in appendix G. The UKRR requires a standard set of data items regarding comorbid conditions at the time of commencement of renal replacement therapy and first registration of the patient with the UKRR. The detailed methods of comorbidity data collection by the UKRR are described elsewhere [2].

Results and discussion

Prevalent transplant numbers across the 4 UK nations are described in table 5.3.

The prevalence of renal transplant recipients in each PCT in England, Northern Ireland (called District Council), Scotland (called Council Area) and Wales (called Local Authority area) and the proportion of prevalent patients according to modality in the renal centres across the UK are described in tables 5.4 and 5.5 respectively. After standardisation for age and gender, unexplained variability was evident in the prevalence of renal transplant recipients, with some areas having higher or lower than the predicted number of prevalent transplant patients per million population. The UKRR is undertaking further work to study whether this is secondary to differential access to transplantation.

The proportion of prevalent RRT patients with a transplant relative to the number on dialysis has been stable since at least 2000. Whilst the proportion of patients on HD has been increasing, the proportion (and absolute number) on PD has been falling. However, the increasing transplant activity has not been able to keep pace with the number of patients joining the national organ waiting list; the number of patients awaiting kidney-only transplantation increased by 7% between 2007 and 2008.

Age and gender

The gender ratio amongst incident and prevalent transplant patients has remained stable since 2003

Table 5.1. Kidney and kidney plus other organ transplant numbers in the UK, 1st January 2006–31st December 2008

Organ	2006	2007	2008	% change 2007–2008
Heartbeating donor kidney[a]	990	907	944	4
Non-heartbeating kidney[b]	250	300	439	46
Living donor kidney	671	804	924	15
Kidney and liver	17	9	17	89
Kidney and heart	1	1	0	
Kidney and pancreas[c]	138	197	162	−18
Total kidney transplants	**2,067**	**2,218**	**2,486**	**12**

[a] Includes en bloc kidney transplants (3 in 2006, 7 in 2007, 3 in 2008) and double kidney transplants (0 in 2006, 4 in 2007, 1 in 2008)
[b] Includes en bloc kidney transplants (1 in 2006, 1 in 2007, 2 in 2008) and double kidney transplants (11 in 2006, 4 in 2007, 3 in 2008)
[c] Includes non-heartbeating transplants (2 in 2006, 13 in 2007, 16 in 2008) and transplant including liver (1 in 2007)

Table 5.2. Risk-adjusted first adult kidney transplant only, graft and patient survival percentage rates for UK centres[a]

	Deceased donor 1 yr survival		Deceased donor 5 yr survival		Living kidney donor 1 yr survival		Living kidney donor 5 yr survival	
Centre	Graft	Patient	Graft	Patient	Graft	Patient	Graft	Patient
Belfast	95	98	79	88	97	100	94	100
Birmingham	90	96	81	90	93	98	89	97
Bristol	94	97	87	86	97	99	93	100
Cambridge	92	97	83	87	97	100	92	97
Cardiff	91	96	85	91	95	99	84	98
Coventry	98	98	90	89	96	100	90	96
Edinburgh	92	98	83	87	96	98	91	93
Glasgow	93	97	80	84	98	98	91	97
London Guy's	92	97	82	89	97	99	95	94
Leeds	95	97	79	86	98	99	90	93
Leicester	89	89	75	86	95	96	88	93
Liverpool	89	98	80	89	94	97	86	93
Manchester	93	94	81	88	97	100	83	94
Newcastle	93	95	82	84	96	99	92	90
Nottingham	87	96	80	84	93	96	88	97
Oxford	94	97	87	87	98	99	88	97
Plymouth	92	95	74	84	94	98	73	91
Portsmouth	91	94	83	86	93	95	89	90
London Royal Free	94	96	81	88	95	100	87	100
Royal London	96	96	83	85	98	97	80	96
Sheffield	89	99	83	90	98	100	86	96
London St George's	92	98	88	90	98	99	89	95
WLRTC [b]	96	97	87	88	94	99	90	95
All centres	**93**	**96**	**82**	**87**	**96**	**99**	**89**	**95**

[a] 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://www.organdonation.nhs.uk/ukt/statistics/statistics.jsp)
[b] WLRTC = West London Renal and Transplant Centre
Cohorts for survival rate estimation: 1 year survival: 1 Jan 2003–31 Dec 2007; 5 year survival: 1 Jan 1999–31 Dec 2003; 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

(table 5.6 and figure 5.1). The average age of incident transplant patients has slowly increased since 2003. There has also been a small but steady increase in the average age of prevalent transplant patients, which could reflect the increasing age at which patients are transplanted and/or improved survival after renal transplantation over the last 6 years. The prevalent transplant patient workload across the UK has nearly doubled from 12,720 patients in 2003 to 22,300 patients at the end of 2008. The rapid expansion of this patient group suggests the need for careful planning by renal centres for future service provision and resource allocation.

Primary renal diagnosis

Recent years have seen an upward trend in the number of patients with diabetes receiving a kidney transplant, attributed to increasing rates of simultaneous pancreas

Table 5.3. Prevalence of transplants in adults in the UK on 31/12/2008

	England	Wales	Scotland	N Ireland	UK
All UK centres	18,563	1,148	1,979	610	22,300
Total population, mid-2008 (millions)[a]	51.4	3.0	5.2	1.8	61.4
Prevalence pmp transplant	361	384	383	344	363

[a] Estimates from the Office of National Statistics, UK

Table 5.4. The prevalence per million population (pmp) of patients with a renal transplant and standardised rate ratio in the UK, as on 31st December 2004–2008

[a] PCT = Primary Care Trust (England); District Council (N Ireland), Local Authority (Wales) and Council Area (Scotland)
[b] Population numbers based on 2006 mid-year estimates by age group and gender obtained from the ONS
[c] O/E = age and gender standardised acceptance rate ratio
PCTs with significantly high average rate ratios are bold in greyed areas; PCTs with significantly low average rate ratios are italicised in greyed areas
Blank cells = no data returned to the registry for that year

UK Area	Region	PCT/LA[a]	Population covered[b]	Rate pmp					Age and gender standardised rate ratio 2008		
				2004	2005	2006	2007	2008	O/E[c]	L 95% CL	U 95% CL
North East	County Durham and Tees Valley	County Durham	500,400	344	364	366	396	410	1.08	0.94	1.24
		Darlington	99,100	293	313	313	333	363	0.97	0.70	1.35
		Redcar and Cleveland	139,200	438	438	453	481	503	**1.33**	**1.05**	**1.68**
		Hartlepool	91,100	395	373	395	406	373	1.02	0.73	1.43
		Middlesbrough	138,500	397	397	390	397	440	1.26	0.98	1.62
		North Tees	189,200	322	338	381	359	396	1.08	0.86	1.35
	Northumberland Tyne and Wear	Gateshead	190,500	388	430	399	394	399	1.06	0.85	1.33
		Newcastle	270,400	307	322	340	370	374	1.08	0.89	1.32
		North Tyneside	195,100	415	456	441	492	502	**1.33**	**1.09**	**1.62**
		Northumberland	309,900	368	371	368	381	390	0.99	0.83	1.18
		South Tyneside	151,000	344	371	391	424	417	1.12	0.88	1.44
		Sunderland Teaching	280,600	381	364	367	385	396	1.06	0.88	1.28
North West	Cheshire and Merseyside	Wirral	311,100	296	299	318	305	331	0.90	0.74	1.09
		Liverpool	436,200	291	309	307	309	332	0.95	0.81	1.12
		Central and Eastern Cheshire	451,200				299	290	*0.76*	*0.64*	*0.90*
		Western Cheshire	235,100	306	323	306	336	328	0.86	0.69	1.08
		Knowsley	151,500	304	297	304	323	337	0.95	0.72	1.25
		Sefton	277,500	267	274	292	306	303	0.81	0.65	1.00
		Halton and St Helens	297,000	239	259	266	300	330	0.89	0.73	1.08
		Warrington	194,300	273	273	314	386	381	1.01	0.80	1.27
	Cumbria and Lancashire	Blackburn with Darwen	141,200	156	170	177	312	326	0.97	0.73	1.29
		Blackpool	142,800	210	203	224	301	343	0.91	0.69	1.20
		North Lancashire	329,000	219	234	258	322	310	0.83	0.68	1.01
		Cumbria	496,000	260	262	282	317	333	*0.85*	*0.73*	*0.99*
		Central Lancashire	451,600	199	210	233	299	321	0.86	0.73	1.01
		East Lancashire	384,500	257	281	291	398	408	1.11	0.95	1.30
	Greater Manchester	Ashton, Leigh and Wigan	305,500	134	160	203	367	373	0.99	0.82	1.19
		Bolton	262,500	175	213	225	392	434	**1.20**	**1.00**	**1.44**
		Bury	182,900	60	82	98	344	334	0.91	0.71	1.17
		Manchester	451,900				270	288	0.90	0.76	1.07
		Heywood, Middleton and Rochdale	206,400				383	402	1.12	0.91	1.39
		Oldham	219,800	114	114	155	341	359	1.02	0.82	1.27
		Salford	217,800	156	152	156	266	294	0.83	0.65	1.06
		Stockport	280,800				338	356	0.95	0.78	1.15
		Tameside and Glossop	247,700				375	375	1.02	0.83	1.25
		Trafford	212,100				306	344	0.94	0.75	1.18
Yorkshire and the Humber	North and East Yorkshire and Northern Lincolnshire	East Riding of Yorkshire	331,100	227	254	260	299	326	0.83	0.69	1.00
		Hull	256,200	242	262	301	340	359	1.02	0.83	1.25
		North East Lincolnshire	159,900	244	231	263	281	306	0.84	0.63	1.11
		North Lincolnshire	155,200	232	277	296	316	322	0.84	0.64	1.11
		North Yorkshire and York	783,200	260	281	309	326	370	0.97	0.87	1.09
	South Yorkshire	Barnsley	223,700	335	331	358	358	384	1.02	0.82	1.26
		Doncaster	290,400	275	275	310	303	327	0.88	0.72	1.08
		Rotherham	253,000	285	265	296	320	356	0.95	0.77	1.17
		Sheffield	526,100	236	247	266	279	314	0.89	0.76	1.03

Table 5.4. Continued

UK Area	Region	PCT/LA[a]	Population covered[b]	Rate pmp					Age and gender standardised rate ratio 2008		
				2004	2005	2006	2007	2008	O/E[c]	L 95% CL	U 95% CL
Yorkshire and the Humber	West Yorkshire	Bradford and Airedale	493,000	323	341	345	375	387	**1.15**	**1.00**	**1.32**
		Calderdale	198,600	368	393	398	418	448	1.21	0.98	1.49
		Wakefield District	321,000	268	290	296	299	318	0.84	0.70	1.02
		Kirklees	398,400	364	402	424	427	429	**1.20**	**1.03**	**1.39**
		Leeds	750,300	264	272	305	320	337	0.98	0.86	1.11
East Midlands	Leicestershire, Northamptonshire, Rutland and Trent	Leicester City	289,700	418	431	473	501	525	**1.59**	**1.36**	**1.87**
		Leicestershire County and Rutland	673,600	321	343	355	379	410	1.08	0.96	1.22
		Northamptonshire	669,200	179	276	278	302	348	0.94	0.82	1.07
		Nottinghamshire County	657,500	283	295	310	322	330	*0.87*	*0.76*	*0.99*
		Bassetlaw	111,000	207	234	243	288	270	0.70	0.49	1.00
		Derby City	236,400	173	195	228	224	266	*0.76*	*0.59*	*0.97*
		Derbyshire County	720,800	214	223	236	275	298	*0.77*	*0.68*	*0.88*
		Lincolnshire	688,700	267	276	277	280	295	*0.76*	*0.67*	*0.88*
		Nottingham City	286,400	241	244	244	251	258	0.81	0.64	1.01
West Midlands	Birmingham and The Black Country	Dudley	305,200	256	246	252	272	269	*0.71*	*0.58*	*0.89*
		Birmingham East and North	395,900	293	298	328	338	359	1.08	0.91	1.27
		Heart of Birmingham Teaching	271,400	368	391	424	450	479	**1.62**	**1.37**	**1.93**
		South Birmingham	339,400	292	292	298	327	351	1.03	0.86	1.23
		Sandwell	287,700	302	323	330	351	368	1.05	0.86	1.26
		Solihull	203,000	207	236	271	276	286	*0.77*	*0.59*	*0.99*
		Walsall Teaching	254,700	287	298	310	346	365	1.02	0.83	1.24
		Wolverhampton City	236,900	249	245	245	287	308	0.87	0.69	1.09
	Coventry, Warwickshire, Herefordshire, Worcestershire, Shropshire and Staffordshire	Coventry Teaching	306,600	307	326	339	362	382	1.12	0.93	1.34
		Herefordshire	178,000	258	270	292	275	281	*0.72*	*0.54*	*0.94*
		Warwickshire	522,300	347	347	354	362	370	0.97	0.84	1.11
		Worcestershire	553,000	222	248	257	277	288	*0.75*	*0.64*	*0.87*
		North Staffordshire	211,400				293	307	0.80	0.63	1.02
		South Staffordshire	603,500				288	315	*0.82*	*0.71*	*0.94*
		Shropshire County	289,500	200	218	231	276	304	*0.78*	*0.63*	*0.96*
		Stoke on Trent	247,600				319	363	1.00	0.81	1.23
		Telford and Wrekin	161,800	130	124	173	216	241	*0.66*	*0.48*	*0.90*
East of England	Bedfordshire and Hertfordshire	Bedfordshire	403,600	223	253	273	305	337	0.90	0.76	1.07
		Luton	187,200	240	321	363	401	417	1.23	0.98	1.53
		West Hertfordshire	530,600	94	183	198	296	381	1.03	0.90	1.19
		East and North Hertfordshire	527,800	172	250	265	303	330	0.90	0.78	1.05
	Essex	Mid Essex	361,400	227	266	299	321	340	0.90	0.75	1.07
		North East Essex	315,400	193	235	247	263	276	*0.75*	*0.61*	*0.92*
		South East Essex	329,900	167	209	236	276	300	*0.80*	*0.66*	*0.98*
		South West Essex	388,300	203	237	242	304	314	0.87	0.73	1.04
		West Essex	274,700	237	258	273	273	269	*0.72*	*0.57*	*0.91*
	Norfolk, Suffolk and Cambridgeshire	Cambridgeshire	589,600	243	270	287	307	338	0.91	0.80	1.05
		Peterborough	163,400	196	202	239	263	269	0.76	0.57	1.02
		Norfolk	738,900	230	246	281	309	307	*0.80*	*0.70*	*0.91*
		Suffolk	585,300	227	236	265	284	301	*0.80*	*0.69*	*0.93*
		Great Yarmouth and Waveney	210,600	128	123	147	152	209	*0.55*	*0.41*	*0.74*
London	North Central London	Barnet	328,400		305	329	435	460	**1.31**	**1.12**	**1.54**
		Camden	227,200		229	264	295	361	1.05	0.85	1.31
		Enfield	285,400		364	396	431	491	**1.39**	**1.18**	**1.64**
		Haringey Teaching	225,600		288	328	359	408	1.19	0.97	1.45
		Islington	185,500		318	367	431	480	**1.40**	**1.13**	**1.72**

Table 5.4. Continued

UK Area	Region	PCT/LA[a]	Population covered[b]	Rate pmp					Age and gender standardised rate ratio 2008		
				2004	2005	2006	2007	2008	O/E[c]	L 95% CL	U 95% CL
London	North East London	Barking and Dagenham	165,400	230	248	254	290	296	0.91	0.69	1.20
		City and Hackney Teaching	216,200			264	328	361	1.10	0.88	1.37
		Havering	227,500				273	286	*0.77*	*0.61*	*0.99*
		Newham	248,300	226	254	270	294	318	1.02	0.81	1.27
		Redbridge	251,800	258	286	322	353	421	**1.21**	**1.00**	**1.46**
		Tower Hamlets	212,500	174	212	245	254	268	0.86	0.67	1.12
		Waltham Forest	222,100			333	378	401	1.17	0.95	1.45
	North West London	Brent Teaching	271,400			155	497	645	**1.84**	**1.59**	**2.13**
		Ealing	306,400	258	287	307	483	568	**1.60**	**1.38**	**1.86**
		Hammersmith and Fulham	171,400	216	210	257	327	356	1.03	0.80	1.32
		Harrow	214,600				508	648	**1.81**	**1.53**	**2.13**
		Hillingdon	250,100	208	276	296	392	472	**1.35**	**1.13**	**1.62**
		Hounslow	218,600	247	279	320	439	572	**1.62**	**1.36**	**1.94**
		Kensington and Chelsea	178,000				258	298	0.81	0.62	1.06
		Westminster	231,700				272	354	0.99	0.80	1.23
	South East London	Bexley	221,600	370	393	402	451	478	**1.32**	**1.09**	**1.60**
		Bromley	299,400	311	341	364	407	424	1.16	0.97	1.38
		Greenwich Teaching	222,600	211	247	279	332	346	1.02	0.82	1.28
		Lambeth	272,200	198	209	213	287	327	0.95	0.77	1.17
		Lewisham	255,600	360	356	387	454	469	**1.35**	**1.13**	**1.62**
		Southwark	269,000	361	390	409	454	461	**1.35**	**1.13**	**1.61**
	South West London	Croydon	337,000	214	228	279	326	344	0.96	0.80	1.16
		Kingston	156,000				365	378	1.06	0.82	1.37
		Richmond and Twickenham	179,500				228	273	*0.74*	*0.56*	*0.97*
		Sutton and Merton	382,000				385	398	1.11	0.95	1.31
		Wandsworth	279,200				383	390	1.15	0.95	1.38
South East	Hampshire and Isle of Wight	Isle of Wight National Health Service	138,200	304	297	297	289	333	0.86	0.64	1.15
		Hampshire	1,265,900	283	285	312	331	361	0.96	0.87	1.05
		Portsmouth City Teaching	196,300	336	321	331	341	367	1.08	0.86	1.36
		Southampton City	229,100	288	301	323	345	358	1.07	0.86	1.33
	Kent and Medway	West Kent	662,600				367	397	1.06	0.94	1.20
		Medway	251,900				353	409	1.13	0.93	1.37
		Eastern and Coastal Kent	720,400				312	357	0.97	0.86	1.10
	Surrey and Sussex	Hastings and Rother	176,200	216	238	238	267	289	0.77	0.58	1.01
		Brighton and Hove City	251,500	203	211	243	282	306	0.86	0.69	1.07
		East Sussex Downs and Weald	330,200	233	224	218	270	297	*0.79*	*0.64*	*0.96*
		Surrey	1,073,400	229	243	282	346	367	0.98	0.89	1.08
		West Sussex	770,600	244	263	285	328	350	0.94	0.83	1.05
	Thames Valley	Milton Keynes	230,100	256	278	300	339	352	0.97	0.78	1.20
		Berkshire East	382,200	277	267	283	411	445	**1.25**	**1.07**	**1.45**
		Berkshire West	445,400	323	269	281	384	424	**1.17**	**1.01**	**1.34**
		Oxfordshire	607,400	352	367	400	410	430	**1.19**	**1.06**	**1.35**
		Buckinghamshire	500,700	314	340	387	417	415	1.11	0.97	1.27
South West	Avon, Gloucestershire and Wiltshire	Bath and North East Somerset	175,600	233	251	262	279	285	0.79	0.60	1.04
		Bristol	410,700	377	382	402	426	458	**1.34**	**1.16**	**1.55**
		Gloucestershire	578,500	304	323	327	334	342	0.91	0.79	1.04
		Swindon	192,600	317	332	337	343	369	1.01	0.80	1.27
		South Gloucestershire	254,200	366	382	393	433	441	1.18	0.98	1.41
		Wiltshire	448,600	245	256	279	303	319	0.85	0.72	1.00

Table 5.4. Continued

UK Area	Region	PCT/LA[a]	Population covered[b]	Rate pmp					Age and gender standardised rate ratio 2008		
				2004	2005	2006	2007	2008	O/E[c]	L 95% CL	U 95% CL
South West	Dorset and Somerset	Bournemouth and Poole	297,900	282	309	329	369	349	0.96	0.79	1.16
		Dorset	403,100	283	308	337	380	397	1.02	0.88	1.20
		North Somerset	201,200	408	388	388	348	383	1.00	0.80	1.25
		Somerset	518,800	303	326	339	353	357	0.94	0.81	1.08
	South West Peninsula	Devon	740,600	270	274	301	336	356	0.93	0.83	1.05
		Plymouth Teaching	247,900	343	395	420	436	480	**1.34**	**1.12**	**1.61**
		Torbay	133,000	271	301	323	361	421	1.11	0.85	1.44
		Cornwall and Isles of Scilly	526,200	279	312	333	371	410	1.06	0.92	1.21
Wales	Bro Taf	Cardiff	317,500	359	381	406	435	450	**1.34**	**1.14**	**1.58**
		Merthyr Tydfil	55,800	484	520	520	591	609	**1.65**	**1.18**	**2.31**
		Rhondda, Cynon, Taff	234,100	393	436	483	500	521	**1.43**	**1.20**	**1.71**
		Vale of Glamorgan	123,200	317	300	308	308	325	0.88	0.64	1.20
	Dyfed Powys	Carmarthenshire	177,800	326	343	371	366	399	1.05	0.83	1.32
		Ceredigion	77,100	324	298	272	285	324	0.87	0.59	1.29
		Pembrokeshire	116,800	300	334	317	342	334	0.87	0.64	1.19
		Powys	130,900	229	229	267	290	321	0.82	0.60	1.10
	Gwent	Blaenau Gwent	69,500	403	388	403	446	432	1.16	0.81	1.66
		Caerphilly	171,300	362	379	397	426	467	**1.27**	**1.02**	**1.58**
		Monmouthshire	87,800	456	490	490	490	513	1.31	0.98	1.76
		Newport	140,500	363	335	313	363	370	1.03	0.79	1.36
		Torfaen	91,000	451	451	462	505	516	**1.40**	**1.05**	**1.86**
	Morgannwg	Bridgend	132,600	370	400	415	437	498	**1.33**	**1.04**	**1.69**
		Neath Port Talbot	137,100	306	328	401	387	408	1.08	0.83	1.40
		Swansea	227,000	352	366	370	388	392	1.07	0.87	1.32
	North Wales	Conwy	111,300	314	305	305	305	332	0.87	0.63	1.20
		Denbighshire	95,900	240	292	282	271	292	0.77	0.53	1.12
		Flintshire	150,000	260	280	293	360	393	1.03	0.80	1.33
		Gwynedd	118,200	271	305	288	355	321	0.87	0.63	1.19
		Isle of Anglesey	68,800	203	203	203	218	233	*0.60*	*0.37*	*0.98*
		Wrexham	131,000	328	313	359	336	405	1.08	0.83	1.41
Scotland	Scotland	Aberdeen City	207,000	319	324	338	343	357	0.96	0.76	1.20
		Aberdeenshire	236,300	309	334	343	355	360	0.92	0.74	1.13
		Angus	109,500	539	539	575	566	584	**1.50**	**1.17**	**1.91**
		Argyll & Bute	91,200	252	263	340	351	428	1.07	0.78	1.46
		Scottish Borders	110,300	227	254	245	272	308	0.78	0.56	1.09
		Clackmannanshire	48,800	246	266	266	266	266	0.69	0.40	1.20
		West Dunbartonshire	91,100	307	296	318	373	362	0.97	0.69	1.36
		Dumfries & Galloway	148,000	311	318	331	351	399	0.99	0.77	1.28
		Dundee City	142,100	366	366	408	415	443	1.23	0.96	1.57
		East Ayrshire	119,300	268	277	293	285	319	0.83	0.60	1.14
		East Dunbartonshire	105,700	426	435	435	464	445	1.15	0.87	1.54
		East Lothian	92,600	335	313	292	302	292	0.76	0.52	1.11
		East Renfrewshire	89,000	416	427	438	472	506	**1.34**	**1.00**	**1.80**
		Edinburgh, City of	463,300	283	311	291	309	328	0.91	0.78	1.07
		Falkirk	149,500	301	321	288	341	368	0.97	0.74	1.26
		Fife	359,200	259	281	292	290	323	0.86	0.71	1.03
		Glasgow City	580,600	370	382	394	417	437	**1.23**	**1.09**	**1.39**
		Highland	215,400	292	320	348	367	422	1.06	0.87	1.31
		Inverclyde	81,300	344	381	344	332	381	1.00	0.71	1.43
		Midlothian	79,000	291	304	316	367	468	1.23	0.89	1.70
		Moray	86,700	311	369	404	415	415	1.06	0.77	1.48

Table 5.4. Continued

UK Area	Region	PCT/LA[a]	Population covered[b]	Rate pmp					Age and gender standardised rate ratio 2008		
				2004	2005	2006	2007	2008	O/E[c]	L 95% CL	U 95% CL
Scotland	Scotland	North Ayrshire	135,300	333	384	421	451	480	1.26	0.99	1.60
		North Lanarkshire	323,700	312	331	340	349	386	1.04	0.87	1.24
		Orkney Islands	20,000	500	550	550	400	500	1.26	0.68	2.34
		Perth & Kinross	140,200	321	328	335	342	350	0.90	0.68	1.19
		Renfrewshire	169,300	360	384	413	437	449	1.18	0.94	1.47
		Shetland Islands	22,000	318	273	273	273	227	0.58	0.24	1.40
		South Ayrshire	111,900	357	357	375	384	420	1.07	0.80	1.42
		South Lanarkshire	307,700	367	377	377	383	393	1.04	0.87	1.24
		Stirling	87,600	263	251	240	228	228	*0.61*	*0.40*	*0.95*
		West Lothian	165,700	344	368	332	350	368	0.98	0.76	1.26
		Eilean Siar	25,900	232	270	270	347	309	0.77	0.38	1.53
Northern Ireland	Northern Ireland	Antrim	51,500		350	427	447	485	1.39	0.94	2.06
		Ards	76,000		342	342	342	342	0.91	0.62	1.33
		Armagh	56,400		301	337	337	390	1.14	0.75	1.73
		Ballymena	61,400		228	261	277	309	0.86	0.55	1.35
		Ballymoney	29,300		171	239	205	171	0.49	0.20	1.17
		Banbridge	45,400		286	308	352	374	1.06	0.66	1.70
		Belfast	267,600		310	329	344	344	1.03	0.84	1.27
		Carrickfergus	39,800		503	503	503	528	1.45	0.95	2.23
		Castlereagh	65,600		366	427	442	457	1.24	0.87	1.78
		Coleraine	56,900		211	193	193	211	0.59	0.33	1.04
		Cookstown	34,600		58	87	87	116	*0.35*	*0.13*	*0.92*
		Craigavon	86,800		288	300	288	276	0.80	0.54	1.19
		Derry	107,800		297	334	343	343	1.04	0.75	1.43
		Down	68,400		234	249	263	263	0.76	0.48	1.20
		Dungannon	52,700		190	190	228	190	0.57	0.30	1.05
		Fermanagh	60,600		165	215	198	215	0.60	0.35	1.04
		Larne	31,400		573	510	510	510	1.36	0.83	2.22
		Limavady	33,900		354	324	324	354	1.03	0.59	1.82
		Lisburn	113,300		344	406	424	459	**1.32**	**1.01**	**1.74**
		Magherafelt	42,900		396	396	443	466	1.39	0.90	2.16
		Moyle	17,000		294	353	294	353	0.97	0.44	2.16
		Newry & Mourne	93,600		374	353	363	374	1.12	0.80	1.56
		Newtownabbey	81,400		319	393	393	381	1.06	0.74	1.50
		North Down	79,000		316	304	342	367	0.98	0.68	1.41
		Omagh	51,200		215	273	293	352	1.03	0.65	1.63
		Strabane	39,200		255	332	357	332	0.97	0.56	1.67

kidney transplantation (table 5.7). However in 2008, there was a reduction in the number of diabetic patients receiving a renal transplant. This coincided with a fall in the number of simultaneous pancreas kidney transplants performed in 2008. The proportion of patients transplanted with other primary renal diagnoses has remained stable from 2007.

Ethnicity

It was difficult to compare the proportion of patients within each ethnic group receiving a transplant to those commencing dialysis from the same group because data on ethnicity were missing in a considerable number of patients, who were classified as ethnicity 'unknown' (table 5.8). The percentages of patients with unknown ethnicity between 2003 and 2007 are different to those in last year's chapter [3]; this reflects retrospective input of ethnicity data, improving data completeness.

Comorbidity

Although most renal centres' renal IT system contained fields for annual comorbidity data capture, these

Table 5.5. Distribution of prevalent patients on RRT by centre and modality on 31/12/2008

Centre	Total	% HD	% PD	% transplant
Transplant centres				
B QEH	1,714	47	9	44
Belfast	726	36	7	57
Bristol	1,247	36	7	57
Camb	927	39	5	56
Cardff	1,410	35	9	56
Covnt	745	43	10	47
Edinb	695	39	11	50
Glasgw	1,568	41	4	55
L Barts	1,526	41	15	43
L Guys	1,431	36	4	60
L Rfree	1,510	43	6	51
L St G	624	36	9	55
L West	2,570	48	2	50
Leeds	1,342	36	8	56
Leic	1,660	44	10	46
Liv RI	1,200	34	9	58
M RI	1,422	29	7	64
Newc	901	30	6	64
Nottm	944	42	13	45
Oxford	1,306	27	9	63
Plymth	443	29	12	59
Ports	1,268	35	7	57
Sheff	1,216	50	6	44
Dialysis centres				
Abrdn	456	45	8	46
Airdrie	245	65	5	30
Antrim	220	60	9	31
B Heart	594	69	6	25
Bangor	112	73	27	0
Basldn	217	64	16	20
Bradfd	414	47	8	45
Brightn	722	45	13	41
Carlis	203	40	10	50
Carsh	1,249	50	10	39
Chelms	202	51	21	28
Clwyd	146	51	7	42
Colchr	118	100	0	0
D & Gall	113	47	14	39
Derby	389	62	20	18
Derry	96	56	6	38
Donc	154	52	25	23
Dorset	513	41	11	48
Dudley	270	51	20	29
Dundee	370	44	7	49
Dunfn	220	50	11	38
Exeter	708	45	12	43
Glouc	324	49	11	40
Hull	696	46	11	43
Inverns	212	43	14	43
Ipswi	294	35	18	47
Kent	714	45	11	43
Klmarnk	263	54	16	30
L Kings	784	53	10	37
Liv Ain	130	98	2	0
M Hope	758	41	18	41

Table 5.5. Continued

Centre	Total	% HD	% PD	% transplant
Middlbr	682	43	4	54
Newry	158	62	8	30
Norwch	567	53	11	35
Prestn	873	51	7	42
Redng	578	45	14	41
Shrew	325	57	11	32
Stevng	580	63	7	30
Sthend	204	64	8	28
Stoke	603	45	13	42
Sund	343	47	7	46
Swanse	585	59	12	29
Truro	293	48	10	42
Tyrone	136	65	7	28
Ulster	95	88	5	6
Wirral	216	83	17	0
Wolve	489	62	13	26
Wrexm	223	34	11	55
York	274	44	8	48
England	**39,476**	**44**	**9**	**47**
N Ireland	**1,431**	**50**	**7**	**43**
Scotland	**4,142**	**44**	**8**	**48**
Wales	**2,476**	**43**	**10**	**46**
UK	**47,525**	**44**	**9**	**47**

Table 5.6. Median age and gender ratio of incident and prevalent transplant patients 2003–2008

	Incident transplants			Prevalent transplants[a]		
Year	N	Median age	M:F ratio	N	Median age	M:F ratio
2003	1,540	44.5	1.5	12,720	49.5	1.6
2004	1,710	45.3	1.7	14,904	49.7	1.6
2005	1,778	45.3	1.5	16,694	49.7	1.6
2006	2,004	45.2	1.6	17,729	49.9	1.6
2007	2,147	45.6	1.5	20,854	50.2	1.5
2008	2,351	46.3	1.5	22,300	50.4	1.5

[a] As on 31st December for given year

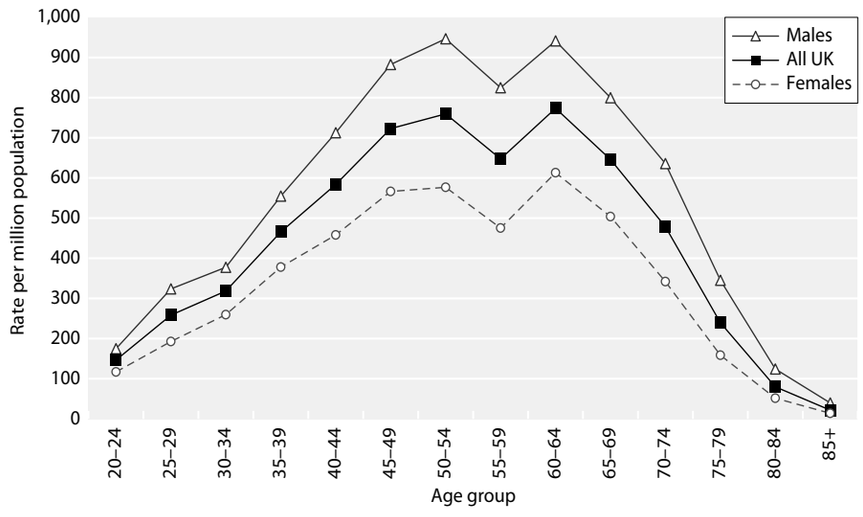

Fig. 5.1. Transplant prevalence rate per million population by age and gender on 31/12/2008

Table 5.7. Primary renal disease in renal transplant recipients 2004–2008

	New transplants by year						Established transplants on 1/1/2008	
Primary diagnosis	2004 %	2005 %	2006 %	2007 %	2008 %	2008 N	%	N
Aetiology uncertain/GN[a] not biopsy proven	18.5	16.8	16.1	16.6	17.2	362	18.9	3,640
Diabetes	11.6	13.0	13.3	14.4	12.4	262	8.3	1,596
Glomerulonephritis	20.6	20.4	20.1	20.3	18.7	395	20.0	3,851
Polycystic kidney disease	13.1	11.6	12.4	13.4	13.0	273	12.2	2,361
Pyelonephritis	12.5	12.1	12.2	12.1	12.2	257	15.4	2,963
Reno-vascular disease	6.9	6.9	6.5	5.5	6.4	135	5.6	1,086
Other	13.1	14.3	15.3	14.7	15.2	321	15.4	2,974
Not available	3.6	5.0	4.3	3.2	4.8	102	4.3	829

[a] GN = glomerulonephritis

Table 5.8. Ethnicity of patients who received a transplant in the years 2003–2008

Year	% White	% South Asian	% African Caribbean	% Other	% Unknown
2003	73.5	5.9	4.6	2.0	14.0
2004	72.5	7.2	4.4	2.2	13.8
2005	73.8	7.2	5.3	1.3	12.3
2006	72.5	7.9	6.1	2.5	11.0
2007	71.5	7.5	5.4	2.5	13.0
2008	66.9	7.9	5.8	2.7	16.7

Northern Ireland centres included from 2005 onwards

fields were mostly incomplete. The UKRR therefore has not attempted to analyse the development of comorbidity after the start of RRT. Data completeness for comorbidities at the start of RRT was also poor at 46.1% for incident patients between 2003 and 2008. With this caveat in mind, it appears that transplanted patients have less comorbidity in comparison to dialysis patients not transplanted or those who died (table 5.9). This is however, a very simplistic comparison as the non-transplanted cohort included patients who were active on the waiting list and also patients deemed unfit for transplantation, who were likely to have more comorbidity than those on the waiting list.

If every renal centre consistently reported the comorbidity of their RRT population, it would be possible to determine whether there are between-centre differences

Table 5.9. Comorbidity amongst incident patients (2003–2008) who underwent transplantation (by the end of 2008) compared to those who remained on dialysis or died

	Not transplanted		Transplanted		
Comorbidity	N	%	N	%	p value[a]
Patients with comorbidity data	12,408		2,501		
No comorbidity present	5,003	40.3	1,891	75.6	
Ischaemic heart disease	3,212	26.2	132	5.3	<0.0001
Cerebrovascular disease	1,352	10.9	65	2.6	<0.0001
Diabetes (not listed as PRD)	1,111	9.1	67	2.7	<0.0001
COPD	961	7.8	40	1.6	<0.0001
Liver disease	354	2.9	28	1.1	<0.0001
Peripheral vascular disease	1,632	13.3	68	2.7	<0.0001
Smoking	1,796	15.0	308	12.5	0.0016
Malignancy	1,656	13.4	42	1.7	<0.0001

[a] Chi square p value comparing proportion with comorbidity between groups

in the degree of comorbidity amongst wait-listed and transplanted patients.

Clinical and laboratory outcomes

Introduction

There continues to be marked variation in the completeness of data (tables 5.10a and b) reported by each centre, particularly for blood pressure. Better data returns (or possibly better extraction of data held within renal IT systems) would facilitate more meaningful comparisons between centres and help to determine the causes of between-centre differences in outcomes. For this reason, along with differences in repatriation policies of prevalent transplant patients between centres as highlighted previously, caution needs to be exercised when comparing performance between centres.

The 72 renal centres in the UK comprise 52 centres in England, 5 in Wales, 6 in Northern Ireland and 9 in Scotland. Centres in Scotland only provide summary information and therefore laboratory outcome data for comparisons were not available for the Scottish renal centres. Four centres (Bangor, Colchester, Liverpool Aintree, Wirral) were reported as having no transplanted patients and were therefore excluded. After exclusion of these 13 centres, prevalent patient data from 59 renal centres across the UK were analysed.

Table 5.10a. Percentage completeness by centre for prevalent transplant patients[a] on 31/12/2008

Centre	Total number of patients	Ethnicity	eGFR[b]	Blood pressure	Centre	Total number of patients	Ethnicity	eGFR[b]	Blood pressure
Antrim	66	100.0	95.5	95.5	Leic	738	92.1	93.5	37.9
B Heart	148	100.0	87.2	0.0	Liv RI	674	93.8	90.5	78.0
B QEH	730	99.6	84.7	0.6	M Hope	308	99.0	94.8	0.0
Basldn	44	100.0	100.0	4.6	M RI	860	92.6	98.0	0.0
Belfast	404	100.0	97.3	92.1	Middlbr	361	91.7	92.5	50.7
Bradfd	179	69.3	89.9	97.8	Newc	561	99.6	95.7	0.7
Brightn	290	54.1	92.4	0.0	Newry	46	97.8	84.8	0.0
Bristol	685	98.3	99.3	91.1	Norwch	194	93.3	94.9	72.7
Camb	484	90.7	97.7	98.4	Nottm	414	96.4	98.6	96.6
Cardff	769	69.7	98.2	97.3	Oxford	792	47.0	98.1	15.3
Carlis	98	100.0	88.8	0.0	Plymth	249	83.9	95.6	1.2
Carsh	483	96.7	94.2	0.2	Ports	708	97.9	86.2	12.6
Chelms	53	90.6	92.5	94.3	Prestn	360	92.5	93.6	0.3
Clwyd	62	69.4	91.9	96.8	Redng	231	100.0	99.1	97.4
Covnt	337	95.9	90.5	86.4	Sheff	520	96.0	98.5	98.9
Derby	67	97.0	85.1	77.6	Shrew	102	100.0	100.0	29.4
Derry	24	100.0	91.7	100.0	Stevng	172	100.0	72.1	2.3
Donc	32	100.0	100.0	100.0	Sthend	53	84.9	96.2	1.9
Dorset	242	100.0	93.4	95.9	Stoke	245	43.7	98.8	0.4
Dudley	77	100.0	94.8	61.0	Sund	154	94.8	100.0	0.0
Exeter	297	88.6	94.6	90.2	Swanse	162	98.8	97.5	12.4
Glouc	124	97.6	96.8	2.4	Truro	116	81.0	97.4	80.2
Hull	289	73.7	86.2	0.4	Tyrone	37	100.0	97.3	94.6
Ipswi	131	100.0	94.7	97.0	Ulster	6	100.0	100.0	100.0
Kent	282	74.5	88.7	5.3	Wolve	123	100.0	98.4	96.8
L Barts	642	95.8	99.8	0.3	Wrexm	116	100.0	94.0	0.9
L Guys	830	85.9	97.7	0.1	York	131	78.6	98.5	97.0
L Kings	277	97.1	84.5	0.0	**England**	**17,936**	**88.5**	**93.7**	**32.8**
L RFree	748	98.7	82.8	0.0	**N Ireland**	**583**	**99.8**	**95.9**	**85.8**
L St G	332	72.0	93.1	0.0	**Wales**	**1,109**	**77.1**	**97.3**	**74.8**
L West	1,238	85.8	94.3	0.2	**E, W & NI**	**19,628**	**88.2**	**94.0**	**36.8**
Leeds	731	72.4	96.7	84.7					

[a] Total number of patients for outcomes analysis = 19,628 as patients transplanted in the last quarter of 2008 were excluded
[b] Patients with missing ethnicity were classed as White for eGFR calculation

Table 5.10b. Percentage completeness by centre for prevalent transplant patients on 31/12/2008

Centre	Total number of patients	Haemoglobin	Total serum cholesterol	Adjusted serum calcium[a]	Serum phosphate	Serum PTH
Antrim	66	95	95	95	95	23
B Heart	148	90	57	78	78	16
B QEH	730	85	84	84	83	60
Basldn	44	100	95	100	82	70
Belfast	404	97	98	95	95	19
Bradfd	179	83	82	89	84	36
Brightn	290	92	40	85	84	32
Bristol	685	99	94	99	99	90
Camb	484	98	94	98	98	87
Cardff	769	98	90	98	98	20
Carlis	98	88	83	87	85	7
Carsh	483	81	71	93	93	4
Chelms	53	92	89	92	91	26
Clwyd	62	92	85	92	92	63
Covnt	337	91	0	91	52	20
Derby	67	82	61	82	70	55
Derry	24	88	100	83	83	42
Donc	32	100	59	97	97	28
Dorset	242	92	88	91	72	22
Dudley	77	94	82	94	94	56
Exeter	297	95	89	93	88	24
Glouc	124	97	77	97	97	35
Hull	289	85	53	85	85	29
Ipswi	131	93	82	95	94	49
Kent	282	96	75	90	88	0
L Barts	642	100	100	100	100	100
L Guys	830	97	87	90	90	23
L Kings	277	84	81	84	84	12
L RFree	748	65	79	81	81	54
L St G	332	93	89	92	92	67
L West	1,238	98	91	8	8	1
Leeds	731	95	94	95	95	28
Leic	738	94	92	93	93	60
Liv RI	674	90	7	90	90	36
M Hope	308	95	95	94	94	83
M RI	860	98	70	98	98	63
Middlbr	361	90	67	91	91	16
Newc	561	95	95	95	95	48
Newry	46	85	89	83	83	43
Norwch	194	95	95	94	94	19
Nottm	414	99	88	92	91	86
Oxford	792	98	78	98	98	38
Plymth	249	92	85	94	94	17
Ports	708	87	60	85	83	8
Prestn	360	92	83	91	89	56
Redng	231	99	98	98	97	71
Sheff	520	99	73	98	98	32
Shrew	102	100	95	96	96	61
Stevng	172	90	87	87	86	40
Sthend	53	96	83	96	96	15
Stoke	245	98	99	99	98	27
Sund	154	100	98	100	100	89
Swanse	162	98	95	98	98	36
Truro	116	98	74	97	97	40
Tyrone	37	89	97	92	92	46

Table 5.10b. Continued

Centre	Total number of patients	Haemoglobin	Total serum cholesterol	Adjusted serum calcium[a]	Serum phosphate	Serum PTH
Ulster	6	100	83	100	100	67
Wolve	123	98	89	98	83	64
Wrexm	116	93	91	94	94	84
York	131	92	82	87	95	29
England	**17,936**	**93**	**79**	**87**	**85**	**42**
N Ireland	**583**	**95**	**97**	**93**	**93**	**25**
Wales	**1,109**	**97**	**91**	**97**	**97**	**32**
E, W & NI	**19,628**	**93**	**80**	**87**	**86**	**41**

[a] Serum calcium corrected for serum albumin

For the one year post-transplant outcomes, with patients assigned to the centres that performed their transplant, the two Scottish transplant centres were excluded as they do not submit biochemical data to the UKRR. London St George's and Manchester RI only commenced submitting data to the UKRR in 2007 and are therefore not shown in the figures. After excluding these 4 transplant centres, one year outcomes are described for 19 transplant centres across the UK.

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 2001–2007, 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 such bias, one year post-transplantation outcomes are also reported in patients. 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 are more robust. However, even the 12 months post-transplant comparisons could be biased by the fact that in some centres, repatriation of patients to their local renal centre only occurs if the graft is failing.

Prevalent patient data

Data from both transplanting and non-transplanting renal centres concerning biochemical and clinical variables for patients with a functioning transplant were included in the analyses. The cohort consisted of prevalent patients as on 31/12/2008. Patients were considered as having a functioning transplant if 'transplant' was listed as the last mode of RRT in the last quarter of 2008. 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 allocated to the non-transplant centre. Patients with functioning transplants of less than 3 months duration were excluded from analyses. One centre, Ulster, with <20 patients is not shown in the figures. For haemoglobin, estimated glomerular filtration rate (eGFR), calcium and phosphate the latest value in quarter 3 or quarter 4 of 2008 was used. For blood pressure (BP) and cholesterol, the latest value from 2008 was used. For parathyroid hormone (PTH), the latest value in the last 3 quarters of 2008 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. 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. Although many laboratories are now reporting assay results that have been aligned to the isotope dilution-mass spectrometry standard (which would necessitate use of the modified MDRD formula), this was not the case at the end of 2008. 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 01 January 2001 and 31 December 2007 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 (table 5.11).

Carshalton/St Helier's was a transplanting centre until 2003, with subsequent transplants performed at London St George's. Therefore, data from this centre refer to patients transplanted locally until 2003. Patients who had died or experienced graft failure within 12 months of transplantation were excluded from

Table 5.11. Number of patients reallocated to transplanting centre

Transplant centre	Number of patients per transplant centre	Number of patients reallocated to transplant centre	Non-transplant centre
B QEH	658	2	Shrew
		4	Stoke
Belfast	273	1	Antrim
		2	Newry
		1	Tyrone
		1	Ulster
Bristol	631	1	Glouc
Camb	649	15	Stevng
Cardff	578	1	Swanse
Covnt	256	n/a	
L Barts	495	n/a	
L Guys	1,023	34	Kent
		248	L Kings
L Rfree	508	2	Sthend
L St G	391	1	Brightn
		155	Carsh
L West	806	n/a	
Leeds	825	17	Hull
Leic	354	n/a	
Liv RI	689	166	Prestn
		2	Wrexm
M RI	709	33	M Hope
Newc	645	11	Carlis
		18	Middlbr
		13	Sund
Nottm	257	1	Derby
Oxford	668	n/a	
Plymth	304	3	Truro
Ports	364	n/a	
Sheff	321	n/a	
Total	**11,404**	**732**	

the analyses. For patients with more than one transplant during 2001–2007, they were included as separate episodes provided each of the transplants functioned for a year.

For each patient, the most recent laboratory or blood pressure for the relative 4th/5th quarter (9–15 months) after renal transplantation was taken to be representative of the one year post-transplant outcome. 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^2 are shown in figures 5.2 and 5.3. The median eGFR was 49.2 ml/min/1.73 m^2, with 14.7% of prevalent transplant recipients having an eGFR <30 ml/min/1.73 m^2. Table 5.12 summarises the proportion of transplant patients with an eGFR <30 ml/min/1.73 m^2 by centre. Whilst local repatriation policies on timing of transfer of care of patients with failing transplants from transplant centres to referring centres might explain some of the differences, it is notable that both transplanting and non-transplant centres feature at both ends of the scale. The accuracy of the 4v MDRD equation in estimating GFR $\geqslant 60$ ml/min/1.73 m^2 is questionable [5], therefore a figure describing this is not included in this chapter. It is likely centres with a high prevalence of patients with eGFR <30 ml/min/1.73 m^2 expend

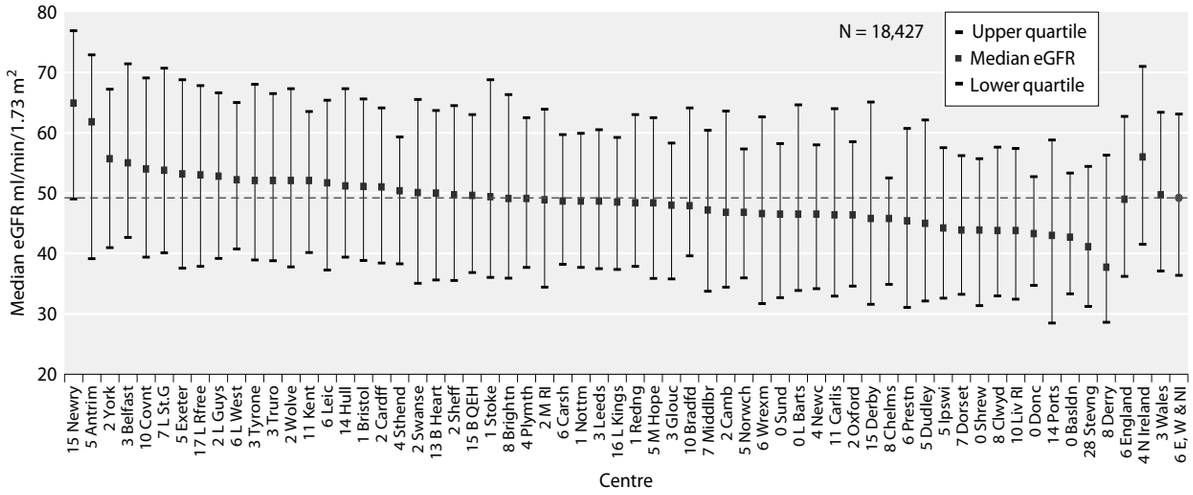

Fig. 5.2. Median eGFR in prevalent transplant patients by centre on 31/12/08

significant resources in the management of complications related to declining renal function as well as ensuring safe transition to dialysis and/or re-transplantation.

Figure 5.4 represents the percentage of prevalent patients by centre with eGFR <30 mls/min/1.73 m^2 as a funnel plot, enabling 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 58 centres included and a normal distribution, 2–3 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.

However, these data show over-dispersion with 19 centres falling outside the 95% CI of which 7 centres were outside the 99.9% CI. Four centres (Belfast, London West, London St George's, Antrim) fall outside the lower 99.9% CI suggesting a lower than expected proportion of patients with eGFR <30 ml/min/1.73 m^2. Liverpool, Portsmouth and Preston fall outside the upper 99.9% CI suggesting a higher than expected proportion of patients with eGFR <30 ml/min.1.73 m^2. The presence of mainly transplanting renal centres at either end of this spectrum suggests that differences in repatriation policies alone are not sufficient to explain this variation.

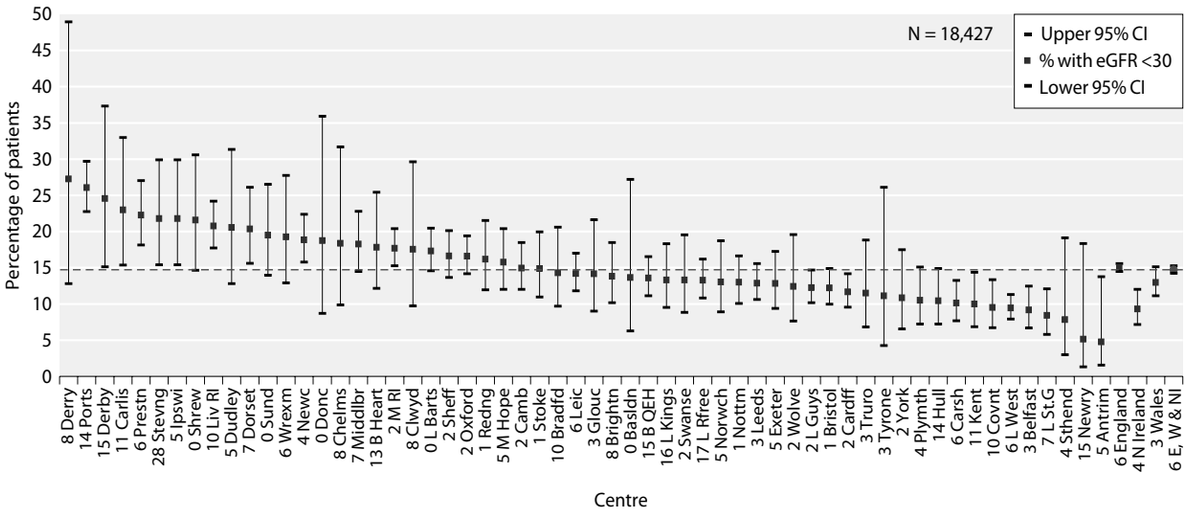

Fig. 5.3. Percentage of prevalent transplant patients by centre on 31/12/08 with eGFR <30 ml/min/1.73 m^2

Table 5.12. Proportion of prevalent transplant patients with eGFR <30 ml/min/1.73 m^2 on 31/12/08

Centre	Number of patients with eGFR data	Patients with eGFR <30 (%)	Centre	Number of patients with eGFR data	Patients with eGFR <30 (%)
Ulster	6	16.7	Stoke	242	14.9
Derry	22	27.3	Hull	249	10.4
Donc	32	18.8	Kent	250	10.0
Tyrone	36	11.1	Brightn	268	13.8
Newry	39	5.1	Exeter	281	12.8
Basldn	44	13.6	M Hope	292	15.8
Chelms	49	18.4	Covnt	305	9.5
Sthend	51	7.8	L St G	309	8.4
Derby	57	24.6	Middlbr	334	18.3
Clwyd	57	17.5	Prestn	337	22.3
Antrim	63	4.8	Belfast	393	9.2
Dudley	73	20.5	Nottm	408	13.0
Carlis	87	23.0	Carsh	455	10.1
Shrew	102	21.6	Camb	468	15.0
Wrexm	109	19.3	Sheff	511	16.6
Truro	113	11.5	Newc	536	18.8
Glouc	120	14.2	Liv RI	607	20.8
Wolve	121	12.4	Ports	610	26.1
Stevng	124	21.8	L Rfree	618	13.3
Ipswi	124	21.8	B QEH	618	13.6
York	129	10.9	L Barts	641	17.3
B Heart	129	17.8	Bristol	680	12.2
Sund	154	19.5	Leic	690	14.2
Swanse	158	13.3	Leeds	707	12.9
Bradfd	161	14.3	Cardff	755	11.7
Norwch	184	13.0	Oxford	777	16.6
Dorset	226	20.4	L Guys	809	12.2
Redng	229	16.2	M RI	843	17.7
L Kings	233	13.3	L West	1,164	9.5
Plymth	238	10.5			

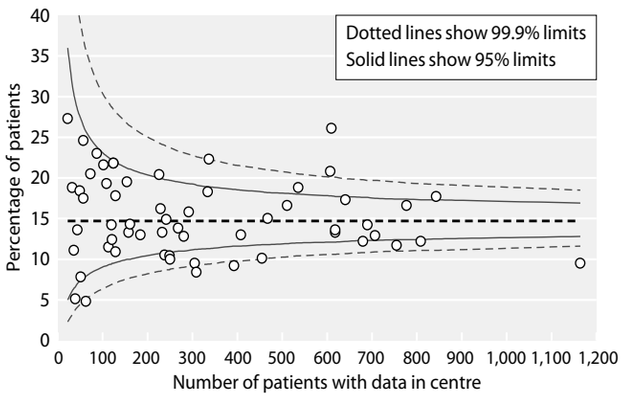

Fig. 5.4. Funnel plot of percentage of prevalent transplant patients with eGFR <30 ml/min/1.73 m^2 by centre size on 31/12/08

eGFR in patients one year after transplantation

Graft function at one year post-transplantation may predict subsequent long-term graft outcome [6]. Figure 5.5 shows that the median one year post-transplant eGFR for patients transplanted 2001–2007 was 50.6 ml/min/1.73 m^2. Figures 5.6a and 5.6b provide the same information divided according to source of organ as live donor and deceased donor respectively. It is interesting to note the same centres are in similar positions at either end of the spectrum for one year post-transplant eGFR for both deceased donor transplants and live donor kidney transplants, raising the possibility that centre variation in clinical management may contribute to this variation.

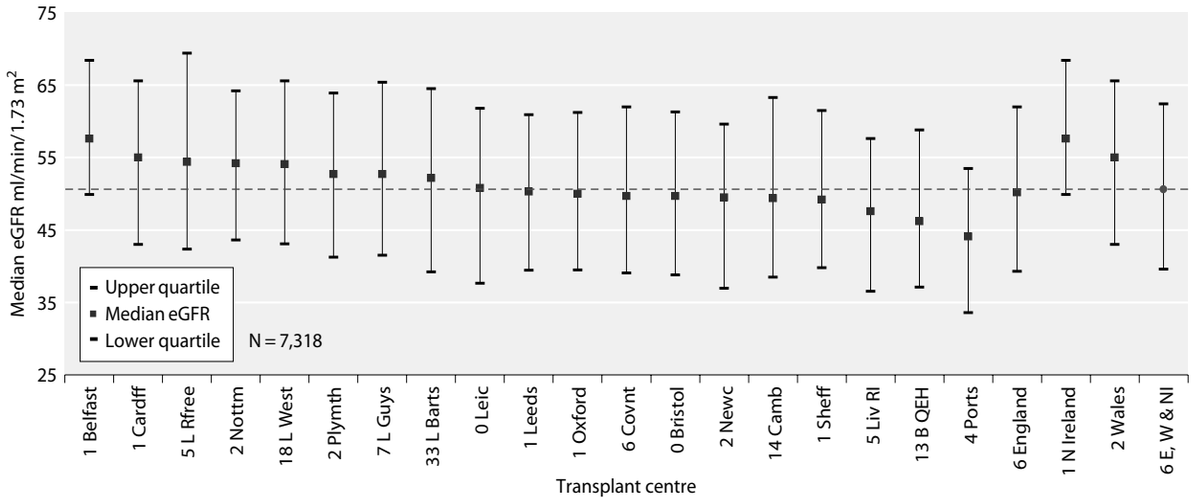

Fig. 5.5. Median eGFR one year post-transplant by transplant centre for patients transplanted between 2001–2007

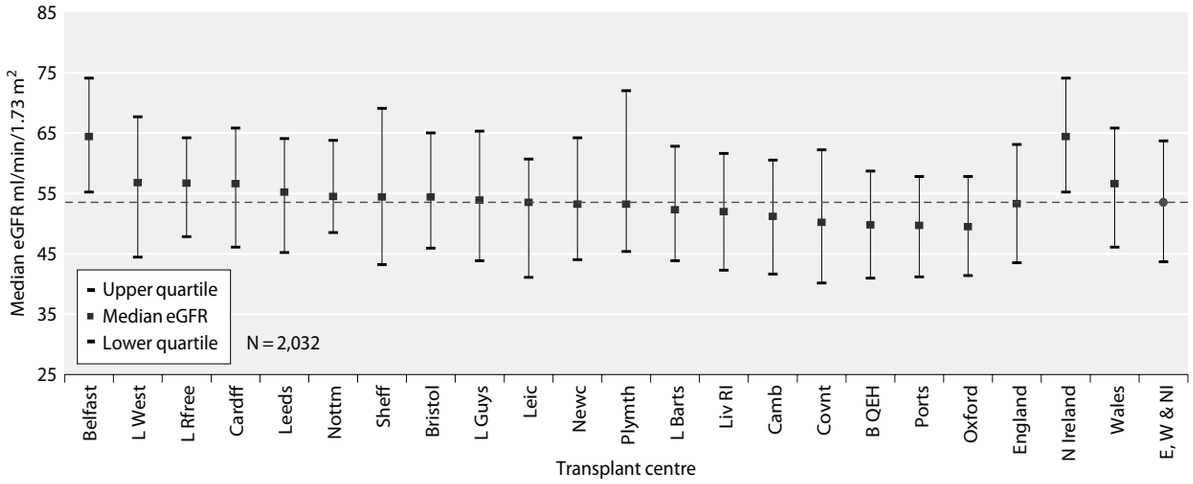

Fig. 5.6a. Median eGFR one year post-living donor transplant by transplant centre 2001–2007

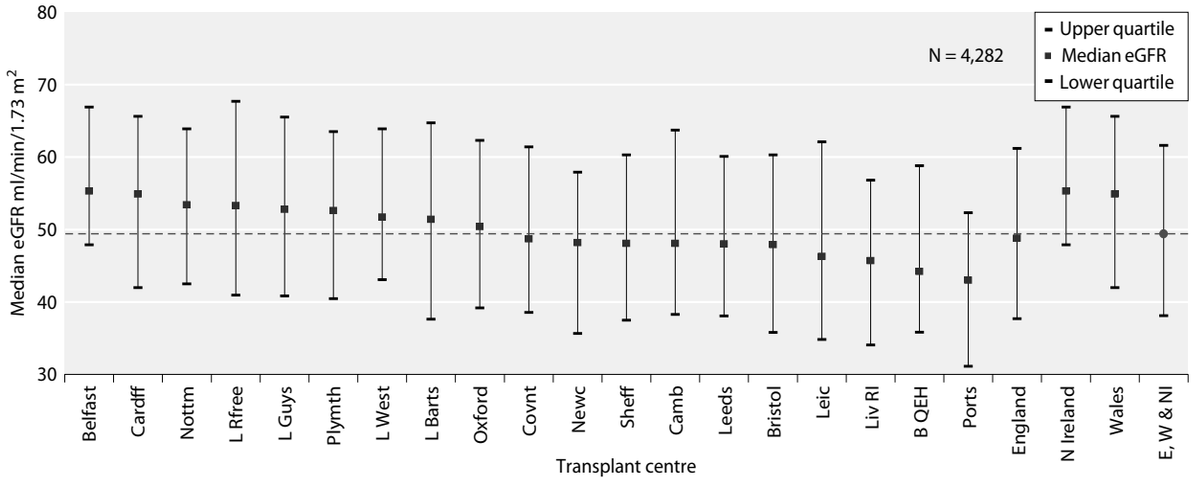

Fig. 5.6b. Median eGFR one year post-deceased donor transplant by transplant centre 2001–2007

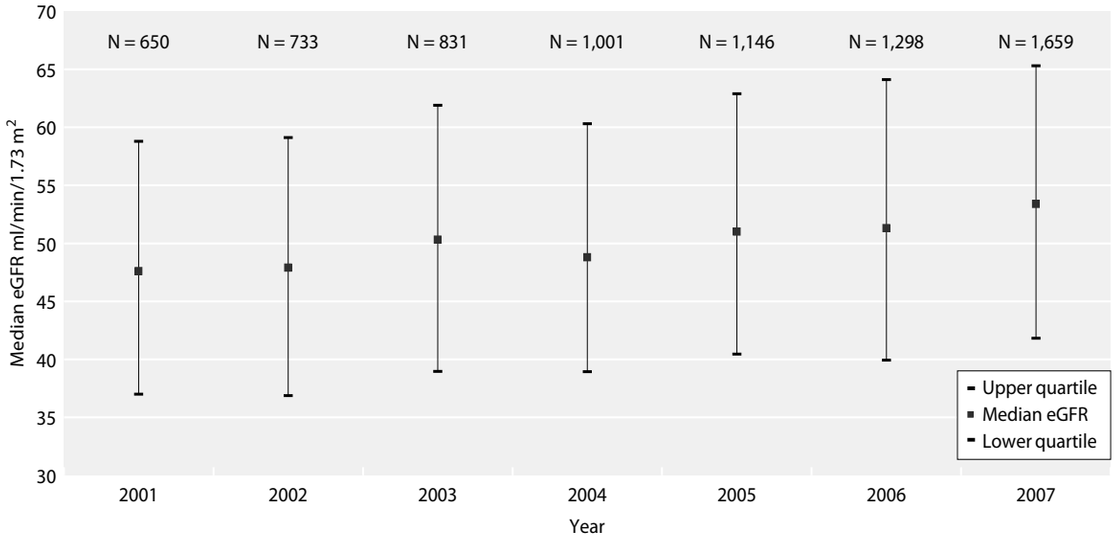

Fig. 5.7. Median eGFR one year post-transplant by year of transplantation 2001–2007

Regression analysis (least squares) indicated a small but significant upward trend (+0.9 ml/min change in eGFR/year) ($p < 0.001$) in the one year post-transplant median eGFR between 2001 and 2007 (figure 5.7). This suggests better graft function for patients transplanted more recently. Live donor transplantation as a proportion of the total number of transplants has been increasing year-on-year since 2000. Such recipients are known to have a higher one year post-transplant eGFR compared to deceased donor transplant recipients [7], so the upward trend seen in figure 5.7 could be due to the increased proportion of live donor transplants over time. However, previous years' analyses have been limited by missing donor information in the years 2005 and 2006. For the first time analysis of one year post-transplant eGFR has been performed based on donor type, with recipients of live kidney donor (figure 5.8a) and deceased donor (figure 5.8b) transplants being analysed separately. An upward trend in eGFR over the time period is noticed with both live and deceased donor transplants and the rate of change in slope of eGFR per year between the donor types (+0.86 ml/min/year for live donor transplants and +0.90 ml/min/year for deceased donor transplants) are also similar. Therefore

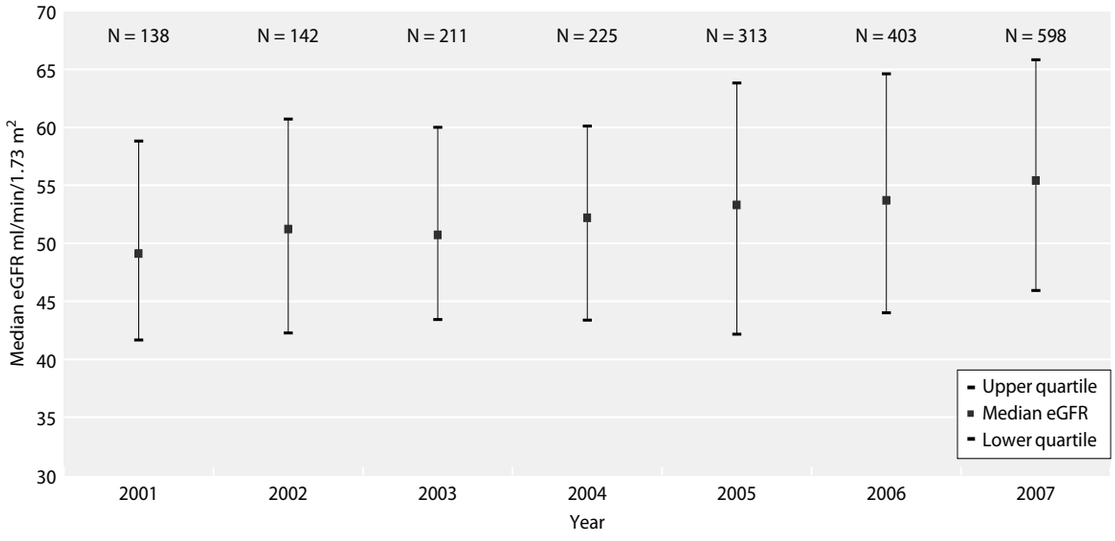

Fig. 5.8a. Median eGFR one year post-live donor transplant by year of transplantation 2001–2007

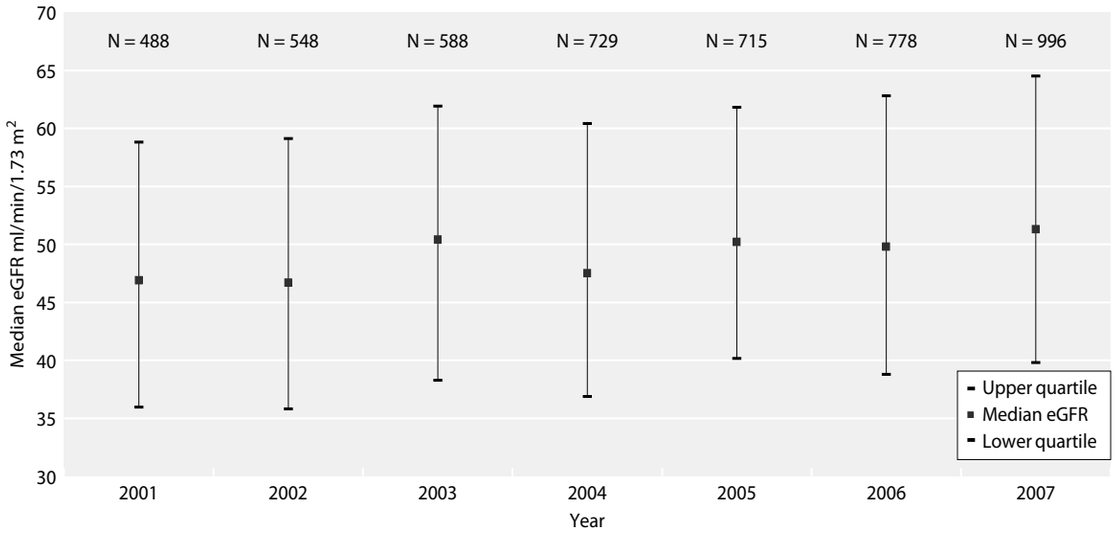

Fig. 5.8b. Median eGFR one year post-deceased donor transplant by year of transplantation 2001–2007

changing donor demographics, with a higher proportion of live donor transplants more recently, do not explain the upward trend in one year post-transplant eGFR.

When analysing eGFR post-transplant by centre, 11 of the 19 centres did not have a significant annual change in the eGFR at one year following transplantation (data not shown). Eight centres demonstrated a significant increase in eGFR one year post-transplant between 2001 and 2007 (median 1.5 ml/min/1.73 m^2 increase per year (range 0.9–2.6 ml/min/1.73 m^2)).

Haemoglobin in prevalent transplant patients

Transplant patients fall under the remit of the UK Renal Association complications of chronic kidney disease (CKD) guidelines, which state '***Patients with CKD should achieve a haemoglobin between 10.5–12.5 g/dl***' [8]. However, many transplant patients with good transplant function will have haemoglobin concentrations >12.5 g/dl 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, as well as centre practices and protocols for management of anaemia, affect haemoglobin concentrations in transplant patients. Whilst it is impossible to control for all the potential variables, this report includes for the first time, centre results stratified according to graft function as estimated by eGFR (figures 5.9, 5.10a and

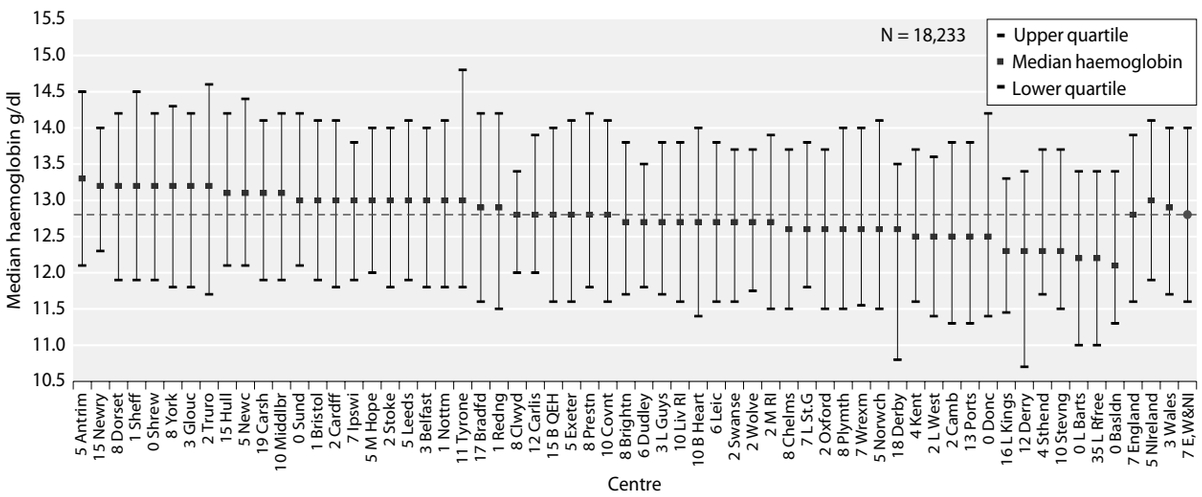

Fig. 5.9. Median haemoglobin for prevalent transplant patients by centre on 31/12/2008

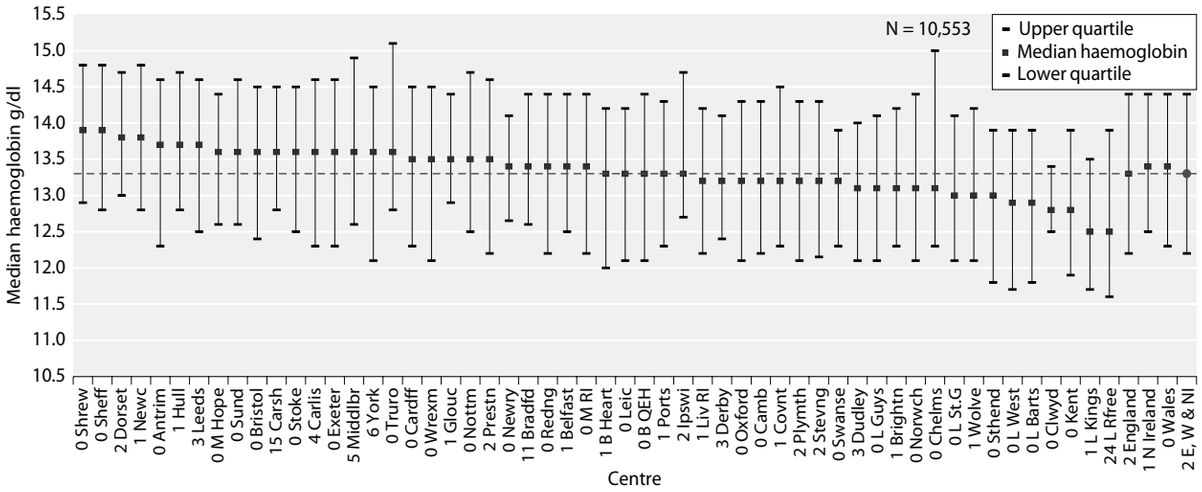

Fig. 5.10a. Median haemoglobin for prevalent transplant patients with eGFR $\geqslant$45 ml/min/1.73 m^2 by centre on 31/12/2008

5.10b). The percentage of prevalent transplant patients achieving Hb >10.5 g/dl in each centre, stratified by eGFR, is displayed in figures 5.11a and 5.11b.

Figure 5.12 describes the percentage of prevalent patients by centre with haemoglobin <10.5 g/dl as a funnel plot enabling more reliable comparison of outcomes between centres across the UK. The solid lines show the 2 standard deviation limits (95% limits) and the dotted lines the limits for 3 standard deviations (99.9% limits). With 58 centres included and a normal distribution, 2–3 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.

Two centres (London Royal Free, London Barts) fall outside the upper 99% CI with one further centre, Portsmouth falling outside the upper 95% CI indicating a higher than predicted proportion of transplant patients not achieving the haemoglobin target. Four centres (Cardiff, Sunderland, Sheffield, Antrim) perform better than expected with fewer than predicted patients having a haemoglobin <10.5 g/dl.

Haemoglobin in patients one year post-transplantation

The one year post-transplant haemoglobin for patients transplanted between 2001–2007 continued to be stable at 13.0 g/dl (figure 5.13).

Blood pressure in prevalent transplant patients

In the absence of controlled trial data, opinion based recommendation from the UK Renal Association (RA)

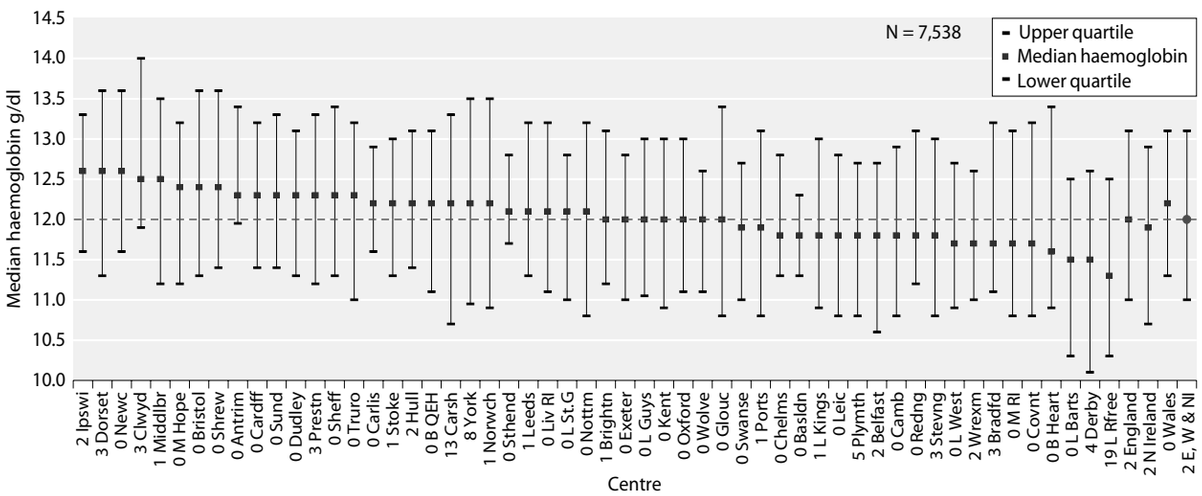

Fig. 5.10b. Median haemoglobin for prevalent transplant patients with eGFR <45 ml/min/1.73 m^2 by centre on 31/12/2008

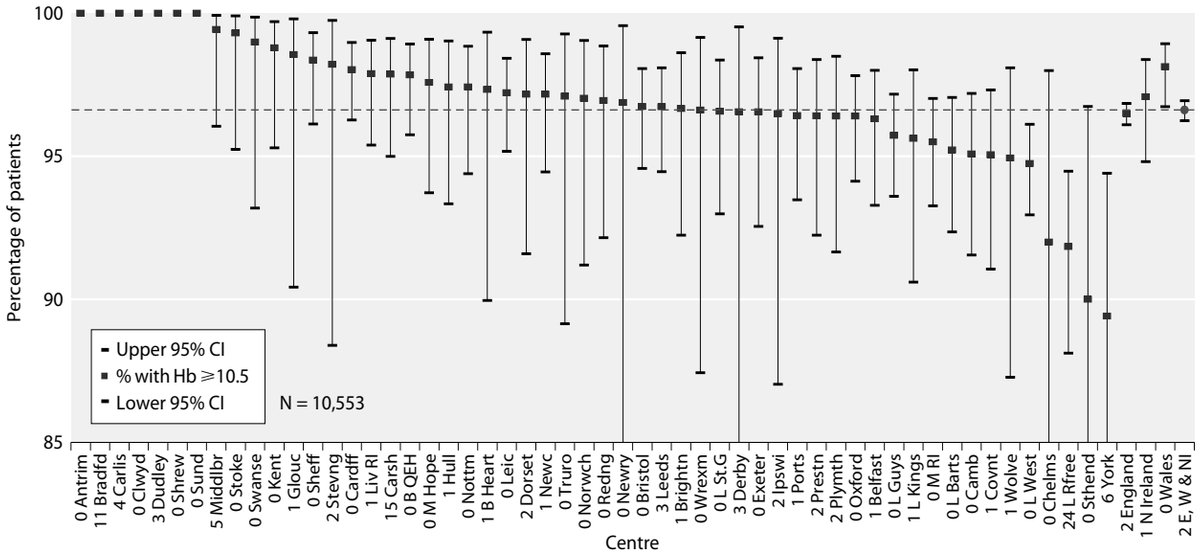

Fig. 5.11a. Percentage of prevalent transplant patients with eGFR ⩾45 ml/min/1.73 m^2 achieving haemoglobin ⩾10.5 g/dl by centre on 31/12/2008

states '***Amongst patients with CKD blood pressure should be lowered to <130/80 mmHg***' [9].

As indicated in table 5.10a, completeness for blood pressure data returns was variable and only centres with >50% data returns were included for consideration. 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).

Median systolic BP (figure 5.14), diastolic BP (figure 5.15) and percentage of patients achieving RA targets (figure 5.16) are shown. Higher blood pressure may have a cause or effect association with degree of graft function. Figures 5.17a and 5.17b are new analyses this year and demonstrate the association of transplant eGFR (stratified as ⩾ or <45 ml/min/1.73 m^2) with blood pressure. The percentage of patients with BP <130/80 (systolic BP <130 **and** diastolic BP <80 mmHg) was higher (29.6% vs. 24.8%) in those with better renal function (eGFR ⩾45 ml/min/1.73 m^2).

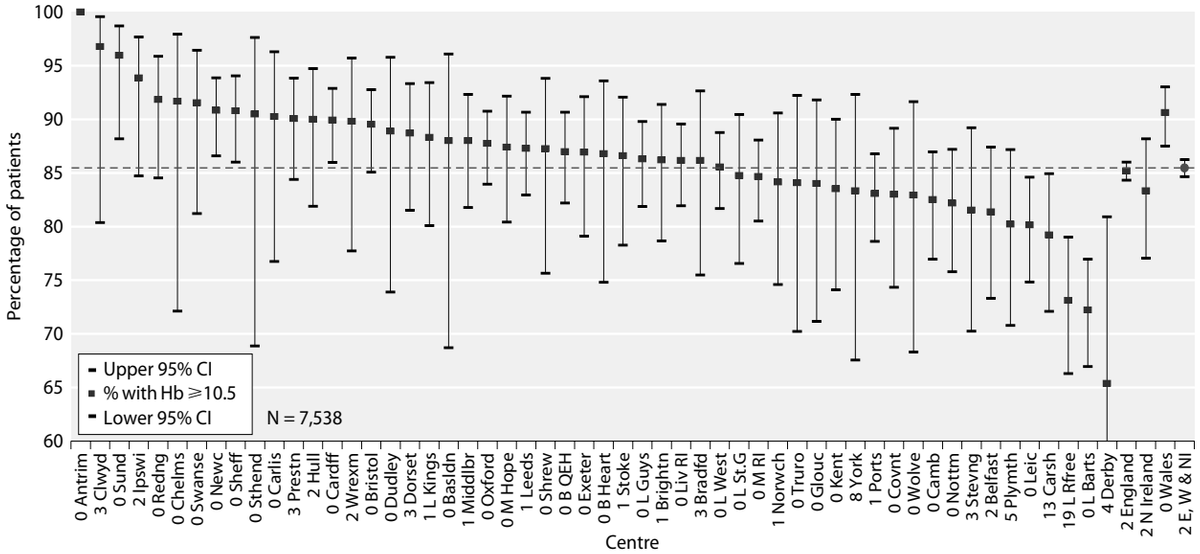

Fig. 5.11b. Percentage of prevalent transplant patients with eGFR <45 ml/min/1.73 m^2 achieving haemoglobin ⩾10.5 g/dl by centre on 31/12/2008

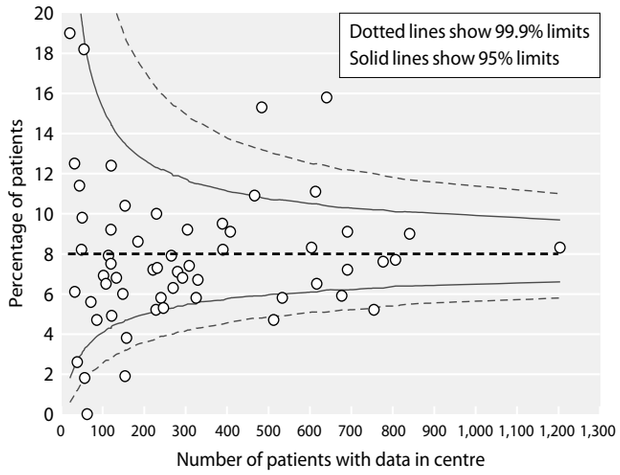

Fig. 5.12. Funnel plot of percentage of the prevalent transplant patients with haemoglobin <10.5 g/dl by centre size on 31/12/2008

Blood pressure in patients one year after transplantation

Figures 5.18 and 5.19 show median systolic and diastolic blood pressures in patients one year after transplantation, respectively.

At present, renal transplant recipients are considered as a sub-group of the native kidney disease population. There is no current evidence that suggests the knowledge gained from native kidney disease literature is not applicable to transplant recipients. Less than 27.7% of prevalent transplant patients across the UK achieved a BP of <130/80 mmHg, and it is necessary to evaluate new ways to achieve this goal or assess whether this is realistically achievable in the majority of patients. Northern Ireland managed to attain a BP <130/80 mmHg in 40.2% of patients; exploring the reasons for this may help to inform UK policy.

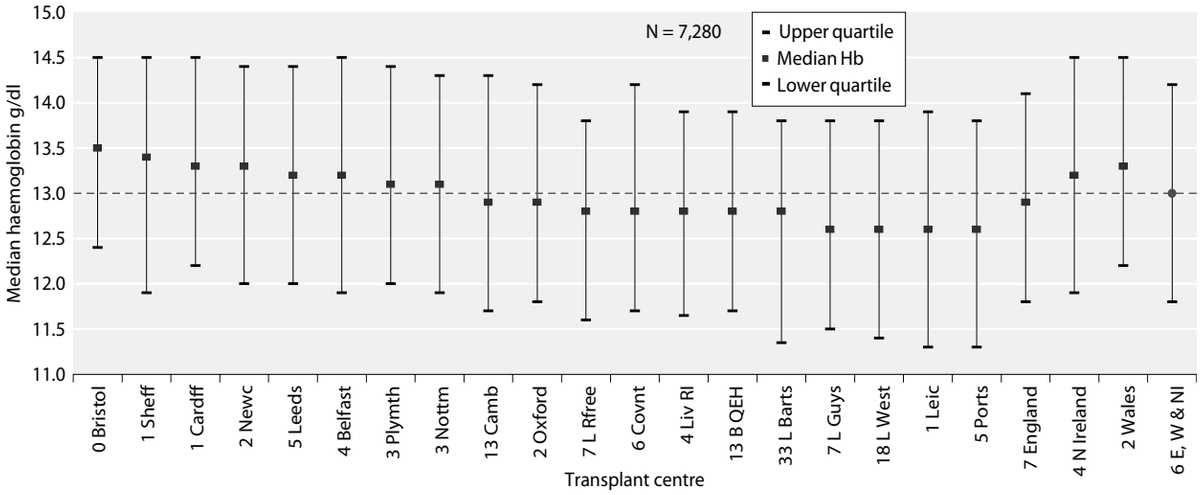

Fig. 5.13. Median haemoglobin one year post-transplant by transplant centre for patients transplanted between 2001–2007

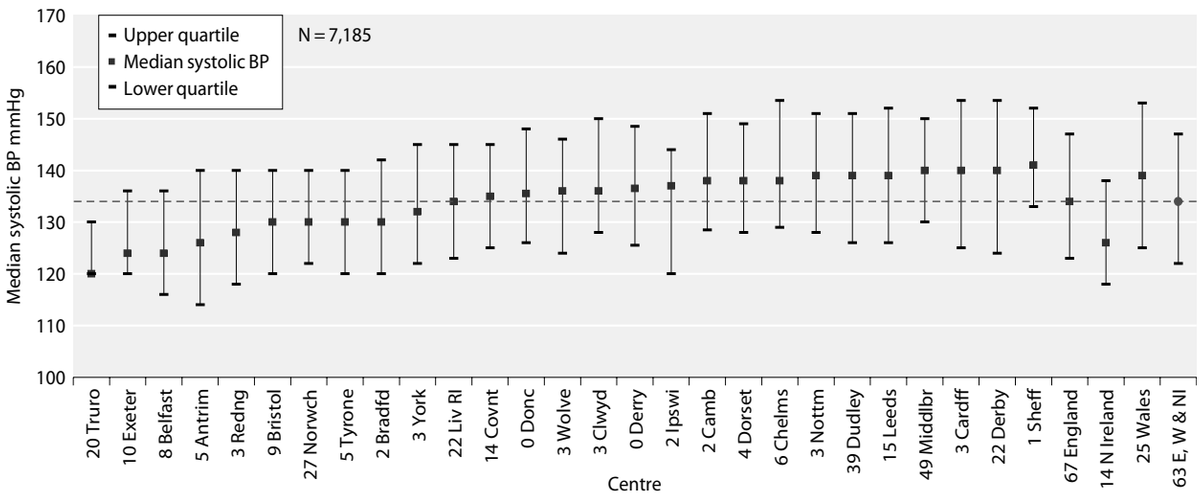

Fig. 5.14. Median systolic blood pressure for prevalent transplant patients by centre on 31/12/2008

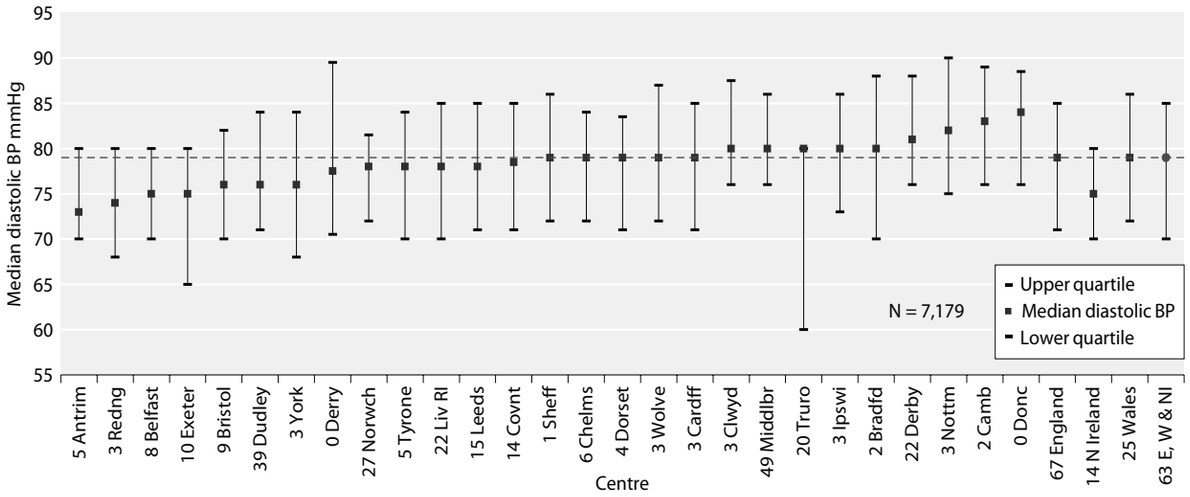

Fig. 5.15. Median diastolic blood pressure for prevalent transplant patients by centre on 31/12/2008

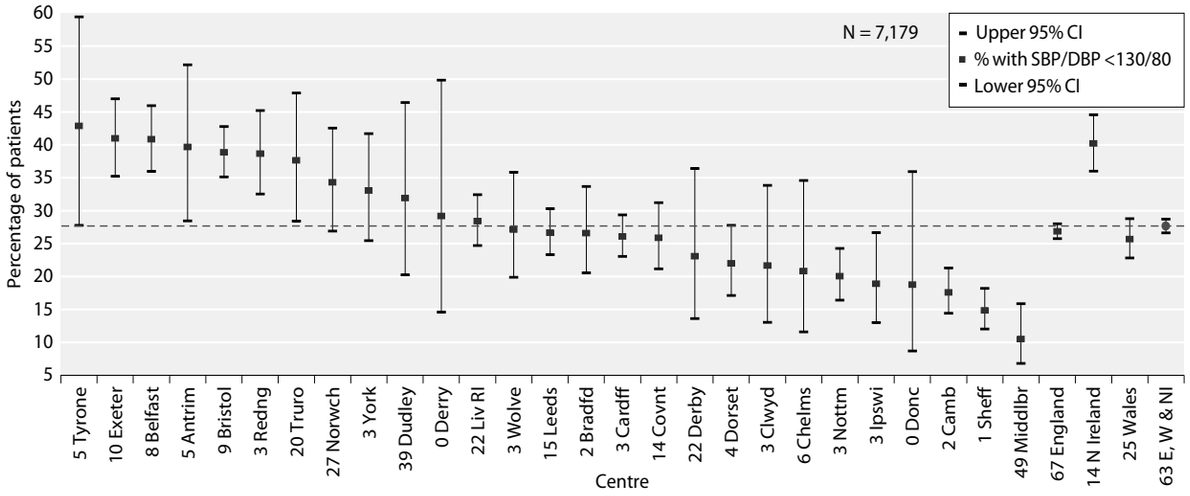

Fig. 5.16. Percentage of prevalent transplant patients achieving blood pressure target of <130/80 mmHg by centre on 31/12/2008

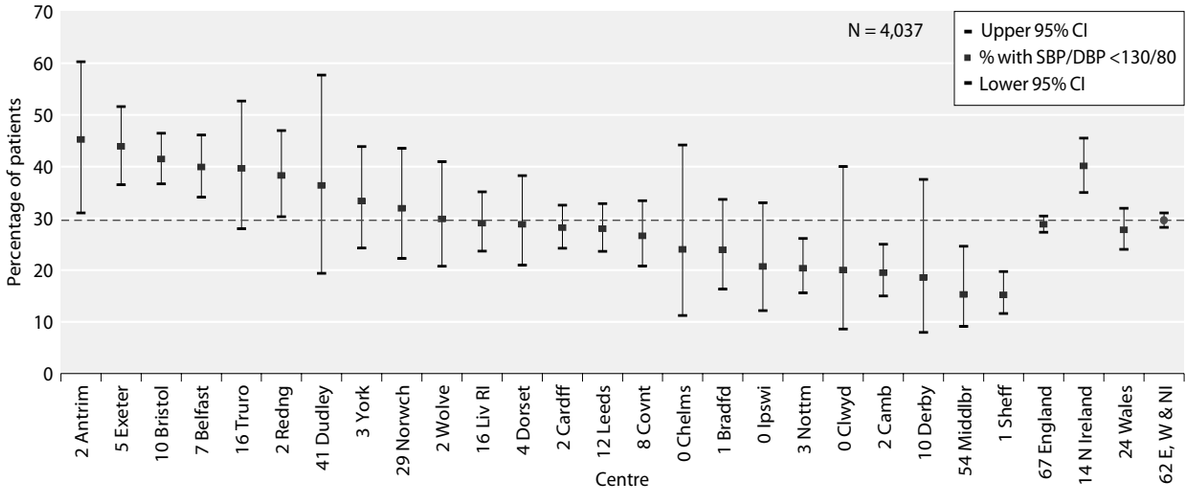

Fig. 5.17a. Percentage of prevalent transplant patients with eGFR $\geqslant$45 ml/min/1.73 m^2 achieving blood pressure of <130/80 mmHg by centre on 31/12/08

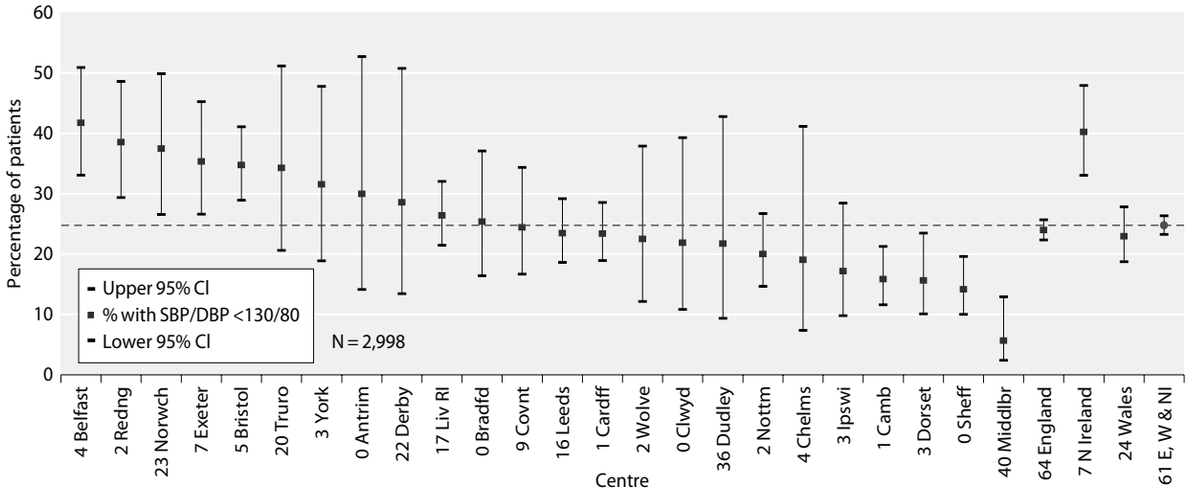

Fig. 5.17b. Percentage of prevalent transplant patients with eGFR <45 ml/min/1.73 m^2 achieving blood pressure of <130/80 mmHg by centre on 31/12/08

Cholesterol in transplant patients

The Renal Association guidelines [9] state '***Three hydroxy-3 methylglutaryl-Co-enzyme A reductase inhibitors (statins) should be considered for primary prevention in all CKD including dialysis patients with a 10-year risk of cardiovascular disease, calculated as >20% according to the Joint British Societies' Guidelines (JBS 2), despite the fact that these calculations have not been validated in patients with renal disease. A total cholesterol of <4 mmol/l or a 25% reduction from baseline, or a fasting low density lipoprotein (LDL)-cholesterol of <2 mmol/l or a 30% reduction from baseline, should be achieved, whichever is the greatest reduction in all patients***'. Audit against this standard is not currently possible using data returned to the Registry, because such an audit would require categorisation of 10-year risk in each patient to allow analysis of serum cholesterol concentrations amongst patients. There is at present no consensus amongst UK clinicians that all transplant patients should be treated as though they have a 10-year risk of cardiovascular disease of >20%, although further guidelines on the medical management of transplant patients and on the management of cardiovascular disease in CKD are in preparation. However, previous Registry reports have contained analyses of total cholesterol, and these are repeated here for comparison.

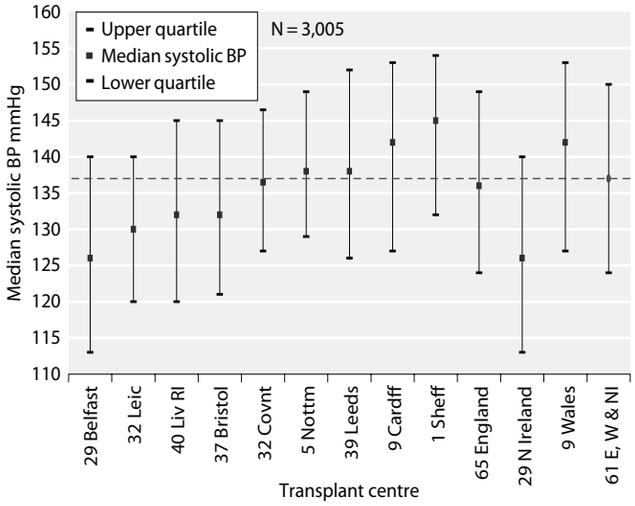

Fig. 5.18. Median systolic blood pressure one year post-transplant by transplant centre for patients transplanted between 2001–2007

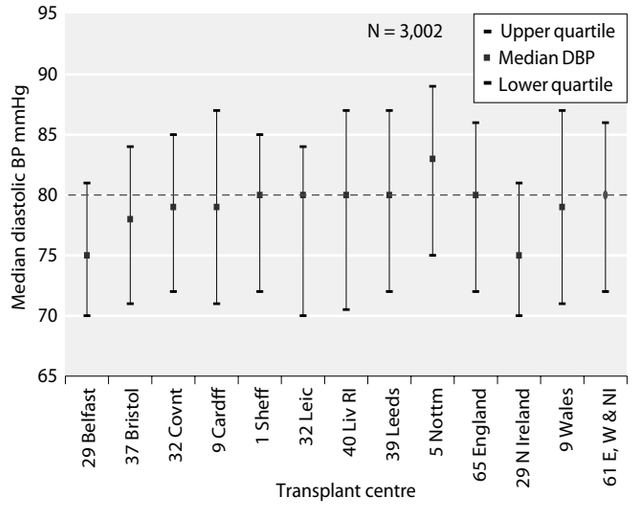

Fig. 5.19. Median diastolic blood pressure one year post-transplant by transplant centre for patients transplanted between 2001–2007

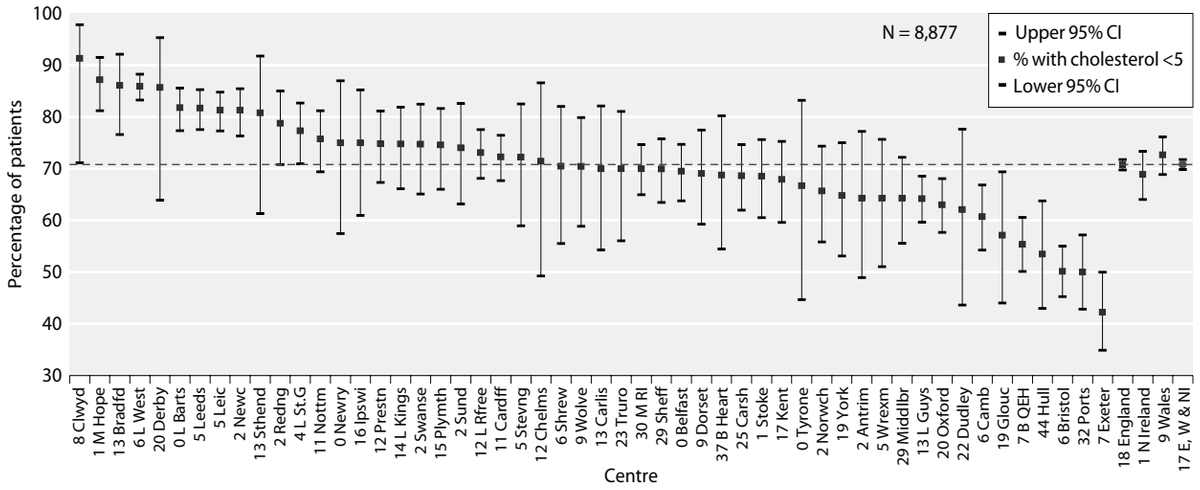

Fig. 5.20a. Percentage of prevalent transplant patients with eGFR $\geqslant$45 ml/min/1.73 m^2 achieving total cholesterol <5 mmol/L by centre on 31/12/2008

The percentage of prevalent transplant recipients achieving a cholesterol concentration <5 mmol/L by centre and stratified according to eGFR ($\geqslant$ or <45 ml/min/1.73 m^2) and median cholesterol concentration one year after transplantation are described in figures 5.20a, 5.20b and 5.21 respectively. The median cholesterol concentration in the UK was 4.6 mmol/L. At the end of 2008, 68.8% of prevalent transplant patients had a total cholesterol concentration <5 mmol/L. The major between-centre differences in total cholesterol concentrations are likely to reflect the effects of significant differences in the clinical approach to the management of hypercholesterolaemia.

Bone mineral metabolism in transplant patients

In the absence of definitive literature concerning evaluation and management of bone mineral disorder in transplant recipients, guidelines derived from chronic native kidney disease are commonly used as a surrogate. It is beyond the scope of this commentary to discuss the appropriateness or otherwise of this strategy. Since there are no other accepted guidelines on target biochemical values concerning bone disease in transplant patients the CKD audit measures have been adopted. It is anticipated the publication of guidelines on the medical management of the kidney transplant recipient by the Renal Association and by the Kidney Disease: Improving

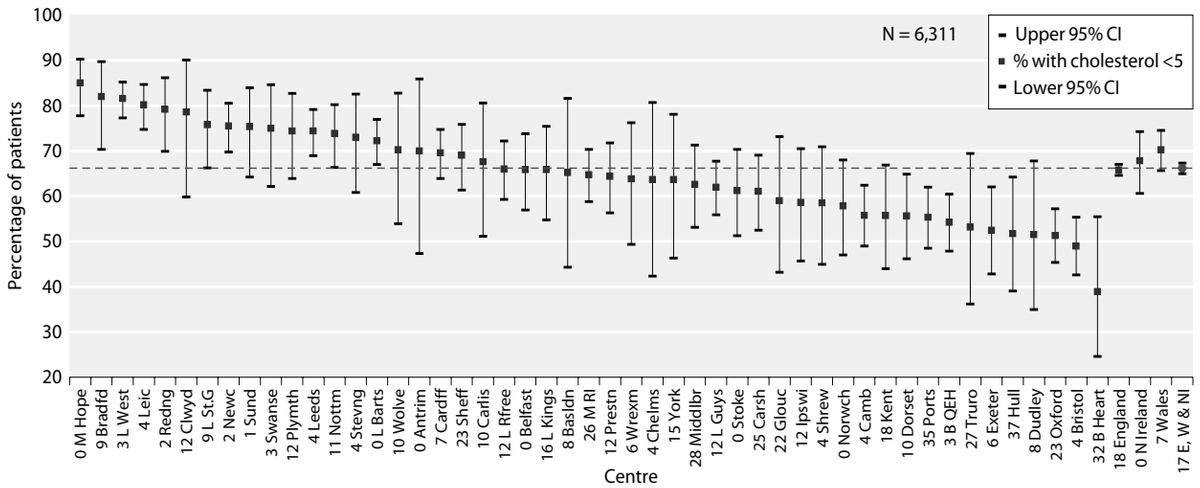

Fig. 5.20b. Percentage of prevalent transplant patients with eGFR <45 ml/min/1.73 m^2 achieving total cholesterol <5 mmol/L by centre on 31/12/2008

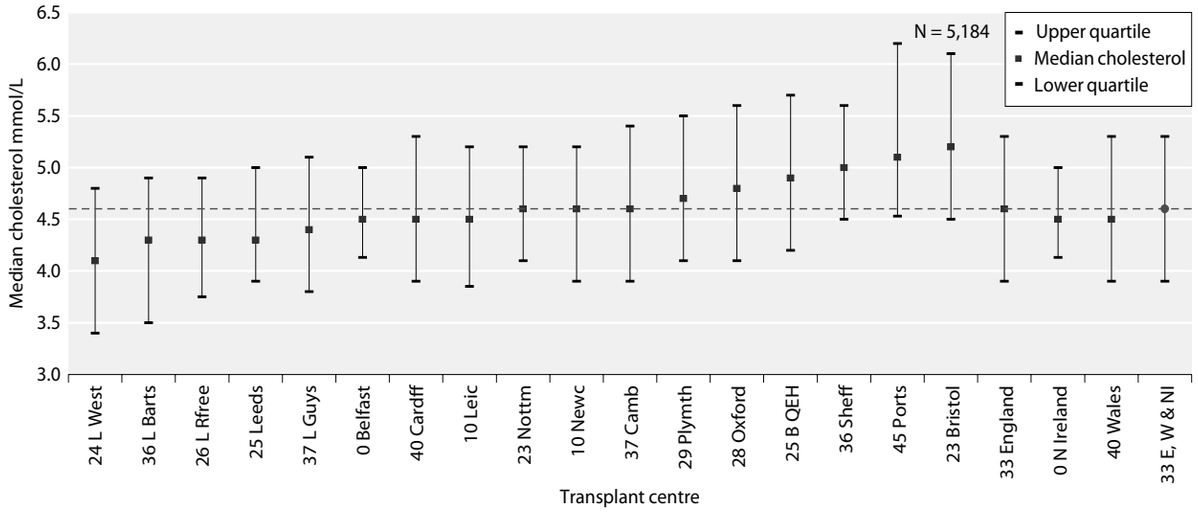

Fig. 5.21. Median total cholesterol one year post-transplant by transplant centre for patients transplanted between 2001–2007

Global Outcomes (KDIGO) initiative will have occurred by the time of publication of the next UKRR report.

Serum phosphate

The percentage of prevalent patients achieving a phosphate concentration <1.8 mmol/L are described in figure 5.22 with further stratification based on eGFR (⩾ or <45 ml/min/1.73 m^2) in figures 5.23a and 5.23b. With 99% of prevalent patients achieving a phosphate concentration <1.8 mmol/L with achievement ranging from 95%–100%, this is probably not a useful clinical performance indicator.

Figure 5.24 describes median phosphate concentrations one year after transplantation. One year post-transplant, 35.2% of kidney recipients have phosphate concentrations in the range of 1.1–1.8 mmol/L. This low percentage mainly reflects patients having serum phosphate concentrations <1.1 mmol/L because of post-transplant phosphate losses.

Serum calcium

The percentage of prevalent transplant patients with a serum calcium concentration within the target range of 2.2–2.6 mmol/L are shown in figure 5.25 with further stratification based on eGFR (⩾ or <45 ml/min/1.73 m^2) in figures 5.26a and 5.26b.

In contrast to the phosphate results, there is wide inter-centre variation in achievement of in-range serum calcium concentrations (61.3% to 93.5%), with both transplanting and non-transplanting renal centres at

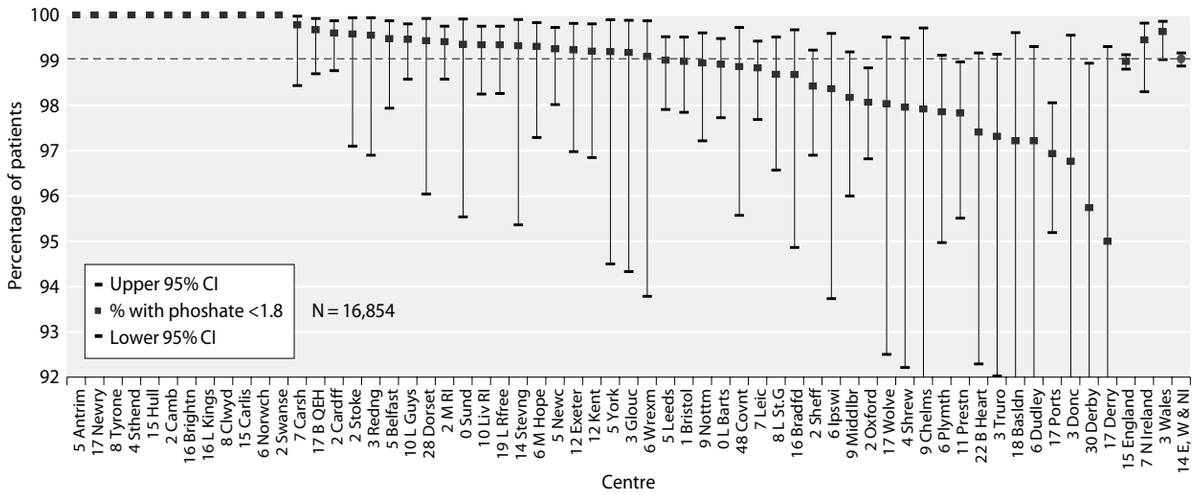

Fig. 5.22. Percentage of prevalent transplant patients with serum phosphate <1.8 mmol/L by centre on 31/12/2008

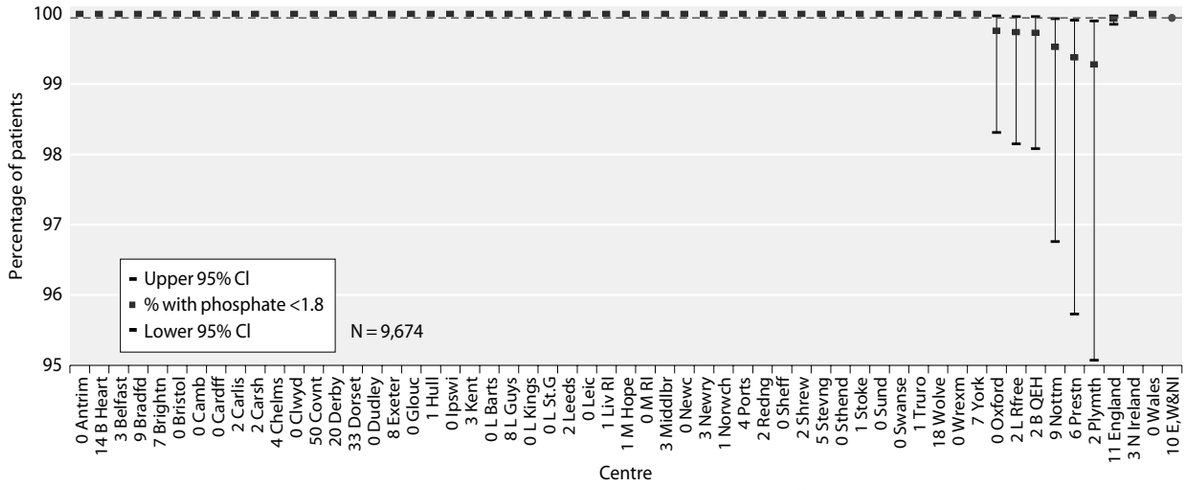

Fig. 5.23a. Percentage of prevalent transplant patients with eGFR $\geqslant$45 ml/min/1.73 m^2 achieving serum phosphate <1.8 mmol/L by centre on the 31/12/2008

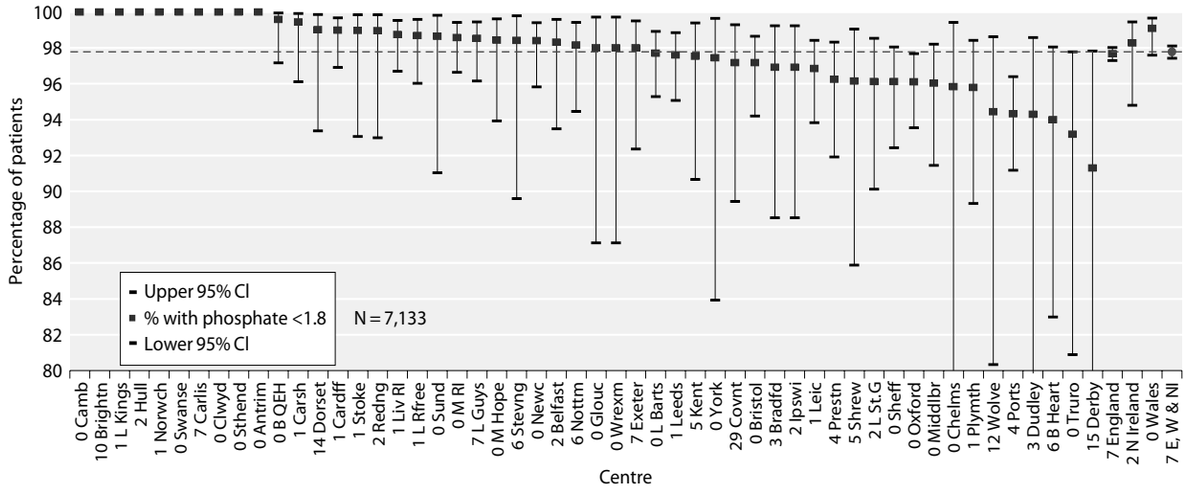

Fig. 5.23b. Percentage of prevalent transplant patients with eGFR <45 ml/min/1.73 m^2 achieving serum phosphate <1.8 mmol/L by centre on the 31/12/2008

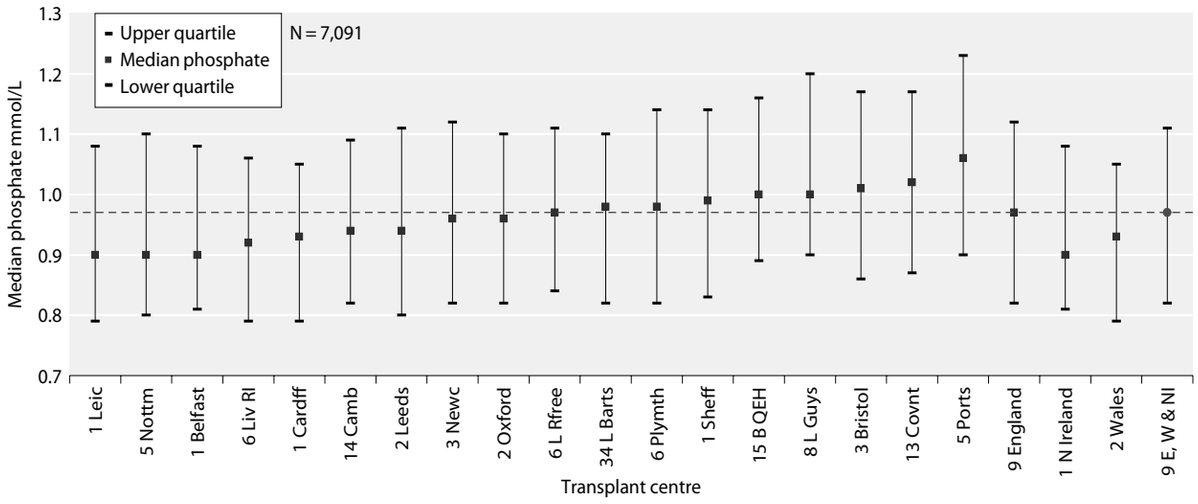

Fig. 5.24. Median serum phosphate one year post-transplant by transplant centre for patients transplanted 2001–2007

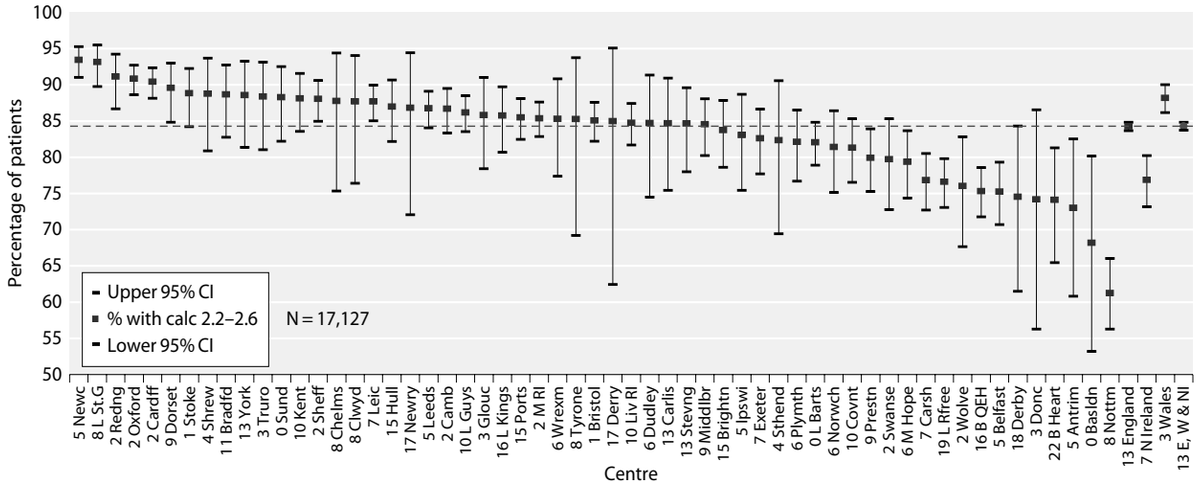

Fig. 5.25. Percentage of prevalent transplant patients with adjusted serum calcium between 2.2–2.6 mmol/L by centre on 31/12/2008

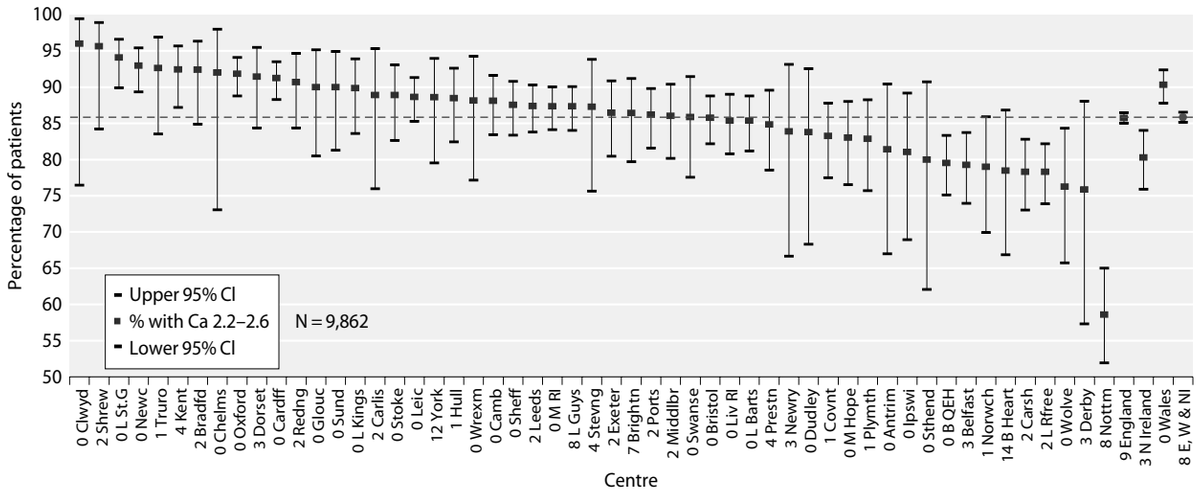

Fig. 5.26a. Percentage of prevalent transplant patients with eGFR $\geqslant$45 ml/min/1.73 m^2 with adjusted serum calcium between 2.2–2.6 mmol/L by centre on 31/12/2008

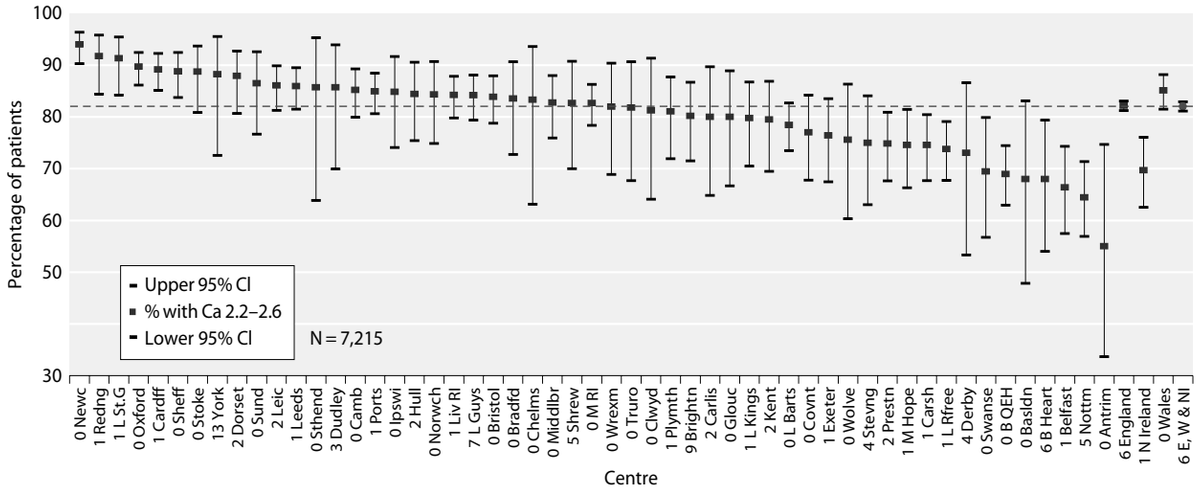

Fig. 5.26b. Percentage of prevalent transplant patients with eGFR <45 ml/min/1.73 m^2 with adjusted serum calcium between 2.2–2.6 mmol/L by centre on 31/12/2008

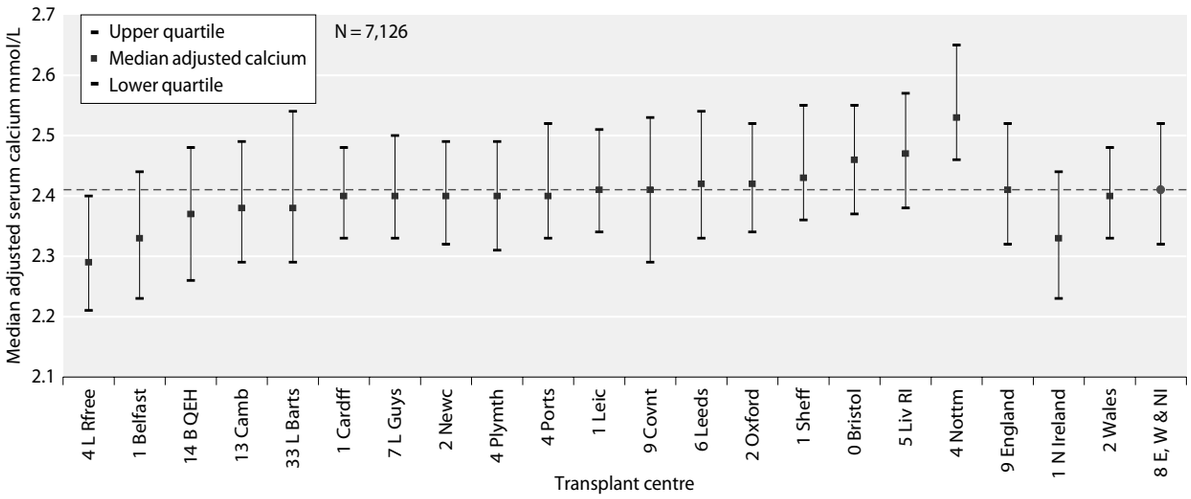

Fig. 5.27. Median adjusted serum calcium in patients one year post-transplant for patients transplanted 2001–2007

either end of the performance spectrum. This spread is not explained by efficiency of graft function as estimated by eGFR. Further work to understand the differences in centre policy and laboratory measurement practices behind these variations is necessary.

Figure 5.27 demonstrates median serum calcium one year post-transplant.

Serum parathyroid hormone concentration

There are no definitive guidelines on the frequency with which serum PTH should be measured in stable transplant recipients. Consequently, there was very wide variability in data completeness across the UK and therefore centre specific outcomes for this biochemical variable have not been analysed.

Analysis of prevalent patients by CKD stage

Introduction

About 3% of prevalent transplant patients returned to dialysis in 2008, a similar percentage to that seen over the last 8 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 31/12/2008 (n = 18,444) and 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 in 2008, comprised the comparison dialysis cohort (n = 17,638) including 2,672 peritoneal dialysis patients. For both cohorts, the analysis used the most recent available value from the last two quarters of the 2008 laboratory data.

Results and Discussion

Table 5.13 shows that 14.7% of the prevalent transplant population, or about 2,700 patients, had moderate to advanced renal impairment of eGFR <30 ml/min/1.73 m^2. The table also demonstrates that patients with failing grafts achieve UK RA standards for key biochemical and clinical outcome variables less often than dialysis patients. This substantial group of patients represents a considerable challenge, as resources need to be channelled to improve key outcome variables and achieve a safe and timely modality switch to another form of renal replacement therapy.

Table 5.13. Analysis by CKD stage for prevalent transplant patients compared with prevalent dialysis patients on 21/12/2008

	Stage 1–2T (⩾60)	Stage 3T (30–59)	Stage 4T (15–29)	Stage 5T (<15)	Stage 5D
Number of patients	5,520	10,208	2,327	389	17,638
% of patients	29.9	55.4	12.6	2.1	
eGFR ml/min/1.73 m^2					
mean ± SD	75.2 ± 14.1	45.3 ± 8.4	23.8 ± 4.1	11.9 ± 2.4	
median	71.4	45.4	24.4	12.3	
Systolic BP mmHg					
mean ± SD	133.5 ± 17.1	136.5 ± 18.1	139.2 ± 19.1	143.0 ± 19.7	131.5 ± 24.7
% ⩾130	58.7	64.1	68.8	78.8	50.2
Diastolic BP mmHg					
mean ± SD	77.6 ± 10.3	78.2 ± 10.7	78.8 ± 11.2	79.3 ± 12.1	70.1 ± 14.4
% ⩾80	45.8	48.4	51.0	51.7	24.8
Cholesterol mmol/L					
mean ± SD	4.5 ± 1.0	4.6 ± 1.1	4.7 ± 1.2	4.6 ± 1.1	4.0 ± 1.1
% ⩾5	29.4	32.6	35.2	35.1	16.8
Haemoglobin g/dl					
mean ± SD	13.5 ± 1.6	12.7 ± 1.6	11.6 ± 1.6	10.9 ± 1.7	11.5 ± 1.5
% <10.5	2.9	6.7	20.6	40.4	21.5
Phosphate mmol/L[a]					
mean ± SD	1.0 ± 0.2	1.0 ± 0.2	1.2 ± 0.3	1.6 ± 0.4	1.6 ± 0.4
% ⩾1.8	0.0	0.2	2.2	25.9	25.3
Corrected calcium mmol/L					
mean ± SD	2.4 ± 0.1	2.4 ± 0.2	2.4 ± 0.2	2.3 ± 0.2	2.4 ± 0.2
% >2.6	6.8	8.9	5.7	9.0	8.6
% <2.2	6.8	7.3	11.9	24.8	17.3
PTH pmol/L					
median	8.0	9.9	16.5	24.6	27.0
% ⩾32	2.4	5.7	20.7	40.8	42.8

[a] Only PD patients included in stage 5D, n = 2,672

Causes of death in transplant recipients

Introduction

Differences in causes of death between dialysis and transplant patients may be expected and may reflect the different priorities required in management of these two groups of patients. Chapter 7 includes a more detailed discussion on causes of death in dialysis patients.

Methods

The cause of death is sent by renal centres as an EDTA-ERA 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.

Adult patients aged 18 years and over, from England or Wales, were included in the analyses on cause of death. Previous analysis was limited to data from centres with a high rate of return for cause of death. When this was compared with an analysis of all the cause of death data on the database, the percentages in corresponding EDTA categories remained unchanged so the latter data were therefore included. Analysis of prevalent patients included all those aged over 18 years and receiving RRT on 1/1/2008.

Results and discussion

Causes of death in prevalent RRT patients in 2008 by modality and age

Tables 5.14, 5.15 and figure 5.28 show the differences in the causes of death between prevalent dialysis and transplant patients. These data are not adjusted for age or differences in comorbidity between the two groups.

Table 5.14. Cause of death by modality in prevalent RRT patients on 1/1/2008

	All modalities		Dialysis		Transplant	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	381	24	341	25	40	21
Cerebrovascular disease	68	4	55	4	13	7
Infection	266	17	235	17	31	16
Malignancy	135	9	96	7	39	21
Treatment withdrawal	220	14	211	15	9	5
Other	110	7	89	6	21	11
Uncertain	388	25	352	26	36	19
Total	**1,568**		**1,379**		**189**	
No cause of death data	2,412		2,047		365	

Table 5.15. Cause of death in prevalent transplant patients on 1/1/2008 by age

	All age groups		<55 years		⩾55 years	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	40	21	12	24	28	20
Cerebrovascular disease	13	7	3	6	10	7
Infection	31	16	5	10	26	19
Malignancy	39	21	11	22	28	20
Treatment withdrawal	9	5	4	8	5	4
Other	21	11	6	12	15	11
Uncertain	36	19	10	20	26	19
Total	**189**		**51**		**138**	
No cause of death data	365		92		273	

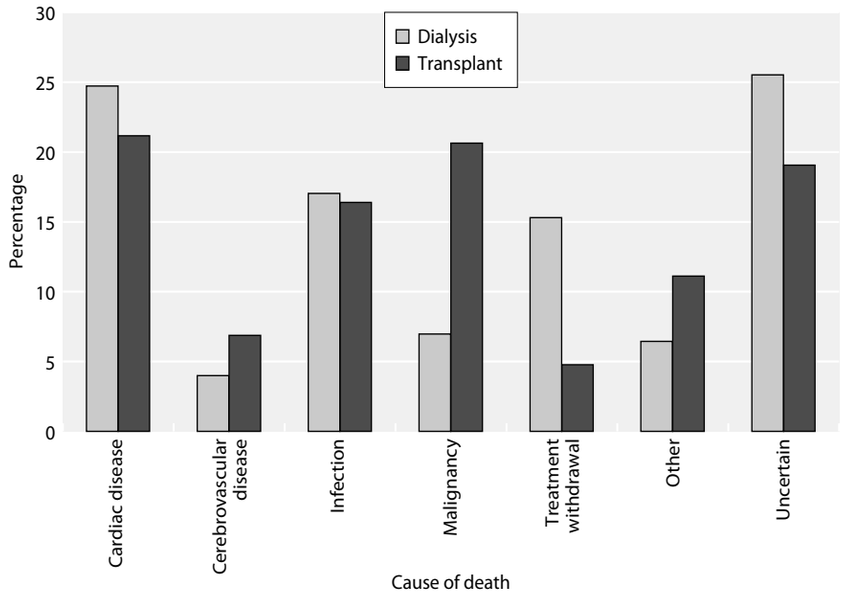

Fig. 5.28. Cause of death by modality for prevalent patients on 1/1/2008

Death due to cardiovascular disease is less common in transplanted patients than in dialysis patients, reflecting the cardiovascular screening undertaken as transplant work-up; transplant recipients are a pre-selected low risk group of patients. In keeping with current literature [10] regarding post-transplantation malignancy, cancer is a frequent cause of death within the transplant population (21% of all deaths) and reflects long-term immunosuppressive therapy. Five percent of transplant patients die due to treatment withdrawal, with some individuals deciding not to commence dialysis following transplant failure.

In table 5.15 there are differences in the percentage of patients dying due to cardiac disease, infection and treatment withdrawal between patients aged <55 or $\geqslant 55$ years and this most likely reflects the small number of patients dying in the <55 age group.

Conflict of interest: none

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Chapter 6
Comorbidities and Current Smoking Status amongst Patients starting Renal Replacement Therapy in England, Wales and Northern Ireland from 2003 to 2008: national and centre-specific analyses

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Key Words
Comorbidity · Diabetes · Dialysis · eGFR · Ethnicity · Haemoglobin · Mortality · Renal replacement therapy · Smoking · Transplant waiting list

Abstract
Introduction: The prevalence of comorbidities in incident renal replacement therapy (RRT) patients changes with age and varies between ethnic groups. This study describes these associations and the independent effect of comorbidities on outcomes. ***Methods:*** Adult patients starting RRT between 2003 and 2008 in centres reporting to the UK Renal Registry (UKRR) with data on comorbidity (n = 14,909) were included. The UKRR studied the association of comorbidity with patient demographics, treatment modality, haemoglobin, renal function at start of RRT and subsequent listing for kidney transplantation. The relationship between comorbidities and mortality at 90 days and one year after 90 days from start of RRT was explored using Cox regression. ***Results:*** Completeness of comorbidity data was 40.0% compared with 54.3% in 2003. Of patients with data, 53.8% had one or more comorbidities. Diabetes mellitus and ischaemic heart disease were the most common conditions seen in 30.1% and 22.7% of patients respectively. Current smoking was recorded for 14.5% of incident RRT patients in the 6-year period. Comorbidities became more common with increasing age in all ethnic groups although the difference between the 65–74 and 75+ age groups was not significant. Within each age group, South Asians and Blacks had lower rates of comorbidity, despite higher rates of diabetes mellitus. In multivariate survival analysis, malignancy and ischaemic/neuropathic ulcers were the strongest independent predictors of poor survival at 1 year after 90 days from the start of RRT. ***Conclusion:*** Differences in prevalence of comorbid illnesses in incident RRT patients may reflect variation in access to health care or competing risk prior to commencing treatment. At the same time, smoking rates remained high in this 'at risk' population. Further work on this and ways to improve comorbidity reporting should be priorities for 2010–11.

Introduction

The importance of adjusting for comorbidity in centre [1, 2] and international survival comparisons [3] has long been recognised and evidence of its importance in anaemia [4], hospitalisation [5–7] healthcare costs [5] and quality of life [8] is emerging. As with all observational data, registry analyses for purposes of epidemiology, access to treatment or quality control, are open to a number of selection biases. Therefore, registry analyses can be significantly strengthened by adjustment for case mix, as differences in patient populations that exist across centres may affect process and outcome measures.

The aim of this chapter is to describe the prevalence of comorbid conditions and current smoking status in incident renal replacement therapy (RRT) patients reported to the UK Renal Registry (UKRR) and to examine the association between these comorbidities and early mortality.

The term established renal failure (ERF) used throughout this chapter is synonymous with the terms of end stage renal failure (ESRF) and end stage renal disease (ESRD), which are widely used internationally. Within the UK, patient groups have disliked the term 'end stage' due to its reference to the inevitable outcome of this disease.

Methods

Study population

Incident adult (⩾18 years) RRT patients (n = 32,356) between 2003 and 2008 in the centres submitting data to the UKRR were considered. Of these, patients who had data on comorbidity were included (n = 14,909; 46.1%). Data on completeness of comorbidity returns from each centre and overall may differ from those in previous UKRR reports due to some centres retrospectively entering previously missing comorbidity data.

Centre exclusions

The nine centres in Scotland do not provide comorbidity data to the UKRR and are not included in these analyses. There was concern that data extraction in two centres (Stoke and Colchester) was inaccurate and these centres were excluded from this year's analyses.

Definition of comorbidity and method of data collection

Clinical staff in each centre are responsible for recording (in yes/no format), on their renal information technology (IT) system, the presence or absence of 13 comorbid conditions and information on current tobacco smoking (table 6.1) for each patient at the time of starting RRT. Definitions of each of these conditions are given in appendix B. Patients were classified as having complete comorbidity data if there was at least one entry (yes/no) for any one or more of the comorbid conditions. Comorbidities were grouped into broader categories for some analyses:

- 'Ischaemic heart disease' was defined as the presence of one or more of the following conditions: angina, myocardial infarction (MI) in the three months prior to starting RRT, MI more than three months prior to starting RRT or coronary artery bypass grafting (CABG)/angioplasty.
- 'Peripheral vascular disease' was defined as the presence of one or more of the following conditions: claudication, ischaemic or neuropathic ulcers, non-coronary angioplasty, vascular graft, aneurysm or amputation for peripheral vascular disease.
- 'Non-coronary vascular disease' was defined as the presence of cerebrovascular disease or any of the data items that comprise 'peripheral vascular disease'.

Ethnicity data reporting

Some centres electronically upload ethnicity coding to their renal IT system from the hospital Patient Administration Systems (PAS) [9]. Ethnicity coding in PAS is based on self-reported ethnicity and uses a different system [10] to the remaining centres where ethnic coding is performed by clinical staff and recorded directly into the renal IT system (using a variety of coding systems). For all these analyses, data on ethnic origin were grouped into Whites, South Asians, Blacks and Others. Appendix G details the regrouping of the PAS codes into the above ethnic categories.

Statistical methods

The statistical methods for the four individual sections of this chapter are described separately. The number of patients with data

Table 6.1. Comorbid conditions listed in the UKRR dataset

Comorbidity
• Angina • Previous myocardial infarction (MI) within 3 months prior to start of RRT • Previous MI more than 3 months prior to start of RRT • Previous coronary artery bypass graft (CABG) or coronary angioplasty (in some analyses the above four variables are combined under the term 'ischaemic heart disease')
• Cerebrovascular disease • Diabetes (when not listed as the primary renal disease) • Chronic obstructive pulmonary disease (COPD) • Liver disease
• Claudication • Ischaemic or neuropathic ulcers • Non-coronary angioplasty, vascular graft, or aneurysm • Amputation for peripheral vascular disease (in some analyses these four variables are combined under the term 'peripheral vascular disease')
• Smoking • Malignancy

on comorbidity and other variables included in the analyses are summarised in figure 6.1.

1) Patient demographics

The proportion of patients starting RRT with various comorbidities was examined by age group (18–34, 35–44, 45–54, 55–64, 65–74 and ⩾75 years), primary renal disease, ethnic origin and first modality of RRT. Chi-squared, Fischer's exact and Kruskal Wallis tests were used as appropriate to test for significant differences between groups.

2) Late presentation (referral), haemoglobin (Hb) and renal function at start of RRT

Referral time was defined as the number of days between the date first seen by a nephrologist and the date of starting RRT. Referral times of more than 90 days and less than 90 days define early and late presentation, respectively. Data on referral time was incomplete and therefore only patients with data on comorbidity and referral time from centres with >75% data completeness for referral time were included in this analysis (n = 6,714; 20.8% of all patients starting RRT).

The association of various comorbidities with Hb concentration at start of RRT was studied amongst patients with comorbidity data and Hb data within 14 days before the start of RRT (n = 9,447; 29.2% of all patients starting RRT). Two-sample t-tests were used to compare the mean Hb at start of RRT amongst patients with each specific comorbidity with the mean for those with none of the comorbidities. As many tests were carried out, only p values <0.01 were considered statistically significant for these analyses.

The association of various comorbidities with estimated glomerular filtration rate (eGFR) at start of RRT was studied amongst patients with comorbidity data and eGFR data within 14 days before the start of RRT. The eGFR was calculated using the abbreviated 4 variable MDRD study equation [11]. For the purpose of eGFR calculation, patients who had missing ethnicity but a valid serum creatinine measurement were classed as White as the Black population only account for 6% of the total UK RRT population. The eGFR values were log transformed in order to normalise the data and then two-sample t-tests were used to compare the means of the log eGFR of those patients with each specific comorbidity against those with none of the comorbidities present. As many statistical tests were carried out, only p values <0.01 were considered statistically significant for these analyses.

There is no defined eGFR at which patients should start RRT and a number of factors, including clinical presentation, symptoms, complications of uraemia and biochemistry, are used to determine dialysis initiation. However, there are defined eGFR thresholds for pre-emptive listing for a kidney transplant. The European Best Practice Guidelines (EBPG) recommend that patients with progressive irreversible deterioration in renal function and a creatinine clearance of <15ml/min/1.73 m^2 should be considered for pre-emptive transplantation; patients with ERF secondary to diabetes should be considered for early and pre-emptive transplantation when their eGFR decreases to <20 ml/min/1.73 m^2 [12]. In the UK, the British Transplantation Society (www.bts.org.uk) endorse the EBPG and current UK Renal Association guidelines recommend that patients should be placed on the kidney transplant waiting list within six months of their anticipated dialysis start date [13]. There are no KDOQI guidelines for listing. It is therefore possible that patients could have started RRT with a transplant and an eGFR value as high as 20 ml/min/1.73 m^2.

For the eGFR analyses, 14,909 patients with comorbidity data were considered for inclusion. Patients with no eGFR data (n = 2,632) were excluded, as were those with no eGFR data in the 14 days preceding RRT (n = 2,056). Patients with an eGFR >20 ml/min/1.73 m^2 (n = 500) were excluded from the eGFR analyses due to concerns about possible data extraction errors. Patients starting RRT between 2003 and 2005 from one centre (London West) were also excluded due to errors in the software data extraction process for this item (n = 319). This left 9,402 (29.1% of all patients starting RRT) eligible for analysis. Many UKRR analyses, including those presented here, rely on the accuracy of the date of start of RRT. A discussion of the issues around definition of the start date is included in chapter 13.

3) Activation on deceased donor kidney transplant waiting list

The association between comorbidity and activation on the

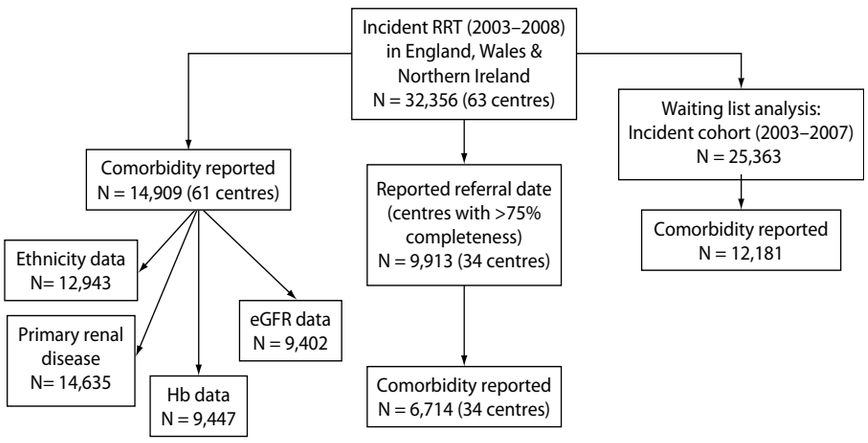

Fig. 6.1. Flow chart showing number of patients included in the various analyses

deceased donor kidney transplant waiting list within one year of starting treatment was examined (n = 12,181). In order to allow a year of follow up, incident patients in 2008 were not included. Date of first activation on the waiting list for all patients on the UKRR database starting RRT (HD or PD) between 2003 and 2007 were obtained from NHS Blood and Transplant, the organisation responsible for maintaining the national organ donor register. All patients were followed until 31st December 2008 to determine the date of activation on the waiting list. The prevalence of various comorbidities amongst patients activated on the waiting list within the first year of RRT was compared with those activated on the waiting list beyond the first year or not activated within the follow-up period. Patients who died within the first year and were not on the active waiting list at the time of death were included under the 'non-waitlisted' group.

4) Patient survival

The Registry collected data with a 'timeline' entry on all patients who had started RRT for ERF. Patients presenting acutely and initially classified as acute renal failure requiring dialysis who continued to require long-term dialysis, can be re-classified by clinicians as having had ERF from the date of their first RRT. The death rate is high in the first 90 days and variable between centres, due partly to individual clinical variation in the classification of patients with acute kidney injury who may be deemed from the start to be unlikely to recover renal function. To remove this centre variation and allow comparison with results from other national registries, the association of comorbid conditions and survival 1 year after 90 days from start of RRT was also analysed.

For each of the follow up periods, the association of baseline comorbidity with survival was studied using univariate and multivariate Cox regression models. For analyses of survival within the first 90 days, the cohort included patients starting RRT between 1st January 2003 and 30th September 2008 to allow a minimum of three months follow-up from the start of RRT. For the 1 year after 90 days survival analyses, the cohort included patients who survived at least 90 days on RRT and who started RRT between 1st January 2003 and 30th September 2007.

For each variable, the models were used to estimate the hazard ratio of death, comparing patients with a particular comorbidity with those who did not have the comorbidity. For both the univariate and multivariate Cox models, patients were first stratified by age group (<65 years and ⩾65 years) to account for the increasing incidence of certain comorbidities with age, which may otherwise obscure the analyses. The multivariate models used an automatic selection procedure to identify the variables most strongly related to survival. The potential variables to be included were: age (per 10 year increase), angina, MI within 3 months prior to starting RRT, MI more than 3 months prior to starting RRT, coronary artery bypass grafting (CABG) or coronary angioplasty, cerebrovascular disease, diabetes mellitus (whether as a cause of primary renal disease or as a comorbidity), chronic obstructive pulmonary disease (COPD), liver disease, claudication, ischaemic/neuropathic ulcers, angioplasty/vascular graft, smoking and malignancy. The automatic procedure starts by including only the variable most strongly related to survival. Then, with that variable included, it fits models adding each of the remaining variables in turn (singly) and chooses the variable that adds most to the model (in addition to the contribution made by the first variable included). The process continues in this way, adding variables that make a further significant contribution to the model, and removing any whose contribution becomes non-significant once other variables have been added. The final model only includes those variables selected by the process. These automatic methods have been used to give an indication of the variables most strongly related to survival but caution is needed in interpreting them because, amongst other things, when using correlated variables, a slight difference in the data (or in the algorithm chosen) could result in different variables being included in the final models. A better analysis would make a considered judgement of which variables should be included (rather than an automatic one) and would use interaction terms and/or adjustments other than age.

All statistical analyses were performed using SAS version 9.1.3.

Results

Completeness of comorbidity returns from each participating centre

Of the 6,107 patients commencing RRT in centres in England, Wales and Northern Ireland in 2008, comorbidity data were provided for 2,442 (40.0%) (tables 6.2 and 6.3). Table 6.2 highlights the continued wide variation in the completeness of data returns with 4 centres providing data on 100% of patients, but 19 centres providing data for less than 5% of their new patients in 2008.

Limiting the analysis to only the centres that reported in 2003, data completeness for comorbidity has fallen from 54.3% in 2003 to 43.8% in 2008. When centres with 0% completeness for comorbidity were excluded, the median percentage of comorbidity returns in 2008 was 52%.

Prevalence of multiple comorbidity

Including all incident patients from the years 2003–2008 (n = 32,356), comorbidity data were available for 14,909 (46.1%). More than half of these patients had one or more comorbidities (53.8%) (table 6.4) but in the subgroup of patients aged 65 years and over, 66.1% had one or more comorbidities (table 6.5).

Frequency of each comorbid condition

Table 6.5 lists the prevalence of specific comorbidities and the percentage this is of the total number of incident

Table 6.2. Completeness of comorbidity data returns on incident patients from individual centres (2003–2008)

	2003		2004		2005		2006		2007		2008	
Centre	N	% return	N	% return	N	% return	N	% return	N	% return	N	% return
Antrim					42	5	33	9	36	14	41	73
B Heart	103	0	102	0	116	1	115	0	101	1	108	0
B QEH			194	1	196	1	186	0	222	1	271	0
Bangor	33	48	36	64	40	55	42	60	36	64	42	57
Basldn	53	45	46	39	28	57	45	82	39	77	40	98
Belfast					130	15	112	14	89	28	68	46
Bradfd	74	85	62	92	66	95	50	100	87	99	59	92
Brightn			118	1	110	2	130	2	117	1	116	1
Bristol	163	87	163	80	175	81	176	97	154	84	181	62
Camb	94	1	107	1	110	1	156	1	125	0	102	1
Cardff	161	0	185	5	181	19	205	4	220	1	153	1
Carlis	31	29	29	79	32	94	27	93	26	92	31	97
Carsh	199	33	168	41	178	47	185	56	195	69	212	61
Chelms			49	47	37	49	48	83	51	55	33	79
Clwyd	11	0	14	0	27	4	18	0	23	4	13	0
Colchr											47	0
Covnt	75	1	76	0	83	0	102	2	110	0	113	0
Derby	60	75	67	82	71	92	70	89	61	98	92	91
Derry							3	67	7	43	6	67
Donc									18	94	25	28
Dorset	66	98	60	100	47	98	53	100	59	95	84	83
Dudley	41	0	54	0	38	0	44	2	39	0	49	0
Exeter	97	54	109	46	111	32	105	28	125	7	134	3
Glouc	53	87	54	89	60	97	73	88	58	95	45	91
Hull	80	90	108	86	126	98	100	96	99	98	117	83
Ipswi	37	43	45	47	58	31	42	62	39	49	38	34
Kent									172	5	132	29
L Barts			185	78	185	90	187	81	210	82	201	69
L Guys	93	3	100	4	128	6	132	3	162	6	169	1
L Kings	108	100	114	98	136	99	113	100	126	100	151	100
L Rfree					131	2	210	1	184	0	160	1
L St.G									89	64	89	57
L West	268	63	290	70	309	55	316	60	276	58	317	48
Leeds	185	86	178	82	161	71	172	73	125	74	155	65
Leic	167	96	162	94	226	64	242	66	244	72	215	73
Liv Ain			3	0	29	3	34	0	35	3	42	0
Liv RI	114	62	130	62	139	63	139	53	114	51	103	32
M Hope	143	33	111	42	112	35	130	12	107	8	112	1
M RI									155	23	136	34
Middlbr	103	99	101	91	84	90	109	70	99	55	93	81
Newc	109	5	114	1	101	2	85	1	107	2	101	2
Newry					28	14	13	23	15	27	20	100
Norwch			94	5	118	8	106	12	106	9	92	76
Nottm	115	98	107	95	145	99	137	98	128	94	117	44
Oxford	186	60	170	65	155	52	157	13	145	85	146	28
Plymth	64	28	62	44	58	47	91	63	76	74	70	31
Ports	140	64	117	68	151	62	174	63	157	64	169	34
Prestn	97	1	79	0	118	0	121	1	129	0	112	0
Redng	65	0	60	0	79	1	75	0	93	1	99	1
Sheff	159	65	167	59	157	41	168	58	166	55	180	45
Shrew			55	0	42	0	54	0	55	4	62	13
Stevng	123	7	83	7	92	9	121	7	88	22	101	39
Sthend	42	67	39	79	34	74	47	96	35	97	35	69

Table 6.2. Continued

	2003		2004		2005		2006		2007		2008	
Centre	N	% return	N	% return	N	% return	N	% return	N	% return	N	% return
Stoke									87	3	84	0
Sund	55	69	50	96	59	93	56	93	62	100	44	100
Swanse	134	97	95	93	98	97	115	97	128	98	120	86
Truro	53	83	67	81	32	88	50	78	46	91	39	36
Tyrone					23	30	30	50	22	41	25	52
Ulster					9	56	8	63	15	100	13	100
Wirral	52	13	66	14	59	7	53	0	53	0	41	5
Wolve	88	100	105	98	92	85	87	83	67	85	87	76
Wrexm	32	3	29	0	41	0	27	0	27	4	22	45
York	57	84	48	92	43	91	48	90	35	83	33	36
Totals	**4,183**		**4,827**		**5,436**		**5,727**		**6,076**		**6,107**	

Blank cells – no data returned to the UKRR for that year

Table 6.3. Summary of completeness of incident patient comorbidity returns (2003–2008)

	Years						Combined years
	2003	2004	2005	2006	2007	2008	
Number of renal centres included	43	50	56	57	62	63	
Total number of new patients	4,183	4,827	5,436	5,727	6,076	6,107	32,356
Number of patients with comorbid data entries	2,271	2,470	2,498	2,555	2,673	2,442	14,909
Percentage	54.3	51.2	46.0	44.6	44.0	40.0	46.1
Percentage restricted to centres reporting since 2003	54.3	55.6	51.6	50.0	51.4	43.8	51.0
Percentage with comorbidity returns							
Median percentage amongst only centres returning >0% comorbidity	63.7	67.5	52.3	62.5	56.6	52.0	60.2

patients for whom data was available for that item. Diabetes mellitus (either listed as cause of PRD or as a comorbidity) was present in 30.1% of all patients. Ischaemic heart disease, cerebrovascular disease and claudication were more prevalent in patients 65 years and over. Liver disease, ischaemic/neuropathic ulcers and prior amputation were more frequently observed in younger patients; actual percentages, nevertheless, were quite small (table 6.5). Smoking was also more common amongst patients under 65 years. This broad stratification is quite misleading however, as prevalence of comorbidities increased markedly from 18–65 years (figures 6.2 and 6.3).

Prevalence of comorbidity by age band

Figures 6.2 and 6.3 illustrate the increasing prevalence of comorbidity with increasing age up to the 65–74 year age group in incident RRT patients. In those patients aged >75 years there was a levelling off or slight reduction of most reported comorbidities.

Prevalence of comorbidity by ethnic origin

Figure 6.4 illustrates the presence of comorbidity by ethnic origin, showing a higher prevalence of having at least one comorbidity amongst patients of White origin

Table 6.4. Number of reported comorbidities in patients starting RRT, as a percentage of those for whom comorbidity data were available (2003–2008)

Number of comorbidities	0	1	2	3	4	5+
Percentage	46.2	27.2	12.7	7.6	3.8	2.4

Table 6.5. Frequency with which each condition was reported in incident RRT patients 2003–2008

Comorbidity	Age <65 years		Age ⩾65 years		p value*	% overall prevalence
	N	(%)	N	(%)		
Any comorbidity present	3,305	(42.5)	4,710	(66.1)	<0.0001	53.8
Angina	695	(9.0)	1,567	(22.2)	<0.0001	15.3
MI in past 3 months	127	(1.6)	264	(3.7)	<0.0001	2.6
MI > 3 months ago	506	(6.5)	1,125	(15.9)	<0.0001	11.0
CABG/angioplasty	408	(5.3)	694	(9.9)	<0.0001	7.5
Cerebrovascular disease	459	(5.9)	958	(13.5)	<0.0001	9.6
Diabetes (not listed as PRD)	387	(5.1)	791	(11.3)	<0.0001	8.1
Diabetes listed as PRD	1,955	(25.1)	1,321	(18.6)	<0.0001	22.0
COPD	312	(4.1)	689	(9.8)	<0.0001	6.8
Liver disease	252	(3.3)	130	(1.8)	<0.0001	2.6
Claudication	363	(4.7)	779	(11.0)	<0.0001	7.7
Ischaemic/neuropathic ulcers	282	(3.6)	190	(2.7)	0.0009	3.2
Angioplasty/vascular graft	140	(1.8)	362	(5.1)	<0.0001	3.4
Amputation	181	(2.3)	105	(1.5)	0.0002	1.9
Smoking	1,289	(17.0)	815	(11.9)	<0.0001	14.5
Malignancy	480	(6.2)	1,218	(17.2)	<0.0001	11.4

* p values from Chi-squared tests for differences between age groups in the percentage with the comorbidity

compared to the ethnic minority. At all ages, incident White RRT patients have more comorbidity than incident South Asian or Black patients (figure 6.5). This difference appears significant for Blacks at all ages above 18–34 (figure 6.5). This difference is attributable to lower rates of ischaemic heart disease, cerebrovascular disease, peripheral vascular disease and malignancy with lower rates of smoking but higher rates of diabetes mellitus (table 6.6). Despite rates of diabetes mellitus almost twice as high in South Asian patients (48.5%) compared to Whites (27.3%), ischaemic heart disease rates are similar and cerebrovascular disease rates and peripheral vascular disease rates are slightly lower in South Asians (table 6.6).

Prevalence of comorbidity amongst patients with diabetes mellitus

Table 6.7 compares comorbidity amongst patients with and without diabetes (as either primary renal

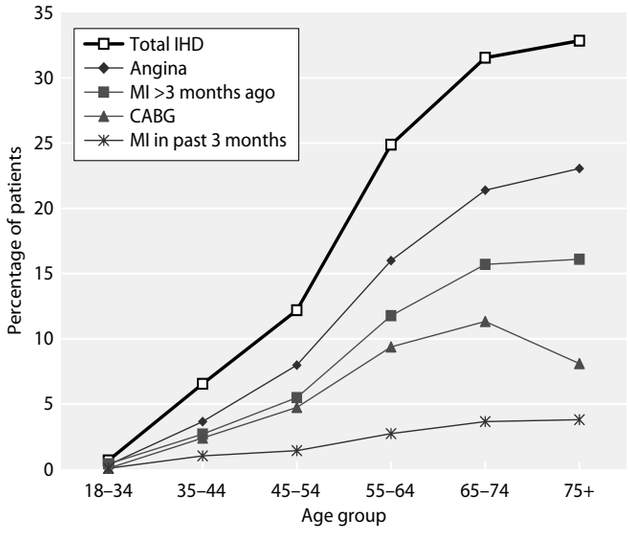

Fig. 6.2. Prevalence of ischaemic heart disease amongst incident patients 2003–2008 by age at start of RRT

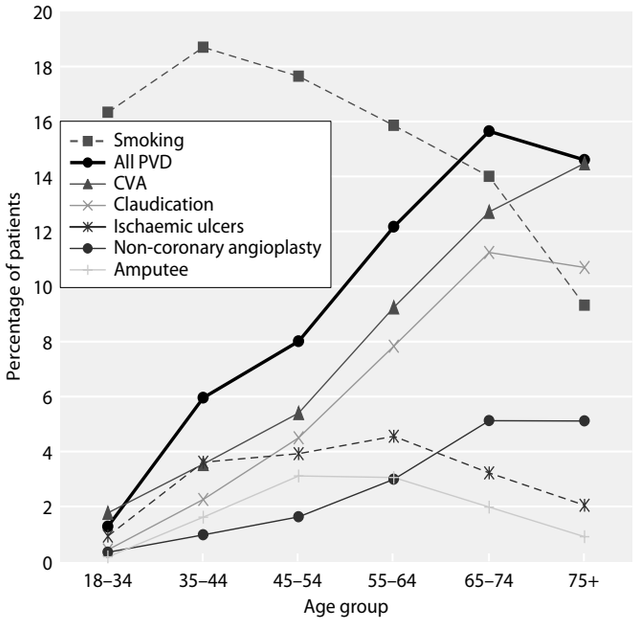

Fig. 6.3. Prevalence of non-coronary vascular disease amongst incident patients 2003–2008 by age at start of RRT

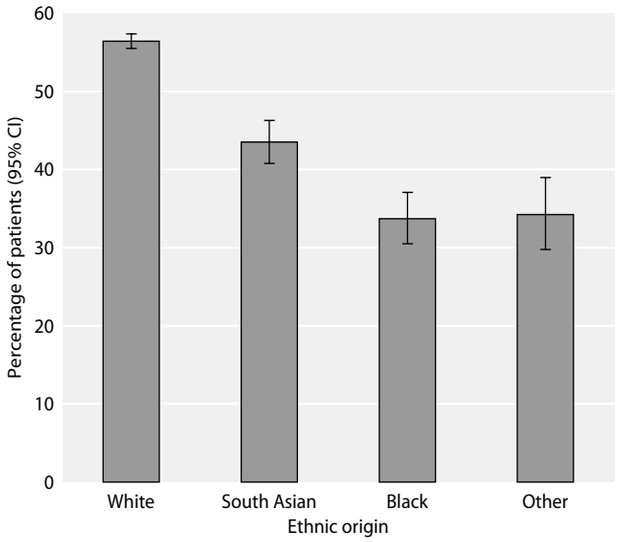

Fig. 6.4. Presence of comorbid conditions at the start of RRT by ethnic origin amongst patients starting RRT 2003–2008

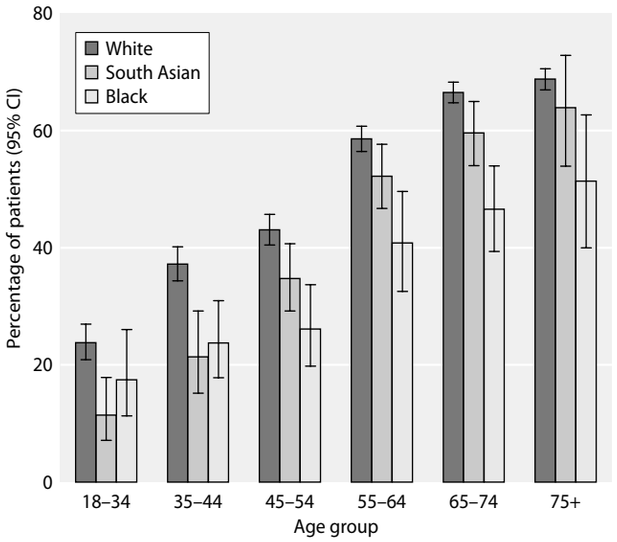

Fig. 6.5. Percentage of patients with comorbidity by ethnic origin in each age group at the start of RRT 2003–2008

Table 6.6. Prevalence of comorbidities amongst incident patients starting RRT 2003–2008 by ethnic group, as percentages of the total number of patients in that ethnic group for whom comorbidity data was available

	No. of patients (%) with comorbidity								
	White		South Asian		Black		Other		p value*
Ischaemic heart disease	2,453	(23.7)	307	(25.0)	77	(9.9)	46	(11.6)	<0.0001
Cerebrovascular disease	1,029	(9.9)	106	(8.5)	67	(8.6)	25	(6.2)	0.03
Diabetes (not listed as PRD)	803	(7.8)	114	(9.4)	42	(5.4)	26	(6.5)	0.01
Diabetes listed as PRD	2,044	(19.5)	491	(39.1)	241	(30.5)	124	(30.5)	<0.0001
COPD	780	(7.5)	45	(3.7)	20	(2.6)	9	(2.3)	<0.0001
Liver disease	247	(2.4)	50	(4.0)	29	(3.7)	14	(3.5)	0.001
Peripheral vascular disease	1,298	(12.5)	97	(7.8)	38	(4.9)	28	(7.0)	<0.0001
Smoking	1,663	(16.3)	60	(5.0)	40	(5.2)	38	(10.0)	<0.0001
Malignancy	1,331	(12.7)	37	(3.0)	53	(6.8)	19	(4.7)	<0.0001

* p values from Chi-squared tests for differences between ethnic groups in the percentage with the comorbidities

Table 6.7. Number and percentage of patients with and without diabetes (either as primary diagnosis or comorbidity) who have other comorbid conditions

	Non-diabetic patients		Diabetic patients		
Comorbidity	N	(%)	N	(%)	p value*
Ischaemic heart disease	1,842	(18.3)	1,424	(32.4)	<0.0001
Cerebrovascular disease	795	(7.9)	591	(13.3)	<0.0001
COPD	697	(6.9)	283	(6.4)	0.3
Liver disease	240	(2.4)	130	(2.9)	0.1
Peripheral vascular disease	755	(7.5)	902	(20.4)	<0.0001
Smoking	1,438	(14.6)	610	(14.2)	0.5
Malignancy	1,320	(13.1)	317	(7.1)	<0.0001

* p values from Chi-squared tests for differences in the percentage with the comorbidities between diabetic patients and non-diabetic patients

Table 6.8. Percentage prevalence of specific comorbidities amongst patients presenting late (0–89 days) compared with those presenting early (>89 days)

	Late referral		Early referral		
Comorbidity	N	(%)	N	(%)	p value*
Ischaemic heart disease	371	(23.0)	1,235	(24.5)	0.2
Cerebrovascular disease	166	(10.2)	524	(10.3)	0.9
Diabetes (not listed as PRD)	132	(8.2)	438	(8.8)	0.5
COPD	112	(6.9)	341	(6.8)	0.8
Liver disease	47	(2.9)	116	(2.3)	0.2
Peripheral vascular disease	173	(10.7)	685	(13.5)	0.003
Malignancy	294	(18.1)	528	(10.4)	<0.0001
Smoking	265	(16.7)	768	(15.3)	0.2

* p values from Chi-squared tests for differences between referral groups in the percentage with the comorbidities

disease or comorbidity). As would be expected, patients with diabetes mellitus have higher rates of vascular disease (20.4% compared to 7.5% in non-diabetics). Similarly, ischaemic heart disease and cerebrovascular disease were more common in diabetics. Smoking at the time of initiation of RRT was similar for diabetics and non-diabetics (table 6.7).

Haemoglobin concentration at the time of starting RRT and comorbidity

The mean Hb prior to starting RRT in patients recorded as starting RRT without any comorbidity present was 10.3 g/dl compared to 10.2 g/dl for patients with one or more comorbidities. Of patients without any comorbidity, 57.1% achieved a Hb >10 g/dl compared to 53.4% with one or more comorbidities. Compared to those without any comorbidity, the mean Hb concentrations at the start of RRT were lower in patients with certain comorbidities, including malignancy (10.0 g/dl, p = <0.0001), a history of claudication (10.0 g/dl, p = <0.0001), ischaemic/neuropathic ulcers (9.8 g/dl, p = <0.0001) and amputation (9.8 g/dl, p = 0.0002). Although statistically significant, these Hb differences at initiation of RRT do not appear clinically significant.

Late presentation and comorbidity

Table 6.8 shows the referral time for patients with and without various comorbidities. Patients with peripheral vascular disease were more likely to be referred to a nephrologist early and patients with malignancy were more likely to be referred late. There was no association between time of presentation and any other comorbidity.

Renal function at the time of starting RRT and comorbidity

Table 6.9 shows the geometric mean eGFR prior to starting RRT in patients with each of the individual comorbidities. The (geometric) mean eGFR prior to starting RRT in patients who were recorded as starting without any comorbidity present was 7.6 ml/min/1.73 m^2. In each case, average eGFR was slightly higher amongst patients with comorbidity compared to patients without any comorbidity.

Age and comorbidity in patients by treatment modality at start of RRT

All comorbidities were more prevalent in patients receiving haemodialysis as their initial modality of treatment rather than peritoneal dialysis (table 6.10). This difference was statistically significant for all comorbid conditions other than previous CABG/coronary angioplasty. The median age of patients with comorbidity data starting RRT on HD was 66.0 years compared with 59.2 years for those starting PD (Kruskal Wallis test, p < 0.0001). For each of the comorbid conditions, the median age of patients on HD was higher than for patients on PD (table 6.10).

Comorbidity and subsequent activation on deceased donor transplant waiting list (TWL)

Table 6.11 shows that patients starting dialysis as their first RRT modality who were activated on the TWL within the first year, were younger and had significantly less comorbidity at the start of RRT than those who were not activated within the first year.

Table 6.9. eGFR within 2 weeks prior to the start of RRT by comorbidity 2003–2008

Comorbidity	eGFR geometric mean (ml/min/1.73 m^2)	eGFR 95% CI	p value*
No comorbidity present	7.6	7.5–7.7	Ref
Any comorbidity present	8.3	8.2–8.4	<0.0001
Angina	8.7	8.5–8.8	<0.0001
MI in past 3 months	8.8	8.4–9.2	<0.0001
MI >3 months ago	8.7	8.6–8.9	<0.0001
CABG/angioplasty	9.1	8.9–9.4	<0.0001
Cerebrovascular disease	8.6	8.4–8.8	<0.0001
Diabetes (not listed as PRD)	8.5	8.3–8.7	<0.0001
Diabetes listed as PRD	8.7	8.5–8.8	<0.0001
COPD	8.5	8.3–8.8	<0.0001
Liver disease	8.3	7.8–8.7	0.003
Claudication	8.8	8.5–9.0	<0.0001
Ischaemic/neuropathic ulcers	8.8	8.4–9.1	<0.0001
Angioplasty/vascular graft	8.6	8.3–9.0	<0.0001
Amputation	8.9	8.4–9.3	<0.0001
Smoking	8.2	8.0–8.4	<0.0001
Malignancy	7.9	7.7–8.1	0.002

* Two-sample t-tests compare log(eGFR) for each comorbidity against those without comorbidity

Comorbidity and survival within 90 days of starting RRT

On univariate analysis stratified for age, most comorbidity was associated with an increased risk of death in the first 90 days when compared with a patient in the same age group without that comorbidity. This was true amongst patients aged <65 years and those aged ⩾65 years, the associations being more profound for those aged <65 years (data not shown). Multivariable stepwise Cox regression analyses stratified by age group (<65 and ⩾65) are shown in tables 6.12 and 6.13. As identified in the univariate models, comorbidities in younger patients were more indicative of early death than when present in older patients. Diabetes did not emerge as an independent predictor of death, probably due to its close association with ischaemic heart disease and peripheral vascular disease. Some comorbidities may appear not to be associated with an increased risk

Table 6.10. Number (and percentage) of incident patients with comorbid conditions starting PD and HD 2003–2008

	HD			PD			
Comorbidity	N	(%)	Median age	N	(%)	Median age	p value*
Angina	1,845	(16.9)	71.3	405	(11.6)	68.5	<0.0001
MI in past 3 months	339	(3.1)	70.7	51	(1.5)	69.1	<0.0001
MI >3 months ago	1,304	(11.9)	70.8	319	(9.1)	69.0	<0.0001
CABG/angioplasty	837	(7.7)	69.0	255	(7.3)	67.9	0.4
Cerebrovascular disease	1,177	(10.8)	71.1	230	(6.6)	66.4	<0.0001
Diabetes (not listed as PRD)	977	(9.1)	70.9	192	(5.5)	68.3	<0.0001
COPD	855	(7.9)	70.8	142	(4.1)	67.3	<0.0001
Liver disease	329	(3.0)	60.0	48	(1.4)	57.4	<0.0001
Claudication	957	(8.7)	70.6	180	(5.1)	67.5	<0.0001
Ischaemic/neuropathic ulcers	410	(3.7)	62.6	60	(1.7)	56.7	<0.0001
Angioplasty/vascular graft	411	(3.8)	71.4	90	(2.6)	70.1	0.001
Amputation	248	(2.3)	61.3	36	(1.0)	59.5	<0.0001
Smoking	1,629	(15.3)	61.2	441	(12.9)	55.3	0.001
Malignancy	1,457	(13.3)	72.0	232	(6.6)	70.1	<0.0001

* p values from Chi-squared tests for differences between modalities in the percentage with the comorbidities

Table 6.11. Number (and percentage) of incident dialysis patients with comorbid conditions who were activated on the transplant waiting list within one year of starting treatment compared to those patients who were not activated within one year of initiating RRT

	Not activated on waiting list in first year			Activated on waiting list in first year			
Comorbidity	N	(%)	Median age	N	(%)	Median age	p value*
Angina	1,849	(18.8)	71.3	86	(3.8)	57.9	<0.0001
MI in past 3 months	312	(3.2)	70.9	11	(0.5)	55.0	<0.0001
MI >3 months ago	1,287	(13.1)	71.0	48	(2.1)	58.9	<0.0001
CABG/angioplasty	818	(8.4)	69.3	57	(2.6)	58.4	<0.0001
Cerebrovascular disease	1,115	(11.3)	71.2	74	(3.3)	58.2	<0.0001
Diabetes (not cause of ERF)	895	(9.2)	71.1	65	(2.9)	54.6	<0.0001
COPD	773	(7.9)	71.1	51	(2.3)	57.9	<0.0001
Liver disease	270	(2.7)	60.1	37	(1.6)	54.6	0.002
Claudication	931	(9.4)	70.5	24	(1.1)	49.6	<0.0001
Ischaemic/neuropathic ulcers	373	(3.8)	63.4	24	(1.1)	45.1	<0.0001
Angioplasty/vascular graft	407	(4.1)	71.3	11	(0.5)	57.7	<0.0001
Amputation	218	(2.2)	61.3	13	(0.6)	52.0	<0.0001
Smoking	1,473	(15.4)	63.6	308	(13.8)	46.5	0.06
Malignancy	1,360	(13.8)	72.0	45	(2.0)	58.7	<0.0001

* p values from Chi-squared tests for differences between transplant waiting list groups in the percentage with the comorbidities

Table 6.12. Multivariate Cox proportional hazards model* for predictors of death within the first 90 days of starting RRT during 01/01/2003–30/09/2008: patients aged <65 years

Comorbidity	Hazard ratio	95% CI	p value
Malignancy	5.4	3.6–8.2	<0.0001
Liver disease	4.6	2.6–7.9	<0.0001
Amputation	4.4	2.3–8.3	<0.0001
Angina	2.1	1.3–3.3	0.001
Age (per 10 yrs)	1.5	1.2–1.9	<0.0001

* This is the result of a stepwise procedure. The variables considered in the model were: age (in 10 year units) and the 14 comorbidity variables except that 'diabetes (not listed as PRD)' and 'diabetes listed as PRD' were replaced by 'Diabetes of either category'.

Table 6.13. Multivariate Cox proportional hazards model* for predictors of death within the first 90 days of starting RRT during 01/01/2003–30/09/2008: patients aged ⩾65 years

Comorbidity	Hazard ratio	95% CI	p value
Ischaemic/neuropathic ulcers	2.4	1.6–3.5	<0.0001
MI in past 3 months	2.1	1.5–2.9	<0.0001
COPD	1.6	1.2–2.0	0.001
Age (per 10 yrs)	1.6	1.3–1.8	<0.0001
Angina	1.4	1.2–1.8	0.001
MI >3 months ago	1.4	1.1–1.8	0.004
Malignancy	1.4	1.1–1.8	0.003

* This is the result of a stepwise procedure. The variables considered in the model were: age (in 10 year units) and the 14 comorbidity variables except that 'diabetes (not listed as PRD)' and 'diabetes listed as PRD' were replaced by 'Diabetes of either category'.

of death partly because of the low number of patients in these groups and partly because those who had severe disease and were thought likely not to survive 90 days, may not be started on RRT (for instance, liver disease in those aged ⩾65 years).

Comorbidity and survival 1 year after 90 days of commencing RRT

Age and five comorbidities were independently associated with an increased hazard of death within the first year after 90 days for patients aged <65 years and 5 of these were among the 9 variables independently associated with mortality beyond day 90 in patients ⩾65 years (tables 6.14 and 6.15). Although diabetes

Table 6.14. Multivariate Cox proportional hazards model* for predictors of death in the year after the first 90 days of starting RRT during 01/01/2003–30/09/2007: patients aged <65 years

Comorbidity	Hazard ratio	95% CI	p value
Malignancy	4.0	3.0–5.4	<0.0001
Ischaemic/neuropathic ulcers	2.5	1.7–3.7	<0.0001
Liver disease	2.2	1.4–3.4	0.0003
Diabetes of either category	1.8	1.4–2.3	<0.0001
Angina	1.4	1.0–1.9	0.03
Age (per 10 yrs)	1.3	1.2–1.5	<0.0001

* This is the result of a stepwise procedure. The variables considered in the model were: age (in 10 year units) and the 14 comorbidity variables except that 'diabetes (not listed as PRD)' and 'diabetes listed as PRD' were replaced by 'Diabetes of either category'.

Table 6.15. Multivariate Cox proportional hazards model* for predictors of death in the year after the first 90 days of starting RRT during 01/01/2003–30/09/2007: patients aged ⩾65 years

Comorbidity	Hazard ratio	95% CI	p value
Liver disease	2.1	1.4–3.1	0.0003
Amputation	1.9	1.1–3.2	0.021
Malignancy	1.8	1.5–2.1	<0.0001
Age (per 10 yrs)	1.8	1.6–2.0	<0.0001
Ischaemic/neuropathic ulcers	1.6	1.1–2.4	0.011
Angina	1.5	1.3–1.7	<0.0001
COPD	1.3	1.1–1.7	0.008
Cerebrovascular disease	1.3	1.1–1.5	0.012
Smoking	1.2	1.0–1.5	0.048

* This is the result of a stepwise procedure. The variables considered in the model were: age (in 10 year units) and the 14 comorbidity variables except that 'diabetes (not listed as PRD)' and 'diabetes listed as PRD' were replaced by 'Diabetes of either category'.

mellitus is independently associated with increased mortality in patients <65 years but not in those aged ⩾65 years, the opposite was true for smoking (tables 6.14 and 6.15).

Discussion

Comorbidity data completeness has been a cause for concern since they were first reported by the UKRR in 1999 [14]. Worryingly, rates of completeness are decreasing not increasing and the current rate of 40% in the UK compares with rates of 85% in Canada, 95–100% in Australia and New Zealand and 100% in the USA. However for the latter, the USRDS has a 'tick if present' policy, therefore no tick is interpreted as no comorbidity but could also represent missing data. Some work has recently been undertaken to learn from experience in these countries [15]. Completeness should improve in the future through a combination of linkage with other secondary data sources (e.g. Hospital Episode Statistics Dataset), statistical imputation techniques and local governance pressures now that comorbidity items form part of the National Renal Dataset. Caution must be taken in interpreting the influence of comorbidity – in at least one study patients with comorbidity recorded have significantly better health outcomes than those with missing comorbidity [16] so the generalisation of findings from this selected group of patients cannot therefore be assumed.

There are two recent reports that highlight the relative contribution of comorbidity to survival analyses in renal replacement patients. Van Manen and colleagues studied the role of comorbidity on survival in over 15,000 incident RRT patients from five European countries [17]. The addition of five comorbidities (diabetes mellitus, ischaemic heart disease, peripheral vascular disease, cerebrovascular disease and malignancy) explained only an additional 1.9% of the variance in survival on top of the 14.4% explained by age, gender, PRD, treatment modality and country. In the DOPPS study, 45 comorbidities were systematically recorded for over 15,000 prevalent HD patients and their relative contribution to survival over 3 years explored [18]. Total R^2 increased from 0.13 to 0.17 upon the addition of the most significant 17 conditions, in addition to demographic (age, gender, race), clinical (systolic blood pressure, body mass index) and laboratory (Hb, albumin, phosphate) variables. These studies highlight that our routinely measured variables at present do not offer good prediction of survival. The need for more complete and perhaps novel comorbidity data goes beyond its role in survival analyses as comorbidity is clearly relevant to patients' quality of life, the daily running of haemodialysis units and performance in other areas such as access to transplantation and achievement of permanent vascular access.

An alternative approach to case-mix adjustment for variations between centres in outcomes would be to use information on the levels of comorbidity or life expectancy in the general population served by a renal centre, given that most renal centres in the UK have relatively well-defined catchment areas. Such an approach has been suggested for analyses comparing different regions or countries [19, 20]. However, adjustment for general population mortality as well as individual patient comorbidity might risk over-adjustment and the catchment areas of many centres would not show uniform levels of general population life expectancy.

In the general population, the prevalence of cardiovascular disease increases exponentially with age, up to and beyond 75 years of age [21]. This appears at odds with the prevalence of cardiovascular disease in incident RRT patients, which increases only modestly beyond 65–74 years of age (figure 6.2). In early reports from the UKRR, the prevalence of cardiovascular disease was lower in incident RRT patients aged 75+ compared to those aged 65–74 [22]. One explanation for this paradox is competing risk: poorer cardiovascular outcomes are observed in patients with chronic kidney disease [23, 24], which may in part reflect lower use of medical therapies that are of proven benefit [25]. Alternatively, older patients with cardiovascular disease may be less

likely to be referred to a nephrologist for consideration of RRT [26, 27] (though this may have become less true in recent years [28]) or consider the benefits of dialysis over supportive care less convincing [29].

Another initially paradoxical observation is the lower (or equivalent) rate of vascular disease in South Asians and Blacks despite higher rates of diabetes mellitus. Rates of diabetes mellitus in ethnic groups commencing RRT in the UK are consistent with general population rates: in the English general population, compared to Whites, the age-adjusted risk ratios for diabetes mellitus range from 2.5 for Black Caribbean males to more than 5.0 for South Asians [30]. Considering the same general population health survey data, age-adjusted risk ratios of cardiovascular disease are only significantly higher for Pakistani and Bangladeshi males and females and Black Caribbean females (risk ratios 1.4–1.7) [30] and mortality from ischaemic heart disease has been observed to be lower for Blacks in the UK than Whites [31]. It is also important to remember that the UKRR diabetes mellitus and cardiovascular disease rates are not age-adjusted and the age profile of the Black and South Asian population in the UK also differs considerably from that of the White population. Sixteen percent of Whites are aged >65 compared with 6% of Blacks and 4% of South Asians [32], with incident non-White RRT patients being significantly younger than their White counterparts [33].

In these analyses, patients with comorbidity started RRT at a higher eGFR than patients with no reported comorbidity. This may suggest physicians advise patients with a higher comorbidity burden to start dialysis earlier or that these patients become symptomatic from their ERF earlier than patients with no comorbidity. Current evidence is conflicting as to whether starting dialysis at a higher eGFR is associated with better survival [34, 35] or poorer outcomes [36, 37]. It may be that improved survival associated with earlier start is just a reflection of lead time bias [38]. Further, this analysis is open to potential bias due to variability in the recording of 'RRT start date'.

The lower Hb concentrations at start of RRT associated with peripheral vascular disease and malignancies could be due to diminished erythropoietin (EPO) responsiveness or varying centre prescribing patterns for EPO amongst patients with these comorbidities. The lower Hb concentration associated with peripheral vascular disease does not seem to be explained by late referral or presentation, as these patients were referred earlier compared to those without this comorbidity.

Patients who started HD were older and had more comorbidity compared to those starting PD. These findings probably reflect a perception amongst UK healthcare practitioners and patients that PD is in general more suitable for younger and fitter patients. In addition, the presence of certain comorbid conditions such as cerebrovascular disease, liver disease and COPD can adversely affect the ability of patients to perform PD exchanges or to tolerate large volumes of dialysate in the peritoneum and hence influence the choice of HD in these patients. Some centres in the UK are starting to provide assisted PD (by a carer) which may alter the distribution of treatment modalities in the future.

The proportion of patients activated on the deceased donor transplant waiting list is much less amongst those with comorbidity compared to those without. Hence, when time taken to activate patients on the transplant waiting list is used as a marker of quality of care provided by the centres, adjustments for differences in comorbidity should be made for meaningful comparisons of the performance of each centre in listing patients for a transplant.

There are important and at times counter-intuitive associations between comorbidity and outcomes in RRT patients with differences between ethnic groups requiring further study. Individual comorbidity items are each associated with significant hazards of death and adjusting for this in centre (and international) comparisons must remain a priority.

Caution must also be taken when interpreting the results of the multivariate survival analyses in which smoking and diabetes are included alongside comorbidities which lie in the causal pathway (such as vascular disease); adjusting for the vascular disease that has been, in part, caused by the smoking or diabetes will attenuate the association between these variables and survival. The absence of an independent significant association between smoking and survival (for example) should not be interpreted as meaning that smoking does not increase a dialysis patient's risk of death. Indeed the observation that almost 15% of new RRT patients start dialysis as smokers is a major concern given the well recognised excess cardiovascular risk that dialysis patients have compared to those without CKD. Although this figure is slowly reducing perhaps it is time to better promote smoking cessation policies and guidance in CKD clinics and renal centres across the UK.

Conflict of interest: none

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Chapter 7
Survival and Causes of Death of UK Adult Patients on Renal Replacement Therapy in 2008: national and centre-specific analyses

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Key Words
Cause of death · Comorbidity · Dialysis · End stage renal disease · End stage renal failure · Haemodialysis · Outcome · Peritoneal dialysis · Renal replacement therapy · Survival · Transplant · Vintage

Abstract
Introduction: These analyses examine survival from the start of renal replacement therapy (RRT), based on the total incident UK RRT population reported to the UK Renal Registry, including the 19% who started on PD and the 5% who received a pre-emptive transplant. Survival of prevalent patients and changes in survival between 1997 and 2007 are also reported. ***Methods:*** Survival was calculated for both incident and prevalent patients on RRT and compared between the UK countries after adjustment for age. Survival of incident patients (starting RRT during 2007) was calculated both from the start of RRT and amongst the cohort who survived at least 90 days after RRT, and both with and without censoring at transplantation. Both the Kaplan–Meier and Cox adjusted models were used to calculate survival. Causes of death were analysed for both groups. Relative risk of death was calculated compared with the general UK population. ***Results:*** The 2007 unadjusted 1 year after 90 day survival for patients starting RRT was 86.2%. In incident 18–64 year olds the unadjusted 1 year survival had risen from 85.9% in 1997 to 92.4% in 2007 and for those aged >65 it had risen from 63.8% to 74.9%. The age-adjusted survival (adjusted to age 60) of prevalent dialysis patients rose from 85% in 2000 to 89% in 2007. Diabetic prevalent patient survival rose from 76.5% in 2000 to 83.0% in 2007. The age-standardised mortality ratio for prevalent RRT patients compared with the general population was 28.6 at age 30 years (and was lower than in the 1998–2001 cohort in all age groups up to 45–49) and 4.6 at age 80 years. In the prevalent RRT dialysis population, cardiovascular disease accounted for 29% of deaths, infection 17% and treatment withdrawal 14%. Of deaths, 26% were recorded as uncertain. Treatment withdrawal was a more frequent cause of death in patients aged >65 at start than in younger patients. The median life years remaining for a 25–29 year old on RRT was 20 years and 5 years for a 70 year old. ***Conclusions:*** Incident 2007 and prevalent 2008 patient survival on RRT in all the UK countries for all age ranges and also for patients with diabetes continued to improve. The relative risk of death on RRT compared with the general population has fallen since 2001. Death rates on dialysis in the UK remained lower than when compared with a similar aged population on dialysis in the USA.

Introduction

The analyses presented in this chapter examine survival from the start of renal replacement therapy (RRT), and also the survival amongst all prevalent RRT patients alive on 1st January 2008. They encompass the outcomes from the total incident UK dialysis population reported to the UK Renal Registry (UKRR), including the 19% who started on peritoneal dialysis and the 5% who received a pre-emptive renal transplant. These results are therefore a true reflection of the outcomes in the whole UK RRT population and are not distorted by focusing solely on the haemodialysis cohort. Additionally, analyses of the 1st year UK survival data include patients who were recorded as having started RRT for established renal failure (as opposed to acute kidney injury) but who had died within the first 90 days of starting RRT, a group excluded from most other countries' registry data.

The term established renal failure (ERF) used throughout this chapter is synonymous with the terms end stage renal failure (ESRF) and end stage renal disease (ESRD) which are in more widespread international usage. Within the UK, patient groups have disliked the term 'end stage'; the term ERF was endorsed by the English National Service Framework for Renal Services, published in 2004.

Centre anonymity for survival analyses was first removed in the publication of the 2006 UKRR Report and the UK remains the only country openly reporting and publishing centre attributable RRT survival. It is again stressed that these are raw data which continue to require very cautious interpretation. The Registry can adjust for the effects of the different age distributions of patients in different centres, but lacks sufficient data from many participating centres to enable adjustment for comorbidity and ethnic origin, which have been shown to have a major impact on outcome (for instance, better survival is expected in centres with a higher proportion of Black and South Asian patients). With this lack of information on case mix, it is difficult to interpret any apparent difference in survival between centres. Using data only from those centres with greater than 85% complete data returns on comorbidity, an analysis has been undertaken to highlight the impact of age, primary renal diagnosis and comorbidity on survival. Now that these data items are part of the mandatory National Renal Dataset to be returned by all hospital Trusts in England, we hope that completeness of returns will rapidly improve. Despite the uncertainty about any apparent differences in outcome for centres which appear to be outliers, the Registry will follow the clinical governance procedures as set out in chapter 2.

This year some analyses on the projected life years remaining are included within this chapter.

Methods

The unadjusted survival probabilities (with 95% confidence intervals) were calculated using the Kaplan–Meier method, in which the probability of surviving more than a given time can be estimated for members of a cohort of patients, without any adjustment for age or other factors that affect the chances of survival in the cohort. Where centres are small, or the survival probabilities are greater than 90%, the confidence intervals are only approximate.

In order to estimate the difference in survival of different subgroups of patients within the cohort, a stratified proportional hazards model (Cox) was used where appropriate. The results from the Cox model were interpreted using a hazard ratio. When comparing two groups, the hazard ratio is the ratio of the estimated hazards for group A relative to group B, where the hazard is the risk of dying at time t given that the individual has survived until this time. The underlying assumption of a proportional hazards model is that this ratio remains constant throughout the period under consideration. Whenever used, the proportional hazards model was tested for validity.

To allow comparisons between centres with differing age distributions, survival analyses were statistically adjusted for age and reported as survival adjusted to age 60. This gives an estimate of what the survival would have been if all patients in that centre had been aged 60 at the start of RRT. This age was chosen because it was approximately the average age of patients starting RRT 14 years ago at the start of the Registry's data collection. The average age of patients commencing RRT in the UK has been stable around an age of 65 years for the last 7 years, but the Registry has maintained age adjustment to 60 years for comparability with all previous years' analyses. All analyses were undertaken using SAS vs. 9.1.3.

Definition of the date renal replacement therapy started

The incident survival figures quoted in this chapter are from the first day of renal replacement therapy. When a patient starts RRT with a pre-emptive transplant there is an easily definable date. Recent UKRR analyses of electronic data extracted for the immediate month prior to the start date of RRT provided by the clinician, have highlighted inconsistencies in the definition of this first date when patients start either on haemodialysis or peritoneal dialysis, with the date of start reported to the Registry being later than the actual date of start. These findings are described in detail in chapter 13 of this Report. This concern is unlikely to be unique to the UK, but will be common to analyses from all renal registries and to any comparison between published studies reported from different centres.

In addition to this varying clinical definition of day 0, there is international variability on when patient data are collected by national registries with some countries (often for financial reimbursement reasons) defining the 90th day after starting RRT as day 0 or others collecting data only on those who have survived 90 days and reporting as zero the number of patients dying within the first 90 days.

In the UK all patients starting RRT for ERF are included from the date of the first RRT treatment (a date currently defined by the clinician) unless they recover renal function within 90 days. These UK data therefore include some patients who develop acute irreversible renal failure in the context of an acute illness for instance and were recorded by the clinician as being in irreversible established renal failure. However, this previously relied on clinicians retrospectively assigning the date of first RRT in such patients and it became clear at the time of preparation of the last Annual Report that many clinicians were not entering timeline data in this way, but rather entering the date on which it was decided to plan for long-term RRT or the date of first outpatient dialysis. All UK nephrologists have now been asked to record the date of the first haemodialysis session, and to record whether the patient was considered to have acute kidney injury (acute renal failure) or to be in ERF at the time of the first session. For patients initially categorised as 'acute', but who are subsequently categorised as ERF, the UKRR will extract information from the first session of RRT onwards (including all forms of RRT for acute renal failure) and will assign the date of this first session as the date of start of RRT.

As many other national registries do not include reports on patients who started RRT for ERF but died in the first 90 days, survival from 90 days onwards is also reported in this chapter, to allow international comparisons. Although the USRDS 2008 Report is now reporting on survival data from day 0, the finding of a lower rate of death which then increases throughout the first 90 day period strongly suggests that there remains variable reporting of patients who do not survive this period. This distinction is important, as there is a much higher death rate in the first 90 days, which would distort any international comparisons.

Methodology for incident patient survival

The incident survival cohort was **NOT** censored at the time of transplantation and therefore included the 5% who received a pre-emptive transplant. Censoring excludes the healthier patient cohort. An additional reason for not censoring was to facilitate comparison between centres. Centres with a high proportion of patients of South Asian and Black origin are likely to have a healthier dialysis population, because South Asian and Black patients are less likely to undergo early transplantation.

The incident ('take-on') population in any specific year included patients who recovered from ERF after 90 days from the start of RRT, but excluded those that recovered within 90 days. Patients newly transferred into a centre who were already on RRT were excluded from the incident population for that centre and were counted at the centre at which they started RRT. Patients re-starting dialysis after a failed transplant were also excluded (unless the transplant also occurred in the same year).

For patients who recovered renal function for >90 days and then went back into ERF, the length of time on RRT was calculated from the day on which the patient restarted RRT. If recovery was for less than 90 days, the start of renal replacement therapy was calculated from the date of the first episode and the recovery period ignored.

The one year incident survival for patients in 2007 was calculated for those who had all been followed for 1 full year through 2007 and 2008 (e.g. patients starting RRT on 1st December 2007 were followed through to 30th November 2008). The 2008 incident patients were excluded from this year's incident survival analysis as they had not been followed for a sufficient length of time.

For analysis of 1 year after 90 day survival, patients who started RRT in October through December 2007 were not included in the cohort, as 1st quarter 2008 data on these patients were not yet available.

It is important to note that in the 1 year after 90 day survival analyses in the 2005 UKRR Report and all reports prior to 2005, the previous year's patient cohort was used to calculate the 1 year after 90 day survival (e.g. this year the alternative would have been to use the 2006 rather than 2007 cohort) starting in October. A comparison of these two methods has shown no difference between them for any but the smallest centres (which will have wide 95% confidence intervals), so for simplicity of understanding the cohort and using a common cohort across analyses, the UKRR uses the previous year's data (2007 cohort).

To help identify any centre differences in survival from the small centres (where confidence intervals are large), an analysis of 1 year after 90 day survival using a rolling 4 year combined incident cohort from 2004 to 2007 was also undertaken. For those centres which had joined the UKRR in the previous 1–3 years, the available data were included.

The death rate per 1,000 patient years was calculated by counting the number of deaths and dividing by the person years exposed. This included all patients, including those who died within the first 3 months of therapy. The person years at risk were calculated by adding up, for each patient, the number of days at risk (until they died or were lost to follow-up) and dividing by 365.

Adjustment of 1 year after 90 day survival for the effect of comorbidity was undertaken using a rolling 5 year combined incident cohort from 2003 to 2007. Thirteen centres had returned >85% of comorbidity data for patients in the combined cohort. Adjustment was first performed to a mean age of 60 years, then to the average distribution of primary diagnosis for all the nine centres. The individual centre data were then further adjusted for average distribution of comorbidity present at these centres.

The survival hazard function was calculated as the probability of dying in a short time interval considering survival to that interval.

Methodology for prevalent patient survival

All patients who had been established on RRT for at least 90 days on 1 January 2008 were included in these analyses. The patients in the transplant cohort had all been established with a transplant for at least 6 months.

As discussed in previous reports, comparison of survival of prevalent dialysis patients between centres is complex. Survival of prevalent dialysis patients can be studied with or without censoring at transplant. When a patient is censored at transplantation, the patient is considered as alive up to the point of

transplantation, but the patient's status post-transplant is not considered. Therefore a death following transplantation is not taken into account in calculating the survival figure. This censoring could cause apparent differences in survival between those renal centres with a high transplant rate and those with a low transplant rate, especially in younger patients where the transplant rate is highest. The differences are likely to be small due to the low post-transplantation mortality rate and the relatively small proportion of patients being transplanted in a given year compared to the whole dialysis population (usually less than 7% of the total dialysis population). To estimate the potential differences, the results for individual renal centres were compared with and without censoring at transplant. Overall there was a 0.2% higher survival using the uncensored data. With such small differences only the censored results have been quoted throughout the prevalent analyses.

Methodology of causes of death

Cause of death was sent in by renal centres as an EDTA-ERA registry code. These have been grouped into the following categories:

Cardiac disease
Cerebrovascular disease
Infection
Malignancy
Treatment withdrawal
Other
Uncertain

Some centres had high completeness of data returns to the UKRR regarding cause of death, whilst others returned no information.

Adult patients aged 18 years and over, from England, Wales, Scotland and Northern Ireland, were included in the analyses on cause of death. The incident patient analysis included all patients starting RRT in the years 2002–2007. Previously data analysis was limited to centres with a high rate of return for cause of death. When this was compared with an analysis of all the cause of death data on the database, the percentages in corresponding EDTA categories remained unchanged so the latter data were therefore included.

Analysis of prevalent patients included all those aged over 18 years and receiving RRT on 1 January 2008. The death rate was calculated for the UK general population (data from the Office of National Statistics (ONS) http://www.statistics.gov.uk/statbase/Product.asp?vlnk = 14409) by age band and compared with the same age band for prevalent patients on RRT on 1 January 2008.

Methodology of median life expectancy (life table calculations)

Kaplan–Meier survival analyses were used to calculate the hazard of death by age group (18–34, 35–44, 45–54, 55–64, 65–74, 75+) for incident patients starting RRT from 1997 to 2007. The patient cohort inclusion criteria are similar to that of the incident cohort described above. Patients were then followed until death, censoring or end of the study period.

This analysis showed that the hazard of death stabilized after year one with variability increasing again after nine years. Due to this, the average hazard of death for the periods 1 to 9 years was calculated for each age group. Life expectancy was calculated as (1 – hazard of death) which gives the probability of surviving until the next time period. Median life years remaining is then the difference between the age when reaching the 50% probability of survival and the age of starting RRT.

Methodology for comparing mortality in prevalent RRT patients with the mortality in the general population

Data on the UK population in mid-2007 and the number of deaths in 2007 was obtained from the Office of National Statistics for each nation separately, and added together. The age-specific UK death rate was calculated as the number of UK deaths/UK population. The age-specific 'expected' rate of deaths in the RRT population was then calculated: years exposed for RRT patients*UK death rate/1,000. The age-specific observed number of RRT deaths was calculated as the actual number of deaths observed in 2008, and the RRT death rate as the actual number of deaths in 2008/years exposed for RRT patients*1,000. The observed/expected ratio was then calculated.

Results of incident (new RRT) patient survival

The 2007 cohort included 6,634 patients who were starting RRT (table 7.1).

Comparison with audit standards

The current 2007 4th UK Renal Standards document [1] does not set any standards for audit of patient survival. This is in contrast to the 2002 3rd UK Renal Standards document [2] (http://www.renal.org/standards/standards.html) which concluded that:

It is hard to set survival standards at present because these should be age, gender and co-morbidity adjusted and this is not yet possible from Registry data. The last Standards document (2nd – 1998) recommended at least 90% one year survival for patients aged 18–55 years with standard primary renal disease. This may have been too low as the rate in participating centres in the Registry was 97%, though numbers were small.

The 3rd Renal Standards document defines standard primary renal disease using the EDTA-ERA diagnosis codes (including only codes 0–49); this excludes patients with renal disease due to diabetes and other systemic diseases. It is more widespread practice to simply exclude patients with diabetes, so these analyses were also included in this report to allow comparison with reports from other registries. The results are shown in table 7.2 and are similar to the previous year.

Table 7.1. Summary of the exclusions from the incident cohorts

	Cohort year				
	2007	2006	2005	2004	2003
All incident patients	6,644	6,322	6,067	5,403	4,784
Exclusion category (1)	−2	−1	−1	−4	−3
Exclusion category (2)	−2	−6	−5	−2	−5
Exclusion category (3)	−6	−8	−24	−23	−16
Remaining incident cohort	6,634	6,307	6,037	5,374	4,760
Died within 90 days of start	−386	−469	−477	−486	−448
Lost within 90 days of start	−31	−29	−18	−28	−17
Cohort at one year after 90 days	6,217	5,809	5,542	4,860	4,295
Deaths at one year after 90 days	829	832	821	775	681

(1) patient had 2nd start in same year, if recovery <90 days, used 1st start date, if recovery ⩾90 days used 2nd start date
(2) recovery <90 days, used 1st start date in previous year(s) which is not in this cohort – delete from current cohort
(3) recovery ⩾90 days, should use 2nd start date in next year(s) which is not in this cohort – delete from current cohort

Table 7.2. One-year incident dialysis patient survival (from day 0–365), patients aged 18–54, 2007 and 2002 cohort (does not include patients whose first modality was transplantation)

	2007 cohort		2002 cohort	
First treatment	Standard primary renal disease	All primary renal diseases except diabetes	Standard primary renal disease	All primary renal diseases except diabetes
All dialysis %	96.5	95.1	95.4	93.9
95% CI	*95.2–97.5*	*93.9–96.1*	93.7–97.1	92.2–95.5
HD %	95.0	93.3	93.4	91.6
95% CI	*93.1–96.4*	*91.6–94.6*	90.7–96.0	89.2–94.0
PD %	99.4	99.3	98.6	97.9
95% CI	*97.7–99.9*	*98.0–99.8*	71.1–100	96.3–99.6

In this younger patient cohort, the trend in the improvement in patient survival from the 2006 cohort continues. The improvement is seen in both those patients with 'standard primary renal disease' and those with all other primary renal diseases (excluding diabetes). For a longer term comparison, the 2002 cohort is shown.

Comparison of survival between UK countries

Two years incident data have been combined to increase the size of the patient cohort, so that any differences between the 4 UK countries are more likely to be reliably identified (table 7.3). These data have not been adjusted for differences in primary renal diagnosis, ethnicity or comorbidity, nor for differences in life expectancy in the general populations of the four countries. There is a significant difference in 90 day survival between the UK countries ($p = 0.02$) that was not seen previously and the 1 year after 90 day survival was once again significantly different ($p = <0.0001$) between countries. It is postulated that greater prevalence of cardiovascular disease in Wales and Scotland compared with England may account for these differences.

Table 7.3. Incident patient survival across the UK countries, combined 2 year cohort (2006–2007), adjusted to age 60

	England	N Ireland	Scotland	Wales	UK
% 90 day	95.7	97.4	94.7	95.1	95.6
95% CI	*95.3–96.1*	*96.2–98.6*	*93.5–95.8*	*94.0–96.3*	*95.2–96.0*
% 1 year after 90 days	89.6	90.8	85.9	85.8	89.1
95% CI	*88.9–90.3*	*88.3–93.3*	*83.9–87.9*	*83.7–88.1*	*88.4–89.7*

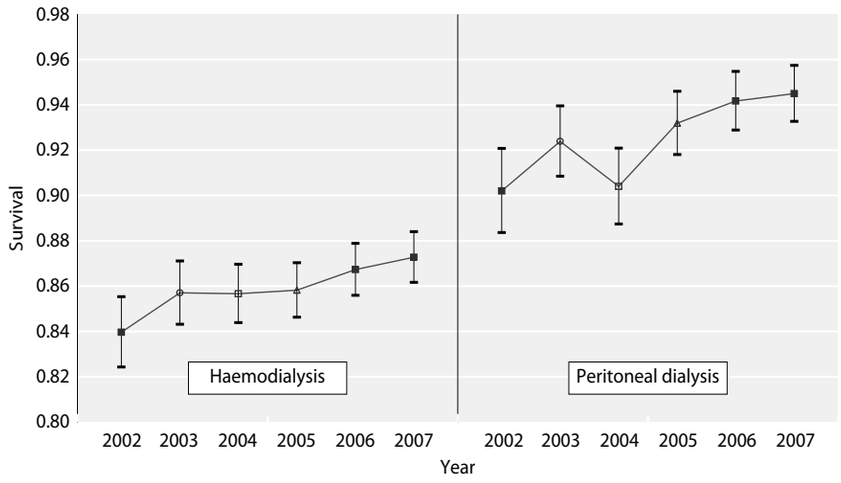

Fig. 7.1. Trend in 1 year after 90 day mortality by first established modality 2002–2007 (adjusted to age 60) (excludes patients whose first modality was transplantation)

Modality

The age-adjusted one year survival estimates on HD and PD were 87.3% and 94.5% respectively which both show a trend in improvement in survival from 2002 (figure 7.1 and table 7.4). There appeared to be better one year survival on PD compared with HD after age adjustment; however, a straightforward comparison of the modalities in this way is misleading, given that in general PD is used in patients with less severe comorbidity. A similar finding is seen in the USRDS and Australasian (ANZDATA) registries even after adjustment for comorbidity.

Age

Tables 7.5 to 7.10 show survival of all patients and those above and below 65 years of age, for up to eleven years after initiation of renal replacement therapy. The UK is showing an improvement in both short and longer term survival on RRT for patients aged both under and over 65 years. As expected, there was also a steep age-related decline in survival over all time periods (see also figures 7.2 and 7.3).

If the survival data in tables 7.8 to 7.10 are recalculated using data only from day 90 onwards, as used by many other countries, (1 year after day 90 survival, 2 year after day 90 survival, etc) the survival in all cases increased by an additional 3–4% across both age bands. These would then be the results most comparable to the figures quoted by the USRDS from the USA [3] and most other national registries.

There was a curvilinear increase in death rate per 1,000 patient years with age, shown in figure 7.3 for

Table 7.4. One-year after day 90 incident patient survival by first established treatment modality (adjusted to age 60) (excluding patients whose first modality was transplantation)

	Adjusted 1 year after 90 days % *95% CI*	
Year	HD	PD
2007	87.3	94.5
	86.2–88.4	*93.3–95.7*
2006	86.7	94.2
	85.6–87.9	*92.9–95.5*
2005	85.8	93.2
	84.6–87.0	*91.8–94.6*
2004	85.7	90.4
	84.4–87.0	*88.7–92.1*
2003	85.7	92.4
	84.3–87.1	*90.9–94.0*
2002	87.3	94.5
	86.2–88.4	*93.3–95.7*

Table 7.5. Unadjusted 90 day survival of incident patients, 2007 cohort, by age

Age	KM* survival (%)	KM 95% CI	N
18–64	97.8	97.3–98.3	3,437
⩾65	90.2	89.2–91.2	3,197
All ages	94.2	93.6–94.7	6,634

* KM = Kaplan–Meier

Table 7.6. Unadjusted 1 year after day 90 survival of incident patients, 2007 cohort, by age

Age	KM survival (%)	KM 95% CI	N
18–64	92.5	91.6–93.4	3,344
⩾65	78.9	77.3–80.4	2,873
All ages	86.2	85.3–87.1	6,217

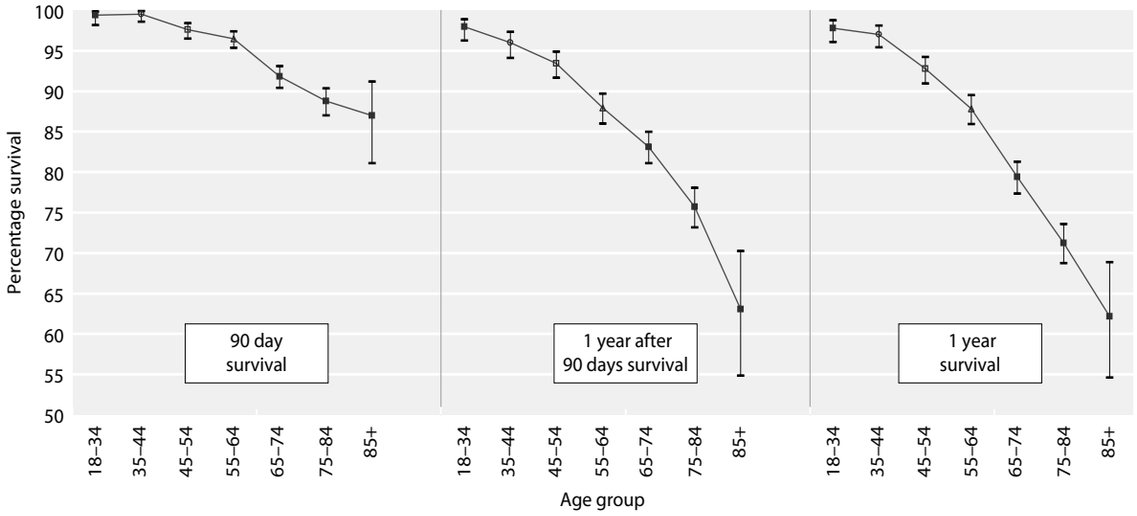

Fig. 7.2. Unadjusted survival of all incident patients by age band, 2007 cohort

the period one year after 90 days. There were no differences between the UK countries.

The effect of censoring age related survival at the time of transplantation

The KM long term survival curves published in all reports prior to the previous 2 years were censored at the time of transplantation. This was not made clear in the description of methodology and although not incorrect, will make the longer term outcomes of younger patients (who are more likely to have undergone transplantation) appear worse than is actually the case. This is because only those younger patients remaining on dialysis (who may have more comorbidity than those transplanted) will have been included in the censored survival analysis. Without censoring, the 10 year survival for patients aged 18–34 years is 80.4%, which contrasts with a 55.2% survival if censoring at the time of transplantation (data not shown). For more detailed information on this effect, refer to the 2008 Report [4].

From figure 7.4, it can be seen that the 50% survival for patients starting RRT in the UK aged 50, 60 and 70 years is 10 years, 5 years and 3 years respectively.

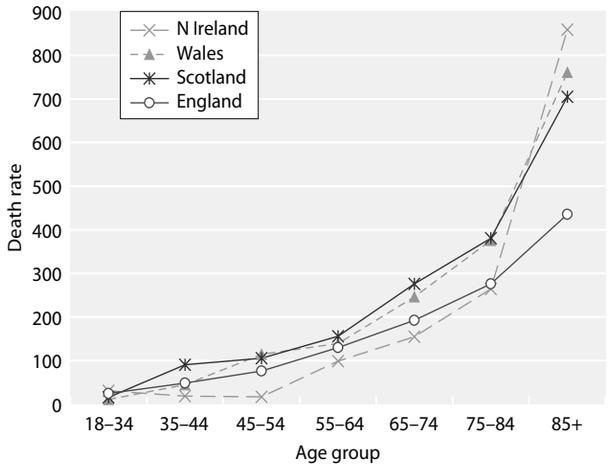

Fig. 7.3. One year after 90 days death rate per 1,000 patients years by UK country and age group for incident patients, 2004–2007 cohort

The change in hazard of death by age, during the first 12 month period

Figure 7.5 shows the monthly hazard of death from the 1st day of starting RRT by age, which falls sharply during the first 3–4 months particularly for older patients. In Renal Registries that receive details on all patients starting RRT from day zero, this difference in the change in hazard of death between the age groups will affect proportionality in any Cox model analysis that uses data starting from day zero and combines these different aged cohorts.

The USRDS, in contrast, reports a rising mortality in the first 3 month period [3] which they have reported as reflecting an under-reporting to the USRDS of patients that start on RRT who do not survive the first 90 days.

The hazard of death per each 10 year increase in patient age (unadjusted for primary renal disease) is shown in table 7.7. The hazard of death increase for each 10 year age band has been stable over time (data not shown).

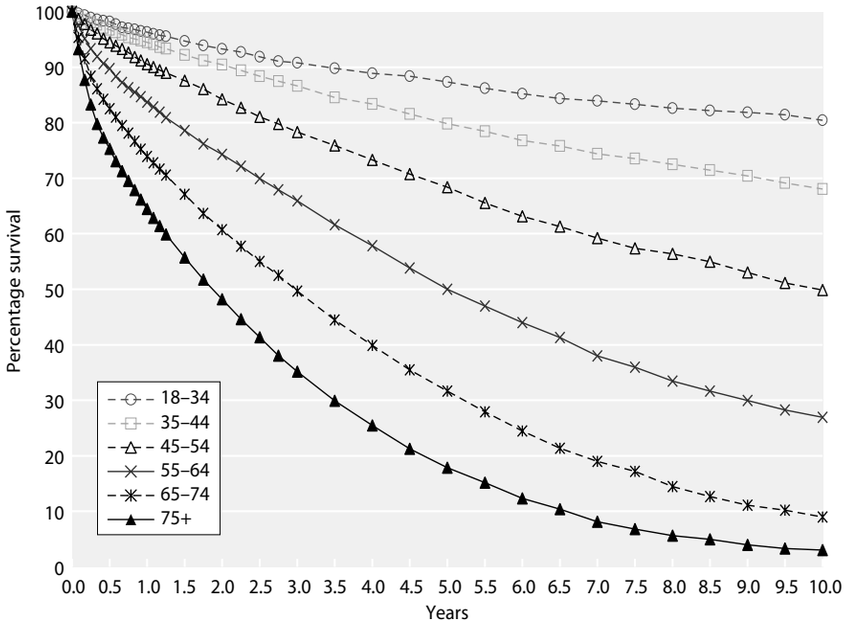

Fig. 7.4. Kaplan–Meier survival of incident patients 1997–2007 cohort (from day 0), without censoring at transplantation

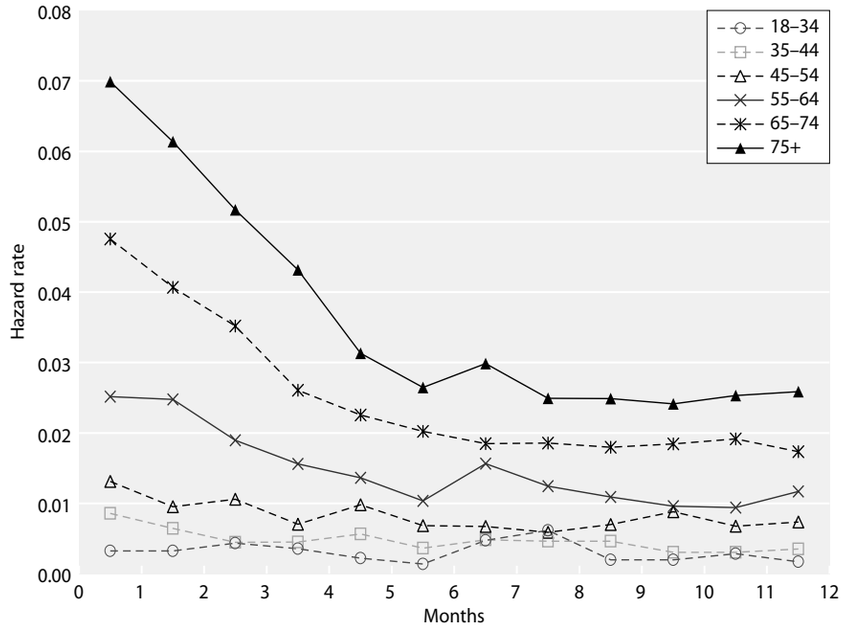

Fig. 7.5. First year monthly hazard of death, by age band 1997–2007 combined incident cohort

Table 7.7. Increase in proportional hazard of death for each 10 year increase in age, at 90 days and for 1 year thereafter, 2007 cohort

Interval	Hazard of death for 10 year age increase	95% CI
First 90 days	1.79	1.64–1.95
1 year after first 90 days	1.63	1.55–1.73

Changes in survival from 1997–2007

The 1st year death rate per 1,000 patient years is shown in figure 7.6. Although in the last UKRR report it was stated that the 2006 death rate for patients aged over 65 years was unchanged from 2005, at 326 per 1,000 patient years, the 2007 data show a continued trend of a further fall to 294 per 1,000 patient years. In the under 65 year age group the fall in death rate

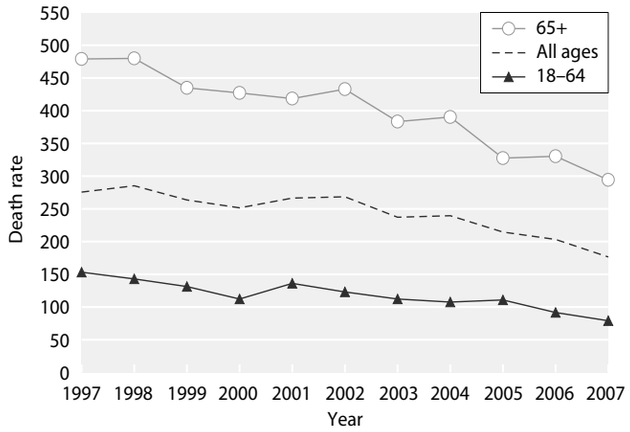

Fig. 7.6. One-year incident death rate per 1,000 patient years for all age groups

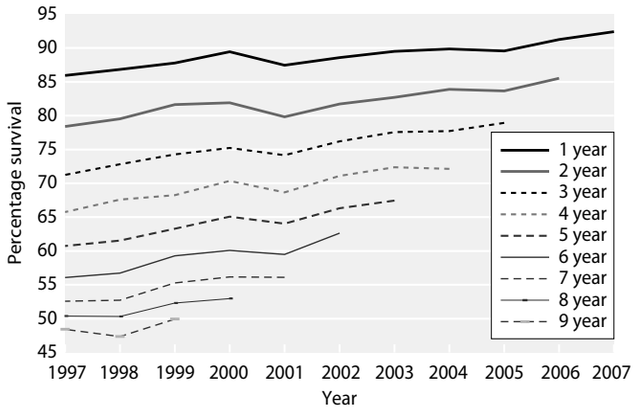

Fig. 7.7. Change in KM long term survival by year of starting RRT; for incident patients aged 18–64 years

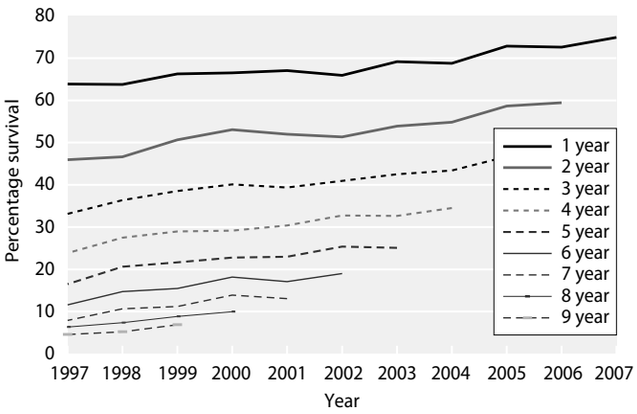

Fig. 7.8. Change in KM long term survival by year of starting RRT; for incident patients aged ⩾65 years

continues: from 111 per 1,000 patient years in 2005 to 92 and 79 per 1,000 patient years in 2006 and 2007 respectively.

It is important to note that these death rates are not directly comparable with those produced by the USRDS Registry, as the UK data include the first 90 day period where the death rates are higher than subsequent time periods.

The unadjusted KM survival analyses (tables 7.8 and 7.9, figures 7.7 and 7.8) and annual death rates show the large improvement in 1 to 11 year survival across the time periods for both the under and over 65s. This has happened even though the average age of patients starting RRT has risen by 5 years during this period. Survival amongst patients aged under 65 years at start of RRT has improved from 85.9% to 92.4%. As survival rates were already high in these patients, the absolute overall survival improvement was only 6.5%. The reduction in the death rate (= relative survival improvement) in figure 7.6 shows that this equates to a 48% relative improvement over this 11 year period.

Similarly for patients aged over 65 years there has been an 11.1% absolute improvement in 1st year survival,

Table 7.8. Unadjusted KM survival of incident patients, 1997–2007 cohort for patients aged 18–64

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	9 year	10 year	11 year	95% CI for latest year	N
2007	92.4											91.5–93.3	3,437
2006	91.3	85.5										84.2–86.7	3,141
2005	89.6	83.7	78.9									77.4–80.4	2,960
2004	89.9	83.9	77.7	72.1								70.4–73.8	2,647
2003	89.5	82.7	77.6	72.4	67.4							65.5–69.3	2,388
2002	88.6	81.7	76.2	71.1	66.3	62.6						60.5–64.7	2,090
2001	87.5	79.8	74.2	68.7	64.0	59.5	56.1					53.8–58.4	1,838
2000	89.5	81.9	75.2	70.4	65.1	60.1	56.2	53.0				50.4–55.4	1,579
1999	87.8	81.6	74.3	68.2	63.3	59.3	55.3	52.3	49.9			47.2–52.6	1,368
1998	86.8	79.5	72.8	67.6	61.5	56.7	52.7	50.3	47.3	46.0		43.2–48.8	1,275
1997	85.9	78.4	71.3	65.7	60.7	56.1	52.6	50.4	48.4	44.2	41.6	38.1–45.1	792

Table 7.9. Unadjusted KM survival of incident patients, 1997–2007 cohort for patients aged ⩾65

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	9 year	10 year	11 year	95% CI for latest year	N
2007	74.9											73.3–76.4	3,197
2006	72.6	59.4										57.7–61.1	3,166
2005	72.8	58.7	46.7									44.9–48.4	3,077
2004	68.7	54.8	43.4	34.5								32.7–36.3	2,727
2003	69.1	53.9	42.5	32.6	25.1							23.3–26.9	2,372
2002	65.9	51.3	40.9	32.8	25.4	19.0						17.3–20.7	2,171
2001	67.1	52.0	39.4	30.4	23.0	17.1	13.0					11.5–14.7	1,854
2000	66.5	53.0	40.1	29.2	22.8	18.1	13.9	9.9				8.5–11.6	1,503
1999	66.3	50.6	38.5	28.9	21.6	15.5	11.2	8.8	6.9			5.6–8.4	1,266
1998	63.7	46.6	36.4	27.5	20.6	14.7	10.7	7.3	5.2	4.0		2.9–5.3	1,139
1997	63.8	45.9	33.1	23.8	16.5	11.6	7.9	6.3	4.6	3.9	2.8	1.7–4.4	582

which translates into a 39% relative reduction in death rate over this 10 year period. This lower rate of relative reduction in risk is probably related to the increasing proportion of very elderly patients in this group over time; the analysis has not been adjusted for differences in age structure within these cohorts. Another potential confounding factor could be that additional renal centres have joined the UKRR over these intervening years. If each additional centre joining had better survival than all the previous centres (unlikely), this would appear as a time trend. However separate analysis of survival in the earlier versus later centres has confirmed this not to be the case.

As these are observational data it remains difficult to attribute this reduction in risk of death to any specific improvements in care. During this period mean haemoglobin in HD patients has shown improvement rising from 10.8 g/dl in 1998 to 11.5 g/dl in 2008 with little change in the last 2 years. In contrast, improvements in serum phosphate and calcium control have been restricted to the last 5 years, and improvement in dialysis dose were mainly in the first 4 years.

Change in survival on renal replacement therapy by vintage

RRT patients in the UK continued to show no evidence of a worsening prognosis with time on RRT (vintage), even with the follow up period now increased to 11 years. Figure 7.9 demonstrates this clearly for all patients. In the older age groups, there are decreasing numbers remaining alive beyond 7 years accounting for the increase seen in the variability. This lack of a 'vintage' effect was partly related to the effect of having a survivor cohort which was healthier than those patients who died early after starting RRT, which was then also partly offset by increasing comorbidity with time in the survivor cohort. Unfortunately, the Registry does not collect data on the incidence of new comorbid conditions amongst prevalent RRT patients, and so is currently unable to study this possibility further.

Table 7.10. Unadjusted KM survival of incident patients, 1997–2007 cohort for patients of all ages

Cohort	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	9 year	10 year	11 year	95% CI for latest year	N
2007	84.0											83.1–84.8	6,634
2006	81.9	72.4										71.3–73.5	6,307
2005	81.0	70.9	62.4									61.2–63.7	6,037
2004	79.1	69.1	60.3	53.0								51.7–54.4	5,374
2003	79.4	68.4	60.1	52.6	46.3							44.9–47.8	4,760
2002	77.0	66.2	58.2	51.5	45.4	40.3						38.8–41.8	4,261
2001	77.2	65.9	56.7	49.5	43.4	38.2	34.5					32.9–36.0	3,692
2000	78.3	67.9	58.2	50.3	44.5	39.7	35.6	32.0				30.4–33.7	3,082
1999	77.4	66.7	57.1	49.3	43.3	38.2	34.0	31.4	29.2			27.4–30.9	2,634
1998	76.0	64.1	55.7	48.8	42.3	37.0	32.9	30.1	27.5	26.2		24.4–28.0	2,414
1997	76.6	64.7	55.2	48.1	42.1	37.3	33.7	31.7	29.9	27.2	25.2	22.9–27.5	1,374

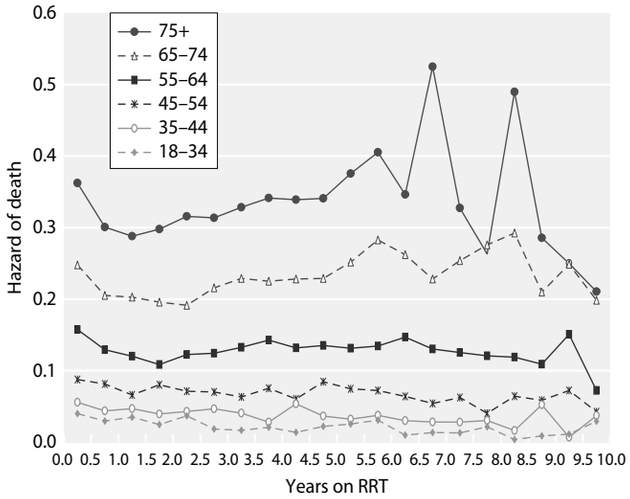

Fig. 7.9. Six monthly hazard of death, by vintage and age band, 1997–2007 incident cohort after day 90

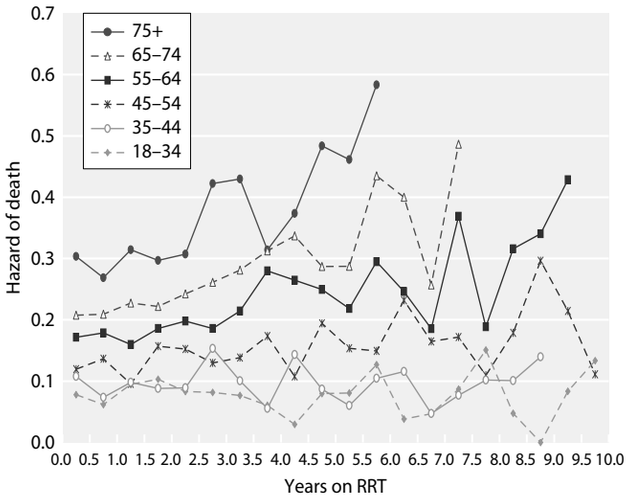

Fig. 7.11. Six monthly hazard of death, by vintage and age band, 1997–2007 diabetic incident cohort after day 90

Figures 7.10 and 7.11 show these data for the non-diabetic and diabetic patients respectively with a suggestion of worsening prognosis in older diabetic patients.

Previously the USRDS has shown a worsening prognosis between being on RRT 1 year, 2–5 years and >5 years. In the latest USRDS report [3] this difference in prognosis with time on RRT has narrowed.

Time trend changes in incident patient survival, 1999–2007

The time trend changes are shown in figure 7.12. The left hand plot includes only those centres that have been sending continual data since 1999. These centres show a similar improvement to when the data are analysed by all renal centres.

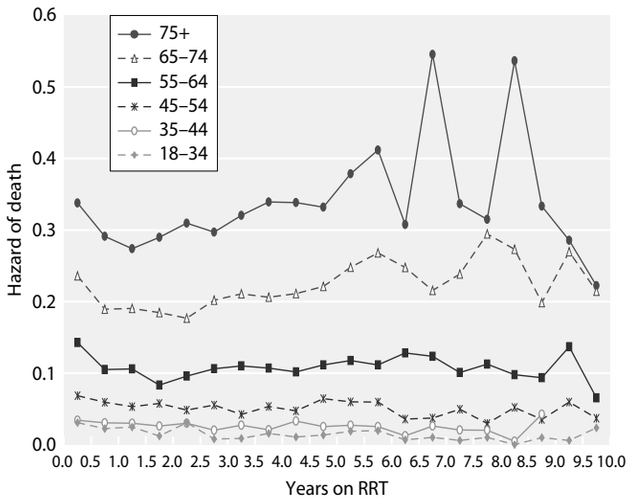

Fig. 7.10. Six monthly hazard of death, by vintage and age band, 1997–2007 non-diabetic incident cohort after day 90

Analysis of centre variability in 1 year after 90 days survival

The one year after 90 day survival for the 2007 incident cohort is shown in figure 7.13 for each renal centre. The tables for these data and for 90 day survival are given in appendix 1 at the end of this chapter (tables 7.24 and 7.25). The age-adjusted individual centre survival for each of the last 9 years can also be found in appendix 1, table 7.26.

In the analysis of 2007 survival data, some of the smaller centres had wide confidence intervals (figure 7.13). This is addressed by including a larger cohort across several years, which will also assess sustained performance. Similar to previous years, this is shown as a rolling 4 year cohort, with the data in this report for the 4 year period 2004 to 2007. These data are presented as a funnel plot in figure 7.14. For any size of incident cohort (x-axis) one can identify whether any given survival rate (y-axis) falls within plus or minus 2 standard deviations (SDs) from the national mean (solid lines, 95% limits) or 3 SDs (dotted lines, 99.9% limits). Table 7.11 allows centres to be identified on this graph by finding the number of patients treated by the centre and then looking up this number on the x-axis.

There are 3 centres that fall between 2 and 3 standard deviations below average (Airdrie, Glasgow, Cardiff), 3 centres between 2 and 3 SDs above average (Kent,

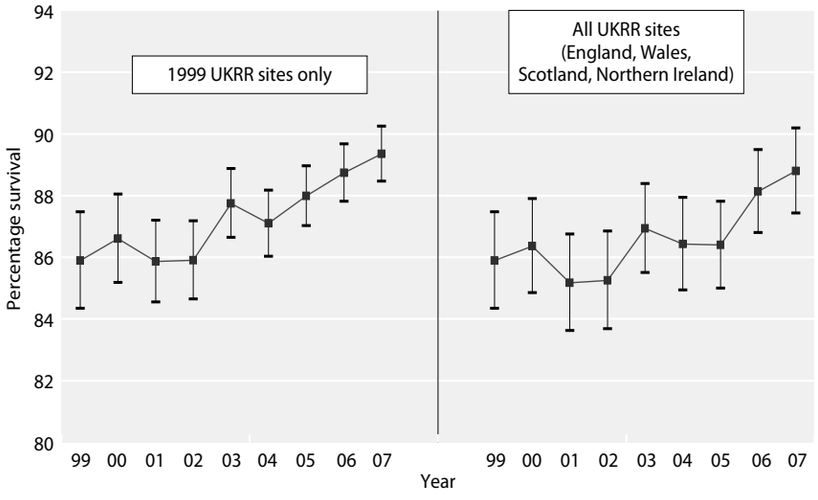

Fig. 7.12. Change in one-year after 90 day adjusted (age 60) survival, 1999–2007 Showing 95% confidence intervals

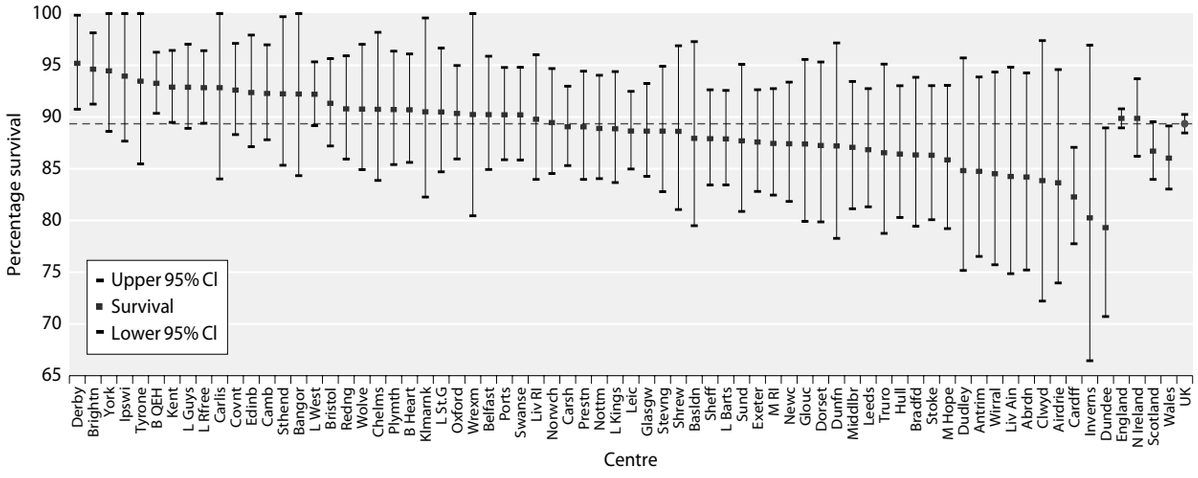

Fig. 7.13. Survival one-year after 90 days, adjusted to age 60, 2007 cohort

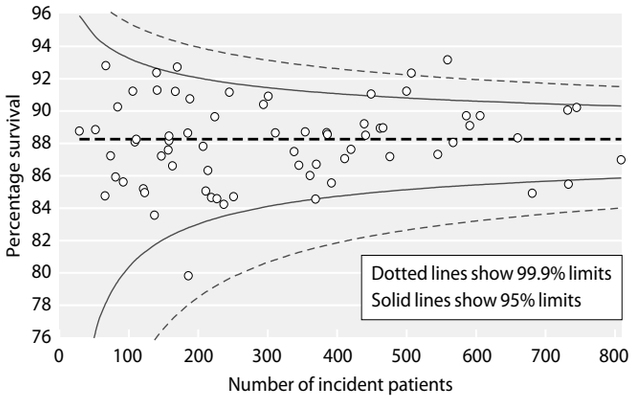

Fig. 7.14. Funnel plot for age adjusted 1 year after 90 days survival, 2004–2007 cohort

Cambridge and London Guys) and 2 centres above the 3 SDs above average (London Royal Free and London West). These data have not been adjusted for any patient related factor except age (i.e. not comorbidity, primary renal disease or ethnicity). This year a funnel plot for the 2007 1 year after 90 day survival is included (figure 7.15) and shows that both Airdrie and Glasgow centres are now close to the mean UK survival (table 7.26), indicating probable improvement in survival in the most recent cohort. Cardiff remains between the lower 2–3 SD limit, although one centre falling within this range would be expected by chance alone.

The 3 London centres within the upper 2–3 SDs (figure 7.14) could reflect the higher proportion of patients from ethnic minorities (associated with better

Table 7.11. Adjusted 1 year after 90 day survival, 2004–2007 incident cohort

Centre	N	1 year after 90 day survival %	Centre	N	1 year after 90 day survival %
Ulster	29	88.8	Redng	294	90.4
Newry	52	88.8	Belfast	301	90.9
D & Gall	66	84.8	Wolve	311	88.7
Tyrone	67	92.8	Covnt	338	87.5
Clwyd	74	87.2	Middlbr	345	86.7
Stoke	81	85.9	Norwch	354	88.7
L St G	84	90.3	Stevng	361	86.0
Liv Ain	92	85.6	Newc	369	84.6
Wrexm	106	91.2	Edinb	370	86.7
Antrim	109	88.1	Hull	385	88.7
Carlis	111	88.2	B Heart	386	88.6
Inverns	121	85.2	Swanse	392	85.5
Bangor	123	85.0	Exeter	411	87.1
Dunfn	137	83.6	Prestn	420	87.6
Sthend	140	92.4	Brightn	439	89.2
Basldn	141	91.3	M Hope	441	88.5
M RI	147	87.2	Camb	449	91.0
Klmarnk	157	87.6	L Kings	462	88.9
York	158	88.2	Nottm	466	89.0
Dudley	158	88.4	Liv RI	476	87.2
Chelms	163	86.6	L Guys	500	91.2
Ipswi	167	91.2	L Rfree	507	92.3
Kent	170	92.7	Ports	545	87.3
Shrew	185	88.6	L West	559	93.2
Airdrie	186	79.8	Leeds	567	88.1
Truro	188	90.7	Oxford	586	89.7
Dorset	207	87.8	Bristol	591	89.1
Sund	211	85.1	Sheff	606	89.7
Wirral	214	86.3	Carsh	660	88.3
Dundee	219	84.7	Glasgw	681	84.9
Glouc	224	89.6	L Barts	732	90.1
Abrdn	227	84.6	Cardff	733	85.5
Bradfd	237	84.2	B QEH	745	90.2
Derby	245	91.2	Leic	809	87.0
Plymth	251	84.7			

Data from centres with <20 incident patients are not shown (Derry, Doncaster)
*Data from London West excluded for 2004–2005

survival) in these centres, but this pattern is not seen in London Kings or other non-London centres with a high proportion of ethnic minority patients. These data have not been censored at transplantation, so the effect of differing centre rates of transplantation was not taken into account. Data for the London West centre only includes the 2006–2007 cohort, due to data problems in the previous years.

There are known regional differences in the life expectancy of the general population within the UK. Table 7.12 shows differences in life expectancy between the UK countries [5, 6]. The UKRR is investigating ways to adjust centre survival for the differences in the underlying population, although crude analysis does not demonstrate any apparent relationship at PCT level between age-adjusted survival on RRT and life expectancy (data not shown).

Analysis of the impact of adjustment for comorbidity on the 1 year after 90 day survival

Comorbidity returns to the UKRR have remained static (chapter 6), although with the recent 2009 mandation of these returns within the National Renal Dataset for England these returns should improve. Figure 7.16 shows the importance of adjusting patient survival for comorbidity. Using the combined incident cohort from

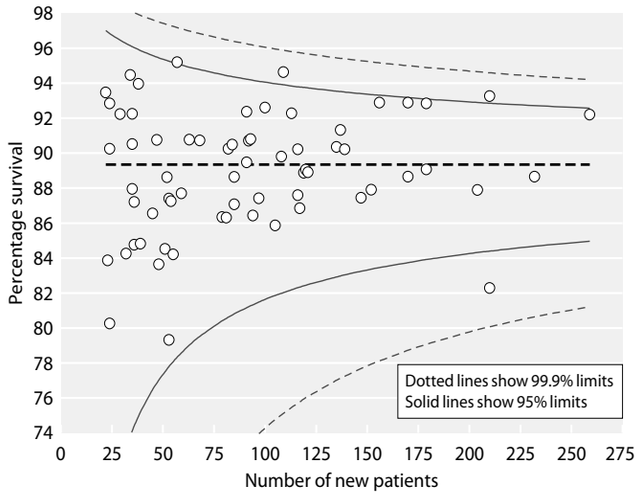

Fig. 7.15. Funnel plot for age adjusted 1 year after 90 days survival, 2007 cohort

2003–2007, 13 centres had returned comorbidity data for more than 85% of patients. Adjustment was first performed to age 60, then to the average distribution of primary diagnoses for all 13 centres. Further adjustment was then made to the average distribution of comorbidities present at these centres.

It can be seen that adjustment for age has the largest effect, with only minor differences within centres after adjustment for primary renal diagnosis; in a few centres, adjustment for co-morbidity has a noticeable effect on adjusted survival.

Table 7.12. Life expectancy in years in UK countries, 2005–2007 (source ONS)

	At birth		At age 65	
Country	Male	Female	Male	Female
England	77.7	81.8	17.5	20.2
Wales	76.8	81.2	17.1	19.8
Scotland	74.8	79.7	16.1	18.8
N Ireland	76.3	81.3	16.9	19.8
UK	**77.3**	**81.5**	**17.3**	**20.0**

Results of prevalent patient survival analyses

Table 7.13 shows the one year survival on dialysis, after censoring at the time of transplantation.

Table 7.14 gives the 2008 one-year death rate for dialysis patients in each UK country. The median age of prevalent patients in Northern Ireland and Wales was higher than those in England and this probably explains the higher death rate in these two countries.

Table 7.15 gives the 2008 one-year survival for transplanted patients.

Figure 7.17 shows the one year survival of prevalent dialysis patients in different age groups on 1 January 2008.

One year survival of prevalent dialysis patients by centre

The age-adjusted one year survival of dialysis patients in each centre is shown in table 7.13 and is illustrated in

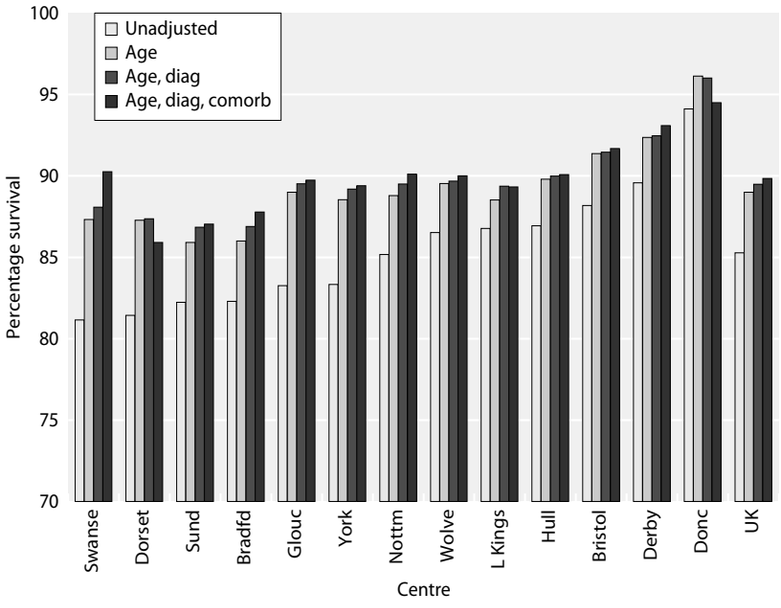

Fig. 7.16. Change in 1 year after 90 day survival after adjustment for age, primary renal diagnosis and comorbidity, 2003–2007 cohort

Table 7.13. Prevalent 1 year KM survival of dialysis patients in 2008, censoring at transplantation (adjusted for age 60)

Centre	Number in centre	Adjusted 1 year survival	Lower 95% CI	Upper 95% CI	Centre	Number in centre	Adjusted 1 year survival	Lower 95% CI	Upper 95% CI
Abrdn	220	89.7	86.1	93.4	L Rfree	699	91.3	89.3	93.2
Airdrie	165	85.5	80.4	90.9	L St G	223	93.9	91.2	96.7
Antrim	144	89.2	85.1	93.4	L West	1,345	90.5	89.1	92.0
B Heart	391	90.5	88.0	93.1	Leeds	587	87.6	85.2	90.1
B QEH	870	88.5	86.6	90.5	Leic	841	89.5	87.6	91.4
Bangor	91	88.9	83.6	94.5	Liv Ain	109	88.9	83.7	94.5
Basldn	155	93.1	89.7	96.5	Liv RI	485	87.5	84.7	90.4
Belfast	313	87.2	83.8	90.7	M Hope	442	87.1	84.1	90.2
Bradfd	207	88.0	84.0	92.2	M RI	475	86.6	83.7	89.7
Brightn	400	89.5	87.0	92.2	Middlbr	293	87.1	83.7	90.6
Bristol	514	87.2	84.7	89.7	Newc	295	88.0	84.6	91.5
Camb	455	92.9	90.8	95.1	Newry	96	90.5	85.5	95.7
Cardff	633	82.7	80.0	85.4	Norwch	323	90.8	88.2	93.5
Carlis	92	86.6	80.6	93.1	Nottm	485	88.4	85.8	91.0
Carsh	729	90.1	88.1	92.0	Oxford	538	88.4	86.0	90.9
Chelms	134	84.3	79.3	89.8	Plymth	170	88.3	84.3	92.5
Clwyd	83	87.6	81.6	94.1	Ports	470	88.7	86.1	91.3
Covnt	360	87.3	84.3	90.5	Prestn	467	90.4	87.9	92.9
D & Gall	66	85.6	78.7	93.1	Redng	283	89.4	86.3	92.6
Derby	274	90.9	87.9	94.0	Sheff	613	88.8	86.5	91.1
Derry	55	92.3	86.6	98.4	Shrew	191	88.9	84.9	93.1
Donc	60	93.4	88.0	99.1	Stevng	447	92.9	90.9	95.0
Dorset	194	89.6	86.0	93.3	Sthend	132	90.3	86.1	94.6
Dudley	168	88.8	84.6	93.3	Stoke	333	87.3	84.0	90.6
Dundee	197	84.2	79.9	88.7	Sund	158	87.6	82.9	92.6
Dunfn	137	90.5	86.2	95.1	Swanse	352	89.5	86.9	92.3
Edinb	347	88.2	85.0	91.6	Truro	172	90.3	86.8	93.9
Exeter	351	85.5	82.4	88.7	Tyrone	85	93.4	88.8	98.2
Glasgw	685	87.9	85.7	90.2	Ulster	83	92.0	87.5	96.9
Glouc	185	87.3	83.4	91.3	Wirral	201	88.6	84.7	92.6
Hull	384	86.9	83.9	90.0	Wolve	297	93.1	90.6	95.7
Inverns	126	89.0	84.2	94.1	Wrexm	127	86.0	80.9	91.5
Ipswi	134	91.5	87.4	95.9	York	138	88.2	83.6	92.9
Kent	347	86.5	83.3	89.8	**England**	**19,350**	**89.1**	**88.6**	**89.6**
Klmarnk	171	88.8	84.7	93.1	**N Ireland**	**776**	**89.6**	**87.7**	**91.6**
L Barts	803	88.7	86.5	90.9	**Scotland**	**2,114**	**87.8**	**86.5**	**89.1**
L Guys	523	90.1	87.7	92.6	**Wales**	**1,286**	**85.8**	**84.0**	**87.5**
L Kings	408	88.4	85.4	91.4	**UK***	**22,831**	**88.8**	**88.4**	**89.3**

* Colchester is the only UK renal centre excluded from this analysis as they only started sending in data in 2008

figures 7.18 and 7.19, dividing the data into those patients aged <65 years and those 65 years and over. Figure 7.20 shows the age adjusted data (60 years) and in figure 7.21 as a funnel plot. The solid lines show the 2 standard deviation limits (95% limits) and the dotted lines the limits for 3 standard deviations (99.9% limits). With over 70 centres included, it would be expected by chance that 3 centres would fall outside the 95% (1 in 20) confidence limits. Figure 7.21 shows 0 centres fall in the lower 2–3 SD interval (compared with 4 in 2007) and 5 in the upper 2–3 SD interval (Basildon, London St George's, Wolverhampton, London Royal Free, London West). Two centres are just above the 3 SD survival (Cambridge, Stevenage) and 1 centre is below the 3 SD survival (Cardiff); reasons for this change are being investigated.

Table 7.14. One-year death rate per 1,000 prevalent dialysis patient years in 2008 by country

	England	N Ireland	Scotland	Wales
Death rate	149	149	164	216
95% CI	144–155	122–180	146–184	189–245
Median age	64.1	66.3	63.3	66.4

Table 7.15. One-year survival of prevalent RRT patients in the UK by modality (unadjusted unless stated otherwise)

Patient group	Patients	Deaths	KM survival	KM 95% CI
Transplant patients 2008				
Censored at dialysis	19,166	443	97.7	97.4–97.9
Not censored at dialysis	19,166	475	97.5	97.3–97.7
Dialysis patients 2008				
All	23,526	3,230	85.7	85.3–86.2
All adjusted age = 60	23,526	3,230	88.8	88.4–89.3
2 year survival – dialysis patients 2007				
All 1/1/2007 (2 year)	22,332	5,567	73.1	72.5–73.7
Dialysis patients 2008				
All age <65	12,137	929	91.8	91.3–92.3
All age 65+	11,389	2,301	79.6	78.9–80.3
Non-diabetic <55	6,023	257	95.3	94.7–95.8
Non-diabetic 55–64	3,482	331	90.0	89.0–91.0
Non-diabetic 65–74	4,410	645	85.1	84.0–86.2
Non-diabetic 75+	4,478	1,114	75.1	73.8–76.3
Non-diabetic <65	9,505	588	93.3	92.8–93.8
Diabetic <65	2,133	310	84.7	83.1–86.2
Non-diabetic 65+	8,888	1,759	80.0	79.2–80.8
Diabetic 65+	2,059	446	78.2	76.3–79.9

KM = Kaplan–Meier survival
Cohorts of patients alive on 1/1/2008 unless indicated otherwise

The 2008, one year death rate in prevalent dialysis patients by age band

The death rates on dialysis by age band are shown in figure 7.22. The younger patients included in this analysis are a selected higher risk group, as the similar aged transplanted patients have been excluded. The increase in death rate is non-linear with age: with a 10 year increase in age in the younger patients, the death rate increased by about 20 per 1,000 patient years compared with an increase of 100 per 1,000 patient years in the older age group. When compared with data from the USRDS report 2007 (the most recent report in which this analysis is available), the death rates for UK dialysis patients were lower than dialysis patients in the USA across all age bands (figure 6.12 USRDS) [7].

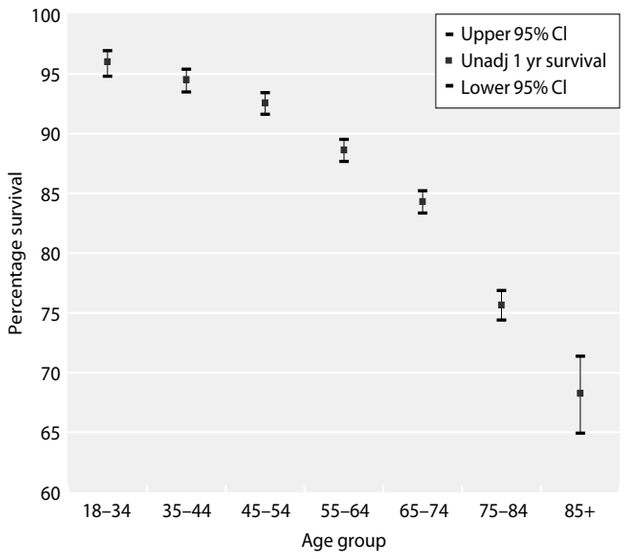

Fig. 7.17. One year survival of prevalent dialysis patients in different age groups, 2008

One year survival of prevalent dialysis patients by UK country from 1997–2008

All UK countries except Wales are showing a continued improvement in the age-adjusted survival on dialysis (figure 7.23). The change in prevalent survival by centre over the years 2000 to 2008 is shown in this chapter appendix 1, table 7.27.

One year survival of prevalent dialysis patients with a primary diagnosis of diabetes from 2000–2008

The UK has shown a continued improvement in the age-adjusted one year survival of prevalent patients whose primary renal diagnosis was diabetes, although this seems to have plateaued in 2008 (table 7.16).

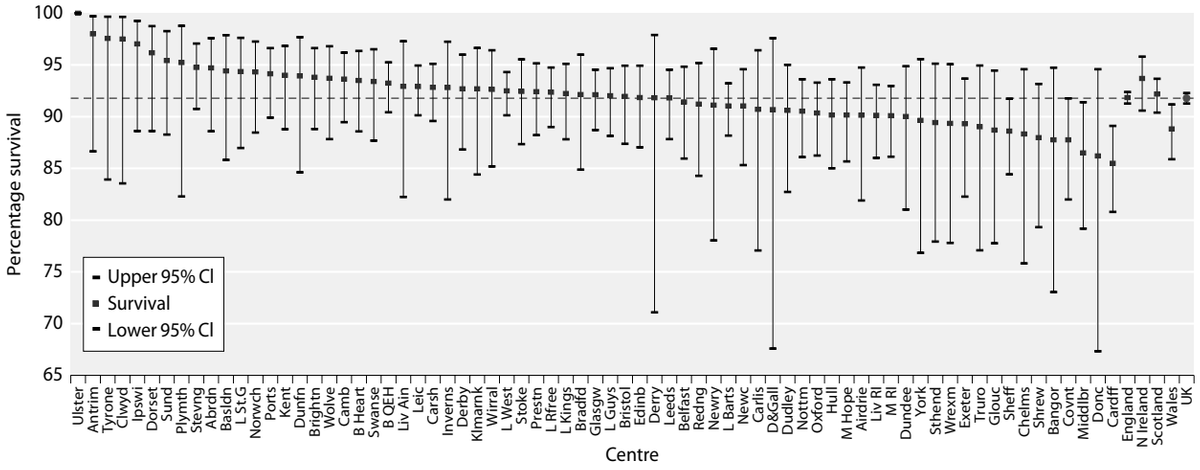

Fig. 7.18. One year survival of prevalent dialysis patients aged under 65 in each centre, 2008

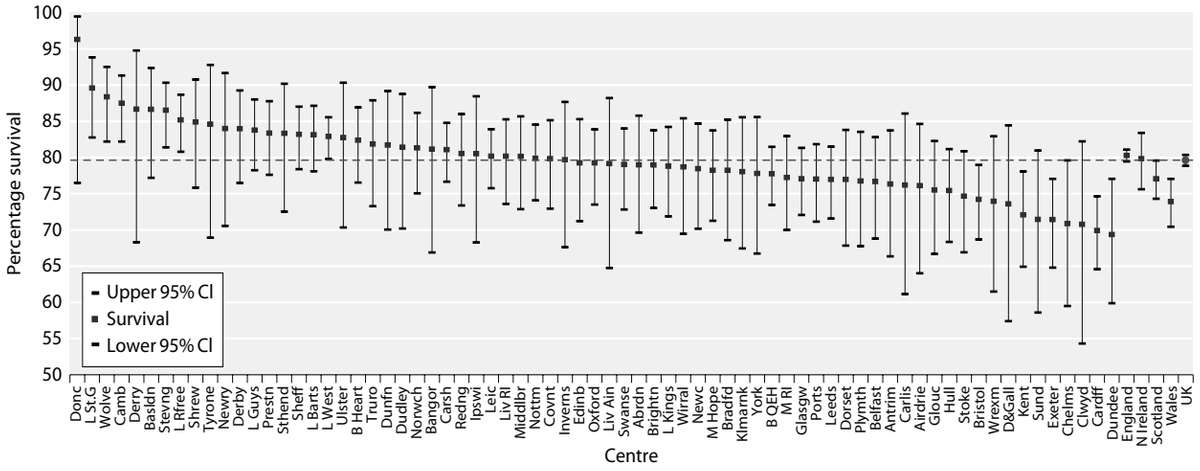

Fig. 7.19. One year survival of prevalent dialysis patients aged 65 and over in each centre, 2008

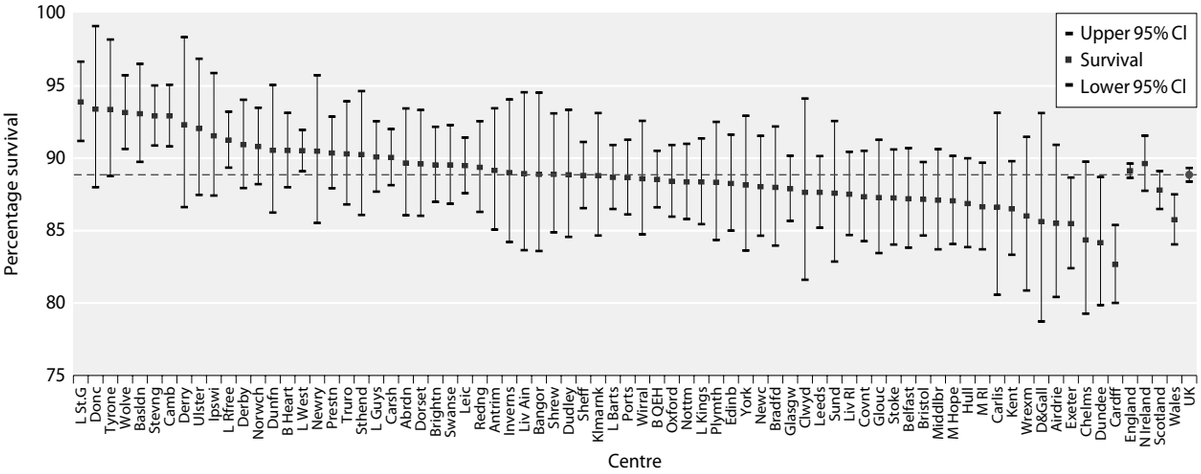

Fig. 7.20. One year survival of prevalent dialysis patients in each centre adjusted to age 60, 2008

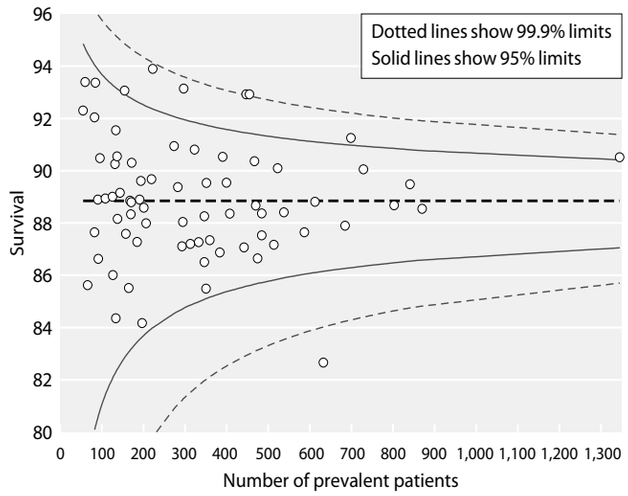

Fig. 7.21. One year funnel plot of prevalent dialysis patients in each centre adjusted to age 60, 2008

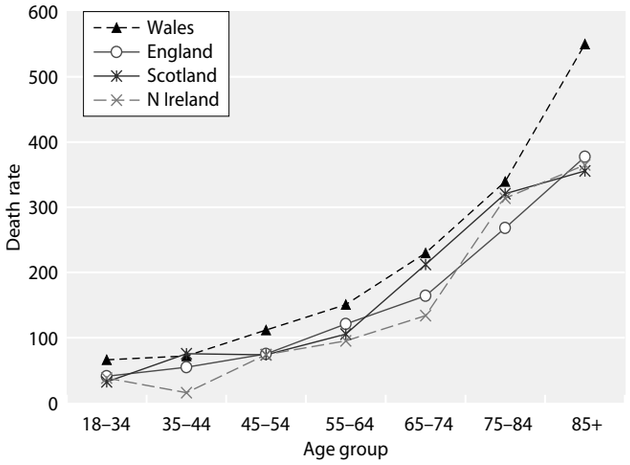

Fig. 7.22. One year death rate per 1,000 patient years by UK country and age group for prevalent dialysis patients

Death rate on RRT compared with the UK general population

The death rate compared to the general population is shown in table 7.17. Figure 7.24 shows that the relative risk of death on RRT decreased with age from 28.6 times that of the general population at age 30 to 34 to 2.7 at age 85+. With the reduction in rates of death on RRT over the last 10 years the age-standardised mortality ratios compared with the general population is falling (7.7 in 2001, 6.9 in 2007).

Results of analyses on causes of death

Data completeness

The data completeness is shown in table 7.18. Overall it is less than 50% and has fallen in recent years, largely

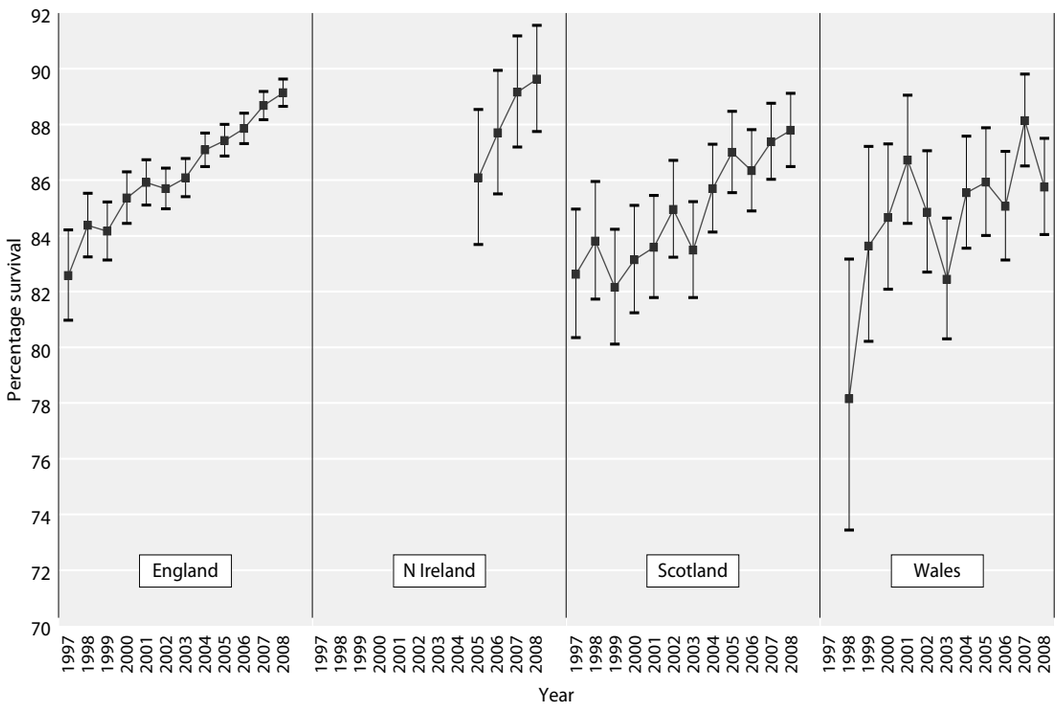

Fig. 7.23. Serial 1 year survival for prevalent dialysis patients by UK country from 1997–2008 adjusted to age 60

Table 7.16. Serial 1 year survival of prevalent dialysis patients with a primary diagnosis of diabetes from 2000–2008

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
1 year survival	76.5	77.1	78.4	77.7	80.6	82.3	81.5	84.2	83.0

Table 7.17. Death rate by age for all prevalent RRT patients on 1/1/2008, compared with the general population and with previous analyses in the 1998–2001 cohort

Age group	UK population mid 2007 (thousands)	UK deaths	Death rate per 1,000 population	Expected number of deaths in UK RR population	Renal Registry deaths	RR deaths per 1,000 prev RRT patients	Observed: expected ratio 2008	Observed: expected ratio 1998–2001
20–24	4,141	2,013	0.5	0	12	13.4	27.5	41.1
25–29	3,966	2,220	0.6	1	18	12.7	22.7	41.8
30–34	3,893	3,066	0.8	2	42	22.6	28.6	31.2
35–39	4,534	4,705	1.0	3	64	21.1	20.3	26.0
40–44	4,714	7,116	1.5	6	106	26.7	17.7	22.6
45–49	4,250	9,749	2.3	10	132	30.3	13.2	19.0
50–54	3,730	13,783	3.7	16	211	47.6	12.9	12.8
55–59	3,748	21,652	5.8	26	300	67.4	11.7	10.1
60–64	3,483	31,368	9.0	42	413	87.9	9.8	10.4
65–69	2,697	39,509	14.6	61	523	124.7	8.5	7.9
70–74	2,360	55,514	23.5	90	637	166.0	7.1	7.2
75–79	1,972	79,911	40.5	120	727	245.0	6.0	5.3
80–84	1,452	102,399	70.5	116	527	321.4	4.6	4.0
85+	1,298	195,076	150.3	97	266	411.0	2.7	3.0
Total	**46,238**	**568,081**	**12.3**	**591**	**3,978**	**93.8**	**6.7**	**7.7**

due to low completeness from a number of centres that have only recently started submitting data to the UKRR. Interpretation of patterns of cause of death must be cautious as it is not known whether non-return is associated with cause. Some centres (e.g. Derby, Nottingham and Swansea) consistently achieved a very high rate of data return for cause of death, because a process is in place to make sure that these data are entered. The Scottish centres overall have the highest rate of data return. Several centres have shown huge improvement in data returns but others that were reporting these data in previous years appear to have discontinued collection.

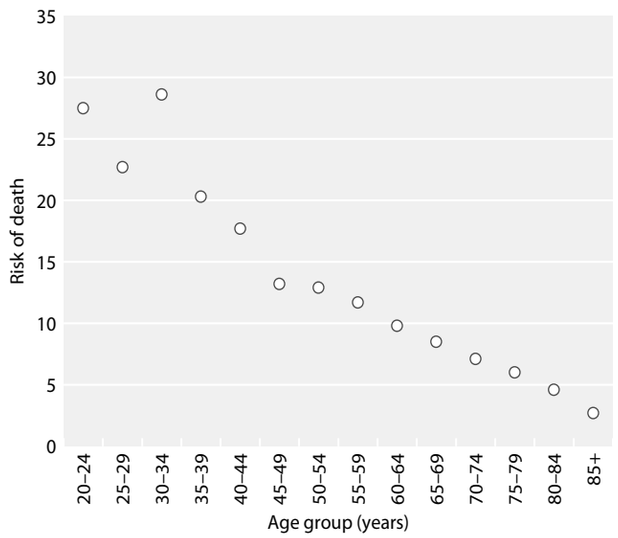

Fig. 7.24. Relative risk of death in all prevalent RRT patients in 2008 compared with the UK general population in 2007

Causes of death in incident RRT patients

Causes of death within the first 90 days

Treatment withdrawal and infection (table 7.19) were slightly more common as a cause of death within the first 90 days within the patient group aged $\geqslant$65 years when compared with the younger age group.

Causes of death within one year after 90 days

Treatment withdrawal as a cause of death (table 7.20) again was more common in the older age group. Cardiac disease accounted for 25% of all deaths and overall cardiovascular disease for 31%. Infection was still an important cause of nearly 1 in 5 deaths.

Table 7.18. Percentage completeness of EDTA causes of death for incident patients by centre and year of starting RRT

Centre	2000	2001	2002	2003	2004	2005	2006	2007	2008
Abrdn	28.0	31.3	26.5	16.1	10.0	16.7	12.5	80.0	60.0
Airdrie	37.0	32.6	30.8	30.3	48.3	34.8	47.6	66.7	100.0
Antrim						11.1	0.0	7.1	0.0
B Heart	75.0	83.3	76.6	70.0	75.9	88.1	88.4	94.1	100.0
B QEH					39.8	2.6	3.6	8.8	0.0
Bangor			50.0	22.2	54.2	48.0	45.5	18.2	33.3
Basldn				47.8	60.9	37.5	54.5	40.0	100.0
Belfast						24.5	11.1	40.9	50.0
Bradfd		77.5	88.6	91.8	82.9	92.9	92.6	100.0	87.5
Brightn					4.3	3.6	4.7	0.0	0.0
Bristol	50.0	49.0	65.0	71.1	75.5	56.6	70.4	51.4	55.6
Camb		0.0	0.0	0.0	0.0	0.0	7.7	0.0	0.0
Cardff	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
Carlis	33.0	28.6	61.1	60.9	72.2	81.8	66.7	75.0	100.0
Carsh	3.6	1.2	0.0	1.0	0.0	0.0	0.0	0.0	0.0
Chelms					51.6	87.5	77.3	90.0	50.0
Clwyd			12.5	0.0	11.1	6.7	62.5	40.0	100.0
Colchr									0.0
Covnt	21.0	9.3	14.3	2.4	0.0	0.0	0.0	0.0	0.0
D & Gall	94.0	72.2	91.7	83.3	72.7	84.6	90.0	100.0	0.0
Derby	39.0	41.0	0.0	54.3	70.6	92.3	85.0	88.9	90.9
Derry							0.0	0.0	100.0
Donc								100.0	50.0
Dorset				30.0	71.0	81.0	71.4	62.5	91.7
Dudley	30.0	4.8	33.3	0.0	0.0	0.0	0.0	0.0	0.0
Dundee	74.0	72.2	59.6	56.4	59.0	29.2	15.0	20.0	20.0
Dunfn	81.0	84.6	78.9	61.5	69.2	60.9	53.8	37.5	0.0
Edinb	75.0	58.5	53.2	39.6	51.0	46.5	55.6	73.3	100.0
Exeter	29.0	27.0	20.3	27.4	16.1	11.1	8.6	0.0	0.0
Glasgw	51.0	57.5	53.4	53.5	44.1	51.1	62.7	84.4	85.7
Glouc	53.0	70.0	51.6	50.0	60.0	52.0	14.3	58.8	40.0
Hull	74.0	75.0	73.4	58.7	71.0	69.1	55.6	69.6	42.9
Inverns	16.0	4.3	6.3	10.0	5.9	28.6	25.0	37.5	100.0
Ipswi			20.7	23.8	30.4	15.4	50.0	0.0	0.0
Kent								44.4	18.2
Klmarnk	0.0	10.0	28.6	23.8	22.2	21.1	16.7	80.0	50.0
L Barts					76.5	84.2	78.3	77.1	83.3
L Guys	0.0	5.5	1.4	3.1	0.0	2.8	0.0	5.3	0.0
L Kings			64.4	72.1	74.1	84.4	87.5	91.7	71.4
L Rfree						2.9	0.0	0.0	0.0
L St G								30.8	33.3
L West			53.4	46.0	42.2	11.5	1.4	5.0	3.8
Leeds	50.0	62.0	57.8	47.7	54.5	52.1	46.7	13.8	18.8
Leic	71.0	76.9	81.5	83.5	82.2	77.6	69.5	55.1	77.3
Liv Ain						45.5	63.6	83.3	62.5
Liv RI		77.8	72.2	72.1	68.8	75.4	76.5	78.9	57.1
M Hope				0.0	0.0	0.0	3.2	0.0	0.0
M RI								0.0	0.0
Middlbr	77.0	78.0	67.6	55.6	52.7	65.8	31.0	25.0	7.7
Newc			40.4	25.6	35.0	55.0	44.4	50.0	40.0
Newry						45.5	0.0	0.0	0.0
Norwch					25.5	19.0	23.3	16.1	23.1
Nottm	93.0	97.5	96.6	95.6	96.4	92.1	88.2	92.3	100.0
Oxford	8.6	7.9	6.5	3.8	13.9	5.3	0.0	0.0	0.0
Plymth	45.0	38.0	50.0	56.5	46.5	43.3	50.0	55.0	40.0
Ports		25.8	20.4	18.4	15.3	7.0	17.7	2.7	7.1

Table 7.18. Continued

Centre	2000	2001	2002	2003	2004	2005	2006	2007	2008
Prestn	70.0	71.8	64.1	64.6	58.1	52.5	51.3	51.9	27.3
Redng	67.0	61.0	76.0	85.7	95.7	70.0	90.5	89.5	81.8
Sheff	57.0	43.5	54.8	29.6	2.7	3.1	0.0	0.0	0.0
Shrew					53.3	37.5	31.3	30.8	25.0
Stevng	25.0	42.7	73.6	41.7	38.7	54.3	54.1	33.3	0.0
Sthend	39.0	30.8	30.4	35.7	18.2	11.8	0.0	60.0	100.0
Stoke								28.0	10.0
Sund	47.0	58.3	61.5	50.0	44.4	71.0	60.9	58.8	100.0
Swanse	83.0	87.0	92.0	94.1	90.4	89.1	95.7	100.0	91.7
Truro		43.5	37.5	40.0	0.0	0.0	0.0	25.0	0.0
Tyrone						45.5	66.7	50.0	0.0
Ulster						75.0	75.0	100.0	0.0
Wirral			54.8	76.7	65.6	67.7	66.7	81.8	33.3
Wolve	91.0	90.6	83.6	82.7	75.5	55.3	54.5	60.0	55.6
Wrexm	9.8	0.0	10.5	5.0	11.8	18.2	28.6	50.0	50.0
York	33.0	44.0	58.7	63.6	61.5	52.4	45.0	62.5	55.6
England	**49.0**	**48.9**	**49.3**	**44.8**	**44.4**	**41.4**	**38.3**	**35.4**	**31.5**
N Ireland						**29.0**	**23.5**	**30.2**	**23.1**
Scotland	**53.0**	**50.4**	**48.1**	**43.3**	**42.9**	**41.6**	**46.2**	**63.6**	**71.8**
Wales	**26.0**	**32.7**	**37.5**	**37.1**	**30.9**	**31.2**	**37.9**	**33.9**	**46.5**
UK	**48.0**	**47.8**	**48.0**	**43.9**	**43.2**	**40.2**	**38.8**	**37.7**	**36.6**

Blank cells, data not available for that year

Table 7.19. Cause of death in the first 90 days for incident patients by age, 2000–2007

	All age groups		<65 years		⩾65 years	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	437	29	106	32	331	28
Cerebrovascular disease	78	5	18	5	60	5
Infection	271	18	43	13	228	19
Malignancy	122	8	32	10	90	8
Treatment withdrawal	236	15	35	10	201	17
Other	145	9	32	10	113	9
Uncertain	244	16	69	21	175	15
Total	**1,533**		**335**		**1,198**	
No cause of death data	1,847		403		1,444	

Table 7.20. Cause of death in 1 year after 90 days for incident patients by age, 2000–2007

	All age groups		<65 years		⩾65 years	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	609	25	189	27	420	24
Cerebrovascular disease	147	6	39	6	108	6
Infection	454	18	131	19	323	18
Malignancy	250	10	89	13	161	9
Treatment withdrawal	395	16	57	8	338	19
Other	172	7	61	9	111	6
Uncertain	455	18	130	19	325	18
Total	**2,482**		**696**		**1,786**	
No cause of death data	3,118		892		2,226	

Table 7.21 Cause of death in prevalent RRT patients by age and modality on 1/1/2008

	All age groups		<65 years		⩾65 years	
Cause of death	Number of deaths	%	Number of deaths	%	Number of deaths	%
Cardiac disease	381	24	341	25	40	21
Cerebrovascular disease	68	4	55	4	13	7
Infection	266	17	235	17	31	16
Malignancy	135	9	96	7	39	21
Treatment withdrawal	220	14	211	15	9	5
Other	110	7	89	6	21	11
Uncertain	388	25	352	26	36	19
Total	**1,568**		**1,379**		**189**	
No cause of death data	2,412		2,047		365	

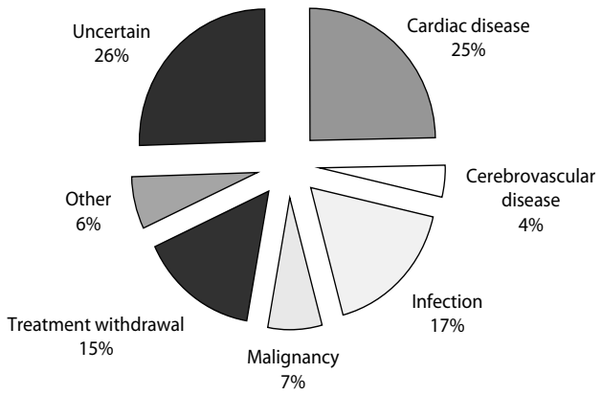

Fig. 7.25. Frequency of causes of death for prevalent dialysis patients in 2008

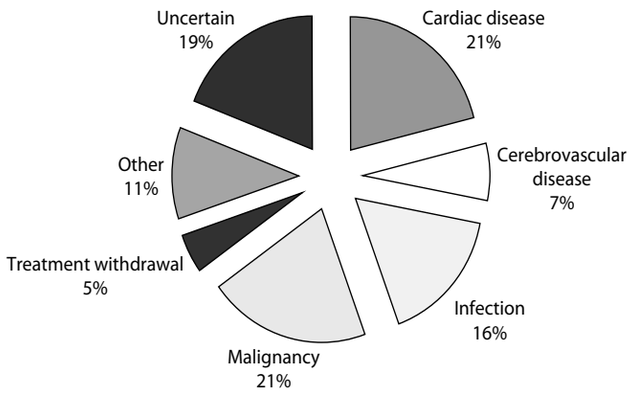

Fig. 7.26. Frequency of causes of death for prevalent transplant patients in 2008

Causes of death in prevalent RRT patients in 2008

Causes of death in prevalent RRT patients in 2008 by modality and age

Table 7.21 and figures 7.25 and 7.26 show the frequency of the causes of death for both prevalent dialysis and transplant patients. In tables 7.22 and 7.23 a comparison has been made with data available from the ANZDATA Registry Report [8]. The Australian Registry appears to have many fewer cases of 'uncertain' causes of death; amongst dialysis patients

Table 7.22. Cause of death in prevalent transplanted patients by age on 1/1/2008

Cause of death in transplanted patients	All age groups		<55 years		⩾55 years		ANZdata*
	Number of deaths	%	Number of deaths	%	Number of deaths	%	%
Cardiac disease	40	21	12	24	28	20	30
Cerebrovascular disease	13	7	3	6	10	7	7
Infection	31	16	5	10	26	19	15
Malignancy	39	21	11	22	28	20	32
Treatment withdrawal	9	5	4	8	5	4	1
Other	21	11	6	12	15	11	15
Uncertain	36	19	10	20	26	19	0
Total	**189**		**51**		**138**		
No cause of death data	365		92		273		

* ANZDATA Registry Report 2008

Table 7.23. Cause of death in prevalent dialysis patients by age on 1/1/2008

Cause of death in transplanted patients	All age groups		<55 years		⩾55 years		ANZdata*
	Number of deaths	%	Number of deaths	%	Number of deaths	%	%
Cardiac disease	341	25	120	30	221	23	35
Cerebrovascular disease	55	4	16	4	39	4	9
Infection	235	17	59	15	176	18	10
Malignancy	96	7	29	7	67	7	7
Treatment withdrawal	211	15	34	9	177	18	34
Other	89	6	30	8	59	6	5
Uncertain	352	26	109	27	243	25	1
Total	**1,379**		**397**		**982**		
No cause of death data	2,047		601		1,446		

* ANZDATA Registry Report 2008

withdrawal of treatment was reported more frequently in ANZDATA, but this apparent difference may be the result of differences in classification of patients whose treatment was withdrawn in the context of another illness.

Figure 7.27 contrasts the differences in frequency of these causes, between the 2 modalities within the UK (figures 7.25, 7.26). These data are neither age-adjusted nor adjusted for differences in the comorbidity between the 2 groups. Cardiac disease as a cause of death was less common in the transplanted patients as these were a pre-selected low risk group of patients. Treatment withdrawal still occurs in the transplanted group, in patients who choose not to restart dialysis when their renal transplant fails.

Table 7.22 shows there were no differences in the causes of death between transplanted patients aged <55 or ⩾55 years. Table 7.23 shows these data for dialysis patients.

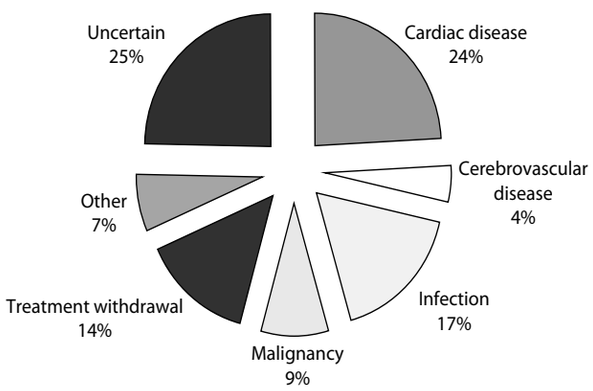

Fig. 7.27. Frequency of causes of death for all prevalent patients in 2008

Expected life years remaining on RRT

For the statistical methodology for this analysis please refer to the methodology section at the start of this chapter.

Figure 7.28 shows the median remaining life years expected by age band. All incident patients starting RRT from 1997 to 2007 have been included in this analysis and the projected median survival will be different for low risk (e.g. polycystic kidney disease with a transplant) vs. high risk (diabetic with previous myocardial infarction on dialysis) patients even within the same age band.

Conflict of interest: none

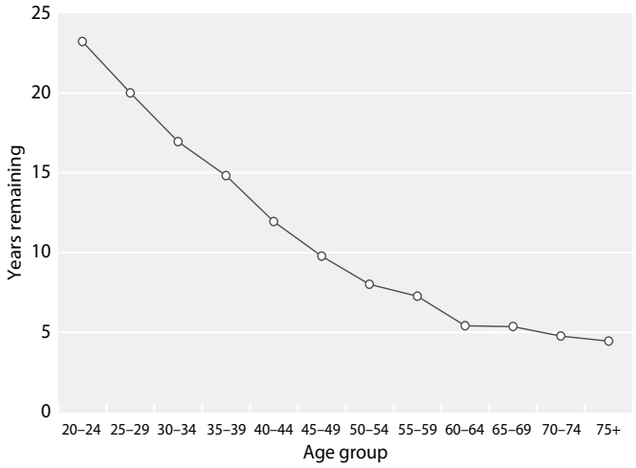

Fig. 7.28. Median remaining life years on RRT by age band

References

1 Renal Association. The 2007 4th Renal Association Clinical Practice Guidelines modules 1–5. (http://www.renal.org/pages/pages/clinical-affairs/guidelines.php)
2 Renal Association. Treatment of Adults and Children with renal failure. Standards and audit measures. 3rd edition. Royal College of Physicians of London, 2002. (http://www.renal.org/Standards/standards.html)
3 US Renal Data System, USRDS 2009 Annual Report Volume 1, Chapter 6 www.usdrs.org/atlas.htm
4 Ansell D, Roderick P, Hodsman A, Ford D, Steenkamp R, Tomson C. UK Renal Registry 11th Annual Report (December 2008): Chapter 7. Survival and causes of death of UK adult patients on Renal Replacement Therapy in 2007: national and centre-specific analyses. Nephron Clin Pract 2009; 111(Suppl 1):c113–c139.
5 General Register Office for Scotland; 2005 Annual Review; Chapter 1 http://www.gro-scotland.gov.uk/statistics/library/annrep/rgs-annual-review-2005/chapter-1/chapter-1-demographic-overview-deaths/deaths-part-1.html#variationsinmortalitylevelswithinscotland
6 Office for National Statistics http://www.statistics.gov.uk
7 US Renal Data System, USRDS 2007 Annual Report Volume 1, Chapter 6 www.usdrs.org/atlas.htm
8 Anzdata Report 2008 http://www.anzdata.org.au/v1/report_2008.html

Appendix 1: Survival tables

Table 7.24. One-year after 90-day incident survival by centre for 2007, unadjusted and adjusted to age 60

Centre	Unadjusted 1 yr after 90 d survival	Adjusted 1 yr after 90 d survival	Adjusted 1 yr after 90 d 95% CI
Abrdn	82.5	84.2	75.2–94.3
Airdrie	82.2	83.6	74.0–94.6
Antrim	72.2	84.8	76.5–93.9
B Heart	87.5	90.7	85.6–96.1
B QEH	90.8	93.3	90.4–96.3
Bangor	88.3	92.2	84.3–100.0
Basldn	82.4	87.9	79.5–97.3
Belfast	86.5	90.2	84.9–95.9
Bradfd	84.2	86.3	79.4–93.8
Brightn	91.5	94.6	91.2–98.1
Bristol	88.5	91.3	87.2–95.6
Camb	90.9	92.3	87.8–97.0
Cardff	76.8	82.3	77.8–87.1
Carlis	91.7	92.8	84.0–100.0
Carsh	83.4	89.1	85.3–93.0
Chelms	85.5	90.7	83.9–98.2
Clwyd	77.4	83.9	72.2–97.4
Covnt	89.7	92.6	88.3–97.1
Derby	93.0	95.2	90.8–99.8
Dorset	82.7	87.3	79.9–95.3
Dudley	82.1	84.8	75.2–95.7
Dundee	69.8	79.3	70.7–89.0
Dunfn	82.9	87.2	78.3–97.2
Edinb	92.2	92.4	87.1–97.9
Exeter	81.0	87.6	82.8–92.6
Glasgw	86.9	88.6	84.3–93.2
Glouc	81.0	87.4	79.9–95.6
Hull	83.7	86.4	80.3–93.0
Inverns	78.3	80.3	66.4–96.9
Ipswi	91.6	94.0	87.7–100.0
Kent	90.9	92.9	89.5–96.4
Klmarnk	88.6	90.5	82.3–99.6
L Barts	87.7	87.9	83.4–92.6
L Guys	92.4	92.9	88.9–97.0
L Kings	87.0	88.9	83.7–94.4
L Rfree	91.3	92.8	89.4–96.4
L St G	88.4	90.5	84.7–96.7
L West	90.9	92.2	89.2–95.3
Leeds	84.1	86.8	81.3–92.7
Leic	85.8	88.6	85.0–92.5
Liv Ain	75.0	84.3	74.9–94.8
Liv RI	89.5	89.8	84.0–96.0
M Hope	86.0	85.9	79.2–93.1
M RI	86.0	87.4	82.4–92.7
Middlbr	81.7	87.1	81.1–93.4
Newc	83.5	87.4	81.8–93.4
Norwch	83.5	89.5	84.5–94.7
Nottm	85.6	88.9	84.0–94.0
Oxford	87.7	90.3	85.9–95.0
Plymth	85.2	90.7	85.4–96.4
Ports	87.1	90.2	85.9–94.8
Prestn	87.1	89.0	84.0–94.4
Redng	86.8	90.8	85.9–95.9
Sheff	83.5	87.9	83.4–92.6
Shrew	86.1	88.6	81.1–96.9
Stevng	85.7	88.6	82.8–94.9
Sthend	88.3	92.2	85.3–99.7
Stoke	81.0	86.3	80.1–93.0
Sund	83.0	87.7	80.9–95.1
Swanse	84.9	90.2	85.8–94.8
Truro	79.0	86.5	78.8–95.1
Tyrone	90.9	93.5	85.5–100.0
Wirral	81.2	84.5	75.7–94.3
Wolve	87.3	90.8	84.9–97.0
Wrexm	85.6	90.2	80.5–100.0
York	91.2	94.5	88.6–100.0
England	**86.9**	**89.9**	**89.0–90.8**
N Ireland	**84.9**	**89.9**	**86.2–93.7**
Scotland	**84.4**	**86.7**	**84.0–89.5**
Wales	**80.4**	**86.0**	**83.0–89.1**
UK	**86.2**	**89.3**	**88.5–90.2**

Excluded: Colchester (contributed data from 2008 onwards), Dumfries & Galloway, Derry, Doncaster, Newry and Ulster all due to <20 patients.

Table 7.25. Ninety day incident survival by centre for 2007, unadjusted and adjusted to age 60

Centre	Unadjusted 90 d survival	Adjusted 90 d survival	Adjusted 90 d 95% CI
Abrdn	98.2	98.6	96.0–100.0
Airdrie	96.0	96.9	92.8–100.0
B Heart	93.9	96.0	92.9–99.2
B QEH	95.0	96.7	94.8–98.7
Bangor	80.6	88.9	81.6–97.0
Basldn	92.3	95.4	90.5–100.0
Belfast	93.2	95.8	92.6–99.2
Bradfd	90.8	93.0	88.5–97.8
Brightn	93.2	96.3	93.7–98.9
Bristol	89.0	92.8	89.5–96.2
Camb	90.4	92.7	88.8–96.8
Cardff	95.5	97.1	95.3–98.9
Carlis	92.3	94.2	86.9–100.0
Carsh	93.8	96.5	94.5–98.5
Chelms	92.2	95.5	91.2–99.9
Covnt	90.9	94.1	90.6–97.8
Derby	93.4	96.1	92.4–99.9
Dorset	91.5	94.6	90.1–99.3
Dundee	86.9	93.0	88.4–97.9
Dunfn	97.3	98.3	95.1–100.0
Edinb	96.8	97.1	94.0–100.0
Exeter	93.5	96.5	94.1–98.9
Glasgw	89.9	92.6	89.4–95.9
Glouc	93.0	96.3	92.7–99.9
Hull	96.0	97.0	94.1–99.9
Inverns	92.3	94.0	86.6–100.0
Ipswi	97.4	98.4	95.3–100.0
Kent	98.8	99.2	98.1–100.0
Klmarnk	97.2	97.9	94.1–100.0
L Barts	98.1	98.3	96.7–100.0
L Guys	97.5	97.9	95.8–100.0
L Kings	94.4	95.7	92.6–98.9
L Rfree	98.4	98.8	97.4–100.0
L St G	96.6	97.5	94.7–100.0
L West	94.9	96.0	94.0–98.1
Leeds	94.4	96.0	93.1–98.9
Leic	95.9	97.1	95.4–98.9
Liv Ain	91.4	95.2	90.2–100.0
Liv RI	95.6	96.0	92.7–99.5
M Hope	99.1	99.2	97.6–100.0
M RI	95.5	96.4	93.8–99.1
Middlbr	85.9	91.3	87.0–95.8
Newc	91.5	94.3	90.7–98.0
Norwch	86.7	92.5	88.7–96.4
Nottm	94.5	96.3	93.7–99.0
Oxford	93.1	95.1	92.2–98.1
Plymth	89.5	94.0	89.9–98.1
Ports	89.7	93.1	89.8–96.5
Prestn	93.0	94.6	91.3–98.1
Sheff	93.9	96.1	93.7–98.5
Shrew	94.5	96.0	91.6–100.0
Stevng	96.6	97.6	94.9–100.0
Stoke	93.1	95.6	92.2–99.1
Sund	95.2	97.1	94.0–100.0
Swanse	90.6	94.8	92.0–97.8
Truro	97.8	98.8	96.4–100.0
Wirral	96.2	97.1	93.3–100.0
Wolve	94.0	96.2	92.5–99.9
Wrexm	88.9	93.5	86.8–100.0
York	97.1	98.4	95.3–100.0
England	**94.3**	**96.2**	**95.6–96.8**
N Ireland	**96.2**	**97.8**	**96.2–99.4**
Scotland	**93.3**	**95.2**	**93.7–96.8**
Wales	**92.6**	**95.7**	**94.2–97.3**
UK	**94.2**	**96.1**	**95.6–96.7**

Excluded: Colchester (contributed data from 2008 onwards), Dumfries & Galloway, Derry, Doncaster, Newry and Ulster all due to <20 patients. Antrim, Tyrone, Southend, Reading, Clwyd and Dudley excluded due to no deaths in the first 90 days

Table 7.26. One year after 90-day incident survival by centre for incident cohort years 1999–2007, adjusted to age 60

Centre	1999	2000	2001	2002	2003	2004	2005	2006	2007
Abrdn	81.9	79.9	92.4	87.9	83.0	89.8	79.5	82.7	84.2
Airdrie	73.7	81.7	84.8	78.4	79.8	85.6	72.3	75.7	83.6
Antrim							86.1	94.4	84.8
B Heart	86.5	83.7	85.2	88.0	86.2	87.3	86.1	89.9	90.7
B QEH						88.5	90.7	87.8	93.3
Bangor				83.0	89.0	84.1	81.3	81.4	92.2
Basldn					92.0	95.1	92.0	90.9	87.9
Belfast							90.4	92.1	90.2
Bradfd			93.4	86.5	84.2	84.5	85.5	76.7	86.3
Brightn						87.8	83.1	90.2	94.6
Bristol	85.9	86.5	85.8	88.0	87.5	87.6	83.7	93.1	91.3
Camb			90.7	82.0	89.0	87.6	90.9	92.3	92.3
Cardff	88.9	88.7	83.2	82.9	89.4	86.3	88.3	85.9	82.3
Carlis	74.6	76.7	94.7	87.7	78.4	87.0	83.3	91.0	92.8
Carsh	86.0	86.2	76.3	84.7	90.8	86.6	91.9	85.6	89.1
Chelms						81.2	85.7	87.0	90.7
Clwyd				87.7	76.3	90.1	81.7	95.9	83.9
Covnt	78.3	82.6	87.8	90.5	82.3	84.9	87.1	84.2	92.6

Table 7.26. Continued

Centre	1999	2000	2001	2002	2003	2004	2005	2006	2007
D & Gall	87.4	87.4	74.6	78.1	85.6	89.1	81.1	84.6	84.4
Derby		88.3	85.1		83.7	86.8	89.4	92.7	95.2
Donc									96.2
Dorset					86.2	91.1	82.0	89.8	87.3
Dudley	90.0	86.3	90.6	89.4	88.9	85.8	96.7	89.5	84.8
Dundee	89.6	77.7	86.8	83.9	89.7	84.1	85.8	89.9	79.3
Dunfn	80.0	72.3	70.4	86.9	85.8	87.9	77.0	83.1	87.2
Edinb	84.8	80.4	80.5	82.5	83.3	79.6	86.0	88.6	92.4
Exeter	88.2	85.5	86.2	87.0	85.3	86.7	86.2	87.6	87.6
Glasgw	85.3	84.8	79.9	84.1	85.1	81.3	84.7	84.7	88.6
Glouc	87.4	95.0	82.4	82.2	84.5	86.9	93.3	89.8	87.4
Hull	86.7	86.0	88.9	85.3	87.5	86.2	89.4	91.9	86.4
Inverns	94.2	84.1	91.7	83.7	88.1	83.5	85.4	90.8	80.3
Ipswi				98.3	93.7	91.1	84.8	96.1	94.0
Kent									92.9
Klmarnk	90.5	91.5	88.3	87.3	85.4	84.0	93.9	84.0	90.5
L Barts						87.5	93.0	91.6	87.9
L Guys		89.4	88.7	85.9	95.6	87.8	92.5	90.1	92.9
L Kings				88.0	86.2	88.8	88.9	89.1	88.9
L Rfree							91.5	92.5	92.8
L St G									90.5
L West				93.0	95.6	92.0	94.3	94.1	92.2
Leeds	81.9	91.3	89.7	85.6	88.8	90.4	89.5	84.8	86.8
Leic	85.7	84.5	87.3	88.0	91.2	85.4	85.6	87.6	88.6
Liv Ain							85.5	86.1	84.3
Liv RI			87.6	85.1	83.2	84.2	91.1	83.6	89.8
M Hope					88.2	82.7	92.2	92.2	85.9
M RI									87.4
Middlbr	82.4	88.9	83.0	78.4	82.5	85.5	83.2	89.7	87.1
Newc				88.0	88.4	83.9	82.2	84.4	87.4
Newry							86.6	82.9	94.7
Norwch						86.0	90.1	88.4	89.5
Nottm	86.9	89.4	89.3	86.6	86.5	84.7	86.5	94.5	88.9
Oxford	94.4	89.9	86.6	88.9	87.9	90.5	86.9	90.7	90.3
Plymth	82.6	86.3	73.0	81.9	81.6	81.0	81.8	83.0	90.7
Ports			86.9	86.2	88.0	89.3	83.6	86.3	90.2
Prestn	87.8	87.3	87.1	87.3	85.8	83.9	91.7	84.8	89.0
Redng		77.7	84.0	91.7	90.8	93.3	88.6	89.4	90.8
Sheff	85.1	94.9	94.3	84.1	90.1	89.9	92.1	89.3	87.9
Shrew						88.0	87.5	89.6	88.6
Stevng	87.9	91.1	81.3	87.5	94.9	87.5	79.3	88.3	88.6
Sthend	88.7	82.6	82.5	87.4	90.8	88.7	92.3	96.3	92.2
Stoke									86.3
Sund	79.7	85.3	83.9	69.6	81.5	87.5	82.5	82.3	87.7
Swanse		85.8	85.7	83.1	83.1	82.9	84.1	83.3	90.2
Truro			91.4	83.8	88.7	93.3	88.0	92.6	86.5
Tyrone							96.4	90.0	93.5
Ulster							89.7	83.9	91.1
Wirral				77.2	95.0	82.5	87.9	90.3	84.5
Wolve	86.5	87.4	77.1	87.0	83.2	88.2	86.6	89.4	90.8
Wrexm	81.7	85.3	83.2	93.2	81.7	91.8	91.6	90.9	90.2
York		83.7	87.1	82.3	78.1	89.6	85.1	83.6	94.5
England	**85.9**	**87.7**	**86.6**	**86.4**	**88.3**	**87.6**	**88.5**	**89.3**	**89.9**
N Ireland							**89.7**	**91.6**	**89.9**
Scotland	**85.3**	**82.0**	**82.8**	**83.8**	**85.3**	**83.7**	**84.1**	**85.1**	**86.7**
Wales	**87.1**	**87.3**	**84.2**	**84.4**	**86.0**	**85.8**	**86.3**	**85.6**	**86.0**
UK	**85.9**	**86.6**	**85.9**	**85.9**	**87.8**	**87.1**	**88.0**	**88.7**	**89.3**

Excluded: centres with <20 patients for that year: Derry; Excluded Colchester (contributing data since 2008); Blank cells, data not available for that year

Table 7.27. One year prevalent survival by centre for prevalent cohort years 2000–2008, adjusted to age 60

	1 year survival by centre and year								
Centre	2000	2001	2002	2003	2004	2005	2006	2007	2008
Abrdn	85.8	89.4	87.2	80.5	85.5	87.5	86.8	87.0	89.7
Airdrie	77.8	77.4	81.6	83.9	84.6	82.8	79.5	78.9	85.5
Antrim						83.4	92.0	85.5	89.2
B Heart	86.7	87.5	87.7	87.7	86.9	87.9	86.2	87.7	90.5
B QEH					89.0	88.9	88.7	88.5	88.5
Bangor			86.3	81.8	89.9	86.7	89.5	81.0	88.9
Basldn				81.4	88.0	90.7	90.2	91.0	93.1
Belfast						86.3	86.8	90.9	87.2
Bradfd		80.2	87.7	82.5	88.0	86.3	82.4	84.3	88.0
Brightn					86.9	84.1	87.9	87.7	89.5
Bristol	87.2	86.1	87.7	88.8	86.8	87.6	87.8	89.2	87.2
Camb		86.0	86.7	86.9	87.6	87.5	89.1	88.5	92.9
Cardff	85.2	85.7	85.9	80.8	84.4	84.3	84.3	88.7	82.7
Carlis	82.8	88.9	80.4	82.5	82.0	84.2	83.8	86.6	86.6
Carsh	83.2	83.9	82.9	85.1	88.0	86.4	89.1	89.0	90.1
Chelms					86.8	81.7	85.3	86.0	84.3
Clwyd			88.3	89.0	75.9	82.4	80.1	91.2	87.6
Covnt	87.2	85.7	85.2	87.8	88.7	89.5	85.5	87.0	87.3
D & Gall	87.2	84.2	84.4	84.8	83.1	91.0	81.5	90.3	85.6
Derby	88.9	89.6		86.6	88.9	88.1	89.1	87.5	90.9
Derry								86.5	92.3
Donc									93.4
Dorset				90.1	88.0	90.2	86.1	87.1	89.6
Dudley	85.5	83.3	83.3	84.8	86.8	86.3	87.2	86.9	88.8
Dundee	77.1	86.2	85.1	83.9	85.3	87.7	87.6	83.7	84.2
Dunfn	76.4	79.2	82.6	83.8	89.0	91.0	88.1	88.8	90.5
Edinb	83.0	81.4	83.6	83.1	85.6	85.8	86.6	88.1	88.2
Exeter	86.1	85.0	87.4	86.6	85.9	84.2	90.8	87.5	85.5
Glasgw	86.1	83.3	85.9	83.7	85.5	87.5	86.4	88.5	87.9
Glouc	89.1	79.9	84.1	82.1	89.1	88.5	91.1	87.9	87.3
Hull	81.5	87.1	87.5	85.6	85.7	84.8	85.8	90.1	86.9
Inverns	81.1	88.9	88.5	87.5	86.8	87.0	86.3	94.4	89.0
Ipswi			82.3	84.9	90.4	85.9	84.8	85.3	91.5
Kent									86.5
Klmarnk	80.4	85.4	82.6	82.2	87.2	84.7	91.5	87.1	88.8
L Barts					83.8	85.5	88.3	89.2	88.7
L Guys	86.1	86.7	86.3	88.6	88.6	89.1	87.8	90.7	90.1
L Kings			81.1	77.4	81.7	86.5	88.9	84.7	88.4
L Rfree						90.1	90.5	90.4	91.3
L St G								95.8	93.9
L West			89.8	91.4	91.1	91.6	91.7	91.9	90.5
Leeds	83.4	85.3	87.1	86.1	85.2	88.7	88.8	88.2	87.6
Leic	83.3	84.7	84.1	83.8	85.2	87.3	84.6	90.0	89.5
Liv Ain		92.6	90.6	90.5	86.9	96.9	86.7	90.9	88.9
Liv RI		81.2	82.2	84.6	86.0	84.1	88.2	85.4	87.5
M Hope				84.5	82.2	84.4	86.2	88.3	87.1
M RI								85.9	86.6
Middlbr	84.1	83.9	84.2	84.3	83.0	85.9	85.4	87.0	87.1
Newc			83.2	81.3	82.2	87.5	85.3	86.7	88.0
Newry						85.9	87.9	86.9	90.5
Norwch					86.9	87.4	89.7	86.8	90.8
Nottm	85.0	87.0	82.6	85.0	86.3	85.1	83.3	89.4	88.4
Oxford	87.7	88.4	85.6	86.6	88.1	87.5	88.1	87.6	88.4
Plymth	85.0	87.3	76.6	84.9	86.9	87.4	83.4	82.8	88.3
Ports		83.8	80.7	81.6	89.1	85.4	84.8	89.7	88.7

Table 7.27. Continued

	1 year survival by centre and year								
Centre	2000	2001	2002	2003	2004	2005	2006	2007	2008
Prestn	85.7	87.2	86.3	84.7	85.9	85.6	86.6	90.9	90.4
Redng	84.0	78.9	86.1	82.2	90.0	86.3	89.0	90.0	89.4
Sheff	84.2	88.0	90.5	91.0	87.8	87.1	89.2	88.6	88.8
Shrew					85.1	87.2	86.2	89.3	88.9
Stevng	89.7	91.1	86.6	88.4	89.5	88.6	89.5	89.6	92.9
Sthend	85.3	88.7	88.8	86.9	88.9	86.4	83.6	85.8	90.3
Stoke								84.5	87.3
Sund	77.2	79.4	78.1	75.8	82.6	86.4	79.4	83.2	87.6
Swanse	84.6	87.6	80.8	82.3	87.8	89.3	85.9	88.4	89.5
Truro		89.0	82.7	90.3	90.1	86.0	91.9	89.0	90.3
Tyrone						89.0	82.8	93.1	93.4
Ulster						85.8	91.3	89.1	92.0
Wirral			93.0	84.9	87.5	89.4	89.3	88.0	88.6
Wolve	84.3	90.1	86.7	83.5	86.5	87.5	89.8	87.9	93.1
Wrexm	83.5	87.9	87.1	85.7	86.1	84.4	84.9	88.9	86.0
York	86.6	79.7	85.2	81.0	83.2	88.7	83.6	88.9	88.2
England	**85.4**	**85.9**	**85.7**	**86.1**	**87.1**	**87.4**	**87.9**	**88.7**	**89.1**
N Ireland						**86.1**	**87.7**	**89.2**	**89.6**
Scotland	**83.1**	**83.6**	**84.9**	**83.5**	**85.7**	**87.0**	**86.3**	**87.4**	**87.8**
Wales	**84.7**	**86.7**	**84.8**	**82.4**	**85.5**	**85.9**	**85.1**	**88.1**	**85.8**
UK	**84.9**	**85.6**	**85.5**	**85.5**	**86.8**	**87.3**	**87.5**	**88.5**	**88.8**

Blank cells, data not available for that year
Colchester not in analysis – does not have any timeline information before 2008
Derry <20 patients in 2006, starting to contribute to the RR in 2006
Doncaster <20 patients in 2007
Kent no deaths in 2007

Chapter 8
Adequacy of Haemodialysis in UK Renal Centres in 2008: national and centre-specific analyses

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Key Words
Haemodialysis · Adequacy · Urea reduction ratio

Abstract
Background: Outcome in patients treated with haemodialysis (HD) is influenced by the delivered dose of dialysis. The UK Renal Association (RA) publishes Clinical Practice Guidelines which include recommendations for dialysis dose. The urea reduction ratio (URR) is a widely used measure of dialysis dose. ***Aim:*** To determine the extent to which patients received the recommended dose of HD in the UK. ***Methods:*** Seventy-two renal centres in the UK submit data electronically to the UK Renal Registry (UKRR). Two groups of patients were included in the analyses: the prevalent patient population on 31st December 2008 and the incident patient population for 2008. Centres returning data on <50% of their patient population were excluded from centre-specific comparisons. ***Results:*** Data regarding URR were available from 62 renal centres in the UK. Fifty-one centres provided URR data on more than 90% of prevalent patients. There has been an increase from 56% in 1998 to 83% in 2008 in the proportion of patients in the UK who met the UK Clinical Practice Guideline for URR (>65%). There was considerable variation from one centre to another, with 9 centres attaining the RA clinical practice guideline in >90% of patients and 5 centres attaining the standard in <70% of patients. The HD dose (URR) delivered to patients who had just started dialysis treatment was lower than that of patients who had been treated for longer and increased further with time. ***Conclusions:*** The delivered dose of HD for patients with established renal failure has increased over 10 years. Whilst the large majority of patients in the UK achieved the target URR there was considerable variation between centres in the percentage of patients achieving this.

Introduction

Amongst patients with established renal failure the delivered dose of HD is an important predictor of outcome [1] which has been shown to influence survival [2–4]. It depends on treatment (duration and frequency of dialysis, dialyser size, dialysate and blood flow rate) and patient (size, weight, haematocrit and vascular access) characteristics [5]. The two widely accepted measures of urea clearance are Kt/V, the ratio between the product of urea clearance (K, in ml/min) and dialysis session duration (t, in minutes) divided by the volume of distribution of urea in the body (V, in ml); and URR,

derived solely from the percentage fall in serum urea (URR) during a dialysis treatment. Kt/V takes into account the contribution of ultrafiltration to urea clearance and is therefore a more accurate descriptor of urea clearance. However, accurate calculation of Kt/V requires iterative computerised modelling [6] and although it can be estimated using one of several formulae [7], these all require additional data items over and above pre- and post-dialysis urea concentration, including the duration of the dialysis treatment and the ultrafiltration volume. URR has been shown to correlate with survival even though it does not take account of the contribution made by residual renal function and ultrafiltration to urea clearance [2, 3].

Further analysis of the data [8] from the National Cooperative Dialysis Study [1] suggested that outcome was improved by maintaining a Kt/V greater than 1.2. However, the HEMO study [9] suggested that there was no benefit accrued by increasing HD dose further. In that study, survival of patients undergoing thrice weekly HD in whom a URR of 75% (equilibrated Kt/V of 1.45) was achieved was not significantly better than in those who had a URR of 65% (equilibrated Kt/V of 1.05), suggesting that there was a 'ceiling effect' to the survival benefit of higher dialysis doses when achieved using thrice weekly haemodialysis.

Based on published evidence, clinical practice guidelines have been developed by various national and regional organisations (www.kdigo.org). There is considerable uniformity between them with regard to the recommendations for minimum dose of dialysis although there are differences in the methodology advised [10–13].

A recent survey undertaken by the Quality European Studies (QUEST) initiative has reported that URR is the most common method used to assess small solute removal in HD patients in Europe with equilibrated Kt/V being used in a minority of centres [14].

The UKRR is part of the RA and provides audit and analysis of renal replacement therapy in the UK. It receives quarterly electronic extracts covering a range of data items from information systems within each renal centre. As most centres do not report duration of dialysis or weight loss during dialysis, the UKRR has chosen URR rather than Kt/V for comparative audit of haemodialysis adequacy.

Several centres in the UK now use online measurement of ionic dialysance to measure clearance of small molecules during HD relying on studies that have demonstrated a close linear relationship between this measure and conventional measures of urea clearance [15, 16]. However, the UKRR strongly encourages these centres to continue to perform and report conventional pre- and post-dialysis measurements of blood urea concentration at least on a 3-monthly basis to allow comparative audit.

The main objective of this study was to determine the extent to which patients undergoing HD treatment for established renal failure in the UK received the dose of HD recommended in the UK RA clinical practice guidelines [11].

Methods

Seventy-two renal centres in the UK submit data electronically to the UKRR on a quarterly basis [17]. The majority of these centres have satellite units but for the purposes of this study the data from the renal centres and their associated satellite units were amalgamated. Two groups of patients were included in the analyses. Firstly, analysis was undertaken using data from the prevalent HD patient population on 31st December 2008. For this analysis, data for URR were taken from the last quarter of 2008 unless that data point was missing in which case data from the 3rd quarter were taken. As the prevalent population only included those patients alive on December 31st, data from those patients who had died before that date have not been included in the analysis. The second analysis involved the patients who had started treatment with HD (incident patient population) during 2008. For these patients, analysis was undertaken using the last recorded URR during the quarter in which the patient had started dialysis. Data from patients known to be receiving more or less than thrice weekly HD were omitted from analysis. However, because not all centres report frequency of HD, it is possible that data from a small number of patients receiving HD less or more frequently than thrice weekly were included in the analyses.

Analysis of the data from both groups of patients included calculation of the median URR and of the proportion of patients who had achieved the RA standard (as outlined below) in each of the renal centres as well as for the country as a whole.

All patients with data were included in the statistical analysis at a national level, although centres with fewer than 20 patients, or providing less than 50% data completeness were excluded from the comparison between centres.

The UK RA Clinical Practice Guidelines [11] in operation at the time these data were collected were as follows:

HD should take place at least three times per week in nearly all patients. Reduction of dialysis frequency to twice per week because of insufficient dialysis facilities is unacceptable.

Every patient receiving thrice weekly HD should have consistently:

- ***either URR >65%***
- ***or equilibrated Kt/V (eKt/V) of >1.2 (or single pool Kt/V of >1.3) calculated from pre- and post-dialysis urea values, duration of dialysis and weight loss during dialysis).***

To achieve a URR above 65% or eKt/V above 1.2 consistently in the vast majority of the haemodialysis population clinicians should aim for a minimum target URR of 70% or minimum eKt/V of 1.4 in individual patients.

The duration of thrice weekly HD in adult patients with minimal residual renal function should not be reduced below 4 hours without careful consideration.

Patients receiving dialysis twice weekly for reasons of geography should receive a higher sessional dose of dialysis. If this cannot be achieved, then it should be recognised that there is a compromise between the practicalities of dialysis and the patient's long-term health.

Measurement of the 'dose' or 'adequacy' of HD should be performed monthly in all hospital HD patients and may be performed less frequently in home HD patients. All dialysis units should collect and report this data to their regional network and the UKRR.

Post-dialysis blood samples should be collected either by the slow-flow method, the simplified stop-flow method, or the stop dialysate flow method. The method used should remain consistent within renal units and should be reported to the Registry.

The RA clinical practice guidelines for HD dose apply specifically to patients undergoing thrice weekly HD. In these patients it is recommended that blood for biochemical measurement (including pre-dialysis urea for URR) should be taken before the mid week dialysis session [11].

A potentially confounding factor is the methodology used for taking the post dialysis blood sample. Advice given to renal centres following a postal survey in 2002 [18] aimed to achieve uniformity and this was reflected in the RA standards [19]. These recommended that the post dialysis blood samples should be collected either by the stop flow method, the simplified stop flow method or the stop-dialysate-flow method. No reliable data were available to clarify whether the important variations in post-dialysis sampling methodology that were identified at that time persist.

Table 8.1. Percentage completeness of URR data returns

Centre	% complete	Centre	% complete
Abrdn	97	L Rfree	0
Airdrie	99	L St.G	0
Antrim	98	L West	0
B Heart	94	Leeds	97
B QEH	96	Leic	98
Bangor	97	Liv Ain	93
Basldn	99	Liv RI	92
Belfast	94	M Hope	57
Bradfd	88	M RI	0
Brightn	0	Middlbr	95
Bristol	99	Newc	0
Camb	38	Newry	99
Cardff	90	Norwch	97
Carlis	99	Nottm	97
Carsh	94	Oxford	69
Chelms	91	Plymth	95
Clwyd	91	Ports	97
Colchr	100	Prestn	81
Covnt	96	Redng	96
D&Gall	96	Sheff	96
Derby	99	Shrew	92
Derry	98	Stevng	96
Donc	100	Sthend	96
Dorset	98	Stoke	0
Dudley	79	Sund	98
Dundee	0	Swanse	97
Dunfn	94	Truro	98
Edinb	98	Tyrone	99
Exeter	99	Ulster	99
Glasgw	97	Wirral	36
Glouc	99	Wolve	76
Hull	96	Wrexm	98
Inverns	98	York	92
Ipswi	100	**England**	**67**
Kent	80	**N Ireland**	**97**
Klmarnk	94	**Scotland**	**88**
L Barts	0	**Wales**	**93**
L Guys	89	**UK**	**71**
L Kings	0		

Results

Data completeness

Data regarding HD dose (URR) were available from 62 of the 72 renal centres which submitted data to the UKRR (table 8.1). Data were available for 71% (13,191) of the total prevalent population (18,520) treated with HD who met the inclusion criteria for these analyses. However it was available for 92% of the prevalent HD patients treated in one of the 62 units providing any data for URR (14,407). Of the total incident patient population (4,526) starting HD during 2008 there were data available for URR for 2,278 (50%) patients during the 3 months after they had started treatment.

Fifty-one centres submitted data on more than 90% of prevalent patients treated with HD. Nine centres were included in the analysis but returned data from less than 90% of patients – Bradford (88.3%), Cardiff (89.6%), Dudley (78.8%), Kent (79.9%), L Guys (89.2%), Manchester Hope (57.4%), Oxford (68.9%), Preston (80.6%) and Wolverhampton (75.6%). Two centres (Cambridge and Wirral) reporting on less than 50% of prevalent patients were not included in the centre level analyses although the patients were included in the national analyses. URR data were not received from ten centres (Brighton, Dundee, London Barts,

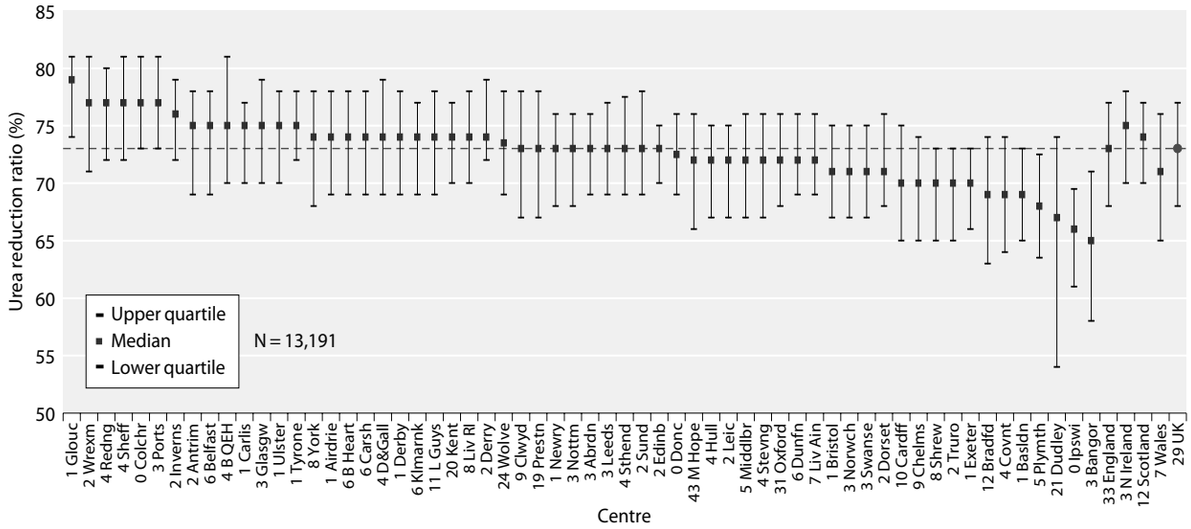

Fig. 8.1. Median URR achieved in prevalent patients in each centre, 2008

London Kings, London Royal Free, London St Georges, London West, Manchester Royal Infirmary, Newcastle and Stoke). The number preceding the centre name in each figure indicates the percentage of missing data from that centre.

Thirty-three centres submitted data regarding URR within 3 months of starting HD on more than 20 patients, representing more than 50% of their incident patient population.

Achieved URR

For prevalent patients, the median URR (73% for UK; centre range 65%–79%) and percentage (83% for UK; centre range 46%–95%) attaining the RA standard of a URR >65% from 60 renal centres are shown in figures 8.1 and 8.2. Figure 8.3 illustrates the close relationship between the two. With one exception (Edinburgh; median URR 73%) all 9 centres which attained the RA standard in more than 90% of patients had a median URR of 75% or more. All centres which achieved a URR >65% in at least 80% of patients had a median URR of at least 70%. The 3 centres with a median URR of 67% or less achieved the RA standard for HD dose in less than 55% of their patients. There was considerable variation from one centre to another, with 9 centres attaining the RA clinical practice guideline

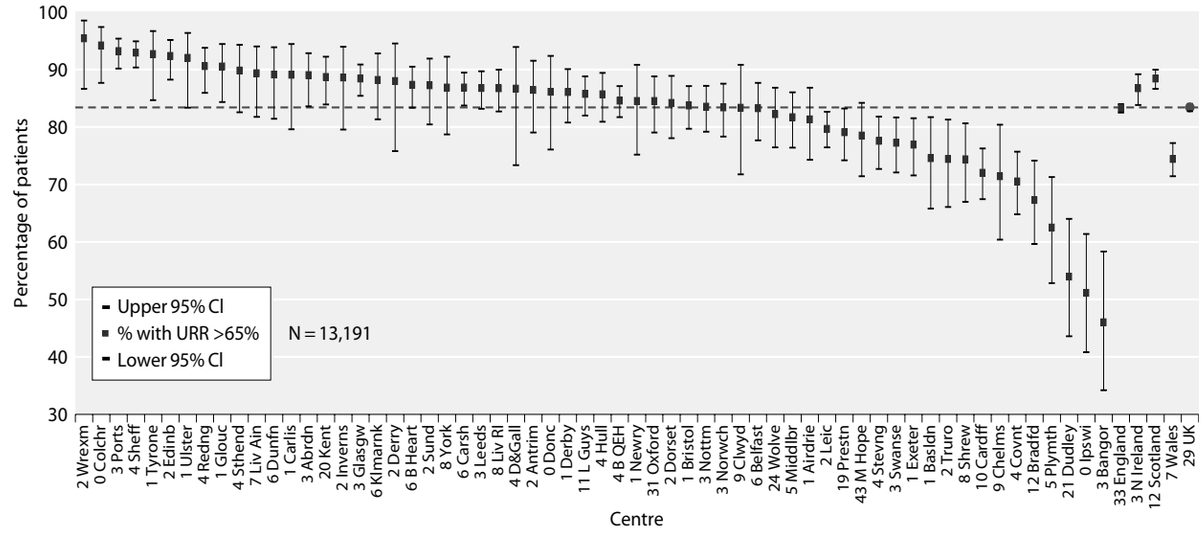

Fig. 8.2. Percentage of prevalent patients with URR >65% in each centre, 2008

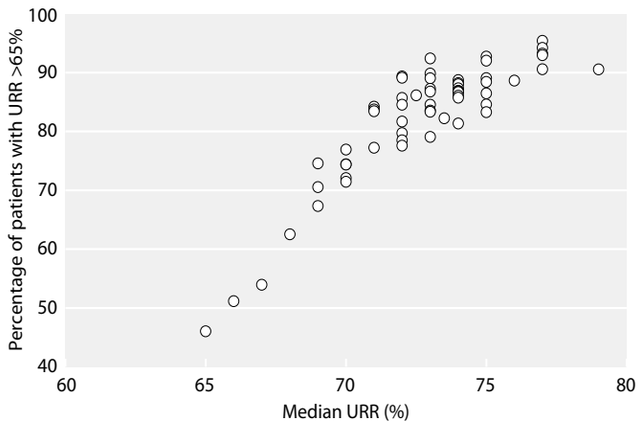

Fig. 8.3. Relationship between achievement of the Renal Association standard for URR and the median URR in each centre, 2008

in >90% of patients and 5 centres attaining the standard in <70% of patients.

Changes in URR over time

The change in the percentage attainment of the RA clinical practice guidelines (URR >65%) and the median URR for the UK from 1998 to 2008 are shown in figure 8.4. Northern Ireland has provided data since 2005 and is included in these analyses.

The proportion of patients attaining the RA standard has increased from 56% to 83% whilst the median URR has risen from 67% to 73% during the same time period.

Variation of achieved URR with time on dialysis

The proportion of patients who attained the RA standard for HD adequacy increased in line with the time since those patients started HD (figure 8.5). Of those dialysed for less than 6 months, 68% had a URR >65% whilst 87% of patients who had been dialysed for more than two years attained the standard in 2008.

The median URR during the first quarter after starting HD treatment of the incident HD population in the UK in 2008 was 65% (figure 8.6).

Discussion

The dose of delivered HD is widely recognised as having an important influence on outcome in patients treated with chronic HD. Although data regarding URR were only available to the UKRR on 71% of the total prevalent UK HD population they were available from 92% of the prevalent patient population treated in any one of 62 of the 72 renal centres which had provided any data. In some of those centres providing data, failure to achieve 100% data return was likely to have arisen in part from a lack of electronic linkage between satellite units and the main renal centre database.

The proportion of patients achieving the RA standard for URR has increased steadily during the 10 years since 1998. This observation is also consistent when patients are grouped on the basis of length of time since starting HD treatment. Over 80% of patients in the UK achieved the target of a URR >65% and of patients who had been treated with HD for more than 2 years 87% achieved the target. The figure for patients during the first 6 months after starting treatment was lower (68%) but in these

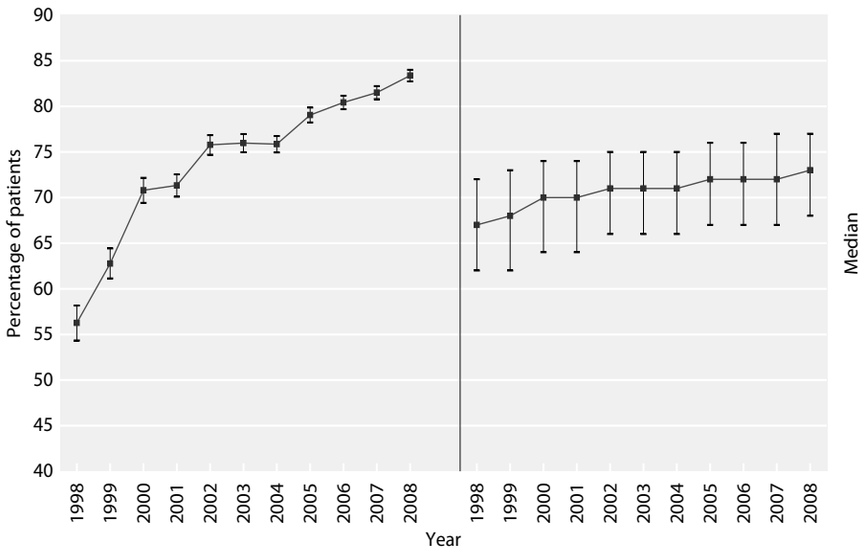

Fig 8.4. Change in the percentage of patients with URR >65% and the median URR between 1998 and 2008 in the UK

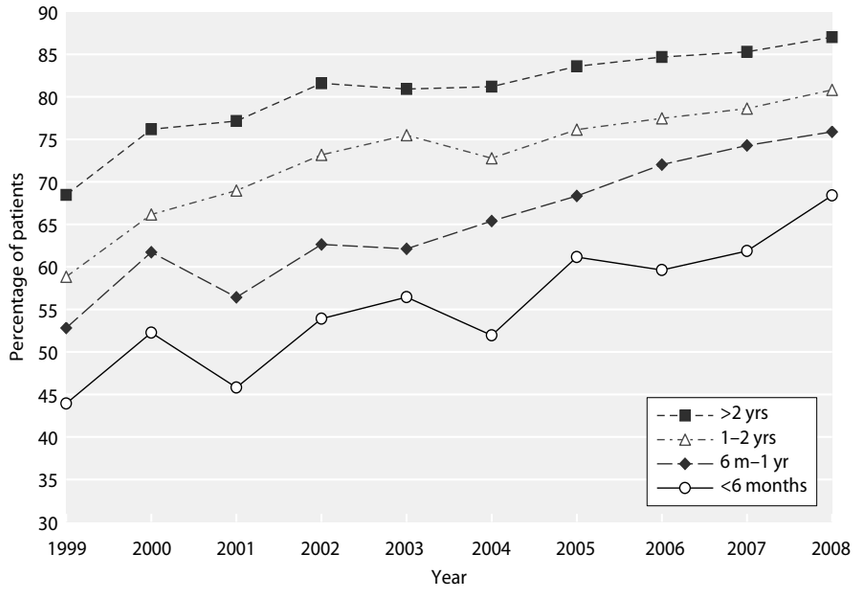

Fig 8.5. Percentage of prevalent haemodialysis patients achieving URR >65% against duration on haemodialysis between 1999 and 2008

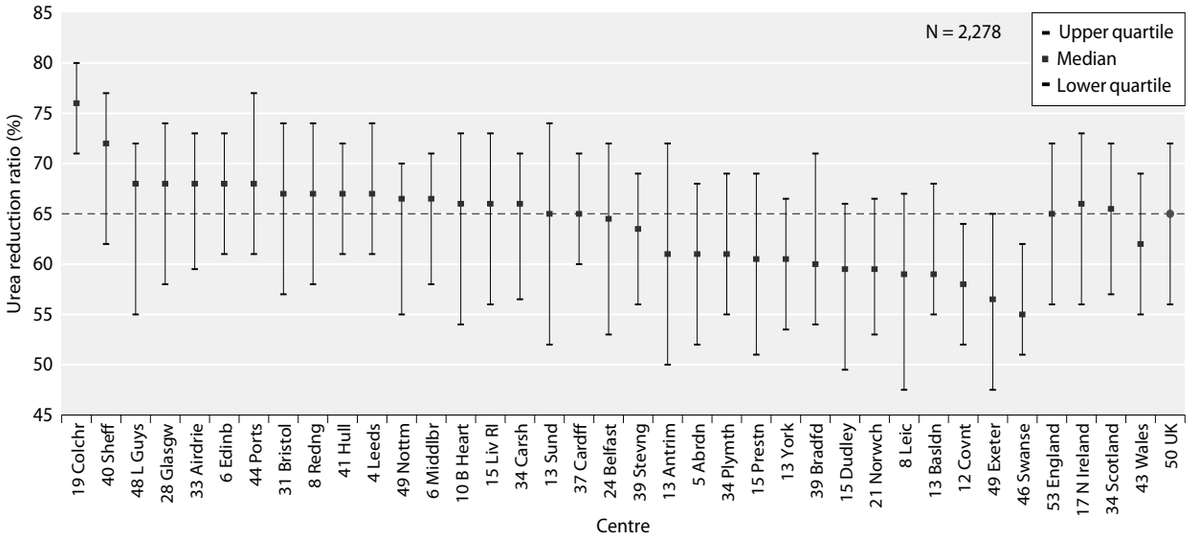

Fig 8.6. Median URR in the first quarter after starting RRT in patients who started haemodialysis in 2008

patients a high proportion will have residual renal function to compensate.

There was a wide range (46%–95%) of achievement of the RA standard (URR >65%) between different centres which is likely to reflect genuine differences in HD dose although inconsistency in sampling methodology for the post dialysis urea sample may play a part [18]. Duration of HD sessions has been shown to have a major influence and current UK RA clinical practice guidelines recommend that ***'the duration of thrice weekly HD in adult patients with minimum residual function should not be reduced below 4 hours without careful consideration'.***

The median URR of patients undergoing HD in the UK in 2008 was 73% (centre range of 65%–79%). In order to consistently achieve a URR >65% the UK RA clinical practice guidelines recommend that clinicians should aim for a minimum target URR of 70% and this approach is supported by the findings in this study. Those units which achieved the UK RA standard in more than 90% of patients had a median URR of 73% or more.

Furthermore, recent studies have suggested that prescription of a target Kt/V of 1.2 in females and small males underestimates the required dose [20]. These observations support the K-DOQI guidelines for HD which advise an increase in the minimum dialysis dose target for women and small men [21] and are reflected in the advice given in the UK RA Clinical Practice Guidelines [11].

The use of urea clearance for measurement of HD dose is criticised by some [22] arguing that outcome is improved by longer treatment time independently of urea removal [5, 23–27] and that clearance of 'middle molecules' has an important impact [28, 29]. Furthermore, residual renal function can improve outcome in incremental HD despite reduced dialysis dose [30] although preservation of residual renal function should not be seen as a primary goal [31].

However, no consensus has yet emerged on alternative markers of HD dose and whilst this is the case the UKRR will continue to audit HD adequacy on the basis of urea clearance as assessed by URR.

Conflict of interest: none

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Chapter 9
Anaemia Variables in UK Adult Dialysis Patients in 2008: national and centre-specific analyses

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Key Words
Anaemia · Chronic kidney disease · Dialysis · End stage renal disease · Epidemiology · Erythropoietin · Ferritin · Haemoglobin · Quality improvement · Renal Registry

Abstract
Background: The UK Renal Association (RA) and National Institute for Health and Clinical Excellence (NICE) have published Clinical Practice Guidelines which include recommendations for management of anaemia in established renal failure. ***Aims:*** To determine the extent to which the guidelines for anaemia management are met in the UK. ***Methods:*** Quarterly data (haemoglobin (Hb) and factors that influence Hb) extracts from renal centres in England, Wales, Northern Ireland (EWNI), and annual data from the Scottish Renal Registry for incident and prevalent renal replacement therapy (RRT) cohorts for 2008 were analysed by the UK Renal Registry (UKRR). ***Results:*** In the UK, in 2008 57% of patients commenced dialysis therapy with Hb $\geqslant$10.0 g/dl (median Hb 10.2 g/dl). For incident patients the Hb at 3 and 6 months of dialysis treatment was 11.4 and 11.7 g/dl respectively. The median Hb of haemodialysis (HD) patients was 11.6 g/dl with an interquartile range (IQR) of 10.6–12.5 g/dl. Of HD patients 85% had a Hb $\geqslant$10.0 g/dl. The median Hb of peritoneal dialysis (PD) patients in the UK was 11.7 g/dl (IQR 10.8–12.6 g/dl). Of UK PD patients 89% had a Hb $\geqslant$10.0 g/dl. The median ferritin in HD patients in EWNI was 436 μg/L (IQR 289–622) and 95% of HD patients had a ferritin $\geqslant$100 μg/L. The median ferritin in PD patients was 246 μg/L (IQR 141–399) with 84% of PD patients having a ferritin $\geqslant$100 μg/L. In EWNI the mean ESA dose was higher for HD than PD patients (9,166 vs. 6,302 IU/week). ***Conclusions:*** Last year for the first time a small fall (from 85.9% in 2006 to 85.6% in 2007) in the % of HD patients with a Hb of $\geqslant$10 g/dl which was thought to be related to the implementation of the new Hb Standard which has a target range of 10.5–12.5 g/dl was seen. This year attainment of Hb $\geqslant$10 g/dl in HD patients fell again slightly to 85.3%. In HD patients, 54% of patients had a Hb $\geqslant$10.5 and $\leqslant$12.5 g/dl compared with 53% in the 2008 Report.

Introduction

This chapter describes data reported to the UKRR relating to management of renal anaemia in dialysis patients during 2008. The chapter reports outcomes of submitted variables and analyses of these variables in the context of established guidelines and recommendations.

The renal National Service Framework (NSF) part one [1] and the RA minimum standards document 3rd edition [2] state that individuals with chronic kidney disease (CKD) should achieve a Hb of at least 10 g/dl within 6 months of being seen by a nephrologist, unless there is a specific reason why it could not be achieved. The UKRR does not collect a Hb specifically from patients 6 months after meeting a nephrologist. Some indication of the standard comes from the Hb of the incident patient population (i.e. the Hb at the start of dialysis).

The European Best Practice Guidelines (EBPG) [3] set a minimum target of 11 g/dl but suggest not to go higher than 12 g/dl in severe cardiovascular disease. The United States Kidney Disease Outcomes Quality Initiative (KDOQI) [4] guidelines set a target Hb range of 11–12 g/dl with a recommendation that the Hb target should not be greater than 13.0 g/dl. The NICE guidelines published in 2006 [5] and the 4th edition of the RA Clinical Practice Guidelines 2006 [6] recommended an outcome Hb of between 10.5 and 12.5 g/dl (with ESA dose changes considered at 11 and 12 g/dl) which allows for the difficulty in consistently narrowing the distribution to between 11 and 12 g/dl. The 2008 UKRR Annual Report reported how the attempt to comply with both the 10.5–12.5 g/dl range and the minimum standard of Hb $\geqslant$10.0 g/dl impacted on performance against a combination of measures. The risks associated with low (<10 g/dl) and high (>13 g/dl) Hb are not necessarily equivalent.

National and international recommendations for target iron status in CKD remained unchanged from the 2006 UKRR Annual Report. The 2007 Renal Association (RA) Clinical Practice Guidelines Document, revised European Best Practice Guidelines (EBPGII), Dialysis Outcomes Quality Initiative (DOQI) guidelines and UK NICE anaemia guidelines all recommend a target serum ferritin greater than 100 µg/L and percentage transferrin saturation (TSAT) of more than 20% in patients with CKD. RA guidelines and EBPGII recommend hypochromic red cells (HRC) less than 10%. In addition, EBPGII recommends a target reticulocyte Hb content (CHr) greater than 29 pg/cell. KDOQI recommends a serum ferritin >200 µg/L for HD patients. The NICE guidelines suggest that a hypochromic red cell value >6% suggests ongoing iron deficiency.

To achieve adequate iron status across a patient population, RA guidelines and EBPGII advocate population target medians for ferritin of 200–500 µg/L, for TSAT of 30–40%, for hypochromic red cells of <2.5% and CHr of 35 pg/cell. EBPGII comments that a serum ferritin target for the treatment population of 200–500 µg/L ensures that 85–90% of patients attain a serum ferritin of 100 µg/L.

All guidelines advise that serum ferritin levels should not exceed 800 µg/L since the potential risk of toxicity increases without conferring additional benefit. The KDOQI and NICE guidelines advise against intravenous iron administration to patients with a ferritin >500 µg/L.

Serum ferritin has some disadvantages as an index of iron status. It measures storage iron rather than available iron, behaves as an acute phase reactant and is therefore increased in inflammatory states, malignancy and liver disease and may not accurately reflect iron stores if measured within a week of the administration of intravenous iron. Of the alternative measures of iron status available, HRC and CHr are generally considered superior to TSAT. Both however require specialised analysers to which few UK renal centres have easy access. Since TSAT is measured infrequently in many centres and most UK centres continue to use serum ferritin for routine iron management, ferritin remains the chosen index of iron status for this report.

Methods

The incident and prevalent RRT cohorts for 2008 were analysed. The UKRR extracted quarterly data electronically from renal centres in England, Wales and Northern Ireland, and quarterly data were sent in a single annual extract from the Scottish Renal Registry. Patients receiving dialysis on 31st December 2008 were included in the prevalent analysis if they had been on the same modality of dialysis in the same centre for 3 months. The last available measurement of Hb from each patient from the last two quarters of 2008 was used for analysis. Patients were analysed as a complete cohort and divided by modality into groups.

For the incident patient analyses, data from the first quarter after starting dialysis was used. Patients commencing RRT on PD or HD were included. Those receiving a pre-emptive transplant were excluded.

The last available ferritin measurement was taken from the last three quarters of the year and analysed for prevalent patients. Scotland is excluded from the analysis as data regarding ferritin is not included in its return.

The completeness of data items were analysed at both centre and country level. All patients were included in analyses but centres with less than 50% completeness were excluded from the caterpillar and funnel plots showing centre performance. Centres providing relevant data from less than 20 patients were also excluded from the plots. The number preceding the centre name in each figure indicates the percentage of missing data for that centre.

The data were analysed to calculate summary statistics. These were maximum, minimum and average (mean and median)

values. Standard deviations and quartile ranges were also found. These data are represented as caterpillar plots showing median values and quartile ranges.

The percentage achieving RA and other standards was also calculated for Hb. The percentage of patients achieving serum ferritin $\geqslant 100\,\mu g/L$, $\geqslant 200\,\mu g/L$ and $\geqslant 800\,\mu g/L$ were also calculated. These are represented as caterpillar plots with 95% confidence intervals shown. For the percentage achieving standards, chi-squared values have also been calculated to identify significant variability between centres and between nations.

Longitudinal analysis has also been done to calculate overall changes in achievement of standards from 1998 to 2008.

The UK RA Clinical Practice [2, 6] and NICE [5] guidelines in operation at the time these data were collected were as follows:

Patients with CKD should achieve a Hb of at least 10 g/dl within 6 months of being seen by a nephrologist, unless there is a specific reason why it could not be achieved.

Patients with CKD treated with RRT should have a Hb of between 10.5 and 12.5 g/dl.

Patients with CKD should have a serum ferritin greater than 100 μg/L and percentage transferrin saturation (TSAT) of more than 20%.

Serum ferritin levels in patients with CKD should not exceed 800 μg/L.

Data regarding ESAs were collected from all renal centres. Centres were excluded if there was <90% completeness of ESA data. Centres reporting fewer than 70% of HD patients or fewer than 50% of PD patients treated with ESAs, were considered to have incomplete data and were also excluded from further analysis. It is recognised that these exclusion criteria are relatively arbitrary but are in part based upon the frequency distribution graph of centres' doses. The UK percentage of patients on ESAs is calculated from these data and incomplete data returns risk seriously impacting on any conclusions drawn. Scotland is excluded from the analysis as data regarding ESA is not included in its return.

Data are presented as weekly erythropoietin dose. Doses of darbepoietin were harmonised with erythropoietin data by multiplying by 200 and correcting for frequency of administration less than weekly. No adjustments were made with respect to route of administration.

The ESA data were collected electronically from renal IT systems but in contrast to laboratory linked variables the ESA dose required manual data entry. The reliability depended upon who entered the data, whether the entry was linked to the prescription or whether the prescriptions were provided by the primary care physician. In the latter case doses may not be as reliably updated as the link between data entry and prescription is indirect.

Results

Haemoglobin

Haemoglobin in incident dialysis patients

The Hb at the time of starting RRT gives the only indication of concordance with current anaemia management recommendations in the pre-dialysis (CKD 5 – not yet on dialysis) group.

Patients for conservative care of established renal failure were by definition excluded from the dataset. Patients were similarly excluded if they received a pre-emptive transplant. The UKRR plans to collect and report CKD 5 data from patients who subsequently commence RRT as well as those managed conservatively.

The percentage of data returned and outcome Hb are listed in table 9.1. Eight of the nine renal centres excluded from inclusion in this analysis are relatively small centres which had submitted data on fewer than 20 patients.

The median Hb of patients at the time of starting dialysis in the UK was 10.2 g/dl with 57% of patients having a Hb $\geqslant 10.0$ g/dl (vs. 58% for 2008 report). The variation between centres remained high (29–84%).

There were six centres with noticeably lower median Hb for new patients compared with last year. For five of these (Basildon, Belfast, Kilmarnock, Wolverhampton and York) this year's 95% CI for the percentage with Hb >10 g/dl overlaps with the centre's 95% CI from last year. For the other centre (Middlesbrough) the lower confidence limit from 2007 is exactly the same as the upper limit from 2008.

The median starting Hb by centre is shown in figure 9.1 and the percentage starting with a Hb $\geqslant 10.0$ g/dl by centre is given in figure 9.2. The distribution of Hb in incident dialysis patients during 2008 is shown in figure 9.3. The median Hb and the percentage of incident dialysis patients in 2007 with Hb $\geqslant 10.0$ g/dl by time on dialysis are shown in figures 9.4 and 9.5.

The annual distribution (figure 9.6) of Hb in incident dialysis patients has remained relatively stable since 2002, although there has been a reduction in the proportion of patients with Hb $\geqslant 12.0$ g/dl in 2008.

Haemoglobin in prevalent haemodialysis patients

The compliance with data returns and Hb outcome for prevalent HD patients in the 72 UK renal centres are shown in table 9.2.

The median Hb of patients on HD in the UK was 11.6 g/dl with an IQR of 10.6–12.5 g/dl. In the UK, 85% of HD patients had a Hb $\geqslant 10.0$ g/dl. The median Hb by centre, compliance with the previous UK minimum standard of Hb $\geqslant 10.0$ g/dl and EBPG standard of Hb $\geqslant 11.0$ g/dl are shown in figures 9.7, 9.8 and 9.9 respectively. The distribution of Hb in HD patients by centre is shown in figure 9.10. The compliance with the NICE and RA Clinical Practice Guidelines recommended range of 10.5–12.5 g/dl is shown in figure 9.11. The majority of centres complied well with respect to both outcomes but it was possible to

Table 9.1. Haemoglobin data for new patients starting haemodialysis or peritoneal dialysis during 2008

Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	% Hb ⩾10 g/dl
Abrdn	100	10.1	8.4–11.9	9.4–10.9	56
Airdrie	84	10.2	8.7–11.9	9.4–11.1	56
Antrim	94	10.1	7.7–12.8	8.9–10.9	50
B Heart	96	10.1	7.4–12.7	9.1–11.3	53
B QEH	70	10.0	7.2–13.0	8.9–11.0	50
Bangor	97	9.7	7.5–12.0	8.8–10.7	43
Basldn	95	9.7	7.1–12.2	9.3–10.6	42
Belfast	85	9.4	7.1–11.7	8.0–10.9	43
Bradfd	98	10.1	7.5–13.2	9.2–11.0	59
Brightn	99	10.2	7.9–13.4	9.3–11.4	59
Bristol	99	10.0	7.2–13.0	9.0–11.1	52
Camb	82	10.3	8.2–13.0	9.6–11.3	60
Cardff	98	10.5	7.9–13.0	9.4–11.3	64
Carlis	100	10.6	8.8–14.3	9.6–11.4	67
Carsh	96	10.1	8.1–12.6	9.3–11.1	57
Chelms	100	10.9	8.9–13.6	9.7–11.5	68
Clwyd	77				
Colchr	81	11.2	9.0–13.5	10.3–12.3	84
Covnt	98	10.0	8.0–13.4	9.4–11.1	54
D & Gall	89				
Derby	96	10.6	8.6–13.2	9.5–11.7	65
Derry	100				
Donc	96	10.2	7.6–13.0	9.4–11.0	52
Dorset	91	10.8	8.6–12.6	9.6–11.8	66
Dudley	98	9.9	7.5–12.7	8.4–10.9	48
Dundee	54	10.1	8.3–13.6	9.1–11.2	54
Dunfn	28				
Edinb	84	10.5	7.5–12.8	9.4–11.4	58
Exeter	100	10.1	7.6–12.5	9.3–11.0	53
Glasgw	97	9.5	7.7–12.1	8.6–10.6	39
Glouc	100	10.2	8.1–12.6	9.4–11.3	57
Hull	87	9.9	7.1–12.6	8.7–10.9	49
Inverns	75				
Ipswi	95	10.0	8.8–12.4	9.4–10.7	51
Kent	99	10.1	7.9–12.2	9.0–11.0	52
Klmarnk	79	10.0	8.7–13.2	9.5–11.5	57
L Barts	99	10.0	7.1–13.2	8.7–11.4	50
L Guys	65	10.2	7.9–12.5	8.9–11.3	53
L Kings	93	9.9	8.2–11.9	9.1–11.0	47
L Rfree	93	10.1	7.8–12.9	9.1–11.2	52
L St.G	97	10.5	8.3–13.1	9.8–11.7	68
L West	44				
Leeds	100	10.3	8.0–13.2	9.1–11.1	57
Leic	99	10.1	8.2–12.8	9.2–11.1	54
Liv Ain	90	9.4	7.2–11.6	8.7–10.0	29
Liv RI	99	11.1	8.1–12.7	9.5–11.9	71
M Hope	75	10.2	7.3–13.8	8.9–11.4	53
M RI	94	10.4	7.9–13.2	9.2–11.6	60
Middlbr	99	9.1	6.3–12.2	8.3–10.7	33
Newc	98	10.3	7.2–13.3	9.1–11.8	58
Newry	95				
Norwch	96	10.2	7.4–12.3	9.2–11.3	56
Nottm	99	9.9	7.6–13.2	9.2–11.4	49
Oxford	100	10.5	7.8–12.8	9.1–11.3	60
Plymth	65	11.3	8.5–14.2	10.4–12.1	79
Ports	100	10.4	7.9–13.4	9.4–11.4	61
Prestn	95	10.0	7.5–12.9	8.8–11.1	52
Redng	100	9.9	7.9–12.4	9.0–10.8	49
Sheff	100	10.4	8.0–12.8	9.5–11.3	61
Shrew	95	10.5	7.9–13.1	9.7–11.5	69

Table 9.1. Continued

Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	% Hb ⩾10 g/dl
Stevng	99	10.6	8.2–13.9	9.4–11.6	64
Sthend	100	10.3	7.3–12.6	9.3–11.0	56
Stoke	100	10.3	7.8–13.3	9.0–11.6	59
Sund	100	10.6	8.4–12.2	9.3–11.5	61
Swanse	97	10.9	7.8–13.5	9.7–11.7	72
Truro	100	10.6	8.8–14.1	9.6–12.1	67
Tyrone	96	10.3	8.3–12.7	9.1–11.3	61
Ulster	100				
Wirral	83	10.2	8.6–13.4	9.3–11.1	61
Wolve	100	9.9	7.3–12.7	9.0–10.8	46
Wrexm	100				
York	93	9.7	6.6–14.7	8.6–10.7	44
England	**91**	**10.2**	**7.8–12.9**	**9.2–11.3**	**56**
N Ireland	**92**	**10.1**	**7.4–12.7**	**8.8–11.1**	**53**
Scotland	**82**	**10.0**	**8.0–12.7**	**9.1–11.1**	**52**
Wales	**97**	**10.6**	**7.8–13.0**	**9.4–11.5**	**65**
UK	**91**	**10.2**	**7.8–12.9**	**9.2–11.3**	**57**

Blank cells = centres excluded from analyses due to poor data completeness or low patient numbers

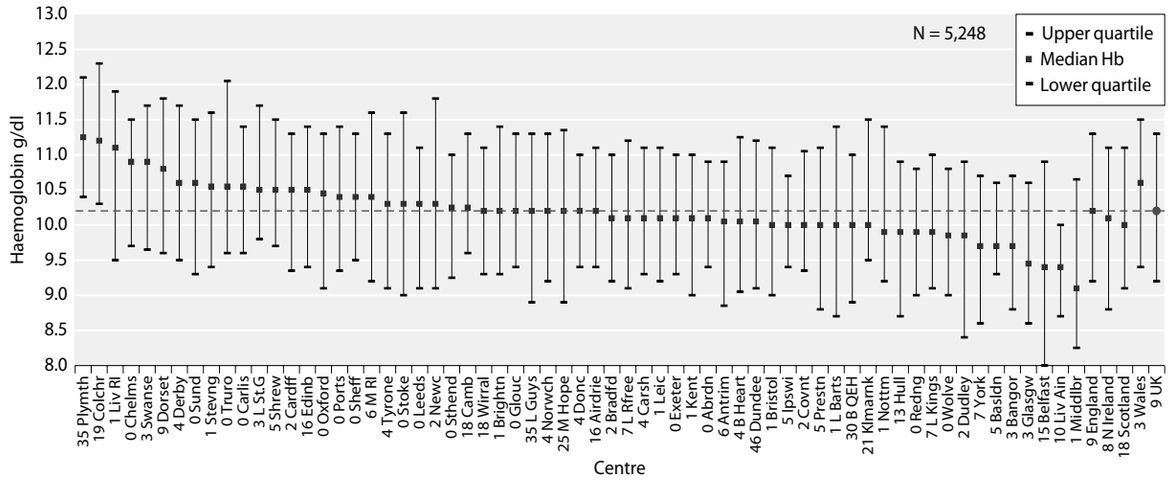

Fig. 9.1. Median haemoglobin for incident dialysis patients at start of dialysis treatment in 2008

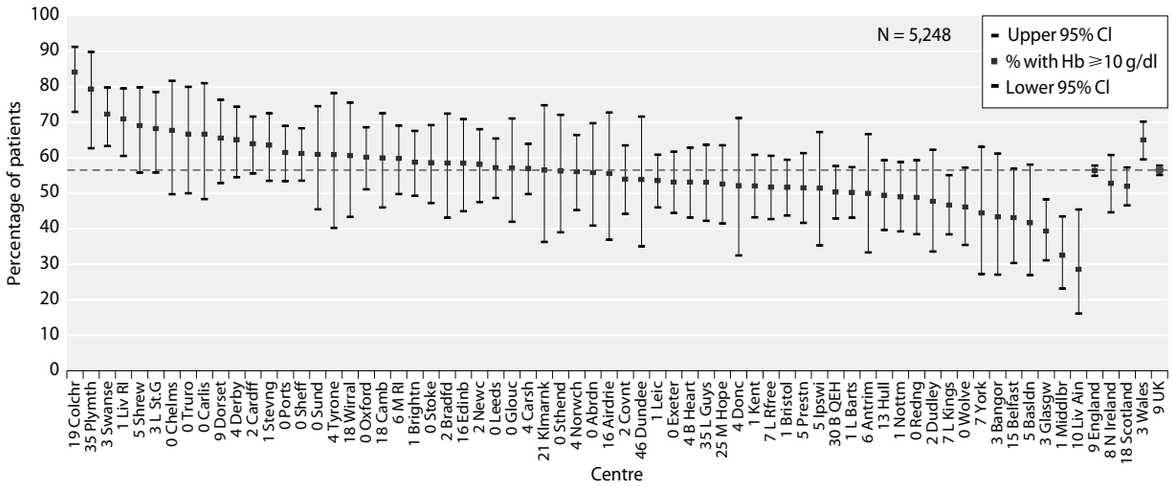

Fig. 9.2. Percentage of incident dialysis patients with Hb ⩾10 g/dl at start of dialysis treatment in 2008

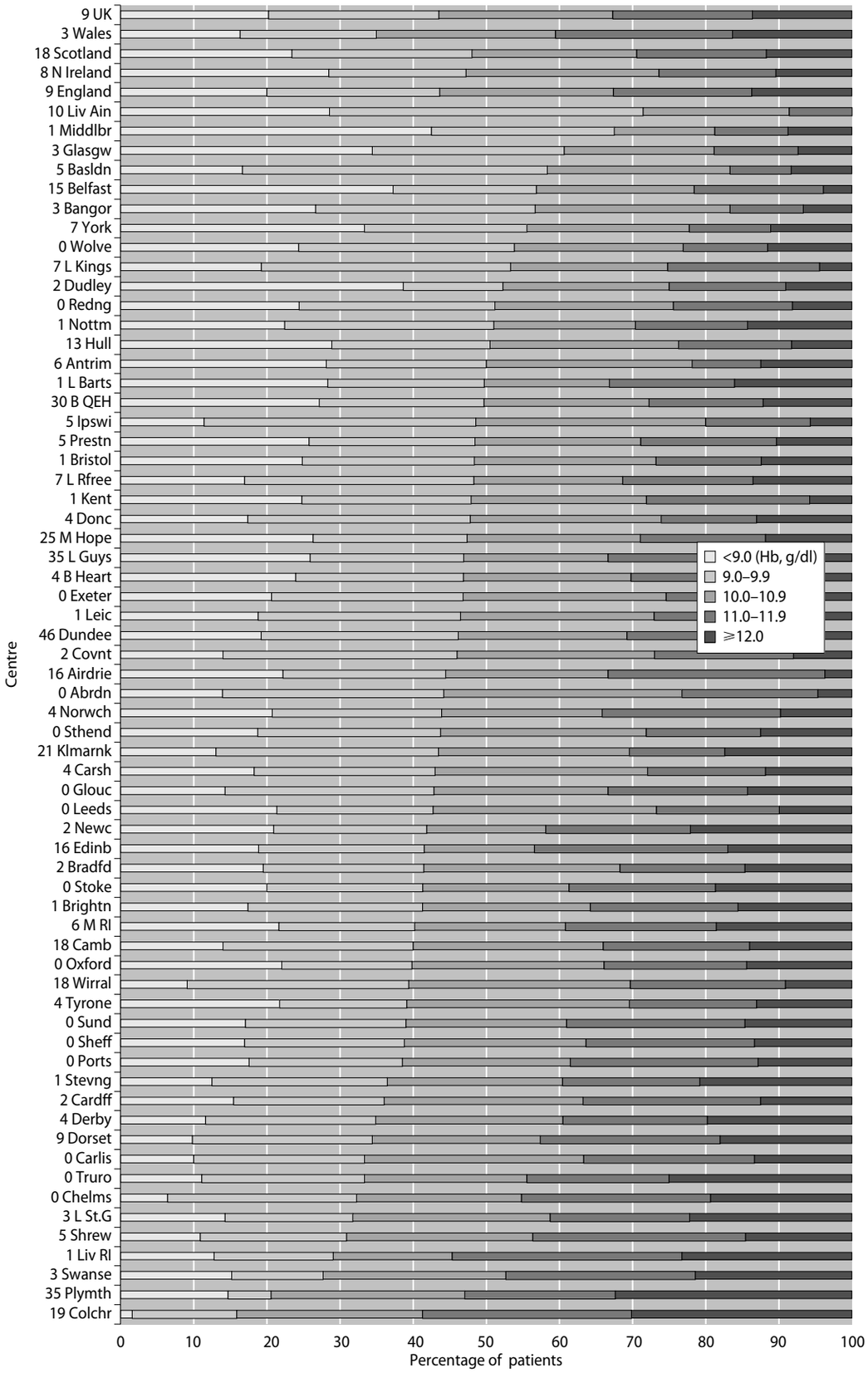

Fig. 9.3. Distribution of haemoglobin in incident dialysis patients at start of dialysis treatment in 2008

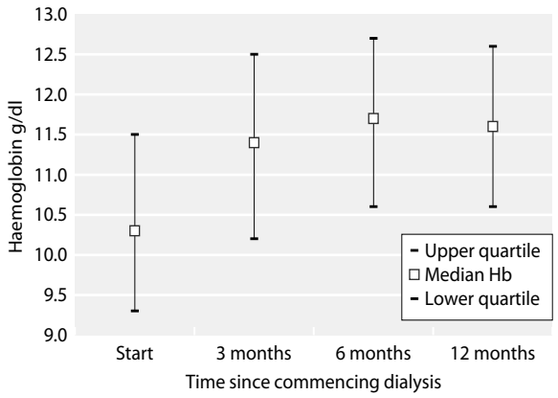

Fig. 9.4. Median haemoglobin, by time on dialysis, for incident dialysis patients in 2007

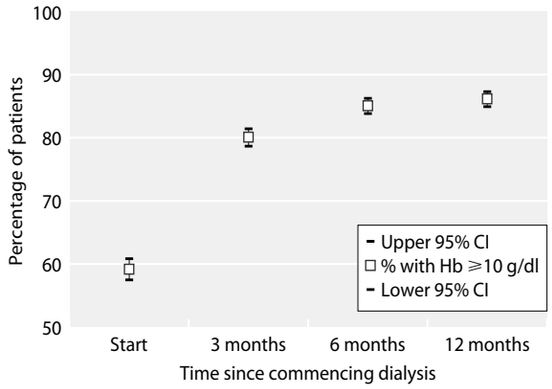

Fig. 9.5. Percentage of incident dialysis patients in 2007 with Hb ⩾10 g/dl, by time on dialysis

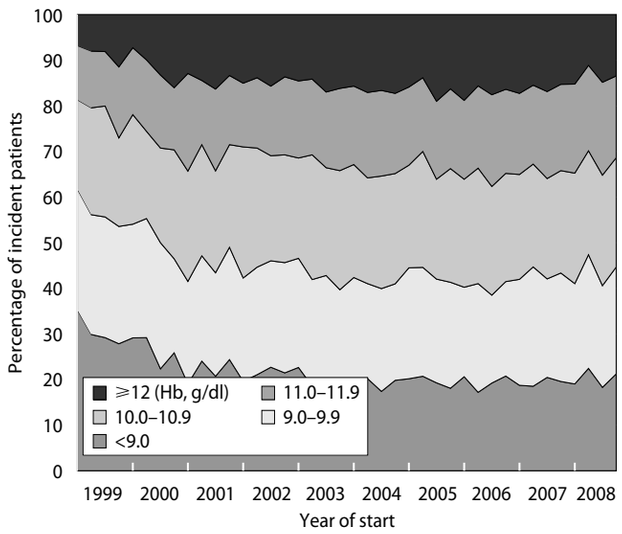

Fig. 9.6. Distribution of haemoglobin in incident dialysis patients by year of start

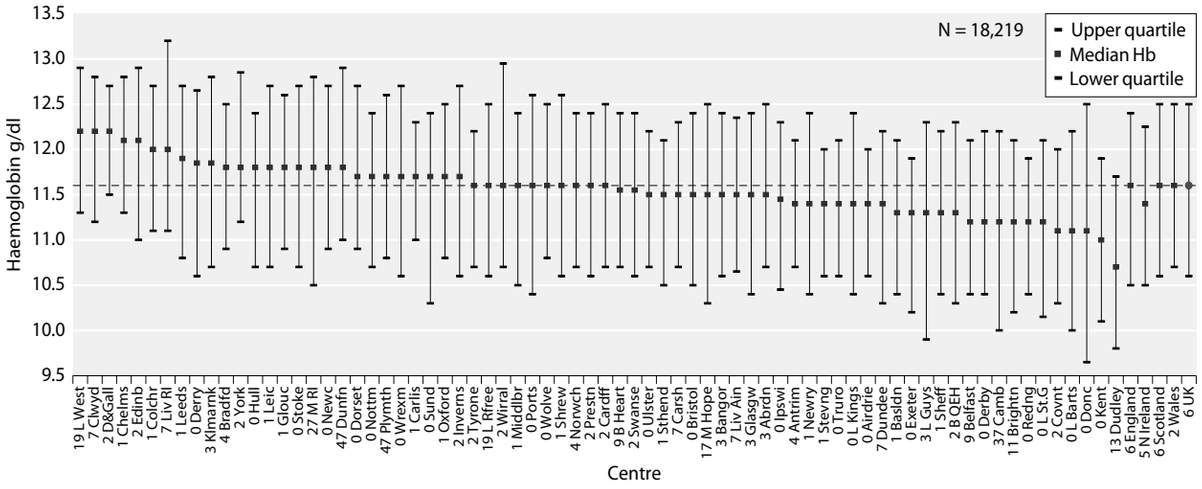

Fig. 9.7. Median haemoglobin in patients treated with HD

Table 9.2. Haemoglobin data for prevalent HD patients

Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10 g/dl	% with Hb ⩾11 g/dl
Abrdn	97	11.5	9.5–13.7	10.7–12.5	11.6	1.3	91	65
Airdrie	100	11.4	9.5–13.0	10.6–12.0	11.3	1.1	89	70
Antrim	96	11.4	8.7–13.9	10.7–12.1	11.3	1.5	84	63
B Heart	91	11.6	8.7–14.0	10.7–12.4	11.5	1.5	86	69
B QEH	98	11.3	8.2–13.7	10.3–12.3	11.2	1.6	80	58
Bangor	97	11.5	8.7–14.3	10.6–12.4	11.5	1.8	87	62
Basldn	99	11.3	8.9–13.4	10.4–12.1	11.3	1.4	86	64
Belfast	91	11.2	8.7–13.7	10.4–12.1	11.2	1.5	82	61
Bradfd	96	11.8	9.7–14.0	10.9–12.5	11.8	1.3	92	73
Brightn	89	11.2	8.7–13.5	10.2–12.1	11.2	1.5	80	56
Bristol	100	11.5	8.7–13.9	10.5–12.4	11.5	1.5	85	66
Camb	63	11.2	8.9–13.5	10.0–12.2	11.1	1.5	77	56
Cardff	98	11.6	9.0–14.0	10.7–12.5	11.6	1.5	86	67
Carlis	99	11.7	9.5–13.3	11.0–12.3	11.6	1.1	91	76
Carsh	93	11.5	9.2–13.4	10.7–12.3	11.5	1.3	89	67
Chelms	99	12.1	9.1–13.8	11.3–12.8	12.0	1.4	91	84
Clwyd	93	12.2	10.0–13.4	11.2–12.8	12.0	1.1	95	83
Colchr	99	12.0	9.3–14.0	11.1–12.7	11.9	1.4	90	77
Covnt	98	11.1	8.9–13.6	10.3–12.0	11.2	1.4	83	54
D & Gall	98	12.2	9.4–14.0	11.5–12.7	12.0	1.4	91	83
Derby	100	11.2	9.1–13.9	10.4–12.2	11.4	1.5	85	60
Derry	100	11.9	9.7–13.3	10.6–12.7	11.6	1.2	87	65
Donc	100	11.1	8.3–13.9	9.7–12.5	11.1	1.8	72	51
Dorset	100	11.7	9.3–13.9	10.9–12.7	11.7	1.4	89	74
Dudley	87	10.7	8.2–14.0	9.8–11.7	10.8	1.7	69	41
Dundee	93	11.4	8.6–13.8	10.3–12.2	11.3	1.5	81	61
Dunfn	53	11.8	9.2–14.8	11.0–12.9	12.0	1.5	91	79
Edinb	98	12.1	9.1–14.2	11.0–12.9	11.9	1.6	88	76
Exeter	100	11.3	8.8–13.0	10.2–11.9	11.1	1.2	79	60
Glasgw	97	11.5	9.0–13.8	10.4–12.4	11.4	1.5	83	63
Glouc	99	11.8	8.9–14.0	10.9–12.6	11.7	1.5	89	73
Hull	100	11.8	9.0–13.8	10.7–12.4	11.6	1.5	88	70
Inverns	98	11.7	9.3–14.4	10.6–12.7	11.7	1.6	90	66
Ipswi	100	11.5	9.4–13.2	10.5–12.3	11.3	1.2	86	60
Kent	100	11.0	8.7–13.3	10.1–11.9	11.0	1.4	77	52
Klmarnk	97	11.9	9.1–14.3	10.7–12.8	11.7	1.5	86	72
L Barts	100	11.1	8.0–13.5	10.0–12.2	11.0	1.7	75	54
L Guys	97	11.3	8.3–13.7	9.9–12.3	11.1	1.6	74	56
L Kings	100	11.4	8.8–13.4	10.4–12.4	11.3	1.4	82	63
L Rfree	81	11.6	8.6–13.9	10.6–12.5	11.5	1.6	85	67
L St.G	100	11.2	9.0–13.1	10.2–12.1	11.2	1.4	82	57
L West	81	12.2	9.9–13.9	11.3–12.9	12.1	1.2	95	82
Leeds	99	11.9	8.9–14.1	10.8–12.7	11.8	1.5	88	72
Leic	99	11.8	8.8–14.1	10.7–12.7	11.7	1.6	86	72
Liv Ain	93	11.5	9.1–13.6	10.7–12.4	11.4	1.4	86	68
Liv RI	93	12.0	9.4–14.5	11.1–13.2	12.0	1.6	93	77
M Hope	83	11.5	8.7–13.7	10.3–12.5	11.4	1.6	83	61
M RI	73	11.8	8.6–14.4	10.5–12.8	11.8	1.8	85	71
Middlbr	99	11.6	8.8–13.7	10.5–12.4	11.5	1.5	87	66

Table 9.2. Continued

Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10 g/dl	% with Hb ⩾11 g/dl
Newc	100	11.8	9.1–14.2	10.9–12.7	11.7	1.5	87	74
Newry	99	11.4	8.6–13.6	10.4–12.4	11.3	1.5	79	62
Norwch	96	11.6	9.3–13.5	10.7–12.4	11.5	1.3	89	69
Nottm	100	11.7	9.1–13.7	10.7–12.4	11.5	1.4	86	70
Oxford	99	11.7	9.1–13.8	10.8–12.5	11.6	1.5	87	68
Plymth	53	11.7	9.5–14.4	10.8–12.6	11.8	1.4	93	71
Ports	100	11.6	8.7–13.9	10.4–12.6	11.5	1.6	83	66
Prestn	98	11.6	9.1–13.7	10.6–12.4	11.5	1.5	88	66
Redng	100	11.2	8.8–13.2	10.4–11.9	11.2	1.3	83	59
Sheff	99	11.3	9.0–13.5	10.4–12.2	11.3	1.4	83	62
Shrew	99	11.6	9.2–13.5	10.6–12.6	11.5	1.3	89	67
Stevng	99	11.4	9.1–13.2	10.6–12.0	11.3	1.2	87	64
Sthend	99	11.5	9.2–12.9	10.5–12.1	11.3	1.2	87	64
Stoke	100	11.8	9.0–13.6	10.7–12.7	11.6	1.5	86	69
Sund	100	11.7	8.5–13.4	10.3–12.4	11.4	1.5	81	67
Swanse	98	11.6	8.9–13.6	10.6–12.4	11.4	1.4	88	66
Truro	100	11.4	9.4–13.2	10.6–12.1	11.4	1.2	89	68
Tyrone	98	11.6	9.6–13.5	10.7–12.2	11.4	1.2	88	66
Ulster	100	11.5	9.8–13.6	10.7–12.2	11.5	1.2	92	65
Wirral	98	11.6	8.8–14.2	10.7–13.0	11.7	1.6	88	69
Wolve	100	11.6	8.9–14.1	10.8–12.5	11.6	1.5	89	71
Wrexm	100	11.7	9.5–13.7	10.6–12.7	11.6	1.4	90	66
York	98	11.8	9.9–13.9	11.2–12.9	11.9	1.3	93	80
England	**94**	**11.6**	**8.9–13.8**	**10.5–12.4**	**11.5**	**1.5**	**85**	**66**
N Ireland	**95**	**11.4**	**8.8–13.6**	**10.5–12.3**	**11.3**	**1.4**	**84**	**63**
Scotland	**94**	**11.6**	**9.1–13.9**	**10.6–12.5**	**11.6**	**1.5**	**86**	**68**
Wales	**98**	**11.6**	**9.0–13.8**	**10.7–12.5**	**11.5**	**1.5**	**88**	**67**
UK	**94**	**11.6**	**8.9–13.8**	**10.6–12.5**	**11.5**	**1.5**	**85**	**66**

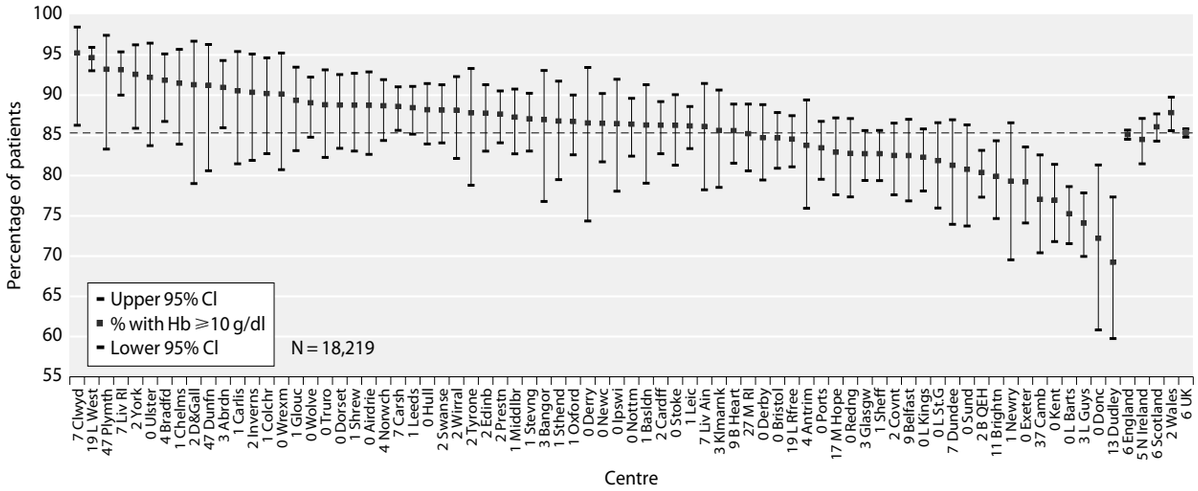

Fig. 9.8. Percentage of HD patients with Hb ⩾10 g/dl

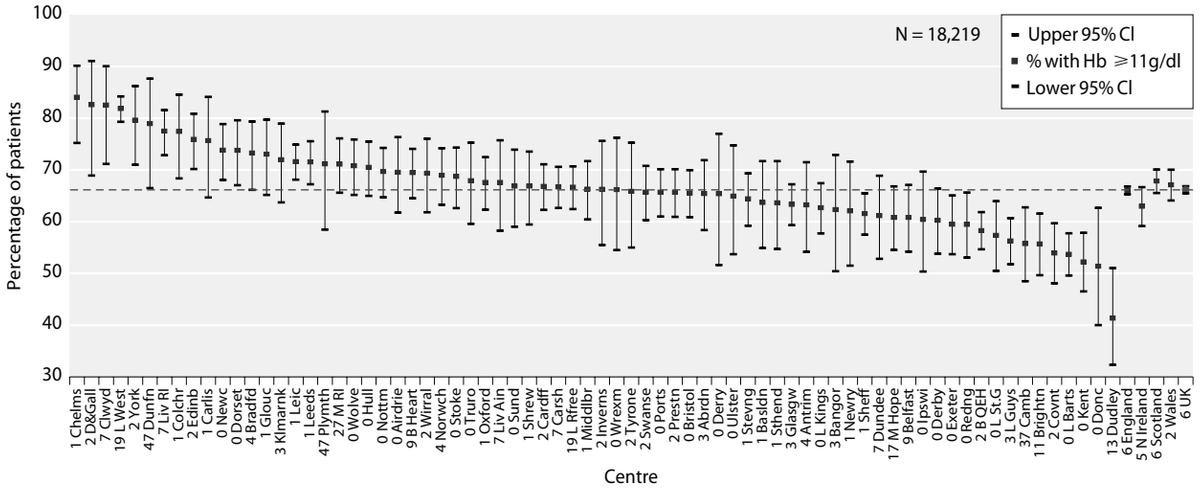

Fig. 9.9. Percentage of HD patients with Hb ⩾11 g/dl

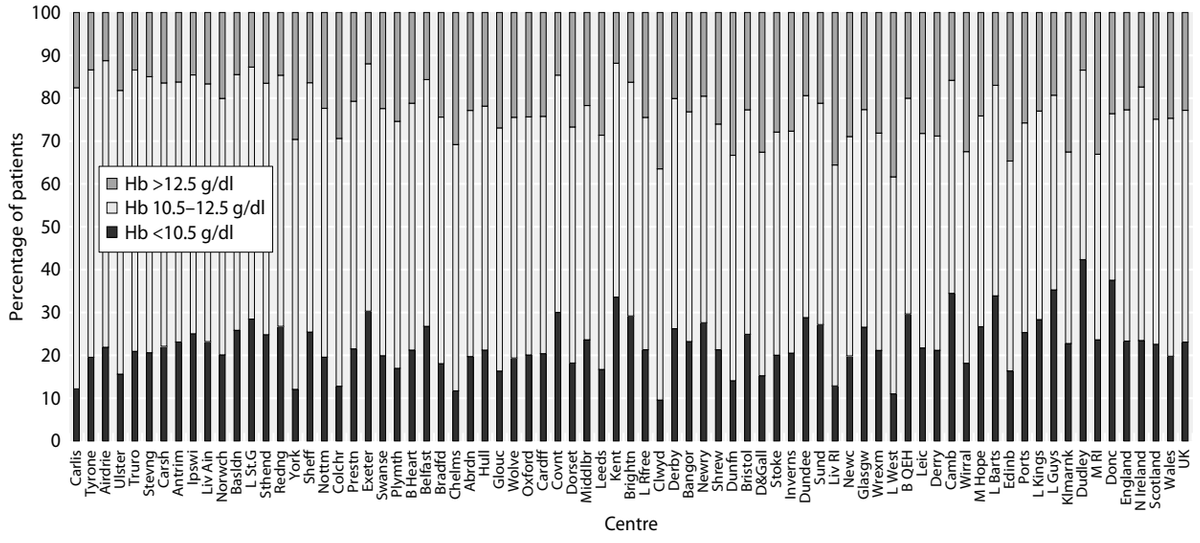

Fig. 9.10. Distribution of haemoglobin in patients treated with HD

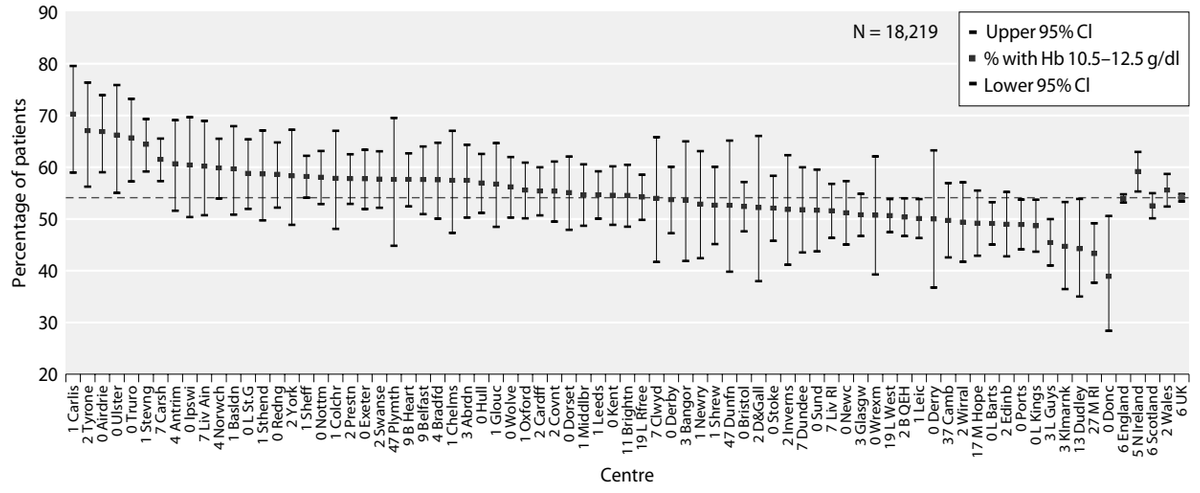

Fig. 9.11. Percentage of HD patients with Hb ⩾10.5 and ⩽12.5 g/dl

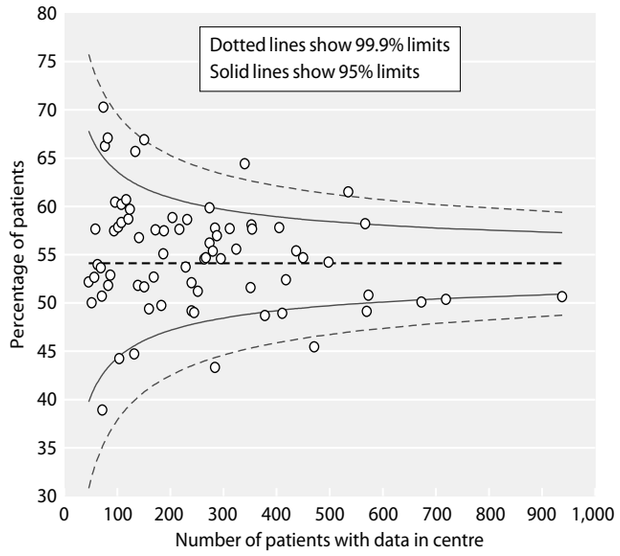

Fig. 9.12. Funnel plot of percentage of HD patients with Hb $\geqslant$10.5 and $\leqslant$12.5 g/dl

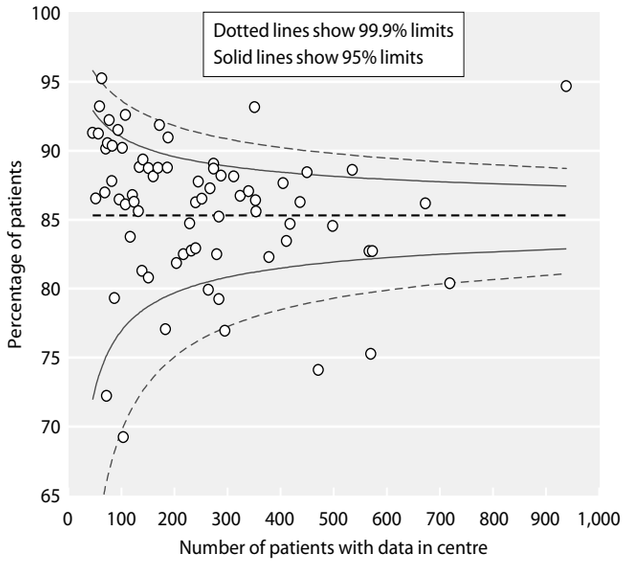

Fig. 9.13. Funnel plot of percentage of HD patients with Hb $\geqslant$10 g/dl

fall within 2–3 SDs of the mean in the funnel plot (figure 9.12) for a percentage of patients with Hb $\geqslant$10.5 and $\leqslant$12.5 g/dl and yet have a poor compliance with percentage of Hb $\geqslant$10.0 g/dl (figure 9.13). This demonstrates that compliance with one standard (Hb $\geqslant$10.5 and $\leqslant$12.5 g/dl) can be achieved without compliance with another standard (Hb $\geqslant$10.0 g/dl). Figures 9.12 and 9.13 should be used in conjunction with table 9.3 to identify centres.

Haemoglobin in prevalent peritoneal dialysis patients

In the UK 89% of patients on PD had a Hb $\geqslant$10.0 g/dl (table 9.4). The median Hb of patients on PD in the UK was 11.7 g/dl with an IQR of 10.8–12.6 g/dl. The median Hb by centre, compliance with the UK minimum standard Hb $\geqslant$10.0 g/dl and EBPG Hb $\geqslant$11.0 g/dl are shown in figures 9.14, 9.15 and 9.16 respectively. The compliance with recommended range Hb $\geqslant$10.5 and $\leqslant$12.5 g/dl (NICE & RA) is shown in figure 9.17. The distribution of Hb in PD patients by centre is shown in figure 9.18. The funnel plot for percentage Hb $\geqslant$10.0 g/dl is shown in figure 9.19 which can be used in conjunction with table 9.5 to identify centres.

Table 9.3. Percentage of HD patients achieving Hb ⩾10 g/dl and Hb 10.5–12.5 g/dl

Centre	N with Hb	% with Hb ⩾10 g/dl	% Hb 10.5–12.5 g/dl	Centre	N with Hb	% with Hb ⩾10 g/dl	% Hb 10.5–12.5 g/dl
D & Gall	46	91	52	Derby	229	85	54
Derry	52	87	50	Redng	232	83	59
Dunfn	57	91	53	M Hope	240	83	49
Plymth	59	93	58	Stoke	240	86	52
Clwyd	63	95	54	Edinb	245	88	49
Bangor	69	87	54	Newc	252	87	51
Wrexm	71	90	51	Brightn	264	80	55
Donc	72	72	39	Middlbr	267	87	55
Carlis	74	91	70	Norwch	274	89	60
Ulster	77	92	66	Wolve	274	89	56
Tyrone	82	88	67	Covnt	280	83	55
Inverns	83	90	52	Exeter	284	79	58
Newry	87	79	53	M RI	284	85	**43**
Chelms	94	91	57	Hull	288	88	57
Ipswi	96	86	60	Kent	295	**77**	55
Colchr	102	90	58	Swanse	312	88	58
Dudley	104	**69**	44	Oxford	324	87	56
Liv Ain	108	86	60	Stevng	340	87	64
York	108	93	58	Liv RI	351	93	52
Antrim	117	84	61	Nottm	353	86	58
Sthend	121	87	59	B Heart	354	86	58
Basldn	124	86	60	L Kings	378	82	49
Klmarnk	132	86	45	Prestn	405	88	58
Truro	134	89	66	Ports	411	83	49
Dundee	139	81	52	Bristol	418	85	52
Glouc	141	89	57	Cardff	437	86	55
Airdrie	151	89	67	Leeds	450	88	55
Sund	151	81	52	L Guys	471	**74**	**45**
Wirral	160	88	49	L Rfree	498	85	54
Shrew	169	89	53	Carsh	535	89	62
Bradfd	172	92	58	Sheff	567	83	58
Camb	183	77	50	L Barts	570	**75**	49
Dorset	187	89	55	Glasgw	573	83	51
Abrdn	188	91	57	Leic	673	86	50
L St.G	204	82	59	B QEH	719	80	50
Belfast	217	82	58	L West	938	95	51

Entries in bold text lie below the lower 99.9% confidence limit in the funnel plot

Table 9.4. Haemoglobin data for prevalent PD patients

Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10 g/dl	% with Hb ⩾11 g/dl
Abrdn	94	12.2	10.3–14.6	11.1–13.1	12.1	1.4	97	84
Airdrie	100							
Antrim	88							
B Heart	100	11.5	9.8–14.3	10.9–12.2	11.5	1.2	89	68
B QEH	86	11.6	8.6–14.2	10.5–12.7	11.6	1.6	87	69
Bangor	100	11.9	10.1–13.7	11.4–12.4	11.9	1.1	97	83
Basldn	100	11.3	9.3–14.7	10.6–12.5	11.5	1.5	87	57
Belfast	98	11.4	7.7–13.5	10.8–12.5	11.3	1.7	84	67
Bradfd	100	11.6	8.9–13.5	10.4–12.2	11.4	1.4	81	66
Brightn	100	12.1	9.9–14.2	11.1–13.1	12.1	1.4	95	79
Bristol	100	12.2	8.7–14.8	11.0–13.3	12.1	1.7	90	76
Camb	100	12.1	10.2–13.9	11.0–12.6	11.9	1.2	98	78
Cardff	100	11.8	9.8–14.5	10.9–12.9	12.0	1.6	93	73
Carlis	100							
Carsh	96	11.4	8.8–14.2	10.6–12.2	11.5	1.4	86	67
Chelms	100	11.9	9.0–13.7	11.1–13.0	12.0	1.3	95	82
Clwyd	80							
Colchr	n/a							
Covnt	96	11.8	9.8–14.5	10.8–12.8	11.8	1.4	93	68
D & Gall	100							
Derby	100	11.5	9.7–14.6	10.7–12.7	11.7	1.5	89	65
Derry	100							
Donc	97	11.7	9.7–13.7	11.2–12.6	11.8	1.3	89	81
Dorset	98	12.2	9.3–13.8	11.1–12.8	12.0	1.3	94	80
Dudley	98	12.2	9.2–14.6	10.8–13.4	12.1	1.8	85	72
Dundee	100	12.6	10.8–15.2	12.1–13.5	12.9	1.4	100	91
Dunfn	96	12.0	10.7–14.0	11.5–12.5	12.1	1.0	100	88
Edinb	97	11.3	8.5–13.8	10.2–12.6	11.4	1.6	83	63
Exeter	100	11.6	9.5–13.4	10.9–12.4	11.6	1.4	90	75
Glasgw	97	11.7	9.2–13.9	10.9–12.7	11.7	1.3	90	75
Glouc	100	11.4	9.3–12.7	10.7–11.9	11.4	1.0	94	73
Hull	99	11.7	9.2–15.7	10.9–12.9	11.9	1.8	92	73
Inverns	4							
Ipswi	98	11.5	8.5–13.1	10.9–12.5	11.4	1.4	88	69
Kent	99	11.5	9.1–13.2	10.7–12.2	11.4	1.3	85	66
Klmarnk	98	11.4	8.9–13.7	10.6–12.1	11.3	1.5	79	72
L Barts	100	11.8	8.5–14.0	10.9–12.7	11.7	1.7	86	72
L Guys	98	11.6	9.4–13.7	10.9–12.1	11.6	1.3	92	73
L Kings	100	11.7	9.1–13.1	10.9–12.2	11.5	1.1	90	74
L Rfree	71	11.1	8.6–13.3	10.3–12.0	11.1	1.4	83	55
L St.G	98	11.8	9.1–14.1	11.1–12.5	11.8	1.6	92	78
L West	100	11.7	9.6–13.4	10.8–12.6	11.7	1.3	90	74
Leeds	99	12.0	9.3–14.2	11.1–13.0	12.0	1.7	91	81
Leic	99	11.3	8.1–14.5	10.4–12.6	11.4	1.8	83	62
Liv Ain	50							
Liv RI	87	11.8	9.6–14.3	10.8–12.7	11.8	1.4	87	72
M Hope	97	11.4	8.4–14.8	10.0–12.3	11.3	1.9	76	58
M RI	100	11.5	8.3–14.1	10.3–12.4	11.4	1.7	82	66
Middlbr	91	11.8	9.0–13.2	11.0–12.1	11.5	1.2	85	75

Table 9.4. Continued

Centre	% data return	Median Hb g/dl	90% range	Inter-quartile range	Mean Hb g/dl	Standard deviation	% with Hb ⩾10 g/dl	% with Hb ⩾11 g/dl
Newc	98	11.3	9.1–13.0	10.6–12.5	11.3	1.4	84	66
Newry	100							
Norwch	93	12.0	9.9–15.5	11.3–13.2	12.3	1.7	95	85
Nottm	99	11.4	9.3–14.0	10.5–12.2	11.4	1.5	88	63
Oxford	100	11.8	9.3–14.0	10.9–12.8	11.8	1.5	91	74
Plymth	93	12.3	10.6–14.3	11.2–13.0	12.2	1.3	95	83
Ports	99	12.1	8.6–14.0	10.9–12.9	11.8	1.6	89	73
Prestn	100	11.3	8.8–13.7	10.6–12.4	11.4	1.4	84	71
Redng	100	11.6	9.2–13.8	10.8–12.5	11.6	1.4	88	68
Sheff	100	11.9	8.5–13.7	10.9–12.6	11.7	1.5	92	72
Shrew	94	11.8	9.1–13.9	11.2–12.8	11.8	1.4	90	83
Stevng	97	11.7	9.8–15.0	10.9–12.8	11.9	1.4	92	75
Sthend	93							
Stoke	100	11.5	9.4–14.3	10.8–12.6	11.6	1.5	92	69
Sund	100	12.0	11.0–14.6	11.6–13.5	12.4	1.2	100	95
Swanse	98	12.1	9.4–14.9	11.3–12.9	12.1	1.4	95	81
Truro	100	12.2	10.1–13.6	11.1–12.5	12.0	1.0	96	88
Tyrone	100							
Ulster	100							
Wirral	74	12.4	9.5–14.0	11.8–13.3	12.2	1.6	88	80
Wolve	100	11.8	9.3–14.2	10.7–12.9	11.8	1.5	91	70
Wrexm	95	11.6	8.2–13.9	11.2–12.5	11.6	1.7	90	81
York	100							
England	**97**	**11.7**	**9.1–14.1**	**10.8–12.6**	**11.7**	**1.5**	**88**	**71**
N Ireland	**97**	**12.0**	**8.2–13.6**	**10.9–12.5**	**11.6**	**1.6**	**90**	**72**
Scotland	**88**	**11.9**	**9.3–14.1**	**11.0–12.7**	**11.8**	**1.5**	**90**	**76**
Wales	**98**	**11.9**	**9.8–14.4**	**11.1–12.8**	**12.0**	**1.5**	**94**	**78**
UK	**96**	**11.7**	**9.1–14.1**	**10.8–12.6**	**11.7**	**1.5**	**89**	**72**

Blank cells = centres excluded from analyses due to poor data completeness or low patient numbers
n/a = not applicable

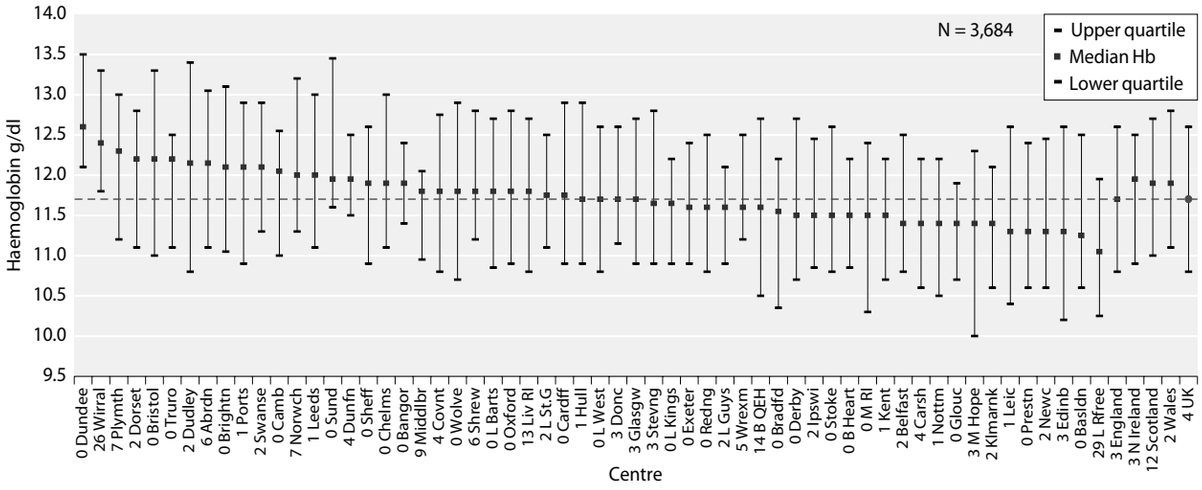

Fig. 9.14. Median haemoglobin in patients treated with PD

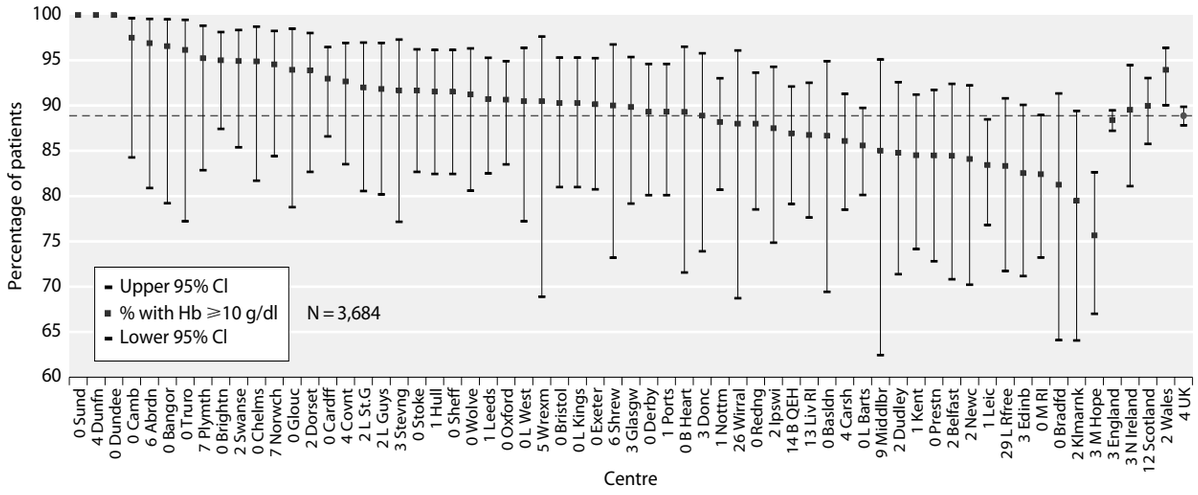

Fig. 9.15. Percentage of PD patients with Hb ⩾10 g/dl

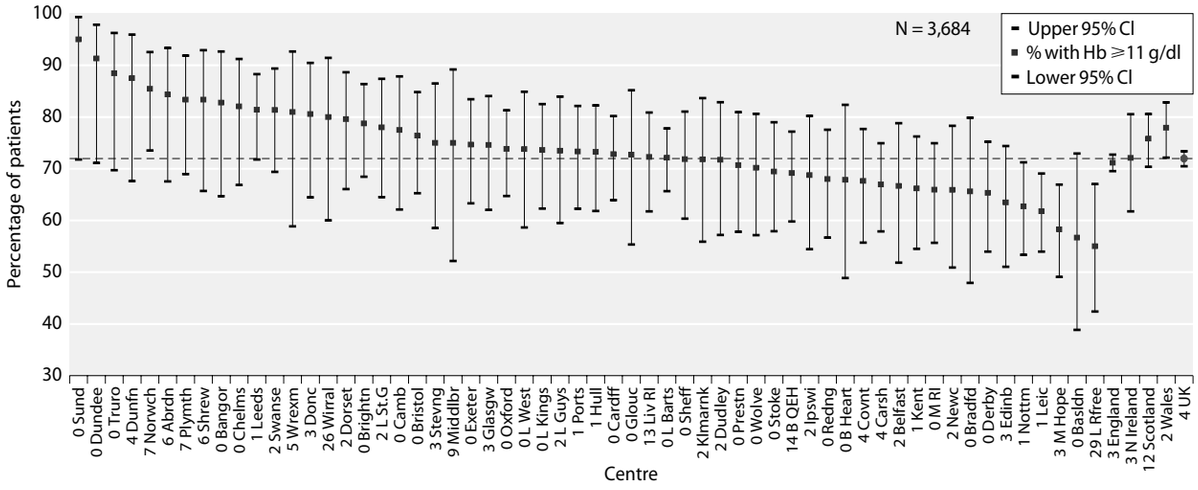

Fig. 9.16. Percentage of PD patients with Hb ⩾11 g/dl

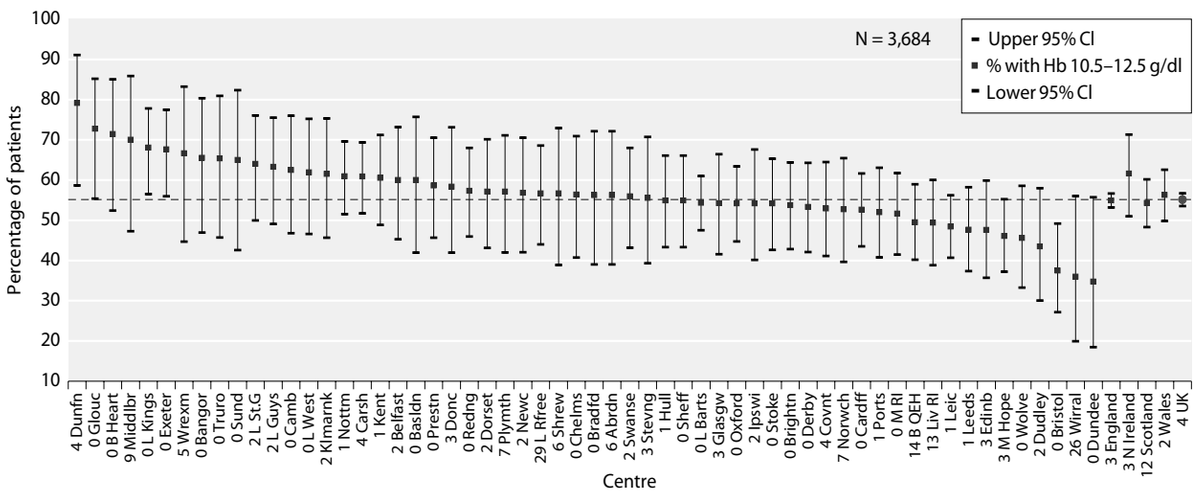

Fig. 9.17. Percentage of PD patients with Hb ⩾10.5 and ⩽12.5 g/dl

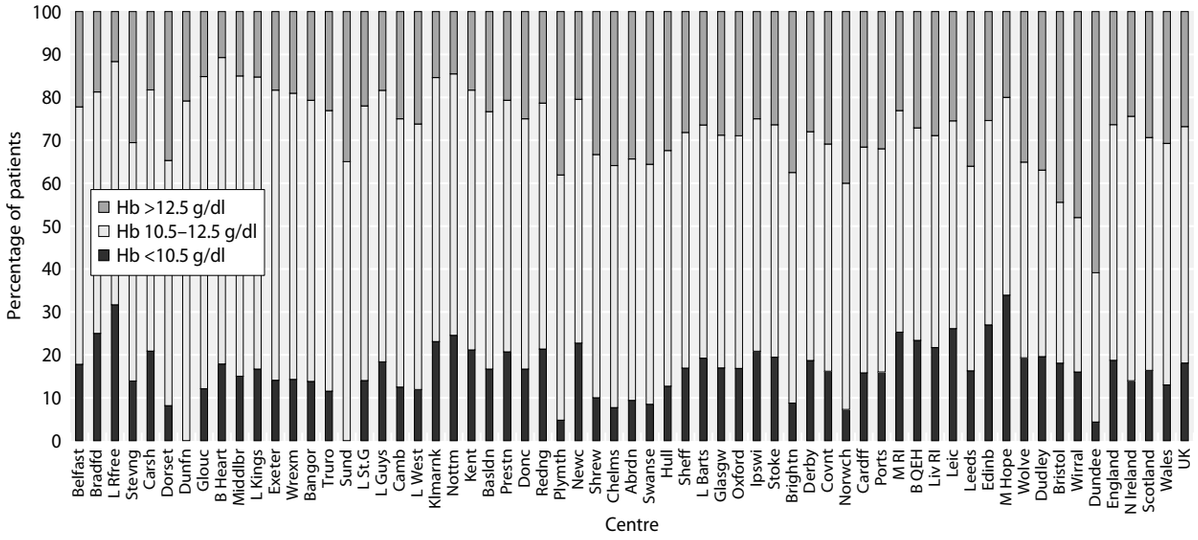

Fig. 9.18. Distribution of haemoglobin in patients treated with PD

Relationship between Hb in incident and prevalent dialysis patients in 2008

The relationship between the percentage of new and prevalent dialysis (HD and PD) patients with a Hb $\geqslant$10.0 g/dl is demonstrated in figure 9.20.

Correlation between median haemoglobin and compliance with clinical guidelines

The use of Rose-Day plots demonstrated the relationship between the population median and the compliance with minimum standards. The plots for Hb $\geqslant$10.0 g/dl and $\geqslant$11.0 g/dl for HD and PD populations are given in figures 9.21 to 9.24. The compliance with minimum standards over time between 1998 and 2008 are shown in figure 9.25 for prevalent patients (by treatment modality) and in figure 9.26 for incident and prevalent patients.

Changes in haemoglobin by length of time on renal replacement therapy over time

The median Hb of patients treated with HD increased during the first year of treatment (figure 9.27) but did not do so in patients treated with PD (figure 9.28). The Hb in PD patients had been stable for some years and remained higher than in HD patients up to 2 years into dialysis therapy.

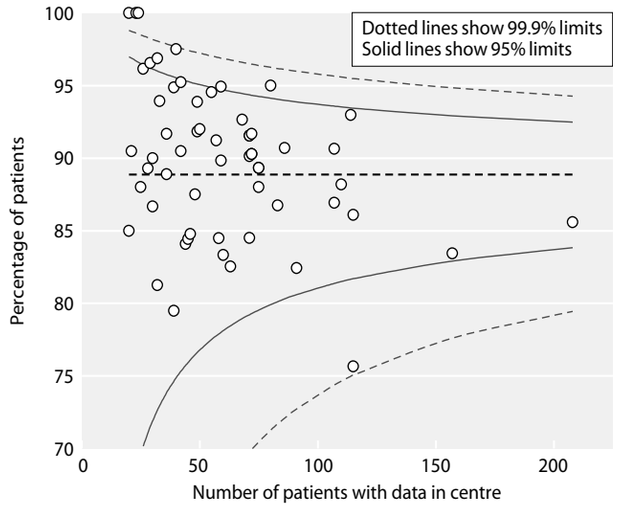

Fig. 9.19. Funnel plot of percentage of PD patients with Hb $\geqslant$10 g/dl

Factors affecting haemoglobin

Ferritin

Completeness of ferritin returns for patients treated with HD and PD

The completeness of serum ferritin returns to the UKRR is shown in table 9.6. Not all centres used serum ferritin as the sole indicator of iron status. Completeness of data for serum ferritin returned for England, Wales and Northern Ireland improved by comparison with the previous year. Renal centres may still need to address organisational processes in dealing with automatic download facilities to ensure that serum ferritin is checked, or alternatively that a declaration is made that alternative measures of iron status are being utilised.

Table 9.5. Percentage of PD patients achieving Hb ⩾10 g/dl

Centre	N with Hb	% with Hb ⩾10 g/dl	Centre	N with Hb	% with Hb ⩾10 g/dl
Middlbr	20	85	Wolve	57	91
Sund	20	100	Prestn	58	84
Wrexm	21	90	Glasgw	59	90
Dundee	23	100	Swanse	59	95
Dunfn	24	100	L Rfree	60	83
Wirral	25	88	Edinb	63	83
Truro	26	96	Covnt	68	93
B Heart	28	89	Exeter	71	90
Bangor	29	97	Hull	71	92
Basldn	30	87	Kent	71	85
Shrew	30	90	Sheff	71	92
Abrdn	32	97	Bristol	72	90
Bradfd	32	81	L Kings	72	90
Glouc	33	94	Stoke	72	92
Donc	36	89	Derby	75	89
Stevng	36	92	Ports	75	89
Chelms	39	95	Redng	75	88
Klmarnk	39	79	Brightn	80	95
Camb	40	98	Liv RI	83	87
L West	42	90	Leeds	86	91
Plymth	42	95	M RI	91	82
Newc	44	84	B QEH	107	87
Belfast	45	84	Oxford	107	91
Dudley	46	85	Nottm	110	88
Ipswi	48	88	Cardff	114	93
Dorset	49	94	Carsh	115	86
L Guys	49	92	M Hope	115	76
L St.G	50	92	Leic	157	83
Norwch	55	95	L Barts	208	86

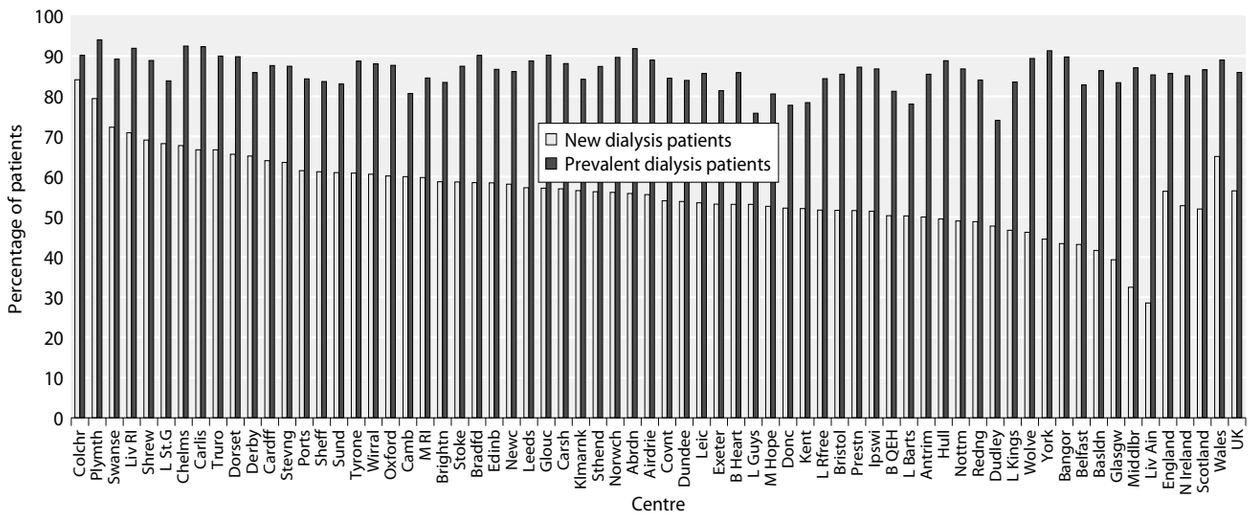

Fig. 9.20. Percentage of new and prevalent dialysis patients with Hb ⩾10 g/dl

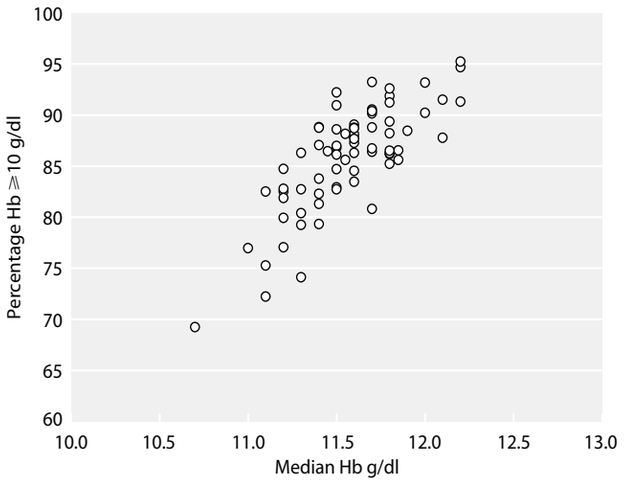

Fig. 9.21. Percentage of HD patients with Hb ⩾10 g/dl plotted against median haemoglobin

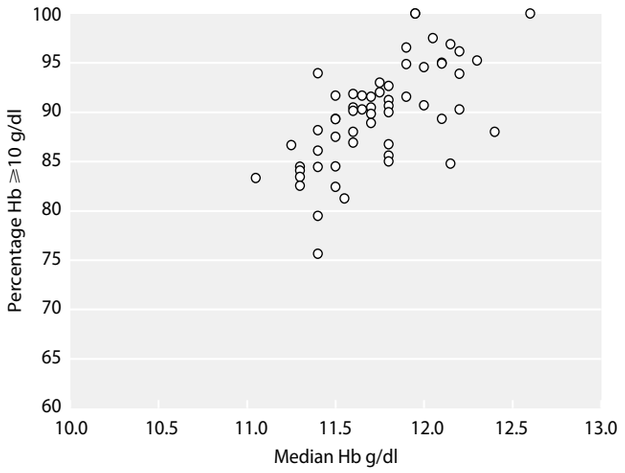

Fig. 9.23. Percentage of PD patients with Hb ⩾10 g/dl plotted against median haemoglobin

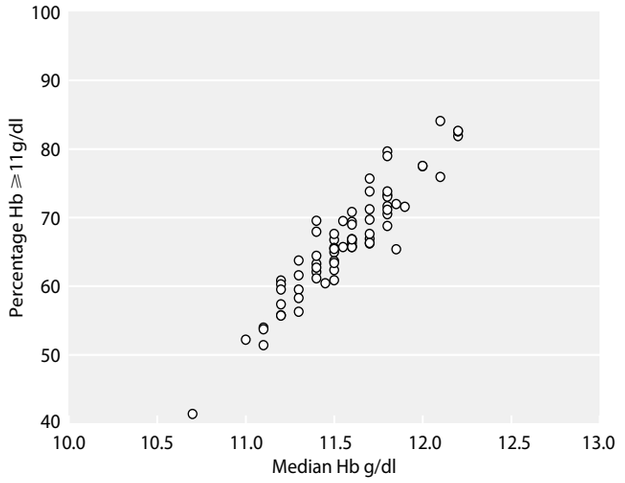

Fig. 9.22. Percentage of HD patients with Hb ⩾11 g/dl plotted against median haemoglobin

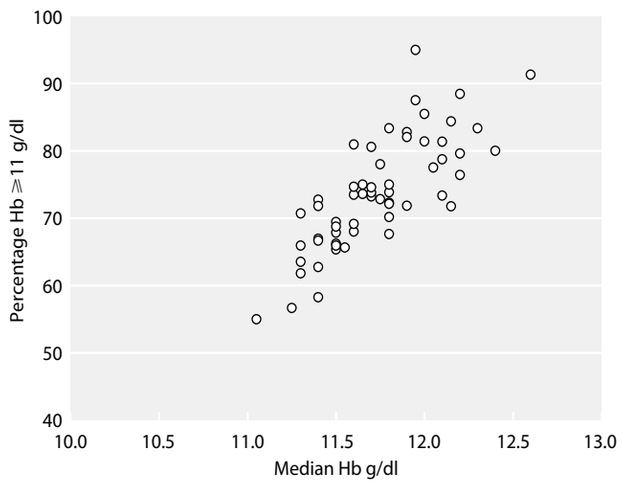

Fig. 9.24. Percentage of PD patients with Hb ⩾11 g/dl plotted against median haemoglobin

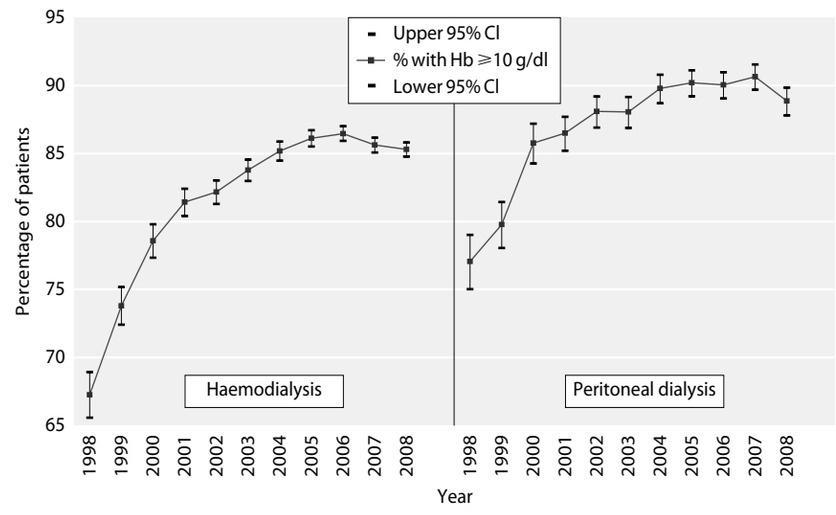

Fig. 9.25. Percentage of prevalent HD and PD patients (1998–2008) with Hb ⩾10 g/dl

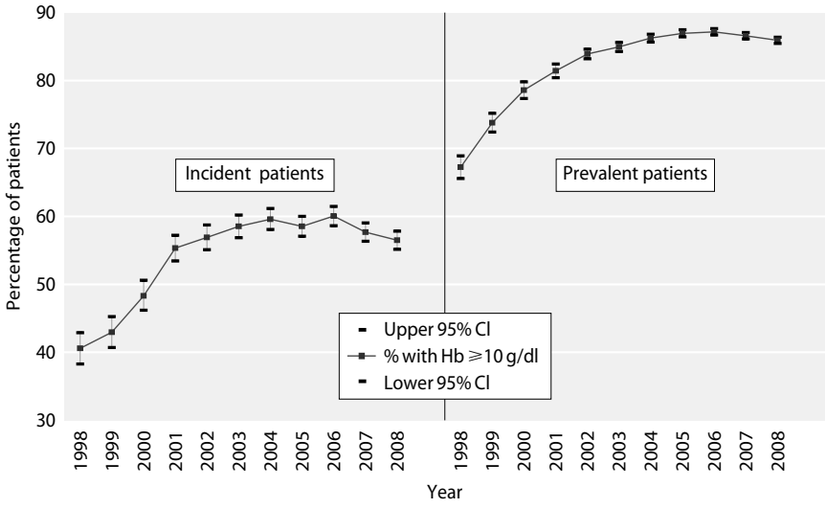

Fig. 9.26. Percentage of incident and prevalent dialysis patients (1998–2008) with Hb ⩾10 g/dl

Ferritin in prevalent dialysis patients

Percentage returns, serum ferritin concentrations and IQR are presented in tables 9.7 and 9.8 for HD and PD patients respectively. The percentage of patients with a ferritin ⩾800 µg/L by centre for HD and PD patients is shown in table 9.9.

The median and IQR for serum ferritin for HD and PD patients by centre is given in figures 9.29 and 9.30 respectively. The percentage of patients with a serum ferritin ⩾100 µg/L, ⩾200 µg/L and ⩾800 µg/L are shown in figures 9.31, 9.32 and 9.33 for HD and figures 9.34, 9.35 and 9.36 for PD respectively.

All centres achieved greater than 75% compliance with a serum of ferritin ⩾100 µg/L for HD patients and all but 6 centres achieved >90% compliance. The PD population had a lower median ferritin value (246 µg/L, IQR 141–399 vs. 436 µg/L, IQR 289–622 for HD). Thirty-five centres report less than 90% of PD patients compliant with serum ferritin ⩾100 µg/L. These results are comparable to last year's.

Changes in ferritin 2001–2008

The compliance with guidelines for ferritin in the HD populations at approximately 95% has remained stable over the last 6 years having reached a peak 5 years ago. In the PD population the compliance has decreased every year for the last 5 years but still remains at 84%. The serial values are shown in figure 9.37. The difference

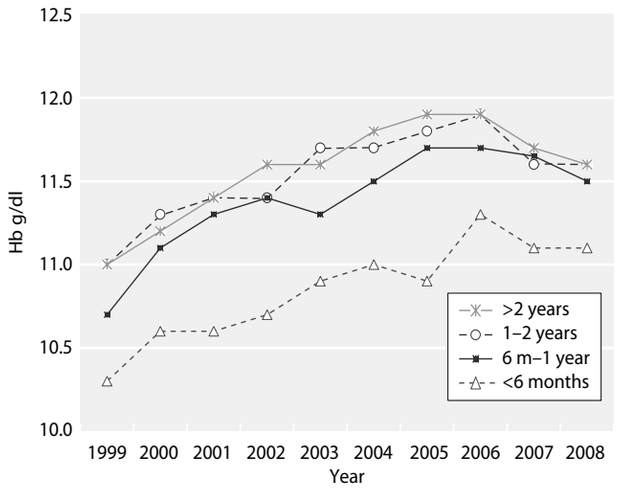

Fig. 9.27. Median haemoglobin plotted by length of time on RRT (HD patients)

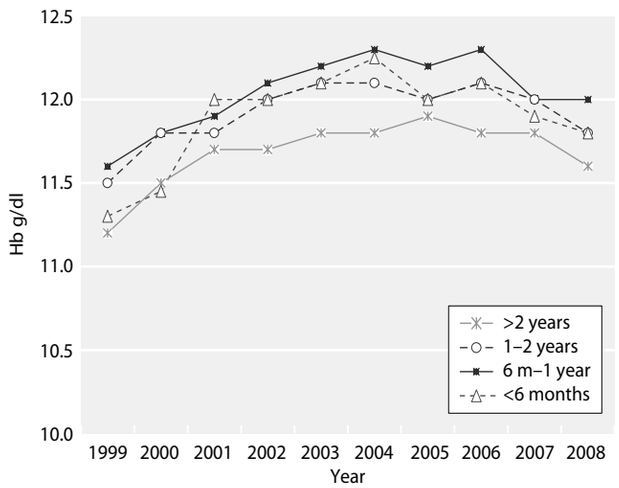

Fig. 9.28. Median haemoglobin plotted by length of time on RRT (PD patients)

Table 9.6. Completeness of ferritin returns

Centre	HD %	PD %	Centre	HD %	PD %
Abrdn	0	0	L Kings	100	99
Airdrie	1	0	L St.G	99	98
Antrim	91	88	L Rfree	81	95
B Heart	93	93	L West	79	98
B QEH	97	84	Leeds	98	99
Bangor	97	97	Leic	98	97
Basldn	99	100	Liv Ain	94	50
Belfast	95	98	Liv RI	94	91
Bradfd	91	100	M Hope	0	0
Brightn	92	99	M RI	68	99
Bristol	99	93	Middlbr	96	86
Camb	86	100	Newc	99	96
Cardff	96	97	Newry	67	100
Carlis	99	100	Norwch	97	93
Carsh	96	98	Nottm	100	100
Chelms	100	100	Oxford	98	96
Clwyd	93	90	Plymth	96	87
Colchr	98	n/a	Ports	98	91
Covnt	97	87	Prestn	99	95
D & Gall	0	0	Redng	99	100
Derby	99	100	Sheff	99	100
Derry	100	100	Shrew	100	100
Donc	100	84	Stevng	98	92
Dorset	99	92	Sthend	98	93
Dudley	78	94	Stoke	100	100
Dundee	0	0	Sund	100	85
Dunfn	0	0	Swanse	98	98
Edinb	0	0	Truro	99	96
Exeter	99	99	Tyrone	54	100
Glasgw	0	0	Ulster	99	100
Glouc	99	97	Wirral	63	74
Hull	98	96	Wolve	100	100
Inverns	0	0	Wrexm	79	23
Ipswi	100	90	York	95	100
Kent	100	97	**England**	**93**	**92**
Klmarnk	0	0	**N Ireland**	**86**	**97**
L Barts	100	100	**Scotland**	**0**	**0**
L Guys	96	96	**Wales**	**95**	**90**
			UK	**84**	**87**

Table 9.7. Ferritin in HD patients

Centre	% data return	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾ 100 µg/L
Antrim	91	454	189–1142	303–724	98.2
B Heart	93	325	66–727	196–460	91.1
B QEH	97	384	165–760	293–480	97.8
Bangor	97	402	154–793	292–533	100.0
Basldn	99	345	91–611	283–441	94.4
Belfast	95	505	100–1280	312–756	95.2
Bradfd	91	460	122–947	336–678	96.9
Brightn	92	457	172–923	354–608	97.4
Bristol	99	337	65–876	205–502	92.3
Camb	86	267	48–703	172–394	88.8
Cardff	96	443	114–964	293–615	95.1
Carlis	99	468	201–1152	346–666	98.7
Carsh	96	357	63–738	248–463	92.4
Chelms	100	661	336–1014	549–779	100.0
Clwyd	93	427	182–941	313–600	100.0
Covnt	97	334	59–1024	186–516	89.2
Derby	99	452	116–955	302–640	96.0
Derry	100	550	78–1006	308–840	94.2
Donc	100	451	120–898	274–606	97.2
Dorset	99	454	188–853	333–630	98.9
Dudley	78	326	28–1028	191–508	86.2
Exeter	99	301	132–637	214–408	97.2
Glouc	99	473	180–1051	319–661	96.5
Hull	98	433	190–898	321–562	99.7
Ipswi	100	404	88–1013	276–554	94.8
L Barts	100	433	140–929	310–592	96.7
L Guys	96	426	89–917	287–605	94.7
L Kings	100	468	134–1103	307–699	98.4
L Rfree	81	415	29–1200	227–663	87.1
L West	79	570	249–1110	415–747	97.6
Leeds	98	465	125–813	342–563	96.2
Leic	98	360	60–810	226–496	91.5
Liv Ain	94	541	129–1201	353–715	98.2
Liv RI	94	614	125–1491	381–827	96.9
M Hope	0				
M RI	68	401	125–964	266–563	96.2
Middlbr	96	477	99–1588	310–843	94.6
Newc	99	521	175–1094	382–703	98.4
Newry	67	746	101–1288	482–960	96.6
Norwch	97	573	113–1254	346–810	95.7
Nottm	100	557	286–1029	460–670	99.2
Oxford	98	328	87–823	224–467	92.5
Plymth	96	466	178–1226	310–723	99.1
Ports	98	196	28–520	102–299	75.5
Prestn	99	589	175–1541	380–891	97.3
Redng	99	506	226–1045	376–664	99.6
Sheff	99	487	153–924	346–624	96.8
Shrew	100	246	36–678	158–373	80.6
Stevng	98	518	168–915	362–690	99.1
Sthend	98	320	132–559	230–394	96.7
Stoke	100	856	239–1853	581–1262	98.8

Table 9.7. Continued

Centre	% data return	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾ 100 µg/L
Sund	100	542	226–1099	346–713	98.0
Swanse	98	438	114–937	272–602	95.5
Truro	99	467	198–911	327–599	98.5
Tyrone	54	816	360–1703	533–1010	100.0
Ulster	99	548	162–1314	368–703	100.0
Wirral	63	694	295–1497	507–937	99.0
Wolve	100	476	165–906	379–607	97.5
Wrexm	79	366	179–841	270–491	100.0
York	95	506	123–920	401–616	95.2
England	**93**	**433**	**100–1081**	**287–617**	**94.9**
N Ireland	**86**	**545**	**150–1276**	**335–806**	**96.8**
Wales	**95**	**434**	**133–932**	**289–599**	**96.2**
E, W & NI	**93**	**436**	**102–1079**	**289–622**	**95.0**

Blank cells = centres excluded from analyses due to poor data completeness or low patient numbers

Table 9.8. Ferritin in PD patients

Centre	% data return	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾ 100 µg/L
Antrim	88				
B Heart	93	183	70–751	122–320	84.6
B QEH	84	162	38–803	92–280	73.3
Bangor	97	254	19–592	158–334	82.1
Basldn	100	170	38–605	116–405	83.3
Belfast	98	263	34–845	150–512	80.0
Bradfd	100	216	52–920	152–484	84.4
Brightn	99	295	77–880	171–400	92.4
Bristol	93	181	18–671	99–308	73.1
Camb	100	243	46–712	158–327	87.5
Cardff	97	105	27–492	47–193	53.2
Carlis	100				
Carsh	98	209	44–545	126–300	82.2
Chelms	100	203	48–795	147–349	89.7
Clwyd	90				
Colchr	n/a				
Covnt	87	204	78–753	119–350	82.3
Derby	100	345	67–796	226–482	94.7
Derry	100				
Donc	84	175	53–645	77–354	67.7
Dorset	92	255	34–467	160–365	87.0
Dudley	94	180	33–480	74–313	68.2
Exeter	99	205	53–789	159–304	85.7
Glouc	97	292	115–705	216–360	96.9
Hull	96	357	36–852	229–496	89.9
Ipswi	90	217	56–704	134–365	84.1
Kent	97	280	53–956	165–395	88.6

Table 9.8. Continued

Centre	% data return	Median ferritin	90% range	Inter-quartile range	% ferritin ⩾100 µg/L
L Barts	100	278	65–899	161–466	91.4
L Guys	96	142	29–783	87–254	70.8
L Kings	99	210	41–593	128–279	85.9
L Rfree	95	302	25–1034	161–473	83.8
L St.G	98	282	106–976	181–473	96.0
L West	98	249	98–976	185–367	92.7
Leeds	99	259	72–714	173–418	89.5
Leic	97	257	38–882	166–390	85.7
Liv Ain	50				
Liv RI	91	274	88–964	124–528	88.4
M Hope	0				
M RI	99	137	24–500	82–211	63.3
Middlbr	86				
Newc	96	350	155–1043	260–453	100.0
Newry	100				
Norwch	93	296	29–1051	115–503	78.2
Nottm	100	265	70–707	156–396	91.0
Oxford	96	236	38–713	154–351	85.4
Plymth	87	203	20–515	82–318	69.2
Ports	91	220	38–728	109–397	76.8
Prestn	95	292	39–635	158–456	87.3
Redng	100	337	64–802	218–531	90.7
Sheff	100	231	59–1090	150–392	85.9
Shrew	100	319	59–1039	225–408	90.6
Stevng	92	212	21–825	107–430	76.5
Sthend	93				
Stoke	100	520	65–1442	289–749	91.7
Sund	85				
Swanse	98	240	21–730	144–458	84.8
Truro	96	280	113–492	228–388	100.0
Tyrone	100				
Ulster	100				
Wirral	74	587	257–1386	428–884	100.0
Wolve	100	264	41–774	107–406	77.2
Wrexm	23				
York	100				
England	**92**	**251**	**44–826**	**149–405**	**85.2**
N Ireland	**97**	**259**	**45–864**	**115–492**	**77.9**
Wales	**90**	**157**	**21–705**	**74–269**	**67.0**
E, W & NI	**92**	**246**	**41–816**	**141–399**	**83.9**

Blank cells = centres excluded from analyses due to poor data completeness or low patient numbers
n/a = not applicable

Table 9.9. Percentage of patients with ferritin ⩾800 µg/L

	HD		PD	
Centre	% ferritin ⩾800 µg/L	95% CI	% ferritin ⩾800 µg/L	95% CI
Antrim	18.0	11.9–26.3		
B Heart	3.6	2.1–6.1	3.9	0.5–22.8
B QEH	3.9	2.7–5.6	5.7	2.6–12.1
Bangor	4.4	1.4–12.6	0.0	
Basldn	1.6	0.4–6.2	3.3	0.5–20.2
Belfast	21.6	16.7–27.4	6.7	2.2–18.7
Bradfd	11.7	7.6–17.6	6.3	1.6–21.8
Brightn	8.5	5.7–12.4	7.6	3.5–15.9
Bristol	6.3	4.3–9.0	0.0	
Camb	3.2	1.6–6.3	2.5	0.4–15.7
Cardff	9.8	7.3–13.0	1.8	0.5–6.9
Carlis	16.2	9.5–26.4		
Carsh	3.3	2.1–5.1	3.4	1.3–8.7
Chelms	23.2	15.8–32.7	2.6	0.4–16.1
Clwyd	9.5	4.3–19.6		
Colchr	26.7	19.0–36.2	n/a	n/a
Covnt	8.7	5.9–12.6	4.8	1.6–14.0
Derby	11.0	7.6–15.8	4.0	1.3–11.7
Derry	28.9	18.2–42.5		
Donc	11.1	5.7–20.7	0.0	
Dorset	7.6	4.5–12.4	0.0	
Dudley	7.5	3.6–14.8	0.0	
Exeter	2.8	1.4–5.6	4.3	1.4–12.5
Glouc	17.7	12.3–24.9	3.1	0.4–19.1
Hull	6.7	4.3–10.3	8.7	4.0–18.0
Ipswi	8.3	4.2–15.8	4.6	1.1–16.4
Kent	9.9	6.9–13.8	5.7	2.2–14.3
L Barts	8.4	6.4–11.0	6.3	3.7–10.5
L Guys	9.4	7.1–12.4	4.2	1.0–15.2
L Kings	16.9	13.5–21.1	1.4	0.2–9.3
L Rfree	16.7	13.7–20.2	7.5	3.4–15.7
L St.G	5.0	2.7–9.0	8.0	3.0–19.5
L West	18.8	16.4–21.5	9.8	3.7–23.3
Leeds	5.6	3.8–8.1	2.3	0.6–8.8
Leic	5.1	3.7–7.0	6.5	3.5–11.7
Liv Ain	17.4	11.4–25.7		
Liv RI	26.4	22.0–31.2	8.1	3.9–16.1
M Hope				
M RI	7.6	4.9–11.4	0.0	
Middlbr	28.4	23.2–34.1		
Newc	18.0	13.7–23.3	9.3	3.5–22.3
Newry	44.1	32.0–56.9		
Norwch	26.4	21.5–31.9	12.7	6.2–24.4
Nottm	13.9	10.7–17.9	2.7	0.9–8.0
Oxford	5.0	3.1–8.0	3.9	1.5–9.9
Plymth	18.5	12.3–27.0	2.6	0.4–16.1
Ports	2.5	1.3–4.5	2.9	0.7–10.9
Prestn	31.5	27.2–36.1	0.0	
Redng	13.4	9.6–18.5	5.3	2.0–13.4
Sheff	9.5	7.4–12.2	7.0	3.0–15.8
Shrew	2.4	0.9–6.1	9.4	3.1–25.4
Stevng	11.6	8.6–15.5	5.9	1.5–20.7
Sthend	0.8	0.1–5.7		
Stoke	54.6	48.2–60.8	23.6	15.2–34.8
Sund	15.9	10.9–22.6		

Table 9.9. Continued

	HD		PD	
Centre	% ferritin ⩾ 800 µg/L	95% CI	% ferritin ⩾ 800 µg/L	95% CI
Swanse	8.7	6.0–12.3	3.4	0.9–12.6
Truro	7.5	4.1–13.4	4.0	0.6–23.6
Tyrone	51.1	36.8–65.2		
Ulster	15.8	9.2–25.8		
Wirral	37.3	28.4–47.0	32.0	16.9–52.2
Wolve	9.5	6.5–13.6	3.5	0.9–13.0
Wrexm	5.4	1.7–15.3		
York	7.7	3.9–14.6		
England	**11.9**	**11.4–12.5**	**5.4**	**4.6–6.3**
N Ireland	**25.4**	**22.0–29.2**	**7.0**	**3.2–14.7**
Wales	**8.7**	**7.1–10.7**	**1.9**	**0.7–4.9**
E, W & NI	**12.2**	**11.7–12.7**	**5.2**	**4.5–6.0**

Blank cells = centres excluded from analyses due to poor data completeness or low patient numbers
n/a = not applicable
Where percentage = 0.0, the confidence intervals have not been calculated

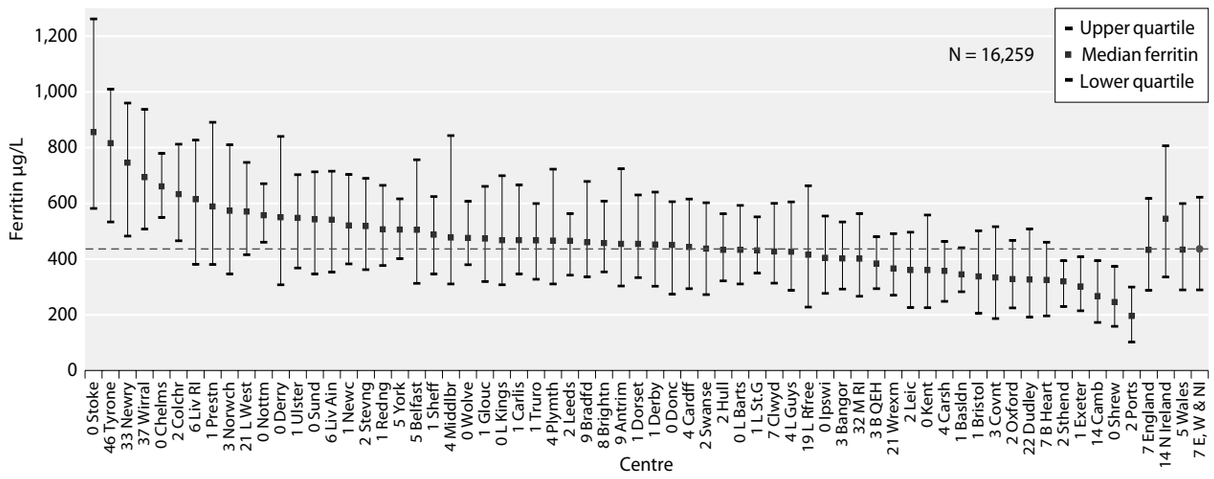

Fig. 9.29. Median ferritin in patients treated with HD

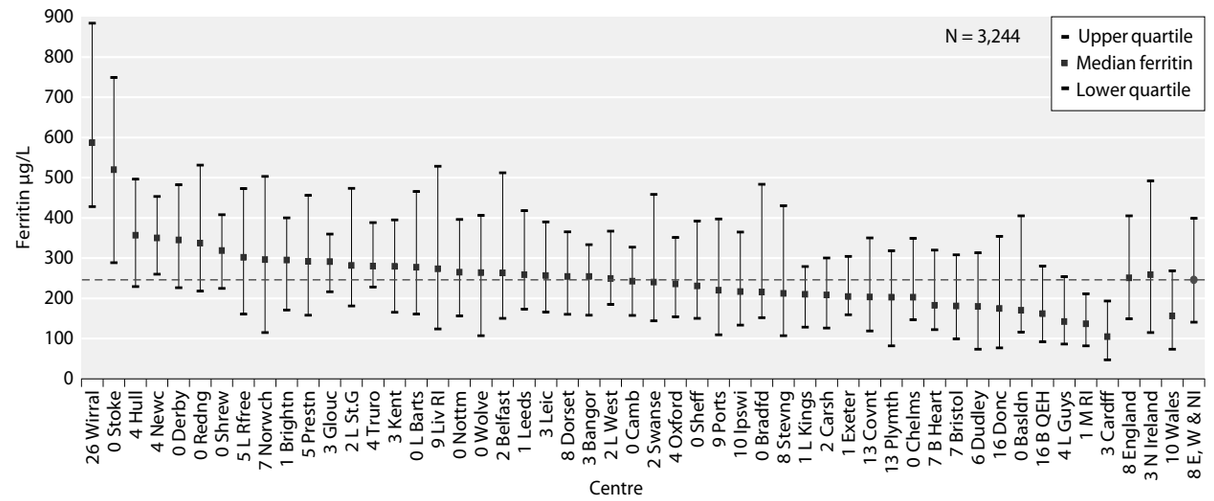

Fig. 9.30. Median ferritin in patients treated with PD

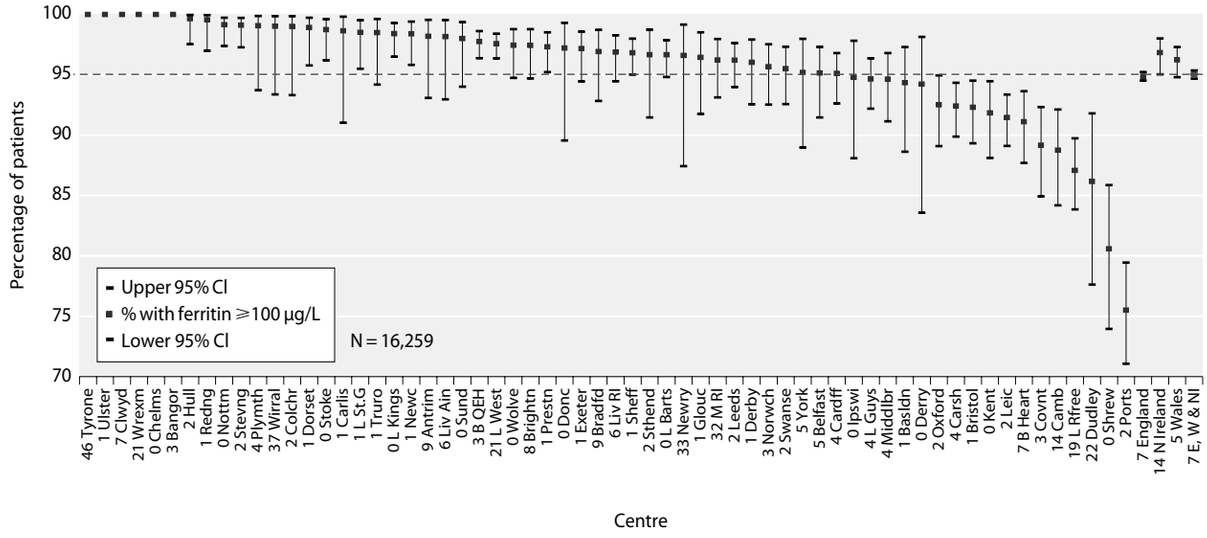

Fig. 9.31. Percentage of HD patients with ferritin ⩾100 µg/L

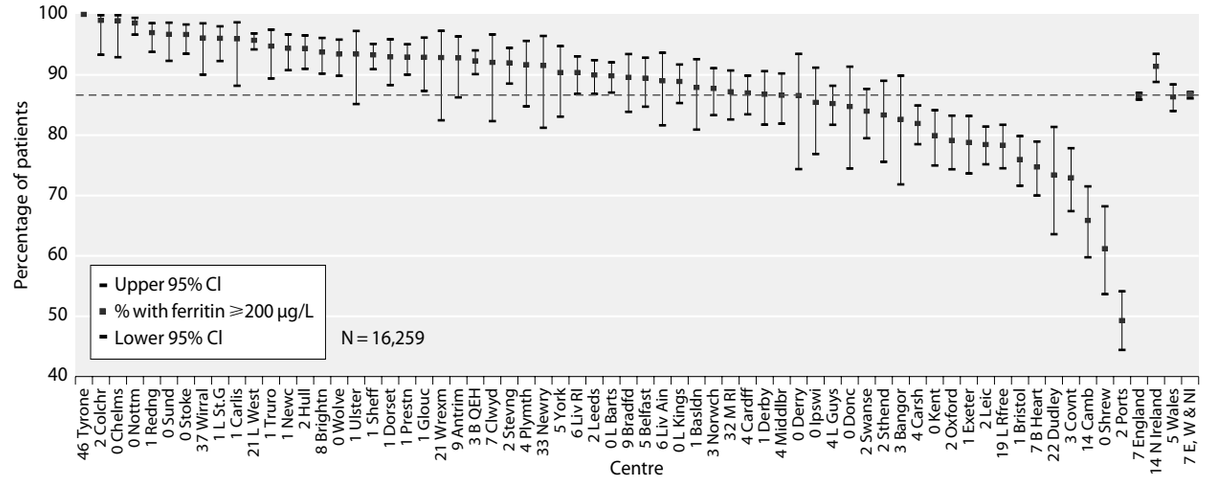

Fig. 9.32. Percentage of HD patients with ferritin ⩾200 µg/L

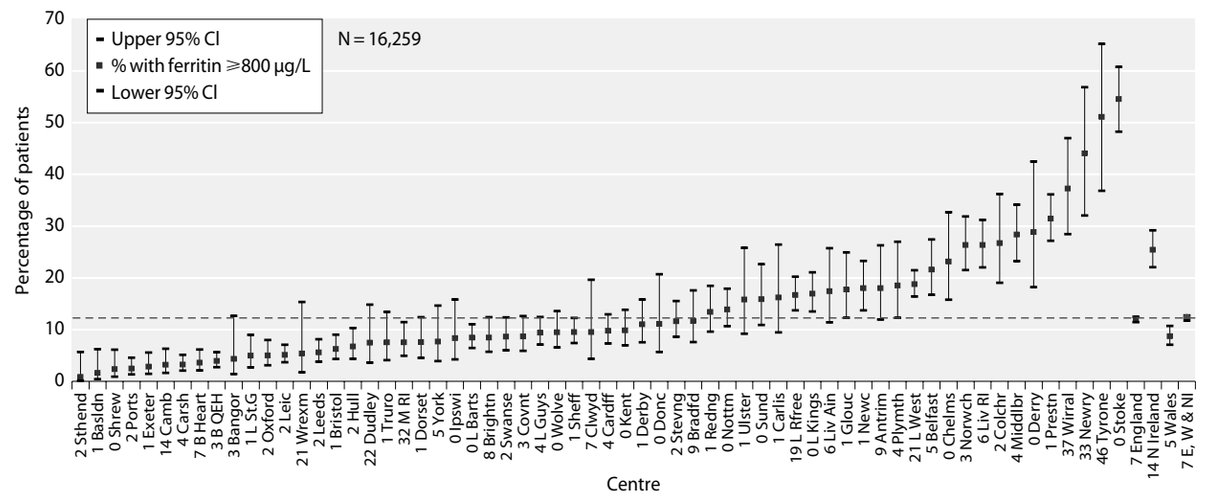

Fig. 9.33. Percentage of HD patients with ferritin ⩾800 µg/L

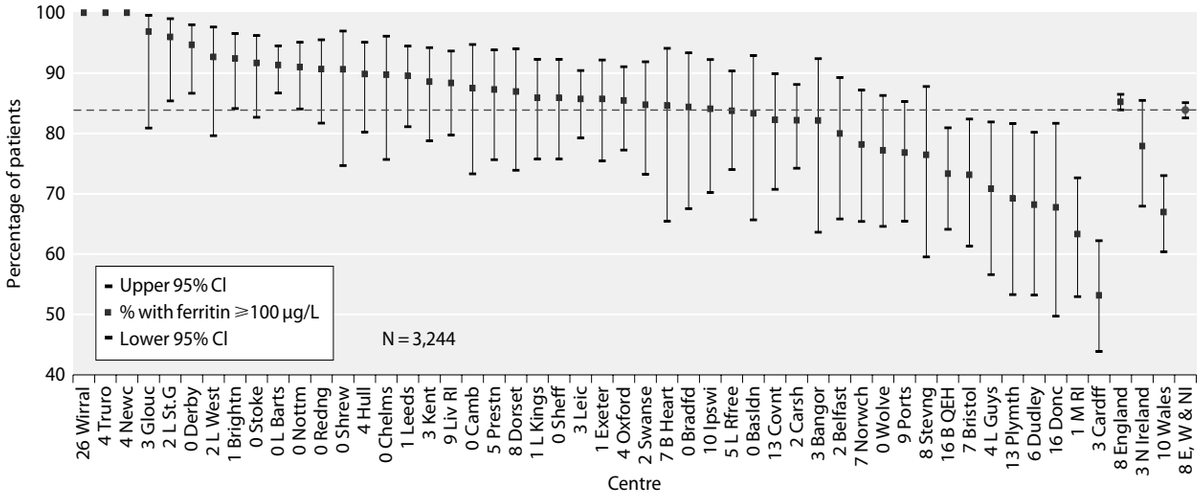

Fig. 9.34. Percentage of PD patients with ferritin ⩾100 µg/L

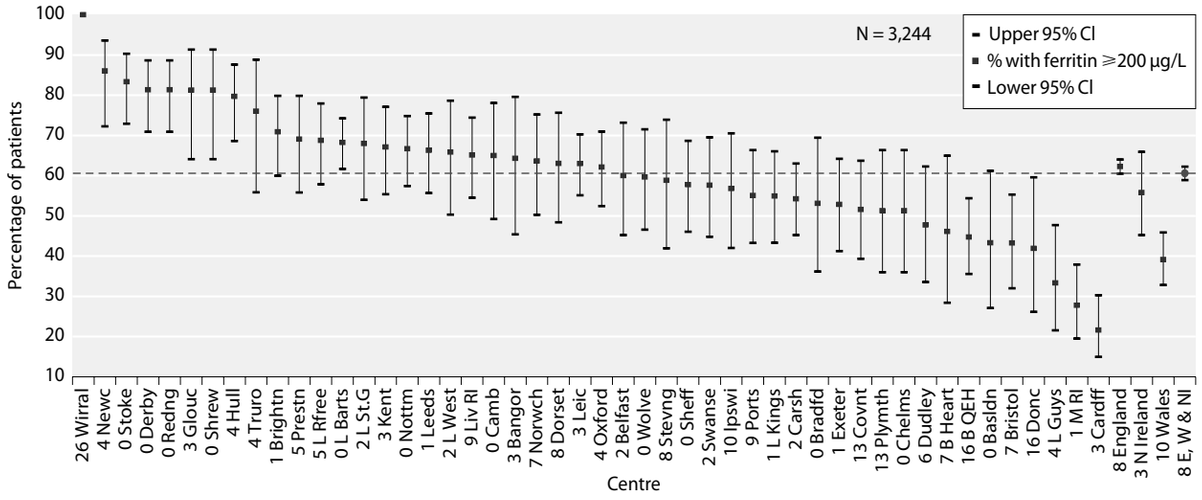

Fig. 9.35. Percentage of PD patients with ferritin ⩾200 µg/L

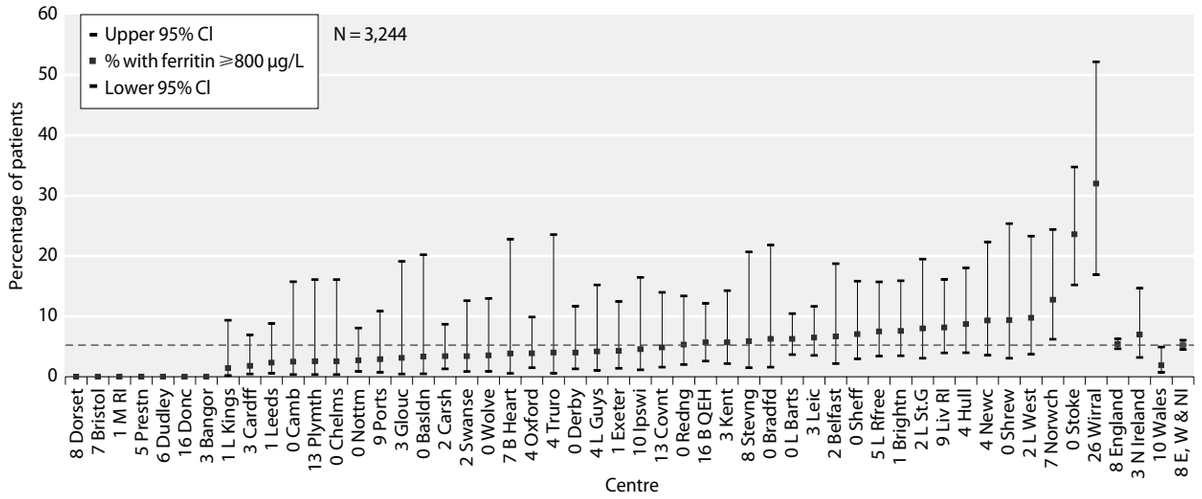

Fig. 9.36. Percentage of PD patients with ferritin ⩾800 µg/L

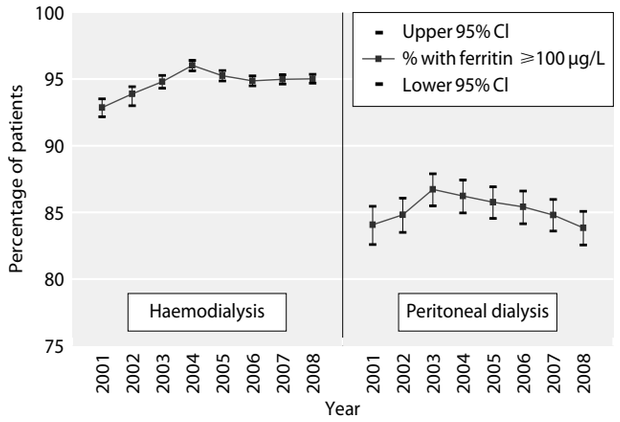

Fig. 9.37. Percentage of patients with ferritin ⩾100 µg/L (2001–2008)

between the compliance in HD and PD was probably because of the lower requirement for ESA to achieve target Hb levels in the PD population. There was therefore a lower requirement for intravenous iron supplementation. The median serum ferritin outcome over time is shown in figure 9.38.

Ferritin and length of time on renal replacement therapy

The median serum ferritin for patients grouped on the basis of length of time since starting dialysis treatment increased in HD and PD (figures 9.39 and 9.40).

Erythropoiesis stimulating agents

Patients treated and dose variation – ESA prescription and modality

Table 9.10 shows the percentage of patients treated and the dose of ESA given in HD patients. Equivalent data for PD patients are shown in table 9.11.

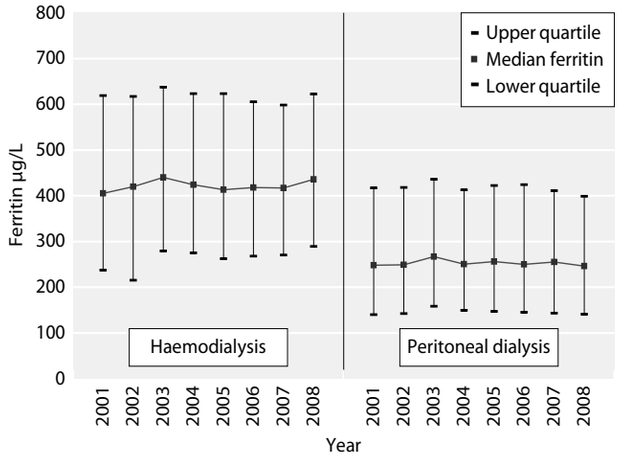

Fig. 9.38. Median ferritin (2001–2008)

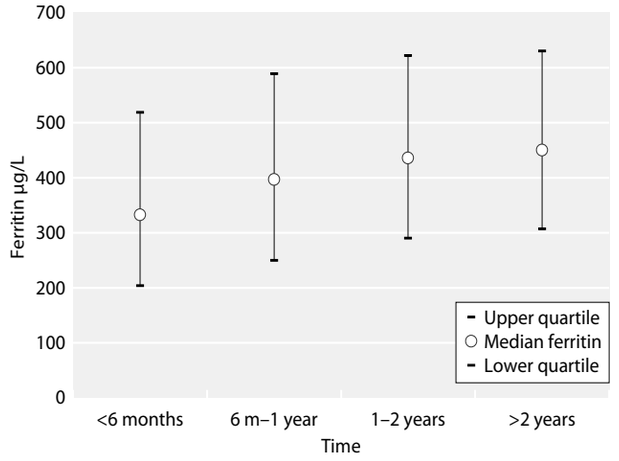

Fig. 9.39. Median ferritin by length of time on RRT in patients treated with HD

Age and ESA prescription

The proportion of patients on an ESA was higher for HD than PD and this discrepancy was evident across the age bands. The percentage of the whole cohort which maintained a Hb ⩾10 g/dl without requiring ESA (by age band and modality) is shown in figure 9.41.

The percentage of dialysis patients receiving ESA at all Hb levels is given in figure 9.42.

Figure 9.43 gives data on the percentage of anaemic patients (Hb <10.0 g/dl) receiving an ESA. Of the minority with Hb <10 g/dl and not on an ESA, some may have been declared unresponsive to ESA therapy and no longer be on treatment, some may have just become anaemic and not yet started therapy and others may have been on ESA but not have had it recorded.

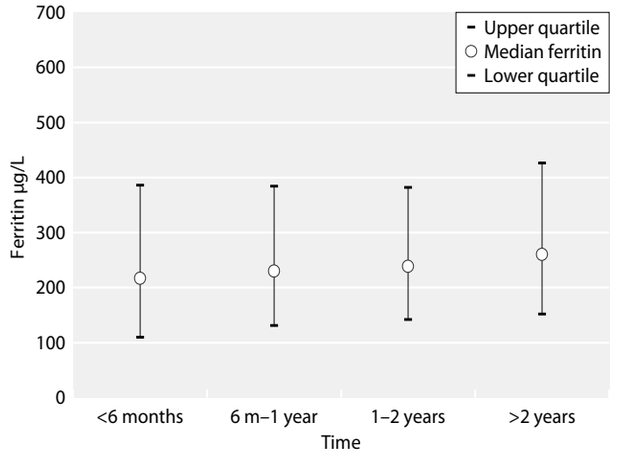

Fig. 9.40. Median ferritin by length of time on RRT in patients treated with PD

Table 9.10. ESA prescribing in HD patients

Centre	% on ESA	Mean weekly dose for pts on ESA (IU/week)	Median weekly dose for pts on ESA (IU/week)	% with Hb <10 g/dl who are on ESA	% with Hb ⩾10 g/dl and not on ESA
Antrim	96	9,179	6,000	100	4
B Heart	79	8,979	8,000	92	19
Bangor	80	9,228	8,000	89	17
Basldn	91	9,544	8,000	100	8
Belfast	91	7,951	6,000	100	6
Bradfd	86	7,724	6,000	100	10
Bristol	94	9,893	8,000	95	5
Chelms	98	10,011	8,000	100	2
Covnt	91	11,946	10,000	96	8
Derry	96	8,710	6,000	100	4
Donc	94	9,890	6,000	100	6
Dorset	90	11,974	12,000	100	10
Dudley	76	6,842	6,000	75	19
Exeter	95	9,245	8,000	100	4
Glouc	93	6,357	4,500	100	6
Ipswi	95	9,095	8,000	92	4
Kent	85	9,496	8,000	94	14
Leeds	93	7,419	6,000	100	6
Leic	96	8,494	6,000	99	3
Liv RI	90	9,141	8,000	96	4
Middlbr	80	6,138	6,000	82	16
Newry	91	6,438	6,000	100	9
Norwch	93	8,955	8,000	97	6
Oxford	95	10,781	8,000	95	4
Prestn	86			94	12
Redng	92			98	7
Sheff	90	10,879	8,000	98	9
Shrew	90	9,305	8,000	100	10
Sthend	95	11,810	10,000	100	5
Swanse	75	8,761	8,000	70	20
Truro	99	7,970	6,000	100	1
Tyrone	96	10,025	9,000	90	2
Ulster	99	7,776	6,000	100	1
Wrexm	94	8,897	8,000	100	6
York	92	9,898	6,000	75	5
England	**91**	**9,283**	**8,000**	**96**	**8**
N Ireland	**94**	**8,297**	**6,000**	**99**	**5**
Wales	**79**	**8,859**	**8,000**	**77**	**17**
E, W & NI	**90**	**9,166**	**8,000**	**95**	**8**

Blank cells denote centres excluded from analyses due to missing dosage data

Table 9.11. ESA prescribing in PD patients

Centre	% on ESA	Mean weekly dose for pts on ESA (IU/week)	Median weekly dose for pts on ESA (IU/week)	% with Hb <10 g/dl who are on ESA	% with Hb ⩾10 g/dl and not on ESA
Antrim*	63				
B Heart	68	5,368	4,000	100	32
Bangor	79	4,122	3,000	100	21
Basldn	60	7,278	3,500	100	40
Belfast	72	5,485	4,000	86	24
Bradfd	81	11,967	10,000	100	19
Bristol	69	6,077	4,000	100	31
Camb	85	6,735	4,000	100	15
Cardff**	75			100	25
Chelms	90	5,714	5,000	100	10
Covnt	80	7,982	6,000	80	19
Derry*	60				
Donc	73	5,704	4,000	100	28
Dorset	88	6,000	4,000	100	10
Dudley	81	5,706	4,000	100	17
Exeter	85	4,779	4,000	86	14
Glouc	82	6,315	4,000	100	18
Ipswi	82	6,235	4,000	83	15
Kent	56	3,764	3,000	45	37
Leeds	72	7,613	4,000	88	26
Leic	79	5,115	4,000	96	20
Liv RI	83	9,206	8,000	91	10
Norwch	58	3,765	2,600	67	40
Oxford	91	6,816	4,000	80	7
Plymth	78	5,543	4,000	50	17
Prestn**	76			78	21
Redng**	79			100	21
Sheff	63	7,289	6,000	100	37
Shrew	75	4,727	4,000	100	20
Sthend*	67				
Swanse	65	6,568	6,000	67	32
Truro	92	4,000	4,000	100	8
Tyrone*	57				
Ulster*	100				
York*	74				
England	**77**	**6,353**	**4,000**	**89**	**21**
N Ireland	**70**	**5,956**	**4,000**	**89**	**26**
Wales	**72**	**5,734**	**6,000**	**92**	**27**
E, W & NI	**76**	**6,302**	**4,000**	**89**	**22**

Blank cells denote centres excluded from analyses due to low patient numbers or missing dosage data
* Low patient numbers
** Missing dosage data

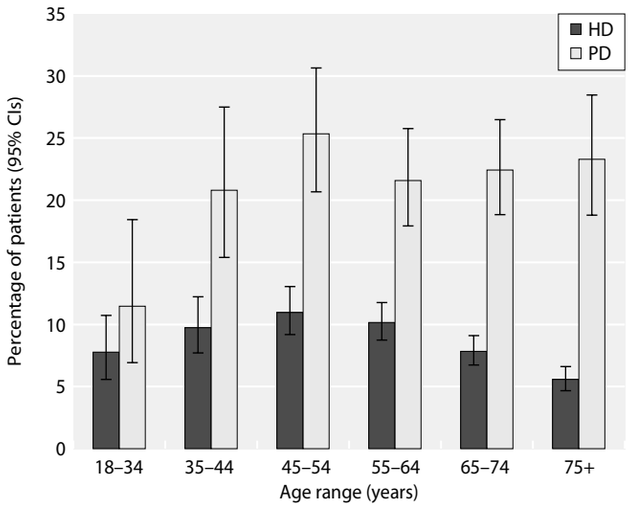

Fig. 9.41. Percentage of whole cohort who are not on ESA and have Hb $\geqslant$10 g/dl, by age group and treatment modality

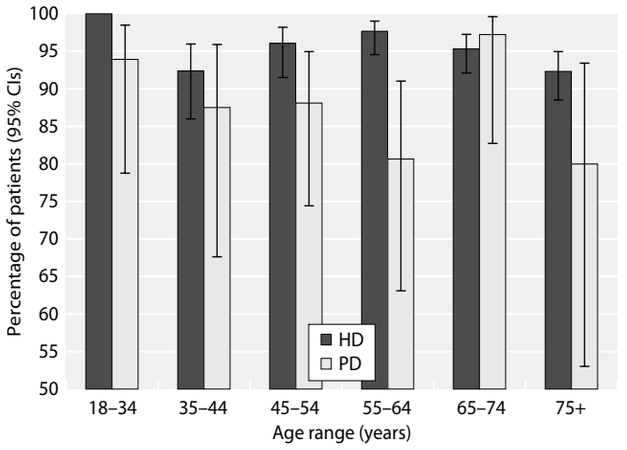

Fig. 9.43. Percentage of patients with Hb <10 g/dl who are on ESA, by age group and treatment modality

ESA prescription and gender

Provision of ESA by age and gender for HD and PD patients is shown in figures 9.44 and 9.45.

ESAs and time on renal replacement therapy

The percentage of patients on ESA by time on RRT and treatment modality is shown in figure 9.46. This is a cross-sectional analysis at the final quarter of 2008. Patients who had previously changed RRT modality were still included in this analysis.

ESA dose and success with guideline compliance

There appears to be no direct relationship between ESA dose and median Hb in HD patients (figure 9.47) or in patients treated with PD (chart not shown). This may be because of the wide spectrum of ESAs available, the frequency and route of administration and the differing policies for iron supplementation. The same was true for compliance with the EPBG minimum standard for Hb in HD patients (figure 9.48). Figure 9.49 shows the frequency distribution of weekly ESA dose by treatment modality.

It is known that not all patients treated with dialysis who have a Hb above the new RA guideline ceiling of 12.5 g/dl are receiving ESA. As a result, it has been suggested that it may be inappropriate to include these patients within the group not meeting this RA target

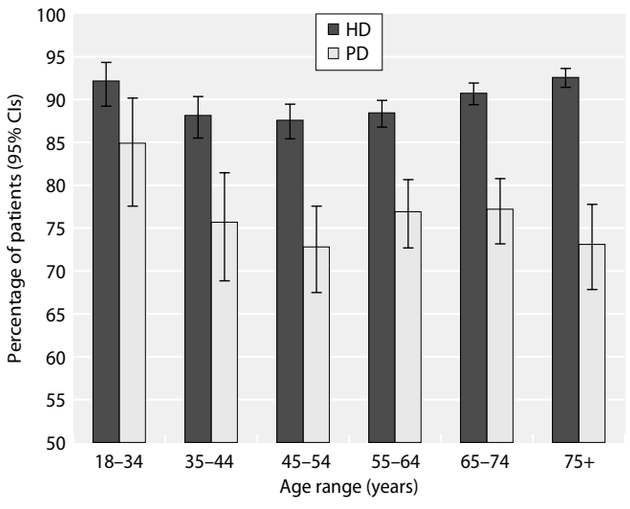

Fig. 9.42. Percentage of dialysis patients on ESA, by age group and treatment modality

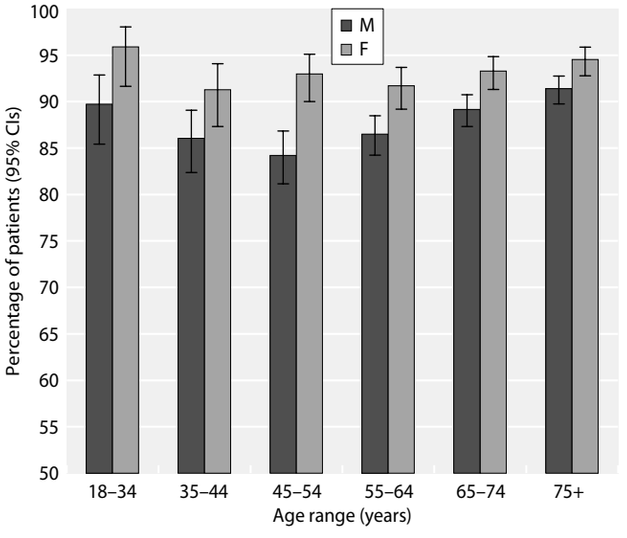

Fig. 9.44. Prescription of ESA by age and gender in patients treated with HD

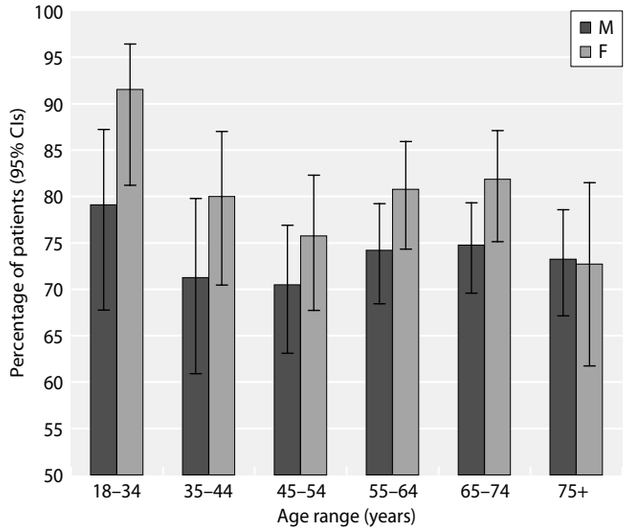

Fig. 9.45. Prescription of ESA by age and gender in patients treated with PD

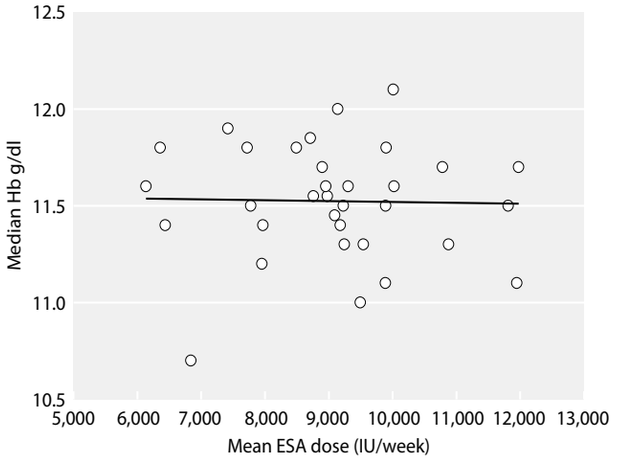

Fig. 9.47. Median Hb versus mean ESA dose in patients treated with HD

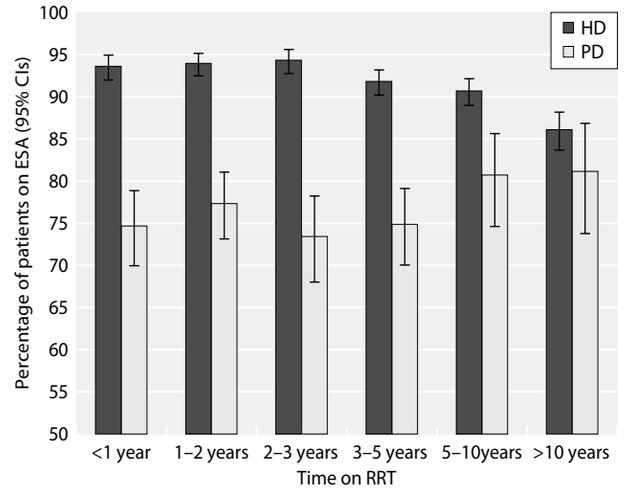

Fig. 9.46. Percentage of patients on ESA by time on RRT

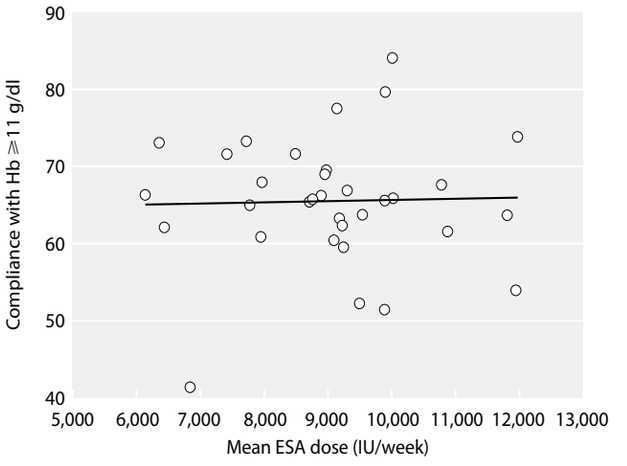

Fig. 9.48. Compliance with European Best Practice Guidelines versus mean ESA dose in patients treated with HD

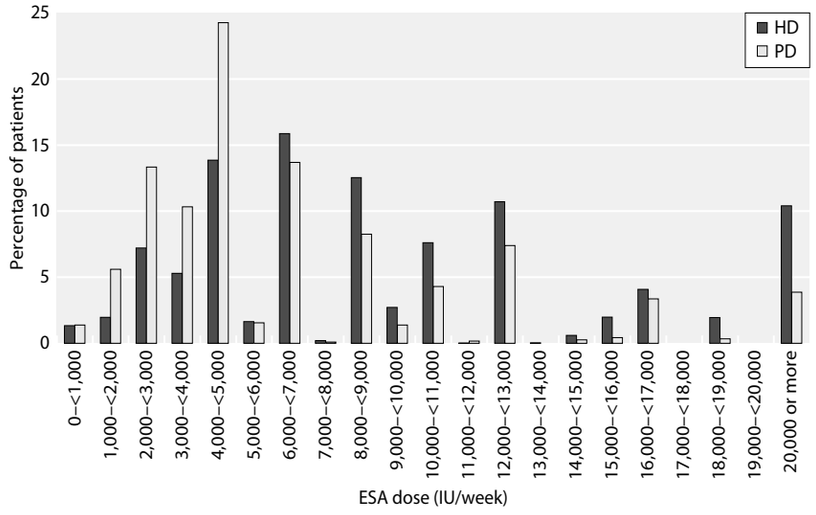

Fig. 9.49. Frequency distribution of weekly ESA dose

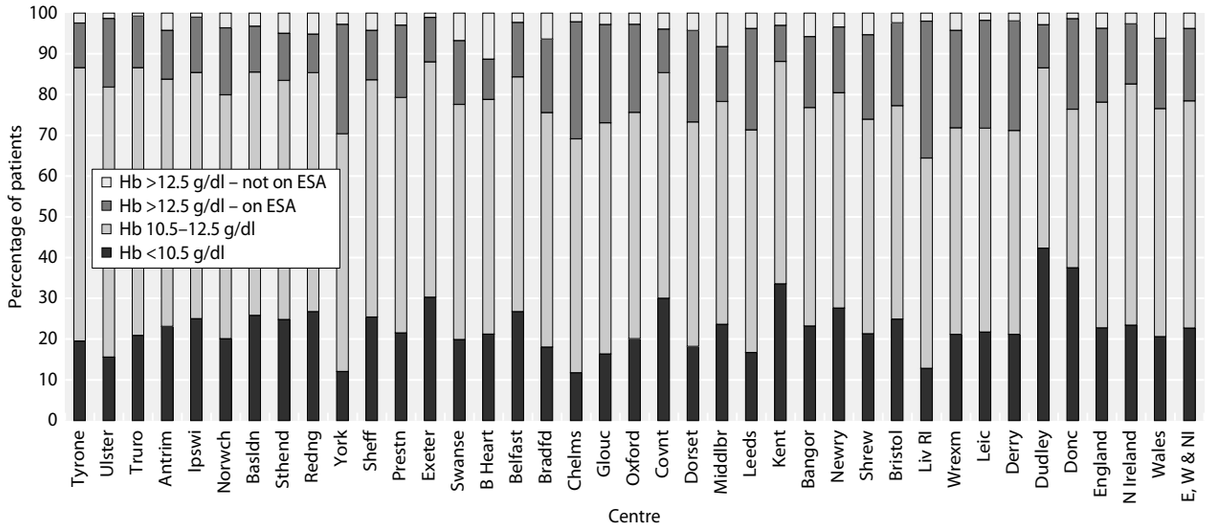

Fig. 9.50. Distribution of haemoglobin in patients treated with HD and the proportion of patients with Hb >12.5 receiving ESA

for two reasons: firstly, the high Hb remains outside the control of the clinician, and secondly, the recent trials suggesting that it may be detrimental to achieve a high Hb in renal patients were based only upon patients treated with ESAs [7, 8].

Figures 9.50 and 9.51 show the percentages of HD and PD patients in each centre whose Hb lies above, within or below the RA guidelines of 10.5–12.5 g/dl. These charts also show the proportion of patients with a Hb above 12.5 g/dl who are receiving, or are not receiving ESAs. These analyses are restricted to the centres with acceptable ESA returns as stipulated above. These figures show that 21.6% of HD patients have a Hb above the RA ceiling of 12.5 g/dl, but 3.8% are not receiving ESA. Patients on PD are more likely to have a high Hb without the use of ESA (28.1% with Hb >12.5, with 11.6% not on ESAs).

Discussion

Haemoglobin outcomes for patients on HD and PD in the UK were largely compliant with the RA minimum standard of Hb ⩾10.0 g/dl (85% and 89% respectively). Achieving compliance whilst also attempting compliance

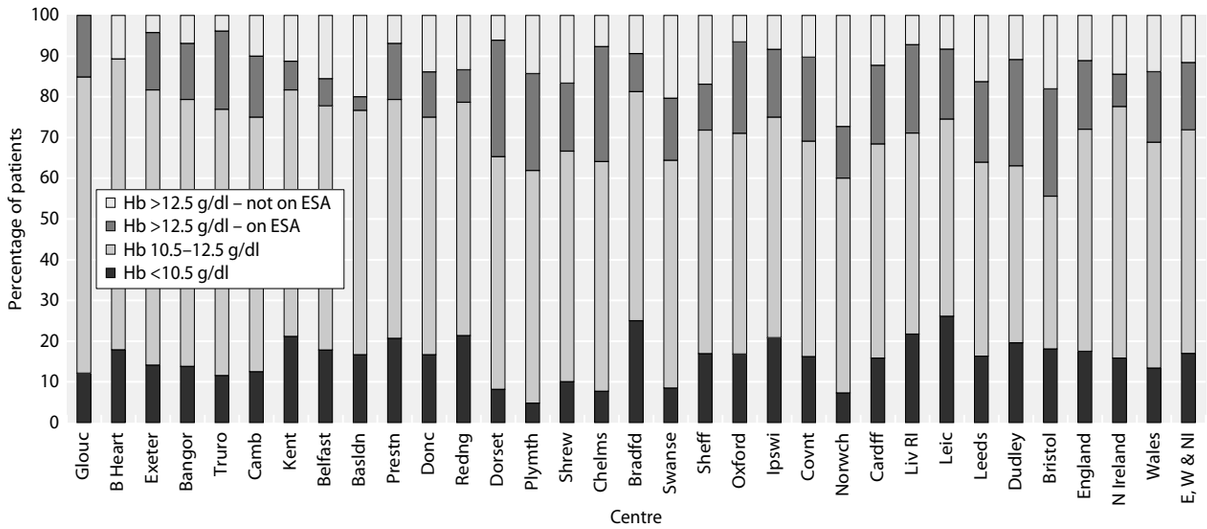

Fig. 9.51. Distribution of haemoglobin in patients treated with PD and the proportion of patients with Hb >12.5 receiving ESA

with the NICE guidelines published in 2006 and the 4th edition of the RA Clinical Practice Guidelines 2006 [6] recommended outcome Hb of between 10.5 and 12.5 g/dl requires careful positioning of the median outcome Hb for each centre. It also requires a reduction in the standard deviation of Hb to reach compliance levels higher than ∼60% even if the median Hb falls on 11.5 g/dl.

Of 47 centres achieving >85% compliance with Hb ⩾10.0 g/dl in HD patients, only 9 centres achieved ⩾60% compliance with Hb between 10.5–12.5 g/dl. The presentation of funnel plots for compliance with Hb ⩾10.0 g/dl and Hb between 10.5–12.5 g/dl (figures 9.12 and 9.13) may enable centres to continue adjusting their desired Hb outcome in light of the NICE guidelines.

Narrowing the population Hb distribution would appear to be important if centres wish to achieve compliance with Hb >10 g/dl whilst avoiding higher Hb outcomes i.e. >12.5 g/dl [7–9]. Seven of the 10 units achieving the greatest compliance with Hb between 10.5 and 12.5 g/dl had the lowest standard deviations for Hb (1.1 to 1.2 g/dl) in HD patients. If centres consistently achieve these narrow distributions and the critical behaviour(s) by which they achieve these outcomes were identified, other centres could attempt to copy their behaviour.

In last year's report the need to avoid improving compliance with the NICE guidelines at the expense of the Hb ⩾10.0 g/dl minimum standard was highlighted. This year's report confirms maintained UK compliance with more than 85% Hb ⩾10.0 g/dl for dialysis patients. The use of a target Hb between 10.5–12.5 g/dl alone would infer equivalent risk of Hb >12.5/dl as for <10.5 g/dl. The NICE guidance [5] on limiting upper Hb was primarily a health economic decision and at the time not given on the grounds of safety. However recent studies highlight the lack of benefit and possible harm related to higher Hb outcomes. The evidence for improving Hb ⩾10 g/dl remains unchanged.

Compliance with advice regarding iron stores as reflected by ferritin has remained stable in the UK and the percentage of patients with serum ferritin greater than 100 µg/L showed that the provision of iron to UK dialysis patients has been maintained.

Haemoglobin outcome did not show a clear relationship with prescribed ESA dose amongst the dataset submitted to the UKRR. The ESA type, frequency and route of administration may all affect the dose requirements in addition to other variables that can affect erythropoietic response.

Overall the data demonstrated that UK renal centres continued to give a high priority to the management of factors influencing Hb. Adjustments seem to have been made in many centres in accordance with the NICE guidelines since the last report was published. Sixty centres achieved ⩾50% compliance with Hb between 10.5–12.5 g/dl for HD patients compared with 51 centres in last year's report and 35 in the report prior to that. The overall UK compliance with this range has also improved from 48% to 53% to 54% over the same period. Further improvements require us to learn from the positive deviants!

Conflict of interest: none

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Chapter 10
Biochemistry Profile of Patients Receiving Dialysis in the UK in 2008: national and centre-specific analyses

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Key Words
Bicarbonate · Biochemical variables · Calcium · Cholesterol · Dialysis · Haemodialysis · Parathyroid hormone · Peritoneal dialysis · Phosphate · Quality improvement

Abstract
Introduction: The UK Renal Association Clinical Practice Guidelines include clinical performance measures for biochemical parameters in dialysis patients [1]. The UK Renal Registry (UKRR) annually audits dialysis centre performance against these measures as part of its role in promoting continuous quality improvement. ***Methods:*** Cross sectional performance analyses were undertaken to compare dialysis centre achievement of clinical performance measures for prevalent haemodialysis (HD) and peritoneal dialysis (PD) cohorts in 2008. The biochemical variables studied were phosphate, adjusted calcium, calcium phosphate product, parathyroid hormone, bicarbonate, total cholesterol and HbA1c. In addition, longitudinal analyses were performed (2000–2008) to show changes in achievement of clinical performance measures over time. ***Results:*** Serum phosphate was between 1.1 and 1.8 mmol/L in 55% of HD and 64% of PD patients, which was similar to 2007. There was a fall in overall mean phosphate concentration to 1.55 mmol/L. A revised adjusted serum calcium target of 2.2–2.5 mmol/L was achieved by 63% of HD and 65% of PD patients. For comparison, the previous target of 2.2–2.6 mmol/L was achieved by 74% and 78% respectively, a figure little changed since 2005. The downward trend in serum calcium results evident for the previous nine years appears to have halted. The calcium phosphate target of $<4.8\ \text{mmol}^2/\text{L}^2$ was achieved by 84% of HD and 87% of PD patients, continuing the steady improvement over the past nine years and reflecting the downward trend in phosphate results. As in previous years, a minority of patients achieved the PTH target range of 16–32 pmol/L and there was considerable heterogeneity between centres. Although analytical and biological variability may have contributed to this, centres achieving the standards relating to one mineral parameter tended to achieve the standards in others suggesting that treatment factors were also relevant. The audit measure for bicarbonate was achieved in 71% of HD and 82% of PD patients. Eighty-five percent of HD patients and 69% of PD patients achieved a value for total cholesterol <5 mmol/L. This was the first year that HbA1c has been audited. Overall, 43% of diabetic dialysis patients

exceeded the target of 7.5% HbA1c and there was considerable variation between centres. ***Conclusion:*** There is wide variation between centres in attainment of biochemical performance measures. There is some evidence in bone mineral metabolism that centres performing well in one variable are more likely to also meet the other standards. The inter-centre variation may be explained in part by laboratory practices and case mix but probably also represents variation in practice and in effectiveness of processes of care. Apart from glycaemic control there are a number of analytical and clinical factors that affect HbA1c that would be worthy of further investigation as a cause of variability.

Introduction

The UKRR collected routine biochemical data from clinical information systems in renal centres in England, Wales and Northern Ireland. Whilst similar data are collected by the Scottish Renal Registry, the UKRR is currently unable to receive these data, a situation the UKRR and Scottish Registry are working together to resolve. Annual cross sectional analyses were undertaken on some of these variables to determine centre level performance against national (Renal Association) clinical performance measures. This enabled UK renal centres to compare their own performance against each other and to the UK average performance. The UK Renal Association Clinical Practice Guidelines were revised and the final version of the 4th edition of these guidelines was published in November 2007 and was used as the source of audit measures [1]. Audit measures for kidney disease increasingly include tighter specification limits in conjunction with a growing evidence base. Out of range observations (e.g. hyperphosphataemia and hypophosphataemia) need to be interpreted cautiously as they may relate to different clinical problems or population characteristics. These will therefore require different strategies to improve centre performance of clinical audit measures. To supplement these performance analyses, summary statistical data provide enhanced understanding of the population characteristics of each centre and longitudinal analyses demonstrate changes over time.

Methods

These analyses relate to biochemical variables in the prevalent dialysis cohort in England, Wales and Northern Ireland in 2008. The cohort studied were patients prevalent on dialysis treatment on 31/12/08. HD and PD cohorts were analysed separately except for HbA1c where HD and PD cohorts have been analysed together.

The biochemical variables analysed were phosphate, adjusted calcium, adjusted calcium phosphate product, parathyroid hormone, bicarbonate, cholesterol and HbA1c. The method of data collection and validation by the UKRR has been described elsewhere [2]. For each quarter of 2008, the UKRR extracted biochemical data electronically from clinical information systems in UK dialysis centres. The UKRR does not collect data regarding different assay methods mainly because a single dialysis centre may process samples in several different laboratories. For centres providing adjusted calcium values, these data were analysed directly as it is these values on which clinical decisions within centres are based. For centres providing unadjusted calcium values, a formula in widespread use was used to calculate adjusted calcium. The audit measure for adjusted calcium in the 4th edition of the Renal Association Clinical Practice Guidelines depends on a local reference range but suggests an upper limit of 2.5 mmol/L [1]. The UKRR has this year changed to using adjusted calcium between 2.2–2.5 mmol/L as an audit measure rather than 2.2–2.6 mmol/L used previously. There are a variety of methods and reference ranges in use to measure parathyroid hormone. To enable some form of comparative audit the UKRR has chosen 2–4 times the median laboratory upper normal limit value as the audit measure. This equates to 16–32 pmol/L and is comparable to KDOQI (15–31 pmol/L) [1, 3, 4]. The measure used for serum bicarbonate in the PD cohort was 22–30 mmol/L as the new audit measure specifies that serum bicarbonate should be maintained in the 'normal range'. The derived measure of calcium phosphate product has an audit measure of below 4.8 $mmol^2/L^2$. There is no audit measure but guidance for cholesterol has changed to the new target of total cholesterol below 4 mmol/L in patients with a 10 year risk of cardiovascular disease of >20% (previously <5 mmol/L). The reporting of achievement of <5 mmol/L continues this year but the plan is to move to the new target for next years report. HbA1c is a new audit measure for the UKRR and the target of less than 7.5% (DCCT harmonised) has been used [1].

A summary of the current Renal Association audit measures and conversion factors from SI units are given in table 10.1.

Quarterly values were extracted from the database for the last two quarters for calcium, bicarbonate, phosphate and HbA1c, the last three quarters for PTH and the entire year for cholesterol. Patients who did not have a data item were excluded from that analysis. The completeness of data were analysed at centre and country level. All patients were included in analyses but centres with less than 50% completeness were excluded from plots showing centre performance. Data were also excluded from plots when there were less than 20 patients with data at centre level. These data were analysed to calculate summary statistics (maximum, minimum, mean and median values in addition to standard deviation and quartile ranges). Where applicable, the percentage achieving the Renal Association or other surrogate clinical performance measure was also calculated. The number preceding the centre name in each figure indicates the percentage of missing data for that centre. Funnel plot analysis was used to identify 'outlying units' [5]. The percentage achieving each standard was plotted against centre size along with the upper and lower 95% and 99.9% limits. Centres can be identified on these plots by cross-referencing the 'n' value with the proportion of patients achieving the audit measure in the relevant table. Longitudinal

Table 10.1. Summary of clinical audit measures from the 4th edition of the Renal Association Clinical Practice Guidelines and used in the current analysis of data

Biochemical variable	Clinical audit measure	Conversion factor from SI units
Phosphate	1.1–1.8 mmol/L	mg/dL = mmol/L × 3.1
Calcium (adjusted)	Normal range (ideally 2.2–2.5 mmol/L)	mg/dL = mmol/L × 4
Calcium*phosphate	<4.8 mmol^2/L^2	mg^2/L^2 = mmol^2/L^2 × 12.4
Parathyroid hormone	2–4 times upper limit of normal (16–32 pmol/L)	ng/L = pmol/L × 9.5
Bicarbonate	HD patients: 20–26 mmol/L PD patients: Normal range (22–30 mmol/L)	mg/dl = mmol/L × 6.1
Total cholesterol	<5 mmol/L	mg/dl = mmol/L × 38.6
HbA1c	$<7.5\%$	n/a

analyses were performed for some data to calculate overall changes in achievement of a performance measure annually from 2000 to 2008. All data were unadjusted for case-mix.

Results

Mineral and bone parameters

Phosphate

The 4th edition of the Renal Association Clinical Practice Guidelines states:

'Serum phosphate in dialysis patients (measured before a "short gap" dialysis session in HD patients) should be maintained between 1.1 and 1.8 mmol/L.' (Module 2: Complications) [1]

The data for serum phosphate were 95% complete overall for HD patients (table 10.2) with seven centres attaining below 90% completeness (lowest 58%). For PD patients the data were 97% complete overall (table 10.4) but five centres with sufficient eligible patients attained below 90% completeness (lowest 74% complete). The individual centres' means and standard deviations are shown in tables 10.2 and 10.4.

There was between centre variation in the proportion of patients with serum phosphate concentration below, within and above the audit range of 1.1–1.8 mmol/L for HD (figures 10.1–10.6) and PD (figures 10.7–10.12) patients. Overall 55% (CI 55.4–56.0) of HD patients (table 10.3) and 64% (CI 62.5–65.7) of PD patients (table 10.5) achieved the target, showing little change

Table 10.2. Summary statistics for phosphate in haemodialysis patients in 2008

Centre	% completeness	Number of patients	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	98	120	1.40	0.54	1.32	1.00	1.78
B Heart	96	371	1.66	0.55	1.55	1.28	1.92
B QEH	97	715	1.53	0.48	1.48	1.20	1.77
Bangor	97	69	1.61	0.52	1.55	1.29	1.98
Basldn	99	124	1.57	0.46	1.53	1.22	1.84
Belfast	96	230	1.54	0.56	1.54	1.10	1.86
Bradfd	96	172	1.61	0.58	1.56	1.20	1.93
Brightn	89	263	1.53	0.53	1.47	1.15	1.84
Bristol	100	418	1.76	0.53	1.71	1.43	2.03
Camb	58	170	1.54	0.57	1.47	1.15	1.86
Cardff	97	434	1.58	0.53	1.50	1.22	1.83
Carlis	99	74	1.63	0.52	1.52	1.30	1.80
Carsh	99	570	1.53	0.55	1.51	1.19	1.84
Chelms	100	95	1.53	0.41	1.49	1.27	1.76
Clwyd	93	63	1.60	0.63	1.52	1.16	1.92
Colchr	100	103	1.51	0.44	1.47	1.24	1.79
Covnt	98	278	1.52	0.48	1.50	1.16	1.86

Table 10.2. Continued

Centre	% completeness	Number of patients	Mean	SD	Median	Lower quartile	Upper quartile
Derby	99	228	1.54	0.53	1.49	1.18	1.77
Derry	100	52	1.56	0.52	1.46	1.19	1.77
Donc	100	72	1.51	0.55	1.50	1.10	1.70
Dorset	99	185	1.57	0.50	1.51	1.26	1.80
Dudley	87	104	1.57	0.52	1.56	1.23	1.88
Exeter	100	284	1.57	0.48	1.50	1.24	1.84
Glouc	99	141	1.55	0.46	1.50	1.21	1.77
Hull	99	287	1.47	0.55	1.44	1.10	1.80
Ipswi	100	96	1.50	0.45	1.51	1.16	1.79
Kent	99	292	1.49	0.53	1.48	1.10	1.77
L Barts	100	570	1.59	0.54	1.53	1.23	1.89
L Guys	98	472	1.45	0.54	1.40	1.10	1.70
L Kings	100	378	1.49	0.42	1.42	1.20	1.71
L Rfree	84	518	1.51	0.52	1.43	1.15	1.82
L St G	100	204	1.48	0.53	1.41	1.14	1.78
L West	79	909	1.29	0.47	1.24	0.96	1.56
Leeds	99	450	1.56	0.54	1.49	1.17	1.86
Leic	99	673	1.64	0.48	1.59	1.30	1.93
Liv Ain	93	108	1.55	0.60	1.43	1.17	1.85
Liv RI	94	353	1.52	0.51	1.43	1.21	1.79
M Hope	84	241	1.54	0.59	1.45	1.12	1.92
M RI	72	277	1.60	0.61	1.52	1.16	1.91
Middlbr	98	265	1.68	0.53	1.60	1.30	2.00
Newc	100	252	1.51	0.57	1.43	1.15	1.77
Newry	99	87	1.60	0.51	1.55	1.23	1.92
Norwch	99	283	1.50	0.53	1.45	1.16	1.84
Nottm	100	352	1.53	0.48	1.50	1.20	1.80
Oxford	99	324	1.59	0.50	1.58	1.20	1.90
Plymth	97	109	1.51	0.62	1.40	1.07	1.84
Ports	100	411	1.70	0.54	1.65	1.33	2.01
Prestn	100	412	1.64	0.53	1.58	1.28	1.94
Redng	100	232	1.34	0.42	1.29	1.05	1.54
Sheff	100	567	1.65	0.48	1.61	1.31	1.96
Shrew	99	168	1.53	0.50	1.53	1.20	1.79
Stevng	98	336	1.58	0.47	1.55	1.25	1.83
Sthend	99	121	1.56	0.48	1.53	1.19	1.83
Stoke	98	234	1.56	0.51	1.50	1.20	1.89
Sund	96	145	1.70	0.58	1.69	1.31	2.05
Swanse	98	312	1.53	0.53	1.47	1.18	1.81
Truro	100	134	1.70	0.48	1.63	1.36	1.95
Tyrone	100	84	1.43	0.42	1.40	1.18	1.70
Ulster	100	77	1.62	0.47	1.59	1.25	1.87
Wirral	98	159	1.55	0.57	1.50	1.16	1.85
Wolve	99	273	1.50	0.51	1.43	1.15	1.80
Wrexm	100	71	1.52	0.64	1.35	1.12	1.87
York	97	107	1.63	0.59	1.55	1.21	1.84
England	**95**	**15,079**	**1.55**	**0.52**	**1.50**	**1.20**	**1.84**
N Ireland	**98**	**650**	**1.52**	**0.53**	**1.47**	**1.16**	**1.83**
Wales	**97**	**949**	**1.56**	**0.55**	**1.48**	**1.20**	**1.83**
E, W & NI	**95**	**16,678**	**1.55**	**0.53**	**1.49**	**1.20**	**1.84**

Table 10.3. Percentage of haemodialysis patients within, below and above the range for phosphate (1.1–1.8 mmol/L) in 2008

Centre	N	% phos 1.1–1.8 mmol/L	Lower 95% CI	Upper 95% CI	% phos <1.1 mmol/L	Lower 95% CI	Upper 95% CI	% phos >1.8 mmol/L	Lower 95% CI	Upper 95% CI
Antrim	120	48.3	39.5	57.2	29.2	21.7	37.9	22.5	15.9	30.8
B Heart	371	56.9	51.8	61.8	9.4	6.9	12.9	33.7	29.1	38.7
B QEH	715	62.8	59.2	66.3	15.0	12.5	17.8	22.2	19.3	25.4
Bangor	69	52.2	40.5	63.6	14.5	8.0	24.9	33.3	23.3	45.2
Basldn	124	58.1	49.2	66.4	14.5	9.3	21.9	27.4	20.3	35.9
Belfast	230	47.8	41.4	54.3	24.4	19.2	30.3	27.8	22.4	34.0
Bradfd	172	49.4	42.0	56.9	20.4	15.0	27.0	30.2	23.8	37.5
Brightn	263	52.5	46.4	58.4	20.2	15.7	25.4	27.4	22.3	33.1
Bristol	418	48.3	43.6	53.1	7.7	5.5	10.6	44.0	39.3	48.8
Camb	170	51.2	43.7	58.6	20.0	14.7	26.7	28.8	22.5	36.1
Cardff	434	57.1	52.4	61.7	15.7	12.5	19.4	27.2	23.2	31.6
Carlis	74	64.9	53.4	74.9	10.8	5.5	20.2	24.3	15.9	35.3
Carsh	570	52.3	48.2	56.4	19.8	16.8	23.3	27.9	24.4	31.7
Chelms	95	64.2	54.1	73.2	12.6	7.3	20.9	23.2	15.8	32.7
Clwyd	63	52.4	40.2	64.3	17.5	9.9	28.9	30.2	20.1	42.5
Colchr	103	62.1	52.4	71.0	14.6	9.0	22.8	23.3	16.1	32.4
Covnt	278	50.4	44.5	56.2	21.9	17.5	27.2	27.7	22.8	33.3
Derby	228	59.2	52.7	65.4	17.1	12.8	22.6	23.7	18.6	29.6
Derry	52	55.8	42.2	68.6	21.2	12.1	34.3	23.1	13.6	36.4
Donc	72	66.7	55.1	76.6	18.1	10.8	28.7	15.3	8.7	25.5
Dorset	185	61.1	53.9	67.8	14.6	10.2	20.5	24.3	18.7	31.0
Dudley	104	52.9	43.3	62.3	16.4	10.4	24.7	30.8	22.7	40.3
Exeter	284	60.9	55.1	66.4	12.7	9.3	17.1	26.4	21.6	31.8
Glouc	141	63.1	54.9	70.7	12.8	8.2	19.4	24.1	17.8	31.9
Hull	287	50.9	45.1	56.6	24.4	19.8	29.7	24.7	20.1	30.1
Ipswi	96	58.3	48.3	67.8	19.8	13.0	29.0	21.9	14.7	31.2
Kent	292	54.1	48.4	59.8	24.7	20.1	29.9	21.2	16.9	26.3
L Barts	570	54.7	50.6	58.8	14.6	11.9	17.7	30.7	27.1	34.6
L Guys	472	58.9	54.4	63.3	21.2	17.7	25.1	19.9	16.6	23.8
L Kings	378	63.2	58.3	67.9	16.9	13.5	21.1	19.8	16.1	24.2
L Rfree	518	54.6	50.3	58.9	20.1	16.9	23.8	25.3	21.7	29.2
L St G	204	54.9	48.0	61.6	22.1	16.9	28.3	23.0	17.8	29.3
L West	909	51.3	48.0	54.5	36.1	33.0	39.3	12.7	10.6	15.0
Leeds	450	52.4	47.8	57.0	19.3	15.9	23.2	28.2	24.3	32.6
Leic	673	58.0	54.2	61.6	9.7	7.7	12.1	32.4	29.0	36.0
Liv Ain	108	54.6	45.2	63.8	17.6	11.5	25.9	27.8	20.2	37.0
Liv RI	353	60.6	55.4	65.6	15.9	12.4	20.1	23.5	19.4	28.2
M Hope	241	45.2	39.1	51.6	22.8	18.0	28.6	32.0	26.4	38.1
M RI	277	47.3	41.5	53.2	21.3	16.9	26.5	31.4	26.2	37.1
Middlbr	265	58.5	52.5	64.3	9.1	6.1	13.2	32.5	27.1	38.3
Newc	252	55.2	49.0	61.2	22.2	17.5	27.8	22.6	17.9	28.2
Newry	87	57.5	46.9	67.4	11.5	6.3	20.1	31.0	22.2	41.5
Norwch	283	49.8	44.0	55.6	21.9	17.5	27.1	28.3	23.3	33.8
Nottm	352	61.7	56.5	66.6	16.2	12.7	20.4	22.2	18.1	26.8
Oxford	324	55.6	50.1	60.9	14.2	10.8	18.4	30.3	25.5	35.5
Plymth	109	45.9	36.8	55.3	27.5	20.0	36.6	26.6	19.2	35.7
Ports	411	49.6	44.8	54.5	11.4	8.7	14.9	38.9	34.3	43.7
Prestn	412	51.2	46.4	56.0	14.1	11.0	17.8	34.7	30.3	39.4
Redng	232	58.6	52.2	64.8	28.0	22.6	34.1	13.4	9.6	18.4
Sheff	567	53.8	49.7	57.9	12.0	9.6	14.9	34.2	30.4	38.2
Shrew	168	57.7	50.2	65.0	19.1	13.8	25.7	23.2	17.5	30.2
Stevng	336	58.9	53.6	64.1	14.6	11.2	18.8	26.5	22.0	31.5
Sthend	121	57.9	48.9	66.3	14.9	9.6	22.4	27.3	20.1	35.9
Stoke	234	61.5	55.2	67.6	12.8	9.1	17.8	25.6	20.5	31.6

Table 10.3. Continued

Centre	N	% phos 1.1–1.8 mmol/L	Lower 95% CI	Upper 95% CI	% phos <1.1 mmol/L	Lower 95% CI	Upper 95% CI	% phos >1.8 mmol/L	Lower 95% CI	Upper 95% CI
Sund	145	48.3	40.3	56.4	13.8	9.1	20.4	37.9	30.4	46.1
Swanse	312	54.8	49.3	60.3	19.6	15.5	24.3	25.6	21.1	30.8
Truro	134	60.5	52.0	68.4	3.0	1.1	7.7	36.6	28.9	45.0
Tyrone	84	64.3	53.5	73.8	17.9	11.1	27.5	17.9	11.1	27.5
Ulster	77	58.4	47.2	68.9	10.4	5.3	19.4	31.2	21.9	42.3
Wirral	159	53.5	45.7	61.1	20.1	14.6	27.1	26.4	20.2	33.8
Wolve	273	54.6	48.6	60.4	21.3	16.8	26.5	24.2	19.5	29.6
Wrexm	71	42.3	31.4	54.0	23.9	15.4	35.2	33.8	23.8	45.5
York	107	56.1	46.6	65.2	15.9	10.1	24.1	28.0	20.4	37.3
England	**15,079**	**55.4**	**54.6**	**56.2**	**17.7**	**17.1**	**18.3**	**26.9**	**26.2**	**27.6**
N Ireland	**650**	**53.2**	**49.4**	**57.0**	**20.8**	**17.8**	**24.1**	**26.0**	**22.8**	**29.5**
Wales	**949**	**54.6**	**51.4**	**57.7**	**17.6**	**15.3**	**20.2**	**27.8**	**25.1**	**30.8**
E, W & NI	**16,678**	**55.2**	**54.5**	**56.0**	**17.8**	**17.3**	**18.4**	**26.9**	**26.3**	**27.6**

Table 10.4. Summary statistics for phosphate in peritoneal dialysis patients in 2008

Centre	% completeness	Number of patients	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	94	15					
B Heart	100	28	1.42	0.36	1.38	1.18	1.67
B QEH	85	106	1.52	0.47	1.43	1.25	1.76
Bangor	100	29	1.46	0.39	1.41	1.22	1.72
Basldn	100	30	1.43	0.29	1.45	1.22	1.58
Belfast	98	45	1.69	0.5	1.56	1.42	1.92
Bradfd	97	31	1.62	0.39	1.6	1.35	1.83
Brightn	100	80	1.42	0.4	1.43	1.14	1.67
Bristol	100	72	1.69	0.44	1.64	1.37	1.95
Camb	100	40	1.35	0.36	1.32	1.15	1.55
Cardff	99	113	1.53	0.41	1.46	1.25	1.74
Carlis	100	17					
Carsh	98	118	1.59	0.48	1.53	1.28	1.78
Chelms	100	39	1.36	0.36	1.28	1.12	1.64
Clwyd	80	8					
Colchr	n/a	0					
Covnt	86	61	1.5	0.37	1.48	1.26	1.71
Derby	100	75	1.44	0.32	1.39	1.23	1.67
Derry	100	5					
Donc	100	37	1.56	0.43	1.5	1.3	1.8
Dorset	98	49	1.42	0.25	1.41	1.26	1.57
Dudley	98	46	1.55	0.4	1.58	1.29	1.76
Exeter	100	71	1.55	0.46	1.47	1.29	1.73
Glouc	100	33	1.63	0.34	1.6	1.5	1.81
Hull	97	70	1.59	0.33	1.59	1.37	1.79
Ipswi	98	48	1.79	0.5	1.71	1.43	2.02
Kent	97	70	1.49	0.39	1.43	1.3	1.61
L Barts	100	208	1.51	0.47	1.46	1.14	1.81
L Guys	98	49	1.51	0.35	1.5	1.3	1.7
L Kings	100	72	1.54	0.38	1.48	1.25	1.78
L Rfree	89	75	1.49	0.36	1.49	1.22	1.74
L St G	98	50	1.44	0.46	1.32	1.12	1.63
L West	100	42	1.55	0.47	1.48	1.22	1.8
Leeds	99	86	1.57	0.44	1.6	1.28	1.83

Table 10.4. Continued

Centre	% completeness	Number of patients	Mean	SD	Median	Lower quartile	Upper quartile
Leic	99	156	1.56	0.45	1.54	1.24	1.84
Liv Ain	50	1					
Liv RI	90	85	1.49	0.4	1.45	1.19	1.75
M Hope	98	116	1.62	0.5	1.52	1.29	1.95
M RI	100	91	1.55	0.55	1.48	1.18	1.86
Middlbr	91	20	1.54	0.39	1.51	1.23	1.8
Newc	98	44	1.6	0.45	1.58	1.34	1.9
Newry	100	10					
Norwch	93	55	1.5	0.35	1.44	1.2	1.77
Nottm	99	110	1.53	0.38	1.5	1.3	1.8
Oxford	99	106	1.59	0.39	1.58	1.24	1.84
Plymth	100	45	1.48	0.37	1.43	1.18	1.74
Ports	92	70	1.78	0.49	1.73	1.45	2.06
Prestn	98	57	1.68	0.44	1.64	1.33	1.94
Redng	100	75	1.4	0.35	1.41	1.24	1.6
Sheff	100	71	1.6	0.38	1.55	1.38	1.88
Shrew	94	30	1.62	0.34	1.65	1.47	1.86
Stevng	97	36	1.56	0.43	1.49	1.29	1.7
Sthend	93	14					
Stoke	100	72	1.53	0.38	1.5	1.3	1.8
Sund	100	20	1.48	0.44	1.52	1.29	1.84
Swanse	98	59	1.4	0.33	1.33	1.15	1.64
Truro	100	26	1.68	0.46	1.57	1.29	2.11
Tyrone	100	7					
Ulster	100	5					
Wirral	74	25	1.54	0.4	1.54	1.26	1.72
Wolve	100	57	1.44	0.42	1.41	1.13	1.64
Wrexm	95	21	1.71	0.59	1.63	1.38	1.88
York	100	19					
England	**97**	**3,104**	**1.54**	**0.43**	**1.5**	**1.26**	**1.8**
N Ireland	**98**	**87**	**1.62**	**0.42**	**1.57**	**1.39**	**1.84**
Wales	**98**	**230**	**1.51**	**0.41**	**1.45**	**1.23**	**1.73**
E, W & NI	**97**	**3,421**	**1.54**	**0.42**	**1.5**	**1.25**	**1.79**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness
n/a not applicable

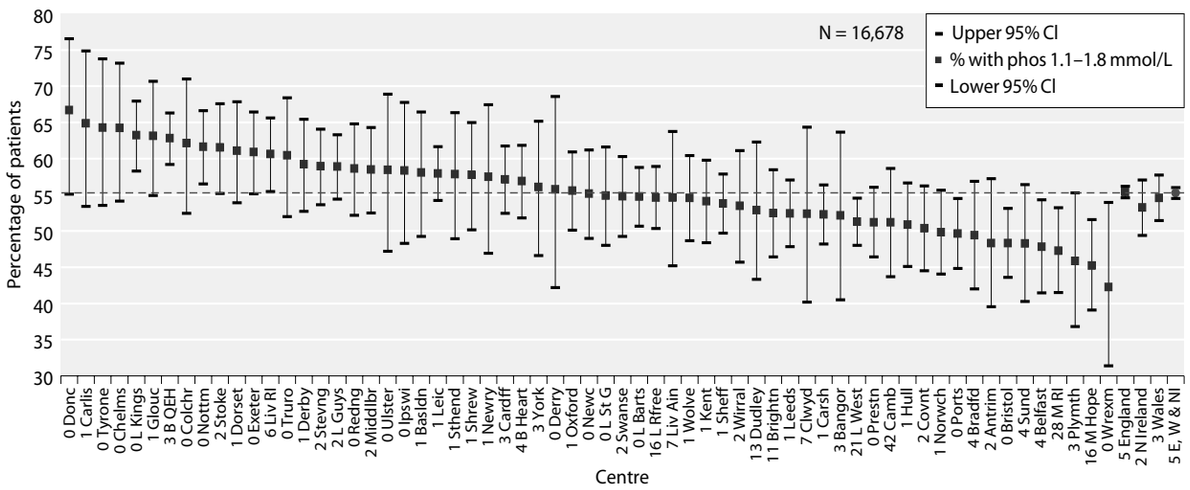

Fig. 10.1. Percentage of haemodialysis patients with phosphate 1.1–1.8 mmol/L by centre in 2008

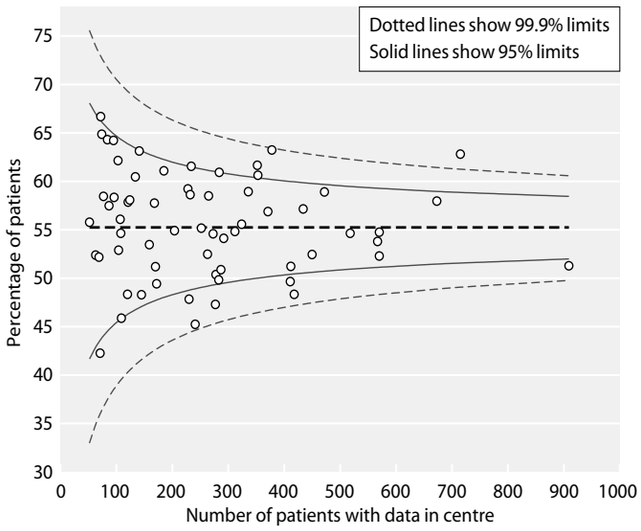

Fig. 10.2. Funnel plot of percentage of haemodialysis patients with phosphate 1.1–1.8 mmol/L by centre in 2008

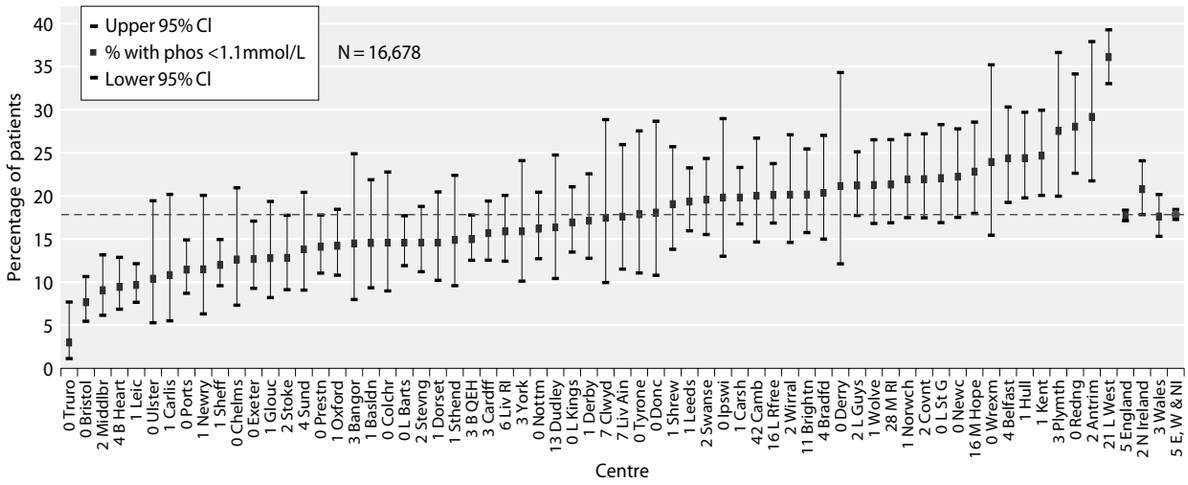

Fig. 10.3. Percentage of haemodialysis patients with phosphate <1.1 mmol/L by centre in 2008

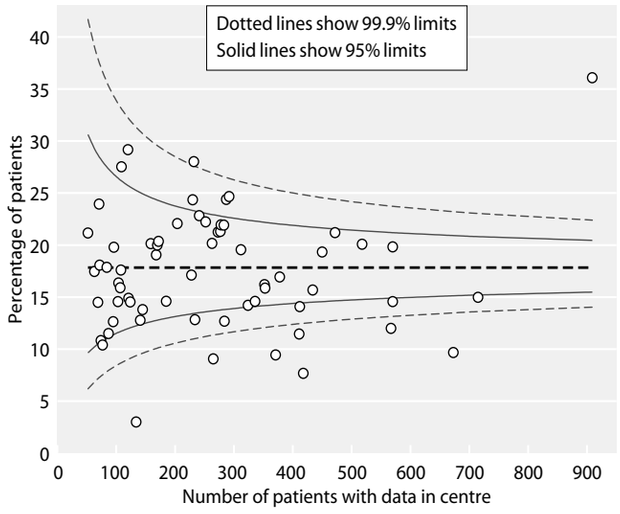

Fig. 10.4. Funnel plot of percentage of haemodialysis patients with phosphate <1.1 mmol/L by centre in 2008

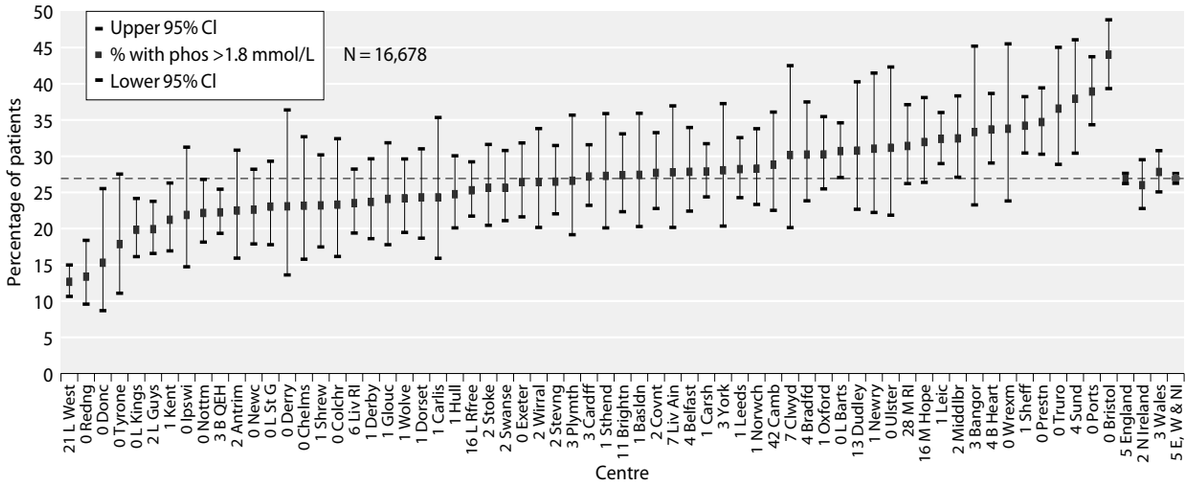

Fig. 10.5. Percentage of haemodialysis patients with phosphate >1.8 mmol/L by centre in 2008

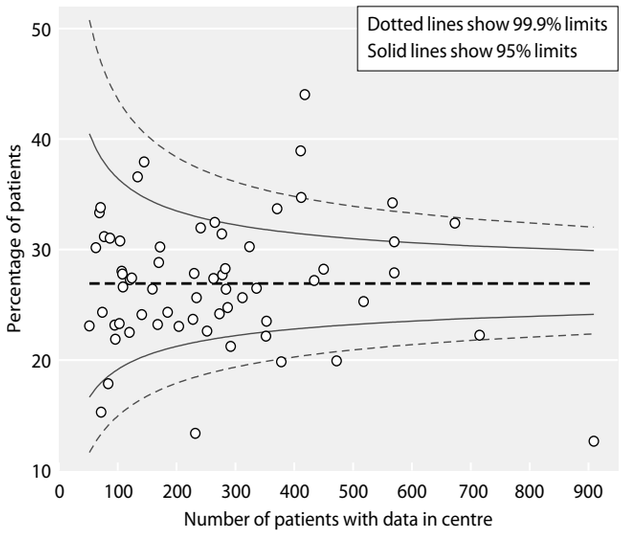

Fig. 10.6. Funnel plot of percentage of haemodialysis patients with phosphate >1.8 mmol/L by centre in 2008

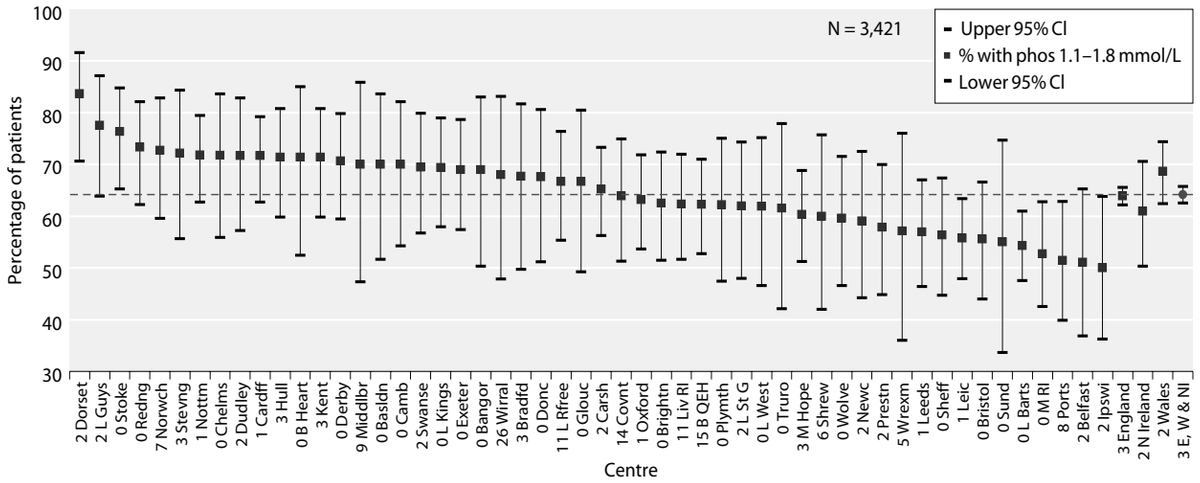

Fig. 10.7. Percentage of peritoneal dialysis patients with phosphate 1.1–1.8 mmol/L by centre in 2008

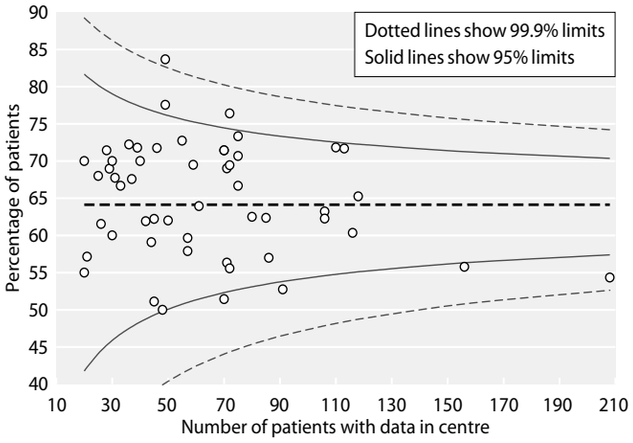

Fig. 10.8. Funnel plot of percentage of peritoneal dialysis patients with phosphate 1.1–1.8 mmol/L by centre in 2008

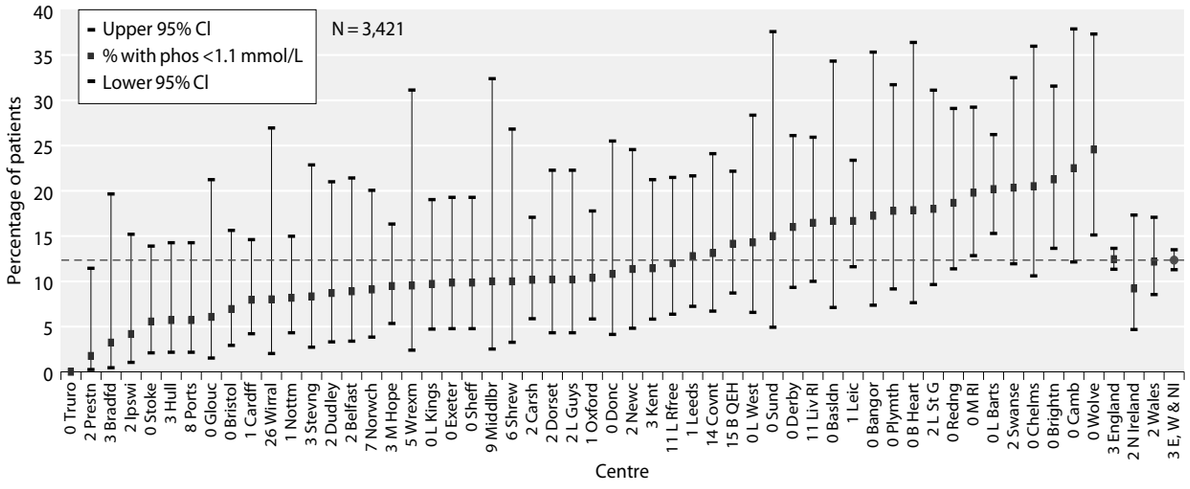

Fig. 10.9. Percentage of peritoneal dialysis patients with phosphate <1.1 mmol/L by centre in 2008

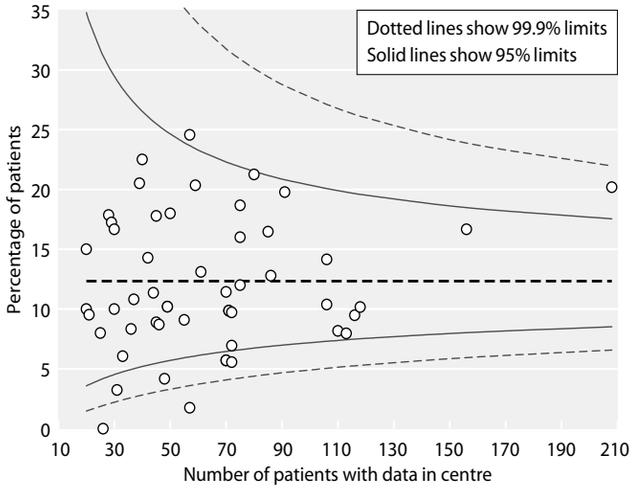

Fig. 10.10. Funnel plot of percentage of peritoneal dialysis patients with phosphate <1.1 mmol/L by centre in 2008

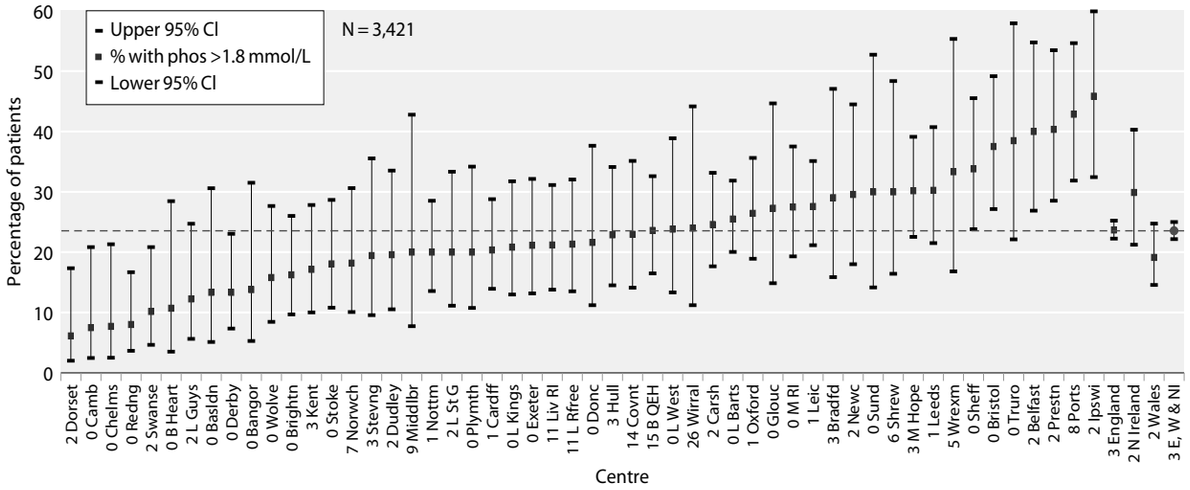

Fig. 10.11. Percentage of peritoneal dialysis patients with phosphate >1.8 mmol/L by centre in 2008

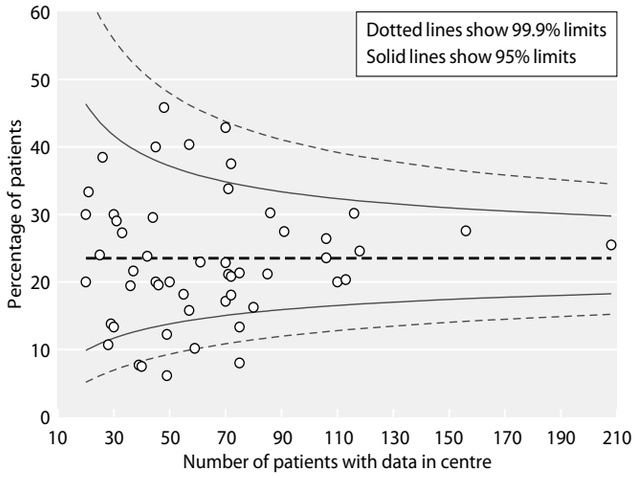

Fig. 10.12. Funnel plot of percentage of peritoneal dialysis patients with phosphate >1.8 mmol/L by centre in 2008

Table 10.5. Percentage of peritoneal dialysis patients within, below and above the range for phosphate (1.1–1.8 mmol/L) in 2008

Centre	N	% phos 1.1–1.8 mmol/L	Lower 95% CI	Upper 95% CI	% phos <1.1 mmol/L	Lower 95% CI	Upper 95% CI	% phos >1.8 mmol/L	Lower 95% CI	Upper 95% CI
B Heart	28	71.4	52.4	85.0	17.9	7.6	36.4	10.7	3.5	28.4
B QEH	106	62.3	52.7	71.0	14.2	8.7	22.2	23.6	16.5	32.6
Bangor	29	69.0	50.3	83.0	17.2	7.4	35.3	13.8	5.3	31.5
Basldn	30	70.0	51.7	83.6	16.7	7.1	34.3	13.3	5.1	30.6
Belfast	45	51.1	36.8	65.2	8.9	3.4	21.4	40.0	26.9	54.8
Bradfd	31	67.7	49.7	81.7	3.2	0.5	19.6	29.0	15.9	47.1
Brightn	80	62.5	51.5	72.4	21.3	13.6	31.6	16.3	9.7	26.0
Bristol	72	55.6	44.0	66.6	6.9	2.9	15.6	37.5	27.1	49.2
Camb	40	70.0	54.3	82.1	22.5	12.1	37.9	7.5	2.4	20.8

Table 10.5. Continued

Centre	N	% phos 1.1–1.8 mmol/L	Lower 95% CI	Upper 95% CI	% phos <1.1 mmol/L	Lower 95% CI	Upper 95% CI	% phos >1.8 mmol/L	Lower 95% CI	Upper 95% CI
Cardff	113	71.7	62.7	79.2	8.0	4.2	14.6	20.4	13.9	28.8
Carsh	118	65.3	56.3	73.3	10.2	5.9	17.1	24.6	17.7	33.1
Chelms	39	71.8	55.9	83.6	20.5	10.6	36.0	7.7	2.5	21.3
Covnt	61	63.9	51.3	74.9	13.1	6.7	24.1	23.0	14.1	35.1
Derby	75	70.7	59.4	79.8	16.0	9.3	26.1	13.3	7.3	23.0
Donc	37	67.6	51.1	80.6	10.8	4.1	25.5	21.6	11.2	37.6
Dorset	49	83.7	70.6	91.6	10.2	4.3	22.3	6.1	2.0	17.3
Dudley	46	71.7	57.2	82.8	8.7	3.3	21.0	19.6	10.5	33.5
Exeter	71	69.0	57.4	78.7	9.9	4.8	19.3	21.1	13.2	32.1
Glouc	33	66.7	49.2	80.5	6.1	1.5	21.2	27.3	14.8	44.7
Hull	70	71.4	59.8	80.8	5.7	2.2	14.3	22.9	14.5	34.1
Ipswi	48	50.0	36.2	63.8	4.2	1.0	15.2	45.8	32.4	59.9
Kent	70	71.4	59.8	80.8	11.4	5.8	21.2	17.1	10.0	27.8
L Barts	208	54.3	47.5	61.0	20.2	15.3	26.2	25.5	20.0	31.8
L Guys	49	77.6	63.8	87.1	10.2	4.3	22.3	12.2	5.6	24.7
L Kings	72	69.4	57.9	79.0	9.7	4.7	19.0	20.8	13.0	31.7
L Rfree	75	66.7	55.3	76.4	12.0	6.4	21.5	21.3	13.5	32.0
L St G	50	62.0	48.0	74.3	18.0	9.6	31.1	20.0	11.1	33.3
L West	42	61.9	46.6	75.2	14.3	6.6	28.3	23.8	13.3	38.9
Leeds	86	57.0	46.4	67.0	12.8	7.2	21.6	30.2	21.5	40.7
Leic	156	55.8	47.9	63.4	16.7	11.6	23.4	27.6	21.1	35.1
Liv RI	85	62.4	51.6	72.0	16.5	10.0	25.9	21.2	13.8	31.1
M Hope	116	60.3	51.2	68.8	9.5	5.3	16.3	30.2	22.5	39.1
M RI	91	52.8	42.5	62.8	19.8	12.8	29.2	27.5	19.3	37.5
Middlbr	20	70.0	47.3	85.9	10.0	2.5	32.4	20.0	7.7	42.8
Newc	44	59.1	44.2	72.5	11.4	4.8	24.5	29.6	18.0	44.5
Norwch	55	72.7	59.6	82.8	9.1	3.8	20.1	18.2	10.1	30.6
Nottm	110	71.8	62.7	79.4	8.2	4.3	15.0	20.0	13.6	28.5
Oxford	106	63.2	53.7	71.8	10.4	5.8	17.8	26.4	18.9	35.6
Plymth	45	62.2	47.4	75.1	17.8	9.2	31.7	20.0	10.8	34.2
Ports	70	51.4	39.9	62.9	5.7	2.2	14.3	42.9	31.8	54.6
Prestn	57	57.9	44.8	69.9	1.8	0.3	11.4	40.4	28.5	53.5
Redng	75	73.3	62.2	82.1	18.7	11.4	29.1	8.0	3.6	16.7
Sheff	71	56.3	44.7	67.4	9.9	4.8	19.3	33.8	23.8	45.5
Shrew	30	60.0	42.0	75.7	10.0	3.3	26.8	30.0	16.4	48.3
Stevng	36	72.2	55.6	84.4	8.3	2.7	22.9	19.4	9.6	35.5
Stoke	72	76.4	65.3	84.8	5.6	2.1	13.9	18.1	10.8	28.7
Sund	20	55.0	33.6	74.7	15.0	4.9	37.6	30.0	14.1	52.7
Swanse	59	69.5	56.7	79.9	20.3	11.9	32.5	10.2	4.6	20.8
Truro	26	61.5	42.1	77.9	0.0	0.0	0.0	38.5	22.1	57.9
Wirral	25	68.0	47.8	83.1	8.0	2.0	26.9	24.0	11.2	44.2
Wolve	57	59.7	46.6	71.5	24.6	15.1	37.3	15.8	8.4	27.7
Wrexm	21	57.1	36.0	76.0	9.5	2.4	31.1	33.3	16.8	55.3
England	**3,104**	**63.9**	**62.2**	**65.6**	**12.4**	**11.3**	**13.6**	**23.7**	**22.2**	**25.2**
N Ireland	**87**	**60.9**	**50.3**	**70.6**	**9.2**	**4.7**	**17.3**	**29.9**	**21.2**	**40.3**
Wales	**230**	**68.7**	**62.4**	**74.4**	**12.2**	**8.5**	**17.1**	**19.1**	**14.6**	**24.7**
E, W & NI	**3,421**	**64.1**	**62.5**	**65.7**	**12.3**	**11.3**	**13.5**	**23.5**	**22.1**	**25.0**

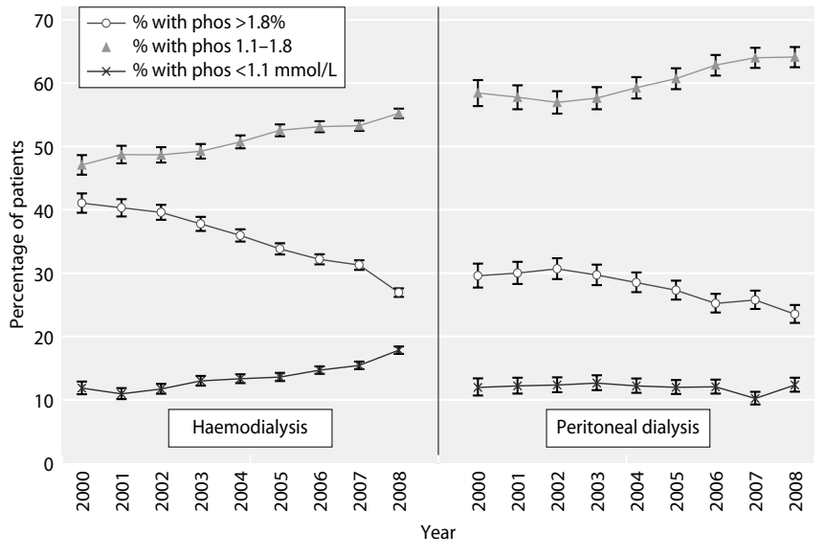

Fig. 10.13. Longitudinal change in percentage of patients with phosphate <1.1 mmol/L, 1.1–1.8 mmol/L and >1.8 mmol/L by dialysis modality 2000–2008

from the numbers in 2007 (53% and 64% respectively). Table 10.3 can be used to identify centres in each funnel plot of phosphate achievement in HD patients (figures 10.2, 10.4, 10.6). The funnel plots for patients within the audit target showed two centres performing significantly better than the national data, Birmingham (QEH) for HD (figure 10.2) and Dorset for PD (figure 10.8).

The mean proportion of HD patients with serum phosphate levels above the upper limit of the target range (1.8 mmol/L) was 27% (CI 26.3–27.6) and below the lower limit (1.1 mmol/L) was 18% (CI 17–18), continuing the gradual improvement in serum phosphate control over the last nine years (figure 10.13). The funnel plot showing the percentage of HD patients with serum phosphate above 1.8 mmol/L (figure 10.6) showed four centres with significantly higher percentages of patients above range (Portsmouth, Bristol, Sheffield, Preston) and four with significantly fewer (Reading, London Guys, London Kings, London West). For the analysis of patients with serum phosphate below 1.1 mmol/L, the funnel plot displayed considerable heterogeneity (figure 10.4) with two centres having significantly higher percentages of patients with low phosphate (Reading, London West). London West had a large percentage (36.1%) of patients with low phosphate although the completeness of data from this centre was relatively low at 78.6%. Seven centres had significantly fewer hypophosphataemic patients (Truro, Middlesbrough, Birmingham Heartlands, Portsmouth, Bristol, Sheffield and Leicester) than the national average. This probably represents a higher median value and range in these centres rather than specific measures to avoid hypophosphataemia. Table 10.4 can be used to identify centres in each funnel plot of phosphate achievement in PD patients (figures 10.8, 10.10, 10.12). The proportion of PD patients above 1.8 mmol/L was 24% (CI 22–25), a continuing improvement on previous years, while below 1.1 mmol/L was 12% (CI 11–14), a figure that appears stable (figure 10.13). The funnel plot for patients with serum phosphate above 1.8 mmol/L (figure 10.12) showed no centres with significantly more but four centres with significantly fewer patients with hyperphosphataemia (Cambridge, Chelmsford, Dorset, Reading). There were no centres with more hypophosphateamic patients but two centres with significantly fewer hypophosphataemic patients (Truro, Preston) (figure 10.10).

Centres should take the opportunity to review the way their blood samples are stored before reaching the laboratory, particularly if the delay is greater than eight hours or if the temperature at which the sample is stored before centrifugation is higher than 25°C [6, 7]. Delays in centrifugation lead to significant increases in serum phosphate due to release of intracellular stores and from organic phosphate esters. If blood samples cannot reach the laboratory within eight hours and at an ambient temperature less than 25°C, centres should centrifuge the samples to preserve them. Centres returning an excessively high percentage of patients with serum phosphate above target should consider whether a delay in sample processing may be a contributing factor. Centres returning a low percentage below target should also consider whether a delay in sample processing may be spuriously increasing the serum phosphate. This might be particularly relevant for the three centres (Portsmouth, Bristol, Sheffield) which, in the funnel

plots for HD, are both high outliers for the percentage of patients above 1.8 mmol/L and low outliers for the percentage of patients below 1.1 mmol/L. There remains large variation in centre level attainment of phosphate control which if laboratory processing errors have been excluded must represent differences in clinical practices.

Adjusted calcium

The 4th edition of the Renal Association Clinical Practice Guidelines states:

'Serum calcium, adjusted for albumin concentration should be maintained within the normal reference range for the laboratory used (measured before a "short gap" dialysis session in HD patients) and ideally maintained between 2.2 and 2.5 mmol/L.' (Module 2: Complications) [1] (Note that previous UKRR reports have used an adjusted calcium of 2.2–2.6 mmol/L as the target range).

The data for adjusted serum calcium were 95% complete overall for HD patients (table 10.6) with eight centres attaining below 90% completeness (lowest 58%). For PD patients, the data were 97% complete overall (table 10.8) but three centres with sufficient eligible patients attained below 90% completeness (lowest 74% complete). The individual centres' means and standard deviations are shown in tables 10.6 and 10.8.

There was between centre variation in the proportion of patients below, within and above the audit range of 2.2–2.5 mmol/L for HD (figures 10.14–10.17) and PD (figures 10.18–10.22) patients. Overall 63% (CI 62–64) of HD patients (table 10.7) and 65% (CI 64–67) of PD patients (table 10.9) achieved the target, substantially less than the numbers in 2007 (73% and 78% respectively) using the previous target of 2.2–2.6 mmol/L. For comparative purposes, the previous target of 2.2–2.6 mmol/L was achieved by 74% of HD patients and 78% of PD patients, indicating that the previous standards had been maintained. Table 10.7 can be used to identify centres in the funnel plot of calcium achievement in HD patients (figure 10.15) and table 10.9 in PD patients (figures 10.19, 10.22). The funnel plot for patients within the audit target showed two centres achieved the target in significantly more HD patients (Ulster and London West) and two centres achieved the target in significantly fewer HD patients (Bristol and the Royal Free) (figure 10.15). In PD patients Brighton achieved the target in significantly more patients whilst Nottingham and Bristol achieved the target in significantly fewer patients (figure 10.19).

The proportion of HD patients above the 2.5 mmol/L target was 19% (CI 17.9–19.1) and below 2.2 mmol/L was 19% (CI 18.0–19.2) (figure 10.23). For comparison with previous years, 8% were above the previous 2.6 mmol/L target (figure 10.24). The proportion of PD patients above 2.5 mmol/L was 23% (CI 21–24) (figure 10.23) and 10% were above 2.6 mmol/L (figure 10.24), while the proportion below 2.2 mmol/L was 12% (CI 11–13), (figure 10.23). These data show that the proportions below the lower target limit has remained constant for HD and PD patients. The proportion of patients above the previous 2.6 mmol/L target has not increased and it is anticipated that as the new guidelines are implemented there will be improvements in the proportions attaining the new target.

Table 10.6. Summary statistics for adjusted calcium in haemodialysis patients in 2008

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	98	120	2.33	0.16	2.33	2.21	2.42
B Heart	96	371	2.27	0.19	2.28	2.15	2.4
B QEH	98	717	2.34	0.2	2.34	2.22	2.45
Bangor	97	69	2.36	0.16	2.37	2.26	2.48
Basldn	99	124	2.42	0.12	2.43	2.35	2.51
Belfast	96	230	2.34	0.17	2.33	2.23	2.45
Bradfd	96	173	2.39	0.19	2.36	2.28	2.49
Brightn	71	210	2.27	0.19	2.29	2.15	2.41
Bristol	100	418	2.5	0.16	2.5	2.39	2.5
Camb	58	170	2.34	0.18	2.32	2.23	2.45
Cardff	97	433	2.35	0.19	2.34	2.23	2.45
Carlis	99	74	2.23	0.22	2.22	2.12	2.33
Carsh	99	570	2.27	0.21	2.27	2.17	2.37

Table 10.6. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Chelms	100	95	2.37	0.2	2.38	2.28	2.51
Clwyd	93	63	2.37	0.16	2.37	2.27	2.48
Colchr	100	103	2.43	0.15	2.4	2.35	2.51
Covnt	98	280	2.33	0.18	2.3	2.21	2.43
Derby	99	228	2.39	0.17	2.4	2.29	2.49
Derry	100	52	2.4	0.13	2.41	2.33	2.48
Donc	100	72	2.42	0.13	2.44	2.35	2.49
Dorset	100	187	2.39	0.23	2.37	2.26	2.52
Dudley	87	104	2.3	0.22	2.32	2.19	2.42
Exeter	100	284	2.35	0.21	2.35	2.23	2.46
Glouc	100	142	2.37	0.18	2.35	2.24	2.45
Hull	99	287	2.41	0.18	2.39	2.3	2.52
Ipswi	100	96	2.35	0.15	2.33	2.27	2.45
Kent	99	292	2.46	0.17	2.5	2.4	2.5
L Barts	100	570	2.3	0.21	2.29	2.17	2.43
L Guys	98	472	2.33	0.19	2.32	2.22	2.43
L Kings	100	378	2.26	0.16	2.27	2.17	2.34
L Rfree	84	519	2.26	0.19	2.26	2.14	2.37
L St G	100	204	2.41	0.16	2.42	2.3	2.52
L West	78	908	2.34	0.16	2.35	2.25	2.44
Leeds	99	449	2.41	0.17	2.41	2.31	2.51
Leic	99	672	2.36	0.18	2.36	2.24	2.46
Liv Ain	93	108	2.42	0.15	2.42	2.34	2.51
Liv RI	94	353	2.38	0.22	2.38	2.27	2.5
M Hope	84	241	2.29	0.19	2.28	2.18	2.41
M RI	72	279	2.27	0.19	2.27	2.16	2.37
Middlbr	98	265	2.32	0.21	2.34	2.2	2.45
Newc	100	252	2.4	0.19	2.39	2.29	2.48
Newry	99	87	2.28	0.18	2.28	2.16	2.4
Norwch	99	283	2.44	0.16	2.42	2.34	2.53
Nottm	100	352	2.45	0.19	2.45	2.33	2.55
Oxford	99	324	2.39	0.19	2.4	2.27	2.52
Plymth	97	109	2.34	0.18	2.34	2.23	2.44
Ports	100	411	2.37	0.17	2.37	2.27	2.48
Prestn	100	412	2.31	0.21	2.31	2.19	2.45
Redng	100	232	2.3	0.14	2.29	2.22	2.38
Sheff	99	567	2.3	0.17	2.3	2.2	2.4
Shrew	99	169	2.3	0.18	2.3	2.2	2.4
Stevng	98	336	2.39	0.17	2.38	2.29	2.51
Sthend	99	121	2.38	0.19	2.39	2.27	2.49
Stoke	100	240	2.38	0.17	2.38	2.3	2.48
Sund	96	145	2.43	0.18	2.43	2.35	2.54
Swanse	98	312	2.27	0.17	2.27	2.17	2.38
Truro	100	134	2.37	0.17	2.35	2.26	2.44
Tyrone	100	84	2.45	0.18	2.46	2.34	2.55
Ulster	100	77	2.4	0.12	2.42	2.34	2.48
Wirral	98	159	2.4	0.16	2.39	2.3	2.48
Wolve	100	274	2.35	0.22	2.33	2.22	2.46
Wrexm	100	71	2.45	0.16	2.48	2.32	2.57
York	87	96	2.37	0.14	2.39	2.31	2.45
England	**94**	**15,031**	**2.35**	**0.19**	**2.35**	**2.23**	**2.47**
N Ireland	**98**	**650**	**2.36**	**0.17**	**2.36**	**2.24**	**2.47**
Wales	**97**	**948**	**2.33**	**0.18**	**2.33**	**2.22**	**2.44**
E, W & NI	**95**	**16,629**	**2.35**	**0.19**	**2.35**	**2.23**	**2.47**

Table 10.7. Percentage of haemodialysis patients within, below and above the range for adjusted calcium (2.2–2.5 mmol/L) in 2008

Centre	Total	% adjusted Ca 2.2–2.5 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca <2.2 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca >2.5 mmol/L	Lower 95% CI	Upper 95% CI
Antrim	120	66.7	57.8	74.5	21.7	15.2	29.9	11.7	7.0	18.7
B Heart	371	55.3	50.2	60.2	33.2	28.6	38.1	11.6	8.7	15.3
B QEH	717	61.4	57.8	64.9	20.2	17.4	23.3	18.4	15.7	21.4
Bangor	69	63.8	51.9	74.2	14.5	8.0	24.9	21.7	13.6	33.0
Basldn	124	71.0	62.4	78.3	4.0	1.7	9.3	25.0	18.2	33.4
Belfast	230	67.4	61.1	73.1	17.4	13.0	22.8	15.2	11.1	20.5
Bradfd	173	69.4	62.1	75.8	8.7	5.3	13.9	22.0	16.4	28.8
Brightn	210	57.6	50.8	64.1	32.9	26.8	39.5	9.5	6.2	14.3
Bristol	418	48.8	44.0	53.6	2.5	1.5	4.7	48.6	43.8	53.4
Camb	170	64.1	56.6	71.0	18.8	13.6	25.4	17.1	12.1	23.5
Cardff	433	64.0	59.3	68.4	18.9	15.5	22.9	17.1	13.8	20.9
Carlis	74	47.3	36.3	58.6	43.2	32.5	54.7	9.5	4.6	18.5
Carsh	570	56.7	52.6	60.7	33.5	29.8	37.5	9.8	7.6	12.6
Chelms	95	55.8	45.7	65.4	19.0	12.3	28.1	25.3	17.6	34.9
Clwyd	63	66.7	54.2	77.2	12.7	6.5	23.4	20.6	12.4	32.4
Colchr	103	68.0	58.4	76.2	5.8	2.5	12.4	26.2	18.6	35.5
Covnt	280	61.8	56.0	67.3	23.9	19.3	29.3	14.3	10.7	18.9
Derby	228	68.4	62.1	74.1	9.7	6.4	14.2	21.9	17.0	27.8
Derry	52	78.9	65.7	87.9	7.7	2.9	18.8	13.5	6.6	25.7
Donc	72	75.0	63.8	83.6	6.9	2.9	15.6	18.1	10.8	28.7
Dorset	187	55.6	48.4	62.6	17.1	12.4	23.2	27.3	21.4	34.1
Dudley	104	58.7	49.0	67.7	26.0	18.5	35.2	15.4	9.6	23.7
Exeter	284	60.6	54.8	66.1	20.4	16.1	25.5	19.0	14.9	24.0
Glouc	142	69.0	61.0	76.1	13.4	8.7	20.0	17.6	12.2	24.8
Hull	287	62.7	57.0	68.1	10.1	7.1	14.2	27.2	22.3	32.5
Ipswi	96	76.0	66.5	83.5	10.4	5.7	18.3	13.5	8.0	21.9
Kent	292	69.2	63.7	74.2	2.4	1.2	4.9	28.4	23.6	33.9
L Barts	570	56.1	52.0	60.2	28.4	24.9	32.3	15.4	12.7	18.6
L Guys	472	67.0	62.6	71.1	18.2	15.0	22.0	14.8	11.9	18.3
L Kings	378	63.0	58.0	67.7	30.2	25.7	35.0	6.9	4.7	9.9
L Rfree	519	55.3	51.0	59.5	34.9	30.9	39.1	9.8	7.6	12.7
L St G	204	63.2	56.4	69.6	10.3	6.8	15.3	26.5	20.9	33.0
L West	908	69.5	66.4	72.4	16.4	14.1	19.0	14.1	12.0	16.5
Leeds	449	63.9	59.4	68.2	8.9	6.6	11.9	27.2	23.3	31.5
Leic	672	64.0	60.3	67.5	17.7	15.0	20.8	18.3	15.6	21.4
Liv Ain	108	67.6	58.2	75.7	5.6	2.5	11.8	26.9	19.4	36.0
Liv RI	353	60.3	55.1	65.3	15.6	12.2	19.8	24.1	19.9	28.8
M Hope	241	56.4	50.1	62.6	29.9	24.4	36.0	13.7	9.9	18.6
M RI	279	57.4	51.5	63.0	32.5	27.4	38.3	10.0	7.0	14.2
Middlbr	265	65.7	59.7	71.1	20.8	16.3	26.1	13.6	10.0	18.3
Newc	252	69.1	63.1	74.5	9.9	6.8	14.3	21.0	16.4	26.5
Newry	87	58.6	48.0	68.5	31.0	22.2	41.5	10.3	5.5	18.7
Norwch	283	68.9	63.3	74.0	3.2	1.7	6.0	27.9	23.0	33.4
Nottm	352	57.1	51.9	62.2	7.4	5.1	10.6	35.5	30.7	40.7
Oxford	324	58.3	52.9	63.6	13.6	10.3	17.8	28.1	23.5	33.2
Plymth	109	66.1	56.7	74.3	19.3	12.9	27.8	14.7	9.2	22.5
Ports	411	69.8	65.2	74.1	11.0	8.3	14.4	19.2	15.7	23.3
Prestn	412	55.3	50.5	60.1	27.4	23.3	31.9	17.2	13.9	21.2
Redng	232	72.4	66.3	77.8	19.8	15.2	25.5	7.8	4.9	12.0
Sheff	567	67.0	63.0	70.8	24.3	21.0	28.0	8.6	6.6	11.3
Shrew	169	73.4	66.2	79.5	16.0	11.2	22.3	10.7	6.8	16.3
Stevng	336	62.2	56.9	67.2	12.8	9.6	16.8	25.0	20.7	29.9
Sthend	121	63.6	54.7	71.7	13.2	8.3	20.5	23.1	16.5	31.5
Stoke	240	68.3	62.2	73.9	13.8	9.9	18.7	17.9	13.6	23.3
Sund	145	60.0	51.8	67.7	8.3	4.8	14.0	31.7	24.7	39.7

Table 10.7. Continued

Centre	Total	% adjusted Ca 2.2–2.5 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca <2.2 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca >2.5 mmol/L	Lower 95% CI	Upper 95% CI
Swanse	312	60.3	54.7	65.5	32.6	27.7	38.1	7.1	4.7	10.5
Truro	1340	64.9	56.5	72.5	13.4	8.6	20.3	21.6	15.5	29.4
Tyrone	84	58.3	47.6	68.4	3.6	1.2	10.5	38.1	28.4	48.9
Ulster	77	83.1	73.1	89.9	2.5	0.7	9.8	14.3	8.1	24.0
Wirral	159	69.2	61.6	75.9	10.1	6.3	15.8	20.8	15.2	27.8
Wolve	274	63.1	57.3	68.7	20.4	16.1	25.6	16.4	12.5	21.3
Wrexm	710	49.3	37.9	60.8	5.6	2.1	14.1	45.1	34.0	56.7
York	96	76.0	66.5	83.5	11.5	6.5	19.5	12.5	7.2	20.7
England	**15,031**	**62.8**	**62.0**	**63.5**	**18.5**	**17.8**	**19.1**	**18.8**	**18.2**	**19.4**
N Ireland	**650**	**67.7**	**64.0**	**71.2**	**15.7**	**13.1**	**18.7**	**16.6**	**14.0**	**19.7**
Wales	**948**	**61.8**	**58.7**	**64.9**	**21.7**	**19.2**	**24.5**	**16.5**	**14.2**	**19.0**
E, W & NI	**16,629**	**62.9**	**62.2**	**63.6**	**18.5**	**17.9**	**19.1**	**18.6**	**18.0**	**19.2**

Table 10.8. Summary statistics for adjusted calcium in peritoneal dialysis patients in 2008

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	94	15					
B Heart	100	28	2.29	0.17	2.31	2.19	2.39
B QEH	86	107	2.33	0.17	2.31	2.21	2.43
Bangor	100	29	2.4	0.12	2.42	2.37	2.49
Basldn	100	30	2.44	0.14	2.41	2.37	2.53
Belfast	98	45	2.35	0.19	2.34	2.22	2.44
Bradfd	97	31	2.43	0.11	2.42	2.35	2.52
Brightn	100	80	2.37	0.13	2.35	2.3	2.45
Bristol	100	72	2.51	0.16	2.51	2.43	2.5
Camb	100	40	2.34	0.15	2.32	2.24	2.43
Cardff	99	113	2.35	0.15	2.35	2.28	2.45
Carlis	100	17					
Carsh	98	118	2.34	0.19	2.33	2.21	2.44
Chelms	100	39	2.42	0.18	2.39	2.27	2.57
Clwyd	80	8					
Colch	n/a	0					
Covnt	96	68	2.32	0.14	2.3	2.21	2.43
Derby	100	75	2.42	0.14	2.44	2.33	2.52
Derry	100	5					
Donc	100	37	2.48	0.13	2.48	2.39	2.57
Dorset	98	49	2.41	0.12	2.42	2.33	2.5
Dudley	98	46	2.36	0.18	2.35	2.26	2.47
Exeter	100	71	2.35	0.21	2.37	2.25	2.46
Glouc	100	33	2.44	0.13	2.44	2.35	2.54
Hull	97	70	2.46	0.11	2.46	2.42	2.53
Ipswi	98	48	2.37	0.16	2.38	2.32	2.46
Kent	99	71	2.54	0.16	2.5	2.4	2.52
L Barts	100	208	2.35	0.18	2.34	2.24	2.45
L Guys	98	49	2.36	0.16	2.37	2.3	2.46
L Kings	100	72	2.3	0.14	2.29	2.2	2.39
L Rfree	89	75	2.35	0.17	2.31	2.23	2.46
L St G	98	50	2.47	0.16	2.46	2.38	2.57
L West	100	42	2.44	0.19	2.41	2.33	2.51
Leeds	99	86	2.43	0.15	2.45	2.36	2.51
Leic	99	156	2.38	0.16	2.4	2.28	2.48

Table 10.8. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Liv Ain	50	1					
Liv RI	90	85	2.41	0.17	2.41	2.3	2.5
M Hope	98	116	2.29	0.2	2.28	2.17	2.39
M RI	100	91	2.34	0.16	2.33	2.24	2.43
Middlbr	91	20	2.28	0.17	2.29	2.2	2.39
Newc	98	44	2.39	0.13	2.37	2.3	2.46
Newry	100	10					
Norwch	93	55	2.48	0.13	2.49	2.37	2.55
Nottm	99	110	2.53	0.16	2.53	2.43	2.54
Oxford	99	106	2.47	0.16	2.47	2.38	2.57
Plymth	100	45	2.41	0.14	2.42	2.33	2.5
Ports	93	71	2.39	0.18	2.4	2.24	2.49
Prestn	98	57	2.36	0.15	2.33	2.26	2.47
Redng	100	75	2.34	0.15	2.34	2.24	2.42
Sheff	100	71	2.35	0.17	2.35	2.28	2.44
Shrew	94	30	2.3	0.17	2.3	2.2	2.4
Stevng	97	36	2.43	0.15	2.45	2.33	2.55
Sthend	93	14					
Stoke	100	72	2.44	0.15	2.44	2.37	2.51
Sund	100	20	2.4	0.13	2.41	2.37	2.5
Swanse	98	59	2.26	0.13	2.27	2.16	2.35
Truro	100	26	2.4	0.22	2.36	2.29	2.49
Tyrone	100	7					
Ulster	100	5					
Wirral	74	25	2.42	0.19	2.44	2.32	2.53
Wolve	100	57	2.32	0.2	2.33	2.2	2.42
Wrexm	95	21	2.54	0.13	2.53	2.48	2.51
York	95	18					
England	**97**	**3,113**	**2.39**	**0.18**	**2.39**	**2.28**	**2.5**
N Ireland	**98**	**87**	**2.36**	**0.17**	**2.35**	**2.23**	**2.48**
Wales	**98**	**230**	**2.35**	**0.16**	**2.35**	**2.26**	**2.46**
E, W & NI	**97**	**3,430**	**2.39**	**0.17**	**2.39**	**2.28**	**2.49**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness
n/a not applicable

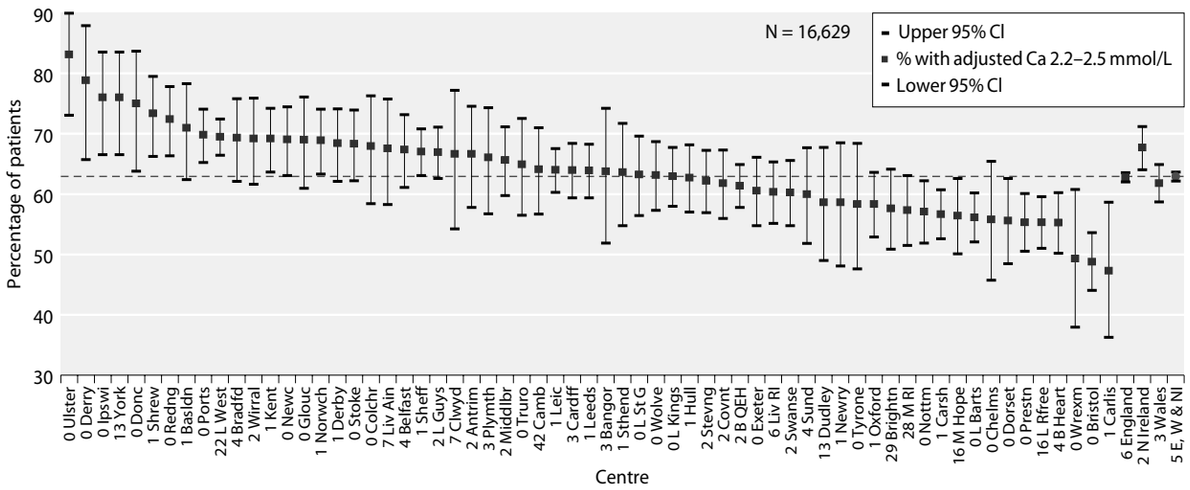

Fig. 10.14. Percentage of haemodialysis patients with adjusted calcium 2.2–2.5 mmol/L by centre in 2008

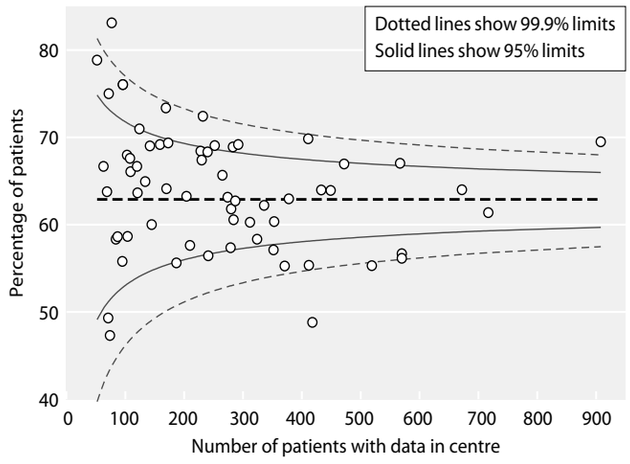

Fig. 10.15. Funnel plot of percentage of haemodialysis patients with adjusted calcium 2.2–2.5 mmol/L by centre in 2008

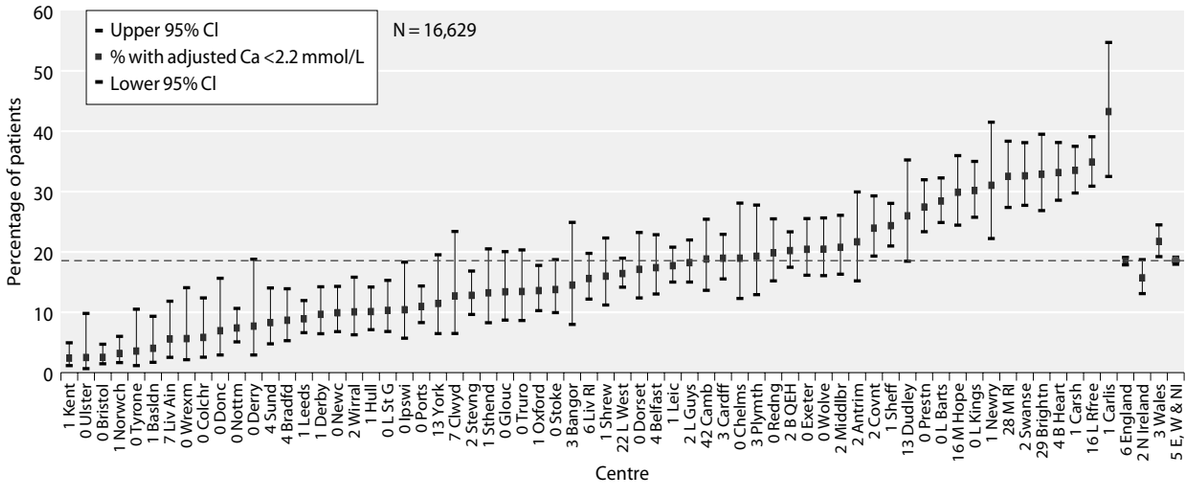

Fig. 10.16. Percentage of haemodialysis patients with adjusted calcium <2.2 mmol/L by centre in 2008

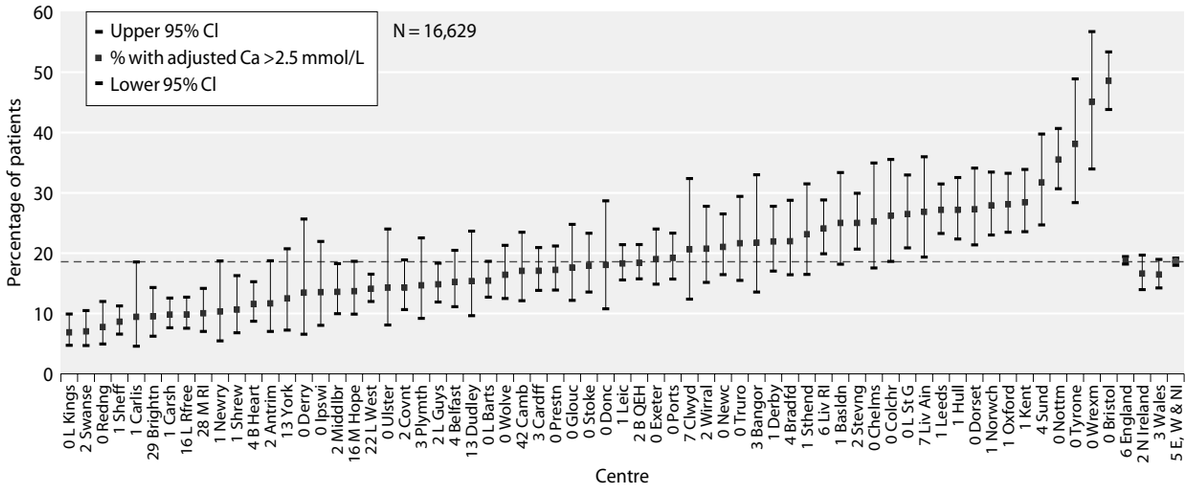

Fig. 10.17 Percentage of haemodialysis patients with adjusted calcium >2.5 mmol/L by centre in 2008

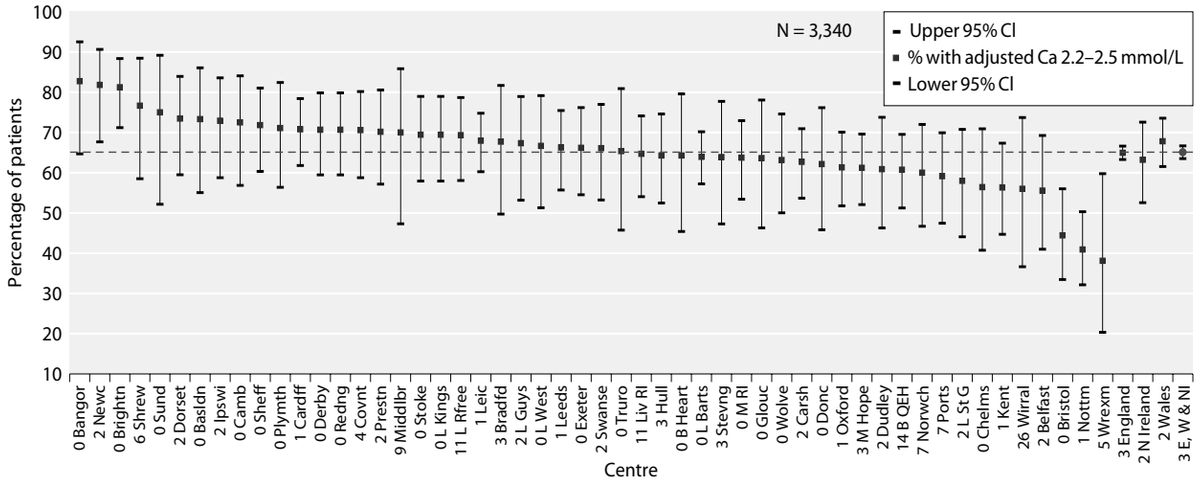

Fig. 10.18. Percentage of peritoneal dialysis patients with adjusted calcium 2.2–2.5 mmol/L by centre in 2008

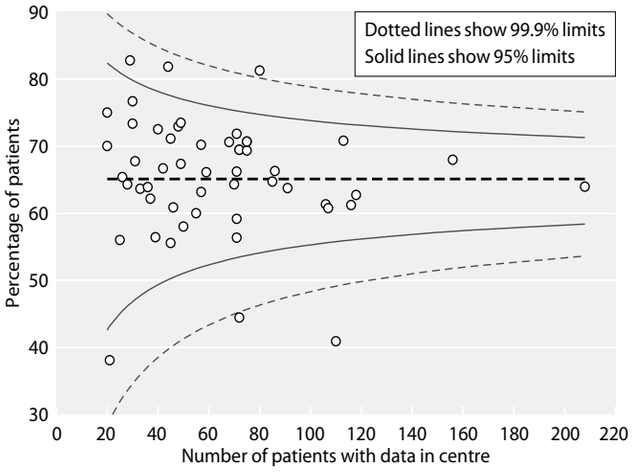

Fig. 10.19. Funnel plot of percentage of peritoneal dialysis patients with adjusted calcium 2.2–2.5 mmol/L by centre in 2008

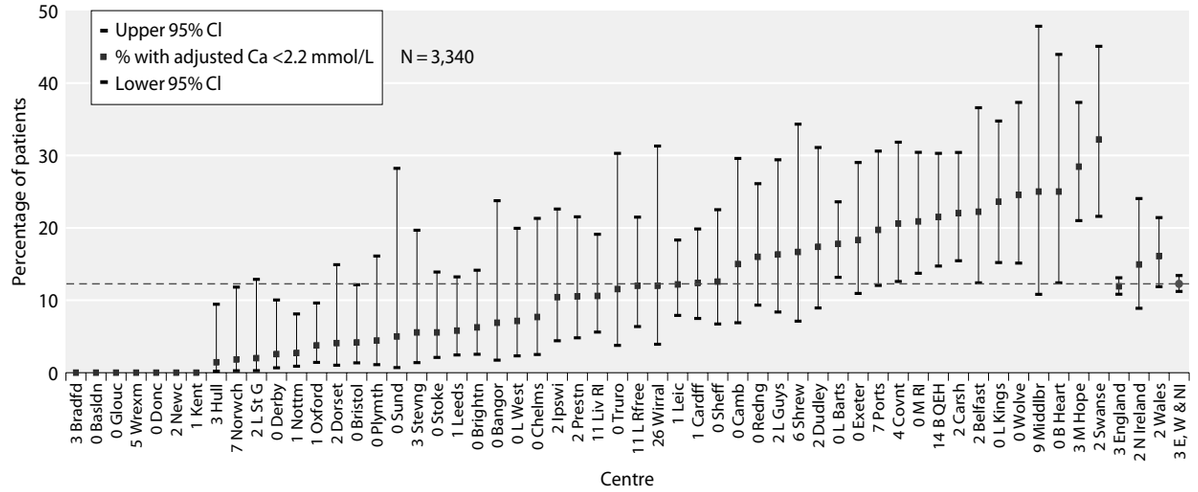

Fig. 10.20. Percentage of peritoneal dialysis patients with adjusted calcium <2.2 mmol/L by centre in 2008

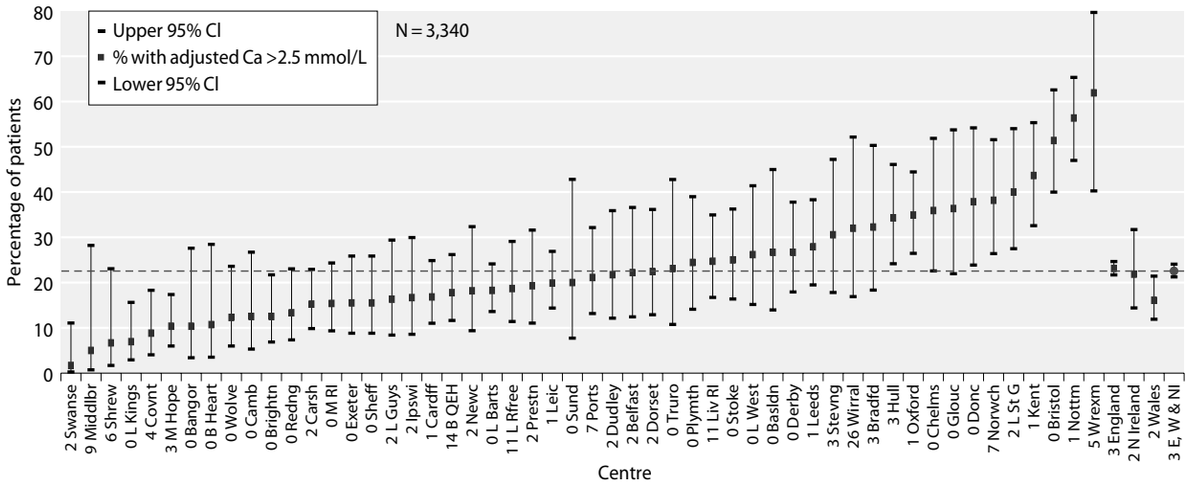

Fig. 10.21. Percentage of peritoneal dialysis patients with adjusted calcium >2.5 mmol/L by centre in 2008

The funnel plots for adjusted calcium concentration greater than 2.5 mmol/L and less than 2.2 mmol/L showed considerable heterogeneity in HD patients (plots not shown). There is over dispersion of the data which makes interpretation difficult. This may have arisen because there are multiple patient and centre level factors which contribute to hyper and hypocalcaemia which are not measured here. For PD patients, there were three centres returning significantly high proportions of patients with calcium levels above 2.5 mmol/L (Kent, Bristol, Nottingham) (figure 10.22).

Examining individual centres longitudinally, one centre (Nottingham) showed an approximately threefold increase in the proportion of both HD and PD patients exceeding the previous upper target limit of 2.6 mmol/L compared with previous years. Further investigations revealed laboratory changes during the year to the formula in use for adjusting calcium and the development of biases in the methods used for albumin and calcium, all factors that conspired to increase adjusted calcium values by some 0.15 mmol/L. Retrospective correction of the adjusted calcium values by 0.15 mmol/L revealed this to be the cause of the increase in proportion of patients exceeding the upper target value. The data shown for Nottingham are as reported without any correction. This problem serves to emphasise the importance of dialysis centres establishing good working relationships with their laboratories. Other centres with excessive proportions of patients outside limits should consider consulting their laboratories about possible biases.

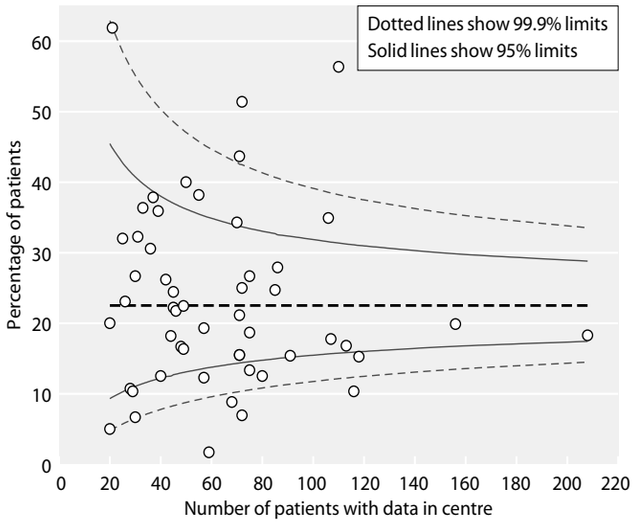

Fig. 10.22. Funnel plot of percentage of peritoneal dialysis patients with adjusted calcium >2.5 mmol/L by centre in 2008

Calcium phosphate product

The 4th edition of the Renal Association Clinical Practice Guidelines states:

'The serum albumin corrected calcium and phosphorus product should be maintained below 4.8 mmol^2/L^2 and ideally below 4.2 mmol^2/L^2 in all CKD patients.' (Module 2: Complications) [1]

The data for calcium phosphate product were 95% complete overall for HD patients with eight centres attaining less than 90% completeness. For PD patients, the data were 97% complete with five centres with sufficient eligible patients attaining below 90% completeness (data not shown).

Table 10.9. Percentage of peritoneal dialysis patients within, below and above the range for adjusted calcium (2.2–2.5 mmol/L) in 2008

Centre	N	% adjusted Ca 2.2–2.5 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca <2.2 mmol/L	Lower 95% CI	Upper 95% CI	% adjusted Ca >2.5 mmol/L	Lower 95% CI	Upper 95% CI
B Heart	28	64.3	45.4	79.6	25.0	12.4	44.0	10.7	3.5	28.4
B QEH	107	60.8	51.2	69.5	21.5	14.7	30.3	17.8	11.6	26.2
Bangor	29	82.8	64.7	92.5	6.9	1.7	23.8	10.3	3.4	27.6
Basldn	30	73.3	55.0	86.1	0.0	0.0	0.0	26.7	13.9	45.0
Belfast	45	55.6	41.0	69.2	22.2	12.4	36.6	22.2	12.4	36.6
Bradfd	31	67.7	49.7	81.7	0.0	0.0	100.0	32.3	18.3	50.3
Brightn	80	81.3	71.2	88.4	6.3	2.5	14.2	12.5	6.9	21.7
Bristol	72	44.4	33.5	56.0	4.2	1.4	12.1	51.4	40.0	62.6
Camb	40	72.5	56.8	84.1	15.0	6.9	29.6	12.5	5.3	26.7
Cardff	113	70.8	61.8	78.4	12.4	7.5	19.8	16.8	11.0	24.9
Carsh	118	62.7	53.7	71.0	22.0	15.5	30.4	15.3	9.8	22.9
Chelms	39	56.4	40.7	70.9	7.7	2.5	21.3	35.9	22.6	51.9
Covnt	68	70.6	58.8	80.2	20.6	12.6	31.8	8.8	4.0	18.3
Derby	75	70.7	59.4	79.8	2.6	0.7	10.0	26.7	17.9	37.8
Donc	37	62.2	45.8	76.2	0.0	0.0	0.0	37.8	23.9	54.2
Dorset	49	73.5	59.5	83.9	4.1	1.0	14.9	22.5	12.9	36.2
Dudley	46	60.9	46.3	73.8	17.4	8.9	31.1	21.7	12.1	35.9
Exeter	71	66.2	54.5	76.2	18.3	10.9	29.0	15.5	8.8	25.9
Glouc	33	63.6	46.3	78.1	0.0	0.0	0.0	36.4	21.9	53.7
Hull	70	64.3	52.5	74.6	1.4	0.2	9.5	34.3	24.2	46.1
Ipswi	48	72.9	58.8	83.6	10.4	4.4	22.6	16.7	8.6	29.9
Kent	71	56.3	44.7	67.4	0.0	0.0	0.0	43.7	32.6	55.3
L Barts	208	63.9	57.2	70.2	17.8	13.2	23.6	18.3	13.6	24.1
L Guys	49	67.4	53.2	78.9	16.3	8.4	29.4	16.3	8.4	29.4
L Kings	72	69.4	57.9	79.0	23.6	15.2	34.8	6.9	2.9	15.6
L Rfree	75	69.3	58.1	78.7	12.0	6.4	21.5	18.7	11.4	29.1
L St G	50	58.0	44.1	70.8	2.0	0.3	12.9	40.0	27.5	54.0
L West	42	66.7	51.3	79.2	7.1	2.3	19.9	26.2	15.1	41.4
Leeds	86	66.3	55.7	75.5	5.8	2.4	13.2	27.9	19.5	38.3
Leic	156	68.0	60.2	74.8	12.2	7.9	18.3	19.9	14.3	26.9
Liv RI	85	64.7	54.0	74.1	10.6	5.6	19.1	24.7	16.7	34.9
M Hope	116	61.2	52.1	69.6	28.5	21.0	37.3	10.3	6.0	17.3
M RI	91	63.7	53.4	72.9	20.9	13.7	30.4	15.4	9.3	24.3
Middlbr	20	70.0	47.3	85.9	25.0	10.8	47.8	5.0	0.7	28.2
Newc	44	81.8	67.7	90.6	0.0	0.0	0.0	18.2	9.4	32.3
Norwch	55	60.0	46.7	72.0	1.8	0.3	11.8	38.2	26.4	51.6
Nottm	110	40.9	32.1	50.3	2.7	0.9	8.1	56.4	47.0	65.3
Oxford	106	61.3	51.8	70.1	3.8	1.4	9.6	34.9	26.5	44.4
Plymth	45	71.1	56.4	82.4	4.4	1.1	16.1	24.4	14.1	39.0
Ports	71	59.2	47.4	69.9	19.7	12.0	30.6	21.1	13.2	32.1
Prestn	57	70.2	57.2	80.6	10.5	4.8	21.5	19.3	11.0	31.6
Redng	75	70.7	59.4	79.8	16.0	9.3	26.1	13.3	7.3	23.0
Sheff	71	71.8	60.3	81.1	12.6	6.7	22.5	15.5	8.8	25.9
Shrew	30	76.7	58.5	88.5	16.7	7.1	34.3	6.7	1.7	23.1
Stevng	36	63.9	47.3	77.7	5.6	1.4	19.7	30.6	17.8	47.2
Stoke	72	69.4	57.9	79.0	5.6	2.1	13.9	25.0	16.4	36.2
Sund	20	75.0	52.2	89.2	5.0	0.7	28.2	20.0	7.7	42.8
Swanse	59	66.1	53.2	77.0	32.2	21.6	45.1	1.7	0.2	11.1
Truro	26	65.4	45.7	80.9	11.5	3.8	30.3	23.1	10.8	42.8
Wirral	25	56.0	36.6	73.7	12.0	3.9	31.3	32.0	16.9	52.2
Wolve	57	63.2	50.0	74.6	24.6	15.1	37.3	12.3	6.0	23.6
Wrexm	21	38.1	20.3	59.8	0.0	0.0	0.0	61.9	40.3	79.7
England	**3,113**	**65.0**	**63.3**	**66.6**	**11.9**	**10.8**	**13.1**	**23.1**	**21.7**	**24.6**
N Ireland	**87**	**63.2**	**52.5**	**72.6**	**14.9**	**8.9**	**24.1**	**21.8**	**14.4**	**31.7**
Wales	**230**	**67.8**	**61.5**	**73.5**	**16.1**	**11.9**	**21.4**	**16.1**	**11.9**	**21.4**
E, W & NI	**3,430**	**65.1**	**63.5**	**66.7**	**12.3**	**11.2**	**13.4**	**22.5**	**21.3**	**24.1**

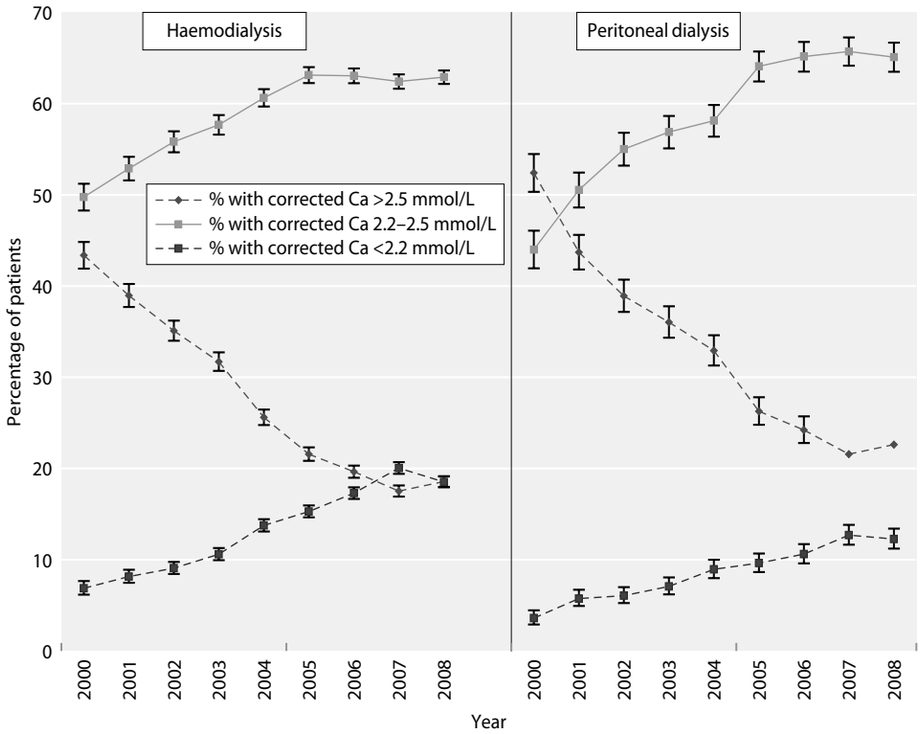

Fig. 10.23. Longitudinal change in percentage of patients with adjusted calcium <2.2 mmol/L, 2.2–2.5 mmol/L and >2.5 mmol/L by dialysis modality 2000–2008

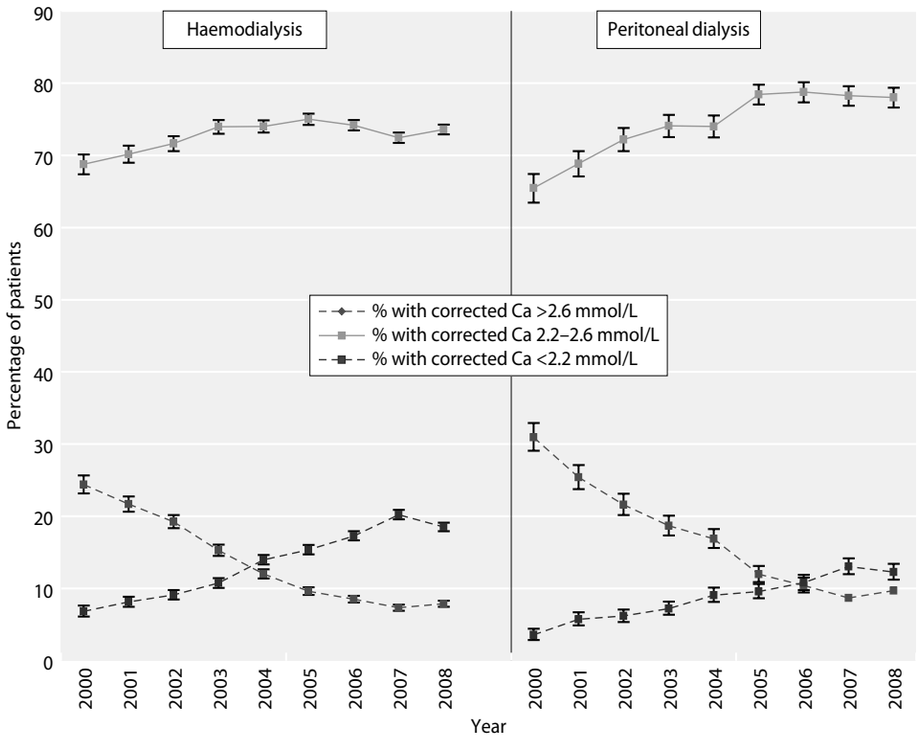

Fig. 10.24. Longitudinal change in percentage of patients with adjusted calcium <2.2 mmol/L, 2.2–2.6 mmol/L and >2.6 mmol/L by dialysis modality 2000–2008

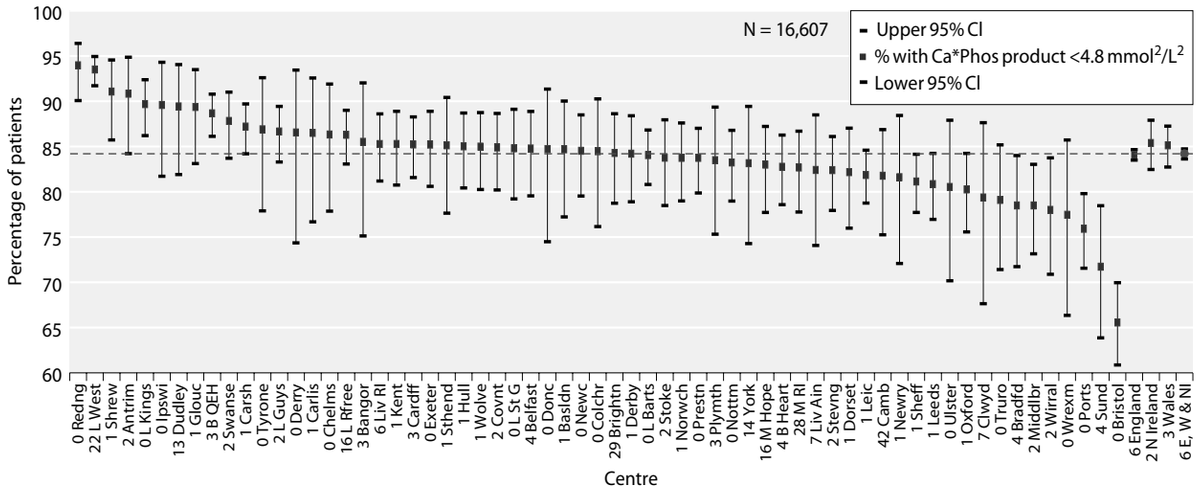

Fig. 10.25. Percentage of haemodialysis patients with calcium*phosphate product <4.8 mmol^2/L^2 by centre in 2008

Overall 84% (CI 84–85) of HD patients (figure 10.25) and 87% (CI 85–88) of PD patients (figure 10.26) achieved the target of below 4.8 mmol^2/L^2. The funnel plots for percentage of patients above 4.8 mmol^2/L^2 showed two centres with significantly more patients above this target than the national average (Portsmouth 24%, Bristol 34%) for HD patients (figure 10.27) but no outlying centres for PD patients (figure 10.28). Four centres achieved the audit standard in significantly more HD patients (Reading, London West, London Kings, Birmingham QE) (figure 10.29) than the national average. Likewise four centres achieved the audit standard in significantly more PD patients (Chelmsford, Cambridge, Dorset and Swansea) (figure 10.30). For both dialysis modes, there has been a continuing steady decline in the proportion of patients with a corrected calcium phosphate product above 4.8 mmol^2/L^2 (figure 10.31).

The two centres (London West, Reading) with the lowest proportion of patients (6–7%) with a calcium-phosphate product above 4.8 mmol^2/L^2 also had large numbers of patients with low serum phosphates but not calcium. This may be due to a number of reasons that cannot be dissected out here but assuming phosphate concentrations are correct might include poor diet and malnutrition, early start dialysis or over-use of phosphate binder therapy.

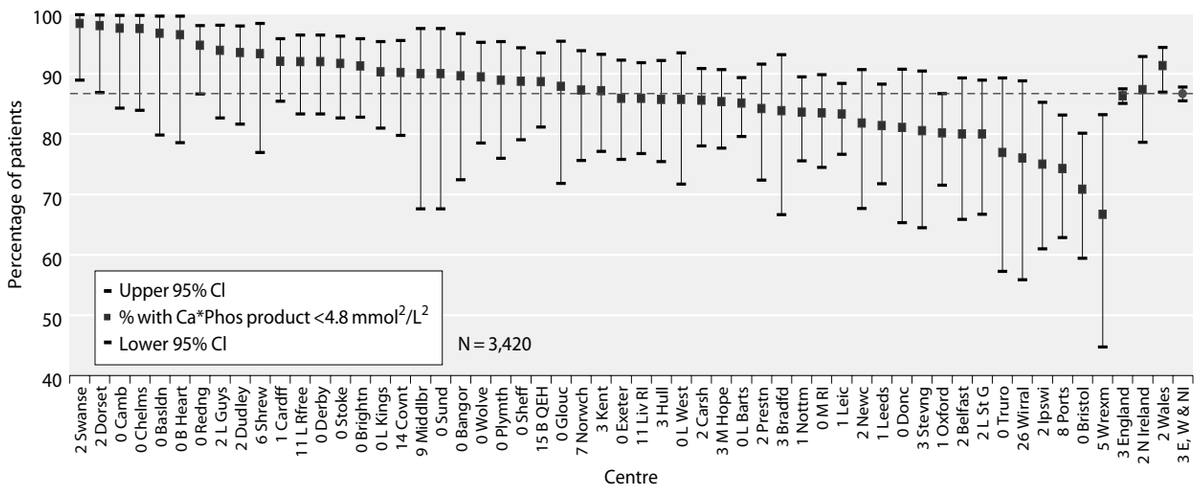

Fig. 10.26. Percentage of peritoneal dialysis patients with calcium*phosphate product <4.8 mmol^2/L^2 by centre in 2008

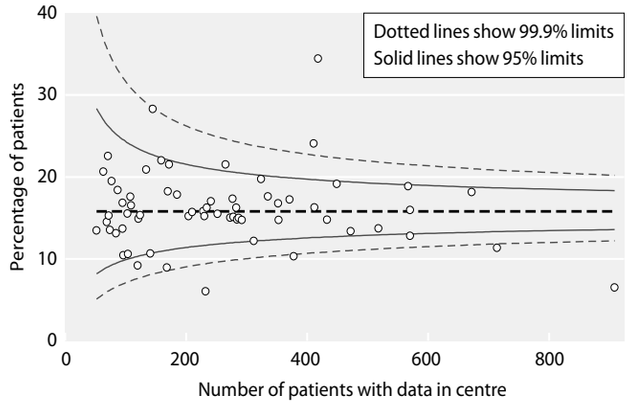

Fig. 10.27. Funnel plot of percentage of haemodialysis patients with calcium*phosphate product $\geqslant 4.8\,mmol^2/L^2$ by centre in 2008

Parathyroid hormone

The 4th edition of the Renal Association Clinical Practice Guidelines states:

'The target range for parathyroid hormone measured using an intact PTH assay should be between 2 and 4 times the upper limit of normal for the intact PTH assay used. The same target range should apply when using the whole molecule PTH assay.' (Module 2: Complications) [1]

As in previous years an upper reference range limit of 8 pmol/L has been adopted as an average giving a target PTH range of 16–32 pmol/L against which to audit.

The data for PTH were 86% complete overall for HD patients (table 10.10) with six centres failing to attain 70% completeness; two centres (Carshalton and Kent) were omitted from the analysis due to less than 50% completeness. In PD patients, the data were 87% complete overall (table 10.12) with only one centre with sufficient eligible patients attaining below 70% completeness. Completeness of data showed a slight improvement over 2007. The individual centres' means and standard deviations are shown in tables 10.10 and 10.12.

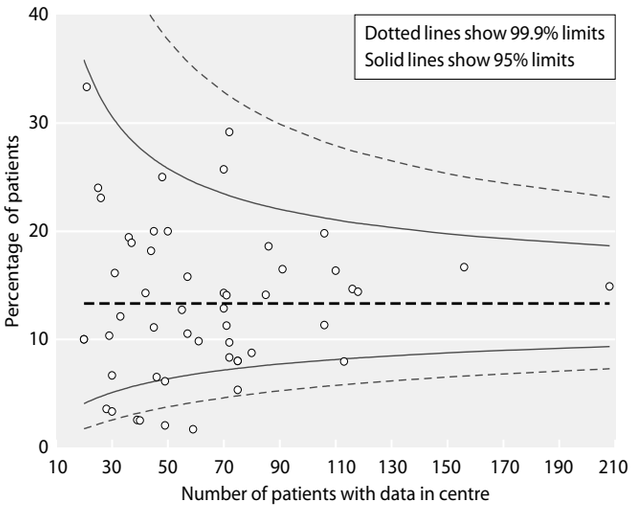

Fig. 10.28. Funnel plot of percentage of peritoneal dialysis patients with calcium*phosphate product $\geqslant 4.8\,mmol^2/L^2$ by centre in 2008

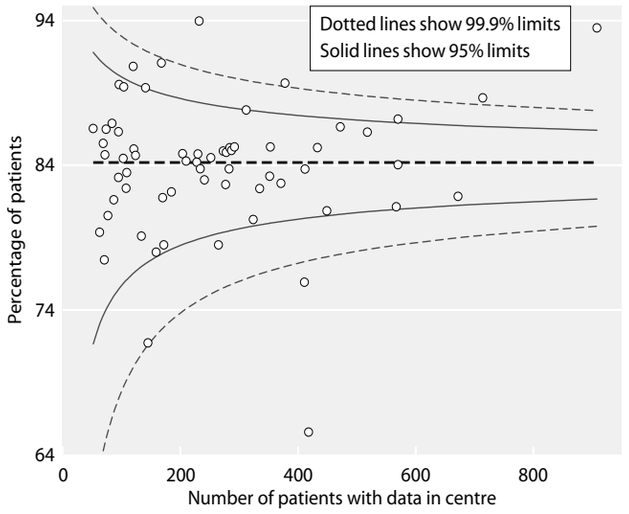

Fig. 10.29. Funnel plot of percentage of haemodialysis patients with calcium*phosphate product $<4.8\,mmol^2/L^2$ by centre in 2008

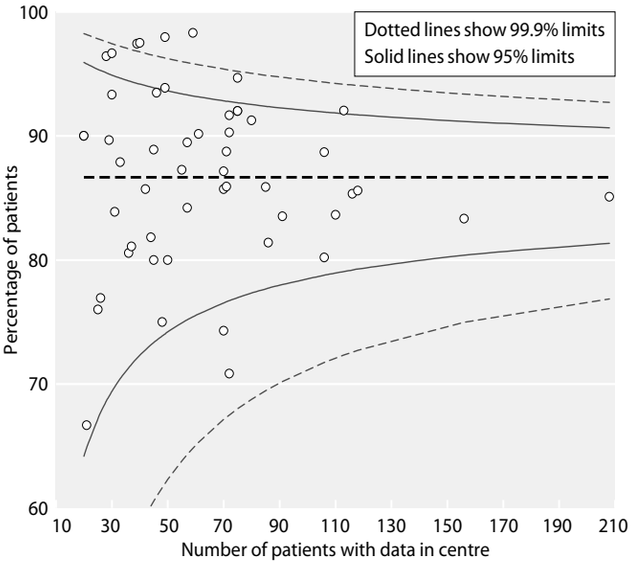

Fig. 10.30. Funnel plot of percentage of peritoneal dialysis patients with calcium*phosphate product $<4.8\,mmol^2/L^2$ by centre in 2008

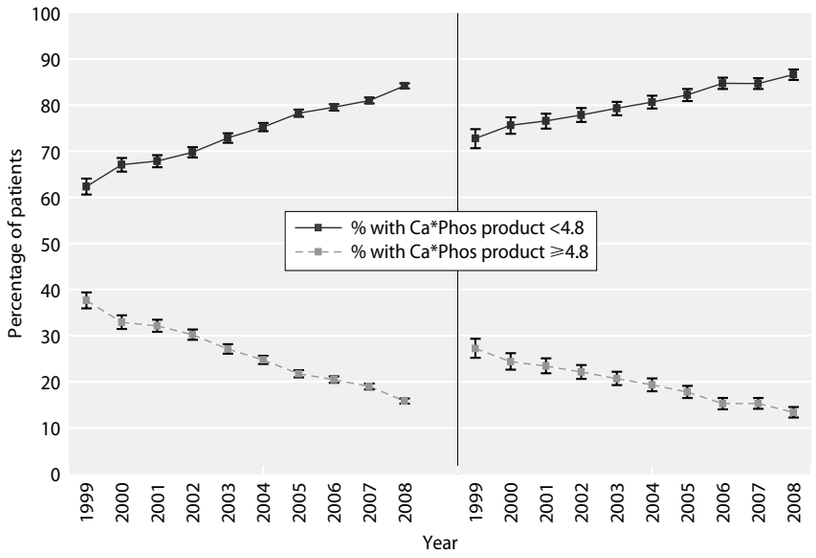

Fig. 10.31. Percentage of patients with calcium*phosphate product <4.8 mmol^2/L^2 and $\geqslant 4.8$ mmol^2/L^2 by dialysis modality 1999–2008

Twenty seven percent (CI 26–27) of HD patients (table 10.11) and 29% (CI 27–30) of PD patients (table 10.13) achieved a PTH within the target range of 16–32 pmol/L. The proportion of HD patients with a PTH exceeding 32 pmol/L was 41% (CI 40–42) and the proportion with a PTH lower than 16 pmol/L was 32% (CI 32–33) (table 10.11). The data were similar for PD patients, the proportion with a PTH exceeding 32 pmol/L being 41% (CI 39–43) and the proportion with a PTH lower than 16 pmol/L being 31% (CI 29–32) (table 10.13). These data show little change from 2007. There was again considerable variation between centres in the proportion of patients below, within and above the range specified by the clinical performance measure for both HD (figures 10.32–10.37) and PD (figures 10.38–10.43).

Table 10.11 for HD patients and table 10.13 for PD patients can be used to identify centres in each funnel plot showing PTH achievement (figures 10.33, 10.35, 10.37, 10.39, 10.41, 10.43). The funnel plot for HD patients within the PTH target range of 16–32 pmol/L showed two centres (Birmingham QE, Ulster) with a significantly high proportion of patients achieving the standard, and three centres (Portsmouth, Leicester, London West) with a significantly low proportion of patients (figure 10.33). For PD patients, there were no

Table 10.10. Summary statistics for PTH in haemodialysis patients in 2008

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	98	120	30.9	36.0	20.6	10.3	36.4
B Heart	89	344	41.2	38.5	32.5	14.7	53.3
B QEH	58	425	22.6	14.5	21.5	11.1	33.7
Bangor	97	69	34.4	50.4	18.8	9.6	36.9
Basldn	96	120	36.9	40.4	25.7	13.3	44.9
Belfast	94	224	43.2	44.5	28.8	13.4	57.7
Bradfd	91	163	38.0	45.6	21.0	10.3	43.3
Brightn	95	281	36.8	40.0	25.2	8.8	50.7
Bristol	95	397	29.9	32.6	20.1	10.6	37.3
Camb	55	160	33.2	35.2	24.8	13.0	40.1
Cardff	93	417	41.0	44.2	27.0	12.7	55.3
Carlis	99	74	36.1	32.1	27.1	12.8	45.9
Carsh	20	118					
Chelms	99	94	43.4	40.5	33.1	20.6	53.6

Table 10.10. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Clwyd	90	61	26.0	30.0	16.0	6.0	33.0
Colchr	98	101	39.0	32.4	27.9	15.6	56.0
Covnt	95	271	46.4	52.1	30.0	14.0	63.0
Derby	99	227	31.1	35.6	23.0	12.2	37.8
Derry	98	51	39.1	29.8	30.4	22.0	41.5
Donc	100	72	44.6	43.3	30.1	16.1	63.0
Dorset	90	169	31.1	33.0	21.9	9.2	43.0
Dudley	74	89	40.9	46.0	27.6	12.8	44.9
Exeter	99	283	20.8	27.8	12.4	3.9	27.1
Glouc	99	141	26.8	26.5	21.0	11.1	31.0
Hull	92	265	39.6	46.9	24.0	9.6	50.6
Ipswi	99	95	35.6	33.7	24.2	12.4	47.3
Kent	0	1					
L Barts	100	569	49.7	54.1	32.0	14.2	62.8
L Guys	95	460	44.6	43.6	29.6	13.6	60.6
L Kings	91	345	42.8	39.8	31.9	16.8	54.8
L Rfree	80	496	35.3	36.4	25.0	13.0	45.0
L St G	96	197	48.6	43.3	31.9	18.4	68.1
L West	75	866	58.8	63.6	37.9	17.5	76.0
Leeds	96	435	28.3	29.9	19.0	10.4	37.3
Leic	94	635	40.6	42.5	27.8	8.7	59.8
Liv Ain	73	85	35.6	40.9	23.0	11.0	44.0
Liv RI	92	346	41.5	40.6	29.5	14.0	54.0
M Hope	79	228	38.2	49.2	20.7	8.9	44.7
M RI	54	207	45.6	39.6	36.0	16.0	63.6
Middlbr	89	241	43.1	39.8	31.5	15.7	55.6
Newc	98	247	30.0	29.6	21.1	10.4	36.6
Newry	98	86	33.0	27.4	25.3	13.7	46.5
Norwch	96	273	35.8	42.9	24.0	13.3	42.0
Nottm	99	348	35.6	43.1	23.9	10.4	39.8
Oxford	95	310	48.3	49.5	31.6	13.7	65.5
Plymth	96	108	26.3	31.8	17.3	6.2	31.7
Ports	95	392	47.5	54.0	27.9	11.9	57.5
Prestn	98	404	36.2	37.2	24.8	10.8	49.7
Redng	100	232	23.8	25.9	17.7	8.3	29.4
Sheff	97	553	40.7	37.1	30.3	15.5	55.2
Shrew	97	164	37.3	39.3	25.4	10.6	47.3
Stevng	97	332	46.1	42.7	38.0	19.0	57.0
Sthend	90	110	52.1	45.6	39.7	19.8	67.8
Stoke	98	234	44.0	42.3	33.2	14.7	53.7
Sund	97	146	35.2	34.6	22.8	12.1	49.2
Swanse	97	308	39.7	37.2	26.4	13.7	55.2
Truro	99	133	30.0	26.7	21.8	9.9	41.9
Tyrone	100	84	36.1	30.0	28.7	16.7	45.4
Ulster	99	76	31.2	29.8	21.9	16.0	35.5
Wirral	62	101	41.2	39.1	25.8	16.7	52.9
Wolve	98	268	21.6	31.8	12.0	5.4	24.8
Wrexm	94	67	30.2	37.1	18.9	6.1	45.0
York	96	105	35.7	36.0	21.3	7.9	56.1
England	**85**	**13,460**	**39.0**	**42.7**	**25.9**	**12.1**	**49.3**
N Ireland	**97**	**641**	**36.9**	**36.7**	**25.2**	**14.1**	**45.2**
Wales	**95**	**922**	**38.3**	**41.3**	**24.7**	**11.9**	**51.5**
E, W & NI	**86**	**15,023**	**38.9**	**42.4**	**25.7**	**12.1**	**49.3**

Table 10.11. Percentage of haemodialysis patients within, below and above the range for PTH (16–32 pmol/L) in 2008

Centre	N	% PTH 16–32 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	Lower 95% CI	Upper 95% CI	% PTH >32 pmol/L	Lower 95% CI	Upper 95% CI
Antrim	120	33.3	25.5	42.2	39.2	30.9	48.2	27.5	20.3	36.2
B Heart	344	21.8	17.8	26.5	27.6	23.2	32.6	50.6	45.3	55.8
B QEH	425	36.5	32.0	41.2	36.7	32.3	41.4	26.8	22.8	31.2
Bangor	69	24.6	15.9	36.1	43.5	32.3	55.3	31.9	22.0	43.7
Basldn	120	30.8	23.2	39.6	33.3	25.5	42.2	35.8	27.8	44.8
Belfast	224	23.7	18.6	29.7	30.4	24.7	36.7	46.0	39.6	52.5
Bradfd	163	27.0	20.7	34.3	36.8	29.8	44.5	36.2	29.2	43.9
Brightn	281	21.7	17.3	26.9	37.4	31.9	43.2	40.9	35.3	46.8
Bristol	397	31.0	26.6	35.7	40.3	35.6	45.2	28.7	24.5	33.4
Camb	160	31.9	25.1	39.5	31.9	25.1	39.5	36.3	29.2	44.0
Cardff	417	26.6	22.6	31.1	30.9	26.7	35.5	42.5	37.8	47.3
Carlis	74	32.4	22.8	43.9	29.7	20.5	41.1	37.8	27.6	49.3
Chelms	94	30.9	22.4	40.9	18.1	11.6	27.2	51.1	41.1	61.0
Clwyd	61	24.6	15.4	36.9	49.2	36.9	61.5	26.2	16.7	38.6
Colchr	101	24.8	17.3	34.1	27.7	19.9	37.2	47.5	38.0	57.2
Covnt	271	23.6	18.9	29.0	28.0	23.0	33.7	48.3	42.4	54.3
Derby	227	33.9	28.1	40.3	35.2	29.3	41.7	30.8	25.2	37.1
Derry	51	37.3	25.2	51.2	13.7	6.7	26.1	49.0	35.7	62.5
Donc	72	30.6	21.0	42.1	25.0	16.4	36.2	44.4	33.5	56.0
Dorset	169	23.7	17.9	30.7	40.8	33.7	48.4	35.5	28.7	43.0
Dudley	89	28.1	19.8	38.3	28.1	19.8	38.3	43.8	33.9	54.3
Exeter	283	22.3	17.8	27.5	57.6	51.8	63.2	20.1	15.9	25.2
Glouc	141	40.4	32.7	48.7	36.2	28.7	44.4	23.4	17.1	31.1
Hull	265	22.6	18.0	28.1	36.2	30.7	42.2	41.1	35.4	47.2
Ipswi	95	34.7	25.9	44.8	29.5	21.2	39.4	35.8	26.8	45.9
L Barts	569	22.5	19.3	26.1	27.6	24.1	31.4	49.9	45.8	54.0
L Guys	460	24.8	21.1	28.9	28.9	25.0	33.2	46.3	41.8	50.9
L Kings	345	27.3	22.8	32.2	22.9	18.8	27.6	49.9	44.6	55.1
L Rfree	496	30.4	26.6	34.6	30.7	26.7	34.8	38.9	34.7	43.3
L St G	197	30.5	24.4	37.2	19.8	14.8	26.0	49.8	42.8	56.7
L West	866	21.7	19.1	24.6	21.9	19.3	24.8	56.4	53.0	59.6
Leeds	435	27.4	23.4	31.7	40.9	36.4	45.6	31.7	27.5	36.3
Leic	635	20.6	17.7	24.0	35.0	31.4	38.8	44.4	40.6	48.3
Liv Ain	85	32.9	23.8	43.6	29.4	20.7	39.9	37.7	28.0	48.4
Liv RI	346	26.9	22.5	31.8	27.5	23.0	32.4	45.7	40.5	50.9
M Hope	228	23.7	18.6	29.6	39.5	33.3	46.0	36.8	30.8	43.3
M RI	207	20.3	15.4	26.3	24.6	19.2	31.0	55.1	48.2	61.7
Middlbr	241	24.5	19.5	30.3	25.7	20.6	31.6	49.8	43.5	56.1
Newc	247	29.2	23.8	35.1	40.9	34.9	47.1	30.0	24.6	36.0
Newry	86	36.1	26.6	46.7	26.7	18.5	37.1	37.2	27.7	47.9
Norwch	273	34.1	28.7	39.9	30.0	24.9	35.7	35.9	30.4	41.8
Nottm	348	29.9	25.3	34.9	35.6	30.8	40.8	34.5	29.7	39.6
Oxford	310	19.4	15.3	24.1	30.7	25.8	36.0	50.0	44.5	55.5
Plymth	108	25.9	18.5	35.0	49.1	39.8	58.4	25.0	17.7	34.0
Ports	392	18.4	14.8	22.5	36.5	31.9	41.4	45.2	40.3	50.1
Prestn	404	28.5	24.3	33.1	33.7	29.2	38.4	37.9	33.3	42.7
Redng	232	37.1	31.1	43.5	42.7	36.5	49.1	20.3	15.6	25.9
Sheff	553	26.6	23.1	30.4	25.9	22.4	29.7	47.6	43.4	51.7
Shrew	164	26.8	20.6	34.1	35.4	28.4	43.0	37.8	30.7	45.5
Stevng	332	32.5	27.7	37.8	14.2	10.8	18.3	53.3	47.9	58.6

Table 10.11. Continued

Centre	N	% PTH 16–32 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	Lower 95% CI	Upper 95% CI	% PTH >32 pmol/L	Lower 95% CI	Upper 95% CI
Sthend	110	21.8	15.1	30.5	18.2	12.0	26.5	60.0	50.6	68.7
Stoke	234	23.1	18.1	28.9	26.5	21.2	32.5	50.4	44.1	56.8
Sund	146	24.7	18.3	32.3	37.0	29.6	45.1	38.4	30.8	46.5
Swanse	308	25.0	20.5	30.1	31.5	26.6	36.9	43.5	38.1	49.1
Truro	133	27.1	20.2	35.2	36.8	29.1	45.4	36.1	28.4	44.6
Tyrone	84	35.7	26.2	46.5	21.4	13.9	31.5	42.9	32.7	53.6
Ulster	76	46.1	35.2	57.3	25.0	16.6	35.9	29.0	19.9	40.1
Wirral	101	35.6	26.9	45.4	22.8	15.6	32.0	41.6	32.4	51.4
Wolve	268	20.5	16.1	25.8	62.7	56.7	68.3	16.8	12.8	21.8
Wrexm	67	23.9	15.2	35.5	43.3	32.0	55.3	32.8	22.7	44.9
York	105	24.8	17.4	33.9	40.0	31.1	49.6	35.2	26.7	44.8
England	**13,460**	**26.4**	**25.7**	**27.2**	**32.5**	**31.7**	**33.3**	**41.1**	**40.3**	**41.9**
N Ireland	**641**	**32.5**	**28.9**	**36.2**	**28.4**	**25.0**	**32.0**	**39.2**	**35.5**	**43.0**
Wales	**922**	**25.6**	**22.9**	**28.5**	**34.2**	**31.2**	**37.3**	**40.2**	**37.1**	**43.4**
E, W & NI	**15,023**	**26.6**	**25.9**	**27.3**	**32.4**	**31.7**	**33.2**	**41.0**	**40.2**	**41.8**

Table 10.12. Summary statistics for PTH in peritoneal dialysis patients in 2008

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	94	15					
B Heart	89	25	27.3	20.4	23.7	13.6	34.4
B QEH	71	89	18.1	13.9	14.8	5.2	29.8
Bangor	100	29	31.7	28.4	28.5	11.9	39.9
Basldn	100	30	34.7	22.5	28.3	18.5	46.9
Belfast	96	44	57.1	41.8	49.2	23.9	78.7
Bradfd	91	29	47.4	42.0	37.2	22.7	62.0
Brightn	94	75	33.0	28.2	23.3	16.3	38.8
Bristol	90	65	48.1	53.5	32.5	13.7	60.7
Camb	100	40	35.7	23.8	33.5	19.2	51.0
Cardff	98	112	46.7	36.5	40.7	22.3	64.5
Carlis	94	16					
Carsh	13	15					
Chelms	95	37	30.3	26.1	25.8	11.1	40.0
Clwyd	80	8					
Colchr	n/a	0					
Covnt	83	59	32.7	26.0	27.0	15.0	39.0
Derby	100	75	21.6	15.3	18.1	12.4	29.9
Derry	100	5					
Donc	87	32	27.0	24.7	20.9	10.1	32.8
Dorset	84	42	23.2	22.8	15.2	7.3	34.6
Dudley	89	42	33.1	41.4	14.3	7.4	37.4

Table 10.12. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Exeter	97	69	24.5	21.4	18.9	10.3	30.4
Glouc	100	33	26.9	28.6	16.9	8.0	37.0
Hull	81	58	29.6	27.8	23.3	7.4	41.9
Ipswi	98	48	38.2	33.0	25.3	16.7	55.9
Kent	0	0					
L Barts	100	208	34.3	32.1	24.0	12.8	46.1
L Guys	98	49	39.5	36.1	28.6	14.3	48.0
L Kings	100	72	35.7	27.2	27.7	16.7	46.1
L Rfree	85	71	26.3	18.8	22.0	13.0	36.0
L St G	94	48	36.0	34.0	25.7	9.4	48.7
L West	100	42	49.5	42.5	35.4	28.7	56.9
Leeds	100	87	29.1	24.9	24.5	13.3	36.9
Leic	89	140	49.9	55.6	36.1	16.2	65.2
Liv Ain	0	0					
Liv RI	84	80	32.3	31.5	23.0	13.0	39.5
M Hope	94	112	30.1	29.0	22.0	11.1	38.7
M RI	99	90	41.6	39.5	34.1	15.9	55.6
Middlbr	73	16					
Newc	93	42	24.6	22.6	18.6	11.7	31.2
Newry	100	10					
Norwch	73	43	31.6	35.1	21.0	9.6	39.4
Nottm	95	105	28.9	27.0	20.1	7.1	45.2
Oxford	93	99	47.6	45.8	30.5	14.7	68.1
Plymth	84	38	23.3	21.5	15.5	8.5	33.1
Ports	80	61	52.0	42.9	41.5	25.0	69.8
Prestn	97	56	38.3	26.6	29.5	20.0	53.9
Redng	99	74	24.6	18.0	23.7	12.4	32.9
Sheff	90	64	53.7	38.5	50.3	27.7	72.8
Shrew	97	31	39.1	37.0	28.0	14.1	47.3
Stevng	87	32	53.4	55.8	38.0	19.0	66.5
Sthend	80	12					
Stoke	82	59	49.1	41.5	33.5	22.5	63.9
Sund	100	20	32.9	27.7	21.5	14.3	45.1
Swanse	93	56	44.3	32.5	39.0	23.7	59.8
Truro	85	22	36.3	30.4	33.1	12.1	45.5
Tyrone	100	7					
Ulster	100	5					
Wirral	68	23	35.7	40.2	18.4	7.5	51.7
Wolve	95	54	25.4	22.7	20.3	11.8	28.9
Wrexm	91	20	20.3	16.2	13.7	7.7	30.6
York	100	19					
England	**86**	**2,748**	**34.8**	**34.4**	**25.3**	**12.8**	**44.8**
N Ireland	**97**	**86**	**43.8**	**35.9**	**31.1**	**18.6**	**58.0**
Wales	**96**	**225**	**41.5**	**33.6**	**34.2**	**18.2**	**55.3**
E, W & NI	**87**	**3,059**	**35.5**	**34.4**	**26.2**	**13.0**	**46.0**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness
n/a not applicable

Table 10.13. Percentage of peritoneal dialysis patients within, below and above the range for PTH (16–32 pmol/L) in 2008

Centre	N	% PTH 16–32 pmol/L	Lower 95% CI	Upper 95% CI	% PTH <16 pmol/L	Lower 95% CI	Upper 95% CI	% PTH >32 pmol/L	Lower 95% CI	Upper 95% CI
B Heart	25	40.0	23.1	59.7	28.0	14.0	48.2	32.0	16.9	52.2
B QEH	89	28.1	19.8	38.3	50.6	40.3	60.8	21.4	14.1	31.1
Bangor	29	27.6	14.4	46.2	34.5	19.7	53.1	37.9	22.4	56.4
Basldn	30	40.0	24.3	58.1	20.0	9.3	38.0	40.0	24.3	58.1
Belfast	44	25.0	14.4	39.7	13.6	6.3	27.2	61.4	46.4	74.5
Bradfd	29	20.7	9.6	39.1	20.7	9.6	39.1	58.6	40.4	74.8
Brightn	75	38.7	28.4	50.1	21.3	13.5	32.0	40.0	29.6	51.4
Bristol	65	18.5	10.8	29.8	30.8	20.8	42.9	50.8	38.8	62.7
Camb	40	30.0	17.9	45.7	20.0	10.3	35.2	50.0	35.0	65.0
Cardff	112	17.9	11.8	26.1	19.6	13.3	28.0	62.5	53.2	71.0
Chelms	37	29.7	17.3	46.1	35.1	21.6	51.6	35.1	21.6	51.6
Covnt	59	35.6	24.5	48.5	27.1	17.3	39.8	37.3	26.0	50.2
Derby	75	40.0	29.6	51.4	40.0	29.6	51.4	20.0	12.4	30.6
Donc	32	40.6	25.3	58.1	34.4	20.2	52.1	25.0	13.0	42.6
Dorset	42	21.4	11.5	36.3	52.4	37.5	66.8	26.2	15.1	41.4
Dudley	42	16.7	8.2	31.1	54.8	39.7	69.0	28.6	17.0	43.9
Exeter	69	36.2	25.8	48.1	40.6	29.7	52.5	23.2	14.7	34.6
Glouc	33	27.3	14.8	44.7	45.5	29.6	62.3	27.3	14.8	44.7
Hull	58	22.4	13.5	34.9	37.9	26.5	51.0	39.7	28.0	52.7
Ipswi	48	35.4	23.3	49.8	22.9	13.2	36.8	41.7	28.7	55.9
L Barts	208	30.3	24.4	36.9	33.2	27.1	39.9	36.5	30.3	43.3
L Guys	49	24.5	14.5	38.4	28.6	17.7	42.6	46.9	33.5	60.8
L Kings	72	36.1	25.9	47.8	19.4	11.9	30.2	44.4	33.5	56.0
L Rfree	71	42.3	31.4	54.0	29.6	20.2	41.2	28.2	19.0	39.7
L St G	48	16.7	8.6	29.9	37.5	25.1	51.8	45.8	32.4	59.9
L West	42	35.7	22.8	51.1	4.8	1.2	17.1	59.5	44.3	73.1
Leeds	87	40.2	30.5	50.8	29.9	21.2	40.3	29.9	21.2	40.3
Leic	140	20.0	14.2	27.4	24.3	17.9	32.1	55.7	47.4	63.7
Liv RI	80	27.5	18.8	38.3	35.0	25.4	46.0	37.5	27.6	48.6
M Hope	112	27.7	20.2	36.7	39.3	30.7	48.6	33.0	25.0	42.2
M RI	90	22.2	14.8	32.0	25.6	17.6	35.5	52.2	42.0	62.3
Newc	42	31.0	18.9	46.3	45.2	31.0	60.3	23.8	13.3	38.9
Norwch	43	25.6	14.8	40.5	44.2	30.3	59.1	30.2	18.4	45.4
Nottm	105	20.0	13.4	28.7	41.9	32.9	51.5	38.1	29.3	47.7
Oxford	99	23.2	16.0	32.6	27.3	19.4	36.9	49.5	39.8	59.2
Plymth	38	23.7	12.8	39.6	50.0	34.6	65.4	26.3	14.8	42.4
Ports	61	16.4	9.1	27.9	18.0	10.3	29.7	65.6	52.9	76.4
Prestn	56	42.9	30.6	56.0	14.3	7.3	26.1	42.9	30.6	56.0
Redng	74	40.5	30.0	52.0	32.4	22.8	43.9	27.0	18.2	38.2
Sheff	64	14.1	7.5	24.9	15.6	8.6	26.7	70.3	58.1	80.2
Shrew	31	29.0	15.9	47.1	25.8	13.5	43.7	45.2	28.9	62.6
Stevng	32	28.1	15.3	45.8	15.6	6.7	32.5	56.3	39.0	72.1
Stoke	59	30.5	20.1	43.3	15.3	8.1	26.8	54.2	41.5	66.4
Sund	20	35.0	17.7	57.4	30.0	14.1	52.7	35.0	17.7	57.4
Swanse	56	33.9	22.8	47.2	10.7	4.9	21.9	55.4	42.3	67.7
Truro	22	13.6	4.5	34.8	31.8	16.0	53.4	54.6	34.1	73.5
Wirral	23	21.7	9.4	42.8	43.5	25.2	63.7	34.8	18.4	55.7
Wolve	54	48.2	35.3	61.3	31.5	20.6	44.9	20.4	11.7	33.2
Wrexm	20	15.0	4.9	37.6	60.0	38.0	78.6	25.0	10.8	47.8
England	**2,748**	**28.9**	**27.3**	**30.7**	**31.6**	**29.8**	**33.3**	**39.5**	**37.7**	**41.4**
N Ireland	**86**	**33.7**	**24.6**	**44.3**	**18.6**	**11.7**	**28.2**	**47.7**	**37.4**	**58.2**
Wales	**225**	**23.1**	**18.1**	**29.1**	**22.7**	**17.7**	**28.6**	**54.2**	**47.7**	**60.6**
E, W & NI	**3,059**	**28.6**	**27.1**	**30.3**	**30.5**	**28.9**	**32.2**	**40.8**	**39.1**	**42.6**

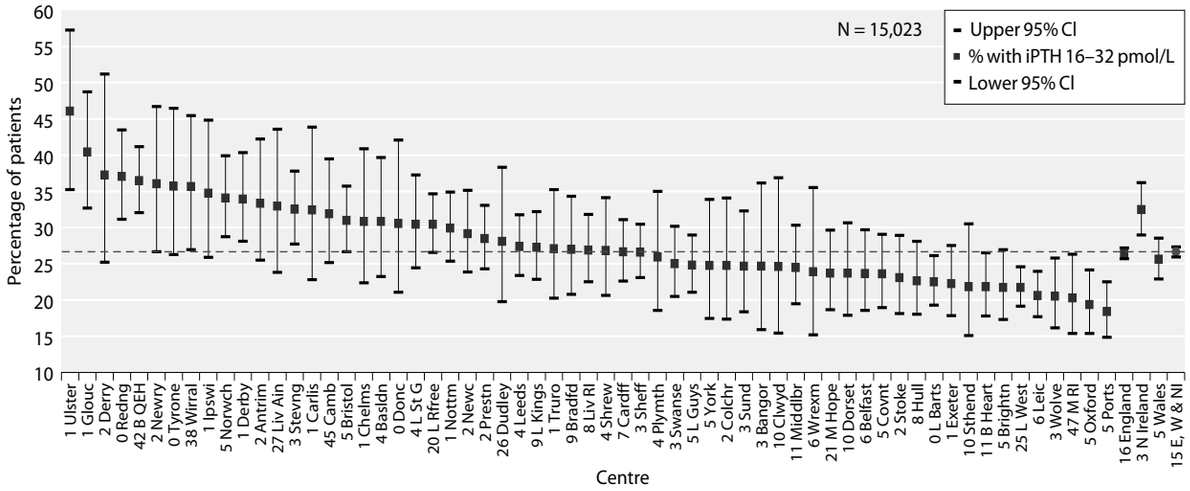

Fig. 10.32. Percentage of haemodialysis patients with PTH 16–32 pmol/L by centre in 2008

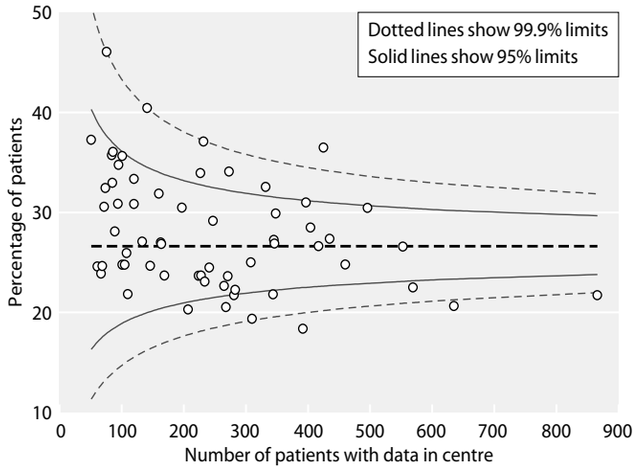

Fig. 10.33. Funnel plot of percentage of haemodialysis patients with PTH 16–32 pmol/L by centre in 2008

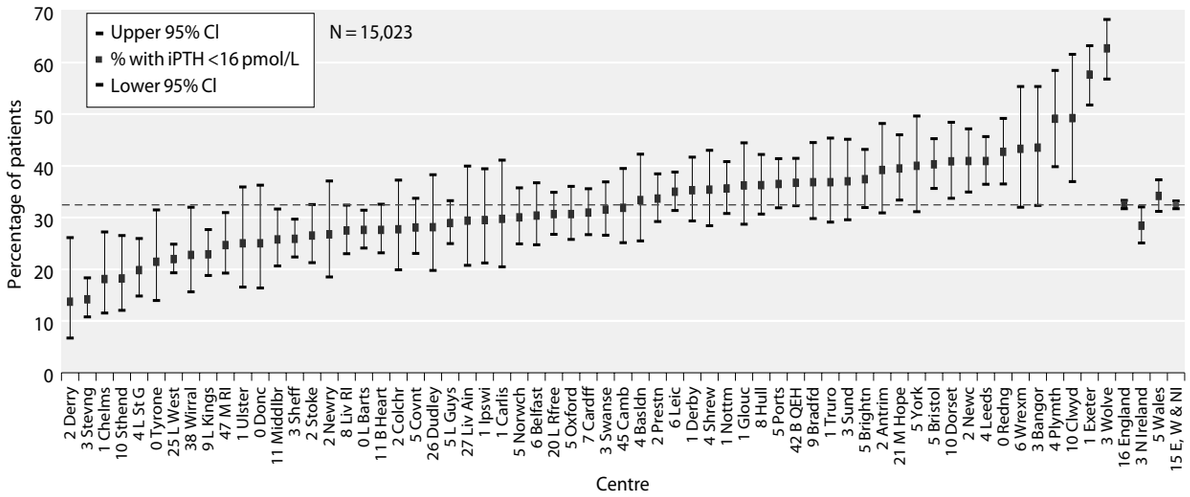

Fig. 10.34. Percentage of haemodialysis patients with PTH <16 pmol/L by centre in 2008

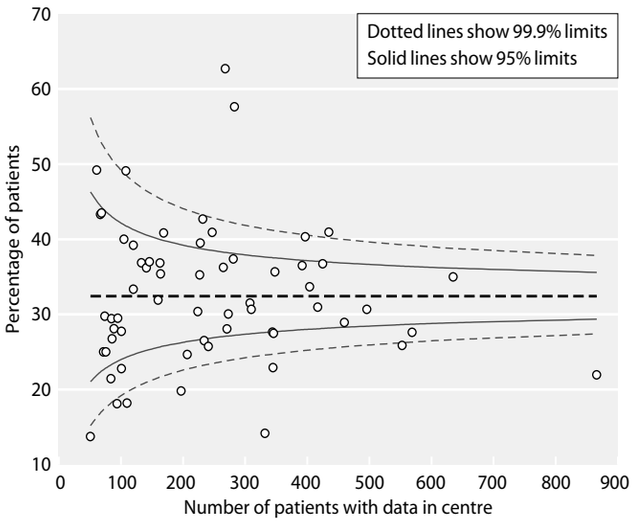

Fig. 10.35. Funnel plot of percentage of haemodialysis patients with PTH <16 pmol/L by centre in 2008

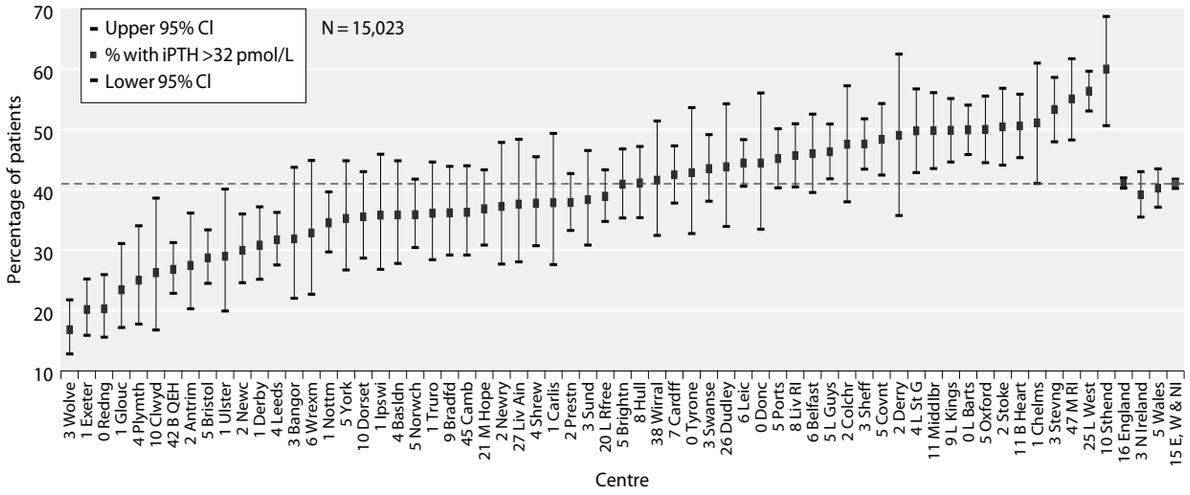

Fig. 10.36. Percentage of haemodialysis patients with PTH >32 pmol/L by centre in 2008

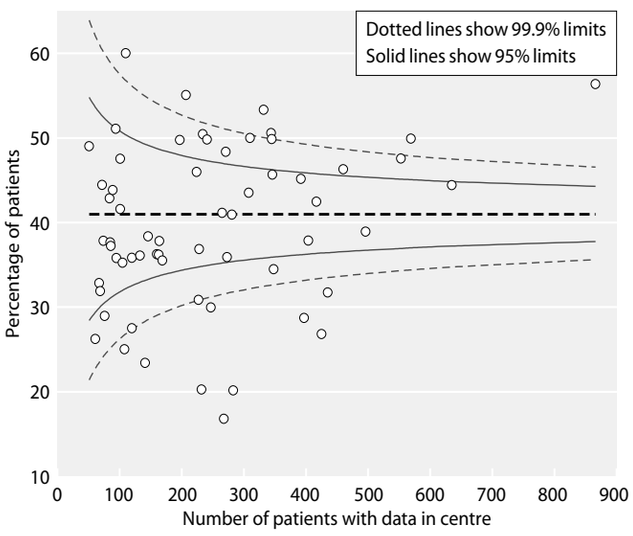

Fig. 10.37. Funnel plot of percentage of haemodialysis patients with PTH >32 pmol/L by centre in 2008

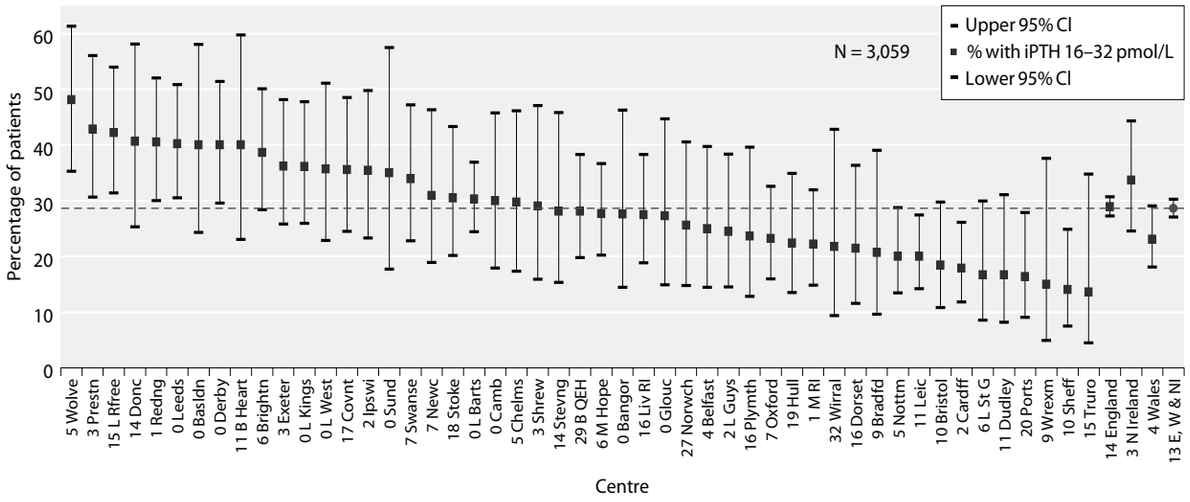

Fig. 10.38. Percentage of peritoneal dialysis patients with PTH 16–32 pmol/L by centre in 2008

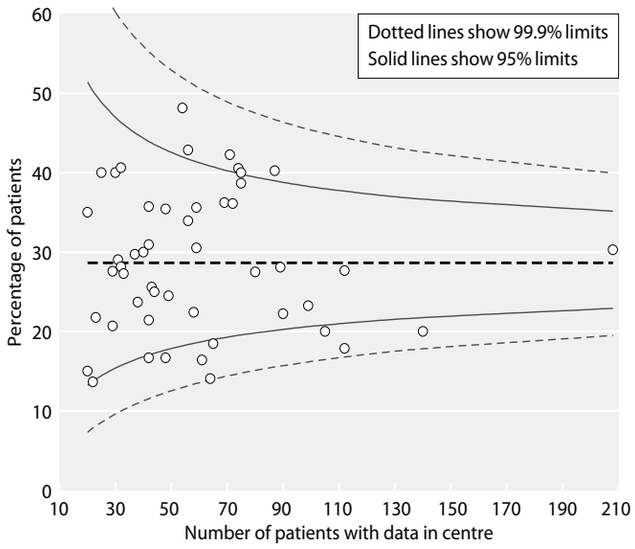

Fig. 10.39. Funnel plot of percentage of peritoneal dialysis patients with PTH 16–32 pmol/L by centre in 2008

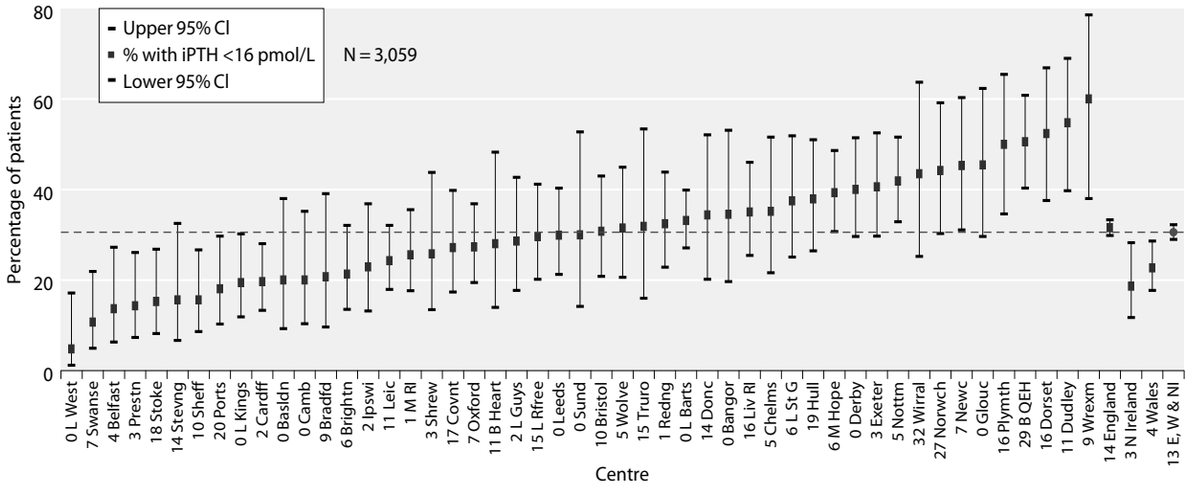

Fig. 10.40. Percentage of peritoneal dialysis patients with PTH <16 pmol/L by centre in 2008

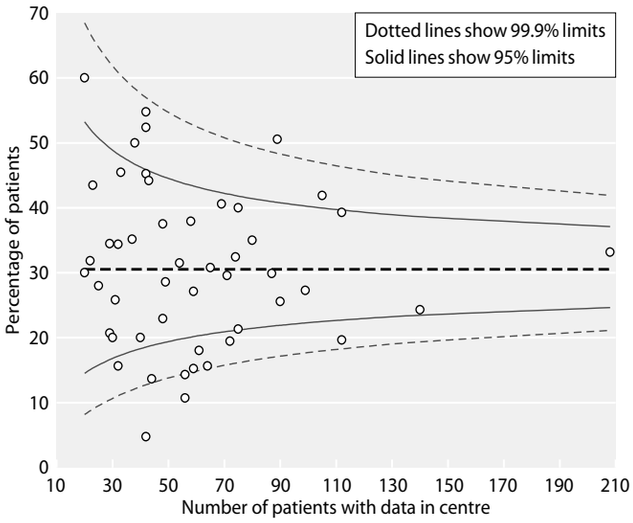

Fig. 10.41. Funnel plot of percentage of peritoneal dialysis patients with PTH <16 pmol/L by centre in 2008

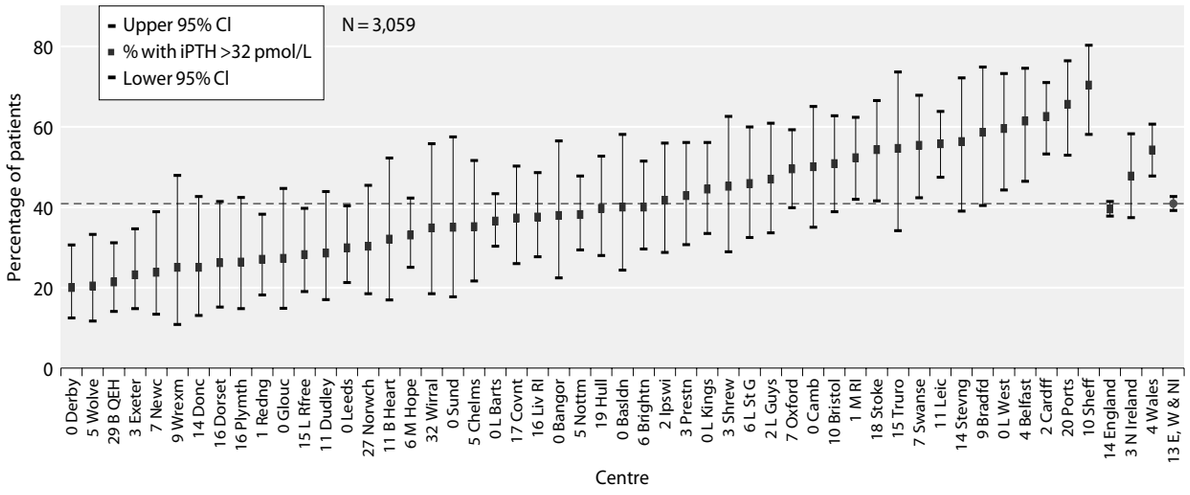

Fig. 10.42. Percentage of peritoneal dialysis patients with PTH >32 pmol/L by centre in 2008

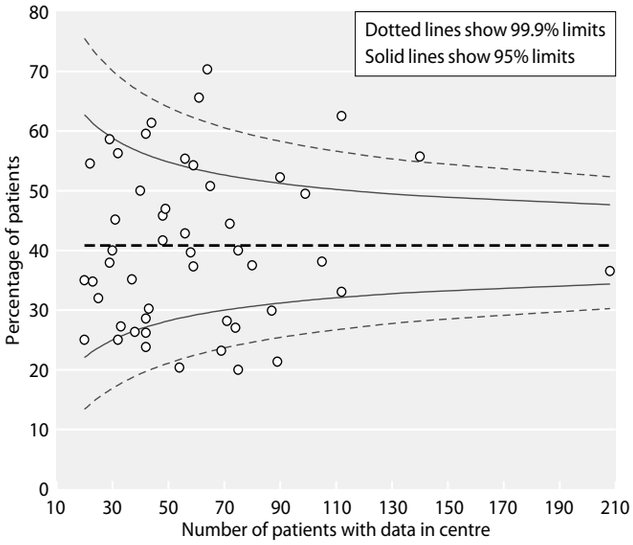

Fig. 10.43. Funnel plot of percentage of peritoneal dialysis patients with PTH >32 pmol/L by centre in 2008

outliers with respect to this target (figure 10.39). The proportion of HD patients with serum PTH concentrations above 32 pmol/L was significantly high in six centres (Southend, London West, Manchester Royal Infirmary, Stevenage, Birmingham Heartlands, London Barts) (figure 10.37). For PD patients, four centres (Portsmouth, Sheffield, Cardiff, Leicester) had a significantly high proportion of their patients with PTH levels above 32 pmol/L (figure 10.43). There was a disproportionately high number of HD patients with PTH levels below 16 pmol/L at four centres (Wolverhampton, Exeter, Plymouth, Leeds) (figure 10.35). One centre (Birmingham QE) had an excess of PD patients with low PTH concentrations (figure 10.41).

Centres which achieved the standards relating to one mineral parameter tended to achieve the standards in others. Figure 10.44 shows the significant relationship between the proportion of HD patients in a centre with calcium levels between 2.2 and 2.5 mmol/L and the proportion with PTH levels between 16 and 32 pmol/L ($r = 0.324$: $p = 0.011$). Figure 10.45 shows the relationship between the proportion of HD patients with serum phosphate levels between 1.1 and 1.8 mmol/L and the proportion with PTH levels between 16 and 32 pmol/L ($r = 0.319$: $p = 0.012$). There is a similar relationship for PD patients between the proportion of patients in a centre with calcium levels between 2.2 and 2.5 mmol/L and the proportion with PTH levels between 16 and 32 pmol/L ($r = 0.402$: $p = 0.004$). The relationship between the proportion of PD patients in a centre with serum phosphate levels between 1.1 and 1.8 mmol/L and the proportion with PTH levels between 16 and 32 pmol/L was not significant.

There are many issues to consider in interpreting PTH levels. There is considerable biological variation in PTH measurements in the normal population [8]. A similar degree of variation in the renal failure population, would require considerable circumspection in determining the significance of even quite considerable concentration changes within the individual and will contribute to variability in target achievement although such effects will not account for the marked bias in some centres. The recent introduction of cinacalcet has added a further layer of complexity, relating to the timing of the sampling. Most clinical studies of the use of this drug in the treatment of secondary hyperparathyroidism describe sampling 24 hours after the previous dose [9] whilst the maximum suppression of PTH occurs at 2–4 hours depending on the dose [10]. Depending on local centre practice, this would contribute to PTH variation within the individual and the population and may be an additional factor in the observed centre variation seen this year, although large variation in centre achievement of PTH targets also existed before the introduction of cinacalcet. Differences in the specificity of PTH assays may also contribute to variation.

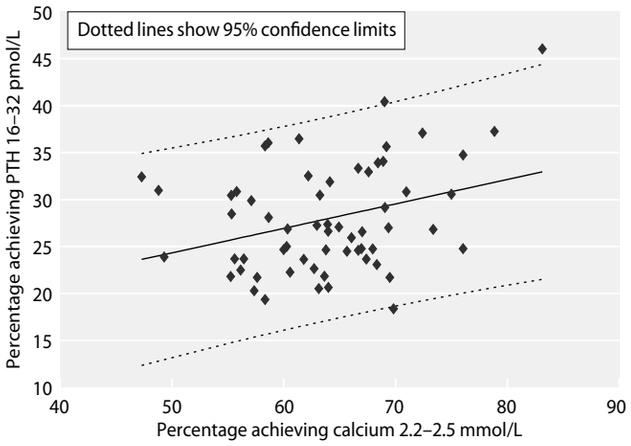

Fig. 10.44. Relationship between the proportion of HD patients achieving calcium and PTH standards within centre in 2008

Discussion – Mineral and bone parameters

There is evidence from epidemiological studies that hyperphosphataemia is a risk factor for secondary hyperparathyroidism and that it predicts mortality [11–19]. However, there is no evidence that lowering serum phosphate to a specific target range improves outcome. There is also evidence that low phosphate levels are associated with increased mortality [15]. High adjusted serum calcium levels are also associated with mortality,

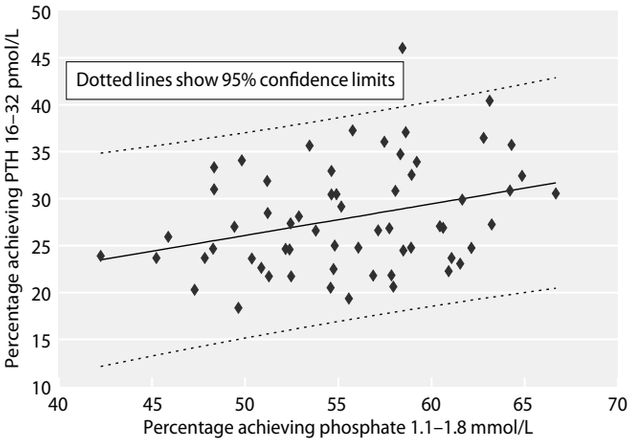

Fig. 10.45. Relationship between the proportion of HD patients achieving phosphate and PTH standards within centre in 2008

though the serum level above which the increased risk occurs varies in different studies across the range 2.38 and 2.85 mmol/L [11, 15–18]. Low serum calcium levels (less than 2.10 mmol/L) may also be associated with increased risk, although this is even more contentious [11, 15].

There are observational data demonstrating increased mortality risk in patients with PTH levels at the extremes [11, 16–19], but again no evidence that controlling PTH within particular limits improves clinical outcomes. Setting a target range is also complicated by methodological problems in that PTH assays differ in their capacity to recognise accumulating PTH fragments, differ in their pre-analytical sample handling requirements and their predictive power for underlying bone histology is poor. Such factors have lead to a significant change of direction in the recent KDIGO guidelines which suggest ***'lowering elevated phosphate levels toward the normal range, maintaining serum calcium in the normal range, and maintaining iPTH levels in the range of approximately two to nine times the upper normal limit for the assay' [20].*** This approach at least has the advantage of recognising the complex relationship between mortality risk and the different possible combinations of serum calcium, phosphate and PTH levels [15–21].

This lack of a firm evidence base, the complexity of the clinical processes required to manage mineral and bone disorders, differences in case-mix, and the potential for measurement bias related to variability in assay methods across the UK for calcium (and albumin), phosphate and parathyroid hormone, may all be factors in the centre level differences consistently demonstrated by the UKRR.

Bicarbonate

The 4th edition of the Renal Association Clinical Practice Guidelines state:

'For HD patients pre-dialysis serum bicarbonate concentrations measured with minimum delay after venepuncture and before a 'short gap' dialysis session should be between 20 and 26 mmol/L (Module 3a: Haemodialysis)

For PD patients, Plasma bicarbonate should be maintained within the normal range' (Module 3b: Peritoneal dialysis) [1]

The data for serum bicarbonate were 84% complete overall for HD patients (table 10.14) with four centres (Coventry, London West, Manchester Hope, Stoke) returning less than 50% and hence excluded from analysis. For PD patients the data were 85% complete (table 10.16) with one centre (Nottingham) with sufficient eligible patients returning below 50% and excluded from subsequent analysis.

Overall 71% (CI 71–72) of HD patients (table 10.15) were within the target range of 20–26 mmol/L, a figure unchanged from 2007. There was considerable variation

Table 10.14. Summary statistics for bicarbonate in haemodialysis patients in 2008

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	98	118	23	2.5	23	21	24
B Heart	93	349	25	2.9	25	23	27
B QEH	89	636	25	2.9	25	23	26
Bangor	97	64	24	3.1	23	21	25
Basldn	99	124	23	2.9	23	21	25
Belfast	96	222	23	2.7	23	21	25
Bradfd	96	172	22	3.4	22	20	24
Brightn	87	238	23	2.7	23	21	25
Bristol	100	391	24	2.7	24	22	26
Camb	54	153	23	3.0	23	21	25
Cardff	83	372	22	3.0	22	20	24
Carlis	99	74	23	2.8	23	22	25
Carsh	98	566	25	3.5	25	22	27
Chelms	100	94	25	2.3	25	24	27
Clwyd	93	62	24	2.8	23	22	25
Colchr	100	103	26	2.6	26	24	28
Covnt	45	124					
Derby	99	215	22	2.7	22	21	24

Table 10.14. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Derry	100	52	21	1.9	21	19	22
Donc	97	70	24	2.5	24	23	26
Dorset	99	183	23	3.2	23	21	25
Dudley	81	96	25	2.9	25	23	27
Exeter	100	283	22	2.8	23	21	24
Glouc	100	142	25	2.6	25	23	27
Hull	99	272	22	2.4	22	20	23
Ipswi	100	93	22	3.1	22	20	24
Kent	100	290	22	2.9	22	20	24
L Barts	100	561	23	3.1	22	21	25
L Guys	85	389	23	2.7	23	22	25
L Kings	100	378	24	2.5	24	22	26
L Rfree	83	499	24	3.2	24	23	26
L St G	100	199	26	3.0	27	24	29
L West	4	43					
Leeds	99	433	22	2.8	22	20	23
Leic	98	650	24	3.7	24	21	26
Liv Ain	95	106	23	2.9	22	21	25
Liv RI	91	337	24	3.4	24	22	26
M Hope	0	0					
M RI	66	217	24	3.6	23	21	26
Middlbr	97	260	26	3.1	26	24	28
Newc	100	241	24	3.4	24	22	26
Newry	99	85	25	2.8	25	23	26
Norwch	97	270	21	2.8	21	19	23
Nottm	76	263	25	3.2	25	23	27
Oxford	98	303	24	3.9	24	21	26
Plymth	98	109	21	3.3	22	20	23
Ports	100	411	23	2.8	23	21	25
Prestn	77	303	23	3.0	23	21	25
Redng	100	231	24	3.0	24	22	26
Sheff	99	528	25	2.7	25	23	27
Shrew	100	169	23	3.4	22	21	25
Stevng	99	339	23	3.2	23	21	25
Sthend	99	121	23	3.1	23	21	26
Stoke	0	0					
Sund	99	149	24	3.2	24	22	25
Swanse	98	297	23	3.5	23	21	26
Truro	99	130	20	2.3	20	19	22
Tyrone	100	83	26	3.5	26	24	28
Ulster	100	76	19	2.0	19	18	20
Wirral	98	156	24	3.3	25	22	27
Wolve	99	273	21	3.1	21	19	23
Wrexm	100	67	23	2.7	23	21	25
York	98	107	23	3.3	23	21	25
England	**83**	**12,843**	**24**	**3.3**	**24**	**21**	**26**
N Ireland	**98**	**636**	**23**	**3.3**	**23**	**21**	**25**
Wales	**91**	**862**	**23**	**3.2**	**23**	**21**	**25**
E, W & NI	**84**	**14,341**	**23**	**3.3**	**23**	**21**	**26**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness

Table 10.15. Percentage of haemodialysis patients within, below and above the range for bicarbonate (20–26 mmol/L) in 2008

Centre	N	% bicarb 20–26 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb <20 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb >26 mmol/L	Lower 95% CI	Upper 95% CI
Antrim	118	83.9	76.1	89.5	9.3	5.2	16.1	6.8	3.4	13.0
B Heart	349	59.6	54.4	64.6	3.7	2.2	6.3	36.7	31.8	41.9
B QEH	636	68.2	64.5	71.7	4.6	3.2	6.5	27.2	23.9	30.8
Bangor	64	67.2	54.9	77.5	10.9	5.3	21.2	21.9	13.4	33.6
Basldn	124	79.0	71.0	85.3	12.9	8.1	20.0	8.1	4.4	14.3
Belfast	222	80.2	74.4	84.9	9.5	6.3	14.1	10.4	7.0	15.1
Bradfd	172	69.8	62.5	76.2	18.0	13.0	24.5	12.2	8.1	18.0
Brightn	238	76.1	70.2	81.1	13.9	10.0	18.9	10.1	6.9	14.6
Bristol	391	81.8	77.7	85.4	5.1	3.3	7.8	13.0	10.1	16.8
Camb	153	76.5	69.1	82.5	12.4	8.1	18.7	11.1	7.0	17.2
Cardff	372	70.7	65.9	75.1	21.2	17.4	25.7	8.1	5.7	11.3
Carlis	74	77.0	66.1	85.2	9.5	4.6	18.5	13.5	7.4	23.3
Carsh	566	64.7	60.6	68.5	6.2	4.5	8.5	29.2	25.6	33.0
Chelms	94	68.1	58.0	76.7	0.0	0.0	0.0	31.9	23.3	42.0
Clwyd	62	83.9	72.6	91.1	3.2	0.8	12.0	12.9	6.6	23.7
Colchr	103	56.3	46.6	65.6	1.0	0.1	6.6	42.7	33.5	52.4
Derby	215	82.8	77.2	87.3	12.1	8.4	17.2	5.1	2.9	9.0
Derry	52	73.1	59.5	83.4	26.9	16.6	40.5	0.0	0.0	0.0
Donc	70	78.6	67.4	86.7	2.9	0.7	10.7	18.6	11.1	29.4
Dorset	183	76.5	69.8	82.1	13.1	9.0	18.8	10.4	6.7	15.7
Dudley	96	61.5	51.4	70.6	4.2	1.6	10.6	34.4	25.6	44.4
Exeter	283	79.2	74.0	83.5	14.1	10.5	18.7	6.7	4.3	10.3
Glouc	142	72.5	64.6	79.2	2.1	0.7	6.3	25.4	18.9	33.1
Hull	272	78.3	73.0	82.8	19.5	15.2	24.6	2.2	1.0	4.8
Ipswi	93	75.3	65.5	83.0	18.3	11.7	27.5	6.5	2.9	13.6
Kent	290	74.1	68.8	78.9	18.6	14.6	23.5	7.2	4.8	10.9
L Barts	561	77.4	73.7	80.6	14.4	11.8	17.6	8.2	6.2	10.8
L Guys	389	84.1	80.1	87.4	5.9	4.0	8.7	10.0	7.4	13.4
L Kings	378	80.4	76.1	84.1	2.4	1.2	4.5	17.2	13.7	21.3
L Rfree	499	73.6	69.5	77.2	5.6	3.9	8.0	20.8	17.5	24.6
L St G	199	44.2	37.5	51.2	1.0	0.3	3.9	54.8	47.8	61.6
Leeds	433	75.3	71.0	79.1	20.3	16.8	24.4	4.4	2.8	6.8
Leic	650	64.6	60.9	68.2	12.2	9.9	14.9	23.2	20.1	26.6
Liv Ain	106	79.3	70.5	85.9	9.4	5.2	16.7	11.3	6.5	18.9
Liv RI	337	70.9	65.9	75.5	9.8	7.1	13.5	19.3	15.4	23.9
M RI	217	68.2	61.7	74.1	8.8	5.7	13.3	23.0	17.9	29.1
Middlbr	260	54.6	48.5	60.6	3.1	1.6	6.0	42.3	36.4	48.4
Newc	241	72.2	66.2	77.5	9.1	6.1	13.5	18.7	14.2	24.1
Newry	85	68.2	57.6	77.2	5.9	2.5	13.4	25.9	17.7	36.2
Norwch	270	71.5	65.8	76.6	25.6	20.7	31.1	3.0	1.5	5.8
Nottm	263	65.8	59.8	71.3	3.4	1.8	6.4	30.8	25.5	36.6
Oxford	303	68.3	62.9	73.3	9.2	6.5	13.1	22.4	18.1	27.5
Plymth	109	70.6	61.4	78.4	23.9	16.8	32.7	5.5	2.5	11.7
Ports	411	74.0	69.5	78.0	12.7	9.8	16.2	13.4	10.4	17.0
Prestn	303	74.9	69.7	79.5	11.2	8.1	15.3	13.9	10.4	18.2
Redng	231	71.4	65.3	76.9	5.2	3.0	8.9	23.4	18.4	29.3
Sheff	528	72.4	68.4	76.0	2.7	1.6	4.4	25.0	21.5	28.9
Shrew	169	71.0	63.7	77.4	17.8	12.7	24.3	11.2	7.3	17.0
Stevng	339	76.1	71.3	80.4	8.9	6.3	12.4	15.0	11.6	19.3
Sthend	121	71.9	63.3	79.2	12.4	7.6	19.6	15.7	10.3	23.3
Sund	149	74.5	66.9	80.9	8.1	4.6	13.7	17.5	12.2	24.4
Swanse	297	68.0	62.5	73.1	15.5	11.8	20.1	16.5	12.7	21.2
Truro	130	57.7	49.1	65.9	40.0	31.9	48.6	2.3	0.8	6.9
Tyrone	83	60.2	49.4	70.2	2.4	0.6	9.1	37.4	27.7	48.2
Ulster	76	38.2	28.0	49.5	61.8	50.5	72.0	0.0	0.0	0.0
Wirral	156	63.5	55.6	70.6	6.4	3.5	11.5	30.1	23.5	37.8
Wolve	273	65.9	60.1	71.3	31.5	26.3	37.3	2.6	1.2	5.3
Wrexm	67	76.1	64.5	84.8	13.4	7.1	23.9	10.5	5.1	20.3
York	107	71.0	61.8	78.8	14.0	8.6	22.0	15.0	9.4	23.0
England	**12,843**	**71.3**	**70.5**	**72.1**	**10.5**	**10.0**	**11.1**	**18.2**	**17.5**	**18.8**
N Ireland	**636**	**71.1**	**67.4**	**74.5**	**15.7**	**13.1**	**18.8**	**13.2**	**10.8**	**16.1**
Wales	**862**	**70.9**	**67.8**	**73.8**	**16.6**	**14.3**	**19.2**	**12.5**	**10.5**	**14.9**
E, W & NI	**14,341**	**71.3**	**70.5**	**72.0**	**11.1**	**10.6**	**11.7**	**17.6**	**17.0**	**18.2**

Table 10.16. Summary statistics for serum bicarbonate in peritoneal dialysis patients in 2008

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	56	9					
B Heart	100	28	25.9	2.5	25.8	24.2	27.3
B QEH	74	92	25.6	3.2	25.9	23.4	27.9
Bangor	97	28	26.0	3.4	25.8	23.5	28.6
Basldn	100	30	26.4	3.3	27.0	23.0	28.0
Belfast	98	45	25.1	2.9	25.0	23.0	27.0
Bradfd	97	31	25.3	4.3	25.0	22.0	28.0
Brightn	98	78	23.9	3.7	23.9	21.6	26.2
Bristol	99	71	25.1	2.6	26.0	24.0	27.0
Camb	100	40	25.9	2.9	26.0	23.5	27.5
Cardff	99	113	22.9	2.8	23.0	21.0	24.7
Carlis	100	17					
Carsh	95	114	27.6	3.0	28.0	26.0	30.0
Chelms	100	39	27.9	2.9	28.0	26.0	30.0
Clwyd	80	8					
Colchr	n/a	0					
Covnt	68	48	26.3	3.0	27.0	24.0	29.0
Derby	100	75	26.4	3.4	26.0	24.0	29.0
Derry	100	5					
Donc	22	8					
Dorset	98	49	25.7	2.3	26.0	24.0	27.0
Dudley	96	45	25.2	2.8	25.3	24.2	27.4
Exeter	100	71	24.5	3.8	25.0	22.0	26.0
Glouc	100	33	27.1	3.2	27.0	25.0	30.0
Hull	96	69	26.6	3.1	26.0	25.0	29.0
Ipswi	98	48	24.7	3.3	25.0	23.5	27.0
Kent	97	70	23.3	3.3	22.0	21.0	26.0
L Barts	100	208	25.5	3.4	26.0	23.0	28.0
L Guys	98	49	24.0	2.7	25.0	22.0	26.0
L Kings	100	72	25.7	2.8	26.0	24.0	27.5
L Rfree	89	75	26.4	3.5	26.0	24.0	29.0
L St G	98	50	26.5	3.2	27.0	24.0	29.0
L West	7	3					
Leeds	99	86	26.2	3.0	26.0	25.0	28.0
Leic	94	149	26.5	3.2	27.0	24.0	28.7
Liv Ain	50	1					
Liv RI	92	87	24.6	2.7	25.0	23.0	27.0
M Hope	0	0					
M RI	100	91	25.8	2.9	26.0	24.0	28.0
Middlbr	86	19					
Newc	98	44	26.0	3.3	26.0	24.0	28.0
Newry	60	6					
Norwch	93	55	21.3	2.5	21.0	20.0	23.0
Nottm	47	52					
Oxford	67	72	26.1	3.7	26.5	24.0	28.0
Plymth	100	45	24.4	3.1	24.0	23.0	26.0
Ports	76	58	24.7	2.6	24.3	22.7	26.7
Prestn	81	47	24.0	2.5	24.0	23.0	26.0
Redng	100	75	25.1	2.3	25.0	24.0	26.0
Sheff	100	71	26.6	2.9	26.0	24.0	28.0
Shrew	100	32	25.9	2.6	26.0	24.0	27.0
Stevng	92	34	25.9	3.0	26.5	25.0	28.0
Sthend	93	14					
Stoke	12	9					

Table 10.16. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Sund	100	20	24.1	2.8	24.5	23.0	26.0
Swanse	98	59	26.3	3.0	26.0	25.0	28.0
Truro	100	26	23.9	2.4	24.0	22.0	25.0
Tyrone	100	7					
Ulster	80	4					
Wirral	74	25	26.2	2.9	27.0	23.0	28.0
Wolve	98	56	25.6	2.9	25.0	23.5	28.0
Wrexm	96	21	25.3	2.2	25.0	24.0	27.0
York	100	19					
England	**84**	**2,700**	**25.6**	**3.3**	**26.0**	**23.1**	**28.0**
N Ireland	**85**	**76**	**24.9**	**3.0**	**25.0**	**23.0**	**27.0**
Wales	**98**	**229**	**24.5**	**3.3**	**24.0**	**22.0**	**26.8**
E, W & NI	**85**	**3,005**	**25.5**	**3.3**	**26.0**	**23.0**	**28.0**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness

between centres in achieving the target, with seven centres achieving it in a significantly higher proportion of patients (Antrim, Derby, Belfast, London Kings, London Guys, Bristol, London Barts) and five in a significantly lower proportion of patients (Ulster, London St George's, Middlesbrough, Birmingham Heartlands, Leicester) (figure 10.46). Table 10.15 for HD patients and 10.17 for PD patients can be used to identify centres in each funnel plot showing bicarbonate achievement (figures 10.46–10.50). Six centres (Ulster, Truro, Wolverhampton, Norwich, Cardiff, Leeds) had a significantly high proportion of their patients with serum bicarbonate below 20 mmol/L (figure 10.47). Twelve centres (Tyrone, Colchester, London St George's, Middlesborough, Nottingham, Birmingham Heartlands, Sheffield, Carshalton, Birmingham QEH, Leicester, Dudley, Wirral) had a significantly high proportion with serum bicarbonate above 26 mmol/L (figure 10.48). These show over-dispersion of data and are therefore difficult to interpret.

For PD patients the target is to maintain values in the normal range which, in contrast to previous years, has been taken as 22–30 mmol/L. Overall 82% (CI 81–83) were within the target range (table 10.17). One centre (Norwich) achieved the target in a significantly lower proportion of their patients whilst in two centres (Dorset and Wrexham), the target was achieved in a significantly higher proportion (figure 10.49). The funnel plot shows two outlying centres (Norwich, Cardiff) with a high proportion of patients below 22 mmol/L (51% and 31% respectively) (figure 10.50). There were

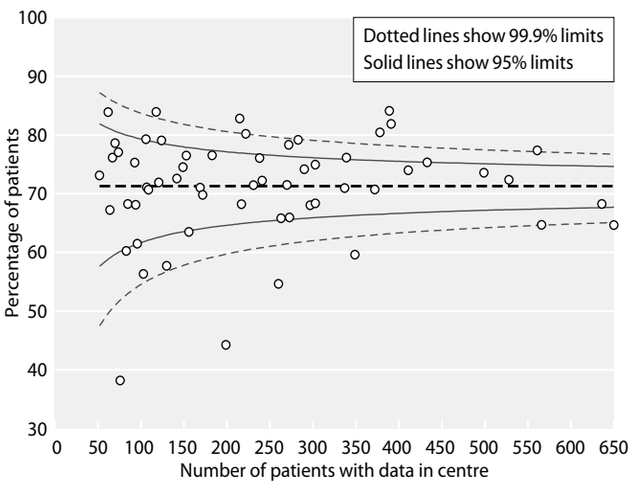

Fig. 10.46. Funnel plot of percentage of haemodialysis patients with bicarbonate 20–26 mmol/L by centre in 2008

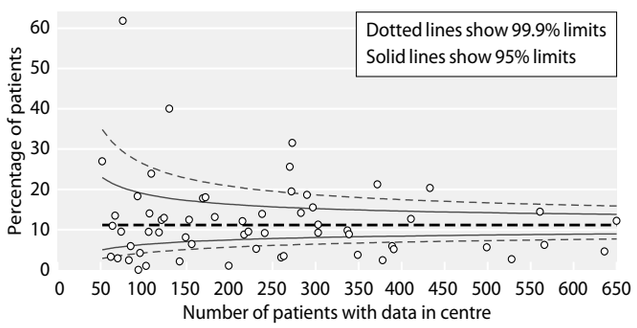

Fig. 10.47. Funnel plot of percentage of haemodialysis patients with bicarbonate <20 mmol/L by centre in 2008

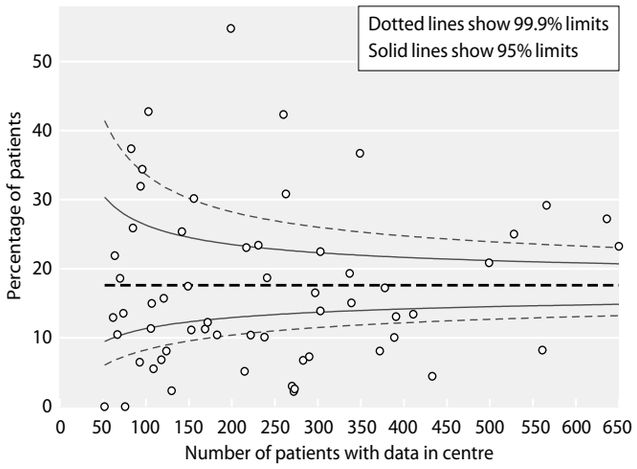

Fig. 10.48. Funnel plot of percentage of haemodialysis patients with bicarbonate >26 mmol/L by centre in 2008

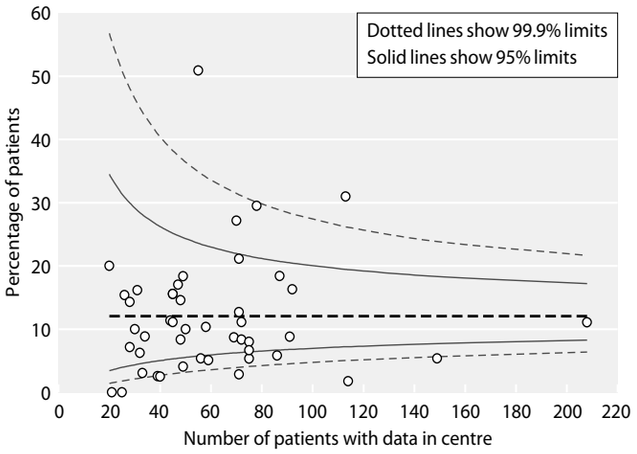

Fig. 10.50. Funnel plot of peritoneal dialysis patients with bicarbonate <22 mmol/L by centre in 2008

no centres with a higher than expected proportion of patients with serum bicarbonate greater than 30 mmol/L (funnel plot not shown).

The determinants of serum bicarbonate concentration in dialysis patients are multiple. They include pre-analytic factors such as the method of sampling, storage of the sample after collection and transport arrangements. Delays in transport to the laboratories can lead to significant reductions in serum bicarbonate. The analytic method employed may also be important. There are also numerous patient related factors including dietary protein intake, the degree of catabolism, dialysis frequency, dialysis adequacy, compliance with dialysis schedules, the dialysate bicarbonate concentration, the use of oral sodium bicarbonate and the use of calcium carbonate and sevelamer hydrochloride for phosphate binding. The UKRR previously conducted a limited survey into the possible underlying causes of the observed variation in serum bicarbonate concentrations and was unable to detect significant differences in sample processing or in dialysis treatment between centres except the association of low serum bicarbonate levels and the use of twice weekly haemodialysis [22].

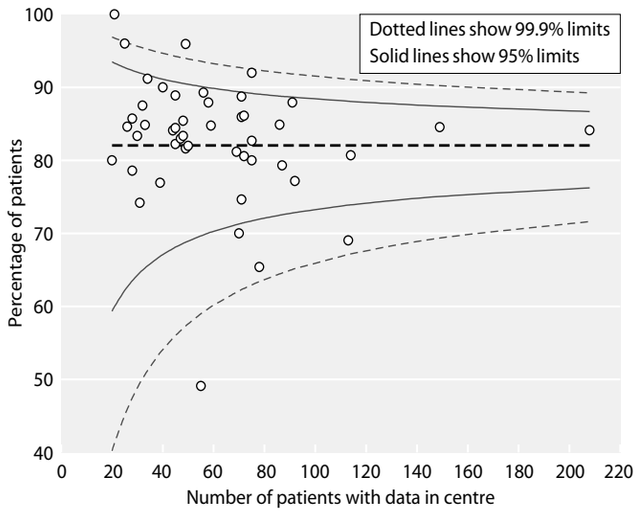

Fig. 10.49. Funnel plot of percentage of peritoneal dialysis patients with bicarbonate 22–30 mmol/L by centre in 2008

Other factors such as case mix or unmeasured processes including dialysis and oral bicarbonate prescription might account for the variation observed. Metabolic acidosis in haemodialysis patients has been positively associated with increased protein nitrogen appearance and negatively with increased Kt/V and increased use of calcium carbonate [23].

The haemodialysis module of the 4th edition of the Renal Association guidelines has recently been revised (1st December 2009) [24] and states (guideline 6.3) that:

'pre-dialysis serum bicarbonate concentrations measured with minimum delay after venepuncture should be between 18 and 24 mmol/L'.

The justification for a 2 mmol/L downward revision of the target range is as follows:

'Complete correction of pre-dialysis metabolic acidosis in HD patients may lead to post-dialysis metabolic alkalosis and consequently hypoventilation, phosphate transfer into cells and a higher risk of soft tissue and vascular calcification.'

It should also be noted that oral administration of sodium bicarbonate may contribute to sodium (and fluid) retention and hypertension.

Table 10.17. Percentage of peritoneal dialysis patients within, below and above the range for bicarbonate (22–30 mmol/L) in 2008

Centre	N	% bicarb 22–30 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb <22 mmol/L	Lower 95% CI	Upper 95% CI	% bicarb >30 mmol/L	Lower 95% CI	Upper 95% CI
B Heart	28	85.7	67.6	94.5	7.1	1.8	24.5	7.1	1.8	24.5
B QEH	92	77.2	67.5	84.6	16.3	10.1	25.3	6.5	3.0	13.8
Bangor	28	78.6	59.8	90.0	14.3	5.5	32.5	7.1	1.8	24.5
Basldn	30	83.3	65.7	92.9	10.0	3.3	26.8	6.7	1.7	23.1
Belfast	45	82.2	68.3	90.9	15.6	7.6	29.2	2.2	0.3	14.2
Bradfd	31	74.2	56.3	86.5	16.1	6.9	33.4	9.7	3.2	26.1
Brightn	78	65.4	54.2	75.1	29.5	20.5	40.5	5.1	1.9	12.9
Bristol	71	85.9	75.8	92.3	12.7	6.7	22.6	1.4	0.2	9.3
Camb	40	90.0	76.2	96.2	2.5	0.4	15.7	7.5	2.4	20.8
Cardff	113	69.0	59.9	76.9	31.0	23.2	40.1	0.0	0.0	0.0
Carsh	114	80.7	72.4	86.9	1.8	0.4	6.7	17.5	11.6	25.6
Chelms	39	76.9	61.3	87.5	2.6	0.4	16.1	20.5	10.6	36.0
Covnt	48	83.3	70.1	91.4	8.3	3.2	20.2	8.3	3.2	20.2
Derby	75	80.0	69.4	87.6	5.3	2.0	13.4	14.7	8.3	24.6
Dorset	49	95.9	85.1	99.0	4.1	1.0	14.9	0.0	0.0	0.0
Dudley	45	88.9	76.0	95.3	11.1	4.7	24.1	0.0	0.0	0.0
Exeter	71	74.7	63.3	83.4	21.1	13.2	32.1	4.2	1.4	12.3
Glouc	33	84.9	68.4	93.6	3.0	0.4	18.6	12.1	4.6	28.2
Hull	69	81.2	70.2	88.7	8.7	4.0	18.0	10.1	4.9	19.8
Ipswi	48	85.4	72.4	92.9	14.6	7.1	27.6	0.0	0.0	100.0
Kent	70	70.0	58.3	79.6	27.1	18.0	38.7	2.9	0.7	10.7
L Barts	208	84.1	78.5	88.5	11.1	7.5	16.1	4.8	2.6	8.7
L Guys	49	81.6	68.3	90.2	18.4	9.8	31.7	0.0	0.0	0.0
L Kings	72	86.1	76.1	92.4	8.3	3.8	17.3	5.6	2.1	13.9
L Rfree	75	82.7	72.4	89.7	8.0	3.6	16.7	9.3	4.5	18.3
L St G	50	82.0	68.9	90.4	10.0	4.2	21.9	8.0	3.0	19.5
Leeds	86	84.9	75.7	91.0	5.8	2.4	13.2	9.3	4.7	17.5
Leic	149	84.6	77.8	89.5	5.4	2.7	10.4	10.1	6.2	16.0
Liv RI	87	79.3	69.5	86.6	18.4	11.6	27.9	2.3	0.6	8.7
M RI	91	87.9	79.5	93.2	8.8	4.5	16.6	3.3	1.1	9.7
Newc	44	84.1	70.2	92.2	11.4	4.8	24.5	4.6	1.1	16.4
Norwch	55	49.1	36.2	62.1	50.9	37.9	63.8	0.0	0.0	0.0
Oxford	72	80.6	69.8	88.1	11.1	5.7	20.7	8.3	3.8	17.3
Plymth	45	84.4	70.8	92.4	15.6	7.6	29.2	0.0	0.0	0.0
Ports	58	87.9	76.8	94.1	10.3	4.7	21.2	1.7	0.2	11.2
Prestn	47	83.0	69.5	91.3	17.0	8.8	30.5	0.0	0.0	0.0
Redng	75	92.0	83.3	96.4	6.7	2.8	15.0	1.3	0.2	8.9
Sheff	71	88.7	79.1	94.3	2.8	0.7	10.6	8.5	3.9	17.6
Shrew	32	87.5	71.1	95.2	6.3	1.6	21.8	6.3	1.6	21.8
Stevng	34	91.2	76.0	97.1	8.8	2.9	24.0	0.0	0.0	0.0
Sund	20	80.0	57.2	92.3	20.0	7.7	42.8	0.0	0.0	0.0
Swanse	59	84.8	73.2	91.9	5.1	1.7	14.6	10.2	4.6	20.8
Truro	26	84.6	65.5	94.1	15.4	5.9	34.5	0.0	0.0	0.0
Wirral	25	96.0	76.5	99.4	0.0	0.0	100.0	4.0	0.6	23.6
Wolve	56	89.3	78.1	95.1	5.4	1.7	15.3	5.4	1.7	15.3
Wrexm	21	100.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
England	**2,700**	**82.4**	**81.0**	**83.8**	**11.4**	**10.3**	**12.7**	**6.2**	**5.3**	**7.1**
N Ireland	**76**	**81.6**	**71.3**	**88.8**	**15.8**	**9.2**	**25.8**	**2.6**	**0.7**	**9.9**
Wales	**229**	**77.7**	**71.9**	**82.7**	**18.3**	**13.9**	**23.9**	**3.9**	**2.1**	**7.4**
E, W & NI	**3,005**	**82.1**	**80.7**	**83.4**	**12.1**	**10.9**	**13.3**	**5.9**	**5.1**	**6.8**

'In a large observational study the risk of death was lowest in HD patients with pre-dialysis serum bicarbonate concentrations within the 18.0–24.0 mmol/L range (Lowrie EG, Teng M, Lew NL et al. Toward a continuous quality improvement paradigm for hemodialysis providers with preliminary suggestions for clinical practice monitoring and measurement. Hemodial Int 2003;7:28–51). Review of the target pre-dialysis serum bicarbonate levels set by international clinical practice guidelines indicates that a mild degree of pre--dialysis acidosis is recommended to minimize the risk of adverse events.'

Total cholesterol

There is no audit standard for total cholesterol in the 4th edition of the Renal Association Clinical Practice Guidelines. Current guidance on lipid management states:

'Three hydroxy-3 methylglutaryl-Co-enzyme A reductase inhibitors (statins) should be considered for primary prevention in all CKD including dialysis patients with a 10-year risk of cardiovascular disease, calculated as >20% according to the Joint British Societies' Guidelines (JBS 2), despite the fact that these calculations have not been validated in patients with renal disease. The target total cholesterol should be <4 mmol/L or a 25% reduction from baseline, and a fasting low density lipoprotein (LDL)-cholesterol of <2 mmol/L or a 30% reduction from baseline, should be achieved, whichever is the greatest reduction in all patients (Evidence in CKD 1–3, Good Practice in CKD 4–5 and dialysis patients). Statins should not be withdrawn from patients in whom they were previously indicated and should continue to be prescribed when such patients start renal replacement therapy (RRT) or change modality. (Good Practice).' (Module 2: Complications) [1]

Total cholesterol data were 83% complete for both HD (table 10.18) and PD (table 10.19) patients. Six centres (Brighton, Colchester, Coventry, Doncaster, Liverpool Royal Infirmary, Stevenage) with <50% completeness for HD and two centres (Brighton, Carshalton) with more than 20 patients but <50% completeness for PD were excluded from further analysis. The median cholesterol achieved for HD patients was 3.8 mmol/L (figure 10.51) and for PD patients was 4.4 mmol/L (figure 10.52).

Serial data for 2000–2008 (figure 10.53) show that the percentage of HD patients achieving a cholesterol less than 5 mmol/L has been stable at 85% for three years whereas there has been a slight decline (72 to 69%) in PD patients over the same time period.

A number of case mix factors (comorbidity, inflammation and malnutrition) may contribute to inter centre variation in cholesterol levels in addition to differences in clinical practice with relation to the prescription of lipid lowering medication and other therapies, such as sevelamer, which are known to influence lipid levels. The UKRR plans to collect an enhanced dataset to include more detailed lipid profiles, which, in conjunction with the awaited results from the SHARP study, may help inform lipid management practice in dialysis patients.

Table 10.18. Summary statistics for total cholesterol in haemodialysis patients in 2008

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	98	119	3.9	1.1	3.9	3.1	4.7
B Heart	87	339	4.4	1.1	4.3	3.7	5.0
B QEH	86	631	4.0	1.1	3.8	3.2	4.5
Bangor	87	62	4.1	1.1	4.1	3.3	4.8
Basldn	99	124	4.0	1.0	3.9	3.4	4.5
Belfast	84	201	4.0	1.0	3.8	3.3	4.5
Bradfd	81	145	4.4	1.4	4.2	3.6	5.0
Brightn	32	95					
Bristol	93	389	4.1	1.1	3.9	3.3	4.7
Camb	80	232	3.8	1.0	3.7	3.1	4.3
Cardff	92	413	4.0	1.1	3.8	3.2	4.6
Carlis	97	73	4.2	1.0	4.2	3.4	4.7
Carsh	84	484	4.1	1.1	3.9	3.4	4.8
Chelms	99	94	4.0	1.2	3.6	3.2	4.7

Table 10.18. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Clwyd	87	59	4.0	0.8	3.9	3.4	4.6
Colchr	20	21					
Covnt	0	0					
Derby	97	222	3.7	0.9	3.7	3.2	4.2
Derry	100	52	4.0	0.9	3.7	3.5	4.4
Donc	36	26					
Dorset	96	179	4.0	1.0	4.0	3.4	4.6
Dudley	75	90	3.4	0.8	3.4	2.7	4.0
Exeter	78	221	4.0	1.1	3.9	3.1	4.7
Glouc	94	134	4.1	1.2	4.0	3.3	4.8
Hull	92	267	4.1	1.1	4.1	3.4	4.9
Ipswi	88	84	3.8	1.0	3.6	3.1	4.3
Kent	99	291	4.1	1.0	4.0	3.4	4.8
L Barts	100	570	3.8	1.0	3.7	3.1	4.4
L Guys	96	462	4.0	1.1	3.9	3.3	4.6
L Kings	93	354	4.0	1.0	3.9	3.3	4.6
L Rfree	83	514	4.1	1.1	4.0	3.4	4.7
L St G	99	203	4.1	1.0	4.0	3.2	4.8
L West	74	861	3.8	1.0	3.6	3.1	4.3
Leeds	96	438	3.9	1.0	3.8	3.2	4.5
Leic	95	642	3.8	1.0	3.7	3.1	4.4
Liv Ain	53	61	4.0	1.1	3.9	3.0	4.7
Liv RI	10	38					
M Hope	80	229	3.6	0.9	3.5	3.0	4.0
M RI	69	265	3.8	1.0	3.8	3.0	4.5
Middlbr	97	264	4.3	1.1	4.3	3.4	5.0
Newc	91	229	3.8	1.0	3.7	3.1	4.4
Newry	99	87	3.6	1.0	3.4	2.8	4.1
Norwch	99	284	4.0	1.1	3.8	3.3	4.6
Nottm	98	344	3.7	1.0	3.6	3.1	4.3
Oxford	89	291	3.8	1.0	3.7	3.0	4.5
Plymth	88	99	3.9	1.0	3.9	3.3	4.6
Ports	64	264	4.0	1.2	3.8	3.1	4.6
Prestn	99	410	4.0	1.0	3.9	3.3	4.6
Redng	92	214	3.7	0.9	3.7	3.1	4.3
Sheff	93	529	3.8	1.0	3.7	3.0	4.3
Shrew	99	169	4.0	1.0	3.9	3.3	4.5
Stevng	40	138					
Sthend	87	106	4.0	1.0	3.8	3.3	4.5
Stoke	95	228	3.6	1.0	3.6	3.0	4.2
Sund	99	149	3.8	1.0	3.6	2.9	4.4
Swanse	96	303	4.1	1.1	4.0	3.3	4.7
Truro	100	134	3.9	1.1	3.9	3.1	4.4
Tyrone	100	84	4.2	1.0	4.1	3.6	4.7
Ulster	100	77	3.9	0.9	3.8	3.2	4.4
Wirral	91	149	3.8	1.1	3.7	3.0	4.4
Wolve	95	262	4.1	1.0	4.0	3.4	4.7
Wrexm	78	55	3.9	1.1	3.8	3.3	4.3
York	90	99	4.5	1.1	4.3	3.7	5.3
England	**83**	**13,140**	**3.9**	**1.1**	**3.8**	**3.2**	**4.5**
N Ireland	**94**	**620**	**3.9**	**1.0**	**3.8**	**3.2**	**4.5**
Wales	**92**	**892**	**4.0**	**1.1**	**3.9**	**3.3**	**4.7**
E, W & NI	**83**	**14,652**	**3.9**	**1.1**	**3.8**	**3.2**	**4.5**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness

Table 10.19. Summary statistics for total cholesterol in peritoneal dialysis patients in 2008

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	88	14					
B Heart	100	28	4.9	1.2	4.9	4.0	5.7
B QEH	82	103	4.4	1.2	4.2	3.7	5.2
Bangor	97	28	4.8	1.1	4.7	4.0	5.2
Basldn	100	30	4.4	1.0	4.5	4.0	5.0
Belfast	91	42	4.6	1.3	4.2	3.7	5.4
Bradfd	97	31	4.9	1.5	4.8	3.7	5.9
Brightn	45	36					
Bristol	79	57	4.6	1.2	4.3	3.7	5.3
Camb	100	40	4.2	1.1	4.2	3.4	5.2
Cardff	99	113	4.6	1.2	4.5	3.6	5.4
Carlis	88	15					
Carsh	39	47					
Chelms	90	35	4.4	1.3	4.3	3.6	4.9
Clwyd	70	7					
Colchr	n/a	0					
Covnt	1	1					
Derby	89	67	4.2	1.0	4.1	3.4	4.8
Derry	100	5					
Donc	60	22	4.4	1.8	3.7	3.3	5.4
Dorset	88	44	4.4	1.0	4.4	3.7	5.0
Dudley	87	41	3.9	0.9	3.9	3.3	4.2
Exeter	82	58	4.8	1.3	4.6	4.0	5.8
Glouc	100	33	4.6	1.2	4.7	3.8	5.3
Hull	86	62	4.6	1.1	4.5	4.0	5.1
Ipswi	96	47	4.2	1.0	4.3	3.4	4.9
Kent	92	66	4.7	1.1	4.6	3.9	5.2
L Barts	100	208	4.4	1.2	4.2	3.6	5.1
L Guys	96	48	5.1	1.4	4.9	4.2	5.7
L Kings	86	62	4.6	1.2	4.5	3.9	5.2
L Rfree	94	79	4.4	1.1	4.3	3.7	5.0
L St G	94	48	5.1	1.4	5.0	4.2	6.0
L West	100	42	4.5	0.9	4.6	4.0	5.0
Leeds	95	83	4.3	1.0	4.1	3.5	4.9
Leic	96	151	4.3	1.4	4.1	3.5	4.7
Liv Ain	0	0					
Liv RI	0	0					
M Hope	88	105	4.3	1.2	4.0	3.4	5.0
M RI	99	90	4.4	1.1	4.3	3.5	4.8
Middlbr	55	12					
Newc	98	44	4.3	1.5	3.9	3.3	4.7
Newry	100	10					
Norwch	97	57	5.0	1.3	4.9	4.1	5.9
Nottm	96	107	4.2	0.9	4.2	3.6	4.8
Oxford	89	95	4.8	1.3	4.6	3.9	5.7
Plymth	82	37	4.9	1.0	4.9	4.2	5.4
Ports	53	40	4.8	1.5	4.6	3.6	5.6
Prestn	97	56	4.5	0.9	4.5	3.9	5.1
Redng	100	75	4.3	1.0	4.2	3.5	4.8
Sheff	55	39	4.4	1.2	4.1	3.4	5.1
Shrew	100	32	5.0	1.4	4.7	4.1	5.8
Stevng	43	16					
Sthend	80	12					
Stoke	100	72	3.4	1.4	3.5	2.1	4.5

Table 10.19. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Sund	50	10					
Swanse	98	59	4.7	1.4	4.4	3.7	5.4
Truro	96	25	4.7	1.1	4.4	3.9	5.4
Tyrone	86	6					
Ulster	100	5					
Wirral	71	24	4.2	1.1	3.9	3.4	4.6
Wolve	90	51	5.1	1.8	4.6	4.0	5.9
Wrexm	96	21	4.4	1.7	4.1	3.6	4.7
York	84	16					
England	**81**	**2,599**	**4.5**	**1.2**	**4.3**	**3.7**	**5.1**
N Ireland	**92**	**82**	**4.6**	**1.2**	**4.3**	**3.7**	**5.2**
Wales	**97**	**228**	**4.6**	**1.3**	**4.4**	**3.7**	**5.3**
E, W & NI	**83**	**2,909**	**4.5**	**1.3**	**4.4**	**3.7**	**5.2**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness

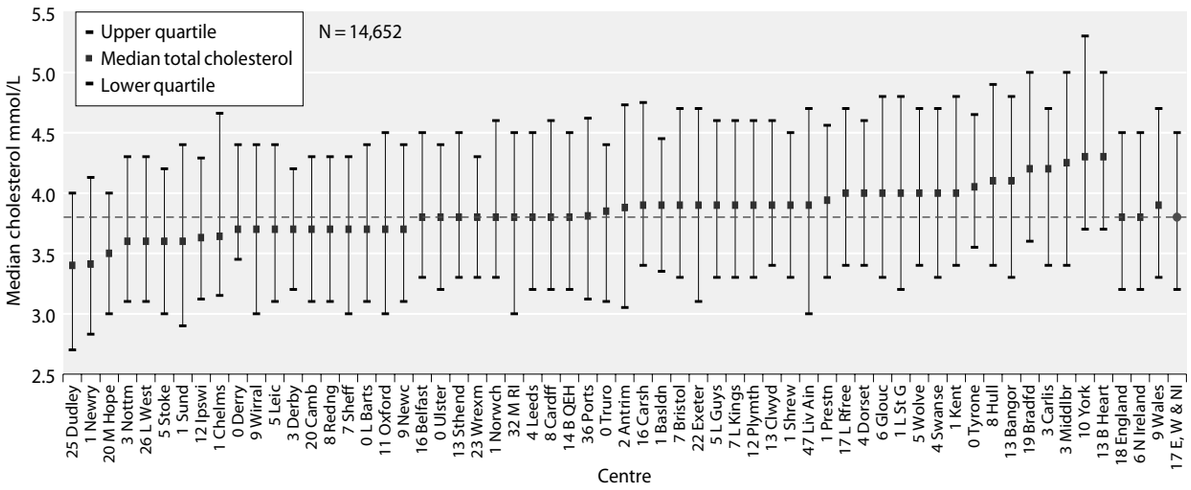

Fig. 10.51. Median total cholesterol in haemodialysis patients by centre in 2008

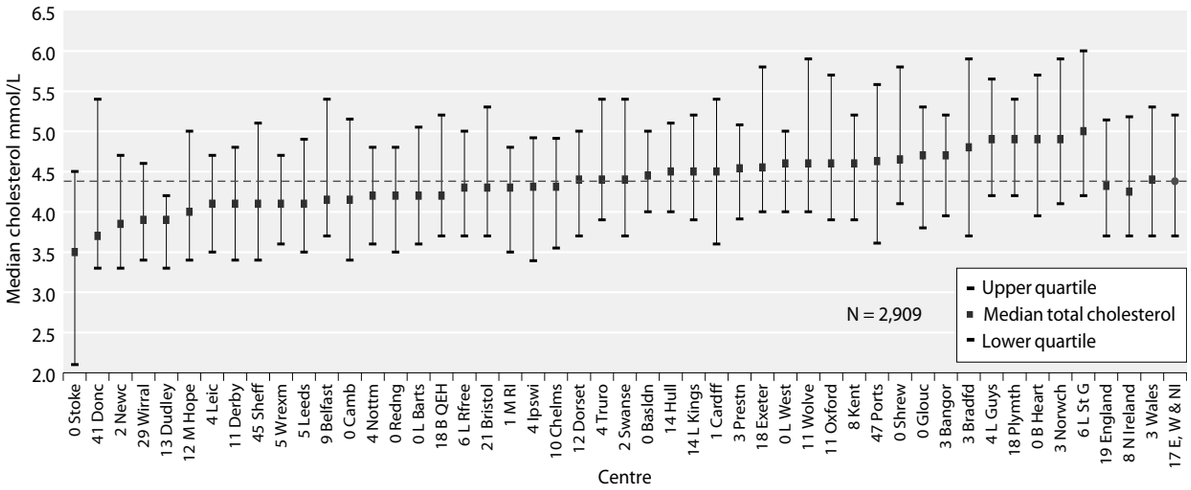

Fig. 10.52. Median total cholesterol in peritoneal dialysis patients by centre in 2008

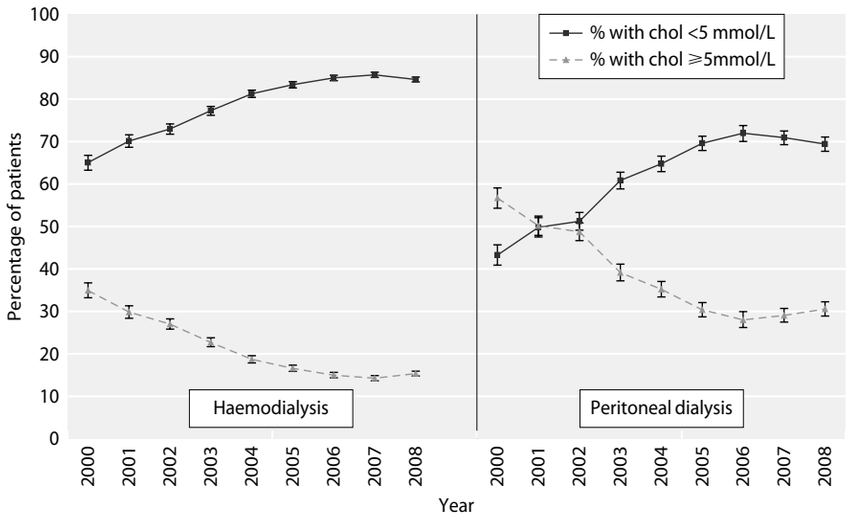

Fig. 10.53. Percentage of dialysis patients with serum total cholesterol <5 mmol/L and ⩾5 mmol/L, 2000–2008

HbA1c

The 4th edition of the Renal Association Clinical Practice Guidelines state:

'In all CKD and dialysis patients with diabetes, the glycated haemoglobin (HbA1c) should be kept below 7.5%. HbA1c should be measured using an assay method which has been harmonised to the Diabetes Control and Complications Trial (DCCT) standard'. (Module 2: Complications) [1]

The data for HbA1c for dialysis patients with a diagnosis of diabetes mellitus were 71% complete overall (table 10.20). Peritoneal and haemodialysis patients were not analysed separately due to low numbers in many centres. Four centres returned no data (Bangor, Cardiff, Derby and Wolverhampton) and four others (Birmingham QEH, Manchester RI, Portsmouth, Stoke) were excluded from further analysis due to less than 50% completeness. Sixteen others were excluded because they had less than 20 eligible patients. Median HbA1c was 7.2% (figure 10.54). Overall, 43% of dialysis patients exceeded the target of 7.5% HbA1c with a two-fold variation between centres (30% of patients at London West, 60% of patients at Ipswich and Swansea) (figure 10.55).

All methods for HbA1c in the UK are DCCT aligned and further harmonisation will be achieved with the ongoing worldwide adoption by manufacturers of

Table 10.20. Summary statistics for HbA1c in dialysis patients with diabetes mellitus in 2008

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Antrim	88	38	7.4	1.2	7.5	6.6	8.0
B Heart	86	91	7.8	1.6	7.6	6.7	8.8
B QEH	50	103					
Bangor	0	0					
Basldn	97	28	7.7	1.2	7.5	7.1	8.6
Belfast	94	50	7.2	1.3	7.2	6.2	8.1
Bradfd	94	51	7.4	1.6	7.3	6.0	8.6
Brightn	65	35	7.4	1.6	7.4	6.2	8.7
Bristol	99	92	7.3	1.5	7.0	6.3	8.0
Camb	44	10					
Cardff	0	0					
Carlis	100	13					
Carsh	72	90	7.4	1.6	7.1	6.3	8.4
Chelms	79	22	7.9	2.4	7.3	6.4	9.5

Table 10.20. Continued

Centre	% completeness	Number of patients with data	Mean	SD	Median	Lower quartile	Upper quartile
Clwyd	95	19					
Colchr	71	5					
Covnt	94	59	7.6	1.7	7.3	6.6	8.1
Derby	0	0					
Derry	100	11					
Donc	78	14					
Dorset	46	13					
Dudley	89	32	7.4	1.6	7.1	6.0	8.6
Exeter	66	25	8.1	1.9	7.7	6.7	9.4
Glouc	95	20	7.5	1.6	7.2	6.2	8.5
Hull	73	43	7.5	1.4	7.4	6.3	8.6
Ipswi	83	20	8.0	1.5	7.9	6.9	9.3
Kent	95	59	7.5	1.5	7.4	6.3	8.4
L Barts	99	231	7.8	1.9	7.6	6.4	8.7
L Guys	94	129	6.9	1.4	6.7	5.8	7.8
L Kings	89	104	7.2	1.5	6.9	6.1	8.1
L Rfree	70	64	7.8	1.6	7.8	6.5	8.7
L St G	90	73	7.7	1.5	7.5	6.7	8.8
L West	62	206	6.8	1.6	6.7	5.8	7.7
Leeds	91	71	7.4	1.7	7.1	6.1	8.4
Leic	69	90	7.1	1.3	7.0	6.0	7.9
Liv Ain	20	1					
Liv RI	72	42	7.0	1.6	7.0	5.6	7.7
M Hope	54	7					
M RI	46	26					
Middlbr	39	18					
Newc	100	37	7.7	1.4	7.5	6.5	8.6
Newry	93	14					
Norwch	84	41	7.6	1.9	7.5	6.2	8.4
Nottm	81	81	7.6	1.7	7.4	6.3	8.6
Oxford	64	47	7.7	1.7	7.4	6.3	8.5
Plymth	91	20	7.4	1.2	7.2	6.5	8.1
Ports	47	36					
Prestn	90	71	7.6	1.5	7.4	6.3	8.5
Redng	99	75	7.5	1.7	7.1	6.1	8.5
Sheff	82	88	7.8	1.5	7.9	6.6	8.8
Shrew	97	34	7.1	1.2	6.7	6.1	8.0
Stevng	92	72	7.3	1.4	7.2	6.3	8.3
Sthend	41	12					
Stoke	46	28					
Sund	69	24	7.2	1.7	6.9	6.1	8.5
Swanse	78	50	7.8	1.6	7.9	6.6	8.7
Truro	96	25	7.1	1.1	6.8	6.4	7.7
Tyrone	91	10					
Ulster	100	18					
Wirral	38	9					
Wolve	0	0					
Wrexm	39	5					
York	79	11					
England	**73**	**2,598**	**7.4**	**1.6**	**7.2**	**6.2**	**8.4**
N Ireland	**93**	**141**	**7.4**	**1.5**	**7.4**	**6.4**	**8.1**
Wales	**31**	**74**					
E, W & NI	**71**	**2,813**	**7.4**	**1.6**	**7.2**	**6.2**	**8.4**

Blank cells denote centres excluded from analyses due to low patient numbers or poor data completeness

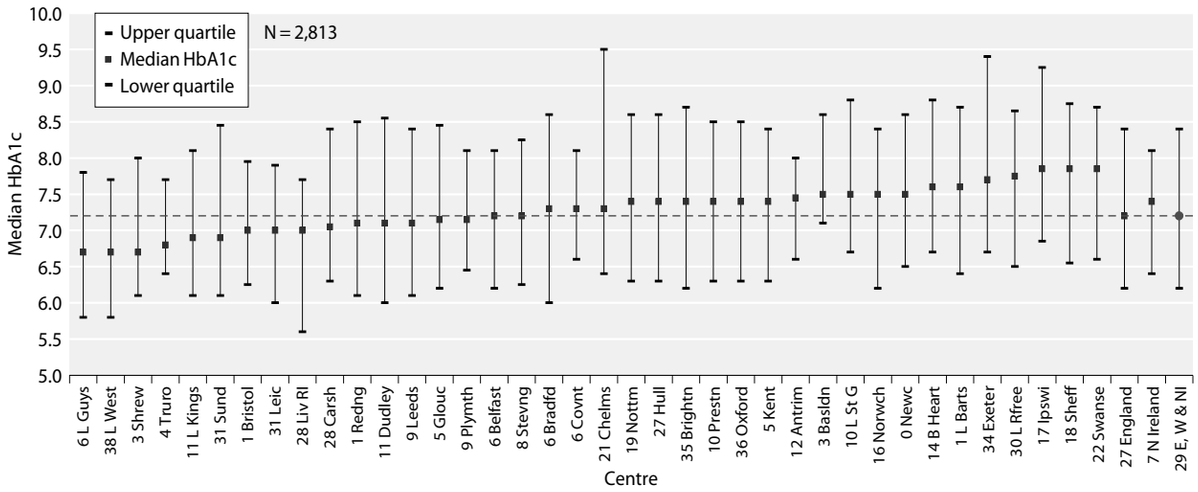

Fig. 10.54. Median HbA1c in dialysis patients with diabetes mellitus by centre in 2008

calibration via the International Federation of Clinical Chemistry reference system with results to be reported as mmol/mol haemoglobin in many countries, including the UK. A master equation will then be applied to derive the percentage HbA1c for a two year transition period of dual reporting. However, these changes will not alter some of the fundamental analytical and clinical problems confounding the interpretation of HbA1c that are unrelated to its use as an indicator of glycaemic control.

Haemoglobinopathies (especially HbS, C and E) may cause analytical interference that may be positive or negative depending on the method. Some methods suffer positive interference from carbamylated haemoglobin. Any cause of shortened red cell survival will diminish the amount of HbA1c simply because there is less time for glycation to occur, whereas it is increased with longer red cell lifespan (e.g. iron deficiency, splenectomy). Recent transfusions invalidate its use due to the presence of donor red cells and erythropoietin use may also have an impact.

Some of the observed variation between centres may be due to variations in the proportion of patients with haemoglobinopathies. Indeed one centre (London West) returned a small number of results (1.5%) below the 4% lower limit of the DCCT aligned reference range, suggesting that patients with haemoglobinopathies may have been included. Some laboratories use methods for HbA1c that will detect the presence of abnormal haemoglobins enabling the reporting of the patient as unsuitable for HbA1c analysis but many

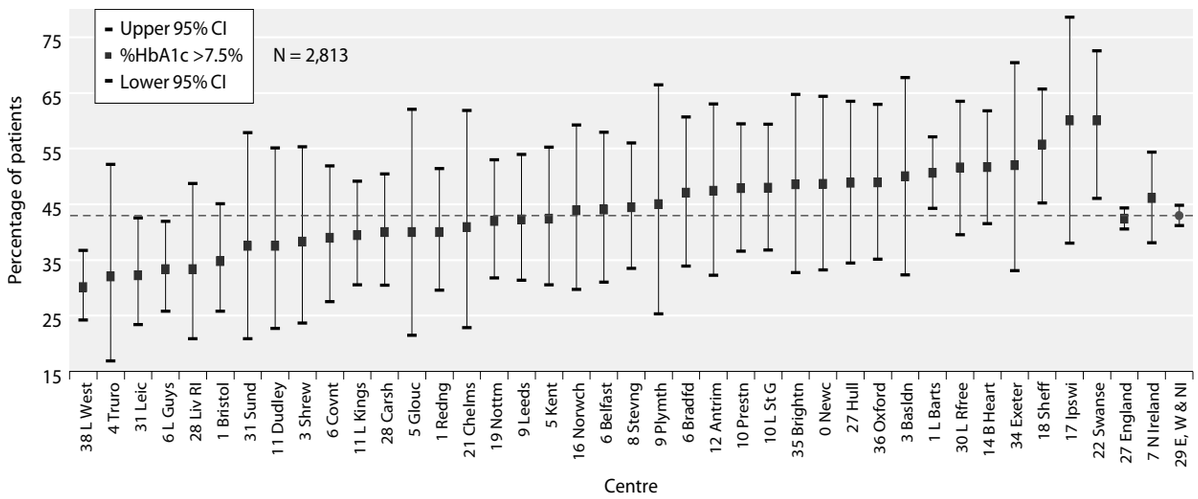

Fig. 10.55. Percentage of dialysis patients with diabetes mellitus and serum HbA1c >7.5% by centre in 2008

laboratories do not. Centres are advised to check with their laboratories about local practice and to consider the likelihood of interference in people of African, Mediterranean or South Asian origin, especially when glucose and HbA1c results are discrepant, or when HbA1c is less than 4% or greater than 15%.

Conflict of interest: none

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Chapter 11
Blood Pressure Profile of Prevalent Patients Receiving Dialysis in the UK in 2008: national and centre-specific analyses

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Key Words
Blood pressure · Chronic kidney disease · Dialysis · Epidemiology · Established renal failure · Haemodialysis · Peritoneal dialysis · Transplant

Abstract
Introduction: The UK Renal Registry (UKRR) assesses blood pressure (BP) control annually for patients receiving renal replacement therapy (RRT) at renal centres in England, Wales and Northern Ireland. ***Methods:*** Patients alive and receiving RRT on 31st December 2008 with a BP reading in either the fourth or third quarter of 2008 were included. Summary statistics were calculated for each renal centre, nation and primary renal disease (PRD) category. Longitudinal analyses were performed to assess the long-term impact of treatment modality and PRD on BP control for incident and prevalent patients. ***Results:*** In 2008, only 26.3% of peritoneal dialysis (PD) and 27.4% of transplant (Tx) patients achieved the Renal Association (RA) guidelines standard of BP <130/80 mmHg. Since the cessation of BP targets for haemodialysis (HD) patients, there has been a reduction (compared to 2007) in the number of HD patients achieving BP <130/80 mmHg. In 2008, 43.1% of patients achieved BP <140/90 mmHg pre-HD and 46.8% BP <130/80 mmHg post-HD. BP control varied significantly between renal centres for each treatment modality ($p < 0.001$). Adjusted mean systolic BP fell significantly during the first year on dialysis (6 mmHg for PD and 8 mmHg for HD). Hypertension was more common in HD patients with vascular disorders such as diabetes and renovascular disease (59.0%) than in patients with glomerulonephritis (51.9%) or tubular disorders (46.7%). ***Conclusions:*** In 2008, a minority of patients on RRT achieved the recommended BP standards. There remained a significant variation in achievement of standards between UK renal centres. Since the removal of specific BP targets for HD patients, there has been an increase in systolic BP pre- and post-HD. BP falls significantly during the first year after starting dialysis and patients with vascular disorders have significantly worse BP control.

Introduction

This chapter reports on blood pressure (BP) analyses carried out by the UK Renal Registry (UKRR) for data

collected from 63 renal centres in England, Wales and Northern Ireland. The Renal Association (RA) Standards Committee sets BP guidelines for patients on renal replacement therapy (RRT) in the UK. In 2002 it recommended that the BP target should be lowered to <140/90 mmHg pre-dialysis and <130/80 mmHg post-dialysis for haemodialysis (HD) patients and <130/80 mmHg for peritoneal dialysis (PD) and kidney transplant (Tx) patients [1]. These recommendations, based on grade C evidence, are in line with BP standards set by other international organisations to reduce cardiovascular disease and mortality in the general population. In 2007, the 4th edition of the RA clinical practice guidelines omitted specific BP targets for HD patients as there was little evidence to support an optimal BP level pre- or post-dialysis [2]. In addition, there was some data to suggest home or ambulatory readings have greater prognostic value than readings obtained in the dialysis unit [3, 4]. The new guidelines recommended interdialytic BP monitoring to aid BP control. The recommended BP for PD and transplant patients remained <130/80 mmHg. Revised KDOQI clinical practice guidelines, issued in 2006, removed specific BP targets for HD patients [5]. Both UK and USA guidelines champion BP control by salt restriction and ultrafiltration as first-line therapy in dialysis patients. KDIGO is currently revising hypertension clinical practice guidelines taking advice from the USA and UK.

Hypertension affects 90% of patients starting dialysis, suggesting BP control might be an important target for intervention to reduce cardiovascular mortality. Several large observational studies in HD patients have reported U-shaped or reverse J-shaped relationships between systolic BP and mortality, with increased mortality in individuals with the highest and lowest BP [6, 7]. Low BP was consistently associated with higher mortality rates in the short term, but lower mortality rates in the long term. Longer-term studies of individuals without established cardiac disease have shown low mortality rates for sustained low BP and increased mortality after three years for patients with systolic BP >150 mmHg [8, 9]. Patients with cardiac failure or serious concurrent medical conditions account for early mortality in these studies. A similar relationship between BP and mortality has been demonstrated in PD patients [10]. In the first year, high systolic BP was associated with low mortality rates. In the 'healthy' subgroup wait-listed quickly for transplantation, high systolic BP was associated with higher mortality rates after 5 years. A large study of renal Tx recipients demonstrated the benefits of sustained BP control, with increased mortality in the younger patient group whose systolic BP was elevated [11]. After three years, the lowest mortality rates were associated with systolic BP consistently being <140 mmHg. A reduction in cardiovascular death rates occurred if high systolic BP one year post-transplant was subsequently controlled <140 mmHg. In older patients (>50 years) changes in systolic BP did not affect cardiovascular mortality. However, graft survival improved in all patients (young and old) if systolic BP was reduced <140 mmHg. The improvement in graft survival was still evident if BP control was delayed until several years after transplantation.

Intradialytic hypotension is common when trying to achieve dry weight on conventional thrice-weekly HD. An audit of HD practice in London showed achievement of BP control was associated with an increased frequency of intradialytic hypotensive episodes [12]. In the most successful unit, 50% of patients achieved the post-dialysis BP target but 28% of patients developed symptomatic intradialytic hypotension. Antihypertensive medication did not appear to affect either BP control or the frequency of hypotensive episodes. The 'Dry weight reduction in hypertensive haemodialysis patients (DRIP)' randomised controlled trial demonstrated achievement of dry weight led to reductions in systolic and diastolic BP of 6.9 mmHg and 3.1 mmHg, respectively, but more symptomatic intradialytic hypotension [13]. Individuals who suffer this complication frequently have poor outcomes related to pre-existing cardiac disease or autonomic neuropathy. However, myocardial perfusion has been shown to drop significantly during the first hour on HD even in fit individuals [14]. Following the introduction of new RA guidelines, median BP may increase for HD patients if units switch from achieving specific BP targets to reducing intradialytic hypotension.

Methods

All adult patients receiving RRT in the UK on 31st December 2008 were considered for inclusion in the BP analyses. The method of data extraction employed, is described in chapter 15 of the 11th UKRR Annual Report [15]. The UKRR extracts quarterly laboratory, clinical and demographic data for all patients receiving RRT in the 63 renal centres in England, Northern Ireland and Wales. Data on some variables from the nine Scottish renal centres are sent annually from the Scottish Renal Registry. However, BP measurements are not received from Scotland, and therefore Scottish renal centres were excluded from all BP analyses.

Any patient alive and receiving RRT on 31st December 2008 with a valid BP reading in either the fourth or the third quarter of 2008 was included. This included incident patients starting RRT during 2008 who were still alive on 31st December. Analyses used the last recorded BP from quarter 4, however, if this was missing, the last recorded BP from quarter 3 was used instead. Patients were excluded from analyses if they had no recorded BP readings in the last two quarters of 2008.

All patients meeting the criteria above were included in the overall national analyses, but renal centres with less than 50% data completeness for any modality, or fewer than 20 patients with results were excluded from the centre-level analysis for that modality. The number preceding the centre name in each figure corresponds to the percentage of missing data in each centre.

Most UK renal centres manage HD, PD and Tx patients. However, Colchester had no PD patients and four centres (Bangor, Colchester, Liverpool Aintree and Wirral) had no transplant patients under their care.

Analyses were performed on each RRT modality (HD, PD and Tx recipients). Patients on HD were analysed both by pre-dialysis and post-dialysis BP. Patients were included if they had been on the same modality and at the same renal centre for 3 months. The BP components analysed included systolic BP (SBP), diastolic BP (DBP) and pulse pressure (PP). The data were analysed to produce summary statistics (mean, median, maximum, minimum). Standard deviation and quartile ranges were also calculated. Median BP and inter-quartile ranges (IQRs) are presented for each analysis. In addition to this, the percentage of PD and Tx patients attaining RA Standards for BP (***<130/80 mmHg***) in individual renal centres and each nation was calculated. There are currently no defined targets for BP in HD patients due to a lack of randomised controlled trials of hypertension management within this population. The UKRR has decided to continue to use the previous RA standards for BP in these patients (***pre-haemodialysis BP <140/90 mmHg and post-haemodialysis <130/80 mmHg) [1]*** to enable comparison with previous annual UKRR reports.

In the longitudinal analyses, mean BP was studied in patients grouped by primary renal disease (PRD). Patients without a recorded PRD were excluded. Primary renal disease diagnoses are listed in appendix G Coding. Analyses were repeated after combining diabetic nephropathy and renovascular disease into a 'vascular' group, and combining pyelonephritis and polycystic kidney disease into a 'tubular' group. These two combination groups were compared with the glomerulonephritis group. For HD patients, post-HD systolic and diastolic BP measurements were used in the longitudinal analyses.

For the incident population longitudinal analyses, all patients commencing dialysis (HD or PD) between 1st January 2000 and 31st December 2004 were considered for inclusion. These patients were subsequently observed for a maximum of 5 years. Patients contributed to any quarter where a BP was recorded. For each quarter, only patients from renal centres with greater than 30% completeness were included. For both PD and HD, the longitudinal analyses were performed using a mixed regression model to account for the use of repeated BP measurements from the same individual (within-patient correlation). The model adjusted for age at starting dialysis, year of starting dialysis, PRD and changes in treatment modality.

When choosing an adequate model to represent the data variability, a linear model, with changes in BP assumed to be linear over time, was compared to a parallel model, where time was fitted as a categorical variable. Additionally, the interaction between time and PRD group was tested to assess if any change in BP with time varied depending on the PRD group. A parallel model with no interaction appeared to be the most appropriate in all cases. This means that, although change over time is not linear, all the groups showed the same pattern of change.

For the prevalent population longitudinal analyses, all patients commencing RRT (HD, PD and Tx) between 1st January 1995 and 30th September 2008, who survived at least 90 days, were considered for inclusion. Only BP measurements between 1st January 2000 and the 31st December 2008 were used in the analyses. Patients contributed to any quarter where a BP was recorded. For each quarter, only patients from renal centres with greater than 30% completeness, by modality, were included. A mixed regression model was used, adjusting for age and duration of RRT (both as time-dependent variables) and PRD. As for the longitudinal analysis of BP in the incident cohort, comparison of a linear versus parallel model and testing for the presence of an interaction between time and PRD showed the parallel model to be the most appropriate of those tested.

Chi-squared tests were used in the analyses of the 2008 BP data to test for statistically significant differences between renal centres, nations and PRD. All statistical analyses were performed using SAS version 9.1.3.

Results

Data completeness

Blood pressure data extractions from 63 centres in England, Northern Ireland and Wales were performed. The UKRR extracted BP readings from 19,263 of a potential 40,726 patients. Most centres managed HD, PD and Tx patients and the data completeness for BP extraction is summarised in table 11.1.

Data was extracted for pre-HD BP from 64.9% of patients, post-HD BP from 61.5% of patients and BP from 41.8% of PD patients and 32.6% of Tx patients. Overall, there has been a small increase in the percentage of data extracted in HD patients but no change for PD or Tx patients.

From two centres (Wirral and Reading) there was discrepancy between extraction of pre- and post-HD BP data, with pre-HD readings available from over 90% of patients, but few returns for post-HD readings (36% and 0%, respectively).

High levels (>80%) of BP data extraction for all 3 RRT modalities was obtained from 13 centres. There were 7 centres where no BP data was available for analysis. The extent to which this is due to a lack of data entry locally in renal centres, as opposed to failings in the extraction of recorded data by the UKRR, is not clear.

Table 11.1. Percentage of patients in each renal centre for whom BP readings were extracted by the UKRR, by modality

	% completed data					% completed data			
Centre	Pre HD	Post HD	PD	Tx	Centre	Pre HD	Post HD	PD	Tx
Antrim	97	97	81	94	Leic	99	96	93	27
B Heart	93	93	0	0	Liv Ain	93	93	0	n/a
B QEH	0	0	0	0	Liv RI	88	87	25	55
Bangor	94	94	100	n/a	M Hope	55	55	4	0
Basldn	99	99	93	2	M RI	1	1	0	0
Belfast	92	91	26	70	Middlbr	96	95	86	39
Bradfd	12	2	97	89	Newc	0	0	0	0
Brightn	0	0	0	0	Newry	99	99	30	0
Bristol	100	98	94	78	Norwch	100	97	27	73
Camb	57	52	98	95	Nottm	99	99	98	93
Cardff	7	0	4	96	Oxford	84	81	61	11
Carlis	99	99	12	0	Plymth	5	0	2	0
Carsh	77	77	3	0	Ports	100	100	68	10
Chelms	100	100	100	94	Prestn	20	0	0	0
Clwyd	91	91	80	87	Redng	97	0	99	97
Colchr	99	100	n/a	n/a	Sheff	99	98	100	98
Covnt	100	98	73	72	Shrew	99	99	25	29
Derby	99	98	100	70	Stevng	98	98	0	1
Derry	98	98	100	92	Sthend	98	98	0	0
Donc	100	100	97	94	Stoke	98	98	4	0
Dorset	99	99	100	89	Sund	97	97	10	0
Dudley	83	81	64	52	Swanse	97	97	3	1
Exeter	100	83	97	75	Truro	99	99	42	66
Glouc	99	99	3	0	Tyrone	100	99	100	86
Hull	6	6	43	0	Ulster	100	100	40	100
Ipswi	99	99	88	90	Wirral	91	36	41	n/a
Kent	99	98	14	5	Wolve	100	99	100	93
L Barts	0	0	0	0	Wrexm	99	92	0	0
L Guys	0	0	0	0	York	95	92	95	89
L Kings	0	0	0	0	**England**	64	61	43	29
L Rfree	0	0	0	0	**N Ireland**	96	96	47	70
L St.G	2	3	0	0	**Wales**	55	51	19	71
L West	76	76	0	0	**E, W & NI**	65	61	42	33
Leeds	97	96	95	80					

n/a not applicable

Summary of BP achievements

Figure 11.1 summarises the median SBP, DBP and PP readings (with IQRs) for all treatment modalities from renal centres in England, Wales and Northern Ireland.

BP readings from 18,669 out of 40,726 patients were analysed. The results shown for HD patients are post-dialysis readings. Median systolic and diastolic BP were lower in HD patients than in both PD and Tx patients (SBP: 129 mmHg (HD), 138 mmHg (PD) and 135 mmHg (Tx); DBP: 68 mmHg (HD), 80 mmHg (PD) and 79 mmHg (Tx)). Pulse pressure readings in HD patients (60 mmHg) were greater than in PD (57 mmHg) and Tx (56 mmHg) patients.

Haemodialysis

Pre-HD readings from 11,397 out of 17,574 patients and post-HD readings from 10,803 out of 17,574 patients were available for analysis. Due to extraction of insufficient readings, 14 centres were excluded from the pre-HD analyses and 16 centres from the post-HD analyses.

Figure 11.2 illustrates the performance of centres and nations in achieving the previous RA standard for pre-HD BP (<140/90 mmHg). Overall, 43.1% (95% CI: 42.2–44.0%) achieved this standard. There was significant variation in achievement between centres ($p < 0.0001$) and between nations ($p < 0.0005$).

Figure 11.3 demonstrates the attainment of the previous post-dialysis BP standard for HD patients

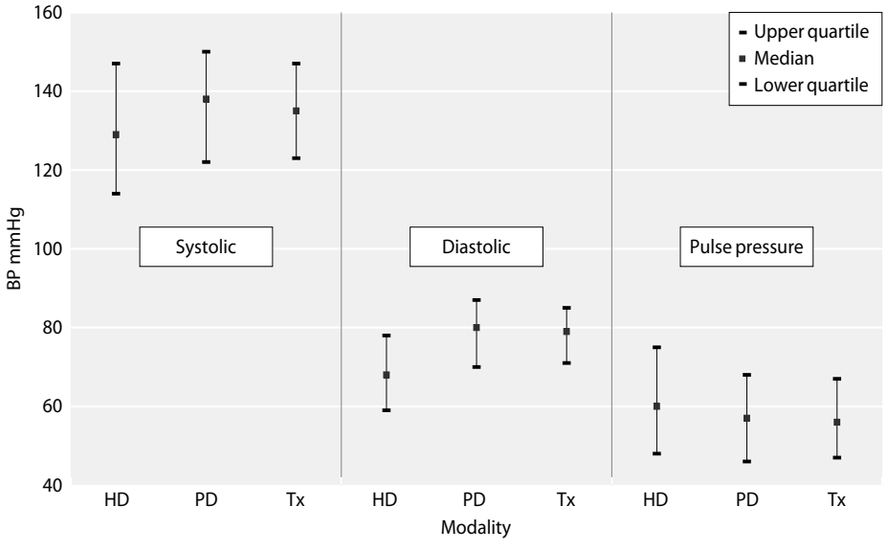

Fig. 11.1. Summary of BP achievements

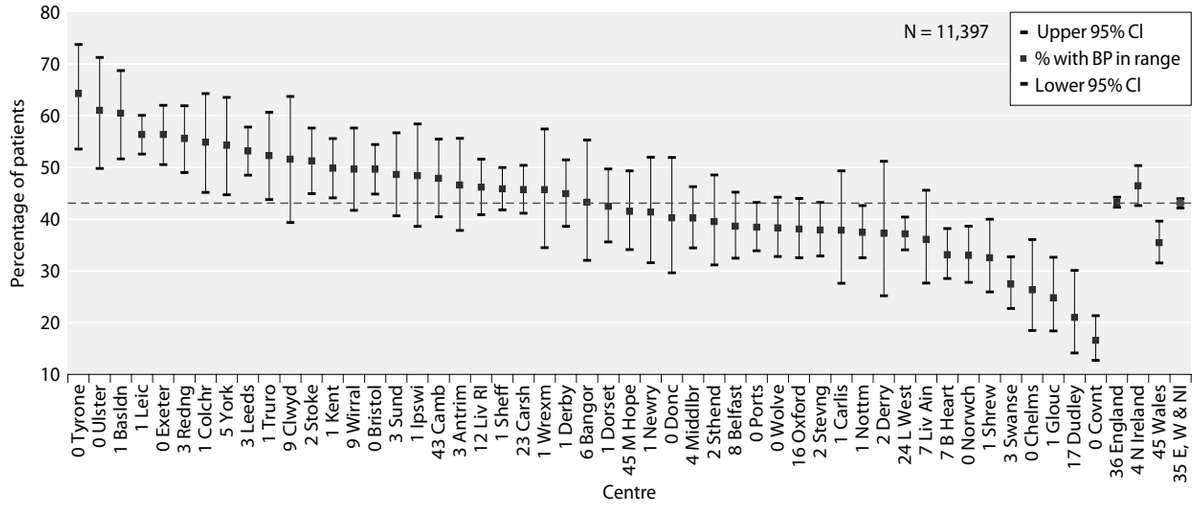

Fig. 11.2. Percentage of patients with BP <140/90 mmHg: pre-HD

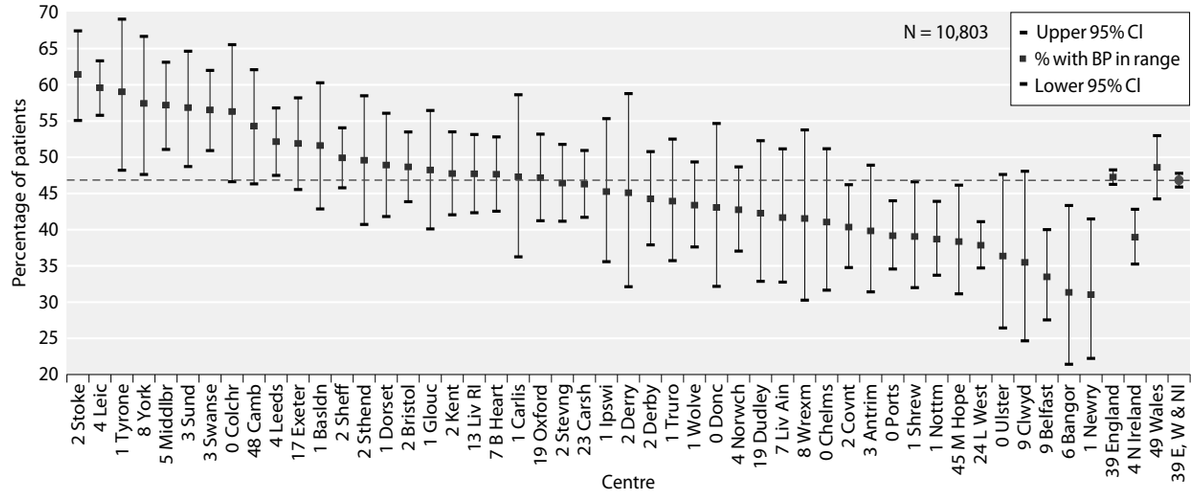

Fig. 11.3. Percentage of patients with BP <130/80 mmHg: post-HD

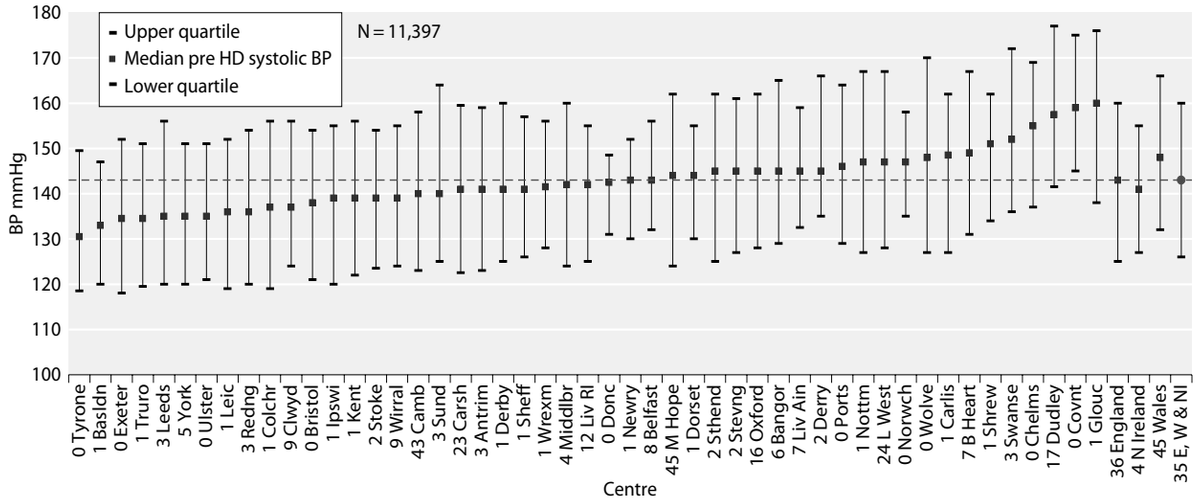

Fig. 11.4. Median systolic BP: pre-HD

(<130/80 mmHg). Overall, 46.8% of all patients (95% CI: 45.9–47.8%) achieved this standard, with a significant variation between centres ($p < 0.0001$) and nations ($p < 0.0005$).

Figure 11.4 describes the median pre-HD systolic BP by both centre and nation. The median pre-HD SBP for all patients was 143 mmHg, ranging from 130.5–160.0 mmHg between centres. Northern Ireland's SBP readings were lower (141 mmHg) compared with England (143 mmHg) and Wales (148 mmHg).

Figure 11.5 demonstrates the attainment of the previous RA standard for pre-HD systolic BP (<140 mmHg) by centre and nation. Overall, 44.7% of all patients achieved this standard (95% CI: 43.8%–45.6%), with significant variation between centres ($p < 0.0001$) and nations ($p < 0.001$).

Figure 11.6 illustrates the median post-HD systolic BP in all centres and nations. The median post-HD SBP for all patients was 129 mmHg, ranging from 119–143 mmHg between centres. Northern Ireland's post-HD SBP was higher (134 mmHg) than those in England and Wales (129 mmHg).

Figure 11.7 shows the attainment of the previous RA standard for post-HD systolic readings (<130 mmHg) for all centres and nations. Overall, 50.3% of all patients achieved this standard (95% CI: 49.3%–51.2%). There was a significant variation in attaining this standard between centres (range 31.3%–64.8%, $p < 0.0001$) and between nations (range 41.6%–50.8%, $p < 0.0001$).

Figure 11.8 demonstrates the median pre-HD diastolic BP by both centre and nation. The median

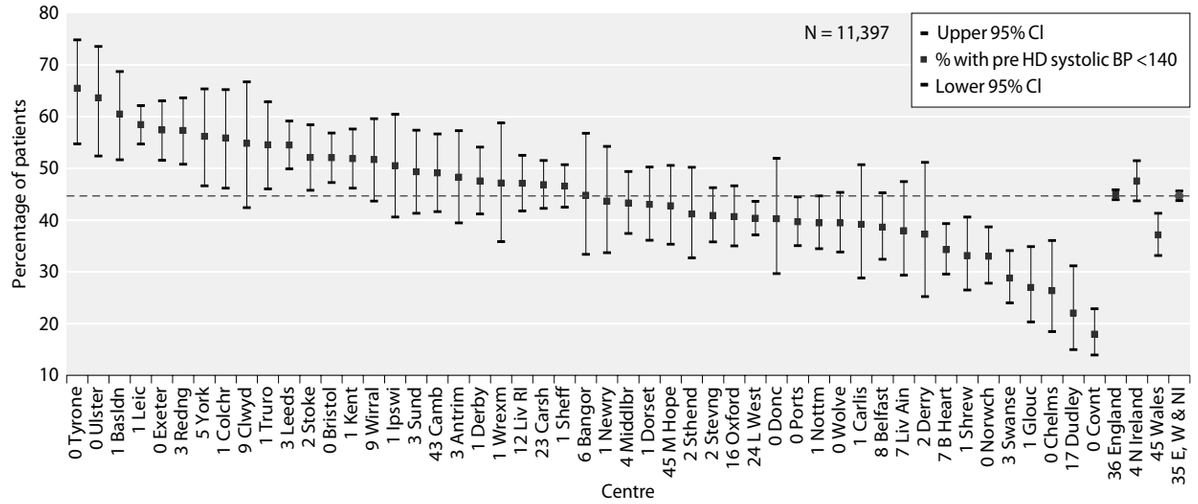

Fig. 11.5. Percentage of patients with systolic BP <140 mmHg: pre-HD

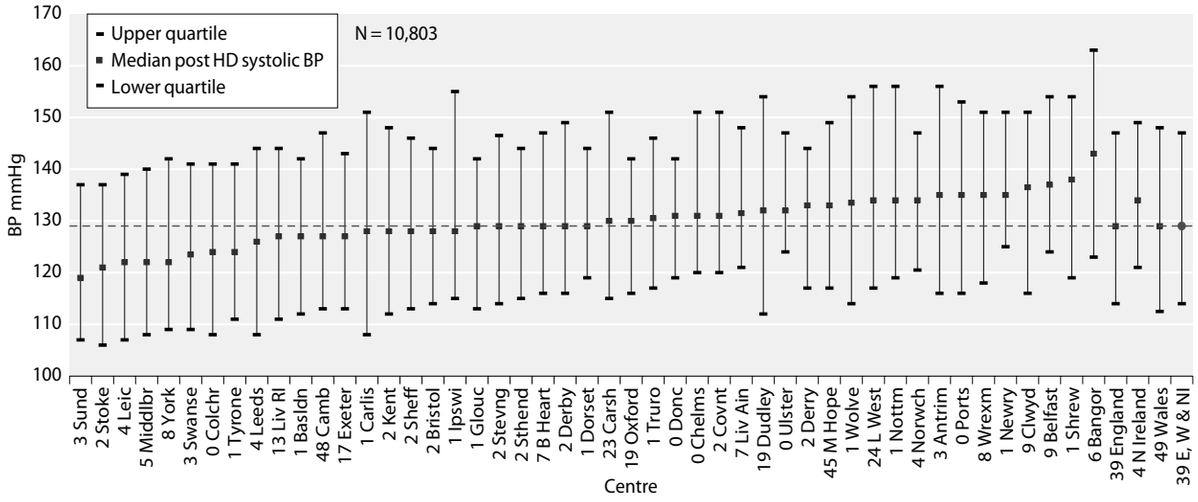

Fig. 11.6. Median systolic BP: post-HD

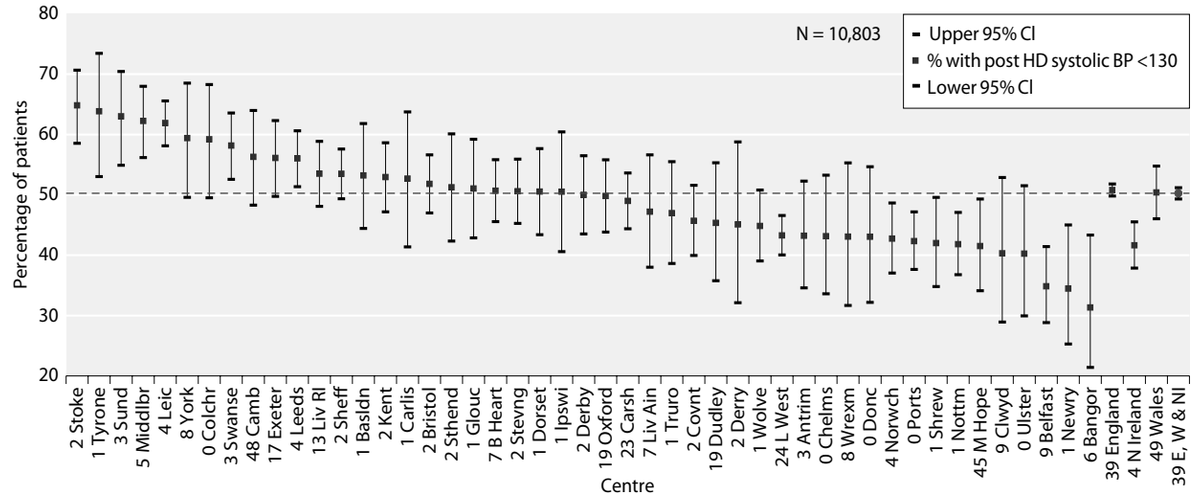

Fig. 11.7. Percentage of patients with systolic BP <130 mmHg: post-HD

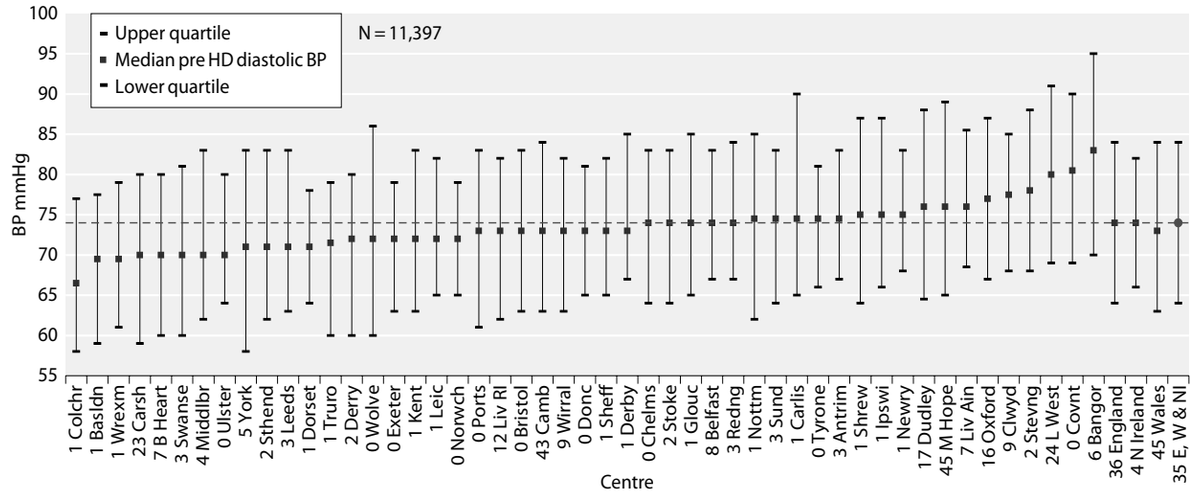

Fig. 11.8. Median diastolic BP: pre-HD

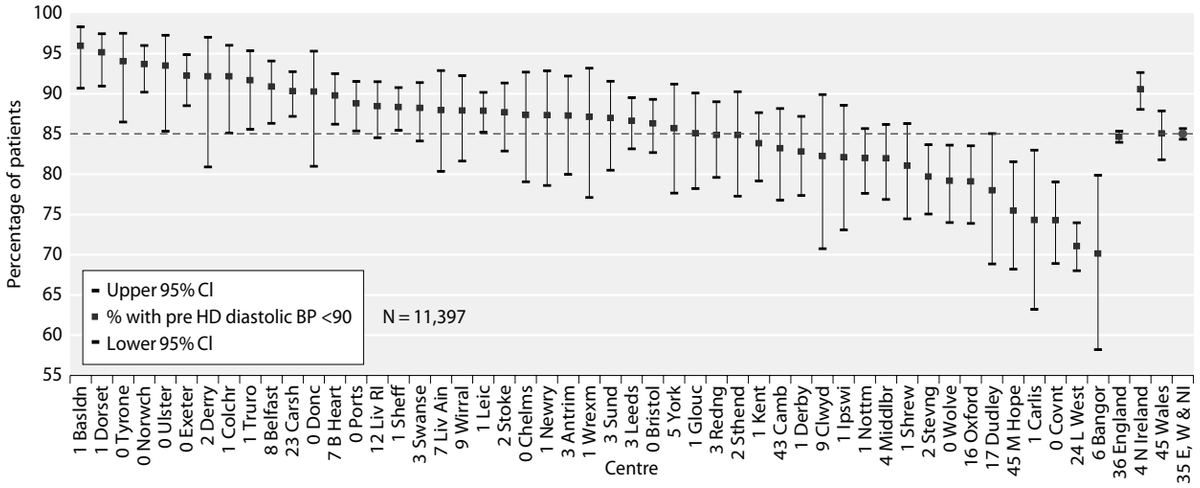

Fig. 11.9. Percentage of patients with diastolic BP <90 mmHg: pre-HD

pre-HD DBP in all patients was 74 mmHg, ranging from 66.5–83.0 mmHg between centres.

Figure 11.9 illustrates the performance of centres and nations in achieving the previous RA standard for pre-HD diastolic BP (<90 mmHg). Overall, 85.0% of patients achieved this standard (95% CI: 84.4% to 85.7%). There was a significant variation in the achievement of this standard between centres (range 70.2%–96.0%, $p < 0.0001$) and between nations (range 84.7%–90.6%, $p < 0.0005$).

Figure 11.10 shows the median post-HD diastolic BP by both centre and nation. The median post-HD DBP for all patients was 68 mmHg, ranging from 61.5–78.0 mmHg between centres. Wales achieved a lower post-HD DBP (66 mmHg) compared with England (68 mmHg) and Northern Ireland (71 mmHg).

Figure 11.11 demonstrates the performance of centres and nations in achieving the previous RA standard for post-HD diastolic BP (<80 mmHg). Overall 78.1% of all patients achieved this standard (95% CI: 77.3%–78.8%). There was a significant variation in attaining this standard between centres (range 56.7%–90.3%, $p < 0.0001$) but not between nations.

Figure 11.12 describes the median pre-HD pulse pressure for all centres and nations. The median pre-HD PP for all patients was 67 mmHg. The median pre-HD PP ranged from 60.0–81.5 mmHg between centres, and from 65–74 mmHg between nations.

Figure 11.13 illustrates the median post-HD pulse pressure by both centre and nation. The median post-HD PP for all patients was 60 mmHg. The median

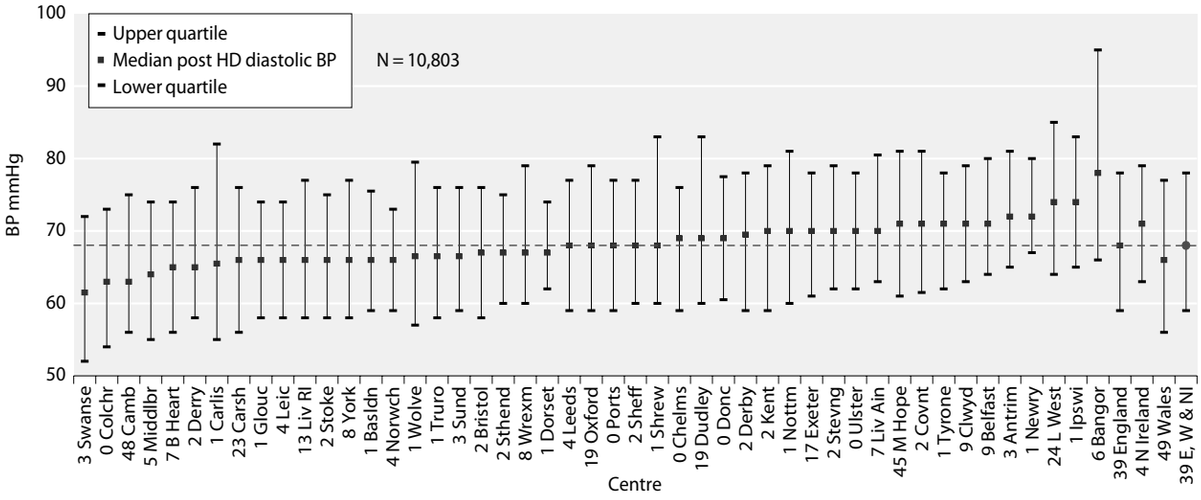

Fig. 11.10. Median diastolic BP: post-HD

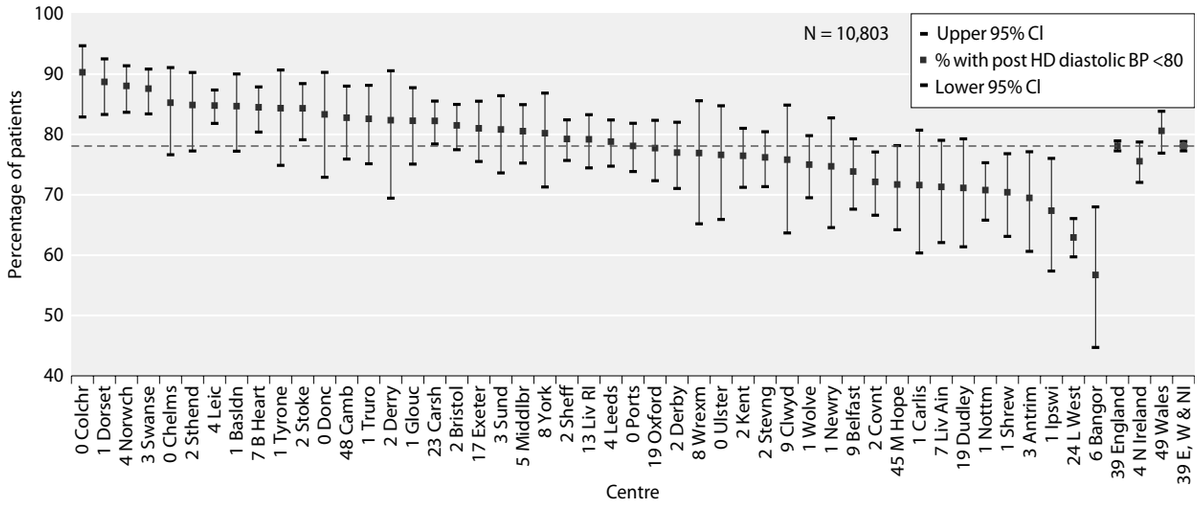

Fig. 11.11. Percentage of patients with diastolic BP <80 mmHg: post-HD

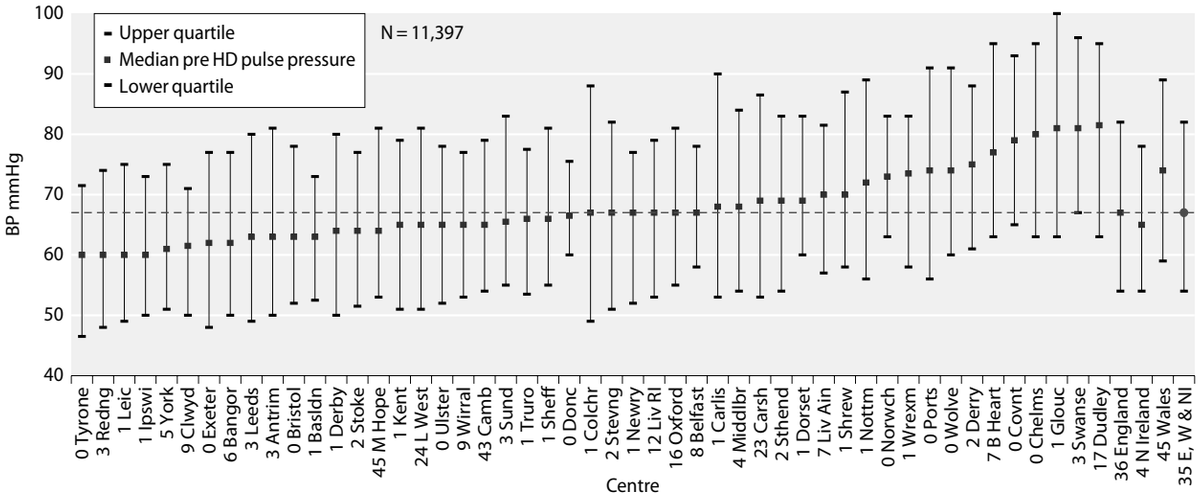

Fig. 11.12. Median PP: pre-HD

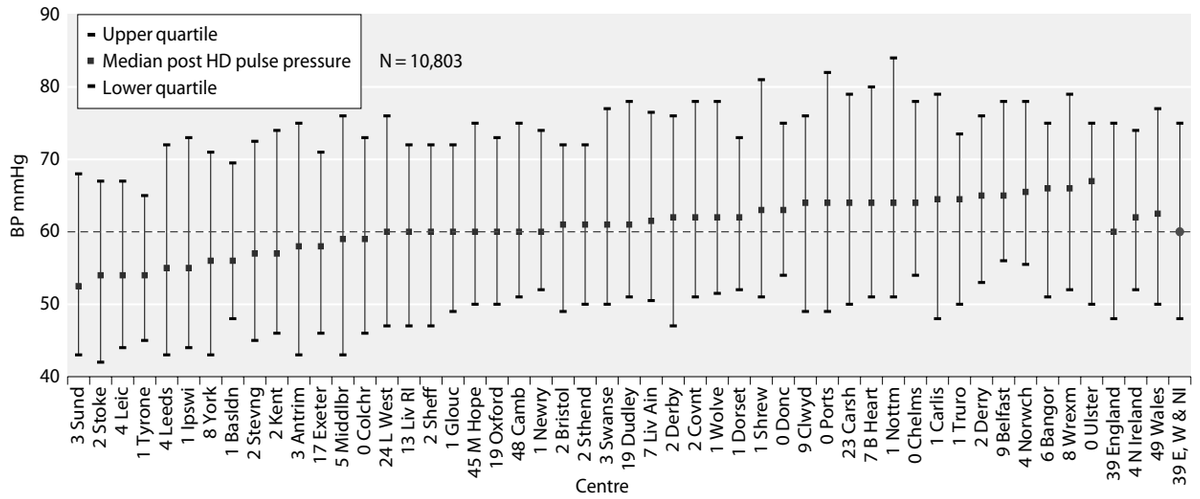

Fig. 11.13. Median PP: post-HD

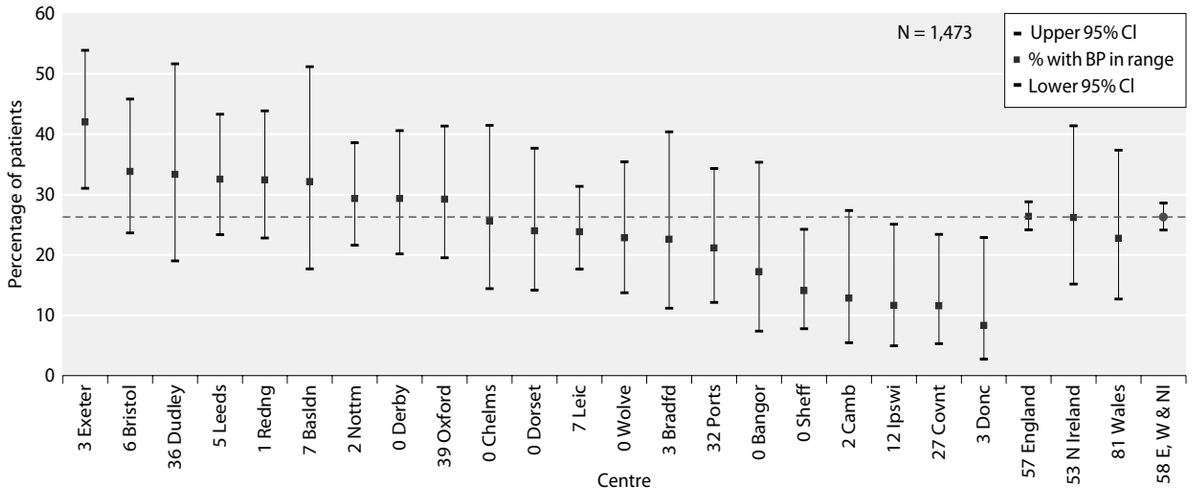

Fig. 11.14. Percentage of patients with BP <130/80 mmHg: PD

post-HD PP ranged from 52.5–67.0 mmHg between centres and from 60.0–62.5 mmHg between nations.

Peritoneal dialysis

A total of 1,473 recordings (41.8%) from 3,524 PD patients were available for analysis. Due to extraction of insufficient readings 41 centres were not included in the centre specific analyses.

Figure 11.14 demonstrates the performance of centres and nations in achieving the RA standard for BP control in patients on PD (<130/80 mmHg). Overall, 26.3% of patients achieved this standard (95% CI: 24.1%–28.6%). There was a significant variation between centres (range 8.3%–42.0%, $p < 0.001$) in attaining this standard.

Figure 11.15 shows the median systolic BP in PD patients by both centre and nation. The median SBP for all PD patients was 138 mmHg, ranging from 126–149 mmHg between centres.

Figure 11.16 illustrates the performance of centres and nations in achieving the RA standard for systolic BP control in patients on PD (<130 mmHg). Overall, 35.2% of PD patients (95% CI: 32.8%–37.7%) achieved this standard. There was a significant variation in the attainment of this standard between individual centres (range 8.3%–58.0%, $p < 0.0001$).

Figure 11.17 shows the median diastolic BP in PD patients by both centre and nation. The median DBP for all PD patients was 80 mmHg, with a range of 73.0–85.5 mmHg between centres.

Figure 11.18 illustrates the performance of centres and nations in achieving the RA standard for diastolic BP control in patients on PD (<80 mmHg). Overall,

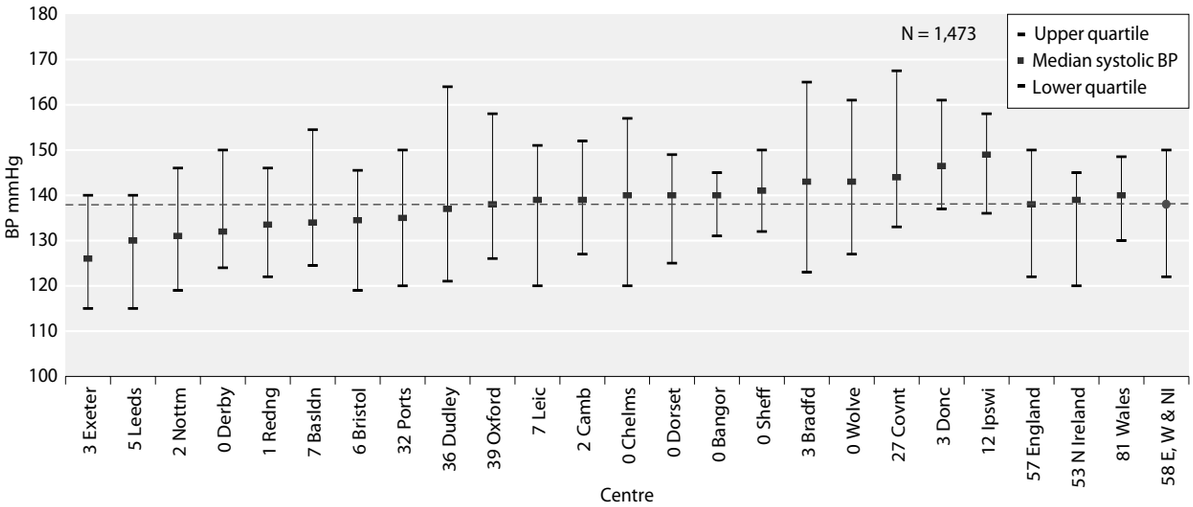

Fig. 11.15. Median systolic BP: PD

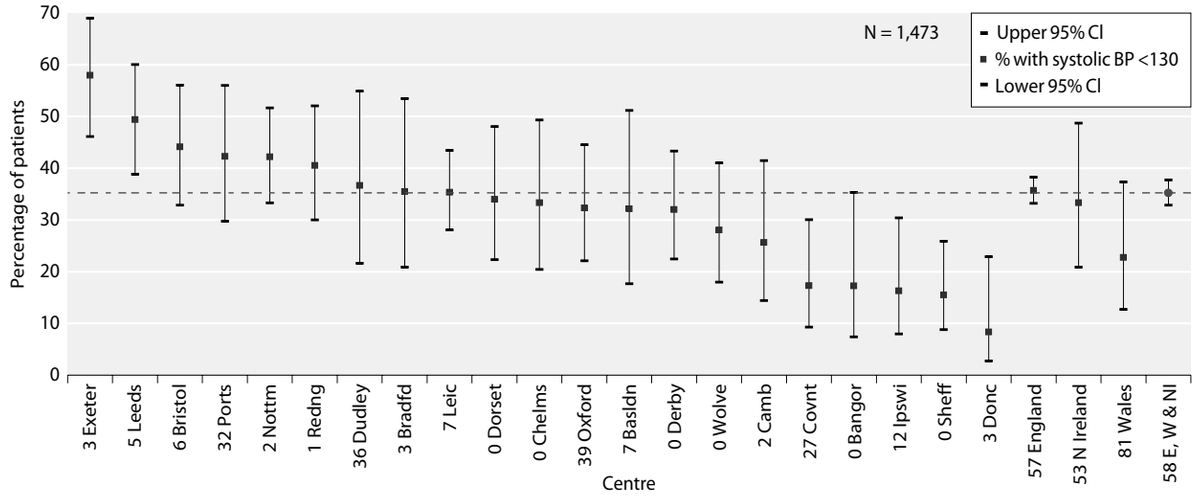

Fig. 11.16. Percentage of patients with systolic BP <130 mmHg: PD

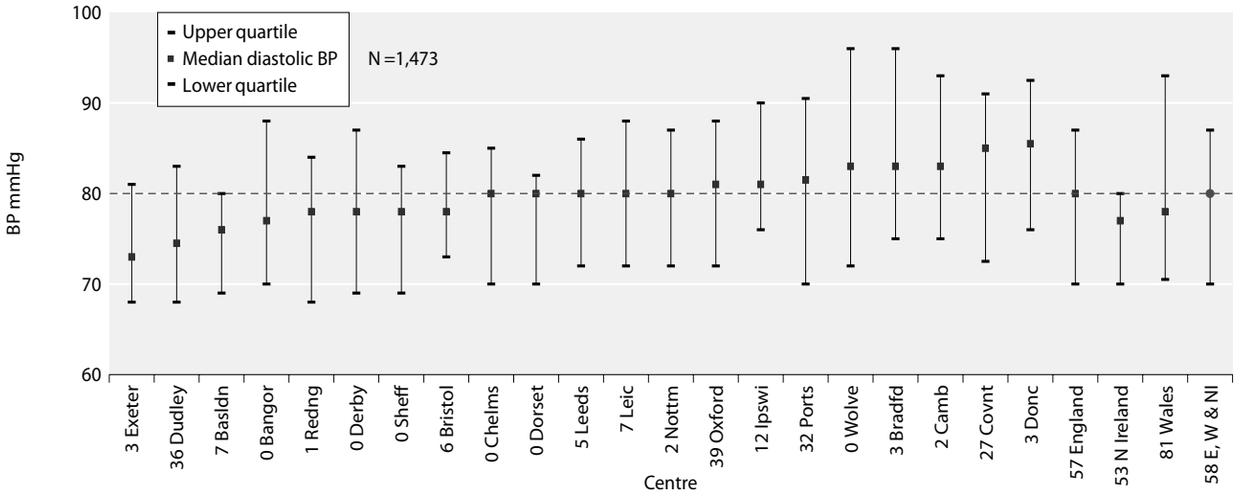

Fig. 11.17. Median diastolic BP: PD

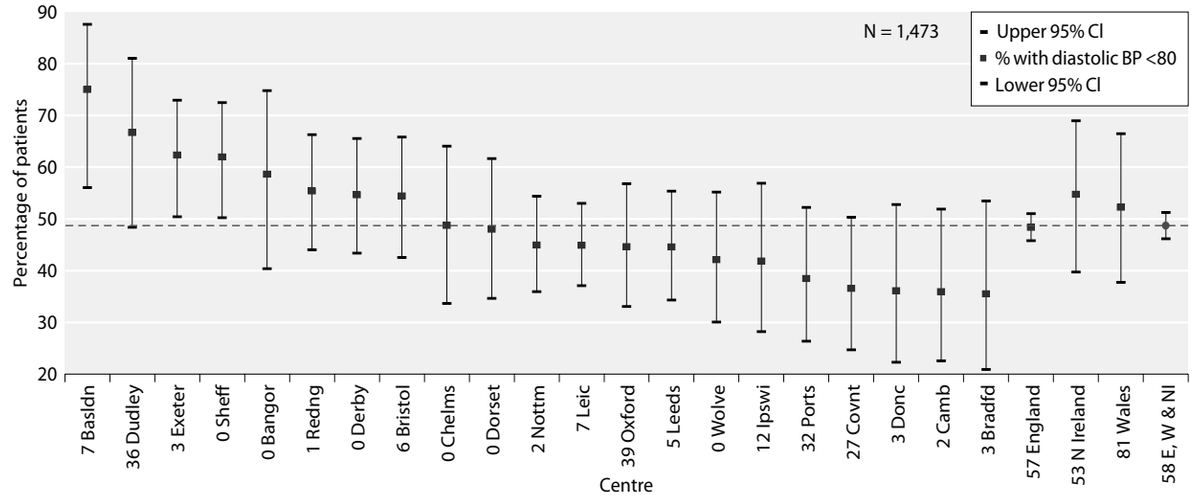

Fig. 11.18. Percentage of patients with diastolic BP <80 mmHg: PD

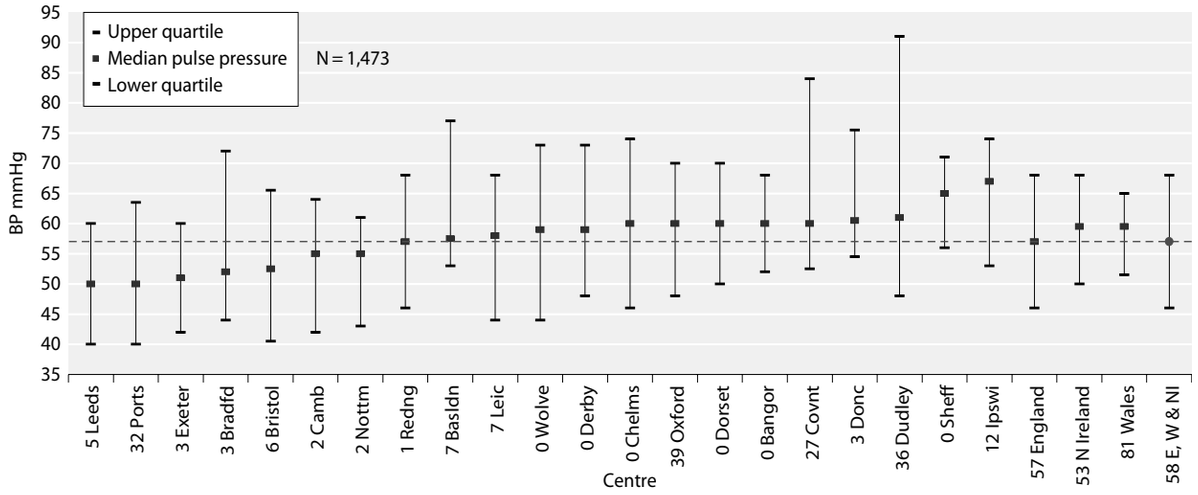

Fig. 11.19. Median PP: PD

48.7% of PD patients (95% CI: 46.1%–51.2%) achieved this standard. There was a significant variation in attaining this standard between individual centres (range 35.5%–75.0%, $p < 0.005$).

Figure 11.19 demonstrates the median pulse pressure in PD patients by both centre and nation. The median PP for all PD patients was 57 mmHg, ranging from 50–67 mmHg between centres.

Transplant

A total of 6,393 (32.6%) blood pressure readings from 19,628 Tx recipients were analysed. Thirty-three centres were excluded from the centre-specific analyses because insufficient readings were extracted.

Figure 11.20 illustrates the performance of centres and nations in achieving the RA standard for BP control in Tx recipients (<130/80 mmHg). Overall, 27.4% (95% CI: 26.3%–28.5%) of patients achieved this standard but there was significant variation in achievement between centres (range 14.9%–43.8%, $p < 0.0001$) and nations (range 25.8%–41.1%, $p < 0.0001$).

Figure 11.21 shows the median systolic BP in Tx recipients by both centre and nation. The median SBP for all Tx patients was 135 mmHg and ranged from 120–141 mmHg between centres.

Figure 11.22 illustrates the performance of centres and nations in achieving the RA standard for systolic BP control in Tx recipients (<130 mmHg). Overall,

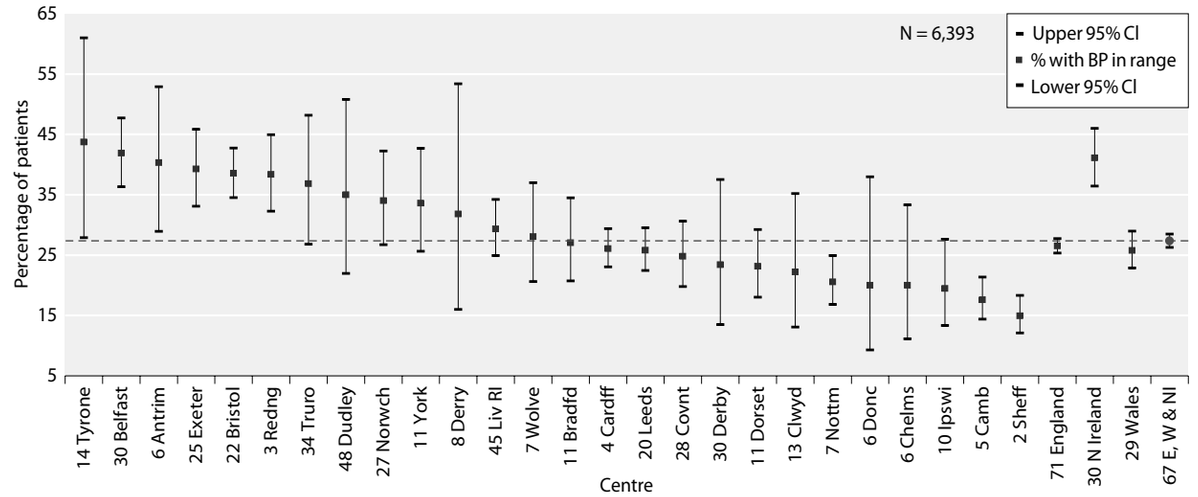

Fig. 11.20. Percentage of patients with BP <130/80 mmHg: Tx

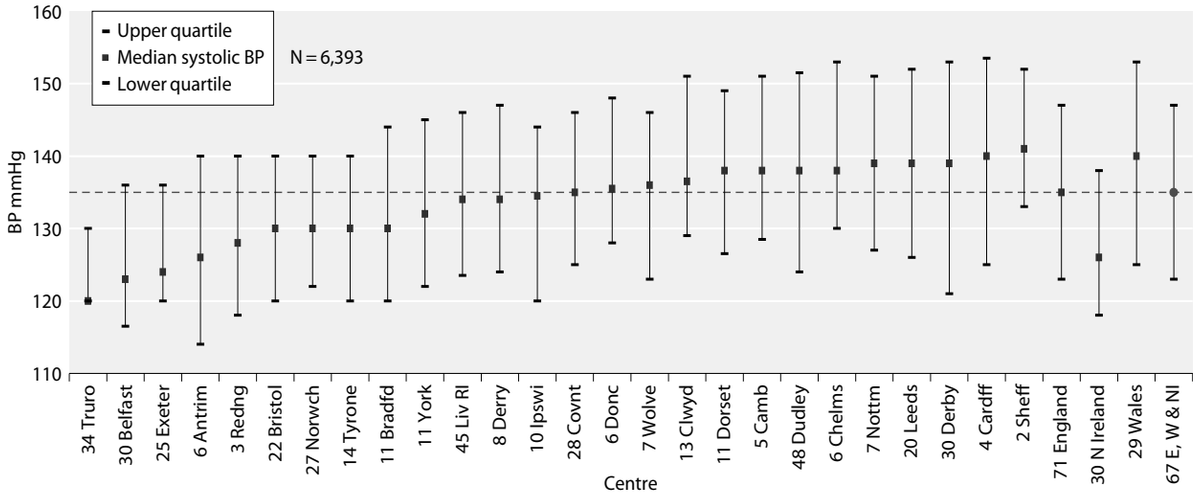

Fig. 11.21. Median systolic BP: Tx

36.7% of Tx patients achieved this standard (95% CI: 35.5%–37.8%). There was a significant difference in achievement of this standard between centres (range 18.7%–65.8%, $p < 0.0001$) and nations (range 30.0%–54.4%, $p < 0.0001$).

Figure 11.23 shows the median diastolic BP in Tx recipients by both centre and nation. The median DBP in all patients was 79 mmHg and ranged from 72.5–83.5 mmHg between centres.

Figure 11.24 illustrates the performance of centres and nations in achieving the RA standard for diastolic BP control in Tx recipients (<80 mmHg). Overall, 52.0% of all patients (95% CI: 50.8%–53.3%) achieved this standard, but there was significant variation in achievement between centres (range 34.0%–66.1%, $p < 0.0001$) and nations (range 51.1%–62.1%, $p < 0.0001$).

Figure 11.25 describes the median pulse pressure in Tx recipients by both centre and nation. The median PP for all Tx patients was 56 mmHg, ranging from 50–62 mmHg between centres and 50–60 mmHg between nations.

Blood pressure by primary renal diagnosis

The prevalence of hypertension was assessed for each renal diagnostic category. BP profiles for each modality were analysed after patients were grouped by primary renal diagnosis (PRD). For prevalent RRT patients in 2008, a renal diagnosis was not available in 4.5% of patients and an uncertain diagnosis was recorded

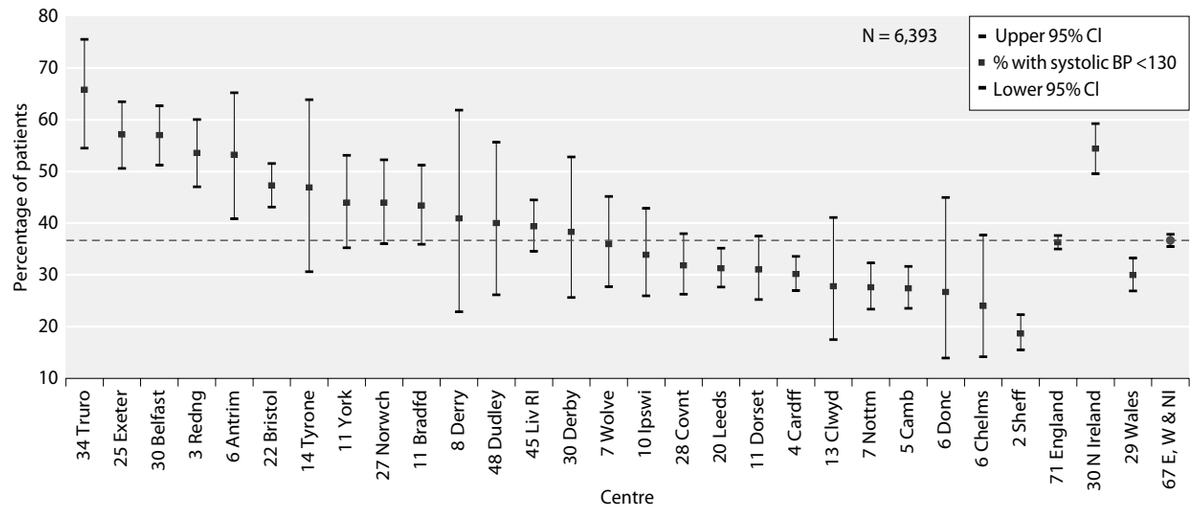

Fig. 11.22. Percentage of patients with systolic BP <130 mmHg: Tx

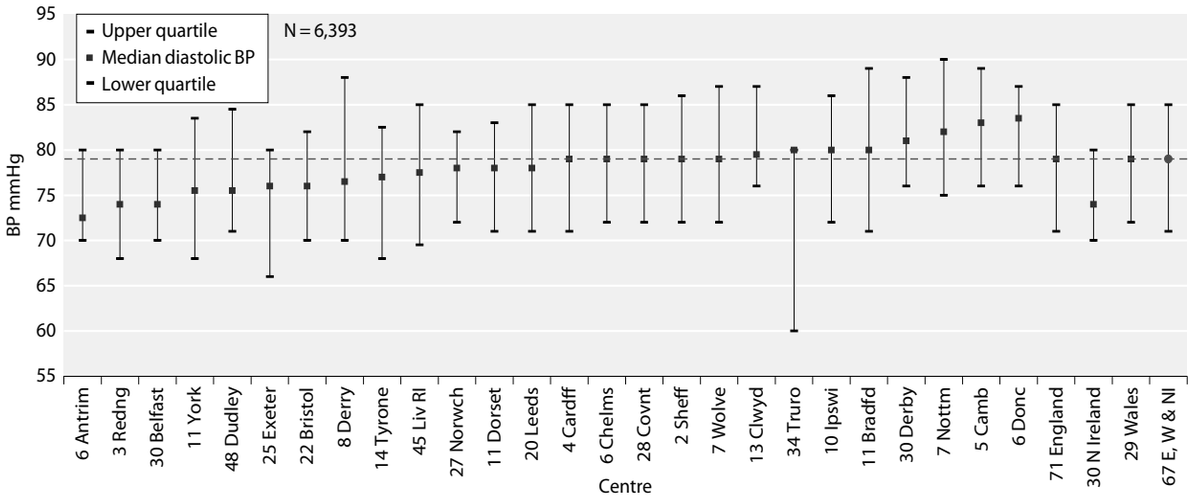

Fig. 11.23. Median diastolic BP: Tx

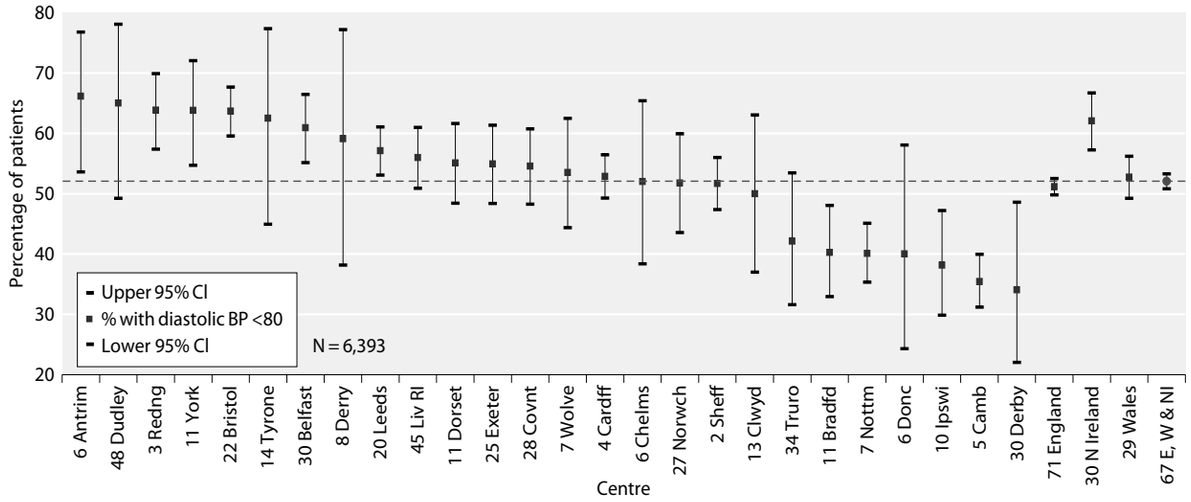

Fig. 11.24. Percentage of patients with diastolic BP <80 mmHg: Tx

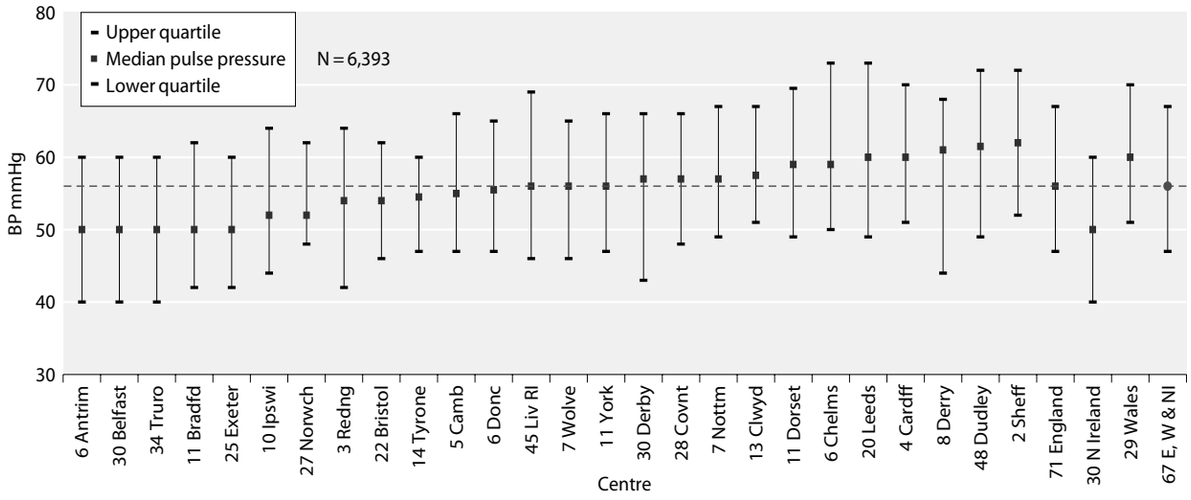

Fig. 11.25. Median PP: Tx

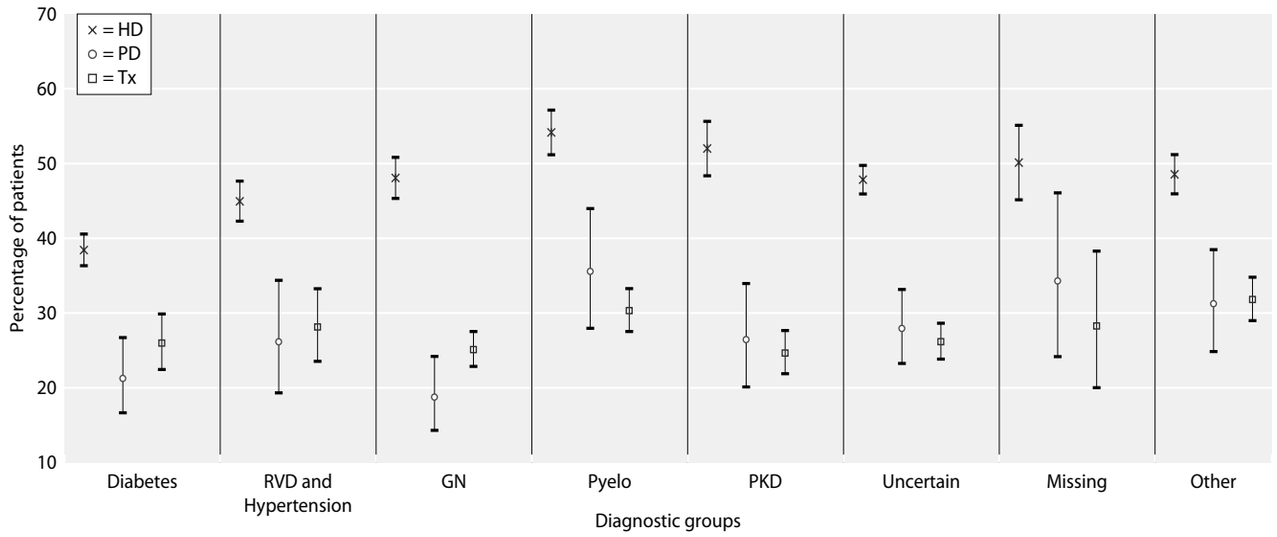

Fig. 11.26. Percentage of patients with BP <130/80 mmHg by primary diagnosis

in a further 21.6%. The main diagnostic groups included glomerulonephritis (15.6%), diabetes (13.4%), pyelonephritis (11.9%), polycystic kidneys (9.4%), renovascular disease (8.9%) and 'other' conditions (14.2%). BP readings within the last two quarters of 2008 were available for between 44.2%–50.1% of patients in each diagnostic category. For those patients with no recorded renal diagnosis only 30.3% had BP data.

Figure 11.26 describes the attainment of BP <130/80 mmHg by diagnostic category and RRT modality (post-HD data shown). There was a significant difference in the attainment of this standard across the PRD groups and each modality ($p < 0.0001$ in HD patients, $p < 0.05$ in PD and Tx patients). In addition, a significantly greater percentage of HD patients achieved this standard (<130/80 mmHg) than patients on PD or Tx recipients. When PD patients were compared with Tx patients, there was a borderline significant difference in achieving a BP <130/80 mmHg in patients with glomerulonephritis ($p < 0.05$). These patterns are shown in figures 11.26–11.31. SBP and PP were significantly higher in patients with vascular disorders (diabetes and renovascular) than patients with glomerulonephritis or tubular disorders.

Longitudinal analysis of incident HD patients

In order to investigate trends in BP control over time, a longitudinal analysis of the BP profile of incident HD patients from 2000 to 2004 was performed. Of the

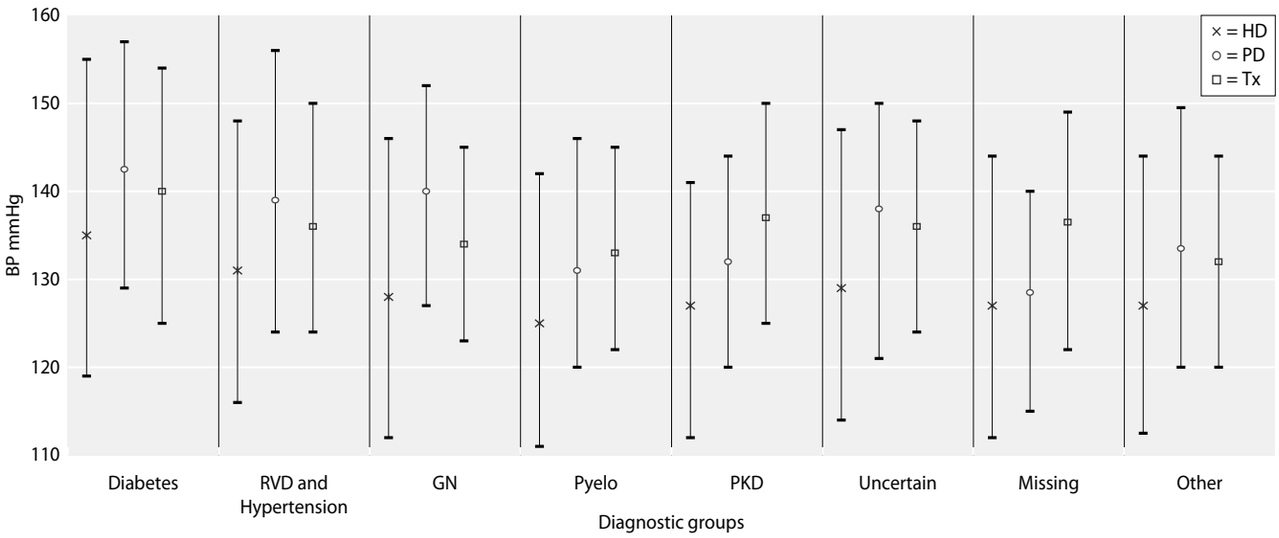

Fig. 11.27. Median systolic BP (IQR) by primary diagnosis

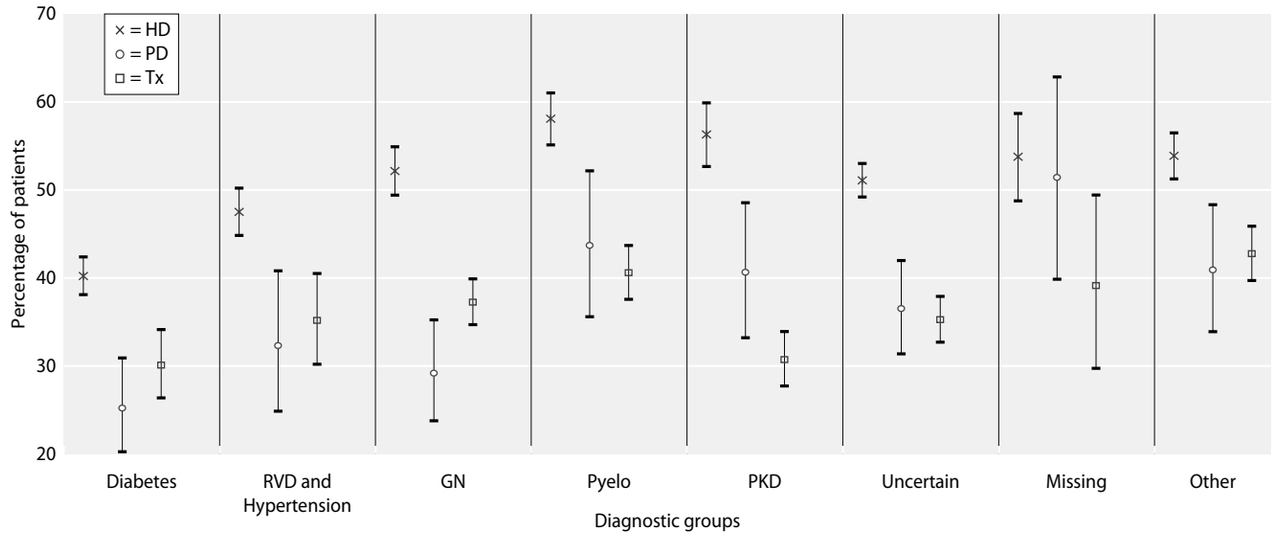

Fig. 11.28. Percentage of patients with systolic BP <130 mmHg by primary diagnosis

13,074 incident HD patients, 7,221 had at least one BP measurement available following dialysis initiation. BP measurements in the 5 years following HD commencement were analysed. There were 4,944 patients who had had BP data extracted during the quarter in which they had started RRT. At one year, there were 3,391 HD, 259 PD and 53 Tx patients with BP measurements. At five years, there were 1,544 HD, 58 PD and 397 Tx patients with BP measurements.

Figure 11.32 shows the adjusted mean systolic BP (post-dialysis in HD patients) for incident HD patients (2000–2004) based upon the RRT modality utilised over the follow-up period. As outlined in the methods, a parallel model rather than a linear one appeared to be most appropriate, as the SBP decreases at different rates depending on time from RRT start. Mean SBP recordings fell an average 8 mmHg within the first year of treatment, decreasing slightly further in the following year. After the end of the second year following RRT start, there was no further change in SBP.

Incident HD patients who remained on HD, achieved a significantly lower mean SBP over the 5 year observation period ($p < 0.0001$). Incident HD patients who were subsequently transplanted during the study period had higher mean SBP measurements than incident HD patients who changed to PD ($p < 0.0001$).

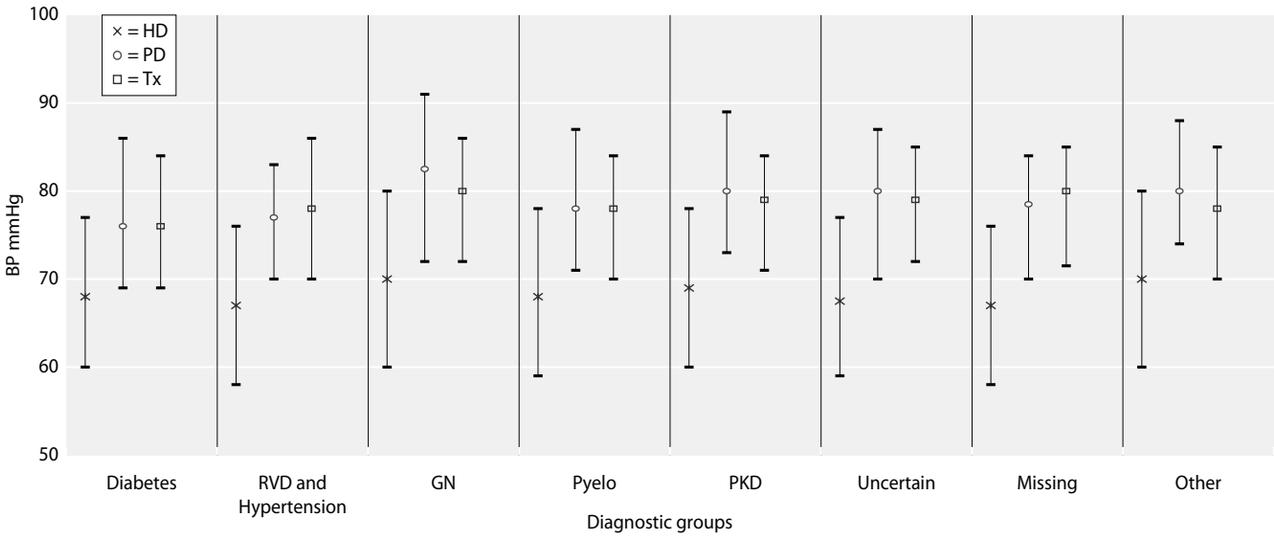

Fig. 11.29. Median diastolic BP (IQR) by primary diagnosis

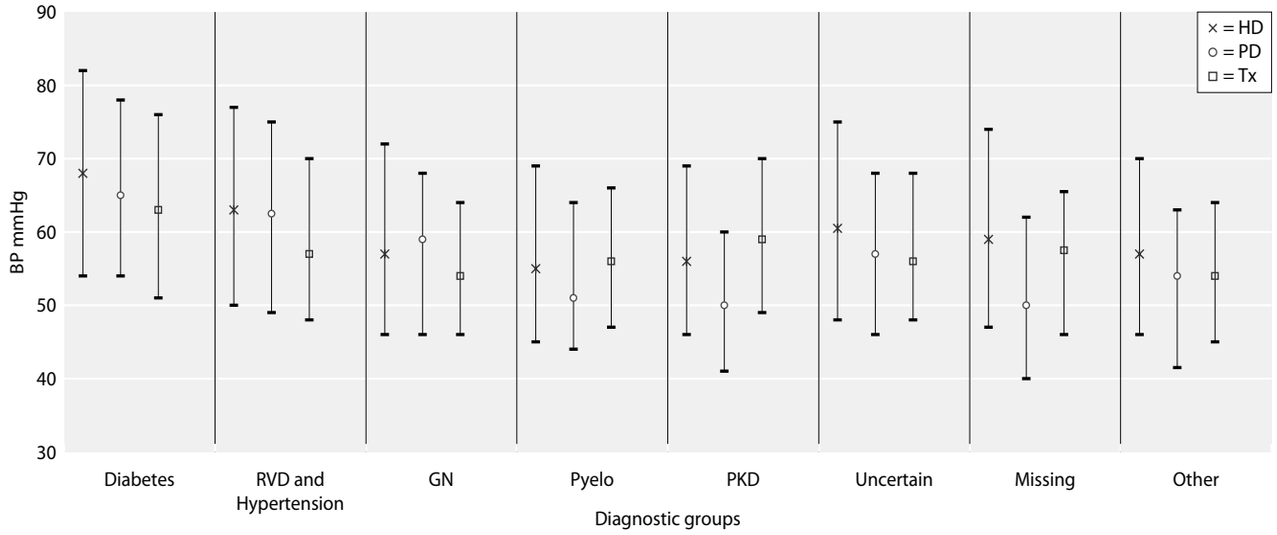

Fig. 11.30. Percentage of patients with diastolic BP <80 mmHg by primary diagnosis

Figure 11.33 illustrates the adjusted mean systolic BP of incident HD patients (2000–2004) stratified by PRD. A test for interaction between time and PRD was not significant. This means that the trend of SBP decreasing with time is not different between PRD groups. A parallel model was therefore applied, which assumes identical SBP trajectories for each PRD group (the same applies to the model for DBP and models for BP in PD patients). Results showed that patients with macrovascular diseases maintained significantly higher BP measurements, compared with all other PRD groups ($p < 0.0001$). SBP was higher in those patients with an uncertain diagnosis (commonly 'small kidneys'), than in patients with tubular or 'other' as their PRD ($p < 0.001$). Finally, SBP was significantly higher in patients with glomerular disorders than in those with tubular diseases ($p < 0.01$), but not compared with patients with 'other' as their PRD.

Figure 11.34 describes the adjusted mean diastolic BP (post-dialysis in HD patients) for incident HD patients (2000–2004) based upon the RRT modality utilised over the follow-up period. Patients who changed modality to Tx or PD had significantly higher DBP recordings than those patients continuing on HD ($p < 0.0001$). In

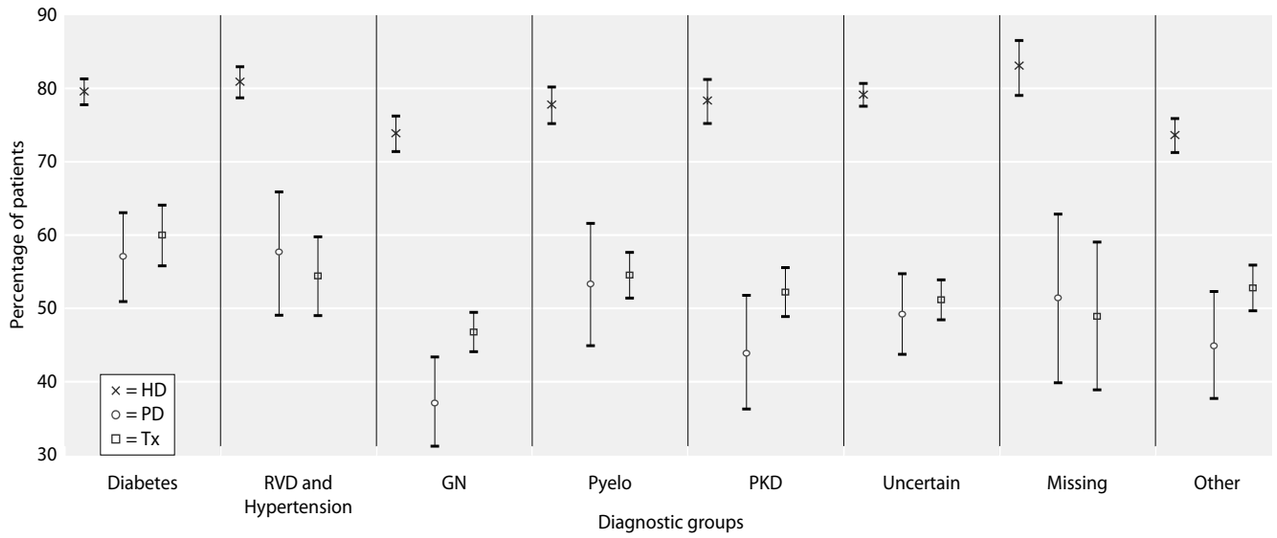

Fig. 11.31. Median PP by primary diagnosis

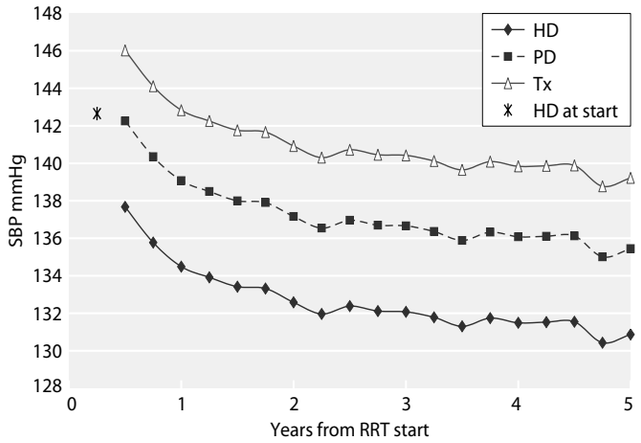

Fig. 11.32. Adjusted mean systolic BP of incident HD patients (2000–2004), by subsequent RRT modality[a]
[a] Reference glomerulonephritis, aged 65, starting in 2000

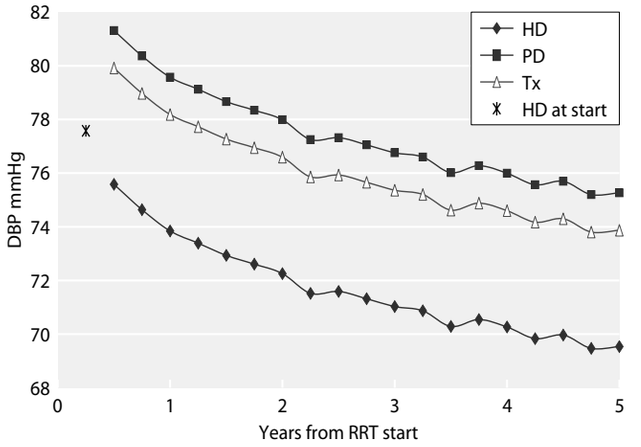

Fig. 11.34. Adjusted mean diastolic BP of incident HD patients (2000–2004), by subsequent RRT modality[a]
[a] Reference glomerulonephritis, aged 65, starting in 2000

addition, the diastolic readings of HD patients who had moved to PD were significantly higher than the HD patients who had been transplanted ($p < 0.005$).

Figure 11.35 demonstrates the adjusted mean diastolic BP of incident HD patients (2000–2004) stratified by PRD. DBP was higher in patients with glomerular disorders than in patients with macrovascular diseases or tubular disorders ($p < 0.01$). Although patients with macrovascular diseases had higher SBP measurements than other PRD groups, the DBP of patients with macrovascular disease only differed significantly when compared with the glomerular disease group.

Longitudinal BP analysis of incident PD patients

There were 4,606 incident PD patients between 2000 and 2004, of which 2,675 patients had BP data available. BP measurements in the 5 years following PD commencement were analysed. There were 1,440 patients who had had BP data extracted during the quarter in which they had started RRT. At one year, there were 1,101 PD, 202 HD and 60 Tx patients with BP measurements. At five years, there were 194 PD, 337 HD and 344 Tx patients with BP measurements.

Figure 11.36 shows the adjusted mean systolic BP for incident PD patients (2000–2004) based upon the RRT modality utilised over the follow-up period. Mean SBP recordings in patients starting on PD fell by an average of 6 mmHg within the first year of RRT, but then remained static.

Incident PD patients who switched to HD achieved significantly lower SBP measurements than those patients who remained on PD or received transplants.

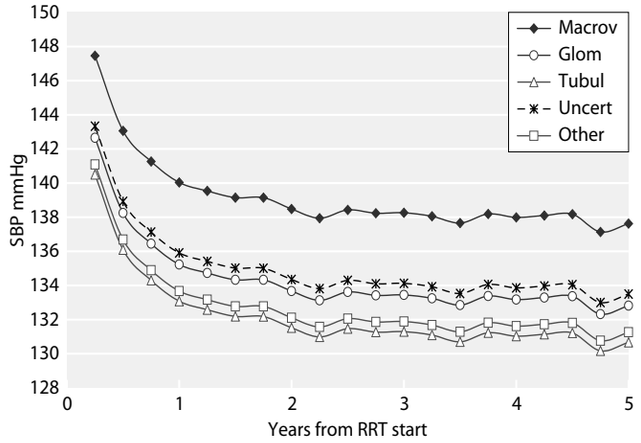

Fig. 11.33. Adjusted mean systolic BP of incident HD patients (2000–2004), by primary renal disease

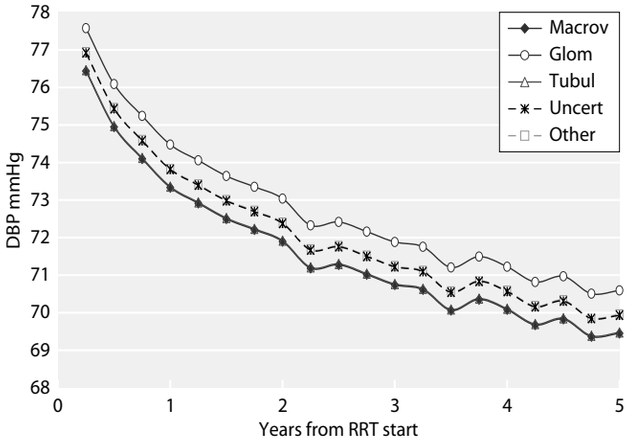

Fig. 11.35. Adjusted mean diastolic BP of incident HD patients (2000–2004), by primary renal disease

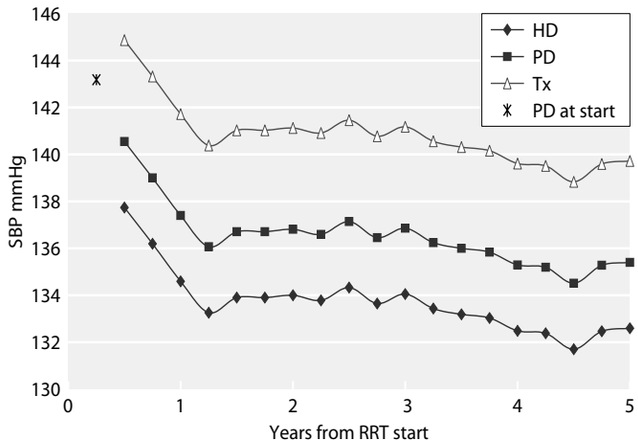

Fig. 11.36. Adjusted mean systolic BP of incident PD patients (2000–2004), by subsequent RRT modality[a]
[a] Reference glomerulonephritis, aged 60, starting in 2000

In addition, SBP was significantly higher in Tx patients than in patients continuing on PD ($p < 0.0001$).

Figure 11.37 illustrates the adjusted mean systolic BP of incident PD patients (2000–2004) stratified by PRD. Patients with macrovascular diseases maintained significantly higher SBP measurements, compared to all other PRD groups ($p < 0.0001$).

DBP was significantly higher in incident PD patients with glomerular disorders, compared with other PRD groups (data not shown).

Longitudinal BP analysis of prevalent RRT patients

All prevalent RRT patients from 2000 to 2008 with BP recordings were analysed. The number of prevalent patients with BP measurements increased from 2,646 in the first quarter of 2000, to 12,812 by the last quarter of 2008.

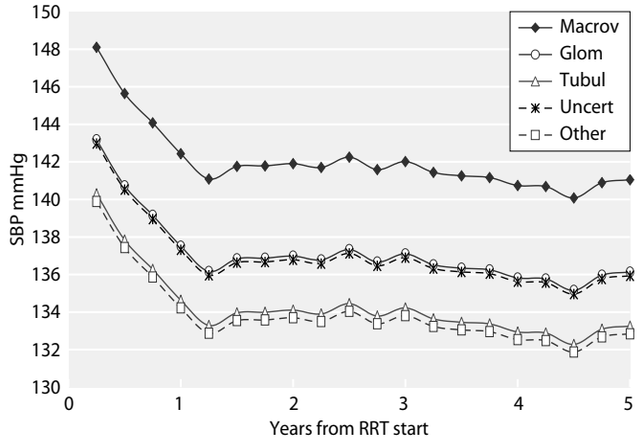

Fig. 11.37. Adjusted mean systolic BP of incident PD patients (2000–2004), by primary renal disease

A reduction in BP is seen over the 9 year study period with pre-HD systolic BP changing from a mean of 152.9 mmHg to 144.7 mmHg, post-HD BP from 137.4 mmHg to 132.4 mmHg, PD SBP from 143.1 mmHg to 138.9 mmHg and Tx SBP from 142.7 mmHg to 137.2 mmHg. In addition, post-HD DBP has fallen from 74.2 mmHg to 69.1 mmHg, PD DBP from 82.1 mmHg to 79.5 mmHg and Tx DBP from 80.4 mmHg to 78.2 mmHg.

When modeling the prevalent longitudinal BP data, no interaction between time and PRD was observed. This is similar to that observed in the incident cohort analysis, producing a model with equal BP trajectories for each PRD. Both parallel and linear models were examined, with the parallel model appearing more appropriate and showing a significant seasonal effect. A simpler linear analysis was also conducted, which ignored the 'seasonal' oscillations, to evaluate any overall decrease of BP in time.

Following longitudinal multivariate modelling, adjusting for PRD, patient age and time from RRT start, post-HD SBP and DBP differed significantly with time ($p < 0.0001$). Similarly there was a significant difference in SBP and DBP in transplanted patients ($p < 0.0001$).

Longitudinal analysis of BP readings from PD patients had to be restricted to a shorter time range (years 2003–2008). When applying a parallel model, significant seasonal effect variation of BP in time was observed. However, the analysis showed no linear change with time in the average BP of PD patients. Corresponding restricted analysis on BP measurements from Tx and HD patients still showed a significant linear decrease of BP with time.

PRD considerations in prevalent HD patients

Figure 11.38 demonstrates adjusted mean post-HD systolic BP in prevalent HD patients, stratified by PRD. This adjusted longitudinal analysis shows post-HD SBP in patients with macrovascular diseases remained significantly elevated in comparison with all the other PRD groups ($p < 0.0001$). However, a reduction in mean SBP, over time, is demonstrated in all PRD categories, with a cyclical fluctuation over the course of each year. SBP in all PRD groups fell by an average of 4 mmHg over the nine years (for illustration the linear trend for decrease is showed only for the macrovascular group). Tubular disorders in general had the lowest SBP and DBP.

Adjusted longitudinal analysis of post-HD DBP showed patients with a glomerular pathology maintained

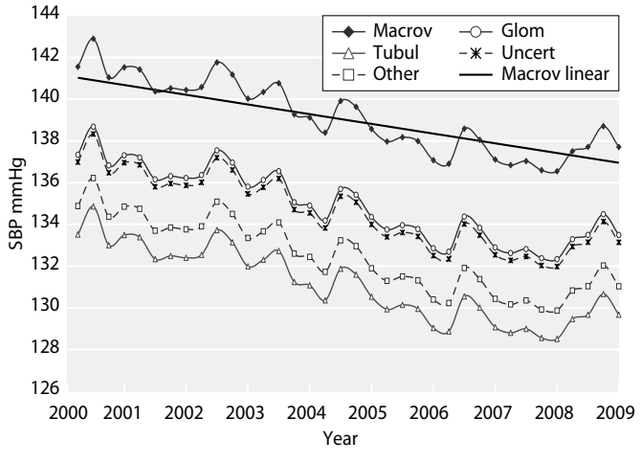

Fig. 11.38. Adjusted mean post-HD systolic BP in prevalent HD patients, by primary renal disease[a]
[a] Adjusted for age 60 years, 1year from RRT start

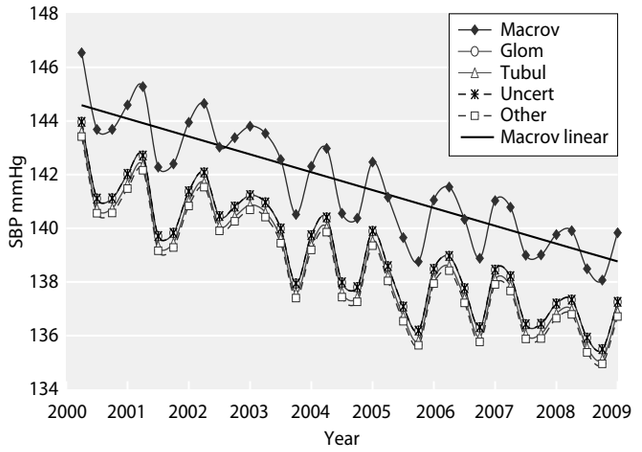

Fig. 11.40. Adjusted mean systolic BP in prevalent transplant patients, by primary renal disease[a]
[a] Adjusted for patient age and time on RRT

higher DBP over the nine-year study period compared with all other PRD groups ($p < 0.0001$). In addition, the patterns of DBP readings remained similar and DBP in all PRD groups fell by an average of 4.4 mmHg over the nine years (data not shown).

PRD considerations in prevalent PD patients

Figure 11.39 shows the adjusted mean systolic BP in prevalent PD patients, stratified by PRD. The analysis fails to demonstrate a linear change in SBP, over time, in prevalent PD patients, regardless of the underlying disease pathology.

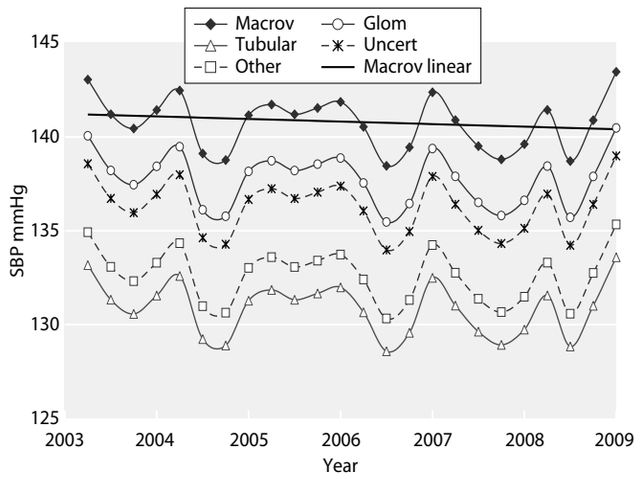

Fig. 11.39. Adjusted mean systolic BP in prevalent PD patients, by primary renal disease[a]
[a] Adjusted for age 60 years, 1year from RRT start

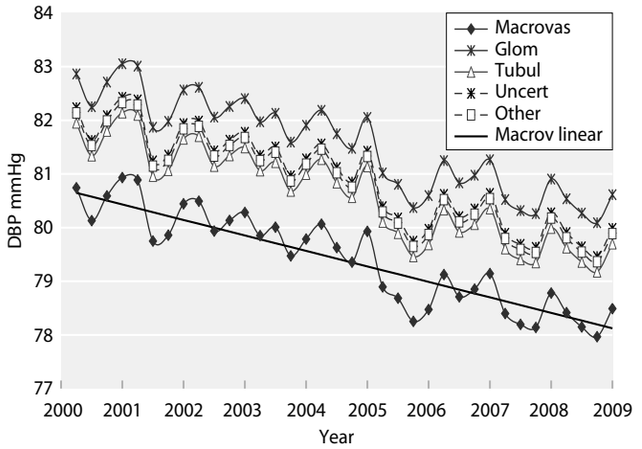

Fig. 11.41. Adjusted mean diastolic BP in prevalent transplant patients, by primary renal disease[a]
[a] Adjusted for patient age and time on RRT

PRD considerations in prevalent transplant patients

The adjusted longitudinal analyses in figures 11.40 and 11.41 show SBP and DBP differ significantly between PRD groups in Tx recipients ($p < 0.0001$). Patients with macrovascular disorders have higher SPB and lower DBP measurements compared with any other PRD, while minor differences were observed between the other four PRD groups.

Discussion

The current study showed only a minority of patients on RRT in England, Wales and Northern Ireland

achieved RA standards for BP control in 2008. Despite BP targets no longer existing for HD patients, the UKRR continues to report achievement against the previous standard to document any effect the new clinical practice guidelines may have. Significantly, more HD patients achieved the old BP standards (43.7% pre-dialysis and 46.8% post-dialysis) than PD (26.3%) or Tx (27.4%) patients achieving the current targets. BP control continues to vary significantly between different renal centres for each treatment modality. BP data were extracted from more patients than previously, but both recording outpatient readings on renal IT systems and extraction of that information by the UKRR remains a challenge, with data analysed for only 41.8% of PD and 32.6% of Tx patients. In the future, the UKRR hopes to collect BP data from every HD session in the UK.

Longitudinal analysis of prevalent BP data collected between 2003 and 2008 showed a significant linear trend of reducing BP for prevalent HD and Tx patients, but not for PD patients. A smaller percentage of HD and PD patients achieved BP standards in 2008 compared with the previous year. A longer period of observation is required to see if this is due to BP variability or the first indication of a rise in BP following the introduction of the new guidelines. The impact of dialysis on BP was shown by analysing incident patients over a five-year period. Systolic BP fell significantly during the first year but then stabilised at that reduced level for both HD and PD. The drop in mean SBP during this first year was greater for HD patients (8 mmHg) than for PD patients (6 mmHg). No drug data for these patients were available, though other studies suggest lower BP is achieved by probing dry weight rather than using antihypertensive medication. A retrospective study of 124 home HD and 44 PD patients from New Zealand examined the effect of BP one-year post-RRT commencement on subsequent survival [16]. Less than five percent continued antihypertensive medication after starting dialysis and only seven percent were diabetic. Although low BP at baseline was associated with decreased survival, patients whose BP became low in the first year were not at additional risk. Median survival after one-year for low, medium and high BP (defined by mean arterial pressure) was 3.79, 4.05 and 1.82 years respectively. These analyses show UK dialysis practice significantly reduces BP in the first year, which could improve life expectancy. HD patients who remained on HD had significantly better BP control than patients who transferred to PD or were transplanted. BP rose significantly when HD or PD patients were transplanted. The introduction of cyclosporin may be one contributing factor to this phenomenon as mean SBP has been shown to fall by 7 mmHg when this drug is withdrawn [17]. The UKRR does not currently collect drug data to pursue the link between hypertension and immunosuppression in Tx patients.

In the UK, patients with vascular disorders (diabetics and renal vascular disease) have the worst prognosis on dialysis and are least likely to be transplanted [18]. The current study showed SBP remained significantly higher in these patients compared to those with glomerulonephritis or tubular disorders over a five-year period. The effect was marked for both HD and PD patients. An audit of London renal centres showed diabetics had the highest BP despite taking more antihypertensive medication and that this was associated with higher interdialytic weight gains and more frequent symptomatic intradialytic hypotension [19, 20]. Diabetics with the lowest HbA1c values had the lowest SBP despite taking fewer antihypertensive medications. Hyperglycaemia clearly influences thirst and fluid intake so should be targeted aggressively to control hypertension in diabetics. There are no equivalent data for patients with renal vascular disease but they often have established cardiac atherosclerosis which would make them more prone to intradialytic hypotension.

Several limitations of this study should be noted. Blood pressure measurements during routine patient care would not have been taken using a standardised protocol across the renal centres. The high rates of missing data may introduce bias and inadequate comorbidity data and absent drug data prevents the UKRR performing the appropriate risk adjustments for BP analyses. A recent meta-analysis has highlighted the need to collect appropriate drug data in dialysis hypertension trials [21]. The study analysed eight small, randomised controlled trials and concluded lowering BP reduced cardiac events and mortality in dialysis patients. Mean systolic and diastolic BP were reduced by 4.5 and 2.3 mmHg, respectively, however four of the trials included patients with cardiac failure. Beneficial drug effects may therefore be due to cardio-protection rather than BP lowering per se. The cardio-protective effects of drugs may take several years to emerge. The beneficial effects of fluvastatin in renal Tx patients were only demonstrated after an extended period of follow up over seven years [22]. The proposed OCTOPUS trial [23] hopes to establish target blood pressure for hypertensive HD patients, the usefulness of home BP

monitoring and the effect of olmesartan. However, a potential limitation of OCTOPUS is its short duration; it is scheduled to run for 3 years, and consequently may not achieve its aims.

It is hoped that over the next few years, renal IT systems will be increasingly used to record patient drug information. Consequently, the UKRR will be able to analyse whether the significant drop in blood pressure during the first year on dialysis identified in the longitudinal analyses reflects medication or ultrafiltration.

Conflict of interest: none

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Chapter 12
Epidemiology of Methicillin Resistant Staphylococcus Aureus Bacteraemia Amongst Patients Receiving Dialysis for Established Renal Failure in England in 2008: a joint report from the UK Renal Registry and the Health Protection Agency

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Key Words
Bacteraemia · Dialysis · Vascular access

Abstract
Background: From April 2007, all centres providing renal replacement therapy in England were asked to provide additional data on patients with Methicillin Resistant *Staphylococcus aureus* (MRSA) bacteraemia using a secure web based system established to capture data for the mandatory surveillance of MRSA bacteramia. ***Results:*** From April 2008 until March 2009 171 discrete episodes of MRSA bacteraemia were identified from the Health Protection Agency database as being potentially associated with patients in established renal failure (ERF) requiring dialysis. Of 171 records, 18 records were rejected by renal centres as not being associated with patients on dialysis or as being duplicates of other records. Following data validation by centres, 139 patients had vascular access documented (no episodes of bacteraemia were recorded amongst patients receiving peritoneal dialysis). Of these patients, 30.2% were utilising an arteriovenous fistula or graft and 69.8% were dialysing on a non-tunnelled or tunnelled venous catheter. Two of the patients on arteriovenous fistulae had used venous catheters in the prior 28 days. Eleven patients had more than one episode in the year and accounted for 30 (20%) of the episodes of MRSA bacteraemia. Overall there was a reduction of 22% in episodes from the previous year. The median centre-specific rate of MRSA bacteraemia was 0.64 (range 0–3.49) episodes per 100 haemodialysis

patients per year, and 0.55 (range 0–2.89) episodes per 100 dialysis (haemodialysis and peritoneal dialysis combined) patients per year. ***Conclusions:*** The rate of MRSA bacteraemia in patients requiring long term dialysis continues to fall within the prevalent dialysis population in England, but there is still marked variation in centre-specific rates.

Introduction

It is now well known that patients with ERF receiving renal replacement therapy (RRT) are at increased risk of bacteraemia [1, 2]. In particular, between 4 and 8% of all episodes of MSRA bacteraemia in the United Kingdom occur in patients with ERF on haemodialysis [1, 2, 3]. This is in part due to the use of venous catheters for access to the circulation [4, 5]. This increased risk of bacteraemia continues to be a major contributor to the high mortality associated with patients requiring RRT [3, 4, 5]. In the last Renal Registry report, the UK Renal Registry and the Health Protection Agency reported on data collected between April 2007 and March 2008 on patients receiving dialysis in England who had an episode of methicillin resistant Staphylococcus aureus (MRSA) [2]. These data were supplied by clinical staff and captured using a secure web-based system, the Health Care Associated Infection Data Collection System (HCAI-DCS). The dataset included the modality of treatment, the type of vascular access in use at the time of bacteraemia and the use of venous catheters in the prior 28 days. This analysis confirmed that the relative risk of MRSA bacteraemia was approximately 100 fold higher for dialysis patients than the general population and an additional 8 fold higher for a patient requiring a venous catheter compared to a fistula. There was also marked variation between renal centres, ranging between zero and 3.28 episodes per 100 patients per year, with a mean rate of 0.92 episodes per 100 prevalent dialysis patients per year [3]. This report contains the analysis of data collected in the second year of this surveillance system.

The term established renal failure (ERF) used within this chapter is synonymous with the terms end stage renal failure (ESRF) and end stage renal disease (ESRD) which are in more widespread international usage. Within the UK, patient groups have disliked the term 'end stage' which formerly reflected the inevitable outcome of this disease.

Methods

The renal component of the HCAI-DCS went live for all centres in England on 1st April 2007. Data are presented from the second year of collection, from 1st April 2008 until 31st March 2009.

The methodology has been described in the previous report [3]: in brief, three stages of data completion were required.

1 A MRSA bacteraemia was identified by the laboratory as possibly being associated with a patient in ERF, using the clinical details provided including the clinical setting in which the sample was taken.
2 This record was 'shared' with the parent renal centre; this required the laboratory staff to select the renal unit responsible for the dialysis of the patient, thus triggering an email alert to be sent to the identified contact within the parent renal centre.
3 The renal centre then completed the additional renal data on the case via the HCAI-DCS website.

An additional step of validation and data capture was introduced this year due to the low rate of both sharing and completion of records in the first year. Leads for infection in renal units and the clinical director were e-mailed with details of the cases at the end of the year, whether shared or unshared, to ensure that cases were completed and accepted as being related to patients in ERF requiring dialysis, or rejected as having occurred in a patient not in ERF, whether or not the patient was undergoing dialysis. The individual centres were then asked to complete and accept the record.

This data reporting mechanism applies only to centres in England and is not utilised in Northern Ireland, Scotland or Wales.

Results

Organisational results

From April 2008 until March 2009 a total of 171 records submitted to the Health Protection Agency database via the HCAI-DCS were identified by laboratory staff as being possibly associated with patients in ERF requiring dialysis. However, only 111/171 records were shared with the identified contact within the renal centre by laboratory staff (table 12.1); clinical details for the remaining 60 episodes were obtained by direct contact between the clinical lead for this joint analysis (RF) and the clinical director of the centre concerned. Of the 111 shared records, 42 had been completed, giving a completion rate via the web portal system of less than 40%. Of all 171 records, 18 episodes were rejected as not having occurred in patients in ERF by renal centres at the final step of validation; these episodes are not included in any further analyses. Of those, 8 had been shared and 6 had not been completed prior to that

Table 12.1. Breakdown of records by accepted/rejected, shared/unshared and completed/not completed status

		N	%
Rejected	Shared and completed	2	1.2
	Shared, not completed	6	3.5
	Not shared	10	5.8
	Total rejected	18	
Accepted	Shared and completed	40	23.4
	Shared, not completed	63	36.8
	Not shared	50	29.2
	Total accepted	153	
	Total	**171**	

point and 2 had been completed and rejected. Three centres (Coventry, Dudley, and Manchester Royal Infirmary) were unable to validate their records. All episodes of MRSA bacteraemia attributed to patients receiving dialysis in these three centres were included, resulting in a total of 153 episodes of MRSA bacteraemia in patients in ERF being included in this analysis.

Access and Modality

Table 12.2 gives a breakdown by modality and access. There were no patients reported to be on peritoneal dialysis at the time of the MRSA bacteraemia, although one patient had been on CAPD previously. For 9 patients both the modality and the access type were unrecorded. Four patients were on haemodialysis but with unknown access and one was reported as having 'other' access; 37 patients were reported as using an arteriovenous fistula, 5 an arteriovenous graft, 13 a non tunnelled catheter and 84 a tunnelled catheter. Of the patients using an AV fistula or an AV graft, 2 had had a venous catheter in-situ in the previous 28 days.

Table 12.2. Access and modality for 153 accepted episodes of MRSA bacteraemia

Modality	Access type	N	%	Access class %
Haemodialysis	AVF	37	26.6	
	AVG	5	3.6	
	AVF/AVG total	42		30.2
	NTC	13	9.4	
	TC	84	60.4	
	NTC/TC total	97		69.8
	Total known access	**139**		
	Other	1		
	Unknown	4		
Unknown		9		
	Total	**153**		

AVF = arteriovenous fistula
AVG = arteriovenous graft
NTC = non tunnelled catheter
TC = tunnelled catheter

Table 12.3. Episodes by recurrence

Episodes per patient	N	Total
1	123	123
2	5	10
3	4	12
4	2	8
Total	**134**	**153**

Assuming a 25% usage of venous catheters for the prevalent dialysis population [1, 2, 3], the relative risk of MRSA bacteraemia can be estimated to be 6.9 fold higher in comparison to a patient using a graft or fistula (calculation based on known access episodes divided by estimated prevalent population on this access: AVF/AVG $42/(16{,}227 \times 0.75)$ vs. catheter $97/(16{,}227 \times 0.25)$).

Individual Episodes

Table 12.3 details repeat episodes in patients. Of the 134 patients, 123 had a single episode, 5 had 2 episodes, 4 had 3 episodes and 2 patients had 4 episodes.

Centre Level Data

Table 12.4 and figure 12.1 detail the absolute number of MRSA episodes by centre. The median absolute number of episodes per centre was 2 (range 0 to 18). Ten of the 52 English centres (Birmingham Heartlands, Bradford, Chelmsford, Exeter, Gloucester, Kent, London St Georges, Nottingham, Middlesbrough and Southend) recorded no episodes of MRSA bacteraemia from April 2008 to March 2009. Five centres recorded 10 or more episodes (Birmingham Queen Elizabeth Hospital, Leeds, Leicester, London Barts, and St Helier (Carshalton)). Figure 12.2 provides details on the access in use at the time of each episode of MRSA bacteraemia, by centre.

The normalised centre-specific rates are based on the number of patients receiving dialysis in each centre at the end of 2008, as reported to the UKRR (see chapter 4). Using the number of prevalent haemodialysis patients as the denominator, the median rate was 0.64 with a range from 0 to 3.49 episodes per 100 haemodialysis patients per year. Using the total number of prevalent

Table 12.4. Centre specific data for episodes of MRSA bacteraemia by access type

	Prevalent patients (31/12/2008)					Episodes (April 2008–March 2009)						Rates	
Centre	HD	PD	Dialysis	Tx	All	Total	AVF	AVG	NTC	TC	UK	HD	HD + PD
B Heart	411	33	444	150	594	0	0	0	0	0	0	0.00	0.00
B QEH	807	149	956	758	1,714	11	1	0	0	10	0	1.36	1.15
Basldn	139	34	173	44	217	1	0	0	0	1	0	0.72	0.58
Bradfd	194	33	227	187	414	0	0	0	0	0	0	0.00	0.00
Brightn	327	96	423	299	722	4	1	0	1	2	0	1.22	0.95
Bristol	453	88	541	706	1,247	5	2	1	0	1	1	1.10	0.92
Camb	358	45	403	524	927	1	0	0	0	0	1	0.28	0.25
Carlis	81	21	102	101	203	1	0	0	0	0	1	1.23	0.98
Carsh	630	128	758	491	1,249	11	5	0	2	3	1	1.75	1.45
Chelms	102	43	145	57	202	0	0	0	0	0	0	0.00	0.00
Colchr	118	0	118	0	118	3	1	0	0	2	0	2.54	2.54
Covnt	317	78	395	350	745	1	0	0	0	0	1	0.32	0.25
Derby	240	79	319	70	389	2	1	0	0	1	0	0.83	0.63
Donc	80	39	119	35	154	1	0	0	0	1	0	1.25	0.84
Dorset	211	55	266	247	513	1	0	0	0	1	0	0.47	0.38
Dudley	139	54	193	77	270	3	0	0	0	0	3	2.16	1.55
Exeter	319	83	402	306	708	0	0	0	0	0	0	0.00	0.00
Glouc	160	35	195	129	324	0	0	0	0	0	0	0.00	0.00
Hull	319	76	395	301	696	4	0	0	1	3	0	1.25	1.01
Ipswi	104	53	157	137	294	2	2	0	0	0	0	1.92	1.27
Kent	324	81	405	309	714	0	0	0	0	0	0	0.00	0.00
L Barts	633	230	863	663	1,526	10	2	2	0	5	1	1.58	1.16
L Guys	517	54	571	860	1,431	5	1	0	0	4	0	0.97	0.88
L Kings	415	82	497	287	784	2	1	0	0	1	0	0.48	0.40
L Rfree	646	91	737	773	1,510	4	1	0	1	2	0	0.62	0.54
L St. G	226	56	282	342	624	0	0	0	0	0	0	0.00	0.00
L West	1,236	44	1,280	1,290	2,570	5	0	0	0	5	0	0.40	0.39
Leeds	487	102	589	753	1,342	17	4	0	0	12	1	3.49	2.89
Leic	733	162	895	765	1,660	18	4	0	5	7	2	2.46	2.01
Liv Ain	127	3	130	0	130	1	0	0	0	1	0	0.79	0.77
Liv RI	403	106	509	691	1,200	4	2	1	0	1	0	0.99	0.79
M Hope	314	136	450	308	758	5	1	0	1	3	0	1.59	1.11
M RI	417	101	518	904	1,422	2	0	0	0	0	2	0.48	0.39
Middlbr	292	24	316	366	682	0	0	0	0	0	0	0.00	0.00
Newc	271	52	323	578	901	1	0	0	1	0	0	0.37	0.31
Norwch	303	64	367	200	567	1	0	0	0	1	0	0.33	0.27
Nottm	395	123	518	426	944	0	0	0	0	0	0	0.00	0.00
Oxford	358	122	480	826	1,306	2	1	1	0	0	0	0.56	0.42
Plymth	128	52	180	263	443	3	2	0	0	1	0	2.34	1.67
Ports	450	93	543	725	1,268	2	0	0	1	1	0	0.44	0.37
Prestn	443	63	506	367	873	1	0	0	0	1	0	0.23	0.20
Redng	260	80	340	238	578	1	0	0	0	1	0	0.38	0.29
Sheff	606	78	684	532	1,216	1	0	0	0	1	0	0.17	0.15
Shrew	184	37	221	104	325	1	0	0	0	1	0	0.54	0.45
Stevng	364	40	404	176	580	3	0	0	0	3	0	0.82	0.74
Sthend	131	16	147	57	204	0	0	0	0	0	0	0.00	0.00
Stoke	272	78	350	253	603	2	1	0	0	1	0	0.74	0.57
Sund	162	23	185	158	343	3	0	0	0	3	0	1.85	1.62
Truro	142	29	171	122	293	3	3	0	0	0	0	2.11	1.75
Wirral	179	37	216	0	216	1	0	0	0	1	0	0.56	0.46
Wolve	301	62	363	126	489	2	1	0	0	1	0	0.66	0.55
York	121	21	142	132	274	2	0	0	0	2	0	1.65	1.41
England	**17,349**	**3,564**	**20,913**	**18,563**	**39,476**	**153**	**37**	**5**	**13**	**84**	**14**	**0.88**	**0.73**

Total = total number of episodes
AVF = number of episodes associated with AVF
AVG = number of episodes associated with AVG
NTC = number of episodes associated with NTC
TC = number of episodes associated with TC
UK = number of episodes access or modality unknown
Rate HD = episodes per 100 HD patients
Rate HD + PD = episodes per 100 dialysis patients

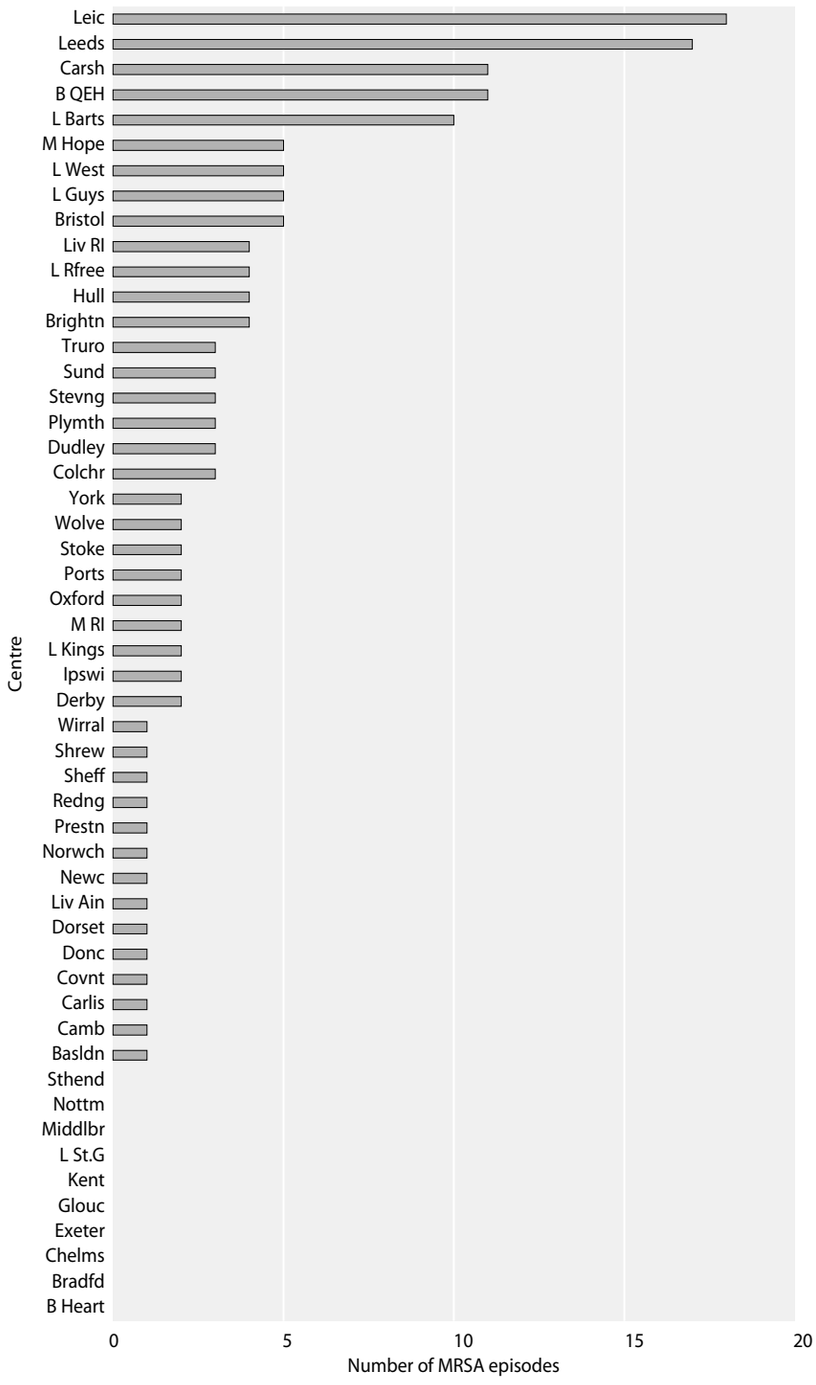

Fig 12.1. Number of MRSA bacteraemia episodes by centre (April 2008–March 2009)

dialysis patients (haemodialysis and peritoneal dialysis) as the denominator, the median rate was 0.55 with a range of 0 to 2.89 episodes per 100 patients per year. Figure 12.3 illustrates the MRSA rate per 100 haemodialysis patients for all centres, again demonstrating wide variation. Six centres had an overall rate of greater than 2 per 100 haemodialysis patients: Colchester, Dudley, Leeds, Leicester, Plymouth, and Truro.

Comparison with 2007 Report [3]

When these data were compared with the data in last year's report, the total number of episodes fell by 19%, from 188 in 2007/08 to 153 in 2008/09. The median centre-specific rate in England decreased from 0.86 to 0.64 episodes per 100 haemodialysis patients and, for haemodialysis and peritoneal dialysis combined, from 0.72 to 0.55 per 100 dialysis patients. The rate in England

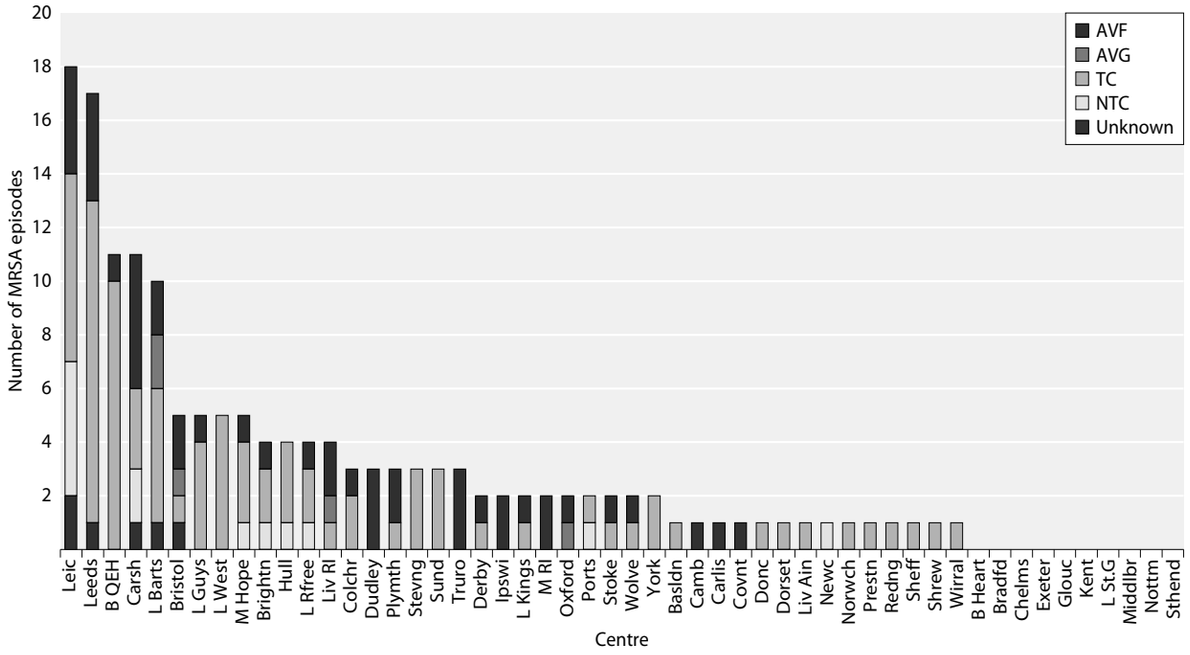

Fig 12.2. Number of MRSA bacteraemia episodes by access and renal centre (April 2008–March 2009)
Stacked bars, coded by access type for each English renal centre
AVF = arteriovenous fistula
AVG = arteriovenous graft
NTC = non tunnelled catheter
TC = tunnelled catheter

decreased from 1.14 to 0.88 episodes per 100 haemodialysis patients, and from 0.92 to 0.73 episodes per 100 dialysis patients (haemodialysis and peritoneal dialysis). Four centres showed an increase in absolute numbers of more than 2 bacteraemias reported. Seven centres that recorded no episodes last year have recorded episodes this year (Basildon, Derby, Doncaster, Reading, Sheffield, Wolverhampton and York), but none of these centres reported more than 2 episodes. Chelmsford and Exeter have recorded no episodes for the second year in succession. Bradford, Birmingham Heartlands, Gloucester, Kent and Canterbury, London St Georges, Middlesbrough, Nottingham, and Southend also all recorded no episodes for the 2008/09 reporting year.

Figure 12.4 shows the change in MRSA episodes by centre between 2007/8 and 2008/9.

Figure 12.5 demonstrates a box and whisker plot for the national data from 2007/08 and 2008/09. The reduction in median centre-specific rate does not reach statistical significance.

Finally, in order to adjust for variation in precision of the estimated rate, the rate of MRSA bacteraemia per 100 prevalent haemodialysis patients for each centre has been plotted against the centre size in a funnel plot (figure 12.6). The curved lines represent the 95% and 99.9% confidence limits. Two centres (Leeds and Leicester) lie between the upper 95% and 99.9% limits.

Discussion

Infection remains the second leading cause of death for patients requiring RRT in the form of dialysis [6], exceeded only by cardiovascular disease. The type of vascular access itself maybe a major factor, as both a primary source of bacteraemia [7–11] or as a potential influence on the outcome of another infective episode [4, 5, 12]. For example, a venous catheter may act as the portal for the direct entry of organisms into the circulation, via either the exit site on the skin or catheter lumen. Alternatively, a bacteraemia secondary to another infection (e.g. skin or soft tissue, pneumonia) may result in colonisation of the catheter biofilm. This may delay the effectiveness of therapy or increase the risk of relapse. These data from the Registry and HPA continue to demonstrate that dialysis patients are at an increased risk of MRSA bacteraemia.

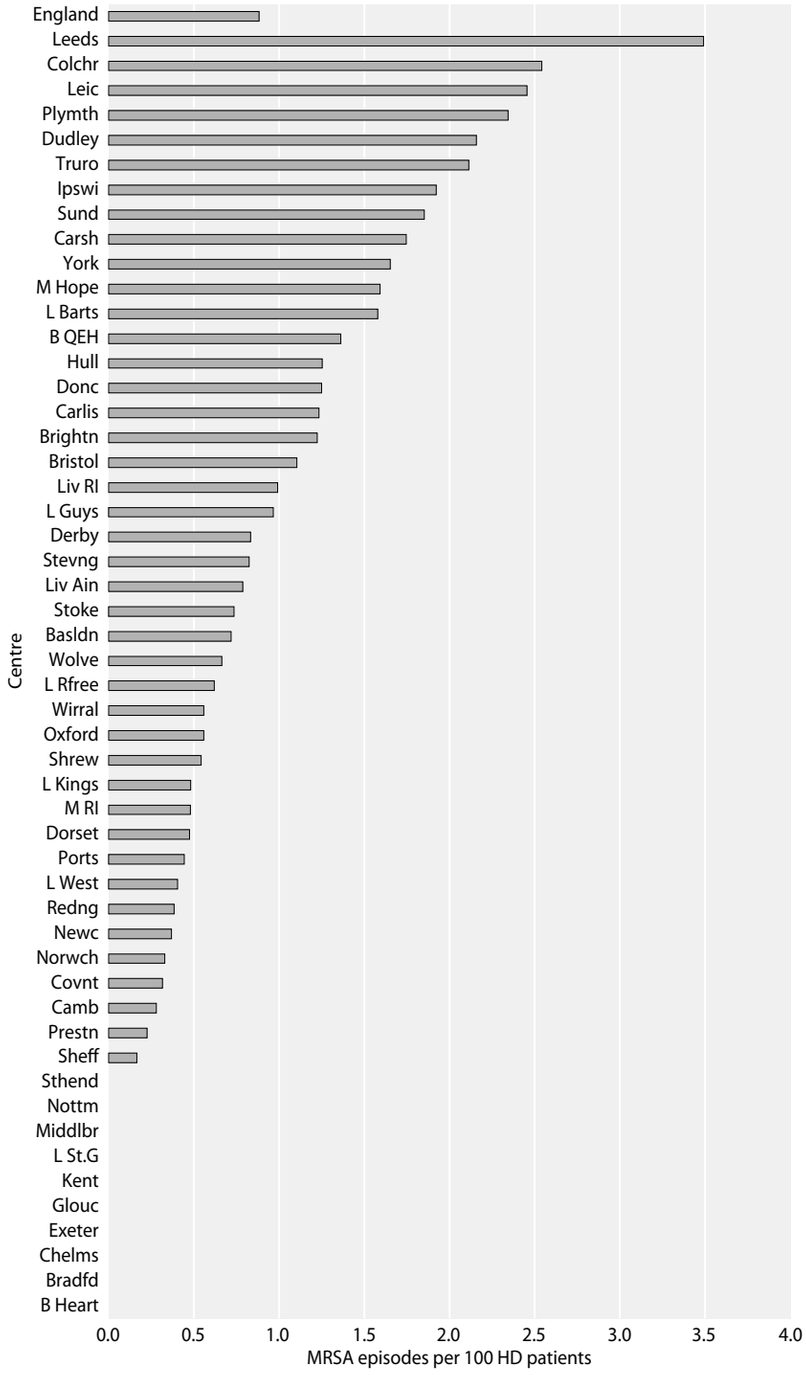

Fig 12.3. MRSA bacteraemia rate (April 2008–March 2009) per 100 prevalent HD patients by renal centre
For each centre the rate per 100 prevalent HD patients as reported 31/12/08 is provided. The overall rate for England is provided at the top of the graph

This is the second year of the full working of the reporting mechanism via the Health Protection Agency and has demonstrated continued decline in the risk of MRSA bacteraemia for patients requiring dialysis. The reasons for such improvement are not clear since the changes in practice that might be responsible are not analysed in this study. This may be related to the adoption of national policies (MRSA screening and general surveillance [13–15], reduction in the use of venous catheters or fundamental shifts in practice (for example antimicrobial lock solutions [16]).

Whatever the cause, there has been a continued reduction in the number of bacteraemia, with a further reduction of 22% from the previous year. There remains considerable variation in rates of MRSA blood related infections between centres in England. However many

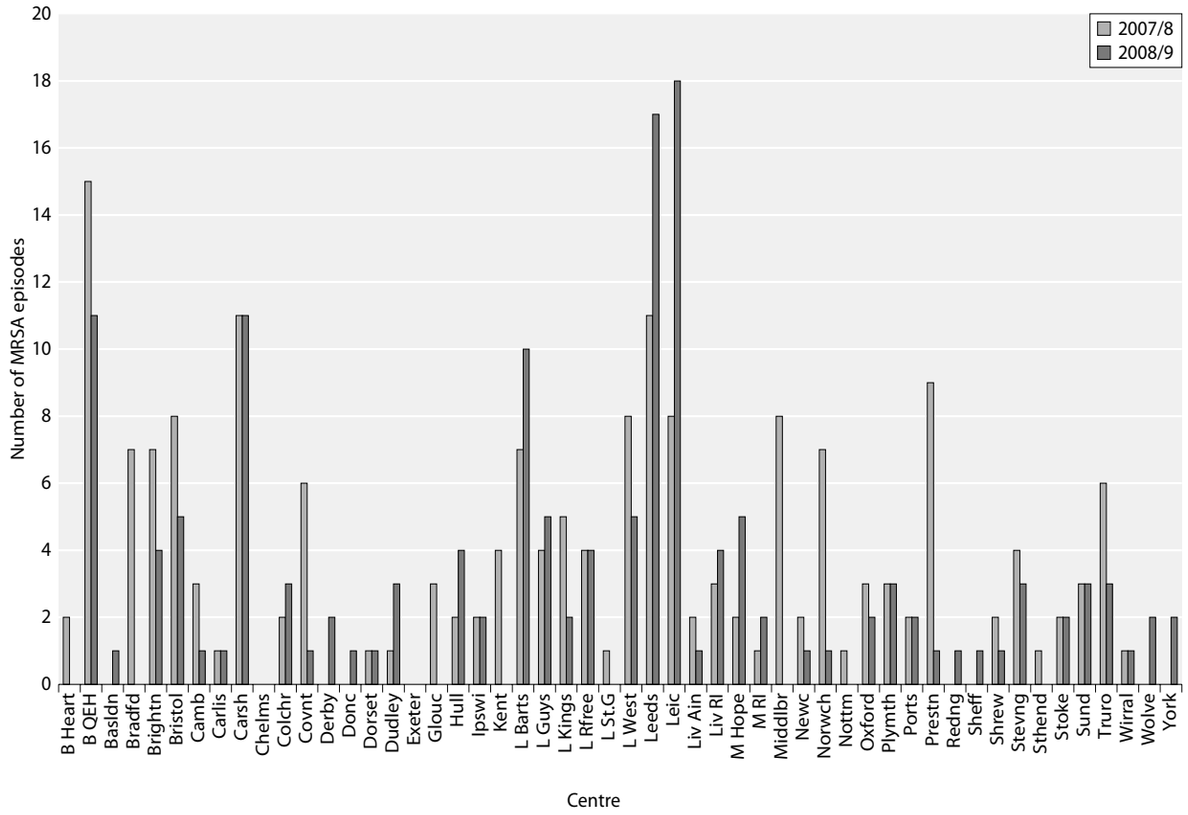

Fig 12.4. Change in MRSA bacteraemic episodes by centre for 2007/8 and 2008/9
2007/8 data Healthcare Associated Infection Data Capture System (HCAI-DCS) (previously called Mandatory Enhanced Surveillance System, MESS published 11th Annual UK Renal Report [2])
2008/9 data Healthcare Associated Infection Data Capture System (HCAI-DCS) (previously called Mandatory Enhanced Surveillance System, MESS)

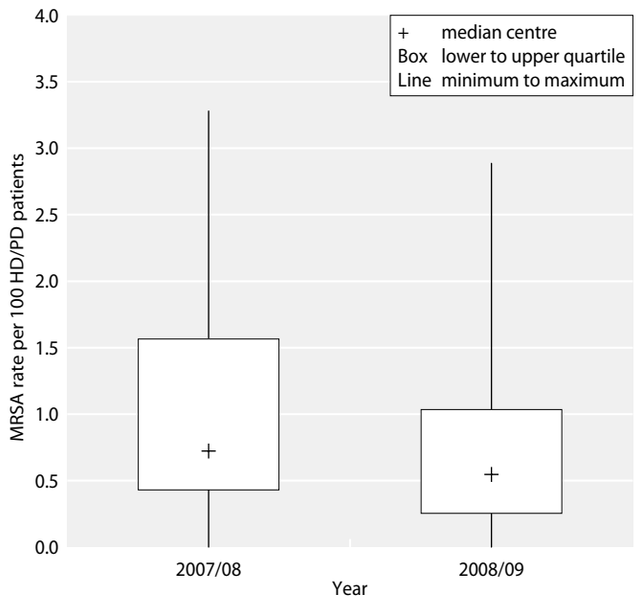

Fig 12.5. Box and whisker plot of MRSA rates by centre per 100 prevalent HD/PD patients for 2007/8 and 2008/9
Data source as per figure 12.4

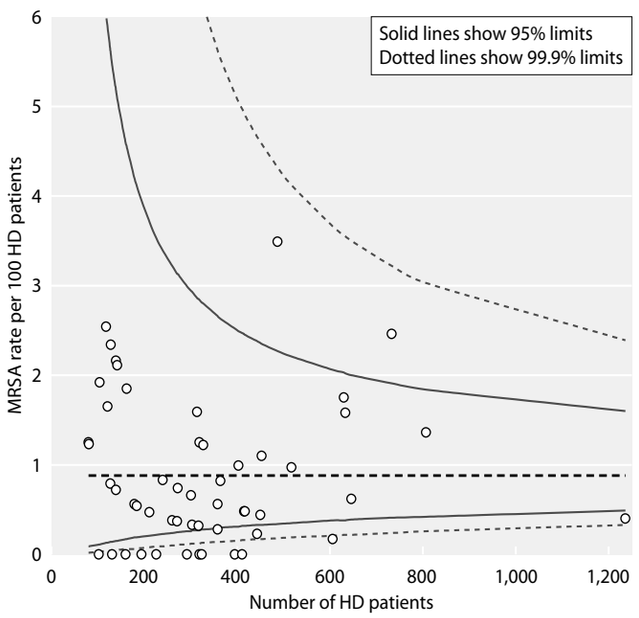

Fig 12.6. Funnel plot of MRSA rate (April 2008–March 2009) per 100 HD patients

centres have reported low or zero rates. Centres with low reporting rates last year have, in general, maintained such rates and many centres have continued to reduce the substantial burden of bacteraemia within their populations. This variation in outcome merits further study to address potential causes and refine therapy. A few centres continue to experience relatively high rates of MRSA bacteraemia. Often those centres have patients with recurrent episodes: 11 individual patients accounted for 20% of all MRSA bacteraemia in the English haemodialysis population. Clearly, chronically colonised patients represent a considerable challenge when access to the circulation is required but further research into the effective suppression or eradication of MRSA bacteraemia in the dialysis population is required. The place of MRSA screening and eradication or suppression therapy has only been documented in small studies and further work is required [17].

In the final round of data validation, many comments were made that the MRSA bacteraemia were not always associated with the type of vascular access but originated, for example, from other sites such as leg ulcers. This is a misconception of the purpose of these data. These data are not a measure of catheter related bacteraemia. Restricting analysis to catheter-related bacteraemia would mask many of the issues of infection burden in dialysis centres. Clearly, patients who have a bacteraemic episode whilst on dialysis but on a fistula, by definition, do not have a catheter related episode but none-the-less that episode is of significance to the individual. However, previous work has shown that the presence of a catheter is associated with a poorer outcome [4]. The Kidney Care National Audit will further examine the relationship between infection, access and hospital admission [18].

On an organisational basis, the current mechanism for sharing and completing records has continued to be problematic and has required an additional step of data validation this year. This was time consuming and required nearly two and a half months to complete. Whilst the quality of the data provided has improved substantially, it does slow down the process of reporting and feedback to centres. It remains a weakness of the current system, although it is hoped that changes made in May 2009 may improve the situation.

Conclusion

The second year of the reporting of the renal component of the mandatory MRSA bacteraemia surveillance scheme continues to show variability in performance between centres but an overall picture of improvement across England and a decline in episodes of about 20% from 2008. Once again, it has demonstrated the association of venous catheters with the risk of MRSA blood stream infection for patients requiring long term haemodialysis. Venous catheters continue to be the main risk factor associated with MRSA bacteraemia and the estimated relative risk compared to a fistula remains 7 fold higher.

Acknowledgements: The authors wish to thank Beverley Matthews, National Programme Director, NHS Kidney Care (England) and her team at NHS Kidney Care for their assistance in the final round of data validation. Thanks are due to Julie Gilg (UK Renal Registry) for preparation of figures 12.5 and 12.6.

Conflict of interest: none

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Chapter 13
The UK Renal Registry Advanced CKD Study: frequency of incorrect reporting of date of start of RRT

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Key Words
Chronic kidney disease · Completeness · Dialysis · End stage renal disease · End stage renal failure · national registry · Renal replacement therapy · Validation

Abstract
Background: A preliminary review of the UK Renal Registry (UKRR) pre-RRT study data revealed results suggesting that, for some patients, the date of start of renal replacement therapy (RRT), as reported to the UKRR, was incorrect and often significantly later than the true date of start. A more detailed study then aimed to validate a set of criteria to identify patients with an incorrect start date. ***Methods:*** Pre-RRT laboratory data were electronically extracted from 8,810 incident RRT patients from 9 UK renal centres. Any patient with a low urea (<15 mmol/L) at the start of RRT or with a substantial improvement in kidney function (either a fall in urea >10 mmol/L or rise in eGFR >2 ml/min/1.73 m) within the two months prior to RRT were considered to potentially have an incorrect date of start. In 4 selected centres, the electronic patient records of all patients flagged were reviewed to validate these criteria. ***Results:*** Of 8,810 patients, 1,616 (18.3%) were flagged by the identification criteria as having a potentially incorrect date of start of RRT, although a single centre accounted for 41% of the total flagged cohort. Of these flagged patients, 61.7% had been assigned an incorrect date of start of haemodialysis (HD), 5.7% had evidence of acute RRT being given before the reported date of start of HD and 9.2% had evidence of starting peritoneal dialysis exchanges prior to the reported date of start. Of those flagged, 10.7% had a correct date of start of RRT. ***Conclusions:*** Accurate reporting of RRT episodes is vital for the analysis of time dependent studies such as survival or time to transplantation. A proportion of patients starting RRT were assigned an incorrect start date. In order to improve the accuracy of this reporting the UK Renal Registry must work with renal centres and clinical staff on improving data input for the start of RRT.

Introduction

The term established renal failure (ERF) used within this chapter is synonymous with the terms end stage renal failure (ESRF) and end stage renal disease

(ESRD), which are in more widespread international usage. Within the UK, patient groups have disliked the term 'end stage' which formerly reflected the inevitable outcome of this disease.

The epidemiology and management of patients with ERF in the United Kingdom has been well described in this, and previous, UKRR reports. However, the UKRR has not previously had access to data on patients prior to starting renal replacement therapy (RRT). The epidemiology and management of patients with advanced chronic kidney disease (CKD) prior to RRT has not been well described in large observational studies.

The increasing prevalence of patients being treated for ERF (a 40% rise in the UK in eight years [1]) has been described by commentators as a public health problem [2]. The National Institute for Clinical Excellence (NICE) guidelines for CKD emphasise a strategy to reduce the rise in ERF by retarding the progression of disease in patients with CKD [3]. The UK National Service Framework for Renal Services emphasises the importance of good pre-dialysis preparation in the final year before RRT is required [4]. A greater understanding about patients with advanced CKD, their progression of disease, the CKD complications they experience and their response to management is therefore essential.

The UK Renal Registry therefore sought to undertake a study of this population by extracting additional laboratory and clinical data at a number of predetermined time points during the year prior to starting RRT in all incident patients on the UKRR database from nine selected UK renal centres. Part of this work was funded by a grant from the Edith Murphy foundation (Registered Charity No. 1026062) through Kidney Research UK as part of a larger project funded by the Health Foundation, the Quality Improvement in Chronic Kidney Disease project.

The preliminary analysis of these laboratory eGFR data revealed an unexpected anomaly. When the median eGFR at each time point pre-RRT for two of the centres was plotted, the overall decline in eGFR was linear, with the exception of the final data time point (1 to 15 days prior to the start of RRT – month zero) which was higher than the previous time point (month minus 1) (figure 13.1). One of the possible explanations for the rise in eGFR at this time point was that there were a number of patients in whom the date of start of RRT, as reported in the dataset extracted from the local IT system and submitted to the UKRR was incorrect and whose laboratory results at the 'month zero time-point' were actually taken once RRT had already commenced. If this hypothesis was correct this would mean that a percentage of the final eGFR results at the start of RRT were artificially high.

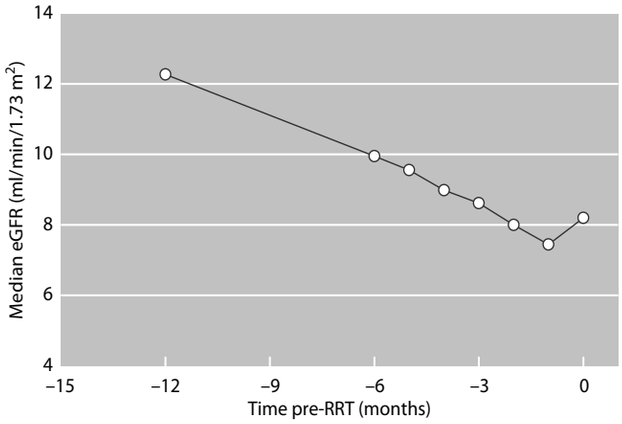

Fig. 13.1. Median eGFR at each time point pre-RRT for Centre D

A preliminary data validation exercise in a small sample of patients at one of the centres confirmed that there were indeed some patients with an incorrect RRT start date recorded in the renal IT system and therefore a falsely low serum creatinine extracted which was after the true start of RRT. It was therefore decided to undertake a more systematic data validation exercise at four of the renal centres to test the hypothesis that there were a number of patients in the cohort with an incorrect date of start of RRT.

Methods

UKRR pre-RRT study methods

All adult patients who had been reported to the UKRR as having commenced RRT (either on dialysis or with a pre-emptive transplant) at nine selected UK renal centres were included in the pre-RRT data extraction. The nine centres were selected for this pilot for a number of reasons. Firstly, they all used a common renal IT system (Proton, Clinical Computing Ltd). Secondly, they were historically some of the more reliable centres at providing complete data for prevalent RRT patients. Thirdly, they were known to register all the general nephrology patients on the renal IT system at earlier stages of CKD, rather than only at the start of RRT, making it more likely that the results of biochemical tests prior to the start of RRT would be available for extraction from the IT system. The study period was from 1997 when the first centres began reporting incident patients to the UKRR, until December 2006.

Patients were excluded if they were younger than 18 years at the start of RRT. Some of the centres did not start reporting

patients to the UKRR until 2001. Only patients starting RRT for the first time were included. Episodes of re-commencement of dialysis or second or subsequent transplants were not counted as 'incident' episodes.

The date of start of RRT was taken from the first modality 'timeline' entry on the renal IT system. This date may have been ascribed by the clinician, PD or HD nurse and responsibility for this would vary between centres. The RRT timeline options (both acute and chronic) are listed in appendix G on the UKRR website [www.renalreg.org].

During the study period, the UKRR definition of the date of start of RRT was:

> ***Established renal failure is defined as the date of the first dialysis (or of pre-emptive transplant). If a patient started as 'acute' renal failure and did not recover function, the date of start of renal replacement therapy should be backdated to the start of acute haemodialysis.***

This definition required that clinicians should retrospectively change the timeline from acute to chronic dialysis once it became apparent that a patient who had started dialysis in supposedly acute circumstances was unlikely to recover function. The reason for this request was that the UKRR extraction software used the date of chronic RRT to flag patients, ignoring episodes of acute dialysis. This was to ensure that patients with acute renal failure were not analysed in the UKRR ERF cohorts. There was no specific definition for the date of start of peritoneal dialysis. This definition was published in appendix B of the UKRR annual report and has been available on-line only since 2005 [5]; hence, many nephrologists may have been unaware of the definition of the date of start used by the registry, and as a result may not have entered data on the timeline in a consistent manner.

In addition to the demographic, clinical and laboratory information held on the UKRR database for these patients, laboratory data were extracted according to a predetermined dataset for the final 12 months before the onset of RRT. The closest serum creatinine to time points: 0, 1, 2, 3, 4, 5, 6 and 12 months pre-RRT were extracted where present.

Estimated glomerular filtration rate was calculated from each serum creatinine measurement using the 4-variable Modification of Diet in Renal Disease (MDRD) equation [6]. In addition to serum creatinine, this equation requires age, gender and ethnicity. A correction factor of 1.21 was applied to patients of Black ethnicity. No correction factor was required for South Asian or other ethnicities. Where evidence of ethnicity was missing, it was presumed to be non-Black for the purpose of eGFR estimation. During the period of this study, standardisation of creatinine assay to that used in the MDRD study, was not available. The UKRR used the original '186-constant' in the MDRD formula to calculate eGFR. In 2009 most UK laboratories were using the '175-constant' formula with an IDMS-aligned serum creatinine assay. It has been shown that there is little inter-laboratory variation at more advanced stages of CKD [7].

Timeline validation study methods

Three arbitrary criteria were adopted for identifying patients with unexpectedly good kidney function prior to RRT after discussion with clinicians and following the single-centre preliminary validation exercise. These criteria were:

1. A serum urea below 15 mmol/L at month 0
2. A fall in serum urea greater than 10 mmol/L within the final two months pre-RRT
3. A rise in eGFR greater than 2 ml/min/1.73 m^2 within the final two months pre-RRT

The purpose of the validation exercise was firstly to test the hypothesis that the reason for the apparently good kidney function was that the majority of these patients had been assigned an inaccurate date of start of RRT, and secondly to confirm the validity of these arbitrary identification criteria to see if they could be subsequently used as exclusion criteria for further analyses.

After obtaining permission from the four renal centres to conduct the data validation exercise by interrogating the electronic records on the local renal IT systems, the above identification criteria were used to create a list of patients at each centre for review. A single investigator reviewed the electronic records of all identified patients to see if there was evidence of earlier renal replacement therapy than that reported to the registry. The IT system screens reviewed included: the haemodialysis (HD) event screen, the blood pressure (BP) record screen, the biochemistry screen, the clinical summary screen and the clinic letter and discharge summary screen. An entry in the HD event screen was taken as evidence that HD had occurred on a particular date, as was an entry of 'pre' and 'post' BP on the same day. An entry of 'pre-HD' and 'post-HD' serum urea on the same day in order to calculate a urea-reduction-ratio (URR) was also taken as evidence that HD had occurred. The free text entries from the summary screen and letters were searched for documented evidence that earlier RRT had occurred. For example, documentation that a patient had been transferred from an intensive care unit with compatible biochemistry was considered evidence that prior haemofiltration had probably occurred. Finally, documentation that a peritoneal dialysis (PD) catheter had been inserted and intermittent PD undertaken prior to the reported date of start was considered evidence that the reported date was incorrect.

Patients were divided into four categories: incorrect date of start of HD, incorrect date of start of PD, correct date of start and details unknown. These categories are summarised in table 13.1 and the possible causes are listed below and discussed in depth in the results section.

Results

After applying the RRT start identification criteria to all patients' results, there were 1,616 patients (18.3%) who met one or more of the identification criteria. There was a significant difference in the proportion of patients meeting these criteria in the nine centres (table 13.2, chi-squared test $p < 0.0001$).

Haemodialysis patients with incorrect dates

Table 13.3 shows a summary of the results of the 4 centre validation exercise. Of the patients starting haemodialysis with an incorrect date, 512 (61.7% of

Table 13.1. Circumstances resulting in apparently good kidney function prior to the start of renal replacement therapy

Coding	Summary	Definition
HD		**Patients with incorrect date of start who started RRT on haemodialysis**
HD-1	Incorrect date	The patient had been allocated an incorrect date, no other obvious cause
HD-2	Previous acute HD/CVVH	Evidence that the patient had received previous acute HD or CVVH
HD-3	Possible previous acute HD/CVVH	Circumstantial evidence that the patient probably underwent previous acute RRT
HD-4	Transfer in on HD/CVVH	Transfer of a patient from another renal centre or ICU without documentation of previous RRT on the timeline
HD-5	Probable incorrect date	Improbable acute fall in urea or creatinine which was unlikely to be caused by circumstances other than acute RRT, but no documentary evidence of this occurrence
HD-6	Spurious result	Isolated spurious biochemistry result e.g. compatible with a drip-arm sample
PD		**Patients with incorrect date of start who started RRT on peritoneal dialysis**
PD-1	Incorrect date	The patient had been allocated an incorrect date, no other obvious cause
PD-2	Previous acute HD/CVVH	A patient starting PD, but with evidence of previous acute HD or CVVH
PD-3	IPD prior to PD training	Evidence that the patient received intermittent PD exchanges prior to the documented date of start of PD
PD-4	Probable IPD prior to PD training	Circumstantial evidence that the patient probably had additional PD exchanges prior to the documented start date
Correct		**Patients starting either HD or PD who were flagged according to the identification criteria, but whose start date was actually correct**
C-1	Bilateral/2nd nephrectomy	Patients undergoing a bilateral or second nephrectomy
C-2	Natural fall in CR/urea prior to RRT	Apparent natural improvement in kidney function with evidence that the date of start of RRT was correct
C-3	Fall in CR/urea because of specific therapy	Specific therapy such as cessation of ACE inhibitor or appropriate fluid therapy in a fluid deplete patient resulting in an improvement in biochemistry
C-4	Urea <15 – elderly/frail	Commencement of RRT with an appropriately low urea in a patient known to be elderly or frail, without evidence of a significant improvement in kidney function which could be caused by acute HD
C-5	Urea <15 – other	Commencement of RRT for appropriate reasons with a low urea without evidence of a significant improvement in kidney function which could be caused by acute HD
Uncertain		**Lack of evidence in the electronic patient record to place patient in any of the above categories**
U	Uncertain	

CVVH = continuous veno-venous haemofiltration (or other continuous renal replacement therapy, usually undertaken in an intensive care unit)
Cr = serum creatinine

the total validation cohort) were found to simply have been allocated an incorrect date of start (code HD-1), with the majority of these patients all at one centre (centre D). This centre systematically allocated a later (incorrect) HD start date for reasons related to local arrangements for financial reimbursement of haemodialysis costs. The date of start of HD for established renal failure was reported as the date a patient started chronic HD at a satellite dialysis unit even if they had been receiving hospital or ward-based dialysis prior to this.

In 47 patients, there was evidence of receipt of acute RRT (either acute haemodialysis or acute continuous RRT in an ICU setting) prior to their reported date of starting HD, and that the date of start had not been retrospectively changed by the clinician when it became clear that the patient had established renal failure, as required by the UKRR definition.

A further 5 patients had an acute fall in urea (code HD-5) and creatinine which could only have been explained by acute RRT. Two patients had a spurious set of results which were markedly different to other biochemistry results at the time and were likely to represent venesection from the same arm as an intra-venous infusion.

Peritoneal dialysis patients with incorrect dates

In 79 patients who had peritoneal dialysis as their first recorded chronic dialysis modality (code PD-2) there was evidence that they had received one or more episodes of either acute HD or acute haemofiltration or similar continuous RRT in an ICU setting.

Table 13.2. Percentage of patients meeting identification criteria by renal centre

Centre	Number of patients meeting identification criteria	Total number of incident patients	Percentage of patients meeting identification criteria
A	128	1,400	9.1
B	78	825	9.5
C	130	795	16.4
D	660	1,755	37.6
E	56	844	6.6
F	216	769	28.1
G	246	1,447	17.0
H	33	298	11.1
J	69	677	10.2
Total	**1,616**	**8,810**	**18.3**
Total (excluding centre D)	***956***	***7,055***	***13.6***

In another 76 patients who started chronic RRT on PD there was evidence (codes PD-3, PD-4) that they had received additional PD exchanges prior to the reported date of start of chronic PD. Some of these were documented as overnight intermittent PD, whilst others were documented as having low-volume continuous PD. Others had no detailed documentation of the circumstances but had an otherwise unexplained improvement in renal biochemistry between the date of PD catheter insertion and documented date of start of PD.

Patients with a correct date of start of RRT despite anomalous results

In 89 patients (10.7% of the validation cohort) the start date appears to have been correctly assigned, despite having unexpectedly good kidney biochemistry as

Table 13.3. Results of the analysis of local electronic patient records of patients meeting the identification criteria

Code	Description	Centre A	Centre B	Centre D	Centre H	Total	%
C-1	Bilateral/2nd nephrectomy	3	3	1	2	9	1.1%
C-2	Cr/Ur fall pre-RRT	19	12	12	6	49	5.9%
C-3	Cr/Ur fall because of specific therapy	9	3	3	0	15	1.8%
C-4	U<15 – elderly/frail	4	2	1	0	7	0.8%
C-5	U<15 – other	2	5	0	2	9	1.1%
		37	**25**	**17**	**10**	**89**	**10.7%**
HD-1	Incorrect date	8	8	491	5	512	61.7%
HD-2	Previous acute HD/CVVH	8	16	4	10	38	4.6%
HD-3	Possible previous HD/CVVH	2	0	2	1	5	0.6%
HD-4	Transfer in on HD/CVVH	4	0	0	0	4	0.5%
HD-5	Probable incorrect date-improbable fall in U/Cr	1	0	4	0	5	0.6%
HD-6	Spurious result	1	0	1	0	2	0.2%
		24	**24**	**502**	**16**	**566**	**68.2%**
PD-1	Incorrect date	1	0	1	0	2	0.2%
PD-2	Previous acute HD/CVVH (<3 m)	5	2	72	0	79	9.5%
PD-3	IPD prior to training	8	0	0	0	8	1.0%
PD-4	Probable IPD	26	9	30	3	68	8.2%
		40	**11**	**103**	**3**	**157**	**18.9%**
U	Uncertain	0	10	6	2	18	2.2%
		0	**10**	**6**	**2**	**18**	**2.2%**
	Total	**101**	**70**	**628**	**31**	**830**	

Cr = serum creatinine, Ur = serum urea, RRT = renal replacement therapy, HD = haemodialysis, CVVH = continuous veno-venous haemofiltration (or other continuous renal replacement therapy, usually based in an intensive-care unit), IPD = intermittent peritoneal dialysis (or other methods of peritoneal dialysis fluid exchange)

defined by the identification criteria. There were 9 patients in this category (code C-1) who had undergone a bilateral or 2nd nephrectomy and would therefore have had reasonable kidney function until the time of the procedure.

A further 64 patients were flagged because of a fall in serum urea and/or an improvement in eGFR (codes C-2, C-3) in the two months prior to starting RRT. In 15 of these patients there was evidence of a specific intervention (code C-3) causing this improvement. For example, an episode of acute kidney injury secondary to fluid depletion followed by appropriate fluid therapy would appear as an improvement in kidney function if the circumstances were not known. Similarly, a patient with deteriorating function on an angiotensin converting enzyme (ACE) inhibitor may have shown a temporary improvement in kidney function on cessation of this drug [8]. In 49 patients there was a similar improvement in kidney function prior to RRT (code C-2) although the exact circumstances of the improvement could not be established.

Another 16 patients were flagged by the identification criteria (codes C-4, C-5) because the urea immediately prior to RRT was below 15 mmol/L, with 7 of these being elderly or frail (code C-4) (whose circumstances otherwise fitted with an appropriate reason for starting dialysis). In 9 patients (code C-5) there was no evidence of frailty but they were thought to have had appropriate indications for starting dialysis despite the low serum urea.

In 18 patients in the cohort it was not possible from the electronic records to establish whether the date of start was correct or not.

Discussion

These results highlight several key points. Firstly that the reported date of start of RRT can be highly dependent on local clinical requirements and reporting. The UKRR electronic data extraction methods are highly reliant on this correct date to extract the correct pre-RRT laboratory variables.

Using the identification criteria stated above, 18.3% of the original cohort of 8,810 patients had unexpectedly good kidney function at the reported date of start of RRT. It should be noted that a single centre (centre D) contributed 41% (660) of these 'flagged' patients (table 13.2). If this centre is excluded from the analysis, the proportion of flagged patients in the remaining 8 centres falls to 13.6%. However, it remains unknown whether the systematic reporting issue in centre D is the exception in the UK, or whether it may also occur in other centres.

The validation exercise suggests that about 10% of the patients flagged by the identification criteria will actually have been assigned a correct date of start. If it is assumed that the systematic errors at centre D are unique to that centre, then the proportion of patients reported to the UKRR with an incorrect date of start may be as low as 12%. The authors are only aware of two other studies looking at the concordance of reported start dates: In a study from the Danish National Registry, 22.5% of the 3,020 incident cohort were found to have a wrong year of entry in the database. A random sample of 118 of these 3,020 patients found that the accuracy of start-date was regarded by the authors as having complete concordance with the day in 46% of patients and overall 87% of reported start dates fell within a range of −30 to +30 days of the actual date recorded in the case notes [9]. These data are not directly comparable to ours, but imply that in the small Danish study possibly up to 30–40% of patients were misallocated to a later start date, which compares to 12–18% in this study (12% after excluding one centre's data). In a 1987 study by the USRDS using a random sample of 1,692 patients, perfect concordance of RRT start-date with the case notes derived start date was described in only 64% of patients [10]. This only rose to 94% of records showing concordance of RRT start date when using a range of ±60 days, with 13% of patients showing a much later start date. These data are closer to those found in this study.

The second key point is that this study highlighted three causes for the majority of the incorrectly reported start dates.

The first cause related to the single centre that only entered patients on the RRT timeline at the time they started HD at a satellite unit. When the reason for this practice was sought it was stated that it was for billing purposes rather than for Registry reporting. The centre informed the UKRR that at the time of inquiry the practice had already ceased, although the change in practice had been made after the end of the study period. The UKRR cannot enforce a change in an individual centre's practice although it can highlight issues such as this and emphasise the importance of reporting RRT episodes accurately on the Registry timeline in renal IT systems.

The second cause for incorrect date reporting was the inability to recognise patients reported as starting on 'acute' HD before it was accepted there was to be no recovery of function. The way in which these

patients are reported to the UKRR has been subject to further discussions in the UKRR steering group, summarised as:

- The existing practice of asking clinicians to retrospectively change the modality from 'acute' HD to 'chronic' HD in patients who were initially thought to have a potentially reversible episode was not practicable.
- The current definition and recommendations for reporting the date of RRT start may have been inadequately publicised and notification of any future changes should be circulated to a wider renal audience.
- The specification for the software that reports these patients to the UKRR should be modified to reflect current clinical practice. If a patient is believed to have a potentially reversible episode of acute kidney injury, this should continue to be recorded locally as 'acute' HD. If a clinician then decides that they are not going to recover function, the RRT modality should be changed to 'chronic' HD at the time when this becomes apparent. At the start of chronic RRT, the software should include in the data transmission any prior recorded episode of 'acute' haemodialysis or haemofiltration.
- Registry analyses will backdate the start of RRT to that of the acute date (provided there has been less than 90 days recovery between 'acute' episodes).

These definitions and suggestions were published in the 2008 UKRR Annual Report [11] and a commentary circulated to the Renal Association membership. The definitions continue to be published in the UKRR Annual Report appendix B.

The third cause for incorrect data was the lack of a definition for the date of start of peritoneal dialysis. This study has highlighted the fact that a percentage of patients had some evidence of PD exchanges taking place at an earlier date than was being reported as the start of RRT. Discussions with the UK PD working party group revealed that there was also no international definition for the date of PD start. The UKRR undertook a small survey of clinicians who indicated that there were at least four different definitions considered to be the date of start of PD. These included: the date of insertion of PD catheter, the date of first PD fluid exchange, the date of start of PD training and the date of PD training completion and independence. These definitions were discussed by the UKRR steering group and UK PD working party and a definition was agreed as:

'the date of start of peritoneal dialysis is defined as the date of first PD fluid exchange given with the intention of causing solute or fluid clearance'.

This clarified that the situation of a fluid flush solely for the confirmation or maintenance of catheter patency is not the start of PD. This definition was first published in the 2008 Annual Report [11] and is now found in appendix B.

The third key point is that other registry analyses that rely upon the accuracy of the date of start of RRT (survival analysis of incident dialysis patients, the estimation of eGFR at the start of RRT and time to listing for renal transplantation) may be inaccurate in 12–18% of patients.

The UKRR has reported the eGFR at the start of RRT, both in the UK incident population [12] and as a contribution to European studies [13]. A small proportion of these eGFR results would be artificially high and it is probable that similar results may be found at other registries if equivalent evaluation exercises were undertaken. In the Danish and American studies mentioned earlier [9, 10], only 46% and 64% of patients respectively, had perfectly accurate start dates. A similar analysis of the eGFR at the start of RRT in these countries would therefore include 54% and 36% respectively of patients who did not start RRT on the day reported. This analysis shows that an incorrect late start date, even by only a few days, would result in the extraction of a serum creatinine result which was not pre-RRT and therefore produce a falsely high eGFR at start. In the UK cohort, the small number of patients affected (in the centres not showing the systematic data reporting error) would only have an almost undetectable effect on median eGFR at the start of RRT (under 0.5 ml/min/1.73 m^2). This bias would be consistent across centres and also across all years. The slow annual rise seen in the UK of the eGFR at the start of RRT is unlikely to be an artefact of this error.

The results of this validation exercise also have implications for the analysis of the pre-RRT data collection. If the study was to include all the patients whose date of start was confirmed to be incorrect, analyses such as rate of decline of RRT and haemoglobin pre-RRT would yield inaccurate results. It was therefore decided to use the identification criteria to exclude patients with anomalous pre-RRT results, on the evidence from the validation study that these criteria correctly identified 87% of patients with incorrect timelines. During the validation exercise, a number of other

exclusion criteria were trialled including more complex models incorporating first treatment modality, primary renal disease and the absolute or percentage improvement in urea, creatinine and eGFR in the final two months pre-RRT. None of these models improved the predictive value of the original identification criteria.

In addition to excluding patients meeting the above criteria from UKRR future analyses on outcomes using pre-RRT data, it was also decided to completely exclude all the data from Centre D. It was felt that including this centre would introduce a systematic selection bias to the study cohort. Data from Centre F, which had the second highest proportion of flagged patients (28.1%), was then also excluded for similar reasons.

A limitation of this validation exercise is that only four renal centres were sampled and these were not randomly selected. One centre was chosen specifically to investigate the reason for the apparent high error rate. After excluding this one centre, it remains uncertain whether these results are representative of other UK renal centres.

Despite these limitations, it is felt that the study has revealed a number of important issues regarding the mechanism of reporting the date of start of RRT which have not previously been recognised by the UKRR and to our knowledge, have not previously been reported elsewhere in the renal literature. Although this study is not directly comparable with the two other validation studies [8, 9], the proportion of patients found to have inaccurate start dates in the UKRR database was much lower than the Danish study and may be similar to the USRDS study. It is likely that start date errors also affect all other national renal registries.

This study illustrates the emphasis and the attention to detail that the UKRR places on the data validation process. There is a large amount of data validation undertaken by the UKRR data management team in conjunction with the renal centres, some of which is automated, the remainder requiring additional human intervention and corroboration with renal centre staff. The publication of this study has resulted in changes in UK guidelines and practices and is evidence of the continuing efforts at the UKRR to improve the quality of the data analysed and interpreted in each Annual Report.

Conflict of interest: none

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Chapter 14
Demography of the UK Paediatric Renal Replacement Therapy population in 2008

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Key Words
Aetiology · Children · Demography · End stage renal disease · Established renal failure · Incidence · Mortality · Prevalence

Abstract
Aims: To describe the demographics of the paediatric RRT population in the UK and analyse changes in demographics with time. ***Methods:*** Extraction and analysis of data from the UK Paediatric Renal Registry and the UK Renal Registry (UKRR). ***Results:*** The UK paediatric established renal failure (ERF) population in December 2008 was 905 patients. The prevalence under the age of 16 years was 56 per million age related population (pmarp) and the incidence 7.4 pmarp. The incidence and prevalence for South Asian patients was much higher than that of the White and Black populations. Renal dysplasia was the most common cause of ERF accounting for 33% of prevalent cases. Diseases with autosomal recessive inheritance were a common cause of ERF in all ethnic groups, 23.5% of prevalent and 18% of incident cases. Whilst the incidence and prevalence of diseases with autosomal recessive inheritance in the South Asian population was 3 times that of the white population, this was not the sole reason for the increased proportion of South Asian patients with ERF, as diseases with no defined inheritance were twice as common in this ethnic group than in White patients. Prevalent mortality stood at 9.4%. Most deaths were in patients presenting with ERF early in life and mortality varied markedly according to the aetiology of ERF. The proportion with new grafts from living donors has steadily risen to 54%. Children from ethnic minority groups were less likely to have an allograft and living donation was less frequent in this population. For those on dialysis, 56% were receiving peritoneal dialysis. This was the main treatment modality for patients under 4 years of age. ***Conclusions:*** The paediatric ERF population continued to expand slowly. Incidence and prevalence rates were stable and similar to other developed nations. The high incidence in patients from ethnic minority groups will lead to a greater proportion of the population being from these groups in time. To maintain the high proportion of engrafted patients it will be necessary to encourage living donation in the ethnic minority population. Case note analysis of the factors involved in mortality would be valuable.

Introduction

As planned at the outset and 13 years after its conception, data from the UK Paediatric Renal Registry has now

been merged into the main UK Renal Registry data repository. This move will allow more complete analyses in the future, including analyses not limited by the artificial boundaries set when patients transfer from paediatric to adult centres. This will be particularly valuable when looking at the teenage and young adult population where complete data for incidence, prevalence and demographic features have been absent in the past. The amalgamation will also allow for more accurate tracking of patients for analysis of outcome.

Whilst data within the paediatric registry had always centred around a census date of the 1st April, the census date used by the adult registry has been the 31st December. This latter census date has now been adopted by the paediatric registry group for future reports as it is in keeping with both the adult registry and the EDTA. As a result of this the current report is based around the census date of the 31st December 2008. The data is thus little changed from that reported in the 2008 Report which used the census date of the 1st April 2008 [1].

Within the UK, treatment of paediatric patients with established renal failure (ERF) takes place within 13 regional centres (Scotland 1, Wales 1, Northern Ireland 1, England 10). All centres have facilities for peritoneal dialysis and haemodialysis. Ten of the 13 centres undertake transplantation for children. Due to the ongoing amalgamation of data, figures for this report have been taken from two data streams. New patients at the smallest centre (Southampton) have not been logged since 2007. The impact upon the figures of these omissions is a potential underestimate of between two and eight patients.

The term established renal failure (ERF) used throughout this chapter is synonymous with the terms end stage renal failure (ESRF) and end stage renal disease (ESRD) which are in more widespread international usage. Within the UK, patient groups have disliked the term 'end stage'; the term ERF was endorsed by the English National Service Framework for Renal Services, published in 2004.

Methods

Data collection took place across the UK looking at patient status on 31st December 2008. Some centres collected data electronically and used the data transfer channel to the UK Renal Registry for data transfer. Other centres used paper data collections which were then manually input into the current paediatric registry database (see chapter 15 for further details). Data were then extracted and statistical analyses performed using SAS 9.1.3.

Results

The UK paediatric prevalent ERF population

The UK paediatric ERF population on 31st December 2008 was 905 patients. The age, ethnicity and gender distribution is shown in table 14.1. The overall gender ratio of males to females was just over 1.5 to 1. Ethnic minority groups composed just under 22% of the population.

Using previous BAPN audits in 1986 and 1992, together with subsequent data from the UK paediatric registry it was possible to look at the growth of the paediatric ERF population. To allow direct comparison, these data only included those under the age of 15 years and are shown in figure 14.1. The population of patients with ERF under the age of 15 years continued to grow slowly. This recent growth is more in line with the ongoing growth of the general UK population with a fairly steady increase in prevalence compared to the early years where the population rose rapidly as the

Table 14.1 The UK paediatric prevalent ERF population on 31st December 2008, by age, gender and ethnicity

	Patients	Male	Female	Ratio	% total
White	711	443	268	1.65	78.6
S Asian	146*	76	65	1.17	16.1
Black	25	16	9	1.78	2.8
Other	22	11	11	1.00	2.4
Total	**905**	**546**	**354**	**1.54**	**100.0**
<18 years	840	505	330	1.53	92.8
<15 years	559	342	214	1.60	61.8

* gender unknown for 5 South Asian patients

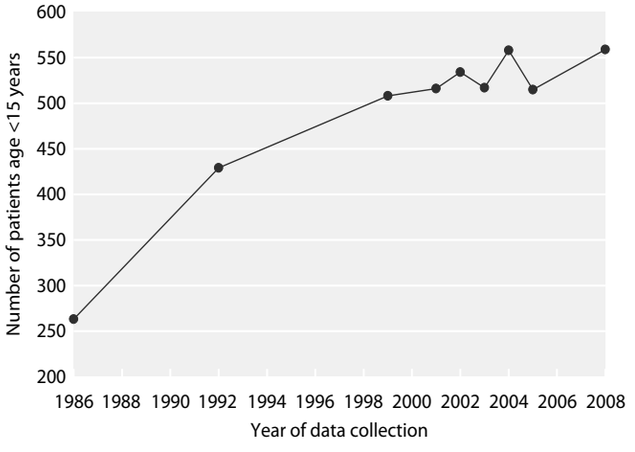

Fig. 14.1. Prevalent patients below 15 years of age on RRT in the UK (1986–2008)

Table 14.2. Prevalent paediatric ERF population by age and year of data collection

	Patient population data					
Age group (yrs)	1986	1992	1999	2002	2005	2008
0–1.99		16	18	14	14	19
2–4.99		55	46	58	45	78
5–9.99		150	151	147	157	148
10–14.99		208	293	315	299	314
15–19.99			253	259	253	344
Total <15	263	429	508	534	515	559
Total <20			761	793	768	905

Table 14.3. Prevalent paediatric ERF population by age and year of data collection

	Patient population		
Age group (yrs)	2002	2005	2008
0–3.99	49	36	70
4–7.99	94	108	103
8–11.99	185	152	178
12–15.99	294	321	295
16–19.99	171	151	257

potential for treatment became apparent. The age distribution of the population is shown in table 14.2. This chart is arranged with data from the census reports of 1986 and 1989 together with prevalent patient numbers every three years from 1999 when paediatric reports were issued.

The proportion of ethnic minority (EM) patients has increased (21.4% vs. 16.9%) and when compared to the previous most complete data collection in 2004, this increase was significant ($p = 0.023$). These data are shown in figure 14.2.

All patients under the age of 16 years in the UK are managed by paediatric centres. To allow meaningful comparisons and equal age distributions, patients were divided into four year age bands from birth to 20 years. These data are shown in table 14.3 for the years of 2002 and 2005 together with the data from the current analysis. Across all years, there was a rise in numbers with each increase in age band until the 16 to 20 year band when the population falls due to transfers to adult centres. In the current dataset the number of patients below the age of 4 years has risen and compared with the 2005 data the proportion under the age of 4 years is significantly larger ($p = 0.012$).

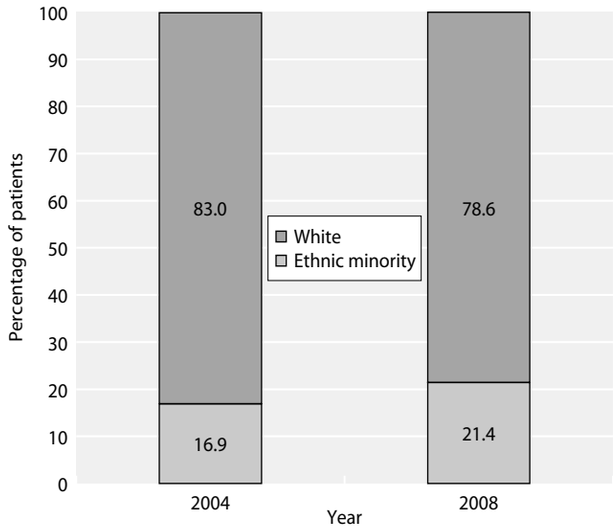

Fig. 14.2. The proportions of prevalent paediatric RRT patients in 2004 and 2008 from ethnic minorities

Incidence and prevalence

The incidence and prevalence of ERF in the UK has been calculated using estimated population figures for the UK from the Office for National Statistics online resource [2]. The overall prevalence of ERF in children under the age of 16 years in the UK was 56.1 per million age related population (pmarp). The prevalence was highest at 97.3 pmarp in the 12 to 16 year age group. At all ages there was a significant excess of males (table 14.4), which is also seen in the adult ERF population. Prevalence over the age of 16 years is not included in this table as many patients in this age group, particularly those over the age of 18 years, are primarily treated in adult centres.

The incidence of ERF is shown in table 14.5. Here the incidence recorded in the 16 to 20 year age group is recorded simply to demonstrate the clear underestimate of incidence in this age group secondary to mixed referral patterns. Figure 14.3 shows the trends with regard to incidence over the past 10 years by age group. Whilst there is marked year to year variability secondary to the small numbers involved, there is no clear trend. The overall incidence in the under 16 years of age population varies around 8 pmarp.

Whilst the prevalence of ERF rises steadily with age, through continued acceptance onto the programme of new patients and survival of existing patients, the

Table 14.4. Prevalence of ERF pmarp by age and gender

	All patients		Male		Female	
Age group (yrs)	Patients	Prevalence	Patients	Prevalence	Patients	Prevalence
0–3.99	70	24.1	44	29.5	26	18.3
4–7.99	103*	38.3	64	46.5	38	28.9
8–11.99	178*	61.9	109	74.1	68	48.4
12–15.99	295*	97.3	170	109.3	123	83.4
<15	559	52.1	342	62.3	214	40.9
<16	646	56.1	387	65.7	255	45.4

* gender unknown for total of 4 patients

Table 14.5. Incidence of ERF per million age related population for the last ten years

	All patients		Male		Female	
Age group (yrs)	Patients	Prevalence	Patients	Prevalence	Patients	Prevalence
0–3.99	24	8.2	15	10.1	9	6.3
4–7.99	12	4.5	5	3.6	7	5.3
8–11.99	19	6.6	12	8.2	7	5.0
12–15.99	29	9.9	17	10.9	12	8.1
16–19.99	11	2.8	6	3.6	5	3.2
<15	74	7.0	46	8.4	29	5.5
<16	84	7.4	49	8.3	35	6.2

distribution of incidence with age showed a V shaped curve with the incidence in the first four years of life being almost twice that of the second four years. This is demonstrated in figure 14.4.

Both the incidence and prevalence of ERF varied with ethnicity. The South Asian population showed a prevalence 2.5 times that of the White population. The incidence of ERF in this group is currently 1.5 times that of the White group. The prevalence and incidence of ERF in the Black population was just slightly higher than that of the White population. Those classified as Other had a prevalence almost 4 times that of the White population but for 2008 there were no new incident patients in this group (figure 14.5).

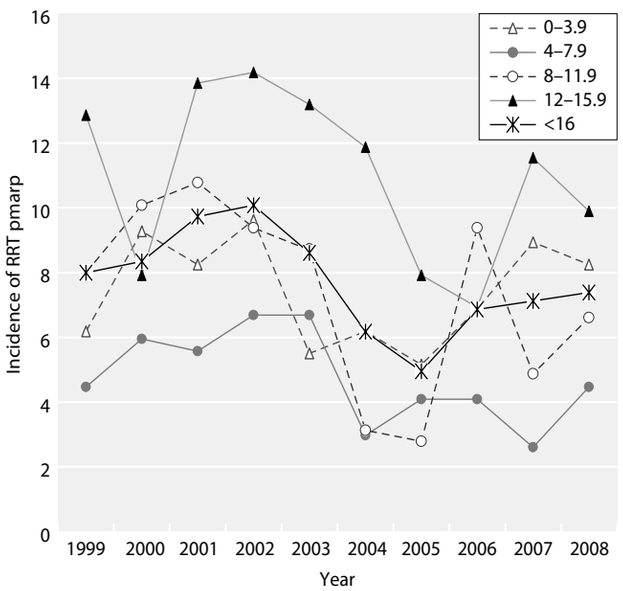

Fig. 14.3. Paediatric incidence of RRT pmarp 1999–2008 by age at onset

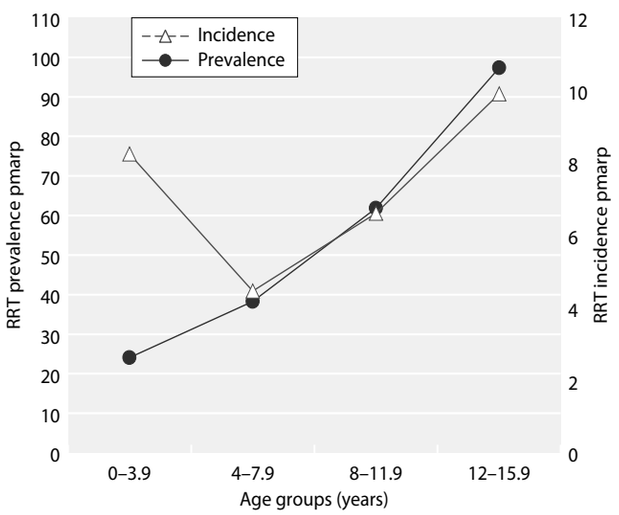

Fig. 14.4. Incidence and prevalence of RRT pmarp in 2008 by age

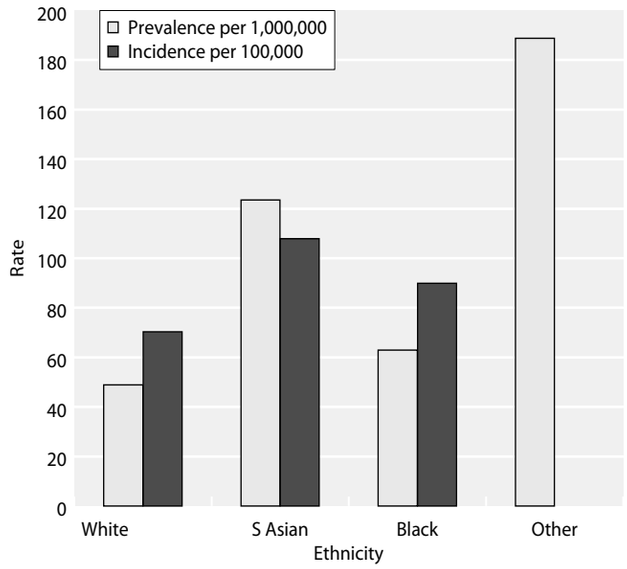

Fig. 14.5. Incidence per 100,000 and prevalence per 1,000,000 age related population by ethnicity

Causes of ERF

The causes of ERF in the paediatric population have been previously outlined [3]. The number of individual diseases and sub-classifications are numerous. For analytical purposes these are best broken down into a smaller number of disease categories. Table 14.6 shows these disease categories for 782 of the 905 current patients (86.4%) for whom a causative diagnosis was listed. Renal dysplasia with or without vesico-ureteric reflux was the predominant cause, accounting for 33% of all patients. The combination of glomerulonephritic diseases and obstructive uropathy accounted for just over a further third and the remainder was composed of the other 8 categories. The male to female ratio for patients with renal dysplasia was high and this, together with the vast excess of males with obstructive uropathy from posterior urethral valves, accounted for the overall predominance of males in the population. For this analysis the group classified as having malignancy leading to ERF has been re-examined. All but one case of malignancy involved Wilms' tumour. However, in many these were unilateral and the true cause of progression to ERF was Wilms' nephropathy. These patients have been reclassified as having a glomerulopathy rather than a malignant cause of ERF. This explains why the size of the group with malignancy as a cause has halved when compared with the last BAPN report.

There is a difference between incident and prevalent diagnoses in terms of proportion. To examine this the cause of ERF in the 428 patients starting therapy in UK centres in the five year period from 1st January 2004 until 31st December 2008 was investigated. Details of the primary cause of ERF were available in 387 patients (90.4%). These data are presented in table 14.7. Whilst the top three groups remain unchanged it is apparent that for some groups, such as congenital nephrosis, the incident percentage is rather less than the prevalent percentage of the population, whilst the reverse is true for conditions such as tubulo-interstitial disease and those with ERF of uncertain aetiology. These data are shown graphically in figure 14.6. The reason for the discrepancies between incidence and prevalence is secondary to the age of presentation of these disorders. Congenital nephrosis is rare but presents in infancy so patients spend a long time in paediatric centres increasing the prevalence. Those with tubulo-interstitial disease and those with renal failure of uncertain aetiology tend to present later in childhood and are therefore transferred

Table 14.6. Diagnostic groups and gender distribution of the prevalent paediatric ERF population

Diagnostic group	Patients	Proportion of total (%)	Male	Female	M:F ratio
Renal dysplasia ± reflux	258	33	168	90	1.87
Glomerular diseases	150	19	73	77	0.95
Obstructive uropathy	120	15	109	11	9.91
Congenital nephrosis	62	8	27	35	0.77
Tubulo-interstitial disease	60	8	30	30	1.00
Renovascular disease	33	4	22	11	2.00
Metabolic diseases	31	4	17	14	1.21
Unknown aetiology	31	4	13	18	0.72
Polycystic kidney disease	24	3	11	13	0.85
Malignancy	7	1	1	6	0.17
Drug nephrotoxicity	6	1	3	3	1.00

Table 14.7. Diagnostic groups and gender distribution of the incident paediatric ERF population

Diagnostic group	Patients	Proportion of total (%)	Male	Female	M:F ratio
Renal dysplasia ± reflux	135	33	83	52	1.60
Glomerular diseases	78	19	40	38	1.05
Obstructive uropathy	49	12	42	7	6.00
Tubulo-interstitial disease	39	10	17	22	0.77
Unknown aetiology	24	6	10	14	0.71
Metabolic diseases	18	4	9	9	1.00
Congenital nephrosis	15	4	8	7	1.14
Renovascular disease	13	3	8	5	1.60
Polycystic kidney disease	10	2	4	6	0.67
Drug nephrotoxicity	4	1	1	3	0.33
Malignancy	2	0	1	1	1.00

to adult centres after a briefer stay in the paediatric centres.

The distribution of causative diagnoses is somewhat different between ethnic groups. This in part relates to a higher incidence of autosomal recessive diseases in populations where consanguinity is more frequent than in the white population. Nineteen percent of prevalent White patients have ERF secondary to a disease with autosomal recessive inheritance, whilst 26% of ethnic minority patients have this. Table 14.8 shows the inheritance of the primary cause of ERF in the prevalent White and ethnic minority populations who were under the age of 16 years at presentation. Table 14.9 shows these data for patients presenting below the age of 16 between 1st January 2004 and 31st December 2008 to allow calculation of incidence. Whilst diseases with no defined inheritance are twice as common in the ethnic minority population than the White population, autosomal recessive diseases are three times as common.

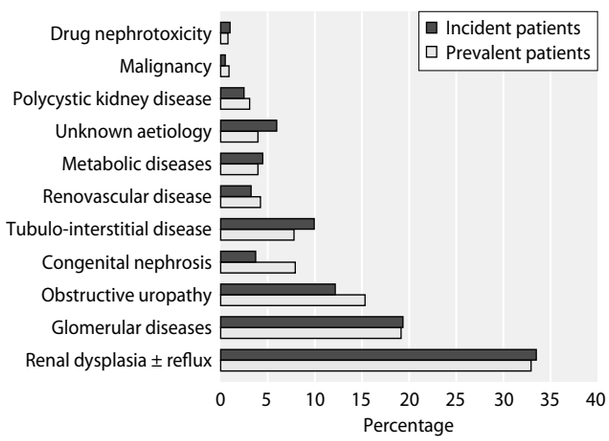

Fig. 14.6. Comparison of incidence and prevalence in different diagnostic groups

The overall figures show 20.5% of prevalent patients and 15.0% of incident patients have diseases with autosomal recessive inheritance causing ERF. This raises the question of whether there is a role for prenatal diagnosis and intervention. Just 4% of these patients were recorded as having had an antenatal diagnosis made though 10.6% had other family members affected by the disorder and 7% had another family member in ERF.

Table 14.8. Mode of inheritance of diseases causing ERF and ethnicity in the prevalent paediatric population (<16 years)

	White		Ethnic minorities	
Inheritance	N	pmarp	N	pmarp
Autosomal recessive	112	10.9	38	29.7
Autosomal dominant	8	0.8	0	0.0
X linked	8	0.8	0	0.0
Mitochondrial	4	0.4	1	0.8
None or other or undefined	448	43.8	110	86.0

Table 14.9. Mode of inheritance of diseases causing ERF and ethnicity in the incident paediatric population from 2004–2008 (<16 years)

	White		Ethnic minorities	
Inheritance	N	pmarp	N	pmarp
Autosomal recessive	45	0.9	20	3.1
Autosomal dominant	5	0.1	0	0.0
X linked	5	0.1	0	0.0
Mitochondrial	2	0.0	1	0.2
None or other or undefined	285	5.6	67	10.5

Mortality

In the previous BAPN report [1] 5 year survival of patients commencing ERF in childhood according to age was examined. In this report mortality and the demographics of patients who have not survived are analysed.

To ensure completeness of the cohort only patients below the age of 16 years at the census date were included. There were 646 current patients within this cohort. One of these patients is known to have subsequently died. Examination of the database yielded 75 registered patients who were deceased but would have been under the age of 16 years at the census date. This gives a mortality in the prevalent population (prevalent mortality) of 10.4% overall. Eight of these patients were detailed as not being accepted onto an ERF programme because of complicating features, often multiple severe comorbidities or life threatening disabilities. This will be an underestimate of patients falling into the category of having ERF but not starting an ERF treatment program as there is no compulsion to register such patients at present. After discounting these patients and only looking at those commencing an ERF programme, the prevalent mortality under the age of 16 years remained at 9.4%.

Figure 14.7 is a cumulative frequency chart of age at death. Whilst 50% of deaths occur before the age of 3 years in patients starting dialysis in infancy, the remainder die at varying ages stretching into adolescence. Data on precise cause of death was too poorly completed to allow meaningful analysis. There was no difference in the ethnic distribution of the cohort that had died compared with survivors. Twenty-two percent of survivors were from ethnic minority backgrounds compared with 26% of the deceased cohort.

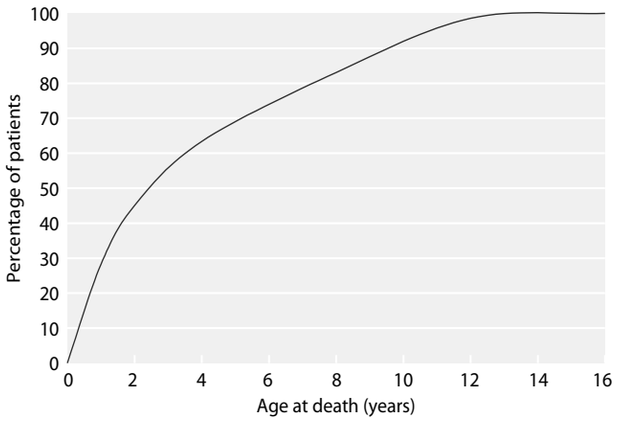

Fig. 14.7. Age at death in patients who would currently be below 16 years of age

Data on the underlying cause of ERF were available in 64 of the deceased patients (85%) and 552 of the survivors (85%). These data are presented in table 14.10. The pattern of diseases causing ERF in the deceased cohort was different from the surviving population, secondary to the large number of patients commencing RRT in infancy within the deceased cohort. Thus renal dysplasia ± vesico-ureteric reflux remained the most common diagnostic group but there were far fewer patients with glomerulonephritides and more patients with congenital nephrosis and infantile polycystic kidney disease. This analysis allows the calculation of mortality according to underlying disease and whilst for children with glomerulonephritic disorders the figure is somewhat lower than the overall figure, mortality in patients with polycystic kidney disease may be

Table 14.10. Causes of ERF in the prevalent and deceased paediatric patients

Diagnostic group	Total number of patients	Percentage	Number of deceased patients	Percentage deceased (95% CI)
Renal dysplasia ± reflux	209	33.9	21	10.0 (6–15)
Glomerular diseases	102	16.6	6	5.9 (2–12)
Obstructive uropathy	99	16.1	13	13.1 (7–21)
Congenital nephrosis	57	9.3	7	12.3 (5–24)
Tubulo-interstitial disease	38	6.2	1	2.6 (0–14)
Renovascular disease	31	5.0	4	12.9 (4–30)
Unknown aetiology	22	3.6	0	0.0 (0–15)
Polycystic kidney disease	27	4.4	8	29.6 (14–50)
Metabolic diseases	20	3.2	3	15.0 (3–38)
Malignancy	7	1.1	1	14.3 (0–58)
Drug nephrotoxicity	4	0.6	0	0.0 (0–60)
Total	**616**	**100.0**	**64**	**10.4**

high although small numbers and wide confidence intervals make interpretation of these results difficult.

Current modality of RRT

Of the 905 current patients, some details of treatment modality in 2008 were available for 879 (97.1%). Of these, 641 (72.9%) had a functioning renal allograft. Peritoneal dialysis was the active modality in 131 (14.9%) and haemodialysis was being used in 104 (11.8%). Three patients were on no active treatment at the time of audit (0.4%).

For the 641 patients with transplants, the type of allograft was known in 640. Living donation (LD) accounted for 234 grafts (36.5%) and 406 (63.3%) were from deceased donors (DD). The proportion of paediatric patients with allografts from living donors has been steadily increasing as demonstrated in figure 14.8.

Figure 14.9 shows the distribution of LD grafts and DD grafts in different ages of children. The proportion of engrafted patients whose graft has come from a living donor is highest in patients still in the first four years of life and then steadily decreases until the 12 to 16 year group where the proportion increases again.

For those on dialysis, 44.3% were having haemodialysis. For those having peritoneal dialysis, the vast majority (90%) were being treated with automated peritoneal dialysis (APD), the remainder being on CAPD. Figure 14.10 shows the distribution of all modalities according to age. Only 15% of patients in the first 4 years of life had an allograft. This figure rapidly rose to about 80% in the 8 to 12 year old group and remained at this level thereafter. Beyond the age of 4 years those on dialysis were fairly evenly split between peritoneal and haemodialysis, whilst peritoneal dialysis predominated in the first 4 years of life.

The distribution of treatment modalities was different between the White patients and those from ethnic minority groups. A significantly larger proportion of White patients had been transplanted than ethnic minority patients ($p = 0.002$). For those who had been engrafted, 38.6% of White patients had an LD graft compared to 28.3% of ethnic minority patients ($p = 0.036$). For those on dialysis, 52% of those from ethnic minority groups were on haemodialysis compared to 41% of White patients. This difference was not statistically significant. These data are demonstrated in figure 14.11.

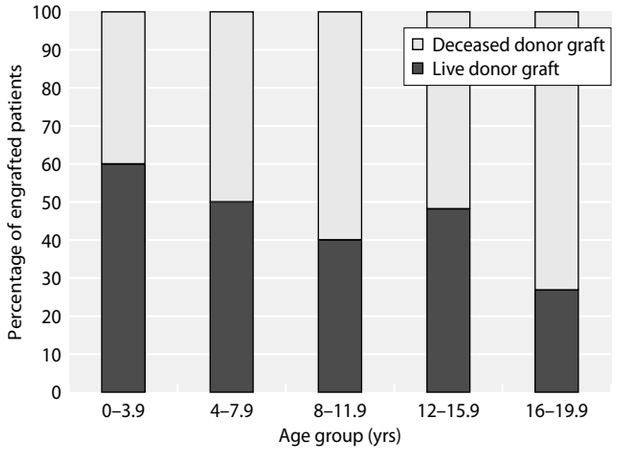

Fig. 14.9. Percentage of engrafted paediatric patients with an LD or DD graft by age

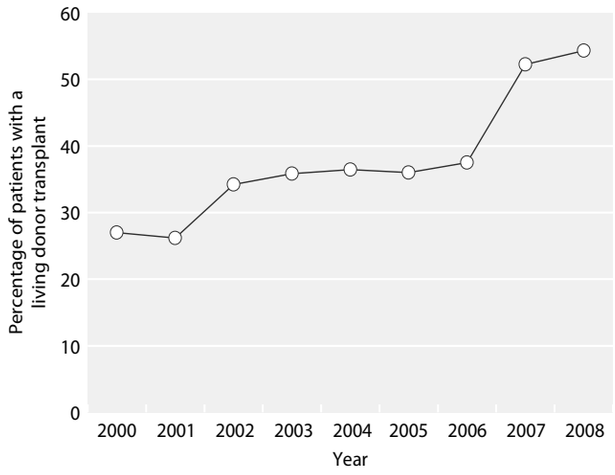

Fig. 14.8. Percentage of prevalent paediatric renal transplant patients with a living donor graft, by year (2000–2008)

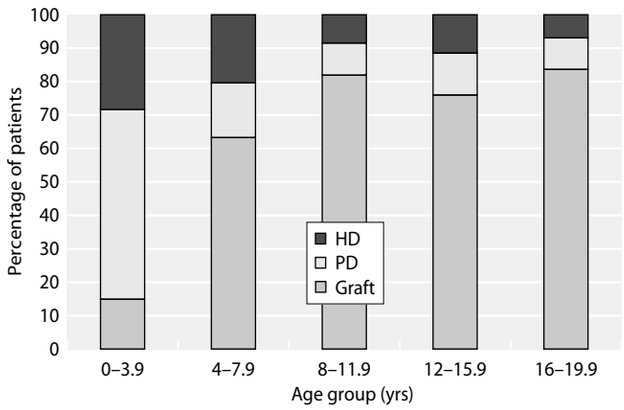

Fig. 14.10. Distribution of RRT modalities by age

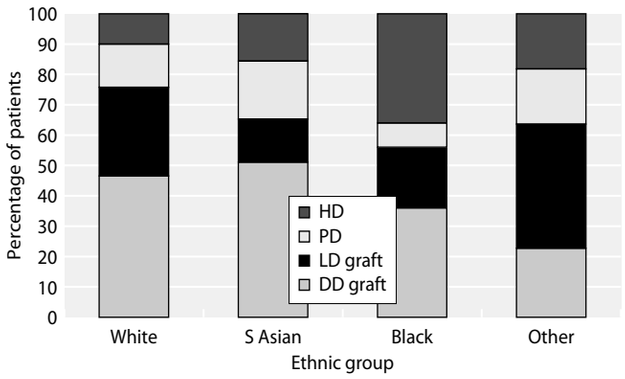

Fig. 14.11. RRT modality by ethnicity

Discussion

ERF paediatric population, incidence and prevalence

The paediatric ERF population continues to slowly grow without there being any significant trend with regards to incidence and prevalence. This will, therefore, simply represent the ongoing growth of the total UK population. The incidence and prevalence rates of childhood ERF are similar to those quoted in the ANZDATA 2008 Registry Report [4]. Comparing incidence rates to previously published rates for both European and non European countries [5], the current UK rates are within the ranges described which vary according to predisposition to particular diseases according to ethnicity and to healthcare provision.

The proportion of the population coming from ethnic minority backgrounds is rising, as would be expected with the higher incidence of childhood ERF in this population. The proportion of patients between the ages of 16 and 20 years has also risen in this analysis. Currently it is impossible to say whether this is due to a change in incidence and prevalence or, more likely, variation in the timing of transfer to adult centres. The current amalgamation of the adult and paediatric data set will allow meaningful analysis of this for the report next year.

Causes of ERF

Renal dysplasia with or without vesico-ureteric reflux remains the most common cause of ERF in the cohort, accounting for about one third of both incident and prevalent patients. Glomerular diseases and obstructive uropathy are the next most common causes. Together these three groups account for 67% of prevalent and 65% of incident cases. The proportion of incident cases from obstructive uropathy is somewhat lower than the proportion of prevalent cases as the majority are secondary to posterior urethral valves presenting with ERF in early childhood and leading to patients with long stays in the setting of the paediatric renal centre. This is even more apparent for congenital nephrosis, which always presents with early onset ERF. Similarly, diseases presenting with ERF in later childhood show a higher incidence than prevalence, the patients being more rapidly moved onto adult centres. Examples of this include tubulointerstitial diseases and those presenting with ERF of unknown aetiology (figure 14.6).

Inherited diseases are a major cause of ERF in childhood accounting for 23.5% of prevalent and 18% of incident cases. The lower proportion of incident to prevalent cases again reflects the fact that, on the whole, these are disorders causing early onset ERF. Of those with diseases where there is a recognised mode of inheritance, 88% of prevalent and 83% of incident cases relate to diseases with autosomal recessive inheritance. These are more common in the South Asian population where consanguineous marriage is more common. However, this does not account for all the difference seen in incidence and prevalence rates between the White and ethnic minority groups as diseases with no recognised pattern of inheritance are also twice as common in the ethnic minority cohort. One major implication of inherited disease is the impact on the family of having more than one affected member and perhaps more than one family member on dialysis. With 10% of families where there is an autosomal recessive cause of ERF having more than one family member affected, and two thirds of these families having more than one family member in ERF the impact upon support services is significant. This will also impact upon family decisions with regard to living donation, decisions becoming difficult when more than one family member requires a graft.

Mortality

The analysis of prevalent mortality shows 9.4% of patients accepted onto an ERF programme have died before reaching the age of 16 years. Whilst this may seem high this is not out of keeping with the survival data in the last analysis which showed 91.7% five year survival. There were also a number of patients with ERF who died without being accepted onto an ERF

programme. This figure will be an underestimate as there is no requirement to register such patients. An independent audit of patients with ERF in childhood not being accepted onto an active treatment programme would be worthwhile to analyse the factors involved in decision making and whether treatment centres have different practices.

As expected the majority of deaths occurred early in life and amongst those with an infantile onset of ERF. This is supported by the analysis of causes of ERF in the deceased population. This is the first breakdown published of underlying diagnosis in patients who have died and knowledge of prevalent mortality according to the aetiology of renal failure is going to be valuable in the counselling of parents both at presentation and after antenatal diagnosis. It is however noteworthy, that deaths occur throughout childhood, and also in children with disorders such as glomerulonephritis, where there would not necessarily be any comorbid problems. The data on cause of death was not complete enough to allow a meaningful analysis. For those where details were available recurring themes were pulmonary hypoplasia, loss of dialysis access, multiple congenital anomalies and multiple or severe disabilities. This is in keeping with the findings of Woods *et al.* [6]. As with those not accepted onto an ERF programme, an independent audit of the casenotes of patients who have died might provide valuable information, particularly with regard to counselling the families of infants and children with multiple problems being considered for ERF treatment.

Current RRT modality

The 73.2% of patients whose current RRT modality was a functioning renal allograft was slightly higher than the 71% reported by both ANZDATA [4] and the USRDS [7]. This figure has remained stable over the years of data collection by the Registry. The proportion of patients being engrafted from a living rather than a deceased donor continues to increase. For those without an allograft, peritoneal dialysis remained the most prevalent treatment though the percentage of patients receiving haemodialysis had risen to 44.3%. This is in keeping with the general trend towards increasing haemodialysis therapy in children described by Warady [8].

The proportion of patients with a functioning allograft rises steadily with age until a small fall in the group of patients between the ages of 12 to 16 years. This could represent either an increased proportion of patients entering ERF at this point or the loss of previously functioning grafts with return to dialysis. Knowing that there has been no change in incidence according to age, the latter is more likely. This is also supported by the observation that the proportion of grafts from living related donations is increased in this group. With the current trend for more grafts to come from living donors than deceased donors it is likely that this cohort is having their second graft from this source.

Patients from ethnic minority groups were significantly more likely to be on dialysis than White patients. As morbidity and mortality are higher in dialysis compared to engrafted patients [6], an education programme promoting living donation in the ethnic minority population is needed. Live donation from ethnic minorities may remain more difficult than in White groups, due to a much higher incidence of chronic kidney disease and renal failure seen in the adult ethnic minorities. Also, as mentioned above, some of these families may have more than one child in ERF, complicating the decision-making process.

Conflict of interest statement: none

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Chapter 15
Clinical, Haematological and Biochemical Parameters in Patients receiving Renal Replacement Therapy in Paediatric Centres in the UK in 2008: national and centre-specific analyses

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Key Words
Biochemical variables · Children · Dialysis · ERF · Haemoglobin · Height · Quality improvement · Transplant · Weight

Abstract
Background: The British Association for Paediatric Nephrology Registry was established thirteen years ago to analyse data related to renal replacement therapy for children. The registry receives data from the 13 paediatric nephrology centres in the UK. In 2008 the registry was relocated to the UK Renal Registry (UKRR). ***Aim:*** To provide centre specific data so that individual centres can reflect on the contribution that their data makes to the national picture and to determine the extent to which their patient parameters meet nationally agreed audit standards for the management of children with established renal failure. ***Method:*** Data were submitted to the UKRR for analysis electronically via renal IT systems from 5 centres and on paper-based returns from the remaining centres. Data were analysed to calculate summary statistics and where applicable the percentage achieving an audit standard. The standards used were those set out by the Renal Association and the National Institute for Health and Clinical Excellence. ***Results:*** Data were received from all but one centre. Anthropometric data confirmed that children with ERF in the UK are short compared with their peers with no change in recent trends. In the UK as a whole, the control of blood pressure, anaemia and bone biochemistry is suboptimal, but for some parameters these appear to be better in the 2008 cohort than in the 1999–2008 cohort. ***Conclusions:*** Key features of this report are the provision of centre specific data and comparison of data to audit standards. It is hoped that this information will provide a basis for discussion and a stimulus to improve the care of children with ERF.

Introduction

The British Association for Paediatric Nephrology (BAPN) registry was established in 1996 by Dr Malcolm Lewis in collaboration with paediatric nephrologists in the 13 centres in the UK. The data to be collected was agreed by the registry committee of the BAPN and data collection forms distributed to each of the participating centres. Data were returned electronically for the first 4 years, then moved to paper returns with a change to the dataset as it was anticipated that amalgamation with UKRR was imminent. All returns went to Manchester where data were entered onto the BAPN registry database and analysed by Dr Lewis with support from members of the committee. Reports on established renal failure and its management in children were included in the majority of registry reports between 1999 and 2008.

This year has seen significant changes to the methods for data collection and analysis. The BAPN registry database has been relocated to the UKRR in Bristol. This was done to improve the professional IT, statistical and managerial support available for the running of the paediatric registry. The BAPN Audit & Registry Committee has met quarterly with colleagues from the UKRR to undertake the relocation of the paediatric registry.

This year the Paediatric Renal Registry report focuses on the following variables for the prevalent paediatric dialysis and transplantation cohort on 31st December 2008:

1. Report on the completeness of data returns to the renal registry
2. Overview of anthropometric characteristics in children with ERF
3. Overview of blood pressure control in children with ERF
4. Anaemia
5. Key biochemical findings in this population

Analyses of prevalent paediatric patients receiving renal replacement therapy for the 'Registry year 2008' and for the period 1999–2008 inclusive are reported. Due to low numbers of patients in each cohort no incident cohort analyses have been undertaken. Another key feature of this report is the presentation of centre specific data for each paediatric nephrology centre in the UK.

The term established renal failure (ERF) used within this chapter is synonymous with the terms end stage renal failure (ESRF) and end stage renal disease (ESRD), which are in more widespread international usage. Within the UK, patient groups have disliked the term 'end stage' which formerly reflected the inevitable outcome of this disease.

Methods

There are 13 centres providing care for children requiring renal replacement therapy in the UK, 10 of which currently also provide surgical renal transplant services. All 13 centres provide outpatient and in-patient follow up for children who have received kidney transplants. Centres are listed in table 15.1 and appendix J.

Data collection

In previous years, paediatric data from children on dialysis were collected on an annual census date which was the 1st of April each year. Data from children with kidney transplants were collected on the anniversary of the transplant. This year the data collection census date was altered to 31st December for all ERF patients bringing it in line with data collection on adult patients in the UKRR. Data from transplant recipients therefore also relate to the census date rather than the anniversary of the transplant as previously reported. The data presented in this report relates to data to 31st December 2008.

The paediatric centres with access to renal IT systems submitted encrypted electronic data directly to the UKRR. The software routines to extract the data were run with the assistance of staff at the UKRR.

Paper returns were sent to Manchester for entry onto the database as in previous years from those centres without access to renal IT systems and then transferred in an encrypted electronic format to the UKRR. Data from all centres were merged and are now held on a paediatric database at the UKRR.

Table 15.1 Paediatric renal centres, their abbreviations and IT systems

Paediatric centre	Abbreviation	Renal IT system
Belfast	Blfst_P	None
Birmingham	Bham_P	CCL Proton
Bristol	Brstl_P	CCL Proton
Cardiff	Cardf_P	CCL Proton
Glasgow	Glasg_P	None
Leeds	Leeds_P	CCL Proton
Liverpool	Livpl_P	None
London Evelina	L Eve_P	None
London Great Ormond Street	L GOSH_P	None
Manchester	Manch_P	None
Newcastle	Newc_P	CCl clinical vision
Nottingham	Nottm_P	CCL Proton
Southampton	Soton_P	None

Table 15.2 Summary of some biochemical clinical audit measures

	Age			
Clinical audit measure	<1 year	1–5 year	6–12 years	>12 years
Haemoglobin in transplant patients (g/dl)	10.5–13.5	12.0–14.0	11.5–14.5	13–17.0
Haemoglobin in dialysis patients (g/dl)	10.0–12.0	Under 2 years 10.0–12.0 Over 2 years 10.5–12.5	10.5–12.5	10.5–12.5
Ferritin (μmol/L)	200–500	200–500	200–500	200–500
Corrected calcium (mmol/L)	2.24–2.74	2.19–2.69	2.19–2.69	2.15–2.55
Phosphate (mmol/L)	1.1–1.95	1.05–1.75	1.05–1.75	1.05–1.75

Information governance

The collection of patient identifiable data without consent is regulated by the statute National Health Services Act 2006, section 251; the UKRR holds a temporary exemption from the requirement to obtain individual patient consent to hold encrypted electronic data. This exemption is reviewed annually. Patients and their parents have the right to request that their identifiers are not submitted at the time of the annual data return. Posters explaining this option are displayed in each paediatric renal centre. Local teams have been advised that consent must be obtained from families of all patients cared for in centres submitting paper returns as the exemption does not apply in these circumstances. A full description of data handling, encryption, cleaning and the legal framework surrounding data storage can be read elsewhere [1].

Reporting and standardisation methods

The demographic variables collected were height, weight, systolic and diastolic blood pressure for all patients. The biochemical variables collected from all patients were haemoglobin, ferritin, creatinine, bicarbonate, cholesterol, triglycerides and urea. In children on dialysis, phosphate, calcium, PTH and albumin were also collected. Due to poor data completeness or non standardised analysis methods between centres the results described here are: (i) height, weight, BMI, systolic blood pressure, ferritin and haemoglobin for all ERF patients; (ii) phosphate and calcium in the dialysis cohort only.

The value of many clinical parameters varies with age and size in childhood. Therefore interpretation of individual values requires comparison with age or size related reference ranges and in this report such data is presented as a z-score. Z-scores are used to express the distance away from the population mean with a z-score of −1.0 being 1 standard deviation below the mean. The 90th percentile is 1.280 SD, the 95th percentile is 1.645 SD and the 99th percentile is 2.326 SD above the mean.

Anthropometry

The reference range for height (Ht), weight (Wt) and body mass index (BMI) in childhood varies with gender and age. BMI was calculated using the formula BMI = Wt (kg)/Ht $(m)^2$. Height, weight and BMI were all adjusted for age and z-scores were calculated based on the British 1990 reference data for height and weight [2].

Blood pressure (BP)

The reference range for blood pressure varies with gender, age and height. The data is therefore presented as z-scores based on data from the Fourth report of the National High Blood Pressure Education Programme (NHBPEP) working group in the United States [3].

Laboratory values

Haemoglobin (Hb), ferritin (Ferr), calcium (Ca) and phosphate (Phos) were analysed using age related laboratory reference ranges as in table 15.2.

Data analysis is presented for each centre individually and at a national level for each variable.

Statistical analysis

Data were analysed to calculate summary statistics (maximum, minimum, mean and median values in addition to standard deviation and quartile ranges). Where applicable the percentage achieving the audit standard was also calculated. Patients without data were excluded from that analysis. Funnel plot analysis was used to identify 'outlying centres' as described previously [4]. Individual centres were plotted with their achieved percentage for a given audit standard against their centre size along with the upper and lower 95% and 99.9% limits. Centres in each funnel plot can be identified by cross-referencing the number of patients with data and the proportion of patients achieving the audit measure from the relevant table. Centres with less than 10 patients were excluded from these plots but all patients were included in calculating the national mean and in any other analyses.

Longitudinal analyses of attainment of standards over time were also performed. This was based on a single data point per ERF patient per year collected as described previously. Changing audit standards over time and variable data return for previous years encourages cautious interpretation of these analyses. All analyses were done using SAS 9.1.3.

Standards

Standards are from the Treatment of Adults and Children with Renal Failure, Renal Association 2002 guidelines unless otherwise stated [5].

Anthropometry

'Height and weight should be monitored at each clinic visit. Measures of supine length or standing head circumference should be measured during each visit up to two years of age and 6 monthly up to 5 years of age. All measurements should be plotted on European reference growth charts for healthy children.'

Blood Pressure

'Blood pressure varies throughout childhood and should be maintained within 2 standard deviations of the mean for normal children of the same height and sex.

Systolic blood pressure during PD or post-HD should be maintained at <90th percentile for age, gender and height.'

The analyses of blood pressure in this report present the achievement of blood pressures at or below the 95th and 90th percentiles.

Anaemia

Guidance on the management of anaemia in adults and children with chronic kidney disease was published by the National Institute for Clinical Excellence (NICE) in 2006 (Clinical Guideline 39) [6]. The recommendation in this guidance is that in children with chronic kidney disease, treatment should maintain stable haemoglobin levels between 10 and 12 g/dl in children below 2 years of age and between 10.5 and 12.5 g/dl in children above 2 years of age.

For the purposes of this report, the NICE standards have been adopted. The pragmatic decision to analyse haemoglobin levels in transplant patients according to the normal range for age as shown in table 15.2 was made. The target range for ferritin 200–500 µmol/L from NICE CG 39 has also been adopted [6]. The previous RA 2002 standards set a ferritin target range 100–800 µmol/L for patients on dialysis [5].

Phosphate and calcium

Phosphate and calcium should be kept within the normal range [5]. For analyses of calcium and phosphate the age related ranges given in table 15.2 have been used.

Results

Data completeness

Tables 15.3 to 15.6 show the completeness of data returns for transplant and dialysis patients for 2008 and the 1999–2008 period.

No data was submitted from Southampton in 2008 pending implementation of a bespoke renal IT system.

In tables 15.5 and 15.6, the 2008 bicarbonate data is incomplete because of problems with extraction of this data item from the renal IT systems. Therefore the

Table 15.3. Percentage data completeness for transplant patients by centre for each biochemical, blood pressure and growth variable and total number of patients per centre in 2008

Centre	Number of patients	% data completeness								
		Chol	Trigs	Ferritin	Hb	BP systolic	BP diastolic	Height	Weight	eGFR
Bham_P	48	52	2	4	100	100	98	100	100	100
Blfst_P	17	59	18	29	100	94	94	88	88	88
Brstl_P	36	61	14	42	97	81	81	97	97	94
Cardf_P	22	45	45	86	100	86	86	86	86	86
Glasg_P	46	59	35	46	100	100	100	96	100	96
Leeds_P	63	98	0	81	100	0	0	97	100	97
L Eve_P	69	64	28	87	100	99	96	97	99	97
LGOSH_P	102	2	2	25	99	88	5	92	93	92
Livpl_P	30	90	87	80	97	93	93	93	93	93
Manch_P	54	0	0	0	98	100	100	96	100	96
Newc_P	35	66	0	54	91	94	0	94	97	94
Nottm_P	69	1	1	81	100	90	90	87	88	87
UK	**594**	**43**	**14**	**51**	**99**	**84**	**63**	**94**	**96**	**94**

Table 15.4. Percentage data completeness for dialysis patients by centre for each biochemical variable and total number of patients per centre in 2008

Centre	Number of patients	% data completeness											
		Alb	Calcium	Chol	Trigs	Ferr	Hb	Phos	PTH	BP systolic	BP diastolic	Height	Weight
Bham_P	33	100	100	88	0	0	100	100	100	97	97	97	97
Blfst_P	14	100	100	21	14	86	100	100	100	100	100	86	100
Brstl_P	21	100	100	71	29	81	95	100	100	90	90	90	100
Cardf_P	8	100	100	38	38	100	100	100	88	100	75	75	88
Glasg_P	25	100	100	64	56	96	100	100	100	100	100	96	100
L Eve_P	14	93	93	14	14	86	100	93	86	71	14	86	86
Leeds_P	18	100	100	94	0	100	100	100	94	0	0	83	89
LGOSH_P	40	100	100	8	8	100	100	100	98	98	0	98	98
Livpl_P	9	89	89	89	89	89	100	89	89	89	89	78	100
Manch_P	30	100	97	0	0	83	97	97	83	73	63	73	73
Newc_P	6	67	83	17	0	50	83	83	50	67	0	67	67
Nottm_P	37	100	100	5	5	95	100	100	84	78	78	59	84
UK	**255**	**98**	**98**	**39**	**16**	**79**	**99**	**98**	**92**	**82**	**60**	**84**	**91**

Table 15.5. Data completeness for each variable for all transplant patients 1999–2008

Centre	Number of patients	% data completeness									
		Bic*	Chol	Trigs	Ferr	Hb	Creat	Systolic BP	Diastolic BP	Height	Weight
Bham_P	360	99	90	3	4	99	99	99	99	99	99
Blfst_P	120	76	41	5	34	100	100	95	94	94	94
Brstl_P	336	79	34	25	15	96	98	96	95	98	98
Cardf_P	149	99	44	44	62	100	100	93	92	90	93
Glasg_P	351	97	45	33	44	99	99	97	96	95	97
L Eve_P	593	98	53	43	50	99	99	98	90	95	98
Leeds_P	292	64	63	17	25	94	96	73	72	93	95
LGOSH_P	843	93	2	1	46	96	97	88	18	86	89
Livpl_P	269	99	65	63	46	99	99	99	99	96	98
Manch_P	633	96	8	7	2	99	100	98	95	98	99
Newc_P	209	93	62	8	28	98	100	97	0	96	98
Nottm_P	601	85	7	6	36	98	99	96	95	95	96
Soton_P	71	79	15	11	25	100	100	94	85	89	94
UK	**4,827**	**91**	**34**	**18**	**32**	**98**	**99**	**94**	**76**	**94**	**96**

* 1997–2007 data

Table 15.6. Data completeness for each variable and total number of dialysis patients in each centre from 1999–2008

Centre	Number of patients	Alb	Bic*	Ca	Chol	Trigs	Ferr	Hb	Creat	Phos	PTH	Systolic BP	Diastolic BP	Height	Weight
Blfst_P	62	97	37	98	26	8	61	100	98	97	94	95	95	90	100
Bham_P	224	100	97	100	91	1	13	100	100	100	97	98	98	99	99
Brstl_P	142	97	70	98	31	22	63	96	99	98	92	98	98	95	99
Cardf_P	26	100	38	100	69	69	88	100	100	100	81	96	85	88	96
L GOSH_P	275	95	79	99	2	2	82	99	100	97	68	92	13	86	94
Glasg_P	111	96	77	97	27	25	84	98	100	99	85	95	95	85	96
L Eve_P	93	97	89	82	3	3	78	98	99	97	94	88	62	84	96
Leeds_P	125	91	65	90	58	7	86	94	96	92	86	75	70	86	90
Livpl_P	73	96	81	96	66	67	85	99	100	96	81	97	84	85	100
Manch_P	209	91	98	97	3	2	71	98	100	97	79	87	51	89	90
Newc_P	68	96	88	99	53	21	84	99	99	99	90	96	0	93	96
Nottm_P	155	95	72	99	19	17	73	98	100	99	79	79	79	81	89
Soton_P	28	100	96	100	14	4	71	100	100	100	100	100	82	93	100
UK	**1,591**	**95**	**80**	**97**	**33**	**12**	**68**	**98**	**99**	**98**	**84**	**91**	**65**	**89**	**95**

* 1997–2007 data

completeness table for the 10 year period for bicarbonate only represents 1999–2007 inclusive. The lack of blood pressure data from Leeds in 2008 also seems likely to be the result of a problem in downloading the data from the renal IT system. This will also have had a negative impact on the figures for blood pressure from Leeds and from the UK as a whole in the 10 year tables. Completeness for many variables is good although there is clearly room for improvement in the reporting of lipids and ferritin (tables 15.3 to 15.6).

Height, weight and BMI

Figures 15.1, 15.4, 15.7 and 15.10 show that children receiving renal replacement therapy are short for their age. The height deficit is greater in children on dialysis than in those who have a functioning kidney transplant.

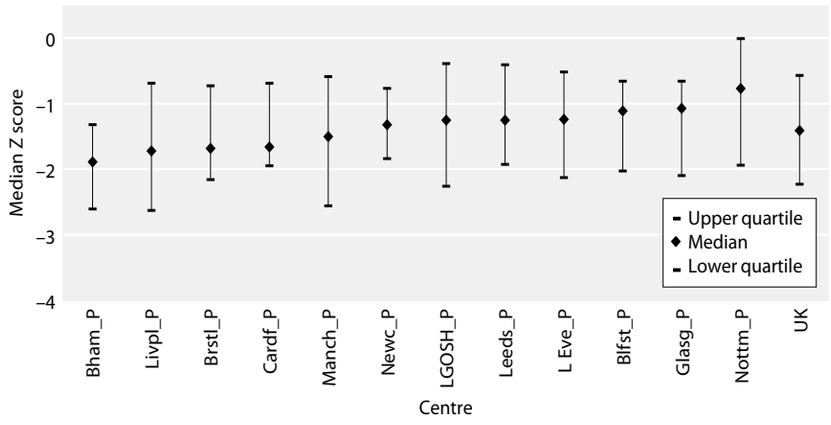

Fig. 15.1. Median height z-scores for transplant patients in 2008

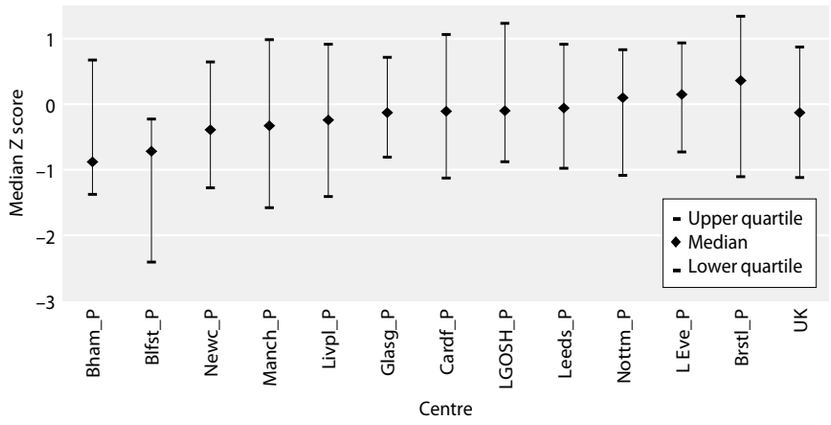

Fig. 15.2. Median weight z-scores for transplant patients in 2008

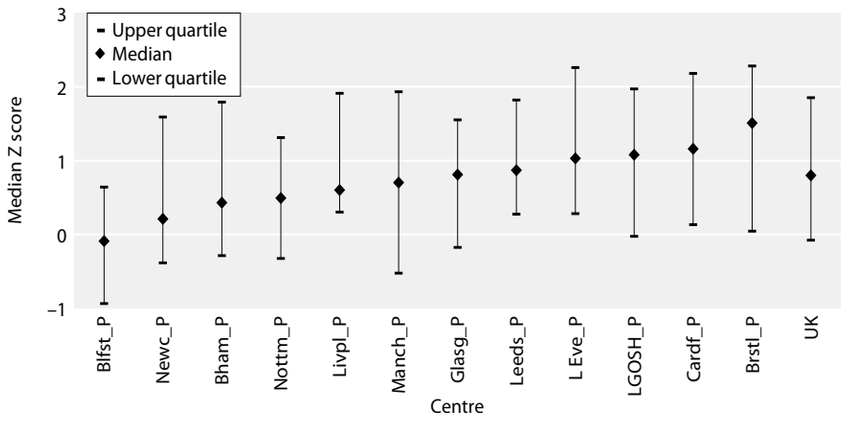

Fig. 15.3. Median BMI z-scores for transplant patients in 2008

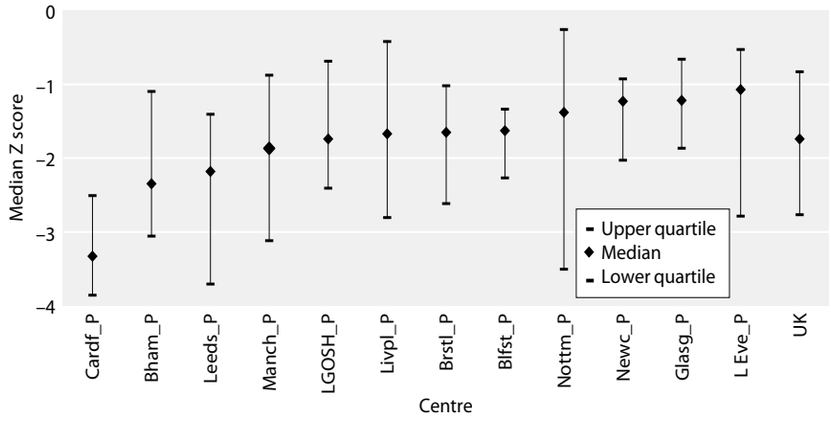

Fig. 15.4. Median height z-scores for dialysis patients in 2008

The height deficit remains unchanged over the last 10 years.

Children with a functioning kidney transplant have a normal weight (figures 15.2, 15.8). Those on dialysis have a weight below that of healthy children (figure 15.5). The variation in weight in dialysis patients seen over the last 10 years with an apparent falling trend from 2001 to 2006 and then an increase in 2007 and 2008 is difficult to explain (figure 15.11). Overall there has been no change in weight trends between 1999 and 2008 with z-scores for weight remaining between −1.0 and −1.5.

Body mass index in children with a functioning transplant in 2008 showed inter-centre variation with a median UK z-score of 0.8 (figure 15.3). Body mass index has remained stable over the period 1999–2008

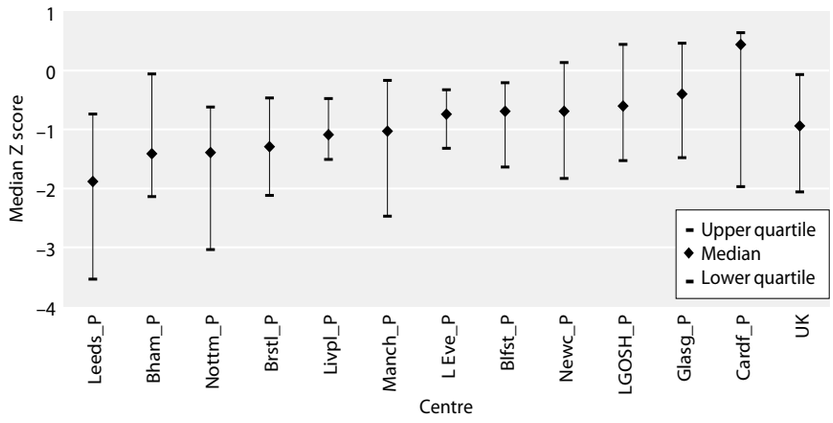

Fig. 15.5. Median weight z-scores for dialysis patients in 2008

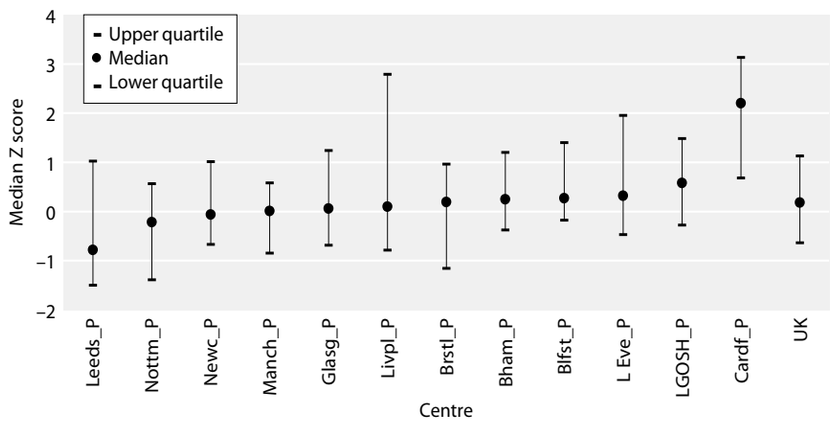

Fig. 15.6. Median BMI z-scores for dialysis patients in 2008

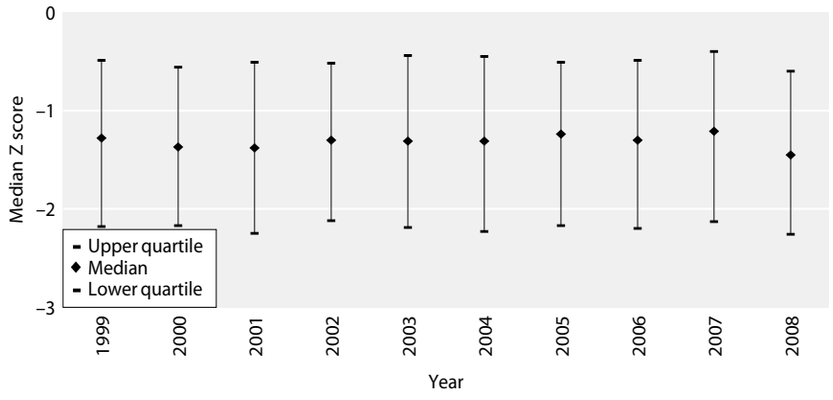

Fig. 15.7. Median height z-scores for all transplant patients from 1999–2008

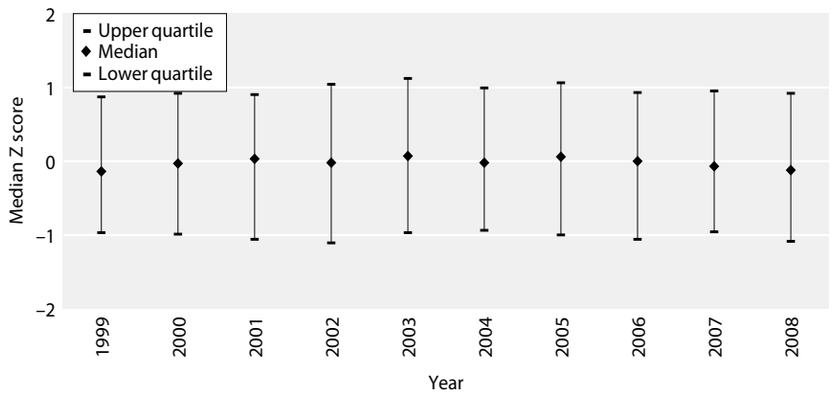

Fig. 15.8. Median weight z-scores for all transplant patients from 1999–2008

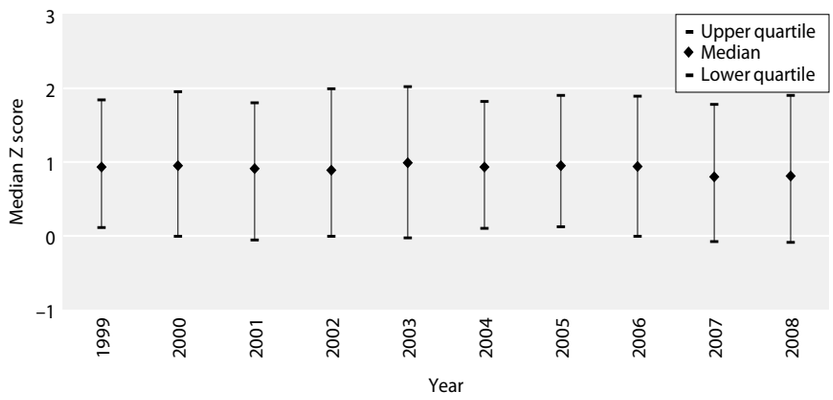

Fig. 15.9. Median BMI z-scores for all transplant patients from 1999–2008

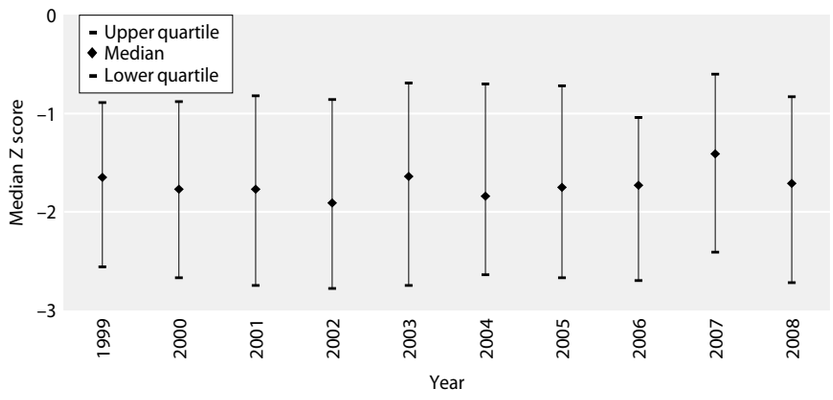

Fig. 15.10. Median height z-scores for all dialysis patients from 1999–2008

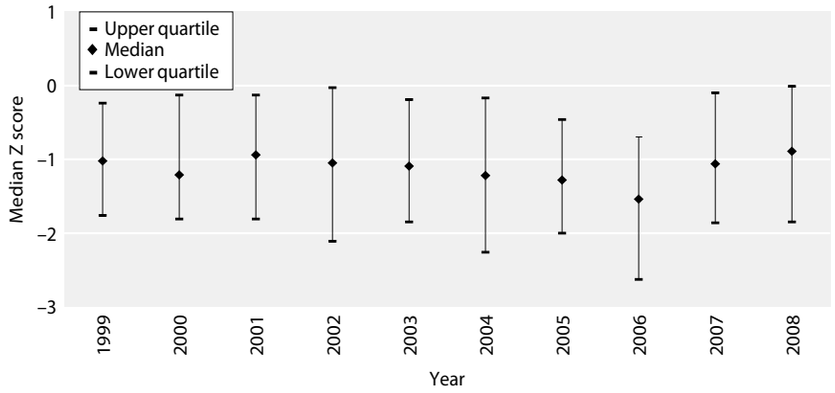

Fig. 15.11. Median weight z-scores for all dialysis patients from 1999–2008

in children with a functioning transplant (figure 15.9), with a median BMI z-score of 1.0. The most likely explanation for this is the short stature seen in this group. The trend of the standardised BMI in children on dialysis mirrors the change in weight (figure 15.12). This is to be expected since the formula for BMI has height and weight as its variables and height has remained unchanged. Over the whole period the standardised BMI in children on dialysis has remained close to zero (figure 15.12). This may suggest that the weight deficit is accounted for by a deficit in height. However a more detailed study is needed to determine whether this is true.

Blood pressure

Analyses of blood pressure management have shown that blood pressure is higher in children receiving renal replacement therapy than in healthy children (figures

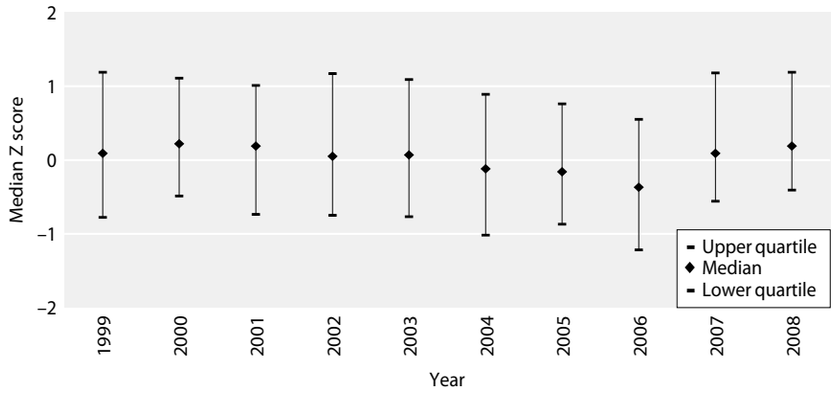

Fig. 15.12. Median BMI z-scores for all dialysis patients from 1999–2008

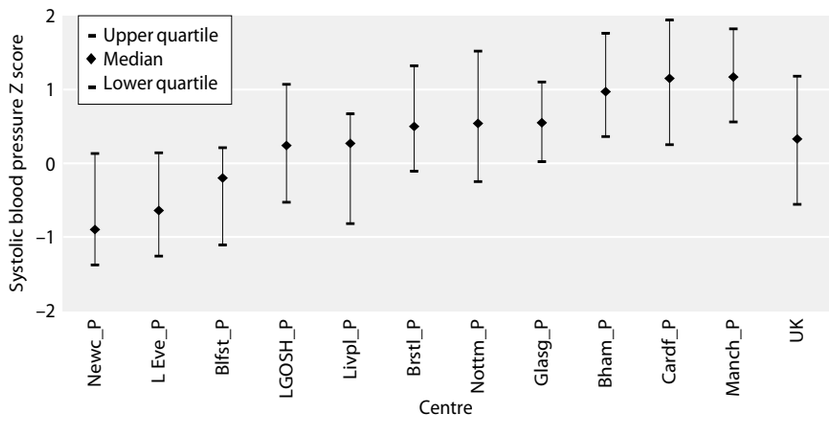

Fig. 15.13. Median systolic blood pressure z-scores for transplant patients in 2008
There were no blood pressure data available for transplant patients from Leeds

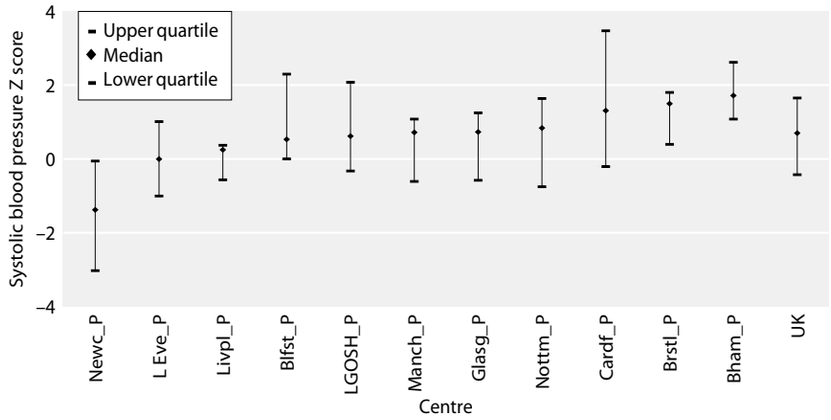

Fig. 15.14. Median systolic blood pressure z-scores for dialysis patients in 2008
There were no blood pressure data available for dialysis patients from Leeds

15.13–15.26). Children receiving dialysis have higher blood pressures than children with kidney transplants (table 15.7). In the UK as a whole in 2008, 75% of children on dialysis had a systolic BP <95th percentile and 67% had a systolic BP <90th percentile (table 15.7). For children with a functioning kidney transplant 85% had a systolic BP <95th percentile and 77% had a systolic BP <90th percentile (table 15.7). The funnel plot for achievement of systolic blood pressure standards in transplant patients showed no centres were achieving the audit standards in significantly fewer patients and one centre had significantly more patients achieving these standards (figures 15.17, 15.18 and table 15.7). The funnel plots for systolic blood pressure achievement

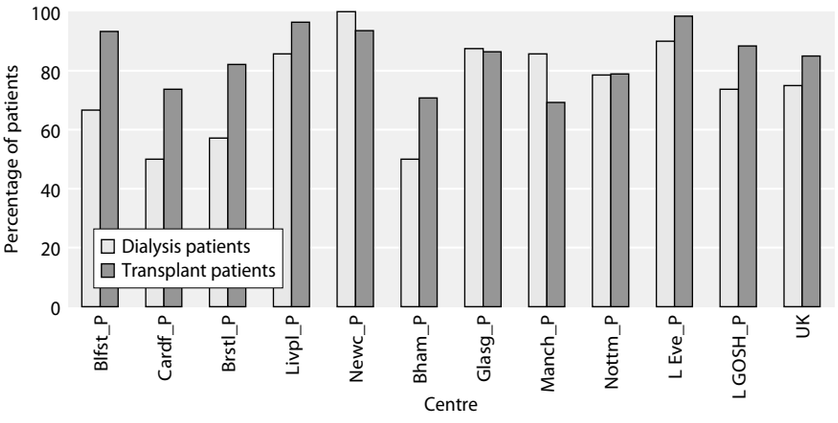

Fig. 15.15. Percentage of patients with systolic blood pressure below the 95th percentile in 2008

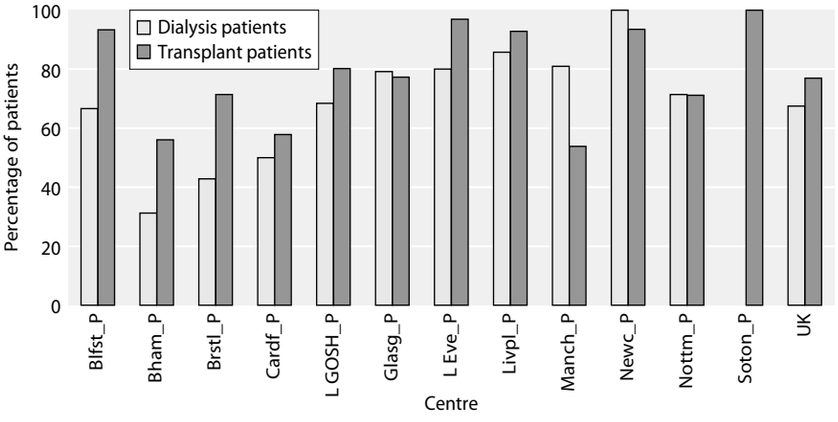

Fig. 15.16. Percentage of patients with systolic blood pressure below the 90th percentile in 2008

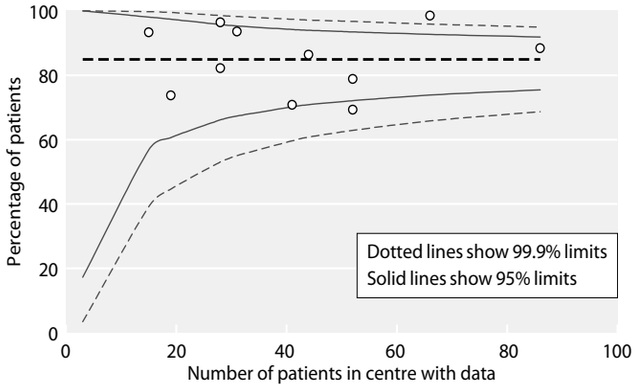

Fig. 15.17. Funnel plot of percentage of transplant patients achieving systolic blood pressure below 95th percentile in 2008

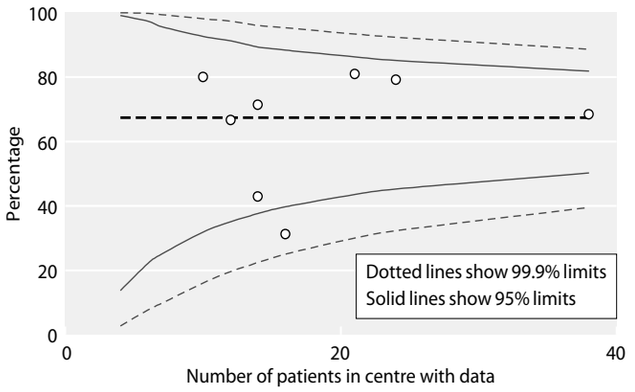

Fig. 15.20. Funnel plot of percentage of dialysis patients achieving a systolic blood pressure below the 90th percentile in 2008

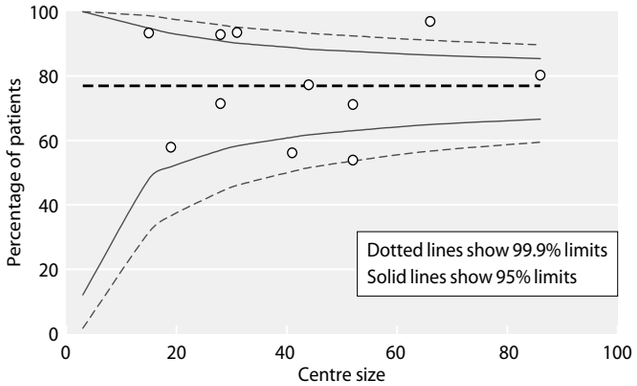

Fig. 15.18. Funnel plot of percentage of transplant patients achieving systolic blood pressure below the 90th percentile in 2008.

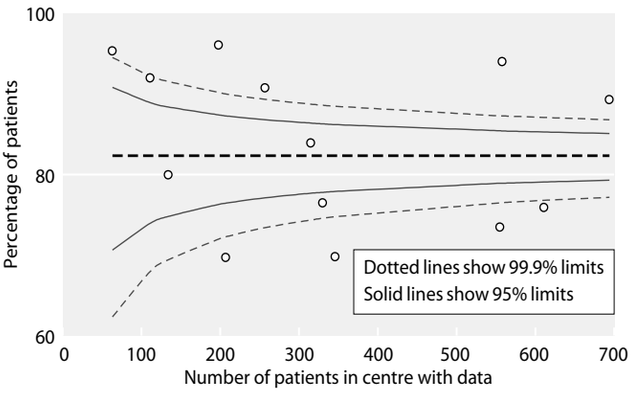

Fig. 15.21. Funnel plot of percentage of transplant patients achieving systolic blood pressure below the 95th percentile from 1999–2008

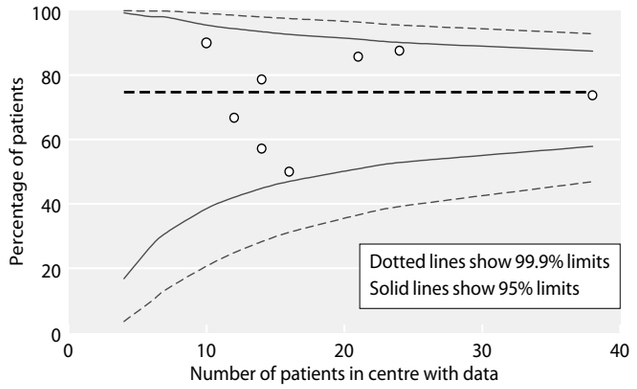

Fig. 15.19. Funnel plot of percentage of dialysis patients achieving a systolic blood pressure below the 95th percentile in 2008

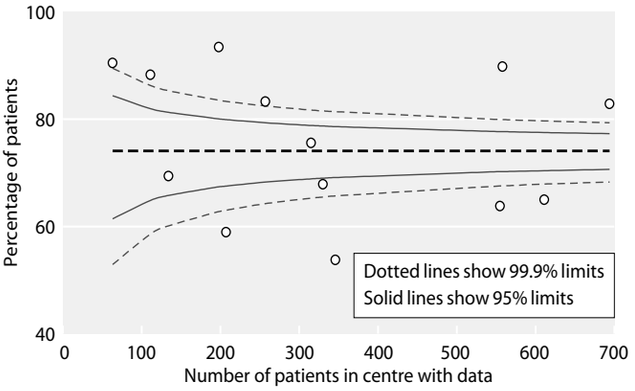

Fig. 15.22. Funnel plot of percentage of transplant patients achieving systolic blood pressure below the 90th percentile from 1999–2008

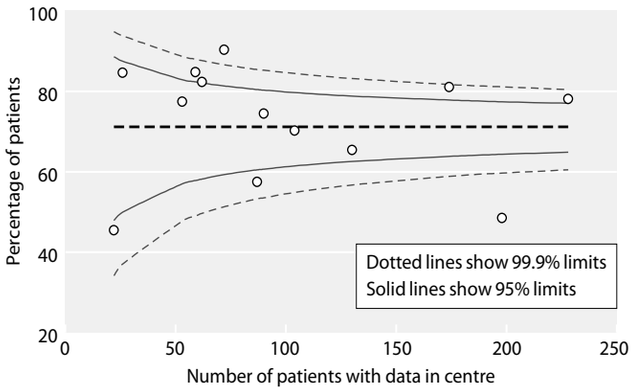

Fig. 15.23. Funnel plot of percentage of dialysis patients achieving systolic blood pressure below the 95th percentile from 1999–2008

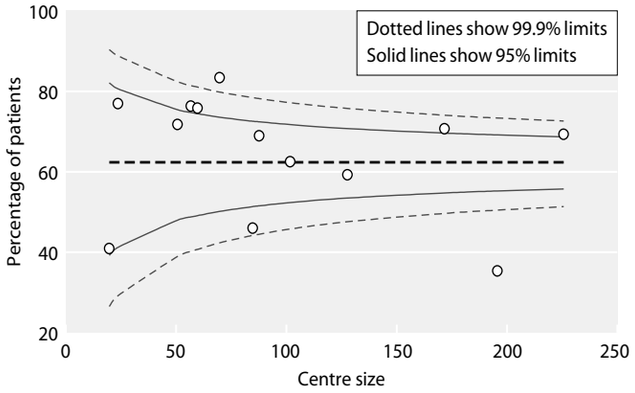

Fig. 15.24. Funnel plot of percentage of dialysis patients achieving systolic blood pressure below the 90th percentile from 1999–2008

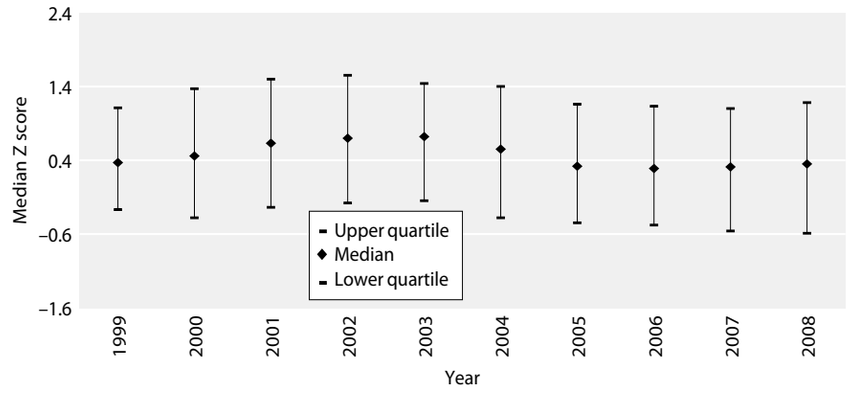

Fig. 15.25. Annual change in median systolic blood pressure z-scores for transplant patients from 1999–2008

in dialysis patients showed no centres had significantly fewer patients achieving the standard than the national average (figures 15.19, 15.20 and table 15.7).

Examination of the trends in systolic BP over time suggests that there has been little change in the median systolic BP of children receiving renal replacement therapy over the last ten years (figures 15.25 and 15.26). Over the period 1999–2008, 71% of children on dialysis had a systolic blood pressure below the 95th percentile and 62% below the 90th percentile (table 15.8). For children with a transplant, 82% had a systolic blood pressure below the 95th percentile and 74% below the 90th percentile (table 15.8). The funnel plots for achievement of systolic blood pressure standards from 1999–2008 for transplant patients show over dispersion of data points and makes interpretation difficult (figures

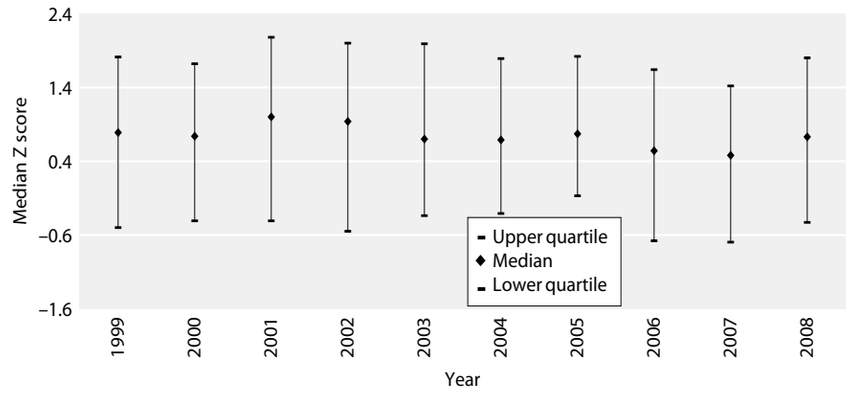

Fig. 15.26. Annual changes in median systolic blood pressure z-scores for dialysis patients from 1999–2008

Table 15.7. Percentage of patients achieving the standards for systolic blood pressure in 2008

	Transplant patients			Dialysis patients		
Centre	Number of patients with data	Below 95th percentile	Below 90th percentile	Number of patients with data	Below 95th percentile	Below 90th percentile
Blfst_P	15	93	93	12	67	67
Cardf_P	19	74	58	6	50	50
Brstl_P	28	82	71	14	57	43
Livpl_P	28	96	93	7	86	86
Newc_P	31	94	94	4	100	100
Bham_P	41	71	56	16	50	31
Glasg_P	44	86	77	24	88	79
Manch_P	52	69	54	21	86	81
Nottm_P	52	79	71	14	79	71
L Eve_P	66	98	97	10	90	80
L GOSH_P	86	88	80	38	74	68
UK	**465**	**85**	**77**	**166**	**75**	**67**

15.21, 15.22 and table 15.8). The funnel plots for achievement of systolic blood pressure standards from 1999–2008 for dialysis patients show one centre had significantly fewer patients achieving the standard (figures 15.23, 15.24 and table 15.8).

Haemoglobin

The analyses in this report show that many children receiving renal replacement therapy are anaemic. Forty-one percent (range 20–50%) of children on dialysis in UK achieve the haemoglobin standard (table 15.9) compared to those transplanted (UK average 50%, range 39–65%). In 2008, a proportion of dialysis patients achieved haemoglobins above the target range (UK average 27%, range 9–60%) (table 15.9), which may be clinically important, with increased morbidity and mortality having been described within adult patients. The funnel plots for 2008 demonstrate that there are no outlying centres (figures 15.27, 15.28 and table 15.9).

The funnel plots of data from 1999–2008 in transplant patients shows one centre is achieving the haemoglobin standard in significantly more patients. There are no outlying centres with respect to dialysis patients over this time period (figures 15.29, 15.30 and table 15.10).

The 10 year trend data suggests some improvement over time with regards to anaemia within the transplant population (figure 15.31) but little change within the dialysis population (figure 15.32).

Table 15.8. Percentage of patients achieving systolic blood pressure standards from 1999–2008

	Transplant patients			Dialysis patients		
Centre	Number of patients with data	Below 95th percentile	Below 90th percentile	Number of patients with data	Below 95th percentile	Below 90th percentile
Blfst_P	111	92	88	53	77	72
Cardf_P	134	80	69	22	45	41
Newc_P	198	96	93	62	82	76
Leeds_P	207	70	59	87	57	46
Livpl_P	257	91	83	59	85	76
Brstl_P	315	84	76	130	65	59
Glasg_P	330	76	68	90	74	69
Bham_P	346	70	54	198	48	35
Nottm_P	555	73	64	104	70	63
L Eve_P	558	94	90	72	90	83
Manch_P	611	76	65	174	81	71
LGOSH_P	694	89	83	228	78	69
UK	**4,379**	**82**	**74**	**1,305**	**71**	**62**

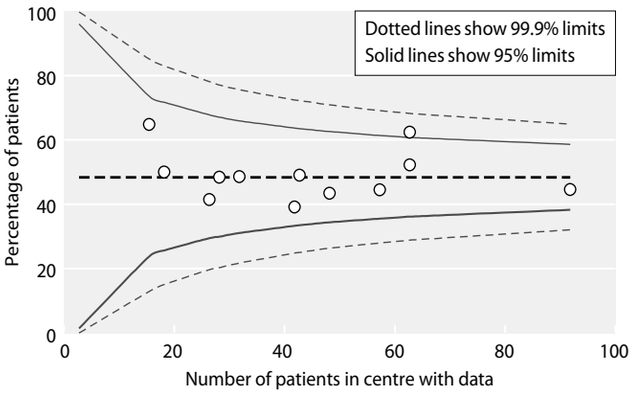

Fig. 15.27. Funnel plot of percentage of transplant patients achieving the haemoglobin standard in 2008

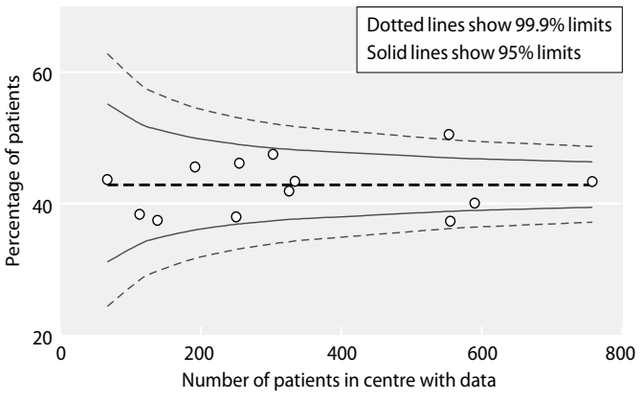

Fig. 15.29. Funnel plot of percentage of transplant patients achieving the haemoglobin standard from 1999–2008

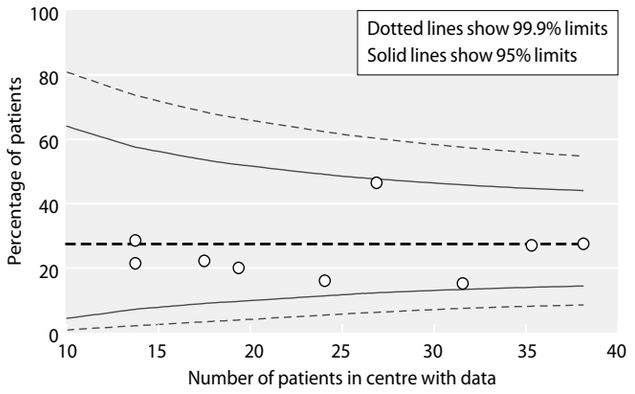

Fig. 15.28. Funnel plot of percentage of dialysis patients achieving the haemoglobin standard achievement in 2008

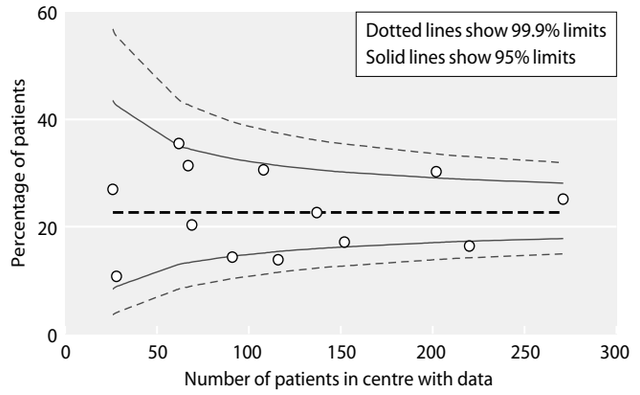

Fig. 15.30. Funnel plot of percentage of dialysis patients achieving the haemoglobin standard from 1999–2008

Table 15.9. Percentage of patients achieving the haemoglobin standard in 2008

	Transplant patients				Dialysis patients			
Centre	Number of patients with data	% achieving standard	% lower than standard	Centre	Number of patients with data	% achieving standard	% lower than standard	% above standard
Blfst_P	17	65	35	Newc_P	5	20	20	60
Cardf_P	20	50	45	Cardf_P	8	50	0	50
Livpl_P	29	41	59	Livpl_P	9	44	33	22
Newc_P	31	48	45	Blfst_P	14	50	14	36
Brstl_P	35	49	51	L Eve_P	14	50	21	29
Glasg_P	46	39	61	Leeds_P	18	28	50	22
Bham_P	47	49	49	Brstl_P	20	35	40	25
Manch_P	53	43	57	Glasg_P	25	48	32	20
Leeds_P	63	44	56	Manch_P	28	46	14	39
L Eve_P	69	62	36	Bham_P	33	39	52	9
Nottm_P	69	52	45	Nottm_P	37	30	38	32
LGOSH_P	101	45	54	LGOSH_P	40	45	28	28
UK	**581**	**50**	**50**	**UK**	**251**	**41**	**32**	**27**

Table 15.10. Percentage of patients achieving the haemoglobin standard from 1999–2008

	Transplant patients			Dialysis patients			
Centre	Number of patients in centre with data	% achieving standard for Hb	Centre	Number of patients incentre with data	% achieving standard for Hb	% above standard	% below standard
Soton	71	44	Cardf_P	26	35	23	42
Blfst_P	120	38	Soton	28	57	0	43
Cardf_P	147	37	Blfst_P	62	50	31	19
Newc_P	204	46	Newc_P	67	48	28	24
Livpl_P	266	38	Livpl_P	69	45	14	41
Leeds_P	271	46	L Eve_P	91	59	12	29
Brstl_P	322	48	Glasg_P	108	45	27	28
Glasg_P	346	42	Leeds_P	116	34	9	57
Bham_P	355	43	Brstl_P	137	45	17	39
Nottm_P	588	51	Nottm_P	152	41	20	39
L Eve_P	590	37	Manch_P	202	41	26	34
Manch_P	627	40	Bham_P	220	34	12	54
L GOSH_P	805	43	L GOSH_P	271	38	22	40
UK	**4,641**	**44**	**UK**	**1,521**	**42**	**19**	**40**

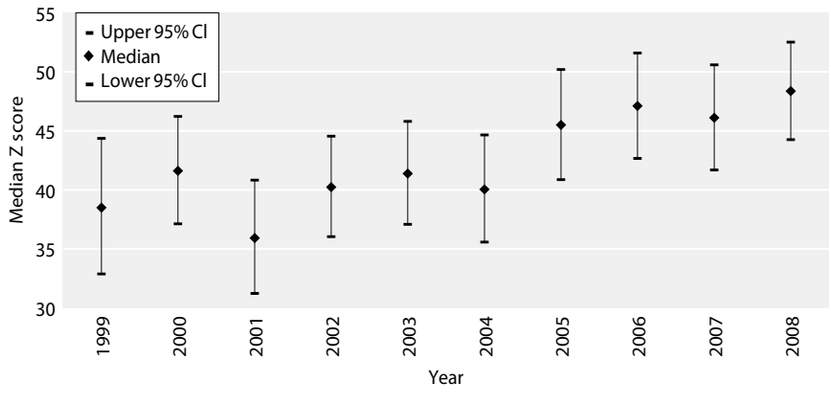

Fig. 15.31. Annual change in percentage of transplant patients achieving the haemoglobin standard

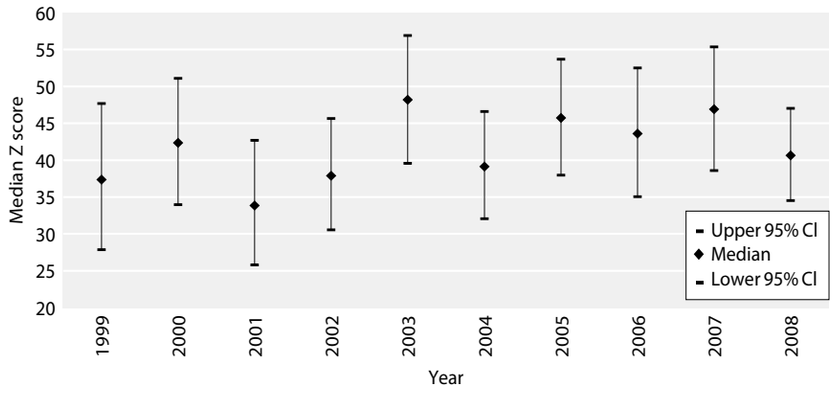

Fig. 15.32 Annual change in percentage of dialysis patients achieving the haemoglobin standard

Ferritin concentrations show a small improvement in dialysis patients over 10 years (figure 15.34), although only a minority of patients have concentrations within the target range (data not shown). There is little change in the transplant population (figure 15.33).

Calcium and phosphate

Difficulties arising from data completeness and the challenges presented by the varying laboratory assays used to measure PTH have limited the analyses of bone biochemistry to analyses of concentrations of calcium and phosphate in children on dialysis.

In 2008 in the UK as a whole, 50% had a phosphate within the target range with 10% below this range and 40% above (table 15.12). The achievement of the standard for calcium was better with 73% of children on dialysis having a calcium level within the target range, 6% below and 20% above (table 15.11). The funnel plot for the achievement of the adjusted calcium standard by children on dialysis showed one centre had a significantly greater percentage of children achieving

Table 15.11. Achievement of the adjusted calcium standard in dialysis patients in 2008

Centre	Number in centre with data	% below standard	% achieving standard	% above standard
Blfst_P	14	0	71	29
Bham_P	33	3	70	27
Brstl_P	21	5	76	19
Cardf_P	8	25	75	0
L GOSH_P	40	3	75	23
Glasg_P	25	8	72	20
L Eve_P	13	0	100	0
Leeds_P	18	11	78	11
Livpl_P	8	0	88	13
Manch_P	28	18	71	11
Newc_P	5	0	20	80
Nottm_P	37	5	68	27
UK	**250**	**6**	**73**	**20**

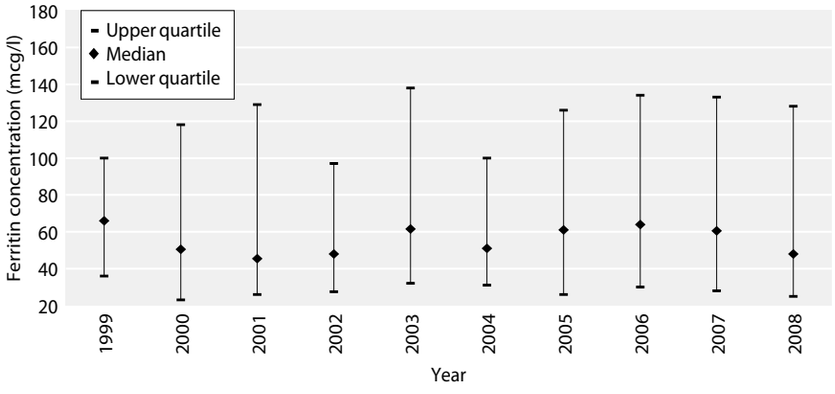

Fig. 15.33. Annual change in median ferritin concentration in transplant patients

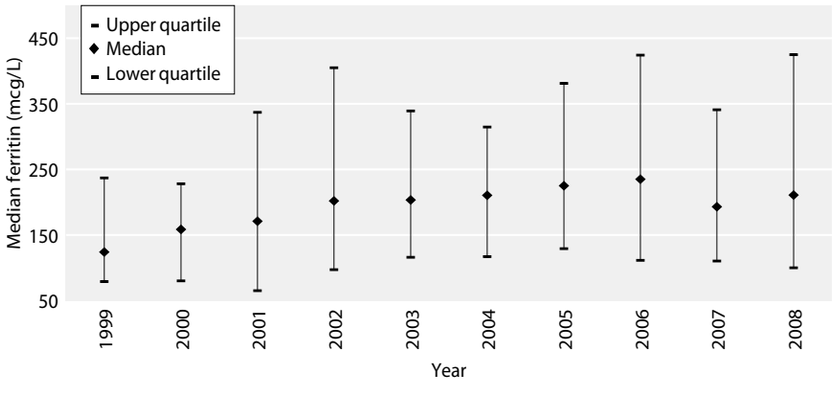

Fig. 15.34. Annual change in median ferritin concentration in dialysis patients

Table 15.12. Achievement of the phosphate standard in dialysis patients in 2008

Centre	Number in centre with data	% below standard	% achieving standard	% above standard
Blfst_P	14	14	50	36
Bham_P	33	6	45	48
Brstl_P	21	24	38	38
Cardf_P	8	38	25	38
L GOSH_P	40	20	58	23
Glasg_P	25	0	48	52
L Eve_P	13	8	85	8
Leeds_P	18	0	56	44
Livpl_P	8	13	25	63
Manch_P	28	0	50	50
Newc_P	5	20	40	40
Nottm_P	37	3	54	43
UK	**250**	**10**	**50**	**40**

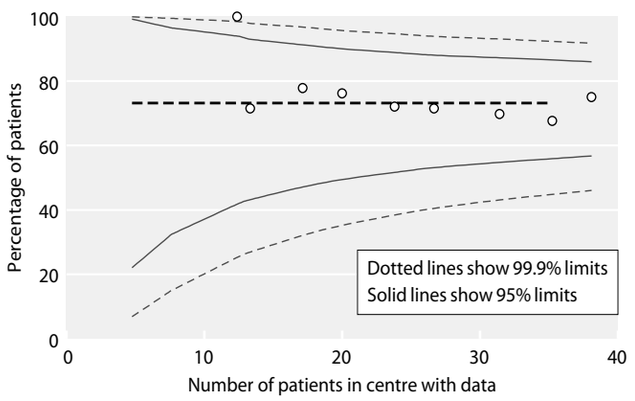

Fig. 15.35. Funnel plot of the percentage of dialysis patients achieving the standard for adjusted calcium in 2008

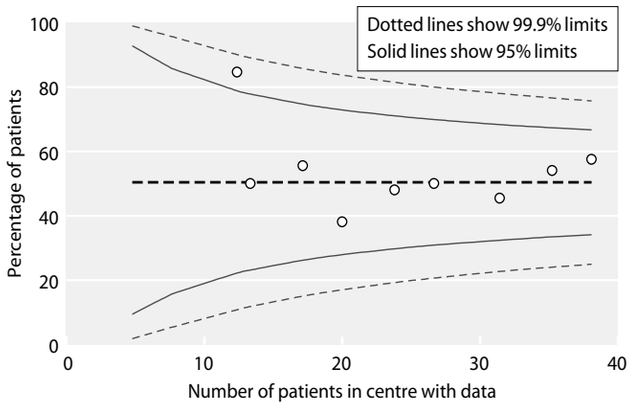

Fig. 15.36. Funnel plot of the percentage of dialysis patients achieving the standard for phosphate in 2008

this standard compared to the national average (figure 15.35 and table 15.11).

The funnel plot for achievement of the phosphate standard shows no outlying centres (figure 15.36 and table 15.12).

Discussion

The relocation of the BAPN Registry database to the UKRR in Bristol and the involvement of colleagues in the UKRR with the production of the paediatric report is a welcome development which will provide the opportunity for increasingly sophisticated analyses of the paediatric data in the future. In this year's report centre specific data is provided so that each clinical team can reflect on the contribution that their data makes to the national picture. The methods established by the UKRR to provide a measure of 'centre performance' have been used. However centres providing data on less than 10 cases have been excluded from the funnel plots. The challenge now is to find meaningful ways to include the data from the smallest centres. In this period of transition with the changes to the reporting routines, unsurprisingly some difficulties were encountered: the failure of extraction of data on bicarbonate from the renal IT systems and the blood pressure data from Leeds being two examples. It is hoped that these problems will be resolved prior to the next report. This is the first report in which analyses of data completeness from paediatric centres have been published. Although unlikely, it is possible that data returns from some centres have not included all patients with ERF during a particular year, if so we believe this is likely to represent a minority of patients at any centre and as such unlikely to influence the average results for that centre. For the UK as a whole the completeness figures in 2008 are similar to or better than the 10 year period for transplant patients with the exception of the blood pressure data for the reasons explained. The completeness figures for dialysis patients were slightly less good in 2008 compared with the ten year period for height 84% compared with 89%, weight 91% compared with 95% and systolic blood pressure 82% compared with 91%. For all other variables the completeness was similar or improved in the 2008 data. The reasons for poorer completeness of some variables in dialysis patients but not transplant patients in 2008 are not clear.

Reporting of paediatric data items to the UKRR was made mandatory in May 2009. Trusts will therefore need to ensure that systems are in place to support the paediatric units to undertake this task. The provision of renal IT support is improving in paediatric centres but is not yet universal.

Anthropometry

The present report shows data on height indicating that short stature remains common in children with ERF. Growth is influenced by many factors including genetic background, nutrition, cause and duration of renal failure as well as aspects of renal failure management for example dialysis dose, nutritional support and use of growth hormone. The assessment and management of poor growth is therefore complex. Centre specific data should therefore be interpreted with caution. The 9th Report of the UKRR (2006) [7] presented data on height and the use of growth hormone in children with ERF in the UK showing that although many children are short compared to healthy children of the same age a minority are treated with growth hormone. To date there are no standards set for BMI in children with chronic kidney disease. The definitions used for children in the NICE clinical guideline on Obesity CG43 published in 2008 [8] are as follows: ***overweight is a BMI greater than or equal to the 85th percentile and obesity is a BMI greater than or equal to the 95th percentile.*** No accepted threshold for underweight has been published for the UK national BMI percentile classification. Establishing a definition of underweight in children with ERF would be of benefit for future audit.

Blood pressure

Increasing numbers of children with ERF are now surviving through childhood. However, heart disease is a major cause of death in young adults with ERF, with the overall risk of cardiac death shown to be about 700-times higher than an age-matched individual from the normal population [11]. The overall restoration of renal function by transplantation reduces but does not eliminate this increased risk. Hypertension is a major cardiovascular risk factor in ERF and is found in 50–70% of children on chronic dialysis and after renal transplantation [9–11]. In transplant patients uncontrolled hypertension adds to the risk of early graft failure [12].

This report highlights significantly lower rates of hypertension in ERF patients in the UK (when compared with other paediatric national registry reports) at 25% in 2008 and 29% over the last 10-years for dialysis patients and 15% in 2008 and 18% over the last 10-years for transplant patients. Similarly, these prevalence rates are significantly lower than that reported for adult patients with ERF [13]. The results from a recent national audit of the BAPN on the management of hypertension in children post transplantation present some further data regarding this issue [14].

In high risk groups such as those with ERF, there is a need to consider lowering blood pressure below current standards in keeping with recommendations for adult patients with renal disease [15]. The results of the recently reported multi-centre study in children with pre-dialysis chronic kidney disease, the ESCAPE study, provides first evidence of benefits of better BP control in children [16]. Therefore the level of blood pressure control in our ERF patients at both the 95th and 90th percentile reported here is in keeping with these trends.

It is important to highlight that there are several limitations to the interpretation of blood pressure data reported. Firstly, there was no uniform methodology in the measurement of BP across different centres as BP was measured by different observers at each centre, using different instruments whilst patients received routine clinical care. Secondly, in dialysis patients because of smaller numbers no distinction was made between patients receiving peritoneal dialysis and haemodialysis. Thirdly, for haemodialysis patients the BP measurements presented here may be a combination of both pre-dialysis and post-dialysis measurements.

Despite these limitations these data highlight the variability of blood pressure control across centres in the UK and hopefully will provide a stimulus for improved data returns to develop more meaningful analyses in the future.

Anaemia

In the context of chronic kidney disease, anaemia has long been associated with reduced quality of life, exercise capacity, cognitive skills, renal and cardiac function, increased hospitalisation and reduced survival on dialysis [17, 18]. It is increasingly recognised as an important issue in transplanted patients, with the same outcomes applying.

A report on aspects of the management of anaemia in children was presented in the 9th Report of the UKRR (2006) [19]. At the time, the clinical practice guidelines for the management of adults and children with ERF [5] gave targets for haemoglobin as follows: children

under 6 months of age Hb $\geqslant$9.5 g/dl, children between 6 months and two years of age Hb $\geqslant$10 g/dl, children above 2 years of age Hb $\geqslant$10.5 g/dl.

This report has demonstrated continued significant levels of anaemia within the dialysis population (UK average of 32% achieving haemoglobin targets (table 15.9)), with no significant inter-centre variation, and that these levels appear to have remained unchanged over the 10 year-period described. The NICE guidelines [6] have introduced an upper limit for stable Hb as well as increasing the lower limit for the younger children. This may account in part for the fact that only 41% of the patients have haemoglobin concentrations within the target range.

The use of intravenous iron and erythropoiesis stimulating agents (ESA) contribute to the management of anaemia and other factors such as hyperparathyroidism may have an impact. The influence of these cannot be determined but there is an aim to address this in future.

Although following successful renal transplantation, some correction of anaemia occurs via endogenous production of ESAs, a significant proportion of patients continue to remain anaemic. Factors that may contribute to this include impaired renal allograft function, myelosuppressive immunosuppressants and other medication such as angiotensin converting enzyme inhibitors.

This report demonstrates anaemia in the transplanted population with only 50% of patients in the UK having haemoglobin concentrations below the normal range for age despite recent improvements (table 15.9). A national audit of the investigation and management of anaemia in children receiving renal replacement therapy may identify contributory factors to the development of anaemia and start to answer some of the questions raised.

Biochemistry

Increasing importance has been placed on the management of calcium and phosphate in children with ERF since the recognition of the association between vascular calcification and the bone mineral disorder of chronic kidney disease [20, 21]. A high serum phosphorus concentration is the risk factor most strongly associated with vascular calcification and mortality. Despite this, in the UK as a whole only 50% of children on dialysis have a serum phosphate within the normal range. It is important that the reasons for the apparent centre variation in achieving the target are understood. It is hoped that future reports will include analyses of lipids, bicarbonate and PTH as well as calcium and phosphate.

Lipids could not be analysed due to insufficient data. It is acknowledged that there are no accepted standards for management of dyslipidaemia in children receiving renal replacement therapy but since cardiovascular events are a major cause of morbidity and mortality the results are presented and related to NICE guidance on the management of familial hypercholesterolaemia [22]. It is hoped that this will be possible in subsequent reports and that the data will help to inform a discussion about standard development for future audit.

Provision of centre specific data and comparison of data to audit standards are new features of the paediatric registry report. It is hoped that this information will provide a basis for discussion and a stimulus to improve the care of children with ERF.

Acknowledgements

Regular readers of the paediatric chapters in the UKRR report will appreciate the huge amount of work that Jo Shaw has done for the paediatric registry in the past and the BAPN would wish to join them in thanking her. The BAPN would also like to thank Dr Malcolm Lewis for his immense contribution over the last thirteen years and for his continued commitment to the paediatric registry committee. Many other colleagues in paediatric centres across the UK and at the UKRR have worked to enable the production of this report and again the BAPN would like to express our appreciation.

Conflict of interest: none

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Chapter 16
International Comparisons with the UK RRT Programme

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Key Words
Acceptance rates · Dialysis · End stage renal disease · End stage renal failure · Haemodialysis · Incidence · International comparison · Peritoneal dialysis · Renal Registry · Renal replacement therapy · Transplantation

Abstract
Background: International comparisons between renal registries are important to highlight epidemiological and practice differences in RRT provision between countries. This report aims to compare the rates of RRT incidence and prevalence in the UK with a number of different countries. ***Methods:*** Data from 19 countries or regions between 2003 and 2007 from four international renal registries were analysed. Rates of RRT incidence, prevalence, transplantation and dialysis modality were compared. A crude mortality rate for each country was calculated. ***Results:*** Despite continued growth, the UK ranked 16th highest in incidence rate and 15th in prevalence rate in 2007. This may partly be related to successful primary care preventing stage 5 CKD. The UK had the 8th fastest rate of increase in RRT prevalence of 18 countries (4.2%/year). The age profile of UK RRT patients was comparable with other countries. The UK had the 6th highest use of home dialysis therapies. The UK has the 8th highest incidence and 9th highest prevalence rate of kidney transplantation of 16 countries. ***Conclusion:*** Meeting the growing demand for RRT is a problem for all countries that choose to offer it. The UK continues to provide for growth in demand for RRT.

Introduction

The number of patients receiving renal replacement therapy worldwide has been rising on an annual basis. It has previously been recognised that there is marked international variation in the rates of incident and prevalent RRT patients, as well as rates of transplantation. The recognition of this variation, by the comparison of results of a number of national renal registries, has generated hypotheses for a number of studies to investigate the underlying reasons behind the observed variation in practice [1–3].

The aim of this chapter is to compare epidemiological factors relating to the provision of renal replacement therapy across a number of different countries representing a spectrum of economic, cultural and geographic backgrounds.

Methods

Data used in this chapter are from National and International registries, specifically:

- The United Kingdom Renal Registry (UKRR)
  - *http://www.renalreg.org*
- The United States Renal Data System (USRDS)
  - *http://www.usrds.org/2008/view/esrd_12.asp*
- The European Dialysis and Transplant Association/European Renal Association (EDTA/ERA)
  - *http://www.era-edta-reg.org/index.jsp?p=annrep*
- The Australian and New Zealand renal database (ANZDATA)
  - *http://www.anzdata.org.au/v1/index.html*

All of the collated and summarised unadjusted data are published and in the public domain. Links to the reports are cited above.

The USRDS has well defined data specification in its collection forms. It is thus in the best position to collate a large amount of information from countries and registries across the world. The ERA/EDTA undertakes a similar exercise for many European countries, and the ANZDATA registry provides very comprehensive data for the Australia/New Zealand population. Whilst other detailed audit data, such as that collected by iDOPPS, are undoubtedly important in drawing international comparisons and provoking discussion, they were not included in the analyses.

The analyses concentrate on the basic demographics of RRT, to highlight the position of the UK in providing this treatment, and to describe the evolving size and practice patterns in the use of RRT globally. These analyses have principally used some of the well defined and organised unadjusted data supplied from around the world to the USRDS for the years 2003 to 2007. For the sake of clarity, data are not shown for all countries in the USRDS report. Instead, 19 countries or regions were selected that represent a spread of global geography, culture and economies.

The only deviation from the USRDS report data is for the UK analysis. This is currently reported in the USRDS as two parts – England/Wales/Northern Ireland as one group and Scotland as another. For this chapter the UK is defined as it should be with the raw data combined.

Limitations of methods

These have been well described in iterations of this chapter in previous reports. Complete congruence of data definitions, timeline events and even the age ranges reported is challenging. There is now much more agreement than before, and the specification of the USRDS data collection form has gone some way to help achieve this. The data used here is for countries that submitted complete data for the period 2003–2007 enabling analysis of trends across the globe over the 5 year period.

Results

Incidence of RRT

The incidence of patients starting RRT gives an indication of the immediate demand for treatment. Increasing incidence and/or better survival of prevalent patients is what drives the annual increases in the number of patients receiving treatment.

The median incidence of these selected countries in 2007 was 136 pmp. The incidence of new patients starting RRT varied from 13 pmp (Bangladesh) to 415 pmp (Taiwan). The UK ranked 4th lowest amongst the countries studied at 109 pmp (figure 16.1). The median annual increase in RRT incidence was 3.5% per annum. Some countries (New Zealand, Finland and

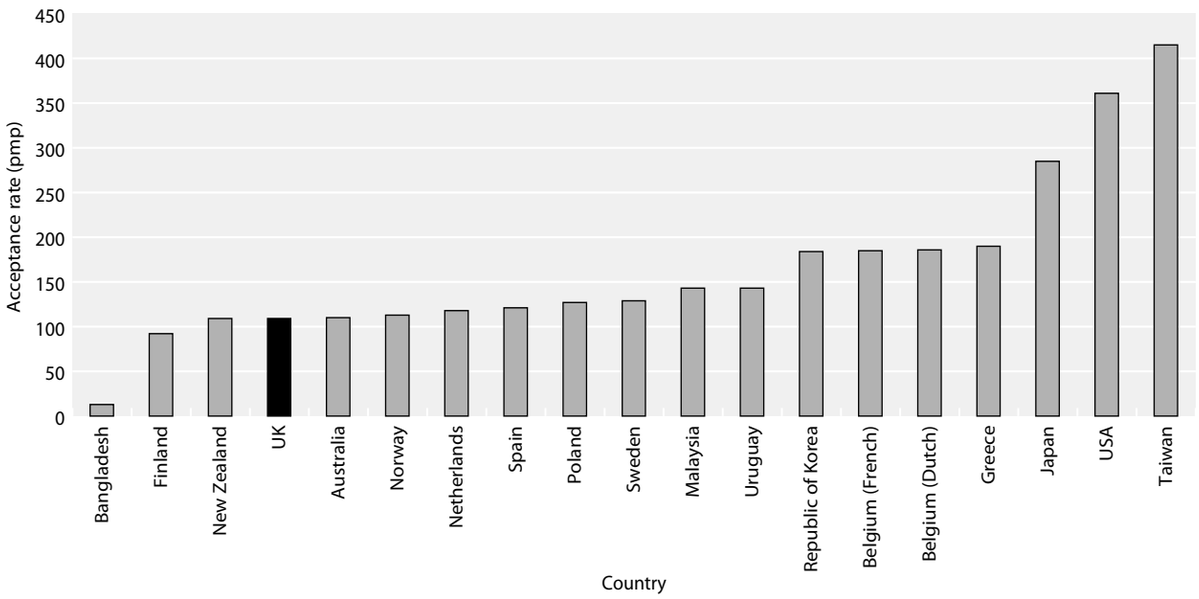

Fig. 16.1. Annual RRT acceptance rate (pmp) by country in 2007

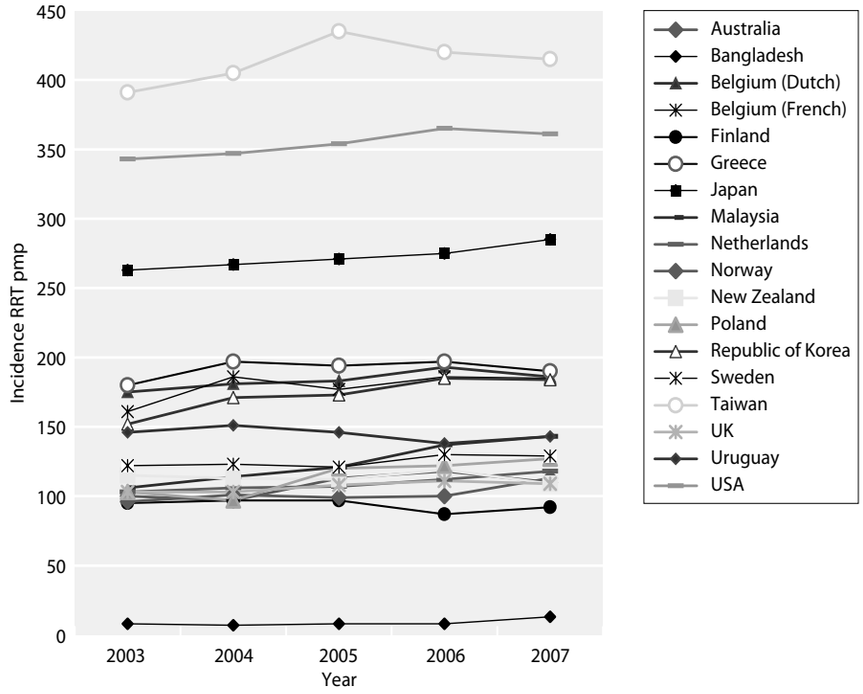

Fig. 16.2. Incidence of RRT between 2003 and 2007

Uruguay) even showed a fall in their incidence rates (figures 16.2 and 16.3).

Prevalence of RRT

The prevalence of RRT is the principal determinant of the need for resource and funding required to treat severe kidney disease. Planning for the future using accurate past data to generate forecast models is now a cornerstone in providing adequate capacity to treat growing numbers of patients. The point prevalence of the selected countries at the end of 2007 varied over 20 fold (Bangladesh 99 pmp v. Taiwan 2,288 pmp). The UK (746 pmp) ranked 15th highest of the 19 countries included (figure 16.4). Three countries (USA, Taiwan and Japan) had considerably higher prevalence than others, whilst Bangladesh had the lowest in this cohort (figure 16.5).

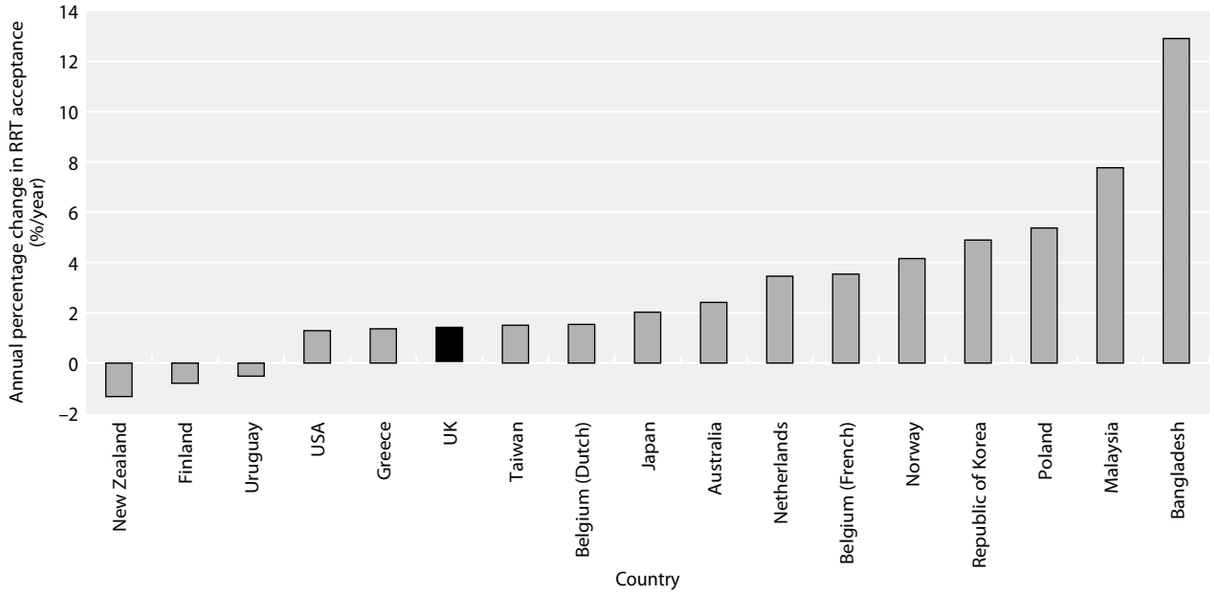

Fig. 16.3. Annual percentage change in RRT acceptance rate between 2003 and 2007

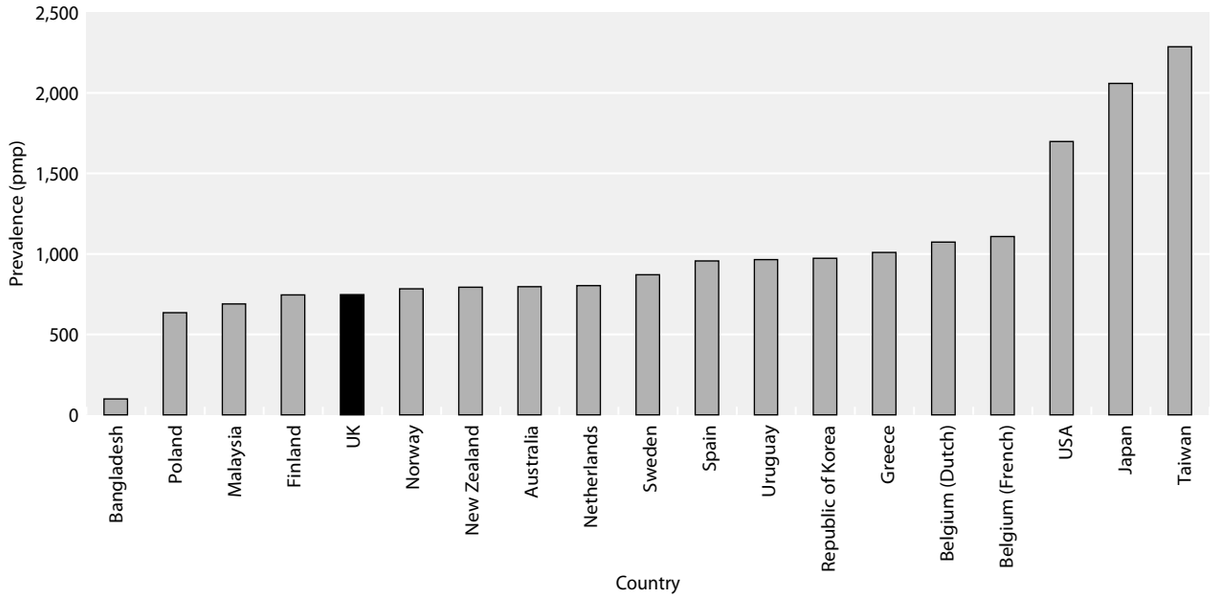

Fig. 16.4. Prevalence of RRT (pmp) by country in 2007

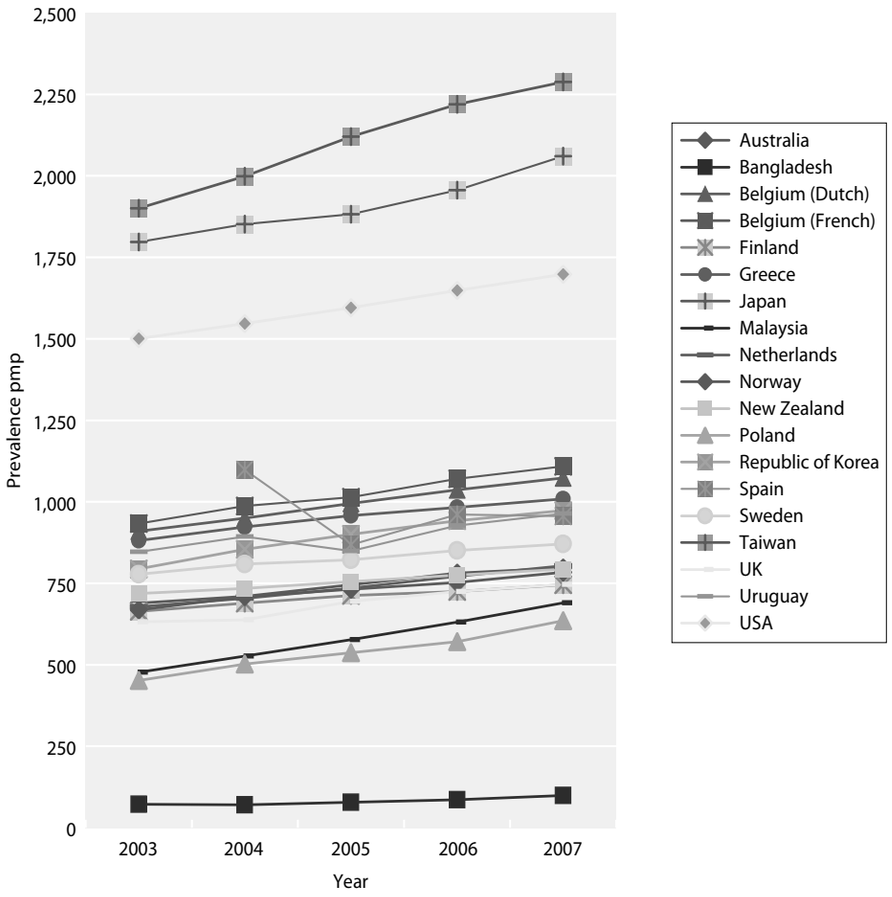

Fig. 16.5. Prevalence of RRT between 2003 and 2007

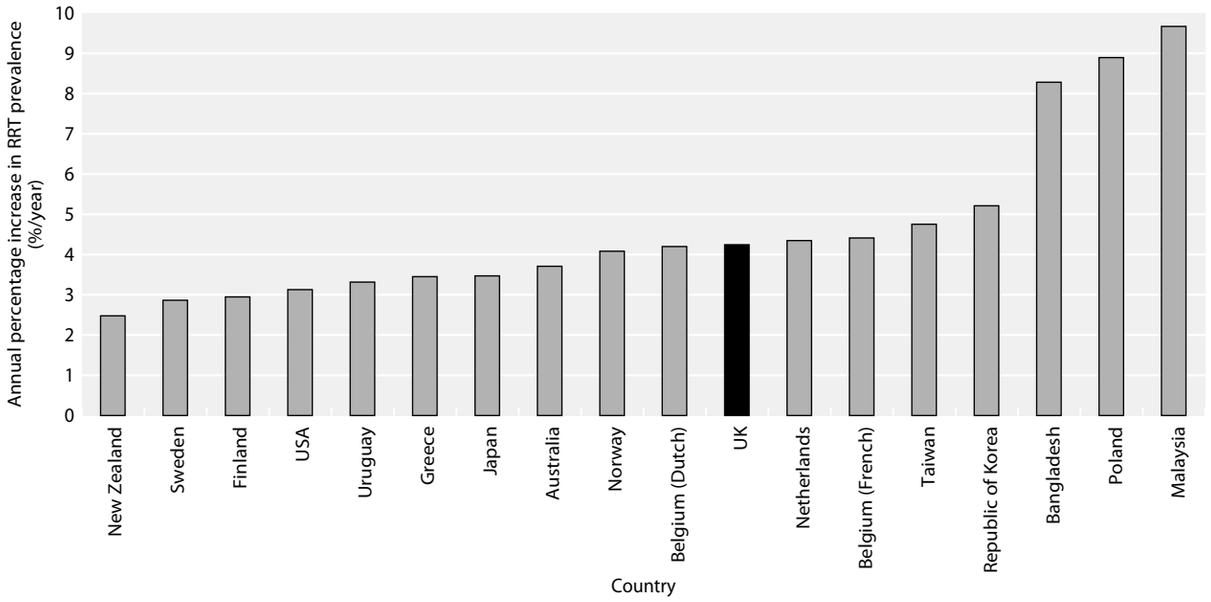

Fig. 16.6. Annual percentage increase in RRT prevalence between 2003 and 2007

Despite the large variability in prevalence, there was sustained growth in the number of treated patients in all the countries. The median annual increase in RRT prevalence was 3.9% per year. This increase varied from 2.5%/year in New Zealand to 9.7%/year in Malaysia (which has a relatively new public funded dialysis programme). The UK RRT prevalence grew at a rate of 4.2%/year (figure 16.6).

Relationship between incidence and prevalence

There was a very clear relationship between incidence and prevalence rates across all countries in 2007, as demonstrated in figure 16.7.

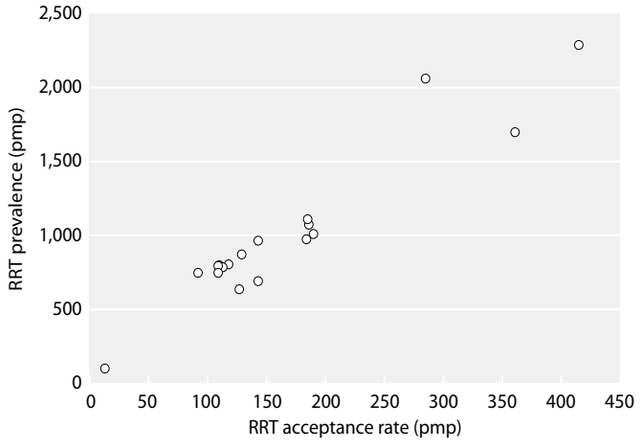

Fig. 16.7. Relationship between RRT prevalence and annual acceptance rate in 2007

Estimated crude annual mortality on RRT

Using the incidence rate per annum and the prevalence data the average crude mortality for the period 2004–2007 was estimated. The estimate required several assumptions. If the annual incident patients all remained on RRT, at the end of the year the new prevalence should be the previous year's prevalence plus the incidence. However, this is never the case as patients also leave the RRT programme. The vast majority of these 'leavers' are patients who died, with a very small number presumably either recovering function or leaving the country. The difference between the estimated prevalence and the actual prevalence thus principally represents the death rate. In this section the average death rate as a percentage of the programme size was calculated for the period 2004–2007. It should be recognised that there are a number of limitations to this methodology. First, this is a crude mortality calculation based upon prevalent patients as opposed to the UKRR's preferred method of measuring survival in incident patients. Second, the raw data were not available to adjust for a number of factors which would be expected to influence outcome, such as: age, ethnicity, duration, primary renal disease or other comorbidity, expected survival in the native population or RRT modality, for example. These results should therefore be interpreted with caution.

The highest mortality was in the USA at 18.7% per annum. The UK ranked 11th highest at 11.1% (figure 16.8). After accounting for Bangladesh as an outlier,

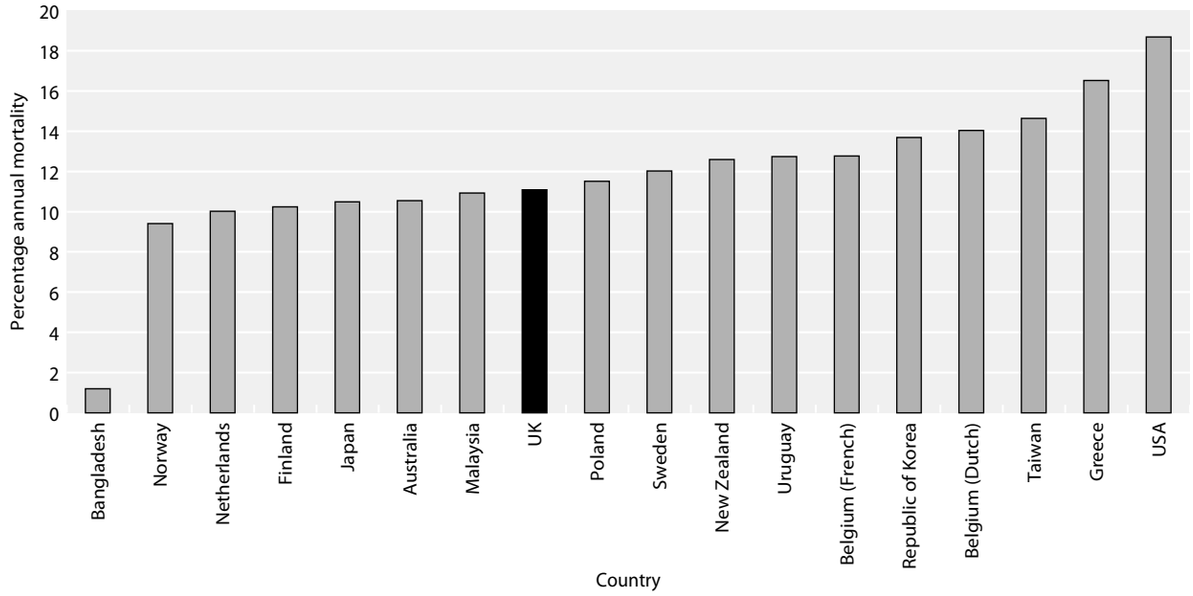

Fig. 16.8. Crude average annual mortality 2004–2007

there is no relationship seen between the size of the country's RRT programme and the estimated crude mortality (figure 16.9).

Treatment modality

Although it is clear that all countries that choose to treat severe kidney disease using RRT face having to treat more and more patients, the methods used to deliver treatment differ substantially. In this analysis, the focus was on traditional methods i.e. dialysis and transplantation in this analysis. However many countries are starting to challenge the concept that treating all patients using RRT is appropriate. This may be particularly applicable to those who are very elderly and/or have severe medical comorbidities and who are also heavily physically dependent.

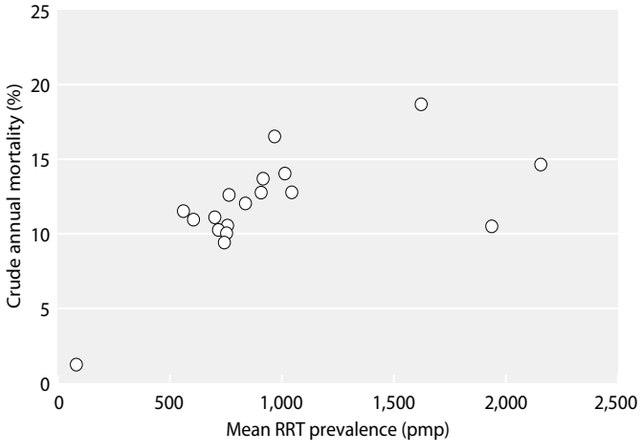

Fig. 16.9. Relationship between crude annual mortality and average prevalence 2004–2007

The whole area of 'non dialytic therapy' or 'conservative management' is controversial, but some programmes have a high proportion of such patients who may have a prognosis not dissimilar to those treated with RRT. Collecting data on such cohorts is a challenge for the future of all registries and is dependent on agreeing definitional criteria that are currently disparate and confusing. The UKRR is starting to collect electronic data on all stage 5 CKD patients so that the number of these patients can be identified and outcomes investigated.

The mode of RRT used is dependent on many factors including finance, availability, attitudes of nephrologists, transplant expertise, geography, cultural and religious beliefs. The variation in RRT modality is demonstrated in figure 16.10. Detailed data for dialysis modes also show disparate international practice. In all countries studied haemodialysis is the most common mode of dialysis ranging from 64.5% (New Zealand) to 100% (Bangladesh) (figure 16.11).

Some countries have embraced home therapy more than others. New Zealand leads the way with 51.8% of dialysis patients treated at home rather than 'in centre'. The UK home patients constitute 20.7% of all dialysis numbers, ranking 6th of the 18 countries. Home haemodialysis was also most prevalent in New Zealand (15.9% of all dialysis) with the UK ranking 6th again at 1.9%. In some countries with large dialysis programmes, home

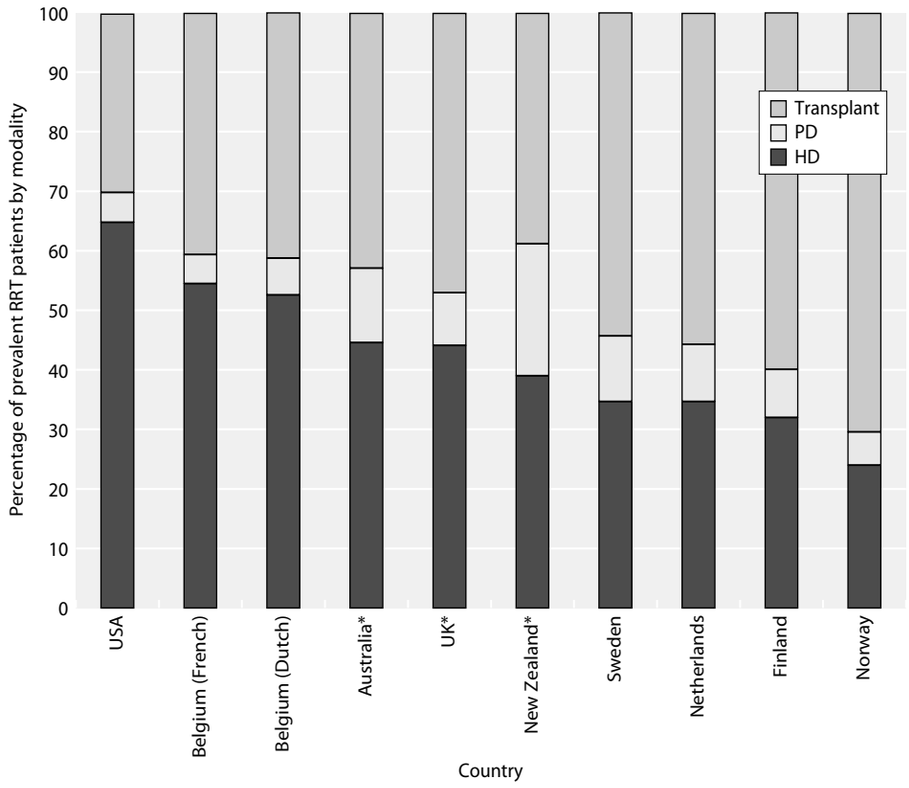

Fig. 16.10. Proportion of prevalent RRT patients by modality (2007 and 2008*)

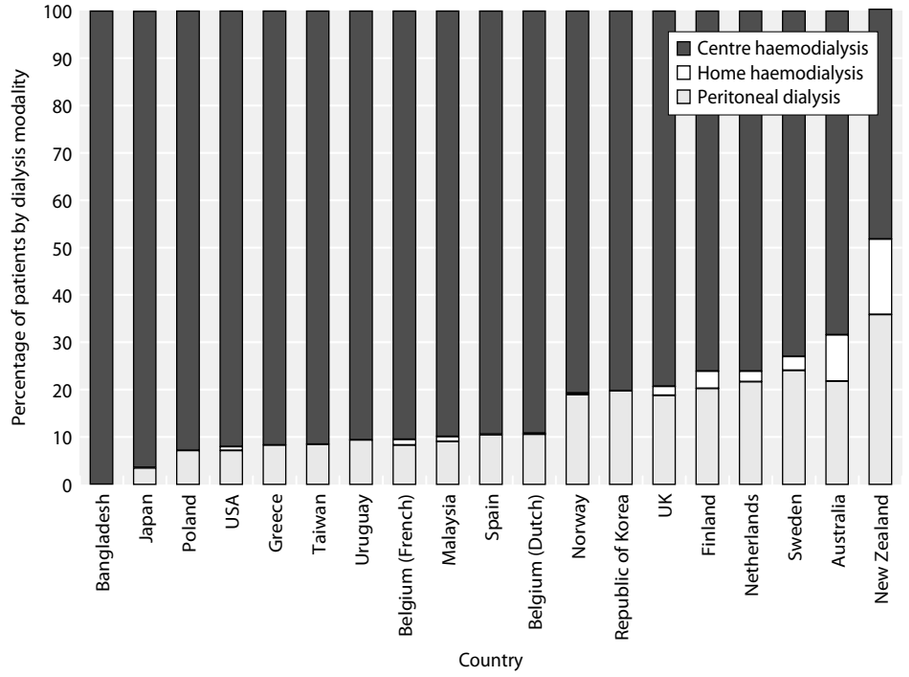

Fig. 16.11. Percentage of prevalent dialysis patients by dialysis modality in 2007

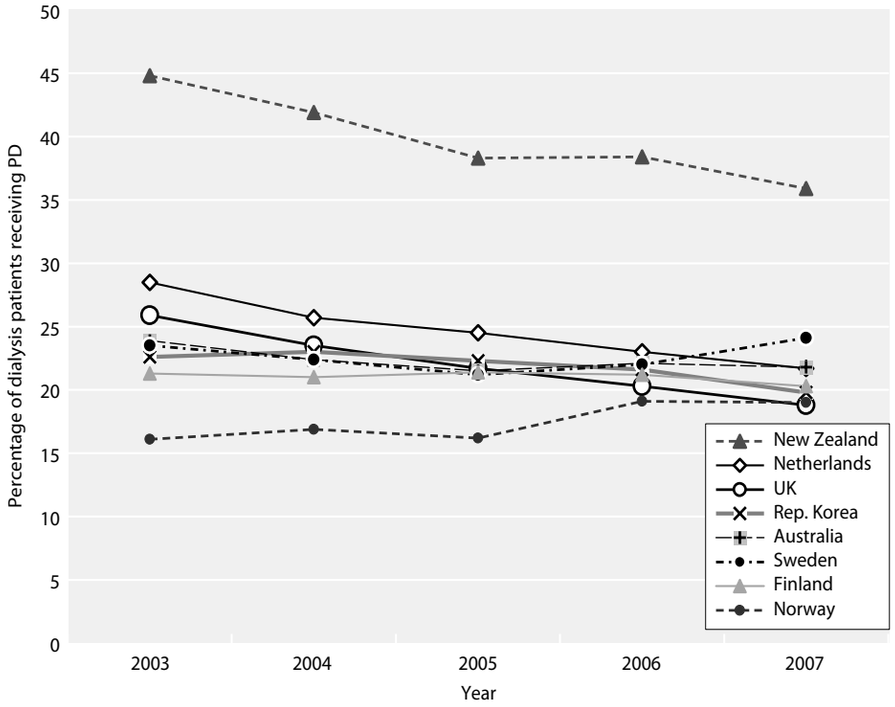

Fig. 16.12. Change in proportion of dialysis patients receiving peritoneal dialysis between 2003 and 2007

haemodialysis was either non-existent (e.g. Taiwan) or very small (Japan 0.07%) (figure 16.11).

Peritoneal dialysis prevalence varied considerably from 0% in Bangladesh to 35.9% in New Zealand, with the UK (18.8%) ranking 7th out of 18. In the top 8 countries with PD programmes many, including the UK, experienced a fall in numbers for reasons that remain unclear (figure 16.12).

There was wide variation in both incidence and prevalence of transplant patients (figure 16.13).

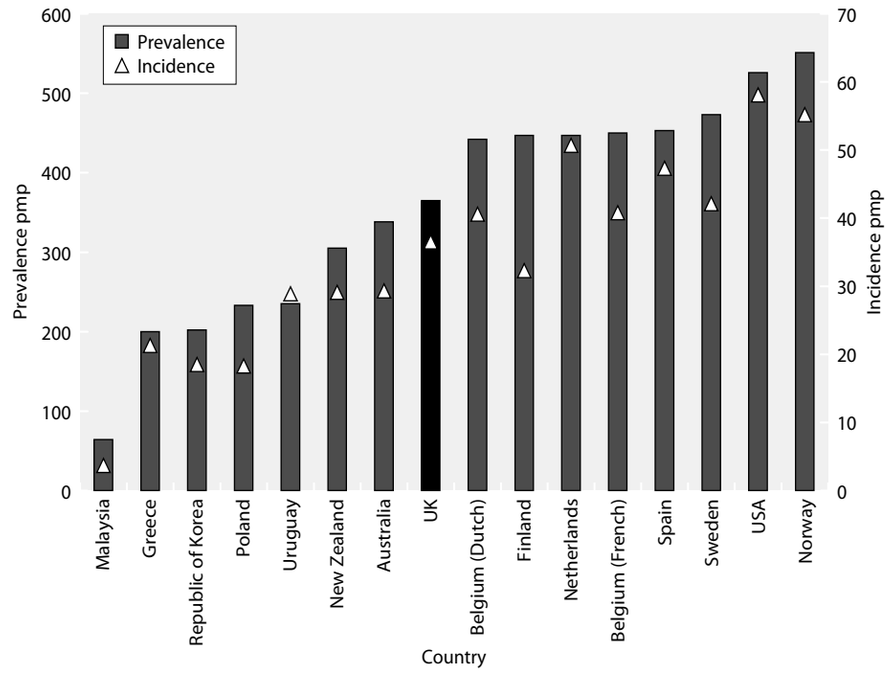

Fig. 16.13. Incidence and prevalence (pmp) of kidney transplants in 2007

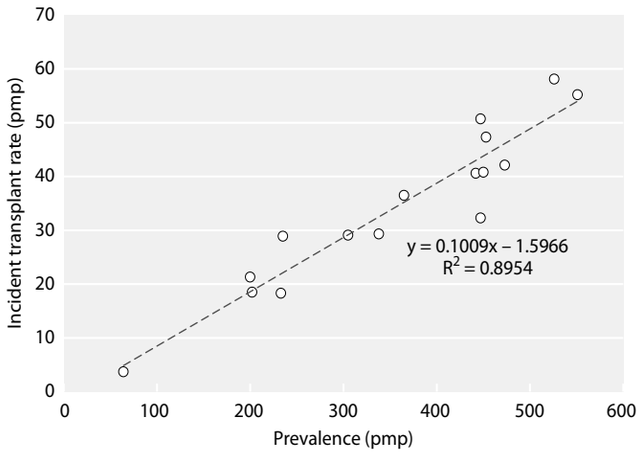

Fig. 16.14. Correlation between incident and prevalent transplant rates by country in 2007

Prevalence of transplant patients ranged from 64 pmp in Malaysia to 551 pmp in Norway. There was a strong correlation between incident rate and prevalence (figure 16.14).

Age

Data on the age of patients on RRT are collected and collated in differing methods within each registry. This makes direct comparisons very difficult. There is however consistent recording of age data for patients aged >44 within the UKRR, EDTA-ERA and the ANZdata registries.

In the USA completely different age ranges were used, which makes proportional comparison difficult without access to the raw numbers and ages. When the percentages of patients in each age group were compared between countries (figure 16.15), the most noticeable spread was within the elderly cohort. In New Zealand this cohort accounted for only 7.6% of the RRT population whereas in Belgium it accounted for 25% and 28% within the French and Dutch sub-populations.

Median ages were not always reported but where they were they appear comparable except for the Belgian cohort who were considerably older, reflecting the high proportion aged >75 (figure 16.16). Although there was no age range data from Italy, this country reported the highest median age on RRT at 67 years.

Discussion

In the UK, the increased awareness of CKD and the implementation of National Service Frameworks have improved access to RRT. In conjunction with the

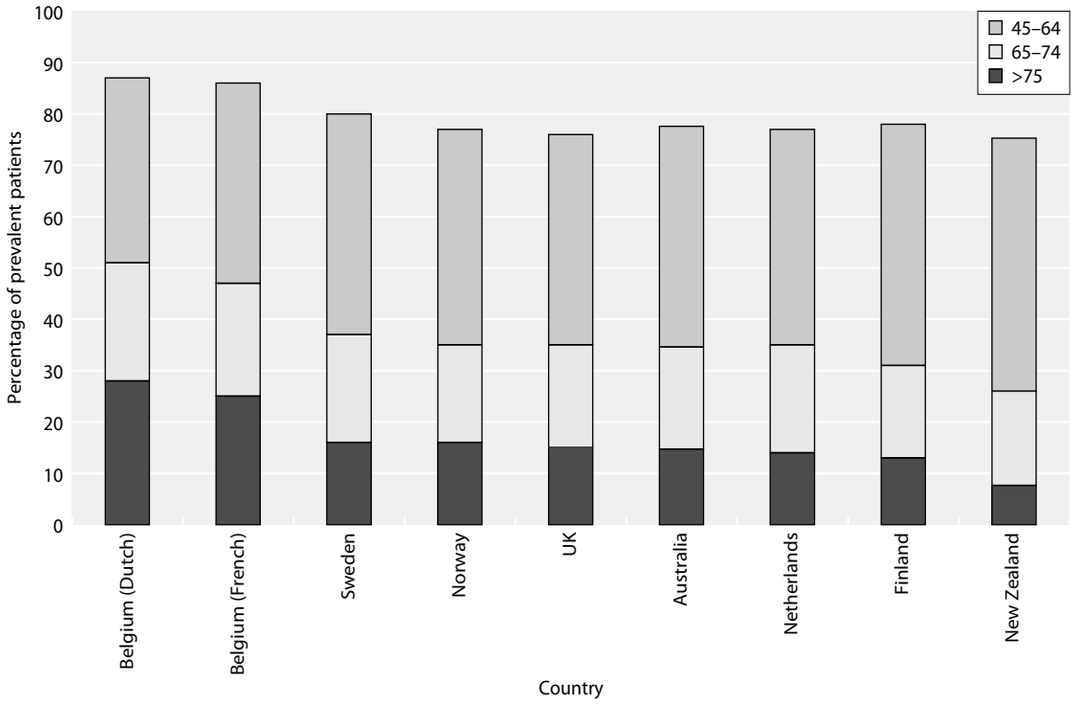

Fig. 16.15. Percentage of prevalent patients receiving RRT by age group

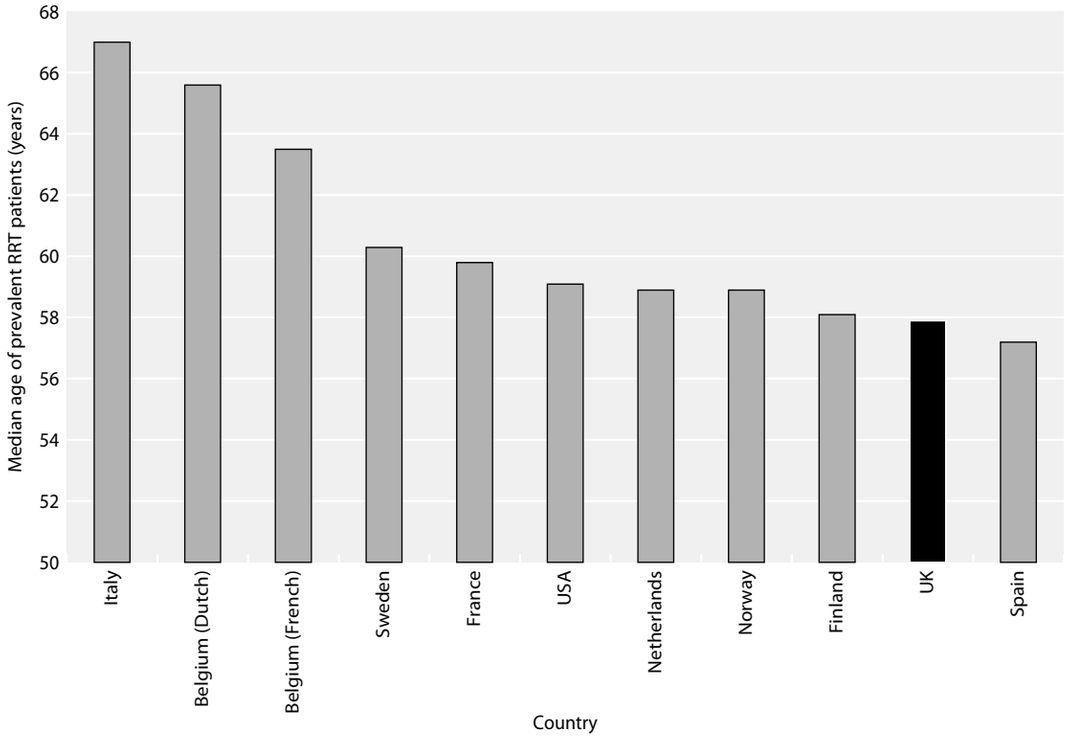

Fig. 16.16. Median age on RRT 2007

annual improvements in survival on RRT (chapter 7) this has resulted in consistent increases in prevalence. Internationally, there remained marked variation in the annual incident and prevalent rates of RRT.

The very high prevalence in some countries reflects many compounding differences in susceptibility to renal disease; obesity causing type 2 diabetes, ethnic mix, attitudes towards kidney disease treatment; affluence, death from ischaemic heart disease in CKD stages 1–4 and the accessibility to treatment. What is clear from this analysis is that an apparent ceiling in prevalence is yet to be seen. The growth in RRT represents a major challenge for all countries that choose to treat severe kidney disease. What these data show is that, whatever the baseline, growth is still the norm and that unless nations provide resource at a rate to match growth, restrictions in the access to treatment will become inevitable. Continued growth in demand, with no apparent end in sight of reaching a steady state, has huge implications for planning and health budgets across the globe.

The disparate approach to the use of home therapies is of interest. The variety reflects geographical and economic factors as well as attitude of nephrologists. The falling number of patients on PD is of concern and the reasons for the fall, particularly in the UK, require more investigation beyond the scope of this chapter. Transplantation is not undertaken in all countries, but in those that do Norway leads the way with a programme strongly underpinned by a successful living donation programme.

The mortality data presented here are not without limitations. The crude rate does not take into account the different modalities, age structure, comorbidity and prevalence. Transplant patients in general, are fitter with lower comorbidity than the average patient on dialysis. Although it is accepted that transplantation confers some survival benefit over dialysis, Taiwan and Japan who have the highest prevalence and no transplantation, appear to have crude mortality rates that are low.

Comparison with others is one of the lynchpins of audit. Reliable interpretation of reported data requires consistent definitions and formatting. It appears there is a slow movement towards congruous datasets and therefore international comparisons will become more reliable and detailed.

Conflict of interest: none

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3 De Vecchi AF, Dratwa M, Wiedemann ME: Healthcare systems and end-stage renal disease (ESRD) therapies – an international review: costs and reimbursement/funding of ESRD therapies. Nephrol Dial Transplant 1999;14:31–41.

Appendix A: The UK Renal Registry Statement of Purpose

This appendix is available on the web only and can be found at www.renalreg.org

Appendix B: Definitions and Analysis Criteria

This appendix is available on the web only and can be found at www.renalreg.org

Appendix C: Renal Services Described for Non-physicians

This appendix is available on the web only and can be found at www.renalreg.org

Appendix D: Methodology used for Analyses of PCT/Local Authority Incidence and Prevalence and of Standardised Ratios

This appendix is available on the web only and can be found at www.renalreg.org

Appendix E: Additional Data Tables for 2008 New and Existing Patients

This appendix is available on the web only and can be found at www.renalreg.org

Appendix F: UK Renal Registry Dataset Specification

This appendix is available on the web only and can be found at www.renalreg.org

Appendix G: Coding: Ethnicity, EDTA Primary Renal Diagnoses, EDTA Causes of Death and Treatment Timeline Modality Codes

This appendix is available on the web only and can be found at www.renalreg.org

Appendix H
Acronyms and Abbreviations used in the Report

ACE (inhibitor)	Angiotensin converting enzyme (inhibitor)
ANZDATA	Australia and New Zealand Dialysis and Transplant Registry
APD	Automated peritoneal dialysis
APKD	Autosomal dominant polycystic kidney disease
APKD	Adult polycystic kidney disease
AVF	Arteriovenous fistula
AVG	Arteriovenous graft
BAPN	British Association of Paediatric Nephrology
BCG	Bromocresol green
BCP	Bromocresol purple
BMI	Body mass index
BP	Blood pressure
BTS	British Transplant Society
CAB	Clinical Affairs Board (Renal Association)
CABG	Coronary artery bypass grafting
CAPD	Continuous ambulatory peritoneal dialysis
CCL	Clinical Computing Limited
CCPD	Cycling peritoneal dialysis
CHr	Target reticulocyte Hb content
CI	Confidence interval
CK	Creatine kinase
CKD	Chronic kidney disease
CK-MB	Creatine kinase isoenzyme MB
COPD	Chronic obstructive pulmonary disease
CRF	Chronic renal failure
CRP	C-reactive protein
CVVH	Continuous veno-venous haemofiltration
CXR	Chest x-ray
DBP	Diastolic blood pressure
DCCT	Diabetes Control and Complications Trial
DH	Department of Health
DM	Diabetes mellitus
DOPPS	Dialysis Outcomes and Practice Patterns Study
E & W	England and Wales
E, W & NI	England, Wales and Northern Ireland
EBPG	European Best Practice Guidelines
ECG	Electrocardiogram
EDTA	European Dialysis and Transplant Association
EF	Error factor
eGFR	Estimated glomerular filtration rate
E_i	Expected cases in area i

EPO	Erythropoietin
ERA	European Renal Association
ERA-EDTA	European Renal Association–European Dialysis and Transplant Association
ERF	Established renal failure
ESA	Erythropoiesis stimulating agent
ESRD	End stage renal disease
ESRF	End stage renal failure
EWNI	England, Wales and Northern Ireland
FEV1	Forced expiratory volume in 1 second
FVC	Forced vital capacity
GFR	Glomerular filtration rate
GN	Glomerulonephritis
HA	Health Authority
Hb	Haemoglobin
HbA1c	Glycated Haemoglobin
HBeAg	Hepatitis B e antigen
HCAI-DCS	Healthcare-associated infection data collection system
HD	Haemodialysis
HDL	High-density lipoprotein
HLA	Human leucocyte antigen
HPA	Health Protection Agency
HR	Hazard ratio
HRC	Hypochromic red blood cells
ICU	Intensive care unit
IDMS	Isotope dilution mass spectrometry
IDOPPS	International Dialysis Outcomes and Practice Patterns Study
IFCC	International Federation of Clinical Chemistry & Laboratory Medicine
IHD	Ischaemic heart disease
IPD	Intermittent peritoneal dialysis
IQR	Inter-quartile range
IT	Information technology
IU	International units
KDIGO	Kidney Disease: Improving Global Outcomes
KDOQI	Kidney Disease Outcomes Quality Initiative
KM	Kaplan Meier
LA	Local Authority
LCL	Lower confidence limit
LDL	Low-density lipoprotein
M:F	Male:Female
MAP	Mean arterial blood pressure
MDRD	Modification of diet in renal disease
MI	Myocardial infarction
MRSA	Methicillin resistant Staphylococcal aureus
N Ireland	Northern Ireland
NE	North East
NEQAS	UK National External Quality Assessment Scheme
NHS	National Health Service
NHS BT	National Health Service Blood and Transplant
NI	Northern Ireland
NICE	National Institute for Health and Clinical Excellence
NSF	National service framework
NTC	Non-tunnelled dialysis catheter
NW	North West
O/E	Observed/expected
ODT	Organ Donation and Transplantation (a Directorate of NHS Blood and transplant)
O_i	Observed cases in area i
ONS	Office of National Statistics
PAS	Patient Administration System
PCT	Primary Care Trust
PD	Peritoneal dialysis

PIAG	Patient Information Advisory Group
PKD	Polycystic kidney disease
PMARP	Per million age related population
PMCP	Per million child population
PMP	Per million population
PP	Pulse pressure
PRD	Primary renal disease
PTH	Parathyroid hormone
PUV	Posterior urethral valves
PVD	Peripheral vascular disease
QOF	Quality and Outcomes Framework
QUEST	Quality European Studies
RA	Renal Association
RI	Royal Infirmary
RNSF	Renal National Service Framework (or NSF)
RR	Relative risk
RRDSS	Renal Registry data set specification
RRT	Renal replacement therapy
SAR	Standardised acceptance ratio (= O/E)
SAS	Statistical Analysis System
SBP	Systolic blood pressure
SD	Standard deviation
SES	Socio-economic status
SHA	Strategic health authority
SHARP	Study of Heart and Renal Protection
SI	System International (units)
SMR	Standardised mortality ratios
SPR	Standardised prevalence ratio (= O/E)
SR	Standardised ratio (used to cover either SAR or SPR)
SUS	Secondary uses service
SW	South West
TC	Tunnelled dialysis catheter
TSAT	Transferrin saturation
TWL	Transplant waiting list
Tx	Transplant
UCL	Upper confidence limit
UK	United Kingdom
UKRR	UK Renal Registry
UKT	UK Transplant (now ODT)
URR	Urea reduction ratio
USRDS	United States Renal Data System

Appendix I
Laboratory Conversion Factors

	Conversion factors from SI units
Albumin	g/dl = g/L × 0.1
Aluminium	μg/L = μmol/L × 27.3
Bicarbonate	mg/dl = mmol/L × 6.1
Calcium	mg/dl = mmol/L × 4
Calcium × phosphate	$mg^2/dl^2 = mmol^2/L^2 \times 12.4$
Cholesterol	mg/dl = mmol/L × 38.6
Creatinine	mg/dl= μmol/L × 0.011
Glucose	mg/dl = mmol/L × 18
Haemoglobin	Hct = g/dl × 3.11 (*NB this factor is variable)*
Phosphate	mg/dl = mmol/L × 3.1
PTH	ng/L = pmol/L × 9.5
Urea	mg/dl = mmol/L × 2.8

Appendix J
Renal Centre Names and Abbreviations used in the Figures and Data Tables

Adult Centres

City	Hospital	Abbreviation	Country
Basildon	Basildon Hospital	Basldn	England
Birmingham	Heartlands Hospital	B Heart	England
Birmingham	Queen Elizabeth Hospital	B QEH	England
Bradford	St Luke's Hospital	Bradfd	England
Brighton	Royal Sussex County Hospital	Brightn	England
Bristol	Southmead Hospital	Bristol	England
Cambridge	Addenbrookes Hospital	Camb	England
Carlisle	Cumberland Infirmary	Carlis	England
Carshalton	St Helier Hospital	Carsh	England
Chelmsford	Broomfield Hospital	Chelms	England
Colchester	Colchester General Hospital	Colchr	England
Coventry	Walsgrave Hospital	Covnt	England
Derby	Royal Derby Hospital	Derby	England
Doncaster	Doncaster Royal Infirmary	Donc	England
Dorset	Dorset Country Hospital	Dorset	England
Dudley	Russells Hall Hospital	Dudley	England
Exeter	Royal Devon and Exeter Hospital	Exeter	England
Gloucester	Gloucester Royal Hospital	Glouc	England
Hull	Hull Royal Infirmary	Hull	England
Ipswich	Ipswich Hospital	Ipswi	England
Kent	Kent and Canterbury Hospital	Kent	England
Leeds	St James's University Hospital and Leeds General Infirmary	Leeds	England
Leicester	Leicester General Hospital	Leic	England
Liverpool	University Hospital Aintree	Liv Ain	England
Liverpool	Royal Liverpool University Hospital	Liv RI	England
London	St Barts and The London Hospital	L Barts	England
London	St George's Hospital	L St. G	England
London	Guy's & St Thomas' Hospital	L Guys	England
London	Hammersmith, Charing Cross, St Marys' and Paddington Hospitals	L West	England
London	King's College Hospital	L Kings	England
London	Royal Free, Middlesex and UCL Hospitals	L Rfree	England
Manchester	Hope Hospital	M Hope	England
Manchester	Manchester Royal Infirmary	M RI	England
Middlesbrough	James Cook University Hospital	Middlbr	England
Newcastle	Freeman Hospital and Royal Victoria Infirmary	Newc	England

City	Hospital	Abbreviation	Country
Norwich	Norfolk and Norwich University Hospital	Norwch	England
Nottingham	Nottingham City Hospital	Nottm	England
Oxford	Oxford Radcliffe Hospital (previously reported as Churchill Hospital)	Oxford	England
Plymouth	Derriford Hospital	Plymth	England
Portsmouth	Queen Alexandra Hospital	Ports	England
Preston	Royal Preston Hospital	Prestn	England
Reading	Royal Berkshire Hospital	Redng	England
Sheffield	Northern General Hospital	Sheff	England
Shrewsbury	Royal Shrewsbury Hospital	Shrew	England
Southend	Southend Hospital	Sthend	England
Stevenage	Lister Hospital	Stevng	England
Stoke	University Hospital of North Staffordshire	Stoke	England
Sunderland	Sunderland Royal Hospital	Sund	England
Truro	Royal Cornwall Hospital	Truro	England
Wirral	Arrowe Park Hospital	Wirral	England
Wolverhampton	New Cross Hospital	Wolve	England
York	York District General Hospital	York	England
Bangor	Ysbyty Gwynedd	Bangor	Wales
Cardiff	University Hospital of Wales	Cardff	Wales
Clwyd	Ysbyty Glan Clwyd	Clwyd	Wales
Swansea	Morriston Hospital	Swanse	Wales
Wrexham	Wrexham Maelor Hospital	Wrexm	Wales
Aberdeen	Aberdeen Royal Infirmary	Abrdn	Scotland
Airdrie	Monklands Hospital	Airdrie	Scotland
Dumfries	Dumfries & Galloway Royal Infirmary	D & Gall	Scotland
Dundee	Ninewells Hospital	Dundee	Scotland
Dunfermline	Queen Margaret Hospital	Dunfn	Scotland
Edinburgh	Edinburgh Royal Infirmary	Edinb	Scotland
Glasgow	Glasgow Western Infirmary, Royal Infirmary and Stobhill Hospital	Glasgw	Scotland
Inverness	Raigmore Hospital	Inverns	Scotland
Kilmarnock	Crosshouse Hospital	Klmarnk	Scotland
Antrim	Antrim Hospital	Antrim	Northern Ireland
Belfast	Belfast City Hospital	Belfast	Northern Ireland
Derry	Altnagelvin Hospital	Derry	Northern Ireland
Newry	Daisy Hill Hospital	Newry	Northern Ireland
Tyrone	Tyrone County Hospital	Tyrone	Northern Ireland
Ulster	Ulster Hospital	Ulster	Northern Ireland

Paediatric Centres

City	Hospital	Abbreviation	Country
Belfast	Royal Belfast Hospital for Children	Blfst_P	Northern Ireland
Birmingham	Birmingham Children's Hospital	Bham_P	England
Bristol	Bristol Royal Hospital for Children	Brstl_P	England
Cardiff	Kruf Children's Kidney Centre	Cardf_P	Wales
Glasgow	Royal Hospital for Sick Children	Glasg_P	Scotland
Leeds	St James's University Hospital – Paediatric	Leeds_P	England
Liverpool	Royal Liverpool Children's Hospital	Livpl_P	England
London	Guy's Hospital – Paediatric	L Eve_P	England
London	Great Ormond Street Hospital for Children	LGOSH_P	England
Manchester	Royal Manchester Children's Hospital	Manch_P	England
Newcastle	Royal Victoria Infirmary – Paediatric	Newc_P	England
Nottingham	Nottingham City Hospital – Paediatric	Nottm_P	England
Southampton	Southampton General Hospital – Paediatric	Soton_P	England